THURSDAY, OCTOBER 2, 1884

THE "CHALLENGER" REPORTS

Report of the Scientific Results of the Voyage of H.M.S. "Challenger" during the Years 1873-76 *under the Command of Capt. George S. Nares, R.N., F.R.S., and Capt. Frank Tourle Thomson, R.N.* Prepared under the Superintendence of the late Sir C. Wyville Thomson, Knt., F.R.S., &c., and now of John Murray, F.R.S.E., one of the Naturalists of the Expedition. Zoology—Vol. IX. Text and Plates. Two Vols. (Published by Order of Her Majesty's Government, 1884.)

ANOTHER volume forming Part XXII. of the Zoological Series of Reports on the Scientific Results of the *Challenger* Expedition has just been published, containing an account of the Foraminifera by H. B. Brady, F.R.S. It will be universally acknowledged that the task of preparing this Report could not have been intrusted to abler hands. The representatives of this interesting group of animals, writes Mr. Murray in an editorial note, are universally distributed over the floor of the ocean and in its surface and sub-surface waters, and the presence or absence of certain surface forms in the deposits from different depths and localities is intimately connected with some of the most remarkable and intricate problems of general Oceanography. It was therefore of the first importance that one very familiar with the group of the Foraminifera should have been chosen to undertake so vast an amount of labour as was requisite to investigate the enormous quantity of material that was collected. The Report itself is the best evidence of the great success which has attended Mr. Brady's investigations; it consists of a volume of text of over 800 pages, and is accompanied by a volume of 115 very exquisitely executed plates.

While the chief part of the Report is taken up with the descriptions of the new or rare species of Foraminifera furnished by the various bottom-dredgings and tow-net gatherings obtained during the *Challenger* Expedition, the author has also included some account of the collections made in the regions of the North Atlantic, which, though not visited by the *Challenger*, were explored during the expedition of the *Porcupine* in 1869, and he has made the survey of the group more complete by also referring to the forms found during the cruise of the *Knight Errant* in 1880, and during the British and Austro-Hungarian North Polar Expeditions.

The Report, however, contains a great deal more than descriptions of new or rare species. From Mr. Brady's large acquaintance with the multifarious forms to be met with in the group and with its literature, he has been enabled to treat in a full and able manner the subject of the classification of these forms, and has thereby developed this Report into an elaborate monograph of recent Foraminifera.

In an admirably written introduction a sketch is given of the gradual development of our knowledge of these forms from the time of D'Orbigny (1826) to the present, and an elaborately compiled bibliography is appended. The various classifications of the Rhizopods, from that of Dujardin in 1841 to that of Leidy in 1879, are glanced at. More details are given as to the various attempts at classifying the Foraminifera, and the author proposes a scheme differing in many respects, and often widely, from those given by previous writers, but one which, in its essential elements, is in no way incompatible with the different conclusions at which they had arrived. The nature of the investment of the animal—that is to say, the minute structure of its test—as an exclusive basis for the primary divisions of the order, has been abandoned. While under all circumstances it furnishes important characters, and is even in some families quite distinctive, it is nevertheless a fact that, whilst there are certain groups which are invariably arenaceous, and some which are always calcareous and perforate, there are yet others in which no uniform rule obtains. The author omits any division of the order into sub-orders, not finding any easily-recognised characters to serve as a basis for such subdivision, and he divides the order at once into families. These families are (1) Gromidæ, (2) Miliolidæ, (3) Astrorhizidæ, (4) Lituolidæ, (5) Textularidæ, (6) Cheilostomidæ, (7) Lagenidæ, (8) Globigerinidæ, (9) Rotalidæ, (10) Nummulinidæ. The Gromidæ, a family composed chiefly of fresh-water organisms, "have been a source of considerable trouble, on account of the want of accuracy and detail in the published descriptions of a number of types more or less closely allied to the group, and only such genera have been included as are known to have long, reticulated pseudopodia." In this portion of the subject the author has had the advantage of the advice of his friend William Archer. "The sub-family Dactyloporinæ, which in the original draft was placed with some reservation amongst the Miliolidæ, pending the fuller publication of the results of Munier-Chalmas's researches, is now entirely omitted. The examination of specimens brought under my notice by E. Perceval Wright and C. Schlumberger has removed any doubt left on my mind as to the propriety of the transfer of the entire group to the calcareous Algæ." The singular genus Bathysiphon of Sars has been removed to the Astrorhizidæ.

With reference to the subject of nomenclature, the following are Mr. Brady's views, which seem founded on common sense, and with which we entirely agree. It is surely not requisite in a group like this "that a uniform standard of fixity of characters should be adopted, or that a set of beings of low organisation and extreme variability should be subjected to precisely the same treatment as the higher divisions of the animal kingdom. The advantages of a binomial system of nomenclature have not diminished since the days of Linnæus, though the views of the naturalist as to what constitutes a 'genus' or a 'species' have changed, and will probably continue to change, but, be that as it may, the Linnæan method is too simple and convenient to be abandoned without some better reason than the different value of these terms as employed in different zoological groups." "The practical point upon which all are agreed is that it is impossible to deal satisfactorily with the multiform varieties of Foraminifera without a much freer use of distinctive names than is needful or indeed permissible amongst animals endowed with more stable characters." All who have had any experience of the life-history of these Rhizopods, who know their immense plasticness, and yet who remember their, within certain limits of deviation, fixedness of type, will cordially agree with this.

The subject of dimorphism is alluded to, and the two quite distinct phenomena among Foraminifera described by this term are explained, but the author does not seem to select one of these above the other for the exclusive right to the term, as would seem desirable.

One of the most interesting subjects in reference to deep-sea deposits is their direct connection with the pelagic species of Foraminifera. As a rule these forms are not of pelagic habit; on the contrary, probably 98 or 99 per cent. of the known species or varieties live in the sand or mud of the sea-bottom, and possess no powers of floating or swimming; but, on the other hand, some few forms, belonging to eight or nine genera, do most certainly pass their existence either in part or in whole at the surface of the ocean, or floating at some depth below that surface. These forms are found, too, in immense profusion, and a relatively very large mass of the oceanic deposits consist of their calcareous shells. A list of the at present ascertained pelagic forms is given. The most prominent genera are Globigerina, Pulvinulina, Hastigerina, Pullenia. The question seems still unsettled as to whether the species are exclusively pelagic, passing the whole of their time living at or near the surface, or whether they can or do pass a certain portion of it on the sea-bottom. Mr. Brady adduces a series of facts which tend to the inference that the Foraminifera which are found living in the open ocean have also the power of supporting life on the surface of the bottom-ooze, and further, so far as our present knowledge goes, there is at least one variety of the genus Globigerina which lives only at the sea-bottom; but the author is most cautious not to express any dogmatic opinion on the subject.

In dealing with the composition of the test, the presence of a considerable percentage (6 to 10) of silica has been established as existing in the arenaceous forms. The substance secreted for the incorporation of the foreign bodies which cover the test has been proved to be composed of ferric oxide and carbonate of lime in variable proportions, the former being often in considerable excess. It is not without interest to note the presence in some of the porcellanous forms of a thin siliceous investment. A few Miliolæ from soundings of a depth of about four and a half miles, with somewhat inflated segments, scarcely distinguishable in form from young thin-shelled specimens of a common littoral species, were found to be unaffected by treatment with acids, and upon further examination it became apparent that the normal calcareous shell had given place to a delicate homogeneous siliceous investment. While immersed in fluid, the shell-wall had the appearance of a nearly transparent film, and this when dried was at first somewhat iridescent.

A list is given of those stations from which soundings or dredgings were obtained in sufficient quantity to furnish good representative series of Rhizopods, and maps are appended showing the tracks of the *Challenger*, with these stations marked, as also of the areas explored by the *Porcupine* and the other northern expeditions.

Any generalised summary of the details of the new forms would be impossible. Of the several hundred species described and figured, over eighty are here noted for the first time, and this without counting numerous well-marked and named varieties, or the numerous new forms already diagnosed in Mr. Brady's preliminary Reports.

The family Astrorhizidæ is the one which has received the largest number of additions; indeed our acquaintance with the larger arenaceous Rhizopods is almost entirely derived from the various recent deep-sea explorations. A knowledge of the life-history of these forms is still needed to place the classification of the group on a secure basis, and as some few of the forms are inhabitants of comparatively shallow water, their investigation would seem to be well worthy of the attention of observers at some of our zoological marine stations. Many other problems to be solved are also pointed out in this Report, the extreme value of which will be recognised by all students of biology.

THE ENGLISH FLOWER GARDEN

The English Flower Garden: Style, Position, and Arrangement. Followed by a Description, Alphabetically Arranged, of all the Plants best suited for its Embellishment; their Culture, and Positions suited for each. By W. Robinson, with the co-operation of many of the best Flower Gardeners of the day. Illustrated with many Engravings. (London: John Murray, 1883.)

A LOVE of flowers seems more or less characteristic of most human beings, and the tending and caring them is to most people a pleasant labour. Their brightness of colour, their charm of form, the sweetness and refreshingness of their varied perfumes please and delight the senses, while the mystery of their lives and deaths captivates the mind and awakes up the pleasures of hope. In no European country has this love of flowers been more manifested than in England, so that a flower garden seems an indispensable adjunct of an English home. It too often happens that many of those who love flowers have not the knowledge requisite to take care of them, and then the flower garden is handed over to the care of others. What to grow and what not to grow becomes then not so much a question of deliberate enlightened forethought as a thing of fashion, commonplace and unstable. No honest lover of Nature, no one who has once known the beauties of plant life, could ever for a moment remain pleased or satisfied with the arrangement of things out of place which is so peculiarly characteristic of one style of modern English gardening. It was not always thus: anywhere in Continental Europe that one visits "Le Jardin anglais" of some fine demesne or of some public park, there one is sure to find some attempt to form a natural prospect by the judicious arrangement of tree, shrub, flower, and grass; but in England itself, the very home of Sylvia, all traces of Nature are too often obliterated, and a meretricious display of colour, inclosed within a sharply defined geometrical sameness of outline, takes the place of a refreshing contrast in contour accompanied with joyful surprises of brightness. What a difference there is in the pleasure of viewing a large mass of *Gentiana acaulis* in the centre of a wide expanse of scarlet geraniums encircled with yellow calceolarias and viewing some few tufts of the same plant opening their blue corollas amid the grass by the borders of some Alpine meadow. Those who love gardens and like to see in them some few touches of Nature owe a debt of gratitude to Mr. W. Robinson for his life-long labours in disturbing our minds as to the correctness of modern views on gardening, and for in a great measure destroying the miserable conventionality that had made our gardens bad imitations of very inartistic carpets, or of nightmare-giving wall-papers. But in destroying what was bad it was also most desirable to build up something good to replace what was gone, and in the present most welcome volume we find indications, clear and distinct, of the abounding wealth of flowers at our disposal which are fitted for the embellishment of our open-air gardens. In the compilation of this work on the "English Flower Garden," Mr. Robinson has had the co-operation of some of the most practical and thoughtful writers of the day, and also the valuable aid of Mr. W. Goldring, whose experience as superintendent for some time of the Hardy Plant Department of the Royal Gardens at Kew has well qualified him for the task. The first part of the work—On Gardens, their Arrangement, &c.—is for the greater part from the pen of the author. We should have liked that a small portion of this part had been devoted to the subject of town and suburban gardens of small size. Many a modest cottage garden has, we read, its lessons to give, but then our ideas of a modest cottage garden are not helped by an illustration of the charming grounds attached to Sheen Lodge. The second part contains in alphabetical order a list of the more important genera and species of plants which will grow in the open air in Great Britain or Ireland, with figures, some very good, some indifferent, of most of the more attractive species. In some few cases we notice figures given which are not referred to in the text; when these are not of "desirable" species for the flower garden, as in the case of *Gentiana lutea* and *Scilla maritima*, it would have been better to have put others in their place. To all our readers who have or contemplate having a garden we cordially recommend this very excellent book.

OUR BOOK SHELF

The King Country; or Explorations in New Zealand. By J. Kerry-Nicholls. (London: Sampson Low and Co., 1884.)

In this interesting volume Mr. Nicholls describes a good stroke of exploring work. The King Country, with which his volume is largely concerned, is that district of the North Island of New Zealand which is still under the sway—not entirely nominal—of the King Tawhiao, who has only recently left our shores. It occupies a very large area between the west coast and the Lake Taupo region, having on its north-eastern border that wonderland with which the late Baron Hochstetter has made us familiar. The additional details of the sub-volcanic action of this region, its boiling springs and glistering terraces, are welcome. From Rotomahana Mr. Nicholls travelled southwards in a zigzag to Lake Taupo, and geologists will be specially interested in the observations regarding the great volcanic plateau on the south of Lake Taupo, and Mr. Nicholls's account of his ascent of Mounts Tongariro and Ruapehu, the former still in a state of volcanic activity. In fact there is abounding evidence that at no very remote period volcanic action must have been widespread and copious over a very large area of the North Island. Though not to be compared with the Southern Alps, which Mr. Green and his companions scaled last year, still Mr. Nicholls's feat was formidable and trying enough. In the King Country the natives have retained many of their original characteristics and customs almost unchanged, and therefore such narratives as that of Mr. Nicholls is of considerable value to the ethnologist. The region is richly wooded, the scenery in many places magnificent, and the geological features well worth minute investigation. In an appendix we find a list of the New Zealand tribes with their localities, and careful lists of the flora and fauna met with during Mr. Nicholls's journey. Altogether the narrative is interesting, and contains a good deal of fresh information. There is an excellent map and many attractive illustrations.

Forests and Forestry of Northern Russia and Lands beyond. Compiled by John Croumbie Brown, LL.D. (Edinburgh: Oliver and Boyd, 1884.)

The forestry of Russia has so recently been the subject of an article in our columns, that we need do little more than refer to this, the latest of the long series of volumes by Dr. Brown on his favourite *Forstwissenschaft* or forest science. It appears to have been compiled *apropos* of the International Exhibition of forest products in Edinburgh, and is intended "to introduce into English forestal literature detailed information on some of the points on which information is supplied to students at the schools of forestry on the Continent." The information contained in the volume has been obtained personally during journeys in Russia, or from the best official sources. There is also, it should be said, much to interest the most general and careless of readers, for Dr. Brown quotes extensively from the best recent writers on the districts of Russia to which his book specially refers.

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.*]

M. Thollon's Views of "Great B" in the Solar Spectrum

The excellence and power of M. Thollon's prisms have become proverbial in the spectroscopic world. For the sake, therefore, of having his own account of what he has himself seen (Nature, vol. xxx. p. 520), with physical apparatus of gigantic size, so well planned, so admirably constructed, and manipulated with such matchless skill,—doubtless every reader will make very little objection to any small accompanying inaccuracy in one outside reference.

To me, therefore, as well as probably to every one else, it is a very trifling matter that he should lay to my charge that I have said "Great B" does *not* increase in intensity as the sun approaches the horizon; although in my "Madeira Spectroscopic" book I have actually introduced Plate 5 to show, as compared with Plate 4, that it does so increase very notably.

But the real point of interest, of special importance just now, and perplexity too, is not that there is *some* effect of the telluric character in the "B" lines—but how much? and in what manner does it grow with zenith distance?

Now that residual question does not seem yet to have occupied M. Thollon, or he would have described the different rates at which the dry gas lines of "B" grow with zenith distance compared with the lines of watery vapour; and, as a first and easy result, he would undoubtedly have obtained, as I have with far inferior means, an indication that the water-vapour of the earth's atmosphere is confined to the lower strata only, while the dry gas composing "B" belongs more nearly to the whole atmosphere, high and low. To that too, at least; for some observations of "B" when near the zenith, or looked at through the shortest aërial path possible at the place, showed me so immense an intensity still in its lines, as to lead to the suspicion that *part* of their producing gas may be even far outside the usually considered limits of everything belonging to the earth.

M. Thollon, indeed, gives a view of the "B" region, "as," he says, "it would appear if observed outside the earth's atmosphere"; and therein he shows every line constituting our magnificent earthly constellation "Great B," absolutely wiped out of existence—a few *ultra*-faint, accidentally intruding solar metallic lines alone excepted. But how has the eminent *savant* obtained that view? Not by ascending in a balloon, or up the sides of a high mountain above all the grosser atmosphere, and seeing that it was so, but merely by observing some small amount of difference of effect, at two slightly different degrees of large zenith distance, viz. 60° and 80°, at the Observatory of Nice.

Two points, however, alone, will never enable a curve to be drawn on their sole authority; and as a curve of effect is what the investigation now requires, M. Thollon's hitherto merely duplex observations will acquire a far greater power of conviction for other men's minds, if he will kindly supplement them with others at 20° Z.D., or as near to it as the latitude of Nice will allow him at time of summer solstice. Still more would he make us all his debtors if he would repeat those three angular directions at three successive stations at greater hypsometric altitudes; duly remembering that while every one knows that water-vapour and oxygen (the gaseous parentage of "B" according to the grand experiments of M. Egoroff) do exist in the earth's atmosphere, that does not, by itself, therefore render them impossible in greater or less quantity to the outer region of the sun's envelopes; or, in a highly attenuated degree, to the 92,000,000 of miles of space between. C. PIAZZI-SMYTH

15, Royal Terrace, Edinburgh, September 27

Shifting of the Earth's Axis

WITH reference to the letter of Mr. W. M. Flinders Petrie (NATURE, September 25, p. 512), I would remark that there has been no sensible change in the latitude of Greenwich (as found by observations of circumpolar stars) during the last forty-seven years, a period nearly twice as long as that covered by the Pulkowa observations which M. Nyrén has discussed. In a paper on the "Systematic Errors of the Greenwich North Polar Distances" (*Mem. R.A.S.* vol. xlv.), I have exhibited the results for the co-latitude of the centre of the Greenwich transit-circle for each year and for groups of years from 1836 to 1877 reduced to the same refractions throughout (Bessel's), and corrected where necessary for index-error of the thermometer, and the accordance of the individual results is as close as can be expected, when allowance is made for the systematic errors to which all observations are liable, but which are usually ignored in estimating theoretically the probable errors of mean results. It may suffice if I here give the results for co-latitude for three periods of years:—

1836–49	mean co-latitude	38° 31′ 21″·85
1851–65		21″·87
1866–83		21″·85

The first and last results are identical and are absolutely inconsistent with Mr. Petrie's supposed increase of the Greenwich co-latitude of 1″ or more in a century.

W. H. M. CHRISTIE

Royal Observatory, Greenwich, S.E., September 27

The Sky-Glows

FROM the great purity of the sky this evening, and from the flatness of the horizon westwards, on the line of the Great Northern Railway between Huntingdon and Hitchin, the sunset glow was of a very beautiful description. At five minutes before six (watch-time, three or four minutes slow) the sun set; and it was no sooner hidden than a parhelion-like patch of white light, 6° or 8° in diameter, brighter than the rest of the sky, occupied a place 10° or 15° above the sunset point of the horizon, and continued shining there with pearly brightness for about ten minutes. The horizon-line became edged at the same time with bright red, melting abruptly away upwards into orange, and higher up into a field of yellow light round the lucid spot. At 6.5 this spot's white light began to acquire a rosy tinge, and during the next ten minutes, until 6.15, it became intensely rose-coloured, preserving its definite place unchanged in the upper expanse of yellow; a vivid golden oriole-yellow stripe some degrees broad divided it from the red fringe along the horizon, the dazzling gold colour shading exquisitely into the fiery red below and rosy red above, and deriving itself from the latter a bronze-like greenish cast in its bright golden hue by contrast.

By 6.15 the rosiness of the bright spot had extended upwards and outwards from its centre, and was now blended in its colour and confines with the yellow band and red fringe below it, until the whole presented a conflagration or red aurora-like outburst of light in the west, 20° or 25° high, and extending 45° or 50° in base along the horizon.

