

AD-A155 192 THE PROCESSING AND ANALYSIS OF THE DATA FROM AN AIR
FORCE GEOPHYSICS LABO. (U) LOWELL UNIV RESEARCH
FOUNDATION MA J E POWERS ET AL. 15 FEB 84
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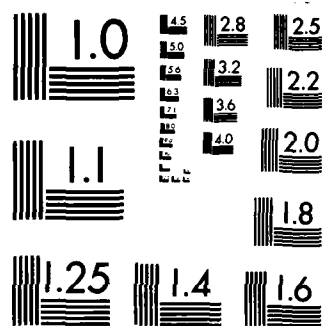
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AD-A155 192

THE PROCESSING AND ANALYSIS OF THE DATA FROM AN AIR FORCE GEOPHYSICS LABORATORY
ATMOSPHERIC OPTICAL MEASUREMENT STATION AND THE MAINTENANCE OF THE CENTRAL DATA
LOGGER SYSTEM

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Lowell, Massachusetts 01854

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AIR FORCE GEOPHYSICS LABORATORY
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
HANSCOM AFB, MASSACHUSETTS 01731

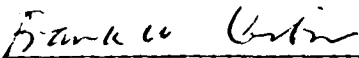
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This report describes the additional data processing programs that have been developed to edit, process, and analyze the digital data tapes generated at the U.S. Air Force Project GHAQUE Field Station in Meppen, Federal Republic of Germany. As a continuation of previous tasks that were reported in AFGL-TR-78-0176 and AFGL-TR-81-0130, the efforts described herein detail the processes and procedures developed to generate, maintain, reduce and analyze the large data base representing continuous measurements of atmospheric optical properties in the visible and infrared regions over the past thirty-three months.				
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INTRODUCTION

The objective of Project OPAQUE was to gather continuous data from a series of measurements in the visible and infrared regions over a period of several years. This requirement for the continuous data recording of the various experiments has resulted in a large data base that must be studied. Concurrent with the management of the data base was the requirement of maintaining the central data logger system and the changes to the control programs to accommodate the insertion and removal of the various measurement sensors at the West Germany field site.

This report describes all of the additional control programs and procedures that have been developed during this contract period to generate, edit, process, and analyze the digital data tapes during the Post-OPAQUE phase and is divided into two parts. Part I of this report describes the raw data tape analysis and cataloging procedures along with the sensor performance and analysis studies. Part II describes the additional programs that have been developed to produce data tapes containing selected sensor data, the generation of additional data tapes in the OPAQUE data bank format, and the additions to the data tape catalogues.

The program design objectives developed during previous efforts^{1,2} on this task have been retained and refined in the development of the additional programs described herein. The use of a standard control language in the program design has proven invaluable in that extensive modifications have been made to the program packages without a major rewrite of the programs. Extensive use was made of procedure files to link the necessary programs to perform specific tasks, and thereby simplify their use in the analysis and production of the various data files along with increasing the cost effectiveness of each computer job execution.

1. Powers, J.E., and Dirkman, R.J. (1978) The Development and Support of the NATO Project OPAQUE USAF System Control Programs, Final Report.
AFGL-TR-78-0176, ADA113105.
2. Powers, J.E., and Dirkman, R.J. (1980) The Reduction and Analysis of Raw Data Tapes from the AFGL Project Opaque Data Processor, Final Report,
AFGL-TR-81-0130, ADA127879.

PART I. RAW DATA TAPE PROCESSING PROCEDURES.

I.1 EXPERIMENT SAMPLING SEQUENCES

Due to the changing experimental requirements, the data channel assignments and sampling rates have undergone a number of revisions over the past three years. Table 1. The Data Channel Assignments, given below reflects the changes in the experimental data values sampled and recorded, along with the various sampling rates programmed for each data channel. It should be noted that the data channel numbers are in octal (base 8) which accounts for the fact that channels 8,9,18,19,28,29,38, and 39 do not appear in the table. Each data channel has two discrete digits assigned to it which are used to record filter positions, gain steps, etc. The unused discrete data digits on several of the data channels are used to record the digital output of the sun sensor, the digital rain gauge, and the ceiling meter. The mnemonics listed in the table are derived in most cases from the instrument names and are used to identify the data in the HISTOGRAM and DATA PROFILE plots.

Each data channel is formatted and recorded as a 36-bit string, grouped as 9 hexadecimal digits. The interpretation of these 36-bit strings is as follows:

BITS	INTERPRETATION
0-3	Always the coding for the data sync character, 1101
4-7	High-order analog channel address, octal.
8-11	Low-order analog channel address, octal.
12-15	Tens digit of discrete data channel, decimal.
16-19	Units digit of discrete data channel, decimal.
20-23	1000's digit of digitized channel voltage, decimal.
24-27	100's digit of digitized channel voltage, decimal.
28-31	10's digit of digitized channel voltage, decimal.
32-35	1's digit of digitized channel voltage, decimal.

TABLE 1. Data Logger Channel Assignments and Changes

Channel	Mnemonic	Sensor Output Sampled	Sampling Rate
0	AGE	AEG, trailer-side unit See NOTE 1	1 min-continuous.
1		Not used (formerly MRI1)	1 min-continuous.
1*	SNTL	Changed June, 1979 to Laser Scintillometer	1 min-continuous.
2		Not used (formerly MRI2)	1 min-continuous.
3		Not used (formerly MRI3)	1 min-continuous.
3*	SNTL	Changed January, 1979 to Laser Scintillometer	1 min-continuous.
3*		Changed June, 1979 to Not used	1 min-continuous.
3*	AGE2	Changed October, 1980 to AEG, 2 meter tower height	20 sec-continuous.
4	ITRO	Fltro, Horizontal path	1 min-continuous.
5	NPH1	Night Path Function Meter, Filter	1 min-continuous.
6	NPH2	Night Path Function Meter, Photopic	1 min-continuous.
7	NPH3	Night Path Function Meter, Range	1 min-continuous.
10		Not used	
11	VLR1	Variable Path Function Meter, Photopic	1 sec/10 min/hour.
12	VLP2	Variable Path Function Meter, Range	1 sec/10 min/hour.
13		Variable Path Function Meter, Range	1 sec/10 min/hour.
11*	AGE	Changed October, 1980 to AEG, 8 meter tower height	20 sec-continuous.
12*	AE16	Changed October, 1980 to AEG, 16 meter tower height	20 sec-continuous.
13*	AE48	Changed October, 1980 to AEG, 48 meter tower height	20 sec-continuous.

modifications to accommodate changes in the types and number of experimental sensors.

An interesting interpretation of these statistics is to view them as a learning curve of the personnel operating the field site at Meppen. After becoming familiar with the operational characteristics of a fully automated data logger, the yearly tape directories show extended periods of continuous operation broken by several half days of outages which suggests increasing operational familiarity and confidence. The use of design techniques that minimize operator intervention to a "reload and restarting of the system" significantly reduces accidental system interruptions and results in an operational procedure that can be taught very quickly to new operators of the system.

The increase of 'off-line' percentages in 1981 and 1982 could possibly be attributed to the operator's uncertainty as to how long the data tape would last, given the fact that as more of the higher sampling rate channels were deleted from operation, the recording time increased. Another factor in this time period was that the more experienced station operators were being replaced by new personnel who had to learn the characteristics of the system controller/data logger.

1.4 SENSOR PERFORMANCE LIBRARY.

While the information provided in a OPA/Meppen Raw Data Tape Directory can be used to determine whether the data logger was operational during a specific time period, it is not descriptive of the individual sensor performance. The Sensor Performance Library is maintained and formatted to provide this information on a yearly basis as the examples in Figures 1 and 2 demonstrate. The yearly directories provide a copy of the PFOFILE program output and the

I.3 DATA LOGGER SYSTEM PERFORMANCE.

Another use of the Raw Data Tape Directories is in determining the percentage of data logger system half-day 'off-line' time on a monthly or yearly basis. Viewed in this way, and using December, 1976 as the starting month for the OPAQUE measurement program, Table 10 below summarizes both monthly and yearly performance through the station close-down in April 1983.

Table 10. Percentage of OFF-LINE Time, Monthly and Yearly

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEARLY
1976	---	---	---	---	---	---	---	20.9	1.67	35.5	23.3	4.83	27.45
1977	46.7	10.7	19.4	8.33	1.61	6.67	12.9	9.67	10.0	16.1	0.00	8.06	12.6
1978	20.9	0.00	1.61	0.00	0.00	8.33	0.00	12.9	0.00	1.61	0.00	11.3	4.79
1979	6.45	0.00	0.00	11.7	6.45	8.33	0.00	0.00	6.67	14.5	0.00	1.61	4.66
1980	3.22	0.00	0.00	5.00	0.00	1.66	25.8	0.00	0.00	0.00	11.6	11.3	4.92
1981	1.61	12.5	51.6	0.00	4.80	10.0	25.8	0.00	15.0	0.00	11.6	4.80	11.48
1982	6.45	3.57	0.00	0.00	0.00	15.0	17.7	37.0	10.0	0.00	0.00	0.00	7.48
1983	0.00	1.78	0.00	0.00	System shut-down 10 April, 1983								

A detailed analysis of the data logger recording time on an hourly or minute basis can be carried out using the data tape timing information contained in the system file, TAPEFILE (the new raw data tape log file).

Considering the fact that the data logger system was operated continuously in an unattended mode, the yearly percentage of "down-time" is quite remarkable for the total period of operation given above. The majority of the daily outages can be attributed to losses of power at the field site and reaching an end of tape condition on the magnetic tape recorder. The remaining outages can be attributed to periods of hardware maintenance or system software and hardware

	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
1	444	444	446	446	448	448	450	450	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
2	444	444	446	446	448	448	450	450	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
3	444	444	446	446	448	448	450	450	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
4	444	445	446	446	448	448	450	450	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
5	445	445	446	446	448	448	450	450	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
6	445	445	446	446	448	448	450	450	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
7	445	445	446	446	448	448	450	450	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
8	445	445	446	446	448	448	450	450	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
9	445	445	446	446	448	448	450	450	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
10	445	445	447	447	448	448	450	450	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
11	445	445	447	447	448	448	450	450	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
12	445	445	447	447	448	448	450	450	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
13	445	445	447	447	448	448	450	450	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
14	445	445	447	447	448	448	450	450	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
15	445	445	447	447	449	449	450	450	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
16	445	445	447	447	449	449	450	450	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
17	445	445	447	447	449	449	450	450	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
18	445	445	447	447	449	449	450	450	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
19	445	445	447	447	449	449	450	450	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
20	445	445	447	447	449	449	450	450	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
21	446	446	447	447	449	449	450	450	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
22	446	446	447	447	449	449	450	450	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
23	446	446	447	447	449	449	450	450	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
24	446	446	447	447	449	449	450	450	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
25	446	446	447	447	449	449	450	450	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
26	446	446	447	447	449	449	450	450	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
27	446	446	447	447	449	449	450	450	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
28	446	446	448	448	449	449	450	450	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
29	446	446	0	0	449	449	0	0	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
30	446	446	0	0	449	449	0	0	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
31	446	446	0	0	450	450	0	0	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G

