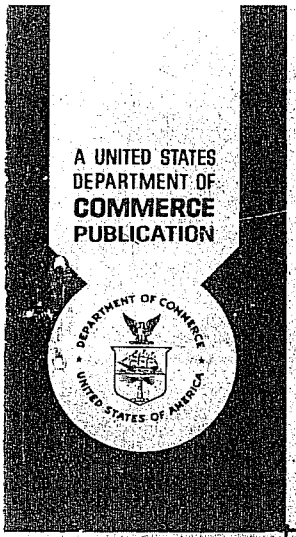

ESSA Technical Memorandum ERLTM-ARL 19

U.S. DEPARTMENT OF COMMERCE
ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION
Research Laboratories

Tetroon Flights in Los Angeles, California - 1969

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Air Resources
Laboratories
SILVER SPRING,
MARYLAND
JUNE 1970

ESSA RESEARCH LABORATORIES

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TETROON FLIGHTS IN LOS ANGELES, CALIFORNIA - 1969

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Research conducted with the support of the National Air Pollution Control Administration, Department of Health, Education, and Welfare, and the Division of Reactor Development and Technology, Atomic Energy Commission.

Air Resources Laboratories
Silver Spring, Maryland
June 1970

TETROON FLIGHTS IN LOS ANGELES, CALIFORNIA - 1969

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The trajectories of low-level constant volume balloon (tetroon) flights from various launch sites in the Los Angeles Basin are presented, along with the balloon heights at 30-min intervals. The tetroon-radar-transponder system for obtaining air trajectories is discussed briefly.

During September 9 through October 2, 1969, several groups of the ESSA Research Laboratories combined to conduct an experiment in measuring air trajectories in three dimensions and periodic, associated, air quality in the Los Angeles Basin. This work was done in cooperation with other research groups studying air pollution in the area. This technical memorandum provides preliminary information on the trajectories and associated height data to assist in the preparation of scientific reports.

Air trajectories were obtained by launching constant volume Mylar balloons shaped in the form of tetrahedrons, or "tetroons". The balloons, approximately 1 m^3 in volume, were inflated with a mixture of helium and air so that their design buoyancy would cause them to float at an altitude of between 100 and 300 m above the surface in the absence of vertical air motions. A small inexpensive radar transponder was attached to the balloon. The three dimensional position of the balloon was determined at 10-sec intervals on

flights 1 through 47 and at 1-sec intervals for flights 48 through 105.

The radar used was the modified M33 fire control radar of the Field Research Office, Idaho Falls, Idaho. The radar was transported to Mt. Thom north of Glendale, California, and emplaced on a small spur of the Verdugo Mountains at 2480 feet MSL. Radar-derived tetroon position data were recorded on magnetic tape, in alpha numeric form on a high speed printer, and the horizontal projection of the trajectories traced out on the M33 plot board. The accompanying figures show the trajectories, as derived from the plotboard information, transferred to a simplified map of the Los Angeles area. The data listings that follow the figures show the tetroon heights in meters above MSL at 30-min intervals, as obtained from the computer-processed magnetic tape data averaged over a 5-min period. The tetroons were launched from several sites as indicated by the letters on the map. Radar and launch site locations were as follows:

Radar Site

X - Mt. Thom, Glendale, California

Launch Sites

A - Downtown Los Angeles, Ethyl Corporation parking lot, Boylston St., between Huntley Drive and Miramar St.

B - Rancho Cienega Playground, Rodeo Road and Santa Barbara Ave., City of Los Angeles, Calif. (West Los Angeles.)

Launch Sites (continued)

D - Near entrance channel of Marina Del Rey, at intersection of Via Marina and Pacific Ave., City of Los Angeles (Venice), Calif.

E - Marine Way and Hermosa Ave., Redondo Beach, Calif. Also north side of Camino Real, near intersection with Knobhill Ave., Redondo Beach, Calif. (Single flight, #5) .

F - Harbor Lake, Anaheim St., midway between Harbor Freeway and Normandie Ave., City of Los Angeles (San Pedro), Calif.

G - Near U. S. Customs House, Ferry St. and Terminal Way, City of Los Angeles (San Pedro), Calif.

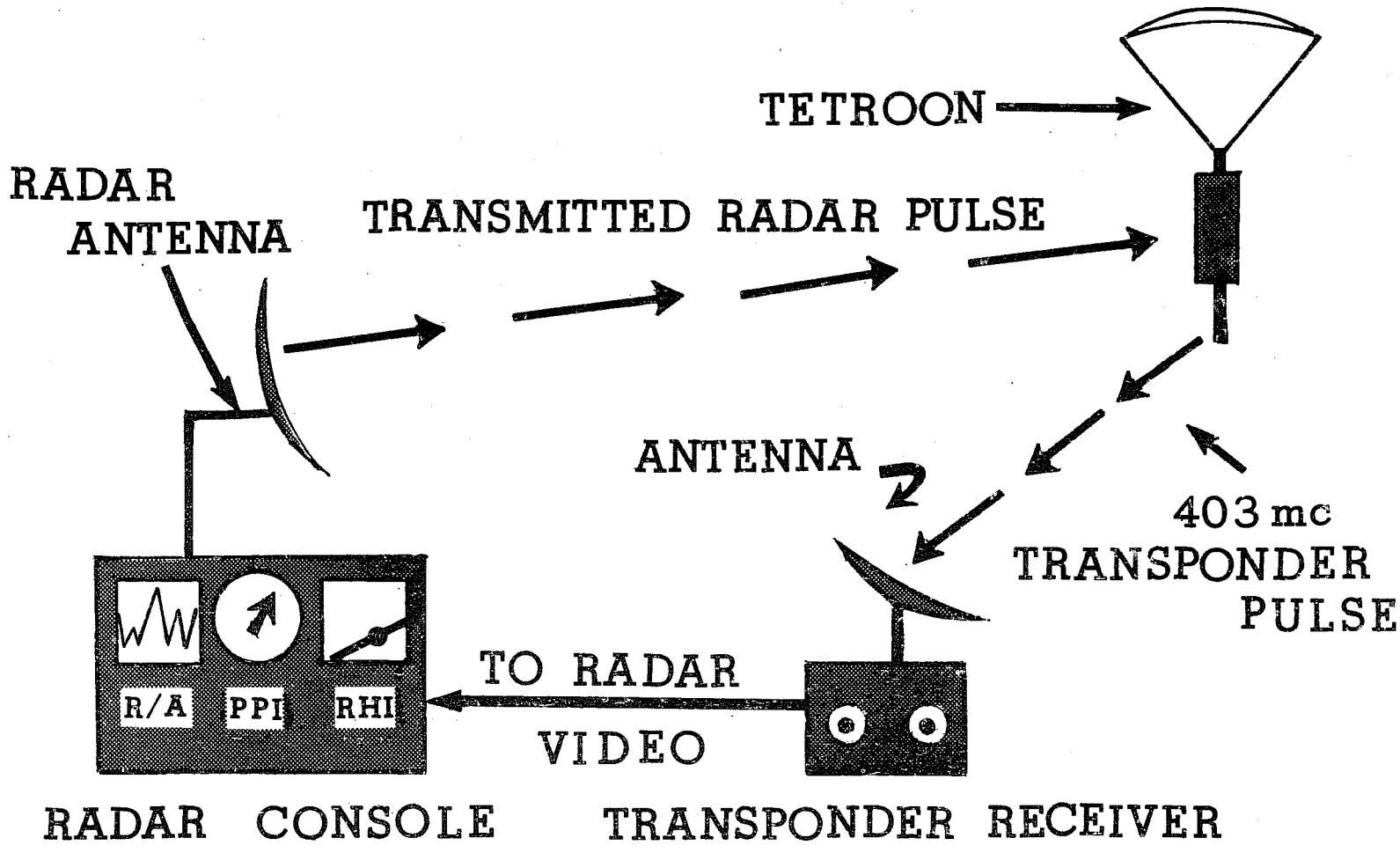

Figure 1. Tetroon-radar-transponder system.

