

## **CHAPTER II**

### **SURVEILANCE SYSTEMS**

## SURVEILLANCE SYSTEMS

### A. GENERAL

SURVEILLANCE QUALITY IS THE KEY TO THE ACCURACY OF EACH WARNING POSITION AT TIME OF ISSUANCE. TYPE, TIMELINESS, CAPABILITIES, AND ACCOMPLISHMENTS OF EACH SYSTEM WILL BE THE SUBJECT MATTER OF THIS CHAPTER.

### B. AERIAL WEATHER RECONNAISSANCE

U. S. AIR FORCE, WB-50 AIRCRAFT  
56TH WEATHER RECONNAISSANCE SQUADRON, YOKOTO AIR BASE, JAPAN  
LT. COL. E. D. WALLACE, COMMANDER  
MAJ. R. H. YAW, WEATHER OFFICER  
DET. 1 - 56TH WEATHER RECONNAISSANCE SQUADRON, ANDERSEN AIR FORCE BASE, GUAM, M. I.  
MAJ. T. J. MAHER, COMMANDER

U. S. NAVY, WV-2 AIRCRAFT (EFFECTIVE 1 JULY 1961)  
AIRBORNE EARLY WARNING SQUADRON ONE, NAS, AGANA, GUAM, M. I.  
CDR. H. B. KENTON, COMMANDER  
LT. M. J. MORAN, WEATHER OFFICER

DUE TO THE EXTREME PAUCITY OF SURFACE AND UPPER AIR METEOROLOGICAL DATA AND INFORMATION IN THE WESTERN PACIFIC AREA (WESTPAC), THE VITALNESS OF AERIAL RECONNAISSANCE TO METEOROLOGICAL ANALYSIS AND FORECAST EFFORT CANNOT BE OVEREMPHASIZED.

THE AVAILABILITY OF ACCURATE AND COMPLETE AERIAL WEATHER RECONNAISSANCE DATA AND INFORMATION IS PARTICULARLY CRITICAL IN CONNECTION WITH THE LIFE CYCLE OF ONE OF NATURE'S MOST DESTRUCTIVE PHENOMENA, THE TYPHOON. THIS IS TRUE FROM THE MOST PRELIMINARY FORMATIVE STAGE TO FINAL DECAY OR TRANSFORMATION TO A SYSTEM EXHIBITING EXTRA-TROPICAL CHARACTERISTICS.

ATTENTION IS INVITED TO THE FACT THAT THE LOCATION AND TRACKING OF TROPICAL DEPRESSIONS/STORMS/TYPHOONS IS MERELY ONE SMALL PHASE OF THE OVERALL REQUIREMENT. THE ABILITY TO DETECT AND ANALYZE VORTEX STRUCTURE, PREDICT FUTURE INTENSITY CHANGES, FORECAST WITH REASONABLE ACCURACY THE VELOCITY AND CHANGES THERETO AND DETERMINE THE PROBABLE AREA OF RECURVATURE DEMANDS ACCURATE AND TIMELY EYE AND PERIPHERAL METEOROLOGICAL DATA.

AERIAL RECONNAISSANCE REQUIREMENTS AND CAPABILITIES FOLLOW:

#### A. REQUISITE METEOROLOGICAL PARAMETERS FOR MEASUREMENT ON EYE-PENETRATION MISSIONS

1. TEMPERATURE, DEW-POINT, WIND SPEED AND HEIGHT OF THE 700 MB SURFACE BY AIRCRAFT INSTRUMENTATION.
2. LAPSE RATE FROM THE 700 MB LEVEL OR ABOVE TO EARTH'S SURFACE WITH SURFACE TEMPERATURE AND PRESSURE BY DROPSONDE.
3. LOCATION OF THE PRESSURE CENTER WITHIN THE EYE BY USE OF THE RADIO ALTIMETER.
4. WIND VELOCITY PATTERN WITHIN THE EYE, WALL-CLOUD CONFIGURATION, TURBULENCE, AND WIND SHEAR BY OBSERVER.

**B. REQUISITE METEOROLOGICAL PARAMETERS FOR MEASUREMENT ON CIRCUMNAVIGATION MISSIONS**

1. SAME AS A1, ABOVE
2. SAME AS A2, ABOVE, AT PRE-SELECTED POINTS
3. 700 MB WIND VELOCITY PATTERN FROM DOPPLER (OR EQUIVALENT) NAVIGATIONAL SYSTEM.
4. SURFACE WIND VELOCITY PATTERN BY OBSERVER.
5. CLOUD DISTRIBUTION BY OBSERVER AND/OR AIRBORNE RADAR.
6. SPOT OBSERVATIONS IN ACCORDANCE WITH ESTABLISHED STANDARD PROCEDURES.

