Title page

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"Polarization dependence of VHF propagation characteristics over a very long East Coast path"

(Final Report for the period Apr.1/81 to Mar.31 /82)

by

W.P. Lonc (Principal Investigator)
Physics Dept.
Saint Mary's University
Halifax, N.S., B3H 3C3

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Summary of work performed between Apr.1/81 and Mar.31./82

1. Collection and some processing of propagation data from Sable to Seaview on 142.605MHz, vertically polarized, from Dec./80 to Feb./82; virtually uninterrupted record. The acquisition of this data is continuing.
2. Collection and some processing of propagation data from Sable to Seaview on 147.995MHz, horizontally polarized, for most of 1981. The acquisition of this data is continuing.
3. Collection and some processing of propagation data from Sable to Halifax on 147.950MHz, horizontally polarized, for most of 1981. The acquisition of this data is continuing.
4. Collection of propagation data from Sable to Halifax on 431.990(later, 431.950)MHz, horizontally polarized, for part of 1981. The acquisition of this data was recently interrupted due equipment malfunction, and is expected to resume by the end of April,1982.
5. Some preliminary observations comparing VHF and UHF propagation on the Sable to Halifax path.
6. Some preliminary observations, with some processing, comparing fast-fade occurrence under various conditions, on VHF, for the Seaview/Arichat area.
7. Installation of a receiver/recorder system on Sable Island to monitor a commercial FM station(100.1MHz), to provide data on the Halifax to Sable path.
8. Installation of a UHF beacon(2.3m dish, etc.) on Sable;70cm band.
9. Installation of a UHF antenna(1.3m dish) on Sable;23 cm band. The transmitter is to be installed by the end of April,1982.
10. Preparation of 'data panels', consisting of 24-hour displays of propagation and weather data for 1981. These displays (or montages) facilitate comparison of data for a given day.
11. Preparation of photo-prints(reduced size) of those data panels which were complete at the time of writing this Report.

PREFACE

The primary purpose of this contract was to obtain VHF propagation data for the contruction of models of VHF propagation phenomena over long over-sea paths. These models are required for the determination of interference and service ranges of maritime and off-shore VHF stations. A secondary purpose was to begin a preliminary program of similar observations in the UHF(70 cm) part of the spectrum.

VHF propagation measurements, therefore, were continued from the previous contract, using both vertical and horizontal polarization over two relatively long over-sea paths, between Sable Island and the Nova Scotia mainland. One path, approximately 200km in length, is from Sable to the south-eastern area of Cape Breton(Seaview and Arichat), and the other path, approximately 285km in length, is from Sable to Halifax. Figures1.1 to 1.5(inclusively)provide information on location and relative orientation of the various sites mentioned in this Report.

Maritime Telephone and Telegraph Company(MTT) continued to provide space and equipment, both at Seaview and Arichat, as well as access(for recording purposes) to receivers at both of the sites. The MTT receivers were tuned to the MTT transmitter on Sable(142.605MHz); this is part of a duplex telephone link.

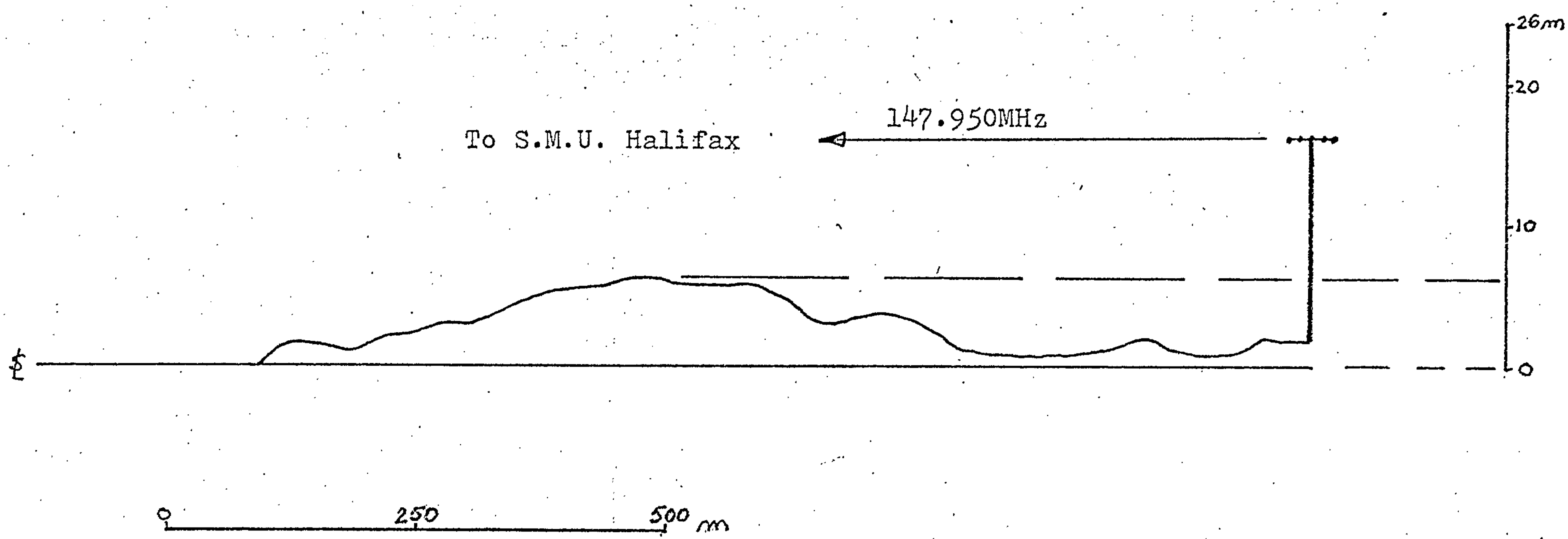
Propagation data was obtained, virtually without interruption from the end of December,1980, to the time of writing this Report, for vertically polarized radiation at 142.605MHz. In addition, metereological('met') data was obtained from three places: the Sable Island Upper Air station(approximately 1.5km east of all the signal sources mentioned in this Report);Shearwater air-base,(approximately 7km east of the receiving site at Saint Mary's University(SMU)); and Eddy Point(approximately 30km S-W of Seaview, and 20km W of Arichat). Propagation of horizontally polarized radiation, on 147.995MHz towards Seaview, and 147.950MHz towards SMU were also monitored, but for a somewhat shorter period of time. Appendix A lists all the charts containing propagation and 'met' data available. Appendix B contains photo prints(reduced size) of all data sets(on a daily basis) which were in a complete form at the time of writing this Report.

In addition to the long-term, continuous data acquisition on propagation and 'met' factors, a number of ancillary tests and experiments were performed: differences in fading between Seaview and Arichat; differences in fading at Seaview due to antenna height; differences in fading at Seaview due to frequency and polarization; and difference between VHF and UHF as monitored at Halifax.

The following chapters discuss the various items mention- above in more detail. The Appendices contain the complete set of Preliminary Reports which were sent to the Contractor at various times during the year, as well as a series of photoprints showing 'data panels' for approximately 4 complete months.

Discussion of equipment and experimental procedures are found in the various Preliminary Reports(Appendices C to I inclusive).

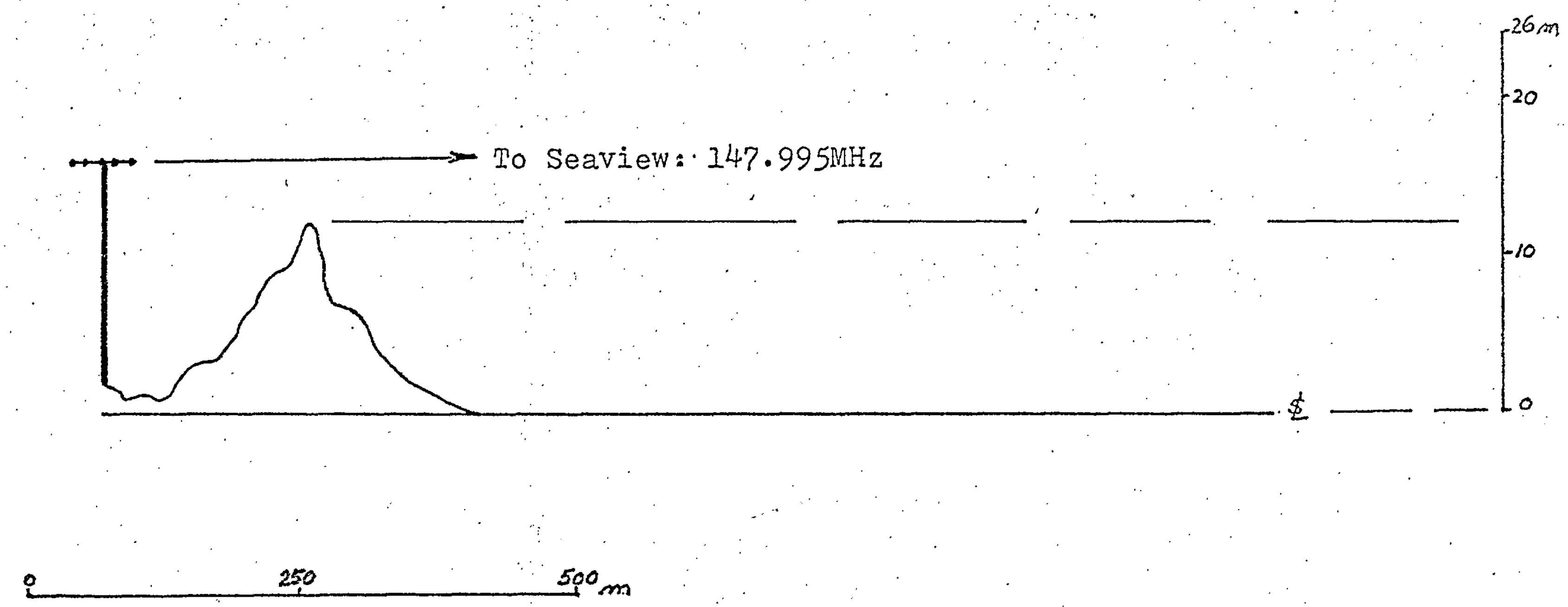
Finally, the author wishes to acknowledge generous assistance from the following: Maritime Telephone and Telegraph personnel at the various sites; Mr. R. Schultz; Mr. G. Ratto; Mr. Elmer Naugler; Mr. W. Rawle; and Miss Jennifer Wells; as well as Dr. J. Whitteker, Mr. Robert Bultitude, and Mr. Charron.



Sable Island

ANTENNA FOREGROUND
VERTICAL PROFILE
TOWER #1 (S.M.U.)
BEARING 286° TRUE

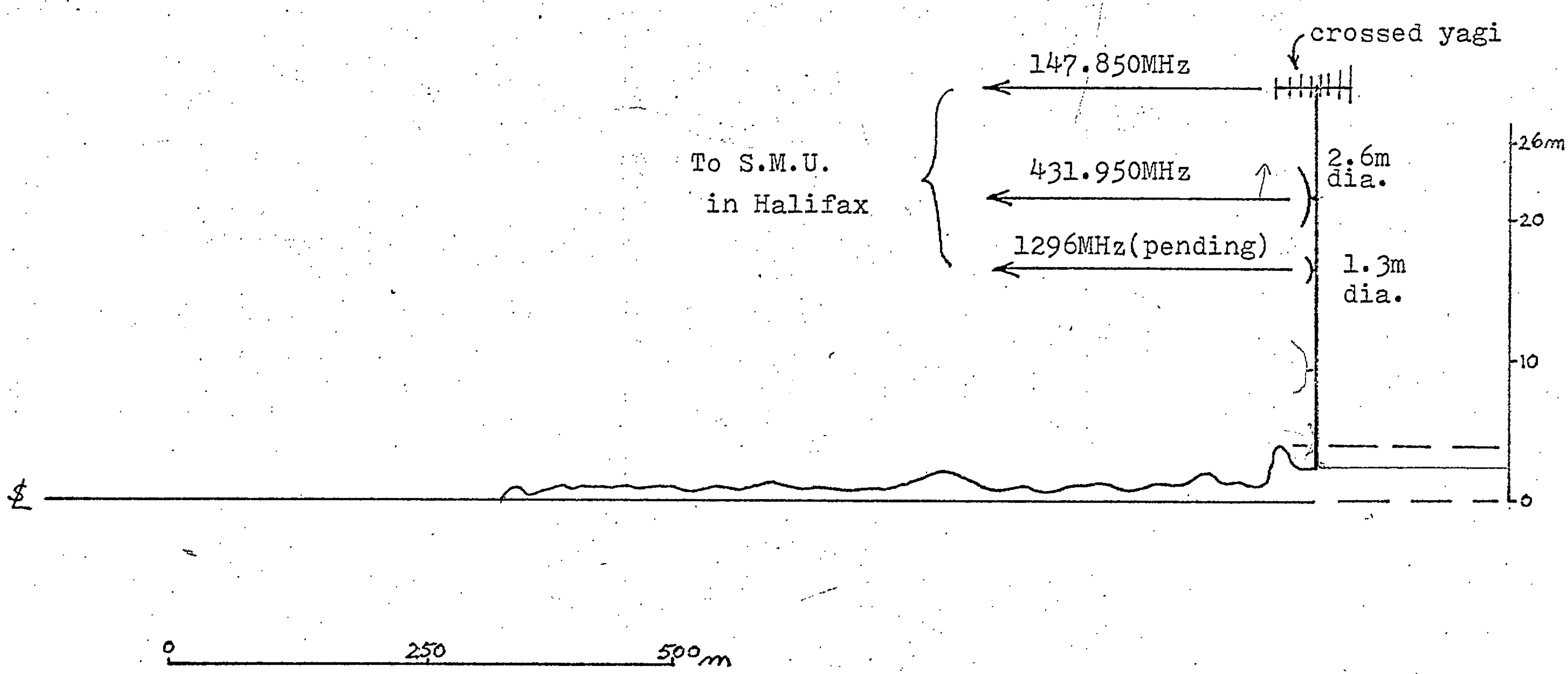
Figure 1.6



Sable Island

ANTENNA FOREGROUND
VERTICAL PROFILE
TOWER #1 (S.M.U.)
BEARING 337° TRUE

Figure 1.7



Sable Island

ANTENNA FOREGROUND
VERTICAL PROFILE
TOWER #2 (S.M.U.)
BEARING 286° TRUE

Figure 1.8

Chapter 1

Chapter 1: Propagation statistics for Sable to Seaview on 142.605MHz, vertically polarized.

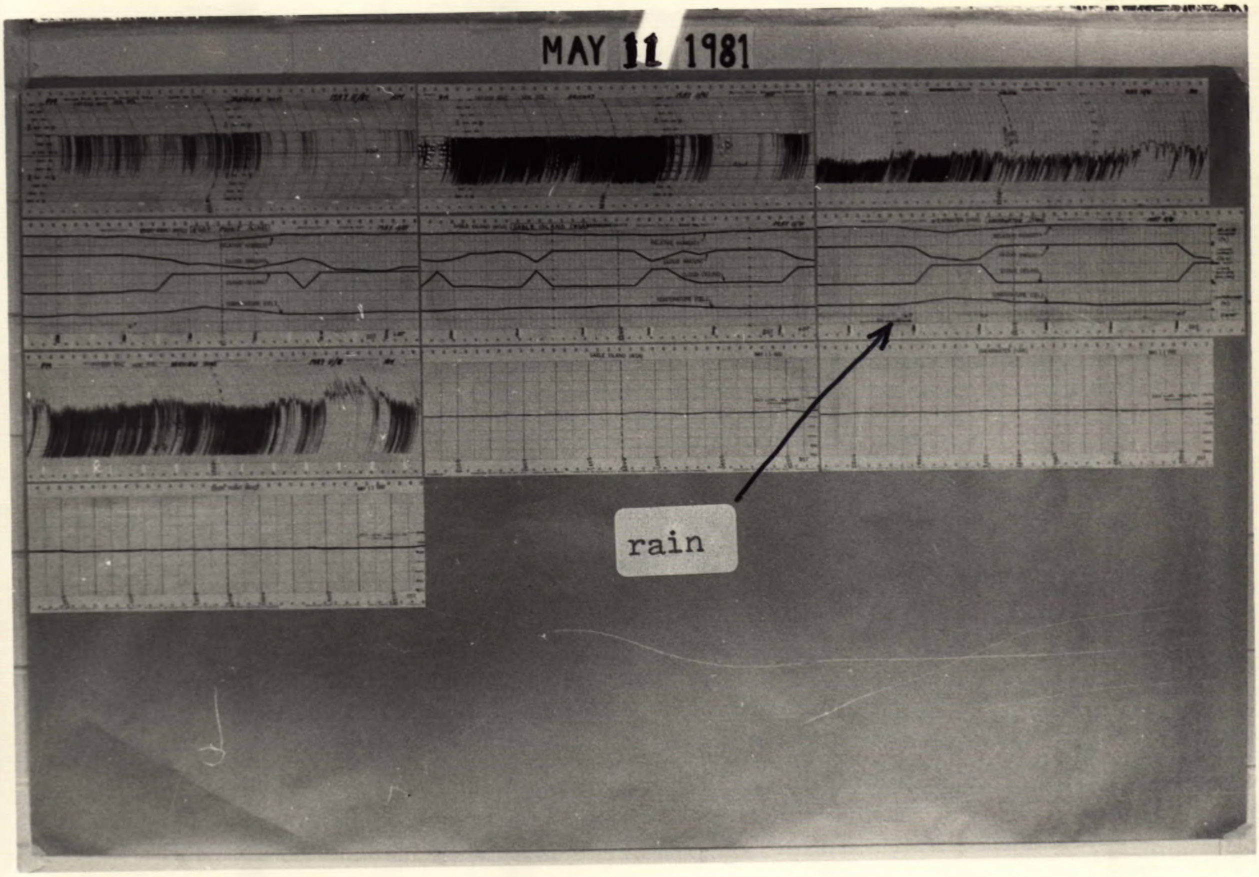
1-1: This chapter contains a very cursory, preliminary, attempt to correlate the observed propagation on the Sable to Seaview path with the available surface 'met' data. In particular, only two features of propagation will be examined: noticeable attenuation, marked by relatively gradual transitions; and enhancements, marked by relatively sudden transitions. For example, the 'data panel' for May 1 exhibits a pronounced attenuation(gradual) during the early part of the day, taking into account the fact that the charts for Seaview and Arichat are associated with FM receivers(hence, limiting). The 'data panel' for May 11, on the other hand, exhibits a sudden enhancement, again, during the early part of the day.

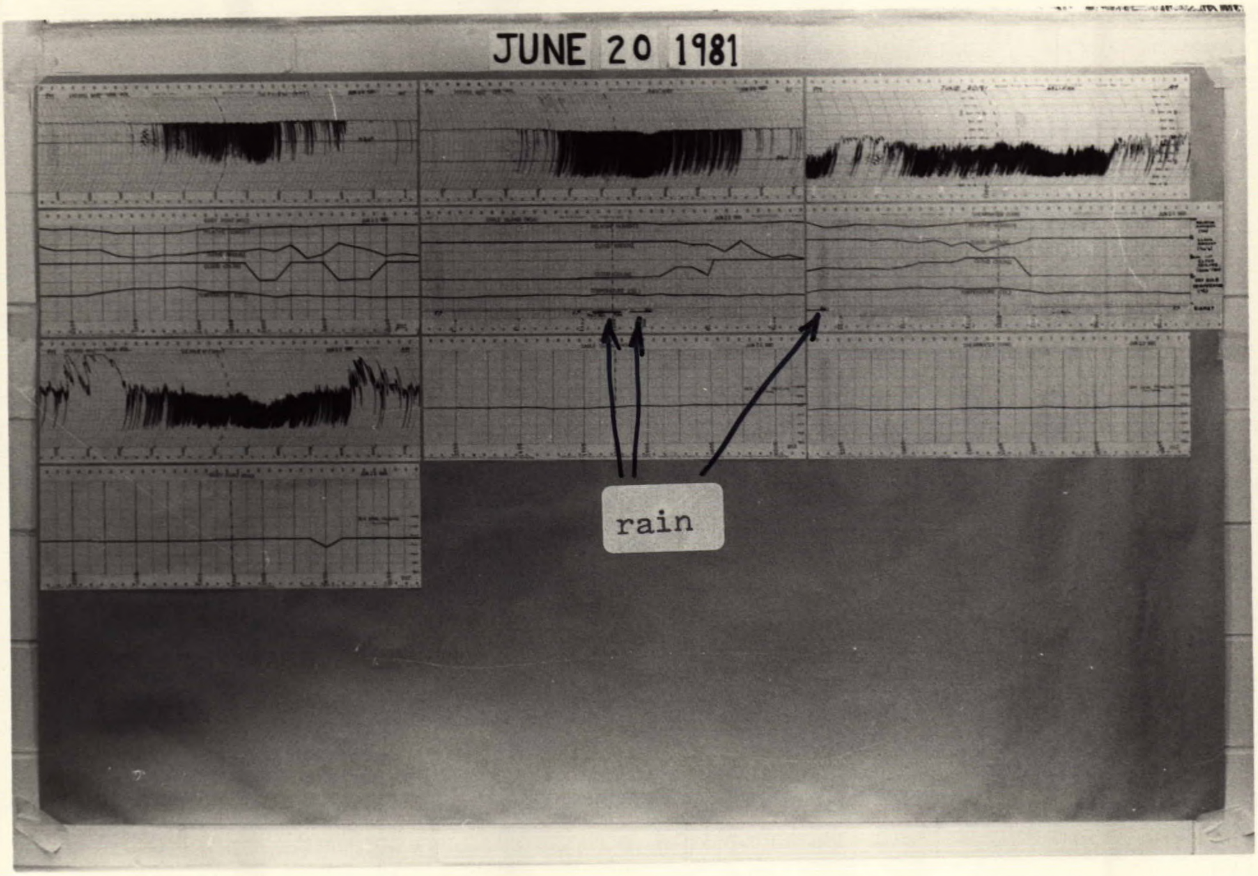
1-2: In the attempt to correlate propagation behaviour with surface 'met' data, it should be noted that the 'met' data could, perhaps, be of very limited significance. For example, on Sable Island, the 'met' data is gathered at a point approximately 1.5km east of the beacon site, whereas the propagation is in the fourth quadrant(of the compass) and presumably depends on 'met' factors in this same quadrant. Similarly, for the Canso Straits area, the 'met' data is obtained at Eddy Point, which is approximately 30km transverse to a line joining Sable and Seaview, and approximately 20km transverse to a line joining Sable and Arichat. For the Halifax area, the 'met' data from Shearwater represents conditions approximately 2km transverse to a line joining Sable and SMU. Of the three cases, only the last one appears to represent a relevant sampling of the surface 'met' conditions along the propagation path. However, even in this case, there is some question regarding the significance of the 'met' data inasmuch as it seems probable that the 'met' conditions along the initial part of the path, rather than those along the final part of the path, are really the relevant factors.

1-3: Hence, it is taken to be probable that the surface 'met' data for Sable Island will not always appear to correlate with the propagation from Sable because the propagation is presumably determined to a large extent by the 'met' conditions west of the antennas; in particular, it is presumed that the conditions near the water from the Island to the horizon are the dominant factors. Hence, any discontinuity in propagation may or may not be accompanied by a discontinuity in the Sable Island 'met' data for the simple reason that this 'met' data does perhaps not apply to the westward part of the region.

1-4: With these preliminary considerations in mind, a cursory examination of the data panels(in Appendix B) for May, June, July(part), and October, suggests that there is no clear-cut correlation between the propagation data in this Report and the 'met' data in this Report. Occasionally, however, there is correlation, such as for June 20(see enlarged photoprint, p.1-3). Here, there is a correlation between rain on Sable Island and gradual attenuation at all three receiving sites. Since there is no concomitant precipitation reported at either Eddy Point or Shearwater, then it would appear that precipitation at the beginning of the path is the significant factor.

If the sudden enhancements are examined, such as for early and later parts of June 20, there appears to be no corresponding discontinuity in the 'met' data at any of the sites, except perhaps the discontinuity in 'cloud amount' and 'cloud ceiling' for Sable and Shearwater. However, even here, the correlation exists(perhaps) for the discontinuity in the early part of the day, but does not exist for the discontinuity towards the end of the day.

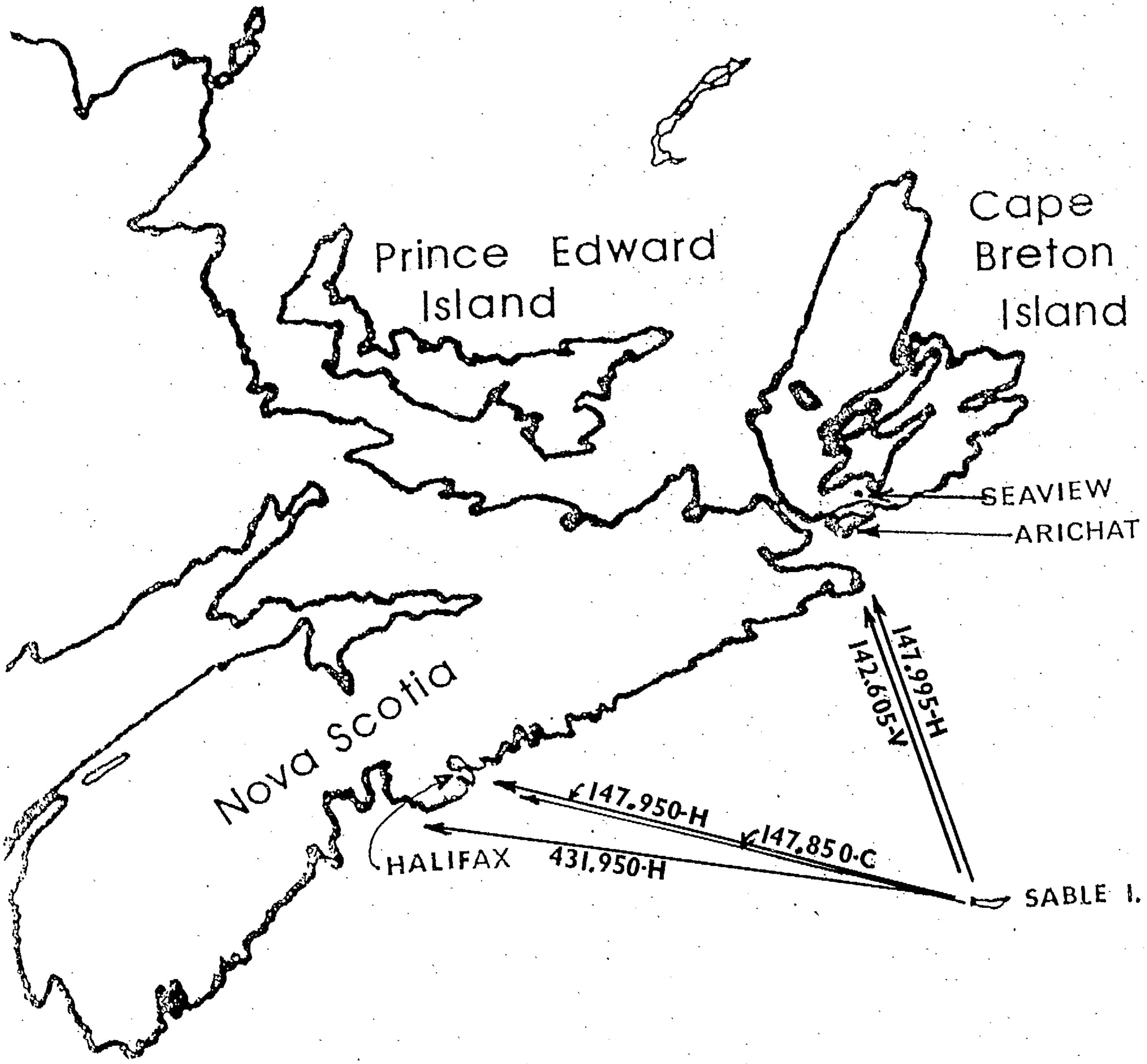

MAY 11 1981
rain


JUNE 20 1981
rain

Examining the data for May 11(also on page 1 -3), sudden enhancements again occur: in the early part of the day for all four monitors, and the later part of the day for the 3 monitors in the Seaview-Arichat area. There is perhaps some correlation between the first enhancement and the 'cloud ceiling/cloud amount' data for Sable, but similar discontinuities in 'cloud ceiling/cloud amount' for Sable later in the day are not accompanied by enhancements. Regarding attenuation effects, which begin around 10AM in the Seaview/Arichat data and around 1PM or so in the Halifax data, the only precipitation reported is a light rain in the Shearwater data; there is no rain reported at either Sable Island or Eddy Point.

In general, and by way of a very tentative and approximate statement, it is observed that there is some correlation, for the four months in question, between precipitation at Sable and gradual attenuation in propogation. Regarding the sudden enhancements, however, there appears to be no correlation whatsoever. These observations are made on the basis of a cursory visual examination of the original data panels. It is again noted that the 'met' data in this Report represents 'surface' weather conditions.

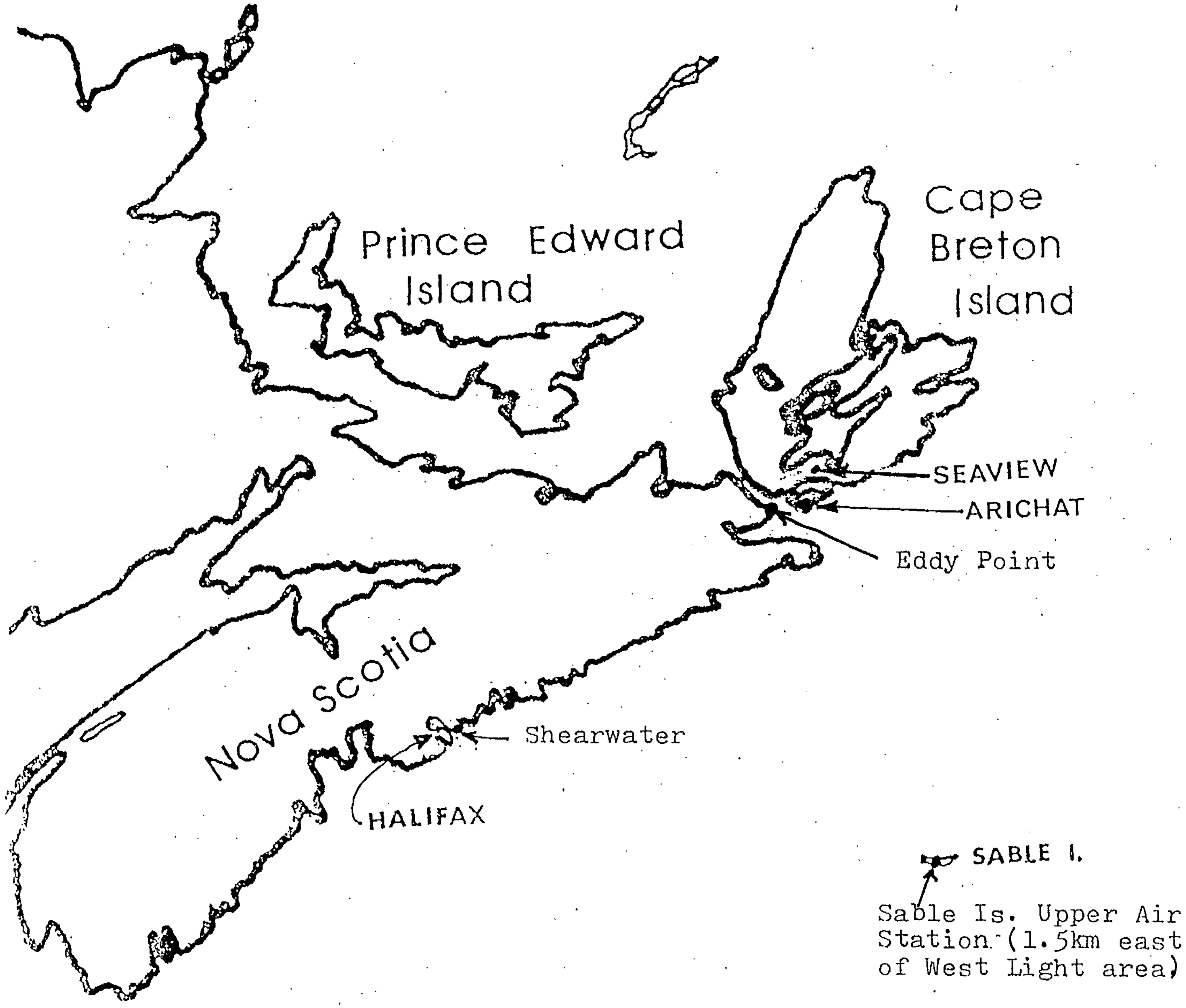
Figure 1.1: General coastline features and orientation of transmission paths.



