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SHIPPING SURVEILLANCE DATA FOR CHURCH GABBRO

Eric L. Sander

Raff Associates, Incorporated

Prepared for:

Office of Naval Research

15 March 1973

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15 March 1973

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report presents the shipping surveillance data gathered during the CHURCH GABBRO Exercise in December 1972 under the sponsorship of LRAPP. The report contains a description of the surveillance methods used and the areas covered. The shipping data are presented on maps and in tabular form for each day of surveillance. The tabulated data include length and speed estimates for some of the ships surveyed.

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TABLE OF CONTENTS

		Page
I	SUMMARY OF OPERATIONS	1
II	TACTICS DESCRIPTIONS	2
III	DATA	3
	A. Data for 2 December 1972	5
	B. Data for 4 December 1972	19
	C. Data for 5 December 1972	38
	D. Data for 6 December 1972	49
	E. Data for 7 December 1972	62
IV	REFERENCES	68

SHIPPING SURVEILLANCE

1. Summary of Operations. The aircraft schedule was carried out in accordance with the exercise plan, by the units which were designated therein, and at the geographic locations which had been specified. The number of aircraft sorties each day is summarized as follows:

	VP 16	VXN 8	NRL	TOTAL
December 2		1	1	2
4	4*	1	1	6*
5		1	1	2
6	3		1	4
7		1		1
	7*	4	4	15*

*Includes one aborted sortie -- engine trouble

This exercise schedule provided a built-in redundance in shipping surveillance over most of the area of interest, with particular emphasis on December 4 and 6. As it turned out there were no apparent gaps in the area coverage of the actual operations despite modifications of the planned survey tactic in five sorties due to difficulties arising on station.

In general, the aircraft crews proved to be capable, motivated and hard working. It is believed that their navigation was excellent, facilitating a knowledge of the ships' locations. For a large fraction of the area surveyed, the use of radar navigation was possible. This more than made up for the poor functioning of the inertial navigation systems and inadequate LORAN coverage. In areas where land was more distant, however, the poor navigation performance will continue to limit the data accuracy. The crews and the PIs modified the planned surveillance tactics in some flights to overcome difficulties due to equipment failures and poor weather. All the surveillance areas were covered, but in some cases the modified

tactics could not provide the quality of data that the original tactic could have provided. Although the crews performed well, the frequency of equipment failures, particularly in the VP 16 aircraft, must be described as disappointing.

The principal technical difficulty of the shipping surveillance was that caused by false radar contacts -- the incorrect identification of clouds as ship contacts. In the exercise, this problem was caused by scattered clouds in generally clear weather areas and probably could have been minimized by reducing the radar range and flying at altitudes of 2000 feet or less, below the clouds. This would, of course, have reduced the surveyed area slightly; but the net effect would have been beneficial. Despite difficulties with equipment failures and false contacts, there are no major gaps in the intended area coverage and the data should provide adequate inputs for modellings of ambient noise.

2. Tactics Descriptions. Three basic surveillance tactics were used. The first is the Radar Only Tactic (ROT). As the aircraft flew a prescribed path, the crew recorded the range and bearing to each radar contact and the aircraft position and the local time at that moment. The APS-80 radar could provide good coverage out to about 60 n.m. and some contacts were recorded at distances greater than twice that range. This method provides only contact positions and was used only in transit to and from surveillance areas of major importance, in sorties in which environmental measurements were the primary objectives which dictated the aircraft track and on the first day when only two aircraft were used to survey the entire area. Naturally, false contacts here would create an inaccurately high ship count.

The second tactic was the Radar Survey Tactic (RST) and it was planned for use in the surveillance areas of major importance. The aircraft crew drops an SSQ 48 sonobuoy at a designated spot, returns to it using the on-top indicator, and records the local time and the range and bearing of all the radar contacts visible on the scope at the moment they pass over the sonobuoy. The aircraft then flies to another location 60 n.m. away and

repeats this procedure. The plane continues to fly back and forth between the two locations making these radar maps for a period of about four hours. Some time is reserved in the middle of this period to visually observe the radar contacts and obtain the ship's name and visual estimates of speed, course, and length. The series of positions of the radar contacts can be used to reconstruct excellent determinations of ship position, speed, and course. False contacts complicate reconstruction; but they are eliminated by reconstruction, because they do not form ship tracks.

The final method is the Visual Survey Tactic (VST). It was used when equipment failure or bad weather prevented the use of the RST. The aircraft followed a nominal ladder search pattern covering the area with a track spacings out to 30 n.m. depending on the radar or visual range available. When a contact was detected whose position was less than half the track spacing away from the intended track, the aircraft flew to it to obtain the name and visual estimates of length, speed, and course. Speed and to a lesser extent course estimates using the VST are not as good as those obtained using the RST tactic. Although false radar contacts do not contaminate VST data, time can be wasted chasing them.

3. Data. The shipping data collected for each day are presented in the following manner:

For 2, 5, and 7 December 1972, the following figures and tables are given for each plane:

1. A figure showing the approximate flight path and ROT coverage.
2. A figure showing the approximate positions of the ROT contacts.
3. A table of the latitudes, longitudes and sighting times of the ROT contacts.

Finally, a figure for the ROT contact density for each day is given. The following assumptions were made in the creation of these maps:

1. If three-fourths or more of a one degree square was within 60 n.m. of a ROT track the square was considered to have been observed by the plane.

2. The square may have been observed by the same plane at a later time for by another plane.

3. The contact density for that square is the total number of contacts observed in that square divided by the total number of observations.

For 4 and 6 December 1972, the following figures and tables are given for each plane:

1. A figure showing the approximate flight paths and RST, VST and or ROT coverage.

2. A figure showing the approximate positions of all contacts.

3. A table of the latitudes, longitudes, and sighting times of the ROT contacts (none were obtained by P3#3).

Also, a table showing the speed, course, position, and size estimates of the VST and RST contacts for all the planes on that day is given. The positions here are the dead reckoned positions for a standard time (1500 Z for the 4th, 1700 Z for the 6th). Also, estimates of the uncertainty in the RST speed and course estimates are expressed as plus or minus one standard deviation and are based on the conservative assumption that the relative positions of the multiple contacts on a single ship are known with a standard deviation of error of 4 n.m. Finally, a figure for the ROT contact density for each day is given. When this data is used in an ambient noise model for a particular hydrophone, the VST or RST data for the nearby squares should be used and these densities for the squares farther out should be used.

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A. Data for 2 December 1972

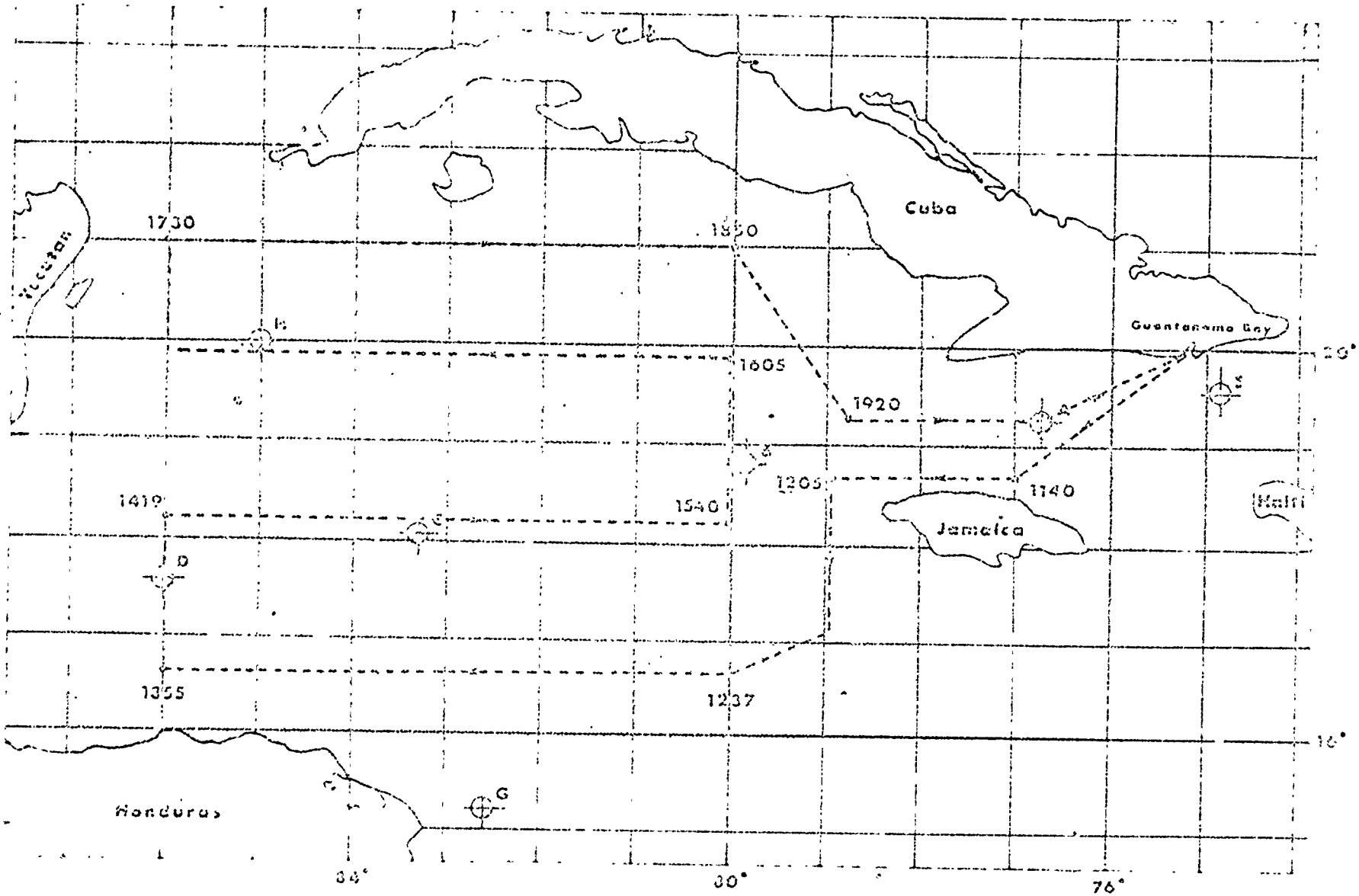

FIGURE I -- The Approximate Flight Path and ROT Area Coverage for P3#4 (VXN 8) on 2 December 1972. The Greenwich Mean Time (Zulu) When the Plane Reached Key Positions are Given.

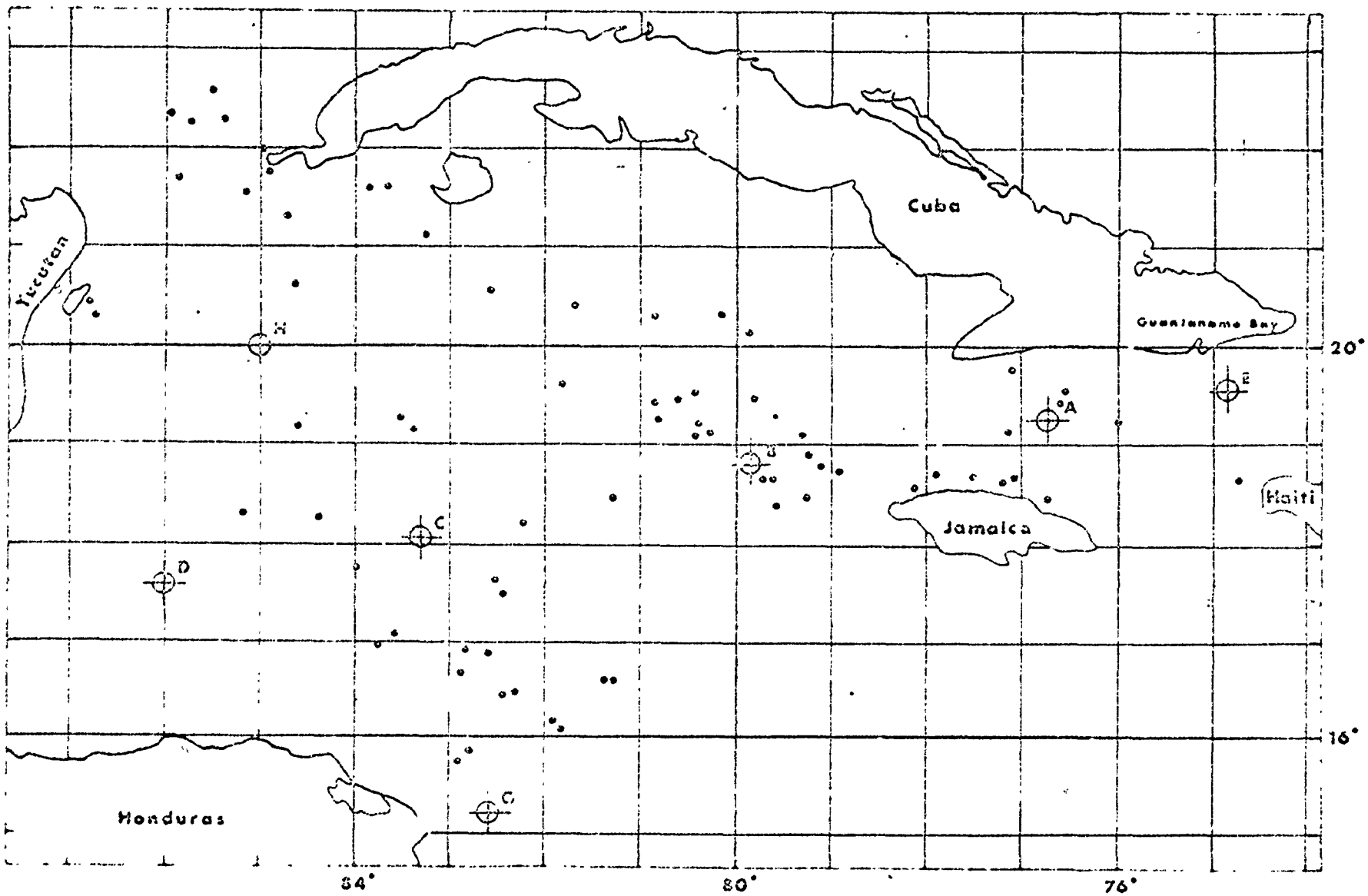

FIGURE II -- The Approximate Positions of the Radar Contacts (•) Made by 2344 (VXN 6) on 2 December 1972.

TABLE 1 - NOT CONTACTS

Plane: P3#4 (VXN 8)
Date: 2 December 1972

Pilot: Lt. Lamb
PI: T. Kane

Contact No.	Time (Zulu)	Latitude	Longitude
1	1732	2220	8604
2	1732	2221	8558
3	1732	2220	8539
4	1732	2233	8533
5	1732	2218	8522
6	1732	2139	8548
7	1732	2131	8508
8	1732	2156	8459
9	1732	2142	8456
10	1734	2120	8440
11	1748	2134	8349
12	1748	2107	8322
13	1748	2135	8340
14	1725	2022	8632
15	1726	2033	8643
16	1650	2040	8445
17	1630	2034	8238
18	1616	2020	8152
19	1835	2018	8012
20	1835	2027	8058
21	1607	2007	7958
22	1654	1909	8438
23	1642	1920	8339
24	1642	1917	8330
25	1613	1942	8150
26	1523	1908	8029
27	1528	1909	8021
28	1545	1903	8029

TABLE 1 - ROF CONTACTS (Cont)

Plane: P3#4 (VXN 8)
Date: 2 December 1972

Pilot: Lt. Lamb
PI: T. Kane

Contact No.	Time (Zulu)	Latitude	Longitude
29	1552	1924	8052
30	1552	1928	8055
31	1552	1930	8027
32	1152	1935	8015
33	1907	1926	7952
34	1158	1906	7921
35	1930	1909	7703
36	1930	1945	7703
37	1935	1917	7643
38	1935	1913	7645
39	1943	1912	7600
40	1422	1817	8513
41	1438	1820	8416
42	1506	1811	8204
43	1519	1830	8117
44	1528	1850	7948
45	1539	1850	7946
46	1157	1834	7913
47	1159	1829	7941
48	1909	1857	7921
49	1915	1852	7905
50	1156	1849	7857
51	1146	1832	7803
52	1152	1841	7758
53	1147	1842	7737
54	1130	1835	7715
55	1933	1835	7704
56	1130	1827	7649

TABLE 1 - ROT CONTACTS (Cont)

Plane: P3#4 (VXN 8)
Date: 2 December 1972

Pilot: Lt. Lamb
PI: T. Kane

Contact No.	Time (Zulu)	Latitude	Longitude
57	1956	1846	7447
58	1438	1753	8401
59	1315	1700	8339
60	1321	1702	8333
61	1504	1746	8228
62	1505	1732	8223
63	1257	1632	8221
64	1300	1656	8229
65	1300	1634	8213
66	1305	1646	8247
67	1305	1656	8241
68	1254	1602	8155
69	1254	1609	8157
70	1254	1634	8120
71	1300	1634	8120
72	1305	1556	8255
73	1312	1558	8252

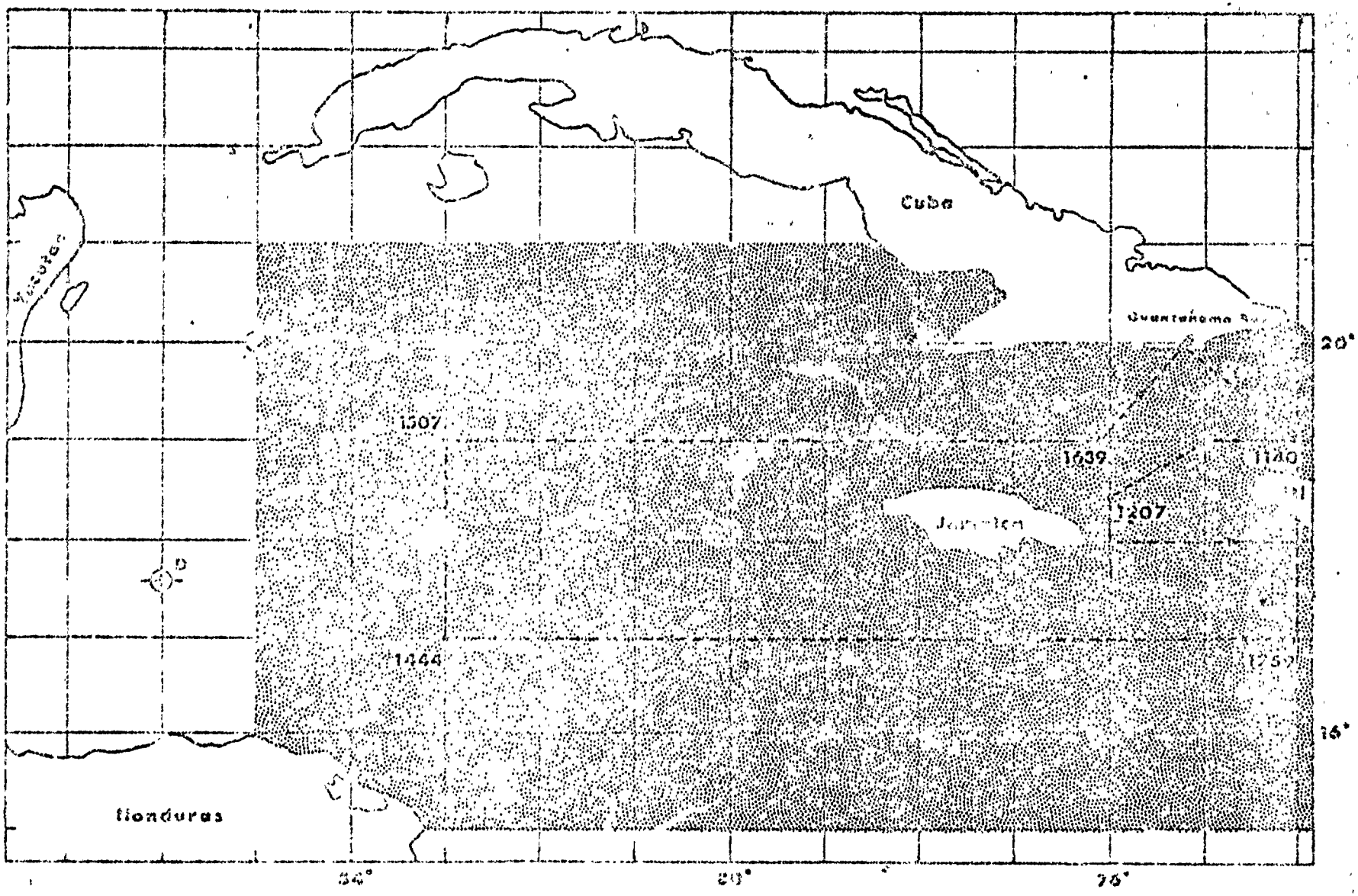

FIGURE III -- The Approximate Flight Path and ROT Coverage for P3#5 (NRL) on 2 December 1972. The Greenwich Mean Time (ZULU) When the Plane Reached Key Positions are Given.