**C. INFORMATION PROVIDED BY FWC/JTWC, GUAM, WARNINGS (BASED UPON REQUISITE METEOROLOGICAL PARAMETERS DELINEATED IN THE PRECEDING PARAGRAPHS A AND B**

1. EXISTENT CYCLONE INTENSITY AND PREDICTED INTENSITY CHANGES.
2. DIRECTION AND SPEED OF MOVEMENT IN TERMS OF INTENSITY AND PAST POSITIONS OF THE CYCLONE.
3. DATA FOR CERTAIN STATISTICAL PREDICTIVE FORMULAE IN THE DETERMINATION OF DIRECTION AND SPEED OF MOVEMENT.
4. DISTRIBUTION OF WIND SPEEDS IN THE VARIOUS CYCLONE QUADRANTS, STRONG AND WEAK WINDS, RADIUS OF WINDS AND CHANGE OF RADIUS.
5. RESEARCH DATA FOR TYPHOON STRUCTURE AND BEHAVIOR.
6. METEOROLOGICAL DATA FOR THE DEVELOPMENT OF SYNOPTIC FORECAST SYSTEMS.

THE DELETION OF ANY PORTION OF THE METEOROLOGICAL DATA REQUIREMENTS CONTAINED IN PARAGRAPHS A AND B ABOVE RESULTS ONLY IN A DECREASE IN THE TYPHOON WARNING ACCURACY AND THE RESULTANT SERIOUS METEOROLOGICAL THREAT TO THE SECURITY OF U. S. AND ALLIED FORCES IN THE WESTERN PACIFIC AREA.

THE DATA OBTAINED BY EYE-PENETRATION AND DROPSONDE TECHNIQUES ARE "KEYS" IN INTENSITY ANALYSES AND THE PREDICTION OF FUTURE INTENSITY CHANGES FOR WARNING PURPOSES. SINCE THE EYES OF TYPHOONS VARY FROM A FEW MI TO 200 MI IN DIAMETER, IT IS EXTREMELY IMPORTANT THAT THE ACTUAL PRESSURE CENTER BE PRECISELY DETERMINED AND THAT THE DROPSONDE BE RELEASED AT THIS POSITION. REPORTS OF THE EYE WIND

PATTERN AND THE VISUAL VELOCITY DISTRIBUTION ALSO SERVE TO CONFIRM THE MEASURED PARAMETERS OF TEMPERATURE AND PRESSURE. FROM A SCIENTIFIC STANDPOINT, THERE IS NO SUBSTITUTE FOR A COMPLETELY METEOROLOGICALLY EQUIPPED AIRCRAFT.

IT CANNOT BE STRESSED SUFFICIENTLY THAT COMPLETE METEOROLOGICAL DATA AND INFORMATION OBTAINED BY AERIAL RECONNAISSANCE TECHNIQUES ARE MANDATORY FOR ACCURATE AND EFFICIENT ANALYSES AND PREDICTIONS RELATING TO TROPICAL AREAS, DEPRESSIONS, STORMS, AND TYPHOONS. "FIXES" BY THEATER AIRCRAFT SUPPLY ONLY AN EXTREMELY LIMITED AND UNACCEPTABLE PARTIAL ANSWER TO A HIGHLY COMPLEX PROBLEM. LOCATION IS BUT ONE ASPECT OF THIS PROBLEM. ANALYSES OF CYCLONE CHARACTERISTICS AND INTENSITY, AND PREDICTIONS OF INTENSITY CHANGES AND MOVEMENT ARE EQUALLY, IF NOT MORE, IMPORTANT TO OPERATIONAL FORCES.

THE CAPABILITIES OF THE JOINT TYPHOON WARNING SERVICE IN THE WESTPAC AREA SUFFERED DURING THE 1961 TYPHOON SEASON AS THE DIRECT RESULT OF DRASTICALLY REDUCED USAF PARTICIPATION IN AERIAL WEATHER/TYPHOON RECONNAISSANCE, PARTICULARLY FROM THE STANDPOINT OF EARLY DETECTION OF POTENTIAL OR NASCENT TROPICAL STORMS AND TYPHOONS. LOSS OF THIS RECONNAISSANCE SUPPORT RESULTED IN THE GENERATION OF TWO TROPICAL STORMS, IDA AND KATHY, WITHOUT KNOWLEDGE AND ADEQUATE PRIOR WARNINGS BEING ISSUED BY JTWC. IN ADDITION, THE DETERIORATION OF ANALYSIS AND FORECAST CAPABILITY DUE TO THE PAUCITY OF RECONNAISSANCE CAUSED A DECREASE IN POSITIONAL FORECAST ACCURACY OF AS MUCH AS 30 MI FOR 24 HOUR PREDICTIONS AND 120 MI FOR THE 48 HOUR OUTLOOKS.

VITAL AND INTEGRAL PARTS OF ANY TROPICAL OCEANIC ANALYSIS ARE SYNOPTIC AND INVESTIGATIVE FLIGHTS. SYNOPTIC RECONNAISSANCE OVER THE TROPICAL OCEAN AREAS OF MICRONESIA MEASUREABLY SUPPLEMENT THE SPARSE ISLAND OBSERVING STATIONS TO THE SE AND SW OF GUAM. THESE FLIGHTS PRODUCE SYNOPTIC AND DROPSONDE DATA ENABLING A BETTER METEOROLOGICAL ANALYSIS OF AN AREA 1.5 TIMES THAT OF THE CONTINENTAL UNITED STATES. THIS WAS NOT ACCOMPLISHED DURING THE 1961 SEASON BECAUSE OF THE RESTRICTED INVESTIGATIVE AND SYNOPTIC RECONNAISSANCE. THE NORMAL CAPABILITY OF ADEQUATE ANALYSIS FROM THE STAGES OF CYCLONE TO DEPRESSION TO STORM WAS COMPLETELY LOST.

