noaa

NATIONAL CLIMATIC DATA CENTER

TD-9677
BOMEX DROPSONDE DATA

Documentation Manual

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration

NOAA Technical Report EDS 12

BOMEX Permanent Archive: Description of Data

TD- 9670
9671
9672
9673
9674
9675
9676
9677

Center for Experiment Design
and Data Analysis

Washington, D.C.
May 1975

UNITED STATES
DEPARTMENT OF COMMERCE
Rogers C. B. Morton, Secretary

NATIONAL OCEANIC AND
ATMOSPHERIC ADMINISTRATION
Robert M. White, Administrator

Environmental Data
Service
Thomas S. Austin, Director

Blank page retained for pagination

CONTENTS

CONTENTS (Continued)

CONTENTS (Continued)

CONTENTS (Continued)

Page

BOMEX PERMANENT ARCHIVE: DESCRIPTION OF DATA

Center for Experiment Design and Data Analysis
National Oceanic and Atmospheric Administration
Washington, D.C. 20235

ABSTRACT

This report describes the data available from the BOMEX Permanent Archive, a depository for data collected during the Barbados Oceanographic and Meteorological Experiment (BOMEX) in 1969. Procedures used in data processing are described, and an inventory of the archived data is given.

1. INTRODUCTION

With the cooperation of the Government of Barbados and with the National Oceanic and Atmospheric Administration as lead agency, the Barbados Oceanographic and Meteorological Experiment (BOMEX) was conducted over the tropical Atlantic east of Barbados in the summer of 1969. The field operations for this multiagency national study of the ocean-atmosphere system were divided into four observation periods: May 3 to 15, May 24 to June 10, June 19 to July 2, and July 11 to July 28. The first three were devoted to the Sea Air Interaction Program--the BOMEX "Core Experiment"--within a 500-km by 500-km square ship array (fig. 1). During the fourth period, the array was extended southward to incorporate the Intertropical Convergence Zone (fig. 2).

Following the field operations, the Barbados Oceanographic and Meteorological Analysis Project (BOMAP) Office was established to reduce and process the data that had been collected by the ship, aircraft, and land-based acquisition systems under the operational control of the BOMEX Field Headquarters. After preliminary processing, these data were placed in a BOMEX Temporary Archive at the National Climatic Center (NCC) in Asheville, N.C., in 1971, and were documented in NOAA Technical Report EDS 10, "BOMEX Temporary Archive: Description of Available Data," issued in January 1972.

On July 1, 1971, the BOMAP Office became the Center for Experiment Design and Data Analysis (CEDDA) and was subsequently transferred from NOAA's Environmental Research Laboratories to its Environmental Data Service. One of the tasks assigned to CEDDA--in addition to its participation in other field experiments, such as the 1972-73 International Field Year for the Great Lakes (IFYGL) and the 1974 GARP Atlantic Tropical Experiment (GATE)--was to reprocess the BOMEX data. Final validation of the data was undertaken through detailed analysis and application of necessary corrections, a task that was completed in the fall of 1974, when the BOMEX Permanent Archive was established at NCC.

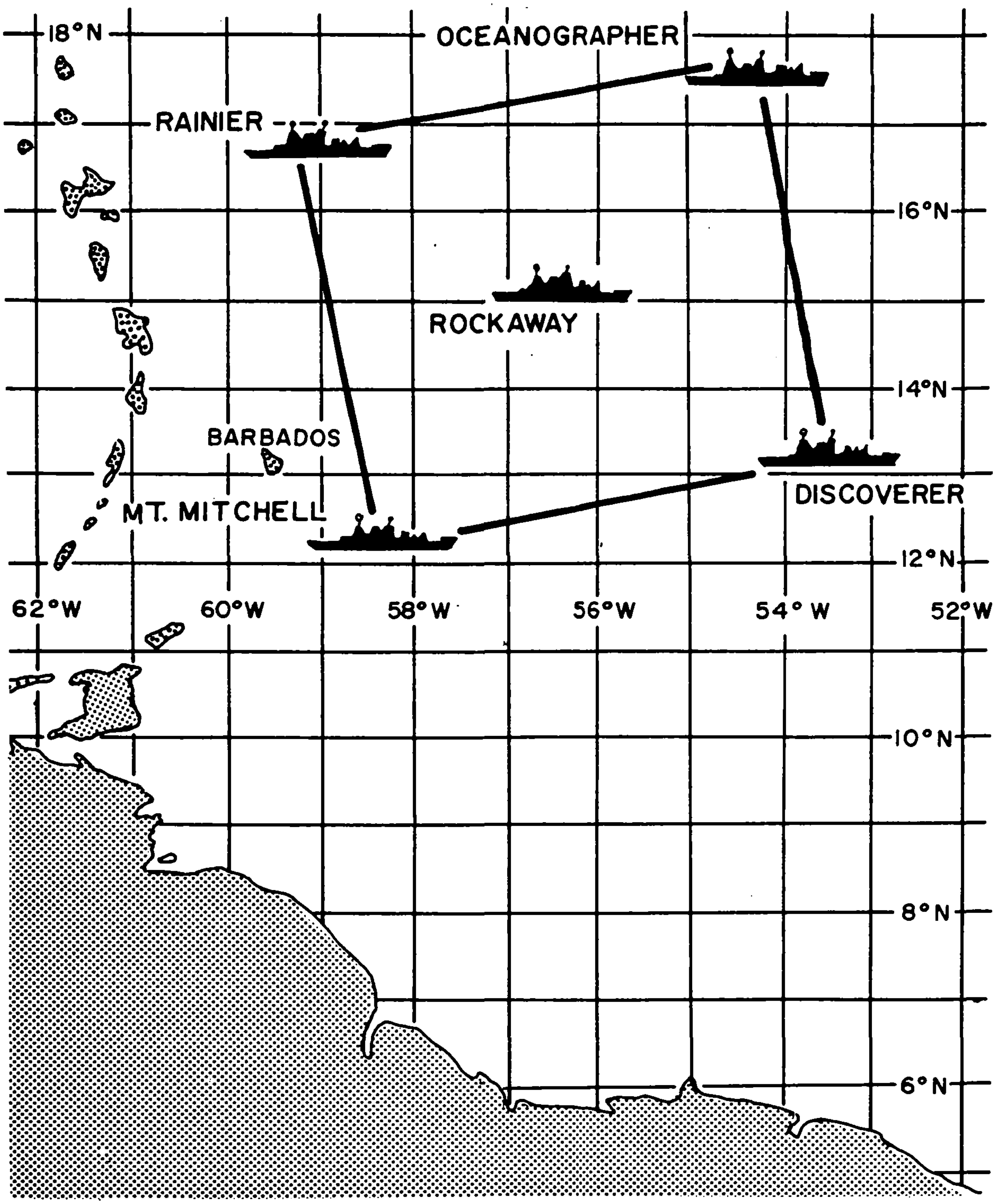


Figure 1-1.--Fixed-ship array during BOMEX Periods I, II, and III.

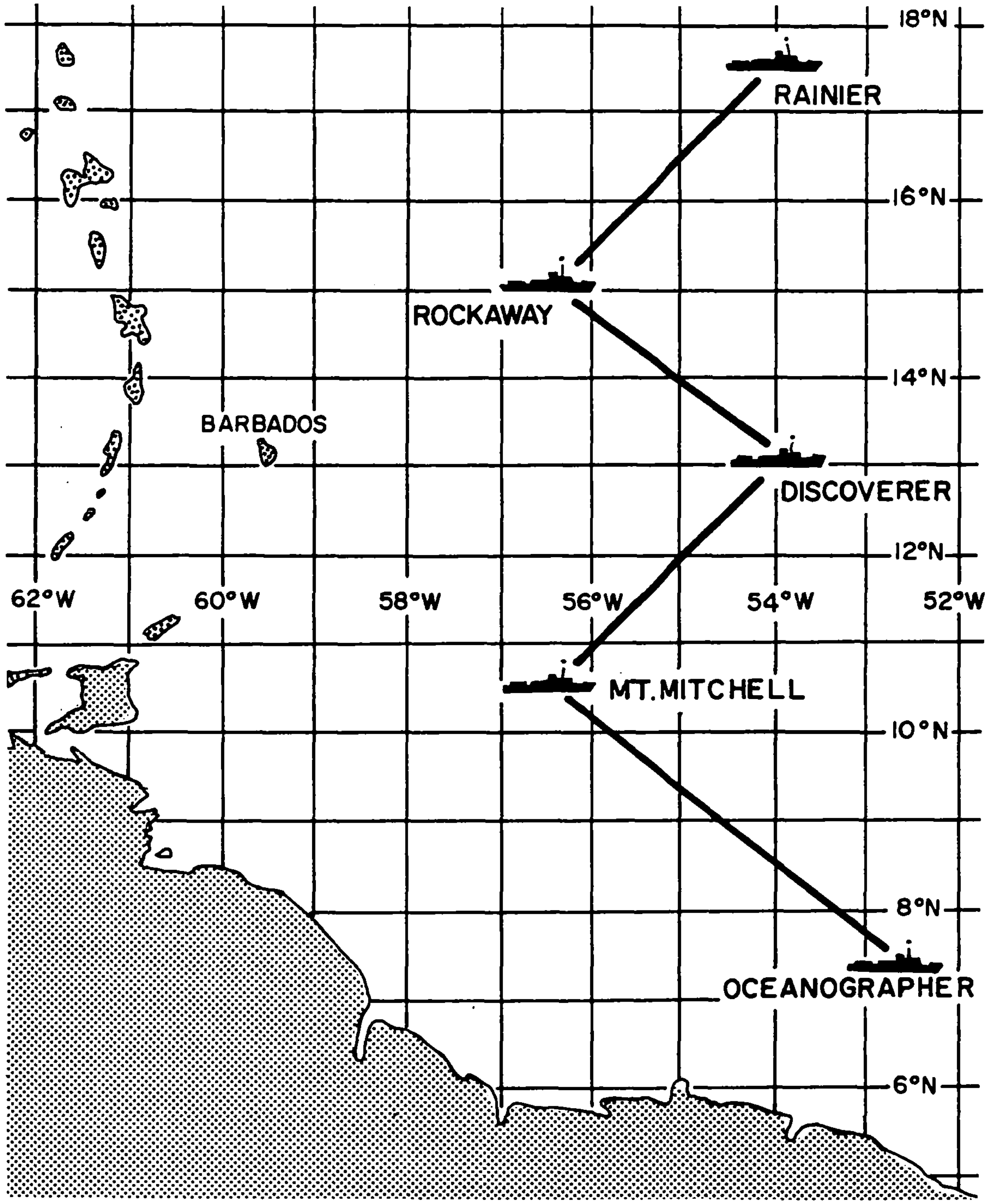


Figure 1-2.--Fixed-ship array during BOMEX Period IV.

This report, which supersedes NOAA Technical Report EDS 10, contains a description of the methods used in the final processing and an inventory of the permanent data sets.

Requests for data should be addressed to:

National Climatic Center
NOAA Environmental Data Service
Federal Building
Asheville, N.C. 28801
Attention: BOMEX Permanent Archive

Note that with the publication of this report, NOAA Technical Report EDS 10 is no longer to be used as a guide in ordering BOMEX data.

2. SHIP OPERATIONS AND NAVIGATION DATA SET

The five ships occupying fixed positions during the first three observation periods were the NOAA ships Rainier, Oceanographer, Mt. Mitchell, and Discoverer and the U.S. Coast Guard cutter Rockaway. Their geographic positions are shown in table 2-1, and a chronological listing of ship operations is given in table 2-2.

During all four periods, the fixed ships made sea-surface and oceanographic measurements and surface and upper air observations. Special instrumentation included the Signal Conditioning and Recording Device (SCARD); rawinsondes and radiometersondes (see sec. 5); a special boom extending from the bow of each ship and carrying meteorological instruments (see sec. 3); salinity-temperature-depth (STD) sensors (see sec. 7); the Boundary Layer Instrument Package (BLIP), released from all ships except the Rockaway and carrying sensors for measuring temperature, humidity, and horizontal and vertical windspeed (see sec. 6); and a Selenia radar aboard the Discoverer (see sec. 8).

Each ship was equipped with a free-fall, deep-sea mooring system to maintain its position. However, the Rainier's mooring system failed on May 1, the Mt. Mitchell's on May 3, the Rockaway's on May 25, and the Discoverer's and Oceanographer's on June 21. All windspeed and wind direction data acquired after mooring failure, during periods of steaming and drifting, must be corrected for ship motion. Motion and position data have been calculated for all ships, for Periods II and III only, after mooring failure. These data are described in section 2.3.

Table 2-1.--Geographic positions of BOMEX fixed ships

Ship	Station	Latitude	Longitude
BOMEX Observation Period I, II, and III (square array)			
Rainier	Alfa (A)	16°50' N	59°12' W
Oceanographer	Bravo (B)	17°36' N	54°34' W
Rockaway	Charlie (C)	15°00' N	56°30' W
Mt. Mitchell	Delta (D)	12°23' N	58°23' W
Discoverer	Echo (E)	13°08' N	53°51' W
BOMEX Observation Period IV (staggered array)			
Rainier	Bravo (B)	17°30' N	54°00' W
Rockaway	Charlie (C)	15°00' N	56°30' W
Discoverer	Echo (E)	13°00' N	54°00' W
Mt. Mitchell	Lima (L)	10°30' N	56°30' W
Oceanographer	Golf (G)	7°30' N	52°42' W

Table 2-2.--Chronology of ship operations during BOMEX

Date 1969	Ship activity* Oceanographer	Discoverer	Mt. Mitchell	Rainier	Rockaway
April					
30	In port at Bridgetown	In port at Bridgetown	In port at Bridgetown	Arrived at Station "A"	En route to Station "C"
May					
1	En route to Station "B"	"	Arrived at Station "D"	Deep-sea moor. failed	Arrived at Station "C"
2	Arrived at Station "B"	"	Moored on Station "D"	On Station "A"	Moored on Station "C"
3	Moored on Station "B"	"	Deep-sea moor. failed	"	"
4	"	"	Medical evacuation to Bridgetown	"	"
5	"	"	On Station "D"	"	"
6	"	Arrived at Station "E" and moored	"	"	"
7	"	Moored on Station "E"	"	"	"
8	Moored on Station "B"; M&C Day	Moored on Station "E"; M&C Day	On Station "D"; M&C Day	On Station "A"; M&C Day	Moored on Station "C"; M&C Day
9-14	Moored on Station "B"	Moored on Station "E"	On Station "D"	On Station "A"	Moored on Station "C"
15	Departed for Bridgetown	Departed for Bridgetown	Departed for Bridgetown	Departed for Bridgetown	Departed for Bridgetown

Table 2-2.--Chronology of ship operations during BOMEX (continued)

Date 1969	Ship activity*				
	Oceanographer	Discoverer	Mt. Mitchell	Rainier	Rockaway
May 16	Arrived in Bridgetown	Arrived in Bridgetown	Arrived in Bridgetown	Arrived in Bridgetown	Arrived in Bridgetown
17-21	In port at Bridgetown	In port at Bridgetown	In port at Bridgetown	In port at Bridgetown	In port at Bridgetown
22	In port at Bridgetown	Departed Bridgetown for Station "E"	In port at Bridgetown	Departed Bridgetown for Station "A"	Departed Bridgetown
23	Departed Bridgetown	Arrived and moored on Station "E"	Departed Bridgetown	Arrived at Station "A"	Arrived and moored on Station "C"
24	Arrived and moored on Station "B"	Medical evacuation to Bridgetown	Arrived on Station "D"	On Station "A"	Moored on Station "C"
25	Moored on Station "B"	Arrived at Bridgetown; departed	On Station "D"	"	Deep-sea moor. failed
26	"	En route to Station "E"	"	"	On Station "C"
27	"	Arrived and moored on Station "E"	"	"	"
28	"	Moored on Station "E"	Departed for Bridgetown; returned to Station "D"	"	"
May 29 to June 9	Moored on Station "B"; 5/29 M&C Day	Moored on Station "E"; 5/29 M&C Day	On Station "D"; 5/29 M&C Day	On Station "A"; 5/29 M&C Day	On Station "C"' 5/29 M&C Day

Table 2-2.--Chronology of ship operations during BOMEX (continued)

Date 1969	Ship activity*				
	Oceano-grapher	Disco-verer	Mt. Mitchell	Rainier	Rockaway
June					
10	Departed for Bridgetown	Departed for Bridgetown	Departed for Bridgetown	Departed for Bridgetown	Departed for Bridgetown
11	Arrived in Bridgetown	Arrived in Bridgetown	Arrived in Bridgetown	Arrived in Bridgetown	Arrived in Bridgetown
12-18	In port at Bridgetown	In port at Bridgetown	In port at Bridgetown	In port at Bridgetown	In port at Bridgetown
19	Departed Bridgetown	Departed Bridgetown	Departed Bridgetown	Departed Bridgetown	Departed Bridgetown
20	Moored on Station "B"	Moored on Station "E"	On Station "D"	On Station "A"	On Station "C"
21	Deep-sea moor. failed	Deep-sea moor. failed	"	"	"
22-25	On Station "B"	On Station "E"	"	"	"
26	"	"	Departed "D" to recover buoy, then returned	"	"
27	On Station "B"; M&C Day	On Station "E"; M&C Day	On Station "D"; M&C Day	On Station "A"; M&C Day	On Station "C"; M&C Day
28	On Station "B"	On Station "E"	On Station "D"	On Station "A"	On Station "C"
29	"	"	Departed "D" to recover BLIP, then returned	"	"
30	Departed "B" for Bridge-town	"	On Station "D"	"	Departed "C" for "B," ar-rived at "B"

Table 2-2.--Chronology of ship operations during BOMEX (continued)

Date 1969	Ship activity*				
	Oceano-grapher	Disco-verer	Mt. Mitchell	Rainier	Rockaway
July					
1	Arrived in Bridgetown	On Station "E"	On Station "D"	On Station "A"	On Station "B"
2	In port at Bridgetown	Departed for Bridgetown	Departed for Bridgetown	Departed for Bridgetown	Departed for Bridgetown
3	"	Arrived in Bridgetown	Arrived in Bridgetown	Arrived in Bridgetown	Arrived in Bridgetown
4-8	"	In port at Bridgetown	In port at Bridgetown	In port at Bridgetown	In port at Bridgetown
9	Departed Bridgetown for "G"	Departed Bridgetown for "E"	Departed Bridgetown for "L"	Departed Bridgetown for "B"	Departed Bridgetown for "C"
10	En route to Station "G"	Arrived at Station "E"	Arrived at Station "L"	En route to Station "B"	Arrived at Station "C"
11	"	On Station "E"	Departed for Bridgetown, then returned	Arrived at Station "B"	On Station "C"
12	Arrived at Station "G"	"	On Station "L"	On Station "B"	"
13-15	On Station "G"	"	"	"	"
16	On Station "G"; M&C Day	On Station "E"; M&C Day	On Station "L"; M&C Day	On Station "B"; M&C Day	On Station "C"; M&C Day
17-23	On Station "G"	On Station "E"	On Station "L"	On Station "B"	On Station "C"

Table 2-2.--Chronology of ship operations during BOMEX (continued)

Date 1969	Ship activity*				
	Oceanographer	Discoverer	Mt. Mitchell	Rainier	Rockaway
July					
24	On Station "G"; M&C Day	On Station "E"; M&C Day	On Station "L"; M&C Day	On Station "B"; M&C Day	On Station "C"; M&C Day
25-27	On Station "G"	On Station "E"	On Station "L"	On Station "B"	On Station "C"
28	Departed for Bridgetown	Departed for Bridgetown	Departed for Bridgetown	Departed for Bridgetown	Departed for Bridgetown

* M&C Day — Maintenance and calibration day.

Table 2-3.--Fixed-ship basic observation system

Ship	SCARD	Rawinsonde*	Boom**	STD	BLIP	SITS
Oceanographer	x	Scanwell WFSS	x	x	x	-
Rainier	x	Scanwell WFSS	(x)	x	x	-
Mt. Mitchell	x	Scanwell WFSS	x	x	x	-
Discoverer	x	Selenia radar	x	x	x	-
Rockaway	x	AN/SPS 29 radar	(x)	x	-	x

* Wind direction and windspeed acquired as slant range and azimuth.

**Parentheses indicate inclusion of instrumentation for radiation.

2.1 Ship Operations and Navigation

2.1.1 Oceanographer

The Oceanographer occupied two BOMEX array positions, station BRAVO during Observation Periods I through III and station GOLF during Period IV. The ship arrived on station and deployed its mooring system on May 3. On June 21, the anchor cable failed and the ship, still made fast to the buoy, started to drift. Divers sent out to disconnect the mooring cable reported that the cable had broken about 7 ft below the Miller swivel. Wind at the time of failure was from the east and tension was 6,000 lb. It is believed that the failure was gradual from strain of previous moorings.

During the first three Observation Periods, when the ship occupied station BRAVO, Omega navigational control was the only control available except celestial. At station GOLF, Omega was completely worthless, and the ship relied on satellite fixes, which were accurate within 1/2 mi or less at all times. The main limitations on satellite fixes are having the pass angle of orbit within the prescribed limits and a minimum number of Doppler returns. At least 80 percent of the fixes are usable, and the others close enough for general location.

During Periods I and II, the Oceanographer was tied to the anchored mooring system, which minimized on-station movement, although there was movement of as much as 4 mi during a day as the wind and current changed. The effect of this movement on recording instruments was considered minimal. After loss of the mooring on station BRAVO, and on station GOLF, the ship had to go into a "steam and drift" mode of operation in order to remain within the prescribed distance from the station. The best procedure was found to be drifting for 1 hr and steaming for 1/2 hr. A fix was taken at the beginning and end of the run period.

On station GOLF it was somewhat difficult to take fixes at the preferred times, particularly when the schedule required rawinsonde observations to last 110 mi every 3 hr. The satellite navigation system was available at varying times, and during some of these times the fixes were not accurate due to low or high pass angles. The best solution was to try to hold within 4 mi of the station by taking satellite fixes whenever possible and steaming back to position between rawinsonde observations. Fortunately, winds on station GOLF were of less force, which required far less steaming than found necessary on BRAVO. Even though the fixes could not be taken at the beginning and end of the steaming times, it is believed that the increased accuracy of the satellite fixes during drift periods minimized errors introduced by using dead-reckoning positions.

Navigation presented no problem except for the lack of Omega control on GOLF, which was compensated for by the satellite equipment.

2.1.2 Mt. Mitchell

The Mt. Mitchell occupied two BOMEX array positions during the four Observation Periods, station DELTA during Periods I, II, and III, and station LIMA during Period IV. The ship arrived on station DELTA on May 1. The free-fall mooring system was deployed that day, but failed on May 3. The ship then began to operate in a mode consisting of steaming at steerageway speeds and of drifting with engines secured. This mode of operation was maintained not only at DELTA but was also used at station LIMA.

On May 1, a current station was established within a few yards of position DELTA, consisting of a "plank-on edge" mooring buoy that was lighted and fitted with a radar reflector. A series of several dozen celestial observations fixed the position of the buoy at 12°21'N and 58°23'W with a high level of confidence. During Periods I, II, and III, with the buoy as a reference, the Mt. Mitchell obtained visual bearings and/or radar bearings and radar ranges to position the ship relative to the buoy. The position of the buoy was checked daily by Omega fixes and, when possible, by celestial observations.

During BOMEX Period IV, at station LIMA, no buoy was planted, and the ship had to rely on Omega for hourly positions, with celestial verification mornings and evenings. A general plan of drifting 3 to 4 hr and then returning to station was contemplated, but because of the slow drift and the inaccuracy of Omega this drifting period was extended in some cases and a celestial fix was taken before steaming toward the station.

At both stations the ship would bracket the station position either by steaming very slowly "up current" or by securing the engines and drifting "down current," the current being the result of both ocean current and wind effects on the ship. The distance in this "steam and drift" mode of operation was held within 3 nmi when possible.

Omega rates A-D, A-C, and B-D picked on the basis of available Omega tables for the BOMEX area were used and were found to have mediocre intersections. This had the effect of increasing Omega error. The rate B-D (Trinidad - New York) was inaccurate due to ground-wave mixing from Trinidad. This problem was solved by generating on-the-spot sky-wave corrections. These corrections, which are the heart of Omega navigation because they determine position accuracy, were generated by the Rainier during each in-port period between BOMEX Observation Periods for rates A-D and A-C. The Mt. Mitchell generated its own corrections for B-D at station DELTA, but due to the distance between station LIMA and Bridgetown these corrections were found to be below standard. The combination of unreliable sky-wave corrections and weak intersection of the Omega rates increased unadjusted position error in some cases from approximately 2 mi (minimum) to 6 mi (maximum).

2.1.3 Rainier

The Rainier operated in a "drift and steam" mode throughout the four BOMEX Observation Periods. The ship occupied position ALFA during Periods I through III and position BRAVO during Period IV.

The initial plan for the fixed ships was to use deep-sea anchoring systems to eliminate slow-speed running to hold station. After failure of its mooring, the Rainier adopted a slow-speed steaming mode, running generally NE and SE, quartering the expected wind and currents. The intent to use just enough power to remain stationary in one position did not always prove effective because of unexpected current velocities. This procedure was used for Periods I and II; during Period III, however, the ship would shut down both main engines and lie in the trough of the sea; a procedure that was largely effective. Power was applied to the ship when necessary to change the ship's heading for rawinsonde tracking or STD lowerings, or to return to station ALFA. Before Period IV, a change in the Operations Plan established a "steam and drift" mode for all ships, a procedure that was tried throughout Period IV, when the Rainier was positioned at station BRAVO. Due to the requirement to change ship's heading for rawinsonde tracking, the port main engine was kept on the line throughout most of this period.

Omega receiving systems, Tracor Series 599, were furnished for all fixed ships. The equipment functioned quite well during the entire BOMEX project. Due to insufficient data on sky-wave corrections within the array, serious jumps in position were experienced at sunrise and sunset. During each in-port period, Omega stations A, B, C, and D were monitored, and average hourly corrections were provided to the other four ships. However, the corrections did not prove usable over the entire 90,000 mi^2 covered by the BOMEX array. Because of fairly heavy cloud cover, celestial control was impossible to obtain.

2.1.4 Discoverer

The Discoverer occupied position ECHO during all four BOMEX Observation Periods. The ship was moored from May 6 to June 20. On June 21, the mooring failed, and the ship began a "steam and drift" mode of operation.

The mooring was established in approximately 2,800 fathoms of water. It held the ship in winds to 25 kn during the first two Observation Periods, when the wind and current were in different directions. Tension in the anchor cable normally ran 2,500 lb, 3,500 to 4,000 lb, and 5,000 to 7,500 lb with a wind speed of 15 kn, 20 kn, and 25 kn, respectively. When the tension reached 7,000 lb, the ship would steam ahead dead slow on one engine to ease the strain down to 4,500 lb. During this time the ship lay at an angle of from 30° to 90° to the anchor cable. For one period of approximately 20 hr it lay directly north of the buoy with less than 500 lb of tension, despite an easterly wind of 15 kn, indicating a good current setting to the east.

During Period III, the wind and current were in the same direction, indicated by the fact that the ship headed directly toward the anchor cable, and tension built up to 7,500 lb with wind less than 20 kn. Despite the ship's steaming mode, the cable parted after approximately 18 hr. It parted about 1,500 to 1,800 fathoms down from the buoy, judging by the depth of the buoy at first launch and before and after failure. The cause of failure is unknown, but is believed to be that the current drag on the cable and the ship's tension on the buoy were in the same direction, as opposed to Periods I and II, when the current and direction of ship's tension were in two different directions.

When the mooring failed, an attempt was made at first to keep the ship directly on station by steaming slowly (20 to 55 turns on one shaft) into the wind. If accurate control had been available, this would probably have been the most desirable procedure, since the wind, current, and ship's steaming would nullify one another, and the ship would be stationary. However, the only control available other than celestial was Omega, which did not furnish control with the accuracy necessary. Jumps of as much as 8 to 10 mi occurred from hour to hour. The Omega readings would plot in two or three different positions within a 20-mi area without definite lane identification, which the Discoverer's Omega did not have. Readings on different frequencies did not resolve the ambiguity of position.

The direction and velocity of current on the station site were not constant, adding to the difficulty of attempting to maintain station or making good courses steered.

After 6 days, the ship abandoned the attempt to remain on station by continuous steaming. A procedure was adopted of drifting for approximately 6 or 7 hr, and then steaming for 1 or 2 hr back to and past the station. This procedure allowed enough time during drifting to obtain an approximate drift rate and direction even with erratic fixes. The ship would then proceed back at the maximum speed that would not disrupt the instrumented boom extending from the ship's bow. Steaming times were selected that would interfere least with the observations being made. By this procedure the ship might have drifted as much as 15 mi off station, but relative movements could be approximated by using the Omega readings only. Celestial fixes and lines of position kept track of absolute position,but could not be combined with Omega for drift rates.

2.1.5 Rockaway

The Rockaway occupied BOMEX array position CHARLIE throughout all four BOMEX Observation Periods and operated in two modes: moored, and steaming and drifting to maintain position on station.

The Rockaway's deep-sea mooring system was deployed on May 2, 1969. The launch position of the system was determined by Florida State University's Triton buoy previously moored at position CHARLIE by the U.S. Coast Guard cutter Laurel. Because of a practical requirement for the Rockaway to be outside the radius of the Triton's mooring, the ship's anchor was dropped 300 yd downwind from the Triton. The ship was made fast to the buoy paying out a 350-ft catenary through the bullnose. The ship was 400 ft from the mooring buoy, since the 350-ft nylon mooring line was attached to a 50-ft pendant at the mooring buoy.

While the ship was moored, its position was always known with a very high degree of confidence. Triton's position was confirmed each day by celestial fix, and once every 30 min the Rockaway confirmed its position with reference to the Triton by a radar range and bearing. By means of a Universal Plotting Sheet (UP-OS), with a scale change so that 1 in equalled 1 nmi, the ship's position was reported once every hour on the BOMEX Ship Operations Form. The ship rode comfortably -- even though stopped it did not lie in the trough -- during high seas and wind conditions with 8-ft swells and 25-kn winds, which were the worst encountered during Period I. The mooring was used from May 2 to May 14. On May 25, after returning to station CHARLIE from the inport period between Periods I and II, the mooring system was remade, and mooring was tried after the ship had been on station for 35 hr, rough seas having discouraged the small-boat operations necessary for mooring to the buoy. During the first 4 hr after mooring, the ship's drift rate remained constant (tension remaining steady at approximately 1,350 lb), and the range between the Rockaway and the Triton buoy opened up from 5,400 yd to 10,600 yd. At first the ship's navigator thought that the excessive range between the Triton and the ship was attributable to the fact that the Triton's drift about the scope of its mooring was the result only of ocean currents, while the Rockaway's drift was a result of both ocean currents and wind effects. However, the range continued to open up, and eventually the Triton was lost on radar. A celestial fix 14 hr after the attempt to moor indicates the ship was 13 mi off station (relative to the Triton). In the next 24 hr, the ship had drifted 30 mi off station. The mooring buoy was then sunk, and the ship proceeded back to station.

After the mooring failure during Period II, and during the subsequent BOMEX Observation Periods, a continuous plot of the ship's position and movement, whether underway or adrift, was kept. Except as modified by small-boat operations, the daily routine during Periods II, III, and IV was to drift downwind each day from 0830 to 1930 GMT and from 2100 to 0700 GMT. (During Period I small boats operated every day except one. During Periods II, III, and IV, they operated once every 4 days.) During the remaining two periods of 1 1/2 hr, the ship would be underway, proceeding upwind.

A revised plotting grid provided an accurate chart with a scale of 1 in to 1 nmi. The Triton was always placed at the center, and coordinates of the chart and the ship's position were plotted relative to the Triton. A geographic plot was maintained on this chart, and accurate ship's positions were always available. The true velocity and direction of the ship's movements, whether underway or adrift, were determined by the navigator from these plots on a locally prepared form. The position data were taken from this form and entered on the Ship Operations Form.

The Omega navigation system did not serve a useful purpose. Celestial fixes were usually available, and, when on station, the ship was either moored or keeping station on the anchored Triton buoy.

During Period III, the ship relieved the Oceanographer on station BRAVO for a few days (see table 2). The ship was not moored at BRAVO, and the Triton was left at station CHARLIE. Thus, Omega was the only source of position data available for station keeping. The Omega lines for rates A-D, B-C, A-C, and B-D were laid down on a locally prepared chart with a scale of 1 in equaling 1 nmi. Positions were plotted every 30 min. While these positions, based on an updated lane count, were satisfactory for offshore trackline navigation, they proved useless for station keeping because of excessive variability in fix quality as compared with the suspected dead-reckoning position.

2.1.6 Ship Operations Form

Ship operations and navigation data were recorded manually on a Ship Operations Form as follows:

Card Code - Column 1. Code 4 was used on each form to identify it as pertaining to ship operations and navigation data.

Ship Code - Column 2. The following codes were used to designate the ship from which observations were made: 0, Oceanographer; 1, Rainier; 2, Mt. Mitchell; 3, Discoverer; 4, Rockaway.

Date and Time - Columns 3 through 9. Julian day and time of observation in GMT was entered to the nearest minute.

Latitude - Columns 10 through 14. The actual latitude in degrees and minutes for the ship's position at the time of observation was entered in columns 10 through 13. Code 1 was used for north and code 2 for south in column 14.

Longitude - Columns 15 through 20. Actual longitude in degrees and minutes for the ship's position at the time of observation was entered in columns 15 through 19. Code 3 was used for east and code 4 for west in column 20.

Means of Navigation - Column 21. The method used for determining the ship's latitude and longitude at the time of observation was indicated by choosing the appropriate code from the following: 1, Dead reckoning (DR); 2, Astro; 3, Omega; 4, Loran A; 5, Loran C; 6, Satellite; 7, Radar; 8, Visual.

True Speed - Columns 22, 23, and 24. As determined from the navigational plot, the ship's true speed was recorded in knots and tenths. If the speed had changed during the preceding hour, the speed at the time of observation was used.

True Course - Columns 25 through 28. The ship's heading was recorded to the nearest degree and tenth of a degree at the time of observation.

Indicated Speed - Columns 29, 30, and 31. The ship's speed as indicated by the pit log or other device at the time of the observation was entered in knots and tenths.

System Status - Columns 32 through 43. These entries indicate the status of the following ship observation systems: rawinsonde; Scanwell WFSS; radar wind; meteorological boom instrumentation; surface observation system; BLIP; STD; AEC air, rain, and water sampler; Niskin water sampler; Braincon current meter; ship navigation system; and SCARD. For each of these, code 0 was entered if the system was operational, code 1 if it was partly operational, code 2 if it was nonoperational but reparable, and code 3 if it was nonoperational and nonreparable.

Columns 44 and 45. Not used.

Ship's Gyro Correction - Columns 46 through 49. The ship's gyro correction was indicated in column 46 by a plus or a minus sign and recorded in columns 47, 48, and 49 in degrees and tenths.

Final two columns of the form. Observer's initials.

2.1.7 BOMEX Event Log

The BOMEX Event Log was designed as an aid in verifying the completeness of the data obtained, and all events, whether routine or special, were recorded on it. A new Event Log sheet was begun with each SCARD tape change, several sheets being required for one SCARD analog tape recording period. The Event Log consists of the following:

Heading - Ship's name; day, month, year; and the SCARD magnetic tape number.

Time - Julian Day, and hours and minutes in GMT.

Sequential No. - A sequential number assigned to each observation type, starting with 1 and successive numbers thereafter until the end of the BOMEX Observation Period.

Event - Hand-written description of event.

Summary - Checked (✓) by person verifying that the event has been properly entered. An X in this column means that a discrepancy has been found and corrected; an O indicates that the discrepancy cannot be corrected, and the problem is then described in the Event column.

Initials - Initials of the observer.

2.2 Renavigation (Ship Motion and Position)

Failure of the deep-sea mooring systems for the fixed ships in the BOMEX array on the dates shown in table 2 resulted in contamination of all wind measurements conducted on or from these ships due to ship motion as the ships tried to maintain their assigned geographical positions. Also, as the ships altered their orientation into the prevailing trade-wind flow, the wind measurements taken with instruments mounted on a boom extending from the bow of each ship (see sec. 3, BOOM SURFACE METEOROLOGICAL DATA SET) were affected by the deviation of airflow around the hull and superstructure, resulting in a bias in these measurements.

After mooring failure, the ships initially attempted to remain on station by steaming at a rate and heading so that they would remain stationary with reference to their assigned stations. It became evident, however, that the navigational systems available failed to provide the required accuracy. The accuracy is estimated to have been on the order of 4 to 5 mi. In addition, there were engine problems as a result of the continuous slow steam mode.

A procedure of steaming and drifting was then adopted, i.e., the ships would steam to a position up-drift of their positions and then drift some distance past their stations. This made it possible to obtain approximate drift rates and direction of drift even with erratic fixes. The procedure also eased engine problems.

For these alternate periods of drifting and steaming, a characteristic trace type or "signature" typical of a particular mode could be determined in most instances from time-series plots of gyro heading and relative winds obtained with the ship boom instruments. These data were supplemented by rawinsonde and salinity-temperature-depth (STD) observations (see secs. 5 and 7), indicated course changes, values of ship speeds from ship operations data, notes from log books pertaining to ship operations and recorded values of screw rpm's, which were converted to knots. Speed values as determined from navigational plots proved to be somewhat ambiguous because they were recorded only every hour and reflected either the speed during the preceding hour or, if a speed change had occurred within the hour, the value of the latest speed change. Times of speed or mode change were not recorded, except for the Rockaway, which did maintain a log of times of mode change. No data on ship speed were available for the Discoverer for BOMEX Period III.

Drift values were obtained for BOMEX Observation Periods II and III. An interval of 6 hr was selected in order that changes in drift with time could be detected. The erratic nature of the navigational fix data made it necessary to use a smoothing procedure while preserving the trend. Drift motion of the ship was then obtained by determining the difference between the summation of the respective steam distances, to which a smoothing process had first been applied, over each 6-hr period. It was then possible to make adjustments to the smooth fix positions every 6 hr. After application of the drift factors to the steam mode for each 6-hr increment, the ship positions for each operational mode were determined through dead reckoning, and were recalculated in terms of latitude and longitude. These data were then interpolated to give hourly positions.

2.3 Archive Format and Data Inventory

The BOMEX Event Logs are contained in the archive on 35-mm microfilm, arranged by BOMEX Period, i.e., Period I first, followed by Periods II, III, and IV, Within each Observation Period, the Events Logs for the Oceanographer comes first, followed by those for the Rainier, Mt. Mitchell, Discoverer, and Rockaway.

The Ship Operations Form was converted to punched cards, listed, and edited for punching errors only. The data are stored on both microfilm and magnetic tape. The tape format consists of five separate files, of which the third constitutes the ship operations data. The five files of information are separated by end-of-file mark and followed by a double end-of-file. All information is in binary coded decimal (BCD) format, even parity, 800 bits per inch. The first file consists of 80-column card images, one card image per record, describing the formats of the data files. The other four files contain data in BCD card images, 50 cards (4,000 characters) per record. The second file contains marine meteorological observations (see sec. 4); the fourth file contains hand-tabulated STD support data (see sec. 7); and the fifth file contains radiometersonde data (see sec. 5).

The format of the third file, containing the ship operations data, is as follows:

Character	Element
1	Card code, should always be 4
2	Ship code
	0 - *Oceanographer*
	1 - *Rainier*
	2 - *Mt. Mitchell*
	3 - *Discoverer*
	4 - *Rockaway*
3-5	Modified Julian day (day of year)
6-7	Hour, GMT
8-9	Minute
10-11	Latitude, degrees
12-13	Latitude, minutes
14	Should always be 1 for north
15-17	Longitude, degrees
18-19	Longitude, minutes
20	Should always be 4 for west
21	Means of navigation
	1 DR
	2 Astro
	3 Omega
	4 Loran A
	5 Loran C
	6 Satellite
	7 Radar
	8 Visual

22-24	True speed, knots to tenths
25-28	True heading, degrees true to tenths
29-31	Indicated speed, knots to tenths
32-45	System status for the last hour 0 - operational 1 - partly operational 2 - nonoperational, reparable 3 - nonoperational, nonreparable
32	Rawinsonde
33	Scanwell
34	Radar wind
35	Boom
36	Surface
37	BLIP
38	STD
39	AEC
40	Niskin
41	Braincon
42	Ship navigation system
43	SCARD
44-45	Not used
46	Sign of ship's gyro correction, plus or minus
47-49	Ship's gyro correction, degrees to tenths

Ship motion and position data for all fixed ships after mooring failure for Periods II and III are available on seven-channel, 800 PBI magnetic tape. The data for each ship are broken into sections corresponding to continuous periods of observations. An EOF is placed between each section; two EOF's separate Observation Periods II and III data as well as the motion and position data; three EOF's are placed at the end of all data. Data format is as follows:

Ship Motion Data

Column	Type of data	Variable
1	Ship number	Integer
6-7	Julian day	Integer
15-16	Start time (GMT)	Integer

21-24	Stop time (GMT)	Integer
28-32	Duration (min)	Integer
40	Operational mode (0 = drifting; 1 = steaming)	Integer
43-48	u component (m/s)	Real F6.2
51-58	v component (m/s)	Real F6.2
67-72	u component (kn)	Real F6.2
75-80	v component (kn)	Real F6.2

Ship Position Data

Column	Type of data	Variable
1	Ship ID number	Integer
5-7	Julian day	Integer
13-14	Calendar day	Integer
20-23	Time (GMT)	Integer
29-30	Latitude (deg)	Navigational fix data
35-36	Latitude (min)	Navigational fix data
42-44	Longitude (deg)	Navigational fix data
49-50	Longitude (min)	Navigational fix data
59-60	Latitude (deg)	Adjusted positions
65-66	Latitude (min)	Adjusted positions
72-74	Longitude (deg)	Adjusted positions
79-80	Longitude (min)	Adjusted positions

Tables 2-3 and 2-4 contain inventories of the ship operations and navigation data.

Table 2-3.--Inventory of ship operations data

Magnetic tape No.	Microfilm reel No.	Description
B9622*		All ship operations data from all fixed ships.
	DOC.-1	Tabulation of all fixed ship operations data.
	"	BOMEX Event Log.
	DOC.-7**	Ship Operations Form for all fixed ships.

*One of six files on the tape.
**Card 4 on this reel. Also on this microfilm are Card 2 - BLIP Calibration Form, and Card 3 - STD Observation Form.

Table 2-4.--Inventory of renavigation (ship motion and position) data

	Magnetic tape No. 8960		
Data	File No.	Ship	Date, 1969
Ship motion	1	Rainier	May 24 to May 28
"	2	"	May 30 to June 4
"	3	"	June 5 to June 10
"	4	Mt. Mitchell	May 24 to May 28
"	5	"	May 30 to June 4
"	6	"	June 6 to June 10
"	7	Discoverer	May 25 to June 3
"	8	"	June 4
"	9	"	June 6 to June 10
Ship position	10	Rainier	May 24 to May 28
"	11	"	May 30 to June 4
"	12	"	June 5 to June 10
"	13	Mt. Mitchell	May 24 to May 28
"	14	"	May 30 to June 4
"	15	"	June 6 to June 10
"	16	Discoverer	May 25 to June 3
"	17	"	June 4
"	18	"	June 6 to June 10
Ship motion	19	Oceanographer	June 21 to June 26
"	20	"	June 28 to June 30

Table 2-4.--Inventory of renavigation (ship motion and position) data (continued)

		Magnetic tape No. 8960	
Data	File No.	Ship	Date, 1969
Ship motion	21	Rainier	June 21 to June 26
"	22	"	June 28 to July 1
"	23	Mt. Mitchell	June 21 to June 26
"	24	"	June 28 to July 2
"	25	Discoverer	June 21 to June 26
"	26	"	June 28 to July 2
"	27	Rockaway	June 21 to June 26
"	28	"	June 28 to June 29
"	29	"	June 30 to July 2
Ship position	30	Oceanographer	June 21 to June 26
"	31	"	June 28 to June 30
"	32	Rainier	June 21 to June 26
"	33	"	June 28 to July 1
"	34	Mt. Mitchell	June 21 to June 26
"	35	"	June 28 to July 2
"	36	Discoverer	June 21 to June 26
"	37	"	June 28 to July 2
"	38	Rockaway	June 21 to June 26
"	39	"	June 28 to June 29
"	40	"	June 30 to July 2
		Microfilm reel No. NAV-1	
	Computer tabulation of the ship motion and position data		

2.4 Supplementary Material Available From the Archive

Microfilm reel No. DOC-5, containing the SCARD Event Log for all ships, all periods.

Microfilm reel No. DOC-8, consisting of Card 5 - Observation Summary Form for all ships, all periods; Card 6 - System parameter failure, all periods; ods; Card 7 - Slant range and azimuth, the Rockaway, all periods; and Card 9 - Boom Calibration Form, all ships, all periods.

2.5 Material in Temporary Storage

Hard-copy materials, consisting of original manual logs, strip charts, and the like, have been put into temporary storage for a 3-yr period. Inquiries concerning these materials should be addressed to the Center for Experiment Design and Data Analysis, EDS, NOAA, Page Bldg. 2, Washington, D.C. 20235.

3. BOOM SURFACE METEOROLOGICAL DATA SET

Meteorological data were obtained from instruments mounted on a boom extending from the bow of each ship approximately 10 m above the sea surface. These were recorded automatically on the Signal Conditioning and Recording Device (SCARD) at 30-s intervals. Parameters measured aboard all five ships were dry- and wet-bulb temperatures, relative humidity, sea-surface temperature, wind direction, and windspeed. In addition, boom instrumentation on the Discoverer, Rainier, and Rockaway included radiometers and pyranometers that yielded data on incident, reflected, and net radiation. Table 3-1 lists the sensors used for the various measurements.

Barometric pressure was also recorded automatically on SCARD. During BOMEX Period I, the Oceanographer, Rainier, Mt. Mitchell, and Rockaway carried the Rosemount Engineering Company's capacitive pressure sensing unit, Model 1101-A33BADB (999.0 to 1,010 mb = 0 to 5 V d.c.). The Discoverer also carried a DPD barometer developed by the National Center for Atmospheric Research (NCAR). However, the Rockaway's Rosemount sensor did not work, and the Rosemount unit aboard the Discoverer was transferred to the Rockaway for measurements during Periods II, III, and IV.

Ship's true heading was recorded in SCARD from the output of a precision potentiometer mounted to a repeater that was slaved to the master gyro (0 to 360° = 0 to 5 V d.c.) on each of the ships.

Routine maintenance and calibration were performed daily for the boom sensors and during the two of the four in-port periods for the gyro and Rosemount barometers. The DPD barometer was calibrated at NCAR before and after the field operations.

3.1 Data Processing

The original boom data were digitized at NASA's Mississippi Test Facility (MTF), where two-samples-per-minute (2 spm) time series were produced for each parameter. These digitized tapes were used as the base in the final processing to generate three data sets: (1) "cleaned-up" 2-spm values on magnetic tape, (2) edited 10- and 30-min averages, and (3) time-series plots of 10-min averages on 35-mm microfilm. The transfer coefficients used in converting the digitized data to engineering units are given in table 3-2.

In generating the 2-spm data, the original MTF time series were checked against manual observations and logs, and periods of known noise or obviously erroneous data were deleted. No further editing was done. However, for the 10- and 30-min averages, a least-squares routine was applied to the original 2-spm data to eliminate noise spikes before calculations were made. Of the 20 values used in forming the average, not more than 4 falling outside a prescribed limit were rejected. Some spikes may therefore remain in the data. If the number of values was less than 10, an average was not derived.

Table 3-1.--Boom sensors

Measurement	Sensor	Remarks
Air dry-bulb temperature	Thermivolt thermometer, Model #752-10, Yellow Springs Instruments, Inc.	20 to 35°C
Air wet-bulb temperature	Thermivolt thermometer, Model #752-10, Yellow Springs Instruments, Inc.	20 to 35°C
Sea-surface temperature	Thermivolt thermometer, Model #752-10, Yellow Springs Instruments, Inc.	20 to 35°C
Relative humidity	Relative humidity transducer, Model No. 15-7012, Hydrodynamics, Inc.	0.0 to 100%
Windspeed relative to ship	Windspeed transmitter, F420 series, U.S. Weather Bureau	0 to 30 m/s
Incident solar radiation	Pyranometer, Model 15, Eppley Laboratory	Spectral range up to 2.5 μ
Incident terrestrial radiation	Pyranometer, Model 15, Eppley Laboratory	Spectral range up to 2.5 μ
Net total radiation	Suomi-Fransilla-Izlitser ventilated net radiometer	Spectral range 0.5 to 40 μ
Precipitation	Rain gage	Manually recorded

Table 3-2.--Final transfer equations and coefficients used for conversion of measured voltage counts to scientific units

Ship	Dry-bulb temperature (T_{DB})	Wet-bulb temperature (T_{WB})	Sea-surface temperature (T_{SS})
	T_{DB}, T_{WB}, T_{SS} $= k_1V + k_2$, where V = counts/2000		
		Period I	
Oceanographer	T = 0.00140(counts) + 14.9°C	T = 0.00140(counts) + 14.9°C	T = 0.00140(counts) + 14.9°C
Rainier	0.00140(counts) + 15.0°C	0.00140(counts) + 15.0°C	0.00140(counts) + 15.0°C
Mt. Mitchell	0.00141(counts) + 15.0°C	0.00142(counts) + 14.99°C	0.00140(counts) + 15.0°C
Discoverer	0.00140(counts) + 15.0°C	0.00140(counts) = 15.0°C	0.00140(counts) + 15.0°C
Rockaway	(did not work)	(did not work)	(did not work)
		Period II	
Oceanographer	T = 0.00140(counts) + 20.0°C	T = 0.00140(counts) + 20.0°C	T = 0.00140(counts) + 20.0°C
Rainier	0.00140(counts) + 20.0°C	0.00140(counts) + 20.0°C	0.00140(counts) + 20.0°C
Mt. Mitchell	0.00140(counts) + 20.0°C	0.00140(counts) + 20.0°C	0.00140(counts) + 20.0°C
Discoverer	0.00140(counts) + 20.0°C	0.00140(counts) + 20.0°C	0.00140(counts) + 20.0°C
Rockaway	0.00140(counts) + 20.0°C	0.00140(counts) + 20.0°C	0.00140(counts) + 20.0°C
		Period III	
		All ships same as in Period II	
		Period IV	
		All ships same as in Period II	

Table 3-2.--Final transfer equations and coefficients used for conversion of measured voltage counts to scientific units (continued)

Ship	Windspeed (WS)	Wind direction (WD)	Ship's gyro (G)
	WD, WS, G $= k_1V + k_2$, where V = counts/2000		
		Period I	
Oceanographer	WS = 0.002522(counts) + 1.03 m/s	WD = 0.036(counts) + 167°	G = 0.036(counts) + 0°
Rainier	0.002510(counts) + 1.03 m/s	0.036(counts) + 162°	0.036(counts) + 0°
Mt. Mitchell	0.002466(counts) + 1.03 m/s	0.036(counts) + 162°	0.036(counts) + 280°
Discoverer	0.002476(counts) + 1.03 m/s	0.036(counts) + 179°	0.036(counts) + 0°
Rockaway	(did not work)	(did not work)	(did not work)
		Period II	
Oceanographer	WS = 0.002522(counts) + 1.03 m/s	WD = 0.036(counts) + 167°	G = 0.036(counts) + 5°
Rainier	0.002510(counts) + 1.03 m/s	0.036(counts) + 167°	0.036(counts) + 0°
Mt. Mitchell	0.002466(counts) + 1.03 m/s	0.036(counts) + 162°	0.036(counts) + 290°
Discoverer	0.002476(counts) + 1.03 m/s	0.036(counts) + 179°	0.036(counts) + 0°
Rockaway	(did not work)	(did not work)	0.036(counts) + 0°
		Period III	
Oceanographer	WS = 0.002522(counts) + 1.03 m/s	WD = 0.036(counts) + 167°	G = 0.036(counts) + 5°
Rainier	0.002510(counts) + 1.03 m/s	0.036(counts) + 167°	0.036(counts) + 0°
Mt. Mitchell	0.002466(counts) + 1.03 m/s	0.036(counts) + 162°	0.036(counts) + 290°
Discoverer	0.002476(counts) + 1.03 m/s	0.036(counts) + 179°	0.036(counts) + 0°
Rockaway	0.002252(counts) + 1.03 m/s	0.036(counts) + 167°	0.036(counts) + 0°
		Period IV	
		All ships same as in Period III	

Table 3-2.--Final transfer equations and coefficients used for conversion of measured voltage counts to scientific units (continued)

Ship	Relative humidity (RH)	Sea-level pressure (PR)
	$\frac{RH}{PR} = k_1V + k_2$, where V = counts/2000	
	Period I	
Oceanographer	RH = 0.01(counts) + 0.0%	PR = 0.003400(counts) + 999.0 mb
Rainier	0.01(counts) + 0.0%	0.003350(counts) + 1001.1 mb
Mt. Mitchell	0.01(counts) + 0.0%	0.003400(counts) + 999.5 mb
Discoverer	0.01(counts) + 0.0%	0.003400(counts) + 1000.4 mb
Rockaway	(did not work)	(did not work)
	Period II	
Oceanographer	RH = 0.01(counts) + 0.0%	PR = 0.003400(counts) + 1000.1 mb
Rainier	0.01(counts) + 0.0%	0.003400(counts) + 1000.3 mb
Mt. Mitchell	0.01(counts) + 0.0%	0.003400(counts) + 1000.0 mb
Discoverer*	0.01(counts) + 0.0%	0.003360(counts) + 1003.1 mb
Rockaway	0.01(counts) + 0.0%	0.003400(counts) + 1000.1 mb
	Period III	
Oceanographer	RH = 0.01(counts) + 0.0%	PR = 0.003400(counts) + 1000.4 mb
Rainier	0.01(counts) + 0.0%	0.003400(counts) + 999.8 mb
Mt. Mitchell	0.01(counts) + 0.0%	0.003400(counts) + 1000.0 mb
Discoverer*	0.01(counts) + 0.0%	0.003360(counts) + 1003.1 mb
Rockaway	0.01(counts) + 0.0%	0.003400(counts) + 1000.2 mb
	Period IV	
Oceanographer	RH = 0.01(counts) + 0.0%	PR = 0.003400(counts) + 1000.6 mb
Rainier	0.01(counts) + 0.0%	0.003400(counts) + 1000.3 mb
Mt. Mitchell	0.01(counts) + 0.0%	0.003400(counts) + 1000.1 mb
Discoverer*	0.01(counts) + 0.0%	0.003360(counts) + 1003.1 mb
Rockaway	0.01(counts) + 0.0%	0.003400(counts) + 1000.3 mb

*NCAR barometer used. Rosemount barometers were installed on all other ships.

Table 3-2.--Final transfer equations and coefficients used for conversion of measured voltage counts to scientific units (continued)

	Incident (RI)	Reflected (RR)	Net (RN)
	RI, RR, RN $= k_1V + k_2$, where V = counts/2000		
		Period I	
	RI =	RR =	RN =
Rainier	0.00013330(counts) + 0.0 ly/min	0.00006935(counts) + 0.0 ly/min	0.00044756(counts) + 0.0 ly/min
Discoverer	0.00013830(counts) + 0.0 ly/min	0.00006545(counts) + 0.0 ly/min	0.00038375(counts) + 0.0 ly/min
Rockaway	0.00022990(counts) + 0.0 ly/min	0.00012310(counts) + 0.0 ly/min	0.00037486(counts) + 0.0 ly/min
		Period II	
	RI =	RR =	RN =
Rainier	0.00020000(counts) + 0.0 ly/min	0.00006935(counts) + 0.0 ly/min	0.00044756(counts) + 0.0 ly/min
Discoverer	0.00020745(counts) + 0.0 ly/min	0.00006545(counts) + 0.0 ly/min	0.00019187(counts) + 0.0 ly/min
Rockaway	0.00022990(counts) + 0.0 ly/min	0.00012310(counts) + 0.0 ly/min	0.00018719(counts) + 0.0 ly/min
		Period III	
	RI =	RR =	RN =
Rainier	0.00020000(counts) + 0.0 ly/min	(did not work)	0.00044756(counts) + 0.0 ly/min
Discoverer	0.00020745(counts) + 0.0 ly/min	0.00006545(counts) + 0.0 ly/min	0.00019187(counts) + 0.0 ly/min
Rockaway	0.00022990(counts) + 0.0 ly/min	(did not work)	(did not work)
		Period IV	
	RI =	RR =	RN =
Rainier	0.00020000(counts) + 0.0 ly/min	0.00006935(counts) + 0.0 ly/min	0.00044756(counts) + 0.0 ly/min
Discoverer	0.00020745(counts) + 0.0 ly/min	0.00006545(counts) + 0.0 ly/min	0.00022837(counts) + 0.0 ly/min
July 22	0.00019635(counts) + 0.0 ly/min	(did not work)	0.00035873(counts) + 0.0 ly/min
Rockaway	0.00022990(counts) + 0.0 ly/min	0.00012331(counts) + 0.0 ly/min	0.0002228 (counts) + 0.0 ly/min

3.1.1 Wind Direction and Windspeed

Final wind direction was converted from measured relative wind direction to true wind direction by inclusion of ship's headings. Ship's speed, however, which was usually less than 1 m/s, was not included. Therefore, the boom wind velocities are relative to the ship's velocity. To obtain true heading, a correction had to be made because of voltage reduction at the sensing potentiometer. For this correction, which was applied to the gyro voltage before conversion to engineering units, the following equation (an approximation) was used:

$$v = v_i(1.00000 + 5.10204 \times 10^{-10}/v_i(10{,}000 - v_i) \quad ,$$

where v = corrected voltage in counts, and v_i = recorded voltage in counts.

The renavigated ship motion and position data for Periods I, II, and III, when, after mooring failure, the ships operated in alternating steaming and drifting modes, were not taken into account in processing the boom data. The corrected motion and position data are discussed in section 2 of this report.

3.1.2 Sea-Surface Temperature

Temperature readings from the thermistor suspended from the boom did not always compare favorable with Nansen bottle measurements. On the Oceanographer and Discoverer the differences amounted to only ± 0.3°C, but in some cases they were as high as ± 1.0°C. The average values by which the Nansen readings exceeded those of the thermistor are given in table 3-3. However, since the two sensors were mounted on different platforms and possibly at slightly different depths, no attempt was made to apply these corrections to the final boom data.

3.1.3 Humidity

Both the wet-bulb temperature (T_{WB}) sensor and the relative humidity (RH) transducer values contained biases, and there were problems with drift. The T_{WB} readings were often contaminated for several hours because the wick had dried out. Such segments of erroneous readings were eliminated during the final processing. The RH values, however, showed trends that could not be defined, and much of these data may be questionable.

The 10- and 30-min averages include computed values of relative humidity, RH; wet-bulb temperature, T_{WB}; specific humidity, Q; u and v wind components; and wind direction relative to the ship's boom.

In deriving an expression for the T_{WB} computation, T_{WB} was first expressed by

$$E_s(T_{WB}) - (RH/100) * E_s(T_{DB}) = 0.00066 * P * (1+0.00115 * T_{WB}) * (T_{DB} - T_{WB}) \quad , \quad (1)$$

Table 3-3.—Average differences between the Nansen readings and the boom sea-surface temperatures—Nansen minus boom

Observation Period	Beginning Date	Beginning Time (GMT)	Ending Date	Ending Time (GMT)	Difference* (°C)
		Oceanographer			
I	May 3	through	May 15		+0.3
II	May 24	00:00:00	May 26	10:15:00	+0.3
II	May 26	10:15:00	June 10	23:59:59	+0.2
III	June 21	00:00:00	June 26	23:59:59	+0.1
III	June 27	00:00:00	June 30	10:15:00	0.0
IV	July 12	05:00:00	July 15	01:59:59	0.0
IV	July 15	02:00:00	July 23	23:59:59	+0.3
IV	July 24	00:00:00	July 29	05:00:00	+0.2
		Rainier			
I	No Nansen cast temperatures available				
II	May 24	00:00:00	May 25	11:30:00	+0.2
II	May 25	11:30:01	May 27	23:59:59	0.0
II	Thermistor measurements missing from May 28 through May 29				
II	May 30	00:00:00	June 4	15:30:00	+0.2
II	June 4	15:30:01	June 4	23:59:59	0.0
II	June 6	00:00:00	June 10	08:30:00	+0.1
III	June 21	00:00:00	June 28	23:59:59	+0.2
III	June 29	00:00:00	July 1	22:30:00	0.0
IV	July 11	00:00:00	July 14	16:00:00	+0.7
IV	July 14	16:00:01	July 17	15:00:00	+0.8
IV	July 17	15:00:01	July 18	03:00:00	+0.7
IV	July 18	03:00:00	July 18	16:00:00	+0.6
IV	July 18	16:00:01	July 19	23:59:59	+0.5
IV	July 20	00:00:00	July 21	09:00:00	+0.4
IV	July 21	09:00:01	July 28	23:59:59	+0.3

Table 3-3.—Average differences between the Nansen readings and the boom sea-surface temperatures—Nansen minus boom (continued)

Observation Period	Beginning Date	Beginning Time(GMT)	Ending Date	Ending Time(GMT)	Difference* (°C)
			Mt. Mitchell		
I	Data bad from May 3 through 14; no thermistor readings				
II	May 24	00:00:00	June 10	23:59:59	+0.6
III	June 21	21:30:00	June 22	09:00:00	+1.0
III	June 22	09:00:01	June 23	14:00:00	+0.5
III	June 23	14:00:01	June 26	23:59:59	+0.1
III	June 28	00:00:00	June 28	23:59:59	0.0
III	June 29	00:00:00	June 30	23:59:59	+0.2
IV	July 11	00:00:00	July 28	23:59:59	+0.6
			Discoverer		
I	May 7	00:00:00	May 9	16:15:00	+0.2
I	May 9	16:15:01	May 10	14:30:00	0.0
I	May 10	14:30:01	May 11	16:05:00	-0.4
I	May 11	16:05:01	May 12	16:25:00	-0.3
I	May 12	16:25:01	May 14	23:59:59	-0.1
II	May 24	through	June 10		0.0
III	June 21	09:00:00	June 21	20:00:00	+0.1
III	June 21	20:00:01	June 23	14:30:00	+0.2
III	June 23	14:30:01	June 24	14:30:00	+0.1
III	June 24	14:30:01	July 1	23:59:59	0.0
IV	July 11	14:30:00	July 11	23:59:59	-0.2
IV	July 12	00:00:00	July 28	00:00:00	0.0
			Rockaway		
	No Nansen cast temperatures available				

*Correction not applied to final boom data.

where

T_{WB} = wet-bulb temperature, degrees Celsius;
T_{DB} = dry-bulb temperature, degrees Celsius;
P = ambient temperature, millibars;
E_s = saturation vapor pressure over water, millibars; and
RH = ambient relative humidity, percent;

and by Tetens' equation (Handbook of Meteorology, McGraw-Hill Book Co., N.Y., 1945, p. 343)

$$E_s(T_{WB}) = 6.11 * 10^{\left(\frac{7.5 * T_{WB}}{237.3 + T_{WB}}\right)} \qquad (2)$$

When eq. (2) is substituted into eq. (1), the resulting equation cannot be solved by the usual procedure of finding the root of a polynomial. Thus, to find T_{WB}, the following equation, which approximates the wet-bulb depression, was introduced:

$$[T_{DB} - T_{WB}^{(o)}]_{p=1000} = 6.6 + 2 *\left(\frac{T_{DB} - 20}{10}\right) - 3 *\left(\frac{RH-50}{20}\right) - 1 *\left(\frac{T_{DB} - 20}{10}\right) *\left(\frac{RH-50}{20}\right)$$

where $T_{WB}^{(o)}$ is a reasonably close first approximation of T_{WB}. Tetens' formula can now be accurately written in the form

$$E_s(T_{WB}) \doteq E_s[T_{WB}^{(o)}] * [1 + a_1(\Delta T) + a_2(\Delta T)^2] \quad ,$$

where $\Delta T \equiv T_{WB} - T_{WB}^{(o)}$. Now ΔT is the solution to a quadratic equation and is added to the first estimated depression to give the true depression. This method gives an accuracy of about $\pm$ 0.01°C for the data set in question.

Relative humidity is computed from

$$RH = 100[E(T_{DB})/E_s(T_{DB})] \quad ,$$

where $E(T_{DB})$, the ambient vapor pressure in millibars, is computed from the psychrometric equation

$$E(T_{DB}) = E_s(T_{WB}) - 0.00066 * P * (1 + 0.00115 + T_{WB}) * (T_{DB} - T_{WB}) \quad .$$

Here, $E_s(T_{WB})$ is the saturation vapor pressure in millibars at the wet-bulb temperature, T_{WB}, and is computed from Tetens' equation

$$E_s(T_{WB}) = 6.11 * 10^{\left(\frac{7.5 * T_{WB}}{237.3 + T_{WB}}\right)} \quad .$$

By substituting T_{DB} for T_{WB}, the saturation vapor pressure at dry-bulb temperature, $E_s(T_{DB})$, is also derived from Tetens' equation.

Specific humidity, Q, in grams per kilogram, is computed from

$$Q = 6.22 * E(T_{DB})'/[P_{(mb)} - 0.378 * E(T_{DB})'] \quad ,$$

where $E(T_{DB})'$ is a function of relative humidity as measured by the boom instrument (RH'). By solving the RH equation for $E(T_{DB})$, we can form the expression

$$E(T_{DB})' = (RH'/100) * E_s * (T_{DB}) \quad ,$$

and calculate $E_s(T_{DB})$ from Tetens' equation as described previously.

3.1.4 Atmospheric Pressure

All five ships were equipped with Weather Service precision aneroid barometers, scaled in millibars. Operating procedures called for comparison of these barometers with a portable standard during in-port periods to determine the proper instrument and barometric corrections. With these corrections, the observers were to measure sea-level pressure to the nearest 0.10 mb. As noted earlier, at the beginning of the experiment, all ships carried Rosemount transducers, and the Discoverer, in addition, was equipped with an NCAR DPD barometer during Observation Period I.

Examination of the initial Rosemount and DPD pressure values revealed many inconsistencies, stemming from insufficient in-port calibration documentation, and uncertainties as to whether (1) station or sea-level pressures had been recorded and (2) corrections had been applied by adjustments of the instruments during in-port periods. Pressure values for the Rockaway for Period I are missing, because the Rosemount transducer was malfunctioning. The Discoverer's Rosemount instrument was transferred to the Rockaway at the end of Period I, producing few data during Period II, but continuous records for Periods III and IV. Several methods were used in an attempt to solve these problems.

First, 10-min average Rosemount station pressure values generated with the manufacturer's transfer equations were plotted as time series for all periods and ships, except for the Discoverer, all periods, and the Rockaway, Periods I and II. The manually recorded 1 1/2-hourly sea-level aneroid pressure values were added to these plots, which were then inspected for errors.

Since the Rosemount values were station pressures, they should have differed from the sea-level aneroid values by an amount equal to the barometric correction for the Rosemount instrument's height above sea-level. This was not the case, however, and the average differences between the two (sea-level aneroid values minus corresponding transducer station pressures) were determined for each observation period. The results are shown in table 3-4.

To further define the differences between the two types of barometer readings, mean sea-level pressure charts were constructed for the BOMEX area for each observation period (figs. 3-1 to 3-4). This was done by plotting smoothed values extracted from daily charts prepared routinely by the National Hurricane Center for 0000 to 1200 GMT, at the BOMEX ship positions. Comparison of these results with similarly averaged values for the same times based on the shipboard aneroid sea-level readings showed that the aneroid values tended to fit a smoothed isobaric pattern, except for the Rainier, Period I, and the Mt. Mitchell, Periods II, III, and IV. The average Rainier aneroid value was slightly more than 1 mb lower than the value plotted on the chart, and a correction of +1 mb was therefore applied to the Rainier data for Period I, as shown in table 3-4. In the case of the Mt. Mitchell, the reported aneroid pressures were substantially higher than the smoothed sea-level chart values. However, if the former had been adjusted to conform entirely with the charts, a forced perturbation in the isobars would have resulted, which would not have been realistic in view of the continuous, smooth flow suggested by the surface winds measured on this ship, as well as on the Discoverer and on the island of Barbados. Based on these considerations, and on a momentum balance analysis done at CEDDA, a correction of -0.4 mb was applied to the Mt. Mitchell data for Periods II, III, and IV (table 3-4).

The sum of the aneroid minus transducer ("A-T") and the adjusted aneroid ("Adj. A") values in table 3-4 was added algebraically to the k_2 term in the initial transfer equations to obtain the final sea-level pressures for the Rosemount and NCAR DPD transducers, shown as "Adj. T" in table 3-4. In the case of the Discoverer, however, a completely modified transfer equation had to be applied to the data for Periods II, III,and IV. The initial transfer equation for conversion to engineering units was

$$\text{Pressure} = k_1 V(\text{counts}) + k_2 \quad ,$$

where k_1 = -0.003478 and k_2 = +1033.0 mb. It was later discovered that these k values were erroneous, and another attempt was made at NCAR to derive a correct set of k terms. The results were k_1 = +0.003360 and k_2 = 1000.5 mb. However, a comparison of the pressures obtained with this second set of k terms with the pressures for the other ships and with the values extracted from the sea-level charts indicated that the k_2 term was too low. Based on additional studies at CEDDA, a correction factor of +2.6 mb (table 3-4) was applied to the Discoverer data for the Periods II, III, and IV, and k_2 = 1003.1 mb (table 3-2, sec. 3.1) was used in the final processing of these data.

3.1.5 Radiation

Correction factors for the initial net radiation data were furnished by P. Kuhn, Atmospheric Physics and Chemistry Laboratory, Environmental Research Laboratories, NOAA, Boulder, Colo. 80302. The resulting transfer coefficients are given in table 3-2, section 3.1.

3.2 Archive Format and Data Inventory

The final 2-spm boom data are archived on seven-track, 556 BPI, BCD magnetic tape, as well as on microfilm. The first file consists of ANSI

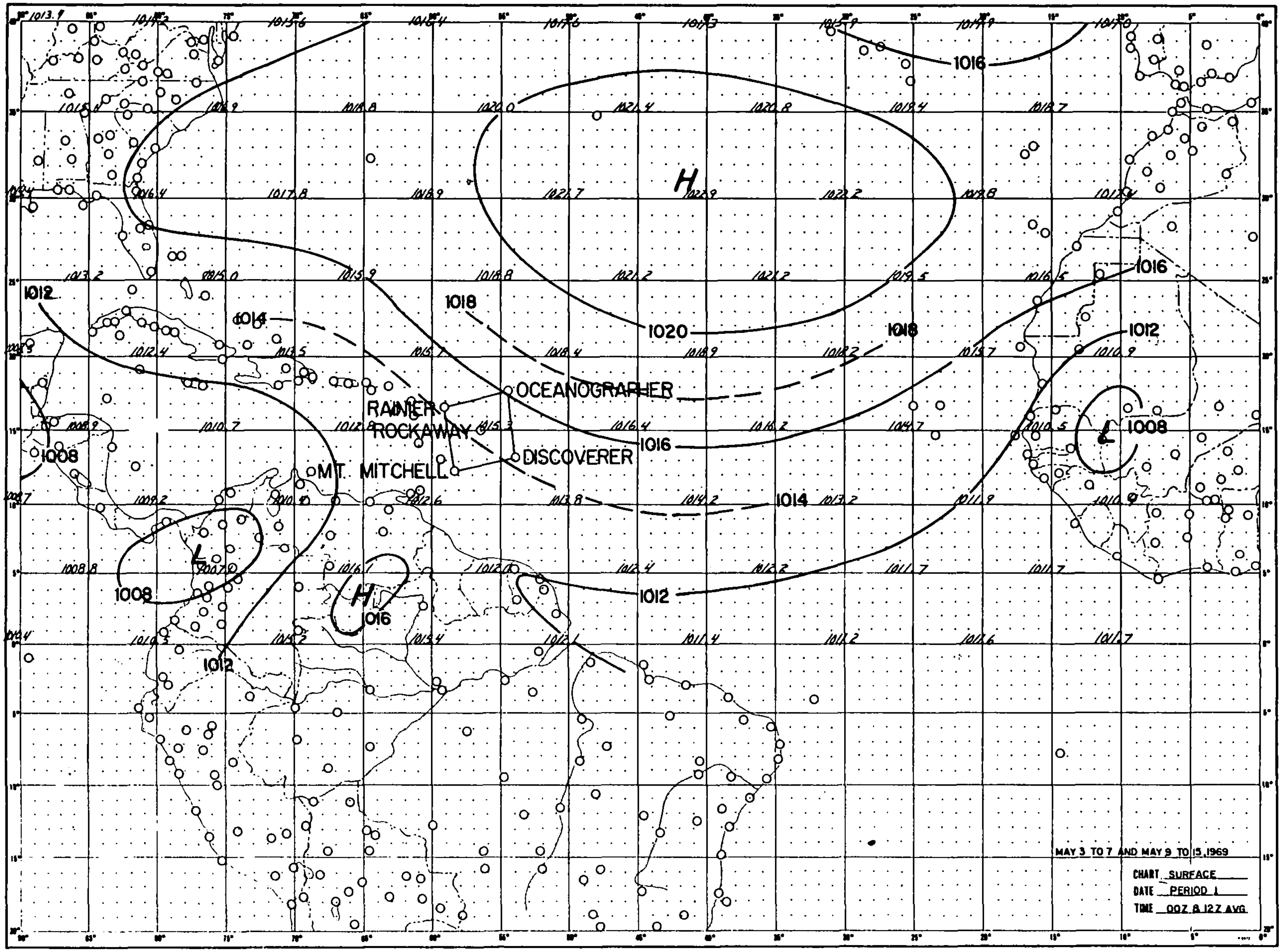


Figure 3-1.--Mean sea-level chart, Period I.

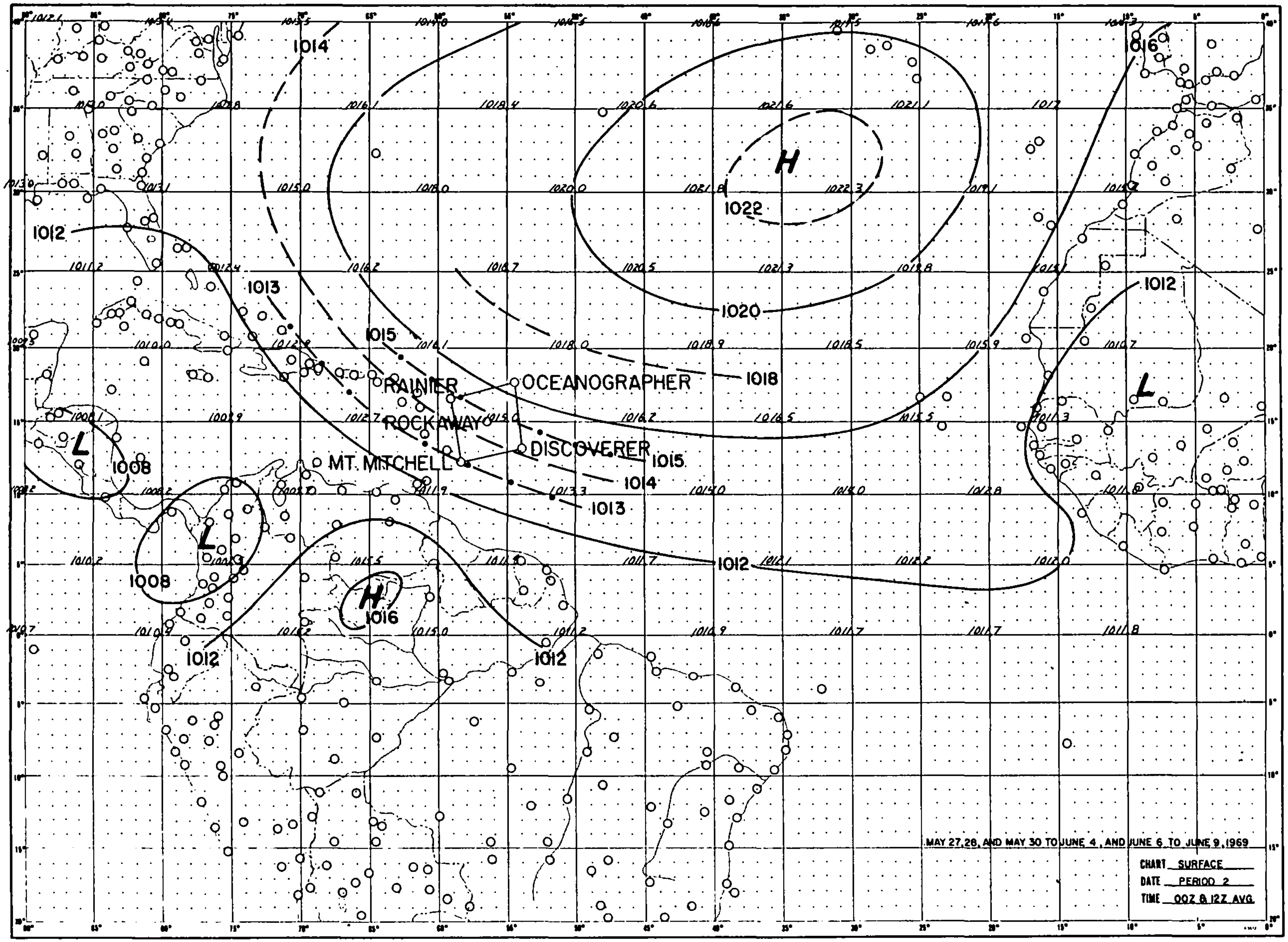


Figure 3-2.--Mean sea-level chart, Period II.

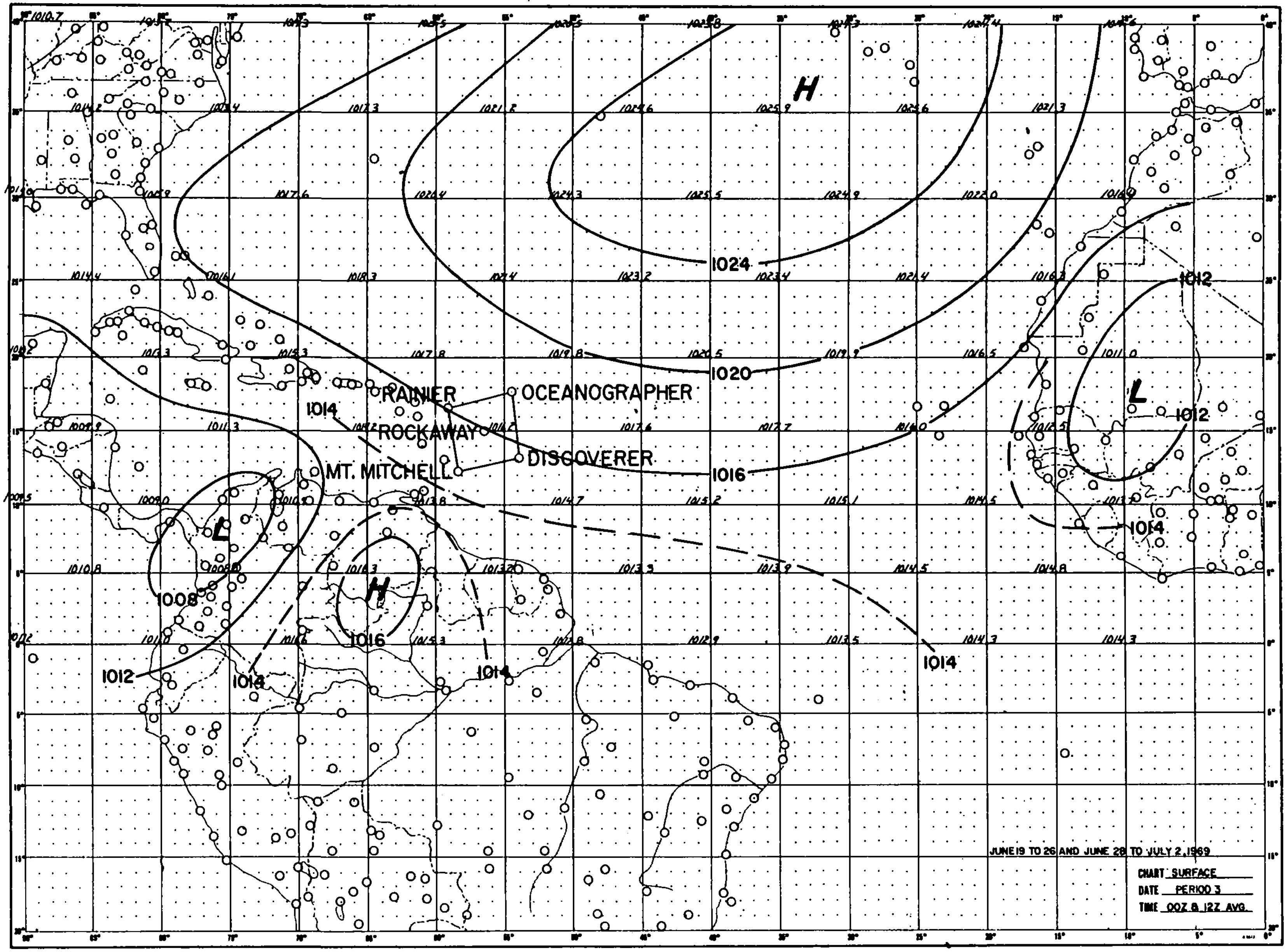


Figure 3-3.--Mean sea-level chart, Period III.

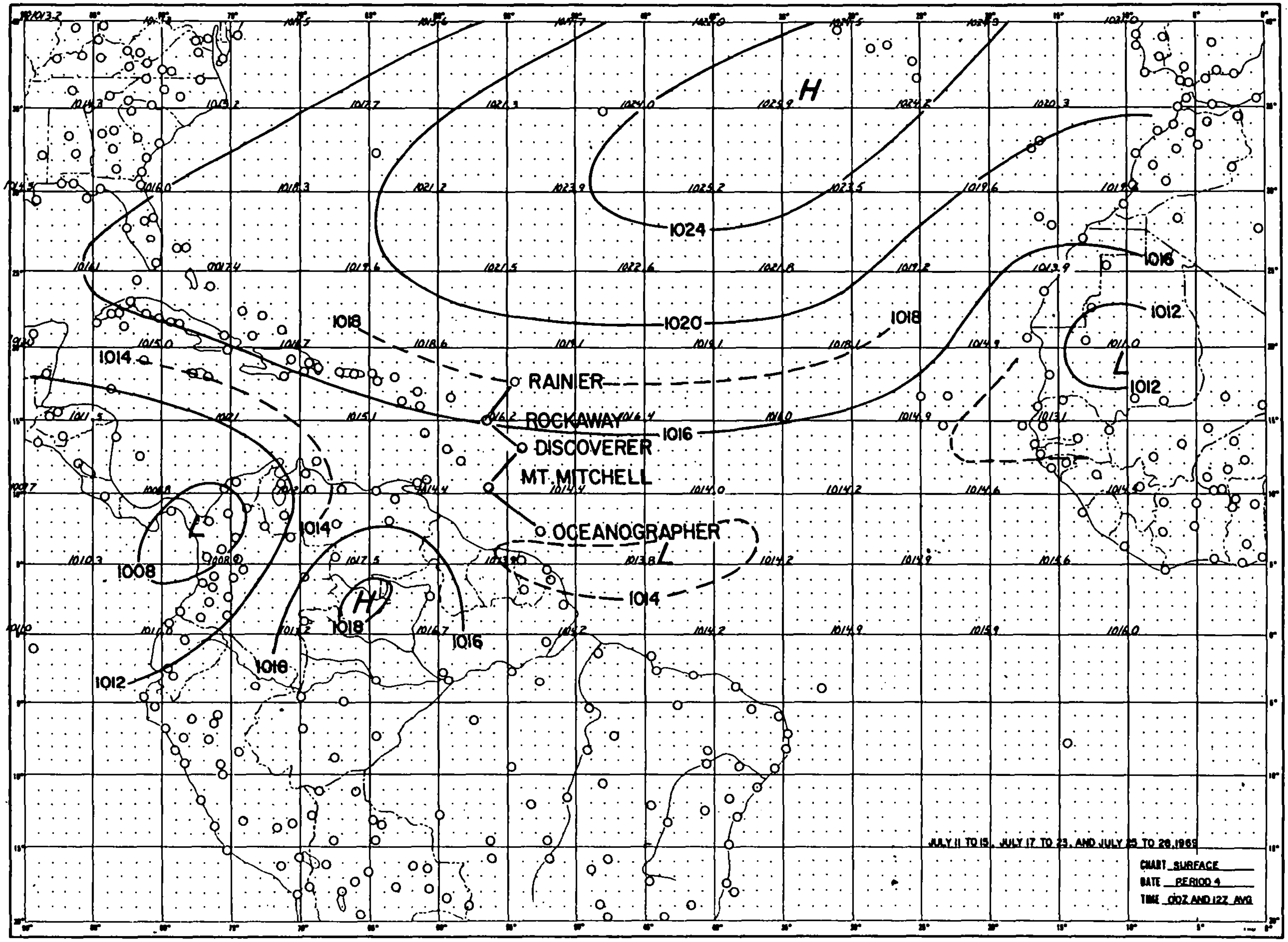


Figure 3-4.--Mean sea-level chart, Period IV.