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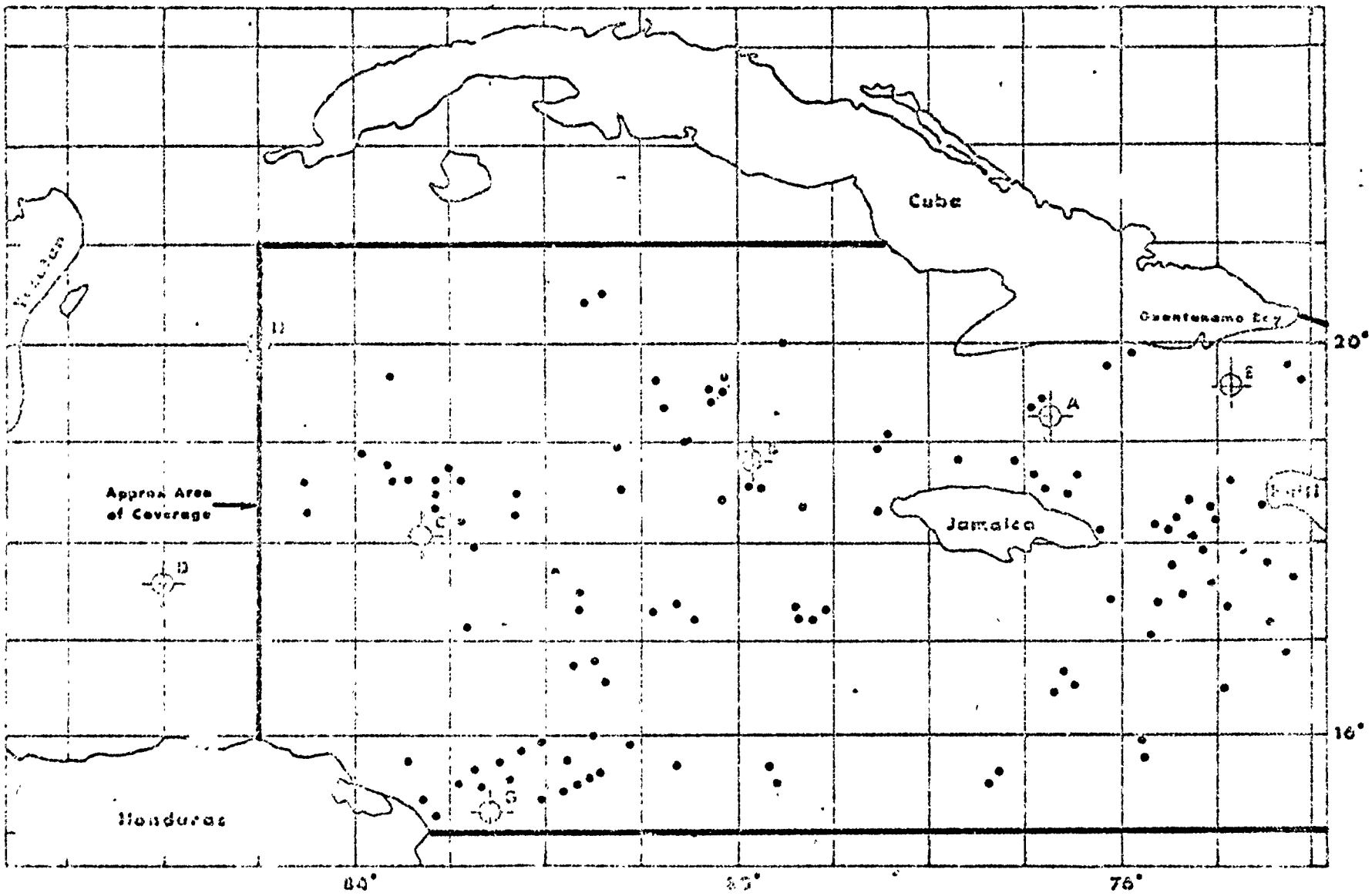

FIGURE IV -- The Approximate Positions of the Radar Contacts (•) Made by P3#5 (NRL) on 2 December 1972. No Contacts Were Made East of 74°W.

TABLE 2 - ROT CONTACTS

Plane: P3#5 (NRL)
Date: 2 December 1972

Pilot: LCDR Hutching
PI: Barrett

Contact No.	Time (Zulu)	Latitude	Longitude
1	1521	2017	8131
2	1525	2019	8123
3	1543	2000	7939
4	1507	1942	8342
5	1521	1920	8047
6	1521	1930	8055
7	1526	1900	8030
8	1530	1928	8018
9	1530	1933	8015
10	1540	1935	8010
11	1541	1932	8019
12	1549	1902	7818
13	1609	1922	7651
14	1618	1924	7647
15	1623	1946	7604
16	1642	1955	7555
17	1130	1940	7419
18	1130	1930	7413
19	1448	1819	8429
20	1448	1835	8426
21	1448	1853	8358
22	1458	1822	8302
23	1458	1829	8311
24	1502	1833	8309
25	1453	1841	8309
26	1504	1845	8342
27	1504	1841	8332
28	1504	1848	8344

TABLE 2 - ROT CONTACTS (Cont)

Plane: P3#5 (NRL)
Date: 2 December 1972

Pilot: LCDR Hutchins
PI: Barrett

Contact No.	Time (Zulu)	Latitude	Longitude
29	1503	1837	8259
30	1453	1810	8259
31	1453	1815	8217
32	1514	1829	8218
33	1525	1833	8117
34	1405	1856	8120
35	1541	1822	8017
36	1535	1838	7954
37	1540	1838	7951
38	1547	1821	7922
39	1549	1854	7824
40	1554	1815	7824
41	1332	1846	7742
42	1332	1845	7702
43	1332	1839	7658
44	1332	1832	7647
45	1332	1823	7638
46	1332	1837	7635
47	1251	1804	7619
48	1307	1809	7543
49	1211	1807	7531
50	1155	1818	7528
51	1223	1812	7532
52	1248	1801	7518
53	1211	1814	7504
54	1307	1813	7500
55	1149	1838	7452
56	1248	1824	7428

TABLE 2 - ROT CONTACTS (Cont)

Plane: P3#5 (NRL)
Date: 2 December 1972

Pilot: LCDR Hutchins
PI: Barrett

Contact No.	Time (Zulu)	Latitude	Longitude
57	1443	1706	8249
58	1455	1759	8249
59	1451	1742	8155
60	1402	1730	8142
61	1411	1721	8142
62	1348	1718	8039
63	1348	1713	8035
64	1348	1717	8053
65	1347	1723	7905
66	1347	1723	7907
67	1347	1724	7912
68	1347	1726	7916
69	1308	1729	7606
70	1155	1744	7529
71	1155	1741	7512
62	1213	1726	7536
73	1248	1729	7525
74	1307	1755	7519
75	1248	1752	7537
76	1249	1758	7450
77	12[illegible]	1745	7418
78	1252	1704	7442
79	1248	1726	7459
80	1248	1709	7432
81	[illegible]	1600	8134
82	1411	1637	8124
83	1411	1649	8131
84	1418	1645	8141

TABLE 2 - [illegible] CONTACTS (Cont)

Plane: P3#5 (NRL)
Date: 2 December 1972

Pilot: LCDR Hutchins
PI: Barrett

Contact No.	Time (Zulu)	Latitude	Longitude
85	1308	1642	7640
86	1308	16[illegible]4	7630
87	1308	1628	7640
88	1228	1641	7505
89	1228	1631	7458
90	1248	1654	7420
91	1434	1525	8323
92	1435	1518	8316
93	1435	1546	8321
94	1443	1540	8257
95	1432	1526	8204
96	1433	1531	8232
97	1418	1544	8229
98	1434	1556	8203
99	1433	1540	8242
100	1443	1538	8251
101	1443	1531	8249
102	1424	1552	8147
103	1418	1557	8107
104	14[illegible]4	1547	8137
105	1432	1546	8152
106	1433	1544	8149
107	1418	1551	8131
108	1410	1500	8032
109	1417	1538	8048
110	1404	1530	7950
111	1409	1532	7956
112	1339	1541	7718

TABLE 2 - ROT CONTACTS (Cont)

Plane: P3#5 (NRL)
Date: 2 December 1972

Pilot: LCDR Hutchins
PI: Barrett

Contact No.	Time (Zulu)	Latitude	Longitude
113	1339	1536	7720
114	1309	1559	7551
115	1312	1555	7552

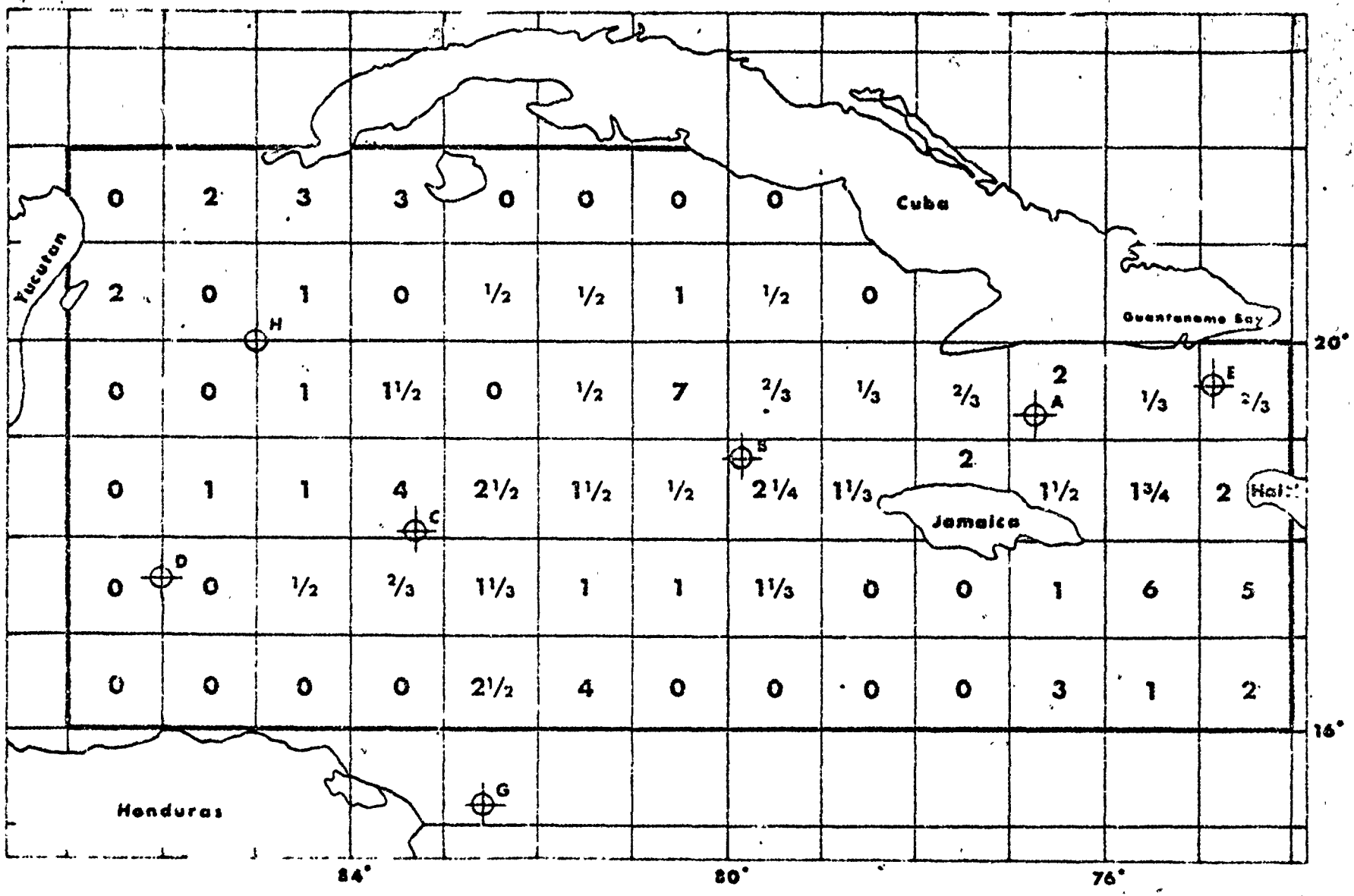

FIGURE V - The Observed Density for One Degree Squares of ROT Radar Contacts on 2 December 1972 (Average Density: 2.0 Contacts Per One Degree Square).

B. Data for 4 December 1972

TABLE 3 -- Results of RST's and VST's on 4 December 1972

Contact	Name	1700 Zulu Time Lat.	Long.	Zulu Time of Observ.	Speed	Course	Length	Comments	Plane
1		2048	8540	1604	14.3 ±1.1	203 ± 3			P3#1
2		2021	8547	1544	14.5 ±1	149 ± 3			P3#1
3	Maru Pilend	1952	8350	1556	14.6 ±6.6	141 ± 5	613	Merch	P3#1
4	Honk Ksam Maru Kobe	1907	8342	1659	15.0 ±1.6	324 ± 4	650	Merch	P3#1
5		2027	8520	1527	8.5 ± 1	021 ± 5			P3#1
6		2051	8521	1609	19.8 ±2.4	162 ± 5		U.S. DE	P3#1
7		2024	8625	1420	18.4 ±3.7	233 ± 8		Only two observations	P3#1
8		1925	8559	1647	10	190		GP4	P3#2
9		1551	8456	2016	15	360		GP2	P3#2
10		1547	8339	2031	15	350		GP2	P3#2
11	Indus	1926	8108	1342	13	315	271	GP4	P3#3
12		1931	8122	1343	14	300	100	Tug	P3#3
13		1931	8034	1350	9	110	250	GP4	P3#3
14	Baume	1943	8035	1355	13.5	120	657	GP4	P3#3
15	Phoeleadrs	2003	7945	1407	16	100	579	GP4	P3#3
16	αωλΝα	1920	7925	1426	9	295	500	GP4	P3#3

TABLE 3 -- Results of RST's and VST's on 4 December 1972 (Cont)

Contact	Name	1700 Zulu Time Lat.	Long.	Zulu Time of Observ.	Speed	Course	Length	Comments	Plane
17	Pierce	1837	7931	1549	0			GP4	P3#3
18	Monica	1831	7619	1321	9.5 ±3.4	144 ± 14	275	FTR	P3#5
19	El Salvador	1853	7655	1436	11.7 ±1.1	073 ± 4	358		P3#5
20		1944	7729	1318	12.0 ±1.5	290 ± 5			P3#5
21		1912	7716	1409	20	062	36	Cabin Cruiser	P3#5
22*		1937	7525	1430	22			Destroyer	P3#5
23*		1937	7525	1430	10				P3#5

*It is believed that these are two destroyers maneuvering within 13 n.m. of this position. Only Contact 22 was sighted and no straight tracks could be obtained from the RST.

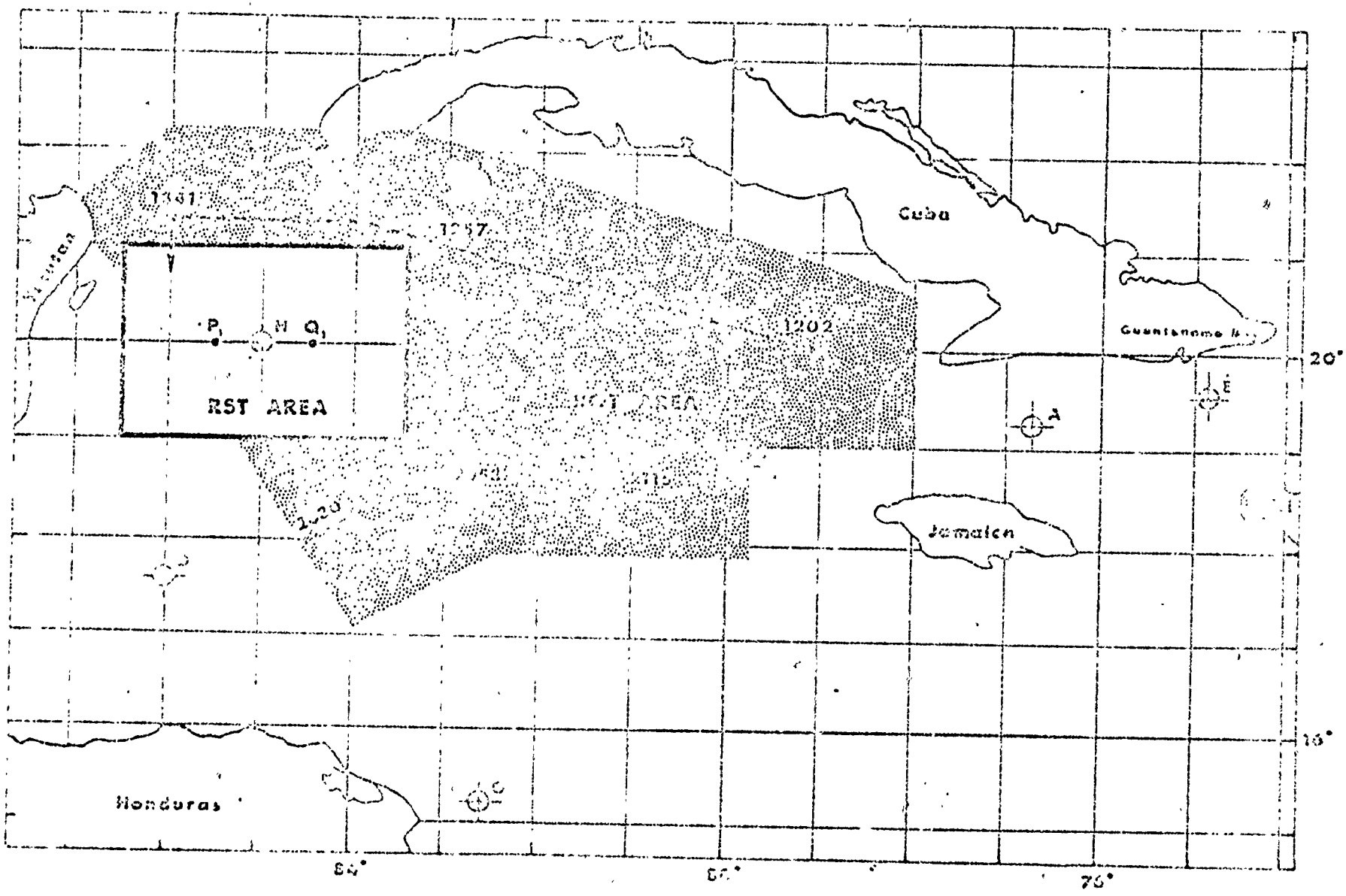

FIGURE VI -- The Approximate Flight Path and RST and ROT Coverage for P3#1 (VP-16) on 4 December 1972. The Greenwich Mean Times (Zulu) for Key Positions are Given.

