THURSDAY, APRIL 14, 1887

A NATURALIST IN SOUTH AMERICA[1]

Notes of a Naturalist in South America. By John Ball, F.R.S., M.R.I.A., &c. (London: Kegan Paul, Trench, and Co., 1887.)

II.

LEAVING Valparaiso, and steering southwards amongst the evergreen islands of the South Chilian Archipelago and Fuegia, Mr. Ball encountered all the disagreeables of those inhospitable and desolate regions, signalised by a fall of the barometer and thermometer, gales of wind, the rolling seas of a tempestuous ocean, fogs, and darkness. And here he observes (and the observation is new to us) that one of the main features of the Andes suffers a great change. The western chain, which runs for 900 miles as an almost continuous range of high land on the coast of Chili, from lat. 40° S. to the Straits of Magellan becomes separated from the range to the east of it by a broad belt of low country including several large lakes. Further south the chain first dips under the ocean, to emerge as the great Island of Chiloe and the Chonos Archipelago, after which it joins the continent again at Cape Tres Montes. Further south is the Gulf of Peñas, forty miles wide, beyond which are the famous channels that lead into the Straits of Magellan. The new geographical features are accompanied by a change of climate, and this again is marked by the appearance of many types of the so-called Antarctic (or rather Fuegian) flora, which may be traced northward from Fuegia to the Mountains of Valdivia, and some few of which types, profiting by the fogs of the desert region of the Andes, straggle northwards into Northern Chili. In Messier's Channel, lat. 50° S., the wild celery of Europe was found, of which Mr. Ball says: "Growing in a region where it is little exposed to sunshine, it has less of the characteristic smell of our wild plant, and the leaves may be eaten raw as salad, or boiled, which is not the case with our plant until the gardener, by heaping soil about the roots, diminishes the pungency of the smell and flavour." "The 5th of June," he goes on to say, "my first day in the channel, will ever remain a bright spot in my memory. Wellington Island, which lay on our right, is over 150 miles in length, a rough mountain range, averaging apparently about 300 feet in height, with a moderately uniform coast-line. On the other hand, the mainland presents a constantly varying outline, indented by numberless coves and several deep narrow sounds rnnning far into the recesses of the Cordillera. In the intermediate channels crowds of islands, some rising to the size of mountains, some mere rocks peeping above the water, present an endless variety of form and outline. That which gives the scenery a unique character is the wealth of vegetation that adorns this seemingly inclement region. From the water's edge to a height which I estimated at 1400 feet, the rugged slopes were covered with an unbroken mantle of evergreen trees and shrubs. Above that height the bare declivities were clothed with snow, mottled at first by projecting rocks, but evidently lying deep upon the higher ranges. I can find no language to give any impression of the variety of the scenes that followed in quick succession against the bright blue background of a cloudless sky, and lit up by a northern sun that illumined each new prospect as we advanced."

In another passage the scenery is compared to that of the Upper Lake of Killarney, where the evergreen beeches of Fuegia are represented by the arbutus; and where, Mr. Ball might have added, similar climatal features nurture a similar wild variety, profusion, and luxuriance of cryptogamic plants, mosses, ferns, and hepaticæ, and especially broad foliaceous lichens that grow nowhere else in the northern hemisphere in like number and variety. A further similitude between Fuegia and the south-west of Ireland may be traced in the rock-girt deep sounds that run far into the land of both, and which harbour a marine vegetation that has perhaps no parallel for variety, luxuriance, and beauty in their respective hemispheres.

The meeting with floating masses of glacier ice in Eyre Sound suggests some excellent remarks on the well-known phenomenon of the depression of the snow-line and of glaciers in this region, as compared with the northern hemisphere. Threading a devious course through the Straits of Magellan, Mr. Ball's enthusiasm rises to a white heat, that warms the land- and sea-scapes of the grim "Land of Desolation." In his eyes, Fuegia's midwinter glows with brilliant hues. It would make Magellan and Del Canot, Narbough and Davis turn in their coffins could they but read Mr. Ball's ecstasies over the features of the countries in which they starved and froze, and where so many of their ill-starred comrades left their bones, after their bodies had endured incredible sufferings. No doubt we may attribute much of the rapture experienced by our traveller to the contrast which the luxuriant vegetation and picturesque scenery of Fuegia presented to the dismal sterility of the Peruvian and North Chilian coasts, and more to the keen interest which he took in the botany of the region. Still, though "Tantus amor florum" may account for a good deal, there is a large measure of beauty in the scenery of Fuegia that he has been the first to analyse, appreciate, and describe with truth and picturesqueness. Take his picture of Mount Sarmiento, for example, a mountain 7000 feet high. "Sole sovereign of these Antarctic solitudes, I know of no other peak that impresses the mind so deeply with a sense of wonder and awe. As seen from the north, the eastern and western faces are almost equally precipitous, and the broad top is jagged by sharp teeth, of which the two outermost—one to the east, the other to the west—present summits of apparently equal height." Speculating on its geological age, he considers it evident that it is not of volcanic origin, for that no volcanic rock can retain slopes so nearly approaching the vertical. He regards it as a portion of the original rock-skeleton that formed the axis of the Andean Chain during the long ages that preceded the great volcanic outbursts that have covered over the framework of the western side of South America, and that in the course of upheaval its flanks have been carved by marine action to the nearly vertical form which impresses the beholder.

[1] Continued from p. 531.

After a short stay at Sandy Point, a Chilian settlement at the eastern mouth of the Straits, Mr. Ball proceeded to Monte Video and Buenos Ayres, from whence he ascended the Uruguay River; and, passing Fray Bentos, the great factory of "Liebig's Extract of Beef," finally reached Paysandu, equally familiar to English housekeepers for its preserved tongues. This digression gave him a fair view of the aspect of the flora of a great extent of the Argentine Confederation, which, with its Pampas, Salinas, and riparian vegetation differs wholly from that of all the regions he had hitherto visited. For the Argentine Confederation he proposes the term "Argentaria," a good one, which will, we hope, be acceptable to biologists, and to geographers too.

Santos, in South Brazil, was the next point visited, and from there Mr. Ball took the rail to Sto. Paolo, and thence on to Rio de Janeiro. Here he is upon ground familiar to naturalists, and we need only allude to the singular speculation to which his observations on the geology of that part of Brazil, and his reading of the observations of others on the same subject, have given birth. After dwelling on the enormous area of Brazil occupied exclusively by granite and gneiss, and the extent and depth of the deposits of the disintegrated materials formed out of the same matrix, including 200,000 square miles of the plateau of Brazil, the Argentine Pampas, and Paraguay, he goes on to say: "To my mind the conclusion is irresistible that ancient Brazil was one of the greatest mountain regions of the earth, and that its summits may very probably have exceeded in height any now existing in the world." And it is these mountains which he regards as the probable birthplace of the chief types of the phanerogamous vegetation of South America. A few peculiar types, indeed, may have been developed in the Andes, but not such as have stamped their features on the vegetation of the continent. Mr. Ball further correlates this speculation with another as bold, which he gave to the Geographical Society in 1879 (Proceedings, p. 464), and which is, that the chief types of existing flowering-plants originated in the higher mountain regions of the globe "at a period when the proportion of carbonic acid gas present in the atmosphere was very much greater than it has been since the deposition of the Coal-measures." To discuss these novel ideas would be out of place here; but we must, in justice to our author's candour, add his avowal that he regards them "as having no claim to rank as more than probable conjectures, but that, as they rest on some positive basis of facts, they may be serviceable to the progress of science by stimulating inquiry."

It remains to add that the work concludes with two appendixes—one "on the fall of temperature in ascending to heights above the sea-level," which is a model of painstaking research into the methods and observations hitherto adopted, but which leaves this complex subject no further advanced; the other, "on Mr. Croll's theory of secular changes of the earth's climate," is a really valuable contribution to that fascinating inquiry. And here we take leave of Mr. Ball, congratulating him heartily on having added to our library of South American travels a volume that well deserves a corner of the shelf that contains those of Humboldt, Darwin, and Bates.

PALÆOLITHIC MAN IN NORTH-WEST MIDDLESEX

Palæolithic Man in North-West Middlesex. By J. A. Brown. (London: Macmillan and Co, 1887.)

THIS work has two faults by no means peculiar to itself, but which it shares with many books on science.

One of these is the large amount of introductory matter that bars the way to the special subject of study. Thus we do not get into Middlesex until reaching page 42, and then we quit it again after p. 120, to return at p. 185. Certainly, our author shows us how much trouble he has taken in looking up authorities on palæolithic and savage man in general; but he should remember that some folk don't like their whisky to be over-watered.

The second fault one must allude to with sorrow. Why is it that so many scientific scribes have such a weakness for slipshod English? Is it that they feel the advance of science to be so rapid that their works will be passed by in a few years, as out of date, so that it is not worth while to cultivate style, and grammar is hardly essential? Or is it that they expect the bad language of to-day to be the good language of the future, by an evil process of evolution, the survival of the unfittest? Let Prof. Lankester note this as a possible case of degeneration.

One cannot resist giving some examples. On p. 11 we are told that "abundant traces of man in the Neolithic Age are found on the surface of the ground, which may be picked up on ploughed fields." The surface of the ground is usually a good deal picked up on ploughed fields; but of course that is not what is meant. An author who has written much on prehistoric man might perhaps be justified in bringing an action for libel for the remark on p. 67 that "the fauna—as Prof. Dawkins says—is the same, and are referable to the same geological horizon." On p. 90 it is said of a certain tool that "it certainly has the appearance of greater antiquity as an implement, than do a very large proportion," &c. In the middle of p. 94 three successive sentences begin with "It," but that awkward little word in two cases stands for one particular implement, whilst in the third the general type to which that implement belongs must be referred to, as the particular "it" cannot have been found, in these unmiraculous times, in three distinct places: at Ealing, in Kent, and in Surrey. At p. 112 the singular "No. 131" is shortly followed by the plural "They," the latter being meant to refer to other numbers as well.

Having said this much as to things in general, we may say that Mr. Brown's book is a praiseworthy account of a particular district, and that it would not be amiss if other districts had as careful an observer in their midst, eager to see every section, and to record every find. It is a work that London antiquaries and geologists should possess.

Up to the time when Dr. Evans's great work on stone implements was published, but few specimens of worked flints had been recorded from the metropolitan district; but in the same year, Colonel Lane-Fox (now General Pitt-Rivers) recorded the finding of a large number in the

gravels round Ealing. Notwithstanding this, however, hardly any addition was made to London implements for some years, when Mr. Worthington Smith developed the marvellous faculty of finding them in nearly every gravel-pit he went into. Our author makes a good third to these two, and that is saying a great deal. It is to be hoped that his book may lead other observers to join in the work that he has so much advanced, and to do for other parts of London and the surrounding country what he and the above-named authors have done on the north-west and north-east, and Mr. F. Spurrell on the south-east.

The antiquity of man is so controversial a subject that anyone who writes on it must expect to find more foes than friends. Mr. Brown, therefore, must not be surprised at exception being taken to some of his views, and in noticing his work one may fairly point out some matters on which opinions are likely to differ.

The remark, on p. 13, of piles (for dwellings) having been found at Moorfields received a curious illustration whilst it was in the press; for a building in that district was then being underpinned, on account of part of the pile-structure on which it was based having decayed; that building being none other than the lecture-hall of the London Institution.

The name "chalky boulder clay" was given by Mr. S. V. Wood, Jun., and not by Mr. Skertchly, as the foot-note on p. 27 says.

That the brick-earths of Erith, Crayford, &c., are pre-glacial few geologists will be found to believe; perhaps, indeed, only Prof. Dawkins; and our author wisely throws the burden of this belief on that gentleman (p. 33).

As to the Tilbury man, alluded to on p. 42, there can be no doubt that his remains were found in a very late post-glacial deposit, simply the alluvium of the Thames. Mr. T. V. Holmes has set this question at rest (Trans. Essex Soc.).

By a slip, on p. 45, hard chalk, flint, and greywethers have been classed amongst rocks that do not occur in the valley of the Thames.

Probably there are geologists who would be disposed to question the strictly glacial origin of the furrowed gravel and the bent loam carefully described on pp. 45-47. Such irregular surface-deposits are so common in districts far from undoubted glacial beds as to leave their origin doubtful.

"The large encroachments of the sea which have taken place . . . in historic times" are no proof of depression (p. 48). They are simply the result of denudation along coasts.

The term "alluvium" should be confined to the deposits of rivers and not applied generally to surface-soil, as on p. 50, in which case it becomes a useless synonym.

The peculiar black bands often seen in gravels have troubled many observers, but from finding particles of carbonised wood occasionally in them Mr. Brown is not justified in saying that "there seems to be no doubt that such black strata are due to vegetable life," especially as he recognises the fact that the *colour* (which is what he refers to) is generally due to oxide of iron or of manganese. And even were the blackness due to vegetation, it is by no means a reasonable assumption that the beds were land-surfaces (p. 54), for the vegetable remains may have been carried down by water. That the white beds occasionally seen are "probably the result of decomposition of animal or vegetable matter" is also rather doubtful, the colour (which here again is what the author refers to, though his language implies the beds themselves) being often the result simply of the washing-out of the iron-oxide, which gives the usual brown tint, by percolating water.

There may be some doubt whether, when man first invaded England, the connexion of our country with the mainland was caused "by the uprise of the bottom of what is now the . . . North Sea." The present severance need not have been brought about by depression, but perhaps is owing simply to denudation, so that there is no need to invoke uprise to account for former connexion. There is also some difficulty in the uprise in question, as Mr. Brown thinks that Middlesex, &c., "was slowly emerging from the sea," and therefore must have been at a lower level than now. It is most likely indeed that at that time the whole land was higher than now, as otherwise it would be hard to account for the greater size of the rivers, as compared with their present descendants, for higher land would give greater rainfall, and greater rainfall means stronger streams. If "man beheld the land now under the 300-foot contour in Middlesex as an arm of the sea," there could have been nothing worthy the name of river, or even of brook, in the county, and the deposition of such coarse matter as our river-gravels would be out of the question (pp. 67, 68), those gravels certainly not being marine deposits.

In the picture of a Palæolithic scene from Castlebar Hill (pp. 185, &c.), it would seem as if the author were, as is often the case with geologists, a little too much impressed with the present features of the country, so as to allow too little for the amount of denudation that has happened since the time his picture represents. Instead of water then occurring over the whole of the low clay-country to the north, is it not possible that the tract in question was much higher than now, a great sheet of clay having been gradually swept off it since? Indeed, the author distinctly recognises the great amount of denudation that has occurred south of Castlebar Hill, along the valley of the Thames (pp. 191, 192), and of course there is no possibility of the process being confined to one side of the ridge.

The conclusions of Dr. Hicks as to the Glacial or pre-Glacial age of man in North Wales, noticed at the end of the work, are not altogether accepted, and should be considered as still waiting for the verdict of geologists.

Mr. Brown is clearly a positivist, as far as worked flints are concerned, and one is tempted to speculate on his direct descent from Palæolithic ancestors, for, as if by some hereditary instinct, he is enabled to be quite positive as to the uses to which sundry implements have been put, to an extent, indeed, to which probably few of even that highly imaginative class of men, antiquaries, will follow him. Some examples of this positivism may be noticed. Thus certain flakes were "evidently intended for spear-heads" (p. 58); and certain "triangular stones . . . could hardly have been intended for use in any other way" than as arrow-heads, "they were no doubt hafted" (p. 117); but from the figures given of some of these stones one would be inclined to regard them as little else

than castaways (Nos. 167, 169). In another case, "as the greater part of one side is flat . . . it is evidently done for the purpose of being held in the hand" (p. 86). Again, "the object of making such an instrument is clear,' namely, "for insertion in a club" (pp. 94, 95). "There can be no doubt that . . . they have been, or were intended to be, inserted into sockets" (p. 109). No. 159, in which "we have a shaft-smoother, borer and knife included in one object" (p. 116)," must have been the delight of some Palæolithic schoolboy! Where statements of opinion occur in such form as "*I* have no doubt," they are of course justifiable; but in this sceptical age it is risky to say "there can be no doubt." It is quite refreshing to hear that there are implements whose "use is almost beyond conjecture" (p. 98). Most likely differentiation in the use of tools did not go far in Palæolithic times.

In the illustrations it would seem that in some cases justice has hardly been done to the specimens, or we should not be told by so experienced a person as the author that No. 144 (Plate ii.) is "the finest example of Palæolithic work" that he has seen. There is, too, a deficiency that should be supplied in another edition: a map and a general section of the district would much help most readers; and these could well be given instead of some of the foreign objects, such as the eternal carved reindeer, &c., without which no anthropological work seems to be thought complete, and which, by frequent repetition, have grown to be nearly as irritating as the faces and figures ever obtruding themselves from the advertising columns of newspapers and magazines.

The frontispiece, by Mr. Worthington Smith, should be acceptable to the advocates of women's rights. The woman is represented as the skilled artist, whilst the man is the mere labourer!

OUR BOOK SHELF

Hand-book of Practical Botany for the Botanical Laboratory and Private Student. By Prof. E. Strasburger. Edited from the German by W. Hillhouse, M.A., F.L.S. (Swan Sonnenschein, Lowrey, and Co., 1887.)

PROF. STRASBURGER'S well-known work, "Das Botanische Practicum," has already been reviewed in the pages of NATURE (vol. xxx. p. 214), so that a short notice may suffice for the present hand-book, which is essentially a translation of the *smaller* German edition. Only the account of the fall of the leaf (pp. 156-59) has been taken from the larger work.

The present edition has been fully revised by the author, and also contains a considerable number of editorial notes and additions. The latter are usually indicated by being inclosed in brackets. It would, perhaps, have been better if this had been done throughout, especially in the introduction. A number of additional figures have been inserted by the editor. These are almost all reproductions of familiar text-book illustrations. Many of them certainly come in well, but we cannot help feeling that the constant reappearance of old figures has become rather wearisome, and that in this instance it tends to take off from the freshness which was so pleasant a characteristic of Prof. Strasburger's "Practicum."

We much regret that no account of any of the seaweeds finds a place in this edition. The admirable description of Fucus in the larger treatise of the author might well have been introduced here, while we think that the editor would have been well advised to add an example of the real seaweeds on his own account, or at least to reproduce Prof. Strasburger's description of the fresh-water Batrachospermum. It is easy to see why the author, writing for German elementary students, omitted all reference to seaweeds in his smaller edition. In England we are in a very different position, and it is a pity that students should not at once be made acquainted with plants which are so instructive and so easily accessible.

As the editor explains in his preface that the translation was executed at a time of serious pressure, it would be unfair to enter into any detailed criticism. It must, however, be admitted that the signs of haste are very frequent, and that there is much need for revision in a future edition. There are one or two instances of this which cannot be quite passed over. At p. 11, "durchschnittlich," which means *on the average*, is translated "sectionally," while at p. 49 we have "carefully," where the author says "with advantage" ("mit Vortheil"). At p. 169, note 2, "perfection" should be "development," while on p. 208 the statement that "we *know* the angular outline of the crystals [in Spirogyra] even without reagents," has an odd effect. The word should of course be *recognise*. At p. 67 the use of the word "pits" for the deep depressions ("Grübchen") which lead down to the stomata in Aloe, &c., seems to us likely to confuse the beginner. The phrase "starch-builders" (p. 43, &c.) strikes us as awkward, and is certainly not accurate as a translation. The use of the term *luticiferous cells*, in speaking of Chelidonium, is unfortunate. The organs in question of course come under the head of luticiferous *vessels*.

