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SESAME '79 FIELD PROGRAM — T-28 ARMORED AIRCRAFT WORK PLANS

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1. INTRODUCTION

The Institute of Atmospheric Sciences (IAS) of the South Dakota School of Mines and Technology (SDSM&T) will participate in the field program of the 1979 Severe Environmental Storms and Mesoscale Experiment (SESAME '79). The IAS participation in the SESAME Storm Scale Sub-program is sponsored by the National Science Foundation under Grant No. ATM-7827018. This participation will involve the IAS armored and instrumented T-28 aircraft as the principal source of observations. The overall research project involving the T-28 will be a cooperative effort with the Convective Storms Division (CSD) of the National Center for Atmospheric Research (NCAR) and the National Severe Storms Laboratory (NSSL).

The work to be accomplished during the SESAME '79 field season involves gathering *in situ* observations and measurements inside thunderstorms to help answer the following scientific questions:

1. What are the dynamic and thermodynamic characteristics and interactions in and around Oklahoma storms at mid-levels?

2. What are the prime processes of precipitation initiation and growth in the storms?

This report contains the work plans for the T-28 operations during the Oklahoma field season. Section 2 summarizes the scientific objectives of the T-28 project. Section 3 identifies the personnel who will participate in the field work, and the T-28 instrumentation system to be used in SESAME '79 is described in Section 4. The procedures to be used in gathering the data are described in Section 5. Section 6 outlines the data reduction procedures.

2. SCIENTIFIC OBJECTIVES

The objectives of the SESAME '79 Storm Scale Sub-program include observational studies leading toward increased understanding of intra-storm processes and storm-environment interactions. The cooperative research based on T-28 and other related data will relate to those aspects of the program.

Specific objectives of this research are as follows:

1. To understand the dynamic and thermodynamic characteristics and interactions in and around the storms at middle levels, with emphasis on the updraft characteristics and entrainment processes.

2. To understand the processes of precipitation initiation and growth in the storms, with emphasis on the micro-physical evolution of the precipitation and the formation and growth of hail. A related objective is to determine whether or not the Hallett-Mossop ice multiplication process is occurring.

In addition, the T-28 observations will provide storm truth data for a number of other experiments in SESAME '79 and will be used by other investigators in a variety of studies.

3. PERSONNEL

Dr. Paul L. Smith, Jr., from the IAS, Dr. Andrew J. Heymsfield from the NCAR CSD, and Mr. Stephan P. Nelson from the NSSL, are co-principal investigators for this research project. The T-28 field operations in Oklahoma will be carried out by the following members of Dr. Smith's Data Acquisition and Analysis Group:

Name	Function
Mr. Dennis J. Musil	Project Meteorologist
Mr. John Prodan	Pilot
Mr. Gary N. Johnson	Instrumentation Engineer
Mr. Jon E. Leigh	Aircraft Technician

In addition, the NCAR CSD will provide an instrumentation technician, Mr. Kenneth Evans, to maintain the Particle Measuring Systems probes and the particle camera. The field personnel will be based at Norman, Oklahoma. The "quick look" data reduction will be accomplished by Mr. Jerry L. Halvorson of the IAS at Rapid City, South Dakota, and Ms. Joanne Parrish of the NCAR CSD at Boulder, Colorado.

4. AIRCRAFT DATA SYSTEM

4.1 Instrumentation

The data system on the T-28 includes sensors to measure atmospheric and aircraft variables which are recorded on digital magnetic tape. The emphasis of the atmospheric measurements is on updraft characteristics and hydrometeor types, sizes, and concentrations. The instrument configuration for SESAME is essentially the same as that used on the T-28 since 1976. The instruments that will be carried during the SESAME '79 field season are summarized in Table 1. The particle camera and hail spectrometer cannot be carried simultaneously on the aircraft because of space, weight, and electrical power limitations. It is planned to carry each instrument about half the time during SESAME '79.

4.2 Data Recording and Telemetry

The primary data recording system consists of a Precision Instruments Model 1387 incremental recorder coupled with a Monitor Labs Model 9100 multiplexer and digital conversion package. The basic recording interval is once per second although, as shown by Table 2, some variables are sampled twice during each one-second cycle to provide higher frequency response. Daylight Saving Time will begin during the project, but data will be recorded using Central Standard Time throughout the season. A separate Pertec recorder is used to record data from the PMS probes, as well as for the duplicate recording of certain variables from the primary recording system. Data from the foil impactor and particle camera are separate from, but coordinated in time with, the tape-recorded data.

Audio tapes from an on-board recorder used for the pilot's voice comments and hail impacts on the windscreen will also be available. A side-looking super-8 mm movie camera with automatic exposure feature and remote control of operation is also carried on the T-28, and some film will be available from it.

Air-to-ground UHF telemetry of some data from the T-28 will also be available during flight operations. Three channels will carry voice signals from the cockpit and the aircraft altitude and rate-of-climb, respectively. The receiver will be installed at Norman to provide this information to the project meteorologist in the operations control room. The telemetry transmitter operates at 230.4 MHz.

