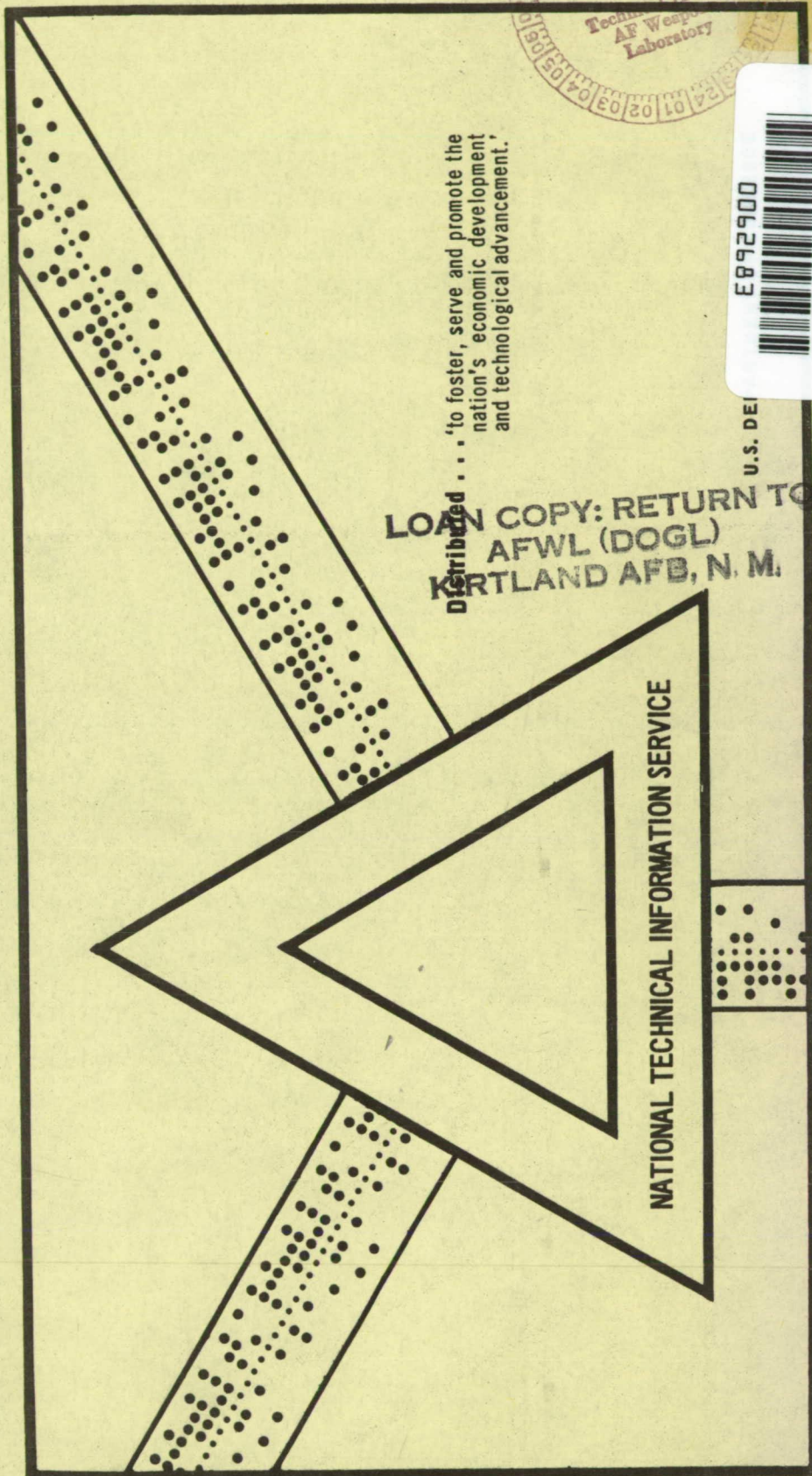


N71-10042

SIMULTANEOUS MEASUREMENT OF ATMOSPHERIC DUST BY LASER
AND BALLOON SOUNDING TECHNIQUES

University of Wyoming



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DEPARTMENT OF PHYSICS

✓ Progress Report
NASA Grant NGR 51-001-019

Simultaneous Measurement of
Atmospheric Dust by Laser
and Balloon Sounding Techniques



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I. INTRODUCTION

This is a final report covering the period of November 1, 1968 to June 30, 1970, during which the Atmospheric Physics Laboratory operated under Grant NGR 51-001-019, supplement 1, plus one three month extension. In addition to the major financial assistance of the National Aeronautics and Space Administration, the research also received material support from the University of Wyoming.

The major goal of the research was to develop a better understanding of atmospheric aerosols and study them relative to atmospheric phenomena such as clear air turbulence. The relation between the aerosol concentration and optical properties of the atmosphere were studied in a series of four simultaneous laser back scatter and dust soundings from Wallops Island, Virginia.

The secondary goal of the research was to develop a small compact aerosol sounding device primarily for balloon-borne measurements. Two types of detectors were developed and tested.

II. FIRST SIMULTANEOUS BASES AND AEROSOL SOUNDINGS

The initial research was concerned primarily with obtaining two successful aerosol soundings during the time laser back scatter measurements were being made. The first successful sounding was made in March of 1969 and the results have been presented in another report. However, the complete tabulated data is also presented in Appendix I. During both soundings the instruments functioned normally and there is no reason to doubt the validity of the data.

These two aerosol soundings represent the first attempts ever made to quantitatively determine the relation between the laser back scatter signal and the dust concentration. A comparison of the results will provide a valuable and difficult to obtain inter-calibration between the two sounding methods.

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III. RESULTS OF THE FIRST TWO SOUNDINGS

A relatively detailed analysis of the first flight has already been presented in an earlier progress report. A preliminary comparison between the aerosol sounding and the laser back scatter results indicated good correlation. However a rigorous and quantitative comparison of the results has not yet been made.

During the time of the aerosol sounding, an aircraft was flying in the area searching for clear air turbulence. On this particular occasion no significant turbulence was encountered. Unfortunately, therefore, nothing can be said concerning the relationship of clear air turbulence to the aerosol concentration.

The results of the second dust sounding have been presented in another progress report, but a detailed analysis was not made. Since the results of the related laser back scatter measurements are not yet available, a more detailed discussion at this time is not possible.

IV. DEVELOPMENT OF NEW DETECTORS

The original dust particle counters were large, cumbersome and weighed about 80 pounds. No attempt had ever been made to reduce their size and weight. Some research on improving the detector configuration therefore seemed justified.

The first effort was to construct a dust detector consisting of two-six pound units, because such a configuration is not subject to any balloon flight regulations whatsoever. For a period of six months an attempt was made to develop a small scattering chamber that would not have excessive background light problems. This effort was not successful and finally had to be abandoned. No scattering chamber tested equalled the performance of the one already in use.

A new direction in the research was initiated and an effort was made to reduce the weight of the original particle counter as much as possible without changing the geometry of the scattering chamber. This approach proved more successful.

It was at first believed that a photometer method of measuring the dust concentration rather than a particle counting method would result in a lighter weight

package. This method employs only one photomultiplier and measures the integrated light scattered from the sensitive sampling volume. By alternating clean air with ambient air in the sensitive volume the device will measure molecular scattering alternating with total scattering. A detailed description of the operation of this instrument is given in Appendix II. The final weight of the instrument including enough batteries for six hours of operations was reduced to 23 pounds. By using smaller batteries and improving on the packaging of the electronics, the weight could possibly be reduced to about 19 pounds.

The instrument is small enough to fly on a 7,000 gm rubber balloon and can achieve an altitude of about 100,000 feet. The complications and expense of using a plastic balloon can therefore be eliminated.

An effort was also made to reduce the size and weight of the particle counter type aerosol detector. The result was a 24 pound package capable of sensing two size ranges of particles and also capable of measuring ambient temperature, ozone and pressure. A more detailed account of the configuration of this package is presented in Appendix III.

The types of measurements made with the photometer and particle counter are fundamentally different. The photometer measures the total light scattered from the sensitive volume; this signal is proportional to the product of the number concentration and the scattering crosssection. The dust counter, on the other hand, is sensitive to the ambient dust concentration and the corresponding size distribution. Thus, in regions of the atmosphere where the two types of detectors do not show agreement the light scattering properties are determined primarily by aerosols not in the sensitivity range of the particle counter.

Comparison of the particle counter and the dust photometer:

The two types of aerosol detectors were field tested on consecutive soundings the evening of April 16, 1970 at Wallops Island, Virginia. The particle counter was launched at 8:20 p.m. local time and the dust photometer was launched at 11:30 p.m. The complete results of these soundings are presented in Appendix I.

There are several unusual features of the dust concentration profile worth noting:

1. A rather well-pronounced dust layer is evident at 5 km in the profile of .25 micron diameter dust. This layer is completely missing in the profile for .40 microns diameter dust. Thus the dust at this altitude is on

the average very small and has a very steep size distribution between .25 and .40 microns. If the counter was not sensitive to particles smaller than .40 microns diameter, the 5 km layer would have gone undetected. This is a good example of why it is necessary for the particle counter to be quite sensitive.

2. The dust between the tropopause and 16 km does not have the attributes of normal stratospheric dust. The size distribution is much too steep and the concentration is not correlated with the ozone layer found in this region.

3. A well-pronounced second tropopause occurs at 17 km and is certainly associated with the advection of tropical air.

4. The dust immediately above the second tropopause has a concentration and size distribution typical of that of the stratosphere. The profile itself is very similar to that found in tropical regions.

The profile obtained with the dust photometer is very similar to that obtained with the particle counter. The 5 km layer is present in the photometer sounding and indicates that this is a scattering layer made up of particles smaller than .40 microns diameter. There is an indication of a dust layer at 13 km that would correspond to the ozone layer observed at this altitude four hours earlier. It should be noted that there is no indication of a layer at 13 km in the dust concentration profile. The general overall agreement between the two types of soundings indicates that the scattering profile is similar to the profile for submicron dust particles. These results imply that particles smaller than .1 micron diameter do not play a dominant roll in the optical properties of the atmosphere.

Direction of Future Research

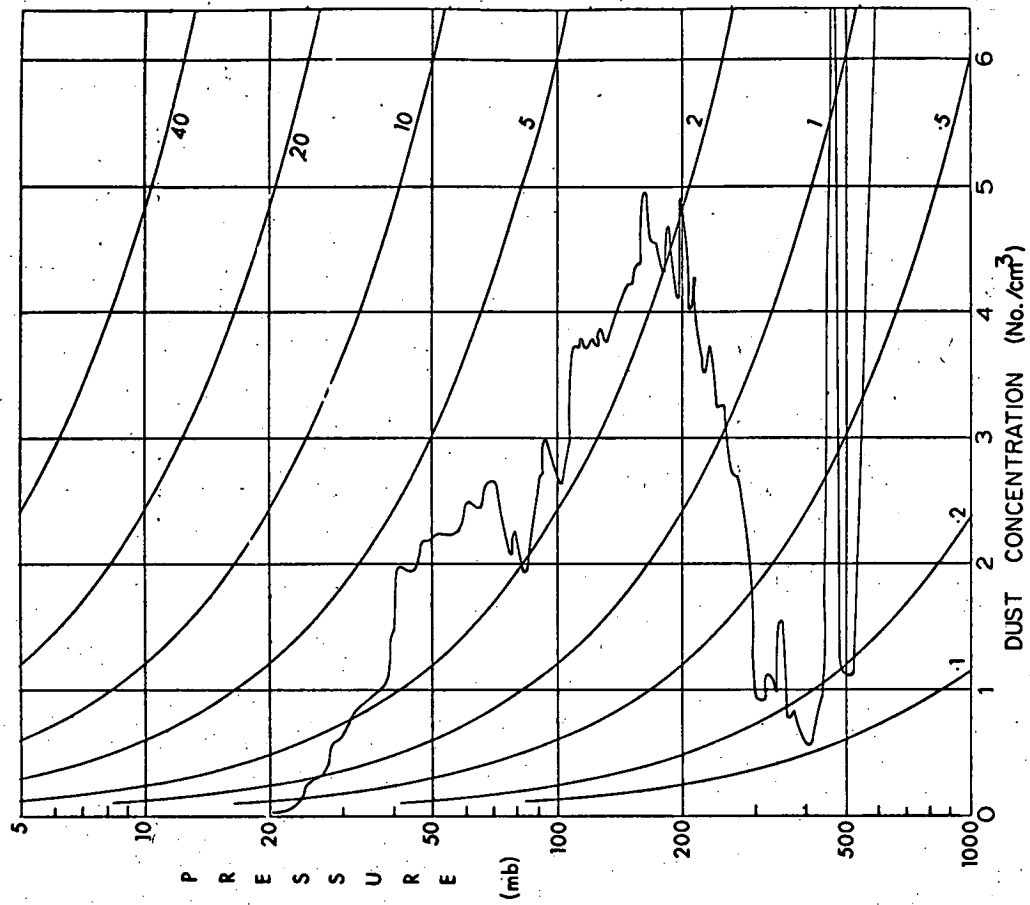
Although useful tools and techniques have been developed during the course of this research, there was not enough time to adequately study certain atmospheric phenomena, such as the relation of clear air turbulence to the aerosol structure. Now that a small balloon-borne aerosol sampler has been developed, more time can be spent obtaining data rather than improving instrumentation.

Some effort could be made to obtain a better size distribution of stratospheric dust by increasing the number of channels in the pulse height analyzer. At present the size distribution of high altitude dust is not well known, but it is crucial to a quantitative understanding of the relation between the atmospheric optical properties and the aerosol concentration.

The variation of atmospheric dust with latitude is poorly understood and should be given some consideration. The newly developed particle counter could easily be flown at higher and lower latitudes to determine whether or not the dust profiles at these latitudes are extremely different from those at mid-latitude.

APPENDIX I

Complete Set of Graphical
and Tabulated Data



The ascent dust concentration for particles .20 microns diameter and larger.

1969 March 22

DUST CHANNEL I

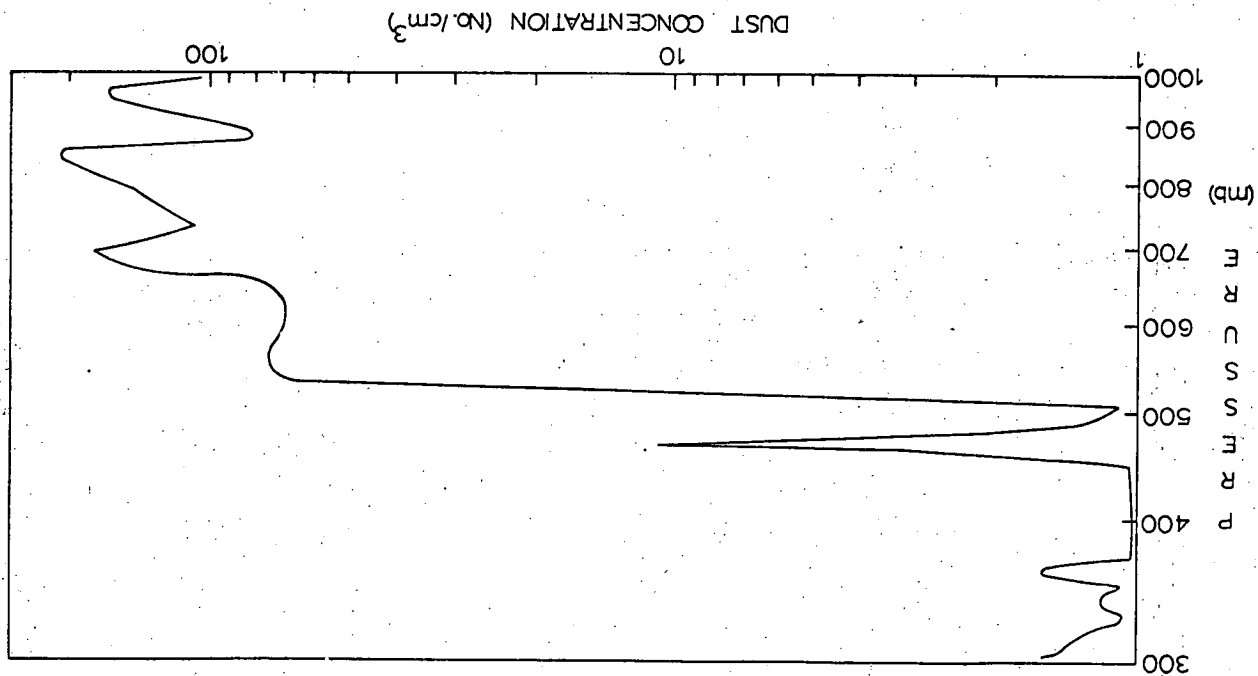
ASCENT

1969 March 22

Wallops Island, Virginia

Diam. $\geq$ 20 microns

No/cm ³	Press. (m _b)	Alt. (km)	No/cm ³	Press. (m _b)	Alt. (km)	No/cm ³	Press. (m _b)	Alt. (km)
105.00	985	0.10	1.35	332	8.25	4.35	158.0	13.00
173.00	960	0.26	0.92	321	8.50	4.35	155.0	13.12
155.00	930	0.50	0.88	310	8.72	4.20	151.0	13.22
124.00	910	0.70	1.40	300	8.92	4.20	148.0	13.40
92.00	892	0.94	2.12	290	9.15	4.10	145.0	13.55
79.00	870	1.18	2.46	280	9.35	4.00	141.0	13.68
215.00	845	1.44	2.70	273	9.55	3.90	137.0	13.85
195.00	815	1.72	2.72	265	9.70	3.80	134.0	14.00
146.00	780	2.04	3.15	258	9.88	3.70	131.0	14.15
122.00	748	2.32	3.28	251	10.08	3.90	127.0	14.30
107.00	720	2.66	3.10	245	10.22	3.70	124.0	14.50
181.00	691	2.95	3.58	239	10.40	3.77	121.0	14.65
155.00	668	3.24	3.84	233	10.52	3.70	118.0	14.80
76.00	642	3.55	3.43	229	10.68	3.80	115.0	14.95
68.00	615	3.90	3.65	223	10.82	3.70	112.0	15.15
71.00	590	4.20	3.86	219	10.92	3.70	109.0	15.30
74.00	570	4.50	3.90	214	11.10	3.05	107.0	15.50
75.00	548	4.80	4.40	212	11.15	2.70	105.0	15.62
69.00	528	5.08	3.95	208	11.26	2.70	103.0	15.72
1.07	501	5.42	4.50	204	11.40	2.60	102.0	15.82
1.38	484	5.65	5.00	201	11.50	2.70	99.0	15.96
2.12	475	5.80	4.15	198	11.60	2.90	97.5	16.08
2.90	465	5.90	4.05	194	11.72	2.90	95.2	16.18
10.80	462	5.99	4.30	190	11.82	3.00	94.0	16.30
3.10	457	6.01	4.50	186	11.95	3.00	92.8	16.38
1.27	448	6.18	4.70	183	12.08	2.70	91.2	16.50
0.44	422	6.42	4.50	181	12.16	2.50	89.5	16.63
0.44	411	6.80	4.30	176	12.30	2.37	87.9	16.73
0.64	391	7.12	4.55	173	12.41	2.05	85.5	16.88
0.85	376	7.40	4.55	170	12.50	1.94	84.9	16.95
0.76	362	7.68	4.55	167	12.61	1.87	82.5	17.10
1.60	353	7.86	5.00	164	12.75	2.24	80.5	17.30
0.80	345	8.00	4.95	161	12.85	2.24	78.9	17.45



The vertical profile of the dust concentration near the surface of the earth on ascent.

1969 March 22

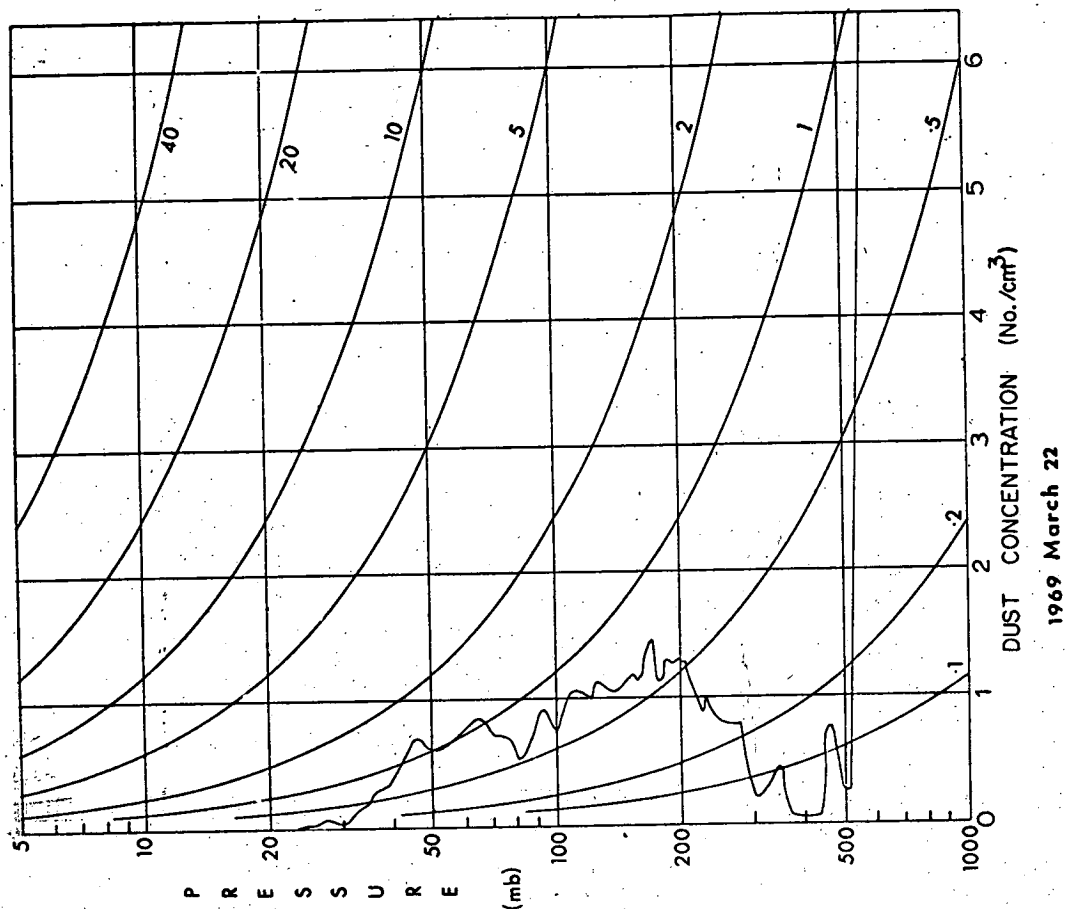
DUST CHANNEL 1 (continued)

ASCENT

1969 March 22

Mallopos Island, Virginia

No./cm ³	Pressure (mb)	Alt. (km)	No./cm ³	Pressure (mb)	Alt. (km)
2.00	77.0	17.60	1.95	42.1	21.26
2.24	76.0	17.67	1.37	41.7	21.45
2.30	74.2	17.80	1.42	40.2	21.70
2.50	72.8	17.96	1.00	38.5	21.95
2.70	71.0	18.08	1.00	36.6	22.25
2.60	69.5	18.21	0.91	34.7	22.62
2.65	68.6	18.34	0.82	32.5	23.00
2.60	67.1	18.46	0.59	30.0	23.50
2.50	65.5	18.62	0.45	28.4	23.84
2.40	64.1	18.75	0.30	26.7	24.30
2.45	62.4	18.92	0.23	25.8	24.55
2.45	61.4	19.02	0.05	23.0	25.45
2.45	60.1	19.15	0.03	20.3	26.28
2.30	58.2	19.30			
2.24	57.5	19.45			
2.24	55.8	19.60			
2.20	59.6	19.78			
2.25	53.1	19.92			
2.20	52.1	20.06			
2.20	50.5	20.25			
2.15	50.0	20.38			
2.15	48.5	20.55			
2.15	47.4	20.66			
2.05	46.0	20.84			
1.90	45.0	21.00			
1.90	43.7	21.18			



The ascent dust concentration for particles .80 microns and larger.

DUST CHANNEL II

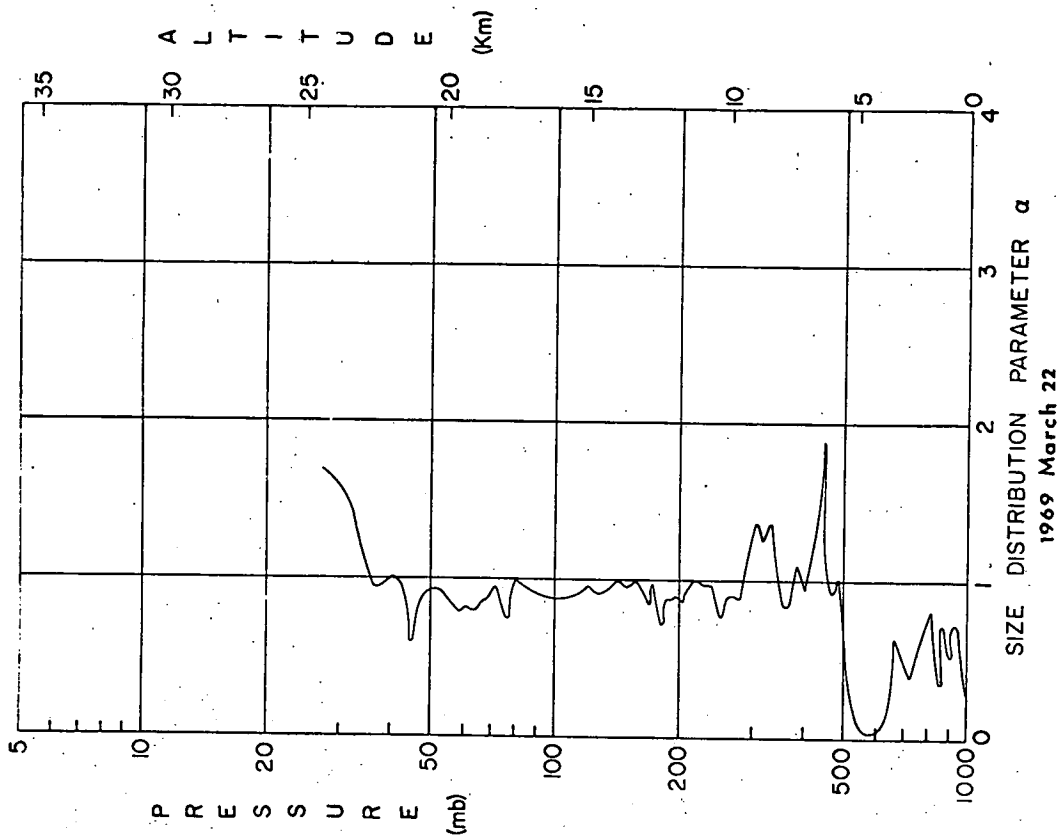
ASCENT

1969 March 22

Wallops Island, Virginia

Diam. $\geq .80$ microns

No./cm ³	Press. (m _b)	Alt. (km)	No./cm ³	Press. (m _b)	Alt. (km)	No./cm ³	Press. (m _b)	Alt. (km)
113.0	970	0.16	0.764	265.0	9.70	0.790	59.0	19.25
61.0	951	0.35	0.860	252.0	10.06	0.641	55.5	19.68
56.2	927	0.60	0.907	241.0	10.35	0.610	52.1	20.08
62.1	905	0.80	1.010	232.0	10.60	0.610	48.7	20.50
32.2	881	1.05	1.090	221.0	10.85	0.706	45.7	20.90
69.6	865	1.30	1.100	213.0	11.10	0.525	42.9	21.30
66.0	830	1.55	1.270	208.0	11.30	0.312	40.0	21.72
65.5	800	1.87	1.370	201.0	11.49	0.278	37.5	22.12
70.0	765	2.18	1.250	195.0	11.70	0.195	35.0	22.55
69.0	735	2.50	1.330	187.0	11.90	0.093	32.0	23.15
68.2	705	2.80	1.330	182.0	12.10	0.032	27.2	24.15
69.0	680	3.10	1.090	175.0	12.32			
71.0	652	3.40	1.470	169.0	12.52			
67.5	630	3.70	1.300	164.0	12.72			
69.6	607	4.02	1.130	158.0	12.92			
72.5	580	4.30	1.210	152.0	13.25			
72.0	561	4.60	1.060	146.0	13.50			
72.5	539	4.90	1.030	139.0	13.80			
0.2	516	5.25	1.090	133.0	14.6			
0.3	488	5.65	1.150	127.0	14.35			
0.7	470	5.88	0.990	122.0	14.62			
0.8	457	6.00	1.040	116.0	14.92			
0.8	462	5.80	1.070	110.0	15.25			
0.1	430	6.50	0.880	106.0	15.55			
0.1	410	6.80	0.785	100.0	15.95			
0.1	391	7.15	0.870	92.7	16.40			
0.3	372	7.48	0.660	87.0	16.80			
0.5	355	7.84	0.480	82.0	17.18			
0.2	336	8.18	0.726	77.0	17.60			
0.2	321	8.50	0.677	72.0	18.00			
0.2	304	8.85	0.809	67.8	18.40			
0.4	290	9.20	0.809	64.2	18.78			
0.8	278	9.40	0.791	61.0	19.06			



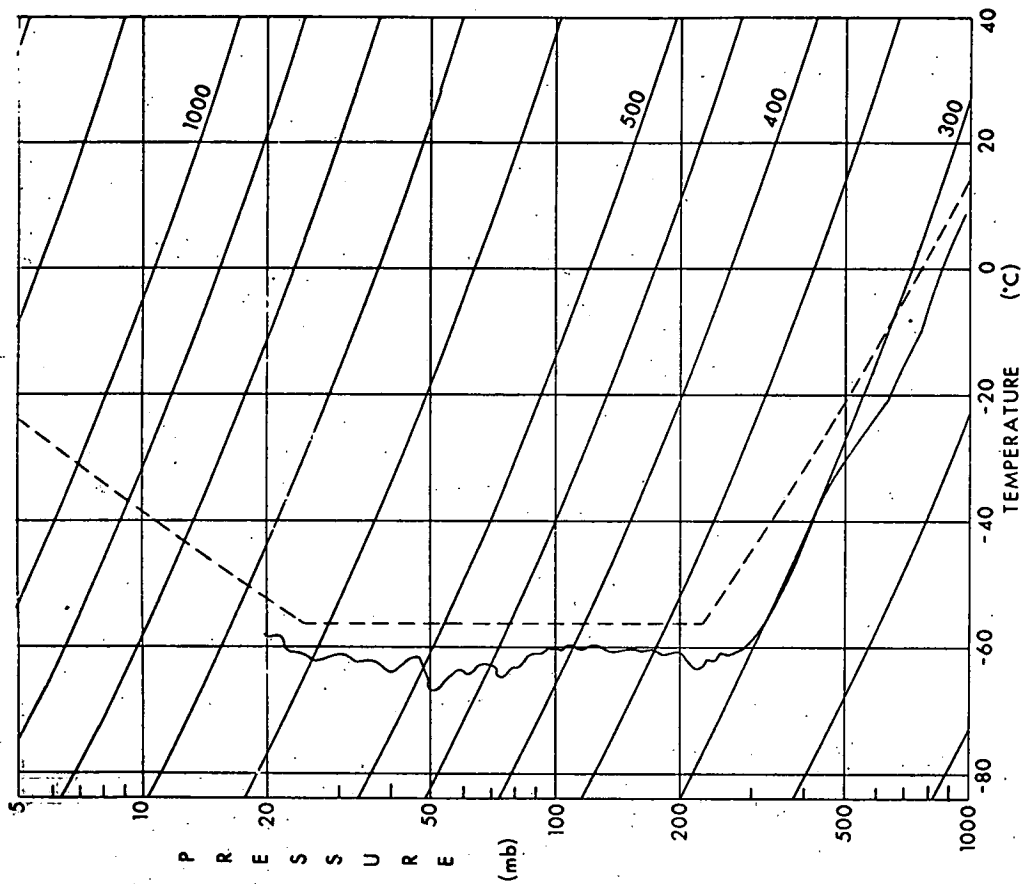
The size distribution parameter as a function of altitude on ascent.
A cumulative size distribution of the form $h(r) = r^{-a}$ has been assumed.

