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*Operation*

# ROLLER COASTER

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DEFENSE NUCLEAR  
AGENCY

PROJECT OFFICERS REPORT—PROJECT 2.6c

JUL 10 1974

## SPECIAL PARTICULATE CHARACTERISTICS

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Research and Development

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## ABSTRACT

The procedures developed and used in obtaining data on individual particles resulting from the four events of Operation Roller Coaster are presented with discussions of their accuracy and reliability. A very large amount of data on particle size, shape, color, and plutonium content was obtained. Less extensive data on uranium content was obtained by standard fluorometry. Special techniques for obtaining the density of irregular particles, identifying submicron radioactive particles, and observing the elemental distribution quantitatively in individual particles were investigated in depth; recommendations on further development of these techniques are included.

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## CHAPTER 1

### INTRODUCTION

#### 1.1 OVERALL OBJECTIVES

The objective of Project 2.6c, Special Particulate Characteristics, was to investigate those characteristics of plutonium-uranium-bearing particulates formed during a one-point detonation of a nuclear weapon which are pertinent to evaluation and prediction of the effectiveness of various storage configurations in minimizing the hazard resulting from accidental non-nuclear detonation.

##### 1.1.1 Specific Objectives of Individual Analytical Tasks

###### Optical Microscopy:

1. To determine size distribution input data for analyzing and predicting atmospheric dispersion, fallout patterns, and hazard arising from inhalation and ingestion of particles.
2. To provide knowledge relative to particle-formation mechanisms and the role of background materials (e. g. cover soil) in determining the observed characteristics of the particles.

###### Alpha Counting of Unaltered Particulates:

1. To provide indication of the plutonium content, and thus alpha activity, of the particulate debris.

Although for particles above a given size range ( $\sim 10$  microns) self-absorption of alpha rays may be significant, measurements were to be performed on large as well as small particles in anticipation that particle characteristics in the main would be sufficiently uniform to allow utilization of appropriate calibration curves. The relative simplicity of such gross counting allows for the accumulation of extensive data for meaningful statistical analysis of activity distributions in the particulate debris.

#### Precision Alpha Counting:

1. To determine the true plutonium content of individual particulates.
2. To seek the relationship between true plutonium content, particle physical characteristics (size, color, morphology), and gross alpha count of individual particles.

#### Density of Individual Particles:

1. To provide requisite density data for fallout analysis studies.
2. To provide input data for interpretation of alpha counting data on unaltered particles.

#### Fluorometric Uranium Analysis:

1. To investigate the distribution of uranium and plutonium within particles for fractionation effects and possible correlation of such observations with other particulate characteristics.

#### Electron Microscopy:

1. To investigate utilization of the electron microscope for extending the input data on particulate size distributions into the domain of submicron particles.

#### Electron Diffraction:

1. To investigate the utilization of electron-diffraction pattern analyses towards determination of the matrix composition of individual particles to provide input data for developing understanding of the observed physical and radiological characteristics of the particulates analyzed.

2. To provide means for identifying fallout particles in the submicron size range.

#### Electron Probe Microanalysis:

1. To investigate the utilization of electron-probe microanalysis for the determination of matrix composition of individual particles to provide input data for developing understanding of the observed physical and radiological characteristics of the particulates analyzed.

## 1.2 THEORY

A major portion of the theories behind the physical and nuclear analytical techniques utilized to obtain the special particulate characteristics is extensively described in the literature. The

procedures for utilization of these techniques for the analyses associated with Project 2.6c. however, were in many instances unique.

We shall thus confine the theoretical discussions within this chapter to a brief review, indicating the points of particular interest to the reader who may be unfamiliar with the analytical methods employed, citing references to more extensive discussions. The significance of these theoretical considerations will be expanded upon in the following chapter, where their relation to the experimental and analytical procedures employed will be emphasized.

1.2.1 Optical Microscopy. Optical microscopy is an effective technique for studying the size, color, and morphology of particles larger than 2 microns. The image of an object formed by spherical lenses is never identical with that object but suffers from the five monochromatic Seidel (third order) aberrations; the two primary chromatic aberrations; the usually ignored fifth and higher order aberrations; and the often ignored tertiary chromatic aberrations. Certain nonlinear effects present are unimportant in the present application.

The most important effect of these aberrations is to reduce the sharpness of the image and to make its true color somewhat difficult to determine. Microscopic equipment is designed with the assumption

of a two-dimensional object and the restriction of a fixed geometrical relationship between light source, condenser, object, objective lens combination, and ocular lens combination, which permits three of the five monochromatic aberrations to be brought to zero at the expense of a highly curved field with some distortion. The curved field is of small importance because of the accommodation of the eye and the focal depth of the camera, and residual distortion is unimportant for small measurements near the center of the field. The most perfect system ordinarily obtainable uses Kohler illumination, an aplanatic-achromatic condenser, apochromatic objectives with correction collars, and compensating oculars.

The procedures employed at Tracerlab, the resolution limits and aberrational considerations associated with these procedures, are described in Chapter 2. Reference 1 contains a comprehensive theoretical dissertation on optical microscopy.

1. 2. 2 Alpha Counting of Unaltered Particles. Sample particles in the micron-size range containing alpha-emitting plutonium can be directly counted for alpha emission. This counting is performed in a counter producing an output pulse which is roughly proportional to the residual energy of the alpha particle after leaving the sample particle matrix. The theory of operation of such counters ( $2\pi$  proportional flow counters) is well described in the literature (see Reference 2) and will not be discussed here.

Of prime concern is the effect of loss of alpha-particle energy within the sample particle matrix, or self shielding. The alpha particles from Pu-239 have an energy of 5.15 Mev and a range of 5.6 mg/cm<sup>2</sup>. If the density of the matrix material is  $\rho$  grams/cm<sup>3</sup>, it is easily shown that the alpha particle range in microns, R, is approximately given by:

$$R = \frac{56}{\rho} \text{ microns}$$

For a sample particle of diameter d, and for a homogeneous uniform distribution of plutonium within the matrix, the relation between observed counts per minute in the counter, CPM, and sample diameter d will be:

1. for  $d \ll R$ ,  $CPM \propto d^3$ , since self shielding is negligible
2. for  $d \gg R$ ,  $CPM \propto d^2$ , since the countable sample can be considered to have a surface equal to that of the sample, of thickness infinite in relation to the alpha range, R.

In general, then, for a given matrix material and a given volumetric distribution of plutonium, D,

$$CPM \propto Dd^n \quad (2 \leq n \leq 3)$$

Now the total plutonium content of the particle is given by:

$$[Pu] = \frac{4}{3} \pi \left(\frac{d}{2}\right)^3 D$$

Thus the relation between observed CPM and true Pu content is given by:

$$\frac{\text{CPM}}{[\text{Pu}]} \propto \frac{d^n}{d^3}, \quad 2 \leq n \leq 3$$

1. 2. 3 Precision Alpha Counting. Precision alpha counting is employed to determine the true plutonium content of the sample, without dependence upon matrix composition or self absorption. The technique utilized for precision alpha counting relies on the fact that the alpha particles from radioisotopes are emitted at discrete energies. A detector with sufficient energy resolution is thus capable of differentiating between the alpha radiations from different isotopes.

The preparation of samples for analysis requires chemical separation of the plutonium, with subsequent preparation of the sample for counting. During this process, a portion of the sample may be lost. Since it is required to determine the true total plutonium content of the initial sample, means must be available to account for such losses. This is accomplished by adding a known quantity of a tracer of a plutonium isotope not present in the initial sample, this tracer being equilibrated with the dissolved sample before chemical separation is initiated.

In addition, the detector must be capable of independently measuring the quantity of tracer and sample isotopes in the final sample. This is accomplished through identification of the isotopes by the energy of their emitted alpha particles.

Utilizing this approach, the means are available for precise determination of the total plutonium content of the initial sample.

1. 2. 4 Density of Individual Particles. Information on the density of the fallout particles is of interest for understanding fallout characteristics and to provide input data for interpreting the results of gross alpha counting.

Principle of the Technique Utilized. The density of spherical particles down to 10 microns has been measured with ease and accuracy by the application of Stokes' law for terminal velocities (see Reference 3). The particle is immersed into and allowed to fall slowly (with respect to the speed of sound in the medium) through an incompressible, viscous fluid infinite in extent with relation to the particle size. The particle accelerates until a terminal velocity is approached, at which time the bouyant force is equal to the drag force. For spheres a simple relationship was derived by Stokes in 1847 between the terminal velocity, diameter of the sphere, the densities of sphere and fluid, and the viscosity of the fluid useful for a Reynolds Number up to around 1.2. For irregular particles, the two unknown quantities are the density of

the particle and a geometrical factor. If the terminal velocity is measured independently in two different fluids, both the density and geometrical form factor can be obtained by simultaneous solution of the equations. Given these, the terminal velocity in any medium can be predicted.

Experimental Considerations. The small size of the particulate samples studied required that special techniques be utilized for observing the particle rate of fall. If a collimated beam of light is passed axially through a column of liquid in a darkened room, the only visible light will be the glow from the liquid itself, due to the Tyndall effect. The scattering of light will render any extraneous matter, with a diameter larger than a few microns, visible to the naked eye. The intensity of the scattered light will depend on the strength of the illuminating source and the size and reflectivity of the particle. By means of this principle of light scattering, a 20-micron particle can easily be observed at a distance of one meter, and even a 5-micron particle can be visually followed. This allows replicate measurements of a single particle to be made during its fall and permits the use of a fluid with a comparatively low variation of viscosity with temperature.

A large diameter for the liquid-filled tube compared with that of the particle eliminates the effect of drag exerted by the tube wall on

the falling particle. Faxen (see Reference 3) has shown that the reduction of particle velocity due to interaction with the cylinder wall is less than one percent when the ratio of particle diameter to cylinder diameter is 0.01.

The apparatus used consisted of two highly polished, concentric, 35 cm-long borosilicate glass cylinders with inside diameters of 2.5 cm and 0.5 cm. A calibrated linear scale is etched on the surface of the outer cylinder. Both tubes are filled with trichloroethylene. As this liquid has essentially the same index of refraction as borosilicate glass, reflections from the wall of the inner tube are eliminated; and, in effect, the inner tube is invisible. The liquid in the outer tube also serves to stabilize thermally the fluid in the inner tube.

1.2.5 Fluorometric Uranium Analysis. Quantitative measurement of nanogram quantities of uranium was required to determine uranium content of individual fallout particles.

Melts obtained by fusing uranium salts with sodium fluoride fluoresce a brilliant yellow green when illuminated by long-wave (3650Å) ultraviolet light. The intensity of fluorescence is directly proportional to the total uranium content and is measured with commercially available apparatus. Although the test is specific (niobium causes weak fluorescence but at shorter wavelength) several elements including platinum quench the fluorescence if present in sufficient concentration; other elements may enhance the fluorescence or shift its

wavelength. In the analysis of submicrogram particles, these effects can be ignored. The fluorescence of the melt is dependent on its thermal history, so one must be careful to prepare all samples in the same manner. The molten NaF (with 5% LiF to lower melting point and adhesion to the crucible) is extremely corrosive and will attack the platinum dish if heating is prolonged. No chemical pretreatment of the particle is required (see Reference 4).

1. 2. 6 Electron Microscopy. Interest in studying particle-size distributions below the limits of optical microscopy (~2 microns) prompted consideration of electron microscopy.

Electron microscopy is quite analogous to optical microscopy except that the wavelength associated with a 100-Kev electron is so small that the resolution and ultimate magnification is limited only by the perfection of the magnetic lenses, stability of currents and voltages, and the thinness of specimens. This resolution ranges from 3 millimicrons in simple instruments used for training and preliminary inspection to 0.2 millimicron in the finest research instruments. The principal limitations on electron microscopy are that the specimen or mounting film must be not more than 20 millimicrons thick and capable of withstanding several amps/cm<sup>2</sup> of 100-Kev electrons in a vacuum below 10<sup>-5</sup> Torr. In thicker films (or lesser vacua) the fraction of electrons in the beam undergoing scattering becomes sufficient to impair resolution and reduce contrast.

The contrast between small, low-density particles and most substrates tends to be poor but can be improved by heavy element shadowing if the particles lie on the supporting film. If the particles are inside the film, shadowing is impossible.

1.2.7 Electron Diffraction. The Roller Coaster particles were expected to consist of a fairly pure, if complex, oxide of uranium, plutonium, and silicon. It was thus anticipated that identification of submicron-fallout particles by their diffraction pattern would be possible.

The wavelength of 50-Kev electrons is the order of the distance between atoms in a crystal, so the Bragg condition can be satisfied and diffraction patterns form. e.g., Laue spots for single crystals or Debye rings for strongly polycrystalline materials, and even Kikuchi patterns for unusually perfect crystals. The diffraction pattern is determined by the crystalline structure of the substance and usually identifies it uniquely; extensive tabulations of patterns are available.

The low penetrating power of electrons limits this technique to clean particles with thin edges. The electron diffraction pattern is formed in the electron microscope by bringing the magnification to zero.

1.2.8 Electron Microprobe. The matrix composition of the individual fallout particles is of interest for correlation with other physical and radiological characteristics observed.

The electron microprobe represents a development of the science of X-ray fluorescence spectroscopy in which the fluorescence of the specimen is excited directly by an electron beam rather than by an X-ray source. The electron beam can be focussed to a micron diameter spot or less, but due to scattering in the specimen, the effective spot size is not less than 2 microns. Thus a very small region of the specimen may be selected for analysis, or the specimen may be scanned to produce an analysis as a function of location. The energy of the beam is under control and one may select to some extent which lines will be excited and to what degree. The fluorescence is analyzed by a standard X-ray spectrometer, and by monitoring the intensity of a particular line as a function of beam position, a map or line profile can be built up showing the distribution of a given element in the specimen.

CHAPTER 2  
EXPERIMENTAL AND ANALYTICAL PROCEDURES,  
DATA RELIABILITY AND ERRORS

The material presented in this chapter is an outline of techniques utilized for sample analysis, treatment of data, and estimate of errors. The customary section on operations is omitted because no on-site participation by Project 2. 6c was required.

Particulate samples consisting of five-stage Anderson impactors, four-stage Casella impactors, total air samplers, and sticky cylinders were available. The samples to be analyzed were selected by the Scientific Director's staff, which also specified the samples upon which composition analyses were to be performed. Before leaving the experimental site, the samples were processed by Project 5. 1a. sent first to the Naval Ammunition Depot, Concord, California, and then dispatched for particulate studies.

The first two stages of the impactors and the total air samples were analyzed only for particles larger than two microns; the latter stages of the impactors were analyzed for submicron particles. The first two stages were combined in a single sample and the latter three (Anderson) or two (Casella) stages were combined in a second sample as specified by the scientific director. The exit filters were considered a part of the second sample but were not

combined with it because of the different handling procedure required.  
No sticky cylinders were analyzed by Project 2.6c.

All chemicals are of reagent grade; acids and bases are concentrated but not fuming, unless otherwise noted.

## 2.1 OPTICAL MICROSCOPY

### 2.1.1 Procedures, Experimental

#### Sample Preparation:

##### Impactor Slides, Stages 1 and 2:

1. Remove the samples from their containers in a clean glove box lined with absorbent paper with clean gloves and clean glassware, etc.
2. Wash the sticky surface off into an evaporating dish, using a minimum quantity of amyl acetate. Use a rubber policeman to make sure all material is removed.
3. Add a small amount of collodion flexible to make about a 10% mixture.
4. Pour carefully onto microscope slides and set aside to dry.
5. Remove from glove box and label.

##### Impactor Slides, Latter Stages:

1. Proceed as in Steps 1 and 2, above.
2. Pour into a small bottle.

3. Extreme care must be exercised to insure cleanness, since this solution will be used to make electron microscope grids.

Total Air Samplers:

1. Under the Safelight in the darkroom, place a sheet of Kodak No-Screen X-ray film in an exposure folder and cover with a very thin sheet of polyethylene, mylar, or something similar.

2. Place the filters on the sheet and puncture each sheet and the film in two places for orientation.

3. Carefully close the folder and expose for 24 hours. If over or underexposure results, vary the time.

4. Develop as in Radioautography Procedure for Individual Slides (see next section).

5. Match the filter to the film and punch out the radioactive sites.

6. Place the punched out filter paper on a slide and tease apart in a few drops of amyl acetate.

7. Add a drop of collodion flexible and spread over the slide.

8. Autoradiograph the slide as in Radioautography Procedure for Individual Slides and examine microscopically for the particle. If necessary, tease the paper further and re-autoradiograph.

9. Repeat until the particle can be isolated.

Radioautography Procedure for Individual Slides:

1. Under the Series 1 Safelight in the darkroom, cut 8- by 10-inch sheets of Kodak No-Screen X-ray Film into one-inch strips.
2. Fit the film to the microscope slides carrying the particles and cut the film to the appropriate length.
3. Fix the film to the slide at the end with a hinge of masking tape. This will register the particle.
4. Lay the slide in an X-ray Exposure Folder.
5. Repeat Steps 2 to 4 for the remaining slides.
6. Close the exposure folder and allow the exposure to continue for 24 hours. (If the first slides developed are either underexposed or overexposed, vary the exposure time for the best radioautography.)
7. Open the folder under the Safelight, bend the film back from the slide at the tape and place the film in the developer (Eastman Kodak X-ray Developer) for one minute (being careful not to wet the slide) by draping the slide over the edge of the tank.
8. Dip the film in the wash water for around 10 seconds, remove, and place the film in the fixer (Eastman Kodak X-ray Fixer) for five minutes.
9. Remove and place the film in the wash water for 30 minutes.
10. Place the film on the drying rack and leave until dry. Care must be taken in each step to avoid wetting the slide.

#### Particle Separation Procedure:

1. Take the radioautographed slide and make a small hole through each black spot where a particle is to be separated.
2. Bend the film back down to the slide and place it under the microscope.
3. Locate a punched hole under the microscope. Look through the hole to locate the particle under it.
4. Bend the film away from the slide and relocate the particle.
5. With a steel rod sharpened to a 20-micron radius, cut the collodion around the particle in the shape of an eye with two cuts.
6. Pick up the cut-out with the steel rod and place it on a microscope coverslide.
7. Fix the particle to the coverslide with a drop of 1-percent collodion solution.
8. Write the particle identification on an identification tag and fix the tag to the coverslide.
9. Place the coverslide in a sample can.

#### Particle Size Measurement Procedure:

1. Tape the coverslide containing the (single) particle to be measured under the optical microscope (Type A066), using lowest illumination and blue filter.

2. Locate the particle under 100X magnification. Close field diaphragm and focus condenser. If necessary, make adjustment of alignment.

3. Position the appropriate objective (10X for particles >100 microns; 43X for particles >30 microns; and 97X for particles <30 microns).

4. Focus the microscope with the fine focus adjustment. Check for proper numerical aperture on condenser.

5. Set the filar micrometer eyepiece on one edge of the particle and read the micrometer. Always approach the particle from the same side.

6. Carefully screw the filar across the particle to the other edge. Read the micrometer and subtract the previous reading. Write the result in the notebook.

7. Rotate the micrometer eyepiece  $60^{\circ}$  and repeat Steps 5 and 6. Then rotate it another  $60^{\circ}$  and again repeat Steps 5 and 6. (Note: With irregular particles measure the maximum dimension, the minimum dimension, and the best visual average dimension.

8. If the particle is transparent, record its color, using the filterless position. If the particle is opaque, transfer to the microscope with the vertical illuminator.

9. Calculate the particle volume. The true particle diameter is the apparent diameter less the resolving power of the microscope.

#### Microphotography Procedure:

1. Place the camera and microscope attachment on a microscope with an Ortho Illuminator.
2. Check that the microscope and illuminator have been properly adjusted. If not, adjust them according to the Procedure for Initial Photomicrographic Adjustment.
3. Place the particle to be photographed under the microscope and locate it with the objective to be used.
4. Set the color filter to green for a black and white exposure and to daylight for a color exposure.
5. Focus the particle through the ocular of the microscope attachment.
6. Set the light intensity at medium or high for the 10X objective, depending on the darkness of the subject; set it at high or ultra high for 43X; and set it at ultra high for 97X.
7. Set the exposure at 1/10 second.
8. Load the Polaroid camera carefully with Polaroid P/N film.
9. Take the picture.
10. Remove the particle from the microscope.

#### Carbon Film Coating:

1. Place the coverslide on a wire screen support directly under the electrodes.

2. Evacuate to at least  $10^{-5}$  mm.
3. Strike an arc and hold for five seconds.
4. Examine coverslide with a flashlight through the porthole. If a just-visible coat of carbon has not formed, repeat Step 3.

#### 2.1.2 Analytical Procedures and Data Reliability

Particle Diameter and Volume. Table 2.1 presents information on field depth and resolution for the various combinations of objective and ocular utilized for these analyses. Size measurements were with an achromatic objective using a positive Ramsden ocular with a movable hairline to scan the image. Microphotographs were with achromatic objectives and negative Huygenian oculars except at the highest magnification where an apochromatic objective with compensating ocular was employed. The high-power objectives were immersed in cedarwood oil, and the condenser was also oiled in this case.

The resolution limits reported in the table indicate the minimum possible error in particle diameter determination. The optical system employed depended upon the particle size being measured, as indicated in Table 2.2.

For spherical particles, the error in diameter can be taken as the resolution. It should be noted that the fractional error in the reported volume is three times that of the reported particle diameter.

For non-spherical irregular particles, a mean diameter is determined as described in the procedure. The reported volume is computed utilizing this mean diameter.

The error in such a determination is, in general, difficult to establish. It is reasonable to assume, however, that the number of particles whose volume is overestimated will be comparable to the number underestimated, given a random variation in shape and orientation on the microscope slide.

The accumulation of data on a large number of particles should then result in a measured mean size (volume) distribution representative of the true one, although the dispersion may be anomalous. It should be noted that specific activity distributions, which are also related to particle volume, are subject to the same argument.

Since the errors associated with irregular particles are related to geometrical considerations, no bias with particle size is to be anticipated.

As an indication of the validity of this hypothesis, studies of specific activity distributions for the irregular particles and the spherical particles for a given sample were performed. This material is discussed in Chapter 3, Section 3.2, where it is shown that the distributions observed with irregular particles are indistinguishable from those based upon spherical particles, since the observed activity dispersion in the spherical particles was exceedingly large.

## 2.2 ALPHA COUNTING OF UNALTERED PARTICLES

### 2.2.1 Experimental Procedure for Using 2 $\pi$ Flow Counter

1. Place the planchet containing the particle on a cover-slide and carbon coated to be counted in the ready chamber of the 2 $\pi$  flow counter.
2. Secure the chamber cover and rotate the sample wheel to position the particle in the counting chamber.
3. Flush the counting chamber with gas for one minute and return the gas flow switch to "Operate."
4. Start the counter and count for 1,000 counts or 100 minutes, whichever will occur first.
5. Stop the count and rotate the sample so as to position the particle in the ready chamber once again. Open the chamber and remove the planchet.

Note: Any particle having less than 100 counts in 100 minutes should be returned to be counted by radioautography methods.

### 2.2.2 Analytical Procedures and Data Reliability

Geometrical Considerations. As discussed in Section 1.2.2, the measurements performed on gross alpha activity of unaltered particles are influenced by absorption of alpha particle energy within the particle matrix.

The counters employed are individually calibrated with an infinitely thin (no self absorption) standard alpha source, resulting

in a standard factor which relates observed counting rate for such a source to true DPM. Because of the  $2\pi$  geometry, the efficiency of the counter is slightly under 50%, and the standard factors for the counters utilized vary between 1.940 and 1.950 .

The sensitivity of these counters is such that the dissipation of greater than 0.5-Mev energy within the counting chamber results in a pulse of sufficient magnitude to be recorded. Since the energy of  $\text{Pu}^{239}$  alpha particles is 5.15 Mev, an alpha particle can lose up to 90% of its initial energy within the sample and still be recorded.

For sample particles of diameter  $d$  microns satisfying the condition:

$$d \ll \frac{56}{\rho} \quad (\text{see Section 1.2.2}) \quad (2.1)$$

where  $\rho$  is the density of the sample matrix, the standard factor defined above can be directly applied to obtain true DPM within the sample. Allowing for the energy discrimination (0.5 Mev) cited above, this condition will actually hold provided:

$$d \leq (0.9) \frac{56}{\rho} \quad (2.2)$$

$$\geq \frac{50}{\rho}$$

Thus we see that the low discrimination level of the counters reduces the stringency of Equation 2.1 to that of Equation 2.2, the application of the standard factor now being appropriate for particles satisfying Equation 2.2.

For sample particles violating Equation 2.2, the correlation between DPM and observed CPM is altered by two effects: (1) self absorption within the particle matrix becomes significant, and (2) the standard factor for the detector (which is fundamentally a geometrical parameter) becomes inapplicable.

The latter effect is more readily understood by reference to Figure 2.1. In Region I, the original standard factor applies, whereas for Region II a significantly larger standard factor would be applicable. Thus for larger particles, the relation

$$\text{CPM} \propto d^n \quad (2 \leq n \leq 3)$$

discussed in Section 1.2.2 becomes questionable and places further emphasis upon the desirability of obtaining a calibration curve which relates true DPM to observed CPM for larger particles, which is only possible through the technique of precision counting described elsewhere.

Statistical Considerations. The precision of the observed CPM values can be considered independently of the question of accuracy of conversion of CPM to DPM of the sample. The statistical error in the CPM measurement is determined as follows:

Let  $S$  = total sample counts accumulated

$B$  = total background counts accumulated

$t$  = accumulation time in minutes

$N$  = total counts accumulated

then  $N = (S + B) \pm \sqrt{N}$  counts

and  $\frac{N}{t} = \frac{(S + B)}{t} \pm \sqrt{\frac{N}{t}}$  counts/minute

Let  $B_t$  = background counting rate of the counter

$\Delta B_t$  = error in the background counting rate of the counter

$$\text{then: } \frac{S}{t} = \left( \frac{N}{t} - B_t \right) \pm \sqrt{\left( \sqrt{\frac{N}{t}} \right)^2 + (\Delta B_t)^2} \quad \text{CPM} \quad (2.3)$$

For all counters utilized, the maximum value of  $\Delta B_t$  was  $\pm 0.02$  CPM, as determined by 800-minute background measurements. The counting criteria cited in Section 2.2.1, however, indicate a maximum value of  $t$  of 100 minutes, and a minimum value of  $N$  of 100 counts.

Thus:

$$\left( \frac{\sqrt{N}}{t} \right)_{\text{min.}} = \frac{10}{100} = 0.1 \quad \text{CPM}$$

while  $(\Delta B_t)_{\text{max.}} = 0.02 \quad \text{CPM}$

Referring to Equation 2.3, we see, then, that the statistical error in determination of the sample CPM is thus always predominantly determined by the error in the sample measurement, and the error in the background of the counter contributes insignificantly.

For the lowest activity sample reported, then, the statistical uncertainties will be  $\pm 0.1$  CPM, for a sample counting 1 CPM.

For samples measuring  $R$  CPM ( $R > 1$ ) the counting error will be:

$$E \leq (\sqrt{R}) (0.1) \text{ CPM} \quad (2.4)$$

(Note: For high activity samples 100-minute counting time was not required, hence the  $\leq$ )

For all samples measuring in excess of 1 CPM, the statistical error is thus always less than 10%; the actual error can be determined from Equation 2.4.

For those isolated instances where ( $R$ )  $< 1$  CPM, a lower limit for error will be  $\pm 0.02$  CPM, that of the counter.

## 2.3 PRECISION ALPHA COUNTING

### 2.3.1 Experimental Procedure

#### Particle Dissolution:

1. Place coverglass containing particle mounted in collodion (or the fluorometry bead) in a glass beaker.

2. Add a quantity of  $\text{Pu}^{236}$  tracer equal to the disintegration rate of the particle determined by gross counting.

3. Add concentrated  $\text{HNO}_3$ , a small amount of perchloric acid, and a few drops of  $\text{H}_2\text{SO}_4$ .

4. Evaporate to perchloric acid fumes.

5. Transfer to a teflon beaker.

6. Add concentrated HF.

7. Evaporate to perchloric acid fumes.
8. Repeat Steps 6 and 7.
9. Proceed to decontamination.

Plutonium Electroplating Procedure:

1. Evaporate the solution containing the heavy element tracer and activity to approximately 1 ml. Add 1 ml  $\text{HNO}_3$  and 1 ml  $\text{HCl}$ . Evaporate to wet dryness. Repeat the  $\text{HNO}_3$ - $\text{HCl}$  treatment twice.

2. Pick up in 1 ml  $\text{HCl}$  and take to dryness. Do not bake. Rotate the beaker to insure complete dryness. Add 2 ml  $\text{HCl}$ , boil to 1 ml and transfer to a prepared electroplating cell. Rinse the beaker with two 1/2-ml  $\text{HCl}$  washes and one 1/2-ml water wash. Transfer each wash to the plating cell. (Use a fresh platinum disc free from dents or scratches.)

The platinum disc and anode must be freed of any grease film by rinsing several times with acetone and alcohol. Write the sample identification on the back of the disc. Ignite to red heat in a Fisher burner flame. The electroplating cell must be clean and free of any foreign material. Check for leakage before use.

Keep the plating solution at minimum volume during this transfer and also during the titration.

3. Add 1 drop methyl red indicator. Add  $\text{NH}_4\text{OH}$  dropwise until the indicator shows the solution to be basic (yellow). Add  $2\text{N}$   $\text{HCl}$  dropwise until solution is just acid. Add 1 drop in excess.

4. Place the sample on the Sargent-Sloman electroplater. Adjust the anode to approximately 1/4-inch above the platinum disc. Plate for 10 minutes at a starting current of 2.5 amps and about 5 volts. The current may fluctuate during the plating period. Check occasionally and adjust the current to maintain 2.6 amps throughout the plating period.

5. At the end of the electroplating period, add 1 ml  $\text{NH}_4\text{OH}$ . Stir for 15 seconds. Turn off the current and stirrer. Remove the anode from plating solution.

6. Immediately transfer the plating solution into the beaker used for evaporation. Rinse the inside of the plating cell 3 times with water washes. Combine the washes with the plating solution in the beaker.

7. Dismantle the plating cell and remove the platinum disc. Rinse with alcohol and ignite the disc to red heat; cool. Check yield on laboratory alpha counter before submitting sample to the counting room.

8. Place sample in a lined and labeled tin box and submit for counting analysis.

2.3.2 Analytical Procedures and Data Reliability. The plutonium samples were analyzed in Tracerlab Frisch Grid Chambers, a detector which produces an output pulse of magnitude directly related to the energy of the alpha particle detected (most meaningful if source is infinitely thin to eliminate self absorption effects). A tracer ( $\text{Pu}^{236}$ ) was added to each sample to allow correction for yield in the radiochemical separation and electroplating procedures.

The detector completely resolves the alpha rays from  $\text{Pu}^{236}$  and  $\text{Pu}^{239}$ , as shown in Figure 2.2, which is a recorded spectrum for an electroplated standard sample. The total quantity of  $\text{Pu}^{239}$  in the initial particle sample is determined as follows:

1. A short run of a calibrated plutonium standard source is made both before and after the analysis of an unknown plutonium sample. This procedure gives an evaluation of the counting geometry and resolution of the instrument in this interval of time.

After counting a sample, a Pulse Height Graph sheet is used to make a graphical plot of the data. Channel counts on the ordinate are plotted versus channel number and/or energy on the abscissa. From this graph, together with the data tape, an analysis of the isotope peaks is carried out utilizing a Calculation Sheet.

In selecting the group of channels representing each isotope peak, the following points are considered:

Width of Isotope Peak Base. Since each isotope peak which represents a single alpha particle energy is theoretically of the same contour, its base will cover the same number of channels with only the height of the peak differing in each case. The peak contour may be represented approximately by a Gaussian distribution curve.

Low Energy Tail. The low energy tail of each isotope peak will continue down to zero energy. However, no counts less than 1% of the peak height are added to the totalized peak count. The totalized count of the calibrated plutonium standard source is evaluated in the same manner.

Background. On low counting samples, it is necessary to correct for background. This correction is compiled from a statistical summation of consecutive background determinations. It may be applied if it does not distort the peak contour. Background may also be subtracted empirically, from a knowledge of the isotopes present, and of their peak contour.

Peak Resolution. The resolution is determined by the width of the peak contour and will determine the possibility of detecting isotope peaks in close proximity. Resolution may be mathematically denoted as the peak width at its mid-height divided by the peak energy, each value expressed in the same energy units. The resolutions for

each analysis are calculated in order to determine the amount of instrument drift. A value of 1.5% is considered as an optimum resolution.

2. Determination of Geometry. A geometry factor is used to convert the observed counting rate of the unknown sample to absolute disintegrations per minute (DPM).

The geometry factor is defined as the observed corrected counting rate divided by the absolute disintegration rate of the calibrated plutonium standard source.

The observed counting rate of the sample always contains the following inherent losses.

2 $\pi$  Geometry. The geometry is restricted to 2 $\pi$  steradians by virtue of a flat disk mounting.

Collimation Loss. A collimating ring is used with the sample disk to obtain an ideal peak contour by decreasing the relative amount of degraded alpha particles and thereby further reducing the counting rate.

### 3. Computation of Pu<sup>239</sup> in Sample:

Tracer Yield. Pu-236 is used as a tracer to establish the procedure yield. The corrected DPM of this isotope is divided by the amount of tracer originally introduced.

$$\text{Tracer Yield} = \frac{\text{DPM of recovered 236}}{(\text{DPM of added 236}) (\text{Decay factor from standardization})}$$

Total Sample DPM. A summation is made of counts under all isotope peaks present. These counts are corrected for low energy tail, background, peak resolution, and Section 3 as follows:

This corrected count is divided by the counting time, the geometry factor and the tracer yield.

$$\text{Total DPM} = \frac{\text{Total corrected counts}}{\text{Total counting time} \times \text{geometry factor} \times \text{tracer yield}}$$

4. Errors. The errors in the Pu<sup>239</sup>-Pu<sup>240</sup> analyses arise fundamentally from the statistics associated with the sample counts accumulated. The background of the detectors is less than 0.01 counts/min under the Pu<sup>236</sup> and the Pu<sup>239-240</sup> peaks and is therefore negligible.

The reported errors represent the statistical sum of the fractional error in the tracer yield (or equivalently the Pu<sup>236</sup> DPM) and the Pu<sup>239</sup>-Pu<sup>240</sup> count and are reported as percent errors in the data tables.

## 2.4 DENSITY OF INDIVIDUAL PARTICLES

### 2.4.1 Experimental Procedures for Measuring Spherical Particle Density by Constant Density Column

1. Place the particle to be measured under the microscope (100X) and locate the particle. Turn off the room lights.

2. Place a drop of acetone near the particle but not on the collodion.

3. Cut the particle out with the steel rod as in the particle separation procedure.

4. Place the eye-shaped piece of collodion in the acetone and locate it under the microscope. Slurry the particle in the acetone to remove the collodion.

5. Remove the particle with the steel rod. If any collodion remains, repeat Step 4.

6. Have the Stokes' law density column set up in advance, that is, fill the column with trichloroethylene and allow to settle for several hours. Position the light source 6 inches above the column and shining directly down it. Fix the centimeter scale to the back of the column. Position the electric stopwatch conveniently. Calibrate the liquid by dropping several measured aluminum and steel microspheres through the apparatus individually and measure their terminal velocity. The latter is done by timing their fall through given centimeter lines. Several measurements may be taken during the fall of each particle. Choose only particles in the size range 30 to 100 for calibration.

7. Place the end of the steel rod with the particle attached to it into the trichloroethylene, and the particle will fall free.

8. Time the fall of the particle as it passes the centimeter lines. Measure the particle's fall as many times as possible

during its single fall consistent with maintaining accuracy in judging when the particle passes the centimeter lines.

9. Calculate the density  $\rho$  from Stokes' law:

$\rho = 4.5 \text{ g} \eta / (a^2 v) \rho'$  (Particles down to 10 microns may be readily measured by this technique.)

where  $\rho'$  = density of trichloroethylene = gm/cc

$g$  = acceleration of gravity = 980 cm/sec/sec

$\eta$  = viscosity of trichloroethylene

$a$  = radius of particle

$v$  = terminal velocity

2.4.2 Data Reliability and Errors. A comprehensive analysis of the errors associated with this particular apparatus and technique appears in Reference 4. Based upon the measurement of 23 spherical stainless steel particles, the observed deviation was  $\pm 2.0\%$ , at a mean density of 8.04 grams/cm<sup>3</sup>. For the spherical particles reported here, this error is applied.

For the measurement of irregular particles, the unknown shape factor can be eliminated through measurement with two different fluids of known densities and/or viscosities. (Note: It was not possible to locate a satisfactory second fluid (trichloroethylene being the first) for these measurements. It is thus difficult to objectively assign an error factor to the irregular particles. However, the observed density variation among the spherical particles can be

compared with that of the irregular particles, from which a meaningful error estimate for the latter can be made. This is discussed more extensively in Section 3.4, where the results of the experimental measurements are considered.)

## 2.5 URANIUM FLUOROMETRY

ordinate intercept provides an estimate of the average blank for the calibration samples employed.

The slope of the line,  $\frac{\Delta y}{\Delta x}$ , provides a measurement of the gain of the amplifier system for the day in question. Since the amplifier gain was found to display daily variation, the total uranium content of the samples was determined by reference to the appropriate calibration for the day of the measurement.

Twenty two separate calibrations were taken, each resulting in a measured average blank value by extrapolation as described above. The average value for the blank based upon 22 measurements was  $2.0 \pm 1.8$  nanograms. This value was subtracted from the total uranium measurement of all samples to determine the net uranium content of the particles.

The error in the blank,  $\pm 1.8$  nanograms, greatly exceeded the error in total uranium determination. Thus,  $\pm 1.8$  nanograms is taken to be the uncertainty in uranium content for all samples (or  $\pm 3.6$  nanograms for 95% confidence). In Table 3.5, a dash indicates a total uranium content less than 1.8 nanograms.

## 2.6 ELECTRON MICROSCOPY

2.6.1 Experimental Procedures. The analysis of fallout particles in the submicron range utilizing the electron microscope required the following:

1. Samples must be mounted on the electron microscope grid 3 mm in diameter.
2. Material covering the sample must be minimal in thickness to avoid excessive electron scattering.
3. Means must be available for differentiating between true fallout particles and extraneous material in the sample.

The large amount of background material in the samples, coupled with difficulties in removing the organic substrate, combined to make meaningful collection of electron microscope data impracticable.

A brief review of the techniques investigated is presented below.

Sample Preparation. The first sample was prepared by washing Stages 3 and 4 of Casella impactors and Stages 3, 4, and 6 of Anderson impactors with a small amount of amyl acetate, adding a small amount of collodion, and transferring drops of the mixture to fresh electron microscope grids. After the grids evaporated to dryness they were individually examined in the electron microscope. The exit filter was not processed at this point.

The particles which resembled the larger particles (visible in the optical microscope) in general morphology and showed high opacity to the 100-kilovolt electron beam were tentatively identified as the fallout particles. All such particles, and no others, were found enshrouded by a low density material 790 Ångstrom units

thick (0.079 micron). Particles believed to be radioactive were rarely found singly but usually in clumps of up to one hundred, apparently held together by the same low density material. The fallout was thinly dispersed through large amounts of background material. The size of the aliquot on each grid was increased in an attempt to facilitate the location of fallout particles; the resulting thick films gave poor resolution or contrast.

The low-density shroud was tentatively identified as radiation-polymerized Canadian balsam and an attempt was made to remove it with solvents. Various esters, alcohols, ketones, chain and cyclic hydrocarbons, ethers, and sulfoxides were unsuccessful. Aliquots of samples were then placed on copper electron microscope bar grids with silicon monoxide films and electroashed for a few minutes on each side, at low power to avoid excess recombination heating on the copper.

The low density material was reduced to ash, as were all other organic materials. It also appeared that there had been a thin, uniform film of residual Canadian balsam which had ashed into clumps of fairly high opacity. The quantity of ash in relation to the number of fallout particles was still excessive.

Aliquots of the samples were electroashed on microscope slides, slurried in amyl acetate, and transferred to a centrifuge cone. The cone was taken to dryness and a few milliliters of acetylene bromide (1, 1, 2, 2 tetrabromo-ethane) were added. This liquid has a high

specific gravity (2.96), and it was expected that the ash, sand, and other background material would rise to the surface while the plutonium-bearing particles would settle, due to their high density. This also was unsuccessful, however, in that everything settled.

Most of the ash seemed to be due to organic background, so centrifugation in acetylene bromide prior to mounting and/or ashing was attempted.

Centrifugation after ashing had produced no improvement because the ash of organics was heavier than the fluid; centrifugation before ashing often caused a large amount of olive green or brown material to separate out. The surface film contained no activity and appeared organic. A large amount of background material settled along with the activity so that the ratio of fallout to background remained very low.

