Making A Meteor

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NASA's Deep Impact mission is about to smash into comet 9P/Tempel 1 to excavate a crater and probe the comet's internal structure. It's possible, however, that the comet will break into fragments, creating a cloud of meteoroids. That, say astronomers, may not be unnatural.

"If comet 9P/Tempel 1 breaks during NASA's Deep Impact mission on July 4, a meteoroid stream will be created in much the same manner as the mechanism that causes most of our meteor showers," according to SETI Institute astronomer Dr. Peter Jenniskens in a paper accepted for publication in the Astronomical Journal.

Jenniskens has discovered a fragment of lost comet D/1819 W1 (Blanpain), last seen in 1819. It has survived for 36 orbits, and was detected on November 22, 2003 by the Catalina Sky Survey as a minor planet called 2003 WY25. It passed Earth at a distance of only 0.025 AU (3.7 million kilometers) on December 11, 2003.

After its orbit was better determined, Jenniskens traced the object back to that of Blanpain in 1819. 2003 WY25 is a tiny object, only 400 meters in diameter, assuming that, like similar objects, it reflects about 4% of the sunlight that hits it.

Jenniskens and co-author Esko Lyytinen, an amateur astronomer from Finland, calculated how the debris of a breakup in 1819 would have spread under the influence of planetary perturbations.

They discovered that a breakup during (or just before) the return of

1819 can explain a spectacular shower of meteors that radiated from the constellation of Phoenix in 1956. In that year, the planet Jupiter had steered the trail of debris into Earth's path.

This image is a compilation of 4 images that were taken on June 13, 2005, through the clear filter of the Medium Resolution Imager (MRI) camera. The spacecraft is 18,675,137.9 km (11,604,190 miles) away from comet Tempel 1, and the Sun is located to the right of the image. Image credit: NASA/JPL-Caltech/UMD.

"The 19th century idea that meteor showers originate from the breakup of comets went into remission after astronomer Fred Whipple, in 1951, developed a quantitative description of meteoroid acceleration by the drag of water vapor," says Jenniskens.

"Ever since, meteor showers were thought to be caused by the gradual ejection of meteoroids when the comet's ices evaporated on approach to the Sun."

Instead, it now appears that many meteoroid streams are caused by wholesale disintegration of comets, which are loose assemblages of cometesimals and are known to frequently break apart.

There are several possible causes of such fragmentations, one of which is collisions with large meteoroids such as simulated in the Deep Impact mission.

Last year, Jenniskens identified minor planet 2003 EH1 in the orbit of the strong Quadrantid shower of January, and argued that the object was the residue of a broken comet giving rise to the Quadrantid shower. A comet seen in A. D. 1490 - 1491 (C/1490 Y1) was perhaps the manifestation of that breakup.

The detection of 2003 WY25 provides a second example of the formation of a meteoroid stream by the disintegration of a comet.

Other well known meteor showers that likely originated from the breakup of a comet, according to Jenniskens, include the December Geminids (with remnant 3200 Phaethon), as well as the June Daytime Arietids and July delta-Aquariids that are associated with the Marsden-group of sun-skirting comet fragments. It is now also likely that the spectacular meteor storms of Andromedids in 1872 and 1885 were due to the progressive fragmentation of comet 3D/Biela in 1846 and 1852.