To study the fluorescent spectrum many physicists adopt the method of projecting a spectrum sufficiently pure to show the principal Fraunhofer lines, on a fluorescent body, solid perhaps, or the side of a glass vessel containing a fluorescent liquid, and determining the parts where the fluorescence appears, reaches a maximum, and disappears. Others develop the direct spectrum on the surface of a liquid; Herr Hagenbach places the slit and the prism horizontally, and projects the spectrum on the free surface of the liquid. The disadvantages of these two methods M. Lamansky (*Jour. de Phys.*, Dec.) has sought to avoid in a spectroscope he has had recently constructed by M. Duboscq, and which he finds very convenient. The collimator and the telescope of this direct vision spectroscope are fixed separately on a graduated circle; they may be placed at various angles in the vertical plane. The collimator is furnished with a small adjustable mirror for directing the luminous rays along the optic axis. In the prolongation of the collimator tube is placed the direct-vision prism and a lens which throws the spectrum on the surface of the liquid contained in a small vessel on a table which can be raised or lowered. The telescope is directed to the same liquid surface, and the focal distance of the ordinary telescope is shortened by the addition of a second object-glass, which may be removed at will. The division of the circle allows of determining the angles at which the coloured rays fall on the liquid surface and the angles at which the fluorescent spectrum is observed. A dark cloth may be thrown over the apparatus to exclude disturbing light.

AN interesting observation on the supernumerary or spurious rainbows occasionally seen lining the inner edge of the primary arc of a rainbow has been made by M. Montigny. These supernumerary rainbows usually consist of a red band touching the violet on the inner side of the bow, followed by green and violet, and passing again to red. Indeed it is possible occasionally to observe as many as four or five recurrences of the red and green tints. They are, however, almost always confined to the highest portion of the bow, and are rarely observed near the ground. M. Montigny, on August 30, 1879, watching a rainbow near Rochefort, a little before sunset, noticed that while the upper portion of the primary bow showed no trace of supernumerary bows, the lower portions on each side, which came out brilliantly against a stratum or zone of misty air, were furnished with no fewer than four supernumeraries of paler tint. According to the received theory of Young and Airy these bows are due to diffraction, caused by very small drops, the smallest drops giving the broadest and most brilliant fringes of colour. Usually it happens that in the higher regions of the air the falling drops are smaller than they are at the lower regions; hence the occurrence of supernumerary arcs at the upper part of the bow. In M. Montigny's observation, doubtless, the misty zone lying near the ground provided the drops of the requisite degree of smallness to produce the diffractive effects. This is, at least, his view of the case.

IN the December number of *Silliman's Journal* is a memoir of extreme interest by Dr. E. L. Nichols on the character and intensity of the rays emitted by glowing platinum. Several tables of statistics of observations are given, and two graphic charts which embody the tabular results. Reviewing the *à priori* law of Kirchhoff, concerning the emission of rays of greater refrangibility at higher and higher temperatures, he remarks: "Strictly speaking, however, the temperature at which each individual wave length becomes visible depends solely upon the sensitiveness of the observer's eye. We are furthermore forced to conclude from experiment that the more refrangible rays really exist at temperatures far below those at which we begin to see them. The directions of the curves (Plates I. and II.) seem to denote that all the rays studied begin to be emitted at some temperature not included in the interval embraced by the experiments. *I suspect indeed that all of them originate at some very low degree (the absolute zero?), and are recognizable no sooner, simply because the various instruments at command, the thermopile, eye, photographic plate, &c., are not more delicate.* That the various colours do not appear simultaneously, follows from the very different degrees of sensitiveness shown by the eye for different rays."

AN interesting electric toy, contrived by M. Pfeiffer, is described in a recent number of *La Nature*. It is a small electrophorus consisting merely of a thin plate of ebonite about 1 mm. in thickness; the usual wooden disk with tinfoil is replaced by a small piece of tin about the size of a playing-card, attached to one of the faces of the ebonite plate. This electrophorus produces electricity with great facility. You have merely to place it on a wooden table and rub it successively on its two faces with the open hand; then on lifting it with the left hand and bringing the right hand near the tin plate, a spark is obtained 1 to 2 centimetres long. Several small accessories, skilfully contrived, are added to the electrophorus; among these are dancing puppets made of pith, which manifest very amusingly the phenomena of electric attraction or repulsion. Electrify the ebonite plate, put the three puppets on the tin, and then raise the plate from its support. One small personage lifts his arms above his head; the hair of a second stands out; and the third, lighter than the others, jumps about like a clown, while two pith balls placed at his side dance with him. M. Pfeiffer has also collected in one small box all the known accessories of an electric machine; a miniature Leyden jar, an electric carillon, a Volta pistol, a Geissler tube, &c., these being operated with the electrophorus.

