Interoffice

NATIONAL RADIO ASTRONOMY OBSERVATORY

TUCSON, ARIZONA

August 20, 1976

12 METER MIL[illegible] ER WAVE TELESCOPE
MEMO [illegible] 5

To: J. M. Payne

From: Jan M. Hollis

Subject: 36' Telescope Mean Surface Computer Study

I have thoroughly processed the mean surface data for the 36' telescope with regard to future foiling over paint and the results are shown in Table 1. I did this for several reasons: (1) We do not know big D accurately. (2) We do not know temperature effects on the surface of the antenna. (3) We do not independently know starting and ending points of cart measured radii accurately. (4) We do not have a method to tie the cart measured radii together. (5) Previous foil attempts have failed except for a concentric ring laid in August 1975. Hopefully foil laid in accordance with a mean surface would minimize most or all of the above unknown effects.

The mean surface should have one ring of foil to correct its deviations from a parabolic surface. If the mean surface is physically meaningful, the ring should be solid. The antenna did improve in aperture efficiency when we applied an almost solid ring of foil in August 1975 (see Table 1). I suspect that our July 1976 negative foil results are due to the fact that the foil we laid was not in a solid concentric ring. I suggest that we foil the antenna surface based on the Row (3) entry in Table 1.

Figure 1 is a graph of expected antenna aperture efficiency increases' versus foil contour level limits (i.e., various foil maps). Data were taken from Table 1.

Figure 2 is a graph of expected antenna aperture efficiency increases versus minimum concentric foil ring radii. Data were taken from Table 1.

Figure 3 is a graph of the residuals of a parabolic surface fit to the mean surface. The mean surface has a geometric RMS surface error of 0.14 mm.

Figure 4 is a graph of the residuals of a parabola fitted to the mean surface radius. Unlike Figure 3, Figure 4 results are constrained to have no rotation or translation included in the fit process. The fit routine (which results in Figure 4) is a completely different one than that used for Figure 3. Thus Figure 4 is a good independent check on the results of Figure 3 and indeed the two figures have similar shapes.