In conclusion we may express a doubt whether the un-English form "fibro-vasal" has any advantages over the familiar word "fibro-vascular."

The appendixes have been much expanded from the original indexes of the author, and should be of great use to the student, to whom the book as a whole will be extremely welcome. D. H. S.

Elementary Practical Biology—Vegetable. By Thomas W. Shore, M.D., B.Sc. (London: Churchill, 1887.)

THIS book is welcome more as a sign of the ever-growing attention paid to plant-structure than for any peculiar merit it has as a guide to the subject. The author fairly expresses his indebtedness to such practical books as Bower and Vines's, and claims originality only for his arrangement and treatment of the subject. The arrangement is as follows:—First comes an introduction dealing with the necessary apparatus and the preparation, &c., of objects. This is very concisely and sensibly done. Part I. deals with general vegetable morphology, treating in due sequence of the cell, the tissues, the systems of tissues, the apices of stems and roots, and cell-multiplication or cell-reproduction. Part II. is devoted to the Cryptogamia, beginning with the Fungi and working up to the vascular forms. Part III. is confined to the Gymnosperms, and Part IV. to the Angiosperms. So much for the arrangement. There may be no guide to practical work covering precisely all these types in this way, but text-books are by no means wanting which contain this arrangement of matter. The originality here is therefore not at all striking—perhaps fortunately so. As for the treatment, the student is conducted through the course with a baldness in the directions to note this and observe that, which reminds one of the style of a personal conductor through an historic building. The book has a purely practical aim, with the excellent purpose of preventing "cram"; but a student who should undergo this course of instruction, noting and observing no more than he is here directed to do, would find himself, at the end of it, the dispirited possessor of a mass of information which would result in a sad fit of mental indigestion. A practical guide of this kind throws too much of the burden of instruction upon the lecturer whose course accompanies

it. The style of the whole book leads one to doubt the author's claims as a botanist to write it, and though it it may be a suitable guide to those who have to acquire a knowledge of botany in the course of their studies, it is practically useless for the rearing of botanists. Though one is reluctant to attribute a wrongly-spelt word to other than the conveniently necessary printer, the occurrence of Felicineæ, not once, but regularly, and, moreover, in the boldest and most conspicuous type of the headings of sections, does tempt one to think that the printer's fault lay in not having corrected it. A detailed criticism of the book would exhibit the author's imperfect acquaintance with the types discussed and his errors in description. Such, however, is beyond the scope of this notice.

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.*]

A Plant which destroys the Taste of Sweetness

DURING his tenure of office as Governor of Madras, Sir Mountstuart Grant Duff found time, in a way at which I never ceased to marvel, to correspond with this establishment about every kind of detail connected with the botanical productions of Southern India. In one of the last letters which I received from him at the close of last year, before his departure from India, he writes:—"I send you inclosed in this a portion of that delightful plant *Gymnema sylvestre*, an Asclepiad. I shall be curious to know whether when it gets to you it retains the very interesting property that, if you chew carefully two or three leaves of it, it absolutely abolishes for the time the power of tasting sugar. This is no fable, for three of us, I being one, tried it this morning at breakfast with the most complete success. I ate pounded sugar after it without the faintest perception of its saccharine character. I also drank coffee without any sugar in it, and tasted it just as well as I ever did.

"General Elles has just been up to my room to tell me that he also found it abolish the power of enjoying a cigar. Do try it, and report to me, when we meet, whether it stands the long journey. This Gymnema might conceivably be important medically."

We found that the leaves sent by Sir Mountstuart Grant Duff did retain the property he described in a marked way. I immediately wrote to Mr. Lawson, the Director of Public Gardens and Plantations, Ootacamund, to endeavour to procure some seed which we might grow at Kew, so as to obtain material for future experiment. In a letter received from him this morning he promises to do this when the fruit is ripe. He has, in the meantime, been so good as to inclose in his letter a paper by Mr. Hooper, the Government Quinologist, which appears to me to well deserve the wider publicity of the pages of NATURE.

The whole matter is a good illustration of the useful work which can be done by scientific men in distant parts of the Empire, which indeed could hardly be done in any other way.

W. T. THISELTON DYER

Royal Gardens, Kew, April 11

[Mr. Hooper's paper will be found on pp. 565–67.]

Units of Weight, Mass, and Force

IT is not easy to follow Mr. Greenhill in his letter which appeared in NATURE of March 24 under the above heading. His main contention appears to be that "weight" connotes not "force" but "mass" in engineering formulæ. Surely it would be more correct to say that the primary idea among engineers is that of force, mass being of secondary consideration and being measured by means of force: the force most commonly referred to being that of gravitation, which is *the* force, *par excellence*, with which the engineer has to deal. And I think it would be impossible to find any ordinary engineering formula involving W (which is generally supposed to stand for *weight*) in which W does not mean gravitation force. Also, in formulæ which have nothing to do with gravitation, and in which M (or *mass*) would naturally appear, the engineer puts $W \div g$ instead of M, so as to enable him to express it in terms of his unit of force, the weight of a pound. Thus, the kinetic energy of a moving body is $\frac{1}{2}Mv^2$ (where M is its mass and v its velocity), and is quite independent of its position in space. Engineers, however, who only care about bodies near the earth's surface, express the energy in terms of the merely local phenomenon, the weight or gravitation force acting on the body, which is sufficiently constant for their purposes, and write $\frac{1}{2}Wv^2 \div g$. There is consequently a struggle between engineers and physicists as to whether "*pound*," "*ton*," &c., shall connote the fundamental engineering quantity, namely, *weight*, or the fundamental physical quantity, namely, *mass*; and, naturally, neither side is very willing to give way. The easiest way perhaps would be for the physicists to give another name to the mass-unit, and leave engineers to the enjoyment of their use of the word "pound"; though meanwhile the word might very well connote either *mass* or *weight* (*i.e.* gravitation force) according to the context, the terms pound-mass and pound-weight being used when special clearness is desired. But do not let us, as Mr. Greenhill seems to desire, use weight and mass as synonyms, so losing the advantage of a good word for no good reason.

But Mr. Greenhill's most incomprehensible attack is on the formula $W = Mg$.

The equation means fundamentally neither more nor less than that the force of gravitation on any mass near the earth's surface gives, or tends to give, to that mass a constant acceleration called "g," and is to be measured by mass and acceleration conjointly, in accordance with Newton's second law, the fundamental law connecting force and motion. The symbol = means "equivalent to," as it often does.

From this fundamental equation can be deduced special *numerical* equations by means of definitions of arbitrary standards. Thus a "poundal" is the force which will produce in a pound-mass an acceleration of a foot-per-second per second;

$$\therefore W(\text{in poundals}) = M(\text{in pounds}) \times g(\text{in ft.-per-sec. per sec.}) = M(\text{in pounds}) \times 32, \text{ approximately,}$$

this equation being merely a *numerical* equation deduced from the fundamental physical equation above. For W (in poundals) means the ratio of the weight of a body to the force called a poundal, or weight per poundal, or $\frac{\text{weight}}{\text{one poundal}}$, and so is a mere number depending on the particular mode of measuring W: and similarly with the other quantities.

Again, a pound-weight is the force which produces in a pound-mass the acceleration g;

$$\therefore W(\text{in pound-weights}) = M(\text{in pound-masses}),$$

or *ambiguously*

$$W(\text{in pounds}) = M(\text{in pounds}),$$

which is another merely numerical equation, and of course also only an approximate one; as Mr. Greenhill incidentally shows by means of his hypothetical balance at the coal-pit.

Too much importance can hardly be laid on the radical distinction between a physical equation and the various numerical equations which by choice of special units can be deduced from it. This must be my excuse for dwelling so much on the above example. It throws light on the way in which the error cited by Mr. Greenhill in his last paragraph can creep in. Thus, if the mass of a body of weight W is $W \div g$, it really follows that the mass of a body whose weight is W pounds (*or*, less ambiguously, W pounds-weight) = W pounds-weight $\div g$; but by definition one pound-weight $\div g$ = one pound-mass, $\therefore$ the mass = W pound-masses. In Mr. Greenhill's example W is a mere number, and he shows the error caused by trying to insert it in a formula where W means a weight.

In conclusion, if Mr. Greenhill insists on the abolition of the equation $W = Mg$, will he kindly say how he would symbolise the connexion between the force of gravitation on a freely falling body and the induced acceleration g?

ALFRED LODGE

Cooper's Hill, March 30

The Association's "Geometry"

AS the President of the Association for the Improvement of Geometrical Teaching did me the high honour to mention with special approval my work on geometry in his remarks before the

Association, printed in the twelfth Annual Report, 1886, I feel impelled, on at length receiving to-day, at this frontier outpost of scientific civilisation, a copy, long ordered, of the Association's "Plane Geometry," Part 2, to say a few words suggested by it, favouring accord in these fundamental matters.

The very first definition and first theorem show the glaring need in English for a word which the Germans have in *Strecke*. Such a word, meaning a piece of a straight line, is needed in the first definition, the definition of a circle, for all straight lines are infinite in size, and radii are pieces of straight lines, and not whole straight lines. This is unconsciously recognised, even in the first theorem, where for "piece of a straight line" the undefined word *distance* is used, inappropriate because of its association with ideas of measurement by a unit and length, and because of its different and confusing use in the phrase "shortest distance."

In the demonstration of this first theorem, "straight line" is used in its proper sense, though just before, in the first definition, it was bunglingly used in the sense here given to *distance*. For the part of a straight line between two definite points I have long used the word "sect," which, carried over to the sphere with the meaning part of the spherical line less than half, gives the key to two-dimensional spherics.

And this suggests another objection to the same first definition. It says a circle is a plane figure. Now one cannot even think of spherics without seeing how immeasurably better it is to define a circle as a curve. It will be so defined as soon as the student reaches analytics, so why have him learn something only to unlearn?

In the fourth definition we have an over-used word, "conjugate." Two arcs which together make a circle should be called *explemental*. Explement is a natural third to complement and supplement. Again *converse* is a term of logic, and does not mean what it is here used to mean, that is, *inverse*.

In the introductory remarks to the fourth book I think it is a mistake to call hunger, love, courage, talent, wisdom, *magnitudes*.

A magnitude is whatever can be added to itself, so as to double. The very first sentence says: "In this book the subjects of the propositions . . . are magnitudes in general;" but the whole treatment is founded upon *multiples*, and is only applicable where multiples can be made. Not only must we have an exact criterion of equality, we must be able to add without shrinkage.

A little farther on we meet the absurd statement, "Fundamentally, number is *counting*."

Now we know that counting is establishing a one-to-one correspondence between the individuals of an aggregate and of a standard group which was primarily the fingers. But a number is fundamentally a picture of an aggregate which for all counting purposes is as good as the aggregate itself—a picture consisting of a mark for each distinct individual in the aggregate, as III.; and then secondarily a symbol for that picture, as 3.

It is questionable whether Book IV. Part 1, has any valid excuse for existing. Proportion for commensurable magnitudes neither calls for nor warrants treatment by multiples. Sandeman, in the preface to his "Pelicotetics," speaks of "the phenomenon of incommensurability, through which alone arises any need of ratio, either the thing or the name." Euclid's marvellously elegant treatment of proportion is only admirable because of the difficulty it so deftly overcomes. To use it on commensurables is to use a Gatling gun on a plucked chicken. The illustration given under Definition 4 of this Part 1 (which definition needs the word commensurable inserted in it), "4 half-crowns = 5 florins," reminds one how badly England needs a decimal system of coinage, weights, and measures. No light is thrown on the compounding of ratios, but the error of A. J. Ellis is avoided. He says: "The ratio of B to A means the order in which the multiples of B are distributed among those of A."

These are points suggested in first turning the leaves of a new book of most gratifying soundness. May it ward off from England the misfortune America now suffers, in that our most popular book on geometry makes the fundamental blunder of basing the treatment of parallels on direction, uses in its proofs the stultifying formula, "a straight line is the shortest distance between two points," and from one end to the other makes us wish for an American Association for the Improvement of Geometrical Teaching.

GEORGE BRUCE HALSTED

University of Texas, Austin, Texas, March 3

The Svastika as both Sun and Fire Symbol

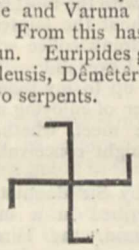
THE late Prof. Dr. Worsaae ("Industrial Arts of Old Denmark") claims the ring-cross  , as he terms it, as a sun symbol, and a small cup-shaped hollow for the moon; both these he places as belonging to the *later* Stone Age of Scandinavia, and, apparently, the only recognised emblems of that period. He observes, in one place: "How many hundred years, or, indeed, how many thousand years, before the Christian era the earlier Stone Age began, it is impossible to say."

The same writer places amongst the emblems of the *later* Bronze Age the wheel-cross  (the chariot wheel of the sun?). To this day, both in Denmark, Holland, and in parts of Germany, a wheel is frequently placed on the roof of a stable or other building, which is thus deemed protected from fire, especially if a stork can be induced to make its nest upon the wheel. The stork, owing to his red legs, was not inaptly considered an emblem of fire; he was also the herald of summer—he brought light and warmth. The Moqui symbol for the sun (as described by Dr. Dryer in NATURE, Feb. 10, p. 345) exists also on articles classed by Prof. Worsaae as belonging to the later Bronze Age in Scandinavia, with the exception of the three marks of which he speaks, as indicating the eyes and mouth of a face.

According to Hyde ("Persian Religion," p. 38), "Idolaters as well as sun-worshippers existed in ancient Persia, and the worship of fire and that of idols were combined at one period."

Quintus Curtius, when describing the march of the army of Darius (writing, however, long after date), says:—"Darius was accompanied by an image of the *sun*, placed in a crystal, and the sacred *fire* carried on a silver altar."

The sun, which was regarded as a wheel, a store of gold, an eagle, was also styled the eye of Varuna.[1] The worship of Mithra was likewise a worship of the sun; Mithra was the god of daylight. He and Varuna were fabled to journey at even in a brazen car. From this has probably arisen the horse-sun and the wheel-sun. Euripides gives the sun a winged car; and, on coins from Eleusis, Dêmêtêr is represented riding in such a car drawn by two serpents.

The *svastika*  has been very generally allowed to be a symbol of Thor, who, to the Scandinavians, was the god of thunder and lightning and of the domestic hearth, and therefore of fire also. The arrows in the hand of Jove, the thunderer of Roman mythology, resemble somewhat a compressed or crushed *svastika*. The above form of this symbol, with a very slight variation 

, may be seen on a slab taken out of a Christian catacomb in Naples, and now in the National Museum there. A very natural inference is, that this stone sealed the grave of one who had suffered martyrdom by fire.

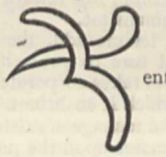
The *svastika* has been held to be an emblem of fire, as being the way in which that element was first produced by primitive peoples—a method which is said to be in use in certain Hindú temples at the present day. It consists in two crooked sticks being laid one across the other, and a hole drilled through both; a pointed stick being there inserted, this is rapidly twirled by the hands until the five points of contact become ignited.

[1] To the Persians, Varuna was the god of the clouds and of the celestial sea. When this branch of the Aryans reached Southern India, he there became to them the god of the earthly sea. To the Greeks he was Ouranos; and to the Germans and Anglo-Saxons, the eye of Woden.

The ground-plan of some well-known Hindú temples in India is that of the Greek cross. The lightning, another of the attributes of Thor, the thunderer, from its zigzag course, may not unnaturally have been likened to a serpent. A Hermes, or torso, in the Museum at Arles, and labelled "A Statue of Mithra," shows that the serpent had its place in the celestial mythology of the ancients. This figure is entwined in the folds of a huge serpent, and between these are sculptured the signs of the zodiac.

During the Bronze Age, which, as regards Scandinavia, Dr. Worsaae fixes at from about 500 B.C. to 100 A.D., the form of the *svastika* received several modifications: amongst others, it became what he styled the single  , or the double 

thus, and also the three-armed figure  , or triskele. In another place he says (*ibid.*): "Curiously enough, in the new Runic alphabet which was adopted at this time (later Iron Age or Viking period), the letter S, which recalls one of the old sun symbols, was called Sol or Sun."

The connection of the triskele with the serpent may possibly seem to some far-fetched, but a tolerably certain proof that it is not so is shown in a bronze brooch found, a few years ago, when excavating the Roman camp on the Saalberg, near Frankfort-on-the-Maine. This ornament is now in the local Museum of Homburg-v.-d.-Hohe. Inclosed in a ring of bronze is a triskele; each arm has a distinct serpent's head; they all turn the same way, as, it may be observed, do the arms of the *svastika* (or Crux Gammata). The connection of this symbol with the serpent survived even down to the so called "cinque-cento" period. It survived in Christian times—under the name of the *fylfot*—even down to the fourteenth or fifteenth centuries, and is alluded to by Sir J. Gardner Wilkinson ("Dalmatia and Montenegro," vol. i. p. 23). He speaks of finding this emblem, in the form of two snakes  entwined, "as a device upon some tombs in those provinces"; and adds:—"This symbol was used in early Christian times in England and other countries, among ornamental devices, in manuscripts, on tombs, and on church ornaments and vestments, from about 1011 to 1400 A.D., after which it is not met with in England. It is very common on monumental crosses of the fourteenth century, and was a favourite ornament of the Greek Church, whence it probably came into England and Western Europe: it is known in heraldry as the fylfot."

In the treasury of the Cathedral at Valencia, in Spain, there are two richly embroidered altar frontals, which (as stated by the officials in charge) formerly belonged to the church of old St. Paul's, in London, having been sold into Spain by our King Henry VIII. The needlework is a triumph of art. On each of these frontals is represented a portion of the old church. On one of them—which depicts our Blessed Lord going to crucifixion—a soldier of the Roman army, or of one of their allies, is represented holding a pennant on which is a *svastika* of the fylfot type.

In this brief sketch I have endeavoured to show the relations between sun- and fire-worship, both of which may have existed contemporaneously amongst primitive peoples, since light and warmth were naturally highly prized by them.

The Greek cross, or cross of Savoy  (the centre of the ring-cross of the later Stone Age), appears to be the earliest known form of that symbol. A form of *svastika* of the Bronze Age—the triskele—may still be traced in the trinacria of the arms of Sicily and the Manx-man of our isles.

Did space permit, much more could be said regarding the *svastika* as a pre-Christian and a Christian cross.

Great Brampton, Hereford

HARRIET G. M. MURRAY-AYNSLEY

Important Points in the History of Earthquake Investigation in Japan

As the various instruments for recording earthquakes which have been invented in Japan appear destined to play an important part in future seismometrical investigations, and as the authorship of many of these instruments has recently formed the subject of a discussion, in which, although my name has been freely used, my distance from Europe practically prevents me from taking part, and which, so far as I can see, can only result in confusing those who are unacquainted with the work done in Japan, I venture to give the following notes as an outline of the more important points in the history of seismometry in this country.

