part of the earth's orbit there is a stream of meteorites plunging down nearly vertically towards the ecliptic; the earth in passing through them would receive the greatest number of blows on its exterior atmosphere on the hemisphere above the plane of the ecliptic at the time, while the other hemisphere would be entirely sheltered, so that the direction of the fall would be capable of demonstration by a consideration of the earth's direction and the relation of its surface to the plane of the ecliptic at the time.

The observations indicate that these bodies are moving towards the plane of the ecliptic, from its northern side, into that part of it through which the earth passes in her annual journey in November; they, in fact, are moving round the sun in an orbit inclined at a not very large angle—17°—to the plane of the earth's orbit.

Similarly, we might observe the August ring rising from one of its nodes, situated in the point of the earth's orbit occupied by our planet on August 10, not at a slight angle like the November ring, but at an angle of 79° or 80°.

It is important to make this point quite clear.

Let us conceive the sun and earth to be half immersed in an infinite ocean which will represent to us the plane of the ecliptic, and let us further for greater simplicity assume that the earth's motion round the sun (in a direction contrary to the hands of a watch) is performed in a circular path with the sun at the centre; let us, moreover, suppose the earth's path, or orbit, to be marked by buoys, remembering that astronomers define the position of a heavenly body in the plane by stating its *longitude*—that is, its angular distance, reckoning from right to left, from a particular start-point, as seen from the sun; and its *latitude*—that is, its angular height above the plane as seen from the same body.

Now, if it were possible to buoy various points of the earth's orbit in the plane of the ecliptic in the convenient manner before suggested, we should see the meteor-ring of "Leonids" meeting the waves of our hypothetical ocean, at a slight angle (17°), at the point of the earth's orbit occupied by our planet on November 14, the point where they pierce them being called the *node*. Where the other node lies, where the meteorites cross the plane again, we do not exactly know; we only know that they do not cross our orbit; if they did, another star-shower would occur in May.

Let us inquire into this point a little more closely. Let us, in imagination, connect the earth and sun by a straight line; at any moment the direction of the earth's motion will be at right angles to that line (or a tangent to its orbit); therefore, as longitudes are reckoned, as we have seen, from right to left, the motion will be directed to a point 90° of longitude behind the sun. The sun's longitude at noon on November 14 was 232°, within a few minutes; 90° from this gives us 142°, which, as we have seen, is precisely the longitude of the radiant point. This, then, is proof positive enough that in longitude at least the meteoric hail was fairly directed against, and as fairly met by, the earth.

But it will be asked, If the radiant point is situated in latitude 8° 30′, how comes it that the inclination of the ring is stated to be 17°? should it not rather be 8° 30′? To this question we may reply by another: How comes it that, when we are hurrying through a shower, we always incline an umbrella at a less angle with the ground than that formed by the falling rain? The answer is the same in both cases. In the case of the meteorites, if our motion in one direction differs little from theirs, they appear to us to fall at an angle which is also almost precisely half of their real one.

Similar ancient records relating to star-showers seen in March and April, and July and August, showed that the earth's longitude was always the same when they were observed, if it was referred to a *fixed equinox*. The constant longitude for the star-showers anciently recorded to have taken place in March–April corresponds to April 20·1d., 1850, and for a like number seen in July–August, August 9·0d., 1850.

Forms and dimensions of the orbit of the August meteors, all of them very steeply inclined to the ecliptic, were calculated among the many combined observations and determinations of heights of those meteors made at German Observatories to conclude their longitudes, in the years following the great November showers of 1832–33, by the German astronomer, Erman. *But an exact value of their velocity was still wanting*; and from an approximate measure of the velocity of the "Perseids," obtained from observations of a fine meteor of the shower in America on August 10, 1861, Prof. H. A. Newton found elements of the ring, concluding it to be not far from circular in form, and nearly perpendicular in its plane to the ecliptic.

It will be seen that the longitude for the showers recorded in October–November advances along the ecliptic from a fixed equinox with a uniform motion of 52″ per annum. Such a motion as this must be due to planetary perturbation, and hence we are in presence of cosmical phenomena.

It is to an American astronomer, Prof. Newton, that we owe the first investigation into the constitution of the November ring.[1] He first considered the question whether the ring is of uniform density, and whether it lies merely near our orbit; the variation in the brilliancy of the showers being caused by the action of the planets and moon on the earth and ring—the greatest perturbation of the earth being 9000 miles each way—sometimes throwing us into the ring, sometimes causing us to pass it without meeting it. He has shown, however, that the ring cannot be of uniform density throughout, but that, on the other hand, in one part of it there is a clustering together of the little bodies of which it is composed—a few stragglers being scattered along the rest of its circuit.

From other considerations he showed that the meteors revolve round the sun in a direction opposed to the earth's motion, the most probable time of revolution being, according to his first view, 354·621 days, our own being accomplished in 365·256 days. This is the same as saying that the annual motion of the group is $1 + \frac{1}{33{\cdot}25}$ revolutions. Consequently, the centre of the group is brought, on this view, into contact with the earth once in every 133 years, but the earth passes very near the centre four times in this interval.

