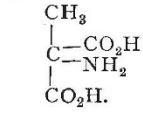
enjoy a property capable of being stated in advance, it constitutes for him an event (*un événement*). By means of some extremely difficult and subtle analytical transformations he arrives at a very general and remarkable formula, by means of which he solves with the greatest ease a number of curious arithmetical problems, such as: "What probability is there that in any given division the most approximate quotient will be the quotient by default (*par défaut*)? What probability is there that, if an integer taken at hazard be divided by the sum of two other integers taken at hazard, the quotient by default will be an odd number?"—On the oxidation of hydrochloric acid under the influence of light, by M. Leo Backelandt. This paper deals with the phenomenon observed by the author, that concentrated pure hydrochloric acid exposed to the action of sunlight in a badly-stopped flask after some time turns yellow, and emits an odour of chlorine. The change is shown to be due to a process of oxidation, the atmospheric oxygen consuming the hydrogen of the hydrochloric acid and liberating the chlorine. Under analogous circum tances hydriodic acid acts in the same way, liberating its iodine.—Notes on the rocks of Kantavu Island, Fiji Archipelago, by M. A. Renard. The author deals mainly with the andesites of the port of Kantavu, where they assume a columnar disposition.—Examination of the objections made by M. Hirn against the kinetic theory of the gases, by M. R. Clausius. While admitting the general care and accuracy with which M. Hirn has conducted his extensive experiments, the author argues on theoretical grounds that they are in no way opposed to the now generally accepted kinetic theory.

Rendiconti del Reale Istituto Lombardo, April 15.—On the permanent magnetism of steel at various temperatures, by Dr. G. Poloni. In this paper, which is supplementary to the two memoirs published by the author in 1878 and 1882, several interesting experiments are described with a series of magnets subjected to the action of heat within the limits of 15° and 300° C.—Note on a new acid isomerous with aspartic acid, by Prof. G. Körner. The formula of this acid, which the author proposes to name α-iso-aspartic or α-amido-isosuccinic acid, is—



Rivista Scientifico-Industriale, April 15.—A new method of measuring the thermic expansion of solid bodies, by Prof. Filippo Artimini. The author describes an ingenious apparatus which he has constructed for the purpose of determining with sufficient accuracy the increase in the linear dimensions of solids, derived from the internal motion communicated to matter by thermic energy.

April 30-May 15.—On the real atomic heat of simple bodies in the mechanical theory of heat and the formulas relating to it, by Prof. Alessandro Sandrucci. In Hirn's "Mechanical Theory of Heat" the expression *real atomic heat* is applied to the product of the atomic weight a of a simple body by its absolute calorific capacity K, and it is shown that this quantity should be independent of temperature, and equal and constant for all existing simple bodies; but the deductions are established independently of any hypothesis on the nature of heat. Prof. Sandrucci now inquires whether, given a certain hypothesis on the nature of heat, and determining the physical concept of *real atomic heat* in said hypothesis, it might be possible to obtain general and numerical results equal, or very nearly equal, to those already found by Hirn.—On a new saponiferous plant, by Prof. G. Licopoli. To the *Saponaria officinalis*, the *Quillaja Saponaria*, and a few other plants of this class Prof. Licopoli now adds the *Enterolobium Timbouva*, Martius, which is widely diffused throughout South Brazil and Uruguay.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, May 20.—"On the Lifting Power of Electro-Magnets and the Magnetisation of Iron." By Shelford Bidwell, M.A.

If an electro-magnet be excited by a gradually increasing current, a limit is soon reached beyond which the ratio of increase of sustaining power to increase of current becomes rapidly smaller; and it has generally been assumed that this ratio continues to diminish indefinitely, so that an infinite current would not impart to a magnet much greater lifting power than that which it possesses when an approach to "saturation" is first indicated. Joule estimated that the attraction would never be as much as 200 lbs. per square inch of sectional area; and, much later, Rowland assigned 177 lbs. per square inch, or 12,420 grms. per square centimetre as the limit for iron of good quality.

Having reason to doubt these conclusions, the author made some experiments with an iron ring cut into two equal parts, each of which was surrounded by a coil containing nearly 1000 turns of insulated wire. When one-half of the ring was used as an electro-magnet, and the other half as an armature (no current being passed through its coil), the weight supported was with a current of 4·3 amperes 13,100 grms., and with 6·2 amperes 14,200 grms., per square centimetre of surface. The lifting power therefore exceeded that which had been previously considered the greatest possible; nor was there any indication that a limit was being approached. But it was of greater interest to observe the effects produced when *both* portions of the ring were brought under the influence of gradually increasing currents, the conditions then being nearly the same as in Rowland's experiments. It was found that when the magnetic force had reached 50 C.G.S. units, at which point the weight sustained was about 10,000 grms. per square centimetre, the falling off in the rate of increase of the lifting power was well marked. And it continued to diminish until the magnetic force was 250 units and the weight supported 14,000 grms. But from this point *the magnetising current and the weight that could be carried increased in exactly the same proportion*, and continued to do so until the magnetic force had been carried up to 585 units, when the experiment was stopped, the maximum weight supported having been 15,905 grms. per square centimetre, or 229·3 lbs. per square inch. Detailed results are given in the first and second columns of the table. A curve plotted with the magnetic forces as abscissæ, and the weights lifted as ordinates, becomes, when the magnetic force is greater than 240 units, a sensibly straight line inclined to the horizontal axis.