SIZE DISTRIBUTION -- ASCENT

1969 March 22

Wallops Island, Virginia

Size Dist. α	Press. (m_b)	Size Dist. α	Press. (m_b)	Size Dist. α	Press. (m_b)
0.260	970	0.740	252.0	0.925	52.1
0.726	951	0.956	241.0	0.910	48.7
0.710	927	0.943	232.0	0.748	45.7
0.452	905	0.891	221.0	0.926	42.9
0.700	881	0.959	213.0	1.069	40.0
0.307	865	0.816	208.0	0.924	37.5
0.816	830	0.934	201.0	1.120	35.0
0.705	800	0.852	195.0	1.537	32.0
0.466	765	0.872	187.0	1.710	27.2
0.365	735	0.897	182.0		
0.528	705	1.001	175.0		
0.636	680	0.816	169.0		
0.282	652	0.970	164.0		
0.035	630	0.971	158.0		
0.000	607	0.904	152.0		
0.000	580	0.982	146.0		
0.021	561	0.966	139.0		
0.000	537	0.891	133.0		
5.043	516	0.884	127.0		
1.033	488	0.958	122.0		
0.862	470	0.927	116.0		
0.964	457	0.896	110.0		
1.900	462	0.850	106.0		
1.340	430	0.884	100.0		
0.861	410	0.894	92.7		
1.130	391	0.885	87.0		
0.756	372	1.018	82.0		
0.791	355	0.730	77.0		
1.350	336	0.970	72.0		
1.199	321	0.850	67.8		
1.386	305	0.790	64.2		
1.087	290	0.814	61.0		
0.825	278	0.795	59.0		
0.895	265	0.904	55.5		



1969 March 22

The temperature profile on ascent. A resolution of 500 ft. was obtained.

TEMPERATURE (continued)

ASCENT

1969 March 22

Hallops Island, Virginia

Temp. °C	Temp. °C	Press. (m _b)
-61.7	-61.7	28.0
-62.6	-62.6	27.3
-62.5	-62.5	26.6
-62.5	-62.5	26.0
-61.5	-61.5	25.2
-61.5	-61.5	24.6
-61.5	-61.5	24.0
-60.5	-60.5	23.5
-61.0	-61.0	22.7
-61.0	-61.0	22.0
-60.7	-60.7	21.5
-58.7	-58.7	20.9
-58.3	-58.3	20.5
-58.7	-58.7	20.1
-58.7	-58.7	19.7

TEMPERATURE

ASCENT

1969 March 22

Hallops Island, Virginia

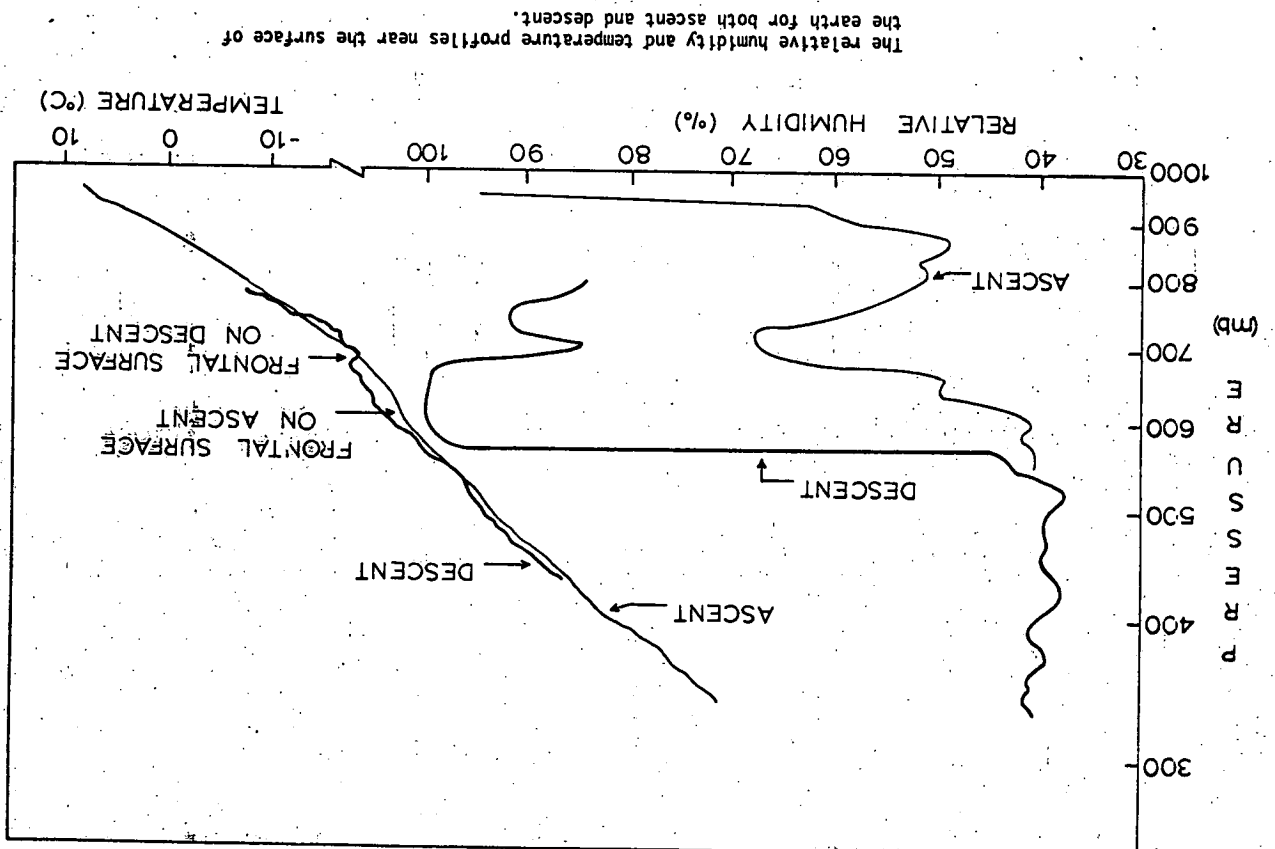
Temp. °C	Press. (m _b)	Temp. °C	Press. (m _b)	Temp. °C	Press. (m _b)	Temp. °C	Press. (m _b)
8.0	962	-28.9	531	-63.0	229.0	-62.0	85.5
7.0	950	-29.6	520	-64.0	223.0	-63.1	83.0
6.0	940	-30.6	508	-63.4	217.0	-63.5	80.2
4.0	930	-31.5	496	-62.5	210.0	-63.4	78.0
3.5	920	-33.1	485	-61.7	204.0	-69.7	76.0
2.0	908	-34.3	475	-60.5	200.0	-64.7	73.0
1.5	900	-35.2	463	-61.0	194.0	-62.6	70.6
1.0	887	-36.7	454	-62.0	189.0	-62.1	68.5
0.0	880	-37.4	444	-61.5	183.0	-62.7	66.6
-1.8	870	-38.6	434	-61.0	179.0	-63.7	64.1
-2.5	860	-39.6	424	-60.6	174.0	-64.4	62.1
-4.0	840	-41.2	412	-60.5	169.0	-64.1	60.2
-5.6	820	-42.3	404	-60.5	164.0	-63.5	58.1
-7.4	805	-44.5	396	-61.0	159.0	-64.8	56.7
-9.0	789	-46.0	386	-60.4	155.0	-65.4	54.6
-10.0	773	-48.0	377	-60.5	152.0	-66.8	52.9
-11.4	758	-48.6	368	-60.2	147.0	-67.4	51.0
-12.7	741	-50.4	358	-60.2	142.0	-66.1	49.5
-14.0	728	-52.0	350	-60.5	138.0	-63.5	48.0
-15.5	712	-53.2	341	-61.1	134.0	-61.0	46.5
-17.0	700	-54.9	332	-60.0	130.0	-61.8	45.0
-18.2	686	-56.1	325	-59.4	126.0	-62.6	43.5
-19.0	672	-57.1	316	-59.5	122.0	-63.8	42.0
-20.0	660	-58.3	308	-60.5	119.0	-64.3	40.6
-20.6	696	-58.7	300	-60.5	115.0	-64.3	39.2
-21.5	636	-59.6	292	-60.2	112.0	-62.7	38.1
-22.0	622	-60.6	285	-59.8	109.0	-61.8	36.7
-22.0	610	-61.2	276	-59.5	105.0	-61.7	35.6
-22.5	600	-61.7	268	-60.4	102.0	-62.3	34.5
-23.8	588	-61.7	262	-59.9	100.0	-62.7	33.5
-25.0	575	-61.4	255	-60.5	96.2	-62.2	32.3
-25.4	566	-62.0	248	-61.2	93.5	-61.6	31.1
-26.5	555	-62.4	240	-60.8	90.5	-61.0	30.0
-27.5	541	-62.0	235	-60.8	88.0	-61.7	29.1

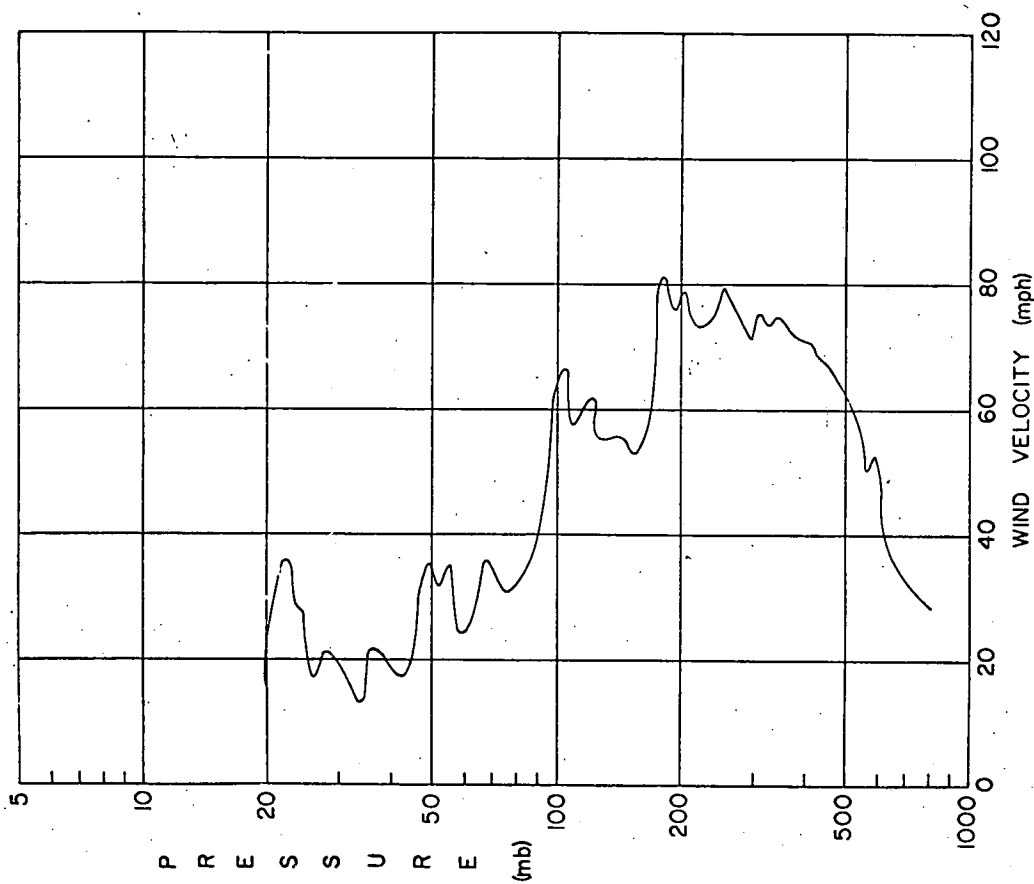
HUMIDITY ASCENT
1969 March 22
Wallops Island, Virginia

Press.
(mb)

Humidity
%

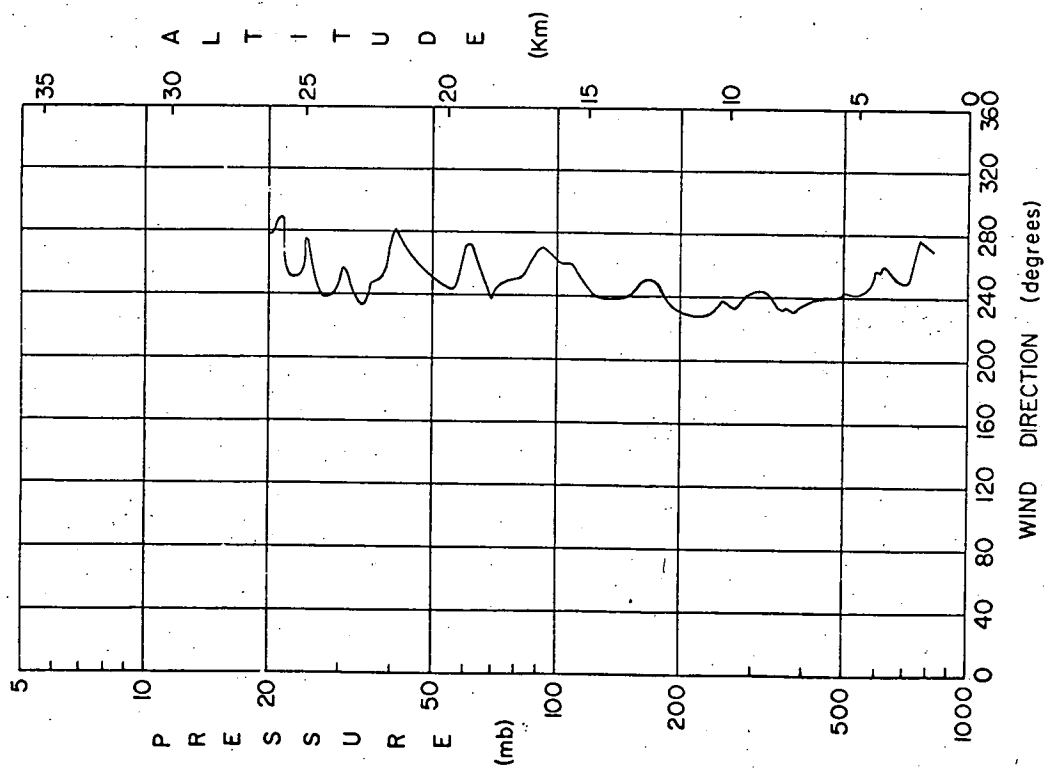
962	94.0
950	75.0
940	62.0
930	59.5
920	58.0
908	57.5
900	51.5
887	49.5
880	49.0
870	48.5
860	49.7
840	52.0
820	51.0
805	52.0
789	53.5
773	56.0
758	58.0
741	62.0
728	68.0
712	67.5
700	66.5
686	62.5
672	52.0
660	49.0
646	50.0
636	46.5
622	42.5
610	40.8
600	40.5
588	42.0
575	40.2
566	40.2
555	40.5
541	40.5





The wind speed profile on ascent as determined by radar. A resolution of about 1000 ft. was obtained.

1969 March 22



The wind direction profile on ascent as determined by radar.

1969 March 22

RADAR WIND DIRECTION (continued)

ASCENT

1969 March 22

Wallops Island, Virginia

Wind Direction (Degrees)	Alt. (km)
258	25.5776
285	25.7359
301	26.0174
285	26.1632
257	26.3968
271	26.5581
292	26.7109
279	26.8330
281	26.9461
276	27.0327
261	27.1035
262	27.1337
277	27.1474
271	27.1215

WIND DIRECTION (RADAR)

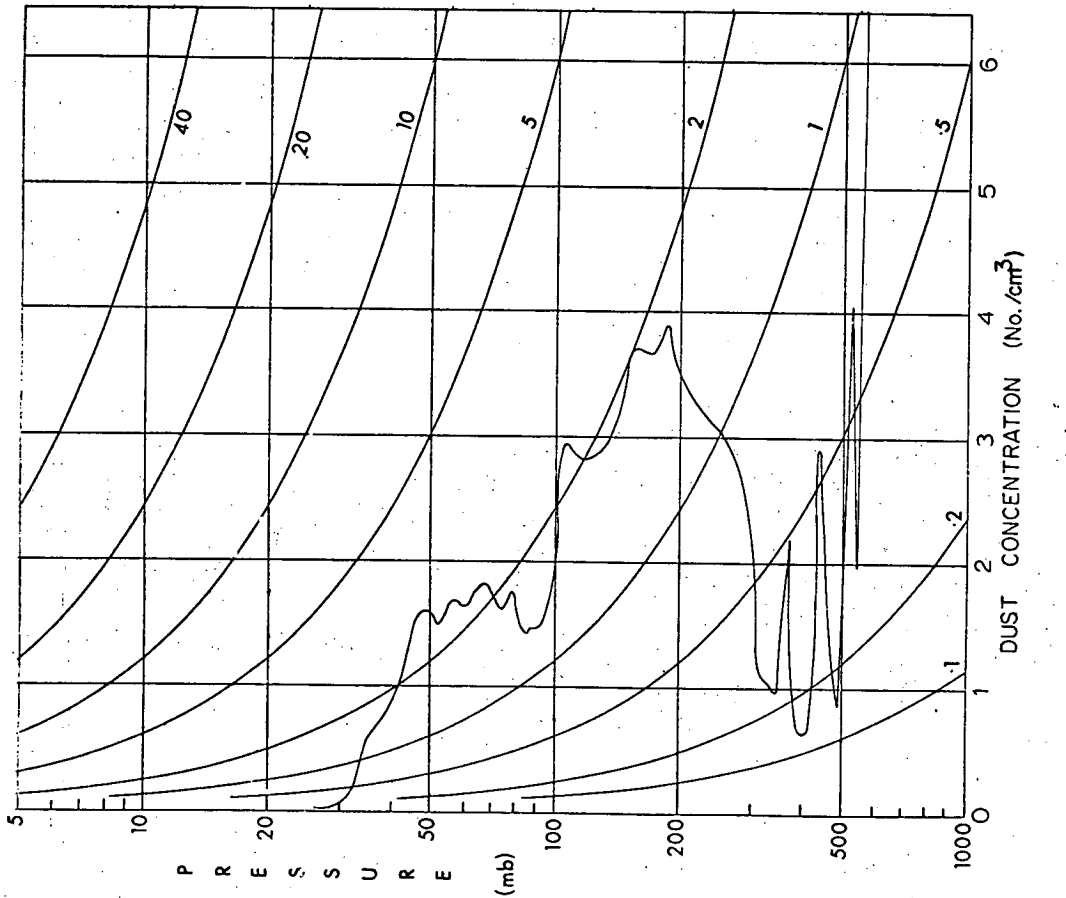
ASCENT

1969 March 22

Wallops Island, Virginia

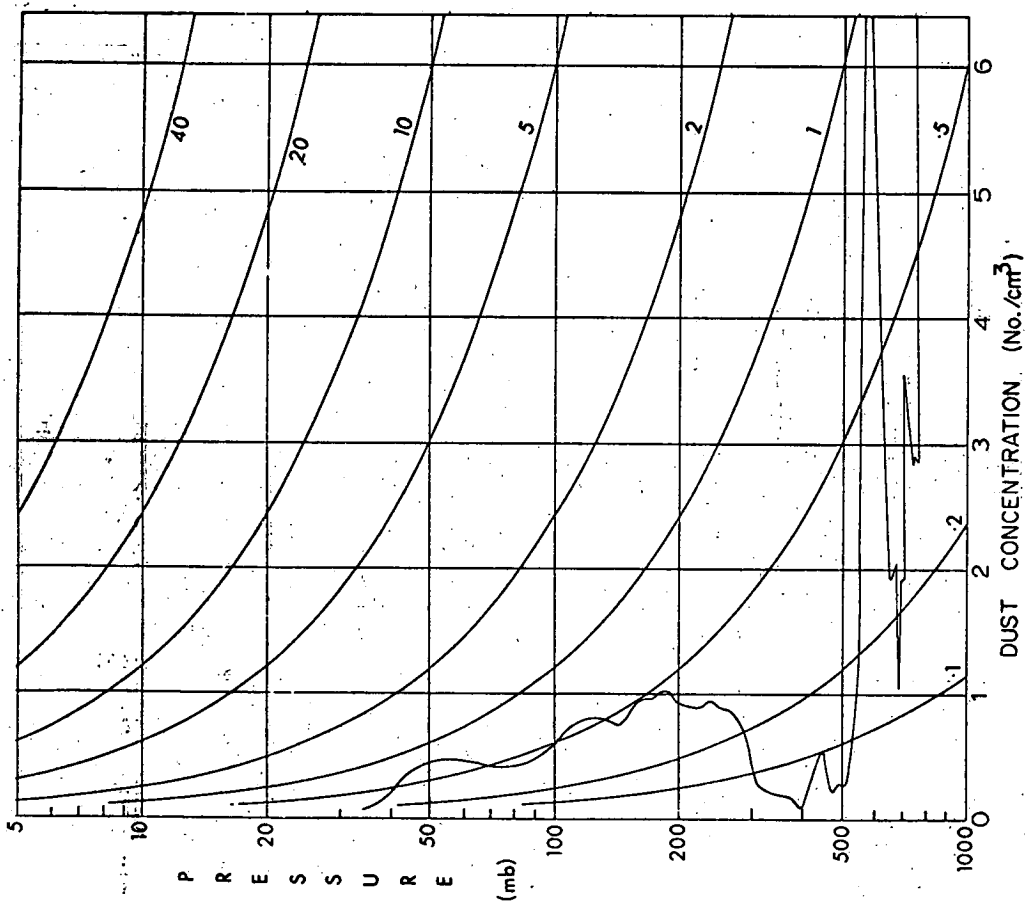
Wind Direction (Degrees)	Alt. (km)	Wind Direction (Degrees)	Alt. (km)	Wind Direction (Degrees)	Alt. (km)
254	1.5308	235	6.6533	247	12.3555
274	1.6375	235	6.8213	244	12.5204
268	1.7869	234	6.9540	252	12.6962
267	1.9669	234	7.1217	244	12.8624
264	2.1021	233	7.2931	246	13.0405
260	2.2271	233	7.4886	236	13.2220
253	2.3906	232	7.6531	235	13.4200
249	2.5657	231	7.8235	238	13.6097
245	2.7124	233	7.9943	240	13.7933
246	2.8694	237	8.1734	241	13.9885
245	3.0116	238	8.3387	239	14.1498
247	3.1829	239	8.5107	234	14.3594
246	3.3395	239	8.6848	236	14.5345
251	3.4983	238	8.8227	243	14.7272
254	3.6325	239	9.0039	253	14.8871
257	3.7841	237	9.1204	256	15.0905
253	3.9576	235	9.3165	261	15.2805
254	4.0684	233	9.4602	257	15.4808
252	4.2117	232	9.6359	262	15.6498
247	4.3544	234	9.8045	255	15.8423
244	4.5116	234	9.9885	256	16.0097
245	4.6491	233	10.1644	263	16.1784
239	4.7955	230	10.3257	273	16.3767
237	4.9456	227	10.5051	270	16.5652
236	5.1033	226	10.6796	247	16.7405
237	5.2430	225	10.8418	251	16.9656
240	5.4321	227	11.0120	253	17.1142
237	5.5702	228	11.1731	242	17.2779
235	5.7081	229	11.3045	253	17.5094
238	5.8816	228	11.4957	248	17.7366
235	6.0417	232	11.6583	240	17.9218
236	6.1777	237	11.8428	236	18.1999
237	6.3278	241	12.0136	238	18.3625
237	6.5029	244	12.1987	257	18.5607
				262	18.7505
				277	18.9719
				261	19.1403
				250	19.3714
				233	19.5547
				260	19.7368
				256	19.9299
				248	20.1608
				246	20.3874
				245	20.5319
				243	20.7522
				256	20.9748
				276	21.1267
				289	21.3531
				262	21.5272
				246	21.7169
				254	21.9203
				251	22.1073
				242	22.3177
				222	22.5186
				256	22.7051
				253	22.9646
				241	23.1635
				223	23.3431
				238	23.5505
				218	23.7286
				244	23.9525
				239	24.1672
				235	24.3622
				261	24.5583
				282	24.7986
				273	24.9731
				236	25.1948
				240	25.3470

DUST CHANNEL I
DESCENT
1969 March 22
Wallops Island, Virginia
Diam. $\geq$.20 microns



-The dust concentration on descent for particles about .20 microns diameter and larger.