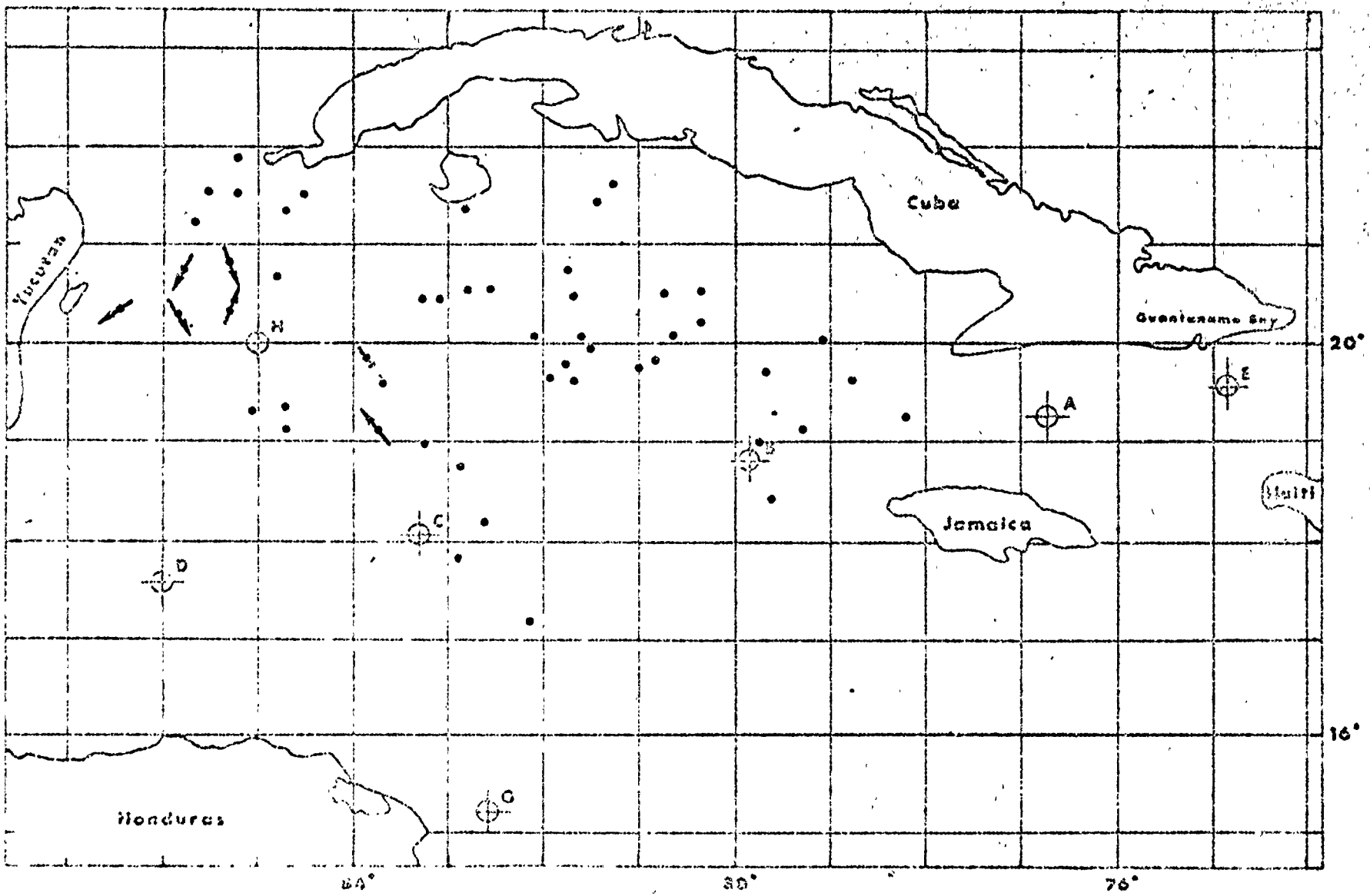

FIGURE VII -- The Approximate Positions of the Rot (•) and RST (—•—1500 Greenwich Mean Time) Contacts Made by P3#1 (VP-16) on 4 December 1972.

TABLE 4 - ROT CONTACTS

Plane: 23#1 (VP-16)
Date: 4 December 1972

Pilot: Brockley
PI: J.I. Bowen

Contact No.	Time (Zulu)	Latitude	Longitude
1	1308	2138	8508
2	1308	2119	8532
3	1308	2139	8526
4	1308	2159	8513
5	1309	2121	8443
6	1308	2132	8439
7	1255	2125	8258
8	1235	2125	8115
9	1235	2124	8133
10	1308	2045	8452
11	1256	2036	8314
12	1252	2031	8305
13	2052	2035	8244
14	2052	2034	8228
15	1235	2004	8210
16	1235	2041	8143
17	2052	2030	8138
18	2359	2001	8039
19	1218	2005	8020
20	1218	2021	8016
21	1218	2020	8041
22	2059	2000	7902
23	2030	1923	8504
24	2030	1920	8441
25	2030	1929	8444
26	2052	1936	8338
27	2052	1900	8312
28	2052	1948	8142

TABLE 4 - ROT CONTACTS (Cont)

Plane: P3#1 (VP-16)
Date: 4 December 1972

Pilot: Brockley
PI: J.I. Bowen

Contact No.	Time (Zulu)	Latitude	Longitude
29	2052	1950	8158
30	1234	1950	8141
31	1232	1958	8130
32	1230	1949	8100
33	1230	1952	8055
34	2059	1942	7928
35	2059	1909	7921
36	2059	1913	7843
37	2059	1921	7818
38	2030	1850	8258
39	2030	1808	8239
40	2059	1859	7944
41	2059	1832	7939
42	2030	1756	8255
43	2052	1713	8204

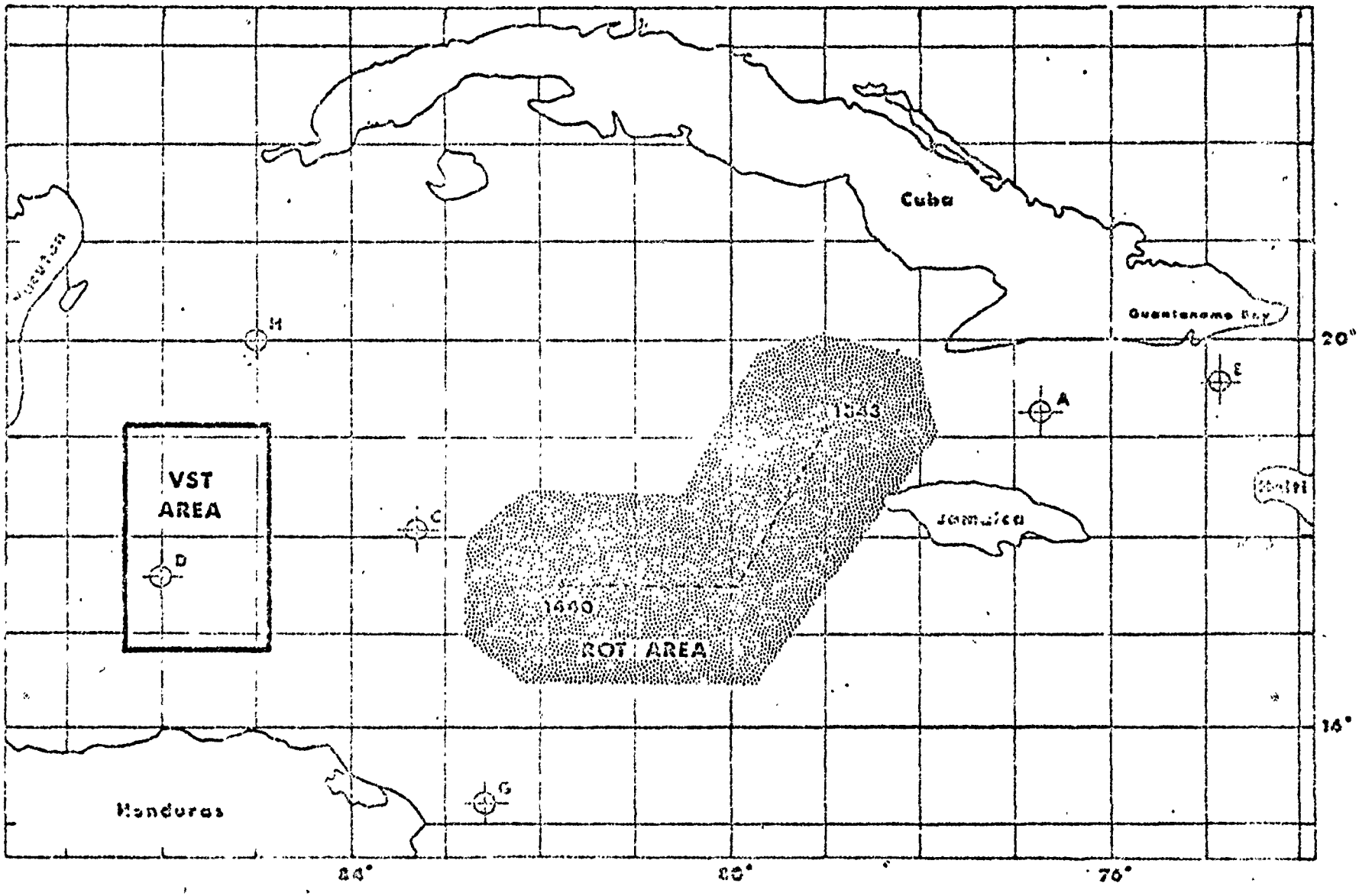

FIGURE VIII -- The Approximate Flight Path and VST and RST Coverage for P3#2 (VP-16) on 4 December 1972. The Greenwich Mean Times for Key Positions are Given.

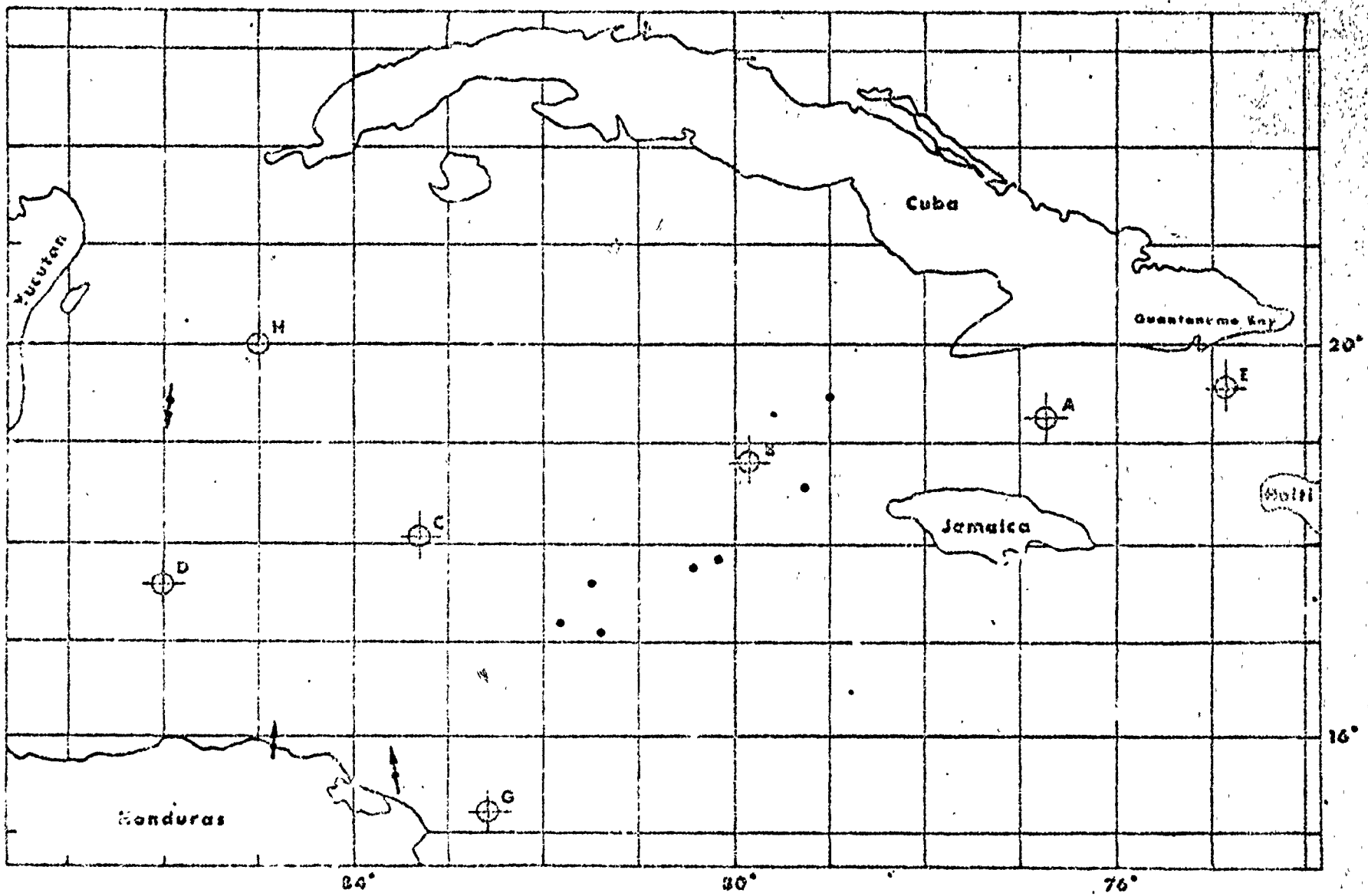

FIGURE IX — The Approximate Positions of the ROT (•) and VST (←•→ 1500 Greenwich Mean Time) Contacts Made by P3#2 (VP-16) on 4 December 1972.

TABLE 5 - ROT CONTACTS

Plane: P3#2 (VP-16)
Date: 4 December 1972

Pilot: Harvey
PI: Lackie

Contact No.	Time (Zulu)	Latitude	Longitude
1	1343	1927	7900
2	1348	1837	7921
3	1429	1706	8126
4	1430	1737	8129
5	1440	1717	8152
6	1405	1753	8005
7	1407	1748	8024

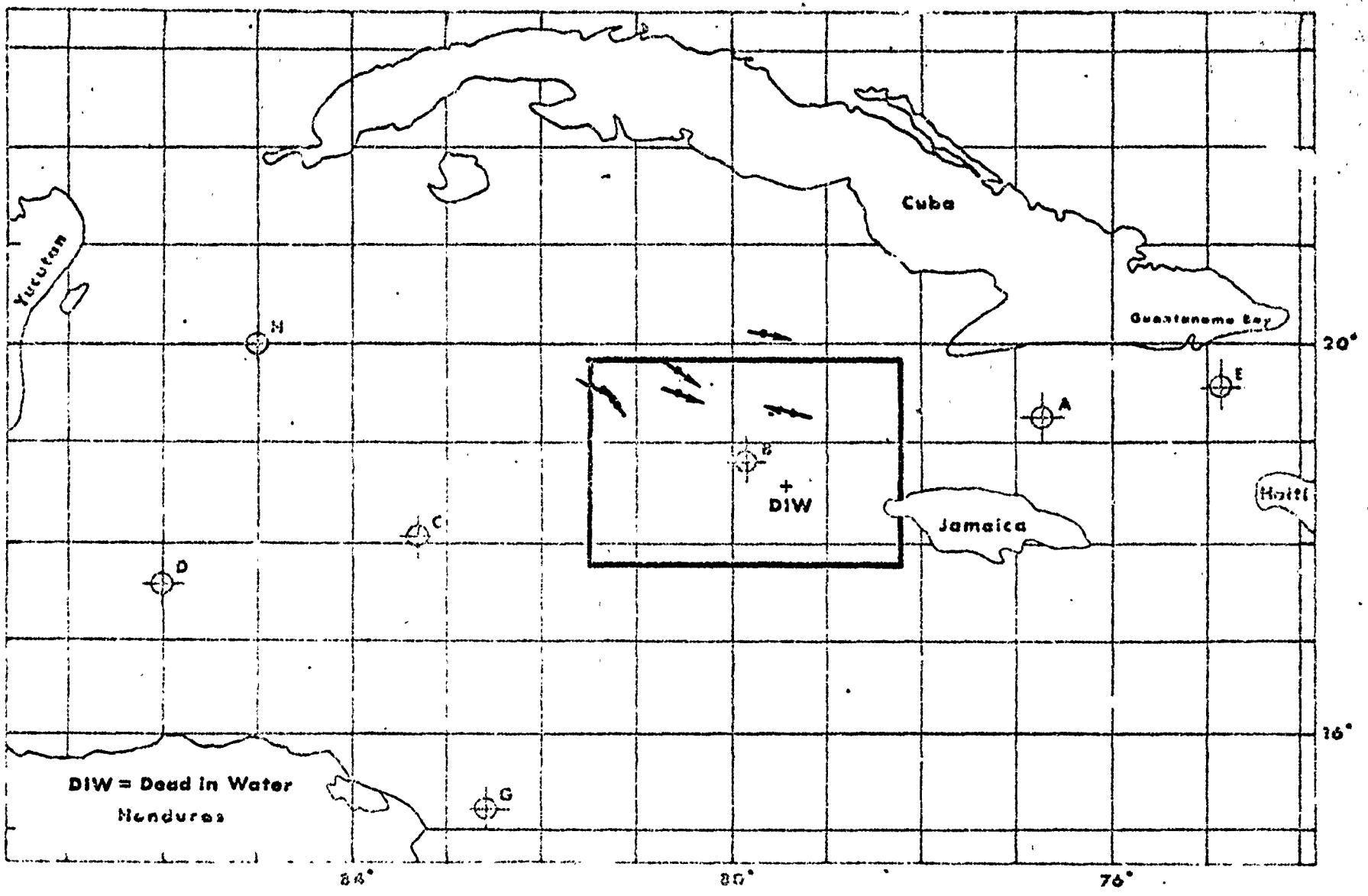

FIGURE X -- The Approximate VST Area and VST Contact Positions Dead Reckoned to 1500 Greenwich Mean Time for P3#3 (VP-16) on 4 December 1972.

