AUTOMATIC WEATHER STATION DEVELOPMENT AND TEST

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This report is a result of work accomplished under WARs D-171, Remote Automatic Weather Station and D-54, GOES-DCP

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INTRODUCTION

BLM has a long standing requirement for rapid access to meteorological, air and water quality information from remote public lands.

In FY-77 BLM's Office of Scientific Systems Development (SSD) undertook a program to develop a portable, low power consumption automatic weather station to accomplish the rapid retrieval of remote data automatically. Two systems were assembled and successful transfer of data from remote areas was accomplished.

Ideally the weather station would adapt to any form of communication available, satellite, meteor-burst, UHF-VHF links or land line. Satellite communication was selected for the first two automatic weather stations for the following reasons:

1. Rapid, near real time return of data and the availability of the Geostationary Operational Environment Satellites (GOES) satellites. GOES satellites are operated by the National Oceanic and Atmospheric Administration/National Environmental Satellite Service (NOAA/NESS).

2. The GOES Satellites are geostationary (East or West) and one or the other is visible from nearly all public lands managed by BLM. Since most of BLM responsibility lands are located in the Western United States and Alaska, the GOES West Satellite was selected (135° W, located directly over the equator).

3. Satellite Data Collection Packages (DCPs) are readily available at a reasonable cost ($3,150, GSA Schedule, La-Barge Electronics, Tulsa, Oklahoma).

4. One also has the choice of geostationary (GOES) or polar orbiting satellites (Landsat) with the La Barge DCP.

5. VHF-UHF links to extremely remote areas are not practical (line of sight limitations).

6. Land lines are not available in some remote areas.

7. Meteor burst communications and equipment is still in the developmental stage.

8. Data can be returned to the user in near real time using the GOES Data Collection System (DCS). Even though these first units have been tested through the GOES-DCS, they are also designed to operate through the other communication media. By blocking the systems into discreet functions, one can attach a data logger and the desired communications systems at the output of the signal conditioning unit. In the case of meteor-burst communication, one has only to change a connector to operate the station through meteor-burst communications system instead of the GOES-DCP.

SYSTEM DESCRIPTION

The BLM Automatic Weather Station consist of six basic parts: (1) physical structure (tripod with tundra pads and steel box), (2) sensors, (3) signal conditioning unit and precipitation gauge accumulating counter, (4) GOES-DCP and test set, (5) GOES antenna, and (6) power system (solar panels and batteries).

1. The tripod is designed as a free standing, high wind load structure (see Fig. 2 and Fig. 3). All structural members are 2" thick wall tubular aluminum. (Prototype tripod manufactured by Synergetics, P.O. Box E, Boulder, Colorado 80306) The structure is approximately 4.3 meters (14 ft.) to the antenna. Swiveling tundra pads are provided with holes for securing if desired. One leg is adjustable to provide for leveling. A 2' X 3' X 1.5' lockable steel enclosure (NEMA) is provided to house the electronics, patch panel, batteries and pressure sensor. One inch steel conduit shields the up-mast sensor wiring and traverses from near the top of the mast to an entry point underneath the steel chassis. The conduit is held in place along the mast and down one of the supporting legs by hose clamps. A weather head located where the cables from the sensors enter the conduit prevents excessive moisture and dust from entering.

2. The sensor specifications are as follows:

   A. Cummulative Precipiation Gauge (w/o heater); Weather Measure Co., 0.01 in. to 99.99 in. (digital output).
   B. Wind Speed (Met 1 Model 014 with 12 sec time constant). Sensor powered for more than 5 time constants before monitoring occurs. 0-125 mph, 1 mph Theshold, $\pm$ 1% or 0.25 mph, 0-5v analog.

C. Wind Direction, Met 1, Model 024 with Model 1190 card 0-548, 12 sec time constant. Sensor powered for more than 5 time constants before monitoring occurs. 0-360 degrees, 1 mph threshold, ± 1/2% of full scale linearity, ± 5 degree accurate, scaled 0-5v analog.

D. Temperature, Met 1 Model 060 with directional radiation shield. Range -50 degree C. to +50 degree C., ± 0.8 degree C. linear to ± 0.15 degree C., scaled 0-5v analog.

E. Relative Humidity, Met 1 Model 083 with sky shield. Sensing element, thin film capacitor, range 0-100%, temp range -40 degree F. to +175 degree F. Response time 10 to 20 seconds, sensitivity--better than ± 3%, hysteresis--excursion less than ± 1%, temperature coefficient 0.07% per 1 degree C. Output scaled 0-5v analog.

F. Barometric Pressure, Met 1, Model 090. Resolution ± .15%, linearity ± .3%, operating temperature -30 degree F. to +180 degrees F., temperature coefficient--less than 0.0025% degrees F. Output scaled 0-5v analog.

G. Battery Monitor, La Barge Electronics, accuracy 0.2V from 8.9 to 15.0 volts. Output scaled 0-5v analog.

3. The signal conditioning unit consists of a power supply card rack, and input output connectors. Also included is a connector to access and test the tipping bucket rain gauge accumulating counter card.

   Each sensor has a signal conditioning card located in this unit. With the exception of the tipping bucket rain gauge, all sensors on these first two stations have their outputs scaled 0-5v analog over the dynamic range of the device. For example, 0-125 mph on wind speed would be represented as a linear voltage varying from 0-5v, with 4v representing 100 mph. The rain gauge signal conditioning card accumulates tipping bucket counts. .01 inches of precipitation tips the balanced bucket in one direction and sends an event signal to the counter in the Signal Conditioning Unit which accumulates one count. The counter continues to accumulate counts to 9999 and then resets to 0000. 9999 represents 99.99 inches of precipitation. To determine accumulated precipitation over any time interval, one subtracts the initial reading from the final reading.

   In the present station configuration the rain gauge is the only sensor with digital data presented to the D.C.P.

4. The DCP used is the ERTS/GOES convertible/Data Collection Platform (CDCP), manufactured by La Barge Electronics. This unit is completely microprocessor-controlled and all control

parameters are entered into the micro system by means of a test set when the station is put into operation.

The BLM station are programmed to automatically record sensor parameters every thirty minutes and transmit the data via the GOES Data Collection System every three hours. This can be varied depending upon user requirements and NOAA/NESS advices.

The DCP will accept four digital inputs and eight analog in the GOES mode giving a total sensor capability of 12.

The most important power saving design feature of the DCP is a switched 12v output that permits "putting the sensors to sleep" (remove all power) until approximately 70 seconds before the sensors are to be sampled. In essence, all the electronics involved is powered down between samples with the exception of the precipitation event counter, the DCP clock and memory. Those exceptions draw such low power that it is insignificant compared to the charging rate of the batteries. (see Table 1)

5. The La Barge GOES Antenna consists of two quadrature phased cross-element yagi antennas mounted on a common boom. The elements are cut to 400 MHz with a $\pm$ 2 MHz bandwidth. The half-power points are $\pm$ 23-1/2° and the gain is 11 dbic.

6. The power system consists on two 3.5w Solarex Co. solar panels with regulators. These panels connected in parallel charge two paralleled 20 Ah Gel-Cell Batteries. The batteries are connected to the 12v input of the DCP.

COST

The cost for the station interfaced and assembled was approximately $13,000 each. One could expect a reduction from this figure if quantities were involved. (This cost does not represent engineering and development costs incurred by BLM).

AUTOMATIC WEATHER STATION TESTS

The primary objective of the Automatic Station Tests was to determine if data from remote areas could be accurately returned to the user in near real-time. Secondary objectives are to test the GOES DCS at a high latitude (low horizon angle to the synchronous satellite), various sensor adaptability and compatibility with the BLM Station and general system configuration usefulness. Also considered was the demand for the information returned.

Table 1. CDCP Output Characteristics, GOES Mode

Description	Characteristics
Transmit Frequency	401.7 to 401.85 mHz
Channel spacing	1.5 kHz
Frequency stability, long term	1 ppm per year
Spurious outputs and harmonics	-50 db (below carrier)
Modulation	Phase shift keyed (PSK)
Phase shift magnitude	± 60° (±10°) with a transition time of 20 (±10 microseconds)
Output bit rate	100 ± .1bps, Manchester encoded
Output format	5 seconds of clear carrier, 2.56 seconds of Manchester encoded clock pulses, 15 bit maximal linear sequence (MLS) of 100 0100 1101 0111, 31 bit CDCP ID address up to 2000 bit data message, and Three ASCII EOT (end of trransmission) pulses
Transmitter Fail Safe Feature	Transmitter will automatically power down after a 90 second transmission interval (independently of microprocessor control)
Coding	Data is encoded into eight bit bytes to ASCII format
Parity	Even or Odd (Selectable)
Message intervals	Selectable (by a constant entered from test set) from 15 minutes to 63 hours, 45 minutes (up to 255 increments) in 15 minute increments
Message interval accuracy	1 part per million (PPM) per year
Accuracy of initial transmission	± 1 second (Controlled by operator)
Emission Classification	1.5F9/5

Ref. 2

THE ALASKA TEST

A long standing demand for remote fire weather information from interior Alaska and the high latitude involved provided a "worst-case" test for the first automatic weather station delivered.

In discussions with BLM Fire Management, BLM contract meteorologists and the Fire Operations People in Alaska, it was mutually decided to test system #1 North of the Eagle-Chicken area in Eastern Alaska.

In that area of Alaska there is an oil exploration airstrip located on native corporation land. Through BLM Fire Management, permission was granted to install the station by the native corporation. On the 28th of July, the BLM automatic weather station was installed at the Salmon-Trout Airstrip located at approximate geographic co-ordinates 67°N, 141° 30'W. A one day delay in transmitting was due to a faulty indication on the test set. On the 29th, the first data was returned via the NWS network in Anchorage and Fairbanks. On 5 August 1977, the data was fed to the BLM Fire Weather Teletype (TTY) drop and arrived in the BLM forecasting office in near real-time. As an added test "bonus", a fire (#8945, 1,350 acres) ignited within a mile of the Automatic Station and BLM Forecasters were able to generate spot forecasts on the basis of the data received. The station was pulled out of Salmon-Trout near the end of the Alaska fire season on 9 Sept. 77.

All sensors worked properly for the duration of the test. There was some question about the relative humidity sensor. Under certain meteorological conditions, the relative humidity would go over 100%. It appears that this over range occurs in fog under low cloud conditions. This is consistant with the Analog to Digital conversion within the DCP. Actually, an absolute 0 volts is digitized as "00000000" and 4.98 volts is represented by the binary number "11111111". The voltage just beyond 4.98 Volts starts over at "00000000" but cannot be interpreted accurately. What it indicates is a super saturated moisture condition in the case of relative humidity.

The tipping bucket accummulating counter was preset to 0100 indicating 100/100 inches of precipitation. This prevented transmitting all zeros before measurable precipitation occurred.

IDAHO TEST

The second of two platforms was assembled and tested in Grassmere, Idaho, about 120 miles South, South East of Boise, at aproximately 42°20' Lat., 115°52' Long.

On September 6, 1977, eleven packages (420 lbs.) arrived at the Boise Interagency Fire Center. After an inventory on September 7,

seven people proceeded by truck to Grassmere. Installation began at 13:30 hrs local and was completed by 17:30.

Some small problems were encountered when it was discovered that some set screws and large bolts for the tripod were missing. Another problem that was encountered was the Thunder Scientific Sensor for relative humidity and temperature had to be modified to adapt to mounting on the tripod. After mounting, it was found to be defective, and as of present date, we have no readings on temperature and relative humidity.

When the DCP was programed, the start time was entered incorrectly; and, consequently, it was transmitting two minutes early. This has now been corrected by simply reprogramming the timing circuit.

Through the experiences it was found helpful to bring along some special equipment to assist in the installation. A small portable generator is convenient to power some hand tools like a drill or soldering iron. A surveyor's transit is good for aligning the antenna, wind direction and leveling the structure. A WWV receiver is necessary to calibrate the timing network to insure the accuracy of the transmitting time.

Weather Station #1 was mechanically assembled at the BLM Fairbanks Fire Center prior to installation at Salmon-Trout. Station #2 was taken directly to Grassmere. It is essential that future stations be assembled prior to installation to insure hardware, connector, wiring and system components are in order.

DATA RECOVERY

All weather data obtained by the "Automatic Remote Weather Station" is transmitted via GOES uplink to the Geostationary Operational Environmental Satellite located at 135 degrees west (GOES west). The data is then retransmitted to a command and data acquisition ground station located at Wallops Island, Virgina. From this point through leased lines the data is transfered to a computer at the World Weather Building (WWB), Campsprings, Maryland. The WWB computer is the point of dissemination of all information to the users.[3]

A properly identified user may access the information by the direct dial in method in the real time mode. Two seperate extensions are used determined by the speed of the users terminal (110 or 1200 BAUD).

Another method that may be used to access the information that is currently being used by the state of Alaska is to go through one or a series of computors. For example, the National Weather Service (NWS) requested the weather data be transfered from the NOAA/NESS data file to the FAA computer at Kansas City, Missouri. From there

it is transfered to the Weather Service Teletype System that is directly tied into Anchorage and Fairbanks. By this second method it takes less than six minutes from time of platform transmission to the time it appears on the teletype in Alaska.

The data on the terminal or teletype arrives in the American Standard Code for Information Interchange and needs to be converted to hexadecimal before the following charts can be utilized to determine meteorological parameters.

STANDARD CODE	HEXADECIMAL
	0
A	1
B	2
C	3
D	4
E	5
F	6
G	7
H	8
I	9
J	A
K	B
L	C
M	D
N	E
O	F

One of our GOES data collection platforms has the I.D. number of 16CE74D4, and a printout of data on this station is as follows: the data was received on the NWS teletype system on July 30, 1977, shortly after 2051 GMT.

The first line is NWS information. The second line starts with the DCP I.D. 16CE74D4. The next nine characters are the date and time group (e.g., 211 = day of the year, 2051 = data transfer time from the DCP).

The Tipping Bucket Rain Gauge (four character) data is displayed above as 00A0 in all six blocks of data. To translate--one first inverts this data to 0A00 and then converts to Hexadecimal to yield 0100 or 100/100 inches (or one inch) of precipitation. This is the value set into the platform on initialization and indicates that there has been no measurable precipitation since. If 2/100 inches of rain should occur before the next transmission, the next data readout would be B0A0, inverted to 0A0B and translated to 0102 or 102/100 inches.

The next two characters represent the wind speed read-out and are IA. Again, this has to be inverted to yield AI and then converted

to the Hexadecimal value of 19. The Hexadecimal value of 19 on the Wind Speed Conversion Chart is a wind speed of 9.9 mph.

This same process is then repeated for wind direction, temperature, relative humidity, barametric pressure, battery voltage and a repeat of wind direction.

One then starts again with the 00A0 reading for the rain gauge, etc.

The six sets of data represent data taken every 30 minutes for three hours with the oldest data appearing first. The first set of data is for sample time 1821Z, the second for 1851Z, etc. An attached chart shows the data converted to Meteorological Units. (see Table 2)

The wind direction sensor is sampled near the beginning and at the end of the sensor scanning operation. Since this sensor uses a 0-540 degree potentiometer, there is a finite possibility that the wind will be from a direction near the crossover point on the potentiometer. Since the wind direction is integrated over a one minute period, this crossover point could introduce direction errors. To get around this, the sensor is sampled twice approximately 12 seconds apart and if there is rough agreement between the two readings, no crossover errors have been introduced and the directions are good.

ADAPTABILITY TO OTHER COMMUNICATIONS MEDIA

The BLM Automatic Weather Station is adaptable to various forms of communication. Because of the modular design concept, the Sensor, Tripod and Signal conditioning package could remain the same regardless of the communication media involved. Externally, the station would look the same if other communications were used with the exception of the antenna and other sensor requirements (i.e., water quality, air quality, etc.). Internally the power system (batteries) and Signal Conditioning Unit would remain the same. Using the meteor-burst communications system would only require replacing the DCP with the meteor-burst unit and antenna. To interface to a VHF, UHF or micro-wave system would require an extra electronics unit between the Signal Conditioning Unit and the transmitter that would consist of a clock, data logger with analog to digital converter, scanner and modulation unit. This would be a unit identical to the DCP but with either a different transmitter or a feed to an external transmitting system.

In designing the existing weather stations, consideration was given to the data output levels and format so that interchangeability between various communications systems could be effected with minimal effort. Coordination with the Forest Service, BLM Meteor-Burst Development and the National Weather Service insured continuality in voltage levels and interchangebility of components between systems.

Table 2

	Wind Speed	Wind Direction	Temperature	Relative Humidity	Barametric Pressure	Baterry Voltage	Wind Direction
7/30/7							
0100*	19	16	AB	74	83	42	17
1821Z	9.9	46.4	16.7	45.7	27.58	12.8	48.5
0100*	17	18	BO	6B	83	42	18
1851Z	9.2	50.6	18.7	42.1	27.58	12.8	50.6
0100*	10	1C	B5	58	B3	42	1D
1921Z	6.4	59.0	20.7	34.7	27.58	12.8	61.1
0100*	18	22	BC	49	84	44	22
1951Z	9.6	71.7	23.4	28.5	27.60	13.2	71.7
0100*	19	33	CO	38	85	45	33
2021Z	9.9	107.5	25.0	21.8	27.63	13.4	107.5
0100*	19	24	CO	37	85	46	24
2051Z	9.9	75.9	25.0	21.4	27.63	13.0	75.9

*0100 indicates 100/100 or 1.00 inches of precipitation

This allows each developer an opportunity to take advantage of advances made by the others and insures a quality product for a reasonable cost.

