6.2 IN SITU MEASUREMENTS OF DUST

O.E. Berg
Goddard Space Flight Center
Greenbelt, Maryland/USA

In this colloquium, my colleagues and I have reported on data from both the lunar surface and from interplanetary space. I am going to comment briefly and individually on each of these disciplines insofar as they pertain to cosmic dust, but first I would preface those comments with a personal philosophy for each of the two stated disciplines. The two philosophies, you will find, are directly opposite. Concerning the lunar surface, one must recognize that it is a relatively unexplored area for in situ measurements. Accordingly, one must be sufficiently flexible and open-minded to include and consider all available experimental evidence and data until a somewhat consistent model of the lunar surface is derived. Further, and in a similar vein, one's thinking must not be limited to what little we already know about the lunar surface nor to what is known about the Earth's surface and terrestrial particles -- assuming that lunar particles are similar to Earth particles. Our lunar experiment shows strong evidence for the electrostatic transport of fines, and yet it is difficult to accommodate that phenomenon on the lunar surface in view of associated parameters that have been derived for the lunar surface, and in terms of what we know about the electrostatic surface properties of terrestrial particulates. But the electrostatic surface properties have been determined in the laboratory on terrestrial particles which are known to have vastly different properties from lunar fines. Thus, it becomes important to compile and consider all available data during this early exploration.

Now in considering the interplanetary space particle, I advocate adopting a philosophy of greater rigidity. We now have a fair idea for the meteoroid model in our solar system, and we can afford to become selective toward the available experimental results and data that should be included in further refining the model. No longer should we carry along the very early and purely exploratory results that are so far out of line with the rapidly refining model we see emerging. In situ measurements of cosmic dust began in 1949 with Drs. Bohn and Nadig, of Temple University. Their results and those of several subsequent exploratory experiments, using acoustical sensors for cosmic dust fluxes, strongly indicated that cosmic dust consti-

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tuted perhaps the major hazard to manned space travel. Consequently, a major effort in cosmic dust measurements was supported with the sole objective of evaluating the meteorite hazard in space. Today, as we all know, more sophisticated experiments and improved data analyses have erased the existence of a significant cosmic dust hazard and although the cosmic dust particle has emerged as an extremely interesting astronomical object, some of us adhere to the outmoded practices of the past. The prime example of this and the one I choose to espouse today is the flux curve which obviously needs total revamping:

1) There are data points on that curve which date back to experiments performed in 1955, and earlier, when the field was purely exploratory. These data should be reconsidered in terms of being obsolete, deleted from the curve, and permanently archived in favor of the more recent and more precise experimental results.
2) It is now obvious that no single curve can reasonably represent the flux of dust particles in our solar system because the flux varies markedly with different sets of conditions. There is an established difference between near-earth measurements and deep-space measurements of flux. There are more than two orders of magnitude variation as the sensor axes point toward and away from the sun.

Offhand, the flux curve does not appear to be an important issue to cosmic experimental results. In fact, however, it is generally the first criterion for judging the accuracy or success of an in situ measurement. Consider the case of a bright young experimenter who has been successful in flying a new type of impact device in a satellite or probe. His first question is concerned with how his measured flux agrees with previous results. If he finds his results do not agree precisely with the well established curve, he may make an adjustment within the extremes of experimental error in order to reasonably comply, even though his results may be very accurate for <u>those specific sets of experimental conditions</u>. That is not good. So I would recommend a near-earth flux curve; a deep-space flux curve; and probably an adopted correction factor to accommodate the exposure angle relative to the sun.

I have truly enjoyed this colloquium and I would like to commend the persons who have organized and directed it so efficiently and effectively. I am sure it has been helpful to everyone here to have, gathered under one roof, the investigators from other disciplines in the overall interplanetary dust and zodiacal light ensemble and to hear their results and comments. In this age of rapidly expanding volumes of information on space, it becomes increasingly difficult to keep up with the literature and progress even in our own specific limited field. A colloquium such as this one offers a summary for some of the more significant contributions from several areas concerned with the meteoroid complex. One cannot help but derive an improved overall portrait of the nature of our subject.

I am quite hesitant to select any particular papers as being outstanding lest through the prejudice of my own specific interests I slight other participants or contributors. Many outstanding papers have been presented, but one that comes immediately to my mind is the work presented by Brownlee, et al. I was involved in cosmic dust collections, many years ago, in attempts to recover evidence of craters from micrometeorites, and I recognize some of the difficulties associated with the work and the omnipresent terrestrial contamination. From the evidence that has been presented, I am quite convinced that their particles are indeed of extraterrestrial origin. Their results should be considered a major advance in the field of space science.

Another set of results presented at the colloquium that, in my opinion, warrants special recognition is the successful compositional analyses of cosmic dust as reported by the Max-Planck-Institut für Kernphysik, Heidelberg. Now that this technique has been proved possible and practical, I would assume that ion analyses of particles in space should become the major objective in cosmic dust studies over the next several years. Through this achievement, it becomes possible to distinguish between cometary, asteroidal, and interstellar origins for the particles.

And now a final note on "stardust" and speculation. Speculation is often very good and certainly scientifically acceptable, because it promotes complete explorations of the extremes of variables, and ties in associated fields of science. Speculation over a long period of time without supporting experimental evidence, however, should be discouraged because it tends to confuse the issue. One can assign speculative origins to almost any set of results, I suppose, and a natural consequence is that the speculative origins become validated or invalidated with time. In my opinion, time has run out for stardust.