CALCULATION OF RETROREFLECTOR ARRAY TRANSFER FUNCTIONS

Final Technical Report

for

NASA Grant NGR 09-015-196

Principal Investigator:

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ABSTRACT

This report covers the work performed under NASA Grant NGR 09-015-096. Computer programs have been developed for calculating the transfer function of a retroreflector array. The transfer functions provide range corrections and effective reflecting areas for the retroreflector arrays carried by satellites now in orbit. This information can be used to estimate laser-echo signal strengths and to correct laser range measurements in order to obtain the range to the center of mass of the satellite. The values are tabulated for various angles of incidence of the laser beam with respect to the symmetry axis of the satellite. Transfer functions have been computed for the following:

BE-B	(1964 64A)	Magnetically stabilized
BE-C	(1965 32A)	Magnetically stabilized
Geos 1	(1965 89A)	Gravity stabilized
D1C	(1967 11A)	Magnetically stabilized
D1D	(1967 14A)	Magnetically stabilized
Geos 2	(1968 2A)	Gravity stabilized
Peole	(1970 109A)	Gravity stabilized
Geos C		Gravity stabilized

(Partial information only: to be launched in 1974)

CALCULATION OF RETROREFLECTOR
ARRAY TRANSFER FUNCTIONS

Final Technical Report

1. INTRODUCTION

This report includes technical data on the geometry of the arrays carried by the seven retroreflector satellites now in orbit; their transfer functions, which give range corrections and effective reflecting areas; and a brief description of the method used in the computer programs developed for doing the calculations.

Data on the Beacon and Geos retroreflector arrays were obtained from the Applied Physics Laboratory of Johns Hopkins University, and those on the Peole and Diademe satellites were supplied by M. Lefebvre of the Groupe de Recherches de Géodesie Spatiale, Brétigny, France.

The major limitation on the accuracy with which transfer functions can be determined for the existing laser satellites is the lack of precise information on the beam patterns of the cube corners in conjunction with the large size of the arrays.

2. RETROREFLECTOR ARRAYS

2.1 Notation and Definitions

A retroreflector array is defined by specifying the geometry and optical parameters of the retroreflectors and the position and orientation of each reflector. The origin of coordinates is the satellite's center of mass in the orbital configuration. The z axis is parallel to the symmetry axis of the satellite. For gravity-stabilized satellites, the z axis points toward the earth, while for magnetically stabilized satellites, it points in the direction of the north-seeking end of the spacecraft. The orientation of each corner cube is specified by the two angles θ and ϕ, which give the direction of the normal to the front face of the reflector, and a third angle α, which gives the rotation of the reflector about the normal to the front face. In Figure 1, the x', y', z' coordinate system, in which the orientation of the corner cube θ, ϕ is specified, is parallel to the x, y, z coordinate system of the satellite. In Figure 2, which shows the angle α, the β and γ axes are in the direction of increasing θ and decreasing ϕ, respectively; the plane is the front face of the reflector.
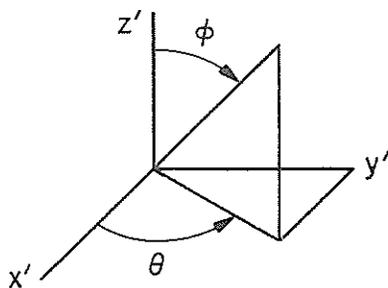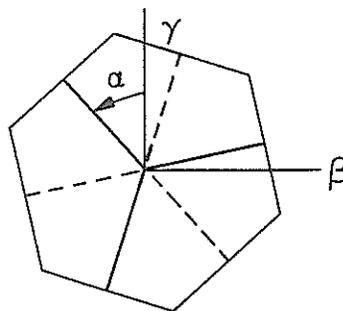

Figure 1.   Figure 2.

2.2 Cube-Corner Specifications

The retroreflectors carried by the seven laser satellites now in orbit are all hexagonal fused-silica cube corners with reflective coatings applied to the back faces.

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The satellites BE-B, BE-C, Geos 1, and Geos 2 have cube corners 2.49 cm across flats and are 1.76 cm long from vertex to face. The full divergence angle is specified as not exceeding 12 arcsec. The reflectors on D1C, D1D, and Peole have a face cut to a hexagon 18 mm on a side (3.12 cm across flats). The deviations D_i between the incident light and the six reflected beams are specified as being between 1 and 8 arcsec. In addition, the deviations must satisfy the condition

$$\sum_{i=1}^{6} (8 - D_i) < 30 \quad .$$

2.3 Geometry of Arrays

Table 1 gives the positions and orientations of the retroreflectors for each of the seven satellites now in orbit. The first three numbers in each row are the panel, row, and individual retroreflector indices. Following are the x, y, and z coordinates, in meters, of the center of the front face of the reflector. The next three numbers are the orientation angles θ, ϕ, and α, in radians. Geos C has been omitted from this table because no information on its center of mass is yet available. As this report was being prepared, more precise information was received on the positions of the retroreflectors carried by D1C, D1D, and Peole. These data are contained in a note received by M. Lefebvre dated November 14, 1972.

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Table 1. Positions and orientations of the retroreflectors.

PANEL	ROW	UNIT	X	Y	Z	THETA	PHI	ALPHA
0	1	1	-.02540	.08799	.39555	-1.57080	0.00000	1.57080
0	1	3	.02540	.08799	.39555	-1.57080	0.00000	1.57080
0	2	1	-.03810	.06599	.39555	-1.57080	0.00000	1.57080
0	2	2	-.01270	.06599	.39555	-1.57080	0.00000	1.57080
0	2	3	.01270	.06599	.39555	-1.57080	0.00000	1.57080
0	2	4	.03810	.06599	.39555	-1.57080	0.00000	1.57080
0	3	1	-.07620	.04399	.39555	-1.57080	0.00000	1.57080
0	3	2	-.05080	.04399	.39555	-1.57080	0.00000	1.57080
0	3	3	-.02540	.04399	.39555	-1.57080	0.00000	1.57080
0	3	4	-.00000	.04399	.39555	-1.57080	0.00000	1.57080
0	3	5	.02540	.04399	.39555	-1.57080	0.00000	1.57080
0	3	6	.05080	.04399	.39555	-1.57080	0.00000	1.57080
0	3	7	.07620	.04399	.39555	-1.57080	0.00000	1.57080
0	4	1	-.08890	.02200	.39555	-1.57080	0.00000	1.57080
0	4	2	-.06350	.02200	.39555	-1.57080	0.00000	1.57080
0	4	3	-.03810	.02200	.39555	-1.57080	0.00000	1.57080
0	4	6	.03810	.02200	.39555	-1.57080	0.00000	1.57080
0	4	7	.06350	.02200	.39555	-1.57080	0.00000	1.57080
0	4	8	.08890	.02200	.39555	-1.57080	0.00000	1.57080
0	5	1	-.05080	-.00000	.39555	-1.57080	0.00000	1.57080
0	5	5	.05080	.00000	.39555	-1.57080	0.00000	1.57080
0	6	1	-.08890	-.02200	.39555	-1.57080	0.00000	1.57080
0	6	2	-.06350	-.02200	.39555	-1.57080	0.00000	1.57080
0	6	3	-.03810	-.02200	.39555	-1.57080	0.00000	1.57080
0	6	6	.03810	-.02200	.39555	-1.57080	0.00000	1.57080
0	6	7	.06350	-.02200	.39555	-1.57080	0.00000	1.57080
0	6	8	.08890	-.02200	.39555	-1.57080	0.00000	1.57080
0	7	1	-.07620	-.04399	.39555	-1.57080	0.00000	1.57080
0	7	2	-.05080	-.04399	.39555	-1.57080	0.00000	1.57080
0	7	3	-.02540	-.04399	.39555	-1.57080	0.00000	1.57080
0	7	4	.00000	-.04399	.39555	-1.57080	0.00000	1.57080
0	7	5	.02540	-.04399	.39555	-1.57080	0.00000	1.57080
0	7	6	.05080	-.04399	.39555	-1.57080	0.00000	1.57080
0	7	7	.07620	-.04399	.39555	-1.57080	0.00000	1.57080
0	8	1	-.03810	-.06599	.39555	-1.57080	0.00000	1.57080
0	8	2	-.01270	-.06599	.39555	-1.57080	0.00000	1.57080
0	8	3	.01270	-.06599	.39555	-1.57080	0.00000	1.57080
0	8	4	.03810	-.06599	.39555	-1.57080	0.00000	1.57080
0	9	1	-.02540	-.08799	.39555	-1.57080	0.00000	1.57080
0	9	3	.02540	-.08799	.39555	-1.57080	0.00000	1.57080
1	1	1	-.02540	-.13139	.36744	-1.57080	.94248	1.57080
1	1	2	.00000	-.13139	.36744	-1.57080	.94248	1.57080
1	1	3	.02540	-.13139	.36744	-1.57080	.94248	1.57080
1	2	1	-.03810	-.14432	.34964	-1.57080	.94248	1.57080
1	2	2	-.01270	-.14432	.34964	-1.57080	.94248	1.57080
1	2	3	.01270	-.14432	.34964	-1.57080	.94248	1.57080
1	2	4	.03810	-.14432	.34964	-1.57080	.94248	1.57080
1	3	1	-.02540	-.15725	.33184	-1.57080	.94248	1.57080
1	3	2	.00000	-.15725	.33184	-1.57080	.94248	1.57080
1	3	3	.02540	-.15725	.33184	-1.57080	.94248	1.57080

Table 1. (Cont.)

BEACON (CONT.)

PANEL	ROW	UNIT	X	Y	Z	THETA	PHI	ALPHA
1	4	1	-.03810	-.17017	.31405	-1.57080	.94248	1.57080
1	4	2	-.01270	-.17017	.31405	-1.57080	.94248	1.57080
1	4	3	.01270	-.17017	.31405	-1.57080	.94248	1.57080
1	4	4	.03810	-.17017	.31405	-1.57080	.94248	1.57080
1	5	1	-.05080	-.18310	.29625	-1.57080	.94248	1.57080
1	5	2	-.02540	-.18310	.29625	-1.57080	.94248	1.57080
1	5	3	.00000	-.18310	.29625	-1.57080	.94248	1.57080
1	5	4	.02540	-.18310	.29625	-1.57080	.94248	1.57080
1	5	5	.05080	-.18310	.29625	-1.57080	.94248	1.57080
1	6	1	-.03810	-.19603	.27846	-1.57080	.94248	1.57080
1	6	2	-.01270	-.19603	.27846	-1.57080	.94248	1.57080
1	6	3	.01270	-.19603	.27846	-1.57080	.94248	1.57080
1	6	4	.03810	-.19603	.27846	-1.57080	.94248	1.57080
1	7	1	-.05080	-.20896	.26066	-1.57080	.94248	1.57080
1	7	2	-.02540	-.20896	.26066	-1.57080	.94248	1.57080
1	7	3	.00000	-.20896	.26066	-1.57080	.94248	1.57080
1	7	4	.02540	-.20896	.26066	-1.57080	.94248	1.57080
1	7	5	.05080	-.20896	.26066	-1.57080	.94248	1.57080
1	8	1	-.06350	-.22189	.24287	-1.57080	.94248	1.57080
1	8	2	-.03810	-.22189	.24287	-1.57080	.94248	1.57080
1	8	3	-.01270	-.22189	.24287	-1.57080	.94248	1.57080
1	8	4	.01270	-.22189	.24287	-1.57080	.94248	1.57080
1	8	5	.03810	-.22189	.24287	-1.57080	.94248	1.57080
1	8	6	.06350	-.22189	.24287	-1.57080	.94248	1.57080
1	9	1	-.07620	-.23482	.22507	-1.57080	.94248	1.57080
1	9	2	-.05080	-.23482	.22507	-1.57080	.94248	1.57080
1	9	3	-.02540	-.23482	.22507	-1.57080	.94248	1.57080
1	9	5	.02540	-.23482	.22507	-1.57080	.94248	1.57080
1	9	6	.05080	-.23482	.22507	-1.57080	.94248	1.57080
1	9	7	.07620	-.23482	.22507	-1.57080	.94248	1.57080
2	1	1	.07494	-.11086	.36744	-.78540	.94248	1.57080
2	1	2	.09290	-.09290	.36744	-.78540	.94248	1.57080
2	1	3	.11086	-.07494	.36744	-.78540	.94248	1.57080
2	2	1	.07511	-.12899	.34964	-.78540	.94248	1.57080
2	2	2	.09307	-.11103	.34964	-.78540	.94248	1.57080
2	2	3	.11103	-.09307	.34964	-.78540	.94248	1.57080
2	2	4	.12899	-.07511	.34964	-.78540	.94248	1.57080
2	3	1	.09323	-.12915	.33184	-.78540	.94248	1.57080
2	3	2	.11119	-.11119	.33184	-.78540	.94248	1.57080
2	3	3	.12915	-.09323	.33184	-.78540	.94248	1.57080
2	4	1	.09339	-.14727	.31405	-.78540	.94248	1.57080
2	4	2	.11135	-.12931	.31405	-.78540	.94248	1.57080
2	4	3	.12931	-.11135	.31405	-.78540	.94248	1.57080
2	4	4	.14727	-.09339	.31405	-.78540	.94248	1.57080
2	5	1	.09355	-.16539	.29625	-.78540	.94248	1.57080
2	5	2	.11151	-.14743	.29625	-.78540	.94248	1.57080
2	5	3	.12947	-.12947	.29625	-.78540	.94248	1.57080
2	5	4	.14743	-.11151	.29625	-.78540	.94248	1.57080
2	5	5	.16539	-.09355	.29625	-.78540	.94248	1.57080
2	6	1	.11168	-.16556	.27846	-.78540	.94248	1.57080

Table 1. (Cont.)

BEACON (CONT.)

PANEL	ROW	UNIT	X	Y	Z	THETA	PHI	ALPHA
2	6	2	.12964	-.14760	.27846	-.78540	.94248	1.57080
2	6	3	.14760	-.12964	.27846	-.78540	.94248	1.57080
2	6	4	.16556	-.11168	.27846	-.78540	.94248	1.57080
2	7	1	.11184	-.18368	.26066	-.78540	.94248	1.57080
2	7	2	.12980	-.16572	.26066	-.78540	.94248	1.57080
2	7	3	.14776	-.14776	.26066	-.78540	.94248	1.57080
2	7	4	.16572	-.12980	.26066	-.78540	.94248	1.57080
2	7	5	.18368	-.11184	.26066	-.78540	.94248	1.57080
2	8	1	.11200	-.20180	.24287	-.78540	.94248	1.57080
2	8	2	.12996	-.18384	.24287	-.78540	.94248	1.57080
2	8	3	.14792	-.16588	.24287	-.78540	.94248	1.57080
2	8	4	.16588	-.14792	.24287	-.78540	.94248	1.57080
2	8	5	.18384	-.12996	.24287	-.78540	.94248	1.57080
2	8	6	.20180	-.11200	.24287	-.78540	.94248	1.57080
2	9	1	.11216	-.21992	.22507	-.78540	.94248	1.57080
2	9	2	.13012	-.20196	.22507	-.78540	.94248	1.57080
2	9	3	.14808	-.18400	.22507	-.78540	.94248	1.57080
2	9	5	.18400	-.14808	.22507	-.78540	.94248	1.57080
2	9	6	.20196	-.13012	.22507	-.78540	.94248	1.57080
2	9	7	.21992	-.11216	.22507	-.78540	.94248	1.57080
3	1	1	.13139	-.02540	.36744	0.00000	.94248	1.57080
3	1	2	.13139	-.00000	.36744	0.00000	.94248	1.57080
3	1	3	.13139	.02540	.36744	0.00000	.94248	1.57080
3	2	1	.14432	-.03810	.34964	0.00000	.94248	1.57080
3	2	2	.14432	-.01270	.34964	0.00000	.94248	1.57080
3	2	3	.14432	.01270	.34964	0.00000	.94248	1.57080
3	2	4	.14432	.03810	.34964	0.00000	.94248	1.57080
3	3	1	.15725	-.02540	.33184	0.00000	.94248	1.57080
3	3	2	.15725	-.00000	.33184	0.00000	.94248	1.57080
3	3	3	.15725	.02540	.33184	0.00000	.94248	1.57080
3	4	1	.17017	-.03810	.31405	0.00000	.94248	1.57080
3	4	2	.17017	-.01270	.31405	0.00000	.94248	1.57080
3	4	3	.17017	.01270	.31405	0.00000	.94248	1.57080
3	4	4	.17017	.03810	.31405	0.00000	.94248	1.57080
3	5	1	.18310	-.05080	.29625	0.00000	.94248	1.57080
3	5	2	.18310	-.02540	.29625	0.00000	.94248	1.57080
3	5	3	.18310	-.00000	.29625	0.00000	.94248	1.57080
3	5	4	.18310	.02540	.29625	0.00000	.94248	1.57080
3	5	5	.18310	.05080	.29625	0.00000	.94248	1.57080
3	6	1	.19603	-.03810	.27846	0.00000	.94248	1.57080
3	6	2	.19603	-.01270	.27846	0.00000	.94248	1.57080
3	6	3	.19603	.01270	.27846	0.00000	.94248	1.57080
3	6	4	.19603	.03810	.27846	0.00000	.94248	1.57080
3	7	1	.20896	-.05080	.26066	0.00000	.94248	1.57080
3	7	2	.20896	-.02540	.26066	0.00000	.94248	1.57080
3	7	3	.20896	-.00000	.26066	0.00000	.94248	1.57080
3	7	4	.20896	.02540	.26066	0.00000	.94248	1.57080
3	7	5	.20896	.05080	.26066	0.00000	.94248	1.57080
3	8	1	.22189	-.06350	.24287	0.00000	.94248	1.57080
3	8	2	.22189	-.03810	.24287	0.00000	.94248	1.57080

Table 1. (Cont.)

BEACON (CONT.)

PANEL	ROW	UNIT	X	Y	Z	THETA	PHI	ALPHA
3	8	3	.22189	-.01270	.24287	0.00000	.94248	1.57080
3	8	4	.22189	.01270	.24287	0.00000	.94248	1.57080
3	8	5	.22189	.03810	.24287	0.00000	.94248	1.57080
3	8	6	.22189	.06350	.24287	0.00000	.94248	1.57080
3	9	1	.23482	-.07620	.22507	0.00000	.94248	1.57080
3	9	2	.23482	-.05080	.22507	0.00000	.94248	1.57080
3	9	3	.23482	-.02540	.22507	0.00000	.94248	1.57080
3	9	5	.23482	.02540	.22507	0.00000	.94248	1.57080
3	9	6	.23482	.05080	.22507	0.00000	.94248	1.57080
3	9	7	.23482	.07620	.22507	0.00000	.94248	1.57080
4	1	1	.11086	.07494	.36744	.78540	.94248	1.57080
4	1	2	.09290	.09290	.36744	.78540	.94248	1.57080
4	1	3	.07494	.11086	.36744	.78540	.94248	1.57080
4	2	1	.12899	.07511	.34964	.78540	.94248	1.57080
4	2	2	.11103	.09307	.34964	.78540	.94248	1.57080
4	2	3	.09307	.11103	.34964	.78540	.94248	1.57080
4	2	4	.07511	.12899	.34964	.78540	.94248	1.57080
4	3	1	.12915	.09323	.33184	.78540	.94248	1.57080
4	3	2	.11119	.11119	.33184	.78540	.94248	1.57080
4	3	3	.09323	.12915	.33184	.78540	.94248	1.57080
4	4	1	.14727	.09339	.31405	.78540	.94248	1.57080
4	4	2	.12931	.11135	.31405	.78540	.94248	1.57080
4	4	3	.11135	.12931	.31405	.78540	.94248	1.57080
4	4	4	.09339	.14727	.31405	.78540	.94248	1.57080
4	5	1	.16539	.09355	.29625	.78540	.94248	1.57080
4	5	2	.14743	.11151	.29625	.78540	.94248	1.57080
4	5	3	.12947	.12947	.29625	.78540	.94248	1.57080
4	5	4	.11151	.14743	.29625	.78540	.94248	1.57080
4	5	5	.09355	.16539	.29625	.78540	.94248	1.57080
4	6	1	.16556	.11168	.27846	.78540	.94248	1.57080
4	6	2	.14760	.12964	.27846	.78540	.94248	1.57080
4	6	3	.12964	.14760	.27846	.78540	.94248	1.57080
4	6	4	.11168	.16556	.27846	.78540	.94248	1.57080
4	7	1	.18368	.11184	.26066	.78540	.94248	1.57080
4	7	2	.16572	.12980	.26066	.78540	.94248	1.57080
4	7	3	.14776	.14776	.26066	.78540	.94248	1.57080
4	7	4	.12980	.16572	.26066	.78540	.94248	1.57080
4	7	5	.11184	.18368	.26066	.78540	.94248	1.57080
4	8	1	.20180	.11200	.24287	.78540	.94248	1.57080
4	8	2	.18384	.12996	.24287	.78540	.94248	1.57080
4	8	3	.16588	.14792	.24287	.78540	.94248	1.57080
4	8	4	.14792	.16588	.24287	.78540	.94248	1.57080
4	8	5	.12996	.18384	.24287	.78540	.94248	1.57080
4	8	6	.11200	.20180	.24287	.78540	.94248	1.57080
4	9	1	.21992	.11216	.22507	.78540	.94248	1.57080
4	9	2	.20196	.13012	.22507	.78540	.94248	1.57080
4	9	3	.18400	.14808	.22507	.78540	.94248	1.57080
4	9	5	.14808	.18400	.22507	.78540	.94248	1.57080
4	9	6	.13012	.20196	.22507	.78540	.94248	1.57080
4	9	7	.11216	.21992	.22507	.78540	.94248	1.57080

Table 1. (Cont.)