FUTURE SYSTEM DEVELOPMENT

Long term testing of the existing systems will continue over the next year.

Development of an accurate wildfire fuel moisture measuring device that will integrate into the Automatic Station has top priority.

To round out the weather station, an input solar radiation sensor should be added. These sensors and signal conditioning cards are available commercially and represent no technical problems.

Other sensors that need to be investigated are water quality, air quality and hydrology. The limiting factors are:

1. Sensor power consumption.

2. Channel capacity (eight analog and four digital).

Most of the sensors were selected on the basis of long term successful field operation, low power consumption and relatively small size. On Station #1 all the sensors met these requirements. On Station #2 a relative humidity sensor that is advertized as having superior specification but not having field testing was installed. Since this sensor also contains the temperature sensing element, these two sensors are different than Station #1.

Much valuable advice, assistance, and time was given by U.S. Forest Service, Riverside, California, and National Weather Service, Anchorage, Alaska. BIFC communications provided excellent technical support for the Grasmere test. Fire Management Alaska and the BLM Alaska Communications Group contributed greatly to the success of the Alaska test.

The electronic communications staff, DSC, aptly handled the frequency coordination and greatly aided in direct-dial data recovery.

La-Barge, Inc., Tulsa, Oklahoma collected the sensors, tripod and associated hardware as well as developed the Signal Conditioning Unit. They then integrated the components into a turn-key system complete with the La-Barge GOES-DCP. Synergetics of Boulder, Colorado solved the tripod fabrication problems and manufactured the station tripods.

REFERENCES

1. The NOAA Operational Environmental Satellite System Status and Plans, George H. Ludwig, NOAA/NESS, Washington, D.C. 20233. Presented at the 6th Conference on Aerospace & Aeronautical Meteorology, November 12-15, 1974, El Paso, Texas. Published by Amer. Meteor. Soc., Boston, MA.

2. Instruction Manual for Convertible Data Collection Platform (CDCP) and Related Equipment, by La-Barge, Inc., Tulsa, Oklahoma, April, 1976.

3. User Interface Manual, prepared for NOAA/NESS by GTE Information Systems, Silver Springs, Maryland, November 5, 1976.

APPENDIX

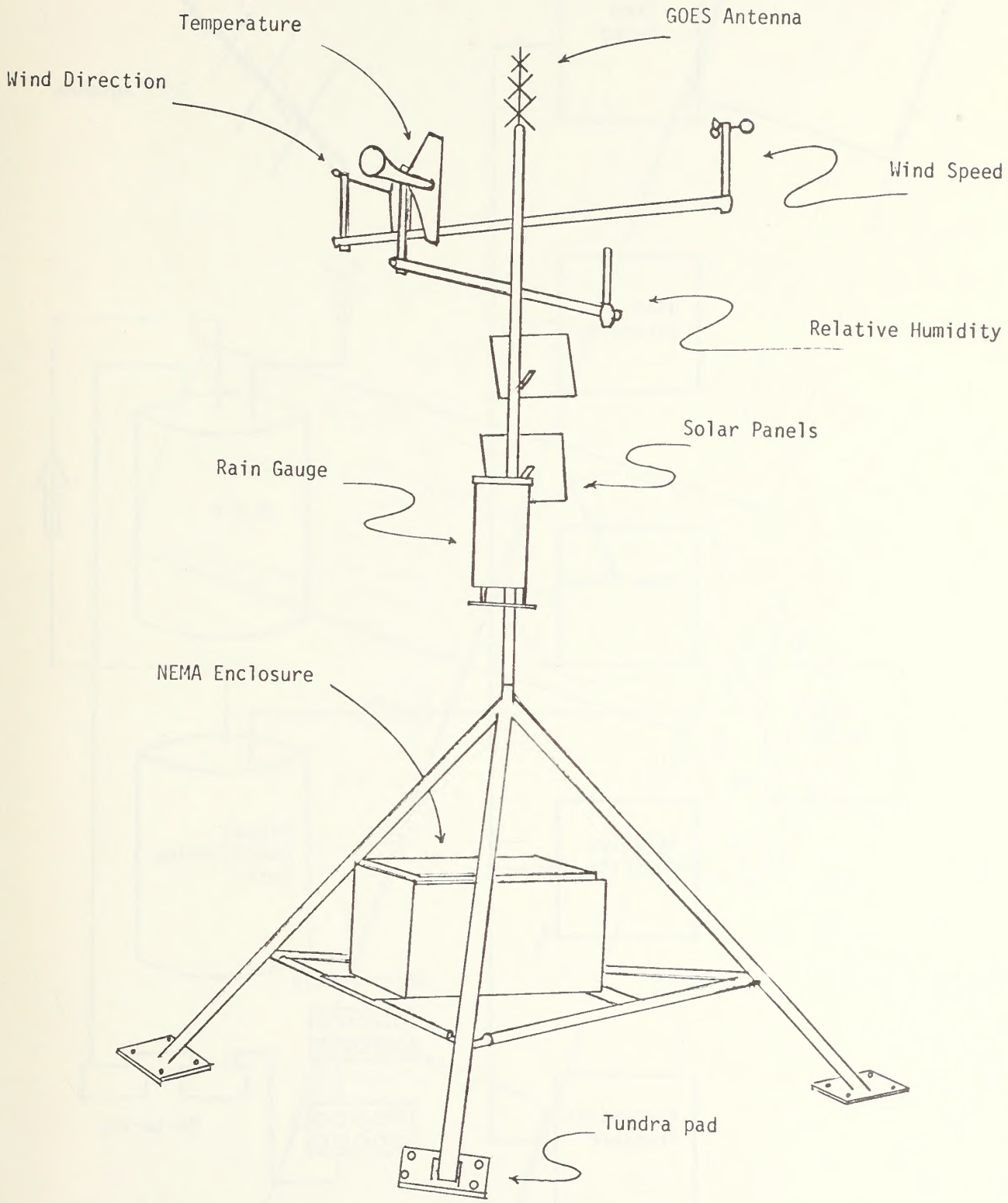

Fig. 1 BLM Automatic Weather Station

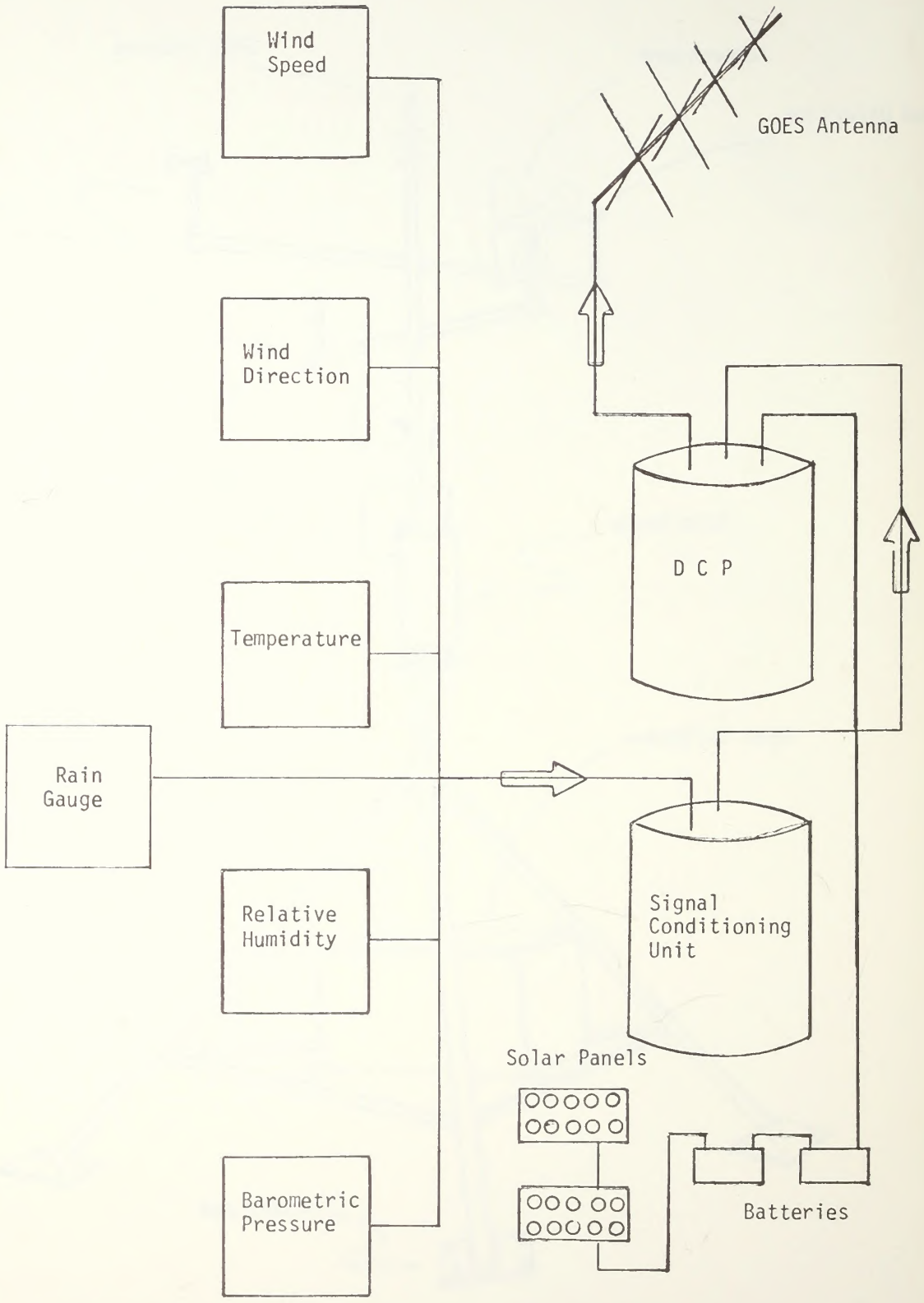

Fig. 2 Block Diagram of BLM Automatic Weather Station Model 1

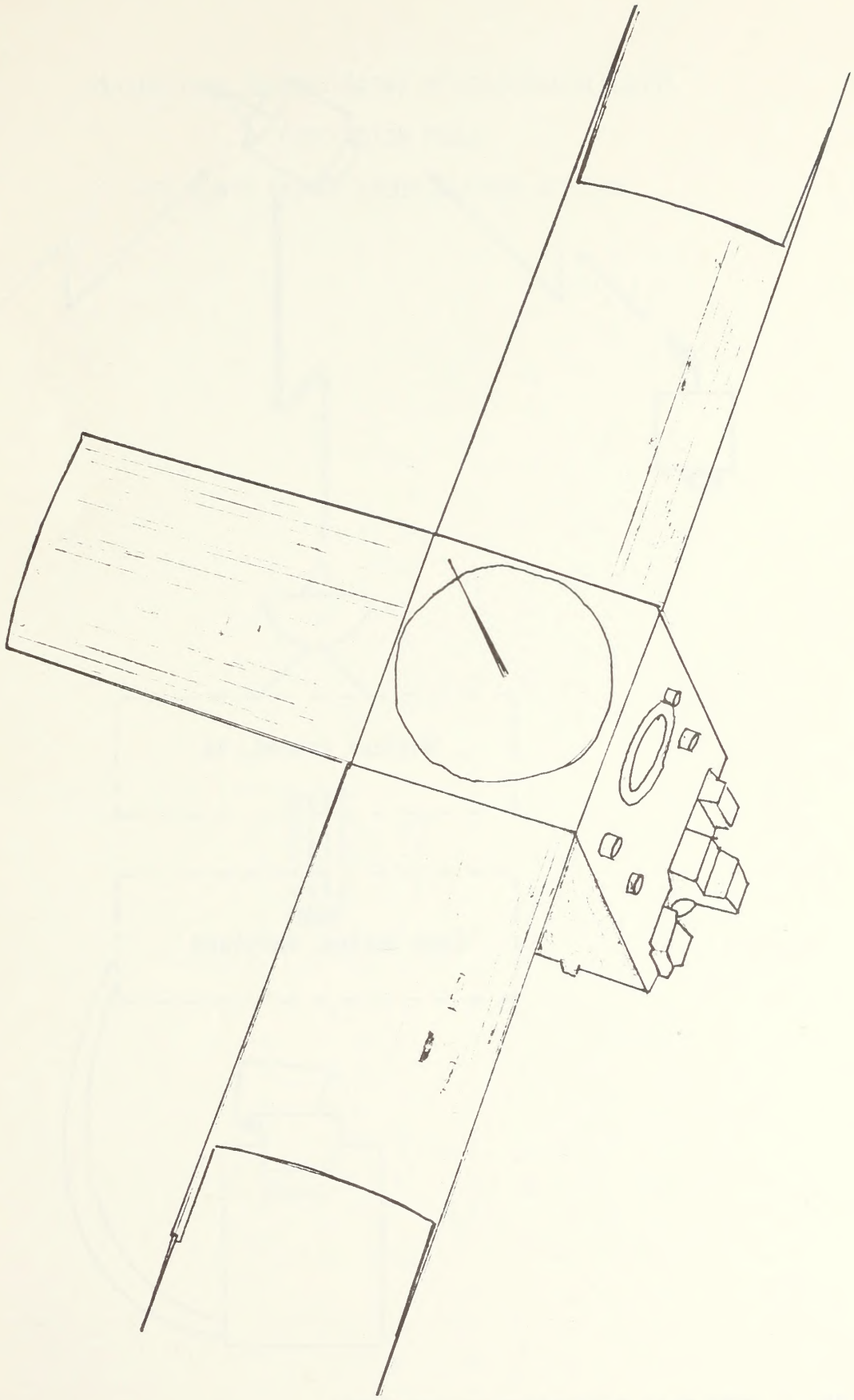

Fig. 3 GOES West Satellite

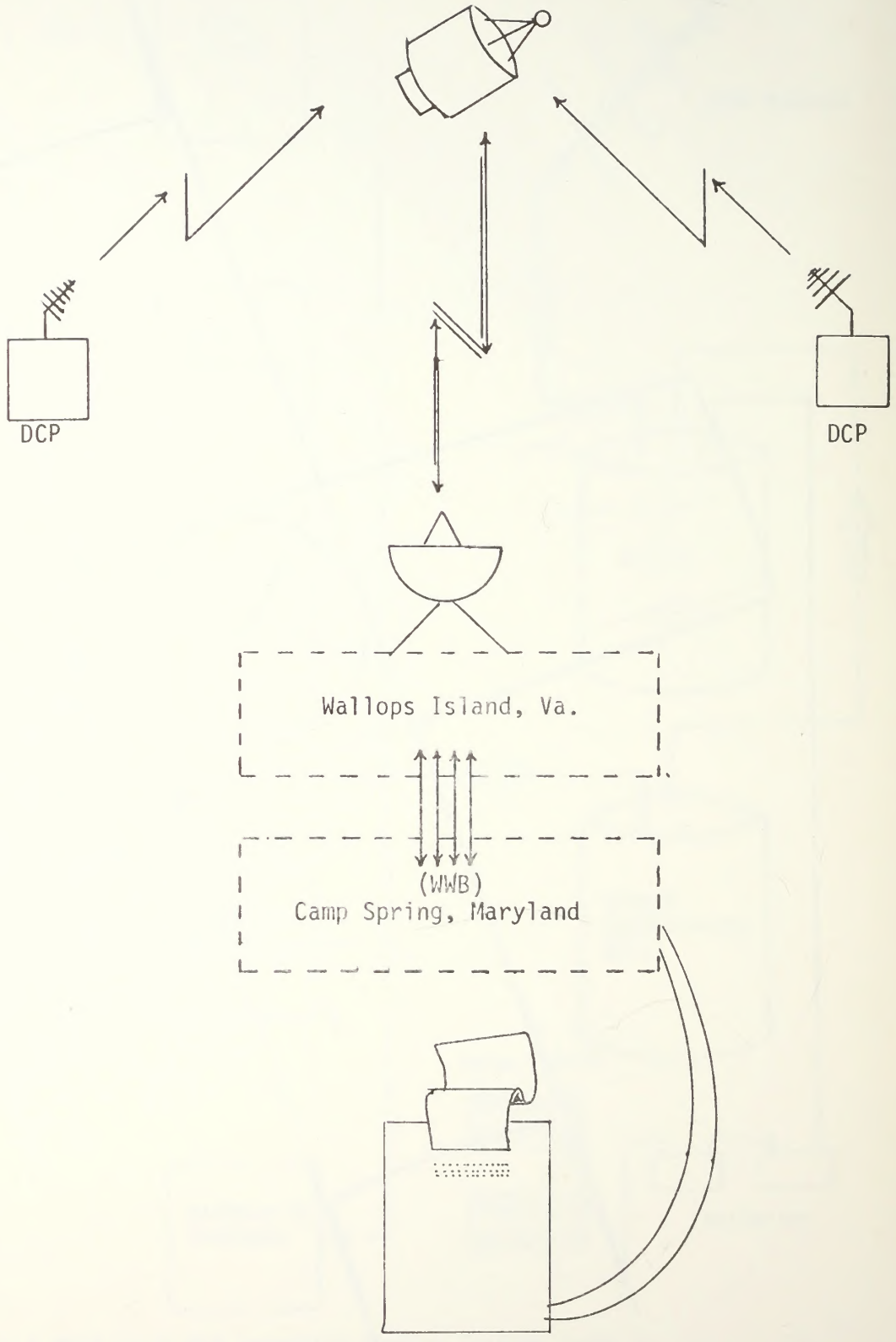

Fig. 4 GOES Data Collection System (DCS)