Conclusion. The very low amount of fallout available made it necessary to spend excessive time scanning grids to locate a single particle which appeared to be fallout, and when a particle was found it had to be photographed individually because of lack of other such particles in the field. A size standard then had to be photographed for accuracy in measurement. Thus the burden of particles on the grid was so low that it would be necessary to photograph each particle separately rather than simply size a number of particles seen in

one electron micrograph. The cost of so doing appeared prohibitive, and further electron microscope studies were not undertaken.

## 2.7 ELECTRON DIFFRACTION

Electron diffraction measurements were performed on a number of particles thought to be fallout, utilizing specimens prepared as previously described. The results of these measurements are presented in Chapter 3, Section 3.7.

## 2.8 ELECTRON PROBE MICROANALYSIS

### 2.8.1 Sample Preparation

1. Remove the particle from its collodion mount and wash it briefly under the microscope in a drop of amyl acetate.
2. Pick the particle out of the amyl acetate and place it in freshly prepared Quickmount (the closer to the surface, the better).
3. When the Quickmount has hardened, prepare the polishing wheel with No. 400 boron carbide and cut the block down to the particle very carefully. Use an optical microscope to determine progress. Exercising extreme caution, cut the particle approximately in half.
4. Prepare the polishing wheel with 6-micron diamond paste. Remove all large scratches as determined under the 10X objective.

5. Prepare the polishing wheel with 1-micron diamond paste. Remove all scratches as determined under the 43X objective.

6. Prepare the polishing wheel with 1/4-micron diamond paste and polish the particle.

7. Cut the particle out of the block with a particle pick and remove the Quickmount with solvent.

8. Place the particle flat side up on a polished beryllium disk which has been marked with a grid. Note the position of the particle in the grid.

9. Place the beryllium disk in the carbon evaporator when the desired number of particles have been placed on the disk. Evaporate carbon onto the disk until it starts to become opaque. The disk is ready for analysis.

2.8.2 Analytical Procedures and Data Evaluation. The techniques for analysis of electron microprobe data are extensively described elsewhere (see Reference 5) and will not be repeated here. The analysis of a number of 316 stainless steel microspheres was performed\* as an indication for accuracy of the technique. The results for a single particle are presented in Table 2.3. This data provides an indication of the accuracy obtainable from measurement of a single particle. For an unknown particle irregular in shape or non-uniform in composition, the results are considerably more qualitative.

\*Materials Analysis Company

TABLE 2.1 VISUAL DEPTH OF FIELD AND RESOLUTION  
IN GREEN LIGHT (5000Å)

| Ocular Power | Objective Power | Total Magnification | Visual Depth (micron) | Numerical Aperture | Resolution (micron) |
|--------------|-----------------|---------------------|-----------------------|--------------------|---------------------|
| 12.5         | 97              | 1212.5 <sup>a</sup> | 0.2-0.3               | 1.25               | 0.2                 |
| 12.5         | 43              | 537.5 <sup>a</sup>  | 0.9-1.7               | .66                | 0.4                 |
| 12.5         | 10              | 125 <sup>a</sup>    | 0.16-32               | .25                | 1.0                 |
| 15           | 90              | 1350 <sup>b</sup>   | 0.1-0.2               | 1.25               | 0.2                 |

a) Ramsden ocular and achromatic objective.

b) Compensating ocular and apochromatic objective.

TABLE 2.2 OPTICAL RESOLUTION

| Particle Size Range          | Optical Systems Resolution |
|------------------------------|----------------------------|
| d > 100 microns              | 1.0 micron                 |
| 30 microns < d < 100 microns | 0.4 micron                 |
| d < 30 microns               | 0.2 micron                 |

TABLE 2.3 ELECTRON PROBE MICROANALYSIS OF SINGLE  
STAINLESS STEEL MICROSPHERES

| Element | Composition of 316<br>Stainless Steel From<br>Handbook of Chemistry<br>and Physics | Single Particle<br>Analysis |
|---------|--|-----------------------------|
| Fe      | 69.0   | 62.5                        |
| Mn      | 2.00   | 1.69                        |
| Si      | 1.00   | 0.34                        |
| Cr      | 16.00  | 18.64                       |
| Ni      | 10.00  | 14.7                        |
| Mo      | 2.00   | 2.18                        |

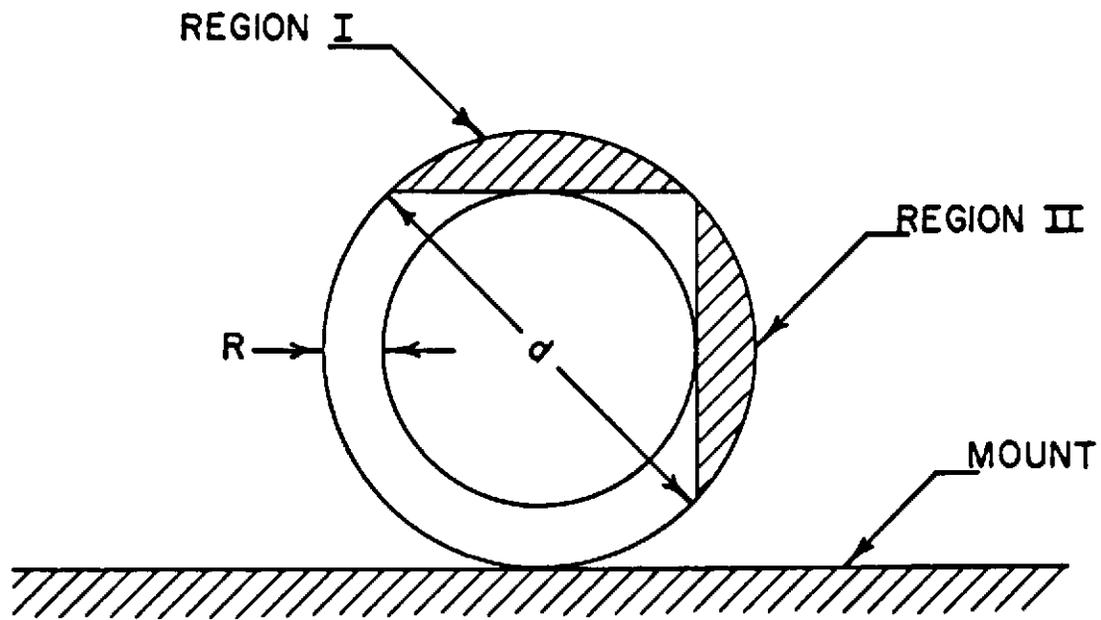


Figure 2.1 Geometrical presentation of  $2\pi$  alpha counter standard factor variation for large particles.

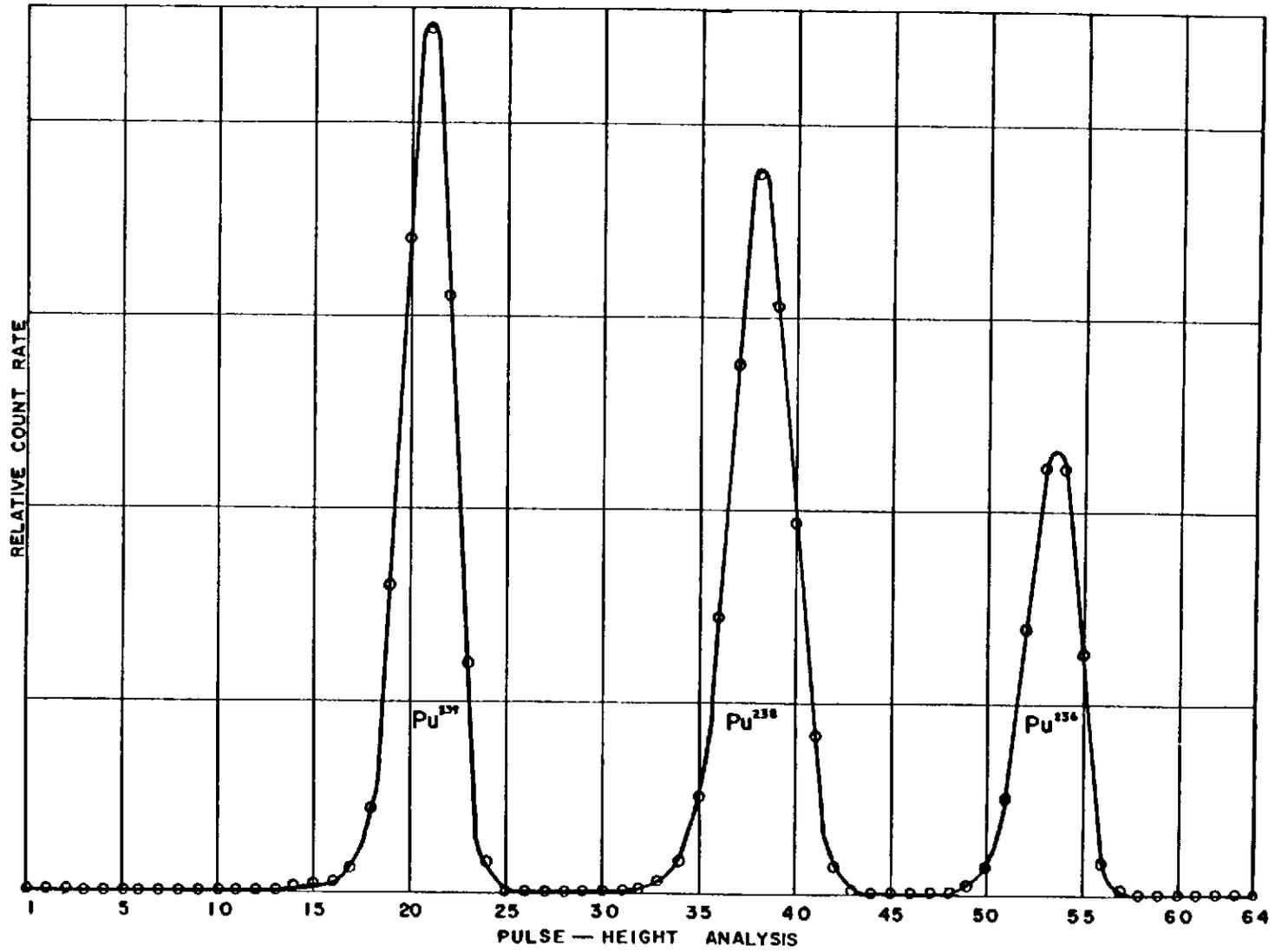


Figure 2.2 Alpha particle spectrum from Tracerlab Frisch Grid chamber.

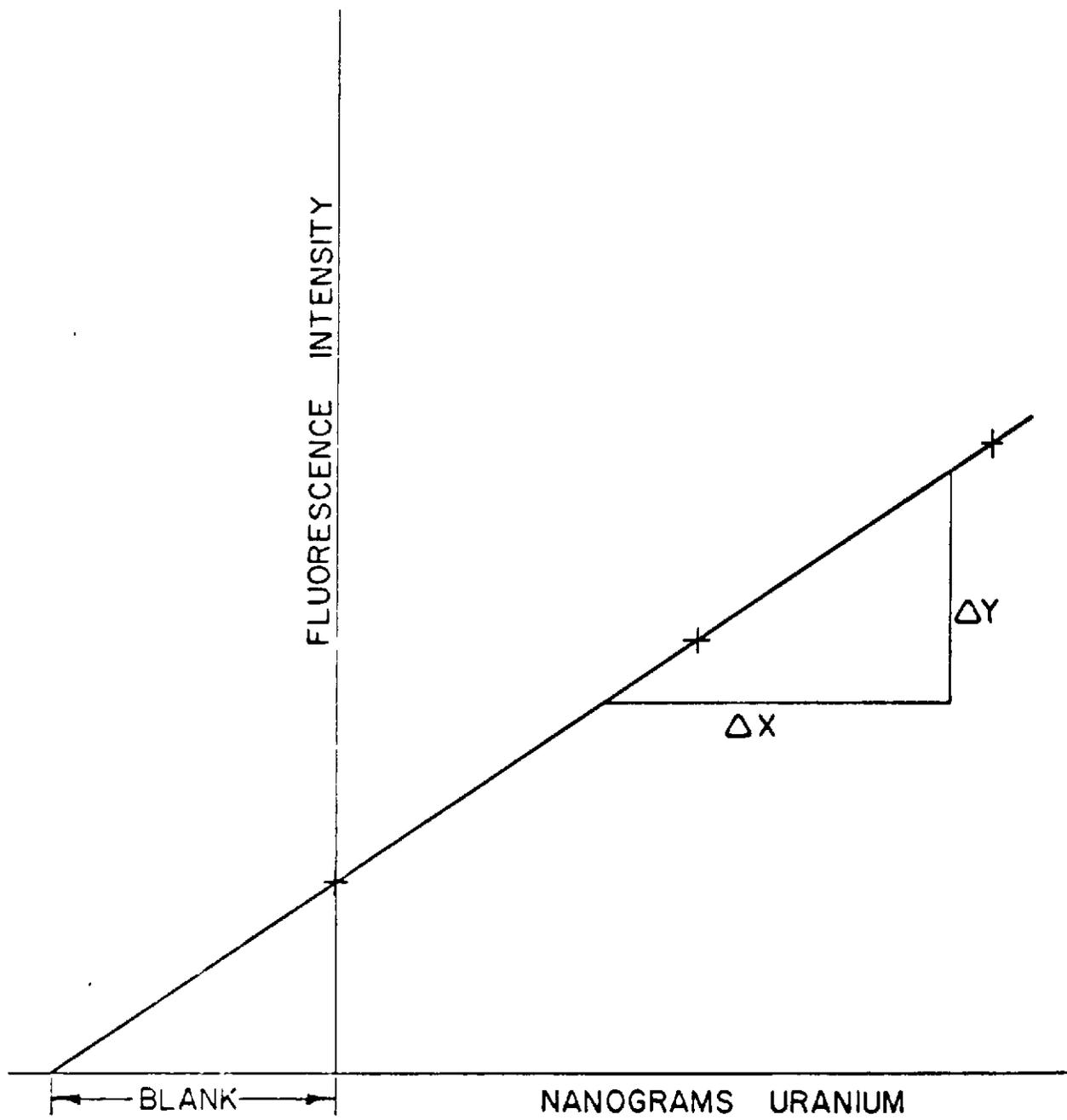


Figure 2.3 Uranium fluorometer calibration curve.

## CHAPTER 3

### PRESENTATION OF RESULTS

A summary of all samples processed by Project 2.6C is presented in Table 3.1. All data appears in the tables following, which are individually discussed.

As will be shown below, the precision and accuracy of the techniques utilized for characterizing the particulate debris are sufficient to allow meaningful interpretation of the resultant data in terms of true particle characteristics. The various modes of analysis lead to self consistent conclusions and provide meaningful information for evaluation.

Interpretation of the accumulated data has been performed only in so far as was required to establish the validity of the experimental measurements, to facilitate proper utilization of the reported data by the evaluation team.

#### 3.1 OPTICAL MICROSCOPY

The following parameters were determined by optical microscopy:

Particle Diameter, hence Volume

Particle Color

Particle Shape

These characteristics are tabulated in Table 3.2, which presents the data on all particles studied.

3.1.1 Accomplishment of Stated Objectives. The objectives of the optical microscopy are re-stated below:

1. To determine size distribution input data for analyzing and predicting atmospheric dispersion, fallout patterns, and hazard arising from inhalation and ingestion of particles.

2. To provide knowledge relative to particle formation mechanisms and the role of background materials (e. g. cover soil) in determining the observed characteristics of the particles.

The size distribution data is of particular interest. We have already shown that for spherical particles the error in diameter is sufficiently small ( $\sim 0.2$  micron) to assure that reported sizes for such particles are precise. However, a large fraction of the collected particles were irregular in shape, and we are interested in the accuracy of the reported size distributions for these particles. Photomicrographs of typical spherical and irregular particles appear in Figures 3.1, 3.2, and 3.3.

It has been postulated (Section 2.1) that the method for determining irregular particle diameters is expected to lead to a true measure of the average size distribution but with a possible anomalous dispersion. This has been examined as follows:

For a given species of particulate material, the total particle activity is a sensitive function of particle volume. Thus, a comparison

of the activity versus size distribution for spherical and irregular particles from a given sample should reveal:

1. Comparison in composition between the two particle classes
2. Bias (if present) in the recording of the diameter for irregular particles.

Figures 3.4, 3.5, 3.6 and 3.7 represent activity versus diameter distributions for four samples ranging from small particles of high Pu content material serially to large particles of lower Pu content material. The irregular particles are distinguished by the symbol (⊠) while the spherical or spheroidal particles by (⊙). Reference to these figures indicates that the spherical and irregular particle activity distributions are indistinguishable.

Thus, it is concluded that the variation in true particle characteristics is such that no detectable bias is introduced by the irregular particle diameter determinations, and that the dispersion in the irregular particle characteristics is no greater than that for spherical particles.

It is also concluded that irregular particles are indistinguishable from spherical particles from a given sample regarding plutonium content.

3.1.2 Conclusions. Size distributions reported are equally valid for spherical and irregular particles.

Plutonium content of irregular particles is indistinguishable from that of spherical particles for a given sample, regardless of the alpha activity content of the particles.

### 3.2 ALPHA COUNTING OF UNALTERED PARTICLES

The alpha count (CPM) of all particles is also presented in Table 3.2. In this instance the standard factors for the alpha counters have been utilized (see Section 2.2). However, since the particles do not simulate an infinitely thin electroplated source, self absorption and geometry effects are present for the larger particles, hence the use of CPM rather than DPM in the tables.

3.2.1 Accomplishment of Stated Objective. The objective of alpha counting of unaltered particles was stated as:

To provide indication of the plutonium content, and thus alpha activity, of the particulate debris.

In Section 2.2 we have discussed the influence of geometry and self-absorption on the count-rate obtained with unaltered particles, and the degree to which such a measurement can be employed to indicate true Pu content.

For particles of dimension  $d \leq \frac{50}{\rho}$  microns (reference Section 2.2) the alpha count is expected to provide a true measure of Pu content. Figure 3.4 shows that the gross alpha count for particles below 6-microns diameter follows a cubic relation with diameter, indicating that: (1) particle composition is uniform, (2) on the average, the particle density falls below 8 grams/cm<sup>3</sup>, and (3) gross alpha count is a true measure of Pu content for particles of this size.

For succeedinglly larger particles, we note from Figures 3.5, 3.6 and 3.7, that the mean count rate qualitatively appears to approach the squared relation with diameter (reference Section 2.2) indicating again that on the average the particles appear homogeneous in composition, and that the gross alpha count rate can be related to true Pu content in a known manner.

However, we note that the larger particles display an extremely wide dispersion in their measured CPM, and we are faced with the question as to whether this dispersion represents true variation in Pu content, or is related to some factor which influences the ability of gross counting techniques to determine Pu content. The possible causes for this wide dispersion are: (1) true variation in total Pu content, (2) density variations between particles, and (3) non-homogeneous Pu distribution within the particles.

Let us initially assume that all particles contain Pu homogeneously distributed throughout their volume. If R is the Pu alpha particle

range in the particle, and  $r$  the particle radius, it is readily shown that the fraction of total plutonium which falls in the outer spherical shell of thickness  $R$  is given by:

$$F = \frac{3R}{r} - 3\left(\frac{R}{r}\right)^2 + \left(\frac{R}{r}\right)^3$$

i. e. the ratio of the volume of the outer shell of thickness  $R$  to the total particle volume.

Since the fraction  $F$  represents that fraction of the particle plutonium which is potentially countable,  $(F^{-1})$  should be related to a correlation factor which corrects observed CPM to true total DPM of the particle.

Figure 3.8 shows the variation in the factor  $(F^{-1})$  which occurs for variation of  $r/R$  over 5:1; and it is noted that even for  $r/R = 5$ , the correction factor is only 2.0.

Thus if  $\frac{r}{R} \leq 5$ , (or since  $R = \frac{50}{P}$ ,  $r \leq 250$ )

for a particle 25 microns in radius or less, density variations between 1 and 10 grams/cm<sup>3</sup> would produce no greater than a factor of 2.0 variation in gross counts.

3.2.2 Conclusion. If the particles are indeed homogeneous, then it would appear that for particles under 50 microns diameter dispersions in gross alpha CPM greater than the order of 100 percent must be attributable to true total plutonium content variation.

Dispersions considerably greater than this were indeed observed (see Figures 3.4, 3.5, 3.6, and 3.7).

### 3.3 PRECISION ALPHA COUNTING

The results of precision alpha counting are presented in Table 3.3, which includes the fractional standard deviation of the measurements. It is seen that the measurement errors are well under the fractional dispersion in gross alpha count indicated in Figures 3.4, 3.5, 3.6 and 3.7, even for the Double Tracks event which displayed the smallest dispersion.

3.3.1 Accomplishment of Stated Objectives. The objectives of precision alpha counting were as follows:

1. To determine the true plutonium content of individual particulates.
2. To seek the relationship between true plutonium content, particle physical characteristics (size, color, morphology), and gross alpha count of individual particles.

It is evident that objective 1 was well satisfied for those particles measured. We shall then direct our attention to objective 2.

The observed correction factor,  $\left(\frac{\text{DPM}}{\text{CPM}}\right)$ , for the particles analyzed is shown plotted in Figure 3.9 as a function of particle

diameter, for particles up to 70 microns diameter. Comparison between Figure 3.8 and Figure 3.9 shows remarkable similarity, and it would appear that for particles in this size range the observed variations in this factor could be attributed to density variations among the particles precision counted which contain Pu homogeneously distributed. Thus, it would appear that deviations in excess of 50% from the mean gross count for a given particle size cannot be attributed to density variations. It should also be noted that the curves correlate quite well when  $(r/R = 1)$  corresponds to a particle diameter of 14 microns, or a radius of 7 microns. Thus for average material,  $R = 7$  microns. Since  $R = \frac{50}{\rho}$  (see Section 2.3) an average particle density of 7 grams/cm<sup>3</sup> is indicated. In Section 3.4 it is shown that a mean particle density of 5.5 grams/cm<sup>3</sup> was measured, based upon measurement of 9 particles. Thus, the manifested correction factors for particles under 70 microns may be somewhat greater than the mean density of 5.5 would predict; a fact which may indicate a slight increase in the required standard factor for the counter as particle size increases.

Attention is now called to particles 2369-24 and 3466-27 in Table 3.3, which displayed anomalously high correction factors. Non-homogeneity in the Pu distribution was evident in these particles from microscopic observation of small inclusions.

Thus, deviations exceeding 50 percent from the mean gross count can in some instances be explained by non-uniformity of plutonium distribution. However, it should be noted that such inhomogeneity can only produce anomalously low gross counts, since from Figure 3.9 we see that correction factors less than 1 are not physically manifested and indeed would be difficult to explain on physical grounds.

Reference to Figures 3.4, 3.5, 3.6, 3.7, however, reveals that anomalous dispersions (i. e. in excess of 50% from the mean line) are in general distributed equally above and below the mean line, leading to the tentative conclusion that the observed dispersion primarily indicates variation in actual plutonium content of the particles, with the exception that a few anomalously low points may be attributable to non-homogeneity in the  $\text{Pu}^{239}$  distribution.

### 3.3.2 Conclusions

1. The gross alpha counting data displays a mean correlation between observed counts and particle size which is compatible with the hypothesis of homogeneity in Pu distribution within the particles.

2. The conversion of mean observed CPM to true Pu DPM within the particles can be accomplished utilizing a calibration curve based upon precision counting, the corrections for which are consistent with the the hypothesis of homogeneous Pu distribution within the particles, self-absorption, and detector standard factor variation with particle size.

3. In a few isolated instances non-homogeneity in plutonium distribution leads to anomalous gross counting results, but these occasions are rare.

4. Large dispersions (>50 percent) observed in gross CPM are attributable to true variations in plutonium content for particles smaller than 70 microns. Density variations can at most produce a factor of 2 uncertainty in this size range. Observed density variations based on 9 particles are discussed in Section 3.4.

3.3.3 Recommendations. It is recommended that size distributions and activity distributions be determined for all samples and correlated with test parameters such as location of sample collection relative to ground zero. Correlation of these results with activity-versus-size distribution on all samples will provide substantiation or rejection of the hypotheses herein presented, which is relevant to appropriate procedures for determining ultimate fate of the weapon plutonium, overall mass balance, and hazard evaluation.

3.3.4 Americium Precision Counting Data. Radiochemical separation and precision counting for americium were determined for a few particles. This data is presented at the end of Table 3.3. The observed DPM of americium are shown plotted against the observed Pu gross alpha count in Figure 3.10, where it is seen that, although based upon a very small sample, correlation between observed

particle content for Pu and Am appears to exist.

### 3.4 DENSITY OF INDIVIDUAL PARTICLES

Table 3.4 presents the results of density determination of 9 individual particles.

3.4.1 Accomplishment of Stated Objectives. The objectives of the density determination were:

1. To provide requisite density data for fallout analysis studies.
2. To provide input data for interpretation of alpha counting data on unaltered particles.

The densities reported for spherical particles can be taken as true density measurements. For irregular particles this is not the case. Within the context of objective 1, however, the rate-of-fall characteristics of irregular particles are determined precisely, which for fallout and dispersion analyses are the requisite information.

Within the limits of the small number of particles analyzed, it appears that the rate of fall characteristics (as indicated by their reported densities) for irregular particles will be indistinguishable from those of spherical particles; i. e. the true variation in spherical particle density produces a variation in rate of fall for a given particle size which compares with the observed dispersion in rate of fall of irregular particles.

For a given spherical particle size, the fall rate in air is linearly related to density ( $\rho_{\text{air}} \ll \rho_{\text{particle}}$ ). In Figure 3.11 relative fall rates for given diameter of spherical and irregular particles are shown. Two spherical particles displayed anomalously high densities. Unfortunately sufficient data is not available to establish whether these particles are unique, or do indeed represent a significant fraction of the particle population.

In relation to objective 2, it has been shown that the effects of density variation on alpha counting results are to introduce dispersions into the data but that the observed dispersions in counting characteristics exceed those anticipated by reasonable density variations and are thus attributed to true Pu content variation. On the other hand, the experimentally determined correction curve for CPM to DPM conversion (Figure 3.9) reflects the average density characteristic of the particles which were precision counted, and thus the possibility of introducing a bias to the data exists if this average density characteristic is significantly different from the average density characteristic of the particular sample in question.

In view of the large density variations observed for particles from a given sample, however, and the fact that the calibration curve is based upon a composite of particles from all events, it is felt that any bias so introduced would not exceed the dispersion in true particle plutonium content already observed.

### 3.4.2 Conclusions

1. For fallout analysis and dispersion studies, the rate-of-fall characteristics for irregular particles appears to compare with that of spherical particles of the same size.

2. Observed density variations in individual particles are not sufficient to explain the wide dispersion observed in gross alpha count of particles.

3.4.3 Recommendations. Analysis of spherical versus irregular particle abundances in varied samples for a given event should serve to confirm or negate the initial conclusion regarding identity of dispersion properties for both particle types for a given particle size. In particular, analysis of samples from locations subject to different wind conditions (e. g. at different altitudes, and upwind and downwind) should reveal the presence of any significant differences in dispersive patterns for a given size range.

## 3.5 URANIUM FLUOROMETRIC ANALYSIS

The results of the uranium fluorometric analyses are presented in Table 3.5. Significant quantities of uranium were found in a number of particles.

3.5.1 Accomplishment of Stated Objective. The stated objective was:

1. To investigate the distribution of uranium and plutonium

within particles for fractionation effects and possible correlation of such observations with other particulate characteristics.

The results obtained in Table 3.5 are plotted in Figure 3.12, which shows uranium nanogram content plotted against Pu DPM. For the Double Tracks particles, no apparent correlation exists. The Clean Slate samples, however, do indicate the presence of correlation between the abundance of both elements. It should be noted that the plutonium CPM dispersion previously observed for a given particle size range will be reflected in the U/Pu correlation; and indeed the dispersion about the mean correlation line is compatible with the Pu variations indicated in Figures 3.5, 3.6, and 3.7 for particles within the same size range.

3.5.2 Conclusions. For the Clean Slate samples analyzed, correlation between U and Pu particle content appears to exist and displays a dispersion comparable with that observed for individual particle plutonium content.

### 3.6 ELECTRON MICROSCOPY

The electron microscope studies failed to yield quantitative results. The basic reasons for this are summarized below:

1. Optical microscopy studies revealed the fact that large quantities of background (non-active) debris were collected with the samples. This required the establishment of means for identifying any submicron particles observed as true fallout rather than inactive debris.

2. The non-crystalline nature of the particles made their identification as fallout by electron diffraction unfeasible.

3. The samples were collected on organic media which could not be adequately separated from the particulates to permit satisfactory electron micrographs to be prepared. This is illustrated in Figures 3.13, 3.14, and 3.15, where typical electron micrographs are presented.

4. The number of fallout particles collected per unit area was extremely low. Thus to obtain reasonably sized samples for meaningful size distribution analysis, concentration of sample collected over relatively large collection area onto a single electron microscope grid (3-mm diameter) was required. The resultant accumulation of organic collection media onto a single electron microscope grid produced prohibitively large quantities of background material for satisfactory electron micrographs to be prepared.

3.6.1 Recommendations. For future programs, where electron microscopic analysis of collected debris is desired, the following procedures are recommended:

1. Satisfactory collection media must be utilized. It is recommended that electron microscope grids be utilized directly for such collections, thereby avoiding the necessity of transference and handling of the sample, with associated accumulation of interfering material.

2. Electron-microscope samples should only be collected at those sites where it is expected that the ratio of active collected material to background debris (e. g. sand) will be high.

### 3.7 ELECTRON DIFFRACTION ANALYSIS

Electron diffraction studies revealed that the fraction of material which produced identifiable patterns, and could therefore be identified as true fallout material, was impractically small. Over 500 possible samples of fallout material were investigated for diffraction, from which 6 positive identifications were made. These results are presented in Table 3.6.

Electron diffraction studies were conducted only on microscope grids which indicated alpha activity, with a lower limit set at 1 CPM. Using highly active particles as a norm (see Figure 3.4), approximately 200 particles of 0.3-micron diameter would produce this activity level. For lower specific activity debris, or a smaller particle size, more fallout particles would be required.

Approximately 25% of the total grid area was scanned per sample. Thus, it is reasonable to assume that a significant fraction of the material analyzed was actual debris. However, since only six particles out of 500 displayed diffraction patterns, it is concluded that the fraction of submicron fallout material which was crystalline was indeed low. Figures 3.13, 3.14, and 3.15

illustrate the nature of the material observed; those objects which displayed identifiable diffraction patterns cannot be physically distinguished from non-diffracting material.

3.7.1 Conclusion. The major portion of the submicron debris was indeed not diffracting and could not be identified.

### 3.8 ELECTRON PROBE MICROANALYSIS

The objective of electron probe microanalysis was to determine the matrix composition of fallout particles.

3.8.1 Analysis of Double Tracks Particle 9698-17. This particle was analyzed first with the ARL microprobe at Sandia - Albuquerque. The particle was mounted unpolished on copper paste. It was found to contain irregular distributions of aluminum, silicon, iron, uranium, and plutonium but no detectable amounts of barium, zirconium, or thorium. An aluminum-rich region appeared to correspond to a black inclusion in the otherwise transparent amber particle. Line profile pictures are on file at Sandia-Albuquerque.

A rough polish was then put on the particle, the black inclusion now becoming exposed, and it was analyzed with the MAC 400 microprobe at Materials Analysis Company, Palo Alto. The details of the analysis are reported in their Analytical Report No. 647B which is hereby incorporated by reference.

In summary it was found that the particle contained detectable quantities of aluminum, silicon, potassium, calcium, titanium, iron, uranium, and plutonium, with calcium predominating. The black inclusion was highly enriched in aluminum. The U/Pu ratio (not absolutely determined) varied by a factor of 6.6 from one place to another. The uranium content was approximately 8 to 9 percent by weight.

3.8.2 Analysis of Clean Slate I Particle 3038-28. This particle was analyzed with the ARL microprobe at Sandia-Albuquerque. The unpolished particle was mounted on copper paste. The analysis showed aluminum, silicon, and uranium but no detectable iron or plutonium. The elements were fairly uniform in distribution. Line profile pictures are on file at Sandia-Albuquerque.

3.8.3 Conclusions. The multiplicity of elements detected in these particles is compatible with the variability in density and plutonium content observed in other large particles.

TABLE 3.1 SAMPLES PROCESSED BY PROJECT 2.6c

| <u>Event &amp; Location</u> | <u>Tracerlab No.</u> | <u>No. of Stages</u> | <u>Sampler Type</u> |
|-----------------------------|----------------------|----------------------|---------------------|
| DOUBLE TRACKS               |                      |                      |                     |
| A-066                       | 2526                 | 5                    | Casella             |
| D-064                       | 2920                 | 6                    | Andersen            |
| D-068                       | 2922                 | 5                    | Casella             |
| E-058                       | 9624                 | 5                    | Casella             |
| E-058                       | 9698                 | 5                    | Casella             |
| E-058                       | 9699                 | 1                    | Tas D               |
| G-058                       | 9660                 | 5                    | Casella             |
| G-058                       | 9661                 | 1                    | TAS D               |
| G-064                       | 9656                 | 5                    | Casella             |
| H-060                       | 2723                 | 5                    | Casella             |
| I-059                       | 9691                 | 1                    | TAS D               |
| I-061                       | 9668                 | 5                    | Casella             |
| I-061                       | 9669                 | 1                    | TAS D               |
| J-058                       | 2812                 | 6                    | Andersen            |
| N-068                       | 2837                 | 5                    | Casella             |
| R-054                       | 2946                 | 5                    | Casella             |
| R-082                       | 2934                 | 6                    | Andersen            |
| B,L5,P17                    | 2907                 | 5                    | Casella             |
| B,L7,P9                     | 2443                 | 1                    | TAS I               |
| B,L8,P21                    | 2151                 | 5                    | Casella             |
| J,L6,P13                    | 2482                 | 5                    | Casella             |
| CLEAN SLATE I               |                      |                      |                     |
| L18,P21                     | 3449                 | 5                    | Casella             |
| L19,P9                      | 3013                 | 1                    | TAS I               |
| L25,P9                      | 3038                 | 1                    | TAS I               |
| L29,P9                      | 3466                 | 5                    | Casella             |
| CLEAN SLATE II              |                      |                      |                     |
| BM-07                       | 4082                 | 1                    | TAS D               |
| TB-P2                       | 2305                 | 5                    | Casella             |

TABLE 3.1 CONTINUED

| <u>Event &amp;<br/>Location</u> | <u>Tracerlab<br/>No.</u> | <u>No. of<br/>Stages</u> | <u>Sampler<br/>Type</u> |
|---------------------------------|--------------------------|--------------------------|-------------------------|
| BB1-01                          | 2366                     | 5                        | Casella                 |
| A-036                           | 4116                     | 1                        | TAS D                   |
| A-054                           | 2286                     | 5                        | Casella                 |
| B-044                           | 2371                     | 5                        | Casella                 |
| B-054                           | 4612                     | 1                        | TAS II                  |
| B-060                           | 2370                     | 5                        | Casella                 |
| B-068                           | 2369                     | 5                        | Casella                 |
| L1,P17                          | 4022                     | 1                        | TAS I                   |
| L3,P9                           | 2312                     | 5                        | Casella                 |
| L4,P21                          | 4024                     | 1                        | TAS I                   |
| L7,P9                           | 4011                     | 1                        | TAS I                   |
| D-030                           | 4163                     | 1                        | TAS II                  |
| D-034                           | 3182                     | 6                        | Andersen                |
| DM-Pos. 12                      | 2272                     | 5                        | Casella                 |
| CLEAN SLATE III                 |                          |                          |                         |
| BM-06                           | 4987                     | 6                        | Andersen                |
| BM-07                           | 5184                     | 1                        | TAS D                   |
| BM-10                           | 4973                     | 5                        | Casella                 |
| A-030                           | 4974                     | 6                        | Andersen                |
| A-102                           | 4964                     | 5                        | Casella                 |
| A-108                           | 5162                     | 1                        | TAS D                   |

TABLE 3.2 PARTICLE SIZE, GROSS ALPHA ACTIVITY, AND MORPHOLOGY  
 Double Tracks Arc A Station 066 Casella

2526

| Particle Number                                     | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color        | Morphology |
|---|----------------------------|------------------|--------------------|--------------|------------|
| 1   | 4.4                        | 18.2             | 45                 | Opaque       | Irregular  |
| 2   | 3.4                        | 7.3              | 21                 | Opaque       | Egg Shaped |
| 3   | 5.1                        | 22.7             | 69                 | Opaque       | Sphere     |
| 4   | 3.3                        | 3.3              | 19                 | Opaque       | Irregular  |
| 5   | 3.4                        | 9.6              | 21                 | Brown        | Spheroid   |
| 6   | 3.7                        | 9.9              | 27                 | Opaque       | Sphere     |
| 7   | 3.0                        | 2.9              | 9.9                | -            | -          |
| 7A  | 2.6                        | -                | 9.2                | Orange Brown | Sphere     |
| 7B  | 1.1                        | -                | 0.7                | Orange Brown | Sphere     |
| 8   | 2.6                        | 3.3              | 9.2                | Opaque       | Spheroid   |
| 9   | 3.6                        | 12.5             | 24                 | Opaque       | Sphere     |
| 10  | 4.0                        | 14.9             | 34                 | Opaque       | Sphere     |
| 11  | 4.6                        | 19.5             | 51                 | Opaque       | Spheroid   |
| 12  | 4.1                        | 22.4             | 36                 | Opaque       | Spheroid   |
| 13  | 3.8                        | 10.7             | 29                 | Opaque       | Sphere     |
| 14  | 3.6                        | 10.5             | 24                 | Opaque       | Sphere     |
| Note: Appears to be attached to piece of collodion. |                            |                  |                    |              |            |
| 15  | 5.4                        | 14.6             | 82                 | Opaque       | Spheroid   |
| 16  | 3.8                        | 13.6             | 29                 | Opaque       | Irregular  |
| 17  | 6.6                        | 47.4             | 151                | Opaque       | Irregular  |
| 18  | 3.6                        | 23.2             | 24                 | Red Orange   | Sphere     |
| 19  | 4.4                        | 18.0             | 45                 | Opaque       | Sphere     |
| 20  | 3.1                        | 7.1              | 16                 | Opaque       | Irregular  |
| 21  | 6.4                        | 16.4             | 137                | Brown Orange | Sphere     |
| 22  | 4.0                        | 12.6             | 34                 | Opaque       | Spheroid   |
| 23  | 2.2                        | 1.9              | 56                 | T. Brown     | Sphere     |
| 24  | 10.5                       | 11.4             | 606                | Yellow Brown | Irregular  |
| 25  | 3.4                        | 6.2              | 11.8               | -            | -          |
| 25A   | 2.6                        | -                | 9.2                | Opaque       | Sphere     |
| 25B   | 1.7                        | -                | 2.6                | Orange       | Hemisphere |
| 26  | 2.9                        | 4.9              | 13                 | Opaque       | Sphere     |
| 27  | 3.0                        | 2.0              |                    | -            | -          |
| 27A   | 2.4                        | -                | 7.2                | Opaque       | Sphere     |
| 27B   | 1.6                        | -                | 2.1                | Opaque       | Irregular  |
| 28  | 2.4                        | 3.4              | 7.2                | Opaque       | Sphere     |

TABLE 3.2 CONTINUED

Double Tracks Arc A Station 066 Casella Continued

2526

| Particle Number   | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                 | Morphology      |
|---|----------------------------|------------------|--------------------|-----------------------|-----------------|
| 29  | 3.4                        | 6.5              | 12                 | -                     | -               |
| 29A   | 2.7                        | -                | 10                 | Opaque                | Sphere          |
| 29B   | 1.6                        | -                | 2.1                | Brown Orange          | Hemisphere      |
| 30  | 3.9                        | 20.6             | 31                 | Opaque                | Sphere          |
| 31  | 3.3                        | 5.0              | 13                 | -                     | -               |
| 31A   | 2.8                        | -                | 11                 | Brown Orange          | Spheroid        |
| 31B   | 1.6                        | -                | 2.1                | Brown Orange          | Sphere          |
| 32  | 2.8                        | 6.7              | 11                 | Opaque                | Sphere          |
| 33  | 3.2                        | 9.8              | 17                 | Opaque                | Sphere          |
| 34  | 5.0                        | 31.4             | 65                 | Opaque                | Sphere          |
| Notes: Combined vertical and substage illumination begins here. |                            |                  |                    |                       |                 |
| 35  | 3.5                        | 2.5              | 15                 | -                     | -               |
| 35A   | 2.5                        | -                | 8.2                | Opaque Brown          | Sphere          |
| 35B   | 2.3                        | -                | 6.4                | Opaque Brown          | Irregular       |
| 36  | 2.4                        | 3.4              | 7.2                | Orange Brown          | Sphere          |
| 37  | 6.7                        | 30.5             | 98                 | -                     | -               |
| 37A   | 5.5                        | -                | 87                 | Opaque Black          | Spheroid        |
| 37B   | 2.8                        | -                | 11                 | Opaque Black          | Spheroid        |
| 38  | 3.5                        | 3.8              | 22                 | Opaque Brown          | Irregular       |
| 39  | 4.6                        | 18.6             | 24                 | -                     | -               |
| 39A   | 3.3                        | -                | 19                 | Opaque Black          | Sphere          |
| 39B   | 2.1                        | -                | 4.8                | Brown                 | Lobe            |
| 39C   | 0.8                        | -                | 0.3                | Opaque Black?         | Sphere          |
| 40  | 8.9                        | 5.2              | 369                | Yellow Brown          | Spheroid        |
| 41  | 3.5                        | 5.8              | 22                 | Opaque Black          | Spheroid        |
| 42  | 2.8                        | 6.8              | 11                 | Opaque Brown          | Serrated Sphere |
| 43  | 5.2                        | 9.1              | 74                 | Yellowish             | Spheroid        |
| 44  | 3.1                        | 6.5              | 16                 | Opaque Black          | Spheroid        |
| 45  | 2.8                        | 4.1              | 6.2                | -                     | -               |
| 45A   | 2.1                        | -                | 4.8                | Orange Brown          | Sphere          |
| 45B   | 1.4                        | -                | 1.4                | Orange Brown          | Sphere          |
| 46  | 3.2                        | 4.3              | 17                 | Opaque Black          | Sphere          |
| 47  | 4.3                        | 1.6              | 42                 | Clear, Orange & Black | Spheroid        |