In 1872, Dr. Verbeck, of Tokio, obtained approximate measurements of the range and direction of earthquake motion by means of an instrument consisting of a heavy slab resting on balls, the slab being the steady-point (Trans. Seis. Soc. vol. i. p. 23). The resemblance of this instrument to the lighthouse tables the invention of the late Mr. Stevenson is apparent.

In 1879, results which were probably more accurate than those of Dr. Verbeck were published in the Transactions of the Seismological Society (vol. i. p. 91), and the residents in Japan were astonished to learn that the amplitude of what were apparently severe earthquakes were to be measured in millimetres and fractions of millimetres rather than in inches. The results were obtained partly by Dr. Wagener and partly by myself. I worked with pendulums writing their records by what I still find to be the most delicate kind of pointers upon the surface of smoked glass. Dr. Wagener used a pendulum which was practically "dead-beat," and a pointer which gave a multiplied representation of the earth's movement. This was the first time that the necessity of multiplying-levers was recognised.

Shortly after this I published examples of diagrams of earthquake motion obtained by allowing smoked glass plates, at the time of a disturbance, to move for a period of three or four seconds beneath the pointers of a pendulum. The diagrams were short, but the results obtained respecting period, amplitude, and quantities calculable from these data, have not been shown by subsequent investigations to have been unsatisfactory (Trans. Seis. Soc. vol. i. p. 91, &c.).

About this time Prof. Chaplin and Mr. T. Gray independently constructed bracket seismographs (Trans. Seis. Soc. vol. i. p. 25). Mr. Gray's bracket seismographs were never specially described, but they still exist in the Imperial College of Engineering. Mr. Gray's next invention was a torsion pendulum seismograph, which, being suspended from horizontal levers which in turn were held up by horizontally placed springs, also recorded vertical motion. A curious feature in this instrument was that the horizontal levers were so supported that for slight displacements they had a constant leverage. In the same paper describing this instrument, Mr. Gray emphasises the importance of having seismographs so constructed that the steady-point should be in neutral equilibrium (Trans. Seis. Soc. vol. i. p. 48).

The next advance was made by Prof. Ewing, who, by using a bracket seismograph with a pivoted weight and a multiplying-lever writing on a continuously moving plate, obtained diagrams which inasmuch as they extended over a considerable portion of time were superior to all that had preceded them.

This instrument was described in Europe and Japan without the briefest mention of the fact that bracket seismographs, multiplying-levers, smoked glass plates, continuous records, &c., had a previous existence. Two of such publications are before me (Trans. Asiatic Soc. of Japan, vol. ix. p. 40, and Trans. Seis. Soc. vol. ii. p. 45).

At the time this excited no *public* comment, and it was not until Prof. Ewing distinctly claimed at least a joint authorship, not only of all bracket seismographs, but of all instruments which might involve the same principle, like the various forms of rolling spheres, rolling cylinders, conical pendulums, double brackets, &c., the inventions of Mr. Gray, that discussions arose. For one of these discussions see Trans. Seis. Soc. vol. iii. p. 9.)

Although Mr. Gray distinctly stated that he had experimented with bracket seismographs prior to the one introduced by Prof. Ewing (Trans. Seis. Soc. vol. iii. p. 5), and although I personally acquainted Prof. Ewing with this fact, so far as I am aware Prof. Ewing has never in any manner whatever referred to this. Mr. Gray's seismograph for registering vertical motion, which in its principle was a new departure in seismometric methods, was constructed and described in April 1881 (Trans. Seis. Soc. vol. iii. p. 137).

At the following meeting of the Seismological Society, Prof. Ewing described an instrument of a similar nature, and only differing from the one described by Mr. Gray in the details of an arrangement for compensating the variable leverage, an arrangement practically adopted by Mr. Gray in the above-mentioned torsion pendulum. This seismograph is now distinctly claimed by Prof. Ewing as his own (NATURE, December 23, 1886, p. 172).

In June 1881, Mr. Gray suggested several methods by which a pendulum might be rendered astatic (Trans. Seis. Soc. vol. iii. p. 145). This was followed by Prof. Ewing's device to obtain the same result by an arrangement which was closely foreshadowed by Dr. Wagener, who *endeavoured* to compensate the movement of a pendulum by a heavy-headed recording index (Trans. Seis. Soc. vol. i. pp. 66 and 67).

In addition to the seismographs here referred to, there are many others that might be mentioned. Amongst them we find the parallel-motion instrument of Mr. West, which was immediately followed by parallel-motion instruments the invention of Prof. Ewing and Prof. Alexander (Trans. Seis. Soc. vol. iv. pp. 22 and 30).

The development of the parallel-motion instruments may be taken as illustrative of what has happened with regard to nearly all the other seismographs, which in great measure have been gradually developed from something which preceded them.

By improving the bracket seismograph, Prof. Ewing made a considerable advance in seismometry, for which the workers in this country undoubtedly accord him their hearty thanks; but while describing a beautifully constructed, but at the same time inconvenient and obsolete arrangement of seismographs (NATURE, vol. xxx. pp. 149 and 175, and vol. xxxiv. p. 343), it is hardly fair that his fellow-workers, especially Mr. Gray, the most prolific of earthquake inventors, should be passed by unnoticed, and have their work practically appropriated.

Tokio, February 10 JOHN MILNE

Supposed Suicide of the Cobra

THE following observations may be of interest as bearing on the reputed suicide of snakes.

Yesterday, while riding over a bare sandy plain I caught sight of a large black cobra moving leisurely along. Having no other weapon with me but a ·450 express rifle, I halted my camel and fired, at about 50 yards, just as it was disappearing down a rat-hole. The bullet passed through the middle of its body without severing the spine; the head was immediately withdrawn from the hole, and the snake began to writhe in agony, rearing its head, spreading its hood, and striking wildly in all directions. I was about to put it out of its agony by a second shot when it struck close to its own tail, and my orderly cried out that now it had bitten itself and would soon die.

Though I had clearly seen that it did not bite itself, I thought this a good opportunity of seeing whether there was any truth in the popular superstition, and if not whether I could obtain any light on the mode of its origin. The following is the result.

The snake repeatedly reared its head, and after holding it reared, struck wildly at some piece of grass or stick; twice again it struck at its own tail, and on each occasion the natives with me declared it had bitten itself. This, however, I can assert, it did not: on one occasion it stopped just short of the skin; on the other, being apparently unable to check itself, it swerved slightly and struck the ground close alongside. It appeared to me that the snake in its agony struck wildly at the first thing that caught its eye and irritated it; in three cases this was its own tail, but as soon as it realised what it was doing—so far from there being a deliberate attempt at suicide—it did all in its power to prevent a fatal result.

It is conceivable that, under similar circumstances, owing to loss of control over its own actions a snake might actually bite itself, and there would be what might pass for a well-authenticated case of suicide; but such a case, did it ever occur, would probably be due to an accident and not to deliberate intention. I have no doubt, however, that the popular superstition finds its support in cases like that described; for the natives with me, if questioned, would reply that the snake had certainly bitten itself three times, the other apparently aimless strikes at sticks or grass having escaped their notice.

A similar explanation of the reputed suicide of scorpions was given in NATURE some time ago, but not having the file with me I cannot give the reference. R. D. OLDHAM

Camp near Pokran, in the Indian Desert, March 4

THE RETIREMENT OF DR. TYNDALL

WE have had on more than one occasion during the last six months to refer with regret to Dr. Tyndall's impaired health brought about by overstrain. Our readers will have gathered from the daily papers during the present week that although much recruited by rest, Dr. Tyndall has yet sent in to the managers of the Royal Institution his resignation of the Chair of Natural Philosophy, which he has held since 1853, and that the resignation has been accepted.

The managers and members, cordially appreciating Prof. Tyndall's services, and being anxious to mark their sense of the benefits he has conferred on the Institution during his long connexion with it, have done what was still open to them in the way of honourable recognition and regard. He has been nominated for election as Honorary Professor, a title previously borne by Sir Humphry Davy and Prof. Brande; and one of the annual courses of lectures will be called "the Tyndall Lectures." He has also been requested to sit for his bust, to be placed in the Institution, in memory of his relations with it.

At the monthly meeting held last week the following letter was read:—

Hind Head, April 3, 1887

DEAR SIR FREDERICK BRAMWELL,—I have halted in my reply to your letter of March 23, through sheer inability to express the feeling which the action of the managers, at their meeting on the 21st, has called into life.

And my reply must now be brief, for I hardly dare trust myself to dwell upon the "resolutions" which you have conveyed to me. Taken in connexion with the severance of my life from the Royal Institution, and with the flood of memories liberated by the occasion, this plenteous kindness, this bounty of friendship, this reward so much in excess of my merits, well-nigh unmans me.

And, let me add, the noble fullness of style and expression, which I owe to yourself, and in which the good will of the managers takes corporate form, is in perfect harmony with the spirit which it enshrines.

Of the managers existent when I joined the Institution, one only remains upon the present Board. The beneficent work of many of them is for ever ended; but I do not forget the sympathy and support which they extended to me during their lives. And now the long line of kindnesses culminates in words and deeds so considerate and appreciative—so representative of their origin in true gentlemanhood and warmth of heart—that they have almost succeeded in converting into happiness the sadness of my farewell.

With heartfelt prayers for the long-continued honour and prosperity of the Institution which I have served so long, and loved so well, believe me, dear Sir Frederick, most faithfully yours, JOHN TYNDALL

However much it may be regretted that Prof. Tyndall has felt himself compelled to withdraw from the onerous duties of a particular office, we may hope that, so far from this being a withdrawal from science itself, further leisure and rest may soon be followed by the old vigour, and that a fresh series of services may reward the labours of future years; for the work in which Profs Huxley and Tyndall have been the best known among the pioneers is not yet half accomplished.

On this subject the *Times* writes as follows:—

"Dr. Tyndall's name, in conjunction with that of Mr. Huxley, stands for a symbol of the nationalisation of natural science as an educational instrument. Sir Humphry Davy and Michael Faraday, in the same position, flashed the light of science into minds already prepared by leisure and cultivation to receive it. Dr. Tyndall's professorship in Albemarle Street has synchronised, and by no casual coincidence, with the recognition of the claims of the masses to be scientifically instructed. Contracted as Sir John Lubbock complains the domain of natural

science is still among educational appliances in general, it is extraordinarily large in proportion to the place permitted it when Dr. Tyndall commenced his courses a third of a century back. Scientific truth was valued and sought by the few then as now. They themselves scarcely regarded it as a subject which concerned the rest of the community. At large the most extraordinary obtuseness prevailed. The feeble attempts to impart a little superficial information in schools and lecture-halls rendered the darkness more visible. From the Royal Institution, as from the several centres occupied at various times by Mr. Huxley, poured a continuous expostulation against popular ignorance of the very bases of physical existence. The force of the appeals lay in their tone of moral anger at an apathy represented as a degrading baseness. Their special virtue was the determination, which never flagged, to abandon nothing of the exactness of science in popularising it. Prof. Tyndall, like his constant fellow-worker, has never for an instant looked upon the masses as entitled only to second-rate knowledge. They have had it of the highest and purest which it was within his means to supply. He has admitted no distinction between esoteric and exoteric teaching. He has not put off an audience even of children with the modern equivalents for the worsted orreries and Prince Rupert's drops of elementary philosophy fifty years ago. In his hands science for the most rudimentary educational purposes has been treated as reverentially as for the most transcendental. It has walked with head as erect in the Royal Institution theatre during the Christmas holidays as at a session of the Royal Society or the British Association. The result has been that, if the country has not learnt all it might and ought, it has learnt little which it will have to unlearn. It has not been condemned to drink either scientific dregs or scientific scum."

We regard the appearance of the article from which the above quotation has been taken as one of the results of the increased appreciation of science which has followed from the crusade in which Prof. Tyndall has played so important a part, and we confess it is not without misgivings that we contemplate a future, which we trust may be a distant one, in which Prof. Tyndall's unswerving advocacy of research for its own sake, and the example of his devotion to science, unsullied by considerations of filthy lucre, are no more among us.

We believe that all the arrangements at the Institution consequent upon Prof. Tyndall's retirement are not yet completed, but we learn that Lord Rayleigh has all but agreed to take some part, at all events, of the duties of the Chair.

This will be good news to all true friends of science. The Institution has a long and noble reputation to keep or to lose. In Lord Rayleigh's hands we know it will be safe.

PRIMROSES

THE very word awakens the pleasantest memories that remain to us from the time when we almost lived in the open air and enjoyed the intense delight of plucking wild flowers without let or hindrance; a pure and unalloyed delight actually experienced only in childhood, though it lives ever green in our hearts, and leavens the more serious pleasures of riper years. The primrose of primroses for all Britons is the wild yellow primrose that adorns woods, hedgerows, and banks from Cornwall and Sussex to the Shetlands, Orkneys, and Hebrides; for none is more lovely, though many among the endless variety spread over the north temperate and cold regions excel it in warmth and brilliancy of colouring. It is now about a year since botanists and gardeners met at South Kensington, whither they had brought their collections of living plants, comprising a large number of species and varieties of *Primula*, solely for the purpose of seeing and talking about primroses, polyanthuses, and auriculas; and the vast amount of information contained in the report of the proceedings of those assembled merits the attention of all naturalists, to say nothing of those who love flowers merely for the pleasure they afford the eye. Being hardy, primroses were among the first plants cultivated in this country when ornamental flower-gardening began, little more than three centuries ago. The old masters—Turner, Gerard, and Parkinson—introduce us to them, the first including in his "Libellus" only the *prymerose;* but at that date (1538) there seems to have been no such thing in England as the cultivation of flowers for their beauty alone. Gerard's first catalogue of plants cultivated in his garden at Holborn, and published in 1596, contains "primroses, birds eies, paigles, cowslips, and beares eares": respectively *Primula vulgaris*, *P. farinosa*, *P. veris*, and *P. auricula;* and this is the earliest English catalogue of professedly cultivated flowers. Parkinson describes in his "Paradisus" (1629) twenty-one sorts of "beares eares" or auriculas, and he mentions that the varieties cultivated were much more numerous than he intended describing. In the report alluded to, Shirley Hibberd states that in the year 1570 many artisans, driven from the Netherlands, settled in this country, bringing with them their favourite flowers, including the best of their auriculas. Thus it would appear that the auricula was one of the very earliest "florists' flowers" cultivated in this country; and it is hardly necessary to say that it is one of the chief favourites of the present day. One of the questions discussed at the Conference was the parentage of the true auriculas and the Alpine auriculas, a question upon which florists and botanists did not quite agree; and the only way of obtaining a solution of the problem is by experiment. It is nearly certain, however, that more than one species has been concerned in the production of the various cultivated races. On the one side it has been argued that the presence of true blue is almost absolute proof that they cannot all have descended from a species having yellow flowers; and it is true that both wild and cultivated plants which exhibit great variety in the colour of their flowers rarely offer both pure blue and pure red. The china-aster (*Callistephus chinensis*) is an exception, but whether both colours exist in the wild plant I cannot ascertain. Philip Miller, who was the first to cultivate it in this country, states that he received seeds from France of the red and white varieties in 1731 and of a blue in 1736. Amongst our native plants a very large number of those having normally blue or red flowers frequently produce white varieties; and I have myself picked red as well as white varieties of the bluebell (*Scilla nutans*), though it is true the red was not a very pure one. On the other hand, normally yellow flowers rarely sport into other colours.

To return to the primroses: the introduction in 1820 of the Chinese primrose added a permanently popular greenhouse flower, which is now raised by hundreds of thousands, indeed one might say millions, annually; and almost every florist of note has his special "strains" or varieties, varying in colour from pure white to crimson, and equally in the size and cutting of the leaves and flowers, which are either double or single. The double-flowered varieties are relatively difficult to cultivate, as they are propagated by offsets, and are less vigorous in constitution. Like the china-aster, this was unknown in a wild state until recently, when the Abbé David discovered it in the province of Hupeh.

Persons familiar only with the species of *Primula* hitherto mentioned can form no idea of the amount of variation exhibited by the whole genus, which embraces at least 110 distinct species, widely spread in the temperate and cold regions of the northern hemisphere, rare in

warmer countries; and one is found in the extreme south of America. But some further particulars of their distribution may be interesting. The forms in Europe are numerous, and the number of species to which they may be referred varies from twenty to nearly forty, according to the views of different botanists. They are most numerous in the Alps, where they constitute one of the most charming features of the vegetation. In Asia, too, the genus is generally diffused, though by far the greatest concentration of species is in the mountains of Northern India, where upwards of fifty species occur, some of them ascending almost to the altitudinal limits of flowering plants. Quite recently Mr. Franchet has described a dozen new species from Eastern Tibet and the Chinese province of Yunnan; and Eastern China and Japan possess their peculiar species; one at least of the latter (*P. japonica*) being now common in English gardens. An isolated species, the gigantic *Primula imperialis*, inhabits the mountains of Java, and the genus is represented in South-Western Asia, in Arabia, even to the neighbourhood of Aden, by *P. verticillata*, the same species recurring in Abyssinia; yet none apparently is found in the mountains of Morocco. In America the distribution of the genus is peculiar, no species having been found in Eastern North America south of Canada, while in the western and central regions three or four endemic species inhabit New Mexico, Arizona, and California, though in the last-named country the genus does not extend south of the Yosemite Valley, where the charming *Primula suffrutescens* is at home. The latest discovery is a new species in the Santa Rita Mountains, near the Mexican boundary. Altogether, nine species are now known from North America, five of which, those in the Arctic regions, are also natives either of Europe or Asia, or both. But the most remarkable fact in the distribution of the genus *Primula* is the presence of a species in the extreme south of South America—a species so closely allied to the northern *P. farinosa*, which is common to Europe, Asia, and North America, that it has been alternately held as a variety of it and an independent species. When writing his "Flora Antarctica," Sir Joseph Hooker could find no character whereby to distinguish the South American primrose as an independent species; but in his recent "Flora of British India" he states that it differs in having large granulate seeds. On the other hand, Dr. Asa Gray ("Synoptical Flora of North America") treats it as the same as *P. farinosa*; yet it is probable that he did not examine the South American plant, although he includes South America in the range of *P. farinosa*, therefore it can hardly be cited as an expression of opinion on the subject. The plant is common in Fuegia and the Falkland Islands. Even admitting that it is sufficiently distinct to be admitted as a species, the genetic connection with *P. farinosa* is so close that as a phenomenon in distribution the question is immaterial. The southern limit of *P. farinosa* in North America, so far as known, is Colorado; therefore there is a break of nearly 90° of latitude.

The greatest diversity is exhibited by the Asiatic species, alike in stature, foliage, and floral structure. In a comparatively restricted region of the Himalayas grow the moss-like species, scarcely an inch high, including the flower, such as *P. minutissima*, and the tall *P. sikkimensis*, with an umbel of twenty to thirty delicate yellow flowers on a scape 2 to 3 feet high. Between these extremes there are all sizes and several distinct types of foliage. The Javan species alluded to above is perhaps the largest of the genus, having whorl above whorl of golden flowers, though it is closely approached by the beautiful and many-coloured *P. japonica*.

The recent novelties from Tibet and Western China include some of the most distinct and peculiar forms of the genus, but none of them is in cultivation.