HEXIDECIMAL TO EQUIVALENT METEOROLOGICAL UNITS

CONVERSION TABLE

FOR BLM'S SALMON-TROUT WEATHER STATION

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WIND SPEED AUG 4 1977

DIRECT CONVERSION OF HEXADECIMAL TO EQUIVALENT WIND SPEED (MPH)

reshold

HEX	MPH	HEX	MPH	HEX	MPH	HEX	MPH
00		20	12.7	40	25.2	60	37.7
01		21	13.1	41	25.6	61	38.1
02		22	13.5	42	26.0	62	38.5
03	1.4	23	13.9	43	26.4	63	38.9
04	1.7	24	14.2	44	26.8	64	39.3
05	2.1	25	14.6	45	27.1	65	39.7
06	2.5	26	15.0	46	27.5	66	40.1
07	2.9	27	15.4	47	27.9	67	40.4
08	3.3	28	15.8	48	28.3	68	40.8
09	3.7	29	16.2	49	28.7	69	41.2
0A	4.1	2A	16.6	4A	29.1	6A	41.6
0B	4.5	2B	17.0	4B	29.5	6B	42.0
0C	4.9	2C	17.4	4C	29.9	6C	42.4
0D	5.3	2D	17.8	4D	30.3	6D	42.8
0E	5.6	2E	18.2	4E	30.7	6E	43.2
0F	6.1	2F	18.5	4F	31.1	6F	43.6
10	6.4	30	18.9	50	31.4	70	44.0
11	6.8	31	19.3	51	31.8	71	44.4
12	7.2	32	19.7	52	32.2	72	44.8
13	7.6	33	20.1	53	32.6	73	45.2
14	8.0	34	20.5	54	33.0	74	45.6
15	8.4	35	20.9	55	33.4	75	45.9
16	8.8	36	21.3	56	33.8	76	46.3
17	9.2	37	21.7	57	34.2	77	46.7
18	9.6	38	22.1	58	34.6	78	47.1
19	9.9	39	22.5	59	35.0	79	47.5
1A	10.3	3A	22.8	5A	35.4	7A	47.9
1B	10.7	3B	23.2	5B	35.7	7B	48.3
1C	11.1	3C	23.6	5C	36.1	7C	48.7
1D	11.5	3D	24.0	5D	36.5	7D	49.1
1E	11.9	3E	24.4	5E	36.9	7E	49.5
1F	12.3	3F	24.8	5F	37.3	7F	49.9

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WIND SPEED

DIRECT CONVERSION OF HEXADECIMAL TO EQUIVALENT WIND SPEED (MPH)

HEX	MPH	HEX	MPH	HEX	MPH	HEX	MPH
80	50.3	A0	62.9	C0	75.5	E0	88.1
81	50.7	A1	63.3	C1	75.9	E1	88.5
82	51.1	A2	63.7	C2	76.3	E2	88.9
83	51.5	A3	64.1	C3	76.7	E3	89.3
84	51.9	A4	64.5	C4	77.1	E4	89.7
85	52.3	A5	64.9	C5	77.5	E5	90.1
86	52.6	A6	65.3	C6	77.9	E6	90.5
87	53.0	A7	65.6	C7	78.3	E7	90.9
88	53.4	A8	66.0	C8	78.7	E8	91.3
89	53.8	A9	66.4	C9	79.0	E9	91.7
8A	54.2	AA	66.8	CA	79.4	EA	92.0
8B	54.6	AB	67.2	CB	79.8	EB	92.4
8C	55.0	AC	67.6	CC	80.2	EC	92.8
8D	55.4	AD	68.0	CD	80.6	ED	93.2
8E	55.8	AE	68.4	CE	81.0	EE	93.6
8F	56.2	AF	68.8	CF	81.4	EF	94.0
90	56.6	B0	69.2	D0	81.8	F0	94.4
91	57.0	B1	69.6	D1	82.2	F1	94.8
92	57.4	B2	70.0	D2	82.6	F2	95.2
93	57.8	B3	70.4	D3	83.0	F3	95.6
94	58.2	B4	70.8	D4	83.4	F4	96.0
95	58.6	B5	71.2	D5	83.8	F5	96.4
96	59.0	B6	71.6	D6	84.2	F6	96.8
97	59.3	B7	72.0	D7	84.6	F7	97.2
98	59.7	B8	72.3	D8	85.0	F8	97.6
99	60.1	B9	72.7	D9	85.3	F9	98.0
9A	60.5	BA	73.1	DA	85.7	FA	98.4
9B	60.9	BB	73.5	DB	86.1	FB	98.7
9C	61.3	BC	73.9	DC	86.5	FC	99.1
9D	61.7	BD	74.3	DD	86.9	FD	99.5
9E	62.1	BE	74.7	DE	87.3	FE	99.9
9F	62.5	BF	75.1	DF	87.7	FF	100.3

A/D# [ ]

WIND DIRECTION

DIRECT CONVERSION OF HEXADECIMAL TO EQUIVALENT WIND DIRECTION (DEGREES)

(See Attached Figure)

ry Location
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[ ] [ ]

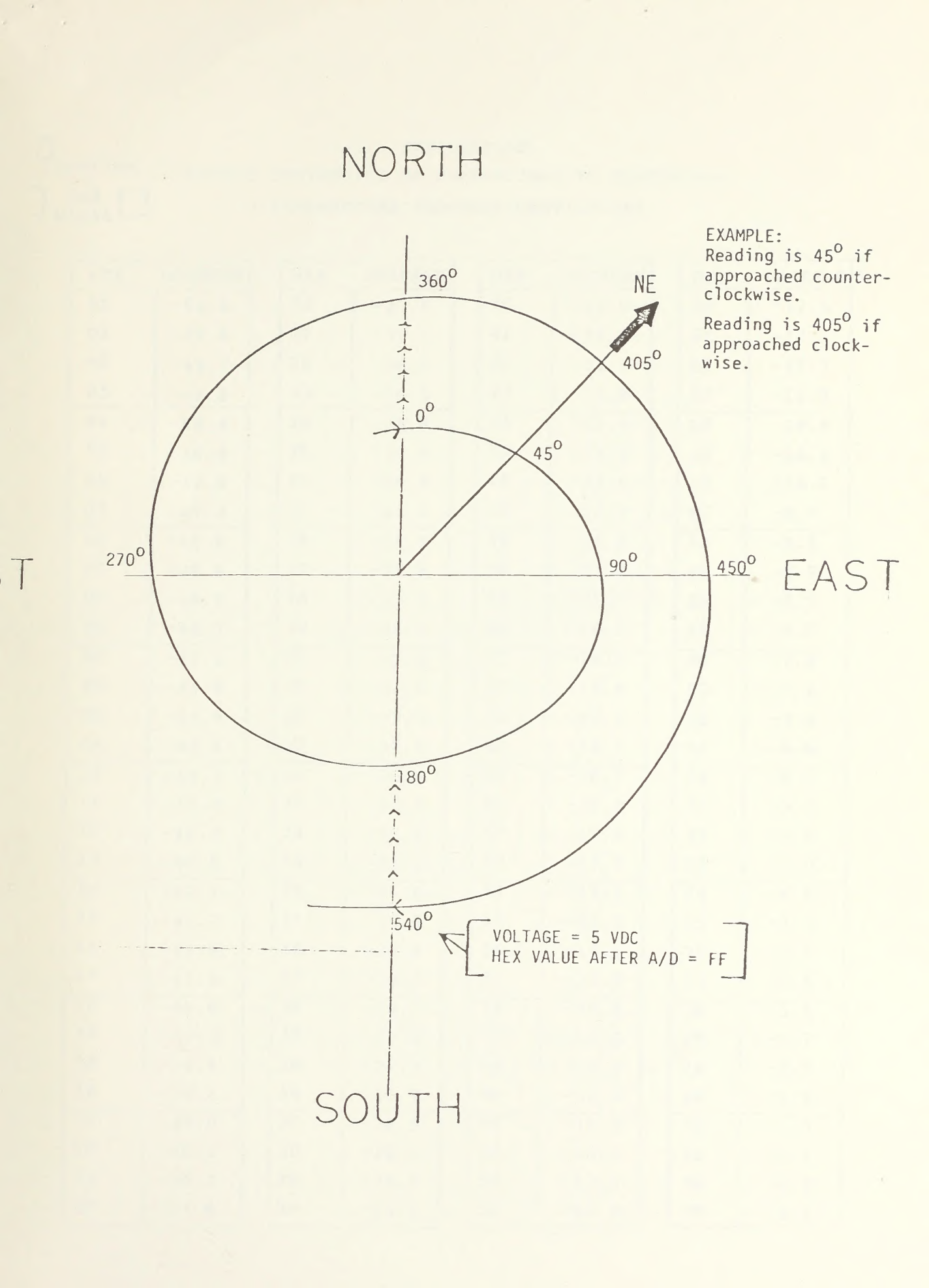
HEX	Degrees	HEX	Degrees	HEX	Degrees	HEX	Degrees
00	0.0	20	67.5	40	135.0	60	202.5
01	2.1	21	69.6	41	137.1	61	204.6
02	4.2	22	71.7	42	139.2	62	206.7
03	6.3	23	73.8	43	141.3	63	208.8
04	8.4	24	75.9	44	143.4	64	210.9
05	10.5	25	78.0	45	145.5	65	213.0
06	12.6	26	80.1	46	147.6	66	215.1
07	14.7	27	82.2	47	149.7	67	217.2
08	16.8	28	84.3	48	151.8	68	219.3
09	18.9	29	86.4	49	153.9	69	221.4
0A	21.0	2A	88.5	4A	156.0	6A	223.5
0B	23.2	2B	90.7	4B	158.2	6B	225.7
0C	25.3	2C	92.8	4C	160.3	6C	227.8
0D	27.4	2D	94.9	4D	162.4	6D	229.9
0E	29.5	2E	97.0	4E	164.5	6E	232.0
0F	31.6	2F	99.1	4F	166.6	6F	234.1
10	33.7	30	101.2	50	168.7	70	236.2
11	35.8	31	103.3	51	170.8	71	238.3
12	37.9	32	105.4	52	172.9	72	240.4
13	40.0	33	107.5	53	175.0	73	242.5
14	42.1	34	109.6	54	177.1	74	244.6
15	44.2	35	111.7	55	179.2	75	246.7
16	46.4	36	113.9	56	181.4	76	248.9
17	48.5	37	116.0	57	183.5	77	251.0
18	50.6	38	118.1	58	185.6	78	253.1
19	52.7	39	120.2	59	187.7	79	255.2
1A	54.8	3A	122.3	5A	189.8	7A	257.3
1B	56.9	3B	124.4	5B	191.9	7B	259.4
1C	59.0	3C	126.5	5C	194.0	7C	261.5
1D	61.1	3D	128.6	5D	196.1	7D	263.6
1E	63.2	3E	130.7	5E	198.2	7E	265.7
1F	65.3	3F	132.8	5F	200.3	7F	267.8

WIND DIRECTION

DIRECT CONVERSION OF HEXADECIMAL TO EQUIVALENT WIND DIRECTION (DEGREES)

cont'd)

HEX	Degrees	HEX	Degrees	HEX	Degrees	HEX	Degrees
80	270.0	A0	337.5	C0	405.0	E0	472.5
81	272.1	A1	339.6	C1	407.1	E1	474.6
82	274.2	A2	341.7	C2	409.2	E2	476.7
83	276.3	A3	343.8	C3	411.3	E3	478.8
84	278.4	A4	345.9	C4	413.4	E4	480.9
85	280.5	A5	348.0	C5	415.5	E5	483.0
86	282.6	A6	350.1	C6	417.6	E6	485.1
87	284.7	A7	352.2	C7	419.7	E7	487.2
88	286.8	A8	354.3	C8	421.8	E8	489.3
89	288.9	A9	356.4	C9	423.9	E9	491.4
8A	291.0	AA	358.5	CA	426.0	EA	493.5
8B	293.2	AB	360.7	CB	428.2	EB	495.7
8C	295.3	AC	362.8	CC	430.3	EC	497.8
8D	297.4	AD	364.9	CD	432.4	ED	499.9
8E	299.5	AE	367.0	CE	434.5	EE	502.0
8F	301.6	AF	369.1	CF	436.6	EF	504.1
90	303.7	B0	371.2	D0	438.7	F0	506.2
91	305.8	B1	373.3	D1	440.8	F1	508.3
92	307.9	B2	375.4	D2	442.9	F2	510.4
93	310.0	B3	377.5	D3	445.0	F3	512.5
94	312.1	B4	379.6	D4	447.1	F4	514.6
95	314.2	B5	381.7	D5	449.2	F5	516.7
96	316.4	B6	383.9	D6	451.4	F6	518.9
97	318.5	B7	386.0	D7	453.5	F7	521.0
98	320.6	B8	388.1	D8	455.6	F8	523.1
99	322.7	B9	390.2	D9	457.7	F9	525.2
9A	324.8	BA	392.3	DA	459.8	FA	527.3
9B	326.9	BB	394.4	DB	461.9	FB	529.4
9C	329.0	BC	396.5	DC	464.0	FC	531.5
9D	331.1	BD	398.6	DD	466.1	FD	533.6
9E	333.2	BE	400.7	DE	468.2	FE	535.7
9F	335.3	BF	402.8	DF	470.3	FF	537.8


NORTH
EXAMPLE:
Reading is 45° if approached counter-clockwise.
Reading is 405° if approached clock-wise.
360°
NE
405°
0°
45°
270°
90°
450°
EAST
180°
540°
VOLTAGE = 5 VDC
HEX VALUE AFTER A/D = FF
SOUTH

Location

2nd Digit

TEMPERATURE

DIRECT CONVERSION OF HEXADECIMAL TO EQUIVALENT TEMPERATURE (DEGREES CENTIGRADE)

HEX	DEGREES
00	-50.0
01	-49.6
02	-49.2
03	-48.8
04	-48.4
05	-48.0
06	-47.6
07	-47.2
08	-46.8
09	-46.4
0A	-46.0
0B	-45.7
0C	-45.3
0D	-44.9
0E	-44.5
0F	-44.1
10	-43.7
11	-43.3
12	-42.9
13	-42.5
14	-42.1
15	-41.7
16	-41.4
17	-41.0
18	-40.6
19	-40.2
1A	-39.8
1B	-39.4
1C	-39.0
1D	-38.6
1E	-38.2
1F	-37.8

HEX	DEGREES
20	-37.5
21	-37.1
22	-36.7
23	-36.3
24	-35.9
25	-35.5
26	-35.1
27	-34.7
28	-34.3
29	-33.9
2A	-33.5
2B	-33.2
2C	-32.8
2D	-32.4
2E	-32.0
2F	-31.6
30	-31.2
31	-30.8
32	-30.4
33	-30.0
34	-29.6
35	-29.2
36	-28.9
37	-28.5
38	-28.1
39	-27.7
3A	-27.3
3B	-26.9
3C	-26.5
3D	-26.1
3E	-25.7
3F	-25.3

HEX	DEGREES
40	-25.0
41	-24.6
42	-24.2
43	-23.8
44	-23.4
45	-23.0
46	-22.6
47	-22.2
48	-21.8
49	-21.4
4A	-21.0
4B	-20.7
4C	-20.3
4D	-19.9
4E	-19.5
4F	-19.1
50	-18.7
51	-18.3
52	-17.9
53	-17.5
54	-17.1
55	-16.7
56	-16.4
57	-16.0
58	-15.6
59	-15.2
5A	-14.8
5B	-14.4
5C	-14.0
5D	-13.6
5E	-13.2
5F	-12.8

HEX	DEGREES
60	-12.5
61	-12.1
62	-11.7
63	-11.3
64	-10.9
65	-10.5
66	-10.1
67	-9.7
68	-9.3
69	-8.9
6A	-8.5
6B	-8.2
6C	-7.8
6D	-7.4
6E	-7.0
6F	-6.6
70	-6.2
71	-5.8
72	-5.4
73	-5.0
74	-4.6
75	-4.2
76	-3.9
77	-3.5
78	-3.1
79	-2.7
7A	-2.3
7B	-1.9
7C	-1.5
7D	-1.1
7E	-0.7
7F	-0.3

y Location 2nd Digit

DIRECT CONVERSION OF HEXADECIMAL TO EQUIVALENT TEMPERATURE (DEGREES CENTIGRADE)

HEX	DEGREES
80	0:0
81	+0.3
82	+0.7
83	+1.1
84	+1.5
85	+1.9
86	+2.3
87	+2.7
88	+3.1
89	+3.5
8A	+3.9
8B	+4.2
8C	+4.6
8D	+5.0
8E	+5.4
8F	+5.8
90	+6.2
91	+6.6
92	+7.0
93	+7.4
94	+7.8
95	+8.2
96	+8.5
97	+8.9
98	+9.3
99	+9.7
9A	+10.1
9B	+10.5
9C	+10.9
9D	+11.3
9E	+11.7
9F	+12.1

HEX	DEGREES
A0	+12.5
A1	+12.8
A2	+13.2
A3	+13.6
A4	+14.0
A5	+14.4
A6	+14.8
A7	+15.2
A8	+15.6
A9	+16.0
AA	+16.4
AB	+16.7
AC	+17.1
AD	+17.5
AE	+17.9
AF	+18.3
B0	+18.7
B1	+19.1
B2	+19.5
B3	+19.9
B4	+20.3
B5	+20.7
B6	+21.0
B7	+21.4
B8	+21.8
B9	+22.2
BA	+22.6
BB	+23.0
BC	+23.4
BD	+23.8
BE	+24.2
BF	+24.6