TABLE 1

T-28 Instrumentation Complement - 1979

Variable	Instrument	Range of Measurement
State:		
Static Pressure (Altitude)	Rosemount 1301-A-4-B	0 to 15 PSI
	Ball Engineering EX-210-B	0 to 27,000 ft (8.2 km) MSL
Total Temperature	Rosemount 102AU2AP	-25 to +25°C
	NCAR Reverse Flow	-25 to +25°C
Hydrometeors:		
Cloud droplets	Johnson-Williams LWC	<50 μm dia (liquid only); 0 to 6 g/m^3
	Particle Measuring Systems FSSP	3 to 45 μm dia; adjustable
Rain, graupel, snow	Williamson Foil Impactor	1 to 20 mm
	Particle Measuring Systems OAP-2D	31 to 1000 μm
	Cannon Particle Camera (alternates with hail spectrometer)	Approx. 50 μm up
Hail	IAS Laser Hail Spectrometer (alternates with Cannon camera)	4.5 to 50+ mm dia
Aircraft Navigation & Performance:		
Attitude	Servomechanisms TR541 angle-of-attack vane	-15 to +15°
	Pitch (Humphrey vertically-stabilized accelerometer)	-50 to +50°
	Roll (Humphrey vertically-stabilized accelerometer)	-50 to +50°
Navigation	IAS Heading indicator	0 to 360° magnetic
	CESSNA 400 DME	0 to 200 n mi
	NARCO UDI-4 DME	0 to 100 n mi
	NARCO MK-12 NAV/COM (2 units)	0 to 360° from station
	NARCO 122 NAV Receiver	0 to 360° from station
Performance	Ball Engineering 101A variometer (rate-of-climb)	-6000 to +6000 ft/min (-30 to +30 m/s)
	Rosemount 1301-D-1-B dynamic pressure (ind. airspeed)	-3 to +3 PSI
	NCAR True Airspeed Computer	0 to 250 knots (128 m/s)
	Humphrey SA09-D0101-1 vertically-stabilized accelerometer	-1 to +3 g's
	Giannini 45218YE manifold pressure	0 to 50 in Hg

TABLE 2

Recorder Channel Assignments for Variables

Recorder Data Channel	Variable	Equipment Used
—	Time	Primary data system internal master clock; Central Standard Time
0	Pressure Altitude	Rosemount Model 1301-A-4-B temperature controlled absolute pressure transducer; output amplified by 5 for rate-of-climb calculations
1	Indicated Airspeed	Rosemount Model 1301-D-1-B temperature controlled differential pressure transducer
2	Instantaneous Acceleration	Humphrey Model SA09-D-0101-1 vertically stabilized accelerometer
3	Pressure Altitude	Rosemount Model 1301-A-4-B temperature controlled absolute pressure transducer
4	Pressure Altitude	Ball Model EX-210-B absolute pressure transducer
5	Temperature	Rosemount Model 102AU2AP total temperature probe
6	Temperature	NCAR reverse flow probe
7	Rate-of-climb	Ball model 101A variometer
8	Manifold Pressure	Giannini Model 45218YE pressure transducer
9	Heading	IAS designed device to enable recording of aircraft heading from gyrocompass
10	VOR Bearing	MetroData Systems, Inc., M-8 used to record from NARCO NAV-122 VOR receiver
11	DME Distance	MetroData Systems, Inc., M-8 used to record from a Cessna 400 DME

TABLE 2 (Continued)

Recorder Data Channel	Variable	Equipment Used
12	DME Distance	MetroData Systems, Inc., M-8 used to record from a Narco UDI-4 DME
13	Cloud Liquid Water Concentration	Johnson-Williams liquid water concentration probe
14	Blank	
15	True Airspeed	NCAR designed true airspeed computer
16	Angle of Attack	Servomechanisms, Inc., Type TR541 relative wind transducer
17	Aircraft Pitch Angle	Humphrey Model SA09-D-0101-1
18	Aircraft Roll Angle	Humphrey Model SA09-D-0101-1
19	Blank	
20	+5VDC	Reference voltage (optional)
21	Blank	
22	Positive Peak Acceleration	IAS designed circuit to record peak output from Humphrey Model SA09-D-0101-1 vertically stabilized accelerometer
23	Negative Peak Acceleration	Same as Channel 22
24	Blank	
25	Pressure Altitude	Same as Channel 0
26	Indicated Airspeed	Same as Channel 1
27	Instantaneous Acceleration	Same as Channel 2
28-29	Blank	

TABLE 2 (Continued)

Recorder Data Channel	Variable	Equipment Used
30	Positive Peak Acceleration	Same as Channel 22
31	Negative Peak Acceleration	Same as Channel 23
3 BCD digits	Event Codes (9)	IAS designed digital event codes
3 BCD digits	Frame Count	Frame counter for Cannon particle camera
24 BCD digits	Hydrometeors	IAS designed hail spectrometer

4.3 Calibration Procedures

The T-28 instrumentation will be calibrated as follows:

Pressure Instruments:	Pre-season calibration at the University of Wyoming, Laramie. Daily checks against ambient conditions during the field season.
Temperature Instruments:	Pre-season calibration of the reverse flow instrument at NCAR. Daily checks against ambient conditions during the field season.
J-W Liquid Water Sensor:	Daily checks during the season using a dummy head.
PMS Probes:	Pre-season calibration at the factory. Daily checks of data quality.
Hail Spectrometer:	Pre-season checkout and calibration at the IAS using test spheres.
Cannon Particle Camera:	Pre-season checkout and calibration at NCAR. Daily test photographs using a calibration jig.

A fly-by at the Boulder Atmospheric Observatory tower is planned to provide independent verification of the pressure and temperature sensors. Additional tower fly-bys are to be scheduled during SESAME operations in Oklahoma. Some in-flight aircraft comparisons are also planned during SESAME.

5. OPERATIONAL PROCEDURES

5.1 Location and Schedule

The T-28 SESAME '79 field operations will be conducted from Norman, Oklahoma. The aircraft will be based at Norman's Westheimer Field. The project meteorologist will operate from the TPN-19 radar aircraft control room, which is to be located adjacent to the NSSL Norman Doppler radar facility.

The IAS T-28 field team will depart Rapid City on Monday, 9 April, and should arrive in Norman on or about Wednesday, 11 April. Flight operations in SESAME '79 will commence as soon thereafter as practical. The T-28 and support team will depart Norman at the end of the field season on Friday, 8 June.

The T-28 will be available for research flights during daylight hours only on a seven-day-per-week basis. However, as a matter of principle to guard against crew fatigue, the project team will not be maintained on flight or active standby status for more than six consecutive full days. If the likelihood of weather suitable for research flights is small, the project meteorologist may designate an extended period (of the order of three days) for R&R during the field season.