Legend
C: circularly polarized
H: horizontally "
V: vertically "
All frequencies in MHz.

Note: Due to structural constraints, the UHF beacon (431.950MHz) points approximately 6 degrees south of the line from Sable to Halifax.

Figure 1.2: General coastline features and location of weather stations.



Note: All the beacons and transmitters mentioned in this Report are located in the West Light area.

Figure 1.3: Coast-line features of the Seaview-Arichat area, and location of antenna sites.

Figure 1.4: General features of the Halifax area, showing Shearwater and Saint Mary's University

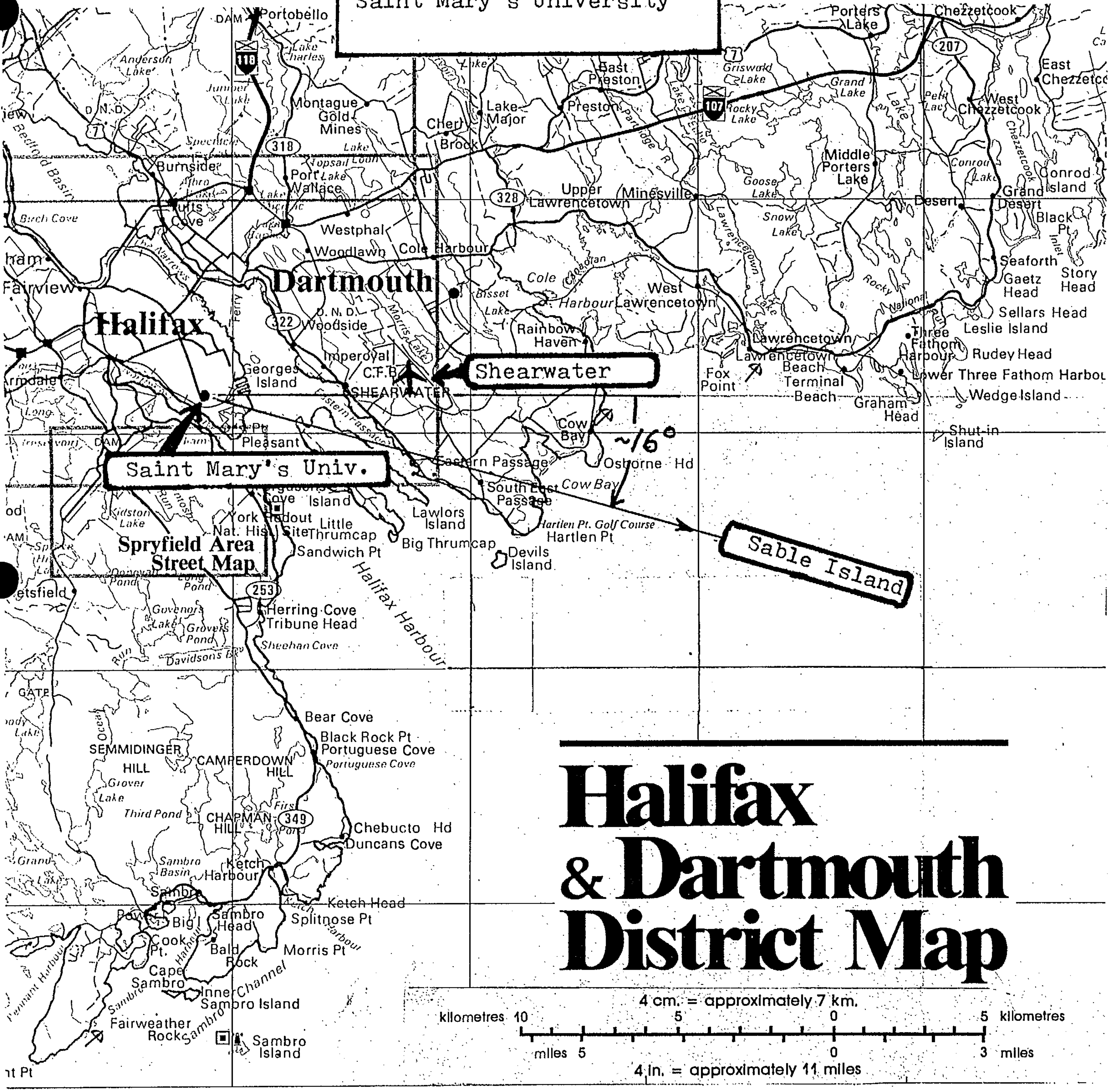
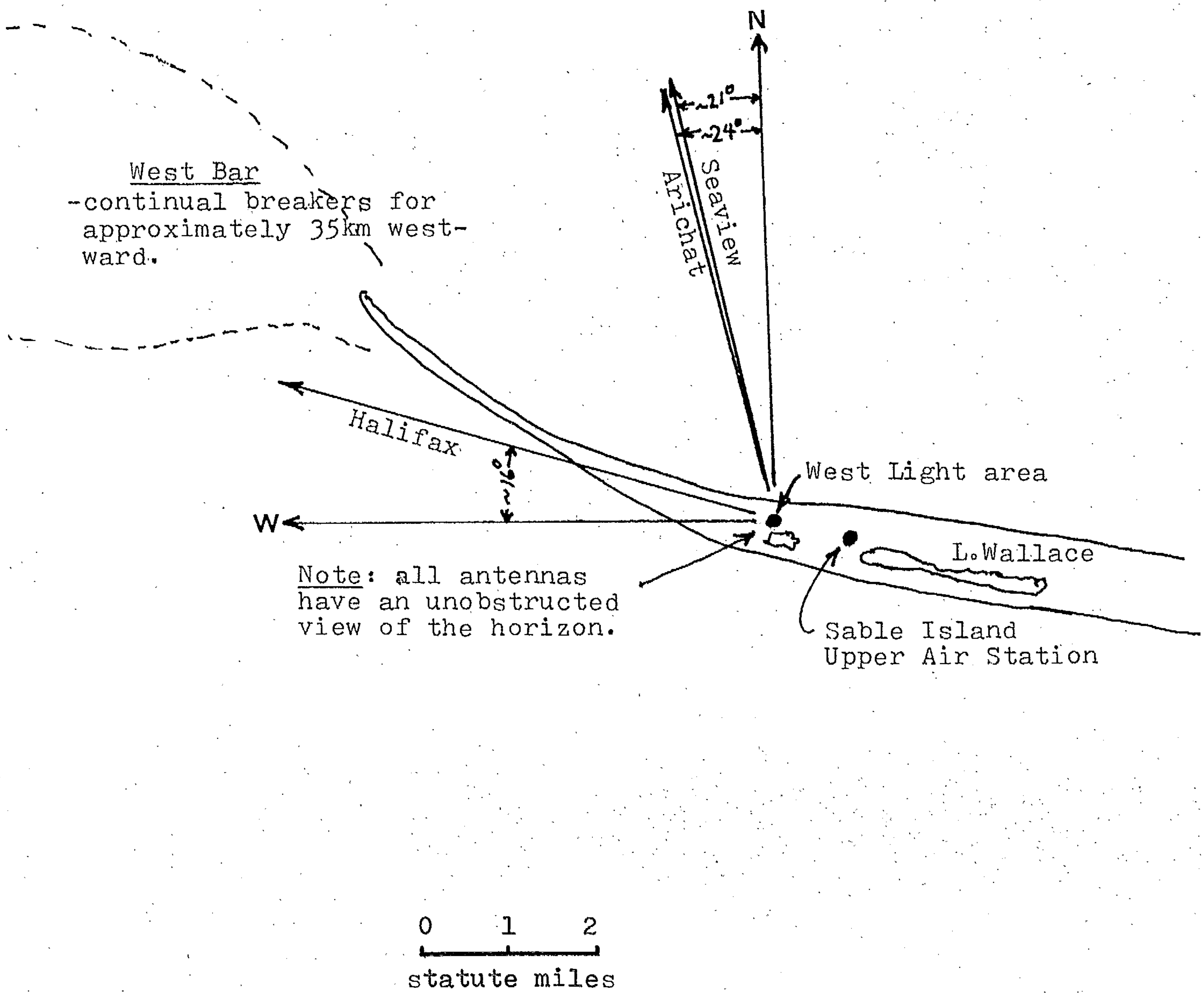


Figure 1.5 General features of the west end of Sable Island.



Chapter 2

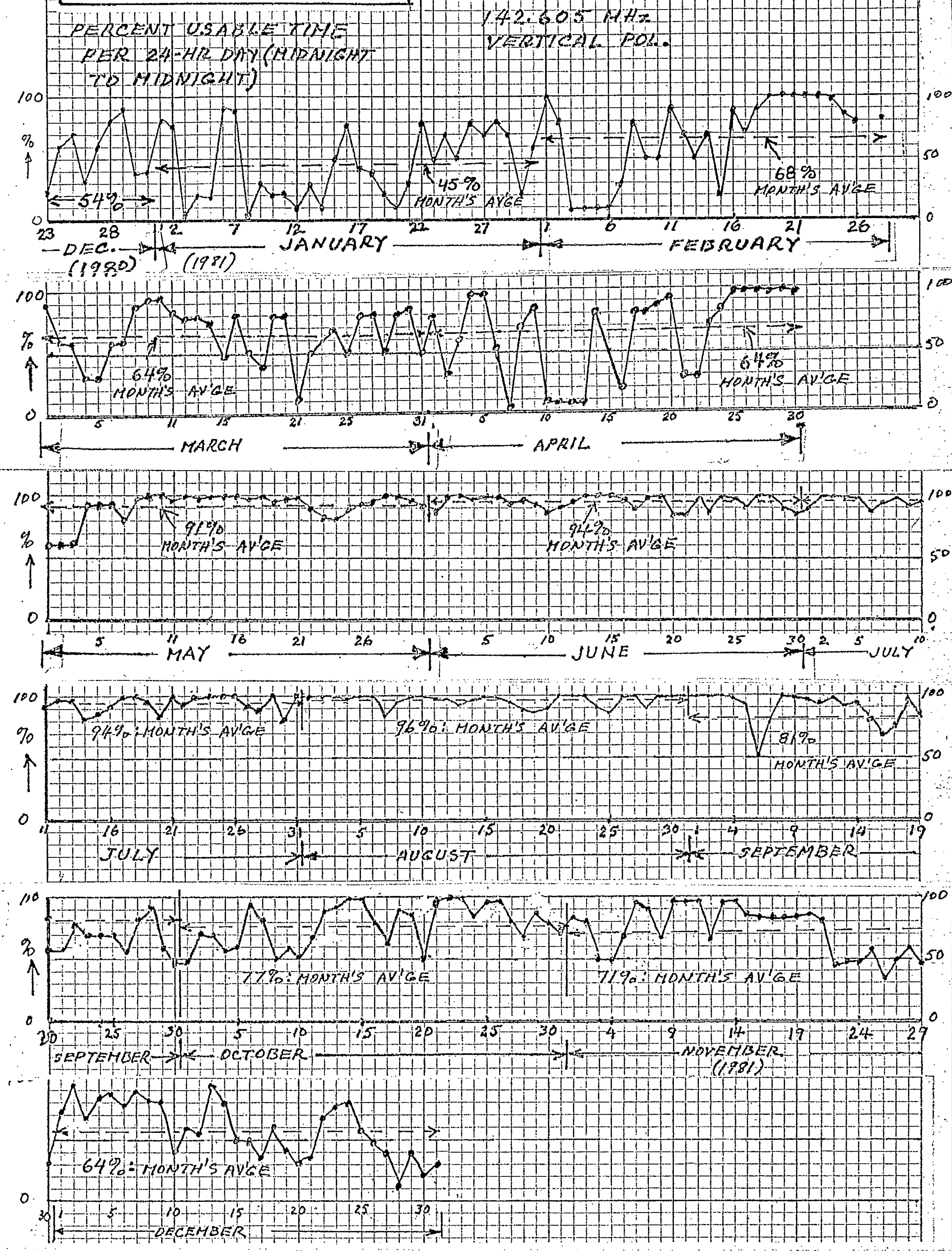
Chapter 2: Propagation statistics for Sable to Seaview on 142.605 MHz, vertically polarized.

2-1 Propagation data for the telephone link from Sable Island to Seaview on 142.605 MHz(vertical polarization) was obtained on an almost continuous basis from December 23,1980 to the time of writing this Report. Each 24-segment of the original chart-recording was examined visually, and an estimate made of 'percentage usuable time' with reference to a 0.2 microvolt datum line as well as with reference to the fading behaviour. Hence, the estimates are rather qualitative, and represent what is thought to be a 'worst case' interpretation of the data. This data is displayed in Figure 2-1. The daily estimates were then averaged for each calendar month, and these monthly averages are shown in Figure 2-2. The monthly averages were then averaged for a 12-month period, giving approximately 75% for the 'percent usuable time' on this link. This is thought to be a 'worst case' value.

2-2 On the basis of several experiments in which chart-recordings were made at higher feed-speeds so that the signal's transition-rates could be observed to within 1 second, it was noted that much of the fading was short-lived(1 second or so) suggesting the conclusion that estimates of usability,as obtained from the normal feed-speed recordings(18"/24 hrs), tended to be too pessimistic by as much as 50%(see paragraph 2-8 in last year's Report) for a period of time marked by frequent fast-fading. Evidently, this correction factor would not apply to periods of time during which there was long-term drop-out of the signal below the 0.2 microvolt datum.

2-3 Hence, the actual value for the 'percent usable time' averaged over one year is thought to be perhaps as much as 10% higher, which would mean that the 'percent usable time' averaged over one year could be as high as 85%.

Figure 2.1: Daily variation in signal strength at Seaview, as estimated from the chart recordings.



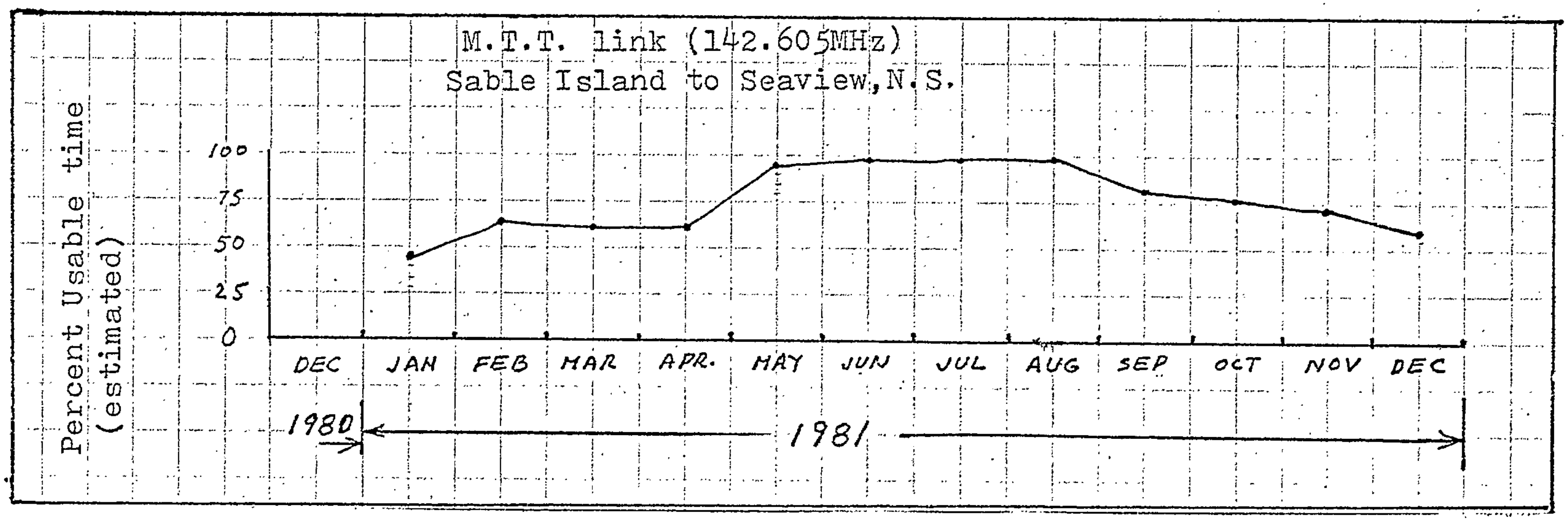


Figure 2.2: Monthly averages of signal strength at Seaview, as estimated from chart recordings.

<u>Note</u>: The average value, from Jan.1/81 to Dec.31/81, is approximately 75%. It is considered to be probable that this estimate represents a 'worst case' value. On the basis that a large proportion of the fading is of relatively short duration(in the context of voice communication), it is considered probable that the annual average could be raised by perhaps as much as 10% for the year 1981.

Chapter 3

Chapter 3: Time-occurrence of Fading on the Sable to Seaview path at two VHF frequencies.

3-1: Observations, with associated statistics, were made at Seaview and Arichat of the time-occurrence of fast fades for purposes of possible diversity configurations to improve the 'percent usable time' on this link. More detailed discussions of the experiments are contained in the Preliminary Reports (Appendices C,E,G, and I of this Final Report). Several configurations of the experiment were employed, as described below.

3-2: Comparison of the signals at Seaview and Arichat on 142.605 MHz. This constituted a simple one-variable diversity experiment, where the geographical separation is thought to be the only significant difference between the two sites. The original data is contained in Appendices C,E, and I, representing approximately 1, 2, and 1 hours, respectively, of observation time. It was found that a significant number of fades at Seaview were not coincident with fades at Arichat, thereby suggesting that diversity could be useful.

In reference to the three experiments, it was observed in the first one that the drop-out time due to fading could have been reduced at Seaview by a factor of about 2, if diversity had been used; in the second, the drop-out time could have been reduced to zero; and in the third, it was estimated that drop-out due to fast-fading could have been reduced by a factor of about 8.

3-3: Comparison of the signals at Seaview at two different antenna heights, at 142.605MHz, vertical polarization. The original data is in Appendix G, and represents an observation of approximately 2½ hours duration. Only a sample of the original chart-recording is included in the Appendix. In general, the experiment indicated that the difference in antenna heights was clearly associated with some non-coincidence between fading events.

It was estimated that of a total of 30 fades in the premium channel(called MTT#1), connected with the top-most antenna on the microwave tower at Seaview, perhaps only 5 of these were fully coincident with fades in the second channel(called MTT#2), connected with an antenna only at the mid-point of the tower. In addition, it was estimated that perhaps another 10 fades in the MTT#1 channel were in partial coincidence with fades in the MTT#2 channel. Here again, a diversity configuration,between antennas at different heights at Seaview, could have reduced the total drop-out time.

3-4: <u>Comparison of signals at Seaview at two different frequencies and two different polarizations.</u> The original data is in Appendix G, representing approximately 2½ hours of observation time. Briefly, the experiment entailed signal strength measurements for two channels:MTT#2(142.605MHz,vert.pol.) and SMU(147.995MHz,hor.pol.). The antennas associated with these receivers are within 2 meters of each other, at the mid-point of the tower. A cursory visual examination of the data indicated that perhaps fewer than 50% of the fades in the two channels coincided significantly. Inasmuch as this experiment is a function of at least two variables--frequency and polarization--the differences in fading behaviour cannot be persuasively ascribed to either one of the variables exclusively.

3-5: <u>Comparison of signals at Seaview combining three variables: frequency, antenna height, and polarization.</u> This experiment, comprising all the results given in Appendix G, combines the observations in paragraphs 3-3 and 3-4 above. In other words, there are three signals being monitored: one on MTT#1(142.605 MHzm vert.pol.), antenna on the top of the tower; one on MTT#2 (142.605MHz, vert.pol.), antenna at the mid-point of the tower; and one on SMU(147.995MHz, hor.pol.), antenna at the mid-point of the tower. The configuration of the experiment was determined primarily from the equipment(receivers and antennas) already in place. In general, it was observed that there was no full coincidence of fading among the three channels. In particular, of 22 fades in the MTT#1 channel, there was only one fade from the remaining channels in full coincidence with MTT#1, and perhaps 5 fades which were in partial coincidence. The observation therefore indicates that at this receiving site, there is a difference in fading behaviour which appears to be a function of frequency, antenna height, and polarization.

Chapter 4

Chapter 4: Miscellaneous Observations

4-1: Comparison of signals from horizontally and circularly polarized antennas on Sable at 147.950MHz and 147.850MHz respectively. The original data for this experiment is found in Appendix D, and represents a semi-quantitative observation inasmuch as no chart recordings were produced for the circularly polarized signal. The experiment was performed to enable a preliminary look at the possibility of significant differences in fading between plane(horizontal) and circular polarization on the Sable to Halifax path. It should be noted that the channel involving circular polarization actually consisted of only one circularly polarized antenna: the one on Sable. The receiving antenna at SMU on this channel(147.850MHz) was horizontally polarized, it being assumed that this arrangement would give at least some indication of a difference between the two channels. It is also being assumed that the difference in frequency between the two channels is not significant. The fact that the receiving antenna on 147.850MHz was horizontally rather than circularly polarized stemmed from the fact that this was the only antennna available at the time.

The experiment, consisting of some 20 observations, each of approximately 5 minutes duration, was performed during the latter part of April and the early part of May,1981. In general, it was observed that there was a noticeable difference between the two channels in terms of fading behaviour, and that the signal from the circularly polarized antenna on Sable had noticeably less fading associated with it than the signal from the horizontally polarized source.

4-2: <u>Comparison of signals on VHF and UHF on the Sable to Halifax path</u>. Appendices F and H contain reports and data on preliminary experiments to compare VHF(147.950MHz) and UHF(431.990, and later, 431.950 MHz) reception on the Sable to Halifax path. In both channels, horizontal polarization was used.

The first experiment, in Appendix F, compares signal strength at two different locations in the Halifax area: the VHF signal was monitored at SMU, but the UHF signal was monitored at the residence of Mr. Elmer Naugler . A receiving system on UHF at SMU was not available at this time. Supplementary observations were made by Mr. Robert Schultz.

The second experiment, in Appendix H, compares signal strength at SMU(the UHF frequency was now 431.950MHz) for both channels, and represents reception at antennas located within a couple of meters of each other. In addition, some further data was obtained at various times during the winter of 1981-2; some of this data is in the form of chart recordings, and some as occasional listening tests.

In general, it has been observed that the UHF signal has been noticeably more intense and noticeably less marked by fast fading than the VHF signal. This was especially apparent during the winter, during which time the VHF signal was often not detectible, whereas the UHF signal was almost always detectible. Although the difference in antenna gains might be adduced as a reason for the difference in intensity, it should be noted that the UHF antenna's optic axis is at least 6° south of the line joining Sable to SMU. If the frequency-dependent path losses are also taken into account, then a very approximate calculation(free space model) suggests that there should be an approximate equality between the VHF and UHF in this case. Hence, the observed superiority of the UHF propagation in this case is considered to be anomalous.

By way of footnote, Mr. Schultz's observations conformed the orientation of the UHF's beacon.

Chapter 5

Chapter 5: Conclusions and Recommendations

5-1: On the basis of the observations in Chapter 1, it could be concluded that the available weather data shows no correlation with the propagation data, especially in reference to sudden enhancements in signal level. There could be, however, some non-insignificant correlation between precipitation(as reported for the surface), but a more detailed analysis of the 'data panels' would be required. Presumably, given the relatively large geographical area, there could be precipitation events(localized) along the progagation paths which would not be observed at the weather-reporting sites.

In reference to possible dependence on polarization, the VHF data for the Sable to Canso Straits path does not exhibit any readily discernable difference. The comparison, of course, is complicated by the fact that the two MTT receivers are accessed in such a way that the signal-strength voltage is taken from a point in the circuit after limiting. Hence, on the basis of the available data, polarization is not relevant. It should be noted, however, that the data is being examined in such a way that short-term depolarization effects--in the order of a few seconds--would not be apparent in the course of a cursory examination of the data. Hence, depolarization could be present, but on a short time-scale.

5-2: On the basis of the observations in Chapter 2, there is a marked seasonal dependence of signal strength on VHF between Sable and the Canso Straits area, going from virtually 100% usability in the summer months to, perhaps, 50% in the winter. A 'worst case' average value for the year appears to be in the order of 75%. If account is taken of the fact that most of the fades are relatively fast(1 second or so in duration), then the average value for the year could possibly be as high as 85%, and this value is predicated on single-channel reception.

5-3: On the basis of the observations in Chapter 3, it could be concluded that fast-fades on VHF for the Sable to Seaview/Arichat path show noticeable dependence on geographical separation, antenna height, and some combination of frequency and polarization. Hence, a multi-channel receiver system, in a diversity configuration, should show a marked decrease in fast-fading in the combined system.

5-4: On the basis of the observations in Chapter 4, it could be concluded that circularly polarized radiation on VHF from Sable to Halifax is noticeably less prone to fast-fading than is the horizontally polarized radiation. Concerning VHF compared with UHF, it could be concluded that UHF on the Sable to Halifax path is also less prone to fast-fading than is the VHF. In addition, the UHF propagation appears to be less prone to slow fading(in the order of tens of minutes) than is the VHF.

Recommendations

1. Continue data acquisition on VHF for the Seaview, Arichat, and Halifax sites, to obtain improved statistics.
2. Undertake a more detailed analysis of the available data to obtain some quantitative indication of the correlation between discontinuities in propagation and discontinuities in weather(surface).
3. Obtain upper-atmosphere data for 1981(especially the summer) for the Sable Island area, with a view to correlating temperature inversions with sudden enhancements in propagation.
4. Perform more detailed observations on possible depolarization events on VHF and UHF.
5. Obtain vertical-profile weather data on the west end of Sable Island to enable a more detailed discussion of 'duct-assisted' propagation over the Sable to Nova Scotia mainland path.
6. On the condition that a diversity system is installed(by MTT) between Seaview and Arichat, monitor the diversity system to determine the expected improvement in fast-fade compensation.

7. Undertake observations in the 23cm band(1296MHz Amateur band) on the Sable to Halifax path, to determine a possible upper limit on the anomalous propagation observed on 70cm.

Appendix A

Appendix A

This Appendix contains 'check-lists' of available charts on each 'data panel'.

A daily 'data panel' is a montage of graphs and chart recordings displaying propagation and surface-weather('met') data, as available. In some instances, the 'met' and/or propagation data was not or is not available, either in part or in whole, for that particular day. The check-list indicates, therefore, the current status(at the time of writing this Report) of each daily 'data panel'. In the case of surface 'met' data, lacunae might be filled at some later time as data becomes available from the appropriate data-gathering agency. The original 'data panels' are being stored in the Archives of the Principal Investigator, and are available for inspection and/or copying.

The various charts and recordings for a given day are always placed in the same position on each 'data panel'(except for May 1/81 to May 7/81) to facilitate comparison between 'data panels'. The panels for all of May, June, and October, 1981, as well as July 1 to July 24, 1981, are considered to be complete, in the sense that all the presecribed surface 'met' and propagation data was available(a total of 10 charts per panel). These particular panels have been photographed, and the reduced-size prints are given in Appendix B of this Report. Although the reduction(from 136x90 to 10x6.5 cm) renders most of the alpha-numeric characters illegible, the general trends in propagation and surface weather are easily discernable, and a closer study is possible by either examining the original panels or perhaps obtaining larger(and more legible) prints from the film negatives. Hence, these reduced-size 'data panel' photographs function primarily as a 'table of contents' or 'index' to the original panels.

Check-list of available charts on each daily 'data panel'

	Propagation data								Weather data (surface)				
DAY	SABLE TO SEAVIEW 142.605(V)	SABLE TO SEAVIEW 147.995(H)	SABLE TO HALIFAX 147.950(H)	SABLE TO ARICHAT 142.605(V)	SABLE TO HALIFAX				SABLE	EDDY POINT	SHEAR-WATER		
1	—	—	✓	—									
2	—	—	✓	—									
3	—	—	—	—									
4	—	—	✓	—									
5	—	—	✓	—									
6	—	—	✓	—									
7	✓	—	—	—									
8	✓	—	✓	—									
9	✓	—	✓	—									
10	✓	—	✓	—									
11	✓	—	✓	—									
12	✓	—	✓	—									
13	✓	—	✓	—									
14	✓	—	✓	—									
15	✓	—	✓	—									
16	✓	—	✓	—									
17	P	—	P	—									
18	✓	—	✓	—									
19	✓	—	✓	—									
20	✓	—	✓	—									
21	✓	—	✓	—									
22	P	—	✓	—									
23	✓	—	✓	—									
24	✓	—	P	—									
25	✓	—	—	—									
26	✓	—	—	—									
27	✓	—	—	—									
28	✓	—	—	—									
29	✓	—	—	—									
30	✓	—	—	—									
31	✓	—	—	—									

Key: P=data partially available(i.e. incomplete)

Check-list of available charts on each daily 'data panel'

	Propagation data								Weather data (surface)				
DAY	SABLE TO SEAVIEW 142.605(V)	SABLE TO SEAVIEW 147.995(H)	SABLE TO HALIFAX 147.950(H)	SABLE TO ARICHAT 142.605(V)	SABLE TO HALIFAX				SABLE	EDDY POINT	SHEAR-WATER		
1	✓	—	—	—									
2	—	—	—	—									
3	✓	—	—	—									
4	✓	—	—	—									
5	✓	—	—	—									
6	✓	—	—	—									
7	✓	—	—	—									
8	✓	—	—	—									
9	✓	—	—	—									
10	✓	—	—	—									
11	✓	—	—	—									
12	✓	—	—	—									
13	✓	—	—	—									
14	✓	—	—	—									
15	✓	—	—	—									
16	✓	—	—	—									
17	✓	—	—	—									
18	✓	—	—	—									
19	✓	—	—	—									
20	✓	—	—	—									
21	✓	—	—	—									
22	✓	—	—	—									
23	✓	—	—	—									
24	✓	—	—	—									
25	✓	—	—	—									
26	✓	—	—	—									
27	P	—	—	—									
28	✓	—	—	—									
29													
30													
31													

Check-list of available charts on each daily 'data panel'

	Propagation data								Weather data (surface)				
DAY	SABLE TO SEAVIEW 142.605(V)	SABLE TO SEAVIEW 147.995(H)	SABLE TO HALIFAX 147.950(H)	SABLE TO ARICHAT 142.605(V)	SABLE TO HALIFAX				SABLE	EDDY POINT	SHEAR-WATER		
1	✓	—	—	—									
2	✓	—	—	—									
3	✓	—	—	—									
4	✓	—	—	—									
5	✓	—	—	—									
6	✓	—	—	—									
7	✓	—	—	—									
8	✓	—	—	—									
9	✓	—	—	—									
10	✓	—	—	—									
11	✓	—	—	—									
12	✓	—	—	—									
13	✓	—	—	—									
14	✓	—	—	—									
15	✓	—	—	—									
16	✓	—	—	—									
17	✓	—	—	—									
18	✓	—	—	—									
19	✓	—	—	—									
20	✓	—	—	—									
21	✓	—	—	—									
22	✓	—	—	—									
23	✓	—	—	—									
24	✓	—	—	—									
25	✓	—	—	—									
26	✓	—	—	—									
27	✓	—	—	—									
28	✓	—	—	—									
29	✓	—	—	—									
30	✓	—	—	—									
31	✓	—	—	—									

Month: April :Year: 1981 Appendix A

Check-list of available charts on each daily 'data panel'

DAY	Propagation data: SABLE TO SEAVIEW 142.605(V)	SABLE TO SEAVIEW 147.995(H)	SABLE TO HALIFAX 147.950(H)	SABLE TO ARICHAT 142.605(V)					Weather data (surface): SABLE	EDDY POINT	SHEAR-WATER		
1	✓	—	—	—					✓	✓	✓		
2	✓	—	—	P					✓	✓	✓		
3	✓	—	—	✓					✓	✓	✓		
4	✓	—	P	✓					✓	✓	✓		
5	✓	—	✓	✓					✓	✓	✓		
6	✓	—	✓	✓					✓	✓	✓		
7	✓	—	✓	✓					✓	✓	✓		
8	✓	—	✓	✓					✓	✓	✓		
9	✓	—	✓	✓					✓	✓	✓		
10	✓	—	✓	✓					✓	✓	✓		
11	✓	—	✓	✓					✓	✓	✓		
12	✓	—	✓	✓					✓	✓	✓		
13	✓	—	✓	✓					✓	✓	✓		
14	✓	—	✓	✓					✓	✓	✓		
15	✓	—	✓	✓					✓	✓	✓		
16	✓	—	✓	✓					✓	✓	✓		
17	✓	—	✓	✓					✓	✓	✓		
18	✓	—	✓	✓					✓	✓	✓		
19	✓	—	✓	✓					✓	✓	✓		
20	✓	—	✓	✓					✓	✓	✓		
21	✓	—	✓	✓					✓	✓	✓		
22	✓	—	✓	✓					✓	✓	✓		
23	✓	—	✓	✓					✓	✓	✓		
24	✓	—	✓	✓					✓	✓	✓		
25	✓	—	✓	✓					✓	✓	✓		
26	✓	—	✓	✓					✓	✓	✓		
27	✓	—	✓	✓					✓	✓	✓		
28	✓	—	✓	✓					✓	✓	✓		
29	✓	—	✓	✓					✓	✓	✓		
30	✓	—	✓	✓					✓	✓	✓		
31													