Table 9. OPA/Meppen Raw Data Tape Directory for 1983

	FEE		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
1	413	418	418	423	423	425	425	427	430	430	432	432	434	434	436	436	438	438	440	440	442	442
2	413	418	418	423	423	425	425	427	430	430	432	432	434	434	436	436	438	438	440	440	442	442
3	413	418	418	423	423	425	425	427	430	430	432	432	434	434	436	436	438	438	440	440	442	442
4	413	418	418	424	424	425	425	427	430	430	432	432	434	434	436	436	438	438	440	440	442	442
5	413	419	419	424	424	426	426	427	430	430	433	433	434	434	436	436	438	438	440	440	442	442
6	413	419	419	424	424	426	426	427	430	430	433	433	434	434	436	436	438	438	440	440	442	442
7	414	419	419	424	424	426	426	427	430	430	433	433	434	434	436	436	438	438	440	440	442	442
8	414	419	419	424	424	426	426	427	430	430	433	433	434	434	436	436	438	438	440	440	442	442
9	414	419	419	424	424	426	426	427	430	430	433	433	435	435	437	437	438	438	440	440	442	442
10	414	419	419	424	424	426	426	427	430	430	433	433	435	435	437	437	438	438	440	440	442	442
11	414	419	419	424	424	426	426	428	430	430	433	433	435	435	437	437	438	438	440	440	442	442
12	415	420	420	424	424	426	426	428	430	430	433	433	435	435	437	437	438	438	440	440	442	442
13	415	420	420	424	424	426	426	428	430	430	433	433	435	435	437	437	439	439	441	441	442	442
14	415	420	420	424	424	426	426	428	430	430	433	433	435	435	437	437	439	439	441	441	442	442
15	425	415	421	424	424	426	426	428	431	431	433	433	435	435	437	437	439	439	441	441	443	443
16	415	415	421	424	424	426	426	428	431	431	433	433	435	435	437	437	439	439	441	441	443	443
17	415	415	421	424	424	426	426	428	431	431	433	433	435	435	437	437	439	439	441	441	443	443
18	416	421	421	424	424	426	426	428	431	431	433	433	435	435	437	437	439	439	441	441	443	443
19	416	422	422	425	425	426	426	428	431	431	433	433	435	435	437	437	439	439	441	441	443	443
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22	416	422	422	425	425	427	427	428	431	431	434	434	436	436	437	437	439	439	441	441	443	443
23	0	422	422	425	425	427	427	428	431	431	434	434	436	436	438	438	439	439	441	441	443	443
24	0	422	422	425	425	427	427	428	431	431	434	434	436	436	438	438	439	439	441	441	443	443
25	417	422	422	425	425	427	427	428	431	431	434	434	436	436	438	438	439	439	441	441	443	443
26	417	423	423	425	425	427	427	429	431	431	434	434	436	436	438	438	439	439	442	442	443	443
27	417	423	423	425	425	427	427	429	431	431	434	434	436	436	438	438	439	439	442	442	443	443
28	417	423	423	425	425	427	427	430	430	430	434	434	436	436	438	438	440	440	442	442	443	443
29	417	423	423	425	425	427	427	430	430	430	434	434	436	436	438	438	440	440	442	442	443	443
30	417	423	423	425	425	427	427	430	430	432	434	434	436	436	438	438	440	440	442	442	444	444
31	417	423	423	425	425	427	427	430	430	432	434	434	436	436	438	438	440	440	442	442	444	444

Table 8. CFA/Meppen Raw Data Tape Directory for 1982

	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
1	360	360	364	364	C	C	373	373	378	378	381	C	384	384	390	390	396	396	401	401	406	406	410	410
2	360	360	365	365	C	C	373	373	378	378	0	0	385	385	390	390	396	396	401	401	406	406	410	410
3	360	360	365	365	C	369	373	373	378	378	382	382	385	385	390	390	0	0	401	401	407	407	410	410
4	360	360	365	365	365	0	373	373	378	378	382	382	385	385	390	390	397	397	401	401	407	407	411	411
5	361	361	365	365	0	0	373	373	0	0	382	382	385	385	390	390	397	397	401	401	407	407	411	411
6	361	361	365	365	0	0	373	373	0	379	382	382	385	385	391	391	397	397	402	402	407	407	411	411
7	361	361	365	365	0	0	374	374	379	379	382	382	385	385	391	391	397	397	402	402	407	407	411	411
8	361	361	365	365	0	0	374	374	379	379	382	382	386	386	391	391	397	397	402	402	407	407	411	411
9	361	361	366	366	0	0	374	374	379	379	383	383	386	386	391	391	397	397	402	402	407	407	411	411
10	361	361	366	366	370	370	374	374	379	379	383	383	386	386	391	391	398	398	402	402	407	407	411	411
11	361	361	366	366	370	370	374	374	379	379	383	383	0	0	391	391	398	398	402	402	407	407	411	411
12	361	0	366	366	370	370	374	374	380	380	383	383	0	0	391	392	0	0	403	403	407	407	411	411
13	362	263	266	266	370	370	375	375	380	380	383	383	0	387	392	392	0	0	403	403	407	407	411	0
14	362	362	366	366	370	370	375	375	380	380	383	383	387	387	392	392	399	399	403	403	407	407	412	412
15	362	362	366	366	370	370	375	375	380	380	383	383	387	387	392	392	399	399	403	403	408	408	412	412
16	362	362	366	367	371	371	375	375	380	380	383	383	387	387	392	392	399	399	404	404	408	408	412	412
17	362	362	367	367	371	371	375	375	380	380	383	383	387	387	392	392	399	399	404	404	408	408	412	412
18	362	362	367	367	0	0	375	375	380	380	384	384	387	387	393	393	399	399	404	404	408	408	412	412
19	363	363	367	367	0	0	376	376	380	380	384	384	388	388	393	393	399	399	404	404	408	408	412	412
20	363	363	367	367	0	0	376	376	380	380	384	384	388	388	393	393	0	0	404	404	408	408	412	412
21	363	363	367	367	0	0	376	376	380	380	384	384	388	388	393	393	400	400	404	404	408	408	412	412
22	363	363	367	367	0	0	376	376	380	380	384	384	0	0	393	393	400	400	405	405	409	409	413	413
23	363	363	367	367	0	0	376	376	380	380	384	384	0	0	393	393	400	400	405	405	409	409	413	413
24	363	363	0	368	0	0	377	377	380	380	384	384	0	0	394	394	400	400	405	405	409	409	413	413
24	363	363	368	368	0	0	377	377	380	380	384	384	0	0	394	394	400	400	405	405	409	409	413	413
26	364	364	0	0	372	372	377	377	380	380	384	384	0	0	394	394	400	400	405	405	409	409	413	413
27	364	364	0	0	372	372	377	377	381	381	384	384	389	389	394	394	400	400	405	405	409	409	413	413
28	364	364	0	0	372	372	377	377	381	381	384	384	389	389	394	395	400	400	406	406	0	0	413	413
29	364	364	0	0	372	372	377	377	381	381	384	384	389	389	395	395	400	400	406	406	0	0	413	413
30	364	364	0	0	372	372	377	377	381	381	384	384	389	389	395	395	401	401	406	406	0	0	413	413
31	364	364	0	0	372	372	378	378	381	381	384	384	389	389	395	395	401	401	406	406	0	0	413	413
31	364	364	0	0	372	372	0	0	381	381	0	0	390	390	395	395	0	0	406	406	0	0	413	413

Table 7. OPA/Neppen Raw Data Tape Directory for 1981

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
1	311	318	324	332	339	341	342	348	349	351	353	354
2	312	318	324	332	339	341	343	348	349	351	0	354
3	312	318	325	332	339	341	343	348	349	351	0	355
4	313	319	325	333	339	341	344	348	350	351	0	0
5	313	319	326	333	339	341	344	348	350	351	0	0
6	313	319	326	333	339	341	344	348	350	351	0	0
7	313	319	326	333	339	341	344	348	350	351	0	0
8	313	319	326	333	339	341	344	348	350	351	0	0
9	313	320	326	334	339	341	344	349	350	352	0	0
10	313	320	326	334	340	341	0	349	350	352	0	355
11	314	320	327	334	340	341	0	345	350	352	0	355
12	314	321	327	334	340	341	345	349	350	352	0	356
13	314	321	327	334	340	341	345	349	350	352	0	0
14	314	321	327	334	340	341	345	349	350	352	0	0
15	314	321	327	334	340	341	345	349	350	352	0	0
16	315	321	328	335	340	341	346	349	350	352	0	356
17	315	321	328	335	340	341	346	349	350	352	0	356
18	315	321	329	335	340	341	347	349	350	352	0	357
19	315	322	329	336	340	341	347	349	350	352	0	0
20	315	322	329	336	340	341	0	349	350	352	0	0
21	316	322	330	337	340	342	0	349	350	352	0	0
22	316	323	330	337	340	342	0	349	350	352	0	357
23	316	323	330	337	340	342	0	349	350	352	0	358
24	316	323	330	337	340	342	0	349	350	352	0	0
25	317	323	330	337	340	342	0	349	350	352	0	0
26	317	323	331	338	340	342	348	349	351	352	353	358
27	317	323	331	338	340	342	348	349	351	352	353	359
28	317	324	331	338	341	342	348	349	351	352	354	359
29	317	324	331	338	341	342	348	349	351	352	0	0
30	318	0	331	339	341	342	348	349	351	352	0	0
31	318	0	332	0	341	0	348	349	0	0	0	360

Table 6. OPA/Neppen Raw Data Tape Directory for 1980

	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
1	0	0	234	234	241	241	250	0	258	258	267	267	275	275	282	282	289	289	292	292	292	300	304	304
2	226	226	235	235	242	242	251	251	258	258	267	267	275	275	282	282	289	289	292	292	292	300	304	304
3	226	226	235	235	242	242	251	251	258	258	267	267	275	275	283	283	289	289	0	0	0	300	300	305
4	226	226	235	235	242	242	251	251	259	259	0	0	275	275	283	283	289	290	0	0	0	300	300	305
5	227	227	235	235	243	243	251	251	259	259	268	268	276	276	283	283	290	290	294	294	294	300	300	305
6	227	227	235	236	243	243	251	0	259	259	268	268	276	276	283	283	290	290	294	294	294	300	301	305
7	227	0	236	236	243	243	0	0	259	260	268	268	276	276	283	283	290	290	294	294	294	301	301	306
8	0	228	236	236	243	243	0	0	260	260	269	269	276	276	284	284	290	290	294	294	294	301	301	306
9	228	228	237	237	244	244	252	252	260	260	269	269	277	277	284	284	290	290	294	294	294	301	301	306
10	228	229	237	237	244	244	252	252	260	260	269	269	277	277	284	284	290	290	294	294	295	301	301	306
11	229	229	237	237	244	244	252	252	261	261	270	270	277	277	284	284	290	290	295	295	295	301	301	306
12	229	229	237	238	245	245	253	253	261	261	270	270	277	277	284	284	290	290	296	296	296	301	301	307
13	229	229	238	238	245	245	253	253	261	261	270	270	278	278	285	285	290	290	296	296	296	301	301	307
14	229	229	238	238	245	245	253	253	261	262	270	271	278	278	285	285	290	290	296	296	296	302	302	307
15	229	230	238	238	245	245	253	253	262	262	271	271	278	278	285	285	290	0	296	296	296	302	302	307
16	230	230	238	238	245	246	253	0	262	262	271	271	278	278	285	285	0	0	296	296	296	302	302	307
17	230	230	238	238	246	246	254	254	262	262	271	271	278	278	286	286	0	291	296	296	296	302	302	308
18	230	230	238	238	246	246	254	254	263	263	272	272	279	279	286	286	291	291	297	297	297	302	302	308
19	231	231	238	238	246	247	254	254	263	263	272	272	279	279	286	286	291	291	297	297	297	302	302	308
20	231	231	239	239	247	247	255	255	263	263	273	273	279	279	286	286	291	291	297	297	297	302	302	308
21	231	231	239	239	247	247	255	255	264	264	273	273	279	279	286	286	291	291	297	297	297	302	302	309
22	231	232	239	239	247	247	255	255	264	264	273	273	279	279	287	287	291	291	299	299	299	302	302	309
23	232	232	240	240	248	248	256	256	264	264	273	273	280	280	287	287	291	291	299	299	299	303	303	309
24	232	232	240	240	248	248	256	256	264	264	273	0	280	280	287	287	291	292	299	299	299	303	303	309
25	232	232	240	240	248	248	256	256	265	265	0	0	281	281	287	287	292	292	299	299	299	303	303	309
26	233	233	241	241	249	249	256	256	265	265	274	274	281	281	287	287	292	292	299	0	0	303	303	0
27	233	233	241	241	249	249	257	257	0	0	274	274	281	281	288	288	292	292	0	0	0	303	304	310
28	234	234	241	241	249	249	257	257	0	0	274	274	281	281	288	288	282	292	0	0	0	304	304	311
29	234	234	0	0	249	249	257	257	266	266	274	275	281	281	288	288	292	292	300	300	300	304	304	311
30	234	234	0	0	250	250	259	258	266	266	275	275	282	282	288	288	292	292	300	300	300	304	304	311
31	234	234	0	0	250	250	0	0	266	266	0	0	282	282	299	299	0	0	300	300	0	0	0	311