A report of the T-28 aircraft and instrumentation equipment status will be available at the regular daily SESAME '79 weather briefings. If the complete system is not fully operational for any research flight that may be called for, an estimated time when the system will be up will be provided. The project meteorologist will alert the aircraft team to the possibility of a research flight at least one hour before the anticipated takeoff time. The aircraft can be airborne approximately one-half hour following receipt from the project meteorologist of a signal to launch a research flight.

On occasion the weather situation may be such that more than one flight on a given day is desirable. The aircraft and data system can be turned around in preparation for a second flight in approximately two hours after landing. It is unlikely that either the duration of daylight or crew endurance will permit more than two flights on any one day.

5.2 General Flight Procedures and Safety Considerations

The T-28 missions will be coordinated with the operations of other aircraft and research groups participating in SESAME '79. Top priority for flights will be given to storms designated as test cases by the SESAME '79 operations director. Preference will be given to storms in the multiple-Doppler radar coverage area. Decisions regarding flights to be undertaken and specific storm penetration profiles will be made by the project meteorologist at Norman after appropriate consultation with the operations director, the SESAME aircraft coordinator, and the T-28 pilot.

The meteorologist will direct the penetrations from the Norman TPN-19 radar installation, although his directions will be relayed through an FAA controller in conformity with the established procedures. The T-28 will make repeated storm penetrations at a single selected altitude on each flight, because past experience has shown that on any given mission a single penetration level works best. However, different operating altitudes may be selected for different flights, as discussed in Section 5.4.

Safety is of primary importance in the storm penetration procedures designed for the T-28. In matters of flight safety, the T-28 pilot has the final decision. From past experience with the T-28 in Colorado and Florida thunderstorms, avoiding the portions of storms with reflectivity factors greater than 55 dBz along the flight path at or above the level of penetration has resulted in no encounters with hail larger than the size for which the aircraft's protection has been tested. In view of our lack of experience with Oklahoma storms, a somewhat lower limit (say, 50 dBz) seems advisable until a reasonable amount of experience has been acquired with those storms. The project meteorologist will establish the penetration vectors in consultation with the pilot, keeping these safety considerations in mind.

Additional safety criteria based on Doppler radar observations are being worked out; these will include the avoidance of any area where a tornado vortex signature has been identified and (at least initially) some restriction on penetrations in regions where mesocyclone signatures appear. The plan is to investigate weaker situations initially and then move toward situations of higher intensity as our knowledge and experience increase.

For mature storms, the flight paths will be designed to penetrate the main updraft region and the high reflectivity zone (or the edge of it if safety restrictions require). In accordance with the discussion in the preceding paragraphs, flight vectors will be established to avoid regions with reflectivity factors greater than about 50 dBz at or above flight altitude until experience indicates that this limit can be increased. The use of such a safety criterion is intended to guard against encounters with storm conditions too severe for the aircraft or pilot. Even with such a limitation in effect, the aircraft sometimes enters regions of somewhat higher reflectivity because of imperfections in the vectoring process.

The SESAME work will constitute the first T-28 flight operations in Oklahoma storms. The lower cloud bases and higher mixing ratios in the Oklahoma environment will likely mean stronger updrafts and higher cloud liquid water concentrations than in Colorado. The latter, coupled with the probable occurrence of supercooled raindrops in Oklahoma, may lead to faster airframe icing rates. However, while the 1978 T-28 flights in Florida did encounter some strong updrafts, the liquid water concentrations were not large and aircraft icing did not restrict the penetrations. Nevertheless, we think it wise to conduct the storm penetrations with particular caution until an adequate basis of experience is established in Oklahoma.

5.3 Specific Flight Procedures

T-28 flight operations will be conducted from Westheimer Field under the control of a SESAME '79 dedicated Federal Aviation Agency (FAA) flight controller. Flight plans will be filed under the code "Rough Rider XX." The working area will generally be limited to a range of no more than 115 km from Norman, this being the approximate working limit for both the TPN-19 surveillance radar and the Norman Doppler radar. All communications between the T-28 pilot and the ground regarding flight clearances will be conducted with the FAA controller. The controller and the SESAME aircraft coordinator will be responsible for coordinating the T-28 flights with other SESAME aircraft operations, with the controller having responsibility for maintaining aircraft separation in flight. The principal coordination problem with respect to the T-28 will involve the other penetrating aircraft, an F-4C. Where any other aircraft are involved, it is expected that the penetrating aircraft will have priority for flight space.

The T-28 project meteorologist will be situated near the FAA controller's position. He will have access to a WSR-57 weather radar display as well as the aircraft position information from a TPN-19 "scientist scope" display. During penetrations, the T-28 ATC transponder positions will appear on the WSR-57 scope as well as the TPN-19 displays, and weather echoes (non-quantitative) will also appear on the TPN-19 scopes. From this information, the meteorologist will determine the initial point (IP) and heading for each T-28 penetration. He will also determine a recommended exit path in case the aircraft should encounter excessively difficult conditions or some in-flight emergency during a penetration. These will be relayed to the T-28 pilot by the FAA controller. Course corrections and abort instructions will be relayed in the same way. If an immediate landing should be necessary, the FAA controller will provide vectors to the nearest suitable airfield and will alert the airport authorities of the impending emergency landing.

During the flights, T-28 positions will be recorded by marks on the display scopes by the project meteorologist. Position information for subsequent analyses will be derived from the following sources:

1. Periodic photos of the TPN-19 display.
2. Periodic photos of the WSR-57 display.
3. Digital data (with skin paint echoes) from the WSR-57.
4. Data tapes from the regular FAA aircraft tracking system.
5. T-28 on-board VOR-DME position recording.

The project meteorologist will hear all air-to-ground communications between the T-28 pilot and the FAA controller, and will also hear the pilot's in-flight comments via the air-to-ground telemetry system. Essential information, such as the aircraft position, heading, altitude, and general comments about the penetrations can be relayed to the meteorologist through the FAA controller if not picked up on the telemetry channel. A separate frequency will also be available for communications between the T-28 pilot and the project meteorologist regarding meteorological information. Such discussions will be on the 123.05 MHz meteorological network.