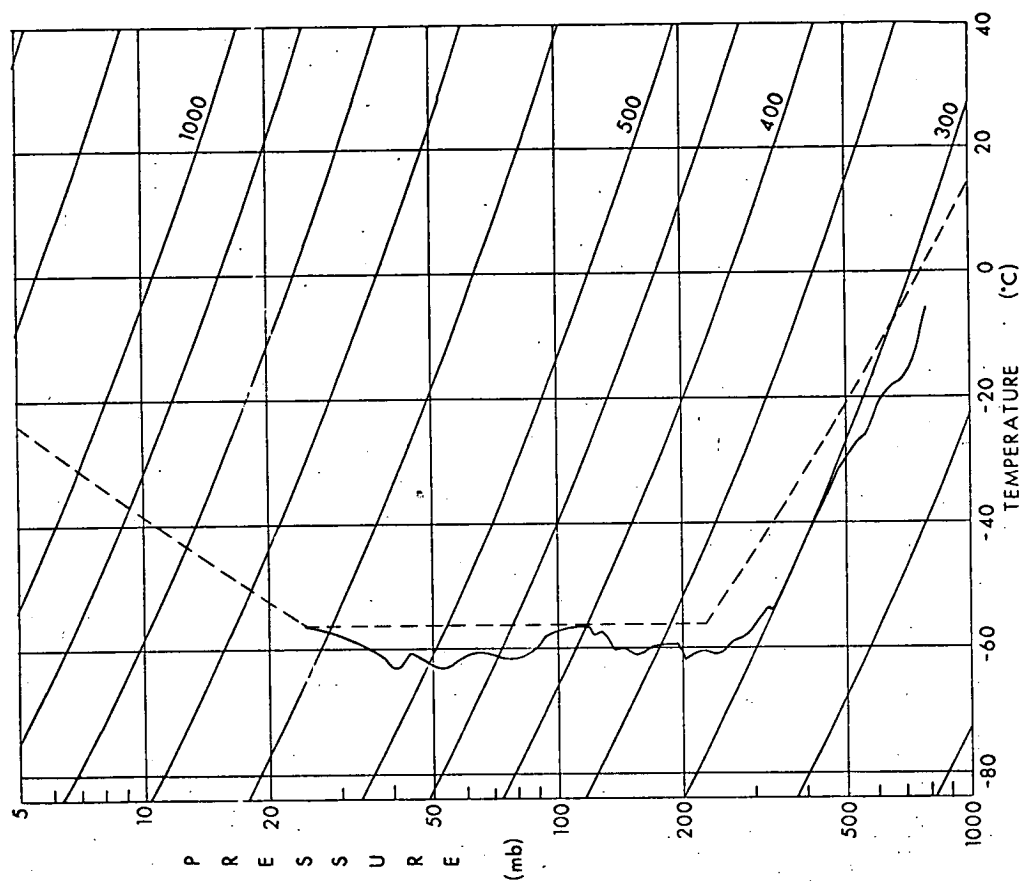
Press. (m_b)	Alt. (km)	Alt. kft	No/cm ³	Press. (m_b)	Alt. (km)	Alt. kft	No/cm ³
25.4	25.8	84.62	0.042	325	9.1	29.84	1.05
26.7	25.5	83.64	0.040	335	8.5	27.88	0.94
30.5	24.6	80.68	0.400	345	8.1	26.57	0.90
36.0	23.6	77.41	0.640	355	8.0	26.24	1.02
40.6	22.7	74.45	0.900	364	7.7	25.26	2.20
46.0	21.9	71.67	1.500	373	7.5	24.60	1.14
49.5	21.4	70.03	1.600	380	7.3	23.95	0.83
52.7	20.8	68.23	1.500	393	7.2	23.62	0.59
56.5	20.2	66.26	1.750	405	7.1	23.29	0.63
59.0	19.8	64.94	1.620	417	6.8	22.31	0.91
63.0	19.5	63.96	1.750	440	6.4	21.00	2.85
67.1	19.0	62.32	1.830	450	6.3	20.66	1.95
70.0	18.7	61.34	1.700	460	6.2	20.33	1.35
74.5	18.4	60.19	1.600	470	6.1	20.00	1.03
78.0	18.1	59.37	1.800	480	6.0	19.68	0.81
83.0	17.8	58.38	1.400	490	5.6	18.37	0.91
88.5	17.4	57.07	1.400	500	5.5	18.04	1.35
95.0	17.0	55.76	1.550	520	5.4	17.55	4.00
106.0	16.3	53.40	3.010	540	5.0	16.40	2.05
112.0	15.9	52.15	2.850	560	4.8	15.75	8.20
127.0	15.1	49.53	2.850	563	4.8	15.58	80.95
141.0	14.5	47.39	3.200	576	4.5	14.76	83.00
157.0	13.7	44.93	3.720	595	4.2	13.77	96.00
171.0	13.1	42.97	3.650	612	4.1	13.45	183.00
185.0	12.6	41.33	3.900	630	4.0	13.12	125.00
200.0	12.1	39.69	3.530	650	3.6	11.81	26.00
217.0	11.7	38.37	3.210	665	3.3	10.82	29.00
233.0	11.3	36.90	3.200	685	3.1	10.17	23.50
247.0	10.9	35.59	3.000	705	3.0	9.84	13.00
262.0	10.5	34.37	2.950	725	2.8	9.18	85.00
278.0	10.1	33.13	2.620	742	2.5	8.20	94.00
295.0	9.8	31.98	2.050	765	2.3	7.54	183.00
300.0	9.6	31.49	1.170	785	2.0	6.56	183.00
310.0	9.4	30.83	1.120				
316.0	9.3	30.44	1.100				



The dust concentration on descent for particles about .80 microns diameter and larger.

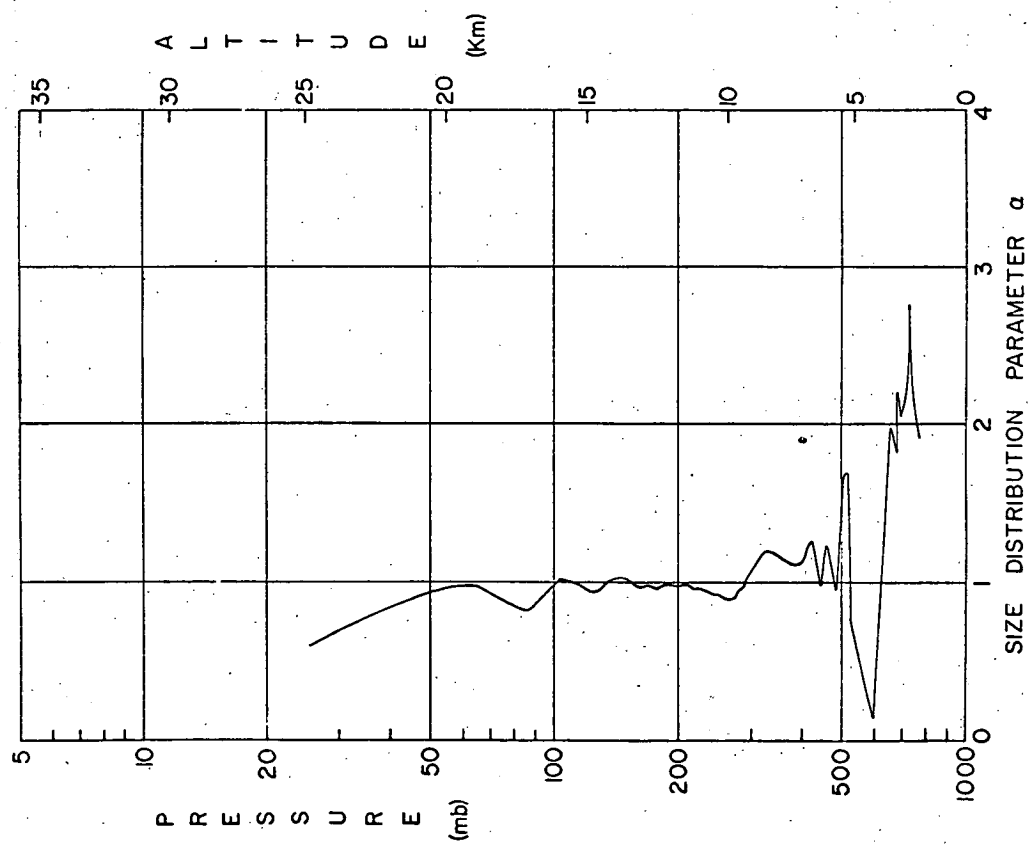
DUST CHANNEL II
DESCENT
1969 March 22
Mallops Island, Virginia
Diam. $\geq$.80 microns

No/cm ³	Press. (m _b)	No/cm ³	Press. (m _b)
0.0175	26.1	0.238	510
0.0550	34.0	0.467	520
0.4240	47.0	0.805	540
0.4130	53.0	1.02×10^2	585
0.4580	66.0	102.000	600
0.4580	86.5	159.000	621
0.5950	102.0	121.000	635
0.7110	112.0	1.810	665
0.8000	126.0	2.120	670
0.7110	143.0	2.290	675
0.9120	157.0	1.710	682
0.9900	165.0	1.020	690
0.9400	175.0	0.916	700
1.0200	183.0	1.610	710
0.9060	193.0	3.630	732
0.9140	203.0	2.800	753
0.8570	215.0	12.800	775
0.8870	227.0	1.630	800
0.9870	237.0		
0.8390	246.0		
0.8300	257.0		
0.8300	268.0		
0.6930	280.0		
0.2670	300.0		
0.1770	330.0		
0.1770	350.0		
0.1770	380.0		
0.1570	412.0		
0.3060	430.0		
0.5300	448.0		
0.1780	468.0		
0.2380	487.0		



The temperature profile on descent.

1969 March 22



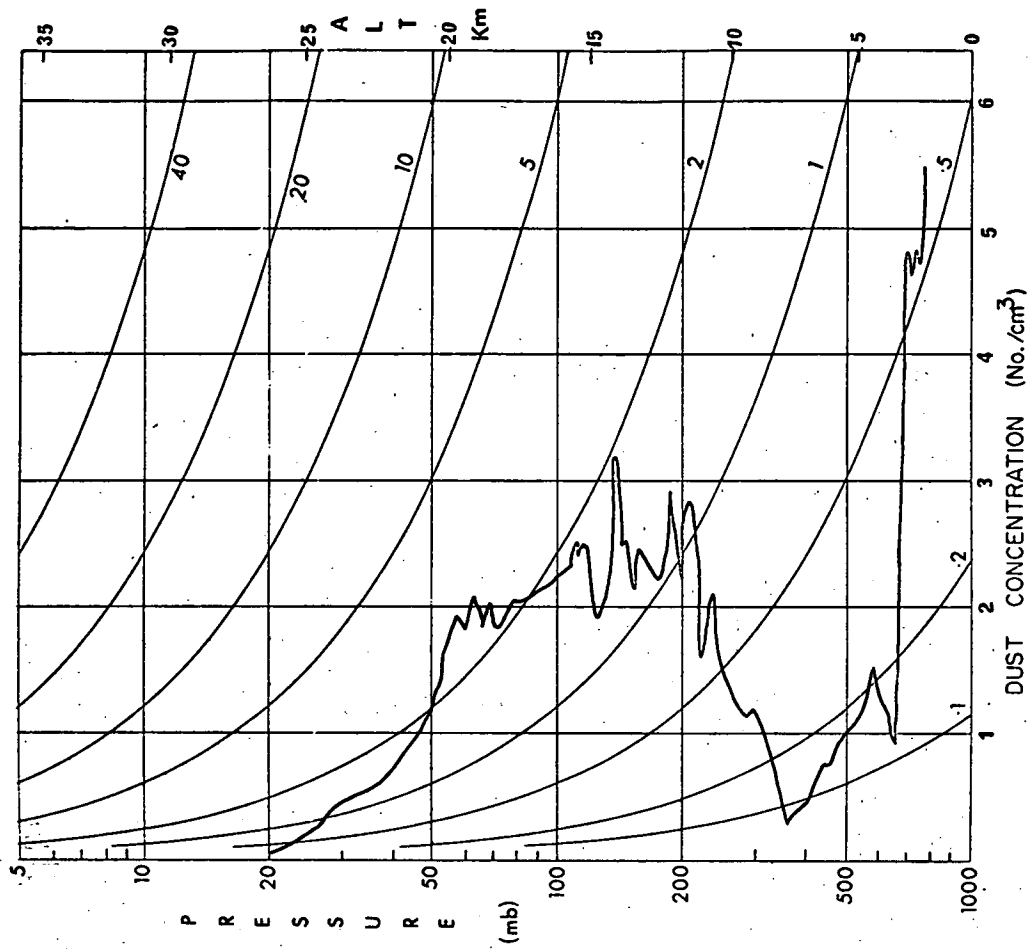
The size distribution parameter as a function of altitude on descent.

TEMPERATURE - HUMIDITY

DESCENT

1969 March 22

Wallops Island, Virginia

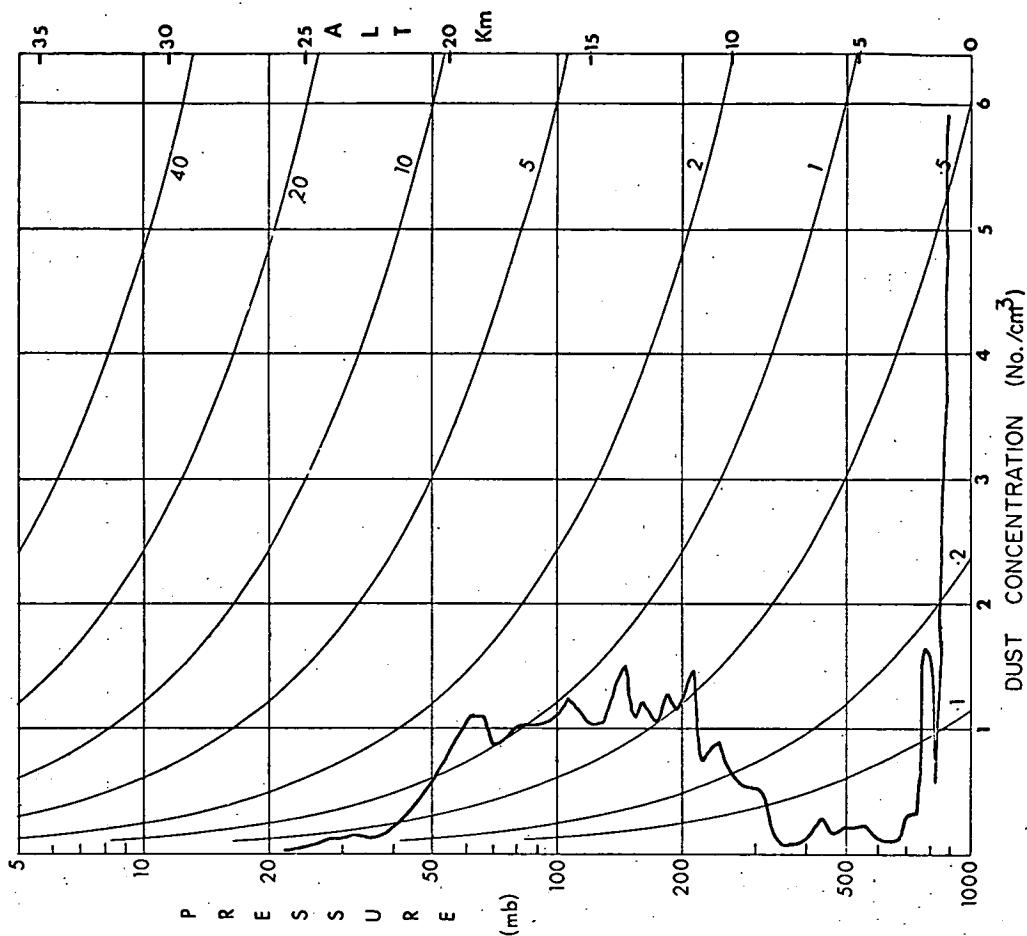


Temp. °C	Press. (mb)	Hum.	Temp. °C	Press. (mb)	Hum.	Temp. °C	Press. (mb)	Hum.
-58.4	24.7	40.0	-61.4	243	40.0	-28.1	536	42.5
-58.9	28.2	40.0	-60.8	250	39.0	-27.3	546	42.5
-59.1	31.7	41.0	-59.4	258	39.0	-26.0	556	44.0
-58.2	35.5	40.0	-58.7	264	38.0	-29.6	562	86.0
-63.5	39.8	40.5	-58.7	271	40.0	-24.3	581	100.0
-60.6	44.4	40.5	-58.5	280	38.5	-24.1	590	100.0
-63.3	49.5	40.0	-57.5	288	40.0	-22.2	600	100.0
-63.7	54.2	41.0	-57.2	296	40.0	-21.9	609	100.0
-61.7	59.6	41.5	-56.5	305	42.0	-20.9	619	100.0
-61.1	65.0	41.5	-55.7	313	41.0	-20.0	626	100.0
-61.4	70.1	40.5	-54.2	320	41.0	-19.6	636	100.0
-62.1	76.1	40.0	-54.8	328	42.0	-19.6	645	100.0
-60.9	82.6	40.0	-52.7	336	41.5	-18.9	651	100.0
-58.9	89.0	41.0	-51.6	345	41.5	-18.3	661	100.0
-57.2	96.5	40.1	-49.9	354	40.0	-18.8	675	100.0
-56.8	103.0	40.0	-49.0	364	40.0	-17.7	680	90.0
-57.4	107.0	40.0	-47.8	371	40.5	-17.7	690	87.5
-56.4	115.0	40.0	-46.7	378	42.0	-19.0	700	83.5
-58.2	122.0	40.0	-45.0	385	41.0	-16.8	710	87.0
-57.1	128.0	40.0	-44.0	393	40.0	-17.0	721	92.0
-60.2	137.0	40.1	-42.6	400	38.0	-15.6	730	92.0
-60.5	145.0	40.0	-41.6	410	38.0	-15.2	740	92.0
-61.3	154.0	40.0	-40.0	418	38.0	-13.6	750	92.0
-60.3	160.0	40.0	-39.0	431	40.0	-11.5	760	92.0
-59.9	167.0	40.0	-37.6	436	40.0	-10.0	770	87.5
-59.4	174.0	41.5	-36.6	444	40.0	-9.2	776	86.0
-59.4	182.0	40.0	-35.5	455	39.5	-8.5	790	84.0
-59.4	188.0	40.5	-34.2	463	40.0	-7.0	800	--
-59.3	196.0	40.0	-32.9	473	39.8	-6.9		
-62.0	204.0	42.5	-32.4	483	38.0			
-60.9	214.0	40.0	-30.9	493	38.0			
-60.3	221.0	40.0	-30.4	502	36.5			
-60.6	229.0	41.0	-29.1	513	38.0			
-61.3	235.0	40.0	-29.2	523	40.0			

The dust concentration on ascent for particle sizes greater than or equal to .25 microns. Wallops Island, Virginia - December 5, 1969. Launch time 01:47 GMT.

DUST SOUNDING CHAINEL I - ASCENT
 Wallops Island, Virginia
 1969 December 5
 Diam. ≥ 25 microns

Alt. (km)	No./cm ³	Alt. (km)	No./cm ³	Alt. (km)	No./cm ³
0.0	73.00	3.71	0.92	13.74	2.50
0.20	78.70	3.93	1.18	13.90	2.60
0.32	80.00	4.14	1.23	14.08	3.24
0.44	78.20	4.35	1.40	14.27	2.18
0.78	66.00	4.52	1.55	14.46	2.45
0.90	63.00	4.70	1.49	14.68	2.01
1.00	51.30	4.91	1.21	14.92	1.86
1.14	36.00	5.78	0.97	15.14	2.58
1.25	23.30	5.94	0.94	15.32	2.39
1.40	19.30	6.31	0.79	15.51	2.51
1.52	13.70	6.57	0.77	15.71	2.36
1.64	9.78	7.16	0.44	15.98	2.32
1.77	3.07	7.93	0.31	16.17	2.23
1.90	5.74	8.75	0.89	17.12	2.09
2.01	16.10	9.10	1.16	17.37	2.06
2.14	15.80	9.30	1.23	17.62	1.99
2.30	9.76	9.58	1.16	17.87	2.05
2.41	5.43	9.89	1.26	18.13	1.80
2.50	5.41	10.60	1.60	18.40	1.85
2.54	4.68	10.75	2.09	18.69	2.06
2.61	4.80	10.96	1.75	18.92	1.80
2.65	4.67	11.20	1.61	19.21	2.09
2.70	4.41	11.42	2.40	19.47	1.85
2.76	4.15	11.60	2.86	19.73	1.89
2.82	4.39	11.73	2.71	20.30	1.62
2.89	4.22	11.91	2.24	20.33	1.48
2.93	4.88	12.10	2.55	20.75	1.26
2.98	4.59	12.27	2.97	21.20	1.06
3.05	4.10	12.41	2.33	21.78	0.74
3.09	3.89	12.60	2.22	22.25	0.62
3.14	3.25	12.80	2.22	23.50	0.49
3.20	2.93	13.00	2.36	24.00	0.41
3.32	2.39	13.18	2.43	24.82	0.20
3.43	2.15	13.33	2.54	25.59	0.12
3.53	1.59	13.53	2.13	26.58	0.07



ASCENT 1969 Dec. 5

Diam ≥ 25 microns

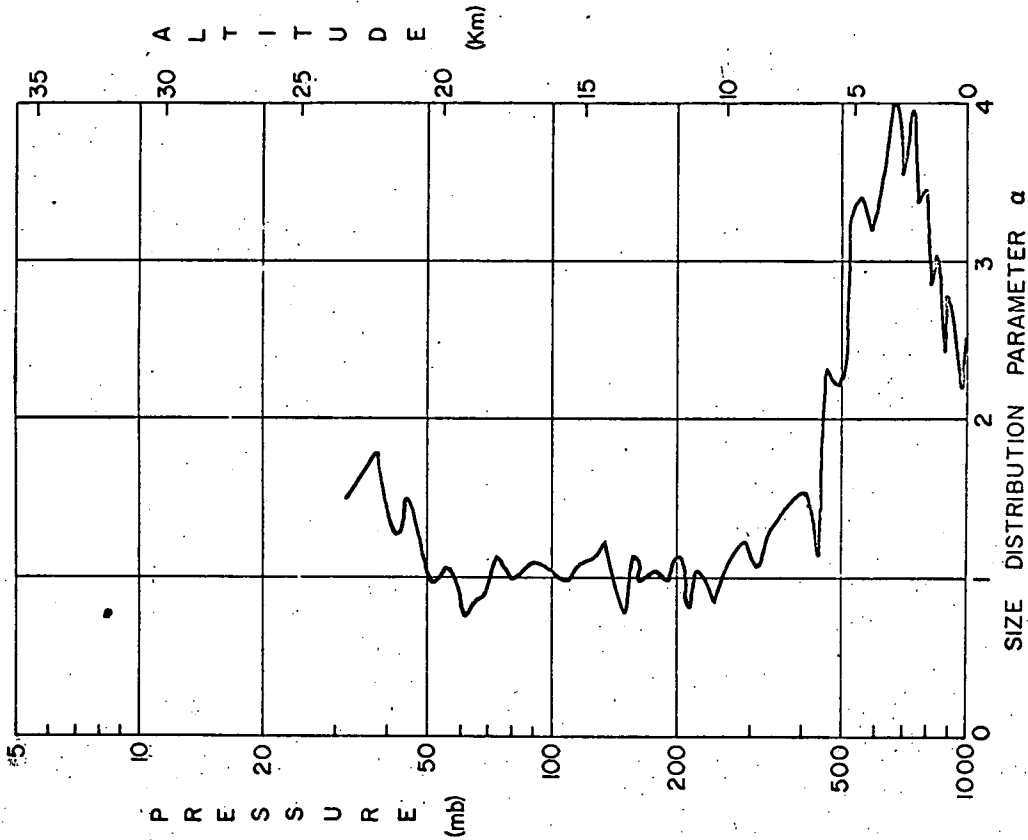
DUST SOUNDING CHANNEL 11 - ASCENT

Wallops Island, Virginia

1969 December 5

Diam $\geq$ 50 microns

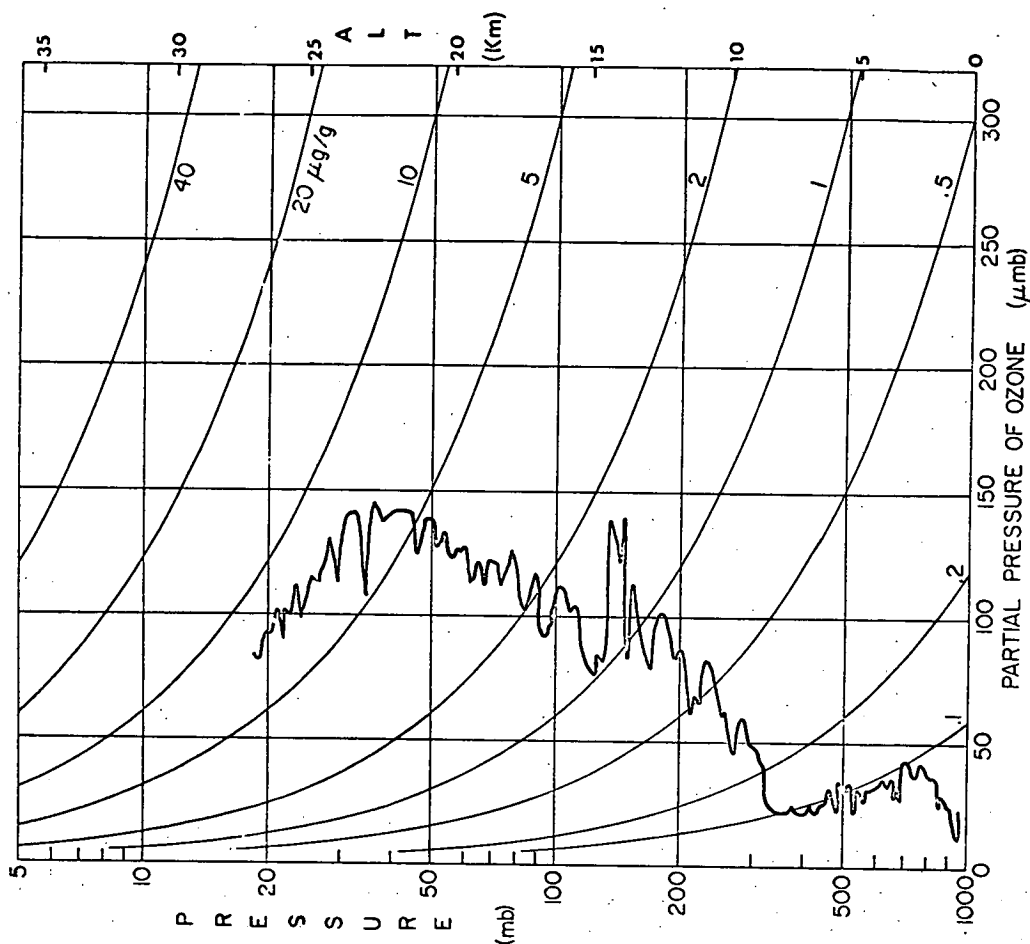
Alt. (km)	No./cm ³	Alt. (km)	No./cm ³
0.14	15.58	9.31	.544
0.26	15.89	9.73	.569
0.38	15.93	10.55	.904
0.83	11.37	10.88	.877
0.96	9.11	11.15	.798
1.07	6.88	11.48	1.510
1.13	6.50	11.67	1.350
1.19	5.49	12.00	1.174
1.27	4.12	12.32	1.311
1.31	3.28	12.70	1.094
1.42	2.37	13.10	1.240
1.49	1.84	13.46	1.109
1.61	1.34	13.81	1.570
1.80	0.59	14.17	1.320
1.99	1.55	14.58	1.021
2.08	1.66	15.01	1.091
2.22	1.43	15.42	1.166
2.37	0.58	15.86	1.224
2.60	0.36	16.12	1.129
2.85	0.36	16.90	1.004
3.08	0.32	17.71	1.037
3.23	0.20	18.26	0.862
3.62	0.11	18.86	1.114
4.40	0.16	19.40	1.114
4.80	0.24	20.00	0.862
5.70	0.22	20.67	0.668
6.15	0.18	21.47	0.357
6.52	0.33	21.90	0.267
7.10	0.16	22.50	0.175
8.03	0.09	23.50	0.184
8.78	0.37	24.25	0.132
9.00	0.51	26.00	0.008



ASCENT 1969 Dec. 5

SIZE DISTRIBUTION - ASCENT
 Wallops Island, Virginia
 1969 December 5

Alt. (km)	α	Alt. (km)	α
0.26	2.20	9.73	1.18
0.38	2.40	10.55	0.84
0.83	2.62	10.88	0.96
0.96	2.74	11.15	1.04
1.07	2.75	11.48	0.79
1.13	2.60	11.67	1.09
1.19	2.94	12.00	1.16
1.27	2.52	12.32	0.97
1.31	2.82	12.70	1.04
1.42	3.07	13.10	0.99
1.47	3.06	13.46	1.12
1.61	3.07	13.81	0.75
1.80	2.86	14.17	1.23
1.99	3.44	14.58	1.15
2.08	3.40	15.01	1.11
2.22	3.36	15.42	1.10
2.37	3.53	15.86	0.97
2.60	3.32	16.12	1.06
2.85	3.70	16.92	1.13
3.08	3.54	17.71	1.01
3.23	4.15	18.26	1.12
3.62	3.76	18.86	0.68
4.40	3.22	19.40	0.73
4.80	2.40	20.00	1.04
5.70	2.24	20.67	0.98
6.15	2.32	21.47	1.50
6.52	1.14	21.90	1.26
7.10	1.57	22.55	1.77
8.03	2.43	23.50	1.49
8.78	1.22	24.25	1.22
9.00	1.09	26.00	3.93
9.31	1.24		