Check-list of available charts on each daily 'data panel'

	Propagation data				Weather data (surface)		
DAY	SABLE TO SEAVIEW 142.605(V)	SABLE TO SEAVIEW 147.995(H)	SABLE TO HALIFAX 147.950(H)	SABLE TO ARICHAT 142.605(V)	SABLE	EDDY POINT	SHEAR-WATER
1	✓	—	✓	✓	✓	P	P
2	✓	—	✓	✓	✓	P	P
3	✓	—	✓	✓	✓	P	P
4	✓	—	✓	✓	✓	P	P
5	✓	—	✓	✓	✓	✓	✓
6	✓	—	✓	✓	✓	✓	✓
7	✓	—	✓	✓	✓	✓	✓
8	✓	P	✓	✓	✓	✓	✓
9	✓	✓	✓	✓	✓	✓	✓
10	✓	✓	✓	✓	✓	✓	✓
11	✓	✓	✓	✓	✓	✓	✓
12	✓	✓	✓	✓	✓	✓	✓
13	✓	✓	P	✓	✓	✓	✓
14	✓	✓	P	✓	✓	✓	✓
15	✓	✓	✓	✓	✓	✓	✓
16	✓	✓	✓	✓	✓	✓	✓
17	✓	✓	✓	✓	✓	✓	✓
18	✓	✓	✓	✓	✓	✓	✓
19	✓	✓	✓	✓	✓	✓	✓
20	✓	✓	✓	✓	✓	✓	✓
21	✓	✓	P	✓	✓	✓	✓
22	✓	✓	P	✓	✓	✓	✓
23	✓	✓	—	✓	✓	✓	✓
24	✓	✓	—	✓	✓	✓	✓
25	✓	✓	P	✓	✓	✓	P
26	✓	✓	✓	✓	✓	✓	✓
27	✓	✓	✓	✓	✓	✓	✓
28	✓	✓	✓	✓	✓	✓	✓
29	✓	✓	✓	✓	✓	P	✓
30	✓	✓	✓	✓	✓	✓	✓
31	✓	✓	✓	✓	✓	✓	✓

Check-list of available charts on each daily 'data panel'

	Propagation data								Weather data (surface)				
DAY	SABLE TO SEAVIEW 142.605(V)	SABLE TO SEAVIEW 147.995(H)	SABLE TO HALIFAX 147.950(H)	SABLE TO ARICHAT 142.605(V)					SABLE	EDDY POINT	SHEAR-WATER		
1	✓	✓	✓	✓					✓	✓	✓		
2	✓	✓	✓	✓					✓	✓	✓		
3	✓	✓	✓	✓					✓	P	✓		
4	✓	✓	P	✓					✓	✓	✓		
5	✓	✓	P	✓					✓	✓	✓		
6	✓	✓	P	✓					✓	✓	✓		
7	✓	✓	P	✓					✓	✓	✓		
8	✓	✓	✓	✓					✓	✓	✓		
9	✓	✓	✓	✓					✓	P	✓		
10	✓	✓	✓	✓					✓	✓	✓		
11	✓	✓	✓	✓					✓	✓	✓		
12	✓	✓	P	✓					✓	P	✓		
13	✓	✓	—	✓					✓	✓	✓		
14	✓	✓	—	✓					✓	✓	✓		
15	✓	✓	P	✓					✓	✓	✓		
16	✓	✓	✓	✓					✓	✓	✓		
17	✓	✓	✓	✓					✓	✓	✓		
18	✓	✓	✓	✓					✓	P	✓		
19	✓	✓	✓	✓					✓	✓	✓		
20	✓	✓	✓	✓					✓	✓	✓		
21	✓	✓	✓	✓					✓	✓	✓		
22	✓	✓	✓	✓					✓	✓	✓		
23	✓	✓	✓	✓					✓	✓	✓		
24	✓	✓	✓	✓					✓	P	✓		
25	✓	✓	✓	✓					✓	✓	✓		
26	✓	✓	✓	✓					✓	P	✓		
27	✓	✓	✓	✓					✓	✓	✓		
28	✓	✓	✓	✓					✓	✓	✓		
29	✓	✓	✓	✓					✓	✓	✓		
30	✓	✓	✓	✓					✓	✓	✓		
31													

Month: July :Year:1981 Appendix A

Check-list of available charts on each daily 'data panel'

	Propagation data							Weather data (surface)				
DAY	SABLE TO SEAVIEW 142.605(V)	SABLE TO SEAVIEW 147.995(H)	SABLE TO HALIFAX 147.950(H)	SABLE TO ARICHAT 142.605(V)				SABLE	EDDY POINT	SHEAR-WATER		
1	✓	✓	✓	✓				✓	✓	✓		
2	✓	✓	✓	✓				✓	✓	P		
3	✓	✓	✓	✓				P	✓	✓		
4	✓	✓	✓	✓				P	✓	✓		
5	✓	✓	✓	✓				P	P	P		
6	✓	✓	✓	✓				P	P	P		
7	✓	✓	✓	✓				P	✓	P		
8	✓	✓	✓	✓				✓	P	✓		
9	✓	✓	✓	✓				✓	✓	✓		
10	✓	✓	✓	✓				✓	✓	✓		
11	✓	✓	✓	✓				✓	✓	P		
12	✓	✓	✓	✓				✓	✓	✓		
13	✓	✓	✓	✓				✓	✓	P		
14	✓	✓	✓	✓				✓	✓	P		
15	✓	✓	✓	✓				P	P	✓		
16	✓	✓	✓	✓				✓	P	✓		
17	✓	✓	✓	✓				P	P	✓		
18	✓	✓	✓	✓				P	✓	✓		
19	✓	✓	✓	✓				P	P	P		
20	✓	✓	✓	✓				✓	✓	✓		
21	✓	✓	✓	✓				✓	✓	✓		
22	✓	✓	P	✓				P	✓	✓		
23	✓	✓	—	✓				✓	✓	✓		
24	✓	✓	✓	✓				✓	✓	✓		
25	✓	✓	✓	✓				P	✓	✓		
26	✓	✓	✓	✓					P			
27	✓	✓	✓	✓					P			
28	✓	✓	✓	✓					✓			
29	✓	✓	✓	✓					✓			
30	✓	✓	✓	✓					✓			
31	✓	P	✓	✓								

Check-list of available charts on each daily 'data panel'

	Propagation data								Weather data (surface)				
DAY	SABLE TO SEAVIEW 142.605(V)	SABLE TO SEAVIEW 147.995(H)	SABLE TO HALIFAX 147.950(H)	SABLE TO ARICHAT 142.605(V)					SABLE	EDDY POINT	SHEAR-WATER		
1	✓	✓	✓	✓					P		P		
2	✓	✓	P	✓					✓		✓		
3	✓	✓	✓	✓					✓		✓		
4	✓	✓	✓	✓					✓		✓		
5	✓	✓	✓	✓					✓		✓		
6	✓	✓	—	✓					✓		✓		
7	✓	✓	✓	✓					✓		✓		
8	✓	✓	✓	✓					✓		✓		
9	✓	✓	✓	✓					✓		✓		
10	✓	✓	✓	✓					✓		✓		
11	✓	✓	✓	✓					✓		✓		
12	✓	✓	✓	✓					✓		✓		
13	✓	✓	✓	✓					✓		✓		
14	✓	✓	✓	✓					✓		✓		
15	✓	✓	P	✓					✓		✓		
16	✓	✓	✓	✓					✓		✓		
17	✓	✓	✓	✓					✓		✓		
18	✓	✓	—	✓					✓		✓		
19	✓	✓	—	✓					✓		✓		
20	✓	✓	—	✓					✓		✓		
21	✓	✓	—	✓					✓		✓		
22	✓	✓	—	✓					✓		✓		
23	✓	✓	—	✓					✓		✓		
24	✓	✓	—	✓					✓		✓		
25	✓	✓	—	✓					✓		✓		
26	✓	✓	P	✓					✓		✓		
27	✓	✓	✓	✓					✓		✓		
28	✓	✓	✓	✓					✓		✓		
29	✓	✓	✓	✓					✓		✓		
30	✓	✓	✓	✓					✓		✓		
31	✓	✓	✓	✓					✓		✓		

Check-list of available charts on each daily 'data panel'

	Propagation data								Weather data (surface)				
DAY	SABLE TO SEAVIEW 142.605(Y)	SABLE TO SEAVIEW 147.995(H)	SABLE TO HALIFAX 147.950(H)	SABLE TO ARICHAT 142.605(Y)				SABLE	EDDY POINT	SHEAR-WATER		
1	✓	✓	✓	✓				✓		✓		
2	✓	✓	✓	✓				✓		✓		
3	✓	✓	✓	✓				✓		✓		
4	✓	✓	✓	✓				✓		✓		
5	✓	✓	✓	✓				✓		✓		
6	✓	✓	✓	✓				✓		✓		
7	✓	✓	✓	✓				✓		✓		
8	✓	✓	✓	✓				✓		✓		
9	✓	✓	✓	✓				✓		✓		
10	✓	✓	✓	✓				✓		✓		
11	✓	✓	✓	✓				✓		✓		
12	✓	✓	✓	✓				✓		✓		
13	✓	✓	✓	✓				✓		✓		
14	✓	✓	✓	✓				✓		✓		
15	✓	✓	✓	✓				✓		✓		
16	✓	✓	✓	✓				✓		✓		
17	✓	✓	✓	✓				✓		✓		
18	✓	✓	✓	✓				✓		✓		
19	✓	✓	✓	✓				✓		✓		
20	✓	✓	✓	✓				✓		✓		
21	✓	✓	✓	✓				✓		✓		
22	✓	✓	✓	✓				✓		✓		
23	✓	✓	✓	✓				✓		✓		
24	✓	✓	✓	✓				✓		✓		
25	✓	✓	✓	✓				✓		✓		
26	✓	✓	✓	✓				✓		✓		
27	✓	✓	✓	✓				✓		✓		
28	✓	✓	✓	✓				✓		✓		
29	✓	✓	✓	✓				✓		✓		
30	✓	✓	✓	✓				✓		✓		
31												

Month: October :Year: 1981 Appendix A

Check-list of available charts on each daily 'data panel'

	Propagation data							Weather data (surface)				
DAY	SABLE TO SEAVIEW 142.605(V)	SABLE TO SEAVIEW 147.995(H)	SABLE TO HALIFAX 147.950(H)	SABLE TO ARICHAT 142.605(V)				SABLE	EDDY POINT	SHEAR-WATER		
1	✓	✓	✓	✓				✓	P	✓		
2	✓	✓	✓	✓				✓	✓	✓		
3	✓	✓	✓	✓				✓	✓	✓		
4	✓	✓	✓	✓				✓	✓	✓		
5	✓	✓	✓	✓				✓	✓	✓		
6	✓	✓	✓	✓				✓	✓	✓		
7	✓	✓	✓	✓				✓	✓	✓		
8	✓	✓	✓	✓				✓	✓	✓		
9	✓	✓	✓	✓				✓	✓	✓		
10	✓	✓	✓	✓				✓	✓	✓		
11	✓	✓	P	✓				✓	✓	✓		
12	✓	✓	✓	✓				✓	✓	✓		
13	✓	✓	✓	✓				✓	✓	✓		
14	✓	✓	✓	✓				✓	✓	✓		
15	✓	✓	✓	✓				✓	✓	✓		
16	✓	✓	✓	✓				✓	✓	✓		
17	✓	✓	✓	✓				✓	✓	✓		
18	✓	✓	✓	✓				✓	✓	✓		
19	✓	✓	✓	✓				✓	✓	✓		
20	✓	✓	✓	✓				✓	✓	✓		
21	✓	✓	✓	✓				✓	✓	P		
22	✓	✓	✓	✓				✓	✓	P		
23	✓	✓	✓	✓				✓	✓	✓		
24	✓	✓	✓	✓				✓	✓	✓		
25	✓	✓	✓	✓				✓	✓	✓		
26	✓	✓	✓	✓				✓	✓	✓		
27	✓	✓	✓	✓				✓	✓	✓		
28	✓	✓	✓	✓				✓	✓	✓		
29	✓	✓	✓	✓				✓	✓	✓		
30	✓	✓	✓	✓				✓	✓	✓		
31	✓	✓	✓	✓				✓	✓	✓		

Check-list of available charts on each daily 'data panel'

	Propagation data								Weather data (surface)				
DAY	SABLE TO SEAVIEW 142.605(V)	SABLE TO SEAVIEW 147.995(H)	SABLE TO HALIFAX 147.950(H)	SABLE TO ARICHAT 142.605(V)					SABLE	EDDY POINT	SHEAR-WATER		
1	✓	✓	✓	✓									
2	✓	✓	✓	✓									
3	✓	✓	✓	✓									
4	✓	✓	✓	✓									
5	✓	✓	✓	✓									
6	✓	✓	✓	✓									
7	✓	✓	✓	✓									
8	✓	✓	✓	✓									
9	✓	✓	✓	✓									
10	✓	✓	✓	✓									
11	✓	✓	✓	✓									
12	✓	✓	✓	✓									
13	✓	✓	✓	✓									
14	✓	✓	✓	✓									
15	✓	✓	✓	✓									
16	✓	✓	✓	✓									
17	✓	✓	✓	✓									
18	✓	✓	✓	✓									
19	✓	✓	✓	✓									
20	✓	✓	✓	✓									
21	✓	✓	✓	✓									
22	✓	✓	✓	✓									
23	✓	✓	✓	✓									
24	✓	✓	✓	✓									
25	✓	✓	✓	✓									
26	✓	✓	✓	✓									
27	✓	✓	✓	✓									
28	✓	✓	✓	✓									
29	✓	✓	✓	✓									
30	✓	✓	✓	✓									
31													

Check-list of available charts on each daily 'data panel'

	Propagation data							Weather data (surface)				
DAY	SABLE TO SEAVIEW 142.605(V)	SABLE TO SEAVIEW 147.995(H)	SABLE TO HALIFAX 147.950(H)	SABLE TO ARICHAT 142.605(V)				SABLE	EDDY POINT	SHEAR-WATER		
1	✓	✓	✓	✓								
2	✓	✓	✓	✓								
3	✓	✓	✓	✓								
4	✓	✓	✓	✓								
5	✓	✓	✓	✓								
6	✓	✓	✓	✓								
7	✓	✓	✓	✓								
8	✓	P	✓	P								
9	✓	✓	✓	✓								
10	✓	✓	✓	✓								
11	✓	✓	✓	✓								
12	✓	✓	✓	✓								
13	✓	✓	✓	✓								
14	✓	✓	✓	✓								
15	✓	✓	✓	✓								
16	✓	✓	✓	✓								
17	✓	✓	✓	✓								
18	✓	✓	✓	✓								
19	✓	✓	✓	✓								
20	✓	✓	✓	✓								
21	✓	✓	✓	✓								
22	✓	✓	✓	✓								
23	✓	✓	✓	✓								
24	✓	✓	✓	✓								
25	✓	✓	✓	✓								
26	✓	✓	✓	✓								
27	✓	✓	✓	✓								
28	✓	✓	✓	✓								
29	✓	✓	✓	✓								
30	✓	✓	✓	✓								
31	✓	✓	✓	✓								

Check-list of available charts on each daily 'data panel'

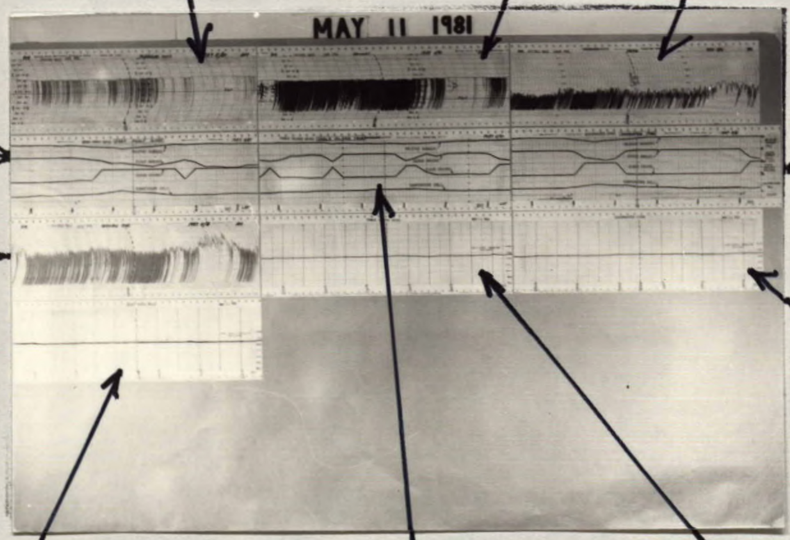
	Propagation data								Weather data (surface)				
DAY	SABLE TO SEAVIEW 142.605(V)	SABLE TO SEAVIEW 147.995(H)	SABLE TO HALIFAX 147.950(H)	SABLE TO ARICHAT 142.605(V)					SABLE	EDDY POINT	SHEAR-WATER		
1	✓	✓	✓	✓									
2	✓	✓	✓	✓									
3	✓	✓	✓	✓									
4	✓	✓	✓	✓									
5	✓	✓	✓	✓									
6	✓	✓	✓	✓									
7	✓	✓	✓	✓									
8	✓	✓	✓	✓									
9	✓	✓	✓	✓									
10	✓	✓	✓	✓									
11	✓	✓	✓	✓									
12	✓	✓	✓	✓									
13	✓	✓	✓	✓									
14	✓	✓	✓	✓									
15	✓	✓	✓	✓									
16	✓	✓	✓	✓									
17	✓	✓	✓	✓									
18	✓	✓	✓	✓									
19	✓	✓	✓	✓									
20	P	P	✓	P									
21			P										
22													
23													
24													
25													
26													
27													
28													
29													
30													
31													

Appendix B

Appendix B

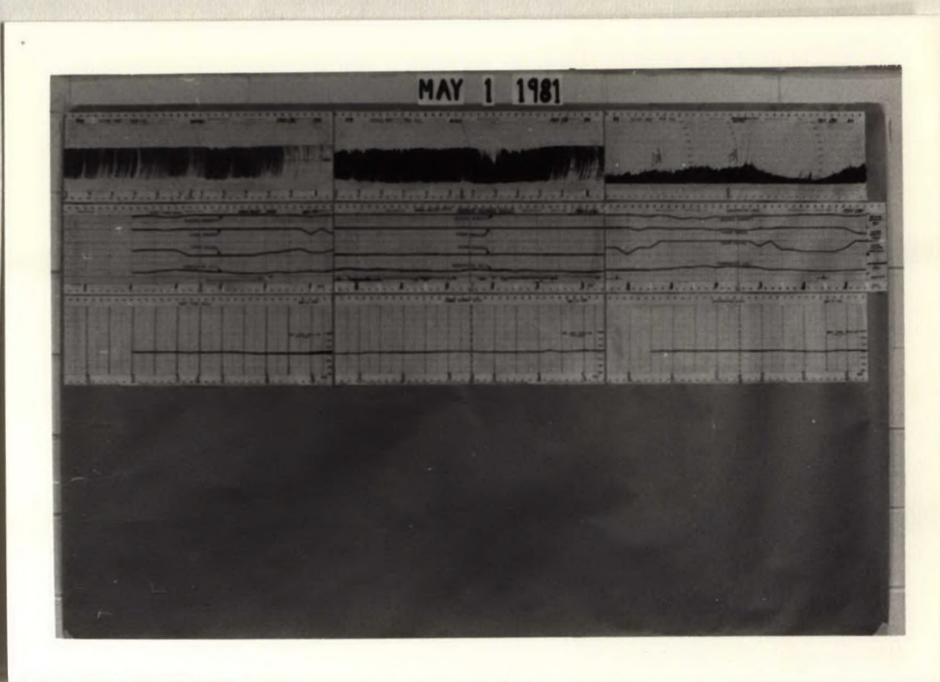
This Appendix contains photographic copies of the original 'data panels'. The originals are approximately 136x90cm.

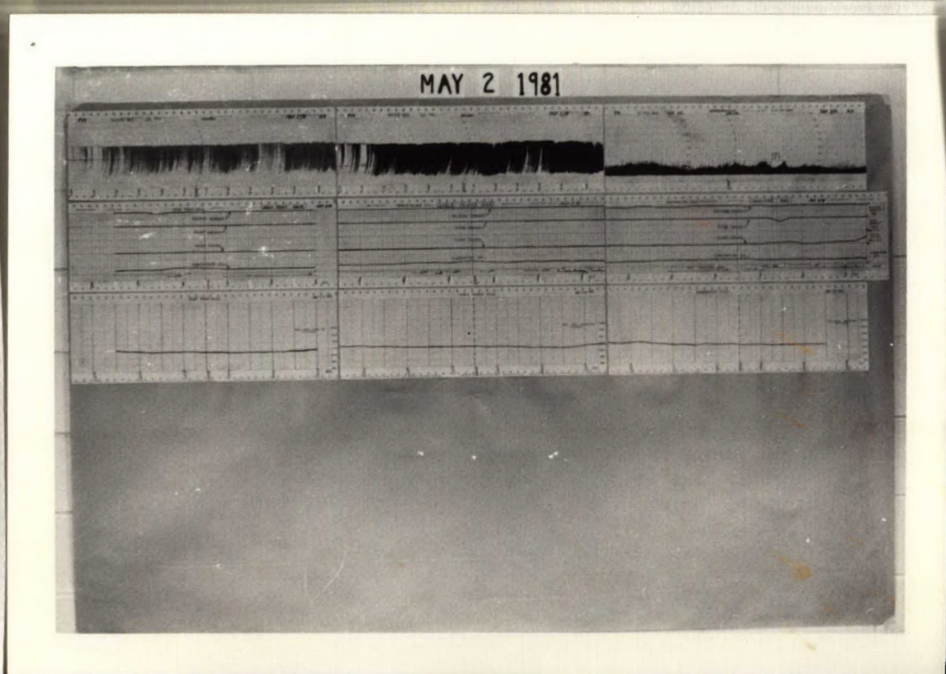
The panel for May 11, 1981 is employed as an example showing the identity of each chart on a panel. Note that the panels for May 1/81 to May 7/81, inclusive, have the Eddy Point graph for sea-level pressure located where the Seaview reception on 147.995MHz is located in subsequent panels. The blank area at the bottom of the panel is to allow for inclusion of additional data at some future date.



<u>Note #1</u>: This chart displays the following(top to bottom): relative humidity; cloud amount, cloud ceiling, temperature (°C), and precipitation, etc.(known as SIGMET data).

<u>Note #2</u>: This chart displays sea-level pressure only.


MAY 1 1981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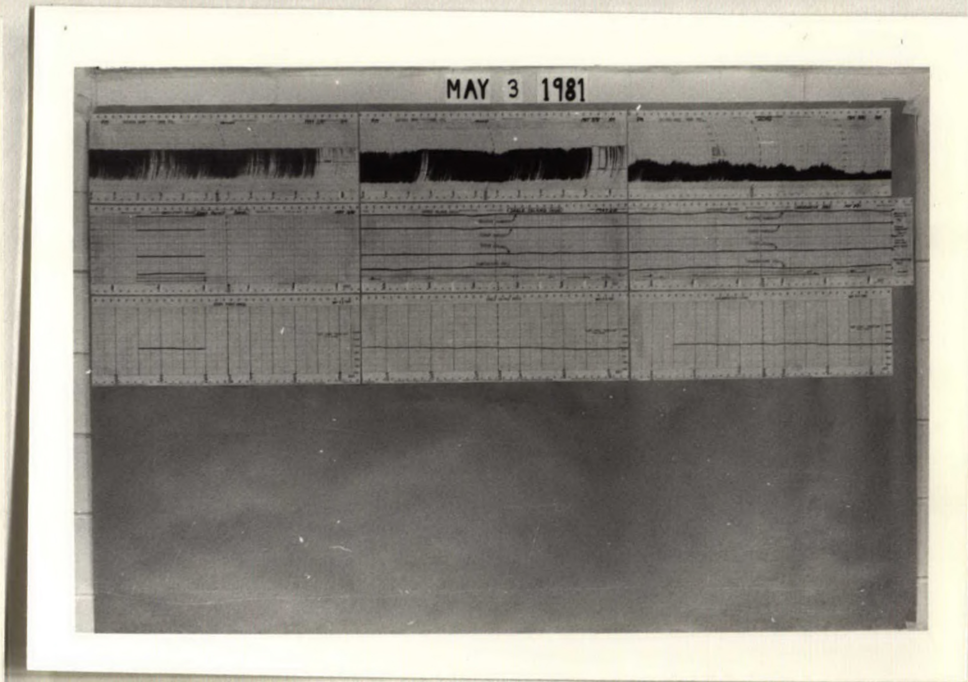
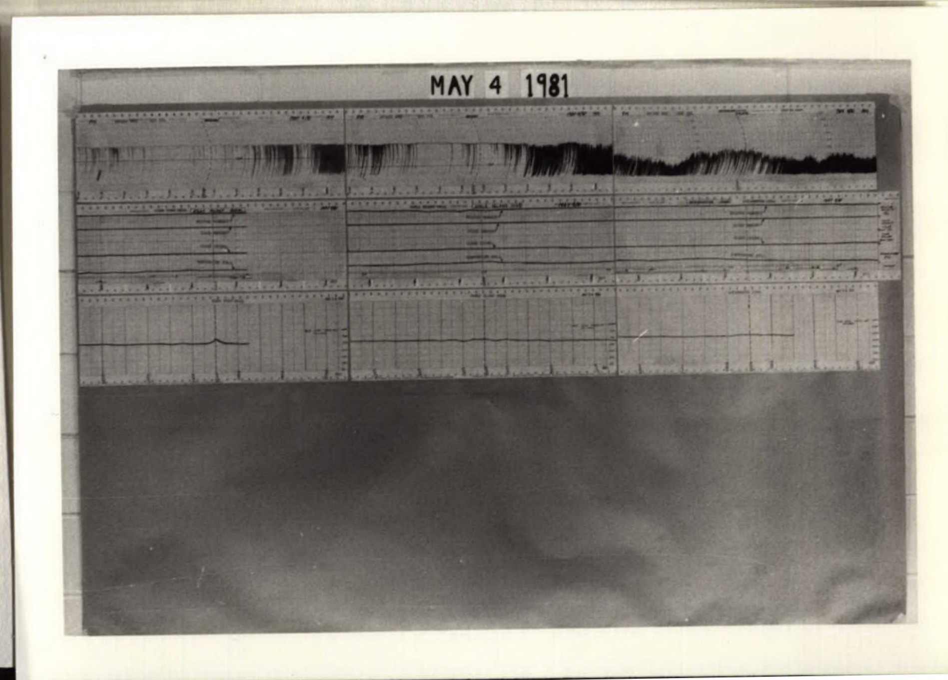

