THURSDAY, FEBRUARY 28, 1884

THE GERMAN CHOLERA COMMISSION

DR. KOCH, as chief of the German Cholera Commission, has just issued his fifth report. When we commented on his first report, which was transmitted from Alexandria on September 17, 1883, we drew special attention to the discovery by that expert of certain bacilli which were found to swarm in the discharges and coatings of the intestines of cholera patients, which were certainly not due to post-mortem changes, and which were absent from the intestines of bodies dead from diseases other than cholera. Dr. Koch believed that these bacilli, which much resembled those found in cases of glanders, stood in some special relation to the operation of cholera, but he was not prepared to say whether invasion of the bacteria was the primary cause of cholera, or whether it was merely an effect of the cholera infection. At that time the epidemic in Egypt had reached its decline, the period which of all others is the least satisfactory for etiological investigation ; and hence, apart from some further record confirming the existence of the same bacilli in other cholera bodies which had since been examined, the reports which Dr. Koch has transmitted to his Government between his first one and the one now under consideration have not dealt with any scientific discovery. But since November last the Commission have pursued their investigations in India, the city of Calcutta having been decided on as the head-quarters of their mission of inquiry ; and it is to the results there obtained that Dr. Koch's last report relates. In the meantime, however, Dr. Straus had reported on behalf of the French Commission, and had expressed his belief that the bacilli discovered by Dr. Koch did not bear the relation to cholera which the German Commission attributed to them ; and that, unlike Dr. Koch, who had found nothing noteworthy in the blood of cholera patients, he had discovered in that fluid a definite micro-organism, which he believed he had succeeded in cultivating in the laboratory.

At this stage the subject is again taken up by Dr. Koch, who now gives an account of the further labours of his Commission. Under conditions of the most favourable sort, experiments have been renewed in Calcutta with an unbroken series of cholera patients and cholera bodies, and at the outset it is stated that microscopical examination has in all cases confirmed the existence, both in the choleraic discharges and in the cholera intestines, of the same bacilli as those which had been found in Egypt. And further, that which had not been possible in Alexandria, namely, the isolation and cultivation in pure media of these special bacilli, is stated to have been successful in Calcutta, with the result that they have been found to exhibit under cultivation certain characteristic peculiarities as to shape and mode of growth which enable the Commission to distinguish them with certainty from other bacilli. The Commission, too, have sought, as far as possible, to exclude sources of error, and hence they have subjected the bodies of patients dying from diseases other than cholera to careful micro-pathological examination, with the result that they are able to say that it has not been possible to find bacilli similar to the cholera bacilli in any of the bodies of persons who had died of pneumonia, dysentery, phthisis, and kidney disease. Nor has it been possible to detect these bacilli in the intestinal contents of animals and in other substances commonly abounding with bacteria.

The inoculation of the lower animals with cholera discharges and other cholera material had, in Egypt, led only to negative results ; and even if nothing further had been adduced as to this, we should in no way have reregarded failure in this respect as invalidating any inferences that may be drawn by Dr. Koch and his fellow-workers as to the speciality of this bacillus, because it has been found impossible to transmit many of the specific infectious diseases of man to any other animal. We now learn, however, that several experiments made on animals have given results which allow of the hope of further success. Reviewing their more recent work, in this and other respects, the Commission are evidently hopeful of establishing an etiological relation between the bacilli in question and the cholera process, and this quite irrespective of success being attained in the reproduction of the disease in the lower animals. A telegram of more recent date than the report itself announces that Drs. Koch, Fischer, and Gaffky have discovered the same bacillus in a water-tank. If this be confirmed, it will be of value as proving that water, which, when polluted with excreta, has so often been alleged to be one of the principal means of conveying the cholera poison, is a medium favourable to the transmission of the "germ" from person to person, and the announcement comes aptly in connection with a report in which the German Commission announce that a diminution in the annual mortality from cholera in Calcutta from 10·1 per 1000 inhabitants before 1870, to 3 per 1000 since that date, is regarded by nearly all the physicians in that city as being solely due to the introduction of a water-supply of excellent quality.

Referring to the report of the French Commission, Dr. Koch declines to accept the conclusions of Dr. Straus as to the existence in the blood of organisms which are peculiar to cholera, and he expresses the belief that the alleged organisms are nothing but certain small, roundish blood-plates, which, not absent even in health, undergo a peculiar increase in the case of cholera patients, and which were referred to as far back as 1872 by Dr. D. Cunningham in his " Microscopical and Physiological Researches into the Nature of the Agents producing Cholera."

Whilst desiring to follow in the steps of Dr. Koch in observing an attitude of caution as to the meaning of the researches of the German Commission, we cannot but feel that the tendency of the reports as yet issued is favourable to the doctrine that cholera is associated with a specific organic contagion. A connection has already been established between specific disease on the one hand, and the staff-shaped bacilli of splenic fever, the spirillum of relapsing fever, and the microzymes of vaccinia and of sheep-pox on the other ; and though it may still be doubtful whether these bodies should be regarded as actual generators of the diseases with which they are associated, or as mere carriers of infection, yet the advance which is being made is in the direction of the doctrine of the particulate nature of contagion. We may have to wait before there is sufficient evidence to warrant the application of this doctrine to the case of cholera, but we can congratulate Dr. Koch on the result of his labours so far, and at the same time trust that the example set us in this instance by the German nation may not be thrown away upon the people of this country, who, whilst having a higher interest than any other in ascertaining the real nature of cholera, allowed the opportunity of the Egyptian epidemic to pass by without attempting any scientific investigation as to its causes.

SCHOPENHAUER

The World as Will and Idea. By Arthur Schopenhauer. Translated from the German by R. B. Haldane, M.A., and J. Kemp, M.A. Vol. I. (London: Trübner and Co., 1883.)

AS the Kantian leaven works, philosophy shows less and less of an inclination to quit what Kant described as the fruitful bathos of experience. No doubt many a structure is still reared around us, "pinnacled dim in the intense inane," but that is simply because philosophy, more than any special department of knowledge, is exposed to the inroads of the uninstructed. But here, as elsewhere, the honest inquirer will find a consensus of competent opinion which estimates these piles at their true value. Serious workers pass by on the other side without controversy, lest perchance they should be as those on whom the tower of Siloam fell. On the other hand, only confusion of thought can lead people to *identify* philosophy with science, and to suppose that, when they have reckoned over the list of the sciences, they may erect a stone to the great god Terminus. For, though the matter of philosophy is the same as that of the sciences (and not, according to the current myth, a spider-like product of intestinal origin), yet the point of view from which the common material is regarded is *ab initio* different. Science, in its whole extent (including psychology), deals with the world of objects, whereas the first task of philosophy is to remind scientific men of the abstraction which they have been making—and for their own purposes rightly making—by showing them that the world of objects is unintelligible without a subject to which it is referred. Having rectified this fundamental abstraction, philosophy proceeds, as theory of knowledge, to a critical analysis of the conceptions on which, as ultimate presuppositions or working hypotheses, the different sciences are based. The notion of the atom and of infinite space may be mentioned as two of the earliest cases where such criticism is required. The result of such a criticism is to show that no science can say of its "facts" that they are absolutely true, because they cannot be stated except in terms of the conceptions or hypotheses which are assumed by the particular science. But conceptions such as those of space or atom are found to dissolve in self-contradiction when taken as a statement of the ultimate nature of the real. It follows, therefore, that they must be regarded as only a provisional or partial account of things. The account they give is one which may require to be superseded by—or rather, which inevitably merges itself in—a less abstract statement of the same facts. In the new statement, the same "facts" appear differently, because no longer separated from other aspects that belong to the full reality of the known world. For the philosopher is essentially what Plato in a happy moment styled him, συνοπτικός, the man who insists on seeing things together; and philosophy, in her office as critic of the sciences, aims at harmonising the notions on which they respectively rest, and thereby reaching a statement of the nature of the real which may claim to overcome the abstractness of the several provisional stages represented by the different sciences.

Judged by this standard, it is to be feared, Schopenhauer's philosophy will be found wanting. Its interest is undoubtedly, in the main, more literary than scientific; and in his central dogma of a metempirical or trans-phenomenal Will, Schopenhauer shows himself quite the traditional "metaphysician." Taken as literature, high praise must be awarded to the style of his productions, which is very different from that of his heavy-footed countrymen generally. Pessimism was lately much in fashion, and Buddhism is still highly esteemed. The philosophic father of these things is tolerably sure, therefore, of an interested audience; and "the general reader" will find rich pasture in the aphoristic wisdom of the man of the world, his keen and often cynical psychological analysis, and his genuine appreciation of art, especially of music, which was almost the one redeeming feature in an otherwise ignoble character. Mr. Haldane and Mr. Kemp have done their work so well, that those who are drawn to the book by the literary reputation of the original will not have their enjoyment marred by the intrusion of foreign idioms, clumsy constructions, and the general lameness of the translation style. All praise must also be given to the clearness and accuracy with which they have rendered the philosophical terminology of the work.

But the translators would probably hardly have undertaken the task, had they not believed that there was more of value in Schopenhauer than what has just been allowed him. And, in point of fact, it is perfectly possible to divide Schopenhauer's work into two parts. The world presents itself to him under the twofold aspect of "Will and Idea." "The world as Idea" is the phenomenal world, the world of science, while Will—one mighty unconscious desire or force—is the inner or noumenal reality of which the phenomenal world is the outward expression. I appear to others, and to myself, as an organised body—that is, as an object or complex of ideas; but I also know myself, Schopenhauer says, on the inner side as Will. He next denudes this Will of the characteristics which belong to it in the conscious life, ignoring at the same time the other features which, equally with Will, go to constitute that life, and then, with a superb sweep of anthropomorphism, declares that Will, as an impersonal force, is the essence of all phenomena—the steam that drives the world. In support of this thesis, he fastens on obscure facts like those of instinct; and, though he scouts at the "Bridgewater Treatises," he argues from teleology in an exactly similar sense. But as no scientific reader is likely to be led away by Schopenhauer's reasoning here, it is needless to enter into any formal refutation of his positions. It is more to the purpose to draw attention to the side of the book which, though not so distinctly Schopenhauerian, and probably not so attractive reading as the collection of brilliant analogies on which his system is built, contains an acute and, so far as it goes, a sound, criticism of certain false or inadequate views of the world. Schopenhauer claimed to be the true follower of Kant, and when he is speaking of "the world as Idea," we find ourselves on the general ground of the modern philosophical criticism which dates from Kant. Schopenhauer certainly neglects much that is valuable in Kant, and presents other elements superficially; but, perhaps for that very reason, he may be useful as a populariser of thoughts which, in one shape or another, it is essential for the modern world to master. We need only note here his insistence on the complete relativity of subject and object—a relativity which, of course, excludes the possibility of any causal relation between them—and his criticism of the ideas of space, time, and matter, leading him to the conclusion that the world of objects exists as a system of complete relativity, in which no individual objects can claim any reality except what consists in their necessary relation to one another. Any one reading these and similar passages must acknowledge that, where his doctrines are otherwise sound, Schopenhauer's clear and incisive style makes him an admirable interpreter.

ANDREW SETH

OUR BOOK SHELF

Cours de Minéralogie. A. De Lapparent. (Paris: Savy, 1883.)

MINERALOGY was the father of Geology; but the son has for many years in this country shown great want of respect to his parent. A very large proportion of our geologists are extraordinarily ignorant of mineralogy. To them as well as to those who have not so seriously neglected that branch of science we recommend a perusal of the work before us. The object of its distinguished author (who has already rescued French Geology from the charge of possessing no modern text-book of native origin) is in the first place to simplify as much as possible the teaching of rational crystallography, as established by the works of Bravais and completed by Mallard, so as to bring it within the comprehension of all earnest students of minerals and rocks; and in the second place to put geologists in possession of the knowledge which they must acquire if they would apply themselves with any satisfaction and profit to the study of the microscopic structure of rocks.

The volume is divided into three parts. In the first of these, entitled *Geometric Crystallography*, M. De Lapparent states the laws of crystalline symmetry and shows in detail the forms of which each system is composed, these forms being rigorously classed and deduced from each other according to the method of Bravais. Tables and stereographic perspective diagrams are added.

The second part, or *Physical Crystallography*, is devoted to the explanation of the physical, and especially the optical, properties of crystallised matter. It concludes with an analysis of the different crystalline groups, with which, following Mallard, the author connects the phenomena of isomorphism and dimorphism.

The object of the third part is the *Description of the Principal Mineral Species*. The author adopts a system of classification which is entirely new, and which might be called the geological system of mineralogy, because it is based upon the part which each species plays in the composition of the earth's crust. From this point of view minerals are divided into four great classes:—(1) silicates or elements of the fundamental rocks. (2) Elements of mineral veins. (3) Metallic minerals. (4) Combustible minerals.

The work consists of 550 pages, with 519 figures inserted in the text, a chromolithographed plate, and an index comprising 3500 names, from which a knowledge can be obtained of all terms employed in mineralogy.

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.*]

The Remarkable Sunsets

THE remarkable and beautiful atmospheric phenomena which within the last four or five months have so powerfully attracted attention in all parts of the world, made their appearance here about the same time that they did in England and on the continent of Europe. It is true that as early as October 14, 1883, something similar was noticed at Santa Barbara, about 280 miles south-east of this place; but the characteristic phenomena were not observed here and at other positions on the coast of California until after the middle of November, 1883. I first observed it on the evening of November 24, when it presented a very striking appearance. That afternoon the sky had been overcast with dark clouds, and the south-east wind had brought a slight rainfall. Towards sunset a bright portion of sky appeared at the western horizon, extending to an altitude of about 10°, while the dark hood of clouds enveloped the remainder of the celestial vault. At 6 p.m. the lurid redness (almost angry) of the western horizon attracted universal attention; it had the appearance of a sky illuminated by an immense conflagration. Doubtless the effect was heightened by the contrast with the dark canopy of clouds. Similar appearances, more or less conspicuous, presented themselves during the remaining days of November, and in a less striking manner (when the weather was favourable) during the month of December, both after sunset and before sunrise. At a quarter past six on the morning of November 29 the eastern sky emitted such a brilliant ruddy light as to arrest my attention by the peculiar red illumination of the window-curtain of my bedroom. On looking out, the whole eastern sky was seen to be drenched in gorgeous red. During the month of January, 1884, the "upper-glows" (as Miss Ley appropriately designates them) became much less conspicuous.

At the period when the phenomena were most conspicuous, the atmosphere during the day was not perfectly clear, although the sunlight was not obscured to any considerable extent:—there was always observed a thin veil of fleecy clouds covering the heavens, and a *whitish glare* manifested itself about the sun, extending to a distance of about 20° or 25° from his centre. It is evident that the suspended matter producing these phenomena must have been above the region of the loftiest cirri, for ordinary changes of weather and disturbances in the atmosphere did not modify the appearances.

But the manifestations presented by the sky seem to have been so nearly identical in all parts of the globe, that detailed descriptions of them, as exhibited here, are unnecessary. It was, however, evident that the phenomena were less pronounced on this coast than they were in many other countries. This was indicated by the fact that, wherever the phenomena were sufficiently developed, the sun during the day was encircled by more or less distinct coloured halos or coronæ; whereas at this place it amounted to nothing more than a *whitish* glare about that luminary. The Rev. S. E. Bishop writes me from Honolulu, that these chromatic circles around the sun were constantly observed in all of the Hawaiian Islands from September 5 to December 15, 1883; and I notice that they were observed in England as frequent accompaniments of the upper-glows.

While the large size of these coloured circles might (as I have indicated in a letter to *Science*) seem to connect them with the well-known ice-crystal halos of 22° radius, yet I am disposed to regard this chromatic feature of the phenomenon as mainly due to the diffractive action of the impalpable dust-particles suspended in the lofty supra-cirri regions of the atmosphere. Nevertheless, inasmuch as the experiments of M. Coulier and Mr. John Aitken show that the presence of dust-particles in the air as nuclei is essential to the condensation of aqueous vapour, it is by no means improbable that *ice* may be associated with these phenomena. For, as these lofty regions must, even within the tropics, be far above the plane constituting the lower boundary of the term of perpetual congelation, the condensed vapour must necessarily assume the form of aggregations of ice around these nuclei. Hence the diffractive coronæ may be associated with imperfectly developed ice-crystal halos.

It seems to me scarcely necessary to invoke—as Mr. Rowell has done (NATURE, vol. xxix. p. 251)—the repulsive agency of electricity to account for the persistent suspension of the volcanic dust, even in these regions of rarefied air. If the attenuation be sufficiently great, there will be no sensible subsidence of the dust-particles. Faraday found that even metallic gold, when minutely divided, required months to subside when suspended in water; and some forms of insoluble mineral matter remain suspended in water for an almost indefinite period. Now, the dust-particles constituting the nuclei of condensation for fogs and clouds are absolutely *ultra-microscopic* in smallness; hence their suspension, even in rarefied air, may be prolonged almost indefinitely. Moreover, it is possible that air may possess some degree of *viscosity;* in which case the indefinitely attenuated dust-particles might have no tendency to subside, and could only be removed from the atmosphere by those meteorological agencies,—such as the condensation of vapour,—which tend to augment their size.

Mr. D. Wetterhan (NATURE, vol. xxix. p. 250) refers to Mr. Kesselmeyer's hypothesis of the atmospheric origin of meteorites put forth some twenty years ago, which ascribes them to the condensation of metallic and other vapours issued from volcanoes. If I am not mistaken this hypothesis was advanced by Biot near the beginning of the present century. The *high velocities* of meteorites is overwhelmingly *fatal* to their *terrestrial* origin.

JOHN LE CONTE

Berkeley, California, February 1

THE recent sunsets were nearly or quite as remarkable in the Rocky Mountain region as they were in Europe, and the phenomena were very similar. There was the same peculiar fire-red after-glow continuing for two hours after sunset, &c. These unusual appearances began to attract attention soon after the middle of November. They were most brilliant during the last week of November, but continued at intervals until early in January. The carefully kept meteorological record of Prof. F. H. Loud, of Colorado College, shows that the atmospheric pressure varied considerably during the latter part of November, but there was no apparent accompanying change in the after-glow. The sunrises were also quite brilliant, but less so than the sunsets. Late in November I began to observe the wide chromatic belt which surrounded the sun, and at midday usually reached from near the sun to the horizon. Somewhat similar appearances and chromatic halos are not uncommon here, and it was not until after several weeks of comparison of colours that I became convinced that the tints seen around the sun during the time of the remarkable sunsets were somewhat different from those ordinarily seen. By degrees the brick, or fire-red, and other abnormal tints of the twilight hours have given place to the ordinary prismatic colours, and a similar but less marked change could be seen in the colours observed near the sun during the daytime. These day colours were brightest when the sky was overcast with thin clouds or filmy cirri, though plainly visible when there was no cloud to be seen. The prevailing day tint is usually a peculiar dull purple, but during the time of the red after-glow the common colour was duller, more like a yellowish brick-dust.

Colorado College, February 8 G. H. STONE

"Probable Nature of the Internal Symmetry of Crystals"

IN reply to the important criticisms offered by Herr L. Sohncke on my new theory published in NATURE of December 20 and 27, 1883 (pp. 186 and 205)—

Taking first those relating to the geometry of the subject; the following explains why only the five symmetrical arrangements of points in space described in my paper are taken as the basis of the theory.

If it is the case that, prior to the act of crystallisation, the chemical atoms of a body fall into some symmetrical arrangement, it is natural to suppose that they do so through some influence they exert on one another—such, for example, as mutual repulsion—and that a similar influence is exerted by each atom of the same kind on atoms around it. And if this be so, there will be no *stable equilibrium* of the forces thus exerted *until the atoms are very evenly distributed throughout the space allotted to them.*

Now although, as Herr Sohncke has shown, there is a large variety of symmetrical arrangements of points in space in which the points are disposed around every one point of the system in precisely the same manner as around every other, it would appear that only four of these regular systems, the first four described in my paper, signally fulfil the requirement of even distribution, these four systems being distinguished from all the rest by the property that, *if the nearest points grouped around any point of either of these four systems are joined, the solid thus outlined has its edges all equal.*

And further, although the fifth system described in my paper is not one of Herr Sohncke's *regular* systems, its points are more evenly distributed through space than those of any of these systems except the four just referred to. In this system the property is found that either lines joining the nearest points around any point of the system, or lines joining the next nearest, in all cases outline a solid whose edges are all equal.