The yellow belt was fading out of this glory, and the brightness and rosiness of its upper part was fast disappearing, when at 6.15 there appeared, with extreme quickness in the brighter base, dark intervals dividing it into upward radiating diverging beams of light, which rapidly acquired such fixed breadths and distinctness that I easily counted six or eight separate beams nearly equidistant from each other, and of equal lengths and strengths, marking out plainly by their divergence the sun's place, and the considerable depth to which it had already sunk below the horizon. The two outer ones only of the beams, on the northern side, were a little confused together, and marred the symmetry which the whole presented, but the full number of their display was several times counted over during the ten minutes—until 6.25—that they continued visible. They were about 15° long from their bases, and extended across and usurped to themselves the light of what had been the golden-yellow belt; but they gradually shortened and became dull red when at the latter hour the horizon assumed the red appearance which it usually presents some time after sunset. The above striking phases of the glow,—the white spot, the rose-red one, and the streamers,—occupied just ten minutes each, and the unusual aspect of the sky ceased entirely just thirty minutes after sunset.

The patch of whitish light observed this evening had all the appearance of a true, but extended and diffused, mock sun of some description; and I have noticed the peculiarity before, in the sunset glows of last winter and spring, whenever I had an opportunity to see the sky and watch their early phase just after sunset; but crystals of ice being then plentiful in cirrus, the evidence of the mock sun's formation by non-aqueous dust in the atmosphere was not so strong as now, when it has recurred after a long continuance of a summer temperature which has been unusually high. It is also singular and curious that the rosy tint began in the white-glow spot, and spread evenly outwards from it as a centre, as the extent and intensity of this remarkable colour grew and increased.

Appearing as the white spot does, when I have seen it, at a pretty fixed height of not less than about 12° from the horizon as soon as the sun has set, it seems difficult to reconcile its presence at such an altitude with a theory of its production by reflection of the sun's horizontal rays from fine films or laminæ of floating glassy dust, unless descending equatorial currents, perhaps, in those extremely stable heights may have a sensible inclination downwards from the west, and may tilt the films' under sides in a direction corresponding with that of the current slightly towards the sun?

With regard to the diverging beams, they are also, perhaps, not quite ordinary, irregularly produced straight lines of radiation; but seemed by their symmetry to be connected, at least in the origin of the shadow-gaps which formed them, with evenly ruled stripes or pleats of the cirrus, and of loftier haze, in this case directed, it seemed, nearly east and west. With such haze-bands and stripes directed rather more south-westerly, or about towards the point of winter sunset, and intersected also with slightly slanting systems of striation, I constantly noticed the sky in Newcastle-on-Tyne, during the prevalence last winter and spring of the repeated sunset glows, to be for weeks and months more or less constantly and uniformly, but in general weakly and dimly, streaked and furrowed over. Either an unusually steady current was prevailing in the upper air; or else a permanent current there, and long lines of aërial disturbances troubling its streams were made more visible and conspicuous than ordinary, by exceptional radiation, or some other unusual refrigerating and haze-engendering cause, depriving the upper air of its transparency, during the time of the sky's presenting such unusual appearances in what Quetelet named and considered to be the "stable" or untempestuous upper regions of the atmosphere.

Whatever may be the explanation of the streamers and of the white glare-spot, observations may perhaps be made of them under even more favourable conditions than occurred this evening, and they would then possibly give a little help towards arriving at some further conclusions both as regards the crystalline or other nature of the haze-causing substance, and as to the manner and direction of the motions of the extremely lofty air-currents in which the finely-divided material is suspended.

A. S. HERSCHEL

Collingwood, Hawkhurst, September 20

ON September 27, being on the river about 6 p.m., I noticed the beautiful colour of the sky, which lasted for three-quarters of an hour after sunset. The day had been very cloudy, but not much rain had fallen, and about 4.30 p.m. the sky cleared and the sun shone out. My attention was drawn to the appearance of the sky about 6.15, after the sun had set. Great masses of red appeared in the west on a background of gold and primrose; above this the sky shaded from green into blue; the red colour extended upwards for about 40°, and appeared of various shades, deep red, magenta, and rose colour, the various small clouds which were floating about being pink. This red light gradually broadened out and died away, giving place to deep orange and gold, the latter colour lasting till 6.45.

The water was as gorgeous as the sky above, the reflections of the trees being bright red and purple on a floor of gold. I may add that the red light from the sky was so strong that a rosy hue was thrown on some trees and everything around.

Hurley Mill, September 28 T. M. BROWNE

September Stream of Krakatoa Smoke at Strong's Island

AFTER long delay, owing to the wrecking at Strong's Island of the *Morning Star*, I feel very fortunate in coming into possession at last of a most important record of fact, which I hasten to publish, in the form of an extract from the journal of Miss Cathcart, the young lady missionary labouring at Strong's Island with Rev. Dr. and Mrs. Pease, and well known in Honolulu. It is as follows:—

"*September* 8.—Yesterday there was a very peculiar appearance of the sun. The sky was somewhat cloudy, but not so as to obscure the sun, which was of a silver blue colour, and not so bright but what we could look at it without any trouble. The shadow was the same as in an eclipse. There was no bright sunshine all day."

Although the journal contains no further record on the subject, nor any mention of the red glows which must have followed, it is so precise as to date and as to the phenomena observed as to be of the greatest value in continuing the history of the equatorial smoke-stream from Krakatoa beyond Honolulu and Fanning's Island, to which it had been continuously traced on its long route *viâ* the Seychelles, Cape Coast Castle, Trinidad, and Panama. It was observed by the barque *Southard Hurlburt* some 2000 miles east-south-east of Honolulu on September 3, at Fanning's Island on September 4, and at Honolulu in conspicuous brilliancy on the evening of the 5th. Mr. Frank Atwater, landing at Maalaea, Maui, on the morning of the 5th, observed a wonderful red glow, and marvelled much (having just arrived) if such were the sunrises in these islands. The same morning passengers on the *Zealandia* steaming southwards towards the Line were awakened by *blue* sunlight streaming into their berths. Mr. F. L. Clarke has supplied a report, somewhat imperfect as to date, of an obscured and coppery sun seen at the Gilbert Islands on or about September 7. This would be September 6 in our reckoning, the Gilbert Islands being west of the meridian of 180°.

Now we have the very precise date given by Miss Cathcart, of September 7 (6th) at Strong's Island, or just one day later than at Honolulu, and thirty-six hours later than the late afternoon coppery and lurid obscuration seen at Fanning's Island. Strong's Island is about 2320 miles nearly due west of Fanning's Island. This gives a rate of progress of the smoke-stream of sixty-four miles an hour. It seems proper to reckon time from Fanning's Island rather than from the Hawaiian Islands, as the latter were evidently north of the central course of the stream, and perceived its atmospheric effects half a day later than the former, although nearly on the same meridian.

It is to be specially noted also that the phenomena were characterised by the peculiarities seen at Fanning's Island, as well as at Panama, rather than those seen at Honolulu. Here the obscuration of the sun was so slight as not to have been noticed during the day, nor was any change in its colour observed, except by Mr. and Mrs. H. M. Whitney, who saw its disk *green* at setting on the 5th. At Strong's Island, as well as at Fanning's Island, Panama, Trinidad, and eastward, the sun was heavily obscured, and its light changed to green at low altitudes, and blue when high up. This proves that the heavier thickness of the smoke-stream did not extend so far north as Honolulu, but was confined to a narrow belt near the equator. Fanning's Island is in lat. 2° 40′ N., long. 159° W. Strong's Island is in lat. 5° N., long. 162° 30′ E. The *Zealandia* was perhaps 5° N. when the blue sun was observed. Honolulu is in lat. 22° 17′ N., and received only the clouds fraying off from the edge of the smoke-belt as it swept by to the southward.

The sun's rays were so greatly obscured by the density of the smoke strata in the main belt that they seem there to have failed to produce the marvellous twilight effects which were so conspicuous in Honolulu. All along the line from Seychelles to Strong's Island, we hear of lurid appearances, green sun, blue light, great obscuration, sun easily observed with the naked eye, but hardly anywhere a word about twilight effects, or red glows; while at Honolulu, under the thinner side clouds of the stream, the colour effects in the twilight were amazing.

The topic is an endless one, and I will not prolong. Many ask what is the cause of frequent revivals of the red glows, such as the very fine one of last evening, August 19. It seems merely to show an irregular distribution of the vast clouds of thin Krakatoa haze still lingering in the upper atmosphere. They drift about, giving us sometimes more, sometimes less, of their presence. It is also not unlikely that in varying hygrometric conditions the minute dust-particles become nuclei for ice crystals of varying size. This would greatly vary their reflecting power. This accords with some observations of Mr. C. J. Lyons, showing that the amount of red glow varies according to the prevalence of certain winds.

S. E. BISHOP

Hawaiian Government Survey, Honolulu, August 20

Biology *v.* Botany

ACCORDING to the regulations of the Cambridge Local Examinations, 1883, junior students can alone take botany, while senior students must take elementary biology instead. What has been the result? Taking the Regent's Park centre as a typical example, for it is a single school of several hundred girls, and sends up probably more than any other school in England, we find that from 1872 to 1882, inclusive, 273 senior students entered, and 191, or 70 per cent. passed in botany. In 1883, however, *none were sent up at all.* If we ask, What is the object of teaching science in schools? the answer is obviously for its educational value. Now this can only be acquired by practical study. Botany is eminently qualified for affording this use, whereas zoology is not. The lady principal of the school in question will not entertain the idea of teaching any branch of science if it cannot be taught practically, and very pertinently asks, "How can I get two to three hundred frogs, and make my girls dissect them? In the first place, the parents would not allow it." Consequently biology becomes a dead letter, and botany is discountenanced by the Syndicate for the elder girls.

On inquiring of a member of the Syndicate, I am informed that the general idea is that the juniors should study botany from this educational point of view, but seniors are of such an age that mere "object-lessons" are no longer necessary, but training in scientific thought is called for. Now, in the first place, it must be borne in mind that, from the pressure of other subjects, it is not generally, if ever, easy to teach science at all adequately in schools; and, secondly, the small amount of botany that can only possibly be taught, even to the elder pupils, is little more than practical descriptions, a certain acquaintance with the leading families of plants, and the general principles of physiology and histology. There is not the time to do more. As an examiner for the College of Preceptors for many years, and having to look over papers from schools, &c., from all parts of England, I can testify to the fact that the standard of botanical teaching is decidedly low. Of course there are exceptions, but the majority, who get less than half marks, show little more than a smattering of the subject. Instead, therefore, of insisting on elder pupils advancing to biology, my own feeling is that it would be decidedly better to encourage seniors to continue the study of botany alone, but more thoroughly. The idea of calling such botany an "object-lesson" will sound somewhat ludicrous to my fellow teachers, who know what teaching practical botany thoroughly really means!

The remedy, therefore, seems obvious. Let the seniors as before pass in botany alone, but of a higher standard if you will; and leave biology as it is for any who may wish to take up that subject. At present the effect can only be to quash the teaching entirely beyond its first and most elementary stage.

There are not wanting signs elsewhere of the evil effects of the younger school of botanists not recognising the importance of first training students in a thorough course of practical and systematic botany before proceeding to laboratory work. In an examination lately held for a post at Kew, I am informed that two gentlemen who had been trained at Cambridge competed with a gardener for the post. The gardener secured it. *Verb. sap.*

GEORGE HENSLOW

Animal Intelligence

HAVING frequently observed in your columns accounts of remarkable instances of reasoning power in animals, I am tempted to send you the following notes, which may perhaps be not without interest to the readers of NATURE.

A young canary belonging to our family is in the habit of receiving small pieces of biscuit, cake, or such like from the tea-table. The hardness of the biscuit has ever been a source of great annoyance to Dicky. One day, however, after an expectant and close examination of the tea-table, he was offered a piece of hard biscuit. Without making the least attempt to break it, he lifted it from the floor of his cage, and taking it to his water-trough, gently dropped it in, following up the action by patiently stirring it round and round with his beak, until it was in a condition to be eaten. He then carefully removed it and devoured it without any trouble. He now puts every *hard* substance which he deems eatable into the water. He endeavoured to soften sweets in the same way, but finding that the sweet became gradually smaller and smaller, he hastily abstracted it, and has never since put anything of that nature into the water.

An equally interesting case of reasoning power was lately exhibited by our cat. Pussy had lately become the mother of a family of kittens, and was naturally indisposed after the occurrence. She wandered about through the house in a strange manner, as if seeking for something, always, however, keeping within near range of the coal bunkers when they were likely to be required. With a view to finding out what she wanted, the bunkers were left open. The cat immediately entered, and commenced searching diligently among the coals, until she found a piece covered with pyrites. This she proceeded to lick vigorously, returning to the bunker and repeating the operation at regular intervals. On ground sulphur being offered her, she at once forsook the pyrites for that, and ere long, by use of that medicine, regained her usual health.

R. J. HARVEY GIBSON

Zoological Laboratory, University College, Liverpool, September 29

IN the notes on Australian ants forwarded by me by the last mail I forget whether any mention was made respecting an idea that has struck me several times, as to the method in which the antennæ are employed by ants as a means of communicating with each other. That ants utter no audible sound is pretty plainly proved by experiments made with the microphone. It is said that the Ambillidæ give a kind of sharp cry when captured, but the statement requires to be verified. Ordinary ants may be generally spoken of as destitute of any means whereby to utter articulate speech. Beyond the fact that they do not appear to be able to speak, so as to be heard by human ears, the tests resorted to by Sir John Lubbock would go to show that it is extremely doubtful whether ants possess the sense of hearing at all. This, however, does not preclude the possibility, or even the probability, of their being in full power of a means by which they are able to converse. It will be remembered that the antennæ are divided into two separate portions, the *scape* and the *flabellum*. The latter is subdivided into about ten separate segments. Now in this arrangement, by adopting a preconcerted system of signals, all the words of an English dictionary might be expressed.

Let us say that A meets B, and, according to the vocabulary of Formicaria, that a touch with the tip of the antenna of A on the terminal segment of the antenna of B signifies any particular word. A similar touch made on the second segment of the antenna of B indicates another word, and so on. Here there is a means of expressing at least ten different words by taking from the point of the flabellum to its base. If the second point of the flabellum of A is employed as a touching organ, the number of signs that might be conveyed from the one ant to the other would be twenty. If all the segments were thus utilised, a hundred different signs might be interchanged. This is for one antenna only. By utilising the pair this number would be doubled, and by multiplying the number of touches, to express words or plurals of words, also, and by crossing the antennæ so that the right antenna of A touched the left of B, and *vice versâ*, all clearly distinct signals, the vocabulary of these little people would be extended almost *ad infinitum*. Say that the one touch of a segment of the flabellum meant an ant, two touches a pair of ants, and three a multitude; here there exists a means by which complicated ideas might be communicated in a manner somewhat similar to that adopted by the Chinese, by whom a particular sign means a woman, two mischief, and three marital unfaithfulness; or, as in the language of the Australian natives, who employ the term "Yarra" as signifying "flowing," and "Yarra-Yarra" as "ever-flowing." All this would be pantomime, of course; but those who have witnessed a public exhibition of the skill of well-taught deaf-mutes, are aware of the amount of information that can be imparted by the simple use of the ten digits, just half the number of separate conversational organs at the disposal of ants. Nor do persons and nations, well able to speak audibly, fail to avail themselves of the same kind of speech. A Chinaman utters a certain word, but it may mean half a dozen different things, as he moves his fingers to the right or to the left, up or down, or describes some imaginary diagrams in the air.

The above views may seem altogether visionary at first sight, but we have been told so many remarkable stories relative to the instincts displayed by the singularly intelligent creatures under consideration, that no persevering student of their habits will be inclined to say that the use by them of some such code of signals is altogether beyond the range of possibility, even of probability.

It might be as well if naturalists, when watching the meeting of ants, would notice carefully whether the observed touches vary in any particular, and whether any noticeable results followed after, and appeared to be connected with, the variations.

THOMAS HARRISON

244, Victoria Parade, East Melbourne, Victoria, July 16

Meteors

I HAVE to record a brilliant series of meteors seen last night (Sunday, July 20) by myself and others. I will describe that seen by myself, as, amid the many splendid meteors I have observed during my sixty years of life, I have never seen one more magnificent. I was walking up and down my "quarter-deck," the carriage-drive in front of my house, which faces due north and south, admiring the glorious tints of the dying day, for we have been having, on a reduced scale, the grand sunsets about which I have already written. I was looking due north, and saw a huge fireball suddenly appear about half way between the horizon and the zenith. It moved slowly and horizontally, leaving a broad trail of red light behind it, as well defined as that emitted by a rocket. The meteor itself was about half the size of a full moon, white, and of the most intense and dazzling brilliancy. It travelled so slowly that I had time to call out, *several* times, to my wife, "Look at that glorious meteor," and she had time to turn round and see it. At about north-north-west it suddenly broke up into six, if not *seven* pieces, but at this moment its light was so intense that I could not be quite certain; six, however, I counted *distinctly*. They did not *fall*, but trailed on in a line after the larger mass, which did not seem diminished by the rupture, and finally, at north-west, they all disappeared. On taking out my watch I found it was just two minutes past six, and as we are a month past our shortest day, you can fancy there was plenty of day-light left to dim its splendour. But it was a magnificent sight, and its intense brilliancy surpassed anything I have seen before.

At 6.30 two friends walked up to dinner. I asked if they had seen the meteor. They said, "Yes, how splendid it was!" I asked, "Could you count the number of pieces into which it broke?" They looked at each other in amazement. "It did not break!" "In what direction did it pass?" was my next question. "From west to east," said one of them; "if you were standing here you could not have seen it; it was low down on the southern horizon, behind your house." I then found on comparing notes that this one, which they both said was large and extremely brilliant, had appeared about *twenty-five minutes past six*.

At night we attended the Governor's last "reception," prior to his leaving the colony. He was handing my wife to her carriage—I was unfortunately in the house—when another fine meteor illumined the sky. It must have been in the west, or, from the position of the carriage and the buildings, my wife could not have seen it. She says it fell straight down from the zenith, and broke into several pieces. This occurred at 10.45; I had just previously looked at my watch. I also heard of other smaller, though bright, meteors, but did not see them myself. What are we doing, Mr. Editor? Are we going through the tail of a comet? or is cosmic dust igniting? or are these "dire and bloody" portents? Whatever they are, I record them, in the hope that others may have seen and noted them.

British Consulate, Noumea, July 21 E. L. LAYARD

The Milleporidæ

SPECIAL interest is attached to any direct evidence as to the nature of the reproductive organs in the Milleporidæ, the more especially as no traces whatever of such organs have hitherto been discovered. In the absence of any direct evidence it has been concluded that, from the apparent absence of ampullæ, the gonophores probably develop free of the cœnosteum; and this seemed partly borne out by the general resemblance between the zooids of the Milleporidæ and those of the gymnoblastic Hydroids.

On some dry specimens, however, of a new species of Millepora (*Millepora murrayi*, characterised by its extremely laminated and coalescent fronds, much and palmately divided at their extremities, and by its minute gastropores, ·25 mm. wide, and its still more minute dactylopores and even surface) from the Philippines, there occur, irregularly and numerously distributed among the young branchlets of the cœnosteum, large receptacles, which, though the absence of the soft parts prevents any absolute confirmation thereof, can leave no doubt as to the true ampullate nature of the generative organs in this family. These receptacles occur either closely, or widely apart, as circular cavities in the superficial reticulations of the cœnosteum, and are covered above by a very thin and porous layer, which is often broken away. When it is thus laid open, the cavity is seen to be about ·75 mm. in diameter. The receptacles are seen on the surface as white, circular, scarcely raised areas about ·5 mm. in diameter, with a small pore in the centre; and they are generally rather numerously placed on one or both faces of the palmated branchlets.