5.4 Storm Penetration Procedures

Most of the penetrations will be conducted at the -10°C to -15°C level, where graupel, hail, and supercooled water are likely to coexist. Some penetrations will be made around the -5°C level to look for ice particles in updrafts as evidence of recirculation processes and to provide data for the ice multiplication study. A few penetrations will also be made near the 0°C level. As noted earlier, the penetrations during any one flight will be made at a nominally constant level. However, on occasion, the accumulation of ice on the airframe may make it necessary for the T-28 to descend to lower altitudes for later penetrations. In that event, there will likely be no attempt to regain the original altitude after the ice has been shed, because too much time would be lost in the process.

In general, the intention is to make the penetrations on relatively simple, usually straight-line paths. An attempt will be made to acquire data over the full life history of identifiable storm elements whenever possible. Specific penetration patterns are expected to be similar to those in Figs. 1, 2, and 3 for different basic storm types. Those patterns are intended mainly to provide guidelines indicating the regions of the storms that are of major interest. If necessary, the patterns can be modified because of dynamic or unforeseen situations. However, real-time storm classification is extremely difficult, so this should be the exception. The capability for real-time adaptation of flight paths should not take the place of sound and thorough planning.

Penetrations of steady-state storms with well developed weak-echo regions will be made on straight lines through the weak echo and embryo curtain regions, avoiding areas where the radar reflectivity factor exceeds the safety threshold. Figure 1 illustrates this pattern. The initial point (IP) and heading for each penetration will be established by the project meteorologist at Norman.

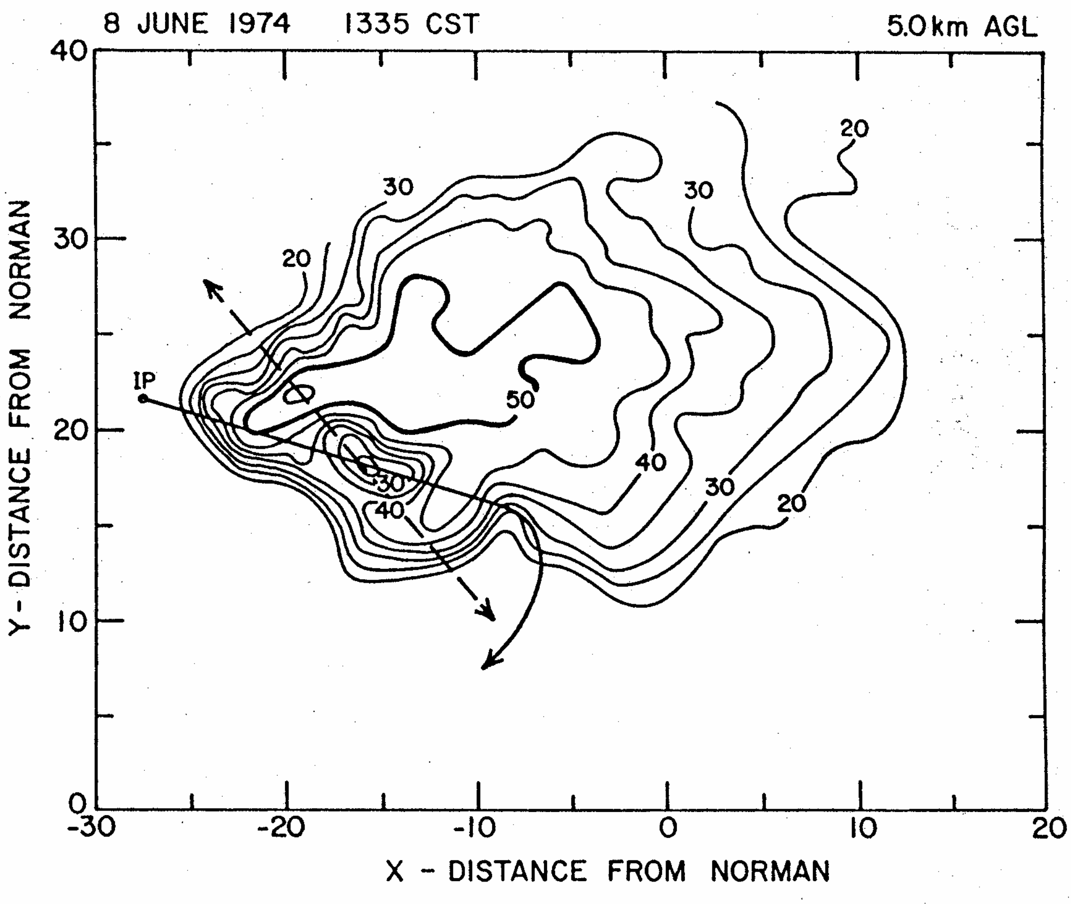

Fig. 1. Radar reflectivity contours at 5 km above ground level for a "steady-state" storm in the SESAME area, showing possible T-28 penetration tracks. The solid track passing along the edge of the high reflectivity zone and through the weak-echo region is appropriate for initial flights. If the reflectivities are not too high, or the safety threshold can be raised somewhat, the track can be moved around towards the dashed line.

Penetrations of multicell storms will preferably be carried out along the line of new cell formation through cells in various stages of development. Figure 2 shows one example of this pattern. If the radar reflectivity factors along the desired flight path exceed the established threshold, the track can be moved several kilometers toward the leading edge of the storm.

An alternate procedure will be to pick a cell expected to merge with the main cloud mass and penetrate it in a direction perpendicular to the line of cell formation. This will allow the T-28 to follow the life cycle of a particular cell without getting into reflectivities which are too high. The decision whether to penetrate a single cell or a line of several cells in various stages of their life cycles will depend mainly on an on-the-spot assessment of whether cells are merging or growing on their own and the strength of the radar echoes. The equipment being carried on the T-28 that day will also be a factor. Thus, the track in Fig. 2 may be more suitable when the hail spectrometer is carried, because of the chance of encounters with higher reflectivity values and larger particles. The "single-cell track" roughly perpendicular to that one may be more suitable when the Cannon camera is carried because it has a much smaller particle size detection limit and can provide information on the phase of particles in the initial stages of growth.