As the five systems I have in my paper too vaguely distinguished as "very symmetrical" thus stand alone, and moreover, if my views are adopted, they appear to be adequate to all cases of crystallisation, I still incline to think that the chemical atoms of bodies about to crystallise always have one or other of these five kinds of symmetrical arrangement. If I am wrong in this, and some other symmetrical arrangements are admissible, the general lines of the new theory will not however be affected.

Next, as to the bearing of the theory on chemical valency and the usual conception of a chemical molecule, it may be remarked that, while there is no clear knowledge of the nature of the union between the different sorts of atoms in a compound by which to test the new theory, this theory appears to receive support from the phenomenon of electrolysis. For the fact that one *ion* is liberated at one pole, the other at the other, while *no apparent alteration takes place in the fluid between the poles,* goes to show that any particular atom can change its partners without dissolving the chemical ties subsisting between the several atoms of the compound, and thus favours the view that similar atoms equally near to a particular atom are similarly related to it.

As to my supposition that the expansion, or contraction, occurring in the act of crystallisation, is due to the increased or diminished repulsion exerted by *some only* of the atoms of a body on surrounding atoms, it is, perhaps, interesting to notice that if this conception could be extended to the gaseous state, and the expansion to the state of gas of any compound attributed to the agency of certain atoms in each molecule, or ideal unit, to the exclusion of the rest, the simple relations found subsisting between the volumes of compounds and the volumes of their uncombined constituents might in this way be accounted for:—Thus the fact that aqueous vapour has a volume two-thirds that of the added volumes of the hydrogen and oxygen of which it is composed would be explained if all the gaseous expansion of this compound is due to the hydrogen atoms only.

Muswell Hill WM. BARLOW

"Mental Evolution in Animals"

MR. FARADAY does not seem to have quite understood one point in my comment on his letter. I said that whether the action of the skate was accidental or designed, "in either case, under the conditions, and more especially the 'attitude' described, seizure of the food at the proper moment can only be ascribed to the sense of smell." When we remember the form of a skate, it is certain that, under the conditions described, the animal could not *see* the approaching food, and therefore Mr. Faraday's illustration from the cricketer would only hold if the cricketer continued to hit the ball after he had been blindfolded.

I do not care to continue this discussion; but I may say that as the glass wall of a tank is not an object upon the solidity of which a skate would be likely to calculate, and as the sense of smell in this animal is so highly developed that it might easily give rise to "the appearance of co-ordination" described, I still think that the incident was probably accidental. Any other piece of food happening to approach the mouth would no doubt have been seized in just the same way.

GEORGE J. ROMANES

Instinct

WERE it merely for the sake of reiterating my views, I should not feel justified in commenting upon Mr. Romanes' letter on instinct in last week's NATURE (p. 379). He seems, however, to have understood my "subjective verification" in a sense somewhat different to that which I intended to convey by that expression. I venture, therefore, to beg a little space in these columns for explanation.

There is but one method in human psychology—that of introspection. By this method I obtain certain results. These results I communicate to my neighbour, and he by introspection verifies them for himself. This I call "submitting the results to the test of subjective verification." In this way and in no other can a science of human psychology be constituted.

I remember once seeing a schoolfellow caned. He did not flinch, but grew deadly pale. "Did it hurt much?" I asked afterwards, in schoolboy fashion. "Hurt! Who cares for pain? I was caned for a lie that I never told." I can remember to this day the indignation that his words roused within me. I could verify to some extent the true nature of his feelings. How can I verify the feelings of my dog? The feeling that I infer may be as wide of the mark as the mere pain I fancied my schoolfellow smarted under. Without myself becoming a dog, I can never know the true nature of my dog's feelings.

Mr. Romanes contends that "the involuntary groan of pain, the pallor of fear, and a thousand other unintended expressions of emotions, as well as a thousand other unintended expressions of thought, are, as it is proverbially said, 'more eloquent than words.'" In this I cannot agree. The groan, the pallor, tell plainly of some intense feeling; of its nature they can tell us little. So do the actions of animals testify to some corresponding mental states; of their nature we can form but a dim conception. Out of such dim conceptions no science of comparative psychology can, as it seems to me, be constituted.

Whether this is common sense (for which, by the way, in these matters I have not quite so much reverence as Mr. Romanes) or "an ingeniously constructed argument of scepticism," I must leave others to judge.

In conclusion let me thank Mr. Romanes for his letter, and assure him that I shall give to his objections to my physiological theory of instinct that weight which I feel to be due to the opinions of one from whose writings I have learnt much and hope to learn more. C. LLOYD MORGAN

University College, Bristol, February 25

Protection by Mimicry—A Problem in Mathematical Zoology

UNDER the above heading in the *Japan Weekly Mail* of February 3, 1883, we drew attention to what appeared to us an error made by Mr. Alfred R. Wallace in a letter to NATURE regarding the protection gained by two distinct species of insects of distasteful nature assimilating in appearance when subject to the attacks of young and inexperienced birds. The article was sent to Mr. Wallace, who by letter, and in an article in NATURE, vol. xxvii. p. 481, without hesitation, acknowledged the correction, saying that he had misstated Dr. Müller's proposition. He then gives Dr. Müller's own words, which are:—"If both species are equally common, then both will derive the same benefit from their resemblance—each will save half the number of victims which it has to furnish to the inexperience of its foes. But if one species is commoner than the other, then the benefit is unequally divided, and the *proportional advantage* for each of the two species which arises from their resemblance is *as the square* of their relative numbers." This alters the question altogether. Mr. Wallace had stated it, through an oversight, quite otherwise. He said:—"The number of individuals sacrificed is divided between them in the proportion of the square of their respective numbers." Such was what we took objection to; and we showed that it was not according to the squares, but to the simple numbers.

Mr. Wallace carries out his article, which is accompanied by one by Mr. Meldola (p. 482), to show by examples how it is that, notwithstanding the *loss* is in direct ratio to the numbers of each species, the proportional *saving* through resemblance is inversely as the squares; and he further says:—"The advantage will be measured solely by the fraction of *its own numbers* saved from destruction, not by the proportion this saving bears to that of the other species." On this Mr. Meldola remarks:—"The fact that these numbers stand to one another in the ratio of" the squares, "is a mathematical necessity from which I do not see how we can escape." Now even if this latter statement were strictly correct, we fail to see how it affects Mr. Wallace's statement. We shall show, however, that it is not correct but only an approximation when the number eaten by the birds is a small percentage, for as this becomes greater the ratio of proportional advantages increases considerably above that of the squares.

The proportional advantage that either species has after imitation over its former state (before imitation), appears to be according to the fraction of its original number remaining. Because while in its former state, should it lose one half its number, it would have one-half left, while if it after imitation lost only one-fourth, it would have three-fourths remaining; a clear advantage of one-fourth over one-half, or 50 per cent. This, however, is not a simple case for an example when we come to consider the relative numbers of the two species; we will therefore put it thus:—A has double the number of B. Supposing that when dissimilar A loses 30 per cent. then B loses 60 per cent. But after assimilation both lose in the same proportion, namely, 20 per cent. A has consequently an advantage, over its former state, of 10, and similarly B of 40. But in the former state the remainder of A not lost was 70 per cent., while that of B was 40 per cent., so that A's real advantage is 10 on 70 or 14·2857 per cent., and B's 40 on 40, or 100 per cent. These two numbers do not bear Dr. Müller's ratio of 1 to 4 (the squares of the numbers) but a greater, namely, 1 to 7 = $1^2 \times 40$ to $2^2 \times 70$.

The following examples will illustrate the increasing ratio:—

1. A to B as 2 to 1.

If when dissimilar A loses 20 per cent. then B loses 40 per cent., the remains being for A, 80 per cent.; for B, 60 per cent. When similar each loses $13\frac{1}{3}$ per cent., leaving remains of $86\frac{2}{3}$ per cent.

The advantage to A therefore is the excess of $86\frac{2}{3}$ over 80 on 80 = 8·33 per cent., and the advantage to B is the excess of $86\frac{2}{3}$ over 60 on 60 = 44·44 per cent. These advantages compared to each other are as 1 to 5·33 (according to Dr. Müller 1 to 4).

2. A to B as 3 to 1.

Dissimilar A loses 20 per cent.; B, 60 per cent. Remains 80—40.

Similar A loses 15 per cent.; B, 15 per cent. Remains 85—85.

Advantage to A excess of 85 over 80 on 80 = 6·25 per cent.

Advantage to B excess of 85 over 40 on 40 = 112·5 per cent.

Ratio 1 to 18 (Müller 1 to 9).

3. A to B as 4 to 1.

Dissimilar A loses 20 per cent.; B, 80 per cent. Remains 80—20.

Similar A loses 16 per cent.; B, 16 per cent. Remains 84—84.

Advantage to A excess of 84 over 80 on 80 = 5 per cent.

Advantage to B excess of 84 over 20 on 20 = 320 per cent.

Ratio 1 to 64 (Müller 1 to 16).

Dr. Müller's squares require to be multiplied by the remains per cent. (taken also inversely) of the two species when dissimilar, to bring out the proper ratios. Thus: 1 to 4 (the squares) in the first example, multiplied by 60 and 80 respectively, give 60 to 320 or 1 to 5·33. In the second 1×40 to $9 \times 80 = 40$ to 720 or 1 to 18. And in the third, 1×20 to $16 \times 80 = 20$ to 1280 or 1 to 64.

It will be understood therefore that, whether we reckon the proportionate advantage that each species obtains over its previous state of existence by the mimic, or calculate the ratio of proportionate advantage of mimicry between the two, the comparison has to be made with the state each would have been in had not mimicry taken place, indicated by the proportion of survivors each would then have had. If we ignore this, the comparison is untrue. What we want is the advantage a species which adopts mimicry has over one which fails to do so. So that if we speak of one numerous species A, and two equal non-numerous species B and B′; if B mimics A, while B′ mimics no species, B receives protection, and thus has an advantage over B′, which in particular cases may amount to so much that, while B survives, B′ may become exterminated. This is perhaps the simplest way of putting it.

It must be remembered, however, that B does no harm to A by mimicking it; on the contrary, the act of mimicry is of advantage to A over its former state of existence as well as to B; but A being the more numerous the advantage is less. Still after the assimilation neither has an advantage *over the other*.

Proportionally they suffer from the ravages of the birds equally; the percentage of losses is the same; they are on equal terms. No matter how long they continue the association, neither gains nor loses on the other; though through one being more numerous it loses more individuals, yet equally in proportion with the other. So that, if one is twice as numerous as the other at the time of assimilation, it must always—other conditions being equal—remain twice as numerous.

We now give the mathematical reduction :—

Designation of species	A		B
(1) Original number	a	$>$	b
(2) No. lost without imitation ...	e	$=$	e
(3) Remains without imitation ...	$(a - e)$		$(b - e)$
(4) No. lost with imitation ...	$\frac{a}{a + b} e$		$\frac{b}{a + b} e$
(5) Remains with imitation	$a\left(1 - \frac{e}{a + b}\right)$		$b\left(1 - \frac{e}{a + b}\right)$
(6) Excess of remains due to imitation, or *absolute advantage* (3)–(5)	$\frac{be}{a + b}$		$\frac{ae}{a + b}$
(8) Ratio of excess to remains without imitation (6) : (3), or *proportional advantage*	$\frac{e}{a + b} \cdot \frac{b}{a - e}$		$\frac{e}{a + b} \cdot \frac{a}{b - e}$

(9) Ratio of proportional advantage of B to proportional advantage of A ... ... $\frac{a\,(a - e)}{b\,(b - e)}$ or $\frac{a^2}{b^2} \frac{1 - \frac{e}{a}}{1 - \frac{e}{b}}$.

From (8) we see that, if $e < b < a$, there is a proportional advantage to both, the mimicry "is twice blessed," but the proportional advantage to B is greater. If e is zero, there is no advantage to either. If $e = b < a$, the prop. advantage to B is infinite, while that to A is still finite; this is as it ought to be, seeing that to B it is a case of "to be or not to be," of existence with mimicry or extinction without. And in this extreme case it must be evident to every one that the ratio of $a^2 : b^2$, both terms finite, cannot be the ratio of the infinite advantage of B to the finite advantage of A. The greater e the greater are both advantages.

From (9) we see that, if e is small compared to b and a, the ratio is nearly $a^2 : b^2$ (Müller's law), but the larger e is the further it deviates from that law, the ratio becoming rapidly greater than $a^2 : b^2$, and approaching infinity as e approaches b.

To conclude, we may point out that Müller's law, as given in his own words and quoted above, is incompletely enunciated, and but for the numerical examples, it might lead any one astray as to what the law is. It ought to have *the ratio of* interpolated between "and" and "the *proportional*"; then "*advantage*" and "*square*" ought both to be plural; "relative" ought to be respective; and, lastly, the fact that the ratio is inverse should be explicitly stated.

Finally we enunciate our law. Let there be two species of insects equally distasteful to young birds, and let it be supposed that the birds would destroy the same number of individuals of each before they were educated to avoid them. Then if these insects are thoroughly mixed and become undistinguishable to the birds, a *proportionate advantage* accrues to each over its former state of existence. These *proportionate advantages* are inversely in the duplicate ratio of their respective original numbers compounded with the ratio of the respective percentages that would have survived without the mimicry.

This last "ratio compounded" corrects Müller's law, but we still think with Mr. Wallace that the law, even when corrected, has not much bearing on the question that the individual absolute advantages (6) above, together with the probable value of e and the ratio $a : b$ indicated by relative frequency of capture, solve the whole question. In our first paper above mentioned we established formulæ for calculating these last-named items, although in a different manner from and quite independent of Müller's law, which we had not then seen.

THOMAS BLAKISTON
THOMAS ALEXANDER

Tokio, Japan, November, 1883

Christian Conrad Sprengel

I BECAME acquainted with Christian Conrad Sprengel's work, "Das entdeckte Geheimniss der Natur im Bau und in der Befruchtung der Blumen" (Berlin, 1793) in 1850 at the University of Berlin through Prof. C. H. Schultz-Schulzenstein, who brought it forward in one of his lectures on botany, praising Sprengel's good observations and illustrations, but making his teleological views appear so irksome as to dispose his hearers rather to depreciate and reject the book than be attracted to it by respect. The value of Sprengel's treatise in its bearing on the theory of selection was first recognised by Charles Darwin, whose writings recalled the remarkable book to my mind, and induced me to buy it, which I did at a very cheap rate at an old book-shop. K. MÖBIUS

Kiel, February 18

Circular Cloud Bows

I FANCY that the phenomenon described by Mr. Fleming in your issue of January 31 (p. 310) is not a very uncommon one. It has twice fallen to my lot, when in Switzerland, to be a witness of these spectral shadows.

On the first occasion I was with a party of three on the mountains to the north-east of Montreux, almost opposite the Cape de Moine. It was midwinter, and the day was very cloudy, even in the valleys, while the high ground on which we stood, and all the surrounding peaks, were completely swathed in mist. Suddenly, and under the impulse apparently of a blast of wind from below, the mists around us were almost entirely dissipated, and a few sickly gleams of sunshine filtered through the fog. At that moment we saw gigantic images of ourselves projected on to the wall of vapour enshrouding the Cape de Moine, immediately opposite the point where the sunbeams had permeated. The effect was very transitory, and, so far as I remember, there were no prismatic colours.

The circumstances under which I saw the second appearance were as follows :—

In August last I was standing, just before sunset, on the summit of the Niesen, in company with a friend. The day had been very hot, and we were just remarking on the extraordinary difference in temperature between our elevated position there and our situation a few hours before on the Lake of Thun, when we saw some scattered wisps of cloud rising out of the depths below. These increased rapidly, both in size and number, uniting as they rose, till the whole abyss presented the appearance of a seething cauldron, from which was escaping a dense cloud of steam. The prospect towards the east was quickly blotted out, while the sky in the opposite quarter remained as clear as before.

We then saw dim and fragmentary signs of prismatic colours in the curtain of cloud, and these became more defined and vivid as the thickness of the cloud increased. Finally there appeared a very distinct circle of rainbow hues, with our own figures looming, weird and awful, in its centre. Both images were visible to myself and my companion, though each could see the other's reflection more distinctly than his own.

Mr. Whymper, in his "Ascent of the Matterhorn," mentions an instance in which the prismatic colours assumed the shape of crosses. This effect, occurring as it did soon after the fatal accident which marked the conquest of the mountain, filled the minds of the guides with superstitious horror. From my own experience on the Niesen I can well imagine that, as Mr. Whymper suggests, this form could be accounted for by the supposition that there were several circles interlaced, and that only segments of them were visible from the point at which he and his companions stood.

Perhaps some of your readers may be able to explain the exact atmospheric conditions under which these appearances become possible. E. H. L. FIRMSTONE

Bewdley, February 21

On the Absence of Earthworms from the Prairies of the Canadian North-West

IN NATURE of Jan. 3 (p. 213) Mr. Robert M. Christy writes on the absence of earthworms from the prairies of the North-West. I can confirm his statements, and extend them to cover the prairies of Kansas, the Indian Territory, Idaho, and Washington Territory. In all the above-mentioned territory of the United States the soil is more or less alkaline, and it seems to me that to this cause the absence of earthworms may be attributed. Ants and burrowing beetles, or the larvæ of the latter, are, however, common, and no doubt do much service in the manufacture of plant-food, as well as in the destruction of decaying material. At Boise City, Idaho, some enthusiastic disciples of Izaak Walton imported and successfully reared the coveted bait for their fish-hooks in soil suited to the habitat of the Lumbricidæ. TIMOTHY E. WILCOX

Vancouver Barracks, Washington Territory, January 30

P.S.—Are earthworms found in Arabia and Egypt?

ZOOLOGICAL RESULTS OF THE WORK OF THE UNITED STATES FISH COMMISSION IN 1883

IN the summer of 1880 the United States Fish Commission steamer *Fish-Hawk* began her first work in dredging upon the Gulf-Stream slope seventy miles south of Rhode Island, working in from 75 to 600 fathoms of water. Upon this steep submarine bank several hundred species of Invertebrates were found which proved to be new to the American coast. Many were entirely new, others had been described from the Mediterranean and the deep waters off the west coast of Europe, and some were identical with fossils from the Italian Tertiary and Quaternary deposits, this being true of the shells more particularly. These species have long since been described in American scientific publications, and two subsequent summers of work in this region have brought to light numerous new and additional species, and at the same time very nearly exhausted the region. The *Fish-Hawk*, built for the purpose of serving as a floating shad-hatching station to work in the shallow inlets of Chesapeake Bay, was, during the summer, when she could not carry on her intended work, made use of for dredging purposes, work for which she was not well suited, for her shallow draft and round bottom rendered her unsafe when far from land and liable to encounter rough weather. She could make trips only when pleasant weather was assured for at least twenty-four hours, thereby losing much valuable time which could have been saved if a perfectly seaworthy vessel had been at the command of the Commission.