By the discovery of the ampullæ in the Milleporidæ, a complete confirmation is given to the relationship which Prof. Moseley has shown to exist between this family and the Stylasteridæ; and it is seen that the two families are even more closely related than had been imagined. The presence of such a structure seems to bring the Milleporidæ into relationship rather with the calyptoblastic than with the gymnoblastic Hydroids, in spite of the general resemblance of its zooids with the latter. JOHN J. QUELCH

Natural History Museum, South Kensington

To Find the Cube of any Number by Construction

THE following graphical construction for finding the cube of a number may interest more than the mere mathematician:—

Take a triangle ABC, in which suppose A to be the vertical angle and B greater than C. Draw the perpendiculars AD, BE, CF, thus obtaining the pedal triangle DEF; take H the middle point of the perpendicular EG on DF. Then $\tan CDH = \tan^3 CDE = \tan^3 A$. If then we take a triangle with vertical angle A such that $\tan A = n$, we see that $\tan CDH = n^3$.

The proof of the above result is quite elementary.

September 22 R. TUCKER

The Failure of the Parsley Crop

WOULD you permit me to ask some subscribers to your paper if it be possible to account for the total failure of the crop of parsley this and last year. Is it owing to any known insect or what? The parsley comes up well, grows to about one inch in height, then begins to dwindle and get yellow, and the whole summer remains about half an inch high, the only green part being the crown. All the market gardeners are in the same position as myself, only one having a crop, and this was sown in freshly cultivated earth. I have carefully examined leaves and roots under the microscope, but can discover no cause for this disease. Have any of your subscribers been troubled in the same manner, and can any one suggest a remedy? W. H. C. B.

Cheltenham, September 23

Wasps as Fly-Killers

YOUR correspondent at p. 385, vol. xxx., may be informed that in this part of the world wasps enter dwellings by the open windows in summer-time, and hunt house-flies unmercifully, leaving the dead flies in hundreds on the floors, ready to be swept into a dustpan. This occurs only in the country, and where wasps' nests are near by. Westwood quotes from St. John's "Letters to an American Farmer" that: "The Americans, aware of their (wasps') service in destroying flies, sometimes suspend a hornets' nest in their parlours" (Introduction to "Modern Classification of Insects," ii. p. 246, foot-note).

GEORGE LAWSON

Dalhousie College, Halifax, Nova Scotia, September 8

GEORGE BENTHAM

WE recently announced the death of the veteran botanist, George Bentham, when within a few days of his eighty-fourth birthday. His life, from a very early age, was one of incessant mental activity, and of much change and vicissitude during its three or four first decades. Through his birth, connections, and various residences on the continent of Europe, as well as in England, he became acquainted with many men famous in literature, science, and art, and his career is rendered especially notable from its intimate association with his uncle Jeremy, the jurist, in the arrangement of whose papers and preparation of whose works for the press he was actively engaged for not a few years, and with whom he resided on the most intimate terms as companion and secretary till the death of that relative in 1832. This and the scientific value now attached to the "pedigree" have suggested the expediency of entering with some detail into the family history and early life of Mr. Bentham (for most of which we are indebted to information imparted by himself) before detailing his botanical career and writings.

About the year 1750 Jeremiah Bentham, an attorney or solicitor, one of a family of scriveners who, as fathers and sons, had inhabited the Minories since the beginning of the seventeenth century, migrated to the West End of London, purchasing property in Queen's Square Place and Petty France (now York Street, on the south side of Birdcage Walk, St. James's Park). He had two sons: the elder, Jeremy, the well-known writer on Jurisprudence, the younger, Samuel (subsequently Sir Samuel), father to George, the botanist. Samuel devoted himself to the study of naval architecture, and at the age of twenty-two visited the arsenals of the Baltic for the purpose of improving himself. From thence he travelled far into Siberia, and became intimate with Prince Potenkin, who induced him to enter into the service of the Empress Catherine, at first in a civil, and afterwards in a military, capacity. In the latter he took a distinguished part in a naval action against the Turks on the Black Sea. For this he received the Cross of St. George, and was given the command of a regiment quartered in Siberia, which enabled him to penetrate eastward to the frontier of China. After ten years of absence he returned to England, and was shortly afterwards promoted to the rank of general. The death of Catherine followed soon after, when he was offered employment in England by his friend Earl Spencer, then First Lord of the Admiralty, who was anxious to avail himself of Gen. Bentham's ingenuity and experience in improving the civil branch of our naval system. This he accepted, resigning the Russian service, and attained the post of Inspector-General of Naval Works. His son has been heard to say that amongst other improvements introduced by Gen. Bentham into the dockyard were the steam sawmills and the machinery for the eccentric turning of blocks, through his employment of the late Isambard Mark Brunel, whom he brought over to England.

In 1796 Gen. Bentham married the eldest daughter of Dr. George Fordyce, F.R.S., the well-known physician and author. Mrs. Bentham was a woman of great ability and energy; she had actively aided her father in the preparation of his works, and with still greater perseverance she devoted herself to assisting her husband in his arduous labours, drawing up as well as writing out his voluminous reports to the Admiralty, and accompanying him on his visits of inspection to the dockyards, which were often of several months' duration. Up to the age of eighty she wrote a most beautiful hand, and it is within the recollection of readers of this article that letters in the *Times*, under her signature, when she was considerably over ninety years of age, appeared during the Crimean War, urging the introduction of improvements in our war material, especially great guns, which her late husband had suggested.

It was during one of the annual inspections of the Portsmouth Dockyard that George was born, at Stoke, then a village near Portsmouth, and now absorbed in that town. He was the second son, and had three sisters, one of them older than himself. All were forward children: on their fourth birthdays the two elder sisters made the clothes they wore on those days and wrote out a list of their possessions; and before he was five years old, George wrote copies, enjoyed reading Miss Edgeworth's "Easy Lessons" with his brother, and began to study Latin. The whole family were taught reading by the words, not letters or syllables.

In 1805 Gen. Bentham was sent by the Admiralty on a mission to St. Petersburg, having for its object the building in Russia of ships for our navy, and he took his family with him. There they remained for two years, during which time the education of the children was intrusted to a talented Russian lady, who could speak no English; and the young people, showing a remarkable facility for the acquisition of languages, were able before leaving to converse fluently in Russian, French, and German. Latin was acquired under a Russian priest, and, at six years of age, music, to which George subsequently became passionately attached, was commenced.

War between England and Russia breaking out in 1807, Gen. Bentham was recalled. The homeward route was by Revel and Sweden, and the voyages were notable. At Revel they embarked for Stockholm in a Russian frigate, a bad sailer, with a crew hardly any of whom had before been at sea; and, after driving backwards and forwards in the Baltic under continuous gales, they landed on the fourteenth day at Carlscrona! In Sweden they were detained several weeks, long enough for the two brothers and their elder sister, by dint of perseverance and hard study, to learn enough of Swedish to converse in that language and read it with tolerable ease. From Gothenburg they sailed for Harwich in a wretched craft, and, after beating about the North Sea in a succession of tempests, arrived on the fourteenth night, when the crew took the boats and hastened ashore, leaving the Benthams till the following midday with no other food but rejected bits of biscuit picked up wherever they could be found.

In England the family settled at Hampstead, whence the father went daily to his offices at the Admiralty and Somerset House, whilst George and his brother pursued their studies. These, then and ever afterwards, were conducted by private tutors, and it was a life-long source of regret to George that he had never been at school or college. This, in his opinion (and not his alone), accounted for an habitual shyness and reserve that often caused him to be misunderstood, and credited with motives or sentiments that were foreign to his disposition and character. Much of his time was spent at Berry Lodge, a house and property which his father had bought between Gosport and Alverstoke, where the summer months were passed, and which still belongs to the family. It was from here that he was once taken by his father on a visit to Lady Spencer at Ryde, and met at her house John Stuart Mill—then on a visit there—a boy of six, in a scarlet jacket and nankeen trousers buttoned over it, and who was then considered a prodigy. Bentham has described him as wonderfully precocious, a Greek and Latin scholar, historian, and logician, fond of showing off, and discussing with Lady Spencer the relative merits of her ancestor the Duke of Marlborough and the Duke of Wellington, he taking the part of the latter.

The year 1814 opened upon a period of great excitement throughout the Continent; the invasion of Russia by Napoleon and the burning of Moscow were naturally matters of intense interest to the Bentham family. The boy George, then only thirteen, now budded into an author, commencing with his brother and sister the translation of a series of articles from a Russian paper, detailing the operations of the armies, which were contributed to a London magazine of ephemeral duration. He gloried in the reverses and final abdication of Napoleon, and was presented to the Emperor of Russia by his father on the visit of that monarch to the naval establishment at Portsmouth.

Peace being proclaimed, the Bentham family went to France, and prepared for a long residence in that country; they resided first at Tours, then at Saumur and Paris, during the eventful period that extended from the return of Napoleon to his final overthrow. Young Bentham kept full journals of all that passed, interspersed with anecdotes relating to the forced exile of Louis, the defeat of the Emperor, the restoration of the Bourbons, the conduct of the allies, the execution of Ney and Labedoyère, the condition of the city of Paris, and the prominent part taken in the politics of the day by Walter Savage Landor, who was intimate with his family. Moreover, he seems to have been able at this early age to enjoy and even take his part in the society of the eminent men of the time and the *salons* of the leaders in literature and science, the Duc de Richelieu, Talleyrand, the Comte de Damas, Jean Baptiste Say, the aged Mme. Andelan (the daughter of Helvétius), were amongst the intimate friends of the family; as was Baron Humboldt, who took warmly to the lad, encouraging especially his taste for geographical science, giving him introductions to libraries and to individuals who could aid him in the preparation of a work which he had begun on the data of physical geography.

In 1816 Gen. Bentham organised what may be called a caravan tour of France for himself and family, having for its objects partly unceremonious visits to his many friends in the provinces, and partly the leisurely inspection of the great towns and other objects of interest. The *cortège* consisted of a two-horse coach fitted up as a sleeping-apartment, a long, two-wheeled, one-horse spring van for himself and Mrs. Bentham, furnished with a library and piano, and another, also furnished, for his daughters and their governess. The plan followed was to travel by day from one place of interest to another, bivouacking at night by the road, or in the garden of a friend, or in the precincts of the prefectures, to which latter he had credentials from the authorities in the capital. In this way he visited Orleans, Tours, Angoulême, Bordeaux, Toulouse, Montpellier, and finally Montauban, where a lengthened stay was made in a country-house hired for the purpose. From Montauban (the *cortège* having broken down in some way) they proceeded, still by private conveyances, to

Carcassonne, Narbonne, Nîmes, Tarascon, Marseilles, Toulon, and Hyères.

It was during this tour, when at Angoulême, that Bentham's attention was first turned to botany, and it fell out on this wise:—His mother, who was fond of plants, and a great friend of Aiton at Kew, had purchased a copy of De Candolle's "Flore Française," which was then just published. Young Bentham took it up accidentally, and was struck with the analytical tables for the determination of the affinities and names of plants, which exactly fitted in with the methodising, analysing, and tabulating ideas which he had derived from his Uncle Jeremy's works, and had endeavoured to apply to his own geographical tables. He at once went into the back-yard of the house, and, gathering the first plant he saw, he spent the whole morning studying its structure with the aid of the introductory chapter of the "Flore," which treated of elementary botany, and succeeded in referring it to its natural order, genus, and species. The plant, *Salvia pratensis*, was not an easy one for a beginner, owing to the irregularity of the flower and abnormal character of the ovary and stamens. His success led him to pursue the diversion of naming every plant he met with in future.

At Montauban, near Tours, where the family resided for many months, Bentham spent what he always regarded as the happiest period of his life; he was entered as a student of the Faculté de Théologie, at Tours, followed with ardour the courses of mathematics, Hebrew, and comparative philology (the latter a favourite study in after-life), and at home occupied his time with music, Spanish, drawing, and botany, whilst, during the holidays, dancing was his delight; it was a favourite boast that at Montauban he attended thirty-four balls between Twelfth-night and Mardi-gras, of which thirteen were consecutive, and lasted from nine at night to the same hour on the following day.

The appearance of the "Dictionnaire d'Histoire Naturelle," a course of lectures under Benedict Prevost, and De Candolle's general works on the structure and classification of plants, first opened his mind to scientific botany, and induced him to take up the study of exotic plants, to which he devoted himself till 1820, when he took to the amusement of shooting and stuffing birds. At this period, too, John Stuart Mill resided in his father's family for seven or eight months, and it was probably due to this that Bentham was diverted to the study of philosophy, and at the age of twenty began a translation into French of his uncle's "Chrestomathia," which was published in Paris some years afterwards. Here, too, he began the study of Lamarck's works, with the "Système analytique des Connaissances positive de l'Homme," only to give it up in disgust on reading "Dieu créa d'abord la matière," followed by the statement that nature was the second thing created, and this produced everything else. Sliding down from great things to small, a fit of entomology supervened, and he commenced tabulating observations on insect life as he had his geographical and philosophical facts and ideas.

The next phase of Bentham's Protean life was that of a practical estate-manager and farmer, his father having bought a property of 2000 acres, that of Restinalières, near Montpellier, and given over the management of it to his now only son, for he had lost his eldest through an accident some years before. Into this work Bentham threw himself with ardour, and now his methodical habits, close application, and familiarity with French country life stood him in good stead. The farms and vineyards rapidly improved, and were very profitable. Still he found time for his favourite pursuits, his holidays were spent in botanical excursions to the Pyrenees and Cevennes, and his spare hours at home in logic and the preparation of a French edition of his uncle's essay on Nomenclature and Classification. Here, too, he wrote his own first work of importance, "Essai sur la Nomenclature et Classification des Arts et Sciences," which was published in Paris, and established his position in France as an acute analyser, clear expositor, and cautious reasoner.

In 1823 Bentham was sent to England for the purpose of purchasing agricultural implements and obtaining information as to improved methods of farming that might be introduced into the Montpellier estate. On arriving in London he was asked by his uncle to visit him, bringing his translation of the "Chrestomathia." This invitation, the attractions of English scientific and literary society, and the fact that provincial jealousies threw every obstacle in the way of the introduction of improvements into the Restinalières estate, led ultimately to the abandonment by his father of the latter (in 1826), and the return of the Bentham family to England.

On his arrival in London he was at once received into the best literary and scientific society; he attended the breakfasts and receptions of Sir Joseph Banks, and studied in his library and herbarium, and that of the Linnean and Horticultural Societies, and formed life-long friendships with Brown, Lambert, Don, Sabine, Menzies, &c. During a tour through England and Scotland, taking with him letters of introduction to the leading botanists there, he became acquainted with Sir James Smith, Dawson Turner, Graham, Greville, Hooker, and many others. It was during this tour that he formed a friendship with the late Dr. Arnott (subsequently Professor of Botany in Glasgow), with whom he made, in 1824, an extended journey into the Pyrenees, which resulted in his first botanical work, "Catalogue des Plantes indigènes des Pyrenées et de Bas-Languedoc, avec des Notes et Observations" (Paris, 1826).

On the settlement of the family in London a new career was opened to Bentham, his uncle Jeremy having invited him to devote much of his time to aiding him in the arrangement and preparation of his MSS. for the press, accompanying the invitation with assurances that he would provide for him at his death. The proposal of aiding his uncle was congenial to him, but not the accompanying one, for he was now desirous of seeking a serious profession that would lead to independence; and after many embarrassing interviews on the subject with his uncle it was arranged that he should enter Lincoln's Inn and study law, whilst devoting some morning hours to his uncle, besides dining with him twice a week and writing for him afterwards from 8 to 11 p.m. In one shape or another this arrangement of working with and for his uncle lasted till the death of the latter in 1832; when, owing to the many foolish and fruitless speculations of the great jurist, the extravagant sums spent by his executors on the posthumous publication of his works, and some irregularity in his will, Bentham found himself in possession of the house in Queen Square Place, but with less property than he should have received. His father's death, however, in the previous year, had rendered him in a measure independent.

From 1826 to 1832 Bentham's life was one of incessant activity. Besides his irksome labours for his uncle, in whose ideas he did not at all participate, and many of whose acts he regretted, he had the editing and often rewriting of his father's (now Sir Samuel Bentham's) voluminous papers on the management of the navy and the administration of the dockyards. His legal studies were sacrificed to logic and jurisprudence; the fruits of the former being the publication of his "Outlines of a New System of Logic, with a Criticism of Dr. Whateley's Elements of Logic" (London, 1827), in which the doctrine of the quantification of the predicate is for the first time clearly set forth. This remarkable work fell still-born from the press; only sixty copies were sold, when the publishers became bankrupt, and the stock was seized and went for waste paper. It was not till 1850 that the fact of its containing a discovery was recognised (*Athenæum*, December 31, 1850); this led to a sharp dispute as to Sir

William Hamilton's claims to the same, and which was ended by a verdict of Herbert Spencer's in the *Contemporary Review* (May 1873) in favour of Bentham.

In jurisprudence two subjects deeply engaged his attention—one was codification, in which he entirely disagreed with his uncle, and his paper on which attracted the attention of Brougham, Hume, and O'Connell; the other was the laws affecting larceny, his suggestions on which he submitted to Sir Robert Peel, *apropos* of his Bill for the consolidation of the criminal law. Of this Peel thought so highly that he wrote a complimentary letter to its author, informing him that his remarks should be fully considered and submitted to Sir John Richardson, to whom the Bill was referred. Brougham also (to whom his uncle showed the paper) wrote a letter of eighteen pages of remarks on it. These and a pamphlet on the "Law of Real Property" are Bentham's chief contributions in his adopted profession. Of practice he had very little; he got his first brief in 1832, and, as junior counsel, bewigged and begowned, followed his leader when called for; but, being overcome with nervousness, he cut short his argument, and had the mortification of hearing the counsel for the opposite side say that "a more preposterous speech it had not been his fortune to hear during a long course of practice"

In botany Bentham was more at home than in the courts. In 1828 his herbarium arrived from France, and in the same year he was elected a Fellow of the Linnean Society, and joined with delight its reunions, attending its meetings punctually, its anniversary dinners, and those of its club. The return of Wallich from India with the enormous collections of the East India Company which first made known the flora of the Himalayas, Burmah, and many other parts of that vast empire, gave him occupation in the study and publication of various intricate genera and natural orders of plants. Of these writings, his "Labiatarum, Genera and Species" was the most important; this large family having been in a state of utter chaos before Bentham brought his remarkable powers of generalisation and description to bear upon it.

In 1829 Bentham finally gave up the law for botany, and amongst other labours accepted the honorary secretaryship of the Horticultural Society, which was in a perilous condition of debt and dissension. From these he extricated it with perfect success, and, aided by his friend Lindley, the assistant secretary, raised it to a flourishing condition financially and scientifically, and which it has never since approached.

In 1833 he married the daughter of the late Right Hon. Sir Harford Brydges of Boultibrooke, formerly Ambassador at the Court of Persia, and in 1834 removed to his late uncle's house in Queen Square Place, the site of which is now occupied by the "Bentham wing" of the "Queen Anne's Mansions." There he resided till 1842, when, with the view of providing better accommodation for his now extensive herbarium and library, and devoting himself more exclusively to science, he removed to Pontrilas House in Herefordshire, where he revised the *Labiatæ*, and elaborated the great families of *Scrophularineæ*, *Polygoneæ*, and others for his friend Alphonse de Candolle's continuation of the "Prodromus Systematis Naturalis Regni Vegetabilis."

In 1854, finding that the expenses of his collections and books were exceeding his means, he determined on presenting the whole to the Royal Gardens at Kew (they were valued at 6000*l*.), and returning to London; at the same time he entertained the idea of abandoning botany, with characteristic modesty regarding himself as an amateur who had hitherto pursued the science rather as an intellectual exercise in systematising, than as a scientific botanist, who, in his opinion, should unite a competent knowledge of anatomy, physiology, and of Cryptogamic plants, to skill as a classifier and describer of Phanerogams. He yielded, however, to the entreaties of his friends, the late Sir W. Hooker and Dr. Lindley, coupled with the offer from the former of access to his own private library and herbarium, and a room in Kew where his own was placed, backed by the request that he would inaugurate the series of colonial floras that was planned at Kew, by elaborating that of Hong Kong. Consequently, in 1855 he again took up his residence in London, first at Victoria Street, and latterly at 25, Wilton Place, and for the remainder of his life, till disabled by age, he almost daily throughout the year, except during autumn excursions to the Continent or visits to friends in Herefordshire, repaired to Kew and occupied himself exclusively with descriptive botany from 10 a.m. till 4 p.m.