Table 3-4.—Pressure differences and adjustments (mb)

	Period I		Period II	Period III	Period IV	Barometer height correction (1)
Oceanographer	May 3-9	May 11-14				
A-T (2)	+0.21	-0.09	+1.14	+1.37	+1.65	+0.9
Adj. A (3)	0.0	0.0	0.0	0.0	0.0	
Adj. T (4)	0.0	0.0	+1.1	+1.4	+1.6	
Rainier						
A-T	-1.39		+1.30	+0.85	+1.33	+1.0
Adj. A	+1.0		0.0	0.0	0.0	
Adj. T	-0.4		+1.3	+0.8	+1.3	
Rockaway						
A-T	---		+1.06	+1.15	+1.31	+0.8
Adj. A	0.0		0.0	0.0	0.0	
Adj. T	---		+1.1	+1.2	+1.3	
Discoverer	May 3-7	May 9-15				
A-T	---	---	---	---	---	+0.8
Adj. A	0.0	0.0	0.0	0.0	0.0	
Adj. T	+4.4	+5.8	+2.6*	+2.6*	+2.6*	+0.5*
Mt. Mitchell						
A-T	+0.54		+1.39	+1.41	+1.52	+1.0
Adj. A	0.0		-0.4	-0.4	-0.4	
Adj. T	+0.5		+1.0	+1.0	+1.0	

(1) Correction for height of barometer above sea level.
(2) Aneroid (sea level) minus transducer (station) pressure values.
(3) Adjustment of aneroid sea-level values to fit mean sea-level charts.
(4) Adjustment of pressure transducer values to agree with mean sea-level charts.
* DPD NCAR pressure transducer used.

standard label, followed by end-of-file. The second file consists of an 80-character descriptive tape header, followed by end-of-file. The third file is repeated for each day. It consists of one or more data records each 1,540 characters long, and is preceded by a header record and followed by an end-of-file. The 350-character header record identifies the data by type, ship name, and Julian day. A double end-of-file follows the last data file on the tape.

An inventory of the 2-spm boom data is given in table 3-5.

The 10- and 30-min average boom data are also archived on both magnetic tape and microfilm. The format is shown in figure 3-5, and an inventory of these data is given in table 3-6.

3.3 Supplementary Material Available From the Archive

Microfilm reel No.	Description
DOC-5	SCARD Event Log.
DOC-6	Card 1 - Surface Observation Form; also on this reel is Card 0 - Rawinsonde Form.
DOC-7	Card 4 - Ship Operations Form; also on this reel are Card 2 - BLIP Calibration Form and Card 3 - STD Observation Form.
DOC-8	Card 9 - Boom Calibration Form; also on this reel are Card 5 - Observation Summary Form, Card 6 - System parameter failure, and Card 7 - Slant range and azimuth, Rockaway.

Note that the information on reels DOC-6 and DOC-7 is also contained on magnetic tape No. B08667.

Documents	Title
(BO-1-4-1000) R-066-17	BOMEX Software System, Program Documentation for Boom/Surface-Standard Engineering Units Conversion Program, General Electric, May 1971.
(BO-1-4A-1000)	BOMEX Software System, Program Documentation for Boom/Surface Average, General Electric, June 1971.
(BO-1-5-1000) R-066-19	BOMEX/Software System, Program Documentation for Boom/Surface Plot 30-Second, General Electric June 1971.

3.4 Material in Temporary Storage

Hard-copy material, consisting of original manual logs, strip charts, and the like, has been placed in temporary storage for a period of 3 years. Inquiries concerning this material should be addressed to the Center for Experiment Design and Data Analysis, EDS, NOAA, Washington, D.C. 20235.

Table 3-5.--Inventory of 2-spm boom data

Magnetic tape No.	Microfilm reel No.	Ship	BOMEX Observation Period	Beginning			Ending		
				Julian day	Date (1969)	Time (GMT)	Julian day	Date (1969)	Time (GMT)
B08120	BO-1	Oceanographer	I	123	May 3	0000	135	May 15	0415
"	"	"	II	144	May 24	1235	161	June 10	0800
"	"	"	III	172	June 21	0000	181	June 30	0930
"	"	"	IV	193	July 12	0945	210	July 29	0400
B08121	"	Rainier	I	121	May 1	1000	134	May 14	1930
"	"	"	II	144	May 24	0000	161	June 10	0800
"	"	"	III	172	June 21	0000	182	July 1	2200
"	"	"	IV	192	July 11	0730	209	July 28	2230
B08122	"	Mt. Mitchell	I	123	May 3	0100	134	May 14	2300
"	"	"	II	144	May 24	0000	161	June 10	0615
"	"	"	III	172	June 21	2145	183	July 2	1300
"	"	"	IV	192	July 11	0000	209	July 28	1125
B08123	BO-2	Discoverer	I	127	May 7	0105	135	May 15	0315
"	"	"	II	144	May 24	1700	161	June 10	0700
"	"	"	III	172	June 21	0915	183	July 2	1315
"	"	"	IV	192	July 11	1515	209	July 28	2145
B08124	"	Rockaway	I	127	May 7	0115	134	May 14	1700
"	"	"	II	145	May 25	2030	161	June 10	0730
"	"	"	III	172	June 21	2105	181	June 30	2359
"	"	"	III*	182	July 1	2315	183	July 2	1225
"	"	"	IV	192	July 11	0515	209	July 28	1645

*The Rockaway occupied the Oceanographer's station BRAVO (B) during this short period.

```
THE FIVE PARTICIPATING SHIPS WERE
       OCEANOGRAPHER = 0
       RAINIER       = 1
       MT. MITCHELL  = 2
       DISCOVERER    = 3
       ROCKAWAY      = 4

PHASE 1 JULIAN DAYS 121 - 135
PHASE 2 JULIAN DAYS 144 - 161
PHASE 3 JULIAN DAYS 170 - 183
PHASE 4 JULIAN DAYS 192 - 209

THIS TAPE CONTAINS THE FOLLOWING ITEMS BEYOND THE STANDARD SYSTEM
LABEL, ALL WRITTEN IN EVEN PARITY (EBCDIC) IN THE FOLLOWING FORMAT
     (1) A DESCRIPTIVE TAPE HEADER IN 80-CHARACTER PHYSICAL RECORDS
         (WHICH IS WHAT YOU ARE READING NOW)

     (2) A SINGLE PHYSICAL EOF

     (3) ONE DATA RECORDS                      730 CHARACTERS LONG

     (4) A SINGLE PHYSICAL EOF

     (5) ITEMS (3) AND (4) MAY BE REPEATED, IN THAT ORDER, SEVERAL
         TIMES

     (6) A DOUBLE PHYSICAL EOF.

EACH OCCURANCE OF ITEM (3) CONTAINS ONE DATA SCAN

      EACH DATA SCAN CONTAINS THE FOLLOWING INFORMATION IN FLOATING
      PT  FORMAT  F10.3.
     FOLLOWING MEAN VALUES ARE EITHER 10 OR 30 MINUTE AVERAGE
    WORD  1       TIME EXTENT IN MINUTES OVER WHICH SAMPLES WERE
                    TAKEN TO FORM STATISTICS OF THIS RECORD (EITHER
                    10 OR 30 MINUTES)
    WORD  2       JULIAN DAY OF OBSERVATIONS
```

Figure 3-5.--Format of 10- and 30-min average boom data.

WORD 3	HOUR (Z-TIME) OF OBSERVATIONS
WORD 4	MINUTES OF OBSERVATION, CENTER OF TIME EXTENT GIVEN IN WORD 1
WORD 5	MEAN SEA SURFACE TEMPERATURE (SST), C
WORD 6	STANDARD DEVIATION, SST
WORD 7	MAXIMUM, SST
WORD 8	MINIMUM, SST
WORD 9	NUMBER OF SAMPLES, SST
WORD 10	MEAN DRY BULB TEMPERATURE (DBT), C
WORD 11	STANDARD DEVIATION, DBT
WORD 12	MAXIMUM, DBT
WORD 13	MINIMUM, DBT
WORD 14	NUMBER OF SAMPLES, (WBT
WORD 15	MEAN WET BULB TEMPERATURE (BT), C
WORD 16	STANDARD DEVIATION, WBT
WORD 17	MINIMUM, WBT
WORD 18	MAXIMUM, WBT
WORD 19	NUMBER OF SAMPLES, WBT
WORD 20	WBT COMPUTED FROM THE DBT AND THE MEAN RELATIVE HUMIDITY
WORD 21	MEAN SEA LEVEL PRESSURE (SLP), MILLIBARS
WORD 22	STANDARD DEVIATION, SLP
WORD 23	MAXIMUM, SLP
WORD 24	MINIMUM, SLP
WORD 25	NUMBER OF SAMPLES, SLP
WORD 26	MEAN RELATIVE HUMIDITY (RH), PERCENT (FROM BOOM SENSOR)
WORD 27	STANDARD DEVIATION, RH
WORD 28	MAXIMUM, RH
WORD 29	MINIMUM, RH
WORD 30	NUMBER OF SAMPLES, RH
WORD 31	RH COMPUTED FROM THE DBT AND WBT
WORD 32	SPECIFIC HUMIDITY, GRAMS PER KILOGRAM (CALCULATED

Figure 3-5.--Format of 10- and 30-min average boom data (continued).

WORD 33	MEAN WIND SPEED (WS), METERS PER SECOND (MEAN RESULTANT MAGNITUDE)
WORD 34	MEAN SCALAR WIND SPEED (SWS)
WORD 35	STANDARD DEVIATION, SWS
WORD 36	MAXIMUM, SWS
WORD 37	MINIMUM, SWS
WORD 38	MEAN WIND DIRECTION (WD), DEGREES TRUE (RESULTANT DIRECTION)*
WORD 39	STANDARD DEVIATION, WD, DEGREES*
WORD 40	MAXIMUM, WD, DEGREES TRUE*
WORD 41	MINIMUM, WD, DEGREES TRUE*
WORD 42	MEAN U WIND COMPONENT (POSITIVE WEST TO EAST), METERS PER SECOND
WORD 43	STANDARD DEVIATION, U
WORD 44	MAXIMUM,U
WORD 45	MINIMUM,U
WORD 46	MEAN V WIND COMPONENT (POSITIVE SOUTH TO NORTH) METERS PER SECOND
WORD 47	STANDARD DEVIATION, V
WORD 48	MAXIMUM, V
WORD 49	MINIMUM, V
WORD 50	NUMBER OF SAMPLES OF WIND
WORD 51	SHIPS HEADING (HDG), DEGREES TRUE
WORD 52	STANDARD DEVIATION, HDG
WORD 53	MAXIMUM, HDG
WORD 54	MINIMUM, HDG
WORD 55	NUMBER OF SAMPLES, HDG
WORD 56	MEAN RELATIVE WIND DIRECTION (TO SHIPS HEADING), DEGREES
WORD 57	MEAN INCIDENT RADIATION (IR) LANGLEYS PER MINUTE
WORD 58	STANDARD DEVIATION, IR
WORD 59	MAXIMUM, IR
WORD 60	MINIMUM, IR
WORD 61	NUMBER OF SAMPLES, IR
WORD 62	MEAN REFLECTED RADIATION (RR), LANGLEYS PER MINUTE
WORD 63	STANDARD DEVIATION, RR
WORD 64	MAXIMUM VALUE, RR

Figure 3-5.--Format of 10- and 30-min average boom data (continued).

WORD 65	MINIMUM VALUE, RR
WORD 66	NUMBER OF SAMPLES, RR
WORD 67	MEAN NET RADIATION (NR), LANGLEYS PER MINUTE
WORD 68	STANDARD DEVIATION, NR
WORD 69	MAXIMUM, NR
WORD 70	MINIMUM, NR
WORD 71	NUMBER OF SAMPLES, NR
WORD 72	RATIO, NET TO INCIDENT RADIATION
WORD 73	RATIO, REFLECTED TO INCIDENT RADIATION

* IF EITHER A MAXIMUM OR MINIMUM WIND DIRECTION SAMPLE DIFFERS FROM THE WD BY 90 DEGREES OR MORE, THE STANDARD DEVIATION, WD, MAXIMUM, WD AND MINIMUM, WD ARE RECORDED AS 0 (ZERO).

A LIST OF THE FILES FOR OCEANOGRAPHER ARE:

FILE 1 DESCRIPTIVE TAPE HEADER
FILES 2-54 ARE 10 MINUTE AVERAGES
FILES 55-107 ARE 30 MINUTE AVERAGES

---NOTE--- ADD 53 TO THE 10 MIN AVE FILE NUMBER FOR GIVEN DAY TO OBTAIN THE FILE NUMBER OF THE CORRESPONDING 30 MIN AVERAGES

FILE	DAY	FILE	DAY	FILE	DAY	FILE	DAY	FILE	DAY	FILE	DAY	FILE	DAY
2	123	10	132	18	148	26	158	34	176	41	195	48	203
3	124	11	133	19	150	27	159	35	177	42	196	49	204
4	125	12	134	20	151	28	160	26	179	43	198	50	206
5	126	13	135	21	152	29	161	37	180	44	199	51	207
6	127	14	144	22	153	30	172	38	181	45	200	52	208
7	129	15	145	23	154	31	173	39	193	46	201	53	209
8	130	16	146	24	155	32	174	40	194	47	202	54	210
9	131	17	147	25	157	33	175						

Figure 3-5.--Format of 10- and 30-min average boom data (continued).

A LIST OF THE FILES FOR RAINIER ARE:

FILE 1 DESCRIPTIVE TAPE HEADER

FILES 2-56 ARE 10 MINUTE AVERAGES
FILES 57-111 ARE 30 MINUTE AVERAGES
---NOTE--- ADD 55 TO THE 10 MIN AVE FILE NUMBER FOR GIVEN DAY TO OBTAIN THE FILE NUMBER OF THE CORRESPONDING 30 MIN AVERAGES

FILE	DAY	FILE	DAY	FILE	DAY	FILE	DAY	FILE	DAY	FILE	DAY	FILE	DAY
2	123	10	132	18	150	26	159	34	177	42	194	50	203
3	124	11	133	19	151	27	160	35	179	43	195	51	204
4	125	12	134	20	152	28	161	36	180	44	196	52	205
5	126	13	144	21	153	29	172	37	181	45	198	53	206
6	127	14	145	22	154	30	173	38	182	46	199	54	207
7	129	15	146	23	155	31	174	39	183	47	200	55	208
8	130	16	147	24	157	32	175	40	192	48	201	56	209
9	131	17	148	25	158	33	176	41	193	49	202		

A LIST OF THE FILES FOR MT. MITCHELL ARE:

FILE 1 DESCRIPTIVE TAPE HEADER

FILES 2-57 ARE 10 MINUTE AVERAGES
FILES 58-113 ARE 30 MINUTE AVERAGES
---NOTE--- ADD 56 TO THE 10 MIN AVE FILE NUMBER FOR GIVEN DAY TO OBTAIN THE FILE NUMBER OF THE CORRESPONDING 30 MIN AVERAGES

FILE	DAY	FILE	DAY	FILE	DAY	FILE	DAY	FILE	DAY	FILE	DAY	FILE	DAY
2	121	10	130	18	147	26	157	34	175	42	193	50	202
3	122	11	131	19	148	27	158	35	176	43	194	51	203
4	123	12	132	20	150	28	159	36	177	44	195	52	204
5	124	13	133	21	151	29	160	37	179	45	196	53	205
6	125	14	134	22	152	30	161	38	180	46	198	54	206
7	126	15	144	23	153	31	172	39	181	47	199	55	207
8	127	16	145	24	154	32	173	40	182	48	200	56	208
9	129	17	146	25	155	33	174	41	192	49	201	57	209

Figure 3-5.--Format of 10- and 30-min average boom data (continued).

A LIST OF THE FILES FOR DISCOVERER ARE:

FILE 1 DESCRIPTIVE TAPE HEADER

FILES 2-50 ARE 10 MINUTE AVERAGES
FILES 51-99 ARE 30 MINUTE AVERAGES
---NOTE--- ADD 49 TO THE 10 MIN AVE FILE NUMBER FOR GIVEN DAY TO OBTAIN
THE FILE NUMBER OF THE CORRESPONDING 30 MIN AVERAGES

FILE	DAY	FILE	DAY	FILE	DAY	FILE	DAY	FILE	DAY	FILE	DAY	FILE	DAY
2	127	9	135	16	154	23	172	30	180	37	195	44	203
3	129	10	144	17	155	24	173	31	181	38	196	45	204
4	130	11	147	18	157	25	174	32	182	39	198	46	205
5	131	12	148	19	158	26	175	33	183	40	199	47	206
6	132	13	151	20	159	27	176	34	192	41	200	48	207
7	133	14	152	21	160	28	177	35	193	42	201	49	208
8	134	15	153	22	161	29	179	36	194	43	202	50	209

A LIST OF THE FILES FOR ROCKAWAY ARE:

FILE 1 DESCRIPTIVE TAPE HEADER

FILES 2-50 ARE 10 MINUTE AVERAGES
FILES 51-99 ARE 30 MINUTE AVERAGES
---NOTE--- ADD 49 TO THE 10 MIN AVE FILE NUMBER FOR GIVEN DAY TO OBTAIN
THE FILE NUMBER OF THE CORRESPONDING 30 MIN AVERAGES

FILE	DAY	FILE	DAY	FILE	DAY	FILE	DAY	FILE	DAY	FILE	DAY	FILE	DAY
2	127	9	145	16	153	23	172	30	180	37	195	44	203
3	129	10	146	17	155	24	173	31	181	38	196	45	204
4	130	11	147	18	157	25	174	32	182	39	198	46	205
5	131	12	148	19	158	26	175	33	183	40	199	47	206
6	133	13	150	20	159	27	176	34	192	41	200	48	207
7	134	14	151	21	160	28	177	35	193	42	201	49	208
8	144	15	152	22	161	29	179	36	194	43	202	50	209

Figure 3-5.--Format of 10- and 30-min average boom data (continued).

Table 3-6.--Inventory of 10- and 30-min average boom data

Magnetic tape No.	Microfilm reel No.	Ship	BOMEX Observation Period	Beginning			Ending		
				Julian day	Date (1969)	Time (GMT)	Julian day	Date (1969)	Time (GMT)
BO8944	BO-3	Oceanographer	I	123	May 3	0000	135	May 15	0400
"	"	"	II	144	May 24	1230	161	June 10	0730
"	"	"	III	172	June 21	0000	181	June 30	0930
"	"	"	IV	193	July 12	1000	208	July 27	1500
BO8945	"	Rainier	I	121	May 1	2100	134	May 14	1900
"	"	"	II	144	May 24	0000	161	June 10	0800
"	"	"	III	172	June 21	0000	182	July 1	2200
"	"	"	IV	192	July 11	0730	209	July 28	2230
BO8946	"	Mt. Mitchell	I	123	May 3	0130	134	May 14	2330
"	"	"	II	144	May 24	0000	161	June 10	0600
"	"	"	III	172	June 21	2200	183	July 2	1300
"	"	"	IV	193	July 12	1730	209	July 28	1130
BO8947	"	Discoverer	I	127	May 7	0130	135	May 15	0300
"	"	"	II	147	May 27	1600	161	June 10	0600
"	"	"	III	172	June 21	0930	183	July 2	1300
"	"	"	IV	192	July 11	1530	209	July 28	2130
BO8948	"	Rockaway	I	127	May 7	0130	134	May 14	1700
"	"	"	II	145	May 25	2100	161	June 10	0730
"	"	"	III	172	June 21	2100	180	Jule 29	2100
"	"	"	III*	181	June 20	1230	183	July 2	1200
"	"	"	IV	192	July 11	0530	209	July 28	1730

*The Rockaway occupied the Oceanographer's station BRAVO (B) during this short period.

4. MARINE METEOROLOGICAL OBSERVATIONS AND SURFACE-PRESSURE--MARINE MICROBAROGRAM DATA SET

In addition to the surface observations recorded automatically by instrumentation mounted on a boom extending from the bow of each of the five fixed ships, conventional manual observations were made from the ships' decks and/or by permanently installed shipboard instruments. These data should be used with the same caution one would apply to routine marine observations, because they were obtained by crewmen or technicians with varying degrees of skill and dedication, the exposure of the sensors was usually not optimum, and the observations were influenced by the usual perturbations caused by the mass of the ship. In the course of final processing of other BOMEX data, a number of these discrepancies have been identified. Corrections have not been applied to this data set, but are incorporated in the boom surface meteorological data set (sec. 3), the rawinsonde and radiometersonde data set (sec. 5), and the Boundary Layer Instrument Package (BLIP) data set (sec. 6).

4.1 Observation Procedures and Parameters Measured

The surface meteorological observations were entered on a Surface Observations Form, and each parameter is discussed here in the order in which it was entered on that form, an 80-column punched-card format.

> NOTE: On the form, the columns were misnumbered, i.e., column 46 is not indicated, and two columns are numbered 58. In recording, this deficiency was taken into account, and the parameters were recorded in the order in which they are described below.

Card Code - Column 1. Code 1 was used on each form to identify it as being a surface meteorological observation.

Card Code - Column 2. The following codes identify the ship from which observations were made: 0, *Oceanographer*; 1, *Rainier*; 2, *Mt. Mitchell*; 3; *Discoverer*; 4, *Rockaway*.

Date and Time - Columns 3 through 9. Julian day and time of observation in GMT to the nearest minute, not exceeding 5 min before or after the beginning or end of the surface observation sequence.

Sea-Level Atmospheric Pressure - Columns 10 through 17. Pressure was determined from a precision aneroid barometer and read to the nearest 0.1 mb, estimating for values between scale graduations and applying correction recorded on the face of the instrument, and then entered in columns 10 through 14 to the nearest 0.1 mb. Values less than 1,000.0 mb are preceded by a zero, i.e., 998.2 mb is recorded as 09982.

Pressure tendency was determined from a marine microbarograph by finding the net amount of pressure change over a 3-hr period through determination, to the nearest 0.1 mb, of the difference in pressure between the beginning and the end of the period. The appropriate code was entered in column 15 on the form in accordance with the codes shown in table 4-1. The amount of 3-hr change in pressure was entered in millibars and tenths in columns 16 and 17.

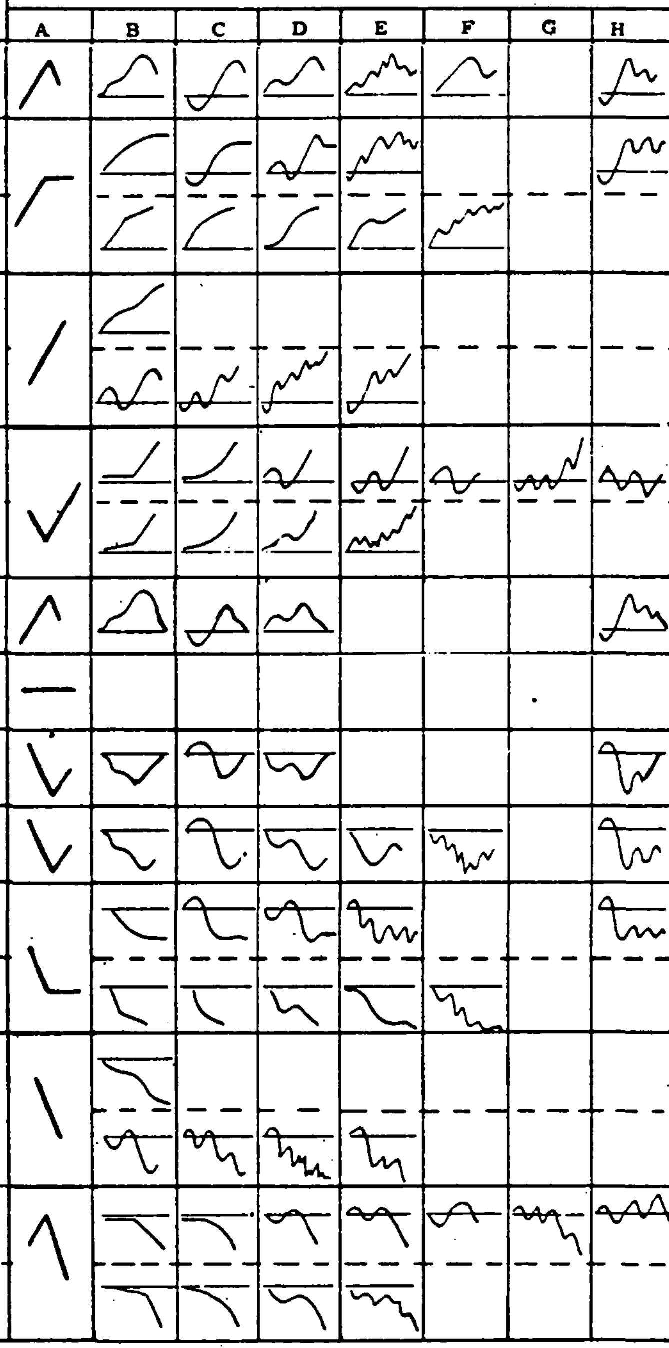
Temperature - Columns 18 through 25. Dry-bulb temperature as measured by an ordinary thermometer exposed to the free air on the windward side of the ship, under conditions that eliminated as completely as possible the effects of extraneous sources of heat, was entered in columns 18, 19, and 20 in degrees and tenths. Wet-bulb temperature, representing the lowest temperature secured by evaporating water from a muslin-covered bulb of a thermometer at a specified rate of ventilation, was entered in columns 21, 22, and 23 in degrees and tenths. When the dry-bulb and wet-bulb temperatures were known, the dewpoint was determined from table 4-2. By subtracting the wet-bulb temperature from the dry bulb, the wet-bulb depression was obtained. The nearest depression across the top of the table and the nearest wet-bulb temperature along the side were then located, and the value at the intersection of the two was entered in columns 24 and 25 in whole °C.

Relative Humidity - Columns 26 and 27. Relative humidity to the nearest whole percent as determined from table 4-3, which was used in the same manner as table 4-2.

True Wind - Columns 28 through 32. Aboard the fixed ships, the true wind could not be read directly from the anemometer indicator. Since "north" on the indicator represents the ship's bow or heading, a reading of 320° would indicate an apparent wind of 040° off the port bow. The apparent wind relative to the bow of the ship was converted to a true compass bearing by adding the apparent wind direction to the ship's heading if the wind was off the starboard bow and by subtracting the apparent wind direction if the wind was off the port bow. Windspeed was read directly from the anemometer indicator and entered in knots.

Aboard the roving ships, the computation of true wind direction and windspeed was somewhat more complicated and was done by use of a shipboard wind plotter.

Table 4-1.--Barometer change characteristics in the last 3 hr



DESCRIPTION OF CHARACTERISTIC: PRIMARY UNQUALIFIED REQUIREMENT	DESCRIPTION OF CHARACTERISTIC: ADDITIONAL REQUIREMENTS	NOMINAL GRAPHIC REPRESENTATION (For Coding Purposes) A	B	C	D	E	F	G	H	Code Figure
HIGHER Atmospheric pressure now higher than 3 hours ago.	Increasing, then decreasing.									0
	Increasing, then steady; or increasing, then increasing more slowly.									1
	Increasing: Steadily / Unsteadily									2
	Decreasing or steady, then increasing; or increasing, then increasing more rapidly.									3
THE SAME Atmospheric pressure now same as 3 hours ago.	Increasing, then decreasing.									0
	Steady or unsteady									4
	Decreasing, then increasing.									5
LOWER Atmospheric pressure now lower than 3 hours ago.	Decreasing, then increasing.									5
	Decreasing, then steady; or decreasing, then decreasing more slowly.									6
	Decreasing: Steadily / Unsteadily									7
	Steady or increasing, then decreasing; or decreasing, then decreasing more rapidly.									8

Table 4-2.--Dewpoint temperature

Wet-bulb temp. °C	Wet-bulb depression, °C																		
	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0
10	10	10	09	09	08	08	07	07	06	06	05	05	04	04	03	02	02	01	00
11	11	11	10	10	09	09	09	08	08	07	07	06	06	05	04	04	03	03	02
12	12	12	11	11	11	10	10	09	09	08	08	07	07	06	06	05	05	04	04
13	13	13	12	12	12	11	11	10	10	10	09	09	08	08	07	07	06	06	05
14	14	14	13	13	13	12	12	12	11	11	10	10	10	09	09	08	08	07	07
15	15	15	14	14	14	13	13	13	12	12	12	11	11	10	10	10	09	09	08
16	16	16	15	15	15	15	14	14	14	13	13	13	12	12	11	11	11	10	10
17	17	17	16	16	16	16	15	15	15	14	14	14	13	13	13	12	12	12	11
18	18	18	18	17	17	17	16	16	16	16	15	15	15	14	14	14	13	13	13
19	19	19	19	18	18	18	17	17	17	17	16	16	16	15	15	15	15	14	14
20	20	20	20	19	19	19	19	18	18	18	18	17	17	17	16	16	16	16	15
21	21	21	21	20	20	20	20	19	19	19	19	18	18	18	18	17	17	17	17
22	22	22	22	21	21	21	21	21	20	20	20	20	19	19	19	19	18	18	18
23	23	23	23	22	22	22	22	22	21	21	21	21	20	20	20	20	20	19	19
24	24	24	24	23	23	23	23	23	22	22	22	22	22	21	21	21	21	20	20
25	25	25	25	24	24	24	24	24	24	23	23	23	23	23	22	22	22	22	21
26	26	26	26	26	25	25	25	25	25	24	24	24	24	24	23	23	23	23	23
27	27	27	27	27	26	26	26	26	26	26	25	25	25	25	25	24	24	24	24
28	28	28	28	28	27	27	27	27	27	27	26	26	26	26	26	26	25	25	25
29	29	29	29	29	28	28	28	28	28	28	28	27	27	27	27	27	27	26	26
30	30	30	30	30	29	29	29	29	29	29	29	29	28	28	28	28	28	27	27
31	31	31	31	31	31	30	30	30	30	30	30	30	29	29	29	29	29	29	28
32	32	32	32	32	32	31	31	31	31	31	31	31	30	30	30	30	30	30	30
33	33	33	33	33	33	32	32	32	32	32	32	32	32	31	31	31	31	31	31
34	34	34	34	34	34	33	33	33	33	33	33	33	33	32	32	32	32	32	32
35	35	35	35	35	35	34	34	34	34	34	34	34	34	34	33	33	33	33	33

Table 4-3.--Relative humidity

Dry-bulb temp. °C	Wet-bulb depression, °C																		
	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	
10	98	95	93	90	88	86	83	81	79	77	74	72	70	68	66	63	61	59	
11	98	95	93	91	89	86	84	82	80	78	75	73	71	69	67	65	62	60	
12	98	96	93	91	89	87	85	82	80	78	76	74	72	70	68	66	64	62	
13	98	96	93	91	89	87	85	83	81	79	77	75	73	71	69	67	65	63	
14	98	96	94	92	90	88	86	84	82	79	78	76	74	72	70	68	66	64	
15	98	96	94	92	90	88	86	84	82	80	78	76	74	73	71	69	67	65	
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5
16	95	90	85	81	76	71	67	63	58	54	50	46	42	38	34	30	26	23	19
17	95	90	86	81	76	72	68	64	60	55	51	47	43	40	36	32	28	25	21
18	95	91	86	82	77	73	69	65	61	57	53	49	45	41	38	34	30	27	23
19	95	91	87	82	78	74	70	65	62	58	54	50	46	43	39	36	32	29	26
20	96	91	87	83	78	74	70	66	63	59	55	51	48	44	41	37	34	31	28
21	96	91	87	83	79	75	71	67	64	60	56	53	49	46	42	39	36	32	29
22	96	92	87	83	80	76	72	68	64	61	57	54	50	47	44	40	37	34	31
23	96	92	88	84	80	76	72	69	65	62	58	55	52	48	45	42	39	36	33
24	96	92	88	84	80	77	73	69	66	62	59	56	53	49	46	43	40	37	34
25	96	92	88	84	81	77	74	70	67	63	60	57	54	50	47	44	41	39	36
26	96	92	88	85	81	78	74	71	67	64	61	58	54	51	49	46	43	40	37
27	96	92	89	85	82	78	75	71	68	65	62	58	56	52	50	47	44	41	38
28	96	93	89	85	82	78	75	72	69	65	62	59	56	53	51	48	45	42	40
29	96	93	89	86	82	79	76	72	69	66	63	60	57	54	52	49	46	43	41
30	96	93	89	86	83	79	76	73	70	67	64	61	58	55	52	50	47	44	42
31	96	93	90	86	83	80	77	73	70	67	64	61	59	56	53	51	48	45	43
32	96	93	90	86	83	80	77	74	71	68	65	62	60	57	54	51	49	46	44
33	97	93	90	87	83	80	77	74	71	68	66	63	60	57	55	52	50	47	45
34	97	93	90	87	84	81	78	75	72	69	66	63	61	58	56	53	51	48	46
35	97	94	90	87	84	81	78	75	72	69	67	64	61	59	56	54	51	49	47
36	97	94	90	87	84	81	78	75	73	70	67	64	62	59	57	54	52	50	48
37	97	94	91	87	84	82	79	76	73	70	68	65	63	60	58	55	53	51	48
38	97	94	91	88	84	82	79	76	74	71	68	66	63	61	58	56	54	51	49
39	97	94	91	88	85	82	79	77	74	71	69	66	64	61	59	57	54	52	50
40	97	94	91	88	85	82	80	77	74	72	69	67	64	62	59	57	54	53	51

Waves - Columns 33 through 46. The wave data, as entered on the Surface Observations Form, consist of the direction, height, and period of wind waves and swells. Wind waves, or "sea," are those raised by the local wind blowing at the time of observation; waves due either to winds blowing at a distance or to winds that have ceased to blow are known as swells.

The direction from which the waves were coming was determined visually or, more accurately, by sighting from a compass along the wave crests and adding or subtracting 90°. Ship's heading was also used as a guide. The averages of several observations were recorded to the nearest degree in columns 33, 34, 35 for wind waves and in columns 40, 41, 42 for swells. When no wind waves were present, three zeros were entered. If the waves were from directly north, 360 was used, and if the sea was confused and direction could not be determined, 9's were used.

Wave height as recorded on the form is an average of the estimated heights of the larger well-formed waves. Estimates were made by an observer from the best available point on the ship that permitted the height of the waves to be compared with the height of the ship. Heights in feet were converted to half-meter codes in accordance with table 4-4 and entered in columns 26, 27, and 43, 44, respectively.

Wave period, the interval in seconds between passage of two successive wave crests of well-formed waves past a fixed point, was determined through observation of at least 15 well-formed waves, by (a) selecting a distinctive patch of foam or a small floating object at some distance from the ship, (b) noting the elapsed time to the nearest second between the moments when the object was on the crest of the first and the last wave in the group and noting also the number of crests that passed under the object during the interval, and (c) adding the elapsed times of the various groups together and dividing the total by the number of waves to obtain the average period. The wave period thus obtained was entered in columns 38, 39, and 45, 46 to the nearest second. A calm sea or the absence of either wind or swell is indicated by 00; 99 was used for confused sea.

Clouds - Columns 47 through 52. Total cloud amount, or "sky cover," was estimated in terms of eighths of sky covered by clouds. A few clouds or fragments of clouds were entered as 1 in column 47; if the sky was completely overcast, the amount entered is 8; 7 indicates a few patches of blue sky visible; when blue sky or stars were seen through fog or analogous phenomena, total cloud amount is reported as 0; and when clouds were observed through fog or similar phenomena, their amount is reported as though these phenomena had not been present; 9 indicates that the sky was obscured by fog, rain, or other phenomena, not clouds.

Low cloud amount, recorded in eighths of sky in column 48 was estimated in the same way as total cloud amount.

Low cloud type is indicated in column 49 by the appropriate code chosen from table 4-5. When several types were present in equal amounts, the code entered is that for the type whose base is at the greatest height above the sea, except (a) when types coded 1 and 2 only were present, code 2 was entered,

Table 4-4.--Wave or swell height in half-meters

Half-meters code figure	Feet	Half-meters code figure	Feet	Half-meters code figure	Feet	Half-meters code figure	Feet
01	2	21	34	41	67	61	100
02	3	22	36	42	69	62	102
03	5	23	38	43	71	63	103
04	7	24	39	44	72	64	105
05	8	25	41	45	74	65	107
06	10	26	43	46	76	66	108
07	12	27	44	47	77	67	110
08	13	28	46	48	79	68	112
09	15	29	48	49	80	69	113
10	16	30	49	50	82	70	115
11	18	31	51	51	84	71	117
12	20	32	52	52	85	72	118
13	21	33	54	53	87	73	120
14	23	34	56	54	89	74	121
15	25	35	57	55	90	75	123
16	26	36	59	56	92	76	125
17	28	37	61	57	94	77	126
18	30	38	62	58	95	78	128
19	31	39	64	59	97	79	130
20	33	40	66	60	98	80	131

regardless of amount, and (b) when types coded 3 or 9 were present, 3 or 9 was chosen, as appropriate, regardless of the amount of low cloud.

Height of the bases of the low clouds was determined relatively closely by taking the elapsed time between release and disappearance of the rawinsonde balloon times the ascent rate. The height thus obtained is indicated in column 50 by the appropriate code taken from table 4-6.

Type of middle cloud is indicated in column 51 by the appropriate code from table 4-7, except (a) when altocumulus were present in a chaotic sky, regardless of amount, code 9 was used; (b) when the sky was not chaotic but tufted or turreted altocumulus were present, code 8 was used; (c) clouds observed when the sky was visible through fog or analogous phenomena were recorded as though these phenomena had not been present; and (d) when condensation trails caused by high-flying aircraft persisted and/or cloud masses that had obviously developed from such trails (but not rapidly dissipating trails) were observed, they were reported as middle clouds when they resembled such clouds.

Type of high cloud is indicated in column 52 by the appropriate code taken from table 4-8 for the predominant type present. When several types were present in equal amounts, the code for the type whose base was at the

Table 4-5.--Code table for clouds of types Stratocumulus, Stratus, Cumulus, and Cumulonimbus

Code figures	Technical language specifications	Plain language specifications
0	No C_L clouds.	No Stratocumulus, Stratus, Cumulus, or Cumulonimbus
1	Cumulus humilis, or Cumulus fractus other than of bad weather, or both.	Cumulus with little vertical extent and seemingly flattened, or ragged Cumulus other than of bad weather, or both.
2	Cumulus mediocris or congestus, with or without Cumulus of species fractus or humilis, or Stratocumulus; all having their bases at the same level.	Cumulus of moderate or strong vertical extent generally with protuberances in the form of domes or towers, either accompanied or not by other Cumulus or by Stratocumulus; all having their bases at the same level.
3	Cumulonimbus calvus, with or without Cumulus, Stratocumulus or Stratus.	Cumulonimbus the summits of which, at least partially, lack sharp outlines, but are neither clearly fibrous (cirriform), nor in the form of an anvil; Cumulus, Stratocumulus,or Stratus may be present.
4	Stratocumulus cumulogenitus.	Stratocumulus formed by the spreading out of Cumulus; Cumulus may also be present.
5	Stratocumulus other than Stratocumulus cumulogenitus.	Stratocumulus not resulting from the spreading out of Cumulus.
6	Stratus nebulosis or Stratus fractus other than of bad weather, or both.	Stratus in a more or less continuous sheet or layer, or in ragged shreds or both, but no Stratus fractus of bad weather.
7	Stratus fractus or Cumulus fractus of bad weather or both (pannus) usually below Altostratus or Nimbostratus.	Stratus fractus of bad weather or Cumulus fractus of bad weather or both (pannus) usually below Altostratus or Nimbostratus.
8	Cumulus and Stratocumulus, other than Stratocumulus cumulogenitus, with bases at different levels.	Cumulus and Stratocumulus, other than those formed from the spreading out of Cumulus; the base of Cumulus is at a different level than that of the Stratocumulus.

Table 4-5.—Code table for clouds of types Stratocumulus, Stratus, Cumulus, and Cumulonimbus (continued)

Code figures	Technical language specifications	Plain language specifications
8	Cumulus and Stratocumulus, other than Stratocumulus cumulogenitus, with bases at different levels.	Cumulus and Stratocumulus, other than those formed from the spreading out of Cumulus; the base of Cumulus is at a different level than that of the Stratocumulus.
9	Cumulonimbus capillatus (often with an anvil), with or without Cumulonimbus calvus, Cumulus, Stratocumulus, Stratus or pannus.	Cumulonimbus, the upper part of which is clearly fibrous (cirriform) often in the form of an anvil; either accompanied or not by Cumulonimbus without anvil or fibrous upper part, by Cumulus, Stratocumulus, Stratus, or pannus.
	Clouds C_L not visible owing to darkness, fog, blowing dust or sand, or other similar phenomena.	No Cumulus, Cumulonimbus, Stratocumulus, or Stratus visible owing to darkness, fog, blowing dust or sand, or other similar phenomena.

Note: "Bad Weather" denotes the conditions which generally exist during precipitation and a short time before and after.

Table 4-6.—Code table for low cloud height; height of base of lowest cloud (C_L or C_M) above sea

Code figure	Height in feet	Height in meters
0	0 - 149	0 - 49
1	150 - 299	50 - 99
2	300 - 599	100 - 199
3	600 - 999	200 - 299
4	1,000 - 1,999	300 - 599
5	2,000 - 3,499	600 - 999
6	3,500 - 4,999	1,000 - 1,499
7	5,000 - 6,499	1,500 - 1,999
8	6,500 - 7,999	2,000 - 2,500
9	8,000 or higher or no clouds	2,500 or higher or no clouds
	Height cannot be reported owing to darkness or other reason	

Table 4-7.--Code table for clouds of types Altocumulus, Altostratus, and Nimbostratus

Code figures	Technical language specifications	Plain language specifications
0	No C_M clouds.	No Altocumulus, Altostratus, or Nimbostratus.
1	Altostratus translucidus.	Altostratus, the greater part of which is semitransparent; through this part the Sun or Moon may be weakly visible as through ground glass.
2	Altostratus opacus or Nimbostratus.	Altostratus, the greater part of which is sufficiently dense to hide the Sun (or Moon), or Nimbostratus.
3	Altocumuls translucidus at a single level.	Altocumulus, the greater part of which is semitransparent; the various elements of the cloud change only slowly and are all at a single level.
4	Patches of Altocumulus translucidus (often lenticular), continuously changing and occurring at one or more levels.	Patches (often in the form of almonds or fishes) of Altocumulus, the greater part of which is semitransparent; the clouds occur at one or more levels and the elements are continually changing in appearance.
5	Altocumulus translucidus in bands, or one or more layers of Altocumulus translucidus or opacus progressively invading the sky; these Altocumulus clouds generally thicken as a whole.	Semitransparent Altocumulus in bands or Altocumulus in one or more fairly continuous layers (semitransparent or opaque) progressively invading the sky; these Altocumulus clouds generally thicken as a whole.

Table 4-7.--Code table for clouds of types Altocumulus, Altostratus, and Nimbostratus (continued)

Code figures	Technical language specifications	Plain language specifications
6	Altocumulus cumulogenitus (or cumulonimbogenitus).	Altocumulus resulting from the spreading out of Cumulus (or Cumulonimbus).
7	Altocumulus translucidus in two or more layers, or Altocumulus opacus in a single layer, not progressively invading the sky, or Altocumulus with Altostratus or Nimbostratus.	Altocumulus in two or more layers usually opaque in places and not progressively invading the sky; or opaque layer of Altocumulus not progressively invading the sky; or Altocumulus together with Altostratus or Nimbostratus.
8	Altocumulus castellanus or floccus.	Altocumulus with sproutings in the form of small towers or battlements, or Altocumulus having the appearance of cumuliform tufts.
9	Altocumulus of a chaotic sky, generally at several levels.	Altocumulus of a chaotic sky, generally at several levels.
•	Clouds C_M not visible owing to darkness, fog, blowing dust or sand, or other phenomena, or because of a continuous layer of lower clouds.	No Altocumulus, Altostratus or or Nimbostratus visible owing to darkness, fog, blowing dust or sand, or other similar phenomena, or more often because of the presence of a continuous layer of lower clouds.

Table 4-8.--Code table for clouds of types Cirrus, Cirrostratus, and Cirrocumulus

Code figures	Technical language specifications	Plain language specifications
0	No C_H clouds.	No Cirrus, Cirrostratus, or Cirrocumulus.
1	Cirrus fibratus, sometimes uncinus, not progressively invading the sky.	Cirrus in the form of filiments, strands or hooks, not progressively invading the sky.
2	Cirrus spissatus, in patches or entangled sheaves, which usually do not increase and sometimes seem to be the remains of the upper part of a Cumulonimbus; or Cirrus castellanus or floccus.	Dense Cirrus in patches or entangled sheaves which usually do not increase and sometimes seem to be the remains of the upper parts of Cumulonimbus; or Cirrus with sproutings in the form of small turrets or battlements or Cirrus having the appearance of cumuliform tufts.
3	Cirrus spissatus cumulonimbogenitus.	Dense Cirrus often in the form of an anvil, being the remains of the upper parts of Cumulonimbus.
4	Cirrus uncinus, or fibratus, or both, progressively invading the sky; they generally thicken as a whole.	Cirrus in the form of hooks or filaments or both, progressively invading the sky; they generally become denser as a whole.
5	Cirrus, often in bands, and and Cirrostratus, or Cirrostratus alone, progressively invading the sky; they generally thicken as a whole, but the continuous veil does not reach 45° above the horizon.	Cirrus, often in bands converging towards one point or two opposite points of the horizon and Cirrostratus, or Cirrostratus alone; in either case they are progressively invading the sky, and generally growing denser as a whole, but the continuous veil does not reach 45° above the horizon.

Table 4-8.--Code table for clouds of types Cirrus, Cirrostratus, and Cirrocumulus (continued)

Code figures	Technical language specifications	Plain language specifications
6	Cirrus, often in bands, and Cirrostratus, or Cirrostratus alone, progressively invading the sky; they generally thicken as a whole, but the continuous veil extends more than 45° above the horizon, without the sky being totally covered.	Cirrus, often in bands converging towards one point or two opposite points of the horizon, and Cirrostratus, or Cirrostratus alone; in either case they are progressively invading the sky, and generally growing denser as a whole; the continuous veil extends more than 45° above the horizon, without the sky being completely covered.
7	Cirrostratus covering the whole sky.	Veil of Cirrostratus covering the celestial dome.
8.	Cirrostratus not progressively invading the sky, and not entirely covering it.	Cirrostratus not progressively invading the sky, and not completely covering the celestial dome.
9	Cirrocumulus alone, or Cirrocumulus predominant among the cirriform clouds.	Cirrocumulus alone, or Cirrocumulus accompanied by Cirrus or Cirrostratus or both, but Cirrocumulus is predominant.
	Clouds C_H not visible owing to darkness, fog, blowing dust or sand, or other similar phenomena, or because of a continuous layer of lower clouds.	No Cirrus, Cirrostratus, or Cirrocumulus visible owing to darkness, fog, blowing dust or sand, or other similar phenomena, or more often because of the presence of a continuous layer of lower clouds.

greatest height above the sea was used, except (a) clouds observed when the sky was visible through fog or analogous phenomena were reported as though these phenomena had not been present, and (b) persistent condensation trails caused by high-flying aircraft and/or cloud masses obviously developed from such trails were reported as high clouds when they resembled such clouds.

Visibility - Columns 53 and 54. Visibility, or the greatest distance from an observer that an object of known characteristics can be seen and identified, was determined, whenever possible, based upon objects whose distance from the observer was known (the horizon or other ships). Appropriate codes from table 4-9 were entered in columns 53 and 54. When the visibility was not the same in all directions, the highest value common to one-half or more of the horizon circle was used; when the visibility was between two of the distances listed in table 4-9, the code for the lesser distance was used.

Table 4-9.--Code table for visibility

Code figures	Visibility range
90	Less than 50 yd (50 m)
91	50 yd (50 m)
92	200 yd (200 m)
93	1/4 nmi (500 m)
94	1/2 nmi (1,000 m)
95	1 nmi (2,000 m)
96	2 nmi (4,000 m)
97	5 nmi (10 km)
98	10 nmi (20 km)
99	25 nmi (50 km) or more

Present Weather - Columns 55 and 56. "Present weather" refers to the state of weather at the time of, or within 1 hr before, the observation. The appropriate codes listed in table 4-10 were entered in columns 55 and 56. When more than one code appeared to be required, the highest was entered.

Past Weather - Column 57. "Past weather" refers to the state of weather since the last scheduled observation (either 1 1/2 hr or 3 hr before observation time). The appropriate codes from table 4-11 were used. When two or more codes appeared to be required, the highest code was used.

Table 4-10.--Code table for present weather

00-49 No Precipitation at the Station at the Time of Observation.

00-19: No Precipitation, Fog, Ice Fog, Duststorm, Sandstorm, Drifting or Blowing Snow at the Station (or Ship) at the Time of Observation, Except for 09 and 17, or During the Preceding Hour.

	Code	Description	
	00	Cloud development not observed.	Characteristic change of the state of sky during the past hour.
	01	Clouds generally dissolving or becoming less developed.	
	02	State of sky on the whole unchanged.	
	03	Clouds generally forming or developing.	
Haze, Dust, Sand or Smoke	04	Visibility reduced by smoke, e.g., from veldt or forest fires, industrial smoke, or volcanic ashes.	
	05	Haze.	
	06	Widespread dust in suspension in the air, not raised by wind at or near the station (or ship) at the time of observation.	
	07	Dust or sand raised by wind at or near the station (or ship) at the time of observation, but no well developed dust whirl(s) or sand whirl(s) and no duststorm or sandstorm seen.	
	08	Well developed dust whirl(s) or sand whirl(s) seen at or near the station (or ship) within last hour, but no duststorm or sandstorm.	
	09	Duststorm or sandstorm within sight of station (or ship) or at station (or ship) at time of observation or during the last hour.	
	10	Light fog, visibility 1,000 meters (1,100 yards) or more.	
	11	Patches of ...	Shallow fog or ice fog at the station (or ship) not deeper than about 2 meters (6 1/2 feet) on land or 10 meters (33 feet) at sea [visibility less than 1,000 meters (1,100 yards)].
	12	More or less continuous	
	13	Lightning visible, no thunder heard.	
	14	Precipitation within sight, but not reaching ground or surface of the sea.	
	15	Precipitation within sight, reaching ground or surface of the sea, but distant [i.e., estimated to be more than 5 kilometers (3 miles) from station (or ship)].	
	16	Precipitation within sight, reaching ground or surface of the sea, near to but not at the station (or ship).	
	17	Thunderstorm, but no precipitation at the time of observation.	
	18	Squall(s)	within sight during the past hour.
	19	Funnel cloud(s)* (tornado or waterspout)	

Table 4-10.--Code table for present weather (continued)

Code	Description	Qualifier
20-29:	Precipitation, Fog or Ice Fog or Thunderstorm at the Station (or Ship) During the Preceding Hour But Not at the Time of Observation.	
20	Drizzle (not freezing) or snow grains	not falling as showers.
21	Rain (not freezing)	not falling as showers.
22	Snow	not falling as showers.
23	Rain and snow or ice pellets	not falling as showers.
24	Freezing drizzle or freezing rain	not falling as showers.
25	Shower(s) of rain	
26	Shower(s) of snow, or of rain and snow.	
27	Shower(s) of hail, or of hail and rain.	
28	Fog or ice fog [visibility less than 1,000 meters (1,100 yards)].	
29	Thunderstorm (with or without precipitation).	
30-39:	Duststorm, Sandstorm or Drifting or Blowing Snow.	
30	Slight or moderate duststorm or sandstorm	has decreased during the preceding hour.
31	Slight or moderate duststorm or sandstorm	no appreciable change during the preceding hour.
32	Slight or moderate duststorm or sandstorm	has begun or increased during the preceding hour.
33	Severe duststorm or sandstorm	has decreased during the preceding hour.
34	Severe duststorm or sandstorm	no appreciable change during the preceding hour.
35	Severe duststorm or sandstorm	has begun or increased during the preceding hour.
36	Slight or moderate drifting snow.	Drifting snow 10 meters (33 feet) or below at sea.
37	Heavy drifting snow.	Drifting snow 10 meters (33 feet) or below at sea.
38	Slight or moderate blowing snow.	Blowing snow above 10 meters (33 feet) at sea.
39	Heavy blowing snow.	Blowing snow above 10 meters (33 feet) at sea.
40-49:	Fog or Ice Fog at the Time of Observation [visibility less than 1,000 meters (1,100 yards)].	
40	Fog or ice fog at a distance at the time of observation, but not at the station (or ship) during the last hour, the fog extending to a level above that of the observer.	
41	Fog or ice fog in patches.	
42	Fog or ice fog, sky discernible	has become thinner during the preceding hour.
43	Fog or ice fog, sky not discernible	has become thinner during the preceding hour.
44	Fog or ice fog, sky discernible	no appreciable change during the preceding hour.
45	Fog or ice fog, sky not discernible	no appreciable change during the preceding hour.
46	Fog or ice fog, sky discernible	has begun or has become thicker during the preceding hour.
47	Fog or ice fog, sky not discernible	has begun or has become thicker during the preceding hour.
48	Fog, depositing rime, sky discernible.	
49	Fog, depositing rime, sky not discernible.	

Table 4-10.—Code table for present weather (continued)

50-99	Precipitation at the Station (or Ship) at the Time of Observation.	
50-59:	Drizzle at Time of Observation.	
50	Drizzle, not freezing, intermittent	slight at time of observation.
51	Drizzle, not freezing, continuous	
52	Drizzle, not freezing, intermittent	moderate at time of observation.
53	Drizzle, not freezing, continuous	
54	Drizzle, not freezing, intermittent	heavy (dense) at time of observation.
55	Drizzle, not freezing, continuous	
56	Drizzle, freezing, slight.	
57	Drizzle, freezing, moderate or heavy (dense).	
58	Drizzle and rain, slight.	
59	Drizzle and rain, moderate or heavy.	
60-69:	Rain at Time of Observation.	
60	Rain, not freezing, intermittent	slight at time of observation.
61	Rain, not freezing, continuous	
62	Rain, not freezing, intermittent	moderate at time of observation.
63	Rain, not freezing, continuous	
64	Rain, not freezing, intermittent	heavy at time of observation.
65	Rain, not freezing, continuous	
66	Rain, freezing, slight.	
67	Rain, freezing, moderate or heavy.	
68	Rain or drizzle and snow, slight.	
69	Rain or drizzle and snow, moderate or heavy.	
70-79:	Solid Precipitation Not in Showers at Time of Observation.	
70	Intermittent fall of snowflakes	slight at time of observation.
71	Continuous fall of snowflakes	
72	Intermittent fall of snowflakes	moderate at time of observation.
73	Continuous fall of snowflakes	
74	Intermittent fall of snowflakes	heavy at time of observation.
75	Continuous fall of snowflakes	
76	Ice prisms (with or without fog).	
77	Snow grains (with or without fog).	
78	Isolated starlike snow crystals (with or without fog).	
79	Ice pellets (i.e., frozen raindrops or largely melted and refrozen snowflakes).	
80-99:	Showery Precipitation, or Precipitation With Current or Recent Thunderstorm.	
80	Rain shower(s), slight.	
81	Rain shower(s), moderate or heavy.	
82	Rain shower(s), violent.	
83	Shower(s) of rain and snow, mixed, slight.	
84	Shower(s) of rain and snow mixed, moderate or heavy.	
85	Snow shower(s), slight.	
86	Snow shower(s), moderate or heavy.	

Table 4-10.--Code table for present weather (continued)

87	Shower(s) of snow pellets or ice pellets* with or without rain or rain and snow mixed	slight.
88	Shower(s) of snow pellets or ice pellets* with or without rain or rain and snow mixed	moderate or heavy.
89	Shower(s) of hail, with or without rain or rain and snow mixed, not associated with thunder	slight.
90	Shower(s) of hail, with or without rain or rain and snow mixed, not associated with thunder	moderate or heavy.
91	Slight rain at time of observation	thunderstorm during the preceding hour but not at time of observation.
92	Moderate or heavy rain at time of observation	
93	Slight snow or rain and snow mixed or hail* at time of observation	
94	Moderate or heavy snow, or rain and snow mixed or hail* at time of observation	
95	Thunderstorm, slight or moderate, without hail* but with rain and/or snow at time of observation	thunderstorm at time of observation.
96	Thunderstorm, slight or moderate, with hail* at time of observation	
97	Thunderstorm, heavy, without hail* but with rain and/or snow at time of observation	
**98	Thunderstorm combined with duststorm or sandstorm -- at time of observation.	
99	Thunderstorm, heavy, with hail* at time of observation.	

* Hail, ice pellets, i.e., pellets of snow encased in a thin layer of ice, snow pellets.

**In reporting code figure 98, the observer is allowed considerable latitude in the presumption that precipitation is or is not occurring if it is not actually visible.

Precipitation - Columns 58 through 68. The amount of precipitation was recorded by a Weather Bureau shielded precipitation gage #D101 mounted on the boom of each fixed ship and graduated in millimeters. With care taken to allow for ship movement, the amount of precipitation during, or 1 1/2 or 3 hr before, the observation was read to the nearest millimeter and entered in columns 58, 59, and 60. If precipitation fell, but was too small to be measured, 001 was entered. If no precipitation was observed, 000 was used.

The times of beginning and ending of precipitation were recorded in GMT to the nearest minute in columns 61 through 64 and 65 through 68, respectively. If precipitation began or ended more than once during the observation period, the time of the first beginning and last ending was entered, and the appropriate codes for showery or intermittent activity were entered in the present- and past-weather columns.

Table 4-11.--Code table for past weather

Code figure	Past weather
0	Clouds covering 1/2 or less of the sky throughout period
1	Clouds covering more than 1/2 of the sky during part of period, and less than 1/2 during part of period
2	Clouds covering more than 1/2 of the sky throughout period
3	Sandstorm, duststorm, or drifting or blowing snow
4	Fog, or ice fog, or thick haze
5	Drizzle
6	Rain
7	Snow, rain and snow mixed, or ice pellets
8	Shower(s)
9	Thunderstorm(s), with or without precipitation

Orientiation of Low Clouds - Columns 69 through 71. When cumulus clouds arranged in bands or several bands separated by clear spaces (streets) were observed, their presence was recorded by entering code 1 in column 69 of the form; 0 was used if they were not present. The orientation of the cloud street axis with respect to true north is indicated in columns 70 and 71 in accordance with table 4-12. (This information was reliably reported.) If columns 69 through 71 are blank, no observations of this type were made.)

Remarks - Columns 72 through 80. These columns were left open for the observer to record any information he considered pertinent to the observation not allowed for in the form, such as wind shifts, gusting wind, waterspouts, hail, second swell group at least 30° different from the one reported, reasons for missing data or unreliability of some data, and whether the observation was transmitted to the Barbados Control Center, indicated by TRANS. The GMT for all such entries in the remarks column is given. The observer's initials appear in the last column of the Surface Observations Form.

Table 4-12.—Code table for orientation of cloud band axis with respect to true north

Code figure	Orientation of band axis with respect to true north along a line			
00	From	0°	to	180°
01	"	10°	"	190°
02	"	20°	"	200°
03	"	30°	"	210°
04	"	40°	"	220°
05	"	50°	"	230°
06	"	60°	"	240°
07	"	70°	"	250°
08	"	80°	"	260°
09	"	90°	"	270°
10	"	100°	"	280°
11	"	110°	"	290°
12	"	120°	"	300°
13	"	130°	"	310°
14	"	140°	"	320°
15	"	150°	"	330°
16	"	160°	"	340°
17	"	170°	"	350°

4.2 Archive Format and Data Inventory

The marine meteorological observations as logged on the Surface Observations Form were punched on cards and edited for punching errors only. These data are contained on magnetic tape as the second of five files. The first file consists of 80-column card images, one card image per record, describing the formats of the five data files. The third file contains manually recorded ship operations and navigation data (these have been supplemented by corrections for ship motion and ship positions for Periods II and III, after the moorings of the fixed ships failed; see sec. 2). The fourth file contains information logged on the STD Observation Form (see sec. 7) and the fifth file consists of radiometersonde data (see sec. 5). All information is in binary-coded-decimal (BCD) format, even parity, 800 bits per inch.

An inventory of the marine meteorological observations is given in table 4-13. The magnetic tape format is as follows:

Character	Element
1	Card code, should always be 1
2	Ship code 0 - Oceanographer 1 - Rainier 2 - Mt. Mitchell 3 - Discoverer 4 - Rockaway
3-5	Modified Julian day
6-7	Hour, GMT
8-9	Minute
10-14	Station pressure, millibars and tenths
15	Three-hour pressure tendency
16-17	Three-hour pressure change, millibars and tenths
18-20	Dry-bulb temperature, degrees and tenths Celsius
21-23	Wet-bulb temperature, degrees and tenths Celsius
24-25	Dewpoint temperature, degrees Celsius
26-27	Relative humidity, percent
28-30	Wind direction, degrees true
31-32	Wind speed, knots
33-35	Direction from which wind waves come, degrees true
36-37	Wind-wave height, half-meters

Character	Element
38-39	Wind-wave period, seconds
40-42	Direction from which swell comes, degrees true
43-44	Swell height, half-meters
45-46	Swell period, seconds
47	Total cloud amount, eighths
48	Low cloud amount, eighths
49	Low cloud type
50	Low cloud height
51	Middle cloud type
52	High cloud type
53-54	Visibility
55-56	Present weather
57	Past weather
58-60	Precipitation amount, millimeters
61-62	Hour precipitation began, GMT
63-64	Minute precipitation began, GMT
65-66	Hour precipitation ended, GMT
67-68	Minute precipitation ended, GMT
69-80	Remarks

The BOMEX surface pressure - marine microbarograms for four of the fixed ships are contained on a reel of 35-mm microfilm. This reel also contains the Weather Radar Log for the Discoverer (see sec. 8) and the NAVOCEANO CTEM Sea-Surface Temperature Log (see sec. 7). Daily charts are available for the time periods indicated in the inventory given in table 4-14.

Table 4-13.--Inventory of marine meteorological observations

Magnetic tape No.	Date (1969) Calendar date	Julian day	Oceanographer No. of observations	Rainier No. of observations	Mt. Mitchell No. of observations	Discoverer No. of observations	Rockaway No. of observations
B9622	May 1	121		9			14
"	" 2	122		15	2		15
"	" 3	123	16	15	15		15
"	" 4	124	15	15	9		15
"	" 5	125	11	8	7		8
"	" 6	126	14	15	14		15
"	" 7	127	10	11	12	11	11
"	" 8	128	1				8
"	" 9	129	9	10	12	10	10
"	" 10	130	13	15	15	16	15
"	" 11	131	15	15	15	15	15
"	" 12	132	14	15	15	15	11
"	" 13	133	15	15	15	15	8
"	" 14	134	7	8	8	9	7
"	" 15	135	2			1	2
"	" 16	136					1
"	" 17	137					
"	" 18	138					
"	" 19	139					
"	" 20	140					
"	" 21	141					
"	" 22	142					
"	" 23	143					
"	" 24	144	4	10	9	10	7
"	" 25	145	13	14	14		9
"	" 26	146	15	15	14		8
"	" 27	147	14	14	15	13	8
"	" 28	148	14	14	14	13	7
"	" 29	149	1			1	5
"	" 30	150	8	8	9	6	7
"	" 31	151	13	14	12	12	7

Table 4-13.--Inventory of marine meteorological observations (continued)

Magnetic tape No.	Date (1969) Calendar		Date (1969) Julian day	Oceanographer No. of observations	Rainier No. of observations	Mt. Mitchell No. of observations	Discoverer No. of observations	Rockaway No. of observations
B9622	June	1	152	15	15	15	15	8
"	"	2	153	15	15	14	13	7
"	"	3	154	15	15	15	15	
"	"	4	155	13	13	14	13	5
"	"	5	156	1			1	1
"	"	6	157	9	10	10	8	7
"	"	7	158	15	15	15	15	8
"	"	8	159	8	8	7	8	6
"	"	9	160	15	15	16	15	9
"	"	10	161	4	4	3	5	2
"	"	11	162					
"	"	12	163					
"	"	13	164					
"	"	14	165					
"	"	15	166					
"	"	16	167					
"	"	17	168					
"	"	18	169					
"	"	19	170					
"	"	20	171	1	1			1
"	"	21	172	8	8	8	8	4
"	"	22	173	4	14	15	16	9
"	"	23	174	14	15	16	14	8
"	"	24	175	15	16	14	15	8
"	"	25	176	15	15	15	15	8
"	"	26	177	13	13	13	13	6
"	"	27	178	1			1	1
"	"	28	179	12	13	12	12	6
"	"	29	180	15	15	15	15	8
"	"	30	181	5	15	14	14	5

Table 3-14.--Inventory of marine meteorological observations (continued)

Magnetic tape No.	Date (1969) Calendar	Julian day	Oceanographer No. of observations	Rainier No. of observations	Mt. Mitchell No. of observations	Discoverer No. of observations	Rockaway No. of observations
B9622	July 1	182		14	14	14	7
"	" 2	183		4	5	4	2
"	" 3	184					
"	" 4	185					
"	" 5	186					
"	" 6	187					
"	" 7	188					
"	" 8	189					
"	" 9	190					
"	" 10	191					
"	" 11	192		6	1	5	5
"	" 12	193	5	8	3	8	4
"	" 13	194	8	8	8	8	8
"	" 14	195	8	8	7	8	5
"	" 15	196	7	7	7	7	6
"	" 16	197	1	1		1	1
"	" 17	198	8	8	8	8	5
"	" 18	199	8	8	8	8	8
"	" 19	200	8	8	8	4	8
"	" 20	201	8	8	8	8	8
"	" 21	202	8	7	8	8	9
"	" 22	203	8	9	8	8	6
"	" 23	204	8	8	7	4	8
"	" 24	205	4	3	4	8	2
"	" 25	206	8	8	7	8	8
"	" 26	207	8	8	7	8	
"	" 27	208	7	8	8	8	
"	" 28	209	7	7	8	1	
"	" 29	210					

Table 4-14.--Inventory of surface-pressure--marine microbarograms

Microfilm reel No.	Oceanographer daily charts	Rainier daily charts	Mt. Mitchell daily charts	Discoverer daily charts
DOC.-3	May 1 - May 16	May 1 - May 14	May 2 - May 14	May 3 - May 15
"	May 22 - May 31	May 22 - May 31	May 23 - May 28	May 22 - May 31
"	June 1 - June 11	June 1 - June 10	May 30 - May 31	June 1 - June 13
"	June 19 - June 27	June 19 - July 1	June 1 - June 10	June 19 - June 30
"	July 10 - July 28	July 10 - July 28	June 20 - June 30	July 1 - July 5
"			July 1 - July 2	July 9 - July 28
"			July 10 - July 29	

5. RAWINSONDE AND RADIOMETERSONDE DATA SET

5.1 Instrumentation and Observation Procedures

Rawinsonde balloons launched from the BOMEX ships carried two instrument packages aloft for each observation: a temperature sonde equipped with a thermistor and a humidity sonde with a hygristor. All sondes and telemetry units were of standard National Weather Service type with these exceptions:

(a) The temperature sondes were specially wired to yield only signals for temperature, low reference (190 Hz) instead of a humidity signal, and a special midreference signal (95 Hz) that replaced every fifth low reference in the sequence. This allowed more frequent reference signals and hence more precise corrections for variations in sonde characteristics. Selected precalibrated thermistors were used.

(b) The temperature sonde pressure sensors were specially selected and precalibrated twice at the factory, once "up" and once "down." Sensors that showed large differences were rejected.

(c) The humidity sondes were modified to yield an almost continuous humidity signal, interrupted only occasionally for a low-reference signal. Because the humidity data are much less sensitive to minor sonde battery variation than the temperature data, there was no need for frequent reference checks. A more sensitive uncalibrated pressure commutator was substituted for the usual baroswitch to further shorten the time occupied by reference signals. All pressure data were taken from the temperature sonde and time correlated to the humidity data. The net result was extraordinarily fine vertical resolution in the humidity profile.

Table 5-1 summarizes the instrumentation and sonde frequency used by the fixed ships during the four BOMEX Observation Periods. Temperature sonde and humidity sonde signal output was acquired by separate receivers aboard ship and recorded automatically on the Signal Conditioning and Recording Device (SCARD), the primary shipboard recording unit, which was developed and operated in the field by personnel from NASA's Mississippi Test Facility (MTF). Data were also recorded on strip charts for quality control.

Two types of balloon-tracking systems were used: the Scanwell Wind Finding at Sea System (WFSS) and radar wind finding systems. The Scanwell WFSS was carried aboard the Oceanographer, Mt. Mitchell, and Rainier. By means of rotary potentiometers mounted within the Scanwell balloon-tracking instrumentation, continuous slant range and azimuth values of balloon position were acquired for computation of upper air wind directions and speeds. These data were also recorded on SCARD, as well as on strip charts for quality control. The Discoverer was equipped with a Selenia radar, METEOR 200 RMT-2S (3.2-cm wavelength). Slant range and azimuth data, for computation of upper air winds, were recorded on punched paper tape at 15-s intervals, with a printed paper tape for quality control. The Rockaway used an AN/SPS-29 radar.

Slant range and azimuth measurements were obtained visually by the radar operator at 1-min intervals and recorded manually for subsequent conversion to punched cards.

Radiometersonde observations were obtained at 0000 GMT each day from the Discoverer, Rainier, and Rockaway during all four BOMEX periods. A Suomi-Kuhn economical net radiometer to measure upward and downward IR radiation was attached to the rawinsonde.

Table 5-1.--BOMEX rawinsonde instrumentation

Ship	Period I	Period II	Period III	Period IV
Oceanographer	Temperature 403/1,680 MHz	Same as I	Same as I	Same as I
Mt. Mitchell	Humidity 72.2 MHz	"	"	"
Rainier[1]				
Discoverer[1]	Temperature 403 MHz	Same as I	Same as I	Same as I except all pulsed sondes used
	Humidity 403 MHz Low-level[2] FM sondes High-level[3] pulsed sondes	"	"	"
Rockaway[1]	Temperature 403 MHz	Same as I	Same as I except all pulsed sondes used	Same as IV
	Humidity 403 MHz Low-level[2] FM sondes High-level[3] pulsed sondes	"	"	Humidity 72.2 MHz

[1]Suomi-Kuhn 403 MHz FM-FM (upward and downward IR) radiometersondes flown at 0000 GMT daily.

[2]Planned termination at approximately 400 mb.

[3]From surface to burst.

The procedures for making rawinsonde observations were essentially the standard ones used by the National Weather Service. An exception was that the frequency of observations, i.e., every 1 1/2 hr, required termination at 400 mb. The requirement for increased accuracy and nearly continuous resolution in humidity data dictated the use of two sondes on the same balloon train, one that measured temperature, the other humidity.

The temperature sonde was not baselined because individually calibrated thermistors were used. Standard preflight check and inspection were performed, however. The sonde was assembled in the normal fashion, except that no hygristor was installed. After the instrument had been checked externally, the temperature sonde ground equipment was turned on and allowed to warm up, and the activated batteries were placed in the sonde for a 2- to 3-min warmup period. By alternate touching of the two test leads with a common lead, the low reference and midscale reference, respectively, were transmitted. The low-reference signal was maintained long enough to set the recorder on ordinate 95.0. After the reference had been tested and set on the strip chart, the temperature signal was checked for proper or expected value. The sonde transmitter was adjusted to the desired frequency; alternate flights were tuned to different frequencies to minimize possibility of an abandoned flight interfering with preflight operations for the next observation. Under normal circumstances, the sonde transmitter was never tuned to the limits of the equipment frequency range, since some latitude was left for postrelease frequency drifts. With the external switching completed and the test leads clipped off, the temperature sonde baroswitch was set to a position corresponding to the nearest 0.1 contact representing the ambient pressure read on the ship's precision aneroid barometer. The procedures used to set the baroswitch were those suggested in Federal Meteorological Handbook 3.

The humidity sonde was inspected and reference checked in the same way as the temperature sonde, and the transmitter was tuned to the proper frequency. Following this, baseline measurements were made in the baseline check box. The baseline wet- and dry-bulb temperature conditions were established to the nearest 0.1°C (by use of special precision thermometers), and the corresponding relative humidity was determined. With the humidity stabilized at 31 to 35 percent (normally around 33 percent), the baseline conditions were recorded on a special Rawinsonde Observation Form (BOMEX Card 0) for use in later data processing. The baseline measurements were considered valid for only 30 min. If release did not occur within 30 min, a fresh humidity element was installed and a new baseline check made. The baroswitch was then set. The humidity sonde baroswitch was set to either contact number 3 or 8, whichever was closest to the original pen arm position. Since the humidity sonde baroswitch was not used for pressure measurements, setting the baroswitch according to ambient station pressure was not required. Only the temperature sonde baroswitch was used for pressure measurements. Setting the pen arm as indicated ensured that relative humidity data were transmitted at release and a low reference shortly thereafter.

A 300-g balloon was used for flights to 400 mb at the 1 1/2-hr release frequency. For all 0000 GMT observations and flights released at the 6-hr release frequency, a 600-g balloon was used. With two instrumentation packages, the ascent rate was nominally 200 m/min for the 300-g balloon and 300 m/min for the 600-g balloon. During BOMEX Observation Period I (May 3 to May 15), the two sondes were strapped together, back to back, but signal interference between the two instruments occurred occasionally, and such flights were not processed. Thereafter, the sondes were separated on the train by 1 1/2 to 2 m, with the temperature sonde nearest the balloon. For flight, the arrangement was balloon, train regulator (15 to 20 m of line included), sondes spaced 1 1/2 to 2 m apart, 3 1/2 m of line, and (for the Discoverer and Rockaway only) target.

Just before release, all ground equipment was rechecked, and the SCARD operators were notified to prepare for release. Immediately before release, the humidity sonde external low-reference wire was grounded to the sonde for at least 5 s, and this connection was broken as the balloon was released. The resulting shift in signal frequency was used in later data reduction as indication of lift-off.

After release, the usual procedures for monitoring rawinsonde ground equipment were followed, and the observation was terminated as scheduled or as soon as sonde failure occurred in flight.

The same preflight checks and procedures used for the rawinsondes were used for radiometersonde observations. The radiometer was attached according to instructions given by P.M. Kuhn, Environmental Research Laboratories, NOAA, Boulder, Colo. 80302.

5.2 Preliminary Data Processing

The rawinsonde data were initially processed by NASA's Mississippi Test Facility (MTF), Bay St. Louis, Miss. After early review of the digitized SCARD analog data, it became evident that, because of inconsistencies in observational techniques, operational difficulties, and other problems (such as digital noise), a comprehensive set of rawinsonde processing software could not be constructed without some intermediate processing step that would produce sufficiently complete output for review and for design of the final software.

Temperature- and humidity-sonde signals for all ships were recorded as frequency-modulated signals on SCARD. Slant range and azimuth from the Scanwell WFSS installed on the Oceanographer, Mt. Mitchell, and Rainier were also recorded on SCARD, but as amplitude-modulated signals. All these parameters were frequency multiplexed on one of the seven SCARD recording channels. The temperature- and humidity-sonde input signals from ground-station receivers aboard the fixed ships were designed to vary between 10 and 200 Hz, but in many cases exceeded 200 Hz. The slant range and azimuth input voltages from the Scanwell WFSS varied between 0 and 5 V d.c. The slant range was a ramped signal representing successive 2,000-m increments of measured slant range. The azimuth input from Scanwell consisted of two inputs: one voltage (0 to 5 V d.c. ramp) representing the range from 0 to 360° (called AZ360), the other (0 to 5 V d.c. ramp) representing successive 0 to 20° ranges (called AZ20). These two azimuth voltages, derived from precision potentiometers mounted within the Scanwell antenna servodrive train, were necessary to achieve appropriate resolution in measured azimuth. On the Discoverer, slant range and azimuth were acquired at 15-s intervals by a Selenia radar, Model METEOR 200 RMT-2S, and recorded digitally on punched paper tape and on a hard-copy printout. On the Rockaway, slant range and azimuth were acquired by an AN/SPS-29 radar and recorded manually at 1-min intervals.

Digitization of the above signals required a two-pass operation: a first pass that converted the analog FM/FM (frequency modulated) and FM/PAM (pulse amplitude modulated) signals to digital form at 16 times real-time recording speed, resulting in 10 samples per second (10 sps) digital values of frequency and d.c. voltages; and a second pass that edited, formatted, scaled, and reduced the 10-sps digitized SCARD data to 2 sps and produced as output one reel of magnetic tape containing all measured frequency values and d.c. voltages gathered in one 24-hr period (0000 through 2400 GMT) for one fixed ship. The first pass was made by an SDS 930 Automatic Telemetry Reduction System, a program-controlled system in which an AMPEX FR-1400 analog tape unit, time-code-generator decoder, 18 discriminators, two cycle counters, input/output tie-in crossbar units, five levels of a priority interrupt system, three digital tape units, and other peripheral input/output devices were used. The second pass was made by an IBM 7094 program that created SDS 930-compatible 2-sps tape from a 10-sps tape. This equipment and the programs were operated and managed by the NASA Slidell Computer Complex, Slidell, La.

5.2.1 Temperature- and Humidity-Sonde Data

First pass. For each element, the demodulated output was input to a zero detection unit. At each positive-going crossover, the following took place:

(a) The appropriate counter was updated by one.

(b) The contents of a 312.5-kHz clock (recorded on SCARD as 3.125 kHz, then multiplied for system control) was transferred to the appropriate storage register. At the end of each 1/10 s, the output for each element (temperature/temperature references or humidity/humidity references) was computed by V = t/c, where V = recorded value; t = the time, in units of the 312.5-kHz clock; and c = the integral number of positive crossovers. Thus, a time series of 10-sps* values, one 10-sps series for the temperature sonde and one for the humidity sonde, were formed as input to the second pass. Each 10-sps time series contained measured temperature or humidity values and their respective reference values in the sequence of normal occurrence during the observation.

Second pass. The 10-sps samples were converted to Hz values for each 1/10 s by dividing the output (V above) of digitizing into 3,125,000. Following conversion to Hz, a noise elimination averaging technique was applied to the 10-sps data with one 1/2-s period, i.e., five 1/10-s data points, to form the 2-sps time series. Selective averaging was done by comparing the new arithmetic average of the input data set with the previously averaged point for this variable. If the difference between these two values exceeded the tolerance as specified on the noise tolerance manual input card to the second pass program (± 0.5 Hz for temperature-sonde and ± 1.0 Hz for humidity-sonde

---

*Used here, and in what follows, to indicate "values per second."

data), the point deviating most from the arithmetic mean was discarded, and the previous average was replaced with a new arithmetic mean of (n-1) 1/10-s points. The process was then repeated until the correct tolerance was established or until only two points remained. The average of these two points was then accepted as the average for one 2-sps data point. Following averaging, the digitizing system calibrations were applied to the 2-sps data points.

5.2.2 Slant Range, Azimuth 360, and Azimuth 20

First pass. For each channel (one for slant range, one for azimuth 360, and one for azimuth 20), the signals were demodulated through a discriminator giving a d.c. voltage nominally in the range of ± 7.5 V. At the beginning and end of each SCARD tape, the calibration outputs were taken for each channel and recorded separately. Each 1/10 s, the three discriminated voltage outputs were multiplexed to an A/D converter at the rate of 50 μs per channel. The converter was capable of digitizing in the range of ± 10 V, with significance to approximately 0.01 V. Thus, a slant range, azimuth 360, and azimuth 20 10-sps time series was formed for each variable for input to the second pass program.

Second pass. The 1/10-s values were scaled to 10,000 counts, where 0 - 5 V ≡ 0 - 10,000 counts as follows:

$$\text{Counts} = 10{,}000\ (A_t - L_c)/(H_c - L_c),$$

where L_c and H_c are low-reference calibration and high-reference calibration, respectively, as recorded on SCARD. The calibrations represent the average of the beginning and ending calibrations on one SCARD tape, and A_t is the variable sample. The 10-sps values were then reduced to 2-sps values by the noise elimination averaging used for rawinsonde temperature and humidity, with the tolerances for slant range and azimuth 360 being 60 counts and for azimuth 20, 250 counts.

5.3 Final Data Processing

The 2-sps magnetic tape data from MTF described above were used for final processing, which consisted of both automated and manual procedures. The overall approach was as follows:

(1) Soundings were processed to termination, or end of usable data.

(2) A check was made for baroswitch setting errors, and the few soundings with errors of more than one contact were discarded.

(3) Care was taken to distinguish between temperature signal and midreference signal at their crossover points.

(4) Thermal lag corrections were applied to the temperature and humidity values, but the final output includes both uncorrected and corrected humidities.

(5) An insolation correction was applied to daytime humidity values, but uncorrected values are also included in the final data set.

(6) Automated corrections were introduced for a number of recurring instrumentation problems.

(7) Low-reference frequencies were accepted up to 210 Hz.

(8) Ship-velocity corrections were determined for computation of winds.

(9) Whenever possible, soundings that were missing or could not be processed automatically from the magnetic tapes were processed manually from strip charts.

The system developed for the final processing of the rawinsonde data consisted of three distinct parts: (1) manual processing, (2) automated processing, and (3) an acceptance phase. The major elements of the system are shown in figure 5-1, where each of the rectangles represents an independent main computer program. This partitioning was made to hold individual program memory requirements and computer time within acceptable limits, and to allow for separate development of program parts. In general, each main program produced its own magnetic tape output as a "check point," so that extensive reruns could be cut down in case corrections were required or runs failed. The two trapezoids represent extensive manual preparation and intervention points. As part of these manual procedures, short computer routines were used in editing and displaying the data for evaluation.

In the <u>manual processing</u>, data on temperature and humidity frequencies from strip charts, and slant range and azimuth readings from various listings, punched paper tape, and, in some cases, magnetic tape, were all reduced to punched cards, or to card images on magnetic tape. Three sets of cards were prepared from the manually logged Surface Observation, Rawinsonde Observation, and Ship Operations Forms. Baroswitch calibration pressures were also punched on cards, a separate set for each sounding. A fifth type of card, one set for each rawinsonde flight, carried the individual flight number assigned during data processing and included several parameters found necessary for correlation with the other punched card data sets. All cards were carefully inspected both visually and by special checking and display programs. A magnetic tape was then prepared, grouping together all data for each flight, and this tape was used as input for a rawinsonde program, by which the conversion to meteorological units and the various sounding computations were carried out. The resulting data were recorded on magnetic tape, from which listings and modified pseudo-adiabatic plots were made on microfilm.

On the magnetic tapes generated at MTF, sea-surface temperature, surface wind, atmospheric pressure, and other data were interspersed with the rawinsonde data. In the <u>automated processing</u>, a first program sorted these data onto two tapes, one containing rawinsonde data, the other the surface data (obtained with the specially instrumented ships' booms; see sec. 3). The rawinsonde data tape was then used as input to two programs. One of these edited and averaged the temperature and humidity data into 5-s values, on magnetic tape, eliminating noise; the other prepared a similar output tape for slant range and azimuth. Next, the manually worked up data referred to above

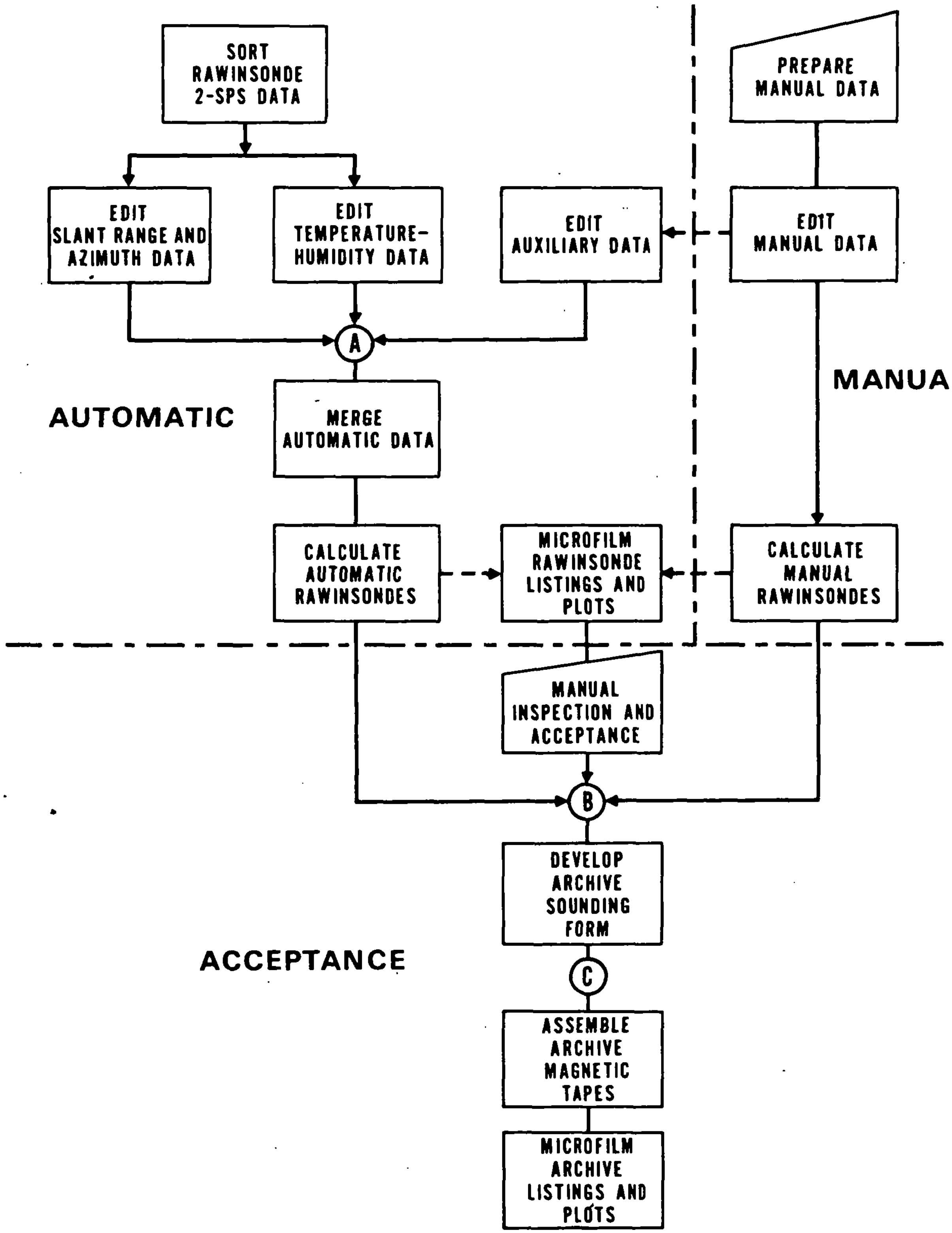


Figure 5-1.--BOMEX rawinsonde processing system.

were introduced into the automatic processing, and a merging program was then used to prepare a tape that combined all pertinent data from the temperature-humidity tape, the slant range-azimuth tape, and the auxiliary data for input to a second rawinsonde program, which was almost identical to the one used in the manual processing and produced output in the same format.