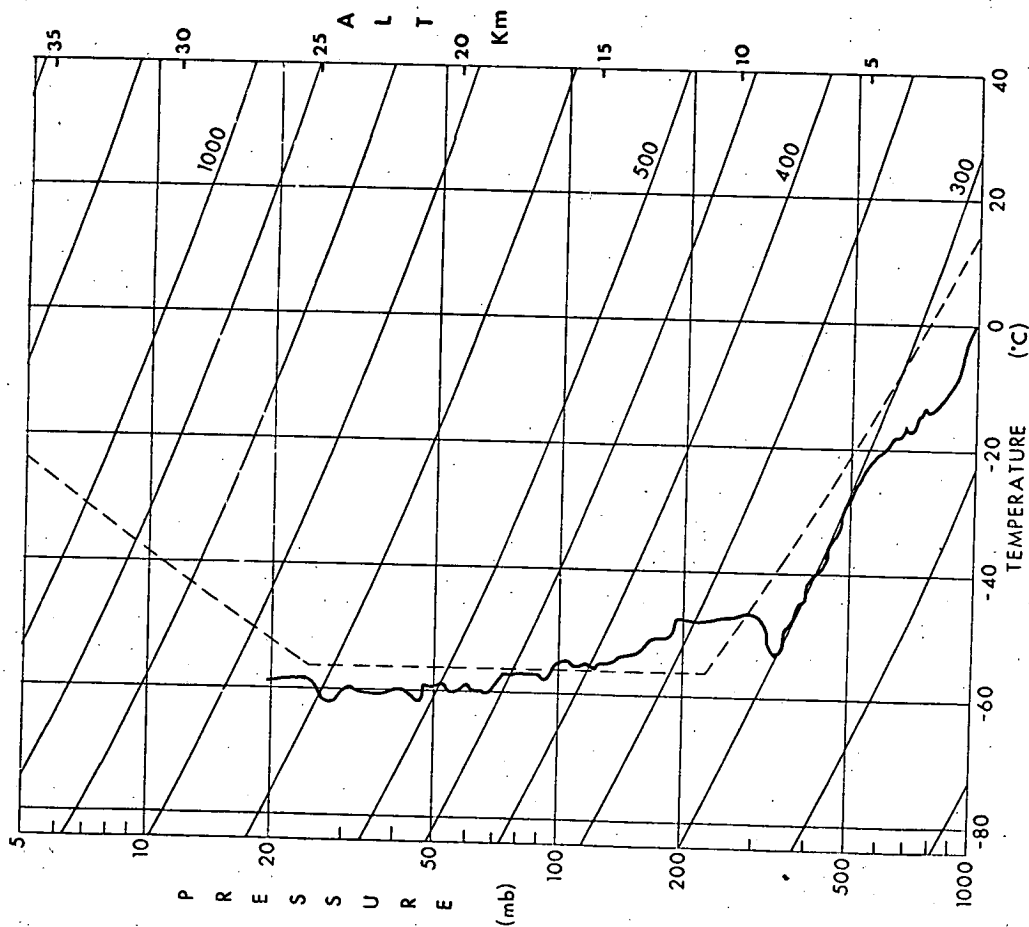
ASCENT 1969 Dec. 5

OZONE SONDE - ASCENT (continued)
 Mallops Island, Virginia
 1969 December 5

Alt. (km)	O ₃	Alt. (km)	O ₃
19.31	126	23.92	110
19.48	122	24.50	130
19.66	124	24.28	118
19.85	120	24.43	116
20.00	122	24.62	112
20.22	132	24.80	114
20.40	126	24.96	106
20.57	138	25.13	98
20.76	138	25.31	110
20.94	138	25.50	98
21.12	122	25.69	100
21.30	140	25.86	88
21.48	140	26.02	100
21.68	140	26.20	90
21.85	140	26.40	90
22.02	138	26.55	80
22.19	136	26.75	82
22.38	140		
22.55	142		
22.70	140		
22.87	106		
23.05	136		
23.23	140		
23.40	138		
23.56	138		
23.75	126		

OZONE SONDE - ASCENT
 Mallops Island, Virginia
 1969 December 5

Alt. (km)	O ₃	Alt. (km)	O ₃	Alt. (km)	O ₃
1.50	20	4.47	30	13.78	140
1.60	10	4.61	24	13.94	120
1.70	14	4.75	24	14.10	138
1.80	14	4.89	30	14.29	90
1.92	20	5.02	20	14.46	80
1.95	24	5.17	34	14.62	84
1.19	24	5.31	30	14.80	76
1.30	30	5.45	30	14.99	80
1.42	24	5.59	34	15.14	100
1.55	34	5.74	20	15.31	104
1.68	34	5.87	24	15.50	100
1.80	34	6.00	30	15.68	104
1.92	34	6.16	24	15.86	110
2.05	40	6.29	24	16.04	110
2.19	34	6.43	24	16.21	110
2.30	34	6.57	20	16.40	90
2.45	34	6.71	20	16.60	92
2.56	34	6.85	24	16.78	116
2.70	34	7.00	20	16.94	112
2.85	34	7.13	20	17.12	102
2.96	40	7.26	20	17.30	104
3.10	40	7.41	20	17.50	116
3.24	24	7.55	24	17.70	122
3.36	34	7.70	20	17.85	118
3.50	24	7.85	20	18.02	110
3.61	34	7.99	20	18.20	120
3.76	30	8.14	20	18.40	120
3.90	34	8.27	20	18.58	120
4.04	30	8.43	24	18.75	110
4.19	30	8.55	24	18.94	120
4.32	30	8.70	40	19.10	112



TEMPERATURE
ASCENT
Wallops Island, Virginia
1969 December 5

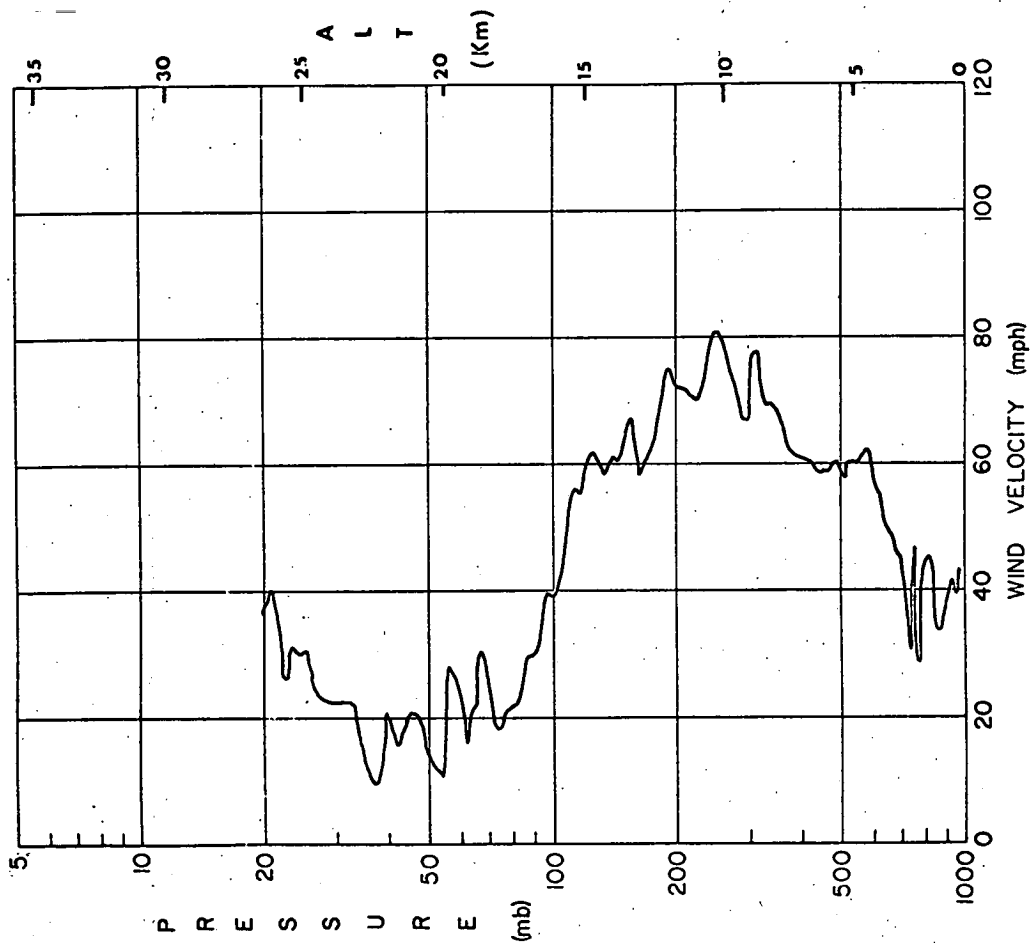
Altitude (km)	Temp.	Altitude (km)	Temp.	Altitude (km)	Temp.	Altitude (km)	Temp.	Altitude (km)	Temp.	Altitude (km)	Temp.
0.13	0.0	4.26	-19.8	8.92	-47.6	14.20	-54.3	18.30	-57.1	22.40	-60.7
0.20	-2.2	4.40	-21.0	9.06	-45.5	14.38	-54.2	18.48	-56.6	22.58	-59.5
0.30	-3.0	4.53	-21.5	9.20	-47.0	14.54	-53.4	18.67	-55.4	22.76	-58.2
0.41	-3.6	4.70	-22.5	9.34	-47.1	14.72	-54.3	18.85	-54.1	22.94	-56.9
0.52	-4.9	4.81	-23.7	9.50	-46.7	14.90	-55.0	19.02	-52.8	23.12	-55.6
0.63	-6.0	4.96	-25.0	9.63	-46.7	15.05	-54.0	19.20	-51.5	23.30	-54.3
0.74	-7.0	5.11	-25.7	9.80	-47.4	15.22	-54.0	19.38	-50.2	23.48	-53.0
0.86	-8.5	5.24	-26.6	9.91	-47.4	15.40	-54.5	19.56	-48.9	23.66	-51.7
1.00	-9.1	5.38	-27.8	10.05	-47.2	15.60	-55.6	19.74	-47.6	23.84	-50.4
1.10	-10.1	5.52	-29.0	10.22	-47.0	15.77	-55.2	19.92	-46.3	24.02	-49.1
1.24	-11.1	5.67	-30.1	10.40	-46.7	15.94	-53.7	20.10	-45.0	24.20	-47.8
1.36	-12.0	5.82	-31.2	10.54	-47.2	16.10	-54.6	20.28	-43.7	24.38	-46.5
1.50	-12.5	5.99	-32.4	10.70	-47.2	16.30	-55.0	20.46	-42.4	24.56	-45.2
1.62	-13.0	6.09	-33.5	10.86	-47.4	16.50	-56.4	20.64	-41.1	24.74	-43.9
1.74	-13.5	6.23	-34.6	11.01	-47.7	16.67	-57.9	20.82	-39.8	24.92	-42.6
1.86	-13.6	6.37	-35.5	11.20	-47.6	16.85	-56.3	21.00	-38.5	25.10	-41.3
2.00	-13.7	6.50	-37.0	11.35	-47.2	17.03	-56.6	21.18	-37.2	25.28	-40.0
2.12	-14.3	6.64	-38.0	11.52	-47.6	17.22	-57.3	21.36	-35.9	25.46	-38.7
2.25	-14.3	6.78	-39.2	11.69	-48.0	17.40	-57.3	21.54	-34.6	25.64	-37.4
2.34	-13.7	6.92	-40.4	11.85	-47.8	17.60	-56.7	21.72	-33.3	25.82	-36.1
2.51	-14.7	7.07	-41.5	12.02	-46.8	17.78	-57.1	21.90	-32.0	26.00	-34.8
2.65	-15.6	7.20	-42.7	12.19	-50.0	17.94	-56.6	22.08	-30.7	26.18	-33.5
2.80	-16.6	7.34	-44.0	12.33	-50.2	18.12	-56.2	22.26	-29.4	26.36	-32.2
2.92	-16.5	7.48	-45.2	12.50	-50.6	18.30	-57.4	22.44	-28.1	26.54	-30.9
3.03	-16.5	7.62	-45.5	12.68	-50.6	18.50	-58.4	22.62	-26.8	26.72	-29.6
3.17	-16.1	7.77	-47.6	12.83	-50.6	18.67	-59.3	22.80	-25.5	26.90	-28.3
3.30	-17.0	7.90	-48.0	13.00	-51.0	18.84	-60.1	22.98	-24.2	27.08	-27.0
3.42	-17.5	8.05	-49.0	13.17	-51.7	19.02	-59.5	23.16	-22.9	27.26	-25.7
3.57	-17.9	8.20	-50.2	13.33	-52.5	19.20	-59.2	23.34	-21.6	27.44	-24.4
3.70	-18.1	8.33	-51.7	13.50	-53.0	19.40	-58.4	23.52	-20.3	27.62	-23.1
3.83	-19.1	8.50	-52.5	13.67	-52.8	19.59	-59.2	23.70	-19.0	27.80	-21.8
4.00	-19.6	8.61	-51.7	13.85	-53.2	19.76	-60.7	23.88	-17.7	27.98	-20.5
4.12	-20.0	8.79	-50.4	14.01	-53.4	19.94	-60.7				

TEMPERATURE (continued)

ASCENT

Matllops Island, Virginia
1969 December 5

Altitude (km)	Temp.	Altitude (km)	Temp.
20.13	-60.7	23.50	-59.5
20.30	-59.2	23.61	-60.2
20.50	-58.1	23.83	-60.8
20.67	-58.4	24.00	-61.5
20.85	-59.2	24.20	-61.5
21.02	-59.0	24.35	-61.6
21.20	-61.4	24.52	-61.4
21.40	-61.3	24.70	-60.0
21.50	-60.5	24.89	-58.8
21.75	-59.9	25.06	-57.8
21.92	-60.4	25.21	-58.0
22.10	-60.4	25.40	-57.8
22.26	-60.7	25.60	-58.0
22.43	-60.6	25.70	-58.0
22.61	-60.6	25.93	-58.0
22.79	-60.2	26.10	-58.4
22.96	-60.8	26.30	-58.4
23.13	-60.7	26.46	-58.6
23.30	-60.2	26.63	-59.2



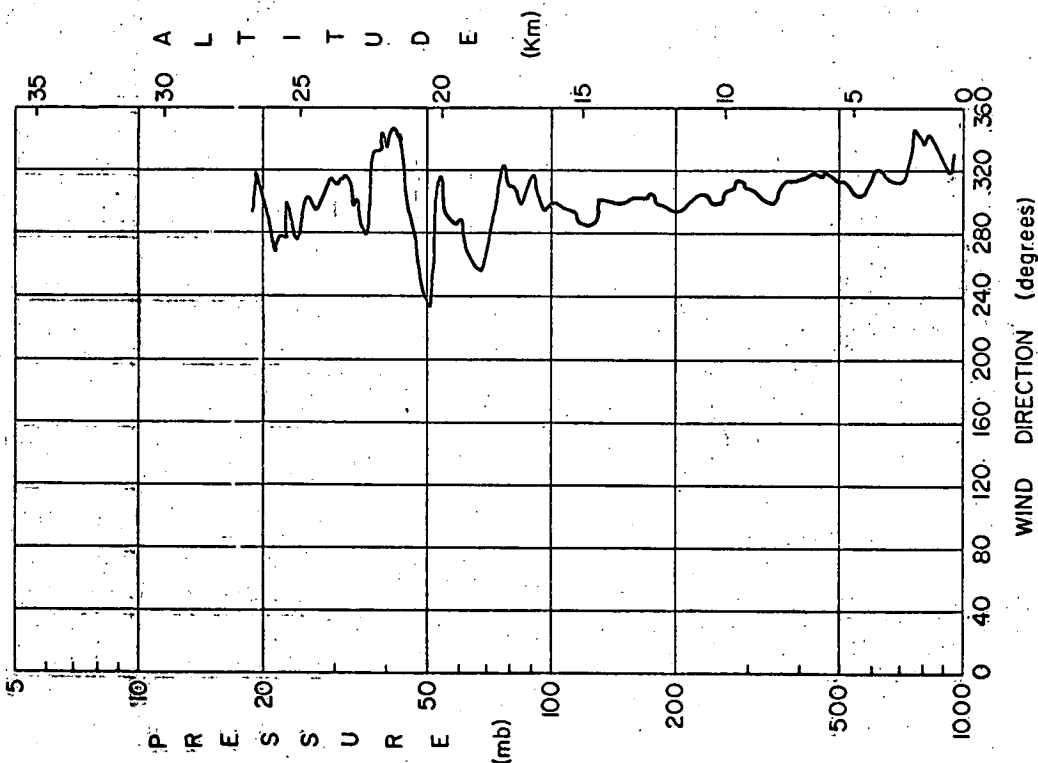
1969 Dec. 5

WIND VELOCITY
(RADAR)
Wallops Island, Virginia
1969 December 5

Wind Velocity mi/hr	Alt. (km)	Wind Velocity mi/hr	Alt. (km)	Wind Velocity mi/hr	Alt. (km)	Wind Velocity mi/hr	Alt. (km)
42.3	0.505	60.0	5.391	75.7	10.845	29.3	17.041
39.5	0.608	57.9	5.530	72.3	10.999	29.3	17.219
40.9	0.730	59.3	5.712	70.9	11.100	25.2	17.396
41.6	0.850	60.7	5.863	70.2	11.308	22.5	17.700
40.2	0.975	60.0	6.012	71.6	11.472	23.2	17.783
38.2	1.110	58.6	6.170	72.3	11.626	21.1	17.994
35.4	1.240	57.9	6.312	72.9	11.795	18.4	18.184
34.1	1.380	58.6	6.457	76.4	11.976	19.8	18.387
34.1	1.510	59.3	6.602	76.4	12.161	25.9	18.570
36.8	1.650	60.0	6.751	72.9	12.358	31.4	18.758
41.6	1.780	60.7	6.900	67.5	12.560	30.0	18.938
45.7	1.910	60.7	7.056	63.4	12.752	21.1	19.137
44.3	2.040	61.3	7.217	60.7	12.936	17.0	19.352
36.8	2.168	61.4	7.320	58.6	13.120	21.1	19.545
30.7	2.316	62.0	7.520	61.4	13.200	25.9	19.739
28.6	2.460	62.0	7.668	67.5	13.454	28.6	20.000
27.9	2.595	63.4	7.822	65.4	13.615	23.2	20.110
30.7	2.752	65.4	7.970	62.0	13.779	11.6	20.303
38.2	2.896	67.5	8.123	60.7	13.954	12.3	20.509
44.3	3.044	69.5	8.279	59.3	14.137	13.0	20.689
45.7	3.182	70.2	8.440	58.6	14.304	15.0	20.884
45.7	3.326	69.5	8.600	58.6	14.494	19.1	21.075
47.0	3.478	72.9	8.761	62.0	14.693	21.1	21.259
49.1	3.614	78.4	8.909	63.4	14.889	21.2	21.440
51.8	3.740	77.7	9.064	60.7	15.068	19.1	21.634
54.5	3.885	71.6	9.170	56.6	15.244	15.7	21.814
55.2	4.028	67.5	9.371	55.9	15.400	19.1	22.011
55.9	4.161	66.8	9.524	56.6	15.603	20.5	22.300
57.9	4.299	69.5	9.674	52.5	15.789	15.7	22.441
60.0	4.454	73.6	9.841	47.0	15.965	9.5	22.647
62.0	4.598	76.4	10.002	40.9	16.156	10.2	22.835
62.7	4.747	79.8	10.180	38.8	16.335	15.7	23.028
61.3	4.899	81.8	10.341	39.5	16.518	21.1	23.219
60.7	5.056	81.8	10.510	36.8	16.695	23.2	23.407
60.7	5.219	79.8	10.677	31.4	16.865	22.5	23.614

WIND VELOCITY (continued)
(RADAR)
Wallops Island, Virginia
1969 December 5

Wind Velocity mi/hr	Alt. (km)
23.2	23.814
23.2	24.016
23.2	24.240
23.9	24.452
23.2	24.750
25.4	24.849
30.7	25.040
31.4	25.230
30.7	25.403
32.0	25.573
27.3	25.600
26.6	25.957
35.4	26.133
40.2	26.314
36.8	26.497
28.6	26.750
29.3	26.800
37.5	27.090
40.9	27.253
43.6	27.366
46.4	27.450



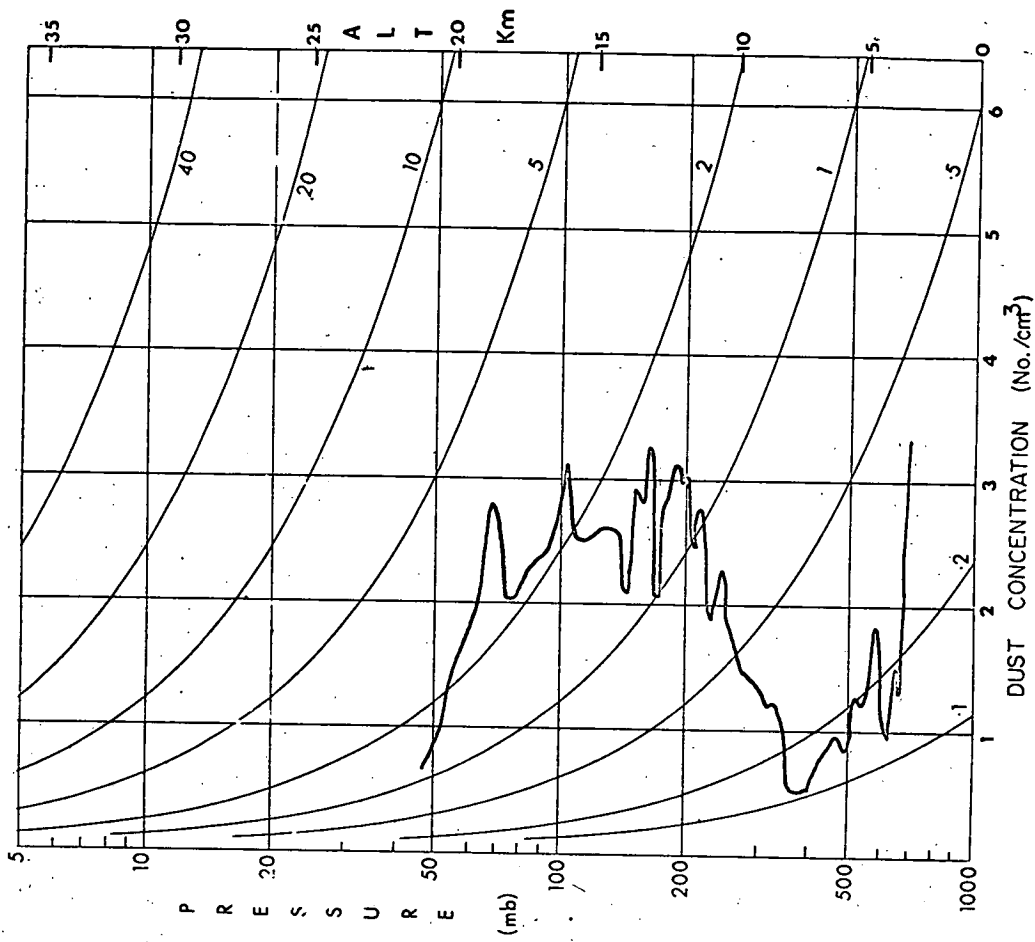
1969, Dec. 5

WIND DIRECTION
(RADAR)
Wallops Island, Virginia
1969 December 5

Wind Direction (Degrees)	Alt. (km)	Wind Direction (Degrees)	Alt. (km)	Wind Direction (Degrees)	Alt. (km)	Wind Direction (Degrees)	Alt. (km)	Wind Direction (Degrees)	Alt. (km)
329.28	0.505	309.71	5.056	301.25	10.180	301.06	15.960		
319.72	0.608	313.17	5.219	301.81	10.341	296.80	16.150		
319.08	0.730	314.59	5.391	301.39	10.510	293.33	16.335		
322.82	0.850	313.60	5.530	304.29	10.680	302.78	16.513		
327.72	0.975	314.79	5.712	305.41	10.840	318.06	16.695		
331.26	1.110	317.83	5.863	304.03	10.990	318.77	16.866		
335.54	1.240	318.48	6.012	303.17	11.100	309.71	17.041		
340.10	1.380	316.85	6.170	300.15	11.310	300.74	17.219		
342.57	1.510	316.74	6.312	297.05	11.470	310.66	17.396		
337.32	1.650	319.04	6.457	295.19	11.626	310.03	17.700		
335.27	1.780	318.20	6.602	295.56	11.795	322.85	17.780		
340.09	1.910	317.72	6.751	296.10	11.976	320.58	17.990		
344.74	2.040	317.04	6.900	299.36	12.161	305.65	18.184		
344.26	2.170	316.15	7.056	301.39	12.358	283.27	18.387		
337.27	2.320	314.87	7.217	303.22	12.560	258.17	18.510		
331.30	2.460	313.73	7.320	301.63	12.795	257.61	18.758		
324.72	2.595	314.04	7.520	301.68	12.940	259.19	18.938		
314.55	2.750	315.15	7.670	303.84	13.120	267.71	19.137		
312.43	2.896	315.45	7.820	302.09	13.200	282.16	19.352		
314.26	3.044	310.59	7.970	299.88	13.450	288.70	19.545		
315.36	3.182	304.19	8.120	298.85	13.615	286.06	19.739		
315.53	3.326	302.46	8.280	301.85	13.779	293.82	20.000		
317.60	3.478	303.78	8.440	302.30	13.954	317.44	20.112		
320.97	3.614	305.63	8.600	300.64	14.137	313.82	20.303		
320.68	3.740	304.49	8.760	302.18	14.304	251.26	20.504		
321.99	3.885	307.88	8.910	239.75	14.494	236.92	20.689		
322.62	4.030	310.13	9.060	280.65	14.693	247.73	20.884		
321.93	4.160	310.92	9.170	285.41	14.889	275.11	21.075		
313.18	4.300	314.21	9.370	288.51	15.068	294.32	21.259		
309.02	4.454	312.30	9.520	293.47	15.244	307.15	21.440		
306.73	4.598	308.69	9.670	295.91	15.400	338.92	21.634		
306.73	4.797	309.80	9.840	296.29	15.603	349.08	21.814		
307.44	4.899	305.64	10.002	298.60	15.789	338.87	22.011		

WIND DIRECTION (continued)
(RADAR)
Wallops Island, Virginia
1969 December 5

Wind Direction (Degrees)	Alt. (km)
334.42	22.300
333.83	22.440
328.32	22.647
280.97	22.835
302.39	23.028
299.65	23.219
311.39	23.407
316.55	23.614
310.79	23.814
316.96	24.016
308.35	24.240
294.59	24.450
305.48	24.750
302.82	24.840
293.53	25.040
276.78	25.230
287.22	25.403
297.77	25.573
275.57	25.600
276.12	25.957
264.78	26.133
288.85	26.314
311.94	26.497
320.82	26.750
296.38	26.800
286.85	27.090
289.13	27.253
284.24	27.366
278.45	27.450



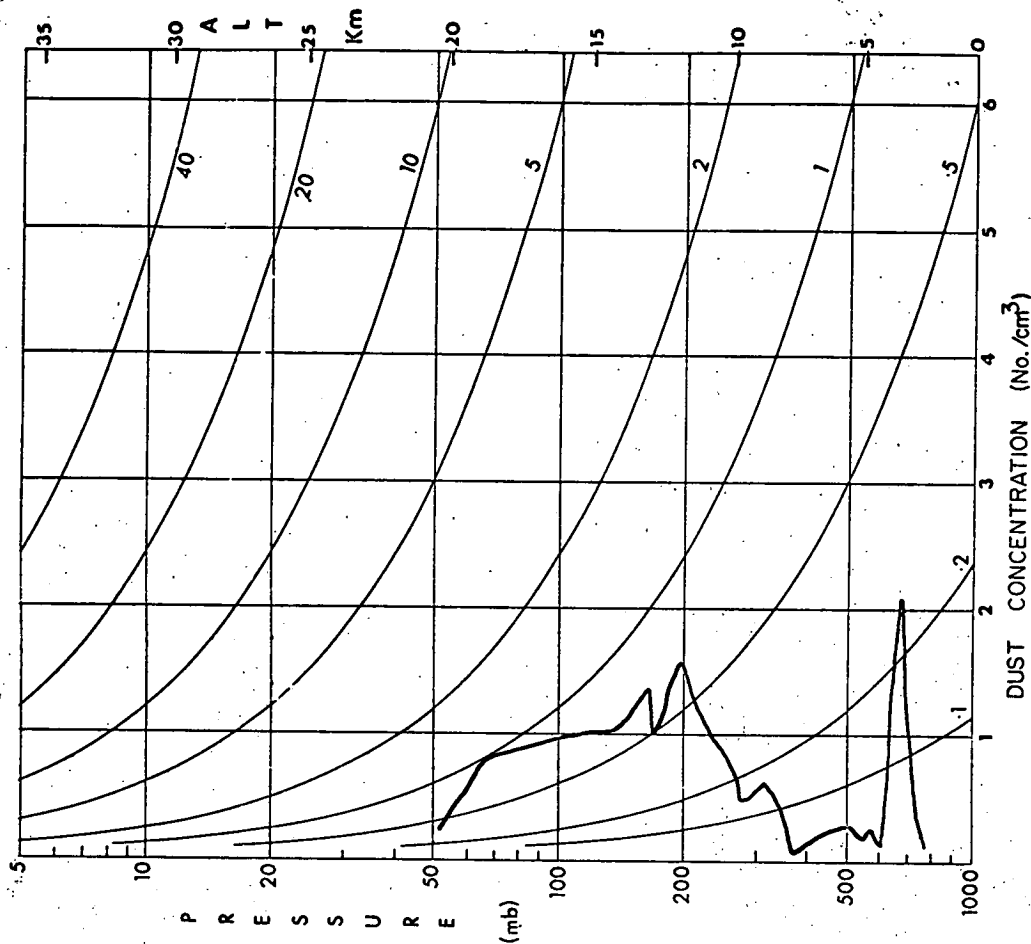
DESCENT
1969 Dec. 5
Diam. $\geq$.25 microns