MAY 3 1981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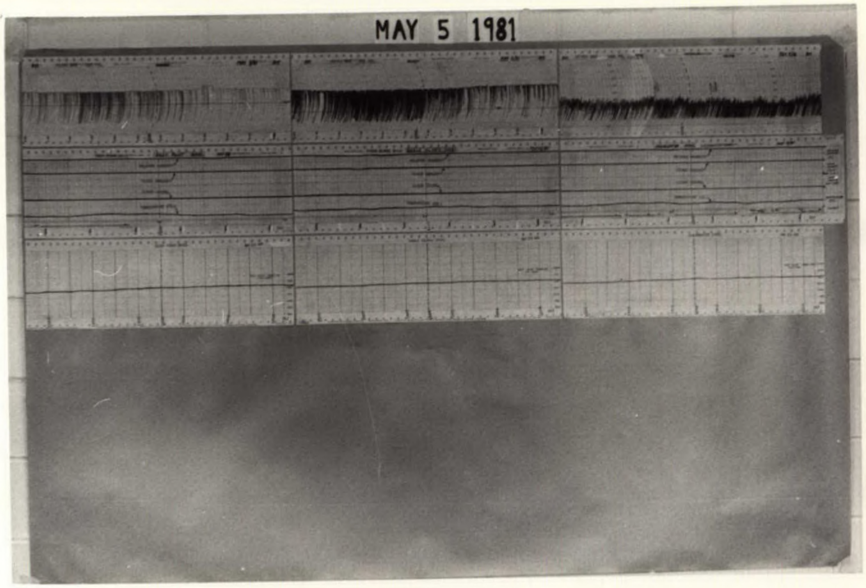
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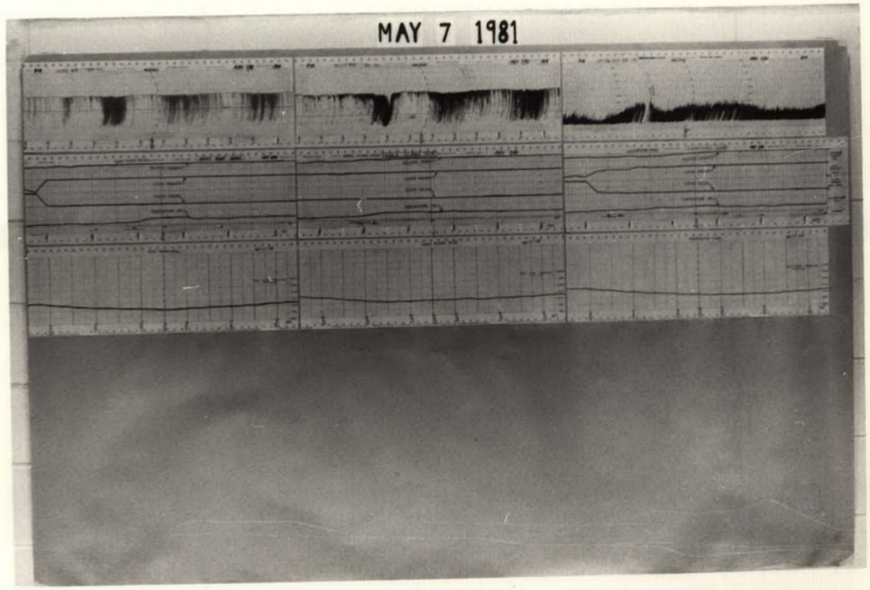
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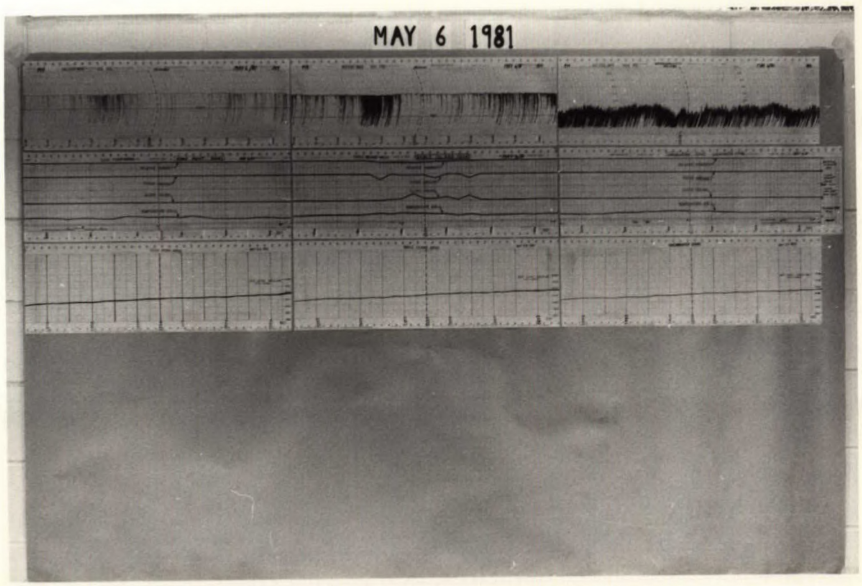
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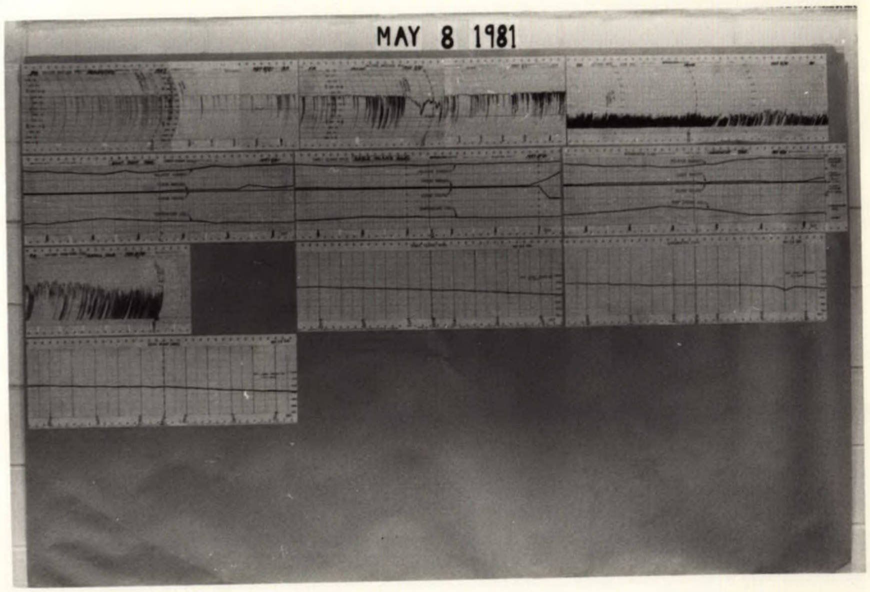
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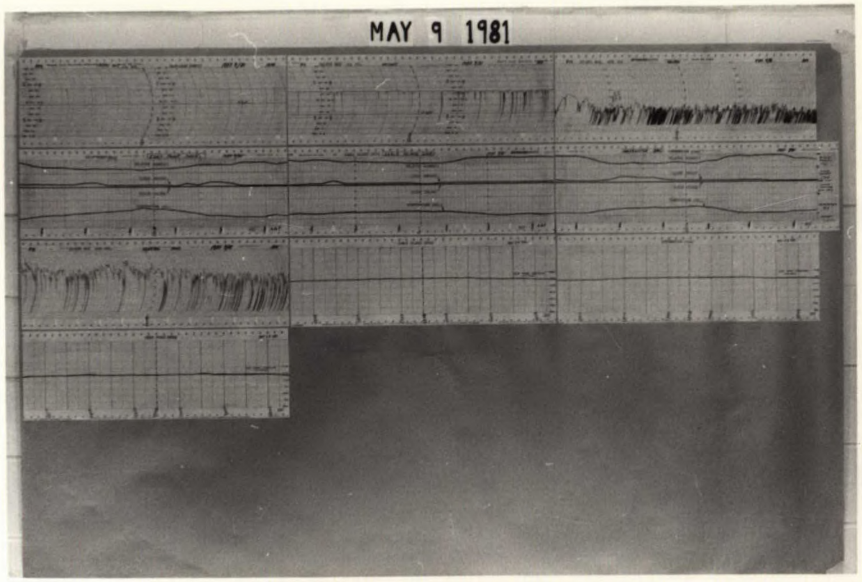
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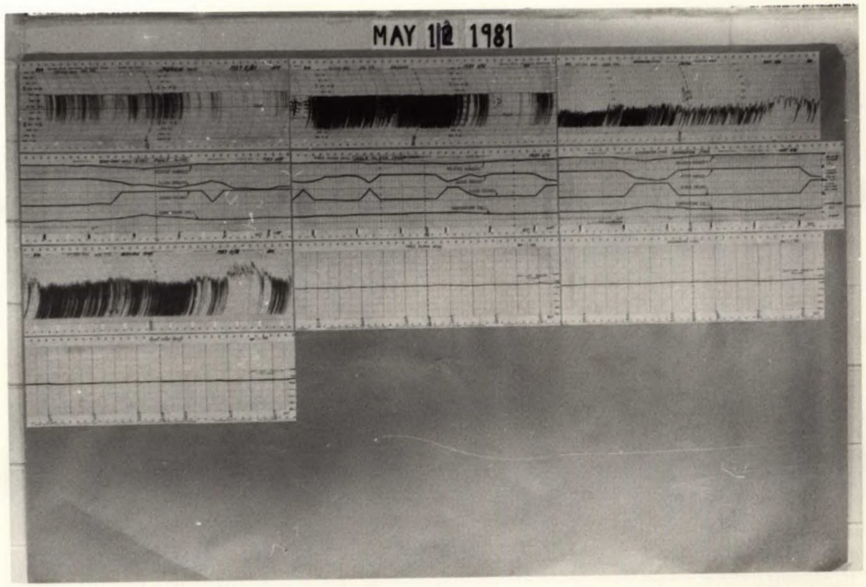
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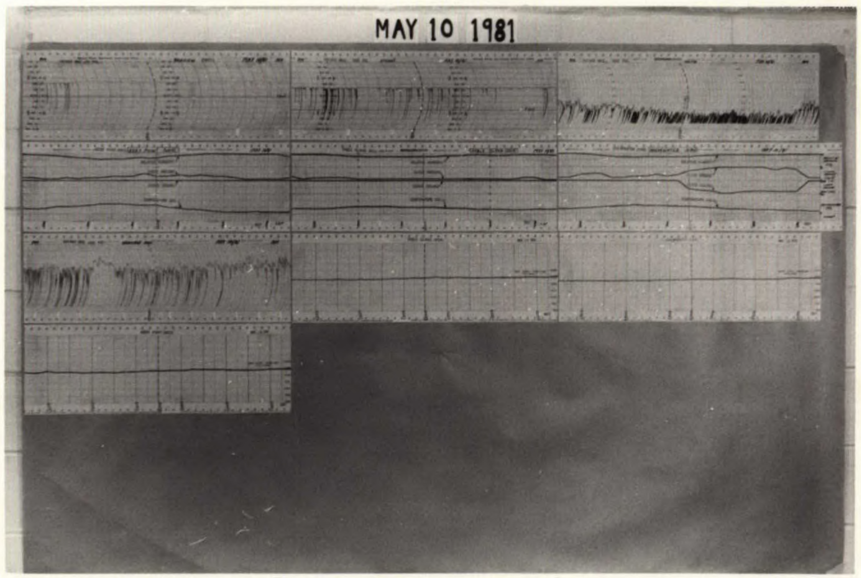
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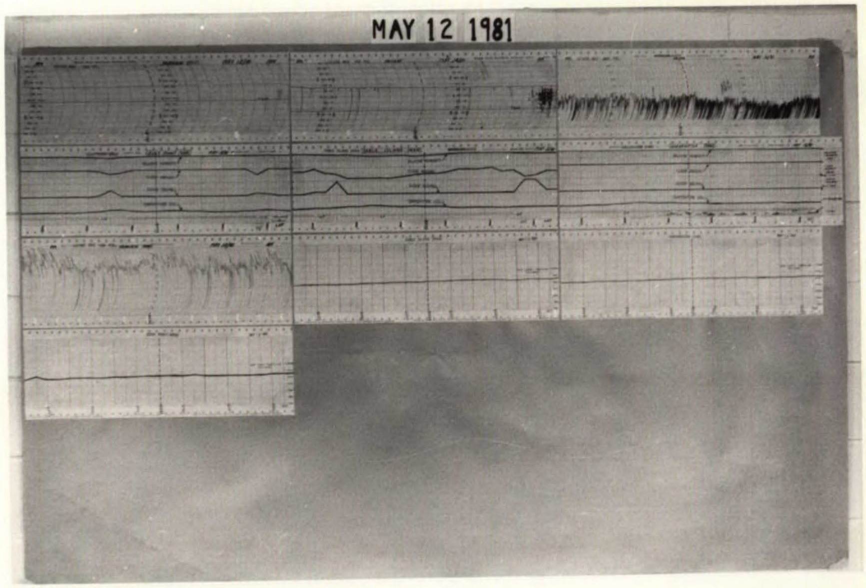
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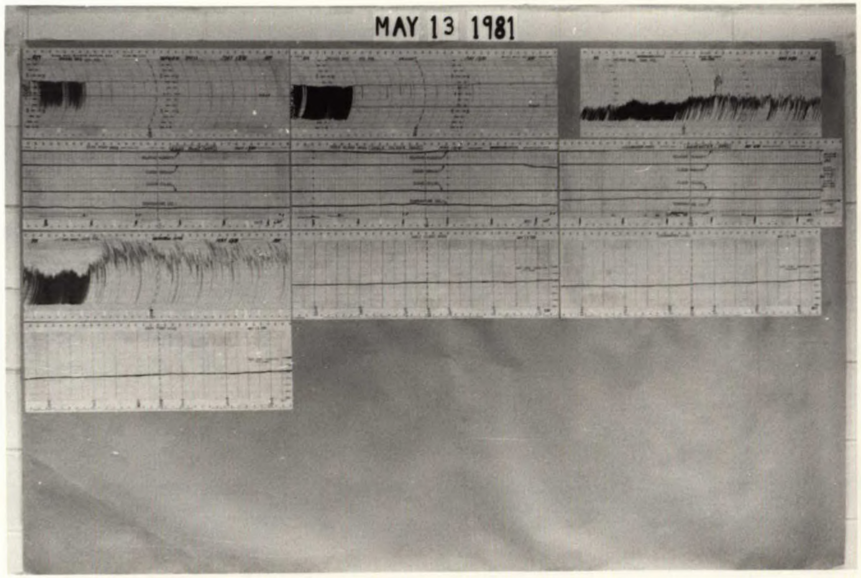
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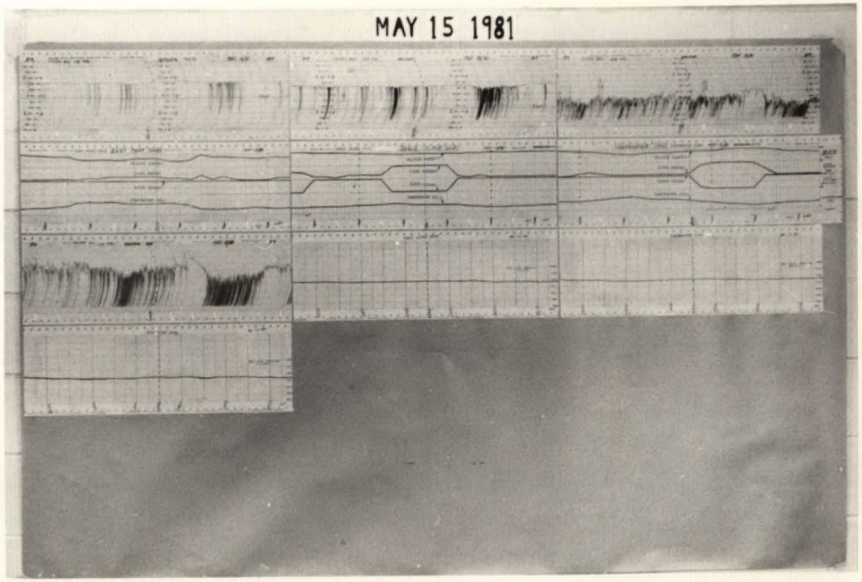
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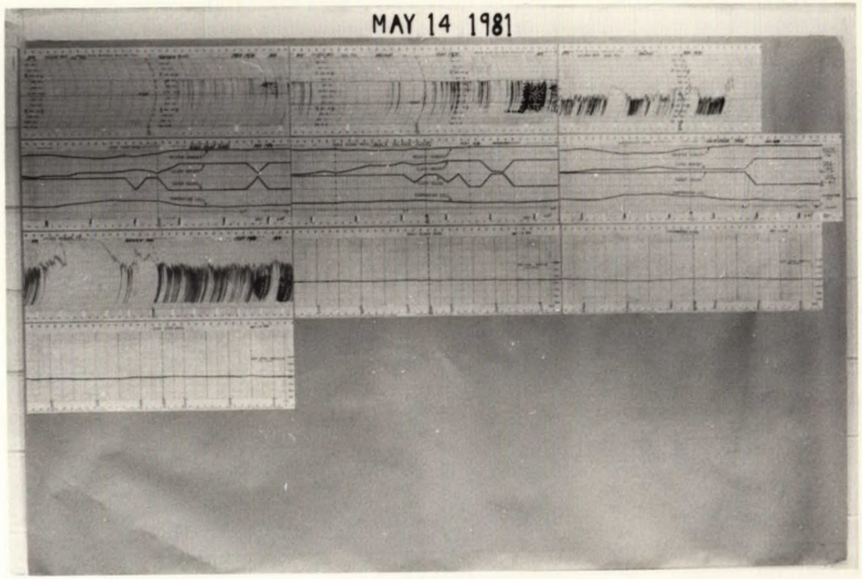
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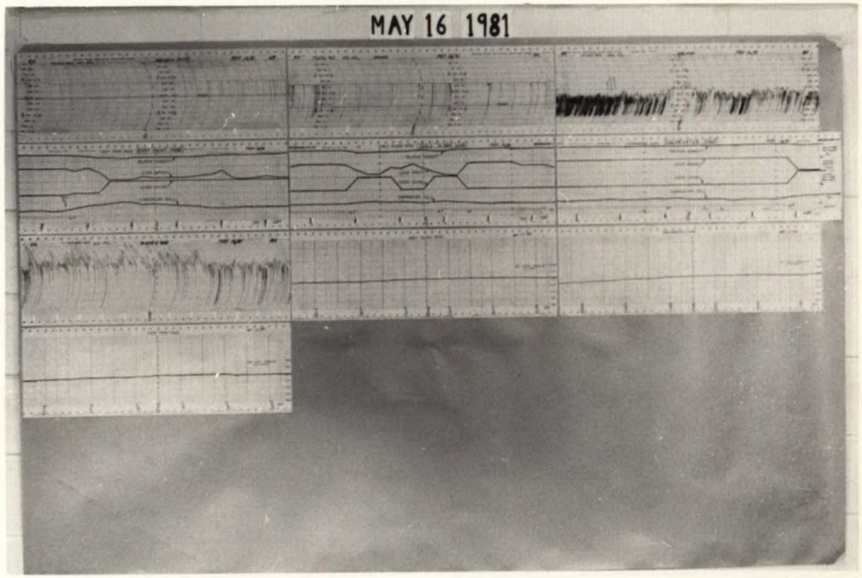
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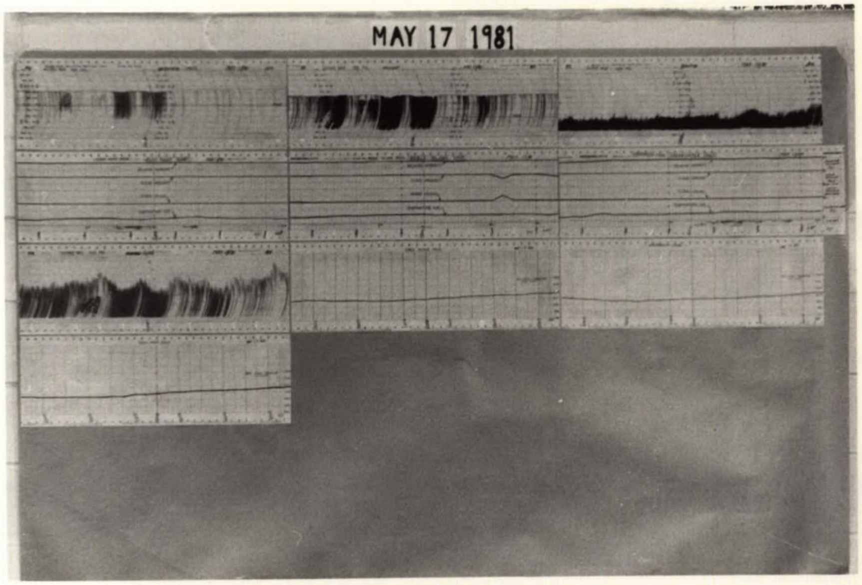
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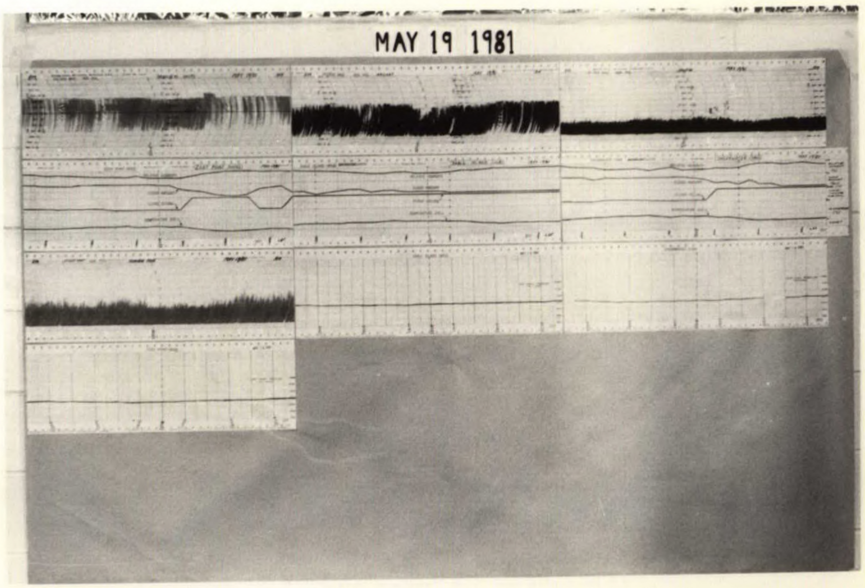
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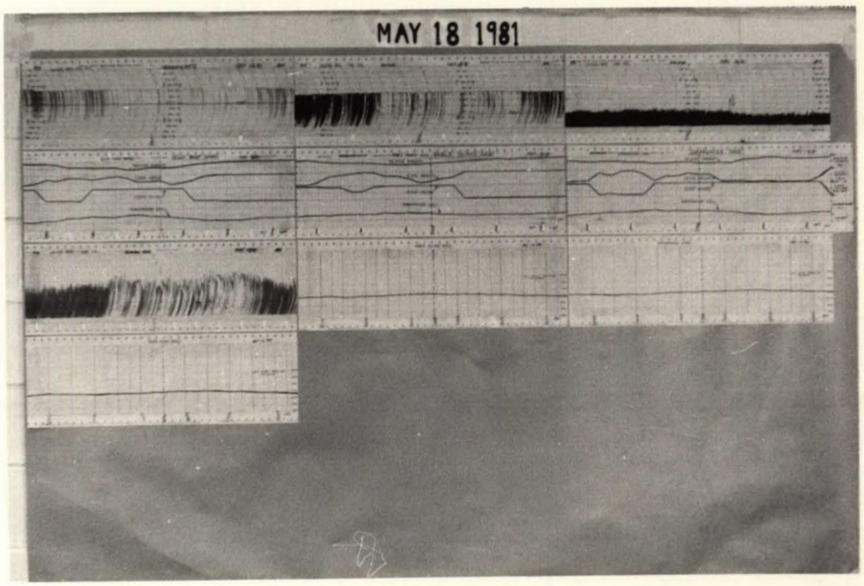
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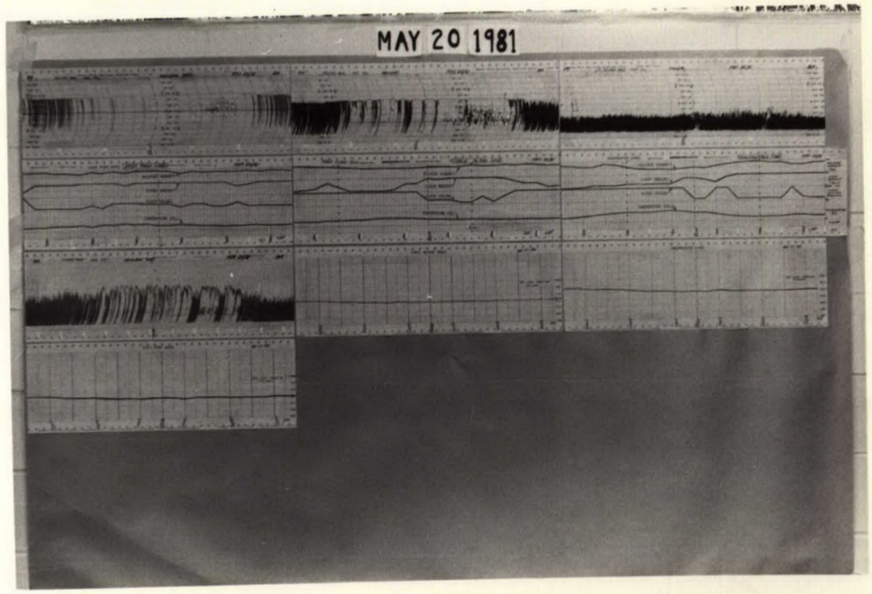
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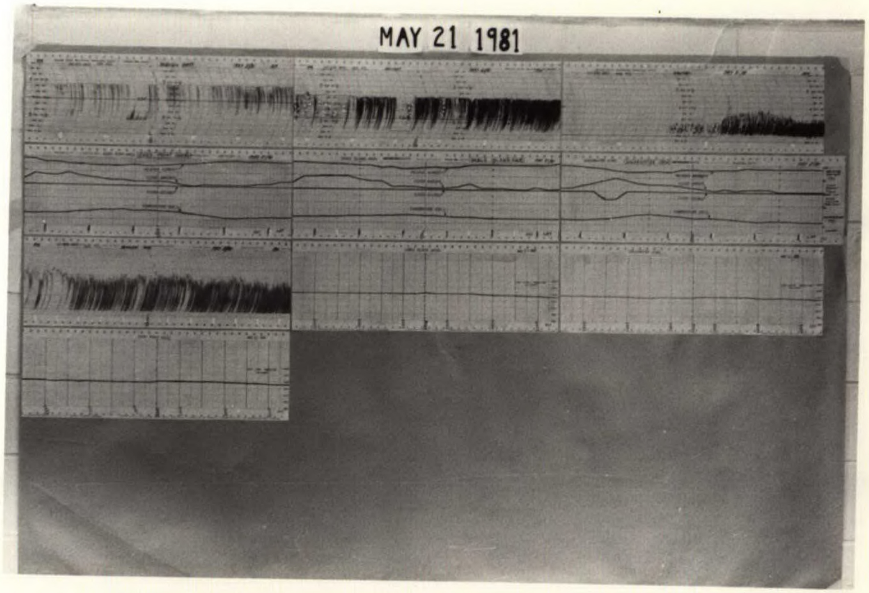
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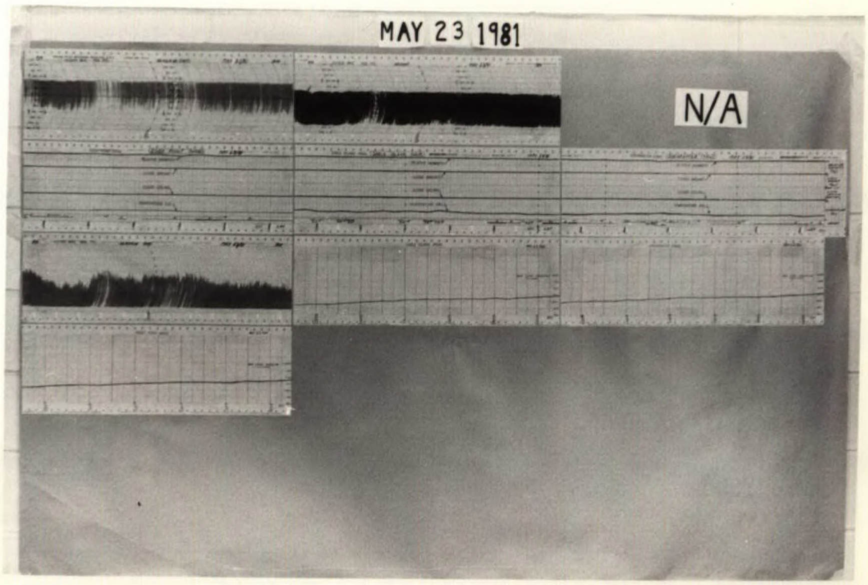
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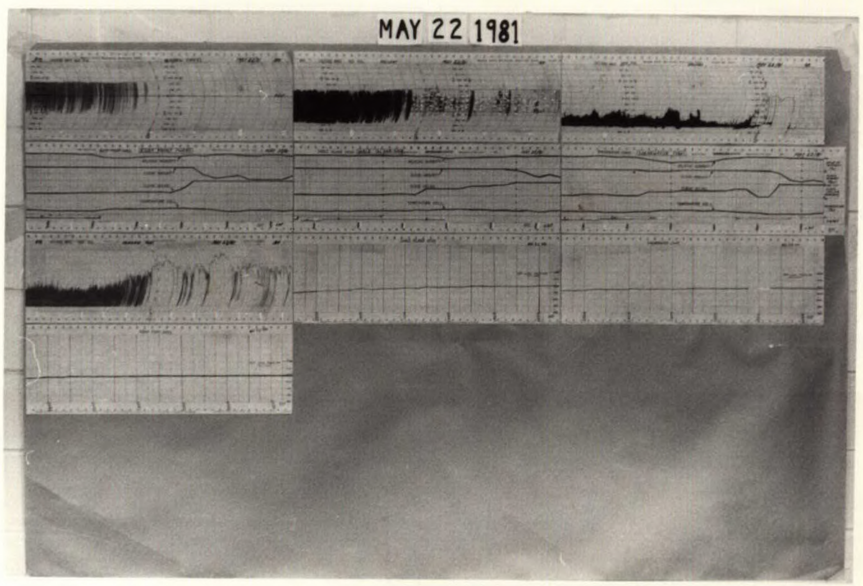
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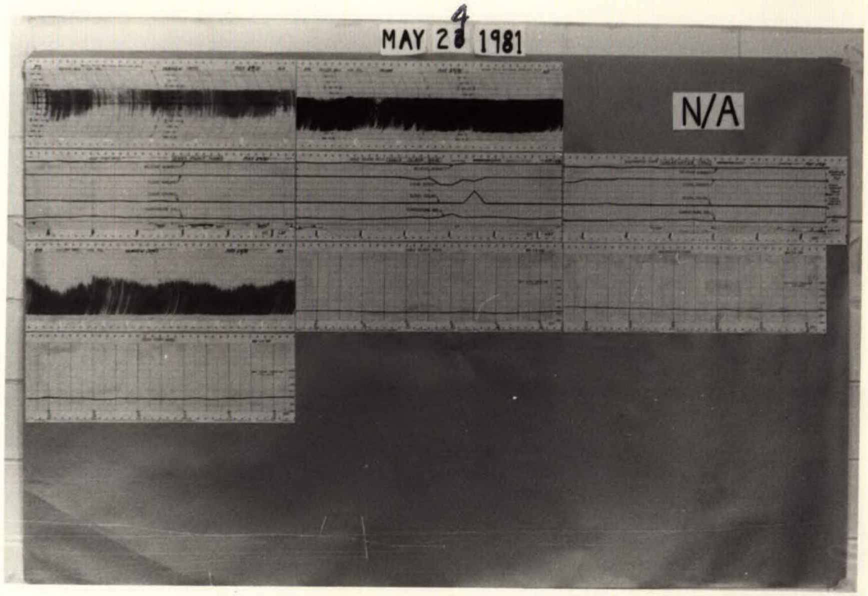
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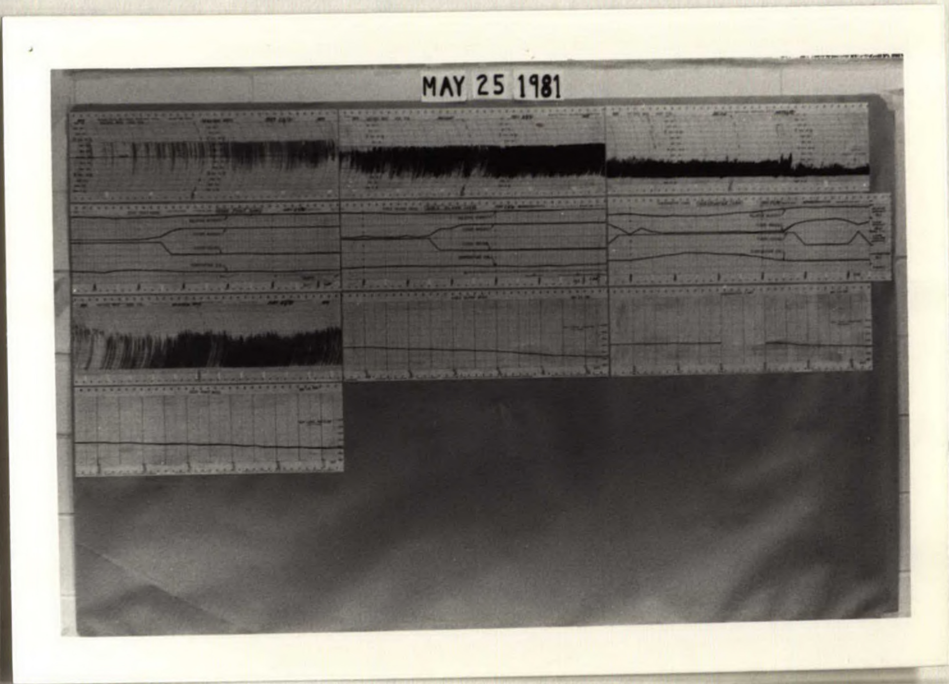
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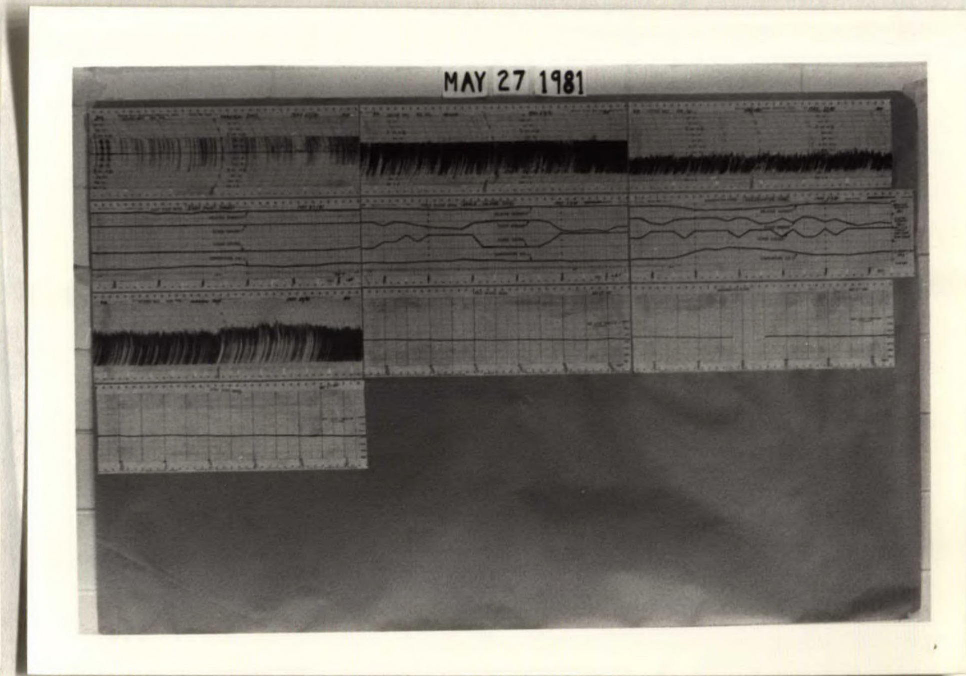
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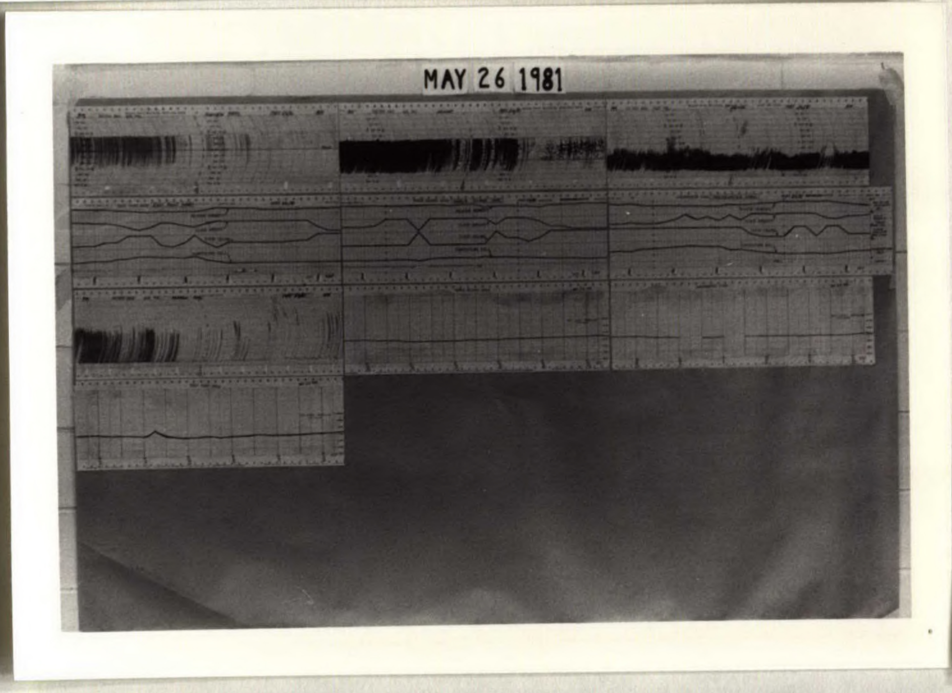
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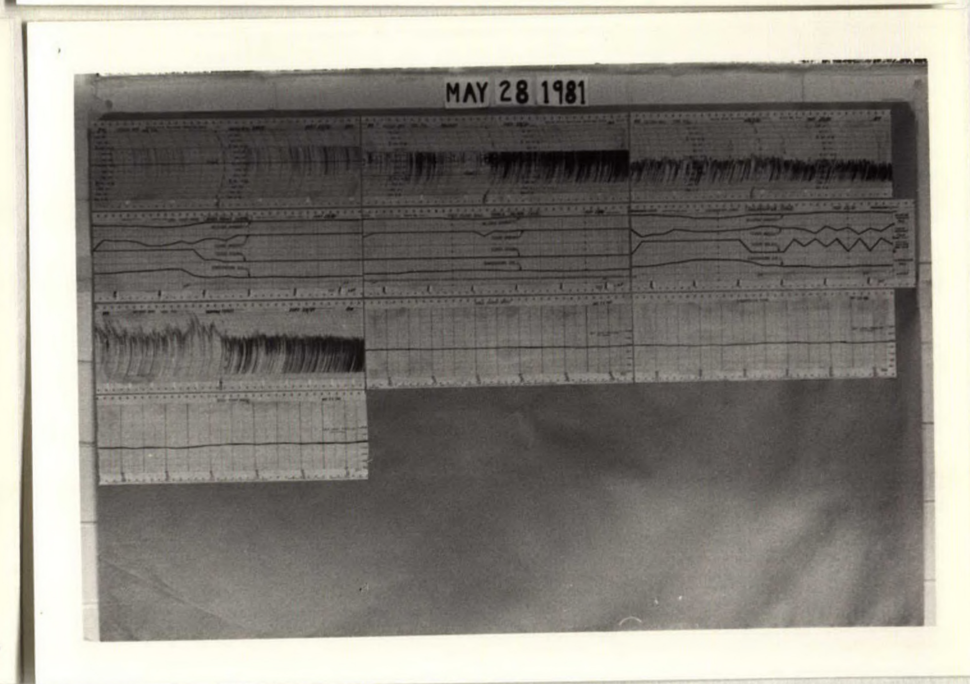
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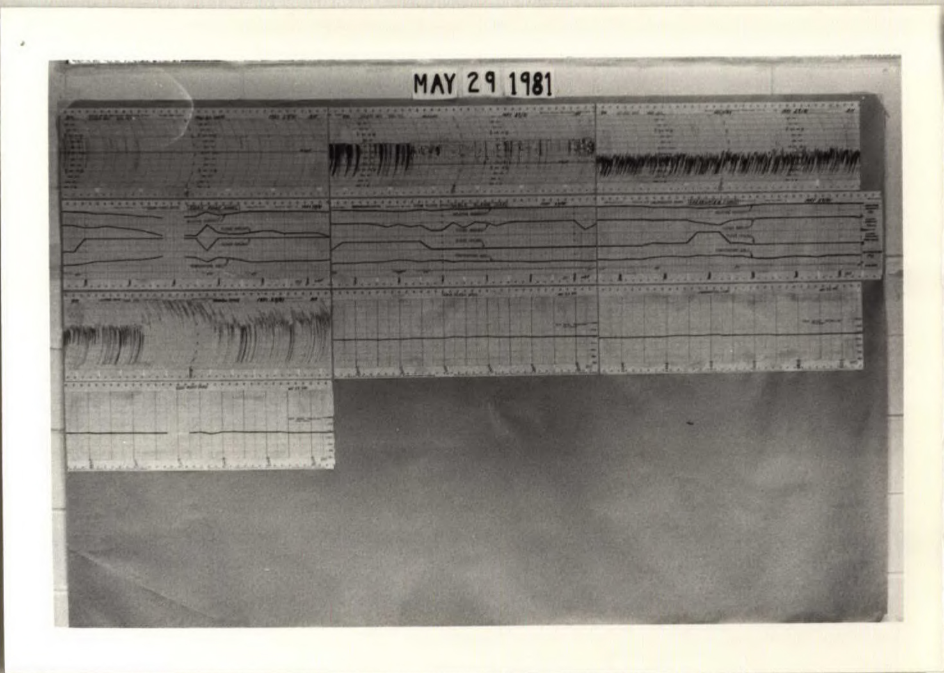