It occurred to the author that these results might be applied to the investigation of the changes of magnetisation which correspond to changes of magnetic force. For if W = the grms. weight supported per square centimetre, H = the magnetic force, and I = the magnetisation, then for the divided ring

$$Wg = 2\pi I^2 + HI;$$

and by giving to W and H the values found to correspond, it becomes possible to find corresponding values of H and I. These are contained in the first and third columns of the table. When H has exceeded about 200, the ratio of I to H no longer continues to diminish, and the curve expressing the relation between them apparently becomes a straight line. Were the experiment carried much further, a tendency to a limit would probably be indicated; but if there is one it must be considerably higher than it is generally believed to be.

If k denote the susceptibility, μ the permeability, and B the magnetic induction, then $I = kH$, $\mu = 1 + 4\pi k$, and $B = \mu H$. Hence the values of k, μ, and B corresponding to different values of H can be found, and are given in the table. The figures in the last two columns are of great interest. Rowland, in order to exhibit the results of his well-known experiments in the form of a curve which (as he believed) would be of finite dimensions, plotted the values of μ as ordinates against those of B as abscissæ. The curve of μ thus obtained, after reaching a maximum for B = 5000, fell rapidly and in an almost straight line towards the horizontal axis. Assuming that the line would continue to be straight until it actually met the axis, Rowland concluded that the maximum of magnetic induction was about 17,500 units.

Now the greatest magnetic force used in Rowland's experiments was only 64 C.G.S. units; the imaginary part of his curve, therefore, corresponds to values of H ranging from 64 to infinity. A part of this exceedingly wide gap is filled by the author's experiments, in which H reaches 585; and if the values of μ and B given in the table are plotted, the curve will be found (after a rapid descent) to *bend round* soon after the limit of Rowland's observations, ultimately becoming, when B = 19,8.0, almost parallel to the axis of B.

The generally-accepted ideas as to the limits of magnetisation and magnetic induction therefore need modification.

TABLE (*Abstract*)

H	W	I	k	μ	B
3·9	2210	587	151·0	1899·1	7390
5·7	3460	735	128·9	1621·3	9240
17·7	7530	1083	61·2	770·2	13630
30·2	9215	1197	39·7	500·0	15100
78	11550	1337	17·1	216·5	16880
208	13810	1452	7·0	88·8	18470
427	15130	1504	3·5	45·3	19330
585	15905	1530	2·6	33·9	19820

May 27.—"On the Relation between the Thickness and the Surface-tension of Liquid Films." By A. W. Reinold, M.A., F.R.S., Professor of Physics in the Royal Naval College, Greenwich, and A. W. Rücker, M.A., F.R.S.

Plateau, Lüdtge, and van der Mensbrugghe have investigated experimentally the relation between the thickness and surface-tension of thin films. None of these observers, however, have used films thin enough to show the black of the first order of Newton's colours. The authors have therefore made a careful comparison of the surface-tension of black films with that of coloured films, the thickness of which was from 10 to 100 times greater. The principle of the method is the same as that utilised in Lüdtge's experiments. The interiors of the films to be compared are connected, and the relation between their surface-tensions is deduced from measurements by which their curvature is determined. In the authors' experiments a cylindrical film was thus balanced against another, which, though sometimes cylindrical and sometimes spherical, was initially of the same curvature as itself. The necessity for this arrangement arises from the fact that the authors' previous observations have shown that a cylindrical film thins to the black of the first order more readily than one of any other form. The fact that small changes in the forms of cylindrical and spherical films, attached to two circular rings, convert them into unduloids or nodoids, renders the mathematical theory somewhat complicated, but other considerations have been made to give way to the necessity of obtaining films which readily yield the black.

Preliminary experiments were instituted to test the observations of Lüdtge and van der Mensbrugghe as to difference of surface-tension between two films, one of which had been formed more recently than the other. These experiments showed that when one of the films was kept thick by supplying liquid to its upper support (flooding), while the other was allowed to thin, a considerable apparent difference of surface-tension was obtained. Before, however, this could be accepted as a trustworthy determination of an actual difference of surface-tension, several possible sources of error had to be considered. Thus, experiment shows (1) that the fact that the thicker film displays the greater surface-tension cannot be attributed to any peculiarity of the apparatus or mode of thickening adopted; (2) that it is not due to the weight of the thicker film; and (3) that only a small part of the observed difference can be ascribed to any slipping of the film over the liquid attachments to the solid supports.

The cause of the phenomenon cannot at present be assigned with certainty. Perhaps many causes are at work. Reasons are given for the conclusion that it is merely an instance of the difficulty which many observers have found in preserving a liquid surface pure.

On the assumption that the rapid change in the surface-tension of a newly-formed film is not due to its thinning, but to a disturbing cause, attempts were then made to eliminate this cause, or reduce it so as to compare films of very different thicknesses.

Two methods of attacking the problem were carried out. In the first the procedure was as follows:—The diameters of two cylindrical films were measured when they were in the same state; an electric current was passed up one of them in order to thicken it; and then, after a sufficient length of time had elapsed for the direct effect due to the disturbance produced by the current to pass off, the diameters were again measured. By this means it was possible to compare two films, one of which was nearly all black, while the other displayed a little black and the colours of the first and second orders. Both films were then allowed to thin, and assuming (in accordance with previous observations of the authors) that that which was already black remained in a constant state, any change of diameter which took place, as the coloured film became black, could be observed.

In a second group of experiments a cylinder was balanced against a sphere. As a spherical film thins more slowly than a cylinder, a comparison between a thick film (sphere) and a black or partially black film (cylinder) could be made without having recourse to an electric current, and greater differences of thickness were obtained than in the earlier observations.

The differences of surface-tension measured in these observations were very small. They never exceeded 1·5 per cent., and the black films were sometimes more and sometimes less curved than the thicker films with which they were compared. There was no evidence of any regular change in the surface-tension as the thickness diminished, and the average difference between the tension of the black and coloured films as deduced from fifteen experiments was only 0·13 per cent.