In the acceptance phase, results were reviewed not only at every major intermediate point in the processing, but a final inspection was made of microfilm plots of the individual soundings. If, for example, at this point a particular sounding "looked bad," as processed automatically, a check was made whether strip-chart data were available and, if they were, these data were introduced into the manual processing cycle for computation. As another example, the occurrence of a "super-adiabat" led in some cases to a special diagnostic run of the sounding in question to check whether a correction was needed. Also, computer runs were made of all soundings for a particular ship for a continuous period in order to compare successive soundings at various pressure levels. If such comparison indicated moisture values for one sounding that were, for example, low compared with values for the preceding and succeeding soundings, the microfilm output was examined in detail for signs of "reality," e.g., a close-by inversion.

Finally, the wind data were corrected for ship motion (see sec. 2), and a sorting and merging computer run was made by which all soundings for each of the five ships and for each of the four BOMEX observation periods were placed in time order for archival.

In the sections that follow, processing is discussed in terms of type of data rather than within the framework of the structure of the processing system as shown in figure 5-1.

5.3.1 Signal Processing

5.3.1.1 General. The transmitted frequencies of the reference signals were not exactly 95 and 190 Hz, and the frequency associated with the temperature sensor varied continuously. Also, although the reference frequencies for a particular rawinsonde flight were nearly constant, they were subject to some drift. In order to differentiate between the three signal types and to distinguish them from noise, frequency bounds were established for each type at the beginning of each sounding. After a first occurrence of one type, the range of acceptable values for that type were narrowed down for processing of later occurrences of the same type.

In view of the small range of surface temperature over the tropical BOMEX area, the following initial ranges for the temperature sonde signals were set:

Low reference--178 to 210 Hz, inclusive.

Midreference--87 to 105 Hz, inclusive.

Temperature frequency--125 to 155 Hz, inclusive.

Noise--any frequency not within the above ranges.

Before a new set of samples for a particular type was collected (after the initial set), new tolerances were established for that type. For either of the reference frequencies, the new bounds were established at ± 2 Hz from the last reference mean. These same bounds were reset also for the temperature frequencies, but were then further expanded as a function of time elapsed since the creation of the last temperature frequency mean. The lower bound was reduced further by 1 Hz and an amount equal to 0.025 times the length of time, in seconds, between the mean time of the previous occurrence of temperature frequency and the beginning time of the latest signal. The upper bound was increased by 1 Hz and an amount equal to 0.045 times the same time interval. These extended bounds were necessary in order to take care of decreases in frequency that occurred because of dry-adiabatic lapse rates and increases associated with fairly sharp temperature inversions.

One problem was related to signal time extent that can result from a leaking or "floating" balloon, a contact that has stuck, or a noisy signal. To avoid uncertain pattern recognition and faulty processing under such circumstances, the time extent of each signal type occurrence was noted and, after some startup uncertainty, an average time extent for each type was computed and kept current for the last five occurrences of each type. The lower tolerance of time extent for a particular type of signal was set at 70 percent of its average time extent, and the higher tolerance at 50 percent longer than the average. When a new signal type could not be recognized because of noise or for other reasons, processing of the sounding was ended if the signal persisted beyond the high tolerance time.

5.3.1.2 Temperature. As temperature decreased with height, its frequency crossed the midreference frequency somewhere between an altitude of 20,000 to 30,000 ft. This often presented a special problem in the program used for signal recognition when the time window for expecting a new midreference contact occurred at a time when the recognition bounds for temperature frequency and midreference frequency overlapped. In these instances, a sample that was larger than the one generally used was set up to include all temperature-sonde frequency data from the onset of the temperature signal to the low-reference signal following the crossover midreference. Also, the normal tolerance bounds for midreference of ± 2 Hz from the last mean was reset to ± 0.2 Hz, and this larger data set was then inspected from the first value until four successive values (2 s of data) were found to be within the new, closely set, midreference bounds. The first value was accepted as the beginning of the midreference frequency set. The search was then continued until another four successive values were found to be outside the midreference bounds, with the first value adopted as the beginning of the following temperature signal set. When the next low-reference signal appeared, the processing of the larger sample was considered ended and normal processing was resumed. The above solution to the crossover problem is illustrated in figure 5-2.

Based on a given value of one type (temperature, midreference, or low reference) within the appropriate range, an average frequency value was calculated. For midreference or low reference, the entire set of values from a given contact was used to form the average. For a temperature frequency set, a subset of approximately 5 s of data was used to derive each average. After a frequency average had been formed, it was compared with individual values. Any value found to be more than 1 Hz from the average was discarded,

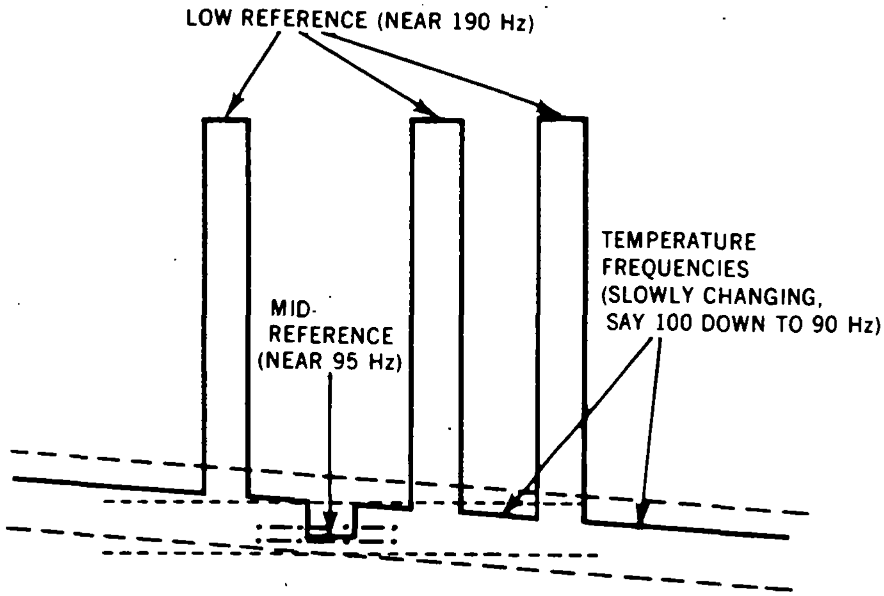


Figure 5-2.--Solution to crossover problem. High and low range of expected temperature and midreference signals (dashed lines); close high and low range for mid-reference at crossover (dashed-dotted lines).

and a new average was calculated from the remaining values. This process was continued until all values were within 1 Hz of the average. For temperature frequency, an average time of occurrence was calculated from the clock values associated with the frequency values entered into the final frequency average. In averaging, the time the first value of a set was recognized was used as the reference time.

5.3.1.3 Humidity. Before noise elimination and averaging, corrections were applied to the 2-sps (2 values per second) humidity frequencies for a characteristic of the 72-MHz ground equipment that caused occasional "frequency doubling" for short periods of time, resulting in humidities that were from 5 to 50 percent too low. Except for the 1/2-s values mentioned below, each value was examined for doubling by checking it against one or two preceding values. If doubling had occurred, the frequency was replaced by 1/2 of its initial value. Excluded from inspection for doubling were (1) null values; (2) values above a certain threshold that were taken to be reference frequencies; (3) values below a threshold of 20 Hz, for which subsequent doubled values were judged to be indistinguishable from real measurements because of the rapid changes possible in humidity measurements; and (4) values succeeding certain values considered to be unreliable for doubling comparisons. The following three types of values seemed unreliable for doubling comparisons due to noise introduced in the analog-to-digital conversion: (1) values immediately following null values, (2) values immediately following reference values, and (3) values that were lower by more than 20 Hz than the value immediately preceding them.

The reference threshold referred to above was initially set at 175 Hz for each sounding. Values above 175 Hz were considered to be possible reference frequencies or, at least, not possible values for humidity measurements. When a group of such high values was first encountered in a sounding, their average was calculated, and the threshold was then reset to that average minus 3 Hz and maintained for the rest of the sounding.

Each 1/2-s value was inspected for doubling. The preceding frequency was doubled, and a range of values was set from minus to plus a small increment from this doubled value. If the value under inspection was within this range, it was replaced by 1/2 of its initial value; if it was not, a similar range was set based on the value before the immediately preceding one, and if this value fell within this range, it was replaced by 1/2 of its initial value. The small increment mentioned above was set at 2 Hz until two "doublings" had been discovered. It was then reset at 5 Hz. If no new doubling was discovered within 60 s of the last occurrence, the increment was reset at its original value of 2 Hz.

Inspection of the results of these correction procedures for flights with known doubling indicate that about 60 to 80 percent of cases of doubling were corrected without introduction of false corrections, i.e., data being "undoubled" when no doubling existed. Also, many flights for which visual inspection of strip charts had not given evidence of doubling were found to contain a few instances of doubling. Not all flights were checked this way, but six soundings were looked at in detail, and the cases of doubling uncovered appeared to be real.

The 2-sps digitized humidity frequency values included relative humidity frequencies and reference frequencies. This made recognition easier than for the three-signal temperature data. Relative humidity measurements can change rapidly, however, and meaningful frequency values at any point in a sounding can range from less than 20 Hz to about 170 Hz. To avoid more sophisticated methods, such as recognizing trends and setting limits on change in time, the processing method used limited groups for averaging to no more than 5 s (about 10 values, each 1/2 s), set a wide range of ± 5 Hz from the last calculated average for collection of new samples to be averaged, and permitted all values within ± 2 Hz of an average to be included in the group processing. Because some changes were very rapid, the signal was occasionally "lost" during processing. In such instances, a "restart" was used in programming by which any values in the range from 0 to 175 Hz were accepted for a new group, a procedure similar to that used at the start of a sounding. For both start and restart, at least two values were required to fall within ± 2 Hz of the average for the average to be formed.

Inspection of 2-sps values of humidity frequencies in "noisy" soundings showed rather frequent rapid excursions of up to 20 to 50 Hz above or below what could be "seen" to be the average value. Where these excursions occurred over a few seconds, they were generally eliminated in the averaging process. However, some persisted in the averaged values, and were apparently associated with dropouts to null values, or near-dropouts, resulting possibly from weak signals and attendant digitizing problems. These spikes were considered unreal and were eliminated by the procedure described below.

A "spike" is here defined as a rapid change in average frequency that returns close to its original value within a short time. The programming for eliminating these spikes consisted of setting an alert when a rapid frequency change--20 Hz in 5 s, 30 Hz in 10 s, and 40 Hz in 20 s--occurred. If the spike alert was not cancelled within less than 1 min by the frequency returning to near-prealert values, or to a new stable value, the intervening humidity indications were judged unreliable, and were nulled (-999). If, within the time limit, four averages were found to be within ± 10 Hz of one another at values beyond the criteria for rapid change, the alert was cancelled and intervening averages were retained.

Only one reference frequency was used with the humidity-sonde transmitter, and its signal occupied much less of the total transmission time than the reference for the temperature sonde. After a range of acceptable values had been established for the first occurrence, 2-sps frequencies from each reference contact were assembled for averaging if it had been found that (1) four successive values fit the reference criteria and (2) the average was within 2 Hz of the average calculated for the previous reference contact. The individual values were then compared with the average, any case found to deviate by more than 1 Hz from the average was dropped, and a new average was calculated from the remaining values. The time of the first reference within each group was noted, and these times were later used to develop reference averages by interpolation at each 5-s time point in order to have reference values available for each time point for which final computations were made. As with other averages, the time points were for every 5 s, beginning 2.5 s after "start-up" time. (For an explanation of "start-up" time, see sec. 5.3.1.5.)

5.3.1.4 Wind. Azimuth measurements from the Scanwell WFSS on the *Oceanographer*, *Mt. Mitchell*, and *Rainier* were recorded from two potentiometers, one for the full range, 0 to 360°, and one for the 20° sector, constituting the coarse and fine azimuths, respectively. These two ranges were used to achieve the necessary resolution in azimuth for wind computations. The coarse azimuth was used in determining for which 20° sector the fine azimuth was valid and to estimate the azimuth bias error. The first step was to convert the azimuth 2-sps voltage values to degrees of azimuth, as follows:

$$CAZ = 0.36\ V_C,$$

$$FAZ = 0.002\ V_F,$$

where

CAZ = coarse azimuth in degrees,

FAZ = fine azimuth in degrees,

V_C = coarse azimuth voltage in voltage counts (0 - 10,000 counts ≡ 0 - 5 V d.c.), and

V_F = fine azimuth voltage in voltage counts.

If at some time, t, either a coarse azimuth or fine azimuth did not exist, there was no conversion to scientific units. In such instances, the 2-sps values were replaced by "dead words" (no data indicator) and not considered or used in any subsequent averaging. After conversion of CAZ and FAZ to degrees, the bias correction was applied. In practice, it was impossible to zero the two potentiometers measuring azimuth (CAZ and FAZ; FAZ = 0 or 20° when CAZ = 0 or multiple of 20°). Therefore, an adjustment for relative bias was necessary before combining the two azimuth readings into a measured azimuth value. The maximum relative bias tolerated was 10° and included an allowance for backlash in the antenna drive gears to which the CAZ and FAZ potentiometers were attached. The azimuth bias routine was based on the assumption that the fine azimuth was correct and that the error was less than 10°. (This assumption, in turn, was based on the operating procedures for orienting the directional antenna.)

The following Fortran routine was used to compute the measured azimuth from CAZ and FAZ and to apply bias correction:

```
     A = CAZ - FAZ
    IA = A/20
     A = A - 20 * IA
    IF (A-10) 2, 2, 1
1   IA = IA + 1
2    A = FAZ + 20 * IA
    IF (A-360) 4, 3, 3
3    A = A - 360
4   CONTINUE
```

As one can see, this method fails when the relative bias reaches 10°. Because this happened occasionally at higher altitudes due to change of bias during flight, an initial bias was determined from the first 5-s averages for each flight. The initial bias was used as a correction to all coarse azimuth averages for the rest of the sounding before the correction routine described above was applied. Change of bias during flight is believed to have been caused by backlash in the gearing between the two potentiometers, but may also have included a small amount of gear slippage on the driving shafts and some minor nonlinearities in potentiometer windings. The corrected bias at this point was always less than 10°.

Following the above manipulation of the 2-sps azimuth values, the resulting values were averaged to form two series of 60-s averages of azimuth. In one, 60-s averages were centered on the minute, in the other on the half-minute. These two series were used alternately in the wind computations.

Slant range from the Scanwell WFSS on the Oceanographer, Rainier, and Mt. Mitchell was recorded as a ramped voltage, where 0 m = 0 V d.c. and 2,000 m = 5 V d.c. Thus, during any one observation, slant-range measurements consisted of repeating voltages in the range of 0 to 5 V d.c. every 2,000 m of slant range. This field of digital voltages was first converted from 2-sps voltage "counts" to 2-sps slant range values in meters as follows:

$$S = 0.2\ V,$$

where

S = slant range, in meters, modulo 2,000 m, and

V = voltage in counts (0 - 10,000 counts = 0 - 5 V d.c.).

After conversion, 30-s averages were calculated as follows:

(1) Five-second averages were formed from the 2-sps data and 30-s averages were formed from the 5-s averages. Displacement between each 5-s average and the preceding 30-s average was checked, with an acceleration of 20 to 25 m/s/min allowed.

(2) After a 30-s average had been obtained, the 5-s averages contained in it were checked again, as in (1) above, but against the 30-s average for these 5-s data points rather than the preceding 30-s average.

(3) Values were linearly interpolated for any missing 30-s averages. If data for more than 3 min were missing, wind computations were terminated.

5.3.1.5 Sea-Level and Station Pressure. The sea-level pressure for processing a sounding was obtained from shipboard National Weather Service aneroid barometer readings near launch time.

When the rawinsondes were released during BOMEX, the balloon and instrument package on most flights dipped below deck level before starting normal ascent. Study showed that the average time from release to a return-to-deck level, and, therefore, to the original station pressure, was close to 5 s. All calculations were based on this 5-s return-to-deck-level, or "start-up" time, unless there was direct evidence to the contrary, i.e., if the type of signal being transmitted at the time of release changed to another type within 5 s (change of temperature frequency to reference, or vice versa), it was assumed that such a change in signal type meant that the instrument was already rising above deck level.

The station pressure needed to process each sounding was obtained by subtracting a pressure, based on the height of the launching deck of each ship, from the recorded sea-level pressure. The factors used were 0.9 mb for the Oceanographer, 1.0 mb for the Rainier and the Mt. Mitchell, and 0.8 mb for the Discoverer and the Rockaway.

5.3.1.6 Baroswitch Pressure. The baroswitch contacts for reference on the temperature sonde were wired in the following two sequences (contact 0 through 125):

M(0), L,L,L,L,M(5), L,L,L,L,M(10),...,

where M refers to the midreference (95 Hz) and L to low reference (190 Hz). Above the 125th contact the pattern becomes:

M(125),L,L,L,L,M(130),L,M,M,L,M(135),...

The beginning of each reference contact, as the aneroid-driven linkage moved across the baroswitch, was associated with a calibration pressure provided for each instrument. Because of the limited range of station pressures during BOMEX, the reference transmitted at launch, or shortly thereafter, had to be the 4th, 5th, or 6th contact (counting the first reference as 0). This was used in the automatic processing to determine which contact was in effect at launch and to establish a valid reference pattern, i.e., if a midreference was the first reference signal transmitted, it had to be from the 5th reference contact. If the first reference signal was a low reference, it had to be the 4th or 6th; if it was followed by a midreference, it was the 4th, otherwise it was the 6th and had to be followed by three more low reference contacts. Any sounding showing a different initial pattern was rejected.

The correct pressure calibration contact number at release was estimated by the calculation described below instead of by the usual method outlined in Federal Meteorological Handbook No. 3. The estimate was made by noting the beginning time of the first and fourth reference contacts after release and the start-up time (see sec. 5.3.1.5). The contact number at time of release was taken as the linear extrapolation of contact number (pressure) at the start-up time from the contact numbers and times of first and fourth contacts after release. The pressure indicated by the baroswitch is the pressure at this start-up time contact in the array of calibration pressures. The difference between this baroswitch pressure and the station pressure, as derived from the aneroid barometer at time of release, was used to compute a contact correction, which was then applied to all contact numbers for the individual soundings. If the correction was equal to or greater than one contact, the sounding was not processed.

After the first and fourth contact times had been located and the indicated baroswitch pressure had been obtained by interpolation, a program was used to calculate the contact correction from:

SWOCR = (PRESS-PREST)/(PRESZ-PRES1),

where

SWOCR is the correction in fractional contacts,

PRESS is the indicated baroswitch pressure,

PREST is the station pressure obtained from the reading of the aneroid barometer,

PRES1 is the calibration-array pressure corresponding to the first contact after launch, and

PRESZ is the calibration-array pressure corresponding to the first contact before launch, the one immediately preceding PRES1.

The pressure at any time during a sounding was obtained by interpolation based on the fractional corrected baroswitch contact number for that time point and the temperature sonde baroswitch pressure calibration provided by the manufacturer for each instrument.

The beginning time of each baroswitch reference contact was noted during temperature-frequency processing. These times and their implied contact numbers were used to develop fractional baroswitch contact numbers at 5-s time points throughout a sounding by interpolation, beginning at 2.5 s after launch. The baroswitch launch-time correction was then applied to each interpolated value to arrive at an array of corrected fractional contact numbers.

5.3.2 Conversion to Meteorological Units

5.3.2.1 Temperature. The low reference correction (a correction for nonstandard battery voltages) applied to temperature and temperature-sonde midreference 5-s average frequencies was as follows:

$$f = f_R * \frac{190}{f_{LR}} ,$$

where

f = corrected temperature, or temperature-sonde midreference 5-s average frequency,

f_R = uncorrected temperature, 5-s average frequency, or temperature-sonde midreference 5-s average,

f_{LR} = low reference, linearly interpolated in time between low-reference frequencies on either side of the f_R, and

$*$ = multiplication.

The internal resistances of the temperature sondes were computed from the midreference frequency obtained by switching a precision 50,000-ohm resistor into the circuit (every fifth reference contact being a midreference, the other four low reference). The internal resistance in ohms was calculated from

$$B = \frac{f_{ms} * 50{,}000}{190 - f_{ms}} - f_{ms} ,$$

where

B = internal resistance in ohms,

f_{ms} = midreference (midscale) frequency corrected for low-reference drift, as described above, and

$*$ = multiplication.

With the above midreference correction, sensor frequency representing temperature in terms of resistance in ohms was calculated from

$$R = \frac{190 * (B + f)}{f} - (B + f) ,$$

where

R = sensor resistance in ohms representing measured temperature,

B = internal resistance in ohms,

f = temperature frequency corrected for low-reference drift, and

$*$ = multiplication.

The temperature and thermistor resistances are related by the equation (furnished by Viz Mfg. Co.):

$$\log_{10} \frac{R}{R_{30}} = \sqrt{27.3710 + \frac{16{,}949.6}{T + 273.00}} - 9.12742 ,$$

where

R = thermistor resistance,

R_{30} = resistance of thermistor at 30°C (furnished by the manufacturer for each thermistor, eliminating the need for baselining the temperature sondes), and

T = temperature in °C.

Solving for T, we have

$$T = \frac{16{,}949.6}{(9.12742 + \log_{10} \frac{R}{R_{30}})^2 - 27.3710} - 273.0 .$$

Following this solution for T, a calibration correction was applied as shown in table 5-2. (The thermistors were calibrated individually by the manufacturer to conform within ± 0.1°C with the values given in the table.)

Table 5-2.--Calibration corrections for rawinsonde temperature

Indicated temperature, T (°C)	Correction, C (°C)
30.00	+ 0.00
20.18	- 0.18
10.21	- 0.21
0.18	- 0.18
- 19.92	- 0.08
- 40.14	+ 0.14
- 60.07	+ 0.07
- 70.04	+ 0.04

Note: $T_c = T + C$, where T_c = corrected 5-s average temperature (°C), T = uncorrected temperature, and C = correction. For values of T not shown in the table, a correction was linearly interpolated.

The lag coefficient of the thermistor was determined from information furnished by C. Harmantas of the National Weather Service. The values used were functions of balloon type, which governed the rate of ascent, and of pressure:

	Pressure			
Balloon type	≥ 500 mb	< 500 mb	≥ 200 mb	< 200 mb
300 g	4 s	5 s		
600 g			4 s	6 s

The basic equation (from Meteorological Instruments, by W.E.K. Middleton and A. F. Spilhaus, 1953) is

$$\frac{d\theta}{dt} = -\frac{1}{\lambda}(\theta - T_o - \beta t) , \qquad (1)$$

where θ = indicated temperature at time t; t = time from initial time in seconds, λ = the lag coefficient in seconds; T_o = true temperature at initial time, and $\beta = dT/dt$ at the sensor, assumed constant over the correction interval.

The true temperature at time t is given by

$$T = T_o + \beta t \ . \tag{2}$$

Combining (1) and (2) gives

$$T = \theta + \lambda \frac{d\theta}{dt} \ . \tag{3}$$

Equation (3) can be evaluated by

$$T_n = \theta_n + \lambda \left(\frac{\theta_{n+1} - \theta_{n-1}}{t_{n+1} - t_{n-1}} \right), \tag{4}$$

where n = sequence number of data point, and t = time of data point from launch. For BOMEX data, the time interval $(t_{n+1} - t_{n-1})$ was 10 s.

Equation (4) was applied after calibration corrections had been made. The use of a correction interval longer than the lag coefficient resulted in a small amount of smoothing in the results. For the data automatically recorded on SCARD, correction was started at the 17.5-s point. Earlier points were given the same correction as the 17.5-s point except for the first temperature, a manual reading, which was not corrected for lag.

5.3.2.2 Humidity. The low-reference correction (a correction for nonstandard battery voltages) applied to the humidity frequencies was

$$f = f_R * \frac{190}{f_{LR}} \ ,$$

where

f = corrected humidity frequency,

f_R = uncorrected humidity frequency,

f_{LR} = low reference, linearly interpolated in time between low-reference frequencies on either side of the f_R, and

$*$ = multiplication.

The corrected humidity frequencies were converted to total resistance values as follows:

$$R = \frac{190 * (B + f)}{f} - (B + f) \ ,$$

where

R = sensor resistance in ohms,

B = 47,680 ohms (nominal internal resistance of the sonde),

f = 5-s average frequency corrected for low-reference drift, and

$*$ = multiplication.

The resistance R as computed above is that of the hygristor and a 1.2×10^6-ohm resistor in parallel. Therefore, the hygristor resistance was calculated from

$$R_H = \frac{1.2 \times 10^6 * R}{1.2 \times 10^6 - R} ,$$

where R_H = hygristor resistance.

The resistance at 33 percent relative humidity, R_{33}, was determined by a baseline check prior to launch of the sonde. In the baseline check box, H_T was measured independently of the sonde from the wet-bulb and dry-bulb temperatures. If conditions were different from the standard 33 percent and 25°C, a correction was made by the equation

$$H_{25} \simeq H_T - \frac{C\ (H_t - 33)\ (t - 25)}{H_T} ,$$

where

H_T = relative humidity determined from dry- and wet-bulb readings,

H_{25} = H_T corrected to 25°C,

T = dry-bulb temperature in baseline box, °C, and

C = constant = 0.25 if $H_T > 33$ percent and 0.03 if $H_T < 33$ percent.

H_{25}, as calculated above, was substituted in the equation

$$A = \log_{10} \frac{R_H}{R_{33}} = 4.733 - 2.500 \log_{10} (110 - H_{25}),$$

to obtain

$$R_{33} = R_H/10^A ,$$

where

R_H = hygristor resistance, determined as above from humidity-signal baseline frequency, and

R_{33} = hygristor resistance at 33 percent relative humidity.

Relative humidity during the sounding was computed by

$$H_{25} = 110 - \text{antilog}_{10} \left(\frac{4.733 - \log_{10} \frac{R_H}{R_{33}}}{2.500} \right) ,$$

where

R_H = hygristor resistance at some temperature t, computed as above,

R_{33} = hygristor resistance at 33 percent (from the baseline computation), and

H_{25} = relative humidity at 25°C.

The relative humidity at temperature T was calculated from

$$H_T = H_{25} + \frac{C_1 \ (H_{25} - 33) \ (T - 25)}{H_{25}} ,$$

where

C_1 = 0.25 for $H_{25} > 33$ percent,

C_1 = 0.03 for $H_{25} < 33$ percent, and

H_T = measured relative humidity at ambient temperature T.

Following these computations, a calibration correction was applied to H_T to obtain the corrected relative humidity. The calibration corrections are shown in table 5-3. Note that these particular corrections apply only to relative humidity as computed above; they include both calibration corrections and corrections for errors in these simplified equations. The procedures described above are expected to give an rms error of less than 3 percent relative humidity (not including errors due to hygristor exposure and thermal lag). Humidities computed to be less than 10 percent were reported as 10 percent. Humidity was reported missing for temperatures below -40°C.

Table 5-3.--Calibration corrections for rawinsonde relative humidity

Indicated relative humidity, H_T (percent)	Correction, C (percent)
14.5	- 4.5
24.5	- 4.5
27.0	- 1.0
31.8	+ 1.2
37.5	+ 2.5
46.1	+ 3.9
56.4	+ 3.6
68.3	+ 1.7
80.3	- 0.3
89.7	+ 0.3
95.0	+ 2.5
100.0	+ 0.0

Note: $H_c = H_T + C$, where H_c = corrected humidity, H_T = calculated humidity, and C = correction from above for a given H_T. If H_T differed from the above, a correction was linearly interpolated.

When humidity is measured with a hygristor, the temperature of the hygristor itself is critical. Because of radiation effects and lack of ventilation, expecially during daytime, the hygristor temperature at the beginning of the sounding differed at times by several degrees from the ambient temperature. In order to arrive at the magnitude of this difference, it was assumed that the specific humidity at the first point of the sounding (usually 5 s after release) was identical to that of the shipboard psychrometer reading at the time of release. The hygristor temperature established under this assumption was used as the initial one in correcting for thermal lag.

In determining the uncorrected moisture measurements, the hygristor temperature was assumed to be the same as the lag-corrected thermistor temperature as determined from the thermistor frequency average. Under the assumption that the instrument was measuring moisture correctly, the problem of correcting the measured moisture became that of making a good estimate of the actual hygristor temperature. From the definition of relative humidity, the true moisture was then obtained from

RH (true) = RH (measured) * (saturation vapor pressure at the hygristor temperature/saturation vapor pressure at ambient temperature).

The problem of correcting the BOMEX rawinsonde data for both thermal lag and radiation effects has been discussed in detail by L.D. Sanders, J.T. Sullivan, and P.J. Pytlowany (NOAA Technical Memorandum EDS BOMAP-16, "Correction of BOMEX Radiosonde Humidity Errors," Center for Experiment Design and Data Analysis, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, 1975). The thermal lag coefficient based on their study is given by

$$\lambda = 34.9/(\rho V)^{0.4}, \tag{5}$$

where

λ = thermal lag coefficient of the hygristor in seconds,

ρ = air density in kilograms per cubic meters

$= \dfrac{0.34837}{T\ (1 + 0.000608q)}$,

T = ambient temperature in degrees Kelvin

q = specific humidity in grams per kilogram, and

V = ventilation rate of the hygristor, which in the case of BOMEX was one-third of the rate of ascent.

The basic equation for lag correction of the hygristor is the same as for the thermistor. The problem is reverse, however, since the true temperature is known, as determined from the thermistor reading, and the hygristor temperature must be computed. The basic equation was therefore rewritten as

$$\frac{d\theta}{dt} + \frac{\theta}{\lambda} = \frac{T_o + \beta t}{\lambda}, \tag{6}$$

where

θ = temperature of the hygristor at time t,

T_o = true air temperature at time zero,

β = dT/dt, assumed constant over the correction interval, and

t = time from beginning of correction interval.

Equation (6) is of the type

$$\frac{dx}{dy} + P\ (y)\ x = Q\ (y),$$

and a solution is

$$\theta = T_o + \beta\ (t - \lambda) + C_e^{-t/\lambda}. \tag{7}$$

Letting $\theta = \theta_o$ when $t = 0$ gives

$$\theta_o = T_o - \beta\lambda + C$$

$$C = \theta_o - T_o + \beta\lambda. \tag{8}$$

Combining (7) and (8) yields

$$\theta = \theta_o e^{-t/\lambda} + \beta t + (T_o - \beta\lambda)\ (1 - e^{-t/\lambda})\ . \tag{9}$$

If $\theta_o = T_o$, eq. (9) reduces to (<u>Meteorological Instruments</u>, by W.E.K. Middleton and A.F. Spilhaus, 1953)

$$\theta - T = \beta\lambda\ (1 - e^{-t/\lambda})\ .$$

For purposes of computation, eq. (9) was rewritten as

$$\theta_n - T_n = (\theta_{n-1} - T_{n-1}) - \beta\lambda(1 - e^{(-t_n - t_{n-1})^T}), \tag{10}$$

where

$$\beta = \frac{T_n - T_{n-1}}{t_n - t_{n-1}}\ ,$$

n is the sequence number of the data point, and $t_n - t_{n-1}$ is normally 5 s.

In the processing of BOMEX data, uncorrected humidities had already been computed before the correction method was developed. Corrections were therefore applied by the procedure described below.

The vapor pressure at the hygristor was, of course, the same for both temperatures (θ_n and T_n). Thus,

$$\frac{H_T}{100} * e_{sT} = \frac{H_\theta}{100} * e_s\theta\ , \tag{11}$$

where H = relative humidity and e_s = saturation vapor pressure.

Saturation vapor pressure is given by Teten's equation (<u>Handbook of Meteorology</u>, McGraw-Hill Book Co., N.Y., 1945, p. 343)

$$e_s = 6.11 * 10 ** \frac{7.5 * T}{237.3 + T}\ , \tag{12}$$

where T is temperature in ^oC.

Substituting (12) in (11) and solving for relative humidity at the hygristor temperature gives

$$H_{Tn} = H_{\theta n} * 10 ** \left[\frac{7.5 * 237.3\ (\theta_n - T_n)}{(237.3 + (T_n - 273.15)\ (237.3 + (\theta_n - 273.15)} \right]$$

$$H_{Tn} = H_{\theta n} + 10 ** \left[\frac{1779.75\ (\theta_n - T_n)}{(T_n - 35.85)\ (\theta_n - 35.85)} \right]\ , \tag{13}$$

where $\theta_n - T_n$ is obtained from eq. (10).

A value of 35.86 rather than 35.85 as given in eq. (13) was mistakenly used in the actual computations, but the resulting error is always less than 0.05 percent relative humidity and hence insignificant.

As noted earlier, the soundings were also subject to error caused by radiation. The hygristor duct on the radiosondes used during BOMEX allowed the hygristor to be heated by solar radiation both directly through the translucent walls of the duct, and indirectly by reflection from the internal duct surfaces. The heated hygristor in turn heated the ambient air, resulting in relative humidity measurements that were as much as 24 percent lower than the humidity in the free atmosphere.

The empirical method used in correcting the isolation error is described in detail by Sanders et al. in NOAA Technical Memorandum EDS BOMAP-16, cited earlier. Briefly, by this method the mean humidity for daytime soundings was made the same as for nighttime soundings. Since radiation data for individual soundings were not available, the correction factor was a mean value, dependent on pressure and time of day only, and resulted in slight overcorrection for soundings taken during very cloudy conditions. The corrected humidities are believed to be accurate to within 5 percent relative humidity.

5.3.2.3 Wind. Inputs to rawinsonde wind computations were slant range (30-s averages), azimuth angle (two series of 60-s averages, one for averages centered on the minute, one centered on the half-minute), altitude (from thickness computation and converted to geometric units), and surface wind (from the Surface Observation Form, Card #1).

The *Discoverer* used the Selenia radar model METEOR 200 RMT-2S for balloon tracking, with output consisting of printed and punched paper tape containing slant range, azimuth angle, and elevation angle at 15-s intervals. The punched paper tape was converted to magnetic tape and a printout of the results prepared, which was scanned and compared with the printed paper tape. Observers' comments on the printed paper tape were used to edit the data. For instance, such a comment as "balloon lost" was used to delete bad data. After deletion from the magnetic tape of records proven to be bad, a computer edit of alternate 15-s data points was performed as follows:

(1) The time difference between alternate samples was first edited for consistent changes (30-s apart). "Dead words" or missing data indicators were inserted for unrecognizable or inconsistent times and the associated slant ranges and azimuths.

(2) For i = 30, 60, 90, ... N S, successive second differences were computed for slant range or azimuth from $M = S_{t_i} - 2(S_{t_{i+1}}) + S_{t_{i+2}}$, where S_{t_i} = slant range or azimuth at time t.

(3) The following logic was used to edit the data:

(a) Until the first value of M less than 100, the value of S_{t_i} was replaced with a "dead word." After M of less than 100 was found, the value of S_{t_i} remained unchanged.

(b) After the first value of M less than 100 and whenever a value of M greater than 100 was detected, the value of $S_{t_{i+2}}$ was replaced with a "dead word."

(c) Whenever a "dead word" was encountered in S_{t_i}, $S_{t_{i+1}}$, or $S_{t_{i+2}}$, the value of M could not be computed and was irrelevant. The dead word was left in the table; condition (a) above was reverted to.

The results of this edit were values of slant range and azimuth sampled at 30-s intervals and, depending on the edit, containing periods of time when no values existed for one or more 30-s periods. No wind computations were made unless two or more consecutive 30-s values of slant range and azimuth were found.

The Rockaway used an AN/SPS-29 radar for balloon tracking. Slant range and azimuth measurements were usually made at 1-min intervals and recorded manually. These data were then punched on cards directly from the form and transferred to magnetic tape. Since the measurements were made at 1-min, rather than 30-s, intervals, linear interpolation was used to supply the intermediate 30-s values of slant range and azimuth.

The slant range, azimuth angle, and altitude values for all fixed ships were used to compute horizontal distance out to the balloon and the S-N and W-E coordinates of that distance for each 30-s point. At each 30-s point, t, the 1-min movement from point t - 30 s to t + 30 s along each coordinate (divided by 60, giving units in meters per second) gave the zonal and meridional components at time t. Linear interpolation was used to derive components at 5-s intervals.

The terms used in the computations are listed below and shown in figure 5-3 as related to wind computations.

HDO = horizontal distance out, meters

SLR = slant range, meters

GH = height of balloon above ship's deck, meters

AZ = azimuth angle

$WWE_{(t)}$ = W-E wind component

$WSN_{(t)}$ = S-N wind component

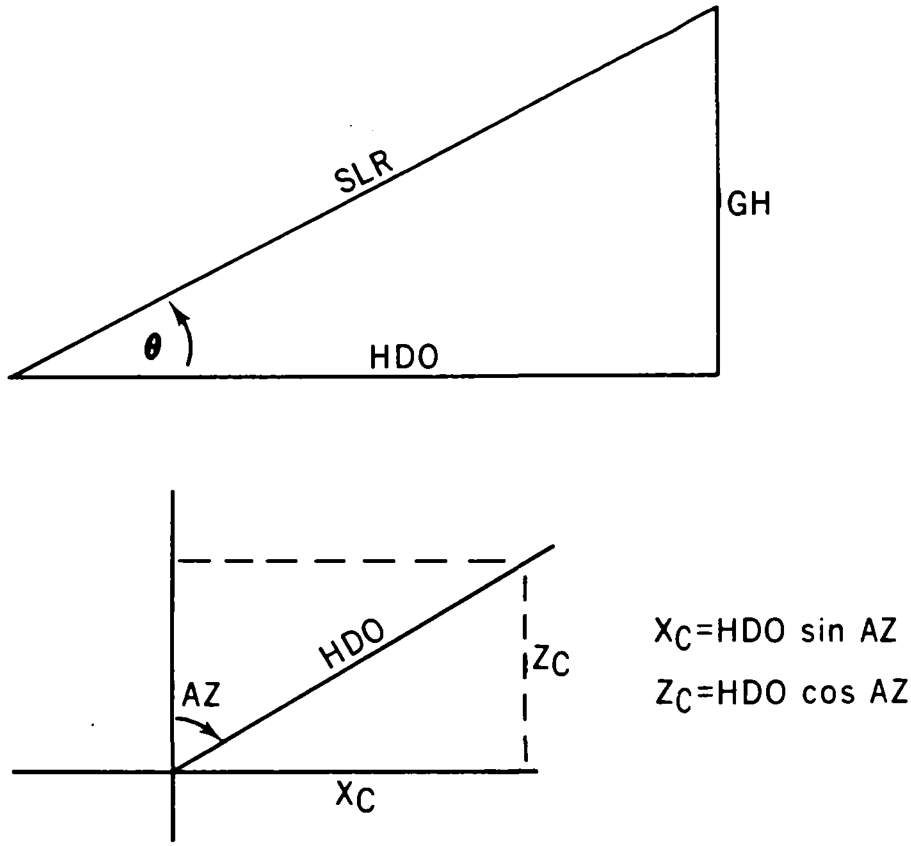


Figure 5-3.--Diagram of terms used in wind computations.

The following equations were then used:

$$HDO = \sqrt{SLR^2 - GH^2} \;*$$

$$X_C = HDO(\sin(AZ)),$$

$$Z_C = HDO\ (\cos(AZ)),$$

$$WWE_{(t)} = \frac{X_{C_{t+30}} - X_{C_{t-30}}}{60},$$

$$WSN_{(t)} = \frac{Z_{C_{t+30}} - Z_{C_{t-30}}}{60},$$

*Curvature of the earth was neglected, but the resulting error (about 10 m at 500 mb for average BOMEX conditions) is negligible.

The following ship deck heights, H, were used:

Oceanographer	8.230 m
Rainier	9.144 m
Mt. Mitchell	9.144 m
Discoverer	6.706 m
Rockaway	7.010 m

5.3.3 Derived Quantities

Equations used in computing derived parameters from those measured are given below. These computations were done for each 5-s data point for each sounding in the case of automatically recorded data and for significant levels in the case of manually recorded data.

Saturation Vapor Pressure

$$e_s = 6.11 * 10 ** (7.5 * T/(T + 237.3)) ,$$

which is based on Teten's equation (Handbook of Meteorology, McGraw-Hill Book Co., 1945, p. 343), and where

e_s = saturation vapor pressure in millibars,

T = ambient temperature in degrees Celsius,

* = multiplication, and

** = exponentiation.

Vapor Pressure

$$e = e_s * RH/100 ,$$

where

e = ambient vapor pressure in millibars, and

RH = relative humidity in percent.

Specific Humidity

$$q = 622 * e/(P - 0.37802 * e) ,$$

where

q = specific humidity in grams per kilogram, and

P = atmospheric pressure in millibars.

Dewpoint

$$T_{dp} = 237.3 * \log_{10} (e/6.11)/(7.5 - \log_{10}(e/6.11)) ,$$

which is also based on Teten's equation, and where

T_{dp} = dewpoint in degrees Celsius.

Virtual Temperature

$$T_v = (T + 273.15) * P/(P - 0.37802 * e) ,$$

where

T_v = virtual temperature in degrees Kelvin.

Layer Thickness

The mean virtual temperature was computed by a method adopted from the Smithsonian Meteorological Tables (Smithsonian Institution, Washington, D.C., 1951, p. 266):

$$\overline{T}_v = (T_{v2} - T_{v1})/\log_e(T_{v2}/T_{v1}) ,$$

where

$\overline{T}_v$ = mean virtual temperature in degrees Kelvin,

T_{v2} = virtual temperature at the 5-s data point, and

T_{v1} = virtual temperature at the preceding 5-s data point.

When humidity measurements for a sounding were missing, a correction in degrees was added to the temperature to obtain an estimate of the virtual temperature. The correction was calculated from specific humidities of a sample of soundings that were considered representative of BOMEX at the pressure levels shown in table 5-4. Values at pressures not shown in the table were arrived at through interpolation. No correction was made above 300 mb.

From the mean virtual temperature, the layer thickness was calculated by the equation

$$\Delta z = 29.2911 * \overline{T}_v * (\log_e P_1 - \log_e P_2) ,$$

where

Δz = layer thickness in geopotential meters,
P_2 = atmospheric pressure in millibars at the 5-s data point, and
P_1 = atmospheric pressure at the preceding 5-s data point.

Table 5-4.--Virtual temperature correction

Pressure (mb)	Correction (°C)
1,020	3.1
1,000	2.9
900	2.6
850	2.1
800	1.6
700	0.8
600	0.5
500	0.4
400	0.2
300	0.03

Geopotential Height

$$z = z_1 + z ,$$

where

z = height of the 5-s data point in geopotential meters above sea level, and

z_1 = height at the preceding 5-s data point.

Geometric Height

$$w = 6337838 * z/(6327368 - z) ,$$

which was also adapted from the Smithsonian Meteorological Tables (p. 219), and where

w = height of data point in geometric meters above sea level, and the constants are for latitude 15°N, approximately the center of the BOMEX array.

5.4 Special Problems

5.4.1 Slant Range

The rotary potentiometers used in BOMEX to obtain slant range and azimuth readings cover slightly less than a full circle, i.e., they go through their full resistance range in slightly less than 360°. This is important only in terms of slant range. A multiplier of 0.98 applied to the raw data solved the problem, and since the raw slant-range readings were modulo 2,000 m, there was no possibility of cumulative error.

The potentiometer readings were also reduced somewhat by the load imposed by the recorder circuit. Potentiometer resistance was 5,000 ohms, recorder circuit resistance was 98,000 ohms, and the power supply was 5 V. A correction was computed for all readings, but amounted, at most, to less than 1 percent.

During BOMEX Periods I and II, one ship had a slant-range error because an electrolytic capacitor was connected backward across the recorder circuit. This placed, in effect, a voltage-controlled variable resistor across the circuit, giving slant-range ramps curved as shown in figure 5-4, rather than the usual nearly straight lines. A calculated correction gave suspicious results, and an empirical correction was therefore developed from data recorded when the "black box" that measured slant range was not locked onto the sonde signal but was running away at a steady rate. The corrected data are believed to be indistinguishable from normal slant-range data, without possibility of cumulative error.

The effect of another slant-range error, apparently in the recording circuit, had the effect of an additional resistor seemingly being occasionally inserted in series with the recorder (fig. 5-5). When it appeared at a ramp change, it caused the "zero reading" to be 252 m, but the maximum ramp value of 2,000 m was not affected. The error appeared and disappeared at infrequent intervals and in a random manner. A correction routine was developed for cases where this error was large, i.e., at, or soon after, a ramp change, but when it was small it was not considered worthwhile to expend the additional effort or time needed to distinguish it from ordinary noise or wind shear. Again, there is no possibility of cumulative error.

In the Scanwell WFSS used by three of the ships during BOMEX the phase comparison for slant-range measurements is the same as for the AN/GMD-2, except that readout is in modules of 2,000 m rather than 2,000 yd. It is well known that there are occasional problems in slant-range measurements with the GMD-2, but the 2-sps BOMEX data brought a number of other problems to light. Unfortunately, it was not possible to investigate these problems beyond the minimum necessary to achieve acceptable accuracy in the data processing.

The most striking feature of the plots of the 2-sps slant-range data is the large number of noise spikes, ranging from a few meters to a few tens of meters. A second striking feature is that these spikes are predominantly toward higher values. This type of problem, however, can be handled by simple editing procedures and is believed not to contribute significantly to errors in the BOMEX wind data.

Multiple ramp changes are illustrated in figures 5-6 to 5-9. This problem, too, can be solved by simple editing, but the unexplained slant-range jumps shown in figure 5-8 are more troublesome. When a jump is followed by a return to normal within a few seconds, as illustrated by (1) in figure 5-8a and by (2) in figure 5-8c, no error resulted in processing; the errors were simply discarded as noise. When the return to normal did not occur as quickly, the processing program interpreted the jump as a short-term increase in radial windspeed, and the resulting displacement in the computed winds would be carried to the end of the sounding.

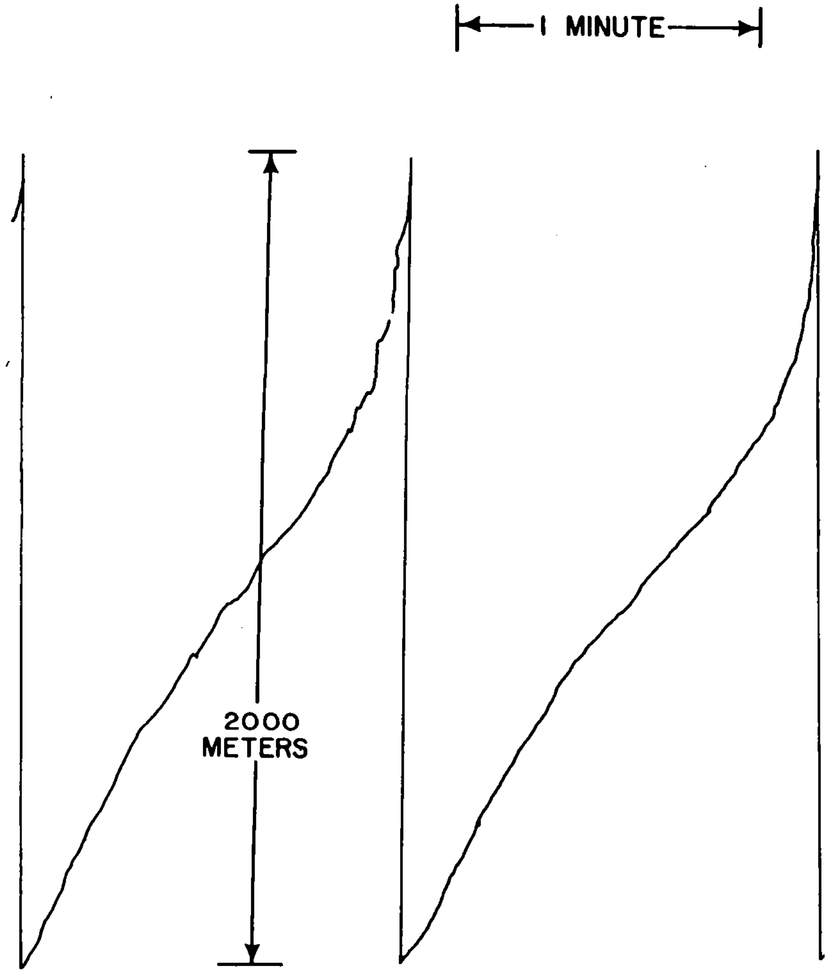


Figure 5-4.--Slant range vs. time, showing variable-resistor error.

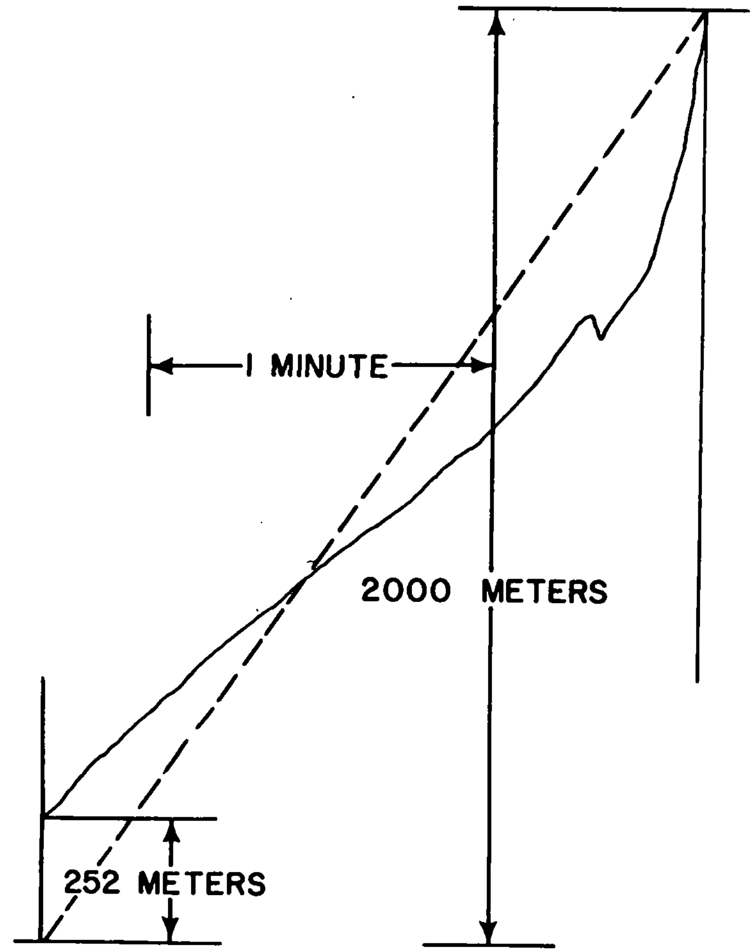


Figure 5-5.--Slant range vs. time, showing intermittent fixed-resistor error combined with variable-resistor error. Dashed line is expected position of trace.

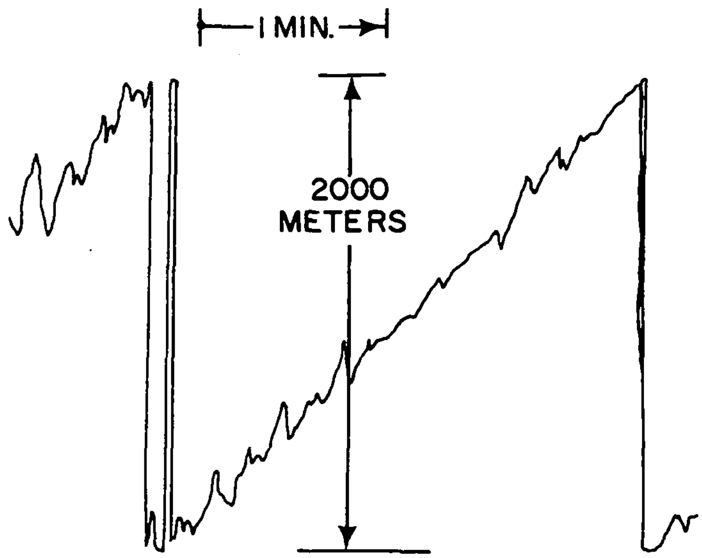


Figure 5-6.--Slant range vs. time, showing typical noise spikes and multiple ramp change.

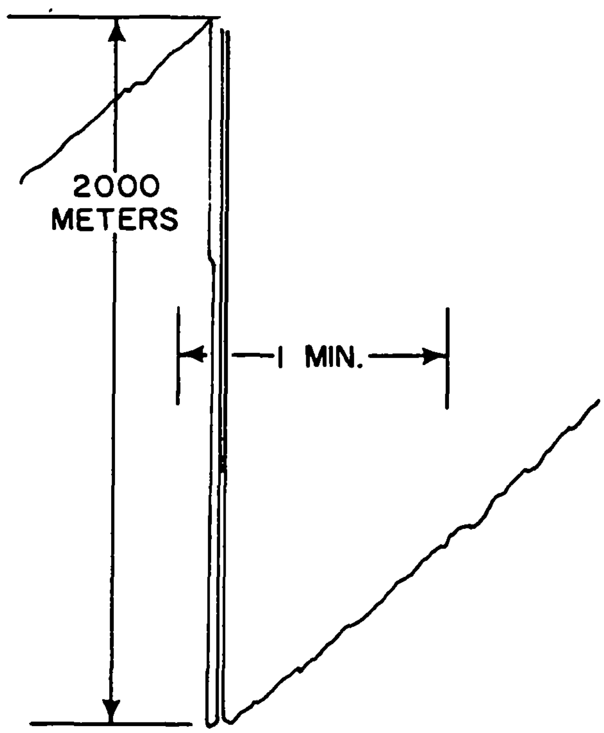


Figure 5-7.--Slant range vs. time, showing multiple ramp change in otherwise clean data.

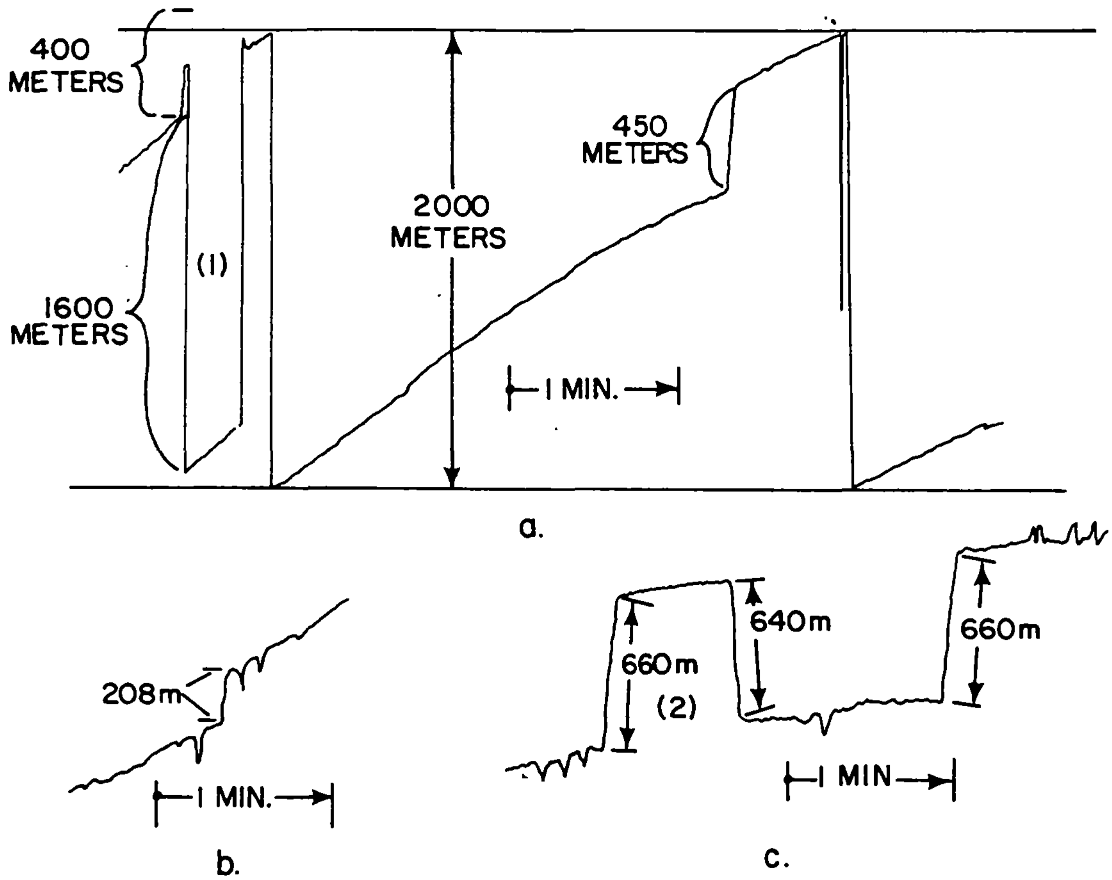


Figure 5-8.--Slant range vs. time, showing unexplained jumps.

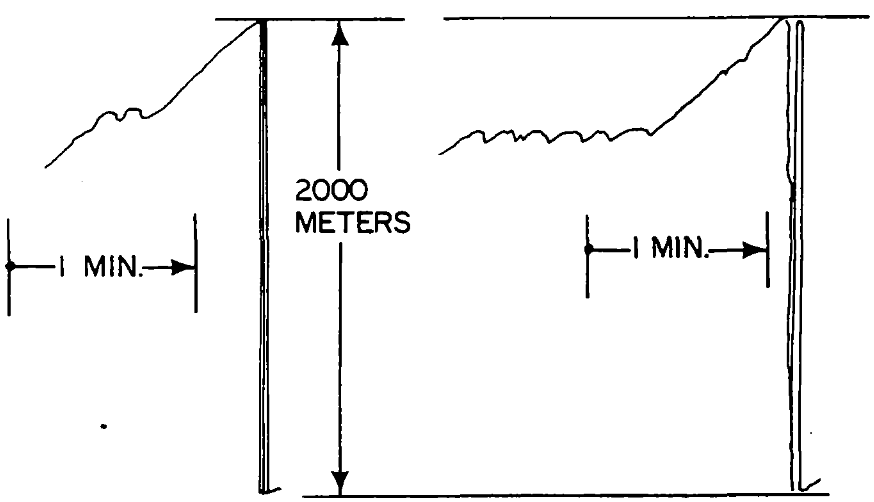


Figure 5-9.--Slant range vs. time, showing "gear slip" error and multiple ramp crossings. The two examples are from different ships.

Figure 5-9 illustrates a "gear slip" error. It was not known whether the cause lay in the normal GMD-2 "black box" or in the special BOMEX readout or recording devices. It resulted in too small a radial displacement of the sonde, but since the error was infrequent, no correction was applied.

5.4.2 Azimuth

The most serious azimuth error was caused by signal saturation of the receiver at time of sonde release. This made it impossible to obtain good direction during the first few seconds of flight, and wind data were therefore disregarded for approximately the first 30 s of flight. In the archived data, winds for this interval were interpolated between the surface wind and wind centered at 1 min after launch. Wind data were also lost during the first few seconds of flight on the Discoverer because of the Selenia radar's inability to track close-in targets.

5.4.3 Pressure

A complicating factor, though not a serious one, in determining the baroswitch correction and low-level temperature is that a rawinsonde released aboard ship rarely begins to rise immediately. It first moves downward, horizontally away below deck level, and then begins to rise. Also, the slight pressure increase occasionally causes the baroswitch to back onto a pressure contact for a short time, making contact recognition difficult.

The mean time at which the sonde rises through deck level ("start-up" time) can be estimated by linear extrapolation back to station pressure, assuming that, in the mean, baroswitch pressures are correct. Eight plots were made of mean pressure versus time from launch for different ships and on-station periods, based on 19 to 54 soundings. The resulting start-up times ranged from 3 to 8 s. In the example shown in figure 5-10, the time is 4 s, the mean station pressure is 1,013.66 mb, and its mean deviation is 1.04 mb. Mean absolute error of sonde pressure extrapolated to the mean start-up time is 1.50 mb.

Although it seems reasonable that surface windspeed should be a factor in determining when the sonde begins to rise above deck level, examination of 70 soundings from one ship, with surface windspeeds ranging from 5 to 10 m/s, showed no significant correlation.

An attempt was also made to determine individual start-up times by use of the 2-sps temperature data. The small amount of noise in these data made this impossible.

The problem of start-up time deserves additional research, which could not be justified for data processing purposes, and a start-up time of 5 s was therefore used for all soundings (see sec. 5.3.1). The only error involved is a small one in baroswitch setting, which cannot be determined more closely than within 1 mb or so.

Baroswitch errors are assumed to be mostly the result of (a) error in the aneroid element, (b) baroswitch detent-setting step (∿ 0.5 mb), (c) improper setting during baseline check, or (d) mechanical shifting of the baroswitch because of shock during launch. The general, National Weather Service, procedure for determining the error is to extrapolate linearly backward in time from the first two, or several, contacts after launch to find the actual contact value at time of release. The actual value is then compared with the contact values corresponding to station pressure at launch as determined from the baroswitch calibration table. The difference is the baroswitch error, which is subtracted from all contacts during a sounding, and the pressures are then obtained from the calibration table. In processing the BOMEX data, the extrapolation was done in pressure, rather than in contacts (fig. 5-10), because pressure proved to be somewhat more linear with time, for short periods, than the contact numbers. Also, values were extrapolated to the start-up time discussed above, not to launch time.

National Weather Service procedures in 1969 called for baroswitch corrections only if the correction exceeded 0.3 contacts, about 4 mb at the surface. For convenience in computations, corrections were calculated for all BOMEX soundings, although most were insignificant.

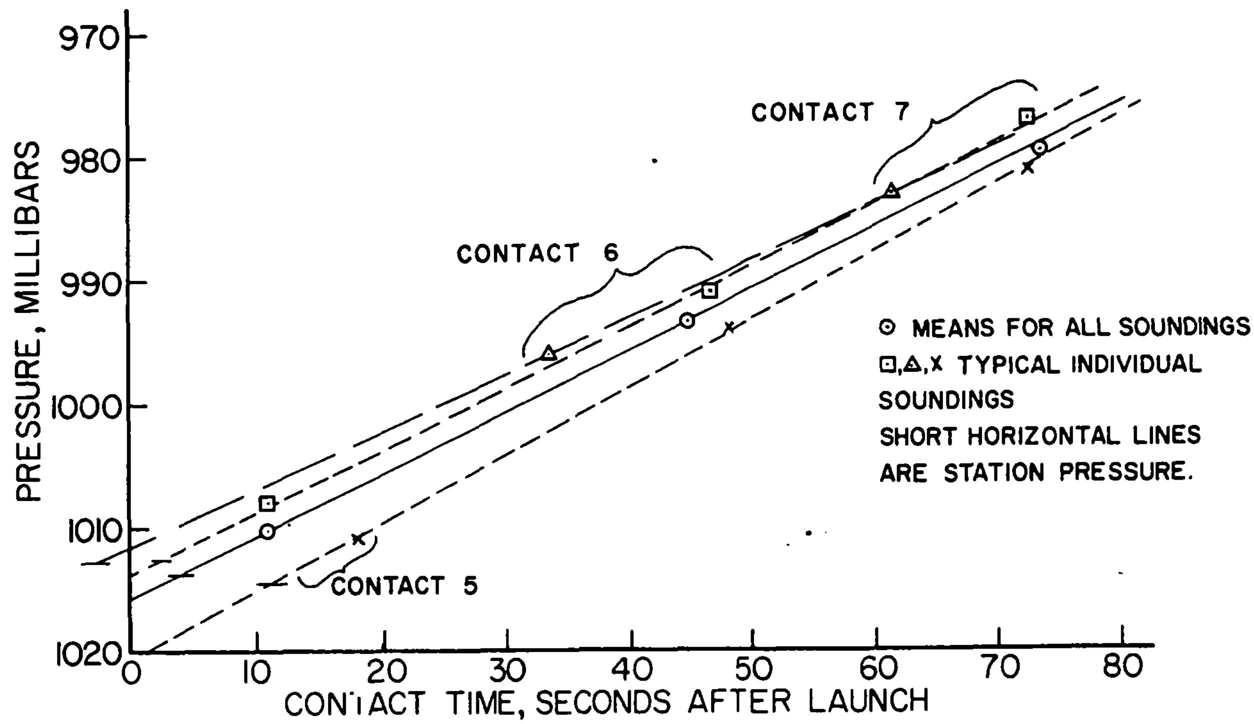


Figure 5-10.--Baroswitch pressure vs. time, from launch data for 52 soundings from the Mt. Mitchell, Period III.

5.5 Archive Format and Data Inventory

5.5.1 Rawinsonde Data

Data from each ship for each BOMEX Observation Period are available on microfilm and on seven-channel, 556 BPI, BCD magnetic tape. Each tape has three files: (1) ANSI standard system label, 80 BCD characters, followed by an end-of-file; (2) descriptive information and a program that will read the data (in 80-character BCD records), followed by an end-of-file; and (3) data file, 1,300 characters per record, followed by a double end-of-file.

The data file is divided into four sections: (1) 5-s or significant levels; (2) 10-mb surfaces; (3) standard pressure surfaces (1,000, 950, 900, 850, 800,...mb); and (4) standard aircraft operating levels (305, 1,220, 2,135, and 3,040 m). Each section has a header, which indicates the number of valid counts, amd a variable number of data scans of 1,300 characters.

There are 22 variables and 10 levels per record, except for the last record, which may be a partial record and is blank filled to complete the record. The format is as follows:

Word	Format	Data Element	Units
1	F7.1	Time from launch (start-up time)	seconds
2	F7.1	Pressure	millibars
3	F6.1	Temperature	degrees Celsius
4	F6.1	Relative humidity (no lag correction)	percent
5	F5.1	Specific humidity "	grams per kilogram
6	F5.1	Dewpoint "	degrees Celsius
7	F6.1	Relative humidity (lag correction)	percent
8	F5.1	Saturated vapor pressure	millibars
9	F5.1	Vapor pressure	millibars
10	F5.1	Specific humidity (lag correction)	grams per kilogram
11	F5.1	Dewpoint "	degrees Celsius
12	F6.1	Virtual temperature	degrees Kelvin
13	F7.1	Thickness	meters
14	F8.1	Geopotential height	meters
15	F8.1	Geometeric height	meters
16	F6.1	Potential temperature	degrees Kelvin
17	F6.1	U wind component	meters per second
18	F6.1	V wind component	meters per second
19	F6.1	Wind direction	degrees
20	F5.1	Windspeed	meters per second
21	F5.1	U component, ship motion	meters per second
22	F5.1	V component, ship motion	meters per second
		999. = missing data	

A summary inventory of the rawinsonde data is given in table 5.5.

Table 5.5--BOMEX archive rawinsonde magnetic tapes and microfilm

Magnetic tape No.	Microfilm reel No.	Ship	BOMEX Observation Period	First sounding			Last sounding		
				Julian day	Date (1969)	Time (GMT)	Julian day	Date (1969)	Time (GMT)
B8455	RS-1	Oceanographer	I	123	May 3	0300	134	May 14	1800
B8456	RS-2	Rainier	"	121	May 1	1200	134	May 14	1800
B8475	RS-3	Mt. Mitchell	"	122	May 2	1800	134	May 14	1800
B8458	RS-4	Discoverer	"	127	May 7	0300	135	May 15	0000
B8459	RS-5	Rockaway	"	122	May 2	0400	134	May 14	1200
B8461	RS-6	Oceanographer	II	144	May 24	1200	161	June 10	0430
B8462	RS-7	Rainier	"	144	May 24	0300	161	June 10	0000
B8463	RS-8	Mt. Mitchell	"	144	May 24	0300	152	June 1	1800
B8463	RS-9	Mt. Mitchell	"	153	June 2	0300	161	June 10	0600
B8464	RS-10	Discoverer	"	144	May 24	0300	154	June 3	0730
B8464	RS-11	Discoverer	"	154	June 3	0900	161	June 10	0730
B8465	RS-12	Rockaway	"	144	May 24	0300	161	June 10	0300
B8467	RS-13	Oceanographer	III	172	June 21	0000	181	June 30	0900
B8468	RS-14	Rainier	"	172	June 21	0000	183	July 2	1200
B8469	RS-15	Mt. Mitchell	"	172	June 21	0000	177	June 26	0430
B8469	RS-16	Mt. Mitchell	"	177	June 26	0600	183	July 2	1200

Table 5.5--BOMEX archive rawinsonde magnetic tapes and microfilm (continued)

Magnetic tape No.	Microfilm reel No.	Ship	BOMEX Observation Period	First sounding			Last sounding		
				Julian day	Date (1969)	Time (GMT)	Julian day	Date (1969)	Time (GMT)
B8470	RS-17	Discoverer	III	172	June 21	0000	177	June 26	0430
B8470	RS-18	Discoverer	"	177	June 26	0000	183	July 2	1200
B8471	RS-19	Rockaway	"	171	June 20	1200	183	July 2	1200
B8472	RS-28	Oceanographer	"*	171	June 20	0000	181	June 30	0000
B8472	RS-29	Rainier	"*	172	June 21	0000	183	July 2	1200
B8472	RS-30	Mt. Mitchell	"*	172	June 21	0000	183	July 2	1200
B8473	RS-31	Discoverer	"*	172	June 21	0000	183	July 2	1200
B8473	RS-32	Rockaway	"*	171	June 20	1200	182	July 1	1800
B8474	RS-20	Oceanographer	IV	193	July 12	1200	203	July 22	0600
B8474	RS-21	Oceanographer	"	203	July 22	1200	210	July 29	0300
B8475	RS-22	Rainier	"	192	July 11	1200	209	July 28	2100
B8476	RS-23	Mt. Mitchell	"	201	July 20	1200	210	July 29	0600
B8476	RS-24	Mt. Mitchell	"	193	July 12	1200	201	July 20	0900
B8477	RS-25	Discoverer	"	192	July 11	0100	201	July 20	0600
B8477	RS-26	Discoverer	"	201	July 20	1500	209	July 28	2100
B8478	RS-27	Rockaway	"	192	July 11	0000	209	July 28	1800

*Manually worked-up soundings.

5.5.2 Radiometersonde Data

The radiometersonde data are archived as the last of four data files on magnetic tape No. B9622 and consist of all observations from the Discoverer, Rainier, and Rockaway, and observations made near Paragon House, Barbados. The first file consists of 80-column card images, one card image per record, describing the formats of the data file. The other files contain data that were either recorded manually or were read manually from strip-chart recordings. The data are in BCD card images, 50 cards (4,000 characters) per record. The second file contains the marine meteorological data (see sec. 4); the third file contains ship operations data (see sec. 2); and the fourth file contains hand-tabulated STD data (see sec. 7).

Each radiometersonde sounding is preceded by a header card with 1 in column 1 indicating beginning of the sounding. The header card gives ship's name and the date of the sounding. The data cards, on which column 1 is left blank, follow the header cards with data elements in the following order on each card:

Pressure, millibars
Time from launch, minutes
Temperature, degrees Celsius
IR radiation upward, langleys per minute
IR radiation downward, langleys per minute
Net IR radiation, langleys per minute
Warming, degrees Celsius per day
Mixing ratio, grams per kilogram
Relative humidity, percent

The format is: 3F*.1, 3F8.4,F8.1, F8.3, 18.

5.6 Supplementary Material Available From the Archive

Microfilm reel No.	Description
DOC-5	SCARD Event Log.
DOC-6	Card 0 - Rawinsonde Form; also on this reel is Card 1 - Surface Observation Form.
DOC-8	Card 5 - Observation Summary Form; Card 6 - System parameter failure; Card 7 - Slant range and azimuth, Rockaway; also on this reel is Card 9 - Boom Calibration Form.

Documents	Title
(BO-1-1-1000) R-066-9	BOMEX Software System, Program Documentation for Rawinsonde Two Samples per Second Reduction, General Electric, May 1971.
(BO-1-1A-1000) R-066-10	BOMEX Software System, Program Documentation for Rawinsonde Edit, General Electric, May 1971.

Documents	Title
(BO-1-1B-1000) R-066-8	BOMEX Software System, Program Documentation for Rawinsonde Raw Data Plots, General Electric, May 1971.
(BO-1-2-1000) R-066-15	BOMEX Software System, Program Documentation for Rawinsonde Engineering Units Conversion, General Electric, May 1971.
(BO-1-3-1000) R-066-16	BOMEX Software System, Program Documentation for Rawinsonde Five Second Engineering Units Profile-Plot, General Electric, May 1971.
(BO-1-6-1000) R-066-14	BOMEX Software System, Program Documentation for Rawinsonde Calibration File Preparation, General Electric, May 1971.
(BO-1-7-1000) R-066-13	BOMEX Software System, Program Documentation for Rawinsonde Master Pressure/Contact File Preparation, General Electric, May 1971.
(BO-1-9-1000)	BOMEX Software System, Program Documentation for Rawinsonde Selenia Tape Revision, General Electric, May 1971.
(BO-1-10-1000) R-066-12	BOMEX Software System, Program Documentation for Rawinsonde Selenia Tape Edit, General Electric, May 1971.
(BO-1-1B-4995) R-066-2	BOMEX Software System, Program Documentation for SCARD Digitize Rawinsonde, General Electric, June 1971.

The U.S. Air Force Air Weather Service 6th Mobile Weather Squadron obtained upper air soundings daily from May 14 to June 4 and from July 8 to 28 near the BOMEX Field Headquarters using GMD-1A tracking and recording equipment. Standard Air Weather Service procedures were used for these rawinsonde observations, which supplemented soundings made at Seawell Airport by the Barbados Meteorological Service. These data are available from the archive in the form of adiabatic charts and winds-aloft computation sheets (WBAN-20).

5.7 Material in Temporary Storage

Hard-copy material, consisting of original manual logs, strip charts, and the like, has been placed in temporary storage for a period of 3 years. Inquiries concerning this material should be addressed to the Center for Experiment Design and Data Analysis, EDS, NOAA, Washington, D.C. 20235.

6. BOUNDARY LAYER INSTRUMENT PACKAGE (BLIP) DATA SET

The data set consists of meteorological parameters measured during BOMEX by the Boundary Layer Instrument Package (BLIP) from the four corner ships of the BOMEX array, the Oceanographer, Mt. Mitchell, Discoverer, and Rainier. The BLIPs were launched by means of tethered balloons or parakites. The tether line was attached to a winch mounted on the afterdeck of the ship. Lifted from a few meters above the deck to various heights, generally about 300 m, the instrument packages were retained at that level for several hours and lowered to the deck. Each of these flights is referred to as a "run."

Data were collected during BOMEX Observation Periods (Phases) II, III, and IV by the Oceanographer and Mt. Mitchell, during Period II by the Discoverer, and a few runs were made from the Rainier during Periods II and III.

Contained in the data set are one-sample-per-second (1 sps) measurements of dry- and wet-bulb temperatures, horizontal windspeed and wind direction, and pressure or relative humidity. Also included are quantities derived from these measurements, consisting of lateral and transversal wind components, and relative humidity computed from the differences between the dry- and wet-bulb temperatures.

The data are available on magnetic tape and in the form of continuous plots on 35-mm microfilm.

6.1 Sensors

The sensors were mounted on an aluminum A-frame that was attached by swivels to the tether line. The electronic circuits, the telemetry system, and the batteries were also mounted on the A-frame, which was directed into the wind by a drogue chute or a fin.

Horizontal wind was measured by a WINDAV transducer developed especially for BOMEX. The transducer consists of a lightweight (2 oz.) three-cup anemometer that incorporates the use of the Earth's magnetic field for determining orientation. Two signals are produced: a sinusoidal wave per revolution for determining windspeed and compass points and a short square wave for determining orientation.

Dry- and wet-bulb temperatures were measured by bead thermistors. The wet-bulb thermistor was kept moist by a wick dipped in a distilled-water reservoir.

Atmospheric pressure was determined by a modified version of the aneroid baroswitch used in a conventional radiosonde, except for the Mt. Mitchell during Period II, when a variable resistance sensor was used. These pressure values (in millibars) for the Mt. Mitchell are contained on the magnetic tape.

Relative humidity was measured with a carbon hygristor, which was substituted for the pressure sensor in several runs (table 6-1).

Table 6-1.--Pressure and relative humidity measurements

Ship	BOMEX Observation Period (Phase) II	III	IV
Oceanographer	RH1	PRES	PRES (runs 1 to 6) RH1 (runs 7 to the end)
Mt. Mitchell	PRES*	PRES	PRES
Discoverer	MSG	RH1	MSG
Rainier	RH1	PRES	MSG

RH1 = relative humidity measurements.
PRES = pressure measurements.
MSG = no relative humidity or pressure measurements.
*Pressure sensor different; runs 1 to 3, no pressure.

6.2 Data Processing

The BLIP data were telemetered to the ship and recorded on magnetic tape. The wind data were continuous; the temperature and pressure/humidity data were commutated at a rate of 3 sps for each parameter. All data patterns were recorded on board ship as analog signals by the Signal Conditioning and Recording Device (SCARD). The analog tapes were digitized at the NASA Mississippi Test Facility, Bay St. Louis, Miss., at rates of 200 and 400 sps. Calibration and transfer equations were applied, and the measured values obtained. The resulting values were then averaged, yielding 1-sps data, and preliminary microfilm plots and data tabulations were prepared. Both manual and automated editing of these preliminary data was done to produce the final archive product.

6.2.1 Manual Editing

The microfilm plots were reviewed, and erroneous data were corrected or deleted; suspect data were flagged. The criterion for deleting data was obvious instrument or sensor malfunction. All data that were judged possibly useful, but which might require further refinement, were labeled S (suspect) in a separate column on the magnetic tape. Examples of this are the relative humidity measurements obtained with the carbon hygristor. A standard curve was used for calibrating the data. When compared on the microfilm, these measured values and the relative humidity values computed from the differences between the dry- and wet-bulb temperatures in some cases show extremely good agreement. Occasionally, however, the measured values drift to much higher values. In these instances, the dry- and wet-bulb temperatures are consistently good, casting suspicion on the measured humidity data.

6.2.2 Automated Editing

After the manual editing, an automated editing routine was used to (1) delete erroneous data, (2) flag or label suspect data, and (3) filter the temperature and wind data.

The dry- and wet-bulb temperatures were edited by a $\pm$ 1.5°C window. Each successive sample was compared with the previous one and was excluded if the difference in magnitude was greater than 1.5°C. The computed relative humidity value was, of course, deleted in such cases. Similarly, the windspeed was edited by a $\pm$ 2.5 m/s and the wind direction by a $\pm$ 15°C difference. The wind components were deleted for the values that failed this tolerance test.

The microfilm plots clearly show the single points that might have passed through the filter window but are still suspect. The user may want to eliminate these by means of another editing routine.

6.3 Archive Format and Data Inventory

The archived BLIP data include the following measured meteorological parameters:

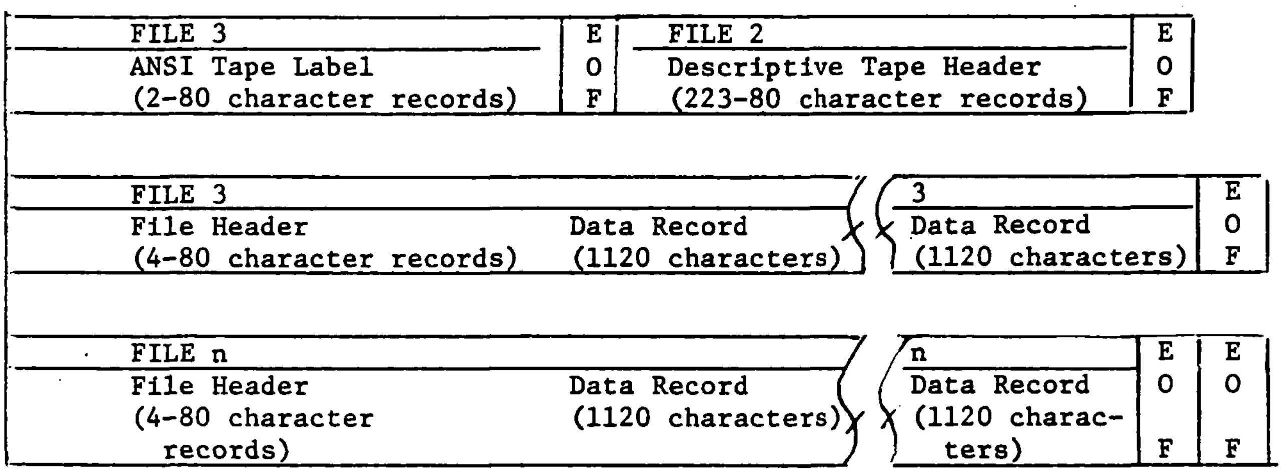
- Windspeed.
- Wind direction.
- Dry-bulb temperature.
- Wet-bulb temperature.
- Pressure or relative humidity.

Included also are derived values for:

- Wind u component.
- Wind v component.
- Relative humidity from dry- and wet-bulb differences.

All data are archived in 1-sps format. An inventory of these data is given in tables 6-2 through 6-5.

6.3.1 Magnetic Tape Data



Each tape has an ANSI standard label. Following the standard label all data are written in even parity EBCDIC in the following format:

(1) A descriptive tape header in 80-character physical records.
(2) A single physical end-of-file.
(3) A file header, which consists of four 80-character physical records.
(4) One or more data records (all 1,120 characters long).
(5) A single physical end-of-file.
(6) Items (3), (4), and (5) may be repeated, in that order, several times.
(7) A double physical end-of-file.

Each file header, item (3), contains the following:

Record 1, which gives ship name, phase number, and run number.
Record 2, which gives Julian day, run number, and ship number.
Record 3 and 4, which contain the following headers and units that describe the data in the data record, item (4):

Element	Header	Description
1	TIME	GMT time in seconds.
	A	Blank.
2	SPEED	Windspeed in meters per second.
	B	Windspeed label, S indicating suspect data.

3	DIREC	Wind direction in degrees. The corrected wind direction was obtained by comparing the mast wind direction with the BLIP wind direction and adding a bias, if needed, to the direction as measured by the BLIP.
	C	Wind direction label, S indicating suspect data.
4	U	East-west wind component.
5	V	North-south wind component.
6	N	Number of samples used in computing the 1-s average for windspeed and wind direction.
7	TDB	Dry-bulb temperature in degrees Celsius.
	D	Dry-bulb temperature label, S indicating suspect data.
8	TWB	Wet-bulb temperature in degrees Celsius.
	E	Wet-bulb temperature label, S indicating suspect data.
9	PR/RH1	Pressure in millibars for the Mt. Mitchell Period II, and pressure in "levels" for all baroswitch measurements; for time and pressure in millibars, see table 6-6. RH1 is the relative humidity in percent measured by the carbon hygristor.
	F	RH1 value label, S indicating suspect data.
10	RH2	Relative humidity in percent computed from the dry- and wet-bulb differences. A constant pressure value of 1,000 mb (not the actual surface pressure nor the pressure at flight level) was used in the computation of RH2. The computation method is the one given in the Smithsonian Meteorological Tables, 1966, Tables 94 and 98.
11	N	Number of samples used in computing 1-s averages of temperatures and RH1.
	G	Blank.

There are 14 data sets in each data record. The format of the data record is as follows:

Element	Character position	Fortran field	Missing data* A	Missing data* B	Description
1	1-6	(I6)		999999	Time
A	8			9	Dummy
2	10-15	(F6.2)	-99.99	999.99	Windspeed
B	17	(1H)		9	Flag
3	20-24	(F6.2)	-99.99	999.99	Wind direction
C	26	(1H)		9	Flag
4	28-33	(F6.2)	-99.99	999.99	u component
5	35-40	(F6.2)	-99.99	999.99	v component
6	42	(I1)		9	N
7	44-49	(F6.2)	-99.99	999.99	Dry bulb
D	51	(1H)		9	Flag
8	53-58	(F6.2)	-99.99	999.99	Wet bulb
E	60	(1H)		9	Flag
9	62-68	(F7.2)	-99.99	9999.99	Pressure or relative humidity
F	70	(1H)		9	Flag
10	72-76	(F5.1)	-99.9	999.9	Computed relative humidity
11	78	(I1)		9	N
G	80			9	Dummy

* When an individual element is missing, form A is used. When all data for a particular second are missing, form B is used.

6.3.2 Microfilm Data

The 1-sps data are shown on 35-mm microfilm in the form of graphical plots consisting of 8-min frames (480 points) that have been butted to form a continuous series of a particular run. Each frame contains a heading giving ship's name, BOMEX Phase number, BLIP run number, and Julian day.

The following is an example of the five-column legend that appears at the beginning of each series:

TRACE	MIN. INPUT	MAX. INPUT	MIN. PLOT	MAX. PLOT
DIR	0.00	360.00	100	900
SPEED	0.00	50.00	0	1000
TDB	0.00	50.00	0	1000
TWB	0.00	50.00	0	1000
PRESS	10.	40.	840	990
RH2	10.00	110.00	0	1000

The abscissa is time in hours, minutes, and seconds, e.g., 15.19.00 means 1500 hr, 19 min, and 0 s. Tbe ordinate is labeled 0 to 1000 in increments of 100. The values in the legend correspond to this scale, e.g., the input for windspeed is from 0 to 50 m/s, which means that each marked increment, or line, is 5 m/s.

Note again that the pressure data have not been reduced to pressure units, except for the Mt. Mitchell, Phase II, and that the contact point changes shown on the plots served as the basis for the pressure values given in table 6-6. The relative humidity plots are labeled RH1 or RH2, the former referring to the hygristor values of relative humidity, the latter to the values derived from the dry- and wet-bulb temperature differences. There is a 10 percent offset in the plots of RH1 and RH2 to facilitate viewing; the legend shows the offset values.

6.4 Sources of Error

The wind bias used in correcting wind direction might be in error by several degrees. Comparison of 1-hr averages between runs will show any such discrepancy.

The catenary caused nonhorizontal wind measurements when the instrument package was at low altitudes. At higher levels (100 m), the package was generally on a horizontal plane.

No pressure reading (in millibars) is given while the package is at flight level. In cases where the pressure data are shown for ascents and descents, the pressure at flight level might be inferred, but the change from one contact to another as the balloon rose and dropped cannot be readily determined. For runs without pressure sensor, the hydrostatic equation and the temperature data might be used to obtain an approximation of the height profiles.

The Mt. Mitchell pressure sensor was not calibrated. In reducing the pressure data obtained, which cover Phase II only, a "first estimate" transfer equation was used. No extensive effort was made to validate the pressure values.