HEX	DEGREES
C0	+25.0
C1	+25.3
C2	+25.7
C3	+26.1
C4	+26.5
C5	+26.9
C6	+27.3
C7	+27.7
C8	+28.1
C9	+28.5
CA	+28.9
CB	+29.2
CC	+29.6
CD	+30.0
CE	+30.4
CF	+30.8
D0	+31.2
D1	+31.6
D2	+32.0
D3	+32.4
D4	+32.8
D5	+33.2
D6	+33.5
D7	+33.9
D8	+34.7
D9	+35.1
DA	+35.5
DB	+35.9
DC	+36.3
DD	+36.7
DE	+37.1
DF	+37.5

HEX	DEGREES
E0	+37.8
E1	+38.2
E2	+38.6
E3	+39.0
E4	+39.4
E5	+39.8
E6	+40.2
E7	+40.6
E8	+41.0
E9	+41.4
EA	+41.7
EB	+42.1
EC	+42.5
ED	+42.9
EE	+43.3
EF	+43.7
F0	+44.1
F1	+44.5
F2	+44.9
F3	+45.3
F4	+45.7
F5	+46.0
F6	+46.4
F7	+46.8
F8	+47.2
F9	+47.6
FA	+48.0
FB	+48.4
FC	+48.8
FD	+49.2
FE	+49.6
FF	+50.0

/ Location

2nd Digit

RELATIVE HUMIDITY

DIRECT CONVERSION OF HEXADECIMAL TO EQUIVALENT RELATIVE HUMIDITY (PER CENT)

HEX	PER CENT	HEX	PER CENT	HEX	PER CENT	HEX	PER CENT
00	0.0	20	12.5	40	25.0	60	37.8
01	0.3	21	12.8	41	25.3	61	38.2
02	0.7	22	13.2	42	25.7	62	38.6
03	1.1	23	13.6	43	26.1	63	29.0
04	1.5	24	14.0	44	26.5	64	39.4
05	1.9	25	14.4	45	26.9	65	39.8
06	2.3	26	14.8	46	27.3	66	40.2
07	2.7	27	15.2	47	27.7	67	40.6
08	3.1	28	15.6	48	28.1	68	41.0
09	3.5	29	16.0	49	28.5	69	41.4
0A	3.9	2A	16.4	4A	28.9	6A	41.7
0B	4.2	2B	16.7	4B	29.2	6B	42.1
0C	4.6	2C	17.1	4C	29.6	6C	42.5
0D	5.0	2D	17.5	4D	30.0	6D	42.9
0E	5.4	2E	17.9	4E	30.4	6E	43.3
0F	5.8	2F	18.3	4F	30.8	6F	43.7
10	6.2	30	18.7	50	31.2	70	44.1
11	6.6	31	19.1	51	31.6	71	44.5
12	7.0	32	19.5	52	32.0	72	44.9
13	7.4	33	19.9	53	32.4	73	45.3
14	7.8	34	20.3	54	32.8	74	45.7
15	8.2	35	20.7	55	33.2	75	46.0
16	8.5	36	21.0	56	33.5	76	46.4
17	8.9	37	21.4	57	33.9	77	46.8
18	9.3	38	21.8	58	34.7	78	47.2
19	9.7	39	22.2	59	35.1	79	47.6
1A	10.1	3A	22.6	5A	35.5	7A	48.0
1B	10.5	3B	23.0	5B	35.9	7B	48.4
1C	10.9	3C	23.4	5C	36.3	7C	48.8
1D	11.3	3D	23.8	5D	36.7	7D	49.2
1E	11.7	3E	24.2	5E	37.1	7E	49.6
1F	12.1	3F	24.6	5F	37.5	7F	50.0

Location
2nd Digit

RELATIVE HUMIDITY

DIRECT CONVERSION OF HEXADECIMAL TO EQUIVALENT RELATIVE HUMIDITY (PER CENT) (cont'd)

HEX	PER CENT	HEX	PER CENT	HEX	PER CENT	HEX	PER CENT
80	50.3	A0	62.8	C0	75.3	E0	87.8
81	50.7	A1	63.2	C1	75.7	E1	88.2
82	51.1	A2	63.6	C2	76.1	E2	88.6
83	51.5	A3	64.0	C3	76.5	E3	89.0
84	51.9	A4	64.4	C4	76.9	E4	89.4
85	52.3	A5	64.8	C5	77.3	E5	89.8
86	52.7	A6	65.2	C6	77.7	E6	90.2
87	53.1	A7	65.6	C7	78.1	E7	90.6
88	53.5	A8	66.0	C8	78.5	E8	91.0
89	53.9	A9	66.4	C9	78.9	E9	91.4
8A	54.2	AA	66.7	CA	79.2	EA	91.7
8B	54.6	AB	67.1	CB	79.6	EB	92.1
8C	55.0	AC	67.5	CC	80.9	EC	92.5
8D	55.4	AD	67.9	CD	80.4	ED	92.9
8E	55.8	AE	68.3	CE	80.8	EE	93.3
8F	56.2	AF	68.7	CF	81.2	EF	93.7
90	56.6	B0	69.1	D0	81.6	F0	94.1
91	67.0	B1	69.5	D1	82.0	F1	94.5
92	57.4	B2	69.9	D2	82.4	F2	94.9
93	57.8	B3	70.3	D3	82.8	F3	95.3
94	58.2	B4	70.7	D4	83.2	F4	95.7
95	58.5	B5	71.0	D5	83.5	F5	96.0
96	58.9	B6	71.4	D6	83.9	F6	96.4
97	59.3	B7	71.8	D7	84.3	F7	96.8
98	59.7	B8	72.2	D8	84.7	F8	97.2
99	60.1	B9	72.6	D9	85.1	F9	97.6
9A	60.5	BA	73.0	DA	85.5	FA	98.0
9B	60.9	BB	73.4	DB	85.9	FB	98.4
9C	61.3	BC	73.8	DC	86.3	FC	98.8
9D	61.7	BD	74.2	DD	86.7	FD	99.2
9E	62.1	BE	74.6	DE	87.1	FE	99.6
9F	62.5	BF	75.0	DF	87.5	FF	100.0

A/D# [ ]

MEMORY LOCATION
1st Digit [ ] 2nd Digit [ ]

BAROMETRIC PRESSURE

DIRECT CONVERSION OF HEXADECIMAL TO EQUIVALENT INCHES OF MERCURY

HEX	In.Hg.	HEX	In.Hg.	HEX	In.Hg.	HEX	In.Hg.
00	24.00	20	24.87	40	25.74	60	26.62
01	24.02	21	24.90	41	25.77	61	26.65
02	24.05	22	24.92	42	25.80	62	26.67
03	24.08	23	24.95	43	25.83	63	26.70
04	24.10	24	24.98	44	25.85	64	26.73
05	24.13	25	25.01	45	25.88	65	26.76
06	24.16	26	25.03	46	25.91	66	26.78
07	24.19	27	25.06	47	25.94	67	26.81
08	24.21	28	25.09	48	25.96	68	26.84
09	24.24	29	25.12	49	25.99	69	26.87
0A	24.27	2A	25.14	4A	26.02	6A	26.89
0B	24.30	2B	25.17	4B	26.05	6B	26.92
0C	24.32	2C	25.20	4C	26.07	6C	26.95
0D	24.35	2D	25.23	4D	26.10	6D	26.98
0E	24.38	2E	25.25	4E	26.13	6E	27.00
0F	24.41	2F	25.28	4F	26.15	6F	27.03
10	24.43	30	25.31	50	26.18	70	27.06
11	24.46	31	25.33	51	26.21	71	27.08
12	24.49	32	25.36	52	26.24	72	27.11
13	24.51	33	25.39	53	26.26	73	27.14
14	24.54	34	25.42	54	26.29	74	27.17
15	24.57	35	25.44	55	26.32	75	27.19
16	24.60	36	25.47	56	26.35	76	27.22
17	24.62	37	25.50	57	26.37	77	27.25
18	24.65	38	25.53	58	26.40	78	27.28
19	24.68	39	25.55	59	26.43	79	27.30
1A	24.71	3A	25,58	5A	26.46	7A	27.33
1B	24.73	3B	25.61	5B	26.48	7B	27.36
1C	24.76	3C	25.64	5C	26.51	7C	27.39
1D	24.79	3D	25.66	5D	26.54	7D	27.41
1E	24.82	3E	25.69	5E	26.56	7E	27.44
1F	24.84	3F	25.72	5F	26.59	7F	27.47

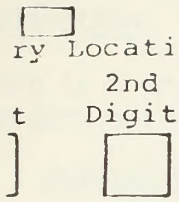
/D# [ ]

Y LOCATION
[ ] 2nd [ ]
Digit

BAROMETRIC PRESSURE

DIRECT CONVERSION OF HEXADECIMAL TO EQUIVALENT INCHES OF MERCURY

HEX	In.Hg.	HEX	In.Hg.	HEX	In.Hg.	HEX	In.Hg.
80	27.49	A0	28.37	C0	29.24	E0	30.12
81	27.52	A1	28.40	C1	29.27	E1	30.15
82	27.55	A2	28.42	C2	29.30	E2	30.17
83	27.58	A3	28.45	C3	29.33	E3	30.20
84	27.60	A4	28.48	C4	29.35	E4	30.23
85	27.63	A5	28.51	C5	29.38	E5	30.26
86	27.66	A6	28.53	C6	29.41	E6	30.28
87	27.69	A7	28.56	C7	29.44	E7	30.31
88	27.71	A8	28.59	C8	29.46	E8	30.34
89	27.74	A9	28.62	C9	29.49	E9	30.37
8A	27.77	AA	28.64	CA	29.52	EA	30.39
8B	27.80	AB	28.67	CB	29.55	EB	30.42
8C	27.82	AC	28.70	CC	29.57	EC	30.45
8D	27.85	AD	28.72	CD	29.60	ED	30.47
8E	27.88	AE	28.75	CE	29.63	EE	30.50
8F	27.90	AF	28.78	CF	29.65	EF	30.53
90	27.93	B0	28.81	D0	29.68	F0	30.56
91	27.96	B1	28.83	D1	29.71	F1	30.58
92	27.99	B2	28.86	D2	29.74	F2	30.61
93	28.01	B3	28.83	D3	29.76	F3	30.64
94	28.04	B4	28.92	D4	29.79	F4	30.67
95	28.07	B5	28.94	D5	29.82	F5	30.69
96	28.10	B6	28.97	D6	29.85	F6	30.72
97	28.12	B7	29.00	D7	29.87	F7	30.75
98	28.15	B8	29.03	D8	29.90	F8	30.78
99	28.18	B9	29.05	D9	29.93	F9	30.80
9A	28.21	BA	29.08	DA	29.96	FA	30.83
9B	28.23	BB	29.11	DB	29.98	FB	30.86
9C	28.26	BC	29.13	DC	30.01	FC	30.88
9D	28.29	BD	29.16	DD	30.04	FD	30.91
9E	28.31	BE	29.19	DE	30.06	FE	30.94
9F	28.34	BF	29.22	DF	30.09	FF	30.97



BATTERY MONITOR

DIRECT CONVERSION OF HEXADECIMAL TO EQUIVALENT BATTERY VOLTAGE (VDC)

HEX	VDC
2E	8.9
2F	9.1
30	9.3
31	9.5
32	9.7
33	9.9
34	10.1
35	10.3
36	10.5
37	10.7
38	10.9
39	11.1
3A	11.3
3B	11.5
3C	11.7
3D	11.9
3E	12.1
3F	12.3
40	12.5
41	12.7
42	12.8
43	13.0
44	13.2
45	13.4
46	13.6
47	13.8
48	14.0
49	14.2
4A	14.4
4B	14.6
4C	14.8
4D	15.0

Explanation

There is a problem with unexpected messages received, and expected messages not received. For example:

259235527 ΛΛ expected message not received
(the computer expected platform to transmitt in its assigned time frame)

2600000908 B222LAGG ECT...
(data was actually transmitted 15 minutes late, but still was entered and disseminated)

2600000908 ΛΛ unexpected message received
(this indicates that the previous data was accepted, but it is not in the assigned time frame)

Grasmere Idaho
Test

```
:)KLKLKLKLYUYU

DCS - ENTER ID.
BLM001

NUMBER OF UNDISSEMINATED MESSAGES 0000
TIME OF LAST DISSEMINATION  262180921
ENTER: MSG,RLT,DIS, OR STOP RLT,259000000


16CE8A82 259145240 B@@@L@LG@@@@BAIDMGB@@@D@CH@@@@AAIDCHB@@@L@GE@@@@BAIDG
EB@@@L@EF@@@@AAIDEFB@@@LALG@@@@AAIDLGB@@@L@OF@@@@AAIDOFB@@@BABG@@@@AAIDB
GB@@@NA@H@@@@CAID@H


16CE8A82 259145240 ^^UNEXPECTED MESSAGE RECEIVED.


16CE8A82 259145519 ^^EXPECTED MESSAGE NOT RECEIVED.


16CE8A82 259175240 B@@@L@EF@@@@AAIDEFB@@@LALG@@@@AAIDLGB@@@L@OF@@@@AAIDO
FB@@@BABG@@@@AAIDBGB@@@NA@H@@@@CAID@HB@@@@BDG@@@@CAKDOGB@@@LAGG@@@@DAMDG
GB@@@HABG@@@@DALDBG


16CE8A82 259175240 ^^UNEXPECTED MESSAGE RECEIVED.


16CE8A82 259175507 ^^EXPECTED MESSAGE NOT RECEIVED.


16CE8A82 259205519 ^^EXPECTED MESSAGE NOT RECEIVED.


16CE8A82 259210908 B@@@BABG@@@@AAIDBGB@@@NA@H@@@@CAID@HB@@@@BDG@@@@CAKDO
GB@@@LAGG@@@@DAMDGGB@@@HABG@@@@DALDBGB@@@IBNF@@@@DAHDNFB@@@HBKF@@@@DALDK
FB@@@FCAG@@@@DALDAG


16CE8A82 259210908 ^^UNEXPECTED MESSAGE RECEIVED.


16CE8A82 259235527 ^^EXPECTED MESSAGE NOT RECEIVED.


16CE8A82 260000908 B@@@LAGG@@@@DAMDGGB@@@HABG@@@@DALDBGB@@@IBNF@@@@DAHDM
FB@@@HBKF@@@@DALDKFB@@@FCAG@@@@DALDAGB@@@ECLF@@@@DAODLFB@@@BCJG@@@@DAMDJ
GB@@@JCKG@@@@DALDKG


16CE8A82 260000908 ^^UNEXPECTED MESSAGE RECEIVED.
```

16CE8A82 260025504 ^^EXPECTED MESSAGE NOT RECEIVED.

16CE8A82 260030908 B@@@HBKF@@@@DALDKFB@@@FCAG@@@@DALDAGB@@@ECLF@@@@DAODL
FB@@@BCJG@@@@DAMDJGB@@@JCKG@@@@DALDKGB@@@FBIG@@@@EAKDIGB@@@NAEG@@@@DAJDE
GB@@@CBEG@@@@EAJDFG

16CE8A82 260030908 ^^UNEXPECTED MESSAGE RECEIVED.

16CE8A82 260055516 ^^EXPECTED MESSAGE NOT RECEIVED.

16CE8A82 260055519 ^^EXPECTED MESSAGE NOT RECEIVED.

16CE8A82 260060908 B@@@BCJG@@@@DAMDJGB@@@JCKG@@@@DALDKGB@@@FBIG@@@@EAKDI
GB@@@NAEG@@@@DAJDEGB@@@CBEG@@@@EAJDFGB@@@NAMF@@@@EAJDMFB@@@BAAG@@@@EAJDA
GB@@@IANF@@@@EAJDNF

16CE8A82 260060908 ^^UNEXPECTED MESSAGE RECEIVED.

16CE8A82 260085518 ^^EXPECTED MESSAGE NOT RECEIVED.

16CE8A82 260090908 B@@@NAEG@@@@DAJDEGB@@@CBEG@@@@EAJDFGB@@@NAMF@@@@EAJDM
FB@@@BAAG@@@@EAJDAGB@@@IANF@@@@EAJDNFB@@@KADG@@@@FAIDCGB@@@NAGG@@@@FAIDH
GB@@@@ABG@@@@FAIDBG

16CE8A82 260090908 ^^UNEXPECTED MESSAGE RECEIVED.

16CE8A82 260115510 ^^EXPECTED MESSAGE NOT RECEIVED.

16CE8A82 260120908 B@@@BAAG@@@@EAJDAGB@@@IANF@@@@EAJDNFB@@@KADG@@@@FAIDC
GB@@@NAGG@@@@FAIDHGB@@@@ABG@@@@FAIDBGB@@@KAEG@@@@FAIDFGB@@@L@NG@@@@GAIDN
GB@@@EAAG@@@@HAIDAG

16CE8A82 260120908 ^^UNEXPECTED MESSAGE RECEIVED.

16CE8A82 260145525 ^^EXPECTED MESSAGE NOT RECEIVED.

16CE8A82 260150908 B@@@NAGG@@@@FAIDHGB@@@@ABG@@@@FAIDBGB@@@KAEG@@@@FAIDF
GB@@@L@NG@@@@GAIDNGB@@@EAAG@@@@HAIDAGB@@@@AFG@@@@HAIDFGB@@@ABMF@@@@IAIDN
FB@@@@B@G@@@@JALD@G

16CE8A82 260150908 ^^UNEXPECTED MESSAGE RECEIVED.

