GATE CONVECTION SUBPROGRAMME

Field Phase Report

by

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CONVECTION SUBPROGRAMME - Field Phase Report

1. Introduction

This is a report on the field phase of the GATE. Its purpose is to provide some useful information to those who were not present in Dakar about what was accomplished during the field phase, and to give some preliminary assessment of data quantity and quality. Some remarks will be made on the successes and shortcomings of the experiment in relation to the experimental objectives of the Convection Subprogram and a few tentative conclusions will be drawn from the day by day observations of convection over the GATE ship array.

The GATE Report No. 7 (The Convection Subprogramme for GATE) discussed in detail the objectives of the subprogram. They fell into three classes: the experimental objectives concerned with the planned observations; the analysis of the data to study scale interactions; and the modelling of convective interactions, and particularly the parameterization of convection. This report is primarily concerned with the experimental objectives. It cannot completely assess whether these have been attained, since in many cases the quality of the data will not be known until they have been validated by the National Data Centers and further processed by the Convection Subprogramme Data Center.

A tentative overall assessment is that the field experiment was very successful. It seems that the SMS satellite and ship radars performed very well; the ship tethered balloon boundary layer systems, after initial problems, provided much data; the aircraft program exceeded expectations; and the A/B-scale ship upper air soundings proved very reliable. Only the NAVAID sounding systems on many B-scale and A-scale ships continued to have problems throughout the experiment. Post-processing will undoubtedly improve the data, but the quantity and quality of the wind data will not be as good as was hoped for. This will impact the definition of A-scale fields, and may reduce the quality of budget studies using the B-scale ship data.

2. In-Field Events, Decisions and Changes of Plan

It is useful to document the significant events and decisions made for scientific or operational reasons in the field, which led to changes in the experiment from the Convection Subprogramme scientific plan (GATE Report No. 7).

2.1 A-Scale Network:

Problems with the NAVAID sounding system, and the absence of certain A-scale ships led to significant reductions in the planned A-scale network which were most severe in phase I. The decision was made to concentrate the A-scale resources towards the Eastern Atlantic to support and extend the A/B-scale network. Additionally, many of the stations planned for the GATE land network were not implemented. Details of the actual GATE ship and land station distributions are contained in the S.S.P. report. The reduced A-scale network is probably still adequate in the Eastern Atlantic to resolved the large-scale fields for A:B scale interaction studies. However, the numerical modelling of the whole GATE A-scale area will be affected adversely.

2.2 B-Scale Network

The A/B-scale network was unchanged, but the problems experienced in phase I with the NAVAID systems led to some changes in the B-scale network. Additionally, medical evacuations meant certain ships were missing at times from the network.

In phase I, the Vanguard remained a station 1A, adjacent to the Oceanographer throughout the phase to provide radar wind data at the central position. At the request of the USSR, in phases II and III, the Professor Vize occupied position 1A, and the Vanguard position 2. The main reason for this was the desire for a homogeneous symmetric network of the A/B-ships and Professor Vize. However, this reduced the radar and tethered balloon coverage at position 2, and placed both an X and C band radar at position 1 during phase II. In phase III, the Meteor, while occupying station 1 as planned, used its radar mainly for the tracking of soundings so the Professor Vize should provide some useful X-band radar coverage.

For details of ships off station - see Ship Operations Report.

2.3 Satellite Coverage

The SMS satellite was successfully launched and provided routine half-hourly coverage in the visible and the infrared from the first day of Phase I, for all three phases. A catalogue is given in Annex 2.

2.4 Scientific Aircraft Operations (reference, GATE Report No. 10.)

The forecasting of the level of convective activity in the B-array was, in general, quite successful, and increasingly influenced the advice of the Subprogram Scientists to the daily 1630 meeting of the Mission Selection team. At this meeting, a primary and alternate mission were selected, and a Mission Scientist (MS) and Airborne Mission Scientist (AMS) were selected who then drew up a preliminary plan for the following day's mission. As much flexibility was maintained in the mission location, and pattern design,as possible. This plan was revised in the early morning hours, based primarily on information from the SMS satellite and fascimile transmission of the C-band radar on the ships Quadra and (mainly during Phase II) Oceanographer. The transience of the mesoscale convection (time scale of typically 3-6 hours) made detailed planning of mission location before take-off undesirable. In general, the Airborne Mission Scientist on the lead aeroplane arrived in the B-array 45 minutes before the other planes, and was responsible for the final selection of pattern coordinates from the prebriefed patterns. Generally, pattern type, location, size and orientation were selected by the AMS 15-30 minutes before the remaining aircraft arrived for a multiaircraft mission. This critical decision was based primarily on radar information: the lead aircraft radar, and on radar information transmitted from the ships, usually Quadra or Oceanographer; as well as on the AMS's visual assessment of the convective situation. It was found that the Mission Scientist in Dakar was rarely able to have significant input to the decision-making, once the AMS reached the B-array, simply because the information available in Dakar though only one hour old was typically already out of date - the convection was changing so rapidly. Communications from the MS in

Dakar to the AMS were also not always satisfactory. The attempt to maintain flexible real-time planning of the multi-aircraft missions was generally very successful.

Ship to aircraft communications were always critical to aircraft operations. As well as radar information, ship location and the status of the ship tethered balloon system were routinely required. In phase I, the tethered balloon systems were generally lowered during aircraft operations during disturbed weather; but in phase II, as communications and confidence improved, generally only one balloon was lowered in the same situation. In phase III, aircraft and tethered balloon operations were closely coordinated for scientific reasons and as far as possible, aircraft patterns were designed to minimize the impact on tethered balloon operations in the C-scale array. This coordination was achieved by daily evening conferences between the MS and the C-scale ship coordinator (M. Garstang), and VHF conferences between the AMS on the lead aircraft and the ship coordinator. For many missions, the aircraft pattern and flight levels were chosen to complement the intensive boundary layer measurements of the C-array.

The transience of mesoscale convection was mentioned above. Convective systems or cloud clusters could not usually be tracked in a Langrangian sense long enough to execute some of the planned missions. In particular, mission 1B to study the life cycle of a cluster, and 3A to study the post-cluster recovery of the atmosphere as a cluster moved out of the B-array, were never flown. A more detailed discussion of the types of missions flown is given in section 3.2.

Throughout the experiment concern was expressed about the existence of a significant diurnal cycle. It was suggested that the initial growth of clusters occurred often in the early morning hours. Several radar and satellite studies were attempted, but no conclusive evidence emerged in the field. The operational difficulties of switching from day to night-time operations were severe, and no night-time multiaircraft missions were attempted. The survey of the missions flown indicates that both the growing and decaying stage of clusters were sampled (section 3.2).

Severe interference problems between the Omega dropsonde and the VLF/Omega upsondes on the B-scale ships were encountered. This resulted in the dropsonde missions having to avoid the B-array by 200 nm while upsondes were in the air. Dropsonde missions were concentrated east of the B-array to supplement the inadequate data along the African coast, and north and west of the B-array to study low level vortices, and extend the A/B-network.

3. Data Collection for Convection Subprogramme

3.1 Ship Program

3.1.1 Introduction

The GATE Convection Subprogramme Ship Observational Program was designed to observe the cloud systems with the B-scale network nested within the A/B network. The horizontal spacing of ships in these two networks were 167Km and 390Km respectively. The observational frequency of three hourly soundings and fifteen minute radar scans were chosen to resolve the convective systems on these scales. During Phase III, an additional three-ship network labeled the "C-scale" with a ship spacing of 100Km was imbeded in the North-East quadrant of the B-scale providing further scale definition particularly in the atmospheric boundary layer. The C-scale observational program was basically hourly soundings in the lower atmosphere with an emphasis on studying the ocean atmosphere interactions and the subcloud-cloud layer interactions.

3.1.2 Upper-Air Observations

The Upper-Air observational strategy for the GATE A/B and B ship arrays was based on the concept of intensive observational periods with three hourly soundings interspaced by non-intensive periods with six hourly soundings. The intensive periods were designed to provide a time series of observations lasting two days or more for each period and, it was hoped, the intensive periods would document examples of the development, maturity and decay of convective systems. Of particular interest was the observation of the developing stage of cloud clusters. The ship board operational considerations limited the intensive periods to no more than seventy-two hours in length each, and for no more than 60 percent of the total time on station. During Phase III, the B-scale ships were all to attempt to accomplish continuous three hourly soundings. In order to supplement the data lease during periods of aircraft missions, the plan also called for selected 90-minute soundings from the B-scale ships.

Figure 1 summarizes the observational program showing the intensive periods as they were related to the convective activity that occurred in the B-scale area. The convective activity was determined from the three hourly IR satellite pictures by the Special Analysis Group in Dakar. It is assumed that the numerical indicator can be equated to the GATE convective code without serious misrepresentation. The summary clearly shows that the intensive periods encompassed periods of convective development and periods of convection decay. Very suppressed days, as well as some of the most convective, were included during periods of intensive observations, thus providing a broad spectrum of convective states for study.

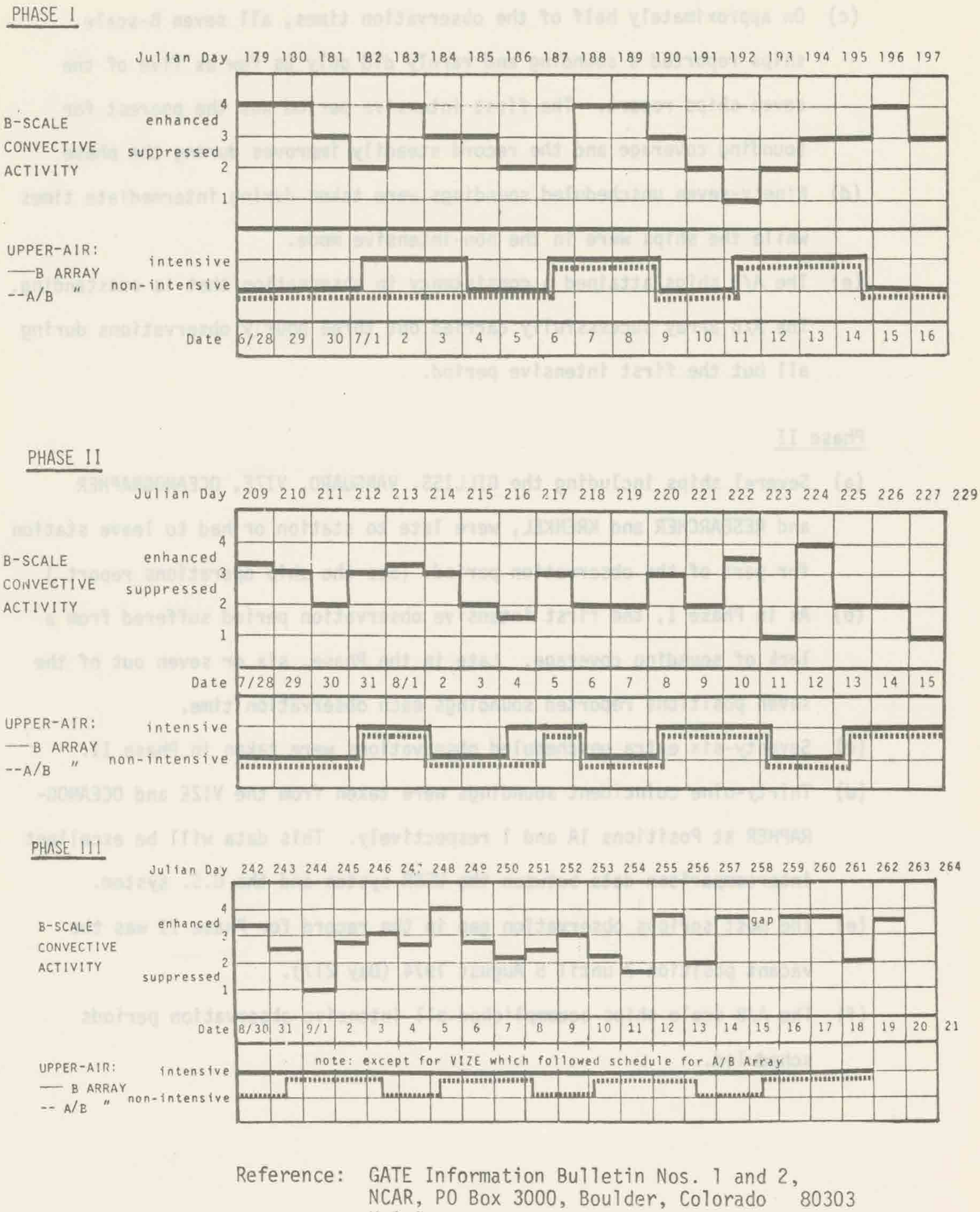
The record of observations for each ship for each observational time are tabulated in Annex 4. The following general comments may be made by way of summary.

Phase I

(a) All ships were on station for the whole period.

(b) The VANGUARD and OCEANOGRAPHER occupied ship position 1 for the whole phase. Approximately twenty OCEANOGRAPHER balloons were tracked by the VANGUARD and this data set provides a convenient data set for VLF soundings quality assessment.

Figure 1. A/B and B ship upper air observation summary.



Reference: GATE Information Bulletin Nos. 1 and 2,
NCAR, PO Box 3000, Boulder, Colorado 80303
U.S.A.

(c) On approximately half of the observation times, all seven B-scale ships reported a sounding and rarely did only as few as five of the seven ships report. The first intensive period was the poorest for sounding coverage and the record steadily improves during the phase.

(d) Ninety-seven unscheduled soundings were taken during intermediate times while the ships were in the non-intensive mode.

(e) The A/B ships attained a consistency in observation that is outstanding. The A/B array successfully carried out three hourly observations during all but the first intensive period.

Phase II

(a) Several ships including the GILLISS, VANGUARD, VIZE, OCEANOGRAPHER and RESEARCHER and KRENKEL, were late to station or had to leave station for part of the observation period. (See the ship operations report.)

(b) As in Phase I, the first intensive observation period suffered from a lack of sounding coverage. Late in the Phase, six or seven out of the seven positions reported soundings each observation time.

(c) Seventy-six extra unscheduled observations were taken in Phase II.

(d) Thirty-nine coincident soundings were taken from the VIZE and OCEANOGRAPHER at Positions 1A and 1 respectively. This data will be excellent intercomparison data between the USSR system and the U.S. system.

(e) The most serious observation gap in the record for Phase II was the vacant position 7 until 5 August 1974 (Day 217).

(f) The A/B scale ships accomplished all intensive observation periods scheduled.

Phase III

(a) The bulk of the ships in the B and C scale arrays attempted to perform eight radiosondes per day. The RESEARCHER at position 5 had to reduce to a 4 per day schedule from 6 September to the end of the phase. The GILLISS at position 7 changed to the A/B intensive-nonintensive schedule on 13 September. The last days of the Phase (18-19 September 1974) had several ships begin buoy retrevial operations so that the network is incomplete for these days. The VANGUARD was off station from 1800Z, 6 September to 00Z, 8 September in order to assist the DALLAS in repair of its navigation buoy. The VIZE was off station during 15-16 September.

(b) The structure sonde and pilot-balloon program in the C-scale array will provide a wealth of information for convective studies (see the boundary layer report).

(c) The HECLA (position 29) took low-level, day-time, upper-air soundings; a summary is given in Annex 4.

(d) No report of the success of the A/B ships confirming their success at meeting the schedule was received in Dakar. We have no reason to expect less for Phase III than the outstanding record they accomplished in Phases I and II.

(e) The summary shown in Annex 4 is incomplete for Phase III because of incomplete information received at the GOCC.

The quality of upper air soundings has not yet been adequately determined. An initial attempt to deal with this problem for GATE has been done by Rodenhuis and Acheson (1974). Further definition of quality control will be gained in the Convection Subprogram Data Center international validation activities.

3.1.3 Ship Radar Observations

a) C-Band Radars

The 5 cm radars designed to provide coverage every 15 minutes (see GATE Report No. 10) of the B-scale array for precipitation estimates, and location and movement of convective systems worked very well. Annex 3 shows the periods of operation of the C-band radars. There were only four days without three C-band radars working on station, and on more than 50% of the days all four were working. During phase II, the Quadra tracked some upper air ascents for comparison with the VLF winds, but mainly during undisturbed periods.

Facsimile transmissions to Dakar from Quadra and Oceanographer (mainly in phase II) played a vital role in the planning and execution of aircraft missions. Verbal messages to the Airborne Mission Scientist primarily from these two ships, were of great value on many occassions in locating suitable active convective systems for study by the aircraft. As anticipated, the ship radars showed the growing phase of cumulonimbus lines before their cirrus outflow became prominent on the SMS images. The infield comparisons of SMS images and ship radar echos showed good agreement during the mature phase of the convection.

b) X-Band Radars

In phases I and II, the radar on the Meteor gathered cloud and precipitation information. The phase II coverage was less complete as the Meteor tracked 36 upper air balloons and experienced some technical problems. In phase III, the Meteor's radar was used primarily for tracking of structuresondes.

The three USSR radars on Professor Zulov, Professor Vize, and Academician Korolov performed their cloud observations according to plan. Hourly photographs were recorded on 35 mm film at a range setting of 200 km and an antenna elevation of 0.5^{o}. The height and intensity of the most significant feature was recorded. When major echos were within 100 km, half-hourly pictures at 100 km range were taken; and when such echos were within 50 km, 15 minute pictures were then taken at this range. When precipitation areas were very close (25 km), frequent PPI and RHI photographs were taken at different attenuations to show the intensity and structure of showers.

3.2 Aircraft Program

3.2.1 Introduction

The GATE aircraft plan anticipated nine long-range research aircraft dedicated to Basic GATE Missions, flying in all between 210 and 290 sorties. Only eight long-range meteorological research aircraft participated in GATE, but they flew a total of about 270 sorties, a remarkable achievement which exceeded the sortie rate per aircraft which we anticipated. These aircraft are listed in Table 3.1, together with the two short range aircraft, and other GATE aircraft.

It is not possible at present to assess the quality of the aircraft data in any detail. All the aircraft operators maintained their own checks on data quality. Hence, this report will simply list the types and numbers of missions flown, and discuss briefly the convection sampled.

3.2.2 Summary Table of Missions Flown

Table 3.2 summarizes the Convection Subprogram aircraft missions planned for GATE and those actually flown. It is clear that overall, the number of missions and sorties closely approached the number planned. Table 3.3 summarizes the Convection Subprogram aircraft missions by phase. A more detailed list of the missions is contained in Annex 1.

3.2.3 Basic GATE Missions: Disturbed Weather

The 1B cluster lifecycle mission was never flown. This mission called for a sequence of aircraft groups at eight-hour intervals to study the mesoscale structure of a cluster throughout

Table 3.1

GATE Aircraft

Long-range Meteorological Aircraft	
DC-7	France
UKC-130	U.K.
DC-6	U.S.A. (NOAA)
USC-130	U.S.A. (NOAA)
L-188	U.S.A. (NCAR)
CV-990	U.S.A. (NASA)
1ℓ-18C	U.S.S.R. (CAO)
1ℓ-18M	U.S.S.R. (MGO)
Short-range Aircraft	
Queen-Air	U.S.A. (NCAR)
Sabreliner	U.S.A. (NCAR)
Other GATE Aircraft	
KC-135/WC-135	U.S.A. (Dropsonde)
RP-3	U.S.A. (Oceanographic)

Table 3.2

Summary of GATE Convection Subprogram Aircraft Missions

		REQUESTED		FLOWN	
TYPE	OBJECTIVE	NUMBER	NUMBER OF SORTIES	NUMBER	NUMBER OF SORTIES
1A/1C1/3	Cluster budget study (Butterfly or box pattern)	13	71	13	65
1C2	Structure of convective band (Line pattern)	4	12	6	30
1D	Sub-cluster mesoscale convection (Area pattern)	5	25	4	20
1B	Cluster life cycle	3	24	--	--
2	Boundary layer ITCZ (to 0^{0}N)	5	25	3	16
2B	ITCZ (Line or box pattern)	-	--	3	16
TOTAL (BASIC GATE MISSIONS)			157		147
4	Vortex off Dakar	3	15	1	4
8	Cloud physics/rings	6	18	11	16
9C	Cluster life cycle (dropsonde)	8	8	1	1
TOTAL			198*		168**

* Based on 290 total sorties by long-range meteorological research aircraft

** Of approximately 270 total sorties by long-range meteorological research aircraft

Table 3.3

Summary of Convection Subprogram Aircraft Missions: Phase I

DATE	NUMBER	TYPE	M.S.	AMS	SORTIES	LOCATION, REMARKS, CONVECTION CODE
June 28	179/2	1A	Zipser	Betts	7	Box: ships 3,4,6,7: Active convergence line: Code 4-5
July 1	182/2	8B2	Holland	Mazin	1	Near Meteor: Cumulonimbus penetrations
July 3	184/2	2	Cox	Holland	5	Line SW to 0^oN: Boundary layer ITCZ: 4
July 5	186/3	1D	Betts	Zipser	5	Butterfly in NE of B-array: Convection code 2-3
July 9	190/1	5A/1D	Borovikov	Weickman	6	Rhombus in B-array: Suppressed conditions: 1-2
July 10	191/1	2	Betts	Zipser	5	Open box to 0^oN: Boundary layer ITCZ: 4
July 13	194/1	1C2	Rasmussen	Betts	5	Line on east of B-array: Growing cluster: 4-5
July 14	195/1	1A	Kuettner	Cox	4	Butterfly between ships 3,4: Active mesoscale system:4-5
July 14	195/2	8B2		Melnichuk	1	Cloud penetrations near ships 9, 10
July 15	196/1	4	Betts	Zipser	4	Butterfly S.W. of Dakar: convective vortex: 5
July 16	197/1	1D	Rasmussen	Cox	4	Butterfly east of ship 8: congestus band or ring: 3
July 16	197/2	8B2		Shur	1	Cloud penetrations near ship 9: Code 2-3

Summary of Convection Subprogram Aircraft Missions: Phase II

DATE	NUMBER	TYPE	MS	AMS	SORTIES	LOCATION, CONVECTION CODE, AND REMARKS
28 July	209-1	1A/3	Kraus	Zipser	5	Line South of QUADRA: code 3-4
29 July	210-1	1A	Alt	Cox	4	Line North of OCEANOG: code 4
31 July	212-2	8B2	James	Borovikov	1	Developing Cb: code 4
2 Aug.	214-1	8B1	Borovikov	Mazin	2	Penetrations 5-20K': code 3-4: S & NE of QUADRA
3 Aug.	215-1	1C2	Hoeber	Zipser	4	Between DALLAS & RESEARCHER: code 4: Balloons up ships 1, 5, 6
4 Aug.	216-1	2	Betts	LaSeur	6	On $20^{o}30'$W to 0^{o}N: code 4: Dropsonde support
5 Aug.	217-1	1C2	James	Cox	4	Between OCEANOG., QUADRA & METEOR: code 3-4 Balloon up ships 1, 3, 4
8 Aug.	220-2	1A	Emmanuel	Zipser	6	Between GILLISS, VANGUARD & OCEANOG.: code 3-4
9 Aug.	221-4	8B1	LaSeur	Zhvalev	2	Code 4
10 Aug.	222-1	1A	Betts	Pennell	6	Between GILLISS & DALLAS: code 5
11 Aug.	223-1	2B	Grossman	Emmanuel	6	On 20^{o}W: code 5
11 Aug.	223-3	9		Simpson	1	Code 5: Cluster life cycle
13 Aug.	225-1	1A	LaSeur	Betts	6	Between VANGUARD/QUADRA: code 4
14 Aug.	226-4	8B1	LeMone	Mazin	2	Code 3-4
17 Aug.	229-1	2B	Pennell	LaSeur	6	Rectangle NE of QUADRA: code 4

Summary of Convection Subprogram Aircraft Missions: Phase III

DATE	NUMBER	TYPE	MS	AMS	SORTIES	LOCATION, CONVECTION CODE, AND REMARKS	
30 Aug.	242/1B	8B2	Rasmussen	Melnichuk	1	Near Poryv: 3	
31 Aug.	243/5B	8B2	Hoeber	Mazin	1	Near Korolov	
2 Sept.	245/1	1C2	Emmanuel	Betts	6	N.S. through C-array $4 \rightarrow 5$	Growing E.W. bands Stacked for radiation 7A
5 Sept.	248/4	1A	Pennell	Cox	6	Box around C-array 5	Good divergence box
6 Sept.	249/1B	8B2	LeMone	Borovikov	1	Near OCEANOG: 3-4	
8 Sept.	251/2	1C2	Gray	Simpson	5	Between QUADRA & VANGUARD: code 4	Good line life cycle
9 Sept.	252/1A	1A	Nicholls	Cox	5 (4)	Box round C-array 4-5	Lost DC-6 (Illness) Highest level 25 K ft.
11 Sept.	254/1	8B1	Rasmussen	Borovikov	3	4 patterns near OCEANOG.: 3	L-188, 1ℓ-18C, USC-130
12 Sept.	255/2	1A	Grossman	Betts	4	Box, L around C-array: 4-5	Quadra, Meteor lost tethered balloons: patterns incomplete
13 Sept.	256/1	1A	Borovikov	Nichols	3	Box east of C-array: 4	
14 Sept.	257/1	1C2	Hoeber	Zipser	6	E.W. line thru C-array: 4	Good 1C2 Mission
16 Sept.	259/3	2B	LeMone	Betts	4	ITCZ S. of OCEANOG.: 4	Persistent S. edge to ITCZ
17 Sept.	260/1	7A2/1A	Vasiliev	Cox	6	N. of C-array: 3-4	Combined radiation, convection mission, stacked
18 Sept.	261/1	1D	Grossman	Simpson	5	Box NE of C-array: 3	Convection grew into box
19 Sept.	262/1	1A	Kuettner	Zipser	3	Box around QUADRA: QUADRA profiling	Convection growing in box

its life cycle. In fact, the clusters observed grew and died rapidly in at most, perhaps 12 hours, followed by the growth of a new system. It was not possible to follow one cluster and particularly its mesoscale structure in a Langrangian sense over a 24 hour period, even though clusters continued to form in the same preferred area of a large-scale wave. Further, the sequential scheduling of aircraft was impractical, so mission 1B was never attempted.

Instead, many more missions of the line cross-section type through a mesoscale system were flown (type 1C2). These were simple to fly and the pattern could easily and quickly be moved. Further, almost all mesoscale systems showed line structure on the radar (East-West or SW-NE), so that the normal cross-section was a simple pattern to orient. In some cases, it was possible to maintain a vertical stack of the low level aircraft to study the vertical structure of the updraft/downdraft pattern as well as make radiative flux divergence estimations. These mesoscale lines had a lifetime of typically four to eight hours and were oriented along the vertical shear of the horizontal wind. They should not be regarded as two dimensional structures, however, so that these 1C2 missions, though providing a detailed picture of the internal structure of the convection line, will not give a budget for the system unless combined with the ship network data, or suitably composited.

The cluster budget studies (1A/1C1/3) were area patterns (either a box or a butterfly pattern). The different labels 1A/1C1/3 did not represent in practice distinct types of mission. In the main butterfly patterns were flown in phases I and II (mainly phase II) and box patterns in phase III. There were two main reasons for this. The nature of the convective systems seemed to change and intensify during the experiment. By phase III, penetration by aircraft of the more severe systems had become difficult and box patterns around the system were simpler to fly. In phase III, also most missions were flown in coordination with the C-scale array. With the ship tethered balloons up, only simple box patterns around the C-array, or with one leg through it, could be flown in disturbed weather. One reason why the butterfly pattern was originally chosen was a deliberate attempt to combine the "budget" and "structure" objectives: the butterfly describes an area field from which budgets can be computed and also penetrates the internal structure of the mesosystem. In phase III, these two objectives were separated again and only box (1A) and line (1C2) patterns were flown. The convergence into a cluster was easily visible from flying a single box around it. A final reason why the shift back from butterfly to box patterns was made was concerned with the transience of the convection on the mesoscale. Systems grew rapidly on the mesoscale in typically about two hours. For the Airborne Mission Scientist to spot this development, locate and fly a multiaircraft butterfly pattern would typically take longer than two hours, so that it was difficult to catch the growth phase of systems. The box pattern is a little quicker and simpler to fly. During the experiment, in disturbed conditions, the number of Basic GATE Missions of each pattern type flown were

Box pattern	7
Butterfly pattern	6
Line pattern	6

with an average of five aircraft per mission.

3.2.4 Basic GATE Mission 1D

This type of mission, planned to study some intermediate state of convection between the suppressed conditions and cluster convection, was never really flown as planned. The intermediate state was rarely observed: convection was typically suppressed or precipitating mesoscale lines were present and the transition to deep convection was very rapid. (Very few 5B2 missions were flown for the same reason.- see Boundary Layer Subprogram) The four 1D missions in the table were in fairly suppressed conditions, with 261/1 the nearest to transitional conditions.

3.2.5 ITCZ Missions

A zonal ITCZ along a convergence line was only rarely observed. (The best case occurred on August 12 when only a few aircraft were available.) The clusters studied were part of the region of transient convection which in the long-term average forms the "ITCZ".

The planned ITCZ Mission type 2 was a boundary layer mission whose purpose was to study the boundary layer structure through a nearly zonal ITCZ and in the cross-equatorial flow. Only three missions of this type were flown, and to these was added the CV-990 to study the outflow structure.

At the request of the mission selection team, a modified ITCZ mission, designated 2B, was flown to explore the structure of the ITCZ convergence line on the B/C-scale and to supplement budget calculations based on the ship arrays.

3.2.6 Cloud Physics Missions

Eleven dedicated cloud physics missions were flown: one with three aircraft, three with two aircraft, and the others single aircraft missions. In addition, multiaircraft cloud physics sampling occurred on almost all the Basic GATE Missions: indeed fourteen of the Basic GATE Missions included three or more of the aircraft with cloud physics instrumentation (DC-6, L-188, 1ℓ-18C, and USC-130). A wide range of convective states was sampled during the summer.

3.2.7 Other Missions

One mission was flown in a small vortex which intensified off Dakar (but later dissipated). No dedicated missions to study ring convection (8A1) were flown. The majority of rings observed were very shallow (top < 10000 feet) and it proved very difficult to forecast their location and plan even an add-on mission to study them in detail. However, it is believed that many flights made cross-sections through ring-like convection.

A number of dropsonde missions were planned to study the life cycle of clusters, but only perhaps one explicitly flown (tropical storm Alma). There were two reasons for this. Interference between upsondes and dropsondes was very severe and the dropsonde aircraft had to stay some 200 n.m. from the nearest ship launching 403 MHz sondes. Secondly, as mentioned in 3.2.2, systems could rarely be followed in a Langrangian sense for two successive days. Many of the dropsonde missions studied larger scale phenomena: particularly waves and vortices at 850 and 700 mb as these moved off the African coast. These missions will be of great value in studying the scale interactions (for mission details - see Synoptic-scale subprogramme).

3.2.8 Preliminary Assessment of Aircraft Program

Earlier sections have discussed the distribution of mission types, and the reasons (in many cases meteorological) for changes from the earlier plans. A wide range of convective development was sampled. The transience of systems on the mesoscale has been mentioned already. This was as expected: typically, if the life cycle of a mesoscale system is divided into three (growing, active and decaying), then a given mission would sample at least two of these phases. A very rough classification of type 1 missions in this manner was attempted in the field and is reproduced in Table 3.4. It is a rather subjective and very preliminary assessment but it may be useful as an initial guide to researchers. It also indicates that a fair life cycle sampling was probably attained. Missions have been divided between two phases where it seemed appropriate. The number in the decaying category is probably an underestimate.

Table 3.4

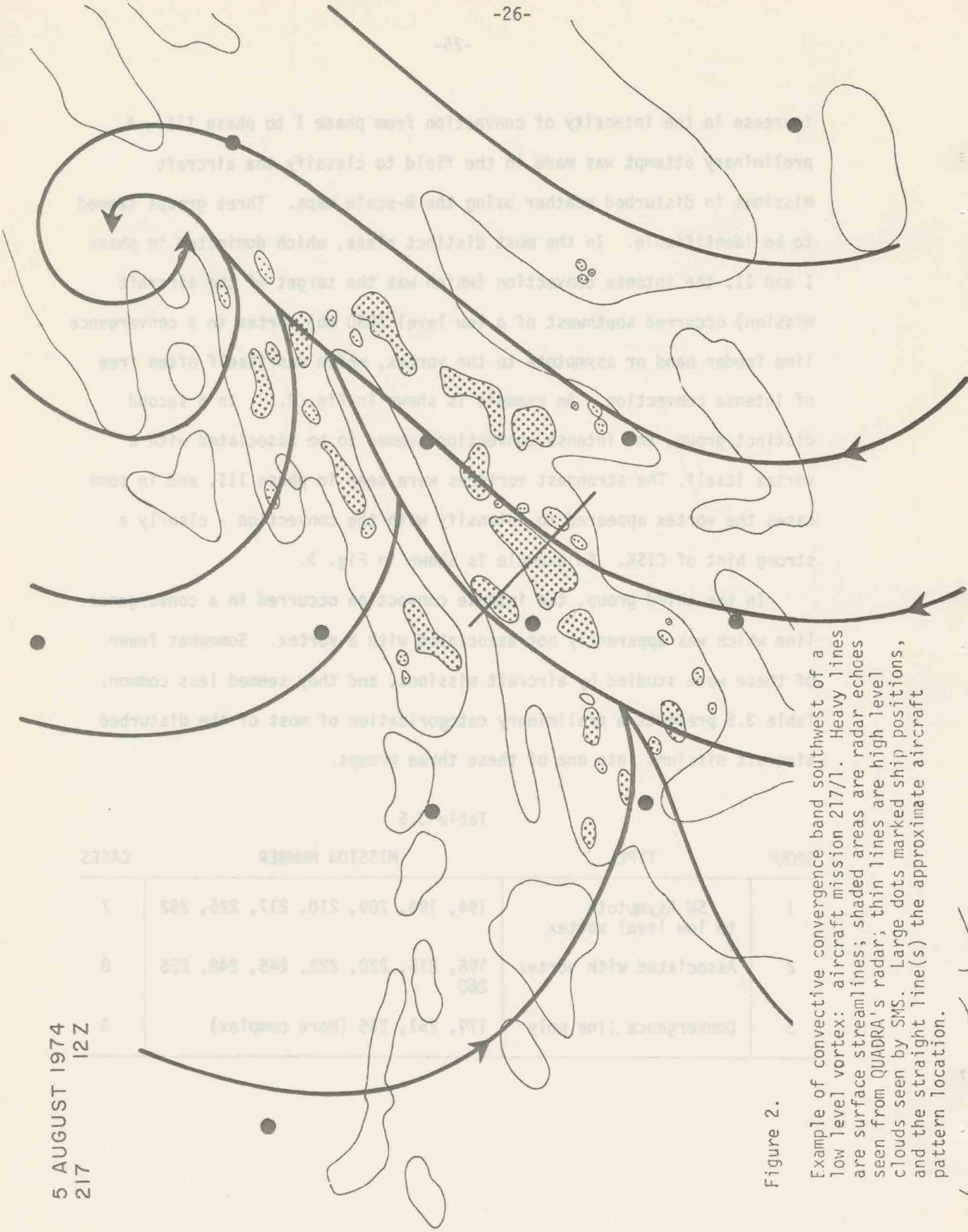
LIFE CYCLE PHASE	MISSION NUMBER AND FRACTION OF MISSION	TOTAL
Growing	194(½), 215(1), 217(½), 225(½), 245(1), 252(1), 255(½), 262(1)	6
Active	179(1), 194(½), 195(½), 210(½), 217(½), 222(½), 225(½), 248(1), 251(1), 255(½), 256(½), 257(1), 260(½)	8½
Decaying	195(½), 209(1), 210(½), 220(1), 222(½), 256(½), 260(½)	4½

The larger-scale meteorological fields associated with disturbed convection were well organized. The forecasting group under Dr. Burpee achieved remarkable success in predicting the level of convective activity in the B-array, by noting the positions of troughs at 700 mb, vortices at 850 mb, and the latitude of the main convergence zone. There was a marked increase in the intensity of convection from phase I to phase III. A preliminary attempt was made in the field to classify the aircraft missions in disturbed weather using the B-scale maps. Three groups seemed to be identifiable. In the most distinct class, which dominated in phase I and II, the intense convection (which was the target of the aircraft mission) occurred southwest of a low level (850 mb) vortex in a convergence line feeder band or asymptote to the vortex, which was itself often free of intense convection. An example is shown in Fig. 2. In a second distinct group, the intense convection seemed to be associated with a vortex itself. The strongest vortices were seen in phase III, and in some cases the vortex appeared to intensify with the convection - clearly a strong hint of CISK. An example is shown in Fig. 3.

In the third group, the intense convection occurred in a convergence line which was apparently not associated with a vortex. Somewhat fewer of these were studied by aircraft missions, and they seemed less common. Table 3.5 presents a preliminary categorization of most of the disturbed aircraft missions into one of these three groups.

Table 3.5

GROUP	TYPE	MISSION NUMBER	CASES
1	SW Asymptote to low level vortex	194, 195, 209, 210, 217, 225, 252	7
2	Associated with vortex	196, 215, 220, 222, 245, 248, 256 260	8
3	Convergence line only	179, 251, 255 (More complex)	3



5 AUGUST 1974
217 12Z

Figure 2.

Example of convective convergence band southwest of a low level vortex: aircraft mission 217/1. Heavy lines are surface streamlines; shaded areas are radar echoes seen from QUADRA's radar; thin lines are high level clouds seen by SMS. Large dots marked ship positions, and the straight line(s) the approximate aircraft pattern location.