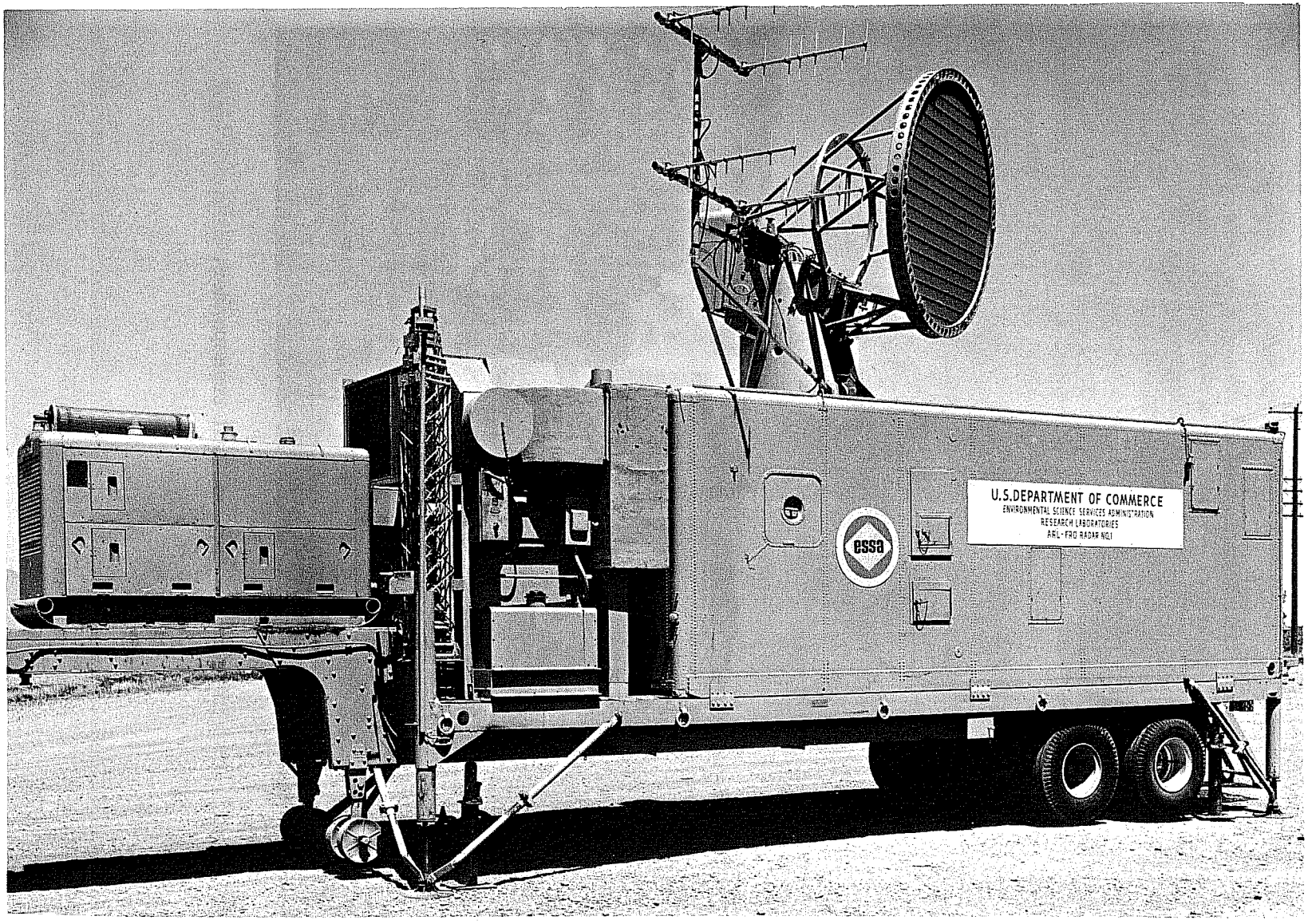

Figure 2. Tracking radar with transponder receiving antenna.

B-88011

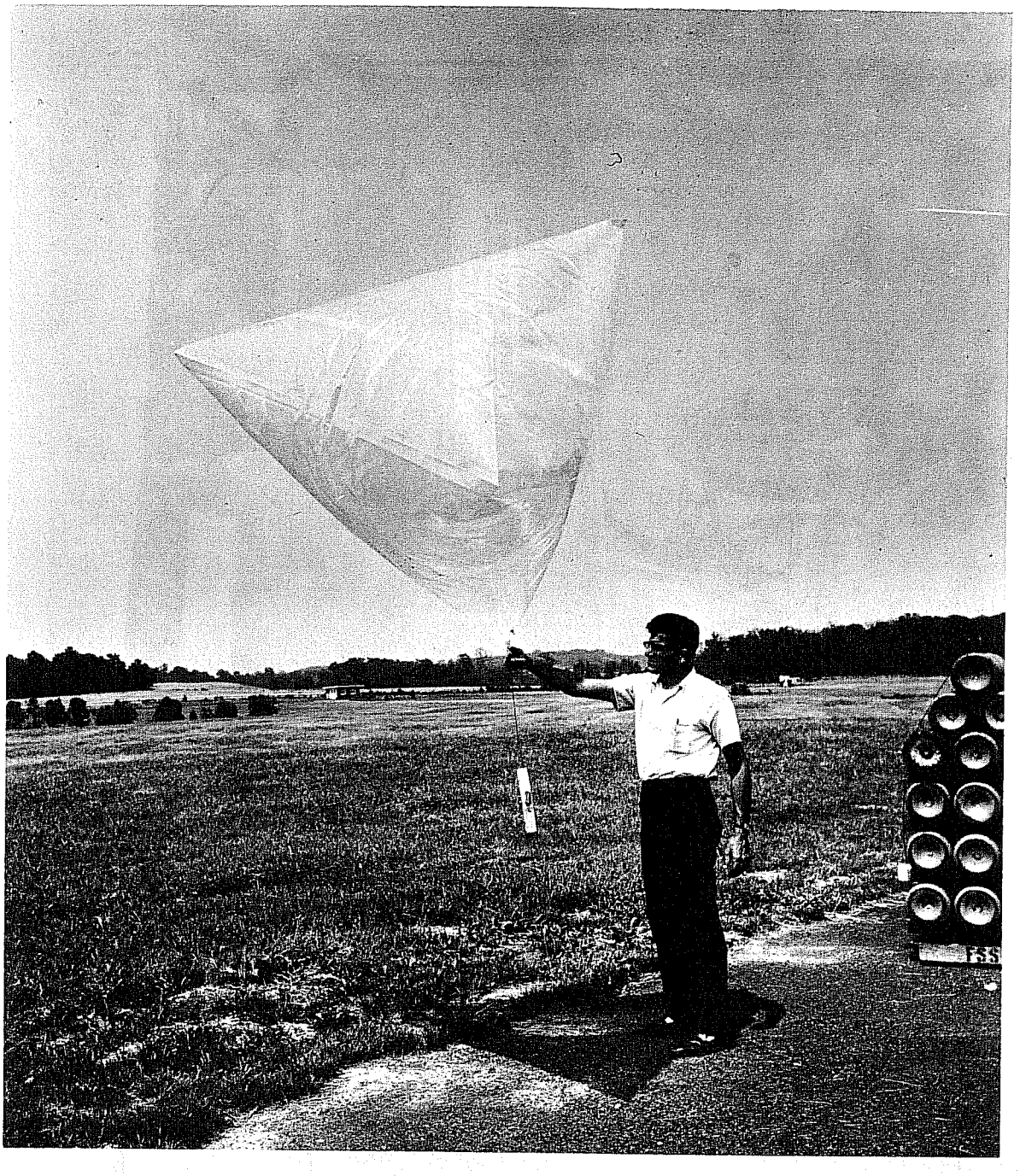

Figure 3. Tetroon and transponder.