The relative humidity values, RH1, from the carbon hygristor were derived from a standard curve of resistance (R) vs. relative humidity (RH) from Humidity and Moisture: Measurement and Control in Science and Industry, Vol. I, by A. Wexler, Ed., Reinhold Publishing Corporation, New York, N.Y., 1965, p.323. The calibration done before the experiment involved the frequency vs. resistance data. The relationship at 25°C is logarithmic, sharply increasing above humidity values in the 90-percent range. The BLIP data contain values higher than 180 percent; these could be due to the transfer equation derived from the standard curve data. The values above 100 percent are included in the magnetic tape data, but are truncated in the microfilm plots.

The height of the balloon was estimated by use of the linear line footage from the counter on the winch. The catenary was not taken into account.

6.5 Recommendations for Data Users

It is highly recommended that the microfilm plots be reviewed before the data are used. Since these are in the form of time series, data gaps can be readily discerned. First estimates of the data can also be made. The BLIP Log (see below) might also be helpful. Note, however, that the times in the log are not necessarily the same as the edited times shown in tables 6-2 through 6-5. The ship motion corrections (see sec. 2) can be used to further correct the BLIP wind data.

6.6 Supplementary Material Available From the Archive

BLIP Log

BOMEX Software System, Program Documentation for SCARD Digitized BLIP (BO-1-1C-4995), R-066-22, General Electric, June 1971.

BOMEX Software System, Program Documentation for BLIP PAM Detect and Wind Computation (BO-1-3-4995), R-066-23, General Electric, July 1971.

BOMEX, Calibration Documentation for Boundary Layer Instrumentation Package, R-074, General Electric.

BOMEX Software System, Program Documentation for BLIP Pressure Contact Change (BO-1-21-1000), R-066-30, General Electric, June 1971.

BOMEX Software System, Program Documentation for BLIP Averaging and Engineering Units Conversion (BO-1-4-4995) and (BO-1-6-4995), R-066-24, General Electric, July 1971.

BOMEX Software System, Program Documentation for BLIP Engineering Units Conversion and Tabulation (BO-1-4A-4995), R-066-35, General Electric, July 1971

BOMEX Software System, Program Documentation for BLIP/STD Plot (BO-1-5A-4995), R-066-25, General Electric, July 1971.

BOMEX Software System, Program Documentation for BLIP Calibration (BO-1-9-4995), R-066-31, General Electric, June 1971.

Microfilm reel No. DOC-7, containing Card 2, BLIP Calibration Form; also on this reel are Card 3, STD Observation Form, and Card 4, Ship Operations Form.

Table 6-2.--BLIP data inventory, <u>Oceanographer</u>

Magnetic tape No.	Microfilm reel No.	Date (1969)	Julian day	BOMEX Observation Period	Run No.	Edited start time (GMT)	Edited stop time (GMT)
B6320	BL-1	May 25	145	II	1	19:54:22	23:51:00
"	"	May 26	146	"	2	19:36:35	23:53:55
"	"	May 28	148	"	3	16:36:46	23:40:34
"	"	May 30	150	"	4	00:00:05	10:48:41
"	"	"	"	"	5	11:12:41	12:44:10
"	"	"	"	"	6	13:00:30	21:15:11
B6321	"	May 31	151	"	7	00:14:10	08:58:30
"	"	"	"	"	8	09:56:01	13:58:25
"	"	"	"	"	9	15:13:51	20:27:51
"	"	"	"	"	10	21:20:21	04:20:05
"	"	June 1	152	"	11	05:20:23	10:25:13
"	"	"	"	"	12	11:12:09	17:34:00
B6322	"	"	"	"	13	18:21:14	20:18:10
"	"	"	"	"	14	23:35:46	02:20:46
"	"	June 3	154	"	15	21:45:10	01:12:10
"	"	June 4	155	"	16	10:59:50	19:30:50
"	"	"	"	"	17	19:59:25	23:53:13
"	"	June 6	157	"	18 *		
"	"	"	"	"	19	14:39:01	20:14:01
"	"	"	"	"	20	21:39:38	08:53:31

Table 6-2.--Blip data inventory, Oceanographer (continued)

Magnetic tape No.	Microfilm reel No.	Date (1969)	Julian day	BOMEX Observation Period	Run No.	Edited start time (GMT)	Edited stop time (GMT)
B6323	BL-1	June 7	158	II	21	09:15:51	20:19:21
"	"	"	"	"	22	21:19:30	07:40:01
"	"	June 8	159	"	23	08:20:00	19:11:41
B6344	"	"	"	"	24	21:34:30	07:19:21
"	"	June 9	160	"	25	07:38:04	17:09:22
"	"	"	"	"	26	21:35:39	07:01:39
B6331	BL-2	June 21	172	III	1	00:07:21	01:16:22
"	"	"	"	"	2	16:28:00	20:36:00
"	"	June 22	173	"	3	00:10:00	11:51:47
"	"	"	"	"	4	15:30:43	19:15:05
"	"	"	"	"	5	21:23:20	01:12:00
"	"	June 23	174	"	6	02:34:20	13:16:41
B6332	"	"	"	"	7	13:33:24	21:02:58
"	"	June 24	175	"	8	21:37:27	08:46:26
"	"	"	"	"	9	12:19:21	21:08:48
B3681	"	"	"	"	10	21:31:12	12:46:22
B6333	"	June 25	176	"	11	15:08:41	21:13:11
"	"	"	"	"	12	21:32:25	07:52:21
"	"	June 26	177	"	13	08:04:40	12:35:20
"	"	"	"	"	14	12:45:38	19:15:03

Table 6-2.—BLIP data inventory, Oceanographer (continued)

Magnetic tape No.	Microfilm reel No.	Date (1969)	Julian day	BOMEX Observation Period	Run No.	Edited start time (GMT)	Edited stop time (GMT)
B6334	BL-2	June 26	177	III	15	23:50:52	12:44:43
"	"	"	"	"	16 *		
"	"	June 28	179	"	17	13:34:17	21:18:03
"	"	"	"	"	18	21:41:39	06:59:00
"	"	June 29	180	"	19	15:27:01	21:08:05
B6347	"	"	"	"	20	21:28:47	03:57:43
B6324	BL-3	July 12	193	IV	1	12:33:21	14:50:41
"	"	"	"	"	2	15:37:43	21:07:30
"	"	"	"	"	3	21:28:08	09:58:08
"	"	July 13	194	"	4	10:19:00	12:06:06
"	"	"	"	"	5	17:30:00	21:09:25
"	"	"	"	"	6	21:20:36	06:44:36
B6325	"	July 14	195	"	7	16:59:25	19:23:29
"	"	"	"	"	8	23:11:45	06:01:45
"	"	July 15	196	"	9	06:03:21	10:03:03
"	"	"	"	"	10	10:18:43	12:30:45
"	"	"	"	"	11	13:10:21	22:56:02
"	"	July 16	197	"	12	23:41:45	02:00:50
"	"	July 17	198	"	13	02:49:35	09:55:06
B6326	"	"	"	"	14	10:33:30	21:04:55
"	"	"	"	"	15	10:33:30	21:04:55
"	"	"	"	"	16	21:28:36	09:52:36
"	"	July 18	199	"	17	10:06:00	13:38:15
"	"	"	"	"	18	15:14:30	17:43:40

Table 6-2.--BLIP data inventory, Oceanographer (continued)

Magnetic tape No.	Microfilm reel No.	Date (1969)	Julian day	BOMEX Observation Period	Run No.	Edited start time (GMT)	Edited stop time (GMT)
B6327	BL-3	July 18	199	IV	19	21:35:15	08:47:21
"	"	July 19	200	"	20	09:20:00	13:44:20
"	"	"	"	"	21	14:13:23	19:04:23
"	"	"	"	"	22	21:22:00	09:06:21
"	"	July 20	201	"	23	09:25:32	10:57:32
"	"	"	"	"	24	11:24:01	14:12:01
B6328	"	"	"	"	25	15:15:10	19:01:43
"	"	"	"	"	26	19:35:45	22:07:40
"	"	"	"	"	27	22:34:35	09:54:35
"	"	July 21	202	"	28	10:09:30	13:29:03
"	"	"	"	"	29	16:53:53	17:31:03
"	"	"	"	"	30	21:37:35	09:31:50
B6380	"	July 22	203	"	31	09:57:23	16:59:30
"	"	"	"	"	32	19:12:10	21:08:02
"	"	"	"	"	33	21:34:21	02:11:21
"	"	July 23	204	"	34	03:59:13	08:34:10
"	"	"	"	"	35	08:54:29	09:33:29
"	"	"	"	"	36	09:50:49	21:04:49
"	"	"	"	"	37	21:27:10	02:12:59

* Deleted due to erroneous data.

Table 6-3.--BLIP data inventory, Mt. Mitchell

Magnetic tape No.	Microfilm reel No.	Date (1969)	Julian day	BOMEX Observation Period	Run No.	Edited start time (GMT)	Edited stop time (GMT)
B6335	BL-5	May 26	146	II	1	02:56:33	06:03:33
"	"	May 27	147	"	2	07:19:00	15:34:28
"	"	"	"	"	3	16:43:40	22:33:37
"	"	May 31	151	"	4	17:38:46	23:07:46
"	"	June 1	152	"	5	13:08:41	21:12:21
"	"	June 2	153	"	6	00:44:05	04:20:01
"	"	"	"	"	7	07:27:40	12:17:00
B6336	"	"	"	"	8	13:30:09	18:50:41
"	"	June 3	154	"	9	00:02:40	04:23:27
"	"	"	"	"	10	07:49:27	12:16:27
"	"	"	"	"	11	23:45:00	04:15:11
"	"	June 4	155	"	12	18:12:22	23:08:22
"	"	June 7	158	"	13	01:33:23	04:33:23
"	"	"	"	"	14	07:31:15	12:31:15
B6337	"	"	"	"	15	13:12:41	20:19:41
"	"	June 8	159	"	16	00:07:03	04:15:05
"	"	"	"	"	17	07:17:05	10:53:03
"	"	"	"	"	18	12:39:21	16:02:01
"	"	"	"	"	19	21:15:18	23:53:55
"	"	June 9	160	"	20	07:21:05	12:25:20
"	"	"	"	"	21	12:47:40	20:23:21
"	"	"	"	"	22	23:33:56	04:10:41

Table 6-3.--BLIP data inventory, Mt. Mitchell (continued)

Magnetic tape No.	Microfilm reel No.	Date (1969)	Julian day	BOMEX Observation Period	Run No.	Edited start time (GMT)	Edited stop time (GMT)
B6338	BL-6	June 23	174	III	1	01:16:01	04:26:30
"	"	"	"	"	2	09:23:40	12:33:55
"	"	"	"	"	3	13:08:21	21:00:30
"	"	June 24	175	"	4	00:02:21	04:12:06
"	"	"	"	"	5	07:28:28	12:25:03
"	"	"	"	"	6	05:23:02	20:05:02
"	"	June 25	176	"	7	00:28:41	04:13:26
B6339	"	"	"	"	8	07:34:15	12:41:26
"	"	"	"	"	9	14:12:26	20:31:05
"	"	June 26	177	"	10	00:06:06	04:27:41
"	"	"	"	"	11	07:26:35	12:20:00
"	"	"	"	"	12	12:44:02	16:52:02
"	"	June 28	179	"	13	01:12:13	04:20:13
"	"	"	"	"	14	07:28:13	12:42:08
B6340	"	June 29	180	"	15	02:25:05	04:33:03
"	"	"	"	"	16	07:32:48	12:17:15
"	"	June 30	181	"	17	00:00:00	04:33:15
"	"	"	"	"	18	07:51:31	12:27:31
"	"	"	"	"	19 *		
"	"	"	"	"	20	19:26:40	23:15:30
"	"	July 1	182	"	21	00:08:16	04:41:16
"	"	"	"	"	22	07:44:22	12:38:22
"	"	"	"	"	23	13:06:17	20:22:41

Table 6-3.--BLIP data inventory, Mt. Mitchell (continued)

Magnetic tape No.	Microfilm reel No.	Date (1969)	Julian day	BOMEX Observation Period	Run No.	Edited start time (GMT)	Edited stop time (GMT)
B6348	BL-6	July 2	183	III	24	00:24:56	04:40:56
"	"	"	"	"	25	07:26:17	12:42:27
B6341	BL-7	July 12	193	IV	1	17:46:00	21:06:30
"	"	July 13	194	"	2	00:00:22	04:27:30
"	"	"	"	"	3	07:27:01	08:24:30
"	"	"	"	"	4	12:23:41	20:16:55
"	"	"	"	"	5	23:57:26	04:15:50
"	"	July 14	195	"	6	07:38:43	12:18:50
"	"	"	"	"	7	12:48:42	20:05:41
B6342	"	"	"	"	8	23:57:10	02:37:47
"	"	July 17	198	"	9	14:42:22	20:01:29
"	"	July 18	199	"	10	00:58:24	04:42:24
"	"	"	"	"	11	08:16:24	12:11:29
"	"	July 19	200	"	12	00:34:43	04:15:55
"	"	"	"	"	13	08:17:15	08:44:00
"	"	"	"	"	14	18:40:02	22:51:55
"	"	July 20	201	"	15	04:44:27	05:28:15
"	"	July 21	202	"	16	01:49:01	04:39:01
"	"	"	"	"	17	07:18:22	12:27:21
B6343	"	"	"	"	18	12:27:41	19:30:25
"	"	July 22	203	"	19	00:19:35	04:26:35
"	"	"	"	"	20	07:21:00	12:35:05
"	"	"	"	"	21	14:59:40	19:56:46

Table 6-3.--BLIP data inventory, Mt. Mitchell (continued)

Magnetic tape No.	Microfilm reel No.	Date (1969)	Julian day	BOMEX Observation Period	Run No.	Edited start time (GMT)	Edited stop time (GMT)
B6343	BL-7	July 23	204	IV	22	00:24:02	04:21:02
"	"	"	"	"	23	18:22:41	23:07:41
"	"	July 24	205	"	24	07:25:22	08:59:55
"	"	July 26	207	"	25	18:07:21	21:04:25
B6349	"	"	"	"	26	23:58:01	04:22:01
"	"	July 27	208	"	27	08:10:21	12:46:30
"	"	"	"	"	28	13:52:03	19:53:01
"	"	July 28	209	"	29	00:16:51	04:43:51

* Deleted due to erroneous data.

Table 6-4.--BLIP data inventory, <u>Discoverer</u>

Magnetic tape No.	Microfilm reel No.	Date (1969)	Julian day	BOMEX Observation Period	Run No.	Edited start time (GMT)	Edited stop time (GMT)
B6345	BL-4	June 24	175	III	1	00:04:58	06:40:50
"	"	"	"	"	2 *		
"	"	June 28	179	"	3	00:28:44	06:02:14
"	"	"	"	"	4	06:34:20	10:38:25
"	"	"	"	"	5	16:51:44	20:57:29
"	"	June 29	180	"	6	00:17:00	04:47:00
"	"	"	"	"	7	07:19:53	12:58:53
"	"	"	"	"	8	17:04:45	19:39:25
B6346	"	June 30	181	"	9	06:39:15	12:53:11
"	"	"	"	"	10	16:00:05	20:12:30

* Deleted due to erroneous data.

Table 6-5.--BLIP data inventory, Rainier

Magnetic tape No.	Microfilm reel No.	Date (1969)	Julian day	BOMEX Observation Period	Run No.	Edited start time (GMT)	Edited stop time (GMT)
B6329	BL-4	May 31	151	II	1	00:03:38	04:13:35
"	"	"	"	"	2	07:37:21	12:47:41
B6330	"	June 22	173	III	1	14:07:23	19:51:53
"	"	"	"	"	2 *		
"	"	June 23	174	"	3	01:16:23	02:24:21
"	"	"	"	"	4	16:24:05	20:11:05
"	"	June 26	177	"	5	17:11:11	17:41:51

* Deleted due to erroneous data.

Table 6-6.--Pressure contact time
(Last column indicates BOMEX Observation Period and BLIP run No.)

OCEANOGRAPHER PRESSURE TIMES

PHASE 3 ASCENT

00.16.08	29.90	00.16.59	29.85	00.31.58	29.00			0301
16.31.41		16.34.14	29.90	16.34.43	29.85	16.38.39	29.68	0302
16.39.37	29.61	16.42.04	29.46	16.43.12	29.40	16.45.07	29.22	0302
16.45.52		16.50.14		16.55.22				0302
00.12.53		00.15.12	29.90	00.16.11	29.85	00.18.51	29.68	0303
00.20.00	29.61	00.23.17	29.46	00.24.12	29.40	00.28.53	29.22	0303
00.30.42	29.14	00.36.30	29.00					0303
15.37.16	29.90	15.37.46	29.85	15.39.08	29.68	15.39.37	29.61	0304
15.41.02	29.46	15.41.26	29.40	15.43.15	29.22	15.44.20	29.14	0304
15.46.09	29.00	15.47.16	28.88	15.55.42	28.74	15.57.52	28.65	0304
21.29.22	29.90	21.29.41	29.85	21.30.58	29.68	21.31.17	29.61	0305
21.32.45	29.46	21.33.02	29.40	21.34.17	29.22	21.34.33	29.14	0305
21.36.13	29.00	21.37.03	28.88	21.38.58	28.74	21.40.01	28.65	0305
21.44.38	28.51							0305
02.39.39	29.93	02.40.18	29.86	02.42.13	29.69	02.42.59	29.64	0306
02.45.29	29.47	02.46.10	29.40	02.48.33	29.25	02.49.36	29.17	0306
02.53.45	29.04	02.57.10	28.94	03.00.23	28.76			0306
13.38.01	29.86	13.39.36	29.69	13.40.11	29.64	13.41.51	29.47	0307
13.42.22	29.40	13.44.36	29.25	13.45.09	29.17	13.46.30	29.04	0307
21.42.17	29.86	21.43.54	29.69	21.44.27	29.64	21.45.58	29.47	0308
21.46.29	29.40	21.48.15	29.25	21.48.47	29.17	21.50.29	29.04	0308
15.17.59	29.94	15.18.18	29.87	15.19.25	29.72	15.19.54	29.65	0311
15.21.08	29.465	15.21.30	29.41	15.22.51	29.25	15.23.30	29.20	0311
15.25.23	29.04							0311
21.37.39	29.94	21.38.09	29.87	21.39.51	29.72	21.40.21	29.65	0312
21.42.26	29.465	21.43.04	29.41	21.45.00	29.25	21.45.29	29.20	0312
21.47.39	29.04							0312
08.08.22	29.94	08.09.08	29.87	08.10.24		08.11.05	29.65	0313
08.12.31	29.465	08.14.10	29.41	08.20.47	29.25	08.21.47	29.20	0313
08.23.59	29.04							0313
23.55.44	29.94	23.56.20	29.87	23.57.58	29.72	23.58.40	29.65	0315
00.00.32	29.465	00.01.33	29.41	00.05.35	29.25	00.11.45	29.20	0315
00.14.15	29.04							0315

Table 6-6.--Pressure contact time (continued
(Last column indicates BOMEX Observation Period and BLIP run No.)

17.11.21	29.94	17.11.48	29.87	17.13.42	29.72	17.14.13	29.65	0317
17.16.30	29.465	17.17.03	29.41	17.19.55	29.25	17.21.18	29.20	0317
17.24.15	29.04							0317
21.45.05	29.94	21.45.30	29.87	21.46.59	29.72	21.47.25	29.65	0318
21.49.02	29.465	21.49.25	29.41	21.51.33	29.25	21.52.18	29.20	0318
21.54.06	29.04							0318
10.04.41	29.94	10.05.01	29.87	10.06.34	29.72	10.06.55	29.65	0319
10.08.52	29.465	10.09.11	29.41	10.10.53	29.25	10.12.20	29.20	0319
10.15.07	29.04	10.16.20	28.92					0319
21.33.14	29.94	21.33.32	29.87	21.34.46	29.72	21.35.12	29.65	0320
21.36.19	29.465	21.36.56	29.41	21.38.04	29.25	21.38.49	29.20	0320
21.40.21	29.04							0320
PHASE 3	DESCENT							
00.52.40	29.14	00.54.00	29.22	00.57.43	29.40	00.58.59	29.46	0301
01.02.05	29.61	01.03.22	29.68	01.06.42	29.85	01.08.04	29.90	0301
01.12.31								0301
20.10.11	29.14	20.19.56	29.40	20.28.32	29.61	20.29.12	29.68	0302
20.32.20	29.85	20.32.56	29.90	20.35.37				0302
11.34.30	29.00	11.39.26	29.14	11.40.25	29.22	11.45.08	29.40	0303
11.45.57	29.46	11.49.28	29.61	11.50.11	29.68			0303
12.51.11	28.76	13.01.26	28.94	13.02.33	29.04	13.05.28	29.17	0306
13.06.35	29.25	13.08.48	29.40	13.09.32	29.47	13.11.59	29.64	0306
13.12.49	29.69	13.14.52	29.86	13.15.40	29.93			0306
20.43.00	29.04	20.49.50	29.17	20.51.14	29.25	20.54.12	29.40	0307
20.55.12	29.47	20.58.14	29.64	21.00.00	29.69	21.03.15	29.86	0307
08.41.17	29.69	08.44.54	29.86	08.46.11	29.93			0308
20.59.24	29.04	21.03.16	29.20	21.03.47	29.25	21.06.23	29.41	0311
21.07.03	29.465	21.09.03	29.65	21.09.41	29.72	21.12.17	29.87	0311
21.12.41	29.94							0311
07.37.00	29.04	07.39.58	29.20	07.40.46	29.25	07.43.27	29.41	0312
07.44.27	29.465	07.46.41	29.65	07.47.55	29.72	07.50.10	29.87	0312
07.51.07	29.94							0312
12.24.56	29.04	12.27.23	29.20					0313
20.41.39	29.04	21.07.40	29.20	21.08.43	29.25	21.11.35	29.41	0317
21.12.12	29.465	21.14.50	29.65	21.15.15	29.72	21.17.30	29.87	0317
21.18.04	29.94							0317
21.00.47	29.04	21.03.22	29.20	21.03.53	29.25	21.06.02	29.41	0319
21.06.18	29.465							0319

Table 6-6.--Pressure contact time (continued)
(Last column indicates BOMEX Observation Period and BLIP run No.)

PHASE 4		ASCENT						
12.38.35		12.40.06	29.90	12.40.43	29.85	12.42.08	29.68	0401
12.42.49	29.61	12.44.15	29.46	12.45.18	29.40	12.56.26	29.22	0401
12.57.00	29.14	12.59.42	29.00	13.01.09	28.88	13.03.07	28.74	0401
15.55.25		15.57.07	29.90	15.57.37	29.85	15.59.16	29.68	0402
15.59.45	29.61	16.00.57	29.46	16.01.39	29.40	16.02.59		0402
16.03.22		16.05.52	29.00					0402
21.36.16		21.37.36	29.90	21.38.02	29.85	21.39.29	29.68	0403
21.39.58	29.61	21.41.23	29.46	21.41.47	29.40	22.09.11	29.22	0403
22.09.38	29.14	22.12.06	29.00	22.15.09	28.88	22.18.03	28.74	0403
10.22.39		10.24.32	29.90	10.27.22	29.68	10.28.16	29.61	0404
10.30.40	29.46	10.31.44	29.40	10.33.54	29.22	10.35.07	29.14	0404
10.39.07	29.00							0404
17.34.33		17.35.44	29.90	17.36.03	29.85	17.41.51	29.68	0405
21.23.41		21.25.04	29.90	21.25.48	29.85	21.26.59	29.68	0406
21.27.22	29.61							0406
PHASE 4		DESCENT						
14.31.21	29.00	14.31.56	29.14	14.32.26	29.22	14.41.46	29.40	0401
14.42.19	29.46	14.46.07	29.61	14.47.25	29.68	14.48.46	29.85	0401
14.49.15	29.90	14.50.20						0401
20.57.00	29.00	20.59.01	29.14	20.59.38	29.22	21.01.37	29.40	0402
21.02.06	29.46	21.03.55	29.61	21.04.16	29.68	21.05.57	29.85	0402
21.06.24	29.90	21.07.37						0402
09.47.16	29.00	09.49.22	29.14	09.50.16	29.22	09.52.05	29.40	0403
09.52.51	29.46	09.55.11	29.61	09.55.36	29.68	09.57.09		0403
10.54.11	29.00	10.56.14	29.14	10.56.59	29.22	10.58.24	29.40	0404
10.59.05	29.46	11.01.04	29.61	11.01.41	29.68	11.03.53	29.85	0404
11.04.46	29.90							0404
21.01.50	29.40	21.03.46	29.46	21.05.27	29.61	21.05.57	29.68	0405
21.07.25	29.85	21.07.49	29.90	21.09.20				0405
			RAINER		PRESSURE TIMES			
PHASE 3		ASCENT						
14.16.39	29.90	14.18.35	29.81	14.23.00	29.72	14.23.53	29.67	1301
14.28.29	29.44	14.29.45	29.37	14.34.40	29.24	14.36.00	29.15	1301
14.40.40	28.98							1301
01.16.40	29.81	01.20.20	29.72	01.21.12	29.67	01.25.40	29.44	1303

Table 6-6.--Pressure contact time (continued)
(Last column indicates BOMEX Observation Period and BLIP run No.)

01.26.30	29.37	01.30.50	29.24	01.32.05	29.15	01.37.50	28.98	1303
16.30.29	29.90	16.31.25	29.81	16.34.58	29.72	16.35.43	29.67	1304
16.39.44	29.44	16.40.13	29.37	16.44.38	29.24	16.45.40	29.15	1304
16.48.42	28.98	16.57.39	28.89	17.06.30	28.75	17.09.01	28.65	1304
17.16.41	28.58	17.26.43	28.47	17.33.50	28.32			1304
PHASE 3	DESCENT							
19.45.58	29.24	19.48.27	29.37	19.48.57	29.44	19.50.03	29.67	1301
19.50.35	29.72	19.51.23	29.81	19.51.50	29.90			1301
17.58.56	28.32	18.01.19	28.47	18.02.04	28.58	18.03.59	28.65	1304
18.04.50	28.75	18.09.04	28.89	18.09.58	28.98			1304
			MT MITCHELL		PRESSURE TIMES			
PHASE 3	ASCENT							
01.39.42		01.40.18		01.41.19	29.81	01.41.48	29.73	2301
01.44.57	29.57	01.45.27	29.53	01.46.38	29.38	01.47.38	29.30	2301
01.49.11	29.17	01.49.41	29.10	01.51.04	28.96	01.51.48	28.86	2301
01.56.13	28.71	01.57.01	28.62					2301
13.20.40		13.23.18	29.81	13.24.26	29.73	13.27.14	29.57	2303
13.27.52	29.53	13.29.31	29.38	13.30.53	29.30	16.40.30	28.96	2303
00.10.22		00.11.14	29.81	00.11.25	29.73	00.12.23	29.57	2304
00.12.43	29.53	00.13.36	29.38	00.13.58	29.30	00.15.21	29.17	2304
00.16.07	29.10	00.17.45	28.96	00.19.07	28.86	00.20.39	28.71	2304
00.21.11	28.62							2304
07.31.41		07.32.26	29.81	07.32.46	29.73	07.33.48	29.57	2305
07.34.09	29.53	07.35.02	29.38	07.35.23	29.30	07.36.36	29.17	2305
07.36.58	29.10	07.38.28	28.96	07.39.27	28.86	07.41.05	28.71	2305
07.41.59	28.62							2305
16.12.44		16.14.03	29.81	16.14.38	29.73	16.16.04	29.57	2306
16.16.27	29.53	16.19.16	29.38	16.19.47	29.30	16.22.14	29.17	2306
16.22.47	29.10	16.24.27	28.96	16.25.48	28.86	16.29.46	28.71	2306
16.30.37	28.62							2306
00.41.30		00.42.10	29.81	00.42.28	29.73	00.43.20	29.57	2307
00.43.47	29.53	00.44.28	29.38	00.44.51	29.30	00.45.51	29.17	2307
00.46.23	29.10	00.47.31	28.96	00.48.24	28.86	00.50.01	28.71	2307
00.50.28	28.62	00.52.24	28.50	00.53.59	28.44			2307
07.41.48		07.42.21		07.43.11	29.81	07.43.31	29.73	2308
07.44.27	29.57	07.44.51	29.53	07.45.31	29.38	07.45.52	29.30	2308

Table 6-6.--Pressure contact time (continued)
(Last column indicates BOMEX Observation Period and BLIP run No.)

07.47.12	29.17	07.47.39	29.10	07.48.33	28.96	07.49.34	28.86	2308
07.51.36	28.71	07.52.12	28.62					2308
14.16.41		14.18.09	29.81	14.18.40	29.73	14.20.41	29.57	2309
14.21.15	29.53	14.23.41	29.38	14.24.31	29.30	14.27.22	29.17	2309
14.28.37	29.10	14.32.34	28.96	14.34.01	28.86	14.37.15	28.71	2309
14.38.20	28.62							2309
00.17.58		00.18.32		00.19.17	29.81	00.19.36	29.73	2310
00.20.18	29.57	00.20.39	29.53	00.21.34	29.38	00.21.52	29.30	2310
00.22.35	29.17	00.22.47	29.10	00.24.17	28.96	00.24.56	28.86	2310
00.26.11	28.71	00.26.39	28.62	00.28.29	28.50	00.29.05	28.44	2310
07.36.02		07.37.13		07.38.02	29.81	07.38.20	29.73	2311
07.39.17	29.57	07.39.33	29.53	07.40.28	29.38	07.40.56	29.30	2311
07.41.53	29.17	07.42.15	29.10	07.43.16	28.96	07.44.14	28.86	2311
07.45.31	28.71	07.45.58	28.62	07.48.19	28.50	07.48.54	28.44	2311
12.56.27		12.57.43	29.81	12.58.12	29.73	12.59.40	29.57	2312
13.00.16	29.53	13.01.42	29.38	13.02.10	29.30	13.03.32	29.17	2312
13.04.10	29.10	13.07.12	28.96	13.[illegible]	28.86	13.13.08	28.71	2312
13.13.26	28.62	13.15.54	28.50	13.16.50	28.44	13.19.06	28.31	2312
01.24.52		01.25.50	29.81	01.25.59	29.73	01.26.51	29.57	2313
01.27.10	29.53	01.28.04	29.38	01.28.23	29.30	01.29.28	29.17	2313
01.29.55	29.10	01.3[illegible].17		01.[illegible].16	28.86	01.33.41	28.71	2313
01.34.13								2313
07.38.58		07.39.39	29.81	07.39.57	29.73	07.40.45	29.57	2314
07.41.05	29.53	07.42.11	29.38	07.42.27	29.30	07.43.33	29.17	2314
07.43.58	29.10	07.44.58		07.45.44	28.86	07.47.04	28.71	2314
07.47.34	28.62	07.49.05	28.50	07.49.33	28.44	07.51.53	28.31	2314
07.53.32	28.24							2314
02.33.07		02.33.39	29.82	02.34.07	29.69	02.34.25	29.64	2315
02.35.36	29.48	02.36.25	29.42	02.[illegible].50	29.26	02.38.09	29.22	2315
02.39.35	29.05	02.40.16	28.94	02.42.10	28.77	02.42.42	28.72	2315
02.44.09	28.55							2315
07.45.00		07.45.20	29.82	07.46.19	29.69	07.46.37	29.64	2316
07.47.41	29.48	07.48.07	29.42	07.49.13	29.26	07.49.36	29.22	2316
07.50.56	29.[illegible]	07.52.31	28.94	07.54.14	28.77	07.54.35	28.72	2316
07.55.53	28.[illegible]	07.56.44	28.46	07.57.46	28.34			2316
00.11.19		00.12.24	29.81	00.12.46	29.73	00.14.00	29.57	2317

Table 6-6.--Pressure contact time (continued)
(Last column indicates BOMEX Observation Period and BLIP run No.)

00.14.42	29.53	00.15.03	29.38	00.15.34	29.30			2317
08.01.53		08.02.40	29.81	08.03.00	29.73	08.04.09	29.57	2318
08.04.24	29.53	08.06.59	29.38	08.07.34	29.30	08.09.44	29.17	2318
08.10.21	29.10	08.15.33	28.96					2318
19.46.46		19.47.48	29.81	19.48.17	29.73	19.49.26	29.57	2320
19.49.52	29.53	19.51.12	29.38	19.51.47	29.30	20.05.03	29.17	2320
00.19.03		00.19.34		00.20.26	29.81	00.22.23	29.73	2321
00.23.32	29.57	00.23.57	29.53	00.25.20	29.38	00.25.48	29.30	2321
00.27.11	29.17	00.27.37	29.10	00.30.00	28.96	00.30.55	28.86	2321
07.54.08		07.54.30		07.55.17	29.81	07.55.35	29.73	2322
07.56.30	29.57	07.56.57	29.53	07.58.35		07.59.13		2322
08.01.09	29.17	08.01.28		08.02.59	28.96	08.04.23		2322
13.16.02		13.16.57		13.18.28	29.81	13.19.02	29.73	2323
13.20.35	29.57	13.21.01	29.53	13.22.29	29.38	13.22.53	29.30	2323
13.24.34	29.17	13.24.40	29.10	13.25.44	28.96	13.27.55	28.86	2323
00.37.52		00.38.13		00.39.05	29.81	00.39.24	29.73	2324
00.40.23	29.57	00.40.44	29.53	00.41.43	29.38	00.42.27	29.30	2324
00.55.13	29.17	00.56.11	29.10	00.58.54	28.96	01.00.13	28.86	2324
01.04.19	28.71	01.05.12	28.62					2324
07.37.52		07.38.25		07.39.11	29.81	07.39.33	29.73	2325
07.51.42	29.57	07.52.16	29.53	07.54.06	29.38	07.54.32	29.30	2325
07.56.18	29.17	07.57.14	29.10	07.58.12	28.96	07.59.37	28.86	2325
PHASE 3	DESCENT							
04.02.37	28.96	04.09.05	29.10	04.10.29	29.17	04.12.44	29.30	2301
04.13.26	29.38	04.15.18	29.53	04.15.53	29.57	04.17.43	29.73	2301
04.18.17	29.81	04.19.51						2301
12.04.05	28.96	12.10.09	29.10	12.11.18	29.17	12.14.26	29.30	2302
12.15.21	29.38	12.16.51	29.53	12.17.19	29.57	12.18.51	29.73	2302
12.19.19	29.81	12.20.31						2302
03.58.37	28.96	04.08.39	29.10	04.09.19	29.17	04.11.07	29.30	2304
04.11.34	29.38							2304
11.42.58	28.96	12.03.03	29.10	12.03.40	29.17	12.05.39	29.30	2305
12.06.17	29.38	12.08.34	29.53	12.09.15	29.57	12.10.44	29.73	2305
12.11.12	29.81	12.12.07						2305
19.26.32	28.96	19.44.44	29.10	19.45.34	29.17	19.47.15	29.30	2306
19.47.38	29.38	19.49.14	29.53	19.49.49	29.57	19.51.10	29.73	2306

Table 6-6.--Pressure contact time (continued)
(Last column indicates BOMEX Observation Period and BLIP run No.)

19.51.39	29.81	19.52.42						2306
03.53.29	28.96	03.54.55	29.10	03.55.26	29.17	03.57.01	29.30	2307
03.57.30	29.38	03.59.11	29.53	03.59.40	29.57	04.01.00	29.73	2307
04.01.21	29.81	04.02.30						2307
12.10.04	28.96	12.11.54	29.10	12.12.24	29.17	12.13.48	29.30	2308
12.14.18	29.38							2308
20.04.45	28.86	20.05.54	28.96					2309
04.07.13	28.96	04.10.55	29.10	04.11.40	29.17	04.13.16	29.30	2310
12.01.59	28.96	12.03.51	29.10	12.04.28	29.17	12.06.06	29.30	2311
04.18.27	29.81	04.19.23						2310
04.13.53	29.38	04.15.11	29.53	04.16.05	29.57	04.17.48	29.73	2310
04.05.23	29.10	04.06.11	29.17	04.08.14	29.30	04.08.47	29.38	2313
12.10.14	29.81	12.11.24						2311
12.06.41	29.38	12.08.08	29.53	12.08.33	29.57	12.09.43	29.73	2311
04.10.14	29.53	04.10.42	29.57	04.11.57	29.73	04.12.27	29.81	2313
04.13.44								2313
12.19.44		12.21.41		12.22.20		12.24.00	29.30	2314
12.24.25	29.38	12.25.56	29.53	12.26.19	29.57	12.27.29	29.73	2314
12.27.57	29.81	12.29.08						2314
04.18.03	29.05	04.20.25	29.22	04.21.21	29.26	04.22.47	29.42	2315
04.23.35	29.48	04.24.33	29.64	04.25.37	29.69	04.26.37	29.82	2315
04.27.10								2315
04.20.22	29.53	04.21.05	29.57	04.23.03	29.73	04.23.45	29.81	2317
04.25.03								2317
12.13.25	29.53	12.14.05	29.57	12.16.12	29.73	12.16.38	29.81	2318
12.17.57		12.18.32						2318
22.49.16	29.17	22.51.12	29.30	22.51.37	29.38	22.53.24	29.53	2320
22.53.57	29.57	22.55.19	29.73	22.55.50	29.81	22.57.08		2320
04.24.25	29.17	04.28.57	29.30	04.29.37	29.38	04.31.24	29.53	2321
04.32.02	29.57	04.32.58	29.73	04.33.27	29.81	04.34.29		2321
04.35.09								2321
12.23.12	29.17	12.24.36	29.30	12.25.09	29.38	12.26.53	29.53	2322
12.27.20	29.57	12.28.26	29.73	12.28.56	29.81	12.30.13		2322
12.30.53								2322
19.36.26	28.96	19.45.41	29.10	19.46.34	29.17	20.02.16	29.30	2323
20.02.57	29.38	20.04.10	29.53	20.04.36	29.57	20.05.41	29.73	2323

Table 6-6.--Pressure contact time (continued)
(Last column indicates BOMEX Observation Period and BLIP run No.)

20.06.08	29.81	20.07.15						2323
04.29.23	29.30	04.30.04	29.38	04.31.27	29.53	04.31.49	29.57	2324
04.33.07	29.73	04.33.32	29.81	04.34.35		04.37.05		2324
12.18.48	29.30	12.19.20	29.38	12.20.48	29.53	12.21.14	29.57	2325
12.22.32	29.73	12.23.05	29.81	12.24.17		12.25.06		2325
PHASE 4	ASCENT							
18.38.18	29.52	18.38.53	29.38	18.40.07	29.28	18.40.21	29.16	2401
18.41.46	29.03	18.42.50	28.88	18.44.37	28.72	18.44.57	28.66	2401
18.47.00	28.47	18.47.45	28.29	18.49.53	28.15	18.50.27	28.07	2401
18.52.44	27.94	18.55.12	27.80					2401
07.53.02	29.52	07.53.40	29.38	07.54.20	29.28	07.54.54	29.16	2406
07.55.58	29.03	07.56.51	28.88	07.58.18		07.58.48	28.66	2406
08.00.23		08.00.44		08.03.20	28.15	08.05.26	28.07	2406
13.07.05	29.82	13.07.36	29.76	13.08.53	29.52	13.09.14	29.38	2407
13.10.36	29.28	13.10.58	29.16	13.12.32	29.03	13.13.39	28.88	2407
13.15.00	28.72	13.15.20	28.66	13.18.12	28.47	13.20.58	28.29	2407
13.22.53	28.15	13.23.01	28.07					2407
00.08.46	29.82	00.10.49	29.76	00.12.00	29.52	00.12.31	29.38	2408
00.13.50	29.28	00.14.22	29.16	00.16.20		00.17.25		2408
00.19.53	28.72	00.20.49	28.66	00.23.45	28.47	00.26.08	28.29	2408
14.59.59		15.00.47		15.03.59	29.52	15.04.20	29.38	2409
15.05.51	29.28	15.06.21	29.16	15.07.42	29.03	15.08.26		2409
15.09.51	28.72	15.10.25	28.66	15.14.42	28.47	15.15.47	28.29	2409
01.28.34		01.37.24	29.76	01.38.11	29.52	01.38.35	29.38	2410
01.39.37	29.28	01.40.00	29.16	01.41.08		01.41.51		2410
01.42.50	28.72	01.43.32	28.66	01.45.15		01.46.21	28.29	2410
01.47.44	28.15	01.48.22	28.07	01.53.37	27.94	01.54.54	27.80	2410
01.03.27	29.82	01.03.48	29.76	01.07.00		01.08.14	29.38	2412
01.09.26	29.28	01.09.50	29.16	01.10.51		01.11.12		2412
01.13.29	28.72	01.14.16	28.66	01.16.22	28.47	01.16.54	28.29	2412
01.19.04	28.15	01.19.20	28.07					2412
00.27.58	29.85	00.28.17	29.78	00.32.41	29.62	00.33.07	29.57	2419
00.33.55	29.42	00.34.21	29.35	00.35.13	29.19	00.35.38	29.14	2419
00.36.43	29.01	00.37.16	28.90	00.38.20	28.72	00.38.52	28.66	2419
00.40.17	28.54							2419

Table 6-6.--Pressure contact time (continued)
(Last column indicates BOMEX Observation Period and BLIP run No.)

07.29.46	29.85	07.30.04	29.78	07.31.13	29.62	07.31.30	29.57	2420
07.32.19	29.42	07.32.39	29.35	07.33.29	29.19	07.33.49	29.14	2420
07.34.44	29.01	07.35.26	28.90	07.36.13	28.72	07.36.36	28.66	2420
07.38.21	28.54							2420

PHASE 4 DESCENT

19.08.28	27.80	19.09.29	27.94	19.12.56	28.07	19.13.22	28.15	2401
19.16.04	28.29	19.16.12	28.47	19.21.21	28.66	19.23.33	28.72	2401
19.26.16	28.88							2401
20.28.53	29.03	20.41.47	29.16	20.41.58	29.28	20.43.47	29.38	2401
20.44.25	29.52	20.45.39	29.76					2401
14.58.16	28.15	15.00.33	28.29	15.01.11	28.47	15.02.58	28.66	2404
15.03.41	28.72	15.05.58	28.88					2404
19.50.10	29.16	19.50.34	29.28	19.52.11	29.38	19.52.35	29.52	2404
19.54.00	29.76	19.54.24	29.82					2404
08.15.52	28.07	08.16.25	28.15	08.17.48	28.29	08.18.34	28.47	2406
08.20.09	28.66	08.20.46	28.72	08.22.10	28.88			2406
12.02.05	29.03	12.03.34	29.16	12.03.59	29.28	12.05.31	29.38	2406
12.06.07	29.52	12.07.33	29.76	12.08.09	29.82			2406
14.53.44	28.29	14.55.26	28.47	14.58.26	28.66	14.59.14	28.72	2407
15.02.37	28.88							2407
19.46.31	29.03	19.48.28	29.16	19.48.54	29.28	19.50.31	29.38	2407
19.51.02	29.52	19.52.19	29.76	19.52.46	29.82			2407
19.35.53	29.03	19.39.43	29.16	19.40.21	29.28	19.41.49	29.38	2409
19.42.21	29.52	19.43.36	29.76	19.44.54	29.82	19.57.54		2409
19.58.08								2409
02.00.53	27.80	02.03.43	27.94	02.05.48	28.07	02.06.39	28.15	2410
02.08.24	28.29	02.08.44	28.47	02.10.26	28.66	02.10.45	28.72	2410
02.12.16								2410
04.28.27		04.30.25	29.16	04.31.01	29.28	04.32.35	29.38	2410
04.33.04	29.52	04.34.30	29.76	04.34.56	29.82			2410
01.28.07		01.29.56	28.15	01.33.10		01.33.44	28.47	2412
01.35.49	28.66	01.36.34	28.72					2412
04.00.16	29.03							2412
22.32.18	29.03	22.34.40	29.16	22.34.54	29.28	22.36.59	29.38	2414
22.37.25	29.52	22.38.55	29.76	22.39.31	29.82			2414

7. SALINITY-TEMPERATURE-DEPTH (STD) DATA SET

7.1 Instrumentation

Hytech STD Models 9006 and 9040 built by the Bissett-Berman Corporation (now Plessey Environmental Systems), San Diego, Calif., were used during BOMEX for measuring seawater salinity, temperature, and depth of the sensor. The instrument's underwater signals were frequency modulated and multiplexed so that salinity, temperature, and depth measurements were transmitted through the lowering cable as a single composite wave form, which was direct-frequency recorded on SCARD (Signal Conditioning and Recording Device) aboard ship. The incoming signal was also separated into salinity, temperature, and depth frequencies, which were strip-chart recorded as a quality control measure and to control operation of the underwater unit. A summary of STD equipment aboard each of the five fixed ships is given in table 7-1.

Table 7-1.--STD sensor characteristics

Ship	STD model No.	Sensor input	Range of measurement System 1 (primary)	System 2 (backup)
Oceanographer	9006	temperature	-2 to +35°C	-2 to +35°C
		salinity	28 to 38°/oo	30 to 40°/oo
		depth 1	0 to 300 m	0 to 300 m
		depth 2	0 to 2,000 m	0 to 2,000 m
Discoverer	9006	temperature	-2 to +35°C	-5 to +35°C
		salinity	28 to 38°/oo	28 to 38°/oo
		depth 1	0 to 300 m	0 to 200 m
		depth 2	0 to [illegible] m	[illegible]
Rockaway	9006	temperature	-2 to +40°C	
		salinity	30 to 40°/oo	
		depth 2	0 to 1,500 m	
Rainier	9040	temperature	-2 to +39°C	-2 to +39°C
		salinity	30 to 40°/oo	30 to 40°/oo
		depth 2	0 to 3,000 m	0 to 3,000 m
Mt. Mitchell	9040	temperature	-2 to +39°C	-2 to +39°C
		salinity	30 to 40°/oo	30 to 40°/oo
		depth 2	0 to 3,000 m	0 to 3,000 m

7.2 Observation Procedures

Uniform procedures for STD data collection were established to ensure consistent results and reliable intercomparison of data obtained from the five ships. Performance checks of every STD sounding were made by comparing salinity and temperature STD surface measurements with simultaneous bucket samples. Two Nansen bottles were attached to the STD lowering cable, allowing for comparisons that were used in applying calibration corrections during later data processing.

Routine STD casts from the surface to 1,000 m were scheduled for the Discoverer, Oceanographer, and Rockaway at 0100, 0300, 0600, 0900, 1200, 1500, 1800, and 2100 GMT; during Period IV, however, the first sounding from the Discoverer was made at 0000 rather than 0100. Soundings from the Mt. Mitchell and Rainier were scheduled at 0100, 0600, 1200, and 1800 GMT. All schedules were adhered to within ± 30 min. The sensor package was soaked at the surface for 5 min, lowered at a rate of approximately 20 m/min to 100 m, and then allowed to descend at 40 to 50 m/min. The depths were determined from the STD strip-chart recorder on deck. Data were recorded during descent only.

During and following periods of significant precipitation, rainy day casts were taken to determine the influence of rain in the upper 15 m of the ocean. The procedure began whenever precipitation greater than 2 n mi across, as confirmed by radar, was approaching the ship. The STD package was allowed to soak for 5 min at the surface (1 1/2 to 3 m), then lowered at a rate not exceeding 10 m/min to 15 m, allowed to soak for 5 min at 15 m, and raised to the surface to soak for another 5 min. This procedure was repeated as long as the rain persisted and was discontinued not sooner than 3 hr after the rain had stopped. Rainy day soundings were interrupted for scheduled 1,000-m casts, and were resumed after the latter had been completed. Salinity, temperature, and depth were recorded continuously during the rainy day cast.

On board the Oceanographer, a special program was conducted by the Woods Hole Oceanographic Institution to determine velocity profiles in the ocean mixed layer. In support of this special study, a sequence of surface region STD casts were taken during BOMEX Period II, from May 25 to 28, May 30 to June 2, and on June 7 and 8, which improved the time resolution of surface region data available for these dates. The STD sensor was allowed to soak at the surface for 5 min, then lowered at a rate not exceeding 20 m/min to a depth of approximately 60 m. Salinity, temperature, and depth were recorded during both descent and ascent.

As a check on the STD system calibration in the field, two-bottle Nansen casts were taken daily at 2100 GMT on the Rockaway and at 0100 and 1200 GMT on the other four ships, except for the Discoverer during Period IV, when the cases were scheduled for 0000 and 1200 GMT. The Nansen bottles were attached to the STD cable 10 m and 15 m above the sensor package. At 1,000 m, the upper bottle was tripped after a 12-min soak. During retrieval, the lower bottle was allowed to soak at the surface for 5 min, then tripped. The bottle thermometers were read to within ± 0.01°C,and salinities were determined within

$\pm$ 0.003^{o}/00 on successive readings of a calibrated salinometer. Values were manually recorded on an STD Observation Form. STD temperatures and salinities of the corresponding depths were recorded on the same form to within $\pm$ 0.01^{o}C and $\pm$ 0.01^{o}/oo, respectively. The Nansen values were compared with the 1,000-m and surface STD values of the same cast. Temperature and salinity calibration corrections were computed from the differences between the Nansen and STD measurements.

7.3 Data Processing

7.3.1 Digital Reduction and Editing

After the field operations, the SCARD analog tapes were digitized at the NASA Mississippi Test Facility (MTF), Bay St. Louis, Miss., which has a data acquisition system designed for acquiring large quantities of data during static test firing of various rocket stages. This 200-channel system is connected to a Beckman 410 computer and includes a number of counters that can develop a period average measurement of a signal, a fact of particular importance in STD digitizing, since it offers the possibility of measuring more precisely the frequency of the signal on the tape and of making the measurement reflect the average value of the frequency during the measuring interval.

The clock frequency used with the counters in initial experiments at MTF was 100 kHz (10-μs period), giving a precision of interval measurement of 1 part in 4,000, a precision insufficient for adequate rendition of STD data. Some improvement was effected by raising the clock frequency to 250 kHz, the maximum value supported by the acquisition system. With 120-ms counting intervals, this results in a precision of 1 part in 30,000. The digitized signals also contained much more scatter than could be accounted for by quantizing alone, and it soon became apparent that a variation in measured frequency of about 1 part in 3,000 was being introduced by tape flutter. A partial solution to this problem consisted of measuring the frequency of the reference signal from the tape, as well as the salinity, temperature, and pressure signals. Since the ideal frequency (3125.0 Hz) of the control track signal was known, it was possible to develop a corrected measure for any signal by use of

$$F_{corrected} = F_{measured} \frac{3125.0}{F_{control\ track}} ,$$

where F is the frequency for salinity, temperature, or pressure, in hertz.

The magnetic tapes produced at MTF were further reduced and edited at NOAA's Center for Experiment Design and Data Analysis by a two-step process, with the basic aim of obtaining continuous time series of data for each sounding that could be used in subsequent analyses. Every effort was made to avoid changing the values of data points, and editing was therefore restricted to

(1) deletion of out-of-range values, (2) linear interpolations of pressure, salinity, or temperature gaps, not more than a few seconds in time, and (3) inserting corrected time, date, and ship position, as well as descriptive comments, in the header information.

Conversion from frequency to oceanographic quantities was effected during the first phase of the two-step digital reduction process by use of the transfer equation

$$X = (F-Z) \times M+C,$$

where X is salinity (°/oo), temperature (°C), or pressure (decibars); F is the frequency (Hz) from the data tape; Z is the bias, or zero frequency (Hz); M is the slope (units of X per Hz) in the linear transform; and C is the y-intercept (units of X). Tables 7-2, 7-3, and 7-4 give values of Z, M, and C for temperature, salinity, and pressure for each ship and time period, Values of C are given in both the uncorrected form as supplied by the manufacturer and in corrected form. The calibration corrections and their application are discussed in further detail below.

Temperature and pressure were smoothed by means of a double running mean low-pass filter that has characteristics by which the response of both the pressure and the temperature sensor, including the effects of ship motion could be preserved, but quantizing noise eliminated. The time control track originally recorded on SCARD was used to minimize the influence of variations in tape drive speed.

Second, in order to obtain a clean time series of salinity, pressure, and time, at a density of 8 sps, corrections were applied both to the header information and the data. The geographic position of each cast was extracted from the BOMEX Ship Operations Form (see sec. 2) and was inserted in the header for that cast. However, before and after each BOMEX Observation Period, STD soundings were often made while the ships were en route to and from their stations. Geographic positions of these casts were not entered on the Ship Operations Form, and the positions were renavigated based on ships' logs. These renavigated positions are shown in table 7-5. In addition, any comments pertaining to sensor malfunctions or other conditions of importance in analyzing a particular sounding were added to the header information.

Regions of rapid changes, discontinuities, or out-of-range values as revealed by the printout produced during the first phase of the reduction process were examined in detail. Any clearly unreasonable values were eliminated or, more frequently, replaced by machine-interpolated values. These procedures were used only when a small number of points were involved; if more extensive corrections were necessary, explanatory comments were inserted into the header information.

The proximity of the STD unit to the air-sea interface during the soaking period can be determined by inspecting the salinity and temperature data for values lying within certain ranges and by examining the pressure data for oscillations corresponding to the roll and pitch of the ship. In some 10 percent of the soundings, pressure values were either excessively high or low. All pressure data for these particular soundings were shifted to make the pressure during the soaking period read between 1 and 2 decibars.

7.3.2 Calibration Corrections

As noted earlier, surface and 1,000-m STD and two-bottle Nansen casts were taken for calibration purposes. The mean differences for each sensor were computed based on comparisons of these casts. The mean differences and the standard deviations of differences for both the surface, 1,000-m, and combined comparisons for each BOMEX Observation Period are shown in tables 7-6, 7-7, 7-8, and 7-9. The calibration corrections for salinity and temperature shown in tables 7-2 and 7-3 constitute the mean differences between the Nansen and STD surface and 1,000-m measurements. The calibration corrections for pressure in table 7-4 were not obtained from Nansen-STD comparisons, but, as described earlier, by shifting unreasonable values to make pressure during the soaking period read between 1 and 2 decibars. Note that the uncorrected C was used in preparing the time-series data. It is recommended that users of these data apply the appropriate C corrections as shown in tables 7-2, 7-3, and 7-4. The corrections were, however, incorporated into the depth-sorted data set, discussed in the next section.

7.3.3 Depth Profiling and Editing

Following the production of the time-series data, each STD sounding was sorted by depth. As noted earlier, the calibration corrections given in tables 7-2, 7-3, and 7-4 were not applied to the time-series data. In preparing the depth profiles, however, these corrections were incorporated. Also, because of the different time constants of the temperature and salinity sensors, salinity spiking occurs in regions of large temperature change. In depth-profiling, compensation was effected by extracting from the salinity a value of conductivity based on the recorded temperature, obtaining a lag-corrected temperature, and calculating a new salinity.

The conductivity G was computed from salinity S without regard to pressure effects by means of the equation (Mosetti, F., "A New Formula for the Connection of Sea Water Conductivity With Salinity and Temperature," Bollettino di Geofisica Teorica ed Applicata, Vol. VIII, No. 31, 1966, pp. 213-217)

$$G = (\alpha + \beta T^k)\, S^h ,$$

and the corrected temperature θ was obtained by assuming a simple lag constant for the temperature and solving

$$\frac{d\theta}{dt} = \frac{1}{\tau}(T - \theta) ,$$

where T is the recorded temperature, τ is a time constant of 250 ms, considered a reasonable value (N.L. Brown 1970, private communication), and α, β, h, and k are suitably chosen constants. The corrected salinity S_c is then

$$S_c = \frac{(\alpha + \beta T^k)}{(\alpha + \beta\theta^k)}^{1/h} S ,$$

where S is the original, uncorrected salinity.

This technique effectively reduces the salinity spiking that occurs as the sensor moves through layers of strong temperature gradients, but leaves data in low gradient regions virtually untouched.

After compensation for lag, the time-series data were sorted by depth into 1,000-point arrays for each sounding. This was done by determining for each integer decibar level of pressure a salinity and temperature by averaging together all salinity and temperature values between 1/2 decibar above and 1/2 decibar below the integer level. Only data of monotonically increasing depth were used. Since the data were originally obtained with the sensors moving at about 40 m/min and were later digitized at 8 sps, the data value at each integer level decibar is the average of approximately 12 data points on the time-series magnetic tapes.

In calculating sigma-t, the salinity-chlorinity relationship given in International Oceanographic Tables (National Institute of Oceanography of Great Britain and UNESCO, 1966, p. 8 ff.) and the temperature-density relationship as analyzed by the U.S. Navy Hydrographic Office (LaFond, E.C., Processing Oceanographic Data, H.O. Pub. No. 614, U.S. Navy Hydrographic Office, Washington, D.C., 1951, p. 14) were used.

Occasional questionable or bad single values, or group of values, were encountered in about 5 percent of all the STD soundings. These were overlooked in preparing the time-series data, but detected during depth sorting due to improved display techniques. A spurious value in excess of $\pm$ 0.2°C and $\pm$ 0.2°/oo from the local mean was manually replaced by a value interpolated between adjacent values. Regions of bad data were manually replaced by zeros. In both cases, this editing procedure is referenced in the cast header.

Table 7-2.--Temperature sensor calibration constants

Ship	STD Model No.	BOMEX Observation Period	Z (Hz)	M (^{o}C/Hz)	C uncorrected (^{o}C)	Calibration correction (^{o}C)	C corrected (^{o}C)
Discoverer	9006	I	2,127	0.01790	-2.00	-0.03	-1.97
"	"	II	"	"	"	0.03	-1.97
"	"	III	"	"	"	0.07	-1.93
"	"	IV	"	"	"	0.03	-1.97
Mt. Mitchell	9040	I	2,127	0.01790	-2.00	-0.51	-2.51
"	"	II	"	"	"	-0.56	-2.56
"	"	III	"	"	"	-0.50	-2.50
"	"	IV	"	"	"	-0.56	-2.56
Oceanographer	9006	I	2,127	0.01795	-2.00	0.01	-1.99
"	"	II	"	"	"	0.0	-2.00
"	"	III	"	"	"	-0.01	-1.99
"	"	IV	"	"	"	-0.01 (-0.02) *	-2.01 (-2.02)*
Rainier	9040	I	2,127	0.01790	-2.00	0*	-2.00
"	"	II	"	"	"	0.02	-1.98
"	"	III	"	"	"	0.02	-1.98
"	"	IV	"	"	"	0.12	-1.88
Rockaway	9006	I	2,127	0.01790	-2.10	-0.01	-2.11
"	"	II	"	"	-2.00	-0.04	-2.04
"	"	III	"	"	"	-0.07 (-0.03) *	-2.07 (-2.03) *
"	"	IV	"	"	"	0 †	-2.00

* Value in parenthesis was recalculated after final processing of the STD data. This value should be applied to the depth-sorted data. Note that no corrections were applied to the time-series data.

† Correction omitted due to insufficient shipboard documentation.

Table 7-3.--Salinity sensor calibration constants

Ship	STD Model No.	BOMEX Observation Period	Z (Hz)	M (^{o}/oo per Hz)	C uncorrected (^{o}/oo)	Calibration correction (^{o}/o)	C corrected (^{o}/o)
Discoverer	9006	I	4,995	0.003430	28.00	0.08	28.08
"	"	II	"	"	"	0.01	28.01
"	"	III	"	"	"	0.01	28.01
"	"	IV	"	"	"	0.05	28.05
Mt. Mitchell	9040	I	4,995	0.003430	30.00	-0.03	29.97
"	"	II	"	"	"	-0.04	29.96
"	"	III	"	"	"	-0.01	29.99
"	"	IV	"	"	"	-0.01	30.01
Oceanographer	9006	I					
		Until May 8 1200 GMT	4,995	0.003445	28.00	0.35	28.35
		After May 8 1200 GMT	"	"	"	0.52	28.52
"	"	II	"	0.003430	"	0.45	28.45
"	"	III	"	"	"	0.02 (0.03)*	28.02(28.03)*
"	"	IV					
		Until July 18 1200 GMT	"	"	"	0.05	28.05
		After July 18 1200 GMT	"	"	"	0.74	28.74
Rainier	9040	I	4,995	0.003430	30.00	0 †	30.00
"	"	II	"	"	"	0.02	30.02
"	"	III	"	"	"	0.02 (0.07)*	30.02(30.07)*
"	"	IV	"	"	"	0.03	30.03

Table 7-3.—Salinity sensor calibration constants (continued)

Ship	STD Model No.	BOMEX Observation Period	Z (Hz)	M (°/oo per Hz)	C uncorrected (°/oo)	Calibration correction (°/o)	C corrected (°/oo)
Rockaway	9005	[illegible]	4,995	0.003440	30.44	0.43	30.[illegible]
"	"	II	"	"	30.00	-0.03	29.97
"	"	III	"	"	"	0 †	30.00
"	"	IV	"	"	"	0 †	30.00

* Value in parenthesis was recalculated after final processing of the STD data. This value should be applied to the depth-sorted data. Note that no corrections were applied to the time-series data.

† Correction omitted due to insufficient shipboard documentation.

Table 7-4.--Pressure sensor calibration constants

Ship	STD Model No.	BOMEX Observation Period	Z (Hz)	M (decibars/Hz)	C uncorrected (decibars)	Calibration correction (decibars)	C corrected (decibars)
Discoverer	9006	I	9,712	2.553	0	0	0
"	"	II	9,704	1.268	"	"	"
"	"	III	"	"	"	"	"
"	"	IV	"	"	"	"	"
Mt. Mitchell	9040	I	9,712	1.915	0	0	0
"	"	II	"	"	"	"	"
"	"	III	"	"	"	"	"
"	"	IV	"	"	"	"	"
Oceanographer	9006	I	9,712	1.282	0	0	0
"	"	II	"	1.279	"	"	"
"	"	III	"	"	"	"	"
"	"	IV	"	"	"	"	"
Rainier	9040	I	9,712	1.915	0	0	0
"	"	II	"	"	"	"	"
"	"	III	"	"	"	"	"
"	"	IV	"	"	"	"	"
Rockaway	9006	I	9,705	0.951	0	0	0
"	"	II	"	"	"	"	"
"	"	III					
		Before June 25, 1500 GMT	9,712	"	"	6.67*	6.67*

Table 7-4.--Pressure sensor calibration constants (continued)

Ship	STD Model No.	BOMEX Observation Period	Z (Hz)	M (decibars/Hz)	C uncorrected (decibars)	Calibration correction (decibars)	C corrected (decibars)
Rockaway	9006	Between June 25, 1500 GMT and June 26, 0300 GMT	9,705	0.951	0	0	0
		Between June 26, 0300 GMT and June 29, 1500 GMT	9,712	"	"	6.67*	6.67*
		Between June 29, 1500 GMT and June 30, 1400 GMT	9,705	"	"	0	0
		After June 30, 1400 GMT	9,712	"	"	6.67*	6.67*

*Erroneous use of Z = 9,712 Hz, instead of 9,705, produced a depth error of -6.67. Correction should be applied to the depth-sorted data. Note that no corrections were applied to the time-series data.

Table 7-5.--Renavigated geographic positions of off-station casts

Ship	Date	Julian day	Time (GMT)	Latitude deg.	min.	Longitude deg.	min.
Discoverer	May 23	143	0756	13	34 N	056	07 W
"	"	"	1755	13	33 N	054	14 W
Mt. Mitchell	May 14	134	1754	12	49 N	058	22 W
"	June 10	161	1018	12	49 N	058	22 W
"	"	"	1305	12	49 N	058	49 W
"	"	"	1615	12	49 N	059	08 W
"	"	"	1757	12	49 N	059	16 W
"	July 10	191	0601	12	29 N	058	45 W
"	"	"	1258	11	29 N	057	41 W
"	"	"	1717	11	02 N	057	03 W
"	"	"	1923	10	48 N	056	50 W
"	July 16	197	1416	10	28 N	056	27 W
"	July 28	209	1728	11	16 N	056	39 W
"	"	"	2050	11	47 N	056	45 W
"	"	"	2149	11	48 N	056	46 W
"	July 29	210	0055	12	15 N	056	51 W
"	"	"	0626	13	12 N	057	02 W
Oceanographer	May 15	135	1004	16	51 N	055	30 W
"	"	"	1558	16	04 N	056	24 W
"	June 10	161	0803	17	35 N	054	38 W
Rainier	July 16	197	0111	17	30 N	054	05 W
"	"	"	0611	17	28 N	054	02 W
"	"	"	1209	17	11 N	054	21 W
"	"	"	1800	17	29 N	053	58 W
Rockaway	May 15	135	2029	14	59 N	058	20 W
"	May 16	136	0024	14	59 N	059	11 W
"	"	"	0317	14	21 N	059	10 W
"	"	"	0639	13	41 N	059	11 W
"	May 30	150	0303	14	59 N	056	37 W
"	June 10	161	2122	15	00 N	059	12 W
"	June 11	162	0033	14	35 N	059	08 W
"	June 19	170	2143	14	05 N	059	08 W
"	June 20	171	0124	14	31 N	059	00 W
"	"	"	0517	15	06 N	058	58 W
"	"	"	1004	15	05 N	058	15 W
"	July 9	190	2304	13	59 N	059	15 W
"	July 10	191	0240	14	34 N	059	14 W
"	"	"	0558	15	05 N	059	15 W
"	"	"	1151	14	53 N	058	20 W

Table 7-6.--Nansen-STD comparisons, BOMEX Observation Period I, showing the amount by which the Nansen measurements are higher than the STD measurements

Ship	Comparison level (decibars)	Temperature: Mean difference (°C)	Temperature: Stand. dev.* of diff. (°C)	Temperature: No. of comparisons
Discoverer	0	+0.05	0.07	8
"	1,000	+0.01	0.09	6
"	0 and 1,000	+0.03	0.08	14
Mt. Mitchell	0	-0.60	0.06	10
"	1,000	-0.44	0.13	14
"	0 and 1,000	-0.51	0.14	24
Oceanographer				
"	0	+0.03	0.01	17
"	1,000	0.00	0.02	19
"	0 and 1,000	+0.01	0.02	36
"	0	Above temperature comparison applies throughout Period I		
"	1,000			
"	0 and 1,000			
Rainier	(Insufficient Nansen-STD comparisons to determine corrections)			
Rockaway	0	-0.07	0.08	8
"	Intermediate (I)†	+0.02	0.13	10
"	1,000	0.00	0.06	10
"	0 and I and 1,000	-0.01	0.10	28

*Unbiased standard deviation, $\sigma^2 = \frac{\Sigma(X-\bar{X})}{n-1}$;

†Intermediate comparison made, when possible, between 500 and 700 decibars.

Table 7-6.--Nansen-STD comparisons, BOMEX Observation Period I, showing the amount by which the Nansen measurements are higher than the STD measurements (continued)

Ship	Comparison level (decibars)	Salinity		
		Mean difference (°/oo)	Stand. dev.* of diff. (°/oo)	No. of comparisons
Discoverer	0	+0.10	0.10	7
"	1,000	+0.07	0.02	5
"	0 and 1,000	+0.08	0.08	12
Mt. Mitchell	0	-0.03	0.05	17
"	1,000	-0.03	0.04	15
"	0 and 1,000	-0.03	0.04	32
Oceanographer		(Until May 8, 1200 GMT)		
"	0	+0.36	0.02	10
"	1,000	+0.33	0.02	10
"	0 and 1,000	+0.35	0.02	20
		(After May 8, 1200 GMTO		
"	0	+0.54	0.01	7
"	1,000	+0.51	0.04	8
"	0 and 1,000	+0.52	0.03	15
Rainier	(Insufficient Nansen-STD comparisons to determine corrections)			
Rockaway	0	+0.43	0.03	9
"	Intermediate (I)†	+0.43	0.04	10
"	1,000	+0.44	0.03	10
"	0 and I and 1,000	+0.43	0.04	29

* Unbiased standard deviation, $\sigma^2 = \frac{\Sigma(X-\overline{X})}{n-1}$.

† Intermediate comparison made, when possible, between 500 and 700 decibars.

Table 7-7.--Nansen-STD comparisons, BOMEX Observation Period II, showing the amount by which the Nansen measurements are higher than the STD measurements

Ship	Comparison level (decibars)	Temperature		
		Mean difference (°C)	Stand. dev.* of diff. (°C)	No. of comparisons
Discoverer	0	+0.02	0.05	23
"	1,000	+0.04	0.06	16
"	0 and 1,000	+0.03	0.06	39
Mt. Mitchell	0	-0.60	0.06	24
"	1,000	-0.51	0.06	21
"	0 and 1,000	-0.56	0.07	45
Oceanographer	0	+0.02	0.04	26
"	1,000	-0.01	0.02	27
"	0 and 1,000	+0.01	0.03	53
Rainier	0	0	0.06	20
"	1,000	+0.03	0.09	19
"	0 and 1,000	+0.02	0.08	39
Rockaway	0	-0.04	0.01	8
"	Intermediate (I)†	-0.12	0.14	4
"	1,000	+0.02	0.04	7
"	0 and I and 1,000	-0.04	0.05	19

*Unbiased standard deviation, $\sigma^2 = \frac{\Sigma(X-\bar{X})}{n-1}$.

†Intermediate Nansen-STD comparison made, when possible, between 500 and 700 decibars.

Table 7-7.--Nansen-STD comparisons, BOMEX Observation Period II, showing the amount by which the Nansen measurements are higher than the STD measurements (continued)

Ship	Comparison level (decibars)	Salinity		
		Mean difference (°/oo)	Stand. dev.* of diff. (°/oo)	No. of comparisons
Discoverer	0	+0.03	0.05	20
"	1,000	-0.01	0.05	19
"	0 and 1,000	+0.01	0.05	39
Mt. Mitchell	0	-0.04	0.04	23
"	1,000	-0.03	0.02	22
"	0 and 1,000	-0.04	0.03	45
Oceanographer	0	+0.44	0.09	23
"	1,000	+0.45	0.08	25
"	0 and 1,000	+0.45	0.08	48
Rainier	0	0	0.07	23
"	1,000	+0.03	0.05	19
"	0 and 1,000	+0.02	0.06	42
Rockaway	0	-0.04	0.04	7
"	Intermediate (I)†	0	0.05	7
"	1,000	-0.04	0.03	7
"	0 and I and 1,000	-0.03	0.04	21

* Unbiased standard deviation, $\sigma^2 = \frac{\Sigma(X-\overline{X})}{n-1}$.

† Intermediate Nansen-STD comparison made, when possible, between 500 and 700 decibars.

Table 7-8.--Nansen-STD comparisons, BOMEX Observation Period III, showing the amount by which the Nansen measurements are higher than the STD measurements

Ship	Comparison level (decibars)	Temperature		
		Mean difference (°C)	Stand. dev.* of diff. (°C)	No. of comparisons
Discoverer	0	+0.05	0.03	18
"	1,000	+0.09	0.08	12
"	0 and 1,000	+0.07	0.08	30
Mt. Mitchell	0	-0.61	0.03	21
"	1,000	-0.39	0.13	17
"	0 and 1,000	-0.50	0.14	38
Oceanographer	0	+0.02	0.02	15
"	1,000	0	0.03	15
"	0 and 1,000	+0.01	0.03	30
Rainier	0	+0.02	0.05	14
"	1,000	+0.01	0.07	13
"	0 and 1,000	+0.03 (+0.02)†	0.06	27
Rockaway	0	-0.03	0.03	8
"	1,000	-0.03	0.09	9
"	0 and 1,000	-0.07 (-0.03)†	0.07	17

*Unbiased standard deviation, $\sigma^2 = \frac{\Sigma(X-\overline{X})}{n-1}$.

†Value in parenthesis was recalculated after final processing of the STD data. This value should be applied to the depth-sorted data. Note that no corrections were applied to the time series data.

††Comparison not used; excessive deviation.

Table 7-9.--Nansen-STD comparisons, BOMEX Observation Period IV, showing the amount by which the Nansen measurements are higher than the STD measurements (continued)

Ship	Comparison level (decibars)	Salinity		
		Mean difference (°/oo)	Stand. dev.* of diff. (°/oo)	No. of comparisons
Discoverer	0	0.02	0.04	16
"	1,000	0.07	0.06	19
"	0 and 1,000	0.05	0.05	35
Mt. Mitchell	0	0.0	0.03	27
"	1,000	-0.02	0.03	25
"	0 and 1,000	-0.01	0.03	52
Oceanographer		Until July 18, 1200 GMT		
"	0	+0.17††	0.19	9
"	1,000	+0.05	0.03	7
"	0 and 1,000			
		After July 18, 1200 GMT		
"	0	+0.39††	0.22	16
"	1,000	+0.74	0.06	15
Rainier	0	0.0	0.08	20
"	1,000	0.06	0.03	16
"	0 and 1,000	0.03	0.07	37
Rockaway	Comparison omitted; insufficient shipboard documentation			

* Unbiased standard deviation, $\sigma^2 = \frac{\Sigma(X-\bar{X})}{n-1}$.

† Value in parenthesis was recalculated after final processing of the STD data. This value should be applied to the depth-sorted data. Note that no corrections were applied to the time series data.

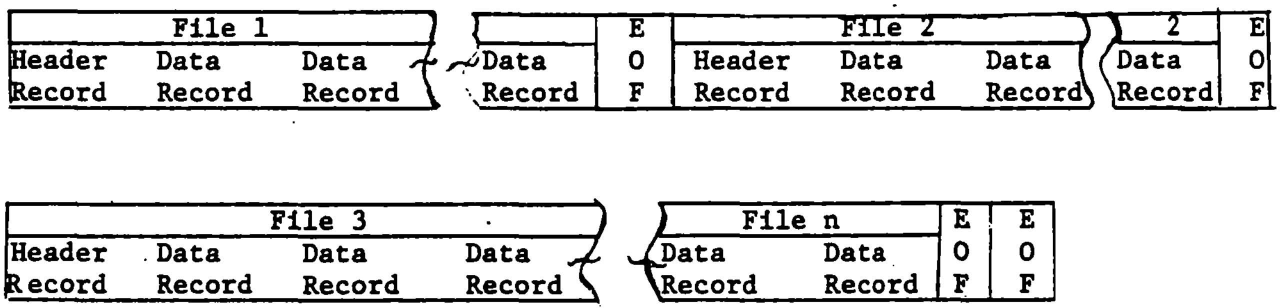
††Comparison not used; excessive deviation.

7.4 Archive Format and Data Inventory

7.4.1 Time-Series Magnetic Tape Data

Tape length - 2,400 ft
Tape width - 1/2 in
Number of tracks - seven
Recording density - 556 BPI
Recording label - unlabeled
Physical block length - 1,600 bytes

Control characters
  Inter-record gap - 3/4 in
  End-of-file mark - physical
Character code - BCD
Parity - even
Length of byte - 6 bits/byte



The first record in each file contains information concerning that particular sounding. The following records contain time-series STD data recorded during that sounding. File organization is repeated as necessary, with one file per STD sounding. A double end-of-file mark is written after the last file on the tape.

The header record is intended to fully describe the data contained witnin within that file. Each header record contains:

Description of data records.
Ship name.
Date and time of sounding.
Geographic location of sounding.
Instrument model and serial number.
Transfer equation for sensors.
Transfer constants for sensors.
Pertinent comments about the sounding.

The header record consists of 20 BCD card images with 80 characters per card image. The format of the header record is described in table 7-10.

The data records also consist of 20 BCD card images per record, with 80 characters per card image. Records are repeated as necessary with 100 STD data scans per record; an average STD soundings lasting about 20 min would fill approximately 100 records. If a cast ends at a depth that is not a multiple of 100 decibars, the remainder of that record is zero filled.

Data are arranged in each card image as 5 triples per 80 characters, having the Fortran format (F6.2, 2F5.3). Each triple contains pressure (decibars), salinity (ppt), and temperature (°C). Time determination is order dependent; the first triple is assumed to be at 0 s of the hour and minute given in the header record. Successive triples are 0.120 s apart, i.e., the first card image contains data from 0 to 0.60 s, the second card image contains data from 0.72 to 1.20 s, etc.

A summary of the time-series data is given in table 7-11.

Table 7-10.--Data field position description

Card image	Field No.	Character position	Fortran field	Description
1	001	001	1H	Carriage control '1'
	002	002-011	10H	'BOMEX STD'
	003	012-025	14H	Ship name
	004	026-029	4H	'YEAR'
	005	030-034	I5	Year '1969'
	006	035-038	4H	'DAY'
	007	039-042	4H	Julian day of year
	008	043-047	5H	'TIME'
	009	048-050	I3	Hour of start of cast
	010	051	1X	Blank
	011	052-053	I2	Minute of start of cast
	012	054-062	9H	'GMT LAT.'
	013	063-064	I2	Latitude degrees
	014	065	1X	Blank
	015	066-067	I2	Latitude minutes
	016	068	1H	Latitude direction 'N'
	017	069-073	5H	'LON.'
	018	074-076	I3	Longitude degrees
	019	077	1X	Blank
	020	078-079	I2	Longitude minutes
	021	080	1H	Longitude direction 'W'

Table 7-10.--Data field position description (continued)

Card image	Field No.	Character position	Fortran field	Description
4	001	001	1H	Carriage control 'blank'
	002	002-080	79H	Description of data format
5	001	001	1H	Carriage control '0'
	002	002-031	30H	Text
	003	032-035	I4	STD model number
	004	036-043	8H	Frame serial number
	005	044-047	I4	STD serial number
	006	048-080	33H	Frequency conversion equation
6-8	001	001	1H	Carriage control 'blank'
	002	002-012	12H	Sensor: 'SALINITY', TEMPERATURE', or 'PRESSURE2'
	003	013-017	5H	'SN='
	004	018-021	I4	Sensor serial number
	005	022-025	4H	'Z='
	006	026-034	F9.0	Zero frequency
	007	035-036	2H	'S='
	008	037-046	F10.3	Slope
	009	047-048	2H	'C='
	010	049-058	F10.3	Y-intercept
	011	059-080	22H	Units: PPT, °C, or 'DECIBARS'
9-13	001	001	1H	Carriage control '0'
	002	002-080	79H	Comment pertinent to data in file
14-20		001-080	80H	Blank
2	001	001	1H	Carriage control '0'
	002	002-080	79H	Description of data format
3	001	001	1H	Carriage control '0'
	002	002-080	79H	Description of data format

Table 7-11.--Summary inventory of STD time-series data

Magnetic tape No.	Ship	BOMEX Observation Period	First sounding: Julian day	First sounding: Date (1969)	First sounding: Time (hr:min)	Last sounding: Julian day	Last sounding: Date (1969)	Last sounding: Time (hr:min)	No. of files (one cast per file)
B9298	Oceanographer	I	123	May 3	01 22	126	May 6	21 00	34
B9300	"	I	127	May 7	00 59	131	May 11	21 04	30
B9302	"	I	132	May 12	00 55	135	May 15	15 58	30
B9276	Oceanographer	II	143	May 23	16 02	146	May 26	23 03	33
B9278	"	II	147	May 27	00 58	148	May 28	13 51	23
B9280	"	II	148	May 28	15 28	151	May 31	23 02	32 (see B9304, end of table)
B9282	"	II	152	June 1	01 19	155	June 4	12 03	36
B9284	"	II	155	June 4	14 51	158	June 7	21 08	22
B9286	"	II	159	June 8	00 55	161	June 10	08 03	24
B9224	Oceanographer	III	171	June 20	10 22	175	June 24	21 06	28
B9226	"	III	176	June 25	00 53	181	June 30	09 10	36
B9206	Oceanographer	IV	192	July 11	10 11	198	July 17	21 11	37 (see B9304, end of table)
B9208	"	IV	199	July 18	00 56	202	July 21	22 23	33
B9210	"	IV	203	July 22	00 57	206	July 25	21 23	26
B9212	"	IV	207	July 26	00 56	210	July 29	03 16	26
B9274	Rainier	I	121	May 1	12 12	134	May 14	01 32	11
B9270	Rainier	II	144	May 24	01 02	148	May 28	18 18	23
B9272	"	II	149	May 29	18 33	161	June 10	06 03	41
B9222	Rainier	III	172	June 21	01 18	183	July 2	01 21	40

Table 7-11.--Summary inventory of STD time-series data (continued)

Magnetic tape No.	Ship	BOMEX Observation Period	First sounding Julian day	First sounding Date (1969)	First sounding Time (hr:min)	Last sounding Julian day	Last sounding Date (1969)	Last sounding Time (hr:min)	No. of files (one cast per file)
B9230	Rainier	IV	192	July 11	12 05	196	July 15	19 40	19
B9246	"	IV	197	July 16	01 11	203	July 22	12 08	23
B9234	"	IV	204	July 23	01 09	209	July 28	18 02	22
B9288	Mt. Mitchell	I	123	May 3	00 57	129	May 9	18 03	19
B9290	"	I	130	May 10	01 05	135	May 15	10 00	23 (see B9034, end of table)
B9260	Mt. Mitchell	II	143	May 23	12 16	148	May 28	18 02	22
B9262	"	II	150	May 30	00 49	161	June 10	17 57	41
B9228	Mt. Mitchell	III	171	June 20	01 30	184	July 3	02 12	48
B9244	Mt. Mitchell	IV	191	July 10	06 01	197	July 16	14 16	20
B9238	"	IV	198	July 17	00 58	205	July 24	06 08	29
B9240	"	IV	205	July 24	14 09	210	July 29	06 26	26
B9218	Discoverer	I	127	May 7	01 09	130	May 10	20 55	24
B9232	"	I	131	May 11	00 59	134	May 14	11 59	28
B9264	Discoverer	II	143	May 23	07 56	148	May 28	20 57	18
B9266	"	II	150	May 30	00 59	155	June 4	21 12	42
B9268	"	II	157	June 6	00 57	161	June 10	22 20	39
B9214	Discoverer	III	172	June 21	01 00	177	June 26	21 02	44
B9216	"	III	178	June 27	00 59	183	July 2	11 56	43
B9200	Discoverer	IV	192	July 11	05 58	198	July 17	21 00	45
B9202	"	IV	199	July 18	00 00	204	July 23	21 00	48
B9204	"	IV	205	July 24	00 00	208	July 27	15 20	18

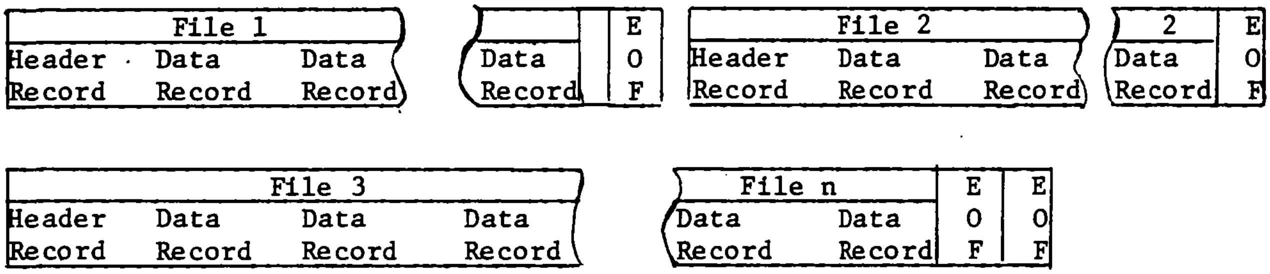
Table 7-11.--Summary inventory of STD time-series data (continued)

Magnetic tape No.	Ship	BOMEX Observation Period	First sounding			Last sounding			No. of files (one cast per file)
			Julian day	Date (1969)	Time (hr:min)	Julian day	Date (1969)	Time (hr:min)	
B9292	Rockaway	I	121	May 1	03 09	126	May 6	20 58	34
B9294	"	I	127	May 7	00 57	131	May 11	18 12	34
B9296	"	I	132	May 12	00 38	136	May 16	06 39	28
B9252	Rockaway	II	144	May 24	09 42	148	May 28	21 02	37
B9254	"	II	150	May 30	01 04	155	June 4	18 01	33 (see B9304, end of table)
B9256	"	II	157	June 6	01 01	162	June 11	00 33	40
B9242	Rockaway	III	170	June 19	21 43	176	June 25	12 25	40
B9220	"	III	177	June 26	03 04	183	July 2	12 28	36 (see B9258, end of table)
B9248	Rockaway	IV	190	July 9	23 04	196	July 15	12 13	37
B9250	"	IV	198	July 17	01 14	204	July 23	15 52	50
B9236	"	IV	204	July 23	15 52	209	July 28	20 28	38
				Miscellaneous casts					
B9258	Rockaway	III	176	June 25	15 03	177	June 26	01 05	01-04
B9258	"	III	180	June 29	15 19	181	June 30	12 01	05-08
B9304	"	II	155	June 4	21 36		(single cast)		01
"	"	III	176	June 25	21 01	177	June 26	00 59	02-03
"	"	IV	195	July 14	01 33	195	July 14	03 05	04-05
B9304	Oceanographer	II	151	May 31	10 56	151	May 31	13 52	06-07
"	"	IV	195	July 14	14 52		(single cast)		08
B9304	Mt. Mitchell	I	134	May 14	01 14		(single cast)		09

7.4.2 <u>Depth-Sorted Magnetic Tape and Microfilm Data</u>

Tape length - 2,400 ft
Tape width - 1/2 in
Number of tracks - seven
Recording density - 800 BPI
Recording method -NRZI
Recording label - unlabeled

Control characters
  Inter-record gap - 3/4 in
  End-of-file mark - physical
Character code - BCD
Parity - even
Physical block length - 1,600 bytes
Length of byte - 6 bits/byte



The first record in each file contains information concerning that particular sounding. Up to 10 records thereafter contain STD data in units of 100 decibars of data per record. File organization is repeated as necessary, with one file per STD sounding.. A double end-of-file mark is written after the last file on the tape. Each header record contains:

Description of data records.
Ship name.
Date and time of sounding.
Geographic location of sounding.
Instrument model and serial number.
Transfer equation for sensors.
Transfer constants for sensors.
Pertinent comments about the sounding.

The header record consists of 20 BCD card images with 80 characters per card image. The format of the header record is described in table 7-12. The data records also consist of 20 BCD card images per record, with 80 characters per card image. Records are repeated as necessary with 100 decibars of data per record. If a cast ends at a depth that is not a multiple of 100 decibars, the remainder of that record is zero filled.

Data are arranged in each card image as 5 triples per 80 characters, Fortran format (5(1X,3F5.3)). Each triple contains salinity (ppt), temperature (^{o}C), and sigma-t. The pressure determination is order dependent; the first triple is at 1 decibar. Each successive triple is 1 decibar deeper; i.e., the first card image contains data from depths of 1.00 to 5.00 decibars, the second card image contains data from depths of 6.00 to 10.00 decibars, etc.

