mand station. The antenna pattern just developed considers primarily the nominal user station under nominal operational conditions.

An attempt to achieve this radiation pattern could rule out the possibility of circular polarization. Since the spacecraft is to be stabilized in two axes, however, this should not be a problem, in fact, it works in favor of the fixed antenna user. Polarization as seen from near the horizon would be either vertical or horizontal. If a "vertical" antenna, one parallel to the vertical axis at the satellite, is used, polarization would be seen as vertical from any ground vantage. If horizontal because of some sort of dipole or turnstile arrangement at the satellite, polarization as seen from the ground would be horizontal from the horizon, circular directly below, and elliptical (with the linear component being horizontal) at intermediate points.

VII. Qualitative discussion of antenna candidates

In satellites that are not stabilized with respect to the geocenter, an isopole is considered ideal. By definition, the gain in all directions is equal and unity. This is adequate in terms of the model just developed except for the five degree "thick" critical area around 60 degrees from the vertical axis that contains 75% of the important coverage. In this region, the isopole is between 30% and 100% adequate. An estimate of the its merit is about 40%.

A "vertical" type whip which by means of mounting or radial geometry could be made to concentrate most of its energy at the critical angle at all azimuths could be very satisfactory. In attempting to "bend" maximum radiation angle down from the local horizontal plane, modifications to the size and shape of the ground plane and distance of the driven element from it should be considered theoretically and experimentally.

A beam like helix or crossed yagi antenna with 5 dB forward gain will have a half power beamwidth of around 100 degrees (50 degrees each side of center). Such a beam placed symmetrically within the desired radiation pattern, that is, with the centerline on the vertical axis, will have most of its gain where it is not needed and where it is not very important statistically. The gain will be falling away drastically just at the angles where it does become very important. Such a beam, or even a more directive one with higher gain, would do well if mounted at the critical angle aiming toward the horizon but its radiation properties would then have azimuth dependencies. Perhaps four or more of them around the "bottom" of the satellite could have satisfactory, overlapping coverage if the feeds could be phased properly.

Table 2. Radiation pattern for the ideal PTSE user antenna

el	S	P	dB	b	A %	accm %
90.0	800.0	0.2	-7.3	0.0	0.0	0.0
81.1	808.7	0.2	-7.2	1.0	0.1	0.1
72.5	834.1	0.2	-6.9	2.0	0.4	0.5
64.6	874.9	0.2	-6.5	3.0	0.7	1.2
57.4	929.0	0.3	-6.0	4.0	1.0	2.2
51.0	994.2	0.3	-5.4	5.0	1.2	3.4
45.4	1068.5	0.3	-4.8	6.0	1.5	4.9
40.5	1150.0	0.4	-4.1	7.0	1.8	6.7
36.2	1237.4	0.4	-3.5	8.0	2.0	8.7
32.4	1329.4	0.5	-2.9	9.0	2.3	11.0
29.0	1425.2	0.6	-2.3	10.0	2.6	13.6
26.0	1523.9	0.7	-1.7	11.0	2.9	16.5
23.3	1625.1	0.8	-1.1	12.0	3.1	19.6
20.9	1728.2	0.9	-0.6	13.0	3.4	23.0
18.7	1833.0	1.0	-0.1	14.0	3.7	26.7
16.6	1939.1	1.1	0.4	15.0	3.9	30.6
14.8	2046.2	1.2	0.9	16.0	4.2	34.8
13.0	2154.3	1.4	1.3	17.0	4.4	39.2
11.4	2263.1	1.5	1.7	18.0	4.7	43.9
9.9	2372.5	1.6	2.2	19.0	5.0	48.9
8.5	2482.4	1.8	2.5	20.0	5.2	54.1
7.2	2592.6	2.0	2.9	21.0	5.5	59.6
5.9	2703.2	2.1	3.3	22.0	5.7	65.3
4.7	2814.1	2.3	3.6	23.0	6.0	71.3
3.5	2925.1	2.5	4.0	24.0	6.2	77.6
2.4	3036.3	2.7	4.3	25.0	6.5	84.1
1.3	3147.6	2.9	4.6	26.0	6.7	90.8
0.3	3258.9	3.1	4.9	27.0	7.0	97.8
0.0	3293.2	3.2	5.0	27.3	2.2	100.0