radiometer, by M. Neesen.—Researches on the motions of radiating and irradiated bodies, by M. Zöllner.—On the determination of the principal and focal points of a lens-system, by M. Hoppe.—On thermo-electric determinations of temperature, by M. Rosenthal.—On the nature of gas-molecules, by M. Boltzmann.

Beiblätter zu den Annalen der Physik und Chemie, Band i. Stück 2.—We note here a useful paper on recent experiments with the radiometer and their explanation; also a doctorate-dissertation by M. Lorentz, on the theory of reflection and refraction of light.

FROM the *Naturforscher* (February) we note the following papers: On the most refrangible part of the solar spectrum, by T. L. Soret.—On the distribution of the electric current in conductors under decomposition, by R. Lenz.—On the southern shore of the northern diluvial sea, by Herr Credner.—On the mixed occurrence of different vegetations, by Oscar Drude.—On the nature of the substance which emits light in the flames of hydrocarbons, by Karl Heumann.—On a prehistoric steppe in the Prussian province of Saxony, by A. Nehring.—On the history of Tertiary deposits in South-eastern Europe, by M. Tournoüer.—On the differences in the chemical structure and in the digestion of higher and lower animals, by F. Hoppe-Seyler.—On a relation of chemical structure to the power of polarising light, by G. J. W. Bremer.—On the conduction of heat by liquids of different densities, by E. Sacher.—On the behaviour of palladium in the alcohol flame, by F. Wöhler.

THE *Archives des Sciences Physiques et Naturelles* (January), contains the following original papers:—On the tendrils of climbing plants, by Casimir de Candolle (see our note on this paper).—On the origin of the ancient alluvium, by Ernest Favre.—On static electricity, by E. Mascart.—Description of *Niphargus puteanus*, var. Forellii, by Aloïs Humbert (see our note on this paper).—Some researches made in the physiological laboratory of Geneva; on the formation of pepsine before and after death, by Prof. Schiff.—Note on the effect of the irritation of a nerve through which a constant electric current is passing, by Dr. B. F. Lautenbach.

THE *Journal of the Russian Chemical and Physical Societies* (vol. viii., part 9, December, 1876), contains the following papers:—On the action of bromine upon acetone, by N. Sokolowsky.—Synthesis of α oxybutyric acid, by S. Przibytek.—On the pinacoline of methylethyl-acetone, by G. Lawrinowich.—On the synthesis and properties of diallyl-carbinol, by M. Saytzew.—On the action of the iodides of ethyl and allyl upon formiate of ethyl, by the same and J. Kanonnikow.—On the synthesis and the properties of dimethylallyl carbinol, by the same and M. Michail.—Theoretical researches concerning the distribution of static electricity on the surface of conductors constituted of heterogeneous parts, by D. Bobylew.—On electric rays, by O. Chwolson.

Reale Istituto Lombardo di Scienze e Lettere, Rendiconti, vol. x. fasc. 2.—On the co-ordinates of points and of lines in a plane, and of points and planes in space (continued), by M. Casorati.—Case of mammary hypertrophy, by M. Scarenzio.—Results of observations on the amplitude of the daily oscillations of the magnetic needle in 1875 and 1876, at the Observatory of Brera, in Milan, by M. Schiaparelli.—On some differential equations with algebraic integral, by M. Brioschi.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, March 8.—"Notes on Physical Geology," by the Rev. Samuel Haughton, M.D. Dublin, D.C.L. Oxon., F.R.S., Professor of Geology in the University of Dublin.