PRECISION NAVIGATION IS OBVIOUSLY MANDATORY AND REQUIRES LITTLE DISCUSSION. ANY COMPROMISE, IN THIS REGARD, LESSENS THE QUALITY OF THE OBSERVATIONS MADE AND TRANSMITTED, POSES A SERIOUS THREAT TO THE ACCURACY OF THE WARNINGS ISSUED, AND, CONSEQUENTLY, IMPEDES SOUND DECISIONS ON THE PART OF ALL OPERATIONAL CONSUMERS IN THE WESTPAC AREA.

THE PRECEDING DISCUSSION IS EXTRACTED FROM A FWC/JTWC STAFF STUDY WHICH HAS PRODUCED THE FOLLOWING RESULTS:

A. THE 54TH WEATHER RECONNAISSANCE SQUADRON, WITH SIX WB-50 AIRCRAFT, IS BEING REACTIVATED AS OF 18 APRIL 1962 AT ANDERSEN AFB, GUAM, IN LIEU OF DET 1 - 56TH WEATHER RECONNAISSANCE SQUADRON.

B. AIRBORNE EARLY WARNING SQUADRON ONE HAS AUTHORITY TO EQUIP ITS WV-2 AIRCRAFT WITH DROPSONDE CHAMBERS AND DOPPLER TYPE NAVIGATION EQUIPMENT FOR THE 1962 SEASON.

THE WV-2 IS A UNIQUE WEATHER RECONNAISSANCE AIRCRAFT IN THAT ITS APS-20E AND APS-45 RADARS CAN PROVIDE ACCURATE DATA SHOWING THE HORIZONTAL STRUCTURE OF A STORM AREA UP TO 250 MI DISTANCE FROM THE AIRCRAFT. RADAR IS EMPLOYED WHENEVER POSSIBLE ON ALL WEATHER RECONNAISSANCE MISSIONS PERFORMED BY AEWRON ONE. FIXES BY RADAR ARE USED EXTENSIVELY DURING HOURS OF DARKNESS AND AT OTHER TIMES WHEN CLOUD PRESENTATION POSITIVELY DEFINES THE CENTER.

AIRBORNE RADAR LIKE LAND RADAR FURNISHES ONLY A GEOGRAPHICAL POSITION TO LOCATE THE CENTER OF A CYCLONE. DURING DAYLIGHT HOURS, WHEN IT IS CONSIDERED OPERATIONALLY SAFE BY THE WV-2 PLANE COMMANDER, OPTIONAL PENETRATION BY THE WV-2 AIRCRAFT IS ACCOMPLISHED THROUGH THE QUADRANT WHICH CIRCUMNAVIGATION AND RADAR PRESENTATION HAS SHOWN TO BE THE WEAKEST.

THE FOLLOWING SET OF PHOTOGRAPHS DEPICT THE SECOND OF TWO PENETRATIONS OF TYPHOON TILDA PERFORMED BY AN AEWRON ONE AIRCRAFT ON 29 SEPTEMBER 1961. THE FIRST PHOTOGRAPH SHOWS THE AIRCRAFT, REPRESENTED BY THE DOT IN THE CENTER OF THE RADARSCOPE, APPROACHING THE WALL CLOUD. THE SPIRAL BANDS NEAR THE AIRCRAFT ARE EASILY RECOGNIZED, AND THE EYE IS CLEARLY DEFINED. THE WALL CLOUDS NEAR THE AIRCRAFT APPEAR TO BE LESS INTENSE, INDICATING THAT THE AIRCRAFT IS PENETRATING THROUGH THE WEAKEST QUADRANT. PHOTO NUMBER TWO SHOWS THE AIRCRAFT ENTERING THE WALL CLOUD, ENCOUNTERING THE ASSOCIATED TURBULENCE AND TORRENTIAL RAIN. FINALLY, IN PHOTO NUMBER THREE, THE AIRCRAFT HAS ENTERED THE EYE AND IS NOW IN AN AREA OF RELATIVE CALM. THE CLOCK INDICATES THAT ONLY TWO MINUTES HAD ELAPSED DURING THE TRANSIT THROUGH THE WALL CLOUD. IN PHOTO NUMBER FOUR, THE AIRCRAFT IS AT THE CENTER OF THE EYE OBTAINING THE DATA WHICH WILL AID IN FORECASTING THE FUTURE INTENSITY OF THE TYPHOON. PHOTOS FIVE AND SIX SHOW THE AIRCRAFT LEAVING THE EYE BY APPROXIMATELY THE SAME ROUTE IT FOLLOWED IN THE PENETRATION.