BEACON (CONT.)

PANEL	ROW	UNIT	X	Y	Z	THETA	PHI	ALPHA
5	1	1	.02540	.13139	.36744	1.57080	.94248	1.57080
5	1	2	.00000	.13139	.36744	1.57080	.94248	1.57080
5	1	3	-.02540	.13139	.36744	1.57080	.94248	1.57080
5	2	1	.03810	.14432	.34964	1.57080	.94248	1.57080
5	2	2	.01270	.14432	.34964	1.57080	.94248	1.57080
5	2	3	-.01270	.14432	.34964	1.57080	.94248	1.57080
5	2	4	-.03810	.14432	.34964	1.57080	.94248	1.57080
5	3	1	.02540	.15725	.33184	1.57080	.94248	1.57080
5	3	2	.00000	.15725	.33184	1.57080	.94248	1.57080
5	3	3	-.02540	.15725	.33184	1.57080	.94248	1.57080
5	4	1	.03810	.17017	.31405	1.57080	.94248	1.57080
5	4	2	.01270	.17017	.31405	1.57080	.94248	1.57080
5	4	3	-.01270	.17017	.31405	1.57080	.94248	1.57080
5	4	4	-.03810	.17017	.31405	1.57080	.94248	1.57080
5	5	1	.05080	.18310	.29625	1.57080	.94248	1.57080
5	5	2	.02540	.18310	.29625	1.57080	.94248	1.57080
5	5	3	.00000	.18310	.29625	1.57080	.94248	1.57080
5	5	4	-.02540	.18310	.29625	1.57080	.94248	1.57080
5	5	5	-.05080	.18310	.29625	1.57080	.94248	1.57080
5	6	1	.03810	.19603	.27846	1.57080	.94248	1.57080
5	6	2	.01270	.19603	.27846	1.57080	.94248	1.57080
5	6	3	-.01270	.19603	.27846	1.57080	.94248	1.57080
5	6	4	-.03810	.19603	.27846	1.57080	.94248	1.57080
5	7	1	.05080	.20896	.26066	1.57080	.94248	1.57080
5	7	2	.02540	.20896	.26066	1.57080	.94248	1.57080
5	7	3	.00000	.20896	.26066	1.57080	.94248	1.57080
5	7	4	-.02540	.20896	.26066	1.57080	.94248	1.57080
5	7	5	-.05080	.20896	.26066	1.57080	.94248	1.57080
5	8	1	.06350	.22189	.24287	1.57080	.94248	1.57080
5	8	2	.03810	.22189	.24287	1.57080	.94248	1.57080
5	8	3	.01270	.22189	.24287	1.57080	.94248	1.57080
5	8	4	-.01270	.22189	.24287	1.57080	.94248	1.57080
5	8	5	-.03810	.22189	.24287	1.57080	.94248	1.57080
5	8	6	-.06350	.22189	.24287	1.57080	.94248	1.57080
5	9	1	.07620	.23482	.22507	1.57080	.94248	1.57080
5	9	2	.05080	.23482	.22507	1.57080	.94248	1.57080
5	9	3	.02540	.23482	.22507	1.57080	.94248	1.57080
5	9	5	-.02540	.23482	.22507	1.57080	.94248	1.57080
5	9	6	-.05080	.23482	.22507	1.57080	.94248	1.57080
5	9	7	-.07620	.23482	.22507	1.57080	.94248	1.57080
6	1	1	-.07494	.11086	.36744	2.35619	.94248	1.57080
6	1	2	-.09290	.09290	.36744	2.35619	.94248	1.57080
6	1	3	-.11086	.07494	.36744	2.35619	.94248	1.57080
6	2	1	-.07511	.12899	.34964	2.35619	.94248	1.57080
6	2	2	-.09307	.11103	.34964	2.35619	.94248	1.57080
6	2	3	-.11103	.09307	.34964	2.35619	.94248	1.57080
6	2	4	-.12899	.07511	.34964	2.35619	.94248	1.57080
6	3	1	-.09323	.12915	.33184	2.35619	.94248	1.57080
6	3	2	-.11119	.11119	.33184	2.35619	.94248	1.57080
6	3	3	-.12915	.09323	.33184	2.35619	.94248	1.57080

Table 1. (Cont.)

BEACON (CONT.)

PANEL	ROW	UNIT	X	Y	Z	THETA	PHI	ALPHA
6	4	1	-.09339	.14727	.31405	2.35619	.94248	1.57080
6	4	2	-.11135	.12931	.31405	2.35619	.94248	1.57080
6	4	3	-.12931	.11135	.31405	2.35619	.94248	1.57080
6	4	4	-.14727	.09339	.31405	2.35619	.94248	1.57080
6	5	1	-.09355	.16539	.29625	2.35619	.94248	1.57080
6	5	2	-.11151	.14743	.29625	2.35619	.94248	1.57080
6	5	3	-.12947	.12947	.29625	2.35619	.94248	1.57080
6	5	4	-.14743	.11151	.29625	2.35619	.94248	1.57080
6	5	5	-.16539	.09355	.29625	2.35619	.94248	1.57080
6	6	1	-.11168	.16556	.27846	2.35619	.94248	1.57080
6	6	2	-.12964	.14760	.27846	2.35619	.94248	1.57080
6	6	3	-.14760	.12964	.27846	2.35619	.94248	1.57080
6	6	4	-.16556	.11168	.27846	2.35619	.94248	1.57080
6	7	1	-.11184	.18368	.26066	2.35619	.94248	1.57080
6	7	2	-.12980	.16572	.26066	2.35619	.94248	1.57080
6	7	3	-.14776	.14776	.26066	2.35619	.94248	1.57080
6	7	4	-.16572	.12980	.26066	2.35619	.94248	1.57080
6	7	5	-.18368	.11184	.26066	2.35619	.94248	1.57080
6	8	1	-.11200	.20180	.24287	2.35619	.94248	1.57080
6	8	2	-.12996	.18384	.24287	2.35619	.94248	1.57080
6	8	3	-.14792	.16588	.24287	2.35619	.94248	1.57080
6	8	4	-.16588	.14792	.24287	2.35619	.94248	1.57080
6	8	5	-.18384	.12996	.24287	2.35619	.94248	1.57080
6	8	6	-.20180	.11200	.24287	2.35619	.94248	1.57080
6	9	1	-.11216	.21992	.22507	2.35619	.94248	1.57080
6	9	2	-.13012	.20196	.22507	2.35619	.94248	1.57080
6	9	3	-.14808	.18400	.22507	2.35619	.94248	1.57080
6	9	5	-.18400	.14808	.22507	2.35619	.94248	1.57080
6	9	6	-.20196	.13012	.22507	2.35619	.94248	1.57080
6	9	7	-.21992	.11216	.22507	2.35619	.94248	1.57080
7	1	1	-.13139	.02540	.36744	3.14159	.94248	1.57080
7	1	2	-.13139	.00000	.36744	3.14159	.94248	1.57080
7	1	3	-.13139	-.02540	.36744	3.14159	.94248	1.57080
7	2	1	-.14432	.03810	.34964	3.14159	.94248	1.57080
7	2	2	-.14432	.01270	.34964	3.14159	.94248	1.57080
7	2	3	-.14432	-.01270	.34964	3.14159	.94248	1.57080
7	2	4	-.14432	-.03810	.34964	3.14159	.94248	1.57080
7	3	1	-.15725	.02540	.33184	3.14159	.94248	1.57080
7	3	2	-.15725	.00000	.33184	3.14159	.94248	1.57080
7	3	3	-.15725	-.02540	.33184	3.14159	.94248	1.57080
7	4	1	-.17017	.03810	.31405	3.14159	.94248	1.57080
7	4	2	-.17017	.01270	.31405	3.14159	.94248	1.57080
7	4	3	-.17017	-.01270	.31405	3.14159	.94248	1.57080
7	4	4	-.17017	-.03810	.31405	3.14159	.94248	1.57080
7	5	1	-.18310	.05080	.29625	3.14159	.94248	1.57080
7	5	2	-.18310	.02540	.29625	3.14159	.94248	1.57080
7	5	3	-.18310	.00000	.29625	3.14159	.94248	1.57080
7	5	4	-.18310	-.02540	.29625	3.14159	.94248	1.57080
7	5	5	-.18310	-.05080	.29625	3.14159	.94248	1.57080
7	6	1	-.19603	.03810	.27846	3.14159	.94248	1.57080

Table 1. (Cont.)

BEACON (CONT.)

PANEL	ROW	UNIT	X	Y	Z	THETA	PHI	ALPHA
7	6	2	-.19603	.01270	.27846	3.14159	.94248	1.57080
7	6	3	-.19603	-.01270	.27846	3.14159	.94248	1.57080
7	6	4	-.19603	-.03810	.27846	3.14159	.94248	1.57080
7	7	1	-.20896	.05080	.26066	3.14159	.94248	1.57080
7	7	2	-.20896	.02540	.26066	3.14159	.94248	1.57080
7	7	3	-.20896	.00000	.26066	3.14159	.94248	1.57080
7	7	4	-.20896	-.02540	.26066	3.14159	.94248	1.57080
7	7	5	-.20896	-.05080	.26066	3.14159	.94248	1.57080
7	8	1	-.22189	.06350	.24287	3.14159	.94248	1.57080
7	8	2	-.22189	.03810	.24287	3.14159	.94248	1.57080
7	8	3	-.22189	.01270	.24287	3.14159	.94248	1.57080
7	8	4	-.22189	-.01270	.24287	3.14159	.94248	1.57080
7	8	5	-.22189	-.03810	.24287	3.14159	.94248	1.57080
7	8	6	-.22189	-.06350	.24287	3.14159	.94248	1.57080
7	9	1	-.23482	.07620	.22507	3.14159	.94248	1.57080
7	9	2	-.23482	.05080	.22507	3.14159	.94248	1.57080
7	9	3	-.23482	.02540	.22507	3.14159	.94248	1.57080
7	9	5	-.23482	-.02540	.22507	3.14159	.94248	1.57080
7	9	6	-.23482	-.05080	.22507	3.14159	.94248	1.57080
7	9	7	-.23482	-.07620	.22507	3.14159	.94248	1.57080
8	1	1	-.11086	-.07494	.36744	3.92699	.94248	1.57080
8	1	2	-.09290	-.09290	.36744	3.92699	.94248	1.57080
8	1	3	-.07494	-.11086	.36744	3.92699	.94248	1.57080
8	2	1	-.12899	-.07511	.34964	3.92699	.94248	1.57080
8	2	2	-.11103	-.09307	.34964	3.92699	.94248	1.57080
8	2	3	-.09307	-.11103	.34964	3.92699	.94248	1.57080
8	2	4	-.07511	-.12899	.34964	3.92699	.94248	1.57080
8	3	1	-.12915	-.09323	.33184	3.92699	.94248	1.57080
8	3	2	-.11119	-.11119	.33184	3.92699	.94248	1.57080
8	3	3	-.09323	-.12915	.33184	3.92699	.94248	1.57080
8	4	1	-.14727	-.09339	.31405	3.92699	.94248	1.57080
8	4	2	-.12931	-.11135	.31405	3.92699	.94248	1.57080
8	4	3	-.11135	-.12931	.31405	3.92699	.94248	1.57080
8	4	4	-.09339	-.14727	.31405	3.92699	.94248	1.57080
8	5	1	-.16539	-.09355	.29625	3.92699	.94248	1.57080
8	5	2	-.14743	-.11151	.29625	3.92699	.94248	1.57080
8	5	3	-.12947	-.12947	.29625	3.92699	.94248	1.57080
8	5	4	-.11151	-.14743	.29625	3.92699	.94248	1.57080
8	5	5	-.09355	-.16539	.29625	3.92699	.94248	1.57080
8	6	1	-.16556	-.11168	.27846	3.92699	.94248	1.57080
8	6	2	-.14760	-.12964	.27846	3.92699	.94248	1.57080
8	6	3	-.12964	-.14760	.27846	3.92699	.94248	1.57080
8	6	4	-.11168	-.16556	.27846	3.92699	.94248	1.57080
8	7	1	-.18368	-.11184	.26066	3.92699	.94248	1.57080
8	7	2	-.16572	-.12980	.26066	3.92699	.94248	1.57080
8	7	3	-.14776	-.14776	.26066	3.92699	.94248	1.57080
8	7	4	-.12980	-.16572	.26066	3.92699	.94248	1.57080
8	7	5	-.11184	-.18368	.26066	3.92699	.94248	1.57080
8	8	1	-.20180	-.11200	.24287	3.92699	.94248	1.57080
8	8	2	-.18384	-.12996	.24287	3.92699	.94248	1.57080

Table 1. (Cont.)

BEACON (CONT.)

PANEL	ROW	UNIT	X	Y	Z	THETA	PHI	ALPHA
8	8	3	-.16588	-.14792	.24287	3.92699	.94248	1.57080
8	8	4	-.14792	-.16588	.24287	3.92699	.94248	1.57080
8	8	5	-.12996	-.18384	.24287	3.92699	.94248	1.57080
8	8	6	-.11200	-.20180	.24287	3.92699	.94248	1.57080
8	9	1	-.21992	-.11216	.22507	3.92699	.94248	1.57080
8	9	2	-.20196	-.13012	.22507	3.92699	.94248	1.57080
8	9	3	-.18400	-.14808	.22507	3.92699	.94248	1.57080
8	9	5	-.14808	-.18400	.22507	3.92699	.94248	1.57080
8	9	6	-.13012	-.20196	.22507	3.92699	.94248	1.57080
8	9	7	-.11216	-.21992	.22507	3.92699	.94248	1.57080

Table 1. (Cont.)

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PANEL	ROW	UNIT	X	Y	Z	THETA	PHI	ALPHA
4	1	1	.39387	.21427	.42291	.78540	0.00000	1.57080
4	1	2	.37591	.23223	.42291	.78540	0.00000	1.57080
4	1	3	.35795	.25019	.42291	.78540	0.00000	1.57080
4	1	4	.33999	.26815	.42291	.78540	0.00000	1.57080
4	1	5	.32203	.28611	.42291	.78540	0.00000	1.57080
4	1	6	.30407	.30407	.42291	.78540	0.00000	1.57080
4	1	7	.28611	.32203	.42291	.78540	0.00000	1.57080
4	1	8	.26815	.33999	.42291	.78540	0.00000	1.57080
4	1	9	.25019	.35795	.42291	.78540	0.00000	1.57080
4	1	10	.23223	.37591	.42291	.78540	0.00000	1.57080
4	1	11	.21427	.39387	.42291	.78540	0.00000	1.57080
4	2	1	.41841	.22084	.42291	.78540	0.00000	1.57080
4	2	2	.40045	.23880	.42291	.78540	0.00000	1.57080
4	2	3	.38249	.25676	.42291	.78540	0.00000	1.57080
4	2	4	.36453	.27472	.42291	.78540	0.00000	1.57080
4	2	5	.34657	.29268	.42291	.78540	0.00000	1.57080
4	2	6	.32861	.31065	.42291	.78540	0.00000	1.57080
4	2	7	.31065	.32861	.42291	.78540	0.00000	1.57080
4	2	8	.29268	.34657	.42291	.78540	0.00000	1.57080
4	2	9	.27472	.36453	.42291	.78540	0.00000	1.57080
4	2	10	.25676	.38249	.42291	.78540	0.00000	1.57080
4	2	11	.23880	.40045	.42291	.78540	0.00000	1.57080
4	2	12	.22084	.41841	.42291	.78540	0.00000	1.57080
4	3	1	.44294	.22742	.42291	.78540	0.00000	1.57080
4	3	2	.42498	.24538	.42291	.78540	0.00000	1.57080
4	3	3	.40702	.26334	.42291	.78540	0.00000	1.57080
4	3	4	.38906	.28130	.42291	.78540	0.00000	1.57080
4	3	5	.37110	.29926	.42291	.78540	0.00000	1.57080
4	3	6	.35314	.31722	.42291	.78540	0.00000	1.57080
4	3	7	.33518	.33518	.42291	.78540	0.00000	1.57080
4	3	8	.31722	.35314	.42291	.78540	0.00000	1.57080
4	3	9	.29926	.37110	.42291	.78540	0.00000	1.57080
4	3	10	.28130	.38906	.42291	.78540	0.00000	1.57080
4	3	11	.26334	.40702	.42291	.78540	0.00000	1.57080
4	3	12	.24538	.42498	.42291	.78540	0.00000	1.57080
4	3	13	.22742	.44294	.42291	.78540	0.00000	1.57080
4	4	1	.46748	.23399	.42291	.78540	0.00000	1.57080
4	4	2	.44952	.25195	.42291	.78540	0.00000	1.57080
4	4	3	.43156	.26991	.42291	.78540	0.00000	1.57080
4	4	4	.41359	.28787	.42291	.78540	0.00000	1.57080
4	4	5	.39563	.30583	.42291	.78540	0.00000	1.57080
4	4	6	.37767	.32379	.42291	.78540	0.00000	1.57080
4	4	7	.35971	.34175	.42291	.78540	0.00000	1.57080
4	4	8	.34175	.35971	.42291	.78540	0.00000	1.57080
4	4	9	.32379	.37767	.42291	.78540	0.00000	1.57080
4	4	10	.30583	.39563	.42291	.78540	0.00000	1.57080
4	4	11	.28787	.41359	.42291	.78540	0.00000	1.57080
4	4	12	.26991	.43156	.42291	.78540	0.00000	1.57080
4	4	13	.25195	.44952	.42291	.78540	0.00000	1.57080
4	4	14	.23399	.46748	.42291	.78540	0.00000	1.57080

Table 1. (Cont.)

GEOS-A (CONT.)