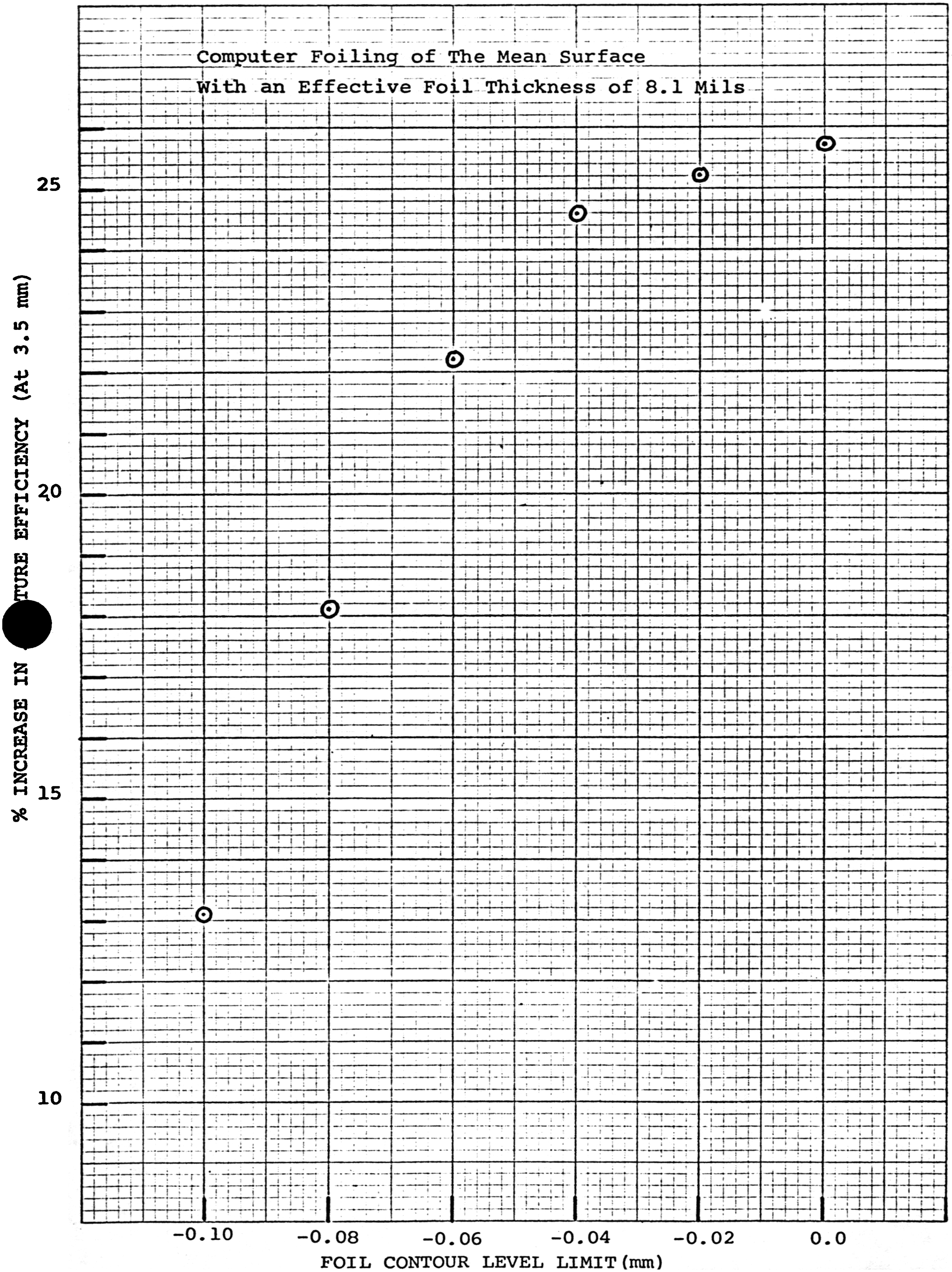
c: J. W. Findlay
B. L. Ulich

Table 1

MEAN SURFACE COMPUTER STUDY FOR AN EFFECTIVE FOIL THICKNESS OF 8.1[a] MILS

ROW	FOIL CONTOUR LEVEL LIMIT (mm)	MINIMUM RADIUS[b] (ft)	MAXIMUM RADIUS[b] (ft)	AT 3.5 mm THE EXPECTED APERTURE EFFICIENCY INCREASE (%)
(1)	0.00	5.0	14.7	25.7
(2)	-0.02	5.2	14.6	25.2
(3)	-0.04	5.5	14.5	24.6
(4)	-0.06	6.5	14.4	22.2
(5)	-0.08	7.8	14.3	18.1
(6)	-0.10	9.8	14.2	13.1
(7)[c]		12.5	14.8	8.5

Notes:
(a) Antenna paint is 5.0 ± 0.6 mils; Foil is 3.1 ± 0.1 mils.
(b) Radii are measured from the center on the surface of the antenna; the edge of the antenna is 18.3 feet from the center.
(c) Row (7) data is from the practical foil experiment conducted in August 1975.


Computer Foiling of The Mean Surface
With an Effective Foil Thickness of 8.1 Mils
% INCREASE IN
TURE EFFICIENCY (At 3.5 mm)
25
20
15
10
-0.10
-0.08
-0.06
-0.04
-0.02
0.0
FOIL CONTOUR LEVEL LIMIT (mm)