Table 5. OPA/Meppen Raw Data Tape Directory for 1979

	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
1	130	130	137	137	144	144	151	151	160	160	171	171	183	183	0	0	198	198	203	203	208	208	215	215
2	131	131	137	137	144	144	151	151	161	161	172	172	183	183	0	0	198	198	203	203	208	208	215	215
3	131	131	138	138	144	144	151	152	161	161	0	0	183	184	0	192	198	198	203	203	209	209	215	215
4	131	131	138	138	145	145	152	152	161	161	0	0	184	184	192	192	198	198	203	204	209	209	215	215
5	131	131	138	138	145	145	152	152	162	162	173	173	184	184	192	192	198	199	204	204	209	209	216	216
6	132	132	139	139	145	145	152	152	162	162	173	173	184	184	0	0	199	199	204	204	209	209	216	216
7	132	132	139	139	145	145	153	153	162	162	0	174	185	195	0	193	199	199	204	204	209	209	216	217
8	132	132	139	139	145	145	153	153	163	163	174	174	185	185	193	193	199	199	204	204	209	210	217	217
9	132	0	139	139	146	146	153	153	163	163	175	175	185	185	193	193	199	199	204	204	210	210	217	217
10	0	0	140	140	146	146	154	154	163	163	175	175	185	186	193	193	199	199	0	205	210	210	217	217
11	0	0	140	140	146	146	154	154	163	163	175	175	186	186	194	194	199	200	205	205	210	210	217	218
12	0	133	140	140	146	146	155	155	164	164	175	176	186	186	194	194	200	200	205	205	210	210	219	0
13	133	133	140	141	146	146	155	156	164	164	176	177	186	186	194	194	200	200	205	205	210	210	0	0
14	133	133	141	141	147	147	156	156	164	164	178	178	187	187	194	194	200	200	205	205	211	211	0	0
15	133	133	141	141	147	147	156	156	164	164	178	178	187	187	194	195	200	200	205	205	211	211	219	219
16	0	0	141	141	147	147	156	156	164	165	179	179	187	187	195	195	200	200	205	206	211	211	219	219
17	0	0	142	142	148	148	157	157	165	165	179	179	187	187	195	195	201	201	206	206	211	212	219	219
18	0	0	142	142	148	148	157	157	165	165	179	179	188	188	196	196	201	201	206	206	212	212	219	220
19	0	134	142	142	148	148	157	157	166	166	180	180	188	188	196	196	201	201	206	206	212	212	220	220
20	134	134	142	142	148	148	157	158	166	166	180	180	188	188	196	196	201	201	208	208	212	212	220	220
21	134	134	142	143	148	148	158	158	166	166	180	180	189	189	196	196	201	201	206	206	212	212	220	221
22	134	134	143	143	149	149	158	158	166	166	180	180	189	189	196	196	201	201	206	206	212	212	222	222
23	135	135	143	143	149	149	159	159	167	167	181	181	189	189	196	196	201	202	207	207	212	212	222	222
24	135	135	143	143	149	149	159	159	167	167	181	181	189	190	197	197	202	202	207	207	213	213	222	223
25	135	135	143	143	149	149	159	159	167	167	181	181	190	190	197	197	202	202	207	207	213	213	223	223
26	135	135	143	143	149	149	159	159	168	168	182	182	190	190	197	197	202	202	207	207	213	213	223	223
27	136	136	143	144	149	0	159	159	168	168	182	182	190	191	197	197	202	202	207	207	213	213	223	224
28	136	136	144	144	150	150	160	160	168	168	182	182	191	191	197	197	202	202	207	207	214	214	224	224
29	136	136	0	0	150	150	160	160	168	169	182	182	191	191	197	197	203	203	208	208	214	214	225	225
30	137	137	0	0	150	150	160	160	169	170	183	183	191	191	198	198	203	203	208	208	214	214	225	225
31	137	137	0	0	151	151	0	0	170	170	0	0	191	191	198	198	0	0	208	208	0	0	0	0

Table 4. OPA/Meppen Raw Data Tape Directory for 1978

	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
1	33	33	38	38	46	46	53	53	64	64	74	74	84	84	90	90	97	98	104	104	112	112	121	121
2	33	33	38	38	46	46	53	0	65	65	74	74	84	84	90	91	98	98	0	0	112	112	122	122
3	33	33	38	38	0	0	0	0	65	65	75	75	84	84	91	91	98	98	0	0	112	112	122	122
4	33	33	39	39	0	0	54	54	65	65	75	75	85	85	91	91	98	98	0	0	113	113	122	122
5	33	33	39	39	0	0	54	54	0	66	75	75	85	85	91	91	99	99	0	0	113	113	123	123
6	33	33	39	39	0	0	54	55	67	67	75	76	85	85	91	91	99	99	0	0	113	113	123	123
7	0	0	39	40	0	0	56	56	67	67	76	76	85	86	91	91	99	99	105	105	113	114	123	123
8	0	0	40	40	47	47	56	56	67	67	76	76	86	86	92	92	99	99	105	105	114	114	123	123
9	0	0	40	40	47	47	56	56	68	68	76	76	86	86	92	82	99	0	105	105	114	115	124	124
10	0	0	40	40	47	47	56	56	68	68	77	77	86	0	92	0	0	0	105	106	115	115	124	124
11	0	0	41	41	48	48	56	0	68	68	0	0	0	0	92	92	0	0	106	106	116	116	124	124
12	0	0	41	41	48	48	57	57	68	69	0	0	0	0	92	0	0	100	106	106	116	116	124	125
13	0	0	41	41	48	48	57	57	69	69	78	78	0	87	0	0	100	100	106	106	116	116	125	125
14	0	0	41	41	48	48	57	58	69	69	78	78	87	87	0	0	100	100	107	107	117	117	125	125
15	0	0	42	42	48	0	59	59	69	69	79	79	87	0	93	93	100	101	107	107	117	117	125	125
16	0	0	42	42	49	49	59	59	69	70	80	80	0	88	93	93	101	101	107	107	117	117	126	126
17	0	0	42	42	49	49	59	59	70	70	80	80	88	88	93	93	101	101	108	108	117	117	126	126
18	0	0	0	0	50	50	59	60	70	70	80	80	88	88	93	93	101	101	108	108	118	118	126	126
19	0	0	0	0	50	50	60	60	70	70	80	80	88	88	94	94	101	101	108	108	118	118	126	127
20	0	0	0	0	50	50	60	60	71	71	81	81	88	88	94	94	101	101	108	109	118	118	127	127
21	0	35	44	44	50	0	60	60	71	71	81	81	89	89	0	95	101	101	109	109	119	119	127	127
22	35	35	44	44	51	51	61	61	71	71	81	81	89	89	95	95	101	101	109	109	119	119	127	127
23	35	35	44	44	51	51	61	61	72	72	81	81	89	89	95	95	102	102	109	109	119	119	128	128
24	35	35	44	44	51	51	61	61	72	72	82	82	89	89	95	95	102	102	109	110	119	119	128	0
25	35	36	45	45	52	52	61	62	72	72	82	82	89	89	96	92	102	102	110	110	120	120	0	0
26	36	36	45	45	52	52	62	62	72	72	82	82	89	89	96	96	102	102	110	110	120	120	0	0
27	36	36	45	45	52	52	0	63	73	73	83	83	90	90	96	96	103	103	110	110	120	120	129	129
28	36	37	46	46	52	52	63	63	73	73	83	83	90	90	96	96	103	103	111	111	120	120	129	129
29	37	37	0	0	53	53	64	64	73	73	83	83	90	90	96	97	104	104	111	111	121	121	129	129
30	37	37	0	0	53	53	64	64	73	73	83	83	90	90	97	97	104	104	111	111	121	121	130	130
31	37	38	0	0	53	53	0	0	74	74	0	0	90	90	97	97	0	0	111	111	0	0	130	130

Table 3. OPA/Meppen Raw Data Tape Directory for 1977

	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	19	22	22	26	26	30	30
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	19	22	22	26	26	30	30
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	19	22	22	26	26	30	30
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	14	19	22	23	26	26	30	30
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	15	19	23	24	26	26	30	30
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	16	19	24	24	26	26	30	30
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	16	19	24	24	26	26	30	30
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	16	19	24	24	27	27	30	30
9	0	0	0	0	0	0	0	0	0	0	0	9	9	16	16	19	19	24	24	27	27	30	30	
10	0	0	0	0	0	0	0	0	0	0	0	9	9	16	16	19	20	24	24	27	27	31	31	
11	0	0	0	0	0	0	0	0	0	0	0	9	9	16	16	20	20	24	24	27	27	31	31	
12	0	0	0	0	0	0	0	0	0	0	0	0	0	16	16	20	20	24	24	27	27	31	31	
13	0	0	0	0	0	0	0	0	0	0	0	0	0	17	17	20	20	24	24	27	27	31	31	
14	0	0	0	0	0	0	0	0	0	0	0	0	0	17	17	20	20	24	24	27	27	31	31	
15	0	0	0	0	0	0	0	0	0	0	0	0	0	17	17	20	20	24	24	27	27	31	31	
16	0	0	0	0	0	0	0	0	0	0	0	0	0	17	17	20	20	24	24	27	27	0	0	
17	0	0	0	0	0	0	0	0	0	0	0	0	0	17	17	21	21	0	0	0	0	32	32	
18	0	0	0	0	0	0	0	0	0	0	0	0	0	17	17	21	21	0	0	0	0	32	32	
19	0	0	0	0	0	0	0	0	0	0	0	0	0	17	17	21	21	0	0	0	0	32	32	
20	0	0	0	0	0	0	0	0	0	0	0	0	0	19	19	21	21	0	0	0	0	32	32	
21	0	0	0	0	0	0	0	0	0	0	0	0	0	18	18	21	21	0	0	0	0	32	32	
22	0	0	0	0	0	0	0	0	0	0	0	10	10	18	18	21	21	0	0	0	0	32	32	
23	0	0	0	0	0	0	0	0	0	0	0	10	10	18	18	21	21	0	0	0	29	29	32	
24	0	0	0	0	0	0	0	0	0	0	0	10	10	18	18	21	21	0	0	0	29	29	32	
25	0	0	0	0	0	0	0	0	0	0	0	10	10	18	18	21	21	0	0	0	29	29	32	
26	0	0	0	0	0	0	0	0	0	0	0	0	0	18	18	21	21	0	26	26	29	29	32	
27	0	0	0	0	0	0	0	0	0	0	0	0	0	18	0	21	21	26	26	29	29	33	33	
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	26	26	29	29	33	33	
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	26	26	30	30	33	33	
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	26	26	30	30	33	33	
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	0	0	26	26	0	0	0	33	

Table 2. OPA/Meppen Raw Data Tape Directory for 1976

high sample rate channels, the data tape can last beyond 20 days, depending on the data channels disabled. Prior to 1980, the disabling of the sampling of the Scanning Nephelometer (data channels sampled every second for thirty minutes on alternate hours) is clearly visible in the tape "life" starting in June, 1977. The changing of the Luxmeter sampling from every 4 seconds, continuously to a sampling rate of once a minute, continuous, is evident in April, 1980 and later. The progressively long tape life through the years 1980, 1981, and 1982 and 1983 is due to the disabling of inactive data channels by the station operator as various instruments were removed from service.