PANEL	ROW	UNIT	X	Y	Z	THETA	PHI	ALPHA
4	5	1	.49201	.24056	.42291	.78540	0.00000	1.57080
4	5	2	.47405	.25852	.42291	.78540	0.00000	1.57080
4	5	3	.45609	.27648	.42291	.78540	0.00000	1.57080
4	5	4	.43813	.29444	.42291	.78540	0.00000	1.57080
4	5	5	.42017	.31241	.42291	.78540	0.00000	1.57080
4	5	6	.40221	.33037	.42291	.78540	0.00000	1.57080
4	5	7	.38425	.34833	.42291	.78540	0.00000	1.57080
4	5	8	.36629	.36629	.42291	.78540	0.00000	1.57080
4	5	9	.34833	.38425	.42291	.78540	0.00000	1.57080
4	5	10	.33037	.40221	.42291	.78540	0.00000	1.57080
4	5	11	.31241	.42017	.42291	.78540	0.00000	1.57080
4	5	12	.29444	.43813	.42291	.78540	0.00000	1.57080
4	5	13	.27648	.45609	.42291	.78540	0.00000	1.57080
4	5	14	.25852	.47405	.42291	.78540	0.00000	1.57080
4	5	15	.24056	.49201	.42291	.78540	0.00000	1.57080
4	6	1	.49858	.26510	.42291	.78540	0.00000	1.57080
4	6	2	.48062	.28306	.42291	.78540	0.00000	1.57080
4	6	3	.46266	.30102	.42291	.78540	0.00000	1.57080
4	6	4	.44470	.31898	.42291	.78540	0.00000	1.57080
4	6	5	.42674	.33694	.42291	.78540	0.00000	1.57080
4	6	6	.40878	.35490	.42291	.78540	0.00000	1.57080
4	6	7	.39082	.37286	.42291	.78540	0.00000	1.57080
4	6	8	.37286	.39082	.42291	.78540	0.00000	1.57080
4	6	9	.35490	.40878	.42291	.78540	0.00000	1.57080
4	6	10	.33694	.42674	.42291	.78540	0.00000	1.57080
4	6	11	.31898	.44470	.42291	.78540	0.00000	1.57080
4	6	12	.30102	.46266	.42291	.78540	0.00000	1.57080
4	6	13	.28306	.48062	.42291	.78540	0.00000	1.57080
4	6	14	.26510	.49858	.42291	.78540	0.00000	1.57080
4	7	1	.52312	.27167	.42291	.78540	0.00000	1.57080
4	7	2	.50516	.28963	.42291	.78540	0.00000	1.57080
4	7	3	.48720	.30759	.42291	.78540	0.00000	1.57080
4	7	4	.46924	.32555	.42291	.78540	0.00000	1.57080
4	7	5	.45128	.34351	.42291	.78540	0.00000	1.57080
4	7	6	.43332	.36147	.42291	.78540	0.00000	1.57080
4	7	7	.41535	.37943	.42291	.78540	0.00000	1.57080
4	7	8	.39739	.39739	.42291	.78540	0.00000	1.57080
4	7	9	.37943	.41535	.42291	.78540	0.00000	1.57080
4	7	10	.36147	.43332	.42291	.78540	0.00000	1.57080
4	7	11	.34351	.45128	.42291	.78540	0.00000	1.57080
4	7	12	.32555	.46924	.42291	.78540	0.00000	1.57080
4	7	13	.30759	.48720	.42291	.78540	0.00000	1.57080
4	7	14	.28963	.50516	.42291	.78540	0.00000	1.57080
4	7	15	.27167	.52312	.42291	.78540	0.00000	1.57080
5	1	1	-.12700	.43002	.42291	1.57080	0.00000	1.57080
5	1	2	-.10160	.43002	.42291	1.57080	0.00000	1.57080
5	1	3	-.07620	.43002	.42291	1.57080	0.00000	1.57080
5	1	4	-.05080	.43002	.42291	1.57080	0.00000	1.57080
5	1	5	-.02540	.43002	.42291	1.57080	0.00000	1.57080
5	1	6	.00000	.43002	.42291	1.57080	0.00000	1.57080

Table 1. (Cont.)

GEOS-A (CONT.)

PANEL	ROW	UNIT	X	Y	Z	THETA	PHI	ALPHA
5	1	7	.02540	.43002	.42291	1.57080	0.00000	1.57080
5	1	8	.05080	.43002	.42291	1.57080	0.00000	1.57080
5	1	9	.07620	.43002	.42291	1.57080	0.00000	1.57080
5	2	1	-.13970	.45202	.42291	1.57080	0.00000	1.57080
5	2	2	-.11430	.45202	.42291	1.57080	0.00000	1.57080
5	2	3	-.08890	.45202	.42291	1.57080	0.00000	1.57080
5	2	4	-.06350	.45202	.42291	1.57080	0.00000	1.57080
5	2	5	-.03810	.45202	.42291	1.57080	0.00000	1.57080
5	2	6	-.01270	.45202	.42291	1.57080	0.00000	1.57080
5	2	7	.01270	.45202	.42291	1.57080	0.00000	1.57080
5	2	8	.03810	.45202	.42291	1.57080	0.00000	1.57080
5	2	9	.06350	.45202	.42291	1.57080	0.00000	1.57080
5	2	10	.08890	.45202	.42291	1.57080	0.00000	1.57080
5	3	1	-.15240	.47401	.42291	1.57080	0.00000	1.57080
5	3	2	-.12700	.47401	.42291	1.57080	0.00000	1.57080
5	3	3	-.10160	.47401	.42291	1.57080	0.00000	1.57080
5	3	4	-.07620	.47401	.42291	1.57080	0.00000	1.57080
5	3	5	-.05080	.47401	.42291	1.57080	0.00000	1.57080
5	3	6	-.02540	.47401	.42291	1.57080	0.00000	1.57080
5	3	7	.00000	.47401	.42291	1.57080	0.00000	1.57080
5	3	8	.02540	.47401	.42291	1.57080	0.00000	1.57080
5	3	9	.05080	.47401	.42291	1.57080	0.00000	1.57080
5	3	10	.07620	.47401	.42291	1.57080	0.00000	1.57080
5	4	1	-.16510	.49601	.42291	1.57080	0.00000	1.57080
5	4	2	-.13970	.49601	.42291	1.57080	0.00000	1.57080
5	4	3	-.11430	.49601	.42291	1.57080	0.00000	1.57080
5	4	4	-.08890	.49601	.42291	1.57080	0.00000	1.57080
5	4	5	-.06350	.49601	.42291	1.57080	0.00000	1.57080
5	4	6	-.03810	.49601	.42291	1.57080	0.00000	1.57080
5	4	7	-.01270	.49601	.42291	1.57080	0.00000	1.57080
5	4	8	.01270	.49601	.42291	1.57080	0.00000	1.57080
5	4	9	.03810	.49601	.42291	1.57080	0.00000	1.57080
5	4	10	.06350	.49601	.42291	1.57080	0.00000	1.57080
5	4	11	.08890	.49601	.42291	1.57080	0.00000	1.57080
5	5	1	-.17780	.51801	.42291	1.57080	0.00000	1.57080
5	5	2	-.15240	.51801	.42291	1.57080	0.00000	1.57080
5	5	3	-.12700	.51801	.42291	1.57080	0.00000	1.57080
5	5	4	-.10160	.51801	.42291	1.57080	0.00000	1.57080
5	5	5	-.07620	.51801	.42291	1.57080	0.00000	1.57080
5	5	6	-.05080	.51801	.42291	1.57080	0.00000	1.57080
5	5	7	-.02540	.51801	.42291	1.57080	0.00000	1.57080
5	5	8	.00000	.51801	.42291	1.57080	0.00000	1.57080
5	5	9	.02540	.51801	.42291	1.57080	0.00000	1.57080
5	5	10	.05080	.51801	.42291	1.57080	0.00000	1.57080
5	5	11	.07620	.51801	.42291	1.57080	0.00000	1.57080
5	6	1	-.16510	.54000	.42291	1.57080	0.00000	1.57080
5	6	2	-.13970	.54000	.42291	1.57080	0.00000	1.57080
5	6	3	-.11430	.54000	.42291	1.57080	0.00000	1.57080
5	6	4	-.08890	.54000	.42291	1.57080	0.00000	1.57080
5	6	5	-.06350	.54000	.42291	1.57080	0.00000	1.57080

Table 1. (Cont.)

GEOS-A (CONT.)

PANEL	ROW	UNIT	X	Y	Z	THETA	PHI	ALPHA
5	6	6	-.03810	.54000	.42291	1.57080	0.00000	1.57080
5	6	7	-.01270	.54000	.42291	1.57080	0.00000	1.57080
5	6	8	.01270	.54000	.42291	1.57080	0.00000	1.57080
5	6	9	.03810	.54000	.42291	1.57080	0.00000	1.57080
5	6	10	.06350	.54000	.42291	1.57080	0.00000	1.57080
5	6	11	.08890	.54000	.42291	1.57080	0.00000	1.57080
5	7	1	-.17780	.56200	.42291	1.57080	0.00000	1.57080
5	7	2	-.15240	.56200	.42291	1.57080	0.00000	1.57080
5	7	3	-.12700	.56200	.42291	1.57080	0.00000	1.57080
5	7	4	-.10160	.56200	.42291	1.57080	0.00000	1.57080
5	7	5	-.07620	.56200	.42291	1.57080	0.00000	1.57080
5	7	6	-.05080	.56200	.42291	1.57080	0.00000	1.57080
5	7	7	-.02540	.56200	.42291	1.57080	0.00000	1.57080
5	7	8	.00000	.56200	.42291	1.57080	0.00000	1.57080
5	7	9	.02540	.56200	.42291	1.57080	0.00000	1.57080
5	7	10	.05080	.56200	.42291	1.57080	0.00000	1.57080
5	7	11	.07620	.56200	.42291	1.57080	0.00000	1.57080
8	1	1	-.39387	-.21427	.42291	3.92699	0.00000	1.57080
8	1	2	-.37591	-.23223	.42291	3.92699	0.00000	1.57080
8	1	3	-.35795	-.25019	.42291	3.92699	0.00000	1.57080
8	1	4	-.33999	-.26815	.42291	3.92699	0.00000	1.57080
8	1	5	-.32203	-.28611	.42291	3.92699	0.00000	1.57080
8	1	6	-.30407	-.30407	.42291	3.92699	0.00000	1.57080
8	1	7	-.28611	-.32203	.42291	3.92699	0.00000	1.57080
8	1	8	-.26815	-.33999	.42291	3.92699	0.00000	1.57080
8	1	9	-.25019	-.35795	.42291	3.92699	0.00000	1.57080
8	1	10	-.23223	-.37591	.42291	3.92699	0.00000	1.57080
8	1	11	-.21427	-.39387	.42291	3.92699	0.00000	1.57080
8	2	1	-.41841	-.22084	.42291	3.92699	0.00000	1.57080
8	2	2	-.40045	-.23880	.42291	3.92699	0.00000	1.57080
8	2	3	-.38249	-.25676	.42291	3.92699	0.00000	1.57080
8	2	4	-.36453	-.27472	.42291	3.92699	0.00000	1.57080
8	2	5	-.34657	-.29268	.42291	3.92699	0.00000	1.57080
8	2	6	-.32861	-.31065	.42291	3.92699	0.00000	1.57080
8	2	7	-.31065	-.32861	.42291	3.92699	0.00000	1.57080
8	2	8	-.29268	-.34657	.42291	3.92699	0.00000	1.57080
8	2	9	-.27472	-.36453	.42291	3.92699	0.00000	1.57080
8	2	10	-.25676	-.38249	.42291	3.92699	0.00000	1.57080
8	2	11	-.23880	-.40045	.42291	3.92699	0.00000	1.57080
8	2	12	-.22084	-.41841	.42291	3.92699	0.00000	1.57080
8	3	1	-.44294	-.22742	.42291	3.92699	0.00000	1.57080
8	3	2	-.42498	-.24538	.42291	3.92699	0.00000	1.57080
8	3	3	-.40702	-.26334	.42291	3.92699	0.00000	1.57080
8	3	4	-.38906	-.28130	.42291	3.92699	0.00000	1.57080
8	3	5	-.37110	-.29926	.42291	3.92699	0.00000	1.57080
8	3	6	-.35314	-.31722	.42291	3.92699	0.00000	1.57080
8	3	7	-.33518	-.33518	.42291	3.92699	0.00000	1.57080
8	3	8	-.31722	-.35314	.42291	3.92699	0.00000	1.57080
8	3	9	-.29926	-.37110	.42291	3.92699	0.00000	1.57080
8	3	10	-.28130	-.38906	.42291	3.92699	0.00000	1.57080

Table 1. (Cont.)

GEOS-A (CONT.)

PANEL	ROW	UNIT	X	Y	Z	THETA	PHI	ALPHA
8	3	11	-.26334	-.40702	.42291	3.92699	0.00000	1.57080
8	3	12	-.24538	-.42498	.42291	3.92699	0.00000	1.57080
8	3	13	-.22742	-.44294	.42291	3.92699	0.00000	1.57080
8	4	1	-.46748	-.23399	.42291	3.92699	0.00000	1.57080
8	4	2	-.44952	-.25195	.42291	3.92699	0.00000	1.57080
8	4	3	-.43156	-.26991	.42291	3.92699	0.00000	1.57080
8	4	4	-.41359	-.28787	.42291	3.92699	0.00000	1.57080
8	4	5	-.39563	-.30583	.42291	3.92699	0.00000	1.57080
8	4	6	-.37767	-.32379	.42291	3.92699	0.00000	1.57080
8	4	7	-.35971	-.34175	.42291	3.92699	0.00000	1.57080
8	4	8	-.34175	-.35971	.42291	3.92699	0.00000	1.57080
8	4	9	-.32379	-.37767	.42291	3.92699	0.00000	1.57080
8	4	10	-.30583	-.39563	.42291	3.92699	0.00000	1.57080
8	4	11	-.28787	-.41359	.42291	3.92699	0.00000	1.57080
8	4	12	-.26991	-.43156	.42291	3.92699	0.00000	1.57080
8	4	13	-.25195	-.44952	.42291	3.92699	0.00000	1.57080
8	4	14	-.23399	-.46748	.42291	3.92699	0.00000	1.57080
8	5	1	-.49201	-.24056	.42291	3.92699	0.00000	1.57080
8	5	2	-.47405	-.25852	.42291	3.92699	0.00000	1.57080
8	5	3	-.45609	-.27648	.42291	3.92699	0.00000	1.57080
8	5	4	-.43813	-.29444	.42291	3.92699	0.00000	1.57080
8	5	5	-.42017	-.31241	.42291	3.92699	0.00000	1.57080
8	5	6	-.40221	-.33037	.42291	3.92699	0.00000	1.57080
8	5	7	-.38425	-.34833	.42291	3.92699	0.00000	1.57080
8	5	8	-.36629	-.36629	.42291	3.92699	0.00000	1.57080
8	5	9	-.34833	-.38425	.42291	3.92699	0.00000	1.57080
8	5	10	-.33037	-.40221	.42291	3.92699	0.00000	1.57080
8	5	11	-.31241	-.42017	.42291	3.92699	0.00000	1.57080
8	5	12	-.29444	-.43813	.42291	3.92699	0.00000	1.57080
8	5	13	-.27648	-.45609	.42291	3.92699	0.00000	1.57080
8	5	14	-.25852	-.47405	.42291	3.92699	0.00000	1.57080
8	5	15	-.24056	-.49201	.42291	3.92699	0.00000	1.57080
8	6	1	-.49858	-.26510	.42291	3.92699	0.00000	1.57080
8	6	2	-.48062	-.28306	.42291	3.92699	0.00000	1.57080
8	6	3	-.46266	-.30102	.42291	3.92699	0.00000	1.57080
8	6	4	-.44470	-.31898	.42291	3.92699	0.00000	1.57080
8	6	5	-.42674	-.33694	.42291	3.92699	0.00000	1.57080
8	6	6	-.40878	-.35490	.42291	3.92699	0.00000	1.57080
8	6	7	-.39082	-.37286	.42291	3.92699	0.00000	1.57080
8	6	8	-.37286	-.39082	.42291	3.92699	0.00000	1.57080
8	6	9	-.35490	-.40878	.42291	3.92699	0.00000	1.57080
8	6	10	-.33694	-.42674	.42291	3.92699	0.00000	1.57080
8	6	11	-.31898	-.44470	.42291	3.92699	0.00000	1.57080
8	6	12	-.30102	-.46266	.42291	3.92699	0.00000	1.57080
8	6	13	-.28306	-.48062	.42291	3.92699	0.00000	1.57080
8	6	14	-.26510	-.49858	.42291	3.92699	0.00000	1.57080
8	7	1	-.52312	-.27167	.42291	3.92699	0.00000	1.57080
8	7	2	-.50516	-.28963	.42291	3.92699	0.00000	1.57080
8	7	3	-.48720	-.30759	.42291	3.92699	0.00000	1.57080
8	7	4	-.46924	-.32555	.42291	3.92699	0.00000	1.57080

Table 1. (Cont.)

GEOS-A (CONT.)

PANEL	ROW	UNIT	X	Y	Z	THETA	PHI	ALPHA
8	7	5	-.45128	-.34351	.42291	3.92699	0.00000	1.57080
8	7	6	-.43332	-.36147	.42291	3.92699	0.00000	1.57080
8	7	7	-.41535	-.37943	.42291	3.92699	0.00000	1.57080
8	7	8	-.39739	-.39739	.42291	3.92699	0.00000	1.57080
8	7	9	-.37943	-.41535	.42291	3.92699	0.00000	1.57080
8	7	10	-.36147	-.43332	.42291	3.92699	0.00000	1.57080
8	7	11	-.34351	-.45128	.42291	3.92699	0.00000	1.57080
8	7	12	-.32555	-.46924	.42291	3.92699	0.00000	1.57080
8	7	13	-.30759	-.48720	.42291	3.92699	0.00000	1.57080
8	7	14	-.28963	-.50516	.42291	3.92699	0.00000	1.57080
8	7	15	-.27167	-.52312	.42291	3.92699	0.00000	1.57080
1	1	1	.12700	-.43002	.42291	4.71239	0.00000	1.57080
1	1	2	.10160	-.43002	.42291	4.71239	0.00000	1.57080
1	1	3	.07620	-.43002	.42291	4.71239	0.00000	1.57080
1	1	4	.05080	-.43002	.42291	4.71239	0.00000	1.57080
1	1	5	.02540	-.43002	.42291	4.71239	0.00000	1.57080
1	1	6	-.00000	-.43002	.42291	4.71239	0.00000	1.57080
1	1	7	-.02540	-.43002	.42291	4.71239	0.00000	1.57080
1	1	8	-.05080	-.43002	.42291	4.71239	0.00000	1.57080
1	1	9	-.07620	-.43002	.42291	4.71239	0.00000	1.57080
1	2	1	.13970	-.45202	.42291	4.71239	0.00000	1.57080
1	2	2	.11430	-.45202	.42291	4.71239	0.00000	1.57080
1	2	3	.08890	-.45202	.42291	4.71239	0.00000	1.57080
1	2	4	.06350	-.45202	.42291	4.71239	0.00000	1.57080
1	2	5	.03810	-.45202	.42291	4.71239	0.00000	1.57080
1	2	6	.01270	-.45202	.42291	4.71239	0.00000	1.57080
1	2	7	-.01270	-.45202	.42291	4.71239	0.00000	1.57080
1	2	8	-.03810	-.45202	.42291	4.71239	0.00000	1.57080
1	2	9	-.06350	-.45202	.42291	4.71239	0.00000	1.57080
1	2	10	-.08890	-.45202	.42291	4.71239	0.00000	1.57080
1	3	1	.15240	-.47401	.42291	4.71239	0.00000	1.57080
1	3	2	.12700	-.47401	.42291	4.71239	0.00000	1.57080
1	3	3	.10160	-.47401	.42291	4.71239	0.00000	1.57080
1	3	4	.07620	-.47401	.42291	4.71239	0.00000	1.57080
1	3	5	.05080	-.47401	.42291	4.71239	0.00000	1.57080
1	3	6	.02540	-.47401	.42291	4.71239	0.00000	1.57080
1	3	7	-.00000	-.47401	.42291	4.71239	0.00000	1.57080
1	3	8	-.02540	-.47401	.42291	4.71239	0.00000	1.57080
1	3	9	-.05080	-.47401	.42291	4.71239	0.00000	1.57080
1	3	10	-.07620	-.47401	.42291	4.71239	0.00000	1.57080
1	4	1	.16510	-.49601	.42291	4.71239	0.00000	1.57080
1	4	2	.13970	-.49601	.42291	4.71239	0.00000	1.57080
1	4	3	.11430	-.49601	.42291	4.71239	0.00000	1.57080
1	4	4	.08890	-.49601	.42291	4.71239	0.00000	1.57080
1	4	5	.06350	-.49601	.42291	4.71239	0.00000	1.57080
1	4	6	.03810	-.49601	.42291	4.71239	0.00000	1.57080
1	4	7	.01270	-.49601	.42291	4.71239	0.00000	1.57080
1	4	8	-.01270	-.49601	.42291	4.71239	0.00000	1.57080
1	4	9	-.03810	-.49601	.42291	4.71239	0.00000	1.57080
1	4	10	-.06350	-.49601	.42291	4.71239	0.00000	1.57080

Table 1. (Cont.)

GEOS-A (CONT.)