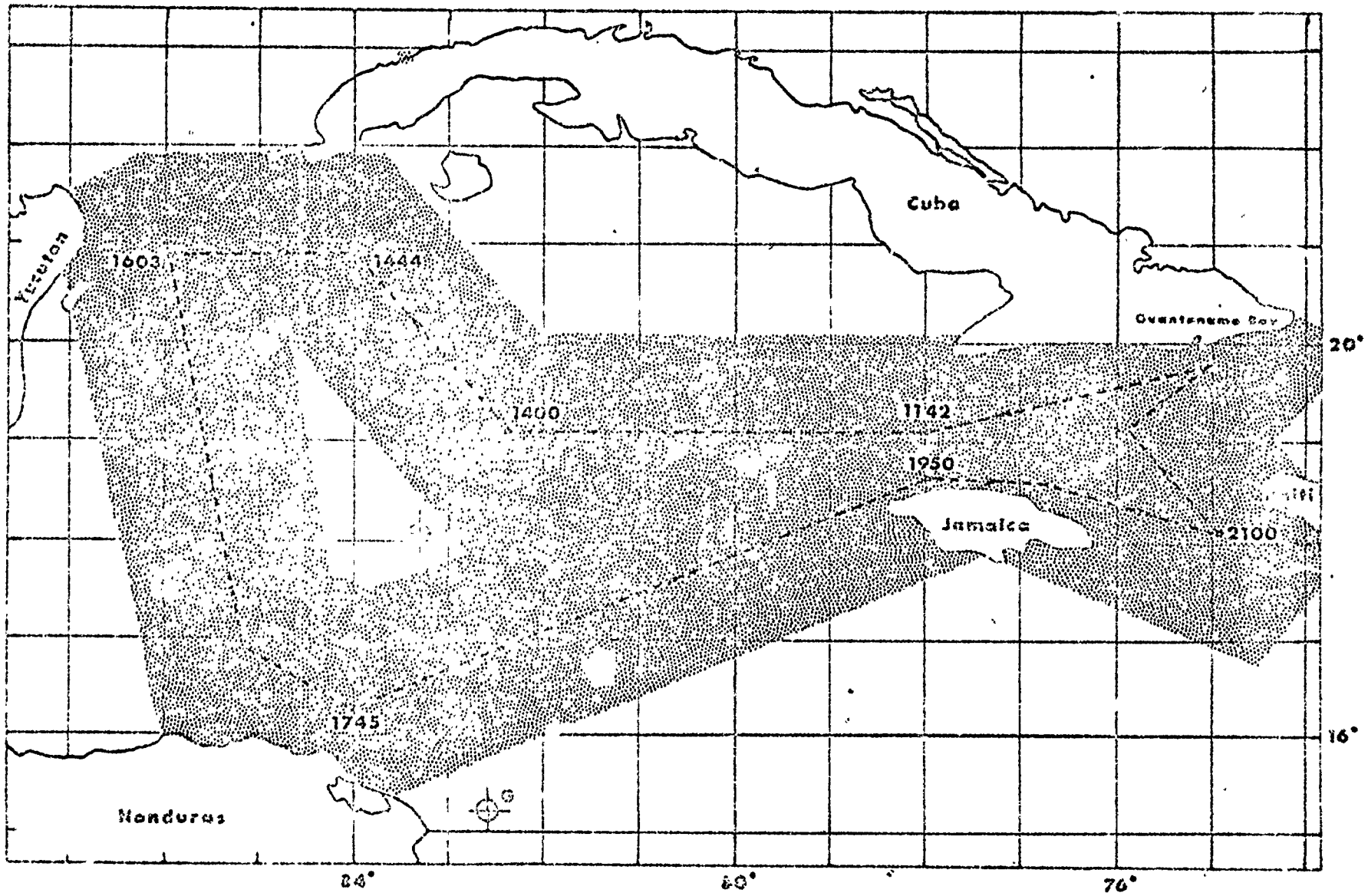

FIGURE XI -- The Approximate Flight Path and ROT Coverage Area for P3#4 (VXN 8) on 4 December 1972. The Greenwich Mean Time for Key Positions are Given.

Reproduced from best available copy.

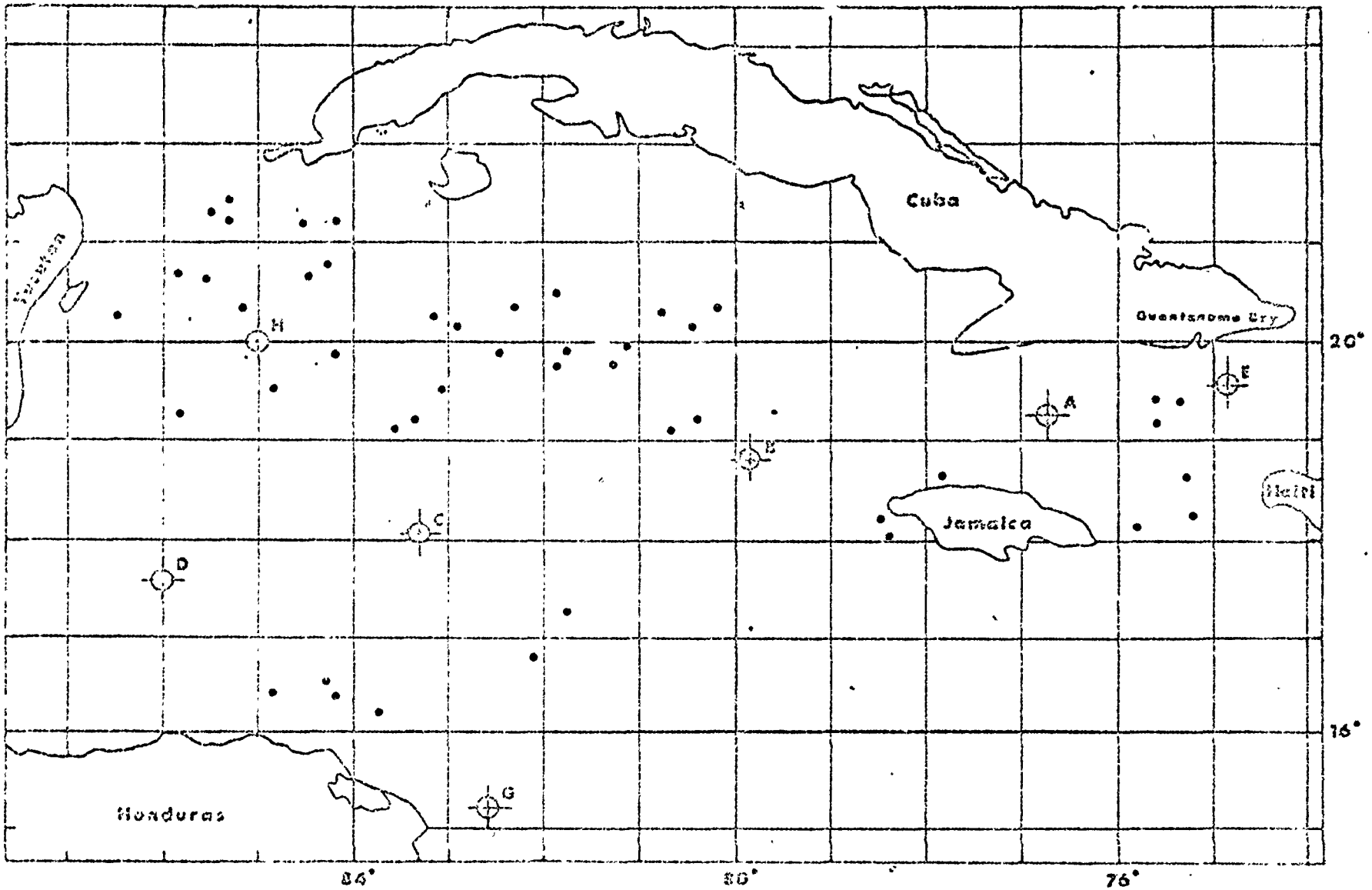

FIGURE XII -- The Approximate Positions of the Radar Contacts for P3#4 (VXN 8) on 4 December 1972.

TABLE 6 - ROT CONTACTS

Plane: P3#4 (VXN 8)
Date: 4 December 1972

Pilot: Lt. Lamb
PI: R. Beckner

Contact No.	Time (Zulu)	Latitude	Longitude
1	1516	2116	8524
2	1516	2127	8515
3	1517	2117	8519
4	1428	2112	8432
5	1448	2121	8406
6	1615	2014	8630
7	1517	2034	8533
8	1517	2020	8509
9	1617	2039	8554
10	1413	2044	8437
11	1413	2051	8427
12	1405	2015	8305
13	1405	2013	8257
14	1254	2023	8221
15	1254	2032	8154
16	1241	2013	8048
17	1241	2017	8026
18	1241	2006	8027
19	1628	1911	8557
20	1413	1924	8454
21	1413	1950	8409
22	1413	1904	8328
23	1412	1906	8320
24	1303	1930	8301
25	1256	1955	8228
26	1240	1945	8152
27	1254	1958	8148
28	1240	1949	8113

TABLE 6 - ROT CONTACTS (Cont)

Plane: P3#4 (AXN 8)
Date: 4 December 1972

Pilot: Lt. Lamb
PI: R. Beckner

Contact No.	Time (Zulu)	Latitude	Longitude
29	1241	1957	8112
30	1225	1907	8026
31	1225	1900	8038
32	2137	1921	7542
33	2137	1923	7533
34	2137	1912	7538
35	1959	1803	7822
36	1935	1810	7825
37	1947	1839	7753
38	2039	1837	7516
39	2050	1817	7512
40	2109	1808	7550
41	1854	1712	8150
42	1736	1628	8435
43	1737	1637	8411
44	1810	1620	8407
45	1747	1613	8340
46	1848	1649	8206

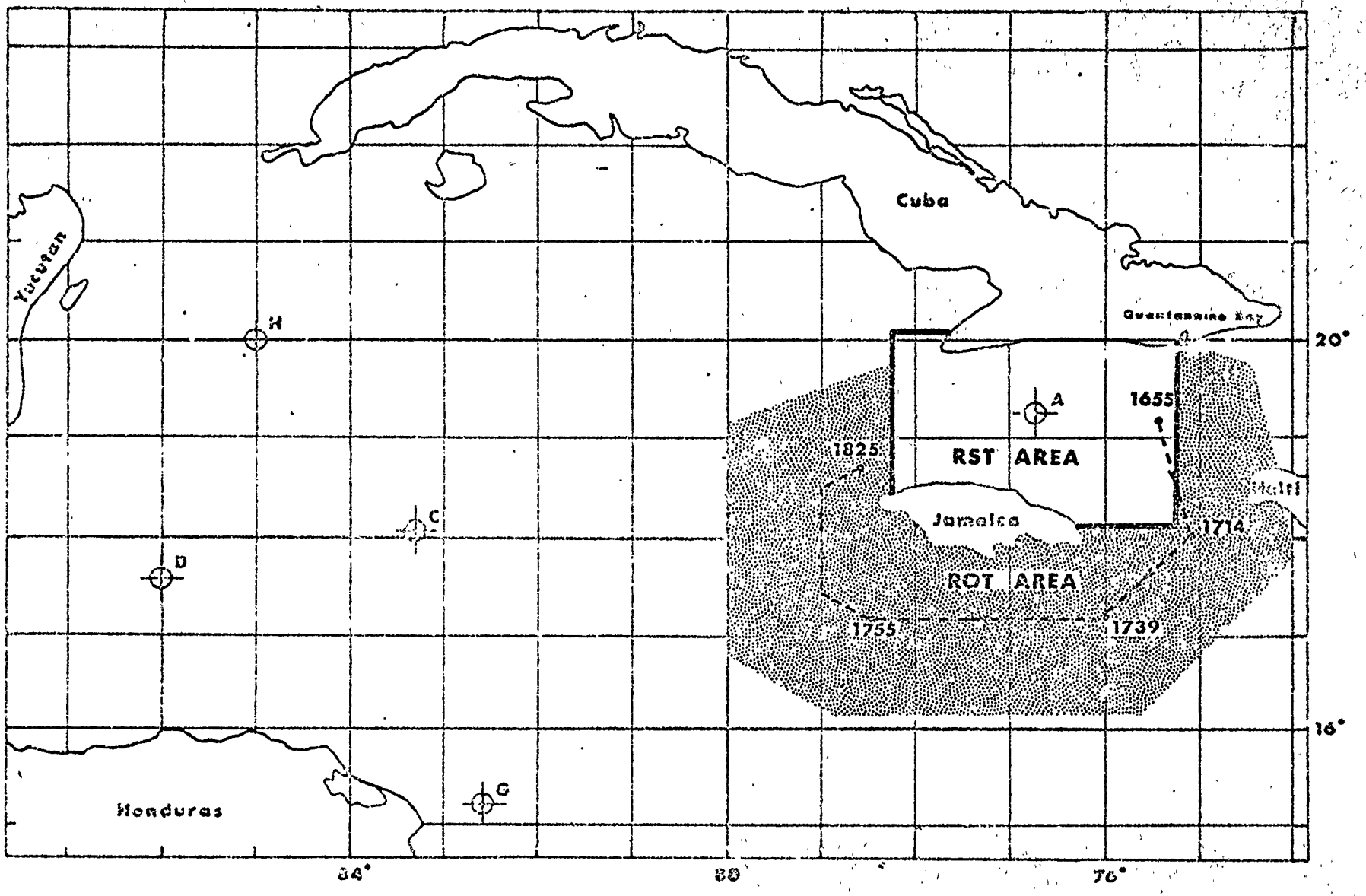

FIGURE XIII -- The Approximate Flight Path and RST and ROT Coverage for P3#5 (NRL) on 4 December 1971. The Greenwich Mean Times for Key Positions are Given.

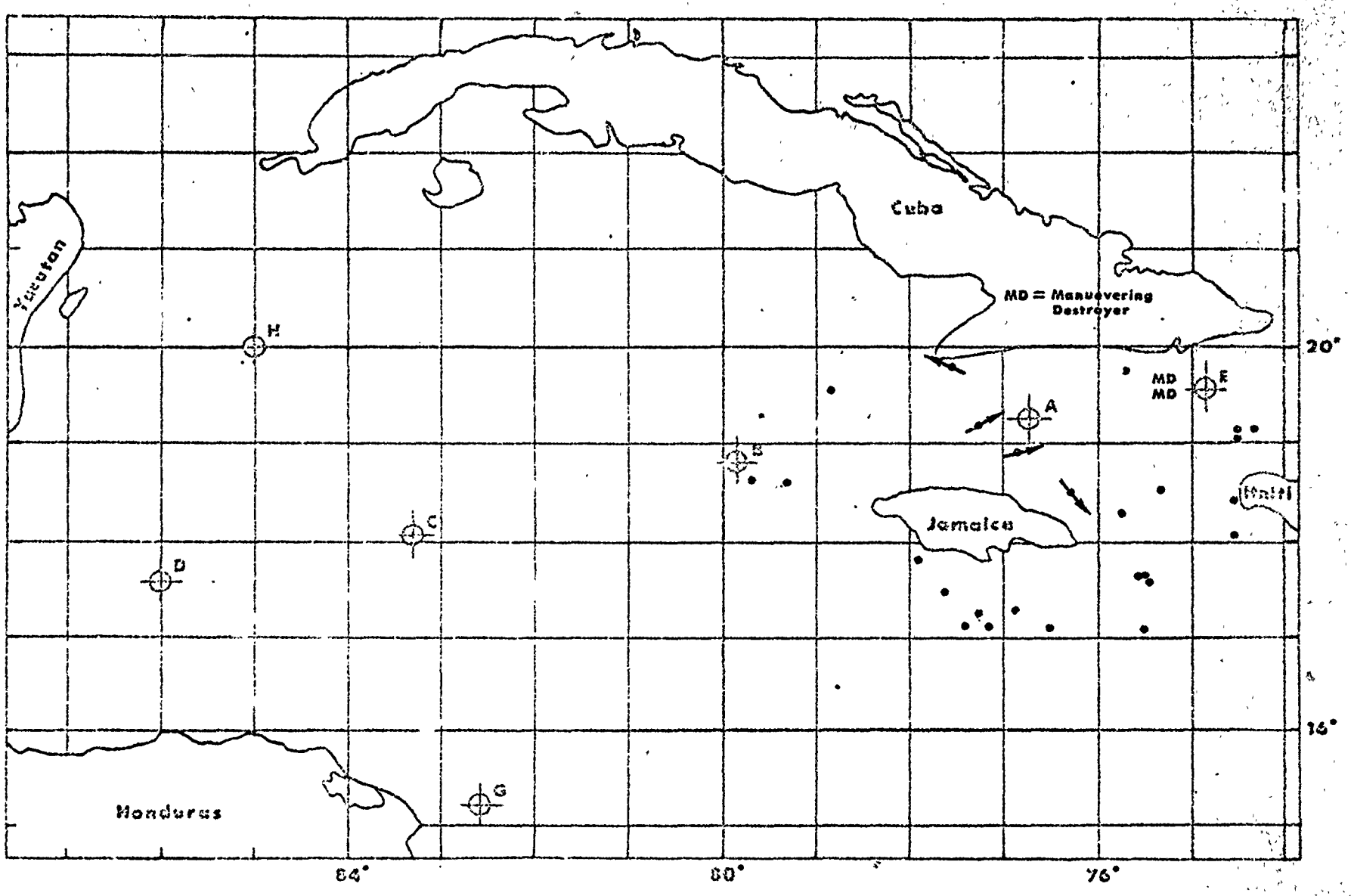

FIGURE XIV -- The Approximate Positions of ROT (•) and RST (—•— 1500 Greenwich Mean Time) Contacts Made by P3V5 (NRL) on 4 December 1972.

TABLE 7 - ROT CONTACTS

Plane: P3#5 (NRL)
Date: 4 December 1972

Pilot: Hutchin
PI: E. Sander

Contact No.	Time (Zulu)	Latitude	Longitude
1	1819	1927	7855
2	1655	1947	7534
3	1706	1907	7429
4	1706	1906	7415
5	1706	1901	7423
6	1816	1845	7915
7	1816	1847	7936
8	1655	1825	7514
9	1655	1814	7552
10	1706	1803	7435
11	1714	1816	7431
12	1755	1759	7757
13	1748	1729	7737
14	1739	1717	7713
15	1739	1715	7716
16	1739	1708	7703
17	1739	1716	7651
18	1732	1703	7628
19	1714	1739	7534
20	1714	1738	7532
21	1714	1736	7533
22	1723	1707	7534

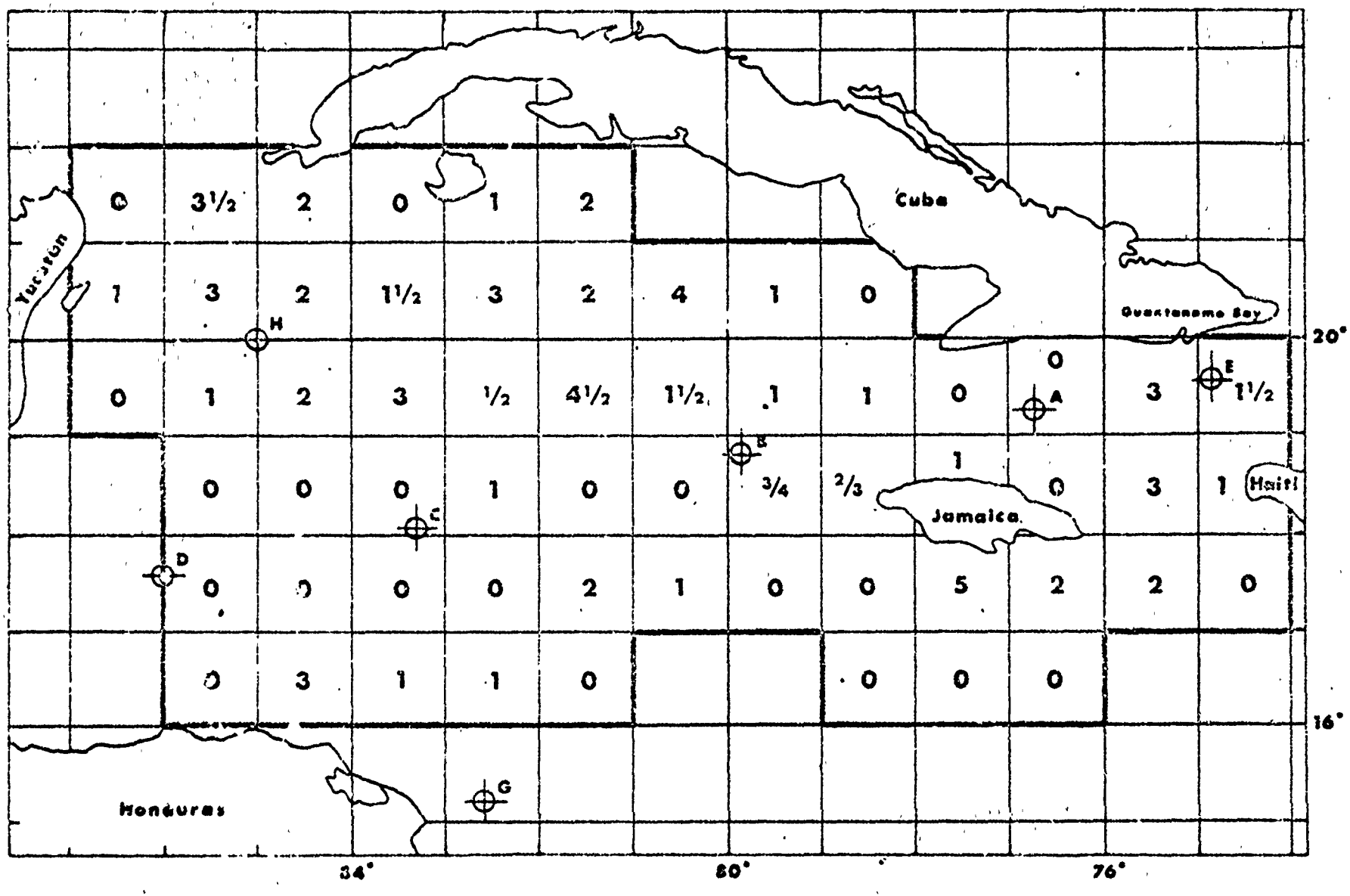

FIGURE XV -- The Observed Density for One Degree Squares of ROT Radar Contacts on 4 December 1972 (Average Density: 1.2 Contacts Per One Degree Square).