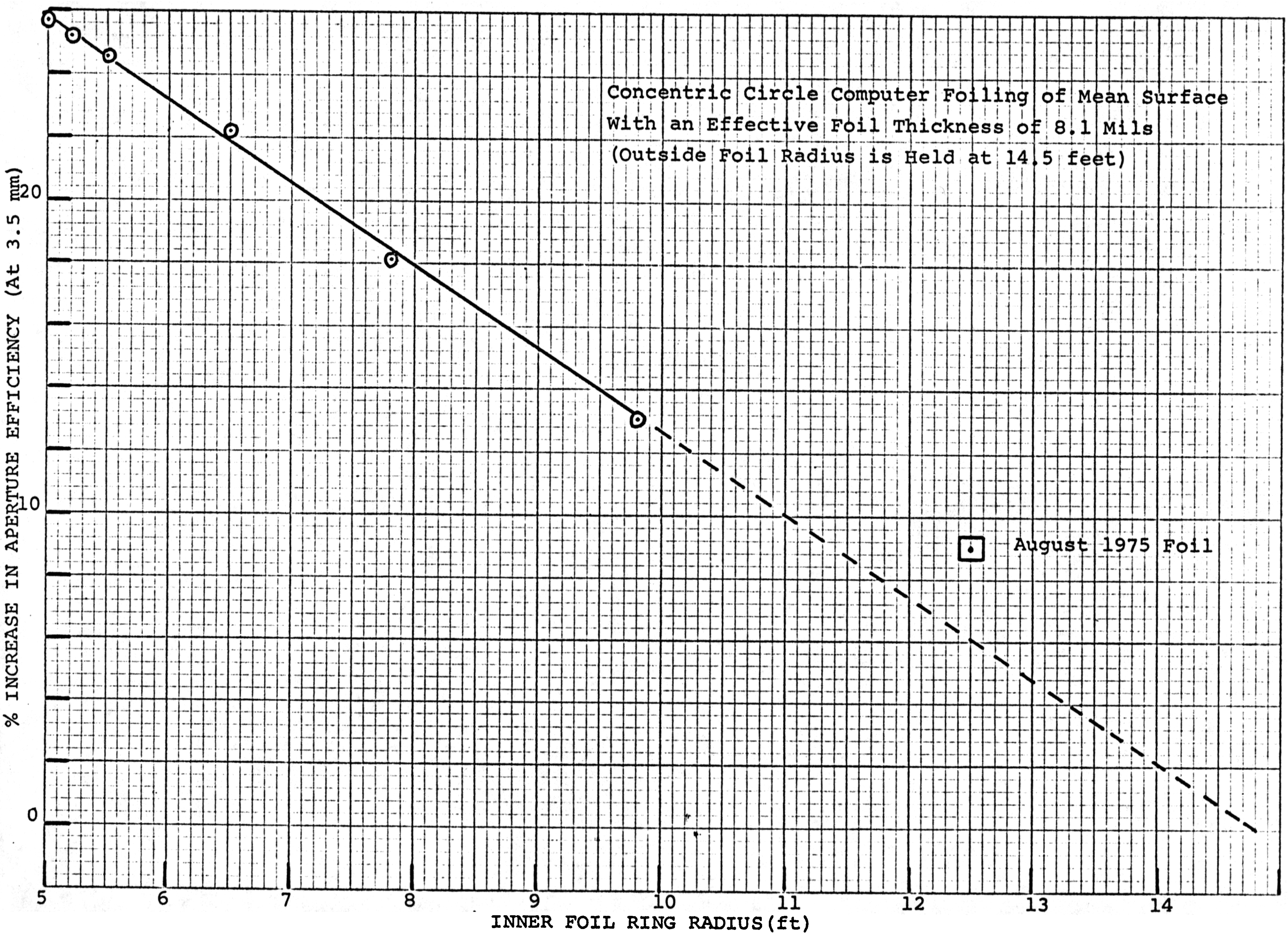

Concentric Circle Computer Foiling of Mean Surface
With an Effective Foil Thickness of 8.1 Mils
(Outside Foil Radius is Held at 14.5 feet)
August 1975 Foil
% INCREASE IN APERTURE EFFICIENCY (At 3.5 mm)
20
10
0
5
6
7
8
9
10
11
12
13
14
INNER FOIL RING RADIUS(ft)