TABLE 3.2 CONTINUED

Double Tracks Arc A Station 066 Casella Continued

2526

| Particle<br>Number | Average<br>Diameter<br>( $\mu$ ) | Count<br>Rate<br>(cpm) | Volume<br>( $\mu^3$ ) | Color        | Morphology |
|--------------------|----------------------------------|------------------------|-----------------------|--------------|------------|
| 48                 | 2.3                              | 3.7                    | 6.4                   | Opaque Brown | Sphere     |
| 49                 | 2.8                              | 7.7                    | 11                    | Orange Brown | Spheroid   |
| 50                 | 2.3                              | 2.9                    | 6.4                   | Orange Brown | Irregular  |

TABLE 3.2 CONTINUED

Double Tracks Arc B Balloon Line 5 Position 17 Casella

2907

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color           | Morphology       |
|-----------------|----------------------------|------------------|--------------------|-----------------|------------------|
| 1               | 16.6                       | 74.3             | 2,395              | Opaque          | Grainy Irregular |
| 2               | 12.0                       | 56.1             | 905                | Opaque & Clear  | Irregular        |
| 3               | 21.1                       | 277.5            | 4,919              | Opaque          | Grainy Spheroid  |
| 4               | 18.5                       | 10.3             | 3,315              | Opaque          | Irregular        |
| 5               | 13.0                       | 9.0              | 1,150              | Opaque & Clear  | Irregular        |
| 6               | 9.3                        | 19.7             | 421                | Opaque          | Spheroid         |
| 7               | 6.3                        | 8.9              | 131                | Yellow          | Irregular        |
| 8               | 8.6                        | 43.3             | 330                | Opaque          | Spheroid         |
| 9               | 17.5                       | 174.8            | 2,806              | Opaque & Clear  | Spheroid         |
| 10              | 7.4                        | 43.6             | 173                | -               | -                |
| 10A             | 6.9                        | -                | 172                | Opaque          | Grainy Spheroid  |
| 10B             | 1.4                        | -                | 1.4                | Clear           | Sphere           |
| 11              | 21.4                       | 142.0            | 5,131              | Opaque & Clear  | Irregular        |
| 12              | 18.4                       | 113.4            | 3,262              | Opaque & Clear  | Rectangular      |
| 13              | 11.0                       | 80.4             | 8,824              | Opaque          | Rectangular      |
| 14              | 7.7                        | 10.7             | 239                | Clear Yellow    | Spheroid         |
| 15              | 4.3                        | 4.6              | 42                 | Opaque & Clear  | Irregular        |
| 16              | 8.4                        | 114.5            | 310                | Opaque          | Sphere           |
| 17              | 10.9                       | 38.6             | 678                | Opaque & Clear  | Irregular        |
| 18              | 12.8                       | 59.9             | 735                | -               | -                |
| 18A             | 10.1                       | -                | 540                | Dark Amber      | Spheroid         |
| 18B             | 7.2                        | -                | 195                | Dark Amber      | Spheroid         |
| 19              | 24.6                       | 302.9            | 7,794              | Opaque          | Irregular        |
| 20              | 8.1                        | 65.2             | 278                | Opaque          | Sphere           |
| 21              | 27.2                       | 364.8            | 10,540             | Opaque & Clear  | Irregular        |
| 22              | 5.2                        | 6.5              | 74                 | Part Opaque     | Irregular        |
| 23              | 5.2                        | 4.2              | 74                 | Mostly Opaque   | Irregular        |
| 24              | 4.7                        | 5.2              | 54                 | Opaque & Clear  | Irregular        |
| 25              | 7.7                        | 22.5             | 239                | Opaque          | Irregular        |
| 26              | 10.0                       | 15.7             | 524                | Opaque & Yellow | Irregular        |

TABLE 3.2 CONTINUED

Double Tracks Arc B Balloon Line 5 Position 17 Casella

2907

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color               | Morphology      |
|-----------------|----------------------------|------------------|--------------------|---------------------|-----------------|
| 27              | 6.0                        | 9.9              | 113                | Opaque & Clear      | Irregular       |
| 28              | 10.7                       | 32.4             | 641                | Opaque & Clear      | Irregular       |
| 29              | 2.7                        | 4.9              | 10                 | Opaque              | Sphere          |
| 30              | 14.3                       | 109.7            | 1,531              | Opaque & Clear      | Irregular       |
| 31              | 5.7                        | 5.9              | 97                 | Opaque & Clear      | Triangular      |
| 32              | 17.5                       | 84.4             | 2,806              | Opaque              | Spheroid        |
| 33              | 6.9                        | 5.6              | 172                | Opaque              | Irregular       |
| 34              | 18.9                       | 569.8            | 3,535              | Opaque & Brown      | Spheroid        |
| 35              | 7.9                        | 12.9             | 258                | Opaque & Yellow     | Spheroid        |
| 36              | 9.5                        | 93.2             | 216                | -                   | -               |
| 36A             | 6.1                        | -                | 119                | Opaque              | Spheroid        |
| 36B             | 5.7                        | -                | 97                 | Opaque              | Spheroid        |
| 37              | 22.4                       | 5.8              | 5,884              | Opaque              | Star Polyhedron |
| 38              | 15.0                       | 2.6              | 1,767              | Opaque              | Irregular       |
| 39              | 6.3                        | 5.4              | 131                | Yellow & Red        | Irregular       |
| 40              | 12.2                       | 49.7             | 951                | Yellow              | Irregular       |
| 41              | 12.4                       | 99.7             | 9,980              | Opaque              | Spheroid        |
| 42              | 6.2                        | 7.1              | 125                | Opaque & Yellow     | Irregular       |
| 43              | 9.9                        | 113.4            | 508                | Opaque              | Spheroid        |
| 44              | 3.1                        | 12.0             | 16                 | Opaque              | Spheroid        |
| 45              | 8.5                        | 7.2              | 322                | Clear & Opaque      | Irregular       |
| 46              | 10.4                       | 120.1            | 589                | Opaque              | Sphere          |
| 47              | 2.5                        | 1.9              | 8.2                | Opaque              | Sphere          |
| 48              | 10.6                       | 1.6              | 624                | Dark Green & Violet | Irregular       |
| 49              | 7.1                        | 11.2             | 187                | Opaque & Clear      | Irregular       |
| 50              | 9.6                        | 124.6            | 463                | Opaque              | Sphere          |

Double Tracks Arc B Balloon Line 7 Position 9 TAS I

2443

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color | Morphology |
|-----------------|----------------------------|------------------|--------------------|-------|------------|
| 1               | 1.9                        | 2.0              | 3.6                | Brown | Sphere     |

TABLE 3.2 CONTINUED

Double Tracks Arc B Balbon Line 8 Position 21 Casella

2151

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                 | Morphology |
|-----------------|----------------------------|------------------|--------------------|-----------------------|------------|
| 1               | 12.8                       | 5.8              | 1,098              | Opaque & Purple       | Hexagonal  |
| 2               | 12.2                       | 152.2            | 625                | -                     | -          |
| 2A              | 9.3                        | -                | 421                | Opaque                | Spheroid   |
| 2B              | 7.3                        | -                | 204                | Opaque                | Spheroid   |
| 3               | 24.0                       | 321.0            | 7,238              | Opaque                | Angular    |
| 4               | 21.9                       | 515.9            | 4,608              | -                     | -          |
| 4A              | 20.5                       | -                | 4,511              | Opaque                | Sphere     |
| 4B              | 5.7                        | -                | 97                 | Opaque                | Sphere     |
| 5               | 42.9                       | 866.8            | 41,340             | Opaque                | Hexagon    |
| 6               | 20.7                       | 238.9            | 4,644              | Brown Orange & Opaque | Irregular  |
| 7               | 15.0                       | 218.3            | 1,767              | Opaque                | Spheroid   |
| 8               | 15.8                       | 322.2            | 2,065              | Opaque & Orange       | Irregular  |
| 9               | 15.2                       | 294.7            | 1,839              | Opaque                | Irregular  |
| 10              | 14.4                       | 54.9             | 1,563              | Yellow Brown          | Irregular  |
| 11              | 15.5                       | 75.4             | 1,950              | Yellow Brown          | Irregular  |
| 12              | 15.7                       | 67.1             | 2,026              | Part Opaque           | Spheroid   |
| 13              | 12.5                       | 19.1             | 1,023              | Opaque                | Irregular  |
| 14              | 5.6                        | 102.8            | 333                | Opaque                | Irregular  |
| 15              | 14.3                       | 151.6            | 1,531              | Opaque                | Spheroid   |
| 16              | 10.2                       | 93.5             | 556                | Opaque                | Irregular  |
| 17              | 12.8                       | 66.2             | 1,098              | Yellow Brown          | Irregular  |
| 18              | 8.7                        | 51.9             | 345                | Opaque                | Spheroid   |
| 19              | 10.5                       | 120.4            | 606                | Part Opaque           | Spheroid   |
| 20              | 12.2                       | 88.8             | 951                | Gold-Orange           | Irregular  |
| 21              | 9.5                        | 67.4             | 449                | Opaque                | Sphere     |
| 22              | 11.6                       | 81.0             | 817                | Opaque                | Irregular  |
| 23              | 12.4                       | 76.1             | 998                | Opaque                | Irregular  |
| 24              | 17.1                       | 35.1             | 2,618              | Opaque                | Spheroid   |
| 25              | 12.9                       | 83.7             | 1,124              | Opaque                | Spheroid   |
| 26              | 8.2                        | 36.9             | 289                | Opaque                | Spheroid   |
| 27              | 9.0                        | 76.4             | 382                | Opaque                | Spheroid   |
| 28              | 6.1                        | 54.3             | 119                | Opaque                | Spheroid   |
| 29              | 18.3                       | 82.7             | 3,209              | Opaque                | Sphere     |
| 30              | 8.0                        | 18.7             | 268                | Part Opaque           | Irregular  |

TABLE 3.2 CONTINUED

Double Tracks Arc B Balloon Line 8 Position 21 Casella Continued

2151

| Particle Number                                 | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color              | Morphology |
|---|----------------------------|------------------|--------------------|--------------------|------------|
| 31  | 8.9                        | 27.3             | 369                | Opaque             | Spheroid   |
| 32  | 10.9                       | 18.4             | 678                | Yellow Grey        | Sphere     |
| 33  | 8.6                        | 20.4             | 333                | Part Yellow Brown  | Irregular  |
| 34  | 9.7                        | 55.4             | 478                | Opaque, Clear Edge | Spheroid   |
| 35  | 9.9                        | 21.7             | 508                | Part Opaque        | Spheroid   |
| 36  | 9.1                        | 31.7             | 299                | -                  | -          |
| 36A   | 7.9                        | -                | 258                | Opaque             | Spheroid   |
| 36B   | 3.7                        | -                | 27                 | Opaque             | Spheroid   |
| 36C   | 2.2                        | -                | 5.6                | Clear              | Spheroid   |
| 36D   | 2.5                        | -                | 8.2                | Clear              | Spheroid   |
| 37  | 8.4                        | 100.0            | 310                | Opaque             | Irregular  |
| 38  | 10.3                       | 52.2             | 572                | Opaque             | Sphere     |
| 39  | 14.9                       | 121.4            | 1,684              | -                  | -          |
| 39A   | 14.7                       | -                | 1,665              | Opaque             | Sphere     |
| 39B   | 3.3                        | -                | 19                 | Opaque & Clear     | Spheroid   |
| 40  | 6.2                        | 19.7             | 125                | Opaque             | Sphere     |
| 41  | 6.5                        | 19.4             | 144                | Opaque             | Spheroid   |
| 42  | 5.9                        | 20.8             | 108                | Opaque             | Spheroid   |
| 43  | 11.2                       | 10.6             | 582                | -                  | -          |
| 43A   | 5.4                        | -                | 82                 | Opaque             | Sphere     |
| 43B   | 3.5                        | -                | 22                 | Opaque             | Sphere     |
| 43C   | 9.7                        | -                | 478                | Yellowish          | Irregular  |
| Note: Parts A and B appear to be inside part C. |                            |                  |                    |                    |            |
| 44  | 6.3                        | 20.4             | 131                | Opaque & Clear     | Egg        |
| 45  | 11.9                       | 13.3             | 882                | Brownish & Opaque  | Spheroid   |
| 46  | 6.7                        | 20.0             | 158                | Yellow             | Spheroid   |
| 47  | 4.5                        | 14.3             | 48                 | Opaque             | Spheroid   |
| 48  | 6.8                        | 8.6              | 165                | Yellow-Brown       | Irregular  |
| 49  | 3.5                        | 8.7              | 22                 | Opaque             | Sphere     |
| 50  | 8.5                        | 8.1              | 321                | Yellow & Opaque    | Irregular  |

TABLE 3.2 CONTINUED

Double Tracks Arc D Station 064 Anderson

2920

| Particle Number  | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color           | Morphology |
|--|----------------------------|------------------|--------------------|-----------------|------------|
| 1  | 1.8                        | 8.6              | 3.1                | Opaque & Clear  | Spheroid   |
| 2  | 3.1                        | 8.7              | 15                 | Opaque          | Spheroid   |
| Note: Combined Vertical & Substage illumination begins here. |                            |                  |                    |                 |            |
| 3  | 3.9                        | 6.0              | 31                 | Yellow & Black  | Spheroid   |
| 4  | 2.6                        | 3.7              | 9.2                | Orange Brown    | Sphere     |
| 5  | 2.5                        | 4.2              | 8.2                | Dark Brown      | Spheroid   |
| 6  | 7.4                        | 4.1              | 212                | Opaque          | Irregular  |
| 7  | 9.9                        | 1.5              | 508                | Shiny T. Yellow | Irregular  |
| 7A   | 6.4                        | -                | 137                | Black Inclusion | Irregular  |
| 8  | 5.8                        | 1.0              | 102                | Black           | Irregular  |
| 9  | 1.4                        | 1.9              | 1.4                | T. Red Brown    | Sphere     |

TABLE 3.2 CONTINUED

Double Tracks Arc D Station 068 Casella

2922

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color        | Morphology  |
|-----------------|----------------------------|------------------|--------------------|--------------|-------------|
| 1               | 3.7                        | 17.4             | 27                 | Opaque       | Spheroid    |
| 2               | 18.1                       | 141.6            | 3,105              | Opaque       | Spheroid    |
| 3               | 3.5                        | 9.8              | 22                 | Opaque       | Oval        |
| 4               | 6.4                        | 65.2             | 137                | Opaque       | Spheroid    |
| 5               | 4.6                        | 9.8              | 51                 | Brown Orange | Sphere      |
| 6               | 6.8                        | 2.9              | 165                | Opaque       | Spheroid    |
| 7               | 5.5                        | 16.7             | 87                 | Opaque       | Prolate     |
| 8               | 5.7                        | 46.5             | 97                 | Opaque       | Spheroid    |
| 9               | 4.1                        | 12.6             | 36                 | Opaque       | Irregular   |
| 10              | 4.8                        | 0.3              | ~26                | -            | -           |
| 10A             | ~2.9                       | -                | ~13                | Opaque       | Spheroid    |
| 10B             | ~2.9                       | -                | ~13                | Opaque       | Spheroid    |
| 11              | 36.8                       | 625.1            | 26,090             | Opaque       | Irregular   |
| 12              | 29.7                       | 44.7             | 13,720             | Opaque       | Irregular   |
| 13              | 4.7                        | 18.3             | 54                 | Opaque       | Irregular   |
| 14              | 5.7                        | 24.2             | 97                 | Opaque       | Oval        |
| 15              | 16.6                       | 34.9             | 2,395              | Opaque       | Rectangular |
| 16              | 20.7                       | 262.9            | 4,644              | Opaque       | Irregular   |
| 17              | 6.5                        | 37.0             | 144                | Opaque       | Spheroid    |
| 18              | 14.7                       | 2.0              | 1,665              | Opaque       | Irregular   |
| 19              | 20.2                       | 185.1            | 4,316              | Opaque       | Spheroid    |
| 20              | 6.4                        | 65.5             | 137                | Opaque       | Spheroid    |
| 21              | 24.3                       | 3.2              | 7,513              | Brown        | Spheroid    |

Note: This particle displays an unusually rough surface.

TABLE 3.2 CONTINUED

Double Tracks Arc D Station 068 Casella (Continued)

2922

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume 3 ( $\mu$ ) | Color           | Morphology |
|-----------------|----------------------------|------------------|--------------------|-----------------|------------|
| 22              | 5.1                        | 14.9             | 67                 | -               | -          |
| 22A             | 5.0                        | -                | 65                 | Opaque          | Sphere     |
| 22B             | 1.6                        | -                | 2.1                | Brown-Orange    | Sphere     |
| 23              | 6.9                        | 24.3             | 172                | Amber           | Sphere     |
| 24              | 6.1                        | 42.1             | 40                 | -               | -          |
| 24A             | 3.5                        | -                | 22                 | Opaque          | Spheroid   |
| 24B             | 2.8                        | -                | 11                 | Opaque          | Spheroid   |
| 24C             | 2.4                        | -                | 7.2                | Opaque          | Spheroid   |
| 25              | 3.7                        | 10.3             | 27                 | Opaque          | Spheroid   |
| 26              | 17.1                       | 22.6             | 2,618              | Opaque          | Irregular  |
| 27              | 24.4                       | 227.1            | 5,212              | -               | -          |
| 27A             | 21.0                       | -                | 4,849              | Opaque          | Irregular  |
| 27B             | 9.5                        | -                | 463                | Opaque          | Irregular  |
| 28              | 3.6                        | 11.0             | 24                 | Opaque          | Sphere     |
| 29              | 7.2                        | 47.3             | 204                | -               | -          |
| 29A             | 7.2                        | -                | 195                | Opaque          | Sphere     |
| 29B             | 1.3                        | -                | 1.2                | Clear           | Sphere     |
| 29C             | 2.5                        | -                | 8.2                | Clear           | Sphere     |
| 30              | 3.0                        | 4.7              | 14                 | T. Brown        | Irregular  |
| 31              | 1.3                        | 2.3              | 1.2                | Shiny Black     | Irregular  |
| 32              | 5.1                        | 15.2             | 58                 | -               | -          |
| 32A             | 2.9                        | -                | 13                 | T. Brown Orange | Irregular  |
| 32B             | 4.4                        | -                | 45                 | Black           | Spheroid   |
| 33              | 6.4                        | 29.0             | 137                | Black           | Sphere     |
| 34              | 3.4                        | 5.0              | 10                 | -               | -          |
| 34A             | 2.4                        | -                | 7.2                | T. Dark Grey    | Sphere     |
| 34B             | 1.6                        | -                | 2.1                | T. Grey         | Sphere     |
| 34C             | 1.1                        | -                | .70                | T. Grey         | Sphere     |
| 35              | 3.8                        | 3.7              | 29                 | T. Orange Brown | Spheroid   |
| 36              | 3.3                        | 3.6              | 19                 | Shiny Grey      | Sphere     |
| 37              | 5.3                        | 5.1              | 78                 | T. Grey Yellow  | Spheroid   |
| 37A             | 1.9                        | -                | 3.6                | Black           | Sphere     |

Note: 'A' appears surrounded by the main body.

|    |     |     |    |            |           |
|----|-----|-----|----|------------|-----------|
| 38 | 3.7 | 6.6 | 27 | Dull Brown | Irregular |
|----|-----|-----|----|------------|-----------|

TABLE 3.2 CONTINUED

Double Tracks Arc D Station 068 Casella (Continued)

2922

| Particle Number | Average Diameter (u) | Count Rate (cpr) | Volume ( $\mu^3$ ) | Color             | Morphology |
|-----------------|----------------------|------------------|--------------------|-------------------|------------|
| 39              | 12.4                 | 9.2              | 100                | T. Dark Brown     | Irregular  |
| 40              | 2.5                  | 3.3              | 8.2                | Very Shiny Yellow | Spheroid   |
| 41              | 3.0                  | 5.5              | 14                 | T. Orange Brown   | Spheroid   |
| 42              | 2.5                  | 4.0              | 8.2                | T. Orange Brown   | Sphere     |
| 43              | 6.2                  | 10.7             | 125                | T. Orange         | Irregular  |
| 44              | 4.3                  | 5.9              | 42                 | Shiny T. Orange   | Sphere     |
| 45              | 3.6                  | 3.9              | 16                 | -                 | -          |
| 45A             | 2.9                  | -                | 13                 | T. Orange Brown   | Sphere     |
| 45B             | 1.7                  | -                | 2.6                | T. Orange Brown   | Sphere     |
| 46              | 6.7                  | 9.7              | 158                | Black & T. Orange | Irregular  |
| 47              | 3.2                  | 0.7              | 17                 | Brown             | Irregular  |
| 48              | 5.0                  | 8.6              | 65                 | T. Yellow         | Spheroid   |
| 49              | 3.9                  | 16.4             | 31                 | Yellow            | Irregular  |
| 50              | 6.1                  | 39.3             | 119                | Yellow & Clear    | Irregular  |

Double Tracks Arc E Station 058 Casella, Resin/Cellulose

9624

Three radioactive sites were observed on 48-hour autoradiograph but appear to have been lost in trying to isolate them. The observed activity was 332 dpm.

TABLE 3.2 CONTINUED

Double Tracks Arc E Station 058 Casella

9698

| Particle Number   | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                      | Morphology |
|---|----------------------------|------------------|--------------------|----------------------------|------------|
| 1   | 36.0                       | 274.2            | 24,430             | Greenish & Opaque          | Irregular  |
| 2   | 17.7                       | 5.3              | 2,903              | Opaque                     | Fuzzy Ball |
| 3   | 12.7                       | 6.6              | 1,073              | Opaque & Clear             | Irregular  |
| 4   | 10.0                       | 21.3             | 524                | Gold                       | Sphere     |
| 5   | 11.6                       | 52.9             | 410                | -                          | -          |
| 5A  | 8.9                        | -                | 369                | Dark Yellowish             | Spheroid   |
| 5B  | 3.2                        | -                | 17                 | Dark Yellowish             | Spheroid   |
| 5C  | 3.6                        | -                | 24                 | Ruddy                      | Irregular  |
| 6   | 5.3                        | 3.2              | 78                 | -                          | -          |
| 6A  | 5.3                        | -                | 78                 | Opaque                     | Sphere     |
| 6B  | 0.8                        | -                | 0.3                | Opaque                     | Sphere     |
| Note: Surrounded by a yellowish tinge 11.5 $\mu$ across, irregular shape. |                            |                  |                    |                            |            |
| 7   | 11.4                       | 26.0             | 658                | -                          | -          |
| 7A  | 9.6                        | -                | 463                | Opaque                     | Spheroid   |
| 7B  | 7.2                        | -                | 195                | Very Transparent Yellowish | Irregular  |
| 8   | 5.7                        | 11.3             | 97                 | Opaque & Clear             | Irregular  |
| 9   | 35.6                       | 82.0             | 23,620             | Opaque                     | Irregular  |
| 10  | 17.3                       | 16.0             | 2,711              | Opaque & Clear             | Irregular  |
| 11  | 8.0                        | 8.6              | 240                | -                          | -          |
| 11A   | 7.7                        | -                | 239                | Deep Amber                 | Sphere     |
| 11B   | 1.0                        | -                | 0.5                | Opaque                     | Sphere     |
| 12  | 15.0                       | 34.6             | 1,767              | Part Opaque                | Irregular  |
| 13  | 7.8                        | 4.4              | 248                | Dark Orange                | Irregular  |
| 14  | 11.2                       | 6.4              | 736                | Part Opaque                | Irregular  |
| 15  | 9.0                        | 18.5             | 299                | -                          | -          |
| 15A   | 7.8                        | -                | 248                | Opaque                     | Spheroid   |
| 15B   | 4.6                        | -                | 51                 | Clear                      | Spheroid   |

TABLE 3.2 CONTINUED

Double Tracks Arc E Station 058 Casella

9698

| Particle Number   | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color               | Morphology      |
|---|----------------------------|------------------|--------------------|---------------------|-----------------|
| 16  | 5.4                        | 10.4             | 63                 | -                   | -               |
| 16A   | 4.9                        | -                | 62                 | Opaque              | Spheroid        |
| 16B   | 1.3                        | -                | 1.2                | Opaque              | Spheroid        |
| 17  | 75.5                       | 1881             | 225,400            | Amber               | Sphere          |
| Note: Particle shows very intricate structure.              |                            |                  |                    |                     |                 |
| 18  | 12.6                       | 8.1              | 1,049              | Transparent         | Irregular       |
| 19  | 3.8                        | 12.2             | 24                 | -                   | -               |
| 19A   | 3.6                        | -                | 24                 | Opaque              | Irregular       |
| 19B   | 0.3                        | -                | 0.01               | Opaque              | Sphere          |
| Note: Six opaque submicron particles are also in the field. |                            |                  |                    |                     |                 |
| 20  | 5.0                        | 6.4              | 65                 | Opaque & Clear      | Irregular       |
| 21  | -                          | 6.9              | 124                | -                   | -               |
| 21A   | 5.9                        | -                | 108                | Opaque & Yellow     | Irregular       |
| 21B   | 3.1                        | -                | 16                 | Opaque & Yellow     | Irregular       |
| Note: Two particles about $15\mu$ apart.                    |                            |                  |                    |                     |                 |
| 22  | 12.2                       | 23.0             | 951                | Opaque & Yellow     | Irregular       |
| 23  | 5.1                        | 8.9              | 69                 | Opaque & Clear      | Spheroid        |
| 24  | 6.7                        | 4.2              | 158                | Part Opaque         | Irregular       |
| 25  | 15.7                       | 59.1             | 2,026              | Opaque & Clear      | Irregular       |
| 26  | 11.0                       | 16.3             | 697                | Opaque              | Irregular       |
| 27  | 6.2                        | 2.7              | 125                | Part Opaque         | Spheroid        |
| 28  | 2.9                        | 9.1              | 13                 | Bright Orange       | Hexagonal       |
| 29  | 2.1                        | 3.9              | 4.8                | Deep Red Orange     | Sphere          |
| 30  | 23.9                       | 155.5            | 7,148              | Opaque, Clear Edges | Grainy Spheroid |
| 31  | 8.4                        | 14.2             | 310                | Opaque & Clear      | Irregular       |
| 32  | 11.3                       | 28.5             | 756                | Opaque & Clear      | Irregular       |
| 33  | 12.2                       | 4.0              | 951                | Clear               | Irregular       |
| 33A   | 5.4                        | -                | 82                 | Opaque              | Spheroid        |
| 33B   | 4.6                        | -                | 51                 | Opaque              | Irregular       |
| Note: A and B are inclusions.                               |                            |                  |                    |                     |                 |
| 34  | 6.2                        | 2.2              | 125                | Brown Black         | Irregular       |
| 35  | 4.9                        | 3.4              | 62                 | Brown               | Irregular       |
| 36  | 4.2                        | 21.2             | 39                 | Opaque              | Irregular       |

TABLE 3.2 CONTINUED

Double Tracks Arc E Station 058 TAS D

9699

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color           | Morphology |
|-----------------|----------------------------|------------------|--------------------|-----------------|------------|
| 1               | 3.2                        | 6.5              | 17                 | Black           | Spheroid   |
| 2               | 4.6                        | 11.9             | 27                 | -               | -          |
| 2A              | 3.6                        | -                | 24                 | Red-Yellow      | Spheroid   |
| 2B              | 1.8                        | -                | 3.1                | Dark Yellow     | Spheroid   |
| 3               | 2.3                        | 2.0              | 6.4                | Brown and Clear | Irregular  |

Double Tracks Arc G Station 058 Casella

9660

| Particle Number                               | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color           | Morphology |
|---|----------------------------|------------------|--------------------|-----------------|------------|
| 1   | 6.1                        | 0.06             | 12                 | Opaque          | Sphere     |
| 2   | 12.7                       | 214.5            | 1,073              | Opaque          | Spheroid   |
| 3   | 30.8                       | 376.1            | 1,530              | Opaque          | Irregular  |
| 4   | 10.6                       | 117.0            | 624                | Opaque          | Sphere     |
| 5   | 11.4                       | 95.8             | 775                | Opaque          | Spheroid   |
| 6   | 16.5                       | 228.4            | 2,352              | Opaque          | Sphere     |
| 7   | 7.5                        | 2.6              | 22                 | Opaque          | Sphere     |
| 8   | 5.8                        | 31.8             | 102                | Opaque          | Sphere     |
| 9   | 5.6                        | 3.4              | 92                 | Opaque & Clear  | Irregular  |
| 10  | 5.3                        | 1.6              | 78                 | Opaque          | Irregular  |
| Note: Four more particles < 2 $\mu$ in field. |                            |                  |                    |                 |            |
| 11  | 8.9                        | 3.3              | 369                | T. Pale Yellow  | Irregular  |
| 11A   | 1.1                        | -                | .70                | Black           | Spheroid   |
| 11B   | 2.6                        | -                | 9.2                | Black           | Dumbell    |
| 12  | 2.0                        | 1.8              | 4.2                | Brown           | Triangle   |
| 13  | 8.4                        | 15.6             | 310                | T. Yellow       | Irregular  |
| 14  | 1.8                        | 2.1              | 3.1                | T. Orange Brown | Spheroid   |
| 15  | 2.2                        | 2.3              | 5.6                | T. Orange Brown | Spheroid   |
| 16  | 3.0                        | 2.6              | 14                 | T. Yellow Brown | Spheroid   |

TABLE 3.2 CONTINUED

Double Tracks Arc G Station 058 TAS D

9661

| Particle Number  | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                  | Morphology |
|--|----------------------------|------------------|--------------------|------------------------|------------|
| 1  | 4.4                        | 6.7              | 45                 | Opaque & Yellow        | Irregular  |
| Note: Appears to be attached to piece of collection media. |                            |                  |                    |                        |            |
| 2  | 16.2                       | 173.9            | 1,342              | -                      | -          |
| 2A   | 11.2                       | -                | 736                | Opaque                 | Sphere     |
| 2B   | 10.5                       | -                | 606                | Opaque & Gold          | Irregular  |
| 3  | 4.2                        | 7.4              | 39                 | Yellow                 | Sphere     |
| 4  | 7.7                        | 50.5             | 239                | Yellow                 | Spheroid   |
| 5  | 3.0                        | 6.5              | 14                 | Gray Yellow            | Spheroid   |
| 6  | 3.4                        | 5.9              | 21                 |                        | Sphere     |
| 7  | 5.6                        | 2.2              | 92                 | Yellow                 | Irregular  |
| 8  | 4.6                        | 13.7             | 51                 | Black                  | Spheroid   |
| 9  | 6.2                        | 12.2             | 125                | Black, T. Brown, Clear | Irregular  |
| 10   | 9.1                        | 11.8             | 395                | Yellow                 | Spheroid   |
| 11   | 2.7                        | 3.9              | 10                 | Black                  | Spheroid   |
| 12   | 3.2                        | 2.3              | 17                 | Yellow                 | Spheroid   |
| 13   | 5.6                        | 8.0              | 79                 | -                      | -          |
| 13A  | 3.0                        | -                | 14                 | Black                  | Spheroid   |
| 13B  | 5.0                        | -                | 65                 | T. Orange Brown        | Spheroid   |
| 14   | 4.2                        | 11.3             | 39                 | Yellow                 | Spheroid   |
| 15   | 9.1                        | 9.5              | 395                | T. Yellow              | Spheroid   |
| 16   | 7.0                        | 4.0              | 180                | Clear, Orange, Black   | Irregular  |
| 17   | 4.1                        | 5.2              | 36                 | Black & T. Gray        | Irregular  |

TABLE 3.2 CONTINUED

Double Tracks Arc G Station 064 Casella

9656

| Particle Number  | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                | Morphology    |
|--|----------------------------|------------------|--------------------|----------------------|---------------|
| 1  | -                          | 8.2              | 84                 | -                    | -             |
| 1A   | 5.4                        | -                | 82                 | Yellow               | Rough Sphere  |
| 1B   | 1.6                        | -                | 2.1                | Opaque               | Sphere        |
| Note: Particles are completely detached about 2 $\mu$ apart. |                            |                  |                    |                      |               |
| 2  | 10.6                       | 8.4              | 624                | Part Opaque          | Sphere        |
| 3  | 15.0                       | 430.1            | 1,767              | Opaque               | Sphere        |
| 4  | 11.2                       | 72.6             | 736                | Opaque               | Spheroid      |
| 5  | 8.5                        | 144.4            | 322                | Opaque               | Bullet Shape  |
| 6  | 13.0                       | 73.2             | 1,150              | Opaque               | Sphere        |
| 7  | 7.4                        | 90.2             | 212                | Opaque               | Sphere        |
| 8  | 3.1                        | 14.3             | 16                 | Yellowish            | Irregular     |
| 9  | 17.6                       | 30.0             | 2,855              | Opaque               | Spheroid      |
| 10   | 5.2                        | 21.1             | 66                 | -                    | -             |
| 10A  | 4.9                        | -                | 62                 | Opaque               | Sphere        |
| 10B  | 1.4                        | -                | 1.4                | Dark Orange          | Hemisphere    |
| 10C  | 1.6                        | -                | 2.1                | Orange               | Sphere        |
| Note: Part C completely detached about 1.5 $\mu$ away.       |                            |                  |                    |                      |               |
| 11   | 8.5                        | 51.8             | 322                | Opaque               | Sphere        |
| 12   | 13.3                       | 63.6             | 1,407              | Opaque               | Irregular     |
| 13   | 8.0                        | 13.8             | 177                | -                    | -             |
| 13A  | 6.6                        | -                | 150                | Opaque               | Irregular     |
| 13B  | 3.5                        | -                | 22                 | Clear                | Spheroid      |
| 13C  | 2.1                        | -                | 4.8                | Opaque               | Spheroid      |
| 14   | 8.1                        | 19.5             | 278                | Opaque               | Sphere w/tail |
| 15   | 5.6                        | 27.1             | 92                 | Opaque & Orange      | Irregular     |
| 16   | 10.7                       | 126.2            | 641                | Opaque               | Sphere        |
| 17   | 4.7                        | 10.9             | 54                 | Orange               | Sphere        |
| 18   | 4.6                        | 19.9             | 51                 | Opaque & Dark Orange | Spheroid      |
| 19   | 4.8                        | 22.7             | 58                 | Opaque & Clear       | Spheroid      |
| 20   | 6.4                        | 37.2             | 137                | Opaque & Clear       | Spheroid      |
| 21   | 3.5                        | 5.5              | 22                 | Opaque               | Irregular     |
| 22   | 5.1                        | 32.8             | 69                 | Opaque               | Sphere        |
| 23   | 3.7                        | 6.9              | 17                 | -                    | -             |
| 23A  | 2.9                        | -                | 13                 | Opaque               | Irregular     |
| 23B  | 2.0                        | -                | 4.2                | Dark Orange          | Spheroid      |

TABLE 3.2 CONTINUED

Double Tracks Arc G Station 064 Casella

9656

| Particle Number   | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                | Morphology |
|---|----------------------------|------------------|--------------------|----------------------|------------|
| 24  | 2.4                        | 3.2              | 7.2                | Dark Orange          | Spheroid   |
| 25  | 3.7                        | 6.1              | 27                 | Opaque & Dark Orange | Irregular  |
| 26  | 9.8                        | 2.8              | 493                | Yellow Orange        | Sphere     |
| 27  | 3.2                        | 4.0              | 17                 | Opaque & Grey Orange | Irregular  |
| Note: Two particles, 1.2 and 1.1 $\mu$ , also in field. |                            |                  |                    |                      |            |
| 28  | 3.8                        | 9.1              | 21                 | -                    | -          |
| 28A   | 3.0                        | -                | 14                 | Opaque & Dark Orange | Spheroid   |
| 28B   | 2.3                        | -                | 6.4                | Opaque & Dark Orange | Bar Shape  |
| 28C   | 0.9                        | -                | 0.4                | Opaque               | Sphere     |
| 29  | 3.4                        | 8.2              | 21                 | Dark Brown           | Ellipsoid  |
| 30  | 3.2                        | 8.1              | 17                 | Opaque               | Spheroid   |
| 31  | 2.6                        | 5.3              | 9.2                | Opaque               | Spheroid   |
| Note: Five submicron particles in field.                |                            |                  |                    |                      |            |
| 32  | 3.5                        | 7.7              | 22                 | Opaque & Orange      | Spheroid   |
| 33  | 29.4                       | 35.0             | 13,310             | Opaque & Yellow      | Sphere     |
| Note: Particle is cleaved in half.                      |                            |                  |                    |                      |            |
| 34  | 16.1                       | 59.6             | 2,185              | Opaque & Yellow      | Irregular  |
| 35  | 7.8                        | 74.3             | 248                | Opaque & Yellow      | Irregular  |
| 36  | 6.5                        | 99.9             | 144                | Opaque               | Sphere     |
| 37  | 16.5                       | 80.5             | 2,352              | Opaque & Grey        | Spheroid   |
| 38  | 11.6                       | 34.7             | 636                | -                    | -          |
| 38A   | 10.6                       | -                | 624                | Opaque               | Spheroid   |
| 38B   | 1.6                        | -                | 2.1                | Opaque               | Spheroid   |
| 38C   | 2.7                        | -                | 10                 | Opaque               | Irregular  |
| 39  | 15.0                       | 175.0            | 904                | -                    | -          |
| 39A   | 11.6                       | -                | 817                | Opaque               | Irregular  |
| 39B   | 5.5                        | -                | 87                 | Opaque               | Sphere     |
| 40  | 4.7                        | 26.3             | 54                 | Opaque               | Spheroid   |
| 41  | 5.7                        | 8.9              | 97                 | Opaque & Clear       | Spheroid   |
| 42  | 10.9                       | 20.7             | 678                | Opaque & Clear       | Irregular  |
| 43  | 4.6                        | 6.2              | 51                 | Opaque               | Sphere     |
| 44  | 4.5                        | 8.1              | 48                 | Red Brown            | Sphere     |
| 45  | 10.1                       | 17.1             | 540                | Opaque               | Irregular  |
| 46  | 3.7                        | 12.7             | 27                 | Opaque               | Irregular  |

TABLE 3.2 CONTINUED

Double Tracks Arc G Station 064 Casella

9656

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color          | Morphology |
|-----------------|----------------------------|------------------|--------------------|----------------|------------|
| 47              | 4.8                        | 9.9              | 58                 | Clear Yellow   | Sphere     |
| 48              | 10.4                       | 12.5             | 589                | Opaque & Clear | Irregular  |
| 49              | 3.9                        | 10.9             | 31                 | Opaque         | Spheroid   |
| 50              | 3.2                        | 8.4              | 17                 | Opaque         | Sphere     |
| 51              | 4.4                        | 13.8             | 45                 | Opaque         | Irregular  |

Double Tracks Arc H Station 060 Casella

2723

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color         | Morphology |
|-----------------|----------------------------|------------------|--------------------|---------------|------------|
| 1               | 11.9                       | 147.4            | 882                | Opaque        | Irregular  |
| 2               | 6.7                        | 42.3             | 115                | -             | -          |
| 2A              | 5.9                        | -                | 108                | Opaque        | Spheroid   |
| 2B              | 2.4                        | -                | 7.2                | Opaque        | Spheroid   |
| 3               | 4.5                        | 7.3              | 18                 |               |            |
| 3A              | 2.5                        | -                | 8.1                | Opaque        | Sphere     |
| 3B              | 2.7                        | -                | 10                 | Part Opaque   | Sphere     |
| 4               | 7.3                        | 28.6             | 204                | Opaque        | Spheroid   |
| 5               |                            | 1.9              | ~8                 | -             | -          |
| 5A              |                            | -                | ~4                 | Opaque        | Sphere     |
| 5B              |                            | -                | ~4                 | Opaque        | Sphere     |
| 6               | 33.4                       | 15.5             | 19,520             | Opaque        | Triangular |
| 7               | 2.5                        | 3.4              | 8.2                | Opaque        | Irregular  |
| 8               | 4.0                        | 56.4             | 34                 | Amber & Black | Spheroid   |
| 9               | 13.2                       | 130.1            | 1,204              | Opaque        | Spheroid   |
| 10              | 3.2                        | 78.1             | 17                 | Opaque        | Spheroid   |
| 11              | 7.6                        | 32.7             | 230                | Opaque        | Spheroid   |

Note: Two clear attachments are probably air bubbles.