PANEL	ROW	UNIT	X	Y	Z	THETA	PHI	ALPHA
1	4	11	-.08890	-.49601	.42291	4.71239	0.00000	1.57080
1	5	1	.17780	-.51801	.42291	4.71239	0.00000	1.57080
1	5	2	.15240	-.51801	.42291	4.71239	0.00000	1.57080
1	5	3	.12700	-.51801	.42291	4.71239	0.00000	1.57080
1	5	4	.10160	-.51801	.42291	4.71239	0.00000	1.57080
1	5	5	.07620	-.51801	.42291	4.71239	0.00000	1.57080
1	5	6	.05080	-.51801	.42291	4.71239	0.00000	1.57080
1	5	7	.02540	-.51801	.42291	4.71239	0.00000	1.57080
1	5	8	-.00000	-.51801	.42291	4.71239	0.00000	1.57080
1	5	9	-.02540	-.51801	.42291	4.71239	0.00000	1.57080
1	5	10	-.05080	-.51801	.42291	4.71239	0.00000	1.57080
1	5	11	-.07620	-.51801	.42291	4.71239	0.00000	1.57080
1	6	1	.16510	-.54000	.42291	4.71239	0.00000	1.57080
1	6	2	.13970	-.54000	.42291	4.71239	0.00000	1.57080
1	6	3	.11430	-.54000	.42291	4.71239	0.00000	1.57080
1	6	4	.08890	-.54000	.42291	4.71239	0.00000	1.57080
1	6	5	.06350	-.54000	.42291	4.71239	0.00000	1.57080
1	6	6	.03810	-.54000	.42291	4.71239	0.00000	1.57080
1	6	7	.01270	-.54000	.42291	4.71239	0.00000	1.57080
1	6	8	-.01270	-.54000	.42291	4.71239	0.00000	1.57080
1	6	9	-.03810	-.54000	.42291	4.71239	0.00000	1.57080
1	6	10	-.06350	-.54000	.42291	4.71239	0.00000	1.57080
1	6	11	-.08890	-.54000	.42291	4.71239	0.00000	1.57080
1	7	1	.17780	-.56200	.42291	4.71239	0.00000	1.57080
1	7	2	.15240	-.56200	.42291	4.71239	0.00000	1.57080
1	7	3	.12700	-.56200	.42291	4.71239	0.00000	1.57080
1	7	4	.10160	-.56200	.42291	4.71239	0.00000	1.57080
1	7	5	.07620	-.56200	.42291	4.71239	0.00000	1.57080
1	7	6	.05080	-.56200	.42291	4.71239	0.00000	1.57080
1	7	7	.02540	-.56200	.42291	4.71239	0.00000	1.57080
1	7	8	-.00000	-.56200	.42291	4.71239	0.00000	1.57080
1	7	9	-.02540	-.56200	.42291	4.71239	0.00000	1.57080
1	7	10	-.05080	-.56200	.42291	4.71239	0.00000	1.57080
1	7	11	-.07620	-.56200	.42291	4.71239	0.00000	1.57080

Table 1. (Cont.)

DIADEME SATELLITES   D1-C (1967 11 A) AND D1-D (1967 14 A)

PANEL	ROW	UNIT	X	Y	Z	THETA	PHI	ALPHA
1	1	1	.14110	.11826	.17400	.78540	0.00000	1.57080
1	1	2	.11826	.14110	.17400	.78540	0.00000	1.57080
1	2	1	.14991	.14991	.17400	.78540	0.00000	1.57080
2	1	1	-.11826	.14110	.17400	2.35619	0.00000	1.57080
2	1	2	-.14110	.11826	.17400	2.35619	0.00000	1.57080
2	2	1	-.14991	.14991	.17400	2.35619	0.00000	1.57080
3	1	1	-.14110	-.11826	.17400	-2.35619	0.00000	1.57080
3	1	2	-.11826	-.14110	.17400	-2.35619	0.00000	1.57080
3	2	1	-.14991	-.14991	.17400	-2.35619	0.00000	1.57080
4	1	1	.11826	-.14110	.17400	-.78540	0.00000	1.57080
4	1	2	.14110	-.11826	.17400	-.78540	0.00000	1.57080
4	2	1	.14991	-.14991	.17400	-.78540	0.00000	1.57080
5	1	1	.12176	.05324	.19750	.78540	.61087	1.57080
5	1	2	.09892	.07608	.19750	.78540	.61087	1.57080
5	1	3	.07608	.09892	.19750	.78540	.61087	1.57080
5	1	4	.05324	.12176	.19750	.78540	.61087	1.57080
5	2	1	.12690	.08122	.18110	.78540	.61087	1.57080
5	2	2	.10406	.10406	.18110	.78540	.61087	1.57080
5	2	3	.08122	.12690	.18110	.78540	.61087	1.57080
6	1	1	-.05324	.12176	.19750	2.35619	.61087	1.57080
6	1	2	-.07608	.09892	.19750	2.35619	.61087	1.57080
6	1	3	-.09892	.07608	.19750	2.35619	.61087	1.57080
6	1	4	-.12176	.05324	.19750	2.35619	.61087	1.57080
6	2	1	-.08122	.12690	.18110	2.35619	.61087	1.57080
6	2	2	-.10406	.10406	.18110	2.35619	.61087	1.57080
6	2	3	-.12690	.08122	.18110	2.35619	.61087	1.57080
7	1	1	-.12176	-.05324	.19750	-2.35619	.61087	1.57080
7	1	2	-.09892	-.07608	.19750	-2.35619	.61087	1.57080
7	1	3	-.07608	-.09892	.19750	-2.35619	.61087	1.57080
7	1	4	-.05324	-.12176	.19750	-2.35619	.61087	1.57080
7	2	1	-.12690	-.08122	.18110	-2.35619	.61087	1.57080
7	2	2	-.10406	-.10406	.18110	-2.35619	.61087	1.57080
7	2	3	-.08122	-.12690	.18110	-2.35619	.61087	1.57080
8	1	1	.05324	-.12176	.19750	-.78540	.61087	1.57080
8	1	2	.07608	-.09892	.19750	-.78540	.61087	1.57080
8	1	3	.09892	-.07608	.19750	-.78540	.61087	1.57080
8	1	4	.12176	-.05324	.19750	-.78540	.61087	1.57080
8	2	1	.08122	-.12690	.18110	-.78540	.61087	1.57080
8	2	2	.10406	-.10406	.18110	-.78540	.61087	1.57080
8	2	3	.12690	-.08122	.18110	-.78540	.61087	1.57080
9	1	1	.33400	-.02400	-.10000	-.22919	1.15585	.09377
9	1	2	.34731	-.02400	-.12943	-.22919	1.15585	.09377
9	1	3	.36062	-.02400	-.15886	-.22919	1.15585	.09377
9	1	4	.37394	-.02400	-.18829	-.22919	1.15585	.09377
9	2	1	.33618	-.05198	-.11925	-.22919	1.15585	.09377
9	2	2	.34950	-.05198	-.14868	-.22919	1.15585	.09377
9	2	3	.36281	-.05198	-.17811	-.22919	1.15585	.09377
9	3	1	.32505	-.07995	-.10908	-.22919	1.15585	.09377
9	3	2	.33837	-.07995	-.13851	-.22919	1.15585	.09377
9	3	3	.35168	-.07995	-.16794	-.22919	1.15585	.09377

Table 1. (Cont.)

DIADEME (CONT.)

PANEL	ROW	UNIT	X	Y	Z	THETA	PHI	ALPHA
9	4	1	.32725	-.10793	-.12836	-.22919	1.15585	.09377
9	4	2	.34056	-.10793	-.15779	-.22919	1.15585	.09377
9	5	1	.31612	-.13590	-.11819	-.22919	1.15585	.09377
10	1	1	.31612	.13590	-.11819	.22919	1.15585	-.09377
10	2	1	.32725	.10793	-.12836	.22919	1.15585	-.09377
10	2	2	.34056	.10793	-.15779	.22919	1.15585	-.09377
10	3	1	.32505	.07995	-.10908	.22919	1.15585	-.09377
10	3	2	.33837	.07995	-.13851	.22919	1.15585	-.09377
10	3	3	.35168	.07995	-.16794	.22919	1.15585	-.09377
10	4	1	.33618	.05198	-.11925	.22919	1.15585	-.09377
10	4	2	.34950	.05198	-.14868	.22919	1.15585	-.09377
10	4	3	.36281	.05198	-.17811	.22919	1.15585	-.09377
10	5	1	.33400	.02400	-.10000	.22919	1.15585	-.09377
10	5	2	.34731	.02400	-.12943	.22919	1.15585	-.09377
10	5	3	.36062	.02400	-.15886	.22919	1.15585	-.09377
10	5	4	.37394	.02400	-.18829	.22919	1.15585	-.09377
11	1	1	.02400	.33400	-.10000	1.34160	1.15585	.09377
11	1	2	.02400	.34731	-.12943	1.34160	1.15585	.09377
11	1	3	.02400	.36062	-.15886	1.34160	1.15585	.09377
11	1	4	.02400	.37394	-.18829	1.34160	1.15585	.09377
11	2	1	.05198	.33618	-.11925	1.34160	1.15585	.09377
11	2	2	.05198	.34950	-.14868	1.34160	1.15585	.09377
11	2	3	.05198	.36281	-.17811	1.34160	1.15585	.09377
11	3	1	.07995	.32505	-.10908	1.34160	1.15585	.09377
11	3	2	.07995	.33837	-.13851	1.34160	1.15585	.09377
11	3	3	.07995	.35168	-.16794	1.34160	1.15585	.09377
11	4	1	.10793	.32725	-.12836	1.34160	1.15585	.09377
11	4	2	.10793	.34056	-.15779	1.34160	1.15585	.09377
11	5	1	.13590	.31612	-.11819	1.34160	1.15585	.09377
12	1	1	-.13590	.31612	-.11819	1.79999	1.15585	-.09377
12	2	1	-.10793	.32725	-.12836	1.79999	1.15585	-.09377
12	2	2	-.10793	.34056	-.15779	1.79999	1.15585	-.09377
12	3	1	-.07995	.32505	-.10908	1.79999	1.15585	-.09377
12	3	2	-.07995	.33837	-.13851	1.79999	1.15585	-.09377
12	3	3	-.07995	.35168	-.16794	1.79999	1.15585	-.09377
12	4	1	-.05198	.33618	-.11925	1.79999	1.15585	-.09377
12	4	2	-.05198	.34950	-.14868	1.79999	1.15585	-.09377
12	4	3	-.05198	.36281	-.17811	1.79999	1.15585	-.09377
12	5	1	-.02400	.33400	-.10000	1.79999	1.15585	-.09377
12	5	2	-.02400	.34731	-.12943	1.79999	1.15585	-.09377
12	5	3	-.02400	.36062	-.15886	1.79999	1.15585	-.09377
12	5	4	-.02400	.37394	-.18829	1.79999	1.15585	-.09377
13	1	1	-.33400	.02400	-.10000	2.91240	1.15585	.09377
13	1	2	-.34731	.02400	-.12943	2.91240	1.15585	.09377
13	1	3	-.36062	.02400	-.15886	2.91240	1.15585	.09377
13	1	4	-.37394	.02400	-.18829	2.91240	1.15585	.09377
13	2	1	-.33618	.05198	-.11925	2.91240	1.15585	.09377
13	2	2	-.34950	.05198	-.14868	2.91240	1.15585	.09377
13	2	3	-.36281	.05198	-.17811	2.91240	1.15585	.09377
13	3	1	-.32505	.07995	-.10908	2.91240	1.15585	.09377

Table 1. (Cont.)

DIADEME (CONT.)

PANEL	ROW	UNIT	X	Y	Z	THETA	PHI	ALPHA
13	3	2	-.33837	.07995	-.13851	2.91240	1.15585	.09377
13	3	3	-.35168	.07995	-.16794	2.91240	1.15585	.09377
13	4	1	-.32725	.10793	-.12836	2.91240	1.15585	.09377
13	4	2	-.34056	.10793	-.15779	2.91240	1.15585	.09377
13	5	1	-.31612	.13590	-.11819	2.91240	1.15585	.09377
14	1	1	-.31612	-.13590	-.11819	-2.91240	1.15585	-.09377
14	2	1	-.32725	-.10793	-.12836	-2.91240	1.15585	-.09377
14	2	2	-.34056	-.10793	-.15779	-2.91240	1.15585	-.09377
14	3	1	-.32505	-.07995	-.10908	-2.91240	1.15585	-.09377
14	3	2	-.33837	-.07995	-.13851	-2.91240	1.15585	-.09377
14	3	3	-.35168	-.07995	-.16794	-2.91240	1.15585	-.09377
14	4	1	-.33618	-.05198	-.11925	-2.91240	1.15585	-.09377
14	4	2	-.34950	-.05198	-.14868	-2.91240	1.15585	-.09377
14	4	3	-.36281	-.05198	-.17811	-2.91240	1.15585	-.09377
14	5	1	-.33400	-.02400	-.10000	-2.91240	1.15585	-.09377
14	5	2	-.34731	-.02400	-.12943	-2.91240	1.15585	-.09377
14	5	3	-.36062	-.02400	-.15886	-2.91240	1.15585	-.09377
14	5	4	-.37394	-.02400	-.18829	-2.91240	1.15585	-.09377
15	1	1	-.02400	-.33400	-.10000	-1.79999	1.15585	.09377
15	1	2	-.02400	-.34731	-.12943	-1.79999	1.15585	.09377
15	1	3	-.02400	-.36062	-.15886	-1.79999	1.15585	.09377
15	1	4	-.02400	-.37394	-.18829	-1.79999	1.15585	.09377
15	2	1	-.05198	-.33618	-.11925	-1.79999	1.15585	.09377
15	2	2	-.05198	-.34950	-.14868	-1.79999	1.15585	.09377
15	2	3	-.05198	-.36281	-.17811	-1.79999	1.15585	.09377
15	3	1	-.07995	-.32505	-.10908	-1.79999	1.15585	.09377
15	3	2	-.07995	-.33837	-.13851	-1.79999	1.15585	.09377
15	3	3	-.07995	-.35168	-.16794	-1.79999	1.15585	.09377
15	4	1	-.10793	-.32725	-.12836	-1.79999	1.15585	.09377
15	4	2	-.10793	-.34056	-.15779	-1.79999	1.15585	.09377
15	5	1	-.13590	-.31612	-.11819	-1.79999	1.15585	.09377
16	1	1	.13590	-.31612	-.11819	-1.34160	1.15585	-.09377
16	2	1	.10793	-.32725	-.12836	-1.34160	1.15585	-.09377
16	2	2	.10793	-.34056	-.15779	-1.34160	1.15585	-.09377
16	3	1	.07995	-.32505	-.10908	-1.34160	1.15585	-.09377
16	3	2	.07995	-.33837	-.13851	-1.34160	1.15585	-.09377
16	3	3	.07995	-.35168	-.16794	-1.34160	1.15585	-.09377
16	4	1	.05198	-.33618	-.11925	-1.34160	1.15585	-.09377
16	4	2	.05198	-.34950	-.14868	-1.34160	1.15585	-.09377
16	4	3	.05198	-.36281	-.17811	-1.34160	1.15585	-.09377
16	5	1	.02400	-.33400	-.10000	-1.34160	1.15585	-.09377
16	5	2	.02400	-.34731	-.12943	-1.34160	1.15585	-.09377
16	5	3	.02400	-.36062	-.15886	-1.34160	1.15585	-.09377
16	5	4	.02400	-.37394	-.18829	-1.34160	1.15585	-.09377

Table 1. (Cont.)

GEOS-B (1968 2 A)

PANEL	ROW	UNIT	X	Y	Z	THETA	PHI	ALPHA
2	1	1	.21427	-.39387	.47274	-.78540	0.00000	1.57080
2	1	2	.23223	-.37591	.47274	-.78540	0.00000	1.57080
2	1	3	.25019	-.35795	.47274	-.78540	0.00000	1.57080
2	1	4	.26815	-.33999	.47274	-.78540	0.00000	1.57080
2	1	5	.28611	-.32203	.47274	-.78540	0.00000	1.57080
2	2	1	.22084	-.41841	.47274	-.78540	0.00000	1.57080
2	2	2	.23880	-.40045	.47274	-.78540	0.00000	1.57080
2	2	3	.25676	-.38249	.47274	-.78540	0.00000	1.57080
2	2	4	.27472	-.36453	.47274	-.78540	0.00000	1.57080
2	2	5	.29268	-.34657	.47274	-.78540	0.00000	1.57080
2	3	1	.22742	-.44294	.47274	-.78540	0.00000	1.57080
2	3	2	.24538	-.42498	.47274	-.78540	0.00000	1.57080
2	3	3	.26334	-.40702	.47274	-.78540	0.00000	1.57080
2	3	4	.28130	-.38906	.47274	-.78540	0.00000	1.57080
2	3	5	.29926	-.37110	.47274	-.78540	0.00000	1.57080
2	4	1	.23399	-.46748	.47274	-.78540	0.00000	1.57080
2	4	2	.25195	-.44952	.47274	-.78540	0.00000	1.57080
2	4	3	.26991	-.43156	.47274	-.78540	0.00000	1.57080
2	4	4	.28787	-.41359	.47274	-.78540	0.00000	1.57080
2	4	5	.30583	-.39563	.47274	-.78540	0.00000	1.57080
2	4	6	.32379	-.37767	.47274	-.78540	0.00000	1.57080
2	5	1	.24056	-.49201	.47274	-.78540	0.00000	1.57080
2	5	2	.25852	-.47405	.47274	-.78540	0.00000	1.57080
2	5	3	.27648	-.45609	.47274	-.78540	0.00000	1.57080
2	5	4	.29444	-.43813	.47274	-.78540	0.00000	1.57080
2	5	5	.31241	-.42017	.47274	-.78540	0.00000	1.57080
2	5	6	.33037	-.40221	.47274	-.78540	0.00000	1.57080
2	6	1	.26510	-.49858	.47274	-.78540	0.00000	1.57080
2	6	2	.28306	-.48062	.47274	-.78540	0.00000	1.57080
2	6	3	.30102	-.46266	.47274	-.78540	0.00000	1.57080
2	6	4	.31898	-.44470	.47274	-.78540	0.00000	1.57080
2	6	5	.33694	-.42674	.47274	-.78540	0.00000	1.57080
2	6	6	.35490	-.40878	.47274	-.78540	0.00000	1.57080
2	7	1	.27167	-.52312	.47274	-.78540	0.00000	1.57080
2	7	2	.28963	-.50516	.47274	-.78540	0.00000	1.57080
2	7	3	.30759	-.48720	.47274	-.78540	0.00000	1.57080
2	7	4	.32555	-.46924	.47274	-.78540	0.00000	1.57080
2	7	5	.34351	-.45128	.47274	-.78540	0.00000	1.57080
2	7	6	.36147	-.43332	.47274	-.78540	0.00000	1.57080
2	7	7	.37943	-.41535	.47274	-.78540	0.00000	1.57080
3	1	1	.43002	-.12700	.47274	0.00000	0.00000	1.57080
3	1	2	.43002	-.10160	.47274	0.00000	0.00000	1.57080
3	1	3	.43002	-.07620	.47274	0.00000	0.00000	1.57080
3	1	4	.43002	-.05080	.47274	0.00000	0.00000	1.57080
3	1	5	.43002	-.02540	.47274	0.00000	0.00000	1.57080
3	2	1	.45202	-.13970	.47274	0.00000	0.00000	1.57080
3	2	2	.45202	-.11430	.47274	0.00000	0.00000	1.57080
3	2	3	.45202	-.08890	.47274	0.00000	0.00000	1.57080
3	2	4	.45202	-.06350	.47274	0.00000	0.00000	1.57080
3	2	5	.45202	-.03810	.47274	0.00000	0.00000	1.57080

Table 1. (Cont.)

GEOS-B (CONT.)