No. I.—*Preliminary Formulæ relating to the Internal Change of Position of the Earth's Axis, arising from Elevations and Depressions caused by Geological Changes.*

In this paper the author proves the following preliminary formulæ, necessary for the further discussion of his subject:—

$$-\operatorname{Tan} 2\theta = 935{\cdot}6\,\rho \sin 2\lambda \quad . \quad . \quad . \quad . \quad (1)$$

where ρ is the ratio of the weight of an elevated mass to the weight of the whole earth;

λ is the latitude at which the elevation takes place, and

θ is the final displacement of the earth's axis of rotation.

$$-r\theta = 14{\cdot}11\,(\cos^3\lambda' - \cos^3\lambda) \quad . \quad . \quad . \quad (2)$$

where $r\theta$ is the displacement of the pole in English miles, caused by a continental slip of 5° longitude in breadth, and lying between the higher and lower latitudes of λ and λ'.

In proving the equations the author distinguishes between three level surfaces, viz.—

1. The surface of the sea.
2. The zero surface of the solid earth.
3. The zero surface, corrected for the weight of the ocean.

The zero plane, from which the elevations are measured, is the surface of the ellipsoid similar to the sea surface, and containing the same volume as the total solid matter of the globe. It is thus found, assuming the mean height of the continents above the sea-level at about 1,000 feet, and the mean depth of the ocean at about two miles, we have, in miles,

$$x = \frac{2{\cdot}2\,L}{W + L},$$

where x is the height of the zero plane above the present mean sea-bottom, and L, W are the areas of land and water;

$$L = 52 \text{ millions of square miles.}$$
$$W = 145 \quad ,, \quad ,,$$

Substituting we find—

$$x = 0{\cdot}58 \text{ mile.}$$

The zero plane, therefore, or original surface of the solid earth, before it became wrinkled by geological forces, lies at a depth of 1·42 mile below the sea-level. In using the equations we must therefore write—

$$\text{Elevation} = +\,1{\cdot}62 \text{ mile (continent).}$$
$$\text{Depression} = -\,0{\cdot}58 \quad ,, \quad \text{(ocean).}$$

In calculating the motion of the pole caused by the ocean excavations, the weight of the sea-water must be considered, and, by chance, it happens that the weight of the sea-water somewhat more than counter-balances the weight of the surface-rock excavated; so that the depression of the ocean-bottoms of the earth beneath the zero plane have had little or no effect in shifting the position of the pole.

Assuming 1·026 and 2·75 as the densities of sea-water and surface-rock, we have for the excess of weight of water added above that of rock excavated; expressed in depth of rock, in miles—

$$\frac{2 \times 1{\cdot}026 - 0{\cdot}58 \times 2{\cdot}75}{2{\cdot}75} = 0{\cdot}17 \text{ mile.}$$

The introduction of the weight of the sea will thus give us (raising the zero plane by 0·17 of a mile)—

$$\text{Elevation} = +\,1{\cdot}45 \text{ mile (continent),}$$
$$\text{Depression} = \quad 0{\cdot}00 \quad ,, \quad \text{(ocean).}$$

No. II.—*On the Amount of Shifting of the Earth's Axis, already caused by the Elevation of the existing Continents.*

Having shown in the preceding note that the motion of the earth's axis caused by the geological wrinkling of the earth's surface depends (in consequence of the weight of the sea-water) only on the continents, it remains to calculate the numerical amount of change of axis produced by each of the existing continents.

For this purpose the author selects the following meridians for the co-ordinates Y and X of the motion:—

Greenwich		0°	...	+ Y
Rangoon	...	90	...	− X
Behring's Strait ...	...	180	...	− Y
Yucatan	...	270	...	+ X

Reckoning the longitudes eastward, round the whole circumference of the earth, the equation (2) gives—

$$r\theta = -\,14{\cdot}11\,(\cos^3\lambda' - \cos^3\lambda),$$

in which the meridian of each 5° of longitude is used, λ' and λ being the lowest and highest degrees of latitude of the land on each meridian.

The expression $\cos^3\lambda' - \cos^3\lambda$ is found by observation on the globe, and resolved into its components X and Y, regarding the North Pole as the axis moved.