The Hong Kong flora finished, Bentham took up that of Australia, and, aided by the observations, collections, and numerous discoveries of his active and able correspondent, Baron Mueller, of Victoria, he, single-handed, completed it in 1867 in seven octavo volumes, containing about 7000 species, the most extensive exotic flora ever brought to a conclusion. Meanwhile, the plan of a general work on Phanerogamic plants had been on various occasions discussed by Dr. Hooker and himself; at first it was proposed to confine it to carpology, but it finally assumed shape in a critical study and description of the genera of plants, founded on all available characters, for which his herbarium and the Hookerian offered unrivalled resources. This work, entitled "Genera Plantarum ad Exemplaria, imprimis in Herbariis Kewensibus servata, definita," was commenced in 1862 and concluded in 1883, the greater portion of it being the product of Bentham's indefatigable industry.

The only material break in Bentham's work at Kew was his acceptance of the presidency of the Linnean Society, which he held from 1863 to 1874, and to the duties and interests of which he devoted his time, his energies, and his purse, with characteristic singleness of purpose. He combined with the duties of President those of Secretary, Treasurer, and Editor of the botanical parts of the *Transactions* and *Journals*, spending a part or the whole of one day a week in the Society's rooms during the eleven years of his presidency. On the final transference of the Society's collections, library, and portraits from the rooms in old Burlington House to those they now occupy, he arranged the whole himself, classifying the books, and literally with his own hands placing them on the shelves they now occupy. His presidential addresses were remarkable for their grasp and wide range, and those who knew him only as a systematist and descriptive writer were surprised to find the great powers of analysis and the sound judgment he displayed in discussing evolution and its bearings, the writings of Haeckel, geographical distribution, the condition and prospects of fossil botany, deep-sea life, abiogenesis, methods of biological study, and the histories and labours of the Natural History Societies and their journals, and the scientific periodicals of every civilised quarter of the globe.

On the conclusion of the "Genera Plantarum" in the spring of 1883, his strength, which had for some years shown signs of diminution, suddenly gave way, and, after several ineffectual attempts to resume his studies, his visits to Kew ended, and, lingering on under increasing debility, he died of old age on September 10 last, when within a few days of his eighty-fifth year, leaving no family, and directions that his funeral was to be a strictly private one.

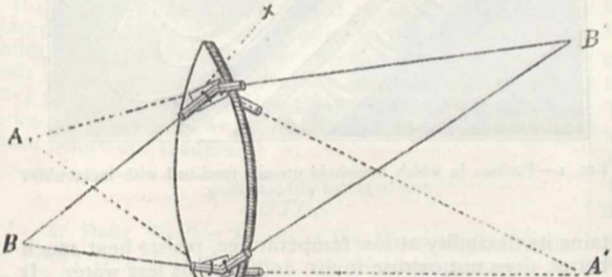
The above sketch conveys no idea of the prodigious amount of systematic and descriptive work in Phanerogamic botany that Bentham accomplished. In the "Genera Plantarum" there is hardly an order of any importance that he did not more or less remodel. His labours on the Compositæ, Gramineæ, Cyperaceæ, and Orchideæ are especially noticeable, and he contributed masterly essays upon these and others to the Linnean Society. His treatises on the Leguminosæ are no less exhaustive and valuable; and there is not a temperate or tropical region of the globe whose floras have not been largely elucidated by him. It may safely be affirmed that for variety and extent of good work of the kind he had no superior. The distinctive qualities of his descriptions are—scientific accuracy, good arrangement, precision of language, lucidity, and the discarding of what is superfluous. In these respects he has had no superior since the days of Linnæus and Robert Brown, and he has left no equal except Asa Gray.

Of his amiable disposition, and his sterling qualities of head and heart, it is impossible to speak too highly: though cold in manner and excessively shy in disposition, he was the kindest of helpmates and most disinterested of labourers for others.

Of recognition by foreign Academies Bentham had his full share, including that of Corresponding Member of the Institute of France. His election into the Royal Society was not till late (1862). It should have been in 1829, when he was proposed by R. Brown, and at his recommendation withdrawn, along with other scientific candidates, who thus showed their dissatisfaction at the Society's election of a Royal Duke to the President's chair. He, however, received the Royal Medal of the Society, and in 1878, on the completion of the Australian flora, the Secretary of State for the Colonies, unsolicited, recommended him to Her Majesty for the Companionship of the Order of St. Michael and St. George.

A MODEL LENS FOR USE IN CLASS DEMONSTRATIONS

IN using diagrams or models as aids in teaching, this question constantly arises—How far may we represent Nature diagrammatically without producing in the mind of a student one-sided and false impressions? I have myself endeavoured to follow this rule: that, if a complicated object or phenomenon is to be studied, we may simplify this, and bring out many salient features, with a diagrammatic representation; this must, however, only be looked upon as a stepping-stone to a more complete study of the object or phenomenon itself. The



model of a lens to be described I have found of much service in lecturing, antecedent to a demonstration of the passage of luminous rays through actual lenses.

This model may be constructed out of the simplest materials, and should cost but two or three shillings. It consists of a piece of deal board cut in the shape of the cross-section of a biconvex lens, and fixed to a stand of wood (see diagram). Four small squares of board, *x*, are fixed in the positions indicated, two on either side of the lens. Glass tubes bent at obtuse angles are fixed to these by staples, and can rotate with them on the screws by means of which the squares are fixed to the lens. Two pieces of string to represent visual rays are then passed through the tubes A A′ and B B′. The theory of the use of this model will be at once apparent. A ray of light passing through a lens of a given curvature and density will practically (this is not absolutely true) be bent at a given angle, whatever be the direction of the ray, so long as it passes through the same part of the lens. In the model this constant degree of bending is given to the string—representing the ray of light—by the bent tubes. These, rotating on the lens, allow one diagrammatically to represent the rays passing through it in any desired direction.

Taking the string B B′, for example, and holding it at these two points in the two hands, and keeping the string taut, it will be found that in shifting the point B—representing a luminous point—in any direction, B′ will shift until it occupies the position of the corresponding focus. By shifting the string it is possible to demonstrate the focal points of parallel, diverging, and converging rays, either parallel to the axis of the lens, or on secondary axes. Then, by using at the same time the string fixed to the other side of the lens A A′, the formation of an image may be shown. Grasping with the two hands A and B, an assistant holding A′ and B′, it will be seen how by this lens an inverted image is produced. Bring the points A and B nearer the lens, keeping them, however, at the same distance apart, and the points A′ and B′ will recede from the lens and from each other, showing how the image of the nearer object is formed farther away from the lens, and is larger in size. On the other hand, if A and B be pulled away from the lens, A′ and B′ approximate to it and to one another.

In working the model the squares should rotate easily, and the strings must always be held taut. For lecture-room purposes the lens should be about two feet high, and the strings may be coloured. On the same principle I have constructed models of other lenses or lens combinations.

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THE ELECTRICAL EXHIBITION AT PHILADELPHIA

[FROM A CORRESPONDENT]

TO one who has visited the various electrical exhibitions held in recent years in the chief European cities, the Exhibition now open in the city of Philadelphia might seem a little disappointing from the absence of novelty in the exhibits, though replete with objects of interest for all to whom this class of show is not familiar. As might be expected, the strong point of the Philadelphia show is electric lighting; and the building—a temporary structure erected close to the depot of the Pennsylvania Railroad Company on the west bank of the Schuylkill—presents both interiorly and exteriorly a blaze of light. The array of dynamo-machines is remarkably complete. Edison leads the way with a variety of machines, including one "Jumbo," of the same type as, but rather smaller than, the pair of machines in use at the Holborn Viaduct lighting station. There are also a large number of Weston's machines, and a very valuable exhibit by the Thomson-Houston Company. The machines of the latter company are quite unique amongst dynamos; one of them can maintain sixty arc lights on one circuit, though there are but three coils on its armature. Other dynamos are shown by Ball, Hockhausen, Van Depoele, and McTighe. There are several excellent arc lamps, possessing novelty, however, in matters of detail only. A great show of incandescent lamps is made by the Edison Company, and also by the Weston Company. The latter has some remarkable lamps with filaments sixteen inches in length prepared from a new parchment-like substance, of which samples are shown. These lamps are from 100 to 200 reputed candle power.

Electric motors are exhibited by several inventors.

The little Griscom motor and the Cleveland motor are of course present, driving sewing-machines and fans. Edison contributes also some small motors of excellent finish. Amongst larger machines there is one by Daft and one by Elihu Thomson. But by far the most important of all exhibits of this class is that of Mr. F. J. Sprague, which shows a very great advance on anything hitherto accomplished. Mr. Sprague appears to have succeeded in producing a motor which runs at a uniform speed whatever its load. It is employed in driving a small loom.

In telephones there is not much new. The Clay Telephone Company exhibits its system, with a remarkably simple and efficient receiving instrument. Beyond this there is absolutely nothing new. The chief interest centres on the historic exhibitions of Elisha Gray, Graham Bell, A. E. Dolbear, and Van der Weyde. The remarkable telephones of Daniel Drawbaugh are not yet exhibited to public gaze on account of pending legal proceedings.

In telegraphy the sole novelty is the marvellous multiplex telegraph of Delaney, based upon the principle of La Cour's "phonic wheel," and capable of transmitting seventy separate messages simultaneously through a single wire.

Passing on to other exhibits, it should be mentioned how Messrs. J. W. Queen and Co. display a very large collection of imported apparatus, including the finest instruments of Elliott Brothers, Carpentier, Breguet, Hartmann, and Edelmann. Some excellent measuring-instruments by the Electric Apparatus Company of Troy, N.Y., are also shown. A collection of a curious and instructive nature was exhibited by the U.S. Patent Office, consisting of the historic models sent by inventors. Here may be seen the original Edison telephone, the original Brush dynamo, the original Edison lamp, and many other similar objects, including many old forms of electric motor dating from the years 1840-50. A special effort has also been made to get together a complete modern library of books bearing on the science of electricity. Some six thousand volumes have in this manner been procured, and form a valuable collection.

The Franklin Institute of Philadelphia, which has organised this Exhibition, must be congratulated on the energy and enterprise which it has put forth. It would be impossible to get together a collection of apparatus more thoroughly representative of the solid progress made in electro-technics on the American continent. Though the Exhibition is yet far from complete, it has become much more so since its opening on September 2. It will remain open until October 11.

A NEW APPLICATION OF INDIA-RUBBER[1]

IF iron takes the lead among articles of modern industry in the extent and number of its applications, it yet falls short of india-rubber in their variety. This latter article, indeed, promises soon to attain a universal diffusion. Its industrial career, though little more than just begun, already outstrips that of most substances that were first in the field.

The mere enumeration of its qualities would suffice to account for the diversity of its applications. It possesses so great an elasticity that by this quality alone it adapts itself to a thousand different uses—brace-bands, garters, sides of boots, &c.

Observe how, if not the lightest, india-rubber is at least the most powerful reservoir of mechanical energy known. It lends itself most readily to the restitution, under the form of mechanical labour, of the energy imparted to it by tension, and this restitution may be effected with remarkable quickness. It is owing to the relative lightness of india-rubber considered as an accumulator of energy, and, above all, to its power, that the exactness of the principle of "heavier than air" may be demonstrated on a small scale.

[1] From *La Nature*.

From an electrical point of view, india-rubber acts as a better insulator than gutta-percha, and is, indeed, one of the best insulating bodies known. At the same time that its specific inductive capacity is weaker than that of gutta-percha, it does not become plastic at a moderate temperature. These properties render it an excellent insulator in electrical applications: submarine and subterranean telegraphy, electric light, transmission of force, &c. While it insulates better than gutta-percha, the conductor, where india-rubber is used, does not run the risk of being put out of centre, as is the case sometimes with gutta-percha.

India-rubber is known to oxidise under exposure to air and light; above all, under alternations of dryness and damp. By subjecting it, however, to a special operation, called vulcanisation, a product is obtained which maintains its flexibility at low temperatures, resists heat much better, does not oxidise in air, and absorbs less water. It is especially under the form of vulcanised india-rubber that its applications are numerous.

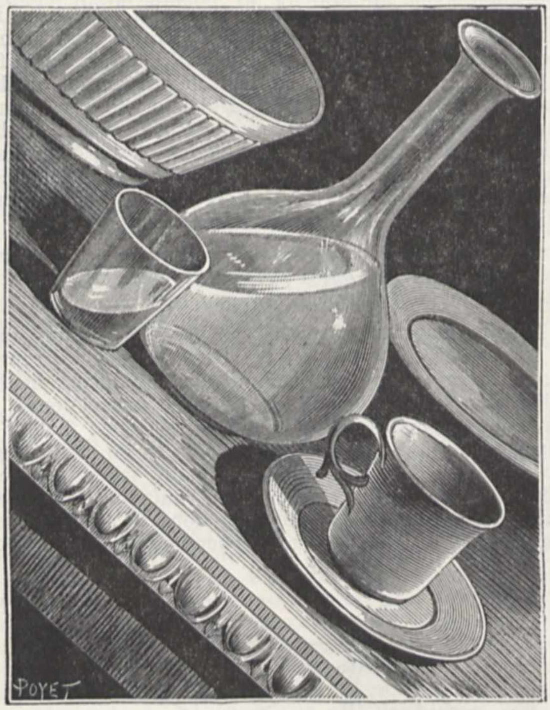

FIG. 1.—Position in which household utensils furnished with india-rubber may be placed without falling.

There is, finally, a third form of india-rubber, no less useful, that of ebonite, or hardened india-rubber, a form which combines with its lightness and great electrical resistance, the further advantage of resisting acids, and which is therefore exclusively employed when vessels for the electric pile or other reservoirs of a light and not readily brittle character are wanted. Like a new Proteus, india-rubber is thus seen to adjust itself to the ever more numerous and pressing demands of modern industry.

To turn now to the new, curious, and original application an idea of which it is the object of this notice to convey. The aim of the inventor, whose name unfortunately has not reached us, has been to take advantage of the great mutual adherence of a soft and a hard body. It is by the utilisation of this relation that the inventor has originated quite a series of household objects in earthenware, porcelain, glass, &c., which manifest a remarkable adherence to the body supporting them, and this result he has obtained by the very simple expedient of securing to the lower part of all kinds of goblet objects (Fig. 2) a groove, A A, in the form of a swallow-tail, into which is lodged a band of red india-rubber, a variety of vulcanised india-rubber, forming, when deposited, a kind of circular cushion. Objects furnished in this manner are almost incapable of falling from their places. They may be placed on a wooden table, and the table be inclined (Fig. 1) from 45 to 50 or even 60 degrees without upsetting any of them. The most direct and immediate use offered by the properties which a vessel so provided with india-rubber thus acquires is evidently in the shipping service. At the Fisheries Exhibition of last year in London, and at the Health Exhibition of this year, the inventor has displayed a little barque, the bridge of which is entirely covered with dishes, plates, &c., all furnished in the manner described, and the barque, floating in a basin, may be

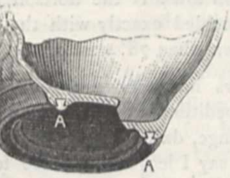

FIG. 2.—Arrangement of the india-rubber covering in a swallow-tail groove A A, provided at the base of the object.

tossed to and fro in every direction without displacing a single piece.

All who have been on long voyages at sea know the disagreeable and painful impression produced by the screen of cord laid along the table to prevent the glasses and bottles from falling.

As an accessory advantage possessed by the undisplaceable india-rubber dishes may be reckoned the less noise they occasion, and the less risk of breaking they run on being clapped down carelessly or hastily on the table. Washhand basins and water-pots may likewise be advantageously constructed with the india-rubber band.

Invalids in bed, and compelled to eat from a board placed more or less horizontally across the bed, and children, so apt to upset glasses and bottles, will both find their advantage in the undisplaceable contrivance. We have thus a simple, ingenious, and useful application of india-rubber, which we thought it incumbent on us to place before our readers.

NOTES

IN the Daily Weather Report of the Meteorological Office for Friday last, there appears a note of some importance on the temperature of the Gulf Stream. A comparison has been made between returns from 28 ships, containing 116 recent observations, with the data in the charts of the Atlantic sea-surface temperature (recently published by the Office), of the area which lies, roughly speaking, between the latitudes of the North of Ireland and of Bordeaux respectively, and extending half way across the Atlantic. It appears from this comparison that during the past summer the ocean temperature in the course of the Gulf Stream was abnormally high, in June the whole of the above-mentioned area being about 3° above the mean, in July the half of the area nearest to the British Isles being about 1°·5 and in August about 1° higher than the mean. It is to be hoped that similar comparisons will from time to time be given by the Meteorological Office, so that the point may be investigated which was long ago suggested by the late General Sabine, as to there being possibly a connection between the temperature of the tropical and sub-tropical waters of the Atlantic and the weather of Europe which followed, and to which we drew attention some years ago (NATURE, vol. xxi. p. 142).

SIR WILLIAM THOMSON lectured on Monday night, under the auspices of the Franklin Institute, at the Academy of Music, Philadelphia, on the "Wave Theory of Light," to a large audience.

GEN. PITT-RIVERS, as Inspector of Ancient Monuments, has issued a very careful and detailed report on his excavations in the Pen Pits, near Penselwood, Somerset. These pits are on the borders of Wilts, Somerset, and Dorset, and consist of a number of hollows in the surface of the ground of various forms and sizes, without order or regularity in their distribution. They cover a tract of high land of greensand formation, the area thus originally covered having been estimated at 700 acres. Various conjectures have been made by antiquaries as to their use, some maintaining that the pits are the remains of a great British city, or formidable series of fortifications; if so, as Gen. Pitt-Rivers points out, it would upset all our conclusions as to the social and political condition of the Britons, and of the extent of the pre-Roman population of these islands. Last autumn Gen. Pitt-Rivers carried out a series of excavations, cutting a section right across the pits in the parts most likely to yield remains of any possible inhabitants. Not a bit of pottery the size of a pea, he tells us, was found, and no indication whatever that these pits have ever been used as habitations. Ample evidence, however, was found that the pits were used as quarries, from which the inhabitants obtained grind-stones or quern-stones. The remains of quern-stones were found, all bearing marks of having been tool-dressed, and in the villages around many such stones are met with, all of them stated to have been obtained from the pits. It is to be hoped that the very careful piece of work thus performed by Gen. Pitt-Rivers, and his report, will set the question permanently at rest. Several plates of sections, plans, &c., accompany the report.

A COMMISSION of five French medical men have reported on their investigations as to the real nature and action of the cholera poison. The substance of their report as it appears in the *Times* is as follows:—"The initial lesion of cholera takes place in the blood. It essentially consists in the softening of the hæmoglobin, which makes some globules lose first their clear shape, the fixity of their form, and the faculty of being indented. Those globules adhere together, lengthen out—*en olive*—stick together, and in fulminating cases especially some are seen which are quite abnormal, while others appear quite healthy. The entire loss of elasticity of the globule (which is shown by the preservation of the elliptic form when it has been stretched out) is, in our view, a certain sign of the patient's death. To stretch out a globule you have merely to alter the inclination of a plate on which a sanguineous current has been established in the field of the microscope. The fluid column stops at one point, whereas the rest continues to flow. An elongation of the intermediary globules results, and then a rupture of the column. In the gap thus formed are some scattered globules. If these revert to their primitive form, the patient may recover. If they keep the elliptic form, we have seen death follow in every case, even if the patient's symptoms were not serious at the time of the examination of the blood."

