The word *meteoroid* was coined by Whipple to describe the dust aggregates which are sloughed from the surfaces of comet nuclei after a stratum of ice has evaporated. Most of the 200 million naked-eye meteors that the Earth receives each day are of this type.[15]

The word *cometoid* has been introduced here to account for cometary matter which is in a physical state between meteoroids and comets, namely, chunks of ice too small to produce observable comets.

A few comets which were accessible to observation have been seen to disintegrate or break up when near the Sun or after having passed close to Jupiter. Others have been observed to throw out luminous pieces of matter. Materials in this class have been completely neglected in discussions pertaining to meteors, although there are logical reasons to assume that comets, with ice nuclei, will occasionally eject sizable chunks of matter. For example, this could result from the tidal actions of Jupiter, by internal "boiler" type explosions, as suggested by Whitney (but on a smaller scale) in connection with comet outbreaks, or by chemical explosions of the type discussed by Urey.[16]

Some comets have been observed to break into two parts, each large enough to carry on as an individual comet. Brooks 2 split into five parts in 1889. The bright comets 1668, 1843 I, 1880 I, 1882 II, and 1887 I all move in similar orbits and probably resulted from the decomposition of a single body. Each one of these objects was brighter and presumably more massive than Halley's comet. Comet 1882 II showed signs of additional disintegration following perihelion, as many bright bodies (cometoids) were reported in its vicinity.

Browning observed a magnificent fireball on 13 October, 1873, and was able to identify, by direct comparison, the spectrum of a hydrocarbon (methane). Observations of this type suggest cometoid fireballs.[17]

Biela's comet is an interesting example of comet breakup. On 27 February, 1826, an Austrian army officer named Biela, discovered a faint comet which was destined to bear his name. Its orbit was studied for several weeks and it was finally identified as the same comet which appeared in 1772 and in 1805. Santini found its period to be 2455 days and predicted that the attractions of the Earth, Jupiter and Saturn would cause it to return 10 days sooner. The comet returned to perihelion in November, 1832, within 12 hr. of the predicted time. It was very faint. The following perihelion passage was due on 13 July, 1839, but it was not seen then because of its close passage to the Sun. The next passage, due on 11 February, 1846, was eagerly awaited because of the long observation period anticipated. When it was observed at Washington, it consisted of two comets, side by side, in place of the single object. Although Kepler has reported a similar event, the double comet was quite surprising. It returned again in September, 1852, and consisted of one chief comet and one small comet. The two apparitions never returned to be seen as comets again. However, on 27 November, 1872, when the Earth passed through the comet's orbit, a fine meteor shower occurred, but these meteors were caused by meteoroids released from the comet at a much earlier stage in its evolution. The cometoids, if such objects were formed, probably missed the Earth. If cometoids had been present they would have tended to slow down to low speeds and exhibit behaviour entirely different from that of the meteoroids.

The fact that comets are able to eject sizable fragments suggests that the masses of comets are small and that their own gravity is on the verge of being too feeble to hold their nuclei together.

The chances of the Earth encountering a sizable ice body during a meteor shower is small because of the limited lifetime of ice in comparison to the lifetime of meteoroids. However, the phenomenon observed during the meteor shower of 1833 could have been caused by such materials.

3. Cometoid Sources

Bright comets are recognized by their immense tails and characteristic heads. However, the average comet is not even visible to the naked eye. Furthermore, it may lack any evidence of a tail and the coma may be very faint. When far from the Sun the nucleus may take on a stellar appearance and be indistinguisable from an asteroid. More likely than not it is too small to be detected. Consequently comets with perihelia of the order of two or more astronominal units are often overlooked. Sometimes they pass by unnoticed even when their orbital elements are known. Furthermore, from probability, there should be many more comets with perihelia lying between Mars and Saturn, for example, than between Mars and the Sun. This applies to both short-period and long-period comets. Thus a number of disruptions, possibly a dozen per century, may occur near Jupiter. Because of the lack of a noticeable coma or tail at this distance, the dismemberment is apt to be inaccessible to observation.

The most favourable circumstances occur when Jupiter perturbs a short-period comet, with an aphelion distance of six or more astronomical units, and attracts it in close enough to achieve a complete disruption. If the cometoids produced under these conditions have perihelia of the order of one astronomical unit, and if the orbital inclination to the ecliptic plane is small, then the Earth is in an excellent position to capture the ice debris. It is assumed, of course, that the short period comet is in a direct orbit.

The probability of an event of this type occurring is not known. In order for the Earth to intercept these ice entities it is required that both the Earth and the fragments be close to the intersection, or nodal point, simultaneously. The stream will gradually deteriorate by sublimation. The dust which remains behind will have a much longer lifetime. Thus, unless the Earth intersects the stream during the first few years of its existence, the