ROLLER COASTER

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PROJECT OFFICERS REPORT—PROJECT 2.6b

SPECIAL PARTICULATE ANALYSIS (U)

R. D. Sherwood, Project Officer

Isotopes, Incorporated
Westwood, New Jersey 07675

Issuance Date: May 26, 1966

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ABSTRACT

Several thousand plutonium-bearing particles, representing over 200 physical samples, from Operation Roller Coaster were examined. Cascade impactors, filters, and deposition collectors were included. Nuclear track autoradiography and optical microscopy measurements of particle size, shape, color and estimated activity were made for particles as small as 0.6 micron projected area diameter. Spherical particles as small as 0.05 micron diameter were measured by electron microscopy and the data compared with nuclear track counts for the same sample. Estimates of the density of particles were made from observation of Casella MK II impactor stages.

Phosphor intensification autoradiography was applied to over 500 samples. No calibration to derive particle size was made due to the inhomogeneous particle composition.

Single particles larger than 14 microns were isolated for alpha counting, radiochemical analysis, X-ray diffraction, and electron microprobe analysis under other projects. Calculation of alpha self-absorption factor, μgm U/μgm Pu, and particle density were obtained from the data.

A wide range of particle compositions was encountered. Evidence that a few particles contained unreacted Pu was found. Most particles contained less than 20 percent plutonium.

PREFACE

The objectives and the general technical approach of this project were specified largely by the Defense Atomic Support Agency (DASA). Details of the analytical techniques were developed as required for the sample types submitted from the activity of Projects 2.2 and 2.3 in the four field tests of Operation Roller Coaster.

Mr. Ray Carter, Nuclear Safety Section of the Atomic Weapons Research Establishment, United Kingdom Atomic Energy Authority, Aldermaston, Berkshire, England, furnished instructions and supplies for the Phosphor Intensification Autoradiography. Mr. Robert H. Wilson, Assistant Professor, Department of Radiation Biology, The University of Rochester, Rochester, New York, supplied samples of laboratory-generated aerosols of plutonium and uranium oxides. Mr. J. Kent Perry, Project 2.6d, The Colorado School of Mines Research Foundation, Incorporated, Golden, Colorado, performed X-ray diffraction on single particles. Lieutenant Donald E. Pichler, USAF, Weapons Laboratory, Kirtland Air Force Base, New Mexico, performed electron microprobe analysis on single particles. Mr. Ralph E. Fried, Isotopes, Inc., provided Radiochemical Analysis under Project 5.2/5.3d. Useful suggestions were received from Mr. Ross K. Fuller, Project 2.6a, Mr. Charles D. Dunn, Project 2.6c, the Data Evaluation Team, the Referee Team, and the Washington Policy Committee. Administrative assistance was provided by DASA Field Command and Mr. Philip W. Krey and Dr. James P. Friend of Isotopes, Incorporated.

The efforts of Mr. James Watson, Mr. Carl L. Tatsch, Mr. Kenneth Hines, and Mr. William R. Watson in performing the tedious analytical procedures are also gratefully acknowledged.

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CHAPTER 1

INTRODUCTION

1.1 OBJECTIVES

The main objective was to characterize as fully as possible the plutonium-compound particles which were produced by non-nuclear detonation of plutonium-bearing weapons. Special emphasis was placed on the respirable range of 0.1 to 10 microns. The investigations were directed toward determination of: (1) particle-size distribution and total mass of plutonium on a large number of samples by means of a scintillation phosphor method of autoradiography, (2) variation with particle size of shape, surface quality and color, and estimated alpha activity of single particles using microscopic examination of particle-nuclear track autoradiograms, (3) chemical and physical composition of individual particles as indicated by microscopic appearance, activity content, electron and X-ray diffraction, electron microprobe and chemical analysis for plutonium and uranium, and (4) the mass of plutonium and uranium in groups of particles using radiochemical and fluorometric analysis, respectively, on samples examined in (2).

An additional objective was to gather data on the quality of operation of the particle samplers by observing evidence of particle agglomeration or shattering, sampler overload and particle size range collected for air samplers, and the uniformity of deposition and the population of active particles on deposition slides.

The objectives were complementary to the other particulate studies performed under Project 2.6 of Operation Roller Coaster (References 25, 26, and 27).

1.2 BACKGROUND AND THEORY

The particle-size distribution and particle characteristics at various locations on the test arrays were required to help account for dispersed activity, evaluate the hazard due to respirable particles, develop cloud models, evaluate sampler performance, and estimate weathering and resuspension effects.

Some guidelines for obtaining particle data had been established previous to Operation Roller Coaster. The spectrum of particle sizes produced in a non-nuclear detonation of a plutonium-bearing weapon had been examined, in part, in Project NTS and TG 56 and 57 of Operation Plumbbob. References 1 through 4 described autoradiographic methods which had been used to locate individual plutonium-bearing particles intermixed with non-contaminated soil. Results of these studies indicated a low ratio of active to inactive particles, a broad range of activity content and a variety of shapes, appearance and states of agglomeration. The lower limit of particle size measurement was approximately 0.8 micron, due to limitations in optical resolution and autoradiographic grain size. The United Kingdom Atomic Energy Authority had described a scintillation phosphor-autoradiography method, calibrated for plutonium dioxide particles larger than 1 micron, for application to field tests.

Guidelines for obtaining information on the respirable submicron particles through the use of electron microscopy were also available. References 6 through 8 described the state of the art of combining electron microscopy and autoradiography to identify submicron size alpha

emitters on the order of 0.5 micron. References 9 through 11 indicated that spatial resolution on the order of 0.1 micron had been achieved for the case of beta emitters of low energy.

Published volumes of physical properties of plutonium and uranium particles were few. Reference 12 described plutonium dioxide particles as olive green or black and having a cubic crystalline structure. Reference 13 mentioned that uranium dioxide ranged from blood red through brown and black, depending on the particle size and method of production. Reference 14 described uranium dioxide as dark brown, U_3O_8 as black to olive green, UO_3 as red to yellow, and uranium hydride as dark grey. Reference 12 mentioned that uranium dioxide had shown cubic edges in some electron micrographs. References 15 and 16 contained micrographs of plutonium dioxide which exhibited cubic shapes and aggregates characterized by straight edges. Nearly spherical shaped particles were observed by optical microscopy in the work under Operation Plumbbob. References 1 and 5 mentioned evidence that some plutonium compound particles may be easily crushed or shattered.

Data on selected area electron diffraction patterns and electron microprobe analyses of plutonium and uranium oxides were not found. It was anticipated that particles generated in Operation Roller Coaster would contain oxides and other compounds of uranium and plutonium mixed with varying amounts of desert soil and that autoradiography would provide the only means of locating active particles and assessing varieties of agglomeration and particle inhomogeneity. The theoretical activity of a 1-micron diameter sphere of plutonium-239 dioxide is 0.74 dis/min,

which allows detection within short exposure times. Due to its low rate of decay, uranium contributes very few tracks for short exposures except for the very large and highly active particles. The 5.1 Mev alpha particle from plutonium-239 is recorded as a straight track approximately 22 microns long. Self-absorption of energy within particles larger than a few microns diameter may shorten the track length or prevent detection. Due to these variables, the track length cannot be relied upon to differentiate the 4.1 to 4.5 Mev alpha from uranium compounds from the 5.1 Mev plutonium emission. Simple masking of tracks by particles larger than 50 microns may result in missing a few active sites.

The use of an emulsion layer thicker than 25 microns results in a detection configuration which approaches or may exceed 2π geometry. The use of very thin layers which are compatible with electron microscopy may lead to the unfavorable situation of a very low detection geometry concurrent with the very low activity of a submicron particle.

Compositional analysis in the 10 micron to 0.1 micron particle size range requires determinations of 10^{-8} to 10^{-14} grams for the optimum case of a particle consisting of a single element. The complex composition anticipated in Operation Roller Coaster made the problem more difficult. The use of groups of particles to achieve more reasonable quantities was possible only to a limited extent due to the difficulty of manipulating fine particles.

CHAPTER 2

PROCEDURE

2.1 SAMPLES RECEIVED

The samples examined under this project were collected and submitted under other projects of Program 2, Operation Roller Coaster.

2.1.1 Type, Identification, and Location of Samples. The samples submitted are described in Table 2.1 according to type and number. Table 2.2 lists the sample type, Tracerlab sample identification number, and field location for each sample. The test array consisted of three square arrays: AA-01 through AK-11; BA-01 through BO-15; and CA-01 through CO-17; centered about ground zero (GZ) which was at AF-06 (coincides with BH-08 or CI-09). These arrays covered distances of 250 feet, 700 feet, and 1,500 feet from GZ, respectively. Superimposed and extending to 48,000 feet were a series of arcs lettered A through R, at 1,250 feet to 48,000 feet from ground zero. The arcs were subdivided into $^{3}/_{4}$-degree intervals numbering 1 to 120 reading clockwise when viewed from above ground zero. Towers and balloon curtain devices were used near ground zero and on Arcs B and J. Locations above ground are given by balloon line numbers L1 to L31 (increasing same direction as degree position) and position numbers P1 to P24 (increasing with descent of a given line).

2.1.2 Special Samples. Samples of background soil and airborne dust and of laboratory-generated aerosols of plutonium dioxide and uranium dioxide were submitted as potential control samples.

2.1.3 Method of Sample Delivery. The samples were collected in the field and decontaminated under other projects of Operation Roller Coaster. The samples were transported several hundred miles to a storage facility. After a period ranging from a few weeks to a few months the samples were shipped across the United States via airmail in containers which offered varying degrees of shock protection. Other variables which might have influenced the samples are unknown.

2.2 SAMPLE ASSURANCE AND PERSONNEL SAFETY

Extraordinary care in handling the samples was required due to the delicate nature of the particulate collections and the high radiotoxicity of plutonium -239.

2.2.1 Sample Assurance Measures. Outer wrappings were discarded and the innermost container transferred to a glove box.

The glove box was an Ultrasonics Industries White-Roomette modified to recirculate air through the absolute filter. The fan was operated only as a clean-up measure between sample unwrapping operations. Only one sample was in the box at a time. A 5-inch circle painted on the glove box formica base outlined the unwrapping area. The beam from a microscope illuminator, American Optical model 359, was directed horizontally 4 inches above the circle to indicate by scattered light any gross sample loss due to dry particle resuspension during opening. The original innermost container and any swipes were retained in a plastic sample box for later reference and spot checked for alpha emission. The sample was transferred to an individual precleaned plastic box and stored on top of 1/2-inch-thick urethane foam to reduce vibration

effects. The collection was stored in a security safe to minimize accidental damage.

Subsequent analyses were performed on uncovered samples in a clean room maintained as follows: The walls were coated with epoxy resin and were cleaned once a week. The floor was white vinyl tile, cleaned once per week with wet steel wool followed by vacuum cleaning when dry to remove any loose particles. The room was kept at positive pressure by a 1,000-cubic-foot-per-minute supply of air which was filtered through a Dorex type R charcoal filter followed by a Ulok roughing filter and a Flanders absolute filter and discharged through perforated-ceiling plenums. Bench tops were off-white formica to accentuate any stray particles and permit easy cleaning. All personnel entering the room were required to vacuum clean the entryway and their clothes and don monofilament apparel including plastic shoe covers and caps and long lab coats manufactured by Angelica Uniform Company.

Samples were removed from the boxes only for brief periods under close scrutiny. Tweezers were used to handle the sample edges. Plastic gloves or finger cots were used for all but the most delicate operations to avoid mutual contamination of sample and hands. Care was taken to prevent sample loss due to breathing upon the sample or by disruption of the sample surface with tweezers, etc. Tweezers were used, wherever possible, to transfer the sample to the stage of a stereo-microscope, American Optical Model 59FS. The sample was examined under a sequence of transmitted white light, reflected white, and

reflected ultraviolet, and outstanding features were sketched on a Sample History Sheet shown in Appendix B, Figure B.1.

The samples were photographed by placing them on a plate glass surface and using a dull black background 6 inches beneath the glass so as to be out of focus. The illumination was at near grazing incidence to produce maximum visibility of the very fine particles. The negative image was attached to the Sample History Sheet as a record of the initial sample condition.

Alpha counting was performed on each sample to provide initial data on possible particle loss during shipment and to provide a reference for accountability and sample subdivision during analysis. The detector was a gas-flow proportional counter produced at Isotopes, Incorporated for this project. It contained a 10-by-10-centimeter gold-mylar window and a 40-foot long cable and gas line which permitted monitoring all laboratory areas. Background was below 0.5 count/minute, and overall efficiency was 32 per cent referred to a plated standard of 35.8 dis/min.

2.2.2 Health Safety Measures. The plastic sample cases were stored in locked steel filing cabinets to minimize accidental spills and provide confinement in the case of fire, etc.

Gamma surveys were made of the initial package and the inner packages as a routine step in logging in samples. Samples were opened in the glove box; a millipore swipe of the glove box base was made after opening a group of samples and checking by alpha counting.

Personnel were required to wear plastic gloves or finger cots when handling samples in the open clean room atmosphere. A general rule

of maintaining at least 10 inches between the face and sample was in force. The alpha probe described above was used to monitor the sample work area as often as required.

Laboratory tools were cleaned by wet swipes using lens tissue moistened with ethyl acetate, followed by dry swipes and checked by alpha counting. Dry waste was temporarily confined in a polyethylene bag prior to formal disposal. Liquid waste from autoradiographic solutions was confined to a storage tank and drained off for formal disposal. Samples were disposed of via formal methods following final chemical analysis.

Urinalysis samples were taken commencing with pre-operations background samples and thereafter at monthly intervals.

Operations were reviewed weekly and safety reminders posted and reiterated.

2.3 ANALYTICAL METHODS

The methods were mentioned in the objectives stated in Chapter 1. The general application of each technique is described below. Specific laboratory steps are outlined in Appendix B.

2.3.1 Phosphor Intensification Autoradiography. The basic principle described in Reference 5 is shown schematically in Figure 2.1. The photographic plate was separated for processing after exposures of 1 hour or 1 day. Realignment for microscopy was insured by an accurate exposure fixture. Image spot size was measured by projecting the plate at 10x magnification and using a series of circles ruled on transparent plastic to classify the image diameters.

A calibration of particle size versus spot diameter was attempted. Selected samples were carefully coated with 3 percent solution of nitrocellulose in amyl acetate in order to cement the particles in place without absorbing a sufficient amount of alpha radiation to affect the spot size. When dry, these samples were treated routinely. After producing a phosphor autoradiogram the tape-phosphor layer was removed. The sample was then treated by the nuclear track autoradiography technique described in Section 2.3.2. Comparison of actual particle size and spot size was possible except for occasional particle losses. Some larger particles were viewed directly without the alpha track step.

A simple calibration of activity versus spot size was attempted. After producing a phosphor autoradiogram, the transparent tape was cut so as to expose an active particle. The tape-phosphor flap was inverted and placed near the exposed sample area. The two exposed surfaces were alpha counted simultaneously under a wide window gas proportional alpha counter. The results are given in Section 3.2 of this report.

The phosphor technique was applied to 212 Glass Slide deposition samples, 202 Casella Impactor Stages 1 or 2 air samples, and a Disk Collector balloon deposition sample (using film) in anticipation of a calibration. The autoradiograms gave an immediate indication of the population and relative surface activities of the particulates. The technique was used as a survey tool for evaluating the uniformity of deposition on Andersen Impactor stages, Membrane filters, Disk Collectors, and Sequential Tape Samples.

2.3.2 Nuclear Track Autoradiography. Nuclear track emulsion plates were placed in close proximity to the surface of several impactor

stages as an initial non-destructive survey. Eastman NTA emulsion 25 microns thick and spacers 0.008 inch (200 microns) thick were employed. Exposure times between 12 hours to 1 week were adequate for the more active particles. This air gap geometry was not practical for detecting the weakly active particles, was difficult to maintain from sample to sample, and was not constant for the wide range of sizes on certain samples. The technique was abandoned in favor of phosphor autoradiography or the melted nuclear emulsion technique.

The melted nuclear emulsion technique for optical microscope readout is shown schematically in Figure 2.2. The alpha radiation from a plutonium-bearing particle resulted in straight tracks approximately 22 microns in length distributed radially about the particle as illustrated in Figure 2.2 (c). The necessity of using a high power oil immersion objective placed a limit on the sample thickness of 0.3mm, the working distance between the lens and the plane of focus. The particles were transferred and cemented to a cover glass of 0.17 mm nominal thickness, by means of a thin plastic layer as shown in (a) and (b) of Figure 2.2. The Canada Balsam-dibutyl phthalate coating on the glass sampling surface was tacky wet as received. This was dried prior to stripping by heating for 15 minutes at 125° Fahrenheit to minimize interaction with the stripping layer and to preserve the planar geometry of the original deposit. Melted nuclear emulsion, Eastman NTA bulk form, was applied to produce a dry film thickness of 25 to 50 microns. Following exposure of at least 1 hour the emulsion was processed, dried and mounted, and immersed in oil, in an inverted position.

Some impactor stages with high particle population densities required dispersing on the cover glass. This was achieved by stripping small portions and adding ethyl acetate solvent and sweeping a needle tip gently across the puddle. Membrane filter portions were dissolved and dispersed on the cover glass in a similar way. These operations, tedious by nature, were performed with the greatest of care to minimize mechanical stress on individual particles.

This technique was applied to samples and read out by optical microscopy.

The electron microscopy version of autoradiography is described in Section 2.3.4.

2.3.3 Optical Microscopy. General observations, alpha track counting, and particle size measurement was achieved for particles as small as 0.6 micron. Particles as small as the 0.25 micron theoretical limit of resolution were not differentiated due to the autoradiographic film grain size of approximately 0.5 micron. Reduction of grain size by development control was contrary to the need for bold alpha tracks to permit recognition of single tracks against the high population background of inactive particles encountered on most samples.

General observations were performed on a low power stereomicroscope, American Optical Model 59FS, at 13x magnification as described in Section 2.2.1. This microscope was also used for isolating and transferring particles larger than 25 microns by means of a needle as described in Section 2.3.5. A Leitz Ortholux microscope equipped with transmitted and reflected light

equipment for polarized illumination was used for higher magnification work. Objective powers of 8x, 16x, 50x achromatic, and 45x and 105x fluorite were used with 16x wide field eyepieces. Photomicrographs of typical or non-typical particles were made on 4x5 Super XX film or Ektachrome B 35 mm film through a Bausch and Lomb Low Ultraplane eyepiece.

Random selection of areas of the sample was made impractical by the nonuniformity of the deposited material and the generally low population of active particles. Representative areas were selected based on a scan of the total sample using the 8x or 16x objective. Straight line scans were made in these areas using a 16x objective, and every alpha star-particle event encountered was examined at maximum magnification of 1680x. The area scanned and the total area of the sample were measured. Alpha tracks were measured, particle color and shape recorded, and particle size measured using the 105x objective and various combinations of transmitted and reflected polarized light. Data was recorded on the Microscope Data Sheet shown in Appendix B, Table B.2, according to the key given in Figure B.3.

Particle size measurement was made in terms of the area diameter defined in Reference 17 as the diameter of a circle whose area was equal to the projected area of the particle. A Porton graticule, available from Mine Safety Appliance Company, Pittsburgh, was used in the eyepiece of the fixed tube of the binocular microscopes. The Porton graticule consisted of a series of circles ruled on glass. The diameter of the circles increased by increments in the ratio of $\sqrt{2}$ or 1.4x. The circles were calibrated by comparison with two-stage

micrometers. At 1680x the smallest circle represented 0.39 micron. The projected area of the particle was matched to the circle which was closest to being filled when overlap and underlap of the particle outline and circle were considered.

The alpha track star consisted of from 1 track to a 45-micron diameter, or larger, hemisphere of silver depending on the activity level of the particle and the exposure duration. Track counting was difficult for track populations greater than 100 tracks per star, therefore the range of particle diameters measured for a given exposure to a homogeneous particle composition would have been a range of $\sqrt[3]{100}/\sqrt[3]{1}$ or about 5/1. The method appeared to cover a wider range of size due to the non-homogeneous composition of the particles, but the weakly active particles might have been missed. The exposure time for Roller Coaster samples was determined chiefly by experience gained from initial trials and knowledge of the theoretical activity of plutonium-239 dioxide (0.74 dpm per 1 micron diameter particle). Exposure ranged from 1 hour to 6 months. Some samples were split and given two exposures to extend the useful size range. Stars containing more than 100 tracks were categorized in terms of solid stars, etc., as shown in Appendix B, Figure B.3.

2.3.4 Electron Microscopy. Development of the use of electron microscopy and autoradiography was undertaken. The sample preparation technique for electron microscopy is shown schematically in Figure 2.3. Portions of the narrow depositions of Casella Impactor Stages 3 and 4 were stripped using extra thin plastic layers as shown in (a). The

strippings were extremely fragile by nature and failed to remove heavy concentrations in a single step. Two or three strippings of a given area were dispersed separately in a drop of solvent resting at a fixed spot on a thin layer of polyvinyl formal plastic (Formvar), as shown in (b). After the drop had evaporated, the Formvar was scored and carefully floated off the glass onto an unrippled surface of distilled water, picked up from beneath onto a copper screen, and carefully dried in air. The resulting preparation was thicker than is commonly employed in electron microscopy but was necessary in order to support the dense particle population. Further reduction of the population density would have resulted in long scanning times to find active particles. The dispersal was approximately 5 mm in diameter and permitted punching at least 2 electron microscope disks of 3 mm (1/8 inch) diameter.

Nuclear-track autoradiography of the preparations was explored by three methods. In the first method a nuclear track plate was placed in contact with the sample. This resulted in a ruptured sample film in many cases and was abandoned. An example of this method is shown in Figure 2.4, which illustrates the problem of obtaining a uniform dispersal in the electron microscope preparation. The second method consisted of coating a thin layer of melted nuclear track emulsion over the particle preparation by means of the surface tension effect in a wire loop as shown in Figure 2.5. The loop was lowered slowly until the film ruptured, leaving the preparation coated. After exposure and processing the autoradiogram was scanned using a 45x high dry microscope objective, and the best area was selected and punched for

electron microscopy. Reasonable numbers of tracks were recorded for the more active particles on the order of 1 micron, but there was a possibility that weakly active particles were present which had not emitted in the plane of the thin layer. Resolution at the center of stars suffered from masking by adjacent silver grains. Particles on the order of 0.5 micron could not be differentiated from the similar size autoradiographic silver grains. Experimentation with emulsions and developers such as Microdol-X and p-phenylene-diamine-sodium bisulfite solution failed to improve particle recognition. Tracks were observed for which no particle could be assigned due to:

a) particle size below the resolution obtainable in these thick preparations, i.e., < 0.05 micron

b) particle loss during processing or electron bombardment

c) film sagging which records emission from other areas of the film

d) slippage between emulsion and sample during processing or bombardment by the microscope beam

Figure 2.6 illustrates several of these observations. The third method was selected as the only means of overcoming the low detection efficiency and the poor particle visibility described above. During the preliminary development work it was observed that the most active impactor from the Double Tracks balloon curtain contained many submicron spheres and that nuclear track autoradiograms had showed tracks associated with some spheres but with relatively few irregular shapes, as shown in Figure 2.7. Therefore, one portion of a sample was examined by electron

microscopy, and the size distribution of spherical particles was measured. A second portion was examined by nuclear track autoradiography, using a thick emulsion layer and optical microscopy readout. The two sets of data were oompared for whatever information that could be obtained.

A Norelco EM-75B electron microscope was used. The sample grids were scanned at 1200x magnification, and at 5500x magnification particle images were photographed or compared with a notched scale placed in contact with the flourescent screen and having square notches of widths which increased by a $\sqrt{2}$ ratio. Micrographic negatives were projected to achieve 4000x, 15000x, or 28000x magnification and compared to transparent plastic scales containing a series of circles with diameters increasing as $\sqrt{2}$ ratio. Data were recorded on the sheet shown in Appendix B, Figure B.2.

Calibration of the electron microscope was made in terms of a carbon shadowed plastic replica of a diffraction grating of known line spacing of 0.883 micron. The spacing of the replica was checked by measuring the overall spacing of 30 lines. The average value of 7 determinations was 0.855 micron. The optical microscope had been calibrated by use of two independent stage micrometers. The electron microscope size measuring scale and the photographic projection systems were calibrated by images of the diffraction grating. The value of 0.85 was deemed to be sufficiently accurate for use with the $\sqrt{2}$ ratio size classification.

This technique was applied to samples of Impactor Stages 3, 4, or 5.

2.3.5 Electron Diffraction, X-ray Diffraction, and Electron Microprobe Analysis. Single particles were selected on the basis of appearance and alpha activity for analyses to determine particle composition and homogeneity.

Selected area electron diffraction was employed in an attempt to identify crystalline phase in individual fine particles. Only one particle out of approximately 100 attempts produced a pattern. This was thought to be due to inadequacy of the EM-75 microscope and perhaps to the complexity of the sample. Samples of laboratory-generated aerosol of PuO_2 and U_3O_8 were submitted to an independent laboratory for analysis in an R.C.A. EMU-3 microscope. The results did not show sufficient agreement with published values to recommend further use.

Analysis by X-ray diffraction was performed on 16 single particles larger than 40 microns and on one portion of the most active impactor backup membrane filter in order to investigate the crystalline phase composition. The particles were mounted on a microscope cover slip glass using 3 percent nitrocellulose diluted in amyl acetate. The particles were analyzed in a Philips Microcamera using filtered copper radiation.

Electron microprobe analysis of the particle topographic composition was performed on 15 single particles larger than 20 microns and on one portion of the most active impactor backup membrane filter. The samples were mounted on the end of a polished beryllium rod using 3 percent nitrocellulose in ethyl acetate cement. Analysis was performed at 30 kv and 110 μ amp beam current in an Applied Research Laboratory

microprobe. Analyses were for elements of atomic number higher than sodium ($Z > 11$).

The compositional data was compared with optical microscope, alpha activity, and radiochemical data where available.

2.3.6 Alpha Counting, Radiochemistry and Fluorometry. Single particles were transferred to Project 5.2d for alpha counting and plutonium and uranium analysis in order to investigate the particle activity, uranium-to-plutonium-content ratio, and self absorption factor.

Isolated particles were mounted on 1-by-1½-inch class slides 0.049 inch thick using 3 percent nitrocellulose in amyl acetate cement. The particle was counted in a Nuclear Measurements Corporation Model PC-3B, 2π gas proportional counter.

Total plutonium was determined by radiochemical procedure consisting of wet ashing, purification, anion exchange separation, electroplating, and alpha counting.

Total uranium was determined by introducing an aliquot of the particle solution into a sodium fluoride-lithium fluoride flux which was fused into a pellet. The ultraviolet-excited fluorescence was measured with a Jarrell Ash fluorometer.

Forty-five particles larger than 15 microns diameter were selected randomly from Cylindrical Collector samples, 15 particles from each of 3 sample locations for analysis.

One hundred ninety-two particles larger than 25 microns diameter were isolated, on the basis of phosphor autoradiographic spots from a Clean Slate II Deposition Disk from the Arc B balloon. The parti-

cles were grouped into eight size intervals for the analyses in order to determine the size-activity relationship for the larger particles.

2.3.7 Analytical Scheme. The analytical techniques were applied to the several types of samples listed in Table 2.2 as follows.

Casella Impactor Stages 1 and 2 were examined in large numbers by phosphor autoradiography. Stages 1, 2, and 3 of a select group of impactors were examined in greater detail by nuclear track autoradiography and optical microscopy. Both procedures were directed toward obtaining the particle size-activity relationship for particles larger than 0.5 micron. Sample performance and individual particle characteristics were observed.

Casella Impactor Stages 4 and 5 and a few Andersen stages were examined by nuclear track autoradiography with optical microscopy, and by electron microscopy, to measure the activity of submicron particles. Electron microscopy was confined chiefly to nearly spherical shaped particles. Large portions of final impactor filters were surveyed by phosphor autoradiography, for signs of sampler overloading.

Andersen Impactor stages were sampled by stripping a small portion and examining by nuclear track autoradiography and optical microscopy. The remaining portions were surveyed by phosphor autoradiography.

Total Air Samples (TAS) were examined by nuclear track autoradiography and optical microscopy. One sample which indicated activity on the back-up membrane filter was examined by nuclear track autoradiography and electron microscopy for the presence of spherical particles.

Glass Slide samples of ground level deposition particles were examined

in large numbers by phosphor autoradiography. Some select samples were re-examined by nuclear track autoradiography in order to calibrate image spot size to particle diameter.

Disk collectors from balloon locations were examined by phosphor autoradiography, subsequent to gamma counting under Project 5.2/5.3d, to provide a survey of the larger airborne particles. One disk from Clean Slate No. 2 was examined as follows. Six hundred particles larger than 30 microns were located and measured. One hundred ninety particles were isolated and classified into size groups for chemical analysis.

Cylindrical collectors from balloon locations were examined by phosphor and nuclear track autoradiography. Forty-five particles larger than 15 microns were isolated for alpha counting and radiochemical analysis. Ten samples were submitted for radiochemical analysis.

Selected particles were isolated and the alpha activity counted before and after crushing in order to determine the particle self-absorption factor.

A selection of several large particle types was isolated and submitted for X-ray diffraction analysis and subsequently for electron microprobe analysis.

Of the samples listed in Table 2.2a, 280 were submitted to Project 5.2/5.3d for determination of total Uranium and Plutonium content. Small portions of some of these Total Air Sample Filters and Impactor Membrane Filters were held for future study in the case that subsequent data analysis warrants it.

Samples which were not examined by radiochemical analysis, such

as a large number of Deposition Slides, several Disk Collectors, and Cylindrical Collectors, were reserved for subsequent study if required.

The field count data of alpha activity, which was submitted with the samples, is included in Table A.16.

TABLE 2.1 TYPE AND NUMBER OF SAMPLES SUBMITTED

Sampler Type	Sampling Medium	Size	Field Locations Represented	Number of Samples
Casella Impactor (air sample)	Canada balsamdibutyl phthalate on glass	1 inch diameter	balloon curtains, ground level (4-1/2 ft), towers	115 plus 202[a] 317
Andersen Impactor (air sample)	Canada balsamdibutyl phthalate on glass. Some with Mylar intermediate layer.	3-3/8 inch diameter	ground level (4-1/2 ft)	59
Membrane Filter (final stage of impactors)	Gelman AM-4 porous cellulose, 0.8 micron pore	47 mm diameter	same as above	39
Total Air Sample (Types I, II, and D orifice)	Gelman-Microsorban polystyrene fibers, 1mm thick mat backed by AM-4	2 inch diameter	balloon curtain, ground level (4-1/2 ft) towers	29
Glass Slide (deposition	Canada balsamdibutyl phthalate on glass	2x3 inches (1-1/2x2-1/2 effective)	ground level (2 ft)	40 plus 224[a] 264
Disk Collector (deposition	Plexiglas coated same as Andersen	6 inch diameter	balloon curtain	16[a]
Cylindrical Collector (air impaction)	Petrolatum in benzol, on 1/16 inch brass wire	14 inch length	balloon curtain	18
			TOTAL	742

[a] For phosphor autoradiography only.

TABLE 2.2 IDENTIFICATION NUMBER AND FIELD LOCATION OF SAMPLES

Four digit number is Tracerlab Sample Identification number.
Letter(s) followed by hyphen and numbers is test array location.
The four columns represent the four field tests.

Double Tracks	Clean Slate I	Clean Slate II	Clean Slate III
A. Samples For Detailed Analysis			
Casella Impactor (5 stages)			
2436 B,L2,P13	3442 B,L17,P5	2292 BM-06	5257 GZ,TB,P3
2906 B,L5,P9	3452 B,L20,P13	2287 A-042	4827 B-078
2152 B,L12,P21	2589 F-024	2309 B,L2,P21	4926 D-038
9625 E-056	3332 N-024	2229 D-028	4886 F-038
9626 G-060	3335 N-038	2273 D-036	4842 H-030
9627 G-054	3317 P-024		
2724 H-068			
9675 I-059			
2477 J,L4,P1			
2947 R-056			
	2558 F-054[a]	2348 B,L30,P5[a]	
Anderson Impactor (6 stages)			
2965 R-064	2608 D-034	3221 B-058	4985 BM-10
	3385 H-034	3161 J-036	4980 A-102
	2646 L-034	3172 L-046	3277 J-082
			3296 L-082
3948 L-058[a]			
Total Air Sample, Type I, II and D			
2527 A-072 (D)	3078 A-024 (D)	4808 B-056 (I)	5166 A-024 (D)
2989 B,L10,P21 (I)	3035 B,L22,P5 (I)	4814 B-068 (II)	5126 B-030 (II)
2709 H-060 (II)	3543 F-036 (II)	4060 H-024 (II)	5132 B-090 (II)
2888 N-068 (D)	3522 H-036 (II)	4053 H-030 (II)	5059 F-090 (II)
2939 R-054 (II)	3491 J-026 (II)	4138 J-054 (II)	5043 H-090 (II)
	3505 J-040 (D)	4075 L-036 (II)	5090 K-084 (I)
	3570 N-030 (II)	4079 L-060 (II)	5110 L-042 (II)
	3579 N-040 (D)		
	3070 P-048 (II)		

TABLE 2.2 (CONTINUED)

Double Tracks	Clean Slate I	Clean Slate II	Clean Slate III
Glass Slide			
8038 CM-09	8080 BM-07[b]	8101 C-064[b]	8165 CO-05.2
8035 B-066A	8080 BO-05[b]	8101 C-066	8165 B-016
8035 D-054	8080 CM-07[b]	8101 D-030	8167 C-024
8038 F-056	8080 CO-05.2	8101 E-024	8167 D-028
8038 H-044	8080 B-024	8103 G-020	8167 E-030
8038 H-048	8080 D-030[b]	8103 J-020	8169 F-034
8038 L-042	8082 D-036[b]	8103 L-026	8169 G-032
8038 L-056	8082 F-030[b]		8171 H-034
8035 P-038	8082 H-028[b]		8171 J-036A
	8082 H-032[b]		8171 L-040
	8082 H-038[b]		
	8082 J-028		
	8082 L-028[b]		
	8082 L-030[b]		
	8084 N-034		
	8084 O-030[b]		
	8084 O-034[b]		
	8084 P-032		
10027 Stake[c]201	9911 Stake[c]822	10057 Stake[c]840	
Disk Collector			
	3109 B,L12, P9	4174 GZ,U.K.#2,P10	
	3110 B,L14,P9	4173 GZ,U.K.#2,P12	
	3114 B,L19,P5	4172 GZ,U.K.#2,P14	
	3112 B,L20,P9	4169 GZ,U.K.#3,P8	
	3113 B,L20,P17	4171 GZ,U.K.#3,P12	
	3122 B,L24,P10	4105 B,L4,P17	
	3120 B,L25,P5		
	3118 B,L28,P9		
	3119 B,L28,P17		

TABLE 2.2 (CONTINUED)

Double Tracks	Clean Slate I	Clean Slate II	Clean Slate III
Cylindrical Collector			
2469 B,L4,P8	5294 B,L11,P7		
2469 B,L4,P9	5298 B,L13,P5		
2469 B,L4,P11	5297 B,L14,P6		
2908 B,L5,P7	5299 B,L17,P6		
2908 B,L5,P13	5342 B,L19,P5		
2119 B,L6,P10			
2445 B,L7,P13			
2121 B,L12,P20			
2122 B,L14,P20			
2123 B,L18,P23			
5306 J,L1,P11			
5306 J,L1,P13			
5335 J,L4,P13			
B. *Samples For Autoradiography Only*			
Casella Impactor (Stages 1 and 2)			
9658 G-060 S1,S2	3431 B,L8,P13 S1,S2	2303 GZ,TA,P1 S1,S2[d]	4823 B-002 S1,S2
	3436 B,L12,P21 S1,S2	2302 GZ,TA,P2 S1,S2	4820 B-026 S1,S2
	3437 B,L14,P13 S1,S2	2304 GZ,TB,P1 S1,-	4822(?) B-026 S1,S2
	3438 B,L14,P21 S1,S2	2367 GZ,UK1,P8 S1,S2	4828 B-038 S1,S2
	3444 B,L17,P1 S1,S2	2291 BM-04 S1,-	4832 B-050 S1,S2
	3446 B,L18,P13 -,S2	2293 BM-08 S1,-	4835 B-054 S1,S2
	3453 B,L23,P9 S1,S2	2294 BM-10 S1,-	4829 B-060 S1,S2
	3456 B,L24,P13 S1,S2	2295 BM-12 S1,-	4836 B-062 S1,S2
	3457 B,L24,P21 S1,S2	2290 A-006 S1,-	4826 B-074 S1,S2
	3459 B,L26,P5 S1,S2	2289 A-018 S1,-	4821 B-086 S1,S2
	3464 B,L27,P9 S1,S2	2288 A-030 S1,S2	4825 B-098 S1,S2
	2688 B-026 S1,S2	2285 A-066 S1,-	4833 B-106 S1,S2
	2629 D-018 S1,S2	2284 A-078 S1,-	4920 D-002 S1,S2
	2621 D-024 S1,S2	2283 A-090 S1,-	4919 D-006 S1,S2
	2619 D-034 S1,S2	2282 A-102 S1,-	4918 D-014 S1,S2
	2618 D-038 S1,S2	2281 A-114 S1,-	4921 D-026 S1,S2
	3478 F-020 P3 S1,S2	2318 B,L23,P9 S1,-	4927 D-050 S1,S2
	3473 F-020 P7 S1,S2	2323 B,L26,P5 S1,-	4922 D-060 S1,-
	2587 F-026 S1,S2	2376 B-028 S1,-	4923 D-062 S1,S2
	3397 H-040 S1,-	2379 B-050 S1,-	4925 D-074 S1,S2

TABLE 2.2 (CONTINUED)

Double Tracks	Clean Slate I	Clean Slate II	Clean Slate III
		2377 B-054 S1,-	4928 D-086 S1,S2
		2382 B-074 S1,-	4917 D-088 S1,S2
		2368 B-078 S1,-	4915 D-110 S1,S2
		2171 F-022 S1,S2	4897 F-080 S1,S2
		2249 H-010 S1,S2	4850 H-030 S1,-
		2247 H-016 S1,S2	4869 H-038 S1,S2
		2251 H-034 S1,-	4873 H-062 S1,-
		2246 H-038 S1,S2	4878 H-074 S1,-
		2253 H-040 S1,S2	4875 H-080 S1,-
		2252 H-044 S1,S2	5020 I-050 P1 S1, S2
		2245 H-050 S1,S2	5019 I-050 P3 S1,S2
		2242 H-056 S1,S2	5018 I-050 P4 S1,S2
		2243 H-058 S1,S2	5016 I-050 P5 S1,S2
		2250 H-062 S1,S2	5021 I-050 P6 S1,S2
		2241 H-080 S1,S2	5022 I-050 P7 S1,S2
		2196 J-010 S1,S2	5024 I-050 P12 S1,S2
		2198 J-016 S1,S2	4952 L-014 S1,S2
		2197 J-022 S1,S2	4951 L-034 S1,S2
		2200 J-026 S1,S2	4955 L-038 S1,S2
		2199 J-028 S1,S2	4950 L-050 S1,S2
		2203 J-038 S1,S2	4947 L-060 S1,S2
		2204 J-042 S1,S2	
		2202 J-044 S1,S2	
		2206 J-050 S1,S2	
		2212 J-056 S1,S2	
		2207 J-062 S1,S2	
		2210 J-080 S1,S2	
		2209 J-106 S1,S2	
		2214 L-006 S1,S2	
		2213 L-010 S1,S2	
		2225 L-016 S1,S2	
		2221 L-028 S1,S2	
		2215 L-032 S1,S2	
		2216 L-034 S1,S2	
		2226 L-044 S1,S2	
		2223 L-056 -,S2	

TABLE 2.2 (CONTINUED)

Double Tracks	Clean Slate I	Clean Slate II	Clean Slate III
Gelman Sequential Air Sampler			
3994 F-068			
Glass Slide			
8038 BM-08	8080 BM-06	8101 C-050	8165 BH-02
8038 BM-09	8080 BM-08	8101 C-056	8165 BH-04
8038 BO-08	8080 BO-06	8101 C-062	8165 BK-02
8038 BO-09	8080 CO-05.3	8101 C-072	8165 BK-04
8038 BO-10	8080 CO-05.4	8101 C-090	8165 BM-12
8038 CO-09	8080 B-016	8101 C-106	8165 BM-13
8038 CO-11	8080 B-020	8101 D-014	8165 BM-14
8035 B-058	8080 B-028	8101 D-016	8165 BO-01
8035 B-062A	8080 B-032	8101 D-018	8165 BO-02
8035 B-070	8080 B-036	8101 D-020	8165 BO-03
8035 D-050	8080 D-020	8101 D-022	8165 BO-12
8035 D-058	8080 D-022	8101 D-040	8165 BO-13
8035 D-062	8080 D-024	8101 D-060	8165 BO-14
8035 D-066	8080 D-026	8101 D-074	8165 CM-05.0
8035 D-070	8080 D-028	8101 D-100	8165 CM-05.1
8038 F-040	8080 D-032	8101 D-114	8165 CM-05.2
8038 F-042	8082 F-022	8101 E-018	8165 CM-05.3
8038 F-046A	8082 F-024	8101 E-020	8165 CM-05.4
8038 F-046B	8082 F-026	8101 E-022	8165 CO-03.4
8038 F-050	8082 F-032	8101 E-030	8165 CO-05.0
8038 F-062	8082 F-034	8101 E-040	8165 CO-05.1
8038 F-068	8082 F-036	8101 E-060	8165 CO-05.3
8038 H-052	8082 J-020	8101 E-080	8165 CO-05.4
8038 H-054	8082 J-022	8101 E-100	8165 CO-07.4
8038 H-060	8082 J-024	8101 E-112	8165 CO-09.4

TABLE 2-2 (CONTINUED)

Double Tracks	Clean Slate I	Clean Slate II	Clean Slate III
Glass Slide (Continued)			
8038 H-034	8082 J-02	8103 I-022-3	8165 B-020
8038 H-070	8082 I-030	8103 I-026-2	8165 B-024
8038 J-026	8082 J-032	8103 G-022	8165 B-028
8038 J-044	8082 J-034	8103 G-024	8167 C-022
8038 J-050	8082 J-036	8103 G-026	8167 C-026A
8038 J-054	8082 J-038	8103 G-028	8167 C-028
8038 J-058	8082 J-040	8103 G-030	8167 C-030
8038 J-064	8082 L-026	8103 G-046	8167 C-092
8038 J-070	8082 L-032	8103 G-060	8167 C-094
8038 L-046A	8082 L-034	8103 H-016	8167 C-098
8038 L-052	8082 L-036	8103 H-020	8167 C-102
8038 L-060	8082 L-040	8103 J-014	8167 D-024
8038 L-064	8084 N-020	8103 L-034	8167 D-030
8038 L-068	8084 N-022	8103 L-036	8167 D-032
8038 L-070	8084 N-024	8103 L-038	8167 D-034
8035 N-034	8084 N-026	8103 L-040	8167 D-038
8035 N-042	8084 N-028	8103 L-042	8167 D-086
8035 N-048	8084 N-030	8103 L-044	8167 D-088
8035 N-054	8084 N-032	8103 L-046	8167 D-092
8035 N-058	8084 N-036	8103 L-048	8167 D-094
8035 N-062	8084 N-038	8103 L-050	8167 E-026
8035 N-066	8084 N-040	8103 L-052	8167 E-028
8035 N-072	8084 N-042	8103 L-054	8167 E-034
8035 P-032	8084 N-044	8103 L-056	8167 E-036
8035 P-034	8084 O-028	8103 L-060	8167 E-038
8035 P-040	8084 O-032	8103 L-062	8169 E-070
8035 P-044	8084 O-036		8169 E-074
8035 P-050	8084 P-020		8169 E-078
8035 P-054	8084 P-022		8169 E-080
8035 P-060	8084 P-024		8169 F-030
8035 P-064	8084 P-026		8169 F-032
8035 P-070	8084 P-028		8169 F-036
8035 R-030	8084 P-030		8169 F-038
8035 R-034	8084 P-034		8169 F-040
8035 R-038	8084 P-036		8169 F-042

TABLE 2.2 (CONTINUED)

Double Tracks	Clean Slate I	Clean Slate II	Clean Slate III
Glass Slide (Continued)			
8035 R-044	8084 P-038		8169 F-074
8035 R-050	8084 P-040		8169 F-076B
8035 R-056	8084 P-042		8169 F-082
8035 R-062			8169 G-036
8035 R-066A			8169 G-040
8035 R-070			8169 G-042
			8169 G-046
			8169 G-070
			8169 G-074
			8169 G-078
			8171 H-032
			8171 H-036
			8171 H-038
			8171 H-042
			8171 H-046B
			8171 H-074
			8171 H-076
			8171 H-086
			8165 H-030Y-1
			8165 H-030Y-3
			8167 H-030Y-7
			8167 H-030Y-10
			8169 H-060Y-2
			8169 H-060Y-7
			8171 H-090Y-4
			8171 H-090Y-6
			8173 H-090Y-9
			8171 J-034
			8171 J-038
			8171 J-042
			8171 J-072
			8171 J-076
			8171 J-080
			8171 L-036
			8171 L-038
			8171 L-042
			8171 L-044
			8171 L-048

TABLE 2.2 (CONTINUED)

Double Tracks	Clean Slate I	Clean Slate II	Clean Slate III
Glass Slide (Continued)			
10014 Stake[c]57	9908 Stake[c]817	10057 Stake[c]835	
10014 Stake[c]61	9908 Stake[c]819	10033 Stake[c]907	
10014 Stake[c]65	9908 Stake[c]820	10033 Stake[c]919	
10027 Stake[c]259	9911 Stake[c]824		
10027 Stake[c]260			
10027 Stake[c]262			

[a]Background Air Sample

[b]Replaces sample from a similar location which was not analyzed in proper sequence

[c]Off-site

[d]Large particles prevented autoradiography, single particles studied

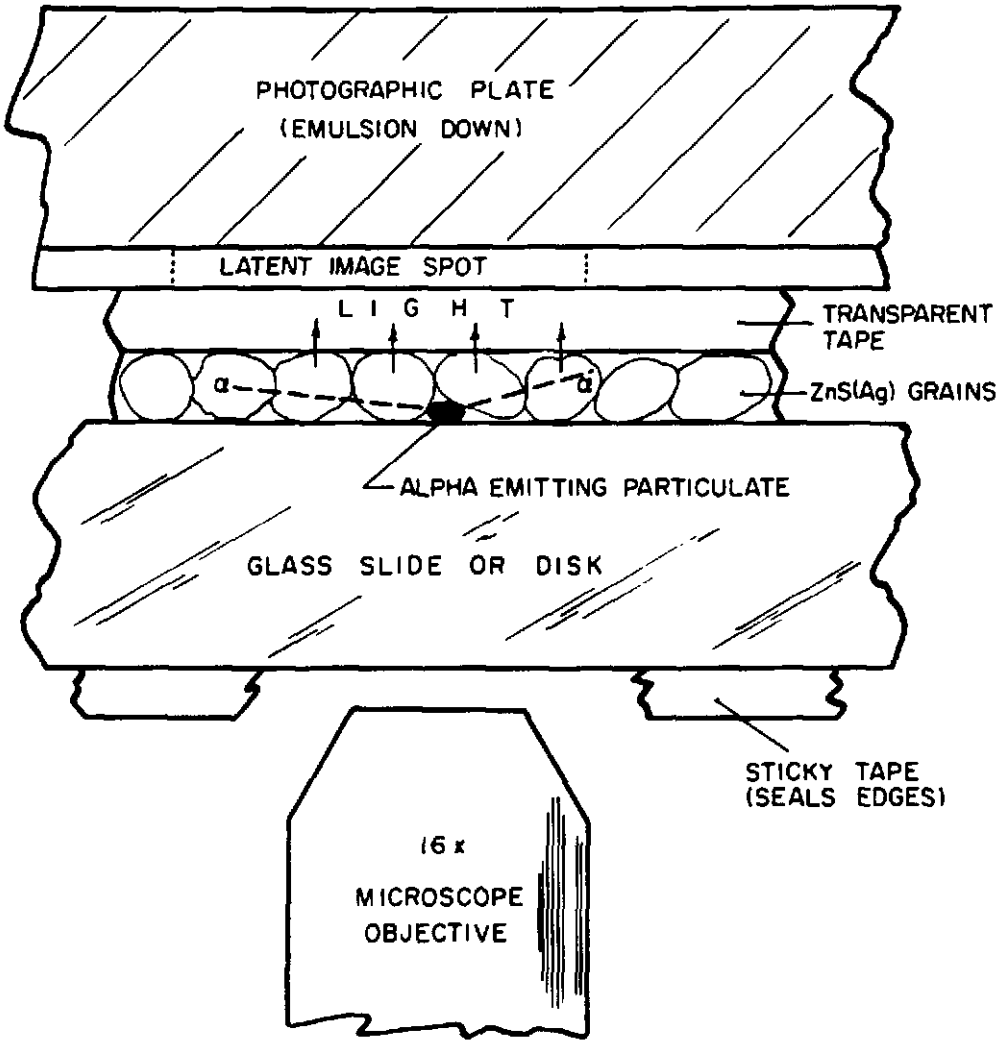
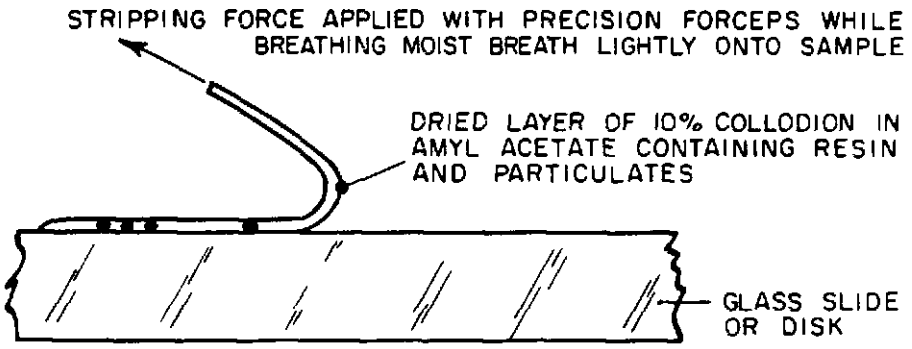
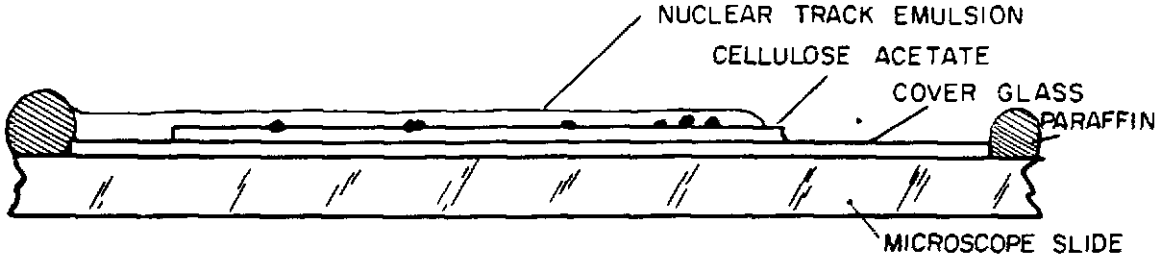


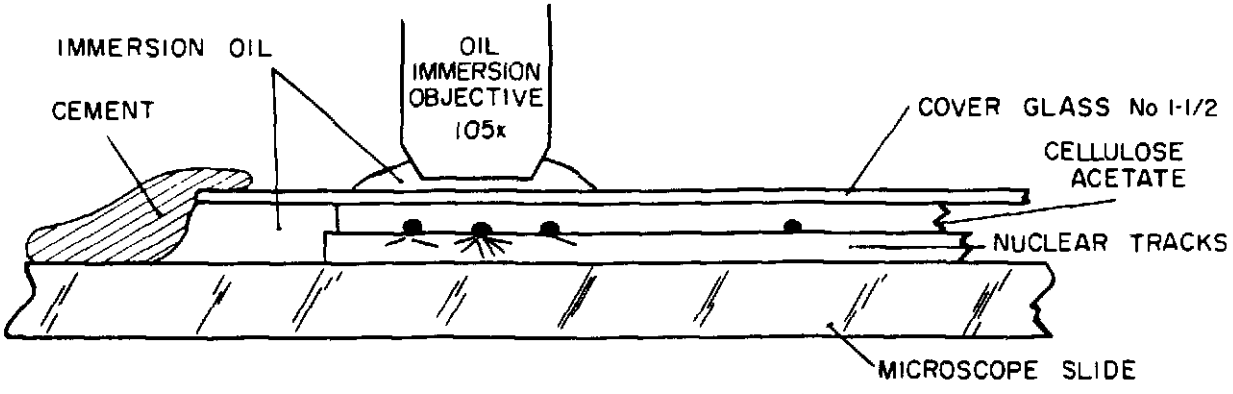
Figure 2.1 Diagram of phosphor intensification autoradiography technique.



(a) PARTICULATES AND RESINS STRIPPED FROM IMPACTOR DISKS OR DEPOSITION SLIDES

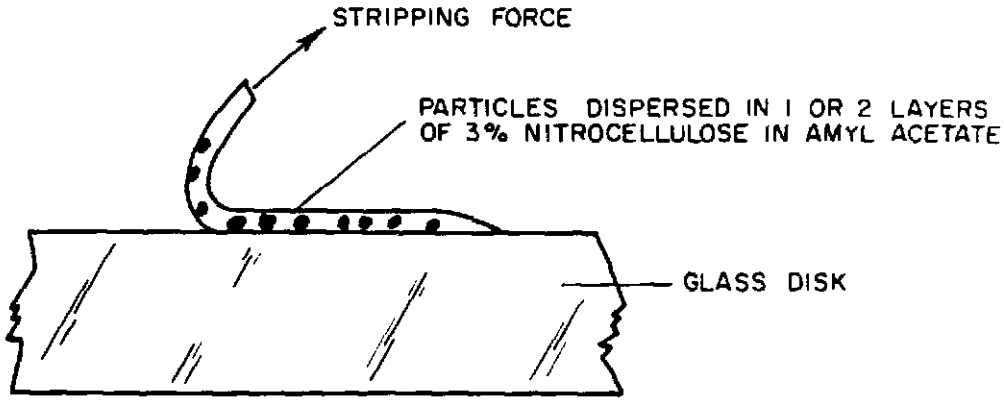


(b) STRIPPED LAYER PREPARED FOR AUTORADIOGRAPHIC EXPOSURE AND PROCESSING

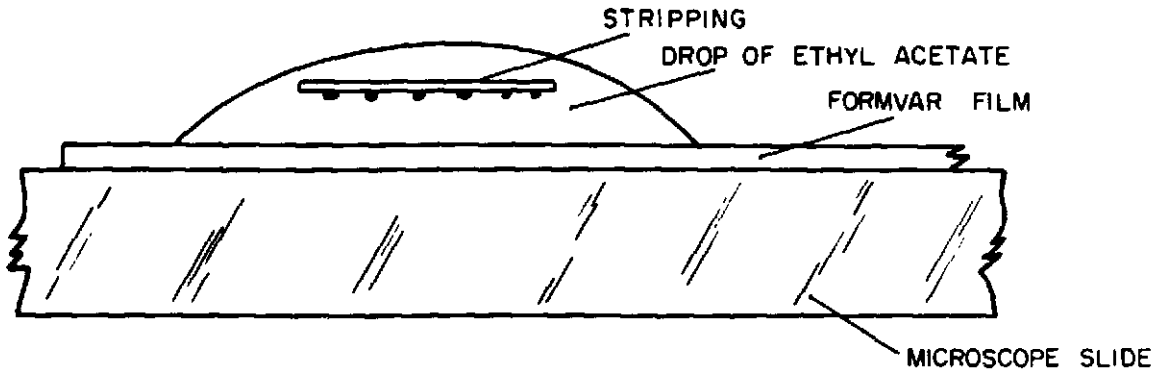


(c) AUTORADIOGRAM - PARTICULATE LAYERS PREPARED FOR OPTICAL MICROSCOPY

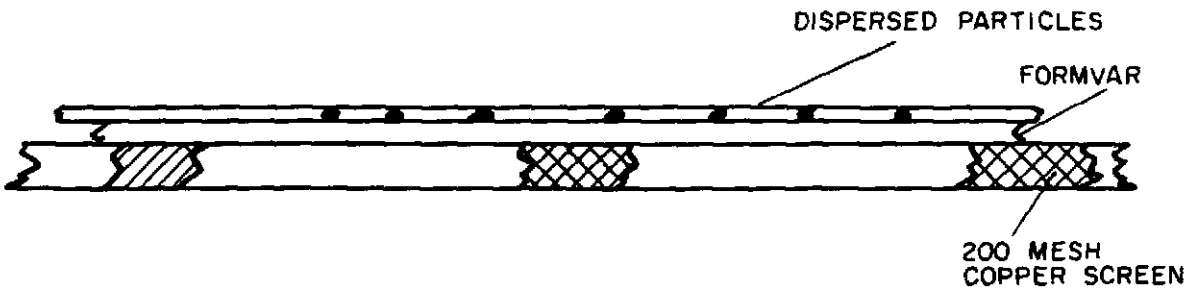
Figure 2.2 Diagram of nuclear track emulsion autoradiography technique.



(a) PARTICLES DISPERSED AND STRIPPED



(b) STRIPPED LAYER DISPERSED ONTO FORMVAR FILM



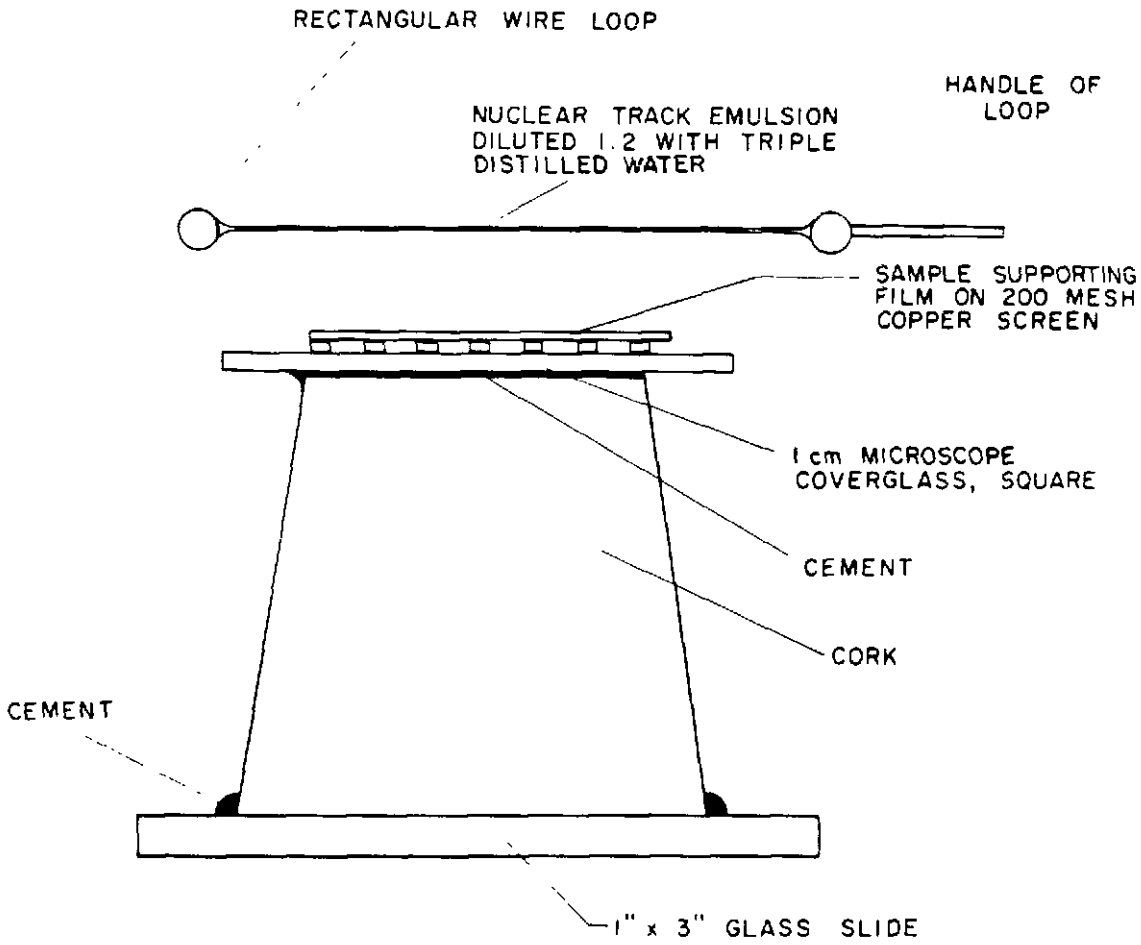
(c) PREPARATION MOUNTED FOR ELECTRON MICROSCOPY OR NUCLEAR EMULSION AUTORADIOGRAPHY

Figure 2.3 Diagram of sample preparation for electron microscopy.

Autoradiogram of preparation below

Electron microscope preparation

Figure 2.4 Contact autoradiogram of electron microscope preparation.



Not Drawn to Scale

Figure 2.5 Coating technique for autoradiography of electron microscope preparation.

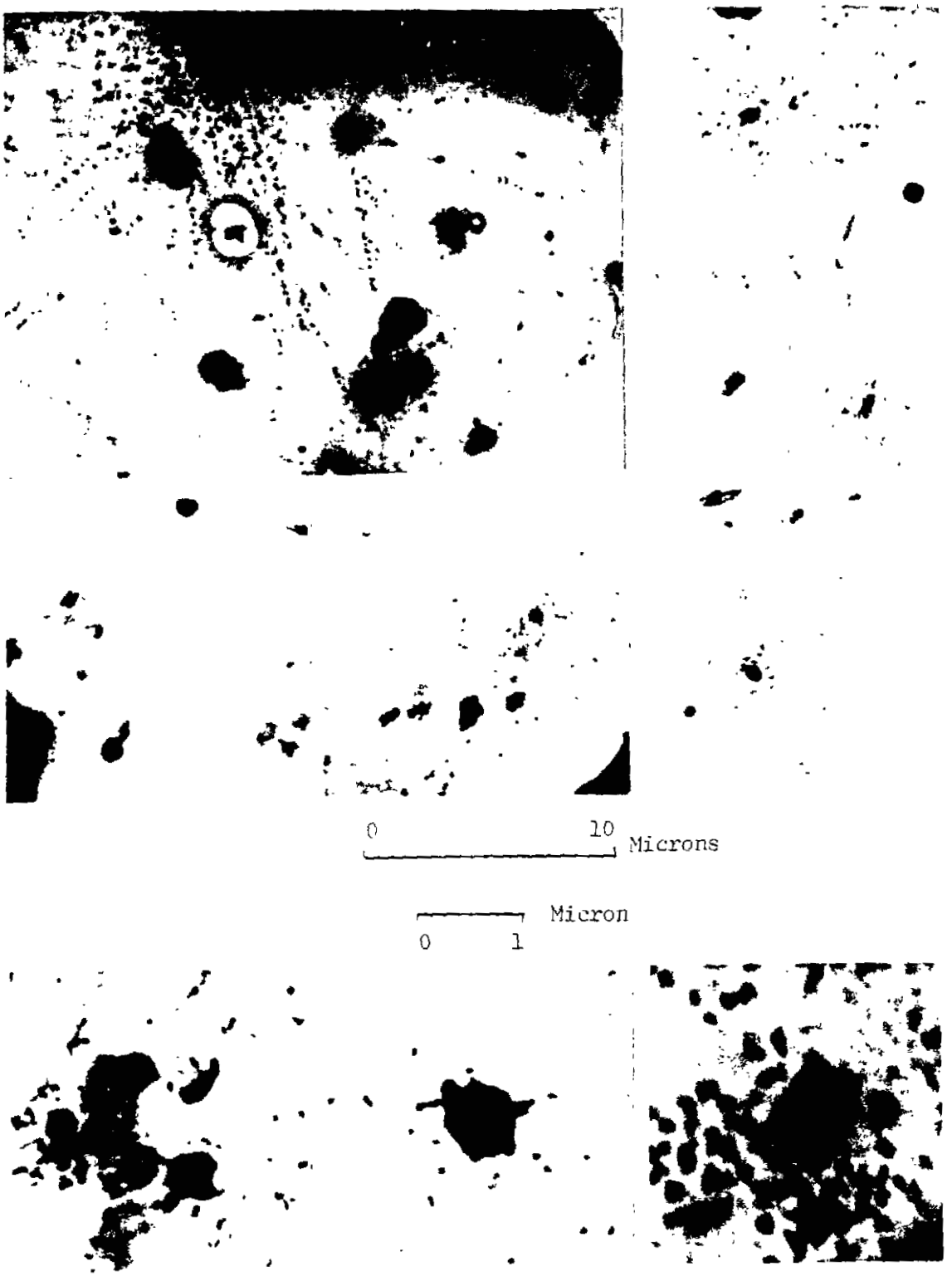
Fine particle smaller than silver grain size.

Masking due to silver, compensated by underexposing electron micrographic plate plus short printing time.

Ilford Type K.O. emulsion D-19 developer.

Eastman Type NTA *p*-phenylenediamine developer.

Figure 2 6 Electron micrograph-autoradiograms.



2906 Stage 4 Arc B, L5, P9 Double Tracks

Figure 2.7 Active spherical particles.

CHAPTER 3

RESULTS

Observations which were indicative of sampler operation are presented before considering the microscopic particle detail.

3.1 OBSERVATION OF SAMPLER PERFORMANCE

3.1.1 Casella Impactor. Photographs of individual stages from four impactors are shown in Figures 3.1 and 3.2, in which the particle deposit appears white against a black background. Color photographs of four deposits are shown in Figure 3.3. Figures 3.4 and 3.5 indicate the distribution of activity on sets of Stage 1 and 2 disks. In the phosphor autoradiograms the active sites appear as white (negative) image spots, and reference to the exposure time is required for comparison of images. Figure 3.6 indicates the activity of the final stage filter for several impactors.

Figure 3.1 illustrates deposits which appeared to approach normal or expected operation but tended to be heavy deposits. Many samples showed particle populations so dense that the collection surface characteristics probably had been changed, a condition which we will call apparent overload. Figure 3.2 indicated gross overloading on 5257 due to location near GZ. Sample 4886 showed overload on latter stages due to improper collection on Stage 1. Most Stage 1 deposits indicated increased deposition toward one side of the rectangular deposit. This was due in part to an angular difference between the cloud direction

and the axis of the impactor inlet orifice. Extreme examples of this are shown in Figure 3.4, Sample 3436, and Figure 3.5, Samples 4822, 4869, and 4923. These illustrations suggest that particles may have been collected on internal surfaces other than the glass disks, and this effect varied greatly from sample to sample. Apparent overload of Stages 2 and 3 is shown in Figure 3.3, Samples 2303 and 2292, and in Figure 3.4, Sample 2288. Sample 2252, Stage 2, suggested overloading due to double exposure. Double or fanned deposits similar to that in Figure 3.1, Sample 2152, Stage 4, were noted, and several Stage 3 and 4 deposits appeared to have been caked together with portions having been chipped away. Figure 3.6 demonstrated that particles of various levels of activity were collected on the backup membrane filters.

The final criterion of sampler performance is how well did the impactor classify the active particles. Data on this was obtained in the microscopic studies and will be discussed later.

3.1.2 Andersen Impactor. The particle deposits varied widely across any given stage, and no color was apparent. Several samples showed preferential deposition along one quadrant of each stage which might indicate a preferred direction of flow through the impactor due either to the orientation of the entrance orifice or possible blockage of a large area of the first orifice plate. Figure 3.7 illustrates the non-uniformity and some heavy deposits on Stages 3, 4, and 6. Stage 2 shows a bubble under the mylar substrate used on this sample. Figure 3.8 illustrates individual deposits on other samples. Great variability in

the size, shape, and particle population among the deposits on a given stage was again evident. The very heavy deposits found on Stage 6 of Sample 4980 were actually deep conical deposits. Figure 3.9 indicates that the activity was distributed quite uniformly across the latter stages in contrast to the irregularity in total particle distribution. Each spot image in Figure 3.9 may represent several particles within a given orifice deposit. Microscopic observations are presented later.

3.1.3 Total Air Filter Samples. The three types of Total Air Sampler employed a 1-mm-thick matrix of fibers. Figure 3.10 indicates the effect of the Type I entrance orifice. The particle appeared to be well embedded in the surface fibers. The Type D filter surface appeared to be fluffed from the air flow, such as shown for Sample 3078. Large particles were noted in the plastic covers of the Type D samples. Figure 3.10 includes an autoradiogram of the membrane filter, used to back up the 1-mm thick Microsorban material, which indicates that some activity had penetrated the 1-mm thick filter. The similarity to the pattern for Sample 2906 in Figure 3.6 suggested that the penetration was probably due to many submicron particles being available in the Double Tracks event. Electron micrographs are shown later. Visual inspection and alpha counting of successive layers of other samples indicated that the activity was confined to the top surface of the Microsorban material.

3.1.4 Glass Slide Deposition Samples. To the naked eye most of the samples resembled frosted glass. Clean Slate II or III samples from near GZ were rich brown, and the quantity of particles was sufficiently large to obscure 50 percent of the area. Photographs were not taken.

Figure 3.11 shows phosphor autoradiograms of a slide and the accessory cardboard frame used to separate the cover slide from the sample slide during storage. The 2 3/4-inch-square autoradiogram did not cover the full 2- by-3-inch slide, but the full width was represented. No loss of particles to the cover slide was indicated, but loss to the frame was observed. For this reason quantitative readout of spot size was confined to the central 1 1/2- by-inch area of the slide. Other autoradiograms are presented in Section 3.2.

There was no evidence that the wet resin surface had resulted in any particle agglomeration or deagglomeration after the particle had been deposited. Figure 3.15, Samples BM-09, BO-09, B-062, F-040, F-046A, and B, and F-050 show series of spots trailing across the slide in an upwind-downwind direction which suggests that some large agglomerates or aggregates were partially dispersed during the deposition process. (Nuclear track autoradiography performed subsequently showed that many of the large image spots were produced by several particles.)

There was no indication from the autoradiograms that the efficiency of collection at the center of the supporting table was different from that at the edge where the slides had been exposed. No conclusion as to efficiency versus particle size for the slides can be made.

For Double Tracks and Clean Slate I samples, apparently uniform deposits of a few hundred active particles occurred in areas where ground level alpha surveys had indicated 10 $\mu g/m^2$ or greater activity. For Clean Slate II and III Sample, uniform deposits were observed on samples from areas as low as 1 $\mu g/m^2$. Microscopic observations are presented later.

3.1.5 Disc Collector. Fifteen samples collected under Clean Slate I and II were examined. The 7-inch-diameter balloon-borne sticky plastic discs each had been exposed horizontally under and coaxial to a cylinder collector (sticky wire) which was suspended vertically. The centers of the samples were disturbed due to contact with a suspension nut and washer. There was no evidence of the wire having influenced the disc deposit due to shadowing or particle fall off. The periphery of several discs appeared to have a higher population than the center.

Figure 3.12 shows a typical phosphor autoradiogram. Blurring was caused by poor contact between film and phosphor screen. Most of the discs had some particles on the bottom side also. Discs exposed on the close-in balloons in Clean Slate II were heavily populated and contained a shredded fibrous material which resembled pieces of desert vegetation. The large area of the disc provided a large number of particles for potential study, but the high levels of activity (10^3 to 10^5 dis/min) and the large sticky surface were difficult to work with. Mylar layers used on some of the discs curled to the extent of being unmanageable for particle work. Several of the storage containers had sticky deposits in the corners which may indicate sample loss. In the absence of criteria for interpreting performance, and since no nuclear track autoradiography was performed, no more can be said about the size of the finest particles collected on the discs. The large end of the active particle-size spectrum was investigated in some detail for Clean Slate II as described later.

3.1.6 Cylindrical Collectors. Eighteen wires from Double Tracks and Clean Slate I combined were examined. Figures 3.13 and 3.14

are photographs of the wire surface and indicate particles as large as 700 microns on 2469. The collection as examined appeared to be fairly uniform when considered over lengths of about 1/2 inch. The deposit was heavier on one side, which probably had faced upwind during exposure. The wires were not sufficiently ridged to prevent whipping of the 17-inch length. Standing waves were produced upon slight jarring when the ends of the wire were supported. Strippings of the inside surface of the cardboard shipping tube containers indicated some alpha activity which probably represented sample loss during handling and shipping.

However, removal of particles required gentle scraping of the surface with a needle while immersed in a puddle of solvent. The degree of removal was evaluated by alpha counting the wire periodically. The results of phosphor autoradiography given later indicate that the largest spot images were comparable to the largest spots produced from deposition slides and therefore the wires retained some of the largest active particles for Double Tracks and Clean Slate I. No wires from other events were examined. Microscope observations are presented later.

3.1.7 Gelman Sequential Tape Samples. One sample from Double Tracks was examined by phosphor autoradiography in order to locate the active areas so that individual deposits could be analyzed by radiochemical methods. The autoradiogram appears in Figure 3.20. There was no evidence of cross contamination or smearing of deposits during storage.

3.2 PHOSPHOR AUTORADIOGRAPHY RESULTS

The measurements of the diameters of the spot images are tabulated in Tables A.1 through A.4 of Appendix A. Data are given for 202 Casella Impactor Stages 1 and 2, 224 Glass Deposition Slides, 11 Disc Collectors,

and 6 Cylindrical Collectors. Each table covers one field test, and the data is compiled in the following order of sample type: Casella Impactor, Glass Slides, and Deposition Discs. For many samples the reported number of particles was normalized from measurement of a few hundred spots within a representative area.

Direct calibration by measurement of spot size and particle size was not successful due to the wide variation of activity in particles of a stated size. Figure A.1 shows these data. Table A.5 includes the results of phosphor autoradiography and nuclear track autoradiography on the same areas of Glass Slide samples from Double Tracks locations B-066, F-056, H-048, L-056, and Offsite Stake 261 which further illustrates this point. Calibration by measurement of the alpha emission in the sample area corresponding to a given spot size is shown in Figures A.1 and A.2. This method did not take into account absorption within the particle or sample matrix and therefore did not permit direct determination of the mass of plutonium on the sample. Thus, Objective 1 was not accomplished. by this technique.

The autoradiographic patterns were instructive on several points, however. Use in indicating sampler performance has been discussed above and patterns for Casella Stages 1 and 2 were shown in Figures 3.4 and 3.5. Deposition slide images representative of the test array in each field event are shown in Figures 3.15 through 3.19. The spot size was a function of particle diameter, particle activity, exposure time, and degree of contact between particle-phosphor-photo plate. (Emulsion and development had been standardized.) It should not be inferred that the large spot

images from Double Tracks slides represent larger particle sizes than those which produced the small images in Clean Slate III.

The most useful data derived from these images were the population densities on the deposition slides. These were of value in discussions of aliquoting soil samples. The images shown in Figure 3.19 indicate uniformity of deposition at intervals of 20 feet or more at Arc H-030 of Clean Slate III. The technique was useful in locating the low-level active deposits imbedded in a filter strip from a Gelman Paper Tape Sequential Sampler. Figure 3.20 illustrates the Double Tracks cloud passage. The technique was useful, also, in selecting larger single particles for sizing and composition analysis.

3.3 PARTICLE SIZE, SHAPE, SURFACE, AND ACTIVITY

The observations and measurements of individual active particles are listed on data sheets in Appendix A, Tables A.5 through A.12. The data are grouped for each field event according to sample type and distance from ground zero. The data are summarized in Tables 3.1 through 3.5 and Figures 3.23 through 3.52.

3.3.1 Active Particles Larger Than 1 Micron. Tables A.5 through A.8 contain optical microscopy measurements for particles larger than approximately 0.5 micron equivalent projected area diameter. A key to the data symbols appears in Figure 3.4.

A large body of data was obtained for many samples. Low particle populations, low activity levels, and difficulty with the intricate procedures resulted in limited data in many cases. The percentage of sample area from which data were obtained was recorded wherever possible. This was based on the nominal values in Table B.1, except

where microscopic observations indicated otherwise. Table B.4 gives the activity level of spheres of $Pu^{239}O_2$ for comparison with the Roller Coaster particles.

The measured particle size was tabulated under a column heading which represented the mean value for the size interval. The accuracy of the measurement was dependent on the observer's judgement in comparing particle outline with reticle circles. The greatest error in sizing occurred for cases where the image of the particle was irregular and the diameter of the equivalent projected area was half way between those of two reticle circles. The maximum error due to recording the data in an adjacent size interval when using the $\sqrt{2}$ ratio for reticle circles was 28 percent. The accuracy improved as the projected cross-section approached a circular shape and the dimensions approached the diameter of a reticle circle. The accuracy decreased with particle size due to several optical phenomena which included the width of the reticle line compared to the particle size, the difference in index of refraction between particle and mountant, and the focal setting. These errors were negligible for particles in the 3 to 18 micron range when measured by means of oil immersion. Above 18 microns, the error depended upon the objective power used. Below 2 microns, the error increased so that at 1 micron it was approximately 20 percent. This error was superimposed on the error due to assigning a projected area diameter. Excluding gross errors in data recording, the size measurements were within $\pm$ 28 percent.

The accuracy of the activity determination by alpha track counting depended on the solid angle of emulsion seen by the particle,

the activity level and exposure time, and the accuracy of the track count. It was assumed that the average particle saw a hemisphere of photographic emulsion. This was supported by observation that most of the particles produced some tracks which were in focus over the whole track length. This would not have been observed under oil immersion unless the emulsion had been sufficiently close to record alpha particles emitted in a direction parallel to the emulsion surface. The minimum exposure times were 2 hours, permitting detection of activity as low as 0.02 disintegration per minute. Table B.2 shows that this is equivalent to a 0.3-micron sphere of pure plutonium-239 oxide. Longer exposures were used on most of the samples. Track patterns of only 1 or a few tracks may have been overlooked especially when they occurred in a heavily populated field. Since very low activity particles were encountered, the size-frequency data were always biased against the less active and, therefore, to some extent against the smaller particles, especially for the shorter exposures. The number of tracks and the exposure time determines the counting statistics. Superimposed on this is the accuracy of the track count and the possibility of fading of the latent image before development. The latter was more likely for very long exposures. The track count was accurate to better than $\pm$ 10 percent for counts of less than 100 tracks. For denser track patterns, estimated as solid patterns etc., particles larger than 5 microns contributed an error in estimating the $\frac{S}{8}$ and $\frac{S}{4}$ levels. Figure A.3 gives the results of an attempt to calibrate the dense patterns. This was achieved by removing active particles smaller than 10 microns, redispersing

the preparation, and alpha counting the particle. The particle was then autoradiographed for sufficient exposure to produce a heavy image. While data from 40 particles showed large scatter due to particles having been fractured or lost or the preparation having been inadequately dispersed, the curve is based on the best selected data. The curve may be in error by as much as a factor of $\pm$ 2. Use of this calibration as described in the next paragraph indicated good agreement with alpha count data for single particles obtained in Project 2.6b. In the case where no particle could be associated with a track pattern, the track count was recorded under a miscellaneous grouping.

Statistical Analysis of Size, Shape, and Track Count Data

The complex data in Tables A.5 through A.8 were treated by statistical methods to elucidate interrelations of particle shape, size, and activity using a computer program. The work, conducted under the Data Evaluation Program, is described in Reference 18. The data were converted to unit density by use of an average particle density, calculated for each event by a method described in Section 3.4. Evaluation by multiple regression analysis indicated that the special particulate data for particles of density (ρ) = 1 and larger than 2 microns yielded a log normal distribution of d^2 versus cumulative percent mass of plutonium from Double Tracks and Clean Slate I. Evaluation of Clean Slate II and III was not available for this writing. Further reference to the data evaluation work is made below.

Description of Single Particles. Data on particle surface and color was not included in the statistical treatment because the observa-

tions depended on the amount of autoradiographic silver present, the color of the illumination, polarization effects, and subjective factors. Particles which were reported to have appeared as opaque may have been transparent to some degree. Color photomicrographs which illustrate the salient features of the particles are shown in Figures 3.21 through 3.28 and are discussed in the next five paragraphs.

Figure 3.21 illustrates preshot airborne particles collected prior to Clean Slate I. Two spherical particles found in a pre-operations soil sample are shown as a point of minor interest. Sample 2906 illustrates typical alpha track patterns which mark the active particles. Sample 9627 illustrates the extreme case where inactive background particles are so numerous as almost to mask the single alpha star pattern.

Figure 3.22 illustrates the presence of spherically shaped particles on the stages of the most active impactor sample from the Double Tracks event. Figure 3.23 shows active spherical particles smaller than 10 microns diameter. The bright halo around several of the particles is due to heavy alpha track patterns which are out of focus. The spheres ranged from opaque with wrinkled surfaces to smooth transparent particles. Figure 3.24 illustrates more complex particles. Transparent spheres with and without inclusions were common in Clean Slate I samples.

Figure 3.25 illustrates irregular shapes which occurred in all events but were much more prevalent in Clean Slate II and III. Also shown are large complex particles and a portion of a hollow sphere with a wall thickness of 20 microns. Sample 5257, Stage 1, showed large spheres located closer to the glass disc than were the irregular shaped soil particles. This indicated that the spheres were collected first. This sample was

located near the bunker door and suggested that the spheres were present in material exhausted via the door. Similar spheres were found in large numbers on a glass slide from BH-04 opposite the bunker door.

Figure 3.26 illustrates from the four field events large particles which exhibited surface entrapment of finer particles. Bubbles and spherical attachments were common at the surfaces. Figure 3.27 shows particles attached in various ways, evidence of plated material and/or emergence of internal material. Figure 3.28 illustrates particles for which X-ray diffraction and electron microprobe data are reported in Section 3.4.

The appearance of particles viewed by optical microscopy is summarized as follows. In general, the active particles larger than 1 micron gave evidence of fused surfaces. Large angular edged particles were rare and usually included activity at only a few sites. Large irregular particles usually exhibited at least one portion which was rounded. The larger spheres or ovoid-shaped particles usually exhibited surface attachments which included bubbles, irregular shaped inclusions, or discrete spheres. Wrinkled surfaces indicative of crystalline boundaries were observed such as in Figure 3.28. The transparent spheres tended to be less active than the opaque spheres. In the 1- to 10-micron-size range aggregation of 2 or 3 particles of similar size was not uncommon. Some irregular particles appeared to be aggregates of submicron spheres. Some particles of about 1-micron size appeared to be associated with flaked material. At high magnification it was difficult to differentiate

between flakes and irregularities in the dried layers of Canada Balsam and nitrocellulose. Flaked material was observed to be very common on all samples and in background samples as shown in Figures 3.21 and 3.22.

Alpha Activity Content. The alpha track counts in Tables A.5 through A.8 indicated a range of levels of activity for a given particle size. The most active particle in each sample was noted and its activity and plutonium concentration (expressed as % PuO_2 equivalent) were compiled in Table 3.1. Except for the values marked by an asteris., the activity was determined by use of the calibration for dense stars given in Figure A.3. The percentage composition of $Pu^{239}O_2$ equivalent to the estimated activity is given in parenthesis for purposes of the following discussion.

If a homogeneous particle composition consisting of only the active components of the source had occurred, the percent $Pu^{239}O_2$ composition would have been approximately 23 percent for Double Tracks, 2 percent for Clean Slate I and 1 percent for Clean Slate II and III. The values in Table 3.1 fell on either side of these source ratio values for the first two events but were generally lower than the source ratio for the later events. Values in excess of 100 percent $Pu^{239}O_2$ were common for the most active particles in Double Tracks, but only 1 value resulted from an actual track count. This may indicate that the calibration for dense track patterns had overestimated the activity. However, allowance of a factor of 200 to 300 percent would still leave some values very close to pure $Pu^{239}O_2$. Unreacted plutonium may have been samples. These particles are of the type shown in the top and center of Figure 3.23. Other Double Tracks samplers which indicated particle activities greater than $Pu^{239}O_2$ were Glass Slide samples from Arcs BM-09, BO-06, F-056, and Cylindrical Collector Sample 2469. A mistake in laboratory procedure made it impossible to check

Clean Slate I deposition slides from close to ground zero. Values for the most active Clean Slate particles from impactors were all well below 100% $Pu^{239}O_2$. Values which were higher than the source ratio usually occurred on Stages 1 through 3.

The great majority of particles in Tables A.5 through A.8 indicated activity levels which were equivalent to a percent composition lower than the source ratios. Examination of the data by multiple regression analysis produced curves of particle size versus activity which are reported in Reference 18. The curves indicated activity levels equivalent to 5 to 20 percent $Pu^{238}O_2$ for Double Tracks particles and 0.5 to 5 percent $Pu^{238}O_2$ for Clean Slate I. No data was available for Clean Slate II and III. The activity of individual particles obtained by other methods is discussed in Section 3.4.

Impactor Performance and Particle Density. The operational performance of the impactor samplers is summarized in Table 3.2. The particle size for which the maximum number of active particles were observed is listed according to stage number. The size of the largest active particle observed is included in parenthesis. The sizes to be expected on the Casella MK II Impactor Stages are given in Table B.2
A severely critical comparison was not justified for the following reasons. Wind speed and direction varied among samples and within the duration of the collection period for each sample. The aerosol concentration may have perturbed flow conditions and impaction phenomena. Variation in the adhesive coatings, accuracy of assembly, and the possibility of leakage may have contributed to sampler performance. Table B.2 permitted an estimate of the particle density (ρ) which corresponded to the size distribution for each stage by use of the equation $\rho d^2 = constant$.

This was attempted as a check on the high values of percent plutonium oxide given in Table 3.1. For this comparison the values agreed upon for 50 percent efficiency of collection (Column A, Table B.2, and Reference 20) were used. This provided a more severe test of the suggested high content of plutonium than would the values in Columns B and C. The estimated density given in Table 3.2 assumed that the particle size measurement was accurate and that the particle had been deposited by proper impaction phenomena. (Similar performance data for submicron particles appears in Table 3.4.) The largest active particles observed on the impactor Stage 1 were quite consistent for the Double Tracks samples and the two sides of Clean Slate III array. The large sizes on the higher stages were disturbing since they suggested sampler overloading. The samples most suspect of overload, based on their appearance, described in Section 3.1, were noted in Table 3.2. Several of these samples indicated a bimodal size distribution on Stage 1. The larger size peak corresponded to density values less than 2.6 for several samples from all events. Table B.4 lists the density for some possible particle compositions for comparison. The smaller size peaks for Stage 1 corresponded to densities of 19 gm/cc or greater, which exceeded the density of the oxides of plutonium and uranium and metallic plutonium or uranium. Since this peak value was close to or identical with the peak size for Stage 2 it may have been that the smaller particles on Stage 1 were the result of impaction phenomena which did not obey the ρd^2 = constant relationship for Stage 1, and therefore, the estimated density values of 19 or greater were not valid. The average of the Double Tracks peak size values in Table 3.2 for Stage 2 was 1.8 microns. This corresponded

to a density of 5 g/cm^3. However, the extreme value of 1.1 microns for Sample 9627 indicated a density of 11.5 g/cm^3. High density values for Stage 1 of Samples 2477, 3442, 4827, and 4842 added support to the high values of percent $Pu^{239}O_2$ in Table 3.1. The percent $Pu^{239}O_2$ values greater than 100 percent given in Table 3.1 occurred for particle sizes smaller than the peak size for that stage. This would lead to higher estimated densities for those determined for the size peak for that stage. It was concluded that the data strongly supported the existence of some single particles of pure $Pu^{239}O_2$. The possibility of particles containing unreacted plutonium was also suggested strongly. However, the Roller Coaster source material was 1.17 times as active as $Pu^{239}O_2$ and helps to account for the high values in Table 3.1. The degree to which high wind speed resulted in increased particle impaction on Stages 1 and 2 and thereby gave enhanced density values is not known.

Stage 3 peaks for Double Tracks produced densities of 1 to 3 when compared to Column A of Table B.2. These lower values may be reasonable in view of the decrease in percent PuO_2 in Table 3.1 and the 0.5 percent $Pu^{239}O_2$ values obtained from Reference 18. Table B.3 indicates a density of 3 g/cm^3 for a composition of 5 percent plutonium plus soil. The curves in Reference 18 indicate a steep increase in activity content starting near 1 micron, which is in agreement with the density values for Stage 3. (Section 3.3.2 shows that these effects are due to limitations in the optical microscopy observations. Density estimates based on Columns B or C of Table B.2 indicated values greater than 19 g/cm^3 for 9627 Stage 2 and the lower peaks of Stage 1, 11.5 g/cm^3 for the average of the peak on Stage 2, and 2 to 7 g/cm^3 for the peaks on Stage 3 for Double

Tracks. The values greater than 10 g/cm^3 had no obvious interpretation, so that the lower density values seemed more reasonable. Values less than 1 g/cm^3 were feasible for high soil and void content. The data for Clean Slate II and III indicated low densities which suggest that the uranium and plutonium were mainly associated with large percentages of soil. The lower peak values for 3442, 3452, 4827, 4926, and 4842 suggested that fine particles of high plutonium content might be present. The data in Table 3.1 supported this for Clean Slate I as expected. The autoradiographic data for Clean Slate II and III failed to indicate high activity levels or percent plutonium composition. This suggested that the high density values for 4827, 4926, and 4842 were due to particles of high uranium content or that they were evidence of improper impaction phenomena. The appearance of the particles as shown in Figures 3.26 and 3.28 suggest that the uranium and plutonium are incorporated in the soil matrix as discrete fine particles. Therefore, much of the respirable fraction of plutonium produced in the last two events was entrapped on non-respirable sizes. The data suggested that the performance of the Casella Impactors was reasonably good in view of the difficulties inherent in field sampling. The presence of large particles on each stage may in some instances have led to overestimation of the respirable fraction. For Double Tracks, the fine particles of high activity collected on Stages 1 and 2 may have offset this effect and actually resulted in an underestimation of the respirable fraction.

The limited data for Andersen Impactors suggested that reasonable size classification had occurred.

Microscopic Performance of Other Samplers. The operation of other types of samplers is summarized in Table 3.3. Comparison with Table 3.2 is difficult because of differences in sampler location. The Total Air Samples were subject to losses in the shipping envelope or disposable cover. The largest sizes observed were much smaller than indicated on impactors except for the Clean Slate I samples.

Cylindrical collector data in Table 3.3 indicated that the largest particles observed were on the same order as those observed as Casella Impactor Stage 1 for Double Tracks balloon samples from Arc B and J. For Clean Slate I balloon samples, the sticky wires appeared to have collected larger particles more efficiently perhaps due to the increased wind velocity in Clean Slate I. A data sheet summarizing the larger active particles on sticky wires is included in Tables A.5 and A.6. This was compared with a composite distribution of plutonium derived in Reference 18, from special particulate data from other types of samples. For Double Tracks, very few active particles larger than 45 microns were found. This size corresponded to a cumulative percent activity of 68.7 percent in the composite aerosol. For Clean Slate I, very few active particles larger than 80 microns were observed. This corresponded to the 96 percent cumulative activity. This suggested that though Clean Slate I produced larger particles, their activity concentrations were smaller than for Double Tracks. All sticky wire data given in Tables A.5 and A.6 were subject to container losses and difficulty in removing particles from the wire.

The glass slides which were examined appeared to have collected larger particles than did the impactors or sticky wires examined for

Double Tracks. This was based chiefly on larger particles which appeared near Arc H and beyond. It may have been due primarily to lofting of large particles which finally descended at rather steep angles and avoided impaction on the vertical wires or diversion to impactor orifices. These larger particles were usually irregular and the activity was localized on the surface.

Inactive particles were measured for several samples. Data for cylindrical collectors from Double Tracks and Clean Slate I are given in Tables A.5 and A.6. The spherical particles were noted. A calculation of the ratio of total particles to spherical particles for the Double Tracks samples indicated values between 31 and 110 in the main portion of the cloud. A ratio of 3900 for sample 2122 (Arc B,L14,P20) which was lower in the cloud may indicate that soil was suspended where the explosion shock wave reflected from the ground. (Photographs of the event indicate a low level dust cloud.) Samples 2123, also from a low position, and 5306 from Arc J balloon, indicated inactive/active ratios of 50. As a check on this approach, the data on active particles in the 1 to 10 micron (respirable sizes) range was normalized and compared with the total particle count. The ratios fell within the ranges 31 to 110 as found above. Sample 2122 data gave a value of 975, and Sample 5306 indicated 1420. Thus, for locations close to the main portion of the cloud, ratios between 31 and 3900 were found. Sample 9627 shown in Figure 3.21 illustrates an extreme ratio, while Figure 3.22 illustrates the condition in the main Double Tracks cloud. Two samples from Clean Slate I gave ratios of 14 and 8 for locations high and toward the edge of the cloud. These ratios did not include accurate information for submicron particles and were limited further by the fact that all particles were not removed from the wires.

Total particles are also recorded in Table A.6 for Casella Impactor 2558 (Arc F-054) collected prior to the Clean Slate I test, for portions of Andersen Impactor 2965 (Arc R-064) from Double Tracks, and for Glass Slide 10072 from Offsite Stake 59, Clean Slate III, in Table A.8.

3.3.2 Active Particles Smaller than 1 Micron. The results of measurements on Impactor Stages 4 and 5 are contained in Tables A.9 through A.12. The data sheets include observations of nuclear track particle events by optical microscopy and spherical particles by electron microscopy. Several of the samples produced little data because of low activity levels and/or low population density of spheres. Table 3.1, which represented observations by optical microscopy and lists Pu concentrations, indicates that the most active particles on Stages 4 and 5 had plutonium concentrations which were considerably lower than those for tage 3. For Double Tracks and Clean Slate I, the concentrations on Stage 4 were close to that of plutonium in the source. For Clean Slate II and III the concentrations were much lower than in the source. All concentrations on Stage 5 were lower than in the source. This suggested that even the most active particles on Stages 4 and 5 must have contained large percentages of inactive weapon components, soil, or other round ero material, and/or that the uranium/plutonium ratio was higher than the ratio in the source.

Table 3.1 did not include consideration of the alpha track patterns for which no particle was observed. The activity data were derived from alpha track counting of autoradiograms which were exposed for long time periods (~ three months). Control blank autoradiograms exposed for equivalent periods (109 days) gave single and double background tracks which were equivalent to a plutonium background activity of 2×10^{-5} disintegrations per minute. Long exposures such as these may

be subject to latent image fading which has not been evaluated in this work. Interpretations of the data for Stages 3, 4, and 5 (Table 3.1) should be made with this caveat in mind also. The observed background activity level was equivalent to a 0.1-micron diameter sphere composed of 1 percent $Pu^{239}O_2$. Table 3.1 indicates that some of the most active particles of 0.55 to 1.1 microns diameter on Stages 4 and 5 showed equivalent compositions lower than 1 percent $Pu^{239}O_2$. Thus, active particles on the order of 0.1-micron diameter which were lower in plutonium content were not detected by autoradiography; and the interpretation of the spherical particles had to be relied on for much of the interpretation which follows.

Electron Microscopy Observations. Electron micrographs which illustrate the spherical particles are shown in Figures 3.29 through 3.49. The spheres were not unlike those active spheres shown in Figure 3.23. Surface attachments and states of aggregation were observed which probably were interpreted as irregular in shape when viewed by optical microscopy. The degree to which aggregation may have been due to sample preparation was unknown. The great depth of field which is in sharp focus in electron microscopy may have caused some overlapping particles to appear to merge. High and low electron beam current was used to check the stability of the spheres. There was no evidence of spheres being formed from fusion of smaller spheres or by condensation of vapors in the electron microscope.

Figure 3.50 shows submicron particles from an impactor which was exposed prior to the Clean Slate I event. Very few spheres were found. Figures 3.51 and 3.52 represent an impactor exposed on the Clean Slate II balloon net. The sampler was located on the opposite side from

where the visible cloud traversed the net. A few spherical particles were observed.

The data obtained from the two methods of examination of Stages 4 and 5 and some Stage 3 samples are summarized in Table 3.4. Detailed treatment of the data from each sample and comments on the electron micrographs are given below. In summary, the data indicated that the population density of submicron spheres varied directly with the alpha count rates for each sample. Sample 2906, Stage 3, indicated that clusters of submicron spheres tended to have peak sizes similar to those observed by optical microscopy. This supported the idea that spheres were the chief form of submicron particle, as had been suggested by Figure 2.7. The size of maximum frequency of occurrence of spheres was observed to be much smaller than the optical data peak. Therefore, the spheres were probably of much higher density than stated in Table 3.2. Double Track samples indicated densities as high as 11.5 and greater; Clean Slate samples gave maximum values between 6 and 7. An estimate of particle activity of the spheres was made by matching maximum occurrence values of unassigned alpha tracks with size distribution peaks. The estimated activity levels were adequate to account for the high density values. This supported the high values given in Tables 3.1 and 3.2 for activity and density on Stages 1 and 2. This approach did not rule out spheres of high percentage content of uranium or dense inactive material. Long autoradiographic exposures examined by optical microscopy indicated spheres 0.5 to 5 microns in diameter which were of low activity or inactive. It is reasonable to expect that such material was included in the submicron spheres so that the high density values could represent high percentages of uranium as well as plutonium. The low density values

suggest that some particles must contain voids and probably large quantities of the lower density ingredients of the desert soil or ground zero material. The peak values in Table 3.4 probably include a wide range of particle compositions so that some particles of higher density than the value for the size peak may have been collected as was suggested in Table 3.4 for Stage 5 of 2906 and 2152. Further conclusions are not warranted due to the assumptions required concerning latent image fading, sampler flow rate, and accuracy of impaction.

The possible presence of inactive spheres variable particle dispersal in sample preparations make direct normalization of electron and optical frequency data for spheres impractical. An estimate of the total number of active particles for several Double Tracks samples was attempted. The alpha activity of the whole sample (from field counting) was divided by the estimated activity level for the particle size at peak frequency. The resultant estimated populations are given in Table 3.5. The number of active particles observed by autoradiography and optical microscopy was normalized and given in parenthesis in Table 3.5. The numbers are useful only as a rough guide to the populations of the finer particles.

Comments on Individual Samples. Sample 2906 was the most active impactor from the Double Tracks balloon. Stage 3 was examined by electron microscopy to aid in the transition from optical observations. Figure 3.29 shows spherical particles which include what appear to be hollow or plated spheres and a chip from either a sphere or elongated smooth particle. Cubic and spherical shapes appear to be merged in several cases. Figure 3.30 shows the high population of spheres on Stage 4. The supporting film has cracked in spots. The aggregates of spheres in the bottom prints indicate two different electron opacities

for a given particle size. The Stage 5 spheres in Figure 3.31 did not undergo the Canada Balsam or nitrocellulose preparation but were subjected to forces produced when the membrane filter was dissolved in ethyl acetate. (Some spheres of very low electron opacity were observed which may be due to the preparation phase.) The summary in Table 3.4 was obtained as follows. The optical data sheet for Stage 3 (Table A.5) gave a peak at 0.97 micron. The most active particles in this peak were equivalent to 67 percent $Pu^{239}O_2$. Omitting the most active particles, the activity concentration was equivalent to 1 percent $Pu^{239}O_2$. Electron microscopy of Stage 3 indicated two situations. Aggregates of spheres were sized as single particles and gave a peak at 0.85 micron. This was in agreement with the optical data when allowance was made for the inaccuracies involved in the optical measurements below 1 micron. However, when data on single spheres and aggregates were combined, the data peaked at 0.43 micron. The optical size track count data for Stage 3 did not resolve a corresponding peak at 0.43 micron, although many tracks were observed for which no particle was assigned which suggested that smaller active particles were present. These unassigned tracks are mentioned later. Stage 4 indicated peaks at 0.43 micron by optical microscopy, and an activity level equivalent to 7.5 percent $Pu^{239}O_2$. Electron microscopy of spheres indicated peaks at 0.43 micron and at 1.4 microns. Stage 5 indicated a peak at 0.14 micron for spheres viewed by electron microscopy. The autoradiography data obtained from a long exposure of Stage 5 indicated a group of particles 1 micron in diameter which were equivalent to

0.08 percent $Pu^{239}O_2$. The size peaks for each stage were compared with Table B.2 for an estimate of particle density. The peaks at 0.85, 0.43, and 0.14 for Stages 3, 4, and 5, respectively, corresponded to estimated densities between 2 and 3. Table B.3 showed that estimated density of 1 to 3 was compatible with compositions equivalent to 1 to 7 percent $Pu^{239}O_2$. The lower peaks at 0.43 and 0.14 micron for Stages 3 and 4, respectively, indicated an estimated density of 11.5. These estimates reflect somewhat arbitrary use of Table B.2 as explained in Section 3.3.1. The higher density value may have indicated the presence of uranium or plutonium. The size peaks may not have been truly representative of the whole sample, and the impactor operation may have departed from the calibration data. As a check on the value of 11.5, the activity data was examined for levels equivalent to 100 percent $Pu^{239}O_2$. In addition to the most active particles shown in Table 3.1, the data sheets in Tables A.5 through A.8 indicated many examples of micron size particles equivalent to 100 percent Pu^{239}. In addition to the impactor stages, such particles were found on Glass Slide samples from Locations BM-09, Arc B-066, F-056, and for Cylindrical Collector 2469 which was located close to Impactor 2309 in Double Tracks. The data in Tables A.9 through A.12 suffered from inadequate exposure times and the limit of resolution of the optical microscope. The track patterns for which no particle was assigned were examined. The numerous cases of greater than 100 tracks shown for Stage 3 (Table A.5) were comparable to the 200 tracks which would be expected for a 0.43-micron sphere of 100 percent $Pu^{239}O_2$. For Stage 4 the cases of track counts under 10 tracks were comparable to the 7 tracks expected from a 0.14-micron sphere of

$Pu^{239}O_2$. Thus, the activity data did not deny the presence of particles composed of approximately 100 percent $Pu^{239}O_2$, but rather, may have confirmed it. The Stage 5 electron micrographs indicated the presence of spheres as small as 0.05 micron. These corresponded to a density greater than 11.5. The activity data indicated many single tracks. The track counts < 3 were suspected to include background tracks. Spheres of 100 percent $Pu^{239}O_2$ of diameter 0.05 and 0.14 micron would have produced approximately 6 and 132 tracks, respectively. The activity data provided a large number of unassigned track counts near 6 tracks but only a few cases of greater than 100 tracks. Therefore, no conclusion could be drawn. The data for Stage 5 would allow a peak of 0.05 micron spheres of 100 percent $Pu^{239}O_2$, a peak of 1.4 micron spheres of a few percent $Pu^{239}O_2$, or perhaps a peak of 1-micron-diameter particles of considerably less than 1 percent $Pu^{239}O_2$, in which case solubility might account for the missing particles. Longer exposures for Stages 3 and 4 would have been helpful provided that latent image fading did not interfere. The tracks produced in the long exposure of Stage 5 included both high and low grain densities which were considered to be evidence of image fading but did not prove that tracks had been completely faded. Insufficient samples remained for a longer exposure of Stages 3 and 4. If the high estimated density of 11.5 had been due to a high plutonium content over a wide range of sizes, Stages 1 and 2 should have indicated this. Stage 1 was shown in Section 3.3.1 to have had a peak estimated to correspond to a density of 19. Stage 2 should have shown peaks at 1.1 and 3.7 but peaked between these values. Examination of the data sheet indicated that at 1.1 microns, the activity was equivalent to 87 percent $Pu^{239}O_2$ and at 3.1 microns it was 4 percent $Pu^{239}O_2$.

Thus, the data from all stages suggested that two general levels of plutonium content had been sampled, and Stages 1 and 5 suggested a very low level in addition. The true peak frequency for Stages 3, 4, and 5 probably occurred somewhere between the peak for spheres and the pseudo peak given by optical data because not all spheres have been shown to be active, and some active irregular shaped submicron particles may have been present.

Sample 2152 was exposed at a lower position in the Double Tracks cloud and each stage was approximately 5 times less active than 2906. The field count data in Table A.16 indicated a sharp increase in activity between Stages 2 and 3 and a sharp decrease between 3 and 4. Only the latter was found in our laboratory count. The optical data for Stage 3 indicated a peak at 0.85 micron with activitiy levels equivalent to 3 percent and 40 percent $Pu^{238}O_2$. Many cases of unassigned track counts were recorded which may have represented a peak near 0.43 micron, as was observed for 2906, and higher percent $Pu^{239}O_2$ than 40 percent for the 0.85-micron size. The electron microscopy sample preparations were poor for all stages. Stage 4 indicated a broad peak of spheres at 0.14 micron, which gave an estimated density of 11.5. Optical sizing and track counting were not successful for Stage 4. Electron microscopy of Stage 5 was limited but indicated some unusual particles, shown in the bottom of Figure 3.32. These consisted of a very dense core surrounded by a fuzzy outline which suggested that a reaction or decomposition had occurred. These particles were in the 0.02 to 0.5-micron range. There was insufficient data to justify them as a significant component of the sample rather than a possible contaminant. Optical microscopy indicated many single tracks produced by particles which were barely resolved or unresolved

but indicated some light scattering. These sizes were estimated to be considerably smaller than 0.3 micron. The activity levels would be equivalent to 1.4 percent $Pu^{238}O_2$ for a 0.1-micron particle, 11 percent for a 0.05-micron particle, 70 percent for a 0.03-micron particle, and 230 percent for a 0.02-micron particle neglecting latent image fading. Many larger transparent spheres 0.5 to 5 microns were observed. Most of these produced no alpha tracks, a few produced 1 to 19 tracks. These spheres were suspected to be of low density because of their size. The larger sphere in Figure 3.32 probably represents one of these spheres. The activity distributed on Stage 5 samples is shown in Figure 3.6. The larger spots were shown (Table A.5, Sample 2477, Stage 5) to be equivalent to a 0.4-micron diameter sphere of $Pu^{239}O_2$ which would indicate some sampler overloading when compared to Table B.2. This observation plus the larger spheres described above may indicate sampler overloading. In general, the uniform autoradiographic pattern suggested a narrow size range of uniform activity which agreed with the many single alpha tracks observed. The location of the sampler may have increased the likelihood of sampling soil particles suspended before or after the detonation, which were mixed with the fireball and fused, or particles of high plutonium content produced in the incandescent jetting observed in Double Tracks.

Sample 2436, Stage 4, indicated a peak at 0.43 micron, corresponding to density of 2 by optical microscopy and an activity level corresponding to 9.5 percent $Pu^{238}O_2$. The electron microscopy data was poor, due in part to the much lower activity for this sample. Total Air Filter Number 2527 indicated activity on the back-up membrane filter, see Figure 3.10. Figure 3.39 shows spheres from this filter. The electron microscope

sizing indicated a peak at 0.14 micron, but autoradiography failed to show alpha tracks. It was probable that these were lower density spheres which avoided collection during transit through the 1-mm thick filter. The size corresponded to the general sizes at which impaction and diffusion processes in filtration are least effective.