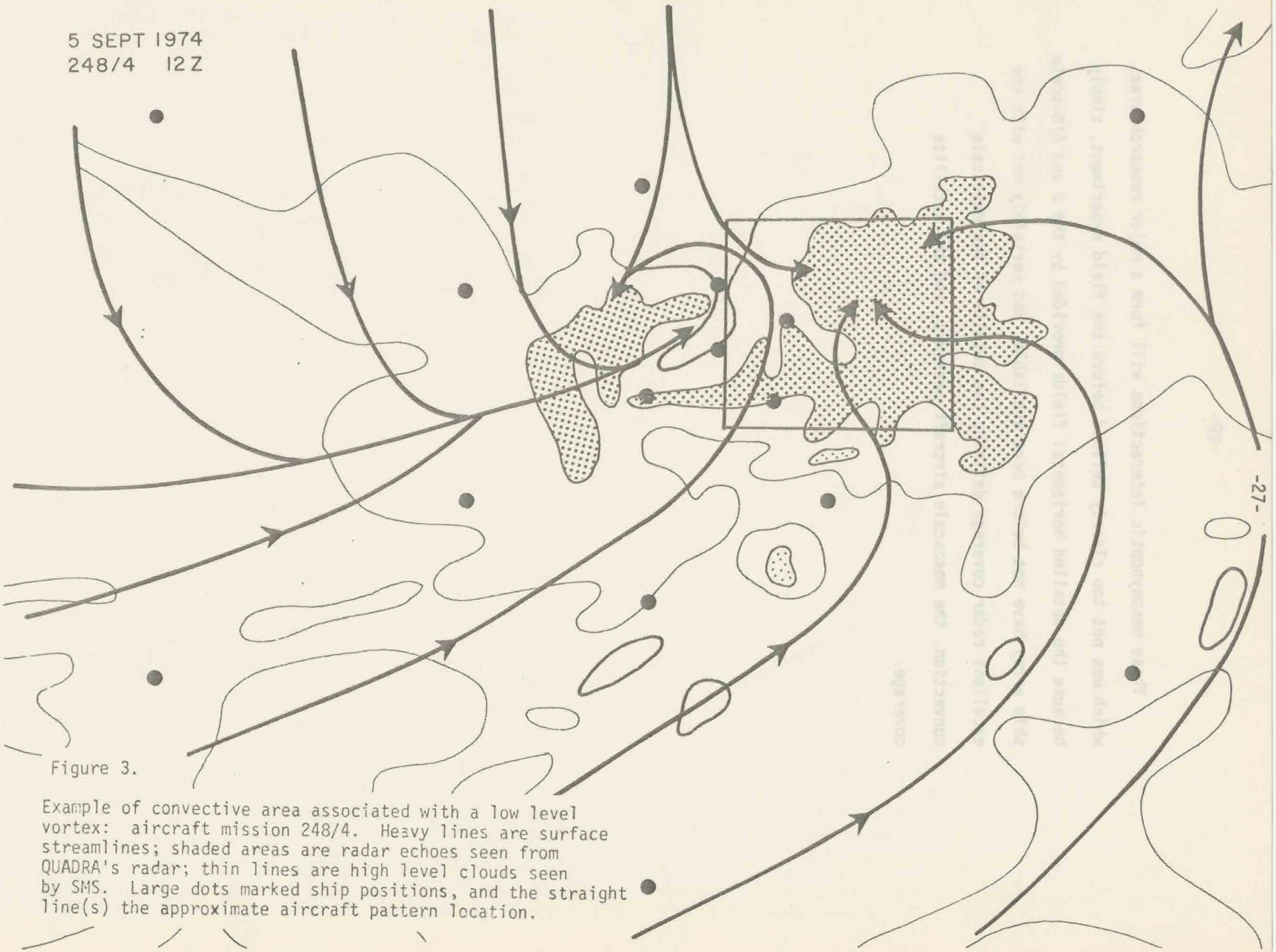


Figure 3.

Example of convective area associated with a low level vortex: aircraft mission 248/4. Heavy lines are surface streamlines; shaded areas are radar echoes seen from QUADRA's radar; thin lines are high level clouds seen by SMS. Large dots marked ship positions, and the straight line(s) the approximate aircraft pattern location.

These mesosynoptic interactions will form a major research area, which was not too clearly defined before the field experiment, simply because the detailed horizontal fields provided by the B and A/B-scale ship array have not before been available, and certainly not with the excellent radar coverage defining the details of the mesoscale convection, the mesoscale aircraft patterns, and the satellite coverage.

3.3 Satellite Program

3.3.1 SMS Satellite

The SMS satellite began operational coverage (½ hourly pictures) of the GATE area on the 27 June (one day before phase I started). Annex 2 gives a preliminary catalog of the SMS data acquired on magnetic tape at the National Environmental Satellite Service (NESS) in the U.S.A. The normal satellite maintenance times were 0130Z, 0430Z: there is also a period in phase III (Sept. 2-19) when the satellite imager was turned off from 0200-0430Z because of interference due to a lunar eclipse. Apart from these times, there are relatively few pictures missing during the three observational periods. The coverage during the between phase periods is less complete.

Routinely, pictures were taken half-hourly. In the infrared, throughout the 24 hour day, of the full earth's disk; and in the visible from about 0800-1900Z in two sectors, a small sector with ½ mile resolution covering the A/B-scale array, and a larger sector with a two mile resolution. From the 4-25 July, a sector with one mile rather than ½ mile resolution was taken (to reduce the effect of satellite motions). The approximate areas covered by those sectors are shown in Fig. 4.

High frequency images (every 15 minutes) were taken on five days in phase III (2, 10, 14, 17, 18 September), and also for the hour 1200-1300 Z from 12-20 September. For these periods, the image of the earth's disc extends only to 20^{o}S because of the reduced imaging time.

Overall, the SMS program was extremely successful.

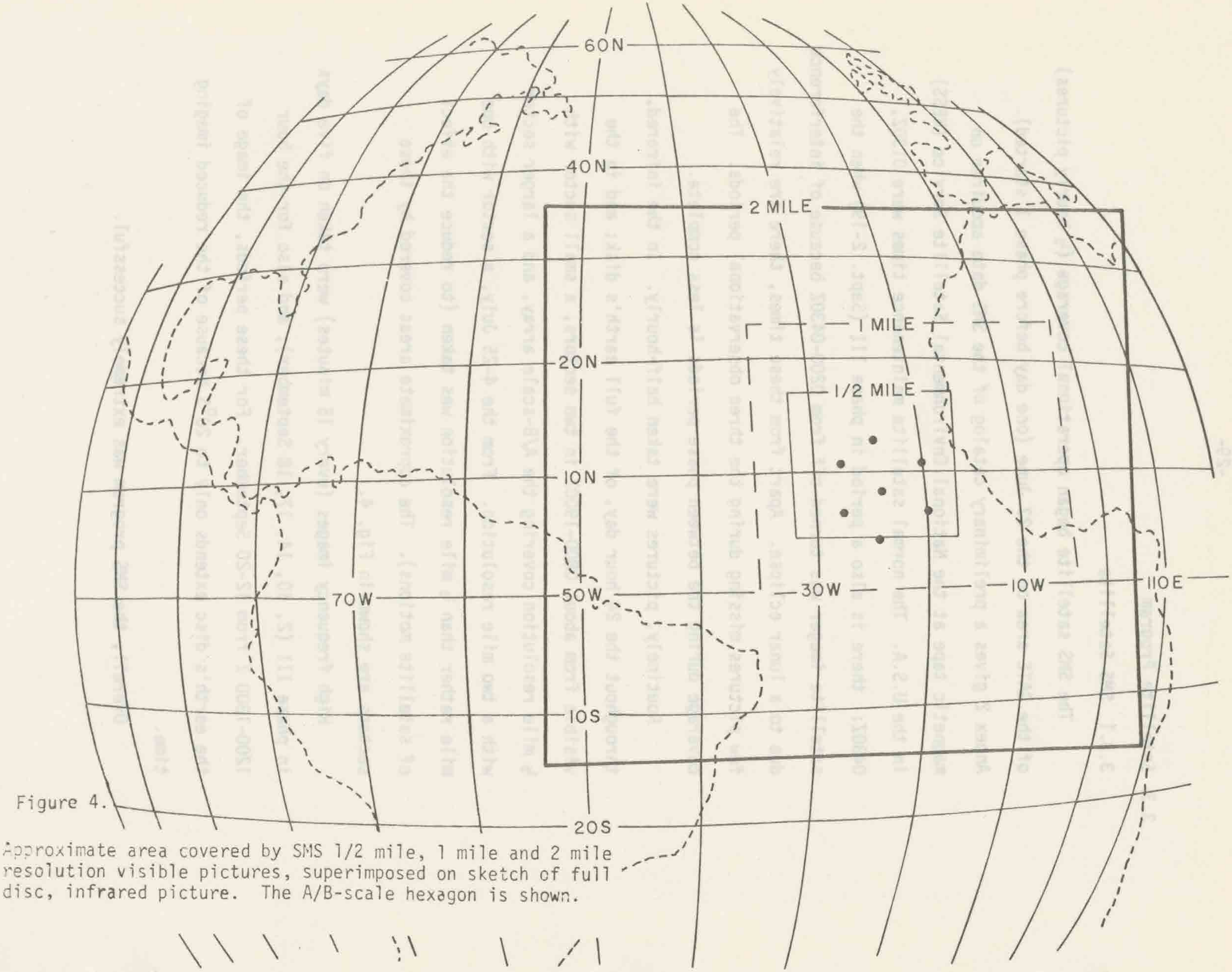


Figure 4. Approximate area covered by SMS 1/2 mile, 1 mile and 2 mile resolution visible pictures, superimposed on sketch of full disc, infrared picture. The A/B-scale hexagon is shown.

3.3.2 Other Satellites

Detailed information on the polar orbiting satellites will not be included in this report.

4. Special Analysis Group

The purpose of the Special Analysis Group of the Convection Subprogram was to perform preliminary scientific analysis in order to:

i) assess the mission objectives

ii) assess overall progress of the experiment

iii) aid the transition from the field phase to the later period of analysis and data management.

The priority of the work that was done changed as the experiment progressed. During the first phase, the emphasis was on the comparison of upper air soundings taken by different systems (Radar, omega and VLF). In addition, many projects were started on a trial basis to test their usefulness in the preliminary interpretation of the data.

During the second phase after the routine work has been established, there was a greater opportunity to explore the data fields from different viewpoints. For example, a series of meridional and zonal cross sections were constructed which reflected the influence of the synoptic-scale disturbances on convection in the B-area.

Finally, during the third phase, the work was restricted by the small number of persons available for the analysis work. Consequently, the only "products" which are available throughout all three phases are the streamline/nephanalysis maps of the B-area, the aircraft mission summary and most of the Convection Summary (cloud cover, vertical motion and radar reports).

Many separate scientists* contributed to the analysis effort. Some were present throughout the entire experiment and dedicated to the

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* The work of David Martin, Wayne Schubert and the UCAR students: Robert Scott, Frank Marks, Hyo-Duck Chang, Sharon Nicholson, Russell Schwanz, Tom Heddinhaus and Nancy Chen are gratefully acknowledged. The analysis group also received the advice and support of many scientists in the GOCC: in particular, Richard Reed, Alan Betts and George Dugdale.

Special Analysis effort, while other entirely independent scientists contributed their time and effort for much shorter periods of time.

4.1 Projects and Results

4.1.1 Streamline maps of the B-area

Streamline maps of the B-area (within the outer hexagon) have been analyzed for selected periods during each phase when the aircraft were conducting intensive observations within the array.

These stream fields are drawn at the surface, 850 mb, 700 mb and 200 mb. The data set consists of the upper-air observations of the ship network, the aircraft flight-level data and the aircraft dropsonde data. In addition, a composite nephanalysis is made of the satellite cloud fields and of the radar echoes from the QUADRA radar, supplemented by information from the GILLIS and OCEANOGRAPHER radars. The map series is available on microfilm as part of the "Quick-Look" data set prepared by the ISMG.

The integration of the combined data source was quite successful in defining mesoscale features within the area of the B-analysis. Small-scale vortices and shear-lines of the horizontal wind were analyzed which were compatible with the observations of radar, satellite, aircraft flight-level observations and upper air soundings from ships and aircraft.

However, these analyses are based on unvalidated and uncorrected data. Also, it is somewhat disappointing that operational constraints did not permit an analysis which was fully consistent with the synoptic-scale maps. Therefore, revisions are to be expected as more accurate and complete data become available.

4.1.2 Mission Summary

A Mission Summary has been prepared for each aircraft flight during the experiment. The Subprogram Scientists and Data Management Group prepared similar aids to assess the missions.

The purpose of this summary was to briefly document the many varieties of missions which were flown to aid a preliminary assessment of the aircraft program. For each mission, the summary identifies the aircraft, their flight times and altitudes and their scientists who conducted the mission. A sketch of the flight track was also provided and a preliminary judgement of the accomplishments of the mission. The success of the mission was judged on the basis of mission type as compared to the observed weather conditions, status of the airborne instrumentation and the subjective opinion of the Mission Scientist and airborne scientists who participated in the flight.

A brief summary of the accomplishments of the aircraft program for the Convection Subprogram has already been given in an earlier chapter.

4.1.3 Convection Summary

A Convection Summary or time-series of convective parameters within the B-area was made throughout each phase. This summary was made in an effort to simplify the sequency of events within the B and A/B network and to provide a view of the entire phase. Most of this summary is available on microfilm as part of the "Quick-Look" data set.

During the experiment, there were many special demands upon the time and personnel available for the task, so the summaries for each phase do not contain identical material. In general, they consist of:

i) Cloud cover over the A/B network as estimated from densitometer measurements of the SMS infrared photographs.

The analysis was performed by A. Gruber and W. Replane and transmitted to Dakar. The extremes in brightness were normalized each day and the fraction of brightest (coldest) clouds were estimated as well as the total cloud cover. (Because of the difficulty in distinguishing the stratocumulus layer from the sea surface, the total cloud-cover may be under-estimated.)

ii) Convective codes and accumulated precipitation as observed from selected ships in the B-area. The convective codes are those developed by Garstang and Aspliden (1974):

1. extremely suppressed
2. moderate-slightly depressed
3. weakly enhanced
4. moderately enhanced
5. strongly enhanced

The series of convective codes is not very continuous due to teletype transmission difficulties. However, the precipitation is useful as a positive indicator of convective activity at a station. Both quantities are "local" measurements as opposed to "regional" observations of other parameters.

iii) Convective codes as estimated from satellite pictures within the B-array using categories devised by Martin (following Garstang and Aspliden): (See Fig. 1.)

Class 1 - clear to scattered small clouds; low-moderate brightness in the visible; low brightness in IR.

Class 2 - scattered to broken small clouds and cloud patches; low-moderate brightness in the visible; low brightness in the IR.

Class 3 - scattered small to medium-sized clouds; sharply defined without cirrus; moderate-high brightness in the visible; low to moderate brightness in the visible; low to moderate brightness in the IR.

Class 3D- (dissipating) medium-sized clouds; solid or mottled pattern; medium brightness in visible; medium-high brightness in the IR.

Class 4 - medium to large cells in groups; bright centers, cloud debris and partial cirrus canopy in visible; bright centers with moderate background in IR.

Class 5 - solid, very bright cloud mass in IR and visible; turrets visible.

iv) The height and areal coverage of the radar echo return from the QUADRA radar as transmitted to the GOCC, Dakar. These observations complement the observations of the cloud fraction within the B-area and do not confuse convective clouds with their products (e.g., cirrus). However, the radar range is approximately 150 miles from the ship (position 3); consequently, the aerial coverage of the satellite and radar observations are not precisely the same.

In addition, two time-series of status of the operational systems are included:

i) the approximate period of time in which the aircraft were operating in a measurement program. The mission number is given above each indicator (the first three digits are the Julian day); below the bar-line, the number of the mission objective or type is shown.

ii) the periods of intensive observations on the ship of the B-network. During these periods, upper air soundings were taken eight times per day.

4.2 Special Studies

Special studies of a variable nature were conducted as the need and opportunity arose.

4.2.1 Time-Height Cross-Sections

Time-height cross-sections of vertical motion and vorticity were observed from the largest triangles of the A-B array. Computations were made at least twice each day from data transmitted by teletype using the preliminary triangle (ship positions 8, 10, 12). When these data were insufficient or missing, the alternate triangle was used (positions 9, 11, 13). The vertical motion is obtained from the mass continuity equation by integrating the velocity divergence upwards from the surface where the vertical motion $\frac{dp}{dt}$ is assumed to be zero.

During the first phase, the computations were made as part of an effort to assess the error in the upper air wind soundings and no correction for mass imbalance was applied to the individual computations. Consequently, a measure of accumulated error in the wind profiles can be estimated from the value of vertical motion near 100 mb on these time-sections. Where several of the profiles are averaged, however, the mass balance occurs naturally.

In the analysis of the second and third phases (the latter is incomplete) a linear correction to the divergence has been applied to invividual computations to enforce mass balance below 100 mb. Under some circumstances, this procedure may artificially concentrate the convergence into the lowest atmospheric layers.

The results of this study indicate that the A/B upper-network using radar-tracked balloon winds was successful in determining the mass budget at least on a composite basis. Although at times the errors were large, there is a great deal of consistency between sequential computations which gives additional credence to the measurements. Both the magnitude and vertical structure of the vertical velocity were in general agreement with earlier results. In addition, these computations indicate good (but as yet undetermined) correlation with other parameters of convection.

The computation of vorticity indicates a layered structure of the tropical atmosphere near the active ITCZ. The nature of the interaction between the cumulus and synoptic-scale vorticity fields is not entirely clear without further analysis, especially since the vertical structure of the divergence does not appear to be the same.

4.2.2 Composite Mass-Budgets

Composite mass-budgets for selected periods (Phase I and II only). Some attempt was made to construct a composite mass budget for disturbed and undisturbed cases separately based upon a very limited sample taken during each of the first two phases.

The results (Rodenhuis and Chang, 1975) for sections of the inner B-scale hexagon, (excluding the center ship) were constructed from two days of observations covering a period of intense convective activity. Since the upper-wind measurements were made primarily with Omega or VLF* devices rather than radar, these calculations represented an important test of the capability of the wind finding devices within the B-network.

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* Very low frequency signals used for global navigation.

The results were consistent with the synoptic changes occurring in the region and reasonable values were obtained from the vertical motion (-13 mb/hr at 800 mb decreasing to zero and oscillatory fashion above 500 mb). The composite vorticity showed a layered structure about 200 mb thick with a magnitude of about +2x 10^{-5} sec^{-1} in the layer below 300 mb; the only negative values occurred near 200 mb, although the "outflow layer" is much lower than that.

Using the outer hexagon network of A/B ships, Schubert and Reed (1975) computed composite vertical motion profiles during the second phase. Similar studies on the same scale were independently computed throughout the experiment by Petrossiants, (1975). For the larger area of the A/B network, the results compared favorably with earlier results from the Pacific, although the convergence in the lowest layers may be interpreted as relatively more important during the GATE experiment.

The attempts which were made to selectively composite the mass-budgets from the smallest triangles of the B-array (e.g., ship positions 1, 2, 3) were not very successful. Not only are the errors of measurement relatively more important, but the determination of the convective state is very difficult when the size of the area is nearly that of the cumulus structures which generate the motion.

4.2.3 Meridional Cross-Sections (Phase II only).

The section was constructed at 23½^{o} W longitude, from the island of Sal (at 16^{o}N) to the Kurchatov (at 0^{o} latitude).

The zonal wind and equivalent potential temperature at 12Z were plotted for each day at the standard levels and analyzed. At the conclusion of the phase, the 19-day average of these variables was calculated and analyzed on a set of separate cross sections.

The sections show the easterly component of the trade-winds at low levels, and increasing with height to the level of the tropical easterly jet. To the south, the southerly flow of the monsoon circulation at low levels develops a col of weak easterly winds along the confluence zone.

The equivalent potential temperature was analyzed in a similar fashion. The general, broad maximum in the region of the ITCZ is apparent even in the average analysis. Presumably, this increase is primarily due to the increase in moisture which is pumped into the high troposphere by cumulus convection.

In addition to these two analyses constructed from data at standard levels, cross-sections of dew-point depression and temperature were constructed to locate and monitor the low-level trade inversion. (This work was done by A. Behlau and S. Nicholson in a joint project between the BLSP and the CSP). The analyses were completed daily for 12Z data and summarized by constructing the average inversion for the entire period. (Nicholson, 1975a)

The average results show the presence of two distinct inversions which may both be identified simultaneously on many individual cross-sections. These features have been noted previously by the scientists of the USSR in the TROPEX-72 expedition (private communication).

Since all the results presented above are restricted to a single phase, interphase comparisons cannot be made. Much of their value is thereby lost, but these results generally confirm the wind, temperature and moisture structure which are usually present in the GATE area. (Sadler, 1974; GATE Report No. 1, 1972; Madden, Zipser and Sapp, 1974; Gray and Oort, 1974).

4.2.4 Time-Height Sections

Time-height sections of wind, temperature and dew-point depression were plotted from the upper air sounding every 12 hours in the B-array during the first two phases. (Phase 1: VIZE, position 2 and OCEANOGRAPHER/ VANGUARD, position 1. Phase 2: QUADRA, position 3) In addition, the meteorological conditions at the surface are also plotted.

The intended use of these sections was for monitoring the passage of synoptic features and the changes in large-scale flow regimes in the B-area. However, the sections were not routinely analyzed because of the limitation of time and because other products were more useful for this purpose. The time sections appear in the microfilm "Quick-Look" data set.

4.2.5 Zonal Sections of Meridional Wind

The east-west section was taken at approximately 10^{o}N, at the northern boundary of the inner hexagon of the B-array. It extends from the coast of Africa to about $32\frac{1}{2}^{o}$ W (the VOLNA). The meridional components of the winds of 850 and 700 mb were plotted and analyzed for the first two phases only.

The wind components are a very reliable indicator of the passage of synoptic waves, sub-synoptic vortices and a general shift in flow regimes at a station as the ITCZ dissolved and reformed at a new location. The phase lines of meridional wind could be associated almost 1:1 with the meteorological features of the satellite pictures and synoptic maps.

The wind shifts occurred persistently during the first two phases, with a period which ranged between two and five days. As far as these observations are concerned, there is a great deal of coherence between the shifts at 850 and 700 mb. Furthermore, there does not appear to be significant differences in the aspect of the wind variation between phases. (During almost the entire two phases, the ITCZ position as determined from SMS photographs lay south of $10^{O}N$.)

4.2.6 The ITCZ Position

The mean position of the ITCZ was estimated subjectively on a daily basis for each of the phases. Only the SMS infrared photographs were used to determine its existence and intensity. While this method has many drawbacks, it provides some indication of the movement between phases (see Nicholson, 1975b, especially with regards to the sea surface temperatures and the ITCZ position).

4.2.7 Census of Convective Clouds

During all three phases, a record was kept of the location, intensity and history of identifiable convective systems. A study was made of their lifetime and size (Martin, 1975). The individual tracks are also available on the microfilm "Quick-Look" data set.

In general terms, the clusters track from continental Africa SW across the B-array. The intensity generally increased throughout the experiment, and the mean position of the tracks progressed steadily northward. The lifetime of the clusters was proportional to their areal size. However, individual systems have a wide variety of lifetimes, intensities and especially tracks.

4.2.8 Radar Reports

This project contributed directly to the operational control of the experiment. In addition, the echo coverage and intensity was calculated and recorded in a time series. These results have been discussed already in an earlier section.

Furthermore, Marks (1975) has discussed the diurnal and semi-diurnal variaticn of radar echoes. He concludes that there is a maximum frequency in precipitation during both early morning hours (00-06Z) and in the afternoon (12-18Z).

4.2.9 Assessment of Upper Air Soundings

During the first two phases, an intensive program of intercomparison was accomplished. Although the primary concern was the wind determination by the VLF or Omega-methods, a few temperature/humidity intercomparisons were assessed.

Detailed reports are available on this subject by Mussa and Reiff, 1975 and Rodenhuis and Acheson, 1975.

The quality of upper air reports produced operationally improved steadily throughout the experiment. In a test study of one week's duration in the B-area, the winds were satisfactory for the purpose of synoptic analysis about 90% of the time. However, approximately 30% of the soundings were not available or did not extend to 200 mb.

Likewise, there were some attempts to compute the composite mass budget for short selected periods during the experiment. (Rodenhuis and Chang; 1974, Schubert and Reed; 1974) These studies have shown that it is possible to obtain consistent results with the VLF wind measurements, but that it is much more difficult than obtaining the mass budget with radar-winds.

A complete assessment of the quality of the upper-wind measurements by VLF/Omega systems cannot be made until the "post-processing" of the data tapes is complete. This process involves a complex analysis which rejects spurious data points and smooths the resulting high-frequency observations into a final result.

From the experience that has been gained applying this method to a limited set GATE data, it is clear that 1) realistic soundings may be obtained from data that appeared useless in its original form, but 2) probably less than half of the soundings will be able to be processed in a routine, automatic fashion. It is not yet possible to predict what fraction of the soundings will be irretrievably lost, nor to what extent the time/space interpolation will be able to make up this deficiency.

4.3 Data Availability

Early reports on the analysis and computational work which were accomplished during the field phase are available in a report of the ISMG/WMO (1975). Furthermore, some national organizations have established "newsletters" where early preliminary results may be published. As the work of the Subprogram Data Centers develops, reports on the progress and problems of the data processing are expected at irregular intervals.

The "Quick-Look" data set on microfilm has been prepared by the ISMG and distributed to participating countries. Some of the analysis products discussed in this report are also available on the microfilm series in a more complete form.

The analysis and data processing of the National Processing Centers are gradually becoming available and should be completed by March, 1975. Subsequent processing and assimilation of national data into our international data set will be completed in the following 18 months (by September, 1976). It will be available to the scientific community from the two World Data Centers (Moscow and Washington, D. C.).

A complete discussion of the data management agreements is available in the International Data Management Plan (de la Moriniere, 1974).

During this period of data processing, some of the raw data and the preliminary data sets that become available will be sent to the GATE Archives directly where they may be obtained for scientific analysis.

5. Preliminary Assessment

The observations planned to support the Convection Subprogramme were for the most part accomplished; although assessment of data quality must await national validation of the data.

The SMS satellite and ship weather radars functioned well, and the aircraft program was successful in sampling a wide range of convective systems at different stages of their lifecycle. As mentioned in the introduction, the NAVAID wind finding systems on many B-scale and A-scale ships, which were new systems developed for GATE, did not work as well as the well-proven radar wind-finding systems. Some improvement in data quality is expected from post-processing, but the quality of budget studies of convective transports using the B-scale ship data may be adversely affected. Additionally, the A-scale network was much reduced in Phases I and II (see Synoptic-scale Subprogramme Report), so the data base for the study of A:B scale interactions will not be as extensive as was planned.

Convection in the B-array appeared to develop in preferred locations near wave troughs or cyclonic vortices in the 700 or 850 mb synoptic-scale wind fields, and the B and A/B-scale wind fields were clearly adequate to define small subsynoptic-scale vortices which usually occurred or developed in association with the convection. The radars showed that the precipitating convection had distinct mesoscale structure, often in the form of bands oriented E-W or NE-SW. The aircraft program sampled a large number of these mesoscale structures. The convective systems and associated low level vortices were generally more intense in Phase III than Phase I; low level convergence was observed through a deeper layer (to at least 850 mb), top heights were greater (above 45,000 feet) and aircraft reported higher levels of turbulance on penetrating convective cores.

An overall assessment is difficult at this stage, but it seems that enough of the observational objectives were met to provide the data needed for the studies of convection and convective interactions over the eastern tropical Atlantic, which are themselves an essential step toward the improved parameterization of tropical convection. Considering the complexity of the experiment and its objectives, our preliminary assessment is that it was a remarkable success.

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ANNEX 1: CSP AIRCRAFT MISSIONS

PHASE I

28 June 179/2 Type 1A   MS Zipser
AMS Betts

Pattern: Large box around ships 3, 4, 6 and 7 (1130-1630Z)

Altitudes:	DC-6	L-188	UKC-130	DC-7	USC-130	1ℓ18C	CV-990	
	.5	1.5	5	10	16	23	35	K feet

Weather: A strong convergence band developed SW to NE across the B-array, containing several mesoscale bands. Preliminary analysis (Reed) shows strong low level convergence and upper level divergence, as well as surface squalls behind mesoscale lines. Only one box was flown at two lowest levels.

1 July 182/1B Type 8B   MS Holland
AMS Borovikov

Pattern & Weather: Line penetrations by the 1ℓ18C from 10-25 K feet, near Meteor (#4) through cumulonimbus (1300-1530Z)

3 July 184/2 Type 2   MS Cox
AMS Holland

Pattern: Line section SW out of Dakar through ITCZ to 0^{O}N (1200-1800Z)

Altitudes:	DC-6	L-188	UKC-130	DC-7	CV-990	
	.5	1.5	5, .5	10, 1.5	25, 35	K feet

Weather: A useful cross-section was obtained (at an angle) through an ITCZ showing only moderate activity. Some boundary layer structure near the equator should be obtained.

5 July 186/3 Type 1D   MS Betts
AMS Zipser

Pattern: Butterfly in NE of B-array (1200-1600Z)

Altitudes:	L-188	UKC-130	DC-7	1ℓ18C	
	.3	.9, 1.2	4	10, 7, 5	K feet

Weather: A budget type pattern was flown on a band of convective clouds with tops up to 10000'. A weak low level convergence was noticed. Mission will fulfill some 5A/5B objectives. Conditions in the B-array were generallv suppressed.

9 July 190/1 Type (5A) MS Borovikov
AMS Weickman

Pattern: A quadrilateral in the B-array: Mission planned as 1A but flown in suppressed weather.

Altitudes:	UKC-130	L-188	DC-7	1ℓ18C	1ℓ18M	CV-990	
	.5	1.5	10	15	21	35	K feet

10 July 191/1 Type 2 MS Betts
AMS Zipser

Pattern: Open box pattern through ITCZ to 0^{O}N (1230-1630Z)

Altitudes:	L-188	UKC-130	DC-7	1ℓ-18M	CV-990	
	.5	1.3	4	15	20, 30	K feet

Weather: Pattern was flown through an ITCZ which was probably past the mature stage, with much stratiform cloud and rain. Good low level profiles were obtained on the equatorial side of the band. The CV-990 flew two box patterns at outflow levels.

13 July 194/1 Type 1C2 MS Rasmussen
AMS Betts

Pattern: Line section from 7^{O}25'N to 10^{O}N on 21^{O}50'W, just east of Quadra and Meteor (1400-1700Z)

Altitudes:	L-188	UKC-130	DC-7	1ℓ-18C	CV-990	
	.5	1.3	6, 4	22, 14, 23	25, 35, 41	K feet

Weather: Repeated line sections were made through a growing "cluster" forming in a feeder band to a vortex NE of the B-array. Data should complement B-array. Some stacked gust-probe data. No winds from 1ℓ-18C, and INS problems reported by L-188 - its wind data could be affected.

<u>14 July 195/1 Type 1A</u> MS Kuettner
AMS Cox

Pattern: Butterfly between Quadra and Meteor (1430-1730Z)

Altitudes:	UKC-130	USC-130	1ℓ-18M	CV-990	
	.5, 1.2	5, 10	16	25, 15	K feet

Weather: An active mesoscale system in a convergence line of a vortex NE of the B-array was studied. The system was initially growing but then started to decay. A successful mission, although the 1ℓ-18M had to leave early with instrument problems.

<u>14 July 195/2 Type 8B2</u> AMS Melnichuk

Pattern &
Weather: Cloud penetrations were flown (1400-1600Z) by the 1ℓ-18C at a series of levels near ships 9 and 10.

<u>15 July 196/1 Type 4</u> MS Betts
AMS Zipser

Pattern: Butterflies near 12°30'N 19°W off Senegal coast SW of Dakar (1100-1600Z)

Altitudes:	L-188	DC-7	1ℓ-18C	USC-130	
	.5	5	10, 15	20 (plus dropsonde)	K feet

Weather: A small tropical depression formed off the coast with distinct low level and upper level circulations. Triangle and butterfly patterns were flown near the low level centre by the lower three aircraft and the USC-130 boxed the system at 20000' releasing dropwind sondes. Heavy precipitation in bands was observed and marked wind shifts, which changed very rapidly. The system dissipated the following night.

<u>16 July 197/1 Type 1D</u> MS Rasmussen
AMS Cox

Pattern: Butterfly pattern at 12°N, just east of ship 8 (1000-1300Z)

Altitudes:	UKC-130	L-188	DC-7	USC-130	
	.5, 1.5	5	10	15	K feet

Weather: A persistent band of congestus (tops ~ 15000') was studied. Individual clouds were transient, but the band persisted along a surface convergence line. Some ring-like structure was observed. Conditions in the B-array were generally suppressed.

16 July 197/2 Type 8B2 AMS Shur

Pattern & Weather: The 1ℓ-18C sampled convective clouds, code 2 or 3 near ship 9.

PHASE II

28 July 209/1 Type 1A/3 MS Kraus/James
AMS Zipser

Pattern: Butterfly south of Quadra (1100-1600Z)

Altitudes:	DC-6	UKC-130	DC-7	1ℓ-18C	CV-990	
	.5	1.3	5, 10	15, 20	25, 35	K feet

Weather: Flew mature and decaying E-W feeder band to vortex NE of B-array. Good documentation of post-cluster collapse: inflow changing to outflow band to North of pattern was intensifying. Vortex cross-section on ferry flights.

29 July 210/1 Type 1A MS Alt
AMS Cox

Pattern: Butterfly north of Oceanographer (1300-1600Z)

Altitudes:	DC-6	UKC-130	1ℓ-18M	CV-990	
	.5	1.2, 5.0	10	15, 25	K feet

Weather: A moderate band of convection just SW of a small low level vortex was flown. The pattern time was shortened by the loss of the weather radar on the CV-990 - the pattern was fixed by using Oceanographer's radar.

31 July 212/2 Type 8B2 MS James
AMS Borovikov

Pattern
& Weather: Single aircraft penetrations of cumulonimbus (1200-1500Z) by Iℓ-18C near 9^{o}N 21^{o}W, from 2000-20000'. Good cloud physics sampling but no wind data

2 August 214/1 Type 8B1 MS Borovikov
AMS Mazin

Pattern: Coordinated penetrations of cumulus congestus near 8^{o}40'N 21^{o}40'W, and 8^{o}25'N 22^{o}30'W (1100-1400Z)

Altitudes:	USC-130	Iℓ-18C	
	5, 10, 12, 14	16, 18, 19, 20	K feet

Weather: Convective code 3. Successful cloud physics sampling within range of Quadra's radar. No wind data on Iℓ-18C.

3 August 215/1 Type 1C2 MS Hoeber
AMS Zipser

Pattern: NS lines between Dallas and Researcher (1130-1430Z)

Altitudes:	L-188	UKC-130	DC-6	DC-7	
	.5	1.3	5	10	K feet

Weather: Aircraft studied the boundary layer structure of bands in a confluence line near Researcher. The three gust-probes were stacked for several legs and the mission meets many 5B2 objectives. Bands on SW side of weak 850 mb vortex, or alternatively regard as northern edge of ITCZ. DC-7 lost INS and radar (still Doppler winds). A very interesting study of C/D-scale boundary layer structure and transports. Tethered balloon support from ships 1, 5 and 6.

4 August 216/1 Type 2   MS Betts
AMS LaSeur

Pattern: NS section through ITCZ to 0^{o}N and 2^{o}S on $20^{o}30$'W. Dropsonde support on 18^{o}W.

Altitudes:	UKC-130	L-188	DC-7	USC-130	1ℓ-18C	CV-990	
	.5, 1.3	1.3	4, 12	8	18	20,25,31	K feet

Weather: Main ITCZ band lay from 9^{o}N to $6^{o}30$'N and was more active on the return leg than on the way south. Very interesting wind shifts. DC-7 to 2^{o}S and low level dropsondes on return, USC-130 and UKC-130 to 0^{o}N. Omega dropsondes on 18^{o}W just East of ITCZ band. 1ℓ-18C no winds but cloud physics data. Three low level aircraft stacked for much of southbound leg.

5 August 217/1 Type 1C2   MS James
AMS Cox

Pattern: Line pattern through convective band between ships 1, 3 and 4 (1200-1630Z).

Altitudes:	DC-6	USC-130	1ℓ-18C	CV-990	
	.3,.85,2	5,10,15	16,19	25,29,33,39,41	K feet

Weather: The line pattern crossed a SW-NE convergence line, which seemed to be a feeder band to a vortex NE of the B-array. The convective line grew in height during the pattern from 25 to 40 K feet. The mission was flown to provide C/D-scale structure, boundary layer data (balloons up on ships 1, 3 and 4) and radiation data. Additionally, the DC-6, USC-130 and CV-990 flew along the line at the end of the mission for cloud physics, dynamics and radiative sampling.

8 August 220/2 Type 1A   MS Emmanuel
AMS Zipser

Pattern: Butterfly NW of Oceanographer (1300-1800Z)

Altitudes:	UKC-130	DC-6	DC-7	1ℓ-18C	USC-130	CV-990	
	.5	4	10	18, 16	18	30,31,35,37	K feet

Weather: Pattern in decaying convection on SE side of weak 850 mb vortex. Convection relatively weak.

9 August 221/4 Type 8B1 MS LaSeur
AMS Zhvalev

Pattern
& Weather: Study of cloud physics and radiative properties of middle clouds near 20^{O}W by 1ℓ-18C and 1ℓ-18M. Instrument problems and both aircraft landed at Conakry.

10 August 222/1 Type 1A MS Betts
AMS Pennell

Pattern: Butterfly between Dallas and Gilliss (1115-1630Z)

Altitudes:	DC-6	UKC-130	DC-7	USC-130	CV-990	Sabreliner
	.5	2, 4	10	20,16,23	29,30,35	39, 41 K feet

Weather: Mission flown to east side of low level vortex which developed over Oceanographer and moved rapidly west at 20 kts - later becoming tropical storm Alma. Very active system but aircraft probably did not reach main activity. Dropsonde support to north and west of B-array. Mission will fulfill some post-cluster recovery objectives.

11 August 223/1 Type 2B MS Grossman
AMS Emmanuel

Pattern: NS line pattern on 20^{O}W from 4^{O}N to 8^{O}N (1130-1600Z)

Altitudes:	DC-6	UKC-130	USC-130	DC-7	1ℓ-18C	CV-990	
	.5	1, 1.5	5	10	18	25,30,35,39	K feet

Weather: Repeated crossings were made of an active ITCZ band, centered 5-7^{O}N. This was the first time the modified 2B mission was flown and it appeared to be very successful (Mission 194/1 was similar in the B-array). The ITCZ flared up even more the following day (12 August) across the S.E. of the B-array.

11 August 223/3 Type 9 AMS Simpson

Pattern
& Weather: The KC-135 flew a dropwindsonde mission to study the vortex (later "Alma") west of the A/B-array. Eight dropwindsondes were released in the area. Thus, (with 222/1) two days of data on the structure of this developing storm was obtained.

13 August 225/1 Type 1A   MS LaSeur
AMS Betts

Pattern: Butterfly between Quadra (#4) and Vanguard (#2) (0745-1230Z)

Altitudes:	DC-6	UKC-130	USC-130	DC-7	1ℓ-18C	CV-990	
	.5	2	5	10, 14	16, 20	33, 37	K feet

Weather: Early morning flight into feeder band on S.W. of vortex moving off coast. Good cross-sections through vortex on ferry. Explosive growth of squall-line around 1200Z as leading edge of vortex reached the convective band. Interesting mission both for budget studies and studies of the interaction between the vortex/squall-line (?) moving off the coast with the convergence band in the C-array.

14 August 226/4 Type 8B1   MS Lemone
AMS Mazin

Pattern: Four patterns through isolated Cb (1245-1630Z) near 10°40'N 22°W

Altitudes:	USC-130	Iℓ-18C	
	12, 1, 6, 18	22,18,14,10,6,8	K feet

Weather: Coordinated cross-sections were flown through selected Cb clouds (tops ∿ 10 km) N.E. of the B-array. A useful microphysical/dynamical study should result.

17 August 229/1 Type 2B   MS Pennell
AMS LaSeur

Pattern: Slim box N.E. of B-array through ITCZ (1100-1500Z)

Altitudes:	L-188	DC-6	DC-7	1ℓ-18C	USC-130	CV-990	
	.5			15	20,25	29,35	K feet

Weather: No satellite data in Dakar, nor much of the ship array, so not much information available on this mission.

PHASE III

30 August 242/1B Type 8B2 MS Rasmussen
AMS Melnichuk

Pattern
& Weather: The 1ℓ-18C flew a series of cloud penetrations from 1000 to 22000' near ship 9 (Poryv). Cloud tops up to 25000' (1410-1810Z)

31 August 243/5B Type 8B2 MS Hoeber
AMS Mazin

Pattern
& Weather: The 1ℓ-18C studied cumulus congestus clouds near ship position 8 (1200-1520Z)

2 September 245/1 Type 1C2 MS Emmanuel
AMS Betts

Pattern: North-South line pattern through C-array, west of Quadra and Dallas (1130-1530Z)

Altitudes:	DC-6	L-188	USC-130	1ℓ-18C	1ℓ-18M	CV-990
	.85,1.3,2	3.2,6	9, 12	15	20	25,31,37 K feet

Weather: Ferry crossed vortex NE of array. Pattern flown in developing EW bands in second vortex forming on eastern edge of B-array. Convection grew steadily, until 1700Z when tops were over 50,000'. A good developing cluster mission, well coordinated with C-array.