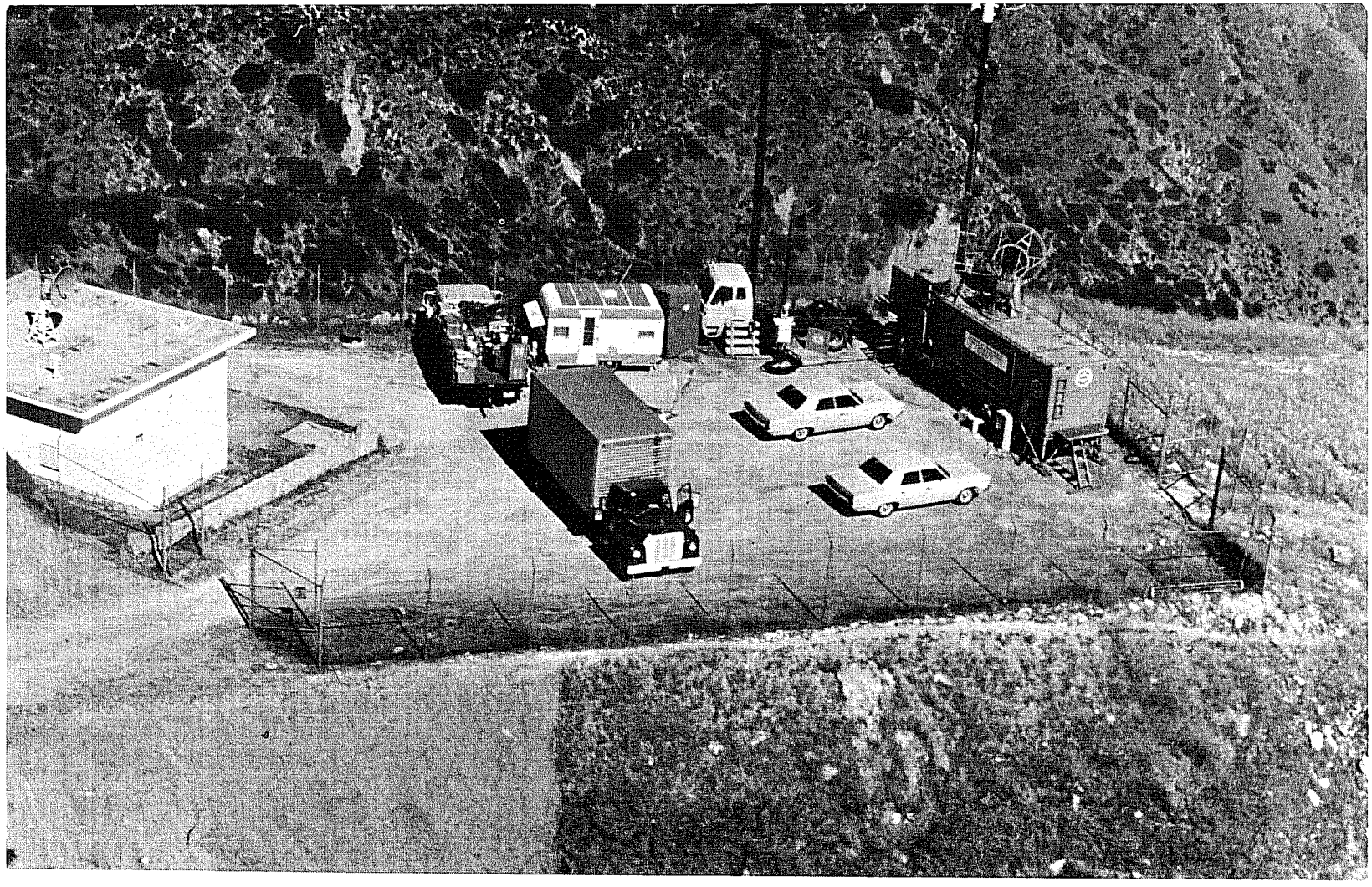

Figure 4. Photograph of Mt. Thom radar site from helicopter.

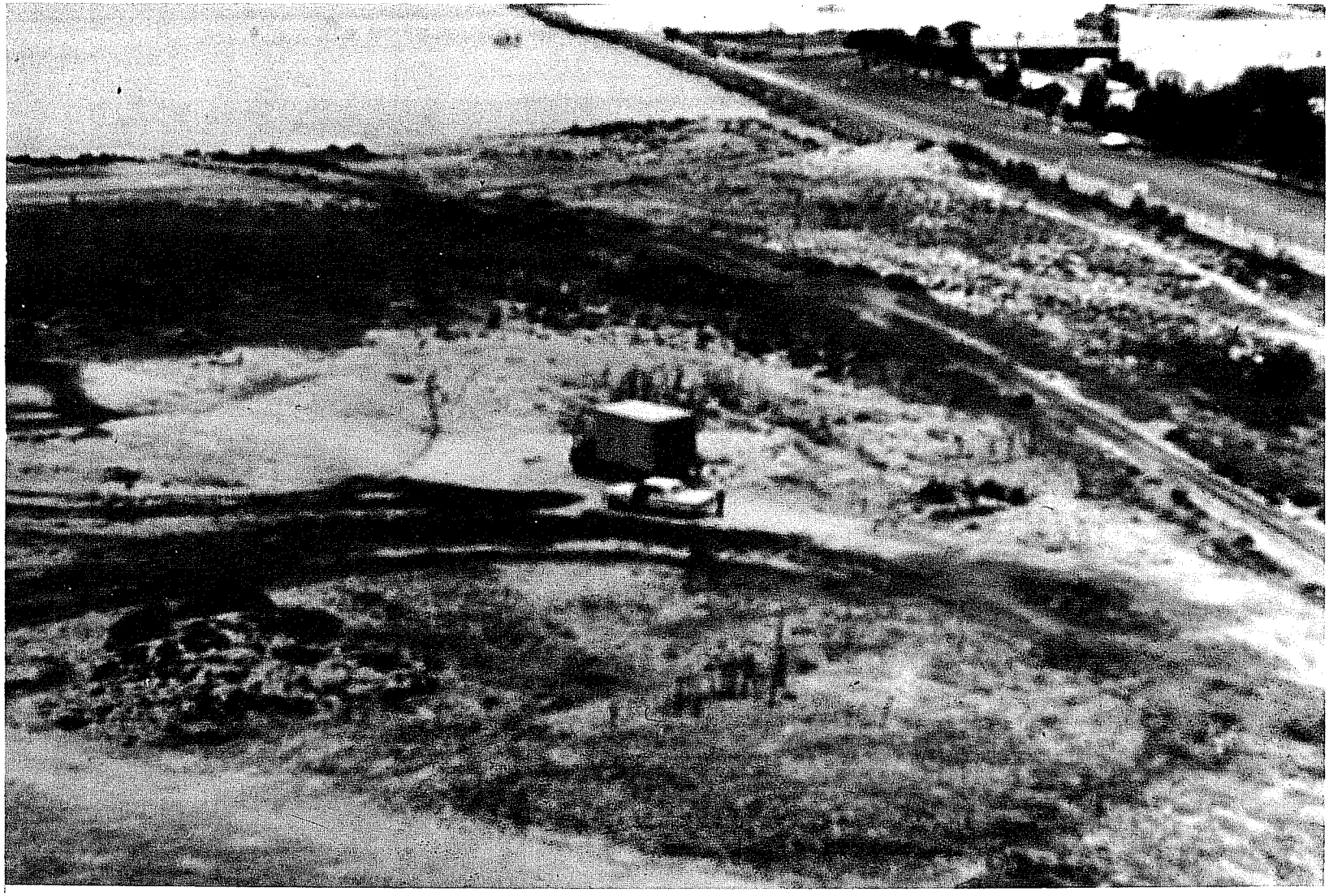

Figure 5. Launch site showing inflation van.