1.2 OPAQUE RAW DATA TAPE LIBRARY.

As the raw data tapes are received by the University of Lowell research team, they are cataloged manually in the tape log and entered into the system file, TAPEFILE, giving the starting and ending day-of-year, hour, and minute for each continuous data recording. Currently there are 450 raw data tapes cataloged, a data base representing seven years of essentially continuous OPAQUE measurements. The need for maintaining this raw tape data base has been demonstrated many times where the raw tape must be rerun to create new working files to replace those lost due to tape mounting problems, or computer system errors.

To assist in locating the raw data tape(s) for a given period of time, or to determine if any data was recorded for any period of interest, the programs MEPPEN6, MEPPEN7, MEPPEN8, MEPPEN9, MEPPEN0, MEPPEN1, MEPPEN2, and MEPPEN have been designed to produce the Raw Data Tape Directories given in Tables 2, 3, 4, 5, 6, 7, 8, and 9. They are formatted on a calendar year basis with the month-of-year along the abscissa and the day-of-month along the ordinate. The day-of-month is divided into two twelve hour periods as A.M. (00:00 to 11:59 hours) and P.M. (12:00 to 23:59 Hours). The values in the columns headed AM and PM are the labels of the data tapes that contain the data for those half-day periods. The value 0 represents either the case that no data was recorded for that twelve hour period or that the month does not contain 31 days.

A careful review of these figures reveals that a given tape may contain a large number of data half-days, while others are in use only for a few half-days. This discrepancy is due to the fact that the data logger samples the data channels with different sampling rates. If a large number of one second or four second data channels are sampled and recorded, the data tape lasts for two or three days. If the station operator disables some of these

36	EPL1	Eppley Pyroheliometer, Filter	1 min-continuous.
37	EPL2	Eppley Pyroheliometer, Direct See NOTE 3	1 min-continuous.
36*	ELP2	Changed April, 1980 to Eppley Pyroheliometer, Direct	1 min-continuous.
37*	SNTM	Changed April, 1980 to Scintillometer, d.c. monitor See NOTE 3	1 min-continuous.

NOTES:

1. Digital ceilometer is recorded on the discrete digits of channel 0 as:
Discrete "tens" = hundreds of ceiling meters.
Discrete "units" = tens of ceiling meters.
Installed October, 1980. Operational since March, 1981.
2. Digital rain gauge is recorded on the discrete digits of channels 16 and 17 as :
Discrete "units" of channel 17 = 100's rain count.
Discrete "tens" of channel 16 = 10's rain count.
Discrete "units" of channel 16 = units rain count.
These "counts" are multiplied by 25.0 millivolts to allow their display in the PROFILE AND HISTOGRAM PLOTS as a voltage. The count range is 0 to 999.
Operational since December, 1978.
3. Digital sun sensor is recorded on the "tens" digit of channel 37 as:
If discrete "tens" digit = 2 or 3, the sun is shining.
If discrete "tens" digit = 0 or 1, no sun (cloudy or dark).
Operational since June, 1979.
4. As various instruments were removed from service, the Station Operators were able to delete the sampling of the data channels assigned to those instruments, which is reflected in the extended recording time intervals of the raw data tapes.
5. Data channel numbers designated by the character indicate sensor assignments at the field site.

14	LSR1	CO2 Laser, PAR Output	1 min-continuous.
15	LSR2	CO2 Laser, Power Output	1 min-continuous.
16	LSR3	CO2 Laser, Angle Output See NOTE 2	1 min-continuous.
17	LSR4	CO2 Laser, Gain Output See NOTE 2	1 min-continuous.
20	TURB	Turbulence on 500M Barnes	1 min-continuous.
21	BRN1	Barnes 500M Transmitter	1 min-continuous.
22	BRN2	Barnes 1500M Transmissometer	1 min-continuous.
23	RAIN	Analog Rain Gauge	1 min-continuous.
24	ILM1	Luxmeter, Horizontal Channel	4 sec-continuous.
25	ILM2	Luxmeter, Vertical Channel	4 sec-continuous.
26	ILM3	Luxmeter, Azimuth	4 sec-continuous.
24*	ILM1	Changed April, 1980 to Luxmeter, Horizontal Channel	1 min-continuous.
25*	AE80	Changed October, 1980 to AEG, 80 meter tower height	20 sec-continuous.
26*	LTR1	Changed October, 1980 to Eltro, Slant path	1 min-continuous.
27	DROP	Not used on the data logger but used in the DATA PROFILE and HISTOGRAM PROFILE plots to report the digital rain gauge effective February, 1979.	
30		Not used	
30*	A-D	Changed August, 1978 to A/D Reference Channel	1 min-continuous.
31	NEP1	Scanning Nephelometer, Angle	1 sec/30/ min/odd hr.
32	NEP2	Scanning Nephelometer, Scale	1 sec/30 min/odd hr.
33	NEP3	Scanning Nephelometer, Photo	1 sec/30 min/odd hr.
34	NEP4	Scanning Nephelometer, Monitor	1 sec/30 min/odd hr.
35		Not used	

HISTOGRAM program output for each raw data tape. Providing this information on a per tape basis yields an estimate of all sensor performances on essentially one hour intervals for most data tapes. It should be noted that these programs normally scan the raw data tape to determine the start and finish times of the recording period, which is not constant as can be seen in Tables 7 through 9. The complete Sensor Performance Directories for the years 1977, 1978, 1979, 1980, 1981, and 1982 have been provided under separate cover.

The DATA PROFILE Tape Directories display all of the active data sensors sampled using the mnemonic designators listed in Section I.1 along the ordinate and the time of day along the abscissa. The directory also gives the starting and ending time of the raw data tape, along with the total number of minutes of recorded data and the number of minutes represented by each abscissa time division. The data designators, A-U and \$ or *, represent the average value of the channel sensor taken over the abscissa time division interval. In reading the directories, one can determine very quickly the average performance of a given sensor by noting if the data designator * (over-range, usually interpreted as meaning the channel is not active) or \$ (meaning the data value is negative and not useable) is displayed over any portion of the plot. Use of these plots is in millivolts and reflect the discrete nature of the analog-to-digital voltage conversion which has a resolution of 2.5 millivolts per count.

A (0- 247)	B (250- 497)	C (500- 747)	D (750- 997)
E (1000-1247)	F (1250-1497)	G (1500-1747)	H (1750-1997)
I (2000-2247)	J (2250-2497)	K (2500-2747)	L (2750-2997)
M (3000-3247)	N (3250-3497)	O (3500-3747)	P (3750-3997)
Q (4000-4247)	R (4250-4497)	S (4500-4747)	T (4750-4997)
U (5000)	* (- 5000)	\$ (negative)	

The HISTOGRAM PROFILE Directories display all of the active data sensors using the mnemonics listed in Section I.1 along the ordinate and the raw data sensor voltage range, (-5 volts to +5 volts), along the abscissa. The information displayed is generated during the execution of the control program AUTHOEX, which also produces the DATA PROFILE plots. Whereas the DATA PROFILE plots average the channel voltage values over the designated time division interval of the plot, the HISTOGRAM PROFILE plots count the total number of data channel values that fall within each 100 millivolt increment to generate the histograms. While the total presentation in the HISTOGRAM PROFILE plot is essentially a "top-down" view of each of the individual data channel histograms, the detail given for each data channel allows a rapid determination of normal or abnormal activity of the experimental sensor assigned to that channel. The right-most column in the plot gives the total number of data points counted per channel over the duration of the raw data tape. A comparison of the total number of minutes (at the top of the plot) with the total number of data points counted on a data channel known to be sampled at one minute intervals does reveal some discrepancies in the the total "run" time of the raw data tape may be larger. This is due to the fact that the total run time is calculated from the start and stop times of the raw data tape and if out of range "time tags" are detected during the processing, the data samples associated with those "bad" times are collected and displayed in the last line of the plot labeled as 0038-00. This line also contains all of the one minute sample points taken on channels 31, 32, 33, and 34 that are not displayed in the HISTOGRAM (and the PROFILE plot also) plot in order to keep the plot on one computer printer page (usually 66 lines).

US JPLA PROFILE	FROM	TO	DATE	TIME	TOTAL MIN	3102
AD-00	+	+	+	+	+	3110
AD-01	+	+	+	+	+	3110
AD-02	+	+	+	+	+	3110
AD-03	+	+	+	+	+	2994
AD-04	+	+	+	+	+	116
AD-05	+	+	+	+	+	3110
AD-06	+	+	+	+	+	3110
AD-07	+	+	+	+	+	3092
AD-08	+	+	+	+	+	3092
AD-09	+	+	+	+	+	3110
AD-10	+	+	+	+	+	3110
AD-11	+	+	+	+	+	3110
AD-12	+	+	+	+	+	780
AD-13	+	+	+	+	+	775
AD-14	+	+	+	+	+	778
AD-15	+	+	+	+	+	777
AD-16	+	+	+	+	+	778
AD-17	+	+	+	+	+	776
AD-18	+	+	+	+	+	778
AD-19	+	+	+	+	+	776
AD-20	+	+	+	+	+	772
AD-21	+	+	+	+	+	789
AD-22	+	+	+	+	+	773
AD-23	+	+	+	+	+	3110
AD-24	+	+	+	+	+	3
AD-25	+	+	+	+	+	4455
AD-26	+	+	+	+	+	1831
AD-27	+	+	+	+	+	6289
AD-28	+	+	+	+	+	6289
AD-29	+	+	+	+	+	3110
AD-30	+	+	+	+	+	5
AD-31	+	+	+	+	+	184
AD-32	+	+	+	+	+	579
AD-33	+	+	+	+	+	1432
AD-34	+	+	+	+	+	2534
AD-35	+	+	+	+	+	4714
AD-36	+	+	+	+	+	4714
AD-37	+	+	+	+	+	5
AD-38	+	+	+	+	+	346
AD-39	+	+	+	+	+	344
AD-40	+	+	+	+	+	346
AD-41	+	+	+	+	+	343
AD-42	+	+	+	+	+	344
AD-43	+	+	+	+	+	346
AD-44	+	+	+	+	+	344
AD-45	+	+	+	+	+	345
AD-46	+	+	+	+	+	3
AD-47	+	+	+	+	+	3107
AD-48	+	+	+	+	+	324
AD-49	+	+	+	+	+	3107
AD-50	+	+	+	+	+	3107

Figure 1. Data from the JPLA profile.
 (The letters or numbers indicate the percentage of measurements in a given interval - see page 23.)

The HISTOGRAM PROFILE designator scale used in these plots is listed below. The numerical values assigned each designator are percentages of the total number of data points listed at the right side of the plot for each sensor.

- (0 - 4%)	A (5- 9%)	1 (10 - 14%)	B (15 - 19%)
2 (20 - 24%)	C (25 - 29%)	3 (30 - 34%)	D (35 - 39%)
4 (40 - 44%)	E (45 - 49%)	5 (50 - 54%)	F (55 - 59%)
6 (60 - 64%)	G (65 - 69%)	7 (70 - 74%)	H (75 - 79%)
8 (80 - 84%)	I (85 - 89%)	9 (90 - 94%)	J (95 - 99%)
* (100%)			

1.5 STRIPPED DATA TAPE PROCESSING MODIFICATIONS.

An expansion to the COMMAND-language of the minute-file stripping program (FSTRIPPER) was implemented in August, 1982. The new commands NEXTFIND, NEXTCLAW, and AUTOCLAW permit more efficient interactive and batch operation than repeated use of the older FINDTIME-CLAW sequence of commands. The older commands were restricted to a format requiring parameters which specify the beginning search-time, and in the case of CLAW, and end-time as well. The new commands do not use parameters.