A summary inventory of the depth-sorted data is given in table 7-13. This table also lists the microfilm reels containing two plots for each sounding of temperature, salinity, and calculated sigma-t: a 0- to 200-decibar plot allowing for fine resolution of the surface layers, and a 0- to 1,000-decibar plot for inspection of the entire sounding.

Table 7-12.--Data field position description

Card image	Field No.	Character position	Fortran field	Description
1	001	001	1H	Carriage control '1'
	002	002-080	79H	Description of data format
2	001	001	1H	Carriage control 'blank'
	002	002-080	79H	Description of data format
3	001	001	1H	Carriage control 'blank'
	002	002-026	25H	Text
	003	027-030	I4	First index of valid point
	004	031-039	9H	Text
	005	040-043	I4	Last index of valid point
	006	044-080	37H	Text
4	001	001	1H	Carriage control '0'
	002	002-080	79H	Description of data format
5	001	001	1H	Carriage control '0'
	002	002-011	10H	'BOMEX STD'
	003	012-023	14H	Ship name
	004	026-029	4H	'YEAR'
	005	030-034	I5	Year '1969'
	006	035-038	4H	'DAY'
	007	039-042	4H	Julian day of year
	008	043-047	5H	'TIME'
	009	048-050	I3	Hour of start of cast
	010	051	1X	Blank
	011	052-053	I2	Minute of start of cast
	012	054-062	9H	'GMT LAT.'
	013	063-064	I2	Latitude degrees
	014	065	1X	Blank
	015	066-067	I2	Latitude minutes
	016	068	1H	Latitude direction 'N'
	017	069-073	5H	'LON.'

Table 7-12.--Data field position description (continued)

Card image	Field No.	Character position	Fortran field	Description
	018	074-076	I3	Longitude degrees
	019	077	1X	Blank
	020	078-079	I2	Longitude minutes
	021	080	1H	Longitude direction 'N'
6	001	001	1H	Carriage control '0'
	002	002-031	30H	Text
	003	032-035	I4	STD model number
	004	036-043	8H	Frame serial number
	005	044-047	I4	STD serial number
	006	048-080	33H	Frequency conversion equation
7-9	001	001	1H	Carriage control 'blank'
	002	002-012	12H	Sensor: 'SALINITY', 'TEMPERATURE', or 'PRESSURE2'
	003	013-017	5H	'SN='
	004	018-021	I4	Sensor serial number
	005	022-025	4H	'Z='
	006	026-034	F9.0	Zero frequency
	007	035-036	2H	'S='
	008	037-046	F10.3	Slope
	009	047-048	2H	'C='
	010	049-058	F10.3	Y-intercept
	011	059-080	22H	Units: PPT, °C, or 'DECIBARS'
10-14		001	1H	Carriage control '0'
		002-080	79H	Comment pertinent to data in file
15-20		001-080	80H	Blank

7.5 Notes for Users

Users of the time-series STD data should apply the calibration corrections given in tables 7-2, 7-3, and 7-4 in the preceding section. In the time-series data, the geographic positions of the off-station casts are indicated by asterisks. In these cases, the renavigated positions given in table 7-5 in the preceding section should be used. Attention is also called to the following errors in the time-series data:

Discoverer	July 23	Julian day 204	1500 GMT

Cast records 2 to 33 contain STD data from 0 to 205 decibars: records 34 to 41 contain spurious data. The data contained in records 42 to 125 overlap the spurious data, repeating values beginning at 113 decibars and continuing past 205 decibars to 1,000 decibars. In reading this cast, allowance should be made for this overlap of data.

Mt. Mitchell	May 30	Julian day 150	0049 GMT

In the header for this cast, the ship name Discoverer was erroneously inserted.

Mt. Mitchell	July 19	Julian day 200	0616 GMT

Cast records 9 to 17 contain spurious data and should not be used. Data record 8 ends at 2 decibars; data record 18 begins at 56 decibars.

Rainier	May 2	Julian day 122	0102 GMT

The salinity sensor malfunctioned throughout this cast. Salinity should not be used.

Rainier	May 2	Julian day 122	0555 GMT

The salinity sensor malfunctioned throughout this cast. Salinity should not be used.

Rainier	May 2	Julian day 122	1214 GMT

The salinity sensor malfunctioned throughout this cast. Salinity should not be used.

Rainier	July 19	Julian day 200	0108 GMT

Cast records 56 and 57 contain spurious data and should not be used. Data record 55 ends at 168 decibars; data record 58 begins at 190 decibars.

Table 7-13.--Summary inventory of STD depth-sorted data

Magnetic tape No.	Microfilm reel No.	Ship	BOMEX Observation Period	First sounding			Last sounding			File position position
				Julian day	Day (1969)	Time (hr:min)	Julian day	Date (1969)	Time (hr:min)	
B9102	STD-1	Discoverer	I	127	May 7	01 09	134	May 14	11 59	001-052
"	"	Mt. Mitchell	I	123	May 3	00 57	135	May 15	10 00	053-095
"	"	Oceanographer	I	123	May 3	01 22	135	May 15	15 58	096-187
"	"	Rainier	I	121	May 1	12 12	134	May 14	01 32	188-198
"	"	Rockaway	I	121	May 1	03 09	136	May 16	06 39	199-293
B9112	STD-2	Discoverer	II	143	May 23	07 36	161	June 10	22 20	0-98
"	"	Mt. Mitchell	II	143	May 23	12 16	161	June 10	17 57	99-161
"	"	Oceanographer	II	143	May 23	16 12	161	June 10	08 03	162-331
"	"	Rainier	II	144	May 24	01 02	161	June 10	06 03	332-392
"	"	Rockaway	II	144	May 24	09 42	162	June 11	00 33	393-503
B9103	STD-3	Discoverer	III	172	June 21	01 00	183	July 2	11 56	001-078
"	"	Mt. Mitchell	III	171	June 20	01 30	183	July 2	12 03	079-122
"	"	Oceanographer	III	171	June 20	10 22	181	June 30	09 10	123-184
"	"	Rainier	III	172	June 21	01 18	183	July 2	01 21	185-221
"	"	Rockaway	III	172	June 21	00 57	183	July 2	12 28	222-301
B9104	STD-4	Discoverer	IV	192	July 11	00 58	208	July 27	15 20	001-111
"	"	Mt. Mitchell	IV	191	July 10	06 01	210	July 29	06 26	112-185
"	"	Oceanographer	IV	192	July 11	10 11	210	July 29	03 16	186-307
"	"	Rainier	IV	192	July 11	12 05	209	July 28	18 02	308-371
"	"	Rockaway	IV	190	July 9	23 04	209	July 28	20 28	372-497

Calibration corrections and renavigated geographic positions are incorporated in the depth-sorted data. However, attention is called to the few instances where new calibration corrections (recalculated after final data processing) should be applied to the depth-sorted data, as noted in tables 7-2, 7-3, and 7-4 in the preceding section.

For those interested in the STD rainy day soundings, table 7-14 lists these soundings. Similarly, for the convenience of users having an interest in the surface-region soundings taken aboard the Oceanographer as part of an investigation by the Woods Hole Oceanographic Institution (WHOI), these soundings are listed in table 7-15. For the appropriate magnetic tape or microfilm reel on which these two types of soundings are contained, see tables 7-11 and 7-13.

Table 7-14.--Rainy day soundings

Ship	Date (1969)	Julian day	Time (GMT)
Discoverer	June 8	159	2039
"	June 8	159	2200
"	June 25	176	0406
"	June 28	179	2139
"	June 29	180	0231
"	July 2	183	0011
"	July 2	183	0159
"	July 2	183	0425
"	July 2	183	1004
Rainier	May 1	121	2217
"	May 3	123	0959
"	May 10	130	1309
"	May 11	131	0048
"	May 14	134	0132
"	May 25	145	1025
"	May 27	147	0241
"	May 27	147	0834
"	June 30	181	1155
"	July 15	196	1940
"	July 27	208	1041
Rockaway	May 24	144	1505
"	June 10	161	0456
"	June 10	161	0643

Ship	Date (1969)	Julian day	Time (GMT)
Oceanographer	May 5	125	0158
"	May 5	125	0337
"	May 9	129	1847
"	May 12	132	1657
"	May 12	132	1750
"	May 12	132	1837
"	May 25	145	0244
"	May 26	146	0517
"	May 26	146	0636
"	May 26	146	1016
"	May 26	146	1250
"	May 26	146	1521
"	May 26	146	1826
"	June 2	153	0248
"	July 12	193	1006
"	July 12	193	1137
"	July 13	194	1251
"	July 18	199	1618
"	July 18	199	1844
"	July 19	200	1849
"	July 21	202	2223

Table 7-15.--WHOI surface-region STD soundings - Oceanographer

Date (1969)	Julian day	Time (GMT)	Date (1969)	Julian day	Time (GMT)
May 25	145	1353	May 31	151	0455
"	"	1658	"	"	1710
"	"	1957	"	"	1953
"	"	2256	"	"	2302
May 26	146	0459	June 1	152	0448
"	"	1955	"	"	0819
"	"	2303	"	"	1055
			"	"	1351
May 27	147	0155	"	"	1656
"	"	0453	"	"	1954
"	"	0755	"	"	2304
"	"	1056			
"	"	1658	June 2	153	0153
"	"	2314			
			June 7	158	0339
May 28	148	0155	"	"	0407
"	"	0503	"	"	0428
"	"	0755	"	"	0445
"	"	1057	"	"	0505
"	"	1351	"	"	0527
"	"	1656	"	"	0544
"	"	2002			
"	"	2256	June 8	159	0331
			"	"	0355
May 30	150	0152	"	"	0415
"	"	0454	"	"	0436
"	"	0750	"	"	0515
"	"	1053	"	"	0536
"	"	1329			
"	"	1702			
"	"	1957			
"	"	2302			

7.6 Supplementary Material Available From the Archive

Microfilm reel No.	Description
STD-5	STD program documentation; depth-sorted STD cast inventory; time-series STD cast inventory.
STD-6	Salinometer log sheets; dead reckoning abstracts; navigation sheets.
STD-7	*Rainier* STD frequency plots generated at MTF.
STD-8	*Discoverer* STD frequency plots generated at MTF.

Microfilm reel No.	Description
STD-9	Mt. Mitchell STD frequency plots generated at MTF.
STD-10	Oceanographer STD frequency plots generated at MTF (reel 1).
STD-11	Oceanographer STD frequency plots generated at MTF (reel 2).
STD-12	Rockaway STD frequency plots generated at MTF (reel 1).
STD-13	Rockaway STD frequency plots generated at MTF (reel 2).
STD-14	Rockaway STD frequency plots generated at MTF (reel 3).
STD-15	Rockaway STD frequency plots generated at MTF (reel 4).
STD-16	Rockaway STD frequency plots generated at MTF (reel 5).
STD-17	STD strip charts, all ships, Period I.
STD-18	STD strip charts, Oceanographer, Rainier, and Mt. Mitchell, Period II.
STD-19	STD strip charts, Discoverer and Rockaway, Period II; Oceanographer, Mt. Mitchell, and Rainier, Period III.
STD-20	STD strip charts, Discoverer and Rockaway, Period III; Oceanographer, Period IV.
STD-21	STD strip charts, Rainier, Mt. Mitchell, Discoverer, and Rockaway, Period IV.
STD-22	Nansen cast reduction sheets, Rockaway; STD R/S (rainy day) recording form, Oceanographer, Rainier, Discoverer, and Mt. Mitchell; oceanographic log sheets, Rainier, Mt. Mitchell, and Discoverer.
DOC-3	Reproduction of the original NAVOCEANO CTEM Sea-Surface Log used on all ships for manual recording of sea-surface temperature based on bucked thermometer readings; also contains the Discoverer Weather Radar Log and the Surface-Pressure--Marine Microbarograms.
DOC-4	Reproduction of the Radio Transmission Log used on all ships for transmission of STD data to Barbados twice daily.
DOC-7	Card 3 - STD Observation Form; also on this reel are Card 2 - BLIP Calibration Form, and Card 4 - Ship Operations Form.

Magnetic tape No.	Description
B9622	STD Observation Form data; one of four data files on this tape; the other files contain marine meteorological observations, ship operations data, and radiometersonde data.

Documents	Title
(BO-1-1A-4995) R-066-2	BOMEX Software System, Program Documentation for SCARD Digitize STD, General Electric, June 1971.
(BO-1-5B-4995) R-066-4	BOMEX Software System, Program Documentation for Rawinsonde/STD Plot, General Electric, July 1971.
(BO-1-5A-4995) R-06625	BOMEX Software System, Program Documentation for BLIP/STD Plot. General Electric, July 1971.

7.7 Material in Temporary Storage

Hard-copy material, consisting of original manual logs, strip charts, and the like, has been placed in temporary storage for a period of 3 years. Inquiries concerning this material should be addressed to the Center for Experiment Design and Data Analysis, EDS, NOAA, Washington, D. C. 20235.

8. SURFACE RADAR DATA SET

Surface weather radar data were collected from two observation stations: (1) the island of Barbados west of the BOMEX array, and (2) aboard the NOAA ship Discoverer, located at the southeast corner of the BOMEX fixed-ship array.

8.1 Equipment and Observation Procedures

8.1.1 Island Radar

The U.S. Army Atmospheric Sciences Laboratory (ASL), Electronics Command (ECOM), Fort Monmouth, New Jersey, as directed by the Army Materiel Command, provided a weather radar team on Barbados to obtain quantitative estimates of precipitation and storm characteristics for mission planning and time-lapse photography of the off-center scope to study the origin, development, movement, size, and intensity of tropical weather disturbances within the range of the radar. An AN/MPS-34 van-mounted weather radar, two U.S. Army power generators, Model 4070, and auxiliary equipment were used, located on Hackleton's Cliff near the east coast of the island approximately 65 mi from the perimeter of the BOMEX square and 96 mi from the Mt. Mitchell, which was positioned at the southwest corner of the BOMEX fixed-ship array. The antenna elevation at approximately 950 ft above mean sea level extended the radar horizon. With the antenna elevation angle at approximately zero degree, it was possible to detect many targets at ranges up to 200 nmi or greater.

Characteristics of the AN/MPS radar are listed in table 8-1. Only long-pulse operation was used.

Fifty-eight 100-ft rolls of 35-mm film containing photographs of the radar plan-position indicator (PPI) scope were obtained. A gain-step system to reduce receiver gain was used to acquire quantitative information about storm intensities. This system provided for five gain steps, calibrated to yield increments of 19 dB for step 1; 8 dB for step 2, step 3, and step 4; and 6 dB for step 5. Gain-step increments were checked for each new roll of 35-mm film and were recalibrated if any step had drifted by more than 2 dB, and the observed gain settings were recorded in an equipment log book. The procedure for calibrating both gain step and film provided a photographic record of minimum detectable signal on the film for the gain settings.

The radar film is documented in "Weather Radar Investigations on the BOMEX," a report by Michael D. Hudlow, who served as Project Scientist for the weather radar team. The report contains a quality review of each reel, describes operational and calibration procedures, and results of gain-step and film calibration, automatic camera settings for each mode of operation, and provides other significant information for film interpretation. Listed

Table 8-1.—Characteristics of the AN/MPS radar (long pulse)

Characteristic	Probable value
Transmitted power (peak)	180 kW
Wavelength	3.2 cm
Antenna shape	Parabolic
Horizontal beam width	1°
Vertical beam width	1°
Antenna gain	26,300 (dimensionless)
Antenna rotation rate	5 rpm
Minimum detectable signal	
Linear receiver	-105 dBm
Dynamic range (receiver)	
Linear receiver	17 to 20 dB
Pulse repetition frequency	186 pps
Pulse width	5×10^{-6} s
Sensitivity time control	Not used
Range units	Statute miles

as Research and Development Technical Report ECOM-3329, the document should be ordered by users from Federal agencies from:

Defense Documentation Center
ATTN: UNC-TCA
Cameron Station (Bldg. 5)
Alexandria, Virginia 22314,

and by users from non-Government groups from:

National Technical Information Service
U.S. Department of Commerce
Sills Bldg., 5285 Port Royal Road
Springfield, Virginia 22151

8.1.2 Discoverer Radar

Weather radar data were obtained aboard the *Discoverer* from the southeast corner of the BOMEX fixed-ship array by a Selenia radar, Model METEOR 200 RMT-2S, whenever this radar was not being used for rawinsonde balloon tracking. Characteristics of the Selenia radar are given in table 8-2.

During weather radar surveillance, 35-mm photographs were taken of the PPI on a VD-2 repeater displaying maximum ranges up to 200 nmi. The photographs were taken every 12 sweeps for 1-sweep exposures (12 s). In addition, every 30 min, usually, an attenuation-elevation sequence was taken, for which the camera mounted on the VD-2 repeater was set to take one frame every other sweep (rotation of the radar antenna). With the tilt angle held at 0°, the receiver gain was attenuated in calibrated steps. The first step was 15 dB; the remaining steps were 6 dB. Following the gain sequence, the antenna was tilted in 1 or 2° steps at normal receiver gain until all echoes had disappeared. At the conclusion of the altitude sequence the antenna was returned to 0°.

A Weather Radar Log was kept aboard the Discoverer for manual recording of daily weather radar operations. Each page is labeled with date, data ID code, and page number. A new page was usually begun at the start of each GMT day.

Table 8-2.--Discoverer Selenia radar characteristics

Characteristics	Nominal value
Transmitted power	175 kW (peak)
Wavelength	3.2 cm
Antenna shape/diameter	Parabolic/1.4 m
Horizontal beam width	1.25°
Vertical beam width	1.25°
Antenna rotation rate	5 rpm
Minimum detectable signal	-97 dBm
Pulse repetition rate	240 ± 10% pps
Pulse width	3×10^{6} s
Range units	Nautical miles
Sensitivity time control	On

8.2 Digitizing of Radar Composites

The photographic data at base tilt angle obtained by the island and Discoverer radars during BOMEX Periods II and III were digitized using a pencil follower coordinate digitizer (Model PF-10C), which records x and y coordinates of radar echoes onto 7 1/2-in magnetic tape. Being the region of interest for the BOMEX array, the Discoverer radar data for the northwest quadrant only were digitized.

The following criteria were used in selecting PPI photographs for digitization:

(1) When cloud cover of any size appears beyond 35 mi on the first photo after the normal, then photo selection should proceed at

the rate of one (1) gain sequence every 20 min when available. This constitutes an "active period."

(2) When no data are beyond 35 mi on the first photo after the normal, selection should proceed at the rate of one (1) photo sequence every hour.

(3) Checks should also be made for:

(a) the absence of, or improper, range markers,

(b) deviation of the antenna angle from zero (noted on the data block),

(c) too much noise, and

(d) an illegible clock or data block.

Every photograph in a gain-step sequence with any radar echoes was digitized. Also, one blank photo at the end of a sequence was required, so that the maximum power returned could be determined. In the absence of a blank photo at the end of a sequence, a "fictitious" or "dummy" photo was used, which consists of a duplicate coding of the last photo available in a gain-step sequence, except for photo number, power level, gain-step number, gain-step indicator, and digitization of echoes. For example:

Normal	-	has data.
First gain-step attenuation	-	has data.
Second gain-step attenuation	-	has data, but is the last photo available in the sequence
Fictitious photo	-	third gain-step attenuation coded as prescribed above.

The power levels for the island radar were taken from the Army radar log contained in "Weather Radar Investigations on the BOMEX," the report referred to in the preceding section. Starting on p. 70 in that document, the 35-mm radar film is itemized by rolls. Whenever a new roll of film was started, calibrations were made to determine the power levels. For the Discoverer radar, power levels were based on the minimum detectable signal (MDS) and the specified attenuation steps. Final determination of the power levels for both radars was made by intercomparisons of the island radar vs. the island rain-gage network and the island vs. the Discoverer radars. These levels are listed with the gain-step sequences for both radars in the digitized data set.

Manual digitizing of the gain-sequenced PPI photographs was restricted to a nominal spatial resolution of 4 statute mi. The exact scale factor is listed in the header information of each gain-step sequence. After each 35-mm PPI oscilloscope photograph in a given gain-step attenuation sequence had been digitized, the individual photographs were edited and checked for correct header information and proper data content. The photos within a gain-step sequence were then superimposed by means of a CDC-6600 computer, which aligned the fiducial line and displayed the digitized radar echoes relative to the radar origin, retaining only the highest gain-step observed at any x-y grid point within the radar y umbrella.

8.3 Archive Format and Data Inventory

8.3.1 Island Radar Photographs

Photographs of the radar plan PPI scope obtained by the island radar are archived on both registered and unregistered 35-mm microfilm. An inventory of these data is given in table 8-3.

8.3.2 Discoverer Radar Photographs

The Discoverer radar photographs are archived on both registered and unregistered 35-mm microfilm. All dates, and beginning and ending times are as read from the original radar film. In some instances, these entries may not be correct, but such anomalies can usually be corrected by referring to the Discoverer Weather Radar Log.

On each roll of film the following code is included:

"STC" means Sensitivity Time Control (STC) is on.

Gain attenuation:

dB	3	6	9	12	15	18	21	24	27	30	33
Light	3,4	1,2	1,2,3	1,3	1	1,4	2	2,3	3	2,4	4

If light #5 is on, add 33 dB.

The normal attenuation sequence begins with 15 dB and increases in 6-dB steps until all echoes disappear.

Elevation: Lights 1,2,3, and 4 are on if elevation is not zero. The normal elevation sequence consists of 1° steps from 0° until all echoes disappear. Before 2230 GMT, June 20, 1969 (Frame #9562), 2° elevation steps were used.

An inventory of the Discoverer radar photographs is given in table 8-4.

8.3.3 Discoverer Weather Radar Log

The Weather Radar Log is archived as microfilm copies of the original handwritten logs, which are arranged in chronological order for BOMEX Observation Periods II, III, and IV; there are no log sheets for Period I. Entries are:

(1) Camera on or off with indication of photograph frequency.

(2) Start to finish of attenuation-elevation sequence.

(3) Change of photograph frequency.

(4) Winding and setting of data chamber clock.

(5) Calibration sequences.

(6) Magazine changes.

(7) Start or stop of precipitation on station.

(8) Hourly synopsis of activity observed.

(9) Error or changes in normal operations procedure.

(10) Any other item the operator thought was significant to the project

The Discoverer Weather Radar Log is contained on microfilm reel No. DOC-3. This reel also contains the BOMEX Surface Pressure-Marine Microbarograms (sec. 3) and the NAVOCEANO CTEM Sea-Surface Temperature Log (sec. 6).

Table 8-3.--Island AN/MPS-34 radar data inventory

Microfilm reel No.	Date and time of first frame		Date and time of last frame	
	1969	Local hr:min	1969	Local hr:min
1	May 3	01 00	May 6	15 40
2	6	18 25	9	23 18
3	9	23 30	13	00 00
4	13	00 13	13	20 07
5	13	22 03	15	19 40
6	15	20 00	23	01 16
7	23	02 45	23	05 18
8	24	07 05	24	22 07
9	25	00 00	26	01 08
10	26	03 09	26	22 10
11	26	23 30	28	14 50
12	29	01 00	30	14 05
13	30	14 50	31	11 04
14	31	12 40	June 1	15 10
15	June 1	15 30	2	03 00
16	2	04 05	2	17 45
17	2	21 12	3	04 50
18	3	07 05	3	16 18
19	3	17 30	4	03 50
20	4	05 25	4	20 35
21	4	21 15	6	10 48
22	6	11 20	7	00 20
23	7	01 55	7	15 48
24	7	17 25	8	10 47
25	8	11 23	9	07 12

Table 8-3.--Island AN/MPS-34 radar data inventory (continued)

Microfilm reel No.	Date and time of first frame		Date and time of last frame	
	1969	Local hr:min	1969	Local hr:min
26	June 9	08 30	June 10	05 00
27	10	06 37	10	15 35
28	10	15 50	19	06 51
29	19	07 20	20	14 07
30	20	14 30	21	05 20
31	21	06 10	21	22 25
32	21	23 58	23	12 37
33	23	12 55	25	08 25
34	25	08 44	26	09 20
35	26	10 08	27	14 25
36	27	14 35	28	08 55
37	28	09 15	29	08 00
38	29	08 15	29	21 35
39	29	22 03	July 1	00 08
40	July 1	00 26	1	20 30
41	8	11 00	9	17 00
42	9	17 24	10	10 00
43	10	12 15	11	14 40
44	12	00 02	12	23 05
45	12	23 19	13	12 57
46	13	22 42	14	10 05
47	15	00 05	16	07 23
48	16	17 35	17	18 08
49	17	18 20	18	12 57
50	18	13 15	19	05 55
51	19	06 45	20	18 00
52	20	18 25	21	22 04
53	21	22 35	22	21 55
54	22	22 15	24	09 00
55	24	09 18	25	14 55
56	25	15 27	26	07 04
57	26	07 30	26	22 55
58	26	23 34	27	11 59

Table 8-4.—Discoverer radar data inventory

Microfilm reel No.	Date and time of first frame			Date and time of last frame		
	1969		GMT hr:min	1969		GMT hr:min
59	May	24	00 00	May	27	21 54
60		27	22 00		29	11 01
61		29	16 30	June	1	16 25
62	June	1	16 45		4	23 00
63		4	23 09		20	23 15
64		20	23 20		24	05 42
65		25	21 43		27	15 57
66		27	15 57		29	03 57
67		29	04 09	July	2	04 33
68	July	2	04 35		13	12 57
69		13	03 03		16	01 05
70		16	01 14		17	14 15
71		17	14 17		30	16 43
72		20	16 51		23	14 49
73		23	14 50		25	16 16
74		25	16 50		27	17 16
75		27	17 22		28	20 49

8.3.4 Digitized Radar Composites

The digitized and superimposed radar composites are stored on magnetic tape and microfilm. Header information on both tape and microfilm consists of the following:

Photo number from gain step 1.

Photo number from last gain step in a sequence.

Julian day, 1969.

Time of first photo (HHMMSS). (Local time.)

Time of last photo (HHMMSS). (Local time.)

Last photo sequence code. (Real = 1, dummy = 2.)

Gain steps 1 through 6. (Recorded in -dBm.)

Antenna tilt in degrees.

Latitude deviation from "on station " in statute miles.
(- = south; + = north.)

Longitude deviation from "on station " in statute miles.
(- = west; + = east.)

Ground clutter range in statute miles.

Fiducial angle in degrees.

Fiducial distance in statute miles.

Radar No. (Island = 1; Discoverer = 2.)

Scale factor times 100 in statute miles.

STC (0 = off; 1 = on.)

Number of composite points.

Reserved.

Percent of accuracy.

The display of the radar echo data consists of digits 1 through 6 on a rectangular x-y grid at a spatial resolution indicated by the scale factor. The interpretation of the digits is as follows:

1 = Normal photo

2 = First gain-step attenuation photo

.

.

.

6 = Fifth gain-step attenuation photo

The accurate superposition of the digitized radar data is limited by such factors as (1) the finite resolution of the digitizing procedure, (2) human error during manual digitizing, and (3) large elapsed time differences between the first and last photos in a gain-step attenuation sequence and resulting drift in radar echo position. The effects of human error were held to a minimum by comparing the digitized data with the original PPI oscilloscope photographs and, when necessary, rechecking and redigitizing. Any remaining problems in superpositioning were flagged in the compositing software by a logic algorithm that requires higher level gain-step attenuation data at any x-y grid point to have been preceded by all lower level gain-step attenuation data at the same x-y point. When these criteria were not met, an error was counted, which is reflected in the header information as the percent accuracy count. Because of the above limitations in the digitized gain-step composites, it is recommended that these data be used in conjunction with the original 35-mm photographic data.

The magnetic tape format for the island radar (radar No. 1) and the Discoverer radar (radar No. 2) is as follows:

An end of file separates the header records from the data files. Each photo is a composite, and there is an end of file after each photo with a double end of file at end of data. The file for each photo is constructed as follows:

Physical record 1 contains 30 right-justified 10-character BCD words. Each word can be decoded via an I10 format.

Word 1. Photo number from gain step 1.
2. Photo number from last gain step in a sequence.
3. Julian date.
4. Time of first photo (HHMMSS).
5. Time of last photo (HHMMSS).
6. Last photo sequence code. (Real equals 1, dummy equals 2.)
7-12. Gain steps 1 through 6. (Recorded in -dBm.)
13. Antenna tilt in degrees.
14. Latitude.
15. Longitude.
16. Ground clutter range.
17. Fiducial angle.
18. Fiducial distance.
19. Radar No.
20. Scale factor times 100.
21. STC, 0 = off, 1 = on.
22. Number of composite points.
23. Reserved.
24. Percent of accuracy.

Physical records 2 and 3 contain the x and y coordinates. The x is packed in the upper half of each word. The y is in the lower half. Each x and y can be decoded using a 2I5 format. The number of points available may be obtained from word 22 of physical record No. 1.

Physical records 4-5 are the gain step value associated with each x-y pair. These values represent the highest gain step that was recorded and/or accepted.

Records 2-5 are filled to the end with dummy values of 99999. They are 500 words long and are in BCD. A word = 60 bits.

Table 8-5 shows the numbers of the magnetic tapes and microfilm reels containing the digitized radar composites. A complete inventory of the digitized radar composites is given in table 8-6.

Table 8-5.--Digitized surface radar composites

Magnetic tape No.	Microfilm reel No.	Radar	BOMEX Observation Period
B8176	RAD-1	Island	II
B8179	RAD-2	Discoverer	II
B8863	RAD-3	Island	III
B8878	RAD-4	Discoverer	III

8.4 Material in Temporary Storage

Hard-copy material, consisting of original manual logs and the like, have been put into temporary storage for a 3-yr period. Inquiries concerning this material should be addressed to the Center for Experiment Design and Data Analysis (CEDDA), EDS, NOAA, Page Bldg. 2, Washington, D.C. 20235.

Table 8-6.—Inventory of digitized radar composites

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
3000	3004	150	123602	124832	2	82	64	58	48	40	0	0	0	0	40	70	300	1	406	0	36	45	95
3005	3008	150	145014	145052	1	82	64	57	48	0	0	0	0	0	35	70	300	1	408	0	26	36	88
3011	3013	150	151001	151126	2	82	64	57	0	0	0	0	0	0	35	70	300	1	399	0	31	36	80
3014	3017	150	153149	153540	2	82	64	57	48	0	0	0	0	0	35	70	300	1	408	0	32	41	65
3018	3021	150	155534	155722	2	82	64	57	48	0	0	0	0	0	35	70	300	1	418	0	29	35	48
3025	3027	150	164324	164914	1	82	64	57	0	0	0	0	0	0	35	70	300	1	407	0	18	22	90
3028	3030	150	165855	170245	1	82	64	57	0	0	0	0	0	0	35	70	300	1	414	0	9	10	89
3031	3032	150	175806	175932	1	82	64	0	0	0	0	0	0	0	35	70	300	1	416	0	2	2	100
3033	3034	150	185655	185655	2	82	64	0	0	0	0	0	0	0	35	70	300	1	410	0	4	4	100
3035	3036	150	195652	195652	2	82	64	0	0	0	0	0	0	0	35	70	300	1	422	0	20	20	100
3037	3040	150	210514	210639	2	82	64	56	48	0	0	0	0	0	35	70	300	1	405	0	32	43	88
3041	3044	150	215930	215959	2	82	64	56	48	0	0	0	0	0	35	70	300	1	406	0	55	63	88
3045	3048	150	233553	233616	2	82	64	56	48	0	0	0	0	0	35	70	300	1	410	0	87	124	81
3049	3053	151	653	1106	1	82	64	56	48	40	0	0	0	0	35	70	300	1	410	0	85	115	79
3054	3057	151	2505	2741	2	82	64	56	48	0	0	0	0	0	35	70	300	1	410	0	69	82	67
3058	3063	151	4435	5008	1	82	64	56	48	40	34	0	0	0	35	70	300	1	409	0	73	86	69
3064	3069	151	10759	11336	1	82	64	56	48	40	34	0	0	0	40	70	300	1	413	0	92	113	76
3070	3075	151	13026	13757	1	82	64	56	48	40	34	0	0	0	40	70	300	1	409	0	96	118	80
3076	3081	151	15450	20049	1	82	64	56	48	40	34	0	0	0	40	70	300	1	408	0	99	131	59
3082	3087	151	21816	22446	1	82	64	56	48	40	34	0	0	0	40	70	300	1	408	0	94	133	65
3088	3093	151	24143	24712	1	82	64	56	48	40	34	0	0	0	40	70	300	1	409	0	92	139	61
3094	3099	151	31000	31531	1	82	64	56	48	40	34	0	0	0	37	70	300	1	411	0	104	169	72
3100	3105	151	33127	33853	1	82	64	56	48	40	34	0	0	0	40	70	300	1	409	0	77	118	55
3106	3111	151	35549	40122	1	82	64	56	48	40	34	0	0	0	35	70	300	1	408	0	110	160	65
3112	3117	151	41816	42546	1	82	64	56	48	40	34	0	0	0	35	70	300	1	408	0	94	132	56
3118	3123	151	44242	44844	1	82	64	56	48	40	34	0	0	0	35	70	300	1	406	0	103	161	73

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	O/O ACC.
3124	3129	151	51353	52026	1	82	64	56	48	40	34	0	0	0	35	70	300	1	406	0	45	69	47
3130	3135	151	53620	54348	1	82	64	56	48	40	34	0	0	0	35	70	300	1	408	0	106	148	60
3136	3141	151	55943	60512	1	82	64	56	48	40	34	0	0	0	39	70	300	1	412	0	76	117	49
3142	3145	151	61518	61953	2	82	64	56	48	0	0	0	0	0	35	70	300	1	410	0	91	137	81
3146	3151	151	64451	65222	1	82	64	56	48	40	34	0	0	0	35	70	300	1	410	0	89	130	59
3152	3157	151	70714	71446	1	82	64	56	48	40	34	0	0	0	35	70	300	1	405	0	90	150	69
3158	3163	151	72352	72925	1	82	64	56	48	40	34	0	0	0	30	70	300	1	410	0	92	147	72
3164	3165	151	74048	74048	2	82	64	0	0	0	0	0	0	0	35	70	300	1	407	0	95	95	100
3166	3169	151	74957	75234	2	82	64	56	48	0	0	0	0	0	35	70	300	1	414	0	121	147	80
3170	3173	151	80830	81207	2	82	64	56	48	0	0	0	0	0	35	70	300	1	411	0	91	119	84
3174	3177	151	82803	83141	2	82	64	56	48	0	0	0	0	0	35	70	300	1	409	0	87	106	88
3178	3181	151	84837	85014	2	82	64	56	48	0	0	0	0	0	35	70	300	1	410	0	84	107	81
3182	3183	151	90829	90829	2	82	64	0	0	0	0	0	0	0	35	70	300	1	409	0	74	74	100
3184	3189	151	93258	93922	1	82	64	56	48	40	34	0	0	0	35	70	300	1	414	0	91	110	76
3190	3195	151	95527	100252	1	82	64	56	48	40	34	0	0	0	30	70	300	1	411	0	79	93	69
3196	3201	151	101956	102528	1	82	64	56	48	40	34	0	0	0	35	70	300	1	409	0	85	115	75
3202	3207	151	104327	104900	1	82	64	56	48	40	34	0	0	0	30	70	300	1	406	0	59	88	76
3208	3213	151	110745	110936	2	82	64	56	48	40	34	0	0	0	35	70	300	1	407	0	79	101	78
3214	3219	151	124025	124540	1	82	67	56	50	42	36	0	0	0	35	70	300	1	402	0	77	102	86
3220	3225	151	130656	131112	1	82	67	56	50	42	36	0	0	0	35	70	300	1	410	0	62	76	81
3226	3231	151	133400	133819	1	82	67	56	50	42	36	0	0	0	30	70	300	1	410	0	69	84	71
3232	3235	151	135436	135619	2	82	67	56	50	0	0	0	0	0	35	70	300	1	398	0	57	76	90
3236	3239	151	141552	141734	2	82	67	56	50	0	0	0	0	0	30	70	300	1	404	0	50	65	84
3240	3243	151	143748	143930	2	82	67	56	50	0	0	0	0	0	30	70	300	1	405	0	59	81	83
3244	3247	151	150008	150250	2	82	67	56	50	0	0	0	0	0	35	70	300	1	403	0	61	81	80
3248	3251	151	152037	152317	2	82	67	56	50	0	0	0	0	0	30	70	300	1	393	0	49	64	76

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	O/O ACC.
3252	3255	151	160820	160844	2	82	67	56	50	0	0	0	0	0	45	70	300	1	402	0	42	54	87
3256	3259	151	164728	164755	2	82	67	56	50	0	0	0	0	0	40	70	300	1	400	0	23	31	87
3260	3263	151	171800	171825	2	82	67	56	50	0	0	0	0	0	45	70	300	1	405	0	29	36	88
3264	3267	151	175945	180008	2	82	67	56	50	0	0	0	0	0	45	70	300	1	403	0	40	53	88
3268	3271	151	183040	183106	2	82	67	56	50	0	0	0	0	0	40	70	300	1	403	0	48	59	91
3272	3275	151	190010	190035	2	82	67	56	50	0	0	0	0	0	45	70	300	1	403	0	43	56	96
3276	3277	151	193745	193745	2	82	67	0	0	0	0	0	0	0	30	70	300	1	403	0	43	43	100
3278	3279	151	220623	220623	2	82	62	0	0	0	0	0	0	0	30	70	300	1	403	0	29	29	100
3280	3281	151	223900	223907	1	82	62	0	0	0	0	0	0	0	30	70	300	1	403	0	21	21	100
3282	3283	151	230615	230625	1	82	62	0	0	0	0	0	0	0	30	70	300	1	403	0	31	31	100
3284	3287	151	232845	232900	2	82	62	54	46	0	0	0	0	0	35	70	300	1	404	0	34	34	82
3288	3290	152	0	22	1	82	62	54	0	0	0	0	0	0	30	70	300	1	404	0	29	30	100
3291	3292	152	3100	3100	2	82	62	0	0	0	0	0	0	0	35	70	300	1	403	0	23	23	100
3293	3294	152	10000	10000	2	82	62	0	0	0	0	0	0	0	30	70	300	1	403	0	33	33	100
3295	3296	152	13100	13100	2	82	62	0	0	0	0	0	0	0	30	70	300	1	404	0	25	25	100
3297	3298	152	20000	20000	2	82	62	0	0	0	0	0	0	0	30	70	300	1	403	0	25	25	100
3299	3301	152	22700	22900	1	82	62	54	0	0	0	0	0	0	35	70	300	1	403	0	30	30	86
3302	3305	152	30000	30200	2	82	62	54	46	0	0	0	0	0	35	70	300	1	404	0	33	35	68
3306	3309	152	33100	33300	2	82	62	54	46	0	0	0	0	0	30	70	300	1	403	0	23	25	71
3310	3313	152	40300	40500	2	82	62	54	46	0	0	0	0	0	30	70	300	1	404	0	26	28	67
3314	3317	152	42900	43200	2	82	62	54	46	0	0	0	0	0	30	70	300	1	404	0	32	32	84
3318	3319	152	50100	50200	1	82	62	0	0	0	0	0	0	0	30	70	300	1	403	0	35	35	97
3320	3321	152	53300	53300	2	82	62	0	0	0	0	0	0	0	30	70	300	1	404	0	25	25	100
3322	3323	152	60000	60000	2	82	62	0	0	0	0	0	0	0	30	70	300	1	404	0	21	21	100
3324	3325	152	63200	63200	2	82	62	0	0	0	0	0	0	0	30	70	300	1	403	0	12	12	100
3326	3327	152	70200	70200	2	82	62	0	0	0	0	0	0	0	30	70	300	1	404	0	20	20	100

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
3328	3329	152	73000	73000	2	82	62	0	0	0	0	0	0	0	30	70	300	1	403	0	17	17	100
3330	3331	152	80300	80300	2	82	62	0	0	0	0	0	0	0	30	70	300	1	403	0	16	16	100
3332	3333	152	83000	83000	2	82	62	0	0	0	0	0	0	0	30	70	300	1	403	0	3	3	100
3334	3334	152	90000	90000	1	82	0	0	0	0	0	0	0	0	30	70	300	1	403	0	0	1	100
3335	3336	152	93100	93100	2	82	62	0	0	0	0	0	0	0	30	70	300	1	402	0	5	5	100
3337	3338	152	100200	100200	2	82	62	0	0	0	0	0	0	0	30	70	300	1	403	0	10	10	100
3339	3340	152	103200	103200	2	82	62	0	0	0	0	0	0	0	30	70	300	1	404	0	10	10	100
3341	3342	152	110400	110400	2	82	62	0	0	0	0	0	0	0	30	70	300	1	403	0	3	3	100
3343	3344	152	113000	113000	2	82	62	0	0	0	0	0	0	0	30	70	300	1	403	0	3	3	100
3345	3345	152	120500	120500	1	82	0	0	0	0	0	0	0	0	30	70	300	1	403	0	1	1	100
3346	3347	152	123200	123200	2	82	62	0	0	0	0	0	0	0	30	70	300	1	402	0	3	3	100
3348	3349	152	130200	130200	2	82	62	0	0	0	0	0	0	0	30	70	300	1	403	0	8	8	100
3350	3351	152	132800	132800	2	82	62	0	0	0	0	0	0	0	30	70	300	1	403	0	3	3	100
3352	3353	152	140000	140000	2	82	62	0	0	0	0	0	0	0	30	70	300	1	403	0	4	4	100
3354	3355	152	143000	143000	2	82	62	0	0	0	0	0	0	0	30	70	300	1	403	0	13	13	100
3356	3357	152	150000	150000	2	82	62	0	0	0	0	0	0	0	30	70	300	1	404	0	7	7	100
3358	3359	152	153640	153640	2	80	55	0	0	0	0	0	0	0	30	70	300	1	403	0	15	15	100
3360	3361	152	160045	160045	2	80	55	0	0	0	0	0	0	0	30	70	300	1	403	0	27	27	100
3362	3363	152	163120	163120	2	80	55	0	0	0	0	0	0	0	30	70	300	1	403	0	22	22	100
3364	3367	152	170355	170420	2	80	55	46	39	0	0	0	0	0	30	70	300	1	403	0	26	28	85
3368	3369	152	173250	173250	2	80	55	0	0	0	0	0	0	0	30	70	300	1	403	0	42	42	100
3370	3371	152	180425	180425	2	80	55	0	0	0	0	0	0	0	30	70	300	1	403	0	69	69	100
3372	3375	152	184412	184538	2	80	55	46	39	0	0	0	0	0	30	70	300	1	403	0	81	93	83
3376	3379	152	192836	192903	2	80	55	46	39	0	0	0	0	0	30	70	300	1	403	0	84	100	90
3380	3383	152	195740	195825	2	80	55	46	39	0	0	0	0	0	30	70	300	1	403	0	71	78	89
3384	3387	152	203120	203144	2	80	55	46	39	0	0	0	0	0	30	70	300	1	403	0	88	102	91

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
3388	3391	152	210305	210330	2	80	55	46	39	0	0	0	0	0	30	70	300	1	403	0	114	133	87
3392	3395	152	212920	213206	2	80	55	46	39	0	0	0	0	0	30	70	300	1	403	0	117	136	88
3396	3399	152	220029	220215	2	80	55	46	39	0	0	0	0	0	30	70	300	1	403	0	102	120	89
3400	3403	152	223043	223330	2	80	55	46	39	0	0	0	0	0	30	70	300	1	403	0	132	154	90
3404	3407	152	230022	230148	2	80	55	46	39	0	0	0	0	0	30	70	300	1	403	0	132	164	87
3408	3411	152	233058	233122	2	80	55	46	39	0	0	0	0	0	30	70	300	1	404	0	145	186	87
3412	3415	153	11332	11357	2	80	55	46	39	0	0	0	0	0	30	70	300	1	400	0	155	179	84
3416	3419	153	14935	15210	1	80	55	46	39	0	0	0	0	0	30	70	300	1	402	0	142	159	91
3420	3424	153	22935	23255	1	80	55	46	39	32	0	0	0	0	30	70	300	1	397	0	186	221	88
3425	3429	153	25930	30450	1	80	55	46	39	32	0	0	0	0	30	70	300	1	397	0	142	165	92
3430	3435	153	40800	40850	2	80	61	53	43	38	32	0	0	0	30	70	300	1	386	0	120	155	90
3436	3441	153	44000	44430	2	80	61	53	43	38	32	0	0	0	30	70	300	1	394	0	116	166	89
3442	3447	153	51010	51425	2	80	61	53	43	38	32	0	0	0	30	70	300	1	395	0	93	131	77
3448	3453	153	54010	54425	2	80	61	53	43	38	32	0	0	0	30	70	300	1	399	0	86	128	81
3454	3458	153	61505	61920	1	80	61	53	43	38	0	0	0	0	30	70	300	1	395	0	79	106	77
3459	3463	153	64500	64920	1	80	61	53	43	38	0	0	0	0	30	70	300	1	396	0	90	132	89
3464	3468	153	71500	71830	2	80	61	53	43	38	0	0	0	0	30	70	300	1	389	0	85	117	74
3469	3473	153	74555	74825	2	80	61	53	43	38	0	0	0	0	30	70	300	1	389	0	51	82	87
3474	3478	153	81555	81920	1	80	61	53	43	38	0	0	0	0	30	70	300	1	397	0	55	80	73
3479	3484	153	84505	84925	2	80	61	53	43	38	32	0	0	0	30	70	300	1	396	0	53	79	70
3485	3488	153	91500	91740	2	80	61	53	43	0	0	0	0	0	30	70	300	1	396	0	30	37	72
3489	3490	153	94550	94550	2	80	61	0	0	0	0	0	0	0	30	70	300	1	397	0	20	20	100
3491	3495	153	101545	101625	2	80	61	53	43	38	0	0	0	0	30	70	300	1	396	0	13	16	75
3496	3498	153	110009	110130	2	80	61	53	0	0	0	0	0	0	30	70	300	1	397	0	11	14	100
3499	3500	153	114821	114912	1	80	61	0	0	0	0	0	0	0	30	70	300	1	396	0	8	8	100
3501	3502	153	121713	121805	1	80	61	0	0	0	0	0	0	0	30	70	300	1	396	0	10	10	100

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
3503	3506	153	124843	125025	2	80	61	53	43	0	0	0	0	0	30	70	300	1	397	0	22	27	100
3507	3509	153	133144	133427	1	80	61	53	0	0	0	0	0	0	30	70	300	1	395	0	32	34	88
3510	3513	153	140005	140355	2	80	61	53	43	0	0	0	0	0	30	70	300	1	397	0	20	23	73
3514	3515	153	143044	143044	2	80	61	0	0	0	0	0	0	0	30	70	300	1	397	0	14	14	100
3516	3519	153	150546	150610	2	80	61	53	43	0	0	0	0	0	30	70	300	1	396	0	31	37	78
3520	3523	153	152950	153015	2	80	61	53	43	0	0	0	0	0	30	70	300	1	396	0	12	15	79
3524	3527	153	160525	160550	2	80	61	53	43	0	0	0	0	0	30	70	300	1	396	0	10	11	72
3528	3529	153	163515	163515	2	80	61	0	0	0	0	0	0	0	30	70	300	1	396	0	15	15	100
3530	3532	153	171045	171110	1	80	61	53	0	0	0	0	0	0	30	70	300	1	405	0	25	25	91
3533	3537	.53	173910	174055	1	80	61	53	43	38	0	0	0	0	30	70	300	1	405	0	22	26	84
3538	3541	153	213350	213530	2	80	62	54	46	0	0	0	0	0	30	70	300	1	406	0	65	72	83
3542	3545	153	220540	220720	2	80	62	54	46	0	0	0	0	0	30	70	300	1	406	0	58	71	87
3546	3549	153	223550	223730	2	80	62	54	46	0	0	0	0	0	30	70	300	1	406	0	61	69	95
3550	3551	153	230530	230530	2	80	62	0	0	0	0	0	0	0	30	70	300	1	405	0	51	51	100

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
3552	3553	153	234320	234320	2	80	62	0	0	0	0	0	0	0	30	70	300	1	405	0	66	66	100
3554	3555	154	11855	11855	2	80	62	0	0	0	0	0	0	0	30	70	300	1	407	0	80	80	100
3556	3559	154	14845	15020	1	80	62	54	46	0	0	0	0	0	30	70	300	1	400	0	96	107	92
3560	3563	154	22030	22110	1	80	62	54	46	0	0	0	0	0	30	70	300	1	399	0	89	107	90
3564	3567	154	25055	25320	1	80	62	54	46	0	0	0	0	0	30	70	300	1	407	0	94	111	84
3568	3572	154	32050	32410	1	80	62	54	46	38	0	0	0	0	30	70	300	1	406	0	133	161	90
3573	3577	154	35045	35403	1	80	62	54	46	38	0	0	0	0	30	70	300	1	400	0	138	171	84
3578	3581	154	42050	42320	1	80	62	54	46	0	0	0	0	0	30	70	300	1	400	0	109	136	84
3582	3587	154	70655	70745	2	80	62	53	44	36	30	0	0	0	40	70	300	1	398	0	83	110	81
3589	3594	154	73435	73755	2	80	62	53	44	36	30	0	0	0	30	70	300	1	399	0	129	141	74
3595	3600	154	75940	80300	2	80	62	53	44	36	30	0	0	0	30	70	300	1	407	0	105	124	77
3601	3606	154	82945	83310	2	80	62	53	44	36	30	0	0	0	30	70	300	1	407	0	79	91	79

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
3607	3608	154	90045	90045	2	80	62	0	0	0	0	0	0	0	30	70	300	1	406	0	88	88	100
3609	3614	154	93005	93325	2	80	62	53	44	36	30	0	0	0	30	70	300	1	408	0	76	87	67
3615	3620	154	100120	100440	2	80	62	53	44	36	30	0	0	0	30	70	300	1	406	0	78	99	92
3621	3626	154	103030	103350	2	80	62	53	44	36	30	0	0	0	30	70	300	1	406	0	75	91	76
3627	3632	154	110040	110400	2	80	62	53	44	36	30	0	0	0	30	70	300	1	405	0	75	103	84
3633	3638	154	113550	113910	2	80	62	53	44	36	30	0	0	0	30	70	300	1	404	0	66	91	73
3639	3641	154	115550	115640	2	80	62	53	0	0	0	0	0	0	30	70	300	1	406	0	64	70	68
3642	3646	154	123148	123510	1	80	62	53	44	36	0	0	0	0	30	70	300	1	407	0	75	105	71
3647	3650	154	130515	130750	2	80	62	53	44	0	0	0	0	0	30	70	300	1	406	0	62	88	90
3651	3655	154	150145	150515	1	82	64	56	48	40	0	0	0	0	30	70	300	1	407	0	67	86	93
3656	3659	154	153355	153630	1	80	64	56	48	0	0	0	0	0	45	70	300	1	400	0	62	67	83
3660	3665	154	155955	160415	1	82	64	56	48	40	34	0	0	0	40	70	300	1	396	0	70	87	75
3666	3669	154	173125	173515	1	82	64	56	48	0	0	0	0	0	30	70	300	1	398	0	70	77	92
3670	3673	154	180520	180655	2	82	64	56	48	0	0	0	0	0	40	70	300	1	399	0	84	101	87
3674	3677	154	182932	183210	2	82	64	56	48	0	0	0	0	0	40	70	300	1	399	0	118	130	84
3678	3680	154	190455	190630	1	82	64	56	0	0	0	0	0	0	40	70	300	1	400	0	98	116	90
3681	3686	154	193020	193108	2	82	64	56	48	40	34	0	0	0	42	70	300	1	400	0	110	156	83
3687	3691	154	200050	200140	1	82	64	56	48	40	0	0	0	0	35	70	300	1	398	0	122	159	89
3692	3696	154	203020	203210	1	82	64	56	48	40	0	0	0	0	40	70	300	1	398	0	157	210	86
3697	3701	154	205825	210015	1	82	64	56	48	40	0	0	0	0	28	70	300	1	399	0	134	174	77
3702	3705	154	213043	213225	2	82	64	56	48	0	0	0	0	0	30	70	300	1	396	0	118	149	67
3707	3712	154	220133	220235	1	82	64	56	48	40	34	0	0	0	35	70	300	1	396	0	115	175	69
3713	3717	154	222920	223110	1	82	64	56	48	40	0	0	0	0	35	70	300	1	396	0	115	146	61
3718	3723	154	230155	230300	1	82	64	56	48	40	34	0	0	0	30	70	300	1	397	0	78	113	69
3724	3728	154	233410	233605	1	82	64	56	48	40	0	0	0	0	30	70	300	1	396	0	111	137	86
3729	3733	155	235920	10	1	82	64	56	48	40	0	0	0	0	30	70	300	1	394	0	59	77	77

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	O/O ACC.
3734	3737	155	3025	3110	2	82	64	56	48	0	0	0	0	0	30	70	300	1	398	0	84	98	85
3738	3741	155	22820	22955	1	82	64	56	48	0	0	0	0	0	30	70	300	1	399	0	125	153	85
3742	3746	155	30220	30638	1	82	64	56	48	40	0	0	0	0	35	70	300	1	401	0	177	216	79
3747	3751	155	32850	32940	1	82	64	56	48	40	0	0	0	0	40	70	300	1	401	0	150	202	82
3752	3756	155	52735	53230	1	81	59	51	44	34	0	0	0	0	35	70	300	1	385	0	32	38	68
3757	3760	155	61015	61515	1	81	59	51	44	0	0	0	0	0	35	70	300	1	387	0	16	20	69
3761	3764	155	65140	65445	1	81	59	51	40	0	0	0	0	0	30	70	300	1	393	0	21	27	85
3765	3768	155	73110	73515	1	81	59	51	44	0	0	0	0	0	40	70	300	1	392	0	21	30	86
3769	3771	155	80430	80615	1	81	59	51	0	0	0	0	0	0	40	70	300	1	394	0	15	19	94
3772	3774	155	82750	83000	1	81	59	51	0	0	0	0	0	0	40	70	300	1	392	0	16	17	82
3775	3777	155	90000	90300	1	81	59	51	0	0	0	0	0	0	40	70	300	1	391	0	13	16	93
3778	3781	155	93340	93645	1	81	59	51	44	0	0	0	0	0	35	70	300	1	399	0	10	14	78
3782	3785	155	100405	100505	1	81	59	51	44	0	0	0	0	0	35	70	300	1	399	0	13	16	81
3786	3790	155	103020	103440	1	81	59	51	44	34	0	0	0	0	35	70	300	1	399	0	18	21	66
3791	3792	155	122345	122345	2	81	59	0	0	0	0	0	0	0	35	70	300	1	396	0	26	26	100
3793	3796	155	130105	130140	1	81	59	51	44	0	0	0	0	0	35	70	300	1	395	0	29	37	94
3797	3800	155	133030	133115	2	81	59	51	44	0	0	0	0	0	35	70	300	1	393	0	40	48	83
3801	3805	155	140025	140118	1	81	59	51	44	34	0	0	0	0	35	70	300	1	400	0	39	43	86
3806	3809	155	143050	143138	2	81	59	51	44	0	0	0	0	0	35	70	300	1	400	0	35	42	88
3810	3813	155	150250	150330	1	81	59	51	44	0	0	0	0	0	40	70	300	1	400	0	41	47	85
3814	3817	155	153005	153143	1	81	59	51	44	0	0	0	0	0	40	70	300	1	399	0	45	56	82
3818	3822	155	160235	160325	1	81	59	51	44	34	0	0	0	0	40	70	300	1	399	0	48	68	85
3823	3827	155	163042	163130	1	81	59	51	44	34	0	0	0	0	35	70	300	1	399	0	52	72	80
3828	3831	155	170220	170310	2	81	59	51	44	0	0	0	0	0	35	70	300	1	400	0	35	45	68
3832	3835	155	173455	173543	2	81	59	51	44	0	0	0	0	0	35	70	300	1	401	0	66	87	82
3836	3839	155	180555	180640	2	81	59	51	44	0	0	0	0	0	40	70	300	1	400	0	51	65	81

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
3840	3844	155	183325	183515	1	81	59	51	44	34	0	0	0	0	40	70	300	1	399	0	60	78	62
3845	3850	155	190035	190120	2	81	59	51	44	34	30	0	0	0	30	70	300	1	405	0	68	107	77
3851	3856	155	193155	193245	2	81	59	51	44	34	30	0	0	0	35	70	300	1	408	0	61	80	64
3857	3862	155	200205	200300	2	81	59	51	44	34	30	0	0	0	35	70	300	1	408	0	48	75	86
3863	3868	155	202910	203000	2	81	59	51	44	34	30	0	0	0	35	70	300	1	408	0	48	73	87
3869	3872	155	212155	212435	2	83	63	55	48	0	0	0	0	0	35	70	300	1	410	0	35	45	82
3873	3878	155	220520	220615	2	83	63	55	48	40	34	0	0	0	35	70	300	1	407	0	26	33	84
3879	3883	155	223000	223045	1	83	63	55	48	40	0	0	0	0	35	70	300	1	409	0	16	32	96
3884	3886	155	225930	230015	1	83	63	55	0	0	0	0	0	0	35	70	300	1	409	0	18	21	95
3887	3890	155	232930	233220	2	83	63	55	48	0	0	0	0	0	35	70	300	1	408	0	17	25	75
3891	3894	156	1320	1530	2	83	63	55	48	0	0	0	0	0	35	70	300	1	408	0	36	48	72
3895	3896	156	5020	5020	2	83	63	0	0	0	0	0	0	0	30	70	300	1	409	0	33	33	100
3897	3898	156	12000	12000	2	83	63	0	0	0	0	0	0	0	30	70	300	1	409	0	38	38	100
3899	3900	156	15200	15200	2	83	63	0	0	0	0	0	0	0	35	70	300	1	408	0	26	26	100
3901	3902	156	22200	22200	2	83	63	0	0	0	0	0	0	0	35	70	300	1	410	0	17	17	100
3903	3904	156	25300	25300	2	83	63	0	0	0	0	0	0	0	35	70	300	1	409	0	26	26	100
3905	3906	156	32400	32400	2	83	63	0	0	0	0	0	0	0	35	70	300	1	410	0	44	44	100
3907	3908	156	35400	35400	2	83	63	0	0	0	0	0	0	0	35	70	300	1	408	0	49	49	100
3909	3910	156	42500	42500	2	83	63	0	0	0	0	0	0	0	35	70	300	1	409	0	61	61	100
3911	3912	156	45500	45500	2	83	63	0	0	0	0	0	0	0	35	70	300	1	407	0	58	58	100
3913	3914	156	52500	52500	2	83	63	0	0	0	0	0	0	0	35	70	300	1	408	0	67	67	100
3915	3916	156	55600	55600	2	83	63	0	0	0	0	0	0	0	35	70	300	1	409	0	77	77	100
3917	3918	156	62600	62600	2	83	63	0	0	0	0	0	0	0	35	70	300	1	409	0	64	64	100
3919	3920	156	65700	65700	2	83	63	0	0	0	0	0	0	0	35	70	300	1	409	0	30	30	100
3921	3922	156	72800	72800	2	83	63	0	0	0	0	0	0	0	35	70	300	1	409	0	42	42	100
3923	3924	156	75700	75700	2	83	63	0	0	0	0	0	0	0	35	70	300	1	410	0	31	31	100

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
3925	3926	156	82900	82900	2	83	63	0	0	0	0	0	0	0	35	70	300	1	407	0	26	26	100
3927	3928	156	90000	90000	2	83	63	0	0	0	0	0	0	0	35	70	300	1	399	0	16	16	100
3929	3930	156	93100	93100	2	83	63	0	0	0	0	0	0	0	35	70	300	1	402	0	18	18	100
5=53	5=54	378	322322	322322	4	15	85	2	2	2	2	2	2	2	57	92	522	3	623	2	53	53	322
3933	3934	156	103100	103100	2	83	63	0	0	0	0	0	0	0	35	70	300	1	400	0	26	26	100
3935	3936	156	110200	110200	2	83	63	0	0	0	0	0	0	0	35	70	300	1	400	0	23	23	100
3937	3938	156	113300	113300	2	83	63	0	0	0	0	0	0	0	40	70	300	1	398	0	28	28	100
3939	3940	156	120400	120400	2	83	63	0	0	0	0	0	0	0	35	70	300	1	400	0	21	21	100
3941	3942	156	123500	123500	2	83	63	0	0	0	0	0	0	0	35	70	300	1	408	0	10	10	100
3943	3944	156	130600	130600	2	83	63	0	0	0	0	0	0	0	35	70	300	1	407	0	11	11	100
3945	3946	156	140700	140700	2	83	63	0	0	0	0	0	0	0	35	70	300	1	407	0	11	11	100
3947	3948	156	150825	150825	2	83	63	0	0	0	0	0	0	0	35	70	300	1	408	0	7	7	100
3949	3950	156	155546	155546	2	83	63	0	0	0	0	0	0	0	35	70	300	1	409	0	9	9	100
3951	3952	156	165700	165700	2	83	63	0	0	0	0	0	0	0	35	70	300	1	408	0	13	13	100
3953	3954	156	175848	175848	2	83	63	0	0	0	0	0	0	0	35	70	300	1	408	0	6	6	100
3955	3956	156	191100	191100	2	83	63	0	0	0	0	0	0	0	35	70	300	1	407	0	14	14	100
3957	3958	156	195800	195800	2	83	63	0	0	0	0	0	0	0	40	70	300	1	407	0	22	22	100
3959	3960	156	210005	210005	2	83	63	0	0	0	0	0	0	0	35	70	300	1	409	0	23	23	100
3961	3964	156	213020	213043	2	83	63	55	48	0	0	0	0	0	35	70	300	1	407	0	19	24	91
3965	3968	156	220405	220541	2	83	63	55	48	0	0	0	0	0	35	70	300	1	407	0	22	26	76
3969	3972	156	223107	223444	2	83	63	55	48	0	0	0	0	0	35	70	300	1	409	0	16	18	88
3973	3976	156	225925	230200	2	83	63	55	48	0	0	0	0	0	35	70	300	1	408	0	13	17	94
3977	3980	156	233035	233314	2	83	63	55	48	0	0	0	0	0	35	70	300	1	409	0	14	19	84
3881	3984	157	100	330	2	83	63	55	48	0	0	0	0	0	40	70	300	1	407	0	18	23	95
3985	3988	157	10100	10335	2	83	63	55	48	0	0	0	0	0	40	70	300	1	408	0	23	27	92
3989	3992	157	13200	13400	2	83	63	55	48	0	0	0	0	0	35	70	300	1	409	0	16	19	89

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	O/O ACC.
4176	4179	158	85630	85815	2	81	59	51	43	0	0	0	0	0	35	70	300	1	399	0	34	43	65
4181	4182	158	122705	122705	2	81	59	0	0	0	0	0	0	0	35	70	300	1	400	0	3	3	100
4183	4185	158	125710	125950	1	81	59	51	0	0	0	0	0	0	35	70	300	1	398	0	16	16	87
4186	4188	158	132815	133055	1	81	59	51	0	0	0	0	0	0	35	70	300	1	398	0	13	14	92
4189	4190	158	140000	140237	1	81	59	0	0	0	0	0	0	0	35	70	300	1	399	0	20	20	100
4191	4194	158	142819	143200	2	81	59	51	43	0	0	0	0	0	35	70	300	1	399	0	17	17	76
4195	4198	158	150500	150545	2	81	59	51	43	0	0	0	0	0	35	70	300	1	399	0	18	20	75
4199	4201	158	153000	153230	1	81	59	51	0	0	0	0	0	0	35	70	300	1	400	0	24	26	92
4202	4205	158	172700	173000	2	82	63	56	48	0	0	0	0	0	35	70	300	1	400	0	52	67	95
4206	4209	158	180000	180445	2	82	63	56	48	0	0	0	0	0	35	70	300	1	397	0	64	79	82
4210	4213	158	183015	183355	2	82	63	56	48	0	0	0	0	0	35	70	300	1	396	0	77	95	72
4214	4217	158	190241	190524	2	82	63	56	48	0	0	0	0	0	35	70	300	1	397	0	69	94	76
4218	4221	158	193000	193200	2	82	63	56	48	0	0	0	0	0	40	70	300	1	403	0	76	119	92
4222	4225	158	200213	200500	2	82	63	56	48	0	0	0	0	0	45	70	300	1	404	0	72	92	77
4226	4229	158	202900	203130	2	82	63	56	48	0	0	0	0	0	40	70	300	1	406	0	72	90	82
4230	4233	158	210015	210138	2	82	63	56	48	0	0	0	0	0	40	70	300	1	405	0	66	83	91
4234	4237	158	212848	213033	2	82	63	56	48	0	0	0	0	0	40	70	300	1	406	0	38	47	59
4238	4243	158	220428	220530	1	82	63	56	48	38	32	0	0	0	40	70	300	1	403	0	60	86	90
4245	4248	158	222810	223055	2	82	63	56	48	0	0	0	0	0	40	70	300	1	405	0	68	85	94
4249	4252	158	230040	230230	2	82	63	56	48	0	0	0	0	0	40	70	300	1	405	0	92	127	88
4253	4256	158	232910	233150	2	82	63	56	48	0	0	0	0	0	40	70	300	1	400	0	86	128	86
4257	4260	159	707	1050	2	82	63	56	48	0	0	0	0	0	40	70	300	1	404	0	73	83	84
4261	4264	159	2900	3145	2	82	63	56	48	0	0	0	0	0	35	70	300	1	402	0	94	110	95
4265	4268	159	10040	10325	2	82	63	56	48	0	0	0	0	0	35	70	300	1	404	0	80	86	93
4269	4272	159	12848	13034	2	82	63	56	48	0	0	0	0	0	35	70	300	1	403	0	83	89	96
4273	4276	159	15850	20042	2	82	63	56	48	0	0	0	0	0	35	70	300	1	404	0	86	95	88

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
3993	3994	157	20000	20100	1	83	63	0	0	0	0	0	0	0	35	70	300	1	408	0	15	15	100
3995	3998	157	23000	23300	2	83	63	55	48	0	0	0	0	0	35	70	300	1	408	0	15	17	70
3999	4001	157	30000	30230	1	83	63	55	0	0	0	0	0	0	35	70	300	1	409	0	10	12	83
4002	4004	157	33000	33300	1	83	63	55	0	0	0	0	0	0	35	70	300	1	409	0	9	11	90
4005	4007	157	40300	40400	1	83	63	55	0	0	0	0	0	0	35	70	300	1	408	0	9	12	83
4008	4011	157	43000	43200	2	83	63	55	48	0	0	0	0	0	35	70	300	1	409	0	12	16	81
4012	4015	157	50000	50300	2	83	63	55	48	0	0	0	0	0	35	70	300	1	409	0	10	12	75
4016	4019	157	53243	53422	2	83	63	55	48	0	0	0	0	0	35	70	300	1	408	0	11	13	69
4020	4021	157	60200	60405	1	83	63	0	0	0	0	0	0	0	35	70	300	1	408	0	5	5	100
4022	4023	157	62913	63131	1	83	63	0	0	0	0	0	0	0	35	70	300	1	409	0	8	8	100
4024	4026	157	65348	65507	2	83	63	55	0	0	0	0	0	0	35	70	300	1	406	0	8	9	100
4027	4028	157	73025	73045	1	83	63	0	0	0	0	0	0	0	35	70	300	1	407	0	5	5	100
4029	4031	157	80100	80530	1	83	63	55	0	0	0	0	0	0	35	70	300	1	406	0	7	8	87
4032	4034	157	82925	83105	1	83	63	55	0	0	0	0	0	0	35	70	300	1	405	0	8	8	87
4035	4036	157	90530	90550	1	83	63	0	0	0	0	0	0	0	35	70	300	1	399	0	7	7	100
4037	4038	157	93003	93020	1	83	63	0	0	0	0	0	0	0	35	70	300	1	401	0	3	3	100
4039	4040	157	100530	100550	1	83	63	0	0	0	0	0	0	0	35	70	300	1	400	0	7	7	100
4041	4042	157	103010	103038	1	83	63	0	0	0	0	0	0	0	35	70	300	1	401	0	5	5	100
4043	4044	157	112530	112530	2	82	65	0	0	0	0	0	0	0	35	70	300	1	395	0	4	4	100
4046	4048	157	120330	120508	1	82	65	57	0	0	0	0	0	0	35	70	300	1	394	0	19	21	100
4049	4052	157	123010	123150	2	82	65	57	48	0	0	0	0	0	35	70	300	1	395	0	17	18	94
4053	4056	157	130143	130320	2	82	65	57	48	0	0	0	0	0	35	70	300	1	395	0	27	34	79
4057	4060	157	133320	133508	2	82	65	57	48	0	0	0	0	0	35	70	300	1	394	0	30	47	87
4061	4064	157	135840	140025	2	82	65	57	48	0	0	0	0	0	35	70	300	1	393	0	34	38	60
4065	4068	157	142940	143125	2	82	65	57	48	0	0	0	0	0	35	70	300	1	393	0	29	32	62
4069	4072	157	145925	150110	2	82	65	57	48	0	0	0	0	0	35	70	300	1	394	0	31	37	81

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
3925	3926	156	82900	82900	2	83	63	0	0	0	0	0	0	0	35	70	300	1	407	0	26	26	100
3927	3928	156	90000	90000	2	83	63	0	0	0	0	0	0	0	35	70	300	1	399	0	16	16	100
3929	393[illegible]	156	93100	93100	2	83	63	0	0	0	0	0	0	0	35	70	300	1	402	0	18	18	100
5=53	5=54	378	322322	322322	4	:5	85	2	2	2	2	2	2	2	57	92	522	3	623	2	53	53	322
3933	3934	156	103100	103100	2	83	63	0	0	0	0	0	0	0	35	70	300	1	400	0	26	26	100
3935	3936	156	110200	110200	2	83	63	0	0	0	0	0	0	0	35	70	300	1	400	0	23	23	100
3937	3938	156	113300	113300	2	83	63	0	0	0	0	0	0	0	40	70	300	1	398	0	28	28	100
3939	3940	156	120400	120400	2	83	63	0	0	0	0	0	0	0	35	70	300	1	400	0	21	21	100
3941	3942	156	123500	123500	2	83	63	0	0	0	0	0	0	0	35	70	300	1	408	0	10	10	100
3943	3944	156	130600	130600	2	83	63	0	0	0	0	0	0	0	35	70	300	1	407	0	11	11	100
3945	3946	156	140700	140700	2	83	63	0	0	0	0	0	0	0	35	70	300	1	407	0	11	11	100
3947	3948	156	150825	150825	2	83	63	0	0	0	0	0	0	0	35	70	300	1	408	0	7	7	100
3949	3950	156	155546	155546	2	83	63	0	0	0	0	0	0	0	35	70	300	1	409	0	9	9	100
3951	3952	156	165700	165700	2	83	63	0	0	0	0	0	0	0	35	70	300	1	408	0	13	13	100
3953	3954	156	175848	175848	2	83	63	0	0	0	0	0	0	0	35	70	300	1	408	0	6	6	100
3955	3956	156	191100	191100	2	83	63	0	0	0	0	0	0	0	35	70	300	1	407	0	14	14	100
3957	3958	156	195800	195800	2	83	63	0	0	0	0	0	0	0	40	70	300	1	407	0	22	22	100
3959	3960	156	210005	210005	2	83	63	0	0	0	0	0	0	0	35	70	300	1	409	0	23	23	100
3961	3964	156	213020	213043	2	83	63	55	48	0	0	0	0	0	35	70	300	1	407	0	19	24	91
3965	3968	156	220405	220541	2	83	63	55	48	0	0	0	0	0	35	70	300	1	407	0	22	26	76
3969	3972	156	223107	223444	2	83	63	55	48	0	0	0	0	0	35	70	300	1	409	0	16	18	88
3973	3976	156	225925	230200	2	83	63	55	48	0	0	0	0	0	35	70	300	1	408	0	13	17	94
3977	3980	156	233035	233314	2	83	63	55	48	0	0	0	0	0	35	70	300	1	409	0	14	19	84
3881	3984	157	100	330	2	83	63	55	48	0	0	0	0	0	40	70	300	1	407	0	18	23	95
3985	3988	157	10100	10335	2	83	63	55	48	0	0	0	0	0	40	70	300	1	408	0	23	27	92
3989	3992	157	13200	13400	2	83	63	55	48	0	0	0	0	0	35	70	300	1	409	0	16	19	89

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	O/O ACC.
4277	4280	159	23005	23350	2	82	63	56	48	0	0	0	0	0	35	70	300	1	404	0	92	99	88
4281	4284	159	30009	30155	2	82	63	56	48	0	0	0	0	0	35	70	300	1	403	0	97	115	100
4285	4288	159	33320	33505	2	82	63	56	48	0	0	0	0	0	30	70	300	1	404	0	86	113	91
4289	4292	159	40225	40512	2	82	63	56	48	0	0	0	0	0	35	70	300	1	404	0	110	119	87
4293	4296	159	43028	43415	2	82	63	56	48	0	0	0	0	0	30	70	300	1	403	0	93	107	89
4297	4300	159	50032	50320	2	82	63	56	48	0	0	0	0	0	30	70	300	1	403	0	65	80	76
4301	4304	159	52935	53120	2	82	63	56	48	0	0	0	0	0	30	70	300	1	402	0	104	128	91
4306	4309	159	60248	60534	2	82	63	56	48	0	0	0	0	0	40	70	300	1	403	0	94	123	95
4310	4313	159	63023	63315	2	82	63	56	48	0	0	0	0	0	30	70	300	1	403	0	114	144	90
4314	4317	159	70034	70120	2	82	63	56	48	0	0	0	0	0	35	70	300	1	403	0	79	93	91
4318	4321	159	72939	73125	2	82	63	56	48	0	0	0	0	0	35	70	300	1	403	0	118	124	92
4322	4325	159	80100	80445	2	82	63	56	48	0	0	0	0	0	35	70	300	1	403	0	90	98	94
4326	4327	159	83010	83010	2	82	63	0	0	0	0	0	0	0	40	70	300	1	403	0	99	99	100
4328	4329	159	90022	90022	2	82	63	0	0	0	0	0	0	0	40	70	300	1	404	0	78	78	100
4330	4331	159	93445	93445	2	82	63	0	0	0	0	0	0	0	40	70	300	1	404	0	131	131	100
4332	4335	159	112343	112615	1	86	66	60	51	0	0	0	0	0	40	70	300	1	403	0	183	217	97
4336	4337	159	120015	120015	2	86	66	0	0	0	0	0	0	0	35	70	300	1	402	0	147	147	100
4338	4342	159	134152	134242	1	86	66	60	51	43	0	0	0	0	40	70	300	1	404	0	221	294	92
4343	4347	159	141542	141633	1	86	66	60	51	43	0	0	0	0	40	70	300	1	404	0	273	331	91
4348	4351	159	144403	144540	2	86	66	60	51	0	0	0	0	0	45	70	300	1	407	0	182	202	94
4352	4355	159	151610	151743	2	86	66	60	51	0	0	0	0	0	40	70	300	1	407	0	173	187	95
4356	4358	159	154515	154856	1	86	66	60	0	0	0	0	0	0	40	70	300	1	408	0	159	162	97
4359	4362	159	162545	162825	2	86	66	60	51	0	0	0	0	0	35	70	300	1	409	0	78	80	100
4363	4366	159	165810	170155	2	86	66	60	51	0	0	0	0	0	30	70	300	1	407	0	48	50	97
4367	4370	159	173035	173320	2	86	66	60	51	0	0	0	0	0	30	70	300	1	409	0	23	25	91
4371	4374	159	175910	180255	2	86	66	60	51	0	0	0	0	0	30	70	300	1	408	0	24	25	75

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	O/O ACC.
4375	4378	159	211320	211345	2	90	72	64	56	0	0	0	0	0	45	70	300	1	408	0	23	24	70
4379	4380	159	214810	214810	2	90	72	0	0	0	0	0	0	0	45	70	300	1	408	0	46	46	100
4381	4384	159	222555	222620	2	90	72	64	56	0	0	0	0	0	45	70	300	1	409	0	50	53	75
4385	4388	159	225955	230230	2	90	72	64	56	0	0	0	0	0	40	70	300	1	409	0	63	73	87
4389	4392	159	233005	233245	2	90	72	64	56	0	0	0	0	0	45	70	300	1	409	0	43	48	79
4393	4396	160	1145	1420	2	90	72	64	56	0	0	0	0	0	45	70	300	1	408	0	29	33	90
4397	4399	160	4455	4530	1	90	72	64	0	0	0	0	0	0	35	70	300	1	409	0	28	30	83
4400	4403	160	11515	11750	2	90	72	64	56	0	0	0	0	0	35	70	300	1	408	0	32	37	89
4404	4407	160	24413	24655	2	90	72	64	56	0	0	0	0	0	35	70	300	1	408	0	49	51	90
4408	4411	160	31420	31611	2	90	72	64	56	0	0	0	0	0	35	70	300	1	407	0	78	85	92
4412	4415	160	34520	34710	2	90	72	64	56	0	0	0	0	0	35	70	300	1	407	0	93	106	86
4416	4419	160	41529	41717	2	90	72	64	56	0	0	0	0	0	30	70	300	1	408	0	86	96	88
4420	4423	160	44444	44630	2	90	72	64	56	0	0	0	0	0	30	70	300	1	409	0	90	105	92
4424	4427	160	51635	51820	2	90	72	64	56	0	0	0	0	0	30	70	300	1	407	0	83	101	83
4428	4431	160	54545	54733	2	90	72	64	56	0	0	0	0	0	30	70	300	1	404	0	75	87	86
4432	4435	160	61555	61740	2	90	72	64	56	0	0	0	0	0	30	70	300	1	410	0	67	78	91
4436	4439	160	64503	64648	2	90	72	64	56	0	0	0	0	0	30	70	300	1	406	0	51	55	90
4440	4441	160	83632	83632	2	88	69	0	0	0	0	0	0	0	35	70	300	1	412	0	20	20	100
4442	4443	160	90010	90010	2	88	69	0	0	0	0	0	0	0	30	70	300	1	409	0	16	16	100
4444	4445	160	92900	92900	2	88	69	0	0	0	0	0	0	0	30	70	300	1	409	0	10	10	100
4446	4447	160	100000	100000	2	88	69	0	0	0	0	0	0	0	30	70	300	1	408	0	17	17	100
4448	4449	160	102600	102600	2	88	69	0	0	0	0	0	0	0	30	70	300	1	406	0	14	14	100
4450	4451	160	110000	110000	2	88	69	0	0	0	0	0	0	0	30	70	300	1	409	0	16	16	100
4452	4453	160	113100	113100	2	88	69	0	0	0	0	0	0	0	30	70	300	1	410	0	18	18	100
4454	4455	160	120000	120000	2	88	69	0	0	0	0	0	0	0	30	70	300	1	407	0	16	16	100
4456	4459	160	125500	125531	2	88	69	61	53	0	0	0	0	0	30	70	300	1	408	0	32	33	75

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
4460	4463	160	133500	133546	2	88	69	61	53	0	0	0	0	0	30	70	300	1	404	0	53	58	94
4464	4467	160	140100	140300	2	88	69	61	53	0	0	0	0	0	35	70	300	1	403	0	57	62	98
4468	4471	160	142900	143100	2	88	69	61	53	0	0	0	0	0	35	70	300	1	402	0	65	69	92
4472	4474	160	150030	150055	1	88	69	61	0	0	0	0	0	0	35	70	300	1	403	0	40	46	89
4475	4478	160	152900	153130	2	88	69	61	53	0	0	0	0	0	30	70	300	1	404	0	81	88	90
4479	4482	160	155935	160325	2	88	69	61	53	0	0	0	0	0	30	70	300	1	402	0	85	95	90
4483	4486	160	163030	163320	2	88	69	61	53	0	0	0	0	0	30	70	300	1	402	0	123	152	94
4487	4490	160	170000	170350	2	88	69	61	53	0	0	0	0	0	30	70	300	1	402	0	138	171	95
4491	4492	160	172925	172925	2	88	69	0	0	0	0	0	0	0	30	70	300	1	402	0	136	136	100
4493	4496	160	175705	175955	2	88	69	61	53	0	0	0	0	0	30	70	300	1	403	0	103	110	72
4497	4500	160	182950	183320	2	88	69	61	53	0	0	0	0	0	30	70	300	1	403	0	82	99	90
4501	4504	160	185640	185930	2	88	69	61	53	0	0	0	0	0	30	70	300	1	406	0	106	118	87
4505	4507	160	192650	192810	2	88	69	61	0	0	0	0	0	0	30	70	300	1	406	0	85	99	92
4508	4513	161	62700	62800	1	89	71	63	54	44	39	0	0	0	30	70	300	1	414	0	496	660	91
4515	4520	161	65921	70024	1	89	71	63	54	44	39	0	0	0	30	70	300	1	414	0	526	761	88
4522	4527	161	72800	73224	2	89	71	63	54	44	39	0	0	0	30	70	300	1	414	0	575	805	87
4528	4533	161	81525	81939	1	89	71	63	54	44	39	0	0	0	30	70	300	1	414	0	421	555	80
4535	4540	161	85614	85705	2	89	71	63	54	44	39	0	0	0	30	70	300	1	414	0	309	400	84
4541	4546	161	92706	93120	1	89	71	63	54	44	39	0	0	0	30	70	300	1	414	0	320	392	85
4548	4553	161	95950	100053	1	89	71	63	54	44	39	0	0	0	30	70	300	1	413	0	270	341	83
4555	4560	161	104203	104306	1	89	71	63	54	44	39	0	0	0	30	70	300	1	414	0	632	811	90
4561	4566	161	110031	110133	1	89	71	63	54	44	39	0	0	0	25	70	300	1	414	0	758	077	95
4567	4572	161	122032	122135	1	89	71	63	54	44	39	0	0	0	30	70	300	1	414	0	806	073	93

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
343	346	172	1543	1822	2	91	72	65	56	0	0	0	0	0	40	70	300	1	405	0	126	134	91
347	350	172	1944	2224	2	91	72	65	56	0	0	0	0	0	40	70	300	1	405	0	106	112	90
351	354	172	4345	4626	2	91	72	65	56	0	0	0	0	0	40	70	300	1	404	0	80	89	89
355	358	172	10346	10625	2	91	72	65	56	0	0	0	0	0	40	70	300	1	406	0	99	104	82
359	362	172	11946	12226	2	91	72	65	56	0	0	0	0	0	40	70	300	1	405	0	77	80	87
363	366	172	14446	14726	2	91	72	65	56	0	0	0	0	0	40	70	300	1	405	0	90	92	83
367	370	172	15946	20226	2	91	72	65	56	0	0	0	0	0	40	70	300	1	409	0	90	98	87
371	374	172	21946	22226	2	91	72	65	56	0	0	0	0	0	40	70	300	1	404	0	92	104	78
375	378	172	23945	24225	2	91	72	65	56	0	0	0	0	0	40	70	300	1	404	0	70	85	79
379	382	172	25946	30226	2	91	72	65	56	0	0	0	0	0	40	70	300	1	405	0	52	58	67
383	386	172	31944	32224	2	91	72	65	56	0	0	0	0	0	40	70	300	1	408	0	52	59	84
387	390	172	33943	34223	2	91	72	65	56	0	0	0	0	0	40	70	300	1	405	0	58	60	83
391	394	172	35943	40223	2	91	72	65	56	0	0	0	0	0	40	70	300	1	405	0	59	62	90
395	398	172	42222	42502	2	91	72	65	56	0	0	0	0	0	40	70	300	1	405	0	105	110	94
399	402	172	44222	44502	2	91	72	65	56	0	0	0	0	0	40	70	300	1	403	0	113	118	92
403	406	172	50222	50502	2	91	72	65	56	0	0	0	0	0	40	70	300	1	404	0	154	166	89
407	410	172	51424	51704	2	91	72	65	56	0	0	0	0	0	40	70	300	1	405	0	202	221	88
411	414	172	60901	61142	2	91	71	61	54	0	0	0	0	0	40	70	300	1	409	0	211	223	91
415	418	172	62902	63142	2	91	71	61	54	0	0	0	0	0	40	70	300	1	409	0	218	247	85
419	422	172	63302	63542	2	91	71	61	54	0	0	0	0	0	40	70	300	1	407	0	220	255	83
423	426	172	63702	63942	2	91	71	61	54	0	0	0	0	0	40	70	300	1	409	0	238	277	86
427	430	172	70102	70342	2	91	71	61	54	0	0	0	0	0	40	70	300	1	408	0	232	275	89
431	434	172	72104	72344	2	91	71	61	54	0	0	0	0	0	40	70	300	1	407	0	250	297	90
435	438	172	73706	73946	2	91	71	61	54	0	0	0	0	0	40	70	300	1	406	0	253	284	88
439	440	172	74106	74106	2	91	71	0	0	0	0	0	0	0	40	70	300	1	404	0	242	242	99
441	442	172	80509	80509	2	91	71	0	0	0	0	0	0	0	40	70	300	1	406	0	289	289	99