For investigations of the development of precipitation in feeder clouds adjacent to parent storms, a "figure 8" penetration track will be followed. Figure 3 shows a diagram illustrating this type of track. On days when no major storms are present, a similar procedure can be used to investigate the development of precipitation in cumulus congestus clouds. For the isolated clouds, one penetration leg will be along the direction of cloud motion, as estimated from the 16,000 ft (4.9 km) wind direction, with the other leg crosswind.

5.5 Special Flight Profiles

In addition to the basic storm penetration procedures outlined in the previous sections, several additional flight profiles are planned to gather data for particular investigations associated with SESAME '79. These missions all have lower priority than the storm penetrations, but will be worked into the research flights when suitable opportunities arise.

5.5.1 PAR approaches for wind shear studies

Landing approaches to Westheimer Field will frequently be guided from the ground using the TPN-19 Precision Approach Radar (PAR). The objective is to gather data for studies of wind shear effects on landing operations. No special data will be acquired by the T-28, but the pilot will record detailed impressions of the wind shear and turbulence during the landing maneuvers.

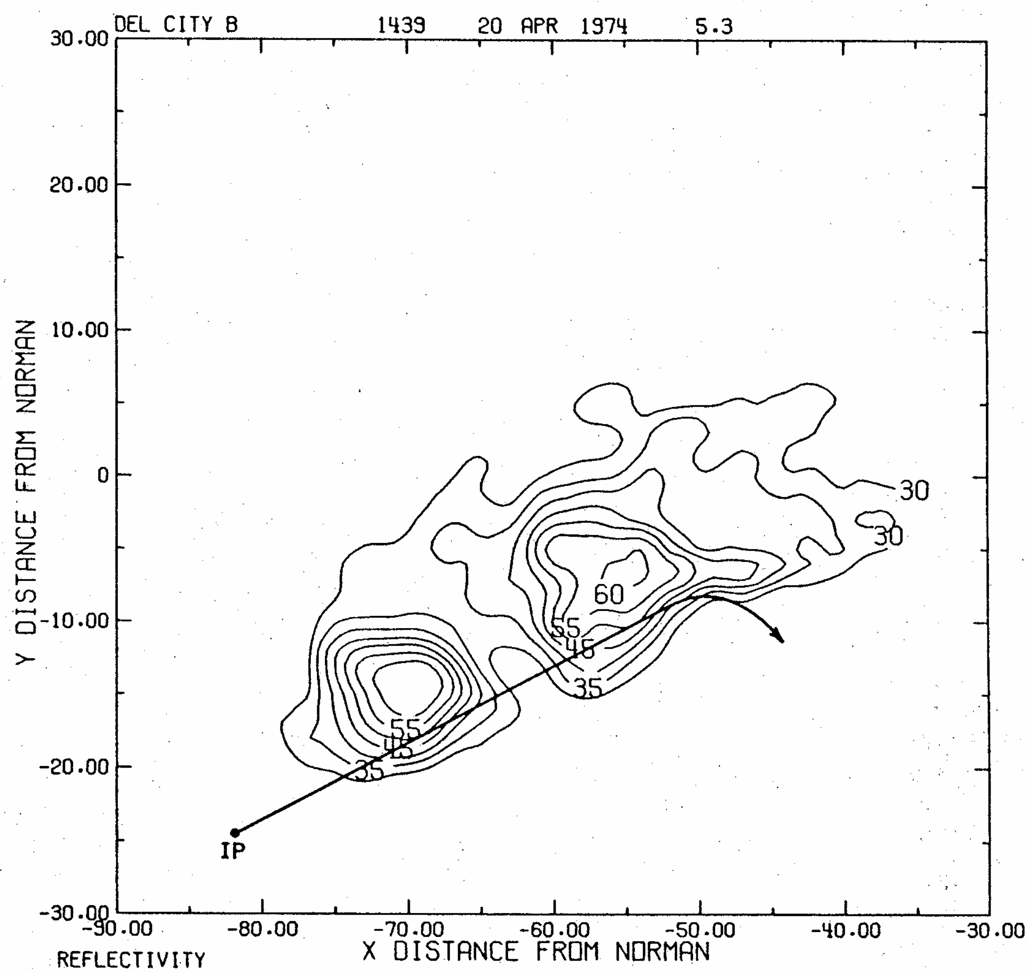

Fig. 2. Radar reflectivity contours at 5.3 km above sea level for a "multicell" storm in the SESAME area, showing a possible T-28 penetration track.

5.5.2 Overflight of vertically pointing Doppler radar

On at least one occasion, an attempt will be made to fly through the beam of the vertically-pointing dual wavelength Doppler radars at Norman. This will occur when the T-28 is inbound from a mission on an occasion when precipitation is falling over the radar site. The objective is to acquire hydrometeor size data for comparison with the radar observations. The intention is to fly through the beam, ideally below cloud base but above the minimum working range of the radars. The basic T-28 microphysics data will suffice for this experiment.