There are many other interesting things connected with primroses, but I have perhaps already covered too much space. I may add, however, that by far the richest collection of living species was contributed to the show by the Royal Gardens, Kew—a collection largely brought together by Mr. G. C. Churchill, part author of the well-known book on the Dolomite Mountains, and cultivated by Mr. Dewar. It contained about fifty species, besides many hybrids and seminal varieties.

The report from which some of the foregoing particulars were extracted forms a part of the seventh volume of the Journal of the Royal Horticultural Society.

W. Botting Hemsley

ON THE ESTABLISHMENT OF THE ROMAN DOMINION IN SOUTH-EAST BRITAIN

BEFORE entering upon the matter which I have stated as the subject of this paper, I think it will be well to premise three notes: (1) on the general authority for the accuracy of the history; (2) on the geography of the approaching coasts of Gaul and Britain; (3) on the pronunciation of names delivered to us in the spelling of the Greek language.

(1) The account of the invasions which I adopt is that of Dion Cassius. His history, in general, is orderly and full. He appears to have been a man of rank, and doubtless had command of State documents. He seems to have been well acquainted with every movement in the Courts of several successive Emperors. He has carefully explained why he was unable to continue his Roman history beyond the time of Severus with due accuracy. The time of the invasion of Britain was about 170 years before the composition of his history—an interval almost equal to the length of our Hanoverian dynasty; and his account of the wars in Britain may claim to be considered as trustworthy as our histories of the campaigns of Marlborough.

(2) In regard to the geography, it is to be observed that the coast-tract in the north of France, apparently from the mouth of the Seine to the mouth of the Scheldt, is called Γαλατία (Galatia). This name occurs at least twice, in separate books of Dion. By Ptolemy it is called Κελτογαλατία Βελγική.

(3) The English writers who have given any attention to this history have had, I believe, no knowledge of the pronunciation of the Greek words. Mitford, however, in his "History of Greece," had pointed out some of its peculiarities. The difficulty is now greatly removed by the publication, at Boston, U.S., of the "Grammar of Modern Greek," by E. A. Sophocles. I extract the substance of his notes which apply best to the present purpose:—

β is the English *v*, or sometimes *bh*.
δ is the English *hard th*, as in *that*, *those*.
θ is the English *soft th*, as in *thin*, *thorn*.
μπ is the English *b*.
νδ or *ντ* is the English *d*.
ι is the English *ee*, as in *seen*.
ου is the English *oo*, as in *soon*.

There is no reason to think that the pronunciation has changed for many centuries. In the Byzantine Greek histories of the Crusades, there are many opportunies of making comparisons of the Greek and the Latin names of places and persons, which appear to follow the same rules as at the present time.

Thus, the name given by Dion to the lady who commanded the Britons in their grand movement against the Romans is spelt by him Βουνδούικα. Interpreted by the list of equivalents just given, it becomes in English letters and sounds, Voo-doo-ee-ka; and this I believe to be the true rendering of the name. Still, I dare not depart from the established custom; and I shall therefore (unwillingly) adhere to the long-used English spelling, "Boadicea."

I now enter upon the national history.

In the reign of the Emperor Claudius (there is no farther indication of time) Kunobellin reigned at Camalodunum (undoubtedly the modern or Saxon Colchester, "the fortress on the River Colne": the Latinised original name is literally "Camal-hill" or "Camal-fort" (a name somewhat similar to this occurs in Arthurian legends). Kunobellin is mentioned by others as King of the Trinobantes. Dion remarks, "they (the people) were not self-governors, but lived under kings."

Vericus (Βέρικος), a political exile from Camal-dun, persuaded the Emperor Claudius to given him military assistance (apparently for restoration); and the Roman general Aulus Plautius was sent from Galatia, and (after a ridiculous mutiny of the soldiers) landed in England. Remarking that he had no motive for entering Kent, and that his object was to reach Camal-dun as soon as possible, I think it likely that he rounded the North Foreland, and debarked at Southend on the west side of Shoeburyness; where there is an excellent beach two or three miles long, sheltered from the open sea, for landing; and a good plain, for temporary encampment.

Without detailing all the affairs of Plautius with Kunobellin and Kunobellin's two independent sons, Kataraktos and Togodumnos, I shall only say that, after a very unsuccessful struggle with the Britons, apparently among the woods and marshes of the Crouch (a complicated river), Plautius retreated, in veritable flight, towards the west. He had, however, made peaceable terms with the Vothuni (a tribe not otherwise known, I believe); and, leaving a guard there, proceeded till he came to a river, deep but fordable, which he passed with some difficulty. This river, I have no doubt, was the Lea, the largest of the Essex rivers, and running in a valley which is in some parts marshy. In crossing this river, he was greatly assisted by the Κέλτοι, who were accustomed to cross rivers in their armour. (It seems not improbable that these Κέλτοι had been levied in the eastern parts of Galatia and the regions of the Scheldt.) The Roman army, by this real flight, reached the tract opposite London. We have now to consider the state of land and water before them.

So far as we can judge, there had never been any power in the country which could have embanked any of the marshes as we see them now. The sea-water, scarcely salt (much fresh water having entered from the Thames and the smaller rivers) ran up with an insignificant tide, above Rotherhithe and to the borders of Southwark, in a great arm of the sea, never less than two miles wide. This gulf is called by Dion Ὠκεανος. It was shallow, in some places actually bearing trees. (See Mr. Spurrell's "Early Sites and Embankments on the Margin of the Thames Estuary," *Archæological Journal*, vol. xlii.) To the point opposite London applies the sentence of Dion, "ἐπὶ τὸν Τάμεσσαν ποταμόν, καθ' ὃ ἔς τε τὸν Ὠκεάνον ἐκβάλλει." And this was Dion's mouth of the Thames, and here was the head of the gulf. There was a bridge at a small distance, which I conceive to have been near the site of William the Conqueror's bridge or modern London Bridge. It is remarkable that there is no mention of a town; but probably Southend was the real port of Britain, and the march of the Romans was on the harbour-road.

The sea-water, after the long passage up the shallow gulf, had almost lost its tidal character, and become a mere lake. The Kelts of the army forded the water, and the Romans crossed at the bridge. And now the army, much shattered, was in Kent or Surrey. The Emperor Claudius, on hearing the state of affairs, sailed in person with troops to Marseilles, crossed France to the north coast, and landed in Britain to join Plautius. There can be no doubt that he landed at one of the southern ports of Kent, as Winchelsea or Rye (the whole of Kent being evidently held in perfect quiet); and the question arises, Where was Plautius waiting? and where did Claudius join him?

It is possible that Plautius may have waited in the neighbourhood of London Bridge; but I offer a conjecture which I think more probable. In the grounds of Holwood (near Farnborough) at the eastern corner of Hayes Common, at an easy day's march from London, and in the direct line from London to the south-eastern ports, are the extensive remains of the earthworks of a large fort, in the best style of Roman permanent encampments. In its straight lines of outline (where circumstances permit), its rounded angles, its lofty inner rampart and its lower second rampart, it admits of comparison with the most complete of those which Agricola established in his marches through the Scotch Highlands, and which are described in General Roy's "Military Antiquities." It is called, in the neighbourhood, Cæsar's Camp. The little river Ravensbourne (which ultimately joins the Thames at Deptford Creek) rises in a strong spring close to the entrance. I think it probable that Plautius wintered here, and was joined here by Claudius.

The united armies marched at once for Camal-dun, and captured it. And it would seem probable that they immediately gave it its present form, and a fairer or nobler provincial and military capital (as adapted to ancient warfare) within my knowledge nowhere exists. It is planted on a steep parallelogrammic hill. The slope of the ground at the east gate was eased, within my recollection, in the year 1816. On the south side, a little less steep than the other sides, the ground has been heavily scarped, and faced with a stone wall. The whole town is surrounded by a stone wall at the brow of the slope, rounded at the angles; the little river Colne is on the north side, and there the wall is lower in the valley. The dells on the south and west sides converge to an angle, near which is placed the principal gate of the town. The great streets are in the true Roman form of capital T, and all the small streets are at right angles. The citadel, I suppose, was in the space on the north side of High Street, in which the castle (a Norman building) now stands.

It would appear that the Romans, as residing in a country which was likely to be troublesome, took early steps for making a great road across it; and then was made the great western road by Marks Tey, Coggeshall, Braintree, Dunmow, to Stortford, on the River Stort (which is the largest affluent of the Lea); and then was formed the large intrenched camp of Wallbury, about two miles south of Stortford, on the Essex side of the river.

And after this was made the road to London. The reason for my placing its date subsequent to that of the western road is singular, but certain. The road to London does not start independently from Colchester: the western road is used as far as Marks Tey, and there the London road branches off at an angle of about 40° (roughly estimated). I have personally surveyed this, taking views from the neighbouring grounds, and can assert that the road from Colchester to Coggeshall passes straight through Marks Tey, totally unaffected by the London road. The same thing is exhibited clearly on our Ordnance map.[1]

All appeared to be peaceably established. And now came the terrible outbreak.

Dion suddenly states that two cities were destroyed (their names or positions are not mentioned), and 80,000 of the Romans and their allies killed, and that this was done by a woman, to the great shame of the Romans; that this was foretold by divine inspiration (τὸ θεῖον); that there came from the Senate-house (βουλευτήριον), at night, barbarous noises, with laughter; from the theatre came a sound of tumult with lamentation, when nobody was near; some houses were seen under water in the Thames; the ocean between Britain and Galatia was disturbed, and had a bloody colour. The cause of the war was the exaction, by Claudius, of money raised by confiscation (δήμευσις), which Claudius gave to the principal men of the Britons

[1] The modern name Marks Tey is an error for Marks Tye, Tye being the customary word in Essex and Suffolk for a bifurcation of roads.

(if I have correctly translated the passage) ; and Decianus Kalus (the Superintendent of the island) asserted that these sums were to be treated as contributions (ἀναπόμπιμα) to be sent to Rome. To this was added that Seneca—who was not only philosopher, poet, and Minister of State, but also the greatest usurer in Rome—having lent (δανείσας) ten millions (χιλιάδας μυριάδας ; which if in sestertii would amount to about 80,000*l.*) ἄκουσιν (I do not understand this word) on sound hopes of interest, suddenly, and with violence, exacted the return of the whole ; that it was Boadicea (Voo-doo-ee-ka) who principally caused the rising of the Britons. In the usual history of this lady there is much to be corrected. She was *not* Queen of the Iceni, though of the royal family (γένους τοῦ βασιλείου). She had *no* husband or children. There is not the slightest allusion to *any* personal insult. She did *not* die in battle, but died from disease (νόσῳ) after the battle.

Boadicea, as Dion remarks, was greater than woman. She collected the army of about 120,000 men. She mounted a βῆμα, made in the Roman fashion, to raise her from the mud. She was tall in person, very awful in countenance, with keen eyes and a rough voice ; her abundance of yellow hair fell far down her body ; she had chain-armour of gold, a variegated vest, and a thick cloak.

A very long speech is given, of which the following are the principal heads :—The superiority of liberty to slavery ; the criminal character of the taxes, some even levied from the dead ; the Britons themselves are the cause of these evils, not having resisted them soon enough ; the habits of our enemies expose them to far greater difficulties than those which we endure ; and other remarks, finishing with a kind of enchantment over a hare.

The Britons proceeded to terrible and savage excesses, the worse because Plautius was absent, having gone to Μῶνα ; which, if it be the same as the Μόνα of Ptolemy, is the Isle of Anglesey. But this appears to me to be, etymologically, very doubtful ; and, practically, I think it very improbable that, in such a state of affairs, Plautius would have gone, by a difficult march, to such a distance. Plautius however returned, and a battle soon took place.

There is no difficulty in fixing on the site of this, one of the great battles of history. In the neighbourhood of Linton, at the north boundary of Essex, in a space perhaps of two square miles, are places which still bear the names of Shudy Camps, Castle Camps, Camp's End, Camp's Green, Camp's Castle. Every one of these has undoubtedly been the scene of a desperate struggle. And, finally, there are the three mighty mounds, known as the Bartlow Tumps, which, as I understand, have been identified as containing Roman remains.

Dion has given a long account of the various phases of the battle. Boadicea died of illness (νόσῳ), and the Britons were driven off the field. The battle was sufficiently decisive to prevent the re-appearance of the Britons in force ; but still it appears, I think, not to have made a complete conquest.

The news was welcomed at Rome with very great interest by the Emperor, the Senate, and every rank of society.

G. B. AIRY

THE EUROPEAN PREHISTORIC RACES

IT would be difficult to overrate the scientific value of the discovery of human remains made last summer in Belgium, and briefly noticed in NATURE of February 24 (p. 405). Hitherto serious doubts have prevailed regarding the true character of the Canstadt, Neanderthal, Eguisheim, Olmo, and four or five other skulls, which are collectively referred to the oldest known race in Europe, but which, owing to their apparently exaggerated simian features, have been looked on with suspicion by Pruner, Virchow, and others, as possibly exceptional or even mere pathological specimens. But these doubts have at last been set at rest by the lucky find made last June by MM. Max Lohest and Marcel de Puydt, who, during their explorations of a cave on the slope of a wooded hill on the banks of the Orneau, in the commune of Spy, province of Namur, came upon numerous remains of two individuals amid hitherto undisturbed Lower Quaternary deposits, and in association with the bones of *Rhinoceros tichorinus*, *Elephas primigenius*, *Ursus spelæus*, *Hyæna spelæa*, *Felis spelæa*, the horse, wolf, sheep, and other now extinct and surviving Pleistocene animals. These remains have been carefully examined by M. Julien Fraipont, Professor of Animal Palæontology in the University of Liége, who unhesitatingly refers them to the Palæolithic race, to which King's expression "*Homo neanderthalensis*" may now be confidently applied. Taken especially in combination with the peculiarities of other parts of the skeleton, such as the evidently angular position of femur and tibia, implying a non-erect or stooping attitude in standing or walking, the skulls of the two Spy men show clearly that those of the Canstadt and Neanderthal men are in no way aberrant, but perfectly normal specimens. They obviously represent a Palæolithic and pre-Glacial race, the earliest of which there is any distinct record, which was already spread over West Central Europe in early Quaternary times, and which De Quatrefages and Dr. Hamy now believe may ultimately be traced back to the later Tertiary epoch.

A far better idea of the physical characteristics of the *Homo neanderthalensis* can be had from the remains of the Spy men, than from any others hitherto brought to light. Prof. Fraipont, who devotes a lengthy memoir to the subject in the *Bulletin* of the Royal Belgian Academy for December, gives detailed osteological descriptions of the two more or less perfect skeletons, from which it appears that of one there are extant : the skull, relatively very complete ; the right portion of the upper jaw, with five molars ; a fragment of the left portion, with the two premolars, incisor and canine ; the under jaw, nearly complete, with sixteen intact teeth *in situ* ; a left clavicle ; the right humerus, less the upper epiphysis ; the left humerus, less both epiphyses ; the left radius ; the right femur, nearly complete ; the left femur, complete ; the left tibia, complete ; the right heel. Several of the parts here missing are supplied by the second skeleton ; and there are also numerous vertebræ, fragments of ribs, &c., which cannot with certainty be referred to one rather than the other.

The first skull (No. 1) includes : the frontal bone from the superciliary arches and naso-frontal suture to the parieto-frontal suture ; the right parietal, nearly complete ; the upper half of the left parietal ; the occipital, less a considerable portion of the region of the cerebellum. Of the second skull (No. 2) there remain : the frontal, very nearly complete ; the right and left parietals, complete all but a few fragments of the former : the right temporal, nearly complete ; the left temporal, complete ; the occipital, less a portion of the region of the cerebellum.

The first is very long, very depressed from above, and narrow, being decidedly platidolichocephalic, with cephalic index 70, as compared with 72 of the Neanderthal skull, and 67·65 of the Clichy. The second is subplatidolichocephalic, with apparent index 74·80, and general characters less pronounced than those of No. 1, but not to such a degree as to prevent the two from being referred to the same race. Of both, the longest antero-posterior diameter is about the same, 200 and 198 to 200 mm. respectively, the former corresponding exactly with the Neanderthal. But the transverse differs considerably, being 140 and 150, between which comes the Neanderthal with 144 mm. On the other hand, the antero-posterior frontal curve of the first coincides exactly with that of the Neanderthal, the frontal itself being, like it, low and retreating. Another typical feature of this

frontal is the great development of the superciliary arches, although slightly less prominent than those of the Neanderthal and Eguisheim. The distance between their outer extremities is no less than 122 mm., while the arches converge at the very root of the nose, leaving a slightly depressed intervening glabellar region, this region differing perceptibly from that of the Neanderthal, in which the glabella is prominent.

Although otherwise well preserved, the under jaw of No. 1 unfortunately lacks the condyles, which would have enabled us to settle the important question of its relative prognathism. This jaw is very high and massive, and the well-preserved teeth of both present the general characters found amongst the New Caledonians and other modern races of low type. The canines and incisors of the under jaw are worn obliquely and outwardly, those of the upper jaw obliquely and inwardly, although in general to a less extent than amongst the Neolithic races.

The right femur of No. 1 is not large, but very strong and heavy, and is specially remarkable for its typical forward curvature. The great posterior development of the articular surface of its condyles, taken in connection with the general curvature of the body, shows that the Spy men walked with the knees bent forward, the thigh being obliquely curved forward and downward, and the leg reversed backwards. In other words, the femur was adjusted obliquely to the tibia, which was itself strong, thick and heavy, but very short.

The discoveries at Spy are specially valuable because found associated with other remains which enable us to determine approximately the epoch of analogous finds elsewhere. The already mentioned fauna, as well as the character of the coarse flints occurring in the same undisturbed strata, would seem to indicate that both the Spy men, and their Canstadt and Neanderthal congeners, must have flourished in the *époque Moustiérienne* of French writers, that is, during the early period of the mammoth, and long before the beginning of the Reindeer Age. They were consequently more recent than the race of the *époque Chelléenne*, which was contemporary with *Elephas antiquus*, but of which no actual remains, beyond the objects of its industry, have yet been discovered. That they belonged in any case to pre-Glacial times seems evident from the remarkable absence of the reindeer, which is not numerously met in West and Central Europe till the Ice period.

M. Fraipont's comparative study of these remains makes it thus abundantly evident that they belong to the Neanderthal type. The two skulls even serve as a sort of missing link between the Neanderthal and the others usually referred to the same race. This race, whose presence in Europe during the early Mammoth Age has now been clearly traced from Stængenæs in Scandinavia to Olmo in Italy, seems in a way to have been resuscitated by the fortunate discovery in the limestone cave on the banks of the Orneau. Their dry bones again assume flesh and blood, and science is enabled confidently to describe the men of Spy as a short, but far from "feeble folk," thick-set, robust, walking knees foremost, and with a figure somewhat analogous to that of the modern Lapps, who also still waddle and are nearly all more or less bandy-legged. Their broad shoulders supported a long, narrow, and depressed head (different therefore from that of the true Papuan, which is long, narrow, and high), with very prominent superciliary arches, enormous orbits, low and retreating brow, high and massive cheek-bones, receding chin. No modern race, however low in the scale of humanity, is collectively characterised by all these traits, so that it may be safely affirmed that the ethnical type of the men of the Mammoth Age has become practically extinct, either through further evolution within itself, or by extirpation, or more probably by fusion with men of a higher physical standard.