TABLE 3.2 CONTINUED

Double Tracks Arc I Station 059 TAS D

9691

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color               | Morphology         |
|-----------------|----------------------------|------------------|--------------------|---------------------|--------------------|
| 1               | 2.8                        | 2.9              | 14                 | Orange Brown        | Irregular          |
| 2               | 17.2                       | 182.8            | 2,664              | Opaque Yellow       | Spheroid           |
| 3               | 2.4                        | 4.3              | 7.2                | Opaque Yellow       | Spheroid           |
| -               | 5.7                        | 23.9             | 75                 | -                   | -                  |
| 4A              | 5.2                        | -                | 74                 | Opaque Yellow       | Sphere             |
| 4B              | 1.3                        | -                | 1.2                | Opaque Yellow       | Sphere             |
| 5               | 4.8                        | 11.9             | 58                 | Opaque Brown        | Sphere             |
| 6               | 4.1                        | 20.5             | 36                 | Opaque Black        | Sphere             |
| 7               | 2.3                        | 2.6              | 6.4                | Brown               | Irregular          |
| 8               | 2.7                        | 3.3              | 10                 | Orange Brown        | Irregular          |
| 9               | 4.2                        | 5.8              | 39                 | Opaque Brown        | Spheroid           |
| 10              | 10.3                       | 39.6             | 572                | Part Opaque         | Crescent           |
| 11              | 4.6                        | 10.7             | 51                 | Opaque Brown        | Sphere             |
| 12              | 2.8                        | 4.3              | 11                 | Dark Orange Brown   | Egg                |
| 13              | 2.8                        | 0.1              | 11                 | Opaque Orange Brown | Irregular          |
| 14              | 2.9                        | 4.9              | 13                 | Opaque Brown        | Irregular          |
| 15              | 4.9                        | 14.6             | 62                 | Opaque Brown        | Sphere             |
| 16              | 2.6                        | 4.1              | 9.2                | Dark Brown          | Sphere             |
| 17              | 22.3                       | 239.7            | 2,057              | -                   | -                  |
| 17A             | 13.9                       | -                | 1,407              | Dull Black          | Sphere             |
| 17B             | 5.4                        | -                | 82                 | Shiny Orange        | Spheroid           |
| 17C             | 6.6                        | -                | 151                | Yellow              | Irregular          |
| 17D             | 9.2                        | -                | 408                | Yellow              | Irregular          |
| 17E             | 2.6                        | -                | 9.2                | Yellow              | Irregular          |
| 18              | 8.7                        | 20.1             | 345                | Black               | Spheroid           |
| 19              | 10.2                       | 27.3             | 556                | Black               | Irregular          |
| 20              | 19.1                       | 20.8             | 1,475              | -                   | -                  |
| 20A             | 7.7                        | -                | 239                | Black               | Spheroid           |
| 20B             | 8.0                        | -                | 268                | Black               | Irregular          |
| 20C             | 11.3                       | -                | 756                | Black               | Irregular          |
| 20D             | 7.4                        | -                | 212                | Black               | Spheroid           |
| 21              | 7.4                        | 9.6              | 212                | Shiny Black         | Blistered Spheroid |

TABLE 3.2 CONTINUED

Double Tracks Arc I Station 059 TAS D (Continued)

9691

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                         | Morphology |
|-----------------|----------------------------|------------------|--------------------|-------------------------------|------------|
| 22              | 10.2                       | 120.8            | 556                | Shiny Black                   | Spheroid   |
| 23              | 2.7                        | 2.6              | 10                 | T. Orange Gold                | Spheroid   |
| 24              | 4.8                        | 6.8              | 98                 | Shiny Brown                   | Irregular  |
| 25              | 2.7                        | 1.0              | 10                 | T. Dark Brown                 | Irregular  |
| 26              | 3.2                        | 2.2              | 10                 | -                             | -          |
| 26A             | 2.6                        | -                | 9.2                | T. Light Brown                | Spheroid   |
| 26B             | 1.3                        | -                | 1.2                | T. Light Brown                | Spheroid   |
| 27              | 3.5                        | 5.7              | 22                 | Dull Black                    | Sphere     |
| 28              | 6.2                        | 9.2              | 125                | Black                         | Spheroid   |
| 29              | 9.3                        | 8.5              | 421                | Black                         | Irregular  |
| 30              | 23.6                       | 11.9             | 6,832              | Yellow                        | Irregular  |
| 31              | 3.5                        | 5.6              | 29                 | Shiny T. Orange               | Spheroid   |
| 32              | 3.4                        | 3.2              | 21                 | V. Shiny Black                | Irregular  |
| 33              | 3.4                        | 3.1              | 10                 | -                             | -          |
| 33A             | 2.0                        | -                | 4.2                | T. Orange Brown               | Spheroid   |
| 33B             | 2.1                        | -                | 4.8                | T. Orange Brown               | Spheroid   |
| 33C             | 1.0                        | -                | 0.52               | T. Orange Brown               | Spheroid   |
| 33D             | 1.0                        | -                | 0.52               | T. Orange Brown               | Spheroid   |
| 34              | 2.6                        | 0.8              | 9.2                | Yellow                        | Spheroid   |
| 35              | 3.5                        | 3.0              | 22                 | Shiny T. Orange Brown & Black | Spheroid   |
| 36              | 3.1                        | 5.6              | 16                 | Shiny Brown                   | Spheroid   |
| 37              | 2.2                        | 1.0              | 5.6                | T. Orange Brown               | Irregular  |
| 38              | 1.8                        | 0.4              | 3.1                | T. Orange Brown               | Irregular  |
| 39              | 2.8                        | 1.6              | 11                 | T. Red Brown                  | Spheroid   |
| 40              | 3.1                        | 1.0              | 16                 | T. Gray Brown                 | Spheroid   |
| 41              | 11.0                       | 3.0              | 697                | T. Gray                       | Irregular  |
| 42              | 4.4                        | 0.5              | 45                 | Yellow                        | Irregular  |
| 43              | 2.4                        | 1.7              | 7.2                | T. Orange Gray                | Sphere     |
| 44              | 2.6                        | 3.0              | 9.2                | T. Dark Gray                  | Irregular  |
| 45              | 2.6                        | 3.5              | 9.2                | Shiny Yellow                  | Irregular  |

TABLE 3.2 CONTINUED

Double Tracks Arc I Station 059 TAS D

9691

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color         | Morphology  |
|-----------------|----------------------------|------------------|--------------------|---------------|-------------|
| 46              | 2.6                        | 5.9              | 16                 | -             | -           |
| 46A             | 2.6                        | -                | 9.2                | Brown         | Sphere      |
| 46B             | 1.1                        | -                | 6.7                | Brown         | Sphere      |
| 47              | 2.0                        | 3.0              | 4.2                | T. Orange     | Sphere      |
| 48              | 2.7                        | 2.6              | 10                 | Opaque        | Sphere      |
| 49              | 3.2                        | 1.7              | 5.4                | -             | -           |
| 49A             | 1.6                        | -                | 2.1                | T. Gray       | Sphere      |
| 49B             | 1.8                        | -                | 3.1                | Black         | Irregular   |
| 49C             | 0.6                        | -                | 0.1                | T. Gray       | Spheroid    |
| 49D             | 0.4                        | -                | 0.04               | T. Gray       | Pear Shaped |
| 49E             | 0.5                        | -                | 0.07               | Black & Clear | Oval        |
| 50              | 4.8                        | 30.7             | 58                 | Black         | Sphere      |

TABLE 3.2 CONTINUED

Double Tracks Arc I Station 061 TAS D

9669

| Particle Number                              | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color             | Morphology     |
|--|----------------------------|------------------|--------------------|-------------------|----------------|
| 1  | 5.9                        | 5.4              | 108                | Black & T. Yellow | Spheroid       |
| 2  | 11.2                       | 70.7             | 736                | Brown             | Spheroid       |
| 3  | 3.9                        | 12.0             | 31                 | T. Brown          | Irregular      |
| 4  | 3.4                        | 4.3              | 13                 | -                 | -              |
| 4A   | 2.6                        | -                | 9.2                | Black             | Spheroid       |
| 4B   | 1.9                        | -                | 3.6                | T. Brown          | Sphere         |
| 5  | 5.5                        | 25.5             | 87                 | Black             | Spheroid       |
| 6  | 7.9                        | 69.0             | 258                | T. Dark Brown     | Spheroid       |
| 7  | 5.5                        | 31.0             | 87                 | Black             | Sphere         |
| 8  | 1.6                        | 2.5              | 2.1                | T. Orange         | Spheroid       |
| 9  | 3.6                        | 2.6              | 24                 | T. Dark Brown     | Spheroid       |
| 10   | 3.6                        | 10.6             | 24                 | Shiny Black       | Egg Shape      |
| 11   | 3.3                        | 7.0              | 19                 | Black             | Irregular      |
| 12   | 6.4                        | 6.4              | 137                | Black to Clear    | Sphere         |
| 13   | 3.4                        | 4.2              | 21                 | Brown             | Spheroid       |
| 14   | 8.1                        | 65.9             | 278                | Brown             | Sphere         |
| 15   | 2.7                        | 2.5              | 10                 | T. Brown          | Spheroid       |
| 16   | 4.9                        | 21.0             | 62                 | Shiny Black       | Sphere         |
| 17   | 7.9                        | 8.7              | 258                | Black & T. Yellow | Spheroid       |
| 18   | 4.0                        | 9.1              | 34                 | Black             | Irregular      |
| 19   | 4.9                        | 13.7             | 62                 | Black             | Sphere w/tail  |
| 20   | 7.0                        | 23.3             | 180                | Black             | Spheroid       |
| 21   | 2.6                        | 3.7              | 9.2                | T. Red Brown      | Spheroid       |
| 22   | 3.2                        | 5.1              | 17                 | T. Dark Brown     | Sphere         |
| 23   | -                          | 2.9              | 7.5                | -                 | -              |
| 23A  | 2.3                        | -                | 6.4                | T. Orange         | Sphere         |
| 23B  | 1.2                        | -                | 0.90               | T. Orange         | Sphere         |
| 23C  | 0.6                        | -                | 0.1                | T. Orange         | Sphere         |
| 23D  | 1.0                        | -                | 0.52               | T. Orange         | Sphere         |
| Note: Parts C and D are completely detached. |                            |                  |                    |                   |                |
| 24   | 4.7                        | 20.5             | 54                 | Shiny Black       | Sphere         |
| 25   | 3.5                        | 1.4              | 22                 | Black             | Very Irregular |
| 26   | 3.9                        | 7.2              | 31                 | Black             | Sphere         |
| 27   | 8.8                        | 5.5              | 357                | T. Gray Yellow    | Irregular      |

TABLE 3.2 CONTINUED

Double Tracks Arc I Station 061 TAS D

9669

| Particle Number                      | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                  | Morphology     |
|--------------------------------------|----------------------------|------------------|--------------------|------------------------|----------------|
| 28                                   | 2.9                        | 4.6              | 13                 | T. Dark Brown          | Sphere         |
| 29                                   | 5.0                        | 20.1             | 65                 | T. Dark Brown, Shiny   | Sphere         |
| 30                                   | 8.9                        | 16.5             | 269                | -                      | -              |
| 30A                                  | 4.2                        | -                | 39                 | Black                  | Spheroid       |
| 30B                                  | 7.6                        | -                | 230                | Clear                  | Irregular      |
| 31                                   | 2.8                        | 16.8             | 11                 | T. Orange Brown, Shiny | Sphere         |
| 32                                   | 2.8                        | 2.3              | 11                 | T. Orange Brown        | Sphere         |
| 33                                   | -                          | 5.9              | 22                 | -                      | -              |
| 33A                                  | 2.6                        | -                | 9.2                | T. Dark Gray           | Irregular      |
| 33B                                  | 2.9                        | -                | 13                 | T. Orange Yellow       | Irregular      |
| Note: Parts A and B became detached. |                            |                  |                    |                        |                |
| 34                                   | 2.5                        | 4.0              | 8.2                | Yellow                 | Spheroid       |
| 35                                   | 5.5                        | 9.9              | 87                 | T. Dark Brown          | Spheroid       |
| 36                                   | 1.9                        | 2.4              | 3.6                | T. Orange Brown        | Sphere         |
| 37                                   | 2.0                        | 3.6              | 4.2                | Bright Yellow          | Sphere         |
| 38                                   | 9.0                        | 75.2             | 303                | -                      | -              |
| 38A                                  | 8.3                        | -                | 299                | T. Dark Yellow         | Sphere         |
| 38B                                  | 2.0                        | -                | 4.2                | T. Yellow              | Sphere         |
| 39                                   | 4.9                        | 29.4             | 62                 | Yellow                 | Egg Shape      |
| 40                                   | 2.4                        | 2.7              | 7.2                | Yellow                 | Spheroid       |
| 41                                   | 3.3                        | 2.5              | 19                 | Yellow                 | Irregular      |
| 42                                   | 3.3                        | 5.6              | 19                 | Yellow                 | Irregular      |
| 43                                   | 3.8                        | 4.5              | 29                 | Red-Yellow             | Sphere         |
| 44                                   | 3.2                        | 8.0              | 17                 | Brown                  | Irregular      |
| 45                                   | 2.1                        | 2.6              | 4.8                | Yellow                 | Irregular      |
| 46                                   | 7.4                        | 13.6             | 212                | Black & Clear          | Irregular      |
| 47                                   | 2.6                        | 4.1              | 9.2                | Brown                  | Sphere         |
| 48                                   | 2.6                        | 2.0              | 9.2                | Black & Clear          | Spheroid       |
| 49                                   | 3.1                        | 4.2              | 5.8                | Black & T. Gray        | Very Irregular |
| 50                                   | 9.6                        | 76.8             | 463                | Black                  | Bubbly Sphere  |

TABLE 3.2 CONTINUED

Double Tracks Arc I Station 061 Casella

9668

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color               | Morphology     |
|-----------------|----------------------------|------------------|--------------------|---------------------|----------------|
| 1               | 9.6                        | 15.9             | 478                | Opaque & Yellow     | Irregular      |
| 2               | 6.7                        | 22.9             | 172                | Opaque              | Irregular      |
| 3               | 3.2                        | 6.6              | 17                 | Opaque              | Irregular      |
| 4               | 5.9                        | 5.1              | 108                | Part Opaque         | Spheroid       |
| 5               | 2.5                        | 5.7              | 13                 | Opaque              | Spheroid       |
| 6               | 4.7                        | 4.0              | 54                 | Part Opaque         | Irregular      |
| 7               | 5.1                        | 5.6              | 69                 | Grey                | Irregular      |
| 8               | 14.6                       | 36.6             | 1,262              | -                   | -              |
| 8A              | 13.2                       | -                | 1,204              | Opaque              | Sphere         |
| 8B              | 4.8                        | -                | 58                 | Clear               | Hemisphere     |
| 9               | 11.5                       | 78.3             | 796                | Opaque & Clear      | Very Irregular |
| 10              | 13.4                       | 360.6            | 1,260              | Opaque              | Spheroid       |
| 11              | 9.9                        | 95.3             | 505                | Opaque              | Spheroid       |
| 12              | 19.6                       | 282.1            | 2,965              | -                   | -              |
| 12A             | 16.3                       | -                | 2,265              | Opaque              | Sphere         |
| 12B             | 11.0                       | -                | 697                | Dirty Yellow        | Irregular      |
| 13              | 3.0                        | 8.2              | 14                 | Opaque              | Sphere         |
| 14              | 6.3                        | 30.5             | 131                | Opaque              | Irregular      |
| 15*             | 3.2                        | 8.0              | 17                 | Opaque & Clear      | Spheroid       |
| 16              | 2.9                        | 7.1              | 13                 | Opaque & Clear      | Spheroid       |
| 17              | 1.8                        | 15.1             | 3.1                | Opaque              | Irregular      |
| 18              | 3.5                        | 0.1              | 22                 | Clear               | Spheroid       |
| 19              | 3.7                        | 8.5              | 27                 | Clear               | Sphere         |
| 20              | 3.5                        | 11.4             | 22                 | Opaque              | Sphere         |
| 21              | 3.5                        | 10.3             | 22                 | Opaque              | Sphere         |
| 22              | 3.0                        | 2.9              | 14                 | Pale Green & Yellow | Sphere         |

Note: This particle shows internal structure like bubbles.

|    |     |      |     |                |          |
|----|-----|------|-----|----------------|----------|
| 23 | 5.5 | 40.5 | 87  | Opaque         | Sphere   |
| 24 | 2.8 | 5.4  | 11  | Opaque         | Sphere   |
| 25 | 4.6 | 4.2  | 51  | Opaque & Clear | Spheroid |
| 26 | 2.3 | 3.2  | 6.4 | Yellow Grey    | Sphere   |
| 27 | 2.6 | 3.2  | 9.2 | Dark Red Brown | Spheroid |

TABLE 3.2 CONTINUED

Double Tracks Arc I Station 061 Casella Continued

9668

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color            | Morphology |
|-----------------|----------------------------|------------------|--------------------|------------------|------------|
| 28              | 3.6                        | 7.1              | 24                 | Brown            | Spheroid   |
| 29              | 3.2                        | 4.1              | 17                 | Brown Orange     | Irregular  |
| 30              | 2.0                        | 2.0              | 4.2                | Brown            | Sphere     |
| 31              | 2.5                        | 1.9              | 8.2                | Brown            | Sphere     |
| 32              | 3.3                        | 4.0              | 19                 | Amber            | Irregular  |
| 33              | 5.6                        | 2.9              | 92                 | Yellow Brown     | Irregular  |
| 34              | 3.1                        | 7.5              | 16                 | Dark Amber       | Irregular  |
| 35              | 2.7                        | 4.1              | 10                 | Dark Brown       | Spheroid   |
| 36              | 2.8                        | 3.1              | 11                 | Amber            | Irregular  |
| 37              | 8.4                        | 60.7             | 310                | Dark Brown       | Sphere     |
| 38              | 2.6                        | 3.8              | 9.2                | Opaque           | Sphere     |
| 39              | 10.4                       | 29.4             | 589                | Opaque & Yellow  | Irregular  |
| 40              | 9.7                        | 17.8             | 478                | Opaque & Yellow  | Irregular  |
| 41              | 6.7                        | 6.7              | 158                | Opaque & Yellow  | Irregular  |
| 42              | 5.8                        | 4.8              | 65                 | -                | -          |
| 42A             | 4.0                        | -                | 34                 | Opaque & Clear   | Irregular  |
| 42B             | 3.9                        | -                | 31                 | Opaque & Clear   | Irregular  |
| 43              | 2.9                        | 7.2              | 13                 | Opaque           | Sphere     |
| 44              | 3.3                        | 6.6              | 19                 | Opaque           | Irregular  |
| 45              | 2.2                        | 2.1              | 5.6                | T. Orange Brown  | Spheroid   |
| 46              | 2.1                        | 2.3              | 4.2                | Opaque           | Spheroid   |
| 47              | 2.5                        | 4.7              | 8.2                | T. Orange        | Sphere     |
| 48              | 2.5                        | 1.6              | 8.2                | T. Orange, Shiny | Sphere     |
| 49              | 16.2                       | 7.6              | 988                | -                | -          |
| 49A             | 10.5                       | -                | 606                | Shiny Yellow     | Irregular  |
| 49B             | 9.0                        | -                | 382                | T. Pale Yellow   | Irregular  |
| 50              | 4.3                        | 1.8              | 42                 | Yellow           | Irregular  |

TABLE 3.2 CONTINUED

Double Tracks Arc J Balloon Line 6 Position 13 Casella

2482

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color              | Morphology  |
|-----------------|----------------------------|------------------|--------------------|--------------------|-------------|
| 1               | 6.0                        | 0.06             | 113                | Opaque & Clear     | Spheroid    |
| 2               | 18.4                       | 0.4              | 3,262              | Opaque & Clear     | Lumpy       |
| 3               | 4.8                        | 19.9             | 58                 | Opaque & Clear     | Ellipsoid   |
| 4               | 4.8                        | 3.7              | 28                 | -                  | -           |
| 4A              | 3.4                        | -                | 21                 | Opaque & Clear     | Irregular   |
| 4B              | 2.4                        | -                | 7.2                | Opaque & Clear     | Irregular   |
| 5               | 1.9                        | 0.1              | 3.6                | Opaque             | Crystalline |
| 6               | 10.2                       | 4.1              | 556                | Opaque & Clear     | Irregular   |
| 7               | 9.2                        | 24.5             | 408                | Opaque & Clear     | Spheroid    |
| 8               | 7.2                        | 17.2             | 111                | -                  | -           |
| 8A              | 5.5                        | -                | 87                 | Opaque             | Irregular   |
| 8B              | 3.6                        | -                | 24                 | Opaque             | Irregular   |
| 9               | 5.2                        | 11.8             | 45                 | -                  | -           |
| 9A              | 4.3                        | -                | 42                 | Opaque             | Sphere      |
| 9B              | 1.7                        | -                | 2.6                | Yellow             | Sphere      |
| 10              | 2.5                        | 5.1              | 8.2                | Brown              | Sphere      |
| 11              | 9.4                        | 17.7             | 147                | -                  | -           |
| 11A             | 6.1                        | -                | 119                | Opaque & Clear     | Spheroid    |
| 11B             | 1.6                        | -                | 2.1                | Opaque             | Irregular   |
| 11C             | 1.9                        | -                | 3.6                | Opaque             | Sphere      |
| 11D             | 3.5                        | -                | 22                 | Opaque             | Sphere      |
| 12              | 4.9                        | 12.5             | 62                 | Opaque             | Sphere      |
| 13              | 9.3                        | 51.2             | 120                | -                  | -           |
| 13A             | 5.7                        | -                | 97                 | Orange Brown       | Irregular   |
| 13B             | 7.6                        | -                | 23                 | Opaque             | Sphere      |
| 14              | 2.5                        | 3.3              | 8.2                | Dark Orange Brown  | Sphere      |
| 15              | 1.8                        | 1.5              | 3.1                | Brown Orange       | Sphere      |
| 16              | 2.4                        | 2.8              | 7.2                | Brown Orange       | Sphere      |
| 17              | 3.4                        | 1.5              | 21                 | Part Opaque Black  | Sphere      |
| 18              | 2.5                        | 1.1              | 8.2                | Part Opaque Black  | Spheroid    |
| 19              | 2.3                        | 1.1              | 6.4                | Shiny Opaque Black | Irregular   |
| 20              | 1.6                        | 1.6              | 2.1                | Transparent        | Sphere      |
| 21              | 2.8                        | 3.5              | 11                 | Brown              | Sphere      |
| 22              | 2.7                        | 2.5              | 10                 | Opaque Brown       | Triangle    |
| 23              | 4.2                        | 3.0              | 39                 | Grey Yellow        | Spheroid    |

TABLE 3.2 CONTINUED

Double Tracks Arc J Balloon Line 6 Position 13 Casella (Continued)

2482

| Particle Number               | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color              | Morphology |
|-------------------------------|----------------------------|------------------|--------------------|--------------------|------------|
| 24                            | 2.1                        | 1.5              | 4.8                | T. Grey            | Spheroid   |
| 25                            | 33.9                       |                  | 20,400             | T. Yellow          | Irregular  |
| 25A                           | 2.1                        | -                | 4.8                | Black              | Sphere     |
| Note: Part A is an inclusion. |                            |                  |                    |                    |            |
| 26                            | 3.8                        | 4.6              | 29                 | T. Grey Brown      | Irregular  |
| 27                            | 3.3                        | 5.8              | 17                 | T. Brown, SHiny    | Spheroid   |
| 28                            | 2.3                        | 1.5              | 6.4                | Dark Grey          | Spheroid   |
| 29                            | 2.8                        | 7.6              | 11                 | Black              | Sphere     |
| 30                            | 7.0                        | 1.5              | 180                | T. Red Orange      | Irregular  |
| 31                            | 2.0                        | 2.4              | 4.2                | T. Dark Gray       | Irregular  |
| 32                            | 2.1                        | 2.5              | 4.8                | T. Dark Gray       | Sphere     |
| 33                            | 6.9                        | 10.0             | 172                | T. Pale Yellow     | Spheroid   |
| 34                            | 2.5                        | 3.8              | 8.2                | T. Orange Brown    | Spheroid   |
| 35                            | 5.9                        | 1.6              | 108                | T. Orange Brown    | Irregular  |
| 36                            | 2.3                        | 2.2              | 6.4                | T. Brown           | Irregular  |
| 37                            | 1.9                        | 0.9              | 3.6                | T. Orange & Clear  | Sphere     |
| 38                            | 1.9                        | 1.2              | 3.6                | Opaque             | Sphere     |
| 39                            | 13.1                       | 16.4             | 1150               | Opaque & T. Yellow | Irregular  |

TABLE 3.2 CONTINUED

Double Tracks Arc J Station 058 Anderson

2812

| Particle Number   | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color           | Morphology |
|---|----------------------------|------------------|--------------------|-----------------|------------|
| 1   | 12.7                       | 158.0            | 1,073              | Opaque          | Diamond    |
| 2   | 5.7                        | 36.6             | 970                | Opaque          | Sphere     |
| 3   | 10.6                       | 10.6             | 813                | -               | -          |
| 3A  | 5.7                        | -                | 97                 | Opaque          | Spheroid   |
| 3B  | 5.6                        | -                | 92                 | Opaque          | Spheroid   |
| 3C  | 10.6                       | -                | 624                | Yellow          | Irregular  |
| 4   | 2.9                        | 8.7              | 13                 | Opaque          | Sphere     |
| 5   | 4.1                        | 14.4             | 36                 | Opaque          | Irregular  |
| 6   | 2.8                        | 5.5              | 11                 | Opaque          | Sphere     |
| 7   | 5.7                        | 16.4             | 97                 | Opaque          | Irregular  |
| 8   | 13.7                       | 8.9              | 1,346              | Yellow Green    | Sphere     |
| Note: This particle shows a complex internal structure. |                            |                  |                    |                 |            |
| 9   | 7.0                        | 3.0              | 180                | Opaque          | Irregular  |
| 10  | 3.5                        | 5.9              | 22                 | T. Dark Brown   | Spheroid   |
| 11  | 23.7                       | 1.4              | 6,965              | T. Pale Yellow  | Irregular  |
| 11A   | 9.6                        | -                | 463                | Black           | Irregular  |
| 12  | 3.8                        | 3.0              | 17                 | -               | -          |
| 12A   | 3.0                        | -                | 14                 | T. Brown Orange | Spheroid   |
| 12B   | 1.7                        | -                | 2.6                | T. Brown Orange | Spheroid   |
| 13  | 3.6                        | 2.6              | 24                 | T. Orange       | Spheroid   |
| 13A   | 2.9                        | -                | 13                 | Black           | Irregular  |
| 14  | 2.2                        | 1.6              | 5.6                | T. Dark Brown   | Sphere     |
| 15  | 2.6                        | 4.2              | 9.2                | Dull Brown      | Spheroid   |
| 16  | 6.5                        | 26.3             | 144                | Black           | Spheroid   |
| 17  | 3.5                        | 5.2              | 13                 | -               | -          |
| 17A   | 2.7                        | -                | 10                 | T. Dark Brown   | Spheroid   |
| 17B   | 1.7                        | -                | 2.6                | T. Dark Brown   | Spheroid   |
| 18  | 4.1                        | 4.2              | 36                 | T. Brown        | Sphere     |

TABLE 3.2 CONTINUED

Double Tracks Arc N Station 068 Casella

2837

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color | Morphology |
|-----------------|----------------------------|------------------|--------------------|-------|------------|
|-----------------|----------------------------|------------------|--------------------|-------|------------|

This sample yielded only particles under two microns in diameter. The observed activity was 732 dpm.

Double Tracks Arc R Station 054 Casella

2946

| Particle Number   | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color         | Morphology |
|---|----------------------------|------------------|--------------------|---------------|------------|
| 1   | 2.7                        | 8.6              | 10                 | Opaque        | Sphere     |
| 2   | 2.9                        | 6.1              | 6.3                | -             | -          |
| 2A  | 2.2                        | -                | 5.6                | Dark Amber    | Sphere     |
| 2B  | 1.1                        | -                | .7                 | Opaque        | Sphere     |
| 3   | 2.5                        | 2.9              | 8.1                | Opaque        | Sphere     |
| 4   | 16.9                       | 75.5             | 2,527              | Opaque        | Spheroid   |
| 5   | 3.2                        | 9.1              | 17                 | Brownish Red  | Sphere     |
| 6   | 2.8                        | 1.2              | 11                 | Orange Tan    | Sphere     |
| 7   | 15.3                       | 65.1             | 708                | -             | -          |
| 7A  | 10.0                       | -                | 527                | Opaque        | Irregular  |
| 7B  | 5.5                        | -                | 87                 | Opaque        | Spheroid   |
| 7C  | 5.7                        | -                | 97                 | Opaque        | Sphere     |
| 8   | 2.8                        | 6.0              | 11                 | Opaque        | Spheroid   |
| 9   | 12.6                       | 55.7             | 1,049              | Opaque        | Sphere     |
| 10  | 11.6                       | 85.9             | 817                | Dark Brown    | Sphere     |
| 11  | 2.3                        | 3.1              | 6.4                | Reddish       | Spherical  |
| Note: This appears to be a mass of $\approx 0.2\mu$ particles |                            |                  |                    |               |            |
| 12  | 3.3                        | 6.8              | 19                 | Opaque        | Sphere     |
| 13  | 6.0                        | 1.9              | 113                | Opaque        | Sphere     |
| 14  | 2.1                        | 2.4              | 4.8                | Opaque        | Irregular  |
| 15  | 2.5                        | 1.4              | 8.2                | Opaque        | Sphere     |
| 16  | 2.9                        | 1.8              | 13                 | T. Dark Brown | Spheroid   |

TABLE 3.2 CONTINUED

Double Tracks Arc R Station 082 Anderson

2934

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color | Morphology |
|-----------------|----------------------------|------------------|--------------------|-------|------------|
|-----------------|----------------------------|------------------|--------------------|-------|------------|

No particles were found. The observed activity, was 373 dpm.

Clean Slate I Arc B Balloon Line 16 Position 21 Casella

3449

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color              | Morphology |
|-----------------|----------------------------|------------------|--------------------|--------------------|------------|
| 1               | 141                        | 61.6             | 1,468,000          | Gray               | Irregular  |
| 1A              | 31.8                       | -                | 16,840             | Black              | "          |
| 1B              | 31.6                       | -                | 16,520             | Black              | "          |
| 2               | 10.9                       | 2.9              | 678                | Yellow             | "          |
| 3               | 2.8                        | 1.8              | 11                 | T. Dk. Gray Yellow | Sphere     |
| 4               | 9.8                        | 13.2             | 493                | Amber              | Irregular  |
| 5               | 11.0                       | 17.5             | 697                | Orange Brown       | "          |
| 6               | 13.1                       | 9.4              | 1,177              | T. Yellow Gray     | Sphere     |
| 7               | 7.2                        | 2.9              | 195                | T. Gray Yellow     | Spheroid   |
| 8               | 30.8                       | 5.4              | 15,300             | Brown              | Irregular  |
| 9               | 9.0                        | 7.2              | 382                | -                  | -          |
| 9A              | 4.9                        | -                | 62                 | Gray Yellow        | Spheroid   |
| 9B              | 6.3                        | -                | 131                | Gray Yellow        | Spheroid   |
| 10              | 28.9                       | 47.6             | 12,640             | T. Yellow Green    | Sphere     |
| 11              | 11.2                       | 19.3             | 736                | Gray Yellow        | Spheroid   |
| 12              | 86.5                       | 43.8             | 338,900            | T. Gray Yellow     | Sphere     |
| 13              | 24.0                       | 16.0             | 7,235              | Yellow             | Spheroid   |
| 14              | 18.5                       | 52.0             | 3,315              | Gray               | Irregular  |
| 15              | 3.6                        | 3.8              | 24                 | Yellow             | Spheroid   |
| 16              | 4.6                        | 3.2              | 51                 | Black & T. Yellow  | Sphere     |
| 17              | 5.3                        | 15.2             | 78                 | T. Orange Gray     | Spheroid   |
| 18              | 6.8                        | 4.4              | 165                | T. Brownish Gray   | Irregular  |
| 19              | 9.1                        | 7.6              | 395                | Yellowish Gray     |            |
| 20              | 9.6                        | 2.8              | 463                | Clear              | Sphere     |
| 21              | 6.5                        | 7.1              | 144                | Yellow Gray        | Sphere     |

TABLE 3.2 CONTINUED

Clean Slate I Arc B Balloon Line 18 Position 21 Casella

3449

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                   | Morphology |
|-----------------|----------------------------|------------------|--------------------|-------------------------|------------|
| 22              | 10.0                       | 4.6              | 524                | Yellow Gray             | Irregular  |
| 23              | 12.8                       | 13.2             | 1,098              | T. Yellow               | Spheroid   |
| 24              | 7.2                        | 4.0              | 195                | Black                   | "          |
| 25              | 117                        | 54.3             | 838,600            | T. Yellow               | Sphere     |
| 26              | 10.7                       | 9.2              | 641                | T. Yellow Gray          | Spheroid   |
| 27              | 5.7                        | 6.2              | 97                 | Brown                   | "          |
| 28              | 20.3                       | 2.3              | 4,380              | -                       | -          |
| 28A             | 17.4                       | -                | 2,758              | Yellow                  | "          |
| 28B             | 10.2                       | -                | 556                | T. Gray                 | "          |
| 29              | 5.7                        | 1.4              | 97                 | Yellow                  | Irregular  |
| 30              | 12.5                       | 1.5              | 1,023              | Green                   | Spheroid   |
| 31              | 13.8                       | 1.1              | 1,376              | -                       | -          |
| 31A             | 12.5                       | -                | 1,023              | T. Yellow               | "          |
| 31B             | 4.9                        | -                | 62                 | T. Yellow               | "          |
| 32              | 14.2                       | 1.4              | 1,497              | Yellow Gray             | Irregular  |
| 33              | 7.6                        | 0.8              | 230                | T. Yellow               | "          |
| 34              | 8.0                        | 0.6              | 268                | T. Yellow               | "          |
| 35              | 5.6                        | 1.0              | 92                 | T. Gray                 | "          |
| 36              | 20.2                       | 3.3              | 4,316              | T. Yellow Gray          | Sphere     |
| 37              | 17.4                       | 1.5              | 2,758              | Brown                   | Spheroid   |
| 38              | 4.2                        | 2.0              | 39                 | T. Gray Yellow          | Sphere     |
| 39              | 72.8                       | 109.5            | 202,000            | -                       | -          |
| 39A             | 69.7                       | -                | 177,300            | Black                   | Irregular  |
| 39B             | 8.1                        | -                | 278                | Black                   | Spheroid   |
| 40              | 11.5                       | 0.7              | 796                | Shiny White Metallic    | Irregular  |
| 41              | 27.6                       | 1.8              | 11,010             | T. Yellow               | Spheroid   |
| 42              | 17.3                       | 1.5              | 2,711              | T. Yellow, Grainy       | Irregular  |
| 43              | 4.7                        | 2.1              | 54                 | T. Gray Yellow          | "          |
| 44              | 5.0                        | 1.0              | 65                 | Black                   | Spheroid   |
| 45              | 7.3                        | 1.4              | 204                | Yellow                  | Irregular  |
| 46              | 18.0                       | 2.4              | 3,054              | T. Yellow Gray & Orange | "          |
| 47              | 13.3                       | 2.5              | 1,232              | Yellow                  | "          |
| 48              | 13.7                       | 0.7              | 1,346              | Yellow                  | "          |
| 49              | 2.2                        | 0.9              | 5.6                | Clear & T. Gray Orange  | Spheroid   |
| 50              | 5.6                        | 0.8              | 92                 | Yellow                  | "          |

TABLE 3.2 CONTINUED

Clean Slate I Arc B Balloon Line 19 Position 9 TAS I

3013

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color               | Morphology    |
|-----------------|----------------------------|------------------|--------------------|---------------------|---------------|
| 1               | 6.3                        | 16.2             | 131                | Black               | Spheroid      |
| 2               | 15.8                       | 41.6             | 2065               | Black               | Sphere        |
| 3               | 17.7                       | 35.4             | 2903               | T. Dirty Yellow     | Sphere        |
| 4               | 14.3                       | 120.2            | 1531               | T. Yellow & Orange  | Sphere        |
| 5               | 8.5                        | 26.4             | 321                | Black               | Grainy Sphere |
| 6               | 6.9                        | 5.4              | 172                | Black               | Oval          |
| 7               | 8.7                        | 13.0             | 345                | Black               | Triangle      |
| 8               | 9.5                        | 3.5              | 449                | Black               | Spheroid      |
| 9               | 11.1                       | 31.0             | 716                | Black & Clear       | Spheroid      |
| 10              | 26.1                       | 240.6            | 9309               | Black & Clear       | Spheroid      |
| 11              | 31.1                       | 80.7             | 15,750             | T. Yellow & Black   | Sphere        |
| 12              | 9.6                        | 37.1             | 463                | Black & Clear       | Spheroid      |
| 13              | 16.5                       | 33.2             | 2352               | T. Yellow & Black   | Spheroid      |
| 14              | 19.3                       | 48.4             | 3764               | T. Yellow & Black   | Irregular     |
| 15              | 29.8                       | 200.9            | 13,860             | Black & Clear       | Irregular     |
| 16              | 17.5                       | 122.4            | 2606               | Black               | Spheroid      |
| 17              | 17.9                       | 89.7             | 3003               | Black & Clear       | Crescent      |
| 18              | 11.4                       | 48.1             | 7752               | Black               | Spheroid      |
| 19              | 18.3                       | 124.3            | 3209               | Black               | Irregular     |
| 20              | 29.8                       | 85.5             | 13,860             | Dark T. Yellow Gray | Sphere        |
| 21              | 8.6                        | 9.9              | 333                | Black               | Spheroid      |
| 22              | 11.6                       | 27.7             | 817                | Black & Clear       | Irregular     |
| 23              | 17.3                       | 108.8            | 2414               | -                   | -             |
| 23A             | 16.6                       | -                | 2395               | Black               | Spheroid      |
| 23B             | 3.3                        | -                | 19                 | T. Orange           | Spheroid      |
| 24              | 13.6                       | 31.6             | 1317               | Black               | Irregular     |
| 25              | 15.1                       | 30.4             | 1803               | Black               | Sphere        |
| 26              | 13.6                       | 93.0             | 1317               | Black               | Oval          |
| 27              | 40.6                       | 197.3            | 35,040             | Black               | Irregular     |
| 28              | 18.1                       | 62.1             | 3105               | Black & T. Yellow   | Irregular     |
| 29              | 28.0                       | 128.3            | 11,490             | Black               | Sphere        |
| 30              | 11.6                       | 66.5             | 817                | T. Orange           | Spheroid      |
| 31              | 12.5                       | 12.5             | 1023               | Black & T. Yellow   | Crescent      |

TABLE 3.2 CONTINUED

Clean Slate I Arc B Balloon Line 19 Position 9 TAS I (Continued)

3013

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                             | Morphology |
|-----------------|----------------------------|------------------|--------------------|-----------------------------------|------------|
| 32              | 6.4                        | 16.4             | 137                | Black & Clear                     | Irregular  |
| 33              | 16.6                       | 27.4             | 2395               | Black                             | Irregular  |
| 34              | 7.2                        | 17.1             | 1954               | Black                             | Egg        |
| 35              | 10.3                       | 56.1             | 572                | Black                             | Spheroid   |
| 36              | 84.6                       | 147.4            | 317,000            | T. Yellow                         | Sphere     |
| 37              | 10.2                       | 8.4              | 556                | Black & Clear                     | Irregular  |
| 38              | 6.3                        | 5.2              | 131                | T. Orange Yellow                  | Ellipse    |
| 39              | 25.4                       | 3.7              | 8580               | T. Yellow Green                   | Spheroid   |
| 40              | 30.2                       | 22.1             | 10164              | -                                 | -          |
| 40A             | 18.6                       | -                | 3369               | Black                             | Irregular  |
| 40B             | 23.5                       | -                | 6795               | Black                             | Lumpy      |
| 41              | 6.5                        | 4.4              | 144                | Black & Clear                     | Irregular  |
| 42              | 5.4                        | 4.1              | 82                 | T. Dark Brown                     | Spheroid   |
| 43              | 26.1                       | 280.5            | 9203               | Black                             | Remisphere |
| 44              | 13.5                       | 173.2            | 1288               | Black                             | Sphere     |
| 45              | 21.9                       | 101.2            | 5499               | Loose Cluster of 11 Black Spheres |            |
| 46              | 16.2                       | 51.7             | 2226               | T. Orange                         | Sphere     |
| 47              | 12.4                       | 21.0             | 9980               | Black                             | Irregular  |
| 48              | 15.7                       | 29.5             | 2026               | Black                             | Spheroid   |
| 49              | 11.5                       | 97.4             | 796                | Black                             | Sphere     |
| 50              | 4.3                        | 2.8              | 42                 | T. Gray                           | Square     |

