points out that if the equation of an anemometer, whose constants have been determined by a whirling machine, be used to reduce observations made in the open air, the computed wind velocities will be too high, by an amount which will depend upon the moment of inertia of the cups and revolving parts. Some of the experiments described were of a delicate nature, the cups being made of paper fastened to pieces of fine knitting-needles, which served as arms.—The concluding article is by Prof. R. Owen, on magnetic phenomena in the southern hemisphere, the object being to give some particulars regarding the experiments made in that hemisphere, as compared with results obtained in the northern half of the globe.

## SOCIETIES AND ACADEMIES.

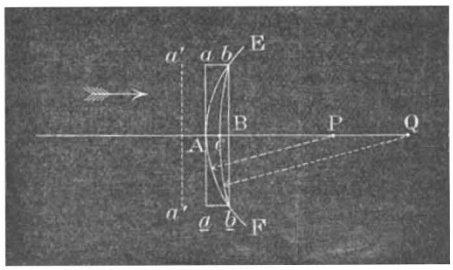
### LONDON.

**Royal Society**, June 6.—"Report on the Effects of Contact Metamorphism exhibited by the Silurian Rocks near the Town of New Galloway, in the Southern Uplands of Scotland." By S. Allport and Prof. Bonney, F.R.S.

In the neighbourhood of New Galloway a mass of granite cuts across and sends veins into a series of Silurian rocks, which are considerably altered near the junction. These, originally, were a variable series of more or less sandy rocks, such as older authors would call greywacke. The minerals resulting from the "contact-metamorphism" were enumerated: these were quartz brown mica (which, as was pointed out, must be much richer in iron than in magnesia), white mica, and iron oxides, with some hornblende, augite, garnet, and perhaps epidote. Chiastolite is absent; andalusite very inconspicuous; tourmaline very rare. The point to which special attention was directed was that in several of the slides, the larger fragments which had been present in the original greywacke could still be recognized, such as clastic quartz, feldspar (often more or less converted into white mica and quartz), bits of argillite or earthy sandstone (represented by mixtures of brown mica and quartz in varying proportions). The bearing of the results of the investigation on general questions of metamorphism was indicated: (1) that heat, in presence of water, and probably under considerable pressure, had produced rocks which bore some resemblance to, but could be distinguished from, crystalline schists, such as those of known Archæan age; (2) that, while these agents of metamorphism have produced a crystalline rock from a clastic one, they have not obliterated the original structure, when this was somewhat coarse. Hence that it is safe to conclude that, at any rate in the less highly crystalline schists, the alternation of mineral constituents which so closely simulates bedding is due to an original stratification of clastic constituents.