It is noteworthy that the points which most separate the men of Spy from the present inhabitants of the globe are precisely those which bring them into closer relation with the anthropoid apes in general, rather than with any particular species of anthropoids. These points, which may thus fairly be described as pithecoid or simian, are chiefly: the prominent superciliary arches, normal in the young male gorilla and adult female orang; the extremely low retreating frontal, constant in the chimpanzee of both sexes and all ages; the almost chinless receding lower jaw, highly typical of gorilla and chimpanzee; lastly, the peculiar curvature of the femur, combined with its adjustment to the tibia, suggesting in the vertical position an attitude somewhat analogous to that of chimpanzee and gorilla. On the other hand, all the other features of cranium, trunk, and limbs are distinctly human, while the cranial capacity alone would suffice to justify the claim of *Homo neanderthalensis* to membership with the human rather than with the simian family. However great the distance separating him even from the lowest of modern races, far greater, undoubtedly, is the interval between him and the highest of the modern anthropoids. At the same time this interval becomes perceptibly diminished by Gaudry's discovery of *Dryopithecus fontanii*, an anthropoid ape of the middle Miocene epoch certainly less simian, or rather more human, than any of its present congeners. Its lower jaw is perceptibly less receding than that either of the gorilla, orang, or chimpanzee. The interval tends to be still further reduced when we remember that, although the *Homo neanderthalensis* is the earliest human type of which any bodily remains have hitherto been discovered, there is a still more primitive race revealed to us by the rude palæolithic implements frequently occurring in association with *Elephas antiquus*, and in later Tertiary deposits considerably older than the Lower Quaternary of the Spy cave. Whenever any characteristic remains of this primæval race come to light, a distinct approach will have been made towards a solution of the difficult questions connected with the genetic descent of mankind.

A. H. KEANE

AN EXAMINATION OF THE LEAVES OF GYMNEMA SYLVESTRE[1]

GYMNEMA SYLVESTRE (R. Br.) is an asclepiadaceous plant growing in the Deccan peninsula, from Concan to Travancore; it is also met with in Assam, and on the Coromandel coast, and is distributed in the continent of Africa. It is a stout woody climber, with long slender branches.

The leaves are opposite, entire, from 1½ to 3 inches long, and from 1 to 2 inches broad, elliptic or obovate, acute or cuspidate, rarely cordate at the base, membranous, thinly pubescent on both sides, the upper surface of a darker green than the lower. *Gymnema sylvestre* is mentioned in the non-official list in the Pharmacopœia of India (1868), and in Dr. Dymock's "Materia Medica of Western India." The powdered root has for a long time been known among the Hindus as a remedy for snake-bites; in such cases it is applied locally to the part affected, and also taken internally in the form of a decoction. But the most curious circumstance connected with this plant was first noticed by Mr. Edgeworth, who discovered that by chewing some of the leaves it destroyed the power of the tongue to appreciate the taste of sugar; he found that powdered sugar, taken immediately after masticating some of the leaves, tasted like so much sand in his mouth, and this effect lasted for twenty-four hours. Dr. Dymock, reviewing this property, said he was unable entirely to confirm this statement; his experience was that sugar taken into the mouth after chewing the fresh plant had a saltish taste, but was still easily recognisable.

[1] A paper read at a meeting of the Nilgiri Natural History Society Ootacamund, by David Hooper, F.C.S., March 7, 1887.

Some authentic leaves were procured by Mr. Lawson from Guindy Park, Madras, who placed them at my disposal for chemical examination. They had a bitterish astringent and slightly acid taste. After chewing one or two leaves it was proved undoubtedly that sugar had no taste immediately afterwards; the saltish taste experienced by others was due to an insufficiency of the leaf being used. Sugar in combination with other compounds in dietetic articles is plainly destroyed as to its taste after using these leaves. In ginger-bread, for instance, the pungency of the ginger is alone detected, the rest is tasteless meal; in a sweet orange the taste of the sugar is so suppressed and that of the citric acid consequently developed that in eating it resembles a lime in sourness. Among the several kinds of foods, drugs, and beverages which affect the palate Gymnema does not pretend to render them all tasteless; it does not affect pungent and saline things, astringents, and acids. It is limited to apparently two diverse substances, sweets and bitters. It has been noted that sugar taken after the leaf tastes like sand, so I have found that sulphate of quinine taken after a good dose of the leaf tastes like so much chalk. I am not going to propose its use in the administration of nauseous drugs, until the medical properties of the Gymnema have been more studied, otherwise the quantity of the vehicle taken may prove to counteract the effect of the medicines. The experience of several friends as well as my own is that the effect does not last for twenty-four hours as stated, but for only one or two hours; after that time the tongue resumes its appreciation of all that is sweet or bitter.

The powdered leaves were submitted to the action of various solvents, and by this means it was ascertained that the peculiar property of Gymnema leaves was dissolved out by alcohol, and, as it occurred in the aqueous extract of the residue, it was therefore soluble in water. As benzene and ether took from the leaves certain principles of the same appearance and weight, it was conceived that nothing would be gained by using both solvents; the preliminary extraction was therefore made with ether rectified from water and spirit. The ether extract consisted of chlorophyll and two resins separated by their solubility in alcohol. The resin insoluble in spirit formed the larger portion; it was soluble in chloroform, bisulphide of carbon, and benzene. It was elastic and tenacious, decomposed by warming with nitric acid, the product being precipitated with water; only partially saponified with caustic potash. Sulphuric acid dissolved it in the cold, giving a green solution. It seemed to consist principally of a neutral resin. The resin soluble in spirit was readily saponified with soda, and gave a permanent bluish-green colour with sulphuric acid; like the former resin, it was of an acrid nature, and left a tingling sensation in the throat.

The alcoholic solution of the leaves was almost entirely soluble in water; in fact, by treating the leaves separately by alcohol and water, 36·37 per cent. organic matter was extracted; by treating the drug with water alone 36 per cent. was removed. By direct experiment it was found that in the former extract 0·47 per cent. was an acrid resin similar to those found in the ether extract. The aqueous solution of the substances soluble in alcohol had a decidedly acid reaction; it gave no coloration with ferric chloride, showing absence of tannin. It was deepened in colour with alkalies, but gave a bulky precipitate with sulphuric, nitric, hydrochloric, and acetic acid. It reduced Fehling's solution on boiling, and gave a cloudiness with Nessler, a precipitate with lead acetate, but none with tannin or picric acid. The precipitate caused by sulphuric acid was collected on a filter and washed till it ceased to give a cloudiness with barium chloride. It yielded a greenish powder, insoluble in water, but soluble in alcohol, ether, benzene, and chloroform. With potash, soda, and ammonia it afforded fine red solutions with orange-coloured froth, but they were both precipitated on the addition of the mineral acids. It dissolved in concentrated sulphuric and nitric acids with intense red colour, but in both mixtures it was destroyed and precipitated by water. It fused at about 60° C. into a blackish brittle mass. Heated in a test-tube it gave off fumes of creosote, but no crystals were obtained in a subliming apparatus. Gently ignited it burned with a bright flame, leaving no ash. It was thrown down as a bulky gray mass by acetate of lead; the lead salt decomposed by sulphuretted hydrogen in water left the substance in the reddish evaporated filtrate from the lead sulphide. The body just described has the characteristics of an organic acid related in some particulars to chrysophanic acid, but having some distinctly peculiar reactions, and possessing the anti-saccharine property ascribed to the leaves. I propose to call it *Gymnemic acid.*

Gymnemic acid forms more than 6 per cent. of the constituents of Gymnema leaves, in combination with a base which has not been isolated. Another organic acid was present in the lead acetate precipitate, which was identified as tartaric acid. The filtrate from the insoluble lead compounds was treated with sulphuretted hydrogen gas, and the clear liquor after evaporation was examined for sugar. Glucose was detected in some quantity by its immediate and abundant reduction of Fehling's solution; the sugar examined in a polariscope had a left-handed rotation.

Chloroform agitated with an alkaline solution of the leaf left a crystalline residue of a brownish colour; it had a bitter taste, and acted as a sialagogue. With the ordinary alkaloidal reagents it afforded coloured precipitates, but was a neutral principle. Its further examination together with that of gymnemic acid are reserved for further investigation.

The leaves after being exhausted with ether and then alcohol were treated with water. The gum was detected and estimated in the usual manner. A carbohydrate, optically inactive, and, after boiling with acid, reducing Fehling's solution, was found in this extract.

Diluted soda removed a brownish liquid which consisted of albuminous matters only partially soluble in alcoholic and acetic acid. These were not weighed but calculated by difference.

A solution of 1 per cent. hydrochloric acid was employed to remove the oxalate of calcium. A microscopical examination of the powdered leaves showed a fair sprinkling of the conglomerate crystals or raphides so well known to exist in rhubarb. The dilution of the acid menstruum rendered this process very tedious, so a stronger acid was used and the marc washed with it until ammonia produced no cloudiness. The collected liquors were allow to deposit, the sediment was then collected on a filter, dried and weighed; then incinerated and weighed again. The calcium carbonate was calculated into oxalate, and the difference between this and the first weighing was reckoned as pararabin. No oxalic acid was found in a free state.

The ash of *Gymnema sylvestre* is very high, a fact in accordance with the amount of lime salts it contains. Gentle ignition of the air-dried leaves left as much as 11·65 per cent., and about one-half of this was calcium carbonate. One hundred parts contained—

15·41 soluble in water.
78·71 soluble in acid.
5·88 sand and siliceous residue.

The cellulose was estimated by steeping the leaves in sulphuric acid of specific gravity 1·50 for 30 hours, washing, drying, burning, and deducting the ash; this result did not differ materially from the weight of the totally exhausted powder treated with chlorine water.

The following is a tabulated analysis of the powdered and sun-dried leaves :—

Ether extract (chlorophyll and resins) ...	5·51
Alcoholic extract (gymnemic acid, tartaric acid, glucose, neutral bitter principle, resin, &c.)	19·50
Aqueous extract (gum 1·45 per cent., glucose, carbohydrate, and extractive) ...	16·87
Alkaline extract, by difference (albuminous and colouring matters)	8·15
Acid solution { calcium oxalate	7·64
Acid solution { pararabin...	2·74
Ash (balance of)...	5·69
Cellulose	27·86
Moisture	6·04
	100·00

NOTES

THE Conference called by the French Government to consider the means to be adopted for the construction of a photographic chart of the heavens, meets at Paris on Saturday next. We believe that the Astronomer-Royal and Mr. Common have been delegated to represent the Royal and the Astronomical Societies.

THE Rev. S. J. Perry and Dr. Copeland have accepted Dr. Bredichin's invitation to observe the total solar eclipse in August next at his residence near Moscow.

WE regret to announce the death of Dr. Daniel Rutherford Haldane, who was for some time President of the Royal College of Physicians of Edinburgh. In response to a request by that body he represented the College in the General Council of Medical Education and Registration in the United Kingdom. He died at his residence in Edinburgh on Tuesday last.

THE annual Conference of the National Union of Elementary Teachers, which has met this week at Portsmouth, has been remarkably successful. It has been attended by about 400 delegates from the different affiliated associations, and by a number of individual members. In his inaugural address, Mr. Girling, the President, made some sensible remarks on technical education in elementary schools. Handicrafts could not be taught in elementary schools, but he was decidedly of opinion that our system of primary education ought to be better adapted to fit children for work when they leave school. He testified to the enterprise and public spirit of the City Guilds, and their Secretary, Sir Philip Magnus, who had started handicraft classes for elementary teachers in London. But he would ask them to co operate in helping to make our educational system a more rational one. Then the teachers would have most valuable aid in preparing the future working-men of the country on intelligent lines, and the technical training of children, now so well begun in our infant-schools through the medium of kindergarten exercises, might be carried still further in the senior schools. At the meeting on Tuesday, a resolution was unanimously passed in favour of the appointment of a Minister of Education. Mr. Salmon, by whom this resolution was proposed, maintained that many educational questions of the highest importance could be adequately settled only by a Minister of much ability and wide experience, invested with large authority and bearing direct and undivided responsibility. Given such a Minister, with great power and noble opportunities, they could justly look to him for great efforts and noble issues.

THE fourth Bulletin of Miscellaneous Information, issued from the Royal Gardens, Kew, contains papers on Manilla hemp, plantain and banana fibre, and pine-apple fibre. Manilla hemp is one of the most important of cordage fibres, and the whole supply comes from the Philippine Islands. Everything made from it can be easily converted into paper of excellent quality. A plant of Manilla hemp may be seen in the Palm House at Kew ; and sets of exhibits in the Kew Museum, No. 2, include the raw fibre, cables, ropes, twine, fine muslin fabrics, "half-stuff," and paper of all kinds, the latter being made from old Manilla ropes. Manilla hemp plants have been introduced from Kew to Jamaica, and to other portions of the West Indies. In favourable situations they grow well, but not so readily as the ordinary bananas and plantains. As the fruit is valueless, they can only be grown for the sake of the fibre, and this alone does not appear to offer sufficient inducement to plant up large areas.

AN Exhibition of the products of the Philippine Archipelago is to be opened at Madrid on June 1. It is to be divided into eight sections, with corresponding sections in the Central Commission at Manilla. Amongst these the following are of specially scientific interest :—(1) For the study of the geography, meteorology, terrestrial magnetism, orography, hydrography, anthropology, geology, and mineralogy of the Philippines ; (4) the botanical geography of the archipelago, its fauna and flora ; (8) general education, public instruction, and the arts and sciences in the Philippines generally. Sub-commissions have been appointed in all the chief places in the archipelago to collect objects for exhibition and information, to be forwarded to the Central Commission, and thence to Madrid.

DURING the next three months a course of lectures on zoology will be delivered at the Zoological Gardens, Regent's Park, by Prof. Beddard. The lecturer will try to make the subject intelligible and attractive to young people, and as the cost will not exceed the bare price of admission to the Gardens, it may be hoped that the course will be largely attended. The arrangements have been made by the Association for the Extension of University Education.

A SMALL Industrial Exhibition was opened on Tuesday last at the Flora Gardens Board School, Hammersmith. Its object is to encourage home industries among the poor.

THE twelfth annual meeting of the members of the Sunday Society was held on Monday, April 4, at the Conduit Street Galleries, Mr. R. Carter in the chair. Mr. Mark H. Judge, Hon. Sec., read the annual report, which claimed for the past year that never before had there been so many or such decisive expressions of public opinion in favour of the Society's object.

A REMARKABLE illustration of the puzzling migratory habits of the herring has just been observed on the south-west coast of Norway, at the so-called Jæderen, between the towns of Stavanger and Egersund. This district used to be one of the richest herring-fishing grounds in Norway during the spring, but about twenty-five years ago the fish suddenly and completely disappeared from the coast. Last month enormous shoals once more came under shore, first "striking land" at the same spot as in former times. The quality of the herring is exactly the same as it was twenty-five years ago, and the shoals were accompanied by numerous "herring" whales.

THE first and second parts of a Catalogue of the remains of Siwalik Vertebrata contained in the Geological Department of the Indian Museum, Calcutta, have been sent to us. The work is compiled by Mr. Richard Lydekker, who says that the magnificent Siwalik collection in the Indian Museum is equalled only by that of the British Museum.

AN Exhibition of Seeds will take place at Trondhjem, from July 4 to 10, in connection with the eighth general Norwegian Agricultural Meeting. At the same time, lectures on the subject will be delivered to the meeting, and a Fisheries Exhibition will also be held.

Dr. Franz Boas, who visited the Indian tribes of British Columbia in the autumn of 1886, has presented in a preliminary Report some of the results of his journey. The large wooden huts of these tribes, their canoes, their fishing-gear, and hunting-methods have often been described, but Dr. Boas points out that their traditions, religious ideas, and social organisation are not equally well known. The principal figure in the mythology of several of them is a raven, who created all things, not for the benefit of mankind, but "in order to revenge himself." Cannibalism is practised by some tribes in connexion with the winter dances; and there is a Kwakiutl tradition, to the effect that one of their ancestors descended from heaven, wearing a ring of red-cedar bark, and taught the people the cannibal ceremonies. These ceremonies have been adopted only in part by the Qomoks, who content themselves with eating "artificial" bodies, which they prepare "by sewing dried halibut to a human skeleton." Among the Tsimpshian, the Tlingit, and the Haida, children belong to the mother's gens; among the Kwakiutl and Selish tribes they belong to the gens of the father. In some tribes there are as many as from fifteen to twenty gentes. Members of the same gens are not allowed to intermarry.

A work on "Physiological Psychology," by Prof. George T. Ladd, of Yale, will shortly be published. The writer, according to *Science*, maintains "a philosophical and psychological stand-point, while admitting to their proper place the conclusions reached by physiology respecting the nature and functions of the nervous system."

The new numbers of "Studies in Microscopical Science," edited by Mr. A. C. Cole, deal with defoliation, spermatozoa in the Invertebrata, acute parenchymatous nephritis, fibrosis of kidney, and microbes.

The seventh Deutsche Geographentag will be held at Carlsruhe to-day. The chief papers will relate to the German African colonies.

Shocks of earthquake were felt at Friedau (Carniola) on March 27, and at Travnik, in Bosnia, on March 31, at 3.30 a.m. In the night of April 1 there was a severe shock at Forli, in Italy.

We have received from the Johns Hopkins University a new number (vol. iii. No. 9) of the series of "Studies from the Biological Laboratory." These "Studies," issued from time to time, contain most of the original scientific papers published by members of the Biological Department of the University. The editor and associate-editor are Dr. H. Newell-Martin and Dr. W. K. Brooks. The present number is a paper, by Dr. J. R. Duggan, on the influence of alcohol on the conversion of starch by diastase.

In a statistical work which is being published, M. E. Levasseur, of Paris, shows that the chances of living long at any given age are much greater now in France than they were before 1789. Of 2000 infants (under one year) 1186 survived in 1789; 1460 survive at present. In 1789, 738 persons out of 2000 reached the age of 40; the number now is 1110. In 1789, 144 persons out of 2000 lived to the age of 75; the number now is 360. The death-rate of France is much the same as that of England, being rather superior at some ages, and inferior at others.

Dr. Dudgeon, of Pekin, has at last published in Chinese a complete work on anatomy, at which he has been working for some years past. The printing was done by the press of the Tung-Wên or Foreign Language College, and the whole expense was borne by the Chinese Government. In accordance with Eastern custom, the title-page of the book is written by one of the Chinese Ministers who is celebrated for his beautiful calligraphy, and there are several prefaces by some of the highest officials of the Empire commending the work to the study of their countrymen. There are in all six volumes, two containing the illustrations, six hundred being plates. The latter were cut on blocks by native artists. Copies were presented to all the Ministers and other high officials. The companion work on physiology is almost ready for the press.

In an article on "The Phylogeny of the Camelidæ," lately printed in the *American Naturalist* extra, Mr. E. D. Cope points out that the development of the camel in North America presents a remarkable parallel to that of the horse. The ancestors of both lines appear together in the Wasatch or lowest Eocene, and the successive forms develop side by side in all the succeeding formations. Both lines died out in North America, and of the two, the camels only have certainly held their own in South America. The history of the succession of horses in Europe, although not so complete as that in America, extends over as wide a period of time. Not so with the camels. There is no evidence of the existence of the camel line in the Old World before the late Miocene epoch; and so far as the existing evidence goes, the New World furnished the camel to the Old.