DUST SOUNDING CHANNEL 1 DESCENT
Mallopos Island, Virginia

1969 December 5

Diam. ≥ 25 microns

Press. (mb)	No./cm ³	Press. (mb)	No./cm ³	Press. (mb)	No./cm ³
48.0	0.63	271	1.50	728	6.80
52.0	1.02	305	1.33	730	4.20
55.2	1.47	316	1.20	735	6.50
61.5	1.84	327	1.20	737	6.06
68.0	2.80	342	1.09	740	5.50
73.5	2.02	365	0.50	741	5.20
81.0	2.24	394	0.48	743	4.86
87.5	2.32	422	0.66	748	3.04
95.0	2.52	445	0.78	751	4.20
103.0	3.14	467	0.92	755	2.98
108.0	2.50	497	0.87	760	2.88
115.0	2.50	507	1.13	768	2.24
122.0	2.60	525	1.26	775	7.00
128.0	2.60	540	1.12		
135.0	2.60	582	1.70		
142.0	3.14	592	1.82		
150.0	2.90	603	1.18		
159.0	2.80	617	0.94		
163.0	3.24	630	1.10		
169.0	2.06	645	1.51		
176.0	2.70	658	1.37		
182.0	2.92	665	1.60		
190.0	3.14	680	2.00		
194.0	3.01	690	2.58		
198.0	3.54	695	3.30		
205.0	2.81	702	6.25		
210.0	2.64	708	7.20		
217.0	2.79	711	7.70		
225.0	2.42	715	7.70		
234.0	1.90	718	7.55		
240.0	2.06	720	7.35		
248.0	2.36	722	7.20		
255.0	1.92	725	6.90		
263.0	1.70	727	6.80		



DESCENT

1969 Dec. 5

Diam ≥ 50 microns

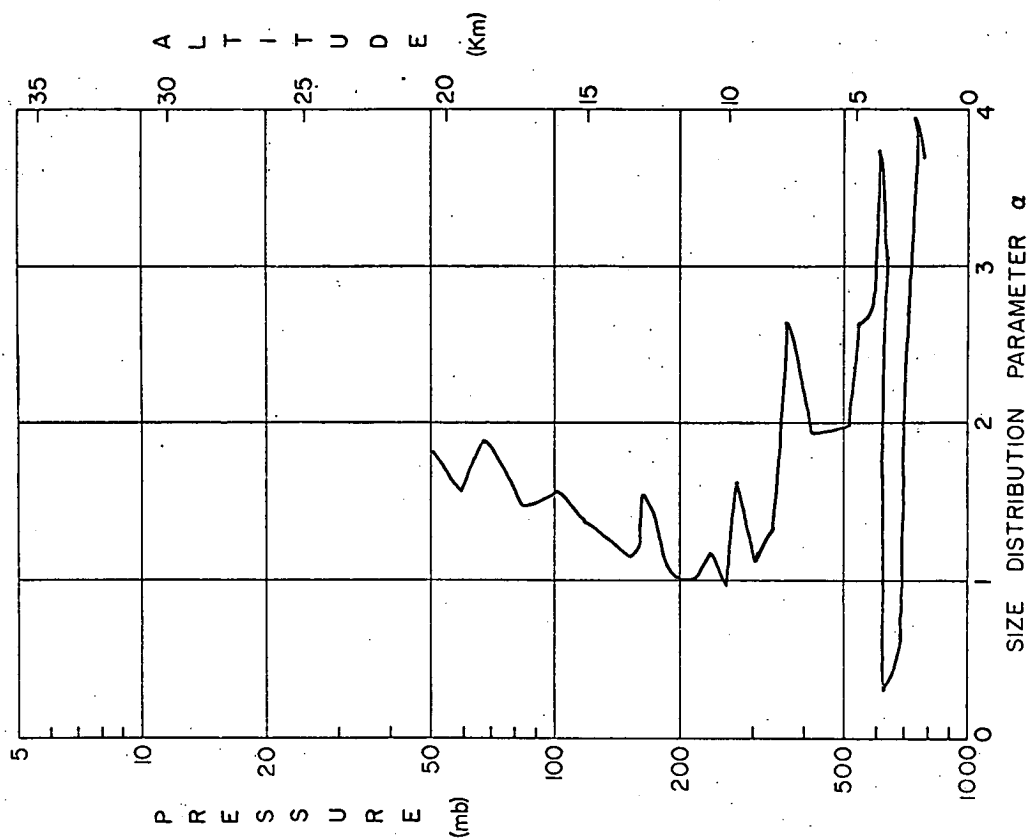
DUST SOUNDING CHAINEL II - DESCENT

Wallops Island, Virginia

1969 December 5

Diam. $\geq$.50 microns

Press. (m_b)	No./ cm^3	Press. No./ cm^3 (m_b)	
51.0	0.242	720	0.469
62.5	0.619	735	0.359
69.5	0.738	762	0.103
84.0	0.831		
104.0	0.985		
120.0	1.004		
136.0	1.077		
155.0	1.264		
162.0	1.392		
168.0	0.999		
179.0	1.183		
188.0	1.451		
197.0	1.482		
208.0	1.280		
225.0	1.167		
240.0	0.939		
260.0	0.852		
265.0	0.692		
275.0	0.474		
310.0	0.598		
340.0	0.482		
365.0	0.082		
427.0	0.172		
510.0	0.268		
545.0	0.197		
585.0	0.279		
600.0	0.130		
637.0	0.998		
695.0	2.105		

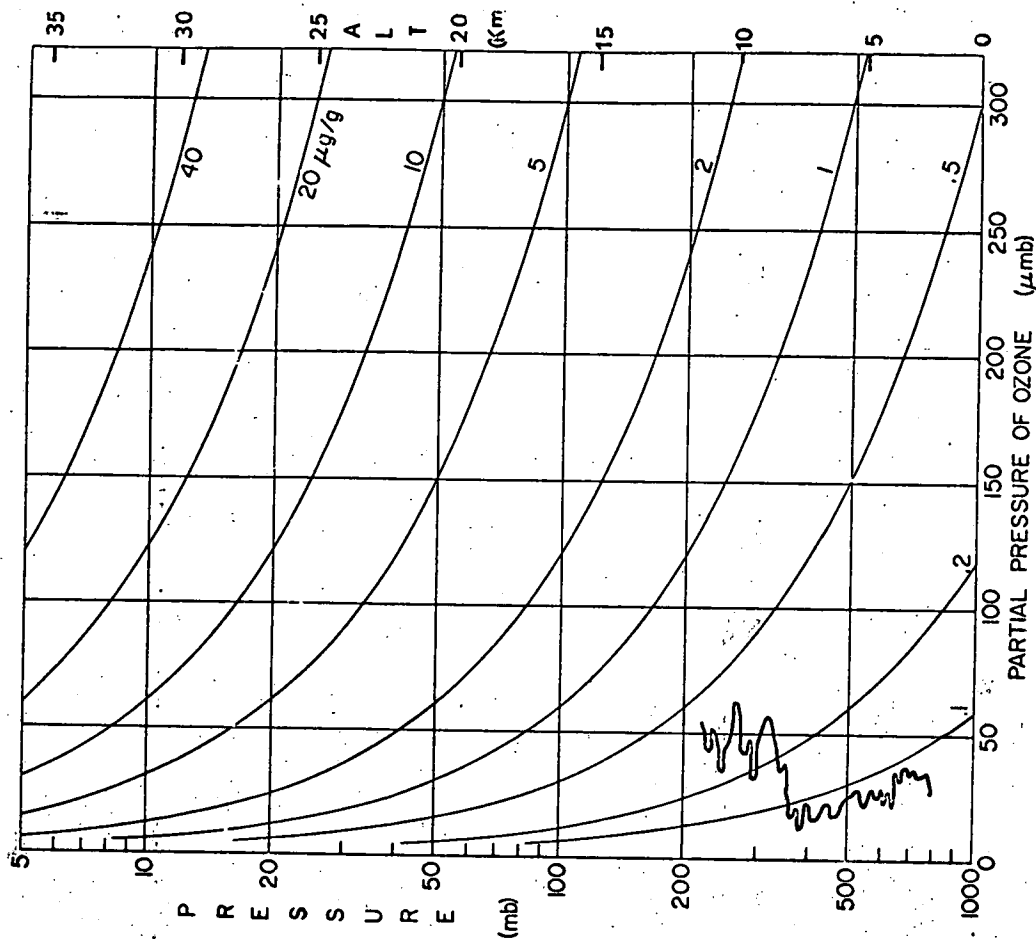


DESCENT 1969 Dec. 5

Wäljöps. Islandi. Vindfjälä.

1969 December 5.

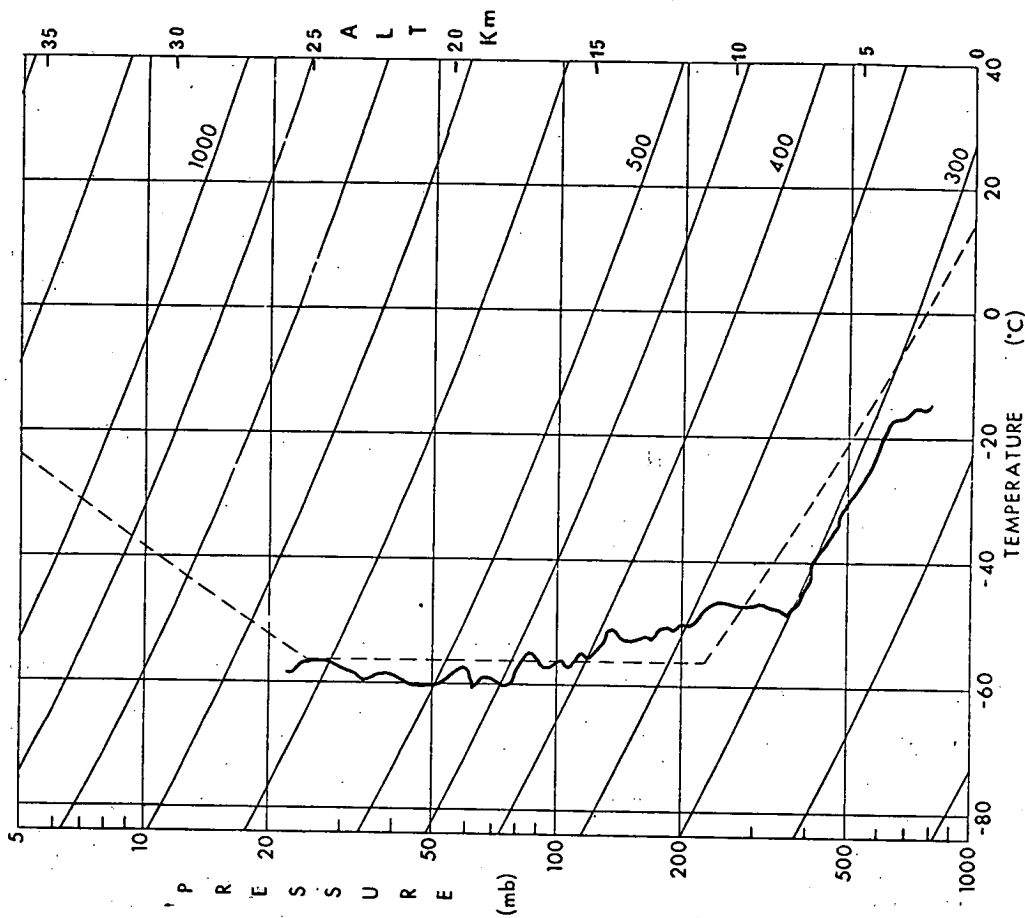
Press. (m_b)	α	Press. (m_b)	α
51.0	1.800	720	3.97
62.5	1.580	735	3.62
69.5	1.870	762	4.76
	1.470		
104.0	1.570		
120.0	1.370		
136.0	1.270		
155.0	1.160		
162.0	1.220		
168.0	1.540		
179.0	1.390		
188.0	1.070		
197.0	1.020		
208.0	1.023		
225.0	1.040		
240.0	1.160		
260.0	0.990		
265.0	1.250		
275.0	1.630		
310.0	1.120		
340.0	1.310		
365.0	2.620		
427.0	1.920		
510.0	1.970		
545.0	2.610		
585.0	2.690		
600.0	3.750		
637.0	0.003		
695.0	0.006		



DESCENT 1969 December 5

OZONE SONDE - DESCENT
1969 December 5
Wallops Island, Virginia

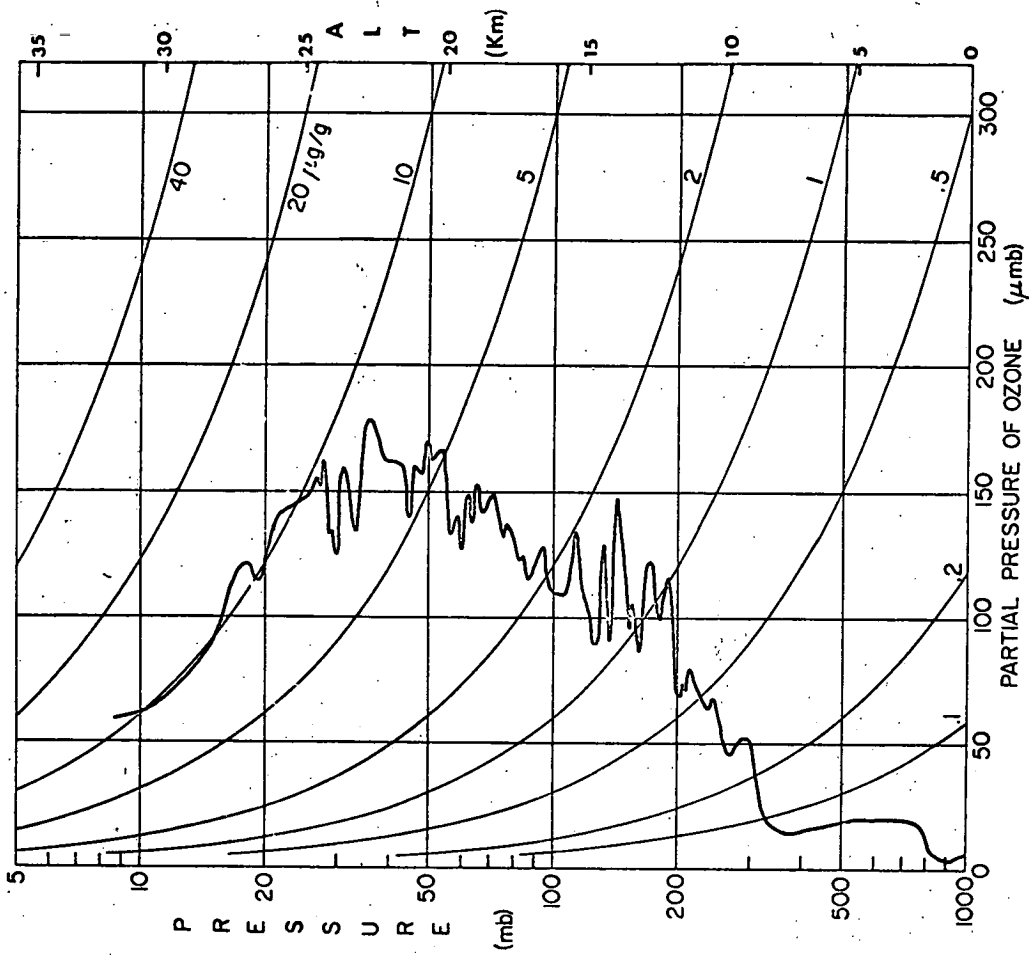
O ₃	Pressure (m _b)	O ₃	Pressure (m _b)
54.6	222	18.9	477
42.0	230	21.0	485
52.5	235	22.4	495
36.4	242	24.5	505
42.0	248	25.9	512
49.0	254	25.9	521
49.0	260	26.6	531
63.0	266	27.3	541
45.5	274	21.0	551
42.0	282	27.3	560
45.5	287	27.3	567
31.5	293	26.6	572
46.9	300	28.0	580
49.0	307	25.2	588
35.0	314	28.0	598
56.0	320	24.5	603
49.0	330	26.6	610
45.5	336	28.0	620
35.0	344	22.4	634
38.5	350	28.0	642
28.0	357	34.3	650
17.5	364	31.5	660
21.0	370	34.3	670
16.1	377	34.3	680
14.7	383	35.0	687
16.8	390	36.5	700
21.0	397	35.0	710
19.6	405	35.7	721
17.5	411	35.0	730
17.5	417	35.0	740
21.0	442	34.3	749
21.7	450	35.0	759
18.2	456	35.0	770
18.2	468	33.6	780
		28.0	787



DESCENT 1969 December 5

TEMPERATURE
DESCENT
Mallopos Island, Virginia
1969 December 5

Temp.	Press. (m _b)	Temp.	Press. (m _b)	Temp.	Press. (m _b)	Temp.	Press. (m _b)
-58.2	22.0	-50.0	211	-36.1	454	-15.7	762
-57.2	24.7	-48.6	219	-35.0	462	-16.0	770
-57.4	27.8	-48.7	227	-33.6	472	-15.4	780
-58.4	30.5	-47.9	235	-32.7	480	-14.0	790
-59.8	33.6	-47.0	240	-32.0	490		
-59.2	37.0	-46.6	244	-31.0	500		
-59.6	41.0	-46.6	250	-30.1	510		
-60.0	45.0	-47.0	257	-29.5	517		
-60.0	49.0	-46.5	264	-28.0	527		
-59.0	54.5	-47.0	270	-28.9	536		
-57.8	58.0	-46.8	277	-27.7	547		
-60.4	62.0	-46.7	283	-26.4	557		
-58.5	66.0	-46.5	290	-25.5	563		
-60.0	72.0	-46.5	296	-24.5	570		
-59.8	77.0	-46.4	303	-23.7	577		
-56.4	82.0	-46.5	310	-23.0	586		
-54.7	87.5	-45.9	317	-22.1	592		
-57.1	94.0	-44.5	324	-21.0	600		
-56.2	100.0	-46.1	334	-20.9	608		
-57.0	106.0	-47.7	340	-20.4	616		
-55.0	112.0	-48.0	348	-19.8	622		
-55.8	117.0	-50.0	355	-19.4	631		
-55.4	123.0	-50.0	360	-18.6	639		
-53.5	130.0	-49.0	367	-17.8	647		
-51.5	136.0	-47.8	372	-17.0	656		
-53.4	143.0	-47.0	380	-16.4	665		
-53.4	150.0	-45.8	387	-15.6	675		
-53.4	159.0	-44.9	394	-15.2	686		
-52.6	163.0	-44.0	401	-15.8	695		
-52.3	170.0	-42.6	409	-16.6	705		
-51.5	177.0	-41.0	415	-16.2	717		
-50.5	183.0	-40.0	420	-15.4	725		
-50.8	190.0	-39.0	432	-15.0	734		
-50.6	197.0	-38.0	438	-15.0	743		
-50.6	204.0	-37.1	446	-15.5	753		



ASCENT 1969 December 4

ESSA

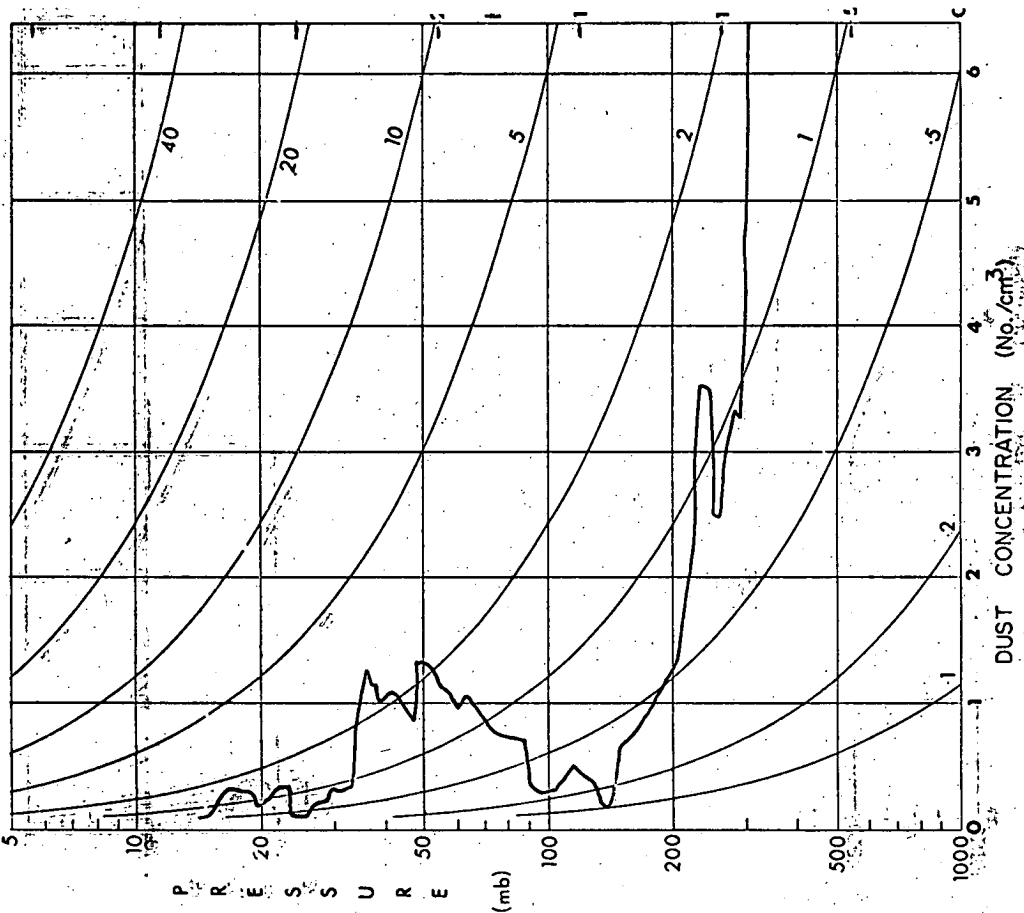
ESSA

OZONE SONDE - ASCENT
1969 December 4
Wallops Island, Virginia

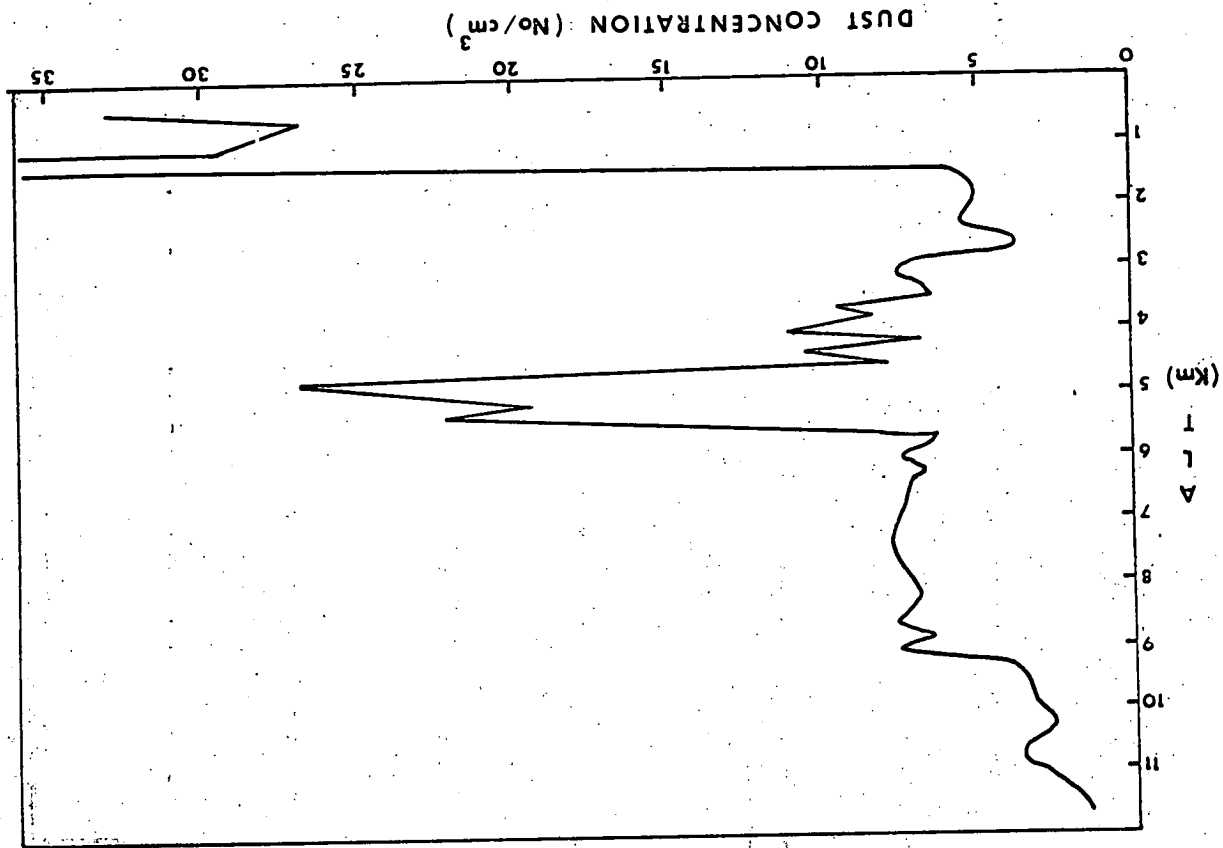
Pressure (m _b)	Temp. (°C)	Height (m)	O ₃ ppm	Pressure (m _b)	Temp. (°C)	Height (m)	O ₃ ppm
1012	0.0	4	6	145	-49.6	13670	150
928	-05.8	680	3	142	-51.2	13800	104
842	-12.8	1450	7	140	-51.7	13890	103
799	-11.8	1850	20	138	-52.1	13980	88
709	-14.9	2760	19	134	-52.6	14170	131
676	-14.7	3120	19	130	-52.2	14360	92
595	-20.3	4070	19	125	-51.6	14611	86
575	-20.3	4320	20	121	-51.2	14820	107
520	-24.9	5050	18	119	-51.4	14950	106
400	-39.5	6920	14	115	-52.6	15150	135
356	-46.3	7710	13	110	-52.8	15420	106
323	-50.5	8340	23	100	-54.9	16052	109
303	-46.0	8760	52	96	-54.4	16300	129
286	-42.6	9150	51	91	-56.8	16640	121
269	-43.2	9560	43	88	-57.4	16850	112
247	-45.3	10130	68	85	-57.6	17080	125
240	-46.2	10330	61	83	-56.9	17230	120
218	-47.1	10980	80	78	-57.0	17630	137
209	-47.3	11160	68	76	-57.0	17790	128
204	-47.1	11260	76	73	-54.9	18050	151
199	-48.2	11420	64	68	-55.3	18500	139
192	-47.8	11580	70	65	-57.0	18790	155
185	-47.6	11820	118	64	-56.8	18880	134
179	-47.6	12070	97	63	-57.2	18980	151
177	-48.3	12280	102	60	-57.2	19282	122
175	-48.2	12360	123	59	-57.2	19370	141
174	-48.2	12420	117	57	-57.6	19590	131
163	-50.2	12470	125	55	-57.6	19820	140
161	-50.4	12800	78	54	-58.0	19930	166
158	-50.2	12880	84	51	-56.6	20300	159
153	-49.9	13100	111	49	-56.9	20550	168
151	-50.0	13310	91	46	-56.8	20680	154
148	-49.6	13400	117	44	-57.0	20950	158
		13520	124	44	-57.7	21230	136

ESSA

Pressure (m _b)	Temp. (°C)	Height (m)	O ₃ ppm	Pressure (m _b)	Temp. (°C)	Height (m)	O ₃ ppm
43.0	-57.4	21360	159	27.0	-59.3	24270	154
39.0	-58.4	22130	159	26.0	-58.8	24500	144
37.0	-58.7	22310	172	21.5	-60.6	25700	135
35.0	-59.3	22660	176	19.8	-60.3	26230	107
34.0	-60.4	22830	149	18.3	-60.2	26680	116
33.0	-60.3	23020	130	17.8	-60.0	26900	115
31.0	-60.4	23420	156	15.0	-57.4	27955	80
30.0	-59.5	23623	120	13.1	-54.7	28820	72
29.5	-60.2	23730	123	10.8	-55.3	30030	57
29.0	-59.3	23830	134	8.7	-57.7	31419	51
28.0	-60.0	24050	114				
27.5	-59.8	24270	147				



The ascent dust concentration for particle sizes larger than .25 microns diameter. Wallops Island, April 16, 1970



The dust concentration near the ground for particle sizes larger than .25 microns. Wallops Island, April 16, 1970.