EDUCATION in British Burmah appears to be in a sad condition. According to a correspondent of *Allen's India Mail*, the province has not yet produced any student capable of attaining the B.A. degree, and only five or six have succeeded in passing the first examination in Arts. There is no local school of medicine, and such native medicine as exists is a compound of empiricism and a belief in charms and enchantments; while the principal legal authority has repeatedly deplored the gross ignorance of law exhibited by both advocates and judges. The Viceroy himself complained of the slowness of the official department in respect to female education. A change, however, appears to have been made by the Government of India, which has authorised the establishment of a College, though not yet of a University. Until 1881 the control of education in British Burmah was purely administrative, being vested in a Government department; but Lord Ripon decided to create a controlling body something like the London School Board, except that its members will be nominated, not elected. The rights of the missionaries, who appear to have been the pioneers of education in the province, as well as of the Burmese themselves, were recognised, and they are represented on the new governing body. The labours of the Board so far have been very successful. It created a law school and a free library; it has organised and simplified all public examinations, and has promoted a movement amongst the wealthy natives for endowing scholarships for the higher branches of education and for the promotion of learning generally. This is all very promising; but, according to the correspondent whom we have quoted, there is a slight rift in the lute in the shape of the hostility of the local officials to the acts and even to the existence of the Board. Bureaucratic prejudice, however, can hardly hinder effectually the work of a council established on such a broad basis as this one is, backed as it also is by the authority of the Government of India.

THE Health Exhibition in connection with the Autumn Congress of the Sanitary Institute of Great Britain was opened at Dublin on Tuesday by the Lord Mayor. The inaugural address to the members of the Institute was delivered in the evening by the President, Sir Robert Rawlinson. He observed that in our own days one of the greatest works to be accomplished is to stem the torrent of sanitary ignorance now working so much mischief. Quarantine, as now practised, works at enormous money cost as well as incalculable inconvenience, and produces much misery without preventing the effects intended to be warded off. Sir Robert Rawlinson referred to the conditions under which cholera has so long afflicted India and China, partly arising from bad or insufficient food, impure water, and defective sanitary arrangements. Turning to England, he spoke of its temperate climate, pure atmosphere, and soil almost entirely free from malaria; but we have much to be ashamed of, and much to amend, in our social economy. Commenting on cholera generally, he said that occasionally it is epidemic we know. That it is contagious in the sense imagined by the ignorant experience does not prove. The President then pointed out the connection between disease and the want of good sanitary arrangements in various countries, and showed the importance of pure air, good food, pure water supply, and efficient drainage and sewerage, putting forward practical suggestions for sanitary engineers.

MAJOR SERPA PINTO, the Portuguese traveller, will leave Mozambique very shortly at the head of an expedition in order to explore the country between Mozambique and Lake Nyassa. The route to be taken is kept secret, but it is rumoured that he will proceed to the Congo, *viâ* Lake Tanganyika. The expedition, which is now being fitted out, will be on a large scale. It will comprise one hundred Inhambane Zulus as a body-guard, and two hundred and fifty carriers, and will be accompanied by a Portuguese naval lieutenant and an English photographic artist.

THE death is announced from Bangkok of Mr. Henry Alabaster, the most eminent European servant of the Siamese Government. Besides various political services, Mr. Alabaster, who had been at one time in the British Consular Service, played an important part in the great advances recently made by Siam. He introduced and established the telegraph and telephone in the country, collected a valuable European library for the palace, and originated the museum and the botanic gardens at Bangkok.

INTELLIGENCE has been received at Mozambique of the death, on August 16, of Capt. Foot, British Consul in the districts adjacent to Lake Nyassa. Capt. Foot has done some good exploring work in the Nyassa region.

THE Annual Exhibition of the Photographic Society opens at the Gallery in Pall Mall on Monday next.

A RED glow, similar to those of last year, was seen in the western sky at Berlin on September 13 at 6.45 p.m., viz. half an hour after sunset. It reached to a height of about 20° above the horizon, the colour being red to violet, which changed into a deep yellow near the horizon. Some measurements of the visible diameter was made by an observer, who discovered that the glow was limited by a spherical segment 20° in height, and with an extension towards the horizon of 35°. The centre of the segment coincided exactly with that of the sun below the horizon, which was then 78° west of the true north.

THE first news has been received from Lieut. Wissmann, leader of the expedition for the exploration of the Kasai. In a letter from Malange, dated August 25, he writes: "I am at last so far that I can say I leave this place to-morrow." Till then he had been merely making preparations.

A RECENT issue of the *Ceylon Government Gazette* contains a correspondence on the "grub" which ravages the coffee plantations of the island. The principal, and in fact only important, document in the publication is a lengthy report by Mr. R. McLachlan on the subject. Some forty species of beetles were submitted to him, but special interest centred in twenty of these, all or nearly all of which were allied to the *Melolontha vulgaris*, or common European cockchafer. Mr. McLachlan assumes that no undergrowth of grass or other herbaceous plants is allowed in the plantations, for the grubs of the European cockchafer and its allies feed on the roots of such plants, and not as a rule on those of trees and shrubs. But the larvæ would make their way from the roots of the weeds to those of the coffee plant. Whether hardening the surface of the ground around the plant so as to render it difficult for the female to deposit her eggs would be of any efficacy, is a point for the planters to decide for themselves in view of the welfare of the plant at the time. Mr. McLachlan professes himself unable to suggest any chemical poison for the grub, although he thinks that dilute kerosene oil might be tried. He advises, "above all things," to encourage insectivorous birds to the fullest possible extent, and adds that a flock of crows probably destroy more grubs in an hour than would be possible by any artificial means in a week; the systematic catching of the perfect insect or larva is also suggested as beneficial, and hand-picking should be resorted to where labour is cheap. Finally, he thinks it highly desirable that the Planters' Association or the Ceylon Government should establish an experimental plantation of a few acres, in which the natural history of the various kinds of grub, and the effect of the various supposed or real remedies, could be carefully watched.

A NEW development of telegraphy has been instituted by Michela in Italy: he has constructed a machine by which signs corresponding to various sounds can be telegraphed; thus we have practically a telegraphic shorthand to which the name "steno-telegraphy" is given. Michela's apparatus has now been in regular use for some period in telegraphing the debates of the Italian Senate. The transmitting apparatus briefly consists of two series of ten keys, each of which corresponds to some particular sound. Each key acts in reality like a Morse key, and thus transmits a current to the receiving instrument. The receiving instrument consists of a combination of twenty Morse receivers, to each of which is attached a style which marks on the receiving paper its proper sign, thus producing a stenographic message. Great speed in transmitting is claimed for this method, and the following figures are given as comparative :—

Morse simple	500	words per hour
Hughes simple	1,200	,, ,,
Wheatstone	1,800	,, ,,
Steno-telegraphic	10,000	,, ,,

A MEDICAL student, M. J. Olsen, who has been engaged during the summer in studying the fungoid flora in the neighbourhood of Bergen (Norway), has found on Ask Island a specimen of the remarkable *Tricholoma colossum*. It is the first time it has been found in Norway, and it has only once been found in Sweden. The stem is 2½ inches in diameter. Prof. Elis Fries in describing this variety says : "I discovered this unique variety for the first time among branches of spruce lying on the ground in a place near the Tem Lake in Småland (Sweden). It is the largest and finest of the hitherto discovered mushrooms."

THE thirteenth annual *conversazione* of the Chester Society of Natural Science was held in the Town Hall on September 25, and was attended not only by the members, but by a contingent of the Iron and Steel Institute, who have been holding their annual meeting in the Cestrian city. The Kingsley Memorial Medal was awarded to Mr. A. O. Walker, F.L.S., and Kingsley Memorial prizes were given for local natural history collections. It was announced that a prize of 10*l.* would be given in 1885 for the best collection of coal-measure fossil plants from the Society's district, a similar sum in 1886 for the best collection of "Bees and Wasps" from the same area, and in 1887 "for the best Essay on the Physiography of the Society's District, on the lines of Prof. Huxley's Physiography ;" the district in question being Flint and Denbigh, with as much of the county of Cheshire as lies west of a line drawn south from Warrington. The exhibition of microscopic objects was, as is usually the case at Chester, exceedingly good, and for teaching purposes they were rendered more useful by the publication by the Society of a little handbook of twenty-eight pages, on Natural History, for use in the annual *conversazioni* and other meetings of the Society. It is drawn up by Mr. C. F. Fish, and appears to be an expansion of the useful programme, on which we commented last year. The information as to the classification and structures of the lower orders of life, both animal and vegetable, appear to be very carefully done, and are very concise. The work could be made much more useful by expanding the geological and physical portions ; it is published at a few pence.

DR. GEORG SCHWEINFURTH has left Berlin to return to Egypt, whence he intends to start upon a new scientific exploring tour through the desert.

ON September 18 the meeting of German naturalists was opened at Magdeburg, under the presidency of Dr. Gachde. Over a thousand men of science were present. Strasburg was fixed upon as next year's meeting-place, with Profs. Kussmaul and De Bary as secretaries. Among the addresses delivered we may mention :—On the relation of micro-organisms to the infectious diseases of man, by Prof. Rosenbach (Göttingen) ; on the importance of German colonisation in Africa, by Dr. Gerhard Rohlfs ; various medical addresses by Drs. Schwarz (Cologne), Paetz (Alt-Scherbitz), Finkler (Bonn), and Prior.

THE death is announced near Sydney of James Snowdon Calvert, the last survivor of Leichhardt's Australian exploring expedition.

A TELEPHONE now transmits, by the ordinary telegraph wire, the music from the Brussels Opera House to the Royal Châlet at Ostend. The system, of course, is Van Rysselberghe's, mentioned in our last number.

THE late Dr. Ferd. von Hochstetter's travelling reports, dating from the celebrated *Novara* Expedition (1857–59), are now being published in book form, upon the occasion of the twenty-fifth anniversary of the *Novara's* safe return to Trieste. The book will contain a portrait of the author, a preface by V. von Haardt, and a map of the course of the *Novara*. Hölzel of Vienna is the publisher.

M. CHARLES HUBER, who was travelling in the interior of Arabia in the service of the French Ministre de l'Instruction Publique (formerly together with Prof. Euting of Strasburg) has been murdered near Labegh (Rabegh ?) by Bedouins of the Harl tribe. His Arabian servant Mahmoud has met the same fate.

NEWS has been received from Capt. Adrian Jacobsen, now travelling in Northern Asia, by order of the Berlin Ethnological Museum with a view of making ethnographical collections. Capt. Jacobsen, after leaving St. Petersburg, visited Kasan, Ekaterinburg, and Tomsk, and has already sent home two large cases containing ethnographical objects collected among the uncivilised Russian tribes of the Tscheremiss, and Tschmrasch, and Wotjäks.

REFERRING to our note of last week on Mr. St. Clair's "Note on a Possible Source of Error in Photographing Blood Corpuscles," the author writes to say that "in Dr. Norris's photographs where the colourless disks are well defined, the dark ones are out of focus." But it has not been shown possible to produce the ghosts while the real images are *at all* visible, and until this is done we must adhere to the opinion we have already expressed.

THE additions to the Zoological Society's Gardens during the past week include a Toque Monkey (*Macacus pileatus* ♂) from India, presented by Mrs. Batchelder ; a Common Marmoset (*Hapale jacchus* ♂) from Brazil, presented by Mr. W. E. Steinscher ; six Great Bats (*Vespertilio noctula*), British, presented by Mr. W. Atkinson ; two King Parrakeets (*Aprosmictus scapulatus*), two Cockateels (*Calopsitta novæ-hollandiæ*) from Australia, presented by Mrs. C. Price ; two Spanish Terrapins (*Clemmys trijuga*), South European, presented by Mr. W. H. J. Paterson ; a Common Viper (*Vipera berus*), British, a Viperine Snake (*Tropidonotus viperinus*) from West Africa, presented by Mr. William Cross ; a Common Snake (*Tropidonotus natrix*), a Common Viper (*Vipera berus*), British, presented by Mr. W. H. B. Pain ; a White-breasted Kingfisher (*Halcyon smyrnensis*) from India, two Reed Buntings (*Emberiza schœniculus*), a Blackcap (*Sylvia atricapilla*), a Pied Wagtail (*Motacilla lugubris*), British, a Tree Boa (*Corallus hortulans*) from Cuba, purchased.

OUR ASTRONOMICAL COLUMN

COMET 1884 *b* (BARNARD, JULY 16).—Dr. Berberich of Strasburg, who has investigated the elements of this comet from observations extending to September 14, has found an elliptical orbit, in which the period is only 5½ years, a result which will perhaps have been rather expected, considering the nature of the parabolic orbits previously calculated, and, as was pointed out by Prof. Weiss, their resemblance to the elements of De Vico's comet of short period observed in 1844. Dr. Berberich's ellipse is as follows :—

Perihelion passage, 1884, August 16·48346 Greenwich M.T.

Longitude of perihelion	306° 7′ 31″·1	Mean Equinox 1884·0
,, ascending node ...	5 3 50·2	
Inclination	5 28 49·6	
Angle of eccentricity	36 3 43·8	
Log. semi-axis major	0·493392	
Period of revolution	2007·9 days or 5·4965 years	

At aphelion in this orbit the comet would be distant from the orbit of Jupiter 0·503, but there is a very much closer approach to the orbit of Mars, at a true anomaly of 37° 13′, corresponding to heliocentric longitude 343° 25′, where the distance of the two orbits is only 0·0088, and it is worthy of note that between April 5 and 10, 1868, both Mars and the comet would pass that point, and if Dr. Berberich's period is approximately correct, there must have been a close approach of the two bodies, possibly a closer one than calculation assigns. The following positions are deduced from the elliptical orbit:—

At Berlin, Midnight

	R.A. h. m. s.	Decl. ° ′	Log. Distance from Earth.
October 5	20 33 51	− 22 30·1	9·8331
9	20 46 54	21 2·5	9·8536
13	20 59 26	19 35·6	9·8746
17	21 11 28	18 10·0	9·8960
21	21 23 4	16 45·9	9·9175
25	21 34 14	15 23·5	9·9391
29	21 45 1	− 14 2·9	9·9608

The comet is rapidly growing fainter, but it is obviously of importance for its theory that observations should be continued as long as possible.

COMET 1884 *c*.—A new comet was discovered by Herr Wolf at Heidelberg on September 17, and was observed at Strasburg on September 20. It was also independently detected by Dr. Copeland at Dun Echt on September 22, the night before the telegraphic notice from Kiel arrived at that Observatory. Prof. Tacchini has favoured us with the following observations made by himself and Prof. Millosevich at the Observatory of the Collegio Romano in Rome:—

	Rome M.T. h. m. s.	R.A. h. m. s.	Decl. ° ′ ″
Sept. 21	9 24 47	21 15 46·00	+ 21 59 22·6
23	7 39 12	21 16 44·33	+ 21 7 48·7

This comet is likely to remain visible for several months, according to the orbits yet calculated, but a somewhat wider extent of observation than is now available will be required to predict its track in the heavens with any degree of certainty.

THE LUNAR ECLIPSE ON OCTOBER 4.—We gave last week the times of occultations of two stars during the totality of this eclipse, of which accurate positions are found in our catalogues. A somewhat extensive list of stars liable to occultation has been determined at Pulkowa with sufficient precision for the predictions of the times of immersion and emersion, which have been communicated to various observatories. Several stars rated higher than the ninth magnitude appear on this list, where the *Durchmusterung* magnitudes are followed. Our remark last week should have been explained as referring only to stars of which accurate places are found in the catalogues.

HYDROXYLAMINE AND THE ASSIMILATION OF NITROGEN BY PLANTS

THE researches of V. Meyer and E. Schulze on the action of hydroxylamine salts upon plants (*Berl. Ber.*, xvii. 1554) were undertaken with the *a priori* probability of showing that this base plays an important part in the synthetical activity of the plant; and although they have not succeeded in establishing the experimental fact, the results obtained are of great interest, and the whole is eminently suggestive of future possibilities. The supply of nitrogen to plants takes the form of nitrates and ammoniacal salts, and these classes of compounds being destitute of synthetical activity, we are driven to assume that the earlier stages of nitrogen assimilation consist in the conversion of these comparatively inert substances into derivatives having the "chemical tension" necessary to synthetic activity. Hydroxylamine and its salts, which occupy in point of oxidation a position intermediate between ammonia and the nitrates, are bodies possessing this character in the highest degree. To use the author's words, "the behaviour of this base towards the organic oxy-compounds is most aggressive: it is indeed astonishing with what facility it converts carbonyl-compounds into azotised derivatives." This is notably the case with the ketones and aldehydes of the fatty series, the products of the union being oximido-derivatives, *e.g.* aldoxime, acetoxime, isonitroso acids; in these the characteristic $C=NO_2$ group easily undergoes reduction, with formation of the corresponding amido derivatives; and upon the hypothesis of the formation of hydroxylamine in the plant as the first stage in nitrogen assimilation, it is easy to see in what manner its non-nitrogenous constituents, which for the most part possess the characteristics of aldehydes and ketones, would contribute to the further stages in its elaboration.

To test this hypothesis, in the first instance, the authors instituted parallel experiments on the culture of maize, to which the nitrogen was supplied in the form of ammonium sulphate, hydroxylamine sulphate, and hydrochlorate and potassium nitrate, respectively. The result was, in a word, to show that the hydroxylamine salts act as direct poisons to plant life, as indeed they have already been shown by Bertoni to act towards animal life. Having established this fact, the authors inferred their probable action as antiseptics, and experiment showed that they possess this property in a remarkable degree. This result, as they contend, does not negative the original hypothesis, as the occurrence of the base in the plant would necessarily be transitional.

It seems to us that the antiseptic properties of hydroxylamine are a direct consequence of its synthetical activity; and further that antiseptics fall into three classes according to their disturbance of one of the three essential conditions of cell life, which are: (1) hydration; (2) oxidation; (3) the synthetical activity of aldehydes (Löw and Bokorny), chiefly in the direction of condensation. In illustration of this classification we may cite as typical members of group (1) common salt, (2) sulphurous acid in its various combinations, (3) phenols.