16CE8A82 260175503 ^^EXPECTED MESSAGE NOT RECEIVED.

16CE8A82 260180908 B@@@L@NG@@@@GAIDNGB@@@EAAG@@@@HAIDAGB@@@@AFG@@@@HAIDF
GB@@@ABMF@@@@IAIDNFB@@@@BGG@@@@JALD@GB@@@HANF@@@@KAMDNFB@@@FBFG@@@@KANDG
GB@@@BBCG@@@@LANDCG

16CE8A82 260180908 ^^UNEXPECTED MESSAGE RECEIVED.

16CE8A82 260205505 ^^EXPECTED MESSAGE NOT RECEIVED.

16CE8A82 260210908 B@@@ABMF@@@@IAIDNFB@@@@BGG@@@@JALD@GB@@@HANF@@@@KAMDN
FB@@@FBFG@@@@KANDGGB@@@BBCG@@@@LANDCGB@@@NALG@@@@MANDLGB@@@NBFF@@@@MA@EF
FB@@@IBHG@@@@MADHG

16CE8A82 260210908 ^^UNEXPECTED MESSAGE RECEIVED.

16CE8A82 260235513 ^^EXPECTED MESSAGE NOT RECEIVED.

16CE8A82 261000908 B@@@FBFG@@@@KANDGGB@@@BBCG@@@@LANDCGB@@@MALG@@@@MANDL
GB@@@NBFF@@@@MA@EFFB@@@IBHG@@@@MADHGB@@@MABG@@@@MAMDBGB@@@CALF@@@@MAMDM
FB@@@DAMF@@@@MALDMF

16CE8A82 261000908 ^^UNEXPECTED MESSAGE RECEIVED.

16CE8A82 261025504 ^^EXPECTED MESSAGE NOT RECEIVED.

16CE8A82 261030908 B@@@NBFF@@@@MA@EFFB@@@IBHG@@@@MADHGB@@@MABG@@@@MAMDB
GB@@@CALF@@@@MAMDMFB@@@DAMF@@@@MALDMFB@@@FACF@@@@MAKDCFB@@@L@KE@@@@LAJDK
EB@@@K@ME@@@@LAJDME

16CE8A82 261030908 ^^UNEXPECTED MESSAGE RECEIVED.

16CE8A82 261055524 ^^EXPECTED MESSAGE NOT RECEIVED.

16CE8A82 261060908 B@@@CALF@@@@MAMDMFB@@@DAMF@@@@MALDMFB@@@FACF@@@@MAKDC
FB@@@L@KE@@@@LAJDKEB@@@K@ME@@@@LAJDMEB@@@N@JF@@@@MAJDJFB@@@AANE@@@@MAJDN
EB@@@@AHE@@@@MAJDHE

16CE8A82 261060908 ^^UNEXPECTED MESSAGE RECEIVED.

16CE8A82 261085532 ^^EXPECTED MESSAGE NOT RECEIVED.

16CE8A82 261090908 B@@@L@KE@@@@LAJDKEB@@@K@ME@@@@LAJDMEB@@@N@JF@@@@MAJDJ
FB@@@AANE@@@@MAJDNEB@@@@AHE@@@@MAJDHEB@@@N@JE@@@@LAIDJEB@@@M@AF@@@@LAIDA
FB@@@@@HE@@@@LAIDHE

16CE8A82 261090908 ^^UNEXPECTED MESSAGE RECEIVED.

00000000 261114324 ^^THE FOLLOWING OUTAGES TOOK PLACE DURING ECLIPSE

ON JULIAN DAY 261 -- (18 SEPTEMBER 1977) .
EAST SATELLITE ECLI
PSE OUTAGE --
DCPI WAS DOWN FROM 0415 ZULU TILL 0532 ZULU .

WEST SATELLITE ECLIPSE OUTAGE --
DCPI WAS DOWN 0810 ZULU
TILL 1005 ZULU .

16CE8A82 261120908 B@@@AANE@@@@MAJDNEB@@@@AHE@@@@MAJDHEB@@@N@JE@@@@LAIDJ
EB@@@M@AF@@@@LAIDAFB@@@@D@HE@@@@LAIDHEB@@@N@KE@@@@LAIDLEB@@@L@DF@@@@LAIDC
FB@@@@D@EF@@@@LAIDDF

16CE8A82 261150909 ^^ADDRESS RECEIVED WITH ERROR AS: 9DCA8A9A

16CE8A82 261180908 B@@@L@DF@@@@LAIDCFB@@@@D@EF@@@@LAIDDFB@@@H@BF@@@@LAIDB
FB@@@J@NF@@@@LAIDNFB@@@K@ND@@@@MAKDNDB@@@CAFD@@@@MANDEDB@@@M@GG@@@@MANDH
GB@@@KAFE@@@@MANDFE

16CE8A82 261210908 B@@@J@NF@@@@LAIDNFB@@@K@ND@@@@MAKDNDB@@@CAFD@@@@MANDE
DB@@@M@GG@@@@MANDHGB@@@KAFE@@@@MANDFEB@@@JA@E@@@@NAODODB@@@D@JC@@@@MANDJ
CB@@@HAJC@@@@MANDJC

16CE8A82 262000908 B@@@M@GG@@@@MANDHGB@@@KAFE@@@@MANDFEB@@@JA@E@@@@NAODO
DB@@@D@JC@@@@MANDJCB@@@HAJC@@@@MANDJCB@@@NA@D@@@@LAND@DB@@@IAND@@@@KAMDM
DB@@@@BGE@@@@JALDGE

16CE8A82 262030908 B@@@D@JC@@@@MANDJCB@@@HAJC@@@@MANDJCB@@@NA@D@@@@LAND@
DB@@@IAND@@@@KAMDMDB@@@@BGE@@@@JALDGEB@@@NAFE@@@@JAJDEEB@@@EAGE@@@@IAJDG
EB@@@G@GD@@@@IAJDGD

16CE8A82 262060908 B@@@IAND@@@@KAMDMDB@@@@BGE@@@@JALDGEB@@@NAFE@@@@JAJDE
EB@@@EAGE@@@@IAJDGEB@@@G@GD@@@@IAJDGDB@@@L@AF@@@@HAJDAFB@@@B@GJ@@@@HAJDH
JB@@@I@@J@@@@HAIDOI

16CE8A82 262090908 B@@@EAGE@@@@IAJDGEB@@@G@GD@@@@IAJDGDB@@@L@AF@@@@HAJDH
FB@@@B@GJ@@@@HAJDHJB@@@I@@J@@@@HAIDOIB@@@L@BG@@@@GAIDBGB@@@N@DE@@@@GHIDD
EB@@@K@GD@@@@FAIDGD

00000000 262112241 ^^THE FOLLOWING OUTAGES TOOK PLACE DURING ECLIPSE ON

  JULIAN DAY 262 ---   (19 SEPTEMBER 1977) .
  EAST SATELLITE
DCPI WAS DOWN FROM 0420 ZULU TILL 0552 ZULU .
  WEST SATELLITE DCPI
 WAS DOWN FROM 0808 ZULU TILL 1007 ZULU .
  THE DCPR'S ON EACH SA
TELLITE WERE DOWN FOR LESS THAN ONE
 MINUTE EACH WHILE SWITCHING TO
BACKUP ANTENNAS .

16CE8A82 262120908 B@@@B@GJ@@@@HAJDHJB@@@I@@J@@@@HAIDOIB@@@L@BG@@@@GAIDB
GB@@@N@DE@@@@GAIDDEB@@@K@GD@@@@FAIDGDB@@@AANE@@@@FAIDNEB@@@O@EE@@@@FAIDE
EB@@@BACE@@@@FAIDCE

16CE8A82 262150908 B@@@N@DE@@@@GAIDDEB@@@K@GD@@@@FAIDGDB@@@AANE@@@@FAIDN
EB@@@O@EE@@@@FAIDEEB@@@BACE@@@@FAIDCEB@@@EAMF@@@@FAIDMFB@@@HA@E@@@@FAID@
EB@@@J@NE@@@@FAJDNE

16CE8A82 262180908 B@@@O@EE@@@@FAIDEEB@@@BACE@@@@FAIDCEB@@@EAMF@@@@FAIDM
FB@@@HA@E@@@@FAID@EB@@@J@NE@@@@FAJDNEB@@@O@AF@@@@FAJDAFB@@@M@LG@@@@FAMDL
GB@@@BAKH@@@@GAMDKH

00000000 262201859 ^^DCS OPERATOR HERE. I SEE YOU GOT IN OKAY.
11
YES THANKS AND TALK TO YOU SOON

16CE8A82 262210908 B@@@HA@E@@@@FAID@EB@@@J@ME@@@@FAJDME B@@@D@AF@@@@FAJDA
FB@@@M@LG@@@@FAMDLGB@@@BAKH@@@@GANDKHB@@@DBCK@@@@FALDCKE@@@IAGJ@@@@FALDG
JB@@@D@DI@@@@FALD@J

16CE8A82 263000908 B@@@M@LG@@@@FAMDLGB@@@BAKH@@@@GANDKHB@@@DBCK@@@@FALDC
KB@@@IAGJ@@@@FALDGJB@@@D@DI@@@@FALD@JB@@@DAKI@@@@GAKDKIC@@@GADG@@@@GAKDC
GC@@@N@DE@@@@HAKDDE

16CE8A82 263030908 B@@@IAGJ@@@@FALDGJB@@@D@DI@@@@FALD@JB@@@DAKI@@@@GAKDK
IC@@@GADG@@@@GAKDCGC@@@N@DE@@@@HAKDDED@@@MADF@@@@HAJD@GD@@@AALE@@@@HAJDL
ED@@@BA@E@@@@GAJD@E

16CE8A82 263060908 C@@@GADG@@@@GAKDCGC@@@N@DE@@@@HAKDDED@@@MADF@@@@HAJD@
GD@@@AALE@@@@HAJDLED@@@BA@E@@@@GAJD@ED@@@M@@G@@@@HAIDDFD@@@@AAE@@@@HAIDA
ED@@@N@FG@@@@HAIDFG

16CE8A82 263091019 ^^EXPECTED MESSAGE NOT RECEIVED.

00000000 263112438 ^^THE FOLLOWING OUTAGES TOOK PLACE DURING ECLIPSE
O
N JULIAN DAY 263 --- (20 SEPTEMBER 1977) .
  EAST SATELLITE EC
LIPSE OUTAGE --
       DCPI WAS DOWN FROM 0410 ZULU TILL 0547 ZULU

       DCPR WAS DOWN FROM 0429 ZULU TILL 0439 ZULU .
  WEST SA
TELLITE ECLIPSE OUTAGE ---
       DCPI WAS DOWN FROM 0807 ZULU TIL
L 1007 ZULU .
       DCPR WAS DOWN FROM 0819 ZULU TILL 0926 ZULU ,

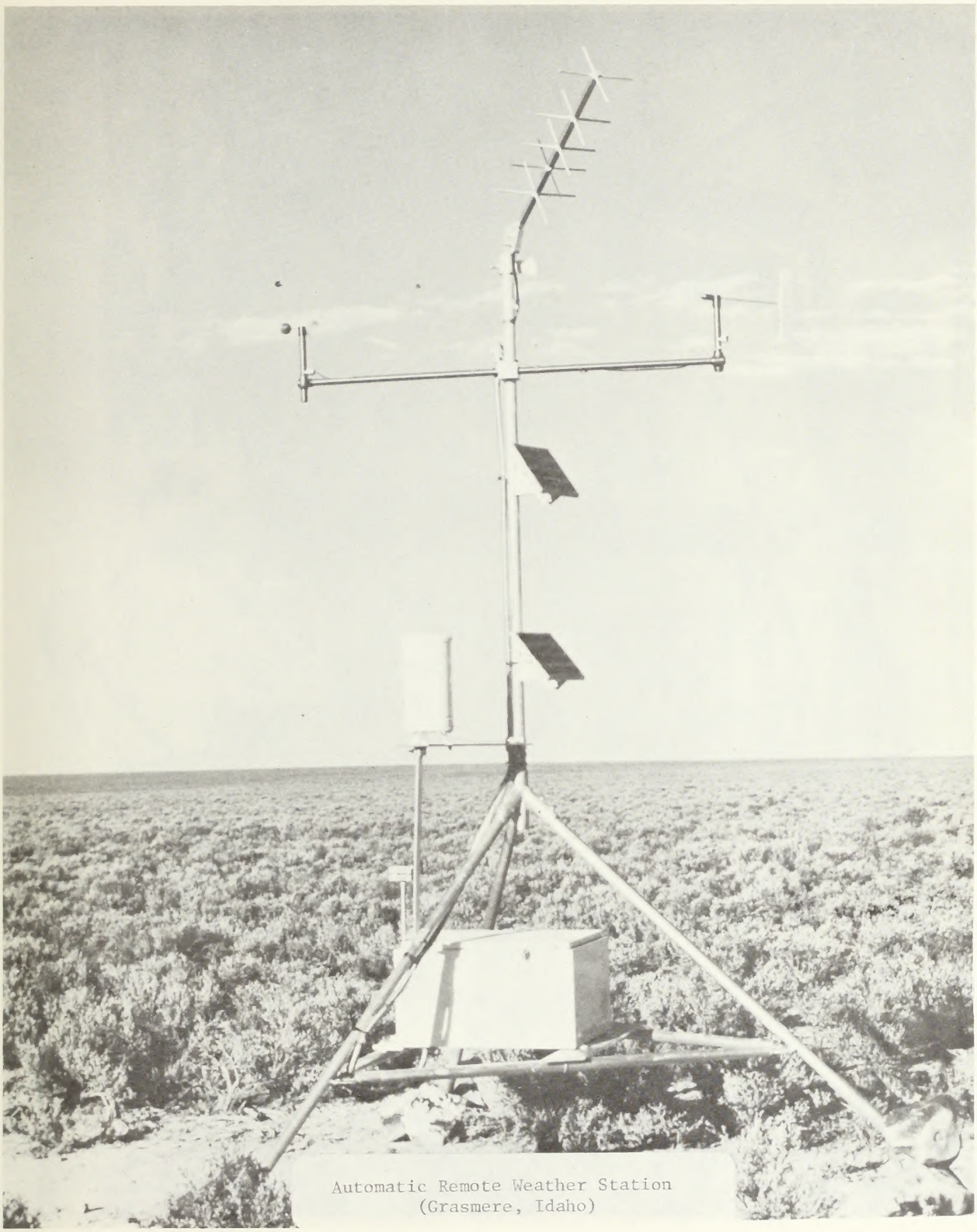
                AND FROM 0936 ZULU TILL 0940 ZULU .

16CE8A82 263120908 D@@@@AAE@@@@HAIDAED@@@N@FG@@@@HAIDFGD@@@@D@HG@@@@HAIDH
GD@@@DAJG@@@@IAIDKGD@@@K@EG@@@@IAIDEGD@@@H@NG@@@@IAIDDGD@@@KAEG@@@@JAIDD
GD@@@IAIG@@@@JAIDJG

16CE8A82 263150908 D@@@DAJG@@@@IAIDKGD@@@K@EG@@@@IAIDEGD@@@H@NG@@@@IAIDD
GD@@@KAEG@@@@JAIDDGD@@@IAIG@@@@JAIDJGD@@@K@@H@@@@JAID@HD@@@@ACG@@@@JAIDD
GD@@@L@MG@@@@KAIDMG

SAMPLE OF 1200 BAUD

```
DCS - ENTER ID. BLM001
YOU ENTERED AN INCORRECT ID - PLEASE ENTER CORREGT ID BLM001
NUMBER OF UNDISSEMINATED MESSAGES 0000
TIME OF LAST DISSEMINATION  263180921
ENTER: MSG,RLT,DIS, OR STOP RLT,263000000


16GE8A82 263000908 B@@@M@LG@@@@FAMDLGB@@@BAKH@@@@GANDKHB@@@DBGK@@@@FALDG
KB@@@IAGJ@@@@FALDGJB@@@@O@OI@@@@FALD@JB@@@OAKI@@@@GAKDKIC@@@GADG@@@@GAKDG
GG@@@@N@OE@@@@HAKDOE


16GE8A82 263030908 B@@@IAGJ@@@@FALDGJB@@@@O@OI@@@@FALD@JB@@@OAKI@@@@GAKDK
IG@@@@GADG@@@@GAKDGGG@@@@N@OE@@@@HAKDOED@@@MAOF@@@@HAJD@GD@@@AALE@@@@HAJDL
ED@@@@BA@E@@@@GAJD@E


16CE8A82 263060908 G@@@GADG@@@@GAKDGGC@@@N@OE@@@@HAKDOED@@@MAOF@@@@HAJD@
GD@@@AALE@@@@HAJDLED@@@BA@E@@@@GAJD@ED@@@M@@G@@@@HAIDOFD@@@@AAE@@@@HAIDA
ED@@@@N@FG@@@@HAIDFG


16CE8A82 263091019 ^^EXPEGTED MESSAGE NOT REGEIVED.


00000000 263112438 ^^THE FOLLOWING OUTAGES TOOK PLAGE DURING ECLIPSE
O
N  JULIAN  DAY  263  ---  ( 20 SEPTEMBER 1977 ) .
  EAST SATELLITE EG
LIPSE OUTAGE --
       DGPI WAS DOWN FROM  0410 ZULU  TILL  0547 ZULU
 .
       DCPR WAS DOWN FROM  0429 ZULU  TILL  0439 ZULU .
  WEST SA
TELLITE ECLIPSE OUTAGE  ---
       DGPI WAS DOWN FROM  0807 ZULU  TIL
L  1007 ZULU .
       DGPR WAS DOWN FROM  0819 ZULU  TILL  0926 ZULU ,

                AND FROM  0936 ZULU  TILL  0940 ZULU .


16GE8A82 263120908 D@@@@AAE@@@@HAIDAED@@@N@FG@@@@HAIDFGD@@@O@HG@@@@HAIDH
GD@@@DAJG@@@@IAIDKGD@@@K@EG@@@@IAIDEGD@@@H@NG@@@@IAIDOGD@@@KAEG@@@@JAIDD
GD@@@IAIG@@@@JAIDJG


16CE8A82 263150908 D@@@DAJG@@@@IAIDKGD@@@K@EG@@@@IAIDEGD@@@H@NG@@@@IAIDO
GD@@@KAEG@@@@JAIDDGD@@@IAIG@@@@JAIDJGD@@@K@@H@@@@JAID@HD@@@@AGG@@@@JAIDD
GD@@@L@MG@@@@KAIDMG
```