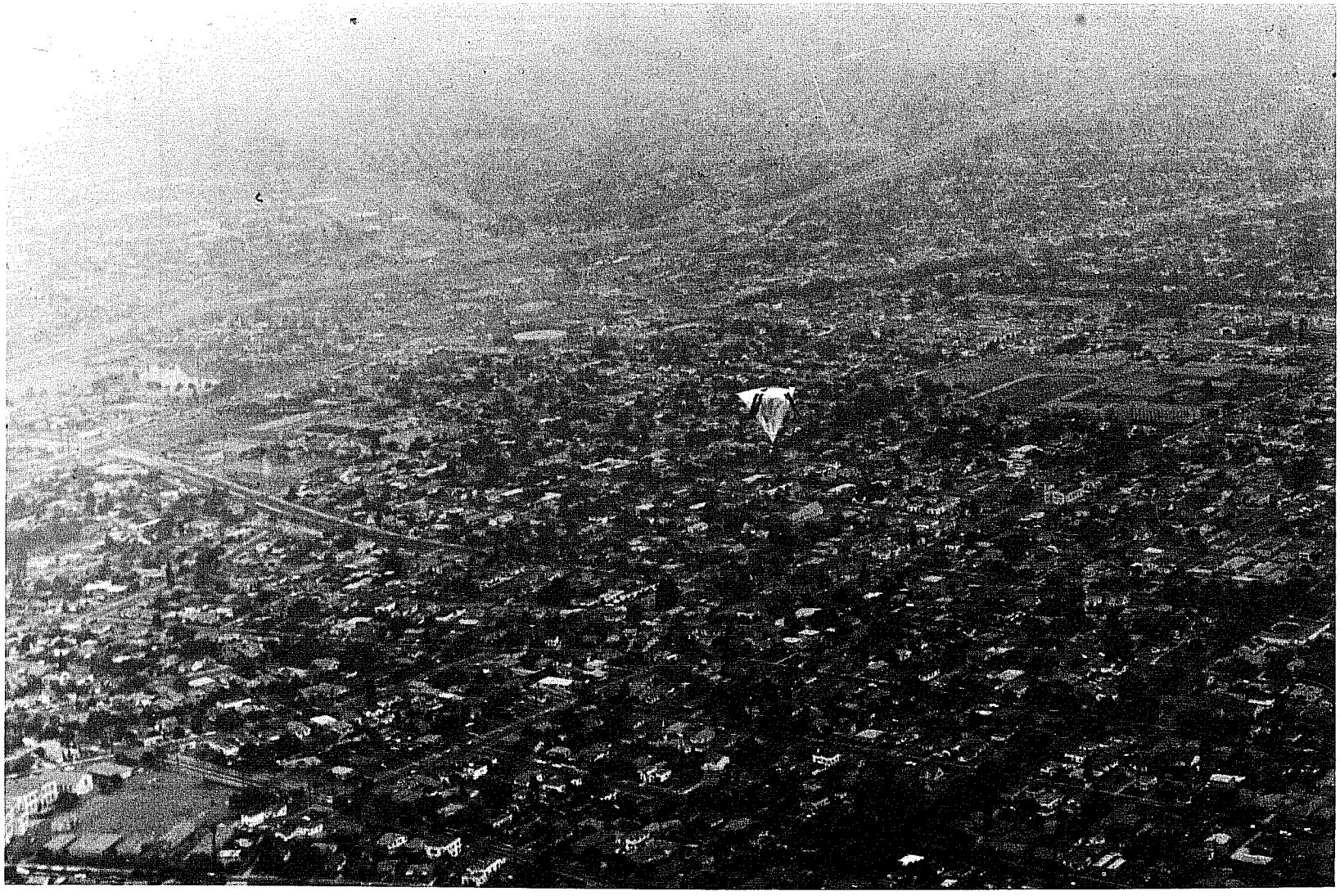

Figure 6. Tetroon in flight.

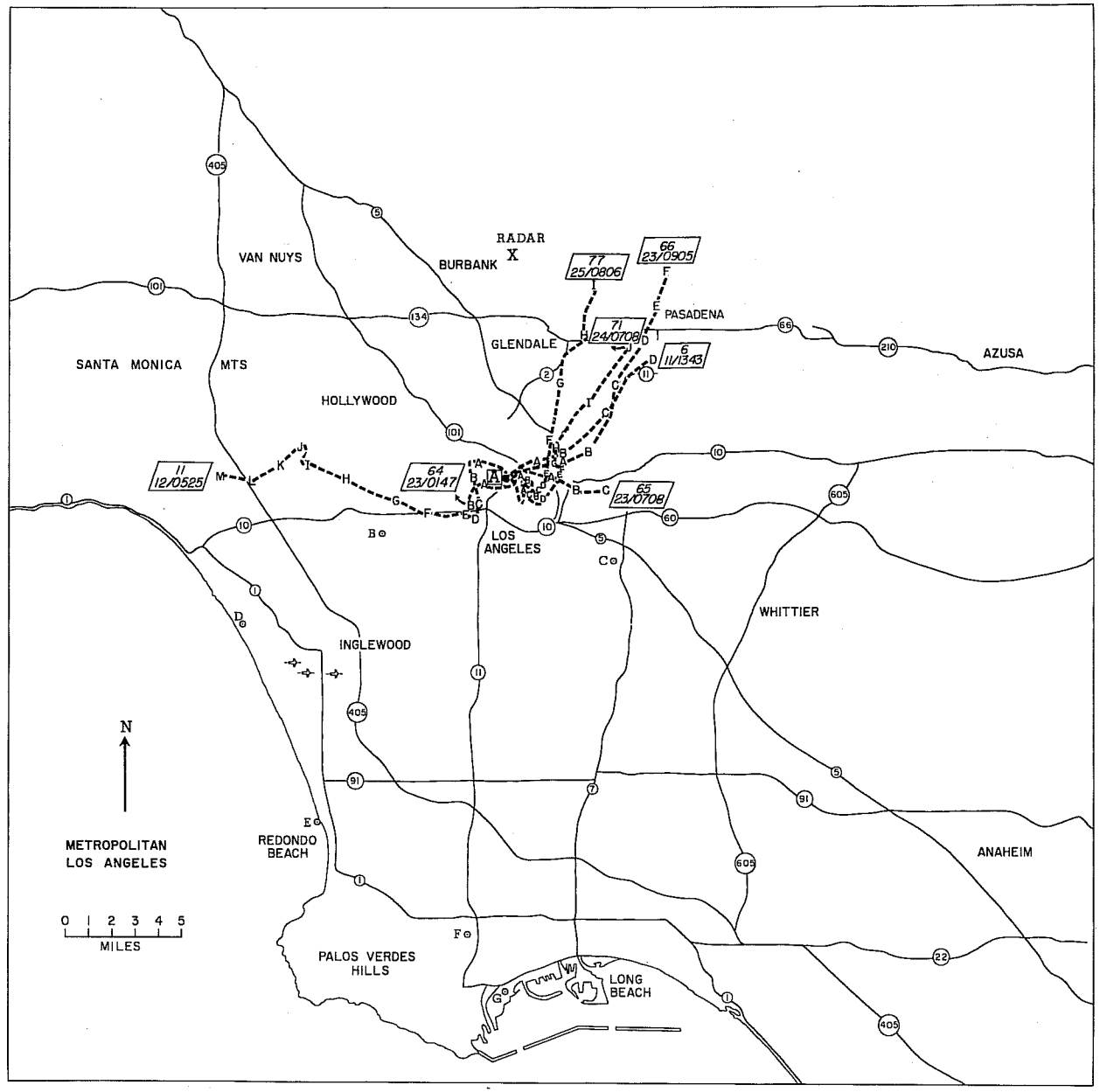

Figure 7. Trajectories from site A. Letters show positions at 30-min intervals. Flight number (top) and launch date and time (Pacific daylight time) indicated within the parallelogram at the end of the trajectory.