Accordingly in 1882 an appropriation was obtained, and early in 1883 the *Albatross* was launched, and made her first trip shortly afterwards. So much has been written about the *Albatross* that a mere passing notice will suffice. She is a 1000-ton iron vessel, 234 feet long, and drawing 12 feet of water. On the port side, near the bows, the sounding-machine is placed. Just forward of the pilot-house is the dredging-machine, and here, in a clear space left for the purpose, the rougher work, picking out the specimens from the mud, &c., is done. Aft of the pilot-house, with a chart-room intervening, are the two laboratories and a store-room,—an upper and lower laboratory, and the store-room beneath. The finer sorting and microscopic work is done in the upper laboratory, this being lighted by a skylight and four deck-windows. The library is in this room. In the laboratory beneath are cases of bottles ready for use and for those containing specimens, and a bench is placed on two ends of the room, where rough sorting can be done. In the room below this, bottles, jars, tanks, dredges, nets, and all apparatus used in the work are contained. Alcohol is carried in a large copper tank. In the upper laboratory are two copper tanks each of 32 gallons capacity, one containing fresh water, the other 95 per cent. alcohol. By means of faucets each can be drawn from its respective tank. The rest of the ship, with the exception of a few state-rooms reserved for naturalists, is given over to machinery and quarters for officers and crew. She is manned from the navy, and is under the command of Lieut. G. L. Tanner, U.S.N. Electricity is used for lighting, Brush incandescent lights being used for ordinary purposes, while an arc lamp suspended from the rigging lights the deck so well that work can go on as well by night as by day. Engineer Baird, U.S.N., chief engineer of the vessel, has succeeded in making an incandescent light that when lowered to 100 fathoms will neither be crushed nor extinguished. Used in connection with some deep-sea trap, this will undoubtedly give good results in capturing such quick-motioned fish as would avoid the trawl but would be attracted by brilliant light. The apparatus in use is the best which the past experience of the Fish Commission, U.S. Coast Survey, and European dredging expeditions could suggest. The vessel is so constructed that she can go backward as easily as forward. When the sounding-wire is running out, she can go completely around it without causing it to depart from its perpendicular. That the *Albatross* is perfectly seaworthy and that the machinery and apparatus and the vessel itself are in the best condition has been proved by the numerous trips made during the year just passed, and by the rough weather encountered. Starting early in 1883 upon her trial trip, she went into water as deep as 1200 fathoms. Afterwards numerous trips were made in the deeper waters off the southern coast of New England, some lasting a month. The principal work was done in from 1000 to 2000 fathoms, the deepest work done on the United States coast by an American expedition. Several successful hauls were made in 2400 fathoms, and one in 2950 fathoms. This latter is the deepest successful recorded haul made with a trawl as far we can find out. Soundings were taken in 3000 fathoms. The naturalist in charge is Mr. James E. Benedict. The *Albatross* has just started on a cruise to the West Indies, where work will be done both on the shores and in the deeper outer waters.

The previous explorations of the *Challenger*, *Blake*, Norwegian, and French deep-sea dredging expeditions, investigating similar regions in the North Atlantic, have rendered the results obtained by the *Albatross* much less remarkable than they would otherwise have been. Notwithstanding this, and the fact that some worked very near the field chosen by the *Albatross*, many new species—some of them of a very remarkable character—were taken, often in great numbers. The bottom in all the hauls deeper than 1000 fathoms was of globigerina ooze, the absence of pebbles and sand being a well-marked and universal fact. Whenever mud was obtained from any locality, it was thrown into a tub of water, stirred, and allowed to settle, and by repeating this several times a perfectly pure deposit of Foraminifera was obtained. Each sounding and mud from each station was treated in a similar manner, so that samples, and often large quantities, were obtained in this manner, so that material was furnished for a complete monograph of the group. Over fifty species have been found in a partial examination of a few hauls. Every variety, both in form and in colour, is represented in these shells. Numerous new species of Gorgonians and Pennatulids were found in many localities. In these soft bottoms, where no stones are to be found, such animals or colonies of animals as must have some firm basis of attachment are almost entirely wanting. Sponges, barnacles, and hydroids are very rare, occurring at times upon the bare stalks of Lepidisis or upon some dead shell. Frequently, barnacles and Actinians are attached to these stalks, fastened in a cramped manner, the base completely surrounding the stem. The barnacles found here are very remarkable, usually being stalked, but one was taken which was sessile. A common mode of fixation among the Pennatulids is by means of a bulb-like process which projects into the mud. Acanella, Lepidisis, and their allies fix themselves by branching, root-like projections. A number of specimens of an undetermined species of Umbellifera were taken. Three new species of Epizoanthus, or, more probably, new genera allied to Epizoanthus, were obtained, each with a new hermit crab. Other genera of Actinians were rare, owing to the few opportunities for attachment. The most abundant starfish was a new species of Zoroaster named *Z. diomediæ*, found in 1200 fathoms. An Archaster-like species was the most interesting, on account of its immense madreporic plate. Several other species of Archaster, and at least one of Solaster, were also taken. Starfishes from these depths belong to the two very opposite genera Asterias and Archaster, or their near allies. *Ophiomusium lymani* and *armigerum* formed the greater bulk of Ophiurians, but we dredged, in smaller quantities, *Ophioglypha convexa*, several species of Ophiocantha, and a number of other species not yet determined. One species of soft, flat sea-urchin was quite abundant, and another much larger one was taken in smaller numbers. *Echinus norvegicus*, previously found only rarely in the dredgings of the Commission, was obtained in great quantities in 1000 fathoms. Several other species of Echinus and a number of Spatangoids formed the best part of the collection of Echini. Holothurians were represented by many forms. One, resembling Leptosynapta in form and in its anchor hooks, another similar to Molpadia, and several others having the form of the typical Holothurian, will undoubtedly prove to be new. The most peculiar species of Holothurian were two new forms taken in great numbers from several localities. They are new species belonging to genera described from the *Challenger* Expedition ; one will be called *Benthodites gigantea*, the other *Euphronides cornuta*. We can describe them no better than by giving the names applied by the sailors, Benthodites being called the "lump of pork," and "animated boxing-gloves," while Euphronides was christened "Old Boot," and its resemblance to an old, unblacked, low shoe was certainly remarkable. As the specimens of Benthodites tumbled from the trawl-net, they looked very much like pork, and reminded one of boxing-gloves, on account of their size and apparently useless bulk. In the 2950-fathom haul, a specimen of a Tunicate, allied to Boltenia, was taken, and a number of shrimps.

Several new and remarkable Cephalopods were dredged during the summer. Pleurostoma, Bela, and allied genera were taken in great variety and abundance. One species of Pleurotomella was very large. A Dentalium, differing in no respect from *D. striolatum*, excepting in size, it being often nearly two inches long, was very abundant in from 1000 to 1500 fathoms. *Nucula reticulata, Cryptodon ferruginosus*, and several other species had their range extended as deep as 1500 fathoms. *Dolium bairdii* was obtained, and several specimens of a species which differs from Dolium only in the fact that it has an operculum, which would lead to the inference that it is a Buccinum. The Mollusca probably have more new species than any other group.

In several of the 200 to 400 fathom hauls, *Calliostoma bairdii* was taken. This species is remarkable from the fact that it is one of the few animals which, when taken from the cold bottom waters, will survive and flourish when placed in the aquarium. It is one of the few shells found in our deep water which has a truly tropical appearance. Many Annelids, mostly very minute, were taken at nearly every locality. It is probable that many will prove to be new. *Hyalinœcia artifex*, a worm which secretes a horny quill-like tube, was encountered in some of the shallowest dredgings.

Crustacea were represented by many new and interesting forms, especially of shrimps, including many very curious types. In 2300 fathoms we dredged a shrimp nearly a foot in length, and an Amphipod 3 inches long. Some very odd species of crabs, and hermits furnishing types for entirely new genera, were taken on several occasions. Collossendes, that gigantic Pycnogonid, was dredged many times, and several other large species were also taken. One specimen measured over 2 feet from the end of one leg to the opposite extremity of the other. Notwithstanding this remarkable length of legs, the body was less than an inch long, and an eighth of an inch in breadth. To support this great length of legs, a branch of the stomach extends into the base of each leg. The fish were perhaps the most remarkable, in point of curious structure, aberrant forms, and marked specialisation. One, *Gastrostomus bairdii*, forms the basis of a new order, and is one of the most remarkable recently-described types of primitive anatomical structure, and, especially as regards the skull and branchial apparatus, it presents a remarkable phase of specialisation. Its nearest ally is a Eurypharynx, described by M. Vaillant. It is at present in the hands of Mr. John Ryder and Prof. Theodore Gill, the former studying the anatomy, the latter working out its systematic position. Together they propose to publish a complete monograph of the species. Another remarkable fish has no external traces of eyes. Most animals from the bottom have well developed eyes, although their use is unknown, for, unless some such light as phosphorescence is common, they must live in nearly absolute darkness. Some shrimps and a few other species have no eyes whatever. There are as many as fifteen new species of fish described from the *Albatross* summer collection, most of them belonging to new genera, while one or two families have been added. The field of deep-sea research is as yet just begun, and with what remarkable results. Hundreds of new animals, belonging to entirely new types, have helped to fill up gaps in the animal kingdom which had been left unfilled after a thorough examination of all the shallow waters. Such groups as Crinoids, for a long time supposed to be extinct, are now found quite abundantly and in considerable variety in certain localities. And when the whole ocean bottom has been examined as thoroughly as some portions of the North Atlantic, who can tell what curious forms may be found?

The collections obtained have been placed in the hands of the best American naturalists. Prof. L. A. Lee, of Bodoin College, Maine, has the Foraminifera, Mr. Jas. E. Benedict and Prof. H. E. Webster the Annelids, Prof. S. I. Smith the Crustacea, who will work up the greater bulk, but will turn a few groups over to other naturalists. Mr. Sanderson Smith and Prof. H. E. Verrill will work up the Mollusca, Alexander Agassiz the more important Echini, and the rest of the Invertebrates will be studied by Prof. Verrill. It is not yet determined who will study the Sponges. The fishes are being worked up systematically by Prof. Theo. Gill, and Mr. Ryder is studying the anatomy of the more interesting forms.

RALPH S. TARR

AFRICAN SPIDERS[1]

THE paper above noted forms Part III. of an important and interesting series upon the Arachnida of Africa, and was first published in *Annali del Museo Civico di Storia Naturali di Genova*, vol. xx. pp. 5-105. Its subject-matter comprises the collection of Arachnids formed by Count Orazio Antinori in the kingdom of Scioa in the years 1877-1882. Before entering upon the details of this paper it will be well to notice briefly the two preceding ones of the same series. Part I. (published in the same *Journal* in 1880) states that the object of the series is to bring together all the existing materials in the shape of papers and other works on African Arachnida and present them on one plan and method in accordance with the following five zoological provinces :—(1) *Mediterranean* (extending nearly to the Tropic of Cancer, and in-

[1] *Memoire della Società Geographica Italiana*, vol. ii. parte quarta, pp. 1-103 (Roma, 1883). Spedizione Italiana nell'Africa Equatoriale. Risultati Zoologici. IV. Aracnidi di Scioa, e considerazioni sull' Aracnofauna d'Abissinia, per il Prof. P. Pavesi.

cluding the Azores, Madeira, Canaries, and Cape de Verde Islands); (2) *Oriental*, or, rather, *Central and Oriental African*; (3) *Western African* (from the Gambia to the Congo); (4) *Southern* (included by a line drawn from Kalabini to Limpopo, and comprising a portion of the eastern coast to the Mozambique); (5) *Malagasic* (*i.e.* the Lemur country with Madagascar). Various expeditions and other means by which materials have been obtained are mentioned, and a bibliographical list is given, in the introduction, of the numerous published works and papers on African Arachnida from the days of Linnæus to the present time. The Arachnida described and recorded in this first part are from Tunis, while the second part (published *loc. cit.* vol. xvi. 1881) simply contains an account of a collection of Arachnids from Inhambane (in the southern region), with some considerations on the Arachno-fauna of the Mozambique, of which a list of species is also added.

The Tunisian collection described in Part I. numbers 115 species of six orders: *Scorpionidea*, 6 species (Scorpiones, 5; Pseudoscorpiones, 1); *Solpugidea* (Solifugæ), 4; *Phalangiidea* (Opiliones), 4; *Araneidea* (Araneæ), 96; *Acaridea* (Acari), 5. Of the above, two new genera, and eleven new species (all but one of the latter—a pseudo-scorpion of a new genus) belong to the Araneidea. As might be supposed, the essential character of the Tunisian collection is South European or Mediterranean. Very different from these are the arachnids described and recorded in Part II. from Inhambane and the Mozambique. Here we have, though the number of species is very scanty, the true tropical character. Only 54 species are recorded, comprised in 43 genera, 20 families, and 5 orders. The larger part (35 species) belong to the *Araneidea*, of which 1 genus and 4 species are new. Coming now to the Arachnida recorded and described in Part III. from Scioa (in the eastern zoological province) we have 71 species belonging to 49 genera, 18 families, and 4 orders. A general catalogue is also added of Abyssinian Arachnida, which, including those from Scioa, number 124 species. It is noted as remarkable that no scorpions were contained in the collection from Scioa, and that 30 of the Arachnids recorded are new to science; also that only 12 of the Scioan species are common to the rest of Abyssinia.

The author enters into some other considerations on the distribution of the Arachnids of Abyssinia; but the researches and materials on which his observations are based appear as yet to be too scanty to sustain any very general conclusions. At the same time it must be acknowledged that the plan on which the author has worked, of bringing the materials of so large and varied a region as the African peninsula under the geographical divisions announced in the introduction to Part I. is a most useful one, and the work he has done so far is undoubtedly a valuable contribution to arachnological science.

O. P. C.

MR. BURNHAM'S DOUBLE-STAR MEASURES

THE recently published volume of the *Memoirs of the Royal Astronomical Society* contains a further series of measures of double stars by Mr. S. W. Burnham, made with the 18-inch refractor of the Observatory at Chicago. This series comprises measures of 151 double stars discovered by this eminent observer, which brings up the number of such objects discovered by him during the last ten years to no fewer than 1013, amongst which are included some of the most interesting stars of this class; also measures of a selected list of double stars, 770 in number, made chiefly in the years 1879 and 1880, with an appendix, the results of observations of several objects, as late as the middle of the past year. Every one who is interested in this branch of astronomical science will read with much regret one remark in Mr. Burnham's introduction: he writes:—"The present catalogue will conclude my astronomical work, at least so far as any regular or systematic observations are concerned." He expresses himself modestly respecting his own labours—"In a field so infinitely large, one can accomplish but little at the most, and how much, or how little, the astronomers of a few centuries hence can perhaps best decide. . . . At this time I may venture to claim that my work in this field has been prosecuted with some enthusiasm, and for its own sake only, and that my interest has not been divided among several specialities."

But a higher estimate of Mr. Burnham's work in this particular line of observational astronomy to which he has devoted himself may be justly taken. To read of the discovery of upwards of a thousand double stars within a limited period by one observer, we might almost suppose we were living in the days of Sir William Herschel, when the heavens were comparatively an open field, and had not undergone the wide and close exploration which they had done when Mr. Burnham commenced his work. He has had, it is true, the advantage of instruments of the finest class, and we may believe an unusually acute vision; but he must have exercised an extraordinary and most meritorious amount of patience, perseverance, and care in the discovery and accurate measurement of such a list of double stars, and it will be gratifying to the astronomical world that such well-directed exertions have met with so exceptional a success.

Among the more noteworthy stars included in Mr. Burnham's new Catalogue (the fourteenth), which may be considered a continuation of that published in vol. xliv. of the same *Memoirs*, the following may be mentioned:—

1. 126 Tauri (β 1007), "a most remarkably close and difficult pair, one of the closest known"; magnitudes 6·0 and 6·2. With a power of 1400 there was only a slight elongation.

2. B.A.C. 346; Mr. Burnham thinks the principal star may be variable, and he is certainly correct in his surmise. Heis gives it as a naked-eye star 6·7 m, Gould 7·0 m., and it has been several times noted 8 m; while the writer has recorded it as low as 9 m.

3. β 117; a star with a proper motion, according to Argelander, of 0″·438; measures in 1883 show a common motion of the components; their distance is 2″·2.

4. ζ Sagittarii; detected by Winlock, probably a retrograde motion of 225° in less than fourteen years; and evidently a change of 48° in less than three years, by Mr. Burnham's measures alone. It is an object for large instruments in the other hemisphere.

5. β Delphini (β 151).—A very rapid binary; since its detection by Mr. Burnham in 1873, there has been an increase in the angle of about 180°, and a diminution in distance from 0″·6 to 0″·25. He thinks "it may prove to have, with the single exception of δ Equulei, the shortest period known."

Mr. Burnham collects the measures of δ Equulei, and infers a period of revolution of about 10·8 years. Measures should be easy again in 1885.

6. 85 Pegasi (β 733).—The close pair was not measurable in 1882; the angle was about 323° at the epoch 1883·75. The mean annual motion is about 12°·5, at which rate the period would be less than thirty years.

In the introduction to the Catalogue will be found references to the publications where the thirteen previous ones are to be found.

MEASURING THE AURORA BOREALIS

THE study of the height of the aurora borealis above the earth's surface is, it will be easily conceived, of the greatest importance in understanding the nature of this phenomenon. Unfortunately the height of the aurora has always been, and is to some extent still, a moot point in natural science. There are, of course, not wanting estimates and observations relating to this question, but the general results of these, particularly of the earlier ones, are very contradictory. There seems, however, to be every probability of this problem being very soon solved.

As a basis for the measurements of the aurora we have generally selected the arcs or the more pronounced solitary streamers, when they have been clearly and simultaneously observed from two points situated some distance from each other, the apparent height or position in each place having been determined by comparisons with, and measurements of, stars. In consequence, however, of the rapid shifting both of appearance and position of the auroræ, this method is difficult and unsatisfactory, and these drawbacks may to a great extent explain the very divergent results which have been obtained by the same.

In order to give an idea of the manner and principle of measuring the auroræ in their simplest form I venture to describe the method I have been in the habit of following.

On March 17, 1880, a great aurora was observed at the 145 stations which I had established over the southern part of Norway, the west coast of Southern Sweden, and in Denmark. One of the characteristics of this phenomenon was a large broad arc, or, perhaps more correctly, band, which for a long time spanned the sky from east to west. In Bergen (Norway), where my own observatory was established, it remained for some time in the zenith, then moving a little to the south, but at the stations lying further north it was seen in the south, while at those south of Bergen it was seen in the north.

By its characteristic internal repose and slow motion this remarkable band was especially suited to establish the identity of this aurora at the various stations and to serve as a basis for its measurement. It had apparently, when in its most southern position, no connection with the types which appeared simultaneously in the north, the latter being streamers which it was impossible, from their rapid change of form and appearance to observe connectedly at the various stations.

If the various reports of this auroral phenomenon be examined, not the slightest doubt will remain of the object seen being the same, *i.e.* that the same arc was observed at the most southern as well as the most northern stations. The further we move southwards however—away from the same—the more the apparently observed height diminishes, until we find that at the most southern points it was seen merely as an ordinary low-lying arc. In Bergen no trace of an auroral phenomenon was seen south of the band in question, and the reports from the stations south of this place all agree that neither was any seen there. From this we may conclude with certainty that the auroral arc observed in the zenith of the horizon of Bergen was the identical one seen at all the southern stations, and that the line of demarcation of the phenomenon seen from that place was the absolute southern extension of the band.

Before it is possible, however, from the observations before us to measure the height of the arc, it is necessary to ascertain its direction and its position in space relatively to the localities on the surface of the earth from which it was seen. In the main the point of culmination of ordinary auroral arcs is in the direction of the magnetic north of the place of observation, and the arcs themselves follow approximately the magnetic parallels. I found, however, from careful calculations that the apex of this arc deviated some 10° west from the magnetic meridian, and that its course or strike was at an angle of about 25° with the geographical parallel circles.

The calculation of the height of the arc rests on the following principle. If in Fig. 1 S and S′ denote points of observation, C the centrum of the earth, and P two points in the aurora borealis situated in the same perpendicular plane through S and S′, whose angles above the horizon h and h' have been determined at each station, and the longitude and latitude of each place is known, it is possible (by a well-known trigonometrical formula, viz. $\cos d = \cos (l - l') \cos b \cos b' + \sin b \sin l'$, where l and l' indicate the longitude and b and b' the latitude of the two places, and d the distance or great circle between the two) to find the arc S S′, which is equal to S C S′. From this again S S′ ($\frac{1}{2}$ S S′ = sin $\frac{1}{2}$ S C S′) is found. Further, $\angle x = x' = \frac{1}{2}$ S C S′. One knows, therefore, in the triangle S P S′, the side S S′ and the angles P S S′ and P S′ S, so that its other parts, as for instance P S, may be ascertained by means of some simple trigonometrical calculations. If P S is known, we further obtain, in the triangle P S C, S C, which is equal to the radius of the earth, and the angle P S C = $90° + h$. From this P C is found, and, subtracting S C, the perpendicular height of P above the earth's surface is determined. Finally, if $\angle$ P C S is ascertained, the point on the earth above which P is situated perpendicularly is found.

