TWO IMPORTANT MECHANISMS CONTRIBUTING TO COMETARY EVOLUTION IN THE OORT CLOUD, S. A. STERN, LABORATORY FOR ATMOSPHERIC & SPACE PHYSICS, UNIVERSITY OF COLORADO, BOULDER, CO 80309.

In the Oort cloud a variety of mechanisms operate to modify the population structure, orbit characteristics, and surface evolution of comets. Three such evolutionary processes have already been discussed. they are the dynamical thermalization of orbits by passing stars (1), high energy radiation surface damage (2), and the erosion of cometary surfaces by impacting ISM grains (3). Here I will demonstrate that two previously unrecognized mechanisms will generate significant cometary evolution over timescales of 1^9 years.

The processes which I will discuss are (a) collisions among objects in the cloud and (b) the passage of luminous stars. Each of these processes cause the size distribution and surface evolution of objects in the cloud to evolve.

Concerning collisions, it is possible to calculate the mean time between collisions of objects in Oort orbits if the population density is known. I assumed there to be 10^{12} comets in the Outer Oort Cloud and 10^{14} comets in the Inner Cloud, and a primordial distribution of smaller and larger objects following the common power-law form, with an exponent of -3.3. Typical collision velocities in the inner cloud are ~400 m/s. Using a computer model to simulate the evolution of the time-dependant size-distribution of objects in the cloud, I found that (a) no primordial objects <10 meters in size will survive to the present, that (b) the population of objects of size <100 meters in size will be enhanced by the generation of collision fragments, that (c) collisions between kilometer-sized objects will occur only infrequently, but that (d) collisions of 10cm-100m sized objects with kilometer-sized (cometary) bodies will occur frequently. I therefore conclude that cometary regolith development can proceed in the Oort cloud, and that a cutoff to the size of primordial objects exists at the 10 meter class.

Turning now to the effects of passing stars, it is clear that any solar-mass main sequence star passing through the Oort cloud will "excite" those comets which it passes at distances <~5 AU. In such events, Oort comets will in effect undergo a "perihelion passage" with another star. Even at 30 au, passing stars will cause the volatiles CH_4, NH_3, CO, and CO_2 to sublimate. After computing the total fraction of Oort comets that have encountered an interloping star in this way, I conclude that only an insignificant fraction of Oort comets have been "processed" by passing solar-type stars. However, stars of $10^{3-10.6}$ solar luminosities exist. For such objects, the insolation "radius of action" is much larger. Taking the relative populations of all stellar luminosity classes into account, and noting that a 10^5 Lsun star can evaporate CH_4 from a distance of ~0.1 parsec, I find that it is statistically likely that all comets in the Oort cloud have been processed to 27 degrees K at least once, and that 20-40% of all Oort comets have experienced at least one episode of surface heating to 50 K. This finding is important to understanding the behavior of new comets approaching the sun, and is in accordance with the lack of observed CH_4 & N_2 volatiles in long-period comet spectra.

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3. Stern, S.A., (1986). The Effects of Mechanical Interaction Between the Interstellar Medium and Comets, Icarus, **68**.