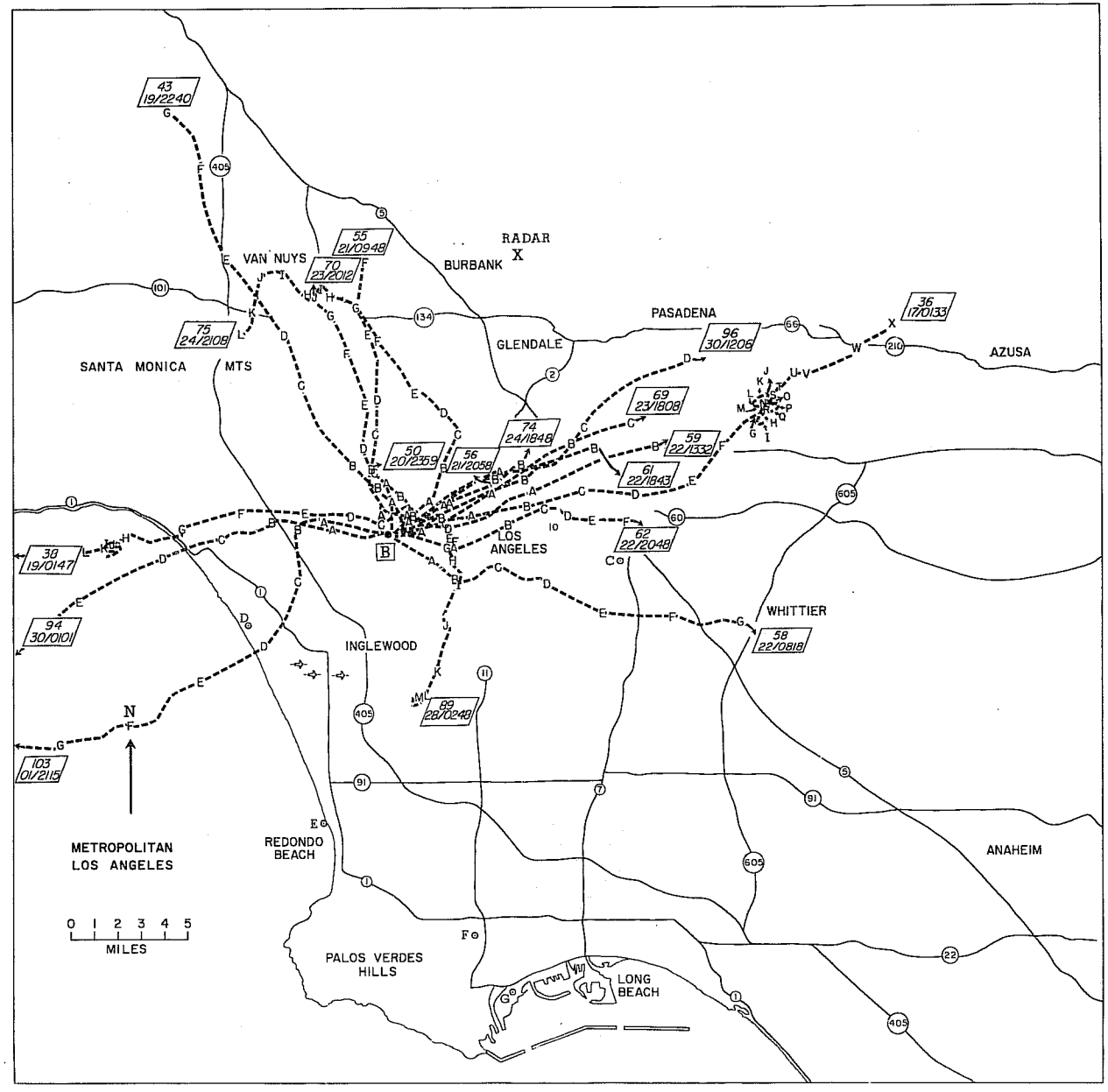

Figure 8. Trajectories from site B.

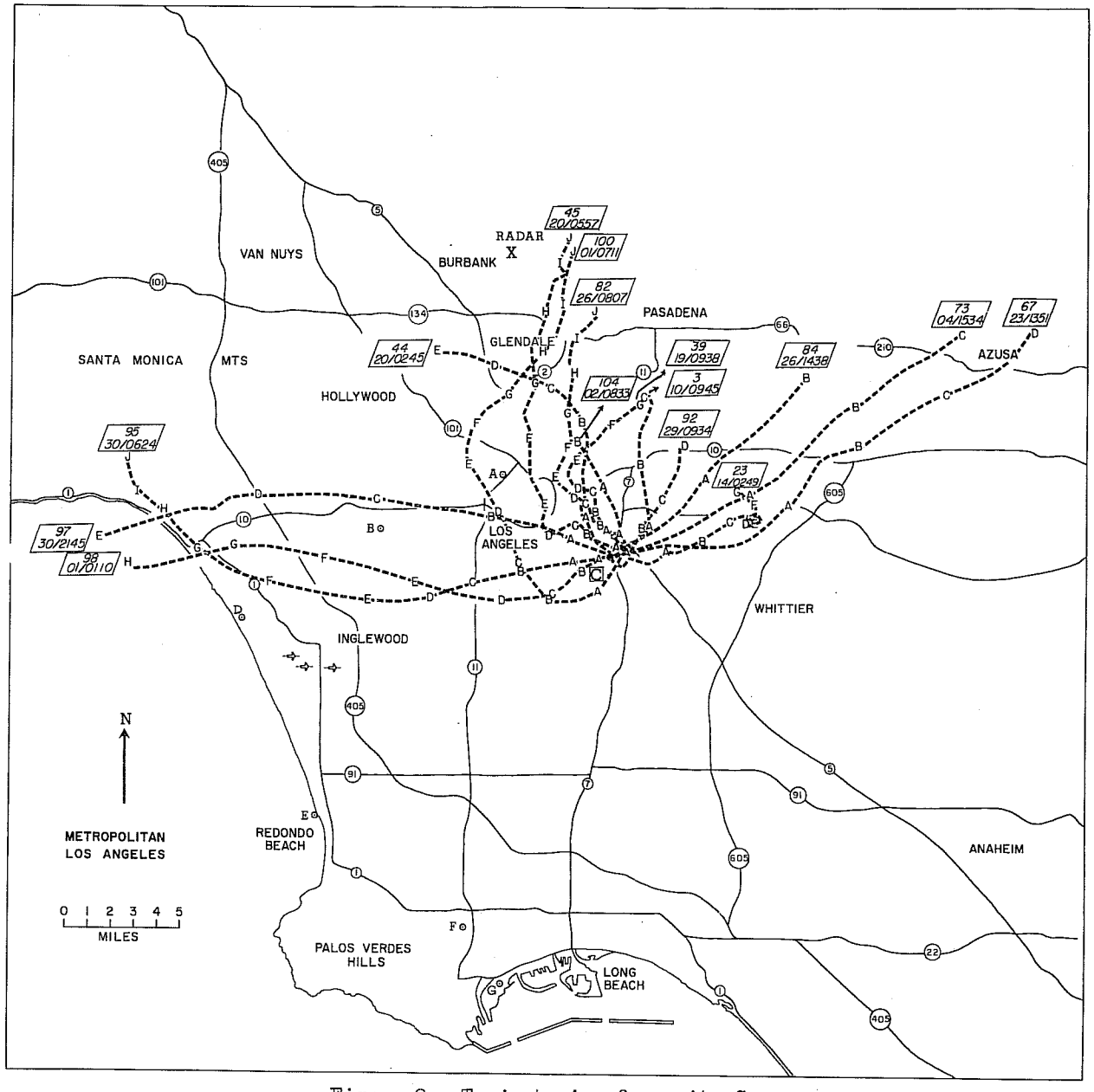

Figure 9. Trajectories from site C.