5 September 248/4 Type 1A MS Pennell
AMS Cox

Pattern: Box through and to the east of the C-array (1200-1630Z)

Altitudes:	UKC-130	L-188	USC-130	1ℓ-18M	1ℓ-18C	CV-990
	.5	1.5	5	16	25	35, 39 K feet

Weather: A cluster developed just east of the C-array and a budget box was flown around it. Strong low level convergence and upper level divergence was seen, with a low level cyclonic circulation. A second low level cyclonic circulation developed to the west as a second mesosystem intensified, and by 18Z, there was a strong 200 mb outflow anticyclone centered just NW of ship position 1. An excellent cluster budget study. The trough associated with this development and that of the 9th of September (252) seemed to merge in the Western Atlantic to form Hurricane Fifi.

6 September 249/1B Type 8B — MS Lemone; AMS Borovikov

Pattern & Weather: The 1ℓ-18C made a series of penetrations from 8-22000' through a cumulonimbus band south of Oceanographer (position 4)

8 September 251/2 Type 1C2 — MS Gray; AMS Simpson

Pattern: Line north of C-array (1230-1600Z)

Altitudes:

L-188	UKC-130	1ℓ-18C	USC-130	CV-990	
.6	2, 5	22,16,12	24,20,17,10	35,37,39,31	K feet

Weather: A cumulonimbus band oriented SW-NE developed just NE of Quadra in a convergence line. A useful line mission through a growing convection band, until the early dissipation stage.

9 September 252/1A Type 1A — MS Nicholls; AMS Cox

Pattern: Box around C-array (1200-1600Z)

Altitudes:

(DC-6)	UKC-130	L-188	DC-7	USC-130	
.3 (1 line only)	.3, 1.2	12,1.2	5	25, 15	K feet

Weather: A budget box was flown around the C-array on a feeder band into an 850 mb vortex NE of the B-array. The cluster was growing actively and strong divergence was observed at 25,000'. Disturbed weather L patterns were flown by the UKC-130 near the Dallas. This trough seemed to merge with the preceding trough in the W. Atlantic in the formation of hurricane Fifi.

11 September 254/1 Type 8B1 MS Rasmussen
AMS Borovikov

Pattern: Four patterns through cumulonimbus band east of Oceanographer (1200-1530Z)

Altitudes: L-188 1ℓ-18C USC-130
.8, 5 12, 9 24, 18 K feet

Weather: A combined cloud physics and dynamics mission was flown in a developing cumulus band. Tops grew from congestus to cumulonimbus and the system started to decay.

12 September 255/2 Type 1A MS Grossman
AMS Betts

Pattern: Box and L around C-array (1130-1530Z)

Altitudes: UKC-130 L-188 USC-130 CV-990
.5, (10) 1.5 5, 3 35,37,39 K feet

Weather: A squall-line moved off the coast SW during the night and seemed to interact with a convergence line through the C-array. A major SW-NE line system developed, and the squall-line edge moved down it. The aircraft pattern showed convergence at 5000' and below and 40 kt winds behind the squall-line. Two tethered balloons were lost, and the pattern was converted to an inverted L to the east of the C-array. The C-array data should help provide a combined data set for budget calculations.

13 September 256/1 Type 1A MS Borovikov
AMS Nichols

Pattern: Box just east of C-array (1230-1630Z)

Altitudes: UKC-130 1ℓ-18C CV-990
.5, 1.5 10, 18 35,36,37 K feet

Weather: A box was flown with western NW leg through the center of a cluster which has formed in a vortex near the C-array. A useful fixed area mission to complement the C-array.

14 September 257/1 Type 1C2 MS Hoeber
AMS Zipser

Pattern: East-West line through cloud band in C-array (1130-1500/1800Z)

Altitudes:	DC-6	L-188	UKC-130	USC-130	Sabreliner	
	.05,.3,.5,1	2	5, 2, .5	15,17,10	39	K feet

Weather: A north-south band formed on the eastern side of a 700 mb trough. Many cross-sections were flown through a growing band in the C-array throughout its life-cycle. A very useful combined C-scale and aircraft mission. Although Meteor, Hecla and Vize balloons were all down, Dallas was profiling, and the structuresonde and wind-sonde programs were executed.

16 September 259/3 Type 2B MS Lemone
AMS Betts

Pattern: Large box in S.E. of B-array through southern edge of ITCZ band (1430-1830Z)

Altitudes: UKC-130 DC-7 1ℓ-18C CV-990

Weather: A persistent ITCZ band formed through the B-array with a southern edge which moved south from 7°N to 6°N during the day. The pattern penetrated this edge which was marked by an active band of cumulonimbus. Useful intercomparison data with the B/C-scale ship tethered balloons which were operating in a fixed level mode should be obtained.

17 September 260/1 Type 7A2/1A MS Vasiliev
AMS Cox

Pattern: Box and horizontal snake north from Quadra (1100-1500Z)

Altitudes:	DC-6	DC-7	L-188	1ℓ-18C	USC-130	CV-990	
	.5	5	10	16	25	35, 37	K feet

Weather: A disturbed area was flown on the east side of a low-level vortex. The pattern was designed primarily to measure radiative divergence, but should provide useful convection data - an exact stack of aircraft was maintained at the center of each E-W leg.

18 September 261/1 Type 1D MS Grossman
AMS Simpson

Pattern: Box north-east of C-array (1300-1730Z)

Altitudes:	UKC-130	L-188	DC-6	USC-130	Sabreliner	
	.1, .8	1.8	3.5	20,17.6	39	K feet

Weather: Some convection developed N.E. of the B-array on a day when conditions were relatively suppressed, and the development moved into the box pattern. A valuable mission, well-coordinated with the C-array. Convection reached code 3.

19 September 262/1 Type 1A MS Kuettner
AMS Zipser

Pattern: Box around Quadra (1030-1430Z)

Altitudes:	UKC-130	DC-7	1ℓ-18C	
	.5, 2	4, 7	14	K feet

Weather: Cumulonimbus convection (code 4) developed in pattern near Quadra: a disturbed day: only part of network left.

ANNEX 2. SMS Satellite Coverage of GATE Area

The standard mode of operation of the SMS satellite during the three observational phases of GATE was one full disk image every thirty minutes. Full disc IR (infrared) images were generally taken throughout the 24-hour period, and visible sectors from 0700Z to 1930Z, except for satellite maintenance times. Coverage between the phases is less complete.

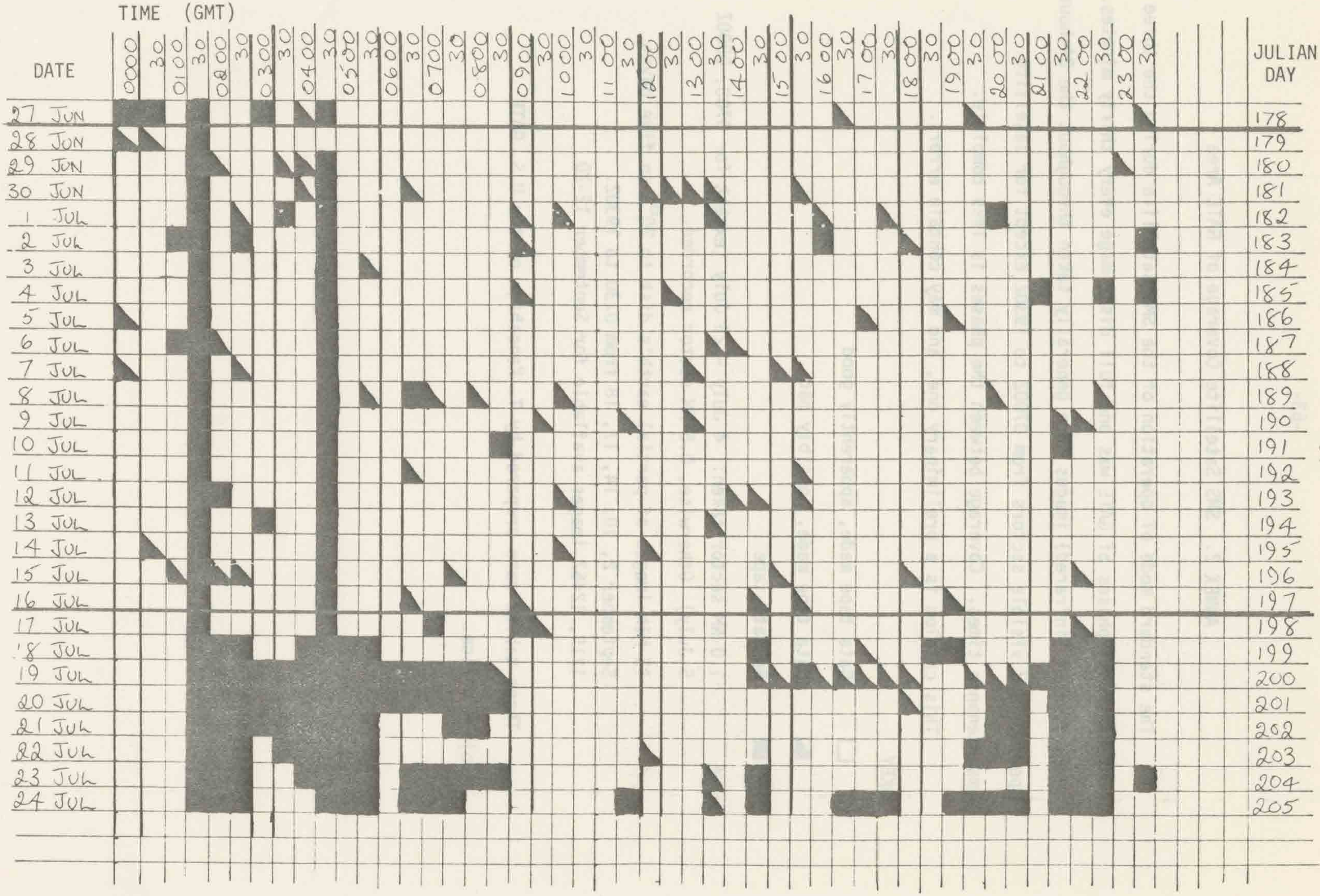
This catalog is a preliminary one, and may contain errors.

KEY

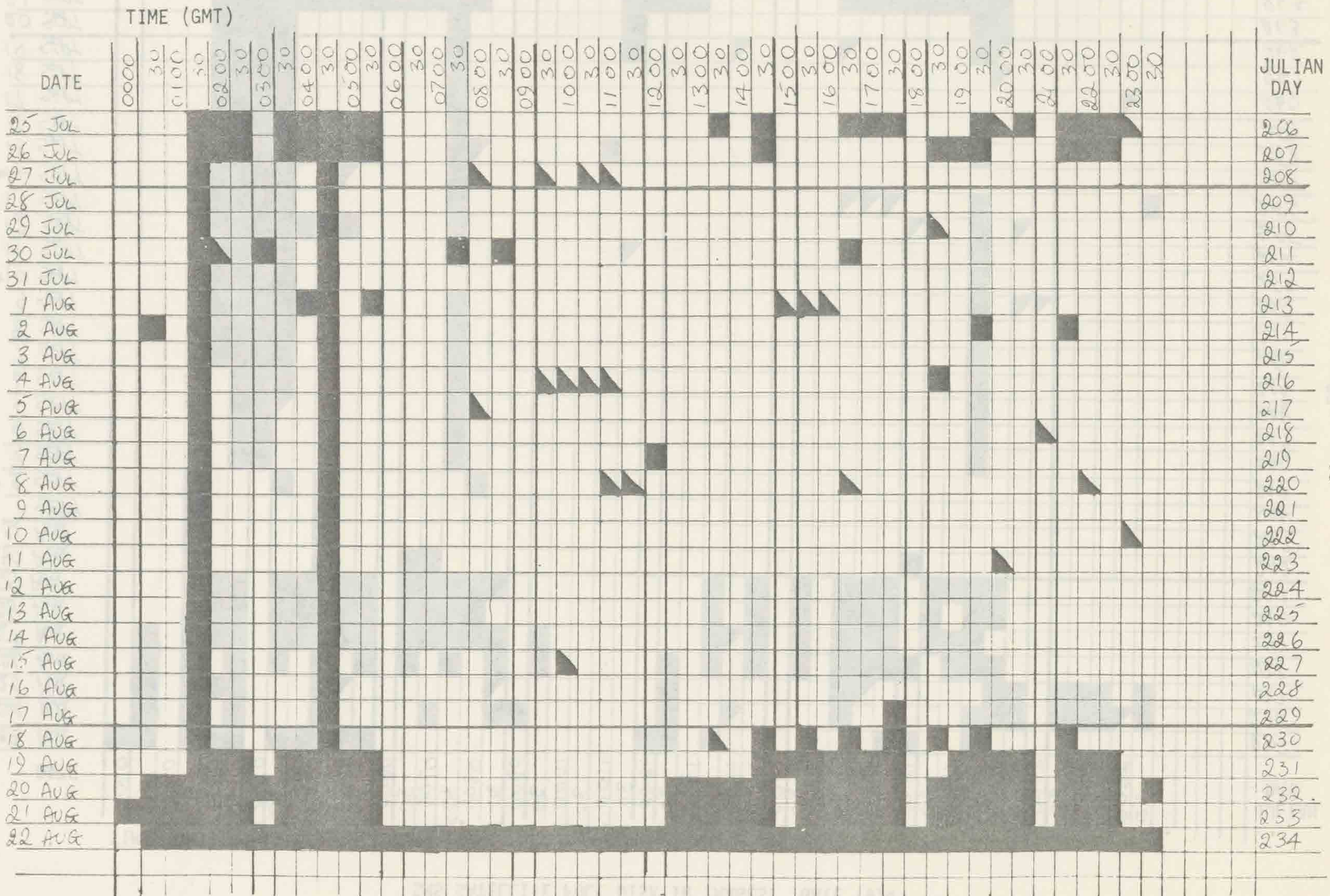
- ☐ Data tape made, apparently good
- ◩ Data tape made, possibly bad
- ■ No data tape
- * 1.0 NM sector taken: 4 July - 25 July (except for 0700, 0800Z 5 July) Otherwise, 0.5 NM sector recorded.
- * * 15 MIN images of partial earth's disk to 20^{o}S on five days: September 2, 10, 14, 17, 18 from 0730 to 1930Z.
  1215, 1245Z images available for September 12-20

These tables were prepared by T. Kaneshige of the U.S. GATE Project Office.

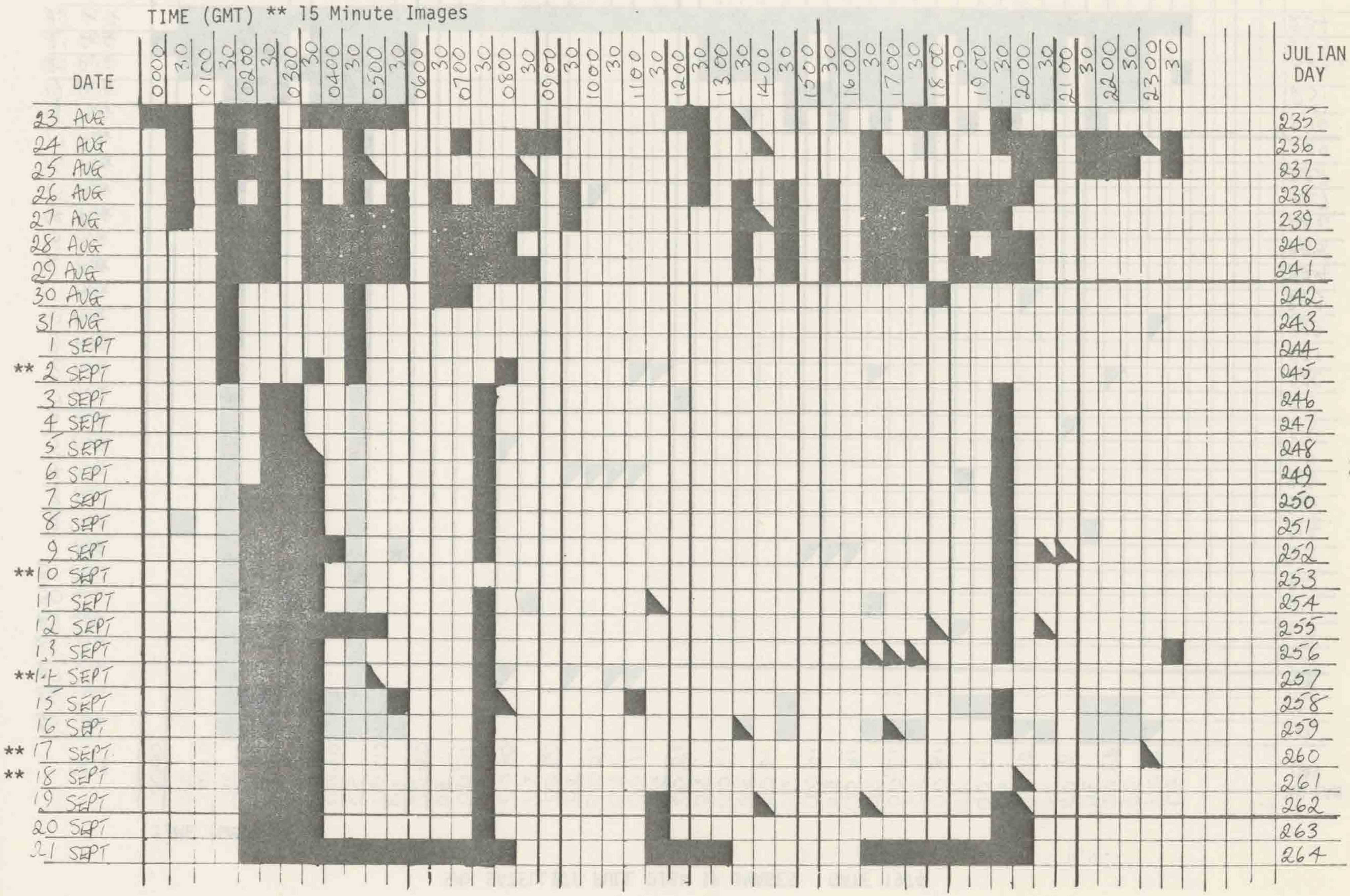
SMS SATELLITE FULL DISK IR IMAGES: GATE 1974



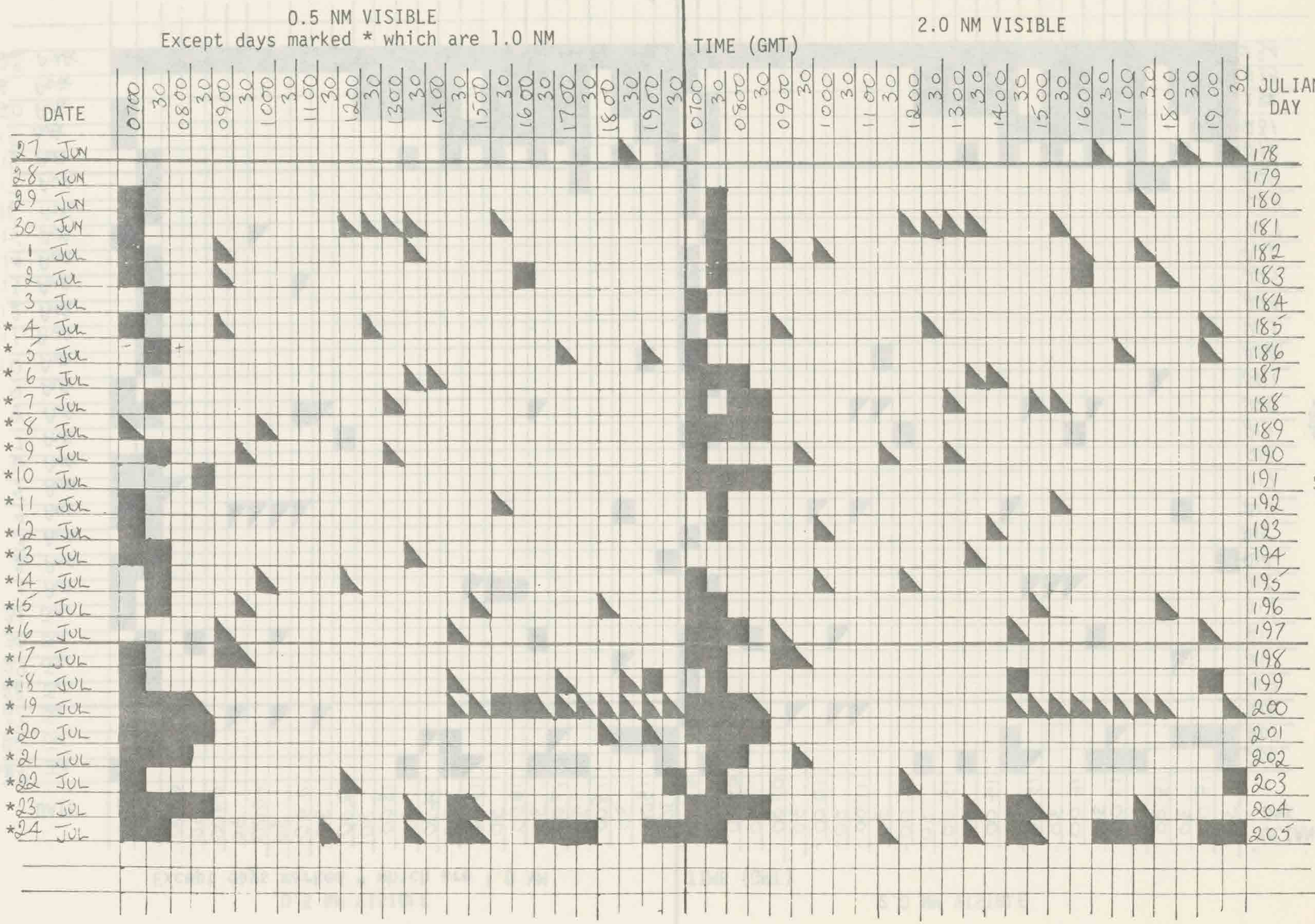
SMS SATELLITE FULL DISK IR IMAGES: GATE 1974



SMS SATELLITE FULL DISK IR IMAGES: GATE 1974



SMS SATELLITE VISIBLE IMAGES: GATE 1974

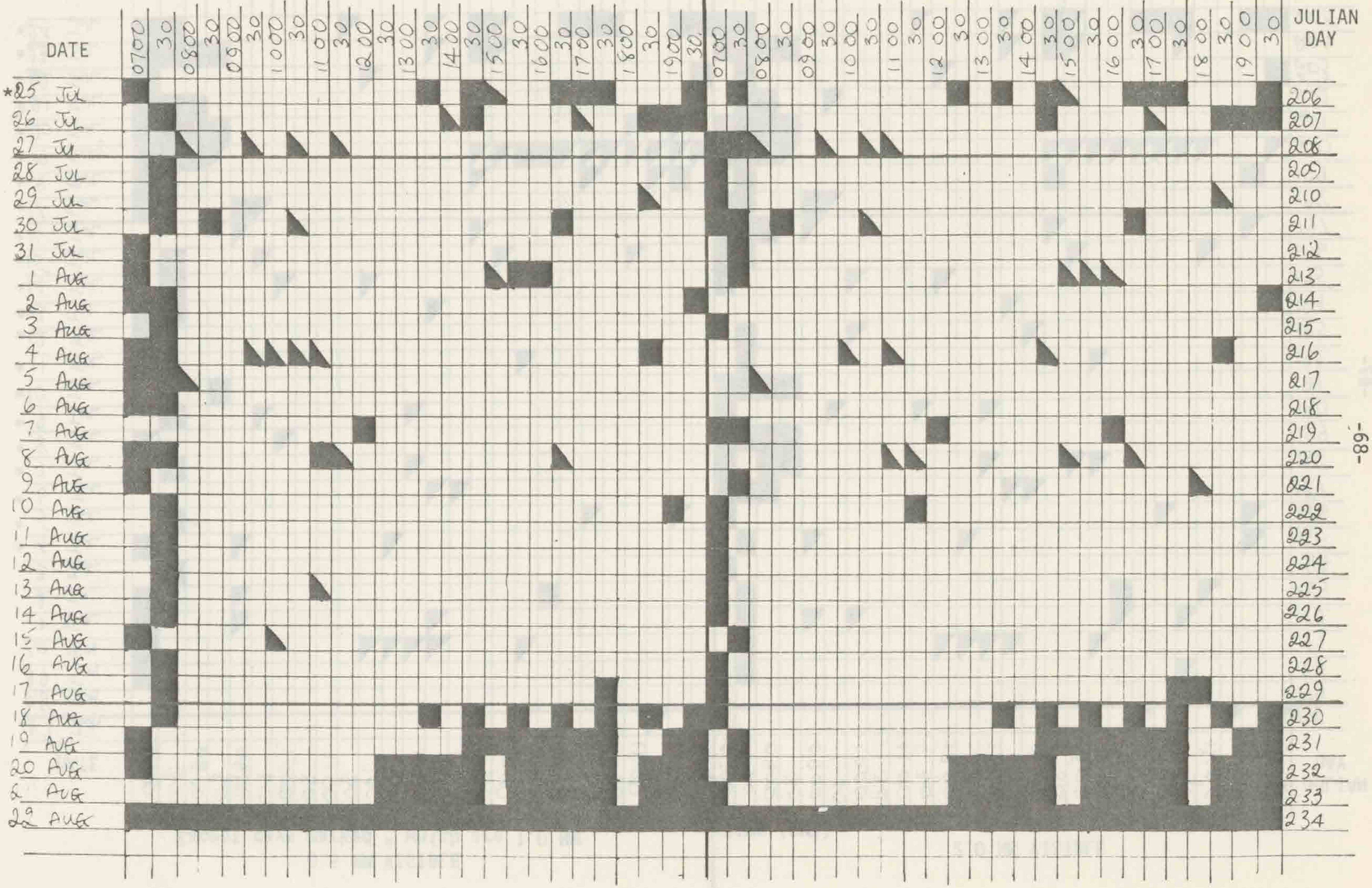


SMS SATELLITE VISIBLE IMAGES: GATE 1974

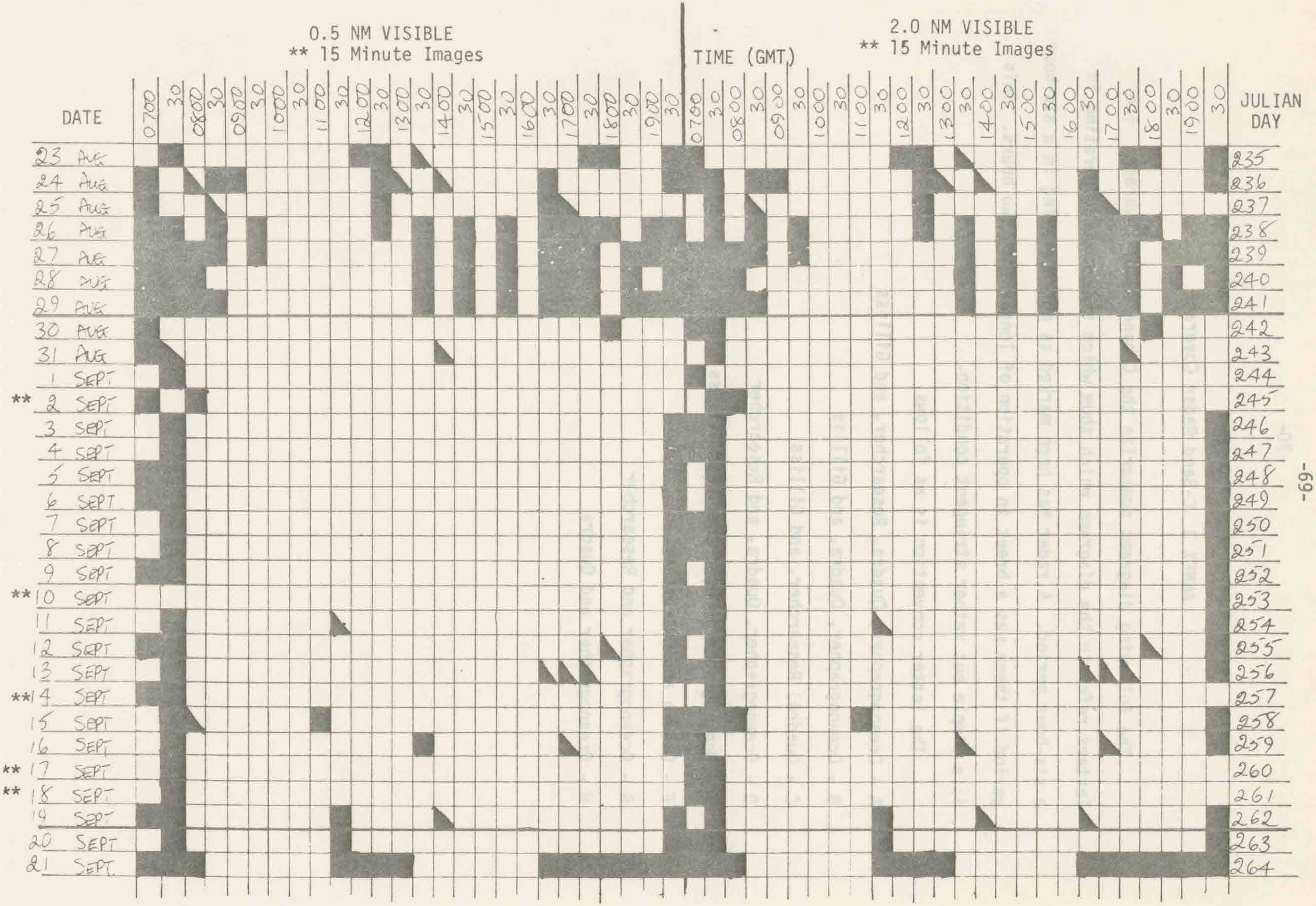
0.5 NM VISIBLE
Except days marked * which are 1.0 NM

2.0 NM VISIBLE

TIME (GMT)



SMS SATELLITE VISIBLE IMAGES: GATE 1974



ANNEX 3 C-Band Radar Coverage

The following diagrams summarize the C-band radar coverage. The letters refer to the diagrams which show which radars were operating in a six-hour period. A radar has been marked as not operating in a six-hour period if there was a break in operation of longer than two hours. This is a simple but rather stringent condition.

The letter convention is as follows.

A - Oceanographer, Quadra, Researcher, and Gilliss

B - Oceanographer, Quadra, and Gilliss

C - Quadra, Researcher, and Gilliss

D - Oceanographer, Quadra, and Researcher

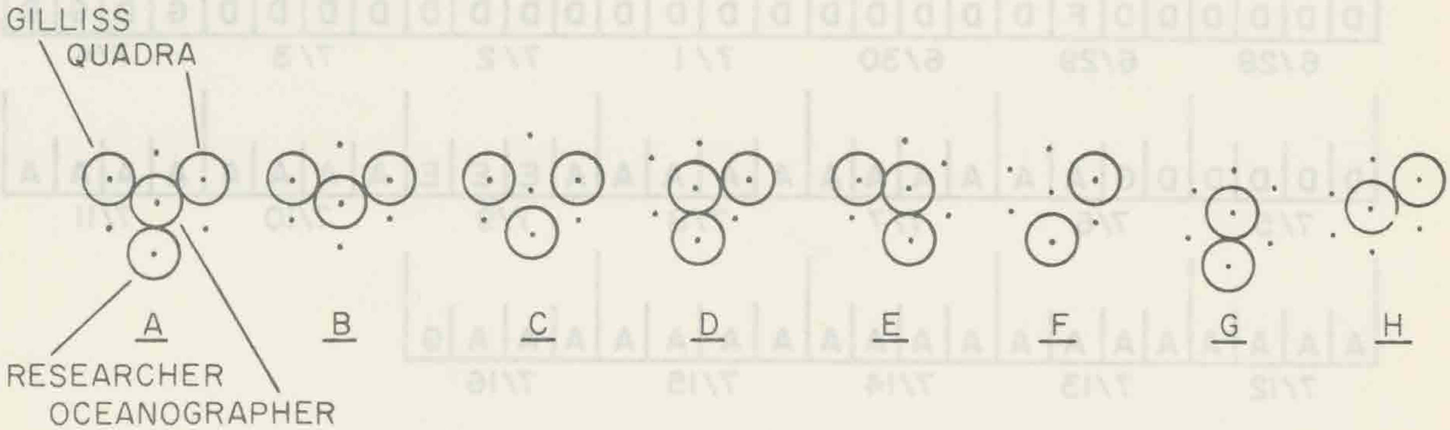
E - Oceanographer, Researcher, and Gilliss

F - Quadra and Researcher

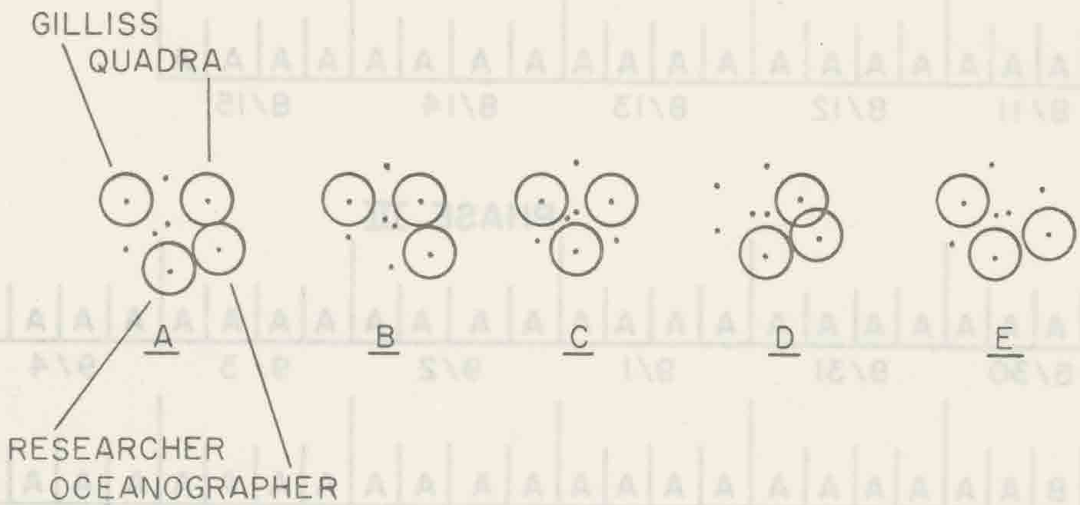
G - Oceanographer and Researcher

H - Oceanographer and Quadra

For Phases I and II, the following ship distribution was in effect with the resultant "code letter" coverages as shown:



During Phase III, the OCEANOGRAPHER moved from the center of the array to the southeastern corner, and the QUADRA moved in toward the center. The resultant code letter coverages for this phase are shown below. NOTE: coverages F, G and H did not occur.



PHASE I

Date	(00Z-06Z)	(06Z-12Z)	(12Z-18Z)	(18Z-24Z)
6/28	D	D	D	D
6/29	D	D	F	D
6/30	D	D	D	D
7/1	D	D	D	D
7/2	D	D	D	D
7/3	D	D	D	D
7/4	G	D	G	D
7/5	D	D	D	D
7/6	D	G	A	A
7/7	A	A	A	A
7/8	A	A	A	A
7/9	A	E	E	E
7/10	A	A	A	A
7/11	A	A	A	A
7/12	A	A	A	A
7/13	A	A	A	A
7/14	A	A	A	A
7/15	A	A	A	A
7/16	A	A	A	G

PHASE II

Date	(00Z-06Z)	(06Z-12Z)	(12Z-18Z)	(18Z-24Z)
7/28	D	D	D	D
7/29	D	D	D	D
7/30	D	D	D	D
7/31	F	F	F	F
8/1	F	F	F	F
8/2	F	F	F	D
8/3	G	D	D	D
8/4	D	D	D	D
8/5	D	D	D	D
8/6	D	D	H	D
8/7	A	A	A	B
8/8	B	B	B	B
8/9	B	B	B	B
8/10	B	B	A	A
8/11	A	A	A	A
8/12	A	A	A	A
8/13	A	A	A	A
8/14	A	A	A	A
8/15	A	A	A	A

PHASE III

Date	(00Z-06Z)	(06Z-12Z)	(12Z-18Z)	(18Z-24Z)
8/30	A	A	A	A
8/31	A	A	A	A
9/1	A	A	A	A
9/2	A	A	A	A
9/3	A	A	A	A
9/4	A	A	A	A
9/5	A	A	A	A
9/6	A	B	A	A
9/7	A	A	A	A
9/8	A	A	A	A
9/9	A	A	A	A
9/10	A	A	A	A
9/11	A	A	A	A
9/12	A	A	A	A
9/13	A	A	A	A
9/14	B	C	C	A
9/15	A	C	C	E
9/16	A	A	A	B
9/17	A	A	A	A
9/18	A	A	A	A
9/19	A	A	A	D

ANNEX 4. Upper Air Observations A/B and C-Scale B Ships.

The following pages contain a summary of the upper air observations taken from the ships during GATE. The data is gleaned from a variety of sources and is intended to provide a preliminary quick reference. Subsequent data processing will need to be accomplished before the details in the table can be confirmed, and may well have to be corrected.

A/B-Scale Ships

The first table lists the number of soundings taken per day by the A/B ships during phases I and II.

KEY - B-Scale Ships

MAP ● sounding reported as taken

⊗ a report of no sounding taken

○ no report, unknown

The tabulations indicate the height reached by the sounding. For some ships, and some soundings, this information is not available at present (labelled NO INFORMATION, or UNKNOWN). Additionally, wind and thermodynamic information may terminate at different heights.

C-Scale Ships

The C-Scale ships in Phase III are included in the B-scale ship tables except for the Hecla which is listed separately at the end. The Hecla took mainly low-level wind soundings at up to hourly intervals during the daytime, with a few temperature, humidity soundings.

