GRAIN FORMATION AND ACCRETION: INITIAL STAGES: Bertram Donn; Code 690, NASA/GSFC, Greenbelt, MD 20771.

Although the mechanism whereby small particles stick together has not been satisfactorily explained, it is well known that aggregation is very effective and hard to avoid. Many proposals have been made for different circumstances: sticky surfaces, electrostatic and magnetic effects, van der Waals forces, shape factors. These will be reviewed.

Recent experiments on vapor phase condensation of refractory grains has shown that unsaturated bonds will occur and non-sphericals grains form. These effects will contribute to grain aggregations. It does not seem that efficient accretion is a problem.

The nature of the aggregate has received little study and has generally been assumed to be a very compact structure. There is now experimental and theoretical evidence that the nucleus is porous with low density (0.2-0.6 g cm^{-3}) that has the characteristics of a fractal, i.e., self-similar at all scale lengths.

Meteors and interplanetary dust particles (I.D.P.'s) collected in the stratospheric also are low density, porous structures. On a much larger scale (up to 1000 kg), the majority of the Prairie Network Fireballs are fragile, low density objects. Meteor shower fireballs have even more extreme characteristics.

Such fractal-like aggregates are what is expected from low velocity, random accretion in the solar nebula. The densities of solid smoke aggregates fall in the range 1-50% of that of the bulk material. Numerical simulations of random accretions by cluster-cluster collisions with ballistic trajectories yield fractral structures with low densities. An analysis of such processes up to several hundred meter size aggregates indicates compression to densities ~0.7 g cm^{-3} will occur in the region of the interface.

This accumulation mechanism produces objects with dimensions of several kilometers which are consistent with known characteristics of cometary nuclei.

Investigations of asteroidal and planetary accumulation need to start with the growth of irregular shaped, fragile, porous, low density aggregates.