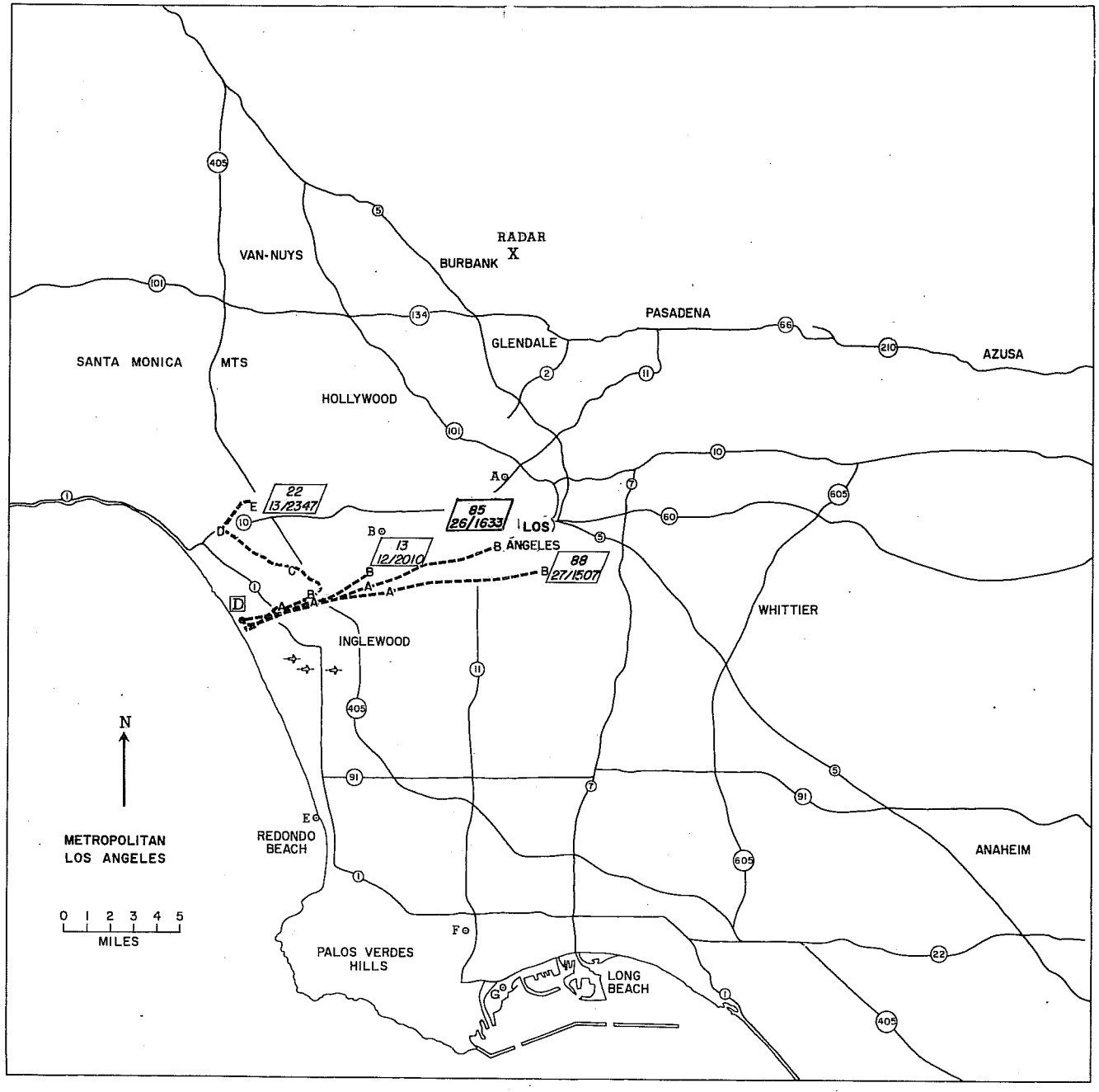

Figure 10. Trajectories from site D.

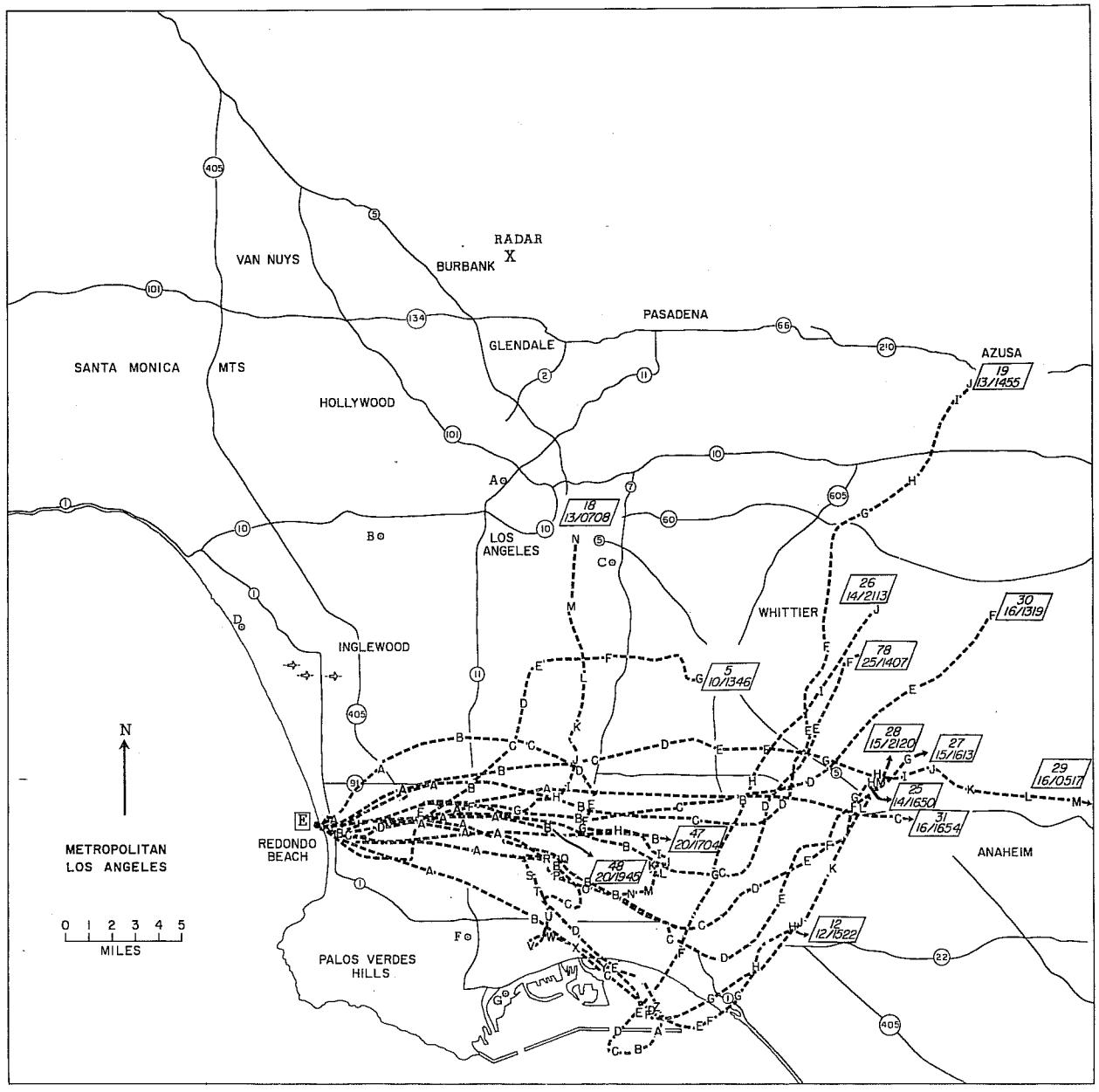

Figure 11. Trajectories from site E.

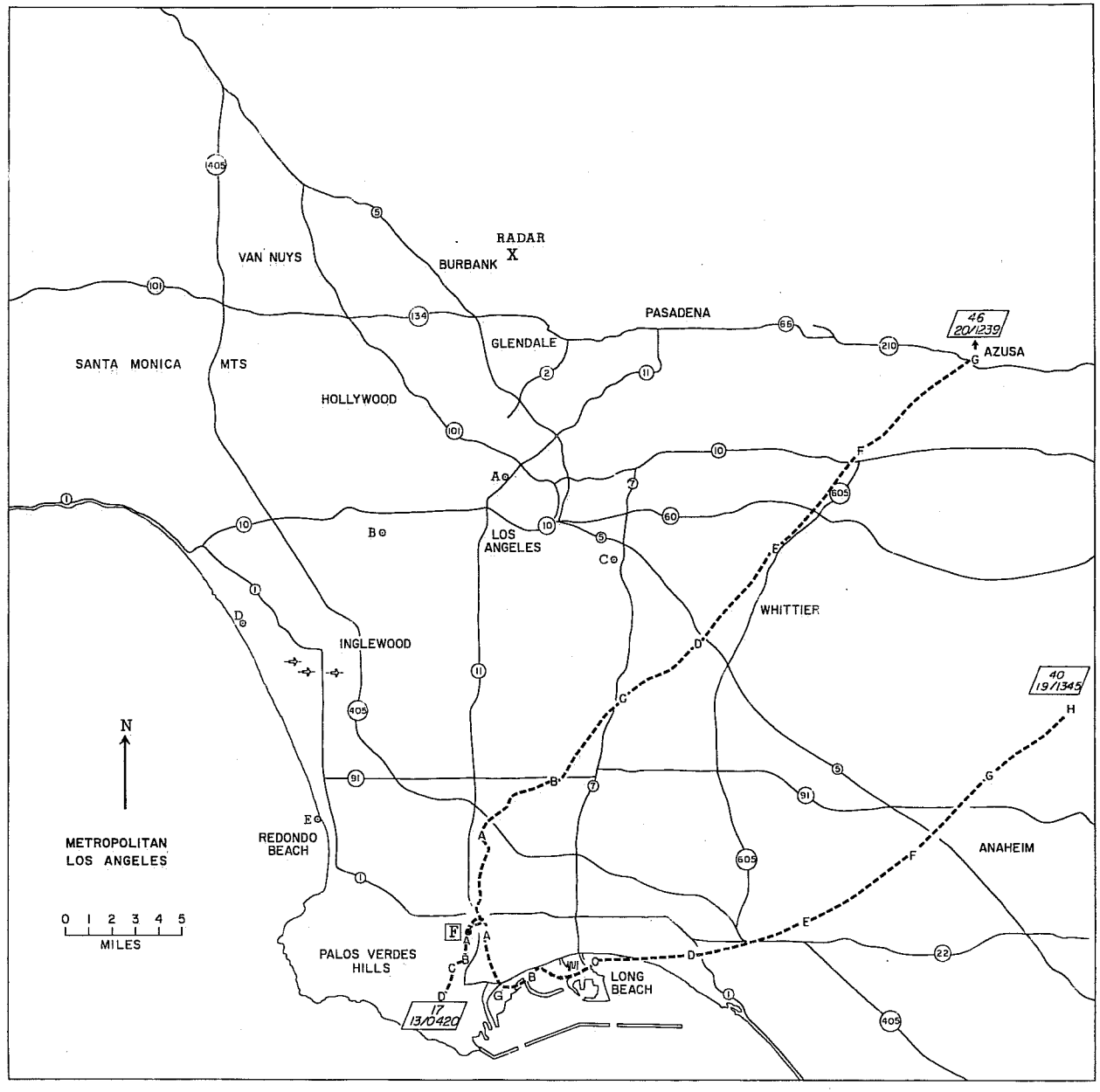

Figure 12. Trajectories from site F.