A/B SHIP UPPER AIR SUMMARY. NUMBER OF OBSERVATIONS PER DAY

PHASE I

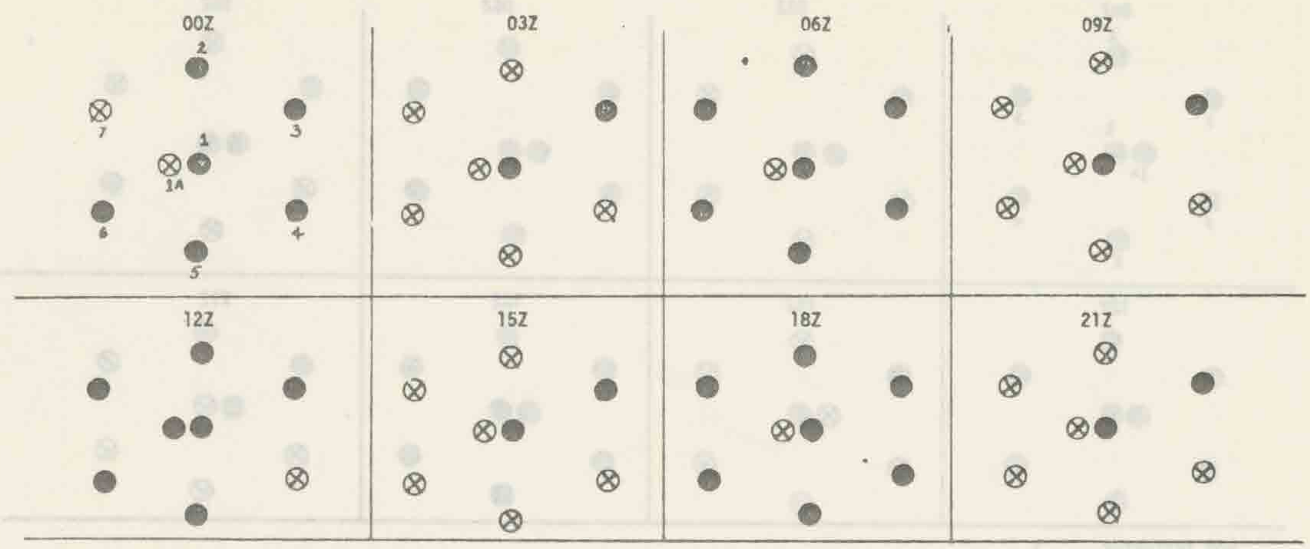
SHIPS	POS	6/28	29	30	7/1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
KOROLOV	8	4	4	4	4	4	4	4	4	7	8	8	5	4	5	8	8	7	4	4	2
PORYV	9	4	4	4	4	4	4	4	4	7	8	6	5	4	6	8	8	5	4	6	2
KRENKEL	10	5	5	4	5	4	4	5	5	8	8	8	6	4	4	4	4	5	4	3	1
ZUBOV	11	3	4	5	3	5	3	4	4	7	8	8	4	5	5	8	8	7	4	4	2
OKEAN	12	4	4	4	4	8	7	4	4	8	8	8	6	4	5	8	8	8	4	4	2
PRIBOY	13	4	4	4	4	4	4	4	4	7	8	8	5	4	6	8	8	7	4	4	2

PHASE II

SHIPS	POS	7/28	29	30	31	8/1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
KOROLOV	8	4	4	4	7	8	7	5	4	8	6	4	7	8	8	5	5	7	8	7	
PORYV	9	3	4	4	7	8	7	5	4	8	4	4	7	8	8	5	5	7	8	8	2
KRENKEL	10	1	1	4	7	8	8	5	5	8	6	5	7	8	8	5	7	7	8	3	2
ZUBOV	11	4	4	4	8	7	7	5	4	7	5	4	7	8	8	5	5	7	8	7	2
OKEAN	12	4	4	4	7	8	6	4	4	8	4	4	7	8	3	5	4	7	8	7	2
PRIBOY	13	4	4	4	7	8	6	5	4	8	5	4	7	8	7	5	5	7	8	3	2

PHASE I

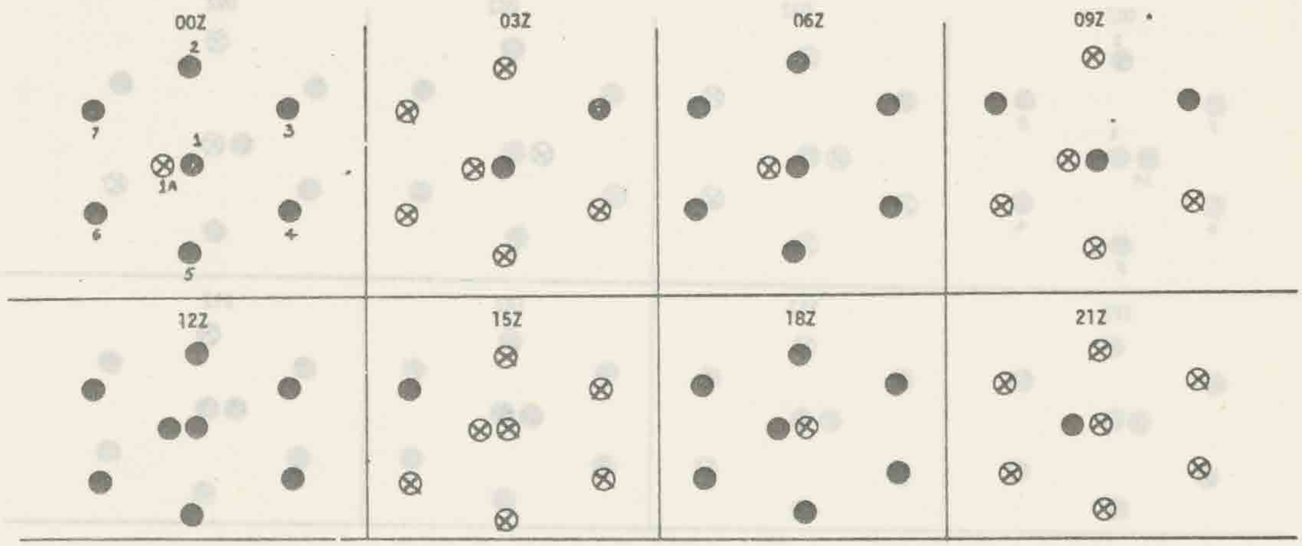
DATE: 6/28 (179)



B NON INTENSIVE ⟶ A/B NON INTENSIVE

STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	153 mb	425 mb	109 mb	129 mb	120 mb	67 mb	441 mb	84
1A	VANGUARD	-	-	-	-	86 k ft	-	-	-
2	VIZE	NO INFORMATION							
3	QUADRA	13 km	70 km	14 km	49 mb	16 km	67 mb	17 km	139 mb
4	METEOR	200 mb	-	200 mb	-	-	-	200 mb	-
5	RESEARCHER	126 mb	-	175 mb	-	57 mb	-	24 mb	-
6	DALLAS	NO INFORMATION							
7	GILLISS	-	-	103 mb	-	107 mb	-	367 mb	-

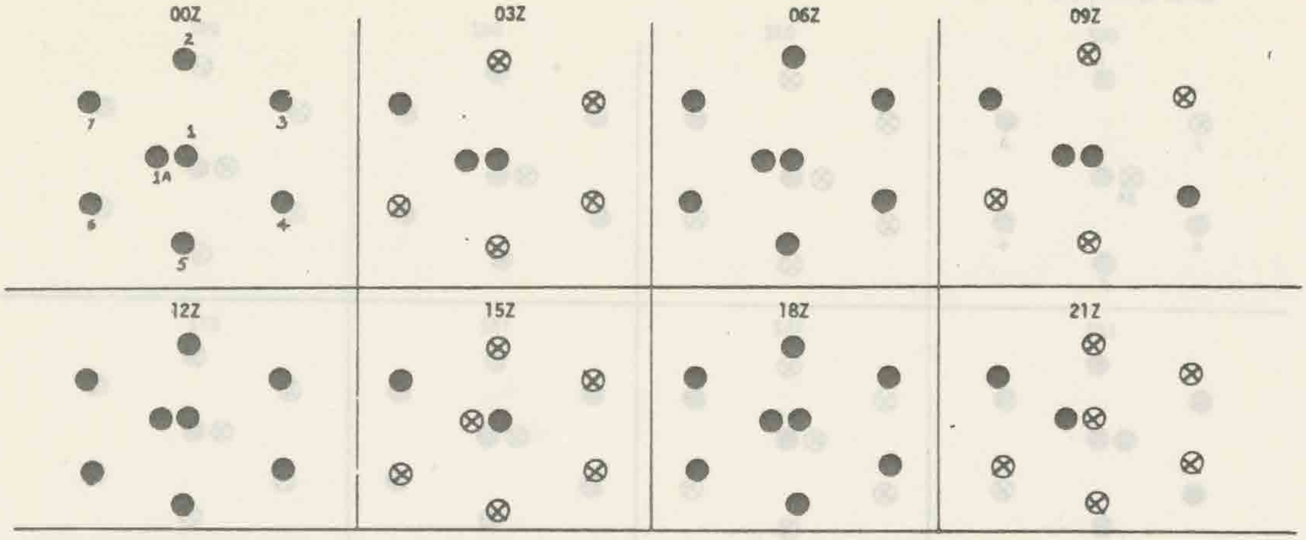
DATE: 6/29 (180)



NON INTENSIVE ⟶
NON INTENSIVE ⟶

STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	425 mb	625 mb	99 mb	164 mb	52 mb	-	-	-
1A	VANGUARD	-	-	-	-	76 k ft	-	28 k ft	51 k ft
2	VIZE	NO INFORMATION							
3	QUADRA	18 km	80 mb	17 km	90 mb	21 km	-	18 km	-
4	METEOR	300 mb	-	200 mb	-	30 mb	-	300 mb	
5	RESEARCHER	59 mb	-	97 mb	-	46 mb	-	356 mb	-
6	DALLAS	NO INFORMATION							
7	GILLISS	300 mb	-	387 mb	70 mb	70 mb	68 mb	67 mb	-

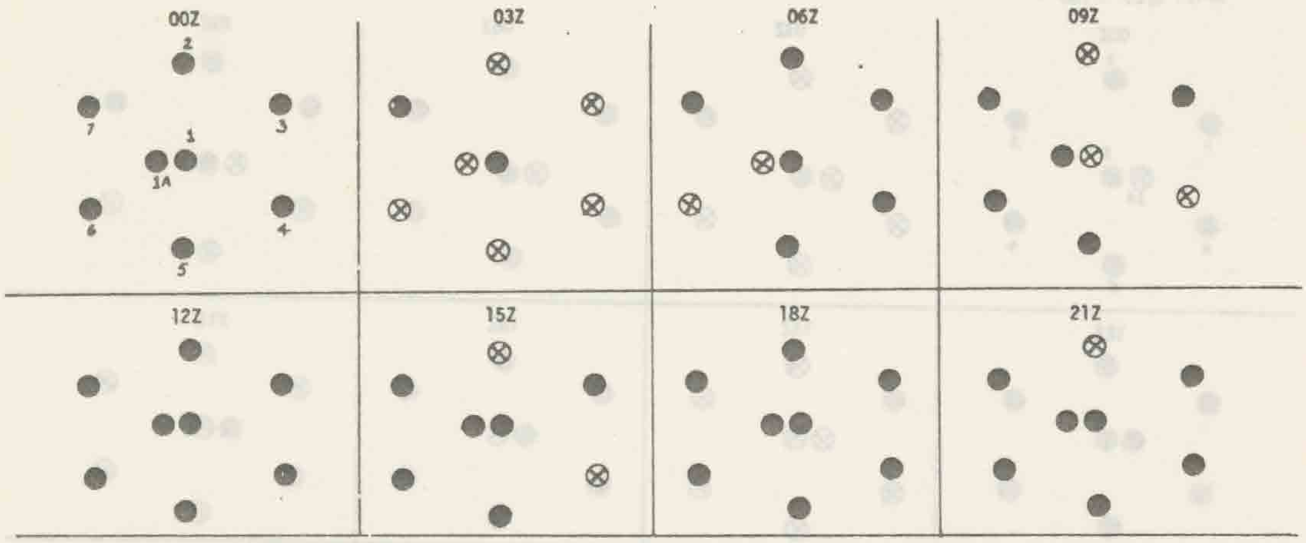
DATE: 6/30 (181)



NON INTENSIVE ⟶
NON INTENSIVE ⟶

STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	104	11 mb	61 mb	70 mb	192 mb	70 mb	65 mb	-
1A	VANGUARD	55 k ft	100 k ft	80 k ft	46 k ft	77 k ft	-	43 k ft	10 k ft
2	VIZE	NO INFORMATION							
3	QUADRA	10 km	-	17 km	-	21 km	-	23 km	-
4	METEOR	200 mb	-	200 mb	300 mb	50 mb	-	300 mb	-
5	RESEARCHER	119 mb	-	14 mb	-	40 mb	-	39 mb	-
6	DALLAS	NO INFORMATION							
7	GILLISS	150 mb	70 mb	150 mb	150 mb	70 mb	28 mb	150 mb	213 mb

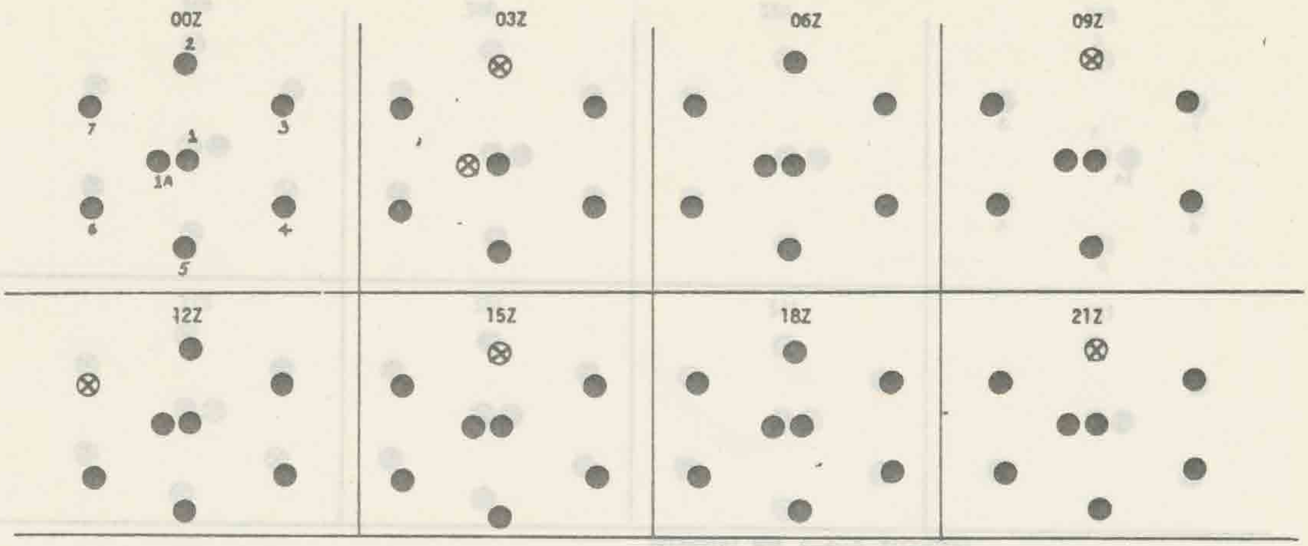
DATE: 7/1 (182)



NON INTENSIVE ⟼ INTENSIVE

STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	123 mb	58 mb	-	-	65 mb	67 mb	70 mb	67 mb
1A	VANGUARD	73 k ft	-	-	87 k ft	63 k ft	82 k ft	41 k ft	70 k ft
2	VIZE	NO INFORMATION							
3	QUADRA	22 km	-	17 km	70 mb	7 km	54 mb	20 km	29 mb
4	METEOR	200 mb	-	300 mb	-	14 km	-	65 mb	200 mb
5	RESEARCHER	39 mb	-	14 mb	59 mb	154 mb	55 mb	101 mb	88 mb
6	DALLAS	NO INFORMATION							
7	GILLISS	70 mb	81 mb	70 mb	27 mb	19 mb	25 mb	52 mb	42 mb

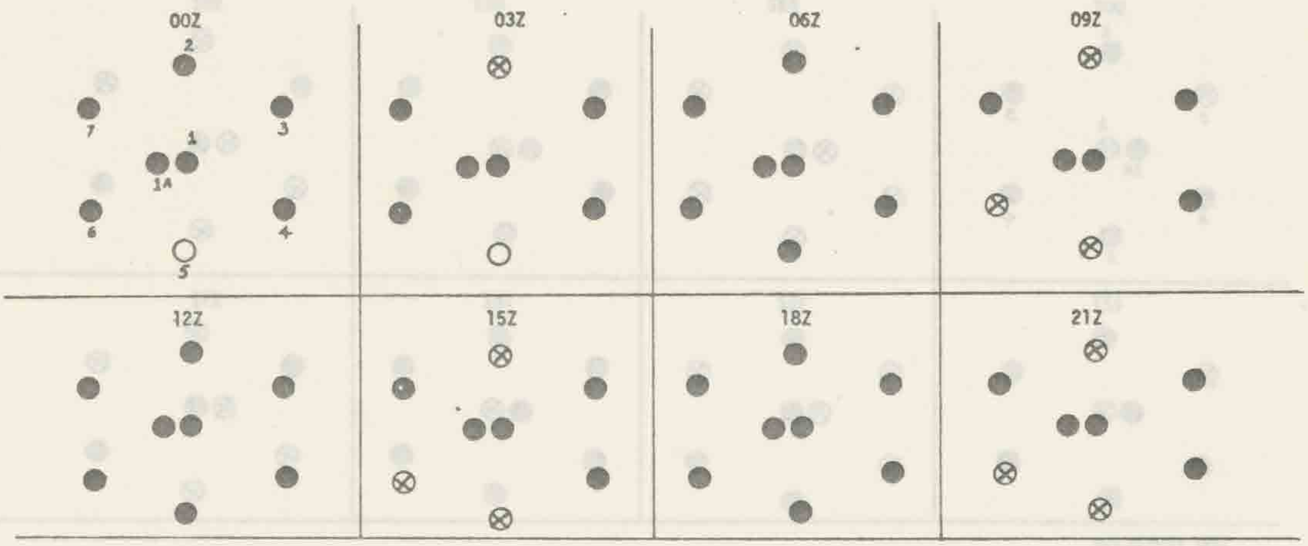
DATE: 7/2 (183)



INTENSIVE ⟶

STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	77 mb	188 mb	107 mb	201 mb	552 mb	126 mb	411 mb	67 mb
1A	VANGUARD	-	-	51 k ft	32 k ft	17 k ft	52 k ft	68 k ft	82 k ft
2	VIZE	NO INFORMATION							
3	QUADRA	20 km	48 mb	17 km	59 mb	22 km	49 mb	22 km	32 mb
4	METEOR	20 mb	200 mb	100 mb	200 mb	650 mb	200 mb	90 mb	200 mb
5	RESEARCHER	400 mb	296 mb	124 mb	52 mb	32 mb	124 mb	384 mb	145 mb
6	DALLAS	NO INFORMATION							
7	GILLISS	150 mb	69 mb	128 mb	65 mb	-	41 mb	70 mb	81 mb

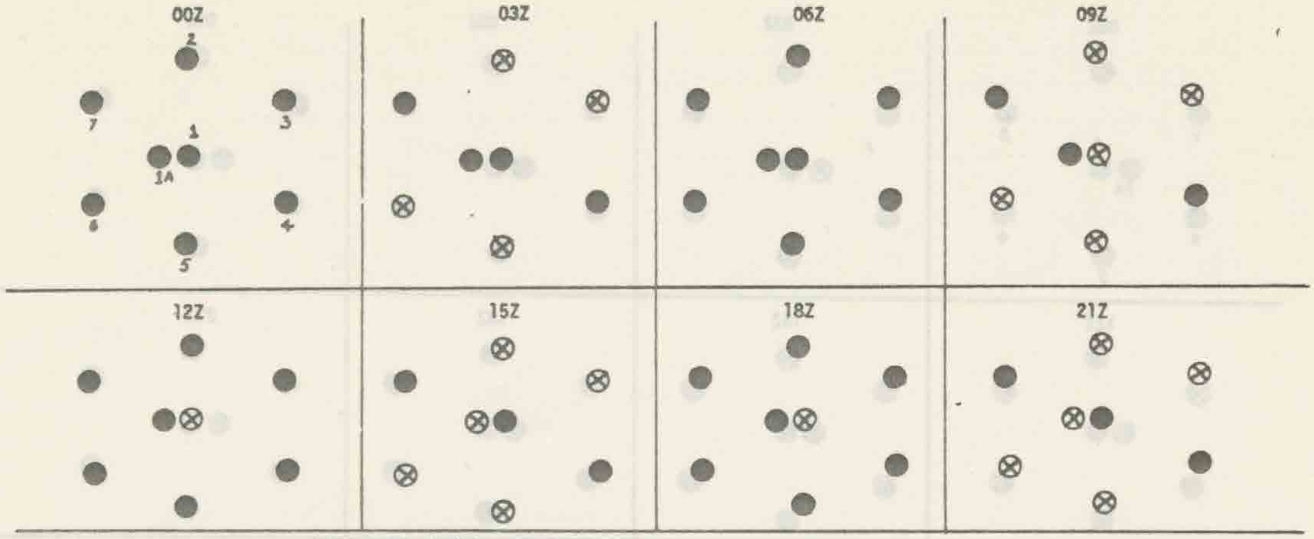
DATE: 7/3 (184)



⟶ INTENSIVE

STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	164 mb	91 mb	61 mb	58 mb	70 mb	42 mb	72 mb	56 mb
1A	VANGUARD	69 k ft	80 k ft	87 k ft	87 k ft	82 k ft	74 k ft	76 k ft	76 k ft
2	VIZE	NO INFORMATION							
3	QUADRA	20 km	46 mb	18 km	50 mb	17 km	70 mb	20 km	94 mb
4	METEOR	35 mb	200 mb	15 mb	200 mb	200 mb	200 mb	200 mb	200 mb
5	RESEARCHER	UNK	UNK	82 mb	-	33 mb	-	19 mb	-
6	DALLAS	NO INFORMATION							
7	GILLISS	83 mb	119 mb	66 mb	36 mb	67 mb	57 mb	353 mb	54 mb

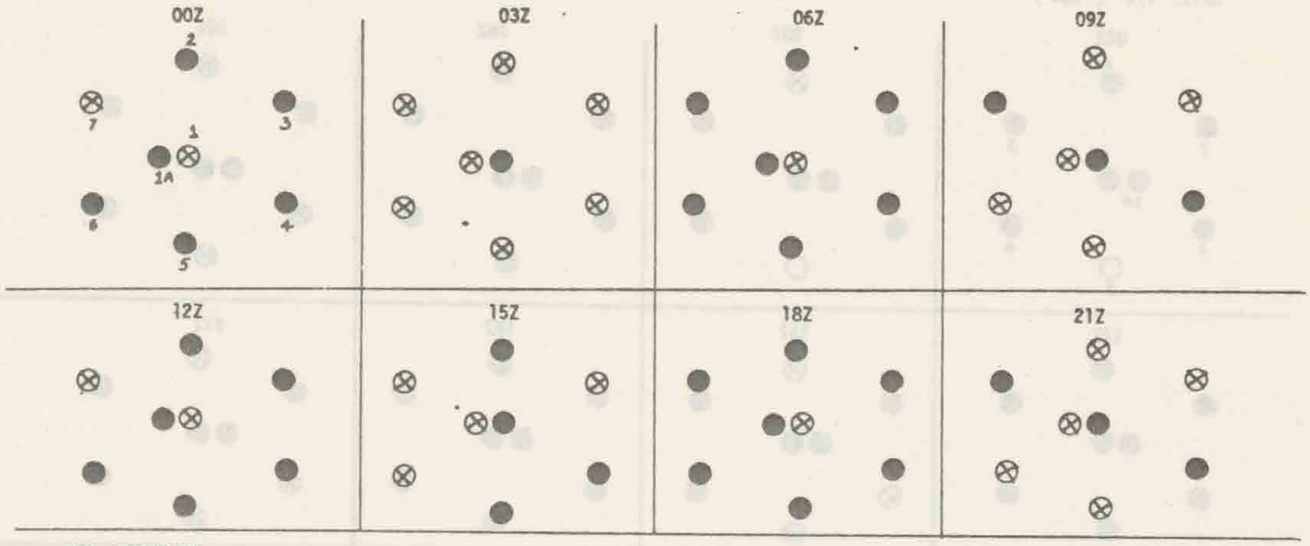
DATE: 7/4 (185)



INTENSIVE ⟷ NON INTENSIVE

STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	80 mb	61 mb	150 mb	-	-	109 mb	-	49 mb
1A	VANGUARD	66 k ft	76 k ft	52 k ft	101 k ft	96 k ft	-	107 k ft	-
2	VIZE	NO INFORMATION							
3	QUADRA	20 km	-	18 km	-	20 km	-	21 km	-
4	METEOR	200 mb	200 mb	200 mb	200 mb	30 mb	200 mb	200 mb	300 mb
5	RESEARCHER	102 mb	-	10 mb	-	44 mb	-	39 mb	-
6	DALLAS	NO INFORMATION							
7	GILLISS	100 mb	155 mb	118 mb	617 mb	33 mb	45 mb	260 mb	190 mb

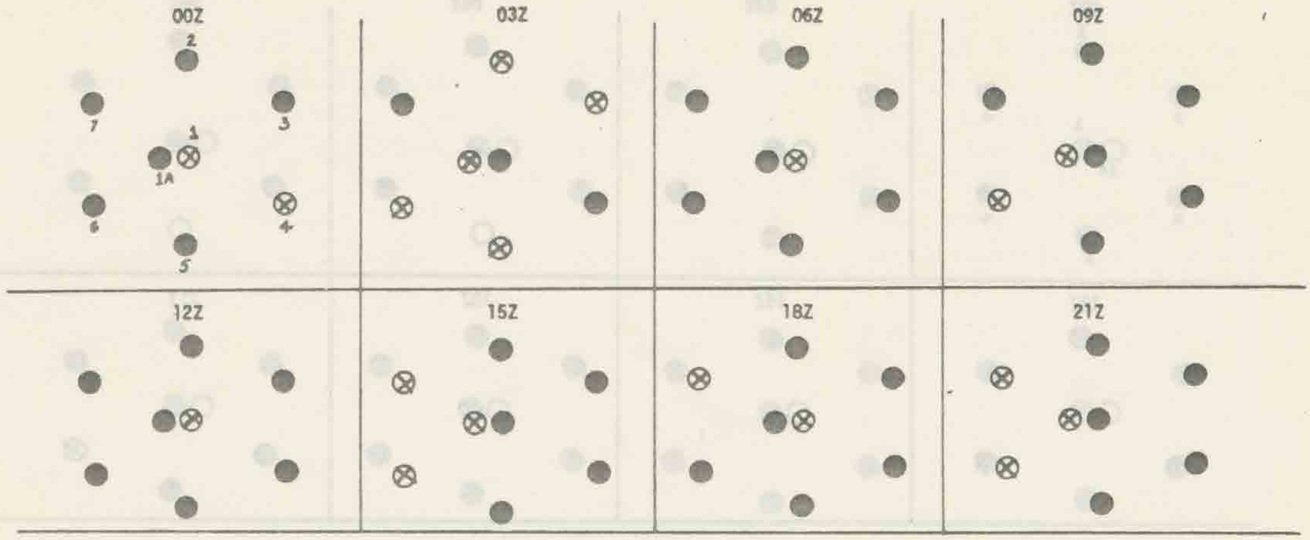
DATE: 7/5 (186)



NON INTENSIVE

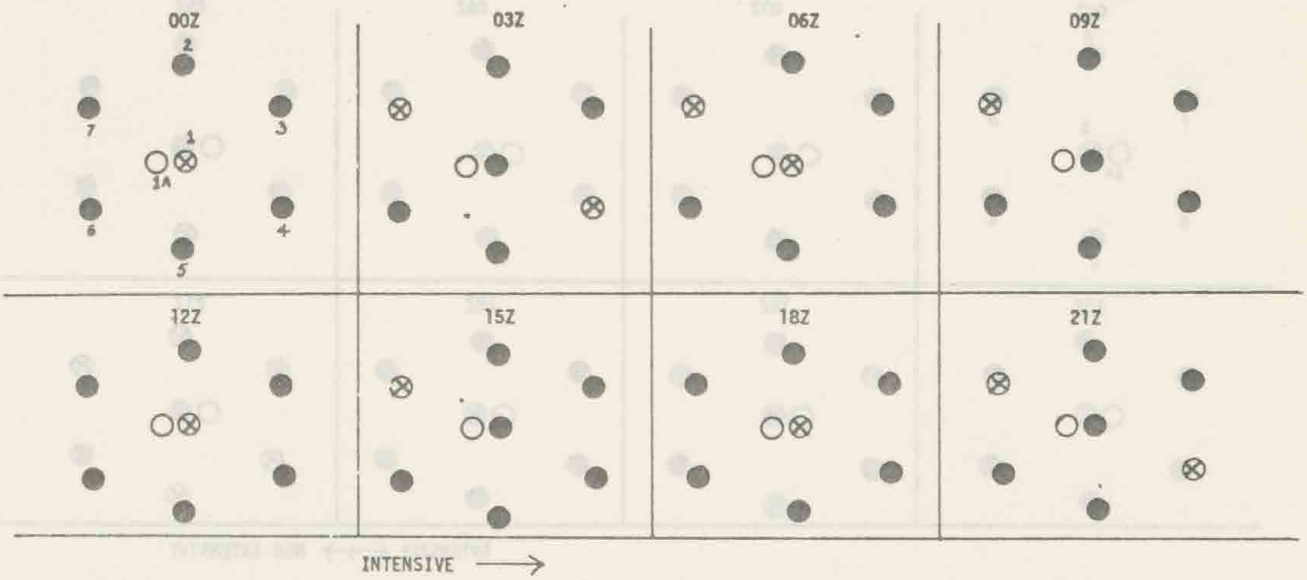
STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	-	65 mb	-	63 mb	-	58 mb	-	112 mb
1A	VANGUARD	87 k ft	-	101	-	77 k ft	-	108 k ft	-
2	VIZE	NO INFORMATION							
3	QUADRA	25 km	-	22 km	-	23 km	-	24 km	-
4	METEOR	200 mb	-	90 mb	110 mb	200 mb	30 mb	40 mb	50 mb
5	RESEARCHER	10 mb	-	17 mb	-	24 mb	27 mb	71 mb	-
6	DALLAS	NO INFORMATION							
7	GILLISS	-	-	66 mb	26 mb	-	-	65 mb	99 mb

DATE: 7/6 (187)



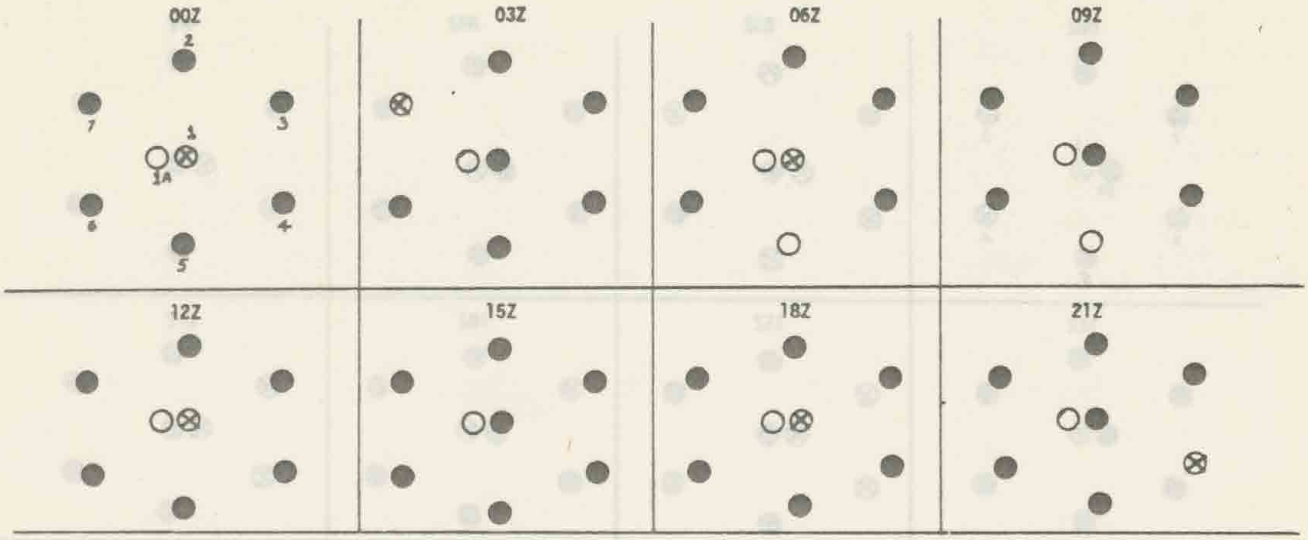
STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	-	67 mb	-	88 mb	-	61 mb	-	56 mb
1A	VANGUARD	104 k ft	-	91 k ft	-	83 k ft	-	94 k ft	-
2	VIZE	NO INFORMATION							
3	QUADRA	20 km	-	23 km	29 mb	15 km	44 mb	24 km	35 mb
4	METEOR	-	50 mb	60 mb	90 mb	40 mb	200 mb	30 mb	300 mb
5	RESEARCHER	30 mb	-	6 mb	53 mb	256 mb	33 mb	21 mb	47 mb
6	DALLAS	NO INFORMATION							
7	GILLISS	68 mb	62 mb	66 mb	41 mb	47 mb	-	-	-

DATE: 7/7 (188)



STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	-	72 mb	-	171 mb	-	58 mb	-	411 mb
1A	VANGUARD	95 k ft	-	55 k ft	-	93 k ft	-	-	
2	VIZE	NO INFORMATION							
3	QUADRA	20 km	65 mb	17 km	46 mb	13 km	88 mb	22 km	48 mb
4	METEOR	50 mb	-	200 mb	200 mb	500 mb	200 mb	500 mb	-
5	RESEARCHER	12 mb	16 mb	6 mb	50 mb	557 mb	49 mb	30 mb	120 mb
6	DALLAS	NO INFORMATION							
7	GILLISS	86 mb	-	-	-	30 mb	-	383 mb	-

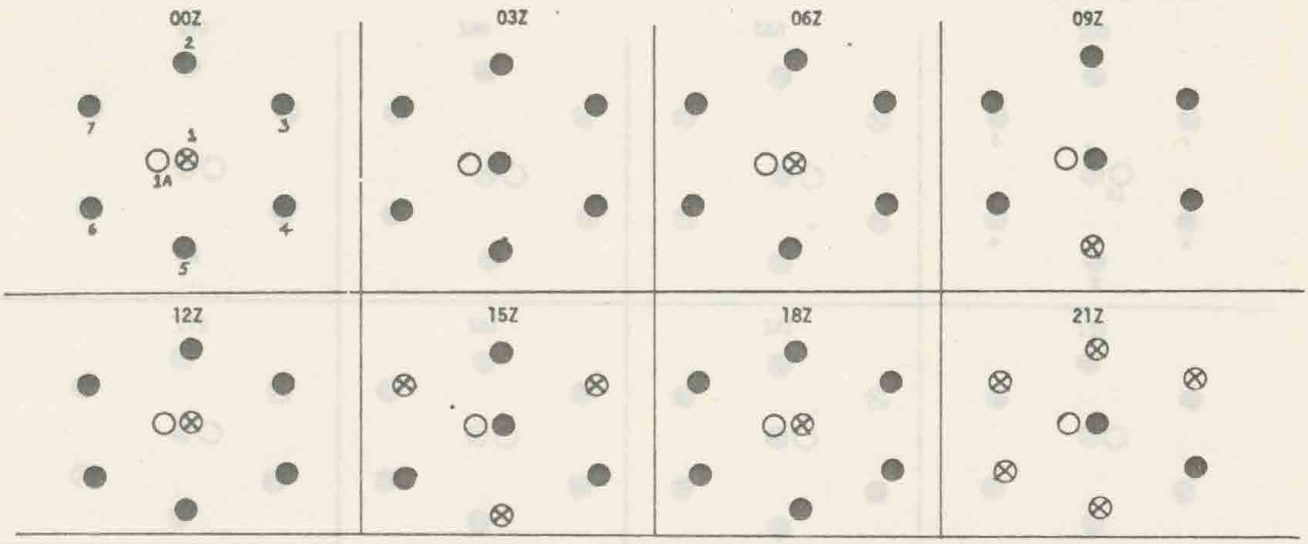
DATE: 7/8 (189)



INTENSIVE ⟶

STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	-	173 mb	-	61 mb	-	67 mb	-	56 mb
1A	VANGUARD								
2	VIZE	NO INFORMATION							
3	QUADRA	23 km	100 mb	21 km	59 mb	18 km	497 mb	20 mb	52 mb
4	METEOR	90 mb	200 mb	50 mb	200 mb	90 mb	20 km	700 mb	-
5	RESEARCHER	96 mb	166 mb	UNK	UNK	260	25 mb	28 mb	185 mb
6	DALLAS	NO INFORMATION							
7	GILLISS	68 mb	-	48 mb	96 mb	138 mb	44 mb	69 mb	70 mb

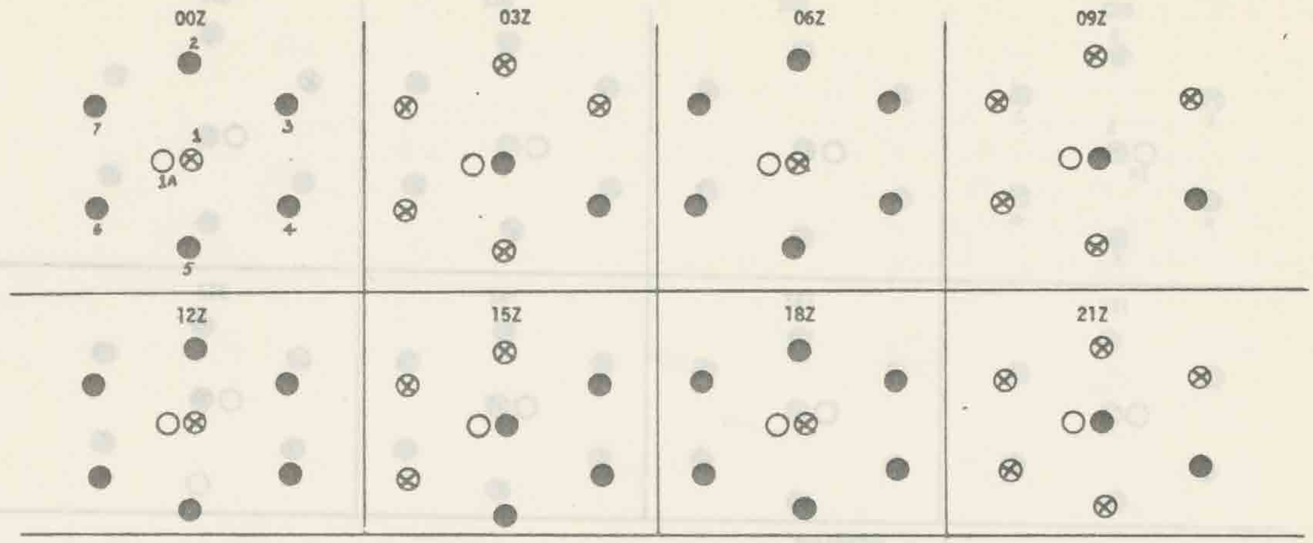
DATE: 7/9 (190)



INTENSIVE ⟵|⟶ NON INTENSIVE

STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	-	67 mb	-	70 mb	-	82 mb	-	74 mb
1A	VANGUARD								
2	VIZE	NO INFORMATION							
3	QUADRA	20 km	30 mb	23 km	20 km	16 km	-	18 km	-
4	METEOR	90 mb	200 mb	200 mb	200 mb	50 mb	200 mb	30 mb	700 mb
5	RESEARCHER	136 mb	UNK	30 mb	-	27 mb	-	50 mb	-
6	DALLAS	NO INFORMATION							
7	GILLISS	66 mb	91 mb	46 mb	164 mb	134 mb		70 mb	-