In the *American Meteorological Journal*, Mr. M. W. Harrington is giving a full and very interesting account of the Chinook winds. The "Chinooks" are warm, dry, westerly or northerly winds occurring on the eastern slopes of the mountains of the north-west, beginning at any hour of the day, and continuing from a few hours to several days. Mr. Harrington says they may occur when a cyclone or anticyclone passes on such a course that the air is forced over the mountains from the western to the eastern slope. They are, therefore, winds similar to the "föhn" of Switzerland. In adding them (as Mr. G. M. Dawson, of the Geological Survey of Canada, had already done) to the class of winds of which the "föhn" is the type, Mr. Harrington points out that he is simply adding another to an already extensive list. Dr. Jelinek, in 1867, called attention to the fact that winds on the eastern slopes of the Caucasus were of this character. A similar wind occurs under the lee of the Elburz Mountains. Trebizond is in the lee of a high range of mountains, and has similar winds. They are common on the north side of the Pyrenees, and on the south coast of the Bay of Biscay. A similar wind has long been known in West Greenland, and Hoffmeyer proved, some years ago, that it is of the same character as the "föhn." It has been felt as far north as 82½° of latitude. Mr. Scott suggests that the hot winds of South Africa and parts of Australia are of the same character, while the analogy is proved complete for the hot "northwesters" of the Canterbury Plains of New Zealand.

The first number of the American journal *The Stevens Indicator*, in its new form as a quarterly, contains an article giving a glowing account of the general prosperity of the Stevens Institute. The advance secured is attributed mainly to the wise and energetic leadership of President Morton. "To him," says the *Indicator*, "belongs the honour of realising, more than twenty years ago, when the Institute was first planned, that it would find its most useful work in the then almost unoccupied field of mechanical engineering, and that to this work it should confine, for a series of years at least, all its resources and efforts. How well the plans have succeeded is borne out by the long list of graduates who have been sent forth into positions of honour and trust, of influence and remuneration, by Stevens Institute during the last twelve years."

Capt. Gates, of the ship *L. Schipp*, has reported to the U.S. Hydrographic Office that on April 19, 1886, when he was off Cape Horn, on a voyage from San Francisco to Liverpool, the

temperature of the water suddenly rose from 42° to 44°. Thinking that the vessel was too close in shore, he hauled off three points, and, after he had stood four hours on this course, he found that the temperature had fallen to 42°. On a previous voyage Capt. Gates noticed this warm belt.

COMMISSIONER COLMAN, of the Department of Agriculture in the United States, has issued a Circular relating to the so-called Australian rabbit. He points out that this animal—the common rabbit of Europe—has been very mischievous in Australia, and expresses his belief that its introduction into America would be an unnecessary and hazardous experiment. Mr. Colman is of opinion that Congress should pass a law conferring upon the Commissioner of Agriculture the power to prevent the landing of any animal, bird, or other pest that might be injurious to agriculture; and he cites the case of the English sparrow as an example of the harm that may be done by species taken without due consideration from the Old World to the New.

THE Swedish Government is anxious to acquire a colony in Africa, and is consequently preparing an Expedition under the direction of Lieut. A. Wester, formerly Chief of the Congo Station, Leopoldville. At the last meeting of the Stockholm Society of Anthropology and Geography, Lieut. Wester reported on the subject. The Expedition may probably start next summer, and will be absent about a year, making Cameroon its base of operations. The cost will be about 160,000 kroner (8000*l.*).

MR. PAUL BEDFORD ELWELL will publish shortly, with Messrs. Whittaker and Co., an English translation of Gaston Planté's work on "The Storage of Electrical Energy."

THE eighth volume of the Journal of the Royal Horticultural Society, just issued, consists of a valuable Report on the effects of the severe frosts on vegetation during the winters of 1879-80 and 1880-81. The Report has been prepared by the Rev. Geo. Henslow, Honorary Secretary to the Scientific Committee of the Royal Horticultural Society. Most of the facts were obtained by means of schedules issued in 1880 and 1881.

A WORK entitled "The Australasian Federal Directory of Commerce, Trades, and Professions," will shortly be published in London under the direction of Mr. J. W. F. Rogers, of Melbourne and Sydney. It has been compiled by the assistance of some thousands of persons, many of them Colonial Government officials, and will give both in an alphabetic and a classified form the business addresses for over three thousand Australasian towns, large and small. Reviews of the social and commercial development of the eight colonies of this group will appear in the Directory, with maps and gazetteer.

AN ingenious system of gas-lighting by electricity has been introduced by Messrs. Woodhouse and Rawson. Gas can be turned on, lit, and turned off from any convenient position irrespective of where the gas-fittings are placed. The principle of attachment is like that of the portable electric gas-lighter—*i.e.* the gas is lighted by an electric spark—but the general arrangements are for permanent fitting.

WE have received the fifth and sixth parts of the fourth volume of Dr. L. Rabenhorst's elaborate "Kryptogamen-Flora von Deutschland, Oesterreich, und der Schweiz." The subject dealt with is Bryineæ: Stegocarpæ (Acrocarpæ). The text is finely illustrated.

THE second part of the Report for 1885 of the Chief Signal Officer of the United States, is a separate treatise by Prof. William Ferrel, entitled, "Recent Advances in Meteorology, systematically arranged in the form of a Text-book, designed for use in the Signal Service School at Fort Meyer, and also for a Hand-book in the Office of the Chief Signal Officer." It is an octavo volume of 440 pages, and is published by the U.S. Government.

THE sixty-fourth number of the Journal of the Society of Telegraph-Engineers and Electricians, contains "The Pre-Determination of the Characteristics of Dynamos," by Mr. Gisbert Kapp; "Some Experiments on Secondary Cells," by Mr. James Swinburne; and "Some Magnetic Problems," by Prof. George Forbes. Reports of the discussions on these papers are also given.

A PERMANENT matrix excluder of draught and dust has been sent to us by Mr. T. J. Porter, the inventor. The excluder is made of a special composition inclosed in long, narrow strips of warm-coloured cloth, and moulded into a suitable form. The application of hot water enables the excluder to be formed into a long, narrow, solid, and permanent matrix round doors and windows. Mr. Porter says that it makes a practically air-tight joint, and entirely precludes the passage of draught and dust between doors and their casings, and windows and their casings.

A HALIBUT weighing thirty-four pounds and measuring 41 inches in length was captured lately in the lower Potomac, near Colonial Beach. It has been preserved in alcohol by the Smithsonian Institution, and a cast has been made and placed on exhibition in the U.S. National Museum. *Science* says this is the first authentic case of a halibut in fresh water.

THE additions to the Zoological Society's Gardens during the past week include a Short-tailed Wallaby (*Halmaturus brachyurus*) from Australia, presented by Mr. Herbert Maude; an American Flying Squirrel (*Sciuropterus volucella*) from North America, presented by Mr. A. R. Verschoyle; an Egyptian Mastigure (*Uromastix spinipes*) from North Africa, presented by Mr. V. J. Chamberlain; a Nepal Hornbill (*Aceros nepalensis*) from Nepal; a Tuberculated Iguana (*Iguana tuberculata*) from the West Indies, deposited; a Burchell's Zebra (*Equus burchelli*) from South Africa; two Adorned Ceratophrys (*Ceratophrys ornata*); an Anaconda (*Eunectes murinus*) from South America, purchased; a Rhesus Monkey (*Macacus rhesus*), a Sambur Deer (*Cervus aristotelis*), two Collared Fruit-Bats (*Cynonycteris collaris*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

ORBIT OF THE BINARY STAR 14 (*i*) ORIONIS.—In the *Monthly Notices* for March, Mr. J. E. Gore publishes elements of the orbit of this binary, which is identical with O Σ 98. Mr. Gore's results, which he regards as only provisional, give a period of 190·48 years, time of periastron passage 1959·05, eccentricity 0·2465, and semi-axis major 1″·22. A comparison of places computed from these elements with the observations extending from 1844 to 1887, shows considerable discordances in the position-angles, whilst the distances agree very closely. The orbit of this double star does not appear to have been previously computed.

THE WASHINGTON OBSERVATORY.—Capt. R. L. Phythian, U.S.N., the Superintendent of the U.S. Naval Observatory, has published the programme of work to be pursued at the Observatory during the year 1887. From it we learn that with the 26-inch equatorial the observations of double stars, of the fainter stars in the Pleiades, and of the conjunctions of the five inner satellites of Saturn with the minor axis of the ring, and of the angles of position and distances of Hyperion will be continued during the year. The small equatorial will be used for observations of comets and of occultations of stars by the moon, as well as of stars and asteroids required for purposes of identification. With the transit-circle it is proposed to complete the observations of miscellaneous stars for the forthcoming transit-circle catalogue and also to observe the sun, moon, planets (major and minor), and stars of the American Ephemeris. Photographs of the sun will be taken daily, when practicable, with the photo-heliograph of the Transit of Venus Commission pattern.

NAMES OF MINOR PLANETS.—Minor planets Nos. 263 and 265 have been named *Dresda* and *Anna* respectively.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1887 APRIL 17-23

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

At Greenwich on April 17

Sun rises, 5h. 2m.; souths, 11h. 59m. 33·9s.; sets, 18h. 57m.; decl. on meridian, 10° 28′ N.: Sidereal Time at Sunset, 8h. 39m.

Moon (New on April 23) rises, 3h. 3m.; souths, 7h. 53m.; sets, 12h. 49m.; decl. on meridian, 14° 2′ S.

Planet	Rises h. m.	Souths h. m.	Sets h. m.	Decl. on meridian ° ′
Mercury ...	4 29 ...	10 22 ...	16 15 ...	2 9 S.
Venus	6 6 ...	14 5 ...	22 4 ...	20 54 N.
Mars	5 8 ...	12 7 ...	19 6 ...	10 45 N.
Jupiter... ...	19 11* ...	0 20 ...	5 29 ...	10 37 S.
Saturn... ...	9 20 ...	17 29 ...	1 38* ...	22 26 N.

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

April h.
18 ... 21 ... Mercury at greatest elongation from the Sun, 27° west.
20 ... 21 ... Mercury in conjunction with and 0° 31′ north of the Moon.
21 ... 11 ... Jupiter in opposition to the Sun.

Variable Stars

Star	R.A. h. m.	Decl. ° ′		h. m.	
U Cephei	0 52·3	81 16 N.	Apr. 19,	4 42	*m*
Algol	3 0·8	40 31 N.	,, 17,	20 45	*m*
δ Libræ	14 54·9	8 4 S.	,, 20,	21 3	*m*
			,, 23,	4 54	*m*
U Coronæ	15 13·6	32 4 N.	,, 17,	5 0	*m*
U Ophiuchi... ...	17 10·8	1 20 N.	,, 18,	4 10	*m*
		and at intervals of		20 8	
W Sagittarii ...	17 57·8	29 35 S.	Apr. 20,	22 0	*M*
β Lyræ...	18 45·9	33 14 N.	,, 20,	0 0	*M*
S Vulpeculæ ...	19 43·8	27 0 N.	,, 20,		*m*
S Sagittæ	19 50·9	16 20 N.	,, 18,	22 0	*m*
δ Cephei	22 25·0	57 50 N.	,, 20,	4 0	*M*
			,, 23,	22 0	*m*

M signifies maximum; *m* minimum.

Meteor-Showers

The most interesting shower of the week is that of the *Lyrids*, April 18-20, R.A. 268°, Decl. 33° N. Other showers are as follows:—Very slow meteors from a radiant between Boötes and Virgo, R.A. 213°, Decl. 9° N.; very swift meteors from near π Herculis, R.A. 255°, Decl. 37° N., and from Vulecula, R.A. 299°, Decl. 24° N.

VALENCY AND RESIDUAL AFFINITY[1]

I.

IN my address to the Chemical Section of the British Association at Aberdeen, I specially called attention to the "affinity" of *negative* elements—chlorine, oxygen, sulphur, &c.—for negative elements; and I sought to show that the formation of so-called *molecular compounds* is largely, if not entirely, an outcome of this peculiarity of negative elements. I also ventured to suggest "that in electrolysing solutions, the friction arising from the attraction of the ions for each other is perhaps diminished, not by the mere mechanical interposition of the *neutral* molecules of the solvent—in the manner suggested by F. Kohlrausch—but by the actual attraction exercised by these molecules upon the negative ion in virtue of the affinities of the negative radicles." In this passage I but vaguely hinted at a modification of the current theory of electrolysis which had occurred to me: as further consideration of the question, especially of Ostwald's electro-chemical studies, has strengthened my views, I am led to think that it may be justifiable to submit them for discussion.

It is usual to divide bodies into three classes according to the mode in which they are acted on by an electromotive force: metals forming one class, electrolytes a second, and dielectrics a third. In making this division, perhaps the fact is not sufficiently borne in mind that some compounds—silver chloride, for example—are *per se* electrolytes, while others—such as hydrogen chloride and water—are *individually* dielectrics, but behave as electrolytes when conjoined. On this account, it appears to me desirable to distinguish between—

(*a*) *Metals*.

(*b*) *Simple* electrolytes—compounds like silver chloride which in the pure state are electrolytes.

(*c*) *Pseudo*-dielectrics—compounds like water, hydrogen chloride, and sulphuric acid, which behave as dielectrics when *pure*, but as electrolytes when mixed with other members of their own class. Conducting mixtures of members of this class may conveniently be termed *composite electrolytes*.

(*d*) Dielectrics.

Simple Electrolytes.—It is undoubtedly a fact that only a limited number of binary compounds are simple electrolytes: and it is especially noteworthy that, with the single doubtful exception of liquefied ammonia, no hydrogen compound—whether binary or of more complex composition—can be classed with the simple electrolytes. Indeed, all the simple electrolytes with which we are acquainted are either compounds, such as the *metallic* chlorides; or *metal'ic* salts—nitrates, sulphates, &c. Including metallic chlorides and their congeners and the corresponding oxides and hydroxides among salts—regarding water as an acid, in fact—and denying the title of salts—hydrogen salts—to the acids, Hittorf's proposition (*Wied. Ann.*, 1878, iv., p. 374), "Electrolyte sind Salze" may be safely upheld. But only some of the binary metallic salts are electrolytes: beryllium chloride, for example, belongs to the class of "pseudo-dielectrics" (Nilson and Petterson, *Wied. Ann.*, 1878, iv., p. 565; Humpidge, Phil. Trans., 1883, p. 604); and in the case of those elements which readily form two classes of salts—so-called *ous* or *proto*-salts and *ic* or *per*-salts, the *ous* compounds alone appear to be electrolytes.

It is highly remarkable that whereas fused silver chloride is easily decomposed on passage of a current of low electromotive force, hydrogen chloride is a "pseudo-dielectric" which forms when coupled with the "pseudo-dielectric" water a readily conducting "composite electrolyte"; while mercuric chloride conducts with great difficulty—possibly not at all when pure—not only in the fused state, but even when coupled with water. No explanation of these facts seems to be afforded by thermo-chemical data.

The consideration of these and other similar cases, I think, can but lead to one conclusion: that electrolysability is conditioned both by the nature of the elements in the compound and its molecular structure.

The remarkable difference in the electrical behaviour of two compounds of the same element, such as stannous chloride, in which the ratio of tin to chlorine atoms is as 1 to 2, and stannic chloride, in which Sn: Cl = 1: 4—the one being a simple electrolyte, the other a pseudo-dielectric, if indeed it be not a dielectric—would appear almost to justify the conclusion that in the case of per-salts such as stannic chloride the metal is, as it were, enveloped in a non-conducting sheath of the negative radicle. But whether this be so or not, if—as appears to be the case—all simple electrolytes are *metallic* compounds, and if only proto-salts are electrolytes, may it not be that electric conduction in simple electrolytes is of the nature of ordinary metallic conduction, differing from it only in the circumstance that the compound is decomposed as a consequence of the passage of the current?

This would lead to the conception of an electrolyte as being a metallic compound of such elements, and so constituted, that electric conduction may take place through its mass in a manner similar to that in which it takes place through a mass of metal: in fact, through the agency of its metallic atoms. On this view, it is essential that the metallic atoms in the molecules comprising a mass of an electrolyte should be in proximity—as they probably are in proto-salts, but not in many per-salts. The conductivity of two-metal alloys is in many cases much less than that of either of the contained metals: for example, the conductivity of the alloy $SnCu_4$ is about one-fourth that of tin and about one-thirtieth that of copper. The specific conductivity of metals may, therefore, be much reduced by association with one another; and this being the case, it appears probable that the specific conductivity of a metal would be still more reduced by association with a non-metal, and that if the metal were one of low specific conductivity, it might thus practically become altogether deprived of conducting power: perhaps the "excep-

[1] Revision and extension of a paper by Prof. H. E. Armstrong, F.R.S., communicated to the Royal Society last year.

tional" behaviour of mercuric and beryllium chlorides is to be explained by considerations such as these.

To discuss such questions at all satisfactorily, however, we require to know much more of the electrical behaviour of *pure* fused salts. It is surprising how little accurate knowledge we possess on this subject.

Composite Electrolytes.—I assume it to be admitted that neither water nor liquid hydrogen chloride, for example, is an electrolyte, although an aqueous solution of hydrogen chloride conducts freely, and is electrolysed by an electromotive force of but little more than a volt.

The theory put forward by Clausius in 1857 in explanation of electrolysis (cf. Clerk Maxwell's "Elementary Treatise on Electricity," p. 104), has been widely accepted by physicists; but it appears to me that, on careful consideration of the evidence, and especially of recent exact observations on conditions of chemical change, it must be admitted, as I have elsewhere contended (B. A. Address), that proof is altogether wanting of the existence of a condition such as is postulated by Clausius. Moreover, it has been shown by Hittorf that cuprous and silver sulphides, and by F. Kohlrausch that silver iodide, all undergo electrolysis in the *solid* state: the partisans of the dissociation hypothesis would, I presume, scarcely contend that it is easily applicable to such cases as these. It also does not appear to afford any explanation of the *abrupt* change in conductivity which occurs in solid silver iodide and sulphide as the temperature is raised; nor of the peculiar variation in conductivity which is observed on diluting sulphuric acid with water.

Again, I venture to think that the conductivity of a *mixture* of compounds which themselves have little or no conducting power is accounted for in but an unsatisfactory and insufficient manner by the hypothesis put forward by F. Kohlrausch (*Pogg. Ann.*, 1876, clix., p. 233); there appears to be *far too great a difference* in the behaviour of the pure compounds, water and liquid hydrogen chloride for example, and of a mixture—no decomposition apparently of either *compound* being effected by any electromotive force short of that which produces disruptive discharge, although the *mixture* of the two will not withstand an electromotive force of little more than a volt. Influenced by these considerations, I am led to conclude that there is no satisfactory evidence that the constituents of the electrolyte either are free prior to the action of the electromotive force, or are primarily set free by the effect produced by the electromotive force upon either member *separately* of the *composite* electrolyte; but that an additional influence comes into play, viz. that of the one member of the composite electrolyte upon the other while both are under the influence of the electromotive force. This influence, I imagine, is exerted by the negative radicle of the other member. Assuming, for example, that in a solution of hydrogen chloride in water the oxygen atom of the water molecule is straining at the chlorine atom of the hydrogen chloride molecule, if when subjected to the influence of an electromotive force the molecules are caused to flow past each other—the phenomena of electric endosmose may be held to afford evidence that in composite electrolytes the molecules are thus set in motion—it is conceivable that this influence, superadded to that of the electromotive force upon the electrolyte, may bring about the disruption of the molecule and conduction: in short, that a state may be induced such as Clausius considers is the state prior to the action of the electromotive force.