In practice the matter is, however, not quite so simple. The method presupposes thus that P lies in the same

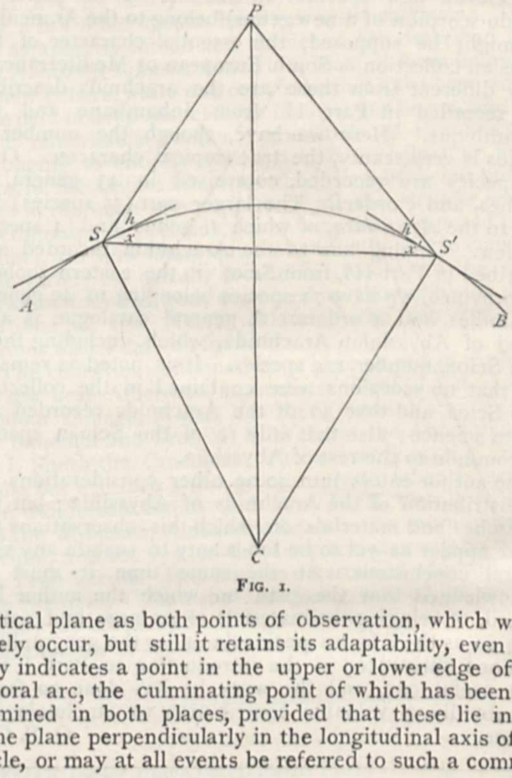

FIG. 1.

vertical plane as both points of observation, which would rarely occur, but still it retains its adaptability, even if P only indicates a point in the upper or lower edge of the auroral arc, the culminating point of which has been determined in both places, provided that these lie in the same plane perpendicularly in the longitudinal axis of the circle, or may at all events be referred to such a common plane.

It is, however, far more difficult to overcome another drawback. Provided that the arc has a perceptible thickness in relation to its horizontal breadth, those parts of the upper or lower edge of the arc which present themselves to the various observers cannot always be referred to the same parts of the arc, in consequence of the circumstance that the apparent breadth, particularly with the lower arcs, is due to a combination of both the real breadth and thickness of the arc.

If a, b, c, d in Fig. 2 represent the circumference of a circle observed from the points A, B, C, assuming that the line of demarcation of the arc north and south is parallel with the inclination needle, the point a will denote the upper (southern) edge for A and B, for C on the other hand b; and, in a similar manner, the lower (northern) edge is determined by the point d for A and B, c for C, &c.

Now if the determination of the apparent height of the upper edge for A and C is taken as a basis for calculation, the height of the same cannot be ascertained therefrom, but from the crossing point of the lines A *a* and C *b*, and so forth. A great many other variations may also be met with according to the dimension and position of the arc. Generally, however, when the arc lies on one side of both places of observation, the edges observed in the respective places are identical.

In the following simple manner I have succeeded in referring the various places of observation to the vertical plane of Bergen, where my own observatory is situated, in order to find the arc S S′ in Fig. 1. The direction of the arc I have, in accordance with observations, let form an angle with the circles of latitude of 25°. I have constructed a globe with the circles on a large scale in Mercator's projection, on which the various stations have been denoted. Through the place "Bergen" a straight line is drawn under an angle of 25° with the circles of latitude, while the perpendicular distance of the various stations from this line has been determined in the construction and by direct measurements. The stations whose observations are so complete that the angle of the arc above the horizon has been determined have been combined with Bergen. I have succeeded in forming nineteen such combinations. The heights of the arc calculated at these

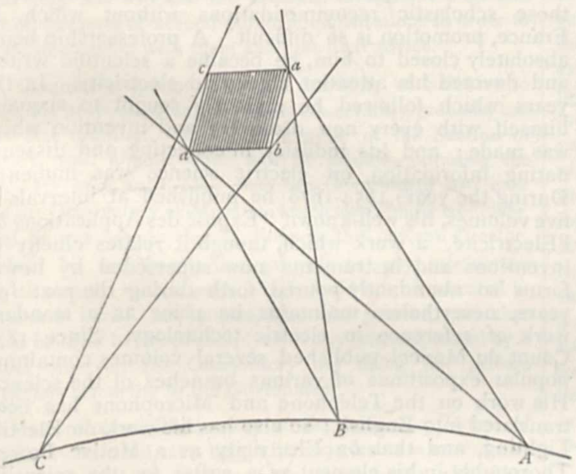

Fig. 2.

stations vary somewhat, but not very much, and if an average is taken we find that the value of the height of this arc above the earth's surface was most probably 146·95 km.

It further appears that the observations were not exact enough to obtain an estimate of the thickness of the arc, so that we can only accept the figure given above as an average one, *i.e.* an average of the distance of the uppermost and lowest layers from the surface of the earth.

If we compare the height arrived at in this case with those obtained through previous researches, we shall find that it agrees to some extent with the value of the arcs measured in recent times. They differ, however, greatly from old ones. Thus Prof. Fearnley finds, through observing sixteen auroral arcs from *one* spot, in Christiania, by an ingenious theoretical method, that the average height in these cases was 27·15 geographical miles, or 201·5 km. Newton found, by the same method, that the average height was 130 English miles, or 209·3 km., while Nordenskjöld, by a similar method, has come to the conclusion that it is 190 km. The French expedition established at Bossekop during 1838-39 obtained no reliable statistics on this point, owing to the small distance between the two points of observation, viz. 15·6 km. But from the results obtained it seems that the height must be sought between 100 and 200 km.

In opposition to this Bergman fixes the height at 753 km., Boscovich at 1328 km., and Mairan at 780 km. More in correspondence with our result Dalton found the height of the auroral arc to be 241 km., and Backhouse found the three measured by him to lie between 81 and 160 km. On the other hand, Franklin found at Cumberland House (North America) that several auroræ which he measured had a height only of 11·3 km. In fact, the *savants* who have studied the aurora borealis in the Arctic regions appear to agree that it does not attain the height given above as the results of researches further south.

I have here only mentioned a few of the very divergent values obtained in measuring the aurora borealis, but I

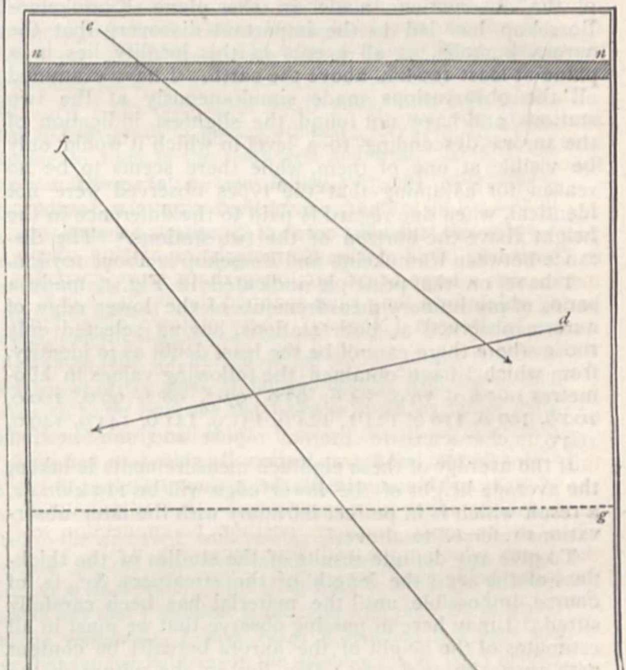

Fig. 3.

do not believe it will be of any service to append more, as the values range from 0 to 2000 km.

In Fig. 3 I have attempted to illustrate the height of the aurora referred to by me by comparing it with other well-known heights. The scale is 1 mm. = 1 km. Below is drawn a profile of Norway from Bergen in a direction E. 25° N. The heights here range to upwards of 5000 feet. Above *n n* indicates the arc of the aurora in its height of 146·95 km. The thickness given is wholly approximate, and probably too small. For comparison is inserted, *a*, the highest mountain in the world (Mount Everest, 8839 m.); *b*, the greatest height reached by man (Glaisher and Coxwell in their balloon on September 5, 1862, 31,800 feet); *c*, the estimated height of the cirrus clouds (25,000 feet); *d*, the plane of the August meteors—beginning and ending (155 and 98 km.); *f*, the point of appearance and disappearance of the large meteor which was seen on March 4, 1863, in England, Holland, Belgium, and Germany (134 and 26 km.); and finally *g*, the hypothetical height of the atmosphere (10 geographical miles = 74 km.).

With regard to the results of the measurements of the aurora which I effected during last winter at Kautokeino, in conjunction with the stations at Bossekop and Sodankylä, I may be brief, from the circumstance that the observations made at the latter station are not to hand, while the material at my disposal requires a more careful analysis than I have as yet been able to bestow upon it.

I must, however, state that a preliminary examination of the observations made in the plane Kautokeino-Bossekop has led to the important discovery that the aurora borealis, at all events in this locality, lies in a plane at least 100 km. above the earth. I have examined all the observations made simultaneously at the two stations, and have not found the slightest indication of the aurora descending to a level in which it would only be visible at one of them, while there seems to be no reason for assuming that the types observed were not identical, when due regard is paid to the difference in the height above the horizon of the two stations.[1] The distance between Kautokeino and Bossekop is about 107 km.

I have, on the principle indicated in Fig. 1, made a series of preliminary measurements of the lower edge of auroræ observed at both stations, having selected only those where there cannot be the least doubt as to identity, from which I have obtained the following values in kilometres:—76·0, 79·9, 84·6, 93·6, 97·7, 98·2, 99·0, 100·0, 100·6, 107·0, 116·6, 124·1, 124·9, 131·9, 141·6, 144·9, 149·0, 163·6.

If the average of these eighteen measurements is taken, the average height of the lower edge will be 113 km., *i.e.* a result which is in perfect harmony with the later observations referred to above.

To give any definite results of the studies of the thickness of the arcs, the length of the streamers, &c., is, of course, impossible, until the material has been carefully sifted. I may here in passing observe that we must in all estimates of the height of the aurora borealis be content with approximate figures; this lies in the nature of the case, apart from inaccuracies in the measurements which it is impossible to avoid. The aurora borealis has, in common with clouds, no absolutely defined and fixed line of extension, either downwards nor upwards. We must therefore rest content with ascertaining only approximately the height of the plane in which the aurora borealis appears.

That the aurora generally appears at a height of 100 km. or more above the earth's surface does certainly not preclude the possibility of its appearance on some occasions much nearer the earth. In fact there are a considerable number of reports in our hands which imply that this is really the case. Thus observers aver that they have seen auroræ below the clouds, in front of mountains and icebergs and coasts, and even on the very ground. These assertions have been greatly doubted as being the result of the imagination, or optical illusions, but with what justice I will not venture to say. For my own part I can only say that during my long stay at Kautokeino I had unfortunately often enough occasion to observe auroræ and clouds simultaneously, but although always paying the closest attention to this particular point I have never seen even a fragment of an aurora in front of or below the clouds. Even the most intense development of light, colour, and motion occurred always above what seemed to be the very highest-lying clouds.

When the entire material relating to the study of the aurora borealis has been collected from the various international circumpolar stations, sifted and carefully analysed, the question of the height of the aurora borealis will not, I believe, long remain one of the unsolved problems of nature. Until then the reader must remain content with the discoveries I have indicated in this paper.

SOPHUS TROMHOLT

[1] The experiences of Prof. Lemström at Sodankylä (NATURE, vol. xxvii. p. 389), which seem to point in a different direction, I intend to discuss on another occasion.

COUNT DU MONCEL

COUNT THEODORE DU MONCEL, whose death we briefly announced last week, was born at Paris on March 6, 1821. His father had been a General of Engineers under Louis Philippe, and the son was at one time destined also for the army. When but eighteen years of age he showed a predilection for scientific pursuits, and published two treatises on perspective, treated mathematically and artistically. He was also at this time an enthusiastic archæologist and traveller. In 1847 he published a volume entitled: "De Venise à Constantinople à travers la Grèce," illustrated with lithographic plates drawn by himself. His family objected to his democratic pursuits, and became estranged from him. In consequence he determined to adopt science as a profession. But not having studied at the Ecole Polytechnique, nor at the Ecole Centrale, he lacked those scholastic recommendations without which, in France, promotion is so difficult. A professorship being absolutely closed to him, he became a scientific writer, and devoted his attention chiefly to electricity. In the years which followed he zealously sought to acquaint himself with every new discovery and invention which was made; and his industry in collecting and disseminating information on electric science was immense. During the years 1854-1878 he published at intervals in five volumes, his well-known "Exposé des Applications de l'Electricité," a work which, though it relates chiefly to inventions and instruments now superseded by newer forms so abundantly poured forth during the past few years, nevertheless maintains its place as a standard work of reference in electric technology. Since 1878 Count du Moncel published several volumes containing popular expositions of various branches of the science. His work on the Telephone and Microphone has been translated into English; so also has his work on Electric Lighting, and that on Electricity as a Motive Power. Thoroughly in his element as a writer for the scientific press, and more of a journalist than a man of science, Count du Moncel nevertheless distinguished himself by a series of valuable contributions to science, chiefly in the form of papers read before the Académie des Sciences. His researches on the properties of electromagnets and on the conductivity of badly-conducting bodies are worthy of mention. To du Moncel we owe the observation that the variation produced by pressure in resistance offered at the point of contact between two conducting bodies—a phenomenon well known before his time—is more marked in certain bodies than in others, wood-charcoal being one. In this observation he laid the foundation for the subsequent applications of this principle made by Clérac and by Edison. Du Moncel was also an inventor, and obtained a gold medal at the Exposition of 1855 for the collection of instruments exhibited by him, including an electric water-indicator, an electric anemograph, an electric recorder of improvised music, a recording galvanometer, and sundry telegraphic instruments. From 1860 to 1873 du Moncel was occupied as electrician to the administration of telegraphs; but he quitted the post somewhat abruptly in 1873 in consequence of disputes in the administration. In 1874 he was elected a member of the Académie des Sciences, in which body he was very active in bringing forward accounts of all discoveries in his favourite science. It was he who thus successively introduced to the Academy the Bell telephone, the Hughes microphone, and the Edison phonograph. He was very prominently connected with the Electrical Exhibition at Paris in 1881. From 1881 until his death he held the editorship of the journal entitled *La Lumière Électrique*, which was founded by him, and to which he was an unceasing contributor. Whether he was a great scientific genius may be doubted, and whether in some matters he did not assume the attitude of partisan rather than that of historian is also perhaps open to debate; but none can deny that he had by his diligence and talents won himself a very important place in the ranks of science. The *rôle* of scientific journalist may be said to have almost been created by him, and he was always anxious to maintain the dignity of science and to advance the interests of scientific workers. It would be difficult to fill up the void left by his sudden decease.

NOTES

M. FAYE read to the Academy of Sciences, on Monday, a report drawn up by the Academical Committee appointed to prepare for the election of the three French delegates to the Meridian Congress of Washington. The Committee, whose conclusions have been adopted by the Academy, declines to take any final step, and will ask the Minister to appoint a certain number of delegates of several public administrations in order to deliberate in common with them and give final advice.

THE Committee appointed by the Academy of Sciences to report on the proposal to sell the Paris Observatory grounds, has held its first meeting. M. Wolff, Member of the Section of Astronomy, read a note, which will be printed, opposing the scheme. He said, *inter alia*, that the Government had constructed an Observatory at Meudon, which was almost complete, and that he was certain that M. Janssen, the present director, would lend his instruments and grounds to any astronomer wishing to execute special work which could not be executed in the interior of Paris. M. Janssen, who was present, said that he should be most happy to comply with any wish expressed by a competent observer, the Observatory not being his private property, but belonging to the Government.

THE Meteorological Observatory of Sentis, in the Canton of Appenzell, Switzerland, at a height of 8094 feet was established in August 1882, and the regular observations began with September 1 of that year. This observatory, which, from its position and height, is *par excellence* the high-level meteorological station of Switzerland, is maintained at an annual cost of 6000 francs, raised jointly by the four neighbouring cantons, the learned societies, and the Alpine Club of Switzerland, and is further subsidised by 1000 francs from the national grant for meteorology. A brief *résumé* of the results of the first year has been received. The eye-observations are made five times daily; the results at these hours, however, are only given in full as regards the force of the wind. These are of some interest, as showing that, so far as regards the observing-hours, viz. 7 and 10 a.m. and 1, 4, and 9 p.m., the mean diurnal force of the wind, for each of the twelve months beginning with August 1882, is least at 1 p.m. We look forward with no small interest to a fuller report than the one now before us of the diurnal results for each month of the barometric, thermometric, hygrometric, and rain observations from this invaluable addition recently made to the high-level stations of Europe.

A CURIOUS tidal phenomenon took place on the morning of the 21st inst. on the west coast of England. The following communication (dated Feb. 21) to the Secretary, Meteorological Office, from Ellis Roberts, Trinity Buoy Keeper, Aberdovey, contains the leading circumstances connected with the occurrence:—"Afternoon of the 20th (civil time), it blew strong (6 to 7) from south-south-west and south-west, increasing towards midnight to very heavy gale (force in the squalls, 10 to 11) with heavy rain. I retired at 11. Barometer at 29·31, falling. I cannot say when it moderated, but at 6 a.m. the sky was beautifully clear, with moderate breeze about west (force 3 to 4). The time of high water for this bar, by the Liverpool almanacs, this morning tide would be 2h. 33m., but from some observations that I have made for eighteen months that I have been living here, the time of high water in the river off the village would be about 3h. 5m. to 3h. 10m. I wish to make this remark on account of the times the phenomenon took place. About 6.30, or near half ebb, I noticed the barometer had risen to 29·34 or ·35, with beautiful, fine, clear sky; moderate breeze (about 3) from west-south-west, but the stream nearly slack when it ought to have been running *ebb* about two knots; very heavy sea on the bar. At 6.50 the vessels were fairly swung to the flood, which was running about 1 to 1½ knot, and the water was fast rising. At 8·15 water again nearly slack, with light breeze (about 2) from south to south-south-east; very fine, but clouds beginning to form in the south-west and west. At 8.30 the water was falling; at 9, water falling very fast, ebb running 2½ to 3 knots; at 10.45, water beginning to rise for the natural tide. As there is no gauge for the rise and fall at this place, I cannot give the *correct* rising and falling, but I will give them according to the best of my judgment. The afternoon tide of the 20th was noticed to be very low, much lower than could be expected from the state of the wind and weather. But this morning's tide rose fully *six* feet above the ordinary level, or nearly to the height of the tides at full and change, with the moon's parallax 59′ to 60′ (this tide had fallen as usual, or rather more rapidly, up to nearly half ebb). I cannot exactly say how much the water had risen before I noticed it, but the unnatural tide rose after I noticed it over 2 feet 6 inches; and from 8.30 to 10.15 the same had fallen over 6 feet, although the wind had shifted to the westward, with passing showers and hard squalls. Barometer all the time very steady at 29·34 or ·35. Now, 4 p.m., it is slack water, ships lying head to wind, but a lower tide than any that I recollect in this river with the wind as strong from the westward. I have heard it reported that there was heavy thunder and lightning in the neighbourhood, but I neither saw nor heard any." Similar occurrences are reported from the Dee, near Chester, and from the Mersey.

THE Second Teyler Society of Haarlem offers a gold medal of the value of 400 florins for a critical study of all that has been said for and against spontaneous generation, especially during the last twenty-five years. The competition is international, and further details may be obtained by applying to "La Maison de la Fondation du feu M. P. Teyler van der Hulst, Haarlem."

WE are asked to state that a society calling itself the "Society of Arts, Letters, and Science," has no connection whatever with the Society of Arts.

THE old Sorbonne and Collège Louis-le-Grand in Paris will soon be demolished, to be reconstructed on a larger and more magnificent scale. The same measure is to be applied to the Collège de France. All this part of the Latin Quarter will be quite remodeled, and will in a few years be unrecognisable.

THE Municipal Council of Paris has passed a resolution to exhibit, in each of the twenty town halls of that city, the meteorological notices issued every day by the French Office.