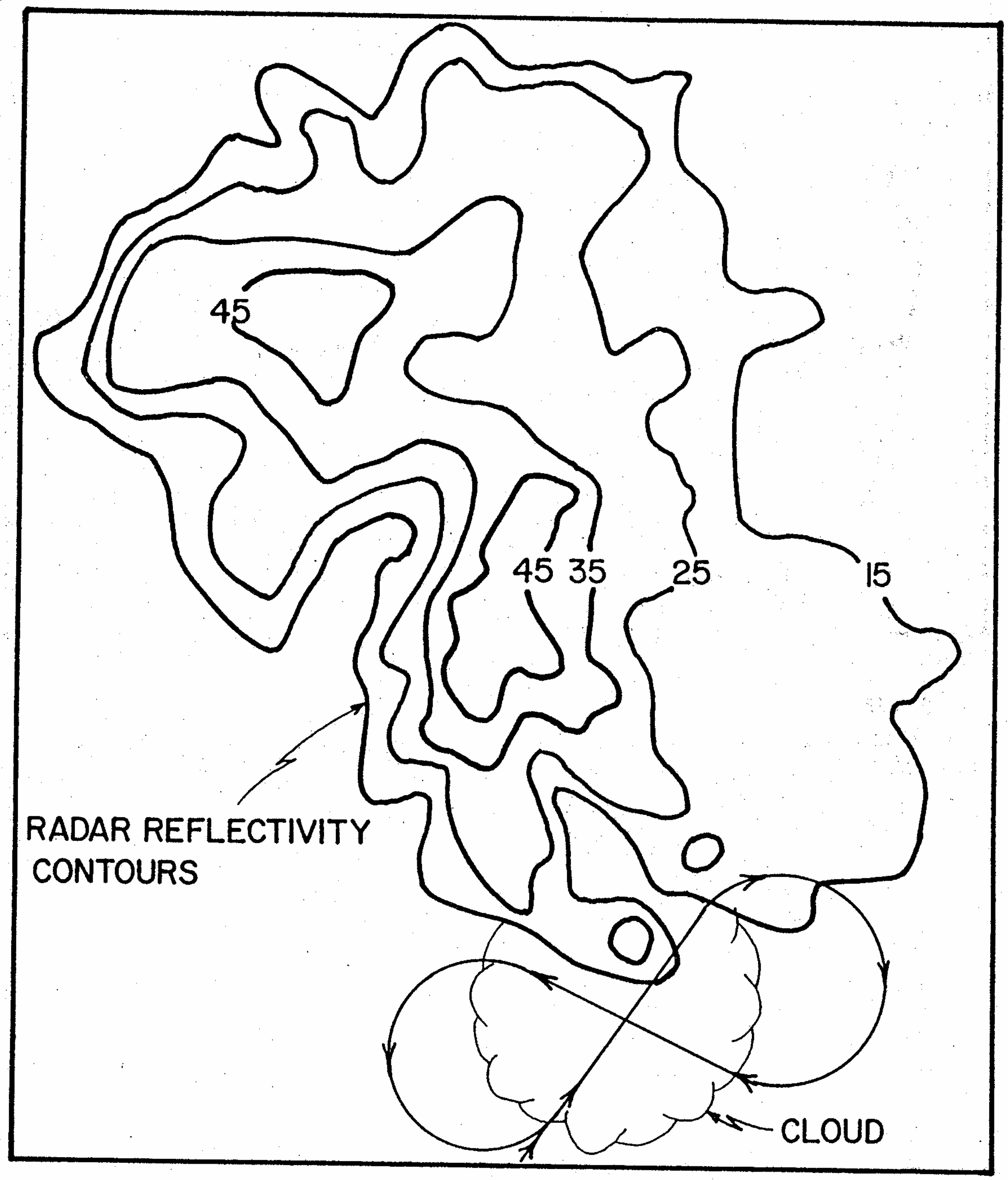

Fig. 3. Penetration patterns suitable for feeder clouds, or isolated cumulus congestus.

5.5.3 In-cloud descent through melting level

On at least one occasion, the T-28 will descend while in-cloud from about the -5°C level to about the +5°C level. The objective is to gather data to aid in evaluating the effects of wetting on the aircraft temperature sensors. The standard data will be suitable for this study.

5.5.4 Storm penetrations to support radar rainfall measurement project

Investigators concerned with radar measurement of rainfall have requested some in-cloud hydrometeor observations over the ARS rain gage network. These data will be acquired during the course of some regular T-28 research flight when suitable storms are over that network. The preferred operating level for this work is in the 0 to -10°C range. The regular T-28 flight pattern appropriate to the storm under study will be used. The investigators request coordination of the T-28 penetrations with the operation of another aircraft, also equipped for microphysics measurements, below the cloud base. Responsibility for effecting this coordination will rest with the SESAME aircraft coordinator.

5.5.5 Observations for temperature profile study

For a study of the temperature patterns in the near environments of storms, an effort will be made on at least one occasion to extend the T-28 penetrations out to about one cloud radius beyond the limits of the visual cloud. To keep the penetration times reasonable, this will be done only when a fairly small storm is under study. The basic T-28 temperature data will suffice for this investigation.

6. DATA REDUCTION PROCEDURES

6.1 Quick Look Data Reduction

Quick reduction and examination of recorded data are essential to the successful conduct of the T-28 SESAME '79 field operations. Original plans for the NCAR CSD to bring a PDP-11/03 computer to Norman for on-site processing of the data tapes to provide a "quick look" have not materialized. In lieu of on-site processing, the T-28 data tapes will be sent by air freight to the IAS in Rapid City, South Dakota, and CSD in Boulder, Colorado, for processing. Film from the particle camera will be shipped to a laboratory in California for processing.

Computer-generated plots of the reduced data from the Monitor Labs 9100 system will be transmitted from the IAS back to Norman by telecopier as soon as the reduction is complete. This should normally be sometime during the second day following a research flight. Samples of the "rapid recall" plots are shown in Figs. 4 and 5; Tables 3 and 4 give keys for the respective plots. The reduced PMS probe data, including 2-D particle images in microfilm form, will first be reviewed at NCAR and then sent back to Norman by the fastest available means.

Upon receipt of the reduced data in Norman, the field team will conduct an immediate review to verify proper instrumentation performance. Very preliminary data analysis will also be conducted at this point to insure that the research objectives can be achieved using the data from the field experiments. This "quick look" examination will help determine the priority of research days as candidates for detailed subsequent analysis, as well as any need for shifting the emphasis or modifying the procedures for subsequent research flights.

Detailed computer listings of the basic data will also be sent from the IAS to Norman, on a somewhat slower time schedule. These listings will permit more accurate checking of measured values to assure proper equipment performance. The value of the "quick look" reduction techniques for the T-28 data in uncovering instrumentation problems and providing a look at the data while the events are still fresh in the field team's minds is firmly established.