Sample 9625 (Arc E-056) was a background sample. Figure 3.33 indicated that a few spheres were present. The hollow particle or sheath shown in the top central print may represent an oxide layer which has been ruptured during cooling; similar to the effects shown in Figure 3.27. Sample 9626 (Arc G-060), Stage 4, produced a broad peak around 0.2 micron by electron microscopy. Sample 2724 (Arc H-068) indicated a caked deposit on Stage 3 as shown in Figure 3.34. The caked deposits contained agglomerates of spherical particles. The optical data peaked at 0.85 micron. The activity data showed two activity levels equivalent to 4.4 percent and 44 percent $Pu^{239}O_2$. Stages 4 and 5 shown in Figure 3.35 yielded very little useful data. Stage 4 indicated a peak at 0.85 micron and activity equivalent to 0.7 percent $Pu^{239}O_2$. The peaks suggested average particle densities of 3 for Stage 3 and < 1 for Stage 4. Sample 9675 was withdrawn as a priority sample before examination was begun.

Sample 2477 (Arc J,L4,P13) was balloon borne. No disc was used in Stage 3. Stage 4 indicated a strong peak at 1.1 microns by optical microscopy and activity equivalent to 0.5 percent $Pu^{239}O_2$. Figure 3.36 illustrates the particles. The surface attachments may have been enhanced due to the absence of Stage 3. The finer particles shown at the bottom of the figure

peaked at 0.21 micron. No estimate of the density was made due to the absence of Stage 3 having affected the collection parameters. Figure 3.6 illustrates activity associated with Stage 5. Sample 2047 (Arc R-056), Stage 3, gave an optical peak at about 1.6 microns and activity levels of 0.2 percent and 3 percent $Pu^{239}O_2$. Figure 3.37 illustrates complex aggregates of small spheres and some large spheres with complex surfaces. The small spheres peaked at 0.1 micron. No sizing of the aggregates considered as single particles was made. The peak at 1.6 microns was composed chiefly of irregular shaped particles and corresponded to a density of about 2.6. The small spheres corresponded to a density greater than 19. It was suspected that the spheres arrived as aggregates of composite density appropriate to obey the size ranges stated in Table B.2, in which case the aggregation either existed in the original aerosol or occurred during the impaction process and not during sample preparation. The aggregates could have arrived attached to larger particles as suggested by the central print in Figure 3.37. (Glass Slide samples from Double Tracks suggest this latter phenomenon for much larger particles). The gross appearance of Stage 3 did not suggest overloading. The autoradiography data did not support strongly the high density value for the spheres. A high value was obtained in the field counting but was not reproduced in the laboratory count. Stages 4 and 5 did not provide useful data.

The Clean Slate I impactors which were examined were a factor of 10 lower in activity than Sample 2906. The samples were difficult to disperse sufficiently for sizing. Figure 3.40 shows a dense portion

of Stage 4 deposit for 3442. A peak at 0.85 was observed by optical microscopy, with activity equivalent to 0.4 percent $Pu^{239}O_2$. Electron microscopy showed a broad peak at 0.18 micron, which gave an estimated density of 7. The track count data suggested 10 percent $Pu^{239}O_2$ as a maximum level for this peak. Sample 3452, Stage 4, gave a slight peak at 1.1 microns by optical microscopy with activity equivalent to 1 percent $Pu^{239}O_2$. Electron microscopy was unsuccessful. Stage 5 gave a peak in the range 0.07 to 0.10 microns by electron microscopy. Activity data indicated that the level was very low. Figure 3.41 illustrates a complex particle surface similar to those shown in Figure 3.38 for a Stage 4 sample. Sample 3332, Stage 5, indicated a few active particles as large as 3.0 microns but of very low activity. All other Clean Slate I samples were of very low activity and generally unsuccessful.

Clean Slate II samples produced more useful data. Sample 2292, Stage 4, gave a suggestion of peaking at 1.6 microns by optical data, with activity equivalent to 0.03 percent $Pu^{239}O_2$. The electron microscopy data peaked at <0.21 micron, but no activity could be assigned. Figure 3.42 and the optical microscope data sheet indicate that the larger particles were not perfectly spherical and tended toward ovoid or elliptical cross sections. Stage 5 indicated a peak of irregularly shaped particles at 1.6 microns with activity equivalent to 0.0003 percent $Pu^{239}O_2$. Electron microscopy data for spheres peaked at 0.28 micron, and no activity could be assigned. Figure 3.43 illustrates that spheres were present, but in some cases other attachments have resulted in an irregular shape.

This sampler was grossly overloaded, as Figure 3.3 illustrates for Stage 3. The density estimates in Table 3.4 correspond to a large percentage. Figure 3.46 includes a conical particle (center) surface attachment approximately 0.05 micron in diameter, a low density zone in a sphere, and an unexplained looped object (upper right). The activity on Stage 5 of Samplers 2292 and 2287 is shown in Figure 3.6. The similarity of the autoradiographic patterns and the micrographs indicate that many oversize particles reached the final stage in the cases of gross overloading.

Sample 2309, Stage 4, from the lower portion of the Clean Slate II balloon indicated a peak at 1.6 microns and activity level equivalent of 0.01 ± 0.1 percent $Pu^{239}O_2$ by optical microscopy. Electron microscopy data peaked at approximately 0.2 micron. Figure 3.47 indicates that the spheres appeared to be similar to those found in samples from the Double Tracks cloud. Electron microscopy of Stage 5 was unsuccessful. Optical data indicated active particles as large as 6.4 microns but of low activity. Sample 2273 from the Arc D mobile array indicated particles as large as 36 microns on Stage 4, and no active particles on Stage 5 preparations. The cellulose acetate stripping film used on this sample was too thick to permit successful preparations for electron microscopy. Andersen Impactor Sample 3221 from Arc B-058, Stages 6 and 7, produced no useful alpha track data. Electron micrographs are shown in Figures 3.48 and 3.49. The spheres are similar to those collected on Casella Impactor 2287, Figures 3.45 and 3.46. The lower size peak in Table 3.4 is questionable. The electron micrographs did not indicate that the spheres might be hollow. Sample 2287 (Arc A-042), Stage 4, indicated a peak of irregular shaped active particles at 1.1 microns with heavy population below 1 micron by optical microscopy. The

activity level was equivalent to 0.01 percent $Pu^{239}O_2$. Electron microscopy data for spheres peaked at 0.21 micron. Figure 3.44 indicates that many of the particles on the order of 1 micron were ovoid in shape. One sphere with a low opacity center is shown. Segments of somewhat larger spheres are shown. The finer particles include almost perfect spheres. The initial stages of this sample appeared to be overloaded, and the Stage 4 deposit appeared to be weak and to correspond to only half of the orifice. Stage 5 indicated a peak at 3.2 microns by optical microscopy with two activity levels equivalent to 0.003 percent and 0.001 percent $Pu^{239}O_2$. The particles were described as irregular by optical microscopy. Spheres peaked at 0.14 micron, and no activity level could be assigned. Figures 3.45 and 3.46 indicate the particles. The variety of aggregates and the perfect spheres showing tiny surface attachments are striking and deserve comment. Figure 3.45 includes a transparent sphere approximately 0.2 micron in diameter (center), a sphere with lower density center and a pear shaped particle (right), and a conical particle with a plume which may indicate ablation or jetting effects (center). The cubic particle with one rounded area, and some shown in Figure 3.29, may represent one crystalline material in a second material.

Clean Slate III samples were unsuccessful in the electron microscopy phase. The optical data were poor, generally due to very low activity per particle. Sample 5257, Stage 4, indicated only very large particles of low activity. Sample 4827, Stage 4, peaked at 0.85 micron. Sample 4916, Stage 4, indicated a peak of irregularly shaped particles at 8 microns and 1.1 microns. Sample 4886 from the hot line was generally unsuccessful due to severe overloading. Much of the activity on

stage 3 was from very large particles. Sample 4842 yielded only a few isolated tracks. Andersen Impactors 4985 and 4980 gave erratic peaks, due probably to overload; such causes are rare, however.

3.4 PARTICLE COMPOSITION

Tables A.13 through A.15 contain the results of compositional analyses of isolated active particles. Table A.16 contains a summary of radiochemical results for the samples (and lab preparation components) which had been examined by autoradiography and microscopy.

3.4.1 Particles Larger Than 14 Microns

Table A.13 lists alpha count and radiochemical data for selected single particles larger than 14 microns. The ratio μgmU/μgmPu, the alpha self absorption factor, and the estimated particle density were derived from the data by methods described in the footnotes to Table A.13. The data was plotted in Figures 3.53 through 3.57. The points which yielded self absorption factors less than 1 were plotted with a tail mark added to the point to indicate that the total plutonium values may have been low for some undetermined reason.

Figure 3.53 indicates a wide spread in the plutonium content for a stated particle size for each event. The Clean Slate events indicated lower values than Double Tracks, as had been observed previously in autoradiographic results. The data for Clean Slate II was obtained from Table A.14 and represents 192 particles grouped into 8 class intervals. The trend is toward a d^3 or volume distribution of activity within the average particle. The single particles had been selected on the basis of size

and then counted for alpha activity. Each particle in the grouped sets had been selected by means of autoradiographic spot image. By both methods the particles of very low activity may have been considered inactive and therefore not submitted for radiochemistry. The highest values of plutonium for the particles examined were less than 5 percent $Pu^{239}O_2$ (DT). The most active Clean Slate particles were a factor of 5 lower than Double Tracks. The topographic composition given in Table A.15 indicated that plutonium was conspicuously absent on the surface of most of the larger particles from Clean Slate events.

Figure 3.54 indicates that the uranium content was much higher than the plutonium content. The high values for Double Tracks indicated that very little material except oxides of the weapon components were present in some of the larger particles. The values for all Clean Slate events indicated that soil material had been incorporated into the particles. The extremely high uranium contents for Double Tracks and Clean Slate I particles were of interest since they exceeded 100 percent metallic uranium content. They might have resulted from analyses of agglomerated particles which were mistakenly thought to have been single. Indications of U or UO_2 contents are supported by the fact that U and UO_2 crystalline phase composition had been observed by X-ray diffraction of single particles as reported in Table A.15. Concentrations as high as 52 percent uranium content on the surface of particles had also been reported in the electron microprobe data in Table A.15. The Double Tracks Arc J particles, in general,

showed higher Pu and U contents than did the Arc B particles. This was probably due to the most active portion of the cloud. None of the Clean Slate I particles were collected in the most active portion of that cloud. The very low uranium contents observed in Clean Slate II were 10^4 to 10^5 times smaller than for Clean Slate I. This suggests the extent to which uranium has been displaced as a carrier of plutonium, since the plutonium values were within a factor of 10 for the two events. The topographic composition data in Table A.15 indicated that large percentages of iron were present on particles from all events. This may be due to the steel base plate used in Double Tracks or the bunker roof material in Clean Slate II and III. The surface content of silicon was generally low, while calcium and aluminum made up sizeable contributions. The increased calcium content for Clean Slate particles is appropiate for the concrete pads used at ground zero.

The mass ratios of U/Pu shown in Figure 3.55 indicate a scatter which is roughly twice as great as either the U or Pu content. The high values for the finest particles are suspect, on the basis of the high uranium content reported. The values of 1500, 900, and 574 were derived from total plutonium counts greater than 14 dis/min, so that inaccurate low alpha count rate was not necessarily the cause of the high ratios. The average ratios listed in Tables A.13 and A.14 were 55 for Double Tracks, 68 for Clean Slate I, and 15.4 for Clean Slate II, when the extremely high values were eliminated from the first two event listings. The ratio in

the sources was approximately 4.4, 50, and 100, respectively. Thus, the incorporation of ground zero material resulted in a lowering of the average U/Pu ratio. No simple relationship between the U/Pu ratio and particle size was noted. Table A.16 shows that the values for Stage 1 of impactors were highly variable. However, it appears that the more active samples for Clean Slate II and III represented higher U/Pu ratios than the more active samples from Double Tracks and Clean Slate I. The U/Pu ratio for Total Air Samplers was higher for Clean Slate II and III than for Double Tracks and Clean Slate I. The ratio for ground level deposition Glass Slide samples was higher for each of the Clean Slate Events than for Double Tracks.

Figure 3.5b indicates the observed self-absorption factor obtained from either crushing (points marked by tails) or by performing radiochemistry on single particles or in the case of Clean Slate II, groups of particles. The average values given in Tables A.13 (and A.15) were 2.9, 4.1, 8.7, (or 5.4), and 6.9 for the four events. These values are in general agreement with the factor obtained for Castle Stage 1 in Table A.16 using field count and total plutonium values, when samples known to be heavily loaded are discounted. The plot in Figure 3.5b shows that the self-absorption of particles was related to the diameter raised to a power between two and three for Double Tracks. The data from the Clean Slate events suggest a relationship with the exponent between 1/2 and two. Care should be exercised in interpreting these plots as proving a mechanism of formation. The larger value of the exponent for Double

Tracks coupled with the microscopic observations of Section 3.3.1 indicate that, whatever the mechanism, the plutonium was more generally dispersed throughout the particle volume for Double Tracks than for Clean Slate II and III. The self-absorption values for the Glass Slides were derived from alpha count data of 1 1/2-inch diameter planchets. The small sample size probably helps account for the wide range of values given in Table A.16.

Figure 3.57 is a plot of calculated density versus diameter which assumed a composition of plutonium oxide of density 11.5 gm/cc, uranium oxide of density 8.3, and other material of density 2.6. The extremely high values are suspect due to values of uranium content in excess of pure uranium. Neglecting these, the Double Tracks data suggested density varied as d^{-2}. This is in agreement with the self-absorption data which was derived without reference to uranium content. The Clean Slate I data suggested that the relationship may have changed from d^{-2} to $d^{-1/3}$ in the vicinity of 50 microns. The several cases of calculated density greater than 11 gm/cc were due to high uranium content.

Table A.15 indicates that a solid solution series of UO_2-PuO_2 was observed in Double Tracks and Clean Slate II and III particles. Crystalline phases of UO_2, UO_3, U, and PuO_2 were found also. One active particle indicated no crystalline phase composition. The most active particle indicated major crystalline phase of PuO_2 and 16 percent plutonium content at the surface. The particle surface shown in Figure 3.28 contained no plutonium according to electron microprobe data. (This particle cracked into 4 pieces

when compressed against a glass microscope objective.) Other particles composed of UO_2-PuO_2 crystalline phase indicated no surface plutonium. Average values indicated that iron and calcium were the most prevalent elements on the surface of Double Tracks particles, and uranium and calcium were most prevalent on the Clean Slate I particles. No evidence of nitrogen compounds was reported.

3.4.2 Particles Smaller Than 14 Microns

No direct compositional data other than the total plutonium and uranium radiochemical data in Table A.16 was obtained. An attempt at X-ray diffraction of the most active back-up membrane from Double Tracks produced a very faint image which gave d spacings similar to UO_3 (monoclinic), but the faintness of pattern and the quality of spacing match made the result questionable. Electron microprobe examination of this sample was unsuccessful.

Table A.16 indicates that the uranium-to-plutonium ratio generally increased as the impactor stage number increased. Rates of several hundred to several thousand were not uncommon but were usually associated with very low plutonium values Ratios of a few hundred were found for the most active Clean Slate II and III samples. The increase in U/Pu ratio on latter stages was in agreement with the very limited X-ray diffraction data. The ratios for Total Air Samples were under 100 except for Clean Slate III filters. Glass Slide samples gave ratios of less than 10 for Double Tracks samples out to Arc L. Beyond, the values were about double those close-in. Clean Slate I ratios were generally smaller than the ratio of approximately 50 for the

sources; Clean Slate II and III slide ratios were generally between 50 and 100, reasonably close to the source ratio. The increase at distant arcs was apparent for Clean Slate I and Clean Slate III samples. The presence of large numbers of spherical particles which had not produced alpha tracks was mentioned for Stage 3, 4, and 5 samples previously. The values of self-absorption factors which were less than 1 raised the question as to how much the samples were modified by lab preparation and whether all sample elements had been put into solution successfully. Interference was noted in the fluorometric analysis.

TABLE 3.1 MAXIMUM PLUTONIUM CONCENTRATIONS (PERCENT PuO_2) IN MICRON-SIZE PARTICLES

Alpha track counts selected from Table A.5 through A.12 for most active particles observed on impactor samples.

Tracerlab Number	Location	Particle Size (mean)	Alpha Activity Level Calculated from Nuclear Track Count[a] Equivalent Percent $Pu^{239}O_2$				
			Stage 1	Stage 2	Stage 3	Stage 4	Membrane[b]
		microns	dis/min (%PuO_2)				
Double Tracks (23% Pu^{239})							
2906	ArcB,L5,P9	3.1	13. (59)	- -	- -	- -	- -
		2.2	1.4(18)*	- -	- -	- -	- -
		1.6	0.8(26)	- -	- -	- -	- -
		1.1	0.2(20)*	0.8(62)	0.3(40)	0.2(22)*	0.002(0.2)*
		0.85	- -	- -	0.3(150)	- -	0.006(0.7)*
		0.55	- -	- -	0.3(250)	- -	- -
		0.43	- -	- -	- -	0.008(10)*	0.002(3)*
2152	ArcB,L12,P21	3.1	13(59)	- -	- -	- -	- -
		2.2	1.4(18)*	- -	- -	- -	- -
		1.6	1.1(36)	- -	- -	- -	0.006(0.2)*
		1.1	1.1(110)	0.8(82)	0.28(29)	- -	0.01(1)*
		0.85	1.1(240)	0.8(180)	0.28(62)	- -	- -
2436	ArcB,L2,P13	6.4	178. (92)	- -	- -	- -	- -
		1.6	4.4(150)*	11.8(39)	- -	- -	- -
		1.1	1.2(120)	- -	- -	- -	- -
		0.85	1.2(260)	- -	0.14(31)	0.028(6.2)*	- -
		0.55	- -	- -	0.14(120)	0.007(4.1)*	- -
9626	ArcG-060	1.6	- -	1.1(37)	- -	- -	- -
		1.1	- -	1.1(110)	- -	- -	- -
		0.85	- -	- -	- -	- -	- -
		0.55	- -	- -	0.28(210)	- -	- -
9627	ArcG-054	1.1	1.1(110)	0.6(62)	- -	- -	- -
		0.85	- -	- -	0.07(16)	0.11(25)*	- -
		0.55	- -	- -	0.18(27)*	- -	- -
2724	ArcH-064	1.1	- -	- -	- -	0.11(11)	- -
		0.85	- -	0.6(120)	0.28(62)	0.016(3.5)*	- -
		0.55	- -	0.02(13)*	- -	- -	- -
9675	ArcI-059	1.6	0.8(27)	- -	- -	- -	- -
		1.1	- -	0.8(82)	- -	- -	- -
		0.85	- -	- -	0.28(62)	- -	- -
2477	ArcJ,L4,P13	3.1	13. (60)	- -	- -	- -	- -
		2.2	2. (26)*	- -	- -	- -	- -
		1.6	1. (33)*	- -	- -	0.08(0.3)	- -
		1.1	- -	0.8(82)	- -	0.016(1.7)*	- -
		0.85	- -	- -	- -	0.006(1.3)*	- -
2947	ArcK-056	1.1	- -	1.1(110)	0.002(0.4)*	- -	- -
		0.85	- -	0.1(22)*	0.001(0.2)*	- -	- -
		0.55	- -	- -	- -	0.007(0.4)*	- -
Clean Slate 1 (2% Pu^{239})							
3442	ArcB,L17,P9)	3.1	- -	6.6(30)	- -	- -	- -
		2.2	0.6(8)	- -	0.08(1.)	- -	- -
		1.6	- -	0.6(20)	- -	0.08(2.7)	- -
		1.1	- -	- -	0.01(7.4)	- -	- -
3452	ArcB,L20,P13	3.1	14.6(67)	- -	- -	- -	- -
		2.2	- -	0.3(3)*	- -	- -	- -
		1.1	- -	0.1(12)	0.02(2.4)*	- -	- -
		0.85	- -	- -	- -	0.01(3)*	- -
3332	ArcN-074	2.2	- -	- -	- -	$1 \times 10^{-5}(2 \times 10^{-4})$*	- -

TABLE 3.1 (CONTINUED)

Tracerlab Number	Location	Particle Size (mean) microns	*Alpha Activity Level* Calculated from Nuclear Track Count[a] Equivalent Percent $Pu^{239}O_2$ Stage 1 dis/min (%PuO_2)	Stage 2	Stage 3	Stage 4	Membrane[b]
Clean Slate II	(1% Pu^{239})						
2292	BM-06	6.4	2.2(1.1)	- -	- -	- -	- -
		4.5	- -	0.5(0.7)	- -	- -	- -
		3.1	- -	- -	0.08(0.4)	- -	- -
		2 2	- -	- -	0.02(0.3)*	- -	0 001(0.02)*
		1.6	- -	- -	- -	- -	0 0002(0.007)*
		1.1	- -	- -	- -	0.0008(0 08)*	
2287	ArcA-042	6.4	1.1(0.6)	- -	- -	- -	- -
		4.5	0.2(0.3)*	0.7(1)*	- -	0.04(0.06)	0.02(0.03)
		3.2	- -	- -	- -	- -	0.008(0.03)
		2.2	- -	- -	0.007(0.1)*	- -	0.0004(0.005)
		1.1	- -	- -	0.002(0 2)*	- -	- -
		0.55	- -	- -	- -	0.0003(0.23)*	- -
2304	ArcB,L2,P21	6.4	1.6(0.8)	- -	- -	- -	- -
		4.5	0.5(0.8)	- -	- -	- -	- -
		3.1	- -	0.6(2.8)	- -	- -	- -
		2.2	- -	- -	- -	- -	8×10^{-5}(0.001)
		1.6	- -	- -	0.02(2.6)	0.0007(0.02)*	- -
		0.55	- -	- -	- -	0.0001(0.08)*	- -
3221	ArcB-058	3.1	0.8(3.8)	- -	- -	- -	- -
		2 2	- -	0.4(5)	- -	0.001(0.01)*	- -
		1.1	- -	- -	- -	0.006(0.6)*	- -
Clean Slate III	(1% Pu^{239})						
5257	Tower B,P3	12.7	8.4(0.7)	- -	- -	- -	- -
		9	- -	0.2(0.004)*	- -	- -	- -
4985(So)	BM-10	1 1	- -	- -	- -	5×10^{-4}(0.05)*	- -
		0.55	- -	- -	- -	5×10^{-4}(0.3)*	- -
4980(37)	ArcA-102	0.85	- -	- -	- -	- -	2×10^{-4}(0.04)*
4827	ArcB-078	12.7	2. (0.2)	- -	- -	- -	- -
		4.5	- -	9.6(0.24)	- -	- -	- -
		3.1	- -	0.2(1.1)*	- -	- -	- -
		1.6	- -	- -	.01(0.3)*	- -	- -
		1.1	- -	0.003(0.3)*	- -	3×10^{-4}(0.03)*	- -
		0.85	- -	0 01(0.3)*	- -	3×10^{-4}(0.07)*	- -
4926	ArcD-038	9.	12. (2.2)	0.2(0.5)	- -	- -	- -
		6.4	20. (10)	- -	- -	- -	- -
4916	ArcD-096	9.	- -	- -	- -	0.003(0.0006)*	- -
		6.4	2.2(1.1)	- -	- -	- -	- -
		4.5	- -	0.2(0.2)*	- -	- -	- -
		2.2	- -	0.05(0.6)*	0.006(0.08)*	- -	- -
		1.1	- -	- -	0.004(0.4)*	- -	- -
		0.85	- -	- -	- -	3×10^{-5}(0.008)*	
4[illegible]	ArcH-030	2.2	0.01(0 1)*	- -	- -	- -	- -

a The smallest particles which exhibited track patterns of $\frac{S}{8}$ or $\frac{S}{4}$ density were used except for those marked with an asterisk which signifies that individual tracks were counted. The percent plutonium ^{239} oxide was referred to 0.74 dpm per 1 micron diameter sphere. Roller Coaster total plutonium would result in 0.87 dpm or percent PuO_2 values which were 80% of the $\%Pu^{239}O_2$ values.

b Electron microscopy data in Table A.4 indicates that much higher levels were probably present on Stage 4.

TABLE 3.2 PARTICLE SIZE AND DENSITY CHARACTERISTICS OF CASELLA MK II STAGES 1, 2, 3

Tracerlab Number	Location	Projected Area Diameter At Peak Frequency And For Largest Particle[a]								
		Stage 1			Stage 2			Stage 3[e]		
		Diameter		Density[d]	Diameter		Density[b]	Diameter		Density[b]
		microns		gm/cc						
Casella Impactors										
Double Tracks										
2906[c]	Arc B,L5,P9	2.2,12.7	(51)	>19,-	2.2	(18)	2.6	0.97	(4.5)	2.6
2152[c]	Arc B,L12,P21	2.6	(51)	19	1.9	(18)	5	0.85	(4.5)	3
2436	Arc B,L10,P13	25.	(51)	-	2.2	(2.7)	2.6	0.97	(1.6)	2.6
9627	Arc G-054	18.	(51)	-	1.1	(12.7)	11.5	1.1	(6.4)	1.5
9626	Arc G-060	12.7	(36)	-	1.9	(9)	4	1.1	(3.1)	1.5
2724	Arc H-068	-	-	-	1.6	(6.4)	5	0.85	(6.4)	3
9675	Arc I-059	6.4	(18)	2.6	1.6	(6.4)	5	-	-	-
2477	Arc J,L4,P1	3.1	(51)	11.5	2.2	(25)	2.6			
2947	Arc R-056	4.5	(18)	7	1.6	(6.4)	5	1.6	(12.7)	1
Clean Slate I										
3442	Arc B,L17,P5	2.2,15	(70)	>19,-	2.2	(140)	2.6	1.3	(9)	1.5
3452	Arc B,L20,P13	4.5	(200)	7	2.2	(70)	2.6	1.1	(4.5)	2
3335[c]	Arc N-038	25	(25)	-	-	-		-	-	-
Clean Slate II										
2292[c]	BM-06	25	(100)	-	9	(50)	<1	3.1	(6.4)	<1
2287[c]	Arc A-042	10	(25)	1	3.1	(18)	1.5	1.1	(25)	2
2309	Arc B,L2,P21	6.4,25	(51)	2.6,-	3.1	(51)	1.5	1.1	(36)	2
2273	Arc D(M)-P11	23	(72)	-	7.7	(50)	<1	3.1	(25)	<1
Clean Slate III										
5257[c]	Tower B,P3	15,50	(200)	-	11	(72)	<1	-	(540)	-
4827[c]	Arc B-078	2.2,15	(36)	>19,-	4.5	(36)	<1	1.1,36	(50)	2,< 1
4926	Arc D-038	5,18,50	(100)	5,-	-	(50)		-	(100)	-
4916	Arc D-098	15	(18)	-	4.5	(18)	<1	2.2,18	(25)	<1
4886[c]	Arc F-038	36	(200)	-	-	(70)		-	-	-
4842	Arc H-030	3.1,18	(70)	11.5,-	-	-		-	-	-

Andersen Impactors No density estimates given.

		Stage 1		Stage 2		Stage 3		Stage 4	
Double Tracks									
2965	Arc R-064	5	(9)	1.6	(4.5)	2.2	(4.5)	1.6	(3.1)
Clean Slate I									
3221	Arc B-058	18	(25)	4.5,9	(12.7)	3.1	(9)	1.6	(3.1)
Clean Slate III									
4985[c]	BM-10	12.7	(100)	6.4	(6.4)	9	(36)	2.2	(3.2)
4980[c]	Arc A-102	18	(25)	-	(12.7)	4.5,9	(9)	4.5	(18)

a. All data obtained from optical observation of nuclear track autoradiograms. Largest active particle observed, given in parenthesis, may not be the largest active particle present.

b. Density estimated from comparison with Table B.2.

c. Suspect gross overloading based on sample appearance.

d. Values for stage 1 are not highly significant due to undefined input.

e. Table 3.4 indicates higher densities.

TABLE 3.3 PARTICLE SIZE OF MAXIMUM FREQUENCY

Tracerlab Number	Location	Size of Maximum Frequency / Size of Largest Active Particle in Parenthesis, microns	
a. Total Air Samples			
Double Tracks			
2527 (D)	Arc A-072	1.6	(4.5)
2989 (I)	Arc B,L10,P21	2.6	(18.)
2709 (II)	Arc H-060	3.1	(6.2)
Clean Slate I			
5078 (D)	Arc A-024	-	(460)
5035 (I)	Arc B,L22,P5	3.1	(51)
Clean Slate II			
4117 (D)	Arc A-048	6.4	(18)
Clean Slate III			
5166 (D)	Arc A-024	6.4	(18)
5152 (II)	Arc B-090	None	-
b. Cylindrical Collector (sticky wire)			
Double Tracks			
2469	Arc B,L4,P11	5.	(65)
2908	Arc B,L5,P13	6.4	(34)
2119	Arc B,L6,P10	2.2	(65)
2121	Arc B,L12,P20	4.5	(18)
2122	Arc B,L14,P20	3.1	(92)
2123	Arc B,L18,P23	3.1	(45)
5306	Arc J,L1,P11	3.1	(45)
Clean Slate I			
5294	Arc B,L11,P7	28.	(120)
5298	Arc B,L13,P5	-	(136)
5297	Arc B,L14,P6	45	(70)
5299	Arc B,L17,P8	-	(68)
5342	Arc B,L19,P6	-	(140)
c. Disk Collector (Balloon Disk)			
Clean Slate II			
4105	Arc B,L4,P17	34-68[a]	(270)
d. Glass Slides			
Double Tracks			
	BM-09	2.2	(9)
	Arc F-056	1.6	(50)
	Arc H-044	-	(100)
	Arc H-048	-	(120)
	Arc L-056	36	(36)
	Arc P-050	-	(51)
10027	Stake 261	1.6	(36)
Clean Slate I			
	BM-07	270[a]	(540)
	BO-05	-	(800)
	CM-07	384[a]	(1080)
	Arc D-030	-	(200)
	Arc D-036	3.1	(50)
	Arc H-028	9	(70)
	Arc H-032	0.55?	(25)
	Arc L-030	140?	(140)
	Arc O-034	3., 9.?	(36)
	Stake 822	2.2?	(36)
Clean Slate II			
	Arc C-064	4.5	(36)
	Stake 840	-	-
Clean Slate III			
	BH-04	6.4	(140)
	BM-14	21,50	(72)
	Arc B-028	6.4,12.7,72	(140)
	Arc C-022	6.4,18,36,280	(280)
	Arc E-034	6.4	(140)
	Arc G-032	18,72	(200)
	Arc H-034	25,87	(200)

a. Only larger particles were examined.

TABLE 3.4 ACTIVITY AND DENSITY OF SUBMICRON ACTIVE PARTICLES

T-Lab No.	Location	Stage No.	Particle with alpha tracks viewed by Optical Microscopy				Spherical particles observed by Electron Microscopy			
			Diameter at Max. Frequency	Equivalent Activity[a]		Density[b]	Diameter at Max. Frequency	Equivalent Activity[a]		Density[b]
			microns	dis/min	% $Pu^{239}O_2$	gm/cc	microns	dis/min	% $Pu^{239}O_2$	gm/cc
Double Tracks										
2906	Arc B,L5,P9	3	0.97	0.007	1	2.5	0.85	aggregates of spheres		3
			0.97	0.3	40-150	-	0.43	spheres to aggregates - up to 100%		11.5
		4	0.43	0.006	7.5	2	0.43	-	-	2
							0.14	- up to 100%		11.5
		5	-	observed activity level for 1 micron was 0.08		-	0.14	-	< 3	2.6
							no lower size peak observed 0.05 micron spheres present			- 19
2152	Arc B,L12,P21	3	0.85	0.013	3	3	-	-	-	-
			0.85	0.18	40	-				
		4	-	-	-	-	0.14	-	-	11.5
		5	-	-	-	-	0.03 micron spheres present			19
2436	Arc B,L2,P13	4	0.43	0.005	9.5	2	-	-	-	-
2527	Arc A-072	*	-	-	-	-	0.14	-	-	low?
9626	Arc G-060	4	-	-	-	-	0.20	-	-	7
2724	Arc H-064	3	0.85	0.02	4.4	3	-	-	-	-
			0.85	0.20	44.	-	-	-	-	-
		4	0.85	0.003	0.7	< 1	-	-	-	-
2477	Arc J,L4,P13	3	no disk was used			-	-	-	-	-
		4	1.1	0.005	0.5	< 1	0.21	-	-	5
2947	Arc R-056	3	1.6	0.005	0.2	1-2.6	0.1 larger aggregates present			197
			1.6	0.92	3.	-	-	-	-	-
2965[c]	Arc R-064	6	0.85	-	-	-	-	-	-	-
Clean Slate I										
3442	Arc B,L17,P9	4	0.85	0.002	0.4	< 1	0.18	-	max 10	7
3452	Arc B,L20,P13	4	1.1	0.01	1.	< 1	-	-	-	-
		5	-	-	-	-	0.85	very low		overload
Clean Slate II										
2292	BM-06	4	1.6(?)	0.001	0.03	< 1	< 0.21(?)	-	-	5
		5	1.6	0.0001	0.003	overload	0.28	-	-	< 1
2287	Arc A-042	4	1.1	0.0002	0.01	< 1	0.21	-	-	6
		5	3.2	0.0002	0.001	overload	-	-	-	overload
			3.2	0.008	0.03	overload	< 0.14	-	-	2.6
2309	Arc B,L2,P21	4	1.1	0.0001	0.01	< 1	-	-	-	-
			1.1	0.003	0.1	-	0.20	-	-	6
3221	Arc B-058[c]	6	-	-	-	-	0.43	-	-	-
		7	-	-	-	-	0.85,0.2	-	-	-
Clean Slate III										
5257	Tower B,P3	4	No peak, particles observed were 12-36	< 0.01	<0.001	overload	-	-	-	-
4827	Arc B-078	4	0.85	0.0001	0.03	< 1	-	-	-	-

TABLE 3.4 (CONTINUED)

T-Lab No.	Location	Stage No.	Particle with alpha tracks viewed by Optical Microscopy				Spherical particles observed by Electron Microscopy			
			Diameter at Max. Frequency	Equivalent Activity[a]		Density[b]	Diameter at Max. Frequency	Equivalent Activity[a]		Density[b]
			microns	dis/min	% $Pu^{239}O_2$	gm/cc	microns	dis/min	% $Pu^{239}O_2$	
Clean Slate III (Continued)										
4916	Arc D-098	4	8	0.0002	-	overload	-	-	-	-
			1.1	0.00002	0.002	< 1	-	-	-	-
4985[c]	BM-10	6	1.1	0.0002	0.02	-	-	-	-	-
4980[c]	Arc A-102	6	4.5	0.0001	< 0.001	-	-	-	-	-
		7	0.85(?)	0.0002	< 0.05	-	-	-	-	-

a. Determined from track count and exposure time, assuming 2 π detection geometry and no latent image fading. Activity of 1 micron sphere of $Pu^{239}O_2$ taken as 0.74 dis/min.

b. Estimated from comparison with Table B.2. See Table 3.2 for density on other impactor stages.

c. Andersen Impactor. All other samples are Casella Impactor.

TABLE 3.5 ESTIMATED POPULATION OF ACTIVE PARTICLES

Ratio of field count alpha activity to estimated activity of particle size at maximum frequency of occurrence.[a]

Tracerlab Number	Location	Stage 3	Stage 4	Stage 5
Double Tracks				
2906	Arc B,L5,P9	5.13×10^5 (1.8×10^5)[b]	1.0×10^6 (1.2×10^5)	3.0×10^6 (3.4×10^6)
2152	Arc B,Ll2,P21	2.1×10^4 (3×10^3)	1.6×10^5 -	9.4×10^5 (4.8×10^5)
2724	Arc H-064	5.1×10^3 (2.8×10^3)	3×10^4 (1.5×10^4)	-
2477	Arc J-L4,P13	Stages 3 plus 4	5.1×10^4 (3.6×10^3)	- (6.1×10^4)
Clean Slate I				
3442	Arc B,Ll7,P9	9×10^4 (1.3×10^4)	3.4×10^4 (2.3×10^5)	-
Clean Slate II				
2309	Arc B,L2,P21	1.8×10^5 -	$\sim 10^4$ -	-

a. For stages 4 and 5 based on estimated activity of submicron sphere sizes.

b. Values in parenthesis obtained by normalizing alpha track pattern occurrences.

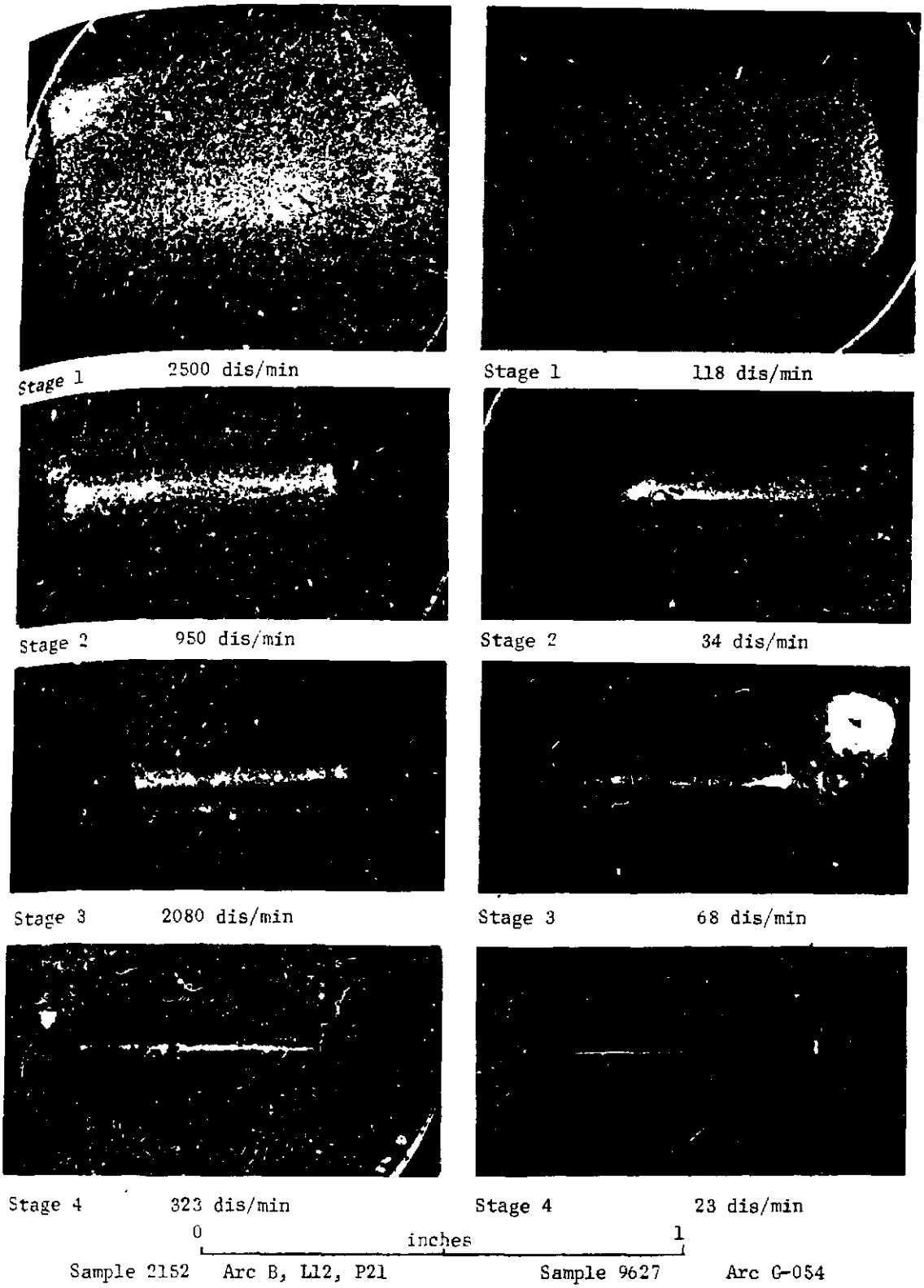


Figure 3.1 Photograph of Casella impactor disks, Double Tracks.

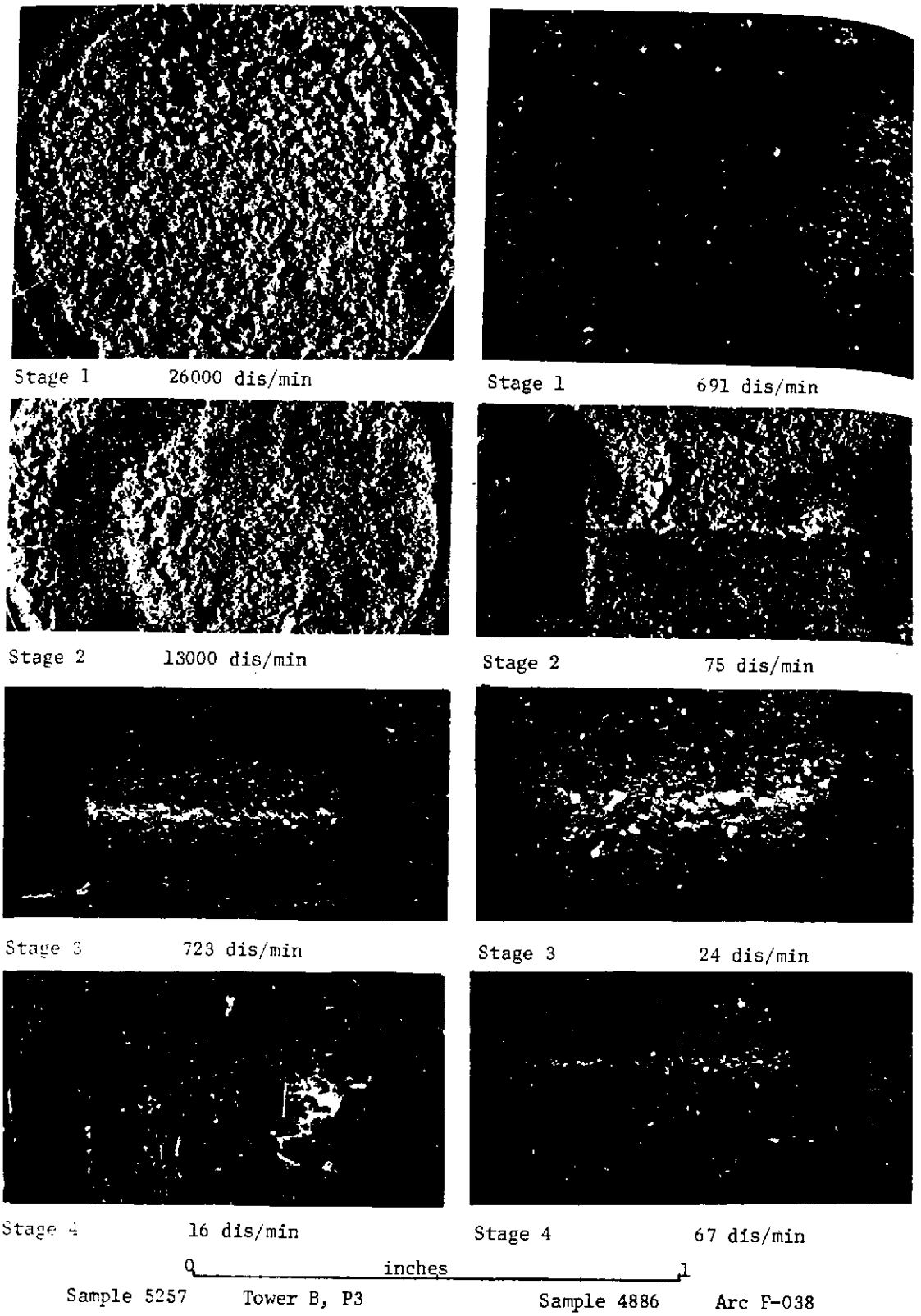
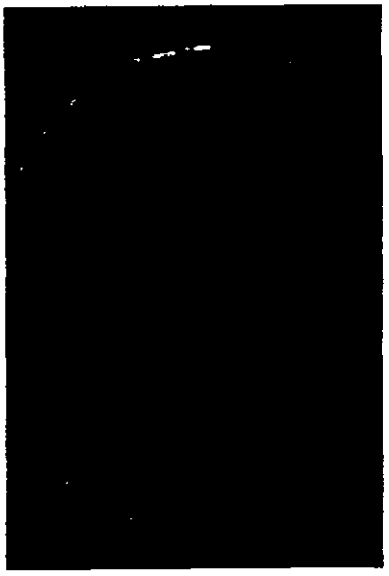
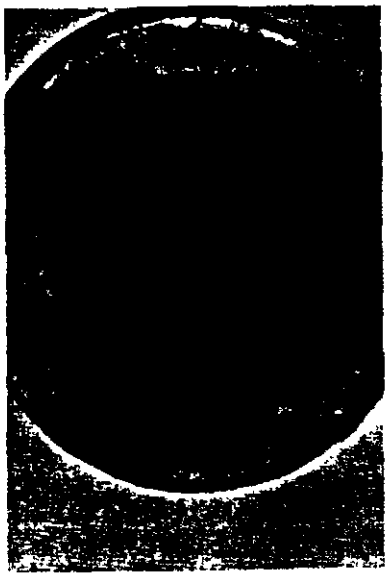


Figure 3.2 Photograph of Casella impactor disks, Clean Slate III.



2906 Stage 3, 4620 dis/min
Arc B, L5, P9
DOUBLE TRACKS

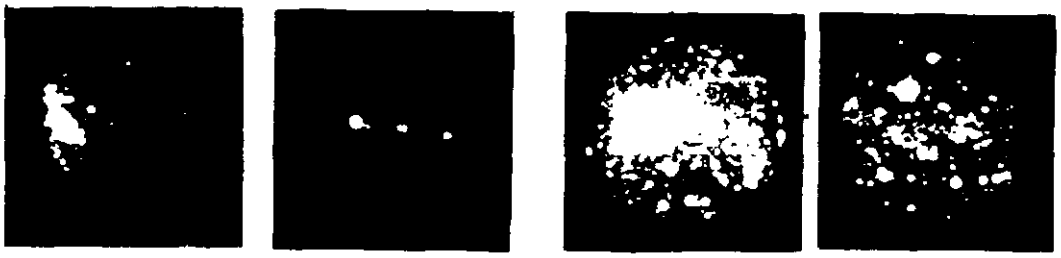
2303 Stage 2
Tower A, P1
CLEAN SLATE II



Stage 1 0 10 millimeters
3317 P-024
CLEAN SLATE I

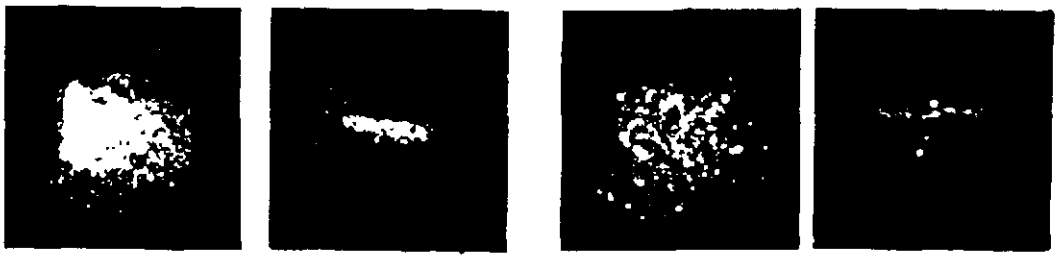
Stage 3 0 0.5 millimeters
2292 BM-06
CLEAN SLATE II

Figure 3.3 Photograph of Casella impactor disks.



Stage 1 Stage 2
3436 Arc B, L12, P21
60 min. exposure

Stage 1 Stage 2
2288 Arc A-030
1000 min. exposure



Stage 1 Stage 2
3453 Arc B, L23, P9
60 min. exposure

Stage 1 Stage 2
2171 Arc F-022
1000 min. exposure

Stage 1
3397 Arc H-040
1000 min. exposure

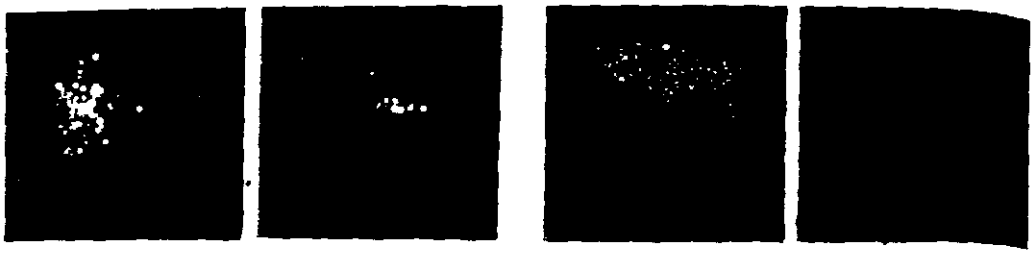
Stage 1 Stage 2
2252 Arc H-044
1000 min. exposure

0 1 2
inches

CLEAN SLATE I CLEAN SLATE II

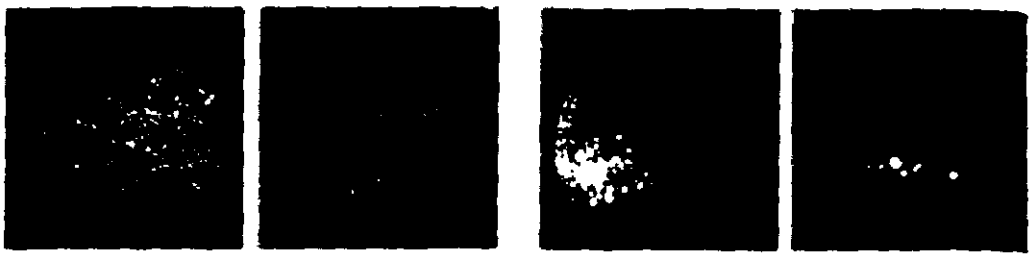
NEGATIVE IMAGES, ZENITH PLATE

Figure 3.4 Phosphor autoradiograms of Casella impactor, Stages 1 and 2, Clean Slate I and II.



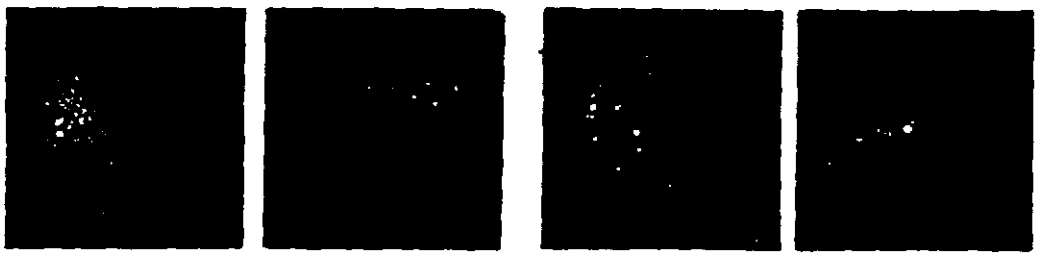
Stage 1 Stage 2
4822 Arc B-026
1000 min. exposure

Stage 1 Stage 2
4897 Arc F-080
1000 min. exposure



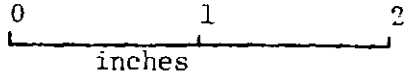
Stage 1 Stage 2
4821 Arc B-086
1000 min. exposure

Stage 1 Stage 2
4869 Arc H-038
1000 min. exposure



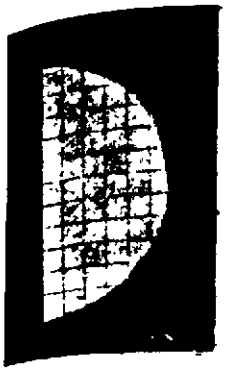
Stage 1 Stage 2
4923 Arc D-062
1000 min. exposure

Stage 1 Stage 2
4955 Arc L-038
1000 min. exposure



CLEAN SLATE III
NEGATIVE IMAGES, ZENITH PLATE

Figure 3.5 Phosphor autoradiograms of Casella impactor Stages 1 and 2, Clean Slate III.



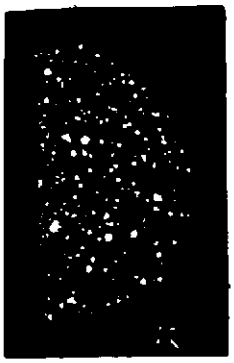
2906
Arc B, L5, P9

2292
BM-06

4886
Arc F-038

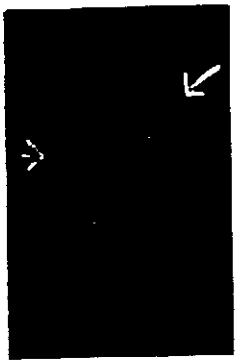
2152
Arc B, L12, P21

2287
Arc A-042



2477
Arc J, L4, P13

DOUBLE TRACKS



2309
Arc B, L12, P21

CLEAN SLATE II

CLEAN SLATE III

NEGATIVE IMAGES, SXX FILM
7400 MINUTE EXPOSURE

0 1
inches

Figure 3.6 Phosphor autoradiograms of Casella backup membrane filters.

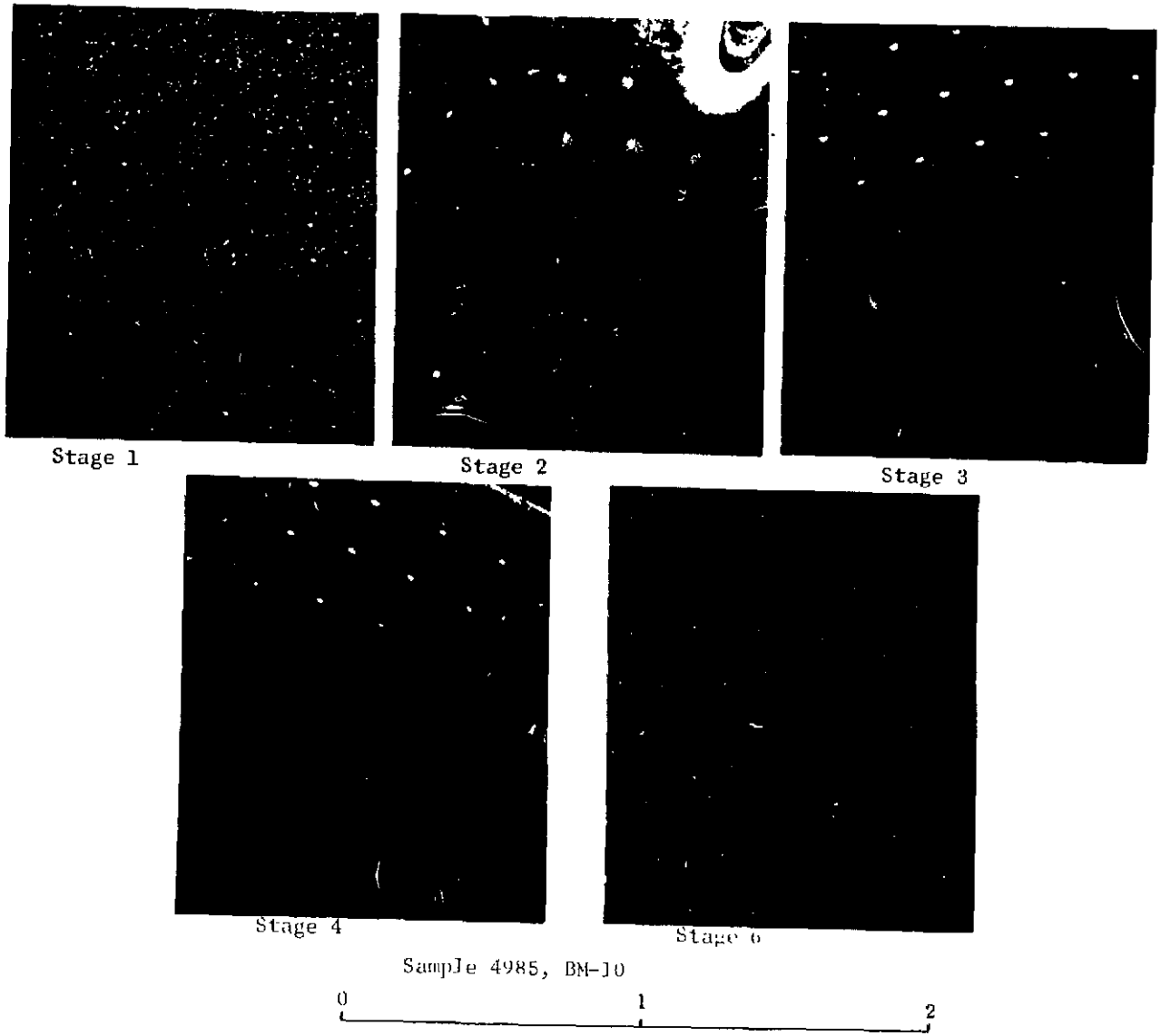


Figure 3.7 Photograph of Andersen impactor stages, *Clean Slate III*.

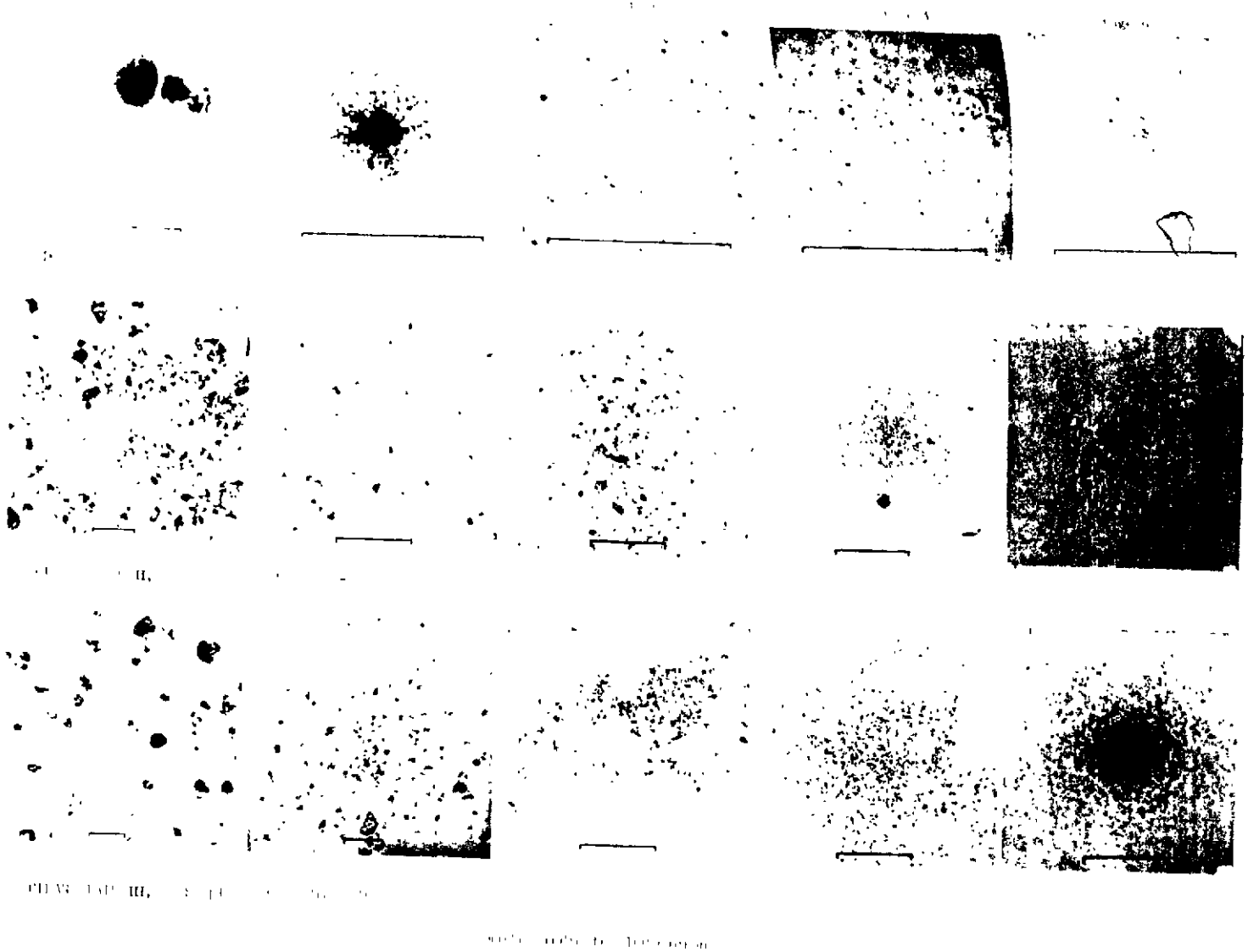


Figure 3.8 Photomicrograph of individual deposits on Andersen stages.

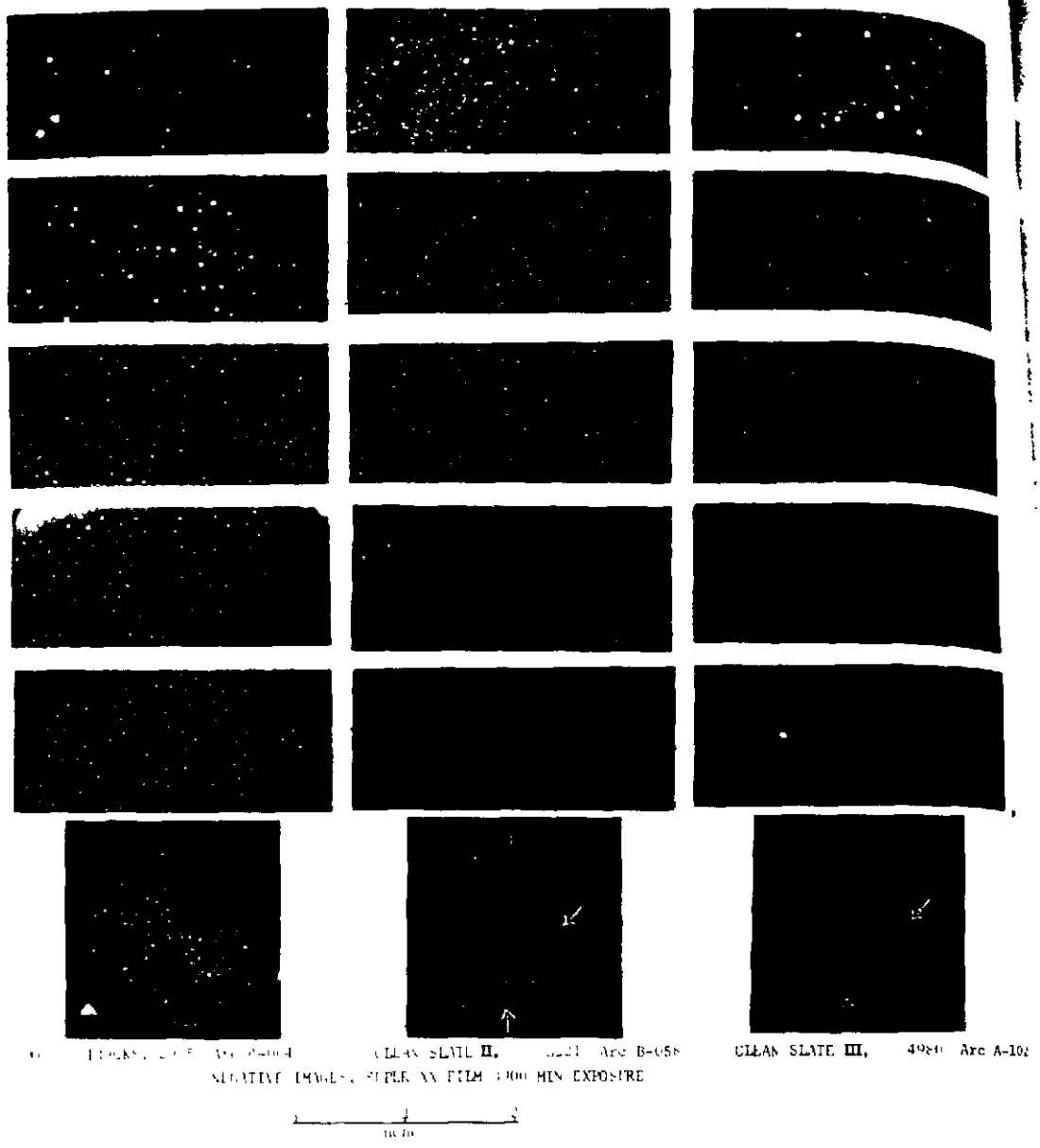
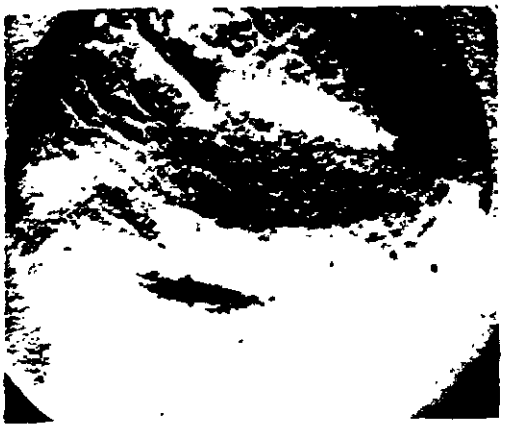


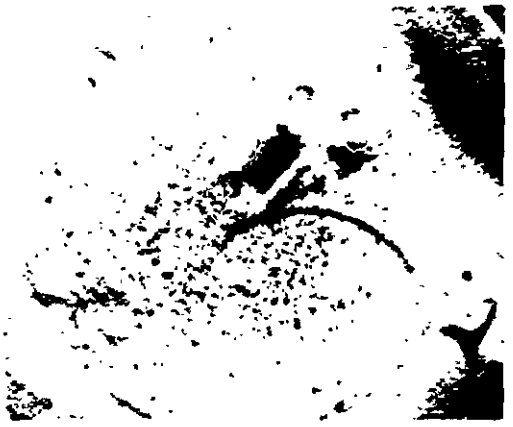
Figure 3.9 Phosphor autoradiogram of Andersen impactor stages.

DOUBLE TRACKS, 2527, Arc A-072, (D)

Phosphor Autoradiogram of Back Up Membrane Filter of 2527



CLEAN SLATE I. 3078, Arc A-024. (D)



3035, Arc B, L22, P5, (I)

CLEAN SLATE II. 4117, Arc A-048, (D)

CLEAN SLATE III. 5166, Arc A-024, (D)

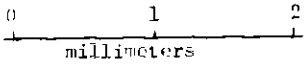
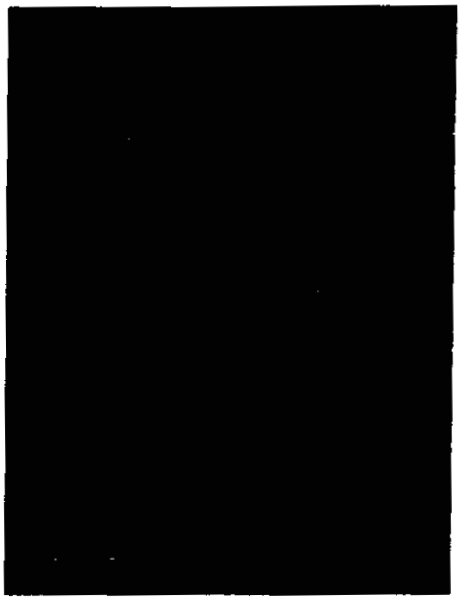
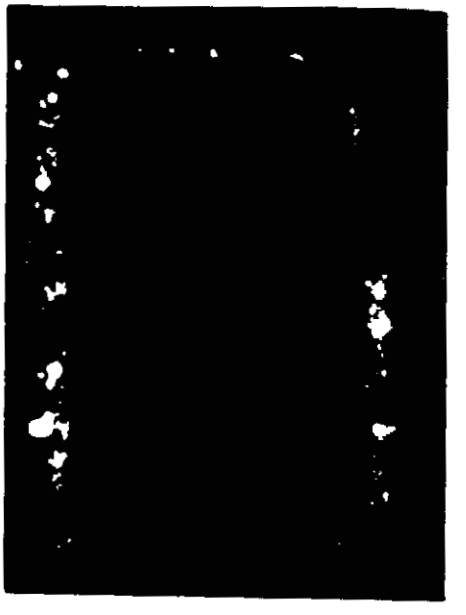


Figure 3.10 Photograph of total air-filter samples.

DOUBLE TRACKS, 8035, BM-09
60 min exposure



Cover slide for above sample
1000 min exposure



Separator frame for cover
1000 min exposure

NEGATIVE IMAGES, ZENITH PLATE

0 1 2
inches

Figure 3.11 Phosphor autoradiogram of deposition slide components.

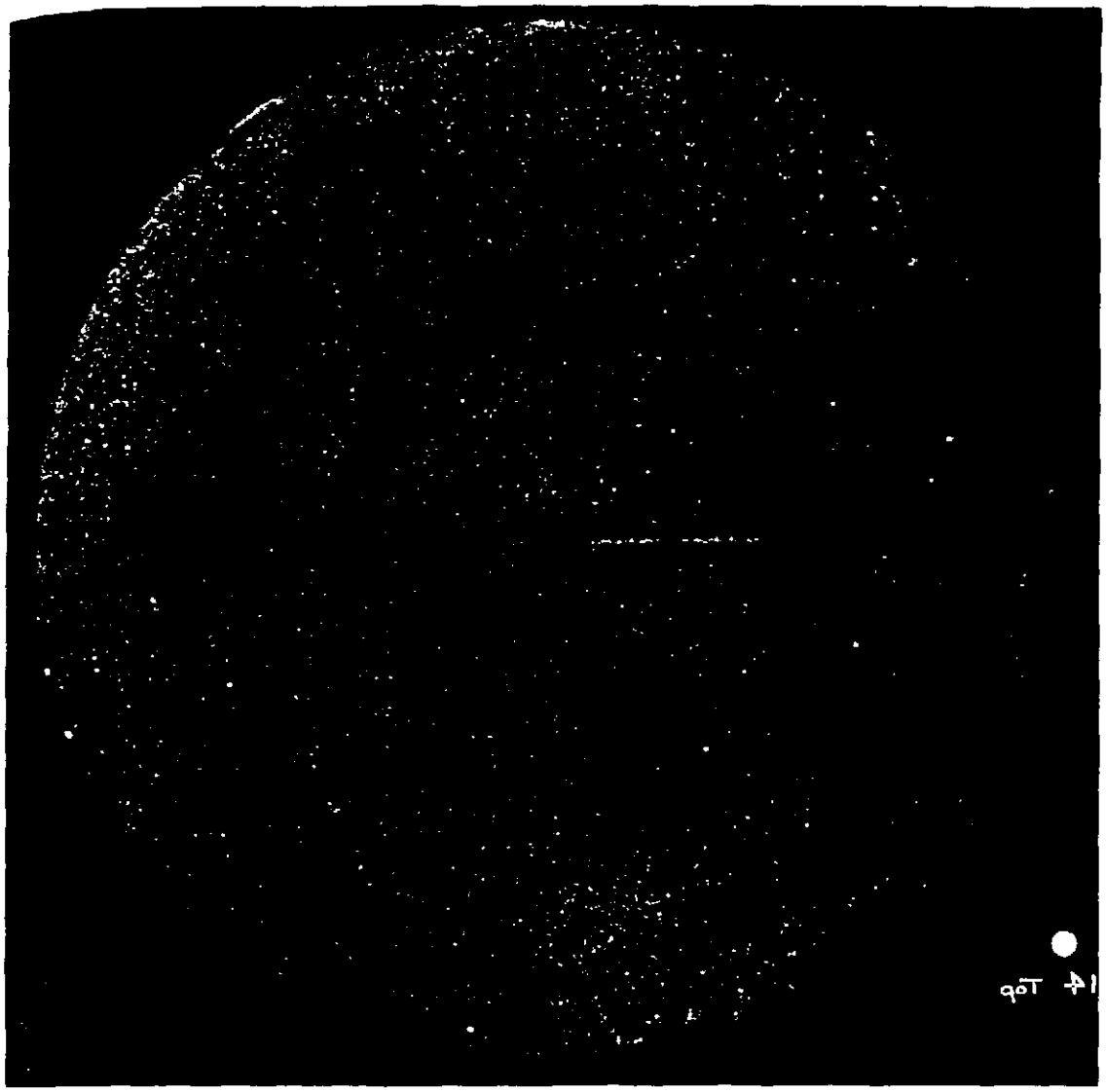
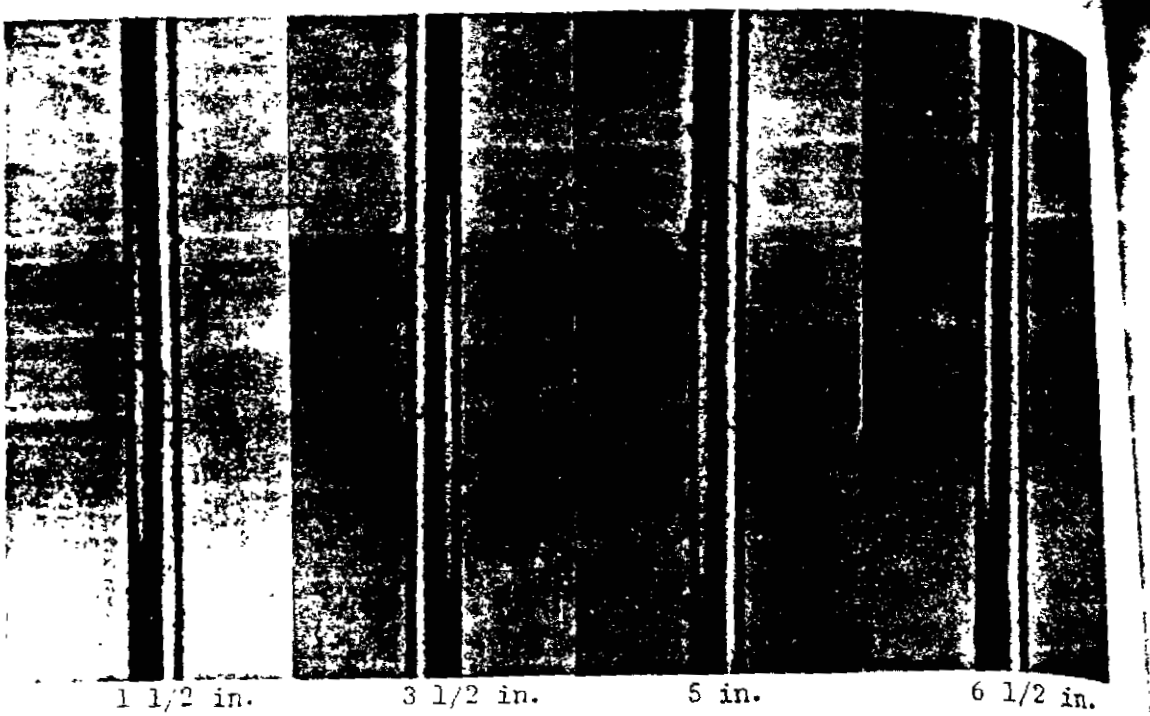
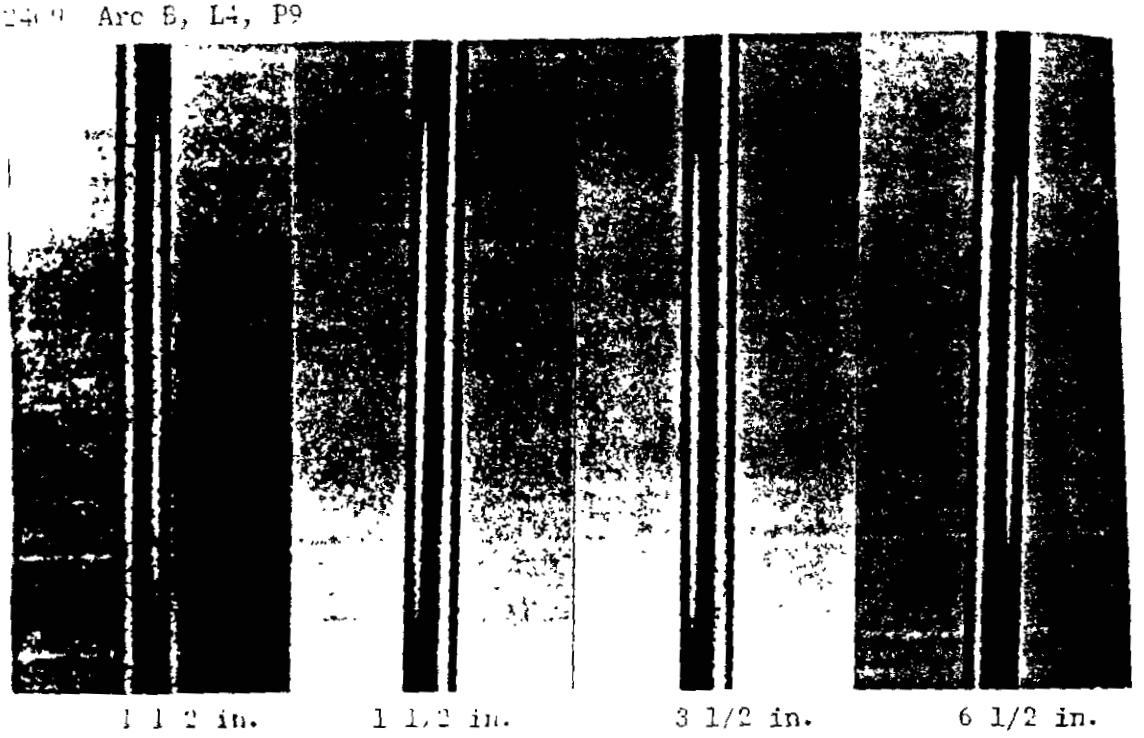


Figure ...12 Phosphor autoradiogram of deposition disk, Clean Slate I.



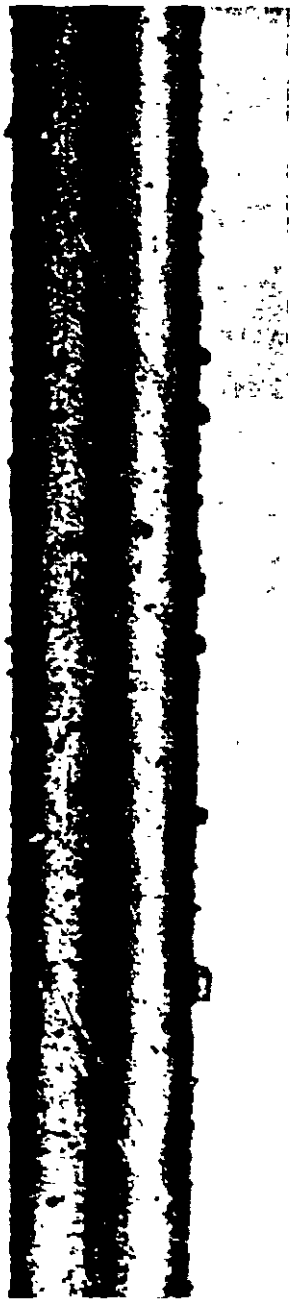
Arc B, L4, P9



Arc J, L3, P13

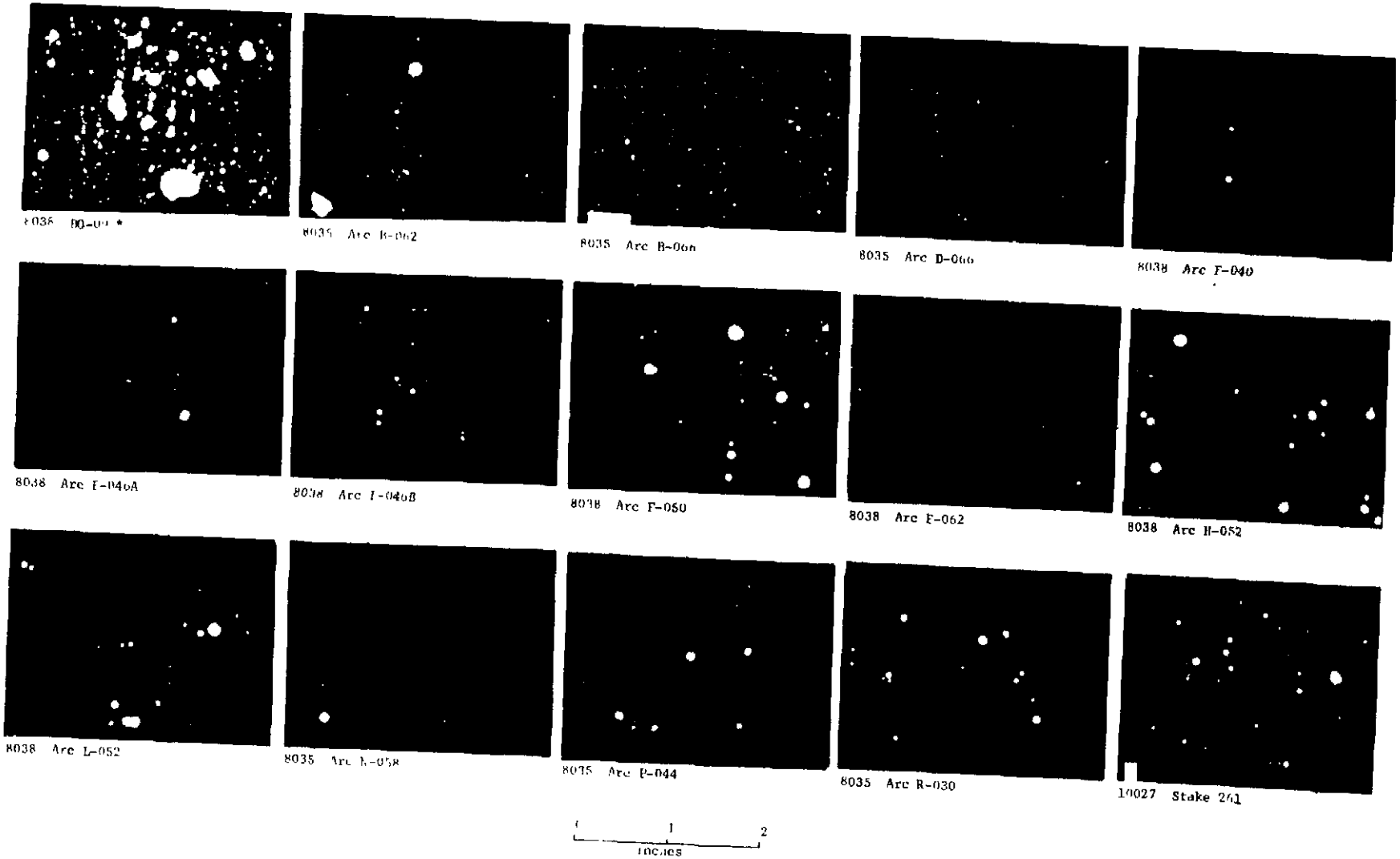
Distance From End Of Wire Given In Inches

Figure 3.13 Photograph of cylindrical collector, Double Tracks.



· 5299 Arc B. L17, P6·

Figure 3.14 Photograph of cylindrical collector, Clean Slate I.



NEGATIVE IMAGES. ZENITH PLATE 1000 MIN EXPOSURE. ASTERISK INDICATES 60 MIN EXPOSURE.

Figure 3.15 Phosphor autoradiogram of deposition slides, *Double Tracks*.

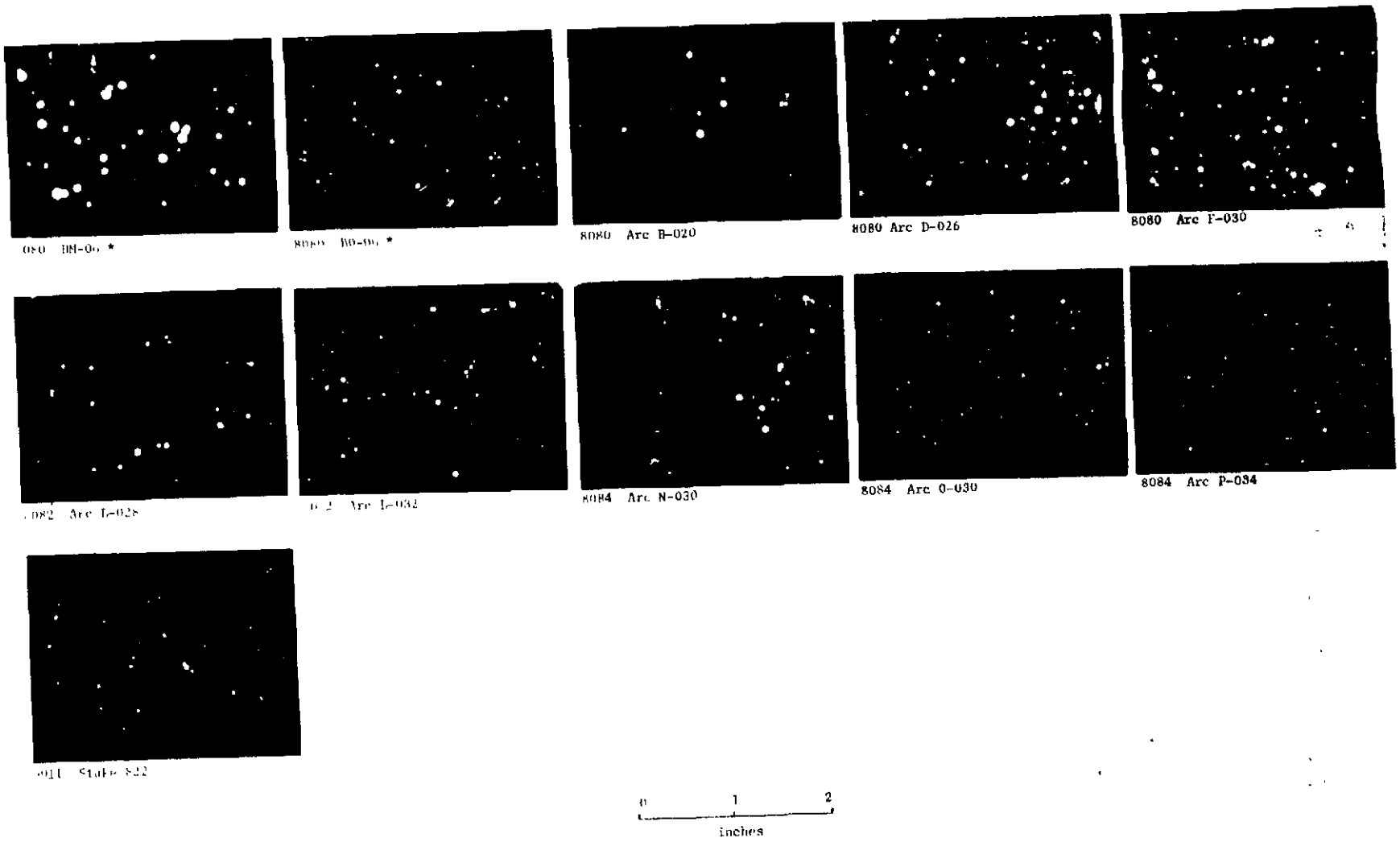


Figure 3.16 Phosphor autoradiogram of deposition slides, Clean Slate I.

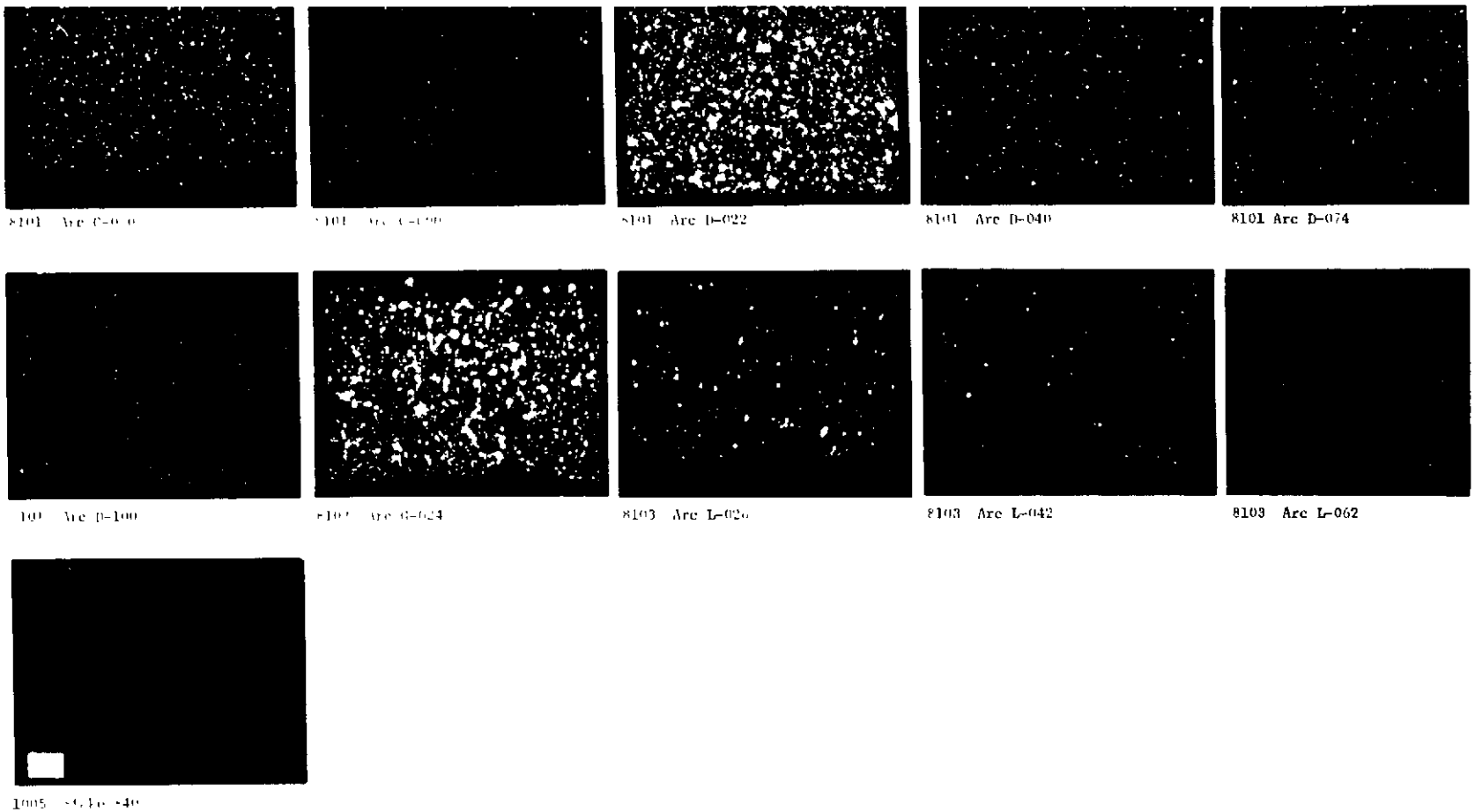
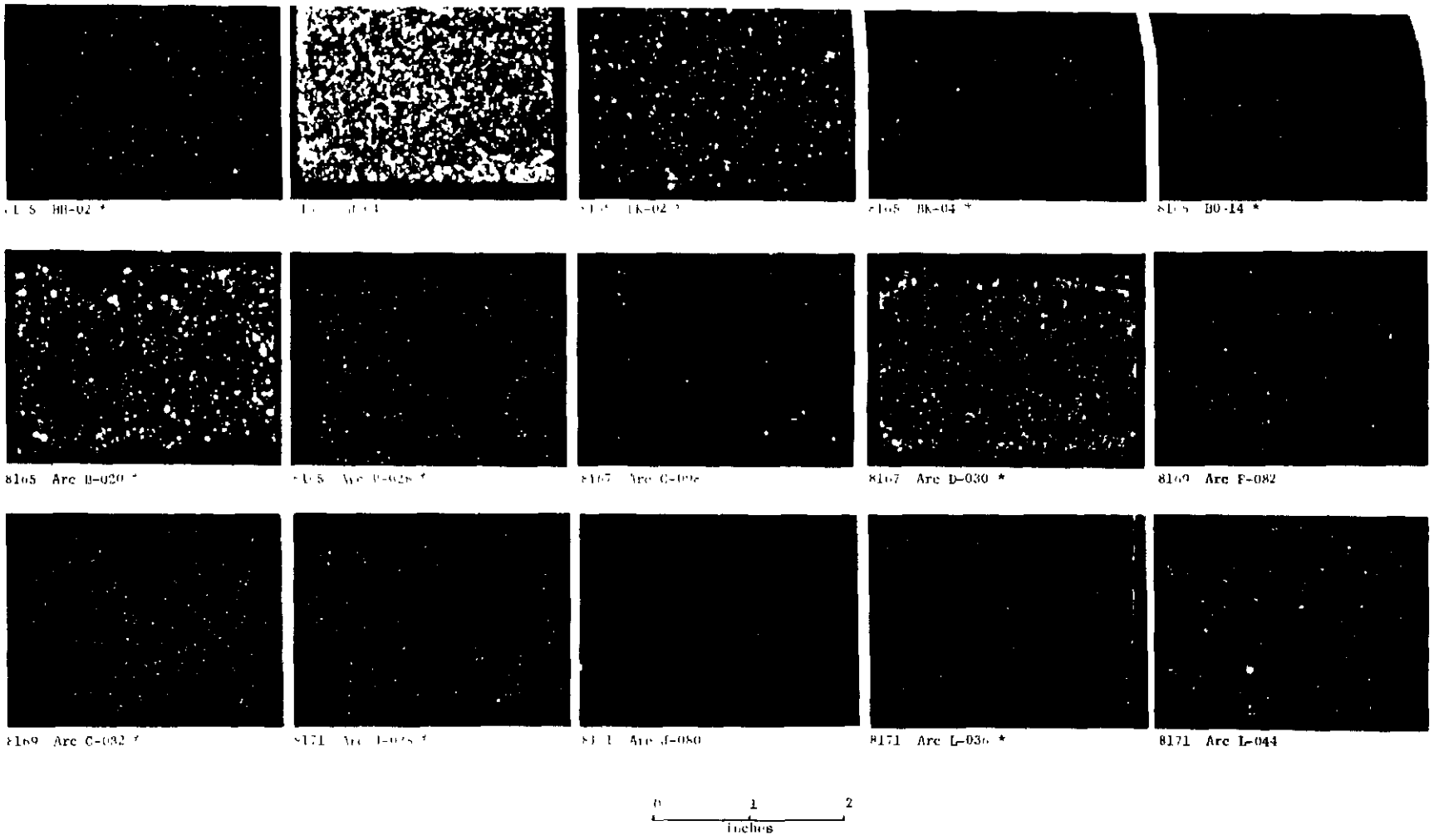


Figure 3.17 Phosphor autoradiogram of deposition slides, *Clean Slate II*.



NEGATIVE IMAGES. FLAT-FIELD PLATE 1000 MIN EXPOSURE. ASTERISK INDICATES 60 MIN EXPOSURE.

Figure 3.18 Phosphor autoradiogram of deposition slides, Clean Slate III.

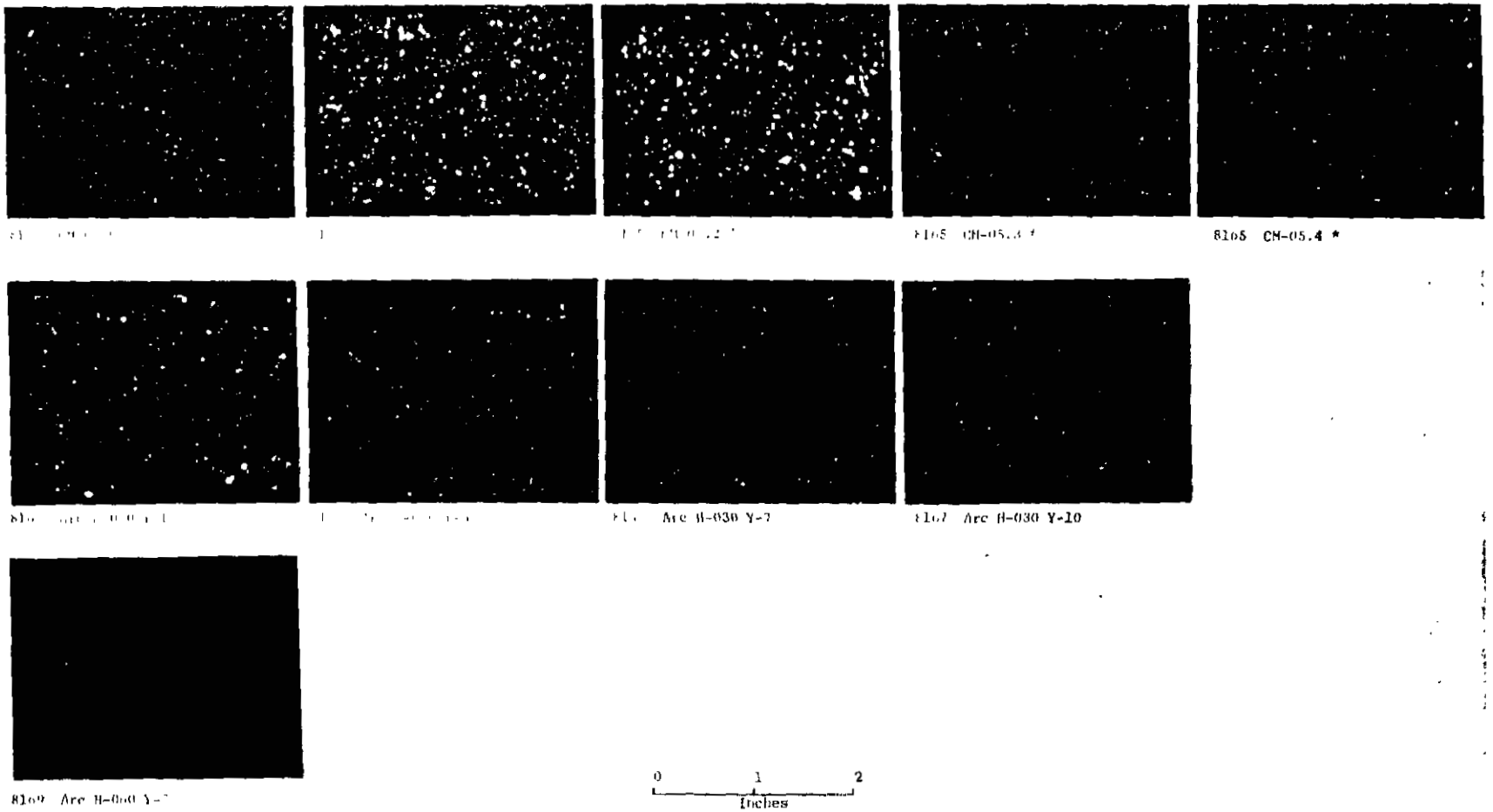
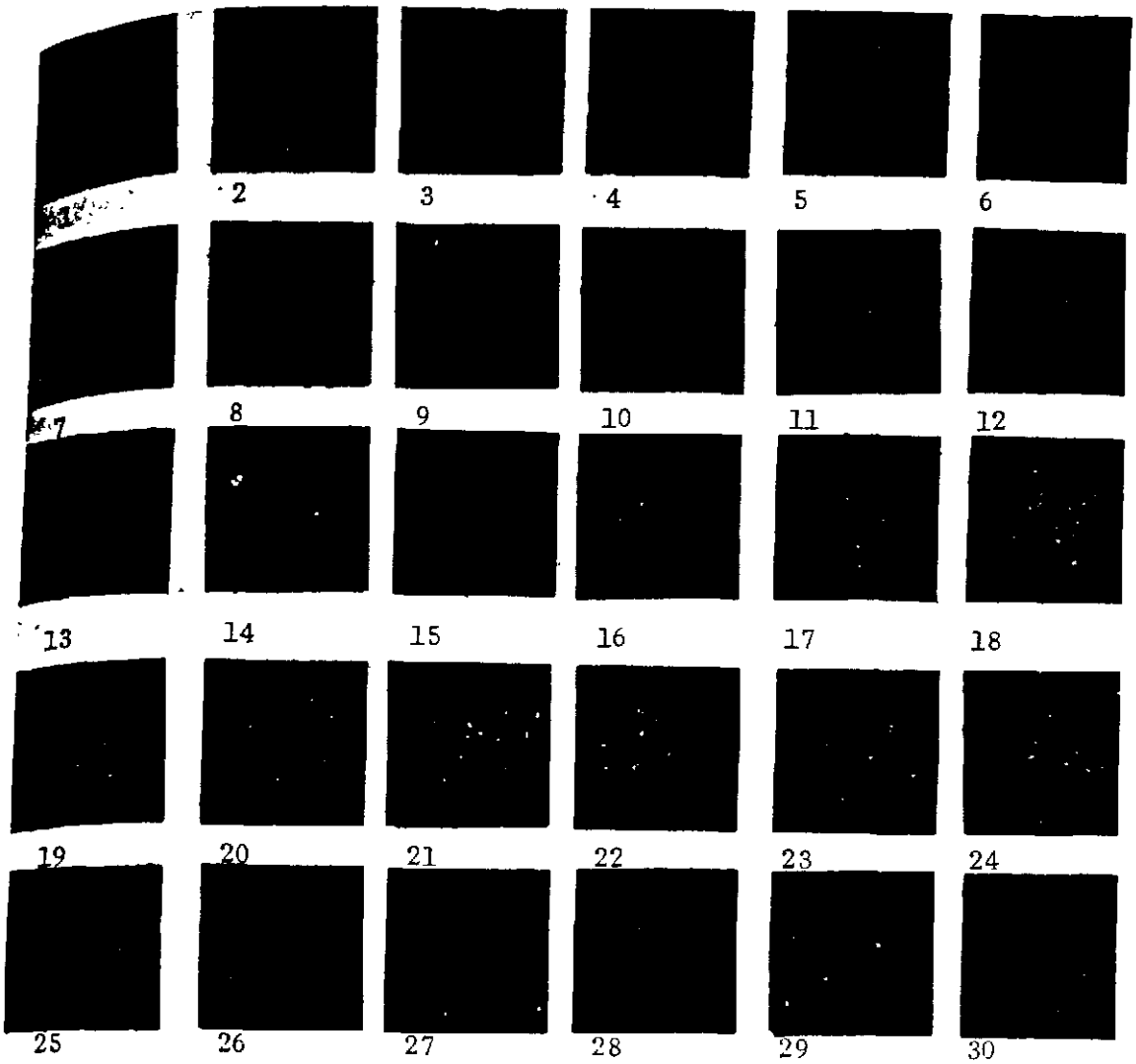


Figure 3.19 Phosphor autoradiogram of deposition slides, special arrays, Clean Slate III.



DOUBLE TRACKS, 3994, Arc F-068

Filter sampling period: 7 sec. per section
Elapsed time from position 1 to position 30: 330 sec.
Elapsed time from Shot Time to exposure of section 1: undetermined
Distance from beginning of tape to section 1: 22 ft., 10.6 in.

0 1
inches

Negative Images, Panatomic-X Film, 44 Hour Exposure

Figure 3.20 Phosphor autoradiogram of Gelman paper-tape sequential air filter.

Stage 1 200μ

Stage 2 100μ

Stage 3 100μ

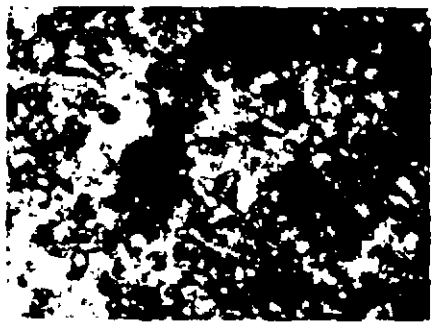
Casella Impactor Stage 4
2558 Arc F-054 50μ

6 Micron
CMR2-A-1 (11) Surface Soil

3 Micron

CLEAN SLATE I. PRESHOT PARTICLES

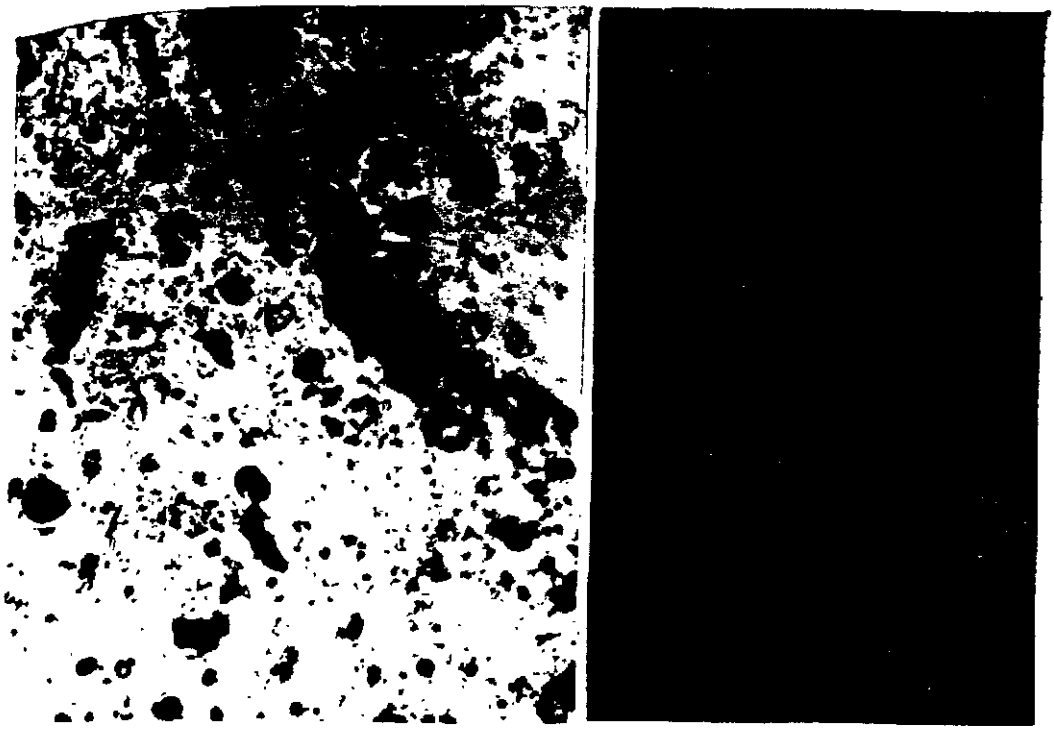
Casella Impactor Stage 1
2906 Arc B, L5, P9



Casella Impactor Stage 1
9627 Arc G-054

DOUBLE TRACKS POSTSHOT AUTORADIOGRAMS. Alpha star diameter is 50μ

Figure 3.21 Photomicrograph, background particles.

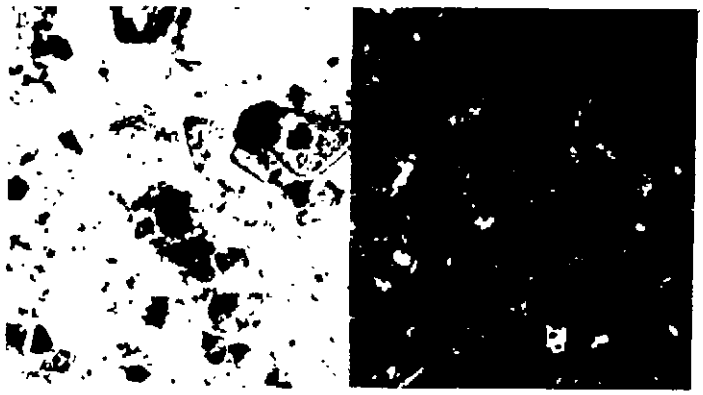


0 100 microns

Stage 1

0 10 microns

Stage 3



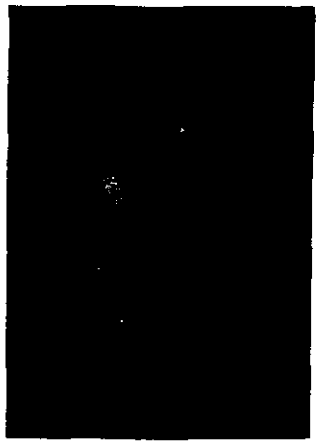
0 10 microns crossed polarizers

Stage 4

Casella Impactor 2900 Arc B, L5, P9

Figure 3.22 Photomicrograph of most active impactor, Double Tracks.