The general result of the inquiry, therefore, appears to be that *when the black part of a soap-film forms in the normal way, spreading slowly over the surface, no evidence of any change in surface-tension dependent on the thickness of the film is furnished by a direct comparison of the tensions of thin and thick films over a range of thickness extending from* 1350 *to* 12 *millionths of a millimetre.*

This conclusion is based upon a method of experiment by which a change of ½ per cent. in the value of the tension must have been detected, had it existed, and upon fifteen independent comparisons of the tensions of black and coloured films.

The authors next discuss the bearing of their observations upon the question of the magnitude of the so-called "radius of molecular attraction." They point out that if the mere equality in the surface-tensions of thick and thin films is to be considered conclusive, they have accumulated much stronger evidence for the statement that the radius of molecular attraction is less than half the thickness of a black film, *i.e.* $< 6 \times 10^{-6}$ mm. than Plateau produced for the assertion that 59×10^{-6} mm. is a superior limit to its magnitude. They are, however, unwilling to draw this conclusion from their experiments until an explanation is forthcoming in harmony with it, of the apparent discontinuity in the thickness of the film which always (except under very special circumstances) occurs at the edge of the black.

They are themselves inclined to look upon the sharp edge of the black as evidence of a change in surface-tension due to the tenuity of the film, and to regard the result of their experiments as fixing a superior limit (0·5 per cent.) to the difference of the tension of the black and coloured parts.

As no explanation of the discontinuity at the edge of the black has (as far as the authors are aware) ever been put forward, they conclude by a suggestion which, though no doubt of a speculative character, may serve to draw attention to a subject which is they believe of considerable interest.

They show that the main facts to be accounted for, viz. the discontinuity, the uniform thickness of the black, the wide variations in the thickness of the part of the coloured film which is in contact with the black, and the equality in the surface-tensions of the black and coloured films, could be explained if it were supposed that the surface-tension has a critical value when the thickness is somewhat greater than 12×10^{-6} mm.

The possibility of the existence of such a critical value has been pointed out by Maxwell (*Encycl. Brit.*, art. "Capillarity"). It would be explained by the assumption frequently made in discussions on the nature of molecular forces, that as the distance between two molecules diminishes, the mutual force between them is alternatively attractive and repulsive.

June 10.—"On some New Elements in Gadolinite and Samarskite, Detected Spectroscopically." By William Crookes, F.R.S., V.P.C.S.

The recent discovery by my distinguished friend M. de Boisbaudran (*Comptes rendus*, cii., p. 1003, May 3, 1886) of the existence of a new element which he calls Dysprosium, makes it unadvisable on my part, as a fellow investigator in spectroscopic research, to delay any longer the announcement of some of the results I have obtained during the fractionations of the samarskite and gadolinite earths.

I will first take the earths which give absorption-spectra when their solutions are examined by transmitted light. These occur chiefly at the higher end, beginning with didymium and proceeding, through samarium, holmium, &c., to erbium, which is one of the least basic. The earths which give phosphorescent spectra chiefly occur at the lower end, but each group overlaps the other; for instance, yttria occurs above erbia.

One of the highest of the absorption-spectrum earths is didymia. The spectrum of didymium, as generally met with, is well known, and is given in my paper on "Radiant Matter Spectroscopy: Part 2, Samarium" (par. 135).

It has long been suspected that didymium is not a simple body, and in June 1885 Dr. C. Auer announced that by a series of many hundred fractional crystallisations he had succeeded in splitting up didymium into two new elements, one giving leek-green salts and the other rose-red salts. The green body he called Praseodymium and the rose-red Neodymium. I have not found that my method of fractionation gives a decomposition similar to this; probably didymium will be found to split up in more than one direction, according to the method adopted; but by pushing the fractionations at the didymium end of the series to a considerable extent, a change gradually comes over the spectrum. At the lower end the earth gives an absorption-spectrum such as is usually attributed to didymium, but with no trace of some of the bands in the blue end, the one at λ 443 being especially noticeable by its absence. The intermediate earths give the old didymium spectrum, the relative intensities of some of the bands varying according to the position of the earth in the series, the band 443 becoming visible as the higher end is approached. The highest fractions of all give the band 443 one of the most prominent in the spectrum, being accompanied by other fainter bands which are absent in the lowest didymium spectrum.

I now come to a branch of the subject which promises to yield results even more fruitful than those given by the examination of absorption-spectra: I refer to the spectra yielded by some of the earths when phosphoresced *in vacuo*. This method has been so fully explained before the Royal Society, in my papers on "Radiant Matter Spectroscopy," that I need not repeat it.

In my Bakerian Lecture on Yttrium (*Phil. Trans.*, Part 3, 1885) I described the phosphorescent spectrum of this earth, and gave a drawing of it. In the Samarium paper I gave a similar description and drawing of the samarium spectrum, and also described and illustrated some anomalous results obtained when yttria and samaria were mixed together. Under the conditions described in the paper a sharp and brilliant orange line made its appearance, which at that time seemed as if it belonged to the samarium spectrum, and was only developed in greater intensity by the presence of yttria. This explanation, however, did not satisfy me, and I called the line $\left(\lambda\ 609 = \frac{1}{\lambda_2}\ 2693\right)$ "the anomalous line," intending to return to it at the first opportunity. I have since further investigated the occurrence of this line, with more than usual good fortune in the extent and importance of the new facts thereby disclosed.