TABLE 3.2 CONTINUED

Clean Slate I Arc B Balloon Line 25 Position 9 TAS I

3038

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color              | Morphology        |
|-----------------|----------------------------|------------------|--------------------|--------------------|-------------------|
| 1               | 43.0                       | 170.2            | 41,630             | Black              | Irregular         |
| 2               | 12.0                       | 63.2             | 905                | Black              | Irregular         |
| 3               | 27.6                       | 214.7            | 11,010             | Black              | Grainy Ball       |
| 4               | 10.8                       | 51.8             | 660                | Black              | Pitted Spheroid   |
| 5               | 14.8                       | 50.9             | 1,697              | Dull & Shiny Black | Spheroid          |
| 6               | 17.1                       | 32.9             | 2,618              | Black              | Grainy Irregular  |
| 7               | 72.0                       | 180.3            | 191,391            | -                  | -                 |
| 7A              | 10.6                       | -                | 624                | Black              | Sphere            |
| 7B              | 15.0                       | -                | 1,767              | Yellowish          | Spheroid          |
| 7C              | 71.2                       | -                | 189,000            | Yellowish          | Irregular         |
| 8               | 36.8                       | 48.5             | 10,964             | -                  | -                 |
| 8A              | 23.3                       | -                | 6,623              | Black              | Spheroid          |
| 8B              | 16.4                       | -                | 2,310              | Yellowish          | Spheroid          |
| 8C              | 13.8                       | -                | 1,376              | Yellowish          | Irregular         |
| 8D              | 3.5                        | -                | 22                 | Dark Yellowish     | Spheroid ?        |
| 8E              | 7.1                        | -                | 187                | Clear              | Hemisphere ?      |
| 8F              | 9.1                        | -                | 395                | Yellowish          | Spheroid ?        |
| 8G              | 4.6                        | -                | 51                 | Black              | Spheroid ?        |
| 9               | 51.4                       | 8.1              | 44,316             | -                  | -                 |
| 9A              | 43.3                       | -                | 42,460             | Dark Orange        | Spheroid          |
| 9B              | 12.0                       | -                | 905                | T. Yellow Orange   | Spheroid          |
| 9C              | 12.2                       | -                | 951                | Dark Orange        | Irregular         |
| 10              | 13.9                       | 45.7             | 1,407              | Brown              | Irregular         |
| 11              | 10.6                       | 5.1              | 624                | T. Yellow Brown    | Irregular         |
| 12              | 11.5                       | 75.3             | 796                | Brown & Clear      | Irregular         |
| 13              | 15.2                       | 18.0             | 1,803              | Brown & Clear      | Irregular         |
| 14              | 24.2                       | 45.2             | 7,420              | Yellow             | Irregular         |
| 15              | 16.7                       | 13.3             | 2,439              | Black              | Irregular         |
| 16              | 8.8                        | 9.1              | 357                | Brown              | Irregular         |
| 17              | 20.5                       | 89.2             | 4,511              | Yellow Brown       | Spheroid          |
| 18              | 16.1                       | 49.9             | 2,185              | Shiny Black        | Irregular         |
| 19              | 55.5                       | 60.7             | 72,543             | -                  | -                 |
| 19A             | 51.5                       | -                | 71,520             | Black & T. Yellow  | Sphere            |
| 19B             | 12.5                       | -                | 1,023              | Black              | Sphere            |
| 20              | 91.7                       | 571.3            | 403,700            | Black & Orange     | Sphere with Warts |

TABLE 3.2 CONTINUED

Clean Slate I Arc B Balloon Line 25 Position 9 TAS I (Continued)

3038

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color             | Morphology       |
|-----------------|----------------------------|------------------|--------------------|-------------------|------------------|
| 21              | 39.3                       | 75.7             | 29,420             | T. Yellow         | Sphere           |
| 22              | 11.6                       | 44.4             | 817                | Black             | Spheroid         |
| 23              | 27.9                       | 55.8             | 11,370             | Dull Black        | Sphere           |
| 24              | 15.7                       | 91.8             | 2,026              | Black             | Spheroid         |
| 25              | 15.2                       | 57.8             | 1,839              | Shiny Black       | Sphere           |
| 26              | 30.7                       | 81.4             | 15,150             | Black             | Grainy Irregular |
| 27              | 11.0                       | 61.6             | 697                | Shiny Black       | Egg              |
| 28              | 105.2                      | 248.6            | 609,600            | T. Shiny Orange   | Sphere           |
| 29              | 11.6                       | 9.8              | 817                | Shiny Yellow Grey | Sphere           |
| 30              | 14.5                       | 2.9              | 697                | -                 | -                |
| 30A             | 10.7                       | -                | 641                | Black & Clear     | Spheroid         |
| 30B             | 4.7                        | -                | 54                 | T. Yellow         | Sphere           |
| 30C             | 1.6                        | -                | 2.1                | Black             | Sphere           |
| 31              | 58.4                       | 1611.2           | 77,328             | -                 | -                |
| 31A             | 52.3                       | -                | 74,900             | Black             | Irregular        |
| 31B             | 15.7                       | -                | 2,026              | T. Yellow         | Spheroid         |
| 31C             | 6.5                        | -                | 144                | Black             | Sphere           |
| 31D             | 7.9                        | -                | 258                | Black             | Sphere           |
| 32              | 21.5                       | 44.2             | 2,591              | -                 | -                |
| 32A             | 15.5                       | -                | 1,950              | Black             | Irregular        |
| 32B             | 10.5                       | -                | 606                | T. Yellow         | Spheroid         |
| 32C             | 3.9                        | -                | 31                 | T. Yellow         | Irregular        |
| 32D             | 2.0                        | -                | 4.2                | Black             | Sphere           |
| 33              | 20.5                       | 56.0             | 4,511              | Yellow            | Rough Irregular  |
| 34              | 26.9                       | 95.2             | 10,190             | Black             | Irregular        |
| 35              | 13.3                       | 83.0             | 854                | -                 | -                |
| 35A             | 11.5                       | -                | 796                | Black             | Spheroid         |
| 35B             | 4.8                        | -                | 58                 | T. Yellow         | Sphere           |
| 36              | 59.8                       | 76.8             | 112,000            | T. Grey Yellow    | Pitted Sphere    |
| 37              | 17.4                       | 44.4             | 2,758              | Black             | Irregular        |
| 38              | 14.0                       | 46.6             | 1,437              | Black             | Irregular        |
| 39              | 19.6                       | 10.2             | 3,942              | Brown             | Grainy Irregular |
| 40              | 6.9                        | 9.2              | 172                | Black             | Irregular        |

TABLE 3.2 CONTINUED

Clean Slate I Arc B Balloon Line 25 Position 9 TAS I (Continued)

3038

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color             | Morphology |
|-----------------|----------------------------|------------------|--------------------|-------------------|------------|
| 41              | 19.8                       | 102.7            | 3857               | -                 | -          |
| 41A             | 19.4                       | -                | 3823               | Yellow            | Spheroid   |
| 41B             | 4.0                        | -                | 34                 | T. Yellow         | Spheroid   |
| 42              | 30.6                       | 245              | 15,000             | Black             | Irregular  |
| 43              | 54.5                       | 25.2             | 84,760             | Black & T. Yellow | Irregular  |
| 44              | 54.8                       | 70.6             | 86,170             | T. Yellow         | Sphere     |
| 45              | 18.8                       | 42.2             | 3479               | T. Yellow         | Irregular  |
| 46              | 43.7                       | 161.4            | 43,700             | Black             | Spheroid   |
| 47              | 15.0                       | 86.3             | 1767               | Yellow & Clear    | Irregular  |
| 48              | 40.3                       | 82.5             | 34,270             | Black             | Spheroid   |
| 49              | 30.9                       | 105.0            | 15,450             | Black             | Sphere     |
| 50              | 33.5                       | 33.0             | 19,680             | T. Yellow         | Sphere     |

TABLE 3.2 CONTINUED

Clean Slate I Arc B Balloon Line 29 Position 9 Casella

3466

| Particle Number                             | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color               | Morphology             |
|---|----------------------------|------------------|--------------------|---------------------|------------------------|
| 1   | 33.8                       | 407.9            | 10,337             | -                   | -                      |
| 1A  | 24.8                       | -                | 7,986              | Black               | Sphere                 |
| 1B  | 16.2                       | -                | 2,226              | T. Yellow           | Spheroid               |
| 1C  | 6.2                        | -                | 125                | T. Yellow           | Hemisphere             |
| 2   | 14.6                       | 190.4            | 1,629              | Black               | Irregular              |
| 3   | 215                        | 337.5            | 5,203,000          | Clear, Black Specks | Spheroid               |
| 4   | 11.9                       | 8.2              | 882                | Black               | Irregular              |
| 5   | 25.6                       | 15.2             | 8,784              | Black               | Sphere                 |
| 6   | 21.3                       | 8.5              | 5,060              | Shiny Brown Black   | Sphere                 |
| 7   | 20.3                       | 9.6              | 4,380              | Black & Clear       | Irregular              |
| 8   | 89.7                       | 192.0            | 111,400            | -                   | -                      |
| 8A  | 57.8                       | -                | 101,100            | Black               | Spheroid               |
| 8B  | 59.5                       | -                | 110,300            | Black               | Spheroid               |
| 9   | 32.3                       | 10.6             | 17,640             | Black to Clear      | Irregular              |
| 10  | 55.4                       | 10.3             | 89,030             | T. Yellow           | Sphere with Blisters   |
| 11  | 11.5                       | 6.2              | 796                | Shiny Black         | Oval                   |
| 12  | 25.0                       | 8.4              | 8,181              | Black               | Irregular              |
| 13  | 19.7                       | 5.0              | 4,003              | Shiny Black         | Spheroid               |
| 14  | 14.8                       | 27.8             | 1,697              | Black & Clear       | Irregular              |
| 15  | 19.0                       | 20.4             | 3,591              | Brown               | Spheroid               |
| 16  | 22.0                       | 12.5             | 5,575              | Very Shiny Black    | Spheroid               |
| 17  | 67.7                       | 46.8             | 162,500            | T. Yellow           | Square with Inclusions |
| 17A   | 8.5                        | -                | 321                | Black               | Sphere                 |
| Note: Part A is apparently inside the mass. |                            |                  |                    |                     |                        |
| 18  | 205                        | 8.4              | 4,511,000          | Dirty Yellow        | Irregular              |
| 19  | 47.5                       | 10.2             | 56,120             | Yellow Brown        | Spheroid               |
| 20  | 67.3                       | 400.7            | 159,600            | Black               | Sphere with Tail       |
| 21  | 30.3                       | 308.8            | 14,570             | Black & Clear       | Irregular              |
| 22  | 48.3                       | 10.7             | 59,000             | Clear               | Irregular w. Inclusion |
| 22A   | 6.3                        | -                | 131                | Black               | Sphere                 |
| 23  | 15.6                       | 4.2              | 1,988              | Black               | Sphere                 |
| 24  | 20.3                       | 6.1              | 3,393              | -                   | -                      |
| 24A   | 18.5                       | -                | 3,315              | Dirty Yellow        | Sphere                 |
| 24B   | 5.3                        | -                | 78                 | Dirty Yellow        | Sphere                 |

TABLE 3.2 CONTINUED

Clean Slate I Arc B Balloon Line 29 Position 9 Casella (Continued)

3466

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                     | Morphology            |
|-----------------|----------------------------|------------------|--------------------|---------------------------|-----------------------|
| 25              | 66.0                       | 21.1             | 150,500            | Black & T. Yellow         | Irregular             |
| 26              | 14.9                       | 23.5             | 1,732              | Dark Brown                | Spheroid              |
| 27              | 26.7                       | 0.08             | 9,966              | Clear                     | Spheroid w. Inclusion |
| 27A             | 15.6                       | -                | 1,988              | T. Yellow                 | Spheroid              |
| 28              | 44.8                       | 19.1             | 47,080             | Clear                     | Sphere w. Inclusion   |
| 28A             | 6.9                        | -                | 172                | Black                     | Sphere                |
| 29              | 40.7                       | 14.0             | 35,300             | Clear w. Black Specks     | Irregular             |
| 30              | 20.5                       | 5.7              | 4,511              | T. Yellow to Amber Center | Sphere                |
| 31              | 34.6                       | 6.4              | 21,690             | Black & Clear             | Irregular             |
| 32              | 11.7                       | 5.5              | 519                | -                         | -                     |
| 32A             | 8.2                        | -                | 289                | Clear to T. Yellow        | Spheroid              |
| 32B             | 7.6                        | -                | 230                | Clear to T. Yellow        | Irregular             |
| 33              | 19.7                       | 26.5             | 4003               | Black                     | Irregular             |
| 34              | 85.6                       | 38.6             |                    | Black & Clear             | Irregular             |
| 35              | 18.0                       | 40.0             | 3054               | Black                     | Irregular             |
| 36              | 7.4                        | 8.8              | 145                | -                         | -                     |
| 36A             | 5.5                        | -                | 87                 | Black                     | Spheroid              |
| 36B             | 4.8                        | -                | 58                 | T. Brown                  | Spheroid              |
| 37              | 226.0                      | 13.5             | 6,044,000          | Clear                     | Irregular             |
| 38              | 117.4                      | 73.7             | 838,600            | Black & Clear             | Irregular             |
| 39              | 26.0                       | 20.0             | 9203               | Clear                     | Irregular             |
| 40              | 40.0                       | 40.0             | 33,510             | Clear Yellow              | Sphere                |
| 40A             | 5.4                        | -                | 82                 | Black                     | Sphere                |
| 41              | 26.2                       | 92.7             | 9417               | Black                     | Sphere                |
| 42              | 7.0                        | 12.1             | 180                | T. Dark Yellow            | Sphere                |
| 43              | 83.0                       | 98.9             | 299,400            | Clear                     | Sphere                |
| 44              | 66.8                       | 177.3            | 156,100            | Black                     | Irregular             |
| 45              | 31.1                       | 12.0             | 15,750             | Black                     | Spheroid              |
| 46              | 49.1                       | 97.0             | 61,980             | Black                     | Irregular             |
| 47              | 112.5                      | 156.5            | 745,600            | Black                     | Irregular             |
| 48              | 10.0                       | 70.1             | 5236               | Black                     | Spheroid              |
| 49              | 36.4                       | 3.9              | 25,250             | Black & T. Yellow         | Cylinder              |
| 50              | 51.2                       | 14.0             | 702,800            | T. Yellow & D. Yellow     | Spheroid              |

TABLE 3.2 CONTINUED

Clean Slate II BM-07 TAS D

4082

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                    | Morphology     |
|-----------------|----------------------------|------------------|--------------------|--------------------------|----------------|
| 1               | 42.8                       | 6.2              | 41,050             | T. Yellow & Black        | Irregular      |
| 2               | 24.2                       | 11.8             | 7,420              | T. Yellow & Black        | Rectangle      |
| 3               | 28.7                       | 71.4             | 12,380             | Black                    | Irregular      |
| 4               | 41.2                       | 52.6             | 33,620             | T. Yellow & Black        | Irregular      |
| 5               | 29.1                       | 17.6             | 12,900             | T. Yellow                | Irregular      |
| 6               | 28.2                       | 28.3             | 11,740             | T. Yellow-Brown          | Irregular      |
| 7               | 22.8                       | 34.2             | 6,206              | Black                    | Irregular      |
| 8               | 20.1                       | 22.0             | 4,252              | T. Dark Brown Orange     | Irregular      |
| 9               | 20.8                       | 55.6             | 4,712              | T. Orange Brown          | Irregular      |
| 10              | 21.5                       | 42.9             | 5,203              | Black                    | Irregular      |
| 11              | 27.0                       | 30.0             | 10,310             | Black                    | Irregular      |
| 12              | 21.8                       | 22.2             | 5,424              | T. Orange, Yellow, Black | Irregular      |
| 13              | 14.7                       | 20.3             | 1,665              | Black                    | Spheroid       |
| 14              | 40.6                       | 19.3             | 35,040             | Black                    | Irregular      |
| 15              | 19.0                       | 14.6             | 3,591              | T. Orange Brown & Clear  | Irregular      |
| 16              | 25.0                       | 40.9             | 11,490             | T. Dark Orange           | Irregular      |
| 17              | 59.0                       | 67.0             | 107,500            | Black & Clear            | Irregular      |
| 18              | 21.8                       | 28.4             | 5,424              | Black                    | Irregular      |
| 19              | 22.6                       | 26.4             | 6,044              | Black & T. Yellow        | Irregular      |
| 20              | 61.6                       | 397.2            | 122,400            | Black                    | Irregular      |
| 21              | 24.3                       | 14.7             | 7,513              | Black & T. Yellow        | Irregular      |
| 22              | 23.3                       | 14.8             | 6,623              | Black & T. Yellow        | Irregular      |
| 23              | 34.9                       | 57.7             | 22,260             | Black                    | Irregular      |
| 24              | 22.1                       | 51.2             | 5,651              | Black                    | Spheroid       |
| 25              | 42.1                       | 196.8            | 39,070             | Black                    | Irregular      |
| 26              | 29.0                       | 77.5             | 12,770             | Black & T. Yellow        | Irregular      |
| 27              | 34.0                       | 19.4             | 20,580             | Black & Clear            | Irregular      |
| 28              | 42.3                       | 63.5             | 39,630             | Black                    | Very Irregular |
| 29              | 25.5                       | 0.04             | 8,681              | T. Orange Brown          | Irregular      |
| 30              | 19.5                       | 24.7             | 3,882              | Black & T. Orange        | Irregular      |
| 31              | 28.5                       | 33.4             | 12,130             | T. Yellow Orange         | Irregular      |
| 32              | 28.7                       | 37.4             | 12,380             | T. Orange & Brown        | Irregular      |
| 33              | 19.4                       | 28.4             | 3,823              | Black & Clear Yellow     | Irregular      |

TABLE 3.2 CONTINUED

Clean Slate II BM-07 TAS D (Continued)

4082

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                   | Morphology |
|-----------------|----------------------------|------------------|--------------------|-------------------------|------------|
| 34              | 23.7                       | 14.5             | 6,965              | T. Yellow & Clear       | Irregular  |
| 35              | 40.8                       | 18.5             | 35,560             | Black                   | Irregular  |
| 36              | 21.7                       | 27.6             | 5,350              | Black & T. Orange       | Irregular  |
| 37              | 30.9                       | 32.0             | 15,450             | Black & T. Orange       | Irregular  |
| 38              | 13.2                       | 3.9              | 1,204              | T. Orange Brown         | Irregular  |
| 39              | 25.8                       | 20.6             | 8,991              | Black & Clear           | Irregular  |
| 40              | 14.6                       | 11.8             | 1,629              | T. Dark Brown           | Rectangle  |
| 41              | 9.5                        | 3.9              | 449                | Black                   | Irregular  |
| 42              | 21.8                       | 7.8              | 5,424              | T. Orange & Clear       | Irregular  |
| 42A             | 11.7                       | -                | 839                | Black                   | Irregular  |
| 43              | 17.4                       | 13.8             | 2,758              | T. Dark Orange          | Irregular  |
| 44              | 17.0                       | 21.3             | 2,572              | T. Yellow               | Irregular  |
| 45              | 17.2                       | 6.0              | 2,664              | T. Dark Orange          | Irregular  |
| 46              | 17.0                       | 13.5             | 2,572              | Black                   | Oval       |
| 47              | 156.7                      | 105.4            | 2,026,000          | Black                   | Irregular  |
| 48              | 53.4                       | 214.6            | 79,730             | Black & T. Orange       | Irregular  |
| 49              | 10.4                       | 3.7              | 589                | Black, T. Orange, Clear | Irregular  |
| 50              | 24.8                       | 41.1             | 7,986              | Black                   | Irregular  |

TABLE 3.2 CONTINUED

Clean Slate II Tower B Position 2 Casella

2305

| Particle Number                       | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                   | Morphology    |
|---------------------------------------|----------------------------|------------------|--------------------|-------------------------|---------------|
| 1                                     | 52.0                       | 111.6            | 73,620             | T. Dark Brown           | Irregular     |
| 2                                     | 386.2                      | 217.7            | 30,110,000         | T. Gray                 | Irregular     |
| 3                                     | 63.2                       | 35.2             | 82,120             | -                       | -             |
| 3A                                    | 51.9                       | -                | 73,200             | T. Gray                 | Irregular     |
| 3B                                    | 24.3                       | -                | 7,513              | Black                   | Sphere        |
| 3C                                    | 13.9                       | -                | 1,407              | T. Gray                 | Hemisphere    |
| 4                                     | 120.4                      | 26.3             | 904,800            | T. Dark Gray            | Irregular     |
| 5                                     | 46.9                       | 37.1             | 54,010             | T. Gray                 | Irregular     |
| 5A                                    | 18.7                       | -                | 3,424              | Black                   | Spheroid      |
| 5B                                    | 16.4                       | -                | 2,310              | Black                   | Spheroid      |
| Note: A and B are partially embedded. |                            |                  |                    |                         |               |
| 6                                     | 137.7                      | 15.4             | 137,600            | T. Gray                 | Irregular     |
| 7                                     | 55.4                       | 9.1              | 89,030             | T. Dark Brown Orange    | Frothy Sphere |
| 8                                     | 45.9                       | 136.5            | 50,630             | Brown & Clear           | Spheroid      |
| 9                                     | 55.0                       | 47.9             | 87,110             | Black & T. Yellow       | Spheroid      |
| 10                                    | 558.7                      | 814.3            | 91,430,000         | Black                   | Irregular     |
| 11                                    | 46.3                       | 10.1             | 51,970             | Clear to T. Yellow      | Spheroid      |
| 12                                    | 605.8                      | 342.6            | 116,500,000        | Black, Clear, T. Yellow | Irregular     |
| 13                                    | 52.4                       | 15.6             | 75,330             | Black                   | Sphere        |
| 14                                    | 107.6                      | 56.7             | 533,050            | -                       | -             |
| 14A                                   | 99.6                       | -                | 517,300            | T. Mottled Gray         | Irregular     |
| 14B                                   | 31.1                       | -                | 15,750             | Black                   | Spheroid      |
| 15                                    | 35.9                       | 21.1             | 24,230             | T. Gray & T. Yellow     | Spheroid      |
| 16                                    | 113.0                      | 39.7             | 115,000            | Black & T. Yellow       | Irregular     |
| 17                                    | 38.9                       | 58.4             | 30,820             | Black & T. Yellow       | Irregular     |
| 18                                    | 44.3                       | 29.1             | 45,260             | Black, Clear Edges      | Spheroid      |
| 19                                    | 94.2                       | 82.4             | 437,700            | Black                   | Sphere        |
| 20                                    | 253.9                      | 138.9            | 8,580,000          | T. Dark Brown           | Spheroid      |
| 21                                    | 59.1                       | 20.2             | 63,090             | -                       | -             |
| 21A                                   | 38.4                       | -                | 29,680             | Black                   | Irregular     |
| 21B                                   | 40.2                       | -                | 34,010             | T. Yellow               | Irregular     |
| 22                                    | 53.8                       | 42.2             | 81,530             | Black & Clear           | Irregular     |
| 23                                    | 332.5                      | 209.2            | 19,160,000         | Black                   | Spheroid      |
| 24                                    | 69.2                       | 4.0              | 173,500            | Clear                   | Sphere        |

TABLE 3.2 CONTINUED

Clean Slate II Tower B Position 2 Casella (Continued)

2305

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color             | Morphology     |
|-----------------|----------------------------|------------------|--------------------|-------------------|----------------|
| 24A             | 52.4                       | -                | 75,330             | Black             | Spheroid       |
| 25              | 27.8                       | 35.7             | 11,250             | Black             | Spheroid       |
| 26              | 24.3                       | 26.0             | 7,513              | Black & Clear     | Irregular      |
| 27              | 36.9                       | 295.2            | 30,820             | Black             | Irregular      |
| 28              | 73.9                       | 15.0             | 211,300            | Black             | Spheroid       |
| 29              | 120.1                      | 25.4             | 904,800            | T. Dark Gray      | Spheroid       |
| 30              | 192.0                      | 54.6             | 3,706,000          | Black             | Irregular      |
| 31              | 50.1                       | 40.4             | 65,840             | Black & T. Yellow | Very Irregular |
| 32              | 35.0                       | 26.1             | 28,730             | Black             | Spheroid       |
| 33              | 47.7                       | 25.1             | 56,830             | Clear             | Spheroid       |
| 34              | 148.2                      | 106.6            | 1,697,000          | Black             | Spheroid       |
| 35              | 34.5                       | 49.2             | 21,500             | Black             | Irregular      |
| 36              | 161.2                      | 38.1             | 2,185,000          | T. Yellow         | Irregular      |
| 37              | 44.5                       | 67.4             | 46,140             | Black             | Square         |
| 38              | 238.5                      | 117.1            | 7,058,000          | Black             | Irregular      |
| 39              | 133.7                      | 31.6             | 1,260,000          | Gray              | Spheroid       |
| 40              | 144.0                      | 47.9             | 1,563,000          | Black & Clear     | Irregular      |
| 41              | 171.5                      | 143.8            | 2,618,000          | T. Gray Yellow    | Irregular      |
| 42              | 158.1                      | 69.9             | 2,065,000          | T. Mottled Gray   | Irregular      |
| 43              | 107.8                      | 32.2             | 6,596,000          | T. Gray Yellow    | Irregular      |
| 44              | 59.3                       | 240.7            | 109,200            | Black             | Egg            |
| 45              | 292.1                      | 43.3             | 13,040,000         | T. Yellow Gray    | Irregular      |
| 46              | 122.8                      | 20.7             | 974,400            | T. Gray Yellow    | Irregular      |
| 47              | 77.5                       | 31.2             | 243,700            | Black             | Irregular      |
| 48              | 270.6                      | 159.4            | 10,420,000         | T. Yellow Gray    | Spheroid       |
| 49              | 135.2                      | 47.8             | 1,288,000          | T. Yellow Gray    | Irregular      |
| 50              | 34.2                       | 31.8             | 20,940             | Black & Clear     | Irregular      |

TABLE 3.2 CONTINUED

Clean Slate II British Balloon 1 Position 01 Casella

2366

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color             | Morphology |
|-----------------|----------------------------|------------------|--------------------|-------------------|------------|
| 1               | 26.6                       | 6.3              | 9854               | T. Orange & Black | Irregular  |
| 2               | 63.5                       | 28.3             | 134,100            | Black             | Irregular  |
| 3               | 48.8                       | 134.7            | 60,850             | Black             | Irregular  |
| 4               | 40.2                       | 62.6             | 34,010             | Black             | Irregular  |
| 5               | 51.7                       | 67.1             | 72,360             | Black             | Irregular  |
| 6               | 66.3                       | 180.8            | 152,600            | T. Yellow Gray    | Sphere     |
| 7               | 9.5                        | 2.5              | 449                | Black             | Irregular  |
| 8               | 4.3                        | 0.7              | 42                 | T. Orange & Black | Irregular  |

Clean Slate II Arc A Station 036 TAS D

4116

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color             | Morphology     |
|-----------------|----------------------------|------------------|--------------------|-------------------|----------------|
| 1               | 86.3                       | 112.8            | 336,500            | Black             | Heart Shaped   |
| 2               | 35.1                       | 37.0             | 22,640             | Black & Clear     | Very Irregular |
| 3               | 77.9                       | 261.2            | 247,500            | Black             | Irregular      |
| 4               | 16.2                       | 10.8             | 2,226              | Black & T. Orange | Irregular      |
| 5               | 105.1                      | 553.0            | 394,700            | -                 | -              |
| 5A              | 74.6                       | -                | 217,400            | Black             | Irregular      |
| 5B              | 69.7                       | -                | 177,300            | T. Pale Yellow    | Irregular      |
| 6               | 31.2                       | 45.9             | 15,900             | Black             | Irregular      |
| 7               | 20.2                       | 13.6             | 4,316              | T. Orange & Black | Irregular      |
| 8               | 12.2                       | 9.4              | 951                | Dark Brown        | Spheroid       |
| 9               | 19.4                       | 38.3             | 29,420             | T. Yellow & Clear | Irregular      |
| 10              | 18.6                       | 19.4             | 3,823              | Black & T. Orange | Irregular      |
| 11              | 16.8                       | 12.1             | 2,483              | Black & T. Yellow | Irregular      |
| 12              | 17.6                       | 22.5             | 2,855              | Yellow Orange     | Spheroid       |
| 13              | 21.7                       | 13.0             | 5,350              | Black             | Irregular      |
| 14              | 18.1                       | 39.4             | 3,105              | Black & T. Orange | Irregular      |
| 15              | 48.2                       | 22.2             | 58,630             | Black & T. Yellow | Irregular      |
| 16              | 17.3                       | 11.1             | 2,711              | Black             | Irregular      |
| 17              | 106.4                      | 32.6             | 659,600            | Black & Clear     | Irregular      |
| 18              | 15.9                       | 21.0             | 2,104              | Yellow Orange     | Irregular      |

TABLE 3.2 CONTINUED

Clean Slate II Arc A Station 036 TAS D (Continued)

4116

| Particle Number            | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                       | Morphology |
|----------------------------|----------------------------|------------------|--------------------|-----------------------------|------------|
| 19                         | 12.9                       | 10.8             | 1,124              | Black & T. Yellow           | Irregular  |
| 20                         | 16.2                       | 12.4             | 2,226              | Black & T. Orange           | Irregular  |
| 21                         | 147.6                      | 25.2             | 1,665,000          | T. Gray                     | Irregular  |
| 21A                        | 28.1                       | -                | 11,620             | Black                       | Sphere     |
| Part A is partly embedded. |                            |                  |                    |                             |            |
| 22                         | 41.6                       | 36.2             | 37,690             | Black                       | Irregular  |
| 23                         | 16.2                       | 16.0             | 2,226              | Black                       | Irregular  |
| 24                         | 135.9                      | 29.0             | 1,288,000          | Black                       | Irregular  |
| 25                         | 27.4                       | 41.5             | 10,770             | Black                       | Sphere     |
| 26                         | 18.3                       | 33.0             | 3,209              | Black & T. Orange           | Irregular  |
| 27                         | 38.7                       | 64.3             | 30,350             | Black & T. Orange           | Irregular  |
| 28                         | 24.0                       | 32.8             | 7,238              | Black & T. Orange           | Irregular  |
| 29                         | 18.9                       | 9.0              | 3,535              | T. Yellow                   | Irregular  |
| 30                         | 30.0                       | 48.8             | 14,140             | T. Yellow & Gray            | Crescent   |
| 31                         | 107.9                      | 3.7              | 659,600            | Orange                      | Sphere     |
| 32                         | 99.2                       | 74.1             | 511,100            | Black                       | Lumpy      |
| 33                         | 29.5                       | 32.9             | 13,440             | Black & T. Orange           | Irregular  |
| 34                         | 12.3                       | 9.2              | 9,744              | T. Yellow                   | Irregular  |
| 35                         | 21.8                       | 9.3              | 5,424              | Black, Clear Edges          | Irregular  |
| 36                         | 23.5                       | 17.7             | 6,795              | Black                       | Irregular  |
| 37                         | 20.4                       | 21.8             | 4,445              | Black & T. Orange           | Irregular  |
| 38                         | 23.3                       | 36.5             | 6,623              | Black & T. Orange           | Irregular  |
| 39                         | 52.9                       | 37.8             | 77,510             | T. Yellow                   | Sphere     |
| 39A                        | 43.0                       | -                | 41,630             | Black                       | Irregular  |
| 40                         | 20.1                       | 24.7             | 4,252              | Black                       | Irregular  |
| 41                         | 68.8                       | 30.8             | 170,500            | Black                       | Sphere     |
| 42                         | 33.4                       | 57.1             | 19,520             | T. Brown-Orange             | Irregular  |
| 43                         | 23.1                       | 19.2             | 6,454              | Black & T. Orange           | Irregular  |
| 44                         | 16.2                       | 15.6             | 2,135              | Black & T. Yellow<br>Orange | Irregular  |
| 45                         | 19.8                       | 14.4             | 4,064              | Black & T. Yellow           | Irregular  |
| 46                         | 19.8                       | 10.8             | 4,064              | Black                       | Key Shaped |
| 47                         | 28.3                       | 8.1              | 11,870             | Black, Clear Edges          | Irregular  |
| 48                         | 14.7                       | 9.7              | 1,665              | Black                       | Irregular  |
| 49                         | 28.3                       | 18.5             | 11,870             | Black & Clear               | Irregular  |
| 50                         | 17.2                       | 15.9             | 2,664              | Black                       | Irregular  |

TABLE 3.2 CONTINUED

Clean Slate II Arc A Station 054 Casella

2286

| Particle Number                     | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                    | Morphology      |
|-------------------------------------|----------------------------|------------------|--------------------|--------------------------|-----------------|
| 1                                   | 55.8                       | 78.9             | 90,970             | Black & T. Orange        | Irregular       |
| 2                                   | 19.3                       | 12.9             | 3,764              | T. Orange & Black        | Irregular       |
| 3                                   | 20.3                       | 13.1             | 4,380              | Black                    | Irregular       |
| 4                                   | 15.4                       | 6.8              | 1,912              | Black                    | Irregular       |
| 5                                   | 15.2                       | 1.7              | 1,839              | T. Orange Yellow         | Irregular       |
| 6                                   | 29.5                       | 11.5             | 13,440             | T. Yellow & Black        | Very Irregular  |
| 7                                   | 57.4                       | 67.1             | 99,020             | Black, T. Orange Edges   | Crescent        |
| 8                                   | 16.9                       | 13.1             | 2,527              | T. Orange Brown          | Irregular       |
| 9                                   | 37.6                       | 21.5             | 27,830             | T. Gray                  | Irregular       |
| 10                                  | 25.4                       | 18.4             | 4,633              | -                        | -               |
| 10A                                 | 18.9                       | -                | 3,535              | Black & Clear            | Irregular       |
| 10B                                 | 12.8                       | -                | 1,098              | Clear                    | Irregular       |
| 11                                  | 19.7                       | 25.5             | 4,003              | Black & T. Dark Orange   | Irregular       |
| 12                                  | 19.6                       | 12.1             | 3,942              | Black                    | Irregular       |
| 13                                  | 33.3                       | 24.3             | 19,330             | Black                    | Rough Rectangle |
| 14                                  | 23.7                       | 11.0             | 6,965              | T. Yellow Brown          | Very Irregular  |
| 15                                  | 24.7                       | 9.8              | 7,890              | T. Yellow                | Irregular       |
| 16                                  | 35.6                       | 139.8            | 23,620             | Black                    | Irregular       |
| 17                                  | 17.0                       | 14.4             | 2,572              | Black & T. Orange        | Irregular       |
| 18                                  | 13.2                       | 10.5             | 1,204              | Black & Clear            | Irregular       |
| 19                                  | 24.6                       | 15.7             | 7,794              | Black                    | Irregular       |
| 20                                  | 37.9                       | 51.2             | 28,500             | Black & Clear            | Irregular       |
| 21                                  | 20.8                       | 33.2             | 4,712              | T. Dark Orange Brown     | Irregular       |
| 22                                  | 33.5                       | 71.5             | 19,680             | Black                    | Irregular       |
| 23                                  | 44.0                       | 23.2             | 44,600             | Clear                    | Sphere          |
| 23A                                 | 8.9                        | -                | 369                | Black                    | Spheroid        |
| 23B                                 | 3.3                        | -                | 19                 | Black                    | Sphere          |
| Note: Parts A and B are inclusions. |                            |                  |                    |                          |                 |
| 24                                  | 26.2                       | 11.5             | 9,417              | Black & T. Orange Yellow | Very Irregular  |
| 25                                  | 29.4                       | 34.7             | 1,331              | Black & T. Orange        | Irregular       |
| 26                                  | 38.6                       | 31.4             | 30,110             | T. Yellow Brown          | Irregular       |
| 27                                  | 61.1                       | 40.8             | 119,400            | Black                    | Irregular       |
| 28                                  | 55.3                       | 27.2             | 88,550             | Black                    | Irregular       |

TABLE 3.2 CONTINUED

Clean Slate II Arc A Station 054 Casella (Continued)

2286

| Particle Number                     | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color              | Morphology |
|-------------------------------------|----------------------------|------------------|--------------------|--------------------|------------|
| 29                                  | 27.9                       | 78.1             | 11,370             | Black              | Irregular  |
| 30                                  | 33.6                       | 27.9             | 19,860             | Black, Clear Edges | Irregular  |
| 31                                  | 26.5                       | 21.5             | 9,744              | Black              | Irregular  |
| 32                                  | 19.9                       | 21.1             | 4,126              | T. Yellow          | Irregular  |
| 33                                  | 88.5                       | 71.8             | 362,900            | Black & Clear      | Irregular  |
| 34                                  | 67.2                       | 32.0             | 158,900            | Black & Clear      | Irregular  |
| 35                                  | 31.7                       | 12.9             | 16,680             | Black              | Irregular  |
| 36                                  | 47.2                       | 27.8             | 55,060             | T. Yellow          | Sphere     |
| 36A                                 | 28.0                       | -                | 11,490             | Black              | Spheroid   |
| Note: Part A is partially embedded. |                            |                  |                    |                    |            |
| 37                                  | 39.4                       | 67.9             | 32,020             | Black              | Irregular  |
| 38                                  | 71.5                       | 44.3             | 191,400            | Black & Clear      | Irregular  |
| 39                                  | 20.1                       | 11.4             | 4,252              | Black & T. Orange  | Irregular  |
| 40                                  | 14.9                       | 9.7              | 1,732              | Black & Orange     | Spheroid   |
| 41                                  | 17.2                       | 7.4              | 1,499              | Black & T. Orange  | Irregular  |
| 42                                  | 24.5                       | 18.6             | 7,700              | T. Yellow          | Irregular  |
| 43                                  | 53.5                       | 51.2             | 80,180             | Black & Clear      | Irregular  |
| 44                                  | 25.8                       | 81.6             | 8,991              | T. Yellow          | Irregular  |
| 45                                  | 30.2                       | 49.1             | 14,420             | Black & Clear      | Irregular  |
| 46                                  | 33.4                       | 28.9             | 19,520             | Black              | Irregular  |
| 47                                  | 33.3                       | 74.2             | 19,330             | Black & T. Orange  | Irregular  |
| 48                                  | 32.2                       | 59.8             | 17,480             | Black, Clear Edges | Irregular  |
| 49                                  | 27.2                       | 7.7              | 10,540             | Black              | Irregular  |
| 50                                  | 23.4                       | 13.2             | 6,709              | Black, Clear Edges | Irregular  |

TABLE 3.2 CONTINUED

Clean Slate II Arc B Station 044 Casella

2371

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                   | Morphology |
|-----------------|----------------------------|------------------|--------------------|-------------------------|------------|
| 1               | 35.9                       | 30.5             | 24,230             | Black                   | Irregular  |
| 2               | 23.6                       | 24.3             | 6,882              | Black                   | "          |
| 3               | 49.7                       | 24.4             | 64,280             | T. Gray                 | "          |
| 4               | 15.8                       | 4.0              | 2,065              | Black & T. Orange       | "          |
| 5               | 13.8                       | 4.0              | 1,376              | T. Yellow & Yellow      | "          |
| 6               | 14.1                       | 4.3              | 1,468              | T. Orange & Clear       | "          |
| 7               | 36.9                       | 17.5             | 26,310             | Mottled Black & Clear   | "          |
| 8               | 8.7                        | 2.9              | 345                | T. Orange Yellow        | "          |
| 9               | 24.7                       | 15.7             | 7,890              | T. Yellow               | "          |
| 10              | 30.8                       | 47.8             | 15,300             | Black                   | "          |
| 11              | 12.8                       | 14.4             | 1,098              | Yellow                  | "          |
| 12              | 26.0                       | 13.8             | 9,203              | Black                   | "          |
| 13              | 20.6                       | 19.6             | 4,577              | Yellow                  | "          |
| 14              | 13.4                       | 4.0              | 1,260              | Yellow                  | "          |
| 15              | 44.6                       | 72.3             | 46,450             | Gray                    | "          |
| 16              | 49.6                       | 38.9             | 63,890             | Black                   | "          |
| 17              | 14.7                       | 5.3              | 1,665              | Yellow, Clear Edges     | "          |
| 18              | 29.5                       | 4.9              | 13,440             | Black                   | "          |
| 19              | 36.4                       | 6.8              | 25,250             | Black                   | "          |
| 20              | 16.1                       | 11.1             | 2,185              | T. Yellow               | "          |
| 21              | 23.2                       | 6.9              | 6,538              | T. Yellow & Yellow      | "          |
| 22              | 7.5                        | 5.2              | 221                | Yellow                  | "          |
| 23              | 10.5                       | 2.8              | 606                | Mottled O. & T. Orange  | "          |
| 24              | 11.4                       | 6.0              | 775                | Dark Yellow             | "          |
| 25              | 13.9                       | 3.2              | 1,407              | O. & T. Orange          | "          |
| 26              | 8.0                        | 1.2              | 268                | T. Gray                 | Spheroid   |
| 27              | 12.6                       | 2.7              | 1,049              | Orange Brown            | Irregular  |
| 28              | 10.7                       | 3.9              | 641                | T. Brown Orange         | Irregular  |
| 29              | 11.8                       | 1.5              | 863                | T. Orange Brown & Black | Irregular  |
| 30              | 19.8                       | 6.0              | 4,064              | Clear w/Black Specks    | Sphere     |
| 31              | 15.8                       | 7.2              | 2,065              | Black                   | Irregular  |
| 32              | 8.0                        | 0.5              | 268                | T. Yellow               | "          |
| 33              | 19.1                       | 4.1              | 3,648              | T. Yellow               | "          |
| 34              | 10.6                       | 4.5              | 624                | T. Orange Yellow        | "          |