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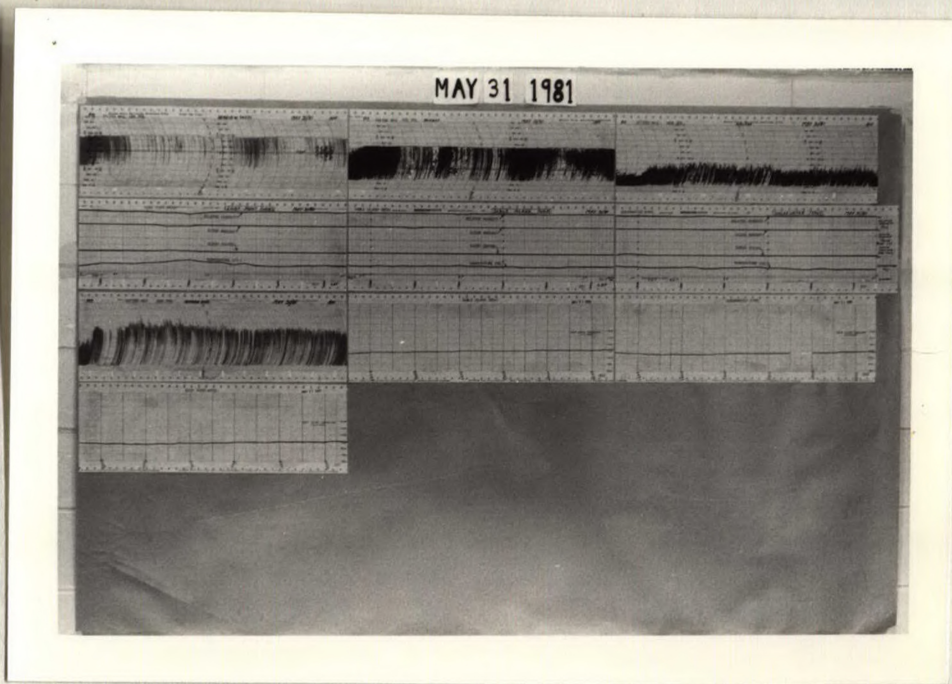
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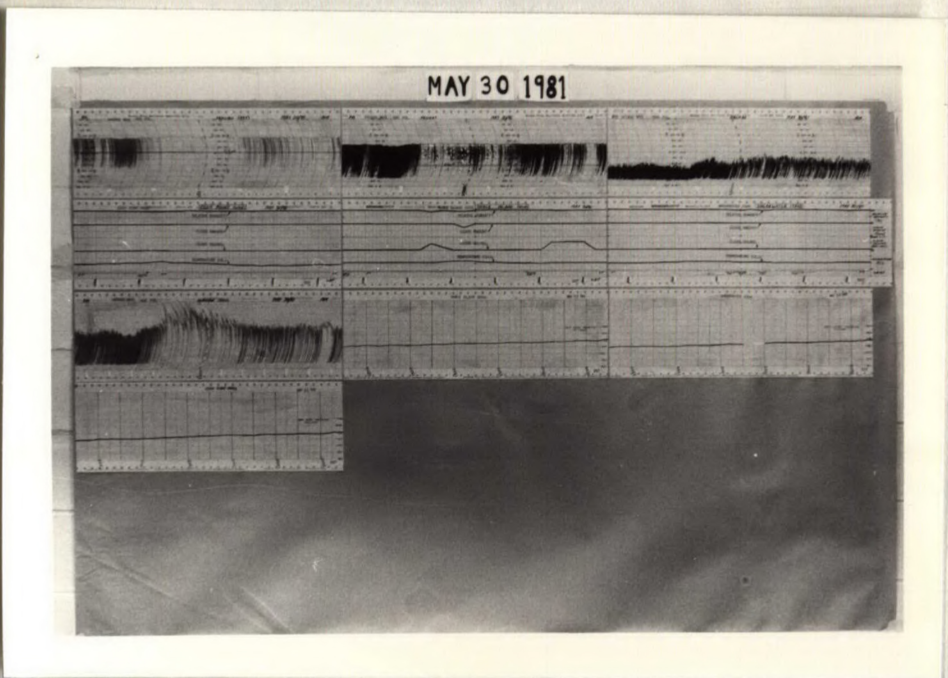
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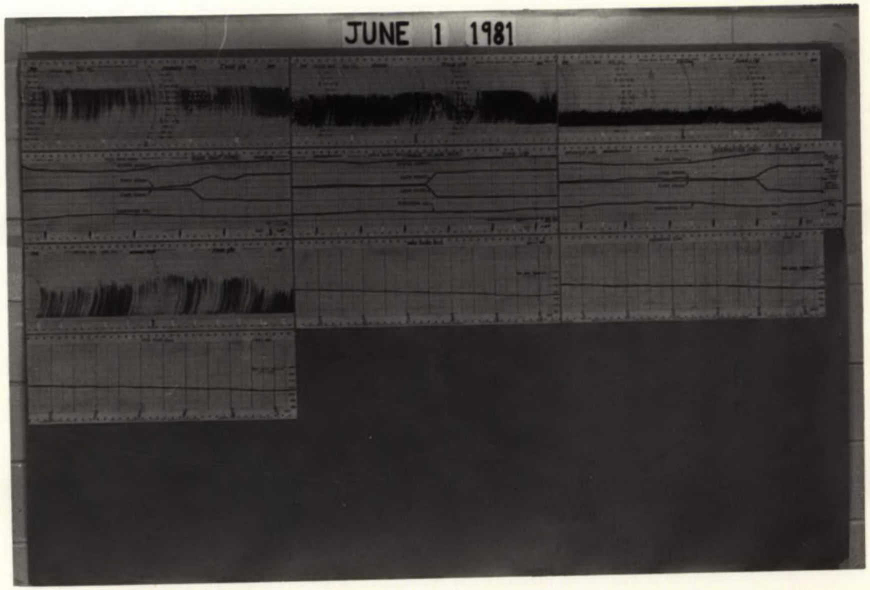
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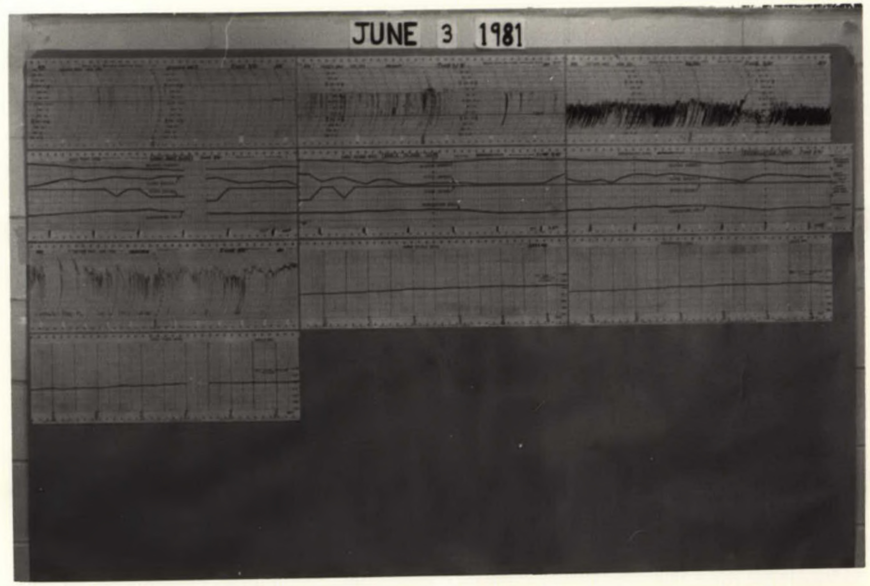
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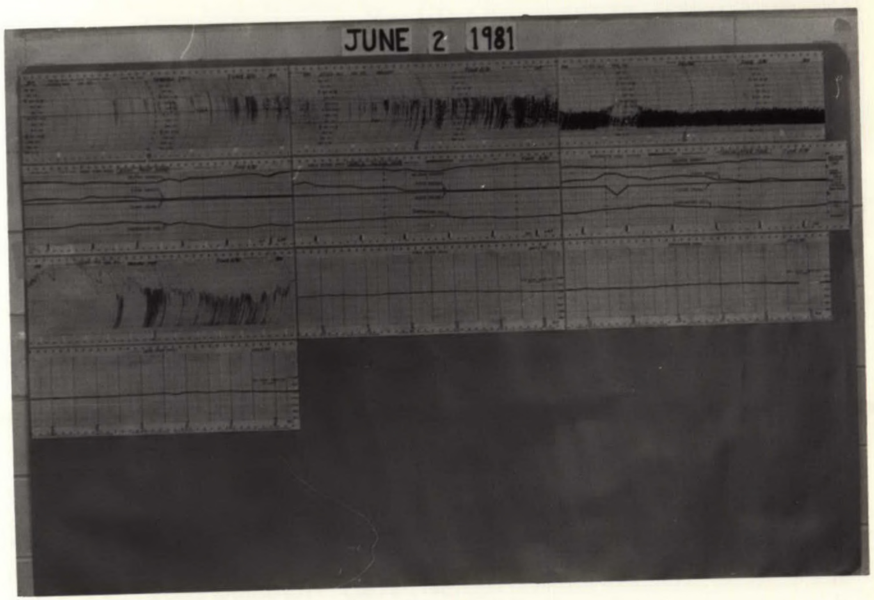
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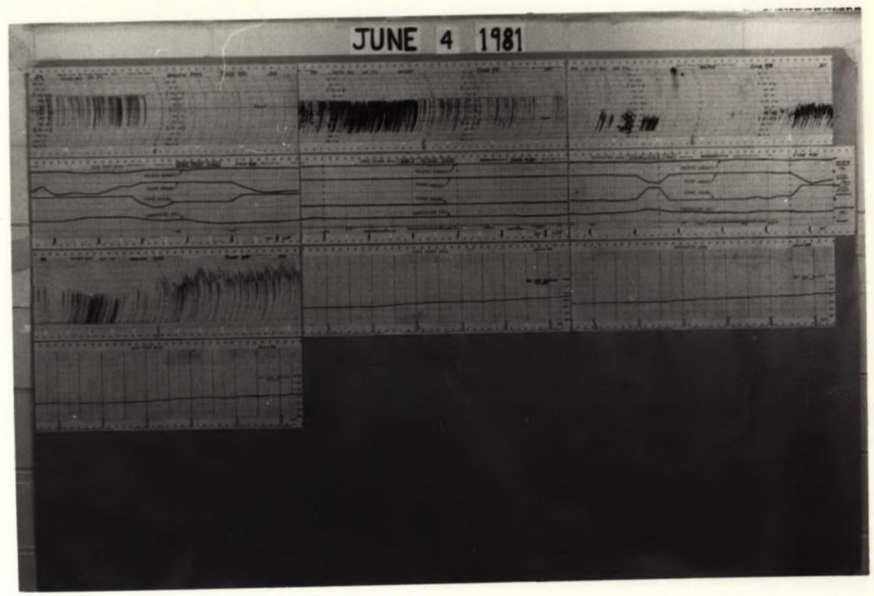
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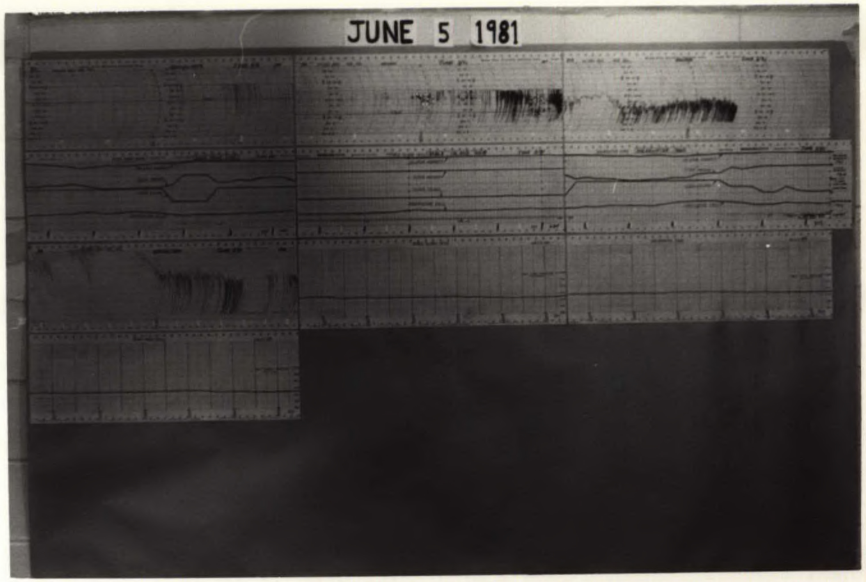
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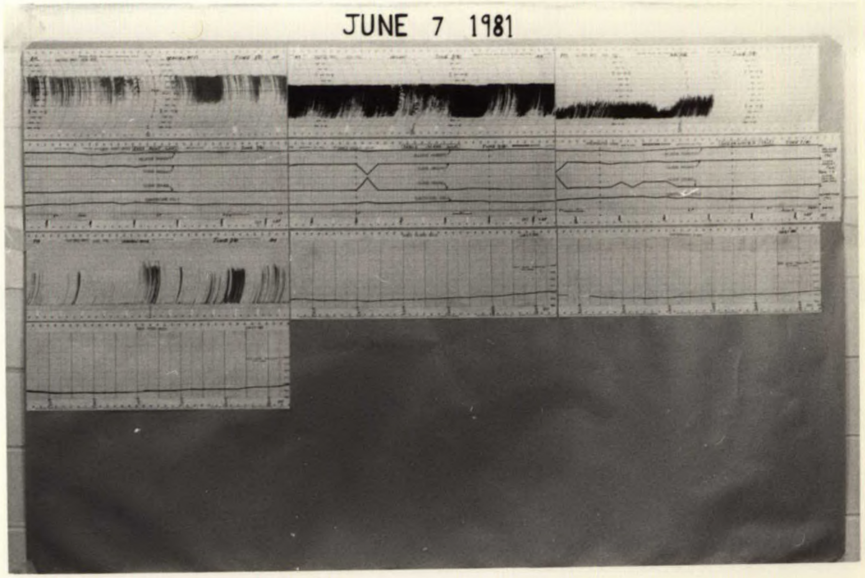
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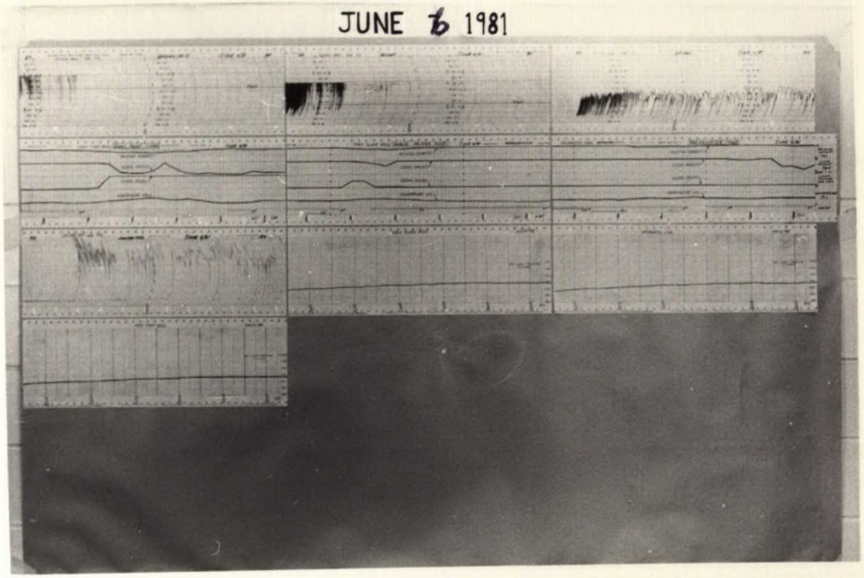
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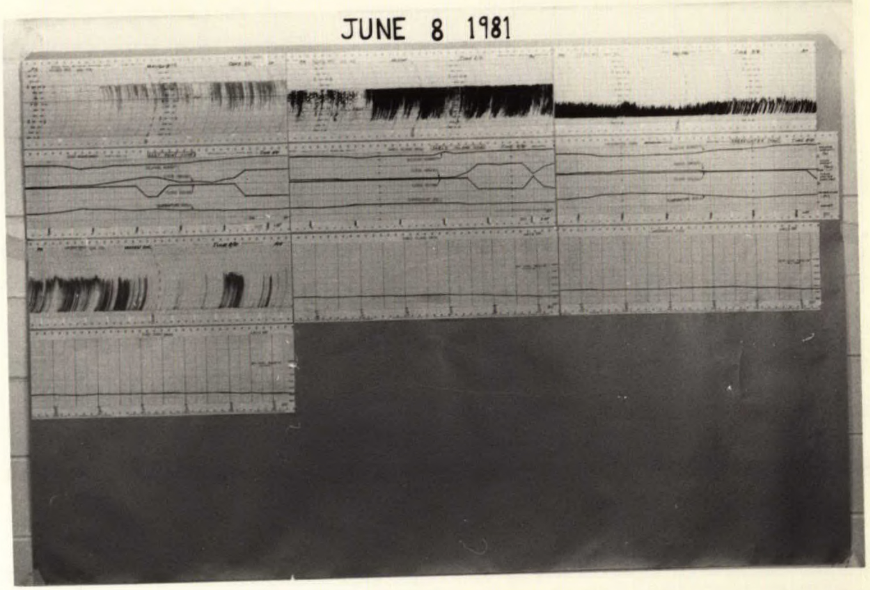
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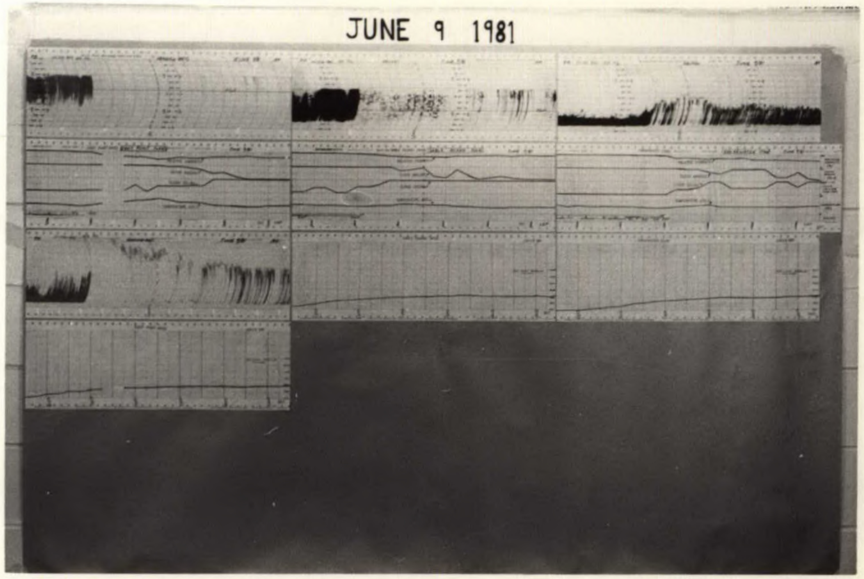
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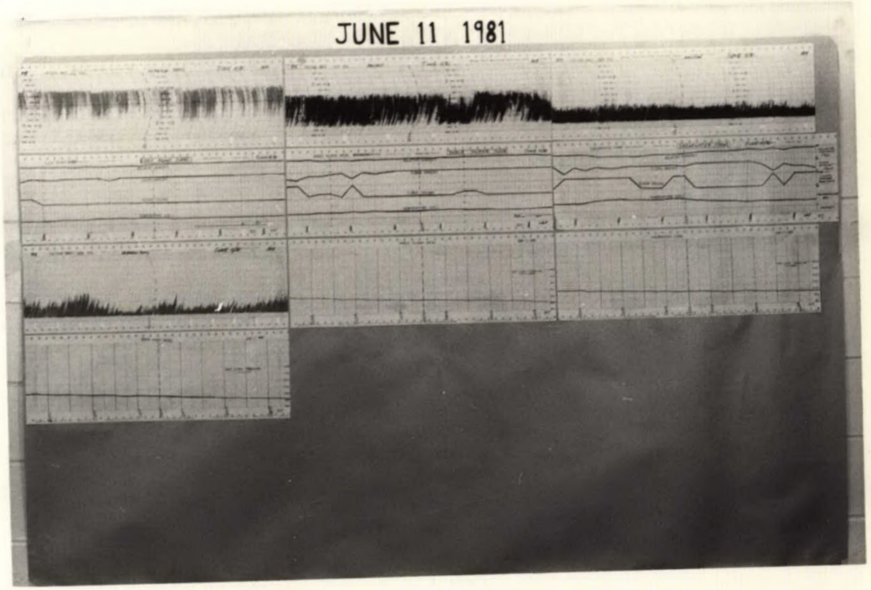
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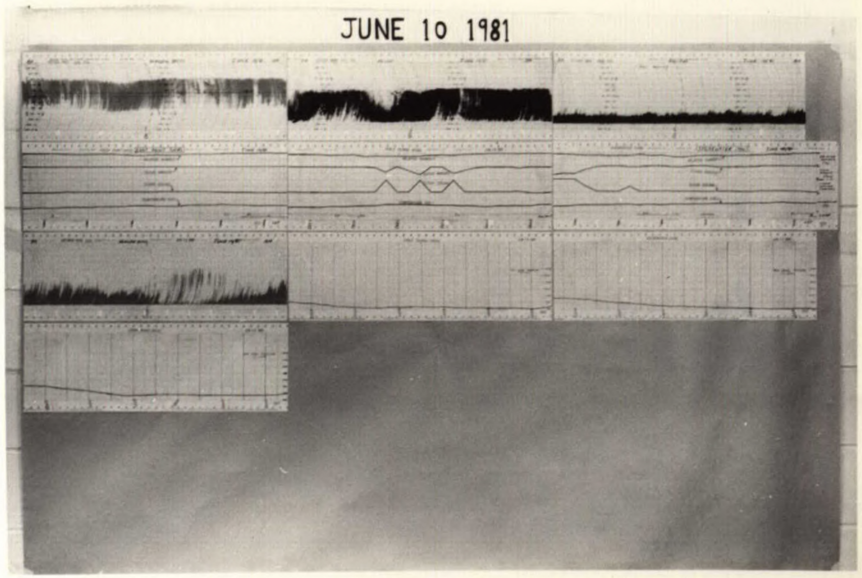
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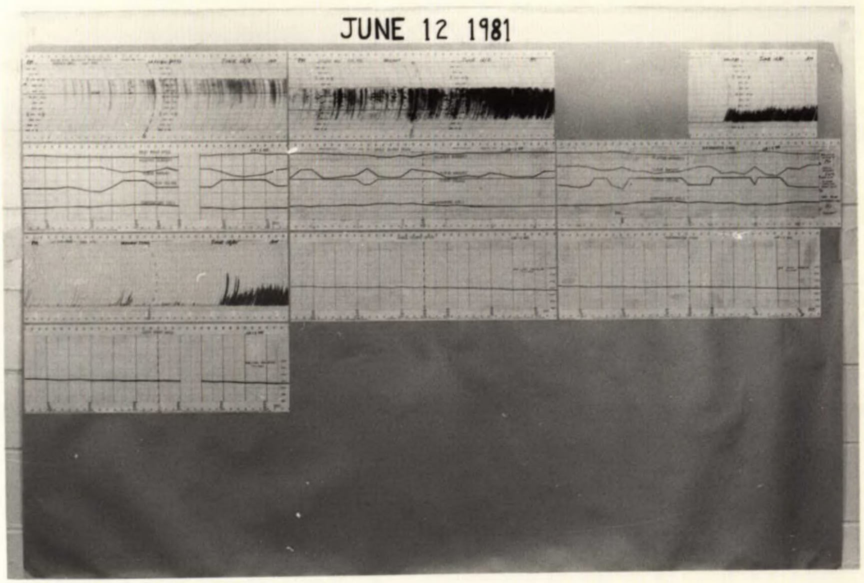
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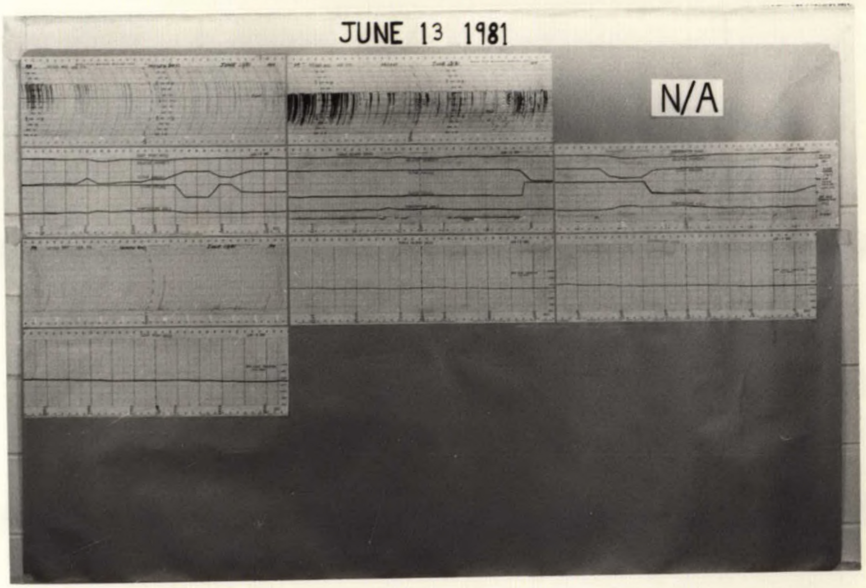
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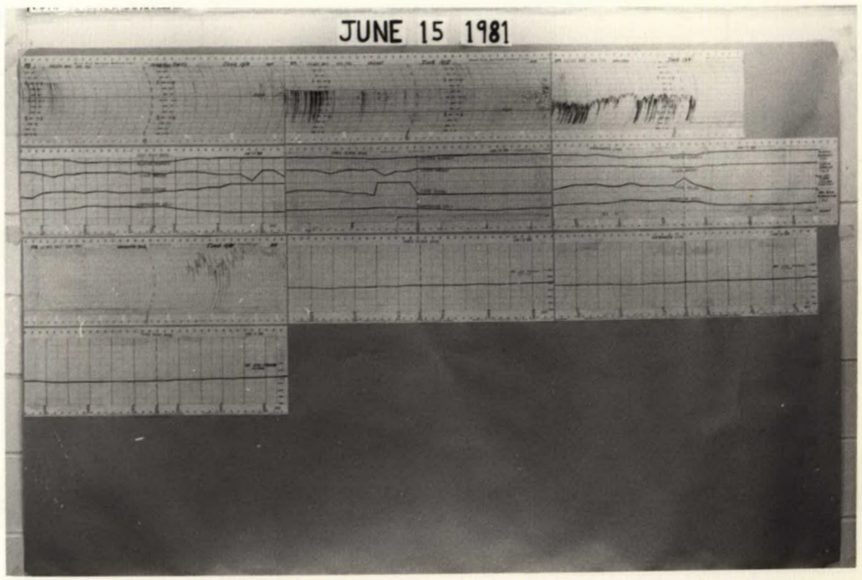
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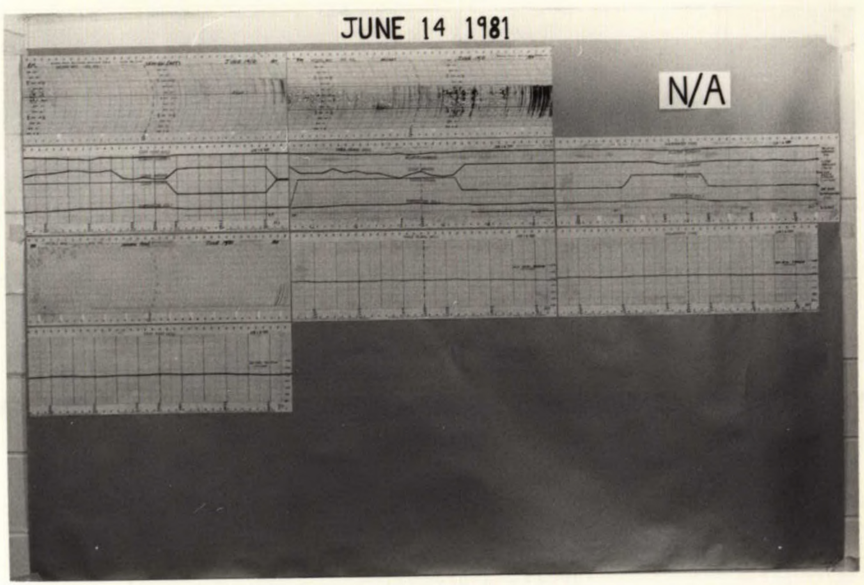
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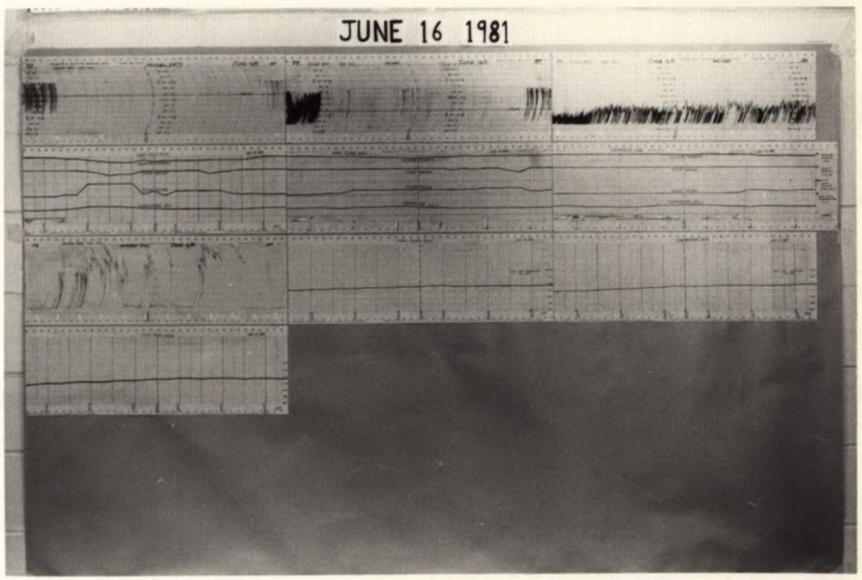
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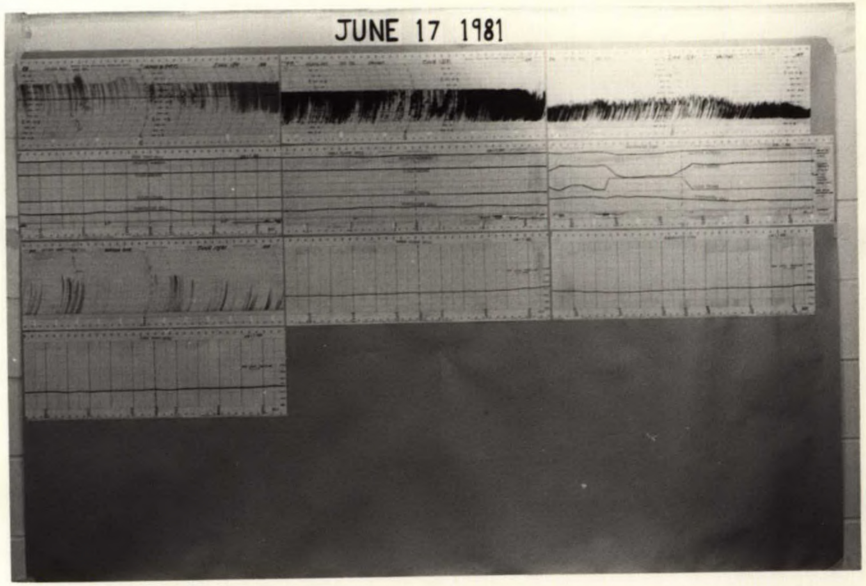
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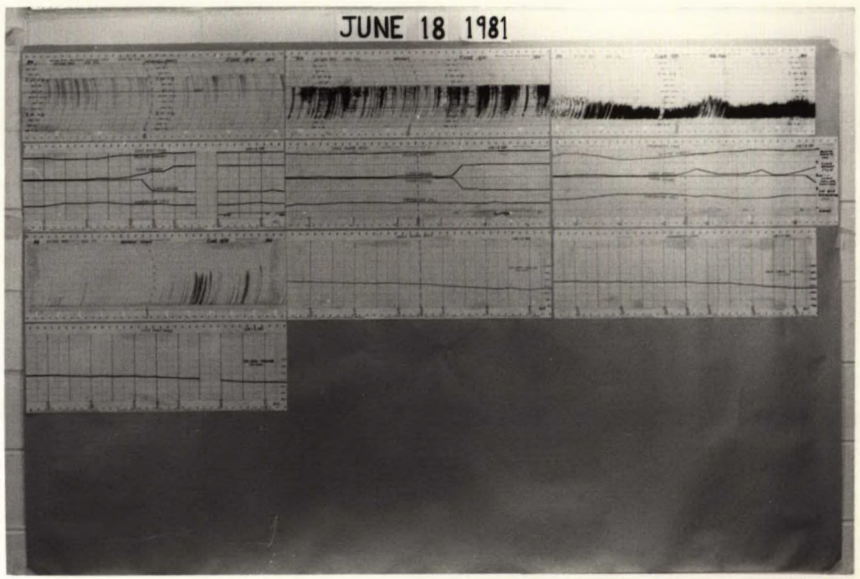
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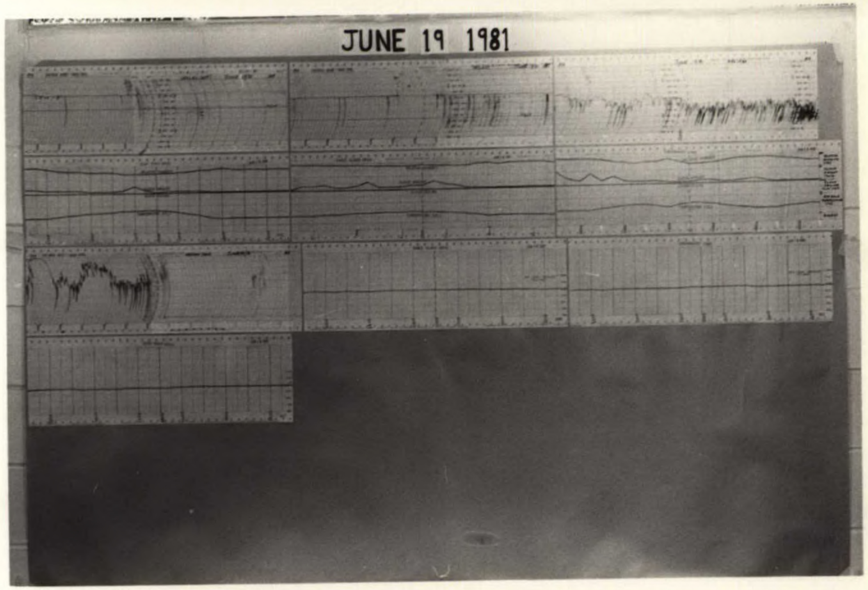
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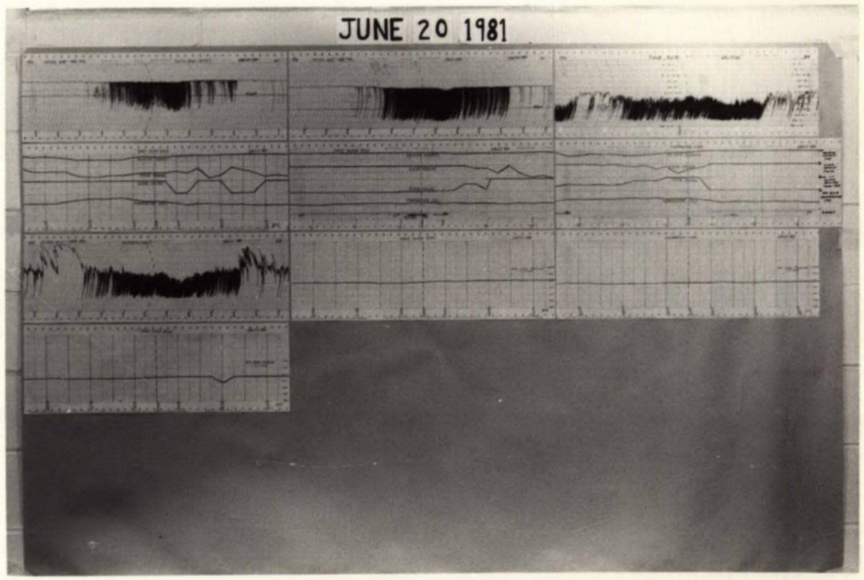
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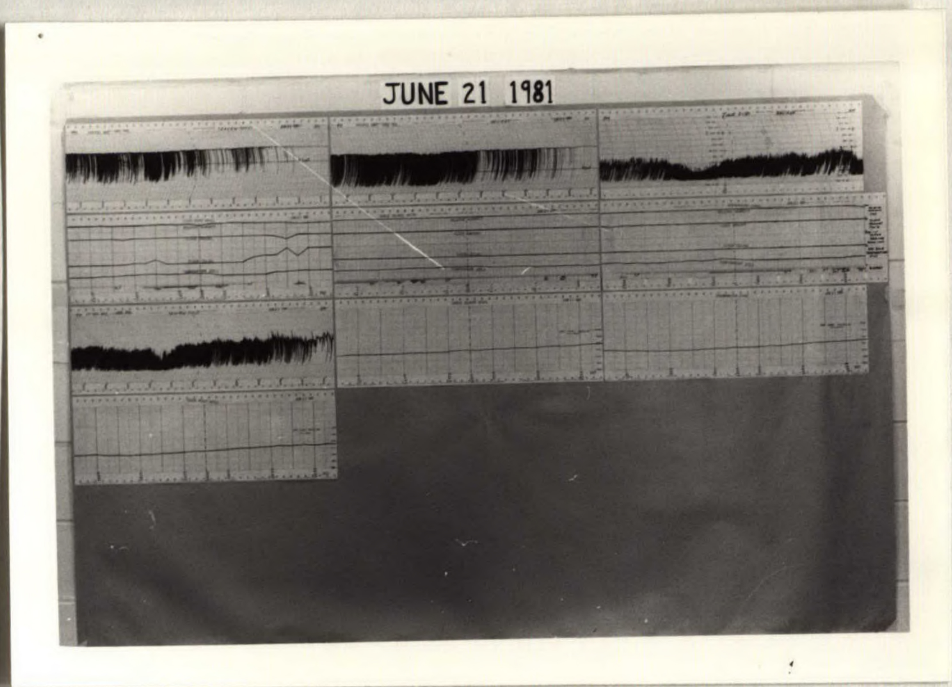
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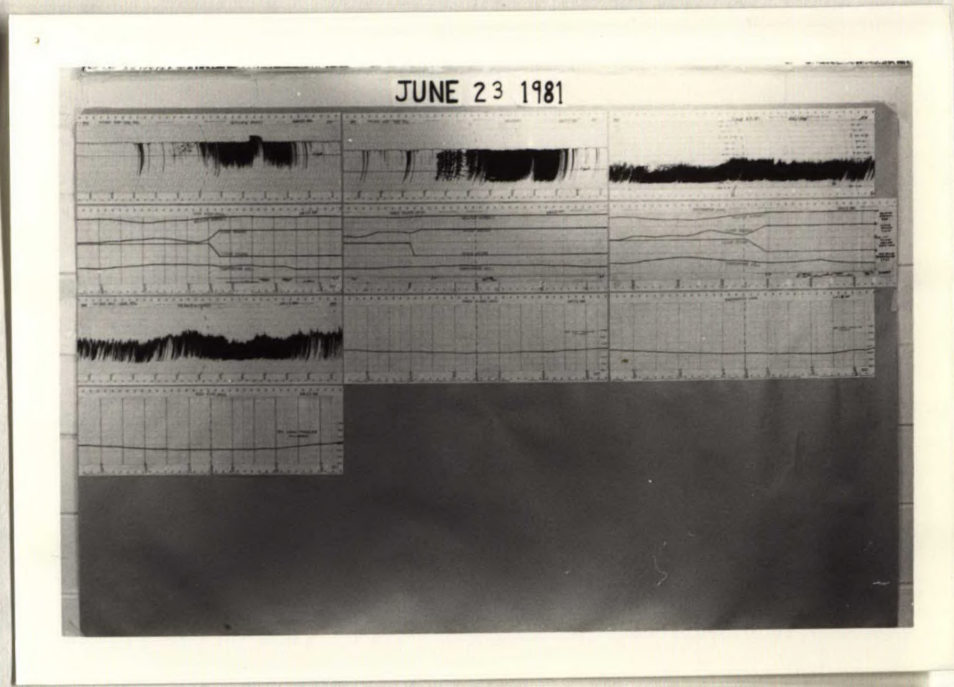
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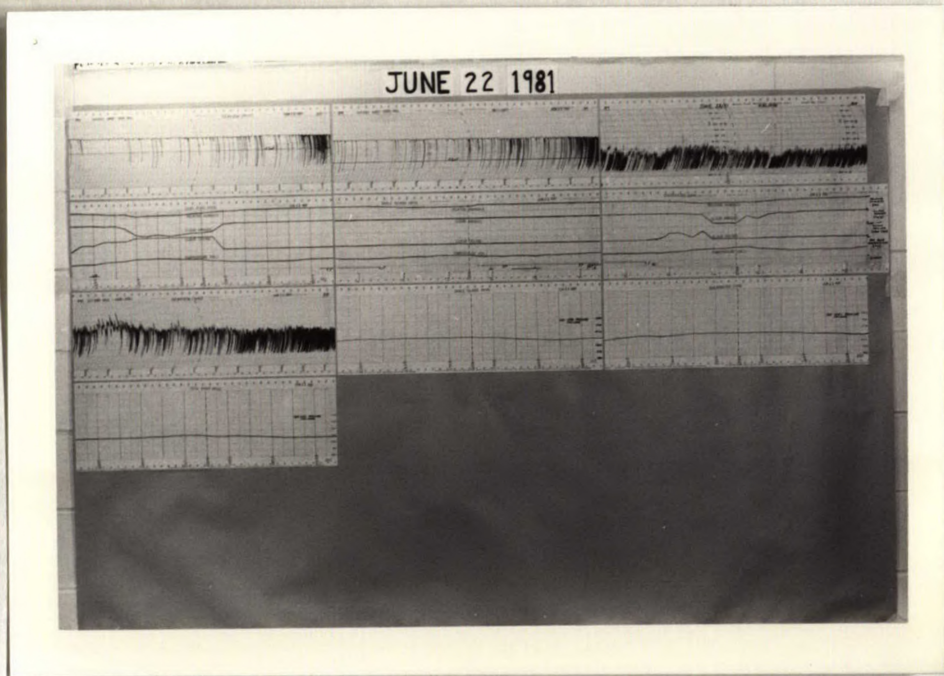