"Old-command" formats

FINDTIME ,d,h,m,s

CLAW,db,hb,mb,de,he,me

"New-command" formats

NEXTFIND

NEXTCLAW

AUTOCLAW

When using the new commands, search begins at the current pointer-position as determined by the history of commands which have already been issued. To get started, at least one of the "old" FINDBLOCK-FINDTIME command sequences must be issued to position the pointer. After this, any of the new commands can be issued.

<u>"Old-style" clawing</u>	<u>"New-style" clawing"</u>	<u>"New" AUTOCLAW</u>
FINDBLOCK,d,h,m,s	FINDBLOCK,d,h,m,s	FINDBLOCK,d,h,m,s
FINDTIME,d,h,m,s	FINDTIME,d,h,m,s	FINDTIME,d,h,m,s
CLAW,dh,hb,mb,d2,h2,m2	NEXT CLAW	AUTOCLAW
FINDTIME,d2,h2,m2,s2	NEXTFIND	
CLAW,d2,h2,m2,d3,h3,m3	NEXTCLAW	
FINDTIME,d3,m3,h3,m3	NEXTFIND	
CLAW,d3,h3,m3,d4,h4,m4	NEXTCLAW	
etc.	etc.	

The AUTOCLAW-command effectively creates a sequence of NEXTFIND AND NEXTCLAW commands to strip an entire minute-month.

1.6 STRIPPED DATA TAPE DIRECTORY.

The execution of the procedure files with the raw data tapes produce output files that consist of formatted data samples stored as half-day records for a whole month of data. These stripped data files are then stored on magnetic tape, packed three months to a tape. This stripped data base is stored on magnetic tapes issued, cataloged, and stored at the A.F.G.L. Computer Center. Table 11, the Computer Center (CC) Stripped Data Tape Directory, lists all of the active CC tapes by tape number and the data interval represented.

Table 11. Computer Center (CC) Stripped Data Tape Directory

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1977	2501	2501	3213	3213	3213	3325	3325	3325	2726	2726	2726	2842
1978	2842	2720	2720	2720	0766	0766	0766	1442	1442	1442	1417	1417
1979	1417	0003	0003	003	0009	0009	0009	3885	3885	3885	3908	3908
1980	3908	3960	3960	3960	4518	4518	4518	2904	2904	2904	0353	0353
1981	0353	2943	2943	2943	3218	3218	3218	4444	4444	4444	4488	4488
1982	4488	3912	3912	3912	4197	4197	4197	3542	3542	3542	4724	4734
1983	4734	2474	2474	System shut down 10 April, 1983								

Due to the time and effort required in generating the stripped data tapes, and the possibilities for program or human error in processing the data tape has been provided by the University of Lowell contractor. Table 12, the Backup (OPA) Stripped Data Tape Directory, lists all of the active backup tapes by tape number and the data interval represented.

Table 12. Backup (OPA) Stripped Data Tape Directory

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1977	971	971	951	951	951	955	955	955	956	956	956	954
1978	954	957	957	957	958	958	958	959	959	959	960	960
1979	960	961	961	961	962	962	962	963	963	963	964	964
1980	964	965	965	965	967	967	967	970	970	970	925	925
1981	925	926	926	926	927	927	927	922	922	922	991	991
1982	991	924	924	924	975	975	975	980	980	980	977	977T
1983	977	979	979	System shut down 10 April 1983								

All raw data tapes received through 15 April, 1983 have been stripped and catalogued.

PART II. DATA FORMATTING AND OUTPUT PROGRAMS.

II.1 CO2 LASER COMPRESSED TIME PLOTTING PROGRAM.

The CO2 laser software package developed under Contract F19628-78-C-0186 Powers and Dirkman (1980) processes the laser data at all scan angles, rather than at fixed angle. Due to the extended time periods of potentially useful data, a fixed angle plot is more useful in determining those periods where a detailed analysis would be required. The program FASTPLT was developed for this purpose and is described below.

The procedure FASTPLT is contained in the permanent file:

LASERPROCFILEXC3664

FASTPLT will generate compressed time plots (approximately one page per four-day period) for a portion or the whole of the stripped minute channel file (about one month). The begin time and end time are parameters, as well as the laser scattering angle. All points plotted by this procedure are associated with this selected scattering angle. All points outside a four degree window centered at this angle will be ignored. On the plot, Figure 3, the PAR (CH. 14), the AEG (CH.0), and the ELTRO (CH.4) are displayed. Table 13 presents corresponding data in tabular form for the following parameters:

CH. 0 AEG
4 ELTRO
14 PAR
15 METER
16 ANGLE
17 GAIN

The commands necessary to generate a compressed plot are:

ATTACH,LPF,LASERPROCFILESX3664,ID=LOWELL,MR=1.

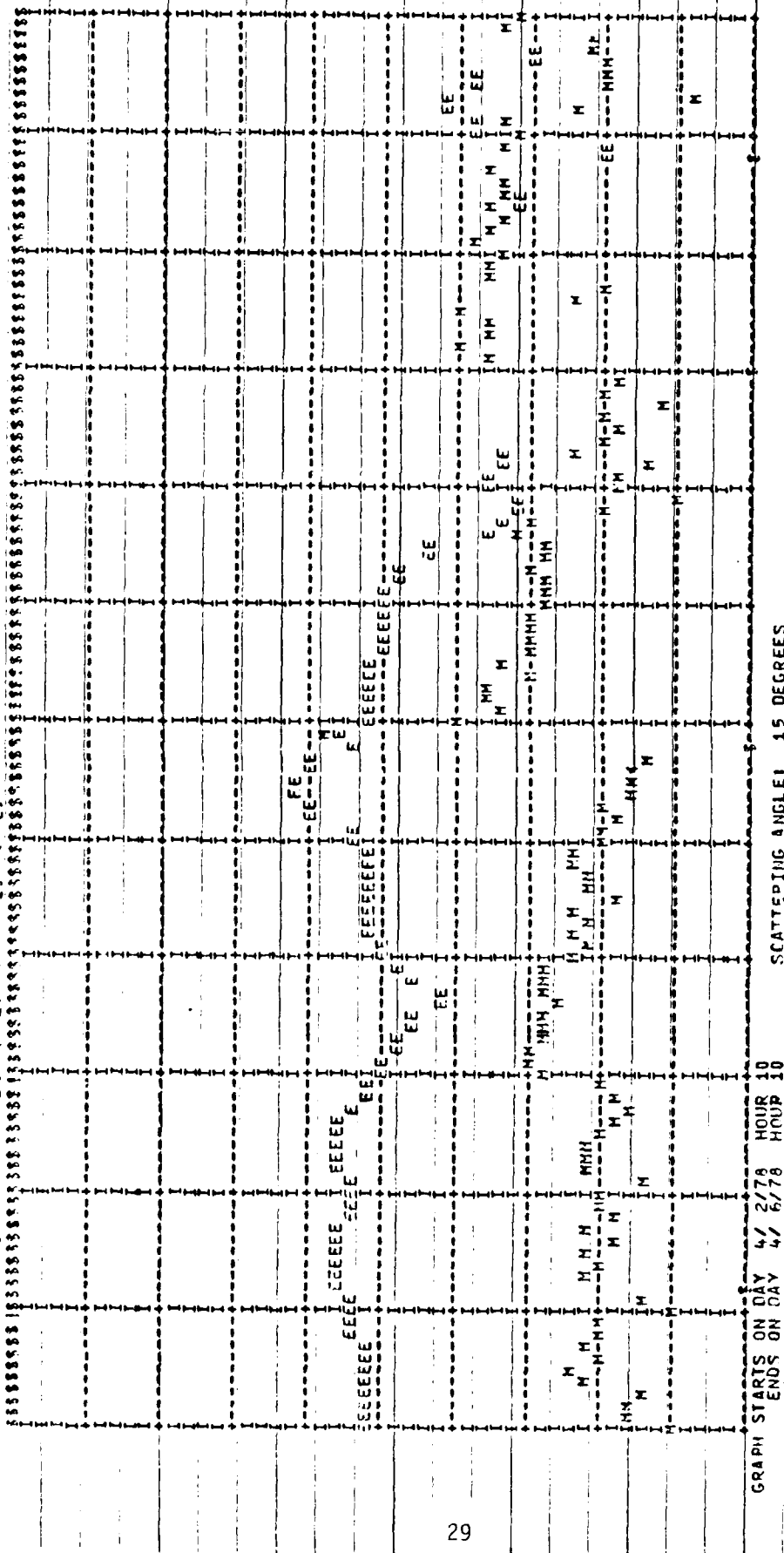
BEGIN,FASTPLT,LPF,month,db,hb,mb,de,he,me,calpackage,year,angle.