TABLE 3.2 CONTINUED

Clean Slate II Arc B Station 044 Casella

2371

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                 | Morphology |
|-----------------|----------------------------|------------------|--------------------|-----------------------|------------|
| 35              | 7.1                        | 1.2              | 187                | T. Orange & T. Yellow | Irregular  |
| 36              | 13.5                       | 2.1              | 1,288              | T. Orange             | "          |
| 37              | 7.3                        | 2.1              | 204                | Black                 | "          |
| 38              | 18.8                       | 1.7              | 3,479              | Black & T. Yellow     | "          |
| 39              | 24.1                       | 4.4              | 7,326              | T. Dark Gray          | "          |
| 40              | 6.3                        | 0.5              | 131                | Black                 | "          |
| 41              | 7.5                        | 1.2              | 221                | T. Yellow             | "          |
| 42              | 17.4                       | 3.3              | 2,758              | T. Yellow & T. Orange | "          |
| 43*             | 42.0                       | 3.1              | 38,790             | Black                 | "          |
| 44              | 10.2                       | 1.3              | 556                | T. Orange & T. Yellow | "          |
| 45              | 6.5                        | 2.4              | 144                | T. Yellow             | "          |
| 46*             | 57.5                       | 15.4             | 99,540             | Black                 | "          |
| 47              | 8.5                        | 1.9              | 321                | T. Yellow             | "          |
| 48              | 28.4                       | 6.7              | 11,990             | Black                 | "          |
| 49              | 36.9                       | 2.7              | 26,310             | Clear                 | "          |
| 50              | 16.8                       | 9.9              | 2,483              | Black                 | "          |

TABLE 3.2 CONTINUED

Clean Slate II Arc B Station 054 TAS II

4812

| Particle No. | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                   | Morphology |
|--------------|----------------------------|------------------|--------------------|-------------------------|------------|
| 1            | 26.2                       | 15.9             | 9,417              | Black                   | Spheroid   |
| 2            | 16.7                       | 8.8              | 2,439              | T. Yellow Brown & Black | Irregular  |
| 3            | 16.5                       | 19.7             | 2,352              | T. Orange Brown         | "          |
| 4            | 40.8                       | 36.8             | 3,556              | Black                   | "          |
| 5            | 17.3                       | 12.4             | 2,711              | Yellow                  | "          |
| 6            | 9.5                        | 5.6              | 449                | T. Yellow, Blue Specks  | "          |
| 7            | 17.8                       | 4.2              | 2,953              | T. Yellow Gray          | "          |
| 8            | 17.3                       | 6.6              | 2,711              | Gold                    | "          |
| 9            | 15.4                       | 10.5             | 1,912              | Yellow                  | "          |
| 10           | 17.8                       | 3.8              | 2,953              | Yellow                  | "          |
| 11           | 48.3                       | 7.4              | 59,000             | T. Yellow               | Sphere     |
| 12           | 14.8                       | 3.9              | 1,697              | Mottled T. Yellow-Gray  | Irregular  |
| 13           | 28.6                       | 3.0              | 12,510             | Black                   | "          |
| 14           | 14.2                       | 2.6              | 1,499              | Orange & Clear          | "          |
| 15           | 25.3                       | 5.1              | 8,479              | Black                   | "          |
| 16           | 12.8                       | 2.8              | 1,098              | Yellow                  | "          |
| 17           | 12.3                       | 5.4              | 974                | Yellow                  | "          |
| 18           | 71.2                       | 4.6              | 189,000            | Black                   | "          |
| 19           | 31.0                       | 9.6              | 15,600             | Mottled Clear & Black   | "          |
| 20           | 13.8                       | 4.6              | 1,376              | T. Yellow Orange        | "          |
| 21           | 9.6                        | 9.5              | 463                | T. Dark Yellow          | "          |
| 22           | 8.5                        | 3.4              | 321                | T. Dark Orange          | Spheroid   |
| 23           | 13.9                       | 3.8              | 1,407              | White-Yellow            | Irregular  |
| 24           | 13.0                       | 5.2              | 1,150              | T. & O. Yellow          | "          |
| 25           | 13.6                       | 2.5              | 1,317              | T. Orange               | "          |
| 26           | 26.2                       | 5.2              | 9,417              | Yellowish White         | Irregular  |
| 27           | 12.9                       | 3.6              | 1,124              | Yellow                  | "          |
| 28           | 29.6                       | 3.9              | 13,580             | Mottled Black & Clear   | "          |
| 29           | 8.6                        | 3.3              | 333                | T. Orange Brown         | "          |
| 30           | 10.9                       | 2.7              | 678                | T. & O. Yellow Orange   | "          |
| 31           | 11.6                       | 1.9              | 817                | T. Yellow               | "          |
| 31A          | 1.5                        | -                | 1.8                | Yellow                  | Sphere     |
| 32           | 12.7                       | 4.1              | 1,073              | Clear w/Bubbles         | Irregular  |

TABLE 3.2 CONTINUED

Clean Slate II Arc B Station 054 TAS II (Continued)

4812

| Particle No. | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                 | Morphology |
|--------------|----------------------------|------------------|--------------------|-----------------------|------------|
| 33           | 22.0                       | 6.8              | 5,575              | Mottled Black & Clear | Irregular  |
| 34           | 13.6                       | 3.9              | 1,317              | T. Dirty Yellow       | "          |
| 35           | 17.8                       | 2.9              | 2,953              | Yellow                | "          |
| 36           | 13.6                       | 2.4              | 1,317              | T. Gray               | "          |
| 37           | 25.1                       | 1.3              | 8,299              | Black                 | "          |
| 38A          | 21.6                       | 0.5              | 5,276              | T. & O. Yellow        | "          |
| 38B          | 7.1                        | -                | 187                | T. & O. Yellow        | "          |
| 39           | 14.5                       | 11.5             | 1,596              | Orange                | Spheroid   |
| 40           | 33.5                       | 14.1             | 1,968              | Black & Clear         | Irregular  |
| 41           | 54.0                       | 12.4             | 82,450             | Dark Gray             | "          |
| 42           | 30.8                       | 12.3             | 1,530              | T. Brown Gray         | "          |
| 43           | 24.9                       | 8.9              | 8,083              | Dark Brown            | "          |
| 44           | 24.6                       | 4.0              | 7,794              | Brown                 | "          |
| 45           | 6.9                        | 0.9              | 172                | Clear                 | Spheroid   |
| 46           | 8.2                        | 3.0              | 289                | Orange                | Irregular  |
| 47           | 6.1                        | 0.4              | 119                | T. Orange Yellow      | "          |
| 48           | 8.2                        | 1.0              | 289                | T. Yellow Orange      | "          |
| 49           | 29.4                       | 0.1              | 13,310             | Gray                  | "          |
| 50           | 15.9                       | 4.8              | 2,104              | Gray                  | "          |

TABLE 3.2 CONTINUED

Clean Slate II Arc B Station 060 Casella

2370

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                   | Morphology |
|-----------------|----------------------------|------------------|--------------------|-------------------------|------------|
| 1               | 38.0                       | 53.7             | 28,730             | Black                   | Irregular  |
| 2               | 15.2                       | 46.3             | 1,839              | T. Gray Yellow          | "          |
| 3               | 46.0                       | 25.6             | 50,960             | Black & Clear           | "          |
| 4               | 24.6                       | 14.2             | 7,794              | Clear, Black Specks     | "          |
| 5               | 16.5                       | 3.0              | 2,352              | Clear, Black Spots      | "          |
| 6               | 14.4                       | 9.3              | 1,563              | T. Yellow               | "          |
| 7               | 27.9                       | 30.7             | 11,370             | T. Orange               | "          |
| 8               | 23.6                       | 16.0             | 6,862              | Black                   | "          |
| 9               | 61.6                       | 14.9             | 122,400            | Black                   | "          |
| 10              | 45.5                       | 23.8             | 49,320             | Black                   | "          |
| 11              | 30.1                       | 64.5             | 14,280             | Black                   | "          |
| 12              | 45.5                       | 6.9              | 49,320             | Mottled Black & Clear   | "          |
| 13              | 27.1                       | 8.8              | 10,420             | T. Gray Yellow          | "          |
| 14              | 19.5                       | 5.4              | 3,882              | Black                   | "          |
| 15              | 13.7                       | 26.3             | 1,340              | O. & T. Orange          | "          |
| 16              | 18.5                       | 27.7             | 3,315              | T. Yellow Gray          | "          |
| 17              | 29.2                       | 12.4             | 13,040             | Clear, Black Spots      | "          |
| 18              | 16.6                       | 8.8              | 2,395              | O. & T. Yellow          | "          |
| 19              | 17.8                       | 9.0              | 2,953              | Black                   | "          |
| 20              | 15.5                       | 4.2              | 1,950              | T. Pale Yellow          | "          |
| 21              | 12.3                       | 7.7              | 974                | T. Yellow Mottled Black | "          |
| 22              | 18.5                       | 4.8              | 3,315              | T. Yellow               | "          |
| 23              | 21.0                       | 4.9              | 4,849              | T. Yellow Mottled Black | "          |
| 24              | 15.8                       | 4.3              | 2,065              | T. Gray                 | "          |
| 25              | 16.3                       | 7.6              | 2,268              | Black & T. Dark Orange  | "          |
| 26              | 35.7                       | 5.1              | 23,820             | T. Gray                 | "          |
| 27              | 29.0                       | 13.2             | 12,770             | T. Yellow               | Sphere     |
| 28              | 31.2                       | 14.6             | 15,900             | Black                   | Irregular  |
| 29              | 30.1                       | 27.2             | 14,280             | Black                   | "          |
| 30              | 14.9                       | 4.5              | 1,732              | T. Yellow               | "          |
| 31              | 24.9                       | 14.7             | 8,083              | Black                   | Spheroid   |
| 32              | 21.1                       | 23.9             | 4,919              | Black & Clear           | Irregular  |
| 33              | 29.5                       | 18.6             | 13,440             | Black                   | "          |
| 34              | 11.2                       | 5.5              | 736                | T. Yellow               | "          |

TABLE 3.2 CONTINUED

Clean Slate II Arc B Station 060 Casella

2370

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color               | Morphology |
|-----------------|----------------------------|------------------|--------------------|---------------------|------------|
| 35              | 14.5                       | 10.5             | 1,596              | Black               | Spheroid   |
| 36              | 10.3                       | 6.1              | 572                | Yellow              | Irregular  |
| 37              | 18.5                       | 10.5             | 3,315              | O. & T. Yellow      | "          |
| 38              | 35.3                       | 113.2            | 29,420             | Black               | "          |
| 39              | 16.4                       | 6.2              | 2,310              | Clear               | "          |
| 40              | 16.8                       | 8.3              | 2,483              | T. Dark Orange      | "          |
| 41              | 28.7                       | 7.5              | 12,380             | Black & Clear       | "          |
| 42              | 13.1                       | 7.4              | 1,177              | T. Yellow Orange    | "          |
| 43              | 45.2                       | 68.0             | 48,350             | Black               | "          |
| 44              | 16.0                       | 13.7             | 2,145              | Dark Orange         | "          |
| 45              | 13.5                       | 3.6              | 1,288              | Black               | "          |
| 46              | 13.2                       | 5.4              | 1,204              | T. Orange           | "          |
| 47              | 16.3                       | 3.8              | 2,268              | Orange, Clear Edges | "          |
| 48              | 13.8                       | 3.0              | 1,376              | T. Orange           | "          |
| 49              | 13.9                       | 3.1              | 1,407              | O. & T. Orange      | "          |
| 50              | 13.0                       | 3.0              | 1,150              | Clear               | "          |

TABLE 3.2 CONTINUED

Clean Slate II Arc B Station 068 Casella

2369

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                 | Morphology |
|-----------------|----------------------------|------------------|--------------------|-----------------------|------------|
| 1               | 39.3                       | 52.3             | 31,780             | Black, Clear Spot     | Irregular  |
| 2               | 15.0                       | 17.9             | 1,767              | Black, T. Orange Spot | Irregular  |
| 3               | 26.8                       | 40.9             | 10,080             | Shiny Yellow          | Irregular  |
| 4               | 15.4                       | 24.2             | 1,912              | Black                 | Irregular  |
| 5               | 15.0                       | 13.7             | 1,767              | Black & T. Orange     | Spheroid   |
| 6               | 20.3                       | 36.6             | 4,380              | Yellow                | Irregular  |
| 7               | 25.1                       | 76.6             | 8,299              | T. Yellow             | "          |
| 8               | 26.2                       | 22.4             | 9,417              | T. Dark Yellow        | "          |
| 9               | 51.1                       | 24.3             | 69,860             | Black, Clear Edge     | "          |
| 10              | 21.7                       | 6.5              | 5,350              | Clear to Pale Yellow  | "          |
| 11              | 40.0                       | 20.0             | 33,510             | Black                 | "          |
| 12              | 15.9                       | 21.8             | 2,104              | Black                 | "          |
| 13              | 23.1                       | 27.7             | 6,454              | Black                 | "          |
| 14              | 31.9                       | 17.5             | 17,000             | Black, Orange Spot    | "          |
| 15              | 13.1                       | 12.7             | 1,177              | Yellow                | "          |
| 16              | 12.2                       | 2.0              | 951                | Black & Clear         | "          |
| 17              | 15.4                       | 8.0              | 1,912              | Black                 | "          |
| 18              | 13.2                       | 13.5             | 1,204              | T. Yellow             | "          |
| 19              | 33.2                       | 76.0             | 1,916              | Black                 | "          |
| 20              | 10.1                       | 2.2              | 540                | T. Yellow Mottled     | "          |
| 21              | 17.3                       | 3.7              | 2,711              | Black & Clear         | "          |
| 22              | 21.0                       | 8.0              | 4,849              | Black & T. Orange     | "          |
| 23              | 35.0                       | 46.9             | 2,245              | Black                 | "          |
| 24              | 12.5                       | 3.4              | 1,023              | Black & Clear         | "          |
| 25              | 16.3                       | 5.3              | 2,268              | T. Orange, Mottled    | "          |
| 26              | 17.2                       | 14.6             | 2,664              | T. Orange & Clear     | "          |
| 27              | 22.4                       | 15.2             | 5,884              | Black                 | "          |
| 28              | 14.2                       | 6.7              | 1,499              | T. Orange & Black     | "          |
| 29              | 39.6                       | 39.5             | 32,510             | Black                 | "          |
| 30              | 27.7                       | 5.2              | 11,130             | Black                 | "          |
| 31              | 9.6                        | 4.2              | 463                | Clear                 | Spheroid   |
| 31A             | 4.0                        | -                | 34                 | T. Purple             | "          |
| 32              | 27.9                       | 28.4             | 11,370             | Black                 | Irregular  |
| 33              | 26.4                       | 11.6             | 9,634              | Black                 | "          |
| 34              | 18.4                       | 13.8             | 3,262              | T. Orange             | "          |

TABLE 3.2 CONTINUED

Clean Slate II Arc B Station 068 Casella

2369

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                | Morphology |
|-----------------|----------------------------|------------------|--------------------|----------------------|------------|
| 34A             | 4.8                        | -                | 58                 | Black                | Irregular  |
| 35              | 43.9                       | 216.7            | 42,300             | Black                | "          |
| 36              | 11.9                       | 10.4             | 892                | T. Dark Brown        | Spheroid   |
| 37              | 16.0                       | 10.0             | 2,145              | Gray & Clear         | Irregular  |
| 38              | 15.7                       | 3.8              | 2,026              | T. Dark Brown        | Spheroid   |
| 39              | 21.1                       | 27.1             | 4,919              | Black                | Irregular  |
| 40              | 24.5                       | 17.5             | 7,700              | Black & T. Orange    | "          |
| 41              | 16.8                       | 11.0             | 2,483              | T. Dark Brown        | "          |
| 42              | 31.0                       | 4.9              | 15,600             | Black, Clear Edges   | "          |
| 43              | 22.6                       | 7.6              | 6,044              | Clear                | Sphere     |
| 44              | 25.0                       | 28.3             | 8,181              | Orange, Clear Edges  | Irregular  |
| 45              | 20.1                       | 19.6             | 4,252              | T. Orange Yellow     | "          |
| 46              | 28.1                       | 10.4             | 11,620             | T. Orange Gray       | "          |
| 47              | 22.9                       | 28.0             | 6,288              | Clear Mottled Orange | "          |
| 48              | 49.4                       | 6.5              | 34,260             | -                    | -          |
| 48A             | 29.8                       | -                | 13,860             | T. Yellow            | Spheroid   |
| 48B             | 33.9                       | -                | 20,400             | T. Gray              | "          |
| 49              | 14.7                       | 10.4             | 1,665              | T. Orange            | Irregular  |
| 50              | 20.7                       | 16.6             | 4,644              | Black                | "          |

Clean Slate II Arc B Balloon Line 1 Position 17 Tas I

4022

Autoradiographic exposures of 24, 48, 96, and 120 hours revealed no radioactive sites.

TABLE 3.2 CONTINUED

Clean Slate II Arc B Balloon Line 3 Position 9 Casella

2312

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                 | Morphology      |
|-----------------|----------------------------|------------------|--------------------|-----------------------|-----------------|
| 1               | 25.5                       | 6.0              | 8,681              | Yellow                | Irregular       |
| 2               | 23.8                       | 5.2              | 7,058              | T. Yellow             | "               |
| 3               | 15.1                       | 14.5             | 1,803              | Yellow                | "               |
| 4               | 47.5                       | 58.5             | 56,120             | Black                 | "               |
| 5               | 58.7                       | 6.0              | 105,900            | T. Yellow             | "               |
| 6               | 45.0                       | 51.2             | 47,710             | Black & Clear         | "               |
| 7               | 32.6                       | 20.8             | 18,140             | Black                 | "               |
| 8               | 24.2                       | 95.8             | 7,420              | Black                 | "               |
| 9               | 46.8                       | 17.9             | 53,670             | Black                 | "               |
| 10              | 21.4                       | 16.0             | 5,131              | Yellow                | Spheroid        |
| 11              | 85.9                       | 13.0             | 212,870            | -                     | -               |
| 11A             | 57.0                       | -                | 96,970             | T. Gray               | Spheroid        |
| 11B             | 58.7                       | -                | 105,900            | T. Gray               | Spheroid        |
| 12              | 46.7                       | 34.4             | 45,830             | -                     | -               |
| 12A             | 42.8                       | -                | 41,050             | Black                 | Spheroid        |
| 12B             | 20.9                       | -                | 4,780              | Black                 | Hemisphere      |
| 13              | 25.2                       | 15.3             | 8,378              | Black & Clear         | Irregular       |
| 14              | 74.3                       | 30.6             | 214,800            | Black                 | "               |
| 15              | 40.1                       | 99.0             | 337,600            | Black                 | Spheroid        |
| 16              | 45.5                       | 102.2            | 49,320             | Black                 | "               |
| 17              | 42.1                       | 11.2             | 39,070             | Mottled Black & Clear | Irregular       |
| 18              | 51.8                       | 25.8             | 72,770             | Yellow                | Sphere          |
| 19              | 53.7                       | 21.2             | 81,080             | Black                 | Irregular       |
| 20              | 34.9                       | 84.0             | 22,260             | Black                 | "               |
| 21              | 15.2                       | 18.6             | 1,839              | Brown                 | "               |
| 22              | 41.4                       | 14.8             | 37,150             | Black                 | Irregular       |
| 23              | 25.7                       | 7.7              | 6,965              | Black & T. Yellow     | Spheroid        |
| 24              | 60.2                       | 11.9             | 114,200            | Yellow Gray           | Blistered Spher |
| 25              | 16.2                       | 6.5              | 2,226              | Yellow                | Irregular       |
| 26              | 22.1                       | 5.9              | 5,651              | Mottled Black & Clear | "               |
| 27              | 30.9                       | 8.6              | 15,450             | Yellow                | "               |
| 28              | 42.0                       | 86.5             | 38,790             | Black                 | "               |
| 29              | 28.4                       | 9.5              | 11,990             | T. Yellow             | "               |
| 30              | 19.6                       | 8.6              | 3,942              | White                 | "               |

TABLE 3.2 CONTINUED

Clean Slate II Arc B Balloon Line 3 Position 9 Casella

2312

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                 | Morphology |
|-----------------|----------------------------|------------------|--------------------|-----------------------|------------|
| 31              | 71.4                       | 32.6             |                    | -                     | -          |
| 31A             | 51.9                       | -                | 73,200             | T. Yellow             | Spheroid   |
| 31B             | 25.8                       | -                | 8,991              | Black                 | "          |
| 31C             | 18.1                       | -                | 3,105              | Black                 | "          |
| 31D             | 15.7                       | -                | 2,026              | T. Yellow             | "          |
| 32              | 24.6                       | 9.1              | 7,794              | T. Pale Yellow        | Sphere     |
| 33              | 31.6                       | 5.3              | 16,520             | Clear & Yellow        | Spheroid   |
| 34              | 62.6                       | 82.8             | 128,400            | Black & T. Gray       | Irregular  |
| 35              | 34.1                       | 14.1             | 20,760             | Black                 | "          |
| 36              | 18.4                       | 13.9             | 3,262              | T. Gray Yellow        | Spheroid   |
| 37              | 49.4                       | 13.7             | 63,120             | T. Yellow             | Irregular  |
| 38              | 53.2                       | 23.2             | 78,840             | Mottled Black & Clear | "          |
| 39              | 44.0                       | 50.6             | 44,600             | Black                 | "          |
| 40              | 42.5                       | 9.0              | 40,190             | Clear                 | "          |
| 41              | 40.0                       | 51.5             | 33,510             | Black                 | Spheroid   |
| 42              | 22.4                       | 12.7             | 5,884              | Black                 | "          |
| 43              | 50.0                       | 9.4              | 65,400             | T. Yellow             | Sphere     |
| 44              | 35.2                       | 13.8             | 22,840             | Black                 | Irregular  |
| 45              | 20.3                       | 8.5              | 4,380              | Black                 | "          |
| 46              | 33.2                       | 14.8             | 19,160             | T. Yellow             | Sphere     |
| 47              | 15.8                       | 6.4              | 20,650             | T. Orange Brown       | Irregular  |
| 48              | 20.7                       | 6.2              | 4,644              | T. Orange Brown       | "          |
| 49              | 8.6                        | 4.4              | 333                | T. Gray               | Spheroid   |
| 50              | 16.9                       | 9.4              | 2,527              | T. Yellow Brown       | Irregular  |

TABLE 3.2 CONTINUED

Clean Slate II Arc B Balloon Line 4 Position 21 TAS I

4024

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color           | Morphology |
|-----------------|----------------------------|------------------|--------------------|-----------------|------------|
| 1               | 17.1                       | 3.2              | 2,618              | T. Orange       | Irregular  |
| 2               | 15.9                       | 3.0              | 2,104              | T. Yellow Brown | "          |
| 3               | 21.5                       | 11.8             | 5,203              | T. Yellow       | "          |
| 4               | 31.3                       | 6.6              | 16,040             | Black           | "          |
| 5               | 33.8                       | 27.6             | 20,220             | Black           | "          |
| 6               | 29.5                       | 4.2              | 13,440             | Clear           | Sphere     |
| 7               | 17.5                       | 3.2              | 2,806              | Clear           | Irregular  |
| 7A              | 13.1                       | -                | 1,177              | T. Orange       | "          |
| 8               | 22.2                       | 13.4             | 5,728              | T. Orange       | "          |
| 9               | 20.7                       | 23.1             | 4,644              | Black           | "          |
| 10              | 13.5                       | 2.1              | 1,288              | T. Yellow       | "          |
| 11              | 45.4                       | 12.8             | 48,720             | Black           | "          |
| 12              | 6.5                        | 4.7              | 144                | Orange          | "          |
| 13              | 17.5                       | 6.3              | 2,806              | Black           | "          |
| 14              | 14.0                       | 6.5              | 1,437              | T. Yellow       | "          |
| 15              | 26.1                       | 11.6             | 9,309              | Black           | "          |
| 16              | 12.5                       | 3.0              | 1,023              | Orange          | "          |
| 17              | 13.6                       | 3.6              | 1,317              | O. & T. Orange  | "          |
| 18              | 13.6                       | 8.8              | 1,317              | T. Orange       | "          |
| 19              | 15.8                       | 5.0              | 2,065              | T. Yellow Brown | "          |
| 20              | 9.4                        | 3.2              | 435                | Gray            | Spheroid   |
| 21              | 14.8                       | 3.5              | 1,697              | T. Yellow Gray  | Irregular  |
| 21A             | 1.7                        | -                | 2.6                | Black           | Spheroid   |
| 21B             | 2.7                        | -                | 10                 | Black           | Irregular  |
| 22              | 18.0                       | 5.0              | 3,054              | Yellow          | "          |
| 22A             | 14.2                       | -                | 1,499              | Clear           | "          |
| 23              | 23.6                       | 1.8              | 6,882              | Black           | "          |
| 24              | 9.3                        | 1.9              | 421                | T. Orange       | "          |
| 25              | 11.6                       | 9.4              | 817                | Yellow Brown    | "          |
| 26              | 12.4                       | 1.6              | 998                | T. Yellow       | "          |
| 27              | 8.4                        | 6.2              | 310                | T. Orange       | "          |
| 28              | 9.2                        | 2.5              | 408                | T. Yellow       | "          |
| 29              | 24.8                       | 17.1             | 7,986              | Black           | "          |
| 30              | 15.5                       | 7.5              | 1,950              | T. Yellow       | "          |

TABLE 3.2 CONTINUED

Clean Slate II Arc B Balloon Line 4 Position 21 TAS I Continued

4024

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                   | Morphology |
|-----------------|----------------------------|------------------|--------------------|-------------------------|------------|
| 31              | 10.3                       | 2.8              | 572                | T. Orange Brown         | Irregular  |
| 32              | 11.2                       | 3.3              | 736                | Black & T. Orange       | "          |
| 33              | 27.9                       | 5.3              | 1,137              | Clear                   | "          |
| 33A             | 12.7                       | -                | 1,073              | Yellow                  | Spheroid   |
| 34              | 19.9                       | 0.7              | 4,126              | T. Yellow               | Irregular  |
| 34A             | 4.8                        | -                | 58                 | Black                   | "          |
| 35              | 18.0                       | 4.5              | 3,054              | T. Yellow Gray          | "          |
| 36              | 15.1                       | 2.2              | 1,803              | T. Dirty Yellow         | "          |
| 36A             | 2.3                        | -                | 6.4                | Black                   | "          |
| 36B             | 2.4                        | -                | 7.2                | Black                   | "          |
| 37              | 9.5                        | 11.0             | 449                | T. Dark Orange Red      | Spheroid   |
| 38              | 10.0                       | 3.8              | 524                | T. Orange               | Irregular  |
| 38A             | 2.7                        | -                | 10                 | Black                   | "          |
| 39              | 27.2                       | 6.5              | 1,054              | T. & O. Gray            | "          |
| 40              | 11.5                       | 5.2              | 796                | Mottled T. & O. Yellow  | "          |
| 41              | 10.4                       | 1.2              | 589                | T. Yellow               | "          |
| 42              | 12.6                       | 8.9              | 1,049              | Brown                   | "          |
| 43              | 7.3                        | 4.9              | 204                | T. Gray                 | Sphere     |
| 44              | 22.9                       | 5.9              | 6,288              | T. Gray & Mottled Black | Irregular  |
| 45              | 9.4                        | 1.1              | 435                | T. Orange               | "          |
| 46              | 13.7                       | 3.6              | 1,346              | T. Orange               | "          |
| 47              | 10.2                       | 0.7              |                    | T. Yellow & Gray        | "          |
| 48              | 10.5                       | 2.1              |                    | Yellow                  | "          |
| 49              | 13.0                       | 0                |                    | Yellow                  | "          |
| 50              | 9.2                        | 1.4              |                    | Orange                  | "          |

TABLE 3.2 CONTINUED

Clean Slate II Arc B Balloon Line 7 Position 9 TAS I

4011

| Particle Number | Average Diameter (micron) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color          | Morphology    |
|-----------------|---------------------------|------------------|--------------------|----------------|---------------|
| 1               | 8.3                       |                  | 299                | T. Yellow      | Spheroid      |
| 2               | 9.3                       |                  | 421                | O. & T. Yellow | Irregular     |
| 3               | 27.1                      |                  | 10,420             | Yellow         | Irregular     |
| 4               | 16.4                      |                  | 2,310              | T. Yellow      | Sphere        |
| 5               | 6.7                       |                  | 158                | T. Grey        | Grainy Sphere |
| 6               | 11.3                      |                  | 756                | Grey Yellow    | Spheroid      |
| 7               | 15.6                      |                  | 1,988              | T. Yellow      | Spheroid      |
| 8               | 11.0                      |                  | 697                | T. Yellow      | Spheroid      |

Clean Slate II Arc D Station 034 Anderson

3182

Autoradiographic exposures up to 120 hours reveal no particles.

TABLE 3.2 CONTINUED

Clean Slate II Arc D Mobile Position 12 Casella

2272

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                   | Morphology |
|-----------------|----------------------------|------------------|--------------------|-------------------------|------------|
| 1               | 26.6                       | 8.3              | 9,854              | Black & Clear           | Irregular  |
| 2               | 22.1                       | 9.8              | 5,651              | Black                   | "          |
| 3               | 31.5                       | 8.2              | 16,370             | Clear                   | Hemisphere |
| 4               | 26.0                       | 22.9             | 9,203              | Black                   | Irregular  |
| 5               | 48.6                       | 3.1              | 60,111             | T. Yellow               | Irregular  |
| 6               | 39.5                       | 5.9              | 3,227              | Black & Clear           | Irregular  |
| 7               | 14.9                       | 2.3              | 1,732              | Black & Clear           | "          |
| 8               | 44.6                       | 11.0             | 46,450             | T. Green & Clear        | "          |
| 9               | 39.1                       | 6.4              | 31,300             | Black, Clear, T. Orange | "          |
| 10              | 39.4                       | 17.5             | 32,020             | Black                   | "          |
| 11              | 44.4                       | 9.8              | 45,830             | Black                   | "          |
| 12              | 12.5                       | 3.9              | 1,023              | T. Pale Yellow          | "          |
| 13              | 31.8                       | .02              | 16,840             | Black                   | "          |
| 14              | 14.9                       | 6.0              | 1,732              | T. Pale Yellow Orange   | "          |
| 15              | 10.8                       | 2.7              | 6,596              | T. Pale Orange          | "          |
| 16              | 30.2                       | 6.1              | 14,420             | T. Yellow               | "          |
| 17              | 51.6                       | 30.0             | 71,930             | Black                   | "          |
| 18              | 4.4                        | 3.9              | 45                 | Yellow                  | "          |
| 19              | 31.0                       | 4.3              | 15,600             | T. Yellow               | "          |
| 19A             | 2.9                        | -                | 13                 | Black                   | Spheroid   |
| 20              | 24.2                       | 9.6              | 7,420              | Black                   | Irregular  |
| 21              | 15.4                       | 2.8              | 1,912              | T. Orange               | "          |
| 22              | 21.6                       | 3.0              | 5,276              | Clear Mottled Gray      | "          |
| 23              | 39.0                       | 12.5             | 31,060             | Brown                   | Irregular  |
| 24              | 31.2                       | 50.7             | 15,900             | Black                   | "          |
| 25              | 20.1                       | 9.8              | 4,252              | Black                   | "          |
| 26              | 30.4                       | 18.1             | 14,710             | Gray                    | "          |
| 27              | 24.2                       | 5.5              | 7,420              | Black                   | "          |
| 28              | 31.4                       | 35.6             | 16,210             | Black                   | "          |
| 29              | 32.6                       | 9.2              | 18,140             | Clear & T. Yellow       | "          |
| 30              | 27.1                       | 41.0             | 10,420             | Black                   | "          |
| 31              | 24.3                       | 25.6             | 7,513              | Black                   | "          |

TABLE 3.2 CONTINUED

Clean Slate II Arc D Mobile Position 12 Casella

2272

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                  | Morphology |
|-----------------|----------------------------|------------------|--------------------|------------------------|------------|
| 32              | 32.2                       | 7.0              | 17,480             | Black                  | Irregular  |
| 33              | 60.4                       | ?                | 115,400            | T. Gray Yellow         | "          |
| 34              | 42.2                       | 36.2             | 39,350             | Black                  | "          |
| 35              | 17.1                       | 7.6              | 2,618              | T. Orange, Black Spots | "          |
| 36              | 21.6                       | 1.4              | 5,276              | Black                  | "          |
| 37              | 31.6                       | 4.4              | 16,520             | Clear Mottled Black    | "          |
| 38              | 28.1                       | 6.0              | 11,620             | T. Dark Gray & Clear   | "          |
| 39              | 13.3                       | 6.2              | 1,232              | T. Orange              | "          |
| 40              | 14.2                       | 4.5              | 1,499              | Clear                  | "          |
| 40A             | 4.8                        | —                | 58                 | Black                  | "          |
| 41              | 32.4                       | 8.4              | 17,810             | Clear                  | "          |
| 41A             | 24.7                       | —                | 7,890              | Black                  | "          |
| 42              | 24.8                       | 70.4             | 7,986              | Orange                 | "          |
| 43              | 16.9                       | 12.2             | 2,527              | T. Yellow              | Sphere     |
| 44              | 19.2                       | 49.5             | 3,706              | T. Yellow              | Irregular  |
| 45              | 13.8                       | 141.1            | 1,376              | Yellow                 | "          |
| 46              | 20.6                       | 7.9              | 4,577              | T. Yellow              | Irregular  |
| 47              | 13.1                       | 2.02             | 1,177              | T. Dark Brown          | "          |
| 48              | 24.2                       | 20.7             | 7,420              | Black                  | "          |
| 49              | 46.1                       | 10.4             | 5,130              | Black                  | "          |
| 50              | 13.8                       | 3.6              | 1,376              | T. Orange              | "          |

TABLE 3.2 CONTINUED

Clean Slate III BM-06 Andersen

4987

| Particle Number | Average Diameter (micron) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                 | Morphology |
|-----------------|---------------------------|------------------|--------------------|-----------------------|------------|
| 1               | 18.8                      | 5.7              | 3,480              | O. & T. Yellow        | Irregular  |
| 2               | 16.3                      | 3.2              | 2,260              | O. & T. Yellow        | "          |
| 3               | 23.5                      | 26.2             | 6,840              | Yellow w. T. edges    | "          |
| 4               | 38.8                      | 66.7             | 30,500             | Black & Clear         | "          |
| 5               | 38.1                      | 35.4             | 29,000             | Black                 | "          |
| 6               | 25.7                      | 18.6             | 8,900              | T. Grey Yellow        | "          |
| 7               | 97.9                      | 19.2             | 492,000            | Black                 | "          |
| 8               | 22.7                      | 5.7              | 6,140              | Yellow                | "          |
| 9               | 14.7                      | 65.1             | 1,660              | Yellow                | "          |
| 10              | 144.8                     | 6.8              |                    | T. Dark Grey          | "          |
| 11              | 18.3                      | 7.3              | 3,200              | Yellow w. T. edges    | "          |
| 12              | 17.6                      | 7.1              | 2,860              | Brown & Clear         | "          |
| 13              | 50.6                      | 16.1             | 68,200             | Black                 | "          |
| 14              | 17.9                      | 1.7              | 2,990              | T. Yellow             | "          |
| 14A             | 3.3                       | -                | 18.8               | Yellow                | "          |
| 15              | 10.2                      | 2.0              | 558                | T. Dk. Brown Orange   | "          |
| 16              | 6.6                       | 2.1              | 151                | T. Yellow Grey        | "          |
| 17              | 12.6                      | 2.3              | 1,050              | T. Yellow             | "          |
| 18              | 8.6                       | 4.4              | 332                | T. Yellow Grey        | Sphere     |
| 19              | 9.4                       | 1.9              | 425                | T. Orange Brown       | Irregular  |
| 20              | 25.3                      | 2.1              | 8,480              | Yellow                | "          |
| 21              | 10.1                      | 3.1              | 540                | T. Yellow             | "          |
| 22              | 10.2                      | 1.0              | 558                | Grey                  | "          |
| 23              | 7.8                       | 2.1              | 248                | T. & O. Yellow        | "          |
| 24              | 5.9                       | 1.1              | 108                | T. Yellow Brown       | "          |
| 25              | 18.2                      | 2.9              | 3,140              | Grey                  | Irregular  |
| 26              | 8.6                       | 0.7              | 332                | T. Dk. Yellowish Grey | "          |
| 27              | 12.1                      | 0.7              | 925                | T. & O. Yellow        | "          |
| 28              | 8.6                       | 1.2              | 332                | T. Yellow             | "          |
| 29              | 10.7                      | 1.3              | 643                | T. Brown Orange       | Spheroid   |
| 30              | 7.7                       | 0.4              | 238                | T. Grey               | Irregular  |
| 31              | 10.7                      | 0.9              | 643                | Clear, Bubbles        | "          |
| 32              | 17.4                      | 1.8              | 2,760              | Yellow                | "          |
| 33              | 19.1                      | 4.4              | 3,640              | Yellow                | "          |
| 34              | 23.7                      | 27.9             | 6,970              | Yellow & Clear        | "          |
| 35              | 45.7                      | 1.6              | 49,700             | Clear                 | Spheroid   |
| 36              | 11.6                      | 1.1              | 820                | Clear                 | Sphere     |
| 37              | 4.1                       |                  | 36.0               | T. Yellow Grey        | Spheroid   |
| 38              | 5.2                       |                  | 73.5               | Yellow                | Irregular  |
| 39              | 23.2                      |                  | 6,560              | Yellow                | "          |
| 40              | 5.3                       |                  | 77.9               | T. Greyish Yellow     | "          |
| 41              | 19.9                      |                  | 4,130              | T. Dark Grey          | "          |
| 42              | 25.8                      |                  | 8,960              | T. Grey & Clear       | "          |
| 43              | 7.7                       |                  | 238                | -                     | --         |
| 43A             | 4.3                       | -                | 41.5               | Yellow                | "          |
| 43B             | 7.3                       | -                | 204                | T. Yellow             | "          |
| 44              | 12.4                      |                  | 1,000              | Yellow                | "          |