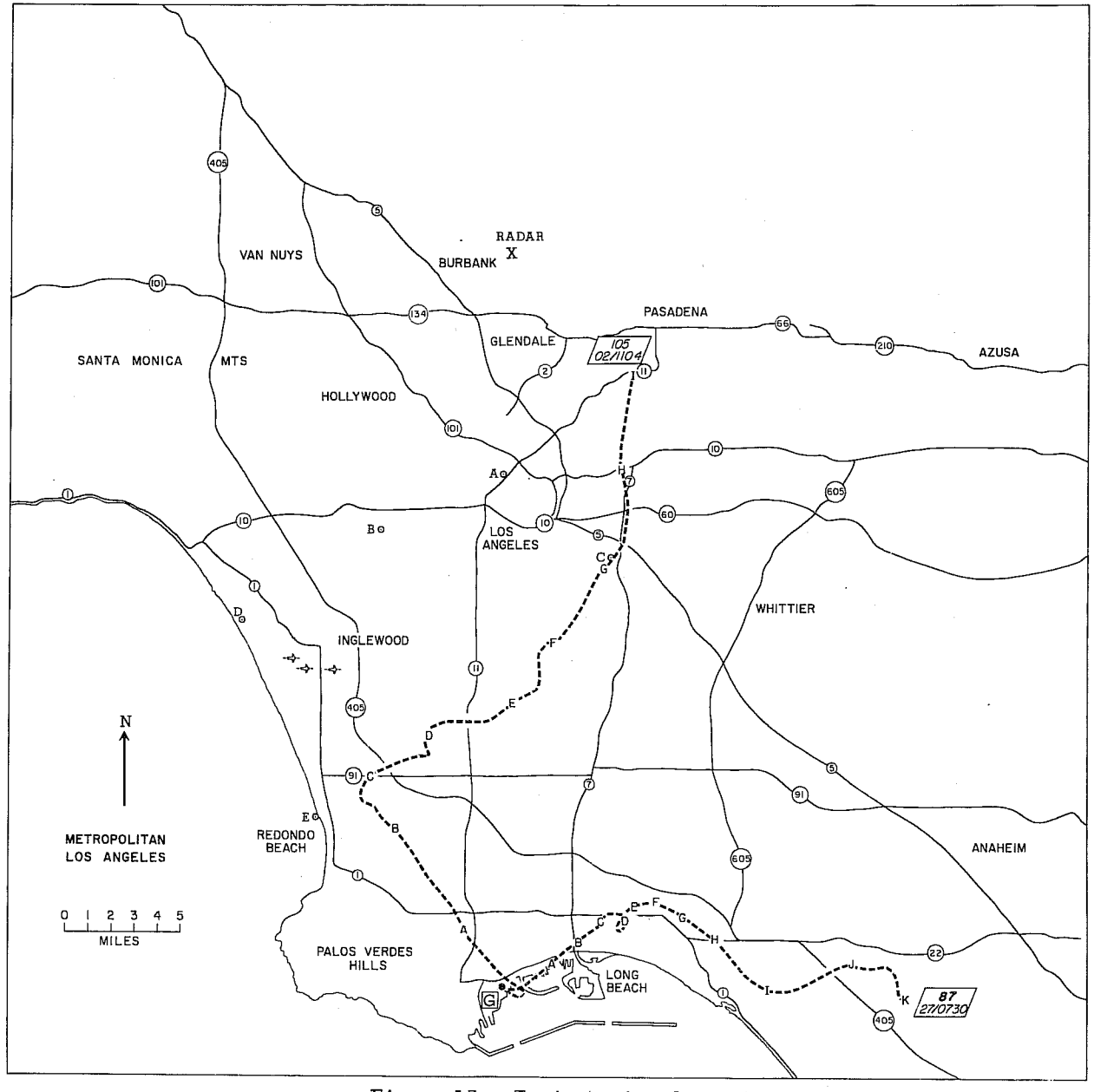

Figure 13. Trajectories from site G.

Data Listings Showing Tetroon Heights in Meters Above MSL at 30-Min Intervals As Derived From the Computer-Processed Magnetic Tape Data Averaged Over a 5-Min Period.

ETHYL CORP. (A) 1969

Time (PDT)	Minutes After Release	Height MSL (Meters)
Flt. 6 9/11 1348-1550		
1418	30	390
1448	60	269
Flt. 11 9/12 0525-1229		
0555	30	287
0625	60	240
0655	90	301
0725	120	339
0755	150	254
0825	180	343
0855	210	373
0925	240	410
0955	270	280
1025	300	338
1055	330	406
1125	360	331
1155	390	440
Flt. 64 9/23 0148-0256		
0218	30	437
0248	60	179
Flt. 65 9/23 0808-0833		
0737	30	108
0807	60	231
Flt. 66 9/23 0906-1205		
0936	30	201
1006	60	348
1036	90	294
1106	120	359
1136	150	545
Flt. 71 9/24 0708-1247		
0738	30	451
0808	60	354
0838	90	451
0908	120	301
0938	150	291
1008	180	282
1038	210	551
1108	240	454
1138	270	188
1208	300	521
Flt. 77 9/25 0805-1303		
0835	30	516
0905	60	275
0935	90	120
1005	120	250
1035	150	394
1105	180	214
1135	210	434
1205	240	618
1235	270	519

RANCHO CIENGA (B) 1969

Time (PDT)	Minutes After Release	Height MSL (Meters)
Flt. 36 9/17 0133-1304		
0203	30	208
0233	60	336
0303	90	265
0333	120	338
0403	150	359
0433	180	380
0503	210	434
0533	240	400
0603	270	394
0633	300	399
0703	330	429
0733	360	435
0803	390	318
0833	420	457
0903	450	335
0933	480	349
1003	510	444
1033	540	560
1103	570	262
1133	600	609
1203	630	377
1233	660	435
1303	690	213
Flt. 38 9/19 0148-0849		
0218	30	398
0248	60	495
0318	90	413
0348	120	462
0418	150	363
0448	180	461
0518	210	426
0548	240	395
0618	270	409
0648	300	266
0718	330	214
0748	360	437
0818	390	343
Flt. 43 9/19 2239-0226		
2309	30	527
2339	60	477
0009	90	467
0039	120	363
0109	150	462
0139	180	395
0209	210	435

Time (PDT)	Minutes After Release	Height MSL (Meters)
Flt. 50 9/20 2349-0111		
0019	30	215
0049	60	132
Flt. 55 9/21 0948-1300		
1018	30	251
1048	60	620
1118	90	743
1148	120	803
1218	150	574
1248	180	572
Flt. 56 9/21 2058-2211		
2128	30	92
2158	60	273
Flt. 58 9/22 0818-1211		
0848	30	422
0918	60	487
0948	90	428
1018	120	236
1048	150	581
1118	180	204
1148	210	434
Flt. 59 9/22 1332-1454		
1402	30	349
1432	60	336
Flt. 61 9/22 1844-1952		
1914	30	261
1944	60	385
Flt. 62 9/22 2049-0221		
2119	30	422
2149	60	155
2219	90	222
2249	120	492
2319	150	363
2349	180	332

RANCHO CIENGA (E), 1969 (Continued)