Table 13

10-23620.	-1.349	1.455	21.5	500000.	0.517	-2351	121.	5.27.
10-23650.	-9.932	1.388	21.9	500000.	0.333	-2352	120.	16.51.
10-23680.	-10.346	1.378	21.1	500000.	0.333	-2537	120.	17.4.
10-23710.	-8.470	1.386	21.1	500000.	0.333	-2245	120.	18.23.
10-23740.	-9.950	1.374	21.6	500000.	0.333	-2121	121.	18.44.
10-23770.	-9.668	1.451	21.6	500000.	0.333	-1076	120.	20.5.
10-23800.	-1.389	1.450	22.0	500000.	0.453	-1121	120.	20.17.
10-23830.	-8.915	1.510	20.3	500000.	0.247	-0374	120.	21.42.
10-23860.	-10.400	1.510	20.4	500000.	0.247	-0322	120.	21.54.
10-23890.	-1.329	1.515	21.6	500000.	0.315	0.077	120.	23.19.
10-23920.		1.505	24.2	500000.	0.315	6.000	120.	23.30.
10-23950.	-10.244	1.495	22.9	500000.	0.273	-0518	121.	0.55.
10-23980.	-9.463	1.495	29.7	500000.	0.273	-0777	121.	1.7.
10-24010.	-1.425	1.539	31.4	500000.	0.183	-1285	121.	2.32.
10-24040.	-7.705	1.539	28.1	500000.	0.183	-1424	121.	2.44.
10-24070.	-10.022	1.554	30.8	500000.	0.2167	-1424	121.	4.9.
10-24100.	-9.793	1.549	28.6	500000.	0.2167	-0873	121.	4.21.
10-24130.	-9.933	1.539	28.3	500000.	0.1917	-1018	121.	5.46.
10-24160.	-8.914	1.544	29.4	500000.	0.1917	-1018	121.	5.58.
10-24190.	-1.753	1.584	29.9	500000.	0.1917	-1828	121.	7.23.
10-24220.	-10.050	1.584	29.6	500000.	0.1917	-1653	121.	7.35.
10-24250.	-10.170	1.549	30.0	500000.	0.1917	-0763	121.	9.6.
10-24280.	-1.061	1.544	30.6	500000.	0.1917	-0612	121.	9.12.
10-24310.	-9.781	1.535	28.9	500000.	0.1633	-0572	121.	10.36.
10-24340.		1.530	31.4	500000.	0.1633	-0479	121.	10.49.
10-24370.	-10.952	1.480	28.2	500000.	0.0550	-2394	121.	12.13.
10-24400.	-9.379	1.475	23.8	500000.	-0.0300	-2394	121.	12.25.
10-24430.	-9.986	1.431	28.8	500000.	-0.3700	-3355	121.	13.50.
10-24460.	-9.472	1.431	30.2	500000.	-0.0783	-3423	121.	14.2.
10-24490.	-9.855	1.401	29.4	500000.	-0.2867	-7783	121.	15.27.
10-24520.		1.406	29.9	500000.	-0.2867	-7400	121.	15.39.
10-24550.	-1.171	1.381	29.8	500000.	-0.2867	-7400	121.	17.4.
10-24580.	-9.290	1.386	20.6	500000.	-0.2883	-7783	121.	17.16.
10-24610.	-8.160	1.401	31.0	500000.	-0.2217	-6236	121.	18.41.
10-24640.	-9.438	1.406	29.4	500000.	-0.2051	-6164	121.	18.53.
10-24670.	-9.632	1.391	31.2	500000.	-0.3957	-4719	121.	20.18.
10-24700.	-8.460	1.386	29.1	500000.	-0.0333	1.3208	121.	20.30.
10-24730.	-8.666	1.421	30.8	500000.	-0.0733	-4934	121.	21.55.
10-24760.	-9.522	1.436	29.4	500000.	-0.0733	-5236	121.	22.6.
10-24790.	-16.014	1.491	30.1	500000.	-0.0733	-5186	121.	23.31.
10-24820.	-1.289	1.505	30.2	500000.	-0.0733	-5154	121.	23.43.
10-24850.	-13.190	1.544	29.4	500000.	-0.0733	-3515	122.	1.8.
10-24880.	-1.535	1.544	29.8	500000.	-0.0733	-3469	122.	1.20.
10-24910.	-10.975	1.530	29.8	500000.	0.0300	-2642	122.	2.45.
10-24940.	-9.277	1.530	30.9	500000.	0.0300	-2883	122.	2.57.
10-24970.	-9.546	1.619	28.3	500000.	-0.2667	-1.0027	122.	9.18.
10-25000.	-7.752	1.614	31.2	1000000.	-0.2667	-0960	122.	9.37.
10-25030.	-8.652	1.589	23.6	500000.	-0.3333	-1190	122.	11.2.
10-25060.	-3.356	1.589	29.9	250000.	-0.3333	-1195	122.	11.14.
10-25090.	-5.423	1.549	29.8	500000.	-0.3333	-1285	122.	12.39.
10-25120.	-8.619	1.531	29.8	500000.	-0.3333	-1408	122.	12.51.
10-25150.	-8.572	1.530	28.8	500000.	-0.4350	0.433	122.	14.16.
10-25180.	-8.282	1.530	28.9	250000.	-0.4233	7.934	122.	14.28.
10-25210.	-8.311	1.564	29.6	500000.	-0.4703	-5525	122.	15.58.
10-25240.	-8.220	1.564	31.2	250000.	-0.4703	-5421	122.	16.10.
10-25270.	-8.255	1.579	28.3	250000.	-0.5150	-5778	122.	17.35.
10-25300.	-8.227	1.584	31.0	250000.	-0.5333	-5967	122.	17.47.
10-25330.	-8.473	1.624	28.5	500000.	-0.5450	-6369	122.	19.12.
10-25360.	-8.464	1.634	30.7	500000.	-0.5450	-6327	122.	19.24.
10-25390.	-8.480	1.658	28.5	500000.	-0.5400	-6245	122.	20.50.
10-25420.	-8.671	1.658	30.1	500000.	-0.5100	-6327	122.	21.2.

PLOT SUPPRESSED FOR CHANNEL 17
PLOT SUPPRESSED FOR CHANNEL 15
PLOT SUPPRESSED FOR CHANNEL 16

CHANNEL 14 (M) LOG SCALE, BOTTOM = 1.00 (-12) TOP = 1.00 (-2)
CHANNEL 5 (A) LOG SCALE, BOTTOM = 1.00 (-2) TOP = 1.00 (-2)
CHANNEL 4 (E) LOG SCALE, BOTTOM = 1.00 (-2) TOP = 1.00 (-2)



C02 LASER COMPRESSED PLOT

TIME	CH14 (M) PAP	CH15 (M) METER	CH16 (O) ANGLE	CH17 (F) GAIN	CH18 (A) SHU	CH19 (E) TOD
7308340.	-11.089	3.277	14.4	5000000.	.1153	92. 10.59.
7308520.	-10.414	3.282	15.5	5000000.	.1142	92. 11. 2.
7308610.	-10.461	3.272	15.2	5000000.	.0542	92. 12.36.
7308730.	-10.612	3.272	14.7	5000000.	.0542	92. 12.39.
7308830.	-9.816	3.252	13.9	5000000.	.0542	92. 14.13.
8010150.	-9.652	3.252	16.0	5000000.	.0542	92. 14.16.
8015740.	-9.933	3.247	16.2	5000000.	.1112	92. 15.49.
8015920.	-9.779	3.247	13.7	5000000.	.1112	92. 15.52.
8011550.	-10.006	3.242	15.2	5000000.	.1542	92. 17.26.

where:

month is "month" is in XX_month_MIN, or XX_month_MINDIR.

db,hb,mb are the begin day, hour, and minute.

de,he,me are the end day, hour, and minute.

calpackage (the calibration package for converting instrumentation output voltages to scientific units) is CAL77 for 1977, CAL78 for 1978, etc.

year is always two digits (i.e. 77 for 1977).

Figure 4 shows a job which generates graphs and tables for several days in May, 1977 at several different scattering angles. Note the core memory requirement of 130000. Time requirements are approximately ten seconds per day, per angle. Thus a four-day presentation over two scattering angles will require approximately eighty seconds.

II.2 CO2 LASER DATA TAPE DIRECTORY.

The CO2 Laser data files that contain the angular scattering output stored on magnetic tapes issued, catalogued, and housed at the A.F.G.L. Computer Center. Table 14. the Computer Center (CC) CO2 Laser Data Tape Directory, lists all of the active CC tapes by tape number and the data intervals represented. For the months with no tape shown, the lower system was not operational.

Table 14. Computer Center (CC) CO2 Laser Data Tape Directory

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1977	2843	2843	2843	2843	2843	----	----	----	----	2843	2843	2843
1978	2843	2843	2843	2843	2843	2843	2843	2843	2843	2843	2843	2843
1979	----	----	----	----	2843	2843	2843	2843	2843	2843	----	----
1980	----	----	----	----	2843	2843	2843	----	----	----	2843	----

where:

month is "month" is in XX_month_MIN, or XX_month_MINDIR.

db,hb,mb are the begin day, hour, and minute.

de,he,me are the end day, hour, and minute.

calpackage (the calibration package for converting instrumentation output voltages to scientific units) is CAL77 for 1977, CAL78 for 1978, etc.

year is always two digits (i.e. 77 for 1977).

Figure 4 shows a job which generates graphs and tables for several days in May, 1977 at several different scattering angles. Note the core memory requirement of 130000. Time requirements are approximately ten seconds per day, per angle. Thus a four-day presentation over two scattering angles will require approximately eighty seconds.

11.2 CO₂ LASER DATA TAPE DIRECTORY.

The CO₂ Laser data files that contain the angular scattering output stored on magnetic tapes issued, catalogued, and housed at the A.F.G.L. Computer Center. Table 14, the Computer Center (CC) CO₂ Laser Data Tape Directory, lists all of the active CC tapes by tape number and the data intervals represented. For the months with no tape shown, the lower system was not operational.

Table 14. Computer Center (CC) CO₂ Laser Data Tape Directory

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1977	2843	2843	2843	2843	2843	----	----	----	----	2843	2843	2843
1978	2843	2843	2843	2843	2843	2843	2843	2843	2843	2843	2843	2843
1979	----	----	----	----	2843	2843	2843	2843	2843	2843	----	----
1980	----	----	----	----	2843	2843	2843	----	----	----	2843	----

```

LOWEQ,T300,CM130000.                                1735      LOWELL
ATTACH,LPF,LASERPROCFILESX3664,ID=LOWELL,MR=1.
BEGIN,FASTPLT,LPF,MAY77,122,10,0,132,12,43,CAL77,77,30.
BEGIN,FASTPLT,LPF,MAY77,122,10,0,132,12,43,CAL77,77,20.
BEGIN,FASTPLT,LPF,MAY77,122,10,0,132,12,43,CAL77,77,10.
EXIT(U)
RETURN,LPF.
*EOR
*EOF

.PROC,FASTPLT,P1=MONTH,P2=DB,P3=HB,P4=MB,P5=DE,P6=HE,P7=ME,P8=CAL,,
P9=YR,P10=ANG.
ATTACH,TAPE2,XX-P1-MIN,ID=LOWELL,PW=A,B,MR=1.
ATTACH,TAPE3,XX-P1-MINDIR,ID=LOWELL,PW=A,B,MR=1.
ATTACH,GRAFER,COMPLASER,ID=LOWELL,MR=1.
ATTACH,CAL,P8-X3664,ID=LOWELL,MR=1.
ATTACH,CMND,CMNDX3664,ID=LOWELL,MR=1.
ATTACH,PLTPAC,PLTPACX3664,ID=LOWELL,MR=1.
ATTACH,SUBS,SUBSX3664,ID=LOWELL,MR=1.
ATTACH,SUBSWO,SUBSWITHOUTPRINTX3664,ID=LOWELL,MR=1.
MAP(OFF)
LDSET(PRESET=ZERO)
LOAD,GRAFER,CAL,CMND,PLTPAC,SUBS,SUBSWO.
EXECUTE,,PL=15000.
EXIT(U)
RETURN,TAPE2,TAPE3,GRAFER,CAL,CMND,PLTPAC,SUBS,SUBSWO,TAPE60.
.DATA,TAPE60
ECHO
YEAR,-P9
ANG,-P10
HOR,12,10$MPD,10
VER,10,5
CHAN,17,15,16,14,0,4,END
SC,0,2,-2,2
SC,4,2,-2,2
SC,14,2,-12,-2
SC,15,0
SC,16,0
SC,17,0
TITLE, CO2 LASER COMPRESSED PLOT
BEGIN,-P2-,-P3-,-P4-,$PARADE,-P5-,-P6-,-P7
DONE
*EOR
*EOF

```

FIGURE 4. Procedure file and Job Run of FASTPLT

EQ,T99,CM177000.
 2718 LOWELL
 TACH,FPP,TFASTPLTPROCS,ID=LOWELL,MR=1.
 MIN,1MONITR,FPP,DEC80,356,11,0,357,10,59,CAL80,80,TABLES,SEEALL,
 2,12,1.
 TURN,FPP.
 OR
 OF

COO,1MONITE,P1=MONTH,P2=DB,P3=HB,P4=MB,P5=DE,P6=HE,P7=ME,P8=CAL,P9=YE,
 0=TABLES,P11=SEEALL,P12=MAXLTAB,P13=NDIVX,P14=NPPDX,P15=MPSMPL.
 TACH,TAPE2,XX-P1-MIN,ID=LOWELL,PW=A,B,MR=1.
 TACH,TAPE3,XX-P1-MINDIR,ID=LOWELL,PW=A,B,MR=1.
 TACH,GRAFER,INTERVALMONITOR,ID=LOWELL,MR=1.
 TACH,CMND,CMNDX3664,ID=LOWELL,MR=1.
 TACH,CAL,P8-X3664,ID=LOWELL,MR=1.
 TACH,PLTPAC,PLTPACWITHCHARSX3664,ID=LOWELL,MR=1.
 TACH,SUBS,SUBSX3664,ID=LOWELL,MR=1.
 TACH,SUBSWO,SUBSWITHOUTPRINTX3664,ID=LOWELL,MR=1.
 P(OFF)
 SET(PRESET=ZERO)
 AD,GRAFER,CAL,CMND,PLTPAC,SUBS,SUBSWO.
 ECUTE,,PL=15000.
 IT(U)
 TURN,TAPE2,TAPE3,GRAFER,CAL,CMND,PLTPAC,SUBS,SUBSWO,TAPE60.
 ATA,TAPE60
 HO
 10-\$-P11-\$MAXLTAB,-P12
 AR,-P9
 R,-P13-,-P14-\$MPSMPL,-P15
 R,1,13
 AD,26,0,25,13,12,11,3,0,4,22,21,24,END
 RESH,1.3,100.,1.3,1.3,1.3,1.3,1.3,1.3,1.3,1.3,40.,40.,0.
 ,26,1,80,210
 ,0,1,80,210
 ,25,1,80,210
 ,13,1,80,210
 ,12,1,80,210
 ,11,1,80,210
 ,3,1,80,210
 ,4,1,80,210
 ,22,1,80,210
 ,21,1,80,210
 ,24,1,80,210
 GIN,-P2-,-P3-,-P4-\$PARADE,-P5-,-P6-,-P7
 NE
 OF
 OF

FIGURE 6. PROGRAMMER FILE AND JOB RUN FILE FOR FASTPLTPROCS.

this procedure are given in Figure 6. IMONITR will generate tables, files, and plots of tower-instrument data taken from stripped minute channel files. Input parameters include:

- 1) Beginning and End times
- 2) Time spacing between samples (MPSMPL)
- 3) Number of samples constituting a standard interval (MAXLTAR)

The job-command language is the same as that used for "Time Plots" with the following additions.