PANEL	ROW	UNIT	X	Y	Z	THETA	PHI	ALPHA
3	3	1	.47401	-.15240	.47274	0.00000	0.00000	1.57080
3	3	2	.47401	-.12700	.47274	0.00000	0.00000	1.57080
3	3	3	.47401	-.10160	.47274	0.00000	0.00000	1.57080
3	3	4	.47401	-.07620	.47274	0.00000	0.00000	1.57080
3	3	5	.47401	-.05080	.47274	0.00000	0.00000	1.57080
3	4	1	.49601	-.16510	.47274	0.00000	0.00000	1.57080
3	4	2	.49601	-.13970	.47274	0.00000	0.00000	1.57080
3	4	3	.49601	-.11430	.47274	0.00000	0.00000	1.57080
3	4	4	.49601	-.08890	.47274	0.00000	0.00000	1.57080
3	4	5	.49601	-.06350	.47274	0.00000	0.00000	1.57080
3	4	6	.49601	-.03810	.47274	0.00000	0.00000	1.57080
3	5	1	.51801	-.17780	.47274	0.00000	0.00000	1.57080
3	5	2	.51801	-.15240	.47274	0.00000	0.00000	1.57080
3	5	3	.51801	-.12700	.47274	0.00000	0.00000	1.57080
3	5	4	.51801	-.10160	.47274	0.00000	0.00000	1.57080
3	5	5	.51801	-.07620	.47274	0.00000	0.00000	1.57080
3	5	6	.51801	-.05080	.47274	0.00000	0.00000	1.57080
3	6	1	.54000	-.16510	.47274	0.00000	0.00000	1.57080
3	6	2	.54000	-.13970	.47274	0.00000	0.00000	1.57080
3	6	3	.54000	-.11430	.47274	0.00000	0.00000	1.57080
3	6	4	.54000	-.08890	.47274	0.00000	0.00000	1.57080
3	6	5	.54000	-.06350	.47274	0.00000	0.00000	1.57080
3	6	6	.54000	-.03810	.47274	0.00000	0.00000	1.57080
3	7	1	.56200	-.17780	.47274	0.00000	0.00000	1.57080
3	7	2	.56200	-.15240	.47274	0.00000	0.00000	1.57080
3	7	3	.56200	-.12700	.47274	0.00000	0.00000	1.57080
3	7	4	.56200	-.10160	.47274	0.00000	0.00000	1.57080
3	7	5	.56200	-.07620	.47274	0.00000	0.00000	1.57080
3	7	6	.56200	-.05080	.47274	0.00000	0.00000	1.57080
3	7	7	.56200	-.02540	.47274	0.00000	0.00000	1.57080
4	1	1	.21427	.39387	.44399	.78540	0.00000	1.57080
4	1	2	.23223	.37591	.44399	.78540	0.00000	1.57080
4	1	3	.25019	.35795	.44399	.78540	0.00000	1.57080
4	1	4	.26815	.33999	.44399	.78540	0.00000	1.57080
4	1	5	.28611	.32203	.44399	.78540	0.00000	1.57080
4	1	6	.30407	.30407	.44399	.78540	0.00000	1.57080
4	1	7	.32203	.28611	.44399	.78540	0.00000	1.57080
4	1	8	.33999	.26815	.44399	.78540	0.00000	1.57080
4	1	9	.35795	.25019	.44399	.78540	0.00000	1.57080
4	2	1	.22084	.41841	.44399	.78540	0.00000	1.57080
4	2	2	.23880	.40045	.44399	.78540	0.00000	1.57080
4	2	3	.25676	.38249	.44399	.78540	0.00000	1.57080
4	2	4	.27472	.36453	.44399	.78540	0.00000	1.57080
4	2	5	.29268	.34657	.44399	.78540	0.00000	1.57080
4	2	6	.31065	.32861	.44399	.78540	0.00000	1.57080
4	2	7	.32861	.31065	.44399	.78540	0.00000	1.57080
4	2	8	.34657	.29268	.44399	.78540	0.00000	1.57080
4	2	9	.36453	.27472	.44399	.78540	0.00000	1.57080
4	2	10	.38249	.25676	.44399	.78540	0.00000	1.57080
4	3	1	.22742	.44294	.44399	.78540	0.00000	1.57080

Table 1. (Cont.)

GEOS-B (CONT.)

PANEL	ROW	UNIT	X	Y	Z	THETA	PHI	ALPHA
4	3	2	.24538	.42498	.44399	.78540	0.00000	1.57080
4	3	3	.26334	.40702	.44399	.78540	0.00000	1.57080
4	3	4	.28130	.38906	.44399	.78540	0.00000	1.57080
4	3	5	.29926	.37110	.44399	.78540	0.00000	1.57080
4	3	6	.31722	.35314	.44399	.78540	0.00000	1.57080
4	3	7	.33518	.33518	.44399	.78540	0.00000	1.57080
4	3	8	.35314	.31722	.44399	.78540	0.00000	1.57080
4	3	9	.37110	.29926	.44399	.78540	0.00000	1.57080
4	3	10	.38906	.28130	.44399	.78540	0.00000	1.57080
4	4	1	.23399	.46748	.44399	.78540	0.00000	1.57080
4	4	2	.25195	.44952	.44399	.78540	0.00000	1.57080
4	4	3	.26991	.43156	.44399	.78540	0.00000	1.57080
4	4	4	.28787	.41359	.44399	.78540	0.00000	1.57080
4	4	5	.30583	.39563	.44399	.78540	0.00000	1.57080
4	4	6	.32379	.37767	.44399	.78540	0.00000	1.57080
4	4	7	.34175	.35971	.44399	.78540	0.00000	1.57080
4	4	8	.35971	.34175	.44399	.78540	0.00000	1.57080
4	4	9	.37767	.32379	.44399	.78540	0.00000	1.57080
4	4	10	.39563	.30583	.44399	.78540	0.00000	1.57080
4	4	11	.41359	.28787	.44399	.78540	0.00000	1.57080
4	5	1	.24056	.49201	.44399	.78540	0.00000	1.57080
4	5	2	.25852	.47405	.44399	.78540	0.00000	1.57080
4	5	3	.27648	.45609	.44399	.78540	0.00000	1.57080
4	5	4	.29444	.43813	.44399	.78540	0.00000	1.57080
4	5	5	.31241	.42017	.44399	.78540	0.00000	1.57080
4	5	6	.33037	.40221	.44399	.78540	0.00000	1.57080
4	5	7	.34833	.38425	.44399	.78540	0.00000	1.57080
4	5	8	.36629	.36629	.44399	.78540	0.00000	1.57080
4	5	9	.38425	.34833	.44399	.78540	0.00000	1.57080
4	5	10	.40221	.33037	.44399	.78540	0.00000	1.57080
4	5	11	.42017	.31241	.44399	.78540	0.00000	1.57080
4	6	1	.26510	.49858	.44399	.78540	0.00000	1.57080
4	6	2	.28306	.48062	.44399	.78540	0.00000	1.57080
4	6	3	.30102	.46266	.44399	.78540	0.00000	1.57080
4	6	4	.31898	.44470	.44399	.78540	0.00000	1.57080
4	6	5	.33694	.42674	.44399	.78540	0.00000	1.57080
4	6	6	.35490	.40878	.44399	.78540	0.00000	1.57080
4	6	7	.37286	.39082	.44399	.78540	0.00000	1.57080
4	6	8	.39082	.37286	.44399	.78540	0.00000	1.57080
4	6	9	.40878	.35490	.44399	.78540	0.00000	1.57080
4	6	10	.42674	.33694	.44399	.78540	0.00000	1.57080
4	6	11	.44470	.31898	.44399	.78540	0.00000	1.57080
4	7	1	.27167	.52312	.44399	.78540	0.00000	1.57080
4	7	2	.28963	.50516	.44399	.78540	0.00000	1.57080
4	7	3	.30759	.48720	.44399	.78540	0.00000	1.57080
4	7	4	.32555	.46924	.44399	.78540	0.00000	1.57080
4	7	5	.34351	.45128	.44399	.78540	0.00000	1.57080
4	7	6	.36147	.43332	.44399	.78540	0.00000	1.57080
4	7	7	.37943	.41535	.44399	.78540	0.00000	1.57080
4	7	8	.39739	.39739	.44399	.78540	0.00000	1.57080

Table 1. (Cont.)

GEOS-B (CONT.)

PANEL	ROW	UNIT	X	Y	Z	THETA	PHI	ALPHA
4	7	9	.41535	.37943	.44399	.78540	0.00000	1.57080
4	7	10	.43332	.36147	.44399	.78540	0.00000	1.57080
4	7	11	.45128	.34351	.44399	.78540	0.00000	1.57080
5	1	1	-.12700	.43002	.44399	1.57080	0.00000	1.57080
5	1	2	-.10160	.43002	.44399	1.57080	0.00000	1.57080
5	1	3	-.07620	.43002	.44399	1.57080	0.00000	1.57080
5	1	4	-.05080	.43002	.44399	1.57080	0.00000	1.57080
5	1	5	-.02540	.43002	.44399	1.57080	0.00000	1.57080
5	1	6	.00000	.43002	.44399	1.57080	0.00000	1.57080
5	1	7	.02540	.43002	.44399	1.57080	0.00000	1.57080
5	1	8	.05080	.43002	.44399	1.57080	0.00000	1.57080
5	1	9	.07620	.43002	.44399	1.57080	0.00000	1.57080
5	2	1	-.13970	.45202	.44399	1.57080	0.00000	1.57080
5	2	2	-.11430	.45202	.44399	1.57080	0.00000	1.57080
5	2	3	-.08890	.45202	.44399	1.57080	0.00000	1.57080
5	2	4	-.06350	.45202	.44399	1.57080	0.00000	1.57080
5	2	5	-.03810	.45202	.44399	1.57080	0.00000	1.57080
5	2	6	-.01270	.45202	.44399	1.57080	0.00000	1.57080
5	2	7	.01270	.45202	.44399	1.57080	0.00000	1.57080
5	2	8	.03810	.45202	.44399	1.57080	0.00000	1.57080
5	2	9	.06350	.45202	.44399	1.57080	0.00000	1.57080
5	2	10	.08890	.45202	.44399	1.57080	0.00000	1.57080
5	3	1	-.15240	.47401	.44399	1.57080	0.00000	1.57080
5	3	2	-.12700	.47401	.44399	1.57080	0.00000	1.57080
5	3	3	-.10160	.47401	.44399	1.57080	0.00000	1.57080
5	3	4	-.07620	.47401	.44399	1.57080	0.00000	1.57080
5	3	5	-.05080	.47401	.44399	1.57080	0.00000	1.57080
5	3	6	-.02540	.47401	.44399	1.57080	0.00000	1.57080
5	3	7	.00000	.47401	.44399	1.57080	0.00000	1.57080
5	3	8	.02540	.47401	.44399	1.57080	0.00000	1.57080
5	3	9	.05080	.47401	.44399	1.57080	0.00000	1.57080
5	3	10	.07620	.47401	.44399	1.57080	0.00000	1.57080
5	4	1	-.16510	.49601	.44399	1.57080	0.00000	1.57080
5	4	2	-.13970	.49601	.44399	1.57080	0.00000	1.57080
5	4	3	-.11430	.49601	.44399	1.57080	0.00000	1.57080
5	4	4	-.08890	.49601	.44399	1.57080	0.00000	1.57080
5	4	5	-.06350	.49601	.44399	1.57080	0.00000	1.57080
5	4	6	-.03810	.49601	.44399	1.57080	0.00000	1.57080
5	4	7	-.01270	.49601	.44399	1.57080	0.00000	1.57080
5	4	8	.01270	.49601	.44399	1.57080	0.00000	1.57080
5	4	9	.03810	.49601	.44399	1.57080	0.00000	1.57080
5	4	10	.06350	.49601	.44399	1.57080	0.00000	1.57080
5	4	11	.08890	.49601	.44399	1.57080	0.00000	1.57080
5	5	1	-.17780	.51801	.44399	1.57080	0.00000	1.57080
5	5	2	-.15240	.51801	.44399	1.57080	0.00000	1.57080
5	5	3	-.12700	.51801	.44399	1.57080	0.00000	1.57080
5	5	4	-.10160	.51801	.44399	1.57080	0.00000	1.57080
5	5	5	-.07620	.51801	.44399	1.57080	0.00000	1.57080
5	5	6	-.05080	.51801	.44399	1.57080	0.00000	1.57080
5	5	7	-.02540	.51801	.44399	1.57080	0.00000	1.57080

Table 1. (Cont.)

GEOS-B (CONT.)

PANEL	ROW	UNIT	X	Y	Z	THETA	PHI	ALPHA
5	5	8	.00000	.51801	.44399	1.57080	0.00000	1.57080
5	5	9	.02540	.51801	.44399	1.57080	0.00000	1.57080
5	5	10	.05080	.51801	.44399	1.57080	0.00000	1.57080
5	5	11	.07620	.51801	.44399	1.57080	0.00000	1.57080
5	6	1	-.16510	.54000	.44399	1.57080	0.00000	1.57080
5	6	2	-.13970	.54000	.44399	1.57080	0.00000	1.57080
5	6	3	-.11430	.54000	.44399	1.57080	0.00000	1.57080
5	6	4	-.08890	.54000	.44399	1.57080	0.00000	1.57080
5	6	5	-.06350	.54000	.44399	1.57080	0.00000	1.57080
5	6	6	-.03810	.54000	.44399	1.57080	0.00000	1.57080
5	6	7	-.01270	.54000	.44399	1.57080	0.00000	1.57080
5	6	8	.01270	.54000	.44399	1.57080	0.00000	1.57080
5	6	9	.03810	.54000	.44399	1.57080	0.00000	1.57080
5	6	10	.06350	.54000	.44399	1.57080	0.00000	1.57080
5	6	11	.08890	.54000	.44399	1.57080	0.00000	1.57080
5	7	1	-.17780	.56200	.44399	1.57080	0.00000	1.57080
5	7	2	-.15240	.56200	.44399	1.57080	0.00000	1.57080
5	7	3	-.12700	.56200	.44399	1.57080	0.00000	1.57080
5	7	4	-.10160	.56200	.44399	1.57080	0.00000	1.57080
5	7	5	-.07620	.56200	.44399	1.57080	0.00000	1.57080
5	7	6	-.05080	.56200	.44399	1.57080	0.00000	1.57080
5	7	7	-.02540	.56200	.44399	1.57080	0.00000	1.57080
5	7	8	.00000	.56200	.44399	1.57080	0.00000	1.57080
5	7	9	.02540	.56200	.44399	1.57080	0.00000	1.57080
5	7	10	.05080	.56200	.44399	1.57080	0.00000	1.57080
5	7	11	.07620	.56200	.44399	1.57080	0.00000	1.57080
6	1	1	-.21427	.39387	.47274	2.35619	0.00000	1.57080
6	1	2	-.23223	.37591	.47274	2.35619	0.00000	1.57080
6	1	3	-.25019	.35795	.47274	2.35619	0.00000	1.57080
6	1	4	-.26815	.33999	.47274	2.35619	0.00000	1.57080
6	1	5	-.28611	.32203	.47274	2.35619	0.00000	1.57080
6	2	1	-.22084	.41841	.47274	2.35619	0.00000	1.57080
6	2	2	-.23880	.40045	.47274	2.35619	0.00000	1.57080
6	2	3	-.25676	.38249	.47274	2.35619	0.00000	1.57080
6	2	4	-.27472	.36453	.47274	2.35619	0.00000	1.57080
6	2	5	-.29268	.34657	.47274	2.35619	0.00000	1.57080
6	3	1	-.22742	.44294	.47274	2.35619	0.00000	1.57080
6	3	2	-.24538	.42498	.47274	2.35619	0.00000	1.57080
6	3	3	-.26334	.40702	.47274	2.35619	0.00000	1.57080
6	3	4	-.28130	.38906	.47274	2.35619	0.00000	1.57080
6	3	5	-.29926	.37110	.47274	2.35619	0.00000	1.57080
6	4	1	-.23399	.46748	.47274	2.35619	0.00000	1.57080
6	4	2	-.25195	.44952	.47274	2.35619	0.00000	1.57080
6	4	3	-.26991	.43156	.47274	2.35619	0.00000	1.57080
6	4	4	-.28787	.41359	.47274	2.35619	0.00000	1.57080
6	4	5	-.30583	.39563	.47274	2.35619	0.00000	1.57080
6	4	6	-.32379	.37767	.47274	2.35619	0.00000	1.57080
6	5	1	-.24056	.49201	.47274	2.35619	0.00000	1.57080
6	5	2	-.25852	.47405	.47274	2.35619	0.00000	1.57080
6	5	3	-.27648	.45609	.47274	2.35619	0.00000	1.57080

Table 1. (Cont.)

GEOS-B (CONT.)

PANEL	ROW	UNIT	X	Y	Z	THETA	PHI	ALPHA
6	5	4	-.29444	.43813	.47274	2.35619	0.00000	1.57080
6	5	5	-.31241	.42017	.47274	2.35619	0.00000	1.57080
6	5	6	-.33037	.40221	.47274	2.35619	0.00000	1.57080
6	6	1	-.26510	.49858	.47274	2.35619	0.00000	1.57080
6	6	2	-.28306	.48062	.47274	2.35619	0.00000	1.57080
6	6	3	-.30102	.46266	.47274	2.35619	0.00000	1.57080
6	6	4	-.31898	.44470	.47274	2.35619	0.00000	1.57080
6	6	5	-.33694	.42674	.47274	2.35619	0.00000	1.57080
6	6	6	-.35490	.40878	.47274	2.35619	0.00000	1.57080
6	7	1	-.27167	.52312	.47274	2.35619	0.00000	1.57080
6	7	2	-.28963	.50516	.47274	2.35619	0.00000	1.57080
6	7	3	-.30759	.48720	.47274	2.35619	0.00000	1.57080
6	7	4	-.32555	.46924	.47274	2.35619	0.00000	1.57080
6	7	5	-.34351	.45128	.47274	2.35619	0.00000	1.57080
6	7	6	-.36147	.43332	.47274	2.35619	0.00000	1.57080
6	7	7	-.37943	.41535	.47274	2.35619	0.00000	1.57080
7	1	1	-.43002	.12700	.47274	3.14159	0.00000	1.57080
7	1	2	-.43002	.10160	.47274	3.14159	0.00000	1.57080
7	1	3	-.43002	.07620	.47274	3.14159	0.00000	1.57080
7	1	4	-.43002	.05080	.47274	3.14159	0.00000	1.57080
7	1	5	-.43002	.02540	.47274	3.14159	0.00000	1.57080
7	2	1	-.45202	.13970	.47274	3.14159	0.00000	1.57080
7	2	2	-.45202	.11430	.47274	3.14159	0.00000	1.57080
7	2	3	-.45202	.08890	.47274	3.14159	0.00000	1.57080
7	2	4	-.45202	.06350	.47274	3.14159	0.00000	1.57080
7	2	5	-.45202	.03810	.47274	3.14159	0.00000	1.57080
7	3	1	-.47401	.15240	.47274	3.14159	0.00000	1.57080
7	3	2	-.47401	.12700	.47274	3.14159	0.00000	1.57080
7	3	3	-.47401	.10160	.47274	3.14159	0.00000	1.57080
7	3	4	-.47401	.07620	.47274	3.14159	0.00000	1.57080
7	3	5	-.47401	.05080	.47274	3.14159	0.00000	1.57080
7	4	1	-.49601	.16510	.47274	3.14159	0.00000	1.57080
7	4	2	-.49601	.13970	.47274	3.14159	0.00000	1.57080
7	4	3	-.49601	.11430	.47274	3.14159	0.00000	1.57080
7	4	4	-.49601	.08890	.47274	3.14159	0.00000	1.57080
7	4	5	-.49601	.06350	.47274	3.14159	0.00000	1.57080
7	4	6	-.49601	.03810	.47274	3.14159	0.00000	1.57080
7	5	1	-.51801	.17780	.47274	3.14159	0.00000	1.57080
7	5	2	-.51801	.15240	.47274	3.14159	0.00000	1.57080
7	5	3	-.51801	.12700	.47274	3.14159	0.00000	1.57080
7	5	4	-.51801	.10160	.47274	3.14159	0.00000	1.57080
7	5	5	-.51801	.07620	.47274	3.14159	0.00000	1.57080
7	5	6	-.51801	.05080	.47274	3.14159	0.00000	1.57080
7	6	1	-.54000	.16510	.47274	3.14159	0.00000	1.57080
7	6	2	-.54000	.13970	.47274	3.14159	0.00000	1.57080
7	6	3	-.54000	.11430	.47274	3.14159	0.00000	1.57080
7	6	4	-.54000	.08890	.47274	3.14159	0.00000	1.57080
7	6	5	-.54000	.06350	.47274	3.14159	0.00000	1.57080
7	6	6	-.54000	.03810	.47274	3.14159	0.00000	1.57080
7	7	1	-.56200	.17780	.47274	3.14159	0.00000	1.57080

Table 1. (Cont.)

GEOS-B (CONT.)