THE BRITISH ASSOCIATION
REPORTS

Second Report of the Committee, consisting of Prof. A. W. Williamson, Chairman, Profs. Sir H. E. Roscoe, Dewar, Frankland, Crum-Brown, Odling, and Armstrong, Messrs. A. Vernon-Harcourt, J. Millar Thomson, V. H. Veley, F. Japp, H. Forster Morley, and H. B. Dixon (Secretary), appointed for the purpose of drawing up a Statement of the Varieties of "Chemical Names" which have come into use, for indicating the causes which have led to their adoption, and for considering what can be done to bring about some Convergence of the Views on Chemical Nomenclature obtaining among English and Foreign Chemists.—The Report is somewhat lengthy, and includes some long tables of varieties of names for common chemical substances. It commences with historical notes on chemical nomenclature. No attempt was made until about 100 years ago to name chemical substances in a way which would indicate their composition; alchemistic or "culinary" names being given to substances in many cases. Macquer is credited with being the first to introduce generic names like vitriol and nitre to indicate sulphates and nitrates. The term salt was used to indicate almost any substance soluble in water and affecting the sense of taste, and in the eighteenth century acids, salts, and bases began to be distinguished. Rouelle was the first to define a salt from its chemical properties, and distinguish it from acids and bases (see Kopp's "History of Chemistry," iii.). Bergmann and Guyton de Mouveau separately proposed systems of nomenclature, many terms of which are still in use. De Mouveau made the terminations of names of acids uniform, and the names of salts to indicate their composition from bases and acids. In 1787 Lavoisier, De Mouveau, Berthollet, and Fourcroy prepared a scheme of naming compounds which is practically that in common use now, introducing the terminations "ate" and "ic," "ite" and "ous," in acids and salts. But higher and lower oxides are not distinguished by generic names. Berzelius made a more elaborate classification of salts, and added some names. He distinguished the halogen compounds of hydrogen as hydracids, and distinguished clearly between "neutral," "acid," and "basic" salts. The views now held of acids, salts, and bases are practically those of Gerhardt and Laurent, who first recognised the part played by hydrogen in acids and salts. The Report then goes on to consider the tables, which give the number of times a substance has been distinguished by any particular name. Table I. deals with the names of oxides of carbon from 1755 to 1882. By far the greater number of sources give the names carbonic oxide to CO and carbonic acid to CO_2; systematic names like carbonous oxide and carbonic oxide only occurring two or three times, the terms carbonic oxide and carbonic anhydride or dioxide being next in frequency. In France and Germany the names oxide de carbon and acide carbonique, Kohlenoxyd and Kohlensäure have been much more frequently used. But in several instances the same names have been used in a different sense; the term carbonic oxide being sometimes used for CO_2, sometimes for CO. In Table II. the prominence of this "diversity of names for the one thing," and giving the same name to distinct substances, is more frequent. The use of numerical prefixes has also been very irregular; "thus, trisodic phosphate has been called 'triphosphate of soda,' 'diphosphate of soda,' and 'sesquiphosphate of soda'; in all these cases the prefix is intended to indicate the number of molecules of soda to one molecule of phosphoric acid." "In some of the older forms of nomenclature ambiguity was avoided by using the prefix 'bi-' to multiply the acid when in excess over the base, and 'di-' to multiply the base when in excess over the acid; thus, Na_2O2SiO_2, bisilicate of soda, $2Na_2OSiO_2$, disilicate of soda." The Report goes on to say that "the usefulness of any system of nomenclature depends on its permanence." Curiously enough the tables show that where names have been adopted supposed to represent in some way the chemical constitution of bodies, they have not, as a rule, endured; the advance of knowledge necessitating a change of opinion, whilst names not expressing a chemical opinion as to constitution have endured. "As a rule, those names are to be preferred which have shown most vitality and have led to no ambiguity. Where there are two compounds composed of the same elements, the terminations 'ous' and 'ic' should be employed. The prefixes 'proto' and 'deuto,' introduced by Thomas Thomson, were intended to mark the compounds in a series, not the number of atoms in a molecule. Where retained this use only should be made of them." Referring to change of name, instance is made of the oxides of carbon, the names of which have recently to some extent been transposed, the higher one being termed "carbonic oxide," and the lower one, to which the term "carbonic oxide" has long been applied, has had a new name. The sensible conclusion of the Report is to retain names of substances which are in common use, rather than to change them for names indicating constitution, and which might be again found to require alteration in accordance with some new view of the constitution of the substance.

SECTION B—CHEMISTRY

At the meeting of the Chemical Section at Montreal a new departure was made in the selection by the Organising Committee of two subjects for special discussion. The subjects chosen were: "The Constitution of the Elements," and "Chemical Changes in their Relation to Micro-Organisms."

Discussion on "The Constitution of the Elements"

Prof. Dewar began by referring to Grove's discovery that water suffered decomposition at the temperature of the oxy-hydrogen flame, an experiment which led Sainte-Claire Deville to undertake his researches on dissociation. Deville has shown that in compound substances there is an equilibrium between decomposition and recomposition, this balanced relation changing with the temperature. The experiments of Deville on the temperature of burning gases agree closely with the results obtained by Bunsen, who determined the pressures generated in the explosion of hydrogen and other gases with oxygen. The breaking up of the iodine molecule, effected by Victor Meyer, is a decomposition of elementary matter. Owing to the rapid recomposition, there seems no hope of isolating atomic iodine at low temperatures. The vapours of potassium and sodium have different densities at different temperatures; probably also their molecules consist of two atoms at lower, and of one atom at higher, temperatures. More exact determinations are needed of those substances which exhibit a variable vapour density. The evidence afforded by spectral analysis proves that oxygen and nitrogen have two spectra, and therefore probably different molecules at different temperatures. Hydrogen has a complicated spectrum under certain conditions. Referring to Mr. Lockyer's speculations, he said there was a general basis of similarity in the type of the vibrations of certain allied elements, viz. the triple lines in zinc and cadmium. Mr. Lockyer has proved that the identity of certain "basic" lines of different elements, such as iron and calcium, is not due to impurity, but the greater dispersion of more powerful instruments has shown that the coincidence of these lines is only apparent and not absolute. The differences observed in some of the spectral lines of a single element in the sun might be accounted for not by the decomposition of the "element" into simpler matter but by great differences of level in the luminous vapour. Prout's hypothesis, that the atomic weights of the other elements are multiples of that of hydrogen, has no basis in experimental fact. Stas and Marignac have both returned in their old age to the redetermination of the atomic weights made by them twenty years ago. Stas, avoiding the possible sources of error in his former methods, has lately found 14·055 for the atomic weight of nitrogen; his old determinations gave 14·044. For potassium he now arrives at the number 39·142 instead of 39·137. Marignac gives the following as the atomic weights of zinc and magnesium, 65·33 and 24·37,—numbers very far removed from whole numbers.

Prof. Wolcott Gibbs drew the attention of the Section to the probability that what is generally regarded as a simple molecule, such as sodium chloride, consists in the solid state of several hundreds of atoms, and that the salt undergoes in solution a kind of molecular dissociation. Very complex molecules, such as those acids he had prepared containing many molecules of the oxides of molybdenum, vanadium, barium, &c., are probably derived by substitution from what are called simple molecules, but which are really composed of a great number of atoms.

Prof. Frankland said he ventured to differ from Prof. Dewar in one point. He thought it might not be impossible by a decomposition of compound molecules to prepare isolated iodine atoms.

Sir Lyon Playfair suggested as a useful line of work the determination of the conditions under which such bodies as nitric peroxide would enter into combination with other compounds.

Prof. Tilden pointed out that a large field lay open to workers in thermo-chemistry, on the one hand in determining the temperatures at which chemical action begins, and on the other the heat-changes of chemical combination and solution at different temperatures.

Rev. Father Perry agreed with Prof. Dewar that some differences in the solar lines were due to difference of level of the luminous vapour. But, on the other hand, the widening of solar lines in the umbra of spots cannot be accounted for in this way. The Astronomer-Royal and Mr. Lockyer have been studying the solar spectrum from the line D to F. The Rev. Father Perry (studying D towards B) has found differences in the lines of the same metal in different spots which could not be attributed to difference of level only.

Prof. Dewar, in answer to Father Perry, stated that the widening of certain lines at the red end of the spectrum might have been anticipated from the results of his own work in the crucible. The supposed allotropic spectrum of magnesium is due to a compound of magnesium and hydrogen. The fact that in the upper regions of the solar atmosphere, where hydrogen and magnesium occur in enormous quantities, this allotropic spectrum is not observed presents a difficulty. Perhaps at the mean temperature of the solar atmosphere this compound is dissociated. If so, somewhere nearer the surface or in the spots a condition of temperature should occur in which the compound should be stable. He hoped Father Perry would succeed in observing this spectrum in the umbra of spots. It had been stated that if our elements are compound substances they should be found decomposed at the enormously high temperatures of the sun; but if it is admitted that the elements are compounded of hydrogen, and that dissociation can occur, the compound vapour is diffused through an atmosphere of hydrogen, one of the products of its dissociation, and is therefore precisely under those conditions in which it is most stable.

Discussion on "Chemical Changes in their Relation to Micro-Organisms"

Prof. Frankland, in opening the discussion, distinguished between two kinds of chemical action—(1) that in which substances brought into contact mutually undergo chemical change, and (2) that in which chemical change is effected in one substance by contact with another, which itself apparently suffers no alteration. The following definitions were proposed to distinguish animal and vegetable organisms:—(1) A plant is an organism performing synthetical functions, or one in which these functions greatly predominate; it transforms actual into potential energy. (2) An animal is an organism performing analytical functions, or one in which these functions greatly predominate; it transforms potential into actual energy. All micro-organisms appear to belong to the second class. Oxidation is the essential condition of life. There are, however, many other chemical transformations in which potential becomes actual energy, and which therefore can support life. After describing the chemical changes produced by a large number of micro-organisms, the author concluded that there is no break in the continuity of chemical functions between micro-organisms and the higher forms of animal life. It is true there are apparently certain sharp distinctions between them. The enormous fecundity of micro-organisms and their tremendous appetites seem to separate them from the higher orders of animals. But this distinction is only comparative. It must be borne in mind that an animal like a sheep converts much of its food into carbonic acid, hippuric acid, and water, thus utilising nearly the whole of the potential energy, while the micro-organism as a rule utilises only a small portion. Those micro-organisms which have been chemically studied produce, like the higher animals, perfectly definite chemical changes. The position of these organisms in Nature is only just beginning to be appreciated. It may safely be predicted that there is no danger of their being spoiled by the petting of sentimentalists, yet these lowly organisms will receive much more attention in the future than they have done in the past.

Principal Dallinger referred to the attempted distinction between the lower animal and vegetable forms. In following out the life-history of certain monads he used a nutritive fluid containing no albuminoid substances, but only mineral salts and tartrate of ammonium. Organisms classed by Prof. Huxley as animal were found to live in this mineral fluid. Bacteria of forms which cannot be distinguished by the microscope have very different physiological functions. These Bacteria can be modified physiologically, but not at all readily morphologically; by a slow change it is possible to completely reverse the conditions of the environment of the Bacterium without changing its form. It is most important to study the physiology of Bacteria.

Dr. Macalister pointed out that the experiments made on the conversion of the Bacillus of the hay infusion into the *Bacillus anthracis* had not been confirmed by more exact experiments. The germs of the *Bacillus anthracis* readily diffused themselves through the air of the laboratory, and without the very greatest care it was impossible to avoid contamination of the liquids with stray germs.

Prof. Dewar referred to the extraordinary behaviour of very small quantities of peroxide of hydrogen on putrescible liquids. One-hundredth of a per cent. of the peroxide perfectly preserved many liquids, keeping them quite clear and without a trace of any Bacteria. The conversion of sugar into anhydrous alcohol and carbonic acid seemed to be unaccompanied by a thermal change, so that an important question arises, Where does the power which effects the change come from? Possibly, like chlorophyll, the Bacteria absorb rays of radiant heat and light. Dr. Engelman has studied the distribution of radiant energy in the spectrum of the sun and flames by the activity of the Bacteria submitted to different parts of the spectrum.

Sir Lyon Playfair regarded it as curious that the products formed in the growth of the higher animals—namely, carbonic acid and urea—should be so much simpler than the products formed by lower organisms.

Complex Inorganic Acids, by Prof. Wolcott Gibbs.—This research may be regarded as a series of generalisations of the class of silico-tungstates discovered by Marignac in 1861, and of the analogous class of phospho-molybdates studied by Deville. Scheibler has described two distinct series of phospho-tungstates; the author finds there are at least ten, the highest having the formula $24WO_3,P_2O_5,6H_2O$, the lowest the formula $6WO_3,P_2O5,6H_2O$, and that the phospho-molybdates are at least equally numerous, and have a similar range. Corresponding compounds containing arsenic oxide also exist. To generalise these results the author replaced phosphoric oxide by vanadic oxide and antimonic oxide, so as to form vanadio-tungstates and antimonio-tungstates, and the corresponding compounds of molybdenum. Many of these salts are very beautiful. Probably the greater number of oxides of the type R_2O_5 form similar compounds. A second series of complex acids contain *two* molecules of the type R_2O_5, so that we have various phospho-vanadio-tungstates and phospho-vanadio-molybdates. The generalisation of the term WO_3 or MoO_3 appears also possible, as the author has prepared compounds in which sulphur and selenium replace oxygen in WO_3 or MoO_3. Again, the author finds that phosphorous and hypophosphorous acids enter into similar combinations with tungstic and molybdic acids, and he has also prepared compounds in which the methyl, ethyl, and phenyl derivatives of phosphorous and hypophosphorous acids occur. An attempt to prepare complex acids containing pyro-phosphoric acid failed, as that acid quickly changed to the ortho-acid; but with meta-phosphoric acid the author succeeded in preparing several new compounds. The author has further shown that the group R_2O_5 may be replaced by R''_2O_3, $R'''Cl_2$—R'' being a metal of the platinum group—and that the chlorine can be replaced by bromine or iodine. The type of silico-tungstates is also capable of generalisation, silica being replaced by a large number of similar oxides, as, for instance, the oxides of selenium, tellurium, platinum, &c. As an instance of the extreme complexity of some of these compound acids, the author gave the body $60WO_3,3P_2O_5,V_2O_5,VO_2,18BaO,+150Ag$. This body has the enormous molecular weight of 20,066. In conclusion the author stated that in formulating certain compounds containing V_2O_5 he found much similar expressions resulted when a part of the V_2O_5 was supposed to have the structure $(V_2O_2)O_3$, (V_2O_2) replacing W or Mo.

On the Incomplete Combustion of Gases, by H. B. Dixon.—The author gave a *résumé* of the work he had done in continuation of the researches of Bunsen, E. von Meyer, Horstmann, and other chemists, on the division of oxygen when exploded with excess of hydrogen and carbonic oxide. The following are the general conclusions arrived at:—(1) No alteration *per saltum* occurs in the ratio of the products of combustion. The experiments made completely confirm Horstmann's conclusion: Bunsen's earlier experiments are vitiated by the presence of aqueous vapour in the eudiometer. (2) A dry mixture of carbonic oxide and oxygen does not explode when an electric spark is passed through it. The union of carbonic oxygen is effected indirectly by steam. A mere trace of steam renders the admixture of carbonic oxide and oxygen explosive. The steam undergoes a series of alternate reductions and oxidations acting as a "carrier of oxygen" to the carbonic oxide. With a very small quantity of steam the oxidation of carbonic oxide takes place slowly; as the quantity of steam is increased the rapidity of explosion increases. (3) When a mixture of dry carbonic oxide and hydrogen is exploded with a quantity of oxygen insufficient for complete combustion, the ratio of the carbonic acid to the steam formed depends upon the shape of the vessel and the pressure under which the gases are fired. By continually increasing the initial pressure a point is reached where no further increase in the pressure affects the products of the reaction. At and above this critical pressure the result was found to be independent of the length of the column of gases exploded. The larger the quantity of oxygen used, the lower the "critical pressure" was found to be. (4) When dry mixtures of carbonic oxide and hydrogen in varying proportions are exploded above their critical pressures with oxygen insufficient for complete combustion, an equilibrium is established between two opposite chemical changes represented by the equations:—

$$\text{(I.)}\ CO + H_2O = CO_2 + H_2.$$
$$\text{(II.)}\ CO_2 + H_2 = CO + H_2O.$$

At the end of the reaction the product of the carbonic oxide and steam molecules is equal to the product of the carbonic acid and hydrogen molecules multiplied by a coefficient of affinity. This result agrees with Horstmann's conclusion. But Horstmann considers the coefficient to vary with the relative mass of oxygen taken. (5) A small difference in the initial temperature at which the gases are fired makes a considerable difference in the products of the reaction. This difference is due to the condensation of steam by the sides of the vessel during the explosion, and its consequent removal from the sphere of action during the chemical change. When the gases are exploded at an initial temperature, sufficiently high to prevent any condensation of steam during the progress of the reaction, the coefficient of affinity is found to be constant whatever the quantity of oxygen used—provided only the quantity of hydrogen is more than double the quantity of oxygen. (6) The presence of an inert gas, such as nitrogen, by diminishing the intensity of the reaction, favours the formation of carbonic acid in preference to steam. When the hydrogen taken is less than double the oxygen, the excess of oxygen cannot react with any of the three other gases present—carbonic oxide, carbonic acid, and steam, but has to wait until an equal volume of steam is reduced to hydrogen by the carbonic oxide. The excess of inert oxygen has the same effect as inert nitrogen in favouring the formation of carbonic acid. The variations in the coefficient of affinity found by Horstmann with different quantities of oxygen are due partly to this cause, but chiefly to the varying amounts of steam condensed by the cold eudiometer during the reaction in different experiments. (7) As a general result of these experiments it is shown that, when a mixture of dry carbonic oxide and hydrogen is exploded with oxygen insufficient for complete combustion, at a temperature at which no condensation of steam can take place during the reaction, and at a temperature greater than the critical pressure, an equilibrium between two opposite chemical changes is established which is independent of the mass of oxygen taken, so long as this quantity is less than half the hydrogen. Within these limits the law of mass is completely verified for the gaseous system composed of carbonic oxide, carbonic acid, hydrogen, and steam at a high temperature.

On Magnetic Rotation of Compounds in Relation to their Chemical Composition, by W. H. Perkin, Ph.D., F.R.S.—The author gave a *résumé* of his researches on the magnetic rotary polarisation of compounds in relation to their chemical composition. After referring to the remarkable discovery of Faraday in relation to this subject, and the results obtained by more recent workers in this field, it was shown that no relationship in reference to chemical composition was likely to be found by the usual method of calculating the results of the observation of unit-lengths of the fluid bodies examined, but that, if lengths related to each other in proportion to their molecular weights—making the necessary correction for the difference of densities—were compared, a useful result would probably be obtained. Experiments have proved this to be the case; and in the series of homologous compounds it was found that for every addition of CH_2 a definite increase of what is called the "molecular rotation" is obtained. Besides this it was found that the rotation also was capable of indicating differences in the construction of organic compounds. Iso, secondary, tertiary bodies give different results from the normal compounds. The compounds containing the halogens were also referred to, and formulæ given by which the molecular rotation of twenty-six series of compounds could be calculated.

Spectroscopic Studies of Explosions, by Profs. Liveing and Dewar.—The explosions observed were chiefly those of hydrogen and oxygen and of carbonic oxide and oxygen, and were made in an iron tube fitted with quartz ends. The spectra were both observed with the eye and photographed. Linings of thin sheet metal of various kinds were introduced into the tube. The metals iron, nickel, and cobalt gave many lines in the flash. No other metal gave anything like so many lines as these three, but magnesium gave the *b* group, copper gave one green and two ultra-violet lines, manganese the violet triplet, and chromium three triplets. On the other hand, zinc, cadmium, mercury, aluminium, bismuth, antimony, and arsenic developed no lines in the flash. It appears to be proved that iron, nickel, and cobalt are volatile in some degree at 3000°. It might be possible to establish a spectroscopic scale of temperature if the lines successively developed with increasing temperature were noted. Thus, the iron line T seems to be just developed at 3000°, the aluminium lines at H at a somewhat higher temperature, the lithium blue line may be just seen in the inner green cone of a Bunsen burner, while the green line comes out in the explosion fla h. [The photographs of the explosion spectra were exhibited to the Section.]

On Evaporation and Dissociation, by Prof. William Ramsay and S. Young, D.Sc.—The authors described experiments made with the object of ascertaining whether the coincidence of the curves which represent the vapour-pressures of stable solid and liquid substances at different temperatures with those indicating the maximum temperatures attainable by the same substances at different pressures, when evaporating with a free surface, holds good also for substances which dissociate in their passage to the gaseous state. The substances examined were chloral hydrate, ammonium carbamate, phthalic acid, succinic acid, aldehyde ammonia, ammonium chloride, nitric peroxide, and acetic acid. It was found that, with chloral hydrate and ammonium carbamate, which cannot exist at all in the gaseous state, the temperatures of volatilisation do not form a curve. When the dissociation was considerable, but not complete, as in the case of phthalic and succinic acids, an indication of a curve was observed at low pressures, but it differed widely both in form and position from that representing the vapour-pressures or pressures of dissociation. As the dissociation increases the curves approach each other more closely, and they appear to be coincident in the case of ammonium chloride and nitric peroxide within the limits of temperature at which observations were made, and at which the amount of dissociation is probably small. With acetic acid very numerous observations proved the perfect coincidence of the curves. The results appear to be unfavourable to the view that, when liquefaction of a stable substance takes place, gaseous molecules coalesce to form more complex groups of molecules, and that these complex molecules dissociate when the substance is vaporised.