- 1) TABLES - Request for printout of a data table for each standard interval.
- 2) FILES - Request for creation of a data file containing one record per standard interval.
- 3) SEEALL - Request to include in the tables/data file all samples examined within each interval. Normally included are only those samples for which at least one instrument passes a threshold test.
- 4) NULL - No request.

The plots which are generated compress one standard interval of data into a single plotted point for each instrument. Using a standard interval of one hour, and samples taken every minute, the graphs for a month of data can fit on a single page. A typical plot is shown in Figure 7. The corresponding tabulation for one of the intervals appears in Table 19.

The following channels are represented with respective thresholds shown:

II.7 ERIKFILE DATA TAPE DIRECTORY.

The ERIKFILE data files that have been produced by the software package described above are recorded on magnetic tapes issued, catalogued, and housed at the A.F.G.L. Computer Center. Table 18. the Computer Center (CC) ERIKFILE Data Tape Directory, lists all of the active CC tapes by tape number and the data intervals represented.

Table 18. Computer Center (CC) ERIKFILE Data Tape Directory

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1977	2460	2460	2460	2460	2460	2460	2460	2460	2460	2460	2460	2460
1978	1784	1784	1784	1784	1784	1784	1784	1784	1784	1784	1784	2801
1979*	2801	2801	2801	2801	2801	2801	2801	2801	2801	2801	2801	2801
1980*	2801	2801	2801	2801	2801	2801	2801	2801	2801	2801	1352	1352
1981*	1352	1352	1352	1352	1352	1352	1352	1352	1352	1352	1352	1352
1982*	1253	1253	1253	1253	1253	1253	1253	1253	1253	1253	1253	1253

NOTE: Monthly files for data years 1979*, 1980*, 1981*, and 1982*

do not have the Barnes corrections or the meteorological data added.

II.8 INTERVAL MONITOR FOR THE TOWER INSTRUMENTS.

The interval monitor program for the tower instruments was developed to assist in both determining individual sensor responses and to contrast the responses of the six AEG extinction meters, the two ELTRO transmissometers, the two Barnes transmissometers, and the Ceiling Meter. This package was developed as a user-called procedure file as described below.

The procedure IMONITR (Interval Monitor) is contained in the permanent file: FASTPLIPPOCS. A copy of the procedure file IMONITR and a typical job utilizing

Table 17. Format of the Hourly OPAQUE Data Bank File (Cont)

Data File			
Word No.	Data Item	Measurement	Data Logger Channel
78	QQQQ	Packed MR1 Data Quality	
79	QQQQ	Packed Eltro Data Quality	
80	QQQQQQQQ	Packed Luxmeter Data Quality	
81	QQQQ	Packed Night Path Data Quality	
82	QQQQQQQQ	Packed Vis Lab Data Quality	
83	QQQQQQQQQQ	Packed Eppley Data Quality	
84	QQQQQ	Packed Barnes Data Quality	
85	RRR	Total Rain for past hour	23 (Total Rain)

Table 17. Format of the Revised Hourly OPAQUE Data Bank File (Cont)

Data File					
Word No.	Data Item	Measurement	Data Logger Channel		
			Before Day 96 1977	Days 96-145 1977	After Day 145 1977
53	T ₁	3-5 μ m BEG	f = 0	-	f = 1
54	T ₂	8-12 μ m Barnes Transmissometer (500m)	f = 3	f = 3	f = 3
55	T ₃	8-13 μ m	f = 2	f = 2	f = 2 Channel 21
56	T _x	Open or 4 μ m	f = 1	-	f = 0
57	T ₈	3-5m FIN	f = 0	-	f = 1
58	X	Aerosol Data			
59	A				
60	B				
61	C				
62	D				
63	E				
64	B ₁₅₋₁	3-5 μ m Barnes Transmissometer (1500m)	(Position 1)	22	
65	B ₁₅₋₃	8-12 μ m (1500)	(Position 3)		
66	H	Turbulence Data			
67	I				
68	M				
69	dd				
70	ff				
71	d ₂ d ₂				
72	f ₂ f ₂				
73	ppp				
74	TTT				
75	T _d T _d T _d				
76	rrr				
77	E				

Table 17. Format of the Revised Hourly OPAQUE Data Bank File (Cont)

Data File				
Word No.	Data Item		Measurement	Data Logger Channel -
28	B ₁₅₋₂		8-13 mm Transmissometer (1500 m) (position2)	22
29*	B ₁₅₋₄		Open (position ϕ) (1500 m)	
30	L _p	BEG		
31	L _p	FIN		
32	L _p	MAX	Night Path Luminance	6
33	L _p	MIN		(with 5 & 7)
34	NV			
35	F _p	BEG	Variable Path	11
36	F _p	FIN	Function Meter (eff. until 10/31/80)	
37	A2	BEG	AEG, 2 meter	3
38	A2	FIN	(eff. 11/1/80)	
39	A8	BEG	AEG, 8 meter	11
40	A8	FIN	(eff. 11/1/80)	
41	A16	BEG	AEG, 16 meter	12
42	A16	FIN	(eff. 11/1/80)	
43	A48	BEG	AEG, 48 meter	13
44	A48	FIN	(eff. 11/1/80)	
45	A80	BEG	AEG, 80 meter	25
46	A80	FIN		
47	A80	MAX (10')	(eff. 11/1/80)	
48	A80	MIN (10')		
49	SEL	BEG	Slant ELTRO	26
50	SEL	FIN		
51	SEL	MAX (10')	(eff. 11/1/80)	
52	SEL	MIN (10')		

*Effective in data file at 1 July, 1980

Table 17. Format of the Revised Hourly OPAQUE Data Bank File

Date File			
Word No.	Data Item	Measurement	Data Logger Channel
1	Station No.	= 71	
2	Date - Year,Month,Day		
3	Time		
4	Duration of Measurement cycle	010	
5	Comment Numbers		
6	Comment Numbers		
7	Comment Numbers		
8	Comment Numbers		
9	Comment Numbers		
10	Scattering x 100 + Filter x 10 + Humidity		
11	S _s BEG		
12	S _s FIN		
13	S _s MAX	AEG Point Visibility Meter	0
14	S _s MIN		
15	NV	Number of measurements	
16	E _g BEG		
17	E _g FIN		
18	E _g MAX	Eltro Transmissiometer	4
19	E _g MIN		
20	NV		
21	E _L BEG		
22	E _L FIN		
23	E _L MAX	Horizontal Luxmeter	24
24	F _L MIN		
25	NV		
26	E ^N (North)	Vertical Luxmeter	25
27	E ^E (East)	(off after 10/31/80 - on April 1980)	See Page 3

files. These changes are reflected in Table 17. Format of the Revised Hourly OPAQUE Data Bank File. The hourly OPAQUE Data Bank Files are identified as the "ERIKfiles".

Considerable reprocessing of the ERIKfiles was performed to correct for the differences in the ELTRO calibration software differences between these files and the LVD files, and to add data words 64 and 65 (the Barnes 1500 m. measurements) to the ERIKfiles from March, 1978 onward. These "corrections" were handled as 'replacements' to the hourly files which had been originally produced by the University of Lowell team and subsequently further processed at AFGL.

Concurrent with the reprocessing of the ERIKfiles as discussed above, the Low Visibility Data files were reprocessed to take advantage of the availability of the data base minute files. Changes to the LVD files were limited to the replacement of the ELTRO calibration default offset of 30 by a zero offset value, and a correction to a Barnes filter position software error beginning with the LVD data tapes for January, 1978.

11.5 LOW VISIBILITY DATA TAPE DIRECTORY.

The low Visibility data files that are produced by the software package described above are recorded on magnetic tapes issued, catalogued, and stored at the A.F.G.L. Computer Center. Table 16. the Computer Center (CC) Low Visibility Data Tape Directory, lists all of the active CC tapes by tape number and the data intervals represented.

Table 16. Computer Center (CC) Low Visibility Data Tape Directory

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1977	2461	2461	2461	2461	2461	2461	2461	2461	2461	2462	2461	2461
1978	2565	2565	2565	2565	2565	2565	2565	2565	2565	2565	2565	2565
1978*	2148	2148	2148	2148	2148	2148	2148	2148	2148	2148	2148	2148

NOTE: 1978* tape files have no threshold, all other tape files are with threshold.

After gaining some experience with the generation of this data set, it was determined that the short runtime of the software procedure files, both with and without the selection 'window', allows a rapid regeneration of either data set and eliminates the backup tape requirement.

11.6 ERIKFILES DATA FILE PRODUCTION AND MODIFICATIONS

The instrumentation for the atmospheric optical measurements at the Meppen OPAQUE site was changed significantly in the Fall, 1980. The reconfiguration of the instruments and the additional measurements added to the data set required a redefinition of the contents of the data words in the post-OPAQUE data bank

STRIP RAW DATA TAPES

BEGIN,STRIP,TESTYNEPHY,nnn-RAW TAPE NO.,MDATA1,MDATA1.

nnn - the raw-data-tape number

This must be done for all raw-data-tapes
containing data for the calendar month.

<u>Tape</u>	<u>Notes</u>
226	
227	
228	
229	
230	
231	
232	
233	
234	

Each tape "RAWnnnX3664" yields a stripped file "RAWnnnNEPH".

CREATE THE MONTHLY DIRECTORY

BEGIN,DIRm,TESTYNEPHY,nn1,nn2,...,MMYY,MDATA1.

"m" is the number of "RAWnnnNEPH" files in the month.

BEGIN,SHOWDIR,TESTYNEPHY,MMYY,MDATA1.

MONTHLY FILE AND BACKUP

Copy the file MMYYNPHDIR followed by all of the files "RAWnnnNEPH"
onto tape CC3117. Make a backup tape OPA800.

PURGE SOME FILES

Purge all "RAWnnnNEPH" files except the last one on the list (if it
overlaps the next month).

FIGURE 5. NEPHELOMETER PROCESSING FOR THE MONTH OF _____.

Raw data tape #229 was not successfully stripped.

Production of Nephelometer Data Files

An organized production scheme was developed to facilitate generation of nephelometer data files by data-terminal operators. This was done to simplify what would otherwise be a somewhat complicated production process (a number of raw data tapes must be stripped to generate a single month's file). Figure 5 shows a form used by the terminal-operator during the generation of a single month's file (JAN79 shown).

II.4 LOW VISIBILITY DATA FILE PRODUCTION AND MODIFICATIONS.

The production of the Low Visibility data files has been carried out in two formats, with and without the minimum visibility 'window'. These files have been used for both data analysis and to test the consistency of the data values reported.

