

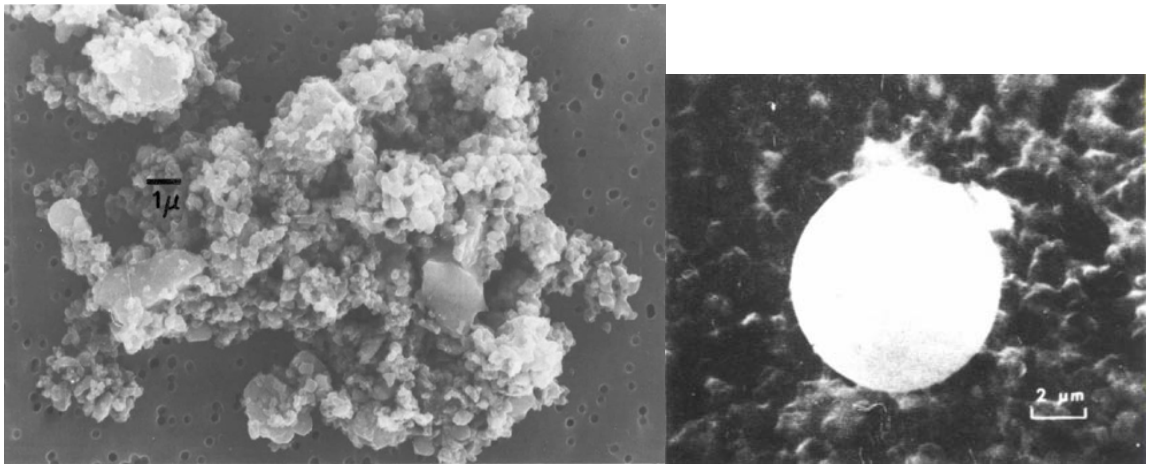

(a) (b)

Figure 8.3. Extraterrestrial dust particles. a) A "chondritic porous" interplanetary dust particle collected from the Earth's stratosphere (Bradley, Brownlee, and Veblen, 1983; photo courtesy of D. E. Brownlee, University of Washington). b) An extraterrestrial microsphere retrieved from a depth of 566 meters in the Byrd Station ice core (Thompson, 1977b, p. 137).

inside chondritic meteorites (as "chondrules"). While spherules are the most common morphology among the smooth surface micrometeorites, odd morphologies such as tear drops, ovals, dumbbells, and rings have also been found in: ocean sediments (Glass and Heezen, 1967), polar ice (Langway, 1970), and in lunar soil (Mueller and Hinsch, 1970).

There is general agreement that these rounded particles must once have been heated to a molten state in order to attain their smooth shapes. One theory is that these were originally irregular micrometeorites that became heated during entry through the Earth's atmosphere. Whether a particle would melt into a spherule would depend on several factors such as the particle's melting point, density, entry velocity, angle of incidence, and diameter. Particles about 10 – 100 microns in size would be most likely candidates for melting; see Whipple (1951). However, this mechanism has difficulty accounting for airborne microspheres found at high altitudes (which have been shown to be non-rocket-exhaust in nature) and for spherules found on the Moon. Parkin, Sullivan, and Andrews (1977) have suggested that some cosmic spherules are already round before they enter the atmosphere. Consequently, some other agent besides air friction may be involved in the production of cosmic spherules. Perhaps these were interplanetary dust grains that were originally irregular in shape but that became abraided into a spherical form by solar wind bombardment. Another possibility would be an intense outburst of solar radiation such as that proposed by Mueller and Hinsch to account for the spherules found on the Moon; see Chapter 4 (Subsection 4.7.3).

Langway (1970) reports that the cosmic spherules he has found in Greenland ice were generally less than 100 microns in diameter, with about 75% - 85% being 5 – 25 microns in size. He has studied the concentration of cosmic spherules at a depth of 300 meters (~1250 A.D. ice) in a core drilled at Site 2, Greenland (77° N, 56.1° W) and at a depth of 6 meters (~1952 A.D. snow) at Camp Century, Greenland. He reports spherule concentrations at these locations of about 44 spherules per liter of ice, or weight concentrations ranging from 1.2 – 4.2 μg/lt of ice. Assuming Holocene dust concentrations of ~200 μg/lt of ice for Camp Century (see Table XII), this represents about 0.5 – 2% of the total dust weight deposited at these locations. Based on known rates of ice (or snow) accumulation at these two sites, it is estimated that cosmic spherules are deposited at the rate of about $0.4 - 1.3 \times 10^{-7}$ μg/cm^2/yr, giving an integral influx of about $10^5 - 10^6$ tons of cosmic dust per year.