IN THE POST FLIGHT SUMMARY, THE TYPHOON WAS DESCRIBED AS FOLLOWS: "EYE PERFECTLY CIRCULAR 14 MI IN DIAMETER. EXTENSIVE WALL CLOUDS ABOVE 40,000 FT, 6 MI THICK. CONSIDERABLE STRATAFORM CLOUDS IN EYE. UNABLE TO SEE SURFACE. MAX SURFACE WINDS 100 KTS WITHIN 20 MI OF EYE. TEMPERATURE ROSE 10° C ON PENETRATION. LIGHT TO MODERATE TURBULENCE AND TORRENTIAL RAIN ENCOUNTERED IN WALL CLOUDS."

AERIAL WEATHER RECONNAISSANCE EFFORTS OF 1961 ARE PRESENTED IN THE FOLLOWING THREE STATISTICAL SUMMARIES.

**FIXES MADE IN 1961**

	TO 30 JUN	FOR YEAR	BONUS
56TH	79	229	2
VW-1	2	119	13
VAP-61		1	
315TH AIR DIVISION		1	
OTHER USAF			6
OTHER USN			4
CIVILIAN			2
<b>TOTAL FIXES MADE AND USED</b>		<b>377</b>	

**FLYING HOURS PER TYPHOON**

TYPHOON	56 WRS	AEWRON 1
TESS	155	6
ALICE	60	5
BETTY	142	N/R
CORA	36	N/R
ELSIE	80	27
HELEN	130	51
IDA	50	20
JUNE	112	33
KATHY	39	10
LORNA	80	11
NANCY	121	30
OLGA	N/R	N/R
PAMELA	35	31
SALLY	29	22
TILDA	28	30
VIOLET	80	74
BILLIE	10	79
CLARA	0	65
DOT	49	68
ELLEN	86	82
<b>TOTAL</b>	<b>1322</b>	<b>644</b>
<b>TOTAL TROPICAL CYCLONE FLYING HOURS</b>	<b>2701*</b>	<b>1947</b>
		<b>854</b>

N/R - MISSIONS NOT REQUESTED BY JTWC

\* - INCLUDES PRECEDING TOTALS BUT NOT THE 56 WRS TROPICAL FIXED TRACKS WHICH WOULD MORE THAN DOUBLE THEIR 1947 HOURS LOGGED

A SERIES OF DROPSONDE PATTERNS WILL BE TESTED IN 1962. EACH OF THESE PATTERNS WILL INCLUDE THE EYE DROP AND WILL LEAD TO A STANDARDIZED PATTERN THAT WILL AUGMENT THE ROUTINE PERIPHERAL DATA AS WELL AS THAT INFORMATION AVAILABLE FROM WITHIN THE EYE.

### C. LAND RADAR

AS TYPHOON JUNE APPROACHED TAIWAN ON 6 AUGUST, JTWC ACCEPTED LAND RADAR FIXES ON AN OPERATIONAL BASIS, AS A SURVEILLANCE AID, WITH THE FULL KNOWLEDGE OF THEIR INHERENT LIMITATION OF PROVIDING ONLY A GEOGRAPHICAL POSITION. THIS LINEAR DIMENSION HAS RESTRICTED OPERATIONAL VALUE; THEREFORE, JTWC REQUIRES A COMBINATION OF BOTH SYSTEMS, LAND RADAR AND AERIAL RECONNAISSANCE.

SPECIFICALLY, JTWC REQUIRES ONE DAILY AERIAL RECONNAISSANCE PENETRATION WITH DROPSONDE IN CONJUNCTION WITH CONTINUOUS LAND RADAR COVERAGE WHEN THE MISSION CAN BE CONDUCTED SAFELY AS PERMITTED BY TERRAIN FEATURES. THE PRESSURE CENTER AND METEOROLOGICAL INTENSITY PARAMETERS, THUS PROVIDED, COMPLIMENT THE RADAR POSITION WHICH ALONE DOES NOT FURNISH THE NECESSARY DATA TO SUPPORT A COMPLETE FORECAST.

FOR THE REMAINDER OF THE SEASON, A TOTAL OF 37 MISSIONS WERE NOT REQUIRED, THUS "SAVED" AS A RESULT OF USING THE CRITERIA OF ONE FIX PER DAY PLUS ADEQUATE LAND RADAR COVERAGE RATHER THAN THE NORMAL FOUR FIX A DAY REQUIREMENT FOR TYPHOONS BY RECONNAISSANCE AIRCRAFT.

### D. SATELLITES

THE TIROS SERIES PROVIDED FWC/JTWC WITH RANDOM NEPHANALYSES OVER THE WESTERN NORTH PACIFIC. SUCH REPORTS HAVE IDENTIFIED THE POSITION OF SIGNIFICANT VORTICES DURING THE PERIOD THAT JTWC WAS ISSUING WARNINGS ON THESE SAME VORTICES. IN 1961, TELEPHONE LIAISON WAS MAINTAINED BY THE METEOROLOGICAL SATELLITE LABORATORY OF THE U. S. WEATHER BUREAU TO CONFIRM OUR POSITION OF THE TROPICAL CYCLONE AT THE TIROS OBSERVATION TIME WHEN JTWC WAS ISSUING WARNINGS AND/OR TO COORDINATE ON TIROS OBSERVATIONS OF DISTAL SYSTEMS WHICH MAY HAVE BEEN NEW OR ADDITIONAL TROPICAL CYCLONES.