PANEL	ROW	UNIT	X	Y	Z	THETA	PHI	ALPHA
7	7	2	-.56200	.15240	.47274	3.14159	0.00000	1.57080
7	7	3	-.56200	.12700	.47274	3.14159	0.00000	1.57080
7	7	4	-.56200	.10160	.47274	3.14159	0.00000	1.57080
7	7	5	-.56200	.07620	.47274	3.14159	0.00000	1.57080
7	7	6	-.56200	.05080	.47274	3.14159	0.00000	1.57080
7	7	7	-.56200	.02540	.47274	3.14159	0.00000	1.57080
8	1	1	-.39387	-.21427	.44399	3.92699	0.00000	1.57080
8	1	2	-.37591	-.23223	.44399	3.92699	0.00000	1.57080
8	1	3	-.35795	-.25019	.44399	3.92699	0.00000	1.57080
8	1	4	-.33999	-.26815	.44399	3.92699	0.00000	1.57080
8	1	5	-.32203	-.28611	.44399	3.92699	0.00000	1.57080
8	1	6	-.30407	-.30407	.44399	3.92699	0.00000	1.57080
8	1	7	-.28611	-.32203	.44399	3.92699	0.00000	1.57080
8	1	8	-.26815	-.33999	.44399	3.92699	0.00000	1.57080
8	1	9	-.25019	-.35795	.44399	3.92699	0.00000	1.57080
8	1	10	-.23223	-.37591	.44399	3.92699	0.00000	1.57080
8	1	11	-.21427	-.39387	.44399	3.92699	0.00000	1.57080
8	2	1	-.41841	-.22084	.44399	3.92699	0.00000	1.57080
8	2	2	-.40045	-.23880	.44399	3.92699	0.00000	1.57080
8	2	3	-.38249	-.25676	.44399	3.92699	0.00000	1.57080
8	2	4	-.36453	-.27472	.44399	3.92699	0.00000	1.57080
8	2	5	-.34657	-.29268	.44399	3.92699	0.00000	1.57080
8	2	6	-.32861	-.31065	.44399	3.92699	0.00000	1.57080
8	2	7	-.31065	-.32861	.44399	3.92699	0.00000	1.57080
8	2	8	-.29268	-.34657	.44399	3.92699	0.00000	1.57080
8	2	9	-.27472	-.36453	.44399	3.92699	0.00000	1.57080
8	2	10	-.25676	-.38249	.44399	3.92699	0.00000	1.57080
8	2	11	-.23880	-.40045	.44399	3.92699	0.00000	1.57080
8	2	12	-.22084	-.41841	.44399	3.92699	0.00000	1.57080
8	3	1	-.44294	-.22742	.44399	3.92699	0.00000	1.57080
8	3	2	-.42498	-.24538	.44399	3.92699	0.00000	1.57080
8	3	3	-.40702	-.26334	.44399	3.92699	0.00000	1.57080
8	3	4	-.38906	-.28130	.44399	3.92699	0.00000	1.57080
8	3	5	-.37110	-.29926	.44399	3.92699	0.00000	1.57080
8	3	6	-.35314	-.31722	.44399	3.92699	0.00000	1.57080
8	3	7	-.33518	-.33518	.44399	3.92699	0.00000	1.57080
8	3	8	-.31722	-.35314	.44399	3.92699	0.00000	1.57080
8	3	9	-.29926	-.37110	.44399	3.92699	0.00000	1.57080
8	3	10	-.28130	-.38906	.44399	3.92699	0.00000	1.57080
8	3	11	-.26334	-.40702	.44399	3.92699	0.00000	1.57080
8	3	12	-.24538	-.42498	.44399	3.92699	0.00000	1.57080
8	3	13	-.22742	-.44294	.44399	3.92699	0.00000	1.57080
8	4	1	-.46748	-.23399	.44399	3.92699	0.00000	1.57080
8	4	2	-.44952	-.25195	.44399	3.92699	0.00000	1.57080
8	4	3	-.43156	-.26991	.44399	3.92699	0.00000	1.57080
8	4	4	-.41359	-.28787	.44399	3.92699	0.00000	1.57080
8	4	5	-.39563	-.30583	.44399	3.92699	0.00000	1.57080
8	4	6	-.37767	-.32379	.44399	3.92699	0.00000	1.57080
8	4	7	-.35971	-.34175	.44399	3.92699	0.00000	1.57080
8	4	8	-.34175	-.35971	.44399	3.92699	0.00000	1.57080

Table 1. (Cont.)

GEOS-B (CONT.)

PANEL	ROW	UNIT	X	Y	Z	THETA	PHI	ALPHA
8	4	9	-.32379	-.37767	.44399	3.92699	0.00000	1.57080
8	4	10	-.30583	-.39563	.44399	3.92699	0.00000	1.57080
8	4	11	-.28787	-.41359	.44399	3.92699	0.00000	1.57080
8	4	12	-.26991	-.43156	.44399	3.92699	0.00000	1.57080
8	4	13	-.25195	-.44952	.44399	3.92699	0.00000	1.57080
8	4	14	-.23399	-.46748	.44399	3.92699	0.00000	1.57080
8	5	1	-.49201	-.24056	.44399	3.92699	0.00000	1.57080
8	5	2	-.47405	-.25852	.44399	3.92699	0.00000	1.57080
8	5	3	-.45609	-.27648	.44399	3.92699	0.00000	1.57080
8	5	4	-.43813	-.29444	.44399	3.92699	0.00000	1.57080
8	5	5	-.42017	-.31241	.44399	3.92699	0.00000	1.57080
8	5	6	-.40221	-.33037	.44399	3.92699	0.00000	1.57080
8	5	7	-.38425	-.34833	.44399	3.92699	0.00000	1.57080
8	5	8	-.36629	-.36629	.44399	3.92699	0.00000	1.57080
8	5	9	-.34833	-.38425	.44399	3.92699	0.00000	1.57080
8	5	10	-.33037	-.40221	.44399	3.92699	0.00000	1.57080
8	5	11	-.31241	-.42017	.44399	3.92699	0.00000	1.57080
8	5	12	-.29444	-.43813	.44399	3.92699	0.00000	1.57080
8	5	13	-.27648	-.45609	.44399	3.92699	0.00000	1.57080
8	5	14	-.25852	-.47405	.44399	3.92699	0.00000	1.57080
8	5	15	-.24056	-.49201	.44399	3.92699	0.00000	1.57080
8	6	1	-.49858	-.26510	.44399	3.92699	0.00000	1.57080
8	6	2	-.48062	-.28306	.44399	3.92699	0.00000	1.57080
8	6	3	-.46266	-.30102	.44399	3.92699	0.00000	1.57080
8	6	4	-.44470	-.31898	.44399	3.92699	0.00000	1.57080
8	6	5	-.42674	-.33694	.44399	3.92699	0.00000	1.57080
8	6	6	-.40878	-.35490	.44399	3.92699	0.00000	1.57080
8	6	7	-.39082	-.37286	.44399	3.92699	0.00000	1.57080
8	6	8	-.37286	-.39082	.44399	3.92699	0.00000	1.57080
8	6	9	-.35490	-.40878	.44399	3.92699	0.00000	1.57080
8	6	10	-.33694	-.42674	.44399	3.92699	0.00000	1.57080
8	6	11	-.31898	-.44470	.44399	3.92699	0.00000	1.57080
8	6	12	-.30102	-.46266	.44399	3.92699	0.00000	1.57080
8	6	13	-.28306	-.48062	.44399	3.92699	0.00000	1.57080
8	6	14	-.26510	-.49858	.44399	3.92699	0.00000	1.57080
8	7	1	-.52312	-.27167	.44399	3.92699	0.00000	1.57080
8	7	2	-.50516	-.28963	.44399	3.92699	0.00000	1.57080
8	7	3	-.48720	-.30759	.44399	3.92699	0.00000	1.57080
8	7	4	-.46924	-.32555	.44399	3.92699	0.00000	1.57080
8	7	5	-.45128	-.34351	.44399	3.92699	0.00000	1.57080
8	7	6	-.43332	-.36147	.44399	3.92699	0.00000	1.57080
8	7	7	-.41535	-.37943	.44399	3.92699	0.00000	1.57080
8	7	8	-.39739	-.39739	.44399	3.92699	0.00000	1.57080
8	7	9	-.37943	-.41535	.44399	3.92699	0.00000	1.57080
8	7	10	-.36147	-.43332	.44399	3.92699	0.00000	1.57080
8	7	11	-.34351	-.45128	.44399	3.92699	0.00000	1.57080
8	7	12	-.32555	-.46924	.44399	3.92699	0.00000	1.57080
8	7	13	-.30759	-.48720	.44399	3.92699	0.00000	1.57080
8	7	14	-.28963	-.50516	.44399	3.92699	0.00000	1.57080
8	7	15	-.27167	-.52312	.44399	3.92699	0.00000	1.57080

Table 1. (Cont.)

PECLE (1970 109 A)

PANEL	ROW	UNIT	X	Y	Z	THETA	PHI	ALPHA
1	1	1	-.06370	-.84300	.06000	-1.57080	.78540	1.57080
1	1	2	-.03185	-.84300	.06000	-1.57080	.78540	1.57080
1	1	3	.00000	-.84300	.06000	-1.57080	.78540	1.57080
1	1	4	.03185	-.84300	.06000	-1.57080	.78540	1.57080
1	1	5	.06370	-.84300	.06000	-1.57080	.78540	1.57080
2	1	1	.55105	-.64113	.06000	-.78540	.78540	1.57080
2	1	2	.57357	-.61861	.06000	-.78540	.78540	1.57080
2	1	3	.59609	-.59609	.06000	-.78540	.78540	1.57080
2	1	4	.61861	-.57357	.06000	-.78540	.78540	1.57080
2	1	5	.64113	-.55105	.06000	-.78540	.78540	1.57080
3	1	1	.84300	-.06370	.06000	0.00000	.78540	1.57080
3	1	2	.84300	-.03185	.06000	0.00000	.78540	1.57080
3	1	3	.84300	-.00000	.06000	0.00000	.78540	1.57080
3	1	4	.84300	.03185	.06000	0.00000	.78540	1.57080
3	1	5	.84300	.06370	.06000	0.00000	.78540	1.57080
4	1	1	.64113	.55105	.06000	.78540	.78540	1.57080
4	1	2	.61861	.57357	.06000	.78540	.78540	1.57080
4	1	3	.59609	.59609	.06000	.78540	.78540	1.57080
4	1	4	.57357	.61861	.06000	.78540	.78540	1.57080
4	1	5	.55105	.64113	.06000	.78540	.78540	1.57080
5	1	1	.06370	.84300	.06000	1.57080	.78540	1.57080
5	1	2	.03185	.84300	.06000	1.57080	.78540	1.57080
5	1	3	.00000	.84300	.06000	1.57080	.78540	1.57080
5	1	4	-.03185	.84300	.06000	1.57080	.78540	1.57080
5	1	5	-.06370	.84300	.06000	1.57080	.78540	1.57080
6	1	1	-.55105	.64113	.06000	2.35619	.78540	1.57080
6	1	2	-.57357	.61861	.06000	2.35619	.78540	1.57080
6	1	3	-.59609	.59609	.06000	2.35619	.78540	1.57080
6	1	4	-.61861	.57357	.06000	2.35619	.78540	1.57080
6	1	5	-.64113	.55105	.06000	2.35619	.78540	1.57080
7	1	1	-.84300	.06370	.06000	3.14159	.78540	1.57080
7	1	2	-.84300	.03185	.06000	3.14159	.78540	1.57080
7	1	3	-.84300	.00000	.06000	3.14159	.78540	1.57080
7	1	4	-.84300	-.03185	.06000	3.14159	.78540	1.57080
7	1	5	-.84300	-.06370	.06000	3.14159	.78540	1.57080
8	1	1	-.64113	-.55105	.06000	-2.35619	.78540	1.57080
8	1	2	-.61861	-.57357	.06000	-2.35619	.78540	1.57080
8	1	3	-.59609	-.59609	.06000	-2.35619	.78540	1.57080
8	1	4	-.57357	-.61861	.06000	-2.35619	.78540	1.57080
8	1	5	-.55105	-.64113	.06000	-2.35619	.78540	1.57080
9	1	1	.24945	-.10332	.91900	-.39270	0.00000	1.57080
10	1	1	.10332	.24945	.91900	1.17810	0.00000	1.57080
11	1	1	-.24945	.10332	.91900	2.74889	0.00000	1.57080
12	1	1	-.10332	-.24945	.91900	-1.96350	0.00000	1.57080

3. METHOD OF COMPUTATION

The transfer function of an array of reflectors can be computed to varying levels of accuracy and complexity, depending on how the physical situation is modeled mathematically. The computer programs developed under this grant compute both the incoherent and the coherent return signals from an array. Subroutines have been written to calculate the active reflecting areas for any incidence angle of a retroreflector whose face is cut in the form of a circle, triangle, or even-sided polygon (such as a hexagon). Other subroutines calculate the diffraction pattern for any incidence angle of the various designs of reflector. These routines take into account changes in amplitude, polarization, and phase at the front face and at the three back reflecting faces, which may be either metalized or uncoated. The directions of the six rays produced by dihedral-angle errors are computed and included in the diffraction calculations.

The structures of certain satellites, such as the two Geos spacecraft and Peole, can obscure some of the reflectors from the incident laser beam. A subroutine checks each reflector to make sure it is visible before including it in the calculation.

When the position of each reflector along the line of sight to the observer is computed, a correction is applied for the fact that the velocity of light is slower in a solid reflector than in a vacuum. The effect is a function of the size, orientation, and index of refraction of the cube corner.

Once the return signal has been constructed, the relationship of the centroid of the signal to the satellite's center of mass can be determined and tabulated for use as a range correction.

We intend to publish a complete description of the equations and computer programs as an SAO Special Report, and we will forward copies to NASA.

4. RESULTS

4.1 Range Corrections and Effective Reflecting Areas

Table 2 gives information on reflecting areas and range (and width) corrections. The active reflecting area is the sum of the contributions of all the reflectors. This quantity is normalized such that one retroreflector illuminated at normal incidence has a reflecting area of unity. The range correction depends on the type of transmitting and detection system used. It therefore cannot be specified uniquely for a given satellite. Two types of corrections are presented here. The first is the displacement of the centroid of the return signal relative to the center of mass of the satellite; this is shown as a one-way correction, in meters. The second is a correction for the spreading of the pulse at the half-amplitude point of the return signal. The absolute as well as the relative size of the spreading due to the array increases as the pulse length decreases. The values are given for a 20-nsec, half-amplitude, full-width incident pulse with a gaussian energy distribution as a function of time. The range corrections are tabulated for the incoherent case, which is the mean of the coherent values. For satellites not symmetrical about the principal axis, the corrections given are the average over a selection of azimuths. No displacement of the centroid of the pulse is shown for Geos C, since the center of gravity of the satellite is unknown at this time. The increase in the range correction for Geos 2 beyond 54° incidence angle is due to shadowing by the hemispherical antenna.

Beside the tabulated corrections in the tables is a computer graph; the implied vertical axis is the incidence angle. For the reflecting area, the scale of the plot has been chosen to fill 50 horizontal printer positions. The range and width corrections are plotted at one horizontal print position per centimeter. The angle is measured from the symmetry axis (z axis) of the satellite.

Table 2. Active reflecting area and range and width corrections.

BE-B(1964 64 A) AND BE-C(1965 32 A)

PHI(DEG)	EFFECTIVE REFLECTING AREA
0.0	48.5583
2.0	46.9807
4.0	45.6750
6.0	44.6447
8.0	43.8921
10.0	43.4187
12.0	43.3714
14.0	43.6817
16.0	44.2287
18.0	45.0079
20.0	45.8747
22.0	46.7614
24.0	47.6366
26.0	48.7259
28.0	49.7669
30.0	50.7555
32.0	51.6886
34.0	52.5646
36.0	53.3961
38.0	54.1873
40.0	54.9364
42.0	55.6475
44.0	56.3631
46.0	57.1160
48.0	57.8883
50.0	58.6253
52.0	59.3103
54.0	59.9319
56.0	57.3570
58.0	54.7376
60.0	52.1356
62.0	49.5029
64.0	46.7424
66.0	43.8602
68.0	40.8635
70.0	37.7574
72.0	34.5569
74.0	31.4126
76.0	28.3947
78.0	25.5045
80.0	22.7425
82.0	20.1088
84.0	17.6033
86.0	15.2252
88.0	12.9762
90.0	10.9117
92.0	9.0485
94.0	7.3788
96.0	5.8941
98.0	4.5850
100.0	3.4819
102.0	2.7138
104.0	2.0602
106.0	1.5146
108.0	1.0698
110.0	.7177
112.0	.4491
114.0	.2542
116.0	.1226
118.0	.0437
120.0	.0067

ONE REFLECTOR AT NORMAL INCIDENCE HAS A REFLECTING AREA OF UNITY

Table 2. (Cont.)

PHI (DEG)	RANGE CORRECTION (METERS)		PHI (DEG)	WIDTH CORRECTION (METERS)
0.0	.3514 *		0.0	.0009 *
2.0	.3504 *		2.0	.0010 *
4.0	.3488 *		4.0	.0010 *
6.0	.3467 *		6.0	.0010 *
8.0	.3441 *		8.0	.0010 *
10.0	.3411 *		10.0	.0009 *
12.0	.3375 *		12.0	.0009 *
14.0	.3335		14.0	.0008 *
16.0	.3296		16.0	.0008 *
18.0	.3258		18.0	.0007 *
20.0	.3224		20.0	.0007 *
22.0	.3194		22.0	.0006 *
24.0	.3168		24.0	.0005 *
26.0	.3140		26.0	.0005 *
28.0	.3115		28.0	.0004 *
30.0	.3093		30.0	.0004 *
32.0	.3072		32.0	.0004 *
34.0	.3052		34.0	.0004 *
36.0	.3033		36.0	.0004 *
38.0	.3014		38.0	.0004 *
40.0	.2995		40.0	.0004 *
42.0	.2975		42.0	.0004 *
44.0	.2954		44.0	.0004 *
46.0	.2931		46.0	.0004 *
48.0	.2906		48.0	.0004 *
50.0	.2879		50.0	.0003 *
52.0	.2849		52.0	.0003 *
54.0	.2816		54.0	.0003 *
56.0	.2772		56.0	.0003 *
58.0	.2725		58.0	.0003 *
60.0	.2673		60.0	.0003 *
62.0	.2616		62.0	.0003 *
64.0	.2557		64.0	.0004 *
66.0	.2495		66.0	.0004 *
68.0	.2430		68.0	.0004 *
70.0	.2364		70.0	.0004 *
72.0	.2297		72.0	.0004 *
74.0	.2228		74.0	.0005 *
76.0	.2156		76.0	.0005 *
78.0	.2081		78.0	.0005 *
80.0	.2004		80.0	.0006 *
82.0	.1924		82.0	.0006 *
84.0	.1842		84.0	.0006 *
86.0	.1757		86.0	.0006 *
88.0	.1670		88.0	.0007 *
90.0	.1582		90.0	.0007 *
92.0	.1493		92.0	.0007 *
94.0	.1405		94.0	.0008 *
96.0	.1317		96.0	.0008 *
98.0	.1234		98.0	.0008 *
100.0	.1152		100.0	.0008 *
102.0	.1044		102.0	.0008 *
104.0	.0934		104.0	.0009 *
106.0	.0823		106.0	.0009 *
108.0	.0710		108.0	.0010 *
110.0	.0596		110.0	.0010 *
112.0	.0481		112.0	.0011 *
114.0	.0366		114.0	.0011 *
116.0	.0249		116.0	.0012 *
118.0	.0132		118.0	.0012 *
120.0	.0015 *		120.0	.0012 *

Table 2. (Cont.)

GEOS-A (1965 89 A)

PHI(DEG)   EFFECTIVE REFLECTING AREA

PHI(DEG)	EFFECTIVE REFLECTING AREA	
0.0	334.0000	
2.0	319.4398	
4.0	304.6935	
6.0	289.8061	
8.0	274.8225	
10.0	259.7868	
12.0	244.7432	
14.0	229.7355	
16.0	214.8069	
18.0	200.0006	
20.0	185.3596	
22.0	170.9261	
24.0	156.7421	
26.0	142.8490	
28.0	122.7066	
30.0	109.7246	
32.0	97.1730	
34.0	85.0897	
36.0	73.5477	
38.0	62.7020	
40.0	52.6687	
42.0	43.4588	
44.0	35.0745	*
46.0	27.3692	*
48.0	20.5127	*
50.0	14.6834	*
52.0	9.8225	*
54.0	5.8716	*
56.0	2.8040	*
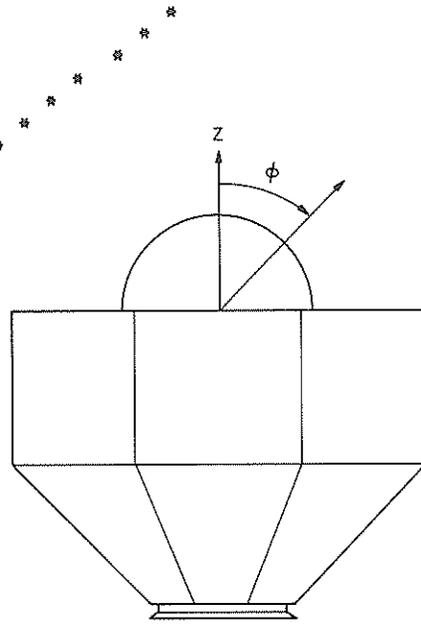
ONE REFLECTOR AT NORMAL INCIDENCE HAS A REFLECTING AREA OF UNITY

Table 2. (Cont.)