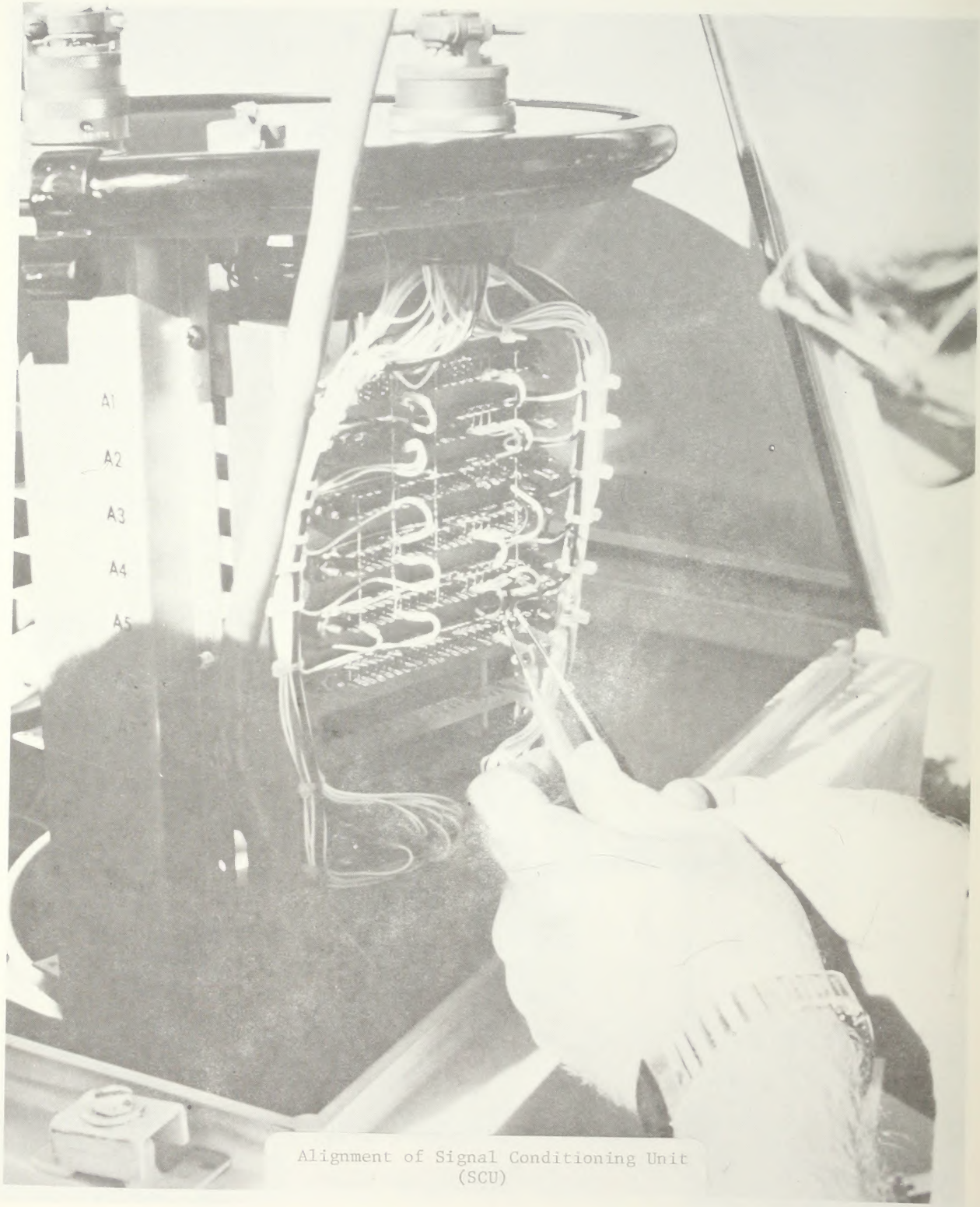
Automatic Remote Weather Station
(Grasmere, Idaho)

Tripod Assembly

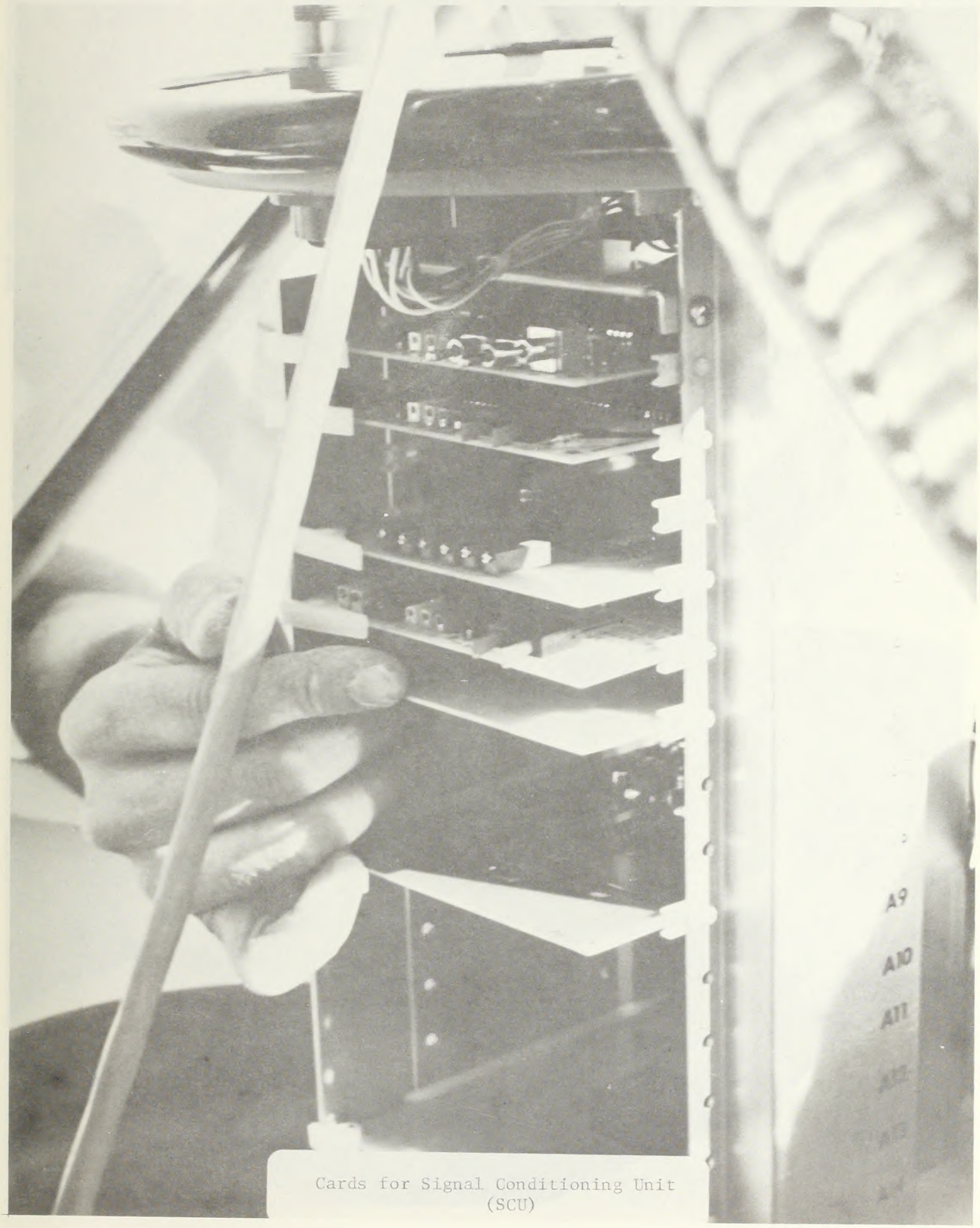
NEMA Enclosure

Crossarm Assembly
(Note Weight Support)

Conduit for Cable Protection

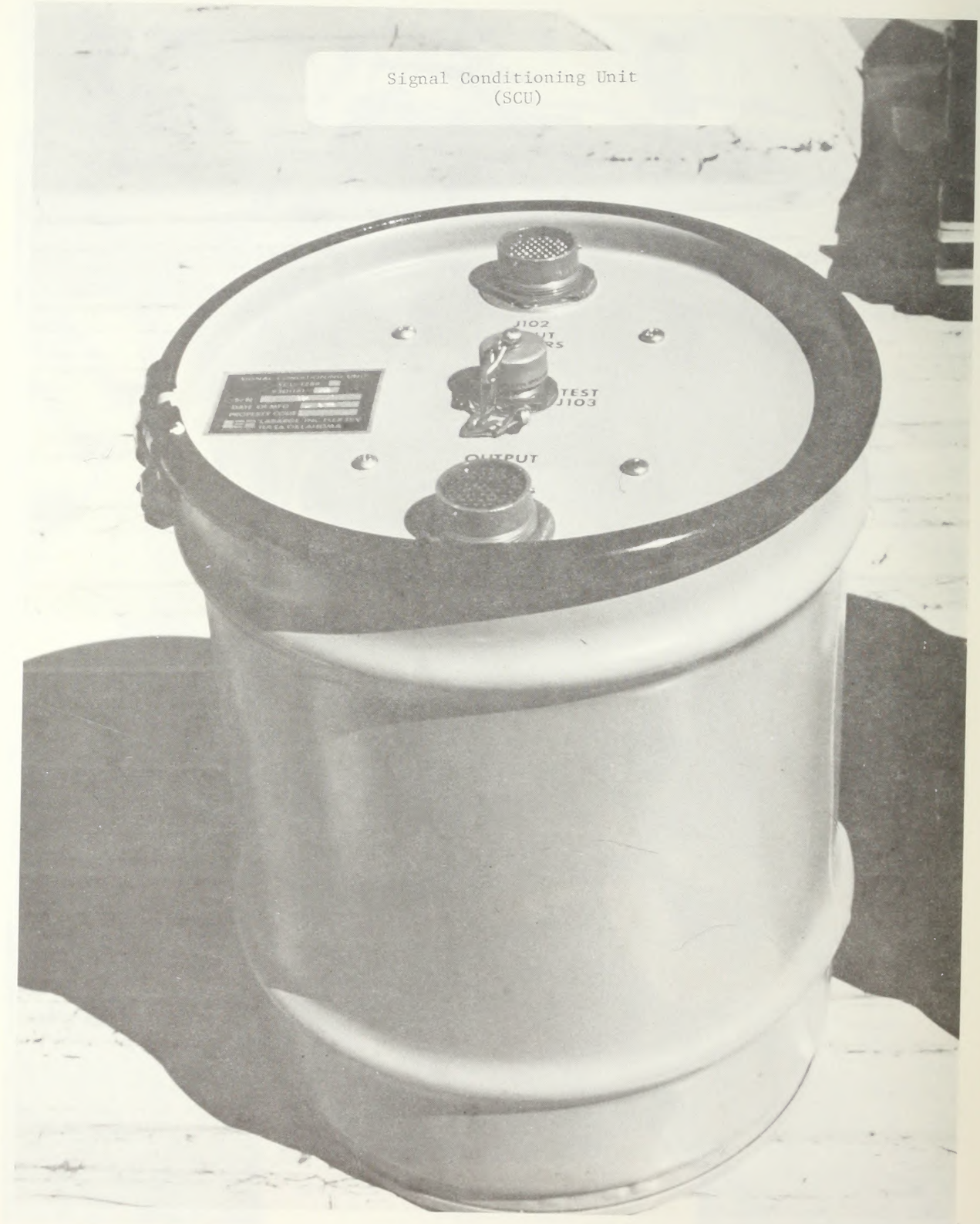


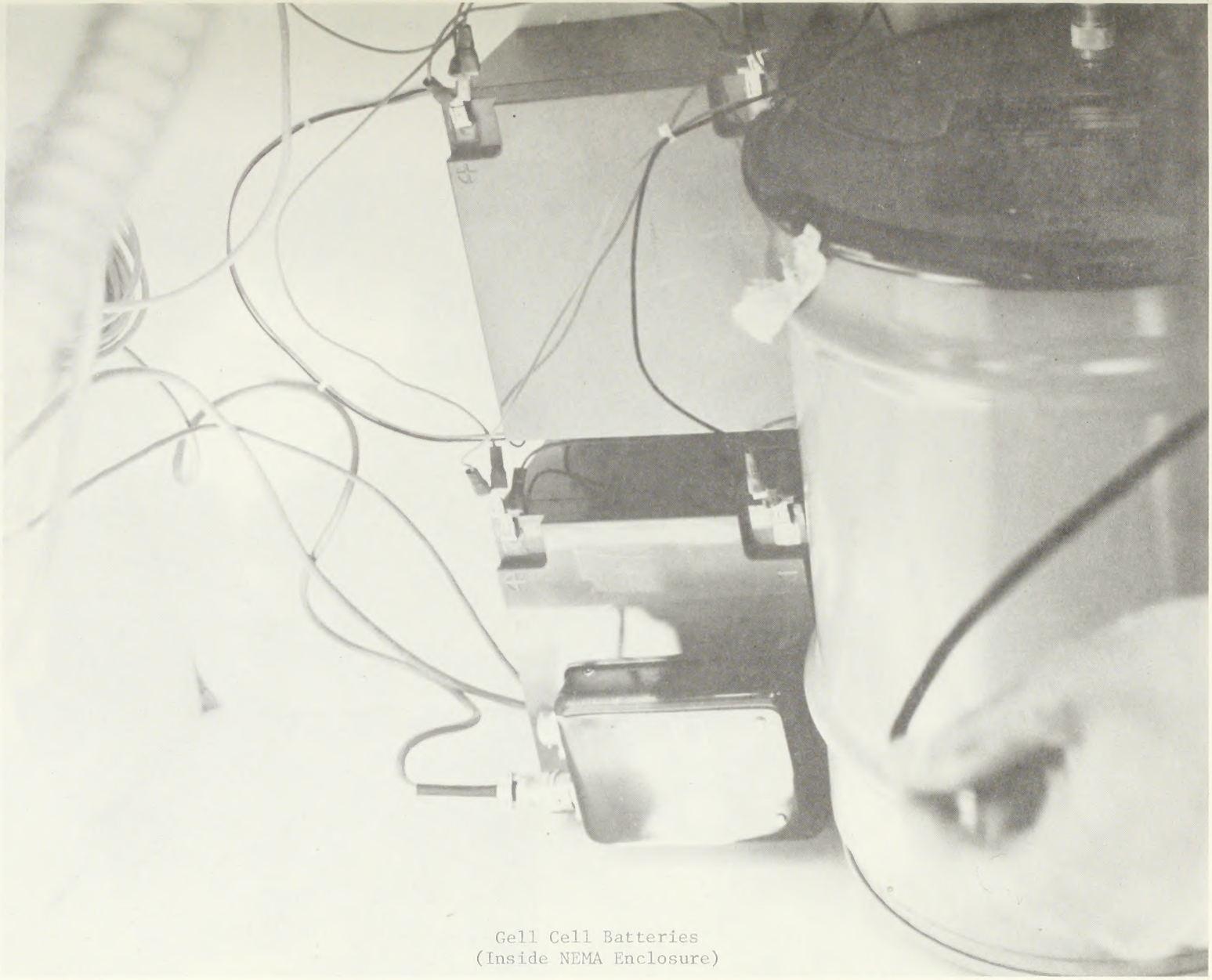
Alignment of Signal Conditioning Unit (SCU)