Around January, 1983 reprocessing of both LVD and ERIK-files was initiated to correct for differences in the treatment of calibration data of the Eltro-transmissometer. The ERIK-file program looked ahead to obtain a calibration count on the half-hour, and then incorporated the calibration count only if it was less than 100. Otherwise the last previously accepted calibration count was used. On startup, a default calibration count of zero was assumed.

For consistency, the later Eltro-calibration software developed for the LVD-files was incorporated into the ERIK-file program, with the following adjustment: The startup Eltro default-calibration count was set equal to zero for both the ERIK and the LVD-file generation.

<u>Raw Data Tape</u>	<u>Neph. File Created</u>
226	Yes
227	Yes
228	Yes
229	No
230	Yes
231	Yes
232	Yes
233	Yes
234	Yes

Eight of the nine raw data tapes were successfully stripped to yield data for the JAN79 Nephelometer-file. The files were subsequently stored on tape, preceded by a directory. CC Tape #3117 along with a backup tape (OPA800) were used for this purpose.

Contents of Tape OPA800

JAN79NEPHDIR

PAW226NEPH

PAW227NEPH

RAW228NEPH

PAW230NEPH

PAW231NEPH

PAW232NEPH

PAW233NEPH

PAW234NEPH

Due to the time and effort required in generating these data tapes, and the possibilities for program or human error in processing the data contained on these tapes, a double or back copy of each CC stripped data tape is provided by the University of Lowell. Table 15, the Backup (OPA) CO2 Laser Data Tape Directory, lists all of the active backup tapes by tape number and the data intervals represented.

Table 15. Backup (OPA) CO 2 Laser Data Tape Directory

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1977	920	920	921	921	921	---	---	---	---	921	921	921
1978	921	921	921	921	921	921	921	921	921	921	921	921
1979	---	---	---	---	921	921	921	921	921	921	---	---
1980	---	---	---	---	921	921	921	---	---	---	921	---

No magnetic tape files are catalogued during the use of the FASTPL1 procedure file as the 'run' can be reproduced on demand from the stripped minute files but depends on the fixed angle selected.

11.3 SCANNING NEPHELOMETER DATA REDUCTION MODIFICATIONS.

Nephelometer Process Verification

In the spring of 1981 a test was made to verify that the scanning nephelometer processing programs were operational. The month January, 1979 (JAN79) was chosen for this test.

Table 19. Sample Interval Monitor Tabulation.

DAY	TIME	CH26 S.ELTRO	CH04 CEILING	CH25 AEG80	CH13 AEG48	CH12 AEG16	CH11 AEG 8	CH03 AEG 2	CH0A AEG	CH 4 ELTRO	CH22 B1560	CH21 B500	CH24 100
12.22	10. 5.	-910.0	0.0	-910.0	8.0	7.9	-910.0	-910.0	.5	.5	3032.9	97.7	-910.0
12.22	10. 6.	-910.0	0.0	-910.0	10.1	8.8	-910.0	-910.0	.5	.5	3073.1	77.2	-910.0
12.22	10. 7.	-910.0	0.0	-910.0	8.9	8.6	-910.0	-910.0	.5	.5	3090.0	91.6	-910.0
12.22	10. 8.	-910.0	420.0	-910.0	11.0	8.1	-910.0	-910.0	.5	.5	3083.8	92.6	-910.0
12.22	10. 9.	-910.0	330.0	-910.0	10.1	7.2	-910.0	-910.0	.5	.5	3056.5	99.1	-910.0
12.22	10.10.	-910.0	430.0	-910.0	11.8	8.5	-910.0	-910.0	.5	.5	3072.3	78.2	-910.0
12.22	10.11.	-910.0	440.0	-910.0	9.8	8.0	-910.0	-910.0	.5	.5	3089.6	91.6	-910.0
12.22	10.12.	-910.0	440.0	-910.0	11.4	7.9	-910.0	-910.0	.5	.5	3082.0	92.6	-910.0
12.22	10.13.	-910.0	440.0	-910.0	15.3	10.3	-910.0	-910.0	.4	.5	3038.6	94.2	-910.0
12.22	10.14.	-910.0	450.0	-910.0	10.2	7.9	-910.0	-910.0	.4	.5	3071.3	78.1	-910.0
12.22	10.15.	-910.0	450.0	-910.0	15.0	10.5	-910.0	-910.0	.5	.5	3088.1	91.4	-910.0
12.22	10.16.	-910.0	450.0	-910.0	10.0	7.4	-910.0	-910.0	.5	.5	3083.6	92.0	-910.0
12.22	10.17.	-910.0	460.0	-910.0	15.1	12.1	-910.0	-910.0	.5	.4	-910.0	93.7	-910.0
12.22	10.29.	-910.0	410.0	-910.0	13.4	12.7	-910.0	-910.0	.4	.4	3041.2	94.4	-910.0
12.22	10.30.	-910.0	420.0	-910.0	13.7	12.7	-910.0	-910.0	.4	.4	3069.9	76.9	-910.0
12.22	10.31.	-910.0	420.0	-910.0	10.9	9.8	-910.0	-910.0	.4	.4	3085.9	91.4	-910.0
12.22	10.32.	-910.0	420.0	-910.0	13.4	11.8	-910.0	-910.0	.4	.4	3082.7	91.3	-910.0
12.22	10.33.	-910.0	430.0	-910.0	12.9	11.1	-910.0	-910.0	.4	.4	3045.7	96.1	-910.0
12.22	10.34.	-910.0	430.0	-910.0	10.6	9.6	-910.0	-910.0	.4	.4	3070.5	77.4	-910.0
12.22	10.35.	-910.0	430.0	-910.0	11.6	12.4	-910.0	-910.0	.4	.4	3086.3	90.8	-910.0
12.22	10.36.	-910.0	440.0	-910.0	12.3	10.6	-910.0	-910.0	.4	.4	3080.6	91.5	-910.0
12.22	10.37.	-910.0	440.0	-910.0	10.1	8.4	-910.0	-910.0	.4	.4	3050.5	97.3	-910.0
12.22	10.38.	-910.0	440.0	-910.0	11.2	9.8	-910.0	-910.0	.4	.4	3071.8	77.2	-910.0
12.22	10.39.	-910.0	450.0	-910.0	11.9	12.9	-910.0	-910.0	.4	.4	3085.6	90.5	-910.0
12.22	10.40.	-910.0	450.0	-910.0	9.5	8.3	-910.0	-910.0	.4	.4	3080.4	91.7	-910.0
12.22	10.41.	-910.0	450.0	-910.0	11.0	11.2	-910.0	-910.0	.4	.4	3050.1	96.2	-910.0
12.22	10.42.	-910.0	450.0	-910.0	10.8	9.5	-910.0	-910.0	.4	3.2	3070.7	77.1	-910.0
12.22	10.43.	-910.0	460.0	-910.0	11.3	11.9	-910.0	-910.0	.4	16.0	3087.3	90.9	-910.0
12.22	10.44.	-910.0	460.0	-910.0	10.5	11.2	-910.0	-910.0	.4	16.0	3082.8	91.1	-910.0
12.22	10.45.	-910.0	460.0	-910.0	9.4	10.0	-910.0	-910.0	.4	.5	3038.5	96.5	-910.0
12.22	10.46.	-910.0	470.0	-910.0	10.1	10.6	-910.0	-910.0	.4	.5	3071.3	76.8	-910.0
12.22	10.47.	-910.0	470.0	-910.0	9.7	10.6	-910.0	-910.0	.4	.5	3088.6	90.8	-910.0
12.22	10.48.	-910.0	470.0	-910.0	8.5	8.8	-910.0	-910.0	.4	.5	3083.5	91.4	-910.0
12.22	10.49.	-910.0	400.0	-910.0	8.5	8.8	-910.0	-910.0	.4	.5	3038.4	96.5	-910.0
12.22	10.50.	-910.0	400.0	-910.0	8.3	9.2	-910.0	-910.0	.4	.5	3070.2	77.2	-910.0
12.22	10.51.	-910.0	400.0	-910.0	8.3	8.3	-910.0	-910.0	.4	.5	3087.7	91.2	-910.0
12.22	10.52.	-910.0	410.0	-910.0	7.6	8.5	-910.0	-910.0	.4	.5	3081.9	91.6	-910.0
12.22	10.53.	-910.0	410.0	-910.0	8.3	9.5	-910.0	-910.0	.4	.5	3048.8	95.8	-910.0
12.22	10.54.	-910.0	410.0	-910.0	10.3	10.2	-910.0	-910.0	.4	.5	3070.6	76.9	-910.0
12.22	10.55.	-910.0	420.0	-910.0	8.8	9.8	-910.0	-910.0	.4	.5	3087.6	90.6	-910.0
12.22	10.56.	-910.0	420.0	-910.0	8.6	7.5	-910.0	-910.0	.4	.5	3083.6	91.7	-910.0
12.22	10.57.	-910.0	420.0	-910.0	10.9	8.8	-910.0	-910.0	.4	.5	3045.1	95.4	-910.0
12.22	10.58.	-910.0	430.0	-910.0	8.2	9.6	-910.0	-910.0	.4	.5	3071.4	76.8	-910.0
12.22	10.59.	-910.0	430.0	-910.0	10.6	11.6	-910.0	-910.0	.4	.5	3086.3	90.6	-910.0

<u>Channel</u>	<u>Instrument</u>	<u>Threshold</u>
26	Slant Eltro	1.3
0d	Ceiling meter	100
25	80m AEG	1.3
13	48m AEG	1.3
12	16m AEG	1.3
11	8m AEG	1.3
3	2m AEG	1.3
0a	AEG	1.3
4	Eltro	1.3
22	1500m Barnes	40
21	500m Barnes	40

The commands necessary to generate tables and plots are:

ATTACH,FFP,FASTPLTPROCS,ID=LOWELL,MR=1.

BEGIN,IMONITR,RPP,month,db,hb,mb,de,he,me,calpackage,
year, TABLES (or FILES or NULL), SEEALL 9or NULL),
maxltab,ndvix,nppdx,mpsmpl.

where: month is "month" as in XX_month_MIN, or XX_month_MINDIR,
db,hb,mb are the begin day, hour, and minute,
de,he,me are the end day, hour, and minute,
calpackage is CAL80 for 1980, CAL81 for 1981, etc.,
year is always two digits (i.e. 80 for 1980),
maxltab is the number of samples expected to be examined
in one standard interval,
ndvix is the number of horizontal graph-divisions,
nppdx is the number of standard intervals per horizontal division,
mpsmpl is the time spacing between samples with a standard interval.

The plots show code letters for each instrument:

- A: 1 to 2 60ths of the samples pass threshold test during a standard interval.
- B: 3 to 4 60ths of the samples pass threshold test during a standard interval.
- C-Y: As above.
- Z: 51 or more 60ths of the samples pass threshold test during a standard interval.
- : The hyphen is printed when more than 50% of the interval shows data either missing, or invalid.
- ?: The question-mark is a control-letter. This letter should never appear when the software is good.

A test job, which generated graphs and tables for several days was run with a core-memory requirement of 177,000. Time requirements were approximately one second per 60-sample interval. Thus a full month presentation with hourly intervals consisting of 60 samples each (one per minute) will require approximately 700 seconds.

CONCLUSIONS.

The raw data base, representing over seven years of continuous measurements, has been edited, stripped, reformatted and re-recorded for analysis and study. The use of back-up tape copies has been the rule in dealing with the stripped data tapes. In later production runs for specific measurements, the use of a back-up tape copy was determined by the procedures and their run-times on the computer system.

The final packages of programs and control procedures allow one to search the data base for measurement parameters in a rapid manner through the use of a procedure file that links all the required programs and data sources in a time-ordered sequence. By studying the format of the procedure files provided, one can design a new procedure file for displaying various sensors together in the same plot or graph.

All of the raw data tapes have been catalogued and stored for possible future use in the analysis of the measurements that used a sampling rate greater than once a minute.

END

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