TABLE 3.2 CONTINUED

Clean Slate III BM-07 TAS D

5184

| Particle Number | Average Diameter (micron) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                   | Morphology |
|-----------------|---------------------------|------------------|--------------------|-------------------------|------------|
| 1               | 21.4                      | 4.9              | 5,120              | Black                   | Irregular  |
| 2               | 16.4                      | 5.3              | 2,310              | Yellow Orange           | "          |
| 3               | 14.1                      | 9.1              | 1,470              | T. Yellow w. O. spots   | "          |
| 4               | 39.4                      | 29.5             | 32,000             | Black                   | "          |
| 5               | 48.0                      | 13.2             | 57,600             | Black & Clear           | "          |
| 6               | 32.5                      | 14.3             | 18,000             | Black                   | "          |
| 7               | 10.2                      | 16.7             | 558                | T. Yellow               | "          |
| 8               | 11.6                      | 3.6              | 820                | T. Yellow Brown         | "          |
| 9               | 16.1                      | 2.1              | 2,180              | T. Dk. to Lt. Grey      | "          |
| 10              | 8.7                       | 13.2             | 344                | T. Dk. Orange Red       | "          |
| 11              | 14.4                      | 6.0              | 1,560              | Yellow                  | "          |
| 12              | 5.5                       | 4.4              | 87                 | T. Dk. Orange Red       | "          |
| 13              | 15.5                      | 22.8             | 1,950              | O. & T. Orange Red      | "          |
| 14              | 35.3                      | 37.8             | 23,000             | Black                   | "          |
| 15              | 42.5                      | 37.0             | 40,300             | Mottled T. Grey & Clear | "          |
| 16              | 18.5                      | 6.4              | 3,310              | Yellow w. T. edges      | "          |
| 17              | 17.6                      | 3.1              | 2,850              | Yellow                  | Spheroid   |
| 18              | 7.3                       | 4.7              | 204                | Yellow                  | Irregular  |
| 19              | 19.9                      | 1.5              | 4,130              | T. Yellow               | "          |
| 20              | 294.3                     | 13.4             |                    | Yellow                  | "          |
| 21              | 16.2                      | 10.0             | 2,220              | O. & T. Yellow          | "          |
| 22              | 12.8                      | 2.2              | 1,100              | T. Yellow               | "          |
| 23              | 26.0                      | 20.3             | 9,200              | Yellow                  | "          |
| 24              | 15.6                      | 12.1             | 1,980              | Yellow                  | "          |
| 25              | 14.6                      | 1.3              | 1,630              | Yellow                  | "          |
| 26              | 3.5                       | 3.4              | 22.4               | Yellow                  | Irregular  |
| 27              | 7.1                       | 1.5              | 187                | T. & O. Grey            | "          |
| 28              | 6.6                       | 0.6              | 151                | T. Yellow               | "          |
| 29              | 6.3                       | 0.6              | 131                | T. Yellow               | "          |
| 30              | 11.3                      | 5.4              | 755                | T. Yellow               | "          |
| 31              | 4.8                       | 0.8              | 58.2               | Brown                   | "          |
| 32              | 18.3                      | 3.4              | 3,200              | Yellow                  | "          |
| 33              | 9.1                       | 0.7              | 394                | T. Yellow               | "          |
| 33A             | 1.9                       | -                | 3.6                | Yellow                  | Spheroid   |
| 34              | 18.8                      | 5.0              | 3,480              | Yellow                  | Irregular  |
| 35              | 5.7                       | 1.0              | 96.9               | Dk. Grey                | "          |
| 36              | 15.3                      | 1.3              | 1,870              | T. Orange & Clear       | "          |
| 37              | 9.5                       | 0.9              | 450                | O. & T. Yellow          | "          |
| 38              | 15.0                      | 6.0              | 1,770              | O. & T. Yellow          | "          |
| 39              | 5.7                       | 0.9              | 96.9               | T. Yellow               | "          |
| 40              | 16.1                      | 2.8              | 2,180              | O. & T. Yellow          | "          |
| 41              | 10.8                      | 3.1              | 659                | Yellow                  | "          |
| 42              | 13.4                      | 1.1              | 1,260              | T. Yellow               | "          |
| 43              | 15.5                      | 0.9              | 1,950              | Yellow                  | "          |
| 44              | 14.2                      | 0.7              | 1,500              | Yellow                  | "          |
| 45              | 15.9                      | 0.8              | 2,100              | Yellow & T. Orange      | "          |
| 46              | 3.5                       | 0.04             | 22.5               | Silver                  | "          |
| 47              | 9.0                       | 0.6              | 382                | T. Yellowish            | "          |
| 48              | 6.6                       | 6.6              | 151                | T. Red Orange & Black   | "          |
| 49              | 23.5                      | 0.7              | 6,840              | T. & O. Yellow          | "          |
| 50              | 9.8                       | 7.0              |                    | T. Orange Yellow        | "          |

TABLE 3.2 CONTINUED

Clean Slate III BM-10Casella

4973

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                | Morphology |
|-----------------|----------------------------|------------------|--------------------|----------------------|------------|
| 1               | 36.8                       | 156.4            | 26,090             | Black                | Irregular  |
| 2               | 39.5                       | 17.5             | 32,270             | T. Gray              | Sphere     |
| 3               | 33.0                       | 31.6             | 18,820             | Black                | Irregular  |
| 4               | 51.8                       | 29.2             | 72,770             | Black                | Spheroid   |
| 5               | 91.7                       | 93.6             | 403,700            | Black                | Irregular  |
| 6               | 74.8                       | 26.3             | 219,100            | Yellow               | "          |
| 7               | 10.9                       | 11.4             | 678                | Black                | "          |
| 8               | 28.9                       | 4.3              | 12,640             | Black                | "          |
| 9               | 33.3                       | 31.3             | 19,330             | Black                | "          |
| 10              | 33.9                       | 23.2             | 20,400             | Black                | "          |
| 11              | 22.7                       | 10.0             | 6,124              | Black                | "          |
| 12              | 35.5                       | 18.5             | 23,420             | Black                | "          |
| 13              | 81.8                       | 74.2             | 28,660             | Black                | "          |
| 14              | 43.9                       | 8.7              | 42,300             | Black                | "          |
| 15              | 22.6                       | 7.1              | 6,044              | Black                | "          |
| 16              | 9.8                        | 9.8              | 493                | Yellow               | Spheroid   |
| 17              | 38.6                       | 6.2              | 30,110             | Black                | Irregular  |
| 18              | 64.4                       | 41.9             | 139,800            | Gray                 | "          |
| 19              | 23.2                       | 12.1             | 6,538              | Black                | "          |
| 20              | 20.1                       | 9.2              | 4,252              | Black                | "          |
| 21              | 26.3                       | 9.0              | 9,524              | Black                | "          |
| 22              | 28.6                       | 29.4             | 12,250             | T. & O. Yellow       | Spheroid   |
| 23              | 58.9                       | 4.3              | 107,000            | Mottled Gray & Clear | Irregular  |
| 24              | 40.1                       | 23.0             | 33,760             | Black                | "          |
| 25              | 10.2                       | 13.2             | 556                | Dark Yellow          | "          |
| 26              | 10.3                       | 6.3              | 572                | T. Dark Orange       | Spheroid   |
| 27              | 29.5                       | 4.2              | 13,440             | T. Gray              | "          |
| 28              | 38.0                       | 10.2             | 28,730             | T. Drk-Lt Gray       | Irregular  |
| 29              | 21.7                       | 5.5              | 5,350              | Black                | "          |
| 30              | 125                        | 42.0             | 1,023,000          | T. Gray              | "          |
| 31              | 56.3                       | 43.5             | 93,440             | Black                | "          |

TABLE 3.2 CONTINUED

Clean Slate III BM-10 Casella (Continued)

4973

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color           | Morphology |
|-----------------|----------------------------|------------------|--------------------|-----------------|------------|
| 31              | 56.3                       | 43.5             | 93,440             | Black           | Irregular  |
| 32              | 19.3                       | 17.3             | 3,764              | Black           | "          |
| 33              | 20.4                       | 7.5              | 4,445              | Clear           | Sphere     |
| 34              | 30.4                       | 15.7             | 14,710             | T. Gray         | Irregular  |
| 35              | 47.0                       | 37.8             | 54,360             | Black           | Irregular  |
| 36              | 31.8                       | 16.8             | 16,840             | Black           | "          |
| 37              | 27.2                       | 18.7             | 10,540             | Black           | "          |
| 38              | 126                        | 4.3              | 1,049,000          | T. Light Gray   | "          |
| 39              | 26.8                       | 5.6              | 100,800            | T. Gray Yellow  | Sphere     |
| 40              | 16.4                       | 7.1              | 2,310              | Yellow          | Irregular  |
| 41              | 52.2                       | 2.6              | 74,470             | Clear & Black   | "          |
| 42              | 36.3                       | 6.4              | 25,040             | Clear & Black   | "          |
| 43              | 12.4                       | 3.5              | 998                | Orange          | "          |
| 44              | 23.6                       | 5.2              | 6,882              | Black           | "          |
| 45              | 68.3                       | 3.6              | 166,800            | Black           | "          |
| 46              | 30.3                       | 2.8              | 14,570             | T. Gray         | Spheroid   |
| 47              | 38.3                       | 6.6              | 29,420             | Black & T. Gray | Irregular  |
| 48              | 53.8                       | 4.5              | 81,530             | Black           | "          |
| 49              | 17.3                       | 4.7              | 2,711              | Yellow Gray     | "          |
| 50              | 44.2                       | 8.0              | 45,210             | Black & Clear   | "          |

TABLE 3.2 CONTINUED

Clean Slate III Arc A Station 030 Andersen

4974

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                 | Morphology |
|-----------------|----------------------------|------------------|--------------------|-----------------------|------------|
| 1               | 41.4                       | 19.5             | 37,150             | Black                 | Irregular  |
| 2               | 21.0                       | 4.2              | 4,849              | T. Mottled Gray       | "          |
| 3               | 25.4                       | 5.1              | 8,580              | Black                 | "          |
| 4               | 93.3                       | 1.8              | 425,200            | Black & Clear         | "          |
| 5               | 93.4                       | 10.5             | 426,600            | Black                 | "          |
| 6               | 13.5                       | 2.9              | 1,288              | T. Orange Yellow      | "          |
| 7               | 19.3                       | 11.7             | 3,764              | T. Orange             | "          |
| 8               | 21.0                       | 2.7              | 4,849              | Black                 | "          |
| 9               | 30.2                       | 8.6              | 14,420             | Black                 | "          |
| 10              | 34.2                       | 17.6             | 20,940             | Black                 | "          |
| 11              | 13.9                       | 4.9              | 1,407              | Dark Yellow           | "          |
| 12              | 46.2                       | 145.8            | 51,630             | Black                 | "          |
| 13              | 16.3                       | 3.8              | 2,268              | T. Orange             | "          |
| 14              | 15.4                       | 9.9              | 1,912              | T. Yellow             | "          |
| 14A             | 2.4                        | -                | 7.2                | Yellow                | "          |
| 14B             | 2.1                        | -                | 4.8                | Yellow                | "          |
| 15              | 34.1                       | 32.1             | 20,760             | Black                 | "          |
| 16              | 18.6                       | 6.7              | 3,369              | Black                 | "          |
| 17              | 21.6                       | 9.7              | 5,276              | T. Yellow             | "          |
| 18              | 40.8                       | 109.4            | 35,560             | Black                 | "          |
| 19              | 12.1                       | 4.4              | 716                | Orange Yellow & clear | "          |
| 20              | 51.9                       | 20.0             | 73,200             | Black                 | "          |
| 21              | 28.4                       | 6.9              | 11,990             | Black                 | "          |
| 22              | 14.5                       | 2.3              | 1,596              | T. Yellow             | "          |
| 23              | 34.7                       | 8.5              | 21,880             | Black                 | "          |
| 24              | 35.1                       | 18.7             | 22,640             | O. & T. Gray          | "          |
| 25              | 122                        | 15.4             | 950,800            | Black & Clear         | "          |
| 26              | 14.9                       | 1.0              | 1,732              | Gray                  | "          |
| 27              | 32.1                       | 1.3              | 17,320             | Black                 | "          |
| 28              | 15.9                       | 0.7              | 2,104              | Gray                  | "          |
| 29              | 35.2                       | 7.1              | 22,840             | Brown                 | "          |
| 30              | 10.5                       | 1.2              | 606                | Gray                  | "          |
| 31              | 17.9                       | 4.4              | 3,003              | T. Orange, Grainey    | "          |

TABLE 3.2 CONTINUED

Clean Slate III Arc A Station 030 Andersen

4974

| Particle Number | Average Diameter ( $\mu$ ) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                   | Morphology |
|-----------------|----------------------------|------------------|--------------------|-------------------------|------------|
| 32              | 11.9                       | 4.8              | 882                | T. Orange & Clear       | Irregular  |
| 33              | 42.2                       | 7.8              | 39,350             | T. Brown                | "          |
| 34              | 9.4                        | 6.9              | 435                | Orange                  | "          |
| 35              | 17.2                       | 3.1              | 2,664              | Yellow                  | "          |
| 36              | 37.9                       | 4.2              | 2,850              | Black & Clear           | "          |
| 37              | 11.0                       | 4.6              | 697                | Yellow                  | "          |
| 38              | 13.4                       | 1.3              | 1,260              | Clear with Black Specks | "          |
| 39              | 9.6                        | 1.9              | 463                | Yellow                  | "          |
| 40              | 31.4                       | 2.9              | 16,210             | Black                   | "          |
| 41              | 10.1                       | 2.7              | 540                | T. Orange Yellow        | "          |
| 42              | 15.0                       | 5.7              | 1,767              | T. Yellow               | "          |
| 43              | 13.1                       | 3.1              | 1,177              | Orange                  | "          |
| 44              | 47.4                       | 9.3              | 55,760             | Gray & Clear            | "          |
| 45              | 36.2                       | 21.6             | 24,940             | Black                   | "          |
| 46              | 20.0                       | 4.3              | 4,189              | Black                   | "          |
| 47              | 14.1                       | 3.1              | 1,468              | Brown-Yellow            | "          |
| 48              | 46.8                       | 28.9             | 53,670             | Black                   | "          |
| 49              | 49.7                       | 1.9              | 64,280             | Black                   | "          |
| 50              | 12.7                       | 0.3              | 1,073              | T. Gray                 | "          |

TABLE 3.2 CONTINUED

Clean Slate III Arc A Station 102 Casella

4964

| Particle Number | Average Diameter (micron) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                  | Morphology |
|-----------------|---------------------------|------------------|--------------------|------------------------|------------|
| 1               | 18.2                      | 1.3              | 3,140              | Yellow                 | Irregular  |
| 2               | 35.9                      | 10.5             | 24,400             | Black                  | "          |
| 3               | 39.1                      | 16.6             | 31,200             | Grey                   | "          |
| 4               | 30.3                      | 8.4              | 14,600             | Black                  | "          |
| 5               | 27.4                      | 5.4              | 10,700             | Black                  | "          |
| 6               | 49.0                      | 8.6              | 61,500             | Grey                   | "          |
| 7               | 29.3                      | 7.8              | 13,200             | Black                  | "          |
| 8               | 14.5                      | 3.1              | 1,600              | Grey                   | "          |
| 9               | 33.7                      | 16.5             | 20,000             | Black                  | "          |
| 10              | 49.5                      | 20.4             | 63,500             | Black                  | "          |
| 11              | 23.5                      | 9.4              | 6,740              | -                      | -          |
| 11A             | 11.7                      | -                | 835                | Orange                 | "          |
| 11B             | 19.6                      | -                | 3,840              | Clear                  | "          |
| 12              | 72.5                      | 8.9              | 200,000            | Grey                   | "          |
| 13              | 29.8                      | 6.0              | 13,800             | T. Yellow              | Spheroid   |
| 14              | 28.7                      | 2.9              | 12,400             | Clear/Specks           | "          |
| 15              | 66.5                      | 70.7             | 154,000            | Black                  | Irregular  |
| 16              | 15.5                      | 1.7              | 1,950              | Yellow                 | "          |
| 17              | 27.0                      | 15.5             | 10,300             | Black                  | "          |
| 18              | 36.1                      | 8.6              | 24,600             | Clear & D. T. Yellow   | "          |
| 19              | 8.6                       | 1.6              | 332                | Yellow                 | Spheroid   |
| 20              | 16.6                      | 3.8              | 2,400              | Dk. Yellow             | Irregular  |
| 21              | 15.3                      | 15.2             | 1,880              | T. Yellow              | "          |
| 22              | 52.9                      | 2.7              | 77,400             | Black                  | "          |
| 23              | 12.3                      | 1.6              | 975                | Orange                 | Irregular  |
| 24              | 24.4                      | 12.2             | 7,610              | Black                  | "          |
| 25              | 32.9                      | 10.5             | 18,600             | Black                  | "          |
| 26              | 59.7                      | 10.6             | 111,000            | Black                  | "          |
| 27              | 34.6                      | 4.1              | 21,600             | Black & Clear          | "          |
| 28              | 62.2                      | 6.8              | 126,000            | Black & Clear          | "          |
| 29              | 16.8                      | 9.6              | 2,480              | Clear                  | "          |
| 30              | 37.0                      | 5.3              | 26,500             | T. Yellow              | "          |
| 31              | 11.3                      | 2.0              | 755                | Black & T. Yellow      | "          |
| 32              | 9.6                       | 3.2              | 462                | Yellow                 | Spheroid   |
| 33              | 15.2                      | 2.1              | 1,840              | Yellow                 | Irregular  |
| 34              | 16.4                      | 3.0              | 2,300              | T. Yellow              | "          |
| 35              | 11.0                      | 4.4              | 696                | T. Yellow-Orange       | "          |
| 36              | 11.2                      | 3.0              | 735                | Yellow                 | "          |
| 37              | 20.7                      | 1.9              | 4,640              | T. Yellow              | "          |
| 38              | 17.5                      | 1.3              | 2,800              | T. Grey                | "          |
| 39              | 13.7                      | 2.2              | 1,350              | Yellow                 | "          |
| 40              | 20.4                      | 2.2              | 4,450              | Yellow                 | "          |
| 41              | 12.0                      | 0.8              | 909                | T. Grey & T. Yellowish | "          |
| 42              | 10.4                      | 3.4              | 590                | Clear                  | Sphere     |
| 43              | 16.8                      | 3.2              | 2,480              | Orange Yellow          | Irregular  |
| 44              | 18.6                      | 2.0              | 3,360              | Grey                   | "          |
| 45              | 10.2                      | 2.0              | 556                | Grey                   | "          |
| 46              | 22.2                      | 1.6              | 5,730              | O. & T. Yellow         | "          |
| 47              | 13.6                      | 1.2              | 1,320              | T. Yellow              | "          |
| 48              | 21.3                      | 1.3              | 5,050              | Orange                 | Irregular  |
| 49              | 8.0                       | 2.4              | 268                | T. Orange Brown        | "          |
| 50              | 21.2                      | 1.2              | 5,000              | Grey Yellow            | "          |

TABLE 3.2 CONTINUED

Clean Slate III Arc A Station 108 TAS D

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| Particle Number | Average Diameter (micron) | Count Rate (cpm) | Volume ( $\mu^3$ ) | Color                  | Morphology |
|-----------------|---------------------------|------------------|--------------------|------------------------|------------|
| 1               | 20.4                      | 29.7             | 4,450              | Yellow                 | Irregular  |
| 2               | 25.6                      | 7.2              | 8,750              | Grey & White           | "          |
| 3               | 31.6                      | 6.4              | 16,500             | Black                  | "          |
| 4               | 34.8                      | 13.9             | 22,000             | Black                  | "          |
| 5               | 20.1                      | 7.4              | 4,250              | Black                  | "          |
| 6               | 37.5                      | 2.8              | 2,760              | Mottled Black & Clear  | "          |
| 7               | 66.0                      | 22.5             | 150,000            | Black                  | "          |
| 8               | 20.8                      | 6.8              | 4,700              | T. Yellow              | "          |
| 9               | 27.5                      | 5.2              | 10,900             | Yellow                 | Spheroid   |
| 10              | 11.5                      | 9.9              | 800                | T. Orange              | Irregular  |
| 11              | 35.5                      | 91.6             | 23,400             | O. & T. Yellow         | "          |
| 12              | 19.7                      | 8.2              | 4,000              | Yellow                 | "          |
| 13              | 28.1                      | 4.7              | 11,600             | T. Brown               | "          |
| 14              | 35.6                      | 8.4              | 23,600             | Mottled Black & Clear  | "          |
| 15              | 4.2                       | 2.3              | 38.8               | Silver, Yellow, Red    | "          |
| 16              | 22.4                      | 2.7              | 5,860              | Yellow                 | "          |
| 17              | 27.0                      | 44.6             | 10,300             | Yellow                 | "          |
| 18              | 46.0                      | 2.2              | 50,800             | Black                  | "          |
| 19              | 13.5                      | 3.2              | 1,290              | Orange                 | "          |
| 20              | 16.2                      | 2.0              | 2,220              | T. & O. Orange         | "          |
| 21              | 19.4                      | 3.2              | 3,810              | Yellow                 | "          |
| 22              | 24.5                      | 5.0              | 7,700              | Yellow                 | "          |
| 23              | 31.8                      | 0.3              | 16,800             | Black                  | "          |
| 24              | 24.0                      | 2.8              | 7,240              | Yellow                 | "          |
| 25              | 11.2                      | 1.1              | 735                | Yellow Orange          | "          |
| 26              | 19.3                      | 2.7              | 3,760              | Brown Yellow           | "          |
| 27              | 11.6                      | 2.4              | 820                | T. Dk. Orange          | "          |
| 28              | 26.9                      | 7.1              | 10,200             | Brown & Clear          | "          |
| 29              | 16.8                      | 4.5              | 2,480              | T. Brown Grey          | "          |
| 30              | 17.4                      | 3.2              | 2,760              | Yellow                 | "          |
| 31              | 10.7                      | 3.9              | 643                | Yellow                 | "          |
| 32              | 55.2                      | 1.8              | 88,300             | Black                  | "          |
| 33              | 6.7                       | 1.0              | 157                | T. Yellow Grey         | "          |
| 34              | 10.4                      | 3.7              | 590                | T. Yellow              | "          |
| 35              | 23.8                      | 1.6              | 7,070              | Yellow Orange/T. Edges | "          |
| 36              | 16.5                      | 3.4              | 2,360              | Yellow                 | "          |
| 37              | 8.1                       | 2.0              | 278                | Bright Yellow Orange   | "          |
| 38              | 10.2                      | 8.2              | 556                | T. Grey Yellow         | "          |
| 39              | 28.0                      | 1.3              | 11,500             | Black                  | "          |
| 40              | 20.1                      | 2.8              | 4,250              | Yellow                 | "          |
| 41              | 11.1                      | 2.1              | 716                | Black & T. Grey        | "          |
| 42              | 7.7                       | 2.1              | 238                | T. Grey Yellow         | "          |
| 43              | 11.8                      | 1.4              | 861                | Yellow                 | "          |
| 44              | 19.9                      | 2.0              | 4,120              | T. Yellow              | "          |
| 45              | 13.3                      | 3.6              | 1,230              | Yellow                 | "          |
| 46              | 21.5                      | 1.5              | 5,210              | Yellow                 | "          |
| 47              | 23.2                      | 9.4              | 6,560              | T. Brown               | "          |
| 48              | 17.9                      | 3.7              | 3,000              | Yellow                 | "          |
| 49              | 5.0                       | 1.1              | 65.7               | T. Brown Yellow        | "          |
| 50              | -                         | 1.2              | -                  | -                      | -          |
| 50A             | 6.6                       | -                | 151                | Orange                 | "          |
| 50B             | 2.3                       | -                | 6.4                | Orange                 | "          |

TABLE 3.3 PRECISION ALPHA COUNTING, PLUTONIUM, AND AMERICIUM

| Sample No.                                  | Particle No. | Location  | Average Diameter<br>(micron) | Gross Count Rate<br>(cpm) | Pu <sup>239+240</sup> Content<br>(dpm) | Error (Percent) | Correction Factor | Class* |
|---|--------------|-----------|------------------------------|---------------------------|--|-----------------|-------------------|--------|
| <b>EVENT DOUBLE TRACKS<br/>(Plutonium)</b>  |              |           |                              |                           |  |                 |                   |        |
| 9668  | 17           | I061      | 1.8                          | 15.1                      | 15.5                                   | 2.5             | 1.03              | III 0  |
| 2812  | 5            | J058      | 4.1                          | 14.4                      | 14.3                                   | 2.4             | .993              | III 0  |
| 9699  | 1            | E058      | 3.2                          | 6.5                       | 8.2                                    | 4.4             | 1.3               | II 0   |
| 2443  | 1            | BL7P9     | 1.9                          | 2.0                       | 1.4                                    | 10.5            | .70               | I T    |
| <b>EVENT CLEAN SLATE I<br/>(Plutonium)</b>  |              |           |                              |                           |  |                 |                   |        |
| 3038  | 21           | BL25P9    | 39.3                         | 75.7                      | 121.3                                  | 2.3             | 1.60              | I T    |
| 3013  | 39           | BL19P9    | 25.4                         | 3.7                       | 4.5                                    | 5.5             | 1.2               | II T   |
| 3466  | 27           | BL29P9    | 26.7                         | 0.08                      | 94.9                                   |                 | 1000              | II P   |
| <b>EVENT CLEAN SLATE II<br/>(Plutonium)</b> |              |           |                              |                           |  |                 |                   |        |
| 4082  | 8            | BM-07     | 20.1                         | 22.0                      | 29.1                                   | 3.0             | 1.32              | III T  |
| 2305  | 24           | TB, P2    | 69.2                         | 4.0                       | 8.4                                    | 4.1             | 2.1               | I T    |
| 2366  | 1            | BB1-01    | 26.6                         | 6.3                       | 6.3                                    | 5.4             | 1.0               | III P  |
| 2370  | 12           | B-060     | 45.5                         | 6.9                       | 8.7                                    | 3.4             | 1.3               | III P  |
| 2371  | 43           | B-044     | 42.0                         | 3.1                       | 4.5                                    | 4.8             | 1.4               | III 0  |
| 2369  | 24           | B-068     | 12.5                         | 3.4                       | 60.0                                   | 3.2             | 18                | III P  |
| 2312  | 14           | B, L3, P9 | 74.3                         | 30.6                      | 56.7                                   | 3.0             | 1.85              | III 0  |

\* Class I - Sphere; Class II - Spheroid; Class III - Irregular  
0 - Opaque; P - Part Opaque; T - Translucent

TABLE 3.3 CONTINUED

| Sample No.                           | Particle No. | Location   | Average Diameter<br>(micron) | Gross Count Rate<br>(cpm)                | Pu <sup>239+240</sup> Content<br>(dpm) | Error (Percent) | Correction Factor | Class* |
|--------------------------------------|--------------|------------|------------------------------|--|--|-----------------|-------------------|--------|
| EVENT CLEAN SLATE II<br>(Plutonium)  |              |            |                              |  |  |                 |                   |        |
| 2272                                 | 39           | DM Pos. 12 | 13.3                         | 6.2                                      | 7.2                                    | 5.0             | 1.2               | III T  |
| 2286                                 | 37           | A-054      | 39.4                         | 67.9                                     | 54.3                                   | 3.6             | 0.800             | III 0  |
| 4116                                 | 22           | A-036      | 41.6                         | 36.2                                     | 55.3                                   | 3.5             | 1.53              | III 0  |
| 4812                                 | 5            | B-054      | 17.3                         | 12.4                                     | 12.6                                   | 5.2             | 1.015             | III 0  |
| EVENT CLEAN SLATE III<br>(Plutonium) |              |            |                              |  |  |                 |                   |        |
| 4964                                 | 10           | A-102      | 49.5                         | 2.1                                      | 34.5                                   | 3.8             | 16                | III 0  |
| 4973                                 | 13           | BM-10      | 81.8                         | 74.2                                     | 126                                    | 2.3             | 1.698             | III 0  |
| EVENT DOUBLE TRACKS<br>(Americium)   |              |            |                              |  |  |                 |                   |        |
|                                      |              |            |                              | <u>Am<sup>241</sup> Content</u><br>(dpm) |  |                 |                   |        |
| 2151                                 | 12           |            |                              | 67.1                                     | 0.956                                  | 7.5             |                   |        |
| 2526                                 | 18           |            |                              | 23.2                                     | 0.166                                  | 24              |                   |        |
| 2723                                 | 10           |            |                              | 78.1                                     | 0.392                                  | 130             |                   |        |
| 2812                                 | 5            |            |                              | 14.4                                     | 0.095                                  | 80              |                   |        |
| 9656                                 | 34           |            |                              | 59.6                                     | 0.990                                  | 10              |                   |        |
| 9668                                 | 17           |            |                              | 15.1                                     | 0.085                                  | 425             |                   |        |
| EVENT CLEAN SLATE I<br>(Americium)   |              |            |                              |  |  |                 |                   |        |
| 3038                                 | 21           |            |                              | 75.7                                     | 1.82                                   | 5               |                   |        |

TABLE 3.4 PARTICLE DENSITY MEASUREMENTS

| Location             | Tracerlab No. | Diameter (micron) | Density (gm/cc) | Description          |           |
|----------------------|---------------|-------------------|-----------------|----------------------|-----------|
| EVENT DOUBLE TRACKS  |               |                   |                 |                      |           |
| BL8P21               | 2151-32       | 10.9              | 15.46           | Trans. Yellow-Gray   | Sphere    |
|                      | 2151-38       | 10.3              | 4.26            | Opaque               | Sphere    |
| E058                 | 9698-9        | 35.6              | 2.19            | Opaque               | Irregular |
| G064                 | 9656-6        | 13.0              | 11.65           | Opaque               | Sphere    |
|                      | 9656-2        | 10.6              | 3.83            | Part Opaque          | Sphere    |
| EVENT CLEAN SLATE II |               |                   |                 |                      |           |
| BM07                 | 4082-14       | 40.6              | 4.58            | Black                | Irregular |
| TBP2                 | 2305-38       | 238.5             | 1.66            | Black                | Irregular |
|                      | 2305-15       | 35.9              | 2.64            | Trans. Gray & Yellow | Spheroid  |
|                      | 2305-35       | 34.5              | 3.37            | Black                | Irregular |

TABLE 3.5 FLUOROMETRIC URANIUM ASSAY

| <u>Sample Number</u> | <u>Particle Number</u> | <u>Location</u> | <u>Average Diameter (micron)</u> | <u>Count Rate (cpm)</u> | <u>Uranium Content (nanogm)</u> | <u>Class*</u> |
|----------------------|------------------------|-----------------|----------------------------------|-------------------------|---------------------------------|---------------|
| EVENT DOUBLE TRACKS  |                        |                 |                                  |                         |                                 |               |
| 2907                 | 8                      | B, L5, P17      | 8.6                              | 43.3                    | 4.9                             | II 0          |
|                      | 12                     |                 | 18.4                             | 113.4                   | 4.3                             | III P         |
| 2922                 | 15                     | D068            | 16.6                             | 34.9                    | 6.7                             | III 0         |
|                      | 19                     |                 | 20.2                             | 185.1                   | 4.2                             | II 0          |
| 9660                 | 2                      | G058            | 12.7                             | 214.5                   | -                               | II 0          |
| 2723                 | 1                      | H060            | 11.9                             | 147.4                   | -                               | III 0         |
|                      | 6                      |                 | 33.4                             | 15.5                    | -                               | III 0         |
|                      | 9                      |                 | 13.2                             | 130.1                   | 3.3                             | II 0          |
| 2812                 | 1                      | J058            | 12.7                             | 158.0                   | -                               | III 0         |
|                      | 2                      |                 | 5.7                              | 36.6                    | -                               | I 0           |
|                      | 8                      |                 | 13.7                             | 8.9                     | -                               | I T           |
|                      | 9                      |                 | 7.0                              | 3.0                     | -                               | III 0         |
| 2946                 | 4                      | R054            | 16.9                             | 75.5                    | 5.3                             | II 0          |
|                      | 7                      |                 | 15.3                             | 65.1                    | 4.7                             | Aggregate     |
|                      | 9                      |                 | 12.6                             | 558.6                   | 5.3                             | I 0           |
|                      | 10                     |                 | 11.6                             | 85.9                    | 2.8                             | I T           |
| 2526                 | 43                     | A066            | 5.2                              | 9.1                     | -                               | II T          |
|                      | 21                     |                 | 6.4                              | 16.4                    | -                               | I T           |
|                      | 40                     |                 | 8.9                              | 5.2                     | -                               | II T          |
|                      | 24                     |                 | 10.5                             | 11.4                    | -                               | III T         |
| 9656                 | 23                     | G064            | 3.7                              | 6.9                     | -                               | Aggregate     |
|                      | 11                     |                 | 8.5                              | 51.8                    | -                               | I 0           |
|                      | 18                     |                 | 4.6                              | 19.9                    | -                               | II P          |
|                      | 45                     |                 | 10.1                             | 17.1                    | -                               | III 0         |
| 9656                 | 48                     | E058            | 10.4                             | 12.5                    | -                               | III P         |
| 9698                 | 12                     | E058            | 15.0                             | 34.6                    | -                               | III P         |
|                      | 18                     |                 | 12.6                             | 8.1                     | -                               | III T         |
|                      | 10                     |                 | 17.3                             | 16.0                    | -                               | III P         |
| 9668                 | 10                     | I061            | 13.4                             | 360.6                   | -                               | II 0          |
|                      | 1                      |                 | 9.6                              | 15.9                    | -                               | III P         |
| 2151                 | 31                     | B, L5, P21      | 8.9                              | 27.3                    | -                               | II 0          |
| 2482                 | 7                      | J, L6, P13      | 11.4                             | 26.0                    | -                               | Aggregate     |

\* Class I - Sphere                    0 - Opaque  
Class II - Spheroid                  P - Part Opaque  
Class III - Irregular                T - Translucent

- indicates a total uranium content less than 1.8 nanograms.

TABLE 3.5 CONTINUED

| Sample Number        | Particle Number | Location    | Average Diameter (micron) | Count Rate (cpm) | Uranium Content (nanogm) | Class* |
|----------------------|-----------------|-------------|---------------------------|------------------|--------------------------|--------|
| EVENT CLEAN SLATE I  |                 |             |                           |                  |                          |        |
| 3038                 | 48              | B, L25, P9  | 40.3                      | (82.5)           | 46.8                     | II 0   |
|                      | 45              |             | 18.8                      | 42.2             | -                        | III T  |
| 3013                 | 15              | B, L19, P9  | 29.8                      | 200.9            | 20.7                     | III P  |
|                      | 47              |             | 12.4                      | 21.0             | -                        | III 0  |
|                      | 25              |             | 15.1                      | 30.4             | 2.2                      | I 0    |
|                      | 44              |             | 13.5                      | 173.2            | -                        | I 0    |
| 3466                 | 33              | B, L29, P9  | 19.7                      | 26.5             | 4.5                      | III 0  |
|                      | 49              |             | 36.4                      | 3.9              | 2.4                      | III P  |
|                      | 21              |             | 30.3                      | 308.2            | -                        | III P  |
|                      | 47              |             | 112.5                     | (156.5)          | 40.2                     | III 0  |
| 3449                 | 19              | B, L18, P21 | 9.1                       | 7.6              | -                        | III 0  |
|                      | 34              |             | 8.0                       | 0.6              | -                        | III T  |
|                      | 40              |             | 11.5                      | 0.7              | -                        | III 0  |
|                      | 45              |             | 7.3                       | 1.4              | -                        | III 0  |
| EVENT CLEAN SLATE II |                 |             |                           |                  |                          |        |
| 2366                 | 2               | BB1-01      | 63.5                      | (28.3)           | 38.4                     | III 0  |
|                      | 3               |             | 48.8                      | (134.7)          | 30.0                     | III 0  |
|                      | 4               |             | 40.2                      | (62.6)           | 18.4                     | III 0  |
|                      | 5               |             | 51.7                      | (67.1)           | 33.8                     | III 0  |
| 2286                 | 32              | A-054       | 19.9                      | 21.1             | -                        | III T  |
|                      | 43              |             | 53.5                      | (51.2)           | 8.1                      | III P  |
|                      | 48              |             | 32.2                      | 59.8             | 3.5                      | III P  |
|                      | 46              |             | 33.4                      | 28.9             | 5.9                      | III 0  |
| 4082                 | 48              | BM-07       | 53.4                      | (214.6)          | 58.9                     | III P  |
|                      | 17              |             | 59.0                      | (67.0)           | 13.4                     | III P  |
|                      | 23              |             | 34.9                      | 57.7             | 18.8                     | III 0  |
|                      | 49              |             | 10.4                      | 3.7              | -                        | III P  |
| 2305                 | 29              | TB-P2       | 120.1                     | (25.4)           | 38.0                     | II P   |
|                      | 32              |             | 38.0                      | 26.1             | 18.7                     | II 0   |
|                      | 33              |             | 47.7                      | (25.1)           | 5.0                      | II T   |
|                      | 50              |             | 34.2                      | 31.8             | 29.4                     | III P  |
| 4116                 | 11              | A-036       | 16.8                      | 12.1             | -                        | III P  |
|                      | 31              |             | 107.9                     | (3.7)            | 53.2                     | I T    |
|                      | 35              |             | 21.8                      | 9.3              | -                        | III P  |
|                      | 44              |             | 16.2                      | 15.6             | -                        | III P  |
| 2370                 | 21              | B-060       | 12.3                      | 7.7              | -                        | III T  |
|                      | 37              |             | 18.5                      | 10.5             | -                        | III P  |
|                      | 43              |             | 45.2                      | (68.0)           | 3.2                      | III 0  |
|                      | 49              |             | 13.9                      | 3.0              | -                        | III T  |

TABLE 3.5 CONTINUED

| <u>Sample Number</u>          | <u>Particle Number</u> | <u>Location</u>   | <u>Average Diameter (micron)</u> | <u>Count Rate (cpm)</u> | <u>Uranium Content (nanogm)</u> | <u>Class*</u> |
|-------------------------------|------------------------|-------------------|----------------------------------|-------------------------|---------------------------------|---------------|
| EVENT CLEAN SLATE II (Contd.) |                        |                   |                                  |                         |                                 |               |
| 2312                          | 5                      | B, L3, P9         | 58.7                             | (6.0)                   | 15.4                            | III T         |
|                               | 14                     |                   | 74.3                             | (30.6)                  | 30.3                            | III O         |
|                               | 24                     |                   | 60.2                             | (11.9)                  | 27.6                            | I S           |
|                               | 45                     |                   | 20.3                             | 8.5                     | 3.1                             | III O         |
| 2272                          | 14                     | D Mob.<br>Pos. 12 | 14.9                             | 6.0                     | -                               | III T         |
|                               | 25                     |                   | 20.1                             | 9.8                     | 2.2                             | III O         |
|                               | 39                     |                   | 13.3                             | 6.2                     | -                               | III T         |
|                               | 48                     |                   | 24.2                             | 20.7                    | -                               | III O         |
| 4812                          | 31                     | B-054             | 15.8                             | 7.2                     | -                               | III O         |
|                               | 34                     |                   | 10.6                             | 4.5                     | -                               | III T         |
|                               | 35                     |                   | 7.1                              | 1.2                     | -                               | III T         |
|                               | 48                     |                   | 28.4                             | 6.7                     | -                               | III O         |
| 4024                          | 13                     | B, L, 4, P21      | 17.5                             | 6.3                     | 3.2                             | III O         |
|                               | 17                     |                   | 13.6                             | 3.6                     | -                               | III P         |
|                               | 29                     |                   | 24.8                             | 17.1                    | 5.7                             | III O         |
|                               | 46                     |                   | 13.7                             | 3.6                     | -                               | III T         |
| 2369                          | 11                     | B-068             | 40.0                             | (20.0)                  | 9.4                             | III O         |
|                               | 40                     |                   | 24.5                             | 17.5                    | 2.4                             | III P         |
|                               | 45                     |                   | 20.1                             | 19.6                    | -                               | III P         |
|                               | 47                     |                   | 22.9                             | 28.0                    | -                               | III T         |
| EVENT CLEAN SLATE III         |                        |                   |                                  |                         |                                 |               |
| 4973                          | 17                     | BM-10             | 38.6                             | 6.2                     | -                               | III O         |
|                               | 34                     |                   | 30.4                             | 15.7                    | 4.8                             | III T         |
|                               | 35                     |                   | 47.0                             | (37.8)                  | 15.8                            | III O         |
|                               | 48                     |                   | 53.8                             | (4.5)                   | 12.3                            | III O         |
| 4964                          | 5                      | A-102             | 27.4                             | 27.6                    | -                               | III O         |
|                               | 23                     |                   | 12.3                             | 1.8                     | -                               | III O         |
|                               | 42                     |                   | 10.4                             | 8.9                     | -                               | I T           |
|                               | 49                     |                   | 8.0                              | 1.6                     | -                               | II T          |
| 4974                          | 11                     | A-030             | 13.9                             | 4.9                     | -                               | III O         |
|                               | 19                     |                   | 11.1                             | 4.4                     | -                               | III P         |
|                               | 28                     |                   | 15.9                             | 0.7                     | 1.9                             | III O         |
|                               | 38                     |                   | 13.4                             | 1.3                     | -                               | III P         |

TABLE 3.6 PARTICLE CONTENTS IDENTIFIED BY  
ELECTRON DIFFRACTION

| Sample No.          | Size<br>(microns) | Identity                        |
|---------------------|-------------------|---------------------------------|
| EVENT DOUBLE TRACKS |                   |                                 |
| 9624                | 1.1               | PuC                             |
|                     | 6.4               | SiO <sub>2</sub> (cristobalite) |
|                     | 1.6               | U <sub>3</sub> O <sub>8</sub>   |
|                     | 2.3               | U <sub>3</sub> Si <sub>2</sub>  |
| CLEAN SLATE I       |                   |                                 |
| 3038                | 0.5               | U <sub>3</sub> Si <sub>2</sub>  |
| CLEAN SLATE II      |                   |                                 |
| 2286                | 1.3               | U <sub>3</sub> Si <sub>2</sub>  |



Figure 3.1 Photomicrograph of debris particles.



Figure 3.2 Photomicrograph of debris particles.