The equation (2) is then used (by quadratures) to determine the total effect of each continent taken separately. The tables of quadratures are given in the paper, and the final results are—

Displacement of North Pole caused by each continent.

	Towards Greenwich. Mile.	Towards Behring's Strait. Mile.	Towards Yucatan. Mile.	Towards Rangoon. Mile.
Europe and Asia	—	58·7	199·4	—
Africa	—	26·9	—	1·7
North America	15·2	—	—	105·5
South America	19·9	—	35·1	
Australia, &c.	—	30·2	—	30.2

The power of Europe and Asia in moving the pole is partly due to the extension of this continent along the parallel of 45°, which is the most effective latitude. The actual effect produced by Europe and Asia was not much less than that of our imaginary continent (Note I.), occupying one eighth part of the surface of the globe.

The foregoing results are positive, and the motions of the pole indicated must have actually occurred when the existing continents were formed. But simultaneously with these elevations depressions must have gone on elsewhere, continents disappearing beneath the sea and sinking to the zero plane, while other continents were rising. It is to be noticed that although the excavation of the sea-bottom to its present depth below the zero plane, corrected for the weight of the ocean, produces no motion in the pole, yet that the depression of a continent down to the zero plane produces a motion of pole equal and opposite to that produced by its elevation. I have calculated the hypothetical effects of the depression of imaginary continents occupying the sites of the present Pacific Ocean, with the following results :—

North Pacific Ocean (depressed).

Towards Yucatan ... ... 3·4 miles.
Towards Behring's Straits ... ... 250·6 „

South Pacific Ocean (depressed).