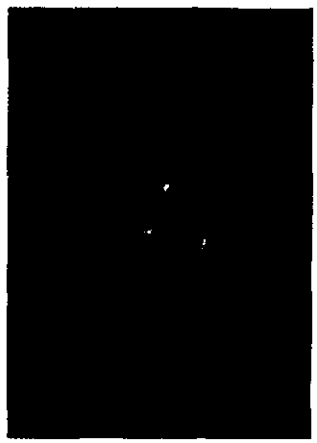
10 microns



4 microns

4.5 microns

3.1 microns



4.5 microns

4 microns

0.8 micron

0.5 micron

2436 Casella Impactor Stage 1 Arc B, L2, P13

Figure 3.23 Photomicrographs of particle-autoradiogram, Double Tracks.

160 microns

35 microns

35 microns

11, 1 microns

9 microns

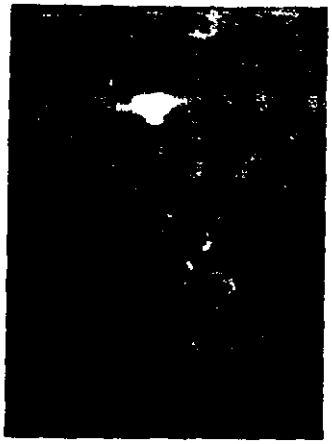
3 × 14 microns

5 microns

3452 Casella Impactor Stages 1&2
Arc B, L20, P13

9911 Stake 822 GLASS SLIDE

Figure 3.24 Photomicrographs of particle-autoradiogram, Clean Slate I.



9, 4.5 microns 3.1 microns 4.5 microns
CLEAN SLATE II 2309 Casella Impactor Stage 3

75 micron sphere
2303 Tower A, P1
Casella Stage 2
CLEAN SLATE II

spheres larger
than 100 microns
5257 Tower B, P3
Casella Stage 1
CLEAN SLATE III

20 micron wall
BH-04
Glass Slide

Figure 3.25 Photomicrographs of particles and autoradiograms, Clean Slate II and III.

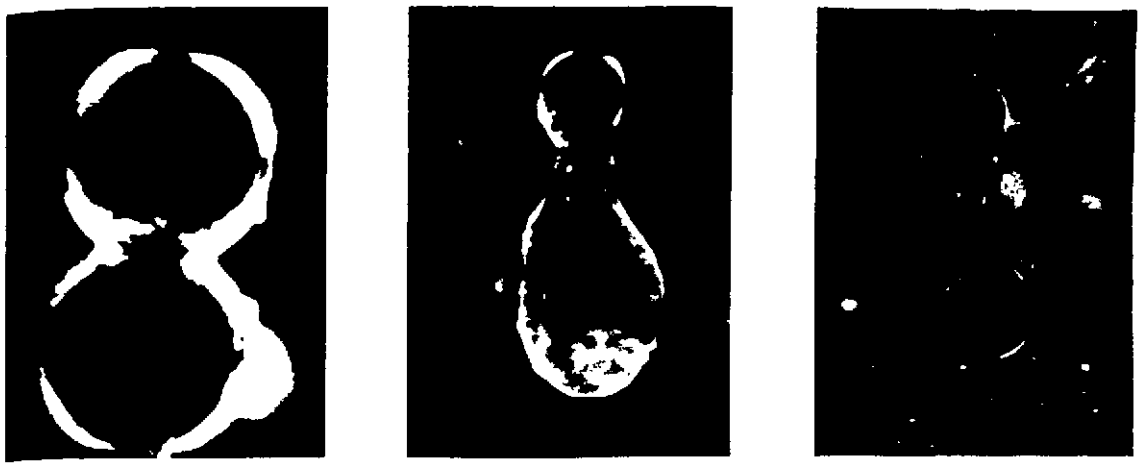
2436 Arc B, L2, P13
Casella Impactor Stg. 1
DOUBLE TRACKS

3078 Arc A-024
Total Air Sample
CLEAN SLATE I

3078

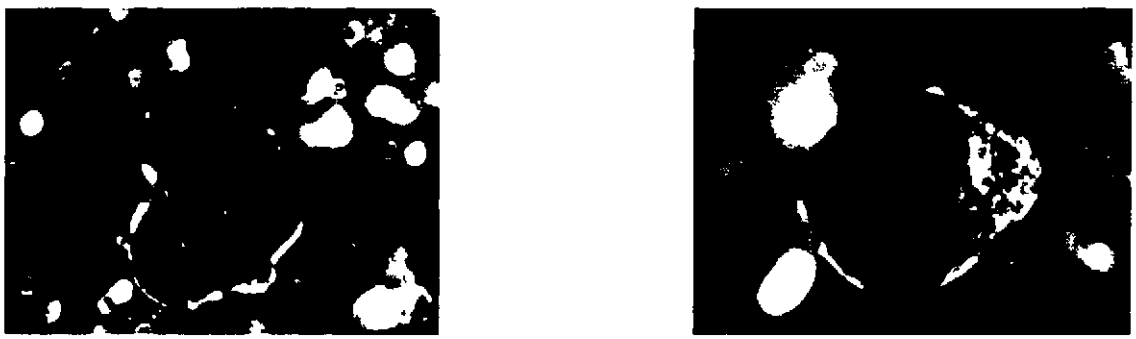
CLEAN SLATE II Casella Impactor 2303 Stage 2 Tower A, P1

Figure 3.26 Photomicrographs of large particle surfaces.



Spherical portions are approximately 120 microns in diameter

CLEAN SLATE I



Particles are from Clean Slate II except as indicated

Figure 3.27 Photomicrograph of large particle cooling effects.

2121 #1 (UO_2-PuO_2)

crossed polarizers

B-044 #A (PuO_2)

B-044 #D (UO_3)

2589 #A Surface (U)

2303 #2 (UO_2)

2303 #4 (UO_2-PuO_2)

5257 #1 (no pattern)

Major crystalline phase given in parenthesis

Figure 3.28 Photomicrographs of X-ray diffraction specimens.

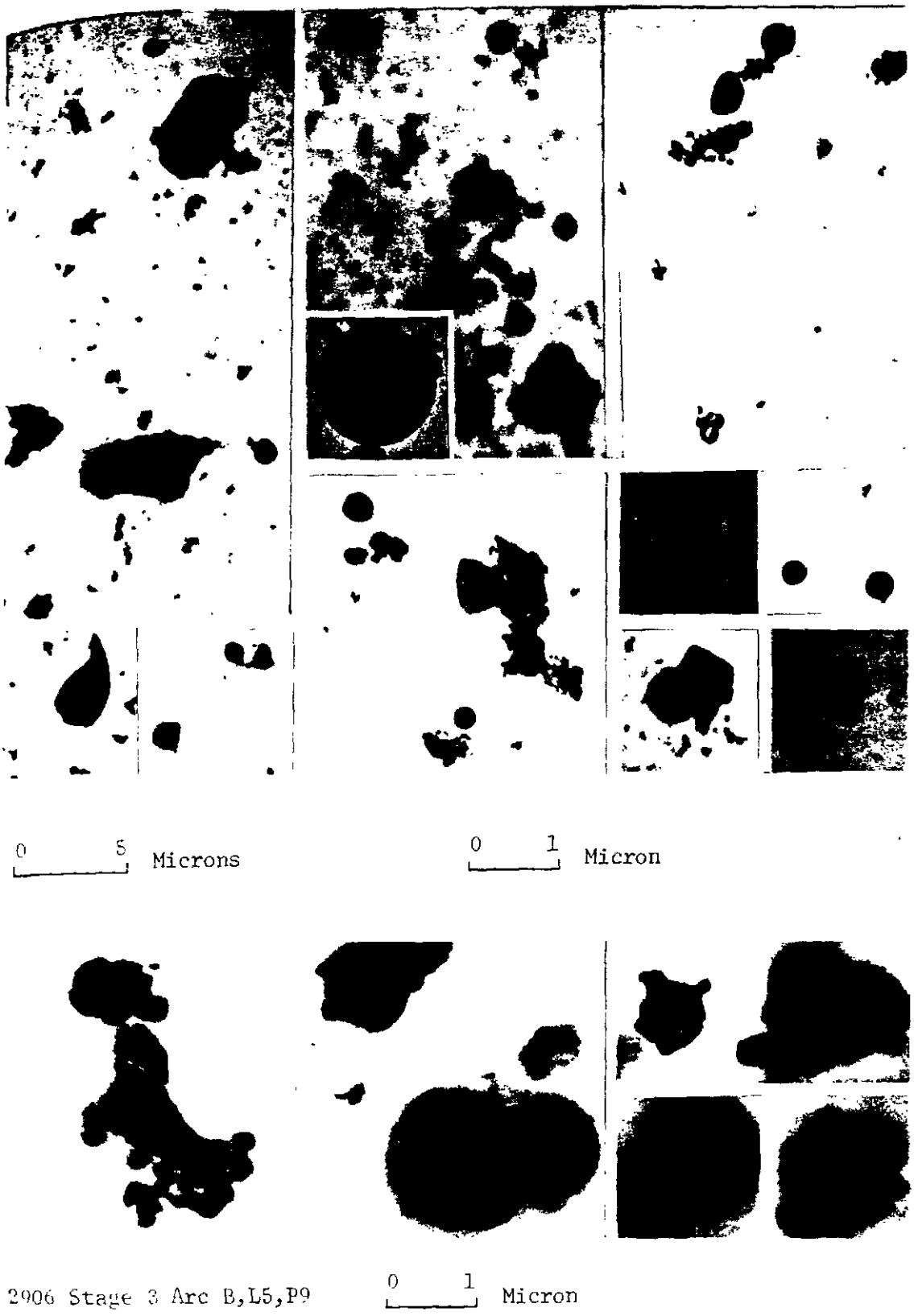


Figure 3.29 Electron micrograph, Double Tracks, Casella impactor.

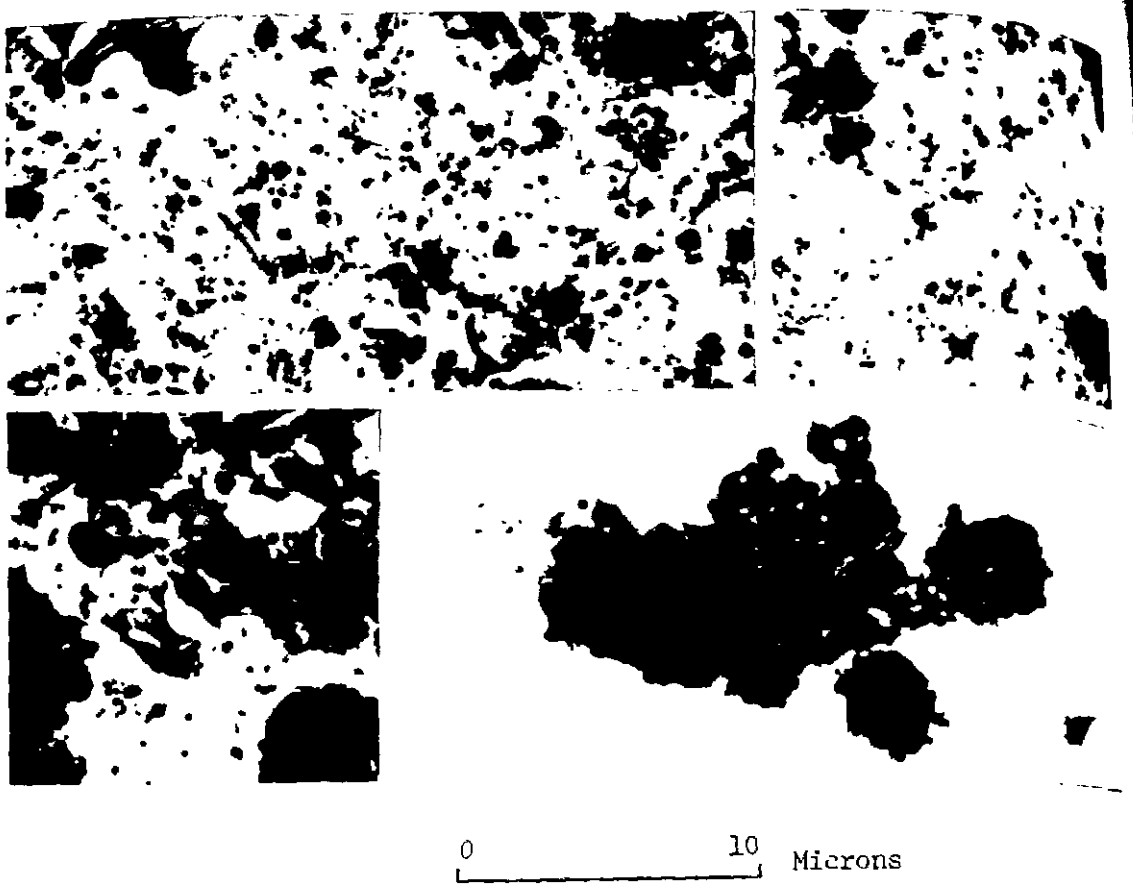
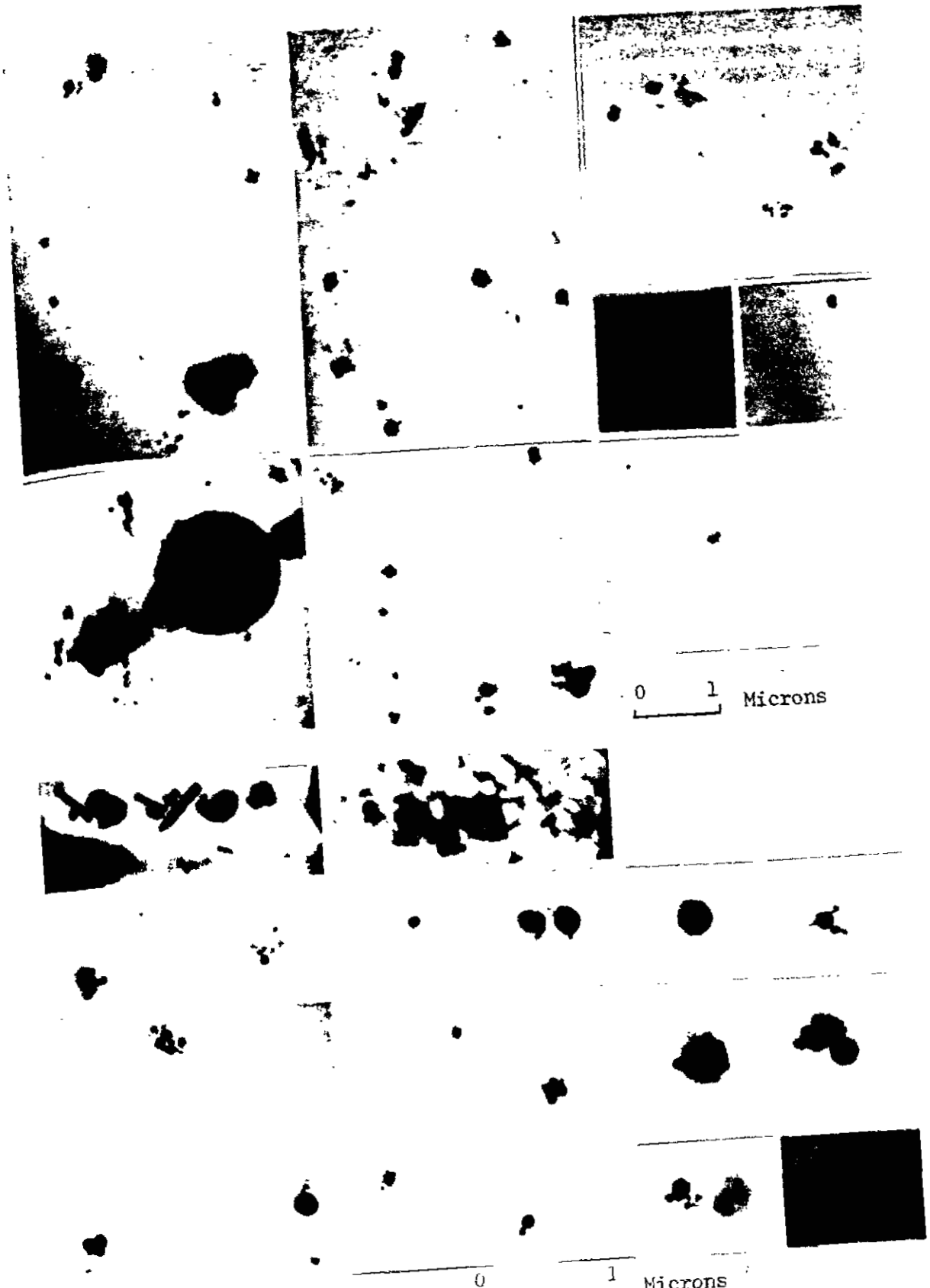
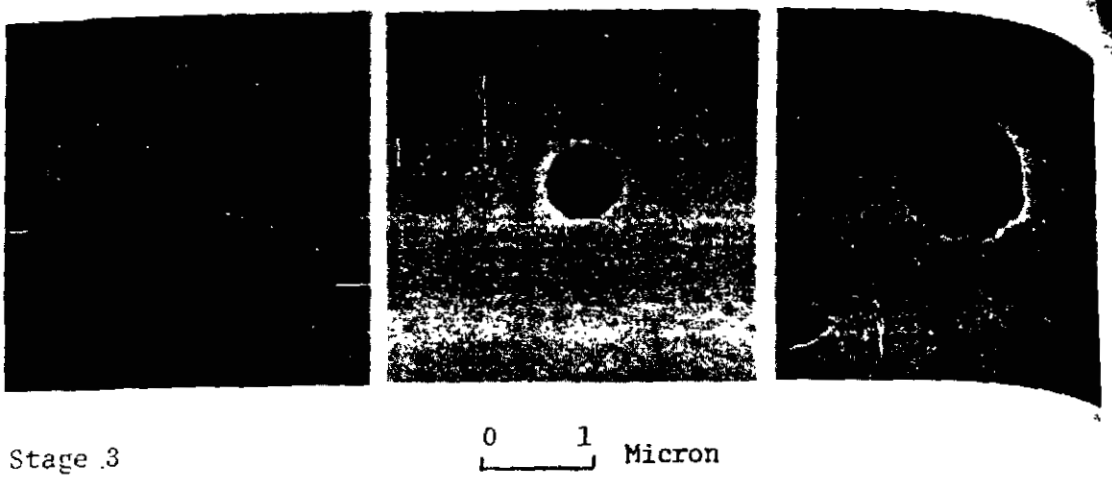


Figure 3.30 Electron micrograph, Double Tracks, Casella impactor.



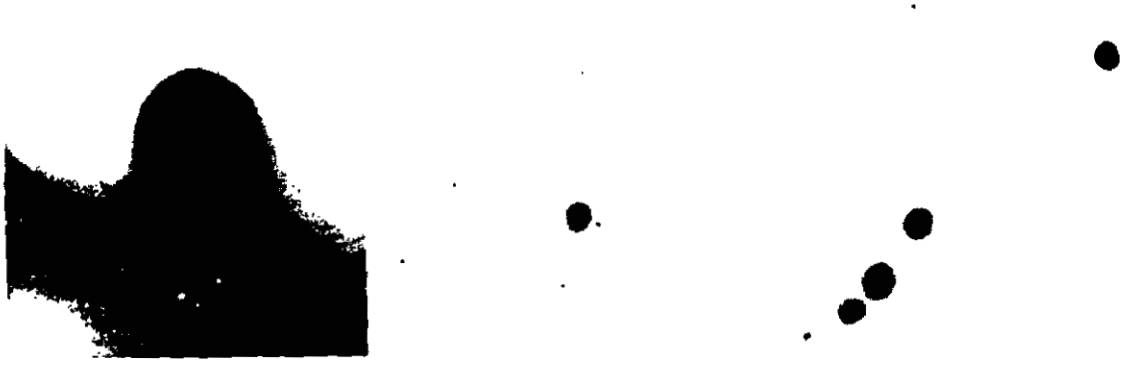
2906 Stage 5 Arc B,L5,P9

Figure 3.31 Electron micrograph, Double Tracks, Casella impactor.



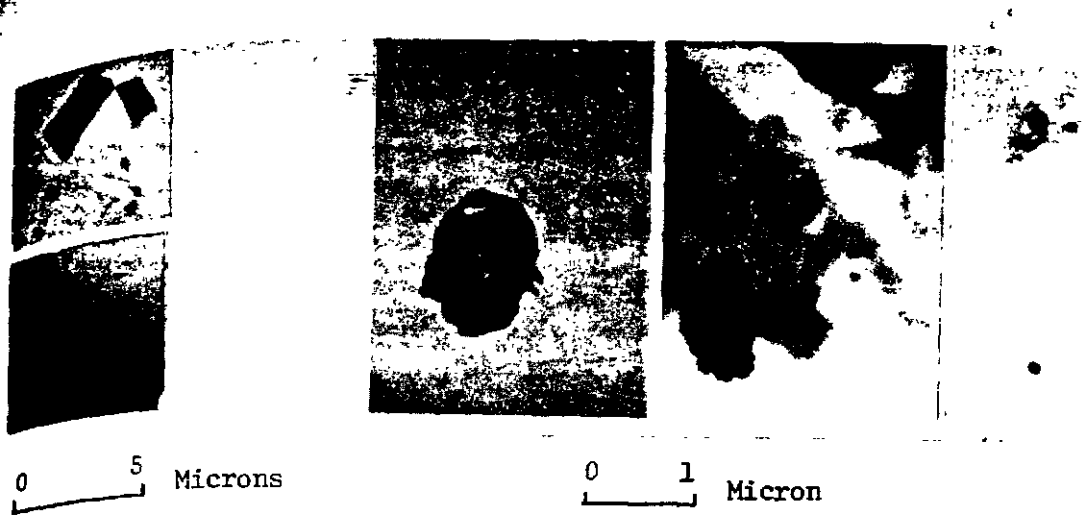
Stage 3 0 1 Micron

Stage 4 0 5 Microns

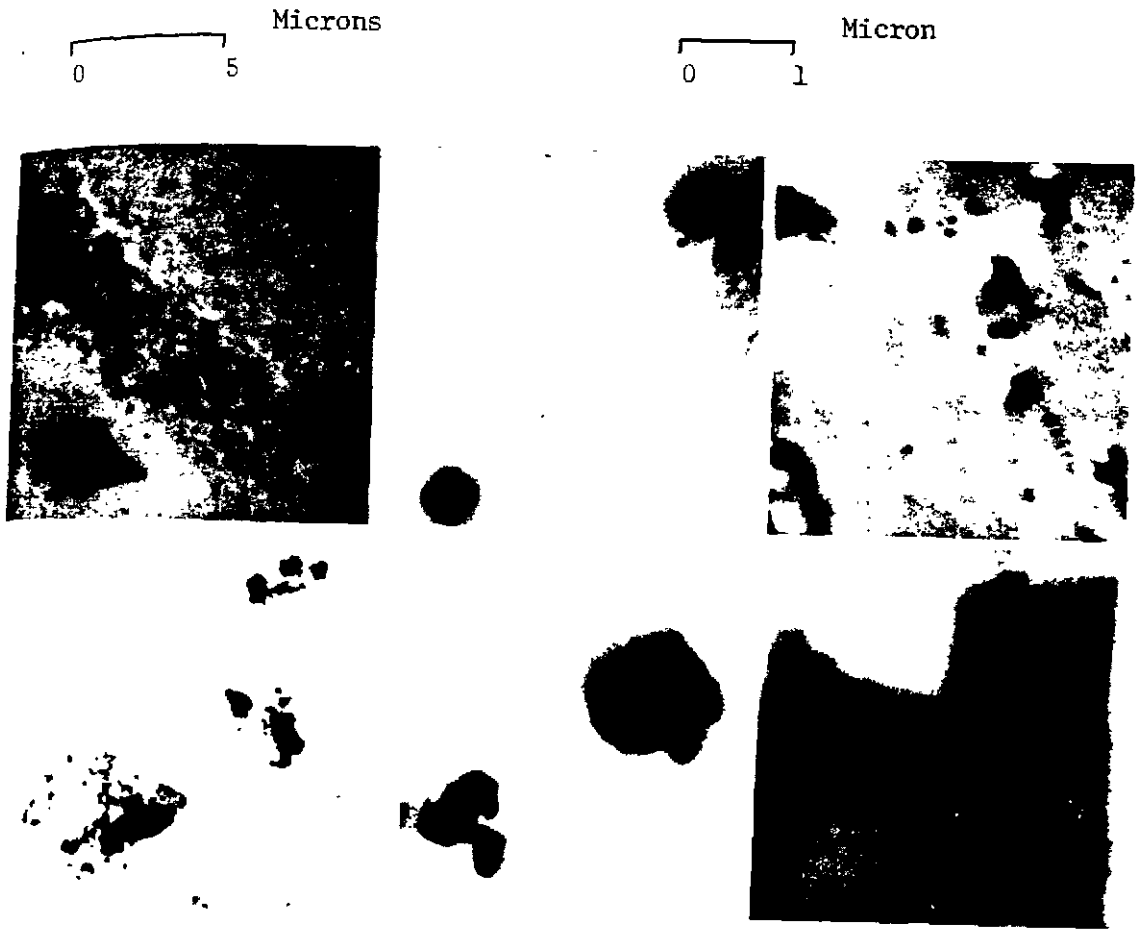


[illegible] Stage 5 Arc B,L12,P21 0 1 Micron

Figure 3.32 Electron micrograph, Double Tracks, Casella impactor.



Stage 3



9625 Stage 4 Arc E-056

Figure 3.33 Electron micrograph, Double Tracks, Casella impactor.

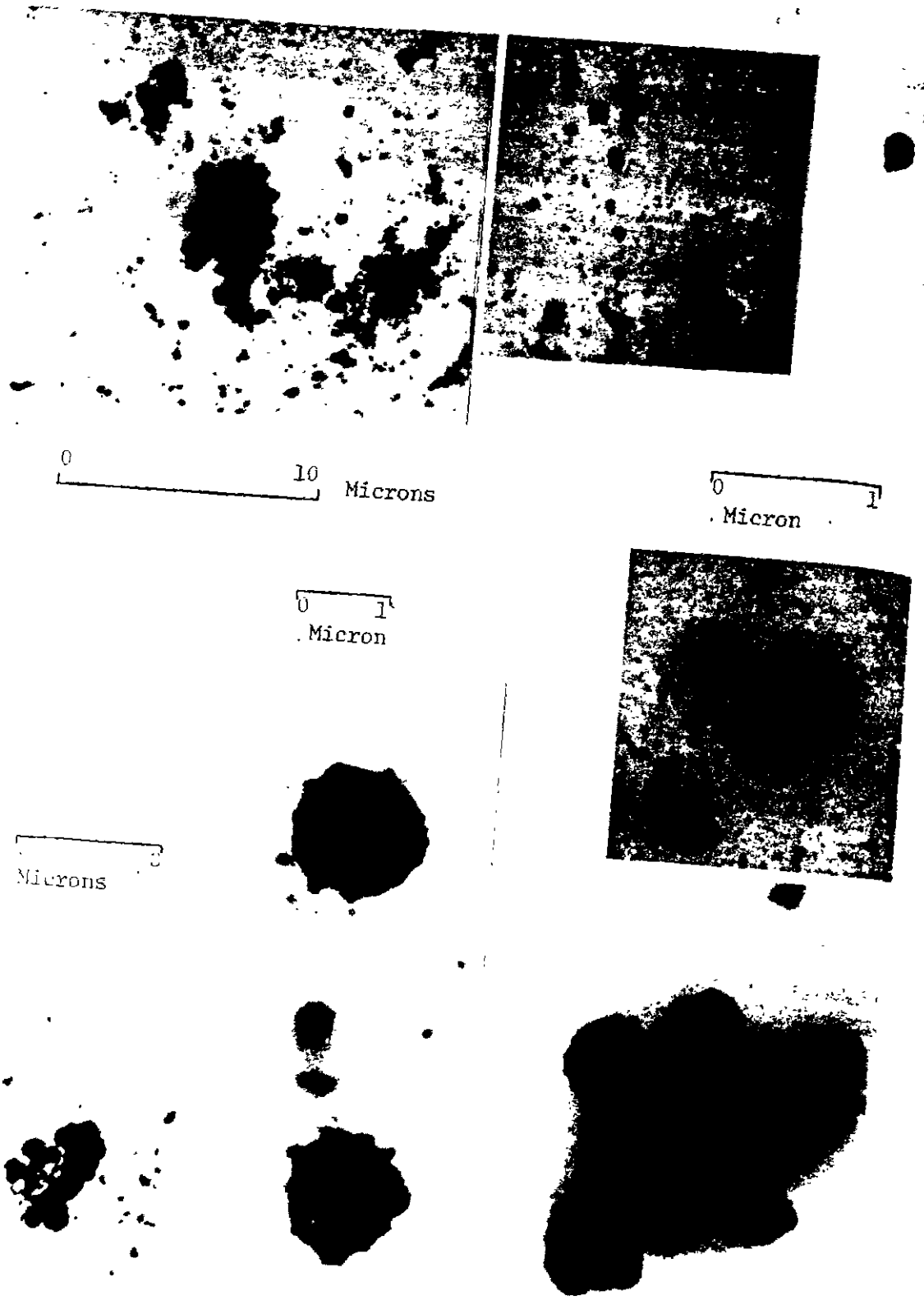
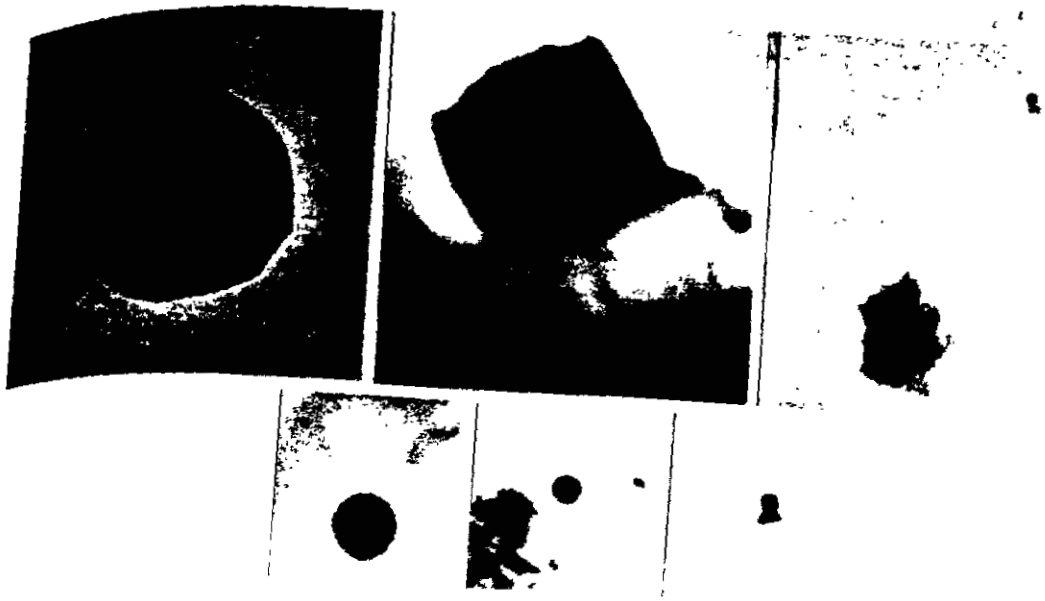


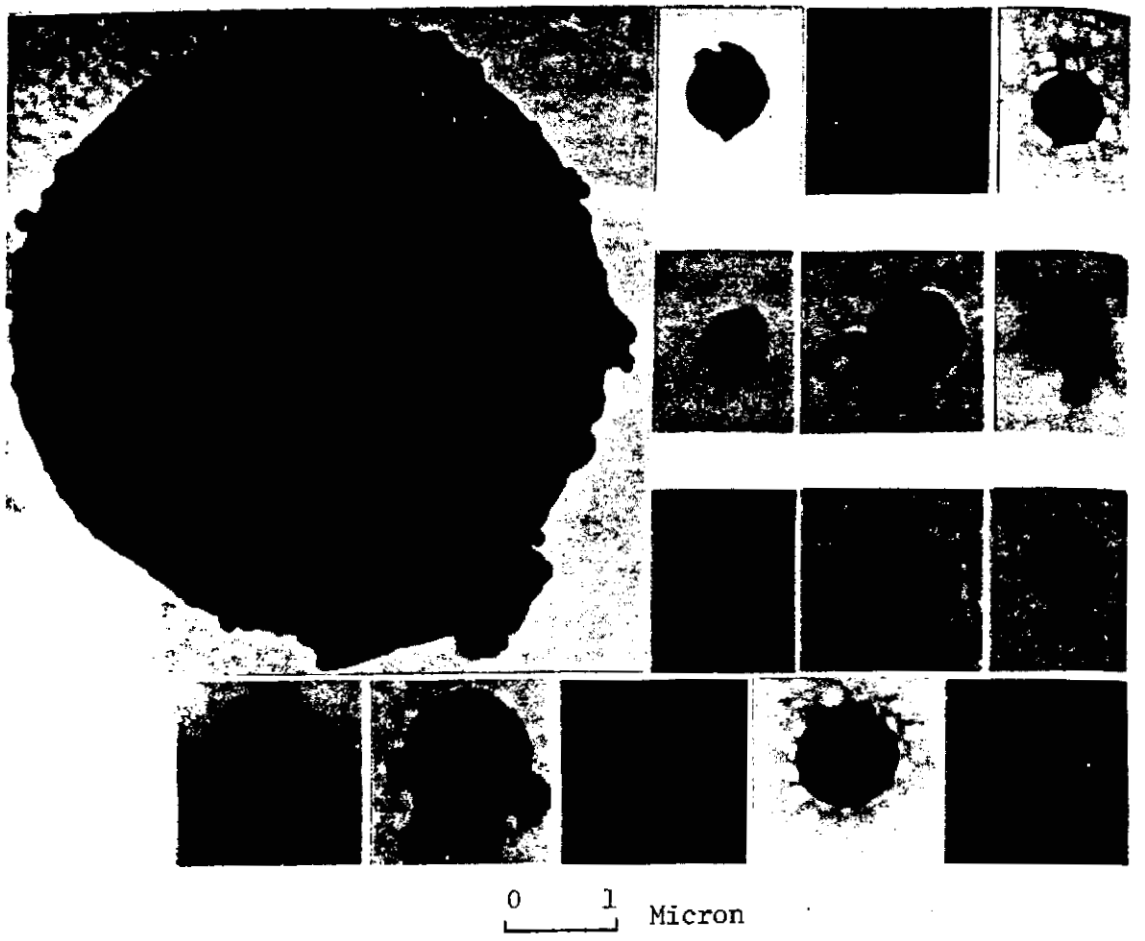
Figure 3.34 Electron micrograph, Double Tracks, Casella impactor.



Stage 4 0 1 Micron

2724 Stage 5 Arc H-064 0 1 Micron

Figure 3.35 Electron micrograph, Double Tracks, Casella impactor.



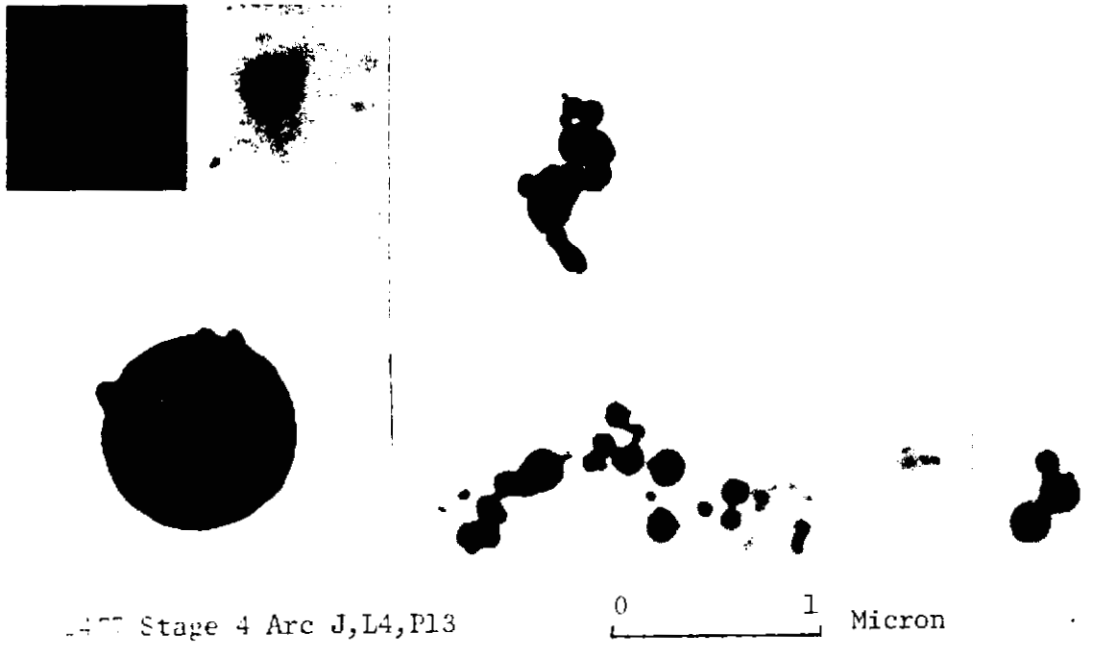
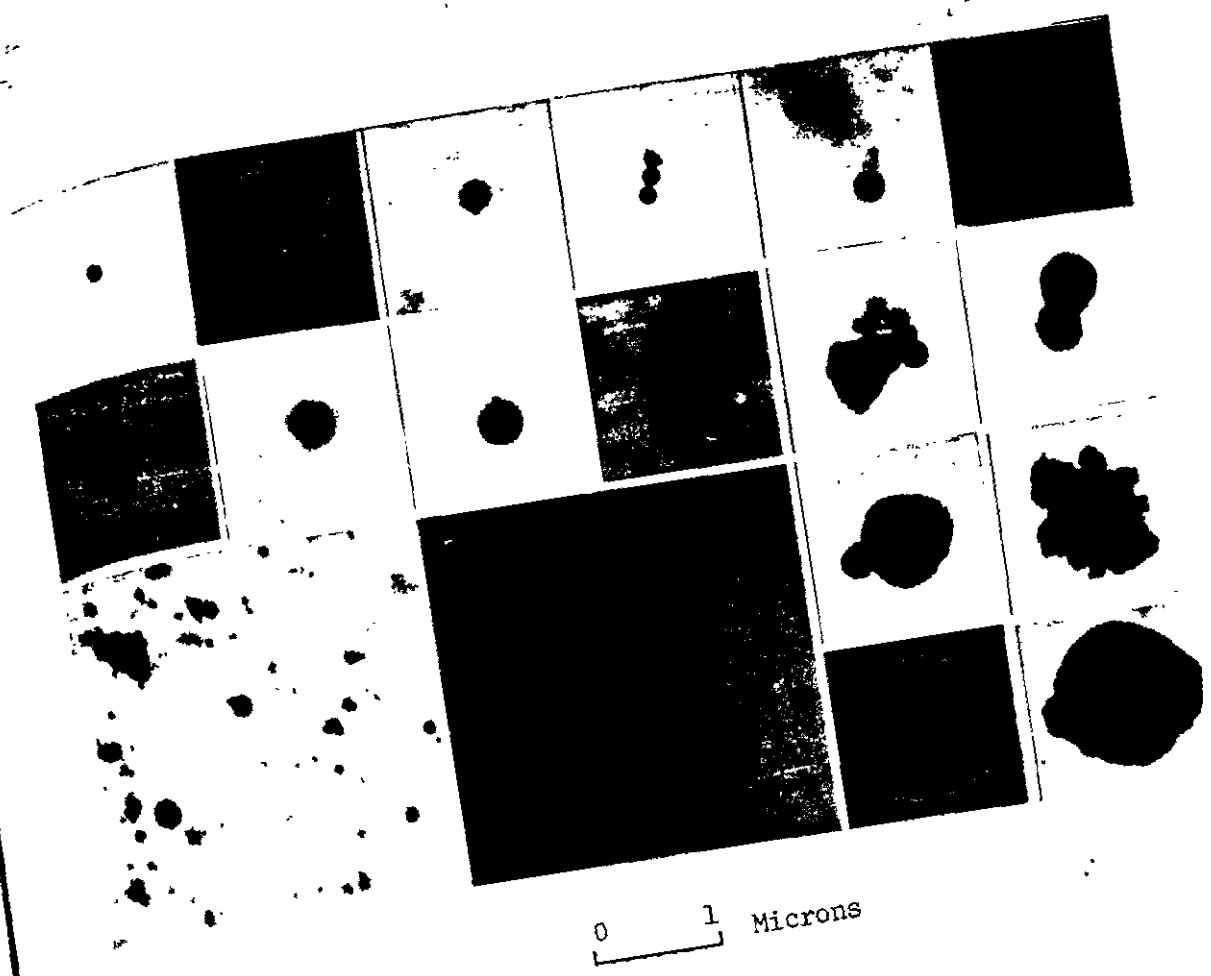
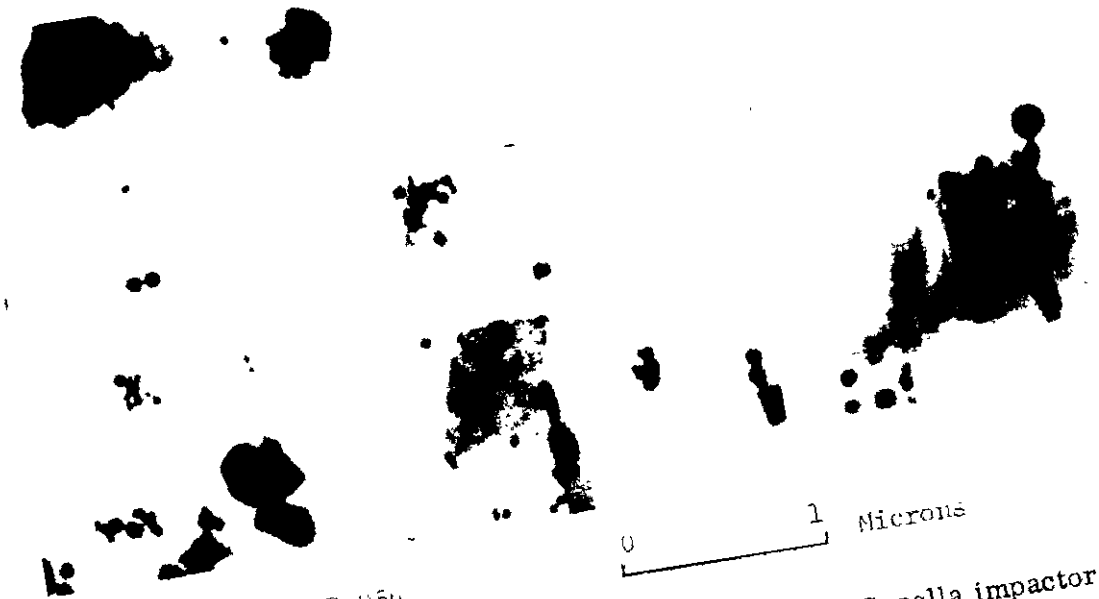


Figure 3.36 Electron micrograph, Double Tracks, Casella impactor.





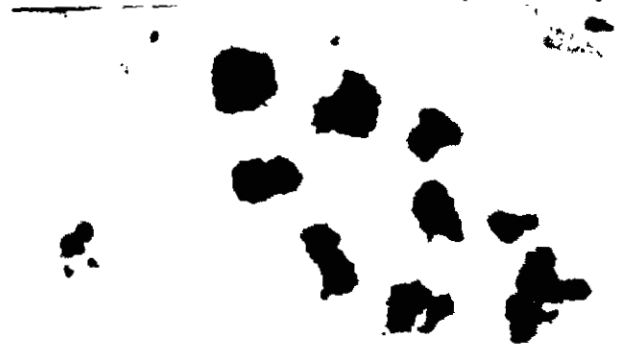
2047 Stage 2 Arc R-056

Figure 3.37 Electron micrograph. Double Tracks, Casella impactor.

0 10 Microns

0 5

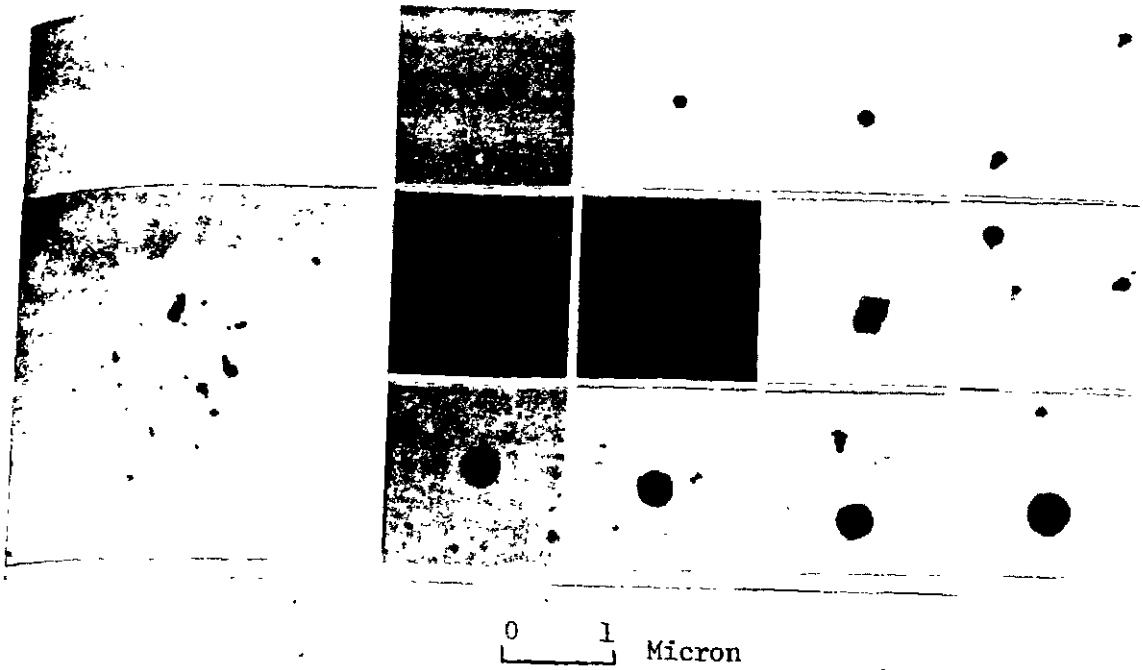
Microns



2947 Stage 4 Arc R-056

0 1 Micron

Figure 3.38 Electron micrograph, Double Tracks, Casella impactor.

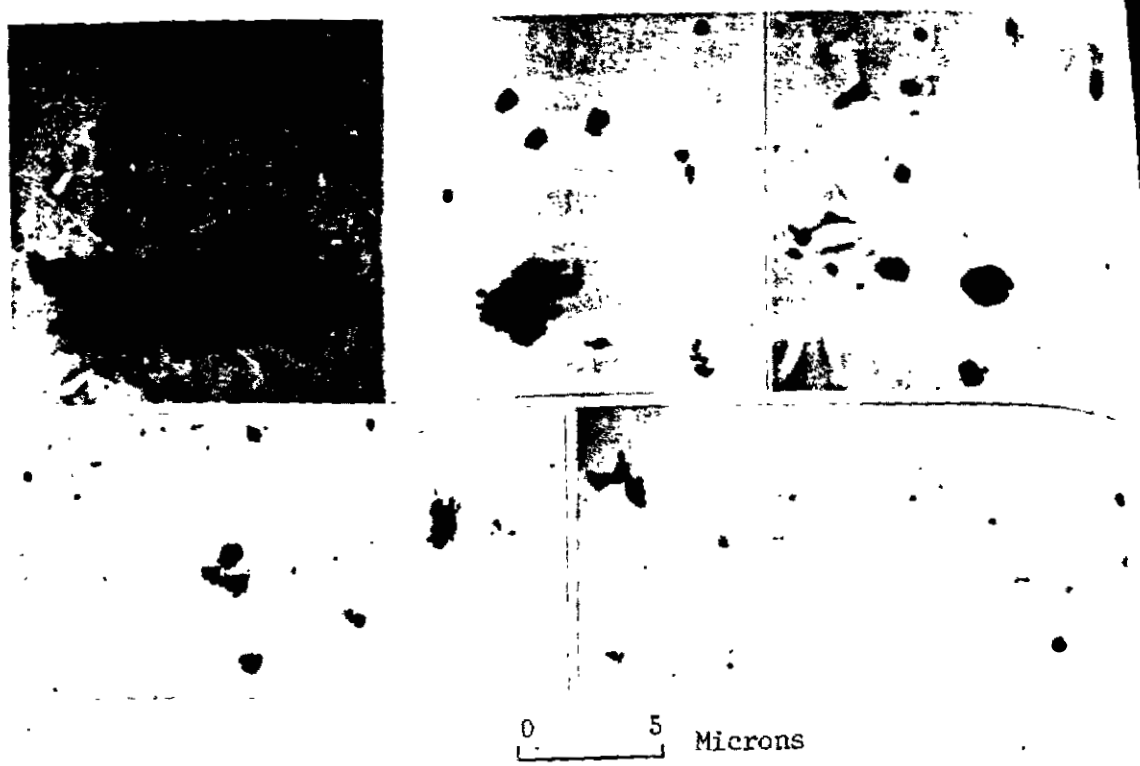


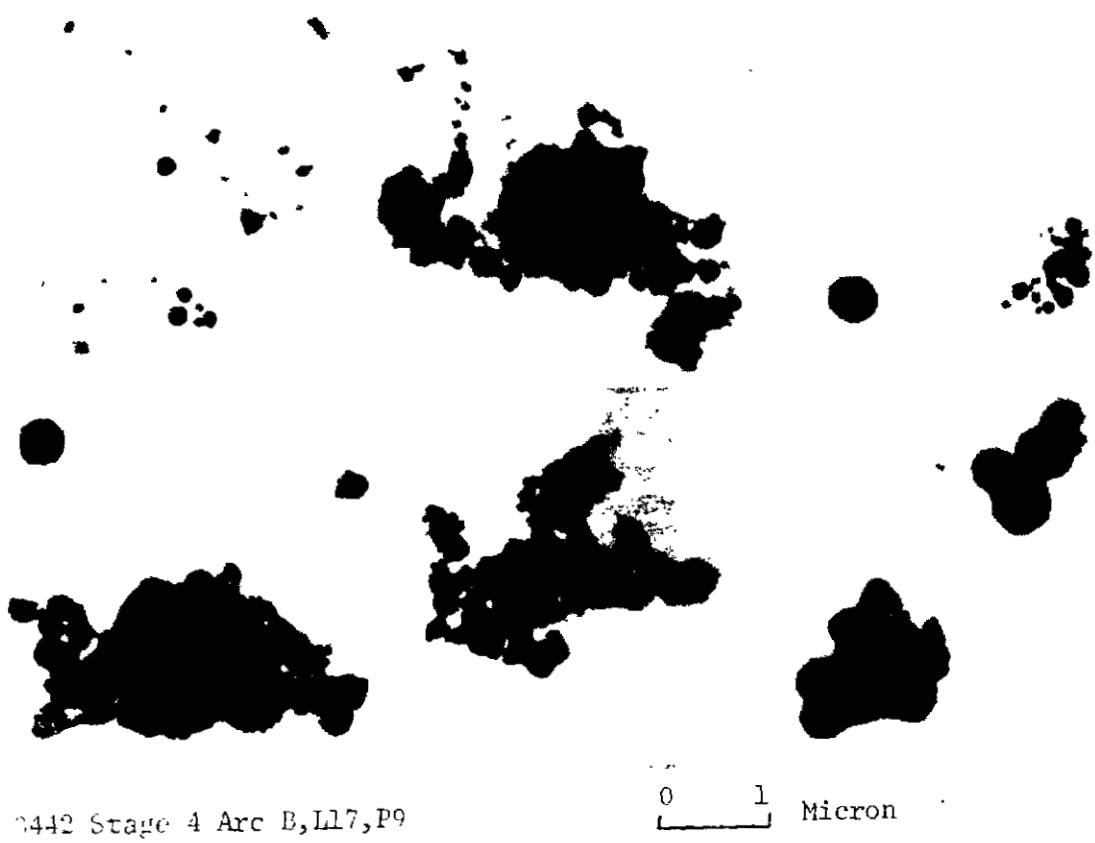
2527 Arc A-072

0 1 Micron

Particles from back-up membrane filter only.

Figure 3.39 Electron micrograph, Double Tracks, total air sample.





3442 Stage 4 Arc B,L17,P9

Figure 3.40 Electron micrograph, Clean Slate I, Casella impactor.

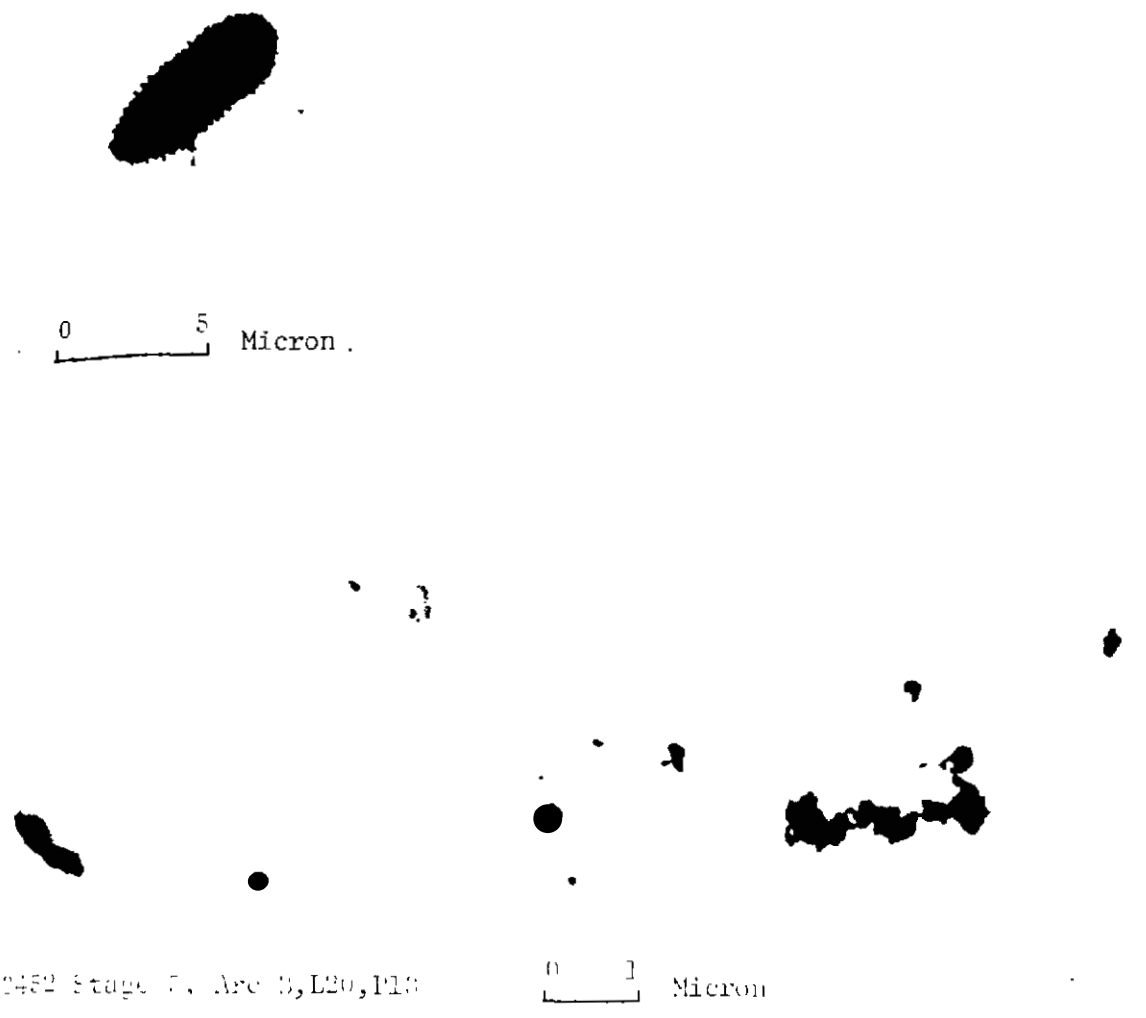
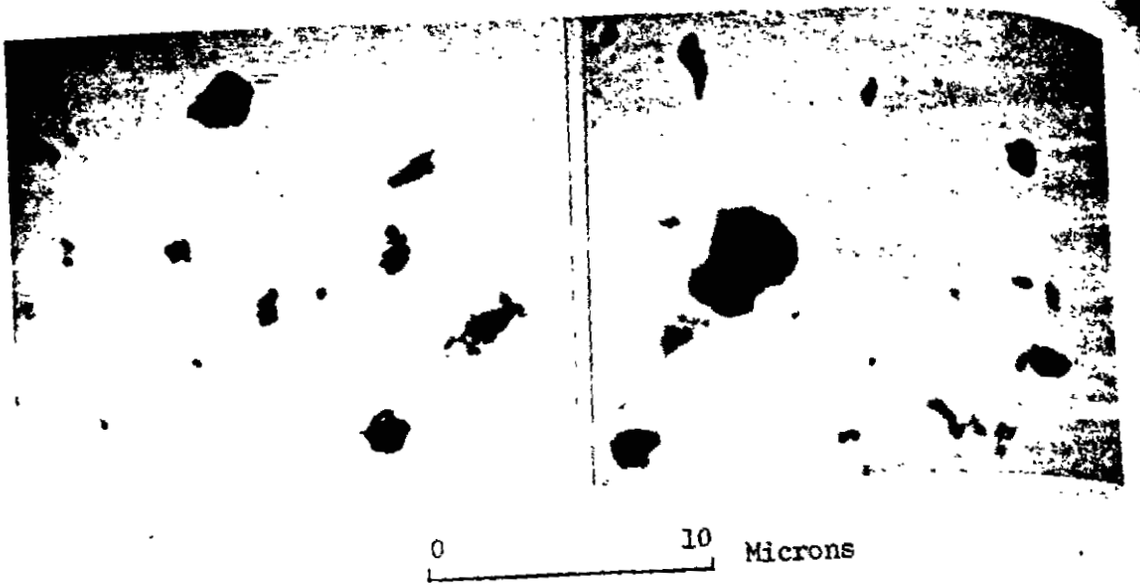


Figure 3.41 Electron micrograph, Clean Slate I, Casella impactor.



2272 Stage 4, BM-06

Figure 3.42 Electron micrograph, Clean Slate II, Casella impactor.

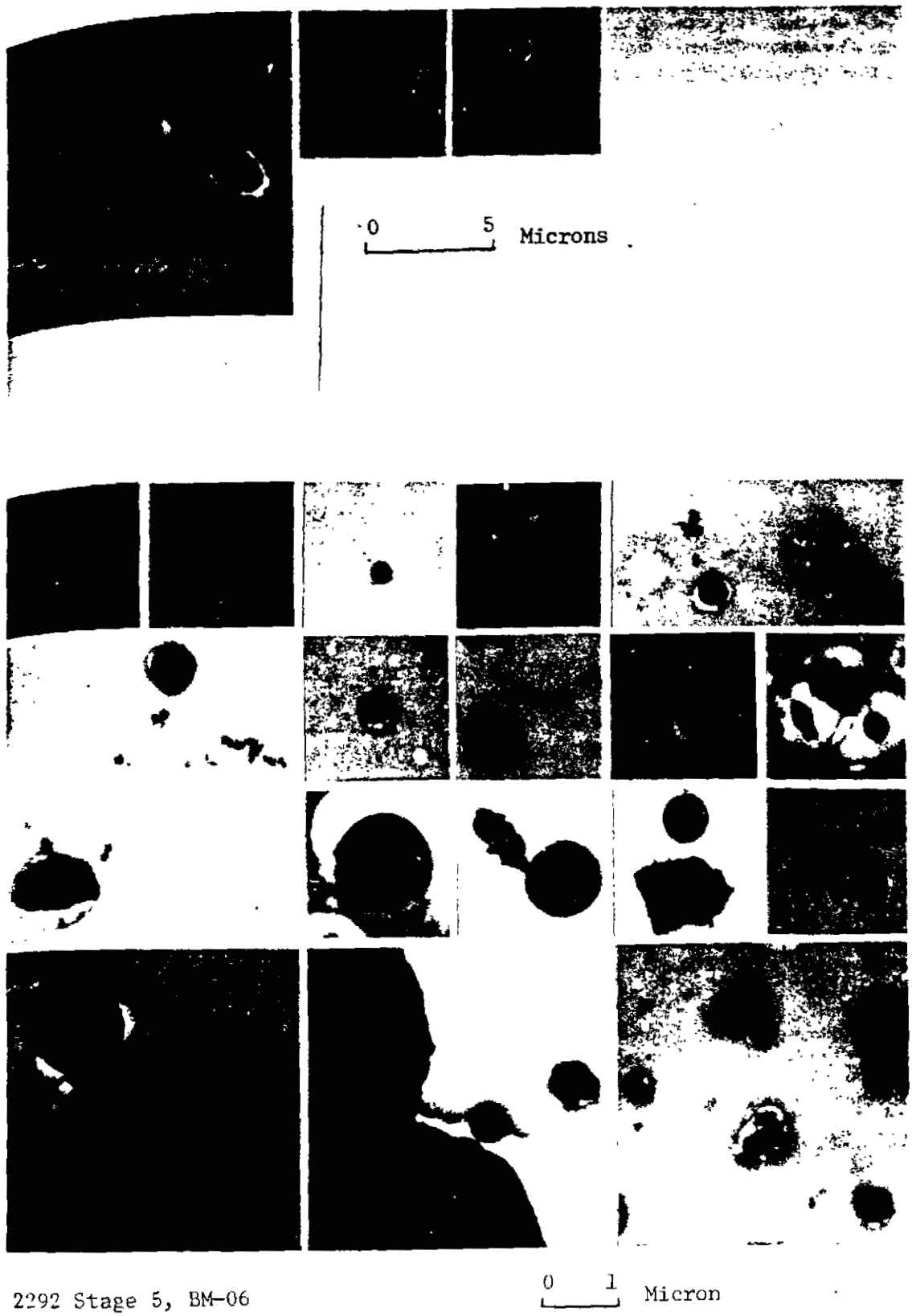


Figure 3.43 Electron micrograph. Clean Slate II, Casella impactor.

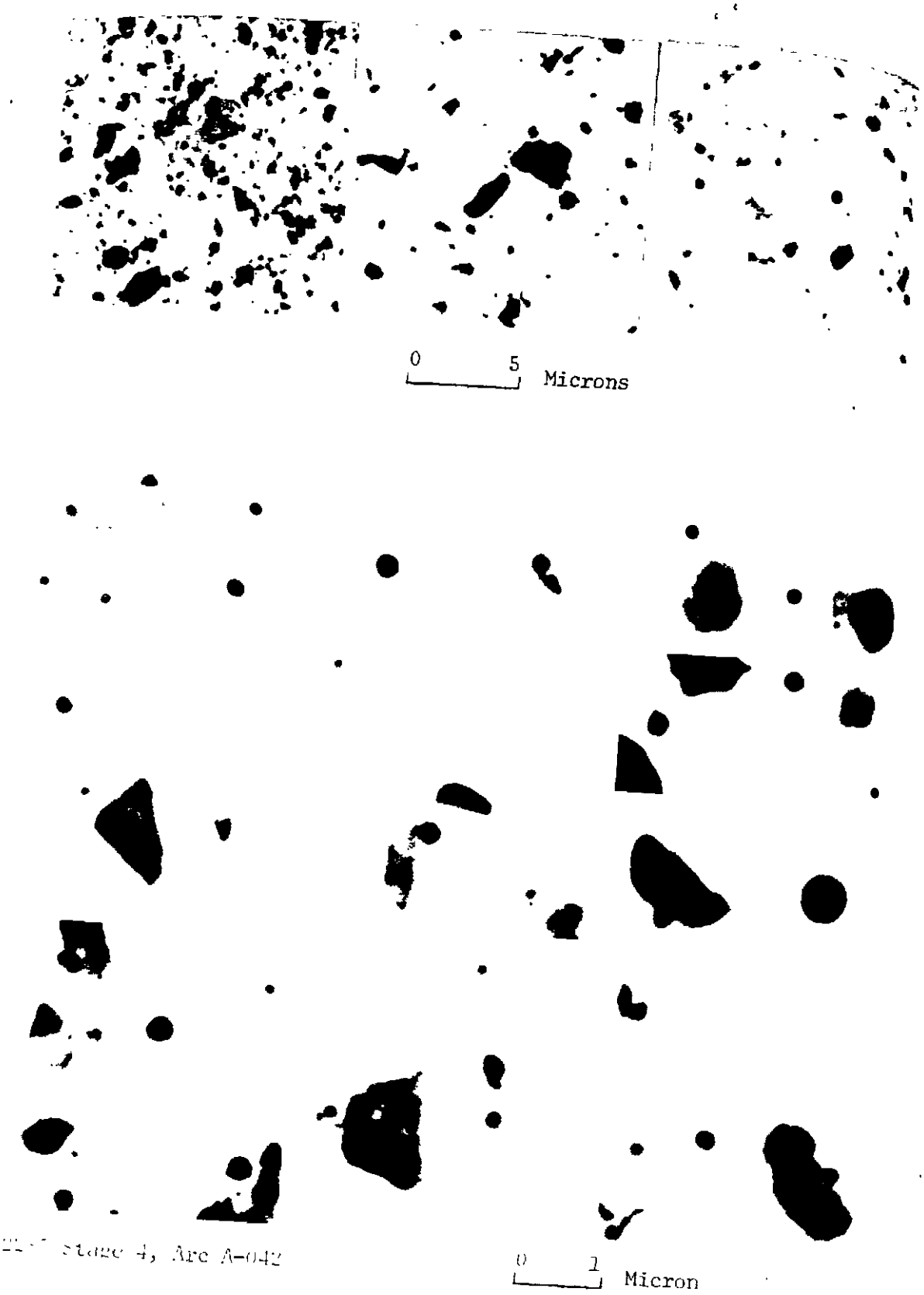


Figure 3.44 Electron micrograph, Clean Slate II, Casella impactor.

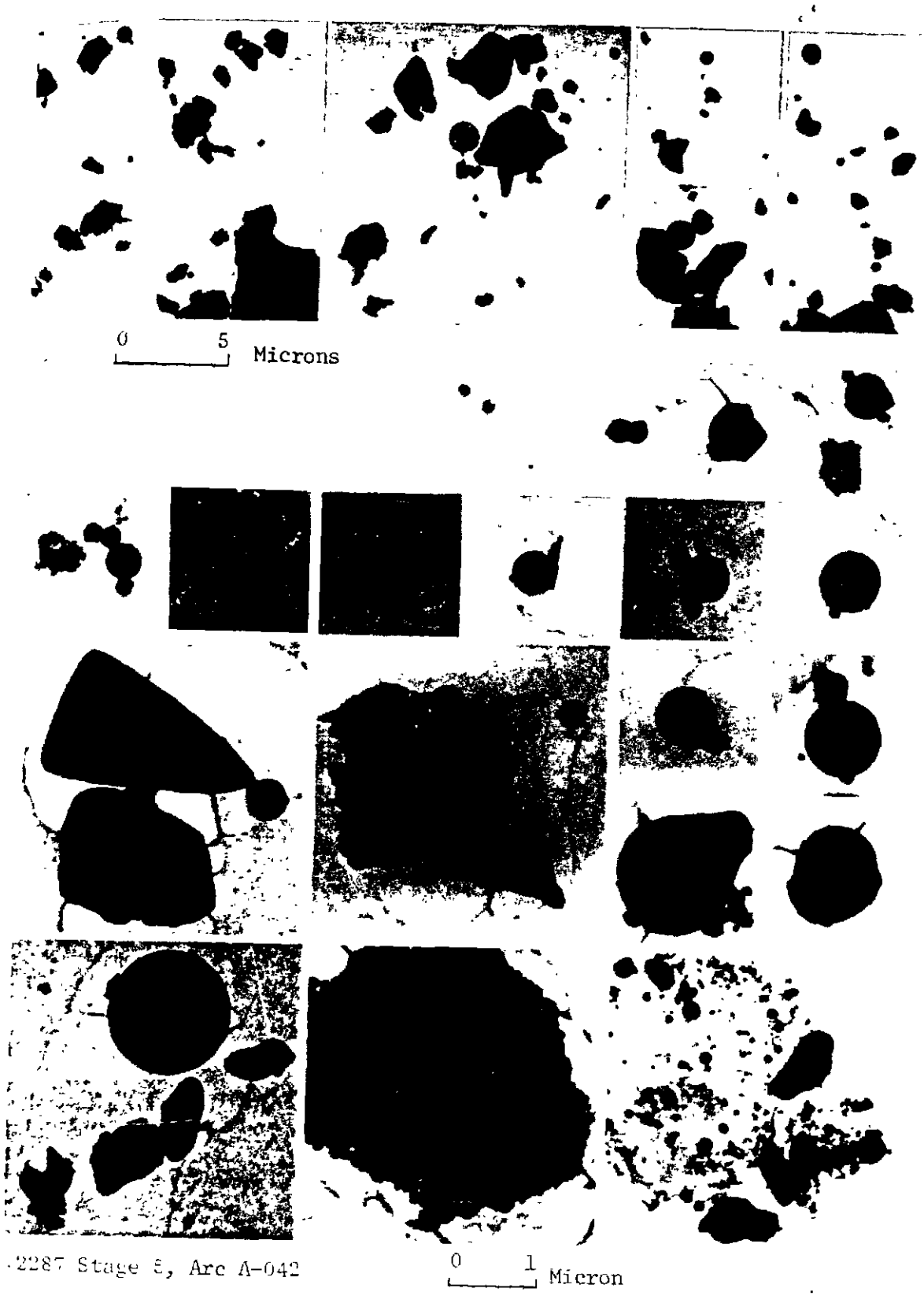


Figure 3.45 Electron micrograph, Clean Slate II, Casella impactor.

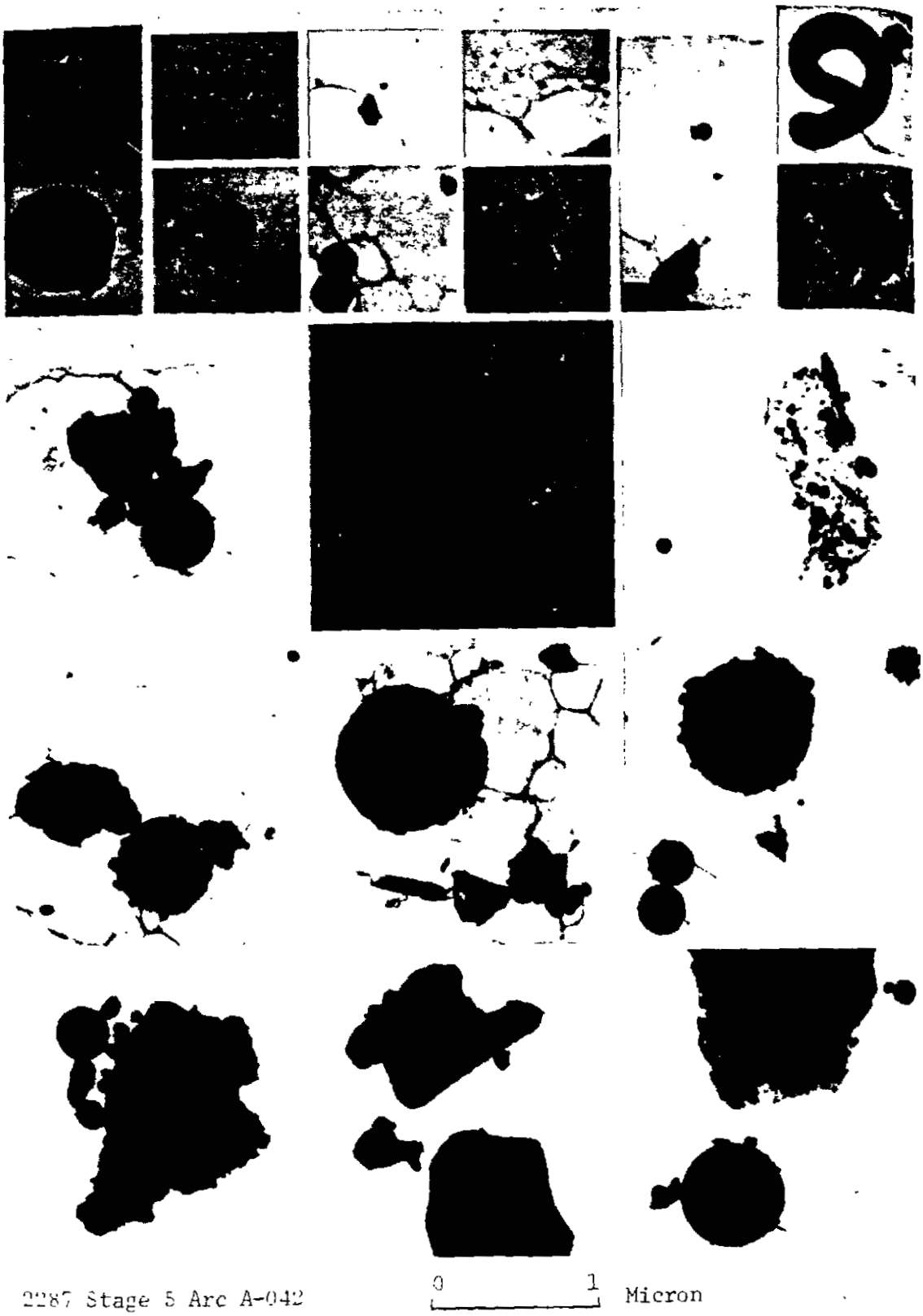
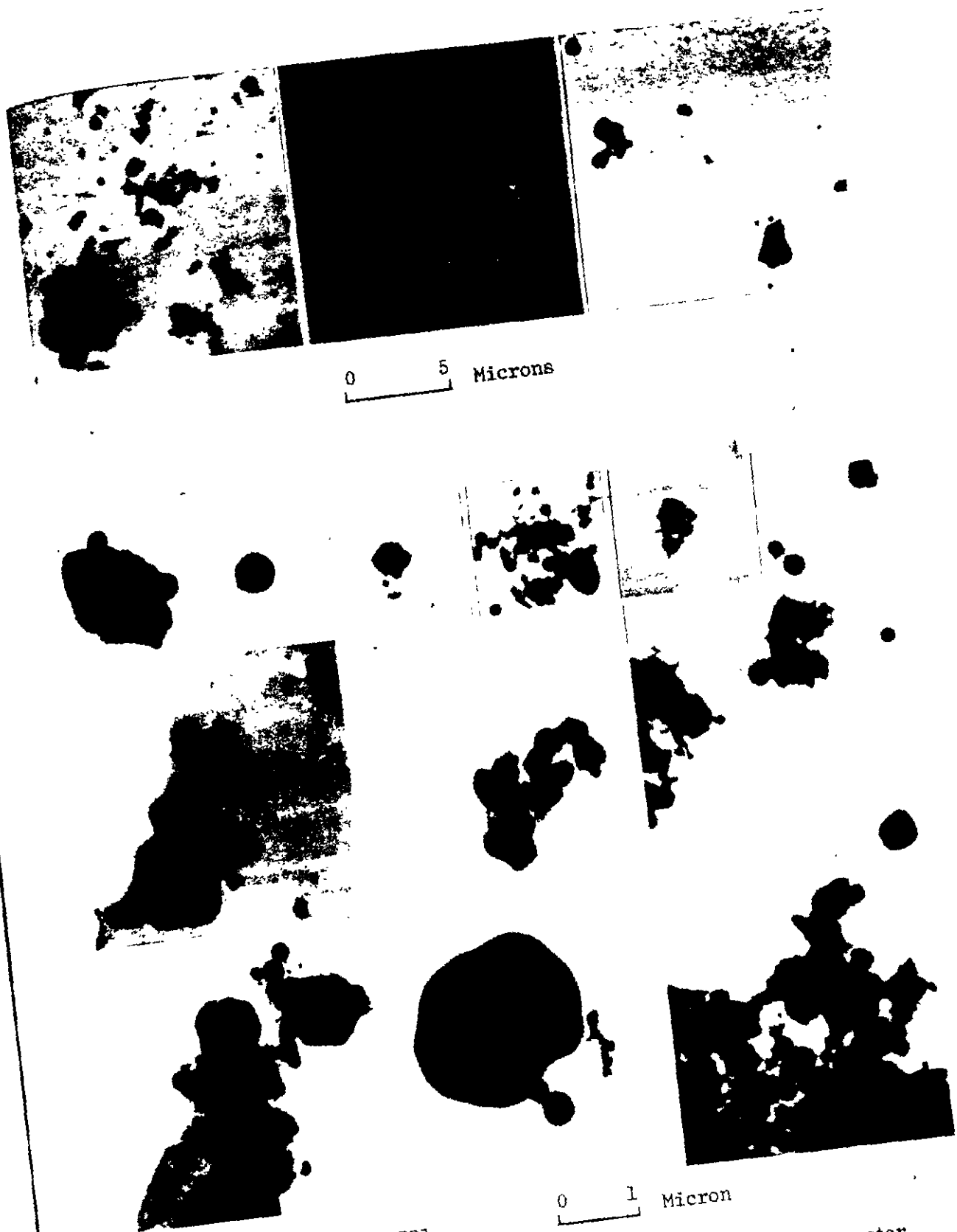
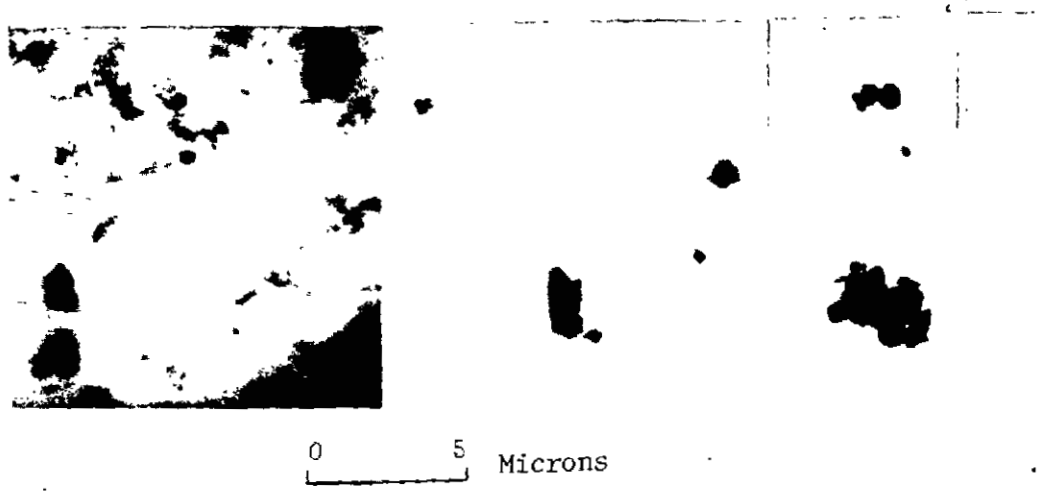


Figure 3.46 Electron micrograph, Clean Slate II, Casella impactor.



2309 Stage 4 Arc B,L2,P21

Figure 3.47 Electron micrograph, Clean Slate II, Casella impactor.



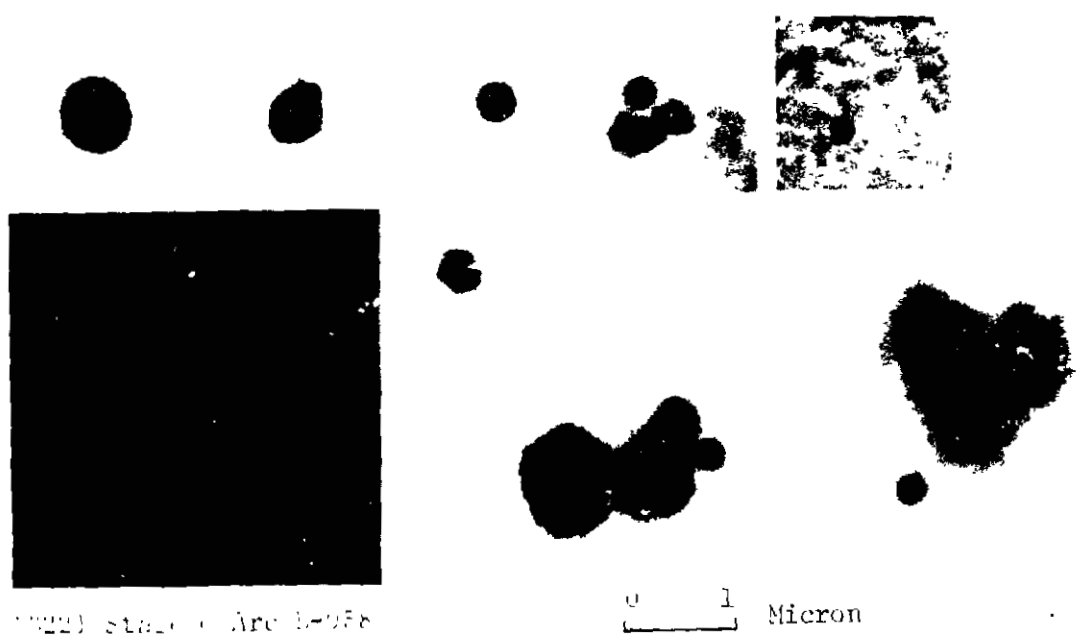


Figure 3.48 Electron micrograph, Clean Slate II, Andersen impactor.

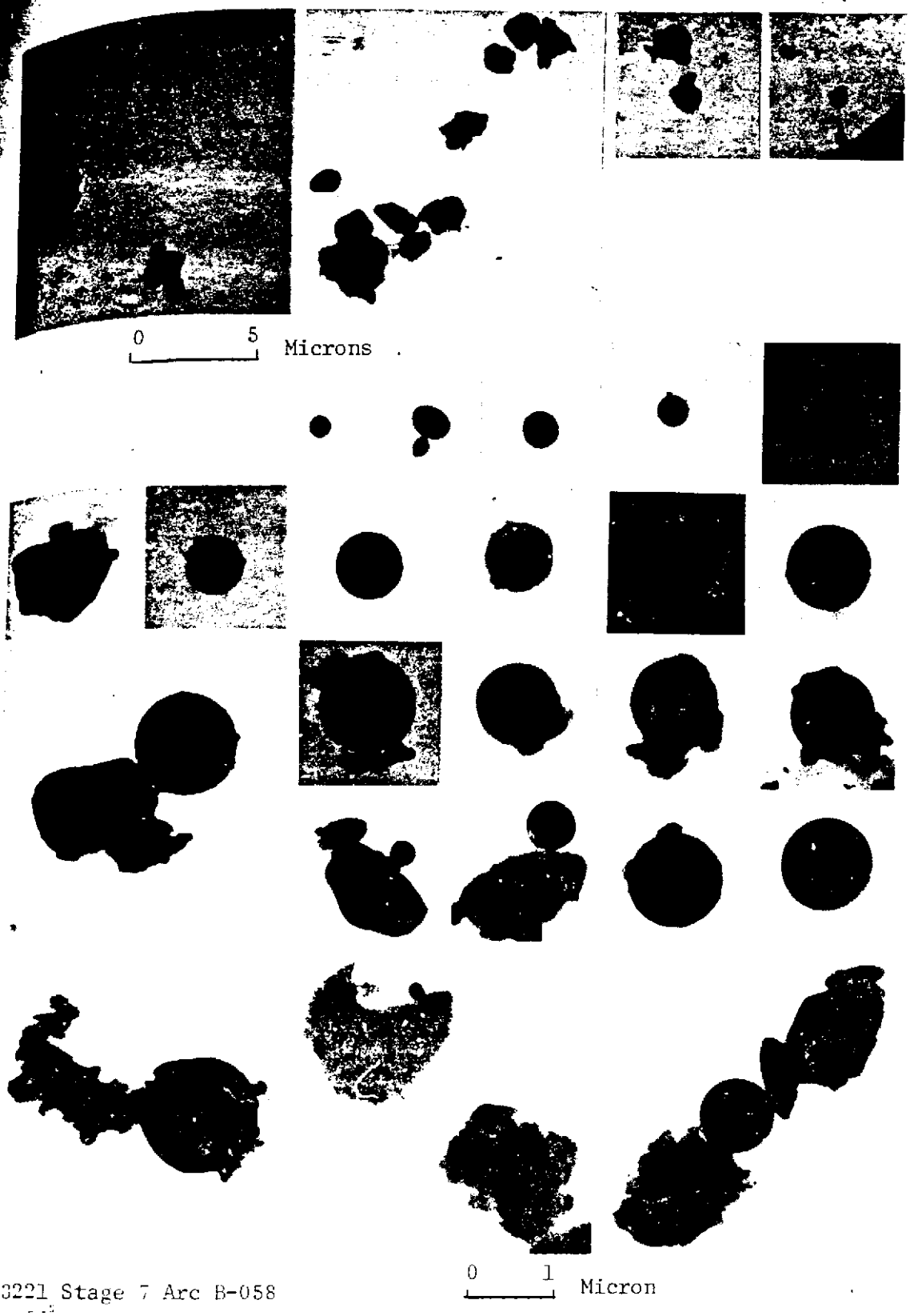
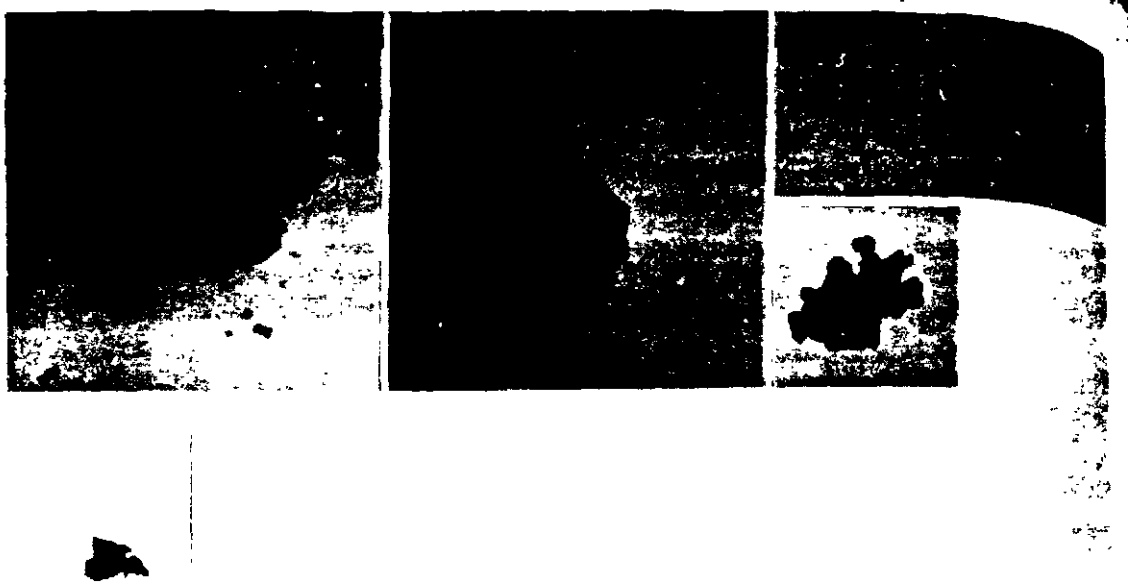


Figure 3.49 Electron micrograph, Clean Slate II, Andersen impactor.



Stage 3

Collected at
Arc I-054
Clean Slate I
Array

Casella Impactor 2558 Stage 4

0 5 Microns

Figure 3.50 Electron micrograph, preshot air-borne particles.

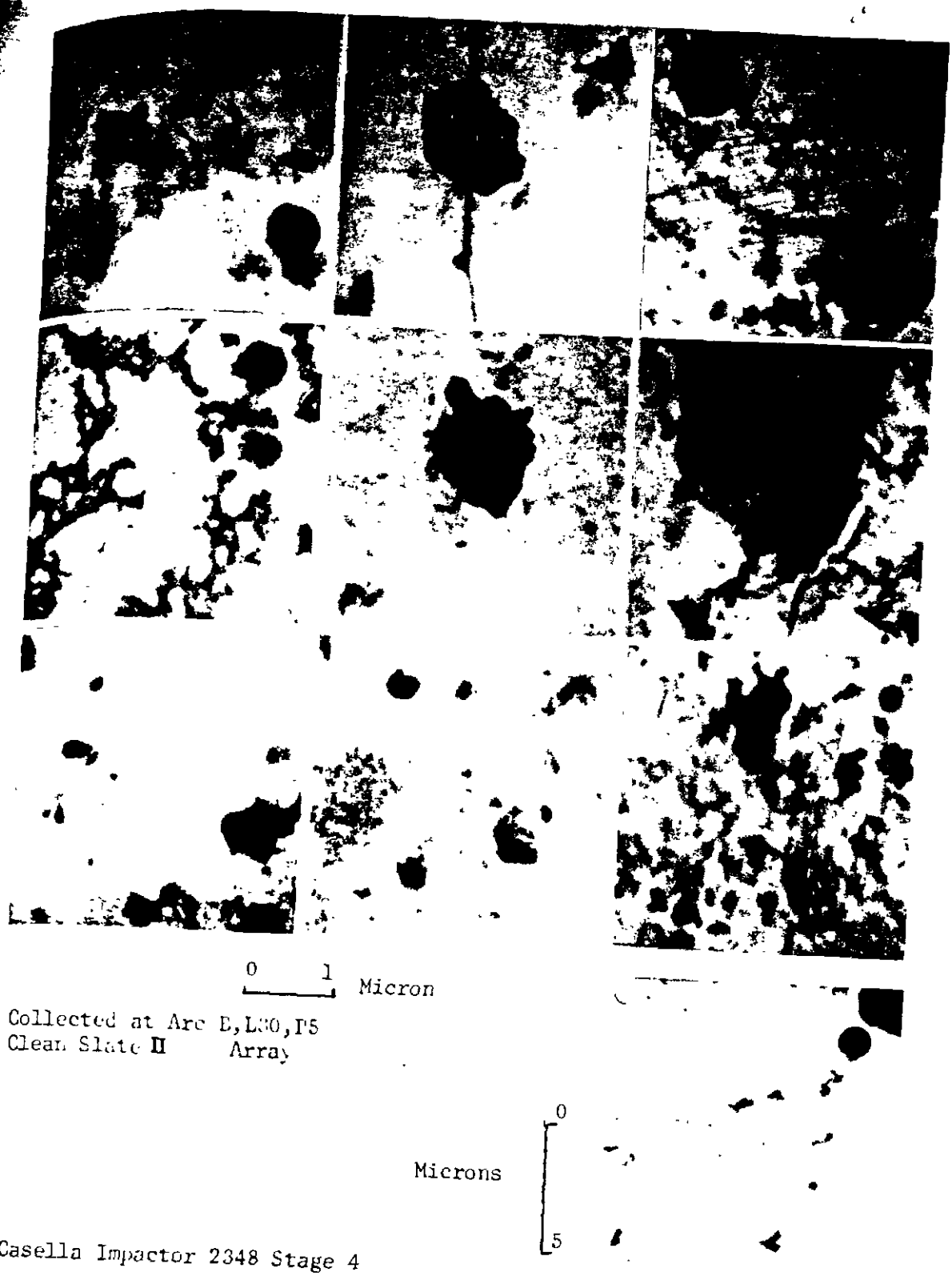
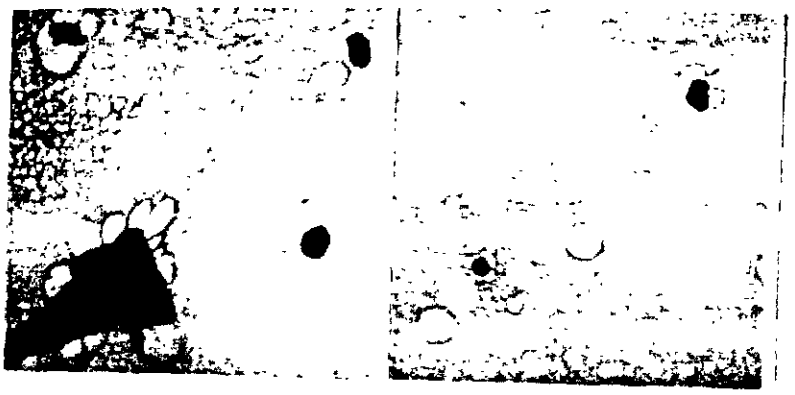


Figure 3.51 Electron micrograph, background air-borne particles.



0 5 Microns

Collected at
Arc B,L30,P5
Clean Slate II
Array

Casella Impactor 2348 Stage 5

0 1 Microns

Figure 3.52 Electron micrograph, background air-borne particles.

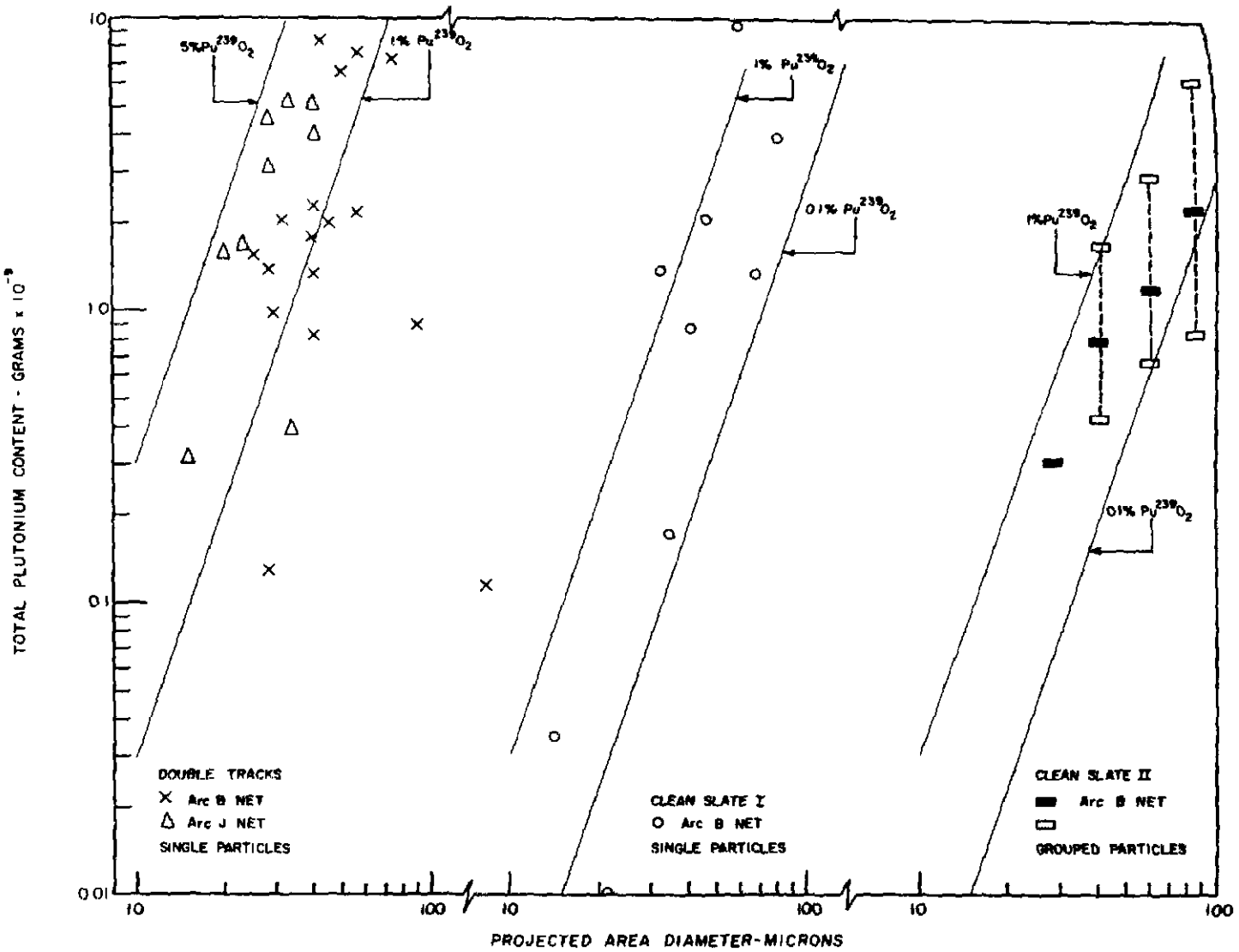


Figure 3.53 Total plutonium content versus particle size.

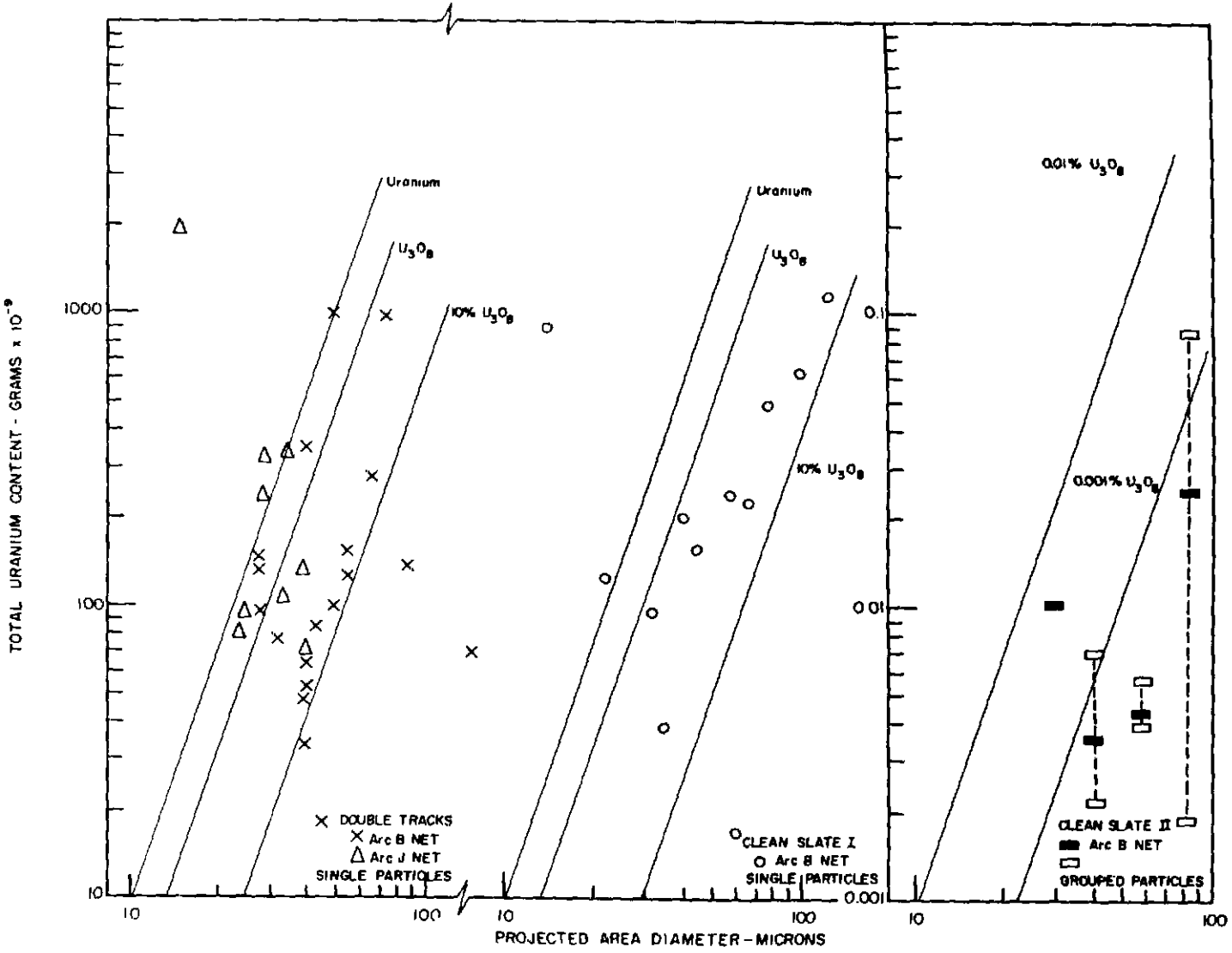


Figure 3.54 Total uranium content versus particle size.

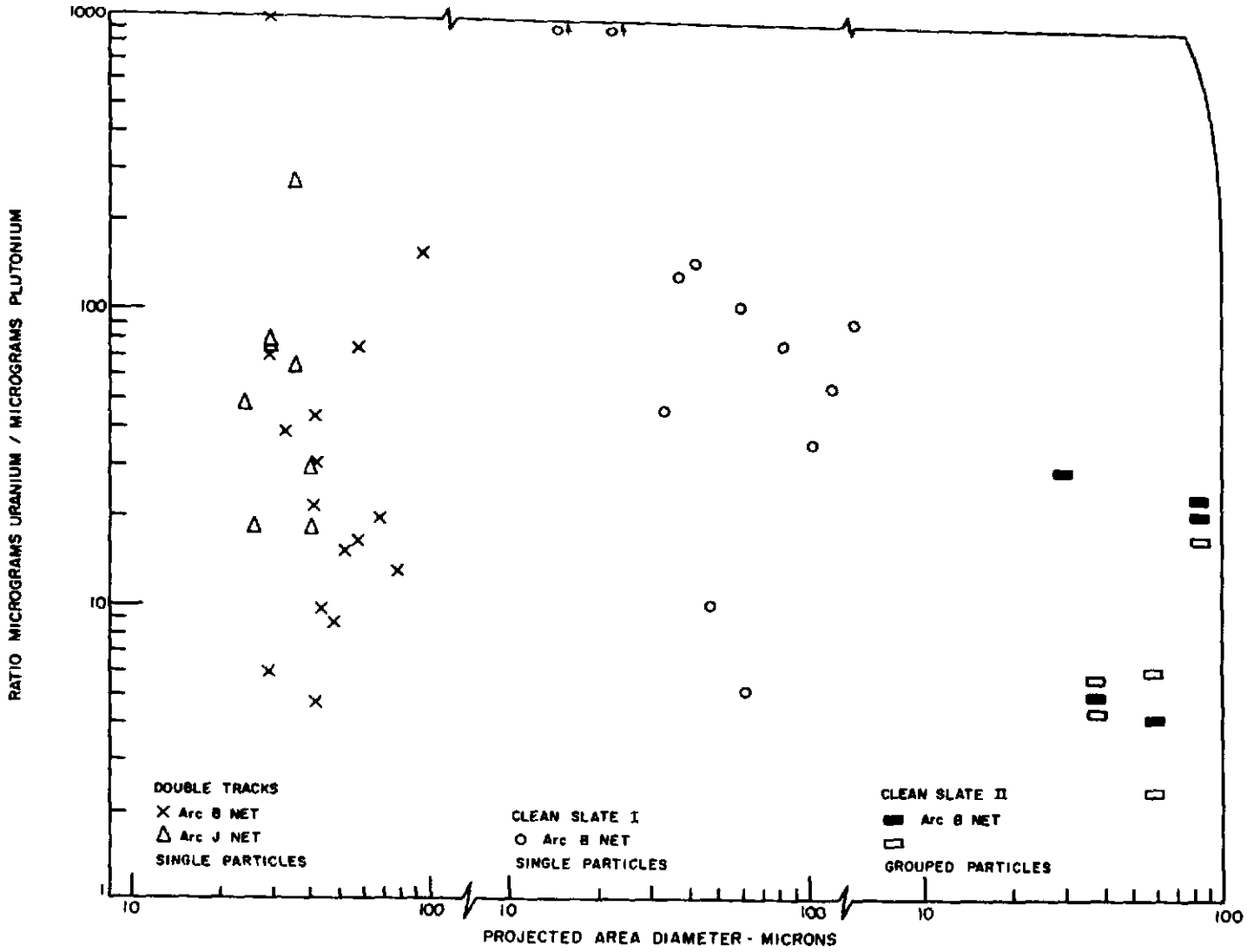


Figure 3.55 Ratio micrograms uranium/micrograms plutonium versus particle size.

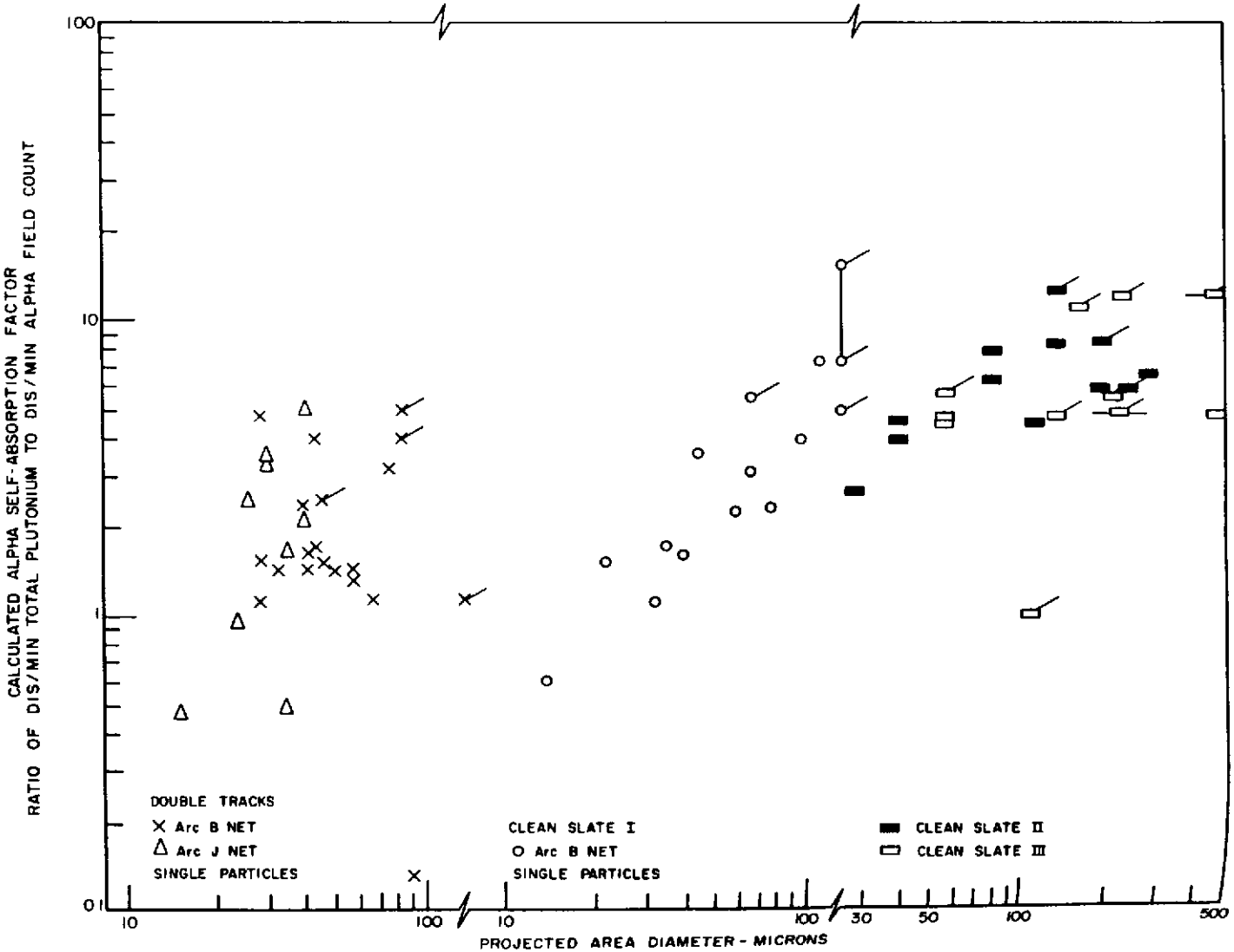


Figure 3.56 Calculated alpha self-absorption versus particle size.