Figure 2

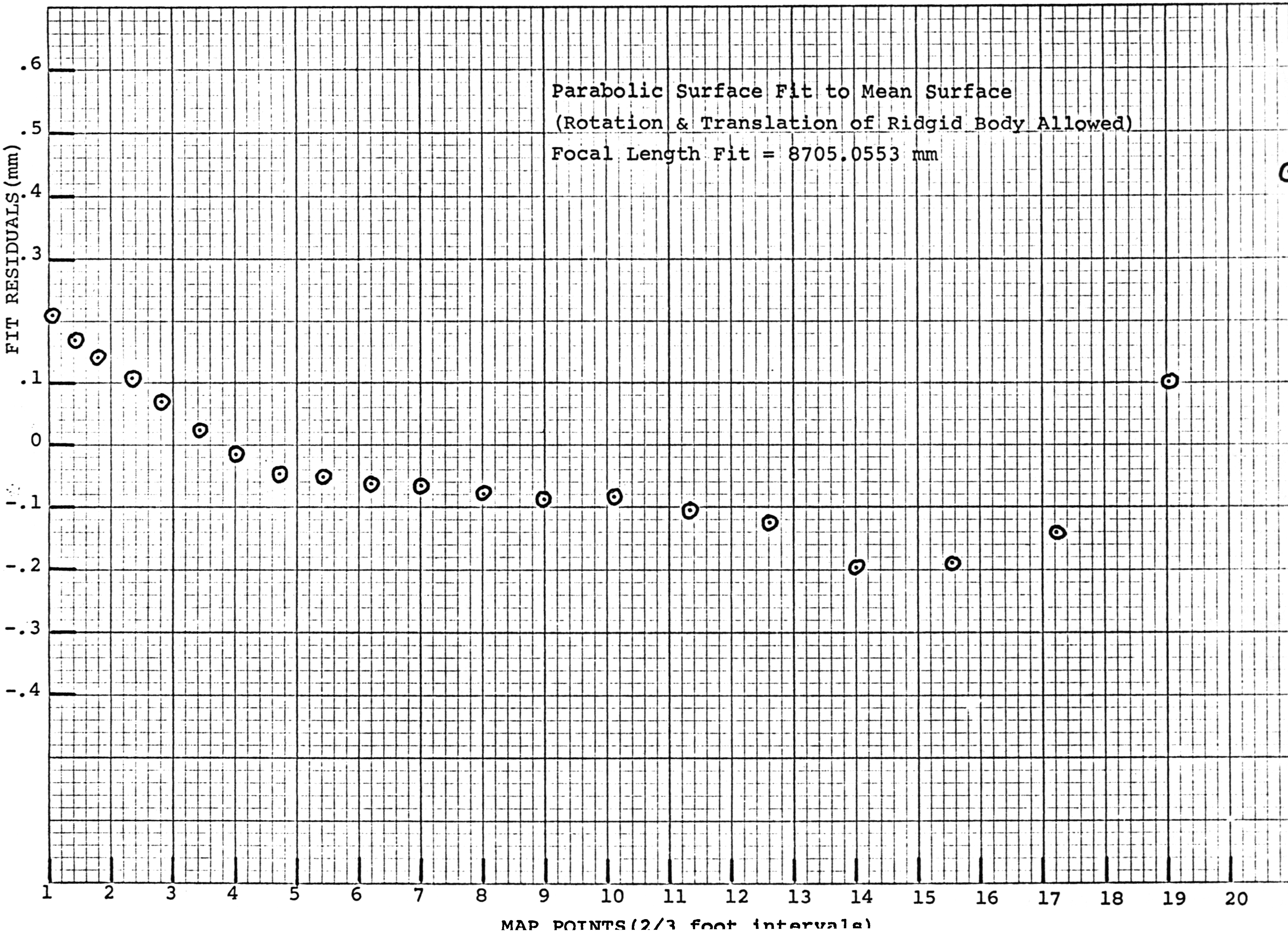

Parabolic Surface Fit to Mean Surface
(Rotation & Translation of Ridgid Body Allowed)
Focal Length Fit = 8705.0553 mm
FIT RESIDUALS (mm)
.6
.5
.4
.3
.1
0
-.1
-.2
-.3
-.4
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
MAP POINTS(2/3 foot intervals)