Systematic fractionation was carried on with the portions of the general series giving the strongest appearance of line 609, and it soon became apparent that the line closely followed samarium. The presence of yttria was not necessary to bring it out, although by deadening the brightness of the other bands it was useful, not seeming to affect the line 609. Several circumstances, however, tended to show that although line 609 accompanied samarium with the utmost pertinacity, it was not so integral a part of its spectrum as the other red, green, and orange lines. For instance, the chemical as well as physical behaviour of these line-forming bodies was different. On closely comparing the spectra of specimens of samaria from different sources, line 609 varied much in intensity, in some cases being strong and in others almost absent. The addition of yttria was found to greatly deaden the red, orange, and green lines of samarium, while yttria had little or no effect on the line 609; again, a little lime entirely suppressed line 609, while it brought out the samarium lines with increased vigour. Finally attempts to separate line 609 from samarium, and those portions of the samarskite earths in which it chiefly concentrated, resulted in sufficient success to show me that, given time enough and an almost inexhaustible supply of material, a separation would not be difficult.

But what was then practically impossible to me, restricted with limited time and means, Nature has succeeded in effecting in the most perfect manner. I had been working on samarskite, and many observations had led me to think that the proportion of band-forming constituents varied slightly in the same earth from different minerals. Amongst others, gadolinite showed indications of such a differentiation, and therefore I continued the work on this mineral. Very few fractionations were necessary to show that the body giving line 609 was not present in the gadolinite earths, no admixtures of yttria and samaria from this source giving a trace of it. It follows, therefore, that the body whose phosphorescent spectrum gives line 609 occurs in samarskite, but not in gadolinite; thus it cannot be due to samarium, yttrium, or a mixture of these two elements; the only other probable alternative is that the source of this line is a new element.

Chemical fractionation is very similar to the formation of a spectrum with a very wide slit and a succession of shallow prisms. The centre portion remains unchanged for a long time, and the only approach to purity at first will be at the two ends, while a considerable series of operations is needed to produce an appreciable change in the centre.

During the later fractionations of the gadolinite earths another set of facts, formerly only suspected, have assumed consistent form. The spectrum bands which hitherto I had thought belonged to yttria soon began to vary in intensity among themselves, and continued fractionating increased the differences first observed. It would exceed the limits of a preliminary note were I to enter into details respecting the chemical and physical reasons which lead me to the definite conclusions I now bring before this Society. More than 2000 fractionations have been performed to settle this single point. I will content myself with stating the results. The earth hitherto called yttria appears to be a highly complex body, capable of being dissociated into several simpler substances, each of which gives a phosphorescent spectrum of great simplicity, consisting for the most part of only one line.

Taking the constituents in order of approximate basicity (the chemical analogue of refrangibility) the lowest earthy constituent gives a violet band (λ 456), which I have reason to believe belongs to ytterbia. Next comes a deep blue band (λ 482); then the strong citron band (λ 574), which has increased in sharpness till it deserves to be called a line; then come a close pair of greenish-blue lines (λ 549 and λ 541, mean 545); then a red band (λ 619), then a deep red band (λ 647), next a yellow band (λ 597), then another green line (λ 564); this (in samarskite yttria) is followed by the orange line (λ 609) of which I have already spoken; and finally, the three samarium bands remain at the highest part of the series. These for the present I do not touch, having my hands fully occupied with the more easily resolvable earths.

In the *Comptes rendus* for April 19, 1886, M. de Boisbaudran announced to the Academy that M. de Marignac, the discoverer of Yα, had selected for it the name Gadolinium. In February last I gave a short note on the earth Yα (*Proc.* Roy. Soc., No. 243, February 1886, and NATURE, vol. xxxiii., p. 525) in which I described its phosphorescent spectrum (agreeing exactly with that given by Yα of M. de Marignac's preparation). Referring to my paper it will be seen that Yα is composed of the following band-forming bodies:—(451), (549), (564), (597), (609), (619), together with a little samarium. Calling the samarium an impurity, it is thus seen that gadolinium is composed of at least four simpler bodies. The pair of green lines (λ 541 and λ 549, mean 545), being the strongest feature in its spectrum, may be taken as characteristic of gadolinium: the other lines are due to other bodies.

A hitherto unrecognised band in the spectrum by absorption or phosphorescence is not of itself definite proof of a new element, but if it is supported by chemical facts such as I have brought forward there is sufficient *primâ facie* evidence that a new element is present. Until, however, the new earths are separated in sufficient purity to enable their atomic weights to be approximately determined, and their chemical and physical properties observed, I think it is more prudent to regard them as elements on probation. I should therefore prefer to designate them provisionally by the mean wave-length of the dominant band. In this I am following the plan adopted by astronomers in naming the minor planets, which are known by a number encircled by a line. If, however, for the sake of easier discussion among chemists a definite name is thought more convenient, I will follow the plan frequently adopted in such cases, and provisionally name these bodies as shown in the following table:—

Position of lines in the spectrum	Mean wave-length of band or line	Provisional name	Probability
Absorption-bands in violet and blue	443	Dα	New.
	451·5	Sα	Dysprosium.
	475	Sβ	New.
Bright lines in—			
Violet	456	Sγ	Ytterbium.
Deep blue	482	Gα	New.
Greenish-blue (mean of a close pair	545	Gβ	Gadolinium.
Green	564	Gγ	New.
Citron	574	Gδ	New.
Yellow	597	Gε	New.
Orange	609	Sδ	New.
Red	619	Gζ	New.
Deep red	647	Gη	New.

The initial letters D, S, and G recall the origin of the earths respectively from Didymium, Samarskite, and Gadolinite.