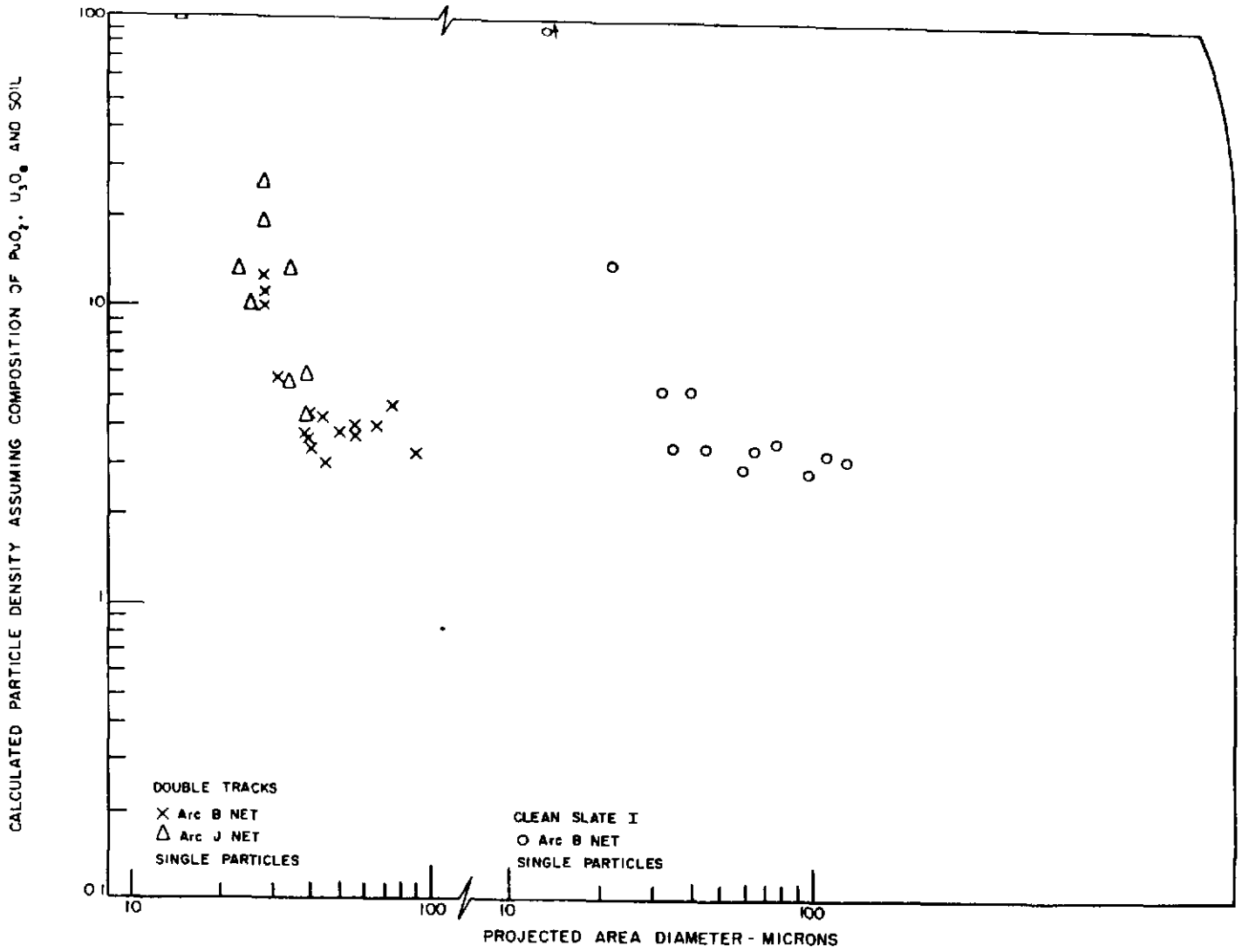


Figure 3.57 Calculated particle density versus particle size.

CHAPTER 4

DISCUSSION

The complex environment attendant to the detonations of Operation Roller Coaster resulted in the production of many and complex types of particles. It was the purpose of Project 2.6 to provide experimental information concerning the nature of the particles produced in the Roller Coaster events. It is not within the scope of this work to interpret the data in detail. It is felt, however, that the data reported in this project are better understood by reference to some recently reported laboratory experiments with materials similar to those involved in Roller Coaster.

Reference 19 describes laboratory experiments on the oxidation of plutonium under various atmospheres and temperature cycling. A few observations are summarized below without attempting to describe the experiment completely. Humid conditions produced yellowish surface and yellow oxide layers a few microns thick. At 123°C, delta alloy exhibited a stepwise oxidation process. A dark brown oxide layer formed which ruptured periodically due to the unit cell expansion required for transition from δ Pu to δ PuO_2. Pure beta phase metal produced an amorphous yellow green oxide (brown in experiment) at a continuous rate and broke down into particles with diameters $\leq$ 3 microns. After the ignition temperature was reached, both β and δ metals melted, oxidized rapidly, crumbled upon cooling, and gave rise to sparking. Brown needle-shaped crystals, 50 to 300 microns in size, were observed as well as smaller

amorphous particles. After cycling as high as 1000°C, large sintered amorphous fragments were observed. Delta metal turnings became covered with black oxide of sintered amorphous particles. Oxygen produced spontaneous ignition of 1 gram of turnings at 225°C. Greenish oxide smears were observed. Quenching of the ignition reaction (approximately 500°C for δ' metal, 400°C for pure metal) by rapid cooling in nitrogen formed a hard scale on the δ alloy.

The observations in Tables A.5 through A.8 indicated very few yellowish particles which were active. Brown or amber particles were very common in all sizes. No needle-like brown crystals were observed. A few sliver-shaped black particles were observed on close-in samples, but these were very rare. Some black flaky material had been observed on samples but was rarely found to be active when checked by alpha counting. Black or dark gray particles were common. Smooth particle surfaces were predominant for the Roller Coaster particles. The hard scale observed for rapid quenching of ignited plutonium gives support to conclusions that some particle data suggested content of unreacted plutonium.

Reference 21 describes laboratory generated spherical particulates of plutonium dioxide, uranium dioxide, and mixtures, produced in sizes as small as 10 microns diameter. The crystalline microspheres showed only a few crystallites per particle. Spheres larger than 50 microns were opaque: spheres smaller than 50 microns were amber. Small vapor voids in the particles reduced the bulk density from 11.45 to 11.0 gm/cm^3. The spheres were stable in air and did not give leaching of Pu after 14 days in 1N acids and 6N basic solutions. Hardness was between 7

and 8 on the Mohs[1] Hardness Scale (7 = quartz, 8 = topaz). Uranium dioxide spheres were black when larger than 50 microns and transparent red when smaller than 50 microns. Spheres of PuO_2 - UO_2 mixture containing up to 60 percent UO_2 by weight were black throughout their cross section. ThO_2 spheres were transparent below 80 microns diameter and translucent white in larger sizes. PuO_2 - ThO_2 spheres were translucent to transparent yellow. ZrO_2 spheres were white. PuO_2 - ZrO_2 spheres were various shades of green. Black spheres tended to indicate oxygen deficiency in the particles. All materials were free from loose surface contamination.

These results can explain the amber and brown (straw color in very small sizes as seen in Figure 3.23) particles observed in Roller Coaster samples. Red particles were observed on occasion in the Roller Coaster samples, but they were not plutonium-bearing spherical particles. Table A.15 shows that the 200-micron-diameter sphere which had a U metallic crystalline phase was black. Active green or white particles were not observed.

In Reference 22, plutonium dioxide was dissolved to 15 percent by weight in complex silicate glasses (approximately 5 percent Al_2O_3, 5 percent CaO, 15 percent Na_2O, 5 percent K_2O) at 1650° C. Spheres as small as 10 microns were produced and were transparent green color. Incorporation of up to 20 percent was achieved using sodium silicate glass and up to 30 percent by working at higher temperature; however, upon cooling the PuO_2 was observed to crystallize as perfect cubes, with voids on each face, and encapsulated in glass. Hygroscopic glasses and glass rods produced at low temperatures were prone to produce loose plutonium at their surface after a few days. Leaching for 19 months

showed < 1 percent of total NuO_2 had leached in water, and very low leaching was observed for several months in 0.1N HCL and 0.5N HNO_3. For apparent glass density of 2.5 gm/cm^3, addition of 5 percent PuO_2 raised it to 2.6 gm/cm^3, and 10 percent raised it to 2.7 gm/cm^3. Glass fibers of this material retained their initial appearance after 2 years, but reduced tensile strength was observed after 5 months.

The above results are compatible with the amounts of plutonium listed in Table A.15. Transparent spheres of light green were observed, but most of the transparent spheres were clear or of straw color indicating higher percentages of Pu. The color of the micron-size spheres was difficult to determine due to optical effects but probably included the glassy type particles. The encapsulation of PuO_2 in clear glass explains the similar observations in Roller Coaster particles.

The stability of the glasses and oxide spheres was of interest in considering the long range or biological hazard of Roller Coaster particles.

The more complex large particles observed in Roller Coaster were similar to particles described below. Reference 23 describes falling molten zirconium particles which produce sudden swellings or explosions during the cooling cycle. The explosion was attributed to the release of gas into the molten material as the exterior begins to solidify. Reference 24 shows spherical particles thought to be composed of extra-terrestial material. Included are spheres from welding operations. The shape and surface textures bear striking resemblance to the Roller Coaster particles.

The Roller Coaster data indicated a wide range of particle densities and activity contents. For Double Tracks the particles with

high densities which suggest U or Pu compositions may have been produced during the terminal phase of the jetting action of the event. Particles of PuO_2, UO_2, and mixtures may have been formed by direct condensation from the well mixed portion of the cloud. Particles with a glassy matrix may have been produced by interaction with soil suspended due to turbulence and reflected shock waves. For Clean Slate I the lower content of plutonium and uranium indicates that further incorporation of soil and concrete had occurred. The sharp reduction in activity for the Clean Slate I and II events and the particle appearance indicates that many of the finer particles had been incorporated into much larger, but more frangible, and less dense particles. Some material which vented the bunker doors probably resulted in particles similar to the Double Tracks and Clean Slate I varieties. The data for submicron size particles indicated strongly that the full range of particle compositions observed for larger sizes extended into the submicron size range. It is obvious that many mechanisms of particle formation were operable even in the simplest case, Double Tracks.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

The active particles indicated evidence of high temperature history by smoothed surfaces, bubbles, and hollow particles. The occurrence of glassy particles, inclusions, and surface attachments were evidence of complex composition.

A wide range of activity was observed for a given particle size. Radiochemical analysis indicated that some particles of very high percentage of plutonium or uranium were formed. Density estimates and activity contents confirmed this. The majority of particles had plutonium oxide contents of less than 20 percent for Double Track and less than 1 percent for Clean Slate. The ratio of uranium to plutonium showed wide variation for a stated particle size in all events.

Compositional analysis indicated that for larger particles the elements Fe, Al, Ca, Si, and K were present in sizable percentages. The U and Pu was observed as U, PuO_2, UO_2, UO_2-PuO_2, U_3O_8, and UO crystalline phases in the particles examined. Crystalline edges were noted in electron micrographs, indicating that some submicron particles may have been single crystallites of one of the crystalline materials.

Particle density estimates as high as 19 and lower than 1 were obtained from the size data for impactors and from the ratio of U/Pu in individual particles. A decrease in density with increasing particle size was noted for particles larger than 14 microns. Self-absorption factors calculated from alpha count rate and plutonium analysis (or crushed particle counting) were generally < 12. One black particle, 189μ in diameter, gave a factor of 47. The high density

values estimated for submicron spheres were given credibility by some estimates of compositions equivalent to pure $Pu^{239}O_2$ or Pu^{239}. The ratio of U/Pu showed a trend to high values for the later impactor stages, so that high density spheres may have contained uranium as well as plutonium. Thus, the exact composition of the submicron particles is not known but observations suggest that a wide range of activities persisted to sizes as small as 0.6 micron.

The size distribution of particles with d > 2 microns for Double Tracks and Clean Slate I events was determined from the particulate data and indicated a nearly log normal distribution of ρd^2 versus cumulative mass of plutonium.

Inactive particles were present on samples from all events. For Double Tracks the ratio of inactive/active in the main cloud was on the order of 10.

Sampler operation was variable. Casella Impactor data appeared to be more reliable than the Andersen data. Some Casella Stages 1 and 2 indicated severe departure from the expected location of the deposit. This may have resulted in variable plate-out on internal surfaces of the device. Large particles were sometimes found on Stages 3, 4, and 5. The net result of these 2 observations may be that the accountancy values derived from impactors may be somewhat low and the mass of respirable plutonium overestimated. Loose active particles were found in the containers for Total Air Samples (Disposable Type) and Cylindrical Collectors and Deposition Discs. The deposition Glass Slide samples gave reasonably representative samples along the hot line.

The following items are recommended.

The phosphor autoradiograms were of variable quality due to limitation of the degree of contact covered by the three largest particles on the sample. A flexible film is recommended. The technique was extremely useful as a survey tool.

Nuclear track autoradiography was not practical for estimating the activity of particles larger than approximately 5 microns. Calibration of the heavy track patterns and evaluation of latent image fading should be given greater emphasis in future work of this type.

Electron microscopy was seriously hampered by the form of sample surface and the high ratio of inactive/active particles. Future efforts should include a high volume impaction device which would permit obtaining sufficient submicron material to perform X-ray diffraction analysis and electron microprobe scanning directly on the specimen. Electron microscopy of Stages 3, 4, and 5 of Casella MK II impactors is required. Preliminary research on the use of electron diffraction and electron microprobe analysis of single particles in the size range 0.1 to 10 microns is recommended.

Preliminary research in strippable films and adhesive coatings is recommended as well as a method of obtaining uniform thickness sticky coating on the glass surface. Shipping containers which guarantee zero contact with the specimen and maintain sticky surface in an upright, horizontal position are strongly recommended for all types of special particulate samples. Special shipping containers which provide adequate anti-vibration and shock mounting are recommended especially for glass

samples and sticky wire type samples.

The use of a computer program to print out particle data and analyze data by statistical methods is recommended. The reporting of microscopic data directly to a key punch operator would reduce data handling time significantly.

The following orders of priority of analysis are suggested:

1. Obtain the population density of deposition samplers to guide soil analysis work. Some sticky paper samples should be recovered in special containers and prepared for phosphor autoradiography at the test site.
2. Examine close-in air samples of high population density to establish particle type categories. A representative portion of each sample should be kept in reserve to provide for analytical accidents or subsequent examination by other methods.
3. Examine sets of samples from various areas on the array to bracket the particle distribution and suggest array areas of greatest significance for special particulate analysis.

Appendix A

MICROSCOPIC OBSERVATIONS, RAW DATA

TABLE A.1 Phosphor Intensification Autoradiography Results, Double Tracks

Tracerlab Sample No.	Stage No.	Field Location	Exposure‡ Time (minutes)	Frequency of occurrence at indicated mean diameter of image spot (millimeters)												
				<0.07	0.07	0.09	0.14	0.19	0.27	0.38	0.54	0.77	1.09	1.54	2.18	3.1	Total
Casella Impactor Stages																	
9658*	S1	G-060	1000		2	5	1										8
	S2	G-060	1000	1	7	12	29	24	2								74+
Deposition Slides, Area Represented is 24 cm^2																	
8038*		BM-08	1000							4	2	2	1				9
"		BM-09	60		9	15	13	37	26	25	12	1	4	7	3		152
"		BM-10	1000		1												1
"		BO-08		Sent to Project 2.6d C. S. M. R. F.													
"		BO-09	60		1	11	11	33	27	10	5	1	4	2	1		116
"		BO-10	1000					1									1
"		CM-09	1000	No images produced													
"		CO-09	1000	No images produced													
"		CO-11	1000	No images produced													
8035*		BO-058		Sent to Project 2.6d C. S. M. R. F.													
"		B-062A	1000			3	4	4	7	8	5		1	1			33
"		B-066A	1000	2	3	8	26	42	42	19	9	1	1				151+
"		B-070	1000			1											1
8035*		D-050		Cracked slide													
"		D-054		Cracked slide													
"		D-058	1000				1		1	1			1				4
"		D-062	1000						1		1	1	1	1			5
"		D-066	1000	1		5	2	10	10	9	3						39+
"		D-070	1000	6	3	10	1		9	13	6						42+

‡ Zenith Plate, 5 1/2 Minute Development in D-19

• Supersedes data presented in Data Report No. 2

TABLE A.1 CONTINUED

TABLE A.1 CONTINUED

Tracerlab Sample No.	Stage No.	Field Location	Exposure† Time (minutes)	Frequency of occurrence at indicated mean diameter of image spot (millimeters)													Total
				<0.07	0.07	0.09	0.14	0.19	0.27	0.38	0.54	0.77	1.09	1.54	2.18	3.1	
8038*		F-040	1000		3								1				4
"		F-042	1000			1											1
"		F-046A	1000				2			1	1			1	1		6
"		F-046B	1000			4	4	3	10	12	2	1	1	2			39
"		F-050	1000				2	5	3	2	5	5	1	3			26
"		F-056	1000		1	3	11	6	4	4	2	2	3				36
"		F-062	1000							1	1						2
"		F-068		Reserved for Project 2.6d C. S. M. R. F.													
8038*		H-044	1000				1					2		1			4
"		H-048	1000				1		1	3	2	1	5	3			16
"		H-052	1000		1	1			5		1	1	3	3	3		18
"		H-054	1000			1		3			1	3		3			11
"		H-060	1000					3			2						5
"		H-066A	1000							2	1	1					4
"		H-070	1000								3	1					4
8038*		J-036		Cracked Slide													
"		J-044	1000					1			2	3	2	5	4	1	18
"		J-050		Cracked Slide													
"		J-054	1000		2		1			1	2		4	2			12
"		J-058	1000					1	1	2		2		1			7
"		J-064	1000				1	1		1	1	3					7
"		J-070	1000	No images produced													

† Zenith Plate, 5 1/2 Minute Development in D-19

* Supersedes data presented in Data Report No. 2

TABLE A.1 CONTINUED

Tracerlab Sample No.	Stage No.	Field Location	Exposure† Time (minutes)	Frequency of occurrence at indicated mean diameter of image spot (millimeters)												
				<0.07	0.07	0.09	0.14	0.19	0.27	0.38	0.54	0.77	1.09	1.54	2.18	3.1	Total
8038*		L-042		Cracked slide													
"		L-046A	1000										1		1	1	3
"		L-052	1000		1					1	3	3	2	1			11
"		L-056	1000					2	2	2			2	2	2		12
"		L-060	1000			1			3		3			1			8
"		L-064	1000		4												4
"		L-068	1000				2			1		1					4
"		L-070	1000	1	1	1											2+
8035*		N-034	1000		2	2			1	1	1	2					9
"		N-042	1000							1	1						2
"		N-048	1000	3	2	1				1							4+
"		N-054	1000	No images produced													
"		N-058	1000	1	2	1					1				1		5+
"		N-062	1000	1		2											2+
"		N-066	1000	1		1		1		2							4+
"		N-072	1000	No images produced													
8035*		P-032		Cracked slide													
"		P-034		Cracked slide													
"		P-038		Cracked slide													
"		P-040	1000	3	1					1		2	3	1			8+
"		P-044	1000			2	4	1		1		1	2	3			14
"		P-050	1000								2			1	1		4
"		P-054	1000	1	1	4		1	1		1	1	1	1			11+
"		P-060	1000		1	2		2				1					6
"		P-064	1000	1	2				1			2	2				7+
"		P-070	1000		1		1					1					3

† Zenith Plate, 5 1/2 Minute Development in D-19

* Supersedes data presented in Data Report No. 2

TABLE A.1 CONTINUED

TABLE A.1 CONTINUED

Tracerlab Sample No.	Stage No.	Field Location	Exposure† Time (minutes)	Frequency of occurrence at indicated mean diameter of image spot (millimeters)												
				<0.07	0.07	0.09	0.14	0.19	0.27	0.38	0.54	0.77	1.09	1.54	2.18	3.1	Total
8035*		R-030	1000				1			1		3	3	3	2		13
"		R-034	1000		2					4	4	1	4	1			16
"		R-038	1000									3	1	1			5
"		R-044	1000								1	1	1	1			4
"		R-050	1000								1						1
"		R-056	1000	No images produced													
"		R-062	1000										1				1
"		R-066A	1000					1									1
"		R-070	1000							2	1		2				5
Offsite Deposition Slides																	
10014		Stake 57	1000	1		1	1						1				4
"		" 61	1000						1								1
"		" 65	1000							1		1					2
10027		" 259	1000	4	2	1	3	1	1	2	1						15
"		" 260	1000	3	2	1	1	3		1	1	1	1				14
"		" 261	1000	2	2	2	3	4	4	4	5	5					31
"		" 262	1000	1	2	2	2	3		2	2	2	2	1			19

† Zenith Plate, 5 1/2 Minute Development in D-19

• Supersedes data presented in Data Report No. 2

TABLE A.1 CONTINUED

Tracerlab Sample No.	Field Location	Exposure* Time (Minutes)	Frequency of occurrence at indicated mean diameter of image spot (millimeters) <0.07	0.07	0.09	0.14	0.19	0.27	0.38	0.54	0.77	1.09	1.54	Total Measured	Est. Total	Alpha Count of Preparation Dis/Min
Cylindrical Collector**																
2469	Arc B,L4, P9	60	133	86	90	132	88	48	14	2				593	8900	1.23×10^6
2121	Arc B,L12, P20	60	35	12	12	19	19	16	8	1	1			123	----	3.9×10^5
2445	Arc B,L17, P13	60	Many	14	26	28	46	39	17	7	2			179	8900	---
5306	Arc B,L1,	60	74	67	84	77	56	17	10	2				387	3800	---

*Super XX Film, S 1/2 Minute Development in D-19

**The Estimated Total is low by undetermined amount due to incomplete removal of particles from wire.

TABLE A.2 PHOSPHOR AUTORADIOGRAPHY RESULTS

Clean Slate I, Casella Impactor Stages 1 & 2

Tracerlab Sample No.	Stage No.	Field Location	Exposure Time (Minutes)	Frequency of occurrence at indicated mean diameter of image spot (millimeters)												
				<0.07	0.07	0.09	0.14	0.19	0.27	0.38	0.54	0.77	1.09	1.54	2.18	3.1	Total
Balloon Net Samples																	
3431	1	B,L8,P13	1000			No image											
	2	"	1000			"	"										
3436	1	B,L12,P21	60	many	5	2	1		2	1	1			1			13 +
	2	"	60**	many		6	7	9	8	5	1	2	1				39 +
3437	1	B,L14,P13	1000			No image											
	2	"	1000			"	"										
3438	1	B,L14,P21	60	many	73	27	30	25	14	4	3						176 +
	2	"	1000		43	21	28	26	22	5	1						146 +
3444	1	B,L17,P1	1000			No image											
	2	"	1000			"	"										
3446	2	B,L18,P13	1000		2	6	1	1		1							11
3453	1	B,L23,P9	15*		404	320	326	270	108	24	8						1460
	2	"	60		54	30	28	51	49	14	6						232
3456	1	B,L24,P13	60	many	34	17	23	36	36	21	16	7	2				192 +
	2	"	60		12	5	8	7	5	2	4	1	1				45
3457	1	B,L24,P21	1000		No image			cover stuck to disk									
	2	"	1000		"	"											
3459	1	B,L26,P5	1000		5	2	1	5	4	1	1						19
	2	"	1000		6	4	1	5	1	1	1	1					20
3464	1	B,L27,P9	60	few	9	2	4	3	Sample Mispackaged								18 +
	2	"	5*	many	61	43	36	53	25								218 +

TABLE A.2 CONTINUED

Tracerlab Sample No.	Stage No.	Field Location	Exposure Time (Minutes)	Frequency of occurrence at indicated mean image (spot) diameter (millimeters) <0.07	0.07	0.09	0.14	0.19	0.27	0.38	0.54	0.77	1.09	1.54	2.18	3.1	Total
Ground Level Array Samples																	
2688	1	B-026	1000			3	2			1	1	1					7
	2	"	1000			8	3		1								12
2629	1	D-018	1000	No image													
	2	"	1000	"	"												
2621	1	D-024	1000	"	"												
	2	"	1000	"	"												
2619	1	D-034	1000					1	cover stuck to disk		1						2
	2	"	1000							2							2
2618	1	D-038	1000	No image													
	2	"	1000	"	"												
3478	1	F-020,P3	1000	No image													
	2	"	1000	"	"												
3473	1	F-020,P7	1000	"	"												
	2	"	1000	"	"												
2587	1	F-026	1000	"	"												
	2	"	1000	"	"												
3397	1	H-040	1000											1			1

* note non-standard exposure required due to high activity
** too dense to evaluate properly

TABLE A.2 CONTINUED

Phosphor Autoradiography Results

TABLE A.2 CONTINUED

Phosphor Autoradiography Results

Clean Slate I, Deposition Slide Samples

Area Represented - 24 cm^2

Tracerlab Sample No.	Field Location	Exposure Time (minutes)	Frequency of occurrence at indicated mean diameter of image spot (millimeters)												
			<0.07	0.07	0.09	0.14	0.19	0.27	0.38	0.54	0.77	1.09	1.54	2.18	3.1	Total
8080	BM-06	60	8	3	9	10	1	10	2	1	7	11	9			71
"	BM-08	1000	36	22	7	11	6	3	2	2	6	5				100
"	BO-05	60	8	8	6	7	7	2	10	3	9	11	4	1		76
"	BO-06	60	29	11	3	6	6		10	12	3	2				82
"	CO-05.2	60	20	18	6	10	17	12	11	8	7	4				113
"	CO-05.3	---	Sent to Project 2.62 C. S. M. R. F.													
"	CO-05.4	1000	20	8	12	6	9	4	6	3	3					71
8080	B-016	1000	3		1	1										5
"	B-020	1000	15	5	8	3	6	1	1	1	3	1	1			45
"	B-024	1000	19	36	34	26	17	21	12	21	9	10	3			208
"	B-028	---	Sent to Project 2.62 C. S. M. R. F.													
"	B-032	1000	6	2			3	2	1							14
"	B-036	1000	4	3	3		3									13
8080	D-020	1000									1					1
"	D-022	1000			2	1	6	3	1	4	5	2	1			25
"	D-024	1000	20	12	3	10	10	3	12	7	7					84
"	D-026	1000	14	8	6	14	17	7	13	7	18	5				109
"	D-028	1000	12	6	4	10	7	4	5	6	10	8				72
"	D-030	---	Sample cracked													
"	D-032	1000		1			3	2	2	3	2	1				14

TABLE A.2 CONTINUED

Tracerlab Sample No.	Field Location	Exposure Time ≠ (Minutes)	Frequency of occurrence at indicated mean diameter of image spot (millimeters)												Total
			<0.07	0.07	0.09	0.14	0.19	0.27	0.38	0.54	0.77	1.09	1.54	2.18	3.1	
8082	F-022	1000		5		2		3					1			11
"	F-024	1000		1		1	1	2		2	3	1				11
"	F-026	---	Sample cracked													
"	F-030	1000		26	12	9	13	9	9	13	6	19	8	1		125
"	F-032	1000		2	2	1	1	1	1		1	2				11
"	F-034	1000		5	1				1							7
"	F-036	1000		4	2	2	1	2	1	2	1					15
8082	J-020	1000		13	1							1				15
"	J-022	1000		5	2											7
"	J-024	1000		1	2											3
"	J-026	1000		2	4	1	2	1	1		1	4	2			18
"	J-028	1000		27	18	21	22	20	8	11	4	6	3			140
"	J-030	1000		13	6	4	16	10	4	7	8	4	1			73
"	J-032	1000		9	4	4	6	5	1	2	1	2				34
"	J-034	1000		4	5	1	1	1		1	2		1			16
"	J-036	1000		4			1	1	1	1	1		1			10
"	J-038	1000		2	2											4
"	J-040	1000	Diffuse area				1		1	2		1				5 +
8082	L-026	1000		4	3	3	2	7	2	4	7	1		1		34
"	L-028	1000		10	2	1	8	6	3	2	3	8	2	2		47
"	L-032	1000		6	3	2	10	8	8	8	5	8				58
"	L-034	1000			2	2	4	1	4	2		1	1			17
"	L-036	1000		3	1		2		4	2	2	1	1			16
"	L-042	1000		1		2	3									6

TABLE A.2 CONTINUED

TABLE A.2 CONTINUED

Tracerlab Sample No.	Field Location	Exposure Time (Minutes)	Frequency of occurrence at indicated mean diameter of image spot (millimeters)												
			<0.07	0.07	0.09	0.14	0.19	0.27	0.38	0.54	0.77	1.09	1.54	2.18	3.1	Total
8084	N-020	1000	1	2												3
"	N-022	1000	No image													
"	N-024	1000	"	"												
"	N-026	1000	"	"												
"	N-028	1000	4	10	3	6	6		2	3	2					36
"	N-030	1000	12	3	4	2	9	6	4	11	4	3				58
"	N-032	1000	5	3	3	3	5		4	5	1					29
"	N-034	1000		1	5	2	3	4		3	3	1				22
"	N-036	1000	1	7	1	7	4	6	5	3	1	2				37
"	N-038	1000	13	3			2	2		1	1					22
"	N-040	1000		1	1				2		1					5
"	N-042	1000	1	1			1									3
"	N-044	1000	No image													
8084	O-028	---	Sample Cracked													
"	O-030	1000	13	7	6	6	8	9	13	10	5	1				78
"	O-032	---	Sample Cracked													
"	O-036	---	Sample Cracked													
8084	P-020	1000	No image													
"	P-022	1000	"	"												
"	P-024	1000	"	"												
"	P-026	1000	"	"												
"	P-028	1000			1											1
"	P-030	1000				2	1	2	2		3					10
"	P-032	1000	10	1	3	6	10	8	10	9	5		1			63
"	P-034	1000	18	6	9	11	8	12	6	8	1					79
"	P-036	1000	5	2	4	5	1	4				1				22

TABLE A.2 CONTINUED

Tracerlab Sample No.	Field Location	Exposure Time + (Minutes)	Frequency of occurrence at indicated mean diameter of image spot (millimeters)												Total
			<0.07	0.07	0.09	0.14	0.19	0.27	0.38	0.54	0.77	1.09	1.54	2.18	3.1	
8084	P-038	1000		2		1	4	3	4	4						18
"	P-040	1000		2	5	2	2	4	1	3	3					22
"	P-042	1000		6	3		4	1	6	4	1	1				26
9908 (Offsite)	Stake															
"	" 817	1000		3	4	1	3	7	2	1	1	1				23
"	" 819	1000				1	2	1	2	3	1	1	2			13
"	" 820	1000			4	2	2	1	2	2	3	1	1			18
"	" 822	1000		3	3	5	4	7	4	8	8	1				43
"	" 824	1000		4	6	1	1	3	4	3	1	3				26

+ Zenith Plate, 5 1/2 Minute Development in D-19

TABLE A.2 CONTINUED

Phosphor Autoradiography Results

Clean Slate I, Disk Collectors

Tracerlab Sample No.	Field Location	Exposure* Time (Minutes)	Frequency of occurrence at indicated mean diameter of image spot (millimeters) <0.07	0.07	0.09	0.14	0.19	0.27	0.38	0.54	0.77	1.09	1.54	Total
3109	B,L12,P9	2880	Images not read out, low spot population											
3110	B,L14,P9	2880	2440	1960	1740	1220	870	740	609	174				10,000
3114 Side A	B,L19,P5	2880	10220	6610	5960	7180	3090	1000	261					34,300
3114 Side B	B,L19,P5	2880	3130	2180	2960	4740	6130	5000	957	174				25,300
3112	B,L20,P9	2880	9270	3920	5610	6310	4220	1910	609	131	44			32,000
3113	B,L20,P17	2880	2870	957	827	1130	1130	218	348	131				7,600
3122	B,L24,P10	2880	12920	4090	4390	4090	3180	1480	348	131	44			30,700
3120	B,L25,P5	2880	3260	2130	2520	2740	1390	1350	609	44				14,000
3118	B,L28,P9	2880	4830	3780	3740	5520	5960	4180	1570	131	44			29,800

* Panatomic-X Film, 8 1/2 Minute Development in D-76

			Cylindrical Collectors**									Total Count	Est. Total
5298	Arc B,L13, P5	60	8	4	4	8	14	2	4	2		46	—
5299	Arc B, L17, P6	60	Many	56	59	81	82	23	6	1	1	307	6700

• Super XX Film, 5 1/2 Minute Development in D-19

** The estimated total is low by an undetermined amount.

TABLE A.3 Phosphor Intensification Autoradiography Results, Clean Slate II

Tracerlab Sample No.	Stage No.	Field Location	Exposure† Time (minutes)		Frequency of occurrence at indicated mean diameter of image spot (millimeters)												
					<0.07	0.07	0.09	0.14	0.19	0.27	0.38	0.54	0.77	1.09	1.54	2.18	3.1	Total
Casella Impactor Stages																		
2303	S1	GZ,TA,P1		Cracked disk														
"	S2	"		Particles too large to allow proper exposure geometry														
2302	S1	GZ,TA,P2		Cracked disk														
"	S2	"		Cracked disk														
2304	S1	GZ,TB,P1		Cracked disk														
2367	S1	GZ,UK1,P8	60			117	95	102	117	100	17	10	8	3				569
"	S2		60	Many		29	12	17	27	33	10	6	1	2	1			137+
2291	S1	BM-04	60	Many		64	19	45	17	6	5							156+
2293	S1	BM-08	60	Few		63	23	25	14	13	3	1						142+
2294	S1	BM-10		Cracked slide														
2295	S1	BM-12	60			158	50	54	42	10	3	2						319
2290	S1	A-006	60			247	57	35	6	3								348
2289	S1	A-018	60	Many		300	141	32	28	1								502+
2288	S1	A-030	60	Many		86	88	51	41	10	5	2						283+
	S2	"	60	Many		16	25	18	16	11	4	3						94+
2285	S1	A-066	60	Many		15	5		26	20	3		1					69+
2284	S1	A-078	60	Many		69	24	21	22	18	5							159+
2283	S1	A-090	60	Many		18	6	23	9		2	1						59+

† Zenith Plate, 5 1/2 Minute Development in D-19

TABLE A.3 CONTINUED

Tracerlab Sample No.	Stage No.	Field Location	Exposure† Time (minutes)	Frequency of occurrence at indicated mean diameter of image spot (millimeters)												
				<0.07	0.07	0.09	0.14	0.19	0.27	0.38	0.54	0.77	1.09	1.54	2.18	3.1	Total
2282	S1	A-102	1000		509	345	197	144	76	19	3						1292
2281	S1	A-114	1000	Many	139	49	178	132	79	10	20						607
2318	S1	B,L23,P9	1000	Many	124	136	160	208	117	55	16	4					820+
2323	S1	B,L26,P5	1000		57	38	27	25	16	4	2	2					171
2376	S1	B-028	1000		49	37	57	64	31	6	3	2	1				250
2379	S1	B-050	60	Many	10	11	15	22	11	3	2						74+
2373	S1	B-054	1000		40	28	42	46	21	14	5	2					198
2382	S1	B-074	1000	Few	132	42	47	43	30	2	1						297
2368	S1	B-078	1000		484	198	174	114	38	8	14	2					1032
2171	S1	F-022	1000	Many	59	83	87	114	79	33	18	9	3				485+
	S2	"	1000	Few	29	27	29	27	6	5	1	2					144+
* 2249	S1	H-010	1000		4		2	1									7
	S2	H-010	1000	3	3	5											8+
2247	S1	H-016	1000		4	1	2										7
	S2	H-016	1000	Few	4	3	3	2									12+
2251	S1	H-034	1000		35	21	14	12	3	1		1					87
2246	S1	H-038	1000		30	14	19	21	11	2	2						99
	S2	H-038	1000					1	1		1						3
2253	S1	H-040	1000		22	16	16	11	13	3	1	3					85
	S2	H-040	1000		16	4	4	1	3	2	3						33

* See next page for other Arc H samples

† Zenith Plate, 5 1/2 Minute Development in D-19

TABLE A.3 CONTINUED

Tracerlab Sample No.	Stage No.	Field Location	Exposure‡ Time (minutes)	Frequency of occurrence at indicated mean diameter of image spot (millimeters)												
				<0.07	0.07	0.09	0.14	0.19	0.27	0.38	0.54	0.77	1.09	1.54	2.18	3.1	Total
2252	S1	H-044	1000		7	13	14	14	11	4	2						65
	S2	H-044	1000		28	32	9	5	2	2	1						79
2245	S1	H-050	1000		29	16	17	18	9	3							92
	S2	H-050	1000		11	5	2	3	2		1						23
* 2202	S1	J-044	1000		26	9	2	3	3	2	1	1					47
	S2	J-044	1000		10	4	3	6	1								24
2206	S1	J-050	1000		42	9	19	15	5	1	2						93
	S2	J-050	1000		15	8	9	1	1								34
2212	S1	J-056	1000		13	10	24	25	9	2	1						84
	S2	J-056	1000		10	8	10	7									35
2207	S1	J-062	1000		20	7	4	8	7		1		1				48
	S2	J-062	1000		29	5	9	9	1	1							54
2210	S1	J-080	1000		50	33	30	24	18	13	4	1					163
	S2	J-080	1000	Many	10	2	8	6	1								27+
2209	S1	J-106	1000		90	44	62	57	10	1	1						265
	S2	J-106	1000	Many	75	37	19	16	4								151+
* 2214	S1	L-006	1000		2												2
	S2	L-006	1000	4	3		1	1									5+
2213	S1	L-010	1000	5	14	2		1	1								18+
	S2	L-010	1000		4	1	1										6
2225	S1	L-016	1000		3												3
	S2	L-016	1000		3	1											4

‡ Zenith Plate, 5 1/2 Minute Development in D-19

* See next page for other Arc J and L samples

TABLE A.3 CONTINUED

TABLE A.3 CONTINUED

Tracerlab Sample No.	Stage No.	Field Location	Exposure† Time (minutes)	Frequency of occurrence at indicated mean diameter of image spot (millimeters)												
				<0.07	0.07	0.09	0.14	0.19	0.27	0.38	0.54	0.77	1.09	1.54	2.18	3.1	Total
2221	S1	L-028	1000		15		13	9	2	3	3						45
	S2	L-028	1000		16	9	5	3	3	1		1					38
2215	S1	L-032	1000		44	33	38	33	17	3							168
	S2	L-032	1000	Many	1	1	2	5		7							16
• 2242	S1	H-056	1000		17	8	6	5	7	2							45
	S2	H-056	1000		6	7	4	3									20
2243	S1	H-058	1000		18	15	9	13	7	3	3	1					68
	S2	H-058	1000		13	4	8	5		1							31
2250	S1	H-062	1000		52	39	16	23	16	4							150
	S2	H-062	1000					1	3	1							5
2241	S1	H-080	1000		26	19	33	15	10	6	2						111
	S2	H-080	1000		16	9	8	14	1	3							51
* 2196	S1	J-010	1000	6	4	6	3	3									16+
	S2	J-010	1000	4	6	4	3										17+
2198	S1	J-016	1000	7	2	3	2										7+
	S2	J-016	1000			1											1
2197	S1	J-022	1000		18	10	11	1	5								45
	S2	J-022	1000		22	13	2	1			1						39
2200	S1	J-026	1000		46	32	14	16	18	3		1					130
	S2	J-026	1000		8	7	6	2	5	2							30
2199	S1	J-028	1000		28	7	7	11	2	3			1				59
	S2	J-028	1000			7	6	3	1	1							18

* See previous page for other Arc H and J samples

† Zenith Plate, 5 1/2 Minute Development in D-19

TABLE A.3 CONTINUED

	Tracerlab Sample No.	Stage No.	Field Location	Exposure‡ Time (minutes)	Frequency of occurrence at indicated mean diameter of image spot (millimeters)												
					<0.07	0.07	0.09	0.14	0.19	0.27	0.38	0.54	0.77	1.09	1.54	2.18	3.1	Total
*	2203	S1	J-038	1000					2	1		2	1		1			7
		S2	J-038	1000		1			3	2								6
	2204	S1	J-042	1000		17	4	2	6	2		1						32
		S2	J-042	1000		3	3	3	1	1	1							12
*	2216	S1	L-034	1000		53	17	19	15	3		2						109
		S2	L-034	1000		48	23	21	11	3								106
	2226	S1	L-044	60		96	29	20	16	5								166
		S2	L-044	60		35	10	11	6									62
	2223	S2	L-056	1000		46	10	11	6	2		1						76
	Deposition Slides			Area Represented - 24 cm^2														
	8101		C-050	1000		380	220	240	250	180	120	50						1440
	"		C-056			Sent to Project 2.6d C. S. M. R. F.												
	"		C-062	1000		640	200	260	180	150	20	20						1470
	"		C-066	1000		420	200	250	250	270	80	30						1500
	"		C-072	1000		120	100	60	160	160	40	30						670
	"		C-090	1000		200	100	80	20	90	40							530
	"		C-106	1000		21	23	29	23	18	5	1						120
	8101		D-014	1000		283	128	115	92	69	29	23	16	13	3			771
	"		D-016	1000		130	160	140	170	180	80	50	20	30				960
	"		D-018	1000		290	360	460	550	310	210	90	60	20				2350
	"		D-020	1000		470	250	380	520	370	180	70	40	10	10			2300
	"		D-022	1000		1090	390	410	620	670	240	170	90	20				3700

• See preceding pages for other Arc J and L samples

‡ Zenith Plate, 5 1/2 Minute Development in D-19

TABLE A.3 CONTINUED

Tracerlab Sample No.	Stage No.	Field Location	Exposure† Time (minutes)	Frequency of occurrence at indicated mean diameter of image spot (millimeters)												
				<0.07	0.07	0.09	0.14	0.19	0.27	0.38	0.54	0.77	1.09	1.54	2.18	3.1	Total
8101		D-030	1000		880	300	290	300	220	80	60						2130
"		D-040	1000		280	100	150	140	100	50	50	30	10				910
"		D-060	1000		240	200	230	70	100	50	40						930
"		D-074	1000		170	200	260	140	130	40	20						960
"		D-100	1000		67	41	42	39	30	10	1						397
"		D-114	1000		52	29	29	36	18	2	1						167
8101		E-018	1000		250	70	240	190	280	90	110	40	20				1290
"		E-020	1000		720	320	370	290	310	120	160	60	10				2360
"		E-022	1000		780	700	700	640	480	280	60	40	10				3690
"		E-024	1000		1030	730	560	910	730	290	150	100	10				4510
"		E-030	1000		710	400	290	450	160	80	60	10					2160
"		E-040	1000		290	150	190	160	80	80	40	20	10				1020
"		E-060	1000		340	140	220	100	190	140		20					1150
"		E-080	1000		44	30	40	42	32	10	14	2					214
"		E-100	1000		180	66	76	70	60	18	8	2					480
"		E-112	1000	Few	11	11	14	14	14	8	9						81+
8103		F-022-3	1000		5	4	2	2	2	1	3	1	1				21
"		F-026-2	1000		25	14	13	6	11	5		3					77

† Zenith Plate, 5 1/2 Minute Development in D-19

TABLE A.3 CONTINUED

Tracerlab Sample No.	Stage No.	Field Location	Exposure† Time (minutes)	Frequency of occurrence at indicated mean diameter of image spot (millimeters)												
				<0.07	0.07	0.09	0.14	0.19	0.27	0.38	0.54	0.77	1.09	1.54	2.18	3.1	Total
8103		G-020	1000		740	330	250	220	160	120	80	20	10				1930
"		G-022	1000	Many	440	210	330	410	350	160	150	50	20				2120+
"		G-024	1000		450	120	390	270	320	160	130	40					1880
"		G-026	1000		650	490	480	370	290	150	30	30					2490
"		G-028	1000		790	470	370	280	200	70	50	40	10	10			2290
"		G-030	1000		440	200	100	140	90	70	60	10					1110
"		G-046	1000	Many	232	44	46	36	18	14	22	10					422+
"		G-060		Sent to Project			2.6d	C. S.	M. R.	F.							
8103		H-016	1000		6		1	3									10
"		H-020	1000		280	120	120	90	100	70	70	30					880
8103		J-014		Not available													
"		J-020		Not available													
8103		L-026	1000		190	180	190	110	50	10	10	20	20				780
"		L-034		Cracked slide													
"		L-036	1000		99	30	19	12	11	6	6	2	3				188
"		L-038	1000		58	31	27	20	22	7	6	2					173
"		L-040	1000	Many	64	49	24	29	20	9	4	1	1				201+
"		L-042	1000	Many	97	65	48	34	33	11	8	5	2				303+
"		L-044	1000	Many	69	49	33	20	17	7	5	1	2				203+

† Zenith Plate, 5 1/2 Minute Development in D-19

TABLE A.3 CONTINUED

Tracerlab Sample No.	Stage No.	Field Location	Exposure Time (minutes)	Frequency of occurrence at indicated mean diameter of image spot (millimeters)												
				<0.07	0.07	0.09	0.14	0.19	0.27	0.38	0.54	0.77	1.09	1.54	2.18	3.1	Total
8103		L-046		Cracked slide													
"		L-048	1000		23	19	22	26	12	3	5	1					111
"		L-050	1000		29	22	10	7	14	8	3		1				90
"		L-052	1000		12	5	8	16	13	9	5	1					69
"		L-054	1000		12	9	7	5	9	7	1						49
"		L-056		Cracked slide													
"		L-060	1000				3	8	5	2	3						21
"		L-062	1000		2	3	4	4	6	2	3						24
Offsite Deposition Slides																	
10057		Stake 835				1	1										2
"		" 840			1	2	3	3	1								10
10033		Stake 907						1									1
"		" 919					1										1
Disk Collector																	
4173		GZ,UK#2,P12	2880*				Image spots not measured										
4172		GZ,UK#3,P14	2880*				Image spots not measured										
4169	Side A	GZ,UK#3,P8	2880*	Many	7400	4520	5180	7570	5440	2310	1310	131					
4169	Side B	GZ,UK#3,P8	2880*		3350	2350	1350	1520	827	174	87						
4171		GZ,UK#3,P12	2880				Image spots not measured										
4105		B,L4,P17	2880		3480	2180	2220	3480	2090	783	218	44	44				

‡ Zenith Plate, 5 1/2 Minute Development in D-19
* Panatomic-X Film, 8 1/2 Minute Development in D-76

TABLE A.4 Phosphor Intensification Autoradiography Results, Clean Slate III

Tracerlab Sample No.	Stage No.	Field Location	Exposure Time (Minutes)	Frequency of occurrence at indicated mean image (spot) diameter (millimeters) <0.07	0.07	0.09	0.14	0.19	0.27	0.38	0.54	0.77	1.09	1.54	2.18	Total
Casella Impactor Stages																
4823	1	B-002	1000		7	3	4	1	1							16
	2	"	"		6	5		1	1							13
4820	1	B-026	1000		40	9	13	18	13	9	8	2	1			112
	2	"	"		10	2	1	2								15
4822	1	B-026	1000		31	11	14	16	23	9	5	6	1			116
	2	"	"		4	4	5	3	3	2	1	3				25
4828	1	B-038	1000		142	34	62	27	5	5	1	2				278
	2	"	"		35	6	6	3	1							51
4832	1	B-050	1000		150	105	69	36	27	8	2	1	1			399
	2	"	"		101	34	18	5	10	1	2					171
4835	1	B-054	1000		124	73	51	34	21	9	7		2			321
	2	"	"		74	17	8	9	5	1	2	1				117
4829	1	B-060	1000		233	88	75	41	11	6	2					456
	2	"	"		106	28	14	8	3		3					162
4836	1	B-062	1000		326	92	88	38	22	9	4					579
	2	"	"		118	21	18	9	6							172
4826	1	B-074	1000		266	123	60	29	17	6	4	2				507
	2	"	"		96	31	9	6	1							143
4821	1	B-086	1000		172	108	67	32	19	9	2					409
	2	"	"		132	19	8	4								163
4825	1	B-098	1000		141	72	40	17	16	3	2					291
	2	"	"		148	20	15	2			1					186
4833	1	B-106	1000		50	25	28	30	16	4	1					154
	2	"	"		98	16	10	4	1							130
4920	1	D-002	1000		6	2		1			1					10
	2	"	"		3	2	2	1		1						9
4919	1	D-006	1000				1									1
	2	"	"			No	Images	Produced								-
4918	1	D-014	1000		7	2	1	1								11
	2	"	"			1	1	1	1							4

TABLE A.4 CONTINUED

Tracerlab Sample No.	Stage No.	Field Location	Exposure Time (Minutes) ‡	Frequency of occurrence at indicated mean image (spot) diameter (millimeters)											
				<0.07	0.07	0.09	0.14	0.19	0.27	0.38	0.54	0.77	1.09	1.54	2.18	Total
4921	1	D-026	1000		12	6	4	6	1	4	1	2	1			37
	2	"	"		3	3	1									7
4927	1	D-050	1000		6	8	3	4	4	3						28
	2	"	"		2	4	2	1								9
4922	1	D-060	1000		31	24	12	6	6	4	1					84
4923	1	D-062	1000		59	20	23	19	10	3	1	1				136
	2	"	"		15	10	3	4	1	3						36
4925	1	D-074	1000		69	30	33	43	15	5	3					198
	2	"	"		30	16	4	3	4							57
4928	1	D-086	1000		155	89	81	26	27	4	4					386
	2	"	"		32	14	10	4	2							62
4917	1	D-088	1000		94	90	30	28	11	8	2					263
	2	"	"		66	14	8	4	2	1						95
4915	1	D-110	1000		38	26	26	13	6		1					110
	2	"	"		29	9	7	5	1							51
4897	1	F-080	1000		59	56	50	61	41	12		1				289
	2	"	"	Many	29			3	3							35
4850	1	H-030	1000		5			2	8	1	1					17
4869	1	H-038	1000		35	33	37	55	43	16	10	5				254
	2	"	"		4	3	4	3	2	1	2	1	1			21
4873	1	H-062	1000		10	4	3	2	1	3	3		1			27
4878	1	H-074	1000		27	22	33	50	16	6						154
4875	1	H-080	1000		45	34	43	41	15	5	2					185
5020	1	I-050	P1 1000		7	5	9	14	9	5	4	1				54
	2	"	"		13	9	1	1	2		1					27
5019	1	I-050	P3 1000				No Images Produced									-
	2	"	"		9	7	1			1						18
5018	1	I-050	P4 1000		2			1								3
	2	"	"		3	1			1							5
5016	1	I-050	P5 1000		14	4	3	1								22
	2	"	"		1	2										3
5021	1	I-050	P6 1000	Few	3			1								4
	2	"	"	Few	4	3		1								8

TABLE A.4 CONTINUED

Tracerlab Sample No.	Stage No.	Field Location	Exposure time (Minutes) ‡	Frequency of occurrence at indicated mean image (spot) diameter (millimeters)											
				<0.07	0.07	0.09	0.14	0.19	0.27	0.38	0.54	0.77	1.09	1.54	2.18	Total
5022	1	I-050	P7 1000	No Images Produced												-
	2	"	"		1	1		1								3
5024	1	I-050	P12 1000			1	1	1	1	3						7
	2	"	"			2	1					1				4
4952	1	L-014	1000				2									2
	2	"	"		6	4	1	1								12
4951	1	L-034	1000		6	5	3	2	3	1						20
	2	"	"		16	6			1	3						26
4955	1	L-038	1000		1	4	7	1	5	1	1					20
	2	"	"		11	6		2	4			1				24
4950	1	L-050	1000		16	14	7	4	5	7	2					55
	2	"	"		4	3										7
4947	1	L-060	1000	No Images Produced												-
	2	"	"	No Images Produced												-
Deposition Slides, Area Represented is 24cm^2																
8165		BH-02	*240		120	36	56	56	76	28	24		4			400
"		BH-04	15	Many			60	110	520	410	150	1				1250
8165		BK-02	*240				12	40	80	92	88	52	32	4		400
"		BK-04	*240		17	14	20	26	22	11	8	1	2			121
8165		BM-12	*240		85	38	43	39	17	4	2					228
"		BM-13	-				Sample Cracked									-
"		BM-14	*240		47	27	23	29	13	7	8					154
8165		BO-00	*240		150	120	40	130	120	190	120	60	20	10	10	970
"		BO-01	-				Sample Cracked									-
"		BO-02	*240				70	20	40	50	70	40	10	20		320
"		BO-03	*240			20	24	32	20	16	16	12	4	4		148
"		BO-12	*240		84	36	28	44	23	13	3					231
"		BO-13	*240		64	28	36	44	24	20						216
"		BO-14	*240		140	44	40	48	40	16	8	8				344

TABLE A.4 CONTINUED

Tracerlab Sample No.	Field Location	Exposure Time (Minutes) ‡	Frequency of occurrence at indicated mean image (spot) diameter (millimeters)											
			<0.07	0.07	0.09	0.14	0.19	0.27	0.38	0.54	0.77	1.09	1.54	2.18	Total
8165	CM-05.0	*240		320	130	120	110	90	80	20	10				880
"	CM-05.1	*240		40	150	20	70	240	160	110	70	10			870
"	CM-05.2	60					12	64	80	120	92	32	4		404
"	CM-05.3	*240		76	36	64	44	84	24	12	4	4			344
"	CM-05.4	*240		28	24	16	12	36	12	12	8	8			156
8165	CO-03.4	-				Sample Cracked									-
"	CO-05.0	60		48	36	36	44	88	104	92	48	12	12		508
"	CO-05.1	60		88	28	88	92	212	96	104	44	4	8		764
"	CO-05.2	60					52	128	80	78	40	4			332
"	CO-05.3	-				Sample Cracked									-
"	CO-05.4														
"	CO-07.4	-				Sample Cracked									-
"	CO-09.1	*3900		20	4	20	56	44	52	12	12	20		4	244
"	CO-09.4	-				Sample Cracked									-
8165	B-016	60				12	20	16	20	52	24	4			148
"	B-020	60			10	50	40	110	170	90	40	20			530
"	B-024	60		10	30	20	110	240	160	120	20	10		10	730
"	B-028	*240		20	25	60	125	85	60	20	10	5			410
8167	C-022	*240			5	35	40	15	110	65	30	5			305
"	C-024	60		24	28	28	64	116	100	44	16	8			428
"	C-026	A 60		10	40	50	110	110	220	60	10		10		620
"	C-028	60		50	60	30	120	150	200	20	20		10		650
"	C-030	60		16	16	24	52	76	72	8	20				284
"	C-092	-				Sample Cracked									-
"	C-094	*3900		17	9	3	11	11	5	5					61
"	C-098	1000		3	6	9	12	14	3	5		1			59
"	C-102	1000		10	5	4	7	4	5						35
8167	D-024	60		4		4	24	28	12	20					94
"	D-028	-				Sample Cracked									-
"	D-030	*240		80	40	70	140	220	150	70	10	20	10		810
"	D-032	*240		36	36	68	64	112	96	36	40	8			1240
"	D-034	*240		92	44	56	104	72	36	20	8	4	4		1100

TABLE A.4 CONTINUED

Tracerlab Sample No.	Field Location	Exposure Time (Minutes) ‡	Frequency of occurrence at indicated mean image (spot) diameter (millimeters)											
			<0.07	0.07	0.09	0.14	0.19	0.27	0.38	0.54	0.77	1.09	1.54	2.18	Total
8167	D-038	*240		48	40	36	24	16	20	8	4				96
"	D-086	1000		17	11	15	14	8	5	4					74
"	D-088	1000		12	7	15	18	4	11	2					69
"	D-092	1000	Few	15	2	3	4	8	7	3	1				43
"	D-094	1000		2	7	5	2	8	5		1				30
8167	E-026	1000				8	7	11	15	19	14	6		1	82
"	E-028	*240		36	28	44	40	28	16	4	4				200
"	E-030	*240		200	80	280	260	140	40		20				1020
"	E-034	*240		10	60	55	100	135	140	35	20				555
"	E-036	*240		92	52	80	112	76	40	4	20	4			480
"	E-038	*240		36	52	52	40	32	28	8	20	4			272
8169	E-070	1000	Few	42	13	6	12	14	3	2	3				95
"	E-074	1000		14	10	2	8	13	8	1					56
"	E-078	1000		10	7	9	7	8	10	2	1	1			55
"	E-084	1000		4	10	6	10	9	9	2	1				51
8169	F-030	*240		25	28	36	36	15	16	4	1				161
"	F-032	*240		128	76	68	128	72	28	16	4				520
"	F-034	*240		120	60	124	136	56	44	8					548
"	F-036	*240		128	92	120	92	40	12	4					488
"	F-038	*240		112	72	72	28	44	40						378
"	F-040	*240		24	36	20	28	28	4	4					144
"	F-042	1000			4	8	24	40	28	32	16	12			164
"	F-074				Sample Cracked										-
"	F-076	B 1000		5	6	5	3	4	2	3		1			29
"	F-082	1000		3	6	4	9	8	8	3					41
8169	G-032	*240			28	40	72	112	60	40	12				364
"	G-036	*240		96	52	148	96	28	32	4	4				460
"	G-040	*240		44	20	48	20	40	8	16					196
"	G-042	1000		12	20	16	24	44	32	20	32	20	4		220
"	G-046	1000		32	12	8	28	28	12	16	24	12			172
"	G-072	1000			1	2	2	5	2		1				13
"	G-074	1000		3	7	4	7	2	1		2				26
"	G-078	1000		1	3	4	1	5	5	3					22

TABLE A.4 CONTINUED

+ Indicated mean image (spot) diameter (millimeters)

TABLE A.4 CONTINUED

Tracerlab Sample No.	Field Location	Exposure Time (Minutes)	Frequency of occurrence at indicated mean image (spot) diameter (millimeters)												
			<0.07	0.07	0.09	0.14	0.19	0.27	0.38	0.54	0.77	1.09	1.54	2.18	Total
8171	H-032	*240		57	46	34	28	15	1	1					182
"	H-034	*240		95	80	140	100	45	30						490
"	H-036	*240		116	68	48	44	36	8	8					328
"	H-038	*240		88	24	32	44	12							200
"	H-042	*240		14	16	11	15	5	4	2					67
"	H-046	B 1000	Few	5	13	6	6	10	11	6	1	1	1		60
"	H-074	1000		2	5	4		1							12
"	H-076	1000		4		1	2	2							9
"	H-086	1000			2	1		2	1		1	1			8
8165	H-030	Y-1 1000		4	4	12	8	52	32	8	12				132
"	H-030	Y-3 *3900		12	20	8	12	32	68	20	16	4			192
8167	H-030	Y-7 *240		18	15	18	18	4	1						74
"	H-030	Y-10 *240		11	7	9	9	6	5	2					49
8169	H-060	Y-2 *3900			1		1	1	4		1				8
"	H-060	Y-7 *3900				1	1								2
8171	H-090	Y-4 *3900		1											1
"	H-090	Y-6 *3900	No Images Produced												-
8173	H-090	Y-9 *3900			1		1			2					4
8171	J-034	*240		100	32	52	32	16	4	8					244
"	J-036	A *240		76	32	68	32	36	16						260
"	J-038	*240		92	64	60	24	24	4	4					272
"	J-042	*3900	Many	184	176	40	44	68	52	32	8	8			612
"	J-072	*3900		3	1	1	1	1							7
"	J-076	*3900		1	2		1								4
"	J-080	*3900		3		1			1						5

TABLE A.4 CONTINUED

Tracerlab Sample No.	Field Location	Exposure Time (Minutes) ‡	Frequency of occurrence at indicated mean image (spot) diameter (millimeters)											
			<0.07	0.07	0.09	0.14	0.19	0.27	0.38	0.54	0.77	1.09	1.54	2.18	Total
8171	L-036	*3900		56	24	28	88	100	76	40	16	16	4		448
"	L-038	*240		47	25	25	20	8	6	2	1				134
"	L-040	*240		32	21	18	16	10	4	1	1				103
"	L-042	*240		29	22	12	9	13	3	1					89
"	L-044	*240		15	15	9	3	4	2	1					49
"	L-048	*3900		12	6	5	7	7	6	4	1		2		50

‡ Zenith Plate, 5 1/2 Minute Development in D-19

* N-40 Plate, 5 1/2 Minute Development in D-19

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER < 0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2906 *Type Casella Impactor Tape No. 1 *

Measured Sample Area Measured 3.5 Autoradiographic Exposure 120 Min.

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER < 0.5 MICRON

Sample Description: Event Double Tracks Accerlab No. 2906 *Type Casella Impactor Stage No. 1 *
Location Ave B, L 5, P 9 % Sample Area Measured ~3.5 Autoradiographic Exposure 120 Min.

NOTE: Open foldout page 486 for legend to nomenclature.

	1.1 μm	1.6 μm	2.2 μm	3.1 μm	4.5 μm	6.9 μm	9 μm	12.7 μm	18 μm	25 μm	36 μm	51 μm		
1	S $\frac{BR}{-}$ W 10	S $\frac{BR}{-}$ W 11	A_3 $\frac{BR}{-}$ W 32	S $\frac{O}{-}$ W 40	S $\frac{O}{-}$ W 50	S $\frac{O}{-}$ W $\frac{3}{4}$	S $\frac{O}{-}$ I 31	A_2 $\frac{O}{-}$ W $\frac{3}{4}$	S $\frac{O}{-}$ W $\frac{3}{2}$	I $\frac{O}{-}$ W $\frac{3}{2}$	S $\frac{O}{-}$ W $\frac{3}{4}$			1
2			A_4 $\frac{BR}{-}$ W 33	S $\frac{O}{-}$ W $\frac{3}{4}$	S $\frac{O}{-}$ W $\frac{5}{8}$	A_2 $\frac{O}{-}$ W $\frac{3}{4}$	I $\frac{3}{4}$	A_3 $\frac{O}{-}$ W $\frac{3}{2}$	A_2 $\frac{O}{-}$ W $\frac{3}{2}$	S $\frac{O}{-}$ I $\frac{3}{4}$	S $\frac{O}{-}$ I $\frac{3}{4}$			2
3				O $\frac{BR}{-}$ W 40	S $\frac{O}{-}$ W 78	I $\frac{O}{-}$ W $\frac{3}{4}$	S $\frac{O}{-}$ W $\frac{3}{4}$	I $\frac{O}{-}$ I $\frac{5}{8}$	S $\frac{O}{-}$ I $\frac{3}{4}$	S $\frac{O}{-}$ I $\frac{3}{4}$	S $\frac{O}{-}$ W $\frac{3}{4}$			3
4				S $\frac{O}{-}$ W 78	S $\frac{O}{-}$ W 68	S $\frac{O}{-}$ W $\frac{3}{4}$	S $\frac{O}{-}$ W $\frac{3}{4}$	S $\frac{O}{-}$ I $\frac{5}{8}$	I $\frac{O}{-}$ W $\frac{3}{4}$	O $\frac{O}{-}$ W S	I $\frac{O}{-}$ W $\frac{3}{4}$			4
5				S $\frac{O}{-}$ W 68	S $\frac{O}{-}$ W $\frac{3}{4}$		S $\frac{O}{-}$ W $\frac{3}{4}$	S $\frac{O}{BK}$ W $\frac{3}{4}$	A_2 $\frac{O}{-}$ W $\frac{3}{4}$	I $\frac{O}{-}$ W $\frac{3}{2}$	O $\frac{O}{-}$ W $\frac{3}{2}$		82 mm²	5
6				S $\frac{O}{-}$ W $\frac{5}{4}$			S $\frac{O}{-}$ W $\frac{3}{4}$	S $\frac{O}{-}$ W $\frac{3}{4}$	A_2 $\frac{O}{-}$ W $\frac{3}{4}$	S $\frac{O}{-}$ W $\frac{3}{2}$	S $\frac{O}{-}$ I $\frac{5}{8}$			6
7								S $\frac{O}{-}$ W $\frac{3}{4}$	A_2 $\frac{O}{-}$ W $\frac{3}{4}$	A_3 $\frac{O}{-}$ W $\frac{3}{4}$				7
8								A_2 $\frac{O}{-}$ W $\frac{3}{4}$	S $\frac{O}{-}$ W $\frac{3}{4}$					8
9								S $\frac{O}{-}$ W $\frac{3}{4}$	A_4 $\frac{O}{-}$ W $\frac{3}{4}$					9
10								A_2 $\frac{O}{-}$ W $\frac{3}{4}$	S $\frac{O}{-}$ W $\frac{3}{4}$					10
11								S $\frac{O}{-}$ I $\frac{3}{4}$						11
12														12
13		O $\frac{BR}{BK}$ W 19	S $\frac{BR}{BK}$ I 21	S $\frac{BR}{Y}$ W 27	S $\frac{O}{BK}$ W 30	S $\frac{O}{-}$ W 50	I $\frac{O}{BK}$ W $\frac{5}{8}$	S $\frac{O}{BK}$ W $\frac{3}{2}$	A $\frac{O}{BK}$ W $\frac{3}{2}$	S $\frac{O}{BK}$ W $\frac{3}{2}$	I $\frac{O}{BK}$ W $\frac{3}{2}$	I $\frac{O}{BK}$ W S		13
14		S $\frac{A}{-}$ S 27	S $\frac{BR}{BK}$ W 64	S $\frac{BR}{Y}$ W 14	O $\frac{O}{BK}$ S 80	I $\frac{O}{BK}$ W $\frac{3}{4}$	A_2 $\frac{O}{BK}$ W $\frac{3}{4}$	I $\frac{O}{BK}$ W $\frac{3}{2}$	I $\frac{O}{BK}$ W $\frac{3}{2}$	A_3 $\frac{O}{BK}$ W S				14
15		S $\frac{Y}{BK}$ S 8	S $\frac{BR}{BK}$ W 40	S $\frac{BR}{-}$ W 25	S $\frac{O}{BK}$ W 72	S $\frac{O}{-}$ W $\frac{3}{4}$	A_2 $\frac{O}{BK}$ W $\frac{3}{4}$	O $\frac{BR}{BK}$ W $\frac{3}{2}$	I $\frac{O}{BK}$ W $\frac{3}{2}$	I $\frac{O}{BK}$ W $\frac{3}{4}$				15
16		S $\frac{BR}{BK}$ W 20	S $\frac{O}{BK}$ W 60	I $\frac{O}{BK}$ W 80			A_2 $\frac{O}{Y}$ W $\frac{5}{4}$	I $\frac{O}{-}$ W $\frac{3}{2}$	S $\frac{O}{BK}$ W $\frac{3}{4}$					16
17		A_3 $\frac{O}{BK}$ - 26	S $\frac{O}{BK}$ - 50	S $\frac{O}{BK}$ W 21			$\frac{Y}{BK}$ W $\frac{3}{4}$		S $\frac{O}{BK}$ W $\frac{3}{4}$					17
18		S $\frac{BR}{BK}$ W 29	S $\frac{BR}{BK}$ W 28	S $\frac{O}{BK}$ W 84			S $\frac{O}{BK}$ W $\frac{3}{2}$		S $\frac{O}{BK}$ I 100					18
19		A_2 $\frac{BR}{BK}$ W 13	S $\frac{O}{BK}$ W 25	S $\frac{O}{BK}$ W 64			S $\frac{O}{BK}$ W $\frac{3}{4}$		S $\frac{O}{BR}$ I $\frac{3}{2}$				8.1 mm²	19
20		S $\frac{BR}{BK}$ W 13	S $\frac{O}{BK}$ W 20				S $\frac{O}{BK}$ W $\frac{3}{2}$		I $\frac{BR}{Y}$ I 25					20
21		O $\frac{BR}{BK}$ W 26	A_2 $\frac{BR}{BK}$ W 23				S $\frac{O}{BK}$ W $\frac{3}{4}$		S $\frac{O}{BK}$ W $\frac{3}{2}$					21
22		S $\frac{BR}{BK}$ W 24	S $\frac{BR}{BK}$ W 35				S $\frac{O}{BK}$ W $\frac{3}{4}$							22
23			S CL I 13				I $\frac{BR}{BK}$ W 48							23
24			S $\frac{O}{BK}$ W 30											24
25			A_2 $\frac{BR}{BK}$ W 10											25
26			S $\frac{O}{BK}$ W 30											26
27			S CL S 9											27
28			A_3 $\frac{BR}{BK}$ W 85											28
29			O $\frac{BR}{BK}$ W 40											29
30			A_2 $\frac{BR}{BK}$ W 40											30
Totals	1	11	28	15	9	8	16	15	19	9	7	1		

*See previous sheet.

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2906 Type Casella Impactor Stage No. 1
Location Arc B, LS, P9 % Sample Area Measured ~9 Autoradiographic Exposure 2000 Min.

Comments: Deposit fairly uniform and heavy; activity much heavier on one side of deposit.

0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9.0μ	12.7μ	18μ	25μ	36μ	51.μ	72μ	
S S S 22		S O/BK W 3/4 S O/BR W 50 S CL W 3/4	S O/BR W 1/2 S O/BR W 1/2	S O/BK W 3/4 I O/BK W 1/2 S CL W 45 I O/BK W S S O/BK W 1/2 S O/BK W S I - - 3/4 S O W S	A2 3/4 S O/BK W S S O/BK W 1/2 S O/BK W S A2 O/BK W 3/4 S CL W S S O W 3/4 I O/BK W S O O/BK W 3/4 I O W 3/4 S O/BK W 1/2	S CL W 64 A2 Y/8 W 23 S O W S S O/BK W 3/4 I O W 3/4	S Y/8 W 3/4 O CL S 30 S O/BK W 3/4 I O/BK W 1/2 I O/BK W S	S Y/8 W S S O/BK W S	S O/BK W S S O W S S I O/BK I S S O W S S S O/BK W S	S O W S S I O/BK I S	S O/BK W S	O O/BK W S	246μm
		S OR/BK W 30 S OR/BK W 31	S OR/BK W 68 S OR/BK W 30 S OR/BK W 72 S OR/BK W 75 S O/BR S 3	S OR/BK W 32	I O/BK W 3/4 S OR/BK W 13 S O/BK W 28	S O/BK W 3/4 S O W 3/4 S O/BK W 3/4	S O/BK W 1/2 A2 O/BK W 3/4 S Δ/BK W 100	S O/BK W 1/2 A2 O/BK W 3/4 I O/BK W 1/2 S OR/BK W 1/2 S O/BK W 1/2 I O/BK W 1/2 S O/BK W 1/2	I O/BK W 1/2 A3 O/BK W 3/4 S OR/BK W 3/4 S O/BK W 1/2 S O/BK W 1/2 A2 O/BK W 1/2 S O/BK W 1/2	I O/BK W 1/2 A3 O/BK W 1/2	I A/BK W 1/2		0.94mm	
1		5	7	9	14	8	8	9	12	4	2	1		22
	1	11	28	15	9	8	16	15	19	9	7	1		23
	1	16	35	24	23	16	24	24	31	13	9	2		25
% $D_{\infty}^{239}O_2$ For Data On Following Sheet		8%	7%	4%			24%	32%						

Self absorption effect not considered

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER MICRON

Sample Description: Event Double Tracks Tracerlab No. 2906 Type Casella Impactor Stage No. 2
% Sample Area Measured 12.5 Autoradiographic Exposure 2000 Min.

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER MICRON

Sample Description: Event Double Tracks Tracerlab No. 2906 Type Casella Impactor Stage No. 2
Location Arc B, L5, P9 % Sample Area Measured 12.5 Autoradiographic Exposure 2000 Min.

Comments: Uniform deposit.

0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9μ	12.7μ	18μ	Alpha Stars Without Particles: 3/4	1/2	5	
	I Br S 200 S Br W 100 S Br W 60 S Br W 25 S Br W 100 S Br W 1/4 S Br W 100 S Br W 3/4 S Br W 3/4 S Y S 30 S Br W 3/4	S CL S 5 I W 16 S Br W 3/4 S Br W 3/4 S Br W 3/4 S Br S 2/4 S Br W 2/4 O Br W 3/4 S Br W 3/4 S Br W 3/4 S Br W 3/4 I 2/4 S Br W 2/4	I Br W 3/4 S Br W 11 I Br W 3/4 I S Br W 3/4 S Br W 3/4 S CL S 5 S Br W 23 S Br S 3/4 S Br W 80 S Br W 3/4 S Br W 3/4 S Br W 3/4 O CL W 3/4 A2 Y W 3/4 S Y W 3/4 S Br W 3/4 A4 Y W 3/4 S Br W 3/4 I CL W 13 S Br W 3/4 S Y S 3/4 S CL S 3/4 S Y W 3/4	I 3/4 S Br W 3/4 S Y W 3/4 I Br W 2/4 S CL S 3/4 S Br W 3/4	I Br W 11 A2 CL S 40	I Br I S A3 Br W 3/4			S Br W S	4	1		1
													2
													3
													4
													5
													6
													7
													8
													9
													10
										0.99 m²			11
													12
													13
													14
													15
													16
													17
													18
													19
													20
													21
													22
													23
													24
													25
													26
													27
													28
													29
													30
	11	13	24	6	2	2			1				

4000/2000 = 4 dis/min = 18 % $Pu^{239}O_2$ mat

800/2000 = 0.8 dis/min = 4% $Pu^{239}O_2$

800 th/2000 = 0.8 dis/min = 82% $Pu^{239}O_2$, 69% $Pu^{239}O_2$ (Calc. Corrected Source)

Continued

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2906 Type Casella Impactor Stage No. 2
Location Ave B, L5, P9 % Sample Area Measured ~2.5 Autoradiographic Exposure 2000 Min.

Comments: Continuation

0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9.0μ	12.7μ	18.μ
A_3 CLS IN	S $\frac{O}{BR}$? 80	S $\frac{O}{BR}$ W $\frac{3}{4}$	I CL S 23	S $\frac{B}{BR}$ N $\frac{3}{2}$	S CL W 25				
	S $\frac{BR}{Y}$ W 53	S CL W 98	S CL S $\frac{3}{4}$	S $\frac{BR}{BR}$ W 1	S CL S 14				
	S $\frac{O}{BR}$ W $\frac{3}{4}$	S $\frac{O}{BR}$ N $\frac{3}{2}$	S $\frac{B}{BR}$ W $\frac{3}{4}$	S CL W 80	S $\frac{O}{BR}$? S				
	S $\frac{O}{BR}$? $\frac{3}{4}$	A_2 $\frac{O}{BR}$ W $\frac{3}{4}$	A_2 $\frac{DA}{BR}$ W $\frac{3}{4}$	S CL S 4					
	S $\frac{O}{BR}$? $\frac{3}{4}$	S $\frac{O}{BR}$ W $\frac{3}{4}$	S $\frac{O}{BR}$ W $\frac{3}{2}$	A_3 $\frac{O}{BR}$ W $\frac{3}{2}$					
	S $\frac{O}{BR}$ W $\frac{3}{4}$	S $\frac{OR}{BR}$ W $\frac{3}{4}$	S $\frac{BR}{BR}$ S $\frac{3}{4}$	S $\frac{O}{BR}$ W $\frac{3}{2}$					
	S $\frac{O}{BR}$? $\frac{3}{4}$	S $\frac{O}{BR}$ S $\frac{3}{4}$	A_2 $\frac{O}{BR}$ N $\frac{3}{4}$	S $\frac{Y}{Y}$ S $\frac{3}{4}$					
	S $\frac{O}{BR}$ S $\frac{3}{4}$	S $\frac{O}{BR}$ W $\frac{3}{4}$	A_2 $\frac{O}{BR}$ W $\frac{3}{4}$						
	S $\frac{BR}{Y}$ N 24	S $\frac{O}{BR}$? $\frac{3}{4}$	S $\frac{O}{BR}$ W $\frac{3}{4}$						
	S $\frac{O}{BR}$ W 50	I CL W 26	S $\frac{O}{BR}$ S $\frac{3}{4}$						
	S $\frac{O}{BR}$? $\frac{3}{4}$	S $\frac{O}{BR}$? $\frac{3}{4}$	A_3 CL S 75						
	O $\frac{BR}{BR}$ W 120	I $\frac{O}{Y}$ W 60	S CL S 6						
		S $\frac{I}{BR}$ W 16	S $\frac{BR}{BR}$ W $\frac{3}{4}$						
			A_4 $\frac{BR}{Y}$ W $\frac{3}{4}$						
			S CL S 1						
			I $\frac{BR}{BR}$ W 35						
			S CL S 3						
			S CL S 1						
1	17	13	18	7	3				
% $Pu^{239}O_2$									
	< 82%	< 45%	< 52%	< 18%	< 12%		Stray	component	

0.98 mm²

Alpha Stars Without Particles

3/4	3/2	5
4		

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

... CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON ... Type Casella Impactor Stage No. 3 ... Scan Min.

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Double Tracks Tracerl [illegible] 2906 Type Casella Impactor Stage No. 3
Location Arc B, L 5, P 9 % Sample Area Measured 0.08 Autoradiographic Exposure 5280 Min.

Comments: Optical microscopy of nuclear track autoradiogram of a dispersed stripping from the line deposit.

Preparation A 2.08 mm²

	0.113μ	0.55μ	0.85μ	1.1μ	1.6μ	2.3μ	3.1μ	4.5μ		
Observed Particle-Star Pairs:	S — 20	O — 2	A_2 — 35	S CL S 1	S CL S 2	S Y S 11	A_2 O W 5	I CL W 31		1
		S — 3/4	S CL S 14	S CL S 4	O — W 3/4	S Br W 48				2
		S — 3	I CL S 7	I — 48	S CL W 4	S Y S 11				3
		S — 64	I — 12	S CL I 4	I CL W 37	S CL S 2				4
			S CL S 1	I — 3/4	O CL W 32					5
			S CL S 10	S CL S 13	S — S 3/4					6
Most active particles reffered to in section 3.3.2			S — 28	S CL S 30	S — S 3/4					7
			S — 22	S CL S 4	I — 3/4					8
			S CL S 3	I — 30	S Y S 1					9
			S CL S 3	S CL S 4	S — S 62					10
			S — 5/4	I Br W 7	S — S 3/4					11
			I — 3/4	S CL S 16						12
			O — W 14	I — 3/4						13
			S Y S 9	S — 78						14
25 Tracks / 5280 = 0.009 dis/min = 9% $P_o^{210}O_2$			S — 20	S CL S 2			Total	143 Track patterns		15
			S CL S 10	S — S 60			Estimated Total	of active Particles		16
			I — 18	S — 44			143 × 1250 =	179000		17
If peak shown in electron microscopy data was due to $P_o^{210}O_2$ (ρ = 11.5) then should see groups of 200 tracks in unassigned column			S — 60	S Y S 1						18
			S Y S 6	S Y S 2						19
			S — S 60	I — 3/4	PERCENT $P_o^{210}O_2$					20
			I — 19	I — 3/4						21
			I CL — 26	S Y S 4	0.55μ	0.85μ	1.1μ	1.6μ		22
			I — 60	S CL S 11	VARIES	(up to 40%)	(up to 31%)			23
			S — 14	I — 5/4	poss. 29 tr	23 tr	18 tr	27 tr		24
			I — 19	A_2 CL — 17	(neglecting most active particles)					25
			I — 36	S CL W 15	See Table 3.1					26
			S — 39	S — 96						27
			S — 3/4	S CL W 13						28
			I — 60							29
Observed Stars Only:										
No. Tracks Per Star	1-10t	11-20t	21-30t	31-40t	41-50t	51-60t	61-70t	71-80t	81-90t	91-100t	>100t	30
No. Stars	3	12	6	6	4	7	2	3	1	2	18	

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2152 Type Casella Impactor Stage No. 1
Location Arc B L12, P21 % Sample Area Measured ~17% Autoradiographic Exposure 120 Min.

Comments:

<0.47μ	0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	Misc.
				A_2 BR = W 7	A_4 BR = W 20	S Cl = S 14	I O = W 3/4	I O = W 15	I O = W 3/2	S O = W 3/4	S O = W 5/8	S O = I S	? ? ? 25
				S BR = ? 13	S BR = W 35	A BR = W 100	S BR = W 3/4	A_2 O = W 3/4	A_2 O = W 3/4	I O = W 3/4	I O = W 3/2	I O = W 3/2	" 80
				S BR = S 12	O BR = W 21	A_2 BR = W 25	A_2 O = W 80		S O = W 3/2	S O = W 3/2	I O = W S		" 40
				S ? ? 17	S BR = W 80	S O = W 25	I BR = W 60		S O = W 60	A_2 O = W 3/2	I O = W S		" 150
				S ? ? 15	S O = W 88	S BR = W 60	S Cl = W 3				S O = W 3/2		" 50
				I BR = W 21	S BR = W 48	S BR = N 15							" 3/2
				A_2 BR = W 50	A_2 BR = W 31	S O = W 3/4							" 3/4
				S BR = W 8	S BR = W 25	S BR = W 27							" 150
					A_2 BR = W 80	A_4 BR = W 3/4							" 200
					S O = W 84								
					S O = W 43								
					S Cl = S 10								
			S BR = ? 4	A_4 BR = ? 8	S BR = W 25	S O = W 80	A_2 ? W 64	S O = W 3/4	A_2 O = W 3/4	S O = W 3/2	S O = W 3/4	O O = W 3/2	? ? 240
			A_2 BR = ? 22	S BR = W 17	O ? W 34	S Cl = S 27	A ? W 84	A_3 O = W 150		S O = W 3/4			" 100
				S O = W 57	S BR = W 60	A_4 BR = ? 50	I O = W 120	S O = W 9					" 3/4
				O O = W 11	S O = W 7	S O = W 48	I O = W 20	A_2 O = W 3/4					
				S O = W 20	S O = W 60	S O = W 27	S O = W 3/4						
				A_2 BR = W 25	S O = W 28	S O = W 21							
				S O = W 25	S O = W 36	A_2 O = W 68							
				S BR = W 24	S O = N 19								
				S O = W 42	S BR = W 11								
					S O = W 17								
					S O = W 30								
					I O = W 50								
					I BR = W 72								
					S O = W 18								
					S O = W 15								
			2	17	27	16	10	6	5	6	6	3	12

4.5 mm²

9 mm²

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Stage No. 1

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER ? 0.5 MICRONS

Sample Description: Event Double Tracks Tracerlab No. 2152 Type Casella Impactor Stage No. 1
Location Area B, L12, P21 % Sample Area Measured ~ 8 % Autoradiographic Exposure 1440 Min.

Comments:

0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9.μ	12.7μ	18.μ	25μ	36μ	50μ
? ○ ? 42	S ○ ? 100	O ○ S ¾	S ○ BR W ¾	O ○ BR W ¾	S ○ ? ¾	O ○ W 2	S ○ W 17	A_3 ○ W ¾	A_4 ○ W 100		A ? ? ?		A ? ? ?
S ○ W 20	A ○ BR ? 12	O ○ BR W ¾	I ○ W 40	I ○ BK W 80	S ○ ? ½	S ○ W 5	I ○ BR W ½						
S ○ BR ? 25	? ○ ? 26	? ○ BR ? ¾	O ○ BR W ½	A ○ W ¾	S ○ S 50	I ○ W 10	A ○ BR W ¾						
	O ○ ? ¾	I ○ W ¾	S ○ BK W ½	S ○ BK S 50	S ○ S ¾	A ○ BR W ¾	O ○ W ½						
	I ○ S 3	A_3 ○ W ¾	O ○ BR W ¾	O ○ BR W ½	S ○ BR W ½	A ○ W ½	S ○ BK W S						
	O ○ BR W 50	? ○ ? ¾	S ○ S ¾	A ○ BR W ½	S ○ S 120	S ○ BK N ½	S ○ W 7						
	? ○ BR ? 50	O ○ BK W ¾	S ○ W ¾	S ○ BR N ¾	S ○ S 2	I ○ BK W ¾	O ○ W 21						
	S ○ BR ? ¾	S ○ BR W ¾	S ○ BR W ½	S ? ? ¾	I ○ BK W 50	A ○ BR W S	S ○ BK W ½						
		A ○ S 45	S ○ BR W ¾	I ○ W 5	I ○ BR W S	I ○ W 3							
		S ○ BR W 4	O ○ BR W ¾	A ○ BK W ¾	S ○ I 8	S ○ S 2							
		I ○ BR W 75	I ○ BR W ¾	S ○ W ½	I ○ I 7	A_2 ○ BR W ½							
		A ○ BK ? ¾	I ○ BK W ½	S ○ BK W 120	S ○ S 5	S ○ S 2							
			I ○ W 3	S ○ S 1	S ○ BK W ½	A_2 ○ BK W ¾							
			? ○ BR W ¾	S ○ ? ¾	S ○ BR W ½	O ○ S 3							
			S ○ BR S ¾	S ○ W ¾	A ○ BR W S	S ○ W ¾							
			S ○ BR W ¾	? ○ W S	S ○ BR W S	A ○ BR W 31							
			I ○ BR S ¾	S ○ W ? ¾	I ○ BR W S	A ○ W 30							
			O ○ BR W ¾	I ○ W 6	S ○ BR S ¾	O ○ W ½							
			S ○ S 9	I ○ BR W ½	A ? S 17	S ○ BK W S							
			O ○ BR W ½	S ○ BR N ½	S ○ W ¾								
				S ○ BK W S	O ○ W B								
				S ○ BR W ¾	O ○ BK W 2								
					S ○ S 33								
					I ○ BK W ½								
					S ○ BK W ½								
					S ○ S ¾								
3	9	13	20	23	28	19	8	1	1		1		1
1	4	6	11	19	18	13	9	7	2	5	3	0	2
		2	17	27	16	10	6	5	6	6	3		
4	13	21	48	69	62	42	23	13	9	11	7	0	3

Miscellaneous Stars without particles

? ? ?	18
"	24
"	¾
"	9
"	5
"	7

41mm²

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2152 Type Casella Impactor Stage No. 1
Location Ave B, L12, P2.1 % Sample Area Measured ~30 Autoradiographic Exposure 1440 Min.

Comments:

0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9.0μ	12.7μ	18μ	25μ	26μ	50μ
S V S 20	O R S 80	S V BR S 60	I R V I 3/4	S O BR W 3/2	I O BR W 3/2	S V W 4	S R BR W 3/4	A_1 R BR W 3/2	S O W S S	I R W I S	S R BR W S		A R W S
	S ? ? 3/4	S O BR W 3/4	A_1 O V W 3/4	I Y W 3	S O BR W S	O R BR W S	S R BR W S	A_2 R BR W 3/2	I O W I S	I O BR I S	S R W W S		I O W I S
	S CL W S 10	S R W S 64	I O V W 3/2	S Y V S 31	S O W 3/4	O R V W 5	I O W W 3/2	I O BR W S		S R BR S S	S CL W S S		
	S ? ? 60	I O BR W 150	S R BR W 3/4	I O BR W 3/4	A_4 2 W S	I O W W 3/2	S O W W S	S O BR W 3/2		1 O W W S			
		S Y W S 70	A_2 O BR W 120	S O BR W 120	S O V W 3/4	O O W W 3/4	I Y W W 20	S O W I 3/2					
		S O BR W 3/4	S Y V S 40	S O BR W 5/2	S O BR I 3/2	S O BR W S	O Y BR W 15	I Y W W 64					
			S O BR W 5/4	S O BR W 3/4	A_2 R BR W 3/4	S CL BR W 15	S O V W 3/2	S O W W S					
			S R BR W 3/4	S Y W S 34	S O V W 3/4	S R BR W 3/4	S CL W W 100						
			S DR W W 65	I O BR W S	O O W W 3/4	S O BR W 3/2	I DR W I 40						
			O O BR N 3/2	I O W W 3/4	I O BR W 3/4	A_3 O BR S S							
			S O BR W 3/4	S O V W 3/4	S DR W 17	I O BR W 3/2							
				S O BR W 3/2	S Y BR W 3/4	S O V W S							
				S O BR W 5/4	S O BR S 3/4	O O BR W S							
				O O BR W 5/4	S CL V S 3/4								
				S Y V S 60	O O V W 3/2								
				A_2 O BR W 5/4	S O V W S								
				O R V S 5/4	S O BR W S								
				S CL W 345	S O BR W S								
				I DR W W 14									
1	4	6	11	19	18	13	9	7	2	5	3	0	2

164 mm²

Size Data Continued

70μ	100μ	141μ
O ? ? S		
1	0	0

Miscellaneous Stars Without Particles			
? ? ? S	? ? ? S	? ? ? 60	? ? ? 27
" S/4	" S	" 80	" S
" S/2	" S/2	" 80	" S/2
" 3/4	" 3/2	" 3/4	" 5/2
" S	" 5/2	" 14	" S
" S	" 10	" S	" 3/2

MICRON

AREA EQUIVALENT DIAMETER

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER

Sample Description: Event Double Tracks Tracer [illegible].2152 Type Casella Impactor Stage No. 2
Location Arc B, L 12, P 21 % Sample Area Measured ~10% Autoradiographic Exposure 2000 Min.

Comments: % area measured is a rough estimate

0.85 μm	1.1 μm	1.6 μm	2.2 μm	3.1 μm	4.5 μm	6.4 μm	9 μm	12.7 μm	18 μm		
S - S 88	S BB 2/4	S BB W 3/4	S O W 3/4	A_2 O W 12	S O W S	A_2 BB S 64	A_2 O W 5/4	A_3 CL W 3/4	I O W S		1
S BB W 3/4	O - S 3/4	I 3/4	S O W 3/4	S BB S 3/4	S CL W 46						2
S BB W 80	O BB - 64	S O W 3/4	A_2 BB W 3/4	S CL S 46	A_2 O W S						3
S BB w 3/4	S BB W 3/4	S BB S 48	S O W 3/2	S O W 3/2	A_3 O W 3/2						4
	S CL - 80	S O W 3/4	SCL S 21	S CL W 7	S BB W 3/2						5
	S BB - 10	S CL S 7	S O W 1/4	S BB W 3/4	S BB W 3/4						6
		A_2 BB W 3/4	S O W 1/2	O CL W 14	S CL S 3						7
		S O W 3/4	SCL S 7		A_2 O W 3/4						8
		S CL S 15	I BB W 3/4		A_3 O W 1/4						9
		S O W 3/4	I 3/4		S BB W 1/2					32.8 mm²	10
		S BB W 3/4	S CL S 7								11
		S BB W 3/4	S CL S 88								12
		S BB N 1/2	S BB W 3/4								13
		S O W 60	S BB W 1/2								14
		I CL W 100	S O W 1/4								15
		S O W 3/4									16
		S Y W 28									17
		S CL S 7									18
	S O ? 3/4	S O W 1/2	S O W 3/4	S O W 1/2	A O W 3/4						19
		A_2 O W 3/4	S O W 3/4	S CL S 84	S CL S 4						20
		I O W 50	S O N 1/2	O O W 1/2							21
			I O N 3/4	S Y S 7							22
			I O W 1/4	S ? ? 3/4						1.2 mm²	23
			S O W 1/4								24
			S BB W 32								25
											26
											27
										34.0 mm² total	28
											29
											30
4	7	21	22	12	12	1	1	1	1		

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 215? Type Casella Impactor Stage No. 3
Location Ave B, L12, P21 % Sample Area Measured 2.7 Autoradiographic Exposure 5700 Min.

Comments:

<0.47μ	0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	Miscellaneous Stars Without Particles					
? ? ? 30	S S 50	S S13	I S112	A_2 I 144	S S 200	I I 26	I I21	0-25	26-50	51-100	101-200	3/4	1/2
S S 2	S S 20	I S100	I I 56	S I 48	I I120	I I 18		? ? ? 22	? ? ? 48	? ? ? 80	? ? ? 120	6	3
S S 31	S S 100	0 ? 25	I I ? 32	S ? 216	I I 38	A_2 S80		" 14	" 50	" 100	" 200		
	S S 16	S S 20	S S 16	S S 68	I I 35			" 10	" 50	" 120	" 200		
	S S 60	S ? 30	I I 34	S W S	I ? 400			" 16	" 50	" 100	" 160		
	S S 14	S ? 19	I I64	A_2 ? 200	S W			" 9	" 30	" 80	" 200		
	S S 60	S I 64	A_2 S	0 W	A_3 W 20			" 8	" 50		" 200		
	S S 64	S S 16	S W75	0 W	S S 100			" 16	" 50				
	0 S27	S S 2	S S	A_4 ? 200	A_2 ? ? 41			" 9	" 30				
	? ? S 10	I S 8	S S 40	A_2 W28	S S 50			" 8	" 50				
	S S 36	S S60	S S 84		A_3 ? W			" 16	" 50				
	0 S 14	S W28	S I 22					" 20	" 40				
	S S26	S S 60	S S88					" 8					
	S ? 60	S S 12	S W					" 11					
	S S 14	I W200	S W					" 16					
	S S 64	I S 8	? ?					" 7					
		S S 15	S W23					" 8					
		S S 200	0 S 12					" 18					
		S S 80	A_4 S300					" 7					
		S W	S S 34										
		S S 100	A_2 ? 37										
		A_2 S 14	S ? ? 200					Total	15	8	5	6	6
		S S 34	A_4 S125										3
		S S 30											
		S S22						Average 3/4 track for 0.85μ = .013d/s/min = 2.9% $D_{a^2}D_2$					
	S ? ?	A_2 S200						200, 3/4 wrap " = .18 " 4/0 "					
	S S 21	0 S 35						Average 3/4 track for 0.55μ = 10% $D_{a^2}D_2$					
	S S 60	S S 38											
	S S 100	A_2 W											
3	16	33	23	10	11	3	1						

13.5 mm²

Continued

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER ≥ 0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2152 Type Casella Impactor Stage No. 3
Location Ave B, L12, P21 % Sample Area Measured below Autoradiographic Exposure 5700 Min.

Comments: Continuation

<0.47	0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ
? ? ? 27	S ? ? 40	S ≤ S 3/4	A_2 S ? 100	S DR ? 200	A_2 ? ? 3/4	? ? ? 3/2	
" 14	S ? ? 30	S ≤ S 7	S ≤ ? 100	A_5 ? ? 3/2	S DR W 200		
	S ? ? 100	A_2 ≤ ? 150	S ≤ ? 3/4		S DR W 3/4		
	S ? ? 45	S ? ? 20	A_2 ? ? 200		S ? ? 3/4		
	S ? ? 40	S ? ? 200	S ≤ ? 80				
		S ? ? 3/4	S DR ? 3/4				
		A_3 ? ? 200	S ? ? 3/4				
		S ? ? 100	O ≤ ? 3/4				
		S ? ? 40	S DR ? 3/4				
		S DR ? 3/4	O ≤ ? 80				
		S ≤ ? 128	O ≤ ? 3/4				
		S ≤ ? 25	S ≤ ? 31				
		S ≤ ? 48					
		S ≤ ? 32					
		S ≤ ? 120					
		S ≤ ? 124					
		S ≤ ? 6					
		O ≤ ? 4					

Alpha STars Only

No. of Tracks	1-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40
Freq. of Occurrence	142	22	9	13	3	5	3	

Miscellaneous 0-25	26-50	Stars 51-100	Without 101-200	Particles 3/4	3/2
? ? ? 11					
" 18					
" 20					
3	0	0	0	3	0

13.5 mm²
2.7%

54. mm²
10 %

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2436 Type Casella Impactor Stage No. 1
Location Arc B, L17, P9 % Sample Area Measured 70 Autoradiographic Exposure Below Min.

Comments: Air gap autoradiogram indicated 12 major particles. Only 1 of 2 preparations was useful for microscopy. Medium population density. Inactive particles as large as 125 μm.

	0.85 μm	1.1 μm	1.6 μm	2.2 μm	3.1 μm	4.5 μm	6.4 μm	9 μm	12.7 μm	18 μm	25 μm	36 μm	51 μm
Preparation A 90 Min.				S 3/S 25	S 2/W 150	S 2/W 250	A 3/- 3	S 2/W 3/2			I 2/1 I 5		I 1/W 5
											I 2/1 I 2		
											I 1/1 I 3		
Preparation B (Poor Quality) 1440 Min.													
	I 1/- I 1		S 1/2 W 100			I 1/W I 3		I 1/W I 22					
								S 1/W 150					
also	several	sets of scattered tracks = 25 tracks											
	Star with 133 t, no particles visible.												
			1	1	1	1	1	1			3		1

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Stage No. 2

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER ≥0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2426 Type Casella Impactor Stage No. 2
Location Ave B, L17, P9 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: Low magnification count shows 85 major alpha stars on ½ of deposit. See shorter exposure on next sheet. Low population density for a stage 2.

			<0.47μ	0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9μ	12.7μ	
Preparation a.			S-S 2	S 0/BR-60	I 7/7 S17	S 0/BR-5/4	S 0/BR S140	O 0/BR W S	S 0/7 S 5/2	O 0/BR W 18	I 0/W W 3/4		A₁-W19	
	1360 Min		S 7/7 S 22	S CL/W S 19	S 0/7-3/4	-0/BK-5/2	O 0/BR W 5/2	O 0/W W85	S 0/BR W 3/2	S 0/7 W S	S 0/BR W S			
	50% of Area				S 0/BR S150	S 0/BK S 5/2	S 0/BR W S	S 0/C S 5/4	S 0/BR W S	O 0/BK I 6	A₂ CL/Z₁ W27			
					S 0/BK-25	S 0/BK W 3/4	S 0/BK S 5/4	S 0/BR W 3/4	S 7/7 S 88	I 0/BR W S				
					S 0/7 W 64	S 0/7 W 120	-0/-S	S 0/BK W S	S 0/7 S 3/4	O W/W W1				
					S 0/7-120	S 0/BK W 3/4	O 0/BR W 5/4	S 0/7 S 2/4	S 0/BK W S	O 0/7 S 3/4				
					S--100	O 0/BR W 3/4	S 0/7 S34	I 0/C W S	S 0/BK W 3/4	S CL/W W4				
					S 0/BR W 3/4	A₂ 0/BK W 100	O 0/BR W S	S 0/BK W S	S CL/W S60	I 0/M W 3/4				
					I 0/BR W 3/4	S 0/BK W 3/4	S 0/BK W 3/4	S 0/7 W 3/4	I 0/BR W 3/2	I 0/BR W S	S A/A W42			
					A₂ 0/-80	S 0/BK W 3/4	S 0/BK W 3/4	S 7/7 S 36	I 0/BR W S	S-S 90				
					S-S 3/4	O 0/BK W 5/4	S 0/BK W 175	S 0/BR W 3/2	S 7/W W65	S-S 90				
						O 0/BK W 5/4	O 0/BR W 3/4	S 0/BK W 3/2						
							S 0/CY W 5/2	I 0/BR W 5/4	A₂ 0/BK W 3/2					
							S 0/BK W 5/4	I 0/BR I 3/2	A₂ 7/7 S100		Alpha Star Only			
							O 0/BR W 3/4	I 0/C W 5/4	I 0/W W 5/4		4 stars		3/4	
							O 0/7 W 5/4	O W/W W140	A₂ 0/M W 3/2		1	"	16 tracks	
							S--200	S 0/BR W S	S 0/BR W S					
							S 0/BR W 3/4	S 0/BR W 5/2	S 0/BK W S					
							S 7/W S 80	S 0/BR W 5/4						
							S 0/BR W 5/4	S 0/BK W 5/4						
								S 0/BR W 5/4						
								S 0/BR W 3/4						
								S 0/BK W 3/4						
								S 0/BR W 5/4						
								S 0/7 W 3/4						
														Total
			2	2	11	12	20	25	18	11	3		1	112

Continued

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2436 Type Casella Impactor Stage No. 2
Location Arc B, L-17, P9 Sample Area Measured below Autoradiographic Exposure Below Min.

Comments: **Continuation**

	0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	Alpha Stars Only
Preparation b.		I 0 ? 12		S 9 W 72	O 8 W 3	S 0 W 3	S 8 N 3		1 star 5/8
180 min		S 0 ? 26		S 18 W 3	S 8 N 3	A_2 – W30			2 " 100
20% of Area				I 84 W 36	A_2 44 N 2				
				S 52 W 48	S 2 S 40				
		2		4	4	2	1		

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2436 Type Casella Impactor Stage No. 3
Location Arc B, L17, P9 % Sample Area Measured 50 Autoradiographic Exposure 5640 Min.

Comments: Low power examination indicates a total of 234 prominent star images.

			0.39μ	0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	Miscellaneous Stars Without Particles										
Preparation a.									1-5	6-10	11-20	21-30	31-40	41-50	51-75	76-100	5/8	3/4	5/2
									2			3	1		1	2	13		1
									800th / 5640 = 0.028 dis/min = 5% Ra^{226}										
Preparation b.									1-5	6-10	11-20	21-30	31-40	41-50	51-75	76-100	5/8	3/4	5/2
									0	0	1	5	4	2	4	0	10	2	0
												↑							
									400 / 5640 = 0.014 dis/min = 10%										
									25th / 5600 = .005 dis/min =										
									activity of 0.N micron sphere is 0.002 dis/min										
				3	19	23	7												

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 9625 Type Casella Impactor Stage No. 1
Location Avc E-056 % Sample Area Measured Total Autoradiographic Exposure 2880 Min.

Comments: Field count data indicated 0 d.p.m. Nuclear track autoradiography indicated several thousand scattered single tracks and approximately 50 alpha stars of track populations up to 150 tracks. Many of these alpha stars were incomplete and scattered track patterns lead away from the star. No particles were found which corresponded to the alpha tracks. These observations suggest that a soluble alpha emitting particulate was present. The possibility of cross contamination exists. Since nothing similar has been found on other earlier stages such contamination might have come from Tweezers used on laboratory standard aerosols of PuO_2 or UO_2.

A few long tracks, approximately 90 microns in length, were observed. These could be scratch artifacts however a radial array of 3 such tracks suggests that they might be proton tracks

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 9625 Type Casella Impactor Stage No. 2
Location Arc E-056 % Sample Area Measured total Autoradiographic Exposure 2880 Min.

Comments: Field count data indicated 0 d.p.m. laboratory counts indicated ≈ 3 d.p.m.
Estimate approximately 1500 alpha tracks scattered, no correlation with particle.
20 micron diameter sphere noted without tracks, may indicate poor autoradiogram.

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 9625 Type Casella Impactor Stage No. 3
Location Arc E-056 % Sample Area Measured Total Autoradiographic Exposure 1440 Min.

Comments: A few random tracks not associated with particles.
One 10 micron diameter sphere noted, no tracks, could mean poor autoradiogram.

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 9627 Type Casella Impactor Stage No. 1
Location Arc G-054 % Sample Area Measured 100 Autoradiographic Exposure 1440 Min.

Comments: Air Gap autoradiogram indicated 13 major particles. Heavy deposit makes determination of active particle difficult. Particles marked A may not be the active particle.

0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9.μ	12.7μ	18μ	25μ	36μ	51μ	MISC. STARS
S 5% W 28	S 2% W 5/3	I 2% W 3/3		S 2% W S	S 2% W S	O 2% W S	S 2% W S	A W I S	O 2% W S	A ? ? S	S 2% W S*	A ? I S	??? 250
	S 2% W 50			S 2% W 3/3			A_2 2% W 3/3	A W I S	A W I S		I 2% I S		
	O - - 29								S 0/0 W 2/3				
	S - - ?												

* may be attached to 18μ aptere and other larger particles

xd / 22 particles

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER ≥ 0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 9627 Type Casella Impactor Stage No. 2
Location Arc G-054 % Sample Area Measured 100 Autoradiographic Exposure 1440 Min.

Comments: Overloaded deposit. Low power scan indicates 53 major active particles. Masking of center of alpha stars suggests that true distribution would peak at 2.2 μ.

		0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9.0μ	12.7μ	18μ	Miscellaneous Stars	
			S 2/M W 3/8	S 2/M W 200	A_2 - 125	S 2/M W 3/2	S 2/M W S			A W-I 175			??? 125
			A ? ? 40	S ?/M S 175	S 2/M W 3/4		O 2/M W 150						??? 200
			S 2/M W 150	I - W 125	S 2/M S 100							11 Cases	A ?? 3/4
			O ? S 90	S 2/M S 110								8 cases	A ?? 1/2
			O ? ? 3/8	S 2/M W 160								4 cases	A ?? S
			O 2/M W 150										
			A_2 2/M W 125							large agglomerates are			
			S 2/M W 160							probably masking		true particle.	
			S 2/M W 125										
			9	5	3	1	2			1		23	Total 44

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 9627 Type Casella Impactor Stage No. 3
Location Arc @-054 % Sample Area Measured 10 Autoradiographic Exposure 5700 Min.

Comments: A dispersal of a portion of the strip deposit. Low power scan indicates 30 prominent alpha stars.

			0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ		Miscellaneous Stars
			S??33	S??14	S??S120	O??S120	O??W60	O??WS		A??WS		???60
			O??40	A??45	S??--	S??S 180	O??W	I??W200				???7
			O??24	O??80	S??W	A??W175						???28
			???100	S??150	A??64	A??--200						???36
			S???29	A??140	O??W	I??W120						???40
			S???24	???--	S??C175	S??S125						???200
				S??W	O??--	I??200						???--
				S??S150		I??150						
				S??S200		A??--						
			6	9	7	9	2	2	1		7	

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER ?0.5 MICRON

Type Casella Impactor Stage No. 1
Tracerlab No. 9626
Autoradiographic Exposure Below Min.

0	1	7	1	7	1	9	1	2	2			1				7		Total WS

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER ≥ 0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 9626 Type Casella Impactor Stage No. 1
Location Arc G-060 % Sample Area Measured 100 Autoradiographic Exposure Below Min.

Comments: Air Gap autoradiogram indicated 11 major active particles. A few tracks 100 μ long, probably proton tracks, were observed. Medium to heavy particle population

	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9.μ	12.7μ	18μ	25μ	36μ	51μ
Preparation a.													
	120 Min					I $\frac{0}{1}$ R W 80	O $\frac{8}{8}$ R W 100	I $\frac{2}{2}$ W 22	S $\frac{0}{8}$ R W S		D $\frac{0}{8}$ R W S	I $\frac{0}{M}$ I S	
								I $\frac{2}{2}$ W 20	I $\frac{8}{1}$ W $\frac{5}{8}$				
									$\frac{C_2}{A_2}$ B - 120				
Preparation b.													
	1440 Min					S $\frac{8}{8}$ R W S	O $\frac{8}{8}$ R W $\frac{5}{8}$			Miscellaneous Stays ONLY			
											e e e S		
											? ? ? S		
											? ? ? 200		
						2	2	2	3		1	1	

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 70.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 9626 Type Casella Impactor Stage No. 2
Location Arc G-060 % Sample Area Measured 100 Autoradiographic Exposure 1440 Min.