C. Data for 5 December 1972

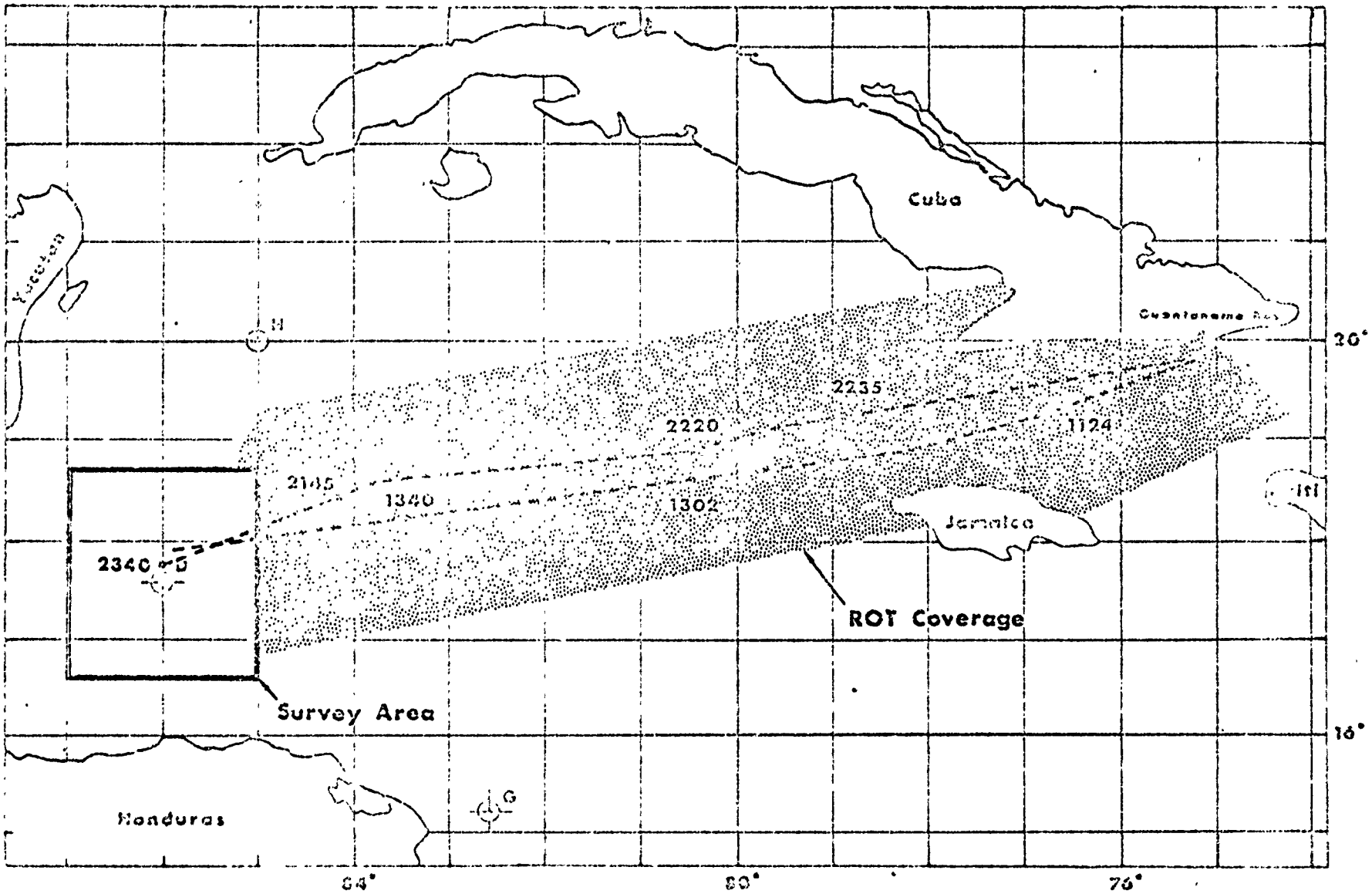

FIGURE XVI -- The Approximate Flight Path ROT Coverage and Survey Area for P3#4 (VXN 8) on 5 December 1972. The Greenwich Mean Times for Key Positions are Given.

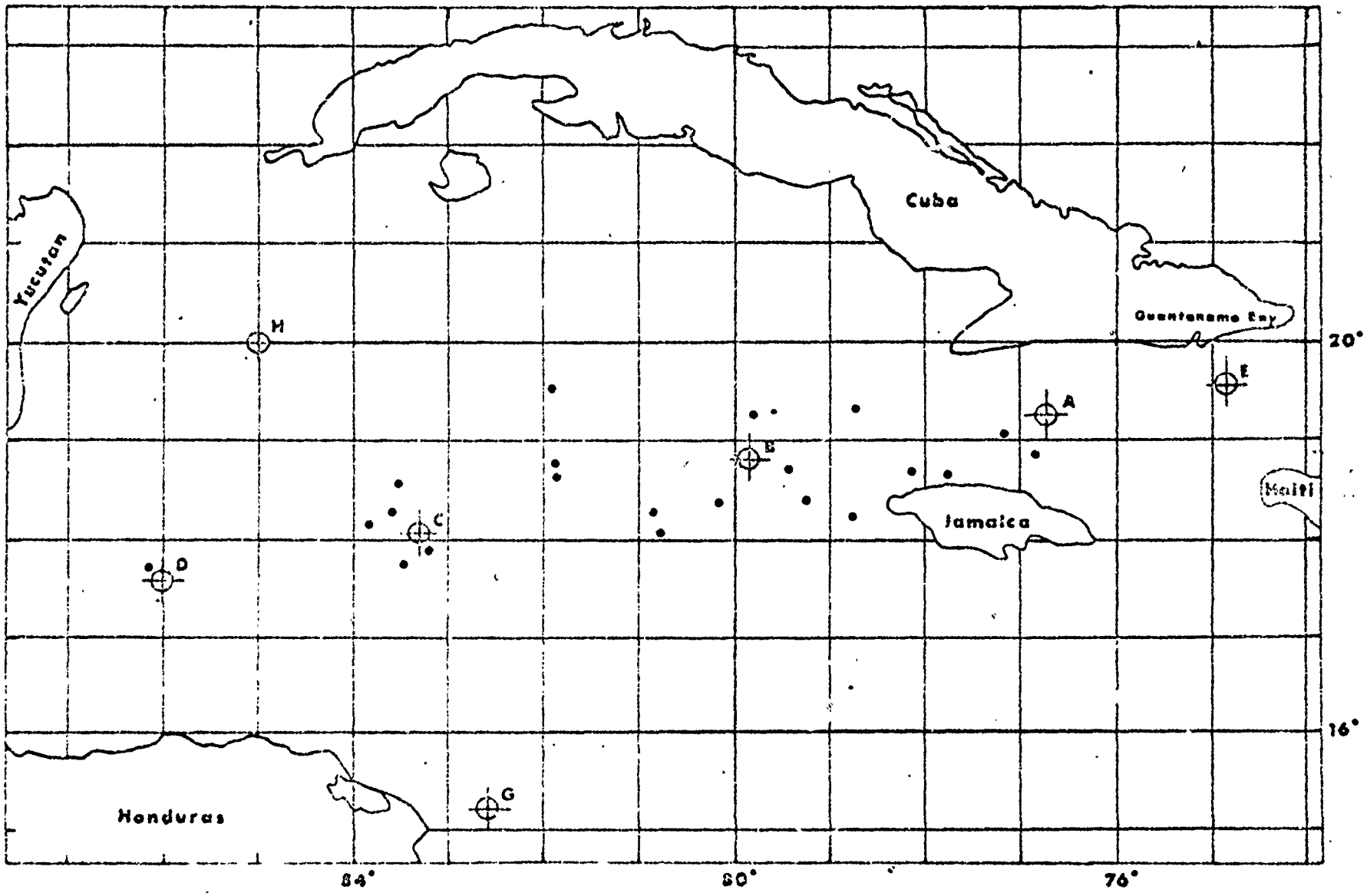

FIGURE XVII — The Approximate Positions of the Radar Contacts (•) Made by P3#4 (VXN 8) on 5 December 1972.

TABLE 8 - ROT CONTACTS

Plane: P3#4 (VXN 8)
Date: 5 December 1972

Pilot: Lt. Lamb
PI: R. Beckner

Contact No.	Time (Zulu)	Latitude	Longitude
1	2200	1928	8159
2	2220	1909	7945
3	1206	1919	7840
4	1124	1905	7718
5	1340	1803	8342
6	2145	1823	8333
7	2145	1821	8334
8	2145	1807	8314
9	2200	1845	8152
10	2211	1822	8058
11	1302	1811	8055
12	1323	1829	8008
13	1211	1846	7923
14	1210	1831	7917
15	1207	1816	7841
16	2233	1839	7807
17	2235	1826	7747
18	1137	1854	7610
19*	1940*	1751*	8617*
20	2145	1754	8314
21	2150	1744	8320

*A fishing boat.

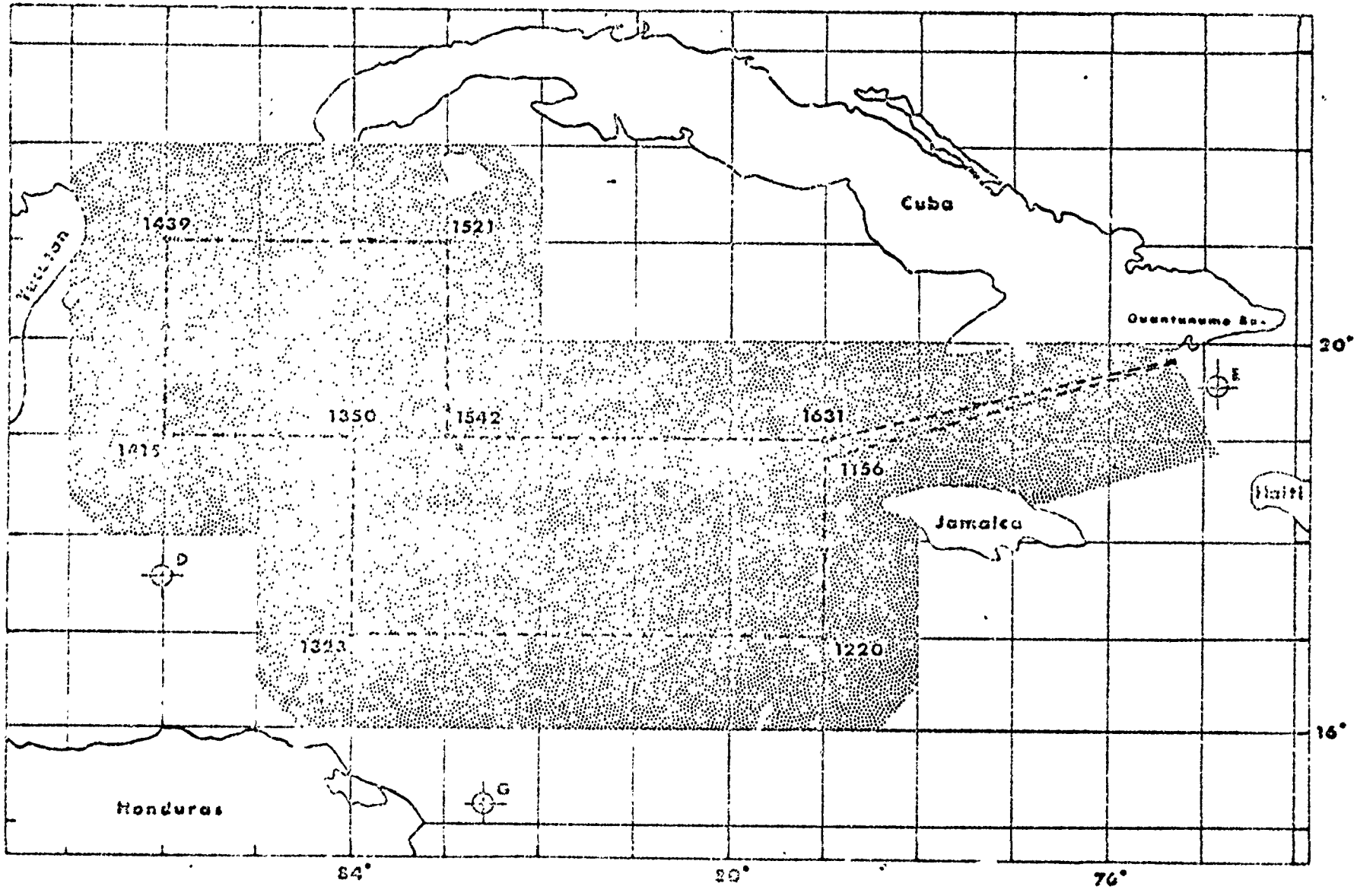

FIGURE XVIII -- The Approximate Flight Path and ROT Coverage for P3#5 (NRL) on 5 December 1972. The Greenwich Mean Times for Key Positions are Given.

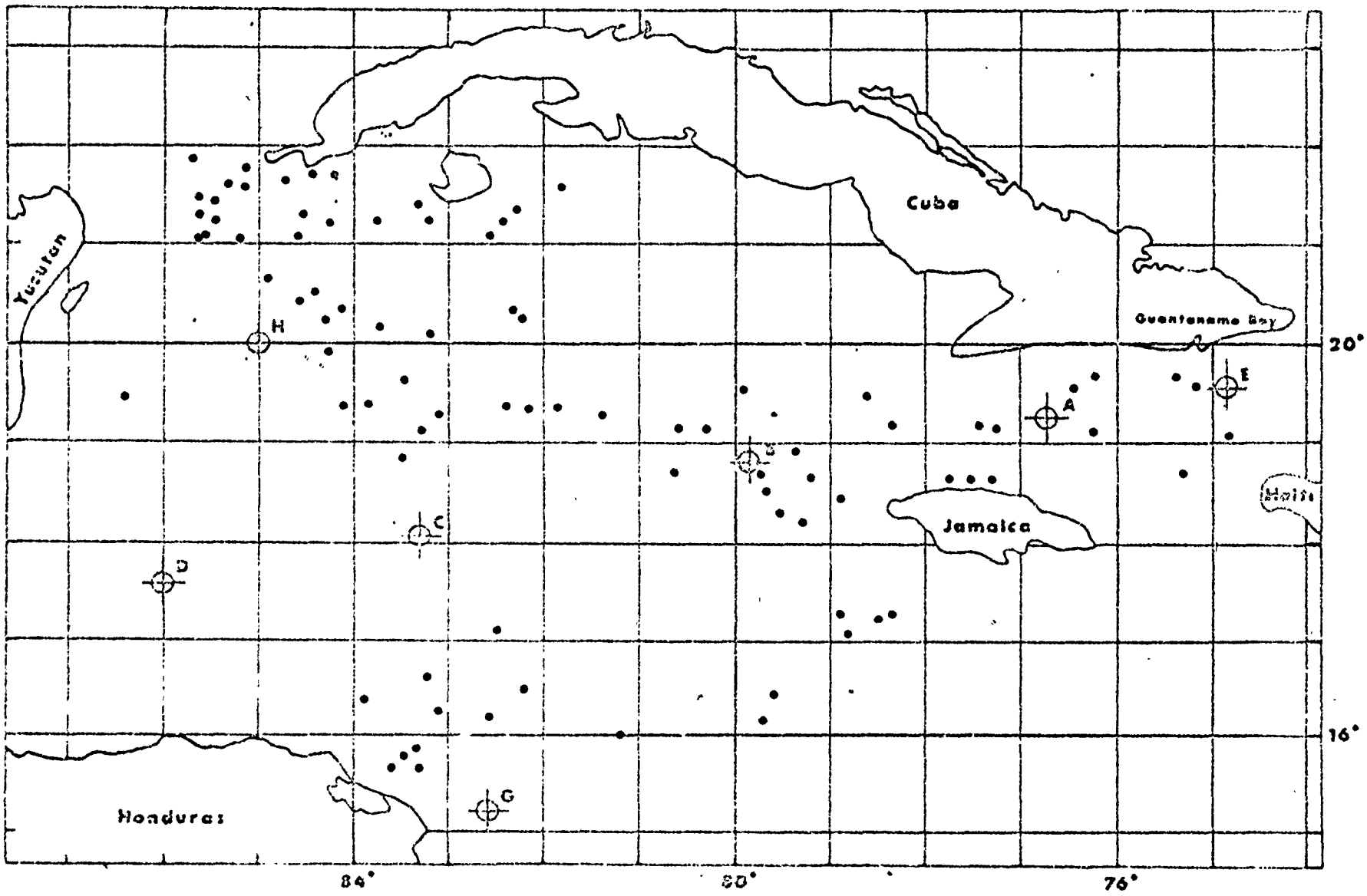

FIGURE XIX -- The Approximate Locations of the ROT Contacts Made by P3#5 (NRL) on 5 December 1972.