Geological Society, May 26.—Prof. J. W. Judd, F.R.S., President, in the chair.—John Allen Brown was elected a Fellow of the Society.—The following communications were read:—Further proofs of the pre-Cambrian age of certain granitoid, felsitic, and other rocks in North-Western Pembrokeshire, by Henry Hicks, M.D., F.R.S., F.G.S. In this paper the author gave the results obtained by him during a recent visit to North-West Pembrokeshire. He stated that he had further examined some of the sections referred to in his previous papers, as well as others not therein mentioned, and that he had obtained many additional facts confirmatory of the views expressed by him in those papers. The Lower Cambrian conglomerates and grits, he said, contained pebbles of nearly all the rocks in that area which he had claimed as of pre-Cambrian age; and the fragments of the granitoid rocks, the felsitic rocks, the hälleflintas, and of the various rocks of the Pebidian series which he had found, showed unmistakably that those rocks had assumed, in all important particulars, their peculiar conditions before the fragments were broken off. Moreover, he stated that there was abundant evidence to show that the very newest of the pre-Cambrian rocks of the area had been greatly crushed, cleaved, and porcellanised before any of the Cambrian sediments were deposited; hence he maintained that there was in the area a most marked unconformity at the base of the Cambrian. At Chanter's Seat, near St. David's, he found that the Lower Cambrian grits and conglomerates were, in parts, almost wholly made up of fragments of characteristic varieties of the granitoid rocks which form the Dimetian ridge near by. The so-called granite of Brawdy, Hayscastle, and Brimaston, he said, there was good evidence to show, was probably of the age of the granitoid rocks of St. David's. The mass of so-called granite near Newgale, he stated, was composed of rhyolities and breccias, undoubtedly of pre-Cambrian age. The Roch Castle and Trefgarn rocks, he stated, could not possibly be intrusive in Cambrian and Silurian strata, but belonged to a series of pre-Cambrian rocks. He referred to the important evidence bearing on the age of these rocks given in a paper communicated to the Society, since his last paper was read, by Messrs. Marr and Roberts. These authors showed that in a quarry near Trefgarn Bridge a Cambrian conglomerate, overlain by Olenus-shales, is to be seen resting on the eroded edges of the Trefgarn series. The author examined this section lately, and obtained from the conglomerate some very large pebbles of the characteristic rocks called hälleflintas, and of the ash-bands, both of which are found *in situ* in the quarry. He therefore maintained that there was the most ample evidence to show that there was a great group of pre-Cambrian rocks exposed in North-West Pembrokeshire, and hence that he had proved conclusively that Dr. Geikie's views in regard to these rocks, as given in his paper and more recently in his text-book, are entirely erroneous.—On some rock-specimens collected by Dr. Hicks in North-Western Pembrokeshire, by Prof. T. G. Bonney, D.Sc., LL.D., F.R.S., F.G.S. The author stated that he had examined microscopically a series of specimens collected by Dr. Hicks, and compared them with those described by Mr. T. Davies, in vol. xl. of the *Quarterly Journal*, and with some in his own collection. He agreed with Mr. Davies's conclusions in all important matters. The Chanter's Seat conglomerate contained many grains of quartz and felspar, curiously like those minerals in the so-called Dimetian, together with numerous small rolled fragments, about a quarter of an inch in diameter, exactly resembling the finer-grained varieties of that rock, besides bits of felsite, similar to some which occur in the St. David's district, quartzite, a quartz-schist, and an argillite. The rocks *in situ* in the Trefgarn quarry were indurated trachytic ashes, together with the curious flinty rock which was the most typical of the so-called hälleflintas. One of the pebbles from the overlying conglomerate perfectly corresponded with the last-named rock; others appeared to be most probably from an altered trachytic ash, differing only varietally from those *in situ*. After prolonged examination of this "hälleflinta" of Trefgarn and the similar rocks from Roch, he was of opinion that while it was possible that some specimens might be altered ashes, most of them were originally rhyolites or obsidians, devitrified, and then silicified by the passage of water which had contained silica in solution. The Trefgarn group obviously could not be intrusive in the Lower Cambrian, and it was extremely improbable that the Roch Castle series was newer than the basement conglomerate of that district. The Brawdy granitoid rock might be a granite, but at any rate it presented considerable resemblance to the "Dimetian." It was therefore evident that the Cambrian conglomerate of St. David's was formed from a very varied series of rocks, some of them much older than it, and that the Dimetian could not be intrusive in it. Moreover, even if the Dimetian should be proved ultimately to be a granite, and the core of a volcano which had emitted the rhyolites, sufficient time must have elapsed after its consolidation and prior to the making of the conglomerate to remove, by denudation, a great mass of overlying rock. Hence, whatever its nature, it was pre-Cambrian.—On the glaciation of South Lancashire, Cheshire, and the Welsh border, by Aubrey Strahan, F.G.S., H.M. Geological Survey. By permission of the Director-General. The author stated that it may be concluded that (1) the striæ on the English and Welsh sides respectively, while showing variations among themselves, by a marked preponderance in one quarter of the compass, indicate a direction of principal glaciation, this direction being on the English side from about N.N.W., and on the Welsh from about E.S.E. (2) The direction of glaciation in both districts agrees very closely with that of the transportation of the drift, but is only locally influenced by the form of the ground. (3) The striæ are by no means universal, but are found almost exclusively in connection with those beds in the drift which contain evidence of the actual presence of ice. The striæ are not such as can have been produced by valley-glaciers; they go across and not down the valleys, nor are there any moraines. The marine origin of the drifts is indicated by their well-marked stratification as a whole, by the alternations of well-washed sands and gravels with the Boulder-clays, and by the occurrence through all the beds of marine shells.