SCIENTIFIC SERIALS

American Journal of Science and Arts, December, 1879.—Mr. Brooks here calls attention to an important difference in the breeding habits of American and European oysters; the eggs of the former are fertilised *outside* the body of the parent; and during the period which the European oyster passes inside the mantle cavity of the parent, the young American oyster swims at large in the open ocean. Mr. Brooks traces the successive stages of oyster development.—Mr. Harting writes on triple objectives with complete colour-correction.—There are geological papers on Virginia, on Galisteo Creek, New Mexico, and on Catrosa Co., Georgia.—Prof. Verrill describes two new species of cephalopods caught off the coast of Massachusetts; also what is the second known representative of the remarkable family of *Cirroteuthidæ*.—Dr. Nichol's researches on the character and intensity of the rays emitted by glowing platinum (see NATURE, vol. xxi. p. 184) are here given in detail.—Prof. Marsh's notes on Jurassic dinosaurs, and Dr. Draper's researches in photography of stellar spectra have been already noticed in our columns.—Prof. Peters contributes observations on the planets Hersilia and Dido; and in the "Scientific Intelligence" we note two useful lists of the (209) minor planets, numerical and alphabetical.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, January 8.—"On the Photographic Method of Mapping the Least Refrangible End of the Solar Spectrum (with a map of the Solar Spectrum from 7600 to 10750)," by Capt. W. de W. Abney, F.R.S., R.E.

The author refers to the sensitiveness of different forms of silver salts when exposed to the action of the spectrum, and shows how he has been able to prepare, by methods indicated, silver bromide which absorbs the red and ultra-red rays, and which is sensitive to these rays.

In his paper he describes the apparatus employed by him in the photography of the invisible least refrangible rays, both with a prismatic, and also with the diffraction apparatus. From photographs taken with the latter, he has constructed a map extending from λ 7600 to λ 10750, which he submits to the Society. He shows also that in the photographs of the prismatic spectrum, he has apparently reached the limiting length by comparing it with photographs of the diffraction spectrum. The author has also compared Lamansky's prismatic thermograph with his photograph. The paper closes with some theoretical remarks on the silver compounds employed.

Mathematical Society, January 8.—C. W. Merrifield, F.R.S., president, in the chair.—Prof. W. S. Burnside was elected a Member.—Prof. Cayley, F.R.S., communicated two formulæ in spherical trigonometry which are included in the one form—

$$\tan \tfrac{1}{2} c (\cos B - i \sin B) = \tan\left(\frac{c}{2} - \phi\right)$$

where $i = \sqrt{-1}$ and $\tan \phi = \tan \tfrac{1}{2} b (\cos A + i \sin A)$.

The note which the President read at the last meeting simply gives (as has been pointed out to him since) some symmetrical cases of the orthogonal transformation, of a much more general character (but unsymmetrical) given by Mr. Cayley, and reproduced in Salmon's "Higher Algebra" (3rd edition, p. 39). The symmetrical form may be obtained from the one there given by writing—

$$\frac{1}{\Delta} = k,\ \frac{\lambda}{\Delta} = a,\ \frac{\mu}{\Delta} = b,\ \frac{\gamma}{\Delta} = c,$$

and then putting $k = 0$. We thus get for the determinant the symmetrical form—

$$\begin{vmatrix} a^2 - b^2 - c^2, & 2ab, & 2ca, \\ 2ab, & -a^2 + b^2 - c^2, & 2bc, \\ 2ca, & 2bc, & -a^2 - b^2 + c^2, \end{vmatrix}$$

the value of which is r^3, and the sum of the terms on the leading diagonal $= -r$, where $r = a^2 + b^2 + c^2$. The terms of this determinant will be integral if a, b, c are either integral, or of the form integer $x\sqrt{2}$, or indeed if they contain any common factor entering under the square root only. It has been shown by Legendre and Gauss that every integer, or its double, is the sum of three squares. It follows that an orthogonal transformation of the above symmetrical character can be found for every whole number r. The transformation is, however, nugatory for certain low values of r. The symmetrical transformation means a turn of two right angles about an axis whose direction cosines are proportional to abc. That is to say, if a cube be taken, with the axes for edges, and those of rational length, in a cubical system, it is always possible to find one or more axes, inclined to the co-ordinate axes, such that if we turn the cube about them through two right angles, its points will still rest on points of the system.—Mr. Hammond gave a form for the complementary function in fractional differentiation. Messrs. Cayley, Merrifield, Roberts, Glaisher, and Freeman took part in a discussion upon Mr. Hammond's communication.