On this view the orbit of the swarm would be nearly circular.

With regard to the rings generally, Prof. Newton made out in 1865[2] (1) that all the sporadic shooting-stars cannot belong to a narrow ring which has a diameter approaching in size that of the earth; and (2) that a large portion of the meteorites, when they meet the earth, are travelling faster than it, or else that the sporadic meteors form a series of radiants at some distance from the ecliptic, and hence come from a series of rings considerably inclined to the plane of the ecliptic.

Further, he pointed out that the distribution of the orbits of the meteorites must be one or other of the following:—

(1) They may form rings passing near the earth's orbit at many points along its circuit (sporadic meteors may be outliers of such a ring).

(2) They may form a disk in the plane of the ecliptic.

(3) They may be distributed at random like the orbits of comets.

J. NORMAN LOCKYER.

(*To be continued.*)

SCIENTIFIC SERIALS.

American Journal of Science, September.—Cambrian fossils from Mount Stephens, North-West Territory of Canada, by Charles D. Walcott. The fossils here studied were first discovered last year by Otto J. Klotz, and partly described by Dr. C. Romiger. A comparison with specimens from the Middle Cambrian Terrane of Central Nevada shows that the two faunas are identical, and that consequently the Mount Stephens remains should be referred to about the horizon of the upper portion of the Middle Cambrian system. Other discoveries near the Kicking Horse Pass on the Canadian Pacific Railway seem to show that this fauna extends all along the western side of the great Keweenawan continental area from Southern Nevada far into British America.—History of changes in the Mount Loa craters (continued), by James D. Dana. Here are studied the relations of Kilauea to Mount Loa, arguments being advanced to establish the independent origin of the former, contrary to the author's earlier views on the subject. But his old conclusion is confirmed that volcanoes are not safety-valves, but are rather indexes of danger, pointing out the parts of the earth's crust that are most subject to earthquakes. A contrast is also drawn between volcanoes of the Mount Loa and Vesuvius types, the discharges of the former being almost exclusively outflows, those of the latter upthrows of cinders combined with lava-streams.—On the formation of deposits of oxides of manganese, by F. P. Dunnington. The main object of this paper is to show that manganese sulphate has probably taken a very important part in the

[1] *Silliman's Journal*, Nos. 111 and 112.
[2] *Ibid.*, vol. xxxix.

formation of deposits of manganese ore.—Maxwell's theory of the viscosity of solids and certain features of its physical verification, by Carl Barus. These researches tend to show that Maxwell's theory is a version of Williamson's theory of etherification and of Clausius's theory of electrolysis. The transition made is from unstable groupings of atoms to unstable groupings of molecules. But while preserving minutely all the essentials of Maxwell's argument, the experiments here described go one step further, showing that viscosity is a phenomenon evoked by certain changes of molecular structure, the inherent nature of which is ultimately chemical.—On the origin of primary quartz in basalt, by Joseph P. Iddings. Here are described certain specimens of basalt occurring in the vicinity of the Rio Grande Cañon, which exhibit a remarkable number of porphyritic grains of quartz. A theory is proposed to account for the possible origin of this porphyritic quartz.—Mineralogical notes, by Geo. F. Kunz. Here are studied some specimens of phenacite and quartz pseudomorphs from Maine, a variety of transparent oligoclase and a cyanite from North Carolina, an apatite from New York, and an aragonite pseudomorph from Arizona.—An appendix of 42 pages contains a complete list of the late Asa Gray's writings, chronologically arranged and disposed in three categories: (1) scientific works and articles, 1834-83; (2) botanical notices and book reviews, 1841-87; (3) biographical sketches, obituaries, &c., 1842-88.

SOCIETIES AND ACADEMIES.

LONDON.

Entomological Society, September 5.—Dr. D. Sharp, President, in the chair.—Dr. Sharp mentioned that he had received, through Prof. Newton, a collection of Coleoptera from St. Kilda, consisting of *Carabus catenulatus* (1), *Nebria brevicollis* (12), *N. gyllenhalii* (3), *Calathus cisteloides* (20), *Pristonychus terricola* (1), *Pterostichus nigrita* (71), *Pt. niger* (31), *Amara aulica* (4), *Ocypus olens* (1). The species being nearly all large Geodephaga, he thought probably that many other Coleoptera inhabited the island. He remarked that these specimens showed no signs of depauperation, but were scarcely distinguishable from ordinary English specimens.—Mr. South exhibited a melanic *Aplecta nebulosa* from Rotherham, bred with five others of ordinary form, and an albino of the same species from Devonshire; a very curious dark variety of *Plusia gamma*; two dark varieties of *Eubolia limitata* from Durham; *Dicrorhampha consortana* from North Devon.—Mr. Champion exhibited *Harpalus cupreus*, *Leptusa testacea*, and *Cathormiocerus maritimus* from Sandown, Isle of Wight.—Mr. Elisha exhibited the following Microlepidoptera: *Œneana atricapitana*, *turionana*, *juliana*, *derasana*, *capreana*, *pomonana*, taken off *Sorbus aucuparia*; *sodaliana*, *zephyrana*, *trigeminana*; also *Schiffermulleriella horridella*, *alpella*, *fuscoaurella*, *therinella*, and *semidecandrella*, on *Cerastium tetrandrum*.—Mr. Jacoby exhibited three boxes of Coleoptera, collected partly by Mr. Fruhstroffer, containing some rare *Cetoniadæ*, *Paussidæ*, &c.—Mr. E. Saunders exhibited *Amblytylus delicatus*, Perr., a new British bug, taken at Woking.—Mr. Jacoby mentioned that he had taken the larva of *Vanessa cardui* on a narrow white-leaved plant in his garden.—Mr. Enock mentioned that out of a batch of two males and six females of the Hessian Fly kept together, all six females had laid fertile eggs, so that each male must have impregnated more than one female.