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
443	446	172	82329	82515	2	91	71	61	54	0	0	0	0	0	40	70	300	1	407	0	334	368	91
447	450	172	84011	84146	2	91	71	61	54	0	0	0	0	0	40	70	300	1	408	0	326	366	94
451	454	172	84234	84412	2	91	71	61	54	0	0	0	0	0	40	70	300	1	408	0	340	383	91
455	458	172	84458	84634	2	91	71	61	54	0	0	0	0	0	40	70	300	1	408	0	342	384	95
459	462	172	92504	92638	2	91	71	61	54	0	0	0	0	0	40	70	300	1	408	0	348	413	90
463	466	172	93849	93925	1	91	71	61	54	0	0	0	0	0	40	70	300	1	407	0	305	350	93
467	470	172	95932	100107	2	91	71	61	54	0	0	0	0	0	40	70	300	1	407	0	313	353	90
471	474	172	101829	102004	2	91	71	61	54	0	0	0	0	0	40	70	300	1	408	0	288	324	91
475	478	172	103725	103901	2	91	71	61	54	0	0	0	0	0	40	70	300	1	409	0	297	338	91
479	482	172	103948	104125	2	91	71	61	54	0	0	0	0	0	40	70	300	1	409	0	299	347	91
483	486	172	104213	104348	2	91	71	61	54	0	0	0	0	0	40	70	300	1	410	0	312	351	85
487	492	172	105953	110041	2	91	71	61	54	47	41	0	0	0	40	70	300	1	409	0	257	302	81
493	496	172	111834	112010	2	91	71	61	54	0	0	0	0	0	40	70	300	1	411	0	262	302	83
497	500	172	115654	115828	2	91	71	61	54	0	0	0	0	0	40	70	300	1	407	0	237	304	90
501	504	172	121735	122017	2	91	71	61	54	0	0	0	0	0	40	70	300	1	409	0	236	282	82
505	508	172	130056	130437	2	91	71	61	54	0	0	0	0	0	40	70	300	1	410	0	205	231	93
509	512	172	131805	132045	2	91	71	61	54	0	0	0	0	0	40	70	300	1	409	0	183	205	86
513	516	172	133955	134235	2	91	71	61	54	0	0	0	0	0	40	70	300	1	408	0	161	180	80
517	520	172	140007	140250	2	91	71	61	54	0	0	0	0	0	40	70	300	1	409	0	177	208	83
521	524	172	142020	142302	2	91	71	61	54	0	0	0	0	0	40	70	300	1	408	0	126	137	72
525	528	172	144032	144315	2	91	71	61	54	0	0	0	0	0	40	70	300	1	407	0	112	134	78
529	532	172	145941	150221	2	91	71	61	54	0	0	0	0	0	40	70	300	1	409	0	113	140	82
533	536	172	152748	152935	2	91	71	61	54	0	0	0	0	0	40	70	300	1	407	0	107	124	90
537	540	172	161658	161724	2	91	71	61	54	0	0	0	0	0	40	70	300	1	406	0	89	103	66
541	544	172	163948	164230	2	91	71	61	54	0	0	0	0	0	40	70	300	1	407	0	77	90	78
545	548	172	170654	171034	2	91	71	61	54	0	0	0	0	0	40	70	300	1	407	0	95	114	83

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	O/O ACC.
549	552	172	181121	181303	2	91	71	61	54	0	0	0	0	0	45	70	300	1	410	0	55	62	77
553	556	172	183231	183517	2	91	71	61	54	0	0	0	0	0	40	70	300	1	410	0	48	58	79
557	560	172	190236	190422	2	91	71	61	54	0	0	0	0	0	40	70	300	1	410	0	38	44	75
561	564	172	200123	200249	2	91	71	61	54	0	0	0	0	0	40	70	300	1	405	0	31	33	87
565	567	172	210311	210459	1	91	71	61	0	0	0	0	0	0	40	70	300	1	405	0	19	22	81
568	569	172	220628	220628	2	91	71	0	0	0	0	0	0	0	40	70	300	1	405	0	16	16	93
570	571	173	142	142	2	91	73	0	0	0	0	0	0	0	40	70	300	1	406	0	18	18	94
572	573	173	10947	10947	2	91	73	0	0	0	0	0	0	0	40	70	300	1	406	0	29	29	96
574	575	173	20030	20030	2	91	73	0	0	0	0	0	0	0	40	70	300	1	404	0	24	24	95
576	577	173	30149	30149	2	91	73	0	0	0	0	0	0	0	40	70	300	1	405	0	22	22	95
578	579	173	40051	40051	2	91	73	0	0	0	0	0	0	0	40	70	300	1	410	0	25	25	95
580	581	173	50222	50222	2	91	73	0	0	0	0	0	0	0	40	70	300	1	410	0	25	25	95
582	583	173	60138	60138	2	91	73	0	0	0	0	0	0	0	40	70	300	1	409	0	46	46	97
584	585	173	70000	70000	2	91	73	0	0	0	0	0	0	0	40	70	300	1	410	0	42	42	97
586	587	173	80000	80000	2	91	73	0	0	0	0	0	0	0	40	70	300	1	411	0	53	53	98
588	589	173	90700	90700	2	91	73	0	0	0	0	0	0	0	40	70	300	1	403	0	52	52	98
590	591	173	104003	104003	2	91	73	0	0	0	0	0	0	0	40	70	300	1	403	0	47	47	97
592	595	173	114811	114835	2	91	73	64	57	0	0	0	0	0	40	70	300	1	429	0	39	55	69
596	597	173	130120	130120	2	91	73	0	0	0	0	0	0	0	40	70	300	1	427	0	35	35	97
598	602	173	130805	130843	2	91	73	64	57	49	0	0	0	0	40	70	300	1	411	0	41	60	75
603	606	173	135826	135851	2	91	73	64	57	0	0	0	0	0	40	70	300	1	410	0	59	75	74
607	608	173	150125	150125	2	91	73	0	0	0	0	0	0	0	40	70	300	1	410	0	60	60	98
609	610	173	160443	160443	2	91	73	0	0	0	0	0	0	0	40	70	300	1	410	0	41	41	97
611	612	173	170022	170022	2	91	73	0	0	0	0	0	0	0	40	70	300	1	413	0	31	31	96
613	614	173	180017	180017	2	91	73	0	0	0	0	0	0	0	40	70	300	1	409	0	16	16	93
615	616	173	190308	190308	2	91	73	0	0	0	0	0	0	0	40	70	300	1	409	0	14	14	92

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
617	618	173	200040	200040	2	91	73	0	0	0	0	0	0	0	45	70	300	1	408	0	24	24	95
619	620	173	205912	205912	2	91	73	0	0	0	0	0	0	0	45	70	300	1	410	0	18	18	94
621	622	173	220405	220405	2	91	73	0	0	0	0	0	0	0	40	70	300	1	407	0	28	28	96
623	624	173	230239	230239	2	91	73	0	0	0	0	0	0	0	40	70	300	1	407	0	32	32	96
625	626	174	1512	1512	2	91	73	0	0	0	0	0	0	0	40	70	300	1	408	0	52	52	94
627	628	174	5906	5906	2	91	73	0	0	0	0	0	0	0	40	70	300	1	408	0	33	33	96
629	632	174	12105	13203	2	91	73	64	57	0	0	0	0	0	40	70	300	1	402	0	54	60	71
633	635	174	23503	23751	1	91	73	64	0	0	0	0	0	0	40	70	300	1	407	0	45	49	93
636	638	174	33106	33357	1	91	73	64	0	0	0	0	0	0	40	70	300	1	413	0	55	59	93
639	642	174	42717	43011	2	91	73	64	57	0	0	0	0	0	40	70	300	1	410	0	61	70	88
643	646	174	52758	53051	2	91	73	64	57	0	0	0	0	0	45	70	300	1	410	0	48	51	70
647	650	174	81018	81958	2	91	73	64	57	0	0	0	0	0	40	70	300	1	411	0	18	21	90
651	652	174	91407	91833	1	91	73	0	0	0	0	0	0	0	45	70	300	1	409	0	21	21	95
653	654	174	105200	105721	1	91	73	0	0	0	0	0	0	0	40	70	300	1	409	0	19	19	94
655	656	174	115800	115800	2	91	73	0	0	0	0	0	0	0	40	70	300	1	410	0	32	32	96
657	658	174	123645	123645	2	91	73	0	0	0	0	0	0	0	40	70	300	1	410	0	41	41	97
659	660	174	140009	140009	2	91	72	0	0	0	0	0	0	0	40	70	300	1	410	0	40	40	97
661	662	174	150516	150516	2	91	72	0	0	0	0	0	0	0	40	70	300	1	411	0	33	33	96
663	664	174	160041	160041	2	91	72	0	0	0	0	0	0	0	40	70	300	1	410	0	27	27	96
665	666	174	170153	170153	2	91	72	0	0	0	0	0	0	0	40	70	300	1	408	0	27	27	96
226	227	174	180257	180257	2	91	72	0	0	0	0	0	0	0	50	70	300	1	407	0	25	25	95
228	229	174	190204	190204	2	91	72	0	0	0	0	0	0	0	50	70	300	1	409	0	28	28	96
230	232	174	201948	202012	1	91	72	65	0	0	0	0	0	0	50	70	300	1	414	0	21	22	81
233	234	174	214126	214126	2	91	72	0	0	0	0	0	0	0	50	70	300	1	409	0	26	26	96
235	236	174	221230	221230	2	91	72	0	0	0	0	0	0	0	50	70	300	1	413	0	28	28	96
667	668	174	225815	225815	2	91	72	0	0	0	0	0	0	0	40	70	300	1	412	0	24	24	95

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
669	670	175	300	300	2	91	72	0	0	0	0	0	0	0	40	70	300	1	402	0	19	19	94
237	238	175	10315	10315	2	91	72	0	0	0	0	0	0	0	50	70	300	1	409	0	35	35	97
239	240	175	20648	20648	2	91	72	0	0	0	0	0	0	0	50	70	300	1	409	0	41	41	97
241	242	175	30013	30013	2	91	72	0	0	0	0	0	0	0	50	70	300	1	410	0	35	35	97
243	248	175	40042	40830	1	91	72	65	56	48	43	0	0	0	45	70	300	1	409	0	61	68	60
249	253	175	50658	51224	1	91	72	65	56	48	0	0	0	0	40	70	300	1	409	0	67	78	73
254	258	175	52317	52846	1	91	72	65	56	48	0	0	0	0	40	70	300	1	410	0	65	84	71
259	262	175	55657	55742	2	91	72	65	56	0	0	0	0	0	40	70	300	1	410	0	62	78	71
671	674	175	62028	62312	2	91	72	65	56	0	0	0	0	0	40	70	300	1	407	0	44	64	73
675	678	175	64055	64340	2	91	72	65	56	0	0	0	0	0	40	70	300	1	404	0	41	49	55
679	682	175	70227	70513	2	91	72	65	56	0	0	0	0	0	35	70	300	1	408	0	40	45	57
683	686	175	72159	72443	2	91	72	65	56	0	0	0	0	0	40	70	300	1	406	0	48	61	70
687	690	175	74225	74509	2	91	72	65	56	0	0	0	0	0	40	70	300	1	407	0	32	45	57
691	694	175	80251	80535	2	91	72	65	56	0	0	0	0	0	40	70	300	1	407	0	22	26	38
695	696	175	90038	90038	2	91	72	0	0	0	0	0	0	0	40	70	300	1	408	0	21	21	95
697	698	175	100046	100046	2	91	72	0	0	0	0	0	0	0	40	70	300	1	408	0	15	15	93
699	700	175	105800	105800	2	91	72	0	0	0	0	0	0	0	40	70	300	1	408	0	13	13	92
701	702	175	120224	120224	2	91	72	0	0	0	0	0	0	0	40	70	300	1	407	0	16	17	76
703	704	175	130500	130500	2	91	72	0	0	0	0	0	0	0	40	70	300	1	404	0	15	16	100
705	706	175	135751	135751	2	91	72	0	0	0	0	0	0	0	40	70	300	1	403	0	13	13	92
707	708	175	150021	150021	2	91	72	0	0	0	0	0	0	0	40	70	300	1	404	0	28	28	96
709	710	175	155916	155916	2	91	72	0	0	0	0	0	0	0	40	70	300	1	403	0	22	22	95
711	712	175	170431	170431	2	91	72	0	0	0	0	0	0	0	40	70	300	1	403	0	4	4	75
713	714	175	180321	180321	2	91	72	0	0	0	0	0	0	0	40	70	300	1	408	0	13	13	84
715	716	175	190211	190211	2	91	72	0	0	0	0	0	0	0	40	70	300	1	409	0	6	6	83
717	718	175	200623	200623	2	91	72	0	0	0	0	0	0	0	40	70	300	1	406	0	11	11	90

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	O/O ACC.
719	720	175	205853	205853	2	91	72	0	0	0	0	0	0	0	40	70	300	1	406	0	17	17	94
721	722	175	220305	220305	2	91	72	0	0	0	0	0	0	0	40	70	300	1	406	0	20	20	94
723	725	175	220539	220605	1	91	72	65	0	0	0	0	0	0	40	70	300	1	406	0	15	16	75
726	727	175	230157	230157	2	91	72	0	0	0	0	0	0	0	40	70	300	1	406	0	50	50	97
728	729	176	1130	1130	2	91	72	0	0	0	0	0	0	0	40	70	300	1	406	0	60	60	98
730	731	176	5951	5951	2	91	72	0	0	0	0	0	0	0	40	70	300	1	406	0	61	61	98
732	733	176	20200	20200	2	91	72	0	0	0	0	0	0	0	40	70	300	1	405	0	53	53	98
734	735	176	30049	30049	2	91	72	0	0	0	0	0	0	0	40	70	300	1	407	0	72	72	98
736	737	176	40043	40043	2	91	72	0	0	0	0	0	0	0	40	70	300	1	406	0	128	134	53
738	739	176	50314	50314	2	91	72	0	0	0	0	0	0	0	40	70	300	1	406	0	65	65	98
740	741	176	60215	60215	2	91	72	0	0	0	0	0	0	0	40	70	300	1	408	0	45	45	97
742	743	176	70450	70450	2	91	72	0	0	0	0	0	0	0	40	70	300	1	408	0	67	67	98
744	745	176	75930	75930	2	91	72	0	0	0	0	0	0	0	40	70	300	1	407	0	62	62	98
746	747	176	85837	85837	2	91	71	0	0	0	0	0	0	0	40	70	300	1	407	0	37	37	97
748	749	176	95757	95757	2	91	71	0	0	0	0	0	0	0	40	70	300	1	407	0	42	42	97
750	751	176	105955	105955	2	91	71	0	0	0	0	0	0	0	40	70	300	1	407	0	24	24	95
752	753	176	120225	120225	2	91	71	0	0	0	0	0	0	0	40	70	300	1	407	0	14	14	92
754	755	176	130100	130100	2	91	71	0	0	0	0	0	0	0	40	70	300	1	407	0	36	36	97
756	757	176	140041	140041	2	91	71	0	0	0	0	0	0	0	40	70	300	1	407	0	37	37	97
758	759	176	145757	145757	2	91	71	0	0	0	0	0	0	0	40	70	300	1	406	0	52	52	98
760	763	176	153335	153400	2	91	71	63	55	0	0	0	0	0	40	70	300	1	405	0	72	84	76
764	765	176	160321	160321	2	91	71	0	0	0	0	0	0	0	40	70	300	1	405	0	63	63	98
766	769	176	162053	162118	2	91	71	63	55	0	0	0	0	0	40	70	300	1	403	0	73	82	76
770	771	176	170253	170253	2	91	71	0	0	0	0	0	0	0	40	70	300	1	405	0	73	73	98
263	266	176	180257	180322	2	91	71	63	55	0	0	0	0	0	40	70	300	1	411	0	118	131	83
267	270	176	190002	190027	2	91	71	63	55	0	0	0	0	0	45	70	300	1	410	0	131	158	57

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
271	274	176	200345	200410	2	91	71	63	55	0	0	0	0	0	40	70	300	1	410	0	110	132	77
275	278	176	210015	210041	2	91	71	63	55	0	0	0	0	0	40	70	300	1	408	0	118	146	76
279	282	176	211830	212116	2	91	71	63	55	0	0	0	0	0	40	70	300	1	412	0	121	144	86
283	286	176	213905	214150	2	91	71	63	55	0	0	0	0	0	40	70	300	1	407	0	120	139	75
287	290	176	220220	220245	2	91	71	63	55	0	0	0	0	0	40	70	300	1	410	0	121	155	81
772	775	176	222013	222258	2	91	71	63	55	0	0	0	0	0	40	70	300	1	406	0	100	126	73
776	779	176	224047	224332	2	91	71	63	55	0	0	0	0	0	40	70	300	1	405	0	105	119	62
780	783	176	230219	230304	2	91	71	63	55	0	0	0	0	0	40	70	300	1	406	0	102	134	76
784	787	176	231745	232030	2	91	71	63	55	0	0	0	0	0	40	70	300	1	406	0	93	122	71
788	791	176	234629	234914	2	91	71	63	55	0	0	0	0	0	40	70	300	1	406	0	106	129	77
792	795	177	259	546	2	91	71	63	55	0	0	0	0	0	40	70	300	1	405	0	135	162	69
291	294	177	5744	5930	2	91	71	63	55	0	0	0	0	0	40	70	300	1	409	0	121	151	81
295	298	177	12133	12419	2	91	71	63	55	0	0	0	0	0	40	70	300	1	409	0	126	159	64
299	302	177	14213	14500	2	91	71	63	55	0	0	0	0	0	40	70	300	1	409	0	122	151	62
303	306	177	20255	20540	2	91	71	63	55	0	0	0	0	0	40	70	300	1	405	0	120	159	69
307	310	177	30444	30730	2	91	71	63	55	0	0	0	0	0	40	70	300	1	405	0	114	148	68
311	314	177	32118	32404	2	91	71	63	55	0	0	0	0	0	40	70	300	1	406	0	110	143	63
315	318	177	34200	34447	2	91	71	63	55	0	0	0	0	0	40	70	300	1	405	0	89	110	69
319	322	177	35835	40122	2	91	71	63	55	0	0	0	0	0	40	70	300	1	405	0	98	120	79
323	326	177	41832	42118	2	91	71	63	55	0	0	0	0	0	40	70	300	1	405	0	86	114	64
327	330	177	44415	44659	2	91	71	63	55	0	0	0	0	0	40	70	300	1	407	0	91	117	74
331	334	177	50047	50334	2	91	71	63	55	0	0	0	0	0	40	70	300	1	404	0	63	79	56
335	338	177	52134	52422	2	91	71	63	55	0	0	0	0	0	40	70	300	1	405	0	65	83	46
339	342	177	54321	54507	2	91	71	63	55	0	0	0	0	0	40	70	300	1	407	0	65	86	75
796	799	177	60142	60429	2	91	71	63	55	0	0	0	0	0	40	70	300	1	405	0	76	107	66
800	803	177	62229	62516	2	91	71	63	55	0	0	0	0	0	40	70	300	1	406	0	67	95	64

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID. DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	O/O ACC.
804	807	177	63906	64155	2	91	71	63	55	0	0	0	0	0	40	70	300	1	404	0	62	85	67
808	811	177	65956	70242	2	91	71	63	55	0	0	0	0	0	40	70	300	1	405	0	75	93	62
812	815	177	72321	72606	2	91	71	63	55	0	0	0	0	0	40	70	300	1	405	0	66	88	80
816	819	177	82530	82815	2	91	71	63	55	0	0	0	0	0	40	70	300	1	406	0	46	52	57
824	827	177	90213	90502	2	91	71	63	55	0	0	0	0	0	40	70	300	1	405	0	23	27	40
828	829	177	110111	110111	2	91	73	0	0	0	0	0	0	0	40	70	300	1	405	0	19	19	94
830	833	177	114331	114612	2	91	73	68	58	0	0	0	0	0	40	70	300	1	406	0	50	61	72
834	835	177	124345	124345	2	91	73	0	0	0	0	0	0	0	40	70	300	1	406	0	51	51	98
836	837	177	130558	130558	2	91	73	0	0	0	0	0	0	0	40	70	300	1	406	0	51	51	98
838	839	177	133622	133622	2	91	73	0	0	0	0	0	0	0	40	70	300	1	404	0	67	67	98
840	841	177	140424	140424	2	91	73	0	0	0	0	0	0	0	40	70	300	1	404	0	57	57	98
842	845	177	142443	142721	2	91	73	68	58	0	0	0	0	0	40	70	300	1	408	0	83	106	72
846	849	177	144720	144958	2	91	73	68	58	0	0	0	0	0	40	70	300	1	408	0	92	129	77
850	853	177	150306	150543	2	91	73	68	58	0	0	0	0	0	40	70	300	1	407	0	82	112	59
854	857	177	152645	152923	2	91	73	68	58	0	0	0	0	0	40	70	300	1	407	0	60	82	62
858	861	177	154626	154902	2	91	73	68	58	0	0	0	0	0	40	70	300	1	408	0	72	107	81
862	863	177	160356	160356	2	91	73	0	0	0	0	0	0	0	40	70	300	1	404	0	76	76	98
864	865	177	162510	162510	2	91	73	0	0	0	0	0	0	0	40	70	300	1	405	0	71	71	98
866	867	177	170243	170243	2	91	73	0	0	0	0	0	0	0	40	70	300	1	404	0	68	68	98
868	869	177	180227	180227	2	91	73	0	0	0	0	0	0	0	40	70	300	1	406	0	46	46	97
870	871	177	182859	182859	2	91	73	0	0	0	0	0	0	0	40	70	300	1	405	0	47	47	97
872	873	177	192837	192837	2	91	73	0	0	0	0	0	0	0	40	70	300	1	404	0	55	55	98
874	875	177	202818	202818	2	91	73	0	0	0	0	0	0	0	40	70	300	1	405	0	48	48	97
876	877	177	221102	221102	2	91	73	0	0	0	0	0	0	0	40	70	300	1	444	0	58	58	98
878	879	177	225726	225726	2	91	73	0	0	0	0	0	0	0	40	70	300	1	404	0	54	54	98
880	881	177	235002	235002	2	91	73	0	0	0	0	0	0	0	40	70	300	1	404	0	21	21	95

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	O/O ACC.
1177	1178	178	4945	4945	2	91	71	0	0	0	0	0	0	0	45	70	300	1	405	0	15	15	93
1179	1180	178	15454	15454	2	91	71	0	0	0	0	0	0	0	45	70	300	1	404	0	2	3	100
1181	1182	178	25340	25340	2	91	71	0	0	0	0	0	0	0	45	70	300	1	404	0	4	4	75
1183	1184	178	34918	34918	2	91	71	0	0	0	0	0	0	0	45	70	300	1	407	0	6	6	83
1185	1186	178	44923	44923	2	91	71	0	0	0	0	0	0	0	45	70	300	1	406	0	30	30	96
1187	1188	178	54924	54924	2	91	71	0	0	0	0	0	0	0	45	70	300	1	405	0	48	48	97
1189	1192	178	180106	180351	2	91	72	63	57	0	0	0	0	0	45	70	300	1	408	0	146	187	75
1193	1196	178	182148	182432	2	91	72	63	57	0	0	0	0	0	40	70	300	1	408	0	120	153	85
1197	1200	178	184228	184513	2	91	72	63	57	0	0	0	0	0	40	70	300	1	405	0	128	145	83
1201	1204	178	190025	190309	2	91	72	63	57	0	0	0	0	0	40	70	300	1	407	0	126	152	90
1205	1208	178	192105	192349	2	91	72	63	57	0	0	0	0	0	40	70	300	1	406	0	125	149	90
1209	1212	178	194145	194430	2	91	72	63	57	0	0	0	0	0	40	70	300	1	406	0	124	146	87
1213	1216	178	195533	195820	2	91	72	63	57	0	0	0	0	0	40	70	300	1	406	0	95	113	86
1217	1220	178	202004	202243	2	91	72	63	57	0	0	0	0	0	40	70	300	1	407	0	97	114	90
1221	1224	178	203959	204238	2	91	72	63	57	0	0	0	0	0	40	70	300	1	405	0	108	123	73
1225	1228	178	205957	210236	2	91	72	63	57	0	0	0	0	0	40	70	300	1	407	0	113	134	79
1229	1232	178	211954	212232	2	91	72	63	57	0	0	0	0	0	40	70	300	1	407	0	136	153	66
1233	1236	178	213949	214228	2	91	72	63	57	0	0	0	0	0	40	70	300	1	406	0	126	158	78
1237	1240	178	215944	220222	2	91	72	63	57	0	0	0	0	0	40	70	300	1	406	0	144	195	85
1241	1244	178	221940	222219	2	91	72	63	57	0	0	0	0	0	40	70	300	1	407	0	143	176	77
1245	1248	178	223935	224215	2	91	72	63	57	0	0	0	0	0	40	70	300	1	407	0	133	182	70
1249	1252	178	225932	230211	2	91	72	63	57	0	0	0	0	0	40	70	300	1	406	0	148	194	70
1253	1256	178	231927	232207	2	91	72	63	57	0	0	0	0	0	40	70	300	1	406	0	192	245	75
1257	1260	178	234042	234322	2	91	72	63	57	0	0	0	0	0	40	70	300	1	406	0	155	222	69
1261	1264	179	40	320	2	91	72	63	57	0	0	0	0	0	35	70	300	1	405	0	174	228	72
1265	1268	179	2044	2324	2	91	72	63	57	0	0	0	0	0	35	70	300	1	406	0	156	204	70

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	O/O ACC.
1269	1272	179	11526	11806	2	91	72	63	57	0	0	0	0	0	35	70	300	1	406	0	115	161	79
1273	1276	179	13935	14216	2	91	72	63	57	0	0	0	0	0	35	70	300	1	408	0	93	119	68
1277	1280	179	20909	21152	2	91	72	63	57	0	0	0	0	0	35	70	300	1	406	0	69	86	67
1281	1284	179	22114	22356	2	91	72	63	57	0	0	0	0	0	35	70	300	1	408	0	59	79	77
1285	1288	179	24119	24406	2	91	72	63	57	0	0	0	0	0	35	70	300	1	404	0	55	69	57
1289	1292	179	30136	30418	2	91	72	63	57	0	0	0	0	0	35	70	300	1	408	0	34	45	79
1293	1296	179	32150	32430	2	91	72	63	57	0	0	0	0	0	35	70	300	1	407	0	29	34	85
1297	1300	179	34200	34358	2	91	72	63	57	0	0	0	0	0	35	70	300	1	406	0	19	20	64
1301	1304	179	40128	40412	2	91	72	63	57	0	0	0	0	0	35	70	300	1	407	0	19	23	86
1305	1307	179	42145	42427	1	91	72	63	0	0	0	0	0	0	35	70	300	1	407	0	38	39	92
1309	1311	179	44205	44447	1	91	72	63	0	0	0	0	0	0	35	70	300	1	408	0	31	33	93
1313	1316	179	60304	60548	2	91	72	63	57	0	0	0	0	0	35	70	300	1	406	0	60	72	83
1317	1320	179	61920	62204	2	91	72	63	57	0	0	0	0	0	35	70	300	1	408	0	66	85	85
1321	1324	179	63943	64225	2	91	72	63	57	0	0	0	0	0	35	70	300	1	406	0	64	79	81
1325	1328	179	70012	70257	2	91	72	63	57	0	0	0	0	0	35	70	300	1	405	0	52	63	77
1329	1332	179	72044	72328	2	91	72	63	57	0	0	0	0	0	35	70	300	1	407	0	58	66	83
1333	1336	179	73953	74237	2	91	72	63	57	0	0	0	0	0	35	70	300	1	406	0	38	42	71
1337	1340	179	80025	80309	2	91	72	63	57	0	0	0	0	0	35	70	300	1	406	0	34	42	80
1341	1343	179	82058	82342	1	91	72	63	0	0	0	0	0	0	35	70	300	1	405	0	25	27	85
1344	1347	179	84130	84415	2	91	72	63	57	0	0	0	0	0	35	70	300	1	405	0	29	33	84
1348	1349	179	85757	85757	2	91	72	0	0	0	0	0	0	0	35	70	300	1	405	0	27	27	96
1350	1351	179	92116	92116	2	91	75	0	0	0	0	0	0	0	35	70	300	1	405	0	15	15	93
1352	1353	179	94031	94031	2	91	75	0	0	0	0	0	0	0	35	70	300	1	404	0	19	19	94
1354	1355	179	95945	95945	2	91	75	0	0	0	0	0	0	0	35	70	300	1	403	0	30	30	96
1356	1357	179	101902	101902	2	91	75	0	0	0	0	0	0	0	35	70	300	1	405	0	24	24	95
1358	1359	179	103939	103939	2	91	75	0	0	0	0	0	0	0	35	70	300	1	403	0	20	20	94

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
1360	1361	179	110015	110015	2	91	75	0	0	0	0	0	0	0	35	70	300	1	404	0	31	31	96
1362	1363	179	111924	111924	2	91	75	0	0	0	0	0	0	0	35	70	300	1	405	0	36	36	97
1364	1365	179	114034	114034	2	91	75	0	0	0	0	0	0	0	35	70	300	1	405	0	39	39	97
1366	1369	179	115916	120155	2	91	75	67	60	0	0	0	0	0	35	70	300	1	407	0	45	60	78
1370	1373	179	121921	122202	2	91	75	67	60	0	0	0	0	0	35	70	300	1	406	0	48	56	57
1374	1377	179	124049	124329	2	91	75	67	60	0	0	0	0	0	35	70	300	1	406	0	57	66	54
1378	1381	179	130055	130233	2	91	75	67	60	0	0	0	0	0	35	70	300	1	405	0	47	55	50
1382	1385	179	132101	132341	2	91	75	67	60	0	0	0	0	0	35	70	300	1	404	0	74	86	75
1386	1389	179	134107	134349	2	91	75	67	60	0	0	0	0	0	35	70	300	1	406	0	82	89	86
1390	1393	179	135835	140115	2	91	75	67	60	0	0	0	0	0	35	70	300	1	406	0	101	119	87
1394	1397	179	141844	142124	2	91	75	67	60	0	0	0	0	0	35	70	300	1	407	0	128	144	92
1398	1401	179	143850	144130	2	91	75	67	60	0	0	0	0	0	35	70	300	1	406	0	140	160	84
1402	1405	179	145859	150139	2	91	75	67	60	0	0	0	0	0	35	70	300	1	406	0	203	228	89
1406	1409	179	152026	152306	2	91	75	67	60	0	0	0	0	0	35	70	300	1	405	0	220	256	88
1410	1413	179	154032	154313	2	91	75	67	60	0	0	0	0	0	35	70	300	1	405	0	243	279	87
1414	1415	179	155940	155940	2	91	75	0	0	0	0	0	0	0	35	70	300	1	406	0	255	255	99
1416	1419	179	161646	161927	2	91	75	67	60	0	0	0	0	0	35	70	300	1	407	0	255	326	84
1420	1423	179	164334	164618	2	91	75	67	60	0	0	0	0	0	35	70	300	1	407	0	244	327	89
1424	1427	179	165912	170157	2	91	75	67	60	0	0	0	0	0	35	70	300	1	406	0	248	313	83
1428	1431	179	171950	172235	2	91	75	67	60	0	0	0	0	0	35	70	300	1	405	0	243	311	85
1432	1435	179	174007	174250	2	91	75	67	60	0	0	0	0	0	35	70	300	1	407	0	216	278	81
1436	1439	179	175929	180211	2	91	75	67	60	0	0	0	0	0	35	70	300	1	408	0	223	285	82
1440	1443	179	184253	184318	2	91	75	67	60	0	0	0	0	0	35	70	300	1	407	0	199	235	87
1444	1447	179	190243	190530	2	91	75	67	60	0	0	0	0	0	35	70	300	1	406	0	192	233	92
1448	1451	179	191925	192213	2	91	75	67	60	0	0	0	0	0	35	70	300	1	407	0	213	254	91
1452	1455	179	194021	194308	2	91	75	67	60	0	0	0	0	0	35	70	300	1	408	0	223	268	93

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
1456	1459	179	200012	200036	2	91	75	67	60	0	0	0	0	0	35	70	300	1	407	0	209	255	91
1460	1463	179	202459	202747	2	91	75	67	60	0	0	0	0	0	35	70	300	1	405	0	162	169	97
1464	1466	179	203730	204017	1	91	75	67	0	0	0	0	0	0	35	70	300	1	407	0	118	118	95
1467	1469	179	210237	210525	1	91	75	67	0	0	0	0	0	0	35	70	300	1	407	0	77	78	96
1470	1473	179	215133	215158	2	91	73	65	57	0	0	0	0	0	35	70	300	1	405	0	51	55	83
1474	1475	179	222006	222006	2	91	73	0	0	0	0	0	0	0	35	70	300	1	404	0	36	36	97
1476	1477	179	223913	223913	2	91	73	0	0	0	0	0	0	0	35	70	300	1	405	0	32	32	96
1478	1479	179	225817	225817	2	91	73	0	0	0	0	0	0	0	35	70	300	1	405	0	23	23	95
1480	1481	180	2020	2020	2	91	73	0	0	0	0	0	0	0	35	70	300	1	404	0	76	76	98
1	4	180	30453	30529	1	91	73	65	57	0	0	0	0	0	45	70	300	1	404	0	284	316	89
5	8	180	30606	30644	1	91	73	65	57	0	0	0	0	0	45	70	300	1	399	0	291	325	89
9	13	180	41344	41434	1	91	73	65	57	49	0	0	0	0	40	70	300	1	400	0	291	330	91
14	17	180	53844	54123	2	91	73	65	57	0	0	0	0	0	45	70	300	1	405	0	299	345	92
18	21	180	63821	64103	2	91	73	65	57	0	0	0	0	0	45	70	300	1	406	0	291	355	91
22	25	180	70231	70513	2	91	73	65	57	0	0	0	0	0	45	70	300	1	405	0	285	317	92
26	29	180	71958	72239	2	91	73	65	57	0	0	0	0	0	45	70	300	1	406	0	277	296	95
30	33	180	74011	74156	2	91	73	65	57	0	0	0	0	0	45	70	300	1	406	0	288	315	93
34	37	180	74756	74939	2	91	73	65	57	0	0	0	0	0	45	70	300	1	405	0	306	332	94
38	41	180	81840	82019	2	91	70	60	52	0	0	0	0	0	40	70	300	1	407	0	263	272	95
42	45	180	83913	84056	2	91	70	60	52	0	0	0	0	0	45	70	300	1	406	0	308	324	94
46	49	180	85944	90126	2	91	70	60	52	0	0	0	0	0	45	70	300	1	406	0	323	349	94
50	53	180	90242	90423	2	91	70	60	52	0	0	0	0	0	45	70	300	1	406	0	298	331	95
54	57	180	102041	102224	2	91	70	60	52	0	0	0	0	0	45	70	300	1	406	0	300	337	93
58	61	180	103841	104024	2	91	70	60	52	0	0	0	0	0	45	70	300	1	408	0	269	296	95
62	65	180	105913	110056	2	91	70	60	52	0	0	0	0	0	45	70	300	1	408	0	246	266	97
66	69	180	111941	112125	2	91	70	60	52	0	0	0	0	0	45	70	300	1	404	0	198	215	91

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
70	73	180	120042	120224	2	91	70	60	52	0	0	0	0	0	45	70	300	1	399	0	165	186	94
74	77	180	121842	122018	2	91	70	60	52	0	0	0	0	0	45	70	300	1	402	0	144	164	86
78	81	180	123856	124134	2	91	70	60	52	0	0	0	0	0	45	70	300	1	400	0	144	164	89
82	85	180	135942	140223	2	91	70	60	52	0	0	0	0	0	45	70	300	1	402	0	104	117	80
86	89	180	141942	142123	2	91	70	60	52	0	0	0	0	0	45	70	300	1	405	0	91	105	86
90	93	180	143943	144124	2	91	70	60	52	0	0	0	0	0	45	70	300	1	400	0	68	82	75
94	97	180	145944	150126	2	91	70	60	52	0	0	0	0	0	40	70	300	1	402	0	66	82	75
98	101	180	151947	152128	2	91	70	60	52	0	0	0	0	0	40	70	300	1	403	0	68	84	77
102	105	180	153946	154126	2	91	70	60	52	0	0	0	0	0	45	70	300	1	402	0	62	79	83
106	109	180	155819	155959	2	91	70	60	52	0	0	0	0	0	45	70	300	1	400	0	59	71	87
110	113	180	170027	170053	2	91	70	60	52	0	0	0	0	0	45	70	300	1	401	0	106	112	75
114	117	180	181818	181958	2	91	70	60	52	0	0	0	0	0	45	70	300	1	400	0	89	103	84
118	121	180	184045	184226	2	91	70	60	52	0	0	0	0	0	45	70	300	1	400	0	90	109	81
122	125	180	185942	190219	2	91	70	60	52	0	0	0	0	0	45	70	300	1	401	0	86	103	76
126	129	180	191912	192150	2	91	70	60	52	0	0	0	0	0	45	70	300	1	400	0	84	108	76
130	133	180	193842	194119	2	91	70	60	52	0	0	0	0	0	45	70	300	1	401	0	70	82	73
134	137	180	200207	200445	2	91	70	60	52	0	0	0	0	0	45	70	300	1	401	0	95	116	73
138	141	180	202139	202415	2	91	70	60	52	0	0	0	0	0	45	70	300	1	401	0	96	122	66
142	145	180	204110	204345	2	91	70	60	52	0	0	0	0	0	45	70	300	1	400	0	99	128	62
146	149	180	205920	210158	2	91	70	60	52	0	0	0	0	0	45	70	300	1	401	0	91	124	66
150	153	180	211850	212127	2	91	70	60	52	0	0	0	0	0	45	70	300	1	401	0	78	97	43
154	157	180	220130	220355	2	91	72	61	53	0	0	0	0	0	45	70	300	1	402	0	56	78	67
158	161	180	230759	230824	2	91	72	61	53	0	0	0	0	0	45	70	300	1	400	0	48	62	56
162	165	180	232236	232919	2	91	72	61	53	0	0	0	0	0	45	70	300	1	401	0	40	55	54
1482	1483	181	2010	2010	2	91	72	0	0	0	0	0	0	0	45	70	300	1	400	0	22	22	95
1484	1485	181	10125	10125	2	91	72	0	0	0	0	0	0	0	45	70	300	1	399	0	12	12	91

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	O/O ACC.
1486	1487	181	15255	15255	2	91	72	0	0	0	0	0	0	0	45	70	300	1	398	0	12	12	91
1488	1489	181	30141	30141	2	91	72	0	0	0	0	0	0	0	45	70	300	1	399	0	41	41	97
1490	1491	181	35913	35913	2	91	72	0	0	0	0	0	0	0	45	70	300	1	399	0	29	29	96
1492	1493	181	42946	42946	2	91	72	0	0	0	0	0	0	0	45	70	300	1	399	0	26	26	96
1494	1495	181	45955	45955	2	91	72	0	0	0	0	0	0	0	45	70	300	1	399	0	33	33	96
1496	1497	181	52905	52905	2	91	72	0	0	0	0	0	0	0	45	70	300	1	400	0	36	36	97
1498	1501	181	55937	60003	2	91	72	61	53	0	0	0	0	0	45	70	300	1	402	0	43	49	81
1502	1505	181	62015	62201	2	91	72	61	53	0	0	0	0	0	45	70	300	1	402	0	46	52	82
1506	1509	181	64104	64350	2	91	72	61	53	0	0	0	0	0	45	70	300	1	403	0	43	51	84
1510	1513	181	65955	70020	2	91	72	61	53	0	0	0	0	0	45	70	300	1	400	0	37	43	81
1514	1517	181	71548	71734	2	91	72	61	53	0	0	0	0	0	45	70	300	1	402	0	27	33	96
1518	1521	181	73924	74209	2	91	72	61	53	0	0	0	0	0	45	70	300	1	401	0	32	40	79
1522	1525	181	80012	80258	2	91	72	61	53	0	0	0	0	0	45	70	300	1	402	0	38	49	65
1526	1529	181	82105	82350	2	91	72	61	53	0	0	0	0	0	45	70	300	1	402	0	32	41	70
1530	1533	181	84123	84404	2	91	72	61	53	0	0	0	0	0	45	70	300	1	402	0	34	42	80
1534	1537	181	90034	90316	2	91	72	61	53	0	0	0	0	0	45	70	300	1	401	0	29	40	72
1538	1541	181	91905	92147	2	91	72	61	53	0	0	0	0	0	45	70	300	1	401	0	33	40	67
1542	1545	181	93917	94158	2	91	72	61	53	0	0	0	0	0	45	70	300	1	401	0	32	40	60
1546	1549	181	95928	100208	2	91	72	61	53	0	0	0	0	0	45	70	300	1	401	0	23	30	83
1550	1551	181	102205	102205	2	91	72	0	0	0	0	0	0	0	45	70	300	1	398	0	24	24	95
1552	1553	181	105955	105955	2	91	72	0	0	0	0	0	0	0	45	70	300	1	398	0	25	25	95
1554	1555	181	112237	112237	2	91	72	0	0	0	0	0	0	0	40	70	300	1	398	0	23	23	95
1556	1557	181	120143	120143	2	91	72	0	0	0	0	0	0	0	40	70	300	1	399	0	21	21	95
1558	1559	181	121856	121856	2	91	72	0	0	0	0	0	0	0	40	70	300	1	398	0	24	24	95
1560	1561	181	124025	124025	2	91	72	0	0	0	0	0	0	0	40	70	300	1	397	0	22	22	95
1562	1563	181	130153	130153	2	91	72	0	0	0	0	0	0	0	40	70	300	1	397	0	24	24	95

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
1564	1565	181	132320	132320	2	91	72	0	0	0	0	0	0	0	40	70	300	1	398	0	31	31	96
1566	1567	181	134029	134029	2	91	72	0	0	0	0	0	0	0	40	70	300	1	397	0	24	24	95
1568	1569	181	140258	140258	2	91	72	0	0	0	0	0	0	0	40	70	300	1	399	0	37	37	97
1570	1571	181	141908	141908	2	91	72	0	0	0	0	0	0	0	40	70	300	1	397	0	28	28	96
1572	1573	181	144035	144035	2	91	72	0	0	0	0	0	0	0	40	70	300	1	398	0	33	33	96
1574	1575	181	150203	150203	2	91	72	0	0	0	0	0	0	0	40	70	300	1	398	0	28	28	96
1576	1577	181	151912	151912	2	91	72	0	0	0	0	0	0	0	40	70	300	1	399	0	25	25	95
1578	1579	181	154038	154038	2	91	72	0	0	0	0	0	0	0	40	70	300	1	400	0	24	24	95
1580	1581	181	160204	160204	2	91	72	0	0	0	0	0	0	0	40	70	300	1	400	0	40	40	97
1582	1583	181	162330	162330	2	91	72	0	0	0	0	0	0	0	40	70	300	1	400	0	38	38	97
1584	1585	181	170105	170105	2	91	72	0	0	0	0	0	0	0	40	70	300	1	398	0	40	40	97
1586	1587	181	171914	171914	2	91	72	0	0	0	0	0	0	0	40	70	300	1	399	0	40	40	97
1588	1589	181	174045	174045	2	91	72	0	0	0	0	0	0	0	40	70	300	1	400	0	46	46	97
1590	1591	181	180215	180215	2	91	72	0	0	0	0	0	0	0	40	70	300	1	400	0	47	50	100
1592	1593	181	182029	182029	2	91	72	0	0	0	0	0	0	0	40	70	300	1	407	0	53	53	98
1594	1595	181	184124	184124	2	91	72	0	0	0	0	0	0	0	40	70	300	1	399	0	55	55	98
1596	1597	181	185958	185958	2	91	72	0	0	0	0	0	0	0	40	70	300	1	399	0	51	51	98
1598	1599	181	192053	192053	2	91	72	0	0	0	0	0	0	0	40	70	300	1	399	0	81	81	98
1600	1601	181	193928	193928	2	91	72	0	0	0	0	0	0	0	40	70	300	1	400	0	97	97	98
1602	1604	181	195939	200220	1	91	72	63	0	0	0	0	0	0	40	70	300	1	401	0	80	81	86
1605	1608	181	201945	202225	2	91	72	63	55	0	0	0	0	0	40	70	300	1	401	0	98	105	73
1609	1612	181	203951	204231	2	91	72	63	55	0	0	0	0	0	40	70	300	1	401	0	96	120	88
1613	1616	181	205957	210237	2	91	72	63	55	0	0	0	0	0	40	70	300	1	400	0	90	108	87
1617	1620	181	211902	211926	2	91	72	63	55	0	0	0	0	0	40	70	300	1	401	0	90	117	76
1621	1624	181	214128	214408	2	91	72	63	55	0	0	0	0	0	40	70	300	1	402	0	93	113	82
1625	1626	181	220133	220133	2	91	72	0	0	0	0	0	0	0	40	70	300	1	400	0	100	100	98

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
1627	1630	181	220254	220533	2	91	72	63	55	0	0	0	0	0	40	70	300	1	400	0	98	122	74
1631	1634	181	221859	222141	2	91	72	63	55	0	0	0	0	0	40	70	300	1	401	0	95	123	82
1635	1638	181	223906	224148	2	91	72	63	55	0	0	0	0	0	40	70	300	1	401	0	90	111	81
1639	1642	181	225912	230154	2	91	72	63	55	0	0	0	0	0	40	70	300	1	399	0	108	140	82
1643	1646	181	232200	232441	2	91	72	63	55	0	0	0	0	0	40	70	300	1	400	0	109	148	82
1647	1650	181	234223	234503	2	91	72	63	55	0	0	0	0	0	40	70	300	1	400	0	117	150	79
1651	1654	182	212	452	2	91	74	63	59	0	0	0	0	0	40	70	300	1	399	0	98	133	81
1655	1658	182	2639	2920	2	91	74	63	59	0	0	0	0	0	40	70	300	1	400	0	96	114	80
1659	1662	182	3844	4125	2	91	74	63	59	0	0	0	0	0	40	70	300	1	400	0	93	109	88
1663	1666	182	5849	10127	2	91	74	63	59	0	0	0	0	0	40	70	300	1	399	0	104	123	76
1667	1670	182	11841	12118	2	91	74	63	59	0	0	0	0	0	40	70	300	1	400	0	106	127	83
1671	1674	182	14332	14612	2	91	74	63	59	0	0	0	0	0	40	70	300	1	400	0	130	154	85
1675	1677	182	21324	21445	2	91	74	63	0	0	0	0	0	0	40	70	300	1	400	0	147	167	84
1678	1681	182	21628	21912	2	91	74	63	59	0	0	0	0	0	40	70	300	1	400	0	154	187	78
1682	1685	182	24151	24431	2	91	74	63	59	0	0	0	0	0	40	70	300	1	401	0	165	205	76
1686	1689	182	25808	30051	2	91	74	63	59	0	0	0	0	0	40	70	300	1	403	0	145	184	70
1690	1693	182	32236	32520	2	91	74	63	59	0	0	0	0	0	40	70	300	1	400	0	126	158	73
1694	1697	182	33858	34141	2	91	74	63	59	0	0	0	0	0	40	70	300	1	400	0	121	149	67
1698	1701	182	35924	40208	2	91	74	63	59	0	0	0	0	0	40	70	300	1	401	0	119	166	80
1702	1705	182	41951	42232	2	91	74	63	59	0	0	0	0	0	40	70	300	1	401	0	126	173	79
1706	1709	182	44021	44304	2	91	74	63	59	0	0	0	0	0	40	70	300	1	401	0	127	170	75
1710	1713	182	50050	50331	2	91	74	63	59	0	0	0	0	0	40	70	300	1	401	0	128	168	74
1714	1717	182	52115	52400	2	91	74	63	59	0	0	0	0	0	40	70	300	1	401	0	124	151	72
1718	1721	182	54145	54428	2	91	74	63	59	0	0	0	0	0	40	70	300	1	402	0	113	155	69
1722	1725	182	60213	60455	2	91	74	63	59	0	0	0	0	0	40	70	300	1	401	0	121	161	80
1726	1729	182	61835	62118	2	91	74	63	59	0	0	0	0	0	40	70	300	1	401	0	127	177	74

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	O/O ACC.
1730	1733	182	63905	64147	2	91	74	63	59	0	0	0	0	0	40	70	300	1	402	0	114	144	68
1734	1737	182	65933	70217	2	91	74	63	59	0	0	0	0	0	40	70	300	1	402	0	96	126	69
1738	1741	182	72005	72248	2	91	74	63	59	0	0	0	0	0	40	70	300	1	401	0	91	112	66
1742	1745	182	73859	74144	2	91	74	63	59	0	0	0	0	0	40	70	300	1	402	0	67	80	54
1746	1749	182	75937	80221	2	91	74	63	59	0	0	0	0	0	40	70	300	1	401	0	76	104	80
1750	1753	182	82006	82248	2	91	74	63	59	0	0	0	0	0	40	70	300	1	402	0	65	80	39
1754	1757	182	84032	84316	2	91	74	63	59	0	0	0	0	0	40	70	300	1	402	0	49	61	62
1758	1761	182	90045	90325	2	91	74	63	59	0	0	0	0	0	40	70	300	1	399	0	40	44	72
1762	1765	182	92043	92321	2	91	74	63	59	0	0	0	0	0	40	70	300	1	399	0	33	37	70
1766	1769	182	94039	94317	2	91	74	63	59	0	0	0	0	0	45	70	300	1	400	0	41	57	77
1770	1771	182	100201	100201	2	91	74	0	0	0	0	0	0	0	40	70	300	1	399	0	38	38	97
1772	1775	182	100321	100600	2	91	74	63	59	0	0	0	0	0	40	70	300	1	400	0	41	52	76
1776	1779	182	101921	102200	2	91	74	63	59	0	0	0	0	0	40	70	300	1	400	0	48	61	85
1780	1781	182	115234	115234	2	91	73	0	0	0	0	0	0	0	40	70	300	1	398	0	31	31	96
1782	1783	182	115355	115355	2	91	73	0	0	0	0	0	0	0	40	70	300	1	398	0	30	30	96
1784	1787	182	121516	121757	2	91	73	65	57	0	0	0	0	0	40	70	300	1	400	0	34	44	52
1788	1791	182	123916	124156	2	91	73	65	57	0	0	0	0	0	40	70	300	1	400	0	44	61	70
1792	1795	182	125919	130158	2	91	73	65	57	0	0	0	0	0	40	70	300	1	399	0	48	59	62
1796	1799	182	131921	132202	2	91	73	65	57	0	0	0	0	0	40	70	300	1	399	0	43	57	78
1800	1803	182	134042	134323	2	91	73	65	57	0	0	0	0	0	40	70	300	1	399	0	46	69	72
1804	1807	182	140045	140324	2	91	73	65	57	0	0	0	0	0	40	70	300	1	400	0	43	65	78
1808	1811	182	142046	142326	2	91	73	65	57	0	0	0	0	0	40	70	300	1	400	0	52	74	77
1812	1815	182	145531	145812	2	91	73	65	57	0	0	0	0	0	40	70	300	1	402	0	54	73	78
1816	1819	182	151934	152213	2	91	73	65	57	0	0	0	0	0	40	70	300	1	401	0	48	68	76
1820	1823	182	153936	154216	2	91	73	65	57	0	0	0	0	0	40	70	300	1	400	0	61	86	73
1824	1827	182	155640	155919	2	91	73	65	57	0	0	0	0	0	40	70	300	1	401	0	57	87	78

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	O/O ACC.
1828	1831	182	162244	162526	2	91	73	65	57	0	0	0	0	0	40	70	300	1	401	0	75	100	62
1832	1835	182	165944	170009	2	91	73	65	57	0	0	0	0	0	40	70	300	1	400	0	47	76	72
1836	1837	182	172133	172133	2	91	73	0	0	0	0	0	0	0	40	70	300	1	399	0	48	48	97
1838	1839	182	174101	174101	2	91	73	0	0	0	0	0	0	0	40	70	300	1	400	0	43	43	97
1840	1841	182	180025	180025	2	91	73	0	0	0	0	0	0	0	40	70	300	1	398	0	50	50	97
1842	1843	182	181950	181950	2	91	73	0	0	0	0	0	0	0	40	70	300	1	398	0	39	39	97
1844	1845	182	184139	184139	2	91	73	0	0	0	0	0	0	0	40	70	300	1	399	0	35	35	97
1846	1847	182	190330	190330	2	91	73	0	0	0	0	0	0	0	40	70	300	1	398	0	40	40	97
1848	1849	182	191704	191704	2	91	73	0	0	0	0	0	0	0	40	70	300	1	398	0	42	42	97
1850	1851	182	194056	194056	2	91	73	0	0	0	0	0	0	0	40	70	300	1	397	0	34	34	97
1852	1853	182	200226	200226	2	91	73	0	0	0	0	0	0	0	40	70	300	1	399	0	25	25	95
1854	1855	182	201833	201833	2	91	73	0	0	0	0	0	0	0	40	70	300	1	399	0	24	24	95

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	O/O ACC.
5000	5002	150	152515	152630	1	91	76	70	0	0	0	0	0	0	25	0	345	2	448	1	22	23	95
5003	5005	150	171100	171200	1	91	76	70	0	0	0	0	0	0	25	0	345	2	448	1	32	33	100
5006	5008	150	174900	174930	1	91	76	70	0	0	0	0	0	0	20	0	345	2	450	1	40	43	100
5009	5011	150	194040	194200	1	91	76	70	0	0	0	0	0	0	20	0	345	2	448	1	21	22	95
5012	5013	150	195800	195800	2	91	76	0	0	0	0	0	0	0	20	0	345	2	447	1	12	12	100
5014	5017	150	222300	222500	1	91	76	70	64	0	0	0	0	0	20	0	345	2	443	1	38	43	88
5018	5021	151	23120	23240	1	91	76	70	64	0	0	0	0	0	25	0	345	2	435	0	21	29	79
5022	5025	151	25710	25815	2	91	76	70	64	0	0	0	0	0	25	0	345	2	435	1	28	31	93
5026	5028	151	32815	32900	1	91	76	70	0	0	0	0	0	0	20	0	345	2	438	1	24	28	85
5029	5032	151	40100	40130	2	91	76	70	64	0	0	0	0	0	20	0	345	2	436	1	42	45	79
5033	5035	151	43430	43530	1	91	76	70	0	0	0	0	0	0	20	0	345	2	435	1	69	73	100
5036	5038	151	51830	51920	1	91	76	70	0	0	0	0	0	0	20	0	345	2	438	1	56	59	91
5039	5042	151	53740	53900	1	91	76	70	64	0	0	0	0	0	20	0	345	2	438	1	49	52	88
5043	5045	151	55700	55800	1	91	76	70	0	0	0	0	0	0	25	0	345	2	440	1	71	81	97
5046	5047	151	74300	74320	1	91	76	0	0	0	0	0	0	0	25	0	345	2	442	1	23	23	100
5048	5049	151	80000	80000	2	91	76	0	0	0	0	0	0	0	20	0	345	2	439	1	21	21	100
5050	5051	151	82100	82100	2	91	76	0	0	0	0	0	0	0	25	0	345	2	437	1	18	18	100
5052	5054	151	84300	84325	2	91	76	70	0	0	0	0	0	0	25	0	345	2	441	1	29	30	96
5055	5056	151	85900	85900	2	91	76	0	0	0	0	0	0	0	20	0	345	2	440	1	36	36	100
5057	5058	151	95900	95900	2	91	76	0	0	0	0	0	0	0	20	0	345	2	442	1	27	27	100
5059	5061	151	102500	102620	1	91	76	70	0	0	0	0	0	0	25	0	345	2	440	1	26	28	96
5062	5065	151	112040	112230	1	91	76	70	64	0	0	0	0	0	25	0	345	2	440	1	54	62	88
5066	5069	151	123900	124030	1	91	76	70	64	0	0	0	0	0	25	0	345	2	440	0	57	70	94
5070	5071	151	125930	125930	2	91	76	0	0	0	0	0	0	0	25	0	345	2	442	0	47	47	100
5072	5074	151	130700	131250	1	91	76	70	0	0	0	0	0	0	25	0	345	2	435	1	29	33	90
5075	5078	151	141600	141700	1	91	76	70	64	0	0	0	0	0	20	0	345	2	431	1	13	14	85

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100.	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
5079	5082	151	144840	145000	1	91	76	70	64	0	0	0	0	0	20	0	345	2	430	1	22	25	95
5083	5086	151	152110	152230	1	91	76	70	64	0	0	0	0	0	20	0	345	2	436	1	23	29	93
5087	5089	151	160000	160020	2	91	76	70	0	0	0	0	0	0	20	0	345	2	429	1	20	20	89
5090	5092	151	162500	162550	1	91	76	70	0	0	0	0	0	0	20	0	345	2	435	1	18	19	89
5093	5095	151	172000	172100	1	91	76	70	0	0	0	0	0	0	20	0	345	2	432	1	20	21	85
5096	5098	151	174840	174900	2	91	76	70	0	0	0	0	0	0	20	0	345	2	434	1	33	34	97
5099	5100	151	175900	175900	2	91	76	0	0	0	0	0	0	0	20	0	345	2	434	1	20	20	100
5101	5103	151	184900	185020	1	91	76	70	0	0	0	0	0	0	20	0	345	2	432	1	50	51	98
5104	5107	151	191700	191800	2	91	76	70	64	0	0	0	0	0	20	0	345	2	432	1	29	30	86
5108	5110	151	201800	201900	1	91	76	70	0	0	0	0	0	0	20	0	345	2	436	1	20	21	100
5111	5112	151	205700	205700	2	91	76	0	0	0	0	0	0	0	20	0	345	2	435	1	28	28	100
5113	5116	151	215130	215320	1	91	76	70	64	0	0	0	0	0	20	0	345	2	437	0	43	52	80
5117	5118	151	222300	222300	2	91	76	0	0	0	0	0	0	0	20	0	345	2	434	1	30	30	100
5119	5121	151	230630	230700	2	91	76	70	0	0	0	0	0	0	20	0	345	2	436	0	53	63	98
5122	5123	152	4210	4210	2	91	76	0	0	0	0	0	0	0	20	0	345	2	437	1	75	75	100
5124	5127	152	13430	13630	1	91	76	70	64	0	0	0	0	0	20	0	345	2	434	1	56	68	92
5128	5131	152	20400	20500	2	91	76	70	64	0	0	0	0	0	20	0	345	2	437	1	63	69	88
5134	5138	152	55830	60020	1	91	76	70	64	58	0	0	0	0	20	0	345	2	435	1	149	175	87
5139	5143	152	72040	72200	2	91	76	70	64	58	0	0	0	0	20	0	345	2	436	1	148	178	89
5144	5145	152	73220	73220	2	91	76	0	0	0	0	0	0	0	20	0	345	2	434	1	142	142	100
5146	5147	152	83030	83030	2	91	76	0	0	0	0	0	0	0	20	0	345	2	436	0	114	114	100
5148	5149	152	90430	90430	2	91	76	0	0	0	0	0	0	0	20	0	345	2	435	0	123	123	100
5150	5151	152	95120	95120	2	91	76	0	0	0	0	0	0	0	20	0	345	2	434	1	102	102	100
5152	5155	152	101000	101130	1	91	76	70	64	0	0	0	0	0	20	0	345	2	436	1	87	102	96
5156	5157	152	103130	103130	2	91	76	0	0	0	0	0	0	0	20	0	345	2	436	1	80	80	100
5158	5160	152	111730	111800	2	91	76	70	0	0	0	0	0	0	20	0	345	2	435	1	67	72	98

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
5161	5164	152	115240	115400	1	91	76	70	64	0	0	0	0	0	20	0	345	2	434	1	40	50	97
5165	5166	152	125420	125420	2	91	76	0	0	0	0	0	0	0	20	0	345	2	436	1	31	31	100
5167	5168	152	132520	132520	2	91	76	0	0	0	0	0	0	0	20	0	345	2	436	1	44	44	100
5169	5172	152	141400	141530	1	91	76	70	64	0	0	0	0	0	20	0	345	2	436	1	26	31	93
5173	5175	152	160400	160500	1	91	76	70	0	0	0	0	0	0	20	0	345	2	436	1	22	24	100
5176	5177	152	162720	162720	2	91	76	0	0	0	0	0	0	0	20	0	345	2	436	1	18	18	100
5178	5182	152	184700	184800	2	91	76	70	64	58	0	0	0	0	20	0	345	2	455	1	16	20	100
5183	5185	152	201240	201330	1	91	76	70	0	0	0	0	0	0	20	0	345	2	454	1	22	22	90
5186	5187	152	205700	205700	2	91	76	0	0	0	0	0	0	0	20	0	345	2	455	1	19	19	100
5188	5191	152	214540	214630	2	91	76	70	64	0	0	0	0	0	20	0	345	2	457	1	23	27	88
5192	5194	152	220100	220200	1	91	76	70	0	0	0	0	0	0	20	0	345	2	457	1	29	30	96
5195	5196	152	222100	222100	2	91	76	0	0	0	0	0	0	0	20	0	345	2	457	1	25	25	100
5197	5198	152	230500	230500	2	91	76	0	0	0	0	0	0	0	20	0	345	2	458	1	26	26	100
5199	5200	153	4930	4930	2	91	76	0	0	0	0	0	0	0	20	0	345	2	455	1	23	23	100
5201	5204	153	11700	11810	1	91	76	70	64	0	0	0	0	0	20	0	345	2	455	1	53	64	90
5205	5206	153	13050	13050	2	91	76	0	0	0	0	0	0	0	20	0	345	2	457	1	39	39	100
5207	5211	153	20940	21110	1	91	76	70	64	58	0	0	0	0	20	0	345	2	456	1	55	63	87
5212	5215	153	23200	23310	1	91	76	70	64	0	0	0	0	0	20	0	345	2	456	1	34	42	95
5216	5219	153	25300	25400	1	91	76	70	64	0	0	0	0	0	20	0	345	2	457	1	38	46	95
5220	5224	153	33530	33740	1	91	76	70	64	58	0	0	0	0	20	0	345	2	456	1	48	61	80
5225	5229	153	40300	40500	1	91	76	70	64	58	0	0	0	0	20	0	345	2	457	1	31	45	82
5230	5234	153	42550	42800	1	91	76	70	64	58	0	0	0	0	20	0	345	2	454	1	39	46	80
5235	5238	153	51500	51620	1	91	76	70	64	0	0	0	0	0	20	0	345	2	452	1	33	46	89
5239	5243	153	55100	55200	2	91	76	70	64	58	0	0	0	0	20	0	345	2	457	1	31	42	85
5244	5245	153	60200	60200	2	91	76	0	0	0	0	0	0	0	20	0	345	2	455	1	43	43	100
5246	5249	153	64330	64500	1	91	76	70	64	0	0	0	0	0	20	0	345	2	457	1	47	54	88

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
5250	5253	153	71800	71930	1	91	76	70	64	0	0	0	0	0	20	0	345	2	443	1	36	49	93
5256	5259	153	81510	81630	1	91	76	70	64	0	0	0	0	0	20	0	345	2	439	1	35	46	80
5260	5261	153	83300	83300	2	91	76	0	0	0	0	0	0	0	20	0	345	2	440	1	43	43	100
5262	5263	153	85900	85900	2	91	76	0	0	0	0	0	0	0	20	0	345	2	440	1	41	41	100
5264	5268	153	100000	100130	2	91	76	70	64	58	0	0	0	0	20	0	345	2	443	0	52	67	88
5269	5270	153	102900	102900	2	91	76	0	0	0	0	0	0	0	20	0	345	2	441	0	49	49	100
5271	5275	153	111830	112000	2	91	76	70	64	58	0	0	0	0	20	0	345	2	442	1	40	52	84
5276	5277	153	114500	114500	2	91	76	0	0	0	0	0	0	0	20	0	345	2	442	1	37	37	100
5278	5281	153	130300	130500	1	91	76	70	64	0	0	0	0	0	20	0	345	2	456	1	25	34	88
5283	5284	153	133130	133130	2	91	76	0	0	0	0	0	0	0	20	0	345	2	446	1	22	22	100
5285	5287	153	143330	143430	1	91	76	70	0	0	0	0	0	0	20	0	345	2	440	1	36	40	92
5288	5289	153	150100	150100	2	91	76	0	0	0	0	0	0	0	20	0	345	2	443	1	24	24	100
5290	5291	153	151630	151630	2	91	76	0	0	0	0	0	0	0	20	0	345	2	454	1	27	27	100
5292	5293	153	160900	160900	2	91	76	0	0	0	0	0	0	0	20	0	345	2	451	1	22	22	100
5294	5295	153	162510	162510	2	91	76	0	0	0	0	0	0	0	20	0	345	2	459	1	13	13	100
5296	5299	153	172420	172550	1	91	76	70	64	0	0	0	0	0	20	0	345	2	444	1	37	42	90
5300	5304	153	184540	184720	1	91	76	70	64	58	0	0	0	0	20	0	345	2	452	0	58	67	79
5305	5309	153	191940	192115	1	91	76	70	64	58	0	0	0	0	20	0	345	2	464	1	50	55	79
5310	5313	153	201500	201530	2	91	76	70	64	0	0	0	0	0	20	0	345	2	456	1	70	80	98
5314	5318	153	204900	205030	1	91	76	70	64	58	0	0	0	0	20	0	345	2	457	1	56	64	85
5319	5322	153	215000	215100	1	91	76	70	64	0	0	0	0	0	20	0	345	2	457	1	54	63	77
5323	5324	153	215900	215900	2	91	76	0	0	0	0	0	0	0	20	0	345	2	456	1	48	48	100
5325	5326	153	222000	222000	2	91	76	0	0	0	0	0	0	0	20	0	345	2	455	1	45	45	100
5327	5329	154	14445	14530	1	91	76	70	0	0	0	0	0	0	20	0	345	2	456	1	25	25	95
5330	5333	154	20900	21030	1	91	76	70	64	0	0	0	0	0	20	0	345	2	457	1	37	40	89
5334	5335	154	23800	23800	2	91	76	0	0	0	0	0	0	0	20	0	345	2	456	1	37	37	100

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
5336	5337	154	25400	25400	2	91	76	0	0	0	0	0	0	0	20	0	345	2	456	1	37	37	100
5338	5342	154	34530	34800	1	91	76	70	64	58	0	0	0	0	20	0	345	2	456	1	62	83	86
5343	5344	154	43200	43200	2	91	76	0	0	0	0	0	0	0	20	0	345	2	455	1	50	50	100
5345	5346	154	50900	50900	2	91	76	0	0	0	0	0	0	0	20	0	345	2	455	1	52	52	100
5347	5348	154	53200	53200	2	91	76	0	0	0	0	0	0	0	20	0	345	2	455	1	61	61	100
5349	5352	154	54800	54930	1	91	76	70	64	0	0	0	0	0	20	0	345	2	450	1	54	79	94
5353	5354	154	63100	63100	2	91	76	0	0	0	0	0	0	0	20	0	345	2	456	1	59	59	100
5355	5356	154	65900	65900	2	91	76	0	0	0	0	0	0	0	20	0	345	2	455	1	56	56	100
5357	5360	154	72400	72510	1	91	76	70	64	0	0	0	0	0	20	0	345	2	455	1	47	56	87
5361	5365	154	81230	81410	2	91	76	70	64	58	0	0	0	0	20	0	345	2	456	1	69	82	81
5366	5369	154	84700	84820	1	91	76	70	64	0	0	0	0	0	20	0	345	2	456	1	65	86	84
5370	5371	154	85800	85800	2	91	76	0	0	0	0	0	0	0	20	0	345	2	456	0	52	52	100
5372	5375	154	94600	94700	1	91	76	70	64	0	0	0	0	0	20	0	345	2	449	0	53	70	89
5376	5379	154	102030	102230	1	91	76	70	64	0	0	0	0	0	20	0	345	2	443	1	67	71	71
5380	5384	154	111930	112100	2	91	76	70	64	58	0	0	0	0	20	0	345	2	450	1	37	42	83
5385	5389	154	123330	123500	2	91	76	70	64	58	0	0	0	0	20	0	345	2	447	1	48	55	94
5390	5392	154	130730	130800	2	91	76	70	0	0	0	0	0	0	20	0	345	2	448	1	31	35	97
5393	5396	154	151000	151130	1	91	76	70	64	0	0	0	0	0	20	0	345	2	445	1	25	28	85
5397	5399	154	155740	155830	1	91	76	70	0	0	0	0	0	0	20	0	345	2	446	1	29	31	77
5400	5401	154	162200	162200	2	91	76	0	0	0	0	0	0	0	20	0	345	2	447	1	20	20	100
5402	5405	154	171340	171430	2	91	76	70	64	0	0	0	0	0	20	0	345	2	446	1	19	23	95
5406	5407	154	174340	174400	1	91	76	0	0	0	0	0	0	0	20	0	345	2	445	1	17	17	100
5408	5410	154	184700	184750	1	91	76	70	0	0	0	0	0	0	20	0	345	2	448	1	12	13	92
5411	5414	154	191640	191730	2	91	76	70	64	0	0	0	0	0	20	0	345	2	456	1	11	13	69
5415	5417	154	201200	201310	1	91	76	70	0	0	0	0	0	0	20	0	345	2	450	1	2	2	100
5418	5420	154	204020	204110	1	91	76	70	0	0	0	0	0	0	20	0	345	2	452	1	4	4	100

Table 8-6.--Inventory of digitized radar [illegible]

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	NO	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5421	5423	154	215030	215120	1	91	76	70	0	0	0	0	0	0	20	0	345	2	448	1	8	[illegible]	[illegible]
5424	5425	154	222250	222250	2	91	76	0	0	0	0	0	0	0	20	0	345	2	448	1	6	6	100
5426	5427	154	232950	232950	2	91	76	0	0	0	0	0	0	0	20	0	345	2	450	1	4	4	100
5428	5430	155	12850	12940	1	91	76	70	0	0	0	0	0	0	20	0	345	2	449	1	27	27	88
5431	5432	155	20000	20000	2	91	76	0	0	0	0	0	0	0	20	0	345	2	450	1	30	30	100
5433	5436	155	21740	21900	1	91	76	70	64	0	0	0	0	0	20	0	345	2	450	1	35	43	97
5437	5438	155	25000	25000	2	91	76	0	0	0	0	0	0	0	20	0	345	2	450	1	46	46	100
5439	5441	155	34410	34500	1	91	76	70	0	0	0	0	0	0	15	0	345	2	451	1	24	26	96
5442	5445	155	41100	41230	1	91	76	70	64	0	0	0	0	0	15	0	345	2	457	1	42	50	93
5446	5447	155	43050	43050	2	91	76	0	0	0	0	0	0	0	20	0	345	2	450	1	38	38	100
5448	5450	155	52150	52250	1	91	76	70	0	0	0	0	0	0	20	0	345	2	455	1	39	44	93
5451	5453	155	55700	55810	1	91	76	70	0	0	0	0	0	0	20	0	345	2	451	1	27	34	100
5454	5456	155	64510	64700	1	91	76	70	0	0	0	0	0	0	20	0	345	2	455	1	27	28	100
5457	5459	155	72020	72110	1	91	76	70	0	0	0	0	0	0	20	0	345	2	456	1	12	12	91
5460	5462	155	82100	82130	2	91	76	70	0	0	0	0	0	0	20	0	345	2	449	1	18	19	100
5463	5465	155	85030	85130	1	91	76	70	0	0	0	0	0	0	20	0	345	2	451	1	23	25	87
5466	5469	155	94400	94500	2	91	76	70	64	0	0	0	0	0	20	0	345	2	454	1	14	16	93
5470	5472	155	101740	101840	1	91	76	70	0	0	0	0	0	0	20	0	345	2	450	1	16	17	82
5473	5474	155	111030	111100	1	91	76	0	0	0	0	0	0	0	20	0	345	2	451	1	19	19	100
5475	5477	155	122830	122930	1	91	76	70	0	0	0	0	0	0	20	0	345	2	453	1	3	4	100
5478	5479	155	130000	130000	2	91	76	0	0	0	0	0	0	0	20	0	345	2	449	1	3	3	100
5480	5481	155	141740	141810	1	91	76	0	0	0	0	0	0	0	20	0	345	2	451	1	2	2	100
5482	5483	155	145200	145230	1	91	76	0	0	0	0	0	0	0	20	0	345	2	454	1	4	4	100
5484	5486	155	160200	160300	1	91	76	70	0	0	0	0	0	0	20	0	345	2	452	1	4	5	100
5487	5488	155	162500	162500	2	91	76	0	0	0	0	0	0	0	20	0	345	2	452	1	5	5	100
5489	5490	155	171840	171910	1	91	76	0	0	0	0	0	0	0	20	0	345	2	454	1	3	3	100

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
5491	5492	155	174640	174700	1	91	76	0	0	0	0	0	0	0	20	0	345	2	451	1	1	1	100
5493	5494	155	191810	191840	1	91	76	0	0	0	0	0	0	0	20	0	345	2	455	1	2	2	100
5495	5496	155	201440	201440	2	91	76	0	0	0	0	0	0	0	20	0	345	2	446	1	2	2	100
5497	5498	155	204320	204400	1	91	76	0	0	0	0	0	0	0	20	0	345	2	441	1	7	7	100
5499	5501	155	214710	214800	1	91	76	70	0	0	0	0	0	0	20	0	345	2	450	1	12	13	100
5502	5503	155	221500	221500	2	91	76	0	0	0	0	0	0	0	20	0	345	2	445	1	13	13	100
5504	5507	155	232110	232230	1	91	76	70	64	0	0	0	0	0	20	0	345	2	446	1	22	28	92
5508	5510	156	300	430	1	91	76	70	0	0	0	0	0	0	20	0	345	2	447	1	23	26	96
5511	5514	156	3530	3650	1	91	76	70	64	0	0	0	0	0	20	0	345	2	448	1	22	23	95
5515	5517	156	15840	15920	1	91	76	70	0	0	0	0	0	0	20	0	345	2	454	1	11	11	100
5518	5519	156	22930	22930	2	91	76	0	0	0	0	0	0	0	20	0	345	2	456	1	19	19	100
5520	5521	156	30300	30300	2	91	76	0	0	0	0	0	0	0	20	0	345	2	457	1	25	25	100
5522	5523	156	32930	32930	2	91	76	0	0	0	0	0	0	0	20	0	345	2	456	1	12	12	100
5524	5526	156	40300	40400	1	91	76	70	0	0	0	0	0	0	20	0	345	2	455	1	8	8	100
5527	5528	156	44900	44940	1	91	76	0	0	0	0	0	0	0	20	0	345	2	456	1	8	8	100
5529	5531	156	51850	52010	1	91	76	70	0	0	0	0	0	0	20	0	345	2	456	1	16	16	100
5532	5534	156	60000	60100	1	91	76	70	0	0	0	0	0	0	20	0	345	2	455	1	9	10	100
5535	5537	156	63100	63200	1	91	76	70	0	0	0	0	0	0	20	0	345	2	456	1	10	11	100
5538	5539	156	70100	70100	2	91	76	0	0	0	0	0	0	0	20	0	345	2	456	1	13	13	100
5540	5541	156	72900	72900	2	91	76	0	0	0	0	0	0	0	20	0	345	2	456	1	20	20	100
5542	5544	156	80400	80550	1	91	76	70	0	0	0	0	0	0	20	0	345	2	456	1	18	21	100
5545	5547	156	82950	83040	1	91	76	70	0	0	0	0	0	0	20	0	345	2	455	1	29	33	100
5548	5551	156	91440	91610	1	91	76	70	64	0	0	0	0	0	20	0	345	2	454	1	10	10	100
5552	5554	156	93840	94000	1	91	76	70	0	0	0	0	0	0	20	0	345	2	451	1	15	17	100
5555	5556	156	100100	100100	2	91	76	0	0	0	0	0	0	0	20	0	345	2	453	1	7	7	100
5557	5559	156	102600	102700	1	91	76	70	0	0	0	0	0	0	20	0	345	2	455	1	7	7	100

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
5560	5562	156	110400	110510	1	91	76	70	0	0	0	0	0	0	20	0	345	2	453	1	4	4	100
5567	5567	156	123000	123000	1	91	0	0	0	0	0	0	0	0	20	0	345	2	455	1	0	1	100
5573	5574	156	140300	140300	2	91	76	0	0	0	0	0	0	0	20	0	345	2	456	1	1	1	100
5575	5576	156	142900	142900	2	91	76	0	0	0	0	0	0	0	20	0	345	2	458	1	3	3	100
5577	5577	156	150000	150000	1	91	0	0	0	0	0	0	0	0	20	0	345	2	457	1	0	1	100
5579	5580	156	153600	153620	1	91	76	0	0	0	0	0	0	0	20	0	345	2	459	1	1	1	100
5582	5582	156	160700	160700	1	91	0	0	0	0	0	0	0	0	20	0	345	2	460	1	0	1	100
5584	5585	156	163300	163300	2	91	76	0	0	0	0	0	0	0	20	0	345	2	457	1	5	5	100
5586	5587	156	170200	170200	2	91	76	0	0	0	0	0	0	0	20	0	345	2	456	1	9	9	100
5588	5589	156	173000	173000	2	91	76	0	0	0	0	0	0	0	20	0	345	2	457	1	5	5	100
5590	5591	156	174830	174830	2	91	76	0	0	0	0	0	0	0	20	0	345	2	457	1	9	9	100
5592	5593	156	210200	210200	2	91	76	0	0	0	0	0	0	0	20	0	345	2	457	1	9	9	100
5594	5595	156	212900	212900	2	91	76	0	0	0	0	0	0	0	20	0	345	2	457	1	10	10	100
5596	5598	156	220100	220200	1	91	76	70	0	0	0	0	0	0	20	0	345	2	457	1	12	13	92
5599	5600	156	222930	222930	2	91	76	0	0	0	0	0	0	0	20	0	345	2	455	1	23	23	100
5601	5602	156	230000	230000	2	91	76	0	0	0	0	0	0	0	20	0	345	2	452	1	15	15	100
5603	5604	156	231600	231600	2	91	76	0	0	0	0	0	0	0	20	0	345	2	453	1	24	24	100
5605	5607	157	5030	5120	1	91	76	70	0	0	0	0	0	0	20	0	345	2	457	1	16	20	94
5608	5609	157	12900	12900	2	91	76	0	0	0	0	0	0	0	20	0	345	2	455	1	20	20	100
5610	5612	157	15530	15630	1	91	76	70	0	0	0	0	0	0	20	0	345	2	458	1	25	27	100
5613	5614	157	23020	23020	2	91	76	0	0	0	0	0	0	0	20	0	345	2	456	1	27	27	100
5615	5616	157	25430	25430	2	91	76	0	0	0	0	0	0	0	20	0	345	2	455	1	26	26	100
5617	5619	157	40900	41000	1	91	76	70	0	0	0	0	0	0	20	0	345	2	456	1	50	57	98
5620	5621	157	43030	43030	2	91	76	0	0	0	0	0	0	0	20	0	345	2	457	1	34	34	100
5622	5624	157	51230	51330	1	91	76	70	0	0	0	0	0	0	20	0	345	2	457	1	32	33	84
5625	5626	157	53000	53000	2	91	76	0	0	0	0	0	0	0	20	0	345	2	454	1	23	23	100

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
5627	5628	157	60100	60100	2	91	76	0	0	0	0	0	0	0	20	0	345	2	456	1	14	14	100
5629	5630	157	71200	71200	2	91	76	0	0	0	0	0	0	0	20	0	345	2	455	1	21	21	100
5631	5633	157	73000	73230	1	91	76	70	0	0	0	0	0	0	20	0	345	2	457	1	21	22	100
5634	5635	157	75900	75900	2	91	76	0	0	0	0	0	0	0	20	0	345	2	457	1	13	13	100
5636	5637	157	81940	81940	2	91	76	0	0	0	0	0	0	0	20	0	345	2	456	1	10	10	100
5638	5640	157	84840	84930	1	91	76	70	0	0	0	0	0	0	20	0	345	2	456	1	4	4	100
5641	5642	157	92200	92230	1	91	76	0	0	0	0	0	0	0	20	0	345	2	444	1	2	2	100
5643	5644	157	95500	95520	1	91	76	0	0	0	0	0	0	0	20	0	345	2	443	1	6	6	100
5645	5646	157	102900	102900	2	91	76	0	0	0	0	0	0	0	20	0	345	2	445	1	15	15	100
5647	5648	157	110800	110830	1	91	76	0	0	0	0	0	0	0	20	0	345	2	451	1	15	15	100
5649	5650	157	130900	130930	1	91	76	0	0	0	0	0	0	0	20	0	345	2	442	1	29	29	100
5651	5652	157	132730	132730	2	91	76	0	0	0	0	0	0	0	20	0	345	2	443	1	30	30	100
5653	5654	157	140100	140100	2	91	76	0	0	0	0	0	0	0	20	0	345	2	444	1	24	24	100
5655	5657	157	144700	144800	1	91	76	70	0	0	0	0	0	0	20	0	345	2	444	1	46	49	97
5658	5659	157	163900	164000	1	91	76	0	0	0	0	0	0	0	20	0	345	2	443	1	19	19	100
5660	5661	157	171800	171830	1	91	76	0	0	0	0	0	0	0	20	0	345	2	444	1	29	29	100
5662	5664	157	174840	174920	1	91	76	70	0	0	0	0	0	0	20	0	345	2	443	1	27	28	100
5665	5666	157	191840	191920	1	91	76	0	0	0	0	0	0	0	20	0	345	2	441	1	21	21	100
5667	5668	157	195800	195800	2	91	76	0	0	0	0	0	0	0	20	0	345	2	441	1	23	23	100
5669	5670	157	202440	202520	1	91	76	0	0	0	0	0	0	0	20	0	345	2	442	1	16	16	100
5671	5672	157	220000	220000	2	91	76	0	0	0	0	0	0	0	20	0	345	2	446	1	18	18	100
5673	5674	157	222520	222520	2	91	76	0	0	0	0	0	0	0	20	0	345	2	439	1	7	7	100
5675	5676	158	5100	5130	1	91	76	0	0	0	0	0	0	0	20	0	345	2	441	1	6	6	100
5677	5678	158	12530	12530	2	91	76	0	0	0	0	0	0	0	20	0	345	2	443	1	10	10	100

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
887	888	172	25655	25655	2	91	76	0	0	0	0	0	3	-7	25	0	345	2	437	0	267	267	99
889	892	172	30000	30040	2	91	76	70	64	0	0	0	3	-7	25	0	345	2	436	0	221	244	96
893	896	172	33620	33720	2	91	76	70	64	0	0	0	3	-7	25	0	345	2	435	0	167	183	93
897	901	172	40500	40600	2	91	76	70	64	58	0	0	3	-7	25	0	345	2	436	0	172	191	93
902	906	172	43415	43535	2	91	76	70	64	58	0	0	3	-7	25	0	345	2	436	0	104	125	89
907	910	172	50430	50530	1	91	76	70	64	0	0	0	3	-7	25	0	345	2	441	0	106	132	91
911	915	172	53230	53340	2	91	76	70	64	58	0	0	2	-7	25	0	345	2	441	0	86	96	72
916	918	172	80200	80215	2	91	76	70	0	0	0	0	2	-7	15	0	345	2	442	0	98	103	98
919	921	172	83125	83220	1	91	76	70	0	0	0	0	2	-8	25	0	345	2	442	0	83	89	94
922	924	172	90140	90200	2	91	76	70	0	0	0	0	2	-8	25	0	345	2	441	0	80	83	95
925	928	172	92620	93715	2	91	76	70	64	0	0	0	2	-8	25	0	345	2	441	0	68	72	97
929	932	172	100120	100300	1	91	76	70	64	0	0	0	2	-8	25	0	345	2	441	0	64	69	89
933	934	172	103715	103745	1	91	76	0	0	0	0	0	2	-8	25	0	345	2	441	0	67	67	98
935	937	172	110215	110300	2	91	76	70	0	0	0	0	1	-9	25	0	345	2	442	0	56	59	98
938	939	172	135800	135830	1	91	76	0	0	0	0	0	0	10	25	0	345	2	441	0	13	13	92
940	941	172	144005	144050	1	91	76	0	0	0	0	0	0	10	25	0	345	2	441	0	11	11	90
942	943	172	153545	153610	1	91	76	0	0	0	0	0	0	10	25	0	345	2	441	0	6	6	83
944	946	172	160405	160420	2	91	76	70	0	0	0	0	0	10	25	0	345	2	439	0	7	9	88
947	948	172	171220	171240	1	91	76	0	0	0	0	0	0	11	25	0	345	2	440	0	9	9	88
949	950	172	175450	175450	2	91	76	0	0	0	0	0	0	11	25	0	345	2	442	0	5	5	79
951	952	172	193040	193110	1	91	76	0	0	0	0	0	0	13	25	0	345	2	440	0	14	14	92
953	954	172	203055	203110	1	91	76	0	0	0	0	0	0	13	25	0	345	2	440	0	15	15	93
955	957	172	223155	223210	2	91	76	70	0	0	0	0	0	14	25	0	345	2	441	0	15	16	87
958	960	173	12400	12600	1	91	76	70	0	0	0	0	1	22	25	0	345	2	441	0	11	13	92
961	963	173	22450	22535	1	91	76	70	0	0	0	0	1	25	25	0	345	2	441	0	25	27	96
964	967	173	35300	35420	1	91	76	70	64	0	0	0	2	29	25	0	345	2	441	0	55	59	67

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
968	971	173	52235	52400	1	91	76	70	64	0	0	0	2	33	25	0	345	2	441	0	41	47	91
972	975	173	64400	64620	1	91	76	70	64	0	0	0	6	36	25	0	345	2	440	0	41	45	79
976	978	173	71400	71505	1	91	76	70	0	0	0	0	6	37	25	0	345	2	441	0	21	25	91
979	981	173	80630	80800	1	91	76	70	0	0	0	0	6	39	25	0	345	2	440	0	36	37	91
982	985	173	83700	83820	1	91	76	70	64	0	0	0	6	39	25	0	345	2	442	0	36	40	89
986	988	173	84620	94740	1	91	76	70	0	0	0	0	6	39	25	0	345	2	441	0	37	39	94
989	990	173	110800	110800	2	91	76	0	0	0	0	0	6	40	25	0	345	2	441	0	27	27	96
991	993	173	125605	125700	1	91	76	70	0	0	0	0	6	38	25	0	345	2	440	0	15	17	94
994	996	173	162215	162335	1	91	76	70	0	0	0	0	5	15	25	0	345	2	440	0	13	15	93
997	999	173	173940	174005	2	91	76	70	0	0	0	0	2	-3	25	0	345	2	441	0	27	29	96
1000	1001	173	190200	190300	1	91	76	0	0	0	0	0	0	0	25	0	345	2	440	0	10	10	89
1002	1003	173	202735	202800	1	91	76	0	0	0	0	0	0	-1	15	0	345	2	440	0	5	5	79
1856	1857	174	20400	20400	2	91	76	0	0	0	0	0	3	-1	25	0	345	2	449	1	10	10	89
1858	1860	174	34100	34200	1	91	76	70	0	0	0	0	2	-1	25	0	345	2	449	1	27	28	92
1861	1862	174	41500	41545	1	91	76	0	0	0	0	0	2	-1	25	0	345	2	445	1	28	28	96
1863	1865	174	51400	51500	1	91	76	70	0	0	0	0	0	0	25	0	345	2	450	1	38	39	94
1866	1867	174	55930	55930	2	91	76	0	0	0	0	0	-2	1	25	0	345	2	451	1	41	41	97
1868	1869	174	70100	70100	2	91	76	0	0	0	0	0	0	0	25	0	345	2	448	1	46	46	97
1870	1873	174	71700	71840	1	91	76	70	64	0	0	0	0	-1	25	0	345	2	451	1	62	72	79
1874	1877	174	80500	80700	1	91	76	70	64	0	0	0	0	-3	25	0	345	2	452	1	62	76	94
1878	1879	174	82350	82350	2	91	76	0	0	0	0	0	0	-3	25	0	345	2	450	1	43	43	97
1880	1881	174	84200	84200	2	91	76	0	0	0	0	0	-1	-3	25	0	345	2	451	1	51	51	98
1882	1886	174	84700	84900	1	91	76	70	64	58	0	0	-1	-3	25	0	345	2	450	1	55	71	90
1887	1890	174	94420	94520	1	91	76	70	64	0	0	0	-2	-3	25	0	345	2	450	1	67	75	91
1891	1894	174	101120	101320	1	91	76	70	64	0	0	0	-2	-3	25	0	345	2	451	1	68	74	91
1895	1896	174	111200	111200	2	91	76	0	0	0	0	0	-2	-3	25	0	345	2	451	1	79	79	98