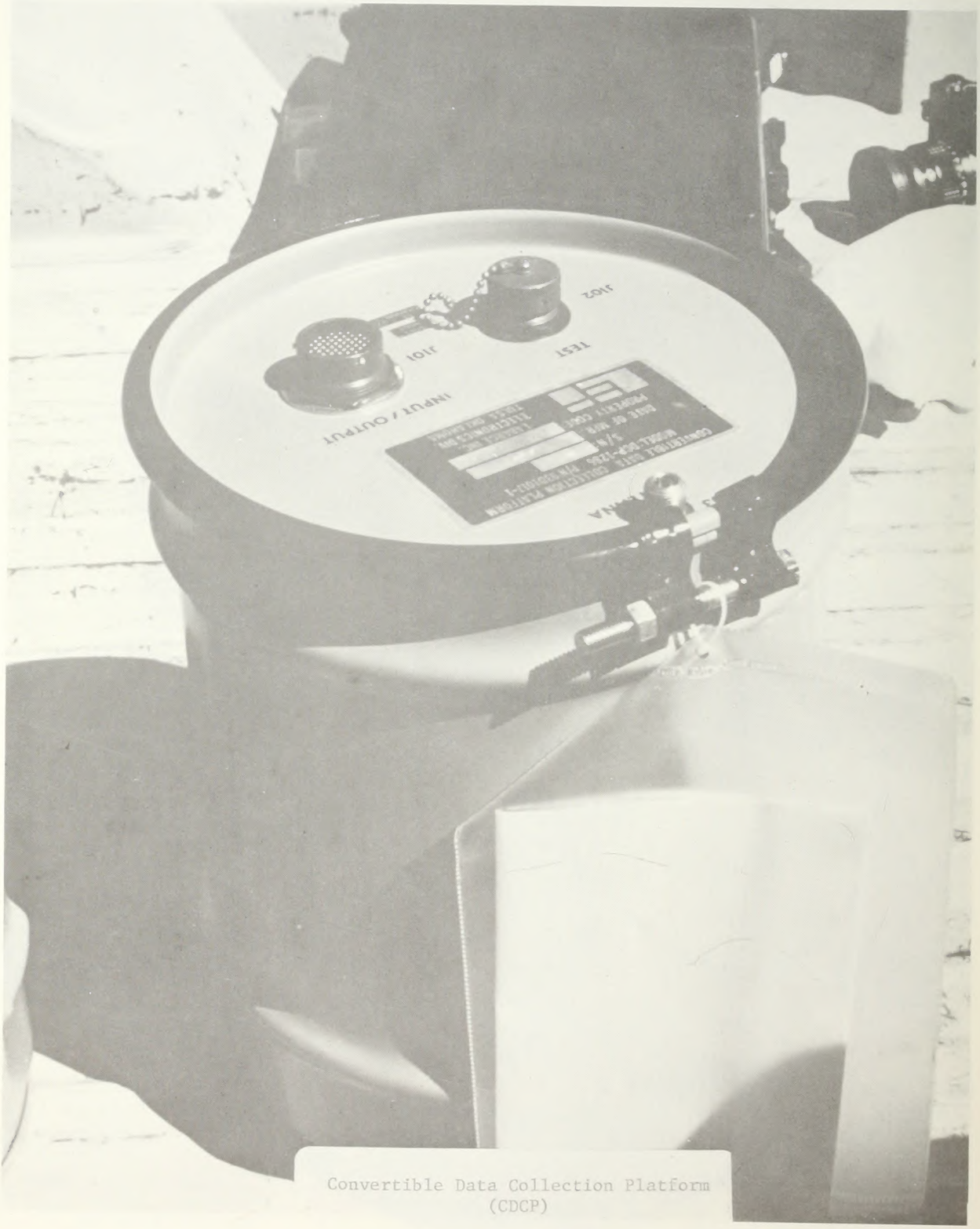
Cards for Signal Conditioning Unit (SCU)

Signal Conditioning Unit
(SCU)

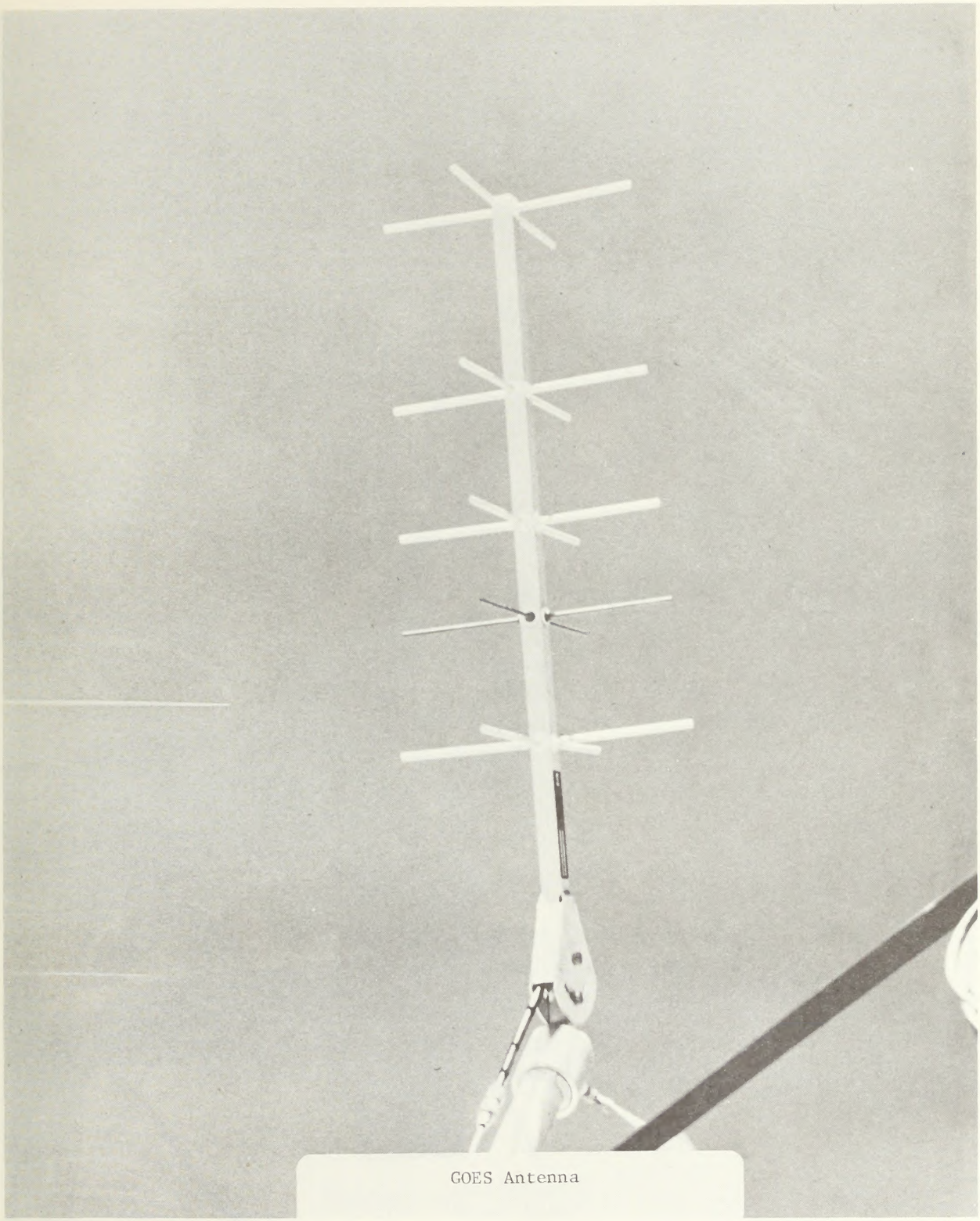




Gell Cell Batteries
(Inside NEMA Enclosure)

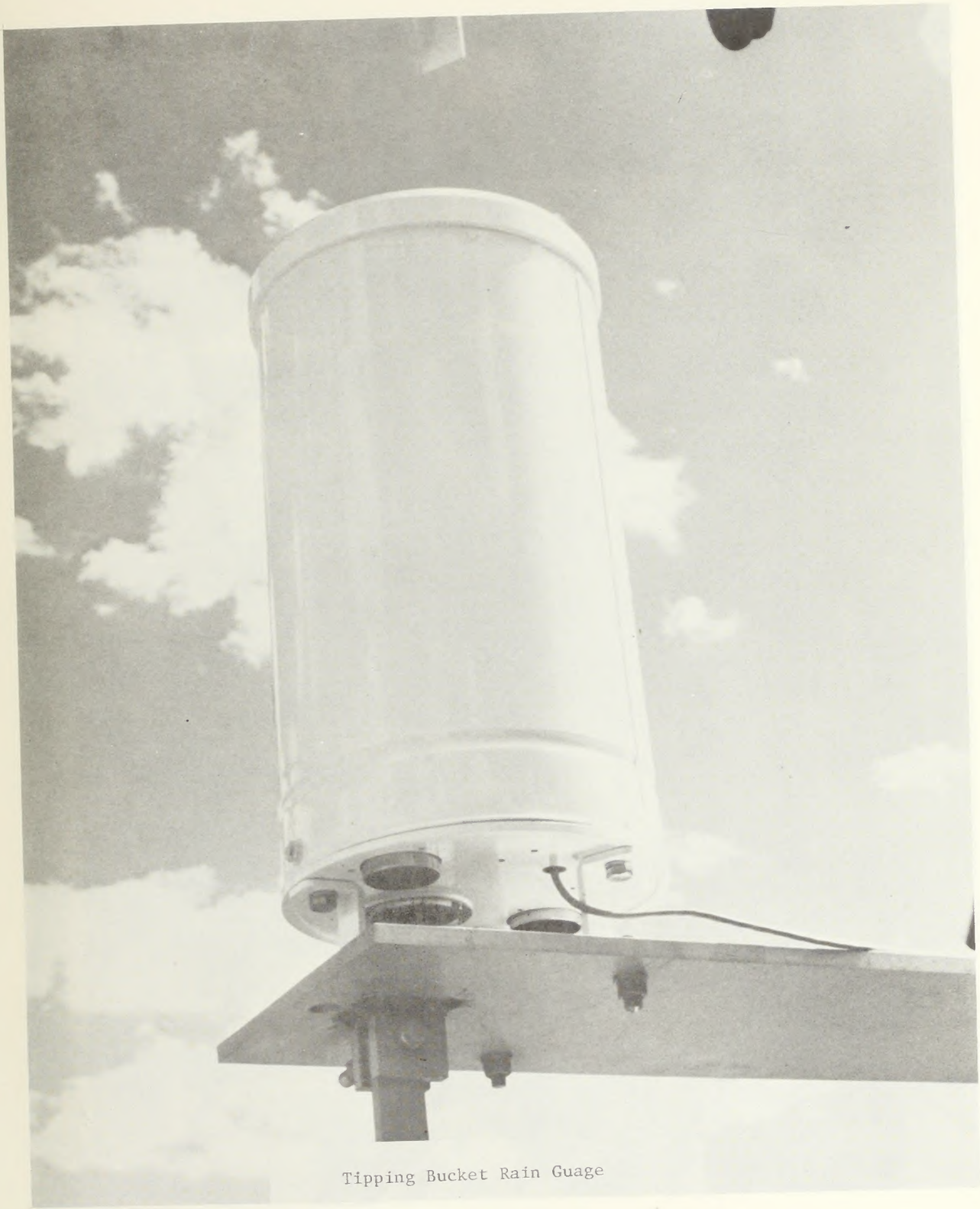


Convertible Data Collection Platform
(CDCP)

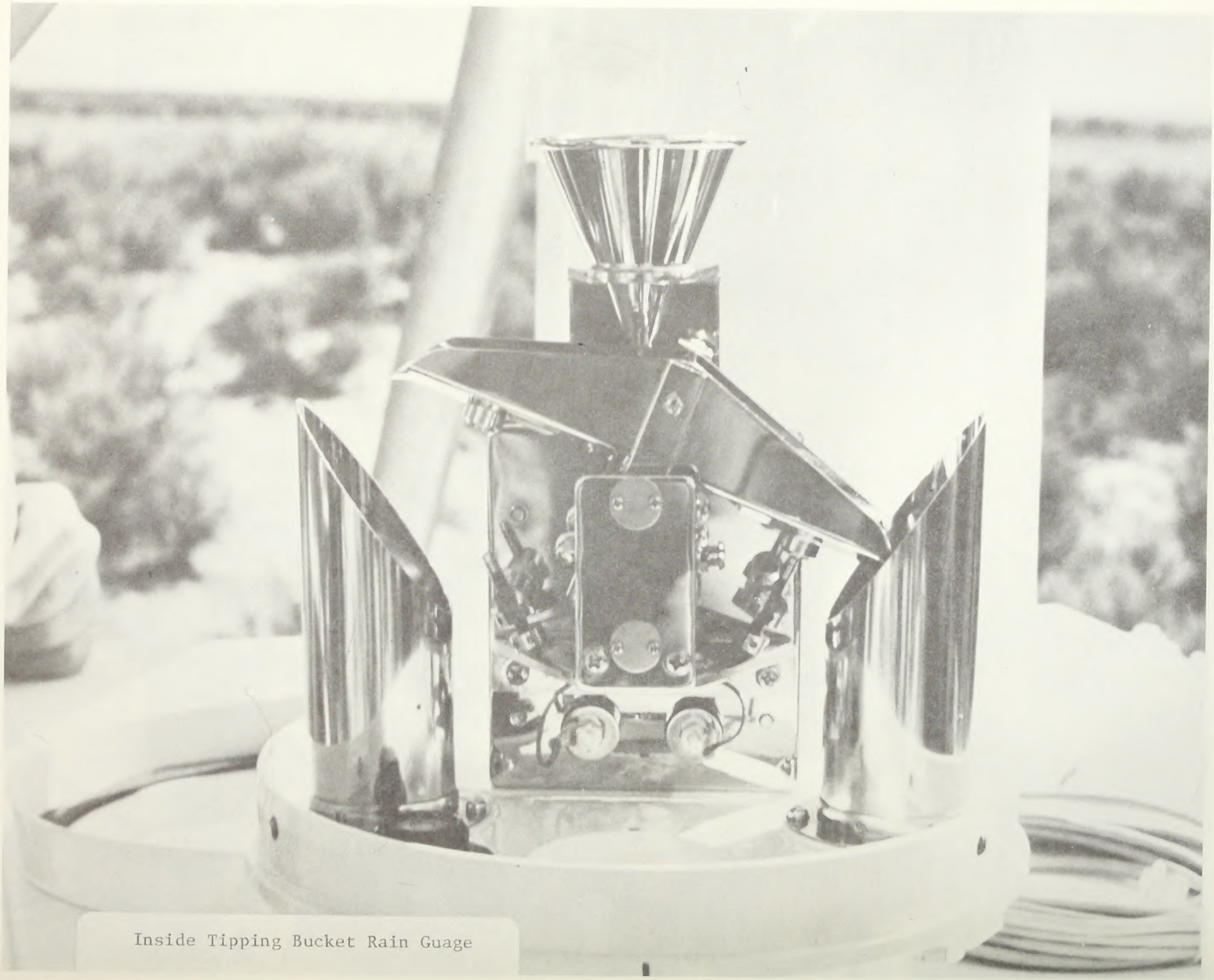


GOES Antenna

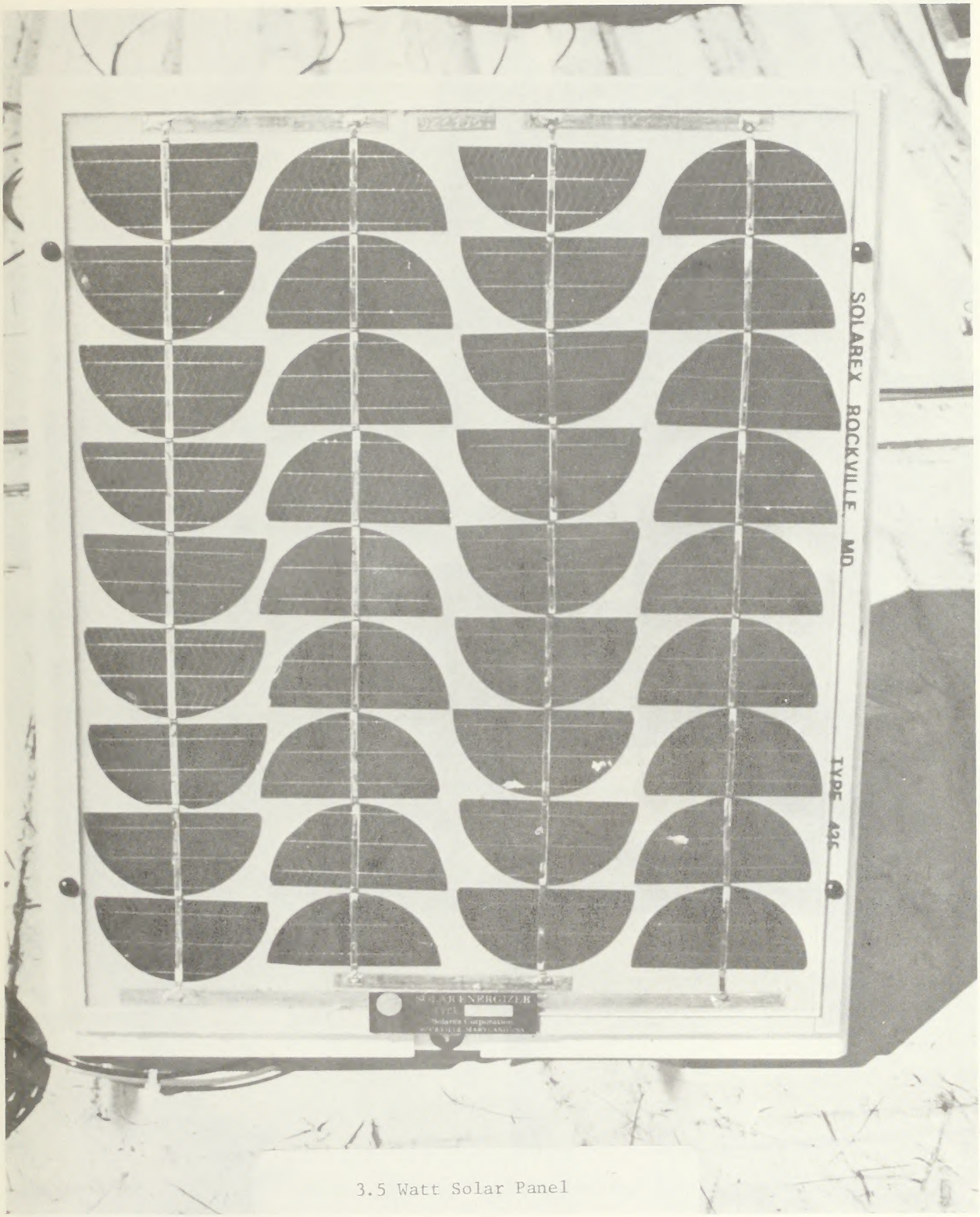
Anemometer
(Wind Speed)