A large amount of most valuable information on the connexion of dilution and electrical conduction in aqueous solutions has been recently published by Arrhenius, Bouty, F. Kohlrausch, and Ostwald. In his most recent paper, Ostwald (*Journal für praktische Chemie*, 1885, xxxii., p. 300) has given the results of his determinations of the *molecular conductivity* in the case of no less than about 120 different acids; and it appears to me that many—indeed all—of his observations afford most distinct evidence in favour of the view I have expressed above. The general result of his investigation is that the molecular conductivity increases with dilution: in other words, that the dissolved substance exercises a greater specific effect, finally attaining a maximum; it then diminishes, but he believes this to be due to impurities in the water, especially to neutralisation of the acid by traces of ammonium carbonate. The maximum, he appears to think, would be the same for all acids if the dilution could only be pushed far enough: in the case of monobasic acids it is about 90 (arbitrary units); it is twice this in the case of dibasic, thrice in the case of tribasic, and so on.

I will quote first his results in the case of solutions of hydrogen chloride, bromide, iodide, fluoride, and silicon fluoride. v is the volume in litres which contains a weight in grammes corresponding to the formula of the dissolved substance—36·4 grammes of hydrogen chloride, for example.

v	HCl	HBr	HI	HF	H_2SiF_6
2	77·9	80·4	80·4	...	47·81
4	80·9	83·4	83·2	6·54	57·29
8	83·6	85·1	84·9	7·59	62·20
16	85·4	86·6	86·4	10·00	67·08
32	87·0	87·9	87·6	13·14	71·52
64	88·1	88·9	88·7	17·38	75·61
128	88·7	89·4	89·4	23·11	79·22
256	89·2	89·6	89·7	30·30	83·39
512	89·6	89·7	89·7	39·11	91·62
1024	89·5	89·5	89·3	49·49	109·5
2048	89·5	88·9	89·0	59·56	144·0
4096	88·6	87·6	87·8	69·42	187·1
8192	...	...	...	...	226·6
16384	...	...	...	...	258·6
32768	...	...	...	...	282·6

It will be observed that hydrogen chloride, bromide, and iodide practically behave alike; the numbers for the chloride are, however, slightly lower than those for the bromide and iodide, and the maximum is not reached quite so soon in the case of the chloride. Hydrogen fluoride is altogether different; its molecular conductivity is exceedingly low to begin with, and is considerably below the maximum even when $v = 4096$. But I would call special attention to the numbers for hydrogen silicon fluoride, which is commonly regarded as a dibasic acid: at first, as Ostwald says, it behaves as a monobasic acid of moderate strength—iodic acid, for example; but the maximum for monobasic acids being exceeded, the molecular conductivity increases more and more rapidly, ultimately exceeding the treble value, 270. It must be supposed that it undergoes decomposition in accordance with the equation—

$$H_2SiF_6 + 2H_2O = SiO_2 + 6HF.$$

The noteworthy point is *the large excess of water* required to initiate this change: when $v = 16$ the solution contains less than 1 per cent. H_2SiF_6, and at this point, according to Ostwald, decomposition probably begins; but that it is far from complete even when a very much larger excess is present is evident from the fact that the maximum when $v = 32{,}768$ is 282 and not above 400.

Now it is well known that hydrogen chloride, bromide, and iodide are, practically speaking, perfect gases under ordinary circumstances: in other words, masses of these gases would mainly consist of molecules such as are represented by the formulæ HCl, HBr, and HI. It has been proved, however, by Mallet, that hydrogen fluoride at temperatures near to its boiling-point mainly consists of molecules of the formula H_2F_2. In the aqueous solution the molecules would be brought more closely together, and therefore it is probable that, even in the case of hydrogen chloride, bromide, and iodide, a certain proportion of more complex molecules would result: the relatively high boiling-point of hydrogen fluoride (19°·4) renders it probable that in the liquid state this compound would at least partially consist of molecules more complex even than is represented by the formula H_2F_2. On the hypothesis put forward in this paper, the influence exercised by the one member of the composite electrolyte upon the other member during electrolysis is at all events mainly exercised by their respective negative radicles, and the extent of the influence thus mutually exerted by these radicles would depend on the extent to which they are still possessed of "residual affinity." If the hydrogen chloride, bromide, and iodide are present chiefly as simple molecules, they should exert, *ab initio*, almost the full effect which they are capable of exerting; and the chief effect of dilution being to decompose the more complex molecules, conductivity should increase to but a slight extent if the extent to which simplification can take place be but small. On the other hand, if owing to the formation of molecular aggregates the residual affinity be more or less exhausted, the initial conductivity will be low, and it will increase on dilution only in proportion as these aggregates become broken up.

It appears to me that the behaviour of the four hydrides under discussion is absolutely in accordance with these requirements of the hypothesis. Evidence of the same kind is afforded by all of Ostwald's results.

The behaviour of solutions of neutral metallic salts on dilution

is very similar to that of acids ; abundant proof of this is afforded especially by F. Kohlrausch's refined measurements, of which an account has recently been published (*Wied. Ann.*, 1886, xxvi., p. 162). I venture to think that a similar explanation to that above given for oxides will apply to salts ; and also that the low molecular conductivities of salts as compared with corresponding acids may be regarded as confirmatory of my hypothesis. I think we must admit that the metals generally have less affinity than hydrogen for negative radicles ; if this be granted, we have at once an explanation of the fact that metallic salts are mostly fixed solids, few of which are more than moderately soluble in water while many are very difficultly soluble or insoluble, whereas the corresponding acids are mostly volatile and readily soluble in water, if not miscible with it in all proportions. The affinity of the negative radicles being less exhausted by union with metals than with hydrogen, the fundamental molecules of salts are more prone to unite together to form complex aggregates.

Arrhenius, who has studied the electrical behaviour of solutions of a number of salts, attributes the change observed in molecular conductivity on dilution—as I have done—to molecular changes ; but his deductions are all based on the acceptance of the Williamson-Clausius hypothesis of dissociation.

My hypothesis would also account for the increase in conductivity in composite electrolytes with rise of temperature. It is true that as temperature rises the influence which individual molecules exert upon each other would be lessened ; but, on the other hand, the complex aggregates would become more and more completely resolved into their fundamental molecules, the velocity of molecular motion would increase, and the tendency of the constituent atoms to remain united would be lessened. From this point of view the determination of the coefficient of change of conductivity with temperature in the case of substances whose molecular conductivity increases considerably on dilution in comparison with allied compounds which exhibit only a slight variation in molecular conductivity on dilution affords an interesting subject for investigation. F. Kohlrausch has already pointed out (*Pogg. Ann.*, 1875, cliv., p. 236) that in the case of all neutral salts, "der Einfluss der Temperatur auf das Leitungsvermögen mit wachsender Verdünnung sich Anfangswerthen nähert, die zwischen engen Gränzen liegen ;" and the experiments of F. Kohlrausch and Nippoldt on solutions of sulphuric acid (*ibid.*, 1869, cxxxviii., p. 286) show that the resistance diminishes to a much greater extent for equal increments of temperature in concentrated than in dilute solutions.

As concentrated solutions would be richer in complex aggregates than dilute solutions, these results are in entire accordance with my hypothesis : it does not appear to me that they can be satisfactorily interpreted in terms of the dissociation hypothesis.

In cases where the influence of the one member of the composite electrolyte upon the other is but slight, it may happen that the effect of temperature in diminishing this influence will outweigh that due to molecular simplification, and that, in consequence, conductivity will diminish with rise of temperature ; a mixture of alcohol and ether would appear to furnish an example of this kind : according to Pfeiffer's recent observations (*Wied. Ann.*, 1886, xxvi., p. 216), such a mixture behaves as a metallic conductor of very high resistance.

The increase in conductivity of graphite and gas-retort carbon on heating, and the effect of light on the conductivity of (? impure) selenium and some other substances (Shelford Bidwell, Phys. Soc. Proc., pp. 122, 256), appear to me to be also explicable on the assumption that in all these cases we are dealing with composite electrolytes.

If any further proof be needed of an intimate connexion between molecular composition and electrolytic conduction, it is most conclusively afforded, I think, by the observations of W. Kohlrausch on chloride, bromide, and iodide of silver (*Wied. Ann.*, 1882, xvii., p 642). In the fused state, these compounds are better conductors than the most highly-conducting mixture of sulphuric acid and water, which of all liquids is the best conductor at ordinary temperatures, but when the change from the fused to the solid state sets in the resistance of both silver chloride and bromide suddenly increases. No such change takes place, however, in the case of silver iodide. This iodide fuses at 557° according to Rodwell, but at about 540° according to Kohlrausch ; its electrical resistance increases only gradually after it has become solid, and remains almost a linear function of the temperature during an interval of 400°, until suddenly at near 150° it increases enormously, this change taking place at the moment when, according to Rodwell (Phil. Trans., 1882, p. 1153), it passes from the transparent, plastic, amorphous solid to the opaque, crystalline state, the volume increasing considerably. Kohlrausch has proved most conclusively that the solid iodide may undergo electrolysis. It would seem that almost immediately after solidification in the case of silver chloride and bromide practically the whole mass consists of complex aggregates so constituted as to be exceedingly bad conductors, but that such aggregates are formed much less readily by silver iodide.

(*To be continued.*)

THE MAZAPIL METEORIC IRON[1]

AMONG the large number of meteoric irons which have been described, only eight[2] are recorded as having been seen to fall. It is my privilege to be able to add a ninth fall to this short list, and one which may prove to be of exceptional scientific importance. This mass of meteoric iron I received in August last as a gift from my friend, Prof. José A. y Bonilla, Director of the Astronomical Observatory at Zacatecas, Mexico. He stated that it was *seen to fall* at about 9 p.m. on November 27, 1885, during the periodical star-shower of the "Bielids." Such is the unique interest of this meteorite, as shown by its history, that I have delayed announcing it until the evidence of its fall had been substantiated as thoroughly as possible.

The general freshness of surface, which shows very perfectly the flow of the melted crust ; the presence of unusually large nodules of a very compact graphite ; the very slight superficial oxidation, and its dissimilarity to other meteorites of the region, are all interesting features of this iron, and serve to confirm the statement of its recent fall. When received it weighed about 3950 grammes. Its present weight is 3864 grammes, or 10 pounds 4¼ ounces, troy. Its greatest length is 175 millimetres as measured diagonally across the mass. In its thickest part it measures about 60 millimetres. It could be described as a flat irregular mass, covered with deep depressions, having a smooth surface (see Fig. 1).

The evidence of the fall is set forth in the following communication from Prof. Bonilla.

(Translation).—"It is with great pleasure that I send to you the uranolite which fell near Mazapil, during the night of November 27, 1885. That you may the better appreciate the great scientific interest which this uranolite possesses, I will state that everything points to the belief that it belongs to a fragment of the comet of Biela-Gambart, lost since 1852. I here give you the history of this celestial wanderer. On December 2 (1885) I received, to my great delight, from Eulogio Mijares, who lives on the Conception Ranch, 13 kilometres to the east of the town of Mazapil, a uranolite, which he saw fall from the heavens, at nine o'clock on the evening of November 27, 1885. The fall, simply related, he tells as follows, in his own words :—

"'It was about nine in the evening when I went to the corral to feed certain horses, when suddenly I heard a loud hissing noise, exactly as though something red-hot was being plunged into cold water, and almost instantly there followed a somewhat loud thud. At once the corral was covered with a phosphorescent light and suspended in the air were small luminous sparks as though from a rocket. I had not recovered from my surprise when I saw this luminous air disappear and there remained on the ground only such a light as is made when a match is rubbed. A number of people from the neighbouring houses came running toward me and they assisted me to quiet the horses which had become very much excited. We all asked each other what could be the matter, and we were afraid to walk in the corral for fear of getting burned. When, in a few moments, we had recovered from our surprise, we saw the phosphorescent light disappear, little by little, and when we had brought lights to look for the cause, we found a hole in the ground and in it a ball of fire. We retired to a distance, fearing it would explode

[1] From the March number of the *American Journal of Science*, vol. xxxiii. pp. 221–26.

[2] Agram, Croatia, May 26, 1751 ; Charlotte, Dickson Co., Tenn., August 1, 1835 ; Braunau, Bohemia, July 14, 1847 ; Tabarz, Saxony, October 18, 1854 ; Victoria West, Africa, in 1862 ; Nejed, Arabia, spring of 1865 ; Nedagolla, India, January 23, 1870 ; Rowton, Shropshire, England, April 20, 1876. See the Catalogue o the Meteorites in the Mineral Department of the British Museum, by L. Fletcher, p. 42.

and harm us. Looking up to the sky we saw from time to time exhalations or stars, which soon went out, but without noise. We returned after a little and found in the hole a hot stone, which we could barely handle, which on the next day we saw looked like a piece of iron; all night it rained stars, but we saw none fall to the ground as they seemed to be extinguished while still very high up.'

"The above is the simple recital of the ranchman, and the uranolite which fell is the one I send to you. From the numerous questions I have asked Sr. Mijares, I am convinced that there was no explosion or breaking up on falling. Others who saw the phosphorescence, &c., were Luz Sifuentes, Pascual Saeuz, Miguel Martinez, Justo Lopez, and some whose names I have not obtained. Upon visiting the place of the fall I was particular to examine the earth in and around the hole, and by careful search and washing the earth I found a few small bits of iron, which must have become detached from the uranolite when it penetrated the earth.

"The hole was 30 centimetres deep. Probably the light which was seen came from the volatilisation of the surface of the celestial body due to the high temperature acquired by friction with the atmosphere, and of this volatilised matter falling to the earth as an incandescent powder."

The above communication was followed by an account of the observation of the Biela meteors at Zacatecas by Prof. Bonilla and his assistants. (See Annals N.Y. Acad. Sci. 1887.)

The locality of the fall is situated in latitude 24° 35′ N. and in longitude 101° 56′ 45″ West of Greenwich.

That no explosion was heard when this iron fell, is paralleled by the account of the fall of the fifty-six pound aërolite near Wold Cottage, Yorkshire, England, on December 13, 1795. "This stone fell within 10 yards of where a labourer was at work. No thunder, lightning, or luminous meteor accompanied the fall; but in two of the adjacent villages the sounds were so distinct of something passing through the air towards Wold

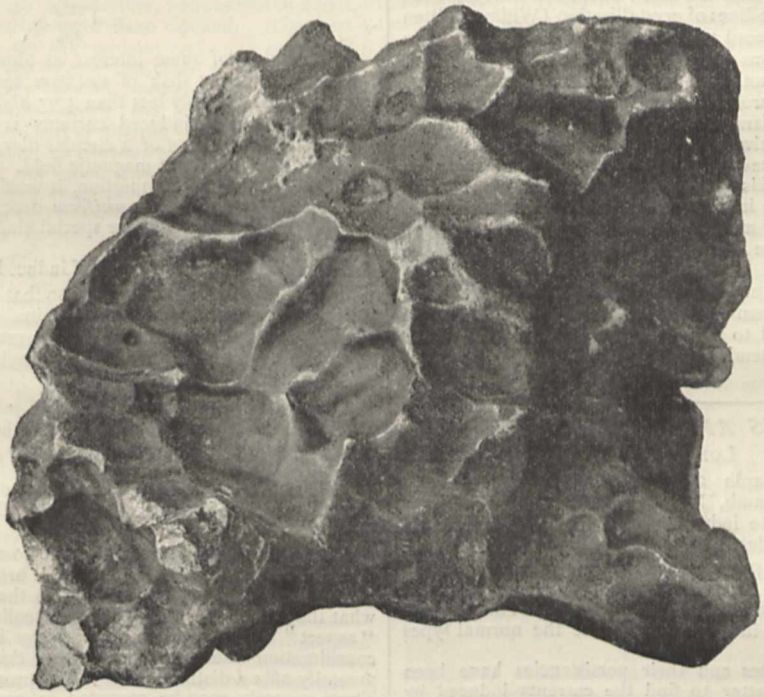


FIG. 1.—Mazapil Meteoric Iron. Weight 10 lbs. 4¼ oz. troy (¾ natural size.)

Cottage that several people went to see if anything extraordinary had happened to the house or the grounds" (L. Fletcher, "An Introduction to the Study of Meteorites," 1886, p. 22). Concerning the aërolites which fell at 11.50 a.m., on June 28, 1876, at Ställdalen, in Sweden, "it is remarkable that no meteor was visible at the place where the stones fell, though it was seen over nearly all Sweden."

The surface of the Mazapil iron is of great interest. The deeply hollowed depressions entirely cover the mass (see Fig. 1). A thin black crust coats the surface, and exhibits well the striæ of flow, as seen on meteorites whose fall has been observed. In eleven places nodules of graphite are noticed extruding from the surface (the engraving shows some of these), one of them is nearly an inch in diameter. The graphite is very hard and apparently amorphous; troilite and schreibersite were noticed on a section cut off for analysis and for the development of the figures of Widmanstätten. The crystalline structure (see Fig. 2) is well shown in the engraving (Ives' process) which is of natural size. The lines are somewhat similar to that of the Rowton iron in their width and distribution, and are very unlike the known Mexican irons from Toluca, &c.

In its surface and general flatness the mass bears a remarkable resemblance to the Hraschina, Agram, iron[1] which fell May 26, 1751. In its weight it is nearly like the irons of Rowton

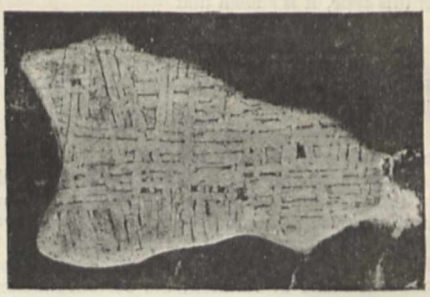


FIG. 2.—Section of Mazapil Meteoric Iron (natural size.

(7¾ lbs.), Charlotte (9½ lbs.), Victoria West (6 lbs. 6 ozs.), and Nedagolla (9¾ lbs.), which were all seen to fall.

[1] See "Beiträge zur Geschichte und Kenntniss meteorischer Stein-un Metalmassen," by Dr. Carl von Schreibers, Wien, 1820, plate viii.

Mr. J. B. Mackintosh has kindly analysed a small fragment with the following results, which, for comparison with other irons seen to fall, I have placed in tabular form :—

	Mazapil.	Rowton. Flight.	Charlotte. Smith.	Estherville.[1] Smith.
Iron.....	91·260	91·250	91·15	92·000
Nickel.....	7·845	8·582	8·05	7·100
Cobalt	0·653	0·371	0·72	0·690
Phosphorus...	0·300	.....	0·06	0·112
	100·058	100·203	99·98	99·902

Carbon is distributed all through the iron between the crystalline plates, and it is noteworthy that this element was observed with the spectroscope as present, in the "Bielids" of November 27, 1885. Chlorine is also present and shows itself by a slight superficial deliquescence. Of this latter I will state that most of the surface oxidation of the ferrous chloride has occurred since August last. As yet no tests have been made to ascertain the amount of occluded gases, or to analyse the graphite nodules, and it is probable that this might only lead to results similar to those already obtained. Over the mass, where the crust has been accidentally removed, the lines of crystallisation (Widmanstätten figures) can readily be traced without etching the surface. The abrasion due to impact was very slight.