DUST COUNTER

Wallops Island, Virginia

April 16, 1970

Channel I

Diameter $\geq .25$ microns

cm^3	Alt. (km)	Press. (mb)	No./ cm^3	Alt. (km)	Press. (mb)	No./ cm^3	Alt. (km)	Press. (mb)
.00	0.43	963	6.960	8.04	353.0	0.950	18.90	65.1
.60	0.68	935	6.750	8.22	344.0	1.080	19.20	62.1
.20	0.92	907	6.980	8.45	333.0	0.960	19.50	59.2
.50	1.10	882	7.600	8.62	325.0	1.100	19.80	56.5
.60	1.28	859	6.300	8.85	314.0	1.160	20.00	54.7
.64	1.45	851	7.430	9.05	305.0	1.260	20.25	52.6
.00	1.62	832	4.050	9.25	296.0	1.300	20.45	51.0
.97	1.89	815	3.300	9.45	287.0	1.340	20.65	47.4
.43	2.35	761	3.320	9.60	281.0	1.040	20.90	47.5
.59	2.52	744	3.130	9.90	268.0	0.870	21.05	46.4
.05	2.71	728	2.990	10.00	264.0	1.100	21.75	41.6
.10	2.90	710	2.760	10.05	262.0	1.080	22.05	40.0
.58	3.10	692	2.460	10.20	256.0	1.000	22.30	38.2
.60	3.26	679	2.470	10.35	250.0	1.170	22.50	37.0
.40	3.44	662	3.490	10.58	242.0	1.220	22.75	35.6
.56	3.62	647	3.530	10.90	230.0	1.130	22.95	34.5
.32	3.80	632	2.180	11.15	221.0	0.710	23.20	33.2
.24	4.09	616	1.760	11.42	212.0	0.370	23.35	32.4
.70	4.15	604	1.350	11.70	203.0	0.360	23.80	30.2
.77	4.35	589	0.980	12.65	174.0	0.330	24.00	29.3
.74	4.55	573	0.720	13.20	160.0	0.220	24.20	28.4
.17	4.75	558	0.650	13.72	148.0	0.220	24.60	26.7
.50	4.85	544	0.190	14.15	138.0	0.120	25.10	24.7
.31	5.15	529	0.196	14.34	133.0	0.118	25.40	23.6
.20	5.35	515	0.198	14.50	130.0	0.350	25.60	22.9
.20	5.65	495	0.360	14.65	127.0	0.350	25.75	22.4
.72	5.85	482	0.385	14.85	123.0	0.350	25.90	21.8
.52	6.09	472	0.490	15.28	115.0	0.085	26.05	21.3
.43	6.22	457	0.304	16.05	102.0	0.085	26.50	19.9
.13	6.40	445	0.280	16.65	93.0	0.200	26.80	19.1
.61	7.22	398	0.370	16.90	89.3	0.310	27.05	18.3
.71	7.40	388	0.690	17.15	85.3	0.310	27.32	17.7
.48	7.65	374	0.750	18.08	73.8	0.330	27.58	16.9
.35	7.82	365	0.880	18.60	68.3	0.330	27.70	16.6

DUST COUNTER (continued)

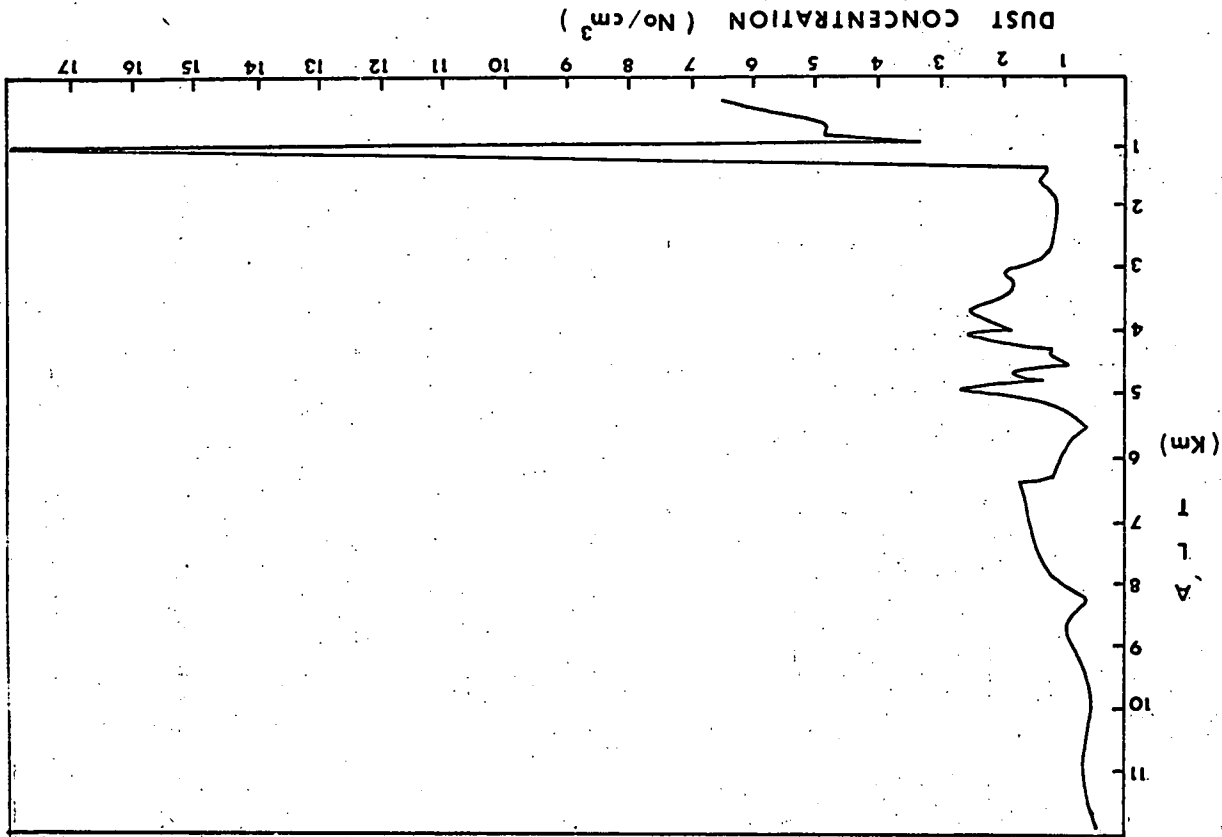
Wallops Island, Virginia

April 16, 1970

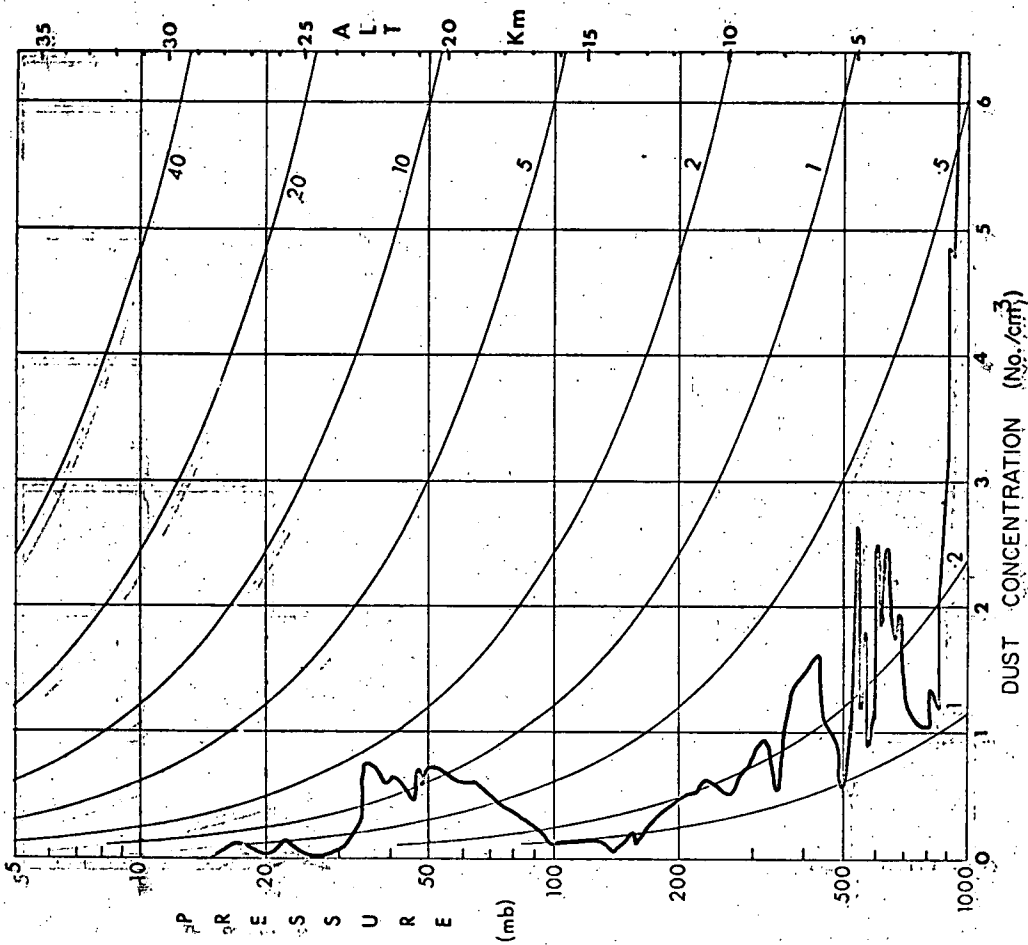
Channel I

Diameter $\geq .25$ microns

No./ cm^3	Alt. (km)	Press. (mb)
0.250	28.12	15.6
0.128	28.50	14.7
0.104	28.85	13.9
0.020	29.35	12.9



The dust concentration near the ground for particle sizes larger than .40 microns diameter. Wallops Island, April 16, 1970.



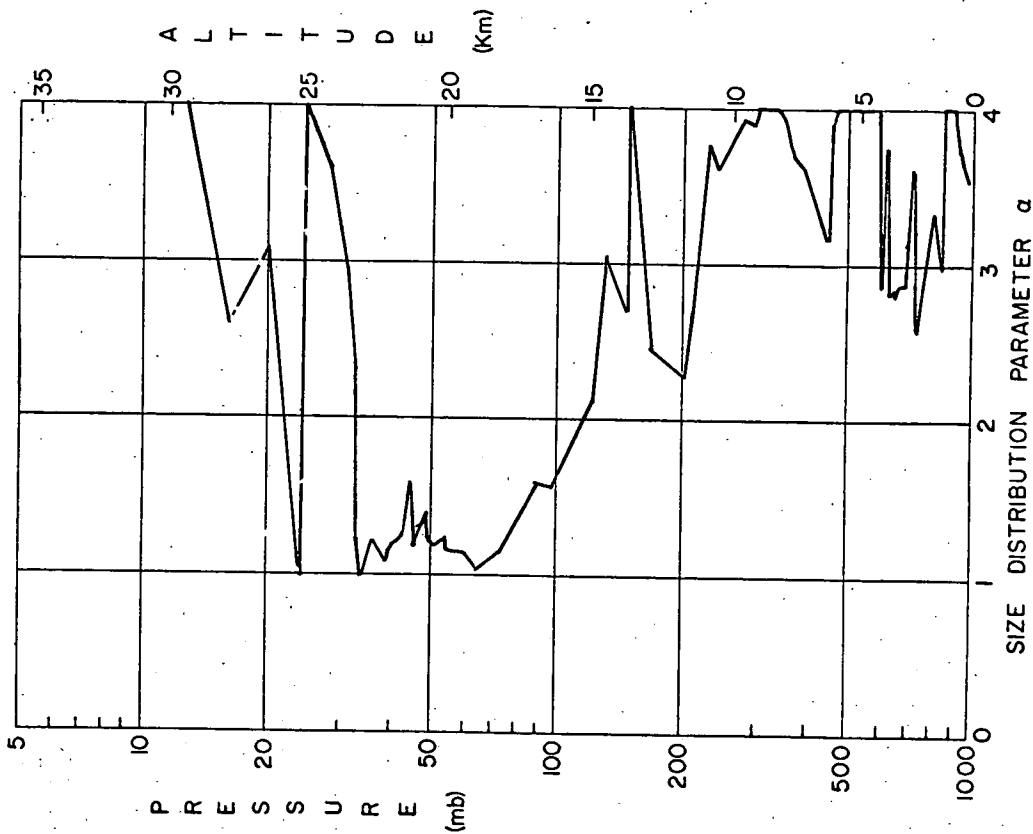
The ascent dust concentration for particle sizes larger than .40 microns diameter. Wallops Island, April 16, 1970

DUST COUNTER

CHANNEL II

Diameter ≥ 0.40 microns
 Wallops Island, Virginia
 1970-April 16

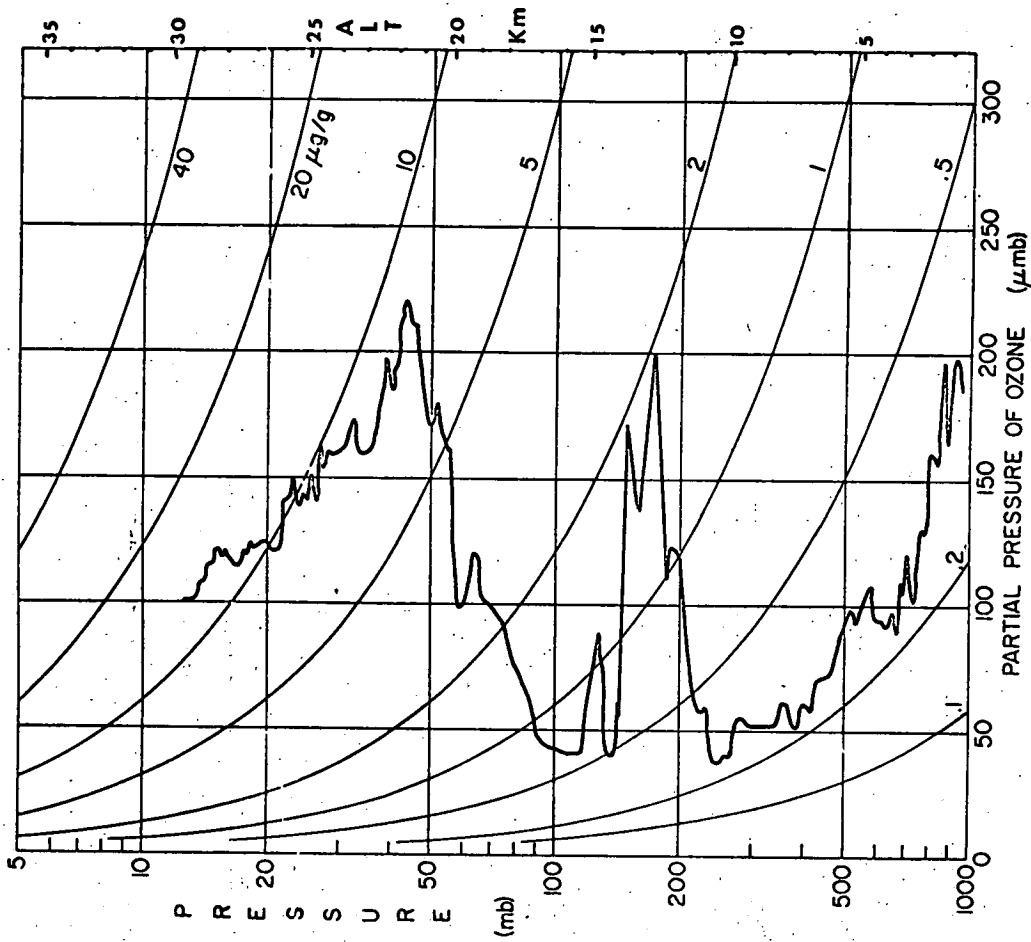
No/cm^3	Alt. (km)	Press. (m_b)	No/cm^3	Alt. (km)	Press. (m_b)	No/cm^3	Alt. (km)	Press. (m_b)
6.37	0.40	966	0.51	8.22	345.0	0.090	23.60	31.2
4.81	0.70	932	0.97	8.62	325.0	0.040	24.30	27.9
4.82	0.90	909	0.84	9.00	307.0	0.016	25.10	24.7
3.27	1.00	899	0.73	9.16	301.0	0.099	25.55	23.2
18.30	1.20	877	0.63	9.30	294.0	0.150	25.78	22.2
2.06	1.35	861	0.51	9.72	276.0	0.020	26.50	19.9
1.18	1.40	856	0.49	10.00	264.0	0.097	27.68	16.6
1.27	1.50	845	0.58	10.50	245.0	0.050	28.20	15.4
1.37	1.62	833	0.60	10.90	230.0	0.028	28.45	14.8
1.04	1.80	815	0.52	11.35	214.0	0.006	29.15	13.3
1.08	2.52	744	0.46	11.70	203.0			
1.21	2.88	712	0.31	12.66	174.0			
1.96	3.08	694	0.09	13.30	157.0			
1.72	3.24	679	0.19	13.50	153.0			
1.73	3.40	666	0.04	14.20	136.0			
2.49	3.65	645	0.14	14.75	125.0			
2.24	3.80	633	0.14	16.45	95.8			
1.79	3.95	620	0.28	17.05	87.2			
2.54	4.05	612	0.47	18.28	71.6			
1.12	4.24	596	0.61	19.00	64.1			
1.20	4.32	591	0.59	19.45	59.7			
0.90	4.55	573	0.67	20.05	54.3			
1.80	4.65	566	0.69	20.20	53.0			
1.22	4.75	558	0.74	20.45	51.0			
2.62	4.90	547	0.73	20.65	47.4			
1.54	5.05	536	0.67	20.75	48.6			
0.81	5.25	522	0.58	20.88	47.5			
0.52	5.50	505	0.42	21.15	45.7			
0.90	5.80	485	0.59	21.65	42.2			
1.00	6.00	472	0.62	21.90	40.6			
1.09	6.32	451	0.59	22.30	38.2			
1.62	6.40	446	0.72	22.70	35.8			
1.42	7.30	394	0.72	22.95	34.5			
1.34	7.62	376	0.52	23.06	33.9			
1.15	7.90	361	0.24	23.20	33.2			



The ascent size distribution parameter. Wallops Island April 16, 1970

SIZE DISTRIBUTION PARAMETER
 Wallops Island, Virginia
 1970 Apr 11 16

Alt. (km)	Press. (m_b)	Dust Conc. (μ)	Alt. (km)	Press. (m_b)	Dust Conc. (μ)	Alt. (km)	Press. (m_b)	Dust Conc. (μ)
0.40	966	3.54	8.22	345.0	5.49	23.2	33.2	2.31
0.70	932	3.65	8.62	325.0	4.38	23.6	31.2	2.97
0.90	909	3.74	9.00	307.0	4.55	24.3	27.9	3.63
1.00	899	4.62	9.16	301.0	4.46	25.1	24.7	4.28
1.20	877	1.89	9.30	294.0	3.87	25.6	23.2	1.00
1.35	861	5.92	9.72	276.0	3.93	25.8	22.2	1.80
1.40	856	6.25	10.00	264.0	3.82	26.5	19.9	3.08
1.50	845	2.31	10.50	245.0	3.57	27.7	16.6	2.60
1.80	815	3.33	10.90	230.0	3.77	28.2	15.4	3.18
2.52	744	2.55	11.30	214.0	2.70	28.5	14.8	3.45
2.88	712	3.64	11.70	203.0	2.28	29.2	13.3	4.66
3.08	694	2.86	12.60	174.0	2.45			
3.24	679	2.86	13.30	157.0	4.36			
3.40	666	2.79	13.50	153.0	2.71			
3.65	645	2.82	14.20	136.0	3.08			
3.80	633	2.80	14.70	125.0	2.13			
3.95	620	3.77	16.40	95.8	1.56			
4.05	612	2.86	17.10	87.2	1.59			
4.25	596	4.40	18.20	71.6	1.13			
4.32	591	4.56	19.00	64.1	1.05			
4.55	573	4.58	19.50	59.7	1.13			
4.65	561	5.45	20.00	54.3	1.14			
4.75	558	6.60	20.20	53.0	1.24			
4.90	547	4.67	20.50	51.0	1.19			
5.05	536	5.53	20.70	47.4	1.28			
5.25	522	6.90	20.80	48.6	1.45			
5.50	505	5.02	20.90	47.5	1.24			
5.80	485	4.24	21.10	45.7	1.59			
6.00	472	4.29	21.60	42.2	1.26			
6.32	451	3.90	21.90	40.6	1.19			
6.40	446	3.15	22.30	38.2	1.11			
7.30	394	3.58	22.70	35.8	1.25			
7.62	376	3.66	22.90	34.5	0.96			
7.90	361	3.91	23.10	33.9	1.21			



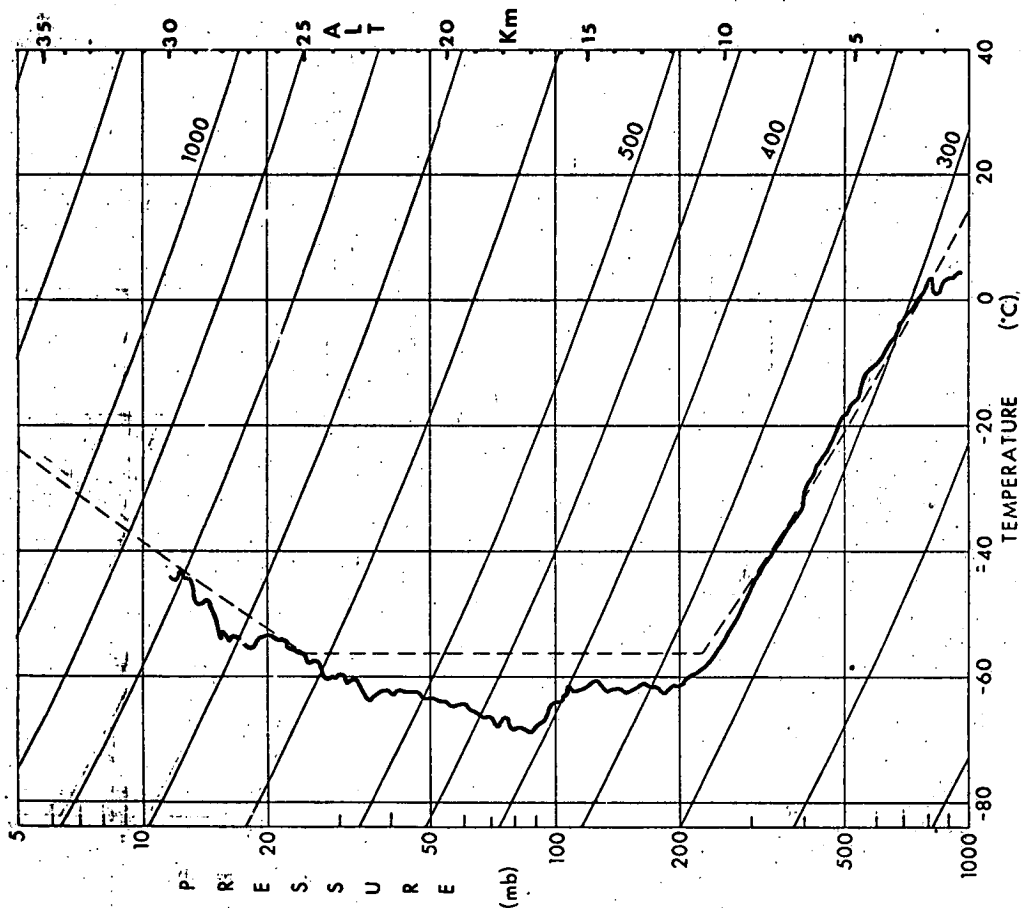
The ascent ozone concentration measured simultaneously with the dust particle concentration. Wallops Island, April 16, 1970.

OZONE
(WITH DUST COUNTER)
Wallops Island, Virginia
1970 April 16

Partial Press. (μm_B)	Partial Press. (m_B)	Alt. (km)	Partial Press. (μm_B)	Partial Press. (m_B)	Alt. (km)
210	45.7	21.15	124	21.5	26.00
210	44.6	21.30	120	21.2	26.12
220	43.9	21.40	120	20.6	26.28
212	42.6	21.58	120	20.2	26.40
200	41.9	21.70	120	19.8	26.55
192	40.6	21.88	124	19.5	26.65
190	39.9	22.00	124	19.1	26.80
184	39.4	22.10	120	18.8	26.90
196	38.5	22.25	120	18.3	27.05
192	37.6	22.40	122	18.1	27.15
180	37.0	22.50	118	17.8	27.25
168	36.1	22.65	120	17.5	27.36
160	35.3	22.80	116	17.1	27.50
160	34.8	22.90	112	16.9	27.60
156	33.9	23.05	114	16.6	27.70
160	33.4	23.16	116	16.2	27.85
170	32.7	23.30	120	15.9	27.95
172	31.9	23.45	120	15.8	28.00
170	31.2	23.60	116	15.6	28.10
160	30.5	23.75	118	15.5	28.15
160	29.8	23.90	120	15.4	28.20
160	29.3	24.02	120	15.2	28.30
158	28.4	24.18	120	15.0	28.35
160	27.9	24.30	120	14.9	28.40
152	27.3	24.45	116	14.7	28.50
160	26.7	24.58	116	14.6	28.55
140	26.3	24.70	114	14.4	28.65
140	25.7	24.84	110	14.2	28.75
150	25.1	25.00	108	13.9	28.85
140	24.7	25.10	108	13.7	28.95
144	24.3	25.22	104	13.5	29.05
138	23.8	25.36	102	13.3	29.15
140	23.3	25.50	102	13.2	29.22
150	22.9	25.60	100	13.0	29.30
140	22.4	25.75	100	12.7	29.45
138	21.9	25.90	100	12.6	29.50

OZONE
(WITH DUST COUNTER)
Wallops Island, Virginia
1970 April 16

Partial Press. (μm_B)	Partial Press. (m_B)	Alt. (km)	Partial Press. (μm_B)	Partial Press. (m_B)	Alt. (km)
180	969	0.38	90	127.00	14.65
196	943	0.60	72	123.00	14.85
200	915	0.85	58	119.00	15.05
164	893	1.05	40	116.00	15.25
200	877	1.20	40	112.00	15.45
152	856	1.40	40	108.00	15.70
160	840	1.55	40	105.00	15.92
156	820	1.75	42	99.70	16.20
140	799	1.95	42	95.80	16.45
126	785	2.10	44	92.10	16.70
130	766	2.30	46	88.30	16.90
110	749	2.48	60	85.80	17.15
100	733	2.65	66	83.10	17.35
120	714	2.84	72	79.90	17.58
104	697	3.05	80	77.40	17.78
108	683	3.20	90	75.00	18.00
88	666	3.40	94	73.30	18.16
96	651	3.58	96	71.00	18.35
94	636	3.75	100	68.80	18.55
90	622	3.92	102	67.20	18.70
94	608	4.10	100	65.10	18.88
94	593	4.30	118	64.10	19.00
106	577	4.50	120	62.10	19.18
102	562	4.70	120	61.10	19.30
98	547	4.90	100	59.70	19.45
90	535	5.08	96	58.30	19.60
98	519	5.30	120	57.40	19.72
96	505	5.50	160	55.62	19.88
88	495	5.66	160	54.75	20.00
80	482	5.85	160	53.47	20.15
72	469	6.06	172	52.22	20.30
70	454	6.28	180	51.40	20.42
70	443	6.45	172	50.20	20.55
68	431	6.65	170	49.00	20.70
56	419	6.85	180	47.90	20.85
60	408	7.05	196	46.80	21.00



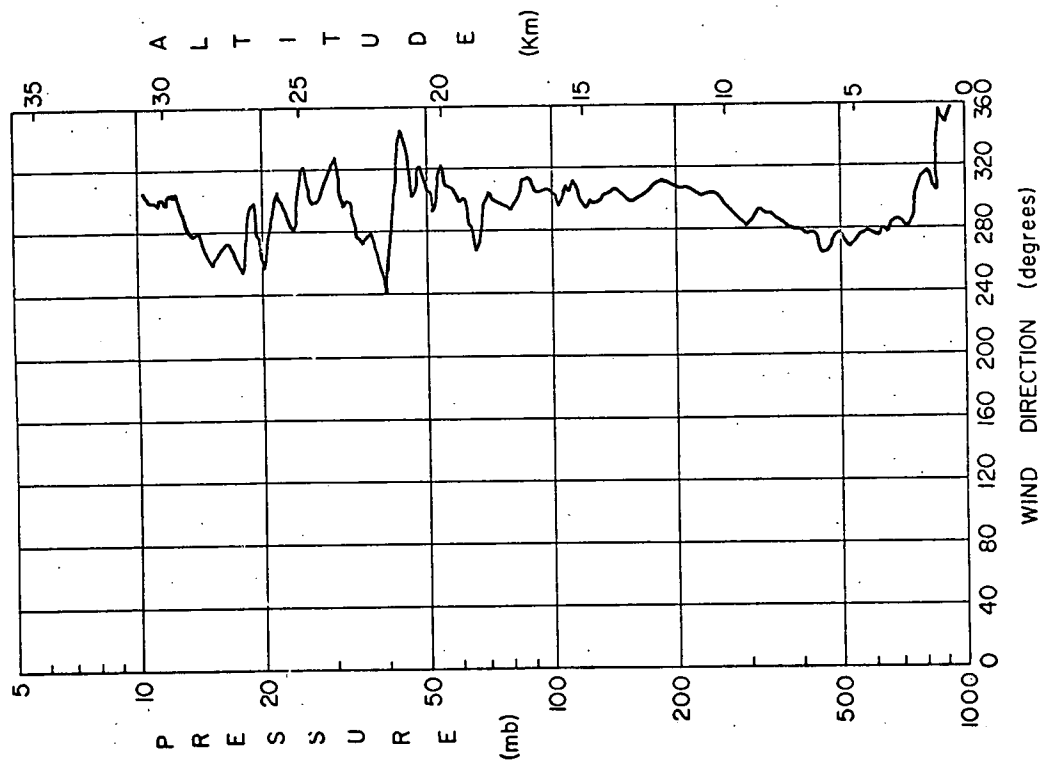
The ascent temperature profile measured simultaneously with the dust particle concentration. Wallops Island, April 16, 1970.