PROFESSOR MILNE of Japan has just made a new move in the direction of investigating seismic phenomena. He has made preparations for the establishment at Takashima, near Nagasaki, of an underground or catachthonic observatory. The workings in the coal-mine at that place not only extend beneath the island of Takashima itself, but also beneath the sea, and have a total length of about seventy miles. About 2500 people are employed there, and the output of coal is about 1200 tons a day. Owing to chemical decomposition going on in the workings, which are on the "post and stall" system, the temperature is so high that spontaneous combustion is constantly occurring. Prof. Milne visited places having a temperature of 110° F. This, together with the escape of fire-damp, make the mine very dangerous. The experiments which have been commenced, and which are to be continued systematically, are: (1) the observation of earth-currents, which so far appear to be but feeble; (2) listening in a telephone to the sound produced by the movement of a microphone placed in the solid rock; (3) the observation by means of a tromometer, or tremor measure, of earth-tremors; (4) the observation of two delicate levels to see if the seasonal movements of the soil on the surface exist also underground; (5) attempts to measure the influence of the tide, which rises there about eight feet every twelve hours, in producing a bend, or crushing in the roof of the mine. Observations on atmospheric electricity may subsequently be added. All these will be carried on in conjunction with tidal, barometrical, and thermometrical observations, as well as with those on the escape of fire-damp and the entrance of water to the mine. One practical object of these series of observations is to ascertain whether any of these phenomena are connected with each other, and especially with the escape of fire-damp in the mine. At present it appears that the gas shows itself about eight hours before a fall in the barometer, and therefore the indications of the latter are useless as danger warnings. On the *surface* of the earth tremors increase with a barometrical fall, and perhaps before it. Earth-tremors and the escape of fire-damp may, therefore, Prof. Milne thinks, be connected; but, whether practical results be obtained or not, the experiments will enable a comparison to be made between surface phenomena and those which are subterranean. The native company which now owns the mine, as well as the resident engineer there, have afforded every assistance to Prof. Milne in his investigations, and that gentleman, we are informed, will be glad to receive suggestions for improved or additional observations, from any scientific men in this country interested in the subject. Any communications intended for him should be addressed to the Imperial College of Engineering, Tokio.

THE Russian *Izvestia* publishes the results of the researches of M. Brounoff into the variations of temperature in consequence of the cyclones in Europe. He has taken seventy-six cases in which the meteorological bulletins showed the presence of a cyclone in Europe, and prepared a meteorological map for each of these days, showing the deviation of temperature from the normal, and the route of the cyclone. The average deviations of temperature in the regions of the cyclones appear as follows for different months: January, 3·7° Cels.; February, 2·2°; March, 1·2°; April, 0·2°; May, 0·0°; June, −0·7°; July, −0·2°; August, −0·4°; September, −0·1°; October, 0·2°; November, 0·9°; December, 1·4°. It results from these figures that, as might have been foreseen, during the winter the cyclones bring warmer air, and colder air during the summer. If the region of the cyclone be divided into four parts by two perpendicular lines traced through its centre, the two right parts widely differ from the two left, the deviations being for the former: winter, 4·6°; spring, 1·9°; summer, 0·7°; and autumn, 1·7°, all positive; while for the two left parts the deviations are all negative as well during the summer as during the winter, namely: −0·9° for the winter, −1·1° for the spring, −1·7° for the summer, and −0·9° for the autumn.

IT appears from a notice published in the last issue of the *Izvestia* that stone-age implements were used by Russians in Siberia at a time very near to our own. Thus, owing to the difficulty of having iron implements, and even iron, the Cossacks who occupied the valley of the Irkut at Tunka availed themselves of the numberless stone implements they found scattered on the hills around Tunka, where large manufactures of stone implements have been discovered. There are still people who remember also that their grandfathers were compelled to follow the advice of the Mongols, and to make use of nephrite hatchets; the tradition says also that there were Cossacks who understood themselves the art of making jade implements. Any one who knows the difficulties of obtaining iron in Siberia some thirty years ago, and even now, will not doubt the trustworthiness of the tradition. We may add also that the late Prof. Schapoff has found the settlers at Turukhansk largely using stone pestles and hammers, some of which were exhibited at the Irkutsk Museum, before it was destroyed by fire.

IN the last number of *Naturen* Herr Geelmuyden of Christiania describes the so-called "Jættegryder" giant-bowls of Orholm, on the east side of Christiania fjord. These curious geological formations, of which good drawings are given, are not only the largest of their kind in Scandinavia, but are of greater size than those of the well-known glacier garden of Lucerne, which have hitherto been considered as the most extensive of such natural depressions. In two of the upper cavities at Orholm, all of which lie on the edge of a steep fjeld, a few pine and birch trees have taken root and grown in a tolerably normal manner till they reached the level of the surrounding rock, when the branches have invariably been bent and distorted by the force of the winds, and their growth has been arrested. The depth of the depressions has not been determined, but the perpendicular inclination of the inner walls would lead to the inference that it is considerable.

MESSRS. CROSSLEY BROTHERS, of Manchester, have recently added an important improvement to their "Otto" gas-engine. This consists of a self-starting apparatus by means of which the engine can be put in motion by simply opening a valve. The apparatus consists of a small receiver into which the engine exhausts for a very short portion of its strokes the burnt gases which result from the ignition of the charge in the cylinder. These gases fill the receiver, and in the course of half a minute raise a pressure in it nearly corresponding to the pressure in the cylinder during the moment of ignition. These stored burnt gases are admitted again to the cylinder at the moment of starting by a very simple piece of mechanism, and thus put the engine in motion in much the same way as steam moves a steam-engine, thus saving the trouble of pulling the wheel round to get in the first charges.

ON January 22, at 8.47 p.m., a meteor was observed in the province of Kalmar, Sweden. It appeared in the north as a fire-ball, without trail, gradually descending to the earth, so slowly that some observers, in order that it should not become hidden from view by intervening houses, ran about 300 m., and still beheld the object. The speed decreased by degrees, and finally the ball seemed to remain stationary and then went out. No whizzing noise or report was heard. The object was observed for a minute and a half. Its path was not regular but marked by great deviations. When first seen its size and lustre was like that of Jupiter, and its point of issue 50° above the horizon, while when disappearing it was 10° above the horizon. It seemed to increase in size as it descended. Its slow speed was particularly remarkable, as it differed so greatly from that of ordinary meteors.

THE Anthropological Society of Paris is constituted as follows for 1884:—President: Dr. Hamy; Vice-Presidents: Drs. Dureau and Letourneau; Secretary: Dr. P. Topinard; Assistant Secretaries: M. Girard de Rialle, Dr. Prat, and M. Issaurat; Committee of Publication: Drs. de Quatrefages, Matthias Duval, and Thulié.

THE death is announced of Dr. Gotthilf Heinr. Ludw. Hagen, with whose name for the last sixty years progress in the domain of hydrotechnics in Germany is closely associated. He died at Berlin on the 3rd inst., having nearly completed his eighty-seventh year.

THE death is announced of Dr. A. Bernstein, the well-known author of the "Naturwissenschaftliche Volksbücher." He was born at Danzig in 1812, and died at Berlin on the 12th inst.

ON February 18 an earthquake was felt in several parts of the Department of Algiers. Its duration was very short. The *Turkestan Gazette* states that as many as ninety distinct shocks of earthquake have been felt at Oosh since November 14. Other shocks have also recently occurred at Viernoe and Tashkend. A violent earthquake is also reported from the Birvari district (province of Bitlis, on Lake Van, in Asiatic Turkey) on February 10. Great damage was done, as many houses fell.

MR. W. WHITAKER desires us to point out in reference to the article on the "Geological Survey of the United Kingdom," printed in the last number of NATURE (p. 395), that some of the bulkiest publications of the Survey have appeared since 1855. He favours us with a list of these, in which we are glad to observe his own "London Basin, pp. xii. 620."

IN consequence of a generally expressed wish from many hundreds of intending participators at the forthcoming Ornithological Congress at Vienna, the Committee of the Congress has a tered the date for the first meeting from April 16 to April 7. As the Ornithological Exhibition will be held from April 4 to April 14, the ornithologists present in Vienna at that time will have an opportunity of seeing the Exhibition, while at the same time attending the Congress. Numerous Belgian, Danish, French, German, Austrian, Italian, and Russian men of science will meet in Vienna upon that occasion.

THE German Government has issued an edict concerning the preservation of prehistoric burial-mounds which may be discovered henceforth upon German soil.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus sinicus* ♂) from India, presented by Mr. W. Graeme; a Sambur Deer (*Cervus aristotelis* ♂) from Ceylon, a European Flamingo (*Phœnicopterus antiquorum*) from Southern Europe, presented by Mr. James McGregor; a Vulpine Phalanger (*Phalangista vulpina* ♂) from Australia, presented by Mr. A. H. Lowder; a Pine Marten (*Mustela martes*), British, presented by Mr. Edward de Stafford; a Common Hare (*Lepus europæus*), British, presented by Mr. G. Pottier; a Rhesus Monkey (*Macacus rhesus*) from India, presented by Master A. J. Neill; two Laughing Kingfishers (*Dacelo gigantea*) from Australia, presented by Dr. Evans; a Black-footed Penguin (*Spheniscus demersus*) from South Africa, presented by Mr. F. Bloor; a Greek Tortoise (*Testudo græca*), European, presented by Miss M. L. Fergusson; a Stump-tailed Lizard (*Trachydosaurus rugosus*) from New Holland, a Bearded Lizard (*Amphibolurus barbatus*) from Australia, presented by Mr. J. W. Bostock; a Pike (*Esox lucius*) from British fresh waters, presented by Mr. Charles D. Hoblyn, F.Z.S.; a Lesser White-nosed Monkey (*Cercopithecus petaurista* ♀), a Campbell's Monkey (*Cercopithecus campbelli* ♀) from West Africa, a Ruddy Ichneumon (*Herpestes smithi*) from India, a Bactrian Camel (*Camelus bactrinus* ♂) from Central Asia, three White-crowned Pigeons (*Columba leucocephalus*) from the West Indies, purchased.

OUR ASTRONOMICAL COLUMN

THE SOLAR ECLIPSE OF 1806, DECEMBER 10.—When Rümker was on the point of leaving England to undertake the direction of the observatory erected by Sir Thomas Brisbane at Paramatta, N.S.W., he came into possession of a letter addressed to Maskelyne by Admiral Bligh, Governor of the colony, containing observations of a solar eclipse on December 10, 1806, which was described as almost total; the observations were made at Government House, Sydney Cove, with a three-feet achromatic and two chronometers by Arnold; Rümker communicated the Admiral's letter to Zach, who published it in vol. v. of his "Correspondance Astronomique," with the places of the sun and moon from Delambre and Burckhardt, and the longitude of Sydney Cove, which he had deduced from Bligh's observations. Employing Burckhardt's Lunar Tables and the last Solar Tables of Carlini the elements of this eclipse will be found to be approximately as follows:—

G.M.T. of conjunction in R.A. 1806, Dec. 9 at 14h. 19m. 14s.

	°	′	″
R.A.	256	19	1
Moon's hourly motion in R.A. ...		35	3
Sun's ,, ,, ...		2	45
Moon's declination	23	1	8 S.
Sun's ,, ...	22	52	2 S.
Moon's hourly motion in decl. ...		0	5 S.
Sun's ,, ,, ...		0	14 S.
Moon's horizontal parallax		56	16
Sun's ,, ,, ...		0	9
Moon's semi-diameter		15	20
Sun's ,, ,, ...		16	15

The eclipse was therefore an annular one: it was central and annular with the sun on the meridian in longitude 143° 23′ E. and latitude 32° 23′ S. Admiral Bligh's position was not within the annular phase, but on making a direct calculation for it, we find the greatest eclipse at 0h. 41m. p.m. local mean time, magnitude 0·92. Perhaps this is the first eclipse that was astronomically observed at Sydney, and it may be noted in connection with Mr. Russell's historical account of the progress of astronomy at that place, of which we gave some account last week.

THE LATE PROF. KLINKERFUES.—Ernst Friedrich Wilhelm Klinkerfues was born at Hofgeismar in Hesse, on March 29, 1827. He was attached to the Observatory of Göttingen as assistant in 1851, under Gauss; he became provisional director of that establishment in 1859, and in 1868 was confirmed in that appointment. Since 1863 he was one of the professors in the Philosophical Faculty at Göttingen. He was an able practical and theoretical astronomer, and discovered the comets 1853 III., 1854 I., 1854 III., 1854 IV., 1855 II., and 1857 V.; the first of these, which bore his name very generally while under observation, was telescopically observed in full sunshine, and only a few degrees from the sun's place by Mr. Hartnup at Liverpool, and by Schmidt at Athens. In 1860 Klinkerfues proceeded to Cullera in Spain for the observation of the total solar eclipse in July. His work in theoretical astronomy included a method of determining the orbits of the binary stars, and he was the author of a valuable theoretical treatise on the science. When, on the occurrence of the great meteor shower of November 27, 1872, it was found that the meteors followed the track of Biela's comet, and the comet itself was supposed to be close to the earth on that day, Klinkerfues thought it might be found opposite the radiant of the meteors in Andromeda, and accordingly telegraphed to Mr. Pogson at Madras to this effect, "Biela touched earth November 27, search near θ Centauri." It will be remembered that, in consequence of this telegram from Klinkerfues, Mr. Pogson actually detected a comet in the vicinity, but was only able to obtain its place on two mornings; so that the orbit could not be determined. There was a divided opinion at the time as to its connection with Biela, and perhaps this may now be said to be more than doubtful, notwithstanding the singular circumstances attending its discovery. Klinkerfues died suddenly at the Observatory of Göttingen on January 28.

GEOGRAPHICAL NOTES

MR. H. H. JOHNSTON leaves London to-morrow for Zanzibar, to conduct an expedition to Mount Kilimanjaro. The expenses of the expedition are borne by the Royal Society and the British Association, the object being to form as large a collection as possible of the flora and fauna of the highest mountain in Africa.

ANOTHER attempt will be made this year to rescue the United States observing party in Lady Franklin Bay, under Lieut. Greeley. This party, twenty-five in all, went out in August 1881 and in 1882 and 1883 unsuccessful attempts were made to reach them. This year four vessels will be sent out, one of them H.M.S. *Alert*, which we are glad to know has been presented for the purpose of the search to the United States Government. It is to be expected that with such a formidable expedition the Greeley party will be reached, and we fervently hope brought home, though it is to be feared that some at least must have succumbed to the hardships of three winters in 81° N.

THE fourth German Geographical Congress will meet at Munich from April 17 to 19 next. The preparations are now being made. The main subjects for discussion are: the present state of Polar investigation; the innovations relating to the standard meridian; the Glacial epoch; and the mode of drawing large-sized maps for schools. Numerous travellers and investigators have promised to read papers.

DR. WILD of St. Petersburg, the President of the International Polar Commission, is now sending out invitations for the Polar Congress which is to meet at Vienna on April 22 next. All the leaders of the International Polar Expeditions of 1882 are expected to attend.

DR. ZINTGRAFF of Berlin is about to follow Dr. Chavanne to the Congo, by order of the Brussels National Geographical Institute. His special investigations are to be of an ethnological nature.

HERR L. STEINEGER informs *Naturen* that his fortnight's stay in Kamchatka in May, 1883, proved fairly satisfactory. The complete success of the expedition was, however, interfered with by the exceptionally late snowfalls, which had buried the whole district round Petropaulovski under a layer of six to nine feet of snow, the surface of which melted daily under the scorching sun only to be frozen again at night. Among other interesting points he has noted the presence of four distinct species of the sea-eagle in Kamchatka, while Europe and the whole of the North American continent had only one species of this magnificent bird. One of these four, which Herr Steineger has named *Haliæetus hypoleucus*, is distinguished from *H. leucocephalus*, *H. albicilla*, and the giant *Thalassætus pelagicus*, by the dazzling whiteness of some parts of the body and its generally lighter colour. Herr Steineger's collections, which have been sent on to Washington, include the bones of a complete skeleton of the sea-cow, seventeen sea-calves, three skins of the Kamchatkan Alpine sheep, a considerable number of crania of the Cetacea, of which three would appear to belong to new species. Besides these and some 700 skins of birds, with a large number of mammalian crania, he sends back a large and interesting collection of fish, crustaceans, land and freshwater mollusks, and numerous fossil and living plants.

AFTER having done so much in restoring to our maps the old bed of the Amu-daria, the Russian explorers seem to be inclined now to take a quite opposite view. Thus, Prince Hedroits, geologist of the Amu daria Expedition of 1880, after having explored the eastern part of the Uzboy, came to the conclusion that the total want of river-beds in the ravine and the presence of Aral-Caspian mollusks in it are a sufficient proof that the water of the Amu never ran on the stretch between the Sary-kamysh lakes and the Caspian. Now, M. Konshin—a mining engineer who has recently explored the western part of the Uzboy—arrives independently at the same conclusion with regard to the western part of the supposed old bed of the Amu. He considers that its passage between the Greater and the Smaller Balkhan Mountains is a recent strait of the Aral-Caspian Sea, and that the western part of the Uzboy is merely a remnant of the outflow towards the Caspian of the brackish water of the Sara-kamysh lakes. The ravine of the Uzboy would be thus one of the numerous *sors*, or elongated lakes, the likeness of which to beds of rivers had already struck Pallas in the Astrakhan steppes, where the Daban-gol has a length of sixty miles. The view of M. Konshin may be summed up as follows:—The immense Sara-kamysh depression, 4400 miles wide, and at some places 280 feet below the level of the Aral, formed at a geologically recent time a single basin with the Aral; the fossils found on its borders show that it was filled up with at least brackish water. This lake had an outflow into the Caspian; but for 130 miles west of Sara-kamysh there is nothing like a river-bed. The likeness begins only west of Balla-Ishem, where the Uzboy begins. This channel, however, was filled up, not with the sweet and muddy water of the Amu, but with a brackish and rather pure water of the Aral-Sara-kamysh Lake. In fact, in this channel, on its whole stretch from Balla-Ishem to the Caspian, one finds everywhere the typical Aral-Caspian *Cardita*, *Dreyssena*, *Neritina*, and *Hydrobia* in the most perfect state, whilst there are no traces at all of a fluviatile flora or fauna, nor any traces of human settlements. However opposite to current opinion, this view of the Uzboy surely has much to be said in its favour.

THE same geologist publishes in the *Izvestia* of the Russian Geographical Society an interesting account of his explorations in the Kara-kum desert, between Kyzyl-arvat and Khiva. He considers the bad reputation of this desert quite exaggerated. In the neighbourhood of the Caspian and Lake Aral the Kara-kum sands offer a great many difficulties to the traveller. Geologically speaking they have quite recently emerged from the sea, and the *barkhans*, or sandy hills, are devoid of vegetation and move freely before the wind; the same is true with regard to the neighbourhood of Sara-kamysh and the Uzboy. But farther in the steppe the sands are older, and the brushes which cover them render them quite stable, so that the Akhal-Tekkes like better to stay in the steppe, and return to the oasis only for the needs of agriculture. The routes are quite comfortable, with exclusion of steeper ascents and descents on the slopes of the *barkhans*; and the cisterns (*kaks*) when kept in order contain plenty of water; while the steppe yields throughout the year abundance of food for the horses and camels. The *barkhans* are often intermingled with *takyrs*, that is, with places covered with firm clay, on whose surface small canals collect rain-water and bring it to a common basin called *kak*. The *sors*, or elongated ravines, the sandy bottom of which is impregnated with brackish water, are most numerous, especially in certain parts of the steppe; in the neighbourhood of the Akhal-Tekke oasis they run in numerous parallel lines for several dozen miles in length. The Uzboy, which M. Konshin visited at Kurtysh, is a ravine, sometimes crossed by hills of sand, at the bottom of which one perceives a narrow serpentine of brackish water. The Tertiary beds are covered there with a fine dirty dust filled with remains of the Aral-Caspian *Dreyssena*, *Neritina*, and *Cardium*. Above Kurtysh the supposed old bed of the Amu can be distinguished only by these marine remains. Notwithstanding the most careful search, M. Konshin failed to discover any traces of fluviatile deposits at Shikh, where the Charjuy bed of the Amu is traced on our maps. The hills at Shikh are remarkable as a rich mine of very pure sulphur (62 per cent.) One of them would contain at least 160,000,000 cwt. of pure sulphur, and sulphur appears on the surface of very many of them.