EDINBURGH

Royal Society, January 5.—The Right Hon. Lord Moncrieff, president, in the chair.—At the request of the Council an address on the Trigonometrical Survey of Palestine was given by Lieut. Conder, R.E., late in command. Apart from its more technical nature, the paper contained many details of archæological, ethnological, and geological interest, including the discovery of the positions of not a few historic localities, such as the Cave of Adullam, Bethabara beyond Jordan, the vineyard of Naboth, &c.—Prof. Tait communicated a note on Minding's theorem by Prof. Chrystal. This beautiful theorem in rigid dynamics, the proof of which originally occupied many quarto pages of *Crelle's Journal* with elaborate analysis, had been proved by Prof. Chrystal by means of Plücker's congruencies, in a manner almost rivalling in brevity the quaternion demonstration by Prof. Tait. A generalisation of the theorem led to the discovery of a *volume-locus*.—Prof. Tait then communicated two mathematical notes: (*a*) on a problem in arrangements; (*b*) on a graphical solution of the equation $V\rho\phi\rho = 0$. The former was given under the name of The Mad Schoolmaster. A schoolmaster went mad, and began to operate upon his class of boys according to the following method:—The dux he put down one place, the new dux two places, the next dux three places, and so on till every boy in the class had been shifted at least once. He then began again putting the first dux down one place, the next dux down two, and so on as before. After 306 operations, he found the boys arranged exactly as they had been at the beginning. He then cast one out, and set to work operating similarly upon the remainder; but to his dismay found that he had to operate 1,120 times before they were brought back to their old arrangement. The problem is to find how many boys were in the class, and is of course a particular case of a much more general problem in arrangements. Prof. Tait gave a graphical method by which the inverse problem could be solved by a simple inspection for any number.

PARIS

Academy of Sciences, January 5.—M. Edm. Becquerel in the chair.—M. Wurtz was elected vice-president for 1880.—M. Daubrée gave information as to the Academy's publications and changes in members and correspondents. Two members have died in the year—MM. de Tessan and Gervais—and one correspondent—Mr. MacLear.—The following papers were read:—On the motion engendered by diffusion of gases and liquids, by M. Sainte-Claire Deville. The difference of velocity in passage of gases through a porous septum is utilised in raising liquid, a machine being thus produced which apparently does not consume heat. M. Debray's diffusion apparatus is used, being changed into a machine simply by adding tubes of discharge and valves. Dutrochet's endosmometer may be similarly changed to a machine.—On the hydride of copper; reply to M. Berthelot, by M. Wurtz.—On the heat of formation of hydrate of chloral; reply to M. Berthelot, by M. Wurtz.—Remarks on a recent communication regarding the photospheric network, by M. Janssen. The reticulated aspect produced by faculæ round spots has been long known, but has nothing in common with the photospheric network revealed by photographs. This is formed by the totality of points where the solar granulation is disturbed by upward currents of hydrogen, while the faculæ are due to gaseous masses above the granulated region. The former is in the photospheric layer, the latter above it; the network seen chiefly in the central parts, the faculæ only easily visible at the border. M. Lamey seems to have confounded the phenomena. The network is only visible in photographs 0·25 m. to 0·30 m. in diameter.—On treatment of phylloxerised vines, by M. Maren.—M. Perry was elected Member in Geography and Navigation in room of the late M. de Tessan.—Carbonic acid in the air in its relations with the great movements of the atmosphere, by M. Marié-Davy. A discussion of daily mid-day analyses (April, 1876, to June, 1879) at Montsouris, by MM. Levy and Allaire. The quantity of CO_2 in 100,000 parts of air in volume varied between twenty-two and thirty-six. Winds blowing from Paris contained, on an average, less CO_2 than those from the country. This might be explained by CO_2 occurring more largely in air *below* than *above* the layer of clouds. Three periods are noted: in the first, to November, 1877, the CO_2 was below the mean, and sometimes very low; in the second, to September, 1879, it was considerably above the mean; the third, commencing in October, 1879, showing very little CO_2. The second period was one of wet weather, and comprised two bad harvests; the equatorial current was predominant in France. This current had less extension in the first, which was also less wet, and gave better harvests. A complete change in the atmospheric circulation seems to have occurred since October.—On an application of the pre-existence of Ampère's currents in soft iron, by M. Trève. With iron solenoids he gets much better effects than with copper.—On new luminous tubes, by M. Trève. Into a large Geissler tube he introduces a Fizeau condenser, and fixes the electrodes (connected with the two poles of the induced current of a Ruhmkorff coil) to the eleventh and twelfth tin sheets. On reducing the pressure to 0·003m. or so, sound is no longer heard, but a brilliant white light springs in pearls from the sheets of the condenser, quite distinct from the common light of Geissler tubes.—Action of acetic anhydride on some phenol-aldehydes, by M. Barbier.—On a new synthesis of saligenine, by M. Greene. This is by reaction of chloride of methylene with phenate of sodium in presence of hydrate of sodium.—On the preparation of iodised and bromised derivatives of benzine, by M. Greene.—On the comparative value of monochromatic impressions in invertebrates, by M. Chatin. In arthropods, decapod crustaceans, and some insects, Dewar's current of the retina is well marked, and varies with different rays, reaching a maximum in the yellow-green region. In molluscs, and especially in pulmonated gasteropods, the differences are still more pronounced.—Histology, development, and origin of the testicle and ovary of *Campanularia angulata* (Hincks), by M. Fraipont. M. Touchimbert presented a photograph of forms of snow (resembling small roses) observed at Poitiers.

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