**Physical Society**, June 8.—Prof. Ayrton, F.R.S., Vice-President, in the chair.—The following communications were made:—A photograph of lightning flashes was exhibited and described by Dr. Hoffert. The photograph was obtained during the storm on the 6th inst., whilst the camera was being waved about in the hand, and shows three similar and parallel flashes, thus proving that successive sparks in multiple flashes may traverse the same path and may be separated by appreciable intervals of time. The supposed primary spark is intersected by numerous tributary ones spread out on both sides, the second spark shows one tributary, and the third none. Faint bands of light pass across the plate parallel to the direction of motion, and these prove that some residual illumination exists during the intervals between the successive flashes. A dark flash is also seen on the plate. Prof. Herschel, who had taken photographs during the same storm, referred to the fluttering appearance of the flashes, and on their long duration; in many cases the time was sufficient to allow him to direct the camera towards the flash, and make a successful exposure. He had also observed multiple flashes with the unaided eye, and on waving his hand about he had sometimes noticed about a dozen distinct images of it during one discharge. Mr. Gregory said that he watched the storm along with two others, and they could seldom agree as to the shape of the flashes, or on their simple or multiple character. The want of agreement as to multiplicity he thought might be caused by their eyes being directed towards different parts of the sky when a multiple flash occurred; the one who happened to be looking towards the flash might be conscious of only one impression, whereas the others in directing their eyes would receive the flashes on different parts of the retina. In some cases as many as three distinct flashes (occurring at intervals of about ten seconds) traversed the same path, and a number of the discharges presented a beaded or striated appearance. The beads seemed to remain after the main flash had faded, and this might account for the bands shown in Dr. Hoffert's photograph. Mr. C. V. Boys, in referring to multiple flashes, said that although his statements made in the discussion of Mr. Whipple's paper on April 13 were not readily accepted, yet no one who watched the recent storm could doubt their existence. Prof. S. P. Thompson thought the order of the flashes on the photograph may have been the reverse of that supposed, for he observed that the band of light extended on both sides of the (so-called) primary flash, whereas the outside of the third flash was quite dark. Mr. E. W. Smith noticed many cases of "sympathetic discharge," in which a flash in the north seemed to precipitate another in the north-west within a few seconds, and in this he was corroborated by Mr. Gregory, who viewed the storm from a different locality. Mr. C. V. Burton thought the heating of the air by the first spark of a multiple flash might give rise to the tributaries intersecting the succeeding main sparks. Mr. A. W. Ward mentioned a long flash observed at Cambridge which passed from the zenith, and struck some farm-buildings at a distance, and he was particularly impressed by the considerable time occupied in its progress.—On the methods of suppressing sparking in electro-magnets, by Prof. S. P. Thompson. The object of this paper is to classify the methods which have been suggested, and to draw attention to a novel method of some importance. The classification is as follows: (1) *Mechanical devices:* (*a*) simple snap switch; (*b*) break in magnetic field; (*c*) break under liquid; (*d*) wiping break (asbestos, &c., brushes); (*e*) blow out. *Electrical devices:* (A) use of condensers, (*a*) placed across gap, and (*b*) across terminals of magnet; (B) mutual induction protectors, (*a*) copper sheath around core, and (*b*) layers of foil between windings; (C) short-circuit working; (D) differential winding; (E) high-resistance shunt (non-inductive); (F) voltameter or liquid resistance across gap; (G) multiple wire arrangement of Mr. Langdon Davies; (H) electro-magnet with two bobbins in series or parallel. The merits and demerits of the different methods are indicated. The multiple-wire arrangement used by Mr. Langdon Davies in his harmonic telegraph consists in winding each layer separately and uniting all in parallel. The effect of this is to make the time constants of the layers different, and on breaking the circuit the energy is spent in mutual discharges.—A shunt transformer, by Mr. E. W. Smith. Two conductors, A and B, of equal impedance, are placed in series between alternate current mains, and the same mains are connected through two incandescent lamps in series. The conductor A has great resistance, and B has large self-induction, and when their junction is joined to that of the two lamps, both lamps become brighter, and the main current may be reduced. These phenomena were shown before the Society. Since A may consist of lamps and B may be a choking coil, the arrangement will serve to increase the P.D. between the terminals of the lamps without wasting much energy. Experiments of a similar nature have been made on a Mordey transformer wound with three equal coils. One coil was used as primary, and the other two as separate secondaries, their respective circuits consisting of lamps and an alternate current motor. Under these conditions the arithmetical sum of the mean secondary currents exceeded the primary current by about 14 per cent., and the secondary volts were 8 per cent. less than the primary. All these experiments strikingly illustrate the effects of acceleration and lag in alternate current circuits, and (as was pointed out by the author) show that meters registering "ampere hours" merely, may give readings differing greatly from the numbers representing the energy used.—Notes on geometrical optics: (1) on the deduction of the elementary theory of mirrors and lenses from wave principles; (2) on a diopteric spherometer; (3) on the formula of the lenticular mirror, by Prof. S. P. Thompson. Instead of deducing the formulæ for lenses and mirrors by means of "rays," and the relations between angles of incidence, reflection, and refraction, the author considers it better to derive them from the curvatures impressed on waves at the bounding surfaces of the different media. Indices of refraction are replaced by their reciprocals, which express the relative velocities of light, and curvature is measured by the camber at the middle of chords of equal, but small, lengths. An example will assist in making the method of treatment clear. Suppose $a', a', a, a$ two successive positions of a plane wave-front in air, which impinges on a curved surface, EAF, at A, and let the curvature at A be R, and the velocity constant of the substance $h$. Then, whilst the part $a$ travels

in air to $h$, the part in the denser medium reaches C, where $AC = h \cdot ab$, and a curvature, F, represented by BC, is impressed on the wave, which thus converges to a point Q. Since $AC = h \cdot ab = h \cdot AB$, and $\frac{BC}{AB} = \frac{AB - AC}{AB}$, $\therefore \frac{BC}{AB} = 1 - h$, and the relation between the impressed curvature and that of the surface becomes $F = R(1 - h)$. By successive application of the above method, all the ordinary lens problems may be treated,