Royal Microscopical Society, May 12.—The Rev. Dr. Dallinger, F.R.S., President, in the chair.—The President referred to the death of Dr. J. Matthews, a member of Council, and a resolution of sympathy and condolence with the family was adopted.—Mr. J. Mayall, jun., exhibited and described a new pattern of the radial microscope by Mr. Swift, in which a rack was added to the arc, and a removable mechanical stage provided by which the object was clipped without any intermediate plate.—Mr. J. D. Hirst's communication was read referring to the report in the *Journal* of the Royal Society of N.S. Wales, attributing to him the view that a highly refractive mounting medium enabled objectives of small aperture to compete in resolution with wide-angled oil-immersion objectives. Mr. Hirst explained that the report was so worded as to convey a totally erroneous impression of what he claimed, which was only that the highly refractive medium would render difficult test diatoms so easy to a good high-angled water lens that the superiority of the oil-immersion objective will not be apparent, except under the very deepest eye-pieces.—Mr. C. D. Ahrens's paper, on a new polarising prism, was read; also Prof. Thompson's letter in commendation of it as unrivalled for use as a polariser, having flat ends, wide angle, and absence of distortion or coloured fringes.—Dr. Sternberg's paper on *Micrococcus pasteuri* was read, in which he called attention to the characters which distinguish it in a very definite manner from the microbe of fowl-cholera, it differing from the latter, not only in its morphology, but in the fact that it is not fatal to fowls.—Mr. F. H. Evans exhibited some photomicrographs produced by the Woodburytype process from negatives by himself, and transferred

to glass for lantern illustration. They were shown upon a portable screen by Mr. G. Smith of the Sciopticon Co. Mr. Evans claimed that he had been more than ordinarily successful in overcoming the chief difficulty in the matter, that of obtaining such a focus as would properly represent the various planes of even deep objects, and this without loss of natural effect. The objects illustrated comprised Diatoms and Desmids, Foraminifera, Polycystina, star-fishes, sections of Echinus spines, insect preparations, animal parasites, and anatomical and vegetable sections, the remarkable clearness of most of the photographs calling forth frequent favourable comments from the Fellows present.

Entomological Society, June 2.—Mr. R. McLachlan, F.R.S., President, in the chair.—The following gentlemen were elected Fellows, viz. Mr. C. Baron-Clarke, M.A., F.R.S., Mr. Dannatt, Mr. H. Wallis-Kew, Mr. J. P. Mutch, Mr. B. W. Neave, Mr. A. C. F. Morgan, and Mr. W. Warren, M.A.—Mr. Stevens exhibited an example of *Heydenia auromaculata*, from the Shetlands, a species new to Britain.—Dr. Sharp exhibited certain specimens of *Staphylinidæ*, specially prepared and placed in cells of cardboard, sealed up with layers of bleached shellac.—Mr. Billups exhibited *Meteorus luridus*, Ruthe, a species of *Ichneumonidæ* new to Britain.—Mr. W. White exhibited cocoons of *Cerura vinula*, and made some observations as to the mode by which the perfect insect escapes from these solid structures. He thought that formic acid secreted by the insect was a probable factor in the operation. The question of how the parasitic *Ichneumonidæ* and *Diptera* escaped from these cocoons was also raised, and the President, Baron Osten-Sacken, Mr. Waterhouse, and Prof. Meldola, made remarks on the subject.—Mr. Elisha exhibited living larvæ of *Geometra smaragdaria*, from the Essex marshes. He also exhibited the singular pupæ of *A. bennettii*.—Mr. Howard Vaughan exhibited a long series of *Peronea hastiana*, showing the innumerable varieties of the species. He also exhibited, on behalf of Mr. Sidney Webb, of Dover, an interesting series of *Cidaria suffumata*, and read notes on the varieties of this species, communicated by Mr. Webb. Mr. Jenner-Weir, Mr. Waterhouse, Dr. Sharp, Mr. Distant, and Mr. Stainton took part in the discussion which ensued.—Mr. A. G. Butler communicated a paper on new genera and species of *Lepidoptera-Heterocera* from the Australian region, in which 21 new genera, and 103 new species were described.—Dr. Baly communicated a paper on uncharacterised species of *Diabrotica*.

EDINBURGH

Mathematical Society, June 11.—Dr. R. M. Ferguson, President, in the chair.—Mr. Alexander Robertson discussed a problem in combinations.—Mr. John Alison gave a mnemonic for a group of trigonometrical formulæ.—Mr. A. Y. Fraser read a communication from Mr. George A. Gibson on integration by parts and successive reduction.