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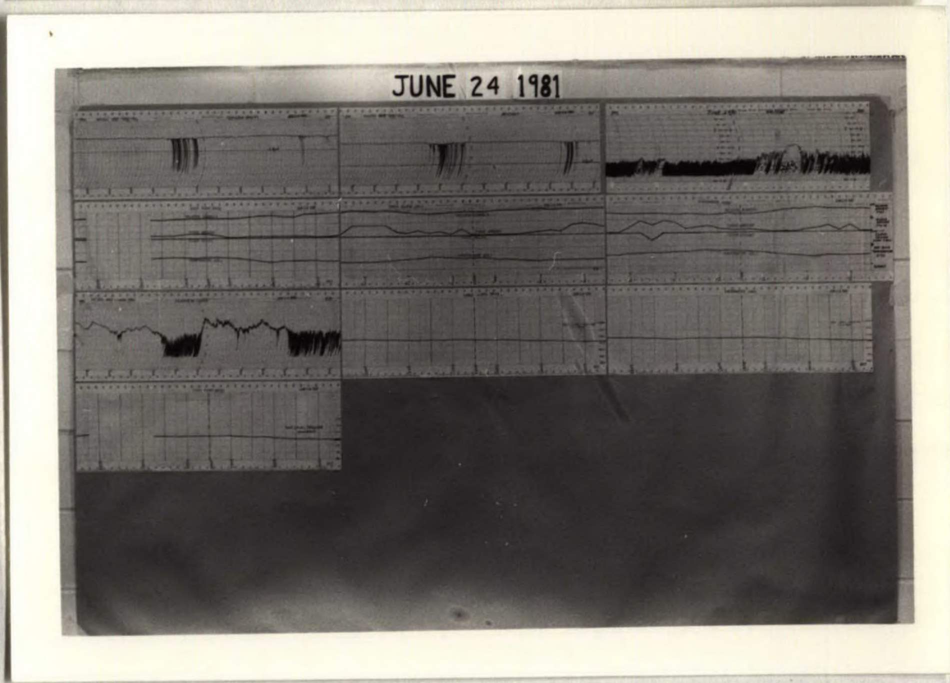
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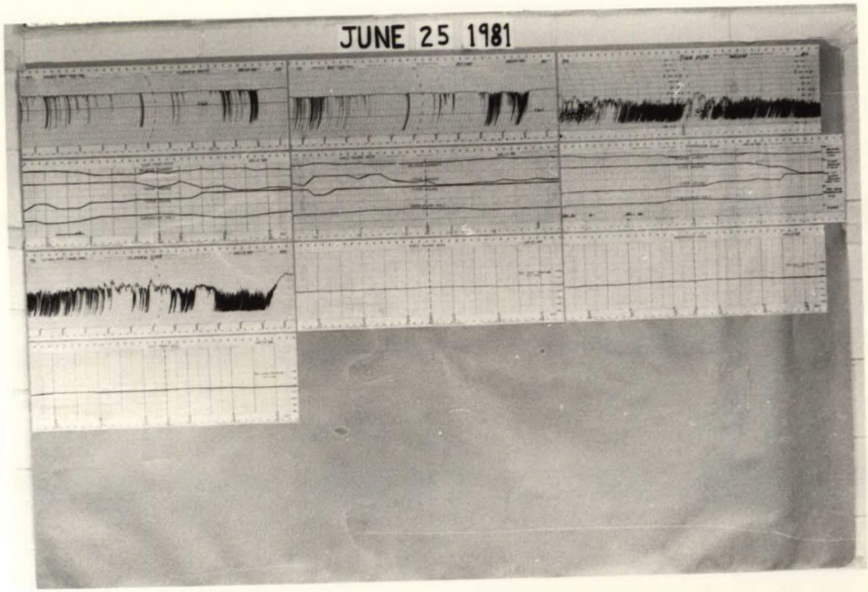
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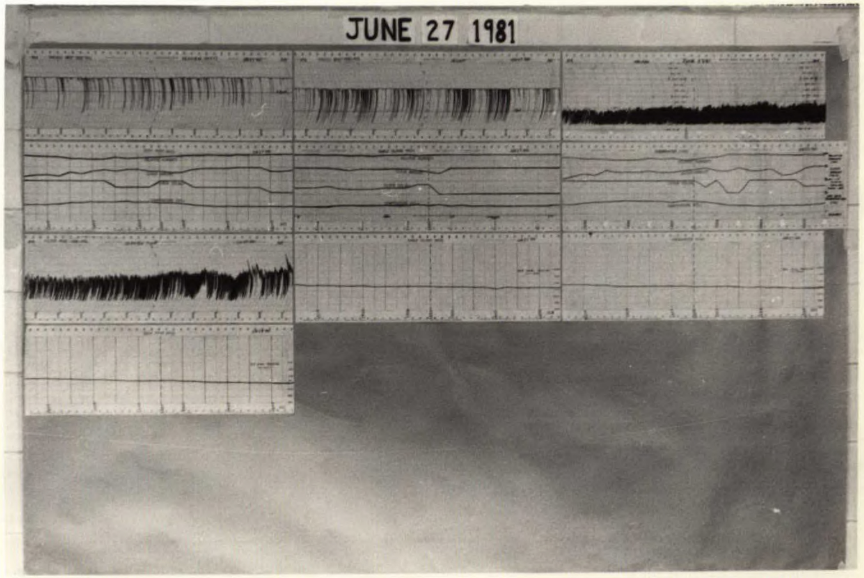
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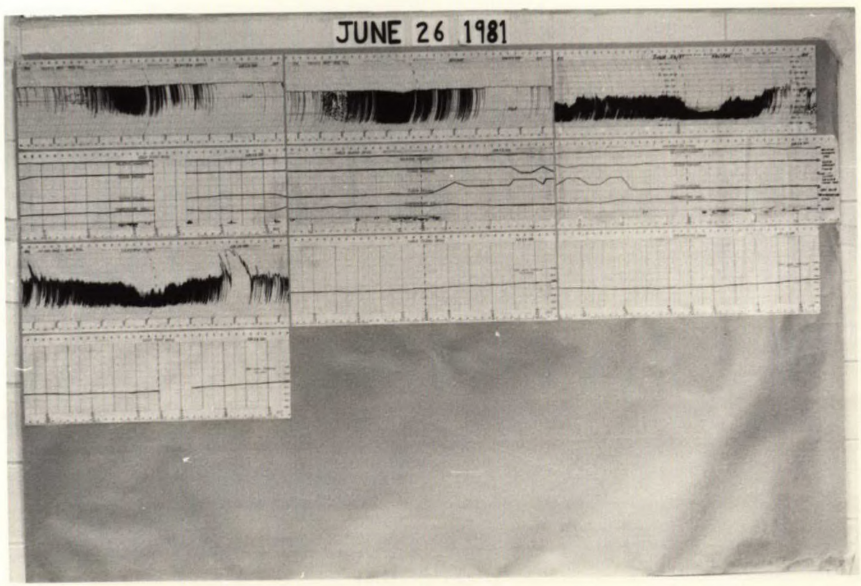
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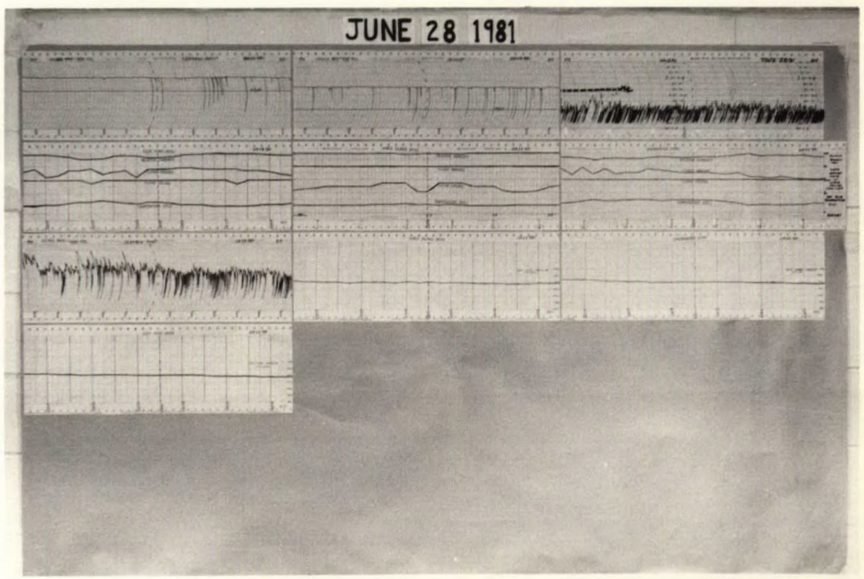
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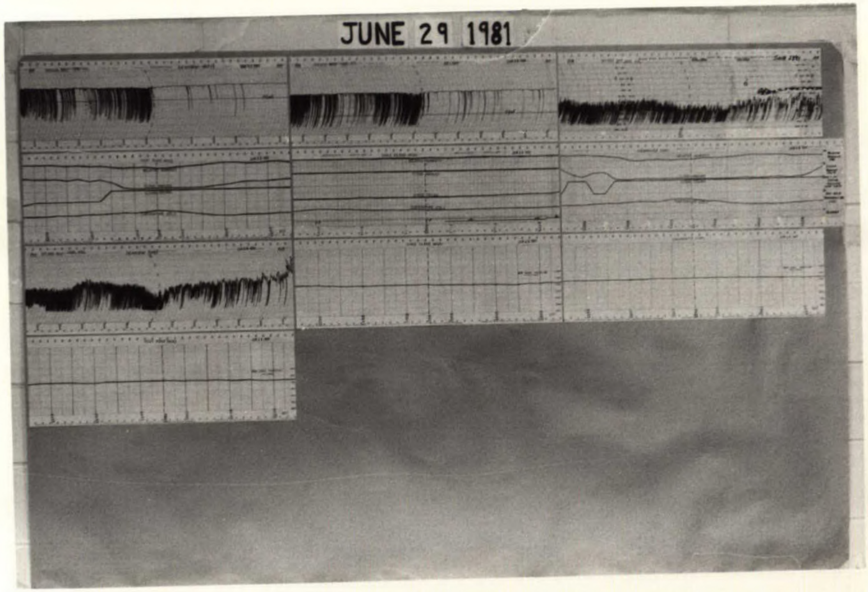
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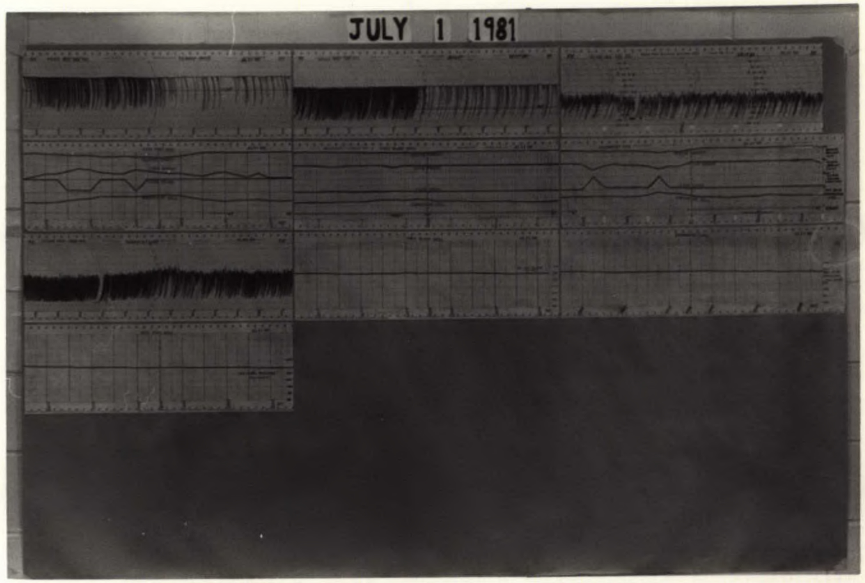
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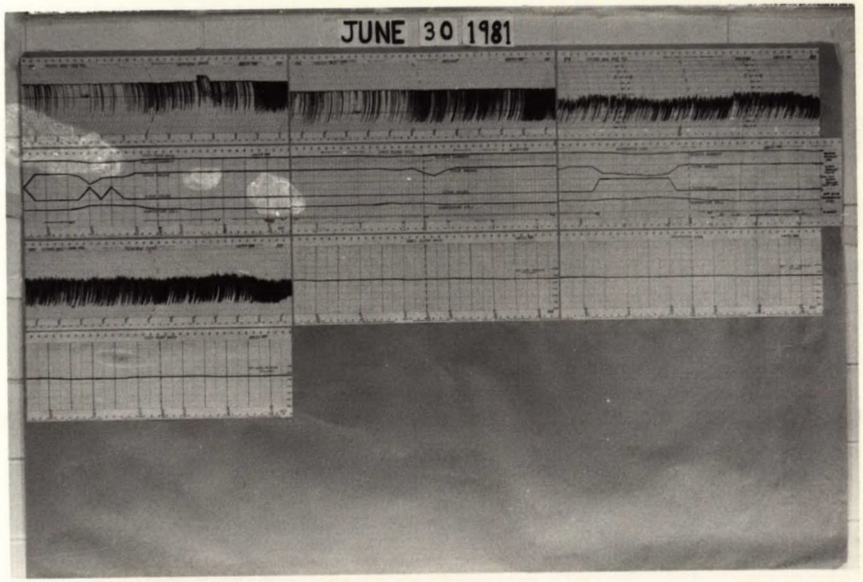
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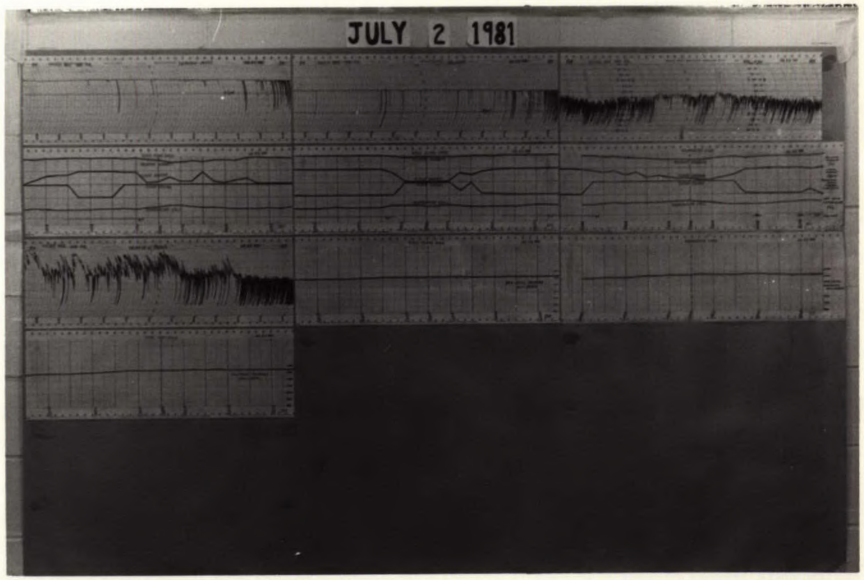
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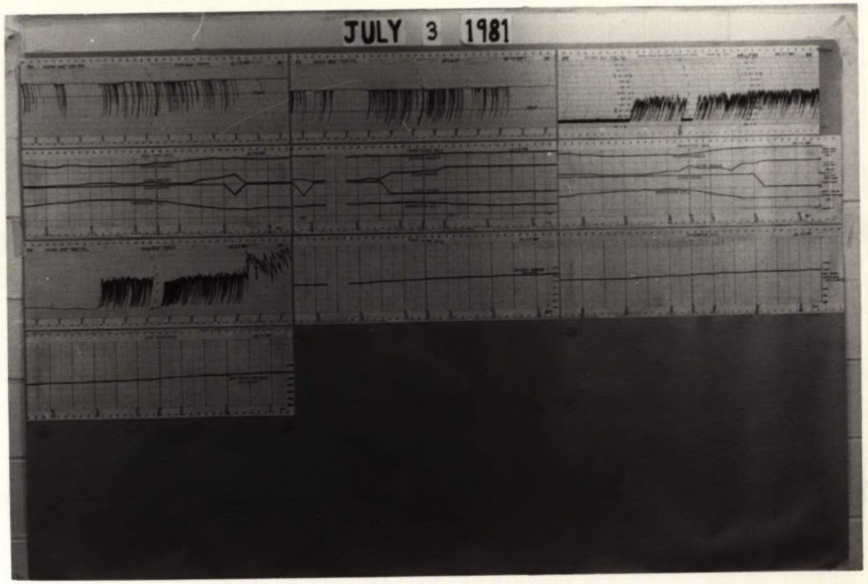
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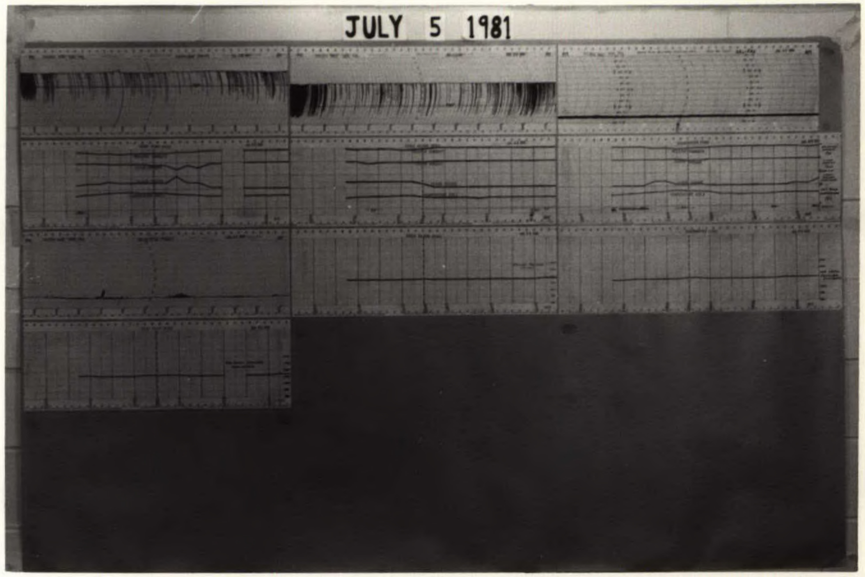
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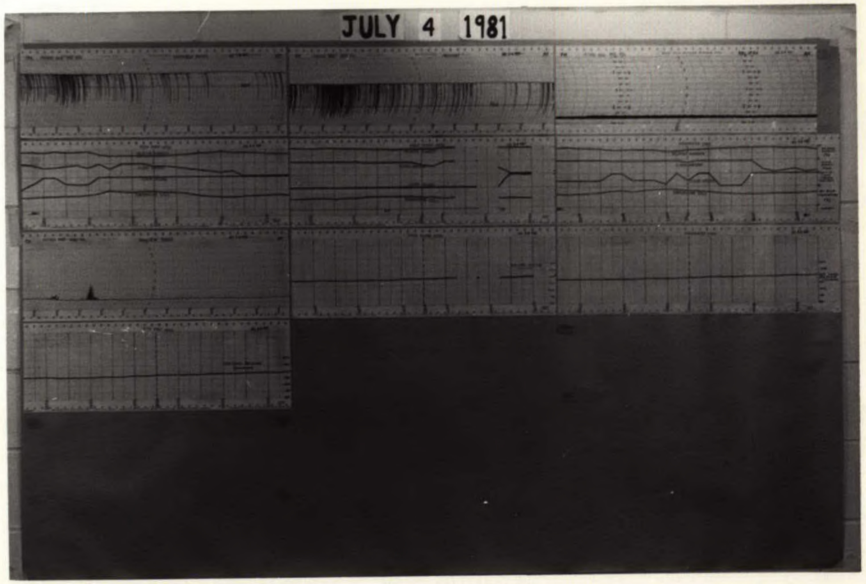
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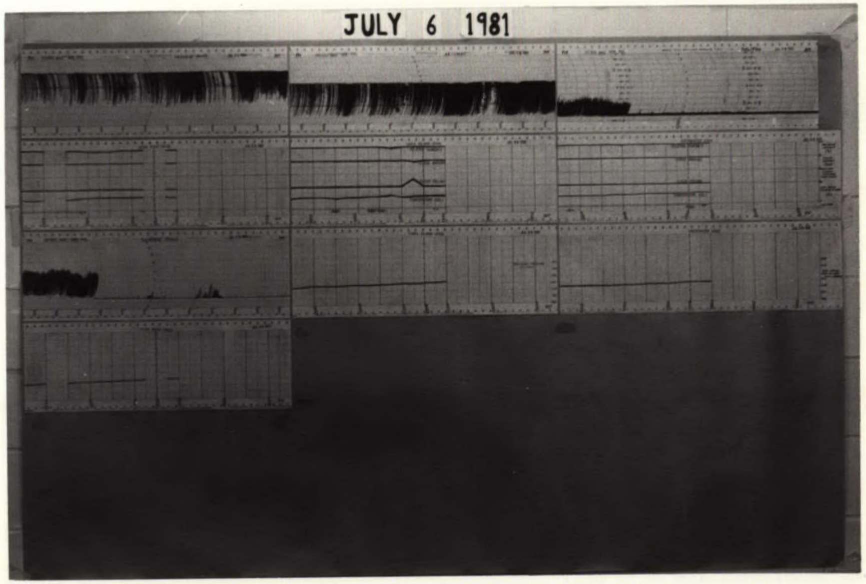
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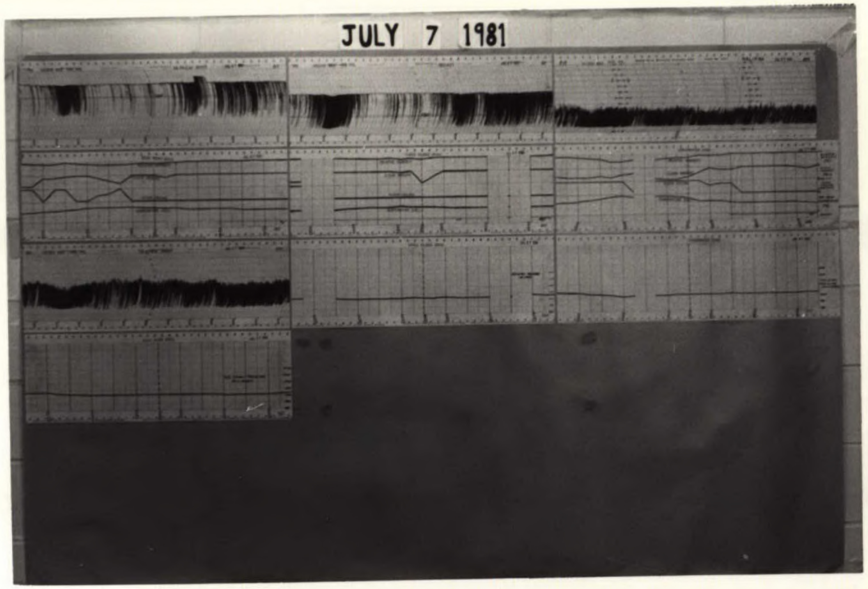
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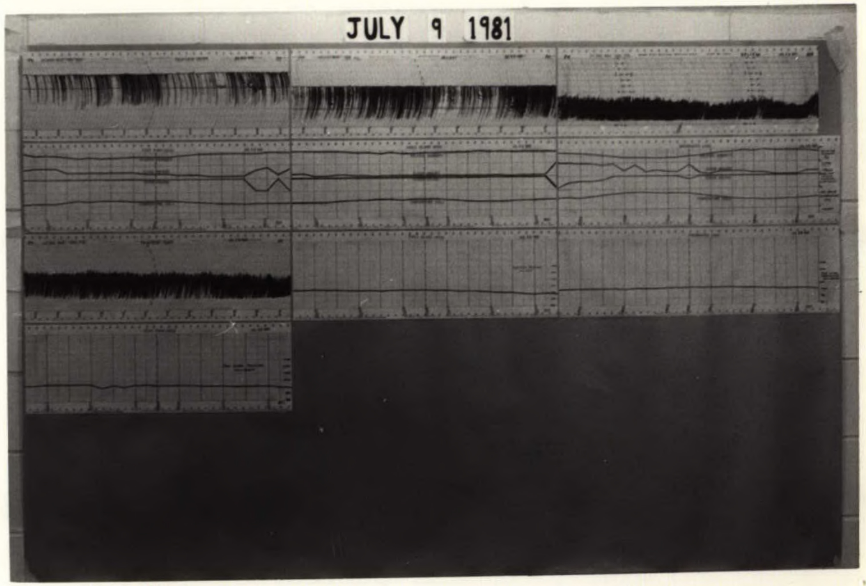
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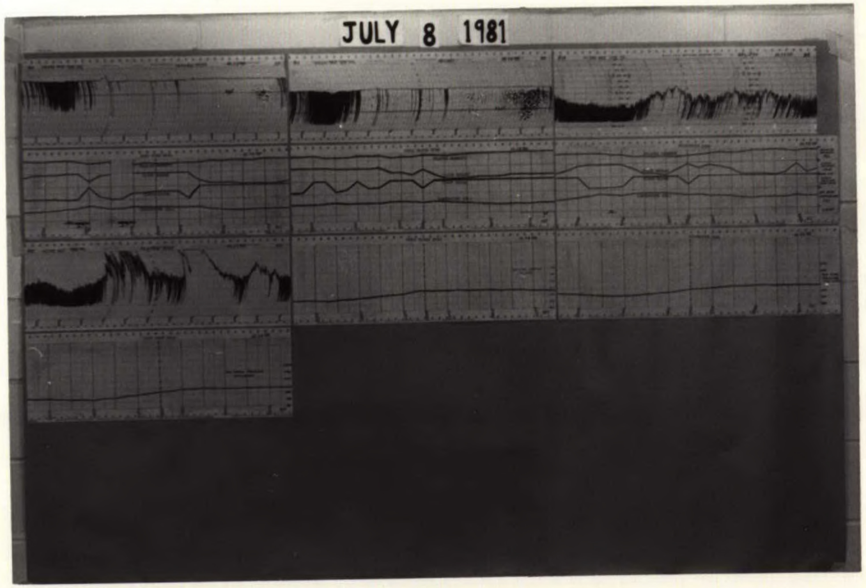
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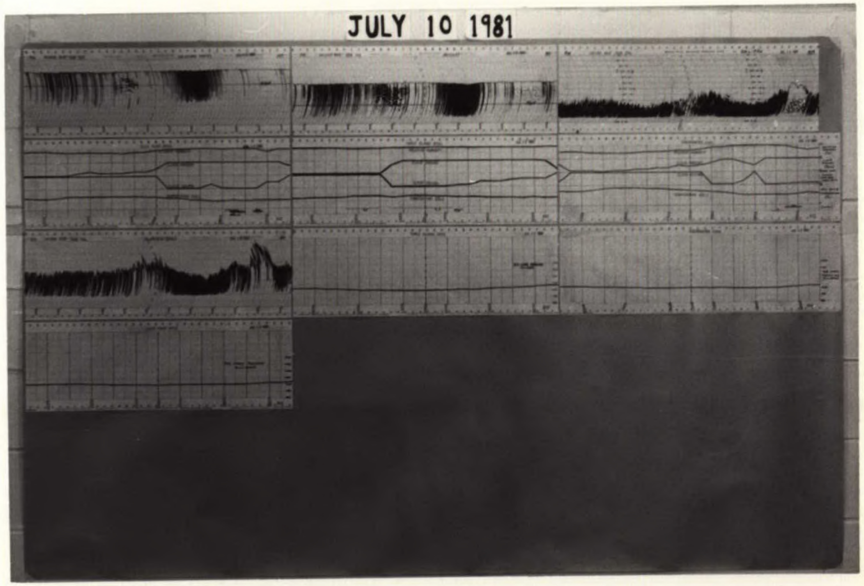
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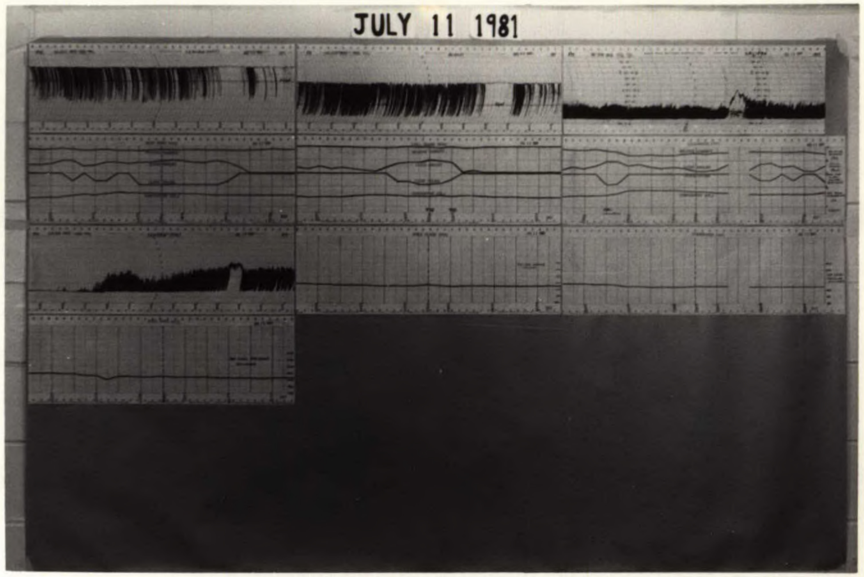
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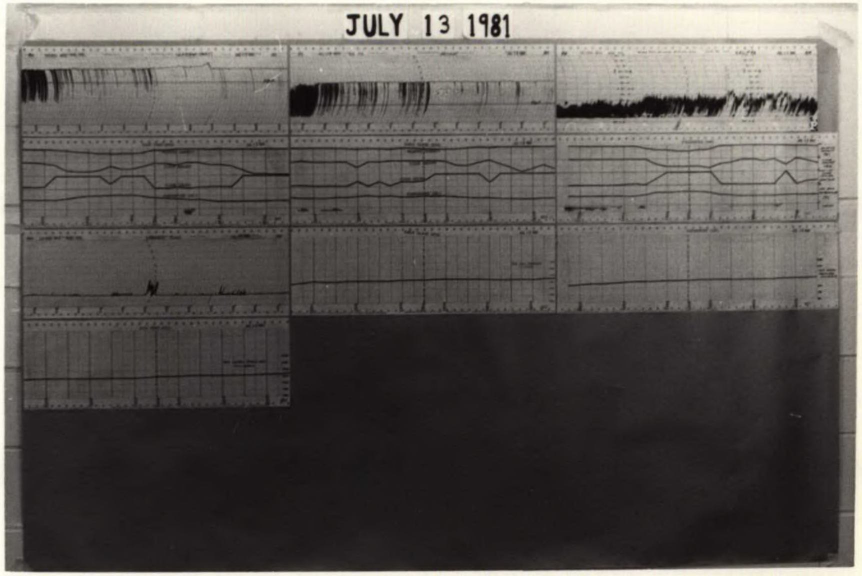
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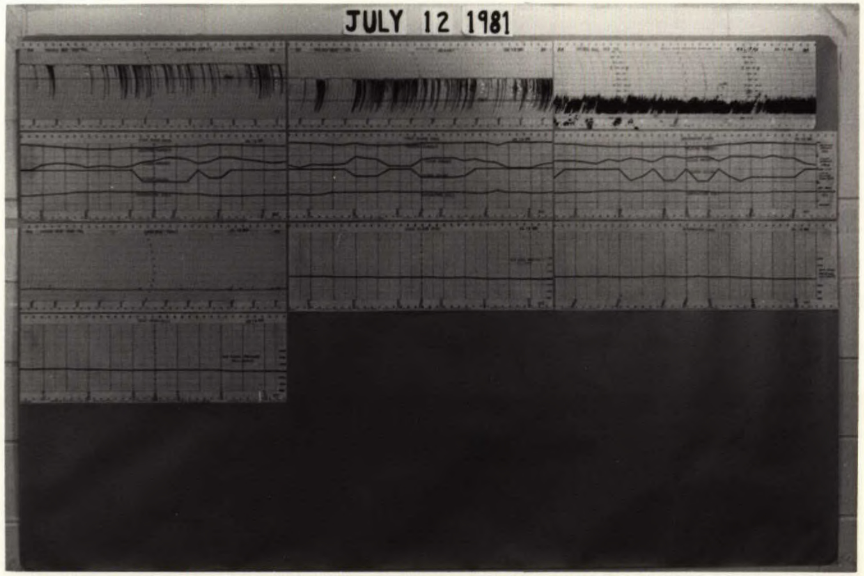
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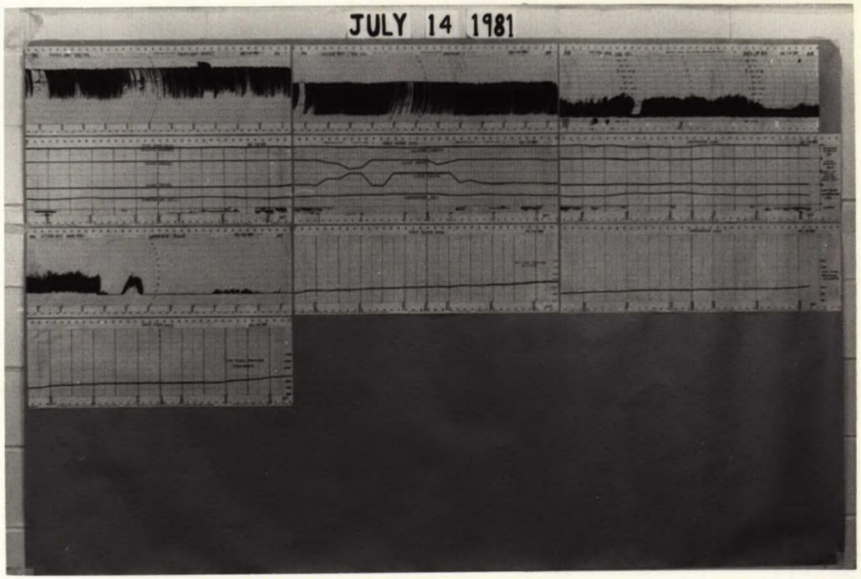
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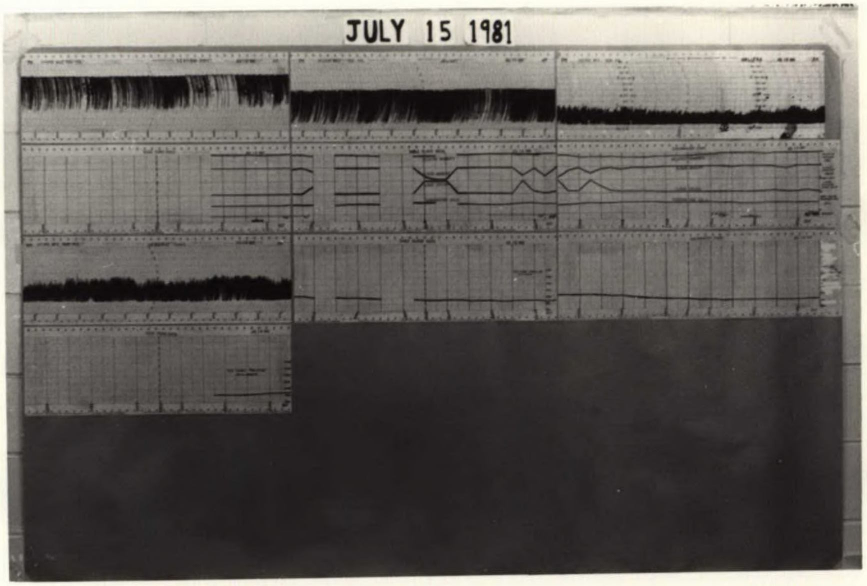
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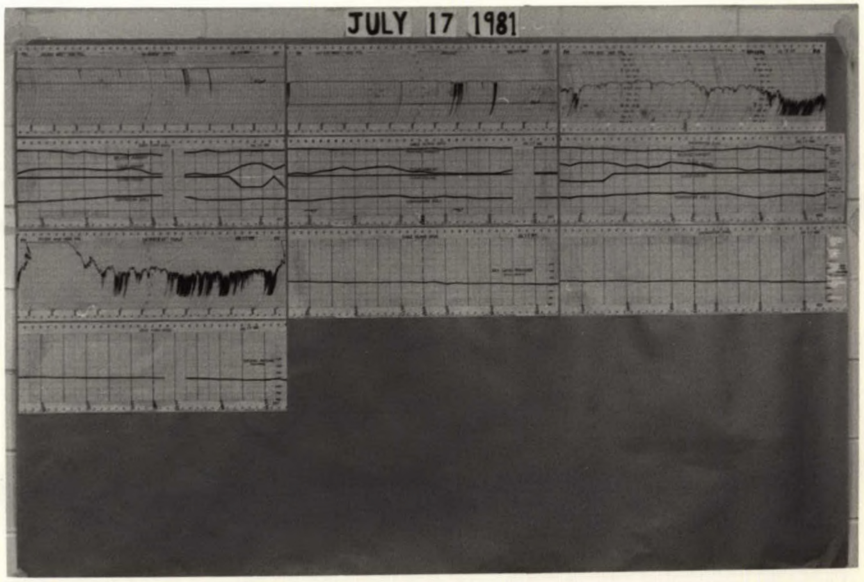
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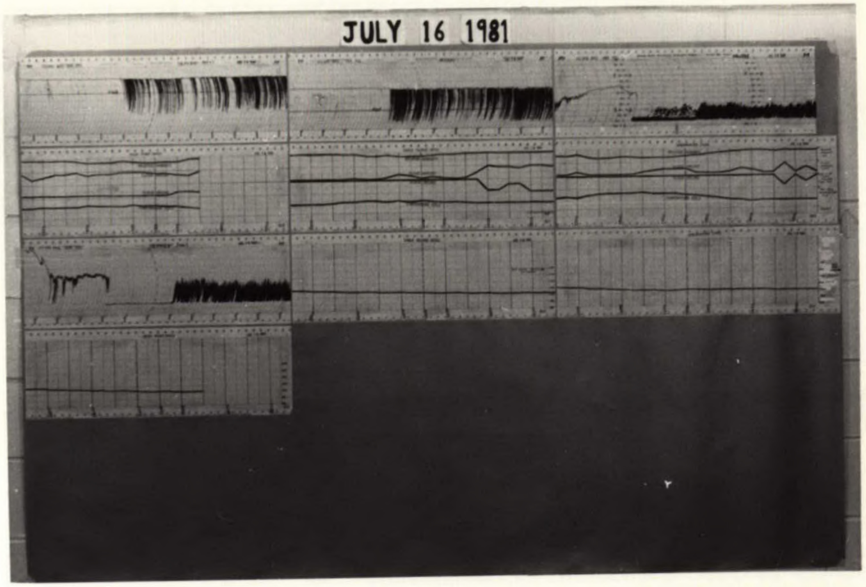
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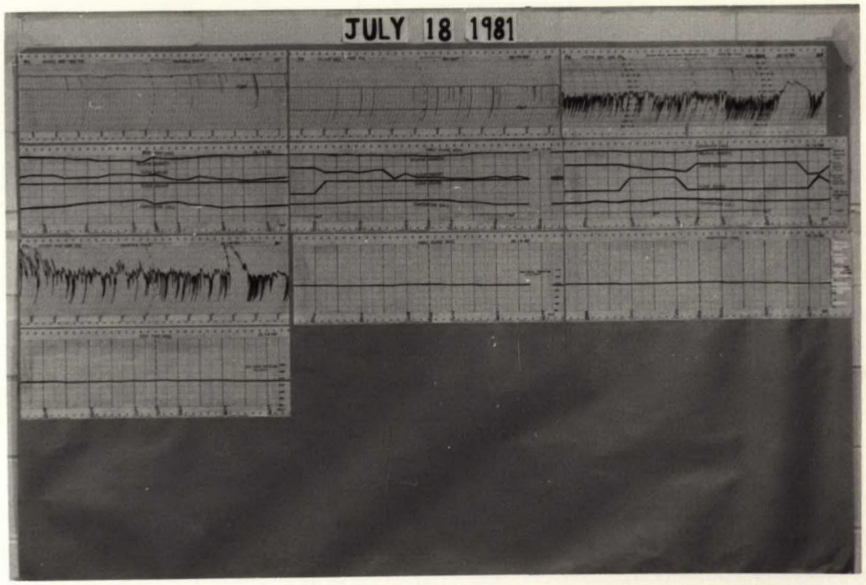