GEOS-A (1965 89 A)

PHI(DEG)   RANGE CORRECTION(METERS)

PHI(DEG)	RANGE CORRECTION(METERS)
0.0	.3972
2.0	.3970
4.0	.3962
6.0	.3950
8.0	.3932
10.0	.3910
12.0	.3882
14.0	.3850
16.0	.3813
18.0	.3771
20.0	.3724
22.0	.3673
24.0	.3617
26.0	.3556
28.0	.3456
30.0	.3384
32.0	.3308
34.0	.3227
36.0	.3143
38.0	.3054
40.0	.2961
42.0	.2865
44.0	.2765
46.0	.2682
48.0	.2610
50.0	.2540
52.0	.2478
54.0	.2421
56.0	.2232
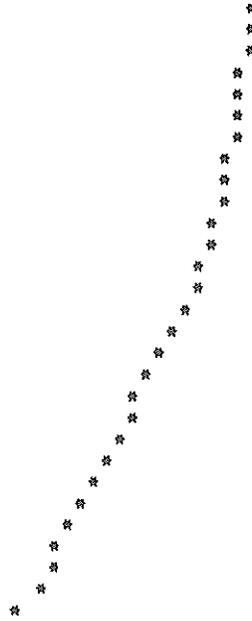
GEOS-A (1965 89 A)

PHI(DEG)   WIDTH CORRECTION(METERS)

PHI(DEG)	WIDTH CORRECTION(METERS)
0.0	0.0000
2.0	.0001
4.0	.0003
6.0	.0007
8.0	.0012
10.0	.0018
12.0	.0026
14.0	.0036
16.0	.0046
18.0	.0058
20.0	.0072
22.0	.0086
24.0	.0102
26.0	.0118
28.0	.0146
30.0	.0165
32.0	.0185
34.0	.0205
36.0	.0227
38.0	.0250
40.0	.0272
42.0	.0295
44.0	.0318
46.0	.0339
48.0	.0360
50.0	.0378
52.0	.0387
54.0	.0374
56.0	.0266
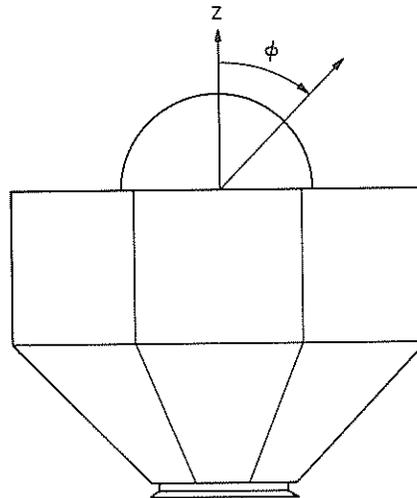
Table 2. (Cont.)

D1-C(1967 11 A) AND D1-D(1967 14 A)

PHI(DEG)	EFFECTIVE REFLECTING AREA
0.0	18.9516
2.0	18.4487
4.0	17.9522
6.0	17.4529
8.0	16.9507
10.0	16.5512
12.0	16.2979
14.0	16.1197
16.0	15.9937
18.0	15.9161
20.0	15.8725
22.0	15.8602
24.0	15.8766
26.0	15.9226
28.0	16.0170
30.0	16.1822
32.0	16.2702
34.0	16.3763
36.0	16.4558
38.0	16.5227
40.0	16.6458
42.0	16.7999
44.0	16.9795
46.0	17.1681
48.0	17.2812
50.0	17.3627
52.0	17.4335
54.0	17.4908
56.0	17.5120
58.0	17.4232
60.0	17.3343
62.0	17.2137
64.0	17.0599
66.0	16.8441
68.0	16.3816
70.0	15.7385
72.0	15.0659
74.0	14.3462
76.0	13.6041
78.0	12.8434
80.0	12.0649
82.0	11.2694
84.0	10.4580
86.0	9.6199
88.0	8.7700
90.0	7.9254
92.0	7.1219
94.0	6.3337
96.0	5.5926
98.0	4.8849
100.0	4.2120
102.0	3.5807
104.0	3.0019
106.0	2.4783
108.0	2.0101
110.0	1.5966
112.0	1.2351
114.0	.9229
116.0	.6567
118.0	.4331
120.0	.2485
122.0	.0990
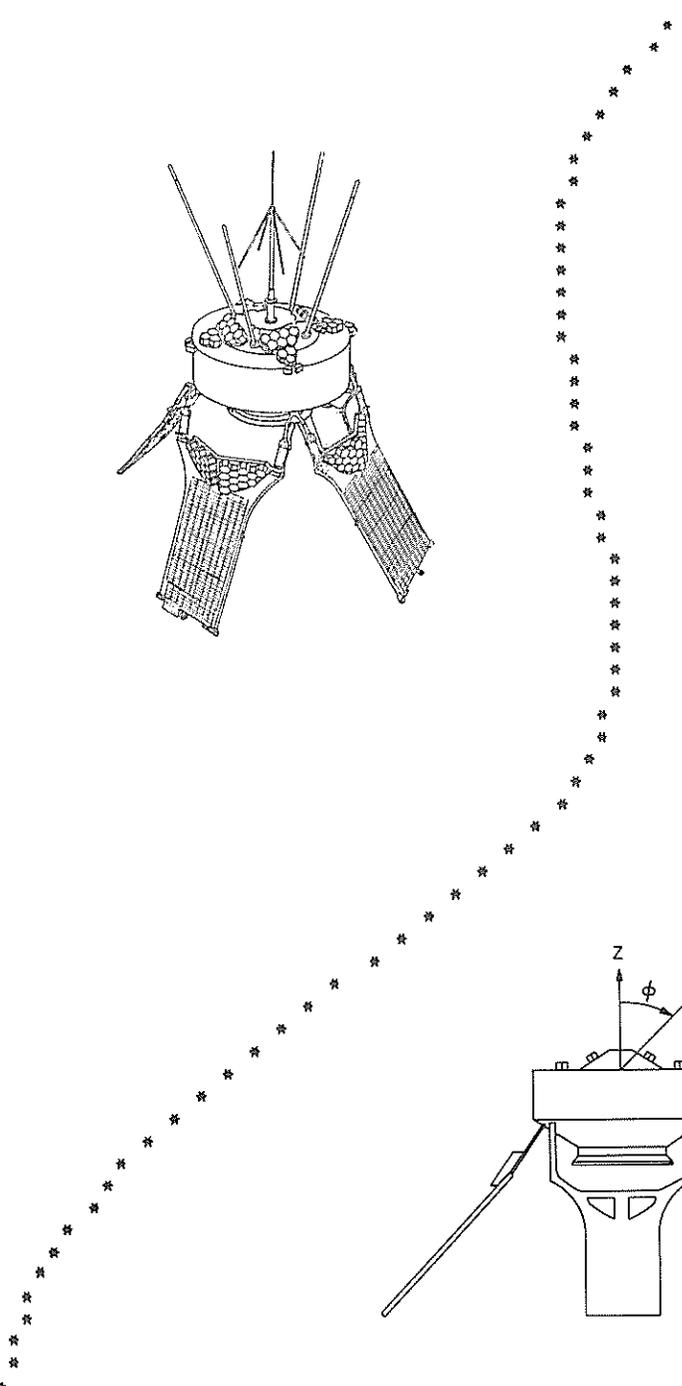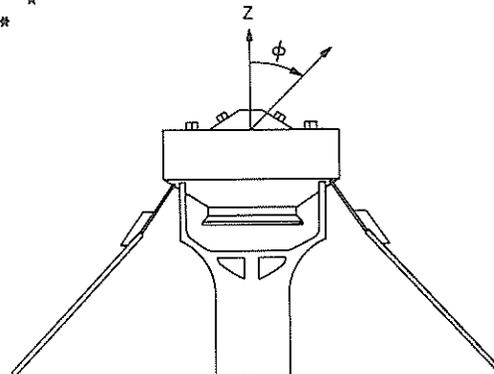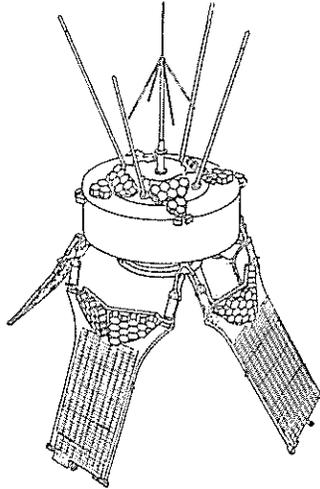
ONE REFLECTOR AT NORMAL INCIDENCE HAS A REFLECTING AREA OF UNITY

Table 2. (Cont.)

D1-C(1967 11 A) AND D1-D(1967 14 A)

D1-C(1967 11 A) AND D1-D(1967 14 A)

PHI(DEG)	RANGE CORRECTION(METERS)		PHI(DEG)	WIDTH CORRECTION(METERS)
0.0	.1488	*	0.0	.0001 *
2.0	.1490	*	2.0	.0001 *
4.0	.1493	*	4.0	.0001 *
6.0	.1497	*	6.0	.0001 *
8.0	.1502	*	8.0	.0002 *
10.0	.1491	*	10.0	.0005 *
12.0	.1459	*	12.0	.0010 *
14.0	.1417	*	14.0	.0016 *
16.0	.1373	*	16.0	.0022 *
18.0	.1327	*	18.0	.0027 *
20.0	.1283	*	20.0	.0031 *
22.0	.1243	*	22.0	.0034 *
24.0	.1208	*	24.0	.0036 *
26.0	.1178	*	26.0	.0036 *
28.0	.1153	*	28.0	.0036 *
30.0	.1136	*	30.0	.0035 *
32.0	.1121	*	32.0	.0033 *
34.0	.1114	*	34.0	.0031 *
36.0	.1113	*	36.0	.0028 *
38.0	.1117	*	38.0	.0025 *
40.0	.1130	*	40.0	.0022 *
42.0	.1153	*	42.0	.0019 *
44.0	.1185	*	44.0	.0017 *
46.0	.1227	*	46.0	.0014 *
48.0	.1277	*	48.0	.0012 *
50.0	.1335	*	50.0	.0009 *
52.0	.1401	*	52.0	.0008 *
54.0	.1474	*	54.0	.0006 *
56.0	.1552	*	56.0	.0005 *
58.0	.1633	*	58.0	.0005 *
60.0	.1716	*	60.0	.0005 *
62.0	.1800	*	62.0	.0004 *
64.0	.1886	*	64.0	.0004 *
66.0	.1972	*	66.0	.0005 *
68.0	.2055	*	68.0	.0005 *
70.0	.2137	*	70.0	.0005 *
72.0	.2218	*	72.0	.0006 *
74.0	.2299	*	74.0	.0006 *
76.0	.2379	*	76.0	.0006 *
78.0	.2459	*	78.0	.0007 *
80.0	.2537	*	80.0	.0007 *
82.0	.2615	*	82.0	.0006 *
84.0	.2693	*	84.0	.0006 *
86.0	.2769	*	86.0	.0005 *
88.0	.2840	*	88.0	.0004 *
90.0	.2906	*	90.0	.0004 *
92.0	.2964	*	92.0	.0003 *
94.0	.3019	*	94.0	.0003 *
96.0	.3065	*	96.0	.0003 *
98.0	.3108	*	98.0	.0003 *
100.0	.3146	*	100.0	.0002 *
102.0	.3178	*	102.0	.0002 *
104.0	.3206	*	104.0	.0002 *
106.0	.3230	*	106.0	.0002 *
108.0	.3250	*	108.0	.0002 *
110.0	.3266	*	110.0	.0003 *
112.0	.3277	*	112.0	.0003 *
114.0	.3284	*	114.0	.0003 *
116.0	.3287	*	116.0	.0003 *
118.0	.3286	*	118.0	.0003 *
120.0	.3282	*	120.0	.0003 *
122.0	.3278	*	122.0	.0003 *

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Table 2. (Cont.)

GEOS-B (1968 2 A)

PHI(DEG)   EFFECTIVE REFLECTING AREA

PHI(DEG)	EFFECTIVE REFLECTING AREA
0.0	400.0000
2.0	382.6719
4.0	365.1065
6.0	347.3576
8.0	329.4786
10.0	311.5224
12.0	293.5418
14.0	275.5892
16.0	257.7168
18.0	239.9764
20.0	222.4196
22.0	205.0975
24.0	188.0610
26.0	171.3602
28.0	155.0449
30.0	139.1640
32.0	123.7656
34.0	108.9021
36.0	94.7269
38.0	81.3193
40.0	68.7091
42.0	56.9829
44.0	46.3800
46.0	36.7998
48.0	28.3920
50.0	20.9721
52.0	14.6863
54.0	9.3762
56.0	5.0486
58.0	1.8431
60.0	.3018
62.0	.1318
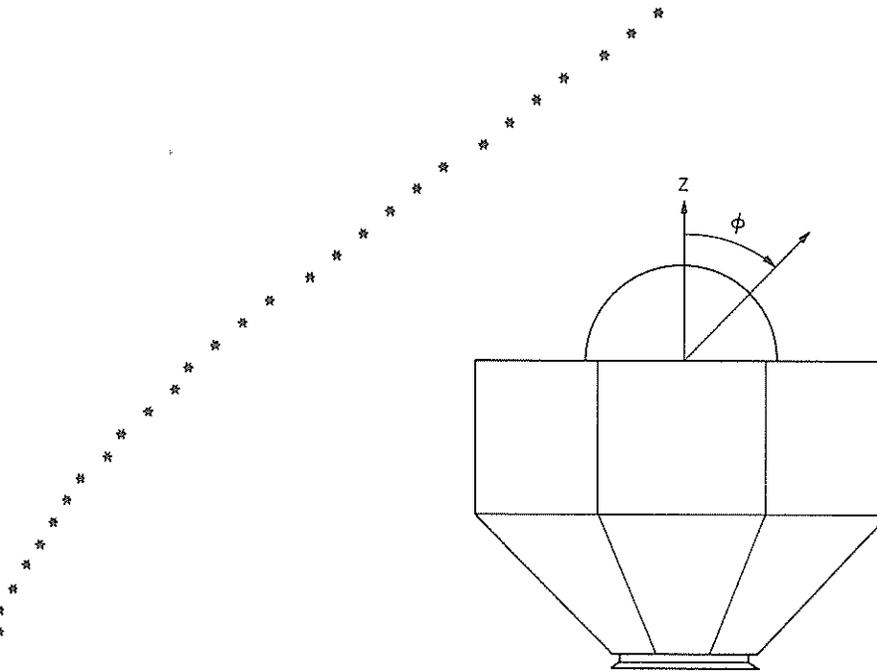
ONE REFLECTOR AT NORMAL INCIDENCE HAS A REFLECTING AREA OF UNITY

Table 2. (Cont.)

GEOS-B (1968 2 A)

PHI(DEG)	RANGE CORRECTION(METERS)
0.0	.4298
2.0	.4290
4.0	.4276
6.0	.4257
8.0	.4234
10.0	.4204
12.0	.4169
14.0	.4129
16.0	.4084
18.0	.4033
20.0	.3978
22.0	.3918
24.0	.3852
26.0	.3781
28.0	.3706
30.0	.3626
32.0	.3542
34.0	.3452
36.0	.3358
38.0	.3260
40.0	.3158
42.0	.3052
44.0	.2942
46.0	.2836
48.0	.2727
50.0	.2631
52.0	.2534
54.0	.2464
56.0	.2439
58.0	.2632
60.0	.2858
62.0	.3175
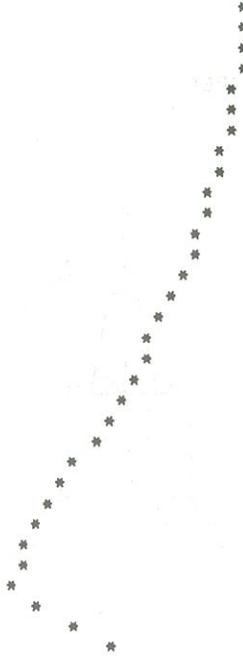
GEOS-B (1968 2 A)

PHI(DEG)	WIDTH CORRECTION(METERS)
0.0	.0001
2.0	.0002
4.0	.0004
6.0	.0007
8.0	.0012
10.0	.0019
12.0	.0027
14.0	.0036
16.0	.0046
18.0	.0058
20.0	.0070
22.0	.0084
24.0	.0099
26.0	.0115
28.0	.0131
30.0	.0149
32.0	.0167
34.0	.0185
36.0	.0203
38.0	.0223
40.0	.0242
42.0	.0261
44.0	.0280
46.0	.0300
48.0	.0320
50.0	.0341
52.0	.0365
54.0	.0396
56.0	.0449
58.0	.0570
60.0	.0443
62.0	.0342

Table 2. (Cont.)

PEOLE (1970 1C9 A)
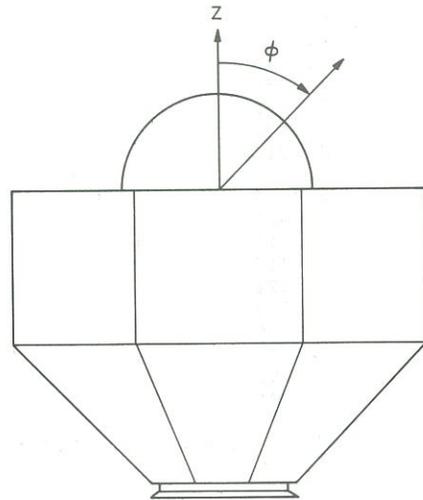
PHI(DEG)	EFFECTIVE REFLECTING AREA
0.0	7.9103
2.0	7.7627
4.0	7.6640
6.0	7.6142
8.0	7.6131
10.0	7.6602
12.0	7.7399
14.0	7.8269
16.0	7.9137
18.0	7.9957
20.0	8.0932
22.0	8.1852
24.0	8.1347
26.0	8.2264
28.0	8.2985
30.0	8.3565
32.0	8.4055
34.0	8.4489
36.0	8.4864
38.0	8.5169
40.0	8.4633
42.0	8.3458
44.0	8.2180
46.0	7.9816
48.0	7.5989
50.0	7.2528
52.0	6.8946
54.0	6.5245
56.0	6.1470
58.0	5.7598
60.0	5.3354
62.0	4.9005
64.0	4.4681
66.0	4.0423
68.0	3.6614
70.0	3.2954
72.0	2.9448
74.0	2.6101
76.0	2.2913
78.0	1.9892
80.0	1.7049
82.0	1.4424
84.0	1.2014
86.0	.9815
88.0	.7822
90.0	.6029
92.0	.4429
94.0	.3070
96.0	.1952
98.0	.1026
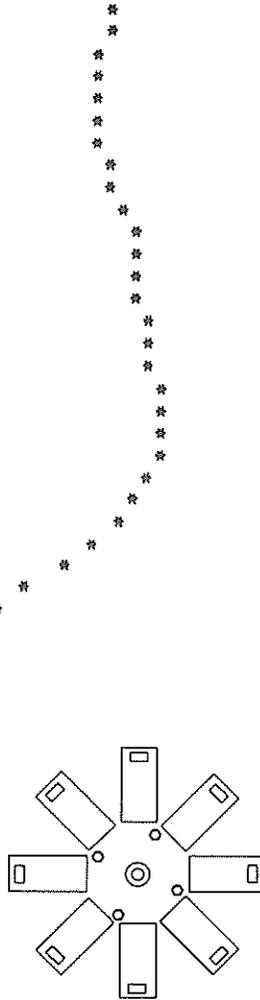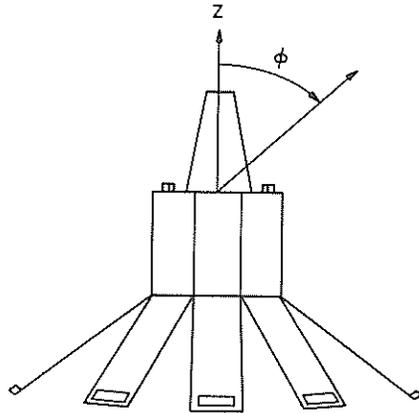
ONE REFLECTOR AT NORMAL INCIDENCE HAS A REFLECTING AREA OF UNITY

Table 2. (Cont.)