Towards Rangoon ... ... 156·2 miles.
Towards Greenwich ... ... 238·2 „

The total effect of a continent equal to the North Pacific would be—

$$\sqrt{X^2 + Y^2} = 250{\cdot}6 \text{ miles.}$$

$$\frac{X}{Y} = \tan(\phi),\ \phi = 0^\circ\ 47'\ \text{E. of } 180^\circ.$$

The total effect of a continent equal to the South Pacific Ocean would be—

$$\sqrt{X^2 + Y^2} = 201{\cdot}8 \text{ miles.}$$

$$\frac{X}{Y} = \tan(\phi),\ \phi = 23^\circ\ 17'\ \text{E. of Greenwich.}$$

Geological Society, March 21.—Prof. P. Martin Duncan, F.R.S., president, in the chair.—William B. Coltman, William James Grimshaw, and Alexander Ross were elected Fellows of the Society.—The following communications were read :—On the strata and their fossil contents between the Borrowdale series of the North of England and the Coniston flags, by Prof. Robert Harkness, F.R.S., Cork, and H. Alleyne Nicholson, F.R.S.E., Professor in St. Andrew's. The object of this paper was the investigation of the strata between the great volcanic series of the Lake-district, the Borrowdale rocks, and the sedimentary rocks called Coniston Flags by Prof. Sedgwick. The Borrowdale series, the Green Slates and Porphyries of Sedgwick, are underlain by the Skiddaw Slates, forming the base of the Silurian series, and equivalent in age to the Arenig rocks of Wales, according to their fossil contents. The Borrowdale rocks consist of ashes and breccias, alternating with ancient lavas, and are partly subaërial, partly submarine. They contain no fossils except in a band of calcareous ashes near the summit of the group, which is followed by the Coniston Limestone, with or without the intervention of a bed of trap. The fossils are of Bala types. Sometimes this band is recognisable, with no traces of fossils except cavities filled with peroxide of iron. The authors regard this as proving the prevalence of volcanic activity in the Lake District up to the later portion of the Bala period. The deposits specially discussed in the paper sent lie, apparently quite conformably, upon the Borrowdale rocks, and are grouped by the authors as follows, in ascending order :—(1) Dufton Shales ; (2) Coniston Limestones and Shales ; (3) Graptolitic Mudstones or Skelgill beds ; (4) Knock beds. The "Dufton Shales" are a well-marked but locally distributed group of muddy deposits, especially well developed in the Silurian area underlying the cross Fell range, where they are seen in four principal exposures, and their thickness probably exceeds 300 feet. They are richly fossiliferous. The "Coniston Limestone" has long been recognised as the best-defined division of the Lower Silurian rocks of the north of England. The "Graptolitic Mudstones" overlie the Coniston Limestone, wherever the summit of the latter is to be seen. Besides Graptolites, they contain many other fossils, including Corals, Brachiopods, Cephalopods, and Crustaceans ; and from the consideration of the whole fauna, the authors are led to believe that the position of these deposits must correspond either with the highest beds of the Bala series or with the lower portion of the Llandovery group. The Graptolitic Mudstones are succeeded by the "Knock beds," so called from their great development in Swindale Beck, near Knock. Wherever they occur they consist chiefly of pale green, fine-grained slates, very ashy in appearance, and presenting many dendrites, and frequently crystals of cubic pyrites. There is no evidence of unconformity between them and the underlying Mudstones.—On a new area of Upper Cambrian Rocks in South Shropshire, with the description of a new fauna, by C. Callaway, F.G.S. The purpose of the author was to prove that certain olive, micaceous, thin-bedded shales exposed at Shineton, near Cressage, and covering an area of eight miles in length by two in the greatest breadth, which had been mapped as Caradoc in the survey, were of Tremadoc age. They were seen clearly to underlie the Hoar Edge Grit, the lowest beds in the district, with Caradoc fossils ; and no rock distinctly underlying the shales could be detected. The evidence for their age was chiefly palæontological. With the exception of *Asaphus homfrayi*, a Tremadoc form, the species are new. Genera such as *Olenus*, *Conocoryphe*, *Obolella*, and *Lingulella* suggested a very low horizon, but two Asaphoid forms (though not typical *Asaphi*) pointed in an opposite direction. Corroborative evidence was found in a correlation of the shales at Shineton with the *Dictyonema*-shales at Pedwardine and Malvern.

Anthropological Institute, April 10.—Mr. John Evans, F.R.S., president, in the chair.—The president exhibited two stone instruments from Sandoway District, North Burmah.—Some flint arrow-heads, scrapers, &c., from Ditchley, Oxon, were exhibited by Capt. Harold Dillon.—A paper on some rude stone monuments in North Wales was read by Mr. A. L. Lewis. The chief point of interest being the existence, hitherto, we believe, unnoticed, of single outlying stones on the north-east of the circle near Penmaunmawr which is thus shown to conform to and to lend further confirmation to the rule found by him to exist generally in British circles of a special reference to the north-east by outlying stones or otherwise.—The director read a paper by the Rev. W. Ross, F.S.A. Scotland, on some curious coincidences in Celtic and Maori vocabulary.—Papers were also read by the director, on Australian aboriginal languages, traditions, &c., by Messrs. Greenway, McDonald, Rowlay, Malone, and Dr. Creed, communicated by Mr. William Ridley, M.A., through the Colonial Office.—Col. A. Lane Fox, F.R.S., Messrs. Hyde Clarke, Walhouse, Moggridge, Park-Harrison, and the president, took part in the discussion.

Royal Microscopical Society, April 4.—H. C. Sorby, F.R.S., president, in the chair.—The following papers were read :—On the variability of the chlorophyll bands in the spectrum, by Mr. Thomas Palmer, in which he described the various effects produced by solutions in alcohol, &c., and by treatment with acids and alkalis.—On the mineralogical constitution and microscopical characters of the whetstones of Belgium, by M. l'Abbé Rénard, of Louvain.—On the microscopical character of Krupp's "silicate cotton," by Mr. H. J. Slack, and on the lower Silurian lavas of Cumberland, by Mr. Clifton Ward, in which it was shown that the difference between ancient and modern lavas was not so great as was usually supposed, their actual constituents being very nearly the same, though apparently they differed owing to conditions which had produced metamorphosis in the earlier series.