DR. REGAL, travelling for the Geographical Society in Central Asia, has returned to Tashkend through Sarafshan and Samarcand, after visiting Hissar, the Mura Pass—never before explored—the town of Karatag, and Baldshan, Duway, Rushan, and Shignan. Dr. Regal intends to start again in a few weeks for Baldshan, and in the spring to continue his explorations as far as the Kashgar frontiers.

COLONEL PREJEVALSKY, with his Cossacks, must be now in Mongolia, on his way towards Thibet. The other well-known explorer of the Turcoman region of the Transcaspian, M. Lessar, is again on his way to the scene of his geographical triumphs along the Persian frontier to complete his work for the General Staff. He will probably be absent another year or a year and a half.

THE Director of the Russian Observatory at Peking, Dr. Fritsche, who made last winter a journey through Southern China, from Peking to Kai-fong-fu on the Huan-Lo, has determined on his route the positions and the magnetic elements of forty-six places. A few days after his return to Peking he left again and went, *viâ* Changhai-kuan, on the Gulf of Pe-che-li, to Tsitsigar Mergen, Aïhun, and Blagoveschensk, on the Amur, determining the positions and magnetical elements of sixty three new points.

A CORRESPONDENT in *Naturen* draws attention to a curious narrative of an expedition to high northern latitudes, undertaken in 1266, at the instigation of priests belonging to the Monastery of Garde in Greenland. This narrative is derived from an Icelandic transcript of the so-called "Hauksbok," compiled about 1300 by the Norsk law-expounder, Hauk Erlandsön. It must be observed, however, that the particulars of the Garde Expedition are not to be found in the still extant parts of the original manuscript of the "Hauksbok," from which various pages have been lost. Notwithstanding the absence of this conclusive proof, northern scholars are inclined to accept the later transcript as a *bonâ fide* version of the original before the loss of its missing parts, and if this assumption can be maintained, we have evidence that the Northmen advanced four days' journey north of 76°. The object of the expedition, we are informed, was to discover what lands and people were to be found north of the Christian Station at Garde, and whether the much dreaded Skröllinger or native Esquimaux occupied those unknown regions in any formidable numbers. The seamen, we are told, saw many islands on which there were traces of the presence of these people, but they were unable to land, owing to the number of bears which, together with numerous seals and whales, frequented the coasts. In reference to the high latitude said to have been reached by these early explorers, and which is inferred from the description of the height of the sun on St. James's Day (July 25), it may be observed that a runic stone was found in 1824 in 72° 55′ N. lat., about twenty miles north-west of Upernivik, the northernmost existing Danish station. The inscription, which records that three men, whose names are given, erected the stone as a landmark, concludes with six runic characters, which have been variously interpreted to indicate the years 1135 and 1235.

From his scientific expedition to Anatolia, Syria, Egypt, India, Indo-China, China, and Japan during the years 1880–83, Dr. Emil Riebeck has lately returned to Europe laden with ethnological and archæological treasures of all sorts. This splendid collection, on which the enterprising explorer has expended no less than 30,000*l*., has during the past few months formed a chief attraction to naturalists in Berlin, where it has been on exhibition at the Kunstgewerbe Museum. Here the available space was not sufficient to allow of a thoroughly systematic arrangement of the objects, which however have been roughly disposed in three main geographical groups:—(1) Western Asia and Africa; (2) India and Further India; (3) East Asia (China and Japan). Some idea of the immense variety of articles here brought together may be had from the detailed catalogue of Dr. Riebeck's "Asiatic Collection," recently issued by Messrs. Weidmann of Berlin. From Palestine and Syria we have objects of every description; while the articles from Somaliland, which are very numerous, illustrate almost every phase of the social life of the little known inhabitants of that region. Several specimens are shown of the masks used in Ceylon at the "devil dances" performed during illness. The masks represent divinities of the Hindu mythology, rakshasas or demons, nāgakanyās or snake masks, lions, tigers, crocodiles, negroes, Mussulmans, Malays, &c. India is largely represented. From Burmah, where the Irrawadi was ascended as far as Bhamo, were brought many costly articles, such as royal coronets and dresses, alabaster and gilt wooden statuettes of Buddha, masks of strolling minstrels and players, amber rosaries, richly carved consols, lacquer ware, ornamental drinking vessels, writing materials, &c. A visit to Bangkok yielded models of Siamese floating houses, fishing gear, agricultural and industrial implements, &c. Amongst the most characteristic objects from China are brightly painted clay models of popular types, bronze vases, chased, inlaid in silver, and studded with gems; shallow dishes of "imperial bronze" (yellow picked out in red), silver teapots, artistic articles in jade, rock crystal, and marble, &c. The rich and varied Japanese collection comprises specimens of all the most characteristic productions of the country, especially Satsuma porcelain and other ceramic ware, illustrating the development of Japanese porcelain from the sixteenth to the nineteenth century. During the first part of his journey Dr. Riebeck was accompanied by Dr. Moock, who, after escaping from many perils amongst the Bedouin tribes in the Moabite country, was drowned in crossing the Jordan, and now lies buried in Jericho. During the visit to Egypt he was attended as far as the Nubian frontier by Dr. Schweinfurth, who again accompanied him in March 1881 to the south coast of Arabia and the Island of Socotra. During the rest of his wanderings throughout the Far East Dr. Riebeck had for his associates M. C. B. Rosset, who joined him in Germany, and Dr. Mantei, whom he engaged in Egypt after the untimely death of Dr. Moock.

In the March part of *Good Words* Mr. Edward Whymper gives some particulars of his journeys in Greenland which have not been heretofore published; and states that he found the height of the interior in the latitude of Umenak (about 70° 30′ N.) considerably exceeded 10,000 feet. Mr. Whymper says that from the various mountains he has ascended on the eastern side of Davis Straits he has had continuous views of the glacier-covered interior of Greenland between about 68° 30′ and 71° 15′ N. lat., and that there is no break or depression within those limits, and that the country is everywhere so absolutely covered by snow and glacier that not a single rock or crag can be seen.

ON THE PHENOMENA EXHIBITED BY DUSTY AIR IN THE NEIGHBOURHOOD OF STRONGLY ILLUMINATED BODIES[1]

In 1870 Dr. Tyndall described the dark or dust-free plane which rises from a hot body in illuminated dusty air, and gave two explanations of the dust-freeness of this dark space. Another explanation was suggested by Dr. Frankland. In 1881 Lord Rayleigh re-examined the phenomenon, and discovered that a cold body gave a similar down-streaming plane. He also suggested a totally different explanation. The writers discuss all these suggested explanations, and see reasons for rejecting them all. They have, moreover, observed that the dark plane rising from a hot body is only a prolongation of a well-defined dust-free *coat* of nearly uniform thickness under ordinary circumstances surrounding the body, and they point out that this dark coat is the thing really requiring explanation, the dark plane being merely due to the up-carrying of portions of this coat by convection currents.

The preliminary experiments were described in a letter to Nature last July (vol. xxviii. p. 297).

The dark coat is found to increase in thickness with the temperature of the body, becoming very thick at high temperatures, say 1000° C., but being narrow for temperatures only a few degrees above the air. When the temperature of the body is the same as that of the air surrounding it, the dust-free coat is either non-existent or exceedingly thin. The thickening of the coat by a rise of temperature is interfered with by convection-currents, which sweep the outer portions off more rapidly than they can be renewed, and so make the coat thinner than it otherwise would be. By means of a blast of air the coat can be almost wholly or entirely blown away; but convection-currents are never able to sweep it off, for the same cause which increases the convection-currents also broadens and assists the formation of the coat. The coat can be seen on round rods of all materials, on flat plates, both horizontal and vertical, on hollow and irregularly shaped pieces, and in general on every substance whatever. Nevertheless the behaviour of certain bodies is peculiar, and is detailed in the paper; such bodies, for instance, as a stick of phosphorus, which itself gives off smoke, a volatile solid like camphor, moistened solids like soaked carbon, liquids like sulphuric acid water and ether, and thin films of glass or mica. Other substances examined are: copper, iron, zinc, electric-light carbon, charcoal, glass, mica, selenite, selenium, Iceland spar, tourmaline, potash, rock-salt, bismuth, silver, chalk, and all kinds of paper. In every case the method of examination was as follows:—A glass box was mounted in front of the nozzle of an electric lantern, and the body to be examined was supported in any convenient manner, so as to be about the middle of the box, and to be well illuminated. Smoke was introduced, the lamp turned on, and the effect examined by looking along the length of the body at right angles to the light. Sometimes a microscope was used, but it was not necessary except for measurements. A hand lens is useful. For smoke, tobacco was the most common, but ammonic chloride was used when a distinctly volatile smoke was desired, and magnesic oxide whenever a non-volatile and incombustible smoke was wanted. Any kind of smoke serves equally well. Hydrogen and carbonic acid and other gases have been used as well as air: in hydrogen the coat is much thicker, in carbonic acid a little thinner, than in air. The effect of pressure on the dark coat was examined, and it is found that the coat broadens as the pressure diminishes. An increase in pressure of 4½ atmospheres renders the coat very thin and sharp, and at the same time causes the convection-currents to be sluggish.

The writers considered that it would be very instructive to examine whether a dark coat and plane could be observed when a warm body was immersed in a dusty *liquid*; and they accordingly devoted a good deal of attention to this point. After failures with mastic and other substances, they succeeded in observing a very thin, dark coat on the surface of an iron wire immersed in water

[1] Abstract of a paper by Oliver J. Lodge and J. W. Clark, read at the Physical Society, February 9.

holding rouge in suspension, with a dark plane rising from it. It is not always easy to obtain the dark coat in liquids, however, and its thickness is enormously less than it is in air. Moreover, the results are less definite and satisfactory. In gases the thickness of the coat may be anything below the eighth of an inch, according to the circumstances of the case, but its commonest width is more comparable with the hundredth of an inch. On a carbon rod in an electric beam the coat is about half a millimetre thick, no other heat being applied. Glass shows a perfect coat and dark plane, but for some reason or other very thin films of glass (·0003 inch thick) behave differently, and it is sometimes by no means easy to see any coat at all. It may be that such thin films are unable to absorb enough radiation, or it may be that the cause is more deeply seated. It can hardly be that they give off their heat too rapidly, because the convection-currents set up by them are very sluggish. It is pretty certain that they fail to absorb radiation; for a plate of rock-salt in a perfectly dry atmosphere behaves in the same way. In ordinary air, a lump of rock-salt is able to absorb sufficient radiation to give a satisfactory dark plane. The behaviour of thin films is under further investigation. Covered with lampblack they act perfectly well. Incidentally it has been noticed that films of freshly-blown glass adhere together though cold, giving the black spot; but that when films are a day or two old they refuse to adhere, doubtless because of the condensed air-sheets with which they have coated themselves. The slow formation of these condensed sheets, as studied recently by Bunsen (*Wied. Ann.* February 1884) is of great interest.

The effect of electrifying rods from which a dark plane is streaming is not marked except when the potential is high; 100 volts or so produce a little effect, positive potential broadening the coat, negative potential narrowing it. As soon as a brush discharge occurs, the effects are violent and the air is rapidly cleared of smoke, the particles being deposited on all the surfaces near. Various electrical phenomena can be conveniently examined by means of smoky air and a strong beam of light. Thus a flake of mica, on being examined for its coat one day, showed a curious phenomenon. The dust aggregated on its surface in little bushes or trees, and its edge became fringed with long aggregations of dust particles. Our first thought was that mica was photo-electric, but we now think that it had been perhaps electrified by casual pressure. This also is still under investigation. Tourmaline shows all its pyro-electric properties exceedingly well by being simply illuminated in dusty air. If mica be written on with a blunt point, a sheet of paper intervening, the writing becomes manifest when it is exposed to dust. We find, however, that a brass plate is capable of acting in a similar way, and we are not prepared to be content with a mere electrical explanation. We are probably here dealing with phenomena allied to those known as *Hauchbilder*, which are supposed to be connected with the condensed air-sheet on the surface of solids; though their explanation may also be associated with vapour-condensing nuclei on solid surfaces. The phenomena connected with the settling of dust on surfaces by gravitation have also been investigated, and it is found that so long as a body is warmer than the air it keeps itself free from dust; except that just at the top, where the air is stagnant, the excess of temperature being only small, a large particle or two may drop on. The dust-free coat is not an absolute barrier to dust: it marks the region into which dust is not carried *by convection-currents*; but other causes may drive dust into this region. Thus it may be blown into it either from outside or through a hole in the rod itself if it be hollow; or the rod may give off smoke, or the dust may, as stated, occasionally drop into the dark region by common gravitation. The persistence of the dust-free plane at a distance from the body which produced it is dependent on the motion of the dust particles *with* the air stream-lines; whatever drives dust across stream-lines interferes with and tends to obliterate detached dust-free regions. All dark streaks in smoky air are commonly the wiped-off coats of bodies.

We have been led to a fairly complete explanation of the whole phenomenon, and though it is impossible to attribute every case of dust-freeness to one single well-defined cause, we see reason to believe that the main causes in ordinary operation are two, viz. :—

1. Molecular bombardment.
2. Gravitative settling.

We were long under the impression that the sheets or films of condensed gases which are known to exist on the surface of all bodies were connected with the dark coats, and had some share in their production; and this view was pressed home by an observation of the surface of warm water in dusty air. The evaporation of the water drives back the dust and keeps a clear space of some thickness above the water; and if the water be linearly heated by a platinum wire stretched just beneath its surface and warmed by a current, the dark coat streams upward in a fine and well-defined dust-free plane. The up-streaming of the portion above the wire causes the remainder to become thinner, until there is an evident equilibrium between the rate at which the evaporation reproduces the dark coat and the rate at which the convection-current carries it off. That the dust is kept off a solid, say a warm copper wire, by an evaporation and continued renewal of its condensed air-sheet, we think decidedly improbable, but we are convinced that the dust particles are driven away from the solid by some form of molecular bombardment, possibly such as goes on from the vanes of a Crookes' radiometer. There is, however, a very great difference between the two phenomena; the Crookesian layer is supposed to correspond with the mean free path, and this is enormously less than the thickness of a dust-free coat. A possible suggestion is that the dust-free coat represents something more like the extreme free path of the molecules, the dust particles being so easily moved that they are driven away by the blows of even a few molecules. A simpler and more satisfactory mode of putting the matter is this. The temperature of the air near a warm solid decreases gradually as we recede from its surface. Consequently a dust particle in the neighbourhood of the solid has warmer air on one side of it than on the other; in other words, it receives heavier and more numerous blows on one side than on the other, and accordingly is driven away from the warm body. Whenever the temperature of air is steadily different in successive layers, there the dust particles must get driven in the direction of decreasing temperature at a rate depending on the temperature slope. This is not complete, however, because the extra temperature really shows itself as a diminution of density, not as an increase of pressure. The explanation is further elaborated in the paper, which will appear in the *Philosophical Magazine* for April. The conduction of heat across the air near a hot body is itself an interesting problem. So also is the distribution of up-streaming velocities. The maximum velocity of convection occurs at some distance from the body, being often distinctly outside the dust-free coat.

Some few cases of the dust-free coat and plane can hardly be explained in the manner now indicated. We point out, however, that gravitation is an effective cause certainly in operation, which of itself is competent to account for the formation of dust-free spaces when circumstances are favourable. Dust is always settling or falling downward relatively to the air in which it is. The velocity of relative fall depends on the size of the particle, on the density and viscosity of the gas, but not on the motion of the gas. Immediately below a solid body round which gentle currents are rising, there is a small region of nearly stagnant air; out of this dust slowly falls, leaving it free, and if then part of it is dragged round the body by the currents, it contributes to the dark coat and to the ascending dark plane. Underneath horizontal plates, also, this gravitation-settling of the dust assists and broadens the coat. But there is also a coat on the upper surface; and this coat gravitation, so far from producing, does its best to spoil. A few of the larger particles are in fact seen to fall occasionally through it on to the surface of the body, their weight being too great for the bombardment to sustain. In the case of a *cold* body the down-streaming currents deposit a good deal of dust on the upper surface of the body, and so that portion of air which has grazed the surface passes on dust-free. The tendency now is for the warmer air outside the dust to bombard it on to the cold surface. This goes on all over the upper half of the body, but over the lower half a coat is visible when the cold is not too great, but it is only fairly thick at the bottom of the body when it forms the base of the inverted dark plane. A smooth vertical surface of ice gives no dark coat, and the maximum velocity of the particles in the descending current is apparently little, if at all, distant from the actual surface. Finally the writers call attention to a paper just read at the Royal Society of Edinburgh by Mr. John Aitken. They have only seen an abstract of this paper at present, but it appears that Mr. Aitken has been travelling over much of the same ground as they have, and that he has arrived on the whole at fairly the same conclusions. The abstract of Mr. Aitken's interesting paper was printed in NATURE of January 31 (p. 322).

AGATES

THE following letter was addressed by the writer in 1871 to Mr. Joseph John Murphy, and though not originally intended for publication, is now published with the writer's consent :—

St. Andrews, November 4, 1871

DEAR SIR,—I have on my return found your note as to agates. Though I have been at work on the subject in different ways for many years, I have not found myself in a position yet to publish. In fact I cannot yet say that I *know* much as to how they have been formed, though I do know, or rather am able to show, that they have not been made in the manner usually supposed.

The late Principal Forbes conceived that they had been formed by concentric deposition round a central nucleus :—this I showed him to be untenable. Others conceive that siliceous matter in a state of fusion has been poured into cavities through an opening, such opening being called the "point of infiltration." I am able to show that this so-called point of infiltration is an orifice of escape or exit of something.

Fully to state how (from examination of their mode of occurrence, experiments upon the decomposibility of trap rocks under the action of carbonated water, section of agates in every conceivable direction, experiments upon their powers of absorbing liquids, and from microscopic examination) I conceive agates to be formed would call for indeed a long statement.

I will attempt briefly to put it thus :—

Igneous rocks are being poured forth from a volcanic vent, in perfectly fluid or at least plastic flow ; some are dense, some scoriaceous, some frothing, and so when solidified are vesicular, or perchance even hold in suspension bubbles of included water, this latter holding in solution (red-hot solution) solids afterwards to separate as rheolites. Should the air-bubbles of the vesicular rocks arise through the plastic mass while it is motionless, these bubbles will be more or less rounded or pear-shaped. Should the solidifying rock, however, become crystalline or porphyritic, as generally is the case with amygdaloids, the separating crystals of labradorite, &c., will more or less roughen the sides, and so destroy the smooth and rounded figure of the cavity ; while, if the lava-flow continues its motion while the bubbles are still rising, their shape will be more or less flattened or altered :—try bubbles in flowing treacle.

Stage the first.—An empty cavity of any shape.

Stage the second.—The rock, while solidifying, may contain an excess of a magnesian mineral, which is exuded into the cavity ; or this excess of magnesian compound (magnesia not being, to any large extent, a *natural* constituent of the mass of a trap) may be held as vapour in the cavity, to be, on cooling, deposited on its sides. This forms in Scotland, Faroe, Iceland, &c., the layer of celadonite or delessite ; at Giant's Causeway, of chlorophœite, which, on the extraction of the afterwards filled-up cavity, forms the "skin of the pebble."

Stage the third.—One of two processes, the first very doubtful. The cooling and shrinking rock holds in a state of *liquidity, from heat*, an excess of colloidal silica which is exuded into the cavity forming a chalcedonic druse. But, admitting the process, it must here stop, and a *solid* agate could not thus be formed. This seems to have been the view of Sir George Mackenzie.