Comments: low power scan indicated approx. 60 stars most of which were $\frac{5}{4}$ or heavier. Preparations were difficult to examine due to heavy deposit.

	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9μ	12.7μ	18μ	Miscellaneous stars Only	
Preparation a.	0-3 35	I $\frac{8}{8}$R W $\frac{3}{4}$	S $\frac{0}{2}$? 64	S $\frac{8}{8}$R W $\frac{3}{2}$		I $\frac{0}{2}$ W 80		A_3 -- $\frac{3}{2}$			??? 4	
		S $\frac{0}{2}$ W 120	S $\frac{8}{8}$R ? $\frac{3}{8}$	S $\frac{8}{8}$R W $\frac{3}{2}$		I $\frac{0}{2}$RW $\frac{5}{4}$					??? 13	
			S $\frac{8}{8}$R W $\frac{3}{2}$								??? 80	
											??? $\frac{3}{8}$	
											??? $\frac{1}{8}$	
											??? $\frac{5}{8}$	
											??? $\frac{3}{4}$	
											??? $\frac{1}{2}$	
Preparation b.		S $\frac{8}{8}$R W 80	S $\frac{8}{7}$W 10	? $\frac{8}{8}$R W S	S $\frac{8}{8}$R W S			S $\frac{3}{2}$ S 35			??? 5	
		I $\frac{8}{8}$R W $\frac{5}{8}$	S $\frac{8}{8}$R W $\frac{3}{2}$	S $\frac{8}{8}$R W S							??? 16	
		S $\frac{8}{8}$R N $\frac{3}{4}$	A_3 $\frac{8}{8}$R N $\frac{3}{4}$	0 $\frac{8}{8}$R W $\frac{3}{4}$							??? 73	
			S $\frac{8}{8}$R N $\frac{3}{4}$	I $\frac{8}{8}$R W $\frac{5}{2}$							$\frac{5}{8}$	3
				S $\frac{8}{8}$S $\frac{5}{2}$							$\frac{3}{4}$	7
											$\frac{1}{2}$	11
											5	7
	1	2	7	7	1	2		4			23	54

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 70.5 MICRON

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER ≥ 0.3 MICRON

Sample Description: Event Double Tracks Tracerlab No. 9626 Type Casella Impactor Stage No. 3
Location Ave G-060 % Sample Area Measured ~25 Autoradiographic Exposure 5700 Min.

Comments:

Alpha Star-Particle Pairs:

<0.47μ	0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ
S CL S24	S CL S 60	A 1/2 S NM	A_2 CL W 3/4	I BR ? 3/4	O ? ? 5/2	A_2 ? ? 3/4		
	I CL W S 31	S CL S 3/4	I ? ? 3/4	I CL W 280	O BR W 7			
	I CL ? 5/4	S CL S 17	S R S160		I G W 4			
		S V S 3/4	S A CL S80		I BR 1/2 W 7			
		S CL S 44	A_2 CL ? 180		I BR 1/2 W10			
1	3	5	5	2	5	1		

Alpha Stars Only:

0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	101-200	3/4	5/2	S
0	2	4	3	3	0	1	1	1	0	1	5	1	0

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 70.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2724 Type Casella Impactor Stage No. 1
Location Arc H-06B % Sample Area Measured _____ Autoradiographic Exposure _____ Min.

Comments: Phosphor autoradiogram assembled in field indicates 50 prominent stars.

Reticle Value, Zenith Plate 1800 Min.	3	4	5	6	7	8	9	10	11	
Spot image diameter in mm.	0.07	0.09	0.14	0.19	0.27	0.38	0.54	0.77	1.09	
Frequency of Occurrence	0	4	8	7	3	12	10	2		Total 50
Particle Size PuO_2 in microns†	0.4	0.5	0.8	1.0	1.4	2.1	3.0	4.6	7.3	
" " R.C.S. " " †	1.2	1.5	2.2	2.9	4.0	5.8	8.7	14.0	25.	

See figure A.2 Data fits curve indicating that radiation damage from several months exposure of phosphor has not diminished response seriously.

† Calibration by R. Cooper, UNREF

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 70.5 MICRON

Sample Description: Event _____ Tracerlab No. _____ Type Casella Impactor Stage No. 2
Location _____ % Sample Area Measured _____ Autoradiographic Exposure _____ Min.

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUI ALENT DIAMETER 7.05 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2724 Type Casella Impactor Stage No. 2
Location Area H-068 % Sample Area Measured 9.30% Autoradiographic Exposure _____ Min.

Comments: Low power examination indicates 1188 prominent alpha stars.
Total particle population is medium. Deposit fairly well defined. Some large particles in deposit

			0.85 μ	1.1 μ	1.6 μ	2.3 μ	3.1 μ	4.5 μ	6.4 μ	9. μ	12.7 μ	Alpha Stars Only	
Preparation a.			S ? ! 3/8	S 0/7 ? 72	S 3/7 ? 64	S 0/4 S 5/8	A_3 0/8R W S	A_{10} 0/8R W S	A_4 -- S				
				S 0/8R S 3/8	O 0/8R W 3/8	A_3 0/8R W 3/8	S 0/8 W 3					<0.5 ? ? 20	
	1200 mm			S 0/8R ? 7/8	A_2 -- 3/8	A_2 0/8R W 3/8	J 0/8R W S					<0.5 ? ? 20	
				S 0/8R ? 40	O 0/8R W 3/8	S 0/8R W 3/4	I 0/8R W 33					<0.5 ? ? 6	
				S 0/8R W 3/8	A_3 0/8R W 3/8	A_2 0/8R W 3/4	S 0/8R W 1					? ? ? 52	
				S 0/8R S 80	S 0/8R S 80	A_2 0/8R W 3/4	A_2 -- 3/8					? ? ? 80	
				S 0/8R W 3/8	I 0/8R N 3/4	A_2 -- 80	A_2 -- S					? ? ? 3/8	
				S 0/7 W 3/8	S 0/8R N 3/4	A_2 0/8R W 3/2	S 0/7 W I 2					? ? ? 9	
				S 0/8R ? 3/8	S 0/8 W 1	S 0/8R W S	J 0/8R W S						
					I 0/8R W 3/2		A_2 0/8R W 3/8						
					I 0/8R N 3/4								
					A_2 0/8R W 3/8								
					J 0/8 ? 100								
					A_3 0/8R ? 7/8								
					S 0/8R W 5/4								
					S 0/8R ? 3/8								
			1	9	16	9	10	1	1			7	Total 53
													53/1188 = 4.5%

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2724 Type Casella Impactor Stage No. 3
Location Arc H-068 % Sample Area Measured ~2.5 Autoradiographic Exposure 5700 Min.

Comments:

<0.47μ	0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9μm
S ? ? 19	A_2 BR/Y ? 19	I BR/Y W 5/8	S A/Y S 5/8	I Y/DK W 10	A_2 Y/Y : 5/8		S BR/DK W 38	A_2 P/BR W 5/2	
S Y/Y ? 6	S ? ? 16	A_2 BR/S ? 5/8	A_2 BR/DK W 5/4	S P/BR W 5/2			S P/Y W 5		
S ? ? 3	S ? ? 26	A_3 BR/S ? 5/8	A_3 A/Y W 5/8	A_2 BR/Y W 5/4					
S ? ? 29	S ? ? 26	S BR/Y ? 60	I BR/BR W 5/4	S BR/Y ? 5/4					
? ? ? 24	S ? ? 33	A_2 BR/Y ? 5/8	S BR/BR W 5/4	? P/DK W 5/4					
S ? ? 13	S ? ? 16	A_2 BR/Y W 5/8	A_2 BR/S W 5/4						
	S ? ? 35	S Y/Y S 3	S BR/S W 5/4						
	S ? ? 34	S BR/DK W 5/4	S BR/S W 5/4						
	S ? ? 48	I BR/Y W 5/8	S Y/Y I 5/4						
	? ? ? 25	I BR/Y W 5/8	A_2 P/Y ? 5/4						
	S ? ? 21	S ? ? 3	A_2 P/Y ? 5/4						
		A_2 BR/Y ? 5/8	A_2 BR/Y ? 5/8						
		I BR/Y ? 80	S Y/DK S 30						
		A_2 BR/Y ? 5/4	A_2 Y/Y S 80						
		O BR/Y ? 52	S P/Y ? 5/4						
		A_2 BR/S ? 80	? P/DK ? 5/4						
		S BR/S ? 5/4	S C1 W 56						
		I BR/S ? 5/4	? O/DK ? 5/4						
		S Y/DK ? 35							
		A_2 ? ? 5/4							
		S O/Y ? 5/4							
		S O/Y ? 5/8			27/5700 = 7.3% $P_u^{239}O_2$		for 0.85μ class		
		A_2 P/Y ? 78							
		S BR/Y ? 60							
		S ?/Y ? 49		60/5700 =	4.4 % $P_u^{239}O_2$	for	0.85μ class		
		S O/Y ? 148							
		S O/S ? 5/8							
average	(27t)	(tot on PS)			.175/5700 = 6out/5700		wt% $P_u^{239}O_2$		

7.6 mm²

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Stage No. 1

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 9675 Type Casella Impactor Stage No. 1
Location A-L I-059 % Sample Area Measured ~50% Autoradiographic Exposure below Min.

Comments: Priority Sample for Project 4.1, Submitted for radiochemistry before area determination, estimate area scanned to be 50%

0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.6μ	6.4μ	9μ	12.7μ	18μ	25μ	Misc.	
				S Cl/W S 4	S Cl/W S 26	S O/W W 3/4	O O/Pk W 3/4	I O/Pk W 3/4	S O/W I 3/2	S O/Pk I 3/2			
						S O/Pk W 3/4	S O/W W 3/4	A2 O/W W 5/4	A2 ?? 80	I O/W I 4/4			120 Min
							S O/Pk W 3/4	O O/W W 3/2		I O/W W 5/2			
							S O/W W 5/4			S O/W I 3/4			
I Cl/W 31	I Cl/W I 15	O O/W I 100	I O/W I 38	S O/W I 3/2	S O/W I 3/2	S O/W I 5	S O/W W 3	O O/W W 5	I O/W I 5/2	I O/W I 5		??? 34	
			I O/Pk I 3/4	S O/W I 3/4	A2 O/W I 1/2	I Cl/W I 45	I O/W I 50	I O/W I 5		A2 O/W I 5		" 50	
				I O/W I 80		I O/W I 3/4	I Cl/W S 60	S O/W I 5		A2 O/W I 50		" 1	
				S O/W I 120		I O/W I 5	I O/W S 5	S O/W I 5				" 32	
							I O/W I 3/4					" 5	
							A2 O/W I 5					" 11	
												" 24	
												" 3/4	2000 Min
												" 3/4	
												" 6	
												" 1	
												" 1	
												" 80	
												" 5	
1	1	1	2	5	3	6	10	7	3	7		14	

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 7 0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 9675 Type Casella Impactor Stage No. 2
Location Arc I - 059 % Sample Area Measured ~ 10% Autoradiographic Exposure 2000 Min.

Comments: Priority sample Project 4.1. Estimate area scanned to be 10%.
In Data Report No 3.

< 0.47 μ	0.55 μ	0.85 μ	1.1 μ	1.6 μ	2.2 μ	3.1 μ	4.5 μ	6.4 μ	9. μ	12.7 μ	Misc.
S V/W S 9	S ? ? 10	? ○/Y ? 3/4	S ○/DK S 3/4	S ○/W W 3/4	O ○/DK W 6	I ○/W W 3/4	I ○/DK W 20	A_2 ○/W 60			? ? ? 25
S ○/W S 11	? ○/W S 5	O ○/W S 6	O ○/DK W 3/4	S ○/DK W 3/4	S ○/DK S 4	S V/W I 7		O ○/DK W 80			" 3/4
? ? ? 40	S V/W S 7	S ○/W S 16	I ○/DK W 60	S ○/DK W 3/4	S ○/Y S 3/4	S ○/W S 60					" 1/2
	A_2 V/W S 9	S ○/DK W 72	S ○/DK W 3/4	S ○/DK W 3/4	A_2 ? W 3/4	S ○/W W 2					" 10
	S ? S 3	S ○/W N 17	S ○/DK W 3/4	S ○/DK W 3/4	S ○/W S 8	S ○/DK W 3/4					" 15
	S ○/W S 31	S ○/W W 80	S ○/DK W 3/4	A_2 ○/DK W 3/4	S ○/Y S 3/4	I ○/W W 2					" 3/4
	? ○/Y ? 28		S ○/DK W 3/4	S ○/DK W 3/4	S ○/Y S 3/4	I ○/W W 5					" 6
			S ○/DK S 3/4	S ○/DK S 3/4	S ○/W W 8						" 10
			S ○/DK W 60	S ○/DK W 3/4	S ○/DK W 3/4						" 18
			S ○/DK W 3/4	I ○/Y W 3/4	A_2 ○/DK W 3/4						" 2
			S ○/DK W 3/4	S ○/DK W 3/4	S ○/W W 3/4						" 18
			? ○/Y ? 3/4	O ○/DK W 3/4	S I/W W 100						" 20
			S ○/DK S 3/4		? ○/DK W 3/4						" 3/4
					S ○/DK W 3/4						" 3/4
3	7	6	13	12	14	7	1	2			14

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER MICRON

... No. 2477 Type Casella Impactor Stage No. 1
... Exposure 2000 Min.

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER MICRONS

Sample Description: V. Double Tracks Tracerlab No. 2477 Type Casella Impactor Stage No. 1

Location Arc J, L4, P1 % Sample Area Measured 1% Autoradiographic Exposure 2900 Min.

Comments: New particle populations

0.85 μ	1.1 μ	1.6 μ	2.3 μ	3.1 μ	4.5 μ	6.4 μ	9 μ	12.7 μ	18 μ	~25 μ	36 μ	50 μ		
80	S $\frac{0}{BK}$ W $\frac{3}{4}$	S $\frac{0}{BK}$ W —	S $\frac{0}{BK}$ W $\frac{3}{4}$	S $\frac{0}{BK}$ W 28	S $\frac{Y}{<}$ S 10	S $\frac{0}{BK}$ W 4	S CL S 80	I $\frac{0}{-}$ I S	I $\frac{0}{Y}$ I S	I $\frac{0}{W}$ W S	I $\frac{0}{W}$ W S	I $\frac{0}{BR}$ I S		1
60			S $\frac{0}{BK}$ W $\frac{3}{4}$	S $\frac{0}{BK}$ W $\frac{1}{2}$	S $\frac{0}{BR}$ W S	S $\frac{0}{BK}$ W S	I $\frac{BR}{W}$ S 68		S $\frac{0}{BR}$ W S		I $\frac{0}{BR}$ I S			2
100			S CL S $\frac{3}{4}$	S CL S 50	A_2 $\frac{0}{-}$ W S	I $\frac{Y}{-}$ W 17	S $\frac{0}{BK}$ W $\frac{3}{4}$							3
				S CL S 15	S CL S 4	I $\frac{0}{BK}$ W S	I CL W 50							4
				S $\frac{0}{BR}$ W S	S CL S 60	S $\frac{0}{BK}$ W S							10 mm →	5
				S CL S 2	S $\frac{0}{BR}$ S $\frac{3}{4}$	S CL W 60								6
				S $\frac{0}{BR}$ W $\frac{3}{4}$	S $\frac{0}{BR}$ W S	S CL S 10								7
				A_2 $\frac{0}{BK}$ W $\frac{3}{4}$	A_2 $\frac{0}{BK}$ W S									8
				S $\frac{0}{BK}$ W $\frac{1}{2}$										9
				A_2 $\frac{0}{BR}$ W S										10
														11
														12
														13
														14
														15
														16
														17
														18
														19
														20
														21
														22
														23
														24
														25
														26
														27
														28
														29
														30
3	1	1	3	10	9	7	4	1	2	1	2	1		

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER ≥0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2477 Type Casella Impactor Stage No. 1
Location Ave J, L4, P1 % Sample Area Measured ~9.5 Autoradiographic Exposure 120 Min.

Comments:

0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9.μ	12.7μ	18.μ	25μ
		S 3/BK W 60	O 3/BK W 50	I 3/E I 100	S 3/W W 76	I 3/Y W 33	S 3/4 S 150	O 3/Y W 3/2	S 3/M I S	
		I 3/BR W 10	S 3/M W 32	I 3/Y I 64	S 3/M W 28	I 3/Y W 88	O 3/Y W 3/4	3 3/Y W 3/2		
		I 3/BR W 10	S 3/4 S 10	S 3/BR W 40	S 3/Y W 80	O 3/Y W 3/4	I 3/BR W 3/4	A_2 3/Y W 3/2		
		A_2 3/Y S 18	S 3/BR W 80	S 3/BK S 7	S 3/BR W 156	S 3/BR I 3/4				
		S 3/Y W 16	S 3/BK W 20	S 3/Y W 60	S 3/BR W 3/4	S 3/BR S 200				
		S 3/BK W 33	S 3/BK N 75	S 3/Y W 24	S 3/Y W 3/4	S 3/4 W 16				
			S 3/BK W 68	S 3/BK S 120	S 3/BK W 90					
			S 3/BK W 60	S 3/BR W 80	S 3/Y W 88					
			O 3/BR W 30	S 3/BK W 120	S 3/BK W 200					
				S 3/W W 21	S 3/BR W 3/4					
				S 3/BK W 3/4						
				S 3/BK S 31						
				S 3/E W 100						
				I 3/BR W 21						
				I 3/BR W 80						
	S 3/4? 20	S 3/Y W 30	S 3/BK W 58	S 3/BK W 3/4	O 3/BK W 3/4	S 3/BR W 3/4	I 3/W I 3/4	S 3/BR W 18	I 3/BR I 50	I 3/BR I 3/2
		S 3/Y S 10	S 3/BK W 120	S 3/BR W 36	S 3/W W 81	S 3/BK W 34	O 3/BK W 3/4	S 3/W W 5	S 3/BR I S	I 3/W W 3/4
		I 3/Y I 22	S 3/BR W 30	S 3/BK W 3/4	O 3/BK W 3/4	S 3/BR W 3/4	I CL I 31			
		S 3/BR W 30	S 3/BR W 30	S 3/BK W 100	S 3/4 W 80	I 3/W W 84	A_2 - W 150			
			S 3/BR W 80	S 3/BR W 74	I 3/BR W 20	S 3/BK W 34				
			O 3/BK N 3	O 3/BK W 100	A_2 3/BR W 30	S 3/BK W 60				
			I 3/E W 50	S 3/BR W 120	A_2 3/BR W 150					
			S 3/BK W 20	S 3/Y W 120	S 3/BR W 200					
				S 3/W W 50						
				S 3/E W 80						
				S 3/BR W 48						
				I 3/BK W 152						
	1	10	17	27	18	12	7	5	3	2

26 mm²

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER ≥0.5 MICRON

...44 Tracks Tracerlab No. 2477 Type Casella Impactor Stage No. 2
...Area Measured ~14 Autoradiographic Exposure below Min.

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2477 Type Casella Impactor Stage No. 2.
Location Arc J, L4, P1 % Sample Area Measured ~14 Autoradiographic Exposure below Min.

Comments:

0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9.μ	12.7μ	18μ	25μ
S??2	S??6	I $\frac{O}{BR}$ W6	S $\frac{BR}{BR}$ N4	S $\frac{O}{W}$ N25	A_3 $\frac{OR}{BR}$ W75	A_2 S?128		S $\frac{O}{W}$ W $\frac{3}{4}$			S $\frac{O}{W}$ WS
		S $\frac{O}{BR}$ W20	S $\frac{O}{BR}$ W26	S $\frac{O}{BR}$ N46	S $\frac{L}{L}$ S27	A_2 $\frac{BR}{BR}$ W21					
		S $\frac{Y}{BR}$ S15	O $\frac{O}{BR}$ W26	A_7 $\frac{BR}{BR}$ N50	S $\frac{L}{L}$ I 2	S $\frac{O}{BR}$ W $\frac{3}{4}$					
		I $\frac{Y}{BR}$ W8	S $\frac{O}{BR}$ W7	I $\frac{BR}{BR}$ N54	S $\frac{O}{BR}$ W150	S $\frac{O}{BR}$ W200					
		S $\frac{BR}{BR}$ S14	S $\frac{Y}{BR}$ W5	I $\frac{BR}{BR}$ W8	S $\frac{O}{BR}$ W52	S $\frac{L}{L}$ I 11					
		A_3 $\frac{Y}{BR}$ W2	O $\frac{Y}{BR}$ W3	S $\frac{BR}{BR}$ W31							
			S $\frac{Y}{BR}$ W5	S $\frac{O}{BR}$ I28							
			S $\frac{O}{BR}$ W30	A_2 ?2 15							
			S $\frac{BR}{BR}$ W17	S $\frac{BR}{BR}$ W14							
			A_4 ??19	S $\frac{BR}{BR}$ W20							
			S $\frac{BR}{BR}$ W13	S $\frac{O}{BR}$ W50							
				S $\frac{O}{BR}$ S36							
				S $\frac{BR}{BR}$ W31							
				S $\frac{L}{L}$ S11							
				S $\frac{L}{L}$ S12							
				S $\frac{L}{L}$ I28							
				S $\frac{O}{BR}$ S60							
				S $\frac{BR}{BR}$ W9							
S $\frac{L}{L}$ S10	I $\frac{Y}{BR}$?60	I $\frac{Y}{Y}$ W $\frac{3}{4}$	I $\frac{R}{Y}$?7	I $\frac{O}{Y}$ I $\frac{5}{4}$	I $\frac{O}{W}$ W $\frac{5}{4}$	S $\frac{O}{Y}$ WS					
		S $\frac{O}{BR}$ W $\frac{3}{4}$	S $\frac{O}{BR}$ W $\frac{5}{4}$	A_2 $\frac{O}{BR}$ I $\frac{5}{4}$	I $\frac{O}{Y}$ I $\frac{3}{4}$						
		S $\frac{O}{BR}$ S $\frac{5}{4}$	S $\frac{O}{Y}$ W $\frac{5}{4}$	I $\frac{O}{Y}$ I $\frac{3}{4}$	I $\frac{O}{Y}$ I $\frac{3}{4}$						
		I $\frac{O}{Y}$ W $\frac{3}{4}$	I $\frac{O}{BR}$?100	S $\frac{O}{BR}$ W $\frac{3}{2}$							
		I $\frac{BR}{L}$?25	S $\frac{O}{C}$ S15	S $\frac{L}{L}$ S2							
			I $\frac{O}{Y}$ I $\frac{3}{4}$	I $\frac{O}{Y}$ W $\frac{3}{4}$							
			I $\frac{O}{BR}$ I $\frac{3}{4}$	I $\frac{O}{Y}$ I $\frac{3}{4}$							
			S $\frac{O}{BR}$ I $\frac{3}{4}$	A_2 $\frac{O}{Y}$ I $\frac{3}{2}$							
			S $\frac{O}{BR}$ I $\frac{5}{4}$	I $\frac{L}{L}$ I30							
				I $\frac{O}{BR}$ I $\frac{3}{4}$							
				S $\frac{O}{BR}$ W $\frac{3}{4}$							
2	2	11	20	29	8	6		1			1

4.5 mm² 120 Min. Exposure

4 mm² 2000 Min Exposure

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 71.0 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2947 Type Casella Impactor Stage No. 1
Location Avc R-056 % Sample Area Measured Total Autoradiographic Exposure below Min.

Comments: Air gap autoradiogram indicates 15 active sites.
Total particle population is medium - heavy, predominantly fine sizes.

		2.2μ	3.1μ	4.5μ	6.4μ	9.0μ	12.7μ	18μ	Alpha Stars Only
Preparation a.			A_2 5% RW 3/8	0 3% WS	S 3% WS	0 1% W 3/8	I 1% W 3/8		? ? 5/8
				S 80/5 W 5/8	A_2 – – 3/4		I 1% WS		? ? 5/8
	1440 Min.				S 3% W 3/8		S 5% I 3/8		
							I 1% WS		
Preparation b.				S ? ? 3/4	I 3% W 5/8			A_2 3% W 5/8	
	~180 Min.			0 ? W 5/8					
				A_2 ? W 3/4					
				A_2 ? 80 3/8					
			1	6	4	1	4	1	2

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 70.5 MICRON

Event Double Tracks Tracerlab No. 2947 Type Casella Impactor Stage No. 2
% Sample Area Measured below Autoradiographic Exposure below Min.

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 70.5 MICRONS

Sample Description: Event Double Tracks Tracerlab No. 2947 Type Casella Impactor Stage No. 2
Location Arc R-056 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: Low power scan indicates 175 prominent alpha stars.
Total particle population is medium, very dense at one edge.

			0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9.0μ	Alpha Stars Only		
Preparation a.			S 88/2R ? 80	I 0/8R ? 88	S 2/2R W 3/4	O 0/y ? 3/4	I 0/8R W S	S 0/75 5/8	S 0/8R W S		<0.5μ ? 7		
	42% of deposit		S 8/y ? 23	S 0/= W 68	S 2/2R ? 3/4	S 2/2R W 5/8	S 0/= S 28		I 2/8R W S		<0.5μ ? 5		
	1440 Min.		S 0/= ? 28	S 0/y ? 2/8	S 2/8R W 5/8	O 2/2R W 5/8	O 0/y W 5/8				<0.5μ ? 19		
			S 88/2R ? 60	S 0/y ? 30	I 2/8R ? 5/8	S 2/2R W 1/4	A2 2/8R W 3/8				<0.5μ ? 11		
			S 88/y ? 72	S 2/8R W 1/8	? 0/2R W 5/8	S 2/2R W 5/8	A2 2/8R W 5/8				? ? ? 18		
				S 2/y ? 1/8	S 2/2R W 3/4	S 2/2R W 3/8	S 2/8R W S				? ? ? 6		
				S 2/2R W 3/4	I 2/2R ? 5/8	S 0= S 80	S 0= W 11				? ? ? 3/8	3 cases	
				S 2/y ? 3/4	S 0= S 48	S 2/2R W 3/4	O 0/W S 3/4				? ? ? 1/4		
				S 2/y ? 1/8	I 2/y W 1/8	A2 2/2R W 3/4	S 0= W 60						
					S 2/2R ? 3/4	S 2/2R W 1/2	S 2/y W 3/8						
					S 2/W S 1/2	I 2/y W 1/2							
					A2 2/2R ? 3/4	S 88/y S 3/4							
					S 2/2R W 3/8	A2 2/2R W 5/8							
					S 0/2R W 5	A2 2/2R W 5/8							
					S 2/2R W 3/4	I 2/2R ? 5/8							
					S 2/y W 3/4	S 2/2R W 5/8							
					S 2/2R W 3/4	S 0= S 5/8							
					S 2/2R W 3/4								
			5	9	18	17	10	1	2		10	Total	72
Preparation b.				I ? ? 13	S 0= ? 10	S 0= ? 51	I 0= W 80				? ? ? 50		
	14% of deposit				S 88= ? 48	I 88= ? 80	S 2= ? 5/8				? ? ? 60		
	120 Min				O 2/W 60						? ? > 5/8	5 Cases	
					S 88= ? 84								
					I 0= W 51								
					S 2= W 8								
					S 2= W 21								
				1	7	2	2				7	Total	19
			5	10	25	19	12	1	2		17	Total	91

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Fixed Double Tracks Track Plate No. 2947 Type Casella Impactor Stage No. 3
Location Arc A-056 Sample Area Measured below Autoradiographic Exposure below Min.

Comments: Estimate 203 predominant alpha emitting particles, based on low power scan of a portion of deposit, total particle population is heavy, well defined deposit.

	0.39	0.5 μm	0.85 μm	1.1 μm	1.6 μm	2.2 μm	3.1 μm	4.4 μm	6.2 μm	9 μm	12.7 μm	20 μm	MISC TRACKS
Preparation a.		I ? 13	I ? 21	S ? 60	S W								4
		I ? 18	S ? 24	S ?	I ?								6
		I ? 5	I ? 15	I ? 19	I ?								7
		S ? 13	S ? 10	S ? 60	I W								12
		I ? 19	S ? 28		S W								15
			S W 9										36
			S ? 30										41
Preparation b.		I -- 20	I - 24	A_3 I 7	I I 15	I I 64	I W 35	I I			S -	20	(1TR)
~15% of Sample	I -- 9		S 18	A_2 --160	I -- 3	S W	A_2 --140	I I			A_2 -- 12	7	(2TR)
86,40 Min	--- 8		O --52		I W32	A - 18	I I160	A --100				5	(3TR)
Exposure	I -- 8				I I 69	A --	I - 96					3	(5TR)
	--- 20				I I 7		I I180					5	(6TR)
					A --20		I -- 80					2	(25TR)
					I -- 7		I --					2	(3/8)
Preparation c.	Poor Preparation						S --	A_3 --				I I	-5
50% of Sample								A_2 --112					
63000 Min. Exposure	4	6	10	6	12	4	8	3			2		
Alpha Tracks Only			1-2	3-5	6-10	11-25	26-50						
Frequency of Occurrence			50	16	5	8	1						

2 Tracks equated to 0.1 micron sphere indicated 9% $Pu^{239}O_2$ equated to 0.7 μm sphere indicated 20% $Pu^{239}O_2$

See Table A.9 For Electron Microscopy of this Sample.

See Figure 3.22 for Electron Micrograph.

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER ?0.33 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2965 Type Andersen Impactor Stage No (TOTAL PARTICLES)
Location Area R-064 % Sample Area Measured — Autoradiographic Exposure — Min.

Comments: Total particles within portion of single deposits. No attempt made to normalize this data.

Stage		0.39μ	0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9μ	12.7μ	18μ
	Spheres	81	9	—	—	1	2	—	—	—	—	—	—
	Irregular	22	29	19	7	1	—	—	1	—	1	—	1
	Flake	—	4	5	6	3	6	4	1	—	—	—	1
	Total	103	42	24	13	5	8	4	2	—	1	—	2
Stage 2													
	Sphere	70	16	—	—	—	—	—	—	—	—	—	—
	Irregular	17	24	14	6	2	1	1	1	—	—	—	—
	Flake	—	1	2	3	6	8	7	6	3	2	1	1
	Total	87	41	16	9	8	9	8	7	3	2	1	1
Stage 3													
	Sphere	95	11	1	—	1	—	—	—	—	—	—	—
	Irregular	11	35	9	1	3	—	—	—	—	—	—	—
	Flake	—	—	1	5	2	1	4	2	2	1	—	1
	Total	106	36	11	6	6	1	4	2	2	1	—	1
Stage 4													
	Sphere	78	11	—	—	—	—	—	—	—	—	—	—
	Irregular	18	41	15	4	3	1	2	—	1	—	—	—
	Flake	—	2	3	7	5	3	1	—	—	—	—	—
	Total	96	54	18	11	8	4	3	—	—	—	—	—
Stage 6													
	Sphere	36	1	—	—	—	—	—	—	—	—	—	—
	Irregular	18	3	3	—	—	—	—	—	—	—	—	—
	Flake	—	2	2	6	3	2	1	—	—	—	—	—
	Total *	54	6	5	6	3	2	—	—	—	—	—	—

Note that fine particles predominate on all stages

* Counted 123 smaller than 0.33 micron.

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON (CONTINUED)

Sample Description: Event Double Tracks Tracerlab No. 2965 Type Andersen Impactor Stage No. 1
Location Arc R-064 % Sample Area Measured 11% Autoradiographic Exposure below Min.

Comments: This data is a good representation of the larger particles on this stage. Several of the particles have satellite particles attached to surface.

			1.1μm	1.6μm	2.2μm	3.1μm	4.5μm	6.4μm	9μm	13.7μm		
Preparation a.	49mm² 1440 Min.			S $\frac{0}{BR}$ W $\frac{3}{4}$				S $\frac{0}{BR}$ S S				1
								S $\frac{0}{BR}$ W S				2
												3
Preparation b.	117mm² 1620 Min.											4
								O $\frac{0}{BR}$ W S	O $\frac{0}{BR}$ W S			5
												6
Preparation c.	151 mm² 5280 Min			S —— $\frac{3}{4}$		S $\frac{0}{BR}$ W $\frac{3}{4}$			O $\frac{0}{BR}$ W S			7
												8
												9
Preparation d.	100 mm² 1620 Min.				S —— $\frac{3}{4}$							10
					S $\frac{0}{m}$ W $\frac{3}{4}$							11
												12
Preparation e.	182mm² 2640 Min						A $\frac{0}{BR}$ W S					13
							A$_2$ $\frac{0}{BR}$ W $\frac{3}{4}$					14
							S $\frac{0}{A}$ I $\frac{1}{2}$					15
Preparation f.	—— 60 Min		No alpha tracks observed									16
												17
												18
												19
	Area Examined / Total Area =	599 / 5407										20
												21
												22
												23
												24
												25
												26
												27
												28
												29
Totals		599mm²		2	2	1	3	5	2			30

Continued

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event [illegible] Tracerlab No. 2965 Type Andersen Impactor Stage No. 1

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2965 Type Anderson Impactor Stage No. 1
Location Arc R-064 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: Continuation

a. Phosphor Autoradiography Data: (Total Area)

	3	4	5	6	7	8	9	10	11	12	
Reticle Value, SuperXX (3900 Min.)	18	12	1	5	9	9	5	7	4 Total 24	1 Total 71 cm²	1
Frequency of Spot Occurrence											2
Reticle Value, Zenith (1000 Min.)		3	4	5	6	7	8	9	10	11	3
Image Diameter, in millimeters		0.07	0.09	0.14	0.19	0.27	0.38	0.54	0.77	1.09	4
Particle Size†, Roller Coater Composition		1.2μ	1.5μ	2.2μ	2.9μ	4.0μ	5.8μ	8.2μ	14μ	17μ	5
Particle Size†, PuO_2		0.4μ	0.5μ	0.8μ	1.0μ	1.4μ	2.1μ	3.0μ	4.6μ	6μ	6
											7

b. Nuclear Track Autoradiography Data: (From previous Table)

Observed Sizes Corresponding To Above Image Spot Diameters											8
											9
						3.1μ	1.6μ	6.4μ	6.4μ		10
						1.6μ	3μ		6.4μ		11
						2.3μ	4.5μ		9.μ		12
						2.3μ	4.5μ				13
						4.5μ					14
											15
											16
											17
											18
											19
											20
											21
											22
											23
											24
											25
											26
											27
											28
											29
											30

† Calibration By R. Carter, U.K.A.E.A.

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2965 Type Andersen Impactor Stage No. 2
Location Arc R-064 % Sample Area Measured 7.4% Autoradiographic Exposure below Min.

Comments: Particles with smaller satellite particles on surface or nearby.

		?	?	?	0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ		
Preparation a.	110 mm² 1440 Min	2	8	1	S $\frac{?}{5}$ W 80	O $\frac{?}{A}$ S 14		O $\frac{?}{BR}$ W $\frac{3}{4}$	S $\frac{?}{C}$ W 200	A $\frac{?}{V}$ I $\frac{3}{4}$			1
		2	3	1	O $\frac{?}{S}$ S 13	S $\frac{A}{}$? 17		A $\frac{?}{A}$? —	S $\frac{?}{A}$ W $\frac{3}{4}$	A $\frac{?}{BR}$ W $\frac{3}{4}$			2
		1	2	7	10	11		33					3
			7	6	S $\frac{?}{S}$ S 7			34					4
			1	5				A $\frac{?}{A}$ W $\frac{3}{4}$					5
			1	42				S $\frac{?}{BR}$ W $\frac{3}{4}$					6
													7
Preparation b.	125 mm² 2640 Min	1	3	3	O $\frac{?}{AL}$ S 5	S $\frac{?}{A}$ S 90	O $\frac{?}{BR}$? 100	I $\frac{?}{BR}$ W $\frac{3}{4}$	I $\frac{?}{BR}$ I 33	O $\frac{?}{BR}$ W $\frac{3}{4}$			8
		6	3	1		S $\frac{?}{BR}$? 110		S $\frac{?}{BR}$ W 200		O $\frac{?}{BR}$ W $\frac{3}{4}$			9
		1	4	6									10
		10	16										11
		14											12
													13
Preparation c.	166 mm² 1440 Min		8				S — $\frac{5}{4}$	I $\frac{O}{}$ W $\frac{3}{4}$	S $\frac{O}{}$ W $\frac{3}{4}$	A $\frac{O}{}$ W $\frac{3}{4}$	S $\frac{O}{}$ W S		14
							— $\frac{5}{4}$		A_2 $\frac{O}{}$ W $\frac{3}{4}$		A_2 $\frac{O}{}$ W S		15
									S $\frac{O}{}$? $\frac{3}{4}$		I — $\frac{5}{4}$		16
													17
													18
													19
	Examined Area / Total Area =	401 / 5407											20
													21
													22
													23
													24
													25
													26
													27
													28
													29
													30
Totals				28	5	5	3	9	6	5	3		
			401 mm²										

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Andersen Impactor Stage No. 2* — Min.

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 [illegible]

Sample Description: [illegible] Double Tracks Tracerlab No. 2965* Type Andersen Impactor Stage No. 2*
Location Arc R-064 % Sample Area Measured — [illegible] Photographic Exposure — Min.

Comments: * Particles listed on previous table are compared with phosphor autoradiogram data.

a Phosphor Autoradiography Data: (Total Area) Brackets indicate closely grouped particles, possibly an orifice effect.

Reticle Value, SuperXX (3000 min.)	3	4	5	6	7	8	9	10	11	12	162 Particles 24 cm²	
Frequency of Occurence of Spots	30	6	8	12	22	32	26	22	4			
Reticle Value, Zenith (1600 Min.)	3		4	5	6	7	8	9	10	11		
Image diameter in millimeters	0.07		0.09	0.14	0.19	0.27	0.38	0.54	0.77	1.09		
Particle Size†, Roller Coaster Composition	1.2μ		1.5μ	2.2μ	2.9μ	4.0μ	5.8μ	8.7μ	14μ			
Particle Size†, PuO_2	0.4μ		0.5μ	0.8μ	1.0μ	1.4μ	2.1μ	3.0μ	4.6μ			

b Nuclear Track Autoradiography Data: (from previous Table)

Observed Sizes Corresponding to Above Image Spot Diameters

Preparation a.	110 mm²		1.6μ 1.6μ 0.85μ		2.2μ	2.2μ 1.6μ 0.85μ 1.6μ	1.6μ 3.1μ 0.8μ 15 lesser		8μ 6μ 3μ 3μ			
Preparation b.	125 mm²					1.6μ 1.6μ 0.85μ 0.85μ 1.1μ 3 lesser 2.2μ 0.55μ		3.1μ 0.55μ 2 lesser 3.1μ				
Preparation c.	166 mm²				1.1μ 1.1μ	2.2μ 1.6μ 3.1μ	2.2μ 2.2μ	4.5μ	4.5μ			

† calibration by R Carter, U.K.A.E.A.

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Double Tracks Tracerlab No. 2965 Type Anderson Impactor Stage No. 3
Area R-064 % Sample Area Measured 8.1% Autoradiographic Exposure below Min.

Comments: Small satellite particles observed on larger spherical particles.

a. Optical Microscope Observation.

			0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ		
Preparation a. (1.5cm from center)	192mm² 4320 Min			S — 5/4	S — 5/4	I 0/BR W 120 I 0/= W 3/4 I 0/= W 5/4	I W 15 I 0/BR W 3/4 I 0/BR I 3/4 S — S 5/4 I 0/BR W 3/2 I 0/BR I 3/2 S — S 3/4 S 0/Y I 3/2	S 0/Y W 13 I BR/BR W 15	I 0/BR I 3/4			1 2 3 4 5 6 7 8 9
Preparation b. (near center)	132mm² 4320 Min					S 3/BR W 160 S 2/BR W 240	S A/S I 200 S 2/BR I 3/4 A₂ 1/BR I 240 A₂ 2/BR I 250					10 11 12 13
Preparation C. (near edge)	156mm² 4320 Min					I BR/BR W 3/4 S 0/S W 3/4 S BR/BR W 3/4		A₅ 0/BR W 2/3 S = S 30				14 15 16 17
	Examined Area / Total Area =	480 / 5407										18 19 20 21
Totals		480mm²		1	1	8	12	4	1		27 particles	22 23 24 25 26 27 28 29 30
b. Electron Microscope Observation of Sphere-like Particle Sizes			1						1	11		

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Anderson Impactor ... No. 3

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETERS IN A MIXTURE

Sample Description: Event Double Tracks Tracerlab No. 2965 Type Anderson Impactor Stage No. 3
Location Arc R-064 % Sample Area Measured below Autoradiographic Exposure Below Min.

Comments: Continuation

a. Phosphor Autoradiography Data: (Total Area)

Reticle Value, SuperXX (3900 Min)	3	4	5	6	7	8	9	518 Particles 24 cm²	
Frequency of Spot Occurence	12	28	22	112	112	22	10		
Reticle Value, Zenith (1000 Min)	2	3	4	5	6	7	8	9	
Image Diameter, in Millimeters		0.07	0.09	0.14	0.19	0.27	0.38	0.54	
Particle Size †, Roller Coaster Composition		1.2μ	1.5μ	2.2μ	2.9μ	4.0μ	6.8μ	8.7μ	
Particle Size †, PuO_2		0.4μ	0.5μ	0.8μ	1.0μ	1.4μ	2.4μ	3.0μ	

b. Nuclear Track Autoradiography Data: (From previous Table)

Observed Sizes Corresponding to Above Image Spot Diameters — Exact correlation could not be obtained. The particle sizes observed have been matched in descending order with the spot sizes observed.

Preparation a. Number of Observed Spots (SuperXX)				2	8	2	1
Observed Particle Size				1.6μ (3)	2.2μ (8)	3.1μ (2)	4.5μ (1)
Preparation b. "				4	4		
"				1.6μ (2)	2.2μ (4)		
Preparation a. "				2	2	1	
"				1.6μ (2)	3.1μ (1)	3.1μ (1)	
					1.6μ (1)		

† Calibration By R. Carter, U.K.A.E.A.

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Double Tracks Track Lab No. 2965 Type Anderson Impactor Stage No. 4
Location Arc R-064 Sample Area Measured: Autoradiographic Exposure below Min.
Comments:

			0.5-.5μ	.85μ	1.1μ	1.6μ	2.3μ	3.1μ		
Preparation a.	260 mm² 5760 Min.	1 80 80 3/4 14		I 1/2 BR ? 3/4 S 0 BK S 3/4 S 1/2 ? 30 I 1/2 BK W 60 S 0 BR S 3/4	I 1/2 BK ? 3/4 I 1/2 BK ? 3/4 I 0 BK S 80 I 0 BR S 3/4 I 0 BR W 25 S 0 BK S 3/4	S 2/2 S 72 S 2/2 S 42 A2 1/2 BK ? 3/4 I 1/2 W 3/4 S 1/2 S 17 S BR S 12 S 1/2 S 3/4 S 0 BK I 3/4 S 0 W 3/4 S 0 BK S 3/4 S 1/2 S 72	I 0 W 3/4 S 2/2 S 3/4 S 2/2 S 60			1 2 3 4 5 6 7 8 9 10 11
Preparation b.	In Process				S 0/1 S 24	S 0/1 S 3/4 0 0/1 S 1/2	I 0/1 BK W 24 I 0/1 BK W 150 S 0/1 W 58	I 0/1 W 67 A3 - W 100			12 13 14 15
					Misc Tracks Only — 22 — 1 — 4	 — 1/2 — 59 — 2					16 17 18 19
TOTAL				5	6	11	3		25 PARTICLES		20 21 22 23 24

a. Phosphor Autoradiography Data: (Total Area)

Reticle Value, Super Xa (3900 Min)	3	4	5	6	7	8	9	32 Particles per 144 cm²	
Frequency of Spot Occurrence	40	92	148	160	108	20	4		2 3 4

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETERS $\geq 5\mu$. MICRON

Sample Description: Event Double Tracks Tracerlab No. below Type Total Air Samples Stage No. ___
Location below % Sample Area Measured _____ Autoradiographic Exposure _____ Min.

Comments: Gross Observations, See Figure 3.10

T-Lab No.	Location			ALPHA ACTIVITY - C.P.M*		
				Sample		Cover
2527	(D) Arc A072		Clean White	5500		127
				Back up	Membrane	= 119
2989	(I) Arc B, L10, P21		Light deposit of dark particles opposite orifice	4000		—
2709	(II) Arc H-060		A few isolated black specs.	600		—
2888	(D) Arc N-068		Several black specs	1.4		—
2939	(II) Arc R-064		A few black specs.	341		—

* 32% counting efficiency

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 70.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2527 Type Total Air Sample (D) Stage No. —
Location Arc A-072 % Sample Area Measured 0.1 % Autoradiographic Exposure 3400 Min.

Comments: Portion 2x2 mm dispersed. No color observed on filter. No large particles observed on cover.

0.55μm	0.85μm	1.1μm	1.6μm	2.2μm	3.1μm	4.5μm	
S cl ≡ S 60	I ○ ≡ - 14	A_4 cl ≡ S 200	A_2 cl ≡ - 200	I BR ≡ I 48	J ○ ≡ W 3/4		
S cl ≡ S 100	I A ≡ S 180	S A ≡ - 200	A_4 cl ≡ S 100	I BR ≡ - 200	I ○ ≡ I 3/4		
	I BR ≡ - 45	S cl ≡ S 100	I ○ ≡ - 3/4	S Bα ≡ - 200			
		I ○ ≡ - 3/4	I BR ≡ - 200	A_4 A ≡ - 300			
		S BR ≡ - 200	A_3 cl ≡ S 200	I BR ≡ W 200			
		I BR ≡ - 200	I A ≡ - 160				
			I BR ≡ - 100				
			S ○ ≡ - 3/4				

$\frac{180}{2100}$ = 0.17 dis/min = 38% $P_{Pu}^{239}O_2$

$\frac{100}{2100}$ = 0.10 ≈ 77% $P_{Pu}^{239}O_2$

An area 5X as large was surveyed for the most dense track patterns

I cl ≡ - 3/2	I ○ Bα ≡ - 23/4	I Bα I 3/4
I ○ ≡ - 3/4	I ○ Bα ≡ - 3/4	
	I Bα ≡ - 3/4	
	I ○ Bα ≡ - 3/4	
	I Bα ≡ - 3/4	
	I Bα ≡ - 3/2	

$\frac{4000}{2100}$ = 3.8 dis/min

Figure 3.10 indicates some activity on the back up membrane filter. A nuclear track autoradiogram exposed for 99000 Min failed to indicate more than a few single alpha tracks.

Electron Micrographs in Figure 3.39

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 70.5 MICRON

Event Double Tracks Tracerlab No. 2989 Type Total Air Sample (I) Stage No. —
Area Measured 0.8% Autoradiographic Exposure 1440 Min.

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 70.5 MICRONS

Sample Description: Event Double Tracks Tracerlab No. 2989 Type Total Aw Sample (I) Stage No. —
Location AwCB, L10, P21 % Sample Area Measured 0.8% Autoradiographic Exposure 1440 Min.

Comments: 2x2 mm portion dispersed, Poor preparation

0.85μ	1.1μ	1.6μ	2.7μ	3.1μ	4.5μ	6.4μ	9μ	12.7μ	18μ	85μ
? - - 7	S Cl/A W 116	I A/BR W 120	S Cl/BR W 112	S A/I 1/2	S R/I 3/4	S O/BR W 3/4	S Cl W S		I OR/I S	
2 - - 5	I A/I 88	S A/BR W 116	I A/I W 200	A2 - - 136	I OR/I 3/4					
2 - - 3	I A S 42		S A S 5							
			I Cl/I W 1							
			I BR/I - 5							
			A2 - W 80							
			S Cl/S W 10							
			I Cl/I W 84							
			S A/I W 120							
			I BR/I W 1/2							

Max. Tracks		
1 case	Solid	Star
3"	3/2	"
4"	3/4	"
8"	3/8	"
20"	101-200	Tracks
9"	51-100	"
4"	26-50	"
4"	16-25	"
4"	6-15	"
27"	≤ 5	"

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 70.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2709 Type Total Air Sample (II) Stage No. _____
Location Arc H-060 % Sample Area Measured ~0.8% Autoradiographic Exposure 2880 Min.

Comments: 2 x 2 mm² dispersed. Poor preparation

0.55 μm	0.85 μm	1.1 μm	1.6 μm	2.2 μm	3.1 μm	4.5 μm	6.2 μm
—— 1	S —— 2	S = S 13	S ∂E = W 3/2	S ∂R S 3/2	I ∂R = W 3/4	S ∂R S S	A₂ = W 5/4
	I —— 1	A₂ cl S 3/2	S cl A S 3/4	S cl S W 5/4	A₂ ∂R = W 3/2		
	S cl = S 45		S cl A S 3/4		I = W 1		
			S cl 3 ~ 60		S ∂R = W 3/2		
			S cl 3 S 80		S A = W 3/4		
			I ∂R ~ 1		S cl = W 3/2		
			A₂ cl 3 S 180		A₂ - W 3/4		
			I cl = N 30		I ∂R I 210		
					I = I 100		
					S = W S		

Misc. TRACKS		
1 case	Solid Star	
10 "	3/2	
2 "	101-200	TRACKS
1 "	51-100	"
1 "	26-50	"
2 "	16-25	"
4 "	6-15	"
16 "	< 5	"

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 7 0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 8038 Type Glass Slide Stage No. —
Location BM-09 % Sample Area Measured 8% Autoradiographic Exposure 1500 Min.

Comments: 2 portions were removed. Three of the larger spots shown in Figure 3.11 had been produced by particles which were crushed during or prior to removal by stripping the surface. Nuclear track autoradiograms indicated that hundreds of fragments were produced and that the original size of the larger particles was on the order of 100 microns diameter. The larger chunks were transparent and activity was localized at one or 2 points in a fashion which suggested that the particle surface or outer layer contained the activity. Dark inclusions were noted in some fragments. The particle size was not recorded since many particles were fragments. Activity levels of the fragments were sufficient to produce solid alpha track star patterns in many cases. Some spheres 0.22 microns in diameter produced solid track patterns. Based on the calibration this was equivalent to 100% $Pu^{239}O_2$

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 8035 Type Glass Slide Page No. —
Location Ave B-066 % Sample Area Measured 30.7 Autoradiographic Exposure below Min.

Comments: 122 A, center of 10 μg/M² contour. Large particles prevent proper focus of oil objective.

		0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	?	
Preparation a. 1620 Min. 357 mm²		S ? S 8			S $\frac{0}{BR}$ W $\frac{5}{2}$ I $\frac{0}{BR}$ W $\frac{5}{2}$ S $\frac{0}{BR}$ W $\frac{5}{4}$ 0 $\frac{0}{BR}$? $\frac{5}{2}$	0 $\frac{0}{BR}$ W $\frac{5}{2}$ S $\frac{0}{BR}$ W S	I — S		I $\frac{0}{BR}$ I S			— $\frac{5}{4}$ — $\frac{5}{4}$ — 5 — $\frac{5}{4}$	1 2 3 4
Preparation b. 1620 Min. 154 mm²		0 — 11	S $\frac{5}{2}$ S 25	S $\frac{0}{BR}$ W $\frac{5}{4}$ S $\frac{0}{BR}$ W $\frac{5}{8}$	S — $\frac{5}{2}$ I — $\frac{5}{4}$ S — 5 A — 75 S $\frac{0}{BR}$ W $\frac{5}{2}$	S ? W $\frac{5}{4}$ A_2 — $\frac{5}{2}$ S $\frac{0}{BR}$ W 75								5 6 7 8 9 10 11
Preparation c. 1500 Min. 144 mm²					S — $\frac{5}{4}$		0 $\frac{5}{BR}$ W S 0 $\frac{5}{BR}$ W S — $\frac{5}{8}$	A_2 - W S					— — A — S	12 13 14
Preparation d. 1500 Min. 109 mm²			S $\frac{0}{BR}$ W $\frac{5}{4}$ S $\frac{0}{BR}$? $\frac{5}{4}$	I $\frac{0}{BR}$ W $\frac{5}{4}$	0 $\frac{0}{BR}$ W $\frac{5}{2}$ A_3 $\frac{0}{BR}$ W $\frac{5}{2}$	S $\frac{0}{BR}$ W $\frac{5}{4}$ S $\frac{0}{BR}$ W S S $\frac{0}{BR}$ — S A_2 $\frac{0}{BR}$ W S								15 16 17 18 19
			↑ equiv to 108% $Pu^{239}Q_2$		↑ equivalent to 34% $Pu^{239}Q_2$									20 21 22 23 24 25 26 27 28 29 30
Totals	764 mm²	2	3	3	12	7	3	1	1					

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA [illegible]

Sample Description [illegible] at Double Tracks Tracerlab No. 8035 Type Glass Slide Stage No. _____
[illegible]ription Arc B-066 % Sample Area Measured ___ Autoradiographic Exposure below Min.

Comments: Continuation

	3	4	5	6	7	8	9	10	11	12
Phosphor Autoradiography:										
Reticle Value, Zenith 1000 min										
† Particle Size, PuO_2	0.4μ	0.5μ	0.8μ	1.0μ	1.4μ	2.1μ	3.0μ	4.6μ	7.3μ	14μ
† Particle Size, R.C.C.	1.2μ	1.5μ	2.3μ	2.9μ	4.0μ	5.8μ	8.7μ	14μ	25.μ	50.μ
Frequency of Occurrance	2	3	8	26	42	42	19	9	1	1
										15 Particles ±4 cm²
Nuclear Track Autoradiogram Correlation:										
Preparation a.						2.5μ/$\frac{5}{8}$	3.4μ/$\frac{3}{2}$	?/S	19μ/S	
						?/$\frac{5}{4}$			5μ/S	
						2.5μ/$\frac{5}{2}$			?/$\frac{5}{4}$	
						2.5μ/$\frac{5}{2}$			0.8μ/8	
						3.3μ/S				
Preparation b.		1.1μ/25	2.5μ/$\frac{3}{4}$		1.6μ/$\frac{5}{4}$	2.5μ/S	2.2μ/$\frac{5}{8}$			
			3.5μ/75		0.8μ/11	2.5μ/$\frac{5}{2}$	2.2μ/$\frac{5}{16}$			
			2.5μ/75		2.5μ/$\frac{5}{2}$					
			1.5μ/$\frac{5}{8}$							
Preparation c.			4μ/$\frac{5}{8}$	A_2/?	2.5μ/$\frac{3}{4}$	A_3/?	4.5μ/S	4.5μ/S		
						A_2/S				
						A/S				
Preparation d.		1.6μ/$\frac{5}{4}$	3.1μ/$\frac{3}{4}$	1.1μ/$\frac{5}{4}$	2.3μ/$\frac{5}{2}$	3.1μ/S				
				1.1μ/$\frac{5}{4}$	2.2μ/$\frac{3}{2}$	3.1μ/S				
						3.1μ/S				

Bracket indicates agglomerate consisting of particles bracketed

† Calibration By R. Carter, U.K.A.E.A.

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Double Tracks Lab No. 8038 Type Glass Slide Page No. —
Location Area F-056 % Sample Area Measured 15.5 Autoradiographic Exposure below Min.
Comments:

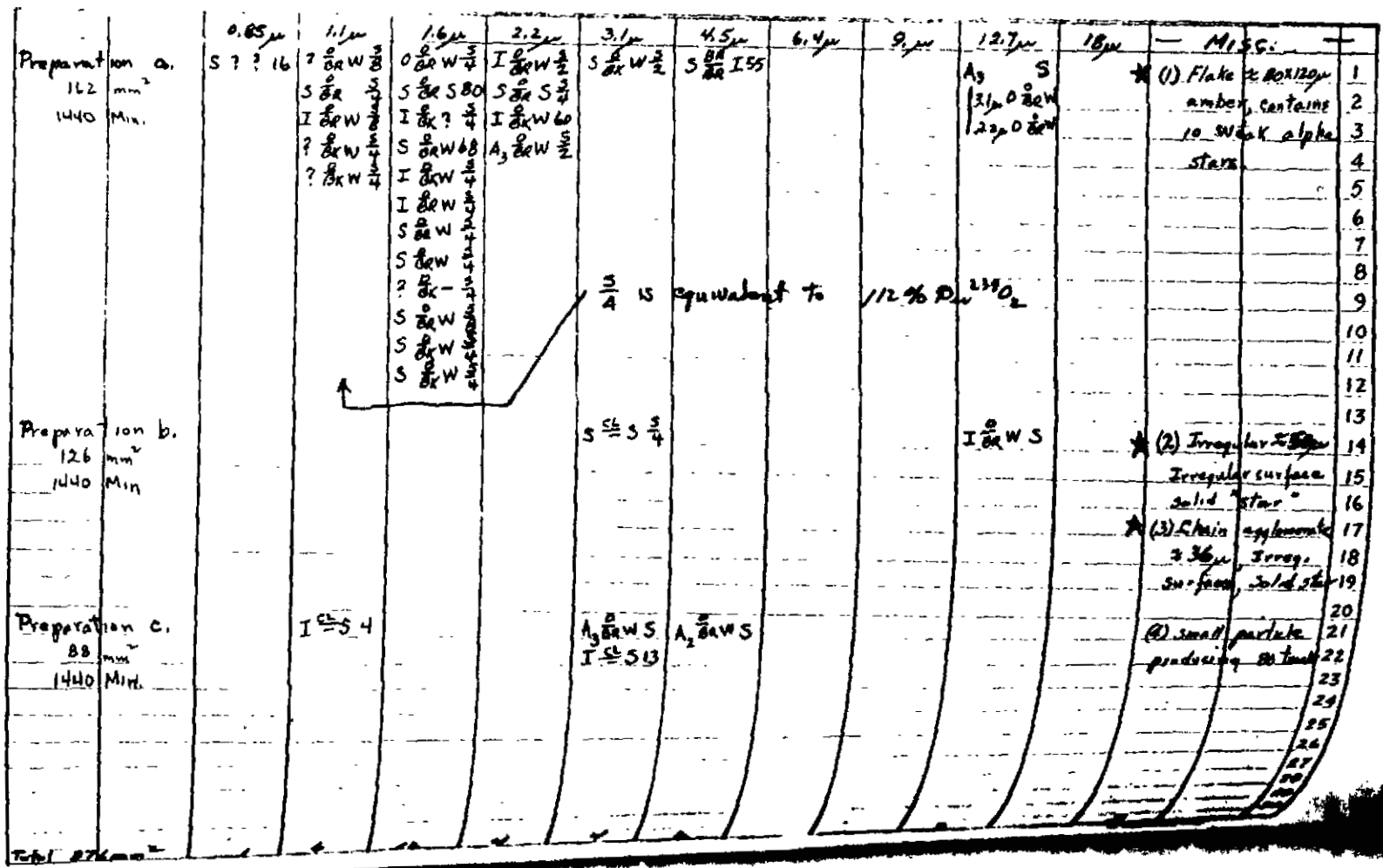


TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT

Sample Description: Event Double Tracks Tracerlab No. 8038 Type : Glass Slide Stage No. ——
Location Arc F-056 % Sample Area Measured — Autoradiographic Exposure below Min.

Comments: Prominent large spot images are due to large irregular shaped particles which are complex fused agglomerates. (Continuation)

Phosphor Autoradiography Data:

Reticle Values, Zenith 1000 Min.	4	5	6	7	8	9	10	11	12		
† Particle Size, PuO_2	0.5μ	0.8μ	1.0μ	1.4μ	2.1μ	3.0μ	4.6μ	7.3μ	14μ		1
† " " R.C.C.	1.5μ	2.3μ	2.3μ	4.0μ	5.8μ	8.7μ	14μ	25μ	50μ		2
Frequency of Occurrence	1	3	11	6	4	4	2	2	3	36 Particles	3
										24 cm²	4
Nuclear Track Autoradiography Data:											5
Preparation a.	2.3μ/60	1.1μ/$\frac{5}{8}$	1.1μ/$\frac{5}{4}$	1.6μ/$\frac{3}{4}$	2.3μ/$\frac{3}{2}$	12.7μ/5	80 | 120μ/?				6
		1.6μ/$\frac{3}{8}$	1.6μ/$\frac{3}{4}$	1.6μ/$\frac{5}{9}$							7
		1.6μ/$\frac{5}{4}$	1.6μ/$\frac{5}{9}$	1.6μ/$\frac{5}{9}$							8
		1.6μ/$\frac{5}{8}$	1.6μ/5/4	4.5/55							9
			2.3μ/$\frac{5}{9}$	1.6μ/$\frac{5}{4}$							10
Preparation b.			3.1μ/$\frac{5}{4}$				12.7μ/5	40μ/5	50μ/5		11
Preparation c.		1.1μ/4 ? 180 3.1μ/13			3.1μ/5	4.5μ/5					12
											13
											14
											15
											16
											17
											18
											19
											20
											21
											22
											23
											24
											25
											26
											27
											28
											29
											30

† Calibration By R. Carter, U.K.A.E.A.

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 1. MICRON

Sample Description: Event Double Tracks Tracerlab No. 8038 Type Glass Slide Stage No.
Location Ave H-044 % Sample Area Measured ~50% Autoradiographic Exposure 1440 Min.

Comments: Phosphor autoradiogram indicated 4 spots. Only 1 preparation by nuclear track autoradiography was successful.

		1.5μ	6.4μ	9μ	12.7μ	18μ	25μ	36μ	51μ	72μ	100μ
			A_{40}^{0} $\frac{35}{3}$								I $\frac{P}{by}$ *

* Several sites along the perimeter showed track populations of approximately 7/2.

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >9.5 MICRON

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETERS [illegible]

Sample Description: Event Double Tracks Tracerlab No. 8038 Type Glass Slide Stage No. —
Location Ave H-048 % Sample Area Measured 22.6 Autoradiographic Exposure below Min.

Comments: Produced very few phosphor spot images, and these were large spots. Note attachment to large particles.

		0.55	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9μ	12.7μ	— Misc —	
Preparation a.		S 7 7 5	S 7 7 85	S 3/Y S 60	S 0/2 R W 3/4	S 0/2 R W S	A$_3$ 7 7 250	S 0/2 W 1	S 0/2 R W S	A$_2$ 0/2 R W S	I 0/2 W 28	(1) Oblong Irregular	1
182	mm^2	0 7 7 3	7 7 7 12	S 3/Y S 50	S 0/2 R W 150	A 7 7 6	I 0/2 W 50	O CL S 150	A$_2$ 0/2 W 3/4			60μ, Number	2
1620	Min	7 7 7 4	S 7 7 10	A 7 7 150	I 7 7 5	A$_2$ CL 7 7 4	S 0/2 W 120		A$_2$ 0/2 W 150			with nine	3
			7 7 7 18	7 7 7 100	S 0/2 R W 120							stars attached.	4
			7 7 7 100		S CL S 3							Part opaque,	5
			7 7 7 75		S 0/2 W 15							part transparent	6
												with inclusions	7
		7 7 7 1		A$_4$ 7 7 100	S 0/2 W 100	S 0/2 R W 3/4	O CL S 3	S CL/2 S 2		I 0/2 W S	A$_3$ 0/2 R W S	(2) Irregular	8
		7 7 7 1		7 7 7 10		S 0/2 W 160	O CL W 25	O 0/2 W 25				80μ, many	9
		O CL/2 S 9		S 0/2 W 35		O CL S 3						tracks along	10
						S 0/2 W 250						periphery	11
						O 0/2 W 75						(3) Flake, 40μ,	12
												attached to 2.2μ	13
												sphere which	14
												produced ≈200 tracks	15
													16
Preparation b.												(4) 25μ agglomerate	17
168	mm^2											composed of an	18
1440	Min											active 12μ sphere	19
												and an inactive	20
												18μ sphere,	21
												solid star pattern	22
										S 0/2 R W 1/2	I 0/2 W 80	(5) 120μ Irregular	23
Preparation c.										I 0/2 W 19		agglomerate of	24
195	mm^2											many dark	25
1440	Min											inclusions, alpha	26
												tracks heavy	27
												around periphery	28
													29
													30
Totals	545mm^2	6	6	7	7	8	5	4	3	4	3		

Continued

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 8038* Type Glass Slide Stage No. —
Location Arc H-048 % Sample Area Measured — Autoradiographic Exposure below Min.

Comments: (Continuation)

Phosphor Autoradiography Data:

Reticle Value, Zenith 100 Min.	4	5	6	7	8	9	10	11	12		
* Particle Size, μm	0.5	0.8	1.0	1.4	2.1	3.0	4.6	7.3	11		1
Frequency of Occurrence		1		1	3	2	1	5	3		2
											3
Nuclear Track Autoradiography Data											4
Preparation a.	The particles		listed	represent 2		pair of	doublet spot images				5
			11–9	reticle values			11–11 reticle values				6
			65x90 μm/5	4.5 μm/25			45x70 μm/5	1.1 μm/150			7
			40 μm/200	1.1 μm/35			9 μm/5	1.6 μm/120			8
			9 μm/5	2.3 μm/3			6.4 μm/5	4.5 μm/150			9
			2.3 μm/$\frac{3}{4}$				6.4 μm/$\frac{3}{4}$	0.5 μm/3			10
			2.3 μm/160				1.6 μm/$\frac{3}{4}$	1.6 μm/3			11
			11 μm/5				2.3 μm/5	0.5 μm/4			12
			4.5 μm/2				1.6 μm/150	0.8 μm/10			13
			3.1 μm/3				0.5 μm/5	0.8 μm/18			14
			0.5 μm/1				4.5 μm/1	0.8 μm/100			15
			0.5 μm/1				12.7 μm/28	1.6 μm/15			16
			1.1 μm/100				2.1 μm/250				17
			2.3 μm/250				1.1 μm/6				18
			0.5 μm/9				1.1 μm/50				19
			1.1 μm/10				0.85 μm/12				20
			1.6 μm/100				1.6 μm/5				21
			2.3 μm/75				2.3 μm/4				22
			3.1 μm/25				3.1 μm/120				23
											24
Preparation b.									18 μm/5		25
											26
Preparation c.					9 μm/$\frac{3}{4}$				1.2 μm/5		27
									12.7 μm/80		28
									9 μm/19		29
											30

* Calibration by Carter, U.K. A.E.A.

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.3 MICRON

Sample Description: Event Double Tracks Tracerlab No. 8038 Type Glass Slide Stage No. —
Location Arc L-056 % Sample Area Measured 19.6 Autoradiographic Exposure below Min.

Comments:

		~	0.85 μ	~	3.1 μ	4.5 μ	6.4 μ	9 μ	12.7 μ	18 μ	25 μ	36 μ	50 μ	
Preparation a.												$I\frac{\circ}{BR}WS$		1
110	mm^2											$S\frac{\circ}{BR}IS$		2
1440	Min.													3
Preparation b			$I\frac{CL}{=}W4$					A_2 $W\frac{3}{4}$			$I\frac{\circ}{BR}WS$			4
155	mm													5
1440	Min.													6
Preparation c.							$S\frac{\circ}{BR}IS$							7
100	mm^2													8
1440	Min.													9
Preparation d.							$S\frac{\circ}{BR}WS$					$I\frac{\circ}{BR}IS$		10
108	mm^2													11
1440	Min.													12
														13
														14
														15
														16
														17
														18
														19
														20
														21
														22
														23
														24
														25
														26
														27
														28
														29
														30
Total	473 mm^2		1				2	1			1	3		

Continued

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 8038 * Type Glass Slide Stage No. —
Location Arc L-056 * % Sample Area Measured — Autoradiographic Exposure Below Min.

Comments: (Continuation)

Phosphor Autoradiography Data:

Reticle Value, Zenith 1000 Min	4	5	6	7	8	9	10	11	12			
Particle Size, D_{eq}												1
" " , Rs.c												2
Frequency of Occurrence			2	2	2		2	2	2		12 Particles 24cm²	3
												4
												5
Nuclear Track Autoradiography Data												6
Preparation a								36μ/s				7
								36μ/s				8
												9
Preparation b.				9μ/E 0.05/4					23μ/s			10
												11
												12
Preparation c.							6.4μ/s					13
												14
												15
Preparation d.				64μ/s						36μ/s		16
												17
												18
												19
												20
												21
												22
												23
												24
												25
												26
												27
												28
												29
												30

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER ≥1.0 MICRON

Sample Description: Event Double Tracks Tracerlab No. 8038 * Type Glass Slide Stage No. —

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER ≥ 1.0 MICRON

Sample Description: Event Double Tracks Tracerlab No. 6035 Type Glass Slide Stage No. —
Location Arc P-050 % Sample Area Measured Total Autoradiographic Exposure 1440 Min.

Comments: Phosphor autoradiogram indicated 4 spots. The largest particle below showed activity localized around a 3.1μ black inclusion.

3.2μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	36μ	51μ	72μ
		$5\frac{0}{9}-\frac{5}{4}$		$5\frac{BE}{M}\cdot 50$	$1\frac{9}{4}-5$			$1\frac{CL}{=}\ 5\frac{}{}$	

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Double Tracks [illegible]erlab No. 10027 Type Offsite Glass Slide [illegible] No. ———
Location Stake 261 , Sample Area Measured 28 Autora liographic Exposure Below Min.

Comments: Approximately 12 miles downwind, near most active air filter.

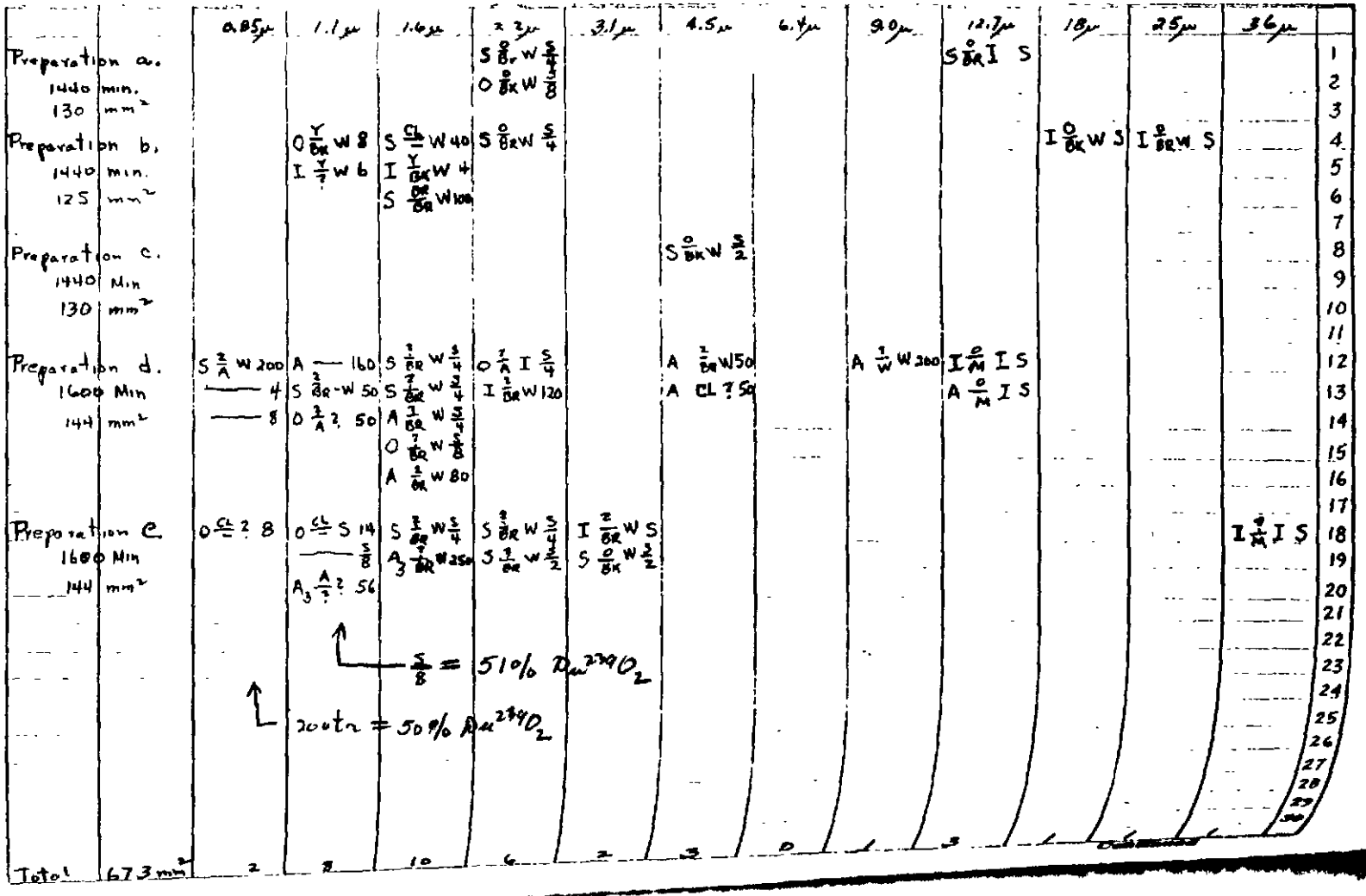


TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER [illegible]

Sample Description: Event Double Tracks Tracerlab No. 10027 Type Offsite Glass Slide Stage No. _____
Location Sta. No. 261 % Sample Area Measured ___ Autoradiographic Exposure [illegible] Min.

Comments: Continued from previous table

	3	4	5	6	7	8	9	10	11	12	13		
Nuclear Track Data:													
Preparation e.			1.6μ/250 1.1μ/56	1.1μ/$\frac{3}{8}$ 1.6μ/$\frac{5}{4}$		2.2μ/$\frac{2}{2}$ 3.1μ/$\frac{5}{2}$	3.1μ/5 2.2μ/$\frac{5}{0}$ 0.3μ/8			2.8μ/5 1.1μ/14			1
													2
													3
													4
													5
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													10
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													30

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 10027 Type offsite Glass Slide Stage No. ———
Location Stake 261 % Sample Area Measured — Autoradiographic Exposure ____ Min.

Comments: Phosphor Autoradiography data for other offsite slides Appears in Table A.1 (Continuation)

PHOSPHOR AUTORADIOGRAPHY DATA:

Zenith Plate, 1000 Min. Reticle Value	3	4	5	6	7	8	9	10	11	12	13	
† Particle Size, PuO_2	0.4μ	0.5μ	0.8μ	1.0μ	1.4μ	2.1μ	3.0μ	4.6μ	7.3μ	14μ	32μ	
† " " , R.C.C.	1.2μ	1.5μ	2.3μ	2.9μ	4.0μ	5.8μ	8.7μ	14μ	25.μ	50.μ	115.μ	
Frequency of Spot Occurrence	1	2	3	3	4	3	4	4	4	4	1	33 Images 24 cm^2

NUCLEAR TRACK AUTORADIOGRAPHY DATA:

Preparation a.								2.2μ	12.7μ 2.2μ			
Preparation b.										18μ 2.2μ 1.6μ	25μ 1.6μ 1.6μ 1.1μ	
Preparation c.		can not correlate										
Preparation d.					1.6μ/S 9μ/200				12.7μ/S 2.2μ/S 12.7μ/S 1.6μ/S 1.6μ/S 1.6μ/S 1.1μ/160 2.2μ/120 4.5μ/50 1.1μ/50 11μ/50 4.3μ/50 1.6μ/80 0.8S/200 0.8S/4			

† Calibration By R. Carter, UK.A.E.A.

TABLE A.5 CONTINUED > 1.5 MICRON, INACTIVE AND ACTIVE

Sample Description: Event Double Tracks Tracerlab No. below Type Cylindrical Collector Stage No. ——
Location below % Sample Area Measured ~ 1% Autoradiographic Exposure —— Min.

Comments: Particle Size Distribution Of Total Particles Removed From ½ Inch Length. * Normalized To 15 Inches. Multiply Frequency By 10^4.

	Tracerlab No., Location		1.8μ	2.5μ	3.6μ	5.μ	7.μ	10μ	14μ	20μ	28μ	40μ	56μ	80μ	112μ	160μ	224μ	320μ	Total
1.	2469 Arc B, L4, P11	Observed Spheres	53	53	53	—	—	—	—	—	—	—	—	—	—	—	—	—	3 ‡
		" Total	4800	4900	2900	1900	1500	900	430	100	60	38	16	11	3	1	—	—	459 ‡
	Total = 110 *	Normalized Sph.	3.	3.	3.	—	—	—	—	—	—	—	—	—	—	—	—	—	9×10^4
	Spheres (64) *	" Total	270.	280.	170.	110.	86.	52.	24.	6.1	3.4	2.2	0.83	0.57	0.18	0.057	—	—	1×10^7
2.	2908 Arc B, L5, P13	Observed Spheres	180	—	120	120	240	—	—	—	—	—	—	—	—	—	—	—	5 ‡
		" Total	9400	6500	4700	2400	1900	600	—	240	63	43	15	7	1	—	—	—	346 ‡
	Total = 46 *	Normalized Sph.	1.3	—	1.3	1.3	2.6	—	—	—	—	—	—	—	—	—	—	—	6.5×10^4
	Spheres (*	" Total	100.	70.	51.	26.	21.	6.4	—	2.6	0.68	0.47	0.16	0.076	0.010	—	—	—	3×10^6
3	2119 Arc B, L6, P10	Observed Spheres	192	—	512	128	192	—	—	64	2	1	—	—	—	—	—	—	19 ‡
		" Total	5600	4200	4600	2700	1200	1400	320	150	100	24	14	8	—	2	1	—	408 ‡
	Total = 31 *	Normalized Sph.	4.4	—	1.2	2.9	4.4	—	—	1.5	0.046	0.023	—	—	—	—	—	—	1.5×10^5
	Spheres *	" Total	130.	96.	110.	62.	27.	32.	7.3	2.9	2.3	0.55	0.32	0.18	—	0.046	0.023	—	4.7×10^6
4.	2122 Arc B, L14, P20	Observed Spheres	50	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1 ‡
		" Total	5100	3600	3700	2700	1800	900	100	200	33	74	18	2	—	2	1	—	363 ‡
	Total = 3400 *	Normalized Sph.	0.22	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2.2×10^3
	Spheres *	" Total	230.	160.	170.	120.	79.	41.	4.6	9.0	4.2	3.3	0.81	0.09	—	0.09	0.045	—	8.6×10^4
5.	2123 Arc B, L18, P23	Observed Spheres	117	117	—	—	117	234	—	—	2	1	—	—	—	—	—	—	6 ‡
		" Total	7800	6000	5200	2700	2800	2900	700	233	36	16	6	1	—	—	—	1	293 ‡
	Total = 49 *	Normalized Sph	1.3	1.3	—	—	1.3	2.6	—	—	0.022	0.011	—	—	—	—	—	—	6.5×10^4
	Spheres *	" Total	87.	68.	58.	30.	31.	32.	7.8	2.6	0.43	0.18	0.067	0.011	—	—	—	0.011	3.2×10^6
6.	5306 Arc J, L1, P11	Observed Spheres	78	117	—	—	—	39	—	—	2	—	—	—	—	—	—	—	6 ‡
		" Total	3900	2500	2000	1900	1300	700	230	120	35	18	6	1	—	—	1	—	369 ‡
	Total = 50 *	Normalized Sph	1.1	1.7	—	—	—	0.56	—	—	0.029	—	—	—	—	—	—	—	3.4×10^4
	Spheres *	" Total	44.	36.	30.	28.	18.	10.	3.4	1.6	0.50	0.26	0.086	0.014	—	—	0.014	—	1.7×10^6

‡ Frequencies expressed are normalized for difference in area corresponding to 2 magnifications. Total value is actual number of particles measured. All values are subject to uncertainty of yield in removing particles.

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 710 MICRON

Sample Description: Event Double Tracks Tracer Lab No. below Type Cylindrical Collectors Stage No. _____
Location below ° Sample Area Measured ~1% Autoradiographic Exposure 240 Min.

Comments: SUMMARY OF LARGER ACTIVE PARTICLES DETECTED IN PREPARATIONS FROM ½ INCH LENGTHS. * (Continuation)

F.Lab No.	Fld Location	10-19μ	20-29μ	30-39μ	40-49μ	50-59μ	60-69μ	70-79μ	80-89μ	90-99μ	100-109μ	110-119μ
2469	Arc B, L4, P11	16 I° S	28 I° 33/4	32 I° 5/2	45 I° 5/4	50 I° S	65 I CL 5/2					
		16 I° S	28 S° S				65 I° 5/2					
			22 I° S									
2908	Arc B, L5, P13	16 I° 5/2	22 S° 5/4	32 I° 3/2								
		16 I° 5/4	22 I A 5/2	32 I° 33/4								
		16 I° 3/4	22 I° 33/4									
		16 I° 33/4										
		11 I° 5/2										
2119	Arc B, L6, P10	115° S	22 I° S	32 I° S	45 I CL 33/4		65 I° S					
				32 I° S	45 I° 5/2		65 S° 33/4					
				32 I° 5/4								
				32 I° 33/4								
2122	Arc B, L14, P20		22 I CL 200	36 I° S	45 I CL 33/4					92 I CL S		
			22 I° S	32 I° 33/4								
			225° S									
2123	Arc B, L18, P23	185° S	22 I CL 200		45 I° S							
		135° 33/4										
		13 I° 5/2										
		13 I° 33/4										
5306	Arc J, L1, P11	13 I° S	28 I° S		45 I° S							
		105° S	28 I° S									
			28 I° S									
			205° 33/4									
			20 I° S									

← Data evaluation report shows cumulative analysis

* Data obtained by examining at least 5 of the heaviest aspirate slots on each preparation to indicate the larger particle sizes present.
Data on the following sheets is from routine scanning.

continued

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 730 MICRON

Continued

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 7.9 MICRON

Sample Description: Event Double Tracks Tracerlab No. below Type Cylindrical Collector Stage No. ____
Location below % Sample Area Measured — Autoradiographic Exposure — Min.

Comments: Alpha count of some larger particles removed by plowing full wire with Teflon scraper. (Continuation)

T-Lab No	Field Location	30 - 39μ	40 - 49μ	50 - 59μ	60 - 69μ	70 - 79μ
2469	Arc B, L4, P9	34μ - 125 dis/min 34μ - 490 dis/min			68μ - 169 dis/min	
2908	Arc B, L5, P7	34μ - 205 dis/min	48μ - 1719 dis/min 48μ - 362 dis/min			
5306	Arc J, L1, P13	32μ - 120 dis/min	48μ - 116 dis/mm 48μ - 288 dis/min			

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2469 Type Cylindrical Collector Stage No. _____
Location Arc B, L4, P11 % Sample Area Measured ~ 0.000% Autoradiographic Exposure 240 Min.

Comments: ½ inch length removed; particles washed off, estimate 56% of activity removed; good preparation three areas examined represent 0.5 % of preparation. Scanned 1.3 mm² of 225 mm² preparation.

0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	36μ	51μ	Misc. Tracks only
I^{cl} 2	I^{D} 20	I^{cl} 7	S^{A} 24	I^{D} 100	I 20	I^{D} 3/4	$I^{3/4N}$ 40	S^{D} 3/4	I^{D} 4	S^{D} 33/4		A 33/4		- 60
I^{A} 3	I^{cl} 2	I^{cl} 2	I^{A} 20	I^{D} 13	I 10	S^{D} 3/4	I^{D} 3/4		I^{D} 3/4	S^{D} 1/2				- 40
I^{cl} 2	I^{cl} 3		I 1	I^{A} 10	I 10	S^{D} 3/4	S^{D} 2/3		$S^{3/4N}$ 18					- 20
			I^{BR} 2	I^{BR} 24	S^{BR} 60	S^{D} 100	I^{BR} 56		I^{D} 3/4					- 48
			I^{cl} 12	I^{cl} 12		$I^{3/4N}$ 12	I^{BR} 25							- 4
						I 49	I^{D} 2/4							- 24
							S 32							- 24
							S^{D} 3/4							- 60
			I^{BR} 16	I^{BR} 5	I^{BR} 80	I^{D} 3/4	S^{D} 3/4	S^{D} 3/4						- 40
			I^{BR} 1	I^{A} 68	S^{D} 3/4	S^{D} 20	I^{D} 3/4	S^{D} 3/4						- 7
			I^{BR} 16	I^{BR} 50	I^{BR} 60	S^{D} 136	S^{D} 3/4	S^{D} 3/4						- 8
				I^{BR} 20	I^{BR} 96	S^{D} 144	I^{BR} 160	$I^{3/4N}$ 3/4						
				I^{cl} 11	I^{BR} 23	S^{D} 3/4	I^{D} 3/4							- 3
				S^{Y} 34	I^{BR} 60	S^{D} 72	S^{D} 100							- 7
				S^{BR} 48	S 56		S^{D} 3/4							
					I^{D} 148									
I^{BR} 109	I^{D} 4		I^{A} 28	I^{D} 1	I^{D} 80	S^{D} 3/4	I^{D} 3/4	I^{BR} 26	I^{D} 33/4	I^{D} 3/4				-60
↑			I^{T} 5	S^{BR} 40	I^{D} 60	I^{D} 3/4	$S^{3/4N}$ 11	I^{D} 3/4						- 40
			I^{A} 13	I^{D} 60		I^{D} 3/4	A^{D} 3/4							- 20
Equiv. to 200% $A_c^{1.19} a_2$				I^{BR} 26		I^{D} 112	I^{D} 3/4							- 20
						I^{D} 3/4	I^{D} 3/4							Total 17
							I^{D} 8							
4	4	2	11	16	14	17	21	7	5	3		1		
Largest particles on total preparation:														
											I^{D} 33/4	I^{D} 33/4	I^{D} 22	
											S^{D} -			
Estimated For ½" length											2	2	1	
800	800	400	2200	3200	2800	3400	4200	1400	1000	600				

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event _____ Tracerlab No. 2908 Type Cylindrical Collector Stage No. _____
Location _____ % Sample Area Measured _____ Autoradiographic Exposure 240 Min.

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2908 Type Cylindrical Collector Stage No. _____
Location Arc B, L5, P13 % Sample Area Measured ~0.01% Autoradiographic Exposure 240 Min.

Comments: ½ inch length removed; particles washed off, 26% of activity removed; poor preparation, slippage between particles and alpha tracks occurred with varying degree of displacement. Examined 20/mm area.

1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	36μ	51μ
	I^A 15	S^A 50	S^A 50	I^{BR} 60	I^O 40	S^A 3/4	I^{BR} 3/4	I^O 5/4	I^O 5/2	S^O 33/4	
	I^O 100	I^O 24	I^O 24	S^{BR} 3/4	I^{BR} 120	S^O 3/4	S^{CR} 100				
	S^A 100	S^O 100	S^O 100	S^O 100	S^O 3/4	I^{BR} 3/4	S^O 100				
	I^{BR} 12			S^A 100	S^O 200	S^O 3/4	S^O 3/4				
	I^{BR} 14			S^O 100	I^O 3/4	I^O 100	I^O 3/4				
	I^A 200				S^O 3/4	I^O 3/4					
	I^A 100				S^O 3/4	S^O 3/2					
					S^O 200	I^O 3/2					
					S^O 3/4	I^O 3/4					
	equivalent to 55% D_a 239				I^O 200	I^O 3/2					
					S^O 200						
					S^O 3/4						
					S^O 60						
					I^O 200						
					I^O 150						
	7	3	3	5	15	10	5	1	1	1	

Data below 6.4μ is poor due to inability to match particle and star. ∴ can't normalize

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2469 Type Cylindrical Collector Stage No. _____
Location Ave B, L4, P11 % Sample Area Measured ~0.000% Autoradiographic Exposure 240 Min.

Comments: ½ inch length removed; particles washed off, estimate 56% of activity removed; good preparation three areas examined represent 0.5 % of preparation. Scanned 1.3 mm^2 of 225 mm^2 preparation.

0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	36μ	51μ	Misc. Tracks only
I^{cl} 2	I^{cl} 20	I^{cl} 7	S^{A} 24	I^{O} 100	I 20	I^{O} 3/4	$I^{3/IN}$ 40	S^{O} 3/4	I^{O} 4	S^{O} 33/4		A 33/4		- 60
I^{A} 3	I^{cl} 2	I^{cl} 2	I^{A} 20	I^{O} 13	I 10	S^{O} 3/4	I^{O} 3/4		I^{O} 3/4	S^{O} 3/2				- 40
I^{cl} 2	I^{cl} 3		I 1	I^{A} 10	I 10	S^{O} 3/4	S^{O} 3/2		$S^{5/IN}$ 118					- 20
			I^{BR} 2	I^{BR} 24	S^{BR} 60	S^{O} 100	I^{BR} 50		I^{O} 3/4					- 48
			I^{cl} 12	I^{cl} 12		$I^{3/IN}$ 12	I^{BR} 25							- 4
						I 49	I^{O} 3/4							- 24
							S 32							- 84
							S^{O} 3/4							- 60
			I^{BR} 16	I^{BR} 5	I^{BR} 80	I^{O} 3/4	S^{O} 3/4	S^{O} 3/4						- 40
			I^{BR} 1	I^{A} 68	S^{O} 3/4	S^{O} 20	I^{O} 3/4	S^{O} 3/4						- 7
			I^{BR} 16	I^{BR} 50	I^{BR} 60	S^{O} 136	S^{O} 3/4	S^{O} 3/4						- 8
				I^{BR} 20	I^{BR} 96	S^{O} 144	I^{BR} 160	$I^{3/IN}$ 3/4						
				I^{cl} 11	I^{BR} 23	S^{O} 3/4	I^{O} 3/4							- 2
				S^{Y} 34	I^{BR} 60	S^{O} 72	S^{O} 100							- 7
				S^{BR} 48	S 56		S^{O} 3/4							
					I^{O} 148									
I^{BR} 108	I^{O} 4		I^{A} 28	I^{O} 1	I^{O} 80	S^{O} 3/4	I^{O} 3/4	I^{BR} 26	I^{O} 33/4	I^{O} 3/2				- 60
↑			I^{T} 5	S^{BR} 40	I^{O} 60	I^{O} 3/4	$S^{5/IN}$ 11	I^{O} 3/4						- 40
			I^{A} 13	I^{O} 60		I^{O} 3/4	A^{O} 3/2							- 20
Equiv. to 200% P_{11} A_2				I^{BR} 26		I^{O} 112	I^{O} 3/4							- 20
						I^{O} 3/4	I^{O} 3/4							Total 17
							I^{O} 8							
4	4	2	11	16	14	17	21	7	5	3		1		
Largest particles on			total	preparation:										
											I = 33/4	I = 48	I = 48	
Estimated For ½" Length											2	1		
800	800	160	2200	3200	2800	3400	4200	1400	1000	600				

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2908 Type Cylindrical Collector Stage No. _____
Location Ave B, L4, P11 % Sample Area Measured ~0.01% Autoradiographic Exposure 240 Min.

Comments: ½ inch length removed; particles washed off, estimate 56% of activity removed; good preparation three areas examined represent 0.5 % of preparation. Scanned 1.3 mm^2 of 225 mm^2 preparation.

0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	36μ	51μ	Misc. Tracks only
I^{cl} 2	I^{cl} 20	I^{cl} 7	S^{A} 24	I^{O} 100	I 20	I^{O} 3/4	$I^{3/IN}$ 40	S^{O} 3/4	I^{O} 4	S^{O} 33/4		A 33/4		- 60
I^{A} 3	I^{cl} 2	I^{cl} 2	I^{A} 20	I^{O} 13	I 10	S^{O} 3/4	I^{O} 3/4		I^{O} 3/4	S^{O} 3/2				- 40
I^{cl} 2	I^{cl} 3		I 1	I^{A} 10	I 10	S^{O} 3/4	S^{O} 3/2		$S^{5/IN}$ 118					- 20
			I^{BR} 2	I^{BR} 24	S^{BR} 60	S^{O} 100	I^{BR} 50		I^{O} 3/4					- 48
			I^{cl} 12	I^{cl} 12		$I^{3/IN}$ 12	I^{BR} 25							- 4
						I 49	I^{O} 3/4							- 24
							S 32							- 84
							S^{O} 3/4							- 60
			I^{BR} 16	I^{BR} 5	I^{BR} 80	I^{O} 3/4	S^{O} 3/4	S^{O} 3/4						- 40
			I^{BR} 1	I^{A} 68	S^{O} 3/4	S^{O} 20	I^{O} 3/4	S^{O} 3/4						- 7
			I^{BR} 16	I^{BR} 50	I^{BR} 60	S^{O} 136	S^{O} 3/4	S^{O} 3/4						- 8
				I^{BR} 20	I^{BR} 96	S^{O} 144	I^{BR} 160	$I^{3/IN}$ 3/4						
				I^{cl} 11	I^{BR} 23	S^{O} 3/4	I^{O} 3/4							- 2
				S^{Y} 34	I^{BR} 60	S^{O} 72	S^{O} 100							- 7
				S^{BR} 48	S 56		S^{O} 3/4							
					I^{O} 148									
I^{BR} 108	I^{O} 4		I^{A} 28	I^{O} 1	I^{O} 80	S^{O} 3/4	I^{O} 3/4	I^{BR} 26	I^{O} 33/4	I^{O} 3/2				- 60
↑			I^{T} 5	S^{BR} 40	I^{O} 60	I^{O} 3/4	$S^{5/IN}$ 11	I^{O} 3/4						- 40
			I^{A} 13	I^{O} 60		I^{O} 3/4	A^{O} 3/2							- 20
Equiv. to 200% P_{11} A_2				I^{BR} 26		I^{O} 112	I^{O} 3/4							- 20
						I^{O} 3/4	I^{O} 3/4							Total 17
							I^{O} 8							
4	4	2	11	16	14	17	21	7	5	3		1		
Largest particles on			total	preparation:										
											I = 33/4	I = 48	I = 48	
Estimated For ½" Length											2	1		
800	800	160	2200	3200	2800	3400	4200	1400	1000	600				

1000 | 600 | 2 | 2 | 1 | 1

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER ≥ 0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2908 Type Cylindrical Collector Stage No. _____
Location Area B, L5, P13 % Sample Area Measured ≈ 0.01% Autoradiographic Exposure 240 Min.

Comments: ½ inch length removed; particles washed off, 26% of activity removed; poor preparation, slippage between particles and alpha tracks observed with varying degree of displacement. Examined 20/MM area.

1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	36μ	51μ
	I^{A} 15	S^{A} 50	S^{A} 50	I^{BR} 60	I^{O} 40	S^{A} 3/4	I^{BR} 3/4	I^{O} 3/4	I^{O} 5/2	S^{O} 33/4	
	I^{O} 100	I^{O} 24	I^{O} 24	S^{BR} 3/4	I^{BR} 120	S^{O} 3/4	S^{CR} 100				
	S^{A} 100	S^{O} 100	S^{O} 100	S^{O} 100	S^{O} 3/4	I^{BR} 3/4	S^{O} 100				
	I^{BR} 12			S^{A} 100	S^{O} 200	S^{O} 3/4	S^{O} 3/4				
	I^{BR} 14			S^{O} 100	I^{O} 3/4	I^{O} 100	I^{O} 3/4				
	I^{A} 200				S^{O} 3/4	I^{O} 3/4					
	I^{A} 100				S^{O} 3/4	S^{O} 3/2					
					S^{O} 200	I^{O} 3/2					
					S^{O} 3/4	I^{O} 3/4					
					I^{O} 200	I^{O} 5/2					
					S^{O} 200						
					S^{O} 3/4						
					S^{O} 60						
					I^{O} 200						
					I^{O} 150						
	7	3	3	5	15	10	5	1	1	1	

equivalent to 55% Pd 239 Ox

Data below 6.4μ is poor due to inability to match particle and star; can't normalize

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2119 Type Cylindrical Collector Stage No.
Location Arc B, L6, P10 % Sample Area Measured ~0.03% Autoradiographic Exposure 240 Min.

Comments: 1/4 inch length removed; particles washed off, estimate 55% of activity removed; good preparation.
Examined 4/132 of area. A second preparation indicated peaking at 6.4-9 μ

0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	36μ	Misc. Tracks only
		I^{O} 30	I^{O} 20	I^{BR} 3	A_2^{O} 60	I^{O} 3/4	I^{S} 40	I^{O} 40	I^{BR} 60	I^{O} 3/4	I^{O} 3/2	I^{O} 3/4	
			I^{A} 14	S^{S} 1	S^{BR} 25	I^{BR} 1	S^{O} 2	S^{O} 10	S^{O} 5	I^{O} 5	$I^{Cl/M}$ 4		
				I^{O} 3/4	I^{O} 200	I^{BR} 3	I^{O} 3/2	I^{Cl} 3	I^{O} 5	I^{O} 5			+ 1
				I^{S} 2	I^{O} 5/4	S^{Cl} 25	I^{BR} 34	I^{BR} 44					+ 3/4
				S^{S} 2	S^{O} 60	I^{O} 1	I^{O} 1	I^{BR} 50		I^{O} 5			+ 1
				I^{BR} 40	I^{O} 80	S^{O} 5/4	I^{O} 3/4						+ 3/4
				I^{O} 30	I^{O} 3/4	I^{O} 200	I^{O} 3/2						
				S^{BR} 25	I^{S} 10								
				I^{BR} 20	S^{O} 200								
				S^{A} 20	I^{BR} 60								
				S^{A} 33									
				I^{A} 24									
		I^{S} 11	I^{A} 7	I^{BR} 28	I^{R} 17	S^{O} 3/4	I^{O} 3/4	I^{O} 15	I^{BR} 3/2				+ 7
		S^{O} 17	I^{O} 5	I^{A} 10	$I^{Cl/M}$ 4	I^{O} 80	I^{O} 72	I^{O} 5/2	I^{O} 3/4				- 18
		I^{T} 5	S^{A} 30	S^{A} 20	S^{O} 140	S^{O} 140	A_2^{O} 3/2	$I^{Cl/M}$ 20	$I^{Cl/M}$ 38				- 1
			I^{O} 8	S^{A} 55	S^{O} 100	S^{O} 5/4	S^{S} 5	$I^{Cl/M}$ 1					- 1
				I^{Cl} 1	S^{O} 3/4	I^{O} 5	$I^{Cl/M}$ 1						
				$I^{Cl/M}$ 30	I^{Cl} 1	$S^{Cl/M}$ 44	I^{O} 3/4						
				I^{T} 11	I^{Cl} 5	I^{O} 92	S^{O} 110						
				I^{BR} 31	I^{O} 20	S^{O} 100	S^{BR} 4						
				S^{Cl} 18	S^{O} 32	$I^{Cl/M}$ 1	$I^{Cl/M}$ 60						
				$I^{Cl/M}$ 5	I^{Cl} 1	S^{BR} 60							
				I^{S} 23	$S^{Cl/M}$ 5	I^{O} 112							
				I^{S} 11									
				$S^{Cl/M}$ 24									
Normalized To ½" Length		4	6	25	21	18	16	9	6	4	2		38

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.8 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2121 Type Cylindrical Collector Stage No.

Equivalent to 85% $Pu^{239}O_2$

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER? 0.8 MICRONS

Sample Description: Fvent Double Tracks Tracerlab No. 2121 Type Cylindrical Collector Stage No. —
Location Ave B, L12, P20 % Sample Area Measured ? Autoradiographic Exposure 1440 Min.

Comments: 1/2" length removed.

0.85 μm	1.1 μm	1.6 μm	2.2 μm	3.1 μm	4.5 μm	6.4 μm	9 μm	12.7 μm	18 μm	28 μm		Misc. Tracks	
I - - 1	S 7/8 W 8	S 5/8 W 15	I 5/8 W 18	I 3/4 W 110	Q 1/8 W 1/2	Q 1/8 S 3/4	I 1/8 W 5	I 1/8 I 1/2	A 5/8 I 13			19 cans	1 TQ
S - - 8	I 1/2 I 5	A 5/8 I 24	S 5/8 W 1/8	S 5/8 S 56	A_2 BR J 134	A_3 1/2 I 7/8	S 1/8 R W 1/8	I 1/2 I 5	I 1/2 I 1/8			3 "	2"
S 1/2 S 2	I 5/8 I 15	I 1/2 I 13	I 1/2 I 45	I 5/8 I 10	I 1/2 I 2	I 1/2 I 108	S - 15	I 1/2 I 1/2	A - - 37			1 "	11"
I - - 6	I 5/8 I 5	A_2 - I 6	S 5/8 S 32	A_4 - - 80	A_2 - - 1/8	I 1/2 I 1/4	A_2 Y I 9					Total	23
I - - 1	I - I 13	I 5/8 I 2	A_2 - W 96	I 1/2 I 1	A_2 1/8 R W 5	A_3 - - 120	I 1/8 R I 5/8						
	I 5/8 - 5	I 5/8 W 2	$A_{3\,cl}$ - - 7	S 5/8 W 1/8	S 1/2 W 1/2	I 1/8 R S 1/8	I 1/2 I 1						
	I - - 3	A_3 - - 15	S 3/4 S 3/4	I 5/8 I 20	S 1/8 R W 1/4	S 1/2 BR W 5	I 1/2 I 21						
	I 1/2 - 9	A_2 - - 10	I 1/2 I 12	A_2 1/2 I 19	I 1/2 BR I 20		I 1/2 I 1/8						
	S CU S 12	I BR I 5	I 1/2 I 18	A_5 - - 25	I 5/8 I 56		I 1/2 I 3						
	S 5/8 S 15	I CU I 9	I 1/2 I 5	I - - 3	S 5/8 S 18		I 1/2 I 1/2						
		S - W 5/8	A_2 - I 1/8	S 1/2 I 5	A_2 BR I 3/8								
		S 5/8 S 13	A_2 - I 2	A - - 100	Q 3/4 W 7								
		I 5/8 W 72	I 1/2 I 16		A - - 23								
		S 5/8 S 3	A_2 - - 9		I 1/2 I 33								
			S 5/8 S 23		A_5 - - 13								
			S 5/8 W 100		A_2 - - 1								
Equivalent To					I 1/2 I 5								
18% $Pu^{239}O_2$					I - - 180								
					A_2 - - 110								
					A_2 - - 52								
5	10	14	16	12	20	7	10	3	3				

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER MICRON

Sample Description: Event Double Tracks Tracerlab No. 2122 Type Cylindrical Collector Stage No.
Location Arc B, 114, P20 % Sample Area Measured ~0.0079% Autoradiographic Exposure 240 Min.

Comments: ½ inch length removed; particles washed off, estimate 38% of activity removed; good preparation
Largest particle observed was 19μ diameter Examined 6.2% of preparation.

0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9.0μ	12.7μ	18μ	28μ	39μ	Misc Tracks
I^A 1		I^A 2	I^A 6	I^{CL} 3	I^A 24	I^{CL} 85	I^O 200	S^O 200	I^O ¾	$S^{O/IN}$ ¾			Only
			I^A 2	I^A 50	I^{BR} 24	I^A 5	I^O ¾		I^O ¾				¾
			I^{CL} 10	I^{BR} 17	S^A 12	I^{BR} 48							
			I^A 8	I^{CL} 26	S^O 70	I^{BR} 25							3
			S^A 3	I^{BR} 45	I^{BR} 200	I^{BR} 42							3
			I^A 8	I^{BR} 51	I^{BR} 30	I^O 128							1
			I^{CL} 2	I^{BR} 10	I^O 20	I^{BR} 150							7
			I^{CL} 7	I^A 70	I^{CL} 72	S^{CL} 1							1
			I^{CL} 32	I^{BR} 14	I^O 72	I^{BR} 100							1
			S^A 62	I^{BR} 7	I^{BR} 22	I^{CL} 28							3
			S^{BR} 8	I^O 120	I^{BR} 28	I^{BR} 128							3
				I^{BR} 14	I^{BR} 18								3
					I^{CL} 50								1
	I^{CL} 8		I^A 24	I^A 112	I^{BR} 92	I^O 72	I^{CL} 2	I^{CL} 9	I^O 120				
	I^O 9		S^{CL} 33	I^A 22	I^A 17	I^{BR} 88							20
			I^A 28	I^{CL} 8	I^A 56	I^O ¾							13
				I^A 29	S^O ¾	I^O ¾							7
				I^O 20									10
				I^O 76									25
													½
I^{CL} 7	I^O 8	I^A 9	I^{BR} 15	I^A 40	I^O 38	I^O 26	I^O ¾	I^O ½	I^S 100				20
		I^O 11	I^A 52	I^O 20	S^{CL} 36	I^O 56	I^O ¾	S^{BR} ½	$I^{S/IN}$ 21				10
				I^O 40	I^O 58	I^O ¾	I^O 110	I^O ¾					25
				I^{BR} 1	I^A 3	I^O 45							30
					I^O 100	I^{BR} 60							50
					I^{CL} 50								22/22
2	2	3	16	22	23	20	6	5	5	1			

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 70.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2123 Type Cylindrical Collector Stage No.
Location Arc B, 114, P20 % Sample Area Measured ~0.1% Autoradiographic Exposure 240 Min.

Comments: ½ inch length removed; particles washed off, estimate 38% of activity removed; good preparation
Largest particle observed was 19μ diameter Examined 6.2% of preparation.

0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9.0μ	12.7μ	18μ	28μ	39μ	Misc Tracks
I^A 1		I^A 2	I^A 6	I^{CL} 3	I^A 24	I^{CL} 85	I^O 200	S^O 200	I^O ¾	$S^{O/IN}$ ¾			Only
			I^A 2	I^A 50	I^{BR} 24	I^A 5	I^O ¾		I^O ¾				¾
			I^{CL} 10	I^{BR} 17	S^A 12	I^{BR} 48							
			I^A 8	I^{CL} 26	S^O 70	I^{BR} 25							3
			S^A 3	I^{BR} 45	I^{BR} 200	I^{BR} 42							3
			I^A 8	I^{BR} 51	I^{BR} 30	I^O 128							1
			I^{CL} 2	I^{BR} 10	I^O 20	I^{BR} 150							7
			I^{CL} 7	I^A 70	I^{CL} 72	S^{CL} 1							1
			I^{CL} 32	I^{BR} 14	I^O 72	I^{BR} 100							1
			S^A 62	I^{BR} 7	I^{BR} 22	I^{CL} 28							3
			S^{BR} 8	I^O 120	I^{BR} 28	I^{BR} 128							3
				I^{BR} 14	I^{BR} 18								3
					I^{CL} 50								1
	I^{CL} 8		I^A 24	I^A 112	I^{BR} 92	I^O 72	I^{CL} 2	I^{CL} 9	I^O 120				
	I^O 9		S^{CL} 33	I^A 22	I^A 17	I^{BR} 88							20
			I^A 28	I^{CL} 8	I^A 56	I^O ¾							13
				I^A 29	S^O ¾	I^O ¾							7
				I^O 20									10
				I^O 76									25
													½
I^{CL} 7	I^O 8	I^A 9	I^{BR} 15	I^A 40	I^O 38	I^O 26	I^O ¾	I^O ½	I^S 100				20
		I^O 11	I^A 52	I^O 20	S^{CL} 36	I^O 56	I^O ¾	S^{BR} ½	$I^{S/IN}$ 21				10
				I^O 40	I^O 58	I^O ¾	I^O 110	I^O ¾					25
				I^{BR} 1	I^A 3	I^O 45							30
					I^O 100	I^{BR} 60							50
					I^{CL} 50								22/22
2	2	3	16	22	23	20	6	5	5	1			

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 70.5 MICRONS

Sample Description: Event Double Tracks Tracerlab No. 2123 Type Cylindrical Collector Stage No. _____
Location Arc B, L18, P23 % Sample Area Measured ~0.1% Autoradiographic Exposure 240 Min.