6.2 Post-season Data Reduction

Following completion of the SESAME '79 field season, a more comprehensive and detailed reduction of the T-28 data from at least the high priority research flights will be conducted. At that time more careful review and editing of the data will be possible. Also, additional derived quantities such as equivalent potential temperature and turbulent eddy dissipation rates will be calculated. A series

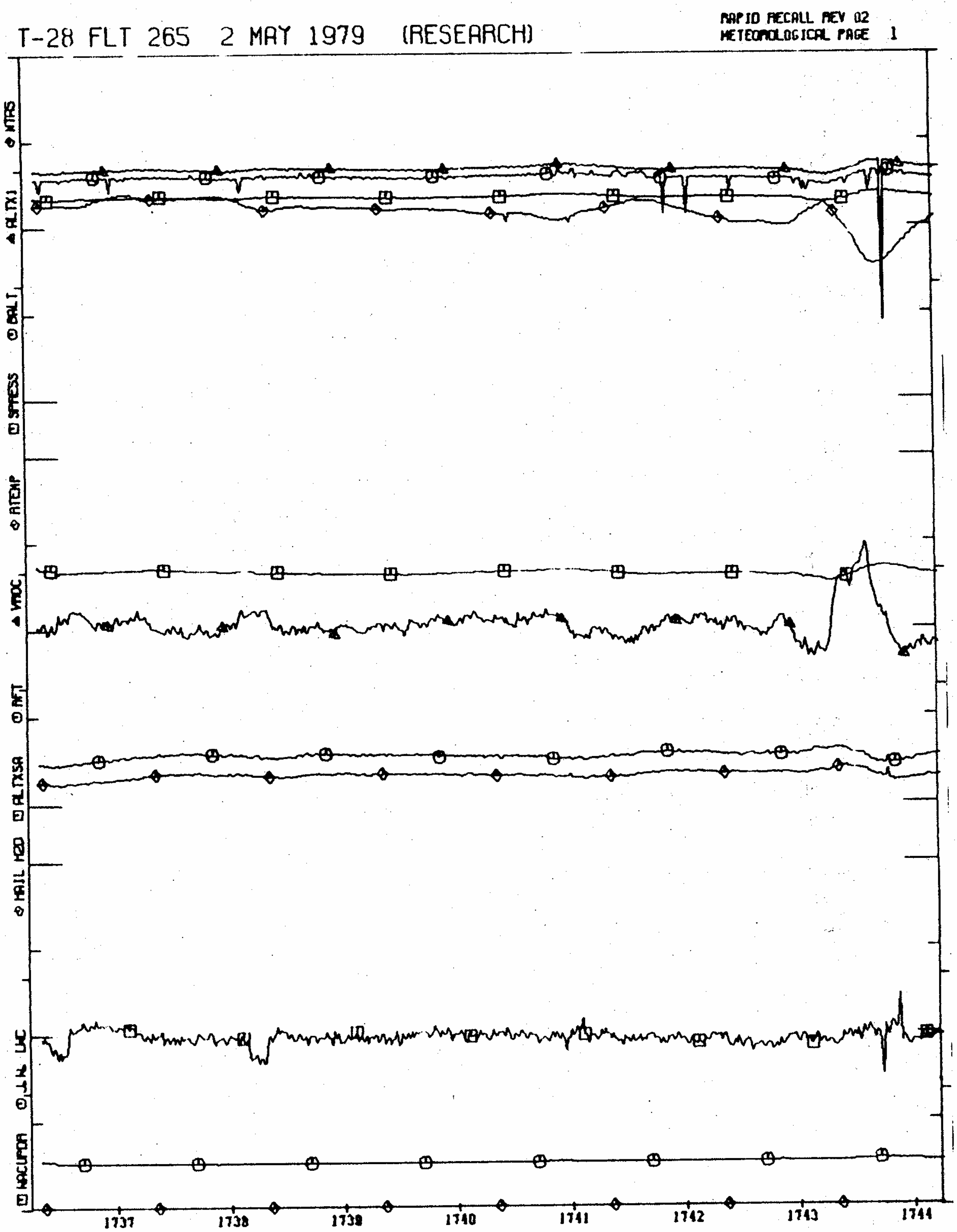

Fig. 4. Example of "meteorological" data rapid recall plot format for 1979. Abscissa scale shows time in minutes (CST), and may be converted to an approximate distance scale using the nominal T-28 flight speed of 6 km/min. Plot is in three sections, with plotting symbols for the variables in each section shown along the ordinate. See Table 3 for key to the variables and their respective plotting scales.

TABLE 3

Key to Meteorological Data Plot* (Fig. 4)

UPPER PLOT

Symbol	Variable	Units	Scale*
ALTx1	Altitude (Rosemount)	ft	10,000 to 25,000 ft
BALT	Altitude (Ball)	ft	10,000 to 25,000 ft
NTAS	True airspeed	m/sec	40 to 120 m/s
SPRESS	Static pressure	mb	700 to 300 mb

MIDDLE PLOT

Symbol	Variable	Units	Scale*
ALTx5A	Altitude (High-resolution)	ft	10,000 to 25,000 ft
VROC	Rate-of-climb	m/sec	Center zero, $\pm$40 m/s
RFT	Temperature (R.F.)	°C	-20°C to +10°C
RTEMP	Temperature (Rosemount)	°C	-18°C to +12°C

LOWER PLOT

Symbol	Variable	Units	Scale*
WAC UPDR	Updraft speed	m/sec	Center zero, $\pm$40 m/s
JW LWC	Cloud LWC	g/m^3	-1 to +7 g/m^3
HAIL H2O	Hail mass conc.	g/m^3	0 to 8 g/m^3

*Plot arrangement and scale ranges are subject to change.