The other process I pin my faith to. The thoroughly solidified—indeed the now *old*—rock is having its felspar (labradorite or other) decomposed by water holding carbonic acid in solution. I have proved that this process is rapid and continuous, and agate-holding traps are all rotten ; the colloidal silica, with a certain quantity of *tridamyte* is taken up by this water, and transfuses into the cavity ; the silica is there solidified—probably the layer of delessite is the coagulation. We have now a cavity slightly lined with chalcedonic matter, containing, within, water more or less pure, while without (that is outside of the now double skin, delessite and first layer) we have a strong solution of colloidal silica constantly supplied. Endosmose and exosmose are set up with all their resistless force. The *strong* solution finds its way through the two or any number of increasing skins : the *weak* water is forced out through the "point of infiltration," and so in its passage out thins all the successively deposited layers *at that place*. By this continuous flow of colloidal silica (held in solution by liquid) through the already coagulated or deposited layers, continuous coagulation of the silica in the yet hollow agate, and continuous extrusion of the residual water, we have the ultimate filling up of the cavity, and a solid agate formed.

The adhesion of agates to the containing rock is slight in most cases from the so-called "skin" being magnesian and soapy.

The "point of infiltration," instead of being at once filled up, as would result from the inflow of coagulable silica, is in reality the last point filled up, being truly the point of escape : indeed it frequently is not altogether filled up, *remaining an open tube.*

The microscope shows on a cross section the concentric layers of coagulated silica, soluble in alkalies ; the crystals or fibres of *tridamyte* cross these layers at right angles, radiating like a rheolite from the skin, and it is always along the sides of these crystals that intruding and staining liquids find a way ; probably, therefore, along their sides also did the ingress of chalcedonic fluid find entrance. I remain very truly yours,

M. FORSTER HEDDLE

THE ORIGIN OF THE SCENERY OF THE BRITISH ISLANDS[1]

THE Lakes of Britain present us with some of the most interesting problems in our topography. It is obvious that the existence of abundant lakes in the more northern and more rocky parts of the country points to the operation of some cause which, in producing them, acted independently of and even in some measure antagonistically to the present system of superficial erosion. It is likewise evident that as the lakes are everywhere being rapidly filled up by the daily action of wind, vegetation, rain, and streamlets, they must be of geologically recent origin, and that the lake-forming process, whatever it was, must have attained a remarkable maximum of activity at a comparatively recent geological epoch. Hardly any satisfactory trace is to be found of lakes older than the present series ; perhaps Lough Neagh, which from its thick deposits and their fossils, has been referred back to Pliocene times, is the solitary exception. How then have our lakes arisen? Several processes have been concerned in their formation. Some have resulted from the solution of rock-salt or of calcareous rocks and a consequent depression of the surface. The "meres" of Cheshire, and many tarns or pools in limestone districts, are examples of this mode of origin. Others are a consequence of the irregular deposit of superficial accumulations. Thus, landslips have occasionally intercepted the drainage and formed lakes. Storm-beaches, thrown up by the waves along the sea-margin, have now and then ponded back the waters of an inland valley or recess. The various glacial deposits—boulder-clays, sands, gravels, and moraines—have been thrown down so confusedly on the surface that vast numbers of hollows have thereby been left which, on the exposure of the land to rain, at once became lakes. This has undoubtedly been the origin of a large proportion of the lakes in the lowlands of the north of England, Scotland, and Ireland, though they are rapidly being converted by natural causes into bogs and meadowland. Underground movements may have originated certain of our lakes, or at least may have fixed the direction in which they have otherwise been produced. A very large number of British lakes lie in basins of hard rock, and have been formed by the erosion and removal of the solid materials that once filled their sites. The only agent known to us by which such erosion could be effected is land-ice. It is a significant fact that our rock-basin lakes occur in districts which can be demonstrated to have been intensely glaciated. The Ice Age was a recent geological episode, and this so far confirms the conclusion already enforced, that the cause which produced the lakes must have been in operation recently, and has now ceased. We must bear in mind, however, that it is probably not necessary to suppose that land-ice excavated our deepest lake-basins out of solid rock. A terrestrial surface of crystalline rock, long exposed to the atmosphere, or covered with vegetation and humus, may be so deeply corroded as, for two or three hundred feet downward, to be converted into mere loose detritus, through which the harder undecomposed veins and ribs still run. Such is the case in Brazil, and such may have been also the case in some glaciated regions before the glaciers settled down upon them. This superficial corrosion, as shown by Pumpelly, may have been very unequal, so that when the decomposed material was removed, numerous hollows would be revealed. The ice may thus have had much of its work already done for it, and would be mainly employed in clearing out the

[1] Abstract of fourth lecture given at the Royal Institution, February 26, by Archibald Geikie, F.R.S., Director-General of the Geological Survey of the United Kingdom. Continued from p. 397.

corroded debris, though likewise finally deepening, widening, and smoothing the basins in the solid rock.

The Hills and Hill-groups of Britain have all emerged during the gradual denudation of the country, and owe their prominence to the greater durability of their materials as compared with those of the surrounding lower grounds. They thus represent various stages in the general lowering of the surface. In many cases they consist of local masses of hard rock. Such is the structure of the prominent knobs of Pembrokeshire and of Central Scotland, where masses of eruptive rock, formerly deeply buried under superincumbent formations, have been laid bare by denudation. In connection with such eruptive bosses attention should be given to the "dykes" so plentiful in the north of England and Ireland, and over most of Scotland. In numerous instances, the dykes run along the crests of hills and also cross wide and deep valleys. Had the existing topography existed at the time of their protrusion, the molten basalt would have flowed down the hill-slopes and filled up the valleys. As this never occurs, and as there is good evidence that the dykes are not of higher antiquity than the older Tertiary periods, we may conclude that the present configuration of the country has, on the whole, been developed since older Tertiary time—a deduction in harmony with that already announced from other independent evidence.

Escarpments are the steep edges of hills in retreat. The British Islands abound in admirable examples of all ages from early Palæozoic rocks down to Tertiary deposits, and of every stage, from the almost unbroken line of cliff to scattered groups of islet-like fragments. The retreat of our escarpments can be well studied along the edge of the Jurassic belt from Dorsetshire to the headlands of Yorkshire, likewise in the course of the edge of the Chalk across the island. Not less suggestive are some of the escarpments of more ancient rocks, such as those of the older Palæozoic limestones, the Old Red Sandstone of Wales, the Carboniferous Limestone and Millstone Grit of Yorkshire, and the Coal Measures of the Irish plain. Our volcanic escarpments are likewise full of interest—those of the Lower Old Red Sandstone along both sides of the Tay, of the Carboniferous system in Stirlingshire, Ayrshire, Bute, and Roxburghshire, and of the Tertiary series in Antrim and the Inner Hebrides.

SUN-GLOWS AND VOLCANIC ERUPTIONS IN ICELAND

In reply to the inquiry despatched to me by NATURE with last mail, whether any remarkable sun-glow had been observed recently in Iceland, and which, I learn, has been observed in nearly all parts of the world, and whether any volcanic eruption had lately taken place in the island to which the same might be attributable, I beg to relate, as regards the first of these points, that on November 23, between 5 and 6 p.m., I noticed for the first time an unusual and striking purple intensity of the sky, a phenomenon which was also observed on the subsequent mornings and nights. I did not attach much importance to this phenomenon at the time, through the circumstance that I was told that sunrises and sunsets were generally attended by very intense auroræ here, and since then I have had so few opportunities of seeing the sky free from clouds that I have not observed any similar phenomenon. I learn, however, on inquiry here, that the same glow was observed once or twice before Christmas by several persons. On one occasion, January 30, the sky was perfectly clear several hours after sunset, but there was no unusual glow.

With regard to the second point, as to recent volcanic eruptions in the island, I have not much new information to transmit (NATURE, vol. xxix. p. 343). The only thing we know as to this is that a man has written a letter to an Iceland paper stating that on October 8 and 9 last year he was at a farm about three geographical miles east-north-east inland from the well-known fishing village Seydisfjord, on the east coast, when he saw, on the first-mentioned day, in the direction of the unexplored gigantic volcanic mountain, the Vatnajökull, about 130 geographical miles in extent, in the south-eastern corner of the island, two columns of fire, and on the following morning, in the same direction, two columns of smoke. He adds that a similar phenomenon was observed on the farm two days previously. It is also reported to us here that ashes have fallen in Seydisfjord.

It is most probable that these eruptions have occurred in the same place where similar phenomena have been observed several times in recent years, viz. in the neighbourhood of the Kverk Mountains on the north side of the Vatnajökull, and that there are, in all probability, several volcanoes in activity in this district, which is utterly unapproachable to explorers.

There is, however, no reason to assume that eruptions of any magnitude have recently taken place in any other part of the island, as such an occurrence would soon have been reported by some means or another to us here.

If, therefore, the remarkable sun-glows of which I read are attributed to terrific volcanic eruptions, the latter must be sought in other localities than Iceland.

SOPHUS TROMHOLT

Reykjavik, Iceland, February 1 (by mail February 8)

COMPOSITE PORTRAITURE ADAPTED TO THE REDUCTION OF METEOROLOGICAL AND OTHER SIMILAR OBSERVATIONS [1]

It has often been remarked that one of the main, if not the chief, of the difficulties the meteorologist has to contend with, is the enormous amount of preliminary labour which has to be expended in the not very pleasing task of forming the observations he may wish to discuss into tables, casting the columns of figures so obtained, and then computing the means. Should, as in many cases nowadays, his original material be in the shape of curves, *e.g.* barograms, thermograms, or anemograms, he has first to reduce these to figures by tabulation, before he can attempt any step towards their reduction.

The deterrent nature of these preliminary operations not unfrequently forms a complete bar to the entering upon most interesting investigations with a view to the advancement of the science, in the case of persons unable to devote sufficient time to such labour, which may almost be termed drudgery. To cite examples, a glance at the recently published papers in the *Proceedings of the Royal Society*, by Prof. Balfour Stewart (vol. xxv. p. 577) and by Mr. C. Chambers (vol. xxxiv. p. 231), in which they endeavour to trace a possible intimate connection between solar and terrestrial phenomena, will show the immense amount of calculation they had to perform in order to arrive at their results—how, for instance, preliminary means had to be taken of three days' observations and the result assumed to be a corrected value for the middle day of the three, then, after the whole series had been so treated, a second or even a third set of averages computed. The author has also a lively recollection of the excessively tedious calculations required to eliminate in a somewhat similar manner the effect of disturbances in the discussion of the Kew magnetic observations for the late Sir E. Sabine. With the view of arriving at results by a shorter cut, the author has been led to consider the possibility of employing a method suggested by an examination of the highly ingenious system of composite portraiture invented by Mr. Francis Galton, F.R.S., and utilised in his anthropological studies.

Mr. Galton's method of experiment is based upon the fact that certain groups of people possess certain physiognomical features in common. This agreement of feature is usually characterised by the term "family likeness." In order, therefore, to select this particular element from the others, and to obtain a picture in which it is most strongly defined; or, in other words, to form a characteristic portrait of the group of individuals, Mr. Galton employs a series of photographs. These, representing a large number of men or women, are first reduced to the same scale, and then projected successively upon a sensitised photographic plate, having been previously so arranged that the eyes or other salient feature shall always fall on the same portion of the plate.

In this manner a negative is eventually obtained which gives a print depicting a countenance which, although resembling but partially any one of the component portraits, gives a fair typical picture of the group of individuals. Among other results Mr. Galton has detected the likeness existing in various classes of criminals, and also in patients suffering from the same disease, as well as the more marked features transmitted through the different members of a family.

Since in meteorological investigations the desire is to select and to identify the one particular variable running through a group of phenomena, it has appeared to the author, arguing by analogy, feasible to perform this operation by a method somewhat resembling that just described. Supposing, for example,

[1] By G. M. Whipple, B.Sc., F.R.Met.Soc., F.R.A.S., Superintendent of the Kew Observatory, Richmond (from the *Quarterly Journal of the Meteorological Society*, vol. ix. No. 48).

it is desired to determine the true curve of diurnal variation of the wind velocity at any given station. In the case of proceeding by the ordinary routine of hourly sums and means, it will be found that the occurrence of a high wind or gale on a single day will vitiate the results for a considerable period of time.

If, on the other hand, instead of doing this, a drawing or photograph be made on one sheet of the daily curves for a few weeks, it will be found that the traces for the days free from storms will lie so fairly close together or upon one another, that little difficulty will be found in selecting or drawing through them a curve representing the general run of the group. Several sets of curves having been so treated, the typical curves must be in turn themselves superimposed, and through them another curve drawn, which will be still less affected by abnormal movements; so eventually the true curve of diurnal variation would be arrived at.

In the case of subjecting photographic traces, *e.g.* barograms, thermograms, electrograms, magnetograms, &c., to this treatment, it would be advisable to employ secondary impressions or prints from the original curves, in order that the composite produced might consist of dark lines on a white background; not the reverse, which would be comparatively useless for the purpose.

For the reduction of anemograms, rain, and sunshine curves by this method, it will be necessary to make drawings or tracings first from the curves, giving the hourly values separated, as is done in the diagrams published in the *Quarterly Weather Reports* of the Meteorological Office and in the Kew *Times* curves.

Another application of the method of composite drawing will serve to facilitate the acquisition of a knowledge of the general distribution of weather systems over large tracts of the earth's surface. To do this, a series of weather charts should be taken, and selecting certain prominent features, such as the centres of cyclonic and anticyclonic disturbances, day by day their positions should be marked off upon one chart. This being done in a sufficient number of cases and combined, a repetition of the process would enable a determination to be made of the average distribution of these systems for a given season.

The author illustrated his proposed applications of the method of composite portraiture by three examples, which were exhibited to the meeting of the Society. The data treated in every case were chosen at random, and therefore may be considered as indicating the applicability of the process to meteorological work in general.

In the first example the mean diurnal variation in the wind velocity at the Kew Observatory, Richmond, was determined for three months—August to October, 1879. Taking the hourly values of the rate at which the wind was blowing from the Meteorological Office publications, they were plotted down on a conveniently open scale, a fortnight's superimposed curves being on a sheet. Through the fourteen curves so drawn in pencil a mean curve was traced in red. This roughly represented the average daily variation during the fortnight.

The pair of fourteen-day curves being superimposed on a third sheet, a third trace drawn between them was assumed to be the mean trace for the month, and finally combining the three so derived months' traces, it became easy to draw the final curve showing the mean diurnal variation of wind velocity during the quarter in question.[1]

The second experiment was an attempt to obtain a monthly mean of the barometer directly by the graphic method. Taking advantage of a self-registering aneroid being on trial, its traces were utilised for the month January 8 to February 7, 1883. These were copied off on a sheet of tracing paper, ruled so as to comprise one day's curve only. The tracing paper was then folded vertically, so as to compress the curves, and the mean positions of the traces were drawn on the folds. After four foldings a point was readily fixed upon as the position of the mean of the month, and the value of this point referred to the scale of the instrument. The resulting value for the mean barometric pressure of the month very satisfactorily agreed with the value determined by calculation from the barometer readings taken daily at the Observatory.

The third series of illustrations represented the general positions of the centres and the contours of the areas of maximum and minimum barometric pressure over the Atlantic during January, February, and March, 1881. A number of blank charts were worked off by the chromograph, on tracing paper, to the scale of the international synchronous charts of the U.S. War Department Signal Service. Tracings were made on one sheet in blue pencil of the cyclonic centre for each day of the month, and then on another a similar set of tracings in red of the anticyclonic centres. Having from these drawn the prevailing positions and areas of the systems for the month, it was easy to draw another chart with the general distribution for the quarter. The diagrams were seen, on comparison, to differ materially from those drawn for the monthly means of the observations. In suggesting the composite method of treatment of meteorological data, the author is fully aware that a somewhat similar process has been already applied in the determination of the radiant points of shooting stars, and would also desire to state that the process is not by him considered as equalling or even approximating in accuracy that of employing the harmonic analyser in computing the periodical variations of the elements. As, however, that instrument is not at the command of many investigators, he is of opinion that the labour of reduction may in many cases be saved by making use of the graphic or composite, instead of the purely numerical, method.

[1] It must be remarked that a due proportion should be preserved between the scales of the ordinates and abscissæ, for unless this is done the combined traces may appear merely as a mass of confused lines. Such was the case in some experiments made by the author, when he attempted to derive mean curves directly from the zinc templates engraved at the Meteorological Office for the Quarterly Weather Reports, kindly placed at his disposal by Mr. Scott.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—Dr. Hans Gadow, Strickland Curator, has been approved as a Teacher of Comparative Anatomy; Mr. L. Humphry, M.B., as a Teacher of Pathology; and Mr. F. H. Neville as a Teacher of Practical Chemistry.

Messrs. J. W. Hicks, R. D. Roberts, and A. S. Lea are appointed Examiners in Natural Science in the Special Examinations for the ordinary B.A. degree.

The Examiners' Report on the Special Examinations in Natural Science states that there was no improvement in the book work, but the practical work was more intelligently done. The few candidates in Geology did well. Botany was ill done. In Zoology the candidates did well.

Mr. J. A. Lyon (Clare College) has been appointed to the new office of Superintendent of the Mechanical Workshops.

SCIENTIFIC SERIALS

Bulletin de l'Académie Royale de Belgique, November 3, 1883. On the anatomy and histology of a new species of derostoma (*D. benedenii*), by M. Francotte.—Report on the work still required to complete the geodesic survey of Belgium, by Capt. Delporte.—Observations on the periodic shooting stars made at Louvain in 1882-83, by M. Terby.—Influence of magnetic disturbances on the scintillation of the stars, by M. Charles Montigny. The paper is accompanied by various comparative tables showing the intensity of scintillation before, during, and after the magnetic disturbances in dry and wet weather.—Summary report on the researches undertaken at the Ostend biological station during the summer of 1883, by Edouard van Beneden. Amongst the remarkable objects fished up near this station were a torpedo of unusual size (*Torpedo marmorata*), a fine specimen of *Labrus maculatus*, an *Amphioxus lanceolatus*, and an unknown species of Scopelidæ, referred by Günther of the British Museum to the Odontostomus, or some allied genus.—On the observation of very rapid movements, especially when occurring periodically, by M. J. Plateau.—Analytical study of the volcanic ashes which fell at Batavia during the eruption of Krakatoa on August 27, 1883, by M. Renard. The author concludes that these ashes are formed by the pulverisation of a fluid igneous mass, whose particles, projected by the expansion of the gases, are subjected to rapid cooling during their passage through the atmosphere. Nothing was detected to indicate the direct action of vapour of water in volcanic disturbances.—On the perfect elasticity of solid bodies chemically defined. New analogy between solids, fluids, and gases, by W. Spring. Here are embodied some of the results of the researches conducted by the author for several years on the action of pressure on solids reduced to a powder. The main object of these researches was to ascertain by experiment whether it be possible by means of pressure permanently to diminish the volume occupied by a given weight of a solid body chemically defined. As a general result, a slight increase of density was obtained under a pressure of 20,000 atmospheres. But, this once realised, most bodies resisted all further permanent diminution of volume. Some even retained their specific weight intact under extreme pressure.—Observations on M. van Beneden's last note respecting the discovery of fossil iguanodons at Bernissart, by E. Dupont. This communication closes the controversy.—Note on the literature of international law before the publication of Grotius's "Jus belli et pacis" (1625), part ii., by Alph. Rivier.—A literary study on the position of words in the Latin sentence, by J. Gantrelle.

Journal of the Russian Chemical and Physical Society, vol. xv. fasc. 8.—On dipropylacrylic acid, by A. Albitsky.—On the action of iodide of allyl and zinc on epichlorhydrine, by M. Lopatkin.—On an accessory product obtained during the preparation of diallyl carbinol, by W. Shestakoff.—On the action of iodide of allyl and of isobutyl on acetone, by A. Shatsky.—On the hydrocarbon C_8H_{14}, by S. Reformatsky.—On the refracting power of $C_{12}H_{20}$, by A. Albitzky.—Attempt of a theory of dissolutions, by W. Alexeyeff.—On $C_{21}H_{20}$ and the products of its oxidation, by W. Hemilian.—Analysis of a phosphorite from Nijni-Novgorod, by N. Lubavin.—On some phenomena of remanant magnetism, by P. Bakhmetieff.—On the changes in the galvanic resistance of selenium under the influence of light, by N. Hesehus. It depends chiefly upon allotropic dissociation of the molecules.—On the characters of the intramolecular force, by M. Bardsky, being a mathematical discussion of its dependence upon temperature.