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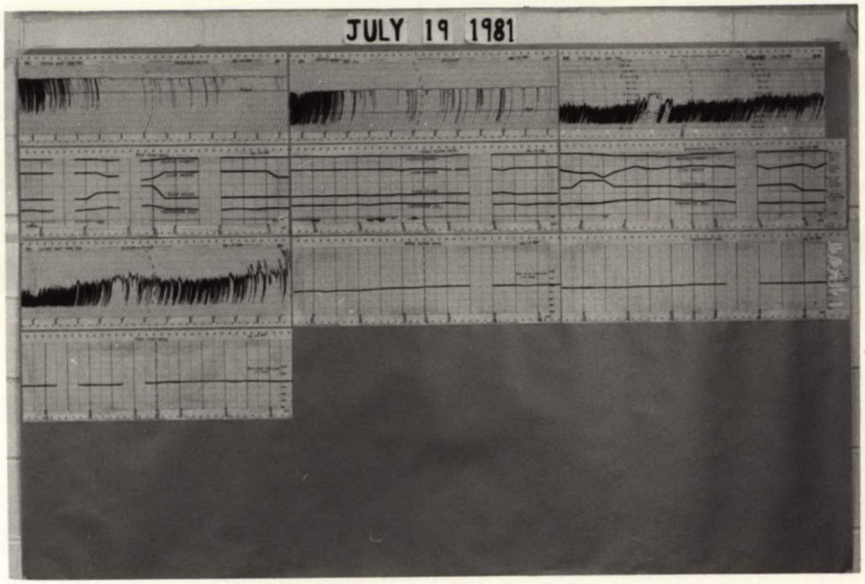
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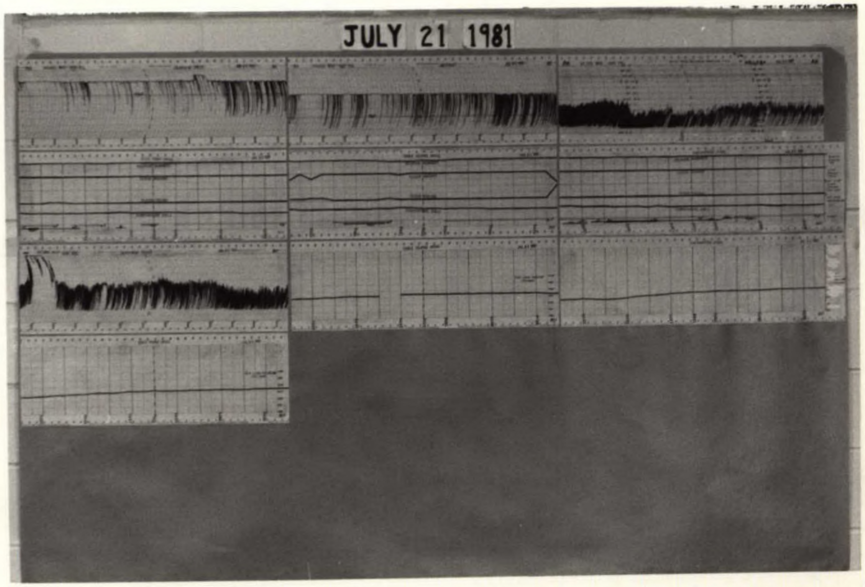
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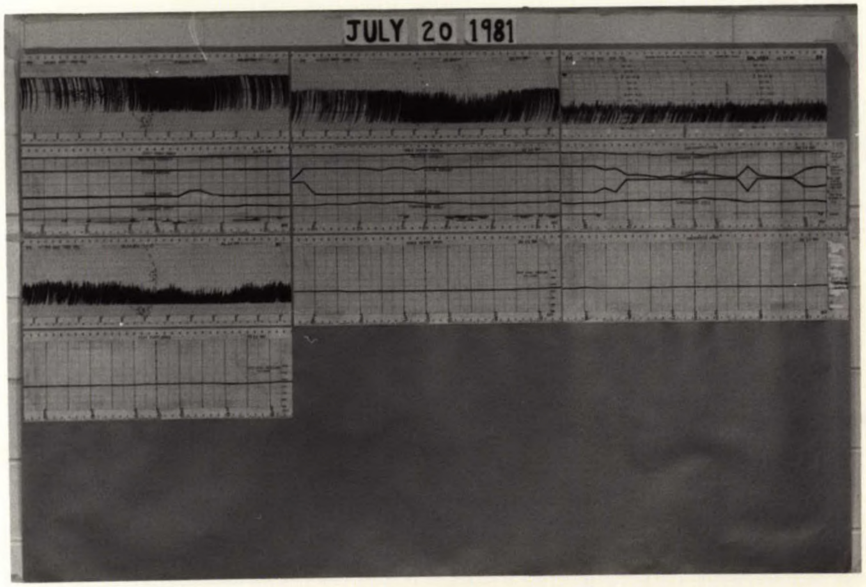
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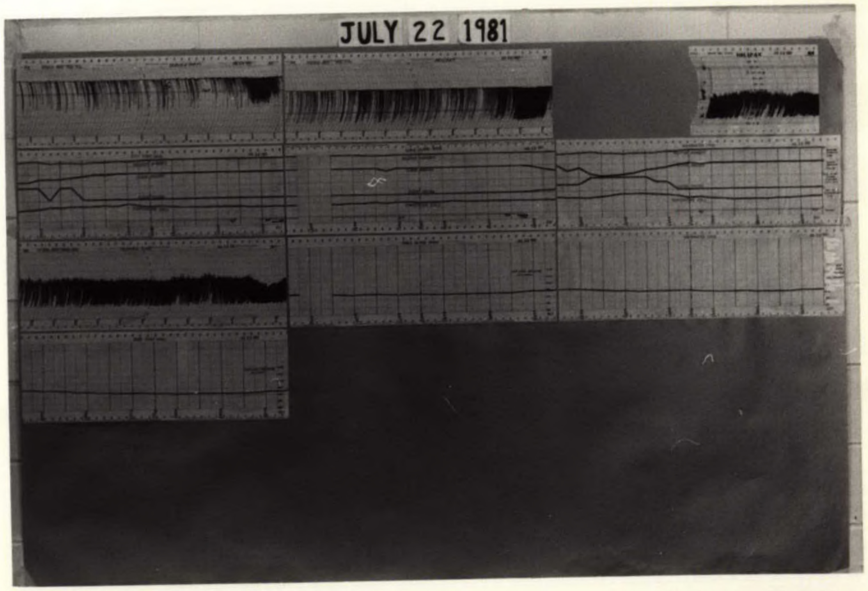
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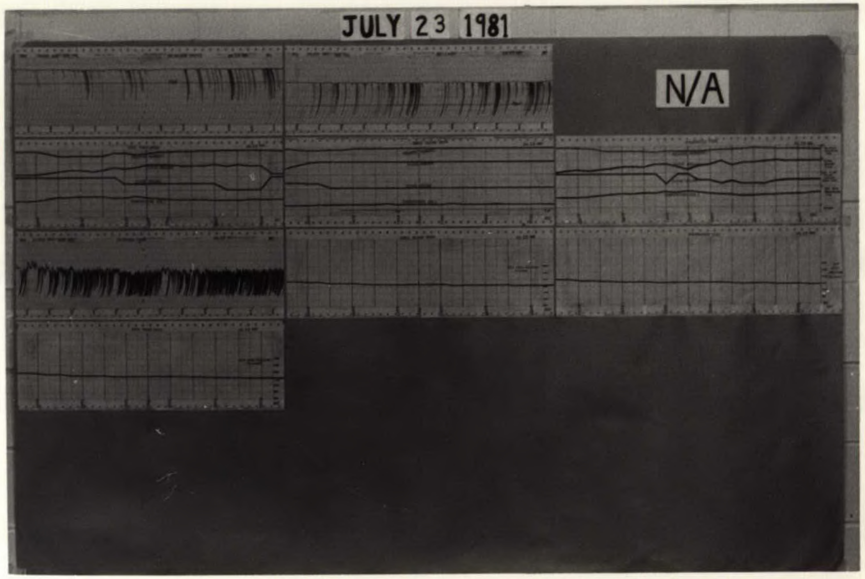
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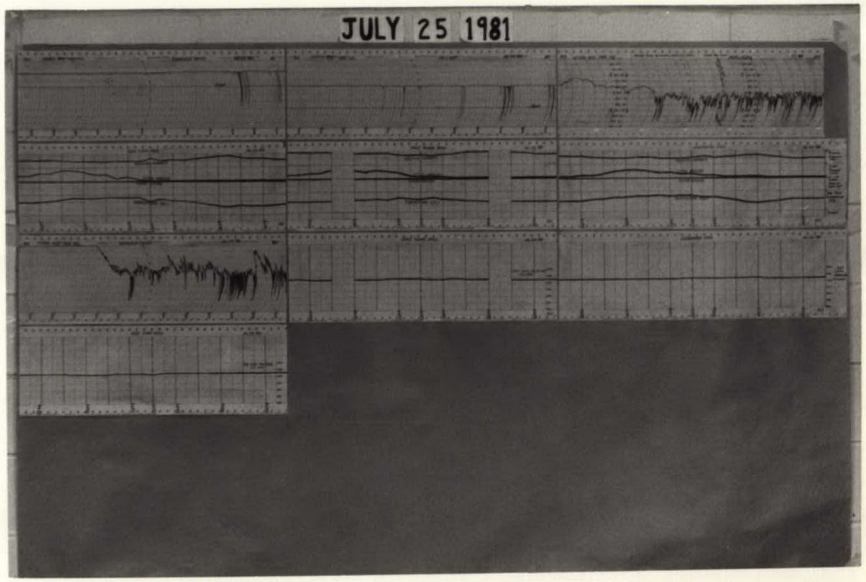
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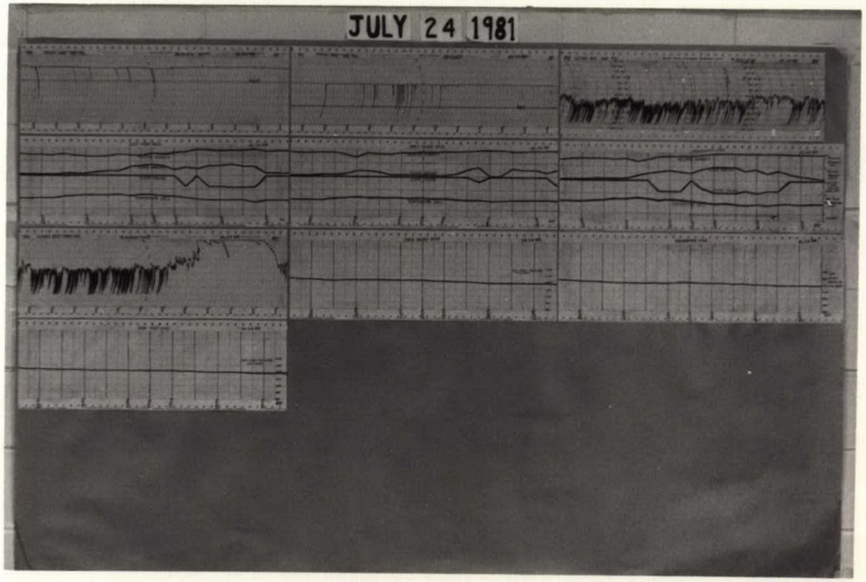
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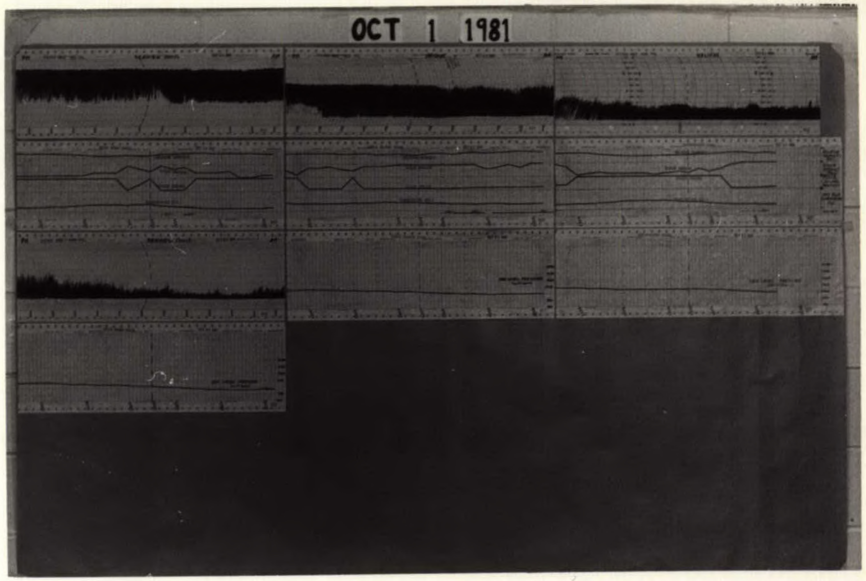
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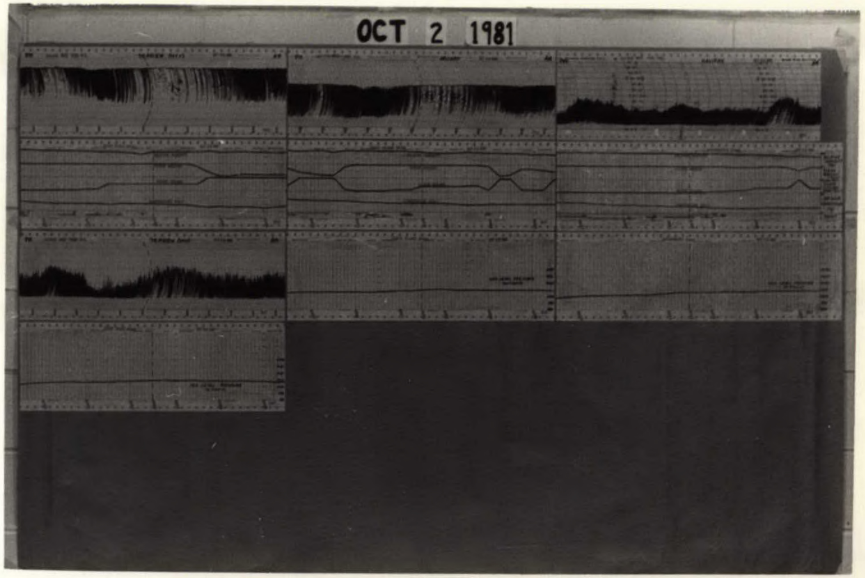
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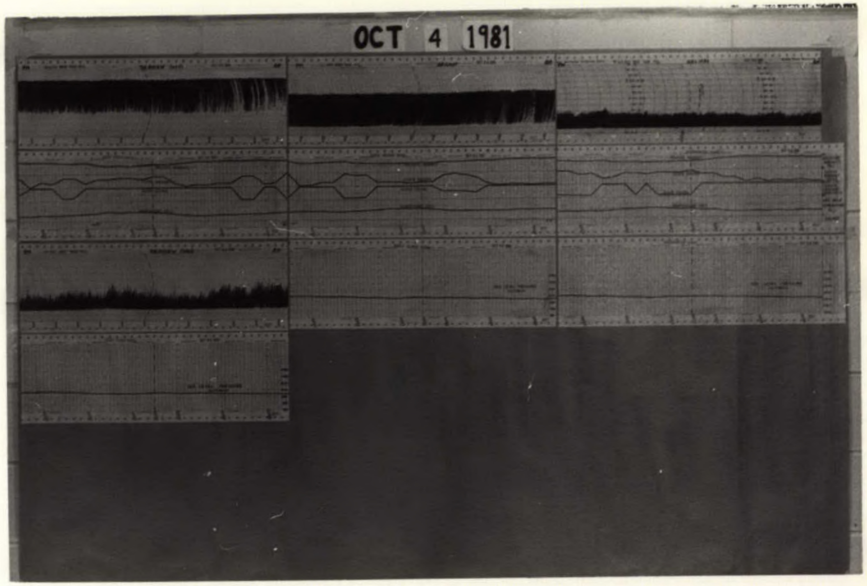
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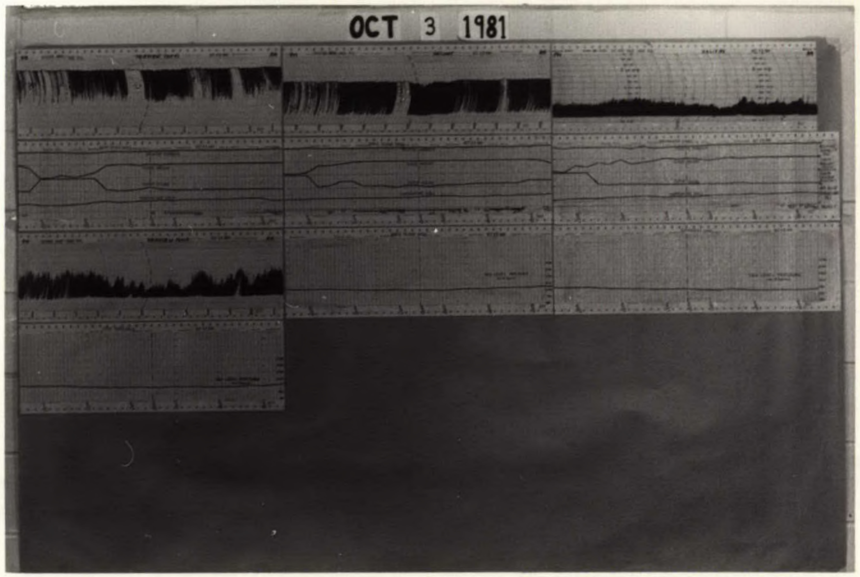
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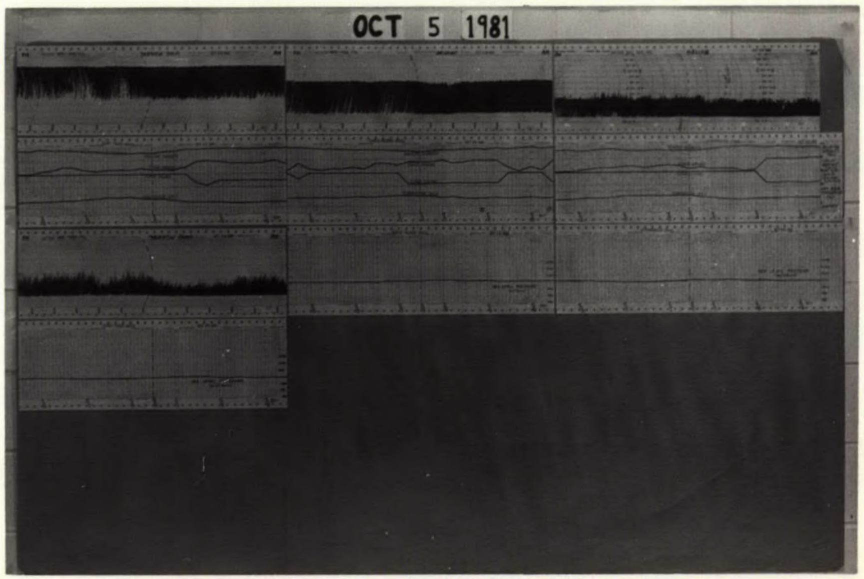
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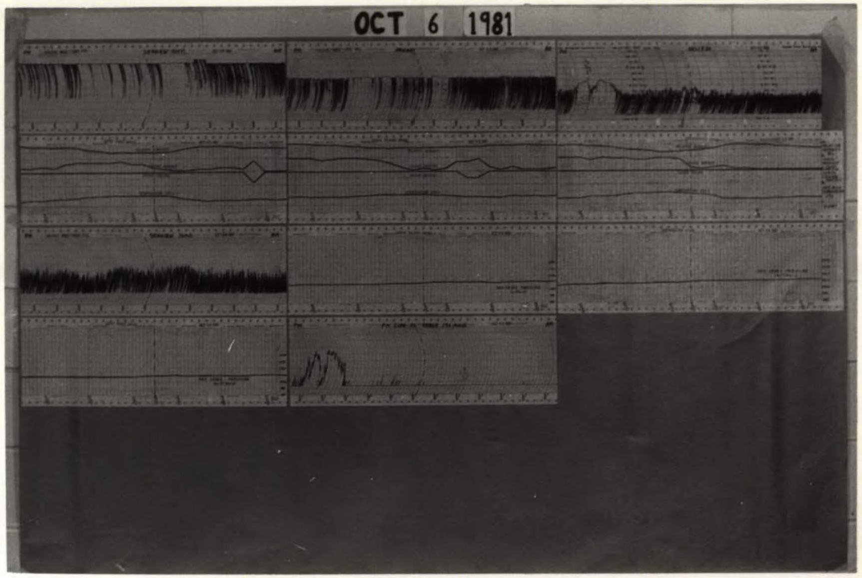
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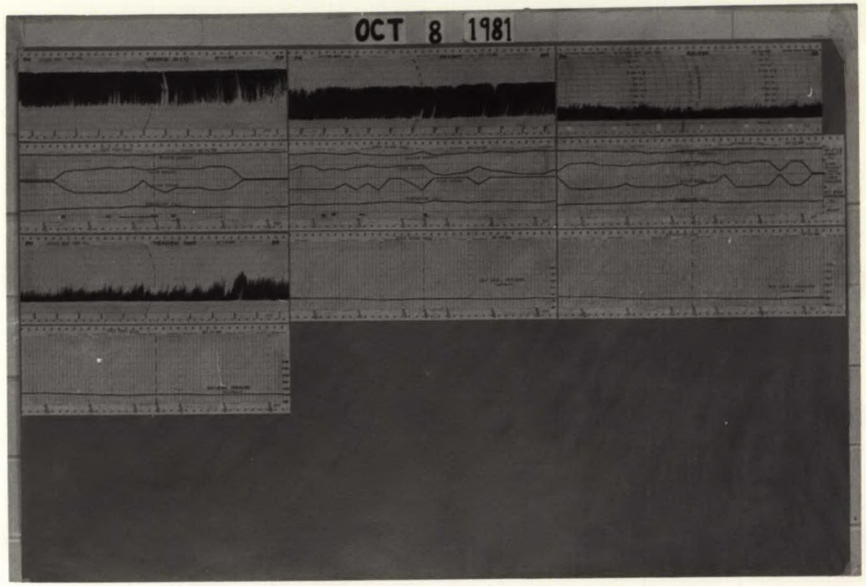
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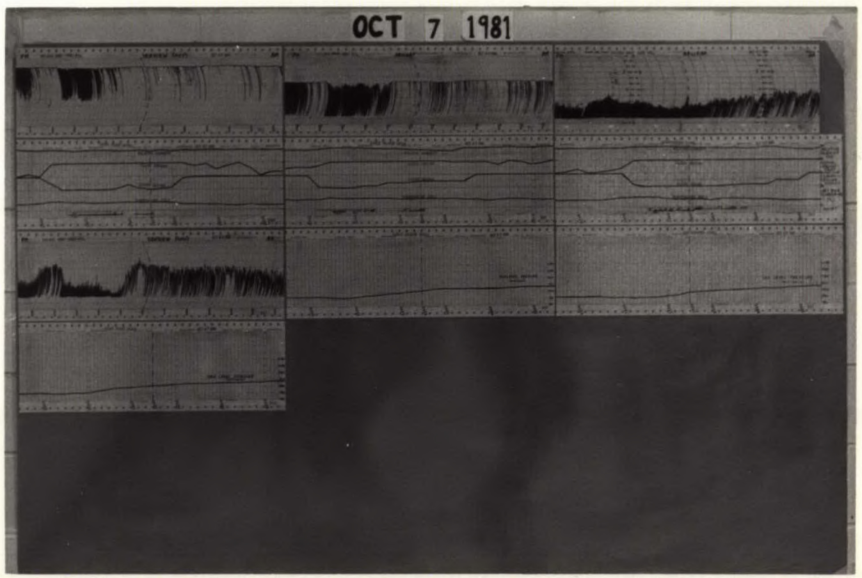
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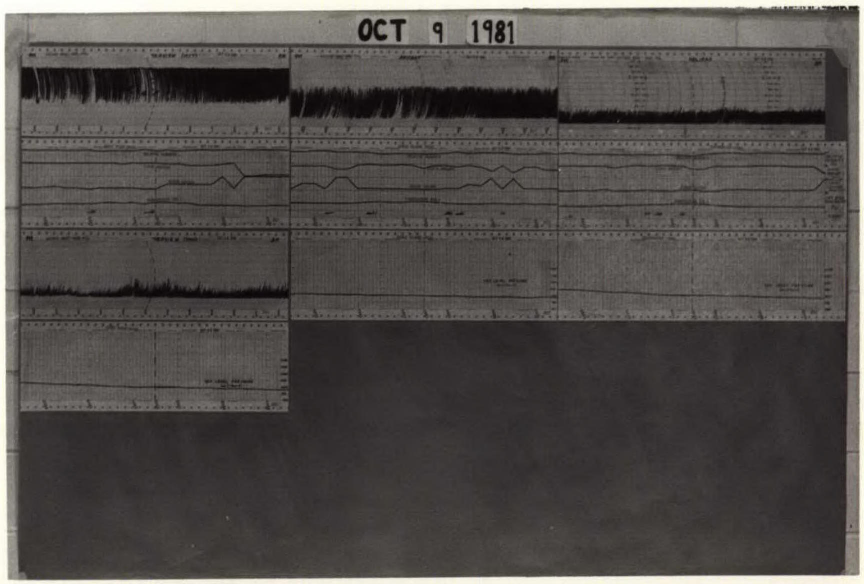
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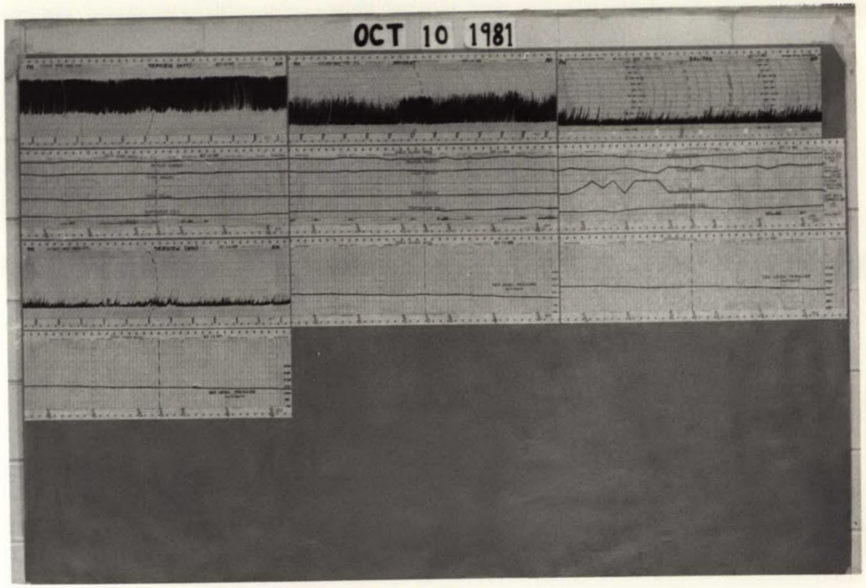
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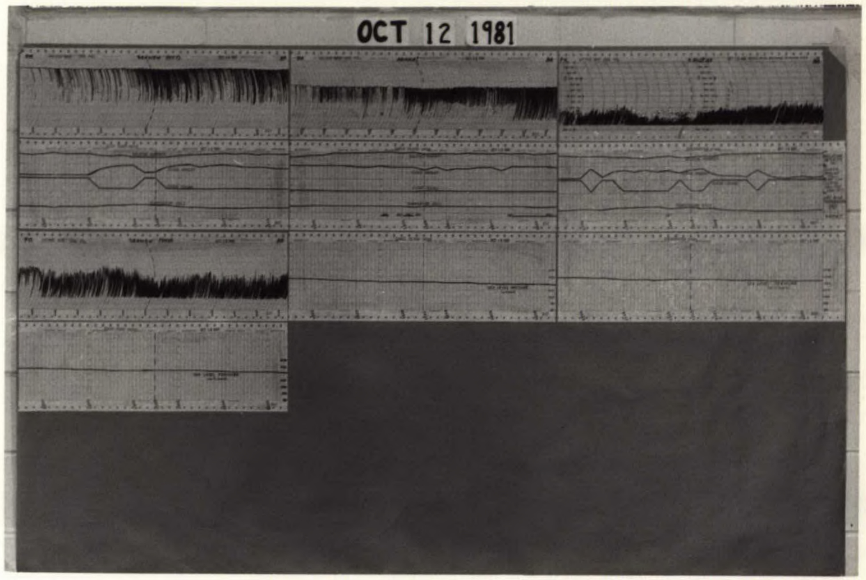
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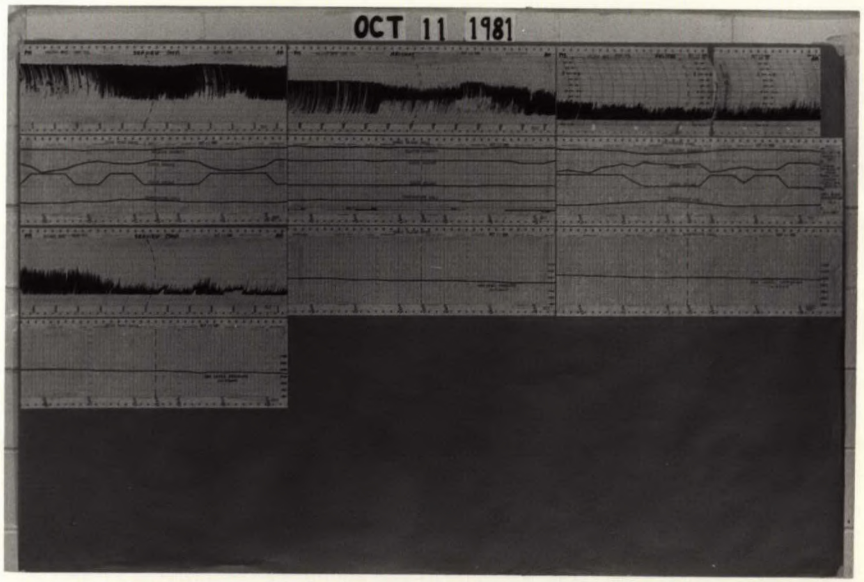
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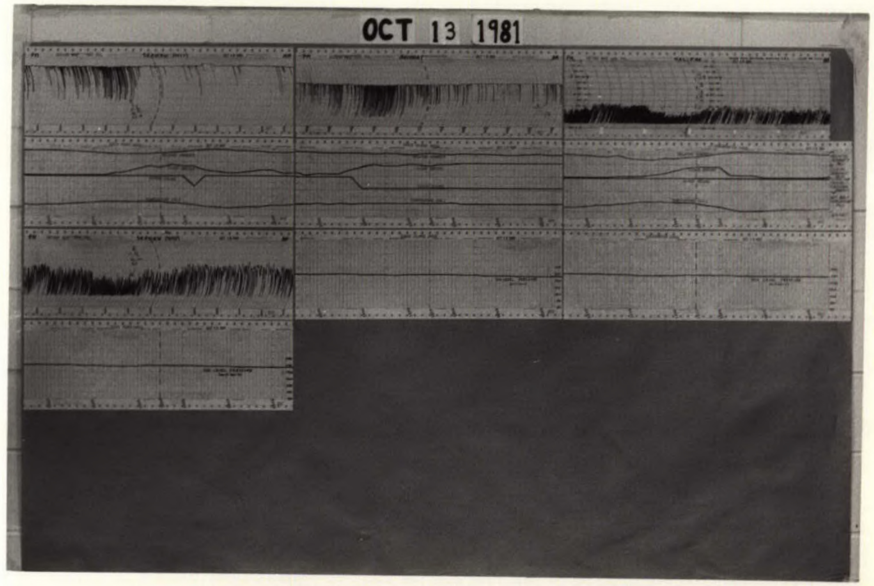
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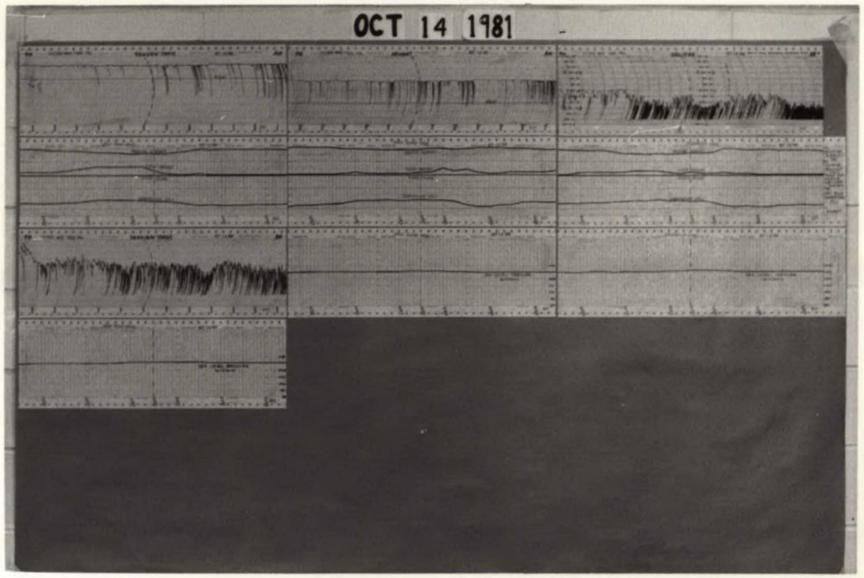
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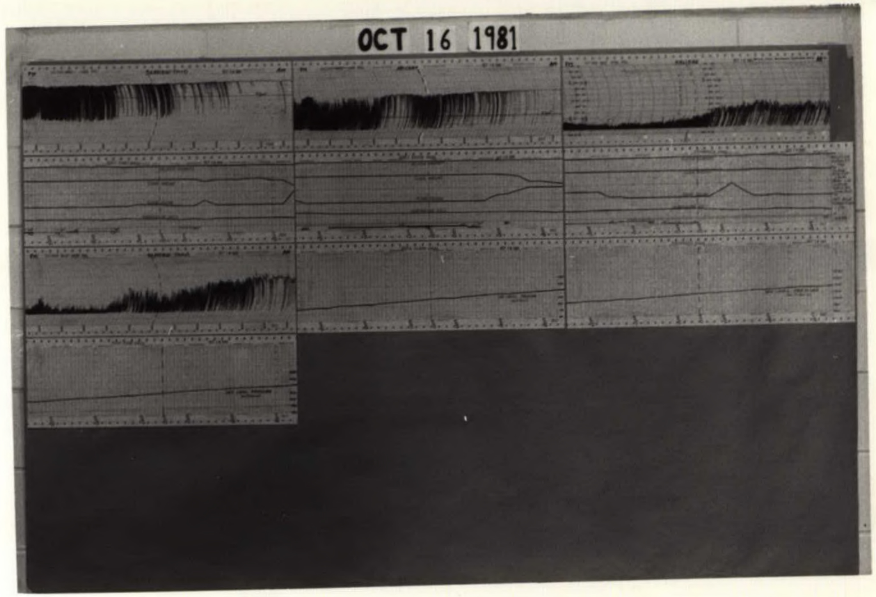
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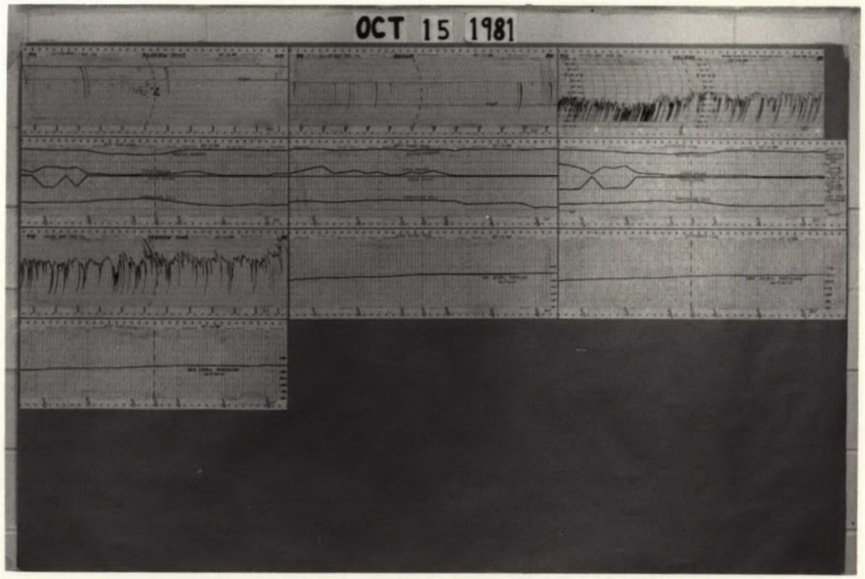
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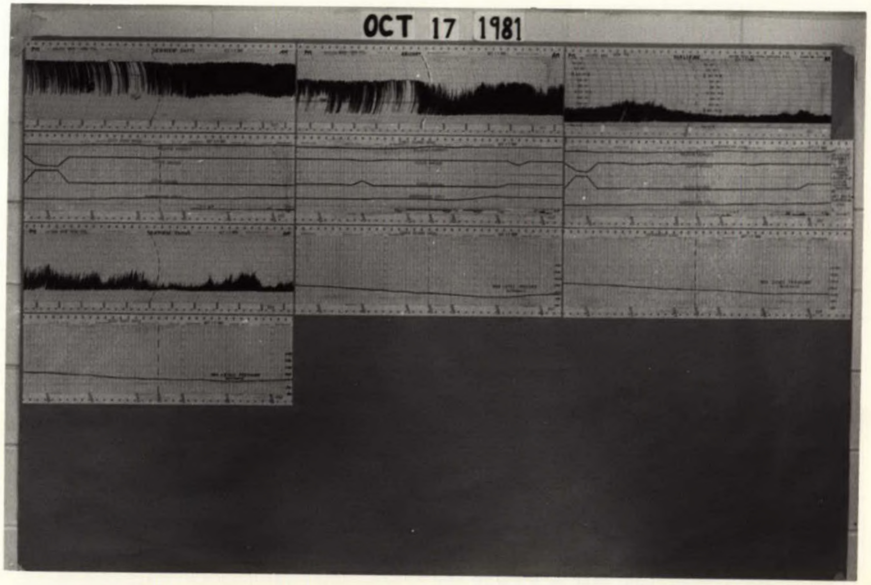
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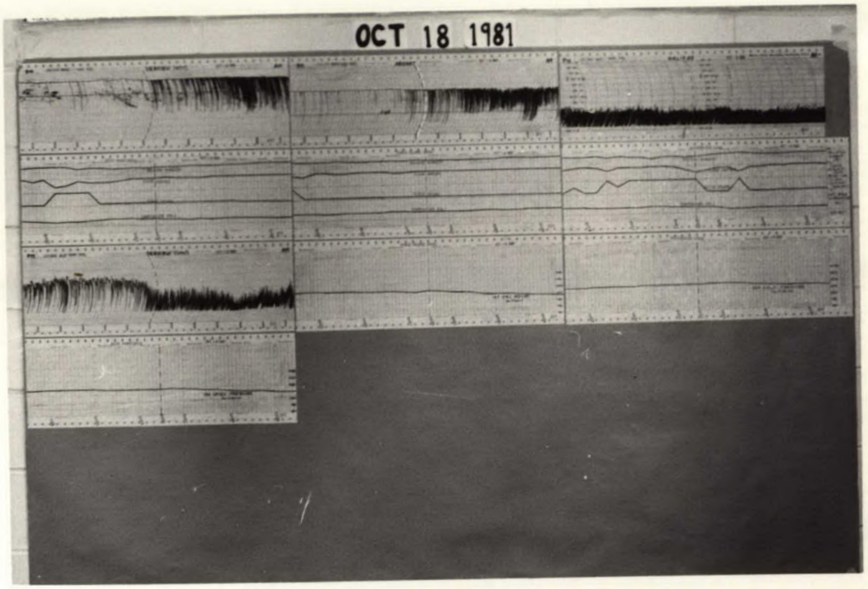

