

has not had the same attention lavished on it as has been given to the more historic epochs of the Leonids, Lyrids and Perseids. Yet occasionally, even when only moderately active, the Quadrantid Radiant furnishes displays of about 40 meteors per hour. In the year 1839 Herrick drew attention to the recurring character of a meteor shower on January 2. A stimulus was given in the same direction when in 1839 Quetelet published his valuable contribution to me teor literature in his "Catalogue des Principales Apparitions d'Etoiles Filantes," in which were cited two instances when meteors were reported to have been unusually numerous on the morning of January 2, viz. in 1835 and 1838. There was also a previous account of the appearance of an extraordinary bolide in the north of Italy in the year 1825, on the morning of January 2 at 5 o'clock, before and after which hour on that night there was noticed a great abundance of meteors.

When Quetelet published a second edition of his work a few years later it contained notices of Quadrantid displays on the same day of the month in the intervening years 1839 and 1840. Their observation in those years, however, may have been due to their having been specially looked for. The next notable display occurred in 1862, and was accidentally witnessed on the morning of January 2, between about 4 and 5 o'clock, by a lady residing in Harford, Connecticut, U.S., who on this occasion seems to have had the honour of being the sole observer of the apparition. Her attention was attracted by a luminous cloud moving from west to east, and also by the appearance of fine meteors at the rate of about three per minute. Two years later there occurred another display in England, on the night, however, instead of the morning of January 2, for which an organised watch had been kept. Profs. Herschel and Gregg (British Association Report, 1864, p. 30) each observed fifty shooting stars from different stations during the hours 10 to 12 p.m. and 10 to 1 respectively, while another observer, Mr. W. H. Wood, reckoned that the Quadrantids were appearing at the rate of one per minute during the hours 12 to 2. Prof. Kirkwood, who instituted researches respecting the periodicity of these meteors and also of other meteor-systems, showed in a paper read before the American Philosophical Society in 1873 that the Quadrantid maximum recurred every thirteen years, the principal displays having taken place in 1825, 1838 and 1864. The intervening maximum between the two last dates is supposed, of course, to have passed unnoticed.

The expected shower, however, in 1877 was looked for in vain owing to unfavourable weather, but on the morning of January 2 in the following year, during a brief interval of clear sky beginning at 4 o'clock, Prof. Herschel noted the appearance of seventeen Quadrantids, nearly half of which ranged in brightness from the brilliancy of Sirius to that of second magnitude stars. Weaker apparitions from the Quadrantid radiant also occurred on the nights of January 2 in the years 1872 and 1873, but seem to have been only partially or imperfectly observed. The circumstance that the principal appearances of these meteors evidently took place in 1825, 1838, 1862 and 1864, and (probably) also in 1878 naturally leads to the expectation that another fine display may be observed in 1902. An examination of the dates at which the first three of these showers occurred shows that the Quadrantid meteoric epoch is gradually, as in the case of other well-known star showers, advancing into the year. The advance takes place on the average, however, and is not very noticeable over short periods, being warped by fluctuations in the date of the shower's appearance with respect to the mean date, such fluctuations being produced by the perturbations which occur in the meteoric orbit.

The display in America in the year 1862 and also those on the night of January 2 in 1872 and 1873 illustrate this advance. A calculation made by the writer with such data as the above displays afford shows that the time of the next shower's expected appearance falls on the night of January 4 in 1902, the maximum or centre of the display being due at 3h. 30m. on the morning of the 5th. Earlier in the night, shortly after 12 o'clock, meteors will probably be unusually numerous. The display in 1864 evidently did not attain the brilliancy of the previous displays. Calculation shows that the maximum of this shower occurred about 10 p.m. on the night of January 2, which prevented the shower being fully observed. Probably some early Quadrantids of the expected display will appear on the morning and also early on the night of January 3. The lateness of the maximum on the night of January 4 is more apparent than real, owing to 1900 not being a leap year.

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Frost Patterns in Mud

ON many occasions recently frost patterns in mud have been exceptionally well marked, similar to those formerly described by Prof. Bonney and others (see NATURE, vol. lxiii. p. 347; Proc. Roy. Soc. vol. lxiii. p. 217).

On December 15 several of the usual forms were to be seen, the patterns generally being rather coarse, but elaborate, having branched and curving axes.

Thus, (1) on many ordinary flagstones the ice-fronds spread from the centre outwards, over a patch, roughly oval on an oblong stone, roughly circular on a square one, leaving bare a space towards the edge; although sometimes radial or branched forms started from the edge in addition. (2) The centre of the pattern on some flagstones was occupied by a lumpy mass. This consisted of frozen mud, sometimes having a border two to three inches wide formed of scattered separate lumps. (3) One example, however, was rather exceptional. On a concrete path in St. James's Park a space of a few square yards was broken into patches (from a few inches to 2 feet or more in diameter) with outlines roughly hexagonal or partly curved, resembling the ends of basalt columns. In these patches the branching frost-fronds had spread from the centre outwards, while, between the patches, a space about $\frac{1}{2}$ inch broad was clear of ice. This example reminded me of the spheruloids with attempts at spherulitic or variolitic structure in various igneous rocks (see *Q.J.G.S.* vol. xlix. p. 155); and here also one asks whether the contraction which caused such jointing was favourable to crystallisation, or did the crystallisation from a centre cause the contraction, or were the two independent though they cooperated to produce the general result?

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THE ROYAL COMMISSION ON COAL RESOURCES.

THE announcement that a Royal Commission has been appointed to inquire into the coal resources of the United Kingdom had not been anticipated by public opinion. Yet, in view of the articles on the subject published in NATURE (1897, p. 389, and 1900, p. 124), it should hardly give occasion for surprise. The duration of the British coal supplies is a question that has lost none of its interest since the previous exhaustive inquiry conducted in 1866-1871 by the Royal Commission of which the late Duke of Argyll was chairman. The fifteen Royal Commissioners—all of whom, with one exception, have now passed away—were among the most eminent men of their day, and their calculations were carried out in a thorough and complete manner. In the course of thirty years, however, unexpected changes have taken place in the coal trade. The annual output of coal in the United Kingdom thirty years ago was not more than 100,000,000 tons; it now exceeds 225,000,000 tons, and the process of exhaustion still continues. The beginning of the twentieth century is evidently an opportune time for taking stock of the national resources of the mineral on which so much of the prosperity of the country depends. The new inquiry is to be of a far-reaching character. The terms of reference are as follows:—

To inquire into—(1) The extent and available resources of the coalfields of the United Kingdom; (2) the rate of exhaustion which may be anticipated, having regard to possible economies in use by the substitution of other fuel or the adoption of other kinds of power; (3) the effect of our export of coal on the home supply and the time for which that supply, especially of the more valuable kinds of coal, will probably be available to British consumers, including the Royal Navy, at a cost which would not be detrimental to the general welfare; (4) the possibility of a reduction in that cost by cheaper transport, or by the avoidance of unnecessary waste in working through the adoption of better methods and improved appliances, or through a change in the customary term and provisions of mineral leases; and