THE RANDOM TRACKS OF TIROS DOES NOT PERMIT ITS USE AS A ROUTINE TOOL EXCEPT TO COLLATE THE INFORMATION WHEN AVAILABLE. NIMBUS' ANTICIPATED REGULARITY WILL ELIMINATE TIROS' IRREGULARITY AND IN EFFECT EXTEND THE LAND RADAR FIX COVERAGE. THESE SYSTEMS ARE LIMITED TO FIX COORDINATES AND NEPHANALYSIS AND DOES NOT POSSESS THE VITAL COLLECTION CAPABILITIES FOR THE INTENSIFICATION PARAMETERS THAT ARE AVAILABLE FROM METEOROLOGICALLY EQUIPPED RECONNAISSANCE AIRCRAFT.

A CONTRIBUTION TO RESEARCH IS POSSIBLE, SHOULD THE TIMING BE IN PHASE FOR AN ACTUAL FORMATION PERIOD, IN THAT THE NEPHANALYSIS WOULD ADD MEASURABLY TO THIS UNKNOWN SEQUENCE OF EVENTS. FURTHER IN THE EXCHANGE OF INFORMATION, FWC/JTWC IS SENDING A DAILY MESSAGE COVERING

**THE ANALYZED POSITIONS OF EASTERLY WAVES AND INTERTROPICAL ZONE OF CONVERGENCE IN WESTPAC.**

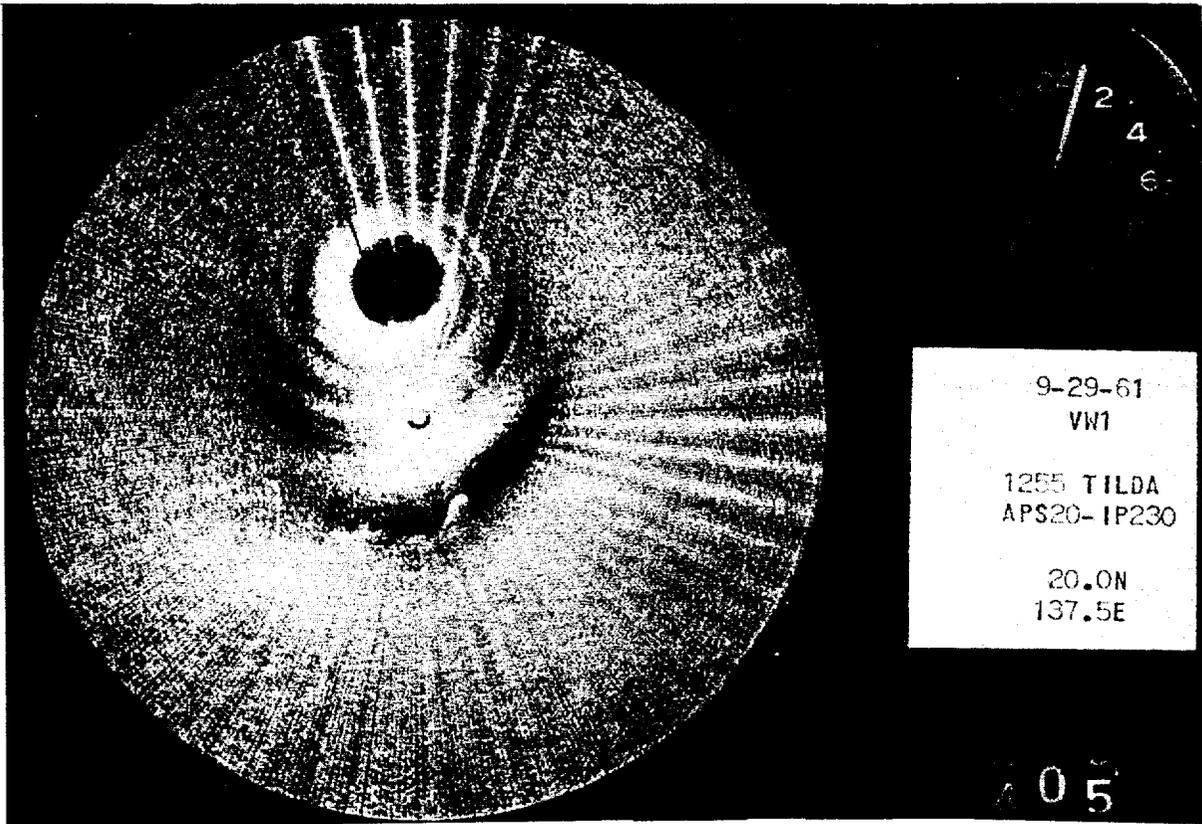