A Redetermination of the Atomic Weight of Cerium, by H. Robinson, B.A. Cambridge.—Cerous chloride was prepared by passing hydrochloric acid over cerium oxalate at first gently heated and afterwards raised to redness. The solution of pure chloride was added to a pure solution of silver nitrate, and then dilute solution of silver nitrate was added from a weighed bulb, until the precipitation of chlorine was complete. The liquids were illuminated by yellow light only during the precipitation. As a mean of seven closely concordant results, the atomic weight of cerium is given as 140·2593, that of silver being 107·93.

The Action of Sulphuretted Hydrogen on Silver, by Prof. F. P. Dunnington, University of Virginia.—A piece of pure silver, flattened and carefully polished on each face, was placed in the middle of a glass tube two feet long. At each end of the tube a plug of five inches of phosphoric anhydride was confined by glass wool. Pure dry hydrogen was passed through this tube while it was gently heated throughout. The hydrogen was then removed by a Sprengel pump, the silver being heated to 300° C. This operation was repeated three times, and then pure dry sulphuretted hydrogen was slowly passed through the apparatus for an hour, and the tube finally drawn off at each end. After a few days the silver was slightly darkened near its edges, and after five months the silver was blackened on its edges, while the main portion of the surface was white and bright. [The silver was exhibited to the Section in this state.]

On Molecular Volumes, by Prof. W. Ramsay.—The object of this research was to ascertain whether, as has long been taken for granted, the boiling-point of compounds under equal pressures really afforded suitable points for a comparison of their molecular volumes. The experiments made with the following series of compounds—water, methyl alcohol, ethyl alcohol, propyl alcohol, isopropyl alcohol, isobutyl alcohol, and ether—prove that the value of the group CH_2 is by no means constant. (1) While at the boiling-points of these liquids at low pressures the value is approximately constant (fluctuating between 17·5 and 22), at high temperatures the difference becomes much more marked, attaining at 20 m. of mercury pressure the greatest irregularity; *e.g.* the difference between the molecular volumes of ether and isobutyl alcohol, two isomeric substances, amounts to a total of twenty units. (2) It was found by experiment that when the liquids were at temperatures corresponding to equal vapour-pressure, but exposed to their critical pressures, no correspondence between their molecular volumes was observable. (3) It was thought possible that if the liquids, still at temperatures corresponding to equal vapour-pressure, could have existed under no pressure, some basis of comparison might be found. From the known compressibility of the liquids it was possible to calculate their volume in this hypothetical state. Although by this method their relative volumes were considerably altered, yet no point of co nparison was reached. (4) The author therefore concludes that the boiling-points of liquids, under whatever pressure they may be taken, are not suitable temperatures at which to compare their molecular volumes.

On Some Phenomena of Solution, Illustrated by the Case of Sodium Sulphate, by Prof. W. A. Tilden, F.R.S.—The study of the solubility of sodium sulphate in water at temperatures above 100° C., leads to the conclusion that the salt dissolves in the anhydrous state. In order to determine whether this salt dissolves in water at lower temperatures in the anhydrous or the hydrated state, the author has made a series of calorimetric measurements of the thermal changes which attend the act of solution of Na_2SO_4 in water at temperatures below and above 33° to 34°, the critical point in the curve of solubility.

Calorimetric Effect of Dissolving Na_2So_4 in n *Molecules of Water at T°*

n	T°	C
100	31·7	1740
100	35·4	1522
100	42·85	1342
100	46·1	1071
100	55·0	985

These figures establish the fact that by dissolving anhydrous sodium sulphate in water at temperatures above 33°, the thermal change is still positive, although a diminishing quantity, and hence that the act of solution is still attended at these temperatures by chemical combination between the salt and the water. These results when plotted out give a line which is nearly parallel to the curve of solubility between these limits of temperature.

On Calcium Sulphide and Sulpho-carbonate, by V. H. Veley, M.A.—Calcium oxide, free from metals of the iron group, was obtained by heating perfectly transparent crystals of Iceland spar in a current of hydrogen. This oxide was hydrated in a damp atmosphere free from carbonic acid. The hydroxide was heated to 60° C., and hydric sulphide passed over it. The resulting calcium sulphide and water were weighed, and the synthetic results thus obtained were found to agree closely with the results of the analysis of the calcium sulphide. It is worthy of note that perfectly dry calcium oxide is unaltered by the passage over it of perfectly dry hydric sulphide, and generally the formation of calcium sulphide proceeded the more rapidly the greater the quantity of water originally present in the hydroxide. This result may be due to the formation, at first, either of the hydrosulphide, or the hydroxy-hydrosulphide (CaOH,SH), and the subsequent conversion of either of these substances into the sulphide. The calcium sulphide, prepared as described above, was moistened with water, and hydrogen saturated with carbon bisulphide passed through it. It gradually turned yellow, and finally red, and on exhaustion with cold water a red solution was obtained, from which, on evaporation *in vacuo*, red, deliquescent, prismatic crystals separated. The composition of these crystals was found by analysis to correspond with the formula $Ca(OH)_2,CaCS_3xH_2O$. A solution of this substance gave characteristic precipitates with metallic salts, which the author intends to examine more minutely.

On the Velocity of Explosions in Gases, by H. B. Dixon, M.A.—MM. Berthelot and Vieille have shown that in oxygen and hydrogen and several other mixtures of gases the "explosive wave" is propagated at a velocity closely approximating to the mean velocity of translation of the gaseous products of combustion calculated on the assumption that all the heat of the reaction is contained for the moment in the products formed. The mean of a number of determinations with electrolytic gas gave a velocity of 2810 m. per second, the calculated mean velocity of the steam molecule formed being 2831 m. per second. These experimenters found that carbonic oxide exploded either with oxygen or nitrous oxide did not agree with the rule. The author has shown that steam is necessary for the burning of carbonic oxide both with oxygen and nitrous oxide, and that, as the proportion of steam is increased, the rate of inflammation is also increased. Experiments made in a lead tube 55 m. long and 13 mm. in diameter entirely confirmed MM. Berthelot and Vieille's experiments with hydrogen and oxygen. The rate of the "explosive wave" was found to be 2817 m. per second as the mean of several closely concordant experiments at 10° C. With carbonic oxide and hydrogen nearly dry, the explosive wave was not established until the flame had traversed a distance of 700 mm. from the firing-point: the explosive wave was found to have a velocity rather over 1500 m. per second. After the explosion a fine layer of carbon was found to cover the inside of the explosion-tube, showing that at the enormous temperature of the explosive wave carbonic oxide is decomposed into its constituents.

A Theory of Solution, by W. W. J. Nicol, M.A., B.Sc.—The author has proposed the theory that the solution of a salt in water is a consequence of the attraction of the molecules of water for a molecule of salt exceeding the attraction of the molecules of salt for one another. It follows, therefore, that, as the number of dissolved salt molecules increases, the attraction of the dissimilar molecules is more and more balanced by the attraction of the similar molecules: when these two forces are in equilibrium, saturation takes place. Any external cause tending to alter the intensity of either of these two opposite forces disturbs the condition of equilibrium, and further solution or solidification ensues. The contraction which occurs on the solution of a salt in water has been regarded as strong evidence in favour of chemical combination having taken place, but the author finds that a further contraction takes place on further dilution, even when the number of water molecules per salt molecule is far in excess of the number in the cryohydrates.

On the Manufacture of Soda and Chlorine, by W. Weldon, F.R.S.—Chlorine is at present manufactured exclusively from hydrochloric acid, obtained as a by-product of the manufacture of soda by the Leblanc process. It is owing to this that the Leblanc process has been able to withstand the severe competition of the ammonia process, which gives soda much more cheaply than the Leblanc process, but does not yield either hydrochloric acid or chlorine. The author announces a process for the preparation of chlorine in connection with the manufacture of soda by the ammonia process. The new process consists in decomposing by magnesia the ammonium chloride of the ammonia-soda process, adding magnesia to the resulting solution of magnesium chloride, and so obtaining solid oxychloride of magnesium, which, heated in a current of air, gives off chlorine and leaves magnesia.

On the Diamond-bearing Rocks of South Africa, by Prof. Sir Henry E. Roscoe, President.—After an introductory description of the geological and physical aspects of the remarkable diamond-bearing deposits at Kimberley and elsewhere, the author gave the chemical composition of these rocks. The most noteworthy feature of the examination of these rocks is the discovery in the so-called diamond earth of a volatile crystalline hydrocarbon, soluble in ether, which seems to confirm the hypothesis that the Carboniferous shales, which are penetrated by the diamond-bearing pipes, have been the source of the carbon now found in the crystalline state in the diamond. The physical structure of the ash or incombustible portion of the diamond is of a very singular character, and has hitherto not been examined. A careful study of the diamond ash may possibly throw light on the important question of the mode of formation of the diamond.

Colour of Chemical Compounds, by Prof. Carnelley, D.Sc.—The colour of chemical compounds is conditioned by at least three circumstances, viz. (1) temperature (Ackroyd); (2) the quantity of the electro-negative element present in a binary compound (Ackroyd); (3) the atomic weights of the constituent elements of the compounds (Carnelley); and that in such a way that the colour passes or tends to pass through the following chromatic scale—white or colourless, violet, indigo, blue, green, yellow, orange, red, brown, black—either by (1) rise of temperature, or (2) increase of the quantity of the electro-negative element in a binary compound, or (3) with *increase* of the *atomic weights* of the elements A, B, C, &c., in the compounds A_xR_y, B_xR_y, C_xR_y, &c., in which R is any element or group of elements, whilst A, B, C, &c., are elements belonging to the same sub-group of Mendeléeff's classification of the elements. Tables accompany the paper in illustration of the above. Out of 426 cases in which the third of the above rules has been applied, there are but sixteen exceptions, or less than 4 per cent. Finally a theoretical explanation is given which appears to account in a very simple manner for the influence of the above three circumstances on the colour of chemical compounds.

Notes of Nitrification, by R. Warington.—He considered the present position of the theory of nitrification, and next gave a short account of the results of recent experiments conducted by him at Rothamsted. Messrs. Schloesing and Müntz, early in 1877, showed that nitrification in sewage and in soils is the result of the action of an organised ferment, occurring in soils and impure waters. The experiments of the author have confirmed the soundness of this theory. The evidence for the ferment theory is now very complete. Nitrification in soils and waters is strictly limited to range of temperature within which the vital activity of the living ferment is confined. It proceeds with slowness at 0°, is at a maximum at 37°, and ceases at 55°. Nitrification is also dependent on plant food suitable for organisms of low character. Further proof of the ferment theory is that antiseptics are fatal to nitrification. Heating sewage to boiling-point, or soil to the same temperature, effectually prevents it. Finally, nitrification can be started in boiled sewage or other sterilised liquid by the addition of a little surface soil or a few drops of a solution already nitrified. These nitrifying organisms have as yet received but little microscopical study.

On the Liquefaction of Oxygen and the Density of Liquid Hydrogen, by Prof. Dewar, F.R.S.—The problem of liquefying oxygen and hydrogen, and consequently others of the so-called permanent gases, having been solved by Cailletet and Pictet, the author has since been employed studying the physical characters of these gases in the condensed state. The critical pressures and temperatures at condensation have been determined, and the relation of one to the other is shown to be constant. The merits of various cold producers that could be employed in the process were discussed. Condensed ethylene he considered the best, then condensed nitrous oxide and carbonic acid. The lowest temperature that could be obtained by carbonic acid is about 115° C., and by nitrous oxide 125° C.

On the Production of Permanent Gas from Paraffin Oils, by

Dr. Stephen Macadam.—For the last fourteen years the author has devoted much attention to the illuminating values of different qualities of paraffin oils in various lamps, and to the production of permanent illuminating gas from paraffin oils. The earlier experiments were directed to the employment of paraffin oils as oils, and the results proved the superiority of the paraffin oils over vegetable and animal oils, especially for lighthouse service. The later trials were mainly concerned with the breaking up of the paraffin oils into permanent illuminating gas, and the results formed the basis on which paraffin oil gas has been introduced into the lighthouse service of Great Britain, both for illuminating purposes and as fuel for driving engines of fog-horns. The following table shows the results of his investigations on the relative values of the crude, green, and blue oils:—

	Crude	Green	Blue
Gas per gallon in cubic feet ...	98 ...	102 ...	127
Candle power	50 ...	53 ...	54
Light value of gas from ton of oil given in lbs. of sperm candles	4494 ...	4741 ...	6044

On the Assimilation of Atmospheric Nitrogen by Plants, by W. O. Atwater.—It is almost a universal opinion that free nitrogen is not assimilated by plants. He referred to the classic experiments of Boussingault and Lawes, of Gilbert and Pugh, which, commonly regarded as decisive, may have been performed without consideration to certain conditions. Experiments made by the author show that at any rate certain plants grown under normal conditions do assimilate nitrogen. Peas were grown in sand which had been purified by burning and washing, and to which were applied nutritive solutions containing known quantities of nitrogen. The amount of nitrogen supplied to the plant plus the amount contained in the seed was compared after the experiment with the amount given by analysis of the plant and the residual solution. The excess of the latter amount over the former, which in some cases was excessive, represented the nitrogen acquired from the air.

Prof. Gilbert dissented from the conclusion drawn by Prof. Atwater, as he had found that, the greater the care used to prevent foreign matters accumulating on the plants under experiment, the less nitrogen was found in excess of that obtained from the seed and soil.

Prof. Frankland communicated the results of a study of the phenomena attending the discharge of accumulator-cells containing alternate plates of lead peroxide and spongy lead: (1) The energy of a charged storage-cell is delivered in two separate portions, one having an E.M.F. of 2 volts and upwards, the other an E.M.F. of 0·5 volt and under. One of these may be conveniently termed *useful*, and the other *useless*, electricity. (2) The proportion of useful electricity obtainable is greatest when the cell is discharged intermittently, and least when the discharge is continuous. (3) Neither in the intermittent nor continuous discharge at high E.M.F. is the current, through uniform resistance, augmented by rest. At low E.M.F., however, the current, after continuous discharge of the high E.M.F. portion, is greatly augmented, but only for a few minutes. This augmentation of current at low E.M.F. after rest is hardly perceptible when the high E.M.F. discharge has been taken intermittently. (4) The suddenness of fall in potential indicates two entirely distinct chemical changes, the one resulting in an E.M.F. of about 2·5 volts, the other in one of about 0·3 volt. (5) The chemical change producing low electromotive force is the first to occur in charging, and the last to take place in discharging, the cell. It is the change which occurs during what is called the "formation" of a cell, and, for economy's sake, a reversal of this change should never be allowed to take place. (6) Currents of enormous strength can be readily obtained from storage batteries coupled up in parallel, viz. a current of 25,000 amperes from only 100 cells. Such a current reduces to insignificance the output of the largest dynamo ever built. It is to be hoped that currents of this magnitude will open up new probabilities of research into the constitution of matter.

SECTION C—Geology

Plan for the Subject-Bibliography of North American Geology, by G. K. Gilbert, of the U.S. Geological Survey.—The United States Geological Survey is engaged on a Bibliography of North American Geology. The work when completed will give the title of each paper with the title-page of the containing book, and the number of plates, the whole being arranged alphabetically by authors. There is in contemplation also the simultaneous preparation of a number of more restricted bibliographies, each covering a division of geologic literature. The plan includes abbreviated titles of papers with reference to the pages on which the special subjects are treated, the entries in each bibliography being arranged alphabetically by authors. The selection of topics for treatment in this manner involves the classification of geologic science, and Mr. Gilbert submitted a tentative classification requesting the criticism of geologists.

Marginal Kames, by H. Carvill Lewis, A.M., Professor of Geology at Haverford College.—After reviewing the work on American kames, and the theories of the origin of kames, the author describes his investigations of short kames at the extreme margin of the ice-sheet along the line of the terminal moraine in Pennsylvania. These *marginal kames* run *backwards* from the edge of the ice, draining it by a sub-glacial drainage. These kames are discussed in detail, and are thought to represent sub-glacial rivers formed during the melting of the ice-sheet.

On the Geology of South Africa, by T. Rupert Jones, F.R.S., F.G.S., &c.—The contour of the south coast is parallel with the outcrop of the strata in the interior, from Oliphant's River (31° 40′ S. lat.) on the west coast, southward to the Cape, and then eastward to about 33° 30′ S. lat. Here the edges of the strata, formerly bending round to the north, have been swept away to a great extent; but their outcrop is again seen on the east coast at St. John's River (31° 40′ S. lat.), where they strike north-eastwardly through Natal, probably far up the country. (1) Gneissic rock and the Namaqualand Schists apparently underlie the others, coming out on the north west, and exposing a narrow strip on the south coast. (2) Mica Schists and Slates, interrupted by Granites here and there, form a curved maritime band, from about 30 to 70 miles broad, and are known as the Malmesbury Beds (Dunn). These and the beds next in succession (the Bokkeveld Beds, 3) are overlain unconformably by the Table-Mountain Sandstone (4), 4000 (?) feet thick, which forms patches and extensive ridges, and possibly dips over No. 3, to join No. 5, the Witteberg Beds. Nos. 3 and 5, together about 2100 feet thick, lie parallel, and form a concentric inner band. The former contains Devonian fossils; the latter is probably of Carboniferous Age (with Lepidodendron, &c.), and forms the Wittebergen and Zwartebergen in the Cape District, and the Zuurbergen in Eastern Province. The Ecca Beds (6) come next; Lower Series, 800 feet; Conglomerate Beds (Dwyka), 500 feet; Upper Series, 2700 feet; conformable with No. 5; in the south much folded, and in undulations throughout, until it passes under the next set of beds, No. 7, in some places 50 miles to the north. The Ecca Beds have fossil wood and plant remains in abundance here and there, but these have not been clearly determined. This series has not been well defined until lately, and even now its limits are not fully determined. It includes the Karoo Desert, and therefore takes in the lowest members of Bain's great Karoo Formation, Nos. 12 and 14 of his map (1856), or the Ecca, Koonap, and part of the Beaufort Beds of Jones (1867). The series No. 7, horizontal and unconformable on the Ecca Beds at the Camdeboo and elsewhere, retains the name of Karoo Sandstones: and after a width of about 40 miles is conformably surmounted by a set of somewhat similar beds (8) in the Stormberg; and thus No. 7 should be regarded as the Lower, and No. 8 the Upper, Karoo Sandstones. The latter end off northwards in the Draakensberg, Natal, Orange Free State, the Transvaal, and Zululand, with the still horizontal Cave Sandstone and associated beds. The Lower Karoo Sandstones probably thin away northwards beneath the others. Below the Karoo Sandstones, and dying out southwards near the Camdeboo (Prof. Green), are the Shales (7*), which constitute the country around Kimberley, described as the Olive Shales of the Karoo Formation by G. W. Stow. These die out northward against the old rocks of Griqualand-West and the Transvaal. They contain Glacial Conglomerates in their lowest (earliest) beds, in Griqualand-West, just as the Ecca series has its great Glacial Conglomerate (the Dwyka Conglomerate in No. 6) in its lowest portion. As the Stormberg Beds (8) lie upon the Olive or Kimberley Shales (7*) in the Orange Free State, the Lower Karoo Sandstones (7) must die out northwards. The Kimberley Shales contain some Reptilian bones and plant remains, and some coal on the Vaal; the Karoo Sandstones are rich with Dicynodont and other Reptilian bones, and have some Fish remains; and their upper portion (Stormberg) contains Ferns and Cycadeous leaves, and some seams of coal. A fossil mammal also has been found in this series. Throughout its range the

Karoo Series is traversed with igneous dykes. Limestones and Sandstones (9) with fossils of nearly pure Jurassic, but with some of Cretaceous type, occur unconformably in the Eastern Province. Their fossil Flora is like that of the Stormberg Beds. Cretaceous strata (10) are known on the Natal coast: and Tertiary and post-Tertiary deposits (11) form several patches on the east, south, and west coasts.

