TABLE 1. Radar System Characteristics

Parameter	Value or Type
Frequency	2380 MHz (12.6 cm wavelength)
Transmit power	400 kW
Antenna gain	71 dB
System temperature	35°–90°K
Transmit waveform	phase-coded CW (4 μs baud-length)
Polarization	right circular (transmit) left circular (receive)
Sampling interval	2 μs
Frequency resolution	0.061 or 0.122 Hz
Integration time	10–20 min

observing system and some relevant observational parameters are listed in Table 1. The measurements were made in the so-called "delay-Doppler" mode. Delay (altitude) discrimination was achieved by phase-coding the transmitted signal, and Doppler (longitude) discrimination was obtained from Fourier analysis of the coherently detected echo. The delay-Doppler data were analyzed in such a way as to yield a profile of altitude along the subradar track.

Mercury's 7° orbital inclination to the ecliptic renders a ± 12° equatorial band accessible to earth-based radar altimetry. Achieving extensive coverage over even this very restricted latitude band requires making observations at a large number of orbital aspects which, in turn, requires that observations be spread out over several years. The data presented in this paper were derived from approximately 150 days of observations spread over the six-year period 1978–1984. The location tracks of the Arecibo altitude profiles on Mercury's surface are mapped in Figure 1.

TABLE 2. Locations of Mercury Radar Profiles: 1978–1984

Number	Longitude	Latitude
1	4°–27°W	10.7°–9.9°N
2	5°–42°W	3.8°–4.1°N
3	6°–54°W	2.0°–3.2°N
4	21°–61°W	0.5°S–0.4°N
5	24°–69°W	10.3°–8.3°N
6	26°–56°W	1.8°–1.4°S
7	37°–69°W	9.4°–7.7°N
8	43°–71°W	5.0°–4.3°S
9	66°–85°W	3.5°–4.1°N
10	71°–97°W	7.2°–6.5°N
11	97°–129°W	6.5°–5.7°N
12	104°–126°W	5.5°–5.3°N
13	106°–120°W	6.0°–5.3°N
14	109°–138°W	3.6°–4.8°N
15	112°–148°W	5.1°–6.5°N
16	113°–141°W	0.1°S–0.7°N
17	122°–140°W	4.5°–4.5°S
18	127°–169°W	5.9°–5.3°N
19	137°–224°W	2.0°S–0.2°N
20	150°–197°W	5.3°–7.4°N
21	158°–241°W	6.9°–10.3°N
22	174°–209°W	4.4°–5.9°N
23	182°–218°W	2.0°–3.4°N
24	216°–259°W	4.3°–5.3°N
25	246°–269°W	0.7°–0.1°S
26	261°–330°W	7.9°–8.9°N
27	261°–291°W	5.7°–6.2°N
28	279°–338°W	10.4°–10.8°N
29	283°–308°W	2.1°–2.7°N
30	287°–309°W	0.3°–0.8°N
31	291°–319°W	11.6°–11.8°N
32	320°–339°W	1.0°–1.3°N
33	328°–360°W	0.1°–1.2°N
34	338°–359°W	11.4°–10.9°N

Altitude Measurements

The first step in the data analysis was to produce an altitude profile for each observing "run." One to three observing runs were made on a given day; a run consisted of a transmit and a receive period, each equal in duration to the round-trip light-travel time (10–20 min). The decoded echo was Fourier analyzed to yield a delay-Doppler array for each 8.4 or 16.8 s coherence interval, giving a frequency resolution of 0.06 or 0.12 Hz or, equivalently, longitude resolutions of about 0.07°–0.15°. These arrays were then summed incoherently over the full receive period to give a single delay-Doppler array for each run. Numerically computed echo power-versus-delay templates were then fit to the run-averaged delay-Doppler array to determine the time delay to the leading edge of the planet at each Doppler frequency. From these delays were subtracted the computed time delays to a reference sphere of radius 2439 km. The resultant residual delays were then expressed as altitudes relative to the reference sphere. Using the Doppler frequencies to provide an effective longitude discrimination, the final result for each run was an altitude profile along a roughly east-west linear track extending approximately 7° of longitude to either side of the subradar point. This is the same analysis technique used by *Ingalls and Rainville* [1972] and *Shapiro et al.* [1972], and the reader is referred to these papers for a more detailed explanation.

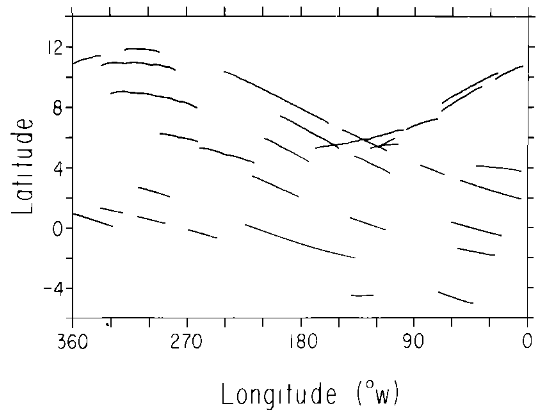

Fig. 1. Location tracks on Mercury for the Arecibo radar altimetry profiles (1978–1984). The radar resolution cell actually extends over 2.5° of latitude centered on the indicated track (see text). Note that the latitude scale is exaggerated; the Arecibo coverage is confined to a near-equatorial band.

By making several runs on the same day and observing on contiguous days (Mercury rotates by about 5° per day), we achieved extensive overlap among the individual profiles. The final step in the analysis consisted of collating overlapping profiles and averaging them over 0.15° longitude bins to produce a single "composite" profile. Each composite profile spans from 20° to 90° of longitude and consists of data taken from as many as 11 days of observing. A list of the composite Mercury profiles from 1978–1984 is given in Table 2.

The surface resolution ("radar footprint") of the altitude measurements is approximately 0.15° × 2.5° (6.4 × 106 km). The 0.15° longitude bin size is roughly equal to the coarsest resolution of the individual profiles and is larger than the maximum longitude smear from planet rotation over an observing run. The latitude resolution is much coarser, as each altitude data point can be influenced by echoes arising from anywhere within roughly a degree to the north or south of the subradar track. Interpretation problems resulting from scat-