Comments: 1/4 inch length removed; particles washed off, estimate 20% of activity removed; good preparation

0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9μ	12.7μ	18μ	28μ	Misc. Tracks	Only single tracks
		S^{A} 6	I^{CL} 24	I^{O} 4	I^{A} 8	I^{A} 20		S 5/4		I^{S} 50		50	
		I^{BR} 7	I^{A} 11	S^{A} 70	I^{A} 24	I^{O} 17		I^{O} 5/4		I^{O} 16		13	Cases 2 Trks
			I^{O} 4	I^{CL} 60	S^{O} 140	S 12				I^{O} 35/4		9	" 3 "
			I^{CL} 7	I^{O} 48	I^{A} 1	I^{O} 40						8	" 4 "
			S^{CL} 22		S^{O} 80	I^{CL} 25						5	" 5 "
			I^{A} 1		I^{A} 60	S^{O} 3/4						2	" 6 "
					I^{BR} 7	I^{BR} 70						2	" 7 "
					I^{BR} 100	I^{O} 60						2	" 8 "
					S^{BR} 60	S^{BR} 90						1	" 10
					I^{A} 7	S^{O} 3/4						1	" 13
					S^{CL} 56							1	" 14
												1	" 25
I^{CL} 1	I^{A} 5	I^{CL} 25	I^{CL} 6	I^{A} 2	I^{CL} 1	I^{CL} 1	I^{BR} 85	I^{BR} 1	I^{O} 35/4			1	" 27
I^{A} 2	I^{CL} 30	S^{CL} 50	I^{CL} 6	S^{A} 50	S^{A} 150	S^{O} 3/4		I^{O} 3/2	I^{O} 33/4			1	" 70
		I^{CL} 5	I^{BR} 9	I^{O} 200	I^{BR} 3	S^{O} 5/4		S^{O} 35/4	I^{O} 14			1	" 200
		I^{CL} 5	I^{CL} 14	S^{O} 200	I^{A} 24	I^{BR} 16							
			I^{BR} 8	I^{BR} 2	I^{BR} 70	I^{CL} 4						Total	93
			S^{CL} 17	I^{O} 5/4	I^{CL} 20	I^{O} 30							
			I^{CL} 11		I^{O} 3/4	I^{CL} 2							
			I^{BR} 24		S^{A} 64	A_2 ^{O} 3/4							
					I^{O} 40	I^{BR} 10							
					I^{BR} 16								
					S^{CL} 6								
					S^{O} 3/2								
					S^{O} 42								
2	2	6	14	10	24	19	1	5	3	3			

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 5306 Type Cylindrical Collector Stage No. _____
Location Arc J, L1, P11 % Sample Area Measured ~0.9 % Autoradiographic Exposure 240 Min.

Comments: ½ inch length removed; Particles washed off, estimate 75% of activity removed first wash, Data from 2 subsequent washes are included. 60% of preparation was examined

0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	36μ	Mass	Tracks
WASH #1				S^{CL} 24	I^{O} 70	I^{O} ¾	I^{O} 150	I^{O} ¾		I^{O} 3		A_2^{O} 5	only	
				I^{CL} 70	I^{O} ¾	S^{O} ¾	S^{O} 33/4			S^{O} ¾			-20	-30
				I^{O} ¾	S^{CL} ¾	S^{O} ¾	S^{O} ¾						-36	-10
				S^{CL} 40		I^{O} ¾	I^{CL} 200						-40	-5
				S^{A} 200									-45	-32
Equivalent To 85%			$A_2^{230}O_2$	I^{BR} 48									-38	-30
				I^{A} 40									-16	-32
													3 cases	100 Tr
WASH #2	I^{CL} 1	I^{O} 12	A_2^{CL} 34	I^{A} 10	A_2^{A} 8	I^{O} ½	I^{O} 7		I^{O} ½	I^{O} 5	I^{CL} 3/4 5		3 "	200 Tr
		I^{CL} 3		I^{A} 20	I^{A} 10	I^{S} 80	S^{CL} 33/4		I^{O} ½				6 "	¼
		I^{S} 2		I^{O} 15		I^{O} 5	I^{CL} 6		I^{CL} 3/4 76				2 "	½
				S^{A} 16									1	¾ 57
				I^{CL} 35	I^{S} 3	A_2^{S} 130	I^{BR} 60	I^{O} ½					17 cm	1 Tr
				I^{A} 1	A_2^{A} 80	S^{A} 100	I^{O} ½	I^{BR} 88					9 "	2 "
						I^{A} 25	I^{S} 10						4 "	3 "
				I^{A} 1	I^{O} 110	I^{A} 16		I^{BR} 12	I^{S} 9				6 "	4 "
				I^{A} 10	S^{O} ¾				I^{BR} 23/4				14"	5 10"
				I^{A} 8	S^{BR} ½								5"	20 30"
				I^{CL} 14	S^{O} ¾								1 "	100 "
					I^{A} 3								7 "	½ " 52
													Total	283
	1	3	1	17	12	11	10	4	5	3	1	1		
		See	following		Sheet									
					24	20	24	9	3	4	2			
	3	9	4	14										
	4	11	5	31	36	31	34	13	8	7	3	1		

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event _____ Tracerlab No. 5306 Type Cylindrical Collector Stage No. _____
Location _____ % Sample Area Measured _____ Autoradiographic Exposure _____ Min.

Comments:

TABLE A.5 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Double Track 3 Tracerlab No. 5306 Type Cylindrical Collector Stage No. _____
Location _____ % Sample Area Measured _____ Autoradiographic Exposure _____ Min.

Comments: continuation from previous page Data On this preparation is poor for particles < 3 micron diameter.*

0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	36μ	Misc. Tracks Only	
	S^A 22	I^O 40	S^O 3/2	S^O 3/4	I^a 21	S^O 3/2	I^{BR} 50	I^O 35/4	I^O 33/4	I^{CL} 100	I^O 35/4		26 cm	ITR
		S^O 8/2	S^O 23/4	I^O 5/2	I^O 3/4	I^O 3/4	I^O 3/4	I^A 44	I^{BR} 3/4	I^{BR} 3/4			8 "	2"
		S^O 5	I^O 100	I^{BR} 13	I^{BR} 3/4	I^O 30	S^O 150	I^O 70		I^O 48			5 "	3"
				I^O 38	S^O 3/2	I^O 3/2	S^O 35/4	I^O 100		I^O 50			3 "	4"
				S^A 18	I^O 3/2	I^O 50	S^O 100						17 "	5-10"
	* Equivalent	To 1600	$D_{21}D_2$		I^O 100		I^O 3/2						9 "	20-30"
					I^{BR} 9		S^{CL} 40						3 "31	-50"
					I^{BR} 8								3" 100	"
	I^O 3	I^O 2	I^A 10	S^O 11	S^O 88	I^O 44	I^O 60	I^O 5/2			I^O 33/4		4" 200	"
		I^A 15		I^A 3	I^A 26	I^O 120	I^O 3/2	I^O 64					7"	3/4"
		I^O 9		S^O 26	I^S 3/4	I^O 3/2	I^O 40						1 "	3/8"
				I^O 88	I^O 80	S^O 3/4	I^O 44						5"	33/4"
						I^O 3/4	S^S 9						2"	5"
						I^{CL} 16								
	S^A 1	I^A 11		I^A 10	S^{CL} 25	I^O 32	I^O 33/4	I^O 3/4	I^O 3/4				Total	93
		I^A 3		I^{CL} 4	I^{CL} 2	S^O 3/2	I^O 80	I^O 3/4						
				I^{BR} 30	I^{CL} 50	S^{CL} 5	I^O 35/4	I^{BR} 3/4						
				I^{BR} 8	I^O 3/4	I^O 3/2	I^{CL} 15							
				I^{BR} 5	S^O 33/4	S^{CL} 9	I^O 3/4							
					I^O 3/4	S^{CL} 3/2	I^{BR} 8							
					I^{CL} 1	I^{BR} 3	S^{CL} 2							
					I^{CL} 1	I^{CL} 3	I^{CL} 21							
					S^O 3/4	I^{BR} 3/4	I^{CL} 30							
					I^{CL} 1		I^O 3/4							
					I^A 40		I^{BR} 24							
					S^S 2		S^{CL} 3/2							
	3	8	4	14	24	20	24	9	3	4	2			

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 70.5 MICRON

Sample Description: Test Clean Site I Laboratory No. 3442 Type Casella Impactor Stage No. 1
Location Area 6, L17, P9 Sample Area Measured 73% Autoradiographic Exposure 1440 Min.

Comments: Low power scan indicates 139 prominent alpha stars. See following sheet also.
Total particle population is medium. Deposit is well defined, more dense toward one edge.

	11 μm	16 μm	22 μm	31 μm	45 μm	6.4 μm	9.0 μm	12.7 μm	18 μm	25 μm	36 μm	50 μm		
Preparation a. 1440 min		S DR W 3/8	O CL S 3/8	S DR S 2	S DR S 16	A4 CL W 3/8	S 0/1 W 50	I 0/2 W 3/8	S DR W 3/8				
		S CL S 17	S 1/1 S 7	S 1/2 W 21	I 0/2 W 3/8	S 0/DK W 3/8		A2 CL W 28	S 0/2 W 1/2				
		S 1/2 19	S 0/2 3/8	S DR W 18	A2 3/4 W 40			I DR W 3/8	S 1/2 W 3/8				
		S 0/2 13	I 0/2 W 16	S DR N 50	S DR/DK S 3/8				S 0/DK W 3/4				
		S 0/2 W 20	I 0/2 W 22	S CL S 19									
		S DR W 48	S DR W 5	S 1/2 I 60									
		S CL S 9	S 0/2 W 6	S 0/2 W 40									
		S CL W 4	S DR W 9	S CL I 9									
		S 0/2 S 8	S DR W 10	A2 - - 60									
		S 1/DK S 11	S 0/2 W 3/8	A2 - - 46									
		S 0/DK W 11	S 1/2 W 11	S DR/DK S 22									
			S DR/DK W 3/8										
			S A2 W 5										
			I DR W 24		400t / 1440 = 0.57 d.p.m. = 7% $Pu^{239}O_2$.								
			S CL S 111										
			S CL S 4										
			S CL W 17										
			I DR W 9										
			S 1/2 S 1										
			S DR/2 S 30										
			S 0/2 ? 30										
		11	21	11	4	1	2	1	3	4			Total	58
Preparation b. 120 Min.		S CL S 8		S CL S 11	S DR W 3/8		A3 ? ? 10	S DR I 3/8	S 0/DK W 3/8			S 0/DR I 3/8		
					S 1/DK S 5		A3 ? ? 15	A2 ? ? 19						
					S 1/DK W 3			I 0/DK I 3/8						
		1		1	3	0	2	3	1			1	Total	12
		12	21	12	7	1	4	4	4	4		1	Total	70

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER MICRON

Casella Impactor Stage No. 1 Min.

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER MICRON

Sample Description: Event Clean Slate I Tracerlab No. 3442 Type Casella Impactor Stage No. 1
Location Arc B, 117, P9 % Sample Area Measured _____ Autoradiographic Exposure _____ Min.

Comments: see previous sheet Continuation

	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9.0μ	12.7μ	18μ	25μ	36μ	50μ	70μ
Preparation C, 1440 Min		S 8R/1 W 30		S CL/1 S 20		S V/10 I 9	S V/2 I 7		I 8/8x I 3/2	I D/M I 3/2		S 8/M I 3/2	A2 I 3/2
				S 8R/8x W 5/8		S CR/8x S 56	S 8R/8x W 17		S CL/1 I 12				
				S CR/1 S 5/8					I 0/2 I 5				
									S 8/8x W 5/2				
			S 0/1 S 5/8		S 0/4 W 5/8		S 0/1 W 3/4						
				S 8R/1x W 7/8									
				S 8R/8 S 50									
		1	1	5	1	2	3		4	1		1	1
							Alpha Stars Only						
							? ? ? 5/8	1 case					
							? ? ? 3/4	1 case					
							? ? ? 5/8	8 cases				Total 31	
Total		13	22	17	8	3	7	4	8	5		2	1
													Total 101

Continued

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 3442 Type Casella Impactor Stage No. 2
Location Arc B, L17, P9 % Sample Area Measured 42% Autoradiographic Exposure 1440 Min.

Comments: Low power scan indicates 250 prominent alpha stars. See following sheet, Total particle population is medium and well defined, somewhat foreshortened long dimension.

	0.85μm	1.1μm	1.6μm	2.2μm	3.1μm	4.5μm	6.4μm	9.0μm	12.7μm	18μm	.....	1140μm
Preparation a.		I $\frac{BR}{y}$ W 14	S $\frac{y}{y}$ W 14	S $\frac{y}{BK}$ S 8	S $\frac{Cl}{=}$ S 13	S $\frac{Cl}{=}$ S 31	A_2 ?? 5	I $\frac{BR}{M}$ I $\frac{5}{14}$		S $\frac{5}{BK}$ W S		S $\frac{BR}{=}$ I ?
		I $\frac{BR}{y}$ N 9	I $\frac{5}{y}$ W 32	S $\frac{Cl}{=}$ W 3	S $\frac{5}{BK}$ S 2	S $\frac{5}{BK}$ S 27	S $\frac{BR}{BR}$ W $\frac{5}{14}$					alpha tracks
		S $\frac{5}{BR}$ W 88	S $\frac{5}{BK}$ S 10	S $\frac{y}{y}$ I 5	I $\frac{BR}{y}$ I 9	S $\frac{5}{y}$ I $\frac{5}{B}$	Ag $\frac{BR}{W}$ N42					penetrating
		S $\frac{5}{y}$ S 49	S $\frac{5}{BK}$ N $\frac{5}{B}$	S $\frac{y}{=}$ S 3	S $\frac{5}{BK}$ S 17	I $\frac{5}{y}$ I 80						surface. Many
			S $\frac{BR}{BK}$ N 56	S $\frac{5}{y}$ W 4	A_2 $\frac{5}{y}$ S 12	I $\frac{BR}{y}$ I $\frac{5}{B}$						small satellite
			I $\frac{5}{y}$ N 8	I $\frac{B}{BR}$ W 32	S $\frac{1}{BR}$ S 8	S $\frac{Cl}{=}$ S $\frac{5}{B}$						spheres on
			S $\frac{y}{y}$ S 21	S $\frac{5}{y}$ S 9	S $\frac{Cl}{=}$ W 1	S $\frac{5}{y}$ S 29						surface.
				S $\frac{y}{y}$ S 60	I $\frac{BR}{y}$ I 30	S $\frac{5}{BR}$ S 2						
				S $\frac{5}{y}$ S 9	S $\frac{5}{y}$ 3 7							
				S $\frac{5}{y}$ S $\frac{5}{B}$	S $\frac{5}{BR}$ W 5B							
				S $\frac{5}{y}$ S $\frac{5}{B}$	A_2 $\frac{y}{y}$ S 5							
				S $\frac{5}{BR}$ W $\frac{5}{14}$	S $\frac{5}{BK}$ W $\frac{5}{B}$							
				S $\frac{5}{y}$ S 8	S $\frac{y}{y}$ W 19							
				S $\frac{BR}{BK}$ S $\frac{5}{B}$								
				I $\frac{BR}{y}$ N 2								
				S $\frac{Cl}{=}$ S 1								
				I $\frac{y}{y}$ W 1								
		4	7	17	13	8	3	1		1		Total 55

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

... 3442 Type Casella Impactor Stage No. 2
...graphic Exposure 120 Min.

Continued

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER TO .5 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 3442 Type Casella Impactor Stage No. 2
Location Ave B, L17, P3 % Sample Area Measured below Autoradiographic Exposure 120 Min.

Comments: See previous page.

		0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9.0μ	12.7μ	18μ			
Preparation b.			S 7/I 4	S 1/S 4	S 5/BR S 6	S 5/BR I 1	S DR/Y I 34	S 5/BR W 24		A2 ?? 5/B				
				S DR/Y I 14	S 9/4 I 20	S 5/7 I 60	I DR/Y W 12	S DR/BR I 26						
				S 1/Y S 2	S 5/BR W 2	S 3/W S 3	O Y/W I 32	S 5/BR S 1						
				O DR/BR W 14	S DR/Y W 2	S 5/BR S 14	S DR/Y N 5/B	S DR/BR I 28						
				S 5/BR S 1	S DR/BR W 10	S 5/BR S 12	A2 ? ? 4							
				S 5/BR S 5	I 5/Y W 11	S 5/BR W 22	S DR/W I 2							
				S DR/BR W 22	S DR/BR W 60	S 5/BR S 1	S 5/BR S 1							
				S DR/Y N 5	S 5/BR S 5	S 5/BR S 39	I 1/Y N 3							
				S DR/Y W 14	S 5/Y W 2	S DR/BR S 88								
				S 9/BR W 18	S 5/BR S 3	O 5/Y W 40								
					S 5/BR I 16	I DR/BR W 5/B								
					S 5/BR I 12	S 5/BR N 2								
					S 5/BR S 12	I 5/BR W 60								
					I 5/BR W 4	S 5/BR I 4								
					S 5/BR W 2	S 7/Y I 3								
					S 5/BR S 3	I DR/Y W 1								
					S 5/BR I 3	S 5/Y I 49								
					O 5/BR N 1									
					S 5/Y W 1									
			1	10	19	17	8	4		1			Total 50	
													Total 105	
Total for 42 % of deposit:			5	17	36	30	16	7	1	1	1		1	

Continued

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 3442 Type Casella Impactor Stage No. 3
Location Arc B, 417, P9 % Sample Area Measured below Autoradiographic Exposure 9385 Min.

Comments: Continuation

	0.55 μ	0.85 μ	1.1 μ	1.6 μ	2.2 μ	3.1 μ	4.5 μ	6.4 μ	9 μ	
Preparation a ~0.8% of deposit	S Y ? 3	S Y ? 4	S BR ? 3	S Y W 1	S Y I 6				S Y W 3	
	S ? ? 2	I Y I 4	S Y S 2	S Y S 2	A_2 - - 2					
	S Y ? 1	I BR ? 14	I BR W 19	S ? S 18	A_2 - - 25				Alpha Stars Only	
	S BR ? 5	S Y ? 3	S Y S 4	S ? S 10	A_2 - - 6				? ? ? 1	8 cases
	S Y ? 2	S Y ? 3	I Y W 4	S Y W 3	I BR W 4				? ? ? 2	2 cases
	S Y ? 2	S Y ? 1	I Y W 9	S ? W 17	A_2 - - B				? ? ? 6	1 case
		S Y ? 1	I BR W 19	A_2 ? ? 8	A_2 - - 2					
		A_2 Y ? 5	S Y S 1	A_2 ? ? 2	A_2 - - 4				1	11
		S Y ? 2	S Y W 1	I CL W 1	S ? W 1					
		S Y S 5	S Y S 1	S ? S 5						
		S Y W 3	S Y S 1	S ? S 4						
		S CL S 2	S Y S 3	S ? S 4						
		S Y S 11	A_2 Y S 8	S CL W 4						
		S Y S 2	I BR S 27	S BR W 3						
		S Y S 2	I BR W 20	S ? S 4						
		S Y S 1	S ? S 1	S ? W 6						
		I Y ? 1	I BR W 5	A_2 - - 26						
		A_2 Y ? 4	A_2 Y W 6	A_2 - - 6						
		I Y ? 1	S BR W 5	S ? W 2				Arc 6 Tr / 9385 = .0003 dis/min		
		S Y S 4	S Y W 1	S ? S 3						
		S S S 8	S ? S 1	S CL W 1						
		S BR ? 10	S ? S 4	A_2 Y W 5						
		S BR ? 11	S ? S 8							
		I BR ? 8	I Y W 1							
		S Y ? 1	S ? W 8							
			I ? W 1							
This sheet	6	25	26	22	9				1	
next sheet	2	2	14	19	15	6	4	1		

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 3442 Type Casella Impactor Stage No. 3
Location Arc B, 417, P9 % Sample Area Measured below Autoradiographic Exposure below Min.

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER? 0.5 MICRONS

Sample Description: Event Clean Slate I Tracerlab No. 3442 Type Casella Impactor Stage No. 3
Location Arc 8, 417, P9 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: Continuation

	0.55μm	0.85μm	1.1μm	1.6μm	2.2μm	3.1μm	4.5μm	6.4μm	9μm	
Preparation C_1	S ≦ - 1	S ≦ S 2	S ≦ W $\frac{5}{8}$	I ≦ - 17	A_3 ≦ S 23	S ≦ S 20	A_2 ≦ I 14	A_2 ≦ I 2		
area: 26%	S ≦ - 1	S ≦ S 75	A_2 - - 5	S ≦ S 20	S ≦ S 20	S ≦ S 80	A_3 ≦ S 1			
exposure: 11088 Min.			S ≦ S 6	S ≦ S 70	S ≦ W 30	S ≦ W $\frac{5}{8}$	I ≦ W 65			
			S ≦ S 15	S ≦ S 4	S ≦ W 35	A_3 - - $\frac{5}{8}$	A_3 - - 2			
			S ≦ S 48	S ≦ W 30	A_2 - W 75	I ≦ W 1				
			S ≦ S 1	A_2 ≦ S 5	S ≦ W 28	A_2 ≦ I 1				
			S ≦ S 1	S ≦ W 30	S ≦ S $\frac{5}{8}$					
			S ≦ S 2	S ≦ S 28	I ≦ W 24					
			S ≦ S 1	S ≦ S 39	A_2 ≦ S $\frac{5}{8}$					
			S ≦ S 1	S ≦ S 8	S ≦ S 55					
			A_3 - - 1	S ≦ S $\frac{5}{8}$	A_2 - - $\frac{5}{8}$					
			S ≦ W 2	S ≦ S 98	S ≦ W 1					
			A_2 ≦ - 4	S ≦ S 42	S ≦ S 1					
			S ≦ W 1	S ≦ W 1	S ≦ S 2				41 Tr / 11088 = .007 ch/μm	
				S ≦ S 1	S ≦ S 2					
				A_2 ≦ I 1						
				A_2 ≦ I 1						
				A_2 ≦ I 1						
				S ≦ S 1						
	2	2	14	19	15	6	4	1		
Miscellaneous Alpha Tracks				1	2	3	4	25-50	51-100	3/8
Frequency of Occurrence				93	2	1	2	3	2	1
								Total	177	

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 3452 Type Casella Impactor Stage No. 1
Location Arc B, L20, P13 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: Low power scan indicates 93 prominent alpha track stars.

	0.85 μ	1.1 μ	1.6 μ	2.2 μ	3.1 μ	4.5 μ	6.4 μ	9 μ	12.7	18 μ	25 μ	36 μ	111 200 μ
	S ≟? 1	S ≐ S 1	O ≟ ? 12	O ≐ S 4	O ≟ W150	O ≟ ? 3	I ≟ I 5	S ≟ W 6	O ≟ 5	A ≟ ? 20	S ≐ S 5	O ≟ W 5	S ≟ 2 escapes
	I ≐ ? 3	O ≐ S 3	O ≟ S 1	S ≐ S 3	A_2 ? ? 5	O ≐ ? 6	O ≟ W 5	A_2 ? ? 5	O ≐ S 55	S ≟ ? 5	B ≟ ? 5	S ≟ W 5	
		S ≐ S 2	A_2 ≟ W 11	S ≟ ? 2	A_2 ? ? 5	O ≐ S 90	O ≟ W 5	A_2 ? ? 20	I ≟ ? 20	I ≟ ? 3	I 3		
		I ≟ W12	S ≐ S 2		O ≐ S 54	O ≐ S 9	I ≟ ? 15	I ≐ ? 4	A_2 ≟ 45	A_2 ≟ ? 20	I ≟		
		O ≐ S 19	A_2 ≐ S 10		O ≟ ? 40	O ≟ W44	I ≟ ? 42	S ≟ W 7	A_2 ? ? 5	A_2 ≟ ? 5	A_2 ≟ W60		
Preparation a.			O ≐ S 90		O ≟ ? 17	O ≟ ? 55	O ≐ S 46		O ≟ W 5	I ≟ ? 16			
50% of deposit					A_2 ? ? 97	S ≐ S 1	A_2 ≐ ? 90		S ≟ ? 110				
1100 Min.					I ? ? 12	S ≐ S 2	A_2 ≐ ? 68						
					I ? ? 3	O ≐ S 70	O ≟ W 8						
					I ? ? 2	O ≟ W100	S ≟ W 15						
					S ≟ W 3	O ≐ S 31							
						O ≐ ? 7							
						A_2 ? ? 70							75 tks/
	2	5	6	3	11	13	10	5	7	6	5	2	... 1 75

See Fig. 3.24 for photomicrographs of single particles.

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 3452 Type Casella Impactor Stage No. 1

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 0.3 MICRONS

Sample Description: Event Clean Slate I Tracerlab No. 3452 Type Casella Impactor Stage No. 1
Location Ave B, L20, P13 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: see additional data on previous page; Low power skan of preparation b indicated 60 prominent alpha stars.

	0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.2μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	36μ
			I ≒ W 2	S ≒ S 1	I ≒ W 2	A_2 ≒ W 2	S ≒ W	S ≒ S	I ≒ W	I ≒ S	A_3 -- 3		A_4 --
Preparation b.			S -- 1	I -- 1	I ≒ W30	I -- 18	A_2 ≒ W12	S ≒ W 35	S ≒ W	S ≒ W44			A_4 -- 5
Area:			I ≒ 1		I ≒ 3	I ≒ I 20	S ≒ S 2	A_2 ≒ W 10	I ≒ I	I ≒ S			
exposure: 1560 Min.			S ≒ 3		I-I 3	I ≒ I 3	A_3 -- 150	A_3 - I 40	I ≒ W	S ≒ S			
			I -- 1		I-I 9	I-I 40	I ≒ I 55	I ≒ I					
						I ≒ I 1	A_2 ≒ I 45	A_2 - I					
						I ≒ I 19	I ≒ I 20	A_1 ≒ I 8					
						I ≒ I 1	I ≒ W 18	S ≒ S					
						A_2 - I 20	I ≒ W 10						
						I ≒ I 4	I ≒ I						
						I - I 26	I ≒ I 15						
						I ≒ W 14	I ≒ I 1						
							A_2 - I 3						
			5	2	5	12	13	8	4	4	1		2

Total 56

See Fig. 3.24 for photomicrographs of single particles

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 3452 Type Casella Impactor Stage No. 2
Location Arc B, L20, P13 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: Low power scan indicates 80 prominent alpha stars. Poor preparations may have resulted in some particle not being observed.

		0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.6μ	4.5μ	6.4μ	9μ	12.7μ	18μ	... 70μ
Preparation a,		? ? ? 5	I ? ? 3	S ≐ S 1	S ≐ W 19	O ≐ S 60	S ≐ S 17	O ≐ S 3	I ≐ ? 9		I ≐ W 5	O ≐ W 5	S ≐ S 6 4d/μm
	50%	? ? ? 2	S ≐ S 4	O ≐ S 7	O ≐ S 3	S ≐ ? ?	S ≐ S 160	A_2 ≐ ? ?	I ≐ ? 85		O ≐ ? 23	O ≐ W 5	
	1560 Min	? ? ? 1	O ≐ S 8	O ≐ ? 12	I ≐ ? 52	A ? ? 8	O ≐ ? 17	S ≐ W 160	A_2 ≐ ? 150			I ≐ ? 5	
				O ? ? 10	O ≐ S 4	S ≐ S 31	O ≐ ? 15	S ≐ W 70	S ≐ ? 13				
				S ? ? 100	S ≐ ? 4	I ≐ ? 40	I ≐ W 2	I ≐ ? 13	I ? ? 63				
				1 ? ? 4	O ≐ ? 7	S ≐ W 22	I ≐ S 60	O ≐ ? 16					
					I ? ? 17	I ? ? 28	S ≐ S 130	O ≐ ? 13					
					O ≐ S 14	S ≐ W 100	O ≐ S 16	O ≐ ? 7					
					S ≐ W 55	O ≐ S 2	S ≐ ? 9	O ≐ W 1					
		2.2 Cont.			O ≐ ? 21	S ≐ S 2	O ≐ ? 1	I ≐ W 50					
		S ≐ W 100			O ≐ ? 13	S ≐ S 4	I ≐ W 11	O ≐ ? 16					
		I ≐ ? 18			I ? ? 130	S ≐ S 2	O ≐ S 5	O ≐ ? 80					
		S ≐ S 75			A ? ? 36	A_2 ? ? 90	O ≐ S 50	A_2 ? ? 45					
		O ≐ W 150			I ≐ ? 22	S ≐ S 28	O ≐ S 35	? ? 125					
		S ≐ S 19			I ? ? 5	O ≐ S 130	O ≐ S 30	I ≐ W 100					
		S ≐ S 18			S ≐ W 75	O ≐ S 20	A_2 ? ? 26						
		O ≐ W 75			O ≐ S 60	I ≐ W 8	S ≐ W 85						
		S ≐ S 45			S ≐ W 55	O ≐ S 1	I ≐ W 11						
		O ≐ W 80			I ≐ W 4	S ≐ W 200	S ≐ S 1						
		I ≐ S 25			S ≐ S 7	S ≐ W 110	S ≐ S 80						
		S ≐ S 55			S ≐ W 19	S ≐ S 9	A_2 ? ? 12						
		I ≐ S 15			O ≐ S 55	O ≐ W 100	I ≐ W 3						
		A_2 ≐ W 110			S ≐ S 50	O ≐ S 32	O ≐ S 63						
		S ≐ S 90			S ≐ ? 80	O ≐ S 45							
		S ≐ S 70				O ≐ S 1							
		I ≐ W 50				I ? ? 5							
		S ≐ S 150				I ? ? 18							
						*Cont.							

See Fig. 3.24 for photomicrographs of single particles

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Event Clean Slate I Tracerlab No. 3452 Type Casella Impactor Stage No. 3
Autoradiographic Exposure Min.

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETERS 0.35 TO 4.5 MICRONS

Sample Description: Event Close Shot I Tracerlab No. 3452 Type Casella Impactor Stage No. 3
Location Arc B, L20, P13 % Sample Area Measured _____ Autoradiographic Exposure _____ Min.

Comments: _____

		0.35μ	0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ
Preparation a.		??? 3	S ? ? 68	? ? ? 3	S≦S 25	S ? ? 80	? ? ? 4		S≦S 1
	4020 Min		S ? ? 7	S≦S 4	S≦S 1	? ? ? 4	? ? ? 8		S ? ? 8
			S ? ? 16	S≦? 32	S≦S 4	S ? ? 64			
			S ? ? 15	S≦S 6					
			S ? ? 2	S≦? 9					
Preparation b.			S ? ? 2	S≦? 5	S≦? 46	S≦? 120			
	9780 Min.		S ? ? 1	S≦? 7	A_2 ? ? 9	S≦? 115			
			S ? ? 1	S≦? 4	S≦? 24	S≦? 60			
			S ? ? 19	A_2 ? ? 100	S≦? 15	? ? ? 5			
				A_2≦? 39	S≦? 10	? ? ? 8			
				S≦S 5	S≦W 64	S≦? 35			
				S≦S 7	O≦? 70	S ? ? 100			
				S≦S 6	I≦? 100	O ? ? 4			
				S≦S 1	O≦? 17	S≦? 33			
				O≦S 1	S≦? 11	S≦? 40			
				S≦? 6	S≦? 9	S≦? 4			
				S≦? 15	S≦? 20	O≦S 150			
				I≦W? 40	I≦? 10	O≦S 8			
				S≦? 7	A_2 ? ? 120	S≦S 1			
				A_2 ? ? 20	S≦? 80	S≦S 100			
				I ? ? 100	S≦? 20	O≦? 30			
				I ? ? 10	A_2 ? ? 25	S≦? 4			
				S≦? 15	S ? ? 100				
				S≦? 13					
Alpha Track Stars Only Normalized Por 4020 MIN. Exposure									
	No. of Tracks/Star	1	2	4	8	16	32	64	128
	Frequency	382	126	181	221	116	34	14	1

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 2589 Type Casella Impactor Stage No. 1
Location Anc F-024 % Sample Area Measured Total Autoradiographic Exposure 1440 Min.

Comments: 3 isolated tracks without particles were the only evidence of activity.

A 203 μm diameter sphere, metallic in appearance, was removed. The particle cracked into 4 pieces when it collided accidently with the microscope objective, the objective glass was unharmed.
The 4 pieces did not produce alpha counts above background of 1.4 dpm.
X-ray diffraction results
See figure 3.28

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 2589 Type Casella Impactor Stage No. 2
Location Anc F-024 % Sample Area Measured Total Autoradiographic Exposure 1440 Min.

Comments: No alpha tracks were found.

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 2589 Type Casella Impactor Stage No. 3
Location Anc F-024 % Sample Area Measured Total Autoradiographic Exposure 1440 Min.

Comments: 4 isolated tracks without particles were the only evidence of activity.

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Tracerlab No. 3532 Type Casella Impactor Stage No. 1 Min.

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 3332 Type Casella Impactor Stage No. 1
Location Arc N-024 % Sample Area Measured Total Autoradiographic Exposure 2640 Min.

Comments: No active particles were found on this sample.

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 3332 Type Casella Impactor Stage No. 2
Location Arc N-024 % Sample Area Measured Total Autoradiographic Exposure 2640 Min.

Comments: One alpha track was observed, no active particle observed.

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 3332 Type Casella Impactor Stage No. 3
Location Arc N-024 % Sample Area Measured 50% Autoradiographic Exposure 61920 Min.

Comments: Field count data indicated 4 dpm. No active particles were observed.

Alpha stars without Particles								
No. of Tracks	1	.....	7	.....	152	.....	578	
Frequency	4		1		1		1	

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 3335 Type Casella Impactor Stage No. 1
Location Arc N-038 % Sample Area Measured Total Autoradiographic Exposure 1440 Min.

Comments: Only 1 active particle on total sample. Alpha count indicates 27.5 ± 1.0 d.p.m.

							9.0μ	12.7μ	18μ	25μ				
										S OR IS				

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 3335 Type Casella Impactor Stage No. 2
Location Arc N-038 % Sample Area Measured Total Autoradiographic Exposure 2820 Min.

Comments: No active particles were found on this sample.

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 3335 Type Casella Impactor Stage No. 3
Location Arc N-038 % Sample Area Measured 100% Autoradiographic Exposure 51840 Min.

Comments: No alpha tracks were observed. Field count data indicated 1-10 d.p.m.

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Stage No. 1

Type Casella Impactor

Lab No. 3317

Exposure 2880 Min.

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 3317 Type Casella Impactor Stage No. 1
Location Arc P-024 % Sample Area Measured Total Autoradiographic Exposure 2880 Min.

Comments: No alpha tracks observed. Sample was heavily loaded.
See Figure 33 for photograph

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 3317 Type Casella Impactor Stage No. 2
Location Arc P-024 % Sample Area Measured Total Autoradiographic Exposure 2880 Min.

Comments: No alpha tracks observed. Sample was heavily loaded.

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 3317 Type Casella Impactor Stage No. 3
Location Arc P-024 % Sample Area Measured 100% Autoradiographic Exposure 51840 Min.

Comments: No alpha stars were observed, one single track was noted. Field count data indicated 0-1 d.p.m.

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA DIAMETER >0.8 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 2558 Type Casella Impactor Stage No. 1, 2, 3, 4
Location Arc F-054 % Sample Area Measured ____ Autoradiographic Exposure NONE Min.

Comments: PRE-TEST BACKGROUND AIR SAMPLE. Data taken directly from glass slide with 5X and 45X objective

Data Normalized To Area Of Main Deposit. Multiply Frequencies By 10^3	0.9μ	1.3μ	1.8μ	2.5μ	3.5μ	5μ	7μ	10μ	14μ	20μ	28μ	40μ	56μ	80μ	112μ	160μ	—
Stage 1																	
Measured 412 Particles	55.	15.	50.	28.	18.	18.	25.	50.	52.	53.	44.	13.	0.16	0.11	0.05	0.05	—
Normalized Total 4.3×10^5																	
Stage 2																	
Measured 294 Particles	12.	6.8	4.0	3.4	7.4	8.7	9.9	4.0	1.6	1.2	1.5	0.8	0.06	0.03	0.01	0.005	—
Normalized Total 6.1×10^4																	
Stage 3																	
Measured 291 Particles	29.	13.	7.6	4.2	1.8	1.5	2.2	1.3	0.2	0.7	0.3	0.2	0.01	—	0.01	—	—
Normalized Total 6.2×10^4																	
Stage 4																	
Measured 237 Particles	10.	4.3	3.1	4.0	3.1	3.1	0.70	0.15	0.31	0.31	0.65	0.16	0.005	—	0.002	—	—
Normalized Total 2.9×10^4																	
Total Normalized Data	106.	39.	65.	40.	30.	31.	37.	55.	58.	55.	46.	14.	0.24	0.14	0.072	0.055	—
					Total Stages 1 — 4 5.76×10^5												
Note. Underlined values indicate size classification effect																	
Particles larger than 224 microns were not measured. Zero Gates 21																	

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TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >50 MICRON

Sample Description: Event Clean Slate I Tracerlab No. below Type Total Air Samples Stage No. —
% Sample Area Measured — Autoradiographic Exposure — Min.

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETERS > 50 μm

Sample Description: Event Clean Slate I Tracerlab No. below Type Total Air Samples Stage No. —
Location below % Sample Area Measured — Autoradiographic Exposure — Min.

Comments: Gross Observations See figure 3.10

T-LAB No.		LOCATION			Alpha Count Sample	cpm* cover
3078	(D)	A-024		Clean except for dark particles 200-400 μm diameter	1473	n/b
3035	(I)	B, L23, P5		Heavy sprinkling of irregular particles < 200 μm heavier opposite orifice.	4035	—
3543	(II)	F-036		a few particles > 50 μm	1	—
3522	(II)	H-036		several particles > 50 μm		
3491	(II)	J-026		clean, no particles > 50 μm		
3505	(D)	J-040		Several particles > 50 μm		
3570	(I)	N-030		No particles > 50 μm		
3579	(D)	N-040		Clean except for few black particles		
3070	(I)	P-048		Light brown ring at edge of ring, many particles > 50 μm beyond edge of ring.		

* Counting efficiency 33%

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 3078 Type Total Air Sample (D) Stage No. _____
Location Arc A-024 % Sample Area Measured _____ Autoradiographic Exposure 1440 Min.

Comments: Nuclear Track Preparation was ruined in processing. See figure 3.10 and 3.26 for illustration of larger particles approximately 400 micron diameter. Many large particles were observed in the cover of this sample. Particle activities of larger particles were 310 - 1200 dis/min.

460μ	ovoid	white-tan
390μ	ovoid	with 160μ attachment
390μ	irreg	reddish cast
190μ	sphere	with 10μ satellites

} Figure 3.26

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event _____ Tracerlab No. _____ Type Total Air Sample (I) Stage No. _____
Location _____ % Sample Area Measured _____ Autoradiographic Exposure 2880 Min.

Comments: Nuclear Track Preparation was ruined in processing. See figure 3.10 and 3.26 for illustration of larger particles approximately 400 micron diameter. Many large particles were observed in the cover of this sample. Particle activities of larger particles were 310 - 1200 dis/min.

460μ	ovoid	white-tan
390μ	ovoid	with 160μ attachment
390μ	irreg	reddish cast
190μ	sphere	with 10μ satellites

} Figure 3.26

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRONS

Sample Description: Event Clean Slate I Tracerlab No. 3035 Type Total Air Sample (I) Stage No. —
Location Ave B, L23, P5 % Sample Area Measured ~0.5% Autoradiographic Exposure 2800 Min.

Comments: _____

1.1 μm	1.6 μm	2.2 μm	3.1 μm	4.5 μm	6.4 μm	9 μm	12.7 μm	18 μm	25 μm	36 μm	51 μm
S = S 20	I = W 30	I = 200	I = W 180	I = I 150	S = I 250	I = I 250					
	S = S 150	S = S 5	S = S 64	S = S 3/4	I = I 200	I = W 1/2					
		I = 32	S = S 200	I = S	S = S 18						
		I = S 4	S = S 6		I = I 100						
		S = 310	O = S 80		S = S 200						
		S = S 60	I = I 1/4		S = S 200						
		I = S 80	O = S 118		I = S 120						
		S = S 200									
		I = S 36									
		O = S 18									
		S = S 1/2									
Larger area examined for most active particles only:											
			S = W S	S = I S	S = S S	I = I S	A_1 = I S				S = I S
			S = W 1/2	S = W S	I = S S	A_2 = I S	A_2 = I 1/2				
				I = W 33/4	S = W 1/2	S = W S	A_2 = W 1/2				
				I = W 23/4	I = W S						
				I = W 33/4							

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER MICRON

Sample Description: Event Clean Slate I Tracerlab No. 8080 Type Glass Slide Stage No. —
Location BM-07 % Sample Area Measured Total Autoradiographic Exposure 60 Min.

Comments: Larger active particles. Represents approximately 50 per cent of the total number of spots registered on N-40 Plate exposed for 60 Min. Spot diameters are 1-2 mm.

	96µm	135µm	192µm	270µm	384µm	540µm	768µm	1080µm
Spherical	—	6	6	6	—	1	—	—
Irregular	—	—	1	9	8	5	—	—
Total		6	7	15	8	6	—	—

See CM-07 sheet for similar data.

Comments: In the course of attempting to calibrate phosphor autoradiography, several particles were uncovered and alpha counted. Some of the larger particles are listed.

800µm	Sphere	5050 dpm	Similar to Fig. 3.27 Second row first photo.
554µm	Irregular	320 "	
388µm	Sphere	605 "	
388µm	Ovoid	127 "	
194µm	Sphere	420 "	

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 789 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 8080 Type Glass Slide Stage No. —
Location BM-07 % Sample Area Measured Total Autoradiographic Exposure 60 Min.

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 7.0% VICINITY

Sample Description: Event Clean Slate I Tracerlab No. 8080 Type Glass Slide Stage No. ———
Location CM-07.0 % Sample Area Measured Total Autoradiographic Exposure 60 Min.

Comments: Larger active particles. Represents approximately 50 percent of the active particles registered on N-40 plate for 60 Min exposure. Spot sizes represented below are ~1-2 mm diam.

		34μ	48μ	68μ	96μ	135μ	192μ	270μ	384μ	540μ	768μ	1080μ
Spherical					—	—	4	5	3	1	—	—
Irregular					2	—	5	11	26	16	2	1
Total					2	—	9	16	29	17	2	1
See	CM-07 sheet for similar data,											
"	adjacent sheet for active particles											

Continued

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >17 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 8080 Type Glass Slide Stage No. —
Location CM-070 % Sample Area Measured —— Autoradiographic Exposure —— Min.

Comments: Large Particles Active And Inactive Normalized To Total Slide Area 2400 mm²
Examples are described by code. Continuation

17μ	24μ	34μ	48μ	68μ	96μ	135μ	192μ	270μ	384μ	540μ	769μ	1080μ	
					I^{A}	I^{BR}	I^{BR}	S_2^{BR} (48)	I^{W}	I^{W} (48)	I^{BR}	I^{M}	
					I^{A}	I^{BR}	S^{CL} (54)	I^{A} ○	I^{BR}	I^{CL} (54)			
					I^{BR}	I^{W}	I^{S}	S^{GY} (51)	I^{BR} (47)	I^{BR}			
					I^{BR}	I^{GY}	S^{GY} ○	I^{BR}	I^{S}	S^{M} ○			
					I^{CL}	I^{CL}	I^{CL}	I^{BR} (60)	S^{M} (52)	I^{BR}			
					I^{BR}	I^{S}			S^{GY} ○	I^{M}			
					I^{BR}	I^{CL}			I^{M} ○	I^{CL}			
					I^{BR}	I^{W} ○			S^{GY} (49)	I^{A}			
					I^{BR}	I^{W}			S^{GY} ○	I^{W} (58)			
						I^{GY}			I^{CL}	I^{W}			
						I^{A}			I^{CL}	I^{CL} ○			
						I^{CL}			I^{GY} ○	I^{CL} ○			
						I^{CL}			I^{W} ○	I^{GY} ○			
						I^{CL}			I^{BR}	I^{BR}			
						I^{CL}			I^{CL} (42)	I^{W} (68)			
						I^{BR}			I^{W}	S^{W} (45)			
						I^{CL}			I^{CL} ○	S^{M} (48)			
						I^{CL}			A_c^{BR} ○				
						I^{CL}			I^{W} ○				
						I^{W}			I^{GY}				
						I^{W}			S_2^{M} (35) (36)				
									S^{GY}				
									S^{W} (135)				
						37	16*	8*	31	17	1	1	Total Items Normalized
6760	1650	2800	2300	1250	800								

• Circle indicates large Autoradiographic particle of given diameter expressed in microns

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 7 0.5 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 8080 Type Glass Slide Stage No. —
Location [illegible] % Sample Area Measured below Autoradiographic Exposure below Min.

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER ≥ 0.5 MICRON

Sample Description: Event Clean Slab I Tracerlab No. 8080 Type Glass Slide Stage No. ——
Location Ave D-030 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: The sample was coated with 3% nitrocellulose. Following phosphor autoradiography, 13 particles were isolated, sized, alpha counted, re-exposed to Zenith, N-40 plates and Super XX film.

Particle Number		#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13
Phosphor Autoradiography Spot Size in Millimeters														
N-40	4 hrs	0.46	0.54	0.77	0.54	0.65	0.65	0.77	0.77	0.92	0.38	0.27	0.27	0.19
"	"	0.33	0.54, 0.14	—	0.54	0.65	0.77							
Zenith	1 hr.	0.33	0.38, 0.27	—	0.54, 0.09	0.65	—	0.65, 0.27, 0.19	0.4, 0.14	0.14	—	0.27	0.38	*
Super XX	6 Shr	0.65	0.77*		0.92*	1.09*		1.09*	0.92, 0.38*	0.54	—	0.54*	0.65	*
	* indicates many spot images make up or surround the main image. This is indicative of particle shattering or deagglomerations. Particle #3 crumbled upon transfer. Nuclear track emulsion coated on the portions indicated > 500 individual particles.													
Particle Size – Projected Area Diameter														
		104μ	80μ	?	40μ	104μ	?	40μ	193μ	?	28μ	64μ	?	Many Many μ
				↓										
				>500 particles										
			rewritten →			25μ	36μ	50μ	72μ	100μ	141μ	200μ	283μ	
						1	2		2	2		2		
Alpha Count Data – d.p.m.														
		36.1	91.2	540.	53.5	111.	—	153.	148.	178.	95.7	16.8	3.08 ± 0.34	5.32 ± 1.36
		precision is better than 5% except as stated.												

Continued

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 8080 Type Glass Slide Stage No. —
Location Ave D-030 % Sample Area Measured Total Autoradiographic Exposure — Min.

Comments: During calibration of phosphor autoradiography several particles were uncovered and alpha counted.

Continuation

192μ	ovoid	162 dpm	
180μ	Sphere	5	"
104μ	sphere	126	"
104μ	sphere	40	"
80μ	ovoid	101	"

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event CLEAN SLATE 1 Tracerlab No. 8082 Type GLASS SLIDE Stage No. —
Location Ave D-036 % Sample Area Measured 4.2% Autoradiographic Exposure 1440 Min.

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Fvent CLEAN SITE 1 Tracerlab No. 8082 Type GLASS SLIDE Stage No. —
Location ARC D-036 % Sample Area Measured 4.2 % Autoradiographic Exposure 1440 Min.

Comments: _____

	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9.0μ	12.7μ	18μ	36μ	50μ
PREPARATION a		S C% - 1	S C% - 1	I C% - 4	A_3 C% - 90	I C% - 120	I B% - 15		I % - 200		I % - S	
		S C% - 1		I C% - 12	S - - 200	I C% - 16			0 % - 1			
				A_5 C% - 20	I C% - 14	I C% - 1						
					I % - 3	A_6 C% - 28						
					I % - S/8							
					I C% - 3							
					I C% - 12							
					I C% - 80							
PREPARATION b.		S C% - 1										I % - S
		2	1	3	8	4	1		2		1	1
Comparison of Phosphor Spot Diam in mm. →						0.76			1.86			
with Particle Size in microns →						50μ			36μ			
for Zenith Plate, 1000 Min Exp.									12μ			
									15μ	Approximate		
									3.1μ			
									3.1μ			
									Etc			
		3	1	3	8	4	1		2		1	1
												TOTAL 24

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event CLEAN SLATE 1 Tracerlab No. 8082 Type GLASS SLIDE Stage No. —
Location ARC H-028 % Sample Area Measured 5.7% Autoradiographic Exposure 1440 Min.

Comments: _____

		1.6 μ	2.2 μ	3.1 μ	4.5 μ	6.4 μ	8.0 μ	12.7 μ	18 μ	25 μ	36 μ	50 μ	70 μ
PREPARATION a.		I^{C}_{4}-1	S^{C}_{4}-3	I^{C}_{4}-6	I^{0}_{0}-24	$I^{0}_{0}W^{5}_{8}$	I^{0}_{0}-1	A_2-$5/8$	$A_2 0_0 W 60$	$A_6 0_0$-100	$A_5 6_4$-$5/8$		$I^{0}_{0} I^{5}_{8}$
1440 MIN		S^{C}_{4}-2			S^{0}_{0}-80	$A_2 0_0 W^{5}_{8}$	$A_3 C_4$-3	$A_2 0_0$-5/8	$A_3 0_0 W^{3}_{8}$	$A_3 0_0 S^{3}_{8}$	$A_2 0_0 IS$		
						$A_2 5_0$-6	$A_4 C_4$-18	I^{B}_{0}-200	$A_3 0_0 W 5_8$	$I 0_0 W S$			
						$A_2 C_4$-6	$S 0_0$-6	I^{B}_{0}-100	$A_2 0_0 W 5_8$				
						$S 0_0 W 18$	$A_3 5_0$-$5/8$		$I^{0}_{0} W S$				
							$A_4 C_4$-18						
PREPARATION b.			S^{C}_{4}-2					I^{C}_{4}-34					S--$5/8$
180 MIN													I^{5}_{0}-80
		2	2	1	2	5	6	5	5	3	3		3

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Type GLASS SLIDE Stage No. —

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Clean Slide 1 Tracerlab No. 8082 Type Glass Slide Stage No. —
Location Arc H-032 % Sample Area Measured 3.5% Autoradiographic Exposure 1440 Min.

Comments: _____

0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9.0μ	12.7μ	18μ	25μ	
I^{Cy} - 1	I^{Cy} - 5	I^{Cy} - 20			$I^{Cy}\omega S^{Cy}$		I^{Cy} - 1			$I^{Cy}\omega S$	I^{Bx} - 14	
I^{Cy} - 1		S^{Cy} - 12									$Ac^{Cy}\omega S$	
I^{Cy} - 2												
3	1	2			1		1			1	2	11

Comparison of Phosphor Autoradiograph Spot Size with Particle Size. Zenith Plate, 1000 Min Exposure

Spot size in mm.	0.76	2.18	
Observed Particle Size	18μ	25μ 25μ	} agglomerate

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Cedar Shape 1 Tracerlab No. 9082 Type Glass Slide Stage No. —
Location Arc 6-030 % Sample Area Measured 3.5 % Autoradiographic Exposure 180 Min.

Comments:

	2.2 μ	3.1 μ	4.5 μ	6.4 μ	9.0 μ	12.7 μ	18 μ	25 μ	36 μ	50 μ	70 μ	100 μ	140 μ	
	S B½-18		S B½-160 S B½-80		S B½-70	S C½-22	I O½-5/4	S C½-25		S O½-110	S O½-5/4		I O½-200 S O½-5/4 I O½-5/4	
	1		2		1	1	1	1		1	1		3	12

Comparison of Phosphor Spot Size With Particle Size Zenith Plate 60 Min Exposure

Spot diam in mm.	0.27	0.33	0.39	0.47	0.94	
Observed particle size		150μ	150μ	130μ	80μ	

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Tracerlab No. 8084 Type Glass Slide Stage No. —
Autoradiographic Exposure 1440 Min.

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER>0.5 MICRON

Sample Description: Event Green Slate 1 Tracerlab No. B084 Type Glass Slide Stage No. —
Location ARC O-034 % Sample Area Measured 4.6 Autoradiographic Exposure 1440 Min.

Comments: _____

	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9.0μ	12.7μ	18μ	25μ	36μ	
Preparation a.				SC4-4	TC4-36			I½WS			I½IS		
Preparation b.	IC4-4 SC4-20	IC4-10	SC4-1	IC4-6 SC4-3	IC4-3 SC4-40 IC4-48	SC4-5		TC4-10 SC½W½	IC4-14	I½-22	I½-S	S½IS	
	2	1	1	3	3	1		3	1	1	2	1	19

Comparison of Phosphor Autoradiography Spot Size With Particle Size Zenith Plate 1000 Mm. Exp.

Spot size in mm			0.33	0.39				1.09					
Observed particle size			2μ	25μ				36μ 25μ					

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 70.5 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 9911 Type Glass Slide Stage No. —
Location Offsite Stake 822 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: See figure 3.16 for Phosphor Autoradiogram and Figure 3.24 for Particle-Autoradiogram

		0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9.0μ	12.7μ	18μ	25μ	36μ
Preparation a.					S≤S 27				O≤S 2	S≤W 8	A_{10} ? ? ? 0	S≤W 100	
	132 mm²				O≤S 5				A ? ? 9			S≤W 5	
	360 Min.				S≤S 6								
Preparation b.									S≤W	A_{11} ? ?	I≤W	A_3 ? ? 200	
	78 mm²												
	1440 Min												
Preparation c.					S≤W 30					O≤W			S≤
	96 mm²												S≤I
	360 Min												
					4				3	3	2	3	2

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 70.5 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 9911 Type Glass Slide Stage No. —

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETERS [illegible]

Sample Description: Event Clean Slate I Tracerlab No. 9911 Type Glass Slide Stage No. —
Location Offsite Stake 822 % Sample Area Measured _____ Autoradiographic Exposure ¼ Min.

Comments: See previous sheet.

Phosphor Autoradiography Data:	Zenith Plate						1000 Min.				
Particle Value	3	4	5	6	7	8	9	10	11	12	13
† Particle Size, D_0	0.4μ	0.5μ	0.8μ	1.0μ	1.4μ	2.1μ	3.0μ	4.6μ	7.3μ	14μ	32μ
† " " , R.C.	1.3μ	1.5μ	2.3μ	2.9μ	4.0μ	5.8μ	8.3μ	14μ	25μ	50μ	115μ
Frequency of Occurrence	3	3	5	4	7	4	8	8	1		
NUCLEAR TRACK AUTORADIOGRAPHY											
Preparation a.							18μA/11¼		25μ/5		
Preparation b.			9μ/5/8		12.7μ/5/8 19μ 14μ } 200 10μ	18μ/5/8					
Preparation c.						14μ/5/8 21.3μ/30 }	35μ/250	12.7/5/2			

† Calibration By R. Carter, U.K.A.E.A

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >1.5 MICRON, INACTIVE AND ACTIVE

Sample Description: Event Clean Slate I Tracerlab No. below Type Cylindrical Collector Stage No. _____
Location below % Sample Area Measured ~1% Autoradiographic Exposure — Min.

Comments: Particle Size Distribution of Total Particles Removed From ½ Inch Length. * Normalized To 15" Length. Multiply Frequency By 10^4

T.Lab No., Location			1.8μ	2.5μ	3.6μ	5μ	7μ	10μ	14μ	20μ	28μ	40μ	56μ	80μ	114μ	160μ	224μ	320μ	Total	
5294 AvcB, L11, P7	Observed	Spheres	135	189	270	297	108	54	—	27	3	—	—	—	—	—	—	—	40	‡
	"	Total	3100	3100	3400	3200	1500	1000	219	82	73	23	3	3	—	—	—	—	6951	‡
Total = 14 *	Normalized	Sph.	3.7	5.2	7.5	8.2	3.0	1.5	—	0.75	0.083	—	—	—	—	—	—	—	3.0×10^5	
Spheres *	"	Total	86.	87.	94.	88.	42.	29.	6.0	2.3	2.0	0.64	0.83	0.83	—	—	—	—	4.3×10^6	
5297 AvcB, L14, P6	Observed	Spheres	464	232	406	232	464	232	116	—	14	1	—	—	—	—	—	—	37	‡
	"	Total	3600	3400	2800	3200	2300	1300	520	—	120	29	11	2	1	2	1	—	410	‡
Total = 8 *	Normalized	Sph.	19.	9.8	17.	9.8	19.	9.8	4.9	—	0.29	0.042	—	—	—	—	—	—	8.9×10^3	
Spheres *	"	Total	150.	140.	120.	130.	97.	56.	22.	—	5.2	1.2	0.46	0.084	0.042	0.084	0.042	—	7.2×10^4	

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 7½. MICRON

Sample Description: Event Clean Slate I Tracerlab No. Below Type Cylindrical Collector Stage No. _____
% Sample Area Measured ~1% Autoradiographic Exposure below Min.

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 7 to 120 MICRONS

Sample Description: Event Clean Slate I Tracerlab No. below Type Cylindrical Collector Stage No. _____
Location below % Sample Area Measured ~1% Autoradiographic Exposure below Min.

Comments: SUMMARY OF LARGER ACTIVE PARTICLES DETECTED IN PREPARATIONS FROM ½ INCH LENGTHS.

Tracerlab No.	Field Location	10-19μ	20-29μ	30-39μ	40-49μ	50-59μ	60-69μ	70-79μ	80-89μ	90-99μ	100-109μ	110-120μ
5294	Arc B, L II, P7	16 I BR S	29 I° S 20 S° S 28 S° S 20 S° S	32 S CL 2/4	40 I° S			79 I 3/4 IN 50				110 S CL 3/4 IN 200
5297	Arc B, L/4, P6		22 S° 3/4 22 S CL 3/4		45 I° 200 45 I° 3/4 45 S° 1/2 45 I° 1/4 40 S CL 3/4 IN 40 S° 200	55 I CL 3/4 IN	69 S CL 3/4 65 I° 200	70 I° 1/2				

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 730. MICRON

Sample Description: Event Clean Slate I Tracerlab No. below Type Cylindrical Collector Stage No. _____
Location below % Sample Area Measured — Autoradiographic Exposure — Min.

Comments: Alpha count of some larger particles removed by plowing full wire with Teflon scraper.

T-Lab No.	Field Location	30-39μ	40-49μ	50-59μ	60-69μ	70-79μ	80-89μ	90-99μ	100-109μ	110-119μ	120-129μ	130-139μ
5298	Arc B, 413, P5	34μ, 36 dis/min	42μ, 39 dis/min		68μ, 187 dis/min			95μ, 65 dis/min				136μ, 225 dis/min
5299	Arc B, 417, P6	34μ, 34 dis/mm	48μ, 45 dis/min		68μ, 76 dis/min 68μ, 108 dis/min							
5342	Arc B, 419, P5				68μ, 53 dis/min			95μ, 147 dis/min 95μ, 146 dis/min				140μ, 141 dis/min

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 70.5 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 5294 Type Cylindrical Collector Stage No. _____
Location _____ % Sample Area Measured _____ Autoradiographic Exposure Below Min.

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER ≥ 0.5 MICRONS

Sample Description: Event Clean Slate I Tracerlab No. 5294 Type Cylindrical Collector Stage No.
Location Area B, Lll, P7 % Sample Area Measured Autoradiographic Exposure Below Min.

Comments: 1/2 inch length removed; particles washed off, estimate 50% of activity on wash #1; Data for particles ≤ 6.4 microns is not reliable due to slippage between tracks and particle

0.55μ	0.85μ	1.1μ	1.6μ	2.3μ	3.1μ	4.5μ	6.4μ	9.0μ	12.7μ	18μ	25μ	36μ	Misc Tracks
		I 2		I^{CL} 18	S^{CL} 22	I^{BR} 26	I^{O} 44	S^{O} 41	S^{O} 24	S^{O} 36			2 cons 1 TR
Wash #3				S^{A} 10	S^{CL} 7	S^{CL} 75	S^{CL} 8	I^{CL} 150	S^{CL} 100	S^{BR} 38			6" 2"
(120 Min exposure)					I^{O} 6	I^{O} 30	I^{BR} 4	I^{O} 100	I^{O} 15	S^{O} 100			1" 3"
					S^{CL} 44	S^{O} 20	I^{BR} 24	I^{O} 50	S^{O} 22	I^{O} 50			9" 5-6"
						S^{CL} 20	I^{O} 38	S^{CL} 18	S^{CL} 24	S^{CL} 9			5" 11-20"
						I^{BR} 4	S^{O} 50	S^{O} 120	I^{O} 100	S^{A} 100			5" 21-30"
						S^{CL} 3	S^{O} 100	S^{O} 100	I^{O} 40	I^{O} 100			2" 31-40"
						S^{CL} 45	S^{O} 50	I^{O} 3/4					1" 50"
						S^{CL} 18	S^{O} 45	S^{BR} 18					1" 140"
						S^{CL} 28	I^{O} 18	S^{O} 44					1" 3/4
						I^{O} 30	I^{O} 20	S^{O} 50					1" 3 3/4
							S^{CL} 9	I^{O} 100					30
							I^{O} 100	I^{O} 26					
							S^{O} 120	S^{BR} 12					
								I^{O} 40					
								S^{O} 7					
Wash #1													
(1250 Min exposure)		I^{O} 11		I^{O} 60	I^{O} 40	I^{O} 5	I^{O} 3/4	I^{O} 40	S^{CL} 5		I^{O} 3/4		40 cons 1 TR
				I^{CL} 3/4	I^{O} 3/4	I^{O} 70	I^{O} 3/4	S^{O} 64	I^{O} 5				31" 3"
				I^{CL} 27	A$_3$ 3 3/4	I^{O} 50	I^{O} 5/4	I^{O} 1/2	I^{O} 5				11" 3"
					I^{CL} 12	I^{O} 2 3/4	I$^{CL/M}$ 29	I^{O} 1/2	I$^{CL/M}$ 5				17" 4"
					I^{A} 30	I^{BR} 1/2	I^{O} 5	I^{CL} 5/4					9" 5"
					I^{O} 3/4	I^{BR} 1/2	I^{O} 5	I^{O} 5					33" 6-10"
						I^{O} 1/2	I^{O} 5	I^{BR} 3/4					31" 11-20"
Longer exposure Required?						I^{O} 5	I^{O} 5	I^{O} 5					7" 21-30"
						S^{BR} 1/2	I^{BR} 3 3/4	S^{S} 30					11" 31-50"
						S^{BR} 5	I^{O} 3/4						12" 51-100
					I^{O} 3/4	S^{BR} 35	I^{O} 5						9" 3/4
					S^{CL} 3/4	I^{O} 80	S^{O} 5/2						1" 1
													2" 3 3/4
		2		5	10	25	26	25	11	7	1		234

TABLE A.6 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 5297 Type Cylindrical Collector Stage No. _____
Location Arc B, LIV, P6 Sample Area Measured ~0.06% Autoradiographic Exposure 240 Min.

Comments: ½ inch length removed; particles washed off, estimate 30% of activity removed; Data for particles below 0.4 micron class is not reliable due to slippage between particles and tracks.

0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	36μ	50μ	Misc.	Tracks
				I^{BR} 16	S^{CL} 100	I^{O} 100	I^{CL} 20	I^{O} 36	I^{O} 100	I^{O} 40	I^{O} ½	I^{O} ¾	10 Casella Impactor	
				S^{CL} 5	S^{CL} 8	S^{CL} 40	I^{BR} 100		S^{O} 150	I^{O} 2¼		I^{O} ¾	#3"	6-10"
				S^{O} 100	S^{CL} 2	S^{CL} 20	I^{O} 3¾			S^{O} ½			56"	11-20"
				I^{CL} 2	I^{BR} 28	S^{BR} ¾	I^{O} 30			I^{O} 200			12"	21-30"
					S^{CL} 20	S^{CL} ¾	S^{O} 100						12"	31-50"
					I^{CL} 2	S^{CL} ¾	S^{O} 30						7"	51-100"
					S^{BR} 100		S^{CL} 5						5"	101-200"
					S^{CL} 100		S^{CL} 200						7"	¼ "
			S^{O} ¾	I^{BR} 70	I^{BR} 200	I^{O} ¾	S^{O} 3¾	I^{O} 200	S^{O} ¼	S^{O} 100	S^{O} 5	I^{BR} 80	2"	½ "
						S^{CL} ¾	S^{O} 2¾	I^{O} ¾	S^{O} ¼	I^{O} 5	I^{O} ¼		3"	3¼ "
							I^{O} ½	S^{O} 2¾	S^{CL} 100					
							I^{O} 100						Total	250
				S^{A} ¾	S^{CL} 45	S^{A} 100	S^{O} 11	I^{O} 28	S^{O} 60	S^{O} 56	S^{BR} 80			
				S^{CL} 200	S^{CL} ¾	S^{CL} 40	S^{O} ¾	S^{A} ¾	S^{CL} 80					
				S^{CL} 30	S^{O} ¾	S^{CL} 50	S^{CL} 100	I^{O} ¾	S^{O} 60					
				S^{CL} ¾	S^{CL} 100	S^{BR} 100	S^{CL} 14	I^{O} 2¾	S^{CL} 100					
					I^{O} ¾	I^{O} ¾	I^{O} 2¾	S^{O} 5	I^{O} 5					
					I^{O} ¾	S^{CL} ¾	I^{O} ¾	S^{CL} 50						
					S^{CL} 28	I^{O} ¾	I^{O} ¾	S^{O} ¾						
						I^{O} ¾	S^{O} 100	S^{O} 3¾						
						I^{CL} 3¾	S^{O} 150	S^{O} 3¾						
						I^{O} 150	I^{O} ¾	I^{O} ¾						
						S^{CL} 48	I^{O} ¾	S^{O} ¾						
						S^{O} 50		S^{O} 5						
Longer Exposure Required!						I^{O} ¾		S^{O} ½						
			1	9	16	31	23	12	10	7	4	3		

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate II Tracerlab No. 2292 Type Casella Impactor Stage No. 1
Location BM-06 % Sample Area Measured below Autoradiographic Exposure below Min.

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETERS [illegible]

Sample Description: Event Clean Slate II Tracerlab No. 2292 Type Casella Impactor Stage No. 1
Location BM-06 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: Sample approved to be overloaded.

			7.2 μm	3.1 μm	4.5 μm	6.4 μm	9.0 μm	12.7 μm	18 μm	25 μm	32 μm	50 μm	
Preparation a.						I $\frac{0}{BR}$ W $\frac{3}{8}$	I $\frac{0}{BR}$ W $\frac{3}{8}$		I $\frac{0}{BR}$ W $\frac{3}{4}$	I $\frac{0}{BR}$ W $\frac{3}{4}$	I $\frac{0}{=}$ W $\frac{3}{8}$	A_2 -- $\frac{3}{8}$	
area: 7.2 %									I $\frac{BR}{=}$ I $\frac{3}{4}$	S $\frac{BR}{BR}$ W 36			
exposure: 960 min									I $\frac{0}{BR}$ W $\frac{3}{8}$	O $\frac{0}{=}$ W $\frac{3}{8}$			
									I $\frac{BR}{=}$ W $\frac{3}{4}$	S $\frac{0}{=}$ W $\frac{3}{4}$			
										S $\frac{0}{=}$ W $\frac{3}{4}$			
										I $\frac{BR}{=}$ W $\frac{3}{4}$			
						1	1		4	6	1	1	Total 14

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 70.5 MICRON

Sample Description: Event Clean Slate II Tracerlab No. 2292 Type Casella Impactor Stage No. 2
Location BM-06 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: _____

	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9.0μ	12.7μ	18μ	25μ	36μ	50μ
Preparation a.		S cl≡S 12	I bk≡W 23	S bk≡W 49	S cl≡S 7	I b≡W 3/4	S s≡W 3/4	I s≡W 3/4	S s≡W 3/4	S s≡W 5/8	I s≡N 3/8
area: 2.7%		I 1/2 W 4	I bk≡W 21	I bk≡W 3/8	I s≡W 3/8	S s≡W 3/4	I s≡W 3/4	I s≡W 3/8	S s≡W 5	I s≡I 5/8	
exposure: 1680 Min.			I s≡W 5	I s≡W 60	I bk≡W 60	I s≡W 40	I s≡W 3/4	I s≡W 3/8			
			S cl≡S 13	I s≡W 36		I bk≡W 3/4	I b≡I 39	I s≡W 3/8			
				I bk≡W 3/4		I bk≡W 36	S s≡I 17	A_c -- 3/4			
						I s≡W 3/8	I s≡W 3/8				
						I s≡W 5/8	I s≡W 3/8				
						S cl≡S 75	I s≡W 3/4				
						I s≡W 3/8					
						I bk≡I 1/8					
						I bk≡W 3/8					
Preparation b.					I bk≡W 23	I bk≡W 15	I s≡W 5/8	S cl≡I 9	I s≡W 3/8	S s≡W 3/4	
area: 3%					I bk≡W 7	I s≡W 3/8	I s≡W 3/4	I s≡W 3/2		I s≡W 3/8	
exposure: 360 min					S bk≡W 38		I s≡W 12	S s≡W 3/8		S bk≡I 3/4	
					I s≡W 15					I s≡I 22	

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 70.5 MICRON

Event Clean Slate II Tracerlab No. 2292 Type Casella Impactor Stage No. 3
Area Measured below Autoradiographic Exposure below Min.

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 7a.8 WILCHEM

Sample Description: Event Clean Slate II Tracerlab No. 2292 Type Casella Impactor Stage No. 3
Location BM-06 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: deposit is solid and many layers deep, sandy in appearance with sprinkling of black particles. Many particles in range 10-300μ outside of the strip areaare not represented below.*

	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9.μ	12.7μ	18μ	25μ	*
Preparation a, area: 1%		I 0 W 2	I BF W 72	I BA W 36	I BK I 5/8	I B I 29					
Exposure: 10,110 Min.		S S W 23	S BR W 32	I BA W 5/8	0 E W 2	I BB I 100					
		I A W 11	I M I 4	I S W 23	I BE W 48	I BD W 3/4					
		I Y W 6	I B W 1	I E W 21	I Y I 60	S BF W 2/4					
		0 S S 15	I S W 36	I BE W 41	S S S 12						
		I BK W 17	S S S 21	S BE W 40	I BE W 3/4						
			I BB W 100	I BA W 100	I BE W 90						
			I BR W 19	I BB W 48	I BE W 80						
			I BE W 7	I S S 7	I S S 1						
			I BR W 9	I Y W 100							
				S BE W 3/4							
				I BA W 100							
See Figure 3.3 for photograph									* one sphere 100μ diameter indicated 83 d.p.m alpha activity on the surface.		
		6	10	12	9	4					

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate II Tracerlab No. 2287 Type Casella Impactor Stage No. 1
Location A-1 A-042 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: heavy deposit of fine particles.

			1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	36μ
Preparation a.					I 1/8 I 6	I 1/2 I 9	I 1/8 I 60	I 1/8 W 1/2	I 1/2 W 80	I 1/8 W 3/4	I 1/4 W 30	I 1/4 W 3/4	
area:	0.7%					S 1/8 W 36	S 1/2 W 15	I 1/2 I 10	I 1/16 W 3	I 1/8 W 19	I 1/2 W 3/8		
exposure:	720 Min.					S 1/8 W 11	I 1/16 W 17	I 1/8 W 60	I 1/8 W 3/8	O 1/16 W 29	I 1/2 W 3/8		
						S 1/8 W 17	I 1/8 W 60	S 1/8 W 3/8	S 1/2 S 3/8	A 1/2 – 3/8			
						I 1/2 W ?	S 1/16 W 11	I 1/8 W 64	I 1/8 W 3/8	A 1/2 – 3/8			
						I 1/2 W 5	I 1/16 W 48	I 1/16 W 33	I 1/8 W 3/8	I 1/8 W 40			
						I 1/8 W 14		I 1/2 W 3/8	S 1/2 S 3/8	O 1/8 W 3/8			
						I 1/8 W 80		I 1/8 W 3/8	I 1/16 W 3/8	A 1/2 – – 3/8			
								I 1/2 W 3/8	I 1/16 W 3/8	S 1/8 W 3/8			
								I 1/2 W 28	S 1/2 W 54	I 1/2 W 1/4			
								I 1/8 W 3/8	I 1/8 W 3/4	A 1/2 – – 24			
								S 1/8 W 3/8	I 1/16 W 3/8	I 1/2 I 60			
									A 1/2 W 1/2	I 1/2 W 36			
									I 1/8 W 3/8	I 1/16 W 2/2			

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description:. Event Clean Slate II Tracerlab No. 2287 Type Casella Impactor Stage No. 2
% Sample Area Measured below Autoradiographic Exposure below Min.

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 7 0.5 MICRON

Sample Description:, Event Clean State II Tracerlab No. 2287 Type Casella Impactor Stage No. 2
Location Arc A-042 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: very heavy line deposit.

			0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.9μ	9.μ	12.7μ	18μ		
Preparation a.				S 1/20 S 2	S 1/2 W 8	I 1/10 W 12	S 1/2 W 72	I 1/2 W 40	I 1/2 W 120	I 1/2 W 3/4	A_1 -- 41	A_{20} -- 5/8		
area: 4.8%					I 1/10 W 17	I 1/2 W 31	I 1/10 W 19	I 1/2 W 3/4	I 1/2 W 3/4	I 1/2 N 3/4	I 1/4 W 3/8			
exposure: 1110 Min.					I 1/4 I 4	I 1/20 W 7	I 1/2 I 11	I 1/2 W 3/4	I 1/2 I 15	I 1/2 W 3/4	I 1/2 W 8			
					I 1/10 S 2	I 1/10 W 3	I 1/2 W 80	I 1/10 I 72	O 1/2 W 3/8	S 1/2 I 3/8				
					O 1/2 S 9	S 1/10 I 12	I 1/20 W 40	S 1/20 W 5		I 1/4 I 1/2				
						I 1/2 W 6	I 1/2 W 72	I 1/20 W 15						
						S 1/2 S 1	I 1/2 W 18	O 1/20 W 6						
							I 1/2 W 25	I 1/2 I 15						
							I 1/20 W 20	I 1/10 I 7						
							S 1/2 S 7	I 1/20 W 3/8						
							S 1/2 S 5	I 1/2 I 41						
							I 1/20 W 60	S 1/2 I 1						
							S 1/2 W 45	I 1/10 W 72						
							S 1/20 W 15							
							I 1/20 W 24							
							I 1/20 W 42							
							S 1/2 S 12							

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Clean Slate II Tracerlab No. 2287 Type Casella Impactor Stage No. 3
Location Arc A-042 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: mispackaged, cellophane envelope contacted surface.

		0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9.0μ	12.7μ	18μ	25μ
Preparation a.		I S/S 1	S V/S 3	I V/- 1	S CL/S 5	S CL/W15	A_3 -- 1		I V/W 60	A_{20} -- 28	A_{50} -- 3	I -- 3	I -- 15
area:	1.2%		I BR/- 3	I BR/W 1	I BR/W 8	I O/W23	I BR/W24			A_{50} -- 5			
exposure:	12,360 Min.		I O/W 2	S V/S 1	I BR/- 1	I V/W 3	A_5 -- 9						
				I BR/W 3	I V/W 1	I BR/W 2	I BR/W35						
				S V/S 1	I A/W 4	I CL/W 2							
				I V/W 4	S M/I 1	S S/S 8							
				I BR/W 5	I BR/W 8	I V/W44							
				S S/S 1	I V/W 4	I V/W10							
				I BR/W 5	I V/W 2	I BR/W18							
				I V/W 4	I V/W 3	O V/W 6							
				O CL/W 7	S V/- 6	S V/W11							
				S CL/S 2	I V/W1								
				I CL/W 1	I V/W2								
				I O/W 1	I V/W1								
				S S/S 14									
				I O/- 1									
				I BR/W 3									
				I V/W 4									
				I V/W 5									

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER ?0.5 MICRON

Sample Description: Event Clean Slate II Tracerlab No. 2309 Type Casella Impactor Stage No. 1
Location Arc B, 12, P21 % Sample Area Measured 25% Autoradiographic Exposure below Min.

The area measured is an estimate. The distribution is ... studies is in process.

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 7 0.5 MICRON

Sample Description: Event Clean Slate II Tracerlab No. 2309 Type Casella Impactor Stage No. 1
Location Am B, 12, P21 % Sample Area Measured 25% Autoradiographic Exposure Below Min.

Comments: The sample preparation was too thick. The area measured is an estimate. The distribution is thought to be biased against the smaller particles. An estimate of the total number of active particles is in process.

		3.1 μ	4.5 μ	6.4 μ	9 μ	12.7 μ	18 μ	25 μ	36 μ	51 μ		Alpha Stars Only	
Preparation a.				S 1/2 W 1/8	O 1/8 W 3/8	S 1/8 W 3/8		A 0 - 5/64					
	990 Min.												
Preparation b.				S 1/8 W 3/4	I 0/64 W 3/32	I 1/32 W 3/32	I 1/16 W 3/32	I 1/64 W 1/2	I 1/2 W 5/8	I 0/64 W 3/8		? ? ? 5/8	4 cases
					I 1/8 W 3/8	I 1/16 W 3/32	S 1/16 W 3/32	S 1/64 W S	I 1/64 W 3/32			? ? ? 3/4	1 "
	990 Min.						S 1/2 W 3/8	I 1/64 W 3/32				? ? ? 3/32	1 "
							I 1/64 W 3/32	O 1/64 W 3				? ? ? S	1 "
							I 1/16 W 3/4	S 1/64 W S					
								S 1/8 W 3/8					
								I 0/64 W 3/4					
Preparation c.			I 1/32 I 60	S 1/8 I 100	I 1/8 W 3/8	S 1/2 I 60	I 1/4 I 3/8	I 0/64 W 3/32		I 0/64 I 5/8			
				I 1/32 W 52	I 1/16 W 3/8	I 0/64 W 3/8	I 0/64 I 5/32	S 0/64 W 3/32					
	1080 Min.			I 0/32 W 3/4		I 0/32 W 3/32							
Preparation d.			I 0/64 W 3/8				S 1/8 W 3/32	I 0/64 I S					
	990 Min.						I 0/64 W 3/8	I 0/64 I 1/2					
							I 1/8 W 5/32	I 0/64 I 5/8					
								I 0/64 I 3/8					
								I 0/64 W 5/8					
			2	5	5	6	10	15	2	2		7	54
	1	1	2	11	5	2	4		3	1			
	1	1	4	16	10	8	14	15	5	3		7	

Continued

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate II Tracerlab No. 2309 Type Casella Impactor Stage No. 1
Location Arc B, L2, P21 % Sample Area Measured ___ Autoradiographic Exposure ___ Min.

Comments: Continuation

	2.2μ	3.1μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	36μ	50μ	72μ	100
	S 5/8 S 1	I 3/4 I 50	I 3/4 I 54	I 5/8 I 7/8	I 3/4 I 38	I 3/4 I 190	I 5/8 I 20		I 1/4 I 7/8	I 1/4 I 3/4		
Preparation c.			S 5/8 W 3/8	S 5/8 I 3/8	I 5/8 I 120		I 3/4 I 3/8		S 5/8 W 3/8	A_2 -- 3		
area: 5%				I 1/2 I 80	S 5/8 I 3/8		I 3/4 S 190		A_3 -- 10			
exposure: 1440 Min.				I 1/2 I 120								
				I 5/8 I 3/8								
				I 5/8 W 3/4								
Preparation f				I 5/8 I 3/8	A_2 -- 3/4	I 5/8 I 3/4	I 3/4 I 3/8				S 3/4 S 5	
area: 5%				A_3 -- 3/4	A_2 -- 3/4						A_3 -- 3/4	
exposure: 1440 Min				A_2 -- 180							A -- 3/4	
	1	1	2	A -- 3/4 "	5	2	4		3	1	A -- 5	
											A -- 5	
		Miscellaneous		alpha	stars	only	No. of Tracks		5/8	3/4	3/4	Solid
							Frequency of Occurrence		9	1	2	2
		This preparation was too thick and poorly dispersed and probably accounts for the large agglomerates > 50μ.										

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate II Tracerlab No. 2309 Type Casella Impactor Stage No. 2
Location Arc B, L2, P21 % Sample Area Measured 20% Autoradiographic Exposure 1380 Min.

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 0.5 MICRON

Sample Description: Event Clean Slate II Tracerlab No. 2309 Type Casella Impactor Stage No. 2
Location Arc B, L 2, P21 % Sample Area Measured 20% Autoradiographic Exposure 1380 Min.

Comments: _____

0.85 μm	1.1 μm	1.6 μm	2.2 μm	3.1 μm	4.5 μm	6.4 μm	9 μm	12.7 μm	18 μm	25 μm	36 μm	51 μm
I ½ W 5		I ½ W 19	I 9/64 W 11	S ⅝ W 7	I 5/64 W 60	I ⅝ W I 80	A ⅝ - 5	A ⅝ W ⅜	I 9/16 W 5/32		I 9/16 W 50	I ⅝ W ⅜
S ½ ? 2		I 9/32 W 16	I 9/64 W 5	S ⅝ W 22	I 3/64 W ⅜	I ⅝ S 1	I 13/32 W 12	I 9/32 W 24	I 9/64 W 7			
		I ½ W 11	I 7/16 W 6	S ⅝ W ⅜	I 13/32 W ⅜	I 9/16 W 3	I 9/32 I 18	I ½ W 14	I 9/16 W ⅜			
			S ⅝ S 16	S ⅝ S 4	I 9/32 W 80	I ⅝ W 72	S ½ W 60	I ½ W ¾				
			S ⅝ S 11	I ½ W 30	S ⅝ W 25	I ⅝ W ⅜	I ½ W ⅜	I ½ W ¾				
			S ⅝ S 22	S ⅝ W 60	S ⅝ S 6	S ⅝ I 2	I ½ W 6					
			S ⅝ S 14	I ½ W 37	I 13/32 W 47	I ½ W ¾						
			S 9/16 S 44	S ⅝ S ⅜	I 9/64 W ¾	I ⅝ W 13						
			I ½ W 7	S ⅝ I 20	I ⅝ W ⅜	I ½ W 80						
			I ½ W 2	I ½ W 15	S ½ W 38	I ⅝ W 7						
			I ½ W 31	I ½ W 40	I ½ W 60	I 15/16 W 3						
			S ⅝ S 25	I ½ W ⅜	I 9/32 W ¾	I 9/64 W ¾						
			S ⅝ I 17	I ⅝ W 3	S ½ W ⅜							
				I 9/64 W 26	I ½ W ⅜							
				I 15/32 W 10	I ⅝ W 5							
				I ½ W 8								
				S ⅝ S 18								
				I ⅝ S 49								
				I ½ W 20								
				I ½ W 11								
2		3	13	20	15	12	6	5	3		1	1

Total 81

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate II Tracerlab No. 2309 Type Casella Impactor Stage No. 3
Location Arc B, L 2, P21 % Sample Area Measured 1.5% Autoradiographic Exposure 10,000 Min.

Comments: Evidence of flaky material bearing smaller opaque particles of 0.5μ size, may be due to resin interference in sample preparation.

	0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	36μ	
	S cl – 2	S cl S 1	I g/y W 1	S cl S 1	S cl S 3	I g W 1/8		A_2 cl W 1					S bl W 5/8	
	S cl – 2	I bl ? 2	S cl S 2	S bl W 2	I g/bl W 2									
		S cl ? 1	S cl S 1	I bl W 21	A_2 cl S 19									
		S cl S 1	I g W 6	I g W 14	A_2 cl S 1									
		S cl S 2	S cl S 1	S s S 8										
		S cl S 2	S cl S 5	I cl W 3										
		I y W 1	S s S 2	I y W 7										
		I cl W 2	S bk S 2	O s S 11										
		S y S 2	S cl S 1	A_2 bl W 12										
		I y W 1	S s S 1	I cl S 3										
			I cl W 3	I a W 1										
			I g W 1	I g/y W 8										
			S bl W 1	I cl W 1										
			I g/y S 1	I y I s/8										
			S y W 2	I y W 24										
			I bl W 1											
			I cl W 2											
			S y W 1											
			Ar 27r / 10000	≈ 0.0004 dis/min										

See Figure 3.25 for photomicrographs of particles and Autoradiograms

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TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate II Tracerlab No. 2273 Type Casella Impactor Stage No. 1
% Sample Area Measured below Autoradiographic Exposure below Min.

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER TO .5 MICRONS

Sample Description: Event Clean Slate II Tracerlab No. 2273 Type Cascade Impactor Stage No. 1
Location Ave D(M)-P11 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: light deposit

				4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	36μ	50μ	72μ	100μ	
Preparation a.					I $\frac{R}{Sc}$ W $\frac{S}{S}$ S $\frac{R}{R}$ W $\frac{S}{S}$	I $\frac{R}{Sc}$ I $\frac{S}{S}$ I $\frac{R}{A}$ W $\frac{S}{4}$	S $\frac{S}{-}$ W $\frac{S}{4}$	I $\frac{O}{Sc}$ W $\frac{S}{S}$ I $\frac{R}{Sc}$ W37 I $\frac{O}{Sc}$ W $\frac{S}{S}$	I $\frac{O}{A}$ W S I $\frac{O}{Sc}$ I S I $\frac{O}{Ag}$ I S I $\frac{O}{Sc}$ W35	S $\frac{S}{-}$ W $\frac{S}{S}$	S $\frac{O}{-}$ I S			
area: 14%														
exposure: 360 Min.														
Preparation b.				I $\frac{R}{W}$ I 20		I $\frac{O}{Sc}$ W $\frac{S}{4}$ I $\frac{O}{-}$ N 49	I $\frac{S}{Sc}$ W $\frac{S}{4}$ S $\frac{R}{4}$ W35	I $\frac{O}{-}$ W $\frac{S}{S}$ I $\frac{O}{-}$ W $\frac{S}{S}$ I $\frac{O}{Sc}$ W $\frac{S}{S}$	I $\frac{O}{-}$ W25	I $\frac{S}{Sc}$ W $\frac{S}{S}$ A_g $\frac{O}{In}$ W $\frac{S}{S}$	I $\frac{O}{-}$ W31 I $\frac{O}{-}$ W $\frac{S}{S}$	A_2 -- $\frac{S}{S}$		
area: 14%														
exposure: 360 Min.														
				1	2	4	3	6	5	3	3	1	Total	28

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 0.5 MICRON

Sample Description: Event Clean Slate II Tracerlab No. 2273 Type Casella Impactor Stage No. 2
Location Ave D(N)-P11 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: light deposit at center, heavy at ends.

			2.2 μ	3.1 μ	4.5 μ	6.4 μ	9. μ	13.7 μ	19 μ	25 μ	36 μ	50 μ
Preparation a.				I 8/9 W13	I 4/7 W 9	I 8/8 W 4/8	I 6/8 W 11	I 8/8 I 4/8	I 4/8 W 5/8	I 8/8 W 4/8	I 4/8 W 5	I 4/8 W 2/8
area:	28.5%			I 7/8 W 27	S 6/8 W 5	I 8/8 I 4/8	I 7/8 W 11	I 4/8 W 4/8	I 8/8 I 50		S 4/8 I 3	
exposure:	1680 Min.			S 7/8 S 2/8	I 7/8 W 80	I 8/8 I 11	I 8/8 W 3/8	I 4/8 I 4/8	I 4/8 I 2/8			
				S 6/8 W 31	A 8/8 W 3/8	A -- 30	I 8/8 W 3/8					
					I 8/8 133	S 8/8 S 60	A -- 3/8					
						S 6/8 S 3/8	S 8/8 S 3/8					

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 0.5 MICRON

Event Clean Slate II Tracerlab No. 2273 Type Casella Impactor Stage No. 3
% Sample Area Measured below Autoradiographic Exposure below Min.

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER $\geq$ .5 MICRON

Sample Description: Event Clean Slate II Tracerlab No. 2273 Type Casella Impactor Stage No. 3
Location Avc D(M)-P11 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: light deposit with sprinkling of larger particles as large as 35 μ.

			1.1 μ	1.6 μ	2.3 μ	3.1 μ	4.5 μ	6.4 μ	9 μ	12.7 μ	18 μ	25 μ	36 μ	
Preparation a.			I $\frac{C_1}{=}$ W 4	I $\frac{Y}{-}$ W 30	I $\frac{C_1}{=}$ W 60	I $\frac{C_1}{=}$ W 80	I $\frac{B_1}{=}$ W 100	S $\frac{C_1}{=}$ W $\frac{3}{8}$				S $\frac{B}{=}$ W $\frac{3}{4}$		
area: 20%					I $\frac{B_1}{=}$ W 80	S $\frac{C_1}{=}$ W 25	I $\frac{M}{Ta}$ W 80							
exposure: 10 110 Min.														
			1	1	2	2	2	1				1	Tot 1	10

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Clean Slate II Tracerlab No. 3221 Type Andersen Impactor Stage No. 1
Location Arc B-0.58 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: See Figure 3.8 for photomicrograph and Figure 3.9 for Phosphor Autoradiogram

		1.1μm	1.6μm	2.2μm	3.1μm	4.5μm	6.4μm	9μm	12.7μm	18μm	25μm	36μm
Preparation a.				I⅔ W15	S⅔–⅝	I⅝ W25	S⅔S 10	I⅔W⅜	I⅝W⅜	I⅝W⅜	I⅝W⅜	
area: 1.6%					I⅔ W25	S⅝ W48	I⅔ – ⅜	I – – ⅝	I⅝W⅜	I⅔ W⅜	I⅔– ⅝	
exposure: 960 Min							I – – ⅝	I⅝ W20	S⅔S⅝	I⅔W⅜	I⅝I⅜	
							S⅔ – ⅝	I⅔W⅜	S⅔S⅜	I⅔W⅝	I⅝W⅜	
							I⅔ – ⅜	I⅝W30	I⅔W⅝	I⅝W⅝	I⅔W⅜	
								I⅔W⅜	S⅔–⅝	I⅝W⅝		
								S⅔I⅜	I⅔W⅝	I⅝W⅝		
									I⅔W12	I⅔W⅜		
									I⅔W⅝	S⅔–⅜		
										S⅝W⅜		
										S⅝W30		
										I – – ⅜		
										I⅝W⅜		
										S⅔W⅝		
										I⅔W⅜		

320

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

...Slate II Tracerlab No. 3221 Type Andersen Impactor Stage No. 2
... Area Measured below Autoradiographic Exposure below Min.

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER?o .5 MICRON

Sample Description: Event Clean State II Tracerlab No. 3221 Type Anderson Impactor Stage No. 2
Location Arc B-058 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: Mylar coating resulted in optical interference which distorted the appearance of the particles.

	2.2μ	3.2μ	4.5μ	6.4μ	9.μ	12.7μ	18μ	25μ	Miscellaneous
Preparation a. area: 1.4% exposure: 960 Min.			I ○ - 5/8 I ○ - 5/4 I ◐ - 9/8 I ◐ - 5/8 I ○ W 3/4	I ○ W 3/4 I ◐ W 3/4	I ◐ W 3/4 I ○ W 3/8 -- - 3/4 I ◐ W 3/4	I ○ W 3/4			1 star 3/2
See Figure 3.8 for photomicrograph and Figure 3.9 for Phosphor Autoradiogram									
			5	2	4	1			1 Total 13

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate II Tracerlab No. 3221 Type Andersen Impactor Stage No. 3
Location Arc B-058 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: mylar resulted in poor resolution. At least one active particle per orifice deposit.

	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9μ	12.7μ
Preparation a, area: 1.6% exposure: 2250 Min		I - - 9	O = -40	I = W ½	I = - 20	I = W 25		I = W 10	
		I = - 1	I = - 6	I = - 50	I = W 20				
		I - - 9	I = - 4	I = - 40	I = W 11				
		I - - 4	I = - 2	S = - 7	S = - 8				
		I - - 2	I = - 6	I = W 19	S = W 40				
		I = - 3	I = -29	I & W 1	I = - 75				
				I & W 17	I = W 9				
				S = - 7	S = W 80				
				I = - 1	I = - 1				
				I = - ½	S = - 5				
				I = - 1	S = W 35				
				S = - 1	I = W 8				
					I = W 2				
					I = - 2				
					I = - 4				

Miscellaneous Star Images

No. of Tracks	1	2	.....	6	.....	20 - 30	.....	50	.....	3/4 .....
Frequency	11	1	.....	1	.....	3	.....	1	.....	1 .....

See Figure 3.8 for photomicrograph and Figure 3.9 for Phosphor Autoradiogram

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate II Tracerlab No. 3221 Type Andersen Impactor Stage No. 4
Location Arc B-058 % Sample Area Measured below Autoradiographic Exposure below Min.

poor resolution.

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER ≥ 0.5 MICRON

Sample Description: Event Clean Slate II Tracerlab No. 3221 Type Andersen Impactor Stage No. 4
Location Arc B-058 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: Mylar resulted in poor resolution.

	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9.μ	12.7μ
Preparation a.		S--1	I♀-25	I♀-9	I♀-3				
area: 1.4%		I--2	I♀-24	S♀-75	I♀-4				
exposure: 1960 Min.		I--8	I♀-12	I♀-50					
		S--2	S♀-5	S♀-25					
		S--6	I♀-3	I♀-40					
		I--10	I♀-6	S♀-1					
			S♀-8	I♀-4					
			I♀-20	I♀-1					
			I♀-16	I♀-10					
			I♀-8	I♀W1					
			I♀-30	I♀-3					
			I♂-40	I♀-5					
			S♂-1	I--20					
			I♀-5	S♂-11					
			I♀-14	I♀-6					
			I♀-9	I♀-2					
			I♀-1						
			I♀-6						
			S♀-2						
			I--15						
			I--3						
			I--4						
			O♀-2						
			S♂-2						
			I--2						
			S♂-2						
Miscellaneous Alpha Stars			S♂-4						
No. Tracks	1	2	3	4	.....	8	.....	10	11
Frequency	23	7	3	1		1		1	2

See Figure 3.8 for photomicrograph and Figure 3.9 for Phosphor Autoradiogram

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >50 MICRON

Sample Description: Event Clean Slate II Tracerlab No. below Type Total Air Samples Stage No. _____
Location below % Sample Area Measured — Autoradiographic Exposure — Min.

Comments: See Figure 3.10 Gross Observations Below.

T.L. No.		Location		Alpha Activity Sample	C.P.M. Cover
4117	(D)	Arc A-048	Medium brown particles <100μ, No large spheres	2869	729
4808	(I)	Arc B-054	Similar to 4117 except only opposite orifice	1185	—
4814	(II)	Arc B-068	Light Brown ring, most particles <100μ	634	—
4060	(II)	Arc H-024	Clean	56	—
4053	(II)	Arc H-030	Clean	30	—
4138	(II)	Arc J-054	Clean	6.5	—
4075	(II)	Arc L-036	Clean	115	—
4079	(II)	Arc L-060	Light brown ring around edge	72	—

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Event Clean Slate II Tracerlab No. 4117 Type Total Air Sample (D) Stage No. —
% Sample Area Measured ~ 1% Autoradiographic Exposure 1440 Min.

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETERS

Sample Description: Event Clean Slate II Tracerlab No. 4117 Type Total Air Sample (D) Stage No. —
Location Avc A-048 % Sample Area Measured ~ 1 % Autoradiographic Exposure 1440 Min.

Comments: See Figure 3.10

		.85 μm	1.1 μm	1.6 μm	2.2 μm	3.1 μm	4.5 μm	6.4 μm	9 μm	12.7 μm	18 μm		Misc. Tracks
		S -- 1	S -- 1	I 1/2 I 1	I 1/2 W 30	I 1/4 I 1	I 1/4 W 1	I 1/4 I 30	I 1/4 I 3/4	A_2 -- 2	S 1/2 W 3/4		Scrapes 3/8
		I 1/4 I 2	I 1/4 I 3	A_2 -- 1	A_2 1/2 I 2	I 1/4 W 1	I 1/8 W 1	I 1/2 I 250	I -- 21	I 1/2 - 2	I 1/4 - 8		7" 101-200 ft.
				I^2 1/2 I 3	I -- W 8		S 1/4 W 2	I -- 20	I 1/2 I 3/4	I 1/2 - 1	I 1/4 I 1		1" 51-100 "
					I 1/4 W 40		O 1/4 I 3/8	A_2 -- 8	A_2 -- 17		A_2 - I 2		7" 26-50 "
					S 1/2 W 1		S 1/2 S 3/8	S 1/4 W 128	I 1/2 W 58		A_2 1/2 I 1		3" 16-25 "
					S 1/2 W 7		I 1/2 I 50	I 1/8 I 15	A_2 -- 7				4" 6-15 "
					I 1/4 W 1		I 1/2 - 14	I -- 1	I - I 7				9" 2-5 "
					I 1/8 W 27			I -- 1	I 1/4 W 11				99" 1 "
					I 1/2 W 3			I 1/2 W 76	I 1/8 W 48				
					I 1/4 W 1			I 1/4 W 3/4					
					I 1/8 -1								
					S 1/2 - 24								
					I 1/2 - 6								
					I 1/2 - 6	I 1/4 - 60	I 1/4 - 68	I 1/2 - 48	I 1/2 - 80	S 1/2 S 200	I 1/2 - 33/4		
						S 1/2 - 120	I 1/2 - 200	I 1/2 - 200	I 1/4 - 75	I 1/8 I 160	I 1/2 I 120		
							I 1/2 - 70	I 1/2 - 80	I 1/2 I 3/4	I 1/2 I 200	I 1/2 I 3/4		
							I 1/2 - 80	I 1/4 - 60	I 1/2 - 3/4	I 1/2 I 48			
							I 1/2 - 120	I 1/2 - 200					
							I 1/4 I 26	I 1/2 - 60					
							I 1/2 I 200	I 1/2 - 100					
								A_2 1/2 - 23					
								I 1/2 - 200					
								I 1/2 - 40					

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Cuban Slate 2 Tracerlab No. 8101 Type Glass Slide Stage No. —
Location Arc C-064 % Sample Area Measured 3.2% Autoradiographic Exposure 1440 Min.

Comments: _____

0.85 μ	1.1 μ	1.6 μ	2.2 μ	3.2 μ	4.5 μ	6.4 μ	9.0 μ	12.7 μ	18 μ	25 μ	36 μ
	$I^{C\ell}$-6	$I^{9/2}$-10	$I^{C\ell}$-3	$I^{3/2}$-30	$I^{9/2}\omega 80$	$I^{O/2}\omega^{5/4}$	$I^{O/2}\omega^{3/4}$	$I^{O/2}\omega^{5/2}$	$I^{O/2}$-20	$I^{O/2}\omega 5$	$I^{O1/2}$-100
			$I^{C\ell}$-7	$I^{Ru/2}$-38	$I^{C\ell}$-18	$I^{O/2}$-24	$I^{O/2}$-43	$I^{O/2}\omega 5$	$I^{O/2}$-45	$I^{O/2}\omega 5$	$I^{O/2}$-3 3/4
			$I^{C\ell}$-4	$I^{C\ell}$-20	$I^{9/2}$-40	$S^{C\ell}$-62	$I^{O/2}\omega 200$	$S^{C\ell}$ S70	$I^{O/2}\omega^{3\,3/4}$	$I^{O/2}\omega^{5/2}$	$I^{O/2}\omega 5$
			$I^{C\ell}$-13		$I^{C\ell}$-48			$I^{O/2}\omega^{5/2}$	$I^{O/2}\omega 40$		$I^{O/2}\omega^{33/4}$
					$I^{O/2}\omega 38$			$I^{O/2}$-10	$S^{O/2}\omega 5$		
					$I^{O/2}\omega^{5/2}$			$I^{O/2}$-28	$I^{C\ell}$-5/4		
								$I^{5/2}$-60	$I^{O/2}\omega^{3\,3/4}$		
	1	1	4	3	6	3	3	7	7	3	4

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event [illegible] Tracerlab No. 10057 Type Glass Slide Stage No. —
Location [illegible] % Sample Area Measured [illegible] Autoradiographic Exposure 1440 Min.

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER ≥0.3 MICRON

Sample Description: Event Clean Slate II Tracerlab No. 10057 Type Glass Slide Stage No. —
Location offsite Stake 840 % Sample Area Measured — Autoradiographic Exposure 440 Min.

Comments: Area corresponding to a few tiny spot images produced by phosphor autoradiography have failed to produce alpha tracks or alpha counts above background.

See Figure 3.17 for Phosphor Autoradiogram

TABLE A.7 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER MICRON

Sample Description: Event Clean Slate II Tracerlab No. 4105 Type Disk Collector Stage No. —
Location Arc B, C4, P17 % Sample Area Measured 20.8% Autoradiographic Exposure — Min.

Comments: Active particles isolated by phosphor autoradiography, sized with stereomicroscope at 26.6x,

			34μ	48μ	68μ	96μ	135μ	192μ	270μ	384μ
Area a	975 mm²									
		Spherical	3	3	4	6	3	—	—	—
		Irregular	23	20	11	15	8	5	1	—
		Total	26	23	15	21	11	5	1	—
Area b	975 mm²									
		Spherical	15	12	9	7	2	1	—	—
		Irregular	8	10	22	15	8	6	—	—
		Total	23	22	31	22	10	7	—	—
Area c	1313 mm²									
		Spherical	15	6	5	5	2	—	—	—
		Irregular	19	22	27	25	15	5	—	—
		Total	34	28	32	30	17	5	—	—
Area d	975 mm²									
		Spherical	15	18	10	8	4	1	—	—
		Irregular	20	18	16	14	9	4	1	—
		Total	35	36	26	22	13	5	1	—
Area e	975 mm²									
		Spherical	7	4	12	6	3	—	—	—
		Irregular	7	18	22	20	20	1	1	—
		Total	14	22	34	26	23	1	1	—
Total										
		Spherical	55	43	40	32	14	2	0	—
		Irregular	77	88	98	89	60	21	3	—
		Total	132	131	138	121	74	23	3	—
Normalized To 7 Inch Disk Area										
		Spherical	260	210	190	153	67	10	—	—
		Irregular	370	420	470	427	283	100	14	—
		Total	630	630	660	580	350	110	14	—

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 70.5 MICRON

Tracerlab No. 5257 Type Casella Impactor Stage No. 1
Autoradiographic Exposure below Min.

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 7 0.5 μm

Sample Description: Event Clean Slate III Tracerlab No. 5257 Type Casella Impactor Stage No. 1
Location Tower B - P3 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: Gross overload, large spheres located beneath an overall layer of coarse sand. See Figure 3.2 for photograph and Figure 3.25 for photomicrograph

0.85 μm	1.1 μm	1.6 μm	2.2 μm	3.1 μm	4.5 μm	6.4 μm	9 μm	12.7 μm	18 μm	25 μm
Preparation a.	O A/- 4			S cl/- S 2	S cl/3 S 3	S A/- S 19	A3 -- 40	S A/- S 9	O cl/I 9	S A/- S 3/2	A2 -- 9
area: 0.3%						O cl/3 W 1	S cl/3 S 12		O 3/- W 3/2	I - I 15	
exposure: 960 Min.									A3 -- 28	A -- 29	
									A10 -- 21	S cl/3 S 3/2	
									A2 -- 3/2	S cl/3 S 3/2	
									I - I 1	S 0/3 S 3/2	
1			1	1	2	2	1	6	6	1

36 μm	50 μm	72 μm	100 μm	141 μm	200 μm	282 μm
S A/- W S	(-- 3/4	S cl/3 S 3/4	S A/- W S		S A/- W 3/2	
A2 -- 3	A10 { -- S	S A/- W S			O A/- W S	
	{ -- S	S A/- S S			O cl/3 W S	
	O 2/3 W 3/2				A -- S	
	S 2/- - 3/2					
	A2 cl/3 S 3/4					
2	4	3	1		4	

Total 35

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 5257 Type Casella Impactor Stage No. 2
Location Tower B-P3 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: Overloaded, includes many large spherical particles and overall layer of coarse soil. See Figure 3.2 for photograph.

	3.2μm	3.1μm	4.5μm	6.4μm	9.μm	12.7μm	18μm	25μm	36μm	50μm	72μm	
Preparation ar. area: 0.5%	S ≡ W 38		I ≡ W 1	I ≡ W 2	I ≡ W 2	O ≡ S 11	I ≡ W 38	S ≡ W			S ≡ S S	
exposure: 960 Min.				I - W 2	I ≡ W 72	A_2 ≡ W 44	S ≡ S					
					A_2 -- 4	A_3 -- 42	I ≡ W					
					I ≡ W 14	A_2 -- 1						
					O ≡ W 9							
	1		1	2	5	4	3	1			1	Total 18

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 5257 Type Casella Impactor Stage No. 3
Location Tower B-P3 % Sample Area Measured below Autoradiographic Exposure below Min.

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT [illegible]

Sample Description: Event Clean Slate III Tracerlab No. 5257 Type Casella Impactor Stage No. 3
Location Tower B, P3 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: Particles as large as 500 micron diameter. Dow fluid had migrated toward one edge
Field Count indicated 723 d.p.m. See figure 3.2 for photograph.

Removed Some Large Particles And Gave Alpha Count

See Table A.13 for Particle Description and Post Crushing Alpha Count

Size	α Count, 32% efficiency
425µ + 135µ	95.1 c.p.m
190µ + 190µ	51.7
540µ	22.9
225µ	15.3
210µ	10.1
160µ	15.3
110µ	0.4
475µ	17.0
135µ	11.3

Nuclear Track Autoradiography of ~ 7% of main deposit.

40,000 Min Exposure

12.7µ	18µ	28µ	39µ	56µ	Max
	A_1 Ct $\frac{3}{4}$		I Ct 200	I Ct 100	— $\frac{3}{4}$
				I Ct $\frac{3}{4}$	

Absence of fine active particles may be due to interference of Dow Fluid with stripping operation.

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 4827 Type Casella Impactor Stage No. 1
Location Arc B-078 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: Deposit is dense but covers only 1/5 normal area, Largest particles are 100μ.

	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	36μ	50μ
Preparation a.	I ≈ W 4	I ≈ W 7	S ≈ W21	I ≈ W60		I ≈ W11	I ≈ W24	S ≈ W	O ≈ W5	I ≈ I	
area: 10%	I ≈ W 2	I ≈ W 4	I ≈ W51	I ≈ W42		S ≈ S8	I ≈ W	I ≈ W			
exposure: 840 Min.	I ≈ W 1	I ≈ W 9	S ≈ W13				I ≈ W	I ≈ W60			
		I ≈ W 8					I ≈ W	S ≈ W5			
	3	4	3	2		2	4	4	1	1	

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER ? 0.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 4827 Type Casella Impactor Stage No. 2
Location Arc B-078 % Sample Area Measured below Autoradiographic Exposure below Min.

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETERS ≥ .5 MICRONS

Sample Description: Event Clean Slate III Tracerlab No. 4827 Type Casella Impactor Stage No. 2
Location Arc B-078 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: Heavy deposit.