PEOLE (1970 109 A)

PHI (DEG)	RANGE CORRECTION (METERS)
0.0	.4642
2.0	.4547
4.0	.4447
6.0	.4348
8.0	.4250
10.0	.4160
12.0	.4085
14.0	.4034
16.0	.4008
18.0	.4006
20.0	.4009
22.0	.4030
24.0	.4032
26.0	.4091
28.0	.4172
30.0	.4269
32.0	.4382
34.0	.4505
36.0	.4640
38.0	.4785
40.0	.4940
42.0	.5100
44.0	.5265
46.0	.5428
48.0	.5592
50.0	.5750
52.0	.5908
54.0	.6067
56.0	.6221
58.0	.6375
60.0	.6524
62.0	.6670
64.0	.6816
66.0	.6960
68.0	.7064
70.0	.7161
72.0	.7250
74.0	.7329
76.0	.7401
78.0	.7463
80.0	.7517
82.0	.7565
84.0	.7606
86.0	.7642
88.0	.7675
90.0	.7710
92.0	.7753
94.0	.7775
96.0	.7732
98.0	.7680

PEOLE (1970 109 A)

PHI (DEG)	WIDTH CORRECTION (METERS)
0.0	.0897
2.0	.0884
4.0	.0854
6.0	.0808
8.0	.0748
10.0	.0679
12.0	.0605
14.0	.0530
16.0	.0458
18.0	.0390
20.0	.0330
22.0	.0279
24.0	.0229
26.0	.0192
28.0	.0161
30.0	.0134
32.0	.0112
34.0	.0094
36.0	.0080
38.0	.0069
40.0	.0061
42.0	.0056
44.0	.0053
46.0	.0051
48.0	.0050
50.0	.0049
52.0	.0048
54.0	.0047
56.0	.0047
58.0	.0045
60.0	.0042
62.0	.0039
64.0	.0034
66.0	.0028
68.0	.0028
70.0	.0028
72.0	.0028
74.0	.0028
76.0	.0027
78.0	.0027
80.0	.0026
82.0	.0025
84.0	.0023
86.0	.0021
88.0	.0018
90.0	.0014
92.0	.0007
94.0	0.0000
96.0	0.0000
98.0	0.0000
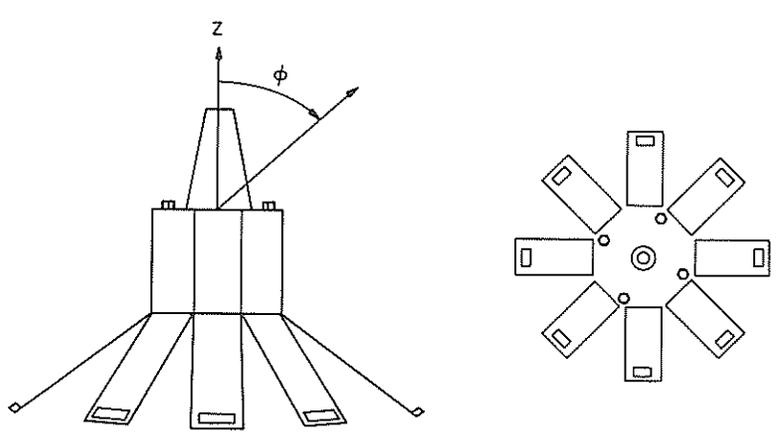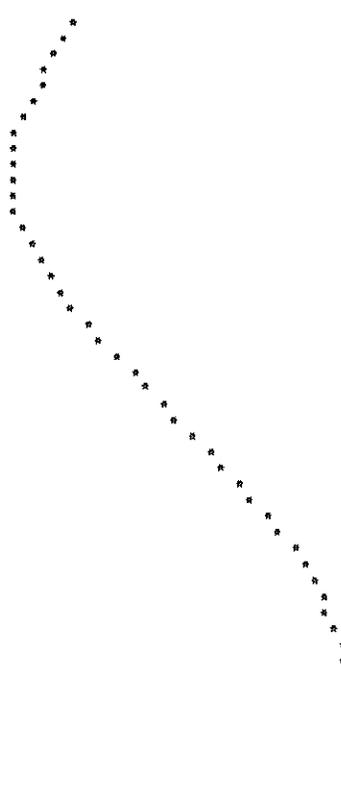
Table 2. (Cont.)

GEOS-C (TO BE LAUNCHED IN 1974)

PHI(DEG)   EFFECTIVE REFLECTING AREA

```
    0.0       25.8083
    5.0       26.8657
   10.0       29.9975
   15.0       34.3334
   20.0       38.6515
   25.0       42.8426
   30.0       46.2943
   35.0       49.2603
   40.0       51.2414
   45.0       50.2158
   50.0       46.5169
   55.0       41.0925
   60.0       34.7408
   65.0       28.0119
   70.0       21.5541
   75.0       15.9472
   80.0       11.1195
   85.0        7.0720
   90.0        3.8600
   95.0        1.5539
  100.0         .4188
  105.0         .0647
  110.0         .0016
```
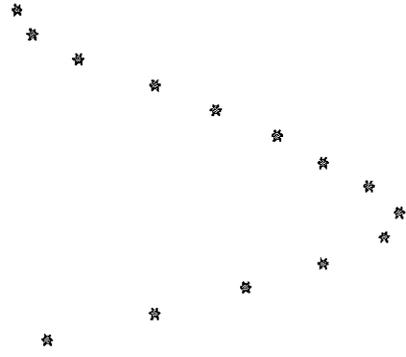
ONE REFLECTOR AT NORMAL INCIDENCE HAS A REFLECTING AREA OF UNITY
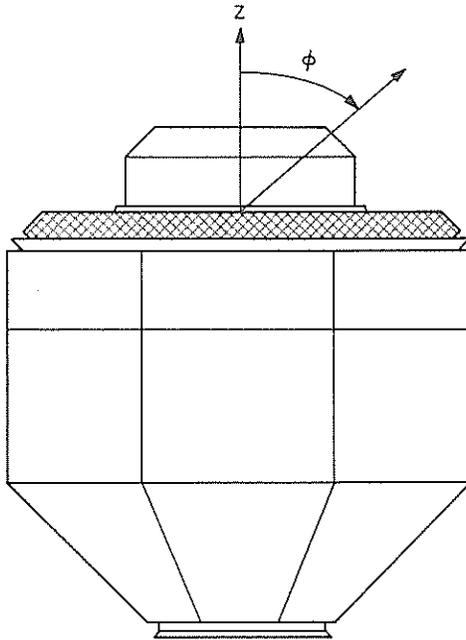
Table 2. (Cont.)

GEOS-C (TO BE LAUNCHED IN 1974)

PHI(DEG)	WIDTH CORRECTION(METERS)	
0.0	.0003	*
5.0	.0007	*
10.0	.0016	*
15.0	.0019	*
20.0	.0018	*
25.0	.0019	*
30.0	.0019	*
35.0	.0020	*
40.0	.0020	*
45.0	.0021	*
50.0	.0021	*
55.0	.0020	*
60.0	.0019	*
65.0	.0017	*
70.0	.0014	*
75.0	.0013	*
80.0	.0011	*
85.0	.0010	*
90.0	.0008	*
95.0	.0004	*
100.0	.0004	*
105.0	.0004	*
110.0	.0004	*
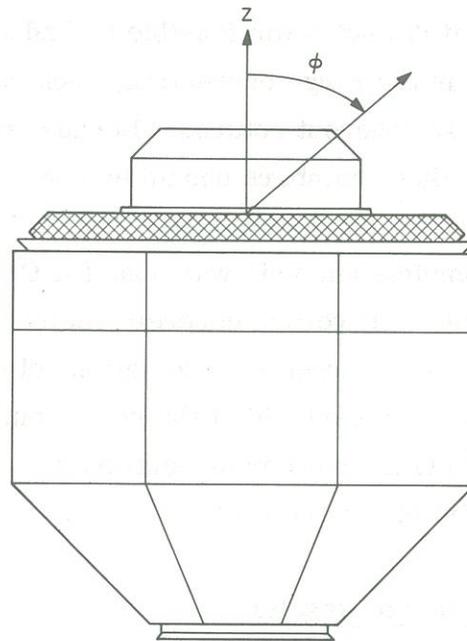
4.2 Influence of Optical Coherence

Table 3 presents the variations of the range corrections due to coherent interference of the signals from individual retroreflectors. The mean value of the coherent range corrections is the incoherent value. The magnitude of these variations decreases as pulse length decreases. Again, the values are given for a 20-nsec pulse.

The variations in signal strength have a nearly Rayleigh distribution as long as the pulse is long compared to the spacing between reflectors and there are a large number of reflectors. Variations in signal strength have not been presented, as they are proportional to the mean energy.

Since it did not seem feasible to find an analytic method of computing the coherent variations in the range correction, each value presented is the rms deviation of a sample of 40 coherent returns. Because of the limited number of coherent returns computed, these numbers should be considered approximate.

No complete analysis was done for Geos C, since final data for that satellite are not available. However, coherent returns computed at angles of 30° and 60° from the symmetry axes showed rms deviations of 0.09 and 0.13 m, respectively, for the displacement of the centroid of the return pulse. The computer graph is plotted at one horizontal print position per centimeter. The angle is measured from the symmetry axis (z axis) of the satellite.

4.3 Accuracy of Results

The construction of the arrays carried by the present retroreflector satellites is such that the reflectors contributing to the return signal have a spread in range from the observer that is generally an appreciable fraction of a meter. The accuracy with which the return signal can be computed depends on how well the positions of the reflectors relative to the satellite's center of mass are known and on how precisely the contribution to the signal from each reflector can be calculated. Generally, the geometric configuration of the satellite and the location of the center of mass do not present a significant problem. The effect of the uncertainty in the attitude of the satellite can be estimated from the change of the range correction with respect to a change in viewing angle.

Table 3. Coherent variations of range and width corrections.

BE-B(1964 64 A) AND BE-C(1965 32 A)

PHI (DEG)	R.M.S. DEVIATION OF RANGE CORRECTION (METERS)	
0.0	.0617	*
20.0	.0588	*
40.0	.0382	*
60.0	.0230	*
80.0	.0412	*
100.0	.0444	*
120.0	.0563	*

BE-B(1964 64 A) AND BE-C(1965 32 A)

PHI (DEG)	R.M.S. DEVIATION OF WIDTH CORRECTION (METERS)	
0.0	.0032	*
20.0	.0026	*
40.0	.0008	*
60.0	.0004	*
80.0	.0011	*
100.0	.0018	*
120.0	.0029	*
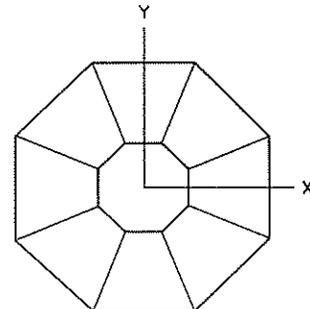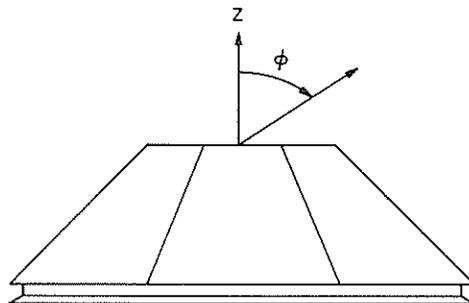
Table 3. (Cont.)

GEOS-A(1965 89 A) AZIMUTH -22.5 DEG.

PHI (DEG)	R.M.S. DEVIATION OF RANGE CORRECTION(METERS)
0.0	0.0000
10.0	.0608
20.0	.1162
30.0	.1635
40.0	.2026
50.0	.2342
60.0	.2586
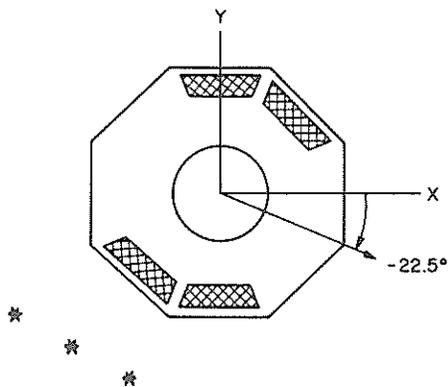
GEOS-A(1965 89 A) AZIMUTH -22.5 DEG.

PHI (DEG)	R.M.S. DEVIATION OF WIDTH CORRECTION(METERS)
0.0	0.0000
10.0	.0054
20.0	.0206
30.0	.0381
40.0	.0528
50.0	.0641
60.0	.0728
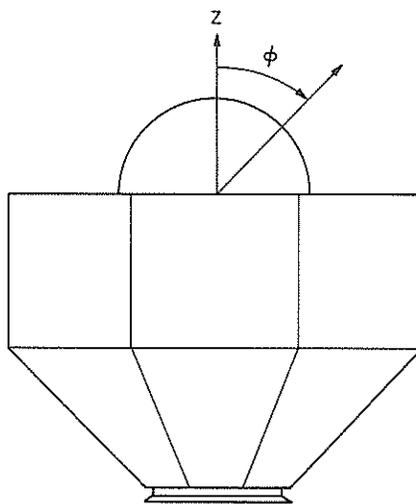
Table 3. (Cont.)

GEOS-A(1965 89 A) AZIMUTH 67.5 DEG.

PHI (DEG)	R.M.S. DEVIATION OF RANGE CORRECTION(METERS)
0.0	0.0000
10.0	.0946
20.0	.1825
30.0	.2594
40.0	.3232
50.0	.4400
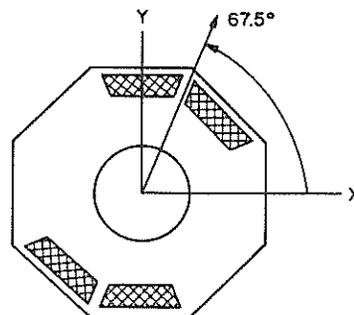
GEOS-A(1965 89 A) AZIMUTH 67.5 DEG.

PHI (DEG)	R.M.S. DEVIATION OF WIDTH CORRECTION(METERS)
0.0	0.0000
10.0	.0057
20.0	.0207
30.0	.0401
40.0	.0605
50.0	.1109
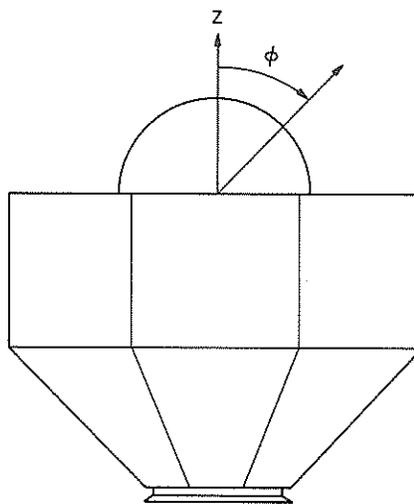
Table 3. (Cont.)

D1-C(1967 11 A) AND D1-D(1967 14 A)

PHI (DEG)	R.M.S. DEVIATION OF RANGE CORRECTION(METERS)				
0.0	.0116	*			
10.0	.0401		*		
20.0	.1817				*
30.0	.1168			*	
40.0	.1174			*	
50.0	.0658		*		
60.0	.0417		*		
70.0	.0754		*		
80.0	.0959			*	
90.0	.0384		*		
100.0	.0536		*		
110.0	.0402	*			
120.0	.0377	*			
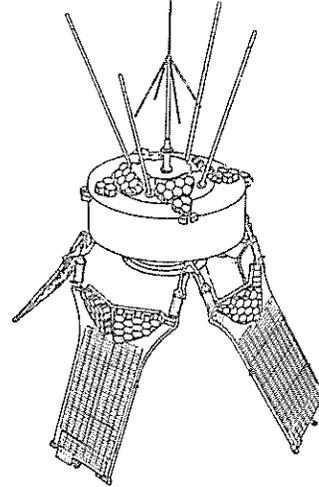
D1-C(1967 11 A) AND D1-D(1967 14 A)

PHI (DEG)	R.M.S. DEVIATION OF WIDTH CORRECTION(METERS)		
0.0	.0012	*	
10.0	.0025	*	
20.0	.0250		*
30.0	.0075	*	
40.0	.0062	*	
50.0	.0111	*	
60.0	.0013	*	
70.0	.0049	*	
80.0	.0056	*	
90.0	.0020	*	
100.0	.0029	*	
110.0	.0010	*	
120.0	.0010	*	
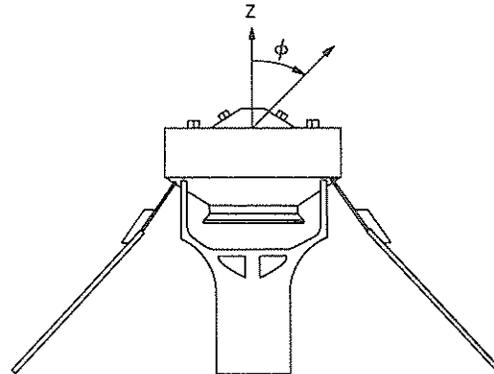
Table 3. (Cont.)

GEOS-B (1968 2 A)

PHI (DEG)	R.M.S. DEVIATION OF RANGE CORRECTION(METERS)
0.0	.0164
10.0	.1449
20.0	.2430
30.0	.3095
40.0	.3603
50.0	.4006
60.0	.3382

GEOS-B (1968 2 A)

PHI (DEG)	R.M.S. DEVIATION OF WIDTH CORRECTION(METERS)
0.0	.0004
10.0	.0111
20.0	.0297
30.0	.0542
40.0	.0768
50.0	.1249
60.0	.1325
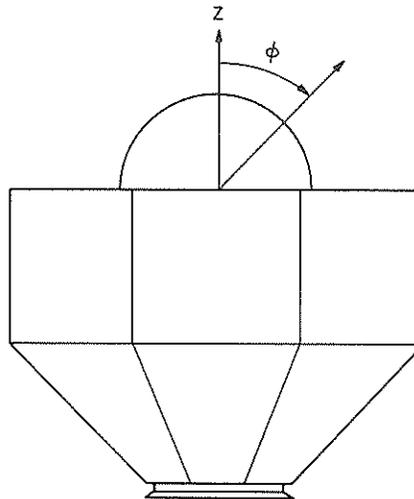
Table 3. (Cont.)

PEOLE (1970 109 A)

PHI (DEG)	R.M.S. DEVIATION OF RANGE CORRECTION(METERS)	
0.0	.4844	
20.0	.2669	
40.0	.1077	
60.0	.1914	
80.0	.1460	
100.0	0.0000	

PEOLE (1970 109 A)

PHI (DEG)	R.M.S. DEVIATION OF WIDTH CORRECTION(METERS)	
0.0	.1320	
20.0	.0528	
40.0	.0237	
60.0	.0642	
80.0	.0204	
100.0	0.0000	
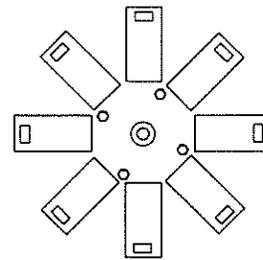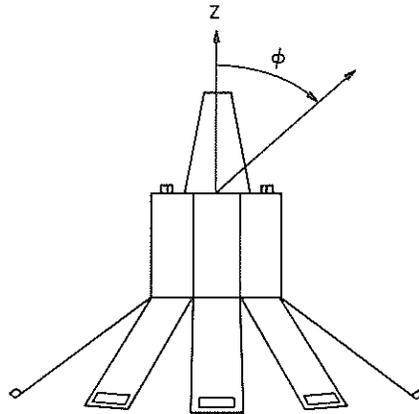
The biggest problem for the existing satellites is the lack of detailed information on the cube corners. The specifications of the retroreflectors are such as to ensure sufficient energy at the values of velocity aberration encountered, but the actual shape of the pattern for each cube corner is generally unknown.

Since the total reflected energy from a retroreflector is proportional to the active reflecting area, the latter has been used in calculating the contribution of each reflector to the transfer functions presented in this report. This is equivalent to assuming that the diffraction patterns of all reflectors are identical. This assumption is probably most reasonable for the two Geos satellites (1965 89A and 1968 2A) since the arrays aboard these satellites all face the same direction and changes with aspect angle of the diffraction patterns should be similar for all the reflectors.

To estimate the error due to assuming identical diffraction patterns for each cube corner in an array, a matrix of range corrections was computed for the Peole satellite by modeling the reflector as perfect except for a dihedral-angle error of 8 μrad. The range corrections (assuming a velocity aberration of 40 μrad) were from 4 to 11 cm greater than those computed on the assumption of constant diffraction patterns. The spread in range of the reflectors was 86 cm. Perhaps something on the order of 10 cm would be a reasonable estimate of the largest errors in the transfer functions computed. Some may be significantly more accurate than this, but the only positive limitation on the errors occurs when the contributing reflectors have a small spread in distance from the observer. As with the example above for Peole, the range corrections computed on the basis of active reflecting area are probably too small for all the satellites except Geos 1 and 2. The reason for this is that the reflectors farther from the observer are generally being viewed at a more oblique angle; therefore, they probably have a wider beam spread and should be weighted less in the transfer function. A crude estimate of the systematic error for satellites (except Geos) would be to assume it proportional to the random error due to coherent interference, since both are a function of the spread in range of the active reflectors. For the Peole example, the systematic error (about 10 cm) under the assumed conditions is 20% of the random error (about 50 cm).

5. ACKNOWLEDGMENTS