and the resulting expressions are simplified by being expressed in curvatures. The ordinary mirror formula, $f = \frac{r}{2}$, becomes $F = 2R$, and that for the lenticular mirror, $F' = 2R + F$. The method readily lends itself to the determination of the changes in the shape of wave-fronts entering or emerging from surfaces of irregular outline. The diopteric spherometer has its outer feet situated on a circle of 44·71 millimetres radius, and is provided with a screw of 1 millimetre pitch. The instrument so constructed reads off directly in "diopteries," *i.e.* curvatures expressed on a scale in which that of a sphere of 1 metre radius is taken as unity.—On the use of the biquartz, by Mr. A. W. Ward. This is a mathematical investigation into the causes of the varying degrees of accuracy obtained by different observers who have used the biquartz in rotation measurements. Assuming that elliptically polarized light passes through the biquartz, the equation which must be satisfied to give equality of tint on the two halves is shown to be: $\cos 2\gamma \cdot \sin 2\phi \cdot \sin 2(\omega - \theta) = 0$, where $\tan \gamma$ = ratio of axes of ellipse, $\phi$ = rotation produced by quartz for wave-length $\lambda$, $\theta$ = angle between plane of vibrations of analyzer and that of $xz$, the axis of $z$ being parallel to the direction of transmission, and $\omega$ = angle between one axis of the ellipse and that of $x$. The equation is satisfied by either $\cos 2\gamma = 0$, or $\sin 2\phi = 0$, or $\sin 2(\omega - \theta) = 0$. The first solution relates to circularly polarized light, and need not be considered; the second can only hold for one particular wave-length depending on the thickness of the quartz; and, in interpreting the third solution, it is shown that a satisfactory result is only obtained when the light is plane-polarized. The deductions are in accordance with experiment, for the biquartz has been used with considerable accuracy when experimenting on isotropic media; but with doubly refracting substances, where the light is liable to become elliptically polarized, the results are very discordant.

*Errata.*—Page 143, lines 27 and 29, for "volumes" read "densities."

**Mathematical Society**, June 13.—Mr. J. J. Walker, F.R.S., President, in the chair.—The President opened the proceedings of this the last meeting of the session with commenting on the losses the mathematical world had recently sustained by the deaths of Prof. Genocchi, of Turin, Prof. Du Bois-Reymond, Berlin, and M. Halphen, of Paris.—The following communications were made:—The square of Euler's series, by Dr. Glaisher, F.R.S.; a theorem in the calculus of linear partial differential operations, by Major Macmahon, R.A.; on crystalline reflection and refraction, by A. B. Basset, F.R.S.; on some rings of circles connected with a triangle and the circles (Schoute's system) that cut them at equal angles, by W. W. Taylor; the figures of the Pippian and Quippian of a class of cubic curves, by the President (Sir J. Cockle, F.R.S., in the chair); and a generalization of Buffon's problem, by Prof. Sylvester, F.R.S., (communicated by J. Hammond).—The following papers, on the small wave-motions of a heterogeneous fluid under gravity, by Prof. W. Burnside, and on the uniform deformation in two dimensions of a cylindrical shell of finite thickness, with applications to the general theory of deformation of thin shells, by Lord Rayleigh, Sec. R.S., were taken as read.

**Zoological Society**, June 4.—Mr. Osbert Salvin, F.R.S., Vice-President, in the chair.—The Secretary read a report on the additions that had been made to the Society's Menagerie during the month of May 1889.—Mr. H. E. Dresser exhibited and made remarks on some eggs of the Adriatic Black-headed Gull (*Larus melanocephalus*) and of the Slender-billed Gull (*Larus gelastes*), which had lately been obtained at their nesting-places in the marshes of Andalusia by Colonel Hanbury Barclay and himself.—Dr. G. J. Romanes, F.R.S., read a paper on the intelligence of the Chimpanzee, as shown in the course of experiments made with the female Chimpanzee called "Sally," which has been living several years in the Society's Menagerie.—A communication was read from Signor Fr. Sav. Monticelli, containing notes on some Entozoa in the collection of the British Museum.—Mr. Sclater read a list of the birds collected by Mr. George A. Ramage (the collector employed by the joint Committee of the Royal Society and the British Association for the exploration of the Lesser Antilles) in Dominica, West Indies, and made remarks upon some of the species.