In conclusion, we cannot, from the very circumstantial account of the fall, and the corroborative evidence of the iron itself, which in several particulars contains heretofore unrecorded observances, decline to receive this meteorite as the ninth recorded fall of an iron mass to the earth ; and perhaps at another period of the November "Bielids" this fall will be confirmed in all its interesting details. The interest connected with this meteorite, because of its beautifully marked and fresh surface, is enhanced by the concurrence of the time of its fall with the shower of the Biela meteors.

I wish to express here my deep obligation to Prof. Bonilla for the interesting data concerning this meteorite and for the gift of the meteorite itself, and to Mr. Mackintosh also for his kind interest in making the chemical analysis.

WILLIAM EARL HIDDEN

SOCIETIES AND ACADEMIES

LONDON

Royal Society, March 24.—"On Ellipsoidal Current Sheets." By Horace Lamb, M.A., F.R.S.

The paper treats of the induction of electric currents in an ellipsoidal sheet of conducting matter whose conductivity per unit area varies as the perpendicular from the centre on the tangent plane, or (say) in a thin shell of uniform material bounded by similiar and coaxial ellipsoids. The method followed is to determine in the first instance the normal types of free currents.

When the normal types and their persistencies have been found, it is an easy matter to find the currents induced by given varying electromotive forces. Supposing that we have an external magnetic system whose potential varies as e^{ipt}, we can determine a fictitious distribution of current over the shell, which shall produce the same field in the interior. If $\bar{\phi}$ denote the current-function for that part of the distribution which is of any specified normal type, ϕ that of the induced currents of this type, it is shown that

$$\phi = -\frac{ip\tau}{1 + ip\tau}\bar{\phi},$$

where τ is the corresponding persistency of free currents. When $p\tau$ is very great this becomes

$$\phi = -\bar{\phi},$$

in accordance with a well-known principle.

This method can be applied to find the currents induced by rotation of the shell in a constant field, it being known from Maxwell's "Electricity," § 600, that the induced currents are the same if we suppose the conductor to be fixed, and the field to rotate in the opposite direction. When the conductor is symmetrical above the axis of rotation, the current-function of any normal type contains as a factor $\cos s\omega$ or $\sin s\omega$, where ω is the azimuth, and s is integral (or zero). When we apply Maxwell's artifice, the corresponding time-factor is $e^{isp t}$, where p is the angular velocity of the rotation ; and we easily find that the system of induced currents of any normal type is fixed in space, but is displaced relatively to the field through an angle,

$$\frac{1}{s}\arctan p\tau$$

in azimuth, in the direction of the rotation.

In the most important normal types the distribution of current over the ellipsoid is one which has been indicated by Maxwell ("Electricity," § 675) as giving a uniform magnetic field throughout the interior.

In the higher types the current-function ϕ is a Lamé's function, degenerating into a spherical harmonic when two of the axes of the ellipsoidal shell are equal. Of the special forms which the conductor may assume, the most interesting is that in which the third axis (that of symmetry) is infinitesimal, so that we have practically a circular *disk*, whose resistance ρ' varies according to the law

$$\rho' = \rho_0' \sqrt{\{1 - r^2/a^2\}},$$

where ρ_0' is the conductivity at the centre, a is the radius, and r denotes the distance of any point from the centre. In the most persistent type

$$\tau = \frac{\pi^2 a}{2\rho_0'}.$$

This result is of some interest, as showing that the electrical time-constant for a disk of *uniform* resistance ρ_0' must at all events be considerably less than $4\cdot93\ a/\rho_0'$.[1]

The problem of induced currents is then discussed, more particularly in the case of a circular disk, of the kind indicated, rotating in any constant magnetic field. In view of the physical interest attaching to the question, it would be interesting to have a solution for the case of a *uniform* disk ; but in the absence of this, the solution for the more special kind of disk here considered may not be uninstructive.

In the most important types of induced currents, the magnetic potential $\bar{\Omega}$ due to the field $\propto xz$, so that the lines of force at the disk are normal to it, but the direction of the force is reversed as we cross the axis of z. The current-function relatively to axes displaced through the proper angle η in the direction of rotation, varies as

$$y\sqrt{\{1 - r^2/a^2\}}.$$

In the next type $\bar{\Omega} \propto z(x^2 - y^2)$, and the current-function, relatively to displaced axes as before, varies as $xy\sqrt{1 - r^2/a^2}$.

"Note to a Memoir on the Theory of Mathematical Form" (Phil. Trans. 1886, vol. clxxvii. p. 1). By A. B. Kempe, M.A., F.R.S.

The object of this note is to make some slight but important amendments of certain sections of the original memoir (viz. secs. 5, 7, 73 to 77, and 167), relating to the definition and use of what the author terms "aspects" of collections of things. An "aspect" of a collection of n things is that which is under consideration when to each individual thing of the collection we mentally affix a distinctive degree of prominence or other mark. These n marks may be regarded as interchangeable with each other, and we thus get $\lfloor n$ aspects of the collection, of which some are undistinguishable from each other. If the interchanges corresponding to a complete system of undistinguishable aspects of the collection are given we know the "form" of the collection.

March 31.—"On Clausius's Characteristic Equation for Substances applied to Messrs. Ramsay and Young's Experiments on Alcohol." By Prof. Fitzgerald, Trinity College, Dublin.

This paper is an investigation of how far Clausius's equation

$$\frac{P}{R\tau} = \frac{1}{v - \alpha} - \frac{1}{\odot(v + \beta)^2}$$

represents accurately Messrs. Ramsay and Young's experimental results. It is shown that, considering the enormous range of values to be represented, it represents the results remarkably accurately, except that from the volume of the liquid, where alone the value of α is of much consequence, it follows that α is not constant, but is a function of both the temperature and pressure.

The paper contains a short discussion of the geometrical forms of the curves—a particular case of which is represented by this equation.

[1] Fell May 10, 1879, and contained embedded nodules of nickeliferous iron surrounded by silicates.

[1] I find by methods similar to those employed by Lord Rayleigh for the approximate determination of various acoustical constants, that the true value lies between $\pi a/\rho'$ and $2\cdot26\ a/\rho'$. For a disk of copper (ρ=1600 C.G.S.), whose radius is a decimetre and thickness a millimetre, the lower limit is 0·0014 sec. For disks of other dimensions the result will vary as the radius and the thickness conjointly.

It concludes with a hope that the velocity of sound in a substance near the critical point may be investigated, in order that we may know the two specific heats under these exceptional circumstances.

Physical Society, March 26.—Prof. Balfour Stewart, President, in the chair.—The following paper was read:—On the production, preparation, and properties of the finest fibres, by Mr. C. V. Boys. The inquiry into the production and properties of fibres was suggested by the experiments of Messrs. Gibson and Gregory on the tenacity of spun glass, described before the Society on February 12, and the necessity of using such fibres in experiments on which Prof. Rücker and the author are engaged. The various methods of producing organic fibres such as silk, cobweb, &c., and the mineral fibres, volcanic glass, slag wool, and spun glass, were referred to, and experiments shown in which masses of fibres of sealing-wax or Canada balsam were produced by electrifying the melted substance. In producing very fine glass fibres, the author finds it best to use very small quantities at high temperatures, and the velocity of separation should be as great as possible. The oxyhydrogen jet is used to attain the high temperature, and several methods of obtaining a great velocity have been devised. The best results obtained are given by a cross-bow and straw arrow, to the tail of which a thin rod of the substance to be drawn is cemented. Pine is used for the bow, because the ratio of its elasticity to its density (on which the velocity attainable depends) is great. The free end of the rod is held between the fingers, and when the middle part has been heated to the required temperature the string of the cross-bow is suddenly released, thus projecting the arrow with great velocity and drawing out a long fine fibre. By this means fibres of glass less than 1/10,000 of an inch in diameter can be made. The author has also experimented on many minerals, such as quartz, sapphire, ruby, garnet, feldspar, fluor-spar, augite, emerald, &c., with more or less success. Ruby, sapphire, and fluor-spar cannot well be drawn into fibres by this process, but quartz, augite, and feldspar give very satisfactory results. Garnet, when treated at low temperatures, yields fibres exhibiting the most beautiful colours. Some very interesting results have been obtained with quartz, from which fibres less than 1/100,000 of an inch in diameter have been obtained. It cannot be drawn directly from the crystal, but has to be slowly heated, fused, and cast in a thin rod, which rod is attached to the arrow as previously described. Quartz fibre exhibits remarkable properties, as it seems to be free from torsional fatigue, so evident in glass and metallic fibres, and on this account is most valuable for instruments requiring torsional control. The tenacity of such fibres is about fifty tons on the square inch. In the experiments on the fatigue of fibres great difficulty was experienced in obtaining a cement magnetically neutral, and sealing-wax was found the most suitable. An experiment was performed illustrating the fatigue of glass fibres under torsion, and diagrams exhibited showing that the effect of annealing them is to reduce the sub-permanent deformation to about 1/10 its original amount under similar conditions. Annealing quartz fibres does not improve their torsional properties, and renders them rotten. Besides the use of quartz for torsional measurements, the author believes that quartz thermometers would be free from the change of zero so annoying in glass ones. He exhibited an annealed glass spiral capable of weighing a millionth of a grain fairly accurately, and also a diffraction grating made by placing the fine fibres side by side in the threads of a fine screws. Gratings so made give banded spectra of white light. The author regretted that his paper was so incomplete, but thought the results already obtained would be of interest to the Society. Prof. W. G. Adams congratulated the author on his most interesting paper, and considered the results to be of great importance. He believed the banded spectra exhibited by the grating were probably due to internal reflection within the fibres. Mr. Cunyngham asked whether the glass mirror used in the torsional experiments was magnetic, to which the author replied that this was probable, but even this assumption did not explain all the peculiarities observed.—A paper by Prof. Pickering was postponed till the next meeting, on April 23.

EDINBURGH

Scottish Meteorological Society, March 30.—Half-Yearly Meeting.—Mr. John Murray in the chair.—It was reported that four new stations had been recently added, viz., Aberlour, Oban, and Ailsa Craig and Oxcar Lighthouses; and an arrangement had been entered into with the Meteorological Council by which daily observations of temperature and rainfall are transmitted for the Weekly Weather Report issued by the Council for agricultural and sanitary purposes from the Society's stations at Lairg, Glencarron, Fort Augustus, Braemar, Ochtertyre, Marchmont, and Glenlee. Messrs. R. M. Smith, John Murray, and J. Y. Buchanan were re-elected members of the Council. The work of collecting and discussing the sea temperatures round the Scottish coast, for which a grant of 50*l.* has been obtained from the Government Grant Committee, has been transferred to Mr. H. N. Dickson. The report from the Council enters somewhat in detail into the physical and biological work carried on at the Scottish Marine Station. Six trips have been made since July by the *Medusa* in the Firth of Clyde and connected lochs, during which observations of sea temperatures were taken at all depths from the surface to the bottom, special attention being directed to the further investigation of the remarkable and unexpected distribution of temperature occurring in this part of the ocean at certain seasons, as disclosed during previous trips of the *Medusa*. Dredging was also vigorously prosecuted, and all the specimens obtained have been determined, their anatomy investigated, and the results prepared for publication by the staff of the Scottish Marine Station. This Station continues to be largely taken advantage of by biologists, for whom tables are provided in the laboratory free of charge, for prosecuting their zoological researches. As regards the Ben Nevis Observatory, it was reported that the subscriptions raised since the commencement of the present year for clearing off the debt and founding a low-level station of the first order at Fort William now amounted to 822*l.*, thus bringing up the amount contributed by the public since the establishment of the Observatory in 1883 to nearly 8000*l.*—An address was then delivered by the Hon. Ralph Abercromby, at the request of the Council, on modern developments of cloud knowledge, with lime-light illustrations of clouds from all parts of the world. It was shown that clouds were everywhere the same, and that the different forms of clouds which he had exhibited from all regions of the globe could be seen in Scotland. A modification of the present classification of clouds which has been proposed by Prof. Hildebrandsson, of Upsala, and himself, was explained and illustrated. He then dealt successively with the structure of clouds and their height, the atmospheric conditions concerned in the formation of the different kinds of clouds, the remarkable results to which cloud-motions led as regards the nature of cyclones and anticyclones, the forecasting value of clouds, and finally the necessity of attending, in all efforts to interpret the indications of clouds, not merely to their forms, but also to their surroundings. In moving a vote of thanks to the lecturer, Prof. Chrystal took occasion to refer to the great beauty of the photographs shown by the lime-light, which were highly appreciated by a large and influential audience.

PARIS

Academy of Sciences, April 4.—M. Janssen, President, in the chair.—Researches on certain phenomena connected with the aberration of light, by M. Fizeau. The paper deals chiefly with the nature of the phenomena that may be produced in the reflection of a pencil of light on the surface of a mirror, assuming this mirror to be endowed with a velocity comparable to that of light.—Stroboscopic method for comparing the duration of vibration of two diapasons, or that of the oscillation of two pendulums, by M. Lippmann. A description is given of a very accurate process of making these comparisons derived from the stroboscopic method.—On the central calm in cyclonic storms, by M. H. Faye. This central stillness is found to be present in all tropical cyclones, persisting even beyond the 50° latitude, but becoming modified according as the storm approaches the Pole without ever disappearing altogether.—On various effects of irritation in the throat, and especially on loss of sensibility and sudden death, by M. Brown-Séquard. Numerous experiments tend to show that the skin of the throat possesses, like the larynx, but to a less degree, the power of arresting sensibility; also that the larynx, the trachea, and also, perhaps, the cuticle covering them, possess the power of causing death under a mechanical irritation in the same way as the rachidian bulb.—On the seismic phenomena of February 1887, by M. Ch. V. Zenger. A parallelism is suggested between these disturbances and atmospheric, electric, and magnetic phenomena and volcanic eruptions so often occurring simultaneously.—Rectification of right, unicursal, circular cubics by means of the elliptical integrals, by M. G. de Longchamps. In supplement to his recent note, the author

here establishes the important generalisation that all these cubics may be rectified by means of the elliptical integrals.—On the voltaic arc, by M. G. Maneuvrier. A new process is described, by means of which the voltaic arc may be excited without previous contact of the two electrodes.—Law of distribution of the rays and bands common to several spectra of bands, by M. Deslandres. Having already shown that the rays composing the same band may be divided into a series of identical rays, such that in each series the intervals between one ray and the following run pretty well in arithmetical progression, the author here extends this simple law of distribution to the bands of the same spectrum of bands, indicating an analogy with the law of succession of sounds in a solid body.—Fatal accidents in electric workshops, by M. A. d'Arsonval. Some remarks are presented on the causes of these accidents, on their physiological effects, and on the means of preventing them.—Quantitative analysis of vanadic acid, by M. A. Ditte. It is shown that by observing certain precautions the method indicated by Berzelius, based on the insolubility of the vanadate of ammonia in sal ammoniac may be applied to the analysis of vanadium in the form of vanadic acid with satisfactory results.—On some ammoniacal combinations of the sulphate and nitrate of cadmium, by M. G. André. Some details are given for the preparation of the ammoniacal sulphates and nitrates of cadmium, with indications of their possible relations to the corresponding salts of zinc and copper.—On the extraction and analysis of the vanadium occurring in rocks and mineral ores, by M. L. L'Hôte. The method here described involves two operations: the extraction of the vanadium in the form of vanadic solution, and its analysis by means of titrated liquors, or by weighing.—On the preparation of the propylamines and iso-amylamines, by M. H. Malbot. The observations recently made by the author on the isobutylamines are here extended to the amines derived from various alcohols.—On the power of multiplication of the ciliated Infusoria, by M. E. Maupas. This power is shown to depend on three factors: the quality and abundance of nourishment; temperature; and the biological adaptation of each species from the alimentary standpoint.—Results obtained by the preventive inoculation of the attenuated virus of yellow fever at Rio de Janeiro, by MM. Domingos Freire, Paul Gibier, and C. Rebourgeon. Of the 1675 cases terminating fatally between January 1885 and September 1886, only 8 had been vaccinated, and these at a time when the treatment was still imperfectly understood. In general, the mortality is now 1 per 1000 for the vaccinated, and 1 per 100 for all others.

BERLIN

Physiological Society, March 25.—Prof. du Bois-Reymond, President, in the chair.—Prof. Falk spoke on the influence of extremes of temperature on the colour of blood. In persons either burnt or frozen to death the *post-mortem* patches present a strikingly bright red colour. The speaker has found, as the result of an experimental investigation, that temperatures of 0° C., and below, lead to the colour of the blood becoming bright red by causing the oxygen of the air to be more readily fixed and more stably retained by the corpuscles than is the case at ordinary temperatures. If, however, the blood has stood exposed to the air until putrefactive changes have set in, in this case the action of cold no longer makes the blood brighter in colour. Other experiments have shown that in animals killed by low temperatures the blood is bright red, not only in the peripheral parts but also in the heart and great vessels. Also in human beings frozen to death the blood even in the heart is sometimes observed to be bright red, although in most cases only the blood of the peripheral parts presents this appearance; probably death has ensued from freezing only in cases presenting the first of these two appearances.—The President read a communication from Prof. Fredericq, of Louvain, on Traube-Hering curves. As is well known, a blood-pressure tracing recorded by a mercurial manometer, shows three distinct kinds of curves:—(1) Curves of the first order, which are caused by the systole of the heart. (2) Curves of the second order, which make their appearance at lengthy intervals and are synchronous with the respiratory movements: these curves represent the influence of the respiration on the blood-pressure. (3) Curves of the third order, which make their appearance at still longer intervals and were first described by Siegmund Meyer: these have usually been regarded as due to a rhythmic increase and diminution in the activity of the vaso-motor centre. The curves described by Traube and Hering have until now been regarded as belonging to the above-mentioned third order of curves. Prof. Fredericq, however, regards this as an incorrect view; he regards them as belonging to the second order, corresponding to and produced by the respiratory movements.—Dr. Wurster stated that he has treated the caseine-like substance (see NATURE, vol. xxxv. p. 455) obtained by the addition of hydrogen-peroxide to white of eggs with ammonia, and finds that a portion of this substance is thereby dissolved. Another portion, however, is converted into a ropy mass, which on being dried yields a horny substance, with a very marked affinity for colouring matters, and which exhibits nearly all the characteristics of horn. He has further found that these two bodies undergo no change by the action of nitrite of soda on the white of eggs. By the addition of lactic or acetic acid he has obtained a yellow precipitate which turned intensely red on exposure to the air: the same reagents applied to blood produced a black coloration.—Prof. Zuntz gave a short communication on the course of experiments which he has made in conjunction with Profs. Virchow and Senator on Cetti during his fast lasting over eleven days. The results of the investigation have not yet been completely put together, but will be communicated at an early sitting of the Physiological Society.

BOOKS, PAMPHLETS, and SERIALS RECEIVED

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