Physical Society, March 17.—Prof. G. C. Foster, president, in the chair.—Mr. W. S. Seaton was elected a member of the society. Mr. Spottiswoode exhibited some experiments on the stratification of the electric discharge in vacuum tubes, and described his attempts to produce the effects as obtained by Mr. Gassiot and Mr. de la Rue, with batteries of several thousand cells, by means of the induction coil. An account of his experiments has already been given in our pages.—Capt. Abney, R.E., then read a paper on the photographic image, prefacing it by a brief account of the two theories, the chemical and the physical, which are held regarding it. On the former, a molecule of bromide of silver is split up into sub-bromide and bromine,

the latter of which is absorbed; and on the latter theory, light acts mechanically on the molecule, shifting the positions of the atoms. Poitevin has done much to confirm the former of these by placing a film of silver iodide in contact with a silver plate, when he succeeded in obtaining an image on the film of iodide and one on the silver plate produced by the liberated iodine. Capt. Abney has performed the following experiments: a portion of a dry plate which had been exposed, was wet with a sensitive collodion emulsion of bromide of silver, and developed by the alkaline method; the films were separated from the glass and from each other by means of gelatinised paper, and were found to bear images: and the same result was obtained when the emulsion was added after exposure, development, and fixing. These experiments entirely disprove the supposition that only those molecules acted on by light are reduced. If the two films be separated by a thick layer of albumen, the lower picture develops as a negative, and the upper as a positive. Capt. Abney is now engaged in an attempt to determine the attraction exercised by the sub-bromide, and this it is hoped, will do much towards the complete solution of the problem of the photographic image.—Mr. O. J. Lodge proposed a modification of Mance's method for determining the intensity of an electric current. This method, of which Wheatstone's Bridge is an application, depends upon the fact that if three conductors be united at a point A, and their extremities $B\,C$ and D be united by three wires, $B\,C$, $C\,D$, $D\,B$, the resistance of $B\,C$ will be independent of that of $A\,D$ if $A\,B$ is to $A\,C$ as $B\,D$ is to $C\,D$. In the arrangement proposed by Mr. Lodge, four wires are joined in the form of a square, and the circuit can be completed across one diagonal by means of a key, and in the other diagonal is included a condenser and a galvanometer, with a long fine wire. The greatest sensitiveness is obtained when the resistances in the four sides are equal. A great advantage of this method consists in the fact that it is equally applicable to the measurement of small and great resistances. Mr. Lodge then showed a modified form of Daniell's cell, capable of giving a constant current for a considerable period. A glass cell half filled with dilute sulphuric acid, contains two vertical glass tubes one of which, open at both ends, is traversed by a zinc rod, while the other is closed at its lower end, and contains cupric sulphate, from which rises a copper wire. The portion of the glass tube projecting above the acid is sufficiently moist to enable the current to traverse its surface while the zinc sulphate is prevented from reacting on the copper.

Victoria (Philosophical) Institute, April 18.—Rev. R. Thornton, D.D., vice-president, in the chair.—A paper on recent Assyrian research, and the light it threw on civilisation at the time of Abraham, was read by the Rev. H. G. Tomkins.

MANCHESTER

Literary and Philosophical Society, March 20.—Mr. E. W. Binney, F.R.S., president, in the chair.—On the action of sea-water upon lead and copper, by Mr. William H. Watson, F.C.S. Communicated by Dr. R. Angus Smith, F.R.S.—Note on the Upper Coal Measures of Canobie, Dumfriesshire, by Mr. E. W. Binney, president, F.R.S.—Losses and gains in the death-toll of England and Wales during the last thirty years, by Mr. Arthur Ransome, M.D.