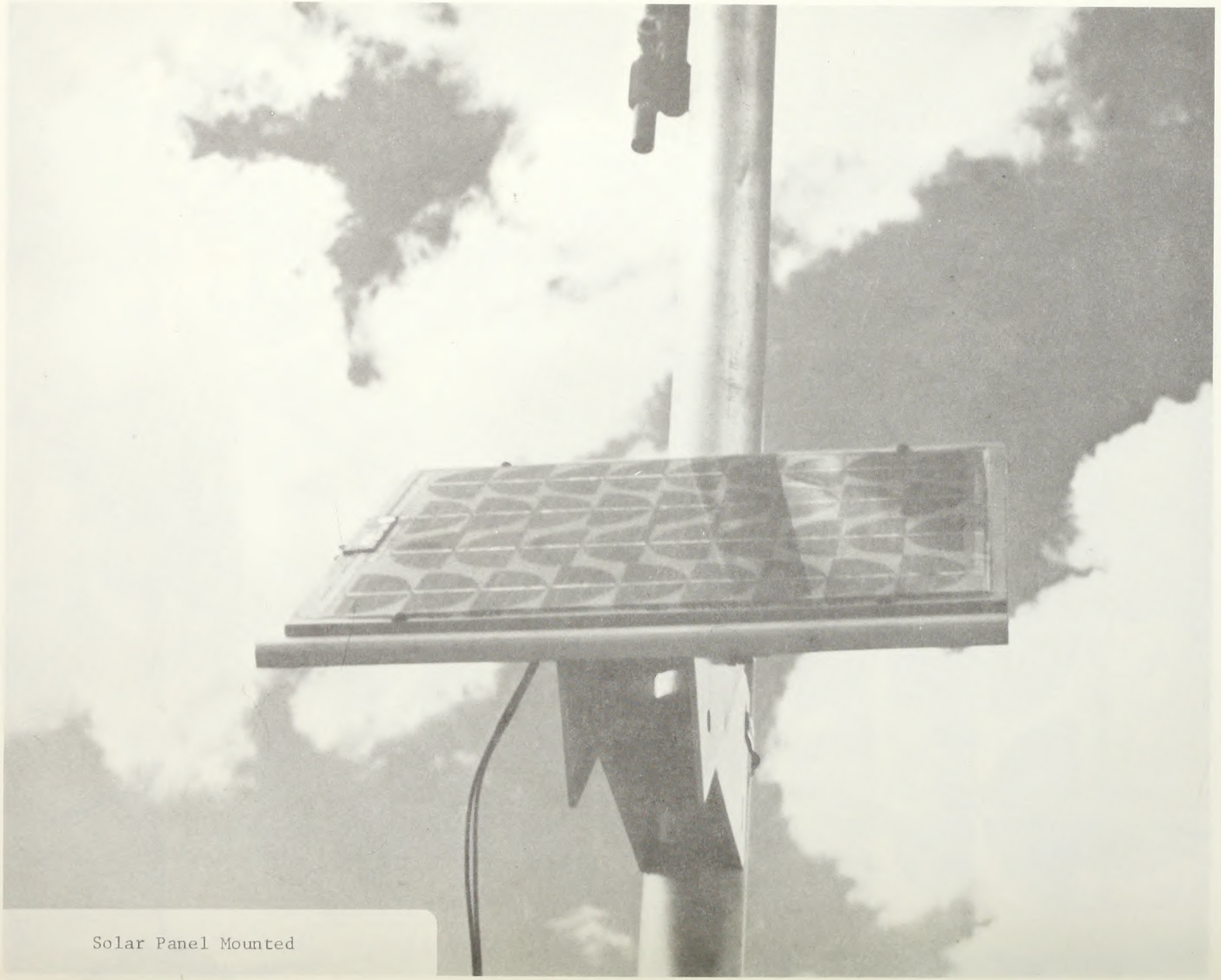
Tipping Bucket Rain Guage



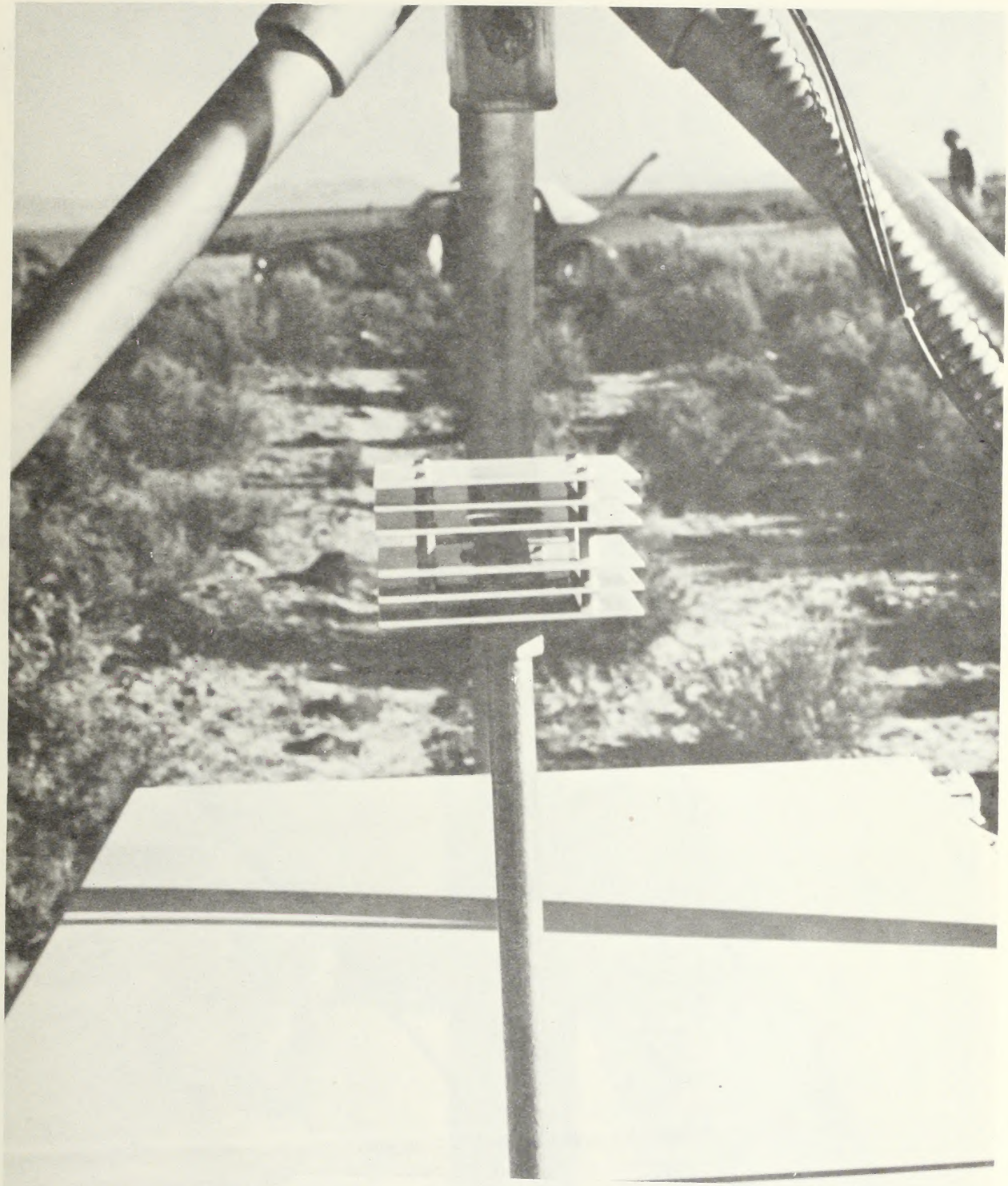
Inside Tipping Bucket Rain Guage



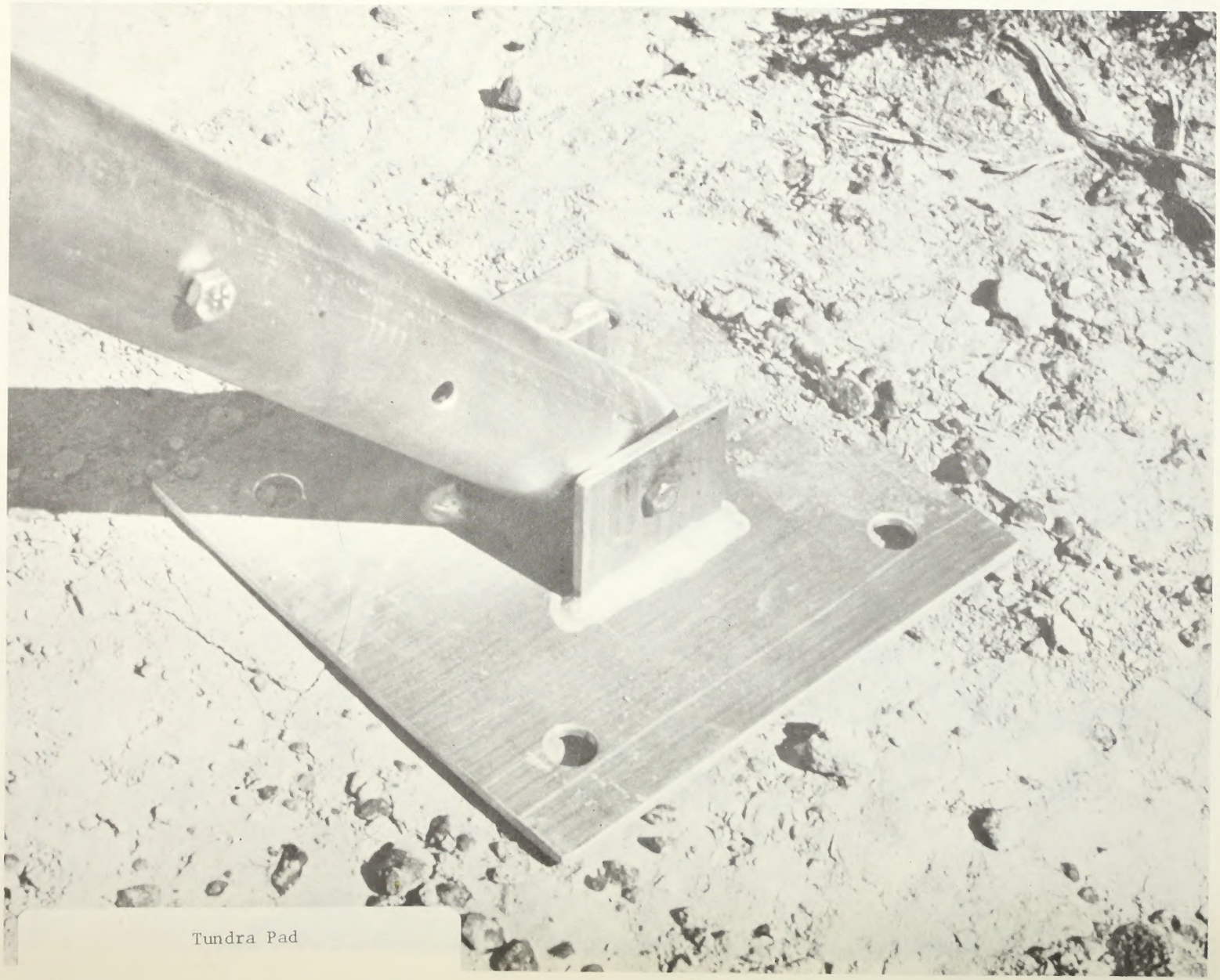
3.5 Watt Solar Panel



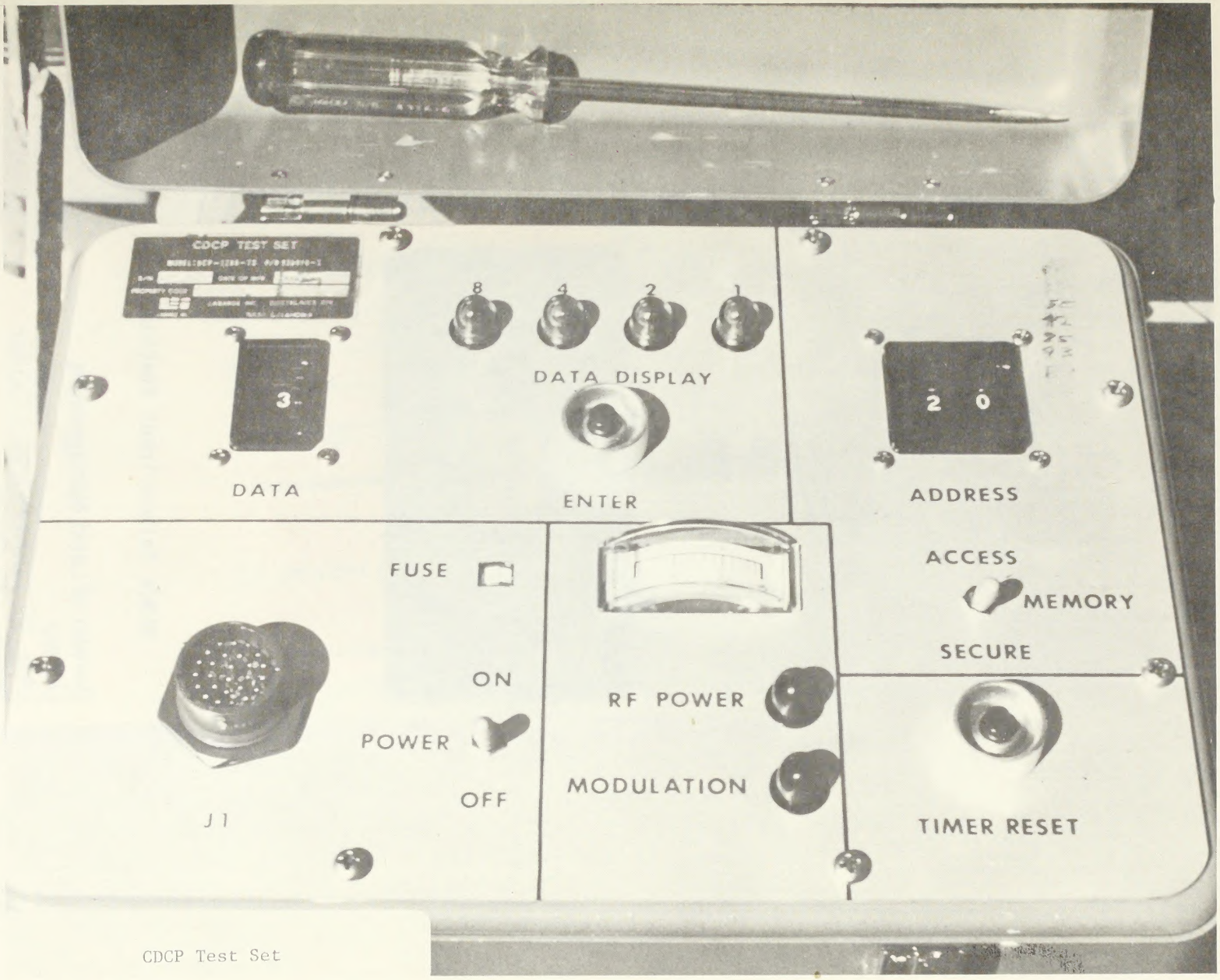
Solar Panel Mounted



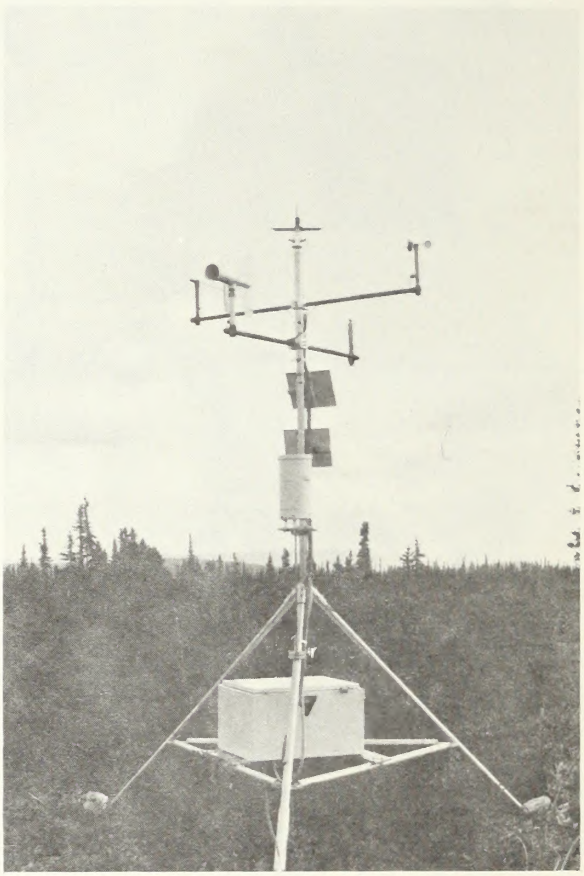
Thunder Scientific Temp-Humidity Sensor



Tundra Pad



CDCP Test Set



BLM's Salmon-Trout Station