TABLE 9 - ROT CONTACTS

Plane: P3#5 (NRL)
Date: 5 December 1972

Pilot: Hutchins
PI: E. Sander

Contact No.	Time (Zulu)	Latitude	Longitude
1	1424	2126	8528
2	1424	2112	8527
3	1424	2102	8508
4	1433	2153	8535
5	1433	2135	8508
6	1433	2126	8533
7	1433	2115	8535
8	1444	2103	8535
9	1444	2103	8535
10	1450	2142	8509
11	1433	2135	8518
12	1433	2138	8444
13	1439	2119	8431
14	1439	2117	8423
15	1439	2104	8437
16	1452	2124	8426
17	1501	2141	8410
18	1501	2113	8351
19	1501	2110	8314
20	1510	2118	8320
21	1521	2113	8233
22	1521	2116	8230
23	1521	2119	8228
24	1521	2131	8157
25	1500	2047	8457
26	1424	2035	8433
27	1452	2039	8425
28	1350	2016	8413

TABLE 9 - ROT CONTACTS (Cont)

Plane: P3#5 (NRL)
Date: 5 December 1972

Pilot: Hutchins
PI: E. Sander

Contact No.	Time (Zulu)	Latitude	Longitude
29	1350	2028	8404
30	1350	2007	8350
31	1350	2002	8317
32	1521	2018	8229
33	1521	2010	8223
34	1408	1924	8624
35	1341	1926	8408
36	1350	1958	8412
37	1341	1929	8351
38	1341	1941	8337
39	1341	1920	8304
40	1341	1906	8320
41	1530	1929	8220
42	1530	1927	8212
43	1548	1926	8159
44	1548	1917	8130
45	1557	1902	8132
46	1611	1906	8042
47	1611	1905	8023
48	1612	1935	7959
49	1147	1927	7844
50	1138	1909	7815
51	1128	1907	7723
52	1128	1905	7710
53	1119	1937	7615
54	1119	1936	7617
55	1123	1905	7613
56	1706	1941	7519

TABLE 9 - ROT CONTACTS (Cont)

Plane: P3#5 (NRL)
Date: 5 December 1972

Pilot: Hutchins
PI: E. Sander

Contact No.	Time (Zulu)	Latitude	Longitude
57	1706	1937	7505
58	1706	1946	7454
59	1530	1856	8326
60	1606	1850	8037
61	1619	1853	7954
62	1619	1847	7943
63	1147	1859	7925
64	1147	1842	7916
65	1156	1817	7930
66	1156	1831	7937
67	1156	1846	7948
68	1147	1826	7855
69	1646	1840	7751
70	1646	1837	7734
71	1655	1837	7729
72	1706	1847	7524
73	1257	1703	8229
74	1205	1718	7859
75	1205	1705	7850
76	1205	1715	7838
77	1205	1719	7831
78	1315	1639	8359
79	1306	1642	8314
80	1308	1620	8310
81	1248	1636	8205
82	1257	1619	8235
83	1238	1601	8106
84	1215	1632	7940

TABLE 9 - ROT CONTACTS (Cont)

Plane: P3#5 (NRL)
Date: 5 December 1972

Pilot: Hutchins
PI: E. Sander

Contact No.	Time (Zulu)	Latitude	Longitude
85	1220	1611	7944
86	1315	1554	8334
87	1315	1552	8328
88	1315	1557	8330
89	1315	1559	8329

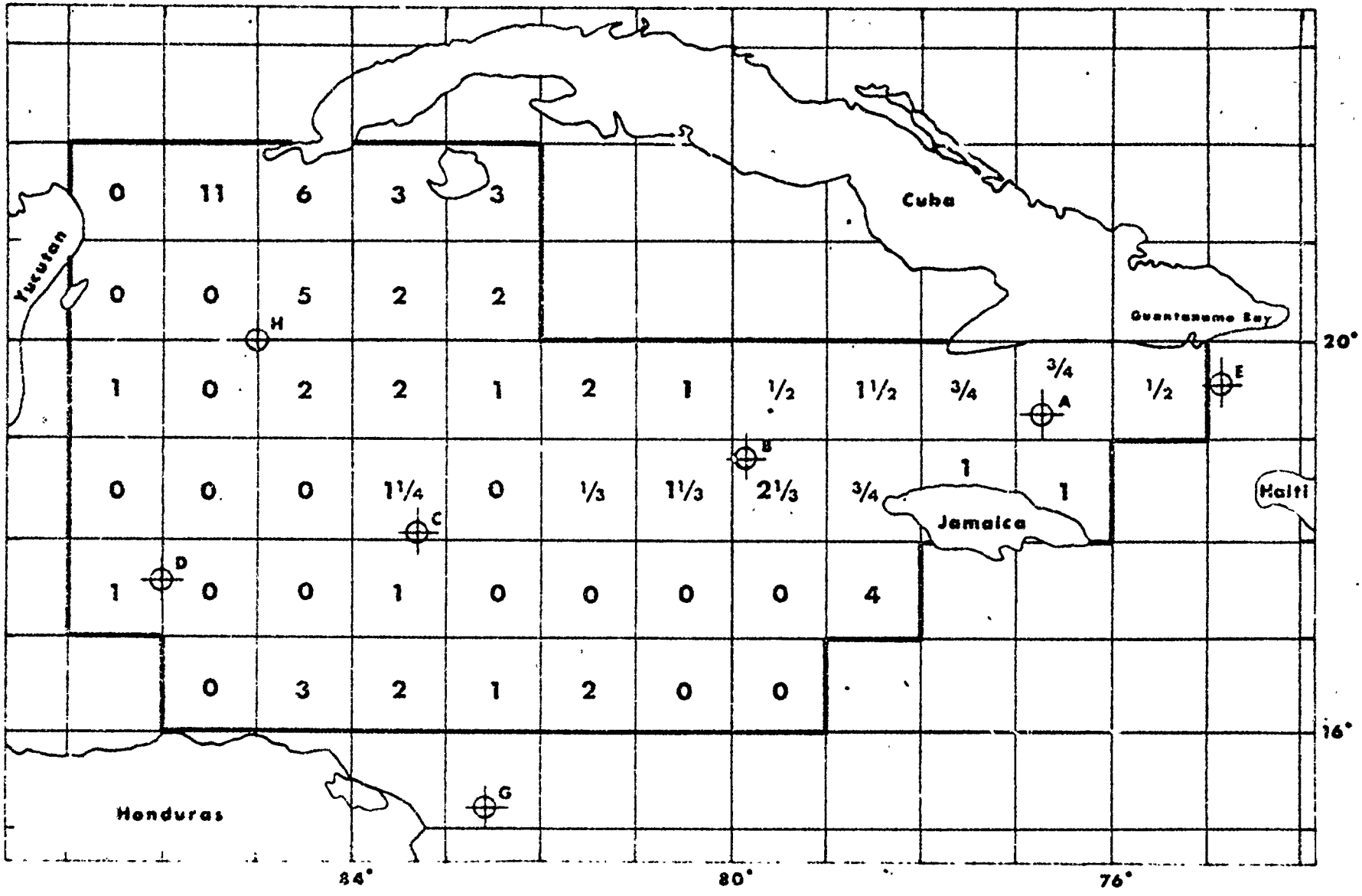

FIGURE XX -- The Observed Density for One Degree Squares of ROT Radar Contacts on 5 December 1972 (Average Density: 1.4 Contacts Per One Degree Square).

D. Data for 6 December 1972

TABLE 10 -- Results of RST's and VST's on 6 December 1972

Contact	Name	1700 Zulu Time Lat.	Long.	Zulu Time of Observ.	Speed	Course	Length	Comments	Plane
1		2000	8419	1614	8	340		Fishing boat	P3#1
2	Inagua Beach	2048	8352	1645	12	350	268	East India Line	P3#1
3		2052	8449	1702	8	350		Tug Pulling Barge	P3#1
4		2059	8622	1756	11	190	200	Container Ship	P3#1
5	Sentinel	2004	8239	1910	12-3/4	330	636	Liberian, GP2	P3#1
6	Texas Trader	2016	8318	1915	14-1/2	120	633		P3#1
7	John D.W. Goff	1747	8610	1519	9	020	300	GP3	P3#2
8	Sands	1825	8121	1629	5	245		209	P3#3
9	North Seal	1849	3109	1636	10	353			P3#3
10	Pierce	1837	7912	1839	0	330			P3#3
11	Clerk-Maxwell	1823	8000	1910	16	110	462	London	P3#3
12		1813	7818	1856	16	305	112	Tug	P3#3
13		949	7732	1346	17.8 ±1.6	270±4°			P3#5
14	Francis Marian	1830	7722	1421	19.9 ±3.8	275±11°	564	AKA 249	P3#5
15	Wanna Beach	1930	7548	1321	11.1 ±1.2	070±6°	174	West Indian Line Ferry	P3#5

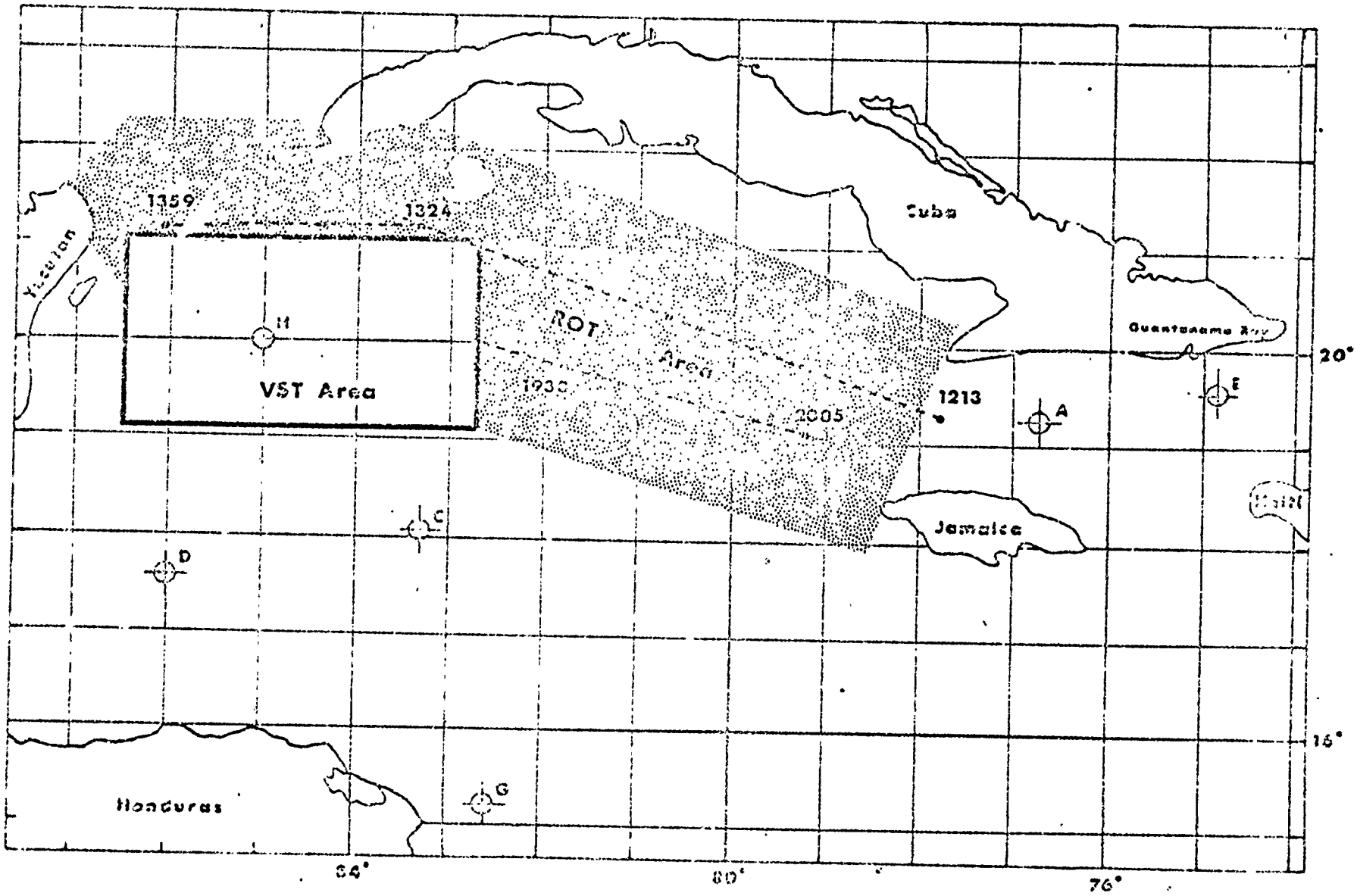

FIGURE XXI -- The Approximate Flight Path and RST and ROT Coverage for P3#1 (VP-16) on 6 December 1972. The Greenwich Mean Times for Key Positions are Given.

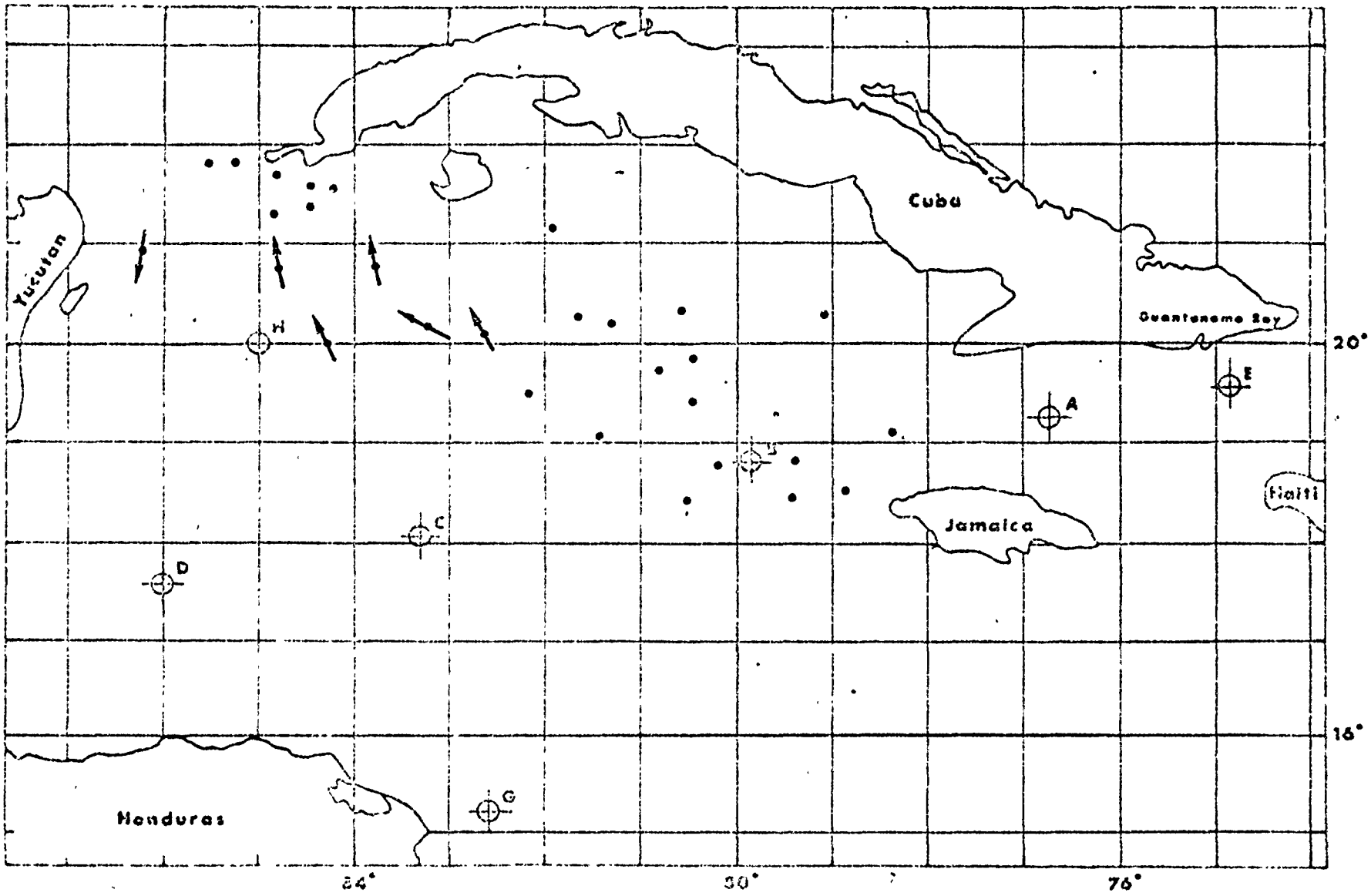

FIGURE XXII -- The Approximate Positions for the ROT Contacts (•) and VST Contacts (←•→1700 Greenwich Mean Time) for P3#1 on 6 December 1972.

TABLE 11 - ROT CONTACTS

Plane: P3#1 (VP 16)
Date: 6 December 1972

Pilot: Brockley
PI: J.I. Bowen

Contact No.	Time (Zulu)	Latitude	Longitude
1	1348	2155	8525
2	1348	2155	8512
3	1325	2148	8452
4	1325	2143	8431
5	1325	2142	8431
6	1325	2135	8435
7	1325	2124	8450
8	1255	2102	8159
9	1255	2012	8133
10	1932	2011	8112
11	1932	2023	8030
12	1235	2026	7905
13	1255	1933	8204
14	1932	1900	8115
15	1235	1946	8038
16	1235	1946	8048
17	2008	1903	7821
18	1953	1840	8023
19	1235	1853	8004
20	1958	1853	7927
21	1958	1835	7921
22	2008	1843	7859

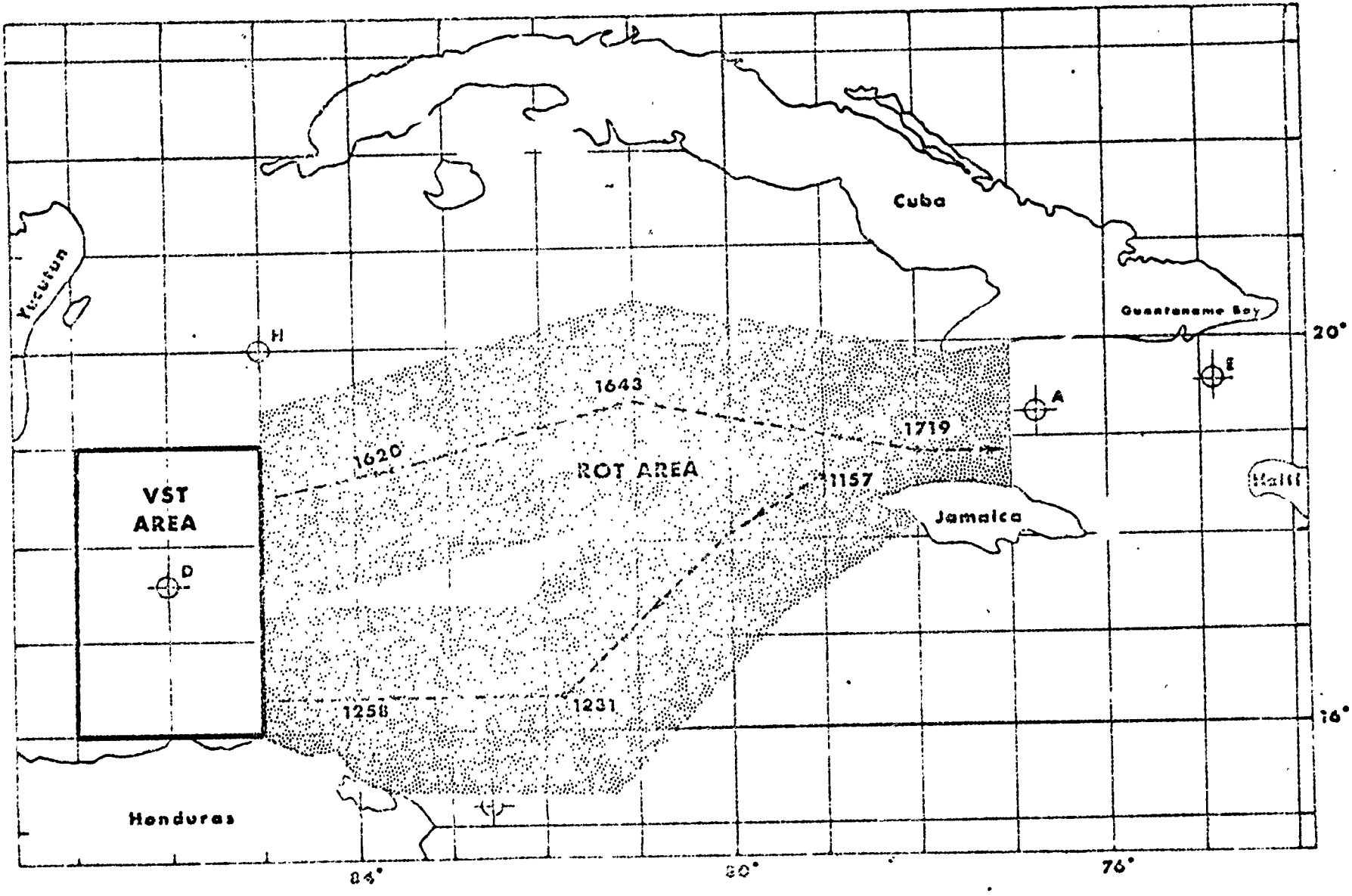

FIGURE XXIII -- The Approximate Flight Path and VST and ROT Coverage Areas for P3#2 on 6 December 1972. The Greenwich Mean Times for Key Positions are Given.