	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	36μ	50μ
Preparation a	A_2 - - 6	S $\overset{cR}{=}$ S 4	O $\overset{cL}{=}$ W 100	O $\overset{N}{=}$ I 120	A - - 15	A - - 2	A_4 - - 1	S $\overset{0}{\underset{R}{=}}$ W $\frac{3}{4}$		S - W S	
area: 2.6%	I - - 12	A_3 - - 31	A_{10} - - 17	S $\overset{0}{\underset{R}{=}}$ S 120	A_3 $\overset{0}{\underset{R}{=}}$ W $\frac{3}{4}$	S $\overset{cL}{=}$ S 42	O $\overset{N}{=}$ I 5				
exposure: 840 Min	O - - 36	A_2 - - 10	I - I 51	O $\overset{cL}{=}$ W 3	A_2 - - 1	A_4 - - 2	O $\overset{0}{\underset{R}{=}}$ W $\frac{3}{4}$				
	S $\overset{cL}{=}$ S 19	S $\overset{cL}{=}$ W13	S $\overset{cL}{=}$ S 27	S $\overset{M}{=}$ W 125	O $\overset{V}{=}$ I 5	O $\overset{0}{\underset{R}{=}}$ S 5	S $\overset{0}{\underset{R}{=}}$ W 5				
	O - - 1		S $\overset{cL}{=}$ W 1	S $\overset{S}{=}$ I 2	O $\overset{0}{\underset{R}{=}}$ S 5		O $\overset{0}{\underset{R}{=}}$ S 5				
			S $\overset{0}{\underset{R}{=}}$ W 2								
			S $\overset{M}{=}$ W $\frac{3}{4}$								
			O $\overset{M}{=}$ W 10								
			S $\overset{0}{\underset{R}{=}}$ W 59								

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 4827 Type Casella Impactor Stage No. 3
Location Area B-078 % Sample Area Measured 6% Autoradiographic Exposure 13,950 Min.

Comments:

Preparation a.

0.55μm	0.85μm	1.1μm	1.6μm	2.2μm	3.1μm	4.5μm	6.4μm	9μm	13.2μm	18μm	25μm	36μm	50μm
S - 4	S 5/8 S 3	S 1/2 S 3	I 3/4 W 4	I 1/2 W 1	I 1/2 W 2	I 5/8 I 60			I 1/2 W 15	I 1/2 W 3/4	S 3/8 W 1/8	O 1/2 I 3/4	I 5/8 W 1/8
S 1/2 S 5	S 1/2 - 88	I 1/2 W 1	I 1/2 W 17	I 1/2 W 2	I 1/2 S 1							I 1/2 W 12	
S 1/4 - 2	I 1/2 - 1	I 1/4 W 1	I 1/4 W 5	S 3/4 W 2	I 1/2 W 2								
S 1/2 - 1	S 1/4 - 2	I 1/8 W 1	I 1/8 W 12	I 1/4 W 2	I 3/8 W 1								
	S 3/4 W 3	S 1/2 3 9	S 1/2 S 3	I 3/4 W 60									
	I 1/2 - 3	S 1/2 S 22	S 1/8 W 1										
	S 3/4 - 5	I 3/4 - 3	S 1/4 S 2										
	I 1/8 - 1	I 1/2 W 9	I 3/4 W 12										
	I 1/2 - 6	S 1/2 3 1	S 1/4 W 30										
	S 1/2 - 1		S 1/2 W 68										

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 4926 Type Casella Impactor Stage No. 1
% Sample Area Measured below Autoradiographic Exposure below Min.

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER ≥ 0.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 4926 Type Casella Impactor Stage No. 1
Location Arc D-038 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: _____

	1.6 μ	2.2 μ	3.1 μ	4.5 μ	6.4 μ	9 μ	12.7 μ	18 μ	25 μ	36 μ	50 μ	72 μ	100 μ
Preparation a. area: 50% exposure: 720 Min.						S^{Cl}_{BR} W 5							
Preparation b. area: 50% exposure: 420 Min													
	I - - 1	$S \overline{=} S$ 2	$I \overline{=} I$ 10	A_3 - - 4	O^{Cl}_{BR} W 15	A_3 - - 12	$I \overline{=} I$ 1	$I^{O}_{BK} S^{S}_{2}$	$S^{O}_{BR} S$ S	$O^{O}_{BR} S$ 5½	$S \overline{=} S$ S	S^{Cl}_{BK} W 200	A_2 - - 250
			A_2 - - 7	A_3 - - 33	$A_3 \overline{=}$ W 15	$O \overline{=} W$ S		$I \overline{=} I$ 9		O^{O}_{BR} W S	S - - S	$S^{S}_{BR} W^{1}_{2}$	
					$I \overline{=} I^{1}_{2}$			$I \overline{=}$ - 21			I - - 22		
	1	1	2	2	3	3	1	3	1	2	3	2	1

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 4926 Type Casella Impactor Stage No. 2
Location Arc D-038 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: Field Count indicated 12 d.p.m. Results are incomplete due to poor preparation.

	1.6 μm	2.2 μm	3.1 μm	4.5 μm	6.4 μm	9 μm	12.7 μm	18 μm	25 μm	36 μm	50 μm	72 μm
Preparation a. area; 50% exposure; 2490 Min				I $\frac{2}{2}$ W10	I $\frac{BB}{BR}$ W5	S $\frac{C}{BR}$ W $\frac{1}{4}$						
Preparation b. area; 50% exposure; 6750 Min	I -- 7 I -- 1 I -- 4	O -- $\frac{5}{4}$ I -- 1	S $\frac{C}{C}$ W23		I $\frac{BR}{C}$ I 1	S $\frac{2}{BR}$ W $\frac{5}{4}$	I $\frac{BR}{C}$ W $\frac{1}{8}$	A$_2$ $\frac{2}{BR}$ S 10 S $\frac{2}{BR}$ W $\frac{3}{4}$			S $\frac{2}{BR}$ W S	
	Poor preparation!											
	3	2	1	1	2	2	1	2			1	

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 4926 Type Casella Impactor Stage No. 3
% Sample Area Measured below Autoradiographic Exposure below Min.

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETERS > 0.5 MICRONS

Sample Description: Event Clean Slate III Tracerlab No. 4926 Type Casella Impactor Stage No. 3
Location Arc D-038 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: The three large particles indicate short alpha tracks which indicate internal sites of activity The tracks are uniformly distributed across the surface of the particle.

1.1μ	1.6μ	2.2μ	3.2μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	36μ	50μ	71μ	100μ
Preparation a area 25% exposure 13950 Min.				Poor preparation, yielded which is listed			below	only 9	single	tracks	and 1	particle.	
Preparation b: area 75% Exposure: 33,120 Min.	$I^{cl} = 10$			$S^{cl} = W2$ $I^{cl} = W220$								$A_2 = -\frac{3}{4}$ $S\ 1\ \ S_2$	$A_2 = -5$

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 4916 Type Casella Impactor Stage No. 1
Location Area D-098 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments:

	1.1μ	1.6μ	2.1μ	3.2μ	4.5μ	6.4μ	9.μ	12.7μ	19μ	25μ	Miscellaneous, Tracks Only	
Preparation a.					A_2^{M} I 2	I $^{BR}_{M}$ I $^{S}_{L}$	0 - I $^{S}_{L}$	0 $^{M}_{M}$ I 60	A_2 $^{BR}_{M}$ I $^{S}_{L}$		frequency	No. Tracks
area: 50%					I - - 44	I $^{S}_{M}$ I $^{S}_{L}$	I $^{M}_{M}$ I 96	A_2 $^{M}_{M}$ I $^{S}_{L}$	0 $^{S}_{BR}$ - $^{S}_{L}$		1	7
exposure: 720 Min.							A_1 - - 10	I $^{S}_{BR}$ W 200	I $^{M}_{M}$ I 120		1	10
								0 $^{S}_{BR}$ W $^{S}_{L}$	0 $^{S}_{BR}$ W $^{S}_{L}$		1	30
											1	40
					2	2	3	4	4		Total	16

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 4916 Type Casella Impactor Stage No 2
Location Area D-098 % Sample Area Measured below Autoradiographic Exposure below Min

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER ≥ 0.5 MICRON

Sample Description: Event Clean Skies III Tracerlab No. 4916 Type Casella Impactor Stage No 2
Location D-098 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: Heavy, well defined deposit.

		1.6 μ	2.8 μ	4.1 μ	4.5 μ	6.4 μ	9 μ	12.7 μ	18 μ	25 μ	Miscellaneous Tracks Only	
											Frequency	No. Tracks
Preparation a.			$S \overset{cl}{=} S\,12$	$S \overset{M}{=} I\,1$	$S \overset{cl}{=} S\,156$	$I \overset{M}{=} I\,1$	$A_2 \overset{M}{=} I\,74$	$I \overset{M}{=} I\,1$			10	1
area: 25%			$S \overset{cl}{=} W\,1$	$S \overset{cl}{=} S\,1$	$I \overset{M}{=} I\,24$	$I --$	$I \overset{M}{=} I\,62$	$I \overset{M}{=} I\,8$			2	2
exposure: 2490 Min.					$I \overset{o}{BR} W\,7$		$A_3 --\,1$	$I \overset{cl}{=} I\,3$			1	6
					$S \overset{M}{=} I\,15$			$A_3 --\,3$			1	11
					$I \overset{M}{=} I\,6$			$A_2 --\,4$				
					$S \overset{M}{=} W\,20$			$I \overset{M}{=} I\,1$				
					$I \overset{M}{=} I\,1$			$A_2 \overset{M}{=} I\,4$				
					$A_2 \overset{M}{=} I\,5$			$A_2 \overset{M}{=} I\,8$				
					$I \overset{M}{=} I\,2$							
Preparation b.		$A_2 --\,3$	$S \overset{cl}{=} S\,5$	$I \overset{M}{=} I\,4$	$I \overset{M}{=} I\,20$	$I \overset{M}{=} I\,34$	$A_3 --\,12$		$A_2 --\,5$			
area: 25%			$S \overset{o}{BR} W\,60$	$S \overset{cl}{=} S\,2$	$I \overset{M}{=} I\,27$	$I \overset{o}{=} W\,20$	$I --\,\frac{3}{4}$		$I --\,8$			
exposure: 2490 Min.			$S \overset{cl}{=} S\,7$	$S \overset{cl}{=} S\,11$	$A_3 \overset{M}{=} I\,38$	$I \overset{cl}{=} W\,3$						
				$A_3 \overset{M}{=} I\,16$	$S \overset{o}{=} S\,7$							
				$I \overset{M}{=} I\,23$	$I \overset{M}{=} I\,114$							
				$I \overset{o}{=} W\,42$	$I \overset{M}{=} I\,10$							
				$I \overset{M}{=} I\,6$	$I \overset{M}{=} I\,32$							
				$S \overset{cl}{=} S\,1$								
				$S \overset{cl}{=} S\,8$								
				$I \overset{M}{=} I\,16$								
				$A_2 \overset{cl}{=} I\,7$								
				$S \overset{cl}{=} S\,12$								
		1	5	14	16	5	5	8	2		14	Total 70

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 4916 Type Casella Impactor Stage No. 3
Location Arc D-098 Sample Area Measured below Autoradiographic Exposure below Min.

Comments: Heavy, well defined deposit.

0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	Miscellaneous Tracks Only
2 - - 1	S cl S 2	S cl S 5	A_3 N - 45	I cl W 2	A_3 N I 49	A_2 N I 2	I N I 1		I N - 2	A - - 15	
	A_2 cl W 2	S cl W 2	A_3 - - 16	I cl W 60	O 0 W 1	I N I 3	A_2 - - 7		I N - 1		
	S cl S 33	I - - 9	A_2 - - 15	I M I 18	I - - 1	I N I 74	A_2 - - 1		I N - 1		Frequency / No. Tracks
	S cl W 2	I M W 35	S cl W 2	I cl W 28	A_2 cl W 58	A_2 N I 1			I - - 2		15 / 1
	S cl W 1	I M W 40	A_3 cl S 3		A_3 - - 1				I - - 3		1 / 2
	I cl S 1	S cl S 4	A_2 Y - 17		O 0 W 1				A - - 15		2 / 3
		S cl S 1	A_2 - - 19		I cl W 100						1 / 6
		S cl S 5	I - - 10		A_3 N I 1						2 / 7
Preparation as,			O 0 R W 34		A_3 N I 9						
area: ~ 20%			I cl I 20								
exposure: 13950 Min.			A_2 - - 7								
			A_3 - - 1								
			A_2 cl S 5								
			A_3 N W 3								
1	6	8	14	4	9	4	3		6	1	31 add'l 22

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

... 11. Tunnelaw Stage No. 1

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 4886 Type Casella Impactor Stage No. 1
Location Area F-038 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: Large particles resulted in poor preparation geometry.
See Figure 3.2 for photograph.

	9.5μ	6.4μ	9μ	12.7μ	18μ	25μ	36μ	50μ	70μ	100μ	200μ
Preparation a. area: 10% exposure: 4260 Min.	No alpha tracks produced.										
Preparation b. area: 15% exposure: 10020 Min.		$I \frac{n}{=} I\ 148$ $A_2 -- 150$		$I \overset{BR}{=} I \frac{1}{8}$ $A_3 -- \frac{1}{8}$	$I \overset{cl}{=} I\ 2$	$0 -- 5$	$A_2 \overset{BR}{=} WS$ $I \overset{BR}{=} I \frac{1}{2}$ $S \overset{O}{BR} I \frac{1}{8}$ $S \overset{O}{=} -5$ $S \overset{cl}{=} WS$	$S \overset{O}{BR} I\ 5$ $A_2 -- \frac{1}{8}$ $A_3 -- 5$	$S \overset{N}{=} I\ 5$ $A_3 -- \frac{1}{8}$ $A -- 5$		$A -- \frac{1}{4}$ $A -- \frac{1}{2}$
	Miscellaneous Stars Only				No Tracks Frequency		1 3	.....	Solid 5		
Preparation c. area: 15% exposure: 11460 Min.					$S \overset{BR}{=} WS$	$S \overset{BR}{=} WS$ $I \overset{BR}{=} -5$ $S \overset{A}{=} WS$	$S \overset{cl}{=} W \frac{1}{2}$ $I \overset{O}{BR} IS$	$A_3 -- 5$ $A_2 \overset{cl}{=} W \frac{1}{8}$	$A_2 -- 5$	$A_3 -- 5$ $A_4 -- 5$ $S \overset{BR}{=} WS$ $A_2 -- 5$	
	2		2	2	4	7	5	4	4	2	Total 32

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 70.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 4886 Type Casella Impactor Stage No. 2
Location Avc F-038 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: Whole sample was examined, only 3 active particles were located, The particle sizes indicate sampler overload. See figure 3.2 for photograph.

	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	36μ	50μ	70μ	100μ	
Preparation a. area: 7% exposure: 5290 Min.								$S\frac{O}{M}W\frac{3}{8}$			
Preparation b. area: 14% exposure: 8220 Min.									$A_2 - -S$		
Preparation c. area: 14% exposure: 25,660 Min							$I\frac{BR}{S}WS$				
Preparation d. area: 65% exposure: 4260 Min		No alpha stars were produced.									
							1	1	1		Total 3

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 70.5 MICRON

[illegible] Tracerlab No. 4886 Type Casella Impactor Stage No. 3

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 70 & VICINITY

Sample Description: Event Clean Slate III Tracerlab No. 4886 Type Casella I-pactor Stage No. 3
Location ARC F-038 % Sample Area Measured _____ Autoradiographic Exposure _____ Min.

Comments: Field count data indicated 24 d.p.m for total deposit. Heavy deposit, produced poorly dispersed preparations. See Figure 3.3 for photograph.

Preparation a, area: 15%
exposure: 64 800 Min.

Miscellaneous Alpha Tracks Only

No. of Tracks	1	2	3
Frequency of Occurrence	2	—	—

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 4842 Type Casella Impactor Stage No. 1
Location Arc H-030 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments:

		2.2μm	3.1μm	4.5μm	6.4μm	9μm	12.7μm	18μm	25μm	36μm	50μm	70μm	100μm	
Preparation a.		A_3 4-2	0 5-3	6 4-5	A_3 --1	0 4-29		0 4 W 4	0 8x W 4	S 8x W 4		0 4 W 4		
Area: 40%		0 --1	0 --3	0 4-14	A_3 --10			0 8x W30						
exposure: 720 Min.		I --3	0 --10	S --16										
		0 --4	0 --5											
		0 --3	A_2 --3											
			S 4-5											
			S 4-1									1		
			I 4-3											
		5	8	3	2	1		2	1	1		1	TOTAL	24

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 4842 Type Casella Impactor Stage No. 2
Location Arc H-030 % Sample Area Measured 50% Autoradiographic Exposure 2490 Min.

Comments: Field count indicated 0 d.p.m. No alpha tracks were produced by the half of the sample which was examined.

TABLE A.8 CLASSIFICATION OF PARTICLES WITH

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 4842 Type Casella Impactor Stage No. 3
Location Arc H-030 % Sample Area Measured 100% Autoradiographic Exposure 45760 Min.

Comments: Field count data indicated 4 d.p.m. No alpha stars were detected.

Miscellaneous alpha tracks only		
No. Tracks	1	2
Frequency	10	2

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 4985 Type Anderson Impactor Stage No. 1
Location BM-010 % Sample Area Measured _____ Autoradiographic Exposure _____ Min.

Comments: Mylar produced optical interference.

	3.3μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	36μ	50μ	70μ	100μ
Preparation a. area: 1% exposure: 11220 Min.			$I \frac{M}{=} W 10\frac{8}{}$		$S \frac{C}{=} S 4$	$I \frac{O}{BK} W \frac{S}{4}$ $I \frac{C}{=} I 1$					
Preparation b. area: 2% exposure:			$I \frac{S}{=} I \frac{S}{4}$ $I \frac{BR}{=} W \frac{S}{8}$		$I \frac{DK}{=} W \frac{S}{8}$ $S \frac{C}{=} W 60$ $I \frac{M}{=} I \frac{S}{4}$ $O \frac{M}{=} I \frac{S}{8}$	$A_2 \frac{BR}{=} W 1$			$A_2 -- \frac{S}{8}$	$O \frac{O}{=} W 300$	$A_3 -- 200$
See Figure 3.7 for photograph			3		5	3			1	1	1

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER MICRON

Sample Description: Event Clean Slate III Tracerlab No. 4985 Type Andersen Impactor Stage No. 2
Location BM-010 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: Mylar produced optical interference. See Figure 3.7 for photograph.

		1.1μ	1.6μ	2.2μ	3.2μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ			
Preparation a			$I \overset{cl}{=} W1$			$S \overset{cl}{=} W17$	$S \overset{cl}{=} W \frac{S}{4}$							
area: 1.2%							$S \overset{cl}{=} W44$							
exposure: 6840 Min.														
			1			1	2							

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 4985 Type Andersen Impactor Stage No. 3
Location BM-010 % Sample Area Measured Below Autoradiographic Exposure below Min.

Comments: See Figure 3.7 for photograph

			1.6μ	2.2μ	3.2μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	36μ	50μ
Preparation a.						$A_3 = 39$	$A_3 = 1$	$S \overset{cl}{=} W5$				$A_3 = 100$	
area: 1.4%								$I \overset{M}{=} I35$					
exposure: 6840 Min.													
Preparation b.					$I \overset{M}{=} I240$								
area: 1.2%													
exposure:													
					1	1	1	2				1	

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER> 0.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 4985 Type Anderson Impactor Stage No. 4
Location BM-010 % Sample Area Measured _____ Autoradiographic Exposure _____ Min.

Comments: Mylar produced optical interference. See Figure 3.7 for photograph

			0.85μ	1.1μ	1.6μ	2.2μ	3.2μ	4.5μ	6.4μ	9μ	12.7μ	Miscellaneous	
Preparation a.						I $\overline{\overline{\text{BR}}}$ I 132	I $\overline{\overline{\text{BR}}}$ I 192					Star	Only
area: 1.4%						S $\overline{\overline{\text{BR}}}$ W 128						Freq.	No. Tracks
exposure: 78480	Min.											1	104

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER> 0.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 4980 Type Anderson Impactor Stage No. 1
Location Arc A-102 % Sample Area Measured Below Autoradiographic Exposure Below Min.

Comments: Mylar produced poor preparations.
See Figure 3.8 for photomicrograph and Figure 3.9 for Phosphor Autoradiogram

		1.1μ	1.6μ	2.2μ	3.2μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	36μ	50μ
Preparation a.				I $\overline{\overline{\text{C}}}$ W 80				I $\overline{\overline{\text{N}}}$ I 46	I $\overline{\overline{\text{BR}}}$ W 46	I $\overline{\overline{\text{O}}}$ N $\frac{5}{8}$	O $\overline{\overline{\text{BR}}}$ W $\frac{3}{8}$		
area: 1.8%										S $\overline{\overline{\text{O}}}$ W 75			
exposure: 960 Min.													
Preparation b.				Failed	in	process.							

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Clean Slate II Tracerlab No. H980 Type Anderson Impactor Stage No. 2
Location Arc A - 102 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: See Figure 3.8 for photomicrograph and Figure 3.9 for Phosphor Autoradiogram

	1.1μm	1.6μm	2.3μm	3.2μm	4.5μm	6.4μm	9μm	12.7μm	18μm	25μm
Preparation a. Area: 3% Exposure: 1110 Min					$A_2 \overset{M}{=} I32$		$S \overset{cl}{=} W\frac{3}{4}$	$S \overset{cl}{=} W\frac{3}{4}$		
Preparation b. Area: 3.2% exposure: 1110 Min	Only 3 isolated alpha tracks were produced.									

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER TO AS [illegible]

Sample Description: Event Clean Slate III Tracerlab No. 4980 Type Andersen Impactor Stage No. 3
Location Ave A - 102 % Sample Area Measured Below Autoradiographic Exposure below Min.

Comments: See Figure 3.8 for photomicrograph and Figure 3.9 for Phosphor Autoradiogram.

	0.85 μ	1.1 μ	1.6 μ	2.2 μ	3.1 μ	4.5 μ	6.4 μ	9 μ	Miscellaneous Alpha Shows Only
Preparation a, area: 4% exposure: 16830 Min	z - - 1	S $\overset{cl}{=}$ S 3 I $\overset{cl}{=}$ - 3			I $\overset{cl}{=}$ I 22 S $\overset{o}{=}$ W 28	S $\overset{o}{=}$ W 220 S $\overset{o}{=}$ W 150 S $\overset{o}{=}$ W 140	A - - 152	A_2 - - 160 A_3 - - 188	? ? ? 60 ? ? ? 126 11 cases 1 3 cases 2
Preparation b area: ? exposure: 12 960 Min.		I - - 1						$O \overset{cl}{=}$ W 1	
		Poor Preparation							
	1	2			2	3	1	2	2

Total 13

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 4980 Type Andersen Impactor Stage No. 4
Location Area A-102 % Sample Area Measured _____ Autoradiographic Exposure _____ Min.

Comments: Mylar produced optical interference.
See Figure 3.8 for photomicrograph and Figure 3.9 for Phosphor Autoradiogram.

	0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.2μ	4.5μ	6.4μ	9μ	12.7μ	18μ
Preparation a.	S--1		S--2	S≐S2	O≐-15	S≐W3	O≐W16		A_2--21	O≐W38	
area: 1.5%			I--2		S≐W3	S≐W1	S≐W9		O≐W17		
exposure: 24480 Min							A_2≐W36		A_3--28		
							O--11		A_2--5		
							A_2--5				
							S--1				
							A_2--1				
Preparation b.				S--6	S--2	S--8	O≐S1		O--19	A_2--9	A--22
area: 0.5%				S--4	S--2	S-S4	S--7		A_3--2		
exposure: 8550 Min.					S--5	S≐S18	I≐-5				
						S≐S21	S≐-¾				
						S≐-¾	I≐-6				
						S≐W10	O≐-7				
						S--2					
						S≐W1					
	1		2	3	5	10	13		6	2	1

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 750. MICRON

[illegible] Tracerlab No. below Type Total Air Samples Stage No. —
Autoradiographic Exposure — Min.

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 75 MICRON

Sample Description: Event Clean Slate III Tracerlab No. below Type Total Air Samples Stage No. —
Location below % Sample Area Measured — Autoradiographic Exposure — Min.

Comments: Gross Observations See Figure 3.10

T. LAB No		Location		Alpha Activity C.P.M* Sample	Cover
5166	(I)	Arc A-024	Medium brown, brown, black particles <200μm. Few Spheres	411	268
5126	(II)	Arc B-030	Clean, few particles >25μm	9	—
5132	(II)	Arc B-090	Light brown cast, predominately < 25μm	106	—
5059	(II)	Arc F-090	" " ring around edge. Note large tear shaped particle, black.	75	—
5090	(I)	Arc K-084	Clean	—	—
5043	(II)	Arc H-090	Clean	9	—
5110	(II)	Arc L-042	Clean.	BKG	—

* Counting efficiency 38%

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER MICRON

Sample Description: Fvent Clean Slate III Tracerlab No. 5166 Type Total Air Sample (D) Stage No. —
Location Arc A-024 % Sample Area Measured ~ 1 % Autoradiographic Exposure 1440 Min.

Comments: Thick preparation may have resulted in low yield.

	0.85μ	1.1μ	1.6μ	2.3μ	3.3μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ			
				I 2/3 W 3/4	I 1/2 W120		I 1 3/4 W62	0 1/32 I 1/2	I 2 3/4 W 3/4	I 1/32 I 3/4				
				I 1/4 S 5/8			I 1/2 W13			S 1/32 I 3/4				

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Fvent Clean Slate III Tracerlab No. 5132 Type Total Air Sample (II) Stage No. —
Location Arc B-090 % Sample Area Measured ~0.8 Autoradiographic Exposure 1440 Min.

Comments: Low activity sample. Only 1 alpha star located, no particle visible. Star consisted of 3/4 population. Appeared to be thick preparation.

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 8165 Type Glass Slide Stage No. ——
Location BH-04 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: Effective area of slide 1.5 x 2.5 inches.
See Figure 3.18 for Phosphor Autoradiogram and Figure 3.25 for photomicrograph of single particle.

		3.2μ	4.5μ	6.4μ	9.0μ	12.7μ	18μ	25μ	36μ	50μ	72μ	100μ	140μ	
		I CL I 80	I CL I 1	I CL I 130	I DK I 100	A_2 -- 100	I CL I 5	I D BR S 200				I -- S	I -- S	
Preparation a.			A_2 M I 55	I CU I S/8	A_2 SH I 80	A_2 -- 9	S CL W S/8						A_3 -- 3	
area: 1%			A_2 -- S	A_2 -- 100	I S/8 W S/8									
exposure: 7200 Min.				A_3 -- 96	I S/8 W 1									
				I -- 96	I M W 1/2									
				A_2 -- 2/8	A_2 -- 1/8									
				I D BR S 2/8										

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 8165 Type Glass Slide Stage No. ——
Location BM-14 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: ——

2.2μ	3.1μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	36μ	50μ	72μ	100μ			
S CL W 57	S CL W 58	I M I 96	A_2 M I 170	I M I 100	I DK I 50	S DK S S/4	I BLK W 1/8	S CL W 1/2	A -- 19	A -- 1/8				
	D -- 3/4	I M I 100	O CL W 200		S CL W 1/2	A_2 DK WS/8	I BLK 1/2	A_4 M I 3	A_2 -- S	I D BR WS				
						S CL W 1/4	I D BR W 3/8		A --150					
Preparation a.						I D W 1/2	S D BR S 60		O BR 3 1/2					
area: 2.3%														
exposure: 8520 Min.														

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER ≥ 0.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 8167 Type Glass Slide Stage No. —
Location Avc C-022 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: The lower set of data was taken to emphasize the large particle end of the sizes encountered.

1.1	1.6	2.2 μ	3.2 μ	4.5 μ	6.4 μ	9 μ	12.7 μ	18 μ	25 μ	36 μ	50 μ	72 μ	100 μ	
I--2	I--1	I--9	I--1	S ≦ I 40	I ≦ -7	S ≦ I 6	I ≦ S 50	A_2 ≧ I - S/B	A_2 ≧ I 100	I ≦ I S/B	I S/Bk W100			
I--2	I--2	I--5	I--4	I ≦ I 1	I ≦ I 15	I ≧ I 96	I ≦ I 1	A_2 - I 140	A_2 ≧ S S/B	A_2 --200				
I--1	I--6	I--3	S ≧ S 1		I ≦ -7	O ≧ S 16	I ≦ I 1	I ≦ I 1	I ≦ S 1	I ≧ I 1				
I--1	I--1	S ≦ W24			I ≧ -1	I - ≧ I 30	I Bk S 1	I ≦ I S/B	S Bk S 1	A_2 -- S/4				
I--1	I--1				I ≦ -25		O Bk W 1	I ≦ I 140	A_2 --130	I O/Bk I S/B				
I--1	I--2				I ≦ -38		A_2 -- 50	I ≦ I 175	A_2 -- 180					
I--5	I--1				I ≦ -20		A -- 8	A_2 ½ I 180	I ≦ I 150					
					I ≦ -6		I ≦ I 180	I ≧ I 1	I A/2 I 140					
Preparation on area: 0.6% exposure: 2550 Min.							I ≦ I 130	I ≦ I S/B	I ≧ I 190					
							I ≦ I 90		I R/2 I 180					
							I ≦ I 105							
							A_2 ½ I 10							
							I ½ I 160							
							I ½ I 80							
7	7	4	3	2	8	4	14	9	10	3	1		1 total	174
				25 μ	36 μ	50 μ	72 μ	100 μ	140 μ	200 μ	280 μ	400 μ	560 μ	
area:	1.8%				I ≦ W 300	O ≧ W 5	I S/Bk S 300	I ≧ W 200			A --200			
					I ≧ W 300	I S/Bk S 200	S S/Bk S S	S S/Bk W 300						
					I ≧ W 400	I ≦ I 300	I ≦ W 100							
					I ≧ W 100	I O/Bk I S/4	A_2 -- 200							
					I ≧ W 400	A --200								
					I ≧ W 200									
					I ≧ I 45									
					I ≧ S 100									
					I ≦ S 170									
					I ≧ I 300									

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 8167 Type Glass Slide Stage No. ———
Location Arc E-034 ° Sample Area Measured below Autoradiographic Exposure below Min.

Comments: numerous events consisting of 1, 2 or 3 tracks without visible particulates indicate presence of particles <0.5μm or solubility effect.

1.6μm	2.2μm	3.2μm	4.5μm	6.4μm	9μm	12.7μm	18μm	25μm	36μm	50μm	72μm	100μm	140μm
		I CL I 3/4	A_2 CL I 1	I S I 20	O CL W5	A -- 5/4	I 3/4 I 6			S 0 W 5	A -- 600		A_2 -- 180
		S CL S 44	I 0 A_2 - 3/4	A_2 - I 3/4	I CL I 50		A_2 -- 5				A -- 700		
				A_2 - - 40									
Preparation a.				A_2 - - 40									
area: 0.4%				I CL I 2									
Signature: 7200 Min.				I S W I 3/4									
				S 0 W 30									
				A_2 - - 100									
				I 0 I 3									
				I CL I 3/4									
				I CL I 1									
			No. of Tracks			1	2	3	4	5			
			Frequency of Occurrence			173	9	1					

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 8169 Type Glass Slide Stage No. ———
% Sample Area Measured ——— Autoradiographic Exposure ——— Min.

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.3 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 8169 Type Glass Slide Stage No. ____
Location Ave G-032 % Sample Area Measured ____ Autoradiographic Exposure ____ Min.

Comments: Large number of single tracks to which no particle can be assigned indicate presence of many active particles < 5μ or evidence of solubility in the wet nuclear emulsion.

2.3μ	3.2μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	36μ	50μ	72μ	100μ	140μ	200μ	
S ≐ ~1	I DR ~1	I ≐ ~1	S ≐ W 3/8	O ≐ W 3/8	I ≐ W76	O DR W S	I ≐ I 50	I DR I 1/4	S DR W 1/4	I ~200	I DR I 1/8	A2 ~ 1/8	A2 DR W 1/8	
1 ~ 1		S ≐ ~1	A2 ≐ I 5	I ≐ I150	O ≐ S 1	O ≐ S 1	S ≐ S 2	S DR W180	I ≐ W 3/8	O DR ≐ W S	S DR W 1/8	A2 ~ 1/8		
		S ≐ ~1	I ≐ I110		I ≐ I56	O DR W 3/8	S ≐ S 80	A2 ≐ I 3/8	A2 DR ~ 1/4	S ≐ DR W 3/4	I DR W 1/8	A2 ~ 1/8		
					A2 ~ 3/8	I DR W140	I DR I 15	I DR W 1/4	I ≐ I 3/8	O ≐ W 3/4	I DR W 1/4			
Preparation a.					O ≐ W 5/8	S DR S 3/8	I DR W170		I DR I 3/8	S ≐ ~ 3/8	A1 ~			
area: 2.1%						S ≐ S 190	I DR W180		S ≐ S 1/4	S ≐ DR W 3/4				
exposure: 2930 Min.						S ≐ S 40	S ≐ W 3			I ≐ I 1/8				
						O ≐ S 1				S DR W 1/2				
						O ≐ S 1				S DR W 3/4				
						S ≐ S 2				O ≐ DR W 3/8				
						S ≐ S 1								Total
2	1	3	3	2	5	11	7	4	6	10	5	3	1	63

tracks without particles area: 0.02%

No. of Tracks 1 2 3
Frequency Of Occurrence 161 4

Single tracks uniformly distributed over whole sample.

See Figure 3.18 for Phosphor Autoradiogram.

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 8171 Type Glass Slide Stage No. —
Location Arc H-034 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: large number of single tracks for which no particle is visible. This suggests the presence of fine particulates, or a solubility effect.

	6.4μ	9μ	12.7μ	18μ	25μ	36μ	50μ	72μ	100μ	140μ	200μ	
Preparation a.				I $\overset{BR}{=}$ W120	I $\overset{M}{=}$ I 35		A_2 – – 150	I $\overset{O}{=}$ N 400	I $\overset{O}{=}$ – 400	A_2 – – 300	I $\overset{O}{BR}$ W200	
area: 3.3%					I $\overset{M}{=}$ I 30		S $\overset{BR}{=}$ W200	O $\overset{BR}{=}$ W300	I $\overset{BR}{=}$ I 300	A_2 – – 200		
exposure: 5280 Min.					I $\overset{CL}{=}$ W 300			S $\overset{CL}{=}$ S 400	I $\overset{BR}{=}$ W300			
								S $\overset{O}{=}$ W 400	I $\overset{D}{=}$ I 300			
								O $\overset{BR}{=}$ W 400	I $\overset{D}{=}$ I 400			
												Total
				1	3		2	5	5	2	1	19
Tracks without particles					No. of Tracks			1	2	3		
area: 0.03%					Frequency of Occurrence			195	4			

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.75 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 10072 Type Offsite Glass Slide Stage No. —
Location Stake 52 % Sample Area Measured — Autoradiographic Exposure — Min.

TABLE A.8 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER ≥ 0.75 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 10072 Type Offsite Glass Slide Stage No. ———
Location Stake 52 % Sample Area Measured —— Autoradiographic Exposure —— Min.

Comments: Normalized To 72 mm² i.e. 3% of effective area. 445 particles measured.
Total Particles Background Sample

0.87μ	1.25μ	1.75μ	2.5μ	3.5μ	5μ	7μ	10μ	14μ	20μ	28μ	40μ	56μ	80μ
27000	13000	7800	4300	2270	860	540	610	500	430	360	110	140	72
				112μ	160μ	224μ	320μ	448μ	640	896		Projected Area Diameter	
				31	20	17	10	3		1		Frequency of Occurrence	

To Normalize to 1½ x 2¼ inch effective area multiply by $\frac{2400}{72} = 33$

TABLE A.9 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 1.0 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2906 Type Casella Impactor Stage No. 3
Location Arc B, L5, P9 % Sample Area Measured ___ Autoradiographic Exposure — Min.

Comments: Electron microscopic count of sphere-like particles on electron micrographs.
Note Table A.5 shows peak at 0.85 - 1.1μ for active particles from this sample.

0.07μ Data	0.10μ	0.14μ	0.21μ	0.28μ	0.43μ	0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.9μ	6.8μ	
	From Dense Area shown in figure 3.29													1
	No. Spheres			26	32	22	17	12	10	4	0	0		2
	No. Agglomerates of Spheres			4	15	22	24	19	9	10	2	2		3
	No. Oval Shaped Particles			~~1 many~~		12	8	10	13	6	3	1		4
	Total			30+	47+	44	41	31	19	14	5	3		5
Data	from Larger Area of preparation, 3 magnifications													6
204	101	57	35	99	82	29	8	1	3	0				7
														8
						115	32	29	17	5	3	2	1	9
		125	62	56	21	4								10
														11
	This data is questioned in view of the results from Stage 4 showing a peak													12
	similar to that above for the dense area													13
														14
														15
														16
														17
														18
														19
Note:	Table A.5 shows peak at 0.85 - 1.1μ for active particles located by neutron track													20
	autoradiographs. The spheres may indicate uranium or very low plutonium													21
	content. The 52 Minute exposure used in Table A.5													22
	should have registered activity on the order of 0.0005 dpm, this													23
	corresponds to a 0.1 micron diameter particle of $Pu^{239}O_2$													24
	The average track count at 0.85μ was													25
														26
														27
														28
														29
														30
See Figure 3.29 for Electron Micrograph														

TABLE A.9 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 1.0 MICRON
(CONTINUED)

... Tracks Tracerlab No. 2906 Type Casella Impactor Stage No. 4
... Measured ___ Autoradiographic Exposure — Min.

TABLE A.9 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 1.0 MICRON (CONTINUED)

Sample Description: Event Double Tracks Tracerlab No. 2906 Type Casella Impactor Stage No. 4
Location Arc 8, 45, P9 % Sample Area Measured ___ Autoradiographic Exposure ___ Min.

Comments: Electron microscopic count of sphere-like particles on electron micrographs

	0.14μ	0.2	0.28μ	0.43μ	0.55μ	0.86μ	1.1μ	1.6μ	2.3μ	3.1μ	4.9μ	Total
Preparation A No. Spheres	126	56	32	72	147	102	47	23	2	1	-	608
Preparation B No Spheres			114	229	118	31	14	3	4	1	0	515
Total			146	301	265	133	61	26	6	2	0	1123

The high population of spheres at 0.14μ is suspect due to poorer visibility for the lower sizes, and the diffuse edge of the particles.

There is no conflict between the nuclear track data and electron microscope data. The exposure time of five minutes was inadequate. No sample area was left for a longer exposure.

See Figure 3.30 for Electron Micrograph.

Continued

TABLE A.9 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >1.0 MICRON (CONTINUED)

Sample Description: [illegible] Double Tracks Tumblerlab No. 2906 Type Casella Impactor Stage No. 4
[illegible]tion Au, B, LS, P9 Sample Area Measured 0.09 Autoradiographic Exposure 7140 Min.

Comments: Optical microscopy of nuclear track autoradiogram.

Preparation A

(Continuation)

Observed Particle-Star Pairs:	0.43μ	0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ	Misc	
	S — 21	A, Y — 24	S Y W 5	S — 3/4		F CLW 5			F CLW 16	Flakes	1
	S — 38	S — 28				F CL W 10				— 20	2
	— 15	S — 25				F CL W 10				— 100	3
	S — 33									— 160	4
	S — 29									— 75	5
	S — 14									— 100	6
	S — 23										7
	S — 14										8
	S — 10										9
											10
Observed Stars Only;											11
No. Tracks/star	1-10t	11-20t	21-30t	31-40t	41-50t	51-60t	61-70t	71-80t	81-90t	91-100t	12
No. Stars	61	26	7	1	1					2 Tracks	13

See Figure 3.30 for Electron Micrograph

Average 2 Tracks / 7140 = 0.006 μg/mm

110 Tracks / 7140 = 0.022 μg/mm

14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30

TABLE A.9 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >1.0 MICRON

[illegible]erlab No. 2906 Type Casella Impactor Stage No. 5 Membrane
[illegible] Autoradiographic Exposure below Min.

TABLE A.9 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >1.0 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2906 Type Casella Impactor Stage No. 5 Membrane
Location Arc B, L5, P9 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: _____

Observed Particles — Star Pairs, Optical Microscopy — Emphasize larger particles

Preparation b:												
0.01% of sample	Finer	see below	0.43μ	0.55μ	0.85μ	1.1μ	1.6μ					
77000 Min Exposure			? ? ? 14		S ≤ ? 60	I ? ? 40						
			? ? ? 100			I ? ? ?						
						S ? ? 72						

Observed Alpha Stars Only, Optical Microscopy — Emphasize Smaller Particles

	No. of Alpha Tracks	1	2	3	4	5	6	7	8	9	10	710
Preparation b:												
0.01% of filter area		460	21	11	1							1
77,000 Min.												

Estimated Total Number of Particles												
				from preparation a:			299	× 5000	= 1,450,000			
				"	"	b:	494	× 10000	= 4,940,000			
									3,900,000			
								average	10330	=	3.4×10⁶	

Continued

TABLE A.9 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 1.0 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2906 Type Casella Impactor Stage No. 5 Membrane
Location Ariz B, L5, P9 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: Data for a shorter exposure is given on a previous sheet. (Continuation)

Preparation c.

data for 1-20 tracks expanded for study.

No of Tracks	1	2	3	4	5	6	7	8	9	10
Frequency of Occurrence	~3500	94	55	19	18	10	17	16	16	13
area: 0.1%										
exposure: 132,000	11	12	13	14	15	16	17	18	19	20
	9	12	13	17	20	5	2	4	2	0

2-5	6-10	11-15	16-20	21-25	26-50	51-75	76-100	101-150	151-200	201-$\frac{5}{8}$	$\frac{5}{4}$	$\frac{5}{2}$	5	
186	72	71	13	11	28	15	6	3	1	6	—	—	—	Total ~3700

In the above events a few particles were large enough to observe:

0.85μ	1.1μ	1.6μ	2.2μ	3.2μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	36μ
84	32	60	A_4 – – 20		A_3 – – 7	$I\frac{1}{2}$ I 84	$A\frac{M}{E}$ I 35		$I\frac{3}{4}$ $S\frac{5}{8}$	$I\frac{1}{2}$ – I 128	I – 100
30	31	1	I – –120		$S\frac{cl}{E}$ W 1		$A\frac{M}{E}$ I 26				
38	x		S – – 20		$I\frac{0}{8}$ – 7						
10	40		I – – 96								
15	14		I – –140								
7	15		$I\frac{cl}{E}$ I 60								
4	3		$I\frac{Y}{E}$ – 60								
8	28										
12	162										
	7										
(Ash 23)	13										
	20										
	4										
	60										
	40										
	78										
	(Ash 32)		(Ash 81)								

The heavier images evidently were produced by micron or smaller size particles. An $\frac{5}{8}$ star equated to a 1 micron sphere is equivalent to $1\% Pu^{239}O_2$. 30 tracks equated to a 1 micron sphere is equivalent to $.45\% Pu^{239}O_2$

Estimate total Number of particles in the < 3 fraction

Continued

TABLE A.9 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER < 1.0 MICRON

Double Tracks Tracerlab No. 2906 Type Casella Filter Stage No. 5
Area Measured below Autoradiographic Exposure below Min.

TABLE A.9 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER < 1.0 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2906 Type Casella Filter Stage No. 5
Location Avc B, L5, P9 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: See figure 3.31 for Electron Micrograph. (Continuation)

Observed Particle Star Pairs, Optical Microscopy							0.43μ	0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	
Preparation: a. 0.97% of filter area							S ≒ S 15				S ≒ S 18		
14,400 Min Exposure.							S ≒ S 8						
Observed Alpha Tracks Only, Optical Microscopy,													
Represents ~ 0.02% of filter area													
Number of Tracks	1	2	3	4	5	6	7	8	9	10	>10		
Frequency of Occurrence	293	3		1		1					1		299
Observed Particles, Electron Microscopy													
Sample preparation by dispersal resulted in an activity loss of approximately 2/3. Spherical particles in the size range 0.5 to 0.05μ were observed. The irregularly shaped particles were of lower density than the spheres. Agglomerates consisting of a few spheres were common.													
Measurements from 15 selected fields, is given below. A normalization factor of 1.6×10^6 has been estimated from the activity loss and area examined.													
Particle Size	0.04μ	0.05μ	0.08μ	0.10μ	0.14μ	0.21μ	0.28μ	0.43μ	0.56μ	0.85μ	1.1μ	1.7μ	
Spherical Particles	2	3	5	8	15	8	1	0	1			1	
Agglomerates of Spheres			2	3	6	8	3	2					
Total	2	3	7	11	21	16	4	2	1			1	68
Phosphor Autoradiography													
An exposure of 7200 minutes to Super XX Film yielded a uniform image density corresponding to the effective filter area. A sprinkling of high density spots was superimposed. The image indicates that the ink grid lines do not allow airflow through the portion beneath the ink. See Figure 3.6.													

TABLE A.9 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER <1.0 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2152 Type Casella Impactor Stage No. 4
Location Ave B, L12, P21 % Sample Area Measured Total Autoradiographic Exposure _____ Min.

Comments: Experimental sample. Liquid emulsion coated over whole sample, exposed for 10000 minutes failed to produce tracks. Undercoat of nitrocellulose was probably too thick.

Electron Microscopy Sample preparation labeled Stage 3.

0.07μ	0.10μ	0.14μ	0.21μ	0.28μ	0.43μ	0.54μ	0.85μ	1.1μ	1.7μ
63		82	48	36	24	16	8	4	3

TABLE A.9 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER <1.0 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2152 Type Casella Impactor Stage No. 5 Membrane
% Sample Area Measured below Autoradiographic Exposure below Min.

TABLE A.9 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER < 1.0 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2152 Type Casella Impactor Stage No. B Membrane
Location Arc B, L12, P21 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: See Figure 3.32 for Electron Micrograph

Observed Particle - Star Pairs, Optical Microscopy - Emphasize Large Particles

Preparation a	0.88% of Area	0.39μ	0.55μ	0.85μ	1.1μ	1.6μ
	77000 Min.				$S = S\frac{5}{8}$	

Observed Alpha Track Stars Only, Optical Microscopy - Emphasize Small Particles

Prep. a	No of Tracks	1	2	3	4	5	6	7	8	9	10	10
0.01 % of area 77,000 Min.	frequency	34	5	0	3		1					1

$\frac{1\ tr.}{77000} = .00002\ d/s/m$

These tracks were associated with particles smaller than 0.4 microns. Many transparent spheres were present in this preparation, as large as 5 microns. None of the larger spheres produced alpha tracks.

Estimated Total Number of Particles from Preparation a. 44 x 10000 = 440,000

Observed Particles, Electron Microscopy Poor preparations. See figure 3.32.

Phosphor Autoradiography An exposure of 7200 minutes to Super XX film yielded a uniform image similar to 2506 Stage 5, except sprinkled with larger spots similar to #477 Stage 5

Continued

TABLE A.9 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2152 Type Casella Impactor Stage No. 5 Membrane
Location Am B, L 12, P21 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: See Figure 3.32 for Electron Micrograph (Continuation)

			0.85μ	1.1μ	1.6μ	2.2μ	3.2μ	4.5μ	6.4μ	9μ	12.7μ	18μ	
			S 1/2 - 5	0 1/8 - 1	A_2 1/2 W 1	S 1/2 W 1	A_2 1/2 - 2	I 1/2 I 5				A - - 2	
Preparation b:			S 1/2 - 1		S 1/2 W 2	S 1/2 W 1		A_2 1/2 I 3					
area: 0.04%			S 1/2 - 1		S 1/2 W 1	S 1/2 W 19							
exposure: 135 360 Min.			S 1/2 - 1		S 1/2 W 2	0 1/2 W 1							
					S 1/2 W 5	S 1/2 W 1							
					S 1/8 W 3/8								
			Miscellaneous Alpha Tracks Only										
			No. of Tracks				1	2	3	4	5	6-10	11-20
			Frequency of Occurrence				150	9	3	3	4	3	1
			Estimate 194 × 2500 = 485,000 particles										
Lower activity per particle than 2906 stage 5.													
All preparations of 215a stage 4 and 5 were poor and the data suspect.													
				58 / 0.002 dis/min = 29,500 particles									

CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 1.0 MICRON

TABLE A.9 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER? 1.0 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2436 Type Casella Impactor Stage No. 4
Location Arc B, L17, P9 % Sample Area Measured below Autoradiographic Exposure Below Min.

Comments: % of sample not determined.

Preparation a, 5640 Min area ?	0.43μ	0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	Miscellaneous Tracks	Stars - Without Particles						
	S ≦ ? 25	S ≦ ? 5	I ≦ W80	I ≦ W4			No. Tracks	1-5	6-10	11-20	21-100	3/8	5/8	5/8	5
	S ≦ ? 19	A_2 ≦ ? 16	I ≦ ? 23	S ≦ S3L			No of Stars	7	9	4	5	1	1	0	0
	I ≦ ? 20	S ≦ ? 15												
	O ≦ ? 2	S O ? 2												
	S ≦ ? 3	S O ? 21												
	I ≦ ? 2	O ≦ ? 17												
	S ≦ ? 4													
	S ? ? 4													
	S ≦ ? 22													
	S ≦ ? 21													
	S ≦ ? 40													
	S ≦ ? 10													
	S ≦ ? 2													
	13	6	2	2										

13 Tr. average = .0046 dis/min = 9.5% $Pu^{239}O_2$

$$\frac{16\ dis/min}{0.008} = 2000\ particles$$

TABLE A.9 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER < 1.0 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2436 Type Casella Impactor Stage No. 5
Location Arc B, L17, P9 % Sample Area Measured — Autoradiographic Exposure 19,000 Min.

Comments: Portion of membrane filter was placed on 3% Nitrocellulose, dried and autoradiographed by nuclear emulsions.

a Optical Microscopy

Alpha Tracks/star	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Frequency	43		1		1									1				1		

The two heavier stars appear to be associated with particles ± 0.5μ diameter

b. Electron Microscopy Preparations were very poor.

TABLE A.9 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER MICRON

No. 9417 Type Casella Impactor Stage No. 4
Exposure 18,000 Min.

TABLE A.9 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER MICRON

Sample Description: Event Double Tracks Tracerlab No. 5627 Type Casella Impactor Stage No. 4
Location Ave G-054 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments:

Alpha Tracks Only

	No. Of Tracks	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Preparation a.	Frequency of Occurrence	45	7	7	2	1	3	1	-	-	-	-	-	-	-	1	-	1

area: 18%
exposure: 7/10 on 20/160 ?

Two particles with tracks noted. 0.55μ 0.85μ 1.1μ
I^{0}_{-36}
I^{00}_{-43}

TABLE A.9 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER < 1.0 MICRON

Sample Description: Event Double Tracks Tracerlab No. 9626 Type Casella Impactor Stage No. 4
Location Arc G-060 % Sample Area Measured 25 Autoradiographic Exposure 10000 Min.

Comments: A portion of the line deposit was dispersed.

Alpha Track Stars Only:

No. of Tracks	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Freq. of Occurrence		6	8	9	7	5	5	9	5	4	4	7	4	2	2	2	2	3	1	3	3	3	1		1	2		1							1	1	1

Misc.			43		60		80		100																											Total 107
			1		1		1		2																												

Median frequency value is 9 tracks, equivalent to 0.008 dis/min, equivalent to 0.14μ $Pu^{239}O_2$
" " 0.6μ 1% $Pu^{239}O_2$

Electron Microscopy

a/a	0.0μ	0.2μ	0.28μ	0.43μ	0.55μ	0.85μ	1.1μ	1.7μ	2.3μ
76	122	86	91	83	85	6	6	1	1

The field count of this sample was 17 d.p.m alpha activity
The activity/particle observed above ranges from 4×10^{-3} to 0.02 d.p.m (assume 2π geometry)
This corresponds to PuO_2 particle size range of 0.3μ to 0.2μ.

Estimate: total number of particles $\frac{17 \text{ dpm}}{0.006} = \frac{17000}{6} \approx 2830$
Normalize by estimated 10X factor → 100,000

TABLE A.9 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER < 1.0 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2724 Type Casella Impactor Stage No. 4
Location Arc H-068 % Sample Area Measured below Autoradiographic Exposure 7110 Min.

Comments: A portion of the line deposit was dispersed and examined.

Alpha Track - Particle OBSERVATIONS

<0.43μ	0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	6.4μ
S ? ? 3	S ? ? 10	I BR ? 17	S Cl ? 16				I ? I 3	
S ? ? 6	S ? ? 18	A_2 ? ? 6	A_2 BR ? ?					
S ? ? 4	S Cl ? 18	O BR ? 17	I BR W8					
	S ? ? 6	O Cl S 19	S Cl ? 16					
	I ? ? 13	A_3 ? ? 8	S BR ? 80					
		S ? ? 60						
		S ? ? 13						
		I ? ? 36						
		O Cl ? 14						
		O Cl ? 23						
3	5	10	5	0	0	0	1	0

5.5% of sample

ALPHA TRACKS ONLY

No. of Tracks	1	2	3	4	5	6	7	8	9	10	11–14	15–20	720
Frequency	46	11	1		1	1						1	28

Area Represented is 0.3% of total deposit.

28 × 181 = 5,100
2 × 4 = 9,400
14500

See Figure 3.35 for Electron Micrograph.

Average
21.3 Tracks = 0.003 d/s/min ≈ 0.65% D_a θ_a

TABLE A.9 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2477 Type Casella Impactor Stage No. 4
Location Arc J, L4, P1 % Sample Area Measured 1.8 Autoradiographic Exposure 9780 Min.

Comments: No disk was used in stage 3. A portion of the line deposit was dispersed. Electron microscopy indicates spheres as small as 0.07μ. See Figure 3.26 for Electron Micrograph.

0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ
S ? 9	I ? 16	S S 1	I W ¾	I W ¾	S S 7	A₂ W 51
S ? 2	S S 8	S ? 60	A₅ ? ¾			A₂ ? 12
S ? 5	O W 3	S ? 80	A₂ S 8			
S ? 11	S ? 3	S W 30	A₄ ¾ 32			
	S W 13	S ? 70				
	? ? 10	S W 25				
	S S 13	S W 36				
	S S 7	S ? 19				
	S S 4	S W 29				
	S S 18	S W 60				
	S S 8	S S 2				
	A₂ ? 8	I S 26				
	? ? 24	S I 5				
	S ? 7	S S 11				
	S ? 6	A₂ ? 15				
	S ? 31	S I 21				
	S W 15	S S 9				
	S S 3	S W 20				
	A₂ ? 11	A₂ ? 25				
	O ? 3	S S 6				
		A₂ ? 21				
		A₂ W 10				
		S W 28				
		A₂ ? 9				
		O S 3				
		A₂ ? 29				
		I W 30				
		S W 5				
		I W 32				

At 1.1μ 25 track average = 0.005 dis/min = 0.5% $D_a^{2.4/1.0}$

At 0.85 10 track average = 0.45% $D_a^{2.4/1.0}$

continued

TABLE A.9 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER < 1.0 MICRON

TABLE A.9 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER < 1.0 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2477 Type Casella Impactor Stage No. 4
Location Ave J, L4, P1 % Sample Area Measured — Autoradiographic Exposure — Min.

Comments: (Continuation)

"Spherical" Particles Observed By Electron Microscopy

<0.09μ	0.11μ	0.14μ	0.21μ	0.28μ	0.43μ	0.56μ	0.85μ	1.1μ	1.7μ
20	12	18	19	13	3	4	9	4	3

TABLE A.9 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER < 1.0 MICRON

Sample Description: Event Double Tracks TracerLab No. 2477 Type Casella Impactor Stage No. 5 (Membrane)
Location Arc J, L7, P1 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: See phosphor autoradiographic image illustration figure

Phosphor Autoradiography		120 Hour to	Super X	X and	1000 Min. to	Zenith	Plate,	Data	normalized			
	to represent	1	grid	area	ie,	9 mm²	or 0.8%	of	the effective	filter	area.	
	Super XX Reticle	Value			≤ 3	4	5	6	7	8	9	
	Zenith "	"			2	3	4	5	6	7	8	
	Equivalent Size	$Pu^{239}O_2$			—	0.4	0.5	0.8	1.0	1.4	2.1	
	Frequency of	Occurrence			≈115	2	3	2			1	Total ≈ 123
Nuclear Track Autoradiography			72000	Minutes		1 grid	area	dispersed		Data	represents	
11% of the dispersal.												
	No. of Tracks	/star	1	2	3	4	5	6	7	8	9	10
	Frequency of	Occurrence	45	4	1	1	1	2				1
	Normalized to	1 Grid	409	36	9	9	9	18				9
	Normalized	total 490/grid opening										
	Estimated	Number of	Active	Particles		490 ×	$\frac{100}{0.8}$	≈	61000			
	From phosphor autoradiogram		estimate		100 spots/grid × 94 grids = 9,400							
			$\frac{10t}{72000}$ =	0.00138 dis/min = equivalent to 0.14 μ sphere of $Pu^{239}O_2$								
				or 0.7 μ sphere of 1% $Pu^{239}O_2$								

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TABLE A.9 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER MICRON

Stage No. 3

TABLE A.9 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER MICRON

Sample Description: Fvent Double Tracks Tracerlab No. 2947 Type Casella Impactor Stage No. 3
Location AM R-056 % Sample Area Measured — Autoradiographic Exposure — Min.

Comments: See Figure 3.37 for Electron Micrograph

Electron Microscopy of Spherical Particles

0.05	0.07μ	0.10μ	0.14μ	0.21μ	0.28μ	0.42μ	0.56μ	0.85μ	1.1μ	1.7μ		
	79	95	87	53	25	7	1	1	1	2		Total 351

Check at higher magnification

2	12	7	2	

Estimate normalizing factor to be at least 48X

Nuclear Track Autoradiography See Table A.5

0.1μ particle PuO_2^{239} has activity of 0.0007 d.p.m., should produce 0.0003 tracks/min

3600 Min. exposure should yield 25 tracks

Bulk of unassigned tracks were 3-20 tracks

Average activity of 0.55 microns was 14 tracks

Conclude that 0.1 micron peak was composed chiefly of approximately 10% $Pu^{239}O_2$ but some unassigned tracks may represent higher levels

TABLE A.9 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER < 1.0 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2947 Type Casella Impactor Stage No. 4
Location Arc R-056 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: See Figure 3.38 for Electron Micrograph.
Total particle population is medium. Deposit is well defined.

Preparation a	0.55μ	0.85μ	1.1μ	1.6μ	2.2μ		Alpha Tracks Only		
16,140 Min.	S 3 ? 6	0 ? ? 2	I Bxw 1	0 S W 1		Number of Tracks	1	2	3
4% of deposit	S ? ? 1	I S ? 1				Frequency of Occurrence	11	1	1
	2	2	1	1					

TABLE A.9 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

TABLE A.9 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2965 From Anderson Impactor Stage No. 6
Location Arc R-064 % Sample Analyzed Autoradiographic Exposure below Min.

Comments: The optical microscopy data is not reliable below 0.85 μ.

Nuclear Track Autoradiography

Preparation a 527 mm² 5720 Min

many single tracks

0.43μ	0.55μ	0.83μ
13	4	S 2 6
2	4	S ? 7
5	7	S ? 10
1	4	S S 40
2	11	S CL S 4
2	1	I ? 14
2	7	I — 13
4	4	S CL ? 26
8		S — 16
2		I — 5
3		
2		

Preparation b

0.83μ	1.1μ	1.6μ	3.1μ	Misc. Tracks
S S 1	S S 2	S S 19		
S S 2			— — 1	
			— — 3	

Phosphor Autoradiography Total Area 2d cm²

Super XX 3900 Min. Exposure

See Figure

Spot Size in mm.	0.07	0.09	0.14	0.19	0.27	0.38
Frequency of occurrence	80	36	40	142	204	36

Total 538 particles

See figure 3.8 for photomicrograph and figure 3.9 for Phosphor Autoradiogram

TABLE A.9 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >1.0 MICRON

Sample Description: Event Double Tracks ... Lab No. 2965 Type Anderson Impactor Stage No. 7
Location Arc R-064 % Sample Area Measured — Autoradiographic Exposure below Min.

Comments: See Figure 3.9 for Phosphor Autoradiogram

a. Phosphor Autoradiography Data: (Extrapolated To Total Area)

Super XX, 7200 Min, Reticle Value Frequency of Occurrence	smaller than 5 estimated to be > 8.6×10^4	5 / 64	6 / 76	7 / 72	8		
Zenith, 1000 Min, Corresponding Reticle Value Particle Size† PuO_2		3 / 0.4μ	4 / 0.5μ	5 / 0.8μ			

b. Electron Microscopy Data: Unsuccessful

† Calibration By R. Carter, U.K.A.E.A.

TABLE A.9 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER < 1.0 MICRON

TABLE A.9 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER < 1.0 MICRON

Sample Description: Event Double Tracks Tracerlab No. 2527 Type Total Air Sample Stage No. Back Up Membrane
Location Arc A-072 % Sample Area Measured ——— Autoradiographic Exposure ——— Min.

Comments: Approximately 1 mm² dispersed. Data cannot be normalized due to uneven dispersal.

Electron Microscopy of Spherical Particles

Diameter	0.07μ	0.10μ	0.14μ	0.21μ	0.28μ	0.42μ	0.56μ	0.85μ		
frequency	8	9	17	15	3	8			Total	60

Estimate minimum normalizing factor would be 1680x, minimum sphere population 101 000

Phosphor Autoradiogram figure 3.10 indicates a minimum of 31 000 active spots

Optical Microscopy - Nuclear Track Autoradiography: Autoradiographic Exposure-100 000 Rem.
Result Showed no tracks and was suspect for other reasons

TABLE A.10 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER < 1.0 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 3442 Type Casella Impactor Stage No. 4
Location Arc B, L17, P9 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: See Figure 3.40 for Electron Micrograph

Observed Particle - Star Pairs, Optical Microscopy				0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ	
14% of effective filter area (emphasis on heavier stars)						S 1/2 ? 48	A2 0/2 W 5/8	S 1/2 W 3/8	I 8/8 W 3/4	S 1/2 I 72	
								S 1/2 S 5			
0.2% of effective filter area (emphasis on all tracks)				8 1/2 ? 1	S ? ? 1	I ? ? 2	S 1/2 W 2	I ? ? 5			
				S ? ? 1	S ? ? 1	S ? ? 3					
					I 8/8 ? 2	S ? ? 5					
Exposure time 11,500					S ? ? 1						
					S ? ? 7						

Observed Alpha Stars Only, Optical Microscopy											
	No. of Tracks/star	1	2	3	4	5	6	7	....	13	Total
0.2% of area	Frequency	245	159	43	2	3	1	1		1	460
		↑ 2/11500 =		0.0001 Hz/cm		Corresponds to 0.18 micron sphere of 10% $Pu^{239}O_2$					

Observed Particles, Electron Microscopy	0.07μ	0.10μ	0.14μ	0.21μ	0.28μ	0.42μ	0.56μ	0.85
Sphere shaped particles	4	31	46	53	26	8	19	1
almost sphere shaped		11	25	21	29	15	7	2
Total	4	42	71	54	55	23	26	3
data cannot be normalized to sample area								
Second run total	7	55	89	83	98	33	33	4

12/11500 = 0.0018 Hz/cm = 0.4%

Continued

...TION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER < 1.0 MICRON

TABLE A.10 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER < 7.0 MICRONS

Sample Description: Event Clean Slate I Tracerlab No. 3442 Type Casella Impactor Stage No. 4
Location Area B, L17, P9 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: See Figure 3.40 for Electron Micrograph (Continuation)
Nuclear Track Autoradiography

	0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.2μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	36μ
								I-- 12	I-- 12	I-- 76			I-- 2
Preparation a:								I-- 10	I-- 32	I-- 34			
aka: 25%									I-- 11	I-- 24			
exposure: 65328 Min.										I-- 112			

These particles appear to be flaky material and may be nitrocellulose lumps or fine particles attached to mica-like soil flakes.

Alpha Tracks without identifiable particles.

Number of Tracks	1	2	3	4	5	.....	6-10	11-15	16-20	
Frequency of Occurrence	302	25	18	4	3		4	3	1	

$\frac{3Tr}{66000} = .0001$ dis/min/cm² corresponds to a 0.18 micron sphere of 2.3% $Pa^{240}O_2$.

TABLE A.10 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER <1.0 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 3452 Type Casella Impactor Stage No. 4
Location Ave B, L20, P13 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: Sample deposit consisted of two intersecting line deposits. The deposit of coarser particles produced only a few alpha tracks.

Alpha Star-Particle Pairs By Optical Microscopy	0.35μ	0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ
		25	S ? 60	28	22	80		A_2 ? 125
		?	? 28	150	20	33		
9080 MIN.			28	S ≟ S 90	37			
			18	75	S ≟ ? 16			
			32		I ? 20			
			40		S ? 24			
					S ≟ ? 42			

Alpha Stars Only - Optical Microscopy - Estimated from count of representative area								
Number of Tracks/star	1	2	4	8	16	32	64	
Frequency	7392	1224	528	335	42	79	—	Total 9600
Estimated Activity/particle	0.22	0.44	0.88	1.7	3.4	6.8	$\times 10^{-3}$ d.p.m.	

Particles Observed by Electron Microscopy - none

In Slit 2 0.01 dis/min = 1% $Pa^{234}O_x$

TABLE A.10 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER <1.0 MICRON

TABLE A.10 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER <1.0 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 3452 Type Casella Impactor Stage No. 5 Membrane
% Sample Area Measured below Autoradiographic Exposure below Min.

TABLE A.10 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER < 1.0 MICRON

Sample Description: Fvent Clean Slate I Tracerlab No. 3452 Type Casella Impactor Stage No. 5 Membrane
Location A-8, L20, P13 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: Field count data indicated 30 d.p.m. for total sample
See Figure 3.41 for Electron Micrograph

Preparation as above
area: 0.01 %
exposure: 98220 Mins

Alpha Tracks Only

No. of Tracks	1	2	3	....	.....	5/3	
Frequency of Occurrence	13	2				1	

Suspect chiefly background tracks

$\frac{4000}{98000}$ = 0.04 dis/min

Electron Microscopy

0.07μ	0.10μ	0.14μ	0.21μ	0.29μ	0.43μ	0.57μ	0.85μ	
53	61	44	21	18	1			

Alpha Stars Only, Optical Microscopy

Preparation as above 18 inked squares embedded in nitrocellulose, coated with liquid emulsion, exposed for 6 mos Mins
produced 3 prominent alpha stars: 2 classed as 3/4 tracks, no particle visible
" 1 " " " but < 2.2μ
1 inked square from above contained 60 single tracks and 1 star of 4 tracks

Phosphor Autoradiography

$\frac{800}{10000}$ = .08 dis/min

Poor,

$\frac{1}{10000}$ = 0.0002 dis/min

TABLE A.10 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER < 1.0 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 2589 Type Casella Impactor Stage No. 4
Location Arc F-024 % Sample Area Measured Total Autoradiographic Exposure 1440 Min.

Comments: No alpha tracks were observed. The exposure was inadequate for a stage 4. The field count data recorded 4 d.p.m. for this sample.

TABLE A.10 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 3332 Type Casella Impactor Stage No. 4
Location Arc N-024 % Sample Area Measured 100% Autoradiographic Exposure 74800 Min.

Comments: Field count indicated 8 d.p.m. No alpha stars were observed, 2 single track occurrences were observed.

TABLE A.10 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER < 1.0 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 3332 Type Casella Impactor Stage No. 5 Membrane
Location Arc N-024 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments:

				1.1μm	2.2μm	3.6μm	4.5μm	6μm
Preparation as					I=V=I I	I=BK=W4		
area: 1%					I--I			
exposure: 135 360 Min.								
		Miscellaneous Alpha Tracks						
			No. of Tracks			1	2	3
			Frequency of Occurrence			5	—	—

TABLE A.10 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

... 3317 Type Casella Impactor Stage No. 4
... Exposure 61920 Min

TABLE A.10 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 3317 Type Casella Impactor Stage No. 4
Location Arc P-024 % Sample Area Measured 100% Autoradiographic Exposure 61920 Min

Comments: Field count data indicated 4 d.p.m. No alpha stars were observed. 5 single track occurrences were observed.

TABLE A.10 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Clean Slate I Tracerlab No. 3335 Type Casella Impactor Stage No. 4
Location Arc N-038 % Sample Area Measured _____ Autoradiographic Exposure 61920 Min.

Comments: Field Count data indicated 0-1 d.p.m. No alpha stars were observed. 6 single track occurrences were observed.

TABLE A.11 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Clean Slate II Tracerlab No. 2292 Type Casella Impactor Stage No. 4
Location BM-06 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: large particles indicate overload. See figure 3.42

Nuclear Track Autoradiography

	1.1 μ	1.6 μ	2.2 μ	3.1 μ	4.5 μ	6.4 μ	.....	36 μ	50	72	144 μ
Preparation a.	I 1/2 W 7	I 8/8 W11	I 3/3 W 12	I 2/2 W 9	I 1/1 W 6			I 8/8 W 10			A_2 — 3%
area: 57%	I 1/1 W15	I 1/1 W 10	I 1/1 W 60								A_3 — 15
exposure: 39,690 Min.	I 1/1 W 9	I 2/2 W 5	I 2/2 W 25								
	av 10th	av 8 th.	av 32 th								
	take 20	Kinds on av	erage for 46 μ		=	0.001 dis/min 2		0.03%	$Pb^{210}O_2$		
Electron Microscopy											
	0.07 μ	0.1 μ	0.14 μ	0.21 μ	0.28 μ	0.43 μ	0.57 μ	0.85 μ	1 μ		
	5	4	2	3	2	4	—	—			
	3	3	3	1	1			1			2

TABLE A.11 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Clean Slate II Tracerlab No. 2292 Type Casella Impactor Stage No. 5 Membrane
Location BM-06 % Sample Area Measured Below Autoradiographic Exposure below Min.

Comments: See Figure 3.43 for Electron Micrograph. Large particles indicate overload

Nuclear Track Autoradiography

	0.95μ	1.1μ	1.6μ	2.2μ	3.2μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	36μ
			I $\frac{BR}{=}$ W 5	S $\frac{=}{=}$ I 72	I $\frac{BR}{=}$ W 1	A - - 6	A_2 - - 5					O $\frac{BR}{=}$ W 4
Preparation a.			I $\frac{BR}{=}$ W 8	I $\frac{BR}{=}$ W 8		I $\frac{BR}{=}$ W 9						
area: 0.3%			I $\frac{=}{=}$ - 1	A_2 - - 7								
exposure: 33600 Min.			I $\frac{BR}{=}$ I 1									
	Miscellaneous	Tracks	Only									
	No. of Tracks:			1	2							
	Frequency of Occurrence:			27	4							

Electron Microscopy

0.07μ	0.1μ	0.14μ	0.2μ	0.28μ	0.4μ	0.5μ	0.85μ	1.1μ	1.6μ	2.2μ
1	1	7	5	10	8	6	1	2	2	1

...WITH PROJECTED AREA EQUIVALENT DIAMETER MICRON

TABLE A.11 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER MICRON

Sample Description: Event Clean Slate II Tracerlab No. 2287 Type Casella Impactor Stage No. 4
Location Arc A-042 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: See Figure 3.44 for Electron Micrograph.

Alpha Stars With Particles		0.39μ	0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ ...	18μ ...	25μ ...
		S - - 1	I 5/8 - 1	I 1/4 W 1	I 3/8 W 2	I 5/8 W 1	I 1/2 W 1	I 5/8 W 1	D 3/8 W 3/4	A 1/2 - 9	A 1/2 - 9
Preparation as		S - - 1	S 5/8 - 1	S 1/2 - 15	I 1/2 W 2	I 3/8 - 2	S 5/8 S 1	I - - 2			
area: 2.1%		S - - 1	S 5/8 - 1	I 3/8 - 3	I 1/2 W 4	I 1/2 W 12					
exposure: 40 4/10 Min.		I - - 1	S 5/8 - 6	I 5/8 W 1	I 1/2 W 1	I 5/8 W 1					
		S - - 1	S 5/8 - 1	I 5/8 - 1	I 1/2 - 1						
		S - - 2	I 5/8 - 1	I 5/8 W 1	I 1/2 W 15						
		S - - 1	I 5/8 - 1	I 5/8 W 1	I 3/4 - 5						
					I 5/8 - 1						
					I 5/8 - 1		over 4 Blanks =		0.0002 d/s/min =	0.01% D_{Pu}^{239} D_{α}	
Miscellaneous					I 3/4 W 3						
Alpha Stars Only	No. Tracks	1	2	3	4	5					
	Frequency	33	3	1							

Electron Microscopy								
	0.1μ	0.14μ	0.21μ	0.28μ	0.43μ	0.56μ	0.85μ	1.4μ
	31	65	75	41	11	13	5	

TABLE A.11 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 70.5 MICRON

Sample Description: Event Clean Slate II Tracerlab No. 2309 Type Casella Impactor Stage No. 4
Location A₁₁ B, L2, P21 % Sample Area Measured _____ Autoradiographic Exposure 10,000 Min.

Comments: Deposit was located well off center. See Figure 3.47 for Electron Micrograph.

Alpha Star - Particle Observed By Optical Microscopy

	0.39μ	0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ
14% of area			I ½ W 1	I ½ - 1	I ½ W 15	I ⅞ W 9	I ½ I 1	
			A_2 - - 2	I ½ - 13	I ½ W 34		I ⅞ W 3	
			I ½ - 5		S ½ S 3		S ½ W 11	
					S ½ W 5			

$\frac{14\%}{10000} = 0.0028\,da/l_m = 0.1\%\,Pu^{239}O_2$

Alpha Tracks Only

	No. of Tracks/star	1	2	3	4	5
1.2% of area	Frequency of Occurrence	47	2	1	2	1

Electron Micrography

0.07μ	0.10μ	0.14μ	0.21μ	0.28μ	0.40μ	0.56μ	0.80μ	1.1μ	1.6μ
32	53	52	66	52	81	17	2		

TABLE A.11 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER 70.5 MICRON

Sample Description: Event Clean Slate II Tracerlab No. 2287 Type Casella Impactor Stage No. 5 Membrane
Autoradiographic Exposure below Min.

TABLE A.11 CLASSIFICATION OF PARTICLES WITH PROJECTED

Sample Description: Event Clean Slate II Tracerlab No. 2287 Type Cascade Impactor Stage
Location Arc A-042 % Sample Area Measured Below Autoradiographic Exposure

Comments: See Figures 3.45 and 3.46 for Electron Micrographs

	0.85μ	1.1μ	1.6μ	2.2μ	3.2μ	4.5μ	6.4μ	9μ
				I 22	I W 2	S W	I 12	O I
Preparation a				S 9	I W 3	I W	S W	
Area: 0.94%				S 4	I I 8	I I28		
Exposure: 98220 Min.				S 2	I I 1	I WH2		
				S 12	A W28			
					I I			
Miscellaneous Alpha Tracks Only								
No. of Tracks:					1	2	3	
Frequency of Occurrence:					6	2		

Electron Microscopy

	0.07μ	0.10μ	0.14μ	0.21μ	0.28μ	0.43μ	0.56μ	0.85μ	1.1μ	1.7μ	2.2μ
	—	—	84	52	30	34	30	10	13	8	9
	61	55	44	32	20	17	10	14	5	1	
	104	117	63	45	25	18	13	6	3	7	2
	165+	172+	191	129	75	69	53	30	21	16	11

Total Spheres in flaky material (vitrocellulose?)

9	2	2	3	2	

TABLE A.11 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Clean Slate II Tracerlab No. 2309 Type Casella Impactor Stage No. 4
Location Arc B, L2, P21 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: See Figure 3.47 for Electron Micrograph.

	0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.2μ	4.5μ	6.4μ		
	S – – 2	S 5	I 5	I 4	I 1	I 6	S 16			
Preparation a.	S 2	S 2	I 2	S 28	I 1	I 1				
area: ~15%	S 1	S 6	I 3	I 19	I 1					
exposure: 82 080 Min	S 4	S 2	I 3	S 1				4 / 82000	≤ 0.000 1 cts/mm	
		S 6	I 5						= 0.01% $Pu^{239}O_2$	
Miscellaneous	Alpha Tracks Only									
No. of Tracks			1	2	3	4	5	....	88	
Frequency of Occurrence			132	16	3	1	1		1	

TABLE A.11 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER < 1.0 MICRON

Sample Description: Event Clean Slate II Tracerlab No. 2309 Type Casella Impactor Stage No. 5 Membrane
Location Arc B, L2, P21 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments:

	0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.2μ	4.5μ	6.4μ		
					I 1	I W 4		O W 2		
Preparation a:					I – – 1					
area: 1.9%										
exposure: 28 320 Min.										
Miscellaneous	Alpha Tracks									
No. of Tracks					1	2	3			
Frequency of Occurrence					11					

TABLE A.11 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

TABLE A.11 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Clean Slate II Tracerlab No. 2273 Type Casella Impactor Stage No. 4
Location Arc D(N)-P11 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: field count indicated 8 d.p.m. Only 4 active particles corresponding to the whole deposit Impactor disk counts 7 d.p.m. after removal of entire strip shaped deposit.

	1.1μm	1.6μm	2.2μm	3.1μm	4.5μm	6.4μm	9μm	12.7μm	18μm	25μm	36μm
Preparation a. area: 50% exposure: 42060 Min			S 52 W		S 11 W						
Preparation b. area: 50% exposure: 70560 Min.										I 80 W	I 3 W
										occur in same field of view, particles are offset from tracks.	

TABLE A.11 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER < 1.0 MICRON

Sample Description: Event Clean Slate II Tracerlab No. 2273 Type Casella Impactor Stage No. 5 Membrane
Location Arc D(N)-P11 % Sample Area Measured below Autoradiographic Exposure below. Min.

Comments: Field count indicated 18 d.p.m for total sample.

Preparation a. area: 0.94% exposure: 134 010 Min.	No alpha tracks were observed.

TABLE A.11 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER < 1.0 MICRON

Sample Description: Event Clean Slate II Tracerlab No. 3221 Type Andersen Impactor Stage No. 6
Location Arc B-058 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: Field count data indicated 28 d.p.m. Phosphor autoradiogram indicated that 2.80 of the orifice deposits were active. See Figure 3.4B for Electron Micrograph.

Preparation area: 2%
exposure: 14,100 Min.

Only single tracks were observed in the Nuclear Track autoradiograms. Resolution was too poor to resolve particle size due to Mylar interference. An average of 10 alpha tracks per deposit was noted.

$\frac{10}{14100}$ = .0007 t.p.m. = 0.0014 d.p.m per deposit

280 x 0.0014 = 0.39 d.p.m. Does not account for Field Count.

See Figure 3.8 for photomicrograph and Figure 3.5 for Phosphor Autoradiogram

Electron Microscopy

0.07μ	0.10μ	0.14μ	0.21μ	0.28μ	0.43μ	0.56μ	0.85μ	1.1μ	1.7μ
1	2	4	4	4	7	3	2	1	

TABLE A.11 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER < 1.0 MICRON

... Type Andersen Impactor Stage No. 7 Membrane

TABLE A.11 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER <1.0 MICRON

Sample Description: Event Clean Slate II Tracerlab No. 3221 Type Andersen Impactor Stage No. 7 Membrane
Location Area B-058 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: Field count data indicated 39 d p.m.
See Figure 3.49 for Electron Micrograph and Figure 3.9 for Phosphor Autoradiogram

Preparation a.
area: 5%
exposure: 110 850 Min

Only 2 single alpha tracks were observed.

Electron Microscopy

0.07μ	0.10μ	0.14μ	0.21μ	0.28μ	0.43μ	0.56μ	0.85μ	1.1μ	1.7μ
1	–	5	5	6	5	2	8	12	3

TABLE A.12 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 5257 Type Casella Impactor Stage No. 4
Location Tower 0, P3 % Sample Area Measured below Autoradiographic Exposure below Min

Comments: Field count data indicated 16 d.p.m. large particles on stage 4 are further indication of overload or contamination during unloading.

	3.2μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	36μ	50μ
Preparation a. area: ~20% exposure: 80, 610 Min.					I OP M S S/8			I DR = 3 S/4	
	a few individual tracks without particles were observed.								
					40μ / 50 000 = 0.001 cts/min = 0.001% $Pu^{239}O_2$				

TABLE A.12 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER >0.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 5257 Type Casella Impactor Stage No. 4
Location Tower B-P3 % Sample Area Measured below Autoradiographic Exposure below Min

Comments: Rerun

	1.1μ	1.6μ	2.2μ	3.2μ	4.5μ	6.4μ	9μ	12.7μ	18μ	25μ	36μ
Preparation a. area: exposure:							I M S S/8				I DR = 3 S/4

TABLE A.12 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER < 1.0 MICRON

TABLE A.12 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER < 1.0 MICRON

Sample Description: Fvent Clean Slate III Tracerlab No. 5257 Type Casella Impactor Stage No. 5 Membrane
Location G.Z. Tower B, P3 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: Field count data indicated 4 d.p.m. for total sample.

Preparation a														
area: 0.01%			Only 1 alpha track was observed.											
exposure: 134,210 Min.														

TABLE A.12 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER MICRON

Sample Description: Fvent Clean Slate III Tracerlab No. 4827 Type Casella Impactor Stage No. 4
Location Arc B-07B % Sample Area Measured _____ Autoradiographic Exposure 106,500 Min.

Comments: _____

			0.39μ	0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.1μ	4.5μ		Misc. Tracks	
				S – 1	S – 10	I – S15	I – S4	I – I34				47 cases	1 Track
					S – 1		A_2 – 4					8 "	2 "
					S – 3							1 "	3 "
					S – S16							2 "	6 "
												1 "	13 "
												1 "	24 "
												1 "	100 "
					$\frac{Av.\ 7th}{1000m}$	= 0.00014 dis/mm		= 0.03% $Pu^{239}O_2$					

TABLE A.12 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER < 1.0 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 4926 Type Casella Impactor Stage No. 4
Location Arc D-038 % Sample Area Measured Below Autoradiographic Exposure Below Min.

Comments: Field count data indicated 53 d.p.m. for total sample

Preparation a.			Miscellaneous Alpha Tracks Only										
area: 6m2%													
exposure: 120 660 Min.				No. of Tracks			1	2	3				
				Frequency of Occurrence			3						

TABLE A.12 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER < 1.0 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 4926 Type Casella Impactor Stage No. 5 Membrane
Location Arc D-038 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: Field count data indicated 39 d.p.m. for total sample.

Preparation a.			Miscellaneous	Alpha Tracks Only									
area: 0.11%													
exposure: 145 440 Min.				No. of Tracks			1	2	3	4	...		
				Frequency of Occurrence			7	—	—	—			

TABLE A.12 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

TABLE A.12 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER>0.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 4916 Type Casella Impactor Stage No. 4
Location Ave D-098 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: Heavy but discrete deposite Particles ~ 1μ covering surface of flaky, transparent material of ~10μ "diameter" is common along edges of deposit.

	0.8 μm	1.1 μm	1.6 μm	2.2 μm	3.2 μm	4.5 μm	6.4 μm	9 μm	12.7 μm	18 μm	25 μm	36 μm --- 120 μm
	2 --- 1	I 5/8 - 1	I 1/2 I 1		2 1/2 I 1	I 3/8 W 6	S 1/4 S 6	I 1/2 I 1	I 1/4 - 3	I 1/2 I 1		I -- 6 I -- 7
	2 --- 1	S 1/4 S 1	I 1/2 I 1		I 1/2 I 1	I 1/2 I 1	0 1/2 I 48	I 1/2 I 1	I 1/4 - 1	I 1/2 I 1		
	2 --- 2	I 1/4 - 2	I 1/2 I 1		I 1/2 I 1	I 1/2 I 1	I 1/2 I 1	A --- 200	I 1/2 - 1			
					I 3/8 I 1	I 3/8 I 1	I 1/2 I 1	I 1/2 I 2	I 1/2 - 1			
Preparation a.						I 1/2 I 1	I 1/2 I 1	I 3/8 I 1	I 1/2 - 1			
area: 0.6%						I 3/8 I 1	I 1/2 I 5	I 3/8 I 26	I 1/2 - 1			
exposure: 120 600 Min						I 3/8 I 1	I 1/4 I 1	I 1/4 I 7	I 1/2 I 2			

Miscellaneous Tracks without Particles

No. of Tracks	1	2	3	4
Frequency of Occurrence	37	0	0	0

$$\frac{\text{av. 9 h}}{120\,000} = 0.0002$$

TABLE A.12 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER MICRON

Sample Description: Event Clean Slate III Tracerlab No. 4886 Type Casella Impactor Stage No. 5 Membrane
Location Arc F-038 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments:

Preparation as				Miscellaneous Alpha Tracks Only										
area: 10%														
exposure: 43200 Min.					No. of Tracks		1	2	3	4	5			
					Frequency of Occurrence		7	—	—	—				

TABLE A.12 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER < 1.0 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 4942 Type Casella Impactor Stage No. 4
Location Arc H-030 % Sample Area Measured 50% Autoradiographic Exposure Min.

Comments: Field count data indicated 32 d.p.m. 12 isolated alpha tracks were produced by 50% of the sample. The remaining half did not count above background.

TABLE A.12 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

TABLE A.12 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 4985 Type Anderson Impactor Stage No. 6
Location BM-010 % Sample Area Measured _____ Autoradiographic Exposure _____ Min.

Comments: Mylar produced optical interfevence which was particularly troublesome at these particle sizes. See Figure 3.7 for photograph

	0.55μ	0.85μ	1.1μ	1.6μ	2.2μ	3.2μ	4.5μ	6.4μ	7μ	12.7μ	18μ
											I = I1%
Preparation a.	I -- 20	A_2 -- 2	I -- 4	I = I%							
area: 1.4%	S -- 1		A -- 2								
exposure: 78480 Min			I -- 18								
			S -- 2								
			S -- 1								
			S -- 14								
			I -- 2								
			I -- 7								
	Miscellaneous	Stars	only			No. Tracks	1	2	.....	20	200
						Frequency	28	4		1	1

av $\frac{7 \text{ tr}}{78000}$ = 0.00018 tr/sq mm = 0.02% $Pu^{239}O_2$

TABLE A.12 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER > 0.5 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 4980 Type Andersen Impactor Stage No. 6
Location Arc A-102 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: Mylar produced optical interference.

	0.85μ	1.1μ	1.6μ	2.2μ	3.2μ	4.5μ	6.4μ	9μ	12.7μ
Preparation a.			I - - 1	S - - 1	O - - 1	S^{M} - 1		A_2 - - 2	
area: 1.5%						O^{M} - 6			
exposure: 24480 Min						A_2 - - 1			
See Figure 3.8 for photograph and Figure 3.9 for Phosphor Autoradiogram									
			1	1	1	3		1	

TABLE A.12 CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER < 1.0 MICRON

Sample Description: Event Clean Slate III Tracerlab No. 4980 Type Andersen Impactor Stage No. 7
Location Arc A-102 % Sample Area Measured below Autoradiographic Exposure below Min.

Comments: See Figure 3.9 for Phosphor Autoradiogram.

	0.39μ	0.55μ	0.85μ	1.1μ	2.2μ	3.2μ	4.5μ	6.4μ
Preparation a		I - - 1	$I^{\frac{1}{2}}$ I 7				$I^{\frac{BB}{2}}$ I 3	
area: 0.52%								
exposure: 80640 Min.								
	Miscellaneous	Alpha	Tracks	Only				
	No. of Tracks					1	2	3	4	5
	Frequency of Occurrence					22	-	-	-	-

TOTAL ALPHA COUNT, TOTAL PLUTONIUM, TOTAL URANIUM, SINGLE PARTICLES, ALL EVENTS

Values

TABLE A.13 ALPHA COUNT, TOTAL PLUTONIUM, TOTAL URANIUM, SINGLE PARTICLES, ALL EVENTS

Sample Description			Optical Microscopy[b]				Alpha Count		Radiochemical Analysis[d]		Calculated Values		
T-Lab. No. – Particle No.	Type[a]	Location	Diam. microns	Shape	Color	Surf.	Pre-Crush dis/min[c]	Post-Crush dis/min[c]	Total Plutonium[e] gm x 10^{-9}	Total Uranium gm x 10^{-9}	Self-Absorption factor[f]	$\frac{\mu g\ U}{\mu g\ Pu}$	Density[g] gm/cc
Double Tracks													
2469-7	CC	AreB, L4, P9	16	S	%BK	W	30	—	lost in analysis		—	—	—
-3			17	O	%BK	W	44.	—	" "	"	—	—	—
-8			28	I	%BR	W	183.	—	1.37	92.	1.1	67.	10.
-10			56	O	CL/-	S	241.	—	2.12	150.	1.3	71.	3.7
2125-2	CC	AreB, L12, P20	28	O	%BK	W	31	—	0.97	146.	4.6	1500.	(12.2)
-19			28	I	%BK	W	13.	—	0.13	132.	1.5	990.	(11.0)
-20			32	I	%BK	W	202.	—	2.00	75.	1.4	38.	5.7
-9			39	S	%-	S	143	—	2.28	47.	2.3	21.	3.7
-15			40	S	%BK	W	154.	—	1.73	50.	1.6	29.	3.6
-22			40	A_g	%BK	W	728	—	0.81	34.	1.6	42.	3.3
-18			40	I	%BK	I	1380	—	13.7	63.	1.4	4.5	4.2
-21			42	I	%BK	W	311.	—	8.33	81.	3.9	9.7	4.2
-8			43	I	%BK	W	1460.	—	lost in analysis		—	—	—
-4			45	I	%BK	–	484	1160.	—	—	2.4	—	—
-10			45	S	%BK	W	206.	—	2.07	18.	1.5	8.8	2.9
-14			50	S	%BK	W	668.	—	6.51	98.	1.4	15.	3.7
-23			56	I	%BK	I	804	—	7.57	126.	1.4	16.	3.6
-16			66	I	%BK	I	1900.	—	14.8	273.	1.1	19	3.9
-13			75	I	%BK	I	335.	—	7.23	967.	3.1	130.	4.5
-20			82	S	%BK	–	976.	2800.	—	—	3.9	—	—

TABLE A.13 ALPHA COUNT, TOTAL PLUTONIUM, TOTAL URANIUM, SINGLE PARTICLES, ALL EVENTS (CONTINUED)

Sample Description			Optical Microscopy[b]				Alpha Count		Radiochemical Analysis[d]		Calculated Values		
T-Lab No	Type[a]	Location	Diam	Shape	Color	Surf.	Pre-Crush	Post-Crush	Total Plutonium[e]	Total Uranium	Self-Absorption	μg U / μg Pu	Density[g]
(Double	Tracks Continued)		microns				dis/min[c]		gm x 10^{-9}	gm x 10^{-9}	factor[f]		gm/cc
2121-6	CC	Arc B, L12, P20	82	S	%BR	—	59	289.	2.06	152.	5.1 4.9	74.	—
-3			90	S	%BR	W	965.	—	0.88	134.	(0.13)	150.	3.1
-5			135	I	BR/—	—	30.	32.	0.11	61.	(0.5) 6.1	574	—
5306-7	CC	Arc J, L1, P13	28	S	%GY	I	204.	—	4.45	310.	3.1	70.	(26.)
-4			39	O	%BK	W	153.	—	5.16	134.	4.9	28.	5.9
-1			39	I	%/—	I	279.	—	4.01	70.	2.1	18.	4.2
5335-16	CC	Arc J, L4, P13	15	S	%BK	W	101.	—	0.32	1860.	(0.46)	5900.	(104.)
-24			23	S	%BK	I	262.	—	1.68	80.	(0.93)	48.	(13.1)
-20			25	S	%BK	W	325.	—	1.54	93.	2.4	18.	(10.0)
-30			28	S	%BK	W	133.	—	3.09	231.	3.4	75.	(19.8)
-7			34	I	%BK	I	469	—	5.14	323.	1.6	63.	(13.1)
-14			34	I	%BK	I	118.	—	0.39	107.	(0.49)	270.	5.6
							Average of Calculated Values				2.9	55/98	4.4, (16)
Clean Slate No. 1													
5298-7	CC	Arc B, L13, P5	22	I	%—	I	245.		0.01	75.	1.5	6800.	(13.5)
-1			32	I	%—	W	174.		1.35	57.	1.1	42.	5.0
-2			40	I	%—	I	77.		0.87	121.	1.6	140.	5.1
-5			68	S	%BK	—	164.	902.	—	—	5.5	—	—
-3c			135	S	BR/—	—	64.	451.	6.75	573	11/15.2	85.	2.9
-4			135	S	A/—	—	182.	892.	—	—	4.9	—	—

TABLE A.13 ALPHA COUNT, TOTAL PLUTONIUM, TOTAL URANIUM, SINGLE PARTICLES, ALL EVENTS (CONTINUED)

Sample Description			Optical Microscopy[b]				Alpha Count		Radiochemical Analysis[d]		Calculated Values		
T-Lab No	Type[a]	Location	Diam.	Shape	Color	Surf.	Pre-Crush	Post-Crush	Total Plutonium[e]	Total Uranium	Self-Absorption[f]	$\frac{\mu g\ U}{\mu g\ Pu}$	Density[g]
(Clean Slate No.1 Continued)			microns				dis/min C		gm x 10^{-9}	gm x 10^{-9}	factor f		gm/cc
5299-5	CC	Ave B, L17, P5	35.	S	%/BK	W	734	—	lost	in analysis	4.315	—	—
-7			45.	S	A/-	S	132.	—	2.02	95.	3.5	9.9	3.3
-2			60.	S	%/-	I	401.	—	9.64	10.	2.2	5.0	2.8
5342-11	CC	Ave B, L19, P5	14.	I	%/-	W	90	—	0.096	526.	(.06)	1900.	(270.)
-1			35	S	%/-	W	15	—	0.17	23.	1.7	135.	3.3
-2			62	S	A/-	S	71.	—	lost	in analysis	—	—	—
-3			67	S	S/BK	W	65.	—	1.36	136	3.0	100.	3.2
-4			79	A_g	%/-	W	251.	—	3.99	291.	2.3	73.	3.4
-10			100	S	%/-	W	418.	—	11.2	377.	3.9	34.	2.7
-7			115	I	%/-	I	245	—	11.9	634.	7.1	53.	3.2
							Average of Calculated Values				4.1	68/748	3.5(3.5)
Clean Slate No.2													
2303-1c	CI	Tower A, P1	135	S	A/-	—	37	447	—	—	12.2	—	—
-3c			190	S	BR/-	—	117	309	—	—	6.2	—	—
-2c			230	S	Y/-	—	32.	188	—	—	5.9	—	—
							Average of Calculated Values				8.7	—	—
Clean Slate No.3													
5257-a	CI	Tower B, P3	425	S+	CL/BR	—	232	3569	—	—	12.1	—	—
"			135	S	CL/Y	—	57						
-d			190+	S	BR/-	—	160	784	—	—	4.9	—	—
"			190	I	W/-	—							

TABLE A.13 ALPHA COUNT, TOTAL PLUTONIUM, TOTAL URANIUM, SINGLE PARTICLES, ALL EVENTS (CONTINUED)

Sample Description			Optical Microscopy[b]				Alpha Count		Radiochemical Analysis[d]		Calculated Values		
T-Lab No.	Type[a]	Location	Diam.	Shape	Color	Surf.	Pre-Crush	Post-Crush	Total Plutonium[e]	Total Uranium	Self-Absorption	$\frac{\mu g\ U}{\mu g\ Pu}$	Density[g]
			microns				dis/min[c]		gm x 10^{-9}	gm x 10^{-9}	factor[f]		gm/cc
5257-a	CI	Tower B, P3	110	O	O/Br	—	1.2	1.2	—	—	1.	—	—
-s			135	S	Br/-	S	35.	169.	—	—	4.8	—	—
-m			160	S	el. Br	S	48.	513.	—	—	11.	—	—
-p			210	O	Br/M	—	31.	172.	—	—	5.5	—	—
-h			225	O	Br/-	Bubbled	48.	570.	—	—	12.	—	—
-r			475	Ag	Br, Bk, W	—	53.	253.	—	—	4.8	—	—
-e			540	I	O/Gy	—	71.	546.	—	—	7.7	—	—
B165-1	GS	BH-04	68	S	O/Bk	—	25.	140.	—	—	5.6	—	—
							Average of Calculated Values				6.9	—	—

a. CI = Casella Impactor, CC = Cylindrical Collector, GS = Glass Slide

b. See Key in Figure B.3

c. Standard deviation less than 5%.

d. Obtained from 5.4/5.3 D data by use of 6.89×10^{-6} μgm/dis/min.

e. Standard deviation less than 5 %

f. Ratio of Total Pu dis/min to pre-crush alpha dis/min

g. Assumes particle volume composed of PuO_2 (density 11.5), U_3O_8 (density 8.3) and soil (density 2.6).

... GROUPS OF PARTICLES.

TABLE A.14 ALPHA COUNT, TOTAL PLUTONIUM, TOTAL URANIUM, GROUPS OF PARTICLES, CLEAN SLATE II

Sample Description		Mean Particle Diameter	No. of Particles	Alpha Count	Radiochemical Analysis[c]		Calculated Values[a]		
T-Lab No	Location				Total Plutonium	Total Uranium	Self-absorption factor	$\frac{\mu g\ U}{\mu g\ Pu}$	Density
		microns		dis/min	gm x 10^{-9}	gm x 10^{-6}			gm/cc
Disk Collectors, Selected Particles Grouped According To Size.									
4105	Arc B, L4, P17	29	18	386±10	6.8 (0.38)[c]	0.18 (0.01)[c]	2.6	26.5	3.2
"	"	40-A	37	597±13	16.0 (0.43)	0.085 (0.002)	3.9	5.3	2.7
"	"	40-B	14	759±15	23.7 (1.7)	0.096 (0.007)	4.5	4.0	2.8
"	"	58-A	48	1049±18	32.4 (0.67)	0.180 (0.004)	4.5	5.6	2.6
"	"	58-B	16	1393±20	44.3 (2.8)	0.096 (0.006)	4.6	2.2	2.7
"	"	81-A	32	626±14	26.9 (0.84)	0.058 (0.002)	6.2	21.5	2.7
"	"	81-B	12	1318±20	71.8 (6.0)	1.08[b] (0.09)	7.9	15.2	2.9
"	"	115	7	361±11	11.1 (1.6)	0.63 (0.09)	4.5	57.3	2.7
4172	UK Balloon 2, P14	135	3	1037±18	82.2 (27.)	1.59 (0.53)	8.3	27.9	2.9
"	"	192	3	1848±23	76.6 (25.)	0.092 (0.03)	5.9	1.2	2.6
"	"	270	2	2168±26	98.7 (49.)	0.32 (0.16)	6.6	3.3	2.6
					Average Values		5.4	15.4	2.77

Total 192 Particles

a. Self absorption factor and $\mu g\ U/\mu g\ Pu$ calculated for groups. Density calculation assumed composition of U, Pu plus soil of density 2.6 and mean diameter, no allowance for bubbles.

b. Poor agreement on flourometric run.

c. Performed under Project 5.2/5.3d. Total Pu alpha dis/min/μg = 2.467 x 10^5. Value in parenthesis indicates average mass per particle.

d. A,B indicate 2 groups of particles segregated on basis of activity content.

TABLE A.15 X RAY DIFFRACTION, ELECTRON MICROPROBE DATA, SINGLE PARTICLES, ALL EVENTS

Sample Description			Optical Microscopy [a]				Alpha	X-Ray Diffraction [b]			Electron Microprobe [c]							
T-Lab No. Particle No.	Sample Type	Location	Proj. Area Diam.	Shape	Color	Surface	Count	Crystalline Phase Composition, Estimated			Topographic Area Percent Composition							
								Major	Minor	Trace	Pu	U	Si	Al	Ca	K	Fe	Mg
			microns				dis/min											
Double Tracks																		
2436-B	CI	Arc B, L2, P13	41	I	%BK	W	187	UO_2-PuO_2 85:15	UO_2	αAl_2O_3, Pu_2C_3	9	24	0	7	13	6	41	–
2906-	CI	" B, L5, P9	15	Two Spheres	—	—	1	UO_2 ?	—	—	11	11	68	0	5	0	5	–
2121-1	CC	" B, L12, P20	70	S	%BK	I	274	UO_2-PuO_2 85:15	UO_2	—	14	17	7	12	26	0	24	0
2121-8	CC	" "	56	S	%BK	W	133	UO_2-PuO_2 90:10	UO_2, UO_3	—	10	19	16	13	24	0	23	–
8038-A	GS	" J-044	70	S	%BK	I	664	PuO_2 ~100	—	UO_3	16	7	0	11	23	14	29	–
8038-D	GS	" J-044	56	I	BK+C	I	410	UO_3	UO_2-PuO_2 70:30	αAl_2O_3, Pu_2C_3	5	13	6	12	25	11	28	–
										Average	10	16	16	9	19	5	25	–
Clean Slate No. 1																		
3452-A	CI	Arc B, L20, P13	225	O	%BK	I	156	UO_2 >99	UO_3	αSi_2, Pu_2C_3	12	52	7	14	8	0	7	–
3452-1	"	" "	35	S	BK+C	S	alpha tracks	not analyzed			0	20	8	9	43	16	5	0
3452-2	"	" "	20	S	%BK	S	"	" "			0	44	0	20	26	0	10	–
3452-3	"	" "	30	S	%BK	W	—	" "			unsuccessful							
2589-A	"	" F-024	Chip of 200, S		%BK	W	BKG.	U	UO_3, UC_2	αAl_2O_3	0	18	7	16	29	0	30	–
										Average	3	33	6	15	26	4	13	–
Clean Slate No. 2																		
2303-1	CI	Tower A, P1	170	S	BK	I	25	UO_2 >99	—	UO_3	0	15	10	21	24	0	30	–
2303-2	"	"	256	S	Mottled Amber	I	31	UO_2 >99	UO_2-PuO_2	—								
2303-4	"	"	155	S	Trans. Br.	I	10	UO_2-PuO_2 85:15	—	αAl_2O_3	0	14	8	9	45	0	20	–
										Average	0	14	9	15	34	0	25	–
Clean Slate No. 3																		
5257-1	CI	Tower B, P3	300	O	Lt-Gy, Br.	I	36	no pattern produced			0	~1	20	8	37	5	30	–
5257-2	"	"	82	S	%BR	I	4.6	UO_3	UO_2-PuO_2, 77:23		unsuccessful, carbonaceous ?							
5257-3	"	"	39	S	%BK	W	—	not analyzed			8	11	11	45	13	0	12	–
4886-1	"	Arc F-038	100	O	Lt. BR	I	12.2	UO_2-PuO_2, 75:25	UO_3	αAl_2O_3, αSiO_2	not analyzed							
4886-2	"	" "	90	S	%BR	I	7.2	UO_2-PuO_2, 45:55	—	—	0	19	1	22	47	0	12	–
4886-3	"	" "	40	S	Lt. BR	I	4.8	UO_3	Pu_2O_3-Pu_4O_7	—	unsuccessful							
										Average	3	10	11	25	32	2	18	–

a. See Key in Figure B.4

b. Performed by Project 2.6d Colorado School of Lines Research Foundation

c. Performed by Air Force Weapons Laboratory, Kirtland Air Force Base

TABLE A.16 FIELD COUNT ALPHA ACTIVITY, TOTAL PLUTONIUM, TOTAL URANIUM, PROJECT 2.5b SAMPLES

Sample Description			Field[a] Count Alpha	Radiochemical Analysis[b]		Calculated		Comments
T-Lab No.	Location	Stage		Total Plutonium	Total Uranium	Self-Absorption Factor[c]	$\frac{\mu g\ U}{\mu g\ Pu}$[d]	
			dis/min	dis/min	gm x10^{-6}			
DOUBLE TRACKS								
CASELLA IMPACTOR								
2436	Arc B, L2, P13	1	774	836	0.020	1.1	3.5	Losses in Lab Preparation Suspected
		2	287	338	0.172	1.2	74.	" "
		3	106	72.6	0.107	(0.7)	213.	" "
		4	16	18.6	0.248	1.2	1940.	
		5	39	66.5	0.0037 0.039	1.7	13 65.	Two runs due to interferences.
2906	Arc B, L5, P9	1	1.26×10^{5}	2.03×10^{5}	15.6	1.6	11.	
		2	7.31×10^{3}	1.43×10^{4}	0.561	2.0	5.7	
		3	4.62×10^{3}	6.10×10^{3}	0.420	1.3	16.	
		4	2.07×10^{3}	9.82×10^{3}	1.54	4.7	23.	
		5	2.12×10^{3}	2.34×10^{3}	0.643	1.1	40.	
2152	Arc B, L12, P21	1	2.35×10^{4}	3.02×10^{4}	1.75	1.4	8.4	
		2	950	—	—	—	—	
		3	2.08×10^{3}	1.46×10^{3}	0.232	(0.7)	23.	Field Count Data Questioned
		4	323	23.8	0.143	(0.7)	872.	
		5	589	850.	0.018 0.220	1.4	3.7 38.	Two runs due to interferences
962	E-056	1	0	55.6	0.014	—	37.	
		2	0	13.4	0.008	—	90.	
		3	0	20.8	0.016	—	110.	

TABLE A.16 FIELD COUNT ALPHA ACTIVITY, TOTAL PLUTONIUM, TOTAL URANIUM, PROJECT 2.6b SAMPLES (CONTINUED)

Sample Description			Field[a] Count	Radiochemical Analysis[b]		Calculated		Comments
T-Lab No.	Location	Stage	Alpha	Total Plutonium	Total Uranium	Self-Absorption	$\frac{\mu g\ U}{\mu g\ Pu}$	
			dis/min	dis/min	gm x10^{-6}	factor[c]		
(DOUBLE TRACKS Continued)								
9625		4	0	10.7	0.007	—	70.	
		5	0	486.	0.152	—	45.	
9627	G-054	1	118.	863.	1.68	7.3	283.	
		2	34.	110.	0.916	3.2	1210.	
		3	68.	117.	0.135	1.7	177.	
		4	23.	86.5	0.313	3.8	525.	
		5	19.	74.3	0.0977	3.9	191.	
9626	G-060	1	501.	989.	0.376	2.0	55.	
		2	17.	110.	0.231	6.5	305.	
		3	60.	45.7	0.111	(0.8)	354.	
		4	17.	69.2	0.106	4.1	223.	
		5	14	96.7	0.575 0.043	6.9	864. 65.	Two runs due to interferences
2724	H-064	1	435.	451	0.291	1.0	95.	Losses in lab Preparation Suspected.
		2	1280.	246.	0.067	(0.2)	40.	Field Count Data Questioned
		3	506.	545.	0.397	1.1	106.	
		4	137.	79.4	0.045	(0.6)	1550.	
		5	273.	196.	1.82	(0.7)	1350.	
9675	I-059	1	1190.	1950.	—	1.6	—	Priority Sample, on U. data.
		2	532.	917.	—	2.7	—	"
		3	349.	631.	—	1.8	—	"

TABLE A.16 FIELD COUNT ALPHA ACTIVITY, TOTAL PLUTONIUM, TOTAL URANIUM, PROJECT 2.6b SAMPLES (CONTINUED)

Sample Description			Field a Count	Radiochemical Analysis b		Calculated		Comments
T-Lab No	Location	Stage	Alpha	Total Plutonium	Total Uranium	Self-Absorption	$\frac{\mu g\ U}{\mu g\ Pu}$	
			dis/min	dis/min	gm x10^{-6}	factor c		
(DOUBLE TRACKS Continued)								
9675		4	130					
		5	180	713.	—	5.5	—	
2477	Arc J.L4.P13	1	2.0×10^3	211.	—	1.1	—	Priority Sample, No U data.
		2	562	1.06×10^4	0.435	4.1	6.3	"
		3	—	2.21×10^3	0.318	3.9	21.	Losses in Lab Preparation Suspected
		4	360	—	—	—	—	
		5	226	283.	0.0840	(0.8)	43.	No Disk used in Stage 3
2947	R-056	1	500	173.	0.083	(0.8)	70.	
		2	291	498.	0.075	1.	22.	
		3	723	434.	0.047	1.5	16.	
		4	31	351.	0.173	(0.5)	69.	
		5	34	95.7	0.208	3.1	316.	Losses in Lab Preparation Suspected
				112.	0.0494	3.3	64.	
ANDERSEN IMPACTOR								
2951	R-064	1	240	492.	0.043	2.0	13.	
		2	447	502.	1.26	1.1	364.	
		3	355	291.	0.118	(0.8)	59.	
		4	198	579.	0.073	2.9	18.	
		6	83	101.	0.030	1.2	43.	Losses in lab Preparation Suspected
		7	90	98.	0.070 0.0085	1.1	103. 10	Two runs due to interferences.