**Entomological Society**, June 5.—The Right Hon. Lord Walsingham, F.R.S., President, in the chair.—Mr. S. Stevens exhibited a specimen of *Acrolepia assectella*, Zeller, included in a lot of *Tineidæ*, purchased by him at the sale of the late Mr. A. F. Sheppard's collection. He also exhibited, for comparison, a specimen of *A. betuletella*.—Mr. J. J. Walker, R.N., exhibited a collection of Lepidoptera made in 1887 and 1888 in the immediate vicinity of the Straits of Gibraltar. The collection included sixty-eight species of butterflies, of which thirty-six were obtained on the Rock of Gibraltar itself, and the remainder on the European side of the Straits; and about 160 species of moths.—Dr. P. B. Mason exhibited a number of specimens of a South European species of ant—*Crematogaster scutellaris*, Oliv. He said that the specimens were all taken in the fernery of Mr. Baxter, of Burton-on-Trent, and had probably been imported with cork.—Mr. O. E. Janson exhibited a pair of *Neptunides stanleyi*, a species of *Cetoniidæ*, recently received from Central Africa, and described by him in the February number of the *Entomologist*; also some varieties of *N. polychrous*, Thoms., from the Zanzibar district.—Dr. N. Manders exhibited a number of Lepidoptera collected by himself in the Shan States, Burmah; also a collection of Lepidoptera made by Captain Raikes in Kárenni.—Mr. McLachlan exhibited over 400 specimens of Neuroptera, being a portion of the collection formed in Japan by Mr. H. J. S. Pryer. They represented nearly all groups (excepting *Odonata*, now in the hands of Baron De Selys). Some of the *Ascalaphidæ*, *Panorpidæ*, and *Trichoptera*, were of great beauty.—Dr. Sharp exhibited the peculiar cocoons of an Indian moth, *Rhodia newara*, Moore; these were the cocoons possessing a drain at the bottom in order to allow water to escape, already described in the Proceedings of the Zoological Society for 1888, p. 120, where, however, their great resemblance to the pods of a plant had not been alluded to.—Mr. Enock exhibited, and made remarks on, specimens of *Cecidomyia destructor*, bred from American wheat.—Mr. W. Warren exhibited a bred specimen of *Retinia posticana*, Zett., from Newmarket; also specimens of *Eupithecia jasioneata* and *Gelechia confinis*, bred by Mr. Gardner.—Mr. C. O. Waterhouse exhibited and explained a number of diagrams illustrative of the external characters of the eyes of insects.—Mr. A. G. Butler communicated a paper entitled "Descriptions of some new Lepidoptera-Heterocera in the collection of the Hon. Walter de Rothschild." He also contributed a second paper entitled "Synonymic Notes on Moths of the earlier genera of Noctuites."—Dr. Sharp read a paper entitled "An Account of Prof. Plateau's Experiments on the Vision of Insects" Lord Walsingham, Mr. Jacoby, Mr. White, and Mr. Waterhouse took part in the discussion which ensued.

## PARIS.

**Academy of Sciences**, June 11.—M. Des Cloizeaux, President, in the chair.—On the exceptional deviations of some tropical cyclones, by M. H. Faye. As far as 35° of latitude tropical cyclones present a remarkable regularity, with the exception that the geometrical figure described by their trajectory is deflected towards the north between 20° and 30° according to the seasons, as has been clearly determined by le Père Viñez, of the Havana Observatory. But although the laws laid down by this meteorologist appeared to be absolute, they were certainly deviated from by the tornado of September 3-4, 1888, in the West Indies, as well as by that of June 1885, in the Gulf of Aden. The disturbing cause in the first instance was attributed by Viñez to a second cyclone exercising a strong

repellent action on the other, and driving it with disastrous consequences across the island of Cuba. But Mr. E. Hayden, of the United States Meteorological Bureau, rejects this explanation, and traces the disturbance to the influence that zones of high pressure appear to exercise on low pressures and especially on cyclones. M. Faye seems inclined to accept this view, if it could be shown that the action of high-pressure zones is felt in the higher atmospheric regions far above the crests of the loftiest mountain ranges.—On the value of a finite continuous and purely periodical fraction, by Prof. Sylvester. The positive root of the equation