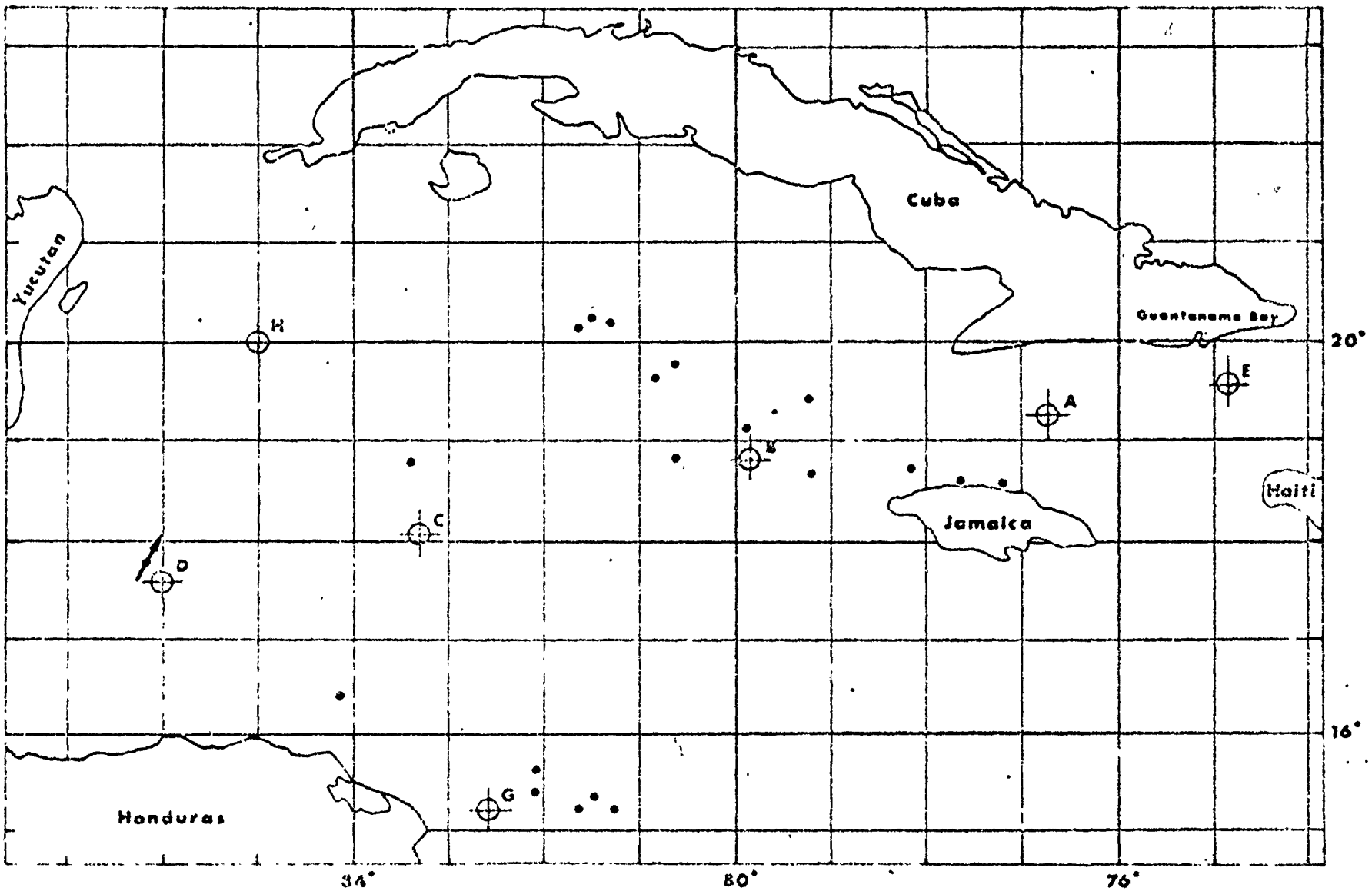

FIGURE XXIV -- The Approximate Locations for the ROT Contacts (•) and VST Contacts (—•—1700 Greenwich Mean Time) for P3#2 on 6 December 1972.

TABLE 12 - ROT CONTACTS

Plane: P3#2 (VP 16)
Date: 6 December 1972

Pilot: Harvey
PI: Watrous

Contact No.	Time (Zulu)	Latitude	Longitude
1	1643	2006	8135
2	1643	2008	8132
3	1643	2008	8117
4	1643	1948	8048
5	1643	1950	8043
6	1157	1917	7913
7	1205	1901	7959
8	1620	1852	8325
9	1211	1851	8038
10	1200	1843	7914
11	1719	1844	7806
12	1719	1838	7745
13	1728	1832	7723
14	1257	1605	8418
15	1234	1545	8202
16	1234	1535	8201
17	1232	1521	8148
18	1231	1521	8136
19	1231	1525	8140

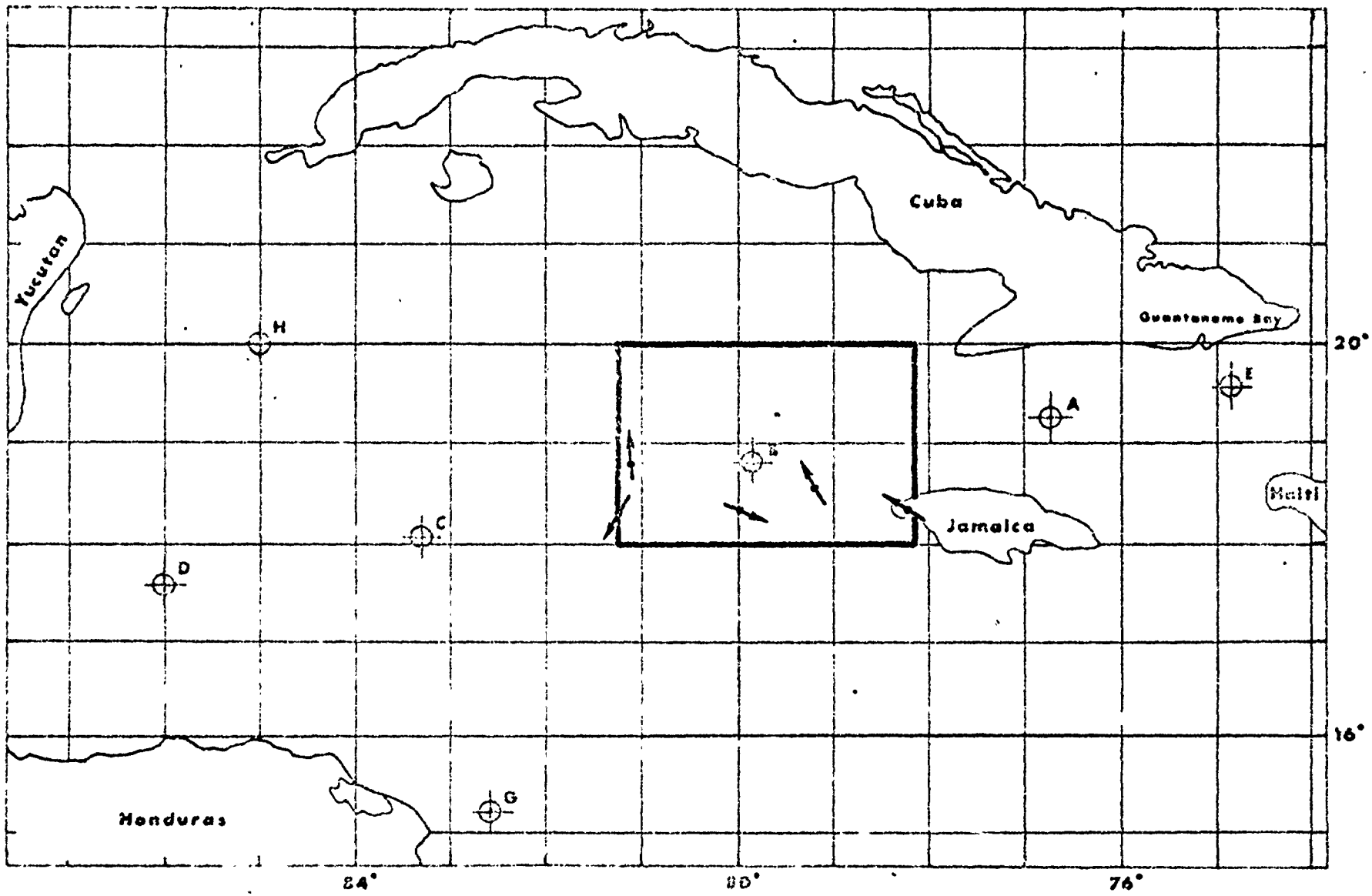

FIGURE XXV — The Approximate VST Area and VST Contact Positions Dead Reckoned to 1700 Greenwich Mean Time for P3#3 on 6 December 1972.

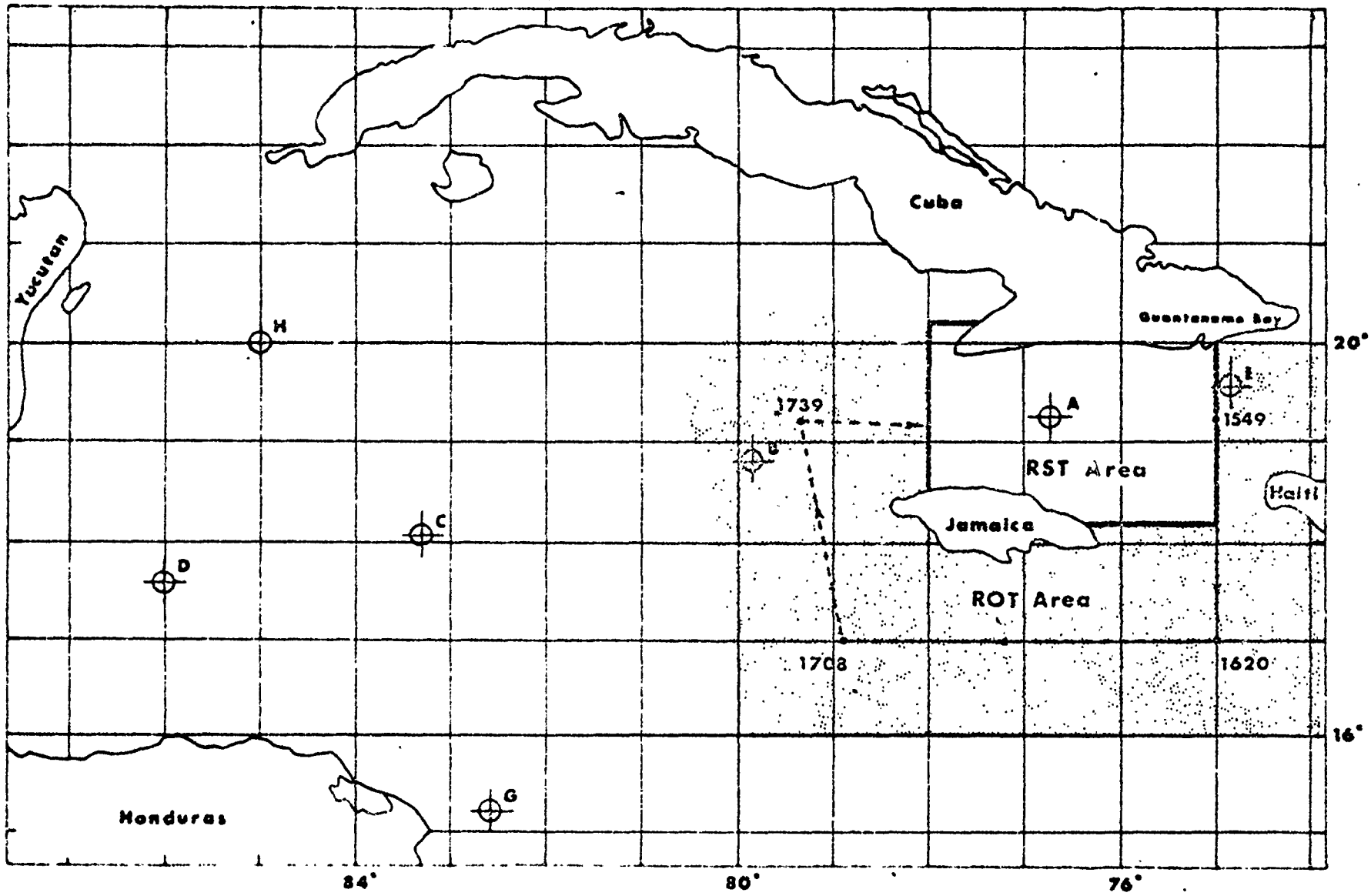

FIGURE XXVI -- The Approximate Flight Path and RST and ROT Coverage for P3#5 (NRL) on 6 December 1972. The Greenwich Mean Times at Key Positions are Given.

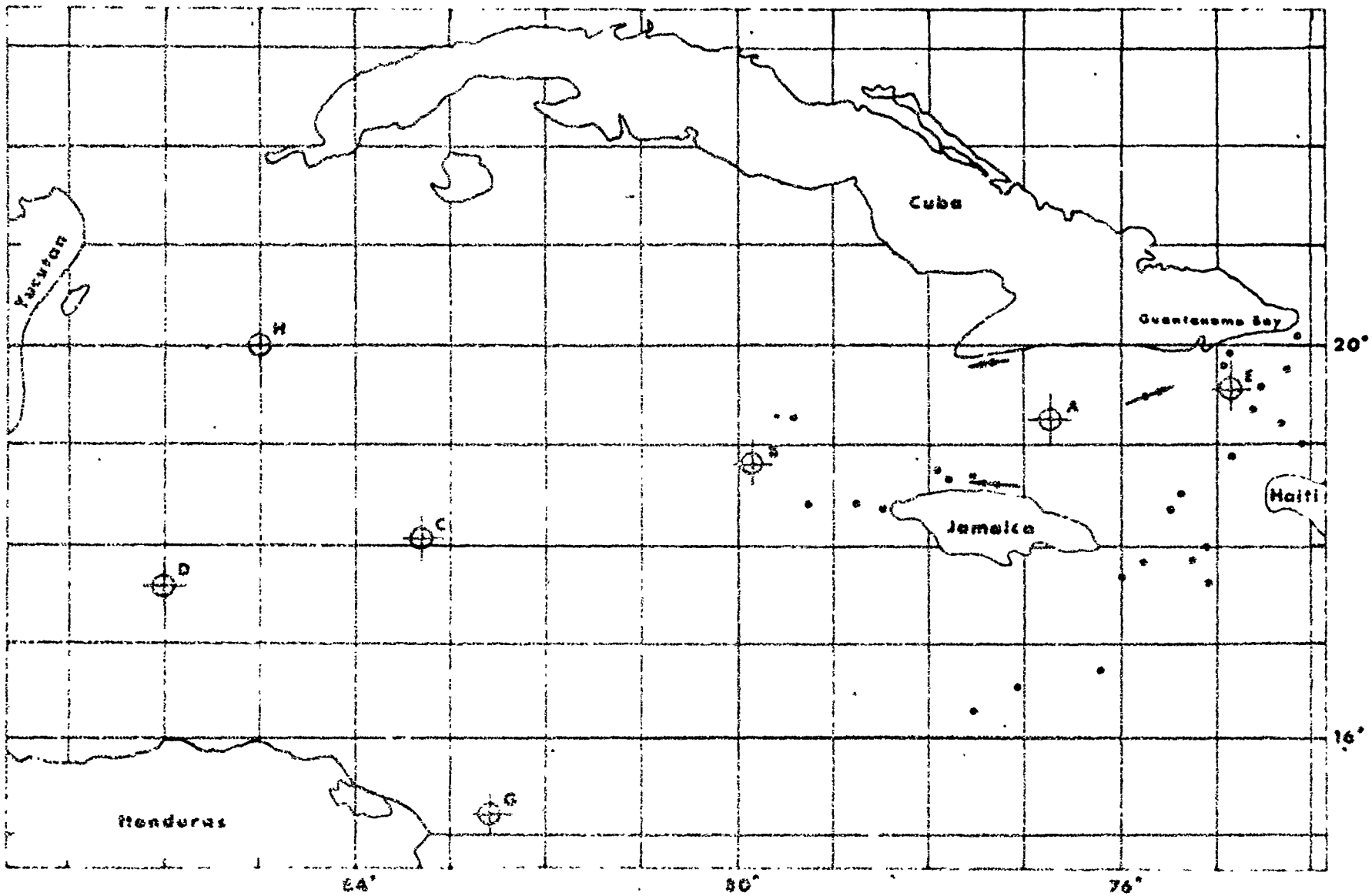

FIGURE XXVII -- The Approximate Positions for the ROT (•) and RST (—•— 1700 Greenwich Mean Time) Contacts for P3#5 on 6 December 1972.