PARIS

Academy of Sciences, June 7.—M. Jurien de la Gravière, President, in the chair.—Remarks on the works of M. Jean Claude Bouquet, by M. Halphen. To this notice is appended a list of the scientific writings of the illustrious mathematician, who was born at Morteau, Franche-Comté, on September 7, 1819, and died on September 9, 1885.—A new method of determining the refractions of light at all altitudes by means of the known value of one alone (continued), by M. Lœwy. The formulas are here given by which various refractions may be found after one has been determined by the method already explained.—On the part played by Lavoisier in determining the unit of weight in the metrical system, by M. C. Wolf. The imperfect data contained in Delambre's "Base du Système Métrique" are here supplemented from fresh documents tracing the action of Lavoisier in determining the various standards of weight in the metrical system adopted by the French Government at the close of the last century.—Heat of combustion and formation of the sugars, hydrates of carbon, and allied polyatomic atoms, by MM. Berthelot and Vieille. By their new method the authors have at last succeeded in effecting complete combustion of the sugars by free oxygen, thereby correcting the determinations already obtained by Rechenberg with the chlorate of potash for mannite, dulcite, lactose, saccharose, cellulose, and some other substances.—Fresh observations on the ammonia present in the ground, by MM. Berthelot and André. In reply to M. Schlœsing's last note the authors deal with the interesting problems suggested by that chemist's remarks on the laws regulating the interchange of ammonia between the atmosphere and the earth.—On the atomic weight and the spectrum of germanium, by M. Lecocq de Boisbaudran. Under the induction-spark a fine specimen of this element received from M. Winkler yields a beautiful spectrum with remarkably bright blue and violet rays, with atomic weight 72·27. Germanium would therefore appear to lie, not between bismuth and antimony, as at first supposed, but between silicium and tin, like the ekasilicium of Mendelejeff's classification. Winkler had fixed its atomic weight provisionally at 72·75.—Note on the age of the Pikermi, Mount Léberon, and Maragha fauna, by M. Albert Gaudry. The author's observations induce him to refer this geological epoch rather to the Middle than to the Upper Tertiary.—Researches on gelatine, by M. P. Schutzenberger.—Influence of the anæsthetic vapours on the living tissues, by M. R. Dubois. The paper gives a description of the action exercised by the vapours of chloroform, ether, sulphuret of carbon, and alcohol on the protoplasm of the animal and vegetable tissues. The action is regarded not so much as one of coagulation, as of substitution analogous to that obtained by Graham when studying the effects of ether, alcohol, &c., on the mineral colloidal hydrates.—Observations of the comet *c* (1886) made at the Observatory of Lyons with the Brunner six-inch equatorial, by M. Gonnessiat.—Note on the herpolhodie, by M. Hess.—Extension of the general law of solidification to thymol and napthaline, by M. F. M. Raoult. The figures 0·61 and 0·64, here determined for these two substances, approach as nearly as possible to 0·62 given by the author's general law of solidification announced some years ago.—On a visual illusion and the apparent oscillation of the stars, by M. H. de Parville. The phenomenon of the apparent motion of slightly illumined bodies in the midst of darkness is here associated with that of the apparent motion of the stars known to the Germans by the name of *Sternschwanken*.—Action of the hydrogenated acids on vanadic acid, by M. A. Ditte.—Action of the oxide of lead on the hydrochlorate of ammonia, by M. F Isambert. This reaction, which absorbs heat, is shown to be entirely analogous to a phenomenon of dissociation, and controlled by the ordinary laws of dissociation.—Note on the molybdate of cerium, by M. Alph. Cossa. The form of this substance prepared by different processes by the author and M. Didier, confirms the strict analogy of molecular structure between certain combinations of the metals of cerite and the corresponding combinations of calcium and lead.—Note on a new alloy of aluminium, by M. Bourbouze. This useful alloy, consisting of 10 parts tin and 100 aluminium, is white, and has rather a higher density (2·85) than the pure metal.—On the presence of cholesterine in some new fatty substances of vegetable origin, by MM. Ed. Heckel and Fr. Schlagdenhauffen.—On the presence of cholesterine in the carrot; researches on this direct principle, by M. A. Arnaud. The cholesterine yielded by the carrot contains: carbon, 83·90; hydrogen, 12·20; oxygen, 3·90. It is insoluble in water, but very soluble in boiling alcohol, in the sulphuret of carbon, chloroform, and oils. It thus differs little from animal cholesterine, and is absolutely identical with the substance derived by Hesse from the Calabar bean.—Note on piliganine, the alkaloid of Lycopodiacea from Brazil, by M. Adriau. The piligan plant, which yields this principle, is a lycopod closely allied to the European *L. Selago*, and probably the variety known in Brazil as *L. Saussurus*. The extract is a strong poison, soluble in water, in alcohol, and chloroform.—Researches on the vegetable development of the sugar beetroot, by M. Aimé Girard.—On the crystalline form of the pyrophosphates and hypophosphates of soda, by M. H. Dufet.—On anthophyllite, an orthorhombic amphibole with two prismatic cleavages, *m* (110) (*mm* = 125° about), and a third, *h*¹ (010), by M. A. Lacroix.—On the development of the elements of the gray cortical substance of the cerebral circumvolutions, by M. W. Vignal.—On a chronometer with magnetic coupling, by M. A. d'Arsonval. This is an apparatus constructed at the suggestion of M. Brown-Séquard for the purpose of determining the velocity of sensitive impressions transmitted through the spinal marrow in a normal or pathologic state.—Note on sacculine, by M. Y. Delage. The author replies to the objections recently urged by M. Giard against some of the results announced by him on the evolution of sacculine.—On the internal air of insects compared with that of plants, by M. J. Peyrou.—On the stratigraphic structure of the Sierra Nevada and Sierra de Ronda, South Spain, by MM. Ch. Barrois and Alb. Offret.—On the geology of the Central Tunisian region between Kef and Kairwan, by M. G. Rolland.—On the genus *Bornia*, F. Rœmer, one of the most charac

teristic fossil plants of the Kulm and Upper Devonian formations, by M. B. Renault.