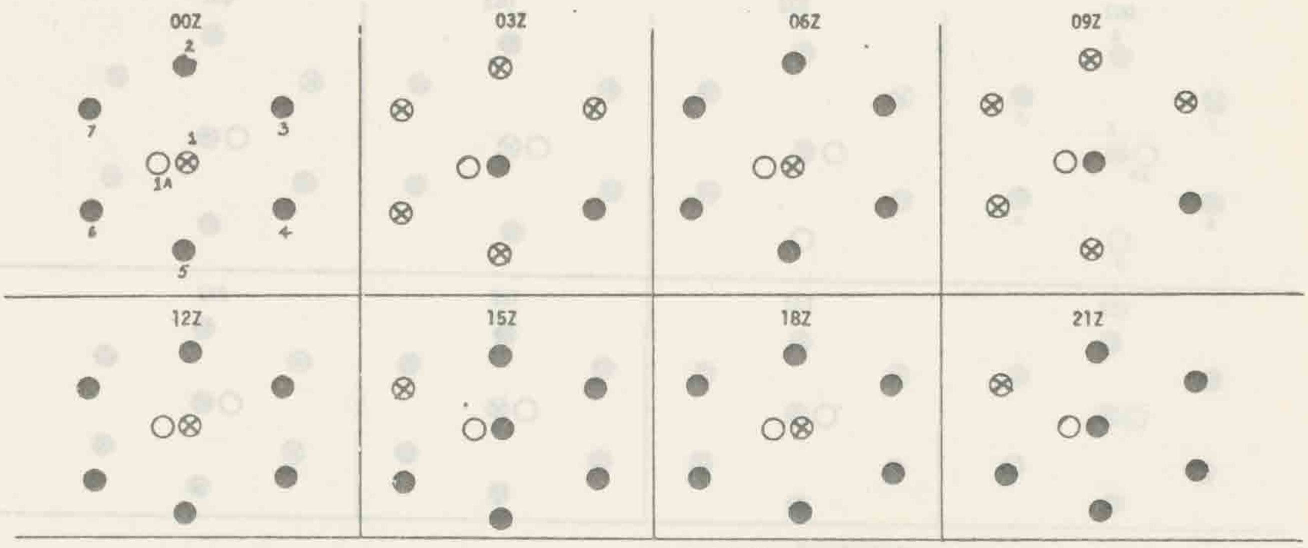
DATE: 7/10 (191)



NON INTENSIVE

STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	-	142 mb	-	61 mb	-	67 mb	-	61 mb
1A	VANGUARD								
2	VIZE	NO INFORMATION							
3	QUADRA	25 km	-	29 km	-	27 km	43 mb	28 km	-
4	METEOR	40 mb	200 mb	75 mb	200 mb	200 mb	200 mb	30 mb	40 mb
5	RESEARCHER	27 mb	-	10 mb	-	17 mb	24 mb	22 mb	-
6	DALLAS	NO INFORMATION							
7	GILLISS	271 mb	-	60 mb	-	65 mb	-	70 mb	

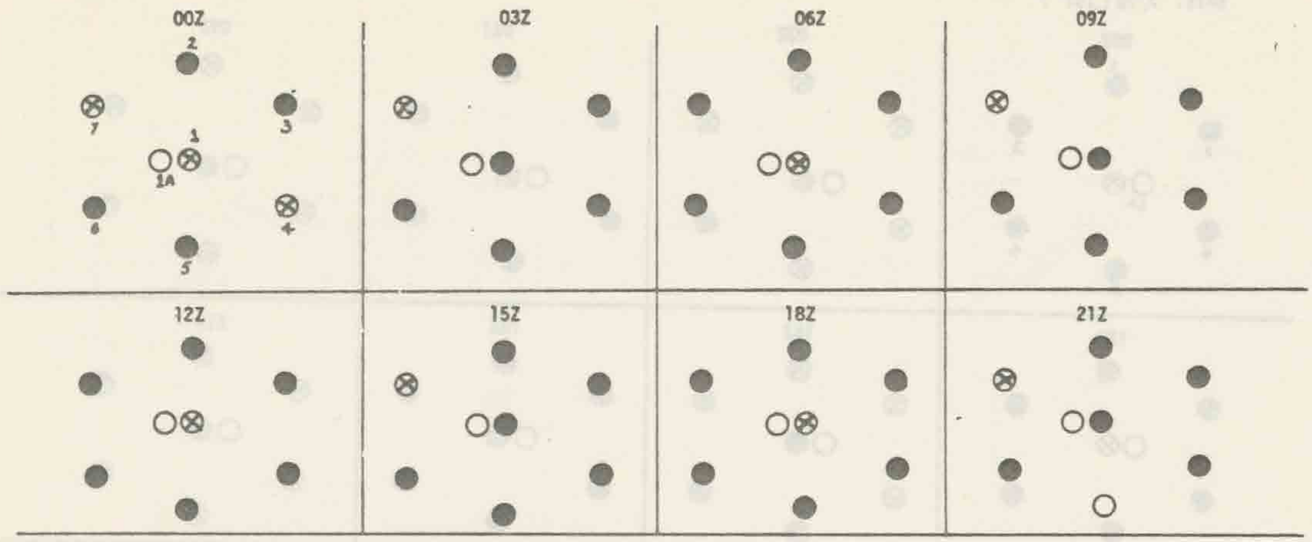
DATE: 7/11 (192)



NON INTENSIVE ⟼ INTENSIVE

STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	-	54 mb	-	52 mb	-	34 mb	-	282 mb
1A	VANGUARD								
2	VIZE	NO INFORMATION							
3	QUADRA	26 km	-	23 km	-	17 km	20 km	23 km	25 km
4	METEOR	650 mb	200 mb	200 mb	200 mb	50 mb	27 mb	200 mb	200 mb
5	RESEARCHER	40 mb	-	12 mb	-	28 mb	28 mb	29 mb	11 mb
6	DALLAS	NO INFORMATION							
7	GILLISS	66 mb	-	67 mb	-	91 mb	-	70 mb	-

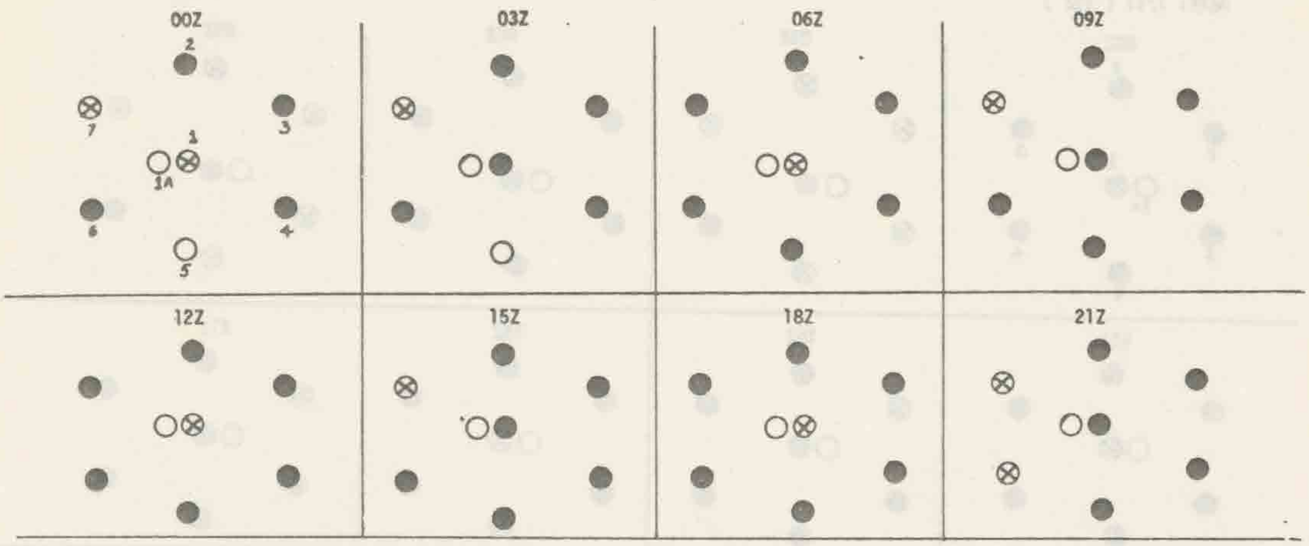
DATE: 7/12 (193)



⟼ INTENSIVE

STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	-	67 mb	-	56 mb	-	27 mb	-	38 mb
1A	VANGUARD								
2	VIZE	NO INFORMATION							
3	QUADRA	22 km	37 mb	21 km	50 mb	23 km	56 mb	23 km	83 mb
4	METEOR	-	200 mb	40 mb	200 mb	25 mb	28 km	100 mb	200 mb
5	RESEARCHER	12 mb	7 mb	51 mb	24 mb	72 mb	23 mb	17 mb	UNK
6	DALLAS	NO INFORMATION							
7	GILLISS	-	-	66 mb	-	30 mb	-	70	-

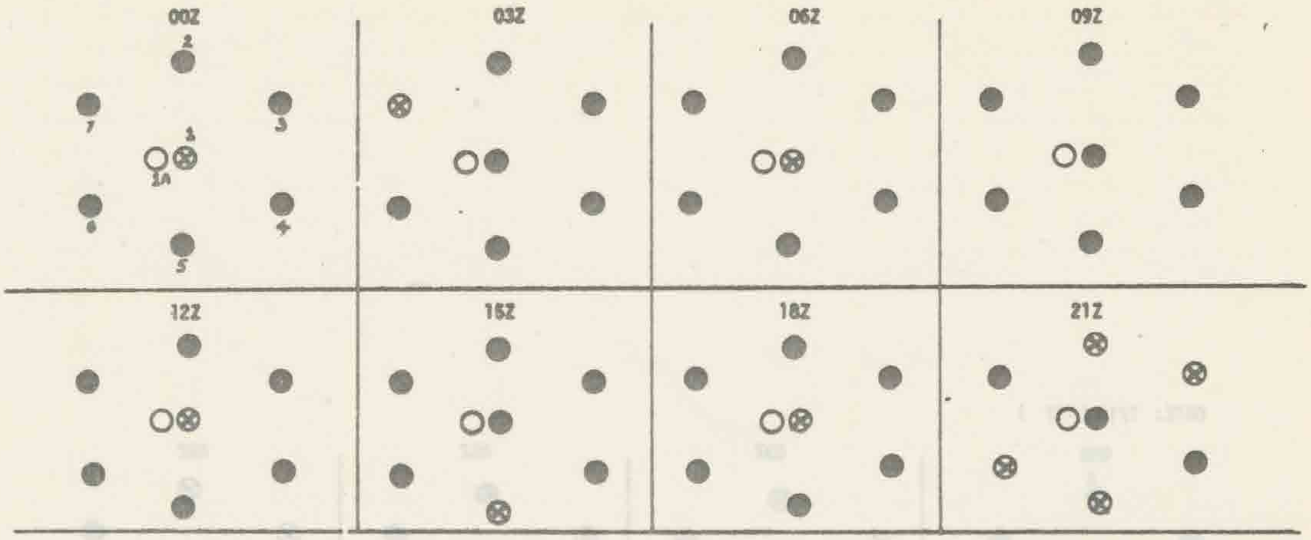
DATE: 7/13 (194)



⟶INTENSIVE

STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	-	88 mb	-	99	-	65 mb	-	52 mb
1A	VANGUARD								
2	VIZE	NO INFORMATION							
3	QUADRA	18 km	39 mb	22 km	58 mb	22 km	608 mb	13 km	88 mb
4	METEOR	45 mb	200 mb	450 mb	700 mb	50 mb	22 km	65 mb	200 mb
5	RESEARCHER	UNK	UNK	26 mb	40 mb	25 mb	600 mb	42 mb	88 mb
6	DALLAS	NO INFORMATION							
7	GILLISS	-	-	457 mb	-	58 mb	-	70 mb	-

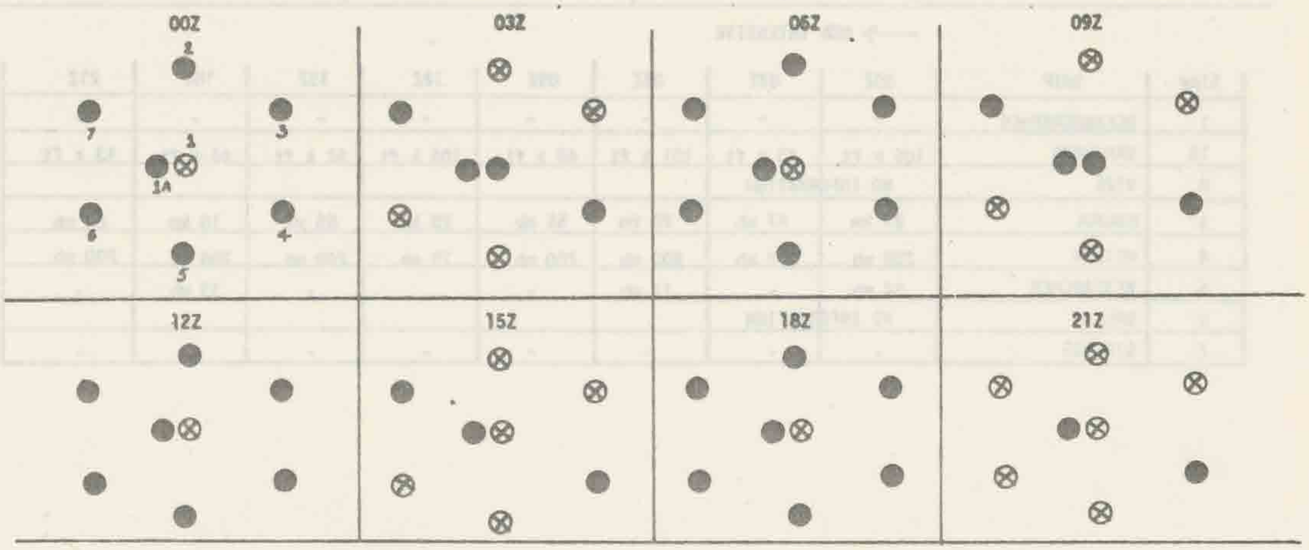
DATE: 7/14 (195)



INTENSIVE ←→ NON INTENSIVE

STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	-	107 mb	-	72 mb	-	70 mb	-	126
1A	VANGUARD								
2	VIZE	NO INFORMATION							
3	QUADRA	17 km	260 mb	19 km	70 mb	17 km	33 mb	23 km	-
4	METEOR	200 mb	200 mb	40 mb	700 mb	200 mb	200 mb	700 mb	200 mb
5	RESEARCHER	106 mb	78 mb	9 mb	65 mb	31 mb	-	24 mb	-
6	DALLAS	NO INFORMATION							
7	GILLISS	136	-	657 mb	28 mb	647 mb	257 mb	150 mb	179 mb

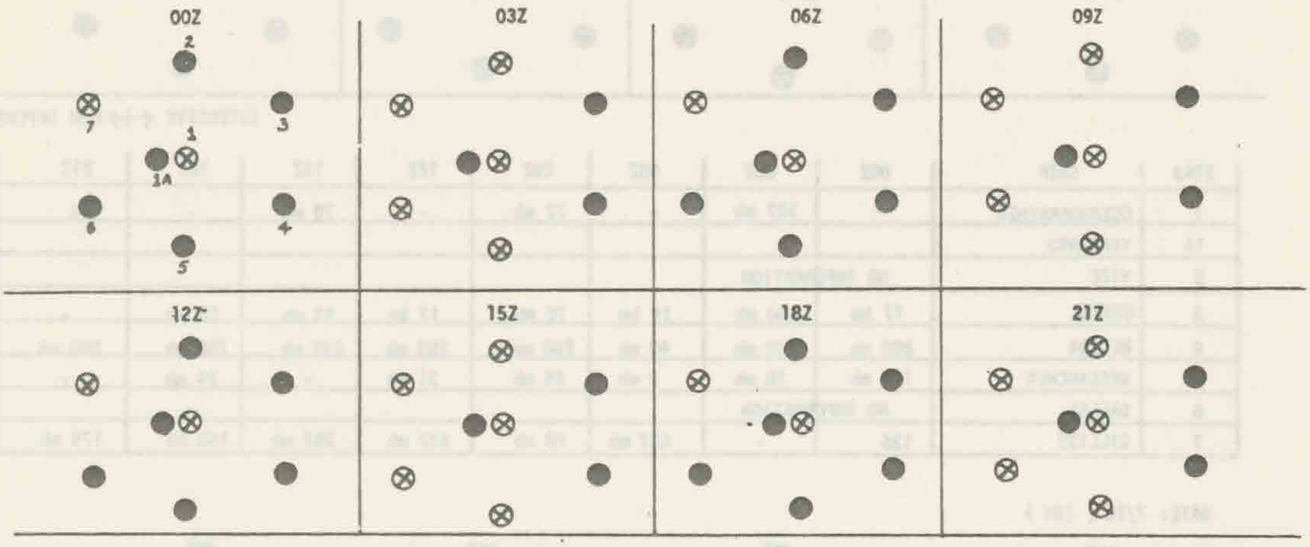
DATE: 7/15 (196)



NON INTENSIVE

STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	-	585 mb	-	72 mb	-	-	-	-
1A	VANGUARD	56 k ft	4 k ft	89 k ft	72 k ft	96 k ft	52 k ft	99 k ft	42 k ft
2	VIZE	NO INFORMATION							
3	QUADRA	16 km	-	17 km	-	23 km	-	20 km	-
4	METEOR	200 mb	50 mb	90 mb	200 mb	18 km	26 km	200 mb	200 mb
5	RESEARCHER	14 mb	-	12 mb	-	250 mb	-	44 mb	-
6	DALLAS	NO INFORMATION							
7	GILLISS	300 mb	388 mb	111 mb	32 mb	83 mb	196 mb	364 mb	-

DATE: 7/16 (197)

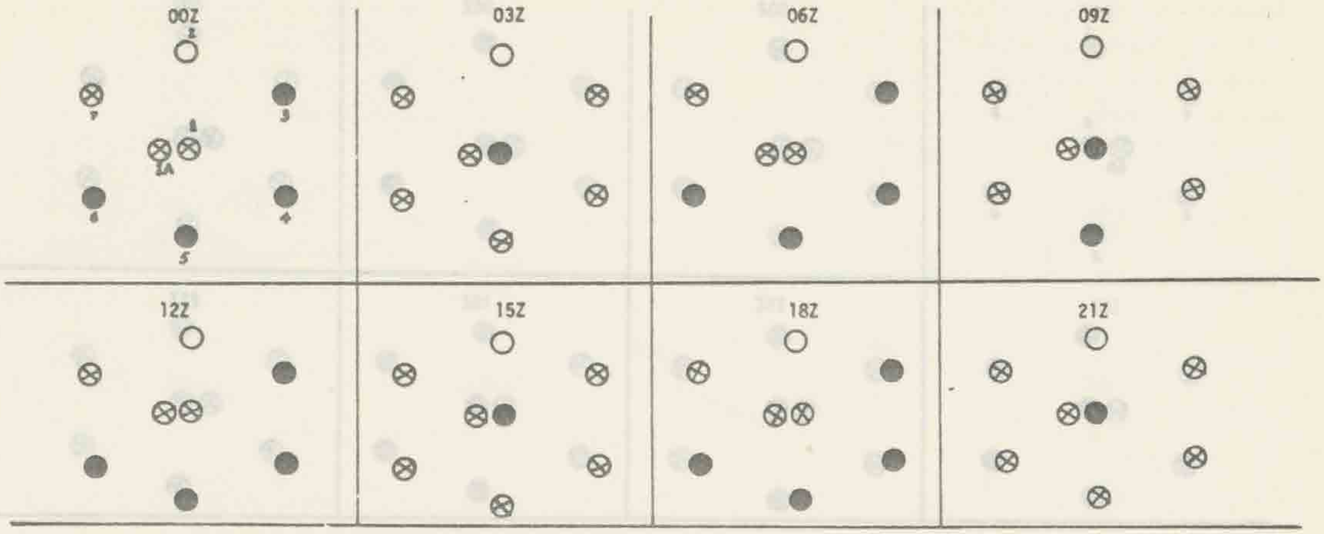


⟶ NON INTENSIVE

STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	-	-	-	-	-	-	-	-
1A	VANGUARD	106 k ft	43 k ft	101 k ft	48 k ft	105 k ft	52 k ft	94 k ft	43 k ft
2	VIZE	NO INFORMATION							
3	QUADRA	24 km	47 mb	20 km	55 mb	20 km	65 mb	18 km	63 mb
4	METEOR	200 mb	200 mb	200 mb	200 mb	70 mb	200 mb	200 mb	200 mb
5	RESEARCHER	24 mb	-	17 mb	-		-	33 mb	-
6	DALLAS	NO INFORMATION							
7	GILLISS	-	-	-	-	-	-	-	-

PHASE II

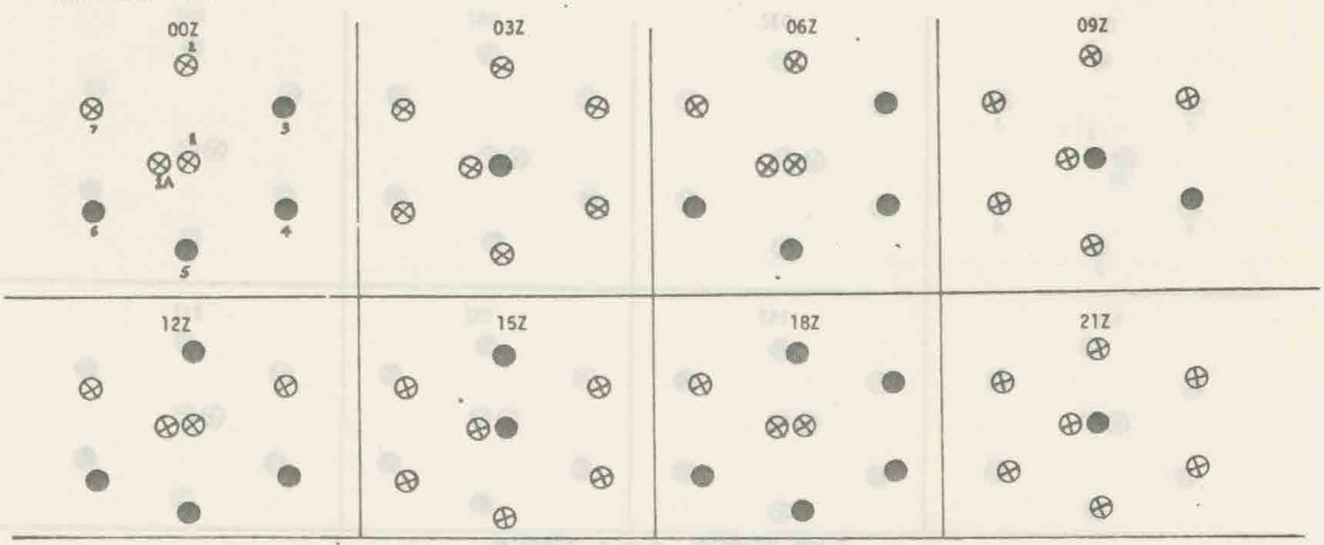
DATE: 7/28 (209)



B NON INTENSIVE ⟶
A/3 NON INTENSIVE ⟶

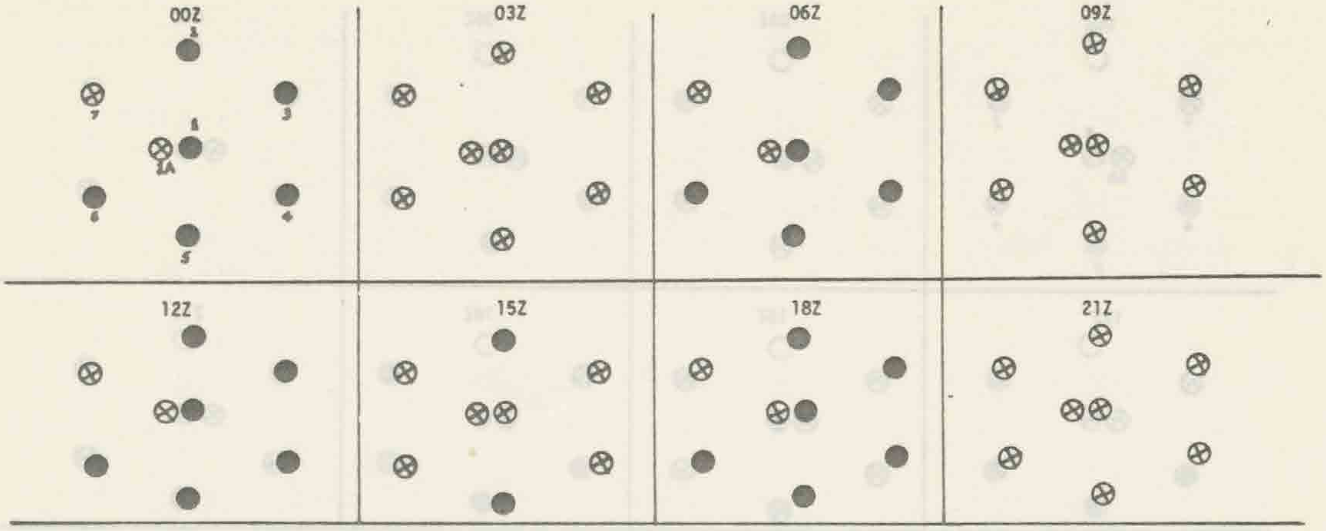
STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	-	86.8 mb	-	72.3 mb	-	70.8 mb	-	87.8 mb
1A	VIZE	NO INFORMATION							
2	VANGUARD	-	-	-	-	-	-	-	-
3	QUADRA	16 km	-	12 km	-	15 km	-	29 km	-
4	METEOR	19 km	-	10 km	-	21 km	-	24 km	-
5	RESEARCHER	96.3 mb	-	141.8 mb	171.3 mb	25.3 mb	-	38.3 mb	-
6	DALLAS	174 mb	-	179 mb	-	122 mb	-	414 mb	-
7	GILLISS	-	-	-	-	-	-	-	-

DATE: 7/29 (210)



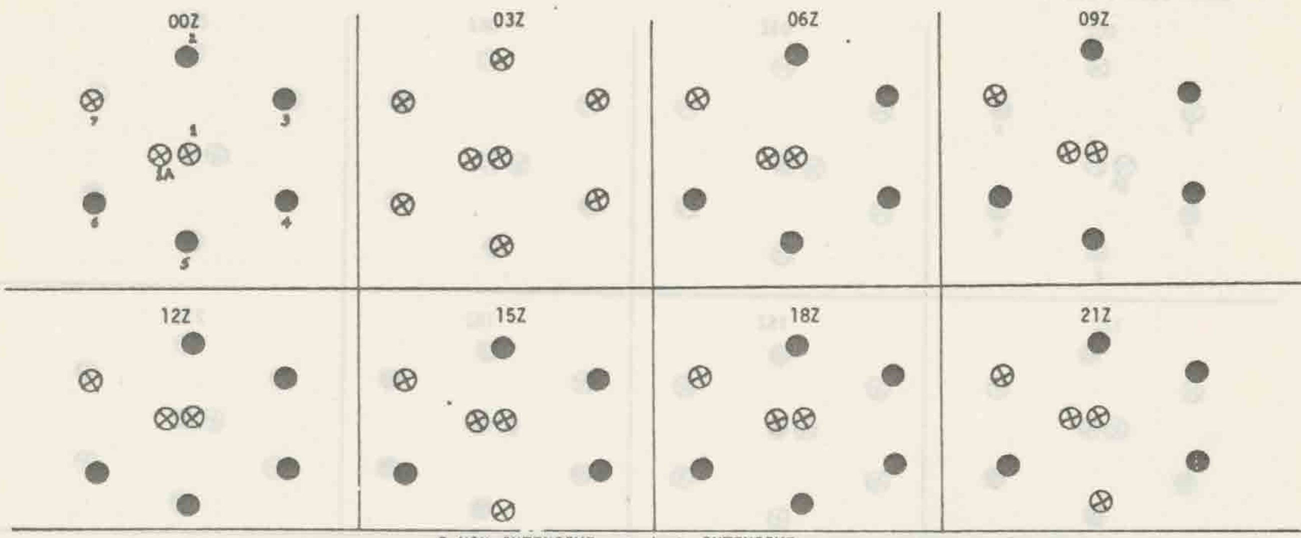
STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	-	100 mb	-	70.3 mb	-	71.8 mb	-	69.3 mb
1A	VIZE	NO INFORMATION							
2	VANGUARD	-	-	-	-	5 km	14 km	23 km	-
3	QUADRA	20 km	-	19 km	-	-	-	24 km	-
4	METEOR	24 km	-	16 km	19 km	23 km	-	28 km	-
5	RESEARCHER	88.3 mb	-	116 mb	-	313.8 mb	-	12.8 mb	-
6	DALLAS	270 mb	-	88 mb	-	70 mb	-	130 mb	-
7	GILLISS	-	-	-	-	-	-	-	-

DATE: 7/30 (211)



STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	153.3 mb	-	71.8 mb	-	65.8 mb	-	68.3 mb	-
1A	VIZE	NO INFORMATION							
2	VANGUARD	24 km	-	22 km	-	26 km	16 km	26 km	-
3	QUADRA	15 km	-	28 km	-	27 km	-	26 km	-
4	METEOR	28 km	-	28 km	-	22 km	-	21 km	-
5	RESEARCHER	22.3 mb	-	28.8 mb	-	29.3 mb	25.8 mb	17.8 mb	-
6	DALLAS	853 mb	-	71 mb	-	72 mb	-	73 mb	-
7	GILLISS	-	-	-	-	-	-	-	-

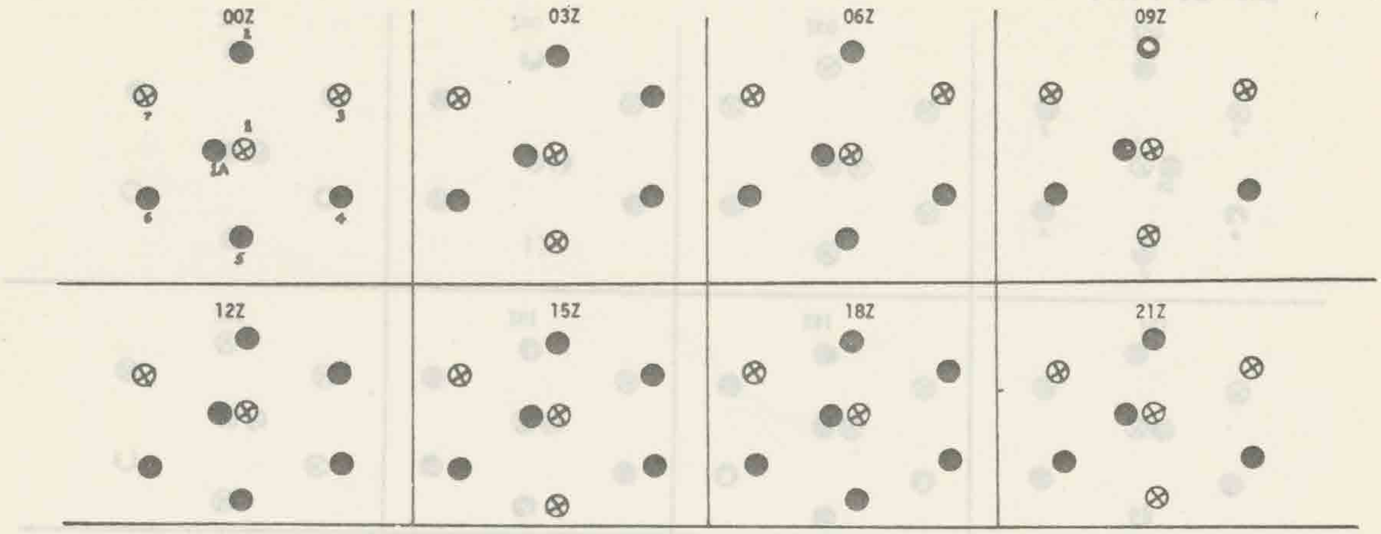
DATE: 7/31 (212)



B NON INTENSIVE ⟷ INTENSIVE
A/B NON INTENSIVE ⟷ INTENSIVE

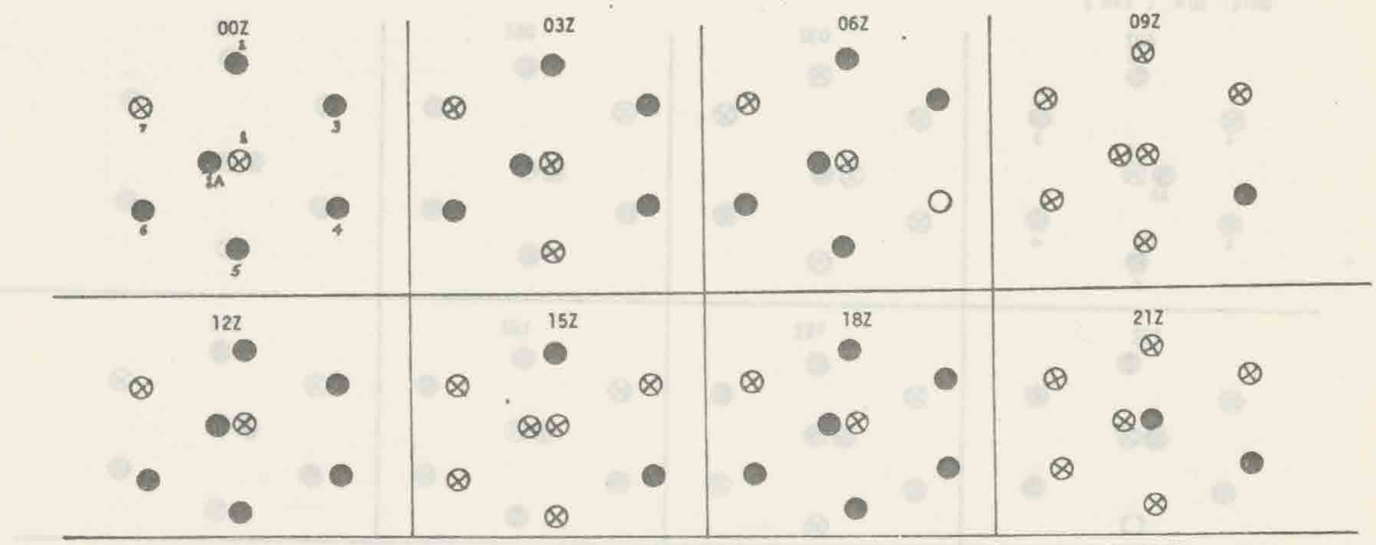
STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	-	-	-	-	-	-	-	-
1A	VIZE	NO INFORMATION							
2	VANGUARD	26 km	-	24 km	22 km	28 km	24 km	24 km	25 km
3	QUADRA	24 km	-	10 km	56 mb	21 km	36 mb	22 km	200 mb
4	METEOR	29 km	-	26 km	31 km	24 km	29 km	17 km	27 km
5	RESEARCHER	27.3 mb	-	168.8 mb	43.3 mb	39.3 mb	-	12.8 mb	-
6	DALLAS	103 mb	-	249 mb	33 mb	334 mb	250 mb	213 mb	74 mb
7	GILLISS	-	-	-	-	-	-	-	-

DATE: 8/1 (213)



STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	-	-	-	-	-	-	-	-
1A	VIZE	NO INFORMATION							
2	VANGUARD	32 km	55 mb	35 mb	22 mb	30 km	25 km	28 km	17 km
3	QUADRA	-	500 mb	-	-	19 km	200 mb	18 km	
4	METEOR	27 km	22 km	23 km	28 km	19 km	29 km	29 km	18 km
5	RESEARCHER	12.8 mb	-	25.3 mb	-	35.8 mb	-	10.8 mb	-
6	DALLAS	402 mb	247 mb	482 mb	69 mb	760 mb	71 mb	104 mb	74 mb
7	GILLISS	-	-	-	-	-	-	-	-

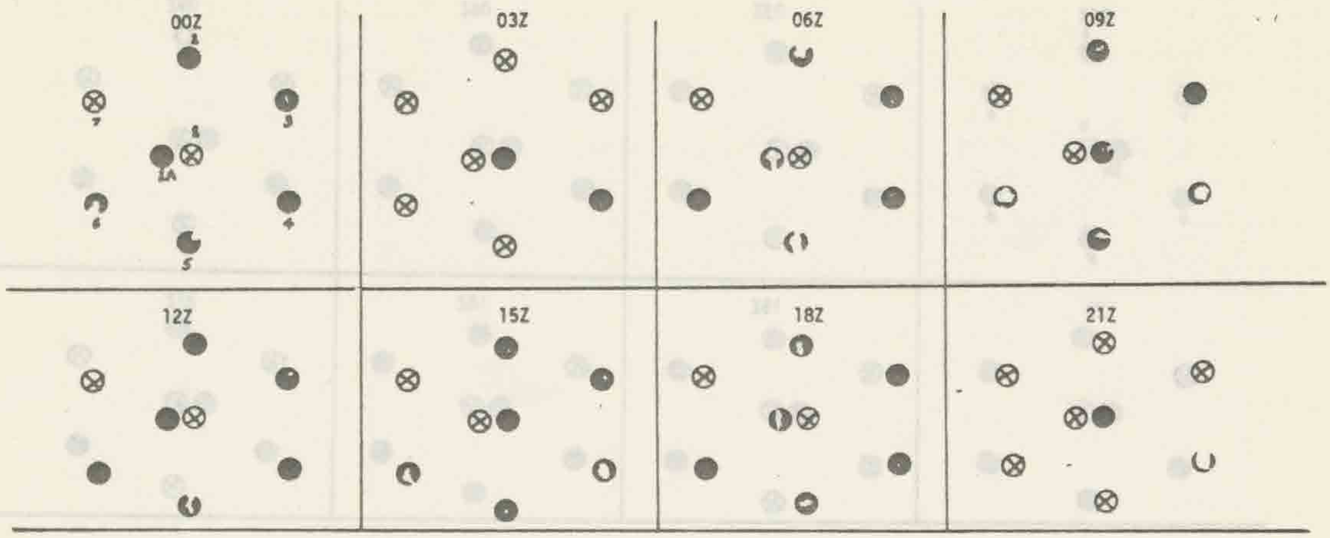
DATE: 8/2 (214)