Figure 3

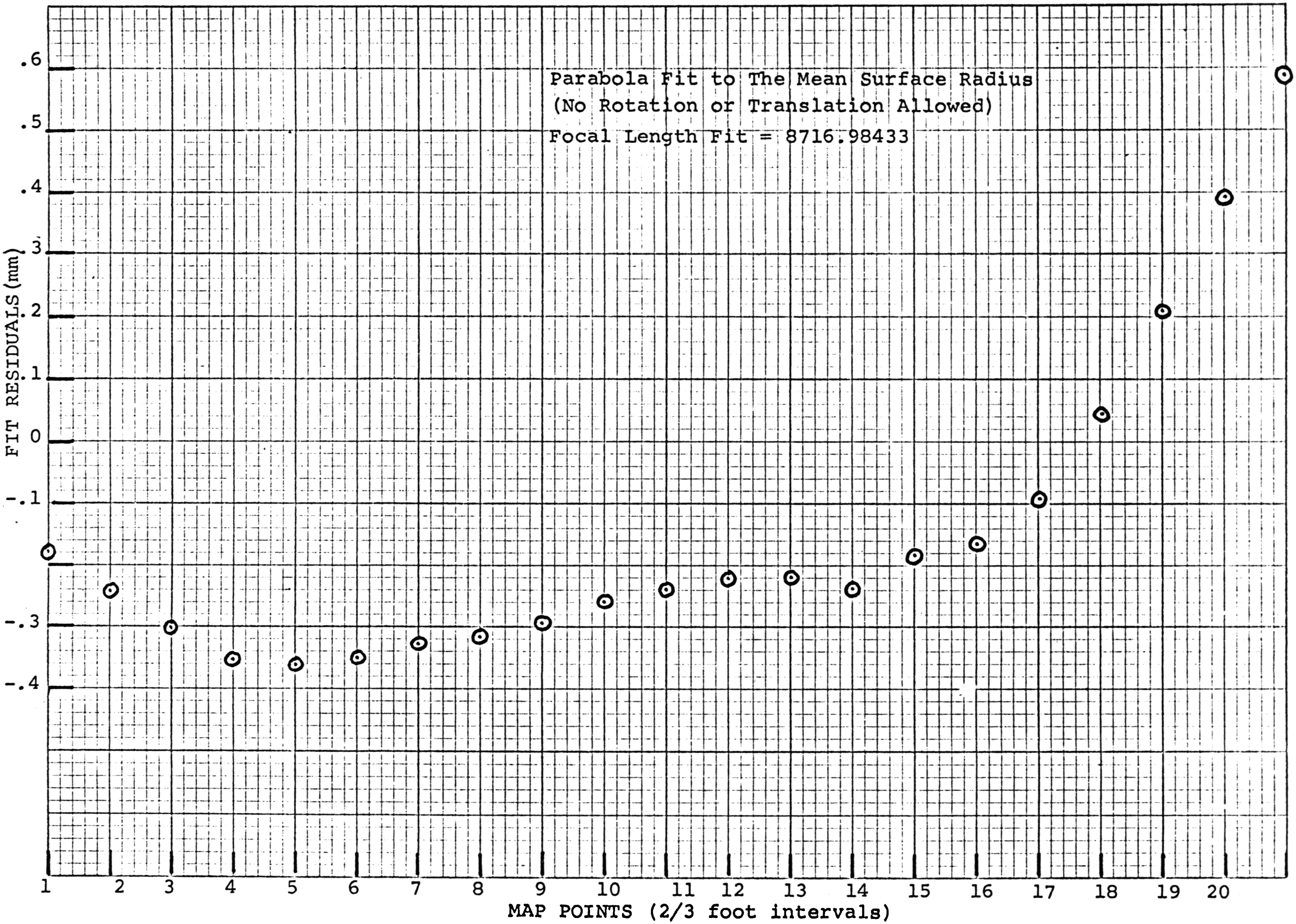

Parabola Fit to The Mean Surface Radius
(No Rotation or Translation Allowed)
Focal Length Fit = 8716.98433
FIT RESIDUALS (mm)
.6
.5
.4
.3
.2
.1
0
-.1
-.3
-.4
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
MAP POINTS (2/3 foot intervals)

Figure 4