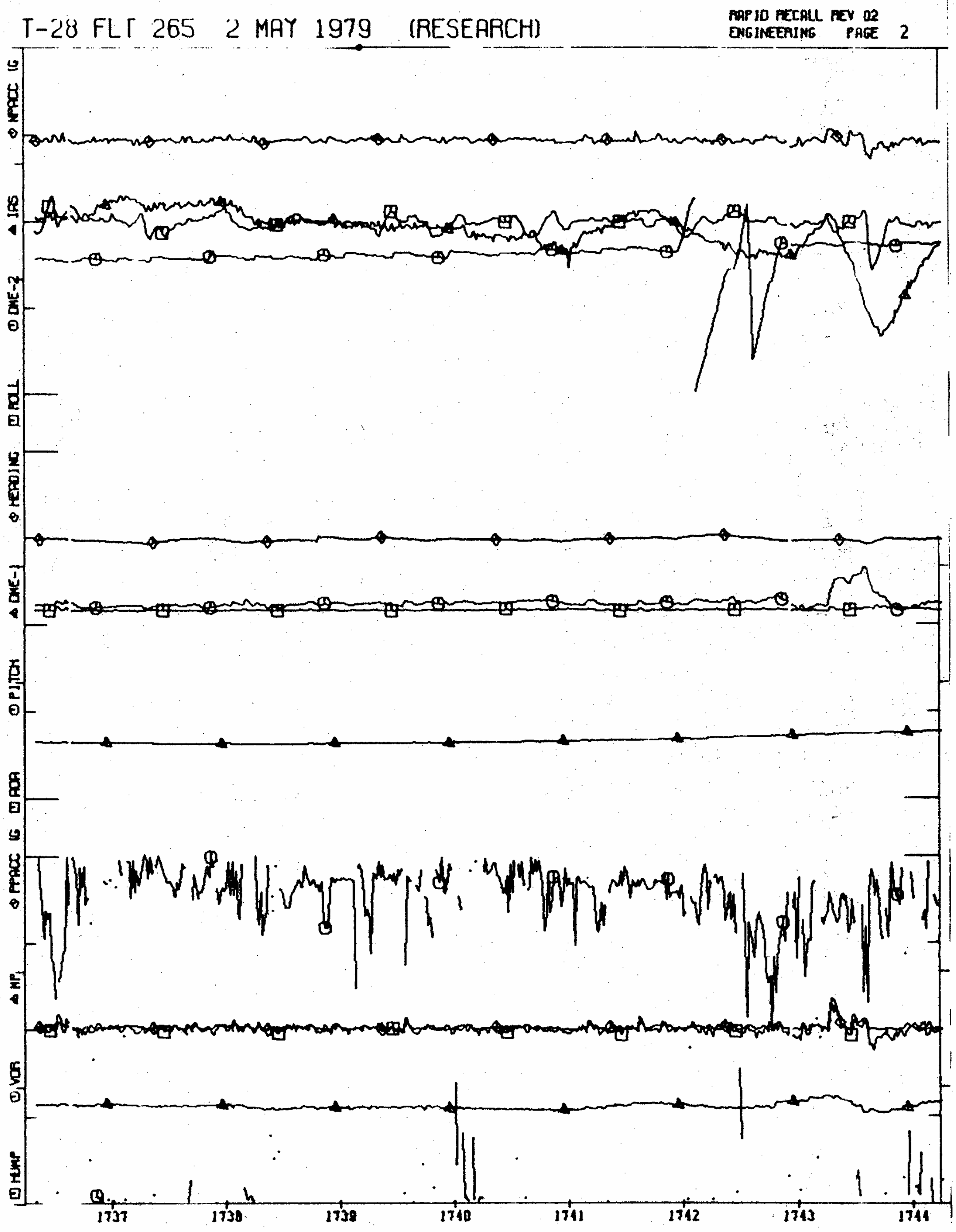

Fig. 5. Example of "engineering" data rapid recall plot format for 1979. Abscissa scale shows time in minutes (CST), and may be converted to an approximate distance scale using the nominal T-28 flight speed of 6 km/min. Plot is in three sections, with plotting symbols for the variables in each section shown along the ordinate. See Table 4 for key to the variables and their respective plotting scales.

TABLE 4

Key to Engineering Data Plot* (Fig. 5)

UPPER PLOT

Symbol	Variable	Units	Scale*
NPACC	Negative peak acceleration	g	-2 to +2 g
IAS	Indicated airspeed	kt	100 to 180 kt
ROLL	Roll angle	deg	Center zero, ±40°
DME2	DME distance	n mi	0 to 100 n mi

MIDDLE PLOT

Symbol	Variable	Units	Scale*
HEADING	Compass heading	deg mag	0 to 360°
PITCH	Pitch angle	deg	Center zero, ±40°
AOA	Angle of attack	deg	Center zero, ±40°
DME1	DME distance	n mi	0 to 100 n mi

LOWER PLOT

Symbol	Variable	Units	Scale*
VOR	VOR bearing from station	deg	0 to 360°
PPACC	Positive peak acceleration	g	-1 to +3 g
HUMP	Instantaneous acceleration	g	-1 to +3 g
MP	Manifold pressure	in Hg	20 to 50 in

*Plot arrangement and scale ranges are subject to change.

of programs described by Heymsfield and Parrish (1979) will be used to process the PMS probe data to derive such quantities as hydrometeor size spectra, mean Doppler fall speeds, and cloud liquid water depletion times. The products of this detailed processing will be best suited for the scientific analysis of the aircraft data.

6.3 Availability of Data to Other Investigators

The T-28 data will form part of the overall SESAME '79 data pool and will be available to all investigators. Copies of the "quick look" plots will be furnished upon request. Data in other formats or requiring further processing will be available after the T-28 project team has had adequate opportunity to examine the data in enough detail to insure the data quality. One exception is the particle camera and foil impactor data, for which there are no provisions for making copies of the originals and only partial data reduction is planned.

For selected high priority research flights, most of the data should be available by 1 September 1979. Additional time, depending upon the priority assigned, is likely to be needed for processing the data from other flights. The T-28 data may be requested from one of the project principal investigators:

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