AIR TEMPERATURE
(WITH DUST COUNTER)
Wallops Island, Virginia
1970 April 16

Temp. °C	Alt. (km)	Press. (mb)	Temp. °C	Alt. (km)	Press. (mb)	Temp. °C	Alt. (km)	Press. (mb)
4.5	0.52	952	-31.6	7.17	400	-61.6	14.58	128.0
4.0	0.78	923	-33.5	7.36	391	-60.8	14.78	124.0
4.2	0.96	904	-34.0	7.56	380	-61.2	14.96	121.0
3.0	1.16	882	-35.7	7.76	369	-62.0	15.18	117.0
1.5	1.31	866	-37.2	7.96	359	-62.3	15.46	112.0
1.5	1.50	845	-39.0	8.18	347	-62.1	15.60	109.0
3.4	1.68	827	-40.5	8.39	336	-63.0	15.82	106.0
3.7	1.85	809	-41.8	8.59	326	-64.1	16.10	101.0
2.7	2.04	790	-43.5	8.80	316	-64.5	16.35	97.3
1.5	2.21	775	-44.6	9.00	307	-67.0	16.62	93.6
0.9	2.40	756	-46.2	9.20	298	-68.2	16.84	90.0
-0.6	2.58	740	-47.9	9.40	289	-69.0	17.05	87.2
-1.5	2.77	721	-49.6	9.60	281	-68.2	17.27	83.8
-2.6	2.96	705	-51.3	9.80	272	-68.5	17.49	81.2
-3.9	3.15	688	-53.0	10.00	264	-68.4	17.70	78.7
-5.2	3.31	675	-55.2	10.25	254	-66.4	17.89	76.2
-6.1	3.50	657	-56.7	10.48	246	-66.4	18.09	73.9
-7.0	3.68	643	-58.2	10.70	237	-68.2	18.30	71.6
-8.4	3.85	628	-59.2	10.92	229	-66.4	18.48	69.4
-9.5	4.05	612	-59.7	11.13	221	-66.8	18.65	67.8
-10.3	4.23	598	-60.5	11.37	212	-66.5	18.80	66.1
-11.1	4.41	584	-61.4	11.60	206	-66.0	18.96	64.6
-12.6	4.61	570	-62.0	11.85	198	-65.7	19.10	63.1
-13.9	4.80	555	-61.8	12.07	190	-65.7	19.25	61.6
-16.1	5.00	540	-62.8	12.28	184	-64.4	19.40	60.2
-16.9	5.20	526	-62.3	12.50	178	-64.4	19.52	59.2
-18.1	5.40	512	-62.3	12.70	173	-64.4	19.68	57.4
-19.5	5.60	498	-61.6	12.94	166	-64.6	19.80	56.5
-21.3	5.78	486	-61.2	13.15	161	-64.4	19.94	55.2
-22.9	5.98	473	-62.0	13.36	156	-64.0	20.10	53.9
-24.0	6.19	459	-62.3	13.58	150	-64.0	20.24	52.6
-25.5	6.38	448	-62.0	13.78	145	-63.5	20.37	51.4
-26.8	6.58	436	-62.0	14.00	141	-63.0	20.50	50.6
-28.5	6.77	424	-62.2	14.20	137	-63.0	20.65	49.4
-30.0	6.96	413	-62.5	14.39	132	-62.5	20.79	48.3

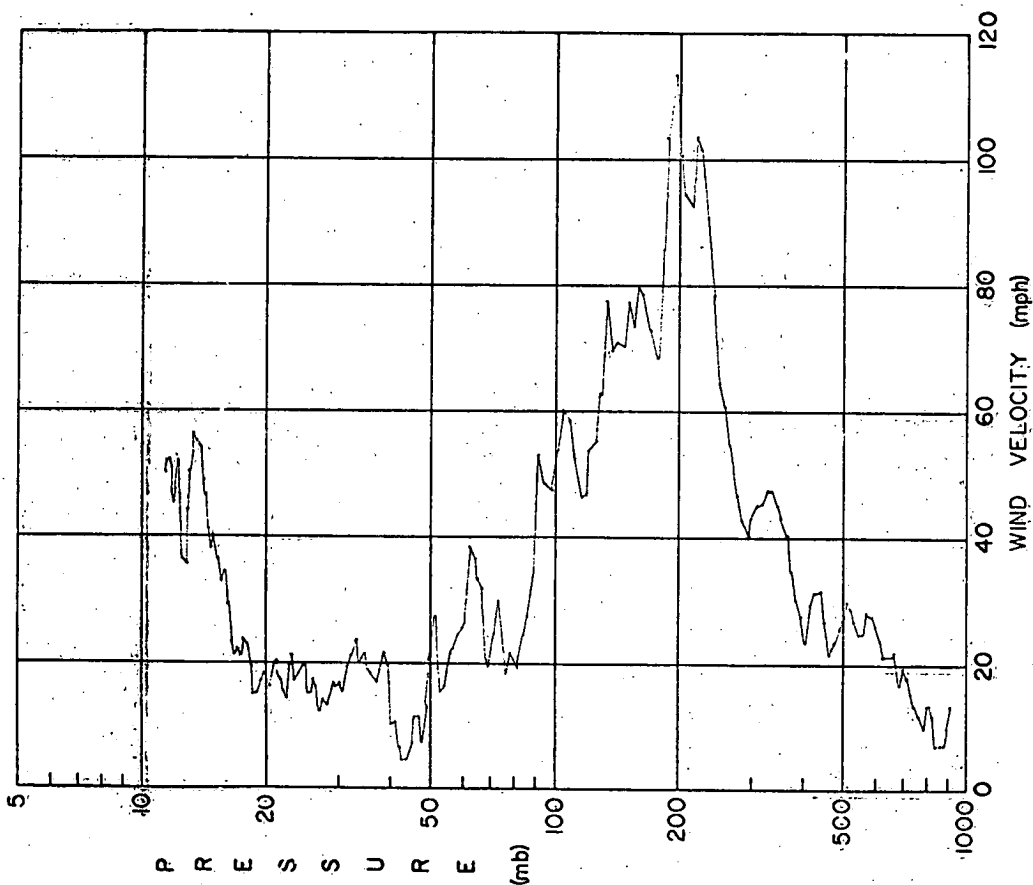
AIR TEMPERATURE
(WITH DUST COUNTER)
Wallops Island, Virginia
1970 April 16

Temp. °C	Alt. (km)	Press. (m_b)	Temp. °C	Alt. (km)	Press. (m_b)	Temp. °C	Alt. (km)	Press. (m_b)
-63.4	20.94	47.15	-55.9	25.70	22.5	-45.6	29.3	13.0
-62.7	21.08	46.05	-55.6	25.80	22.2	-44.4	29.4	12.8
-62.3	21.22	45.34	-54.6	25.95	21.7	-44.4	29.5	12.6
-62.3	21.30	44.63	-54.4	26.09	21.2	-43.7	29.6	12.4
-62.3	21.51	43.25	-54.4	26.20	20.9	-43.6	29.7	12.3
-62.4	21.65	42.25	-55.6	26.34	20.4	-44.4	29.8	12.2
-63.0	21.80	41.27	-53.4	26.48	19.9	-43.3	29.9	12.1
-63.1	21.94	40.31	-53.6	26.60	19.6	-44.4	29.9	11.9
-63.1	22.08	39.40	-53.6	26.73	19.3	-44.0	30.0	11.7
-62.3	22.20	38.80	-54.0	26.85	18.9			
-62.3	22.30	38.20	-54.4	26.95	18.5			
-62.3	22.45	37.30	-55.3	27.10	18.2			
-62.9	22.59	36.40	-55.4	27.20	17.9			
-63.3	22.72	35.90	-55.0	27.30	17.6			
-64.0	22.86	35.00	-54.5	27.45	17.2			
-64.0	23.00	34.20	-54.1	27.56	17.0			
-62.3	23.10	33.70	-53.7	27.68	16.6			
-61.4	23.24	32.90	-53.7	27.80	16.3			
-60.5	23.40	32.20	-54.0	27.91	16.1			
-60.7	23.53	31.60	-53.6	28.00	15.9			
-61.1	23.68	30.70	-52.8	28.06	15.7			
-60.5	23.82	30.20	-53.2	28.12	15.6			
-60.3	23.96	29.50	-54.1	28.20	15.4			
-60.3	24.10	28.80	-52.0	28.27	15.3			
-60.1	24.24	28.20	-51.0	28.33	15.1			
-60.2	24.40	27.50	-50.0	28.40	14.9			
-59.2	24.52	27.10	-49.3	28.45	14.8			
-58.5	24.65	26.50	-48.5	28.50	14.7			
-57.6	24.78	25.90	-48.3	28.60	14.5			
-58.0	24.92	25.50	-48.3	28.70	14.3			
-58.0	25.05	24.90	-47.7	28.80	14.0			
-57.4	25.18	24.40	-48.5	28.90	13.8			
-56.6	25.30	23.90	-48.5	29.00	13.6			
-56.2	25.44	23.40	-47.7	29.10	13.4			
-55.9	25.57	23.10	-46.7	29.20	13.2			



The ascent wind direction measured simultaneously with the dust particle concentration. Wallops Island April 16, 1970.

WIND VELOCITY (RADAR)
DUST COUNTER
Mallops Island, Virginia
1970 April 16



The ascent wind speed measured simultaneously with the dust particle concentration. Mallops Island, April 16, 1970.

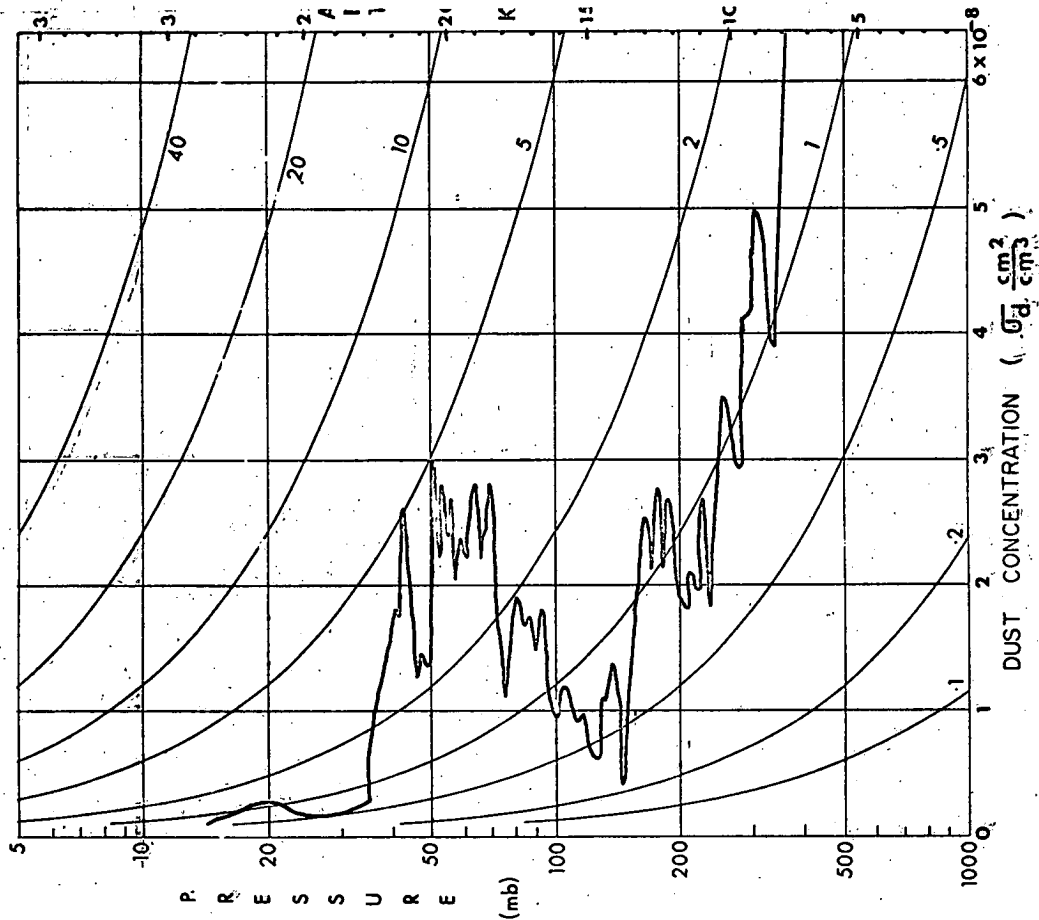
Vel. (mph)	Alt. (km)	Press. (m_b)	Wind Dir. (Degrees)	Vel. (mph)	Alt. (km)	Press. (m_b)	Wind Dir. (Degrees)
12.9	0.79	921	355	29.3	6.87	418	275
9.6	0.95	904	347	23.2	7.07	406	277
6.8	1.11	888	355	27.3	7.25	396	278
6.8	1.26	872	338	30.0	7.44	385	279
11.6	1.42	854	303	34.8	7.63	376	283
12.9	1.56	840	304	40.2	7.81	366	287
12.9	1.73	822	315	42.9	7.98	357	289
12.9	1.89	805	313	45.0	8.15	348	289
9.6	2.06	790	312	47.7	8.34	338	291
11.6	2.23	773	305	47.7	8.52	330	291
12.9	2.42	754	291	45.7	8.72	320	289
15.0	2.58	740	281	45.0	8.93	311	285
17.7	2.76	724	280	42.9	9.14	300	283
19.1	2.92	708	282	40.2	9.32	293	285
16.4	3.09	692	283	43.7	9.50	285	290
21.8	3.27	677	282	46.4	9.70	277	294
21.1	3.44	662	279	54.6	9.90	268	296
21.1	3.62	647	278	60.7	10.10	260	299
23.9	3.79	633	279	64.1	10.30	252	302
25.9	3.96	620	277	79.1	10.50	245	301
27.3	4.14	604	278	90.7	10.70	237	300
27.9	4.32	591	279	102.0	10.90	229	302
24.5	4.50	577	275	104.0	11.10	222	305
24.5	4.68	564	274	91.4	11.30	216	307
26.6	4.85	551	272	95.5	11.50	209	307
26.6	5.03	538	269	101.0	11.70	203	307
28.6	5.21	526	271	113.0	11.90	197	308
29.3	5.38	513	276	104.0	12.10	189	309
26.6	5.57	500	277	85.9	12.30	185	309
25.2	5.75	488	272	68.2	12.50	179	305
23.2	5.94	475	268	72.9	12.70	172	301
21.1	6.13	464	265	78.4	12.90	166	299
26.6	6.32	451	266	79.1	13.10	161	299
31.4	6.50	440	272	73.6	13.30	156	303
31.4	6.70	428	275	77.1	13.50	153	304

WIND VELOCITY (RADAR)
DUST COUNTER
Mallopos Island, Virginia
1970 Apr 11 16

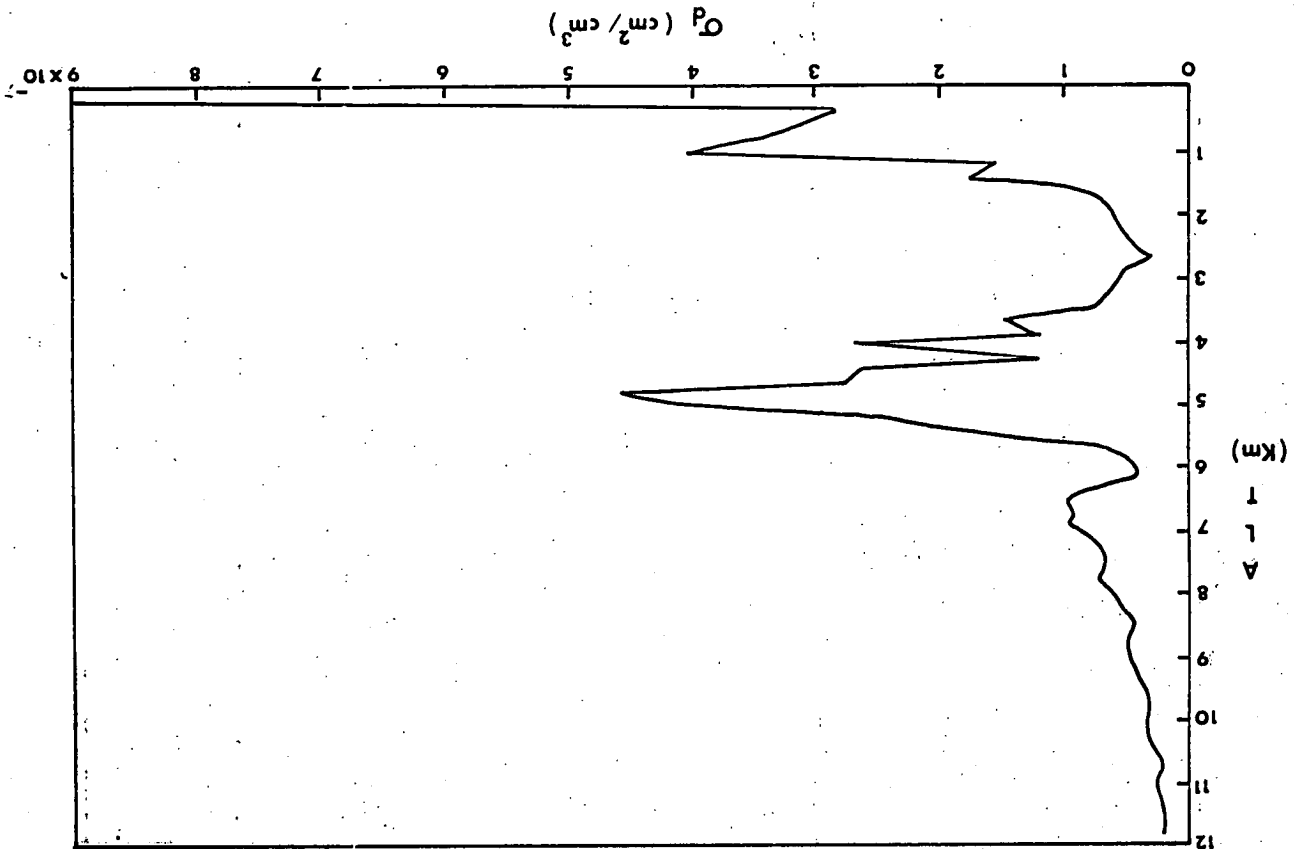
Vel. (mph)	Alt. (km)	Press. (m_b)	Wind Dir. (Degrees)	Vel. (mph)	Alt. (km)	Press. (m_b)	Wind Dir. (Degrees)
70.2	13.7	148.0	303	12.3	24.4	27.5	298
70.9	13.9	143.0	302	16.4	24.6	26.9	308
69.6	14.1	139.0	299	17.7	24.7	26.3	321
77.7	14.3	135.0	298	15.7	24.8	25.9	315
62.7	14.5	130.0	299	15.7	24.9	25.5	301
55.2	14.7	126.0	296	19.7	25.0	25.1	289
53.9	14.9	122.0	302	19.7	25.1	24.7	280
47.0	15.0	120.0	311	18.4	25.2	24.1	282
46.4	15.2	116.0	307	17.7	25.4	23.6	290
52.5	15.4	113.0	308	21.8	25.5	23.2	299
58.6	15.6	109.0	297	19.7	25.6	22.9	304
60.0	15.8	106.0	296	14.3	25.7	22.5	294
53.9	16.0	103.0	302	15.7	25.8	22.2	282
47.7	16.3	98.0	306	17.7	25.9	21.8	277
48.4	16.5	95.0	304	18.4	26.0	21.5	277
53.2	16.7	92.0	304	20.5	26.1	21.2	271
34.8	16.9	89.3	313	19.1	26.2	20.9	256
27.3	17.1	86.5	312	16.4	26.3	20.5	256
24.6	17.3	84.5	296	18.4	26.5	19.9	277
19.7	17.4	81.8	290	17.7	26.6	19.5	294
21.8	17.7	78.7	293	15.7	26.8	19.0	275
18.4	17.9	76.2	294	19.7	26.9	18.7	275
30.0	18.1	73.8	297	23.2	27.0	18.5	259
24.6	18.3	71.6	303	23.9	27.1	18.0	255
19.7	18.4	69.9	295	21.1	27.2	17.7	262
20.5	18.6	68.3	274	22.5	27.3	17.6	269
32.0	18.7	67.2	269	21.8	27.4	17.3	273
33.4	18.8	65.6	276	23.2	27.6	16.9	269
38.8	18.9	64.6	282	29.3	27.7	16.6	261
26.6	19.3	62.6	300	34.8	27.9	16.1	258
23.9	19.4	61.1	294	33.4	28.0	15.8	262
24.6	19.6	60.2	299	36.8	28.2	15.4	268
22.5	19.7	58.7	304	40.2	28.3	15.1	272
21.8	19.8	57.4	306	38.2	28.4	14.9	277
		56.5	308				278

WIND VELOCITY (RADAR)
DUST COUNTER
Mallopos Island, Virginia
1970 Apr 11 16

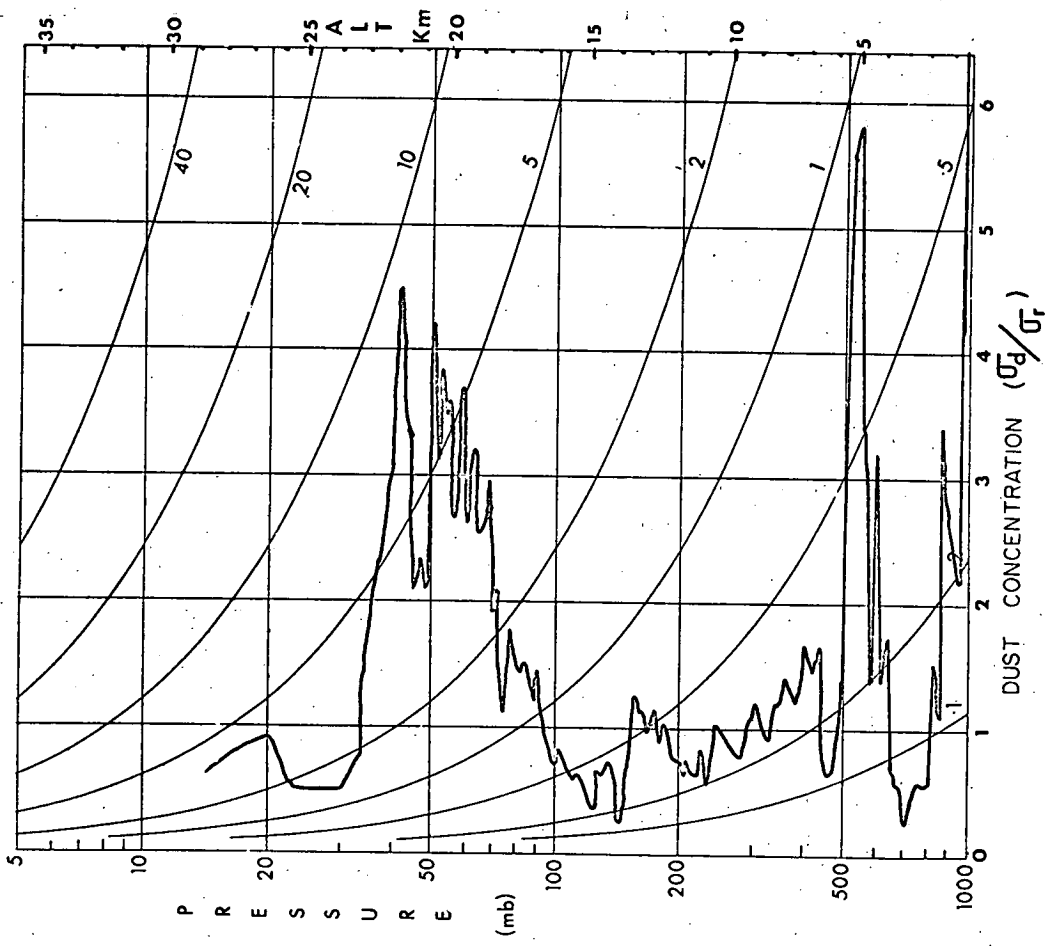
Vel. (mph)	Alt. (km)	Press. (m_b)	Wind Dir. (Degrees)	Vel. (mph)	Alt. (km)	Press. (m_b)	Wind Dir. (Degrees)
70.2	13.7	148.0	303	18.4	19.9	55.6	321
70.9	13.9	143.0	302	16.4	20.0	54.7	318
69.6	14.1	139.0	299	15.7	20.2	53.0	296
77.7	14.3	135.0	298	19.1	20.3	52.4	293
62.7	14.5	130.0	299	27.9	20.4	51.4	306
55.2	14.7	126.0	296	20.5	20.6	49.8	318
53.9	14.9	122.0	302	13.6	20.7	49.0	320
47.0	15.0	120.0	311	7.5	20.8	47.9	307
46.4	15.2	116.0	307	11.6	20.9	46.9	302
52.5	15.4	113.0	308	7.5	21.1	46.1	318
58.6	15.6	109.0	297	4.8	21.2	45.3	334
60.0	15.8	106.0	296	4.8	21.4	43.9	345
53.9	16.0	103.0	302	6.8	21.5	43.1	324
47.7	16.3	98.0	306	10.9	21.6	42.6	293
48.4	16.5	95.0	304	10.2	21.7	41.7	278
53.2	16.7	92.0	304	17.1	21.9	40.7	251
34.8	16.9	89.3	313	19.8	22.0	40.0	240
27.3	17.1	86.5	312	21.8	22.1	39.4	255
24.6	17.3	84.5	296	19.1	22.2	38.7	270
19.7	17.4	81.8	290	17.0	22.4	37.8	279
21.8	17.7	78.7	293	18.4	22.5	37.0	277
18.4	17.9	76.2	294	19.1	22.7	36.1	270
30.0	18.1	73.8	297	21.8	22.8	35.3	275
24.6	18.3	71.6	303	21.1	23.0	34.7	288
19.7	18.4	69.9	295	20.5	23.1	34.2	297
20.5	18.6	68.3	274	23.9	23.3	33.7	296
32.0	18.7	67.2	269	21.1	23.4	33.1	296
33.4	18.8	65.6	276	19.7	23.5	32.2	304
38.8	18.9	64.6	282	15.7	23.7	31.6	320
26.6	19.3	62.6	300	17.0	23.8	30.7	326
23.9	19.4	61.1	294	16.4	23.9	30.2	323
24.6	19.6	60.2	299	17.0	24.0	29.7	317
22.5	19.7	58.7	304	13.6	24.2	29.3	310
21.8	19.8	57.4	306	14.3	24.4	28.4	302
		56.5	308		24.3	27.9	298



The dust scattering crosssection (σ_d) as measured by the dust photometer.
 Wallops Island, April 16, 1970.



The dust scattering crosssection (σ_d) near the ground as measured by the dust photometer.
 Wallops Island, April 16, 1970.



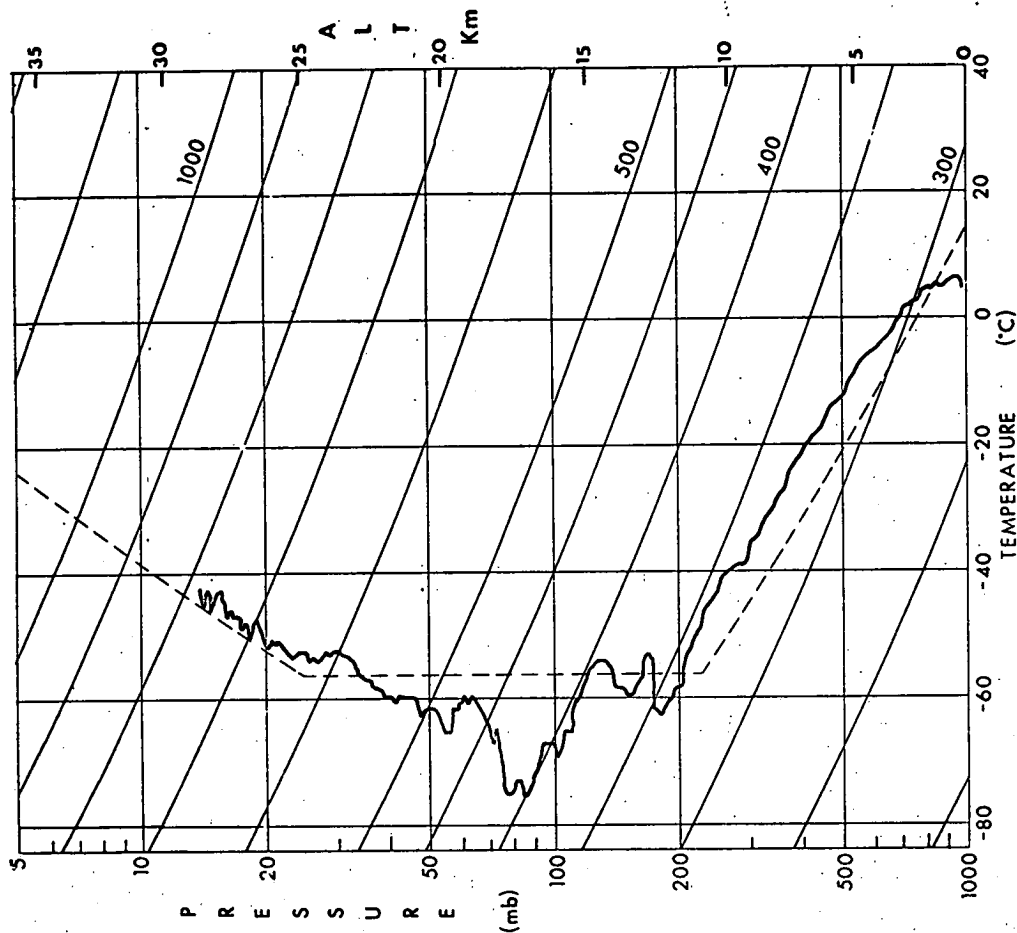
The ratio of dust scattering to molecular scattering as measured by the dust photometer. Wallops Island, April 16, 1970.