Time (PDT)	Minutes After Release	Height MSL (Meters)
Flt. 69 9/23 1809-1946		
1839	30	349
1909	60	322
1939	90	355
Flt. 70 9/23 2012-2324		
2042	30	448
2112	60	229
2142	90	290
2212	120	394
2242	150	297
2312	180	305
Flt. 74 9/24 1848-1959		
1918	30	475
1948	60	346
Flt. 75 9/24 2108-0310		
2138	30	428
2208	60	425
2238	90	522
2308	120	407
2338	150	384
0008	180	504
0038	210	395
0108	240	447
0138	270	390
0208	300	381
0238	330	418
0308	360	421
Flt. 89 9/28 0242-0906		
0312	30	299
0342	60	216
0412	90	298
0442	120	286
0512	150	302
0542	180	292
0612	210	205
0642	240	252
0712	270	271
0742	300	241
0812	330	265
0842	360	215

Time (PDT)	Minutes After Release	Height MSL (Meters)
Flt. 94 9/30 0101-0552		
0131	30	191
0201	60	171
0231	90	184
0301	120	156
0331	150	71
0401	180	79
0431	210	150
0501	240	217
0531	270	187
Flt. 96 9/30 1206-1405		
1236	30	557
1306	60	587
1336	90	620
Flt. 103 10/1 2115-0144		
2145	30	617
2215	60	668
2245	90	695
2315	120	770
2345	150	676
0015	180	634
0045	210	787
0115	240	362

CITY OF COMMERCE (C) 1969

Time (PDT)	Minutes After Release	Height MSL (Meters)
Flt. 3 9/10 0945-1107		
1015	30	287
1045	60	345
Flt. 23 9/14 0248-0618		
0318	30	167
0348	60	224
0418	90	150
0448	120	296
0518	150	283
0548	180	347
0618	210	464
Flt. 39 9/19 0940-1302		
1010	30	241
1040	60	210
1110	90	479
1140	120	248
1210	150	488
1240	180	483
Flt. 44 9/20 0245-0539		
0315	30	275
0345	60	491
0415	90	526
0445	120	811
0515	150	423
Flt. 45 9/20 0557-1056		
0627	30	245
0657	60	334
0727	90	240
0757	120	376
0827	150	516
0857	180	515
0927	210	548
0957	240	348
1026	270	712
Flt. 67 9/23 1351-1608		
1421	30	262
1451	60	551
1521	90	468
1551	120	371

Time (PDT)	Minutes After Release	Height MSL (Meters)
Flt. 73 9/24 1534-1712		
1604	30	366
1634	60	335
1704	90	411
Flt. 82 9/26 0808-1322		
0838	30	202
0908	60	317
0938	90	586
1008	120	161
1038	150	391
1108	180	385
1138	210	453
1208	240	365
1238	270	401
1308	300	450
Flt. 84 9/26 1438-1555		
1508	30	226
1538	60	273
Flt. 92 9/29 0935-1158		
1005	30	247
1035	60	109
1105	90	214
1135	120	292
Flt. 95 9/30 0624-1144		
0654	30	132
0724	60	173
0754	90	-11
0824	120	304
0854	150	304
0924	180	324
0954	210	377
1024	240	258
1054	270	309
1124	300	353
Flt. 97 9/30 2145-0024		
2215	30	316
2245	60	335
2315	90	331
2345	120	376
0015	150	359

CITY OF COMMERCE (C), 1969 (Continued)

Time (PDT)	Minutes After Release	Height MSL (Meters)
Flt. 98 10/1	0110-0513	
0140	30	322
0210	60	311
0240	90	312
0310	120	310
0340	150	298
0410	180	301
0440	210	344
0510	240	264
Flt. 100 10/1	0711-1210	
0741	30	271
0811	60	321
0841	90	322
0911	120	310
0941	150	345
1011	180	250
1041	210	194
1111	240	413
1141	270	584
1211	300	593
Flt. 104 10/2	0833-0953	
0903	30	281
0933	60	455

VENICE MARINA (D) 1969

Time (PDT)	Minutes After Release	Height MSL (Meters)
Flt. 13 9/12	2009-2146	
2039	30	243
2109	60	234
2139	90	141
Flt. 22 (Part I) 9/13	2346-0044	
0016	30	205
0046	60	55
Flt. 22 (Part II) 9/13	0056-0231	
0126	30	499
0156	60	513
0226	90	102
Flt. 85 9/26	1633-1746	
1703	30	298
1733	60	113
Flt. 88 9/27	1506-1619	
1536	30	199
1606	60	195

REDONDO BEACH (E) 1969

Time (PDT)	Minutes After Release	Height MSL (Meters)
Flt. 5 9/10 1346-1455		
1416	30	396
1446	60	361
Flt. 12 9/12 1526-1736		
1556	30	448
1626	60	571
1656	90	787
1726	120	592
Flt. 18 9/13 1015-1425		
1045	30	224
1115	60	342
1145	90	307
1215	120	262
1245	150	315
1315	180	591
1345	210	724
1415	240	668
Flt. 19 9/13 1455-2039		
1525	30	358
1555	60	227
1625	90	202
1655	120	344
1725	150	232
1755	180	385
1825	210	475
1855	240	353
1925	270	374
1955	300	189
2025	330	216
Flt. 25 9/14 1650-2050		
1720	30	278
1750	60	151
1820	90	470
1850	120	300
1920	150	311
1950	180	502
2020	210	112

Time (PDT)	Minutes After Release	Height MSL (Meters)
Flt. 26 9/14/2113 - 9/15/1534		
2143	30	385
2213	60	189
2243	90	326
2313	120	459
2343	150	446
0013	180	374
0043	210	354
0113	240	345
0143	270	332
0213	300	426
0243	330	512
0313	360	310
0343	390	415
0413	420	415
0443	450	427
0513	480	430
0543	510	387
0613	540	385
0643	570	342
0713	600	334
0743	630	413
0813	660	474
0814	690	337
0919	720	233
0943	750	298
1013	780	376
1043	810	400
1113	840	379
1143	870	380
1213	900	381
1243	930	387
1313	960	378
1343	990	329
1413	1020	225
1443	1050	318
1513	1080	753
Flt. 27 9/15 1614-1958		
1644	30	188
1714	60	254
1744	90	433
1814	120	509
1844	150	221
1914	180	213
1944	210	564

REDONDO BEACH (E), 1969 (Continued)

Time (PDT)	Minutes After Release	Height MSL (Meters)
Flt. 28 9/15 2120-0410		
2150	30	261
2220	60	191
2250	90	225
2320	120	256
2350	150	307
0020	180	279
0050	210	243
0120	240	267
0150	270	245
0220	300	199
0250	330	195
0320	360	192
0350	390	112
Flt. 29 9/16 0517-1213		
0547	30	213
0617	60	238
0647	90	168
0717	120	249
0747	150	222
0817	180	285
0847	210	258
0917	240	325
0947	270	416
1017	300	337
1047	330	375
1117	360	592
1147	390	385
Flt. 30 9/16 1320-1616		
1350	30	299
1420	60	196
1450	90	110
1520	120	449
1550	150	555
Flt. 31 9/16 1655-1838		
1725	30	351
1755	60	204
1825	90	410
Flt. 47 9/20 1703-1824		
1733	30	131
1803	60	298

Time (PDT)	Minutes After Release	Height MSL (Meters)
Flt. 48 9/20 1944-2046		
2014	30	473
2044	60	113
Flt. 78 9/25 1408-1718		
1438	30	110
1508	60	234
1538	90	536
1608	120	210
1638	150	171
1708	180	372

HARBOR LAKE (F) 1969

Time (PDT)	Minutes After Release	Height MSL (Meters)
Flt. 17 9/13	**0419-0646**	
0449	30	224
0519	60	426
0549	90	356
0619	120	367
Flt. 40 9/19	**1345-1751**	
1415	30	294
1445	60	536
1515	90	466
1545	120	409
1615	150	479
1645	180	435
1715	210	325
1745	240	611
Flt. 46 9/20	**1239-1613**	
1309	30	879
1339	60	461
1409	90	323
1439	120	292
1509	150	711
1539	180	502
1609	210	319

CUSTOM HOUSE (G) 1969

Time (PDT)	Minutes After Release	Height MSL (Meters)
Flt. 87 9/27	0730-1330	
0800	30	148
0830	60	395
0900	90	151
0930	120	408
1000	150	275
1030	180	549
1100	210	324
1130	240	524
1200	270	407
1230	300	596
1300	330	591
Flt. 105 10/2	1104-1540	
1134	30	277
1204	60	412
1234	90	227
1304	120	476
1334	150	340
1404	180	673
1434	210	501
1504	240	131
1534	270	587