THE SOUTH AFRICAN FORMATIONS

		11. Tertiary and Post-Tertiary, 100'?	
			(Unconformable on several different rocks)
10. Cretaceous			
			(Unconformable on Carboniferous?)
9. Jurassic	Uitenhage Formation		Trigonia Beds; Wood-bed; Saliferous Beds; Zwartkop Sandstone — 400'?
			Enon Conglomerate, 300'
			(Unconformable on Devonian and other old rocks in Albany)
Triassic	Karoo Beds	8. Upper	Cave Sandstone, 150'; Red Beds, 600'; Stormberg Beds, 1000'
		7. Lower	Sandstones and Shales, 5000'; 7*. Kimberley or Olive Shales and Conglomerates, 2300'
			(Unconformable on Ecca Beds in the south, and on the old Vaal and Kaap series in the north)
Carboniferous?		6. Ecca Beds	Upper Ecca Beds, 2700'; Dwyka Conglomerate, 500'; Lower Ecca Beds, 800'
		5. Witteberg and Zuurberg Quartzites, 1000'?	
		4. Table-Mountain Sandstone, 4000'	
			(Unconformable on the Old Cape Schists and Slates and on the Bokkeveld Beds)
Devonian		3. Bokkeveld Beds, 1100'	
			(Probably unconformable to the Malmesbury Beds)
Silurian?		2. Malmesbury Beds, Mica Schists and Slates of the Cape	
			(Probable unconformity)
		1. Namaqualand Schists and Gneiss	

SECTION G—MECHANICAL SCIENCE

On the Flow of Water through Turbines, by Arthur Rigg, President of the Society of Engineers, London.—After remarking that a strict adherence to the older accepted rules of design never produces thoroughly efficient turbines, and that in the best of such motors these rules are disobeyed, the writer pointed out how little reliable practical information can be obtained from all the voluminous literature relating to turbines. He also stated that the course of a stream flowing through the guides and buckets of a turbine had no appreciable influence upon the duty obtained, so long as one essential condition was observed—namely, that its velocity should be gradually reduced to the least that will carry it clear of the buckets. In comparing screw propellers and turbines, each were shown to possess similarities; and experiments made by the writer, and published in the *Transactions* of the Society of Engineers for 1868, were referred to as explanatory of this view of the case. It was further pointed out that there is no such thing as absolute motion, for all velocities are relative to something else; and thus in a turbine we need only concern ourselves with such diminution in velocity as occurs in relation to the earth, and not necessarily with velocities in relation to the moving buckets of a turbine. Impact was considered as a pressure due to the destruction of velocity in a direction perpendicular to a plane surface, while reaction, from a vertical stream, is the natural integration of the horizontal elements of the successive pressures which act vertically in regard to the concave surface upon which the stream is caused to flow. In most theoretical investigations it is assumed that impact and reaction are equal when a current is divided at right angles to its original course, and this condition implies that a maximum result should be obtained from screw propellers when their blades stand at 45° to the plane of rotation. But in practice an angle of 42° is found best, and this is so because impact and reaction under the conditions stated are not equal, but bear to each other the proportions of 71 to 62; and these proportions give an inclination of screw-blade of 41° by taking an experiment which corresponds most closely with the conditions of a screw propeller. The resultant due to these proportions is found to be 94·25 units, whereas if impact had been the same as reaction it would have been 100·75 units, and this is the total amount that can be aimed for in designing a screw prepeller, or pure impact turbine, where the stream is merely turned through a right angle from its original course. But if instead of turning the current only 90° it is turned through 180°, then impact and a still further reduced reaction both act vertically downwards; and it is their sum, and not merely their resultant, that constitutes the total pressure obtainable from a jet of water. Taking the standard unit employed in the experiments described, this sum is found to be 126, of which 71 represents impact, and the remaining 55 the effect of a complete reaction. Therefore, in designing a turbine or screw propeller, it would seem desirable to aim at changing the direction of a stream, so far as possible, into one at 180° to its original course, for it may be said that carrying out this view has placed the modern scientifically designed turbine in that pre-eminent position it now holds among all hydraulic motors.

The Severn Tunnel Railway, by T. Clarke Hawkshaw.—This paper described the Severn Tunnel Railway works, begun in 1873, and now approaching completion. The railway is being made to shorten the direct railway route between the South of England and South Wales. It passes under the River Severn about half a mile below the present steam ferry, which connects the South Wales and Bristol and New Passage lines. The river, or estuary, is about 2¼ miles wide. The length of the line is 7½ miles, of which 4½ miles are in the tunnel which passes under the Severn. The bed of the river is formed principally of Trias rocks (marls, sandstones, and conglomerates), in nearly horizontal strata. These overlie highly inclined Coal-measure shales and sandstones, which are also exposed in the river bed. The tunnel is made almost wholly in rocks of the Trias and Coal-measure formation, the exception being a little gravel passed through near the English end. The lowest part of the line is below the shoots, the deepest part of the river, where there is a depth of 60 feet of water at the time of low water, and 100 feet at the time of high water. Below the shoots, the line is level for 13 chains, rising 1 in 100 to the English end, and 1 in 90 to the Welsh end. Below the shoots, there is a thickness of 45 feet of rock (Pennant sandstone) over the brickwork of the tunnel. Under the Salmon Pool there is less cover, only 30 feet of Trias marl. Much water has been met with throughout the works, which have been flooded on several occasions. In 1879 the works under the Severn were drowned for some months by the eruption of a large land spring into one of the driftways under land on the Welsh side of the river. On another occasion a cavity was formed from the driftway under the Salmon Pool to the bed of the river, when a hole, 16 feet by 10 feet, was found in the marl. The works were flooded by the water which found an entry through this hole. It was filled with clay, and the tunnel is now finished beneath it. The quantity of water now being pumped is about 19,000 gallons per minute. Additional pumps have been erected, as the large land spring, which has been penned back by a brick wall, still remains to be dealt with. When all the pumps are available, the total power will be equal to 41,000 gallons a minute. The tunnel is for a double line of way, and will be lined throughout with vitrified bricks set in Portland cement mortar. It is being made by the Great Western Railway Company. Sir John Hawkshaw is engineer-in-chief; Mr. C. Richardson, engineer; and Mr. T. A. Walker, the contractor.

SECTION H—ANTHROPOLOGY

THE first paper read in this Section was that of Prof. Boyd Dawkins, *On the Range of the Eskimo in Time and Space.* In his introductory sentences Prof. Dawkins remarked on the importance and interest of his subject. He began his inquiry into the condition of the Eskimo by particularising those of Greenland. By the aid of a sketch-map upon the blackboard, he traced the progress of the dwellers on the Arctic shores, following them to the continent of Asia. He noted that in the vast region which is occupied by the Eskimo the degree of civilisation is practically the same, that civilisation being of a rude nature. Speaking of their relations to other nations, the Professor remarked on the broad belt of enmity, a debatable ground, that exists between the Eskimo and the Red Indian, between whom there is no friendship. But, he said, there is a likeness between the tongues of the two races, though this does not by any means prove any affinity between them. Coming to the question of the date of the settlement of the Eskimo in Greenland, he said that Markham's assumption that they crossed by Behring Straits from Asia, being driven forth by Tartar hordes, was purely assumption, and that this opinion was not shared by Mr. Dall or himself. He held that there was proof that the Eskimo, in the year 1000, ranged farther southward than where we are now. There was reason to believe this, he said, by archæological proofs, and he maintained that the Eskimo were a retreating race, being continually driven farther north by stronger and more powerful tribes, such as the Red Indians, and that if the Arctic regions had been less inclement (this being safety to this people), before this time the Eskimo would have been exterminated by the Red Indians. Even in Asia, he said, these were a retreating race, pushed farther to north and east by pursuing tribes. The lecturer remarked on the word "kayak" or boat, used by the Eskimo, and its likeness to the word (caique) used for the same object by the Turkish people, and quoted his friend Dr. Isaac Taylor, who had traced the history of this word. He explained the etymology of this word in an interesting manner, and caused a little laughter by remarking that the boat was used by the Eskimo to carry their "wives, children, and other chattels." He said, in concluding the first portion of his inquiry, that, from proofs established, the Eskimo formerly lived in a wide range of country far more south than their present habitation, and that they were driven to the north by more powerful nations. Speaking of the range of the Eskimo in time, Prof. Dawkins made some very interesting remarks on the habits and implements of the cave-dwellers in Europe. Illustrating the artistic power of these dwellers, the lecturer pointed out an enlarged sketch of a reindeer, drawn on bone, and found in a cave in Switzerland. This sketch, he said, was perfectly natural, and was admirably done by the skin-clad artist whom he pictured. He also showed the picture of an elephant, with trunk uplifted, and mouth opened, found in a cave in Auvergne. The habits of life of these cave-dwellers in Europe, he said, were the same as those of the Eskimo, and those only of the Eskimo; their implements were the same, and he would connect them in many ways, such as neglect of the rites of sepulture, for instance. The cave-dwellers, he maintained, were in every respect similar to the Eskimo, and this bore out his theory that the latter people are a retreating race in Europe, and once lived far southward of their present range. With regard to the time at which these cave-dwellers existed, and when the Eskimo came into America, the Professor said that the former dwelt in Europe in what is known as the "Pliocene" period. He said that in his opinion the Eskimo represented as a race the ancient cave-dwellers of Europe, and as such he regarded them with interest and respect. He thought that the difficulty of the question of migration was partly disposed of by the fact that the water of Behring Straits was extremely shallow, and in concluding a most interesting address, he recapitulated the proofs that he had brought forward in order to support his assertions.

Mr. F. W. Putnam, Curator of the Peabody Museum of American Archæology and Ethnology at Harvard University, gave a short notice of *The Recent Explorations by Dr. C. L. Metz and himself in the Little Nicàmi Valley, Ohio*. The particular mounds to the singular structure of which Mr. Putnam confined his remarks he has called the Turner group. The mounds, out of one of which he had taken seventy-three skeletons, were burial mounds of the ancient Indians, and some seem to have been erected for an entirely different purpose. By means of rough sketches, Mr. Putnam illustrated the formation of these mounds. One of these seemed, from the fact that everything in it had been burnt, to be erected for a sacrificial purpose. A mass of a peculiar substance, like ashes, but which was not ashes, was found in the mound. What this substance was the lecturer did not know, but it was now being analysed by chemists. He described in detail the interior of the mounds which had been explored, noticing the covered pits which were found in them, some of these containing ashes and animal bones. A mixture of iron and gravel, forming a solid cement, was a curious feature in the mound, as the presence of the iron could not be accounted for. He said that previous explorations of the mounds had been very superficial, and had led to misrepresentation on the subject, but he had found that the removal of every inch of earth was necessary in order thoroughly to explore them, and this was done. In one mound two complete skeletons were found, in the midst of ashes. Round these were fragments of three other skeletons, and sixteen skulls, six of these latter having holes bored in them, evidently with stone drills. Scratches on the skulls showed how the flesh had been scraped away with a stone knife, and the skulls had evidently been placed round the skeletons for the purpose of ornament. Mr. Putnam said that in many respects these mounds were totally different from any that had yet been discovered and explored in this country. He showed photographs to illustrate his subject, amongst them being a remarkable specimen of art in the shape of a representation of a human face cut out of a sheet of mica. This, he said, would favourably compare with Dr. Dawkins' sketch of an elephant's head drawn by a cave-dweller of Europe. The speaker also noticed many other artistic objects, such as bracelets of copper covered with native silver, and peculiar and large earrings of the same material. In other cases he had found objects covered with native meteoric iron and with native gold; also terra-cotta images of small size, most of them much broken by the action of the fire into which they had been thrown. He remarked upon the likeness in many respects that the ornamentation of these objects bore to the work of the Egyptians.

A paper by Dr. Paul Topinard was read, entitled *Instructions anthropométriques élémentaire*. The author described various instruments that had been devised by him for enabling inexperienced travellers to take measurements of the human body with moderate accuracy.

Mr. Jeremiah Curtin read a paper *On Myths of the Modoc Indians*. He said that there were between three and four hundred Modocs, most of whom were in the Indian Territory and Southern Oregon. He proceeded to read a "myth" of these people which related to a personage called the Blue Woman, who was supposed by the Indians to be the second person in the Universe. This story, which was something like a fairy tale, was taken down in the original language by the speaker himself. He described the hardships through which the young Modocs went in order to fit themselves for manhood, such as climbing a mountain in order to reach an almost inaccessible pond, in which they swam.

SCIENTIFIC SERIALS

Journal of the Russian Chemical and Physical Society, vol. xvi. fasc. 6.—On the succession of reactions, by M. Lvoff, being an introduction into a series of researches undertaken by the author and several students, in order to disclose the mechanism of polymerisation.—On the action of chlorine on butylenes, by M. Chechoukoff.—On constants of chemical affinity, by W. Ostwald. The author, who maintains the views of Berthollet, further elaborated by Guldberg and Waage, considers that there is, for each body, a certain numerical coefficient of its chemical affinities as characteristic for the body as its atomic weight; and in addition to his former works, already published in the *Journal für pract. Chemie*, he publishes now a preliminary list of "constants of chemical reactions."—On glycidic acids, by P. Melikoff.—On the displacement of chlorine by bromine, and an explanation of the reactions which are accompanied by a disengagement of heat, by A. Potylitzin. The substitution of chlorine by bromine, in seeming contradiction with the law of maximum work, and which Berthelot has endeavoured to explain by the formation of chloric bromine and bromides of metals, could be explained by admitting that the reaction is going on with the heat received from the surrounding medium. This important inquiry, pursued by the author for several years past, brings him to interesting conclusions on thermo-chemistry.—On asarone, by MM. Rizza and A. Butleroff, being an inquiry into the properties of the camphor received from *Asarum europæum*.—On a new apparatus for determining specific heat, by W. Loughinin. It is a modification of the apparatus of Neumann.—On the reduction of isodinitrobenzyl, by P. Goloubeff.—On the preparation of animal colouring matters from albuminoid substances, by W. Mikhailoff.—On azophenylacetic acid, note by M. Wittenberg.—On the solution of lithium carbonate in water, note by J. Bevad.—On a hygienic photometer for schools, by Prof.

Petroushevky. It allows the amount of light received by books, paper, &c., on the desks of scholars, to be rapidly and accurately measured.—On the volume of a liquid considered as a function of temperature under a constant pressure, by K. Jouk. Diethylamine and ethyl chloride both agree with Prof. Avenarius's formula : $v = a + b \log (\tau - t)$.—On the relation between pressure and the density of rarefied gases ; preliminary communication by K. Kraevitch.—Notes on the structure of the atmosphere, by MM. Stankevitch and Rogovsky.

Annalen der Physik und Chemie, No. 7, June 15.—On the electric discharge in gases, by O. Lehmann (2 sheets of figures).—Contribution to the investigation of the origin of thermo-electric streams in a continuous homogeneous conductor, by Rudolph Overbeck (10 figures).—On the changes which the molecular structure of iron undergoes by heating and cooling, by Carl Frounne (2 tables).—On the appearance of electricity with the development of gases, by W. Hankel.—On a constant battery for electrical measurements, by W. von Beetz.—On the position of the pole, the induction and temperature coefficient of a magnet, and on the determination of the magnetic moment by bifilar suspension, by F. Kohlrausch.—On the dispersive power of a diamond, by A. Schrauf.—Researches on radiant heat, by Heinr. Schneebeli.—On the construction of Bohnenberger's reversible pendulum for the determination of the length of a pendulum for observing the period of oscillation in relation to a given length of mass, by Wilhelm Weber.—On the equilibriums of floating elastic plates, by H. Hertz.—The electricity of flame ; reply by J. Kollert.—On a new position for the measuring wire in the Wheatstone-Kirchoff bridge combination, by Hugo Meyer (2 figures).—Wheatstone's rheostat and mercury contact, by J. Bodynski (2 figures).

Journal de Physique théorique et appliquée, July.—On the analytical expression of absolute temperature and Carnot's function, by G. Lippmann.—On the electro-chemical equivalent of silver, by M. Mascart.—On the phenomenon of crystalline over-heating of sulphur and the rapidity of transformation of octahedral to prismatic sulphur, by D. Gernez.—Study of the distribution of potential in conductors of two or three dimensions traversed by continuous currents, by A. Chervet.—On an electrostatic standard of potential, by Messrs. Crova and Garbe.—On the variation of the capillary constant at water-ether and water-carbon bisulphide surfaces under the action of an electromotive force, by M. Kronchkoll and Lord Rayleigh.—On the electro-chemical equivalent of silver, and on the absolute electromotive force of Clark cells, by B. C. Damien.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, September 22.—M. Rolland, President, in the chair.—On algebraic equations : part third, on irrational equations, by M. de Jonquières. The author arrives at the somewhat unexpected conclusion that all algebraic equations, whether rational or not, which belong to the same "species," possess the same maximum number of real roots, whatever be their respective degrees.—Observations on the corona now visible round the sun ; variations in its form and colour ; a method of increasing its luminosity ; polariscopic observations ; polarimetric and photometric observations, by M. A. Co^rnu. The author is still disposed to connect this phenomenon with the Krakatoa eruption. The facts adduced are regarded as numerous enough to support the natural hypothesis of a cloud of particles with a nearly constant mean diameter, projected by the volcano and held in suspension in the higher regions of the atmosphere.—On the general evolution of the vegetable functions in annual plants : the Amaranthaceæ, by MM. Berthelot and André.—On the movement of Hyperion, by Prof. S. Newcomb. The author concludes that all the conjunctions of Hyperion with Titan take place near the aposaturn of the latter satellite. The point of conjunction oscillates about 180° on either side of the aposaturn during the period of revolution of the perisaturn of Hyperion in relation to that of Titan.—On the completion of the new method for resolving the most general linear equation into quaternions, by Prof. Sylvester.—Remarks on the third instalment of the new topographical map of Algeria presented to the Academy by Col. Perrier. This section consists of six sheets, comprising Miliana (province of Algiers), Saint Denis-du-Sig (province of Oran), Herbillon, Cap-de-Fer, Cap-de-Garde, Bugeaud (province of Constantine). The surveys are executed on a scale of 1 : 40,000, and the map, engraved on zinc, is issued at the scale of 1 : 50,000. Each sheet comprises seven plates, the relief being figured geometrically by equidistant curves of 10 m. in 10 m., and the plastic disposition of the surface being obtained by means of a dubbed drawing with lithographic crayon, based on the zenithal light and heightened by a slight touch of oblique light. The map marks a great improvement in the cartographic art.—On a development in a continuous fraction, by M. Stieltjes.—Note on the antiseptic properties of the sulphuret of carbon, by M. Ckiandi-Bey. From numerous experiments carried on for several years, the author finds that this sulphuret, which is soluble in water, arrests all fermentation, kills all microbes, is a most powerful antiseptic, and is, moreover, endowed with considerable penetrative power. Hence he strongly recommends it as a most efficacious remedy for cholera, typhus, diptheria, phthisis, and all diseases traceable to living germs.—Contributions to the study of the Cretaceous flora of the west of France, by M. L. Crié.—The Perpetual Secretary announced to the Academy that the International Committee of Weights and Measures representing the high contracting parties to the Convention for the Metre signed at Paris on May 20, 1875, has received the adhesion of England, which had hitherto taken no part in the Convention. With the further accession of Roumania and Servia the Committee now represents an aggregate population of 421,440,396, distributed over Germany, England, Austria, Hungary, Belgium, the Argentine Republic, Denmark, Spain, the United States, France, Italy, Peru, Portugal, Roumania, Russia, Servia, Sweden, Norway, Switzerland, Turkey, and Venezuela.—The photolithographic facsimile of a letter addressed by Gauss to Olbers on September 5, 1805, was presented to the Academy by Prince Boncompagni.

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