$$[t]x^2 - ([t] - [t'])x - [t'] = 0$$

gives the value of the purely periodical infinite fraction ($t^\infty$), where $t$ is a type—that is, a succession—of any elements whatever. By means of a formula given in a previous communication the author here offers an easy solution for the problem: To find the value of the analogous periodical but finite continuous fraction ($t_n$).—Researches on the elasticity of solids, by M. E. H. Amagat. The method applied by the author to crystal, as described in a former note (*Comptes rendus*, October 15, 1888), is here employed for other substances, such as glass, steel, copper, brass, and lead, which are also treated by the Wertheim process. The tabulated results, obtained at a mean temperature of 12° C., seem to show that for metals the value of Poisson's coefficient $\mu$ increases with the coefficient of compressibility, and for the other substances with the facility with which they undergo permanent deformation. The value of $\mu$, theoretically equal to 0·50 for fluids, would appear to increase in the scale of bodies, passing through all the intermediate states (pasty, viscous, &c., and consequently for the same body passing through these various states), and approaching 0·25 according as the bodies become more and more refractory to permanent deformations—that is, more perfectly elastic. Glass approaches nearest to this theoretic condition, the next in order being steel, copper, and lead, while caoutchouc occupies the opposite extremity of the scale. Hence the perfect solid, for which the value of $\mu$ would be 0·25, should realize the double condition of being at once perfectly elastic and perfectly isotropic.—On the solubility of saccharose in distilled water, by M. Léon Périer. After the disastrous vintages of 1888 in the Gironde district, various growers attempted to substitute for the ordinary wines a drink prepared from grape-cake and sugar refermented. M. Périer here describes the results of the examination he has made of numerous specimens of these liquids submitted to his inspection.—Erosions due to wind action, by M. Contejean. During a recent visit to Corinth the author observed a remarkable instance of this phenomenon on the neighbouring plateau, where an old amphitheatre some fifteen metres from the edge of the escarpment communicates with the beach through a cavern with wide opening at both ends, and above which the limestone rock forms a natural bridge. The walls of this cavern, which is formed in the sandstone stratum at the foot of the cliff, are extremely rugged and irregularly corroded, nowhere showing traces of human workmanship. The tunnel could not possibly have been excavated either by the rains or the running waters, and its existence can be explained only by the action of the sands playing on a point of least resistance under the influence of the fierce northern gales prevalent in this region.—On the rectification of alcohol, by M. E. Sorel. In continuation of his previous communication on this subject (*Comptes rendus*, May 27, 1889), the author here shows how the theoretical data may be verified, and indicates the practical conclusions that may be drawn from them.—Some documents were submitted to the Academy by le Père Denza, on the recent earthquakes in the north-west of France, slight vibrations of which were also felt in Genoa, Sinigaglia, Sienna, and other parts of Italy. At the Observatory of Moncalieri the seismic instruments showed some indications of the underground disturbances.

### BERLIN.

**Physiological Society**, May 31.—Prof. du Bois-Reymond, President, in the chair.—Dr. Nitze described and demonstrated his apparatus for observing and examining the interior of the urinary bladder. The apparatus, called a cystoscope, consists of a small incandescent electrical lamp, a prism, and a small ocular and objective, the whole arranged in the form of a catheter. Before making an observation the bladder is washed out with water, the instrument is then introduced, and the terminals of the electric lamp are connected with a battery. While intended in the first instance to facilitate the ocular inspection of pathological conditions of the bladder, this instrument also makes it possible to observe various physiological functions, such as the periodic extrusion of small quantities of urine from the mouths of the ureters, and the peristaltic movements of the ureters themselves. The applicability of the method was demonstrated on two patients.—Starting with the observed fact that canaries fed with cayenne pepper acquire a ruddy plumage, Dr. Sauermann has based upon it a scientific investigation of canaries, fowls, pigeons, and other birds. From these he has obtained the following results. Feeding with pepper only produces an effect when given to young birds before they moult; the colour of the feathers of older birds cannot be affected. Moisture facilitates the change of colour to a ruddy hue, which is again discharged under the influence of sunlight and cold. A portion of the constituents of cayenne pepper is quite inactive, as for instance piperin and several extractives: similarly the red colouring-matter alone of the pepper has no effect on the colour of the feathers. It is rather the triolein, which occurs in the pepper in large quantities, together with the characteristic pigment, which brings about the change of colour by holding the red pigment of the pepper in solution. Glycerin may be used instead of triolein to bring about the same result. The same statement holds good with regard to the feeding of birds with aniline colours. The red pigment of the pepper is also stored up in the egg-yolk as well as in the feathers. The first appearance of the pigment in the yolk may be observed as a coloured ring four days after the commencement of feeding with the pigment dissolved in fat; after a further two days' feeding the whole yolk is coloured. Dr. Sauermann is still engaged in carrying on his researches.

## BOOKS, PAMPHLETS, and SERIALS RECEIVED.

The Flora of Switzerland for the Use of Tourists and Field Botanists: A. Gremli; translated by S. W. Paitson (Nutt).—Commercial Organic Analysis, vol. iii. Part 1, 2nd edition: A. H. Allen (Churchill).—Morocco: H. M. P. De la Martinière (Whittaker).—Woolwich Mathematical Papers for the Years 1880-88, edited by E. J. Brooksmith (Macmillan).—Physiological Diagrams for Use in Schools; also Index: G. Davies (W. and A. K. Johnston).—Days with Industrials: A. H. Japp (Trübner).—New Verse in Old Vesture: J. C. Grant (E. W. Allen).—Catalogue of the Fossil Reptilia and Amphibia in the British Museum (Natural History), Part 2: R. Lydekker (London).—Climatology of New Jersey (Trenton, N.J.).—Bulletin of the United States National Museum, No. 33: T. Egleston (Washington).

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