DUST PHOTOMETER SOUNDING
Wallops Island, Virginia
April 16, 1970

$\frac{\sigma_D}{\sigma_R} \times 10^{-7}$	$\frac{\sigma_D}{\sigma_R}$	Alt. (km)	Press. (mb)	$\frac{\sigma_D}{\sigma_R} \times 10^{-7}$	$\frac{\sigma_D}{\sigma_R}$	Alt. (km)	Press. (mb)
9.33	7.00	0.20	989	0.64	1.20	7.35	391
2.81	2.14	0.38	969	0.66	1.30	7.55	380
3.12	2.46	0.60	943	0.73	1.41	7.90	366
3.37	2.72	0.80	921	0.58	1.20	8.00	356
4.07	3.40	1.00	899	0.55	1.20	8.22	345
1.31	1.15	1.22	872	0.39	0.87	8.45	333
1.78	1.55	1.45	851	0.48	1.10	8.70	321
0.97	0.78	1.65	830	0.50	1.20	8.90	312
0.62	0.56	1.85	810	0.42	1.05	9.12	302
0.58	0.55	2.05	790	0.41	1.05	9.35	292
0.57	0.55	2.25	770	0.29	0.76	9.55	283
0.5	0.46	2.48	749	0.30	0.82	9.90	273
0.27	0.27	2.70	728	0.33	0.91	10.00	264
0.52	0.54	2.90	710	0.35	1.00	10.15	258
0.54	0.57	3.10	692	0.35	1.02	10.30	252
0.61	0.67	3.30	675	0.27	0.82	10.45	247
0.72	0.81	3.50	658	0.23	0.72	10.60	241
1.49	1.75	3.70	641	0.18	0.56	10.75	235
1.19	1.40	3.90	624	0.27	0.87	10.92	229
2.67	3.20	4.06	612	0.19	0.61	11.10	223
1.14	1.40	4.23	595	0.22	0.74	11.22	219
2.38	3.05	4.45	581	0.22	0.75	11.38	212
2.73	3.60	4.66	566	0.18	0.64	11.52	209
4.36	5.80	4.85	551	0.19	0.70	11.70	203
4.05	5.55	5.05	536	0.20	0.74	11.82	199
2.57	3.66	5.25	522	0.21	0.80	11.98	193
1.93	2.76	5.45	508	0.25	0.95	12.10	190
0.59	0.88	5.70	492	0.66	1.06	12.26	186
0.42	0.64	5.90	478	0.21	0.87	12.40	181
0.39	0.62	6.10	455	0.28	1.15	12.55	177
0.55	0.90	6.30	452	0.25	1.10	12.70	173
0.98	1.65	6.50	440	0.21	0.92	12.85	169
0.86	1.47	6.70	423	0.25	1.14	13.00	165
0.54	1.67	6.92	415	0.25	1.15	13.15	161
0.75	1.40	7.12	403	0.27	1.30	13.30	157

DUST PHOTOETER SOUNDING (continued)
 Wallops Island, Virginia
 April 16, 1970

σ_D $\text{cm}^2/\text{cm}^3 \times 10^{-7}$	σ_D $\text{cm}^2/\text{cm}^3 \times 10^{-7}$	Alt. (km)	Press. (mb)	σ_D $\text{cm}^2/\text{cm}^3 \times 10^{-7}$	Alt. (km)	Press. (mb)
0.180	0.86	13.42	155.0	0.240	2.65	18.70
0.145	0.72	13.58	150.0	0.220	2.50	18.85
0.050	0.25	13.70	148.0	0.280	3.20	18.96
0.040	0.21	13.85	144.0	0.255	3.00	19.10
0.110	0.58	14.00	141.0	0.240	2.90	19.20
0.140	0.74	14.15	138.0	0.220	2.60	19.30
0.118	0.65	14.30	134.0	0.300	3.70	19.43
0.110	0.61	14.40	132.0	0.240	3.00	19.55
0.110	0.64	14.55	129.0	0.220	2.80	19.65
0.050	0.35	14.70	126.0	0.200	2.62	19.77
0.062	0.37	14.85	123.0	0.270	3.60	19.88
0.065	0.40	15.00	120.0	0.260	3.50	20.00
0.100	0.64	15.20	117.0	0.280	3.82	20.12
0.090	0.59	15.35	114.0	0.220	3.10	20.25
0.096	0.64	15.55	110.0	0.295	4.20	20.36
0.113	0.78	15.70	108.0	0.210	3.04	20.50
0.118	0.84	15.90	104.0	0.190	2.85	20.60
0.094	0.69	16.05	102.0	0.140	2.10	20.70
0.091	0.68	16.22	99.6	0.136	2.10	20.80
0.100	0.77	16.40	96.6	0.149	2.35	20.95
0.180	1.20	16.58	93.6	0.130	2.10	21.08
0.160	1.45	16.72	92.1	0.124	2.05	21.20
0.166	1.21	16.90	89.3	0.200	3.32	21.35
0.167	1.42	17.05	87.2	0.203	3.40	21.45
0.177	1.53	17.20	85.1	0.260	4.55	21.60
0.174	1.57	17.38	82.5	0.213	3.75	21.70
0.180	1.65	17.52	81.2	0.173	3.10	21.85
0.190	1.80	17.70	78.7	0.180	3.30	21.95
0.160	1.54	17.82	77.4	0.082	1.70	22.78
0.110	1.03	17.96	75.6	0.065	1.40	22.90
0.180	1.80	18.10	73.9	0.032	0.70	23.00
0.210	2.12	18.20	72.7	0.020	0.49	23.72
0.230	2.40	18.30	71.6	0.014	0.51	25.50
0.280	2.95	18.75	69.9	0.025	0.52	26.40
0.245	2.65	18.60	68.3	0.012	0.60	28.74



The temperature profile measured simultaneously with the dust scattering cross-section. Wallops Island, April 16, 1970.

AIR TEMPERATURE - DUST PHOTOMETER
Wallops Island, Virginia
1970 April 16

Temp. °C	Alt. (km)	Press. (m _b)	Temp. °C	Alt. (km)	Press. (m _b)	Temp. °C	Alt. (km)	Press. (m _b)	Temp. °C	Alt. (km)	Press. (m _b)	Temp. °C	Alt. (km)	Press. (m _b)
5.0	0.20	989	-24.6	7.60	377	-58.6	13.90	143.0	-60.5	19.22	62.1	-53.5	23.42	32.2
6.5	0.45	960	-26.4	7.80	366	-58.0	14.00	141.0	-59.5	19.34	60.6	-53.0	23.55	31.4
6.3	0.65	938	-27.8	8.05	353	-54.0	14.16	138.0	-60.5	19.45	59.7	-53.0	23.75	30.4
6.0	0.86	915	-29.5	8.28	342	-54.0	14.30	134.0	-61.5	19.65	57.9	-52.2	23.85	29.9
5.1	1.05	893	-31.2	8.50	331	-54.0	14.45	131.0	-61.5	19.70	57.4	-52.2	23.96	29.5
6.0	1.25	872	-32.8	8.70	321	-54.0	14.60	128.0	-65.0	19.80	56.5	-52.2	24.10	28.8
5.1	1.50	846	-34.5	8.92	311	-54.0	14.70	126.0	-65.0	19.90	55.6	-53.0	24.20	28.4
5.5	1.68	827	-35.0	9.15	301	-55.0	14.86	122.0	-65.0	20.04	54.3	-52.2	24.30	27.9
5.0	1.88	807	-38.5	9.35	292	-57.0	15.05	119.0	-63.6	20.15	53.5	-53.0	24.40	27.3
4.5	2.10	785	-38.5	9.60	281	-59.5	15.25	116.0	-62.5	20.27	52.2	-53.5	24.60	26.7
3.5	2.30	766	-40.0	10.02	263	-60.5	15.40	113.0	-61.5	20.40	51.4	-53.5	24.70	26.3
2.3	2.50	747	-41.4	10.20	256	-65.0	15.55	111.0	-61.5	20.50	50.6	-53.0	24.80	25.9
2.0	2.70	728	-43.0	10.35	251	-65.0	15.74	107.0	-62.5	20.60	49.8	-53.5	24.95	25.3
0.8	2.95	705	-44.2	10.50	245	-66.0	15.90	104.0	-61.5	20.70	49.0	-52.2	25.05	24.9
0.0	3.10	692	-45.5	10.65	239	-69.0	16.06	102.0	-62.5	20.84	47.9	-52.2	25.18	24.3
-1.2	3.30	675	-46.7	10.80	233	-67.0	16.25	99.0	-61.5	20.96	47.1	-52.2	25.30	23.9
-2.0	3.50	658	-47.5	10.95	228	-67.0	16.45	95.8	-59.5	21.10	46.0	-53.0	25.40	23.6
-3.2	3.70	641	-49.2	11.10	223	-67.0	16.60	93.6	-59.5	21.22	45.3	-52.2	25.55	23.1
-4.6	3.90	624	-51.0	11.25	218	-70.0	16.75	91.4	-59.5	21.55	42.9	-52.2	25.65	22.7
-4.9	4.10	608	-53.0	11.40	212	-71.5	16.90	89.3	-59.5	21.58	42.7	-52.2	25.75	22.4
-6.0	4.30	593	-55.0	11.55	208	-73.0	17.05	87.2	-59.5	21.60	42.6	-52.2	25.85	22.0
-6.0	4.50	577	-58.0	11.70	202	-75.0	17.24	84.5	-60.5	21.74	41.6	-51.6	25.92	21.9
-7.4	4.70	562	-58.6	11.85	198	-73.0	17.40	82.5	-59.5	21.85	40.9	-51.0	26.04	21.3
-8.6	4.90	547	-59.5	12.00	193	-73.0	17.55	80.6	-59.5	21.96	40.3	-50.5	26.10	21.2
-10.0	5.08	533	-60.5	12.15	189	-75.0	17.72	78.7	-59.5	22.08	39.4	-51.0	26.20	20.9
-11.0	5.30	519	-61.5	12.28	184	-75.0	17.85	76.8	-59.5	22.20	38.8	-50.5	26.30	20.5
-12.0	5.50	505	-62.5	12.42	182	-70.0	17.98	75.0	-59.5	22.30	38.2	-51.0	26.40	20.2
-12.3	5.70	492	-61.5	12.60	176	-66.0	18.10	73.9	-58.0	22.40	37.3	-51.0	26.50	19.9
-13.6	5.90	478	-55.0	12.72	173	-65.0	18.22	72.7	-58.0	22.56	36.7	-51.0	26.60	19.6
-15.0	6.12	464	-53.5	12.86	169	-67.0	18.35	71.0	-57.0	22.68	35.9	-49.4	26.70	19.3
-16.8	6.32	451	-54.0	13.02	165	-65.0	18.46	69.9	-57.0	22.80	35.3	-48.2	26.76	19.2
-18.0	6.54	437	-56.2	13.16	161	-63.6	18.60	68.3	-57.0	22.85	35.0	-47.6	26.85	18.9
-19.2	6.76	425	-58.0	13.30	157	-62.5	18.72	67.2	-57.0	22.90	34.8	-47.2	26.95	18.6
-20.0	6.96	413	-59.5	13.45	154	-61.5	18.86	65.6	-57.0	22.95	34.5	-48.2	27.05	18.3
-21.2	7.18	401	-59.5	13.60	150	-60.5	19.00	64.1	-55.6	23.25	32.9	-49.4	27.15	18.1
-22.7	7.40	388	-58.6	13.72	148	-59.5	19.10	63.1	-54.0	23.35	32.4	-47.6	27.25	17.8

AIR TEMPERATURE - DUST PHOTOMETER
Wallops Island, Virginia
1970 April 16

Temp. °C	Alt. (km)	Press. (m _b)	Temp. °C	Alt. (km)	Press. (m _b)	Temp. °C	Alt. (km)	Press. (m _b)
-48.2	27.35	32.2	-48.2	27.35	32.2	-48.2	27.35	32.2
-48.2	27.42	31.4	-48.2	27.42	31.4	-48.2	27.42	31.4
-46.8	27.50	30.4	-46.8	27.50	30.4	-46.8	27.50	30.4
-46.5	27.55	29.9	-46.5	27.55	29.9	-46.5	27.55	29.9
-46.5	27.60	29.5	-46.5	27.60	29.5	-46.5	27.60	29.5
-45.5	27.68	28.8	-45.5	27.68	28.8	-45.5	27.68	28.8
-46.5	27.75	28.4	-46.5	27.75	28.4	-46.5	27.75	28.4
-44.2	27.80	27.9	-44.2	27.80	27.9	-44.2	27.80	27.9
-46.5	27.90	27.3	-46.5	27.90	27.3	-46.5	27.90	27.3
-44.2	27.95	26.7	-44.2	27.95	26.7	-44.2	27.95	26.7
-43.0	28.00	26.3	-43.0	28.00	26.3	-43.0	28.00	26.3
-44.0	28.02	25.9	-44.0	28.02	25.9	-44.0	28.02	25.9
-42.8	28.06	25.3	-42.8	28.06	25.3	-42.8	28.06	25.3
-42.0	28.10	24.9	-42.0	28.10	24.9	-42.0	28.10	24.9
-42.0	28.14	24.3	-42.0	28.14	24.3	-42.0	28.14	24.3
-43.5	28.18	23.9	-43.5	28.18	23.9	-43.5	28.18	23.9
-43.0	28.25	23.6	-43.0	28.25	23.6	-43.0	28.25	23.6
-43.0	28.30	23.1	-43.0	28.30	23.1	-43.0	28.30	23.1
-42.0	28.31	22.7	-42.0	28.31	22.7	-42.0	28.31	22.7
-42.0	28.36	22.4	-42.0	28.36	22.4	-42.0	28.36	22.4
-44.2	28.40	22.0	-44.2	28.40	22.0	-44.2	28.40	22.0
-43.0	28.45	21.9	-43.0	28.45	21.9	-43.0	28.45	21.9
-43.5	28.50	21.3	-43.5	28.50	21.3	-43.5	28.50	21.3
-42.0	28.58	21.2	-42.0	28.58	21.2	-42.0	28.58	21.2
-42.8	28.61	20.9	-42.8	28.61	20.9	-42.8	28.61	20.9
-41.8	28.68	20.5	-41.8	28.68	20.5	-41.8	28.68	20.5
-41.0	28.70	20.2	-41.0	28.70	20.2	-41.0	28.70	20.2
-41.8	28.70	19.9	-41.8	28.70	19.9	-41.8	28.70	19.9
-42.0	28.71	19.6	-42.0	28.71	19.6	-42.0	28.71	19.6
-45.0	28.73	19.3	-45.0	28.73	19.3	-45.0	28.73	19.3
-42.0	28.75	19.2	-42.0	28.75	19.2	-42.0	28.75	19.2
-42.0	28.75	18.9	-42.0	28.75	18.9	-42.0	28.75	18.9
-42.0	28.75	18.6	-42.0	28.75	18.6	-42.0	28.75	18.6
-41.8	28.78	18.3	-41.8	28.78	18.3	-41.8	28.78	18.3
-42.0	28.80	18.1	-42.0	28.80	18.1	-42.0	28.80	18.1
-41.6	28.80	17.8	-41.6	28.80	17.8	-41.6	28.80	17.8
-42.0	28.80	17.5	-42.0	28.80	17.5	-42.0	28.80	17.5

APPENDIX II

Dust Photometer

This instrument essentially measures light scattered by a small volume-element of air. By alternating between samples of dust-free air and ambient air, both the molecular scattering and total scattering can be obtained. Several commercial forms of this instrument are available, but none of them are sensitive enough to measure the molecular scattering, because most of the background signal originates from light scattered off the walls into the photomultiplier. A schematic diagram of the instrument is shown in Figures 1 and 2. The effective scattering angle is about 25 degrees from the forward direction. By opening and closing the valve in the flow system (Fig. 2) the sample is switched between ambient air and clean air. This chopping technique eliminates the need for calibration (all measurements are automatically made in terms of molecular scattering), and the measurement itself is almost completely insensitive to instrument malfunction or drift. By measuring the ambient pressure during the balloon ascent the validity of the data can be determined by noting that the molecular scattering should be proportional to the pressure. If for some reason this is not the case, a correction can be made and the data is not lost.

The effective color temperature of the light source is about 3200°K and plays an important role in the interpretation of the results. The color response of the photomultiplier also plays an important role. By changing the light source temperature the measured ratio of total scattering to molecular scattering will also change. If the color temperature of the light source were 6000°K (about the temperature of the sun's surface), for instance, the above ratio could be expected to be about a factor of 2 smaller. These facts should be kept in mind when comparing the results of the dust photometer with other results, although factors of 2 are frequently not very important.

The flight configuration of the instrument is similar to that shown in Figure 4. All functions of the detector are electronically controlled: the only mechanical movement is that of the pumps and valve. The data cycle starts with a reference voltage and is followed by the ambient air temperature measurement. Next, the light source is turned on for five seconds and its intensity is kept constant by means of a temperature-compensated photo-diode regulator circuit. During this time the photomultiplier and associated circuitry integrate the total scattered light from the sensitive volume. In this mode the valve is kept closed and

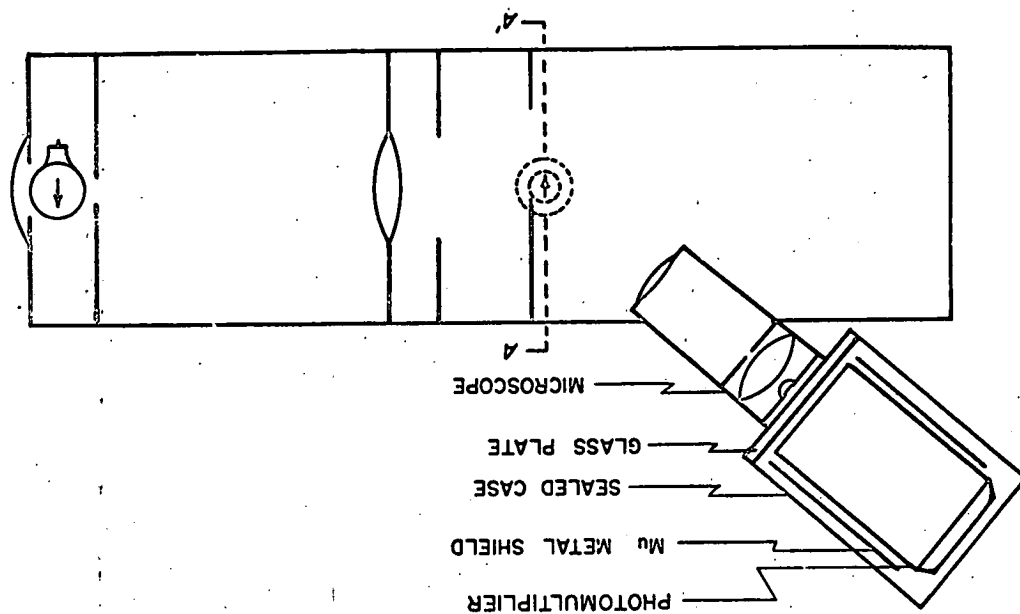


Figure 1: A schematic diagram of the optical system of the dust photometer.

scattering from the ambient air is measured. The next part of the cycle consists of an air temperature measurement inside the scattering chamber. This data can be used to make a temperature correction to the scattering measurements. For the last part of the cycle the valve is opened and no ambient air can be brought into the scattering chamber. With the valve open only dust-free air is in the scattering chamber. The light source is turned on again for five seconds and the output of the photomultiplier is integrated again over this time period. This results in a measurement of the background light, which is made up of light scattered from the dust-free air and from the walls. The amount of light scattered from the walls is only about 1% but must be taken into account only for low pressure measurements. The difference between the ambient air measurement and the clean air measurement is the scattering that comes from the aerosol alone and is not affected by the background light. The ratio of total scattering to molecular scattering can also be computed, but a correction of a geometric origin must first be applied: the illuminated volume element as "seen" by the photomultiplier is about twice as large as the volume occupied by the ambient air when it passes through the light beam. That is, the entire sensitive volume element cannot be filled with ambient air and the resulting aerosol measurement is too low. Keeping this in mind, the ratio of total scattering to molecular scattering can be computed but not directly from the data.

Although calibration of the instrument is not necessary, two aerosols made of material with very different optical properties were observed. The first aerosol was made from a black dye, and the particles themselves did not transmit light. The second aerosol was made from a clear substance with a high index of refraction. Both aerosols had the same size distribution and over half of the particles were less than .1 micron diameter. The dust photometer gave a 20% higher response to the clear aerosol than the black dye aerosol. Thus for the size distribution used here, the response of the instrument is not very sensitive to the optical properties of the material from which the aerosol is made.

By using a calibrated photomultiplier the absolute value of the amount of light scattered by the element of volume can be determined. Knowing this value and the intensity of the light source, the absolute scattering crosssection of the ambient air or clear air can be computed. This calibration was made and then checked against the known value for molecular scattering. The two values were within the experimental error. Thus some confidence can be placed in the absolute values of the scattering crosssection measured for the aerosol. However, due

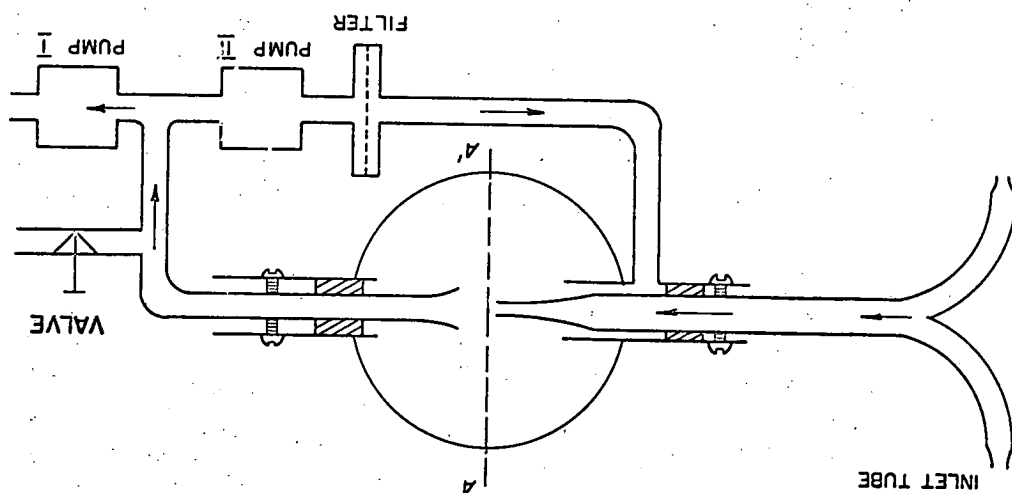


Figure 2:
A schematic diagram of the air flow system in the dust photometer.

to the many uncertainties, the absolute values should be considered to have an accuracy of only 50%.

One of the major advantages of this instrument is that it can be tested under controlled pressure and dust conditions in the laboratory. The instrument was put in a vacuum chamber along with a non-volatile aerosol and the pressure was slowly decreased. The results of this test are shown in Figure 3. Both the background and aerosol concentration start to decrease at a rate proportional to the pressure--just as expected. At very low pressures the light scattered from the walls becomes increasingly more important and the background light approaches a constant value. At pressures below about 20 mb the response of the instrument to the aerosol is no longer proportional to the pressure. This is due to the onset of an extremely different flow regime in the scattering chamber. Thus the maximum altitude to which the dust photometer will function properly is about 20 mb, or 85,000 ft.

During the actual balloon flight test, the instrument functioned normally. There is no reason to believe that the data is invalid due to instrument malfunction. The results of the field test are discussed in a previous section of this report.

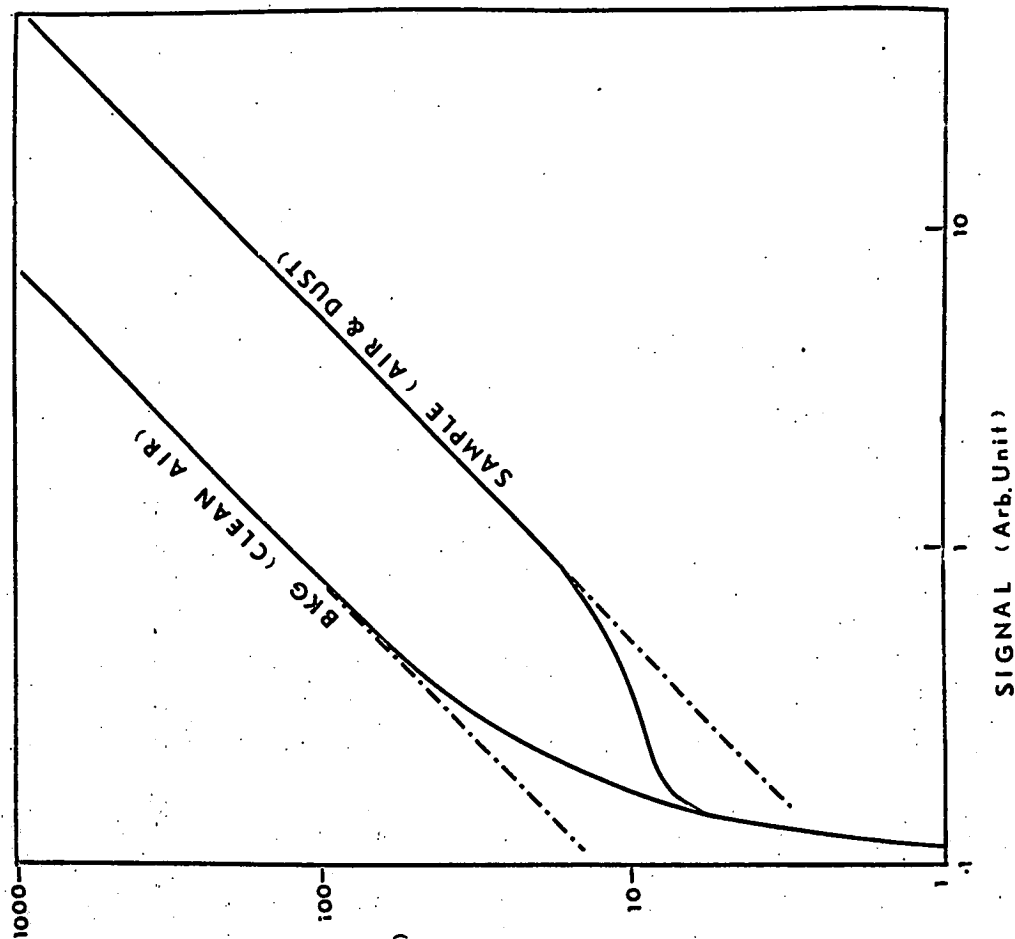


Figure 3: The results of environmental tests conducted on the dust photometer. Ideally, the response should be 2 parallel straight lines at 45° degrees.

APPENDIX III

Description of the Miniature Aerosol Particle Counter:

The Dustsonde

This detector is essentially the same as the original particle counter except that it has been miniaturized. The geometry of the scattering chamber, however, has not been changed. Most of the electronics were improved, miniaturized and made to operate from a single battery power supply. In addition, great care was taken to make all the parts as lightweight as possible. Some short-cut techniques for construction were also developed.

Many improvements were made in the over-all operation of the system. By use of a special valve, background measurements with clean air are made automatically at regular intervals. The intensity of the light source is regulated to better than 1% by means of a temperature compensated photo-diode. The previous 34 pounds of batteries have been replaced by 5 pounds of silver cells. The smaller gondola for the instrument conveniently fits into presently available environmental chambers for testing.

A method was developed for using a small amount of potting compound on the photomultipliers to keep the weight down and yet prevent high voltage breakdown at low pressures.

The pulse height analyzer is the only electronic component that was not changed. This situation should be corrected since the weight could be reduced by redesign. In addition, the number of channels should be increased from two to five.

The final flight configuration is shown in Figure 4. The weight of the instrument with the two pound ozone detector was 24 pounds and carried enough batteries for about 3.5 hours of operation. The data was telemetered using a standard GUD transmitting and receiving system. For the test flight, the instrument was carried to 100,000 feet by a rubber balloon. No instrument malfunctions were encountered and the data obtained was similar to that obtained with the other particle counters.

The above described dustsonde has the following advantages over other sampling methods:

1. It is not experimental in nature but is fully developed and operational. The small size and weight of the device make it a practical method for sounding the atmosphere.
2. Recovery of the instrument is not necessary to obtain the data.
3. The device can easily be flown anywhere in the world.
4. The sample is made in situ, preventing the volatile particles from evaporating before detection.
5. It is not possible for the instrument to give a false indication due to contamination from passage through a high concentration of tropospheric dust.
6. An essentially continuous profile of atmospheric dust concentration is obtained from ground level to 100,000 feet.
7. The instrument is suitable for a standardized sampling technique and can easily be reproduced by other interested scientists.