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
1897	1899	174	113020	113100	1	91	76	70	0	0	0	0	-3	-3	25	0	345	2	452	1	86	91	94
1901	1903	174	125000	125100	1	91	76	70	0	0	0	0	-3	-4	25	0	345	2	451	1	95	108	93
1905	1907	174	141930	142030	1	91	76	70	0	0	0	0	-3	-6	25	0	345	2	450	1	89	92	98
1908	1910	174	145620	145720	1	91	76	70	0	0	0	0	-3	-5	25	0	345	2	452	1	29	33	93
1911	1912	174	161230	161300	1	91	76	0	0	0	0	0	-5	-6	25	0	345	2	448	1	25	25	95
1913	1914	174	171540	171600	1	91	76	0	0	0	0	0	-3	-5	25	0	345	2	450	1	24	24	95
1915	1918	174	184200	184300	2	91	76	70	64	0	0	0	-2	-5	25	0	345	2	448	1	19	23	86
1919	1922	174	201130	201230	2	91	76	70	64	0	0	0	-1	-5	25	0	345	2	450	1	21	25	83
1004	1007	174	202800	202900	2	91	76	70	64	0	0	0	-1	-5	20	0	345	2	443	1	25	30	86
1008	1009	175	20900	21000	1	91	76	0	0	0	0	0	1	-2	20	0	345	2	446	1	9	9	88
1010	1013	175	51800	51900	2	91	76	70	64	0	0	0	-1	-2	20	0	345	2	438	1	45	50	93
1014	1015	175	70400	70400	2	91	76	0	0	0	0	0	1	-2	30	0	345	2	470	1	30	30	96
1016	1017	175	83000	83000	2	91	76	0	0	0	0	0	1	-1	30	0	345	2	473	1	45	45	97
1018	1019	175	95300	95300	2	91	76	0	0	0	0	0	1	1	30	0	345	2	467	1	20	20	94
1020	1021	175	125000	125000	2	91	76	0	0	0	0	0	-3	1	30	0	345	2	466	1	16	16	93
1022	1023	175	162000	162000	2	91	76	0	0	0	0	0	0	-1	30	0	345	2	473	1	12	12	91
1024	1025	175	173000	173000	2	91	76	0	0	0	0	0	-1	0	30	0	345	2	477	1	15	15	93
1026	1027	175	182400	182400	2	91	76	0	0	0	0	0	-3	0	30	0	345	2	469	1	33	33	96
1028	1029	176	24500	24500	2	91	76	0	0	0	0	0	0	-2	30	0	345	2	438	1	32	32	96
1030	1031	176	35000	35000	2	91	76	0	0	0	0	0	-1	-2	30	0	345	2	439	1	24	24	95
1032	1033	176	52200	52200	2	91	76	0	0	0	0	0	-2	-2	30	0	345	2	466	1	24	24	95
103[illegible]	1035	176	70000	70000	2	91	76	0	0	0	0	0	-5	-2	30	0	345	2	465	1	134	134	99
1036	1037	176	82900	82900	2	91	76	0	0	0	0	0	-6	-2	30	0	345	2	468	1	131	131	99
1038	1039	176	131000	131000	2	91	76	0	0	0	0	0	-6	-5	25	0	345	2	465	1	28	28	96
1040	1041	176	142000	142000	2	91	76	0	0	0	0	0	-5	-3	25	0	345	2	467	1	38	38	97
1042	1043	176	172200	172200	2	91	76	0	0	0	0	0	-3	5	25	0	345	2	464	1	19	19	94

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
1044	1045	176	190000	190000	2	91	76	0	0	0	0	0	-2	8	25	0	345	2	465	1	37	37	97
1046	1047	176	214700	214700	2	91	76	0	0	0	0	0	-6	3	25	0	345	2	465	1	36	36	97
1048	1049	176	222800	222800	2	91	76	0	0	0	0	0	-6	3	25	0	345	2	466	1	59	59	98
1050	1051	176	231500	231500	2	91	76	0	0	0	0	0	-5	0	25	0	345	2	465	1	25	25	95
1052	1053	177	12000	12000	2	91	76	0	0	0	0	0	-1	1	25	0	345	2	471	1	29	29	96
1054	1055	177	21500	21500	2	91	76	0	0	0	0	0	0	-2	30	0	345	2	465	0	14	14	92
1056	1057	177	34500	34500	2	91	76	0	0	0	0	0	2	-3	25	0	345	2	466	1	48	48	97
1063	1067	177	51300	51500	2	91	76	70	64	58	0	0	-1	-5	20	0	345	2	443	1	44	55	79
1068	1072	177	54630	54900	2	91	76	70	64	58	0	0	-5	-1	25	0	345	2	441	1	70	104	64
1073	1076	177	65000	65300	1	91	76	70	64	0	0	0	-3	2	15	0	345	2	444	1	55	65	84
1077	1080	177	71600	71800	2	91	76	70	64	0	0	0	-3	2	17	0	345	2	447	1	42	61	81
1081	1084	177	81900	82030	1	91	76	70	64	0	0	0	-1	5	15	0	345	2	440	1	57	71	80
1085	1088	177	84900	85030	1	91	76	70	64	0	0	0	-1	1	15	0	345	2	442	1	53	63	82
1089	1092	177	94030	94200	1	91	76	70	64	0	0	0	1	1	15	0	345	2	441	1	40	43	83
1093	1096	177	101000	101200	1	91	76	70	64	0	0	0	1	1	15	0	345	2	441	1	21	26	88
1097	1099	177	123600	123700	1	91	76	70	0	0	0	0	-6	5	15	0	345	2	442	1	30	31	93
1100	1101	177	131300	131330	1	91	76	0	0	0	0	0	-3	1	15	0	345	2	440	1	10	10	89
1102	1103	177	141700	141800	1	91	76	0	0	0	0	0	-1	-7	15	0	345	2	439	1	11	11	90
1104	1106	177	161400	161500	1	91	76	70	0	0	0	0	5	15	15	0	345	2	441	1	26	28	82
1107	1109	177	171630	172500	1	91	76	70	0	0	0	0	0	-8	15	0	345	2	445	1	51	57	94
1110	1114	177	185530	185800	2	91	76	70	64	58	0	0	2	-3	15	0	345	2	446	1	133	157	91
1115	1118	177	201230	201400	1	91	76	70	64	0	0	0	-1	-3	15	0	345	2	445	1	225	237	96
1119	1122	177	205500	205630	1	91	76	70	64	0	0	0	-1	-2	15	0	345	2	445	1	179	210	89
1123	1126	177	212700	212830	1	91	76	70	64	0	0	0	-1	-2	15	0	345	2	446	1	206	263	94
1127	1130	177	215900	220030	1	91	76	70	64	0	0	0	1	-3	15	0	345	2	449	1	182	215	95
1131	1134	177	222700	222830	1	91	76	70	64	0	0	0	-1	0	15	0	345	2	448	1	135	160	79

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
1135	1139	177	225800	230000	1	91	76	70	64	58	0	0	-3	-2	15	0	345	2	444	1	180	225	91
1140	1143	177	232900	233030	1	91	76	70	64	0	0	0	-3	-2	15	0	345	2	444	1	141	165	90
1144	1148	178	200	330	2	91	76	70	64	58	0	0	-1	-1	15	0	345	2	446	1	160	183	95
1149	1152	178	3330	3530	1	91	76	70	64	0	0	0	-1	1	15	0	345	2	446	1	170	211	92
1153	1156	178	5830	10000	1	91	76	70	64	0	0	0	-1	1	15	0	345	2	445	1	144	155	92
1157	1160	178	12630	12800	1	91	76	70	64	0	0	0	-1	1	15	0	345	2	444	1	140	155	93
1161	1164	178	20200	20400	1	91	76	70	64	0	0	0	-1	1	15	0	345	2	446	1	137	155	92
1165	1168	178	22700	22830	1	91	76	70	64	0	0	0	-1	1	15	0	345	2	442	1	175	205	96
1169	1172	178	25500	25630	1	91	76	70	64	0	0	0	-1	1	15	0	345	2	446	1	168	199	92
1173	1176	178	33400	33530	1	91	76	70	64	0	0	0	-1	1	15	0	345	2	443	1	190	216	92
2053	2054	178	200000	200000	2	91	76	0	0	0	0	0	-1	1	15	0	345	2	453	1	18	18	94
1923	1924	178	200020	200020	2	91	76	0	0	0	0	0	-1	1	25	0	345	2	450	1	24	24	95
1925	1926	178	205925	205925	2	91	76	0	0	0	0	0	-1	1	25	0	345	2	452	1	20	20	94
2056	2059	178	210200	210330	1	91	76	70	64	0	0	0	-1	1	20	0	345	2	452	1	20	23	78
2060	2063	178	213600	213730	1	91	76	70	64	0	0	0	-1	1	20	0	345	2	450	1	29	34	91
2064	2065	178	220000	220000	2	91	76	0	0	0	0	0	-1	1	20	0	345	2	451	1	39	39	97
2066	2069	178	220700	220830	1	91	76	70	64	0	0	0	-1	1	20	0	345	2	451	1	49	57	91
2070	2073	178	223400	223530	1	91	76	70	64	0	0	0	1	1	20	0	345	2	451	1	64	74	87
2074	2077	178	230200	230330	1	91	76	70	64	0	0	0	1	1	20	0	345	2	451	1	73	88	85
1947	1948	179	4240	4240	2	91	76	0	0	0	0	0	-5	-2	25	0	345	2	450	1	102	102	99
1949	1952	179	5130	5300	1	91	76	70	64	0	0	0	-5	-2	25	0	345	2	451	1	114	132	90
1953	1956	179	13020	13130	1	91	76	70	64	0	0	0	-8	-1	25	0	345	2	452	1	122	143	92
1957	1961	179	15640	15840	1	91	76	70	64	98	0	0	-8	-1	25	0	345	2	449	1	122	142	85
1962	1965	179	23100	23230	1	91	76	70	64	0	0	0	-9	-2	25	0	345	2	449	1	153	170	89
1966	1969	179	30130	30300	1	91	76	70	64	0	0	0	-9	-2	25	0	345	2	452	1	161	179	93
1970	1973	179	33330	33500	1	91	76	70	64	0	0	0	10	-5	20	0	345	2	451	1	152	178	93

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	O/O ACC.
1974	1978	179	43200	43330	2	91	76	70	64	58	0	0	-6	-5	20	0	345	2	452	1	177	201	93
1979	1982	179	50300	50430	1	91	76	70	64	0	0	0	-6	-5	20	0	345	2	452	1	178	200	94
1983	1986	179	53400	53500	2	91	76	70	64	0	0	0	-3	-6	20	0	345	2	451	1	189	218	93
1987	1988	179	55830	55830	2	91	76	0	0	0	0	0	-3	-6	20	0	345	2	449	1	185	185	99
1989	1992	179	81030	81200	1	91	76	70	64	0	0	0	1	11	20	0	345	2	450	1	165	182	91
1993	1996	179	82900	83030	1	91	76	70	64	0	0	0	1	11	20	0	345	2	449	1	160	177	90
1997	2000	179	90630	90730	2	91	76	70	64	0	0	0	-1	-9	20	0	345	2	451	1	109	125	92
2001	2004	179	93300	93400	2	91	76	70	64	0	0	0	-3	-6	20	0	345	2	450	1	110	124	95
2005	2008	179	100100	100200	2	91	76	70	64	0	0	0	-3	-3	20	0	345	2	449	1	111	127	92
2009	2012	179	104900	105030	1	91	76	70	64	0	0	0	-8	2	20	0	345	2	449	1	110	126	89
2013	2016	179	123330	123430	2	91	76	70	64	0	0	0	-6	2	20	0	345	2	448	1	101	109	91
2017	2020	179	131330	131500	1	91	76	70	64	0	0	0	-6	2	20	0	345	2	448	1	122	158	82
2021	2024	179	142800	142900	2	91	76	70	64	0	0	0	-5	0	20	0	345	2	450	1	187	212	95
2025	2029	179	154430	154600	2	91	76	70	64	58	0	0	-2	-2	20	0	345	2	449	1	228	258	94
2030	2031	179	162600	162600	2	91	76	0	0	0	0	0	-2	-2	20	0	345	2	451	1	243	243	99
2032	2035	179	174800	174900	2	91	76	70	64	0	0	0	1	0	20	0	345	2	450	1	383	430	96
2036	2039	179	185400	185530	1	91	76	70	64	0	0	0	-1	6	20	0	345	2	451	1	416	450	97
2040	2044	179	201800	202000	1	91	76	70	64	58	0	0	-3	5	20	0	345	2	449	1	269	350	78
2045	2048	179	214100	214230	1	91	76	70	64	0	0	0	-3	0	20	0	345	2	449	1	221	260	93
2049	2052	179	220600	220730	1	91	76	70	64	0	0	0	-3	0	20	0	345	2	443	1	194	228	85
166	170	180	15010	15158	1	91	76	70	64	58	0	0	6	22	30	0	345	2	458	0	205	238	86
171	174	180	22720	22850	1	91	76	70	64	0	0	0	6	22	40	0	345	2	456	0	241	267	88
175	178	180	33545	33700	1	91	76	70	64	0	0	0	8	24	30	0	345	2	455	0	398	431	91
179	182	180	51125	51250	1	91	76	70	64	0	0	0	10	25	30	0	345	2	454	0	330	367	93
183	186	180	55255	55500	1	91	76	70	64	0	0	0	8	25	25	0	345	2	454	0	219	247	90
187	190	180	64300	64420	1	91	76	70	64	0	0	0	9	26	25	0	345	2	456	0	301	322	91

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	0/0 ACC.
191	194	180	71445	71600	1	91	76	70	64	0	0	0	9	26	25	0	345	2	457	0	250	273	92
195	198	180	81445	81600	1	91	76	70	64	0	0	0	8	29	25	0	345	2	456	0	331	364	93
199	202	180	84455	84610	1	91	76	70	64	0	0	0	13	31	25	0	345	2	454	0	316	367	92
203	206	180	94410	94535	1	91	76	70	64	0	0	0	10	28	25	0	345	2	455	0	426	446	93
207	210	180	101350	101500	1	91	76	70	64	0	0	0	10	28	25	0	345	2	454	0	354	387	90
211	213	180	125600	125620	1	91	76	70	0	0	0	0	6	26	25	0	345	2	455	0	153	159	95
214	215	180	154900	154945	1	91	76	0	0	0	0	0	9	25	25	0	345	2	456	0	10	10	89
216	217	180	174550	174605	1	91	76	0	0	0	0	0	7	16	25	0	345	2	456	0	17	17	94
218	219	180	184645	184700	1	91	76	0	0	0	0	0	5	16	25	0	345	2	455	0	9	9	88
220	221	180	191755	191810	1	91	76	0	0	0	0	0	5	16	25	0	345	2	454	0	16	16	93
222	223	180	201200	201220	1	91	76	0	0	0	0	0	5	17	25	0	345	2	456	0	21	21	95
224	225	180	214250	214345	1	91	76	0	0	0	0	0	-1	-8	25	0	345	2	455	0	23	24	95
2078	2081	181	15730	15900	1	91	76	70	64	0	0	0	-3	-1	20	0	345	2	472	1	15	20	89
2082	2083	181	23030	23030	2	91	76	0	0	0	0	0	-2	-2	20	0	345	2	476	1	17	17	94
2084	2085	181	25500	25500	2	91	76	0	0	0	0	0	-2	-2	20	0	345	2	475	1	24	24	95
2086	2089	181	34130	34300	1	91	76	70	64	0	0	0	0	-1	20	0	345	2	474	1	37	44	77
2090	2091	181	40000	40000	2	91	76	0	0	0	0	0	0	-1	20	0	345	2	476	1	30	30	96
2092	2093	181	42800	42800	2	91	76	0	0	0	0	0	0	-1	20	0	345	2	477	1	33	33	96
2094	2097	181	50630	50800	1	91	76	70	64	0	0	0	2	0	20	0	345	2	475	1	45	57	92
2098	2100	181	54730	54830	1	91	76	70	0	0	0	0	5	1	20	0	345	2	475	1	52	54	83
2101	2102	181	64800	64800	2	91	76	0	0	0	0	0	8	0	20	0	345	2	474	1	73	73	98
2103	2106	181	71700	71800	2	91	76	70	64	0	0	0	8	0	20	0	345	2	472	1	65	79	91
2107	2110	181	81200	81300	2	91	76	70	64	0	0	0	9	-1	20	0	345	2	473	1	80	99	85
2111	2115	181	84530	84700	2	91	76	70	64	58	0	0	13	-5	20	0	345	2	475	1	67	75	85
2116	2117	181	85700	85700	2	91	76	0	0	0	0	0	13	-5	20	0	345	2	475	1	68	68	98
2118	2121	181	93730	93900	1	91	76	70	64	0	0	0	16	-5	20	0	345	2	476	1	75	88	90

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	O/O ACC.
2122	2125	181	101330	101500	1	91	76	70	64	0	0	0	19	-8	20	0	345	2	476	1	100	113	84
2126	2127	181	102400	102400	2	91	76	0	0	0	0	0	22	-8	20	0	345	2	476	1	61	61	98
2128	2129	181	110530	110530	2	91	76	0	0	0	0	0	24	13	20	0	345	2	475	1	63	63	98
2130	2133	181	111730	111900	1	91	76	70	64	0	0	0	22	18	20	0	345	2	476	1	77	82	91
2134	2135	181	113130	113130	2	91	76	0	0	0	0	0	22	18	20	0	345	2	476	1	65	65	98
2136	2139	181	125930	130100	1	91	76	70	64	0	0	0	17	14	20	0	345	2	475	1	76	95	90
2140	2141	181	132430	132430	2	91	76	0	0	0	0	0	16	10	20	0	345	2	475	1	83	83	98
2142	2146	181	141230	141400	2	91	76	70	64	58	0	0	10	-6	20	0	345	2	476	1	78	99	76
2147	2148	181	143530	143530	2	91	76	0	0	0	0	0	8	-5	20	0	345	2	478	1	76	76	98
2149	2150	181	145430	145430	2	91	76	0	0	0	0	0	2	-2	20	0	345	2	476	1	84	84	98
2151	2154	181	154630	154800	1	91	76	70	64	0	0	0	-9	-2	20	0	345	2	475	1	108	119	84
2155	2156	181	160130	160130	2	91	76	0	0	0	0	0	13	-2	20	0	345	2	477	1	102	102	99
2157	2161	181	161830	162000	2	91	76	70	64	58	0	0	13	-2	20	0	345	2	476	1	110	126	86
2162	2166	181	171930	172130	1	91	76	70	64	58	0	0	15	-2	20	0	345	2	476	1	92	109	77
2167	2168	181	174700	174700	2	91	76	0	0	0	0	0	17	-5	20	0	345	2	474	1	77	77	98
2169	2173	181	185030	185200	2	91	76	70	64	58	0	0	15	-6	20	0	345	2	482	1	71	88	81
2174	2175	181	190200	190200	2	91	76	0	0	0	0	0	15	-6	20	0	345	2	478	1	93	93	98
2176	2177	181	191800	191800	2	91	76	0	0	0	0	0	15	-6	20	0	345	2	476	1	73	73	98
2178	2182	181	201500	201700	1	91	76	70	64	58	0	0	13	-3	25	0	345	2	476	1	80	100	78
2183	2184	181	203100	203100	2	91	76	0	0	0	0	0	13	-3	25	0	345	2	476	1	67	67	98
2185	2186	181	205000	205000	2	91	76	0	0	0	0	0	13	-5	25	0	345	2	477	1	53	53	98
2187	2192	181	214100	214400	1	91	76	70	64	58	52	0	14	1	25	0	345	2	476	1	60	85	74
2193	2197	181	220300	220500	1	91	76	70	64	58	0	0	14	1	25	0	345	2	475	1	57	78	66
2198	2201	181	231000	231130	1	91	76	70	64	0	0	0	10	3	25	0	345	2	474	1	67	83	83
2202	2207	182	5900	10100	2	91	76	70	64	58	52	0	-3	0	25	0	345	2	476	1	99	118	82
2208	2209	182	12800	12800	2	91	76	0	0	0	0	0	-3	0	25	0	345	2	476	1	81	81	98

Table 8-6.--Inventory of digitized radar composites (continued)

1ST PIC	LAST PIC	J. DATE	START TIME	END TIME	LAST PIC CODE	GAIN STEP POWERS 1	2	3	4	5	6	ANT. TILT	LAT	LON	GND CLTR	FID ANG	FID DIST.	RADAR NO	SCALE X100	STC	COMP. PTS.	TOTAL GS PTS.	O/O ACC.
2210	2214	182	15300	15430	2	91	76	70	64	58	0	0	-4	-2	25	0	345	2	476	1	75	89	82
2215	2216	182	22500	22500	2	91	76	0	0	0	0	0	-4	-2	25	0	345	2	476	1	81	81	98
2217	2218	182	42900	42900	2	91	76	0	0	0	0	0	-4	-4	25	0	345	2	476	1	73	73	98
2219	2223	182	184800	184930	2	91	76	70	64	58	0	0	-2	4	25	0	345	2	473	1	51	61	68
2224	2227	182	192130	192300	1	91	76	70	64	0	0	0	-1	4	25	0	345	2	472	1	77	88	92
2228	2231	182	200730	200830	2	91	76	70	64	0	0	0	0	3	25	0	345	2	472	1	106	111	67
2232	2235	182	204500	204630	1	91	76	70	64	0	0	0	1	2	25	0	345	2	471	1	122	137	87
2236	2240	182	213230	213400	2	91	76	70	64	58	0	0	0	1	25	0	345	2	472	1	157	173	86
2241	2244	182	220130	220300	1	91	76	70	64	0	0	0	-1	1	20	0	345	2	475	1	135	161	90
2245	2249	182	225130	225300	2	91	76	70	64	58	0	0	0	2	20	0	345	2	471	1	180	208	87

9. AIRCRAFT DATA SET

Data were obtained by the following aircraft: DC-6 and DC-4 aircraft of the Research Flight Facility (RFF), NOAA; WC-121 weather reconnaissance aircraft operated by the Navy VW-4 Squadron; and WB-47, RB-57, and WC-130 aircraft operated by the Air Weather Service, U.S. Air Force. Special call signs and designators for the aircraft, used in BOMEX data logs and in the archived data, are identified in table 9-1. Table 9-2 lists the fixed reporting points used to facilitate mission briefing, operational control, and reporting of aircraft position.

In support of the Sea-Air Interaction Program, or BOMEX Core Experiment, line integral missions were flown by the RFF DC-6 and DC-4 and Navy WC-121 aircraft around the periphery of the BOMEX volume, delineated by the 500- by 500-km array formed by the five ships occupying fixed positions at the corners and in the center of the square (sec. 1, fig. 1-1). These missions were flown to obtain data for evaluating the budgets of mass, momentum, water vapor, and total energy for the BOMEX volume.

The line integral patterns can be grouped as follows:

- Day line integral patterns (LID A and LID B).
- Night line integral patterns (LIN, LIN MOD 1, and LIN MOD 2).
- Multiple-level day and night line integral patterns (LID C, D, E, F, and G; LIN C, D, and E).

Table 9-3 identifies the days on which these missions were flown. The basic observation system carried aboard each of the RFF aircraft is described in table 9-4, and the recording systems are listed in table 9-5. Tables 9-6 and 9-7 provide information on the basic observation systems and meteorological instrumentation aboard the Navy WC-121 aircraft.

Also in support of the BOMEX Core Experiment during Periods I, II, and III, U.S. Air Force WB-47 and WC-130 aircraft of the 53rd Weather Reconnaissance Squadron, and RB-57 aircraft of the 58th Weather Reconnaissance Squadron flew missions to obtain special synoptic data to describe conditions within the BOMEX array. The flights are listed in table 9-8, and tables 9-9, 9-10, and 9-11 list the basic meteorological instrumentation carried aboard these aircraft. The dropsonde data obtained during reconnaissance flights by the WC-130 aircraft constitute a separate data set in the Permanent Archive and are discussed in section 9 of this report.

For the Tropical Convection Program during BOMEX Period IV, when the fixed ships formed a staggered array at positions BRAVO, CHARLIE, ECHO, LIMA, and GOLF (sec. 1, fig. 1-2), all aircraft were used to acquire data on tropical disturbances, cloud bands, and the Intertropical Convergence Zone (ITCZ).

All aircraft tracks flown are illustrated in BOMEX Field Observations and Basic Data Inventory (BOMAP Office 1971).

Table 9-1.--Call signs and other identifiers for BOMEX aircraft

Unit name and type of aircraft	Voice call sign	Abbreviated call	Additional designators
	Line Integral Aircraft		
Research Flight Facility			
DC-6	Research Six ALFA	RFF-6A	39C (CHARLIE)
DC-6	Research Six BRAVO	RFF-6B	40C (CHARLIE)
DC-4	Research Four	RFF-4	82E
U. S. Navy VW-4 Squadron			
WC-121*	Navy Twenty-One ALFA	N21A	VW-4 21A
WC-121*	Navy Twenty-One BRAVO	N21B	VW-4 21B
	Special Synoptic Aircraft		
USAF Air Weather Service			
53rd Weather Reconnaissance Squadron			
WB-47*	Air Force Four Seven ALFA	AF 47A	
WB-47*	Air Force Four Seven BRAVO	AF 47B	
WC-130*	Air Force Three Zero ALFA	AF 30A	
WC-130*	Air Force Three Zero BRAVO	AF 30B	
58th Weather Reconnaissance Squadron			
RB-57*	Air Force Five Seven ALFA	AF 57A	
RB-57*	Air Force Five Seven BRAVO	AF 57B	

*The tail number designation differed due to rotation of these aircraft during BOMEX.

Table 9-2.--Fixed aircraft reporting points

Designation of point	Periods I, II, and III May 1 to July 10	Period IV July 11 to 28
ALFA	16°50'N 59°12'W	17°30'N 59°00'W
BRAVO	17°36'N 54°34'W	17°30'N 54°00'W
CHARLIE	15°00'N 56°30'W	15°00'N 56°30'W
DELTA	12°23'N 58°23'W	13°00'N 59°00'W
ECHO	13°08'N 53°51'W	13°00'N 54°00'W
FOXTROT	07°57'N 57°36'W	09°00'N 59°00'W
GOLF	08°42'N 53°03'W	07°30'N 52°42'W
HOTEL	14°37'N 58°48'W	15°15'N 59°00'W
INDIA	17°13'N 56°53'W	17°30'N 56°30'W
JULIETT	15°22'N 54°12'W	15°15'N 54°00'W
KILO	12°46'N 56°07'W	13°00'N 56°30'W
LIMA	Not used	10°30'N 56°30'W
MIKE	Not used	09°00'N 57°00'W
NOVEMBER	Not used	09°20'N 54°00'W
OSCAR	Not used	11°00'N 59°00'W
PAPA	Not used	11°00'N 54°00'W
XRAY	16°29'N 54°23'W	Not used
YANKEE	14°15'N 54°01'W	Not used

Table 9-3.--BOMEX line integral aircraft missions

Date	Aircraft and flight patterns				
	Navy WC-121	Navy WC-121	RFF DC-6 39C	RFF DC-6 40C	RFF DC-4 82E
May					
3	LIN	-	-	-	-
4	-	LIN	-	LID A	LID B
9	Comparison	Comparison	-	Comparison	Comparison
10	-	LIN MOD 1	-	-	-
11	LIN MOD 2	-	-	LID A	LID B
12	LIN MOD 2	-	LID B	LID A	-
25	LIN MOD 2*	LIN MOD 2†	-	-	-
26	LIN MOD 2	-	-	LID A	LID B
27	LIN MOD 2	-	-	LID A	LID B
31	LIN MOD 2	-	-	-	-
June					
1	LIN MOD 2	-	-	LID A	LID B
2	LIN MOD 2	-	-	LID A	LID B
3	LIN MOD 2	-	-	LID A	LID B
7	LID E	LID F	LID C	LID G	LID D
9	LID E	LID F	LID C	LID G	LID D
22	LID E	LID F	LID C	LID G	LID D
23	LIN F	-	LIN C	LIN D	LIN E
25	LIN E	-	LIN C	LIN D	LIN F
29	LID E	LID F	-	LID C	LID D
30	LID E	LID F	LID D	LID C	-

*Aborted prior to H (HOTEL).
†Direct to J (JULIETT) - I, J, H-I, and return.

Table 9-4.--RFF airborne instrumentation systems supporting BOMEX

Parameter	Instrument	Range	Error	Aircraft 39C	40C	82E	Remarks
Aircraft position (latitude, longitude)	Doppler navigation systems; GPL Div. General Precision						
(LAT/LONG)	APN-153	90^{o} N/S 180^{o} E/W		X X	X X	X X	Computed post-flight.
	APN-82	90^{o} N/S 180^{o} E/W		X X	X X	X X	Computed with on-board computer.
	Omega navigation system; Tracor	90^{o} N/S 180^{o} E/W			X		Experimental.
Ground speed (GS)	APN-153	60-1,000 kn	$(0.2\% \pm 0.35)$ kn	X	X	X	PE shown. Scale factor 36^{o} per 100 kn.
	APN-82	70-700 kn	$(\pm 2.1$ kn) or $(\pm 0.3\%)$ GS	X	X	X	PE shown. RFF experience shows that accuracy is approx. 1%. Time constant for system, is: 300 Hz s^{-1}; 14 kn s^{-1}.
Drift angle (DA)	APN-153	$\pm 40^{o}$	$\pm 0.17^{o}$	X	X	X	Pitch/roll stabilization provided.
	APN-82	$\pm 45^{o}$	$\pm 0.15^{o}$	X	X	X	Pitch/roll stabilization provided.

Table 9-4.--RFF airborne instrumentation systems supporting BOMEX (continued)

Parameter	Instrument	Range	Error	Aircraft 39C	Aircraft 40C	Aircraft 82E	Remarks
Wind direction (DDD)	APN-153	360°		X	X	X	Computed post-flight.
	APN-82	360°	$\pm[0.4+(150/FFF)]^{\circ}$	X	X	X	Computed with on-board computer. Response 2.6° s^{-1}. Time constant: 35 s.
Wind speed (FFF)	APN-153			X	X	X	Computed post-flight.
	APN-82	0-240 kn	[$\pm$3 kn for FFF<150 kn] [$\pm$0.02 (FFF) >150 kn]	X	X	X	Computed with on-board computer.
Distance travel count (DTC)	APN-82	0-999.999 nmi	1% DTC	X	X		Recycles through "0."
Aircraft pitch/roll angle (θ/ϕ)	APN-81, Gyro C-1160	$\pm30^{\circ}$(pitch) $\pm45^{\circ}$(roll)	$\pm0.1^{\circ}$ $\pm0.1^{\circ}$	X X	X X		36° s^{-1}. (Removed from digital tape during BOMEX.)
Magnetic heading (MHDG)	N-1 Flux gate system, w/C-2 transmitter	360°	$\pm0.2^{\circ}$	X	X	X	36° s^{-1}. Backup systems available on all aircraft.

Table 9-4.--RFF airborne instrumentation systems supporting BOMEX (continued)

Parameter	Instrument	Range	Error	Aircraft 39C	40C	82E	Remarks
Magnetic variation (MVAR)	Manual setting	180° E/W		X	X	X	Obtained from published values.
Ambient pressure (APRESS)	Giannini 555T1 pressure transducer	1,050-50 mb	$\pm$0.5 mb	X	X	*	*82E used alternate pitot-static system. 10-mb s^{-1} response.
Differential pressure (DPRESS)	Giannini 555T2 pressure transducer	0-200 mb	$\pm$0.5 mb	X	X	*	See note above.
Indicated airspeed (IAS)	Giannini 555T2 pressure transducer	50-400 kn	$\pm$5 kn	X	X	*	See note above.
	Kollsman IAS meter	50-400 kn	$\pm$5 kn	X	X	X	
True airspeed (TAS)	Kollsman TAS transducer	50-700 kn	$\pm$5 kn	X	X	X	80-kn s^{-1} response.
Pressure altitude (PA)	Kollsman altimeter	0-50,000 ft	†	X	X	X	†Bench and in-flight checks performed.
	Giannini 555T1 Pressure transducer	0-50,000 ft	$\pm$15-20 ft	X	X	†	See note above.
Radar altitude (RA)	Stewart-Warner APN-159	Classified	$\pm$8 ft or 1% RA	X	X	X	Pitch/roll stabilization provided. 500-ft s^{-1} response.

Table 9-4.--RFF airborne instrumentation systems supporting BOMEX (continued)

Parameter	Instrument	Range	Error	Aircraft			Remarks
				39C	40C	82E	
Ambient (vortex) temperature (TEMP)	Bendix ML-471/ AMQ-8 vortex	-80 to +50°C	±1°C	X	X	X	10-s response
	RFF modified AMQ-8 thermocouple vortex	0 to 400°K	<1°C	X	X	X	Developmental. Response <5 s.
Sea-surface temperature (SST)	Barnes PRT-5, IR	-40 to +40°C	±0.5°C	X	X	X	50-ms response time.
	Te radiometer	-20 to ±45°C	±0.5°C	X	X	X	2-s response time.
Total temperature	Rosemount system	-60 to ±40°C	±1°C	X	X		1/e time 20 ms. Developmental; requires TAS corr.
Liquid water content (LWC)	Levine hot-wire	0 to 10 $g\ m^{-3}$	30-50%	X	X		Also provides the volume median drop size. 4-s response time.
Absolute humidity	IR hygrometer	0 to 20 (plus) $g\ m^{-3}$	5%	X	X	X	0-10 s for a 90% change.
Dew (frost) point temperature (TD)	Cambridge systems hygrometer	-50 to +50°C	Within ±2°C of IRH	X	X		10-s response time; faster at temperatures >0°C.

Table 9-4.--RFF airborne instrumentation systems supporting BOMEX (continued)

Parameter	Instrument	Range	Error	Aircraft 39C	40C	82E	Remarks
Ice detector	Pressure difference cyclic sensor			X	X		
Aitken nuclei count	APCL System			X	X		Operated by APCL.
Vertical acceleration	Statham AJ-43 accelerometer	0 to ±3 g	10%	X	X	X	
Refractive index (N)	Microwave refractometer			X			System operated by WPL; used for rapid measurement of water vapor.
Solar radiation	Eppley precision spectral pyranometer	λ:285-2,800 mμ T:-20 to +50°C	*	X	X	X	*Comparison data obtained for each flight: Sensitivity: [5mv cal^{-1} cm^{-2} min^{-1}], with impedance of 300 ohms.
Radar systems	APS-20E 10.4 cm	200 nmi		X	X		PPI.
	WP-101 5.6 cm	150 nmi		X	X		PPI.
	RDR-ID 3.2 cm	20 nmi		X	X		Cross section.
	APS-42A 3.2 cm	200 nmi				X	PPI.
Radiation detection	Air sampler, foil assembly FI-2A w/B 200A CRM, 90-GM tube	0-200,000 counts		X	X	X	Used with 4 1/4-in. paper filters.

Table 9-5.--RFF airborne recording system

Recorder/Display	MFG/Model	Speed	Channels	Aircraft 39C	40C	82E	Remarks
Digital (magnetic tape) recorder	ESS GEE, Inc. mod. by RFF	*	7 BCD	X	X		See (1).
Digital (magnetic tape) recorder	Radiation, Inc.	**	7 BCD 20 FM analog			X	See (2).
FM (IRIG) analog recorder	Sangamo series 3560	Var.	14	X			See (3).
Strip-chart recorder (6 and 8 in.)	Honeywell-visicorder	Var.	14 28	X X	X X	X X	See (4).
Strip-chart recorder	Hewlett-Packard	Var.	2	X	X	X	See (5).
Cloud cameras, side-mounted, 35 mm	Automax G-2	1 fr/5 sec	1	X	X		Mounted left/right.
Cloud camera, forward looking, 16 mm	Milliken DBM-5C	1 fr/2 sec	1	X	X		
Photo-panel camera, 35 mm	Automax G-1	1 fr/5 sec	1	X	X	X	
Radar cameras, 35 mm	Fairchild O-15	Var.	1	X	X	X	All radars.

(1) Records are 150 BCD characters each in length. *Tape moves at 76 cm sec^{-1}. Recording capacity 4,500 BCD characters per second with bit density of 200 bits per inch. Original system modified by RFF.

(2) Records are 150 BCD characters each in length. **Capability of recording 50 complete samples per second. System can also be used to record 20 channels of analog (FM) data.

(3) Used to record individual components of the water vapor flux system.

(4) Light-beam galvanometer type. Used to record, continuously, output of special instruments.

(5) Electrostatic recorder used for IR and solar radiation measurement recording.

Table 9-6.--Navy WC-121 aircraft basic observation system

Parameter measured	Sensor or method of recording
Temperature (total)	AMR-42 potentiometer
Temperature (ambient)	DY2861A
Dew point	Cambridge systems 137-C3 dew pointer
Wind direction at flight level	APN-153 Doppler, ASR-41 adapter
Wind speed at flight level	APN-153 Doppler, ASR-41 adpter
Radar altitude	APN-159 potentiometer
Ambient pressure	Rosemount transducer
Cloud cover	Manually recorded
Sea state	Manually recorded
Sea-surface temperature	Barnes PRT-4A
Subsurface seawater temperature	SSQ-36 bathythermograph
Radar precipitation areas (horizontal)	APS-20 CR-1A camera
Radar precipitation areas (vertical)	APS-45 CR-1A camera
Weather	Manually recorded
Icing	Manually recorded
Date	Manually recorded
Time	Clock
Octant of globe	ASN-41 adapter
Lattidue and longitude	ASN-41 adapter
True airspeed	AX-606 TAS computer
True heading	ASN-41 adapter
Ground speed	APN-153 Doppler
Drift angle	APN-153 Doppler
Compass	CGRS

Table 9-7.--Navy WC-121 aircraft meteorological instrumentation

System	Description
Data acquisition logging system (DALS)	
Baththermograph system	SSQ-36 BT probe (0.5°F) ARR-58 receivers (± 1°F) XN-1&3 Rustrack recorder (±0.275°C)
Radiosonde system	AMT-6 radiosonde (± 0.2 mb) AMR-3 radiosonde deceptor MA-1 radiosonde dispenser MH-1 radiosonde adapter sleeve
Airborne radiation thermometer system	PRT-4A radiation thermometer (±0.2°C) 680 Mosely strip-chart recorder (±0.55°C)
AMQ-17 aerograph set	AMA-2 indicator recorder Pressure transducer (± 0.2°C) Temperature humidity probe (±0.5°C, ±3%)
Instruments dials at or near Metro panel	
Absolute altitude indicators	SCR-718 radio altimeter (± 50 ft) APN-159 radar altimeter (± 10 ft)
MA-1 Kollsman pressure altimeter AMQ vortex thermometer C-3 Cambridge dew pointer (± 1°C) True heading indicator Ground speed indicator True airspeed indicator True wind speed indicator Drift angle indicator FA-122 barometer (± 0.5 mb) Clock	
Navigation aids	APN-70 Loran APN-153 Doppler ARN-21 TACAN ARN-14 OMNI ASN-41 navigation computer Sextant BDHI

Table 9-8.--Special synoptic aircraft missions

Date 1969	WB-47		RB-57		WC-130	
	Radar	Air sampling	Photography	Air sampling	Air sampling	Comparison flight
May						
1					X	
3	X	X	X	X	X	
4	X	X	X	X	X	
5	X	X	X	X	X	
6	X	X	X	X	X	X
7	X	X	X	X	X	
8				X		
9	X	X	X	X	X	
10		X	X	X	X	
11	X	X	X	X	X	
12		X	X	X	X	
13	X	X		X	X	
14	X	X	X	X	X	

Table 9-8.--Special synoptic aircraft missions (continued)

Date 1969	WB-47		RB-57		WC-130	
	Radar	Air sampling	Photography	Air sampling	Air sampling	Comparison flight
<u>May</u>						
15				X		
24	X		X	X		
25	X		X			
26			X			
27	X		X			
28	X		X			X
29						
30	X		X			
31	X		X	X		X
<u>June</u>						
1	X		X			
2	X		X			
3	X		X			
4	X		X			
5						

Table 9-8.--Special synoptic aircraft missions (continued)

	WB-47		RB-57		WC-130	
Date 1969	Radar	Air sampling	Photography	Air sampling	Air sampling	Comparison flight
June						
6	X		X			
7	X		X			
8			X			
9	X		X			
10			X			
11				X		
21	X	X	X	X	X	
22	X	X	X	X	X	
23	X	X	X	X	X	
24	X	X	X	X	X	
25	X	X	X	X	X	
26	X	X	X	X	X	X
27				X		
28	X	X	X	X	X	
29	X	X	X	X	X	
30	X	X	X	X	X	
July						
1	X	X		X	X	X
2		X	X	X	X	

Table 9-9.--Air Weather Service WB-47 basic meteorological instrumentation

Measurement	Instrument
Precipitation areas	AN/APS-64 search radar
Altitude	AN/APN-42A radar altimeter MA-1 pressure altimeter
Wind speed and direction at flight level	AN/APN-102 Doppler
Temperature (total)	Rosemount probe
D-value	AN/APN-42, MA-1 altimeter
Particulate air sampling	U-1 foil
Cloud cover	Visual observation
Present weather	Visual observation
Past weather	Visual observation
Turbulence	Subjectively manual
Icing	Visual observation

Table 9-10.--Air Weather Service WC-130 basic meteorological instrumentation

Measurement	Sensor
Temperature (total)	Rosemount probe
Wind direction	AN/APN-147 (V) Doppler
Wind speed	AN/APN-147 (V) Doppler
Altitude	AN/APN-133A or SCR-718 radio altimeter MA-1 STD AC aneroid
Radar precipitation	AN/APN-59 radar system
Dropsonde temperature pressure humidity	AN/AMT-6 system ML-419/AMT-4 rod thermistor aneroid cell ML-476/AMT carbon strip
Particulate air sampling	U-1 foil

Table 9-11.--Air Weather Service RB-57 basic meteorological instrumentation

Measurement	Sensor
Color photographs of cloud cover	F-415P Fairchild camera system
Particulate air sampling	U-1 foil
Temperature	Rosemount probe
Wind direction and speed at flight level	Doppler, APN-102
Altitude	MA-1 pressure altimeter

9.1 RFF Aircraft

The data collected by the RFF aircraft were assigned a flight identification (ID) number for every mission flown. This number is made up of the year, month, and day, and a letter designating a particular aircraft. The letter "A" was used for the DC-6 39C; "B" for the DC-6 40C; and "E" for the DC-4 82E. An extra digit at the end of the flight ID number indicates the number of missions flown in one day, e.g., flight number 690526B1 means that the DC-6 40C was flown on May 26, 1969.

The original meteorological data were recorded aboard the aircraft at the rate of one record every second. Each record consists of 150 characters (7-track BCD) written on magnetic tape at 200 BPI. There are approximately 10 to 12 hr of data, i.e., 36,000 to 44,000 records, per flight. No record counts are available, but each observation is distinguished by time in hours, minutes, and seconds. Most of the parameters contained in each record must be calibrated, based on constants provided by RFF to convert counts to engineering units.

The DC-6 "A" and "B" aircraft use the APN-82 Doppler radar navigation system as the primary source for basic navigational parameters. During BOMEX, an APN-153 Doppler radar navigation system was included and used for the first time on RFF aircraft because of its better response at altitudes below 1,000 ft. Normally, the "A" and "B" aircraft tape records are identical. When the APN-153 was used, the PITCH and ROLL in the tape record were replaced by GS-153 and DA-153.

The DC-6 "A" aircraft operated with the APN-153 on all flights, but the "B" aircraft did not use it until late in May 1969. The "E" aircraft used the APN-153 only; it did not use its APN-82 to record data on tape. The "E" tape record did not contain true airspeed, wind direction, windspeed, longitude, latitude, and magnetic variation; all these elements were derived during subsequent data processing. Pitch, roll, liquid water content, Rosemount temperature, and dewpoint were also missing, and could not be derived. Another parameter unavailable on the DC-4 "E" aircraft data tape is the memory on/off indicator. On the DC-6 aircraft, the APN-82 system goes into memory mode when the return radar signal is too weak to compute a ground speed or drift angle (usually the result of hitting very smooth sea surfaces or the aircraft being in a tight turn). In such cases, the last reliable wind direction and windspeed are stored in the memory and are combined with the true airspeed and magnetic heading plus magnetic variation for computation of ground speed (GS) and drift angle (DA). When the memory is on, a switch on the DC-6 "A" and "B" records indicates this. Because the "E" aircraft record has no memory switch, the memory-on situation has to be interpreted when GS-153 and DA-153 do not change over a short period of time.

9.1.1 Preliminary Processing of Meteorological Data

The original data were recorded at 200 BPI on magnetic tape in BCD format at the rate of one complete record per second, including all parameters. These BCD records were edited by RFF for long records (more than 150 characters), short records (less than 150 characters), and noise records, and for parity and illegal characters. The tape was then rewritten minus the unreliable records onto a higher density (556 BPI) IBM-compatible CONVERT tape. The tape had the same format as the original tape, except for two new parameters: the actual record count and the original record count. These were used to show when records had been deleted. An error summary was provided to indicate the relative merit of each flight. RFF also provided the calibration constants for use in later processing to convert the original count units to meteorological and engineering units, with the exception of the infrared hygrometer (IRH) and liquid water count. The constants are listed in table 9-12.

The following equations were obtained by the method of least squares to relate the IRH count values to absolute humidity at 1,015 mb for each of the aircraft:

$$\text{Absolute humidity } (g/m^3) = C_o + C_1 H + C_2 H^2 + C_3 H^3 + C_4 H^4 + C_5 H^5 + C_6 H^6,$$

where

H = counts, and the coefficients are

	DC-6 "A"	DC-6 "B"	DC-4 "E"
C_o	$- 7.959 \times 10^{-1}$	$- 4.981 \times 10^{-1}$	$- 7.238 \times 10^{-2}$
C_1	9.420×10^{-3}	4.326×10^{-3}	$- 2.660 \times 10^{-3}$
C_2	$- 1.811 \times 10^{-5}$	7.718×10^{-6}	4.098×10^{-5}
C_3	3.854×10^{-8}	$- 1.309 \times 10^{-8}$	$- 7.904 \times 10^{-8}$
C_4	$- 3.635 \times 10^{-11}$	1.544×10^{-11}	8.022×10^{-11}
C_5	1.695×10^{-14}	$- 8.181 \times 10^{-15}$	$- 3.953 \times 10^{-14}$
C_6	$- 2.876 \times 10^{-18}$	1.744×10^{-18}	7.632×10^{-18}

The absolute humidity was then obtained from the expression

$$\text{AHUM } g/m^3 = \text{IRH} \left(\frac{1015}{P + 20}\right)^{0.18} * \left(\frac{P}{P + 20}\right) * \left(\frac{308}{T}\right),$$

where P is ambient pressure, and T is ambient air temperature in degrees absolute.

Liquid water counts from the DC-6 "A" and "B" aircraft data record (the DC-4 "E" aircraft had none) were converted into liquid water measured in grams per cubic meter by use of the latest set of RFF liquid water conversion graphs. Each graph has two curves, one for a 0-2 range and the other for a 0-6 range. The ranges are determined by the state of the two switches operated aboard the DC-6 aircraft and recorded into the tape record. The curves are essentially straight lines, and the linear equations that yield liquid water are

Table 9-12.--Calibration constants

Parameter	Aircraft "A"	"B"	"E"	Range of count	Conversion	Units
GS-153 (ground speed)	X	X	X		COUNT * 0.1489	m/s
DA-82 (drift angle)	X	X	.		(COUNT-500) * 0.1	deg
DA-153 (drift angle)	X	X	X		(COUNT-500) * 0.1	deg
DTC (distance travelled count)	X	X	.		COUNT * 0.001	nmi
MHDG (magnetic heading)	X	X	X		COUNT * 0.1	deg
APRESS (ambient pressure)	X	X	X		(COUNT+1000) * 0.05	mb
DPRESS (differential pressure)	X				COUNT * 0.01381	mb
		X			COUNT * 0.01379	mb
			X		COUNT * 0.01376	mb
RA (radar altitude)	X	X	X		COUNT * 0.3048	m
TEMP (vortex temperature)	X	X			(COUNT-1200) * 0.05	deg
			X		(COUNT-800) * 0.05	deg
TD (CS1 dewpoint temperature)	X		.	< 1005	(COUNT-1005) * 0.05443	deg
				> 1005	(COUNT-1005) * 0.0504	deg
		X		< 1010	(COUNT-1010) * 0.055	deg
				> 1010	(COUNT-1010) * 0.05	deg
TR (Rosemount temperature)	X	X	.		(COUNT * 0.05071 - 60.14) - 0.0004984 * TAS^2	deg

X = available . = unavailable * = multiply blank = ignore

The desired consequence of applying the intercomparison corrections was to force the data from the three aircraft into internal consistency, admitting the possibility that all three might be wrong in the same direction. Since the unusual circumstance was an intercomparison of all three aircraft at the same time, a nontrivial "closure error" can be defined as

$$\varepsilon = \Sigma(40C - 39C) + \Sigma\,(39C - 82E) + \Sigma\,(82E - 40C).$$

The summations were made over the comparisons between the aircraft pairs as indicated. Ideally, ε should be zero. Table 9-15 shows the closure errors and their estimated standard deviations σ_ε for several sensors. The aircraft altimeters were assumed to be correct, and adjustments in pressure and temperature were made for aircraft altitude differences.

Table 9-14.--RFF intercomparison differences

Sensor	DC-6 40C/39C	82E/39C	82E/40C
Pressure (mb)	0.3, -3.5*	5.0	5.8, 9.0*
Heading (deg)	- 0.8	0.1	1.4
APN-82 ground speed (m/s)	1.3	---	---
APN-82 drift angle (deg)	0.8	---	---
Vortex temperature (^{o}C)	2.0	2.1	1.6
Infrared hygrometer (g/m^3)	0.2	0.3	0.8
Differential pressure (mb)	0.8	0.3	- 0.6
APN-153 ground speed (m/s)	1.2	- 1.4	- 1.3
APN-153 drift angle (deg)	- 1.0	- 2.1	0.3
Rosemount temperature (^{o}C)	2.2, -1.3**	---	---
CSI hygrometer (^{o}C)	1.3	---	---

*Applicable to 40C after May 11.
**Applicable to 40C after July 11.

Table 9-15.--Closure errors and their estimated standard deviations

	Pressure (mb)	Heading (deg)	Vortex temperature (^{o}C)	Absolute humidity (g/m^3)	Differential pressure (mb)	APN-153 ground speed (m/s)	APN-153 drift angle (deg)
ε	1.1, 0.5*	0.5	1.5	0.8	- 0.1	1.3	1.4
σ_ε	2.4	1.4	0.8	1.0	2.2	2.6	1.7

*Applicable after May 11.

All three RFF aircraft flew a large number of "wind boxes," a maneuver in which they covered four sides of a square, each side about 10 km long. Under the assumption that the wind velocity does not change significantly during the 8 to 10 min required for the flight pattern, one can compute corrections to an angle-speed pair chosen from heading, drift angle, ground speed, and airspeed. Friedman et al., in the NOAA Technical Report cited earlier, describe the computation for finding the drift-angle and airspeed corrections. Instead of these, the drift-angle and ground-speed corrections were computed in the final processing of the RFF data. Since only two of the four sides of the wind box are needed for computing a pair of corrections and six pairs of sides are available, a single wind box can yield six sets of corrections to the same pair of angle-speed measurements. It was found that the average variance among the six sets was approximately the same as the variance taken across all wind boxes. The drift-angle and ground-speed corrections listed in table 9-16 were therefore applied to all the RFF data.

Wind-box patterns were flown most frequently near the BOMEX ships, from which rawinsondes were released at frequent intervals. By comparing aircraft winds and temperatures with those interpolated from the rawinsonde data, a third set of corrections, given in table 9-17, was obtained under the assumption that the rawinsonde winds and temperatures are correct. The correction to the u component of the wind (positive east) represents the correction for sea drift on the Doppler radar ground speed. Some indication of its value can be seen in figure 9-1, which shows the geographic coordinates for the last data collected on all RFF flights departing from and terminating at Seawell Airport, Barbados. Without the sea-drift correction, the distribution would have been centered about 60 km (approximately 0.6°) east of the island. Beginning latitude and longitude of all these flights were 13.083°N, 59.466°W.

Table 9-16.--Wind box corrections

	Ground speed (m/s)	Drift angle (deg)
39C APN-82	- 0.7 + 0.00033z	0.5
39C APN-153	- 1.9	- 1.0
40C APN-82	- 3.6 + 0.00092z	- 0.5
40C APN-153	- 2.9	+ 0.4
82E APN-153	- 2.2	+ 0.4

Table 9-17.--Aircraft-rawinsonde comparison corrections

Parameter	Aircraft		
	39C	40C	82E
u component (m/s)	- 1.5	- 1.5	- 1.5
v component (m/s)	0.0	0.0	0.0
Vortex temperature (°C)	1.2 + 0.00029z	- 0.6 + 0.00025z	- 0.9 + 0.00066z
Rosemount temperature (°C)	1.2	- 0.6	

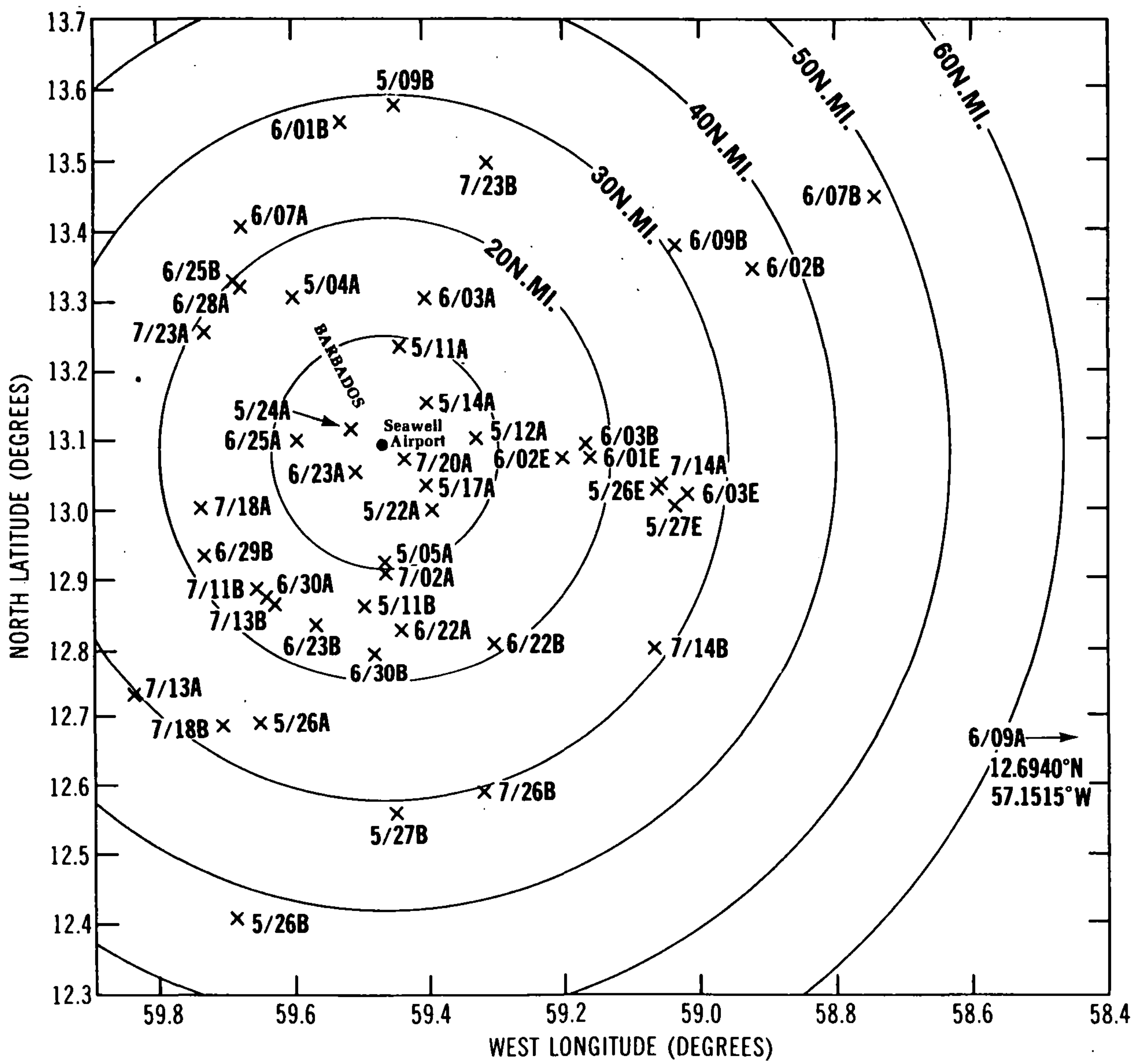


Figure 9-1.--Termination latitudes and longitudes of RFF flights.

Because of redundant sensors aboard each aircraft, and the possibility of deriving height from pressure and vice versa, a priority system had to be used to compute a best estimate of temperature, humidity, height, pressure, and wind at any given time. Two things should be noted. First, the data from a given sensor may not be available at that time because of its deletion during editing or because, in the case of the Doppler radar, the memory switch was on. Second, if data were neither available at that time from any sensor nor could be computed, the last valid datum was carried forward, second by second, until data became available again. The priority scheme, where subscript o denotes the previous value, is as follows:

Height, z	Radar altimeter > hydrostatic computation > z_o
Pressure, P	Pressure sensor > hydrostatic computation > p_o^o
Temperature, T	Rosemount > Vortex > T_o
Humidity, ρ	Infrared > CSI > ρ_o
Wind velocity, u,v	u_o, v_o
Position	APN-153 > APN-82 > f (airspeed, heading, u_o, v_o)
Ground speed	f (airspeed, heading, u_o, v_o)
Heading, D	Magnetic compass > D_o

Priorities or computational intermediates, such as atmospheric density and airspeed, are not shown.

9.1.3 Archive Format and Inventory of Meteorological Data

The RFF meteorological data are archived on 800 BPI, BCD magnetic tape. The length of each record is 2,080 characters (16 s x 130 characters/s). The format of each record is as follows:

Field	Character	Data	Units	Remarks
1	1-6	Air pressure	counts	Notes 1,2,3
2	7-12	Radar altitude	counts	Notes 1,2,3
3	13-17	Heading	counts	Notes 1,2,3
4	18-24	APN-82 distance travel count	counts	Notes 1,2,3
5	25-28	APN-82 drift angle	counts	Notes 1,2,3
6	29-33	Vortex temperature	counts	Notes 1,2,3
7	34-38	Infrared hygrometer	counts	Notes 1,2,3
8	39-43	Differential pressure	counts	Notes 1,2,3,4
9	44-47	APN-153 ground speed	counts	Notes 1,2,3
10	48-51	APN-153 drift angle	counts	Notes 1,2,3

Field	Character	Data	Units	Remarks
11	52-56	Rosemount temperature	counts	Notes 1,2,3
12	57-61	CSI dewpoint	counts	Notes 1,2,3
13	62-66	Liquid water content	counts	Notes 1,2,3
14	67-68	APN-82 and APN-153 memory	counts	Notes 1,2,3
15	69-71	Julian day	day	
16	72-73	Hour	hr	
17	74-75	Minute	min	
18	76-77	Second	s	
19	78-81	u (positive east) wind component	m/s x 10	
20	82-85	v (positive north) wind component	m/s x 10	
21	86-89	Temperature	^{o}C x 10	
22	90-93	Absolute humidity	g/m^3 x 10	
23	94-97	Liquid water content	g/m^3 x 10	Note 5
24	98-102	Pressure	mb x 10	
25	103-107	Altitude	m	
26	108-114	Latitude (positive north)	deg x 10^4	
27	115-121	Longitude (positive east)	deg x 10^4	
28	122-125	Ground speed	m/s x 10	
29	126-129	True heading	deg x 10	
30	130	(9) Dummy character		

Note 1. Data missing from the CONVERT tape are denoted by -1 in field.

Note 2. Edited values are denoted by -count in field.

Note 3. Units of "counts" as originally recorded, with the exceptions noted in 1 and 2 above.

Note 4. A programming error did not allow sufficient room for minus sign for the purpose described in 2 above. Characters 39-43 and their multiples should be read or decoded under an A format since field overflow is on tape as an asterisk.

Note 5. Where liquid water content counts were negative (1 and 2 above), liquid water content in grams per cubic meters was set equal to zero.

An inventory of the RFF meteorological data is given in table 9-18.

Table 9-18.--Inventory of RFF aircraft meteorological data

Magnetic tape No.	Aircraft	BOMEX Observation Period	Julian day	Date (1969)	Start time (hr:min:s)	End time (hr:min:s)
2321	DC-6 39C	I	124	May 4	14:43:30	21:54:24
"	DC-6 40C	"	"	"	10:27:02	21:50:45
2322	DC-6 39C	"	125	May 5	14:53:45	21:00:08
"	DC-6 40C	"	129	May 9	13:59:32	19:56:19
"	DC-6 39C	"	131	May 11	15:05:55	21:35:13
"	DC-6 40C	"	"	"	10:22:30	21:25:57
2324	DC-6 39C	"	132	May 12	11:32:25	21:31:52
"	DC-6 40C	"	"	"	11:25:00	21:26:03
"	DC-6 39C	"	134	May 14	12:10:00	19:49:11
2325	DC-6 39C	"	137	May 17	14:03:10	19:09:49
"	"	"	142	May 22	17:38:25	23:33:36
"	"	II	144	May 24	18:36:10	01:54:33
"	"	"	146	May 26	14:42:40	22:30:55
2326	DC-6 40C	"	146	May 26	10:58:15	21:22:46
"	DC-4 82E	"	"	"	11:03:16	21:18:11
2327	DC-6 39C	"	147	May 27	13:17:00	22:13:30
"	DC-6 40C	"	"	"	10:50:00	21:32:07
2328	DC-4 82E	"	147	May 27	10:55:37	21:28:08
2330	"	"	152	June 1	11:01:41	21:51:16
"	DC-6 40C	"	153	June 2	10:55:01	21:46:12
2331	DC-4 82E	"	"	"	10:53:51	21:44:09
"	DC-6 39C	"	154	June 3	13:07:30	19:32:01
"	DC-6 40C	"	"	"	10:54:15	21:33:32

Table 9-18.--Inventory of RFF aircraft meteorological data (continued)

Magnetic tape No.	Aircraft	BOMEX Observation Period	Julian day	Date (1969)	Start time (hr:min:s)	End time (hr:min:s)
2332	DC-4 82E	II	154	June 3	10:54:36	21:31:54
"	DC-6 39C	"	158	June 7	10:00:00	22:19:43
2333	DC-6 40C	"	"	"	10:24:00	21:10:55
"	DC-6 39C	"	160	June 9	10:01:05	21:53:03
2334	DC-6 40C	"	160	June 9	10:22:00	21:07:19
2335	DC-6 39C	III	172	June 21	17:05:00	21:50:19
"	DC-6 39C	"	173	June 22	10:08:01	22:12:16
"	DC-6 40C	"	"	"	10:26:00	21:30:31
2336	DC-4 82E	"	173	June 22	10:06:31	21:21:42
"	DC-6 39C	"	174	June 23	22:06:00	09:15:51
2337	DC-6 40C	"	174	June 23	22:00:00	09:18:23
"	DC-4 82E	"	"	"	22:40:21	06:58:28
2338	DC-6 39C	"	176	June 25	22:35:20	09:46:15
"	DC-6 40C	"	"	"	22:30:00	09:48:23
2339	DC-6 39C	"	179	June 28	13:24:01	20:34:24
"	DC-4 82E	"	"	"	13:22:11	20:26:10
2340	DC-6 40C	"	180	June 29	10:00:00	21:19:27
"	DC-6 82E	"	"	"	10:11:30	21:12:48
2341	DC-6 39C	"	181	June 30	14:01:15	22:19:54
"	DC-6 40C	"	"	"	11:00:00	22:22:39
2342	DC-6 39C	"	183	July 2	12:29:40	20:29:39
"	DC-4 82E	"	"	"	12:00:08	21:00:08

Table 9-18.--Inventory of RFF aircraft meteorological data (continued)

Magnetic tape No.	Aircraft	BOMEX Observation Period	Julian day	Date (1969)	Start time (hr:min:s)	End time (hr:min:s)
2343	DC-6 40C	IV	192	July 11	11:11:00	22:18:11
"	DC-6 39C	"	194	July 13	12:23:41	22:38:04
2344	DC-6 40C	"	194	July 13	12:01:00	22:36:43
"	DC04 82E	"	"	"	12:07:01	15:51:00
2345	DC-6 39C	"	195	July 14	13:18:00	00:00:39
"	DC-6 40C	"	"	"	13:14:00	23:58:47
2346	DC-4 82E	"	196	July 15	09:43:16	15:03:15
"	DC-6 39C	"	199	July 18	11:09:30	20:17:45
2347	DC-6 40C	"	199	July 18	11:00:00	21:34:07
2348	DC-6 39C	"	201	July 20	15:13:40	21:52:03
"	DC-6 40C	"	"	"	15:12:31	22:11:10
2349	DC-6 39C	"	204	July 23	12:34:15	23:27:02
"	DC-6 40C	"	"	"	12:33:00	22:27:07
2350	DC-4 82E	"	204	July 23	12:33:10	23:19:01
"	DC-6 39C	"	206	July 25	10:06:00	22:05:24
2351	DC-6 39C	"	207	July 26	13:09:40	00:23:15
"	DC-6 40C	"	"	"	10:00:00	20:06:23
2352	DC-4 82E	"	207	July 26	09:15:06	19:59:52
"	DC-6 39C	"	209	July 28	14:26:03	00:00:02

9.1.4 Archive Format and Inventory of Radar and Cloud Photographs

Radar scope photographs taken by RFF aircraft are available for selected days in 35-mm black and white positive film, with synchronized time reference appearing on each frame. Data are from the following radar scopes:

APS-20E 10-cm radar PPI scope (DC-6 39C and 40C only).
WP-101 5.6-cm radar scope PPI scope (DC-6 39C and 40C only).
RDR-ID 3.2-cm radar RHI presentation (DC-6 39C and 40C only).
APS-42A 3.2-cm radar PPI scope (DC-4 82E only).

An inventory of the archived radar photographs, which are registered copies of the original film, is given in table 9-19.

Cloud photographs along the flight tracks were taken on the DC-6 39C and 40C with one 16-mm forward-viewing camera, time lapsed to expose one frame every 2 s and with a synchronized time-synchronized data chamber appearing on each frame; and two 35-mm side-viewing time-lapsed cameras recording 90° each side of the heading of the aircraft, with wide-angle lenses exposing one frame every 5 s. The 16-mm cloud photographs are in Ektachrome color; the 35-mm photographs are on black and white positive film. An inventory of the cloud photographs is given in table 9-20.

Table 9-19.--RFF aircraft radar data inventory

Microfilm reel No.	Aircraft	Radar	BOMEX Observation Period	First frame Date (1969)	First frame Time (GMT)	Last frame Date (1969)	Last frame Time (GMT)
118	DC-6 40C	RDR-1	I	May 4	1102	May 4	1705
119	"	"	"	"	1705	"	2150
120	DC-4 82E	APS-42	"	"	1043	"	1335
121	"	"	"	"	1403	"	1701
122	"	"	"	"	1701	"	1945
123	"	"	"	"	2017	"	2147
124	DC-6 40C	WP-101	"	May 9	1418	May 9	1943
125	"	RDR-1	"	"	1418	"	1943
126	"	APS-20	"	"	1500	"	1752
127	DC-4 82E	APS-42	"	"	1610	"	1942
128	DC-6 40C	APS-20	"	May 11	1736	May 11	2004
129	"	RDR-1	"	"	1030	"	1743
130	"	"	"	"	1743	"	2113
131	DC-4 82E	APS-42	"	"	1030	"	2015
132	"	"	"	"	2015	"	2115
133	DC-6 39C	WP-101	"	May 12	1154	May 12	1805
134	"	"	"	"	1805	"	2125
135	"	RDR-1	"	"	1154	"	1805
136	"	"	"	"	1805	"	2125
137	DC-6 40C	RDR-1	"	"	1141	"	1839
138	"	"	"	"	1845	"	2037
139	"	WP-101	II	May 26	1109	May 26	1135
140	"	"	"	"	1156	"	1600
141	"	"	"	"	1722	"	2105
142	"	RDR-1	"	"	1109	"	1943
143	"	"	"	"	1945	"	2214

Table 9-19.--RFF aircraft radar data inventory (continued)

Microfilm reel No.	Aircraft	Radar	BOMEX Observation Period	First frame Date (1969)	First frame Time (GMT)	Last frame Date (1969)	Last frame Time (GMT)
144	DC-4 82E	APS-42	II	May 26	1106	May 26	2036
145	"	"	"	"	2036	"	2118
146	DC-6 40C	WP-101	"	May 27	1237	May 27	2105
147	"	RDR-1	"	"	1108	"	1844
148	"	"	"	"	1844	"	2121
149	DC-4 82E	APS-42	"	"	1103	"	1312
150	DC-6 40C	WP-101	"	June 1	1109	June 1	1815
151	"	"	"	"	1843	"	2147
152	"	"	"	June 2	1132	June 2	1840
153	"	"	"	"	1840	"	2143
154	"	"	"	June 3	1106	June 3	1824
155	"	"	"	"	1841	"	2114
156	DC-4 82E	APS-42	"	"	1422	"	2131
157	DC-6 40C	WP-101	"	June 7	1031	June 7	1745
158	"	"	"	"	1752	"	2057
159	"	APS-20	"	"	1531	"	2045
160	DC-4 82E	APS-42	"	"	1017	"	2150
161	DC-6 40C	WP-101	"	June 9	1029	June 9	1728
162	"	"	"	"	1728	"	2102
163	"	APS-20	"	"	1445	"	1940
164	DC-4 82E	APS-42	"	"	1126	"	1932
165	DC-6 40C	WP-101	III	June 22	1047	June 22	1749
166	"	"	"	"	1749	"	2123
167	"	RDR-1	"	"	1100	"	1749
168	"	"	"	"	1753	"	2123
169	DC-4 82E	APS-42	"	"	1018	"	1440

Table 9-19.--RFF aircraft radar data inventory (continued)

Microfilm reel No.	Aircraft	Radar	BOMEX Observation Period	First frame Date (1969)	First frame Time (GMT)	Last frame Date (1969)	Last frame Time (GMT)
170	DC-6 40C	WP-101	III	June 23	1215	June 23	1925
171	"	"	"	"	1935	"	2305
172	"	RDR-1	"	"	1215	"	1930
173	"	"	"	"	1935	"	2310
174	DC-4 82E	APS-42	"	"	1840	June 24	0255
175	DC-6 40C	RDR-1	"	June 25	2246	June 26	0130
176	"	"	"	June 26	0409	"	0942
177	DC-4 82E	APS-42	"	June 25	2236	"	0937
178	"	"	"	June 28	1326	June 28	2008
179	DC-6 40C	RDR-1	"	June 29	1012	June 29	1736
180	"	"	"	"	1736	"	2114
182	DC-4 82E	APS-42	"	"	1025	"	2114
183	DC-6 40C	RDR-1	"	June 30	1110	June 30	1838
184	"	"	"	"	1738	"	2116
185	DC-4 82E	APS-42	"	"	1108	"	1304
186	"	"	"	July 2	1237	July 2	2058
187	DC-6 39C	APS-20	IV	July 11	1438	July 11	2112
188	"	WP-101	"	"	1433	"	1719
189	DC-6 40C	APS-20	"	"	1554	"	2004
190	"	WP-101	"	"	1121	"	1816
191	"	"	"	"	1818	"	2208
192	"	RDR-1	"	"	1334	"	1817
193	"	"	"	"	1818	"	2210
194	DC-6 39C	RDR-1	"	July 13	1355	July 13	2000
195	"	"	"	"	2001	"	2225

Table 9-19.--RFF aircraft radar data inventory (continued)

Microfilm reel No.	Aircraft	Radar	BOMEX Observation Period	First frame Date (1969)	First frame Time (GMT)	Last frame Date (1969)	Last frame Time (GMT)
196	DC-6 40C	APS-20	IV	July 13	1431	July 13	2223
197	"	WP-101	"	"	1230	"	1933
198	"	"	"	"	1934	"	2226
199	"	RDR-1	"	"	1232	"	2034
200	"	"	"	"	2035	"	2226
201	DC-4 82E	APS-42	"	"	1225	"	1507
202	DC-6 39C	APS-20	"	July 14	1430	July 14	2345
203	"	RDR-1	"	"	1335	"	2021
204	"	"	"	"	2023	"	2345
205	DC-6 40C	APS-20	"	"	2120	"	2345
206	"	WP-101	"	"	1448	"	2105
207	"	"	"	"	2106	"	2353
208	"	RDR-1	"	"	1339	"	2104
209	"	"	"	"	2104	"	2353
210	DC-4 82E	APS-42	"	July 15	1210	July 15	1702
211	DC-6 39C	APS-20	"	July 18	1145	July 18	2013
212	"	RDR-1	"	"	1145	"	1845
213	"	"	"	"	1546	"	2013
214	DC-6 40C	APS-20	"	"	1136	"	1921
215	"	"	"	"	2002	"	2128
216	"	WP-101	"	"	1323	"	1352
217	"	"	"	"	1518	"	2128
218	"	RDR-1	"	"	1116	"	1522
219	"	"	"	"	1523	"	2128
220	DC-4 82E	APS-42	"	"	1114	"	2053
221	DC-6 40C	APS-20	"	July 20	1636	July 20	2218
222	"	WP-101	"	"	1521	"	2223

Table 9-19.--RFF aircraft radar data inventory (continued)

Microfilm reel No.	Aircraft	Radar	BOMEX Observation Period	First frame Date (1969)	First frame Time (GMT)	Last frame Date (1969)	Last frame Time (GMT)
223	DC-6 40C	RDR-1	IV	July 20	1520	July 20	2223
224	DC-4 82E	APS-42	"	July 21	1309	July 21	1743
225	DC-6 40C	APS-20	"	July 23	1502	July 23	2223
226	"	WP-101	"	"	1240	"	1935
227	"	"	"	"	1937	"	2223
228	"	"	"	"	1240	"	1932
229	"	"	"	"	1933	"	2223
230	DC-4 82E	APS-42	"	"	1240	"	2129
231	DC-6 39C	RDR-1	"	July 25	1016	July 25	1720
232	"	"	"	"	1720	"	2154
233	"	"	"	July 26	1324	July 26	2006
234	"	"	"	"	2006	"	0017
235	DC-6 40C	APS-20	"	"	1028	"	2000
236	"	WP-101	"	"	1011	"	1706
237	"	"	"	"	1706	"	2003
238	"	RDR-1	"	"	1012	"	1704
239	"	"	"	"	1705	"	2000
240	DC-4 82E	APS-42	"	"	0916	"	1615
241	DC-6 39C	WP-101	"	July 28	1435	July 28	2143
242	"	"	"	"	2144	"	2351
243	"	RDR-1	"	"	1435	"	2142
244	"	"	"	"	2143	"	2351

Table 9-20.--RFF aircraft cloud photograph data inventory

Microfilm reel No.	Film type	Aircraft	Camera	BOMEX Observation Period	First frame Date (1969)	First frame Time (GMT)	Last frame Date (1969)	Last frame Time (GMT)
504 AF	16-mm 400-ft reel, color	DC-6 39C	Nose Camera	I	May 4	1440	May 4	2154
505 AF	"	"	"	"	May 5	1446	May 5	2100
510 AF	"	"	"	"	May 10	0941	May 10	1751
511 AF	"	"	"	"	May 11	1346	May 11	2134
512 AF	"	"	"	"	May 12	1129	May 12	2029
514 AF	"	"	"	"	May 14	1200	May 14	1950
517 AF	"	"	"	"	May 17	1400	May 17	1910
522 AF	"	"	"	"	May 22	1730	May 22	2335
524 AF	"	"	"	II	May 24	1835	May 24	2205
526 AF	"	"	"	"	May 26	1437	May 26	2205
527 AF	"	"	"	"	May 27	1310	May 27	2200
601 AF	"	"	"	"	June 1	1255	June 1	2054
603 AF	"	"	"	"	June 3	1300	June 3	1929
607 AF	"	"	"	"	June 7	1130	June 7	2023
609 AF	"	"	"	"	June 9	1130	June 9	2015
621 AF	"	"	"	III	June 21	1701	June 21	2153
622 AF	"	"	"	"	June 22	1130	June 22	2040
628 AF	"	"	"	"	June 28	1316	June 28	2034
629 AF	"	"	"	"	June 29	1320	June 29	2013
630 AF	"	"	"	"	June 30	1358	June 30	2220
702 AF	"	"	"	"	July 2	1222	July 2	2029
713 AF	"	"	"	IV	July 13	1338	July 13	2235
714 AF	"	"	"	"	July 14	1430	July 14	2230
718 AF	"	"	"	"	July 18	1235	July 18	2018
720 AF	"	"	"	"	July 20	1457	July 20	2152
723 AF	"	"	"	"	July 23	1229	July 23	2118
726 AF	"	"	"	"	July 26	1258	July 26	2212
728 AF	"	"	"	"	July 28	1418	July 28	2230

Table 9-20.--RFF aircraft cloud photograph data inventory (continued)

Microfilm reel No.	Film type	Aircraft	Camera	BOMEX Observation Period	First frame Date (1969)	First frame Time (GMT)	Last frame Date (1969)	Last frame Time (GMT)
504 AR	35-mm 800 ft reel, black and white	DC-6 39C	Right side camera	I	May 4	1440	May 10	1751
511 AR	"	"	"	"	May 11	1346	May 12	2132
514 AR	"	"	"	"	May 14	1200	May 17	1910
522 AR	"	"	"	II	May 22	1730	May 26	2205
527 AR	"	"	"	"	May 27	1310	June 1	2220
603 AR	"	"	"	"	June 3	1300	June 7	2220
609 AR	"	"	"	"	June 9	0955	June 9	2153
621 AR	"	"	"	III	June 21	1701	June 22	2211
628 AR	"	"	"	"	June 28	1316	June 30	2159
702 AR	"	"	"	"	July 2	1222	July 2	2029
713 AR	"	"	"	IV	July 13	1201	July 14	2230
718 AR	"	"	"	"	July 18	1108	July 20	2152
723 AR	"	"	"	"	July 23	1227	July 25	2037
726 AR	"	"	"	"	July 26	1257	July 28	2219
504 AL	"	"	Left side camera	I	May 4	1440	May 10	1751
511 AL	"	"	"	"	May 11	1346	May 12	2132
514 AL	"	"	"	"	May 14	1200	May 17	1910
522 AL	"	"	"	II	May 22	1730	May 26	2205
527 AL	"	"	"	"	May 27	1310	June 1	2220
603 AL	"	"	"	"	June 3	1300	June 7	2220
609 AL	"	"	"	"	June 9	0955	June 9	2153
621 AL	"	"	"	III	June 21	1701	June 22	2211
628 AL	"	"	"	"	June 28	1316	June 30	2159
702 AL	"	"	"	"	July 2	1222	July 2	2029
713 AL	"	"	"	IV	July 13	1201	July 14	2215

Table 9-20.--RFF aircraft cloud photograph data inventory (continued)

Microfilm reel No.	Film type	Aircraft	Camera	BOMEX Observation Period	First frame Date (1969)	First frame Time (GMT)	Last frame Date (1969)	Last frame Time (GMT)
718 AL	35-mm 800 ft reel, black and white	DC-6 39C	Left side camera	IV	July 18	1108	July 20	2152
723 AL	"	"	"	"	July 23	1227	July 25	2021
726 AL	"	"	"	"	July 26	1257	July 28	2230
504 BF	16-mm 400 ft reel, color	DC-6 40C	Nose camera	I	May 4	1024	May 4	1541
509 BF	"	"	"	"	May 9	1357	May 9	2001
511 BF	"	"	"	"	May 11	1020	May 11	1730
512 BF	"	"	"	"	May 12	1124	May 12	1951
526 BF	"	"	"	II	May 26	1055	May 26	1950
527 BF	"	"	"	"	May 27	1050	May 27	1948
601 BF	"	"	"	"	June 1	1045	June 1	1958
602 BF	"	"	"	"	June 2	1050	June 2	1948
603 BF	"	"	"	"	June 3	1055	June 3	2011
607 BF	"	"	"	"	June 7	1020	June 7	1958
609 BF	"	"	"	"	June 9	1020	June 9	1823
622 BF	"	"	"	III	June 22	1026	June 22	1915
629 BF	"	"	"	"	June 29	1000	June 29	1855
630 BF	"	"	"	"	June 30	1100	June 30	1930
713 BF	"	"	"	IV	July 13	1205	July 13	2140
714 BF	"	"	"	"	July 14	1314	July 14	1802
718 BF	"	"	"	"	July 18	1135	July 18	1305
720 BF	"	"	"	"	July 20	1513	July 20	2159
723 BF	"	"	"	"	July 23	1230	July 23	1351
726 BF	"	"	"	"	July 26	1012	July 26	1728
504 BR	35-mm 800 ft reel, black and white	"	Right side camera	I	May 4	1024	May 9	1959

Table 9-20.--RFF aircraft cloud photograph data inventory (continued)

Microfilm reel No.		Film type	Aircraft	Camera	BOMEX Observation Period	First frame Date (1969)	First frame Time (GMT)	Last frame Date (1969)	Last frame Time (GMT)
511	BR	35-mm 800 ft reel, black and white	DC-6 40C	Right side camera	I	May 11	1020	May 12	2125
526	BR	"	"	"	II	May 26	1055	May 27	2133
601	BR	"	"	"	"	June 1	1045	June 2	2148
603	BR	"	"	"	"	June 3	1055	June 7	2113
609	BR	"	"	"	"	June 9	1015	June 9	2110
622	BR	"	"	"	III	June 22	1025	June 29	2108
630	BR	"	"	"	"	June 30	1100	June 30	2125
711	BR	"	"	"	IV	July 11	1502	July 11	2116
713	BR	"	"	"	"	July 13	1200	July 14	2230
718	BR	"	"	"	"	July 18	1201	July 20	2220
723	BR	"	"	"	"	July 23	1230	July 26	2007
504	BL	35-mm 800 ft reel, black and white	"	Left side camera	I	May 4	1024	May 9	1959
511	BL	"	"	"	"	May 11	1020	May 12	2125
526	BL	"	"	"	II	May 26	1055	May 27	2133
601	BL	"	"	"	"	June 1	1045	June 2	2148
603	BL	"	"	"	"	June 3	1055	June 7	2113
609	BL	"	"	"	"	June 9	1015	June 9	2110
622	BL	"	"	"	III	June 22	1025	June 29	2000
630	BL	"	"	"	"	June 30	1100	June 30	2125
711	BL	"	"	"	IV	July 11	1334	July 11	0518
713	BL	"	"	"	"	July 13	1200	July 14	2209
718	BL	"	"	"	"	July 18	1100	July 20	2227
723	BL	"	"	"	"	July 23	1230	July 26	2007

9.2 Navy and Air Force Aircraft

Weather reconnaissance data obtained by Navy WC-121 and Air Force WB-47, RB-57, and WC-130 aircraft were recorded on the BOMEX RECCO Code (Aerial Meteorological Reconnaissance Reporting Code) Form. Navigation data were also manually recorded aboard these aircraft. Radar scope photographs were taken by Navy WC-121 and Air Force WB-47 aircraft. Air Force WC-130 aircraft also obtained dropsonde data, which are discussed separately in section 10.

9.2.1 RECCO Data

The RECCO Code form, shown in figure 9-2, was filled in manually by the flight crews aboard all the Navy and Air Force aircraft. The information was later transcribed onto regular coding forms, on which the original 71 columns were preserved, and only columns 72 through 80 were redesignated, as follows:

Column 75. Pressure indicator. If columns 34 through 36 on the RECCO Code Form showed pressure in millibars, code 1 was entered in column 75 on the transcription form.

Column 76. Altitude indicator. Group 9xxx9 at the top of the page indicated the number to be entered. For example, 97779 was coded as 7 in column 76 of the transcription form.

Column 77. Aircraft identifier. The types of Navy and Air Force aircraft used during BOMEX are indicated earlier in table 9-1. However, different aircraft of these types were used on rotating basis, and in processing the data, the following codes were used for the tail number designations: Code 3 for Navy A/C 141323; 6 for Navy A/C 137896, 8 for Navy A/C 143198; 1 for only one or for the first Air Force flight on a given day; and 2 for the second Air Force flight the same day.

Columns 78, 79, and 80. Date, e.g., 522 for May 22.

The notes referred to by number at the bottom of the form, which served as guides in coding the data, are listed below. The tables referred to just below the column head on the form, which were also used in the coding, are shown in figure 9-3.

Notes

9. GGgg and Y - The time the aircraft is on the vertical axis of the observation cylinder is reported for "GGgg." All elements are observed, insofar as practicable, when the aircraft is at the point of observation or in proximity thereto. The actual time of observation is the time at which observation of all elements is completed. All times (GGgg) and the day of the week (Y) are given in Greenwich Mean Time. The day reported for Y is the day on which the observation is taken and NOT the day on which it is transmitted.