TABLE 13 - ROT CONTACTS

Plane: P3#5 (NRL)
Date: 6 December 1972

Pilot: Hutchins
PI: Kane

Contact No.	Time (Zulu)	Latitude	Longitude
1	1546	2006	7407
2	1730	1917	7926
3	1546	1947	7414
4	1546	1939	7432
5	1546	1922	7439
6	1546	1910	7426
7	1500	1950	7453
8	1500	1900	7414
9	1500	1944	7453
10	1720	1844	7916
11	1720	1825	7839
12	1720	1819	7823
13	1804	1840	7754
14	1804	1839	7747
15	1804	1836	7734
16	1558	1820	7522
17	1558	1822	7517
18	1558	1800	7507
19	1546	1854	7456
20	1607	1750	7601
21	1607	1758	7543
22	1607	1759	7518
23	1611	1740	7504
24	1640	1633	7703
25	1640	1625	7730
26	1629	1647	7614

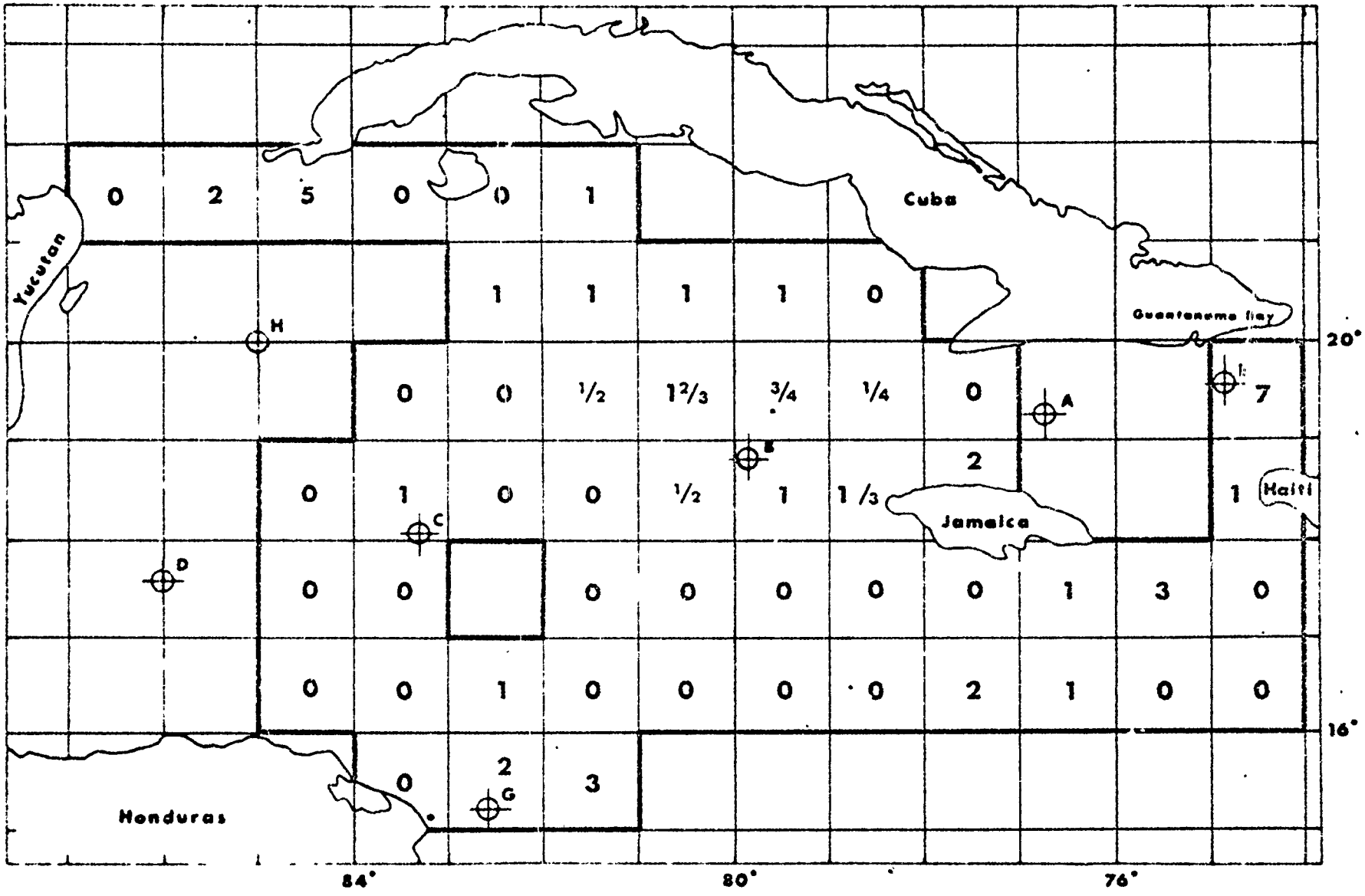

FIGURE XXVIII -- The Observed Density for One Degree Squares of ROT Radar Contacts on 6 December 1972 (Average Density: 0.8 Contacts Per One Degree Square).

E. Data for 7 December 1972

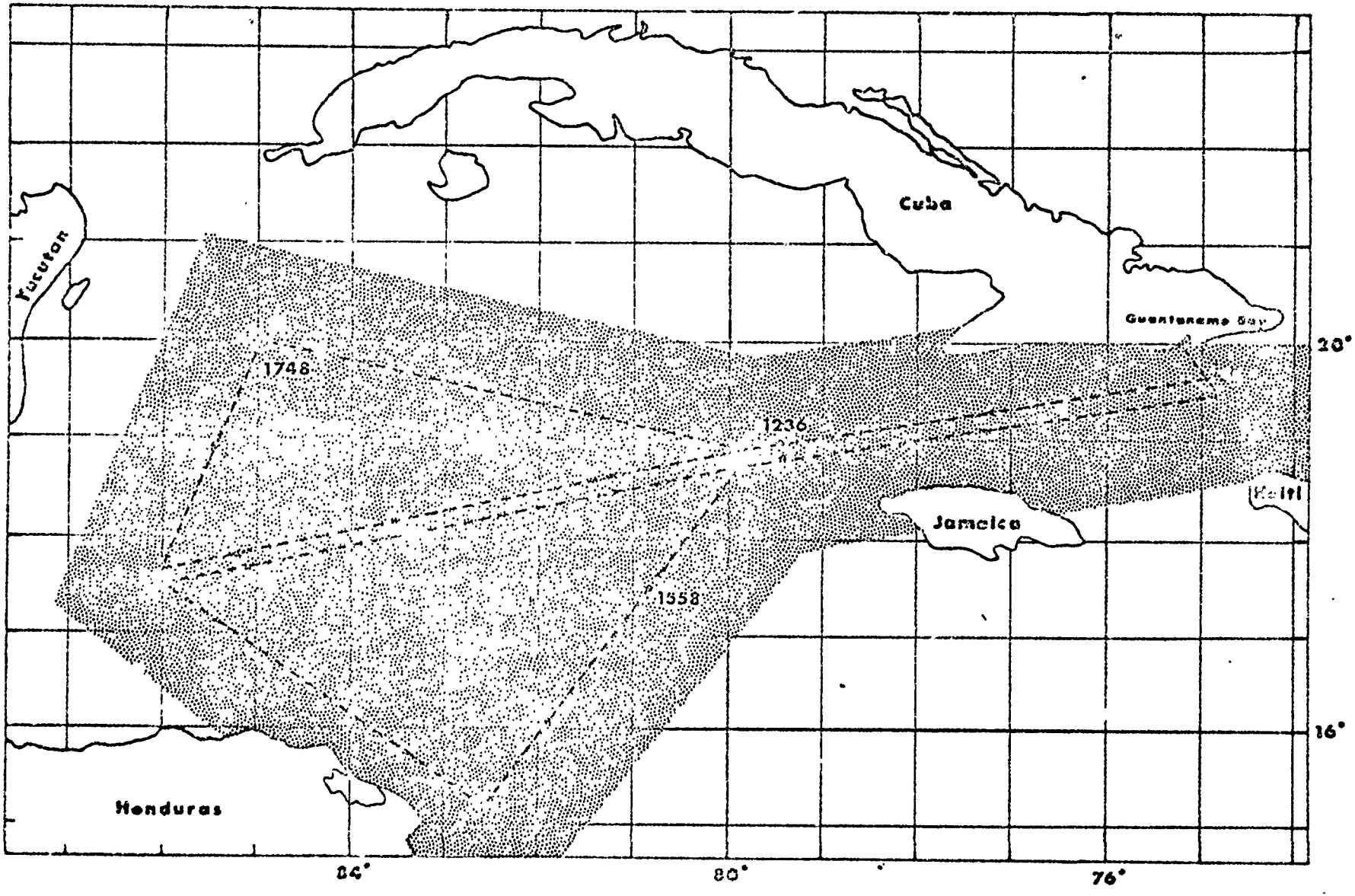

FIGURE XXIX -- The Approximate Flight Path and ROT Area Coverage for P3#4 (VXN 8) on 7 December 1972. The Greenwich Mean Time at Key Positions are Given.

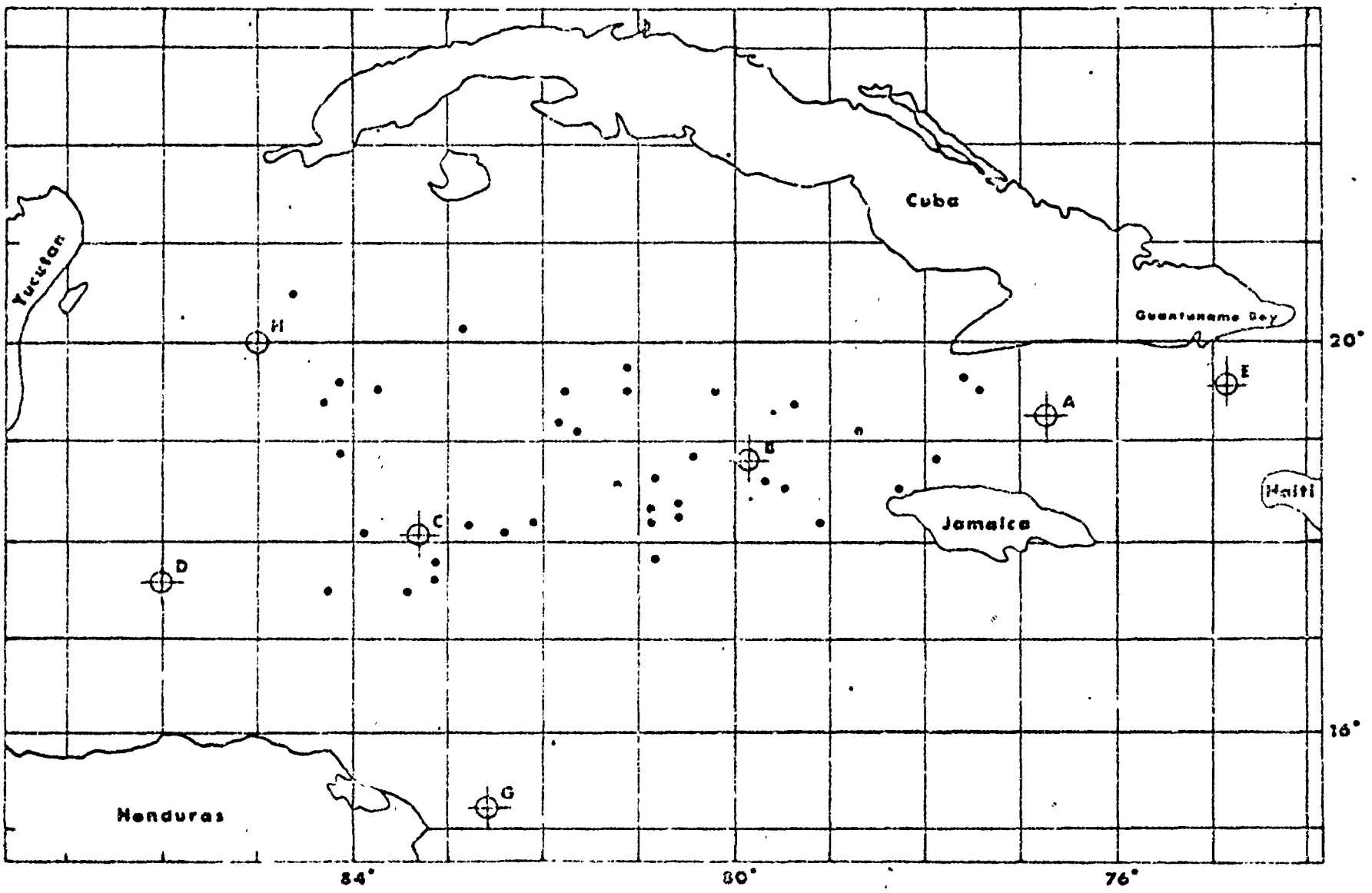

FIGURE XXX — The Approximate Positions of the Radar Contacts Made by P3#4 (VXN 8) on 7 December 1972.

TABLE 14 - ROT CONTACTS

Plane: P3#4 (VXN 8)
Date: 7 December 1972

Pilot: Lt. Lamb
PI: E. Sander

Contact No.	Time (Zulu)	Latitude	Longitude
1	1736	2029	8441
2	1708	2002	8247
3	1716	1947	8403
4	1724	1935	8420
5	1715	1935	8339
6	1647	1927	8110
7	1647	1928	8155
8	1649	1947	8104
9	1306	1909	8155
10	1938	1904	8145
11	1959	1928	8021
12	2010	1915	7926
13	2022	1901	7846
14	1201	1926	7729
15	1202	1945	7736
16	2059	1945	7537
16	1725	1858	8412
18	1324	1806	8351
19	1311	1812	8236
20	1912	1815	8259
21	1932	1822	8207
22	1640	1845	8120
23	1236	1856	8013
24	1245	1851	8047
25	1606	1815	8030
26	1956	1822	8028
27	1613	1835	8049
28	1637	1831	8057

TABLE 14 - ROT CONTACTS (Cont)

Plane: P3#4 (VXN 8)
Date: 7 December 1972

Pilot: Lt. Lamb
PI: E. Sander

Contact No.	Time (Zulu)	Latitude	Longitude
29	1226	1820	7909
30	1235	1841	7941
31	2007	1840	7930
32	1213	1827	7813
33	1209	1841	7758
34	1902	1732	8413
35	1325	1749	8316
36	1326	1743	8320
37	1909	1754	8312
38	1558	1757	8057

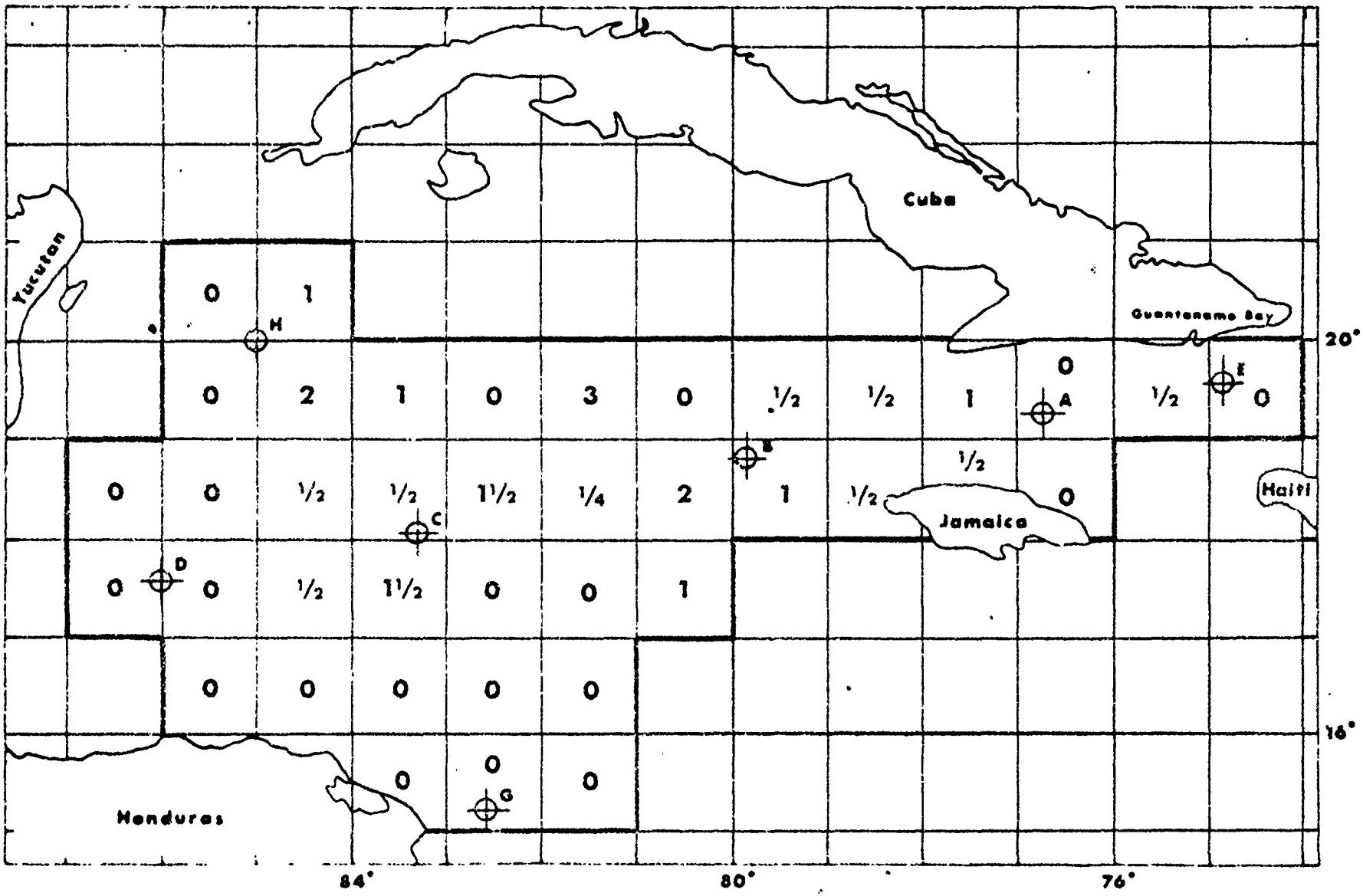

FIGURE XXXI -- The Observed Density for One Degree Squares of ROT Radar Contacts on 7 December 1972 (Average Density: 0.5 Contacts Per One Degree Square).

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Report Number	Personal Author	Title	Publication Source (Originator)	Pub. Date	Current Availability	Class.
Unavailable	Brancart, C. P.	TRANSMISSION REPORT, VIBROSEIS CW ACOUSTIC SOURCE, CHURCH ANCHOR EXERCISE, AUGUST AND SEPTEMBER 1973	B-K Dynamics, Inc.	730101	AD0528904	U
Unavailable	Daubin, S. C., et al.	LONG RANGE ACOUSTIC PROPAGATION PROJECT. BLAKE TEST SYNOPSIS REPORT	University of Miami, Rosenstiel School of Marine and Atmospheric Science	730101	AD0768995	U
NUSC TR NO. 4457	King, P. C., et al.	MOORED ACOUSTIC BUOY SYSTEM (MABS): SPECIFICATIONS AND DEPLOYMENTS	Naval Underwater Systems Center	730105	AD0756181; ND	U
MC-012	Unavailable	CHURCH GABBRO SYNOPSIS REPORT (U)	Maury Center for Ocean Science	730210	ND	U
Unavailable	Hecht, R. J., et al.	STATISTICAL ANALYSIS OF OCEAN NOISE	Underwater Systems, Inc.	730220	AD0526024	U
Raff rept 73-2	Bowen, J. I., et al.	EASTLANT SHIPPING DENSITIES	Raff Associates, Inc.	730227	ND	U
Unavailable	Sander, E. L.	SHIPPING SURVEILLANCE DATA FOR CHURCH GABBRO	Raff Associates, Inc.	730315	AD0765360	U
Unavailable	Wagstaff, R. A.	RANDI: RESEARCH AMBIENT NOISE DIRECTIONALITY MODEL	Naval Undersea Center	730401	AD0760692	U
Unavailable	Van Wyckhouse, R. J.	SYNTHETIC BATHYMETRIC PROFILING SYSTEM (SYNBAPS)	Naval Oceanographic Office	730501	AD0762070	U
MCPLAN012	Unavailable	SQUARE DEAL EXERCISE PLAN (U)	Maury Center for Ocean Science	730501	NS; ND	U
Unavailable	Marshall, S. W.	AMBIENT NOISE AND SIGNAL-TO-NOISE PROFILES IN IOMEDEX	Naval Research Laboratory	730601	AD0527037	U
Unavailable	Daubin, S. C.	CHURCH GABBRO TECHNICAL NOTE: SYSTEMS DESCRIPTION AND PERFORMANCE	University of Miami, Rosenstiel School of Marine and Atmospheric Science	730601	AD0763460	U
MC-011	Unavailable	CHURCH ANCHOR EXERCISE PLAN (U)	Maury Center for Ocean Science	730601	ND	U
Unavailable	Solosko, R. B.	SEMI-AUTOMATIC SYSTEM FOR DIGITIZING BATHYMETRY CHARTS	Calspan Corp.	730613	AD0761647	U
64	Jones, C. H.	LRAPP VERTICAL ARRAY- PHASE II	Westinghouse Research Laboratories	730613	AD0786239; ND	U
Unavailable	Koenigs, P. D., et al.	ANALYSIS OF PROPAGATION LOSS AND SIGNAL-TO-NOISE RATIOS FROM IOMEDEX	Naval Underwater Systems Center	730615	AD0526552	U
NUSC TR 4417	Perrone, A. J.	INFRASONIC AND LOW-FREQUENCY AMBIENT-NOISE MEASUREMENTS OFF NEWFOUNDLAND	Naval Underwater Systems Center	730619	ND AD913668	U
USRD Cal. Report No. 3576	Unavailable	CALIBRATION OF FLIP-CHURCH ANCHOR TRANSDUCERS SERIALS 15 AND 19	Naval Research Laboratory	730716	ND	U