B INTENSIVE ⟷ NON INTENSIVE
A/B INTENSIVE ⟷ NON INTENSIVE

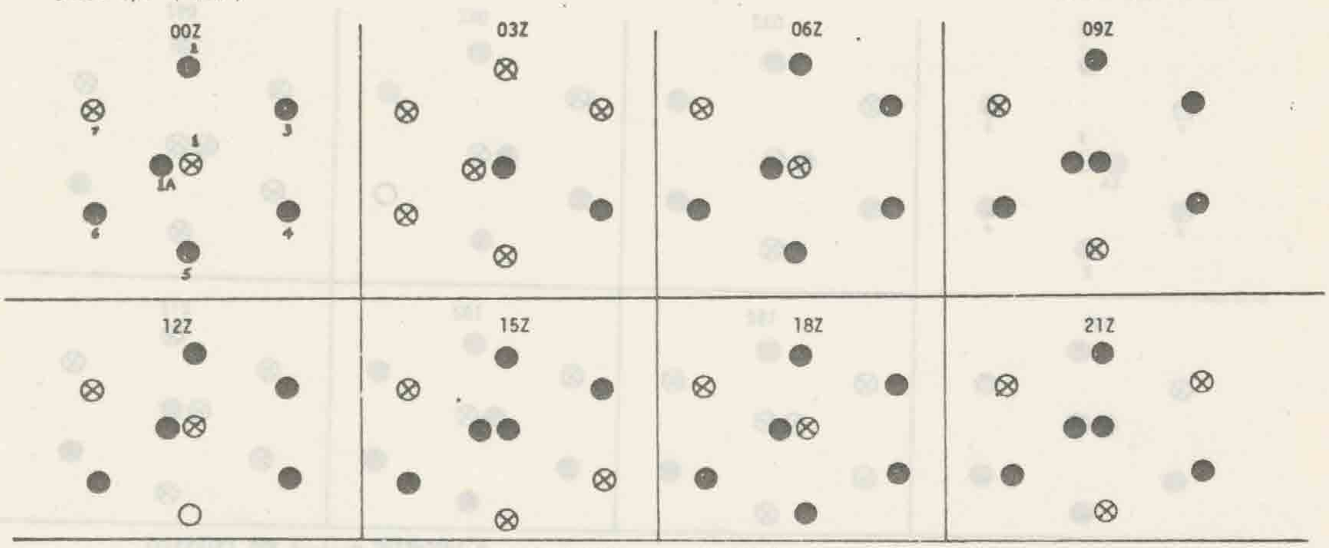
STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	-	-	-	-	-		-	101.3 mb
1A	VIZE	NO INFORMATION							
2	VANGUARD	32 km	23 km	22 km	-	30 km	15 km	21 km	-
3	QUADRA	17 km	200 mb	18 km	-	22 km	-	27 km	-
4	METEOR	20 km	26 km	27 km	20 km	31 km	3 km	14 km	14 km
5	RESEARCHER	8.3 mb	-	153.3 mb	-	19.3 mb	-	20.8 mb	-
6	DALLAS	116 mb	13 mb	70 mb	-	191 mb	-	358 mb	-
7	GILLISS	-	-	-	-	-	-	-	-

DATE: 8/3 (215)



STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	-	71.8 mb	-	72.3 mb	-	62.8 mb	-	68.8 mb
1A	VIZE	NO INFORMATION							
2	VANGUARD	32 km	-	24 km	25 km	29 km	22 km	23 km	-
3	QUADRA	21 km	-	28 km	200 mb	19 km	200 mb	28 km	-
4	METEOR	16 km	21 km	11 km	26 km	32 km	15 km	32 km	23 km
5	RESEARCHER	20.8 mb	-	98.8 mb	10.3 mb	17.3 mb	71.8 mb	12.3 mb	-
6	DALLAS	113 mb	-	70 mb	129 mb	71 mb	33 mb	72 mb	-
7	GILLISS	-	-	-	-	-	-	-	-

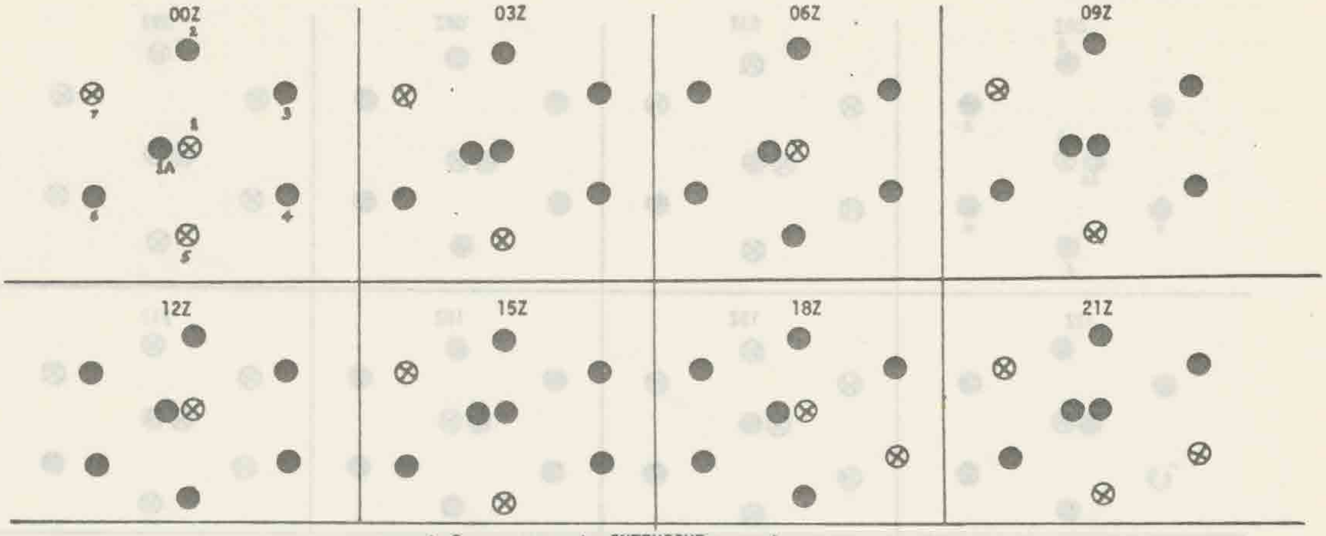
DATE: 8/4 (216)



NON INTENSIVE → INTENSIVE →
NON INTENSIVE →

STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	-	70.8 mb	-	71.3 mb	-	59.3 mb	-	71.3 mb
1A	VIZE	NO INFORMATION							
2	VANGUARD	32 km	-	11 km	22 km	29 km	23 km	21 km	21 km
3	QUADRA	23 km	-	28 km	200 mb	5 km	200 mb	22 km	-
4	METEOR	21 km	29 km	19 km	23 km	20 km	-	22 km	4 km
5	RESEARCHER	15.8 mb	-	29.3 mb	-	14.3 mb	-	17.3 mb	-
6	DALLAS	99 mb	-	93 mb	71 mb	72 mb	71 mb	74 mb	94 mb
7	GILLISS	-	-	-	-	-	-	-	-

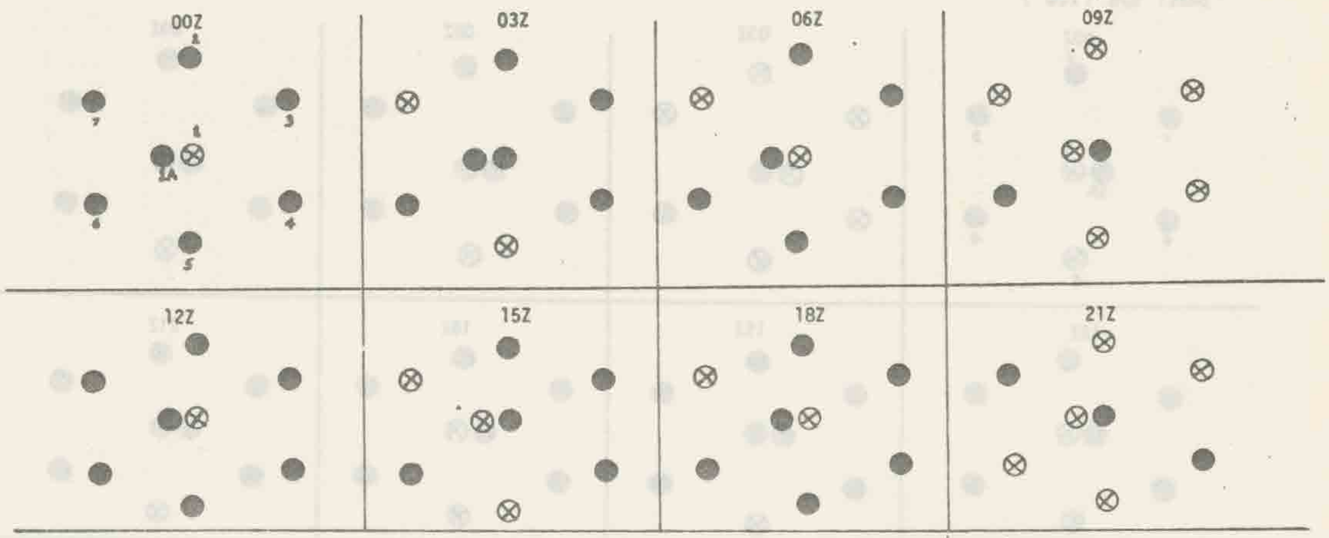
DATE: 8/5 (217)



→ B → INTENSIVE →
A/B NON INTENSIVE ←|→ INTENSIVE

STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	-	70.3 mb	-	70.8 mb	-	71.3 mb	-	91.4 mb
1A	VIZE	NO INFORMATION							
2	VANGUARD	32 km	21 km	22 km	21 km	25 km	23 km	23 km	19 km
3	QUADRA	23 km	42 mb	16.5 km	34 mb	22.3 km	32 mb	16.7 km	94 mb
4	METEOR	29 km	24 km	26 km	29 km	23 km	23 km	-	-
5	RESEARCHER	-	-	54.3 mb	-	17.3 km	-	16.8 mb	-
6	DALLAS	121 mb	70 mb	95 mb	70 mb	70 mb	70 mb	71 mb	152 mb
7	GILLISS	-	-	70 mb	-	14 mb	-	60 mb	-

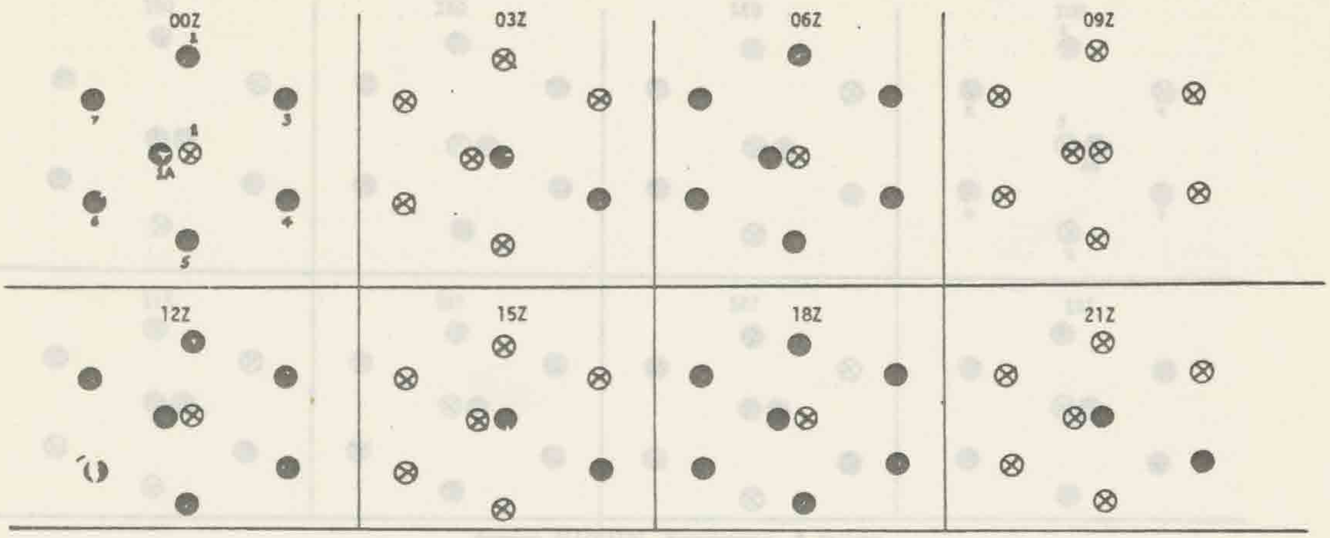
DATE: 8/6 (218)



B INTENSIVE ←|→ NON INTENSIVE
A/B INTENSIVE ←|→ NON INTENSIVE

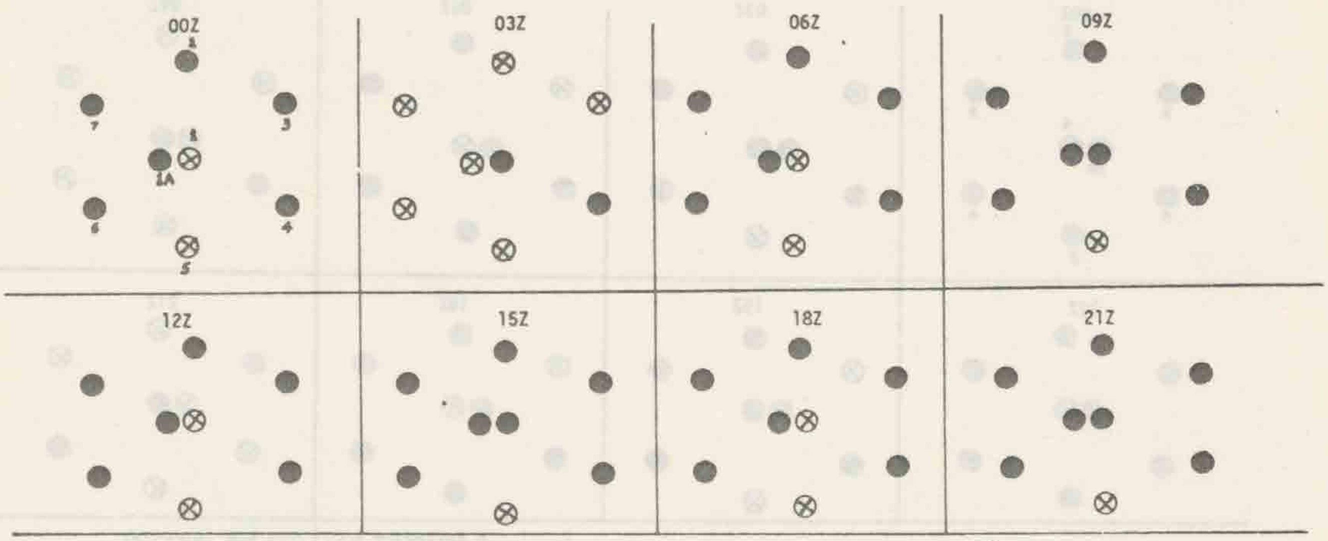
STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	-	270 mb	-	70.8 mb	-	65.8 mb	-	72.3 mb
1A	VIZE	NO INFORMATION							
2	VANGUARD	31 km	14 km	3 km	-	25 km	24 km	22 km	-
3	QUADRA	43 mb	65 mb	10 km	-	90 mb	-	25 km	-
4	METEOR	24 km	27 km	28 km	-	29 km	29 km	30 km	18 km
5	RESEARCHER	16.3 mb	-	122.3 mb	-	17.8 mb	-	19.8 mb	-
6	DALLAS	263 mb	386 mb	171 mb	71 mb	168 mb	143 mb	70 mb	-
7	GILLISS	194 mb	-	-	-	70 mb	-	-	119 mb

DATE: 8/7 (219)



STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	-	71.8 mb	-	-	-	61.8 mb	-	116 mb
1A	VIZE	NO INFORMATION							
2	VANGUARD	30 km	-	24 km	-	31 km	-	24 km	-
3	QUADRA	22 km	-	23 km	-	24 km	-	24 km	-
4	METEOR	24 km	22 km	23 km	-	28 km	29 km	27 km	25 km
5	RESEARCHER	18.8 mb	-	19.3 mb	-	17.3 mb	-	36.8 mb	-
6	DALLAS	74 mb	-	433 mb	-	105 mb	-	73 mb	-
7	GILLISS	95 mb	-	67 mb	-	110 mb	-	11 mb	-

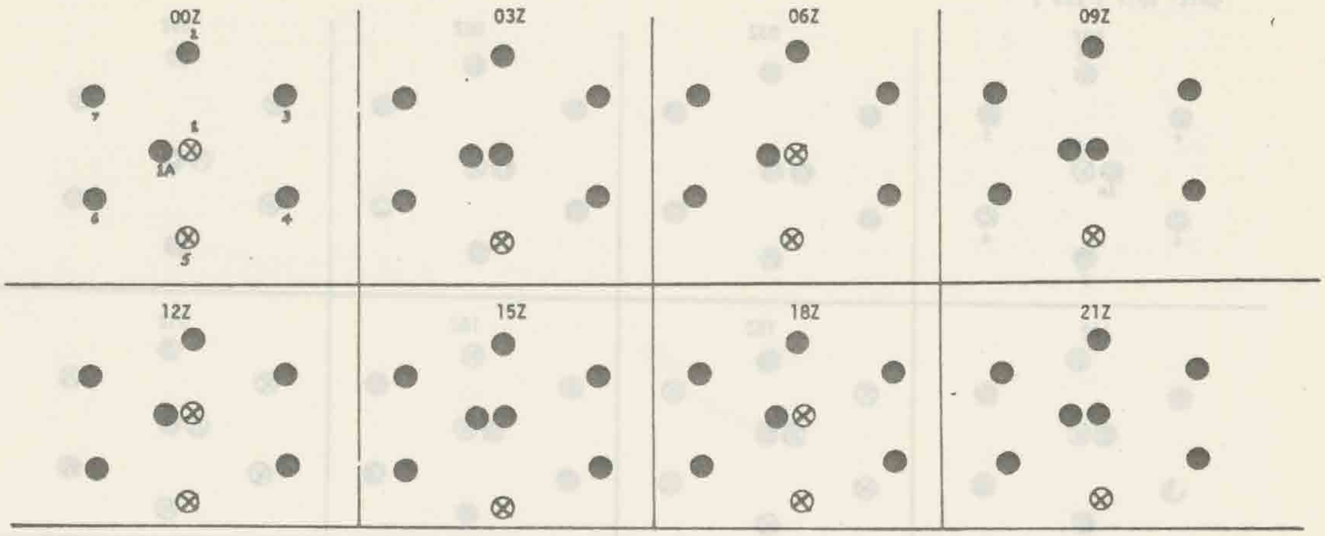
DATE: 8/8 (220)



B NON INTENSIVE ←—|—→ B INTENSIVE
A/B NON INTENSIVE ←—|—→ A/B INTENSIVE

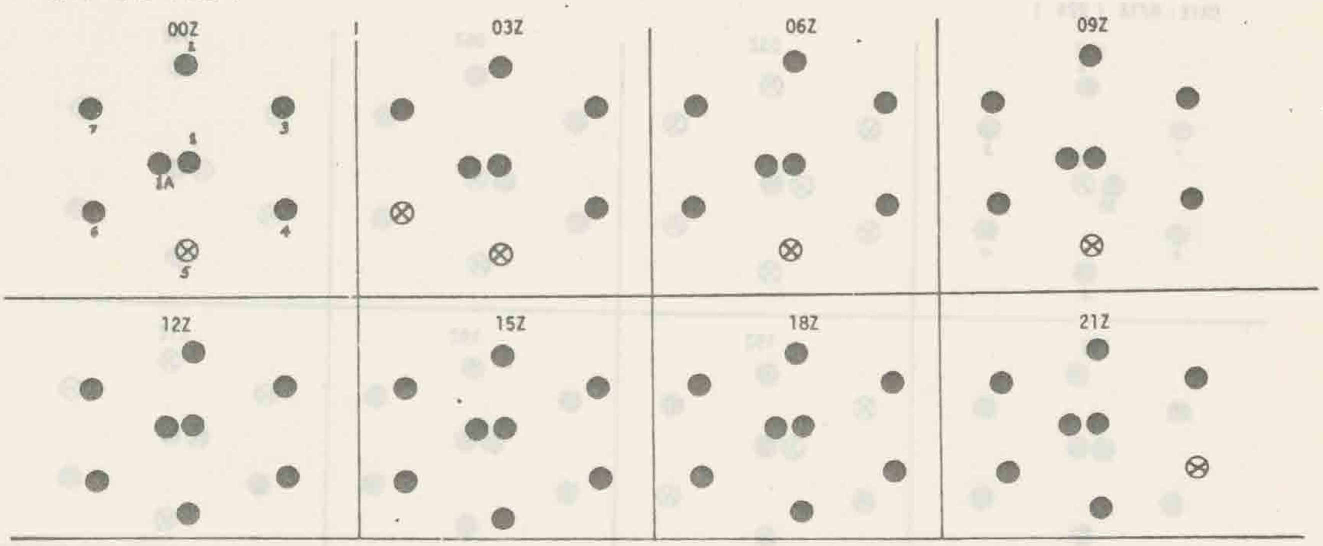
STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	-	104 mb	-	70.8 mb	-	60 mb	-	70 mb
1A	VIZE	NO INFORMATION							
2	VANGUARD	4 km	-	23 km	5 km	20 km	23 km	25 km	21 km
3	QUADRA	28 km	-	9 km	200 mb	24 km	200 mb	23 km	200 mb
4	METEOR	16 km	28 km	22 km	26 km	27 km	30 km	29 km	12 km
5	RESEARCHER	-	-	-	-	-	-	-	-
6	DALLAS	102 mb	-	110 mb	293 mb	72 mb	85 mb	71 mb	75 mb
7	GILLISS	18 mb	-	250 mb	500 mb	70 mb	[illegible]	100 mb	93 mb

DATE: 8/9 (221)



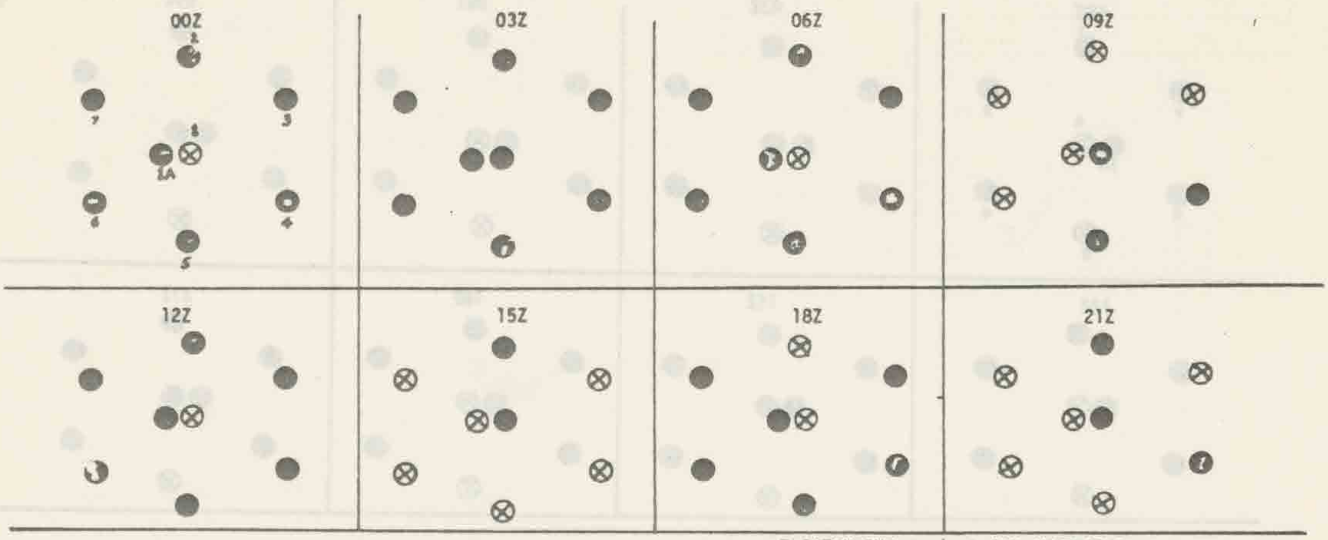
STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	-	100 mb	-	70 mb	-	64 mb	-	70 mb
1A	VIZE	NO INFORMATION							
2	VANGUARD	26 km	11 km	21 km	48 mb	30 km	24 km	22 km	15 km
3	QUADRA	23 km	UNK	22 km	200 mb	23 km	UNK	4 km	UNK
4	METEOR	22 km	23 km	26 km	29 km	18 km	18 km	21 km	18 km
5	RESEARCHER	-	-	-	-	-	-	-	-
6	DALLAS	72 mb	630 mb	70 mb	151 mb	76 mb	71 mb	92 mb	729 mb
7	GILLISS	804 mb	25 mb	65 mb	43 mb	69 mb	70 mb	76 mb	107 mb

DATE: 8/10 (222)



STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	72 mb	71.2 mb	70.3 mb	70.3 mb	64.8 mb	61.8 mb	69.3 mb	78 mb
1A	VIZE	NO INFORMATION							
2	VANGUARD	31 km	17 km	18 km	20 km	17 km	23 km	23 km	30 km
3	QUADRA	23 km	UNK	15 km	200 mb	13 km	200 mb	10 km	UNK
4	METEOR	6 km	24 km	24 km	23 km	16 km	19 km	21 km	-
5	RESEARCHER	-	-	-	-	43.8 mb	54.8 mb	31.3 mb	60.8 mb
6	DALLAS	408 mb	-	134 mb	158 mb	70 mb	71 mb	163 mb	560
7	GILLISS	73 mb	129 mb	90 mb	67 mb	139 mb	45 mb	68 mb	90 mb

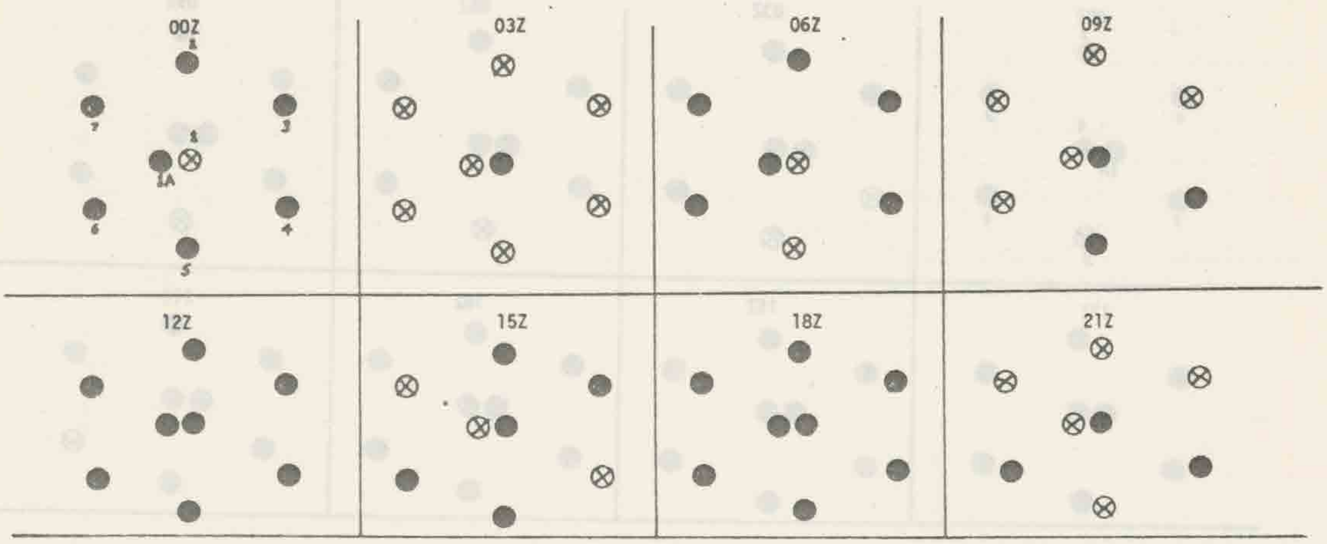
DATE: 8/11 (223)



B INTENSIVE ⟷ NON INTENSIVE
A/B INTENSIVE ⟷ NON INTENSIVE

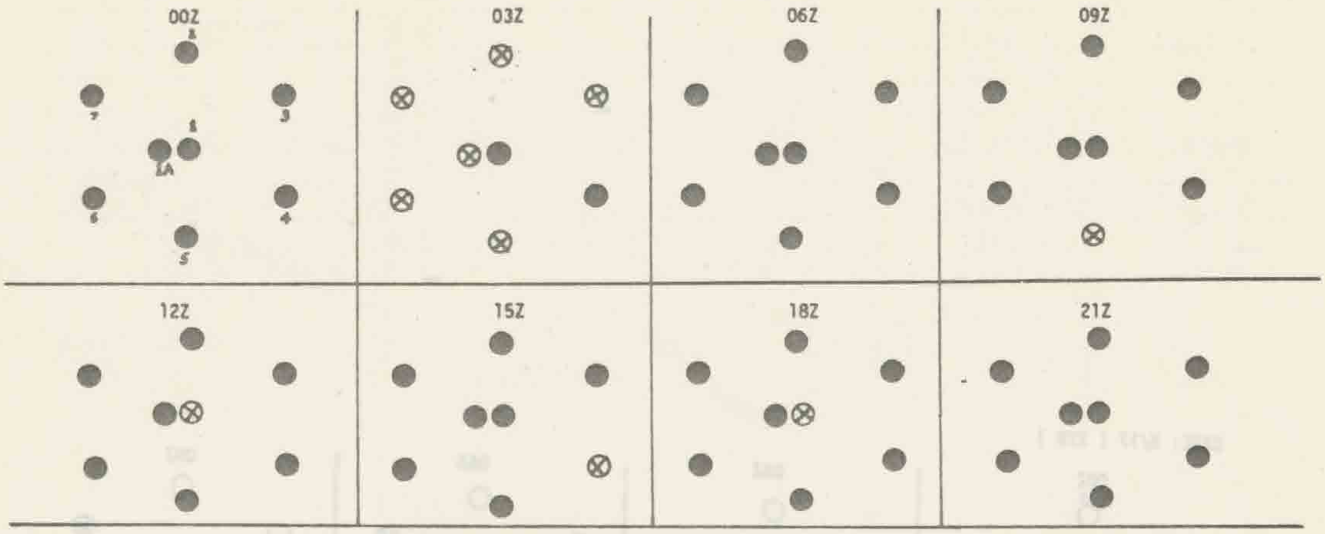
STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	-	111.8 mb	-	70.8 mb	-	70 mb	-	96 mb
1A	VIZE	NO INFORMATION							
2	VANGUARD	22 km	7 km	23 km	-	31 km	22 km	-	-
3	QUADRA	20 km	200 mb	20 km	-	26 km	-	22 km	-
4	METEOR	5 km	18 km	28 km	26 km	32 km	-	27 km	25 km
5	RESEARCHER	5.8 mb	60.8 mb	16.3 mb	31.8 mb	28.3 mb	-	39.8 mb	-
6	DALLAS	70 mb	83 mb	101 mb	-	73 mb	-	281 mb	-
7	GILLISS	67 mb	91 mb	63 mb	-	65 mb	-	91 mb	-

DATE: 8/12 (224)



STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	-	70 mb	-	87 mb	300 mb	68 mb	70 mb	70 mb
1A	VIZE	NO INFORMATION							
2	VANGUARD	17 km	-	24 km	-	23 km	22 km	24 km	-
3	QUADRA	21 km	-	28 km	-	22 km	UNK	28 km	-
4	METEOR	18 km	-	22 km	12 km	26 km	-	18 km	18 km
5	RESEARCHER	681 mb	-	-	20.3 mb	30.8 mb	133.8 mb	47.8 mb	-
6	DALLAS	72 mb	-	95 mb	-	702 mb	449 mb	383 mb	205 mb
7	GILLISS	10 mb	-	150 mb	-	174 mb	-	43 mb	-

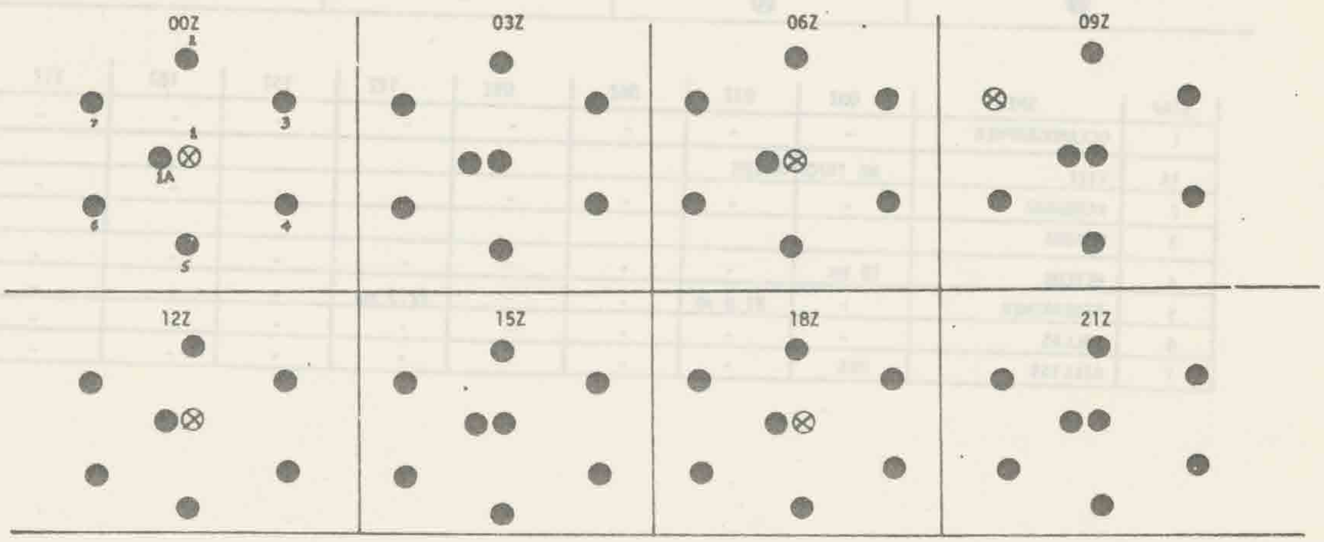
DATE: 8/13 (225)



A/B NON INTENSIVE ⟶ INTENSIVE
A/B NON INTENSIVE ⟶ INTENSIVE

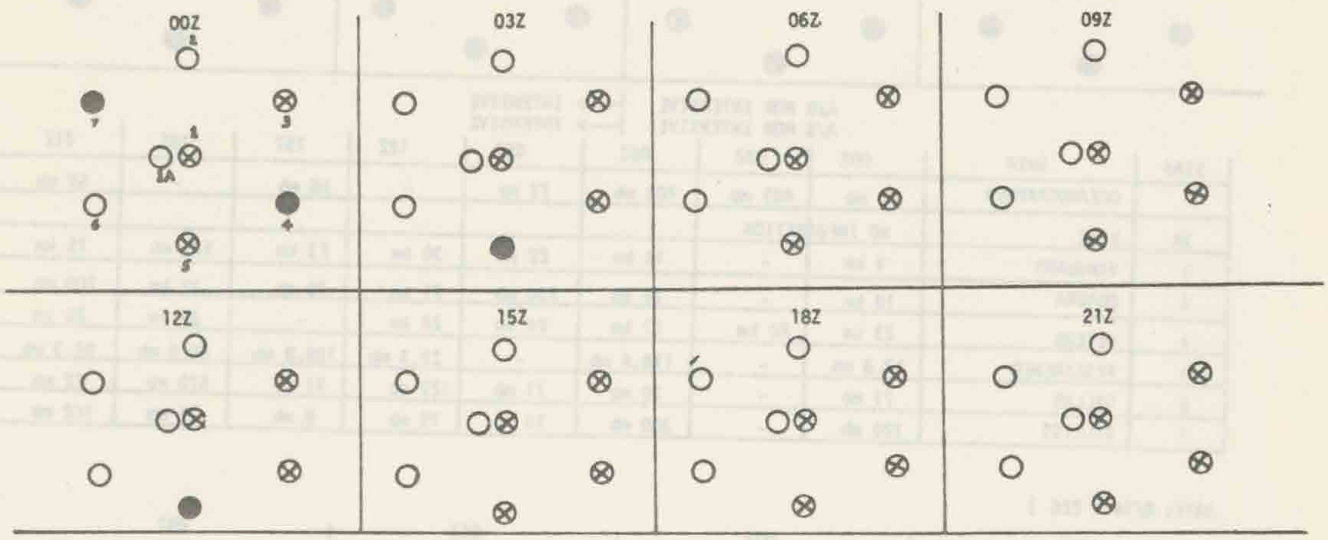
STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	70 mb	401 mb	400 mb	72 mb	-	66 mb	-	69 mb
1A	VIZE	NO INFORMATION							
2	VANGUARD	9 km	-	16 km	22 km	30 km	23 km	505 mb	15 km
3	QUADRA	18 km	-	19 km	200 mb	21 km	70 mb	22 km	200 mb
4	METEOR	23 km	20 km	17 km	24 km	29 km	-	33 km	26 km
5	RESEARCHER	17.8 mb	-	118.8 mb	-	22.3 mb	128.8 mb	40.8 mb	99.3 mb
6	DALLAS	71 mb	-	70 mb	71 mb	122 mb	71 mb	570 mb	72 mb
7	GILLISS	120 mb	-	300 mb	10 mb	75 mb	8 mb	11 mb	102 mb

DATE: 8/14 (226)



STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	-	96 mb	-	72 mb	-	66.3 mb	-	72.3 mb
1A	VIZE	NO INFORMATION							
2	VANGUARD	25 km	25 km	24 km	23 km	24 km	23 km	25 km	25 km
3	QUADRA	15 km	UNK	22 km	300 mb	19 km	200 mb	23 km	UNK
4	METEOR	21 km	20 km	19 km	23 km	35 km	30 km	18 km	35 km
5	RESEARCHER	28.3 mb	92.3 mb	134.8 mb	30.3 mb	33.3 mb	27.3 mb	36.8 mb	32.3 mb
6	DALLAS	71 mb	53 mb	76 mb	211 mb	258 mb	71 mb	792 mb	228 mb
7	GILLISS	15 mb	16 mb	70 mb	-	19 mb	387 mb	179 mb	14 mb

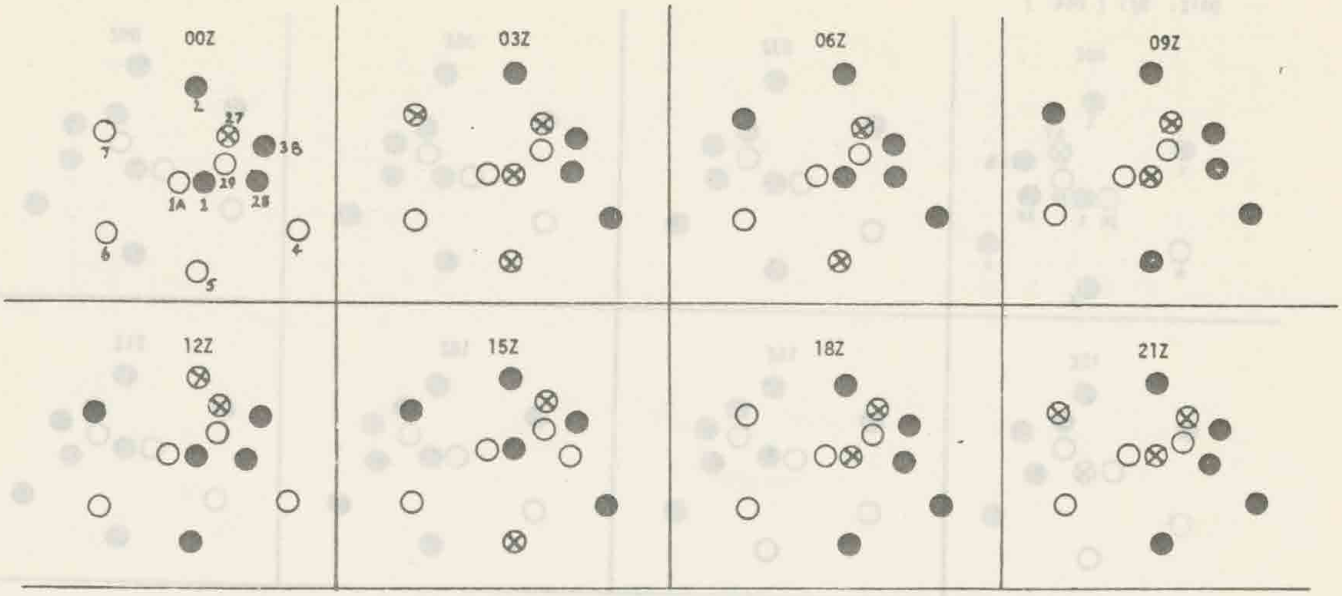
DATE: 8/17 (229)



STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	-	-	-	-	-	-	-	-
1A	VIZE	NO INFORMATION							
2	VANGUARD	-	-	-	-	-	-	-	-
3	QUADRA								
4	METEOR	18 km	-	-	-	-	-	-	-
5	RESEARCHER	-	81.8 mb	-	-	22.3 mb	-	-	-
6	DALLAS	-	-	-	-	-	-	-	-
7	GILLISS	UNK	-	-	-	-	-	-	-

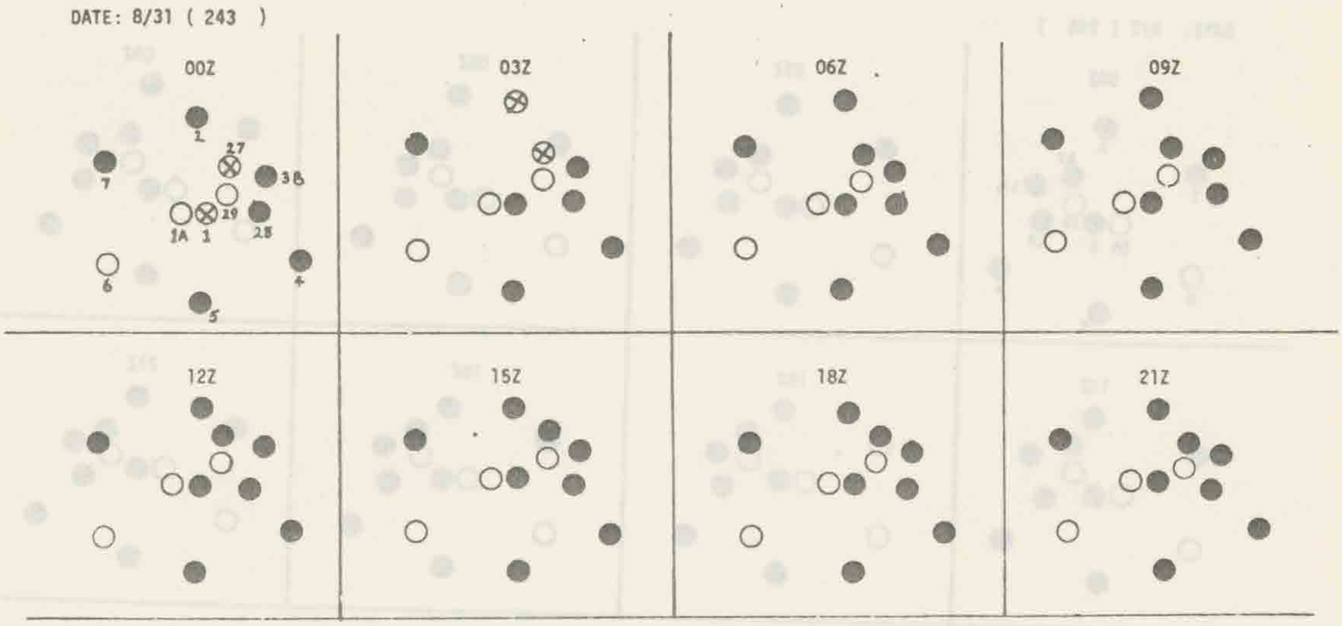
PHASE III

DATE: 8/30 (242)



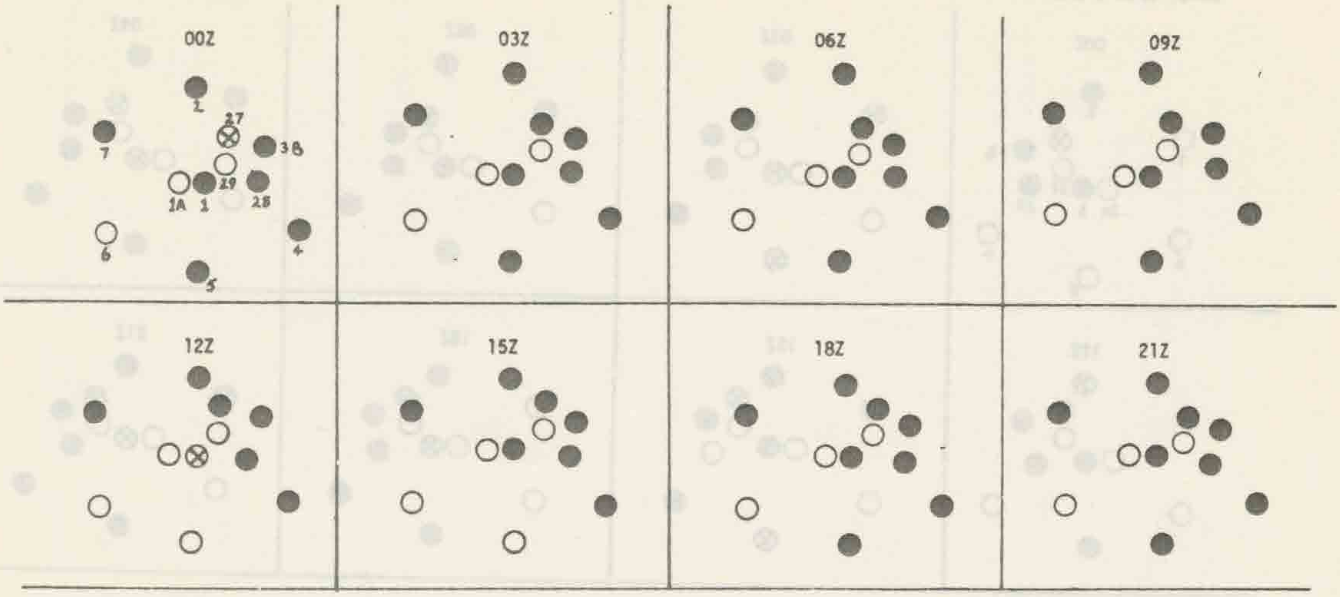
STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	METEOR	20 km	-	20 km	-	29 km	30 km		
1A	VIZE	NO INFORMATION							
2	VANGUARD	95 mb	20 mb	18 mb	39 mb	-	36 mb	36 mb	70 mb
3B	QUADRA	51 mb		85 mb		18 mb		22 mb	
4	OCEANOGRAPHER	266 mb	103 mb	70 mb	70 mb	219 mb	70 mb	70 mb	70 mb
5	RESEARCHER	-	-	-	60 mb	55 mb	-	44 mb	13 mb
6	BIDASSOA	NO INFORMATION							
7	GILLISS	438 mb	-	150	70	70	62	207	-
27	PLANET	-	-	-	-	-	-	-	-
28	DALLAS	70 mb	123 mb	99 mb	70 mb	70 mb	309 mb	180 mb	70
29	HECLA	SEE SEPARATE SHEET.							

DATE: 8/31 (243)



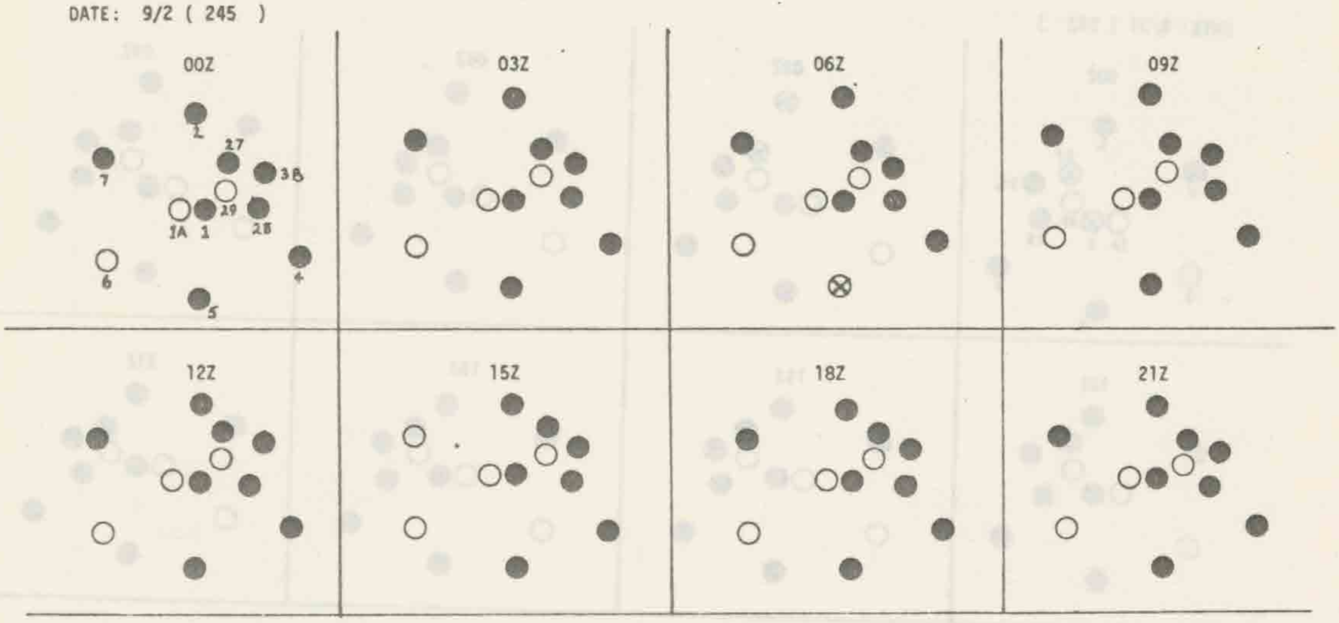
STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	METEOR	-	27 km	24 km	18 km	26 km	21 km	30 km	16 km
1A	VIZE	NO INFORMATION							
2	VANGUARD	7 mb	-	7 mb	213 mb	56 mb	70 mb	29 mb	27 mb
3B	QUADRA	20 mb		25 mb		850 mb		31 mb (MET)	
4	OCEANOGRAPHER	70 mb	70 mb	70 mb	70 mb	70 mb	70 mb	70 mb	76 mb
5	RESEARCHER	15 mb	11 mb	54 mb	29 mb	15 mb	38 mb	30 mb	31 mb
6	BIDASSOA	NO INFORMATION							
7	GILLISS	109 mb	67	172	84	150	41	67	62
27	PLANET	-	-	70 mb	448 mb	13 mb	232 mb	35 mb	46 mb
28	DALLAS	88 mb	242	70	70	70	70	70	70
29	HECLA	SEE SEPARATE SHEET.							

DATE: 9/1 (244)



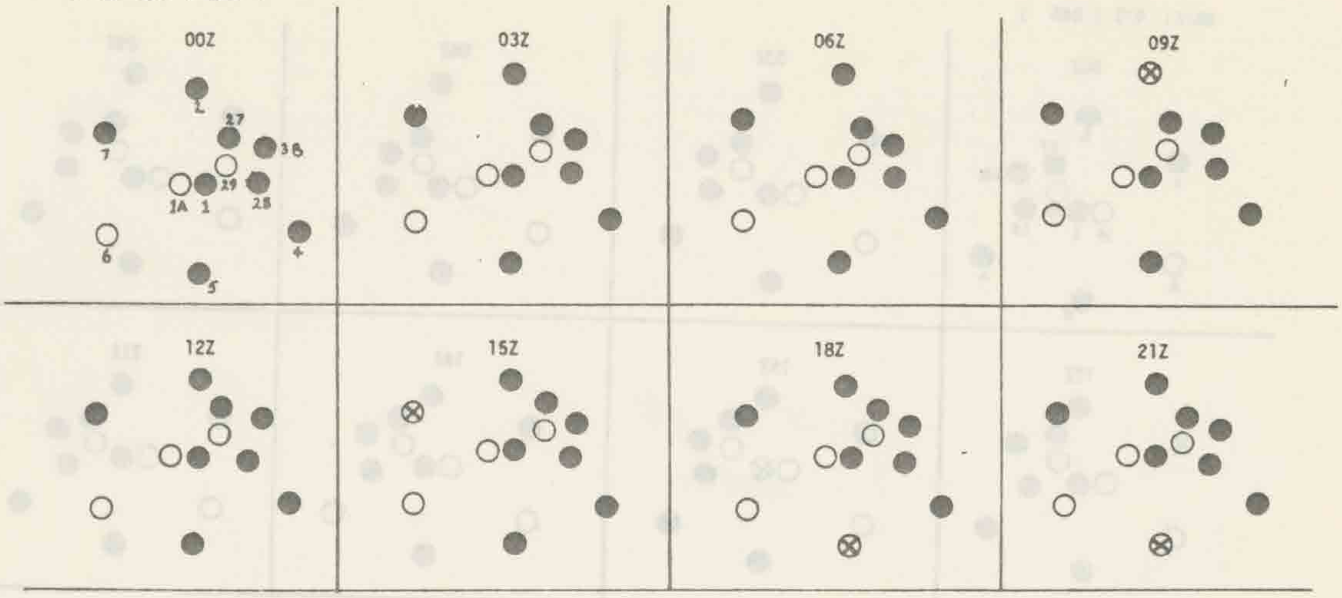
STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	METEOR	22 km	26 km	22 km	21 km	-	28 km	2 km	33 km
1A	VIZE	NO INFORMATION							
2	VANGUARD	16 mb	96 mb	9 mb	67 mb	15 mb	69 mb	21 mb	62 mb
38	QUADRA	24 mb		25 mb		36 mb		15 mb	
4	OCEANOGRAPHER	234 mb	70 mb	70 mb	147 mb	70 mb	70 mb	70 mb	70 mb
5	RESEARCHER	16 mb	46 mb	76 mb	39 mb	37 mb	38 mb	32 mb	19 mb
6	BIDASSOA	NO INFORMATION							
7	GILLISS	61 mb	105	300	92	237	48	64	63
27	PLANET	-	22 mb	92 mb	45 mb	29 mb	24 mb	71 mb	717 mb
28	DALLAS	70 mb	70 mb	70 mb	70 mb	165	119	70	70
29	HECLA	SEE SEPARATE SHEET.							

DATE: 9/2 (245)



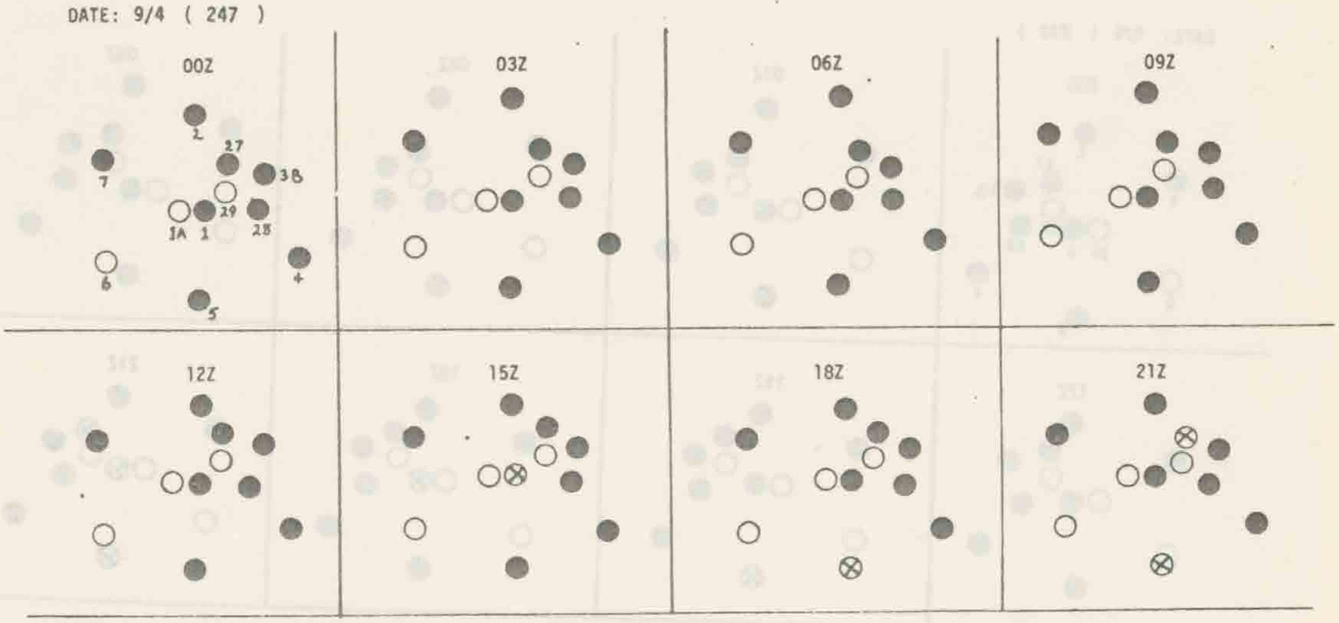
STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	METEOR	13 km	27 km	23 km	28 km	10 km	14 km	2 km	16 km
1A	VIZE	NO INFORMATION							
2	VANGUARD	9 mb	68 mb	8 mb	30 mb	24 mb	66 mb	963 mb	68 mb
38	QUADRA	12 mb		23 mb		15 mb (MET)		64 mb	
4	OCEANOGRAPHER	83 mb	67 mb	258 mb	70 mb	472 mb	474 mb	237 mb	70 mb
5	RESEARCHER	18 mb	19 mb	-	83 mb	30 mb	39 mb	26 mb	117 mb
6	BIDASSOA	NO INFORMATION							
7	GILLISS	66 mb	200	44	38	250	825	58	63
27	PLANET	33 mb	160 mb	12 mb	139 mb	13 mb	145 mb	774 mb	100 mb
28	DALLAS	70 mb	70	123	70	70	166	257	121
29	HECLA	SEE SEPARATE SHEET.							

DATE: 9/3 (246)



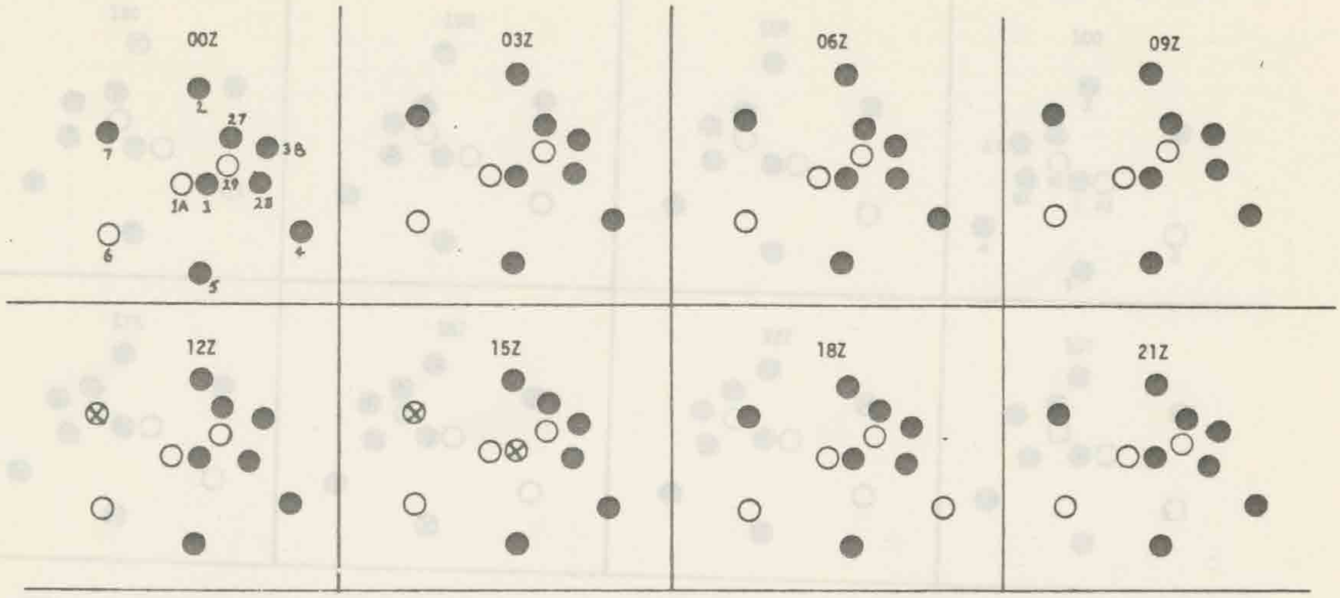
STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	METEOR	21 km	21 km	26 km	20 km	27 km	26 km	21 km	27 km
1A	VIZE	NO INFORMATION							
2	VANGUARD	11 mb	68 mb	12 mb	-	24 mb	65 mb	39 mb	68 mb
3B	QUADRA	38 mb		31 mb		607 mb (MET)		14 mb	
4	OCEANOGRAPHER	152 mb	154 mb	97 mb	70 mb	50 mb	55 mb	70 mb	70 mb
5	RESEARCHER	14 mb	24 mb	61 mb	25 mb	17 mb	20 mb	-	-
6	BIDASSOA	NO INFORMATION							
7	GILLISS	98 mb	58	70	100	77	-	57	61
27	PLANET	39 mb	13 mb	81 mb	104 mb	51 mb	12 mb	37 mb	878 mb
28	DALLAS	70 mb	166	228	554	130	70	70	70
29	HECLA	SEE SEPARATE SHEET.							

DATE: 9/4 (247)



STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	METEOR	25 km	27 km	17 km	30 km	27 km	-	21 km	18 km
1A	VIZE	NO INFORMATION							
2	VANGUARD	14 mb	66 mb	15 mb	70 mb	9 mb	62 mb	700 mb	69 mb
3B	QUADRA	16 mb		15 mb		310 mb		55 mb	
4	OCEANOGRAPHER	73 mb	70 mb	191 mb	70 mb	70 mb	680 mb	70 mb	70 mb
5	RESEARCHER	154 mb	59 mb	751 mb	26 mb	19 mb	62 mb	-	-
6	BIDASSOA	NO INFORMATION							
7	GILLISS	65 mb	52	100	70	500	70	54	62
27	PLANET	19 mb	30 mb	35 mb	128 mb	18 mb	53 mb	29 mb	-
28	DALLAS	94 mb	114	128	114	70	70	70	90
29	HECLA	SEE SEPARATE SHEET.							

DATE: 9/5 (248)

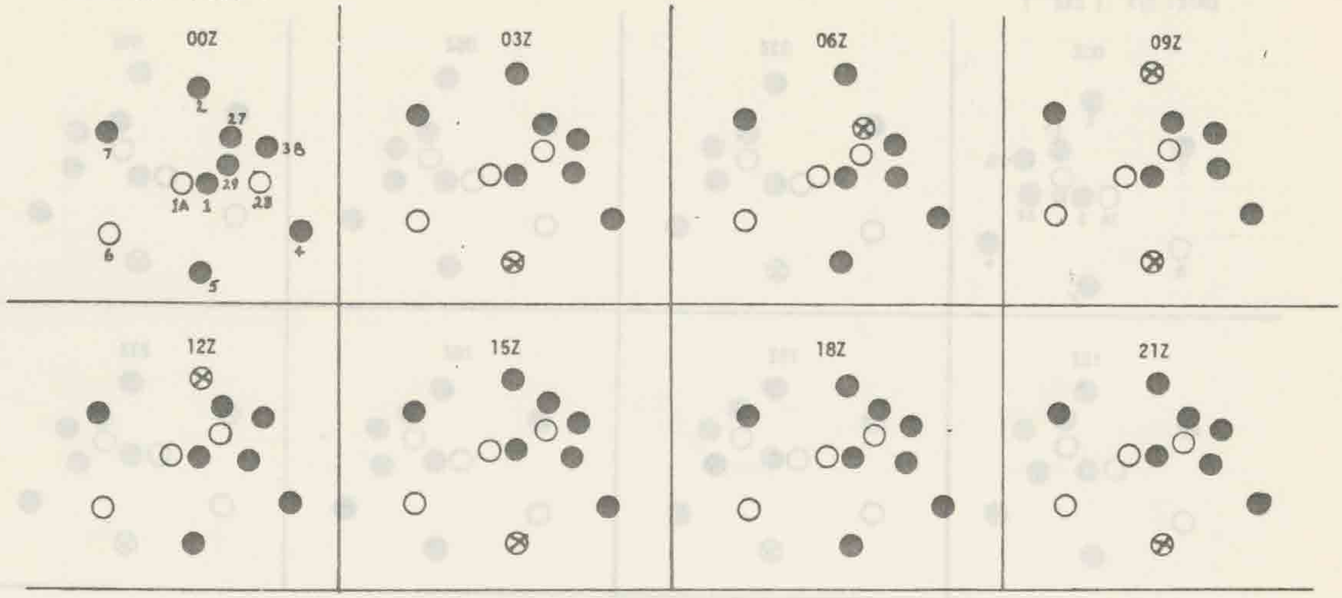


STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	METEOR	18 km	19 km	24 km	25 km	24 km	-	28 km	18 km
1A	VIZE	NO INFORMATION							
2	VANGUARD	10 mb	69 mb	82 mb	69 mb	19 mb	65 mb	23 mb	376 mb
3B	QUADRA	37 mb		51 mb		239mb (MET)		98 mb	
4	OCEANOGRAPHER	70 mb	140 mb	87 mb	70 mb	70 mb	70 mb	70 mb	72 mb
5	RESEARCHER	83 mb	79 mb	73 mb	75 mb	33 mb	27 mb	27 mb	128 mb
6	BIDASSOA	NO INFORMATION							
7	GILLISS	62 mb	40	111	450	-	-	58	90
27	PLANET	218 mb	67 mb	123 mb	108 mb	9 mb	19 mb	140 mb	53 mb
28	DALLAS	70 mb	70	220	175	70	70	129	218
29	HECLA	SEE SEPARATE SHEET.							

DATE: 9/6 (249)

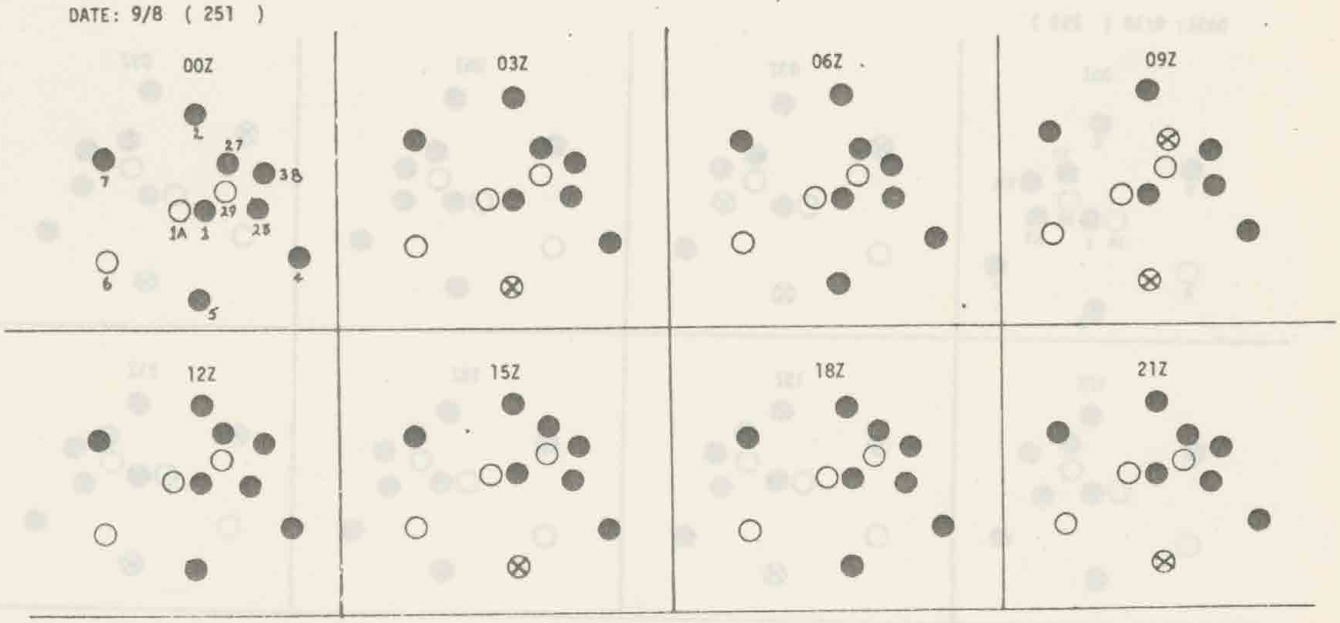
STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	METEOR	5 km	13 km	26 km	9 km	28 km	16 km	-	18 km
1A	VIZE	NO INFORMATION							
2	VANGUARD	424 mb	70 mb	8 mb	70 mb	41 mb	66 mb	10 mb	70 mb
3B	QUADRA	20 mb		30 mb		134 mb		19 mb	
4	OCEANOGRAPHER	132 mb	70 mb	70 mb	70 mb	70 mb	70 mb	123 mb	70 mb
5	RESEARCHER	96 mb	95 mb	120 mb	23 mb	26 mb	-	37 mb	-
6	BIDASSOA	NO INFORMATION							
7	GILLISS	60 mb	45	30	76	300	370	63	57
27	PLANET	54 mb	56 mb	34 mb	305 mb	12 mb	10 mb	14 mb	-
28	DALLAS	94 mb	70	70	70	137	91	86	129
29	HECLA	SEE SEPARATE SHEET.							

DATE: 9/7 (250)



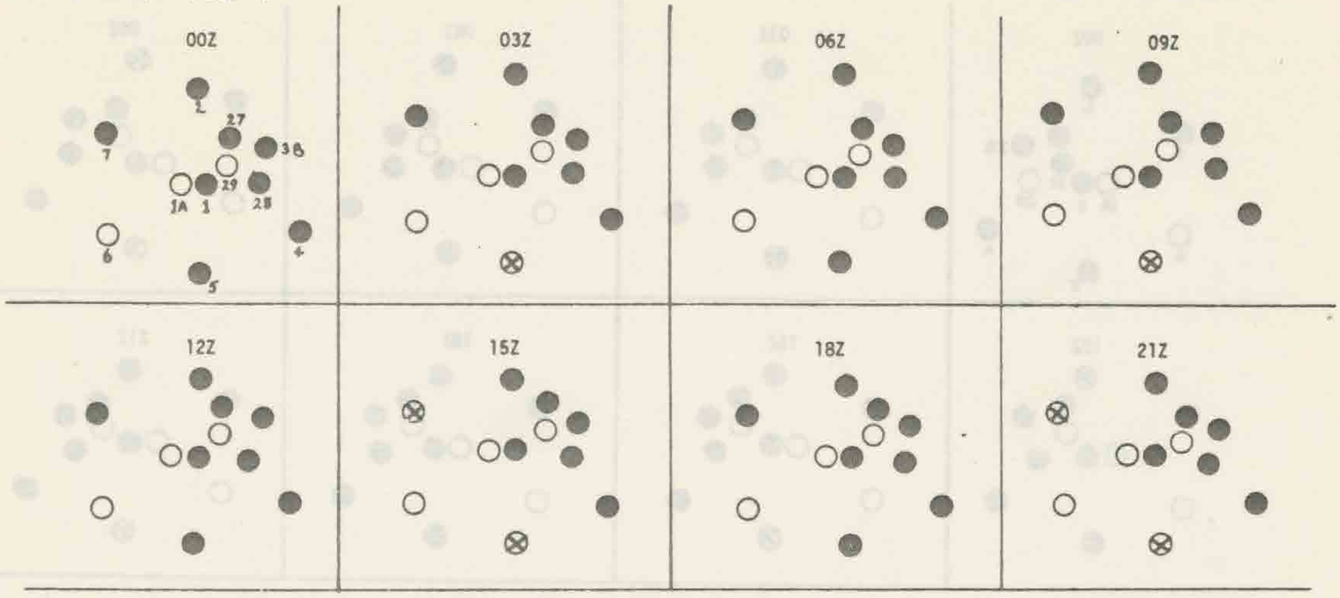
STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	METEOR	20 km	21 km	21 km	22 km	20 km	26 km	25 km	26 km
1A	VIZE	NO INFORMATION							
2	VANGUARD	47 mb	69 mb	19 mb	-	-	67 mb	26 mb	69 mb
38	QUADRA	225 mb		20 mb		37 mb		15 mb	
4	OCEANOGRAPHER	70 mb	70 mb	70 mb	175 mb	70 mb	70 mb	70 mb	70 mb
5	RESEARCHER	12 mb	-	66 mb	-	28 mb	-	72 mb	-
6	BIDASSOA	NO INFORMATION							
7	GILLISS	61 mb	70	50	22	40	40	34	62
27	PLANET	100 mb	109 mb	-	105 mb	15 mb	12 mb	32 mb	423 mb
28	DALLAS	229 mb	103 mb	70	122	80	70	70	70
29	HECLA	SEE SEPARATE SHEET.							

DATE: 9/8 (251)



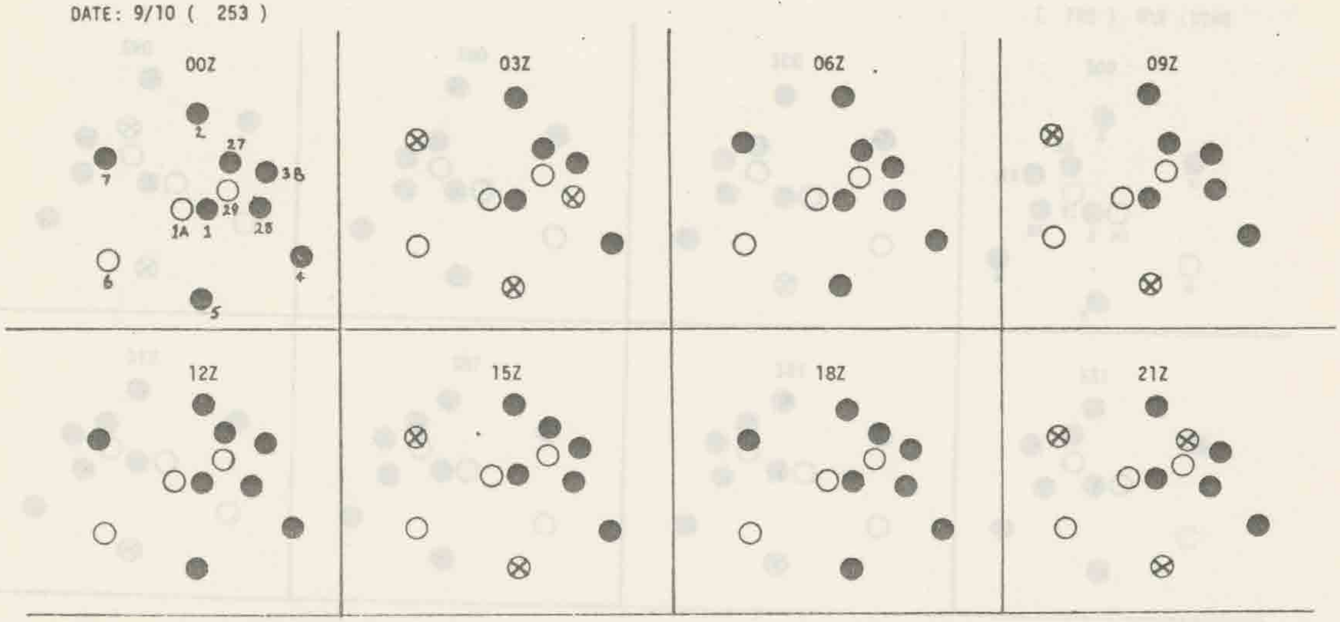
STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	METEOR	28 km	17 km	8 km	29 km	20 km	30 km	25 km	4 km
1A	VIZE	NO INFORMATION							
2	VANGUARD	25 mb	69 mb	11 mb	65 mb	11 mb	70 mb	49 mb	97 mb
38	QUADRA	42 mb		92 mb		135 mb		36 mb	
4	OCEANOGRAPHER	70 mb	70 mb	70 mb	70 mb	70 mb	70 mb	70 mb	70 mb
5	RESEARCHER	15 mb	-	12 mb	-	20 mb	-	45 mb	-
6	BIDASSOA	NO INFORMATION							
7	GILLISS	62 mb	295	60	71	28	208	62	92
27	PLANET	17 mb	58 mb	650 mb	-	17 mb	23 mb	19 mb	78 mb
28	DALLAS	99 mb	110	124	70	124	59	70	133
29	HECLA	SEE SEPARATE SHEET.							

DATE: 9/9 (252)



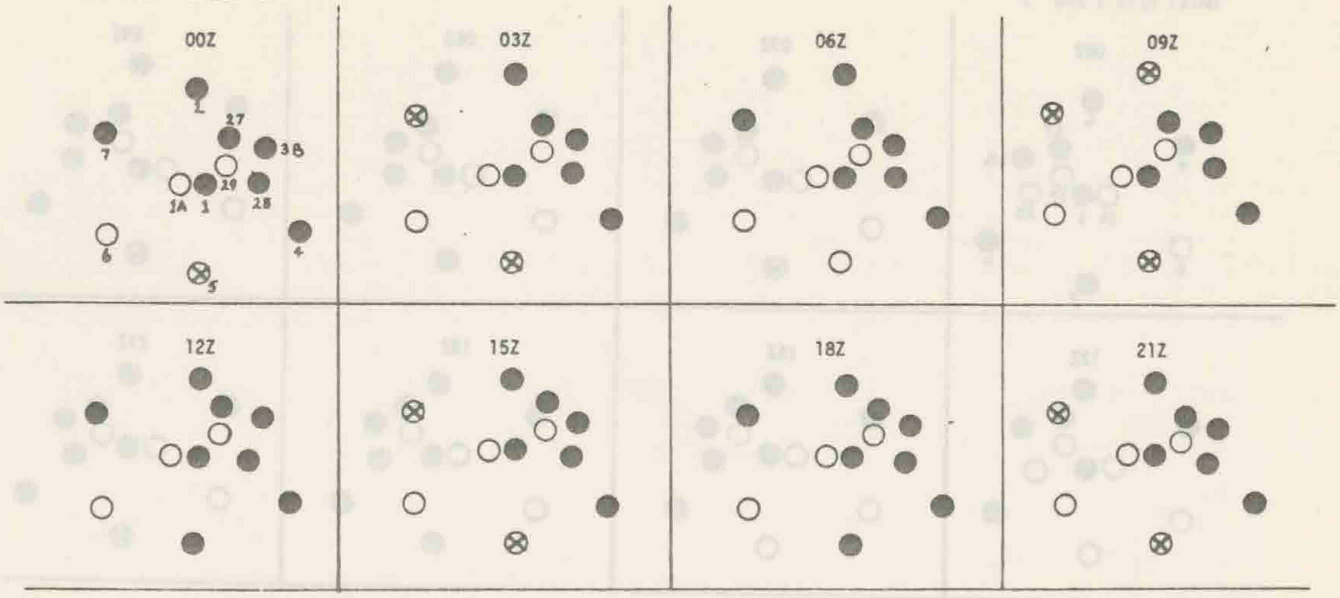
STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	METEOR	20 km	25 km	16 km	29 km	27 km	17 km	28 km	26 km
1A	VIZE	NO INFORMATION							
2	VANGUARD	16 mb	218 mb	7 mb	100 mb	49 mb	49 mb	49 mb	97 mb
3B	QUADRA	96 mb		72 mb		47 mb		13 mb	
4	OCEANOGRAPHER	400 mb	70 mb	110 mb	77 mb	70 mb	70 mb	70 mb	170 mb
5	RESEARCHER	21 mb	-	22 mb	-	697 mb	-	24 mb	-
6	BIDASSOA	NO INFORMATION							
7	GILLISS	69 mb	37	166	130	100	-	39	-
27	PLANET	73 mb	65 mb	63 mb	28 mb	37 mb	42 mb	31 mb	116 mb
28	DALLAS	130 mb	102	110	70	70	70	138	70
29	HECLA	SEE SEPARATE SHEET.							