BERLIN

Physiological Society, May 14.—Dr. Kossel reported on experiments instituted by Dr. Raske in the chemical division of the Physiological Institute, under his superintendence, on the chemical composition of the brain of the embryos of horned cattle. The occurrence of definite chemical substances, for example, elastine, keratine, cerebrine, in altogether special tissues, made it appear desirable to establish whether, during the process of development, the chemical composition or the morphological structure was the primary. Seeing that the brain of the embryo was very lymphatic, the composition and quantity of the lymph, which saturated all tissues of the embryo, were first ascertained and subtracted from the collective mass. The values found in two brains were compared with the results of the chemical investigation of brains carried out a considerable time ago in the laboratory of Prof. Hoppe-Seyler. The investigation referred to had shown that the gray substance of the brain of full-grown cattle differed essentially from the white substance. The gray substance, in the first place, contained but very little cerebrine, probably none at all ; the white substance, on the other hand, contained more than 9 per cent. of the dry material. The gray substance was further distinguished from the white by its less amount of cholesterine and its greater quantity of albumen and extractives. In the defect in cerebrine, in the small amount of cholesterine, and in the copious supply of albumen and extractives, the brains of the embryos of horned cattle held exactly the same position as did the gray substance of grown-up brains. It was only in the quantity of lecithine and of salts that the embryonal brains demonstrated any difference from the gray substance. The embryonal brain was, therefore, very essentially distinguished from the white substance—a phenomenon in harmony with the fact that in the embryonal brain medullated nerve-fibres were not met with.—Prof. Christiani handed in his book published last year, "Zur Physiologie des Gehirns," and added some statements in corroboration of the view there set forth regarding the power of seeing on the part of rabbits after complete extirpation of Munck's sphere of vision. Prof. Gudden and Prof. Luciani had also, he said, found animals which after such operations had yet the power of sight. He sharply defined the difference between Prof. Munk and himself by saying that the former maintained an animal *must* be totally blind after excision of the sphere of vision on both sides, whereas his own observations allowed him to take up the position only that an animal after such an operation *might* get totally blind.—Dr. Virchow communicated the results of the investigations carried out by Herr Canfield, in the Anatomical Museum, into the accommodation apparatus of a bird's eye. In order to get at a knowledge of the physiological process of accommodation in the highly developed bird's eye, the anatomical substratum required to be gained. The investigation brought to light, in point of fact, a very long series of differences in the arrangement and development of the different formations of the apparatus situate between cornea, sclera, lens, and iris, among the different species of birds, great horned owl, owl, starling, dove, goose, and others. These differences the speaker illustrated by drawings, but no physiological explanation of them had yet been arrived at.—Dr. Gossels had made experiments regarding the secretion of nitrates through the urine in men and birds (duck and fowl), the nutriment administered having been in every case the same, nitrates being in some instances given, and also in some instances not given. By these experiments it was demonstrated that, in the case of animals secreting uric acid, a large part of the nitrates that had been partaken was again excreted, but that a still larger part disappeared in the body. As to what became of these latter nitrates, the speaker was not disposed to set up any hypothesis.—Prof. Zuntz, referring to the latter point, observed that several years ago it had been noticed in his laboratory that, after partaking of nitrate of ammonia, animals exhaled free nitrogen. A part at least of the nitrates, therefore, in accordance with this observation, was decomposed in the body and reduced to free nitrogen.

STOCKHOLM

Geological Society, March 4.—Hr. C. W. Crongvirt gave an account of the formation of iron ochre in some little lakes in the province of Helsingland. The lakes drew their water from the surrounding iron-containing streams. The yellow ochre seemed to collect on the clay, and the brown on the sand-bottom of the lakes. A factory has been started for its utilisation.—Prof. W. C. Brögger gave an account of the Olenell zone of North America, maintaining that this zone, with its peculiar fossils, which in several instances seemed to be the original types for varieties subsequently appearing, did in America—as well as had been long known to be the case in Scandinavia—occupy a very low place in the geological strata below the true Paradoxide slate.—Hr. F. Tegræus gave an account of his studies of the glacial formations on the Island of Gothland, in the Baltic. He stated that blocks and drifts proved that the glaciers had first moved in a south-westerly and afterward in an easterly direction. He had never found true ridges on the island, but certainly shore-terraces and terminal moraines.—Hr. E. Svedmark exhibited a specimen of argyrodite sent by Prof. Norkenskjöld, which contains the newly-discovered element germanium.

BOOKS AND PAMPHLETS RECEIVED

"Habit in Education," by F. A. Caspari (Heath, Boston).—"Observaciones Magnéticas y Meteorológicas del Real Colegio de Belen," Julio-Setiembre, 1885 (Habana).—"Transactions of the Royal Irish Academy," vol. xxviii., "Science," part 22, "Alphabetical Catalogue of Earthquakes Recorded as having occurred in Europe and Adjacent Countries," by J. P. O'Reilly (Academy, Dublin).—"Plane and Spherical Trigonometry," by H. B. Goodwin (Longmans).—"Studies from the Biological Laboratory," vol. iii. No. 6 (Johns Hopkins University).—"First Lessons in Geometry," by B. H. Rau (Addison, Madras).—"History of the Royal College of Surgeons in Ireland," by Sir C. A. Cameron, (Fannin, Dublin).—"Journal of the Royal Microscopical Society," June (Williams and Norgate).—"Bees and Bee-keeping," part 10, by F. R. Cheshire (U. Gill).—"British Cage-Birds," part 10, by R. S. Wallace (U. Gill).—"Fancy Pigeons," part 10, by J. C. Ly (U. Gill).—"A New Chapter in the Story of Nature," by C. B. Radcliffe (Macmillan).—"An Introduction to General Pathology," by J. B. Suttor (Churchill).—"The Elementary Principles of Electric Lighting," by A. A C. Swinton (Lockwood).—"Journal of the Society of Telegraph-Engineers and Electricians," No. 61, vol. xv. (Spon).—"British Journal of Photography," June, by J. J. H. Teall (Watson, Birmingham).—"The Aryan Maori," by E. Tregear (Didsbury, Wellington, N.Z.).—"Catarrh of the Upper Air-Tract," by Dr. S. Sexton (Vail, New York).—"The Terraces of Rotomahana," by F. Cowan (Brett, Auckland).—"A Visit in Verse to Halemaumau," by F. Cowan (Honolulu).—"Australia, a Charcoal Sketch," by F. Cowan (Greensburg, Pa.).—"Labour Differences and their Settlement," by J. D. Weeks (New York).—"Torpedoes for National Defence," by W. H. Jaques (Putnam, New York).—"City of Coventry Free Public Library, Report of Committee, 1885."—"Ichthyol und Resorcin," by Dr. P. G. Unna (Voss, Hamburg).

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