TABLE A.16 FIELD COUNT ALPHA ACTIVITY, TOTAL PLUTONIUM, TOTAL URANIUM, PROJECT 2.6b SAMPLES (CONTINUED)

Sample Description			Field Count	Radiochemical Analysis		Calculated		Comments
T-Lab No.	Location	Stage	Alpha	Total Plutonium	Total Uranium	Self-Absorption	$\frac{\mu g\ U}{\mu g\ Pu}$	
(DOUBLE TRACKS Continued)			dis/min	dis/min	gm x 10^{-6}	factor[2]		
BACKGROUND ANDERSEN IMPACTOR								
3948	L-058	1	—	0	0.053	—	—	
		2	—	0	0.0865	—	—	
		3	—	9.41	0.369	—	5690.	
		4	—	0	0.068	—	—	
		6	—	—	—	—	—	Not Submitted
		7	—	108.	0.376	—	102.	
TOTAL AIR SAMPLE								
2527(D)	A-072	-	17300	287.	0.025	(?)	12.	Suspect data represents half of back up membrane only!
2989(I)	Arc B, L10, P21	-	15200	—	—	—	—	Lost In Analysis.
2886(D)	N-068	-	6.0	541.	0.030	90	8.1	Suspect particles in cover account for most of Pu.
2939(I)	R-054	-	619.	47.7	0.011	(0.1)	34.	Low Pu unexplained.
2709(I)	H-060	-	565.	1440.	0.223	2.6	23.	
GLASS SLIDE								
8038	CA1-09	-	23.8[e]	6.42×10^{3}	0.373	220.	8.4	Phosphor autoradiogram showing no spot images may represent cover.
8035	B-066A	-	1700.	2.10×10^{3}	0.131	1.2	9.0	
8035	D-058	-	65.	1.14×10^{3}	0.058	18.	7.3	
8038	F-046A	-	11900.	1.25×10^{4}	0.279	1.1	3.2	
8038	F-046B	-	126.	3.10×10^{3}	0.123	25.	5.8	
8038	F-056	-	9350.	3.96×10^{3}	0.128	(0.4)	4.8	

TABLE A.16 FIELD COUNT ALPHA ACTIVITY, TOTAL PLUTONIUM, TOTAL URANIUM, PROJECT 2 NS SAMPLES (CONTINUED)

Sample Description			Field[a] Count	Radiochemical Analysis[b]		Calculated		Comments
T-Lab No.	Location	Stage	Alpha	Total Plutonium	Total Uranium	Self-Absorption factor[c]	$\frac{\mu g\ U}{\mu g\ Pu}$	
			dis/min	dis/min	gm x 10^{-6}			
(DOUBLE TRACKS Continued)								
8038	H-044	–	2.08×10^{3}	2.01×10^{4}	0.519	9.7	3.8	
8038	H-048	–	1.25×10^{4}	8.20×10^{3}	0.404	0.65	7.2	
8038	L-046A	–	3.57×10^{3}	1.30×10^{3}	0.057	0.37	6.4	
8038	L-056	–	3.55×10^{3}	5.72×10^{3}	0.729	1.0	12	
8038	P-050	–	480.	2.31×10^{3}	0.242	4.8	15.	
10027	Stake 261	–	–	3.31×10^{3}	0.308	–	14.	
	BM-09	–		No data	reported			
	BO-09	–		"	"			

TABLE A.16 FIELD COUNT ALPHA ACTIVITY, TOTAL PLUTONIUM, TOTAL URANIUM, PROJECT 2.6b SAMPLES (CONTINUED)

Sample Description			Field[a] Count	Radiochemical Analysis[b]		Calculated		Comments
T-Lab No.	Location	Stage	Alpha	Total Plutonium	Total Uranium	Self-Absorption Factor[c]	$\frac{\mu g\ U}{\mu g\ Pu}$	
			dis/min	dis/min	gm x 10^{-6}			
CLEAN SLATE I								
CASELLA IMPACTOR								
3442	Arc B, L17, P9	1	1.01×10^3	3.18×10^3	1.04	3.1	47.	
		2	624.	7.62×10^3	0.967	12.	18.	
		3	624	879	0.110	1.4	18.	
		4	204	257.	0.234	1.3	132.	
		5	162	—	—	—	—	Sample missing.
3452	Arc B, L20, P9	1	1.05×10^3	8.66×10^3	3.37 0.050	8.3	57. 25	
		2	198.	363	0.132	1.8	132	Two runs due to interferences
		3	63.	52.6	0.243	(0.8)	671.	
		4	36.	34.0	0.066	1.	282	
		5	30.	64.0	0.096 0.149	2.1	220 344	Lower value represents reestimation
2589	F-024	1	0	12.9	0.083	—	930.	
		2	0	3.1	0.036	—	1700.	
		3	4	3.2	0.015	(0.8)	680.	
		4	4	3.0	0.094	(0.8)	3100.	
		5	0	3.0	0.107	—	5400.	
3332	N-024	1	0	0	1.009	—	—	
		2	4	29.5	0.112	7.4	546.	
		3	4	2.1	0.214	(0.5)	1500.	

TABLE A.16 FIELD COUNT ALPHA ACTIVITY, TOTAL PLUTONIUM, TOTAL URANIUM, PROJECT 2.55 SAMPLES (CONTINUED)

Sample Description			Field[a] Count Alpha	Radiochemical Analysis[b]		Calculated		Comments
T-Lab No.	Location	Stage		Total Plutonium	Total Uranium	Self-Absorption Factor[c]	$\frac{\mu g\ U}{\mu g\ Pu}$	
			dis/min	dis/min	gm x10^{-6}			
(CLEAN SLATE I		Continued)						
3332		4	8.	2.0	0.026	(0.3)	1900.	
		5	80.	0	0.034	(?)	—	
3335	N-038	1	8	83.7	0.332	10.	581.	
		2	0	4.9	0.048	—	1400.	
		3	8	0.	0.009 .215	—	—	Two runs due to interferences
		4	0	2.3	0.035	—	2200.	
		5	4	26.5	0.128	6.6	710.	
3317	P-024	1	0	2.0	0.074	—	5300.	
		2	0	0	0.087	—	—	
		3	4	3.0	0.026	(0.7)	1300.	
		4	4	0	0.093	—	—	
		5	21	0	0.008	—	—	
BACKGROUND CASELLA IMPACTOR								
2558		1	—	3.2	0.094	—	4300.	
		2	—	134.	0.209	—	227.	
		3	—	114.	0.145	—	185.	
		4	—	1.9	0.062	—	4700.	
		5	—	28.3	0.057	—	290.	

TABLE A.16 FIELD COUNT ALPHA ACTIVITY, TOTAL PLUTONIUM, TOTAL URANIUM, PROJECT 2.6b SAMPLES (CONTINUED)

Sample Description			Field[a] Count Alpha	Radiochemical Analysis[b]		Calculated		Comments
T-Lab No.	Location	Stage		Total Plutonium	Total Uranium	Self-Absorption Factor[c]	$\frac{\mu g\ U}{\mu g\ Pu}$ f	
(CLEAN SLATE I Continued)			dis/min	dis/min	gm x 10^{-6}			
ANDERSEN IMPACTOR								
2608	D-034	1	4	38	0.122 0.192	1.	4750. 7430.	Two runs due to interferences.
		2	0	2.8	0.220	—	12000.	
		3	4	2.6	0.047	(0.7)	2600.	
		4	0	37.0	0.714	—	2800.	
		6	0	5.3	0.086	—	2400.	
		7	69	0	0.112 0.013	—	—	
3385	H-034	1	0	3.7	0.115	—	4600.	
		2	0	0	0.0794	—	—	
		3	0	0	0.0852	—	—	
		4	0	0	0.187	—	—	
		6	0	1.2	0.007	—	1000.	
		7	0	8.61	0.260	—	4400.	
2646	L-034	1	67	627.	0.496	9.4	115.	
		2	0	583.	0.214	—	53.	
		3	0	48.4	0.012	—	37.	
		4	9	70.6	0.0312	7.7	64.	
		C	18	13.1	0.084	—	930.	
		7	9	1.03×10^3	0.565 0.044	110.	80. 62	Two runs due to interferences

TABLE A.16 FIELD COUNT ALPHA ACTIVITY, TOTAL PLUTONIUM, TOTAL URANIUM, PROJECT 2.6b SAMPLES (CONTINUED)

Sample Description			Field Count Alpha	Chemical Analysis[b]		Calculated		Comments
T-Lab No.	Location	Stage	Alpha	Total Plutonium	Total Uranium	Self-Absorption Factor[c]	$\frac{\mu g\ U}{\mu g\ Pu}$	
CLEAN	SLATE I (Continued)		dis/min	dis/min	$gm \times 10^{-6}$			
TOTAL	AIR SAMPLE							
3078	A-024	–	4.4×10^{3}[d]	5.92×10^{4}	11.4	13.	28.	
3035	Arc B, 222.75	–	1.2×10^{3}	2.11×10^{4}	1.79	1.8	12.	
3543	F-036	–	3.0	1.9	0.042	(0.6)	3200.	
3522	H-036	–	7.5	0	0.028	—	—	
3491	J-026	–	0	13.3	0.009	—	100.	
3505	J-040	–	4.5	0	0.016	—	—	
3570	N-030	–	7.5	0	0.053	—	—	
3579	N-040	–	1.5	0	0.21	—	—	
3070	P-048	–	6.9	3.3	0.086	(0.5)	3700.	
GLASS	SLIDE							
8080	BO-05	–	1.48×10^{5}[e]	6.31×10^{5}	449.	4.3	103.	
8080	CO-05.2	–	5.30×10^{4}	3.31×10^{5}	212.	5.6	93.	
8080	B-024	–	2.34×10^{4}	1.52×10^{5}	23.2	6.5	22	
8080	D-030	–	3.40×10^{4}	1.35×10^{4}	3.05	0.4	33	
8082	F-030	–	2.80×10^{4}	4.96×10^{4}	14.0	1.8	41.	
8082	J-028	–	7.15×10^{3}	5.27×10^{4}	12.5	7.4	35.	
8082	L-028	–	1.11×10^{4}	4.42×10^{4}	3.87	3.9	13.	
8084	N-034	–	3.73×10^{3}	2.79×10^{3}	0.924	0.75	48.	
8084	O-030	–	4.35×10^{3}	1.70×10^{4}	8.68	3.9	74.	

TABLE A.16 FIELD COUNT ALPHA ACTIVITY, TOTAL PLUTONIUM, TOTAL URANIUM, PROJECT 2.6b SAMPLES (CONTINUED)

Sample Description			Field[a]	Research Analysis[b]		Calculated		Comments
T-Lal No.	Location	Stage	Count Alpha	Total Plutonium	Total Uranium	Self-Absorption Factor[c]	$\frac{\mu g\ U}{\mu g\ Pu}$	
			dis/min	dis/min	$g m \times 10^{-6}$			
(CLEAN SLATE I		Continued)						
8084	P-032	-	2.92×10^{3}	1.75×10^{4}[e]	7.98	6.	67.	
9911	Stake 822	-	—	1.36×10^{3}	1.43	—		
CLEAN SLATE NO. 2								
CASELLA IMPACTOR								
2292	BM-06	1	3310	17100.	11.7	5.2	99.	
		2	1170	9630.	6.28	8.2	98.	Losses in lab Preparation Suspected.
		3.	922	6680.	5.33	7.3	116.	
		4	81	383.	0.416	4.7	158.	
		5	119	47.8	0.162	(0.4)	492.	Losses in lab Preparation Suspected
2287	A-042	1	3020	19900.	2.54	6.6	19.	
		2	652	2060.	0.546	3.2	39.	overload.
		3	28	1690.	1.40	60.	120.	Losses in lab Preparation Suspected
		4	599	4660.	4.32	7.8	135.	
		5	626	744.	0.868	1.2	169.	
2309	Area B, L2, P21	1	1200	3700.	2.73	3.1	107.	Losses in lab Preparation Suspected
		2	81	870.	0.576	20.	97.	
		3	73	235.	0.570	3.2	352.	

TABLE A.16 FIELD COUNT ALPHA ACTIVITY, TOTAL PLUTONIUM, TOTAL URANIUM, PROJECT 2.6b SAMPLES (CONTINUED)

Sample Description			Field	Project Lab	Analytical	Calculated		Comments
Lab No	Location	Step	Alpha	Plutonium	Uranium	Absorption	^{238}U / µg Pu	
			dis/m	d/m	g x 0	factor[a]		
(CLEAN SLATE II Continued)								
2309		4	16	184	0.515	11.	409.	
		5	18	107.	0.352	5.9	476.	
2348	Arc B, L30, P5	1	0	42 5	0.101	—	347.	
		2	0	21.1	0.0216	—	149.	
		3	0	32.2	0.150	—	644.	
		4	0	30.9	0.0930	—	437	
		5	0	5.18	0.0385	—	1090.	
2227	D-028	1	554	1460.	0.709	2.6	70	
		2	74	227.	0.454	3.1	291.	
		3.	20	119.	0.053	6.0	65.	
		4	8	15.6	0.064	1.9	600.	
		5	43	1.9	0.746	(0.4)	57000.	
2273	D-036	1	1000	4510.	3.75	4.5	121	
		2	356	1070.	0.510	3.0	69.	
		3	65	263.	0.176	4.0	97.	
		4	8	52.4	0.259	6.5	719.	
		5	18	36.7	0.057	2.0	230.	Losses in Lab Preparation Suspected

TABLE A.16 FIELD COUNT ALPHA ACTIVITY, TOTAL PLUTONIUM, TOTAL URANIUM, PROJECT 2.6b SAMPLES (CONTINUED)

Sample Description			Field Alpha	Radiochemical Analysis		Calculated		Comments
T-Lab No.	Location		Alpha	Total Plutonium	Total Uranium	Self-Absorption Factor	μg U/μg Pu	
(CLEAN SLATE II Continued)			dis/min	dis/min	$g \times 10^{-6}$			
ANDERSEN IMPACTOR								
3221	B-058	1	2270.	4010.	0.796	1.8	29.	
		2	394.	598.	0.176	1.5	43.	
		3	201.	276.	0.080	1.4	30.	
		4	63.	514.	0.276	8.4	78.	
		6	28.	62.1	0.110	2.1	257.	
		7	39.	30.5	0.228 0.042	(0.8)	1190. 295.	Two runs due To Interferences
3161	J-034	1	78.	25.2	0.025	(0.3)	240.	
		2	9.	7.80	0.050	(0.9)	930.	
		3	0.	22.0	0.037	—	2440.	
		4	0.	9.94	0.067	—	1000.	
		6	0.	3.2	0.617	—	19000.	
		7	38.	0	0.008	—	—	
3171	L-046	1	10.	29.5	0.025	3.0	370.	
		2	0.	0	0.025	—	—	
		3	0.	0	0.016	—	—	
		4	5.	0	0.110	—	—	
		6	0.	0	0.209	—	—	
		7	0.	0	0.012	—	—	

TABLE A.16 FIELD COUNT ALPHA ACTIVITY, TOTAL PLUTONIUM, TOTAL URANIUM, PROJECT 2.00 SAMPLES (CONTINUED)

Sample Description			Field[a] Count Alpha	Radiochemical Analysis[b]		Calculated		Comments
T-Lab No.	Location	Stage		Total Plutonium	Total Uranium	Self-Absorption	$\frac{\mu g\ U}{\mu g\ Pu}$	
(CLEAN SLATE II Continued)			dis/min	dis/min	$gm \times 10^{-6}$	factor[c]		
TOTAL AIR SAMPLE								
4117(D)	A-048	-	8900[d]	9220	4.63	1.0	73.	Losses In Lab Preparation Suspected
4808(I)	B-056	-	3700	9310	0.756	2.5	12.	
4814(II)	B-068	-	1970	3530	0.933 0.406 0.243	1.8	38. 17 73.	
4060(II)	H-024	-	1220	486	0.148 0.004	(0.3)	44. 4.	Losses In Lab Preparation Suspected
4053(II)	H-030	-	91.5	157	0.037 0.035	1.7	37. 110.	
4138(II)	J-054	-	20.2	48.4	0.063 0.247	2.4	198. 58.	
4075(II)	L-036	-	360.	647	0.213 0.146	1.8	48. 74.	Losses In Lab Preparation Suspected
4079(II)	L-060	-	178.	287	0.071	1.6	37.	
GLASS SLIDE								
8101	C-066	-	5700	9220[e]	5.95	1.6	93.7	
8101	E-024	-	30800	86200	51.4	2.8	86.4	
8103	G-020	-	19700	75000	24.3	3.8	47.1	
8103	L-026	-	4580	14300	4.83	3.1	49.1	
10057	Stake 840	-	—	7.64	0.296	—	5630.	

TABLE A.16 FIELD COUNT ALPHA ACTIVITY, TOTAL PLUTONIUM, TOTAL URANIUM, PROJECT 2.6b SAMPLES (CONTINUED)

Sample Description			Field a Count Alpha	Radiochemical Analysis		Calculated		Comments
T-Lab No.	Location	Stage	Total Plutonium	Total Uranium	Self-Absorption Factor	$\Delta\beta$ U-f µg Pu		
			dis/min	dis/min	gm x 10^{-6}			
CLEAN SLATE III								
CASELLA IMPACTOR								
5257	Tower B, P3	1	26000	8*3000	678	33.	117.	
		2	13000	571000	416	44.	107.	
		3	723	3640	9.84	50.	396.	Losses In Lab Preparation Suspected.
		4	16	211	0.0916	13.	63.1	
		5	4	0	0.114	—	—	Losses In Lab Preparation Suspected
4827	B-078	1	679	2280	0.193	34.	12.3	
		2	113	760	0.717	6.7	137.	
		3	32	149	0.075	4.7	73.	
		4	24	21.9	0.333	(09)	2210.	
		5	49	9.92	0.504	(0.2)	7480.	
4926	D-038	1	220	1390	0.753	5.9	86.5	
		2	12	342	0.240	29.	103.	
		3	45	385	0.227	8.6	86.5	
		4	53	65.7	0.177	1.2	397.	
		5	39	0	0.127 0.057	—	—	Losses In Lab Preparation Suspected.
4916	D-098	1	119	171	0.159	1.4	137	
		2	64	101	0.205	1.6	297	
		3	32	24.7	1.15	2.3	2270	

TABLE A.16 FIELD COUNT ALPHA ACTIVITY, TOTAL PLUTONIUM, TOTAL URANIUM, PROJECT 2.86 SAMPLES (CONTINUED)

Sample Description			Field a Count Alpha	Radiochemical Analysis b		Calculated		Comments
T-Lab No	Location	Stage	Alpha	Total Plutonium	Total Uranium	Self-Absorption Factor c	$\frac{\mu g\ U}{\mu g\ Pu}$	
			dis/min	dis/min	gm x 10^{-6}			
(CLEAN SLATE		III	Continued)					
4716		4	36	31.3	0.150	(0.9)	540	
		5	17	13.3	0.024 0.191	(0.8)	270 2130.	Losses In Sample Preparation Suspected.
4886	F-038	1	691	3540	1.60	5.1	65.5	
		2	75	1770	1.13	24.	94.3	
		3	24	326	0.289	14.	131	
		4	67	368	0.444	5.5	177	
		5	13	50.3	0.129	3.9	378	
4842	H-030	1	44	349	0.236	7.9	98.3	
		2	0	13.4	0.221	High	2400.	
		3	4	15.1	0.442	3.8	4240.	
		4	32	9.95	0.229	(0.3)	3340.	
		5	57	2.1	0.066 0.042	(0.04)	3100 1980.	Losses In Sample Preparation Suspected.
ANDERSEN IMPACTOR								
4985	BM-10	1	204	857	0.506	4.2	85.7	
		2	43	688	0.463	16.	97.4	
		3	56	590	0.455	11.	112.	
		4	47	111	0.083	2.4	110.	
		6	11	88.0	0.384	8.	633.	
		7	20	17.9	0.247 0.129	(0.9)	2010. 1040.	

TABLE A.16 FIELD COUNT ALPHA ACTIVITY, TOTAL PLUTONIUM, TOTAL URANIUM, PROJECT 2.6b SAMPLES (CONTINUED)

Sample Description			Field[a] Count Alpha	Radiochemical Analysis[b]		Calculated		Comments
T-Lab No.	Location	Stage		Total Plutonium	Total Uranium	Self-Absorption	$\frac{\mu g\ U}{\mu g\ Pu}$	
			dis/min	dis/min	gm x 10^{-6}	factor[c]		
(CLEAN	SLATE III	Continued)						
4980	A-102	1	419	1110.	0.294	2.6	38.5	
		2	103.	203.	0.154	2.0	73.9	
		3	56	187.	0.209	3.3	162.	
		4	52	84.7	0.220	1.6	377.	
		6	26	57.5	0.768	2.1	3740.	
		7	40	45.2	4.36	1.1	14400.	
3277	J-082	1	11	99.4	0.061	9.	90.	
		2	25	28.9	0.065	1.2	330.	
		3	41	88.8	0.126	2.1	206.	
		4	25	24.0	0.083	1.	500.	
		6	11	29.0	0.092	2.6	480.	
		7	16	8.54	0.122 0.195	(0.5)	209. 331.	Losses In Lab Preparation Suspected.
3296	L-082	1	5	12.5	0.304	2.5	3540.	
		2	23	37.7	0.078	1.6	300.	
		3	37	115.	0.027	3.1	34.	
		4	23	15.7	0.275	(0.7)	2650.	
		6	9	12.4	0.210	1.4	2440.	
		7	5	2.8	$\frac{.010}{.075}$ 0.071	(0.6)	530.	

TABLE A.16 FIELD COUNT ALPHA ACTIVITY, TOTAL PLUTONIUM, TOTAL URANIUM, PROJECT 2.6b SAMPLES (CONTINUED)

Sample Description			Field[a] Count Alpha	Radiochemical Analysis		Calculated		Comments
T-Lab No.	Location	Stage	Total Plutonium	Total Uranium	Self-Absorption	$\frac{\mu g\ U\ f}{\mu g\ Pu}$		
CLEAN	SLATE III Continued		dis/min	dis/min	gm x 10^{-6}	Factor[c]		
TOTAL AIR SAMPLE								
5166(II)	A-024	–	2100[d]	3270	2.57	1.6	114	Losses In Lab Preparation Suspected
5126(II)	B-030	–	28	143	0.147	5.1	149	
5132(II)	B-090	–	326	591	0.497	1.8	122	
5059(II)	E-090	–	232	319	0.577 0.848	1.4	385	Losses In Lab Preparation Suspected.
5043(II)	H-090	–	28	45	0.109 1.92	1.6	6190	
5080(I)	K-024	–	–	115	0.166 0.142	1–	197	
5110(II)	L-042	–	1.6	15.5	0.095 0.274	13.	2560	
GLASS SLIDE								
8165	BH-04	–	127000[e]	–	–	–	–	Lost in Chemical Analysis
8165	BH-14	–	9120	34200	21.3	3.8	90.7	
8165	B-028	–	32200	180000	100	7.8	81.0	
8167	C-022	–	39900	144000	53.4	3.7	53.9	
8167	E-034	–	35000	276000	132	7.9	69.5	
8167	G-032	–	19200	150000	25.5	7.9	24.8	
8167	H-034	–	22300	112000	31.0	5.0	40.2	
8167	L-040	–	51000	19600	15.4	0.38	114.	
10072	Stake 59	–	–	279	0.659	–	343.	

Footnotes For Table A.16

a. Field Count Data From Project 2.5

b. Radiochemical Data From Project 5.2/5.3D

c. Ratio of DIS/MIN Total Plutonium/DIS/MIN Alpha Field Count

d. No Field Count Data Available for Total Air Samples. Values are Relative Lab Counts Obtained With 1 Inch Diameter Scintillation Counter

e. Field Count Data From 1-1/2 Inch Diameter Planchet, Normalized to 2 x 3 Inch Area.

f. Obtained From Total Pu by Relationship 6.88×10^{-6} µgm/dis/min.

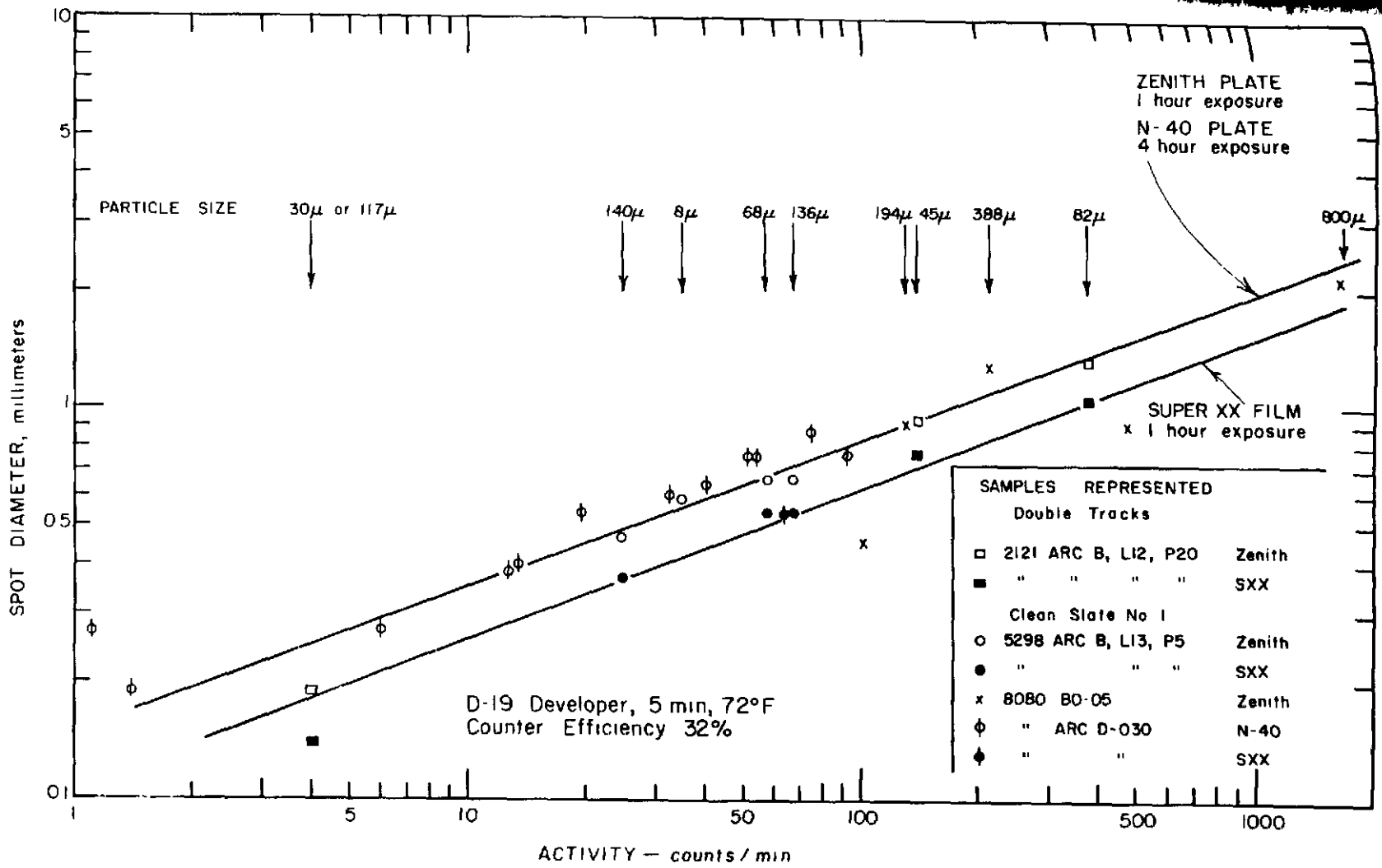


Figure A.1 Phosphor autoradiogram spot diameter versus size and activity of particle.

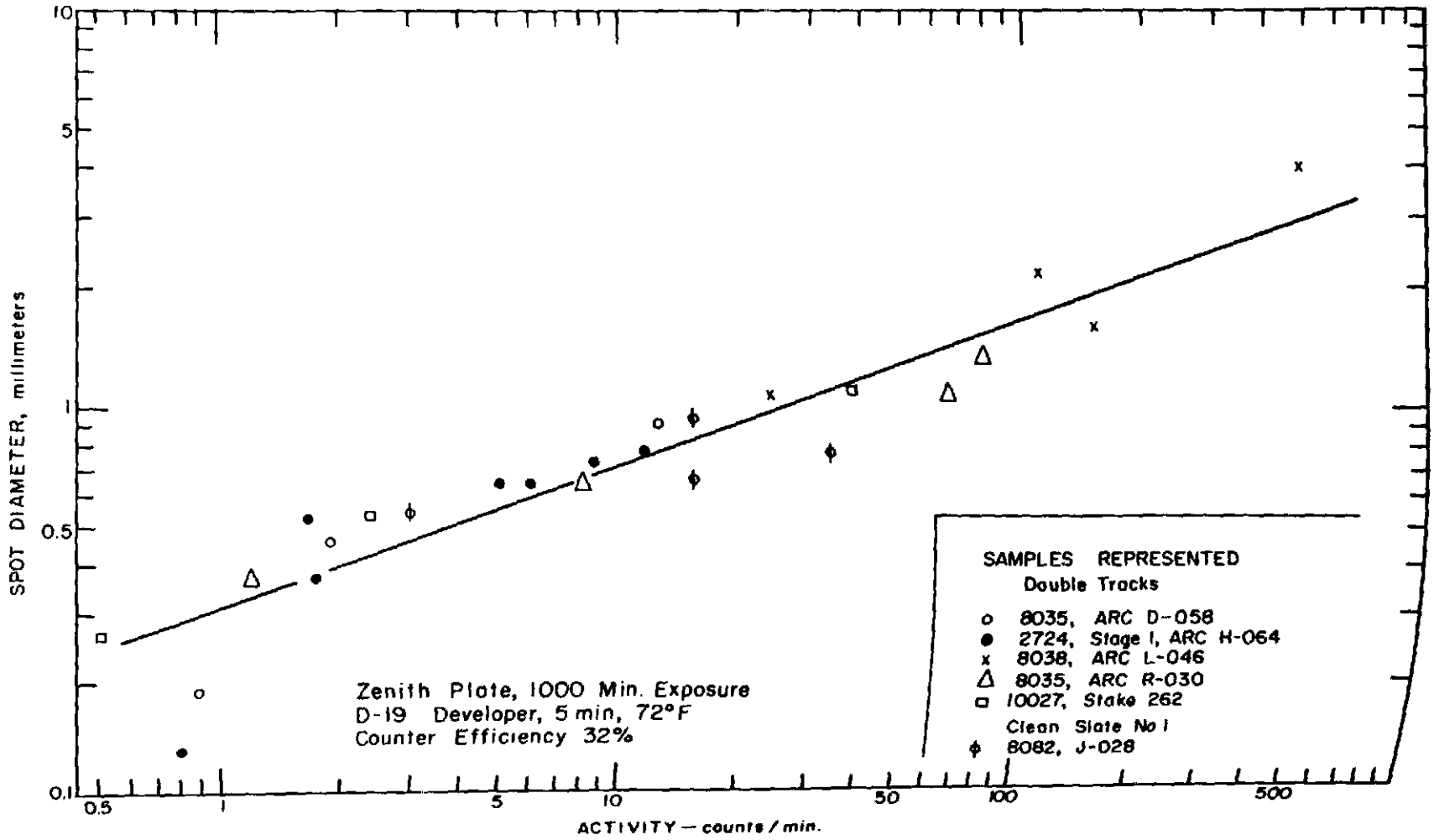


Figure A.2 Phosphor autoradiogram spot diameter versus activity of particle.

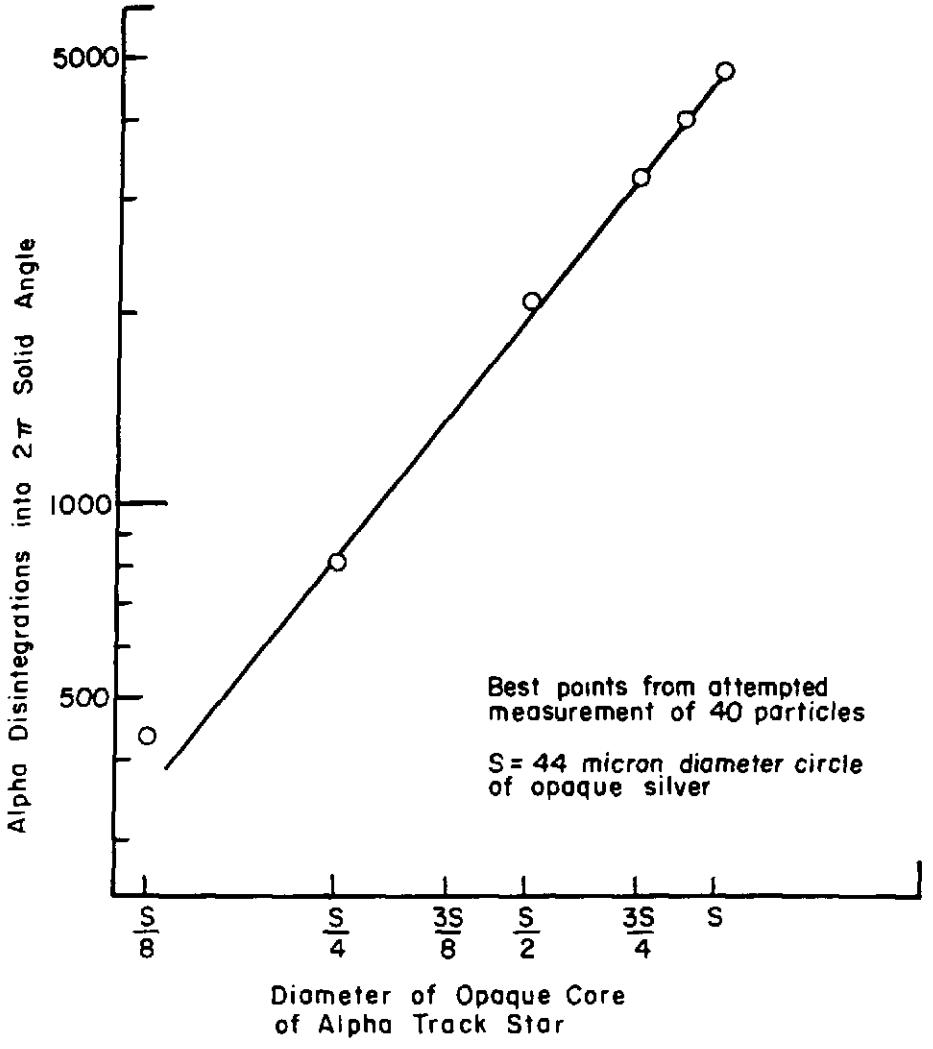


Figure A.3 Calibration of dense alpha track patterns.

APPENDIX B

DETAILED LABORATORY PROCEDURES

The analyst is instructed to review the hazards involved in handling plutonium-239 and uranium compounds in particulate form. The alpha monitoring probe must be available and operative during all phases of handling the samples from Operation Roller Coaster.

B.1 OPENING AND STORING SAMPLE.

Casella Disks, Andersen Disks, Impactor Membranes, Total Air Filters

Equipment

Glove box with 5-inch-diameter circle painted on base between glove inlets, (White Roomette with end doors and glove panel, Ultrasonic Industries, Plainview, New York)

Scalpel and blade (Bard Parker No. 7 with No. 11 blade, E. H. Sargent and Company, Springfield, New Jersey)

Forceps, wide flat tip (#5555, Arthur H. Thomas Company, Philadelphia, Pennsylvania)

Transparent plastic boxes with hinged covers

a. 1/2 x 1 1/4 x 1 1/4 inch for Casella disks (Althor Products, Brooklyn, New York)

b. 1/2 x 2 1/2 x 2 1/2 for Filters (Althor Products, Brooklyn, New York)

c. 1/2 x 2 1/2 x 3 1/2 inch for envelopes and caps (Althor Products, Brooklyn, New York)

Empty 4-by-5 inch photo film box (Eastman Kodak type)

Gummed labels ½-by-¾-inch (Avery Label Company, New York, New York)

Paper squares $1\frac{1}{8}$-by-$1\frac{1}{8}$-inch (Clean bond paper)

Masking tape (Scotch Brand, Minnesota Mining and Manufacturing Company)

Paper swipes, damp and dry (Kimwipes, Kimberly Clark Corporation, Neenah, Wisconsin)

Sample History Sheet No. 1 (see Figure B.1)

Cardboard storage tray ($8\frac{1}{2}$-by-11-inch empty film box or equivalent)

Preparation

a. Log out samples in groups of 4 (5 for Andersen disks).

b. Place labels on 2 boxes for each sample: sample box, envelope box.

c. Fill in sample number on labels and sample history sheets.

d. Place samples, forceps, scalpel, paper squares, boxes into glove box.

e. Clip sample history sheets to board on glove box face.

Procedure (working through gloves)

1. Open flat 2 sample boxes with corresponding numbers.

2. Place celophane bag containing sample particle side up in 5-inch circle. Hold bottom edge by pressing down on corners. Slit top carefully with scalpel.

3. Open bag by carefully squeezing bag sides while using forceps to withdraw sample. The cap must be withdrawn simultaneously with the disk to avoid disturbing the surface. (In case of an accidental spill, clean area with sticky tape followed by wet and dry swipes. Place swipes in sample envelope box, record spill details on data sheet.)

4. Observe sample surface to note general condition and record on data sheet. (For Casella Disks place paper square in bottom of plastic box to absorb resin and particles on back of disk.)

5. Place sample in box with particles facing up, close hinged cover

carefully. Place envelopes and caps in separate box for possible reference.

6. Clean 5-inch circle with swipes.
7. Repeat steps 1 to 6 for other samples.
8. Remove all boxes from glove box.
9. Store plastic boxes in half of cardboard box, particle side up. Do not stack or tip boxes.
10. Return samples to storage or proceed to alpha counting.

Deposition Slides (and a group of Casella Impactor Disks)

Equipment

Items 1, 2, 3, 4c, 8, 9, 10 and 11 above.

24 Sellotape sheets 2 1/2 x 3 1/2 inch (Vinyl 12, 6-inch width, Adhesive Tapes, Limited, Borehamwood, Herts, England)

Zinc sulphide, silver activated phosphor (type 86, blue, Levy West Laboratories, Limited, Wembley, England)

Twenty-five cent piece or 1 1/2-inch-diameter smooth edged washer

Xylene

Single edge razor blade

Micro spatula (9009-K, A. H. Thomas, Philadelphia, Pennsylvania)

Semi rigid plastic sheet $2\frac{1}{4}$ by $2\frac{3}{4}$ inch

Preparation

a. Items 1, 3, 4, and 5 above
b. Coat 12 Sellotape sheets with ZnS phosphor as described in B
c. Prepare phosphor autoradiography exposure fixture to accept samples

Procedure (Steps 1 to 7 in glove box, wear finger cots or gloves for 8,9)

1. Determine which slide contains particle deposit.
2. Scrape bottom of slide with razor to remove masking tape. Record sample number. Clean surface with xylene, using Kimwipes.
3. Slit edge of sample sandwich carefully using scalpel.
4. Carefully pry sandwich apart using micro spatula between particle surface and cardboard frame.
5. Place cover slide and cardboard spacer into storage box.
6. Remove any cardboard from edge of slide, exercise great caution and place scraps in storage box. Make sticky tape swipes of any fine scraps and save.
7. Place slide back side down onto sticky surface of Sellotape, avoid wrinkling the tape.
8. Optional steps:
   a. transfer to alpha count
   b. transfer to photography
   c. if subsequent nuclear track autoradiography is anticipated, **coat the sample carefully with 3 percent nitrocellulose solution** in amylacetate and allow to dry thoroughly.
9. Carefully lay phosphor coated tape, phosphor side down, onto the center of the particle deposit. Gently smooth out tape, seal 2 opposite sides to lower cellotape by pressing along the edge of the slide with coin or washer. Seal opposite sides using care to avoid corner wrinkles.
10. Remove from glove box and swipe surfaces with damp and dry **Kimwipes.**

11. Record sample number on bottom tape using ink.

12. Swipe sample opening area. Repeat procedure for remaining samples.

13. Proceed directly with phosphor-intensification autoradiography exposure. (Phosphor may fatigue due to alpha radiation from sample).

Casella Impactors are treated similarly by mounting 2 on a semi-rigid plastic sheet so as to fit diagonally within the 2-by-3-inch area occupied by the deposition slide.

Deposition Disks

Equipment

Items 1, 2, 3, 8, 9, 10

Sellotape sheets 10 by 10 inch (coated as in B)

Paper clips bent into L shaped hooks

Preparation

a. Put all items and 1 sample container into glove box.

b. Prepare for stereomicroscopy through glove box ports if required.

c. Prepare a simple cardboard fixture for holding mounted sample and sheet film during exposure and other autoradiography items.

Procedure

1. Lay out 10-inch square of Sellotape, adhesive side up, on bottom of glove box.

2. Remove cover from film can, raise one side of sample using wire hooks. Grasp sample firmly using broad tip tweezers at the edge of the disk.

3. Lift disk horizontally and without tipping, inspect both surfaces of disk.

4. Set bottom surface of disk onto sticky surface of Sellotape.

5. If required, coat surface with nitrocellulose solution and dry.

6. If required, examine under microscope in glove box.

7. Place phosphor coated Sellotape over center of sample and gently force out wrinkles toward edge of disk.

8. Seal edge and proceed as in steps 10 to 13 for deposition slides.

Cylindrical Collectors

Equipment

Items 1, 2, 3, 8, 9, 10

Nitrocellulose (3 percent) in amyl acetate

Disposable glass pipette and bulb

Crucible tongs (#9684 A. H. Thomas Company, Philadelphia, Pennsylvania)

16-by-16-inch sheet white bond paper

Teflon scraper (consisting of a 0.060-inch semicircle in tapered edge of 1/2-inch-wide strip of teflon)

Needle in needle holder (4607 A. M. Thomas Company, Philadelphia, Pennsylvania)

2-by-3-inch glass micro slide with beveled edge

Procedure

1. Place 16-inch square of paper on base of glove box.

2. Insert other items and place 2-by-3 slide on white paper.

3. Place one mailing tube containing sample into glove box.

4. Cut sealing tape at ends of tube using scalpel.

5. Push cork at one end of tube into tube slowly to depth of 3 inches. Grasp extruded cork at other end and withdraw wire slowly without bumping it. This step demands great care to avoid knocking particles off wire.

6. Place the cork-wire assembly on the paper so that the wire is still suspended between the corks. Place a drop of nitrocellulose solution on the area of interest and immediately begin to rotate the wire to distribute the drop around the wire surface. When dry, add drops to one side of this area and raise and rotate wire so that drop flows away from area of interest. When dry, repeat for other end. When dry, add a second layer to area of interest. When dry, use side cutter pliers to snip out length of interest.

7. Wash particles onto a cover glass (mounted on **1-by-3-slide** using paraffin), using a needle and a puddle of nitrocellulose solution. Remove wire with **fine** forceps and flush off with nitrocellulose solution. Disperse particles evenly using tip of the needle.

6A. Alternate procedure to sample the whole length is to remove one cork, rest end of wire on **2-by-3-slide** and raise opposite end. Add several drops at top end and rotate wire while drops run down wire and off onto glass slide. Gently plough the wet petrolatum-particle layer by using a teflon scraper. Remove particles from scraper by using nitrocellulose solution and a needle.

7A. Disperse particles over **2-by-3-slide** evenly using needle as gently as possible.

NOTE: In either procedure the particles do not adhere well to the glass due to interference by the petrolatum. Therefore, the slides must be dried and handled with great care.

8. Transfer sample to the nuclear track emulsion coating procedure B.7 or phosphor autoradiography preparation for deposition slides described in B.1.

9. Take an adhesive swipe of the inside of the mailing tube using masking tape and the long tongs and monitor under the alpha probe.
10. Replace wire and cork in mailing tube and seal with tape.
11. Return tube to plastic bag for storage or disposal.
12. Carefully fold edges of white paper inwards and place in hot waste disposal bag.
13. Decontaminate glove box and tools after every session using sticky tape, razor blade scraping of nitrocellulose layers, wet and dry paper swipes, and alpha probe monitor.

B.2 ALPHA COUNTING

All Sample Types

Equipment

Gas flow proportional counter, window **10 cm-by-10 cm, operated at 850** volts with **2 percent Isobutane, 98 percent argon gas at 0.1 liter/minute flow.** Equipped with 40-foot hose and cable. (Isotopes, Inc. experimental arrangement)

Paper supports 1 1/8-inch squares and 3 1/2-inch disks (white bond)

Pu-239 electroplated disk standard (Isotopes, Inc.)

Forceps

Alpha Counter Log Book

Preparation

a. Count background as often as possible.
b. Count standard planchet before commencing.
c. Obtain samples to be counted.

Procedure

1. Transfer sample carefully using forceps. Use paper supports under sticky samples.
2. Hold Millipore and Microsorban down at edges with sticky tape.
3. Count sample for 10 minutes, and record. Check background after counting very hot samples. Count standard if count is suspected to be too low.
4. Transfer very low level samples to Project 5.2 for counting in Nuclear Measurements Corporation Model PC-3B, 2π proportional counter.
5. Transfer sample to next operation or storage.

B.3 PHOTOGRAPHING SAMPLES

All Sample Types

Equipment

Vertical camera stand or tripod

4-by-5 Press-View camera with triple bellows extension (Linhof type, 5-inch lens)

Black background-sample support (unlighted 8-by-10-inch contact printing box)

Black matte construction paper

Graph paper, 1-mm divisions

Microscope illuminator (American Optical, Cyclospot)

High contrast film (Kodak Contrast Process Pan)

High contrast developer (Kodak:D11, acid fixer, photo flo)

Preparation

a. Cut out 1-inch square in graph paper, mount on glass.

b. Place printing box on camera stand base, center.

c. Place microscope illuminator on printing box glass.

d. Attach camera to stand, extend bellows.

e. Load film holders and number holders.

f. Determine, by meter reading or trial, the proper exposure.

Procedure (use finger cots as required)

1. Adjust magnification so that sample fills 4-by-5-ground glass area.
2. Place sample within or over cut out, using graph paper lines as centering guide, using forceps.
3. Adjust microscope illuminator for approximately 20° from grazing incidence.
4. Make exposures on basis of trial runs, record sample sequence.
5. Transfer samples to next operation or storage.
6. Transfer exposed films to corresponding positions in developing tank and process. Retain this order through drying step.
7. Staple dried negative to sample history sheet #1.

B.4 LOW POWER EXAMINATION

All Sample Types

Equipment

Low power stereomicroscope (American Optical model 59 FS, 13.3X or 26.6X with U.V. illuminator and cyclospot illuminator)

Forceps, wide flat tip (#5555, A. H. Thomas Company, Philadelphia, Pennsylvania)

Sample History Sheet #1

Carbide tipped scriber

Sharpened needle

Depression slide (#7040, A. H. Thomas Company, Philadelphia, Pennsylvania)

Cover glass, No. 1½, 22-mm square (#7021-C A. H. Thomas Company, Philadelphia, Pennsylvania)

Preparation

a. Obtain samples, or work simultaneously with alpha counting and photography.

Procedure

1. Place sample box (opened flat) or sample onto microscope stage.
2. Examine by reflected and transmitted white light, sketch prominent features on sample history sheet #1, recording color effects and outstanding large particles.
3. Examine by reflected ultra violet (room lights off).
4. (Optional) Pick off any large particle suspected of being radioactive, using needle. Transfer carefully to cover glass and count. To store particle, invert over depression slide and cement cover slip corners. Record the activity and size of particle on Sample History Sheet (size by high power microscopy).
5. Scribe 1/8-inch reference line on Impactor disks samples and record line on Sample History Sheet.
6. Close sample box and transfer to next operation or storage.

B.5 PREPARING PHOSPHOR AUTORADIOGRAPHY SCREENS

Equipment

Sellotape 2-inch and 6-inch width (vinyl 12 Adhesive Tapes, Limited, Barehamwood, Herts, England)

Zinc sulfide, silver activated powder (type 86, blue, Levy West Laboratories, Wembley, England)

Transparent sticky tape, 1/2-inch wide (Scotch Brand, Minnesota Mining and Manufacturing Company)

Card stock, 2 by 12 inches

$8\frac{1}{2}$ by 11 inches

Large tray, approximately 11 by 14 inches

Paper sheets 4-by-5 inches (white bond)

single edge razor blade

Photo film box 4 by 5 inches

Procedure for 2-inch Squares (For 1-inch glass disk Samples)

(Carry out procedure far from photographic darkroom or counting room areas, under an exhaust hood or near an operating vacuum cleaner nozzle.)

1. Cut a 2-by-12-inch strip of Sellotape and secure 2-inch-square handle of card stock to each end and lay sticky side up in the large tray.
2. Apply approximately 1 cm^3 of ZnS(Ag) powder on one end of the sticky side of of the tape and spread over the surface by rocking and gently shaking the tape strip.
3. When thoroughly coated, invert the strip and remove excess phosphor by flexing the film vigorously.
4. Cut the strip into squares approximately 2 inches in length.
5. Store the sheets between 4- by 5- inch interleaf sheets in a covered box.
6. Cut three strips of 2- by 12-inch tape and secure, sticky side up, to an $8\frac{1}{2}$- by 11-inch card using sticky tape, allowing $\frac{1}{2}$-inch space between strips.
7. Apply $\frac{1}{2}$-inch-wide sticky tape strips across the three strips at 2-inch intervals.
8. Slit the center of the $\frac{1}{2}$-inch tape and cardboard to produce 15 squares of mounted plain sellotape to be applied to the back surface of the sample and provide a seal at the edge of the sample.

Procedure for 3-by-4-inch Screens (For 2-by-3-inch Deposition Slide Samples)

Same as above excepting:

1. Coat a 6-by-12-inch-Sellotape strip with phosphor and cut into approximately 3-by-4-inch pieces.
2. Prepare plain sheets by securing an 11-inch strip of 6-inch-wide Sellotape sticky side up on an 8½-by-11-inch-card, cut into 3-by-4-inch pieces, and tape edges as necessary to keep flat.

Procedure for 10-inch Square Screens (For 7-inch Deposition Disk Samples)

Same as above excepting:

1. Place 2 lengths of Sellotape 6-by-10-inches so that the 10-inch sides overlap by approximately 1/4 inch and press together so as to avoid wrinkles.

B.6 EXPOSING PHOSPHOR AUTORADIOGRAMS

Equipment

Exposure fixture, guides, weight and box shown in Figure B.4

Film box, 8½-by-11-inch size

Black masking tape (Type 234, Minnesota Mining and Manufacturing Company)

Zenith plates, 2¾-by-2¾-inch (Ilford, Limited, Ilford, Essex, England)

Dry tissue swipes (Kimwipe, Kimberly Clark Corporation, Neenah, Wisconsin)

Gummed labels 5/16-inch diameter (Avery labels)

Exposure Data Sheet

Preparation

a. Attach phosphor coated samples at appropriate locations over the double coated tape strips on the exposure fixture and swipe the surface to remove any stray grains of ZnS(Ag).

b. Position the alignment guide strips above the samples so as to locate the slides 1/8 inch from the narrower edge of the slide.

c. Place the fixture in the cover of the film box and apply the bottom of the box as a cover.

d. Allow the assembly to remain in the dark for at least 1 hour.

e. Number 12 labels from 1 to 12 and attach in sequence lightly at one edge to the lab bench.

f. Prepare 12 lengths of tape ½-by-1-inch long and lay out similarly to e.

g. List the sample numbers on the exposure data sheet.

Darkroom Procedure (In total darkness)

1. Open the sample box.
2. Attach label number 1 to one corner of the back side of a Zenith plate.
3. Orient the plate so that the emulsion faces the sample and the labeled corner is in the registration corner of the alignment guide.
4. Place the edge of the slide against the longer edge of the notch in the alignment guide.
5. Carefully lower the slides against the sample surface.
6. Press the edge of the corner diagonally opposite the label to insure proper alignment in the corner and secure the glass to the guide using a piece of tape.
7. Repeat for the other eleven samples.
8. Place the pressure pad over the samples.
9. Replace the cover (bottom) and add the steel weight.
10. Tape the edges of the box with black tape.

11. Record the time and date on the exposure data sheet.

The procedure for other sample sizes is similar. Instead of a realignment fixture, use carbon -14 labeled india ink (available from Schwarz Bioresearch, Inc., Orangeburg, New York) at 2 or 3 spots on the phosphor screen to provide an image for realignment. Use photographic film for samples larger than 2 3/4 **inches square.**

Standard exposure times are:

Zenith Plate 60 **minutes, 1,000 minutes.**

Super XX Film **3,960 minutes, 7,400 minutes.**

Panatomic X Film **2,880 minutes.**

B.7 PREPARING SAMPLE FOR NUCLEAR TRACK AUTORADIOGRAPHY MICROSCOPY

Casella Impactor Disk, Stage 1

Equipment

Hot plate under ventilation hood (6169-P, A. H. Thomas Company, Philadelphia, Pennsylvania)

Nitrocellulose **(5 percent) in amyl acetate (#1121 Ernest F. Fullam, Inc.,** Colonie, New York)

Nitrocellulose **(3 percent) in amyl acetate (#1121 Ernest F. Fullam, Inc.,** Colonie, New York)

Nitrocellulose cement (Duco Cement)

Forceps, flat (5555 A. H. Thomas Company, Philadelphia, Pennsylvania)

Forceps, precision (#1100, Ernest F. Fullam, Inc., Colonie, New York)

Needles and needle holder (4607 A. H. Thomas Company, Philadelphia, Pennsylvania)

Cover glass, No. 1 1/2, 22-by-40 mm and 22-mm square (#7021-C, A.H. Thomas Company, Philadelphia, Pennsylvania)

Microscope slide 1 by 3, 2 by 3 (#7030, 7033, A. H. Thomas Company, Philadelphia, Pennsylvania)

Double coated tape (Type 400, Minnesota Mining and Manufacturing Company)

Transparent tape (Scotch Brand, Minnesota Mining and Manufacturing Company)

Paraffin wax in beaker

Photographic gelatine (Purified Calfskin, Distillation Products, Inc., Rochester, New York)

Gummed labels $\frac{5}{8}$-by-$\frac{7}{8}$-inch (Avery Label, Company, New York, New York)

Lens tissue (Ross, Ladd Research Industries, Inc., Burlington, Vermont)

Disposable pipette, 1-mm bore ($5\frac{3}{4}$-inch, Ace Scientific Supply Company, Linden, New Jersey)

Ethyl acetate (Spectroquality Reagent, Matheson, Coleman, and Bell, East Rutherford, New Jersey)

0.25 percent Formvar solution (#1122 EFF Inc.)

Flotation apparatus (#1139 EFF Inc.)

Copper screen, 200 mesh (#3211 EFF Inc.)

Preparation

a. Clean several cover slips and 1-by-3-inch slides by breathing upon them and wiping with clean lens tissue.

b. Attach a cover slip to a slide by a tiny drop of microscope immersion oil.

c. Cement the edge of the cover glass with a dam of melted paraffin wax applied with a disposable pipette.

d. Prepare a stock solution of gelatine and apply gelatine to the inner edge of the paraffin dam using a fine paint brush.

e. Cut several 1 1/2-inch lengths of double coated tape.

f. Obtain the samples from storage.

g. Prepare Stereomicroscope and ventilation hood areas for work.

Procedure

1. Remove disk from plastic storage box carefully by means of flat forceps and place particle side up onto a 2-by-3-inch glass slide. Maintain sample identity by scribing numbers on the 2-by-3 slide.
2. Adjust the hot plate for 100°F (scribed line determined by 100°F thermometer measurement in 50-ml beaker of water). Adjust exhaust hood to 6 inches above the hot plate surface.
3. Place 2-by-3-inch slide-bearing disk onto hot plate and bake for 5 minutes; some fumes will be noted. If excessive fumes occur, remove sample and cool. Continue baking until glass surface appears to be dry under stereomicroscope; the particles will still appear to be wetted.
4. Attach a Stage 1 disk to bench top by laying disk onto double coated tape. Keep contact area to a minimum.
5. Apply 4 drops of 3 percent nitrocellulose in a cloverleaf pattern and extend solution to cover disk using tip of a needle. Allow sample to dry.
6. Apply 2 drops of 5 percent nitrocellulose solution to the disk and spread with the broad side of a needle, taking care not to touch the sample. Allow the layer to dry thoroughly, preferably over night.
7. Score the edge of the sample and the center to produce two semi-disks each containing half of the main deposit, using a fresh scalpel blade.
8. Tease the plastic layer from the glass by gently breathing onto sample while inserting scalpel under an edge. After ¼-inch is stripped,

forceps may be used to pull the film slowly while moist breath aids in the release. Do not inhale with the mouth near the sample.

9. **Place two drops of 3 percent nitrocellulose onto a mounted cover glass and** spread out with a needle into a thin coating. Place the stripped film particle side up onto the cover glass by lowering one end first to minimize trapping air bubbles.
10. Work out bubbles and help tack down edges using needles, until the stripping lays flat. Dry the preparation under a 60-watt lamp 8 inches from the sample.
11. Repeat the procedure for both halves of each sample.
12. Monitor the glass for alpha activity to ascertain the success of the stripping.
13. Transfer samples for emulsion coating described in B.8.

Casella Impactor Disk, Stages 2 and 3

Sparsely populated samples treat as Stage 1

Densely populated sample treat as follows:

During Step 5 above, gently disperse particles using the tip of a needle, and flush needle with a drop of ethyl acetate.

Proceed as for Stage 1.

Casella Impactor Disk, Stage 4

Preparation

a. Clean a microscope slide as described above.
b. Fill a pipette with a small quantity of Formvar Solution.
c. Draw the broad edge of the pipette across the microscope slide while

gently discharging Formvar.

d. Allow the film to dry and observe the quality of the dried film.

e. Store the slides in a clean covered container so that the surface is protected.

Procedure

A portion is removed for electron microscopy as follows:

1-4 Proceed as for Stage 1 disk.

5. Apply 3 drops of **3 percent nitrocellulose to the line deposit only and** allow to dry.

6. Under a stereomicroscope at 13X magnification, use a sharp scalpel to score a strip approximately 2 mm in width **and** 5 mm in length, at a right angle to the main deposit.

7. Breathe upon the dried film and tease loose a corner of the scored strip, using a fresh scalpel blade or a sharp precision forceps. Gently tease the film loose. Grasp the film with the forceps as required to prevent blowing it loose and to aid in teasing.

8. When the film is almost removed, put one of the Formvar-coated slides onto the microscope stage next to the sample and place one drop of ethyl acetate approximately 1/4 inch in diameter onto the Formvar.

9. Grasp the stripping with precision forceps and remove it completely.

10. While holding the stripping, transfer the Formvar slide into the field of view and drop the stripping onto the drop of ethyl acetate. If the stripping will not drop free, insert it edgewise into the drop without touching the forceps to the drop. This may be performed with a needle instead of forceps at the risk of loosing the stripping. If the plastic tears badly during stripping, use a scalpel blade to scrape up and transfer the pieces.

11. While observing the dissolution of the plastic film, use a needle to aid in dispersing the particles. Add another drop of solvent if required to aid in dispersal.

12. Allow the film to dry for 1/2 hour.

13. Score a 1 cm-by-1 cm area around the dried droplet using a needle.

14. Prepare a clean, quiet surface of distilled water in the flotation apparatus. Cut out squares of 200-mesh copper screen to 1 cm-by-1 cm and pieces of brass screen to $\frac{5}{8}$-by-2 inches. Bend the brass screen to form an L shape. Break an occasional copper wire to provide a fiducial, but do not bend screen.

14. Breath upon the slide and immediately lower one edge slowly under the water surface. Watch for the film to float to the surface (grazing illumination helps) and continue to lower the slide until the square floats free. (Quick strokes with a needle aid in steering the floating film).

16. Place a piece of copper mesh onto the brass screen and lower beneath the surface. (Push copper with needle to overcome surface tension).

17. Raise the screen slowly under the floating film by means of the brass screen.

18. Pick up the film onto the screen, drain the edge against a Kimwipe, and observe that the film draws down against the screen. Further blotting with the twisted corner of a Kimwipe may be required at the edge or back of the screen to accomplish draw down.

19. Dry the films under a dust canopy.

20. Transfer the preparation to nuclear emulsion coating or electron microscopy.

A portion is removed for nuclear track emulsion autoradiography by stripping procedure **Steps 1 to 7.** It is then transferred to a cover glass as follows:

8. Place 2 drops of ethyl acetate on a prepared cover glass-paraffin dam assembly.
9. Place the stripping into the solvent and allow it to dissolve.
10. Transfer the procedure to the stereomicroscope and add a drop of ethyl acetate.
11. Disperse the particles as evenly as possible using a needle tip while the droplet dries.
12. Coat a thin layer of gelatine solution over the inner edge of the paraffin dam.
13. Transfer the dried samples to nuclear track coating described in B.8.

Casella Membrane Filter, Stage 5

Procedure

1. Cut one half of a square, $\frac{1}{16}$-by-$\frac{1}{8}$-inch, from the filter by carefully pressing a sharp scalpel blade into the filter (do not pull or slice).

2. Dissolve and disperse the filter on a prepared cover glass-paraffin dam assembly using ethyle acetate and a needle.
3. Proceed with Steps 12 and 13 as for Stage 4.

Total Air Sample Filters

Procedure

The procedure is the same as for millipore filters except that a larger cover glass is employed.

1. Cut a piece 2 mm by 2 mm from the sample by pressing a sharp scalpel into the filter. Be certain to cut through the back-up membrane filter. Remove the cube of filter with a precision forceps.
2. Divide the cube into 4 layers parallel to the filter face by inserting the scalpel sidewise into the filter cube.
3. Dissolve and disperse these on separate zones of the prepared cover glass, using ethyl acetate.
4. Proceed as in Steps 12 and 13 for Casella Stage 4.

Deposition Slides, Deposition Disks

If the sample is not treated by phosphorautoradiography, handle as a Casella Stage 1. If treated by phosphorautoradiography, the particles have already been cemented to the sample surface.

Procedure

1. Select an area of interest based on phosphor autoradiogram realigned with sample and outline it on the back of the sample with crayon.
2. Cut the phosphor screen using a scalpel and carefully remove the flap and store in a plastic box.
3. Add 2 drops of 5 percent nitrocellulose solution and spread evenly with the broadside of a needle.
4. Proceed with Steps 7 to 14 for Casella Stage 1.

Cylindrical Collectors

The procedure for getting the particles onto glass has been described under B.1. In the case of selecting a short length of interest, the procedure used a cover glass. For a procedure using the whole length of wire, the sample should be handled as described for deposition slides.

B.8 EXPOSING NUCLEAR TRACK AUTORADIOGRAMS

Samples for optical microscopy mounted on top of a cover glass.

Equipment

Nuclear Track Emulsion, bulk form (NTA, Eastman Kodak Co., Rochester, New York)

20-ml and 250-ml beakers

Dropping pipette and bulb

Thermometer, stainless (Weston Photographic)

Hot Plate

Stainless scoop (S-1405 Scientific Glass Apparatus Co., Inc., Bloomfield, New Jersey)

Desiccant (Drierite, W. A. Hammond Drierite Co., Xenia, Ohio)

Empty sheet film boxes (Eastman Kodak Type)

Black photographic tape (Type 200, Minnesota Mining and Manufacturing Company)

Exposure data sheet

Wratten OA Safelight (Eastman Kodak Company, Rochester, New York)

12-by-12-by-½-inch Urethane Foam Pad

Preparation

a. Make certain that samples are labeled and place samples in darkroom.

b. Remove emulsion from refrigeration.

c. Heat 125 ml of water in 250-ml beaker to 115° F.

d. Fashion a wire support to hold the smaller beaker partly immersed in water.

Procedure

1. Under OA safelight, at least 6 feet distant, open the emulsion jar and remove with a scoop approximately 3 cubic centimeters of emulsion preferably in one or two chunks.

2. Place the emulsion in the 20-ml beaker, set the beaker into the water in the large beaker.

3. Stir the emulsion very slowly with the end of the thermometer. Take care to avoid forming bubbles in the emulsion.

4. When no emulsion chunks remain, prewarm the pipette by squirting 115° F water through it.
(To use the pipette, exhaust the bulb before placing it into the emulsion. Never exhaust the bulb while the pipette is in the emulsion.)

5. Withdraw emulsion to half fill pipette.

6. Drop 3 drops rapidly onto the sample surface and spread gently with the side of the pipette so that the whole cover glass is covered out to the paraffin dam.

7. Remove bubbles by dragging them to the side or by picking them up with an exhausted pipette.

8. Place the coated slide on a level cold surface.

9. Repeat Steps 5 to 8 for other samples.

10. Allow samples to dry for 1 hour in total darkness.

11. Transfer to photo box containing Drierite and seal box with tape. Place box on urethane foam pad.

12. Record date, time, and sample numbers on an Exposure Data Sheet.

13. Expose samples for appropriate period. (Exposure less than 1 hour is not advisable due to emulsion not having fully solidified.

Samples for Electron Microscopy Mounted on 1 cm-by-1 cm Copper Mesh.

Equipment

All items above except No. 4.

Wire loop with opening ¾-by-¾-inch fashioned from a plated paper clip and soldered.

Preparation

a. Reduce 22-cm square cover slip to ½-by-½-inch, using a diamond scriber, etc.

b. Attach 1-cm square piece of copper to the cover glass by cementing the corners with Duco Cement, (thinner cement will run under screen) and allow it to dry.

c. Cement the top of a #00 cork to the center of a 1-by-3 slide.

d. Cement the cover glass bearing the sample to the bottom of the cork (see Figure 2.5).

e. Label the 1-by-3 slide with appropriate sample number.

f. Remove emulsion from refrigeration.

Procedure

Proceed with Steps 1 to 3 above but use 6 cm^3 of emulsion.

4. Practice picking up a thin film of emulsion with the loop. (Note the effect that touching the edge of the loaded loop to the side of the beaker has in reducing the film thickness).

5. Fill the loop with emulsion without touching the beaker to drain excess.

6. Lower the loop over the mounted specimen until the film fractures. The specimen should appear to be evenly coated. If not, repeat rapidly with a second loop which has been drained.

7. Proceed as in 8 to 13 above. Shorter drying time may be used.

B.9 DEVELOPING AUTORADIOGRAMS

Phosphor Autoradiograms

Equipment

D-19 Developer (Eastman Kodak Co.)

Acid Fixer (Eastman Kodak Co.)

Developing Tank for 2 3/4 square plates

Developing Tank for 4-by-5 sheet film.

Developing Trays for > 4-by-5 size film

Thermometer (Weston Photographic)

Wetting agent (Photoflo, Eastman Kodak Co.)

Darkroom facilities

Carbide tipped scriber

Preparation (under total darkness)

a. Remove weight, tape, box, and pressure pad from exposure assembly.

b. Place plates into developing tank rack in same sequence as labels were used on back of plates. (Remove hold-down tape from back of slides).

c. Bring solutions to temperature.

Procedure

1. Develop for exactly 5 minutes at 72° F in D-19, undiluted. Agitate tanks for first 15 seconds of each minute, or trays for 15 seconds twice a minute, with interleaving once every minute.

2. Wash in water 30 seconds.

3. Fix in acid fixer for 10 minutes; agitate for first 15 seconds of each minute.

4. Wash 15 minutes in running water.

5. Dip in photoflo solution and dry in rack.

6. Replace dried plates on exposure fixture in same orientation used for exposure. Scribe a line on back of upper left hand corner corresponding to left hand edge of slide.

7. Remove slide and draw a ball point pen along the notched edge of the alignment guide to produce a realignment mark on the phosphor screen (see Figure B.2). The scribed mark and the ink line allow repositioning sample and plate

rapidly. More precise alignment is possible by matching large particles with black image spots under stereomicroscope.

Nuclear Track Autoradiograms

Samples Prepared for Optical Microscopy

Equipment

Items 1 through 3, 6 through 8

Scalpel

Glycerol

1-by-3-inch slides

Cover glass, 22 mm square

Immersion oil

Q-tips

Xylene

Preparation

a. Bring solution, including wash water, to temperature.

b. Select as small a tray as possible to minimize waste disposal problem.

c. Open sample boxes (in total darkness or under subdued OA safelight)

Procedure (wearing rubber gloves)

1. Develop in D-19 for 5 minutes at 72° F, agitating tray twice every minute. This may be adjusted to produce heavier or lighter tracks as preferred.

2. Transfer slides by hand to 72° F wash water for 15 seconds or less.
3. Transfer to 72° F acid fixer for time required to clear.
4. Wash for 8 changes.
5. Immerse in 2 percent glycerol in water for 2 minutes.
6. Dispose of solution in liquid waste.
7. Dry overnight under protective shield.
8. Trim paraffin and surplus emulsion from the edge of the cover glass and remove all pieces.
9. Place a drop of immersion oil on the center of a 1-by-3 slide.
10. Slide the cover glass off the 1-by-3 slide and mount it in on inverted position, i.e. emulsion layer down on the oil. Lower the slide at an angle to minimize trapped air.
11. Place a steel weight on the cover glass for 10 minutes.
12. Clean the edge of the cover glass and slide with a Q-tip, moistened with xylene, to remove excess oil.
13. Apply Duco cement around edge of cover glass.
14. Label slide appropriately and transfer to optical microscopy.

Samples Prepared for Electron Microscopy

The procedure is essentially the same except:

1. Place the whole assembly on its side and immerse in developer.

2. **Develop for 1 to 2 minutes.**

   Developers other than D-19, such as microdal X or p-phenylene-diamine type, may be substituted but will require much longer time.

3. Reduce washing time to 10 seconds. Fix in plain hypo until clear. Wash for 3 minutes, using 3 changes.

4. Omit glycerol treatment.

5. Dry under protective shield.

B.10 MEASURING AND OBSERVING BY MICROSCOPY

Optical Microscopy

Equipment

Leitz Ortholux Pol model research microscope with No. 250 mechanical stage, polarizing vertical illuminator, polarizing condenser 50F, achromatic objectives 8x and 50x and fluorite objectives 45x and 105x, periplanatic wide field 16x eyepieces, and 35 mm and 4-by-5 camera attachments. (E. Leitz, Inc., New York New York)

American Optical Stereomicroscope 59FS (American Optical Co., New York, New York)

Porton Graticule

Immersion Oil (Shillaber A, Cargille & Sons, New York, New York)

Clean room laboratory.

Stage micrometers (American Optical and Leitz)

Preparation

a. Clean and center system according to manufacturer's instructions, using the vertical illuminator as the least flexible and, therfore, the prime reference.

b. Adjust the stage height to accomodate the range of objectives.

c. Clean and mount the graticule in one eyepiece.

d. Insert the graticule eyepiece into the fixed binocular tube.

e. Calibrate the graticule circles and lines by comparison with the stage micrometer. Note the binocular interocular setting. (Focus sharply using fixed eyepiece only, then adjust focusable eyepiece so that both eyes are in focus for a given fine focus position).

Procedure

Strict procedure cannot be set for the variety of samples studied. General rules are to be followed:

1. Scan with as low a power as possible. An 8x objective will detect alpha stars 50 u in diameter, but a 50x may miss single tracks.

2. Use 45 x objective for samples without cover glass and 50 x objective for samples with cover glass.

3. Adjust field diaphragm to match field of view.

4. Adjust aperture diaphragm to fill objective to about 80 percent of the diameter of the rear element. (Check by viewing

with Bertram lens)

5. Use polarizers to control reflections inherent in vertical illumination.
6. Close field diaphragm and use polarizers to emphasize surface texture as required.
7. Sketch the sample roughly as an aid for later reference.
8. Record stage coordinates for the fields scanned and objective power.
9. Record data according to the key shown in Figure B.4.
10. Calculate the area of the sample and the area scanned.
11. Photographic exposures will range from 1/2 second to 30 seconds for 35-mm Ektachrome Hi Speed Type B film and 15 seconds to 3 minutes for 4-by-5-inch Super XX film.
12. Focus above and below particle before making size measurement or alpha track counts to insure that the event is completely observed.

Electron Microscopy

Equipment

Philips EM-75B Electron Microscope (Philips Electronic Instruments, Mount Vernon, New York)

Leitz Microscope (described above)

35-mm film (type P-426 Eastman Kodak Co., Rochester, New York)

35-mm Enlarger

Diffraction grating replica (#1000, Ernest F. Fullam, Inc., Colonie, New York)

Preparation

a. Calibrate microscope by measuring approximately 30 lines of the grating replica using a calibrated optical microscope. Make several determinations of the grating spacing (0.85 micron was used).

b. Prepare a notched scale from 0.002-inch-thick shim stock brass which will cover the range 0.1 to 2 microns with notch widths increasing by a $\sqrt{2}$ factor. The smallest notch must be readily visible when the plate is located at the fluorescent screen. (A value of approximately 1 mm was used.)

c. Using the measured values of the grating spacing and the known value of the notch opening, adjust the microscope magnification so that values of 1500 x and 7500 x are obtained. Observe the kilovolt and current settings of the microscope. Scribe a line on the magnification ring for these two values. Always approach these scribed lines from the same direction to eliminate screw-thread backlash.

d. Photograph diffraction grating at 1500 x and 7500 x and measure the grating spacing on the finished films by optical microscopy. Calculate the magnification value recorded on the film.

e. Set up 35-mm enlarger and project the grating images to achieve a convenient magnification so that 0.1 micron occupies about 1 mm on the easel.

f. Rule a series of circles similar to the Porton graticule on transparent plastic to provide a measuring scale.

Procedure

1. Examine the dispersed samples and/or autoradiograms by optical microscopy and evaluate the uniformity of the dispersal.

2. Punch a $\frac{1}{8}$-inch diameter grid from the best area using the steel punch and a 3-by-5 card stock and $\frac{1}{8}$-inch thick lucite backing. Sharpen the punch previous to use and clean thoroughly with xylene and Q-tip.

3. Insert the grid into the microscope and pump down to vacuum.

4. Scan at 1500 x using as low a beam current as possible. Follow single rows of the screen and scan rapidly. Sketch the location of typical fields and unusual events.

5. Examine and photograph larger particles at 1500x.

6. Examine and photograph typical areas at 7500x.

7. Record magnification for each exposure and measure and make a sketch of outstanding particles.

8. Return sample to storage.

9. Repeat on second grid if necessary.

10. Process films for 7 minutes in Microdal X at 68° F.

11. Project dry films in 35-mm enlarger set for use with transparent measuring scales (check the enlarger height optically for each run.)

12. Measure the projected negative particle images by comparison with the circles on the transparent scales.

13. Record size, shape, number of fields, and area of each field.

B.11 ISOLATING INDIVIDUAL PARTICLES

Equipment

Stereomicroscope 26X (Model 59FS American Optical Company, New York, New York)

1 percent nitrocellulose in amyl acetate

Needle in needle holder

Glass pipette and bulb

Labels ½-by-¾-inch (Avery

1-by-1½-inch glass slides

Plastic box (H-60 Althor Products, Brooklyn, New York)

Wax crayon, red

3-by-5 file card

Emery paper

Scalpel

Ethyl acetate

Preparation

a. Clean glass slides and apply label to one end, leaving one edge folded up for easy removal.

b. Cut a 1-by-1½-inch piece of card. Construct a diagonal and punch a hole at the center of the card using a ⅛-inch punch. Place template against back of 1-by-1½-inch slide and mark outline with a red wax crayon.

c. Sharpen several needles on emery (perform this outside of clean lab)

Procedure

1. Select particle to be isolated using stereomicroscope.

2. Place clean slide on microscope stage and place a drop of nitrocellulose on the center of slide.

3. Carefully approach the particle of interest with a sharpened needle while viewing under the microscope. Allow hand to rest on microscope frame to provide steady base. Move needle with finger motion only.

4. Place needle tip along side of particle and raise particle off surface with a short, rapid motion so that needle tip is still in the field of view.

5. While watching particle, slide sample out of field of view and the drop of nitrocellulose into the field of view.

6. Lower the particle into the drop and allow the needle to touch the glass alongside the particle. Withdraw the needle by simultaneously pulling along the glass and rotating.

7. Spread the edge of the puddle out as thin as possible using the side of the needle.

8. Check and realign particle with center of slide.

9. Place identification number on slide and allow to dry.

10. Monitor particle under alpha probe and record activity.

11. Tape slide to bottom of plastic box.

12. Transfer particle to Project 5.2/5.3d for alpha counting and radiochemical and flourometric analysis.

13. Clean needle and/or resharpen between particles.

Particles may be selected on the basis of phosphor autoradiograms. Align autoradiograms and sample by means of 2 guide lines described in B.9. Outline particle or area of interest on back of sample slide using

red wax crayon. Separate the two and use a scalpel to cut out flap of phosphor screen. If sample was precoated with nitrocellulose, place a drop of ethyl acetate on area to release particle. Remove particle and replace flap.

Particles may be isolated from nuclear track autoradiograms before or after mounting in oil, the latter require cutting cover glass with a diamond scriber. Cut the area surrounding the alpha star with a scalpel while holding thin sample against glass slide with a needle. Transfer this portion to a drop of ethyl acetate and continue to sever the alpha star image with a scalpel and needle. The size of the particle dictates the procedure. With care one may see the particle release. If not, ethyl acetate is added to insure adequate dissolution of the original nitrocellulose stripping film.

B.12 DETERMINING PLUTONIUM AND URANIUM CONTENT

This analysis was performed under Project 5.2/5.3d, Mr. Ralph E. Fried, Project Director, Isotopes, Incorporated.

Individual particles (total 45) and groups of particles (192 particles in 11 groups) were evaluated by alpha counting, plutonium analysis, and uranium analysis following procedure in B.11 and below.

Casella Impactor, Andersen Impactor, Total Air Filters, Deposition Slides, and Cylindrical Collector samples were analyzed for plutonium and uranium following the special particulate studies as follows:

Preparation

a. Collect sample shipping envelopes, sample pieces, and any decontamination swipes generated in the particulate studies and place in individual plastic boxes. Label the boxes with Tracerlab Identification Number.

b. Record any known sample loss, or any sample portion withheld from analysis, for purposes of normalizing data.

c. Deliver samples to Project 5.2/5.3d with tabulation of data from 2.

Procedure (Project 5.2/5.3d)

Impactor Stages, Total Air Samples, Deposition Slides, Individual Particles

The sample, and its immediate cover or envelope, was placed in a beaker and covered with fuming nitric acid. If the activity was low enough, such that the entire sample could be spiked, Pu-236 was added at this point, and the solution evaporated to near-dryness. Alternatively, the spike was withheld until an aliquot of the complete solution was obtained.

Some of the slides receiving special particulate study by Project 2.6b were enclosed in an envelope of vinyl plastic. It was expedient to dissolve the vinyl by evaporation with acetone prior to the treatment with fuming nitric acid. The sample was then covered with a fuming HNO_3 - $HClO_4$ mixture and carefully evaporated to dryness. In the analyses of glass impactor discs and deposition slides, the glass was scrubbed at this point with a rubber policeman and 1N HNO_3 and the glass discarded. If a silicious residue remained, the sample was transferred to a teflon beaker and evaporated to dryness several times with concentrated HF. Fluoride ion was removed by evaporations with HNO_3 and the final residue dissolved in hot 6N HCl.

Uranium analyses were performed on the uranium fraction obtained at the ion-exchange separation of plutonium and uranium (Steps 11 and 12 below).

Ten mg of iron carrier were added to the sample and $Fe(Pu)(OH)_3$ precipitated by the addition of NH_4OH. The precipitate was centrifuged, washed with dilute NH_4OH, and then dissolved in 1N HNO_3. Five mls of a 5 percent solution of $NH_2OH \cdot HCl$ were added and the solution heated on a hot plate for 10 minutes. The analysis proceeded with Step 11 below.

Plutonium Analysis

The reagent quantities given in Steps 1 through 3 below were for a 200 volume size of prepared solution; quantities were proportionately adjusted for larger or smaller volumes.

1. To the 2N HNO_3 solution add 10 mls of 5 percent $NH_2OH \cdot HCl$ and heat for 10 minutes.
2. Add 100 mg Bi^{+++} (as $Bi(NO_3)_3$ solution) and add concentrated NH_4OH until a precipitate forms; add 5 mls of concentrated HNO_3 to obtain a clear solution.
3. To the hot solution slowly add, with vigorous stirring, 30 mls of 10 percent $(NH_4)_2HPO_4$.
4. Digest the precipitate at room temperature for 1/2 hour; aspirate the supernate to 50 ml above the precipitate and discard.
5. Centrifuge the precipitate in a Lusteroid tube and discard supernate. Wash down the sides of the beaker containing the precipitate with 10 ml of 20 percent HCl and boil the solution.

6. Cool the beaker and add the HCl solution to the Lusteroid tube containing the precipitate in order to dissolve the $BiPO_4$.

7. Wash the beaker with 3 ml of **20 percent HCl and transfer the solution to the** Lusteroid tube (Note 1). Add 1 ml of La solution. Add **2 to 4 drops of 5 percent NH_2OH-HCl and wait 10 minutes.**

8. Add ***concentrated HF to make the final solution 2.5 molar in HF (Note 2).*** Digest the precipitate for 5 minutes and then centrifuge; discard the supernate.

9. Wash the LaF precipitate with 2.5M HF-HNO_3 solution. Centrifuge and discard the supernate.

10. Slurry 1 ml of boric acid solution with the LaF precipitate and transfer to 50-ml beaker with 7N HNO_3.

11. Heat the solution and adjust the acidity to 7N HNO_3; transfer the solution to the column and adjust flow rate to 0.2 ml/min (Note 3).

12. Wash the resin with 200 ml of 7N HNO_3 at full flow and discard effluent.

13. **Strip the Pu from the column with 20 ml of 1N HNO_3 followed by 45 ml of 5 percent** $NH_2OH \cdot HCl$. Collect the strip solution in a 100-ml beaker.

14. Recycle the column with 20 ml of 1N HNO_3, 45 ml of $NH_2OH \cdot HCl$, 20 ml of 1N HNO_3. Back flush the resin with H_2O and then add 100 ml of 7N HNO_3. Discard recycling solution.

15. Reduce the volume of the strip solution until the effervescence from the oxidation of $NH_2OH \cdot HCl$ is completed. Caution should be observed in volume reduction due to the frequent violent oxidation

by HNO_3 causing splattering and loss of sample.

16. Transfer the solution to a 30-ml beaker with 1N HNO_3 and take down the volume to about one drop.
17. Wash the sides of the beaker with 5 ml of 1N HNO_3; take the solution to about 1 drop and add 1 ml of 1N HNO_3.
18. Cool the solution and add 1 ml of 2 percent $NH_2OH \cdot HCl$. Wait for 1 hour.
19. Add 8 ml of H_2O and transfer the solution to an electrodeposition cup using 1 ml 0.1N HNO_3 to wash the beaker.
20. Electroplate at 0.5 amp for 1 hour (Note 4).
21. Neutralize the solution with concentrated NH_4OH (Note 5) and flame the stainless steel disc.
22. Count the sample on an alpha spectrometer.

NOTES

Note 1. If the sample contains a high content of Ca as in the case of bone, a second $BiPO_4$ precipitation has to be performed. $Ca(I)_2$ precipitates during the La scavenge, and the Ca interferes with the efficiency of the ion-exchange column.

Note 2. If some Fe has been carried through with the $BiPO_4$ precipitation, sufficient HF must be added to complex this element. When complexing of the Fe is complete, the solution should be decolorized.

Note 3. The 100 to 22 mesh moist(Dowex 1-x2) is washed with 4 portions of H_2O and 3 portions of concentrated HCl, alternating each. After each wash the resin is allowed to settle for 2 to 3 minutes, and the fine particles in suspensions are decanted. The resin is added to a height of 6 to 7 centimeters to

a 1-centimeter-diameter column, and the resin is cycled with the following solutions allowing the resin to run dry before the addition of each solution:

(a) 100 ml of 7N HNO_3

(b) 20 ml of 1N HNO_3

(c) 30 ml of NH_2OH HCl

(d) 20 ml of 1N HNO_3

(e) 100 ml of 7N HNO_3

(f) Follow cycle again ending with 100 ml of 7N HNO_3.

Note 4. The electrodeposition anode is a platinum wire with its upper end attached to the shaft of a 1-rps clock motor and its lower end wound in a horizontal spiral. During the deposition the anode also serves as a stirrer for the solution. The cathode onto which the plutonium is deposited is a 1-inch diameter stainless steel disc made from 26 gauge (0.0185 inch) sheet stock with a Number 4 finish. The cathode disc is held against an O-ring which forms a seal between the plastic plating cell and the cathode. Thus, the active area of the cathode is circular, with a diameter of 13/16 inch.

Note 5. The addition of concentrated NH_4OH is made before the current is turned off in order to prevent the Pu from going into solution.

Uranium Analysis

The separated fractions of the aliquots removed for uranium determination were processed according to the following procedure:

1. Add 5 mg of iron carrier and raise the pH to 8 to 9 with ammonium hydroxide. Centrifuge and discard the supernate.
2. Dissolve the precipitate with a few drops of concentrated nitric

acid and add 5 ml of saturated ammonium carbonate. Centrifuge and transfer the supernate to a 100-ml beaker. Discard the precipitate.

3. Evaporate the uranium carbonate solution to dryness.
4. Add 15 ml saturated aluminum nitrate and transfer quantitatively to a 125-ml separatory funnel.
5. Quantitatively add 10 ml of ethyl acetate and shake for 3 minutes and allow 1 minute for separation of the two layers.
6. Place fourteen washed platinum dishes on a 4-1/2-inch-diameter nichrome wire gauze and dry under a heating lamp. Place a 0.4 gram NaF-LiF flux pellet in each dish.
7. From the ethyl acetate layer (top layer) of each extracted sample, pipette a 0.1-ml aliquot onto a pellet.
8. Transfer the gauze holding the platinum dishes and pellets to the iron tripod of a Fletcher burner.
9. Fuse at about 900°C for 2 minutes. Then decrease the temperature to 850°C and continue the fusion for another minute.

B.13 DETERMINING CRYSTALLINE PHASE BY X-RAY DIFFRACTION

This analysis was performed under Project 2.6d, Mr. J. Kent Perry, Project Director, Colorado School of Mines Research Foundation, Golden, Colorado.

Preparation (Project 2.6b)

a. Select single particles on the basis of appearance or other characteristics determined in the course of analysis.
b. Mount the cover glass on a 1-by-3 slide and label to identify the particle.

c. Cement the particle on the center of an 18 mm-diameter cover glass, No. 1 thickness, using 3 percent nitrocellulose in amyl acetate (Mount two squares of a membrane filter sample which contains submicron particles on one cover glass using Duco Cement).

d. Mount the slides in a plastic box so as to prevent shaking loose. Transfer the box to Project 2.6d.

Procedure (Project 2.6d)

The cover glass was mounted in a Philips X-ray Diffraction Microcamera, a front reflection device (after design by Frank T. Chesley, Review of Scientific Instruments, Volume 18, 1947, pages 422 to 424).

Bombardment was with filtered (nickel) copper radiation generated at 40 kv, 32 ma. Analysis was performed in a helium atmosphere to reduce air scattering. Exposures were for 10 hours.

Semiquantitative determination of mole percent PuO_2 and UO_2 was attempted by using variation in the 111 spacing.

Semiquantitative determination of the relative amounts of individual phases present was attempted by using the single spot images on potential Debye rings.

B.14 DETERMINING TOPOGRAPHIC COMPOSITION OF SINGLE PARTICLES BY ELECTRON MICROPROBE ANALYSIS

This analysis was performed through the courtesy of Colonel Irvin J. Russell and Lieutenant Donald E. Pichler, Air Force Weapons Laboratory, Kirtland Air Force Base, New Mexico.

Preparation (Project 2.6b)

a. Cut beryllium rod to produce cylinders 5/16-inch diameter by 5/16-inch long.

b. Polish one face using varying grades of carborundum paper, 5-micron diamond paste, 3-micron paste, and 1/4-micron paste. (Caution: Ingested beryllium is poisonous.)

c. Construct a plate of 1/8-inch thick lucite with 5/16-inch diameter reamed holes to hold 12 rods.

d. Place masking tape across the back of the holes.

e. Insert the unpolished face into the hole and against the tape using broad face forceps on the cylindrical surface only to avoid scratching the polished surface.

f. Place a drop of 3 percent nitrocellulose solution on the polished surface and bleed excess over the edge of the face.

g. Under the stereomicroscope select a particle as described in B.11 and mount it at the center of the polished face. (On one cylinder dissolve a tiny portion of a membrane filter which contains sub-micron particulates.)

h. Allow the sample to dry and label each sample position.

i. Place tape along the protruding cylindrical surface and the lucite plate to help hold the cylinder in place.

j. Tape the plate to the bottom of a plastic box and transfer to the laboratory.

Procedure

Analysis was performed in an Applied Research Laboratory Electron

microprobe operated at 30 kv and 0.5 μa. Sample current beam penetration was estimated to be 1 to 3 microns, and analysis was for elements of Z>11. A check on the optical measurement of particles size was made using back-scattered electron imaging. Data correction details are not available at this time.

TABLE B.1 NOMINAL VALUES OF EFFECTIVE AREA OF SAMPLES

Values based on low power microscopic examination

Casella Impactor Deposit:			
Stage 1	14mm x 20mm	≈	280 mm^2
Stage 2	2.0mm x 14mm	≈	28 mm^2
Stage 3	1.1mm x 14mm	≈	20 mm^2
Stage 4	0.5mm x 14mm	≈	7 mm^2
Stage 5	35mm diameter	≈	958 mm^2
Andersen Impactor Deposit:			
Stage 1-3	83mm diameter	≈	5407 mm^2
Stage 4-6	75mm diameter	≈	4416 mm^2
Stage 7	47mm diameter	≈	1733 mm^2
Total Air Filter		≈	1250 mm^2
Glass Slide		≈	2400 mm^2
Deposition Disk		≈	2.49×10^4 mm^2
Cylindrical Collector		≈	1880 mm^2 total
		≈	940 mm^2 faced upwind
Gelman Sequential Tape		≈	132 mm^2

TABLE B.2 CALIBRATION DATA FOR CASELLA MK II IMPACTOR

Density	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
	Projected area diameter in microns				
Size range derived from mean curve of collection efficiency at unit density[a].					
1	4.2-23	2.0-6.2	0.60-3.5	0.15-1.5	-
2.6	2.5-14	1.2-3.8	0.36-2.1	0.09-0.91	-
5	1.9-10	0.90-2.8	0.27-1.6	0.07-0.67	-
7	1.6-8.7	0.76-2.3	0.23-1.3	0.06-0.57	-
11.5	1.2-6.8	0.59-1.8	0.18-1.0	0.04-0.44	-
19	0.96-5.3	0.46-1.4	0.14-0.8	0.03-0.34	-

Mean sizes: A=50% efficiency point[b]; B=Number median diameter calculated for spheres[c]; C=Number median diameter observed for irregular shaped particulate[c].

	A	B	C	A	B	C	A	B	C	A	B	C	B
1	11.	20.	26.	3.7	6.1	5.8	1.6	2.1	2.4	0.52	0.75	0.98	0.22
2.6	7.0	13.	16.	2.3	3.8	3.6	0.99	1.3	1.5	0.32	0.47	0.61	0.14
5	5.0	9.1	11.	1.7	2.7	2.6	0.72	0.99	1.1	0.23	0.34	0.44	0.10
7	4.3	7.7	9.6	1.4	2.3	2.2	0.57	0.81	0.92	0.19	0.28	0.37	0.084
11.5	3.3	6.0	7.5	1.04	1.8	1.7	0.49	0.63	0.72	0.15	0.22	0.29	0.066
19	2.6	4.7	5.8	0.85	1.4	1.3	0.37	0.49	0.56	0.12	0.17	0.23	0.051
Stage constant	125	415	643	13.7	37.2	33.1	2.56	4.55	5.94	0.27	0.56	0.97	0.050

a. Mean curve for unit density obtained from experimental data for spheres of densities 1.05 to 21.4, is given in Reference 20.
b. Equals the Agreed Values for Characteristic Diameter given in Reference 20.
c. Obtained from experimental sampling of PuO_2 aerosol having number median diameter of 0.41 microns with standard deviation of 2.9. Calculated value derived from theory of Ranz and Wong as given in Reference 19.

TABLE B.3 DENSITY VALUES FOR POSTULATED COMPOSITIONS

per cent $Pu^{239}O_2$	per cent other material	density of composite
0%	100% Plutonium	-
100%	0%	11.5
23%	77% UO_2 (Double Tracks Source)	11.
0%	100% UO_2	10.9
2%	98% UO_2 (Clean Slate Number 1 Source)	10.7
23%	77% U_3O_8 (Double Tracks Source)	9.
2%	98% U_3O_8 (Clean Slate Number 1 Source)	8.4
0%	100% U_3O_8	8.3
50%	50% Soil or Aluminum	7.0
11.5%	38.5% UO_2 + 50% Soil and Aluminum	6.9
11.5%	38.5% U_3O_8 + 50% Soil and Aluminum	5.8
0%	50% U_3O_8 + 50% Soil and Aluminum	5.5
25%	75% Soil or Aluminum	4.8
5%	95% Soil or Aluminum	3.
~0%	Biotite	2.7-3.2
~0%	Aluminum	2.7
~0%	Feldspar + quartz	2.6
~0%	Kaolinite	2.2-2.6
Mixed particles with voids, hollow particles		< 11.5
Mixed particles with voids, predominantly soil		< 2.6

TABLE B.4 ACTIVITIES OF SPHERES OF $Pu^{239}O_2$

Diameter of Sphere	Theoretical Activity[a]
microns	disintegrations/minute
0.01	0.000007
0.03	0.00002
0.05	0.00009
0.07	0.00034
0.1	0.00074
0.14	0.0020
0.21	0.0067
0.28	0.016
0.43	0.080
0.56	0.13
0.85	0.45
1.0	0.74
1.1	0.98
1.6	3.0
2.2	7.9
3.1	22.
4.5	67.

Self absorption becomes important for larger sizes.

a. Self absorption neglected. Based on 5.6×10^{-12} curie/gram, Roller Coaster source plutonium was 6.6 curie/gram.

Isotopes, Inc.

Particulate Sample
HISTORY SHEET NO. 1
Initial Handling

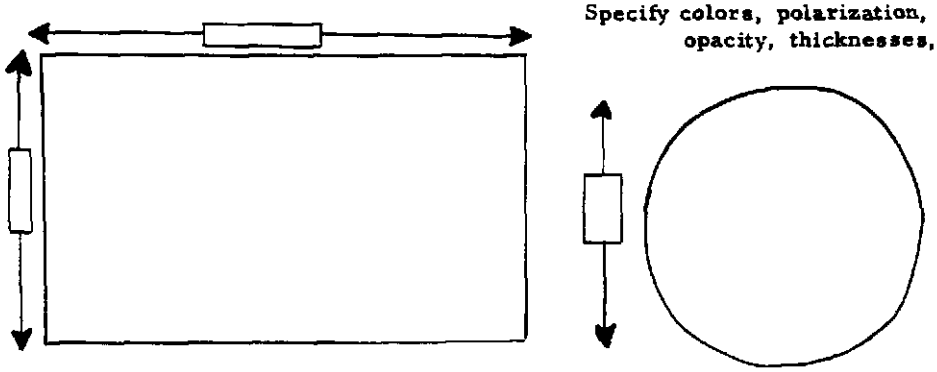
Project _____
Sample No. _____
Location _____
Lab Control No. _____

Date Shipped to I. I. _____
Carrier and Handling _____
Date received at I. I. _____
Condition of Package _____
Radiation Survey: Package Surface _____ ; Inside _____
Initial Storage _____

Date Opened: _____ ☐ Glove box ☐ Clean room

LOW POWER MICROSCOPE EXAMINATION:

Sketch accurately
Record dimensions, areas
Specify colors, polarization, flourescence, opacity, thicknesses, splits



Comments: _____

Staple Negative Here

Cover _____

Sample _____

INITIAL ACTIVITY COUNT: _____

Storage Area _____

Figure B.1 Sample History Sheet No. 1.

TABLE CLASSIFICATION OF PARTICLES WITH PROJECTED AREA EQUIVALENT DIAMETER MICRON

Sample Description: Event_____Tracerlab No._____Type_____Stage No._____
Location_____% Sample Area Measured_____Autoradiographic Exposure_____Min.

Comments:_____

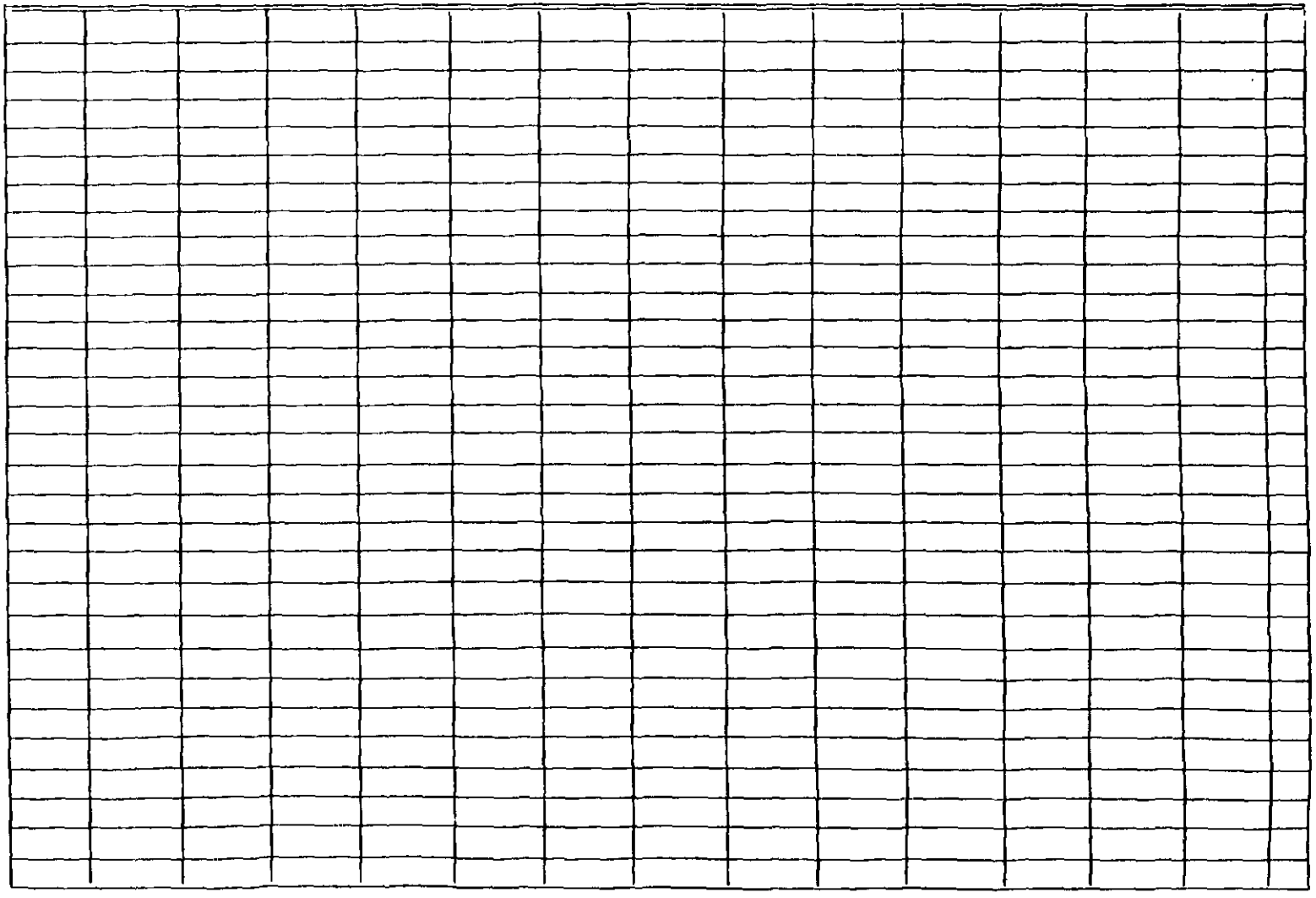


Figure B.2 Microscope readout data sheet.

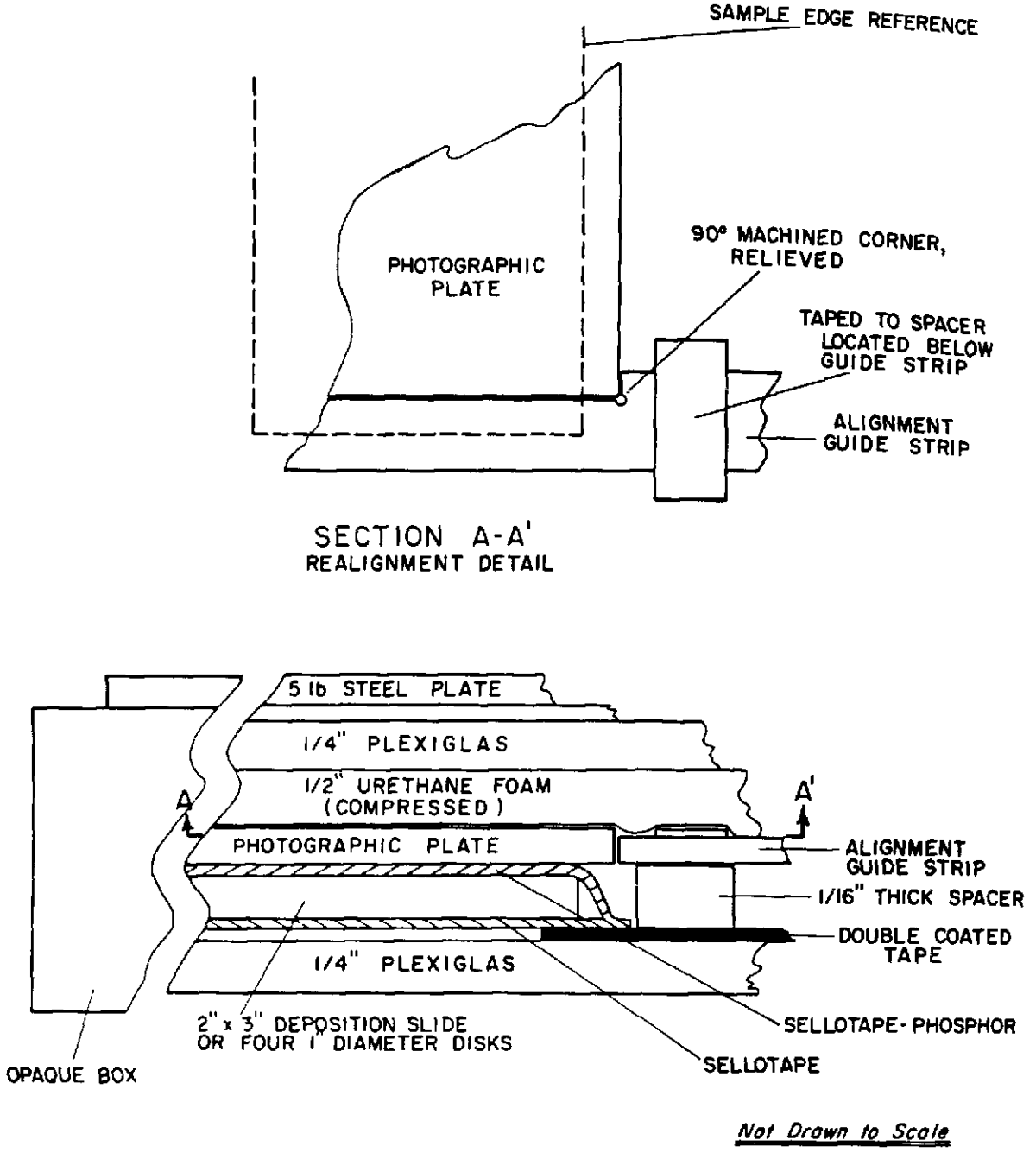


Figure B.3 Phosphor autoradiography exposure fixture detail.

FIVE COLUMNS WERE USED TO RECORD THE FOLLOWING DATA FOR EACH PARTICLE SIZE CLASS

COLUMN 1

Particle Shape Classification

S = spherical

O = ovoid

I = irregular

$A_{(i)}$ = agglomerate of i particles

COLUMN 2

Particle Color in Transmitted Light and Reflected Light

Transmitted	Reflected
O = opaque	M = multi
Cl = clear	W = white
B = blue	B = blue
Br = brown	Br = brown
Y = yellow	Bk = black
S = straw	Y = yellow
A = amber	C = copper
R = red	R = red
G = green	G = green
Gy = gray	

COLUMN 3

Particle Surface Texture

S = smooth

W = wrinkled

I = irregular

COLUMN 4

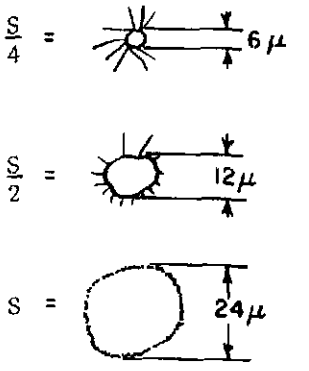
Sketch of Particle Appearance

COLUMN 5

Number of Alpha Tracks

Count quadrant and multiply by four. If less than .15 tracks per quadrant count all tracks.

For >100 tracks estimate and classify image as:



EXAMPLE: O^{O}/Bk W● 75 interprets an oval shaped particle, opaque by transmitted light, black by reflected light, with wrinkled surface, which produced 75 alpha tracks.

Figure B 4 Guide to reporting microscope data.

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