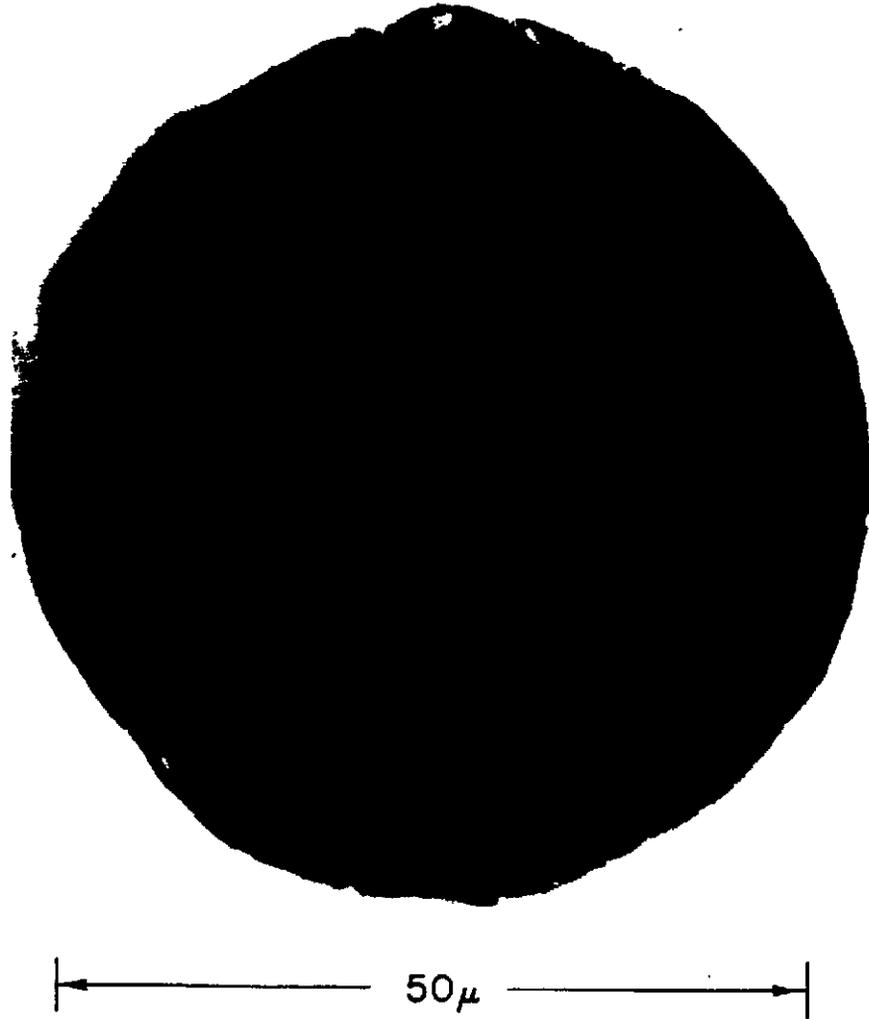


Figure 3.3 Photomicrograph of debris particles.

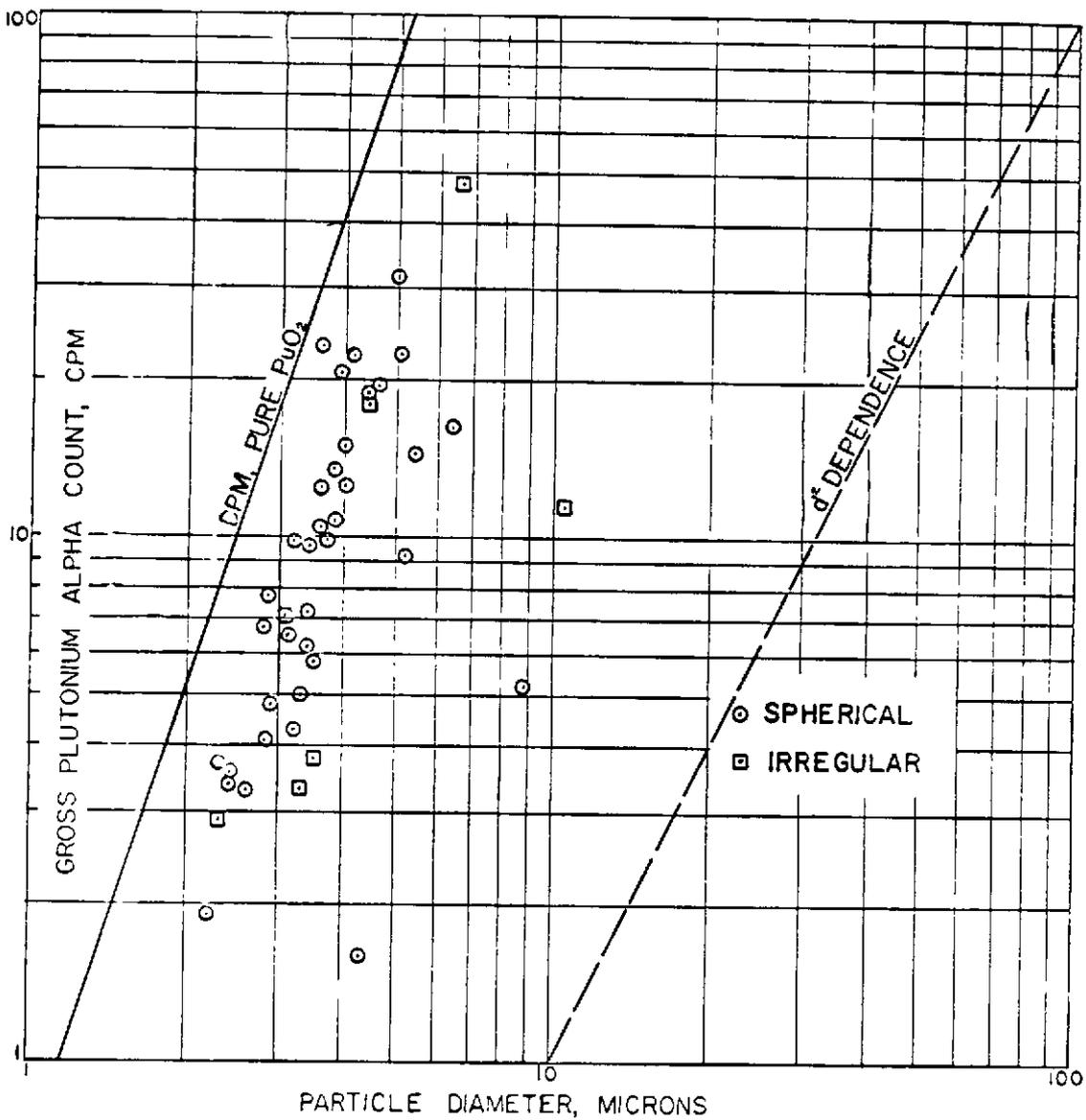


Figure 3.4 Activity-size distribution for Sample DT A-066.

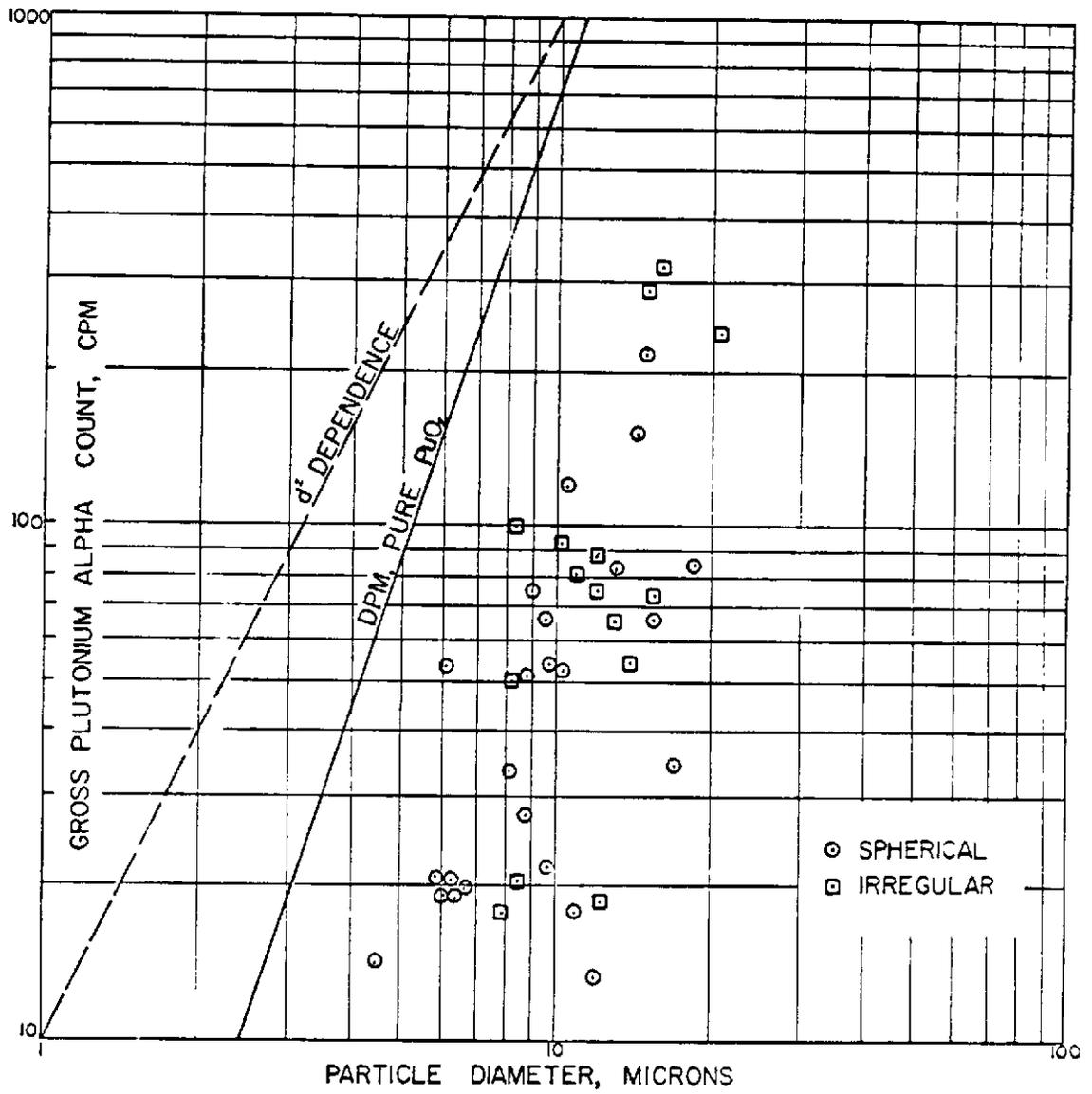
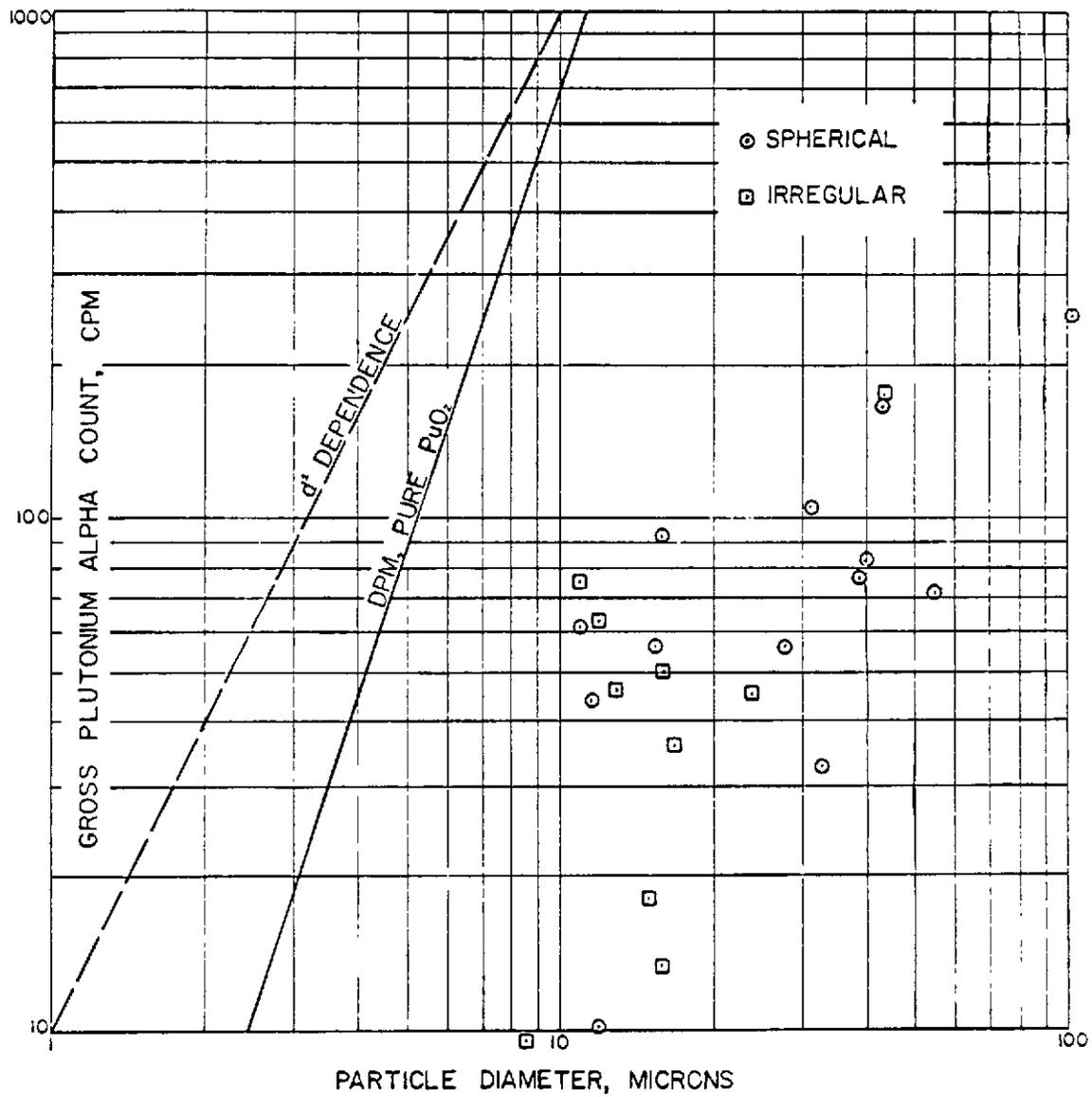


Figure 3.5 Activity-size distribution for Sample DT Arc B, L8, P21.



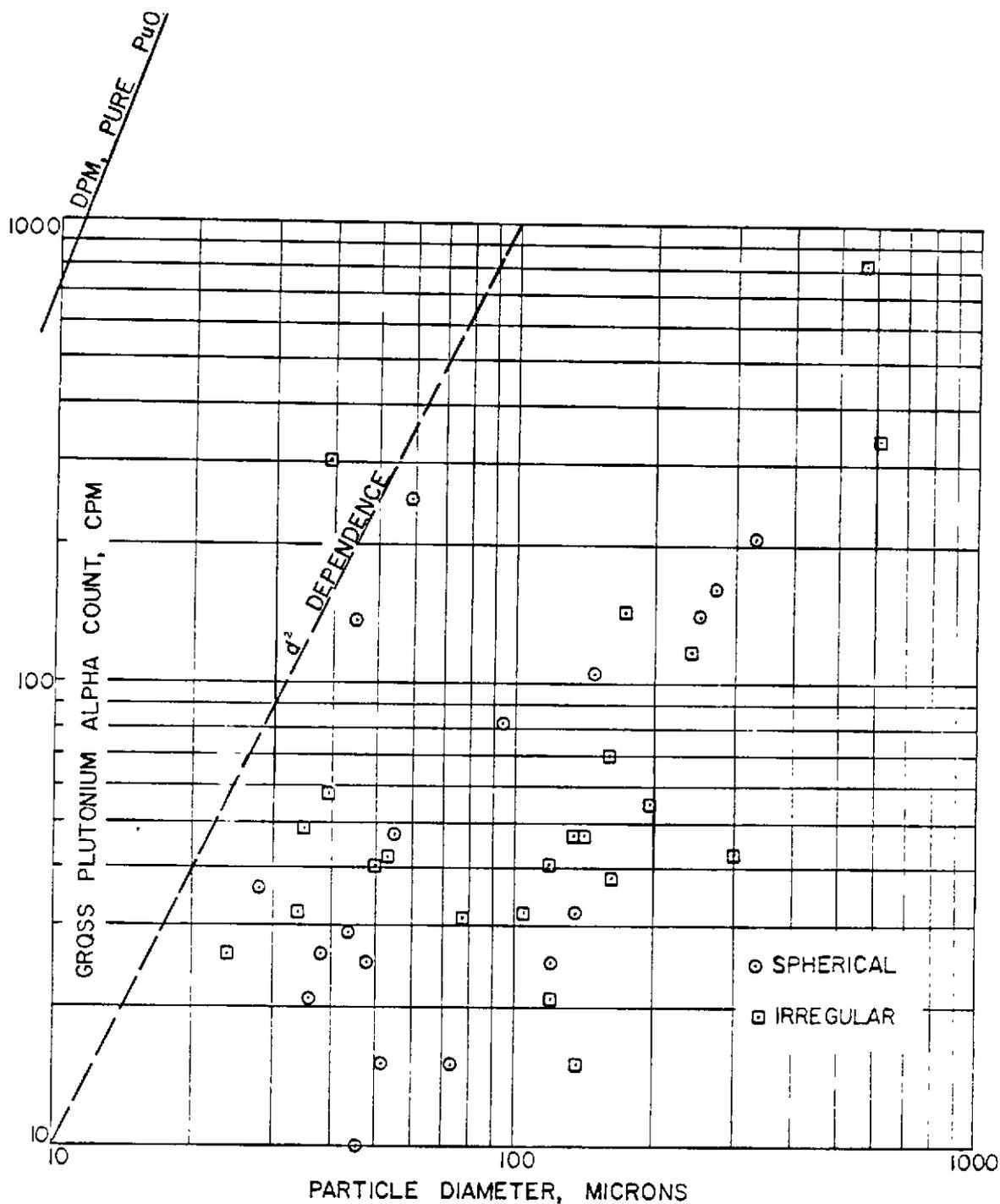


Figure 3.7 Activity-size distribution for Sample CSII TB-P2.

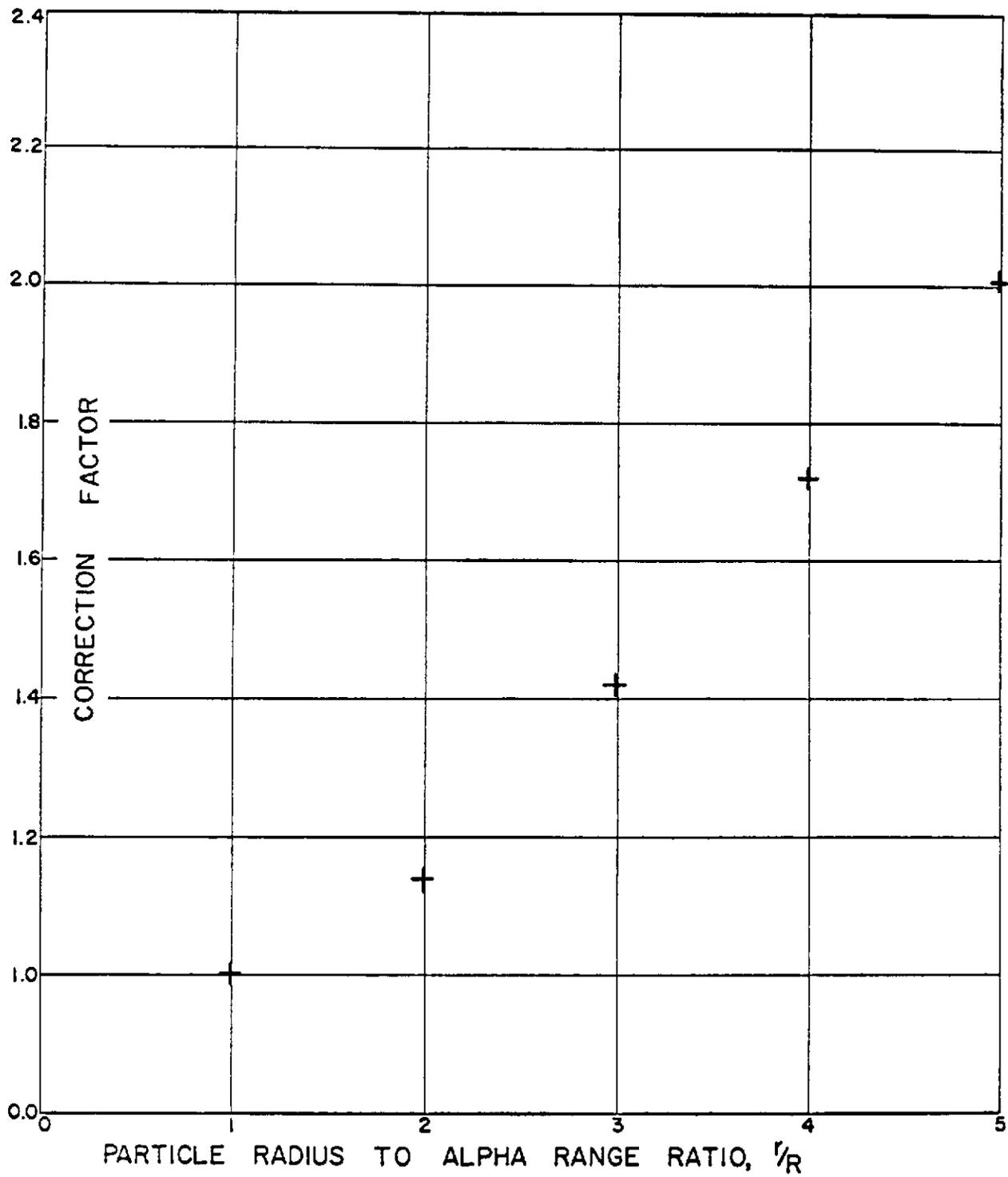


Figure 3.8 Theoretical precision counting/gross counting correction factors based on particle self absorption.

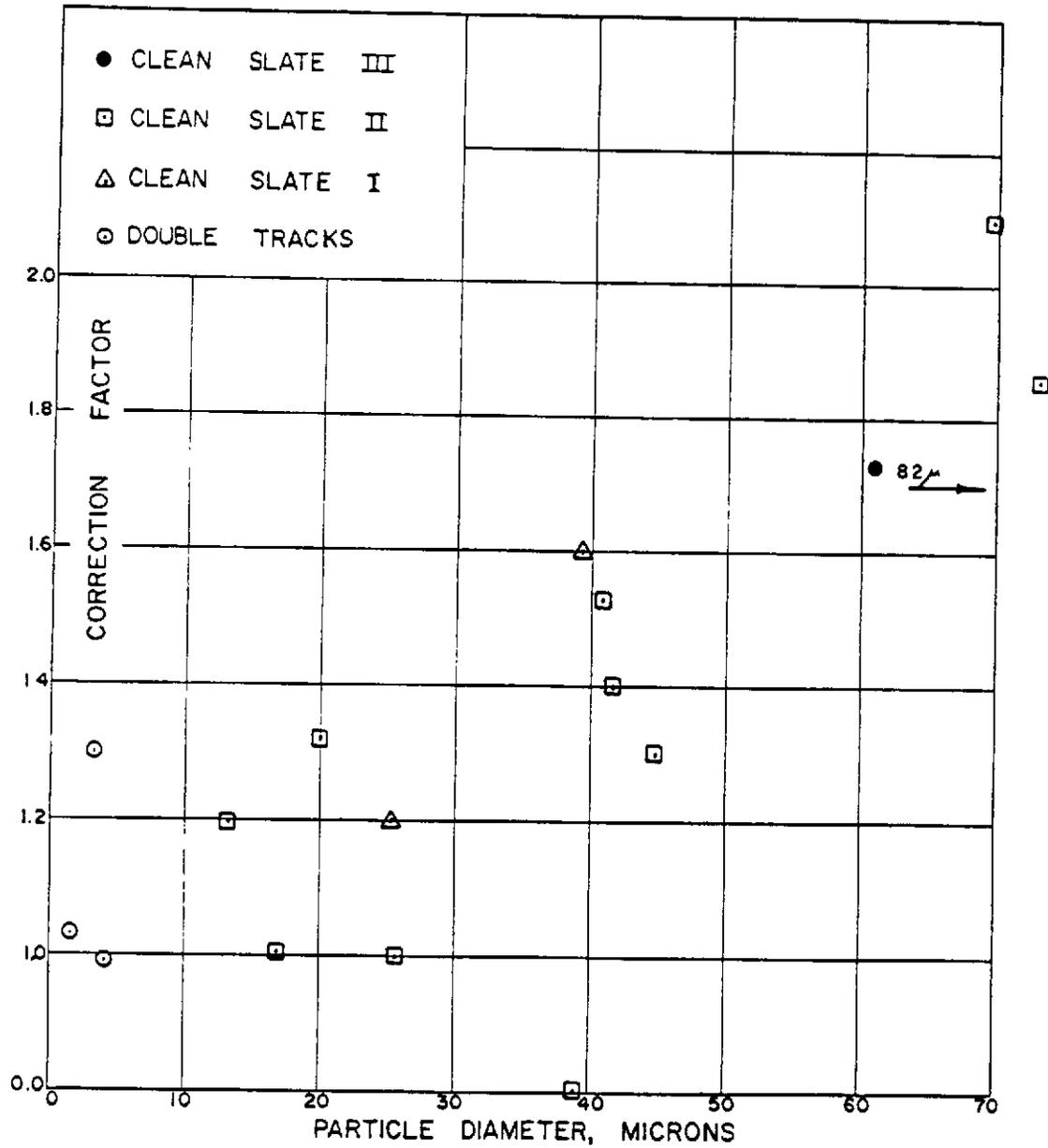


Figure 3.9 Precision counting/gross counting correction factors based on precision alpha counting.

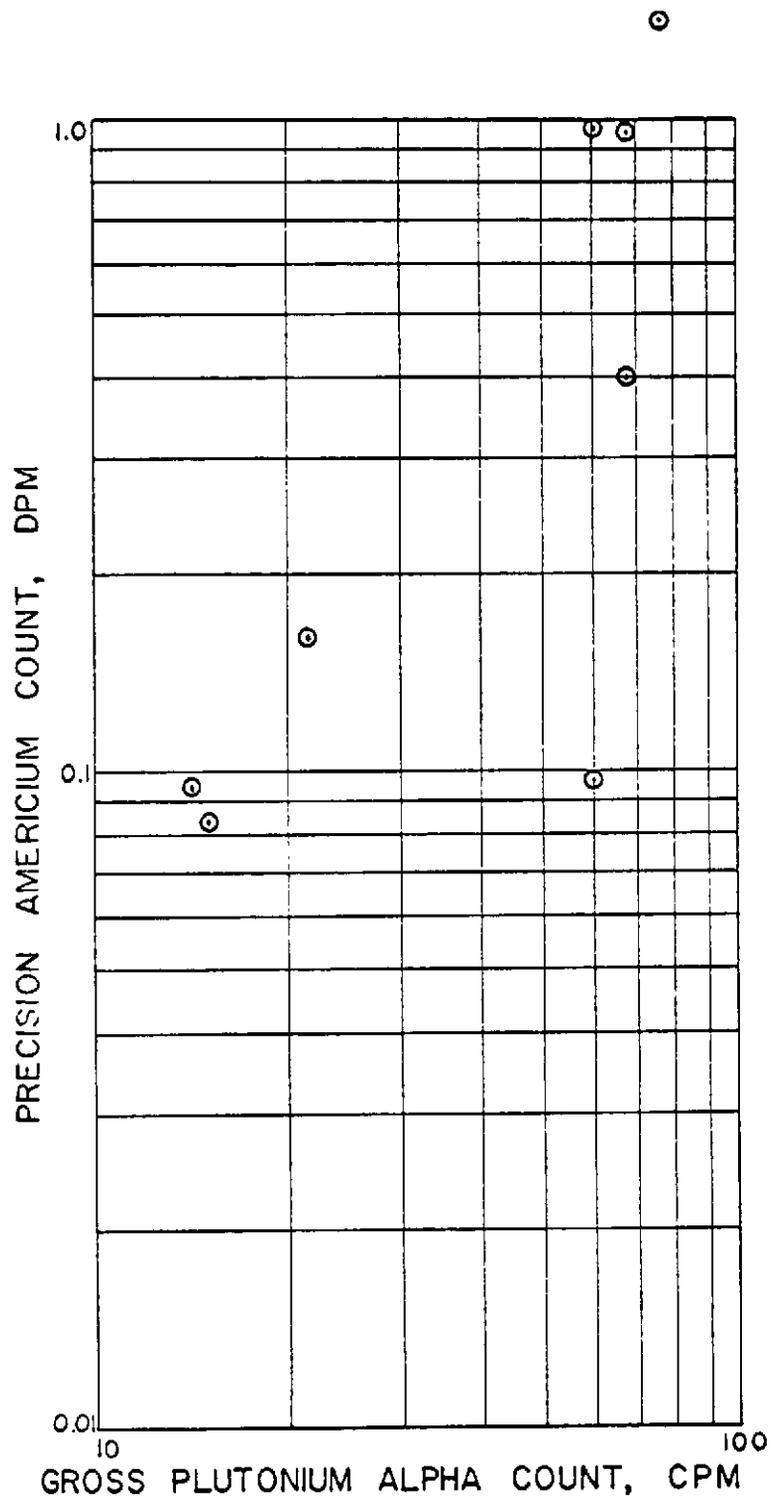


Figure 3.10 Correlation between pu cpm and am dpm.

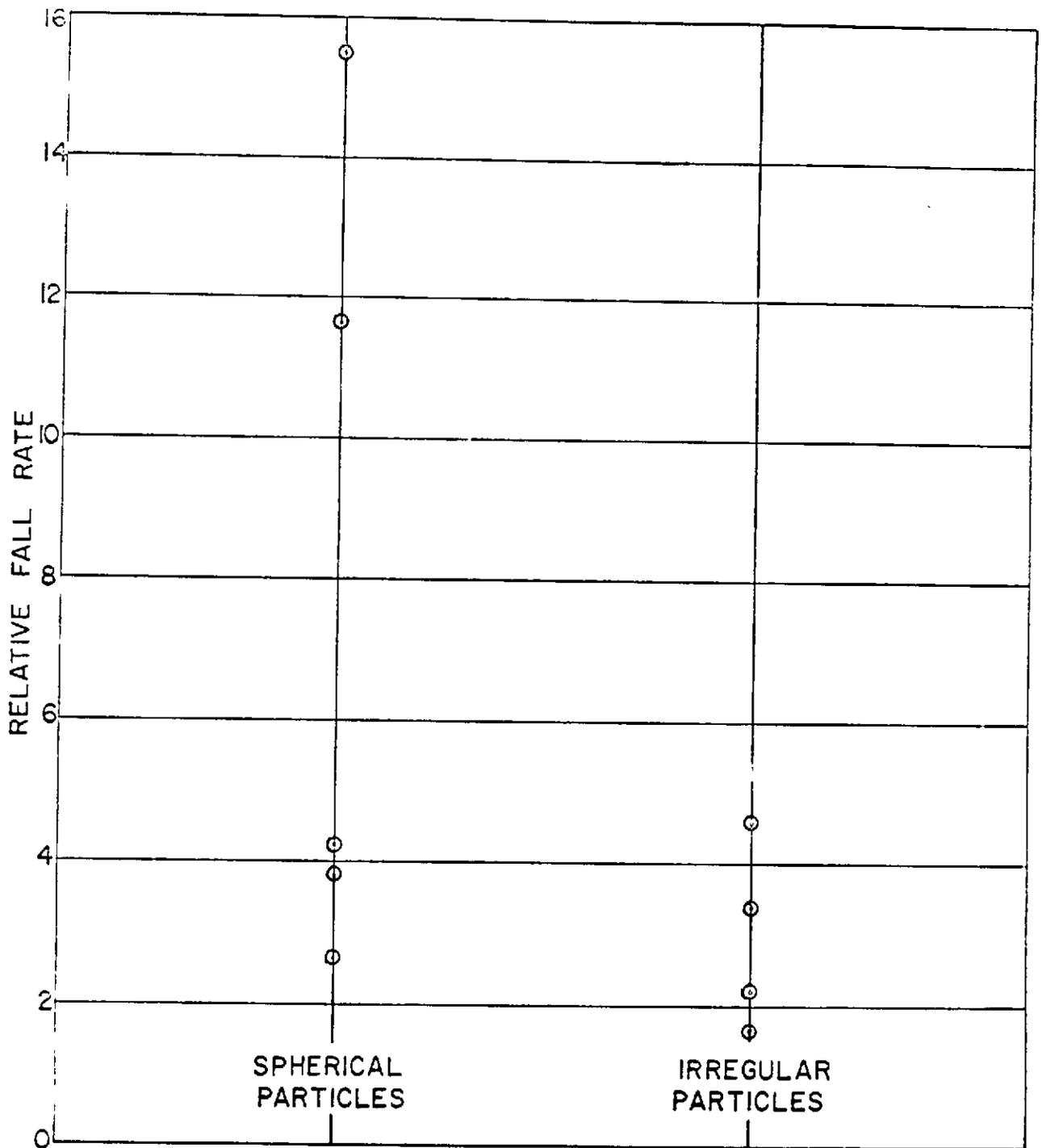


Figure 3.11 Measured relative fall rates for spherical and irregular particles.

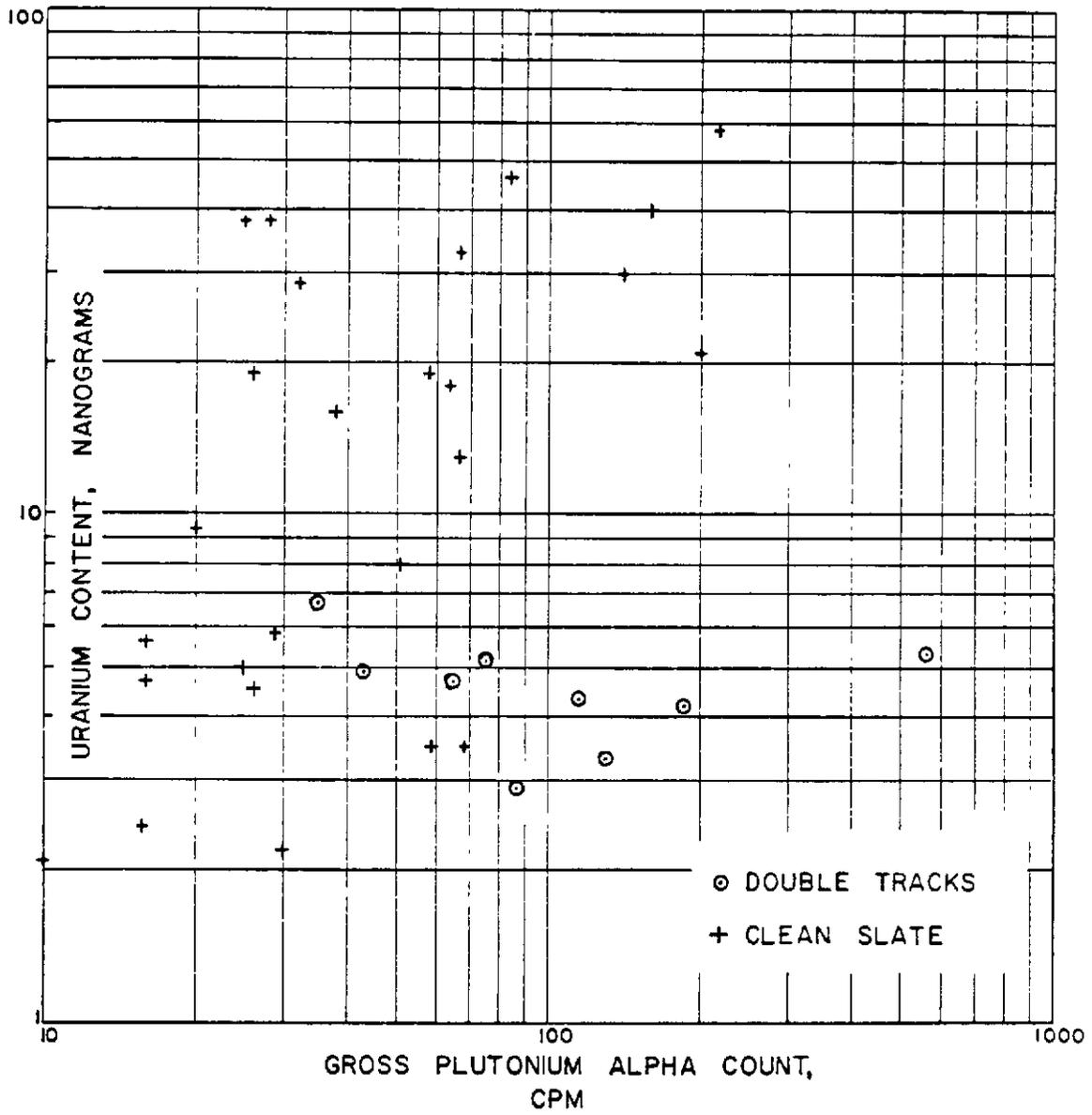


Figure 3.12 Correlation between particle uranium content and particle plutonium content.

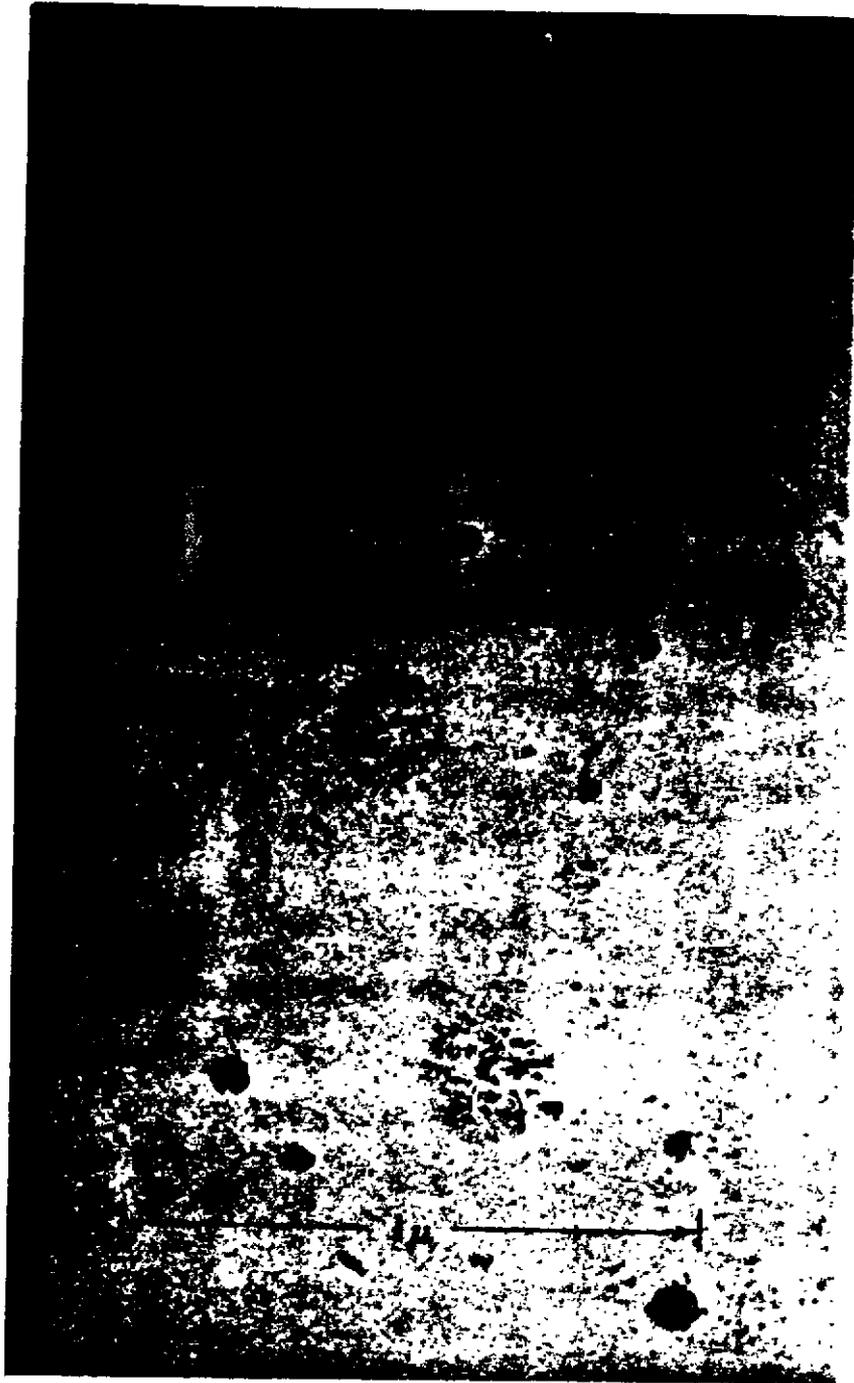


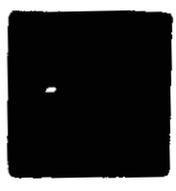
Figure 3.13 Electron micrograph of debris particles.



Figure 3.14 Electron micrograph of debris particles.



re 3.15 Electron micrograph of debris particles.



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