DATE: 9/10 (253)



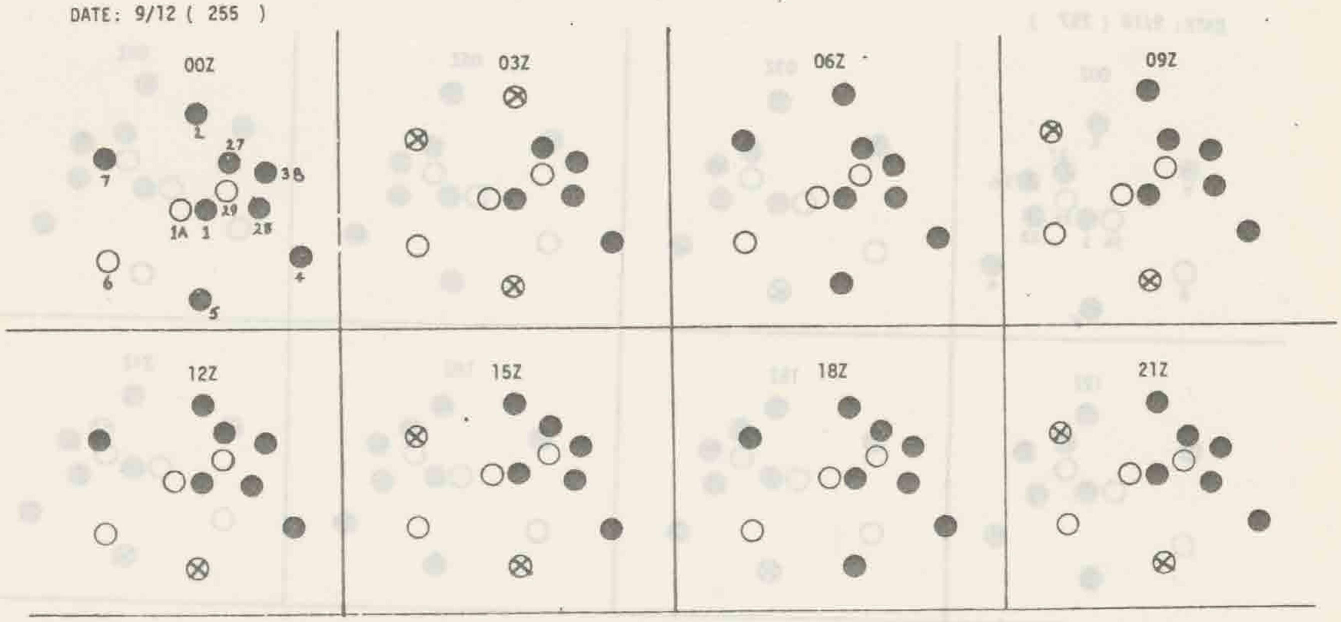
STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	METEOR	20 km	25 km	16 km	29 km	27 km	17 km	28 km	26 km
1A	VIZE	NO INFORMATION							
2	VANGUARD	47 mb	70 mb	49 mb	70 mb	49 mb	48 mb	50 mb	70 mb
3B	QUADRA	130 mb		16 mb		42 mb		37 mb	
4	OCEANOGRAPHER	70 mb	274 mb	70 mb	112 mb	70 mb	70 mb	70 mb	80 mb
5	RESEARCHER	16 mb	-	20 mb	-	732 mb	-	34 mb	-
6	BIDASSOA	NO INFORMATION							
7	GILLISS	57 mb	-	27	-	25	-	63	-
27	PLANET	44 mb	40 mb	28 mb	10 mb	64 mb	36 mb	249 mb	-
28	DALLAS	130 mb	-	108	70	70	70	70	236
29	HECLA	SEE SEPARATE SHEET.							

DATE: 9/11 (254)



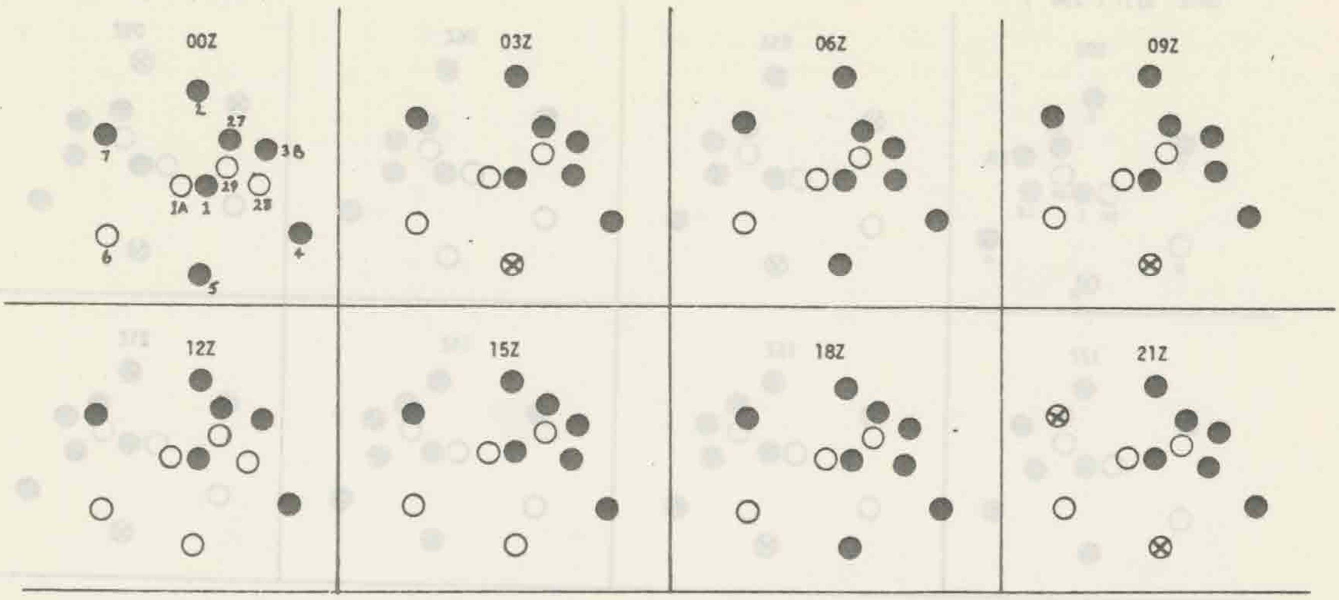
STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	METEOR	14 km	21 km	25 km	27 km	27 km	27 km	17 km	15 km
1A	VIZE	NO INFORMATION							
2	VANGUARD	125 mb	70 mb	49 mb	-	50 mb	68 mb	50 mb	70 mb
3B	QUADRA	87 mb		22 mb		21 mb		21 mb(MET)	
4	OCEANOGRAPHER	230 mb	70 mb	400 mb	160 mb	70 mb	70 mb	125 mb	122 mb
5	RESEARCHER	-	-	33 mb	-	63 mb	-	27 mb	-
6	BIDASSOA	NO INFORMATION							
7	GILLISS	47 mb	-	250	-	160	-	62	-
27	PLANET	11 mb	89 mb	59 mb	60 mb	15 mb	11 mb	17 mb	55 mb
28	DALLAS	108 mb	185	70	70	70	70	128	301
29	HECLA	SEE SEPARATE SHEET.							

DATE: 9/12 (255)



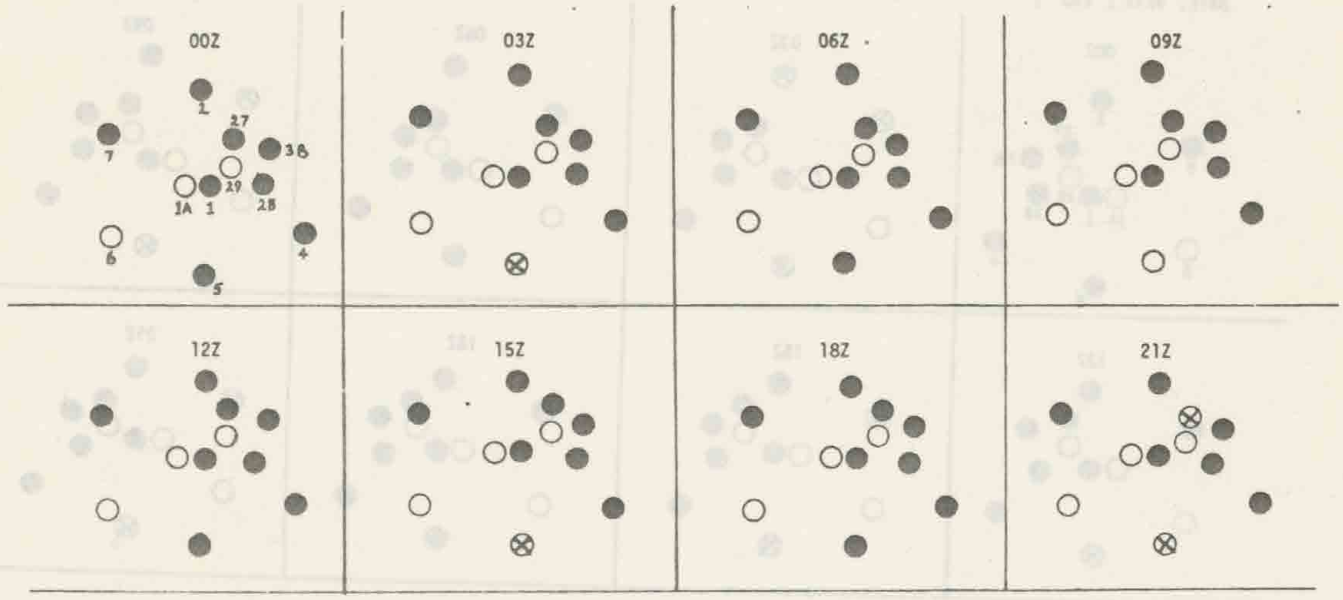
STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	METEOR	16 km	15 km	17 km	29 km	26 km	6 km	30 km	26 km
1A	VIZE	NO INFORMATION							
2	VANGUARD	50 mb	-	53 mb	108 mb	45 mb	69 mb	66 mb	47 mb
3B	QUADRA	23 mb		21 mb		770 mb		70 mb	
4	OCEANOGRAPHER	70 mb	70 mb	76 mb	71 mb	339 mb	70 mb	70 mb	302 mb
5	RESEARCHER	127 mb	-	29 mb	-	-	-	135 mb	-
6	BIDASSOA	NO INFORMATION							
7	GILLISS	143 mb	-	224	-	70	-	115	-
27	PLANET	15 mb	24 mb	23 mb	15 mb	48 mb	10 mb	13 mb	42 mb
28	DALLAS	70 mb	99	70	329	471	650	117	193
29	HECLA	SEE SEPARATE SHEET.							

DATE: 9/13 (256)



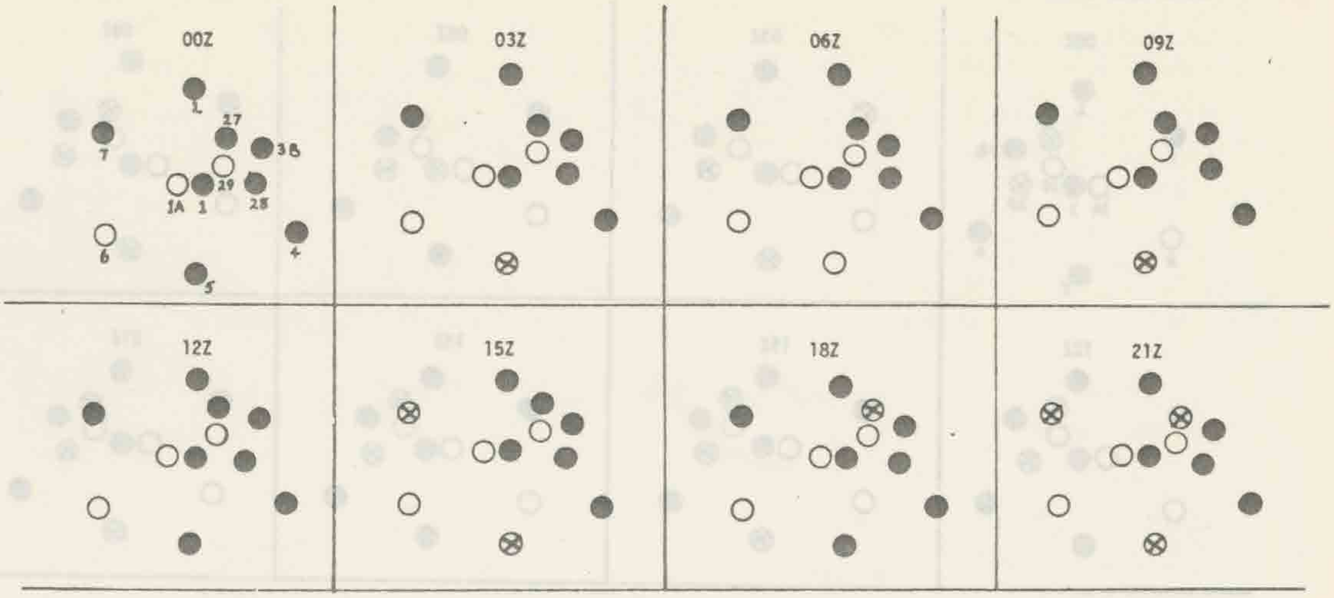
STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	METEOR	16 km	14 km	15 km	23 km	23 km	21 km	16 km	18 km
1A	VIZE	NO INFORMATION							
2	VANGUARD	24 mb	69 mb	91 mb	70 mb	29 mb	69 mb	28 mb	71 mb
38	QUADRA	200 mb		380 mb		700mb(MET)		81 mb (MET)	
4	OCEANOGRAPHER	132 mb	128 mb	88 mb	70 mb	284 mb	243 mb	70 mb	70 mb
5	RESEARCHER	23 mb	-	19 mb	-	-	-	18 mb	-
6	BIDASSOA	NO INFORMATION							
7	GILLISS	193 mb	34	27	153	70	300	130	-
27	PLANET	10 mb	29 mb	30 mb	26 mb	30 mb	31 mb	63 mb	96 mb
28	DALLAS	78 mb	208	76	230	480	70	74	238
29	HECLA	SEE SEPARATE SHEET.							

DATE: 9/14 (257)



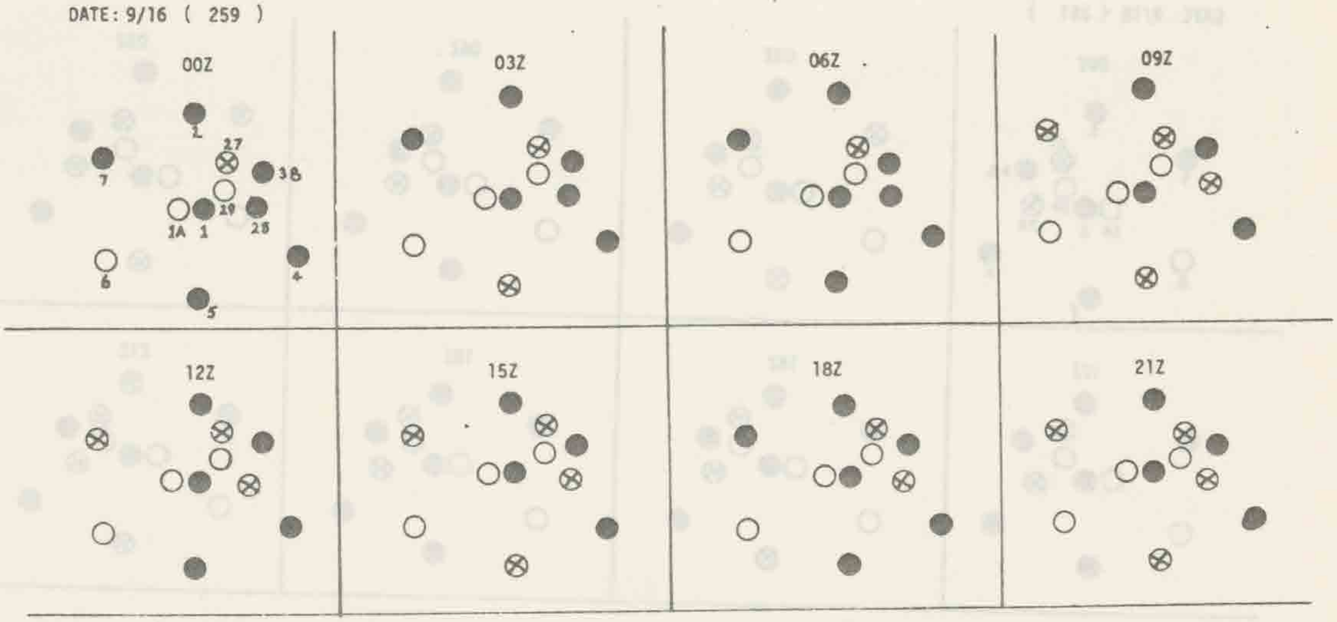
STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	METEOR	16 km	14 km	15 km	23 km	23 km	21 km	16 km	18 km
1A	VIZE	NO INFORMATION							
2	VANGUARD	32 mb	70 mb	30 mb	69 mb	30 mb	506 mb	29 mb	260 mb
3B	QUADRA	82 mb		32 mb (MET)		53 mb		31 mb	
4	OCEANOGRAPHER	95 mb	70 mb	70 mb	70 mb	70 mb	488 mb	70 mb	83 mb
5	RESEARCHER	25 mb	-	44 mb	-	11 mb	-	8 mb	-
6	BIDASSOA	NO INFORMATION							
7	GILLISS	100 mb	225	405	132	591	290	67	68
27	PLANET	76 mb	77 mb	170 mb	43 mb	31 mb	35 mb	15 mb	-
23	DALLAS	636 mb	131	70	70	130	156	116	280
29	HECLA	SEE SEPARATE SHEET.							

DATE: 9/15 (258)



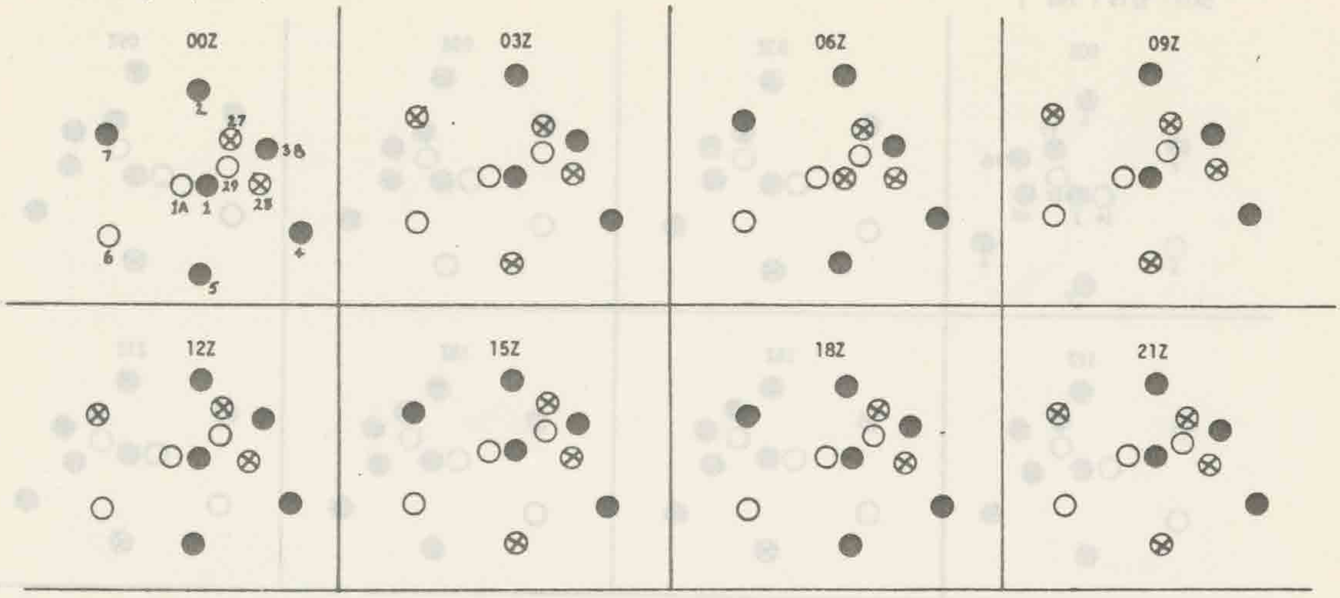
STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	METEOR	26 km	7 km	25 km	30 km	27 km	28 km	30 km	17 km
1A	VIZE	NO INFORMATION							
2	VANGUARD	110 mb	70 mb	30 mb	70 mb	30 mb	70 mb	40 mb	260 mb
38	QUADRA	24 mb		17 mb		15 mb		30 mb	
4	OCEANOGRAPHER	82 mb	70 mb	70 mb	70 mb	100 mb	858 mb	70 mb	70 mb
5	RESEARCHER	15 mb	-	274 mb	-	38 mb	-	41 mb	-
6	BIDASSOA	NO INFORMATION							
7	GILLISS	166 mb	64	200	-	65	-	969	-
27	PLANET	24 mb	11 mb	46 mb	35 mb	12 mb	20 mb	-	-
28	DALLAS	496 mb	70	70	81	70	70	144	70
29	HECLA	SEE SEPARATE SHEET.							

DATE: 9/16 (259)



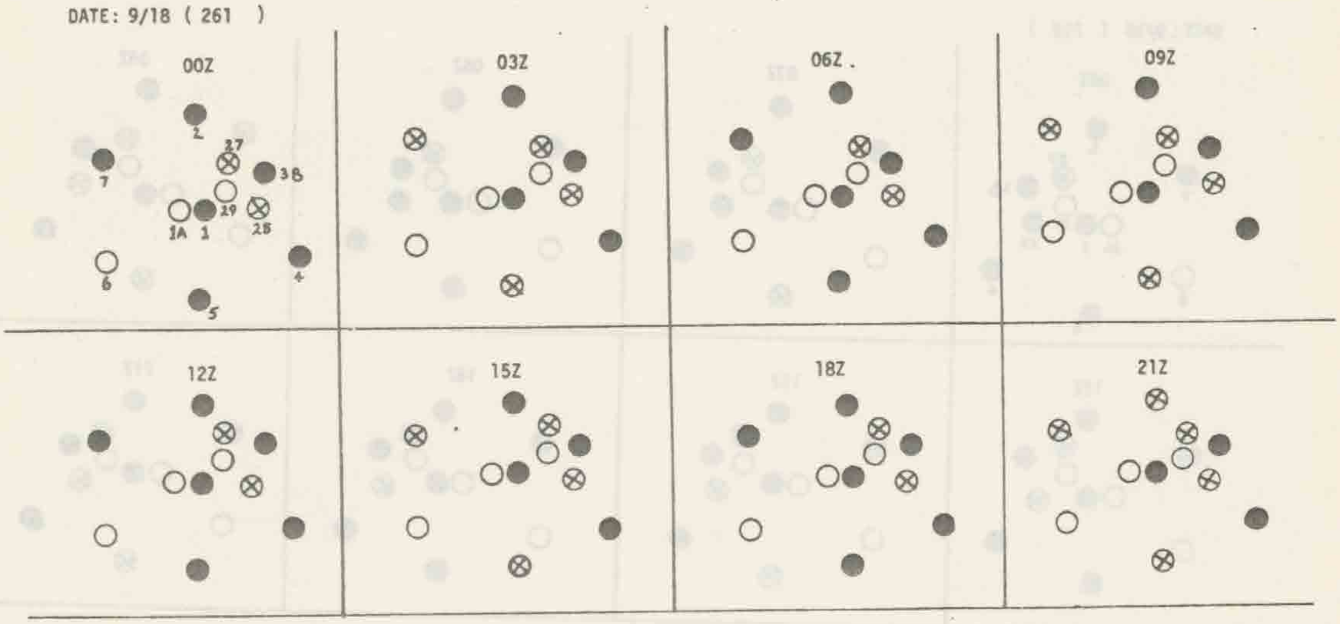
STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	METEOR	24 km	14 km	17 km	23 km	14 km	24 km	26 km	18 km
1A	VIZE	NO INFORMATION							
2	VANGUARD	103 mb	530 mb	29 mb	126 mb	29 mb	703 mb	50 mb	93 mb
38	QUADRA	35 mb		81 mb		131 mb		12mb (MET)	
4	OCEANOGRAPHER	117 mb	70 mb	100 mb	70 mb	70 mb	70 mb	200 mb	152 mb
5	RESEARCHER	21 mb	-	15 mb	-	23 mb	-	23 mb	-
6	BIDASSOA	NO INFORMATION							
7	GILLISS	68 mb	152	205	-	-	-	42	-
27	PLANET	-	-	-	-	-	-	-	-
28	DALLAS	142 mb	106	70	-	-	-	-	-
29	HECLA	SEE SEPARATE SHEET.							

DATE: 9/17 (260)



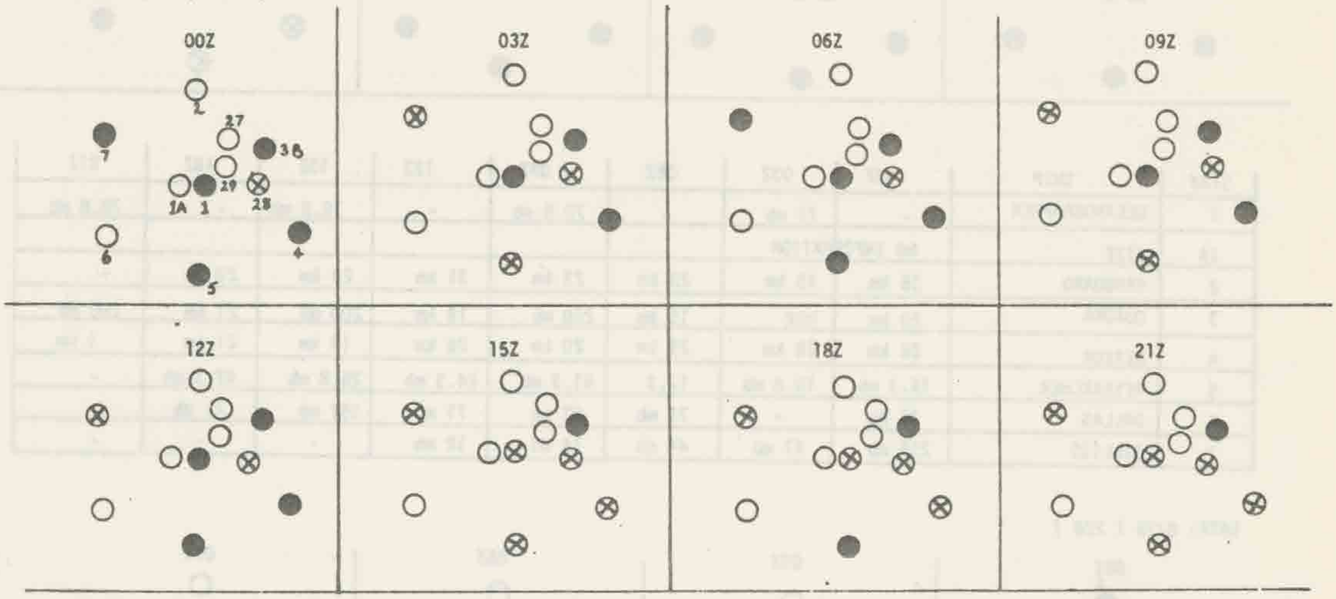
STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	METEOR	31 km	14 km	-	14 km	25 km	15 km	26 km	28 km
1A	VIZE	NO INFORMATION							
2	VANGUARD	30 mb	105 mb	96 mb	70 mb	49 mb	69 mb	321 mb	69 mb
3B	QUADRA	22 mb		68 mb		150 mb		13 mb	
4	OCEANOGRAPHER	127 mb	70 mb	70 mb	170 mb	70 mb	70 mb	70 mb	70 mb
5	RESEARCHER	118 mb	-	8 mb	-	19 mb	-	8 mb	-
6	BIDASSOA	NO INFORMATION							
7	GILLISS	306 mb	-	87	-	-	27	53	-
27	PLANET	-	-	-	-	-	-	-	-
28	DALLAS	-	-	-	-	-	-	-	-
29	HECLA	SEE SEPARATE SHEET.							

DATE: 9/18 (261)



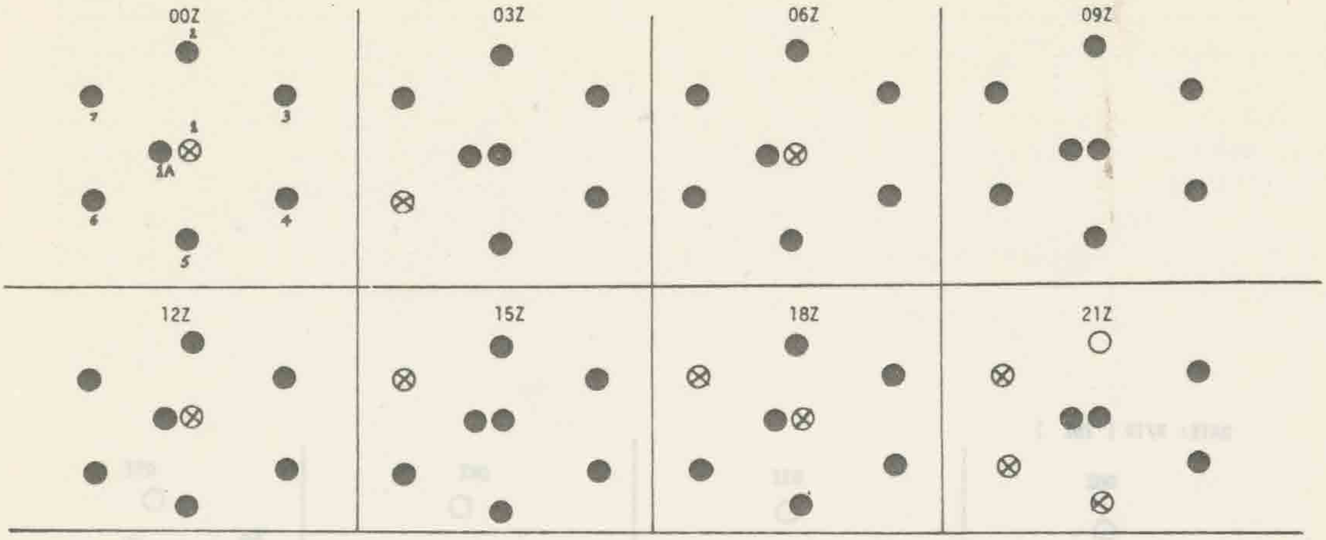
STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	METEOR	20 km	24 km	14 km	23 km	16 km	25 km	22 km	17 km
1A	VIZE	NO INFORMATION							
2	VANGUARD	30 mb	70 mb	30 mb	70 mb	68 mb	70 mb	70 mb	-
3B	QUADRA	36 mb		31 mb		20 mb		13 mb	
4	OCEANOGRAPHER	76 mb	70 mb	107 mb	128 mb	70 mb	70 mb	70 mb	162 mb
5	RESEARCHER	40 mb	-	101 mb	-	11 mb	-	27 mb	-
6	BIDASSOA	NO INFORMATION							
7	GILLISS	109 mb	-	64	-	81		52	-
27	PLANET	-	-	-	-	-	-	-	-
28	DALLAS	-	-	-	-	-	-	-	-
29	HECLA	SEE SEPARATE SHEET.							

DATE: 9/19 (262)



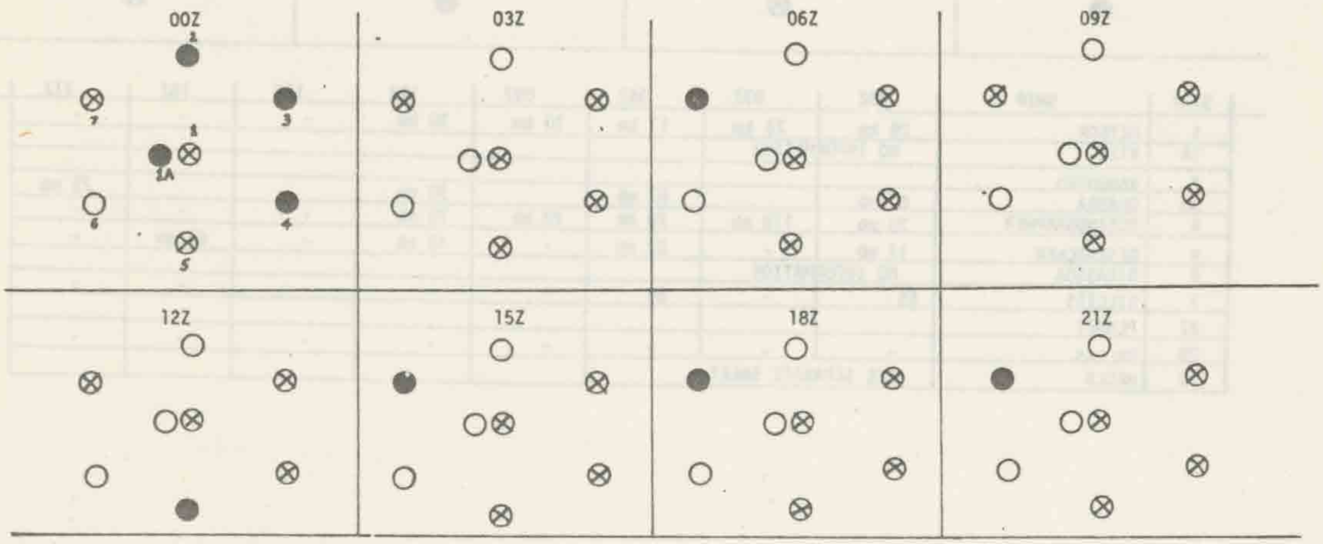
STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	METEOR	29 km	26 km	13 km	10 km	30 km	-	-	-
1A	VIZE	NO INFORMATION							
2	VANGUARD								
3B	QUADRA	87 mb		67 mb		30 mb			25 mb
4	OCEANOGRAPHER	70 mb	118 mb	70 mb	70 mb	70 mb	-	-	-
5	RESEARCHER	17 mb	-	22 mb	-	48 mb	-	67 mb	-
6	BIDASSOA	NO INFORMATION							
7	GILLISS	55	-	86	-	-	-	-	-
27	PLANET								
28	DALLAS	-	-	-	-	-	-	-	-
29	HECLA	SEE SEPARATE SHEET.							

DATE: 8/15 (227)



STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	-	72 mb	-	70.8 mb	-	70.8 mb	-	70.8 mb
1A	VIZE	NO INFORMATION							
2	VANGUARD	28 km	25 km	23 km	23 km	31 km	23 km	20 km	-
3	QUADRA	20 km	UNK	15 km	200 mb	19 km	200 mb	21 km	200 mb
4	METEOR	26 km	28 km	29 km	20 km	26 km	19 km	21 km	3 km
5	RESEARCHER	19.3 mb	10.8 mb	17.3	61.3 mb	24.3 mb	25.8 mb	47.3 mb	-
6	DALLAS	71 mb	-	71 mb	82 mb	71 mb	351 mb	71 mb	-
7	GILLISS	259 mb	47 mb	44 mb	14 mb	12 mb	-	-	-

DATE: 8/16 (228)



STA#	SHIP	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z
1	OCEANOGRAPHER	-	-	-	-	-	-	-	-
1A	VIZE	NO INFORMATION							
2	VANGUARD	-	-	-	-	-	-	-	-
3	QUADRA	24 km							
4	METEOR	21 km	-	-	-	-	-	-	-
5	RESEARCHER	-	-	-	-	12.3 mb	-	-	-
6	DALLAS	-	-	-	-	-	-	-	-
7	GILLISS	-	-	25 mb	-	-	UNK	UNK	UNK

HECLA Phase III UPPER AIR SOUNDINGS

Read for each date as follows:
Time/Wind or Temperature/Lowest Pressure Reached:

30 Aug. 14W 850, 15W 900, 16W 600.
31 Aug. 11T 600, 16T 100, 18W 960, 19W 200.
1 Sept. 11W 700, 16T 850, 18W 700.
2 Sept. 10W 830, 11T 300, 17T 150.
3 Sept. 10T 980, 15T 800, 15W 150.
4 Sept. 11W 700, 15W 600.
5 Sept. 10W 650, 12T 600, 14W 650, 17W 960, 18W 850.
6 Sept. 09W 880, 10W 600, 11W 500, 12T 600, 12W 650, 13W 550,
14W 750, 15W 650, 16W 300, 17T 800.
7 Sept. 12T 600, 12W 300, 15W 900, 15W 800, 16W 850, 17W 900,
18W 650, 19W 650.
8 Sept. 09W 700, 10W 700, 12T 620, 14W 800, 15W 800, 16W 700,
17W 650, 18W 800.
9 Sept. 12T 780, 12W 600, 14W 600, 15W 400, 16W 350, 17T 600,
17W 300, 18W 300.
10 Sept. 10W 400, 12T 640, 12W 500, 15W 500, 16W 720, 17T 640.
11 Sept. 09W 800, 12T 590, 12W 650, 10W 650, 17T 620, 17W 650.
12 Sept. 10W 650, 11T 590, 11W 550, 12W 600, 14W 650, 15W 400,
17W 800, 18T 580, 18W 600.
13 Sept. 10W 300, 11T 590, 11W 600, 12W 600, 14W 750, 15W 300,
16W 300, 17W 750.
14 Sept. 10W 300, 11W 600, 16W 400, 17W 400, 18W 200.
15 Sept. 10W 650, 11W 800, 12T 690, 14W 550, 15W 800, 16W 750,
17W 700.
16 Sept. 15T 800, 21T 660.
17 Sept. 11T 550, 12W 400, 14W 400, 15W 300, 18W 600.
18 Sept. 11W 600, 11T 750, 12W 750, 12W 550, 14W 550, 15W 590,
15W 600, 16W 600, 17W 550, 17W 550.

BIBLIOGRAPHIC DATA SHEET	1. Report No. CSU-ATS-Research Report	2.	3. Recipient's Accession No.

4. Title and Subtitle

GATE CONVECTION SUBPROGRAMME

Field Phase Report

5. Report Date

February 1975

6.

7. Author(s)

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8. Performing Organization Rept. No.

9. Performing Organization Name and Address

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GATE Report

14.

15. Supplementary Notes

16. Abstracts

A summary of the in-field decisions affecting the GATE Convection Subprogramme (C.S.P.) objectives; a preliminary tabulation and discussion of the data collection; and a discussion of the work of the Special Analysis Group in Dakar. Preliminary tables are presented of the upper air data coverage for the B and A/B ship arrays, the C-band ship radars, the SMS satellite coverage and the multi-aircraft missions flown in support of the C.S.P. A preliminary assessment of the subprogramme observational objectives is given.

17. Key Words and Document Analysis. 17a. Descriptors

Tropical Convection

Tropical Field Experiments

GATE Convection Subprogramme

17b. Identifiers/Open-Ended Terms

GATE

GARP

17c. COSATI Field/Group

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