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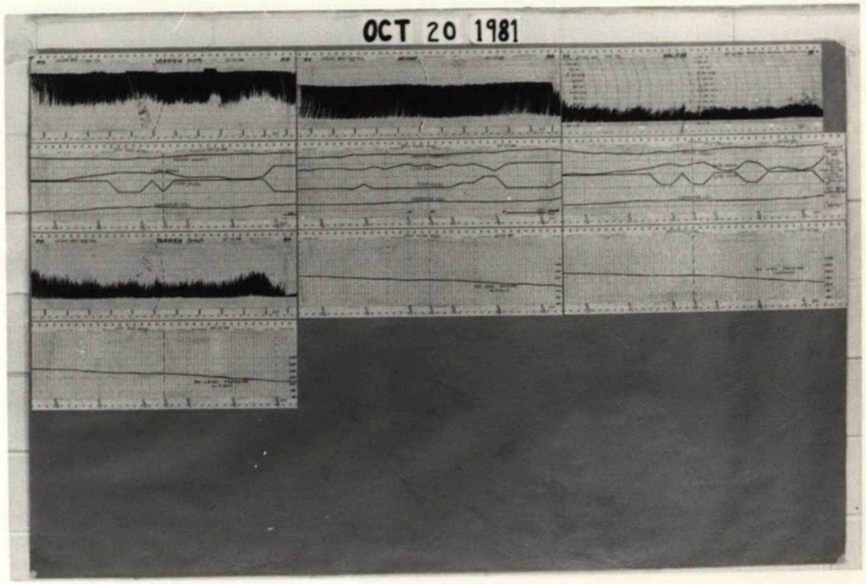

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