PARIS

Academy of Sciences, April 9.—M. Peligot in the chair.—The following papers were read:—On the possibility of deducing from one only of the laws of Kepler the principle of attraction, by M. Bertrand.—Some of the fundamental data of thermo-chemistry, by M. Berthelot. He deals with the heat of formation of sulphurous acid and the compounds formed by bromine and iodine with hydrogen and oxygen.—On a theorem relative to the expansion of vapours without external work (continued), by M. Hirn.—Morphological relations between the antheridia and the sporules developed in the verticillate ramification of a particular form of *Batrachospermum moniliforme*, by M. Sirodot.—Substitution of chlorophyll for salts of copper ordinarily used in preparation and conservation of fruits and green vegetables, by M. Guillemare. This is based on three facts: (1) the chlorophyll of vegetables disappears in boiling; (2) vegetable fibre and its feculant matter put in contact, through washing, with dissolved chlorophyll, is saturated with it near 100;° (3) vegetables wholly or half saturated with chlorophyll, in washing, thenceforth retains, in boiling, this green matter.—On the presence of zinc in the bodies of animals and in plants, by MM. Lechartier and Bellamy. A man's liver weighing 1,780 grammes contained 2 centigrammes of oxide of zinc; 913 grammes muscular tissue of ox contained 3 centigrammes; 1,152 grammes of hens' eggs 2 centigrammes. Zinc was found also in grains of wheat, American maize, barley, winter vetches, and white beans; while beet, the stems of maize, green clover and its seed did not contain it in perceptible quantity. These facts have an important bearing on toxicological researches.—Discovery of a Gallo-Roman port and a Gaulish port, dated by a study of the layers of mud, in the neighbourhood of Saint Nazaire, by M. Bertrand. M. Gervais added some details.—Reconstitution of French wine-growing by sulphocarbonate of potassium, by M. Mouillefert.—Results obtained in the treatment of phylloxerised vines by alkaline sulphocarbonates, applied by means of the distributing pale, by M. Gueyrand.—Note on a new mode of manufacture of sulphides, carbonates, and alkaline sulphocarbonates, by M. Vincent. He utilises the reactions produced in making beet sugar to prepare sulphide of barium. This, mixed with sulphate of potash, gives by double decomposition sulphate of baryta and sulphide of potassium, and the latter, submitted to the action of carbonic acid gives carbonate of potassium. M. Vincent extends his method to manufacture of sulphocarbonate, which he can obtain at 50 francs the kilogramme instead of 120, which it has lately cost.—List of thirty new nebulæ discovered and observed at the observatory of Marseilles, by M. Stephan.—On a modification in the employment of electricity considered as agent of galvanic deposits and chemical decompositions, by M. Thenard. Instead of having only one bath with the two anodes, the conditions being those of small electric resistance and maximum effort, he has several, connecting their anodes like the elements of a battery connected for tension. The quantity of deposited copper increases with the number of baths.—New method for establishing the equivalent in volumes of vaporisable substances, by M. Troost. Given an inclosure filled with vapour of hydrate of chloral, then if the water is always combined, the atmosphere will behave as if it were dry in presence of a body capable of yielding water; if the water is simply in mixture the atmosphere will act as if saturated. Now the former occurs, and this confirms M. Dumas' hypothesis as against that of M. Naumann. The method may have other applications.—On the oxidation of metallic sulphides, by M. De Clermont.—Decomposition of liquid organic substances by the electric-spark, with production of fundamental carburets of hydrogen, by M. Truchot.—On the existence of veins of bitumen in granite in the environs of Clermont Ferrand, by M. Julien.—New experiments on the toxical action attributed to copper and to substances containing copper in combination, by M. Galippe. These confirm former conclusions.—Note on the first phenomena of the development of sea-urchins (*Echinus miliaris*), by M. Giard.—M. Chasles presented (from M. Riccardi) the first part of a work called *La Biblioteca matematica Italiana*, which is to be a bibliography of all Italian works on mathematics from the earliest times to the beginning of the nineteenth century.

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