PARIS.

Academy of Sciences, September 24.—M. Des Cloizeaux in the chair.—Generalization of a theorem of Gauss, by M. J. Bertrand. This theorem is thus expressed: Whatever be the attracting body, the mean value of the potential at the different points of a sphere is equal to the relative potential at the centre of the sphere. The demonstration supposes the sphere to be exterior to the attracting body, and the present paper deals with the theorem when this condition is not fulfilled, and it is shown that by substituting for the full sphere a spherical surface the theorem still holds good.—Complement to the theory of overfalls, by M. J. Boussinesq. Various applications are given to the theory established in the previous paper (*Comptes rendus*, September 17, p. 513) regarding the influence exercised on the discharge by the velocity of the current at the overfall.—Observations of Brooks's comet (August 7), and of Barnard's comet (September 2), made with the 0·38 m. equatorial at the Observatory of Bordeaux, by MM. G. Rayet and Courty. The observations for Brooks's comet are for the period from September 5-17, those for Barnard's comet from September 11-17.—On the physiological action of *Hedwigia balsamifera*, by MM. E. Gaucher, Combemale, and Marestang. This plant, which has been classified and described by Descourtilz ("Flore des Antilles," iii. p. 263), belongs to the family of the Terebinthaceæ, and grows in the West Indies. The experiments on guinea-pigs and rabbits here described show that the alcoholic extract from the bark of stem and root is highly toxic, a dose of 0·161 gramme proving fatal. The aqueous extract is less toxic than the alcoholic, but both produce rapid and considerable lowering of the temperature, paralysis, and convulsions, spreading progressively from the lower part of the marrow to the rachidian bulb.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Lessons in Elementary Physics, new edition: Balfour Stewart (Macmillan).—Ungdomsskrifter, Första Serien, Första Häftet: Carl von Linnés (Stockholm).—The Frog, 3rd edition: A Milnes Marshall (Cornish, Manchester).—Primer of Micro-Petrology: W. Mawer (London).—Memory: F. W. Edridge-Green (Baillière).—Mathematischen Theorien der Planeten-Bewegungen: Dr. O. Dziobek (Barth, Leipzig).—Examples in Physics: D. E. Jones (Macmillan).—A Text-book of Physiology, 5th edition, Part 1: M. Foster (Macmillan).—The Centre of the Central Sea: J. N. Emra (Kegan Paul).—Johannes Kepler und der Tellurisch-Kosmische Magnetismus: Dr. S. Günther (Wien).—Synopsis of the Vertebrate Fauna of the Puerco Series: E. D. Cope (Philadelphia).—Morphologisches Jahrbuch, 14 Band, 2 Heft: C. Gegenbaur (Leipzig).—Zeitschrift für Wissenschaftliche Zoologie, xlvii. Band, 1 Heft (Leipzig).—Geological Record for 1880-84: Topley and Sherborn (Taylor and Francis).—The Calendar of the University College of Wales, Aberystwyth, 1888-89 (Cornish, Manchester).—The Analyst's Laboratory Companion: A. E. Johnson (Churchill).—Memoirs and Proceedings of the Manchester Literary and Philosophical Society, 4th series, vol. 1 (Manchester).—Photography for All: W. J. Harrison (Iliffe).—Ornamental Waterfowl: Hon. Rose Hubbard (Simpkin).—Jahrbuch der Meteorologischen Beobachtungen der Wetterwarte der Magdeburgischen Zeitung, Jarhgang vi. 1887 (Magdeburg).—Proceedings and Transactions of the Royal Society of Canada for the Year 1887, vol. v. (Dawson, Montreal).—Catalogue of Variable Stars: S. C. Chandler (Lynn, Mass.)—Report on the Condition of Growing Crops, &c., August (Washington).—La Zoologia de Colón: J. I. de Armas (Habana).—Vierteljahrs-Wetter-Rundschau, Band i. Heft 3 and 4 (Mittler, Berlin).—Journal of Morphology, vol. ii. No. 1 (Ginn, Boston).—Mind, October (Williams and Norgate).—Journal of Anatomy and Physiology, October (Williams and Norgate).—The Geological Magazine, October (Trübner).

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