FIG. 1

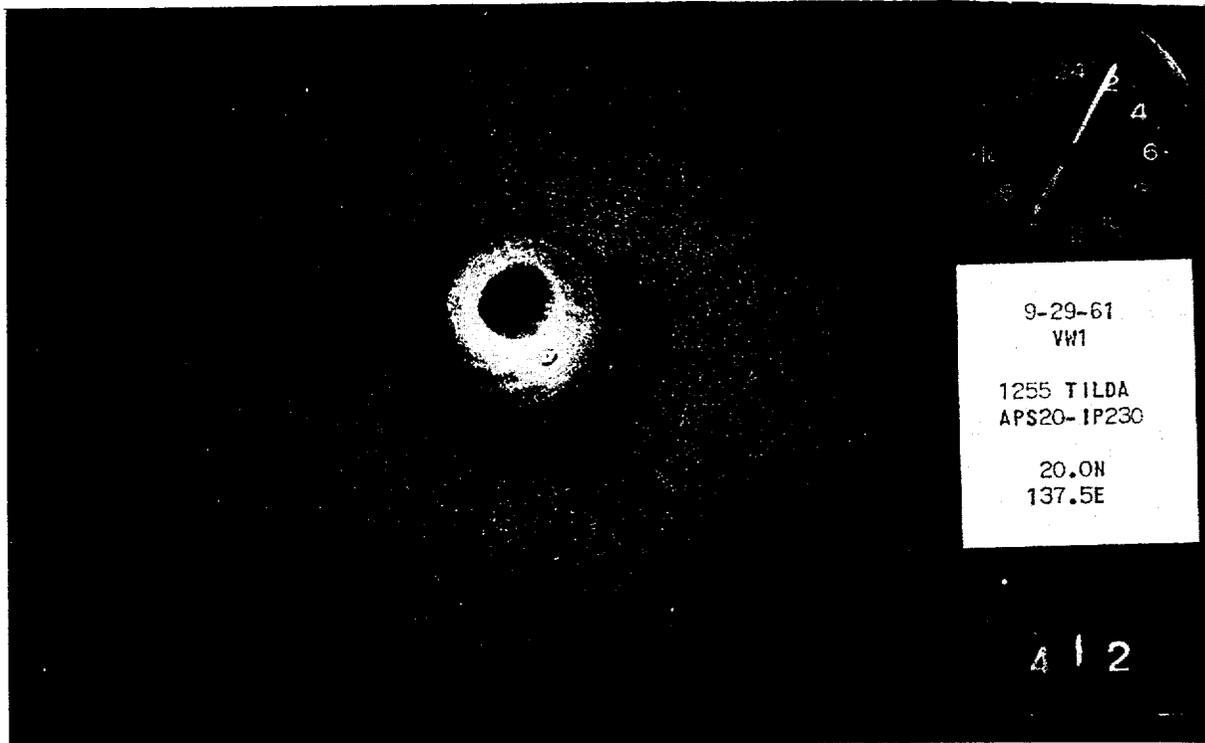


FIG. 2

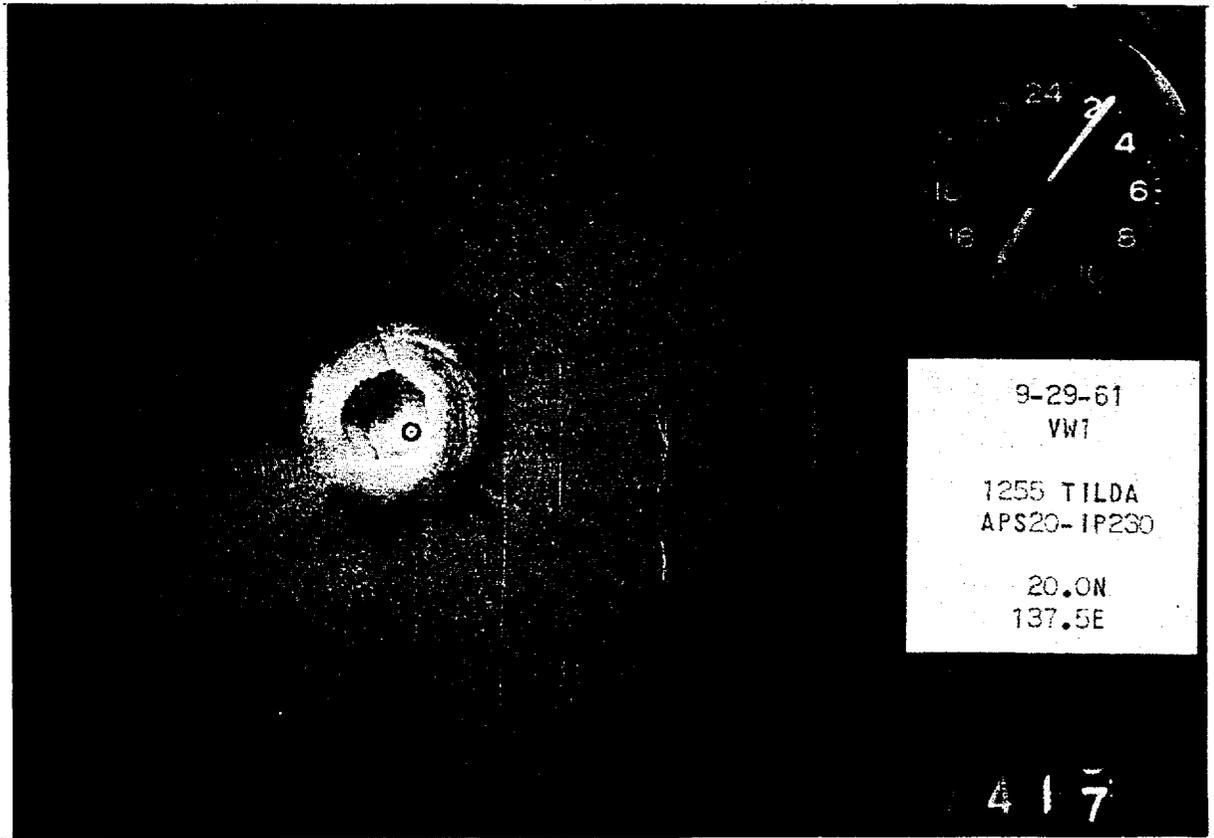


FIG. 3

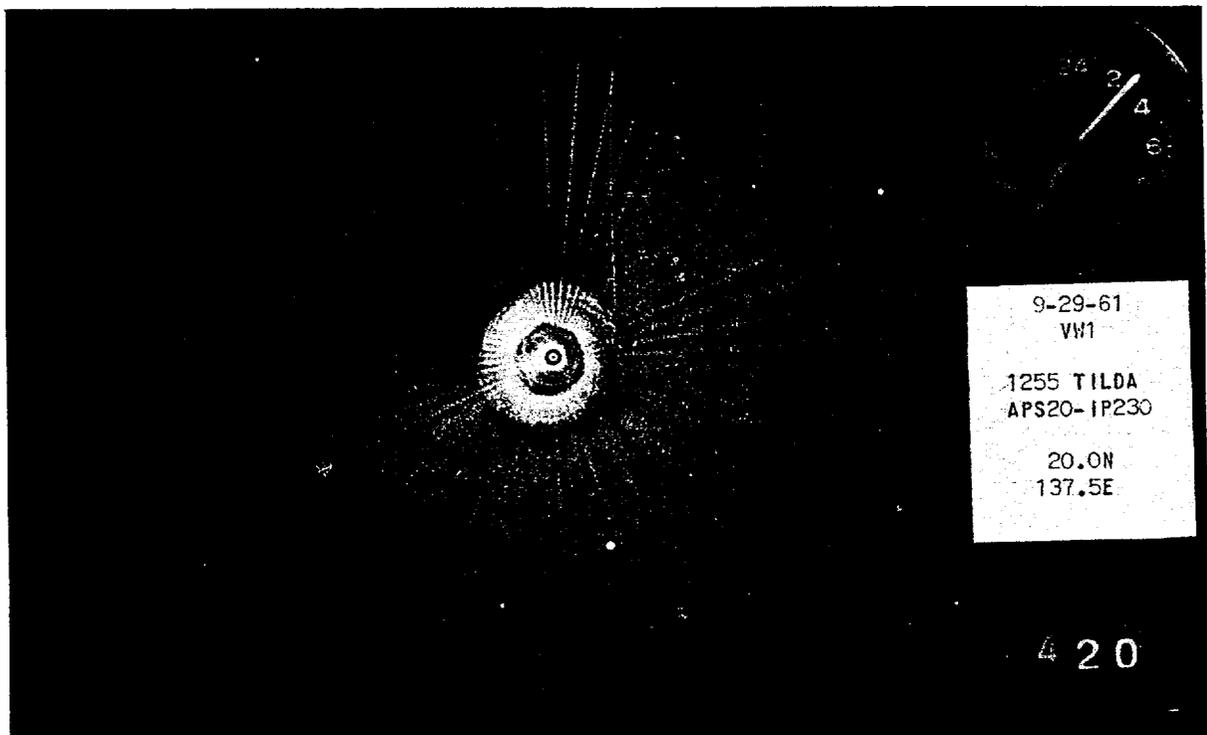


FIG. 4

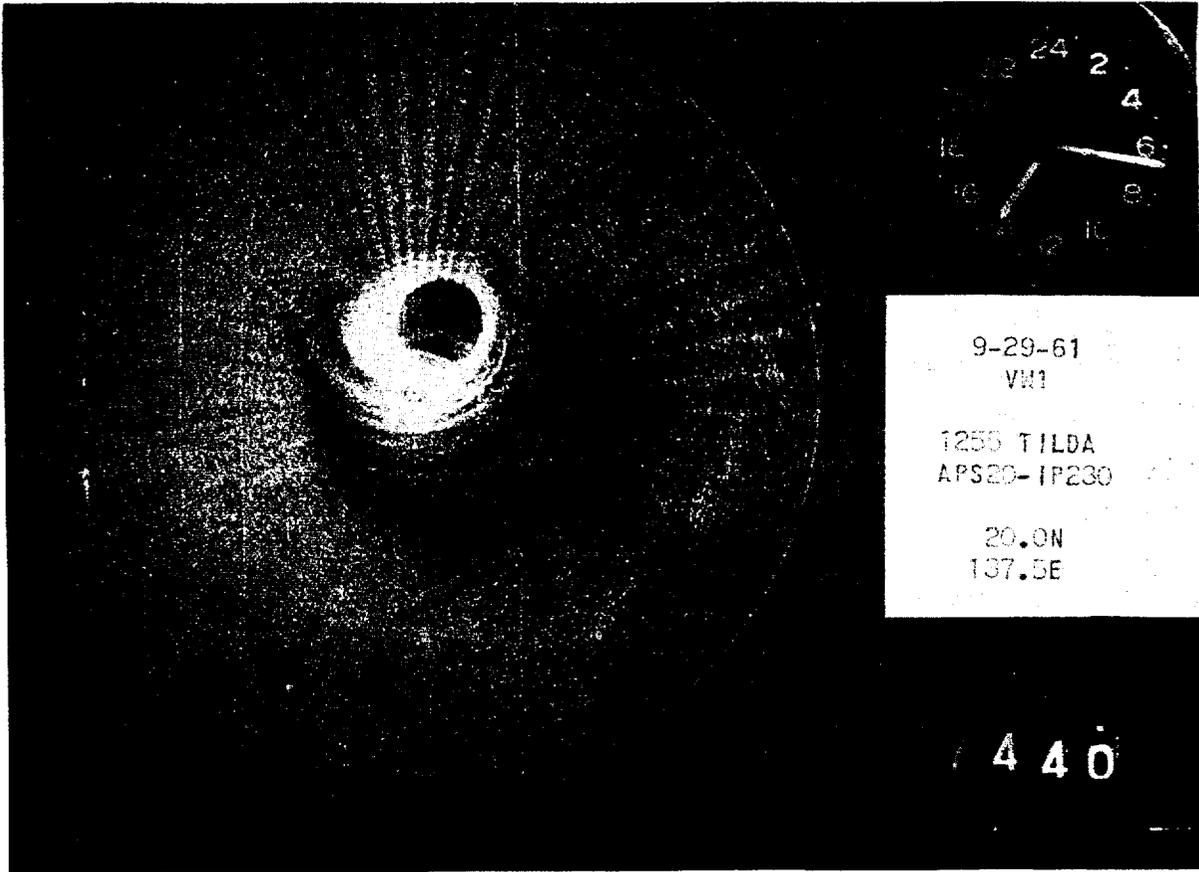


FIG. 5

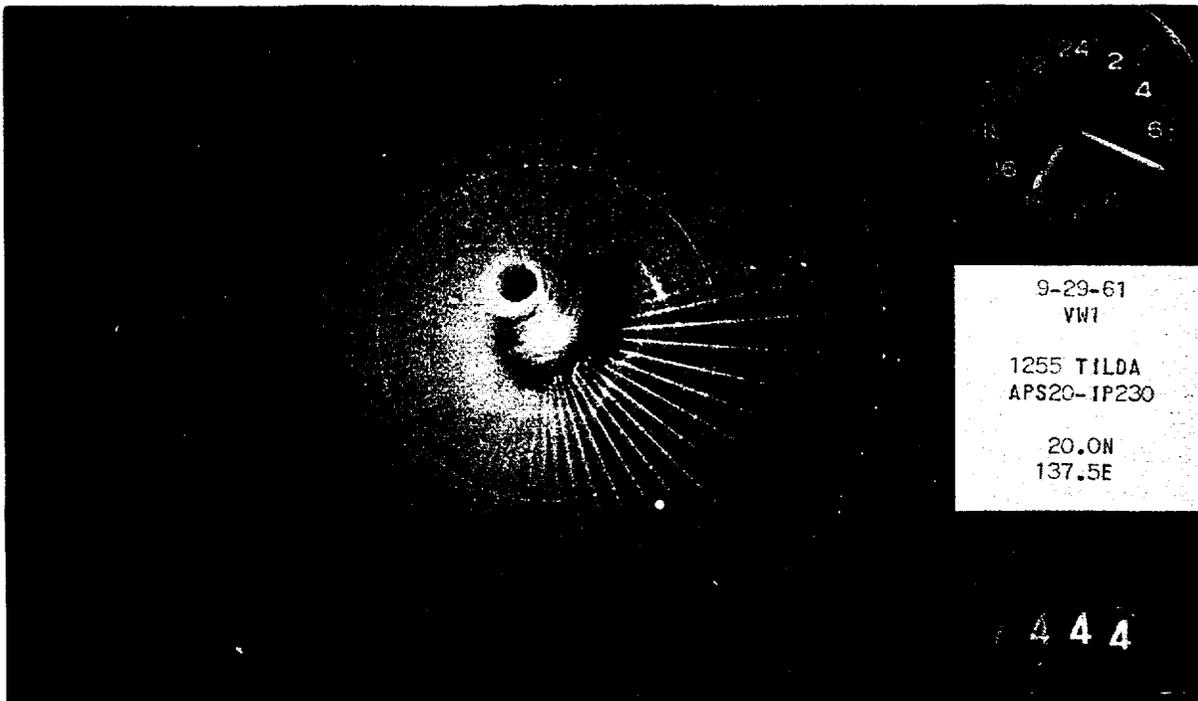


FIG. 6