Bulletin de l'Académie Impériale des Sciences de St. Pétersbourg, vol. xxviii. No. 4.—Demonstration of several propositions relative to the numerical function E(x), second paper, by V. Bouniakovsky.—Contributions towards palæontology, by M. Schmalhausen (with two plates); being a description of fossil plants of the Jura coal-basin of Kuznetsk, in the Altay (*Thyrsopteris prisca* and *Rhiptozamites gœpperti*), from North-West Mongolia, at the sources of the Yenisei, on the high plateau of the Ulu-khem (*Bornia radiata, Neuropteris cardiopteroides, Lepidodendron veltheimianum, Rhiptozamites gœpperti, Czekanowskia rigida*, and *Phœnicopsis angustifolia*), and from the Djün-khair-khan Mountains (*Asplenium argutulum* and *spectabile*, and *Czekanowskia rigida*).—On the sympathetic nervous system of the *Petromyzon*, by Ph. Owsiannikow.—On the camphor of the *Ledum palustre*, by M. Rizza.—Analyses of samples of water from thermal sources of Southern Altay (Byelukha-Rakhmanovka), and from a number of lakes and wells in the same region, by Prof. Carl Schmidt. Compared with thirty other thermal waters of Europe, Asia, New Zealand, &c. (the composition of which is given in a table), the Altay water shows a minimum of mineral substance.—Letter on natural history phenomena observed at the Lena Polar station, by Dr. Bunge.

Rendiconti of the Sessions of the Accademia delle Scienze di Bologna, March 14, 1883.—On a remarkable anatomical peculiarity observed in the eye of the swordfish (*Xiphias gladius*, L.) (one illustration), by Prof. G. V. Ciaccio.—Some observations on the *Mucor racemosus*, Fresenius, by Dr. F. Morini.

April 8.—A century of premature artificial births at the Lying-in Hospital of Bologna, by Dr. C. Belluzzi.—Chemical analysis of the meteorite which fell at Alfianello on February 16, 1883.—Researches on the *Phellandrium aquaticum*, by Dr. Leone Pesci.—Thermal and galvanometrical researches on the internal discharges of condensers, by Prof. E. Villari.—New studies on the polygenesis of crystallised minerals, by Prof. L. Bombicci.—Researches on the action of the magnet and of the thermal agents in hysterical hypnosis.—Observation on the series of functions, by Prof. C. Arzelà.—On the infinite products by analytical functions, by Prof. S. Pincherle.

SOCIETIES AND ACADEMIES

London

Royal Society, January 17.—"On the Electrolysis of Dilute Sulphuric Acid and other Hydrated Salts." By J. H. Gladstone and Alfred Tribe.

On March 1 last a communication was presented to the Royal Society by Prof. Frankland in which, among other things, the reactions the authors had described as taking place in the charging and discharging of secondary batteries were confirmed. Prof. Frankland expressed these reactions, however, by formulæ founded on the electrolysis, not of H_2SO_4, but of hexabasic sulphuric acid, H_6SO_6, in accordance with the views of Bourgoin.

The French chemist employed a divided cell, analysing the liquid in each compartment at the close of the experiment. He calls the increase of the acid in the positive compartment a, and concludes that $2a$ represents the amount of sulphuric acid electrolysed. This conclusion rests on the well-known theoretical views of Grotthuss, and, did his theory express all that goes on in the electrolytic processs, the method would readily discriminate between the actions represented by the following formulæ :—

	Before electrolysis		After electrolysis: Positive pole	After electrolysis: Negative pole
(1.)	SO_3H_2O	=	$SO_3 + O$	H_2
(2.)	SO_33H_2O	=	$SO_3 + O_3$	H_6
(3.)	SO_3nH_2O	=	$SO_3 + O_n$	H_{2n}

But it was pointed out by Reuss, as far back as 1807, that, when electrolytic action occurs across a permeable diaphragm, a portion of the liquid may travel from the positive to the negative compartment of the compound cell by what is now called electrical endosmose. Daniell and Miller in 1844 pointed out that in electrolytic action there was also an unequal transference of the ions. Moreover, Daniell investigated the electrolysis of sulphuric acid of very different strengths by a similar method, and concluded that, for each equivalent of hydrogen liberated, the acid which passed across the diaphragm was not more than one-fourth nor less than one-fifth of an equivalent. Most of his experiments incline to the former. Did $2a$, therefore, represent the amount of sulphuric acid electrolysed, it would appear from his results that *tetra*-, rather than *hexa*-, basic sulphuric acid was decomposed by the current. These discrepancies, both of observation and deduction, led the authors to make some experiments on the subject.

The apparatus employed consisted of a U-shaped tube of about 70 c.c. capacity, having a stop-cock in the centre of the horizontal part. The vertical parts of the apparatus were divided into millimetres, and the hole in the stop-cock packed with asbestos. The authors found that the closeness of the packing could be so nicely adjusted as to allow very little mechanical admixture of the fluids or electrical endosmose. In their experiments the current density was varied, and, unlike Bourgoin, they found that the increase of sulphuric acid in the positive compartment per equivalent of hydrogen set free decreased along with the decrease in the current density. The results are set out in the annexed table.

Current in milli-amperes	Time in hours	Increase of sulphuric acid in positive compartment for one part of hydrogen set free
32·8	20	9·17
33·4	6	9·5
72·3	2·5	10·3
72·7	2	9·4
106	2	11·0
117	2·5	10·5
215	1·5	12·05
220	1	12·04
229	2	12·31

It is necessary also to bear in mind the remarkable phenomenon called by the Germans "Wanderung der Ionen." Daniell long ago described an experiment in which he placed dilute sulphuric acid in the positive compartment and a solution of sulphate of copper in the negative. He found that when 15·5 grs. of copper had been deposited on the negative electrode there were 23 grs. of sulphuric acid in the same compartment. Now, as 15·5 grs. of copper are equivalent to 24 grs. of sulphuric acid, and as Bourgoin's formula allows for the formation of only half an equivalent of sulphuric acid, that is, 12 grs., it is evident that there was a considerable accumulation of that substance unaccounted for. In two similar experiments the authors obtained for 0·147 and 0·125 grm. of deposited copper 0·209 and 0·180 grm. of free sulphuric acid. The half equivalents would be 0·114 and 0·097 grm. respectively. If both compartments had been filled with sulphuric acid, some similar transference would doubtless have taken place, in addition to what is expressed in Grotthuss' chain of decomposition.

The authors conclude, therefore, that the method employed is incapable of determining whether it is H_2SO_4 or some hydrate which yields to the current.

Copper Sulphate

An examination of the chemical changes which accompany the electrolysis of a solution of copper sulphate appeared, however, capable of throwing additional light on the value of this electrolytic method. It is well known that water forms with $CuSO_4$ a definite hydrate, $CuSO_4 5H_2O$. Now, if in the electrolytic process the water of hydration suffers decomposition along with the $CuSO_4$, the primary chemical changes might be expected to be—

$$\text{(A.)}\quad CuSO_4 5H_2O = \overbrace{SO_3 + O_6}^{\text{Positive pole}} \quad \overbrace{Cu + 5H_2}^{\text{Negative pole}}.$$

But, if the water of hydration takes no more part in the electrolysis than the water of solution does, then the chemical changes would manifestly be—

$$\text{(B.)}\quad CuSO_4 = \overset{\text{Positive pole}}{SO_3 + O} \quad \overset{\text{Negative pole}}{Cu}.$$

Of course the collateral action—

$$H_2O = \overset{\text{Positive pole}}{O} \quad \overset{\text{Negative pole}}{H_2}$$

might also take place, but this would occur only with currents of considerable density. The method is obviously capable of discriminating between these two actions, even supposing a considerable quantity of the electrolyte travelled unchanged from one compartment of the apparatus to the other. For, in the first case, either free hydrogen would be liberated at the negative pole, or free acid formed in the negative compartment, equal to five-sixths of the total copper deposited; the free acid, and the five-sixths of the total copper, to which it is equivalent, being produced by the chemical action $5H_2 + 5CuSO_4 = Cu_5 + 5H_2SO_4$; equation A becoming—

$$CuSO_4, 5H_2O + 5CuSO_4 = \overbrace{SO_3 + O_6}^{\text{Positive pole}} \quad \overbrace{Cu_6 + 5H_2SO_4}^{\text{Negative pole}}.$$

On the other hand, if the action was in accordance with B there would be only a deposition of copper on the negative electrode, and no formation of free acid in the negative compartment. In the annexed table the results and particulars of the authors' experiments are set out:—

Experiment	Time in Hours	Free sulphuric acid: Pos. Compart.	Free sulphuric acid: Neg. Compart.
I.	$1\frac{1}{2}$	·0766	nil.
II.	2	·0936	nil.
III.	3	·1868	·0191
IV.	3	·1501	·0204
V.	3	·2442	·0237
VI.	3	·2546	·0372

In none of these experiments was there any trace of hydrogen visibly escaping from the negative electrode, while, as will be seen from the table, there was no free acid formed in the negative compartment till two hours or more had elapsed. By that time some admixture in the horizontal part of the apparatus might reasonably be expected, but even in the greatest instance it is small as compared with the amount of salt decomposed.

Similar experiments were made with the sulphate of zinc, with similar results, no hydrogen being evolved, and little or no sulphuric acid appearing in the negative compartment.

We conclude, therefore, that it is not possible to determine the composition, or even to show the presence of a hydrated salt in aqueous solution by means of this electrolytic method.

Zoological Society, February 5.—Prof. W. H. Flower, F.R.S., president, in the chair.—Mr. F. Day, F.Z.S., exhibited and made remarks on a specimen of a Dog-fish, of which the entire interior had been eaten out by Isopod Crustaceans of the genus Conilera.—Mr. G. F. Butt, F.Z.S., exhibited two specimens of a singular variety of the Red Grouse, shot in Westmoreland.—A communication was read from Mr. W. Leche, of the University of Stockholm, in which he gave an account of a collection of bats from Australia. Two new species were described and named respectively *Nyctinomus petersi* and *N. albidus*.—Mr. Sclater read some notes on the Lesser Koodoo (*Strepsiceros imberbis* of Blyth), with a view of confirming the distinctness of this Antelope from its larger relative, *Strepsiceros kudu*.—A communication was read from Mr. R. Bowdler Sharpe, containing the description of a new species of Bush-Shrike of the genus Laniarius, based on a specimen obtained in Ashantee by Mr. Godfrey Lagden, which he proposed to call *L. lagdeni*, after its discoverer.—Prof. Flower made some remarks on the chief points of interest exhibited by the Burmese Elephant now in the Society's Gardens.

Geological Society, February 6.—J. W. Hulke, F.R.S., president, in the chair.—Edward John Dunn was elected a Fellow, and Dr. Joseph Szabó, of Buda-Pest, a Foreign Member of the Society.—A delta in miniature—twenty-seven years' work, by T. Mellard Reade, F.G.S. The author described a delta deposit, which, during a period of twenty-seven years, had formed in the Rake reservoir (Rivington Waterworks) from materials brought down by a stream of that name. The reservoir at this part was divided by a road, water communication being maintained by a culvert, once eight feet high, now almost silted up. The author described the stratification of these deltas: that near the influx of the Rake consisted of peaty matter, gritty sand, gravel, shingle, and boulders of Millstone-grit up to about one foot diameter; the other chiefly of fine sand with some peaty matter. The former covered an area of 2508 yards, with an average thickness of 2 yards; the latter, an area of 430 yards, with an average thickness of 3 yards. These materials had come from the drainage-area of the Rake. This is estimated as 1·176 square mile, and the delta being estimated at 6306 cubic yards, and the time being 27 years, gives, as the annual rate of denudation over the whole area, 1/432 inch per annum, or 1 foot in 5184 years. The mean rainfall of the Rake Brook watershed for the last ten years was 49·57 inches per annum. In this calculation no account is taken of the finer materials which have doubtless been distributed over the rest of the bed of the reservoir. The author pointed out that this rate of denudation was rather more rapid than that of the Mississippi (1 foot in 6000 years), and that the arrangement of the materials under the varying condition of the stream illustrated the phenomena of larger deltas.—On the nature and relations of the Jurassic deposits which underlie London, by Prof. John W. Judd, F.R.S., Sec.G.S., with an introductory note on a deep boring at Richmond, Surrey, by Collett Homersham, A.M.Inst.C.E., F.G.S. An account of this appeared in NATURE, vol. xxix. p. 329.

SYDNEY

Linnean Society of New South Wales, December 27, 1883.—C. S. Wilkinson, F.G.S., F.L.S., president, in the chair.—The following papers were read:—On the localities of some plants from the southern parts of New South Wales, by Baron von Müller, K.C.M.G., F.R.S., &c.—Descriptions of Australian Microlepidoptera, No. 10, by E. Meyrick, B.A. This is a continuation of the Œcophoridæ of Australia, and deals with the genera *Philobota*, *Leistomorpha*, *Compsotropha*, and *Eriodyta*. About seventy new species are described.—Notes on the geology of the southern portion of the Clarence River basin, by Prof. Stephens. This was an account of the sugar lands of the Clarence, explaining the mode of their formation, and their relation to the Coal-measures which underlie them unconformably. The period of deposition of these latter rocks was also considered, and their immediate superposition upon the vertical Siluro-Devonian slates and quartzites described. The existence of a great north and south fault at the present outcrop of these rocks was demonstrated, and the probable existence of others near the present coast-line supported by various considerations.

PARIS

Academy of Sciences, February 11.—M. Rolland in the chair.—Note on Faraday's law (continued), by M. Ad. Wurtz.—Remarks on the slight horizontal and vertical vibrations of the ground observed at Abbadia, near Hendaye, for several years past, by M. d'Abbadie.—Note on the meteorite which fell at Grossliebenthal, near Odessa, on November 7/19, 1881, by M. Daubrée. In its outward appearance and microscopic structure it presents all the characters of the typical meteorite which fell at Lucé, Sarthe, on September 13, 1768, and which is already represented in the collection of the Natural History Museum, Paris, by fifty-four other identical specimens.—Description of an absolute calculating actinometer invented by M. G. A. Hirn. This delicate instrument is based on the principle of steam condensers, that a saturated vapour contained in a closed vessel acquires a tension corresponding with the minimum temperature of the walls of the receptacle. So far it acts with perfect satisfaction, and the inventor will report the numerical results as soon as he feels that they are absolutely trustworthy.—Report on the thunderstorms observed in France during the first six months of the year 1883, with complete and detailed tables of all the accidents caused by lightning in every part of the country during that period, communicated by the Minister of the Postal and Telegraph Department. The fatalities amounted altogether to nine persons and seventy-eight animals killed, and about fifty persons and seven animals injured, by lightning.—Report on the solar spots and faculæ observed at Rome during the year 1883, by M. P. Tacchini. The paper is accompanied by a table of dates, relative size, frequency, and number of the spots.—Observations on the Pons-Brooks comet at the Observatory of Nice, one illustration, by M. Perrotin.—Note on the appearance of the same comet on January 13 and 19, 1884, by M. Perrotin.—On the sudden modifications of form (wings, egrets, &c.), presented by the same comet during its passage through perihelion, by M. G. Rayet.—On the barometric disturbances caused by the Krakatoa eruption, as recorded by the Rédier barometer of the Observatory of Toulouse, by M. Baillaud.—On linear substitutions (mathematical analysis), by M. H. Poincaré.—Generalisation of Jacobi's theorem on the Hamilton equations, by M. J. Farkas.—On curves of the fourth order, by M. C. Le Paige.—On the propagation of light in a crystallised medium, by Madame Sophie Kowalevski.—On the distribution of potential in a liquid mass having the form of an indefinite rectangular prism, by MM. Appell and Chervet.—On Joule's electric law, by M. P. Garbe.—On the electric conductibility of greatly diluted saline solutions, by M. E. Bouty.—Note on several unsuccessful attempts recently made to liquefy hydrogen, by M. K. Olszewski. These experiments are reported in consequence of M. Wroblewski's statement that he has succeeded in liquefying hydrogen by expansion at a temperature of $-186°$ C. by means of boiling hydrogen.—On a gas-burner yielding a white light by the incandescence of magnesia, by M. Ch. Clamond.—On the law of the thermic constants of substitution (thermo-chemistry), by M. D. Tommasi.—On the formation of the iodide of methyl and of the iodide of methylene by means of iodoform, by M. P. Cazeneuve.—Note on the monobromic methylchloroform $CCl_3 - CH_2Br$, by M. L. Henry.—On the albuminoid substances contained in milk, especially caseine, by M. E. Duclaux.—Fresh observations on the morphology, anatomy, and development of the parasites of the onion and other bulbous plants (*Tylenchus hyacinthi*, *Tylenchus putrefaciens*, &c.), by M. Joannès Chatin.—Remarks on the preparation of farmyard manure, by M. P. P. Dehérain.—On the presence of pegmatite in the diamantiferous sands of South Africa; observations in connection with M. Chaper's recent communication on the subject, by M. Stan. Meunier.—On some freshwater formations during the old and recent Quaternary periods, by M. Ph. Thomas.—On the arched waterspouts of the Indian Ocean (two illustrations), by M. Le Goarant de Tromelin.—Note on the particles of dust found in the snow that fell at Stockholm last December, by M. E. Yung.—Actinometric observations made at Montpellier during the year 1883, by M. A. Crova.

February 18.—M. Rolland in the chair.—Observations of the small planets made with the large meridian at the Observatory of Paris during the third and fourth quarters of the year 1883, communicated by M. Mouchez.—On the reciprocal displacements between fluorhydric and the other acids, by MM. Berthelot and Guntz.—On the law of modules or thermic constants of substitution, by M. Berthelot.—Remarks on a note by M. J. Luvini in connection with the controversies carried on in the eighteenth century on the subject of waterspouts and whirlwinds, by M. Faye.—Determination of the difference of longitude between Paris and the Observatory of Bordeaux, by MM. G. Rayet and Salats. The longitude of the meridian of the Bordeaux Observatory, as here rectified, is fixed at 11m. 26·444s. ± 0·008s.—Remarks in connection with the recent researches made on the propagation of the atmospheric currents caused by the eruptions of Krakatoa, by M. Foerster. The author disclaims priority for the observations made by him on this phenomenon, a priority which he awards to General Strachey, whose paper on the subject appeared in a recent number of NATURE (p. 181).—On the divisors of certain polynomes, and on the existence of certain primary numbers, by M. A. Genocchi.—On the composition of such polynomes as admit only of primary divisors of a determined form, by M. Lefébure.—On certain linear substitutions (mathematical analysis), by M. E. Picard.—On an equation of the *m* degree, which has never more than two real roots, by M. D. André.—On a differential equation of the third order, by M. E. Goursat.—On M. Levy's elastic curve, expressing the equilibrium of an elastic circular rod subjected to normal and uniform pressure throughout its whole length, by M. Halphen.—On the adiabatic expansion of the vapour of water, by M. Paul Charpentier.—Researches on the fluorhydrate of fluoride of potassium, and on its states of equilibrium in various solutions, by M. Guntz.—On the nitrous derivatives of hydride of ethylene, by M. A. Villiers.—On the probable number of homologous and isomerous rosanilines, by MM. A. Rosenstiehl and M. Gerber.—On a new compound arising from the preparation of the hexachloride of benzine, having the same centesimal composition as that substance, by M. J. Meunier.—On the constitution of milk, by M. E. Duclaux. The author reduces milk by a new method of analysis to the following elements:—

	In suspension	In solution
Fatty substance	3·32	—
Sugar of milk	—	4·98
Caseine	3·31	0·84
Phosphate of lime	0·22	0·14
Soluble salts	—	0·39
	6·75	6·35

—On the pigmentary function in the Hirudineæ (common leech, Nephelis, *Aulostoma vorax*, &c.), by M. Rémy Saint-Loup.—On the physiological development of the adult Comatule, by M. Edm. Perrier.—On a placentoid organ in the embryo of birds, by M. Mathias Duval.—Origin and mode of formation of the Belgian Devonian and Carboniferous limestones, by M. E. Dupont. The author explains the formation of the older marine rocks of organic origin by causes still in operation, and from this deduces a fresh proof of the value of the comparative method applied to the study of the past geological history of the globe.—On the variability of the composition and concentration of mineral waters, by M. A. Inostranzeff.

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