MISSION	IDENT.	FLIGHT	YR.	MO.	DAY	9 X X X 9
						9 9

BOMEX RECCO CODE

(Aerial Meteorological Reconnaissance Reporting Code)

U.S. DEPARTMENT OF COMMERCE
ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION

Field	Code	SEE TABLE	SEE NOTE	CARD COLUMN
Section 1 — MANDATORY				
Time (GCT) of Observation (hours and minutes)	GGgg		9	
Humidity Indicator	i_w	2		5
Day of Week	Y	3	9	
Octant of Globe	Q	4		
Latitude (In tens, units, and tenths of degrees)	$L_a L_a L_a$		10	10
Longitude (In tens, units, and tenths of degrees)	$L_o L_o L_o$		10	
Flight Conditions	f_c	6	12	14
True Altitude of Aircraft (100s of ft. or decameters above m.s.l.)	hhh		13	
Type of Wind at Flight Altitude	d_t	7	14	
Reliability of Wind at Flight Altitude	d_a	8	15	19
Wind Direction at Altitude "hhh" (10s of degrees, true)	dd		15	
Wind Speed at Altitude "hhh" (knots)	fff		15	24
Temperature (Degrees and tenths Celsius)	TT		16	
Dew Point (Degrees and tenths Celsius)	$T_d T_d$		17	
Present Weather	w	9	18	31
Remarks on Present Weather	m	10	19	
Index pertaining to HHH	j	11		
Altitude and Other Data	HHH			36
Section 2 — OPTIONAL				
Group Indicator	I		20	
Total Number of Cloud Layers Reported	k_n		21	
Cloud Amount (1st. layer) (Ascending Order)	N_1	12	22	
Cloud Amount (2nd. layer) (Ascending Order)	N_2	12	22	
Cloud Amount (3rd. layer) (Ascending Order)	N_3	12	22	41
Cloud Type	C	13	23–25	
Altitude of Base of Cloud Type Reported by C	hh	14	23–25	
Altitude of Top of Cloud Type Reported by C	HH	14	23–25	46
Cloud Type	C	13	23 – 25	
Altitude of Base of Cloud Type Reported by C	hh	14	23 – 25	
Altitude of Top of Cloud Type Reported by C	HH	14	23 – 25	51
Cloud Type	C	13	23 – 25	
Altitude of Base of Cloud Type Reported by C	hh	14	23 – 25	
Altitude of Top of Cloud Type Reported by C	HH	14	23 – 25	56
Group Indicator	4		26	
Direction of Surface Wind (10s of degrees true)	dd		27	
Wind Speed at Surface (knots)	ff		28	61
Group Indicator	5		26	
Direction of Surface Wind	D	15	29	
Force of Surface Wind	F	16	30	
State of Sea	S	17		
Direction of Swell	D_k	15	31	66
Group Indicator	6		32	
Significant Changes in Weather	W_s	18	33	
Distance of Occurrence of W_s	S_s	19	34	
Weather Off Course	W_c	20	35	
Bearing (true) of Weather Off Course	D_w	15	36	
Radar Info. Indicator	8		44	72
Plain Language Remarks			54 – 55	

Figure 9-2.--RECCO Code Form.

Table 2: i_u

0 °C,	No humidity report
1 °C,	Relative humidity
2 °C,	Difference between dry- and wet-bulb temperatures
3 °C,	Difference between dry-bulb and dewpoint temperatures
4 °C,	Dewpoint

Table 3: Y

1	Sunday
2	Monday
3	Tuesday
4	Wednesday
5	Thursday
6	Friday
7	Saturday

Table 4: Q

0	0° - 90°W	North latitude
1	90° - 180°W	North latitude
2	180° - 90°E	North latitude
3	90° - 0°E	North latitude
4		
5	0° - 90°W	South latitude
6	90° - 180°W	South latitude
7	180° - 90°E	South latitude
8	90° - 0°E	South latitude

Table 6: f'_c

0	Cloud amount less than 1/8
1	Cloud amount at least 1/8, with either 1/8 to 4/8 above or 1/8 to 4/8 below, or combinations thereof
2	Cloud amount more than 4/8 above and 0 to 4/8 below
3	Cloud amount 0 to 4/8 above and more than 4/8 below
4	Cloud amount more than 4/8 above and more than 4/8 below
5	Chaotic sky; many undefined layers
6	In and out of clouds; on instruments 25 percent of the time
7	In and out of clouds; on instruments 50 percent of the time
8	In and out of clouds; on instruments 75 percent of the time
9	In clouds all the time; continuous instrument flight
/	Impossible to determine due to darkness

Figure 9-3.--Tables referred to on RECCO Code form that were used in encoding.

Table 7: d_t

0	Spot wind	
1	Winds averaged over 100 nmi preceding last fix	Last fix
2	Winds averaged over 200 nmi preceding last fix	25 nmi
3	Winds averaged over 300 nmi preceding last fix	prior to
4	Winds averaged over 400 nmi preceding last fix	position.
5	Winds averaged over 100 nmi preceding last fix	Last fix
6	Winds averaged over 200 nmi preceding last fix	75 nmi prior
7	Winds averaged over 300 nmi preceding last fix	to this
8	Winds averaged over 400 nmi preceding last fix	position.
9	Winds averaged over more than 400 nmi	

Table 8: d_a

0	90 to 100 percent reliable
1	75 to 100 percent reliable
2	80 to 100 percent reliable
3	75 to 90 percent reliable
4	60 to 80 percent reliable
5	50 to 75 percent reliable
6	Less than 50 percent reliable
7	No reliability
8	No wind
9	Not used
	(see note 15)

Figure 9-3.--Tables referred to on RECCO Code form that were used in encoding (continued).

Table 9: w

0	Clear (no cloud at any level)
1	Partly cloudy (scattered or broken)
2	Continuous layer(s) of cloud(s)
3	Sandstorm, duststorm, or storm of drifting snow
4	Fog, thick dust, or haze
5	Drizzle
6	Rain
7	Snow or rain and snow mixed
8	Shower(s)
9	Thunderstorm(s)

Table 10: m

0	No remarks
1	Light intermittent
2	Light continuous
3	Moderate intermittent
4	Moderate continuous
5	Heavy intermittent
6	Heavy continuous
7	With rain
8	With snow
9	With hail

Table 11: j

0	Surface pressure in whole millibars; thousands figure omitted
1	Altitude of 1,000-mb surface in decameters or tens of feet; if negative, add 500
2	Altitude of 850-mb surface in decameters or tens of feet; if negative, add 500
3	Altitude of 700-mb surface in decameters or tens of feet
4	Altitude of 500-mb surface in decameters or tens of feet
5	Altitude of 300-mb surface in decameters or tens of feet
6	Altitude of 200-mb surface in decameters or tens of feet
7	Altitude of 100-mb surface in decameters or tens of feet
8	True altitude (radio altimeter or other method) minus pressure altitude (set at 1,013 mb) in tens of feet; if negative, add 500 to absolute value (e.g., minus 100 is reported as 600)
9	Altimeter subscale reading in whole millibars; thousands figure omitted

Figure 9-3.—Tables referred to on RECCO Code form that were used in encoding (continued).

Table 12: N_1, N_2, N_3

0	Zero		Zero
1	1/10 or less, but not zero	1	Okta or less, but not zero
2	2/10 and 3/10	2	Oktas
3	4/10	3	Oktas
4	5/10	4	Oktas
5	6/10	5	Oktas
6	7/10 and 8/10	6	Oktas
7	9/10 or more, but not 10/10	7	Oktas or more, but not 8 oktas
8	10/10	8	Oktas
9	Sky obscured, or cloud amount cannot be estimated		

Table 13: C

0	Cirrus (Ci)
1	Cirrocumulus (Cc)
2	Cirrostratus (Cs)
3	Alto cumulus (Ac)
4	Altostratus (As)
5	Nimbostratus (Ns)
6	Stratocumulus (Sc)
7	Stratus (St) or Fractostratus (Fs)
8	Cumulus (Cu) or Fractocumulus (Fc)
9	Cumulonimbus (Cb)
/	Cloud not visible owing to darkness, fog, dustorm, sandstorm, or other analogous phenomena

Table 14: hh, HH, h_ih_i, H_iH_i

00	Less than 100 ft (30 m)
01	100 ft (30 m)
02	200 ft (60 m)
03	300 ft (90 m)
04	400 ft (120 m)
05	500 ft (150 m), etc.
49	4,900 ft (1,470 m)
50	5,000 ft (1,500 m)
51	Not specified, etc.
56	6,000 ft (1,800 m)
57	7,000 ft (2,100 m), etc.
78	28,000 ft (8,400 m)
79	29,000 ft (8,700 m)
80	30,000 ft (9,000 m)
81	35,000 ft (10,500 m)
82	40,000 ft (12,000 m), etc.
87	65,000 ft (19,500 m)
88	70,000 ft (21,000 m)
89	Above 70,000 ft (21,000 m)
//	Unknown

Figure 9-3.--Tables referred to on RECCO Code form that were used in encoding (continued).

Table 15: D, D_K, D_w

0	Calm or stationary (or at the station)
1	NE
2	E
3	SE
4	S
5	SW
6	W
7	NW
8	N
9	All directions, no definite direction, or unknown, or no report

Table 16: F

0	Calm
1	1 to 3 kn
2	4 to 6 kn
3	7 to 10 kn
4	11 to 16 kn
5	17 to 21 kn
6	22 to 27 kn
7	28 to 33 kn
8	34 to 40 kn
9	41 to 47 kn or over (see note 30)

Table 17: S

0	Calm (glassy)	
1	Calm (rippled)	(0 to 1 ft)
2	Smooth (wavelets)	(1 to 2 ft)
3	Slight	(2 to 4 ft)
4	Moderate	(4 to 8 ft)
5	Rough	(8 to 13 ft)
6	Very rough	(13 to 20 ft)
7	High	(20 to 30 ft)
8	Very high	(30 to 45 ft)
9	Phenomenal, as might exist at the center of a hurricane	(over 45 ft)

Figure 9-3.--Tables referred to on RECCO Code form that were used in encoding (continued).

Table 18: W_s

0	No change
1	Marked wind shift
2	Marked turbulence begins or ends
3	Marked turbulence change (not with altitude)
4	Precipitation begins or ends
5	Change in cloud form
6	Fog bank begins or ends
7	Warm front
8	Cold front
9	Front, type not specified

Table 19: S_s, S_b, S_e

0	No report
1	Reported at previous position
2	Occurring at present position
3	20 nmi
4	40 nmi
5	60 nmi
6	80 nmi
7	100 nmi
8	150 nmi
9	More than 150 nmi

Table 20: W_c

0	No report
1	Signs of hurricane
2	Ugly, threatening sky
3	Duststorm or sandstorm
4	Fog or ice fog
5	Waterspout
6	Cs cloud shield or bank
7	As or Ac cloud shield or bank
8	Line of heavy cumulus
9	Cb heads or thunderstorms

Figure 9-3.--Tables referred to on RECCO Code form that were used in encoding (continued).

10. $L_aL_aL_a$ and $L_oL_oL_o$ - The latitude and longitude of the point at which the flight level observation is made are reported for "$L_aL_aL_a$" and "$L_oL_oL_o$," respectively. Tenths of a degree are obtained by dividing the number of minutes by six, disregarding the remainder. The hundreds digit is omitted from longitudes 100^o to 180^o, inclusive.

12. f'_c - The average flight condition existing during the time required to make the flight level observation is reported for "f'_c."

13. hhh - The true altitude of the aircraft at the time of the flight level observation is reported to the nearest 100-ft or 30-m level, e.g., when the aircraft is 50 ft or more above a 100-ft level, the next higher level is reported for "hhh."

14. d_t - When code figure 9 is reported, the distance over which the wind is averaged is added at the end of the message in plain language.

15. d_a and ddfff - When code figure 8 is reported for "d_a," five solid (/////) are reported for the "ddfff" group. The complete specifications for d_a (table 8, fig. 9-3) are:

    0 90 to 100 percent reliable. Multiple drift with closed wind star, or small open star when winds are 50 kn or greater. Short radar wind runs.

    1 75 to 100 percent reliable. Multiple drift with small open star or double drift or single drift with average ground speed by timing. Short radar run.

    2 80 to 100 percent reliable. Fix-to-fix winds based on the following pin-point visual fixes, radar fixes, or accurate Loran fixes from good ground waves.

    3 75 to 90 percent reliable. Fix-to-fix winds based on two or three lines of positions (LOPs), either Loran, celestial, radio, or sight bearings, or any combination of the above three when all lines of position are considered reliable.

    4 60 to 80 percent reliable. Winds obtained from single drift and single LOP (speed line), air plot, etc.

    5 50 to 75 percent reliable. Fix-to-fix winds based on two or three lines of position, either Loran, celestial, radio or sight bearings, or any combination of the above three when one of the lines is not considered reliable.

    6 Less than 50 percent reliable. Winds obtained by any of the above methods that the navigator believes to be inaccurate or of questionable accuracy.

    7 No reliability. Assumed or estimated winds.

8 No wind. Navigator unable to determine wind.

9 Not used.

16. TT - free-air temperature (corrected for calibration, installation, and dynamic heating effects) at flight level (hhh) at the time of observation is reported for "TT" to the nearest whole degree Celsius.

When the temperature is below zero, 50 is added to the absolute value of the temperature, and the sum is reported for "TT." The hundreds figure, if any, resulting from this addition is disregarded.

17. T_dT_d - When the wet-bulb temperature is below -35°C, "//" is reported for "T_dT_d." Dewpoint is used to indicate the moisture content of the air in United States RECCO reports (see note 16).

18. w - The specification most descriptive of the weather existing at the time of observation is reported for "w." Code figure 2 is reported when the total amount of cloud above or below the aircraft is 7/8 or more.

19. m - The information which best amplifies the present weather reported for "w" is reported for "m."

20. $1k_nN_1N_2N_3$ - If data on more than three layers of cloud are reported, a second $1k_nN_1N_2N_3$ group plus the required number of ChhHH groups are inserted in the message following the last of the first three ChhHH groups. The additional number of layers (exclusive of the first three layers) being reported is given for "k_n" in the second $1k_nN_1N_2N_3$ group. The coverage of the additional cloud layers is reported for N_1, N_2, and N_3 in the second group, as required. When no clouds exist, the $1k_nN_1N_2N_3$ and ChhHH groups are omitted from the message.

21. K_n - When clouds are present in indefinite layers (chaotic sky), code figure 9 is reported for "k_n." If it is impossible to determine that clouds exist (due to darkness or for other reasons) a "/" is reported for "k_n." When a cloud layer is present but data on the type, the extent of coverage, and altitude cannot be observed, "/'s" are reported for N, C, hh, and HH, as appropriate; however, the layer will be included in the number of layers reported for "k_n" (see note 22).

22. N_1, N_2, N_3 - The amount of cloud reported for N_1, N_2, etc., is the amount in the individual layer as though no other clouds were present; the summation concept is not used. The cloud layers are reported in the message in ascending order according to altitude of the base. When code figure 9 is reported for "k_n," the value reported for "N_1" is the total amount of cloud coverage present, and "//" is reported for "N_2N_3." When a "/" is reported for "k_n," "999" is reported for "$N_1N_2N_3$" (see note 21).

23. ChhHH - This group is included in the message for each layer of clouds reported by "k_n" and described by N_1, N_2, etc.

24. C - The type of cloud predominating in the layer is reported as "C."

25. hh and HHH - The average altitude of both the base and top of the cloud layer reported for "C" is reported for "hh" and "HH," respectively.

26. 4ddff and $5DFSD_k$ - Surface data are reported in this group. Surface wind data are included in each low-level report. Either or both of the groups may be included in the message if required.

27. dd - The estimated direction (true) from which the surface wind is blowing is reported for "dd" (see note 28).

28. ff - The estimated speed of the surface wind is reported for "ff." In the range of 100 to 199 kn, inclusive, the hundreds figure is omitted, the tens and the units values are reported for "ff," and 50 is added to the value normally reported for "dd." For speeds in excess of 199 kn, "//" is reported for "ff," and the actual speed is reported in plain language at the end of the message.

29. D - The estimated direction (true) from which the surface wind is blowing is reported for "D."

30. F - The estimated force of the surface wind is reported. When the speed exceeds force 9, code figure 9 is reported for "F," and a plain-language remark is added at the end of the flight level portion of the message giving the actual Beaufort force as "GALE TEN," "STORM ELEVEN," or "HURRICANE TWELVE."

31. D_K - The true direction FROM which the swell is moving is reported for "D_K." Code figure 0 is reported for "no swell," and code figure 9 is reported to indicate "confused" swell. When the waves are from several directions, the direction from which the wave of longest period is traveling is reported.

32. $6W_sS_sW_cD_w$ - Two 6-groups may be included in the message to report two significant weather changes, and/or two weather phenomena off course, or two combinations thereof.

33. W_s - Significant weather changes that have occurred since the last observation, or in the preceding hour (whichever period is shorter) along the track of the aircraft are reported for "W_s."

34. S_s - The distance from the present position back to the location of the significant weather change (W_s) is reported for "S_s."

35. W_c - Any off-course weather condition of importance that is not included or implied in the specification reported for present weather will be reported for "W_c." The information reported for "W_c" supplements the present weather (w) (see notes 2, 18, 54, and 55).

36. D_w - Code figure 9 indicates "in all directions."

44. $8d_rd_rS_rO_e$ $8w_ea_ec_ei_e$ - When radar data are observed, both the 8-groups shall be included in the report. The 8-groups may be repeated as often as necessary to report essential data.

54. Plain-language remarks may be added at the end of the message to supplement the coded data or to supply additional information of importance not provided for in the code, e.g., time of occurrence of significant weather (W_s), past weather, etc.

55. If information on past weather is added as a plain-language remark, the most significant weather encountered since the last report, or in the last hour, whichever period of time is shorter, shall be described by the remark.

9.2.1.1 RECCO Data Processing. After the transcription sheets have been completed, cards were punched and verified. The data were then checked for the following gross errors:

(1) Missing time or date; time $\leq$ 2369 and date $\geq$ 501, $\leq$ 731.

(2) Latitude must be between 0.0° and 20.0°, longitude between 45.0° and 68.0°.

(3) Flight condition must be from 0 through 9.

(4) Wind directions between 00 through 36 and wind directions of 99 are good; windspeed $\leq$ 100 kn.

(5) Temperature and dewpoint were checked for positive values between 00.0 through 30.0 and for negative values $\geq$ 50.0. Sea temperature was checked for values between 20.0 through 35.0.

(6) Altitude indicator must be 1, 2, 6, or 7; with an altitude indicator = 2 or 7, the value of altitude must be 2 and 999 decameters, respectively. With altitude indicator = 1 or 6 and aircraft indicator = 1 or 2, altitude must be between 0 to 60,000 ft; with an altitude indicator = 1 or 6 and aircraft - 3, 5, 6, or 8, altitude must be between 0 to 10,500 ft.

(7) Humidity indicator must be between 0 through 4.

(8) Day of the week must be between 1 through 7.

(9) Octant must equal 0 only.

(10) Pressure field checked for the first 32 files on tape. If pressure indicator = 1, pressure field must lie between $\geq$ 700 and $\leq$ 999. If pressure indicator = 2, pressure field is pressure altitude $\geq$ 350.

(11) Clouds were checked for continuity. Layers should ascend, i.e., no third layer unless second layer is present, and no second layer unless a first layer is present. Height of the top of cloud should be greater than height of bottom.

(12) Surface wind direction and force were checked against sea state and direction of swell for inconsistencies.

Approximately 150 to 200 observations were corrected. When an error was found, the original recording form was checked for error or data transposition between columns. A correction was made only if the inserted data could be validated. If the correction could not be proven, the standard "no report" or "missing data" descriptors were used.

9.2.1.2 Characteristics of the Navy and Air Force Data To Be Considered Before Use in Analysis. Although the RECCO data were checked for gross errors, as described in the preceding section, many errors of various types may have been overlooked. The user must be prepared to test the data quality thoroughly before use in scientific analysis. Also to be noted are the following:

(1) The data (characters 78-90) on Navy RECCO flight from 1615 to 0030 GMT on July 22, 1969, does not change to July 23 at 0000 GMT.

(2) The observations between 1452 and 1534 on Air Force RECCO flight from 1400 to 2230 on July 17, 1969, were written out of order.

(3) The nominal frequencies of RECCO observations reported by the Navy and Air Force flight crews were: Navy WC-121 - observations vary from one every 5 to 10 min in flight; Air Force WC-130 - observations vary from one every 10 to 20 min in flight; Air Force WB-47 - observations vary from one every 10 to 25 min in flight; and Air Force RB-57 - observations vary from one every 15 to 45 min in flight.

9.2.2 Navigation (NAV) Data

The NAV data consist of manual observations of aircraft altitude, airspeed, and heading; drift angle and ground speed; pressure and temperature; and indicated wind direction and windspeed uncorrected for Doppler radar errors and the variation of airspeed with density. The observations were frequently made in rapid succession during long, straight flight paths, and during each leg of a "wind box." The NAV data were punched on cards and scanned for lying within the limits shown in the next section. In addition, the time and position data were scanned for consistency with the flight log. No other processing or error checks were done. Airspeed is uncorrected for density; ground speed and drift angle are not corrected by wind-box or intercomparison data; and windspeed and wind direction are uncorrected for airspeed, heading, ground speed, and drift-angle errors.

9.2.3 Archive Format and Inventory of RECCO and NAV Data

The format of the RECCO data is as follows:

Word	Data Element	Format	Code Reference
1	Time	F4.0	HHMM
2	Humidity indicator Day of week Octant of globe	F3.0	Table 2, fig. 9-3 Table 3, fig. 9-3 Table 4, fig. 9-3
3	Latitude	F3.0	$L_aL_aL_a$
4	Longitude	F3.0	$L_oL_oL_o$
5	Flight conditions	F1.0	Table 6, fig. 9-3
6	Altitude	F3.0	hhh
7	Type of wind Reliability of wind	F2.0	Table 7, fig. 9-3 Table 8, fig. 9-3
8	Wind direction	F2.0	dd
9	Windspeed	F3.0	fff
10	Temperature	F3.1	TT.T
11	Dewpoint	F3.1	TT.T
12	Present weather Remarks on present weather	F2.0	Table 9, fig. 9-3 Table 10, fig. 9-3
13	Index pertaining to HHH	F1.0	Table 11, fig. 9-3
14	HHH (Altitude and other data)	F3.0	HHH
15	Cloud amount group indicator No. of cloud layers Cloud amount layer 1 Cloud amount layer 2 Cloud amount layer 3	F5.0	Table 12, fig. 9-3
16	C1 Cloud type Altitude of base Altitude of top	F5.0	Table 13, fig. 9-3 Table 14, fig. 9-3 Table 14, fig. 9-3
17	C2 same as C1	F5.0	

Word	Data Element		Format	Code Reference
18	C3 same as C1		F5.0	
19	VSFC group indicator	1	F8.0	Notes 26, 27, 28 (sec. 9.2.1)
	Direction of surface wind	2		dd
	Speed of surface wind	2		ff
	Group indicator	1		Note 26 (sec. 9.2.1)
	Surface wind direction	1		Table 15, fig. 9-3
	Surface wind force	1		Table 16, fig. 9-3
20	AMISC state of sea	1	F7.0	Table 17, fig. 9-3
	Direction of swell	1		Table 15, fig. 9-3
	Group indicator	1		Note 36 (sec. 9.2.1)
	Significant change in WX	1		Table 18, fig. 9-3
	Distance of occurrence	1		Table 19, fig. 9-3
	Weather off course	1		Table 20, fig. 9-3
	Bearing WX off course	1		Table 15, fig. 9-3
21	Sea surface temperature		F3.1	
22	Pressure indicator		F1.0	Redesignated columns on RECCO Form (sec. 2.2.1)
23	Altitude indicator		F1.0	
24	Aircraft indicator		F1.0	
25	Date		F3.0	

The format of the NAV data is as follows:

Character	Data Element	Units	Format
1	Data type	see table 9-21	I1
2-4	Location	see table 9-22	I3
5-8	Observation time	month	I4 or F4.0
9-10	Observation time	day	I2 or F2.0
11-13	Latitude	degrees	I3 or F3.0
14-15	Latitude	minutes	I2 or F2.0
16-18	Longitude	degrees	I3 or F3.0
19-20	Longitude	minutes	I2 or F2.0
21-23	Observation time	hours	I3 or F3.0
24-25	Observation time	minutes	I2 or F2.0
26-31	Aircraft altitude	feet	I5 or F5.0
32-35	Aircraft heading	degrees	I4 or F4.0
36-39	Drift angle	degrees	F4.1
40-43	Ground speed	knots	I4 or F4.0
44-49	Pressure altitude	feet	I6 or F6.0
50-52	Pressure altitude indicator	significance unknown	I3

Character	Data Element	Units	Format
53-57	Temperature	degrees Celsius	F6.1
58-61	Airspeed	knots	I3 or F3.0
62-64	Airspeed indicator	significance unknown	I3
65-68	Wind direction	degrees	I4 or F4.0
69-71	Windspeed	knots	I3 or F3.0
72-77	Observation No.		I6

Table 9-21.--Data type

Integer value	Meaning
0	Flying intercomparison leg
1	Flying data leg
2	Sounding
3	Flying wind box
4	Other

Table 9-22.--Location with respect to BOMEX array

Integer value	Location
10	ALFA
20	BRAVO
30	ECHO
40	DELTA
50	HOTEL
60	INDIA
70	JULIETT
80	KILO
90	Barbados
12	ALFA-BRAVO (northern side)
23	BRAVO-ECHO (eastern side)
34	ECHO-DELTA (southern side)
14	ALFA-DELTA (western side)
95	Barbados-HOTEL
00	Other

As noted earlier, the NAV data were scanned for laying within certain limits. These limits are as follows:

$0 \leq$ data type ≤ 4
Location = 10,20,...,90,12,23,34,14,95, or 00
Month = 0,5,6, or 7
$1 \leq$ day ≤ 31

Latitude $\leq$ 25
Longitude $\leq$ 60
0000 $\leq$ time $\leq$ 2400
0 $\leq$ altitude $\leq$ 9999
0 $\leq$ heading $\leq$ 360
-9.9 $\leq$ drift angle $\leq$ 9.9
0 $\leq$ ground speed $\leq$ 225
0 $\leq$ pressure altitude $\leq$ 9999
Temperature $\leq$ 30
150 $\leq$ airspeed $\leq$ 225
0 $\leq$ wind direction $\leq$ 360
0 $\leq$ windspeed $\leq$ 50
Missing data are indicated by 9's

Both the RECCO and NAV data are contained on the same archive magnetic tape, No. B3407. All flights appear sequentially by date as shown in the inventory in table 9-23. In general, on any given date, the Air Force WC-310 flight data come first, followed by Air Force WB-47, Air Force RB-57, and Navy C-121 data. There is only one file on the tape. Each record is 800 characters long and contains 10 card images. Each card image corresponds to one observation. Flights are separated by 800 character records, which are blank except for the first 10 characters, which contain RECCO only or NAV plus RECCO to describe the contents of the following records. The last three characters of the NAV observations are blank, and the last three characters of the NAV plus RECCO observations in a flight are 9's. All 9's is the case where the number of RECCO or NAV observations is an even multiple of 10, necessitating the writing of one record of all 9's to indicate the end of the RECCO and NAV observations for that flight.

Table 9-23.--Inventory of RECCO and NAV data contained on magnetic tape No. B3407

Flight No.	Aircraft	BOMEX Observation Period	Date (1969)	RECCO data Start time (GMT)	RECCO data Stop time (GMT)	RECCO data No. of observations	NAV data Start time (GMT)	NAV data Stop time (GMT)	NAV data No. of observations
1	AF 1	I	May 1	1242	1410	3	-	-	-
2	" 1	"	May 3	0131	0544	15	-	-	-
3	" 2	"	May 3	1139	1827	24	-	-	-
4	" 1	"	May 3	1402	1726	9	-	-	-
5	" 2	"	May 3	1400	1654	11	-	-	-
6	" 1	"	May 3	1425	1715	11	-	-	-
7	Navy 6	"	May 3	2240	0710	89	2240	0731	110
8	AF 1	"	May 4	0136	0552	16	-	-	-
9	" 2	"	May 4	1210	1917	24	-	-	-
10	" 1	"	May 4	1256	1619	9	-	-	-
11	" 2	"	May 4	1349	1647	11	-	-	-
12	" 1	"	May 4	1423	1700	11	-	-	-
13	Navy 3	"	May 4	2247	0853	21	2247	0851	20
14	AF 1	"	May 5	0122	0542	16	-	-	-
15	" 2	"	May 5	1245	1943	24	-	-	-
16	" 1	"	May 5	1247	1608	9	-	-	-
17	" 2	"	May 5	1347	1650	11	-	-	-
18	" 1	"	May 5	1310	1748	14	-	-	-
19	" 1	"	May 6	1138	1826	24	-	-	-
20	" 2	"	May 6	1137	1530	9	-	-	-
21	" 1	"	May 6	1414	1741	9	-	-	-
22	" 2	"	May 6	1407	1656	11	-	-	-
23	" 1	"	May 6	1429	1659	11	-	-	-
24	" 1	"	May 7	1217	1840	14	-	-	-
25	" 1	"	May 7	1255	1628	9	-	-	-
26	" 1	"	May 7	1413	1655	11	-	-	-
27	" 1	"	May 8	1416	1657	7	-	-	-
28	Navy 8	"	May 9	1420	1935	64	1402	1930	49
29	" 6	"	May 9	1502	1925	44	1505	1925	43
30	AF 1	"	May 9	1225	1833	14	-	-	-
31	" 1	"	May 9	1256	1631	9	-	-	-

Table 9-23.--Inventory of RECCO and NAV data contained on magnetic tape No. B3407 (continued)

				RECCO data			NAV data		
Flight No.	Aircraft	BOMEX Observation Period	Date (1969)	Start time (GMT)	Stop time (GMT)	No. of observations	Start time (GMT)	Stop time (GMT)	No. of observations
32	AF 2	I	May 9	1341	1638	11	-	-	-
33	" 1	"	May 9	1421	1756	11	-	-	-
34	" 1	"	May 10	1136	1833	24	-	-	-
35	" 1	"	May 10	1347	1641	13	-	-	-
36	" 1	"	May 10	1253	1629	9	-	-	-
37	" 1	"	May 10	1418	1651	11	-	-	-
38	Navy 8	"	May 10	2313	0811	77	2315	0857	180
39	AF 1	"	May 11	0120	0528	15	-	-	-
40	" 2	"	May 11	1131	1826	24	-	-	-
41	" 1	"	May 11	1347	1644	11	-	-	-
42	" 1	"	May 11	1254	1616	9	-	-	-
43	1	"	May 11	1420	1655	11	-	-	-
44	Navy 6	"	May 11	2245	0914	110	2245	1008	419
45	AF 1	"	May 12	0130	0539	15	-	-	-
46	" 2	"	May 12	1139	1832	24	-	-	-
47	" 1	"	May 12	1347	1647	11	-	-	-
48	" 1	"	May 12	1255	1627	9	-	-	-
49	" 1	"	May 12	1423	1657	11	-	-	-
50	Navy 8	"	May 12	2240	0758	78	2240	0837	615
51	AF 1	"	May 13	0234	0638	15	-	-	-
52	" 2	"	May 13	1134	1842	24	-	-	-
53	" 2	"	May 13	1200	1530	8	-	-	-
54	" 1	"	May 13	1257	1626	9	-	-	-
55	" 1	"	May 13	1421	1656	11	-	-	-
56	" 1	"	May 14	1211	1830	14	-	-	-
57	" 1	"	May 14	1259	1623	9	-	-	-
58	" 2	"	May 14	1345	1638	14	-	-	-
59	" 1	"	May 14	1418	1652	11	-	-	-
60	" 1	"	May 15	1419	1700	7	-	-	-
61	" 1	II	May 24	1243	1557	9	-	-	-

Table 9-23.--Inventory of RECCO and NAV data contained on magnetic tape No. B3407 (continued)

				RECCO data			NAV data		
Flight No.	Aircraft	BOMEX Observation Period	Date (1969)	Start time (GMT)	Stop time (GMT)	No. of observations	Start time (GMT)	Stop time (BMT)	No. of observations
62	AF 1	II	May 24	1414	1600	7	-	-	-
63	" 2	"	May 24	1442	1737	7	-	-	-
64	" 1	"	May 25	1422	1820	15	-	-	-
65	" 1	"	May 25	1247	1612	9	-	-	-
66	" 1	"	May 25	1415	1605	7	-	-	-
67	Navy 6	"	May 26	0207	0835	62	0207	0835	319
68	AF 1	"	May 26	0122	0524	15	-	-	-
69	" 2	"	May 26	1319	1721	15	-	-	-
70	" 1	"	May 26	1424	1612	7	-	-	-
71	Navy 6	"	May 26	2353	0846	73	2349	0848	453
72	AF 1	"	May 27	0119	0525	15	-	-	-
73	" 2	"	May 27	1319	1714	15	-	-	-
74	" 1	"	May 27	1303	1626	9	-	-	-
75	" 1	"	May 27	1428	1600	7	-	-	-
76	Navy 6	"	May 27	2300	0708	109	2300	0708	578
77	AF 1	"	May 28	0118	0523	15	-	-	-
78	" 2	"	May 28	1200	1530	8	-	-	-
79	" 2	"	May 28	1328	1719	15	-	-	-
80	" 1	"	May 28	1257	1626	9	-	-	-
81	" 1	"	May 28	1447	1623	8	-	-	-
82	" 1	"	May 30	1249	1621	9	-	-	-
83	" 1	"	May 30	1442	1626	7	-	-	-
84	" 1	"	May 31	1325	1720	15	-	-	-
85	" 1	"	May 31	1300	1624	9	-	-	-
86	" 1	"	May 31	1408	1652	7	-	-	-
87	" 2	"	May 31	1439	1613	7	-	-	-
88	Navy 6	"	May 31	2324	0820	107	2324	0815	581
89	AF 1	"	June 1	0133	0541	15	-	-	-
90	" 2	"	June 1	1318	1723	15	-	-	-
91	" 1	"	June 1	1254	1626	9	-	-	-
92	" 1	"	June 1	1454	1628	7	-	-	-

Table 9-23.--Inventory of RECCO and NAV data contained on magnetic tape No. B3407 (continued)

				RECCO data			NAV data		
Flight No.	Aircraft	BOMEX Observation Period	Date (1969)	Start time (GMT)	Stop time (GMT)	No. of observations	Start time (GMT)	Stop time (GMT)	No. of observations
93	Navy 6	II	June 1	2359	0831	102	2355	0832	550
94	AF 1	"	June 2	0116	0522	15	-	-	-
95	" 2	"	June 2	1317	1724	15	-	-	-
96	" 1	"	June 2	1253	1618	9	-	-	-
97	" 1	"	June 2	1440	1615	7	-	-	-
98	Navy 6	"	June 3	0001	0856	108	0001	0856	592
99	AF 1	"	June 3	0122	0529	15	-	-	-
100	" 2	"	June 3	1321	1725	15	-	-	-
101	" 1	"	June 3	1254	1626	9	-	-	-
102	" 1	"	June 3	1449	1623	7	-	-	-
103	Navy 6	"	June 3	2350	0806	105	2349	0807	576
104	AF 1	"	June 4	0115	0518	15	-	-	-
105	" 2	"	June 4	1317	1640	12	-	-	-
106	" 1	"	June 4	1254	1620	9	-	-	-
107	" 1	"	June 4	1442	1612	7	-	-	-
108	" 1	"	June 6	1258	1648	9	-	-	-
109	" 1	"	June 6	1439	1610	7	-	-	-
110	Navy 6	"	June 7	1215	1910	60	1050	2045	811
111	" 8	"	June 7	1055	2045	75	1055	2047	856
112	AF 1	"	June 7	1315	1718	15	-	-	-
113	" 1	"	June 7	1305	1618	9	-	-	-
114	" 1	"	June 7	1446	1725	8	-	-	-
115	" 1	"	June 8	0119	0525	15	-	-	-
116	" 2	"	June 8	1327	1748	15	-	-	-
117	" 1	"	June 8	1305	1520	7	-	-	-
118	" 1	"	June 8	1453	1627	7	-	-	-
119	Navy 6	"	June 9	1035	2030	74	1035	2035	829
120	" 8	"	June 9	1035	2025	72	1035	2027	852
121	AF 1	"	June 9	0122	0530	15	-	-	-
122	" 1	"	June 9	1307	1624	9	-	-	-
123	" 1	"	June 9	1443	1622	7	-	-	-

Table 9-23.--Inventory of RECCO and NAV data contained on magnetic tape No. B3407 (continued)

				RECCO data			NAV data		
Flight No.	Aircraft	BOMEX Observation Period	Date (1969)	Start time (GMT)	Stop time (GMT)	No. of observations	Start time (GMT)	Stop time (GMT)	No. of observations
124	AF 2	II	June 10	1313	1717	15	-	-	-
125	" 1	"	June 10	0117	0526	15	-	-	-
126	" 1	"	June 10	1259	1623	9	-	-	-
127	" 1	"	June 10	1447	1620	7	-	-	-
128	" 1	"	June 11	1408	1604	7	-	-	-
129	" 1	III	June 21	1233	1853	15	-	-	-
130	" 1	"	June 21	1300	1628	9	-	-	-
131	" 2	"	June 21	1348	1630	9	-	-	-
132	" 1	"	June 21	1412	1643	7	-	-	-
133	" 1	"	June 21	1424	1654	11	-	-	-
134	Navy 3	"	June 22	1055	2155	101	1055	2205	927
135	" 8	"	June 22	1056	2200	102	1105	2200	787
136	AF 1	"	June 22	0115	0521	15	-	-	-
137	" 2	"	June 22	1123	1826	22	-	-	-
138	" 1	"	June 22	1247	1602	9	-	-	-
139	" 2	"	June 22	1347	1638	11	-	-	-
140	" 1	"	June 22	1425	1702	11	-	-	-
141	" 1	"	June 23	0114	0600	17	-	-	-
142	" 2	"	June 23	1126	1215	3	-	-	-
143	" 1	"	June 23	1407	1716	9	-	-	-
144	" 2	"	June 23	1358	1640	11	-	-	-
145	" 1	"	June 23	1516	1750	11	-	-	-
146	Navy 8	"	June 23	2250	0945	95	2255	0838	800
147	AF 1	"	June 24	0115	0551	17	-	-	-
148	" 2	"	June 24	1128	1825	22	-	-	-
149	" 1	"	June 24	1255	1623	9	-	-	-
150	" 2	"	June 24	1415	1717	11	-	-	-
151	" 1	"	June 24	1424	1702	11	-	-	-
152	" 1	"	June 25	0120	0550	17	-	-	-
153	" 2	"	June 25	1130	1824	24	-	-	-
154	" 1	"	June 25	1257	1628	9	-	-	-

Table 9-23.--Inventory of RECCO and NAV data contained on magnetic tape No. B3407 (continued)

Flight No.	Aircraft	BOMEX Observation Period	Date (1969)	RECCO data Start time (GMT)	RECCO data Stop time (GMT)	RECCO data No. of observations	NAV data Start time (GMT)	NAV data Stop time (GMT)	NAV data No. of observations
155	AF 2	III	June 25	1333	1617	11	-	-	-
156	" 1	"	June 25	1421	1643	11	-	-	-
157	Navy 3	"	June 25	2237	0940	123	2240	0940	946
158	AF 1	"	June 26	0057	0555	15	-	-	-
159	" 2	"	June 26	1201	1530	8	-	-	-
160	Navy 3	"	June 26	1141	1223	3	-	-	-
161	AF 1	"	June 26	1256	1619	9	-	-	-
162	" 2	"	June 26	1344	1646	11	-	-	-
163	" 1	"	June 26	1427	1658	11	-	-	-
164	" 1	"	June 27	1411	1645	7	-	-	-
165	" 1	"	June 28	1140	1858	22	-	-	-
166	" 1	"	June 28	1304	1627	9	-	-	-
167	" 2	"	June 28	1349	1645	11	-	-	-
168	" 1	"	June 28	1413	1650	11	-	-	-
169	Navy 3	"	June 29	1032	2045	83	1035	2045	972
170	" 8	"	June 29	1040	2040	82	1045	2040	789
171	AF 1	"	June 29	0157	0643	17	-	-	-
172	" 2	"	June 29	1200	1904	22	-	-	-
173	" 1	"	June 29	1259	1630	9	-	-	-
174	" 2	"	June 29	1411	1648	11	-	-	-
175	" 1	"	June 29	1410	1637	11	-	-	-
176	Navy 8	"	June 30	1145	2140	83	1150	2145	820
177	" 3	"	June 30	1145	2146	79	1145	2150	980
178	AF 1	"	June 30	0116	0557	17	-	-	-
179	" 2	"	June 30	1052	1828	22	-	-	-
180	" 1	"	June 30	1247	1612	9	-	-	-
181	" 2	"	June 30	1338	1630	11	-	-	-
182	" 1	"	June 30	1415	1651	11	-	-	-
183	" 1	"	July 1	0144	0634	17	-	-	-
184	" 2	"	July 1	1125	1827	24	-	-	-
185	" 1	"	July 1	1257	1625	9	-	-	-

Table 9-23.--Inventory of RECCO and NAV data contained on magnetic tape No. B3407 (continued)

Flight No.	Aircraft	BOMEX Observation Period	Date (1969)	RECCO data			NAV data		
				Start time (GMT)	Stop time (GMT)	No. of observations	Start time (GMT)	Stop time (GMT)	No. of observations
186	AF 2	III	July 1	1347	1645	11	-	-	-
187	" 1	"	July 1	1424	1655	11	-	-	-
188	" 1	"	July 2	1248	1557	9	-	-	-
189	" 2	"	July 2	1348	1637	11	-	-	-
190	" 1	"	July 2	1424	1653	7	-	-	-
191	" 1	"	July 2	1423	1657	11	-	-	-
192	" 1	"	July 3	1921	2319	7	-	-	-
193	" 1	IV	July 13	1415	2100	24	1415	2115	206
194	" 1	"	July 13	1351	1710	15	-	-	-
195	" 1	"	July 13	1305	1815	18	-	-	-
196	Navy 3	"	July 14	1400	2300	36	1400	2300	210
197	AF 1	"	July 14	1415	2100	26	1410	2100	208
198	" 1	"	July 14	1430	1708	11	-	-	-
199	" 1	"	July 14	1428	1630	8	-	-	-
200	" 1	"	July 15	1428	1758	12	-	-	-
201	" 1	"	July 15	1447	1715	11	-	-	-
202	Navy 3	"	July 17	1345	2300	38	1333	2255	265
203	AF 1	"	July 17	1400	2230	40	1355	2255	309
204	" 1	"	July 17	1644	1856	11	-	-	-
205	" 1	"	July 17	1324	1750	15	-	-	-
206	" 1	"	July 18	1426	1710	12	-	-	-
207	" 1	"	July 19	1345	2300	41	1345	2300	228
208	" 1	"	July 19	1531	1755	11	-	-	-
209	" 1	"	July 19	1430	1615	8	-	-	-
210	Navy 6	"	July 19	1345	0000	42	1340	0003	244
211	AF 1	"	July 20	1123	1455	17	-	-	-
212	" 1	"	July 20	1703	1938	12	-	-	-
213	Unknown	"	July 21	1340	1758	12	1340	2015	64
214	AF 1	"	July 21	1350	1615	10	-	-	-
215	" 1	"	July 22	1400	2015	25	1400	2030	157
216	" 1	"	July 22	1525	1834	13	-	-	-

Table 9-23.--Inventory of RECCO and NAV data contained on magnetic tape No. B3407 (continued)

Flight No.	Aircraft	BOMEX Observation Period	Date (1969)	RECCO data: Start time (GMT)	RECCO data: Stop time (GMT)	RECCO data: No. of observations	NAV data: Start time (GMT)	NAV data: Stop time (GMT)	NAV data: No. of observations
217	AF 1	IV	July 22	1723	1929	9	-	-	-
218	Navy 6	"	July 22	1615	0030	33	1615	0030	219
219	AF 1	"	July 23	1400	2015	25	1400	2030	192
220	" 1	"	July 23	1430	1656	11	-	-	-
221	Navy 6	"	July 26	1015	2025	40	1030	2032	229
222	AF 1	"	July 26	1145	1715	23	1115	1727	292
223	" 1	"	July 26	1538	1747	10	-	-	-
224	" 1	"	July 26	1505	1715	10	-	-	-
225	" 1	"	July 27	1430	2015	24	1430	2045	109
226	" 1	"	July 27	1437	1755	8	-	-	-
227	" 1	"	July 27	1525	1621	6	-	-	-
228	" 1	"	July 28	1500	1550	3	-	-	-
229	" 1	"	July 28	1305	1516	10	-	-	-
230	" 1	"	July 28	1422	1721	9	-	-	-

9.2.4 Navy and Air Force Radar Photographs and Archive Format

Radar photographs were taken by an AN/APS-20 radar aboard the Navy WC-121 aircraft, and by an AN/APS-64 radar aboard the Air Force WB-47 aircraft. These photographs are archived on 35-mm microfilm reels as registered copies of the original film. An inventory is given in table 9-24.

9.3 Supplementary Material Available From the Archive

9.3.1 RFF Flight Folder

A folder was prepared for each RFF flight, giving a complete history of the day's operation. It is important that the folder be reviewed when data from a given mission are evaluated. All the RFF Flight Folders are contained on one reel of 35-mm microfilm, labeled DOC-2 in the BOMEX Permanent Archive.

The following is included in each folder:

Detailed Flight Program - RFF-1 Work Form. Lists date and takeoff and landing times; proposed flight patterns and actual flight patterns; takeoff data from aircraft for comparison with meteorological ground observation; and remarks pertinent to the mission.

Flight Information - RFF-2 Work Form. Contains navigation information and Event Light assignments; and crew list.

Flight Data - RFF-3 Work Form. Equipment log for meteorological and photographic equipment; recorder operations log; and dropsonde data.

Digital Station Log - RFF-4 Work Form. Contains camera operation log; digital operation; inventory of data outputs; and remarks on interruptions, power outages, etc.

Radar Station Log - RFF-5 Work Form. Log of the operation of all radar equipment and operation, with pertinent remarks.

RFF Time Check Form. Log of data chamber and clock times from radar and cloud cameras versus digital time from digital recorder with corrections for synchronization with total data package.

Electronic Status and Meteorological Systems In-Flight Data Log. Lists electronic outages and malfunctions at beginning, during, and at end of flight.

Event Log. A chronological log kept by the flight meteorologist, reporting mission progress and the time of significant events. (Useful in locating specific information on the NNV tape for programming or special interest.)

Navigation Log. A record of the aircraft position with a Doppler correction record for updating the Doppler to true position. (The corrections have been incorporated into the NNV tape.)

Table 9-24.--Inventory of Navy and Air Force radar photographs

Reel No.	Type of radar	Aircraft	First frame Date (1969)	First frame Time (GMT)	Last frame Date (1969)	Last frame Time (GMT)
84	AN/APS-64	AF WB-47	May 3	1411	May 3	1813
76	"	"	4	1146	4	1637
77	"	"	5	1149	5	1726
78	"	"	6	1105	6	1359
79	"	"	7	1205	7	1741
80	"	"	9	1320	9	1620
81	"	"	11	1159	11	1623
82	"	"	13	1600	13	2103
83	"	"	14	1155	14	1730
85	"	"	24	0550	24	0940
86	"	"	25	1212	25	1620
87	"	"	27	1240	27	1635
88	"	"	28	1315	28	1620
89	"	"	30	1025	30	1735
90	"	"	31	1220	31	1731
91	"	"	June 1	1230	June 1	1640
92	"	"	2	1150	2	1625
93	"	"	3	1135	3	1625
94	"	"	4	1150	4	1725
95	"	"	6	1239	6	1630
96	"	"	7	1200	7	1530
97	"	"	9	1140	9	1740
98	"	"	21	1425	21	1720
99	"	"	22	1220	22	1612
100	"	"	23	1305	23	1635
102	"	"	24	2305	24	0340
101	"	"	25	1200	25	1755
103	"	"	26	1255	26	1820
104	"	"	28	1210	28	1740
105	"	"	29	1240	29	1630
106	"	"	30	1140	30	1720
107	"	"	July 1	1135	July 1	1735
109	"	"	13	1313	13	1708
111	"	"	15	1358	15	1710
112	"	"	19	1220	19	1829
113	"	"	20	1106	20	1448
114	"	"	23	1215	23	1740
108	"	"	26	1306	26	1724
115	"	"	28	1250	28	1527
117	AN/APS-20	Navy WC-121	14	1550	14	1900
116	"	"	19	1450	26	2035

9.3.2 RFF Photographic Quality Review Log

Following the BOMEX field operations, RFF personnel reviewed all cloud, photopanel, and radar film acquired aboard the RFF aircraft. These log sheets indicate the quality of the processed film, any discrepancies found, and corrections of such discrepancies for each mission flown. They are archived on the same 35-mm reel of microfilm, DOC-2, as the RFF Flight Folder discussed in the preceding section.

9.4 Material in Temporary Storage

Material used in the processing of the aircraft data, such as the RFF CONVERT tapes, Navy and Air Force RECCO punched cards, original flights logs, and the like, has been placed in temporary storage for a period of 3 years. Inquiries concerning this material should be addressed to the Center for Experiment Design and Data Analysis, EDS, NOAA, Washington, D.C. 20235.

10. DROPSONDE DATA SET

Dropsonde observations were made during reconnaissance flights by USAF Air Weather Service WC-130 aircraft operated by the 53rd Weather Reconnaissance Squadron, Ramey Air Force Base, Puerto Rico. During the first three BOMEX Observation Periods, day and night missions were flown along the flight path shown in figure 10-1. On each flight, eight dropsondes were released from an altitude of 20,000 ft at the positions indicated in the figure. Dropsonde release times were nominally between 0130 and 0600 GMT at night and between 1300 and 1830 GMT during the day. In addition, on May 6, 13, and 28, June 26, and July 1, 1969, eight daytime soundings at 30-min intervals were made over position DELTA, the station of the NOAA ship Mt. Mitchell, for comparison with the ship rawinsonde observations.

During BOMEX Period IV, the drop positions, flight altitudes, and observation times varied with the objective of each day's mission. The WC-130 flight tracks for Period IV are shown in BOMEX Field Observations and Basic Data Inventory (BOMAP Office, National Oceanic and Atmospheric Administration, Rockville, Md., 1971).

Of a total of 488 soundings, 438 could be recovered and were processed. The remaining 50 soundings were not processed because of bad, missing, or noisy data resulting from instrument or recorder malfunctions, interference, or weak signals.

10.1 Instrumentation

The system used consisted of an AN/AMT-6 radiosonde; a radiosonde receptor, AN/AMR-1 or AN/AMR-3, on which the signals were recorded; a D-12/AMT-6 radiosonde dispenser for ejecting the sonde from the aircraft; and a baseline-check set AN/GMM-2 for preflight calibration of the temperature and humidity sensors.

10.2 Data Processing

10.2.1 Conversion to Meteorological Units

Tolerances used for selection of significant levels were that no point on the temperature or humidity traces could depart from a straight line between significant levels by more than 0.2 ordinate (about 0.4°C) or 5 percent RH. Data at all significant levels were read to the nearest 0.1 ordinate. Further significant levels were inserted between two validated levels when the pressure difference between levels was more than 70 mb. It is believed that the great majority of interpolated points had a precision of the order of ± 0.25 C and ± 3 percent RH. This procedure proved useful in later interpolation routines. Pressure contacts at significant levels were interpolated to two decimal places--usually to the nearest 0.05 contact (about 0.6 to 1.2 mb).

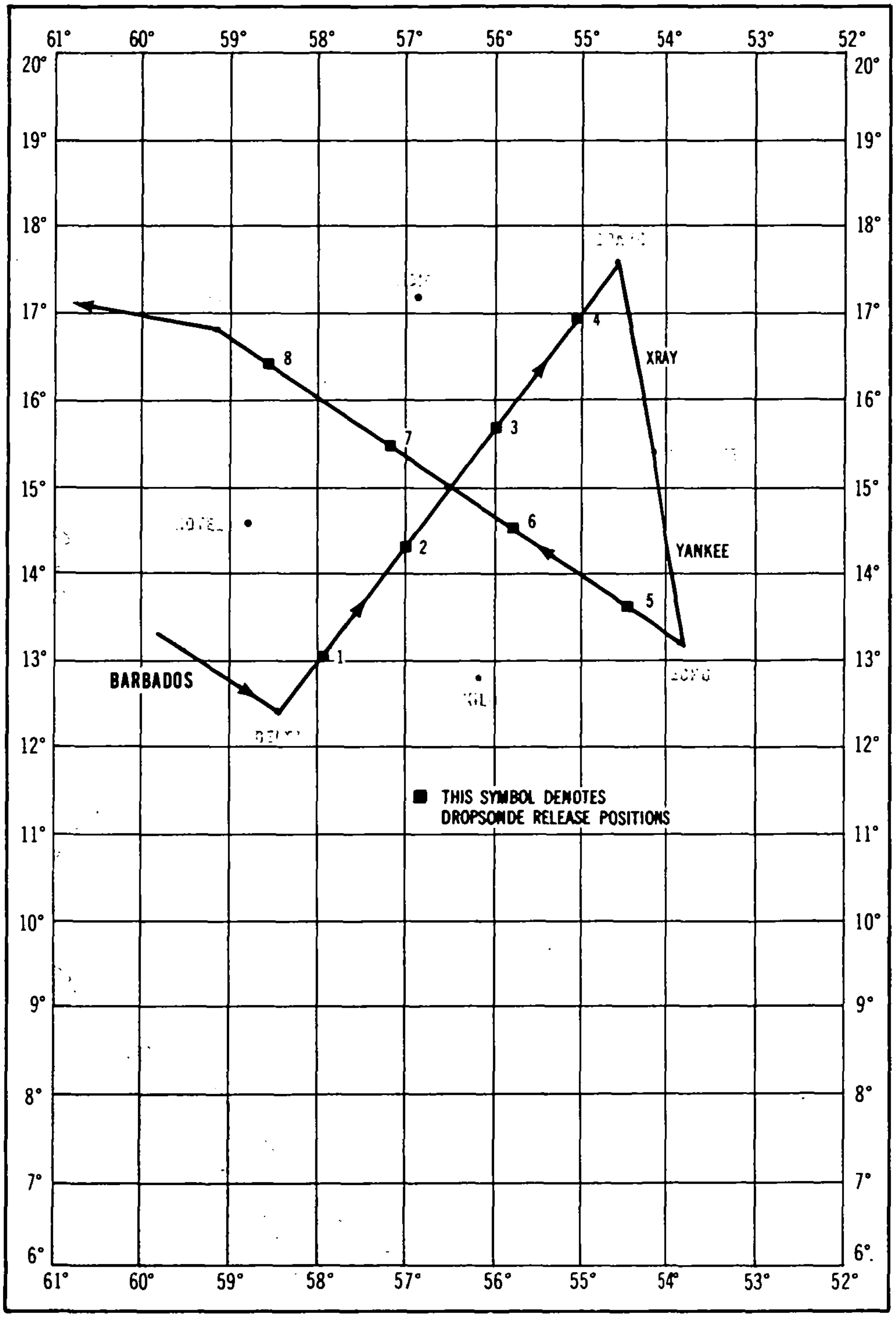


Figure 10-1.--WC-130 flight track for dropsonde observations.

After the significant levels had been chosen, ordinate values for temperature, relative humidity, and low reference and pressure contact were read off and transcribed onto a set of punched cards. Gross errors were eliminated by ensuring that temperature, relative humidity, and low reference were within the proper range of values. The pressure contact was checked to make sure that it was in proper sequence.

A second set of punched cards was then prepared, containing such basic information as time of flight, date, position, serial number of the dropsonde, flight-level temperature, pressure and radar altitude, and interpolated sea-level pressure. Baseline information was also included, after having been checked to ensure that the reported baseline relative humidity was compatible with observed dry- and wet-bulb temperatures. If not, the recomputed humidity was used. If a gross discrepancy occurred, as with transposition of digits, corrections were made based on comparison with baseline information on the other seven dropsondes released during the same mission.

The baroswitch pressure calibration information was transcribed onto a third set of punched cards. An error check was made by finding the difference in pressure between successive contacts for groups of 11 dropsondes. If any of the 11 values deviated significantly from the average, that value was rechecked.

The three atmospheric variables sampled by the dropsonde instruments were pressure, temperature, and relative humidity. The values obtained from the strip charts were converted to meteorological units in the following manner:

(a) The baroswitch calibration chart for each dropsonde gives a pressure in millibars for each whole contact number. A pressure for a contact that lies between two whole contacts was obtained through linear interpolation.

(b) The transfer equation used for temperature follows Inter-Range Instrumentation Group (IRIG) standards:

$$[T(I) + 170.0] = [TB + 170.0] * \left(\frac{1/BASORD-C1}{1/TORD(I)-C1}\right)^{0.19},$$

where

T(I)	= temperature in ^{o}C at the I-th significant level,
TB	= baseline temperature in ^{o}C,
TORD(I)	= temperature ordinate at the I-th level,
BASORD	= baseline temperature ordinate, and
C1	= 0.0105288.

(c) The CP-223B/UM Humidity-Temperature Computer was used as the standard for relative humidity evaluation. A routine for reproducing the CP-223B/UM by a computer program was supplied by Douglas R. Soule, NOAA Air Resources Laboratory, Las Vegas, Nev. It was concluded that this approach agrees with the CP-223B/UM evaluator to within 0.4 percent for relative humidities greater than 20 percent.

Once the soundings had been fully worked up in meteorological units, further checks showed that the sensors had inherent errors in them, as opposed to purely random errors, such as reading and transcription.

The recorded splashdown pressures sometimes differed from interpolated rawinsonde pressures by as much as 30 mb. This can be attributed to a variety of causes. Correction was made by forcing agreement with the interpolated ship pressure by adding a correction to the splashdown contact reading.

The thermistor was subject to thermal lag error because of its inability to respond to rapid changes in the ambient-air temperature. The hygristor was affected by both thermal lag and by solar radiation heating. The methods used in correcting these errors are discussed below.

10.2.2 Correction for Thermal Lag and Radiation Effects

One cause of the thermal lag error was found to lie in deficiencies in the design of the duct in which the hygristor was mounted. The duct opening and the semitranslucent plastic cover permitted solar radiation to penetrate, internally reflect, and heat the carbon-coated hygristor. The positioning of the duct opening and the shape of the duct were such as to reduce the airflow at the sensor to about 30 percent of the ascent rate, giving the hygristor a large thermal lag constant and causing its temperature to lag behind the ambient temperature during ascent by about $1^{\circ}C$, even at night.

The hygristor is assumed to measure correctly the relative humidity of an adjacent thin layer of air that has reached thermal equilibrium with the hygristor. Thus, with a given ambient vapor pressure, if the hygristor temperature is higher than ambient, the measured relative humidity will be less than the true humidity of the air sample at its true ambient temperature. If the temperature of the hygristor is known, the true ambient relative humidity can be determined.

A second cause of the difference between the hygristor and ambient air temperatures was that, in almost all the daytime soundings, the hygristor was warmer than the ambient air at launch time. This was mainly the result of solar radiation, either by direct heating of the hygristor or by pre-launch heating of the ship's deck. A third, and major, cause was the fairly steady daytime heating of the hygristor by solar radiation after launch, depending on the amount of cloud cover.

The heat transfer properties of the hygristor itself are such that the boundary layer of air between the hygristor and the ambient air largely controls the heat-transfer process. This means that Newton's law of cooling accurately describes this transfer. Applying the law to this case, one can state the rate of cooling for the hygristor is proportional to the difference in temperature between the hygristor and the atmosphere. Five-second values of temperature and relative humidity were generated in processing the BOMEX rawinsonde data (sec. 5). Making the plausible assumption that heating by radiation and the rate of change in the ambient temperature are approximately constant during a 5-s interval, we can use the law of cooling in the following form:

$$[T_H(t + \Delta t) - T_A(t + \Delta t)] = [T_H(t) - T_A(t)] * e^{-\Delta t/\tau(t)}$$
$$- \tau(t) * \frac{[T_A(t + \Delta t) - T_A(t)]}{\Delta t} * (1 - e^{-\Delta t/\tau(t)}) \quad (1)$$
$$+ T_R(t) * (1 - e^{-\Delta t/\tau(t)}) \quad ,$$

where

t = time after launch (s),
$T_H(t)$ = hygristor temperature at time t (°C),
$T_A(t)$ = ambient air temperature at time t (°C),
Δt = time interval between sounding points (5 s),
$\tau(t)$ = thermal lag constant (s), and
$T_R(t)$ = the part of the total temperature difference between the hygristor and the ambient air caused by solar radiation heating (°C).

Eq. (1) is used in a recursive manner to find the hygristor temperature profile. Knowing $[T_H(t) - T_A(t)]$, $\tau(t)$, $\Delta T_R(t)$, and the ambient temperature at time t, one can calculate $[T_H(t + \Delta t) - T_A(t + \Delta t)]$, the total difference between the hygristor and ambient air temperatures, from eq. (1). Since $T_A(t + \Delta t)$ is known from thermistor measurements, $T_H(t + \Delta t)$ is obtained. The total temperature difference at time $t + \Delta t$ is then reinserted into eq. (1) to yield the total difference at time $t + 2\Delta t$, and so on.

The initial level for which knowledge of the hygristor temperature is needed is the level reached 5 s after launch. This temperature value was inferred as follows. During BOMEX it was often observed that immediately after launch the rawinsonde would descend for a short time and then begin its ascent. Approximately 5 s after release it should therefore have sampled the same water-vapor content as the psychrometer used aboard ship, and the assumption was made that the specific humidity at the 5-s level was the same as the psychrometric reading. This means that

$$e = e_s \text{ (ship)} * \text{RH (ship)} = e_s \text{ (5 seconds)} * \text{RH (5 seconds)}, \quad (2)$$

where

e = the vapor pressure (mb),
e_s = the saturation vapor pressure (mb), and
RH = the relative humidity (percent).

The quantities e_s(ship), RH(ship), and RH(5 seconds) were recorded. Thus the saturation vapor pressure that the rawinsonde must have sensed, e_s(5 seconds), can be obtained. Since the saturation vapor pressure depends only on temperature, a unique temperature can be found by inverting the saturation vapor pressure equation. Teten's formula (Handbook of Meteorology, McGraw-Hill Book Company, N.Y., 1945, p. 343) was used:

$$e_s(T) = 6.11 * 10^{\frac{7.5 * T}{237.3 + T}}$$

where T is measured in $^{\circ}$C. The final result for the hygristor temperature 5 s after launch, T_H(5 seconds), is

$$T_H(5 \text{ seconds}) = \frac{237.3 * \log_{10}[e_s(5 \text{ seconds})/6.11]}{7.5 - \log_{10}[e_s(5 \text{ seconds})/6.11]} ,$$

where e_s(5 seconds) is calculated from eq. (2). Typical temperature differences at the 5-s level are approximately 6°C at midday and 2°C at night. This term can be evaluated for each sounding individually.

The second term on the right of eq. (1) represents the lag of response to changing ambient temperature during ascent. Theory suggests that the thermal lag constant $\tau(t)$ is a function of ventilation rate and ambient air density. Based on BOMEX data, it was found that a reasonable expression for the lag constant in seconds is given by

$$\tau = 34.9 \ (\rho V)^{-0.4} ,$$

where

ρ = ambient air density (kg m^{-3}), and

V = the ventilation rate of the hygristor = 0.3 * ascent rate (m s^{-1}).

This gives values for the time constant of the order of 30 s near sea level. At ascent rates of 4 to 5 m/s, the lag constant is about 45 to 50 s at the level of p* = 500 mb. (The levels referred to here are the ones used in the analysis of the BOMEX Core Experiment, or the sea-air interaction program, which is based on a p* coordinate system, where p* is the position on the vertical axis in terms of pressure relative to sea level, i.e., p* = 0 at sea level and 500 mb at the top of the BOMEX atmospheric volume.)

For nighttime rawinsonde flights, the hygristor temperature difference stems mainly from this lag in response to changing atmospheric temperature, and is on the order of 1°C. In the moist layer, this difference produces relative humidities that are 4 to 6 percent RH too low.

The radiation term presented a problem because radiation measurements at times of individual rawinsonde ascents were not available. An indirect method based on 7-day average data was therefore used. This means that the effects of varying cloudiness are ignored, and that other heating effects, those due to sonde electronics, for example, will be included in the radiation term. The 7-day averages were derived from data collected during BOMEX Observation Period III, June 19 to July 2. Since there was little variation in solar zenith angle during the other observation periods, the results are considered equally applicable to all BOMEX data.

The aim was to obtain a simplified radiation correction term, $\Delta T_R(t)$, which depends only on p* and the time of day. For every p* level, the time after launch, t, is known, The assumption was made that the daytime ambient vapor pressure of the 7-day averages at each level was equal to the vapor pressure at the same level computed from the nighttime (0000 to 0730 GMT) average temperatures and average relative humidities, the latter having been corrected for the effect of lag in response to changing ambient temperatures. All evidence from surface observations, data obtained with the Boundary Layer Instrument Package (BLIP), and aircraft measurements suggests that the diurnal variation of vapor pressure is nearly zero. Thus,

$$\overline{RH}_N * e_s(\overline{T}_N) = RH_D * e_s(T_D) , \qquad (2a)$$

where

e_s = the saturation vapor pressure (mb),

$\overline{RH}_N$ = the average nighttime relative humidity (percent),

RH_D = the daytime relative humidity (percent),

$\overline{T}_N$ = the average nighttime ambient temperature (°C), and

T_D = the daytime hygristor temperature (°C).

Since $\overline{RH}_N$, $\overline{T}_N$, and RH_D are known, T_D can be computed from eq. (2a), level by level, at each observation time. The hygristor temperature difference caused by radiation is then obtained by subtracting the ambient temperature from T_D.

The temperature differences were averaged vertically at each observation for examination of the average diurnal variation ΔT_R, and these vertically averaged data were then closely fitted by the function $\sin^2(\theta)$, where $\theta = 10*[\text{Hour(GMT)}-6.5]$, covering the 18-hr period from 0630 to 0030 GMT. This same shape function was used at each level to find an amplitude term that depended on the p* level. The radiation term is expressed as

$$\Delta T_R(p^*, \theta) = A(p^*) * \sin^2(\theta). \qquad (3)$$

Estimates of the amplitude at each 10-mb level were obtained by dividing every ΔT_R by the appropriate $\sin^2(\theta)$ for each daytime observation and by averaging at each level. This vertical profile was found to be fitted by the function

$$A(p^*) = 3.8 \qquad (0 \le p^* \le 320 \text{ mb})$$

$$= 3.8 + c^*\log_e \frac{[1016 - 320]}{1016 - p^*}, \qquad (p^* > 320 \text{ mb})$$

where c = 13.03. The value 1016 was taken as typical of the sea-surface pressure in millibars.

By use of eq. (3), ΔT_R was found and substituted in eq. (1), yielding the hygristor temperature T_H. Based on the assumption that the air sampled by the hygristor has the same vapor pressure as the ambient air, the true relative humidity, RH_T, was found from the measured relative humidity, RH_M, by the formula

$$RH_T = RH_M * \frac{e_s(T_H)}{e_s(T_A)} \tag{4}$$

From the corrected values of the basic measured variables -- pressure, temperature, and relative humidity -- 10 atmospheric variables were generated: saturation vapor pressure, ambient vapor pressure, specific humidity, dew-point temperature, potential temperature, virtual temperature, mean virtual temperature, layer thickness, geopotential height, and geometric height. These were computed by standard procedures.

For purposes of comparison with other BOMEX data and for the convenience of users, three different sets of interpolated data were generated:

(a) Data interpolated at every 10 mb in pressure from the sea surface to 500 mb above the surface within the p* coordinate system.

(b) Data interpolated at every 50 mb in pressure, beginning with the 1,000-mb level. These include the standard mandatory pressure levels.

(c) Data interpolated at heights of 1,000, 4,000, 7,000, and 10,000 ft, the nominal flight levels of NOAA's Research Flight Facility aircraft during BOMEX.

Only the basic variables of pressure, temperature, and relative humidity were interpolated; the other parameters were derived as described above.

As noted earlier, significant levels on the strip chart were selected so that the temperature and relative humidity ordinate values are nearly linear between the levels chosen. Conversion of the strip-chart ordinate values to meteorological units showed the temperature and relative humidity values themselves to be approximately linear. Since the strip-chart speed is constant, this also means that these values vary linearly with time between significant levels.

The ascent velocity of radiosondes is approximately constant. The height varies linearly in time, and the appropriate interpolation variable for radiosondes therefore is the height. The descent velocity of the BOMEX dropsondes, however, was not constant, decreasing with time. However, examination of 53 BOMEX soundings showed that, on the average, the dropsonde traveled across equal pressure intervals in equal times. The pressure was therefore chosen as the appropriate interpolation variable.

10.3 Archive Format and Data Inventory

The final BOMEX dropsonde data are available on magnetic tape and microfilm. The magnetic tape contains five separate data sets for each sounding. Information about the tape itself, the content of each set and the format used to place it on tape are given in the first file (see fig. 10-2). A subroutine for reading the rest of the files is also included in this first file, which contains records that are 80-column card images. The first data set for each sounding contains data for the significant levels, without pressure contact or thermal lag correction. This was done in order to preserve the "raw," uncorrected data so that the user might apply a correction scheme of his own if desired. The second data set contains the same data with corrections applied for baroswitch contact error, and thermistor and hygristor thermal lag errors. The last three data sets contain the three types of interpolated data discussed earlier.

The microfilm output contains both plotted data, consisting of plots of temperature, dew point, and relative humidity on a pseudo-adiabatic chart, and tabular data. There are four tabular data sets for each sounding: (1) data for the significant levels without correction, (2) data with corrections, (3) data interpolated at 10-mb p^* intervals, $0 \leq p^* \leq 500$ mb, and (4) data interpolated at mandatory pressure levels.

An inventory of the dropsonde data is given in table 10-1.

10.4 Material in Temporary Storage

Hard-copy material, consisting of original manual logs, computer printouts, and the like, has been placed in temporary storage for a period of 3 years. Inquiries concerning this material should be addressed to the Center for Experiment Design and Data Analysis, EDS, NOAA, Page Bldg. 2, Washington, D.C. 20235.

1. TAPE INFORMATION

A. THE TAPE NUMBER IS B-8106

B. THE TAPE IS A CDC, 7-TRACK,STRANGER TAPE, WRITTEN IN BCD, EVEN PARITY, WITH A DENSITY OF 556 BPI.

C. THE END OF DATA IS SIGNIFIED BY A DOUBLE END OF FILE (EOF).

D. ALL RECORDS ARE 130 CHARACTER PHYSICAL RECORDS, AND ALL EOFS ARE PHYSICAL END OF FILE MARKS.

C

2. METEOROLOGICAL INFORMATION

EACH DATA BLOCK CONTAINS A NUMBER OF DIFFERENT LEVELS AT WHICH INFORMATION HAS BEEN PROCESSED. FOR EACH LEVEL, PRESSURE, TEMPERATURE AND RELATIVE HUMIDITY PLUS 10 OTHER ATMOSPHERIC VARIABLES HAVE BEEN COMPUTED. THE VARIABLES AND THEIR UNITS ARE--

1. PRESSURE (MB) 2. TEMPERATURE (DEG C) 3. RELATIVE HUMIDITY (PERCENT)
4. SATURATION VAPOR PRESSURE (MB) 5. AMBIENT VAPOR PRESSURE (MB)
6. SPECIFIC HUMIDITY(GRAMS/KILOGRAM) 7. DEW POINT (DEG C)
8. POTENTIAL TEMPERATURE (DEG K) 9. VIRTUAL TEMPERATURE (DEG K)
10. MEAN VIRTUAL TEMPERATURE (DEG K) 11. THICKNESS (GEOPOTENTIAL METERS)
12. GEOPOTENTIAL HEIGHT (GEOPOTENTIAL METERS) 13. GEOMETRIC HEIGHT (METERS)

FOR EACH DROPSONDE THERE ARE 5 DIFFERENT WORKUPS, CONTAINING P, T, H AND THE OTHER 10 VARIABLES.

A. UNCORRECTED SIGNIFICANT LEVEL DATA. P,T, AND H ARE OBTAINED FROM THE STRIP CHARTS, USING A PRELIMINARY EDIT. THE 10 OTHER VARIABLES ARE GENERATED FROM THESE. AIRCRAFT READINGS OF P AND T ARE USED AT THE TOP LEVEL. H AT THE AIRCRAFT LEVEL WAS NOT OBSERVED SO IT WAS SET EQUAL TO H AT THE TOP SIGNIFICANT LEVEL OF SOUNDING.

B. CORRECTED SIGNIFICANT LEVEL DATA. THIS DATA HAS A THERMAL LAG CORRECTION APPLIED TO THE RELATIVE HUMIDITY AND A PRESSURE CONTACT CORRECTION. A THERMAL LAG CORRECTION TO THE TEMPERATURE IS ALSO APPLIED. THE PRESSURE CONTACT CORRECTION ADJUSTS THE CALIBRATION PRESSURE AT THE SPLASH CONTACT TO THE SEA-LEVEL PRESSURE AT THE DROP POSITION, WHICH HAS BEEN INTERPOLATED FROM SHIP DATA.

C. P* CORRECTED AND INTERPOLATED 10 MB LEVEL DATA. THE BOMEX CORE ANALYSIS USES A PRESSURE SYSTEM (P*) WHICH ASSIGNS 0.0 MB TO THE SURFACE AND MEASURES UPWARD, I.E (P*=PSURF-P). VALUES WERE NEEDED AT EVERY 10 MB FOR THE ANALYSIS. THE INTERPOLATION SCHEME ASSUMES THAT T AND H VARY LINEARLY WITH P BETWEEN SIGNIFICANT LEVELS.

Figure 10-2.--Archive format of dropsonde data.

D. MANDATORY CORRECTED AND INTERPOLATED 50 MB LEVEL DATA. THE LEVELS START AT 1000 MB AND OCCUR EVERY 50 MB UP TO THE 500 MB LEVEL.

E. MANDATORY HEIGHT CORRECTED AND INTERPOLATED DATA. THE HEIGHT LEVELS ARE AT 1000,4000,7000, AND 10000 FEET FOR COMPARISON WITH AIRCRAFT DATA.

---- AN ERROR IS KNOWN TO EXIST IN THE DAYTIME HUMIDITIES DUE TO SOLAR HEATING OF THE HUMIDITY SENSOR. WE HAVE NOT CORRECTED FOR THIS ERROR ON THIS TAPE. IN GENERAL IT CAUSES THE HUMIDITIES TO READ TOO LOW.----

C

3. FORMAT OF DATA

THERE ARE 5 FILES PER FLIGHT, UPON WHICH ARE WRITTEN RAW, CORRECTED, P* AND 2 MANDATORY DATA BLOCKS AS EXPLAINED IN SECTION 2. AT THE BEGINNING OF EACH FILE IS A HEADER GIVING DROP NUMBER, POSITION, LATITUDE AND LONGITUDE, DATE, TIME, FLIGHT PRESSURE AND ALTITUDE. THIS HEADER CAN BE READ AS 10 PHYSICAL RECORDS, EACH OF WHICH CONTAINS 130 ALPHANUMERIC CHARACTERS. AFTER THE HEADER COMES THE METEOROLOGICAL DATA. THE 13 VALUES AT THE FIRST LEVEL ARE PLACED ON THE TAPE AS ONE 130 CHARACTER PHYSICAL RECORD, THEN THE 13 VARIABLES AT THE SECOND LEVEL, ETC. AFTER THE LAST LEVEL A PHYSICAL EOF IS PLACED. THE 5 FILES FROM ONE SOUNDING FOLLOW IMMEDIATELY AFTER THE 5 FILES FROM THE PREVIOUS SOUNDING, UNTIL THE LAST SOUNDING IS REACHED.. FOR EXAMPLE, IF THERE ARE 100 SOUNDINGS THERE WOULD BE 500 FILES, WITH A DOUBLE EOF AFTER FILE 500. THE FORMAT FOR THE 13 VARIABLES IS--

C

```
FORMAT(1X,1(2X,F7.2),2(3X,F6.2),3(3X,F5.2),4(3X,F6.2),1(2X,F7.2),2(3X,F7.2),13X)
```

C

C

4. GENERAL INFORMATION

A. THIS IS BOMEX PERIOD 1 DROPSONDE DATA. THE DATA COVERS THE PERIOD FROM MAY 3,1969 TO MAY 13,1969 OR JULIAN DAYS 123-133.

B. THERE ARE DROPS AT 8 DESIGNATED POSITIONS INSIDE THE BOMEX ARRAY.

C. THERE ARE A TOTAL OF 87 SOUNDINGS (DROPS 1-101). DURING PERIOD 1 THERE WERE ALSO 16 COMPARATIVE DROPS AT THE SHIP MT. MITCHELL. THESE ARE AVAILABLE ON ANOTHER BOMEX TAPE.

D. THIS DATA WAS PROCESSED 8/20/73.

----THERE WERE A FEW MORE SOUNDINGS MADE IN PERIOD 1 BUT THE DATA WERE EITHER INCOMPLETE OR INACCURATE----

C

Figure 10-2.--Archive format of dropsonde data (continued).

5. SUBROUTINE FOR READING THE REST OF TAPE

THE FOLLOWING SUBROUTINE HAS BEEN CHECKED AND WILL READ EACH INDIVIDUAL FILE ON THE TAPE. THE FIRST 10 RECORDS IN A FILE ARE ALWAYS ALPHANUMERIC. EACH RECORD CAN BE READ BY THE FORMAT (26A5). THE 10 RECORDS ARE STORED IN THE MATRIX IHEADR, WHICH HAS 26 COLUMNS AND 10 ROWS.

THE NUMBER OF NUMERICAL DATA RECORDS (LINES OF DATA) IN THE FILE VARIES WITH THE SOUNDING. THIS NUMBER IS GIVEN BY THE COUNTER NLEV, WHICH IS INCREMENTED BY 1 EVERY TIME A RECORD IS READ. THE NUMERICAL DATA IS READ INTO A MATRIX NAMED ARRAY(I,J). THE MATRIX CONTAINS 13 COLUMNS AND NLEV ROWS. NLEV WILL NEVER BE GREATER THAN 60.

WHEN A SINGLE EOF IS ENCOUNTERED AFTER THE NUMERICAL DATA, THE SUBROUTINE SETS THE COUNTER NDFILE = 1 AND RETURNS TO THE MAIN PROGRAM.

WHEN A DOUBLE EOF IS ENCOUNTERED AFTER THE NUMERICAL DATA, THE SUBROUTINE SETS THE COUNTER NDFILE = 0 AND RETURNS TO THE MAIN PROGRAM. THE END OF DATA HAS NOW BEEN REACHED.

AN ALTERNATIVE METHOD WOULD BE TO ONLY CALL THE SUBROUTINE 5*(NUMBER OF SOUNDINGS) = 435 TIMES.

```
C
C
      SUBROUTINE READER(NDFILE,NLEV,IHEADR,ARRAY)
C
      DIMENSION IHEADR(26,10) , ARRAY(13,60)
C
 5000 FORMAT(26A5)
 5010 FORMAT(1X,1(2X,F7.2),2(3X,F6.2),3(3X,F5.2),4(3X,F6.2),1(2X,F7.2),
     1   2(3X,F7.2),13X)
 6000 FORMAT(1X,26A5)
C     ----------------------------------------------------------------
C
C
C     THE MAGNETIC TAPE IS READ IN ON LOGICAL DEVICE 5.
C     THE PRINTED OUTPUT IS ON LOGICAL DEVICE 6.
C
C     NDFILE = 0  MEANS SINGLE EOF ENCOUNTERED.
C     NDFILE = 1  MEANS END OF DATA ENCOUNTERED.
C     IHEADR CONTAINS TIME, DATE, LOCATION, ETC.
```

Figure 10-2.--Archive format of dropsonde data (continued).

```
C       ARRAY CONTAINS VALUES OF 13 METEOROLOGICAL VARIABLES.
C       NLEV IS THE NUMBER OF LEVELS ACTUALLY FILLED IN ARRAY.
C
C     ***** IF NO PRINTOUT IS NEEDED, REPLACE THE WRITE COMMANDS IN
C     ***** STATEMENTS 100 AND 400 BY CONTINUES.
C
C     --------------------------------------------------------------------
C
      DO 200 JROW=1,10
      READ(5,5000) (IHEADR(I,JROW), I=1,26)
      IF (EOF(5)) 950,100
  100 WRITE(6,6000) (IHEADR(I,JROW), I=1,26)
  200 CONTINUE
C
      NLEV=0
  300 READ(5,5010) (ARRAY(I,NLEV+1), I=1,13)
      IF (EOF(5)) 900,400
  400 WRITE(6,5010) (ARRAY(I,NLEV+1), I=1,13)
      NLEV=NLEV+1
      GO TO 300
C
  900 NDFILE=0
      GO TO 999
  950 NDFILE=1
C
  999 RETURN
      END
```

Figure 10-2.--Archive format of dropsonde data (continued).

Figure 10-1.--Inventory of BOMEX dropsonde data

Magnetic tape No.	Microfilm reel No.	Date (1969) Calendar date	Julian day	Drop position 1	2	3	4	5	6	7	8	Night total	Day total	Combined total
				BOMEX Observation Period I										
B-8106	DR-1	May 3	123	- -	- D	- -	- -	- D	- D	- D	- -	0	4	4
"	"	" 4	124	N D	N D̸	N D	N D	N D	N D	N D	N D	8	7	15
"	"	" 5	125	N D	N D	N D̸	N̸ D	N D̸	N D	N D	N D	7	6	13
"	"	" 6	126	N D	N D̸	N D	N̸ D	N D	N -	N D	N -	7	5	12
"	"	May 10	130	- D	- D	- D	- D	- D	- D	- D	- D̸	0	7	7
"	"	" 11	131	- D	N D	N D	N D	N D̸	N̸ D	N D	- D̸	6	6	12
"	"	" 12	132	N̸ D	N D	N D	N̸ D	N D	N D	N D	N D	6	8	14
"	"	" 13	133	N D	N̸ D	N D	N̸ -	N D	N -	N -	N D̸	6	4	10
									Period I totals:			40	47	87
				BOMEX Observation Period II										
B-8105	DR-2	May 25	145	- D	- D̸	- D	- D	- D	- D	- D	- D	0	7	7
"	"	" 26	146	N D	N D	N D	N D	N D	N D	N D	N D	8	8	16
"	"	" 27	147	N̸ D	N D	N̸ D	N̸ D̸	N D	N̸ D	N̸ D̸	N D	3	6	9
"	"	" 28	148	N D	N D	N D	N D	N D̸	N D	N D	N D	8	7	15
"	"	May 31	151	- D	- D̸	- D	- D̸	- D	- D	- D	- D̸	0	5	5
"	"	June 1	152	N D	N D	N D	N D	N̸ D	N D	N D	N D	7	8	15
"	"	" 2	153	N D	N D	N D	N D	N D	N D	N -	N D	8	7	15
"	"	" 3	154	N D̸	N D̸	N D	N D̸	N D̸	- D	- D̸	- D̸	5	2	7
"	"	" 4	155	N D	N D	N D	N D	N D	N D	N -	N -	8	6	14
B-8107	DR-3	June 7	158	- D	- D	- D	- D	- D̸	- D	- D	- D	0	7	7
"	"	" 8	159	N D̸	N D	N D	- D	- D̸	N D	N D	N D̸	6	5	11
"	"	" 9	160	N -	N D	N D	N D	N D	- D	N D	N̸ D	6	7	13
"	"	" 10	161	N -	N -	N̸ -	N̸ -	N -	N -	N -	N -	6	0	6
									Period II totals:			65	75	140

Table 10-1.--Inventory of BOMEX dropsonde data (continued)

Magnetic tape No.	Microfilm reel No.	Date (1969) Calendar date	Julian day	Drop position 1	2	3	4	5	6	7	8	Night total	Day total	Combined total
				BOMEX Observation Period III										
B-8975	DR-4	June 22	173	N D	N D	N D	N D	N D	N D	N D	N D̸	8	7	15
"	"	" 23	174	N -	N -	N -	N -	- -	N -	- -	N -	6	0	6
"	"	" 24	175	N D	N D	N D	N D	N D	N D	N D	N D̸	8	7	15
"	"	" 25	176	N D	N D	N D	N D	N D	N D	N D	N D	8	8	16
"	"	" 26	177	N -	N -	N -	N -	N -	- -	N -	N -	7	0	7
"	"	June 28	179	- D	- D	- D	- D	- D̸	- D	- D	- D	0	7	7
"	"	" 29	180	- D	N D	N D	N D	N D	N D	N̸ D	N D̸	6	7	13
"	"	" 30	181	N D	N D	N -	N D	N D	N D	N D	N D	8	7	15
"	"	July 1	182	N D	N D	N D	N D	N D	N D̸	- D	N D̸	7	6	13
									Period III totals:			58	49	107
				BOMEX Observation Period IV										
B-8148	DR-5	July 2	183	Lidar special soundings								1		1
"	"	" 3	184									2	2	4
"	"	July 13	194	Positions and flight altitudes variable: All daytime flights.									7	7
"	"	July 14	195										7	7
"	"	July 17	198										3	3
"	"	July 19	200										10	10
"	"	" 22	203										13	13
"	"	" 23	204										16	16
"	"	July 26	207										3	3
"	"	" 27	208										2	2
									Period IV totals:			3	64	66

Table 10-1.--Inventory of BOMEX dropsonde data (continued)

Magnetic tape No.	Microfilm reel No.	Date (1969) Calendar date	Julian day	Drop position 1	2	3	4	5	6	7	8	Night total	Day total	Combined total
			Soundings over the Mt. Mitchell, 12.4°N 58.4°W for comparison with rawinsonde soundings											
B-8152	DR-6	May 6	126										8	
"	"	May 13	133										8	
"	"	May 28	148	All daytime soundings.									7	
"	"	June 26	177										8	
"	"	July 1	182										7.	
											Mt. Mitchell totals:		38	

\- = No sounding made, or unsuccessful drop.

N = Nighttime soundings.

D = Daytime soundings.

/ = Sounding not processed due to bad, missing, or noisy data.

Drop Positions: 1 = 13.0°N 57.9°W; 2 = 14.3°N 57.0°W; 3 = 15.7°N 56.0°W; 4 = 17.0°N 55.1°W; 5 = 13.6°N 54.5°W; 6 = 14.5°N 55.9°W; 7 = 15.5°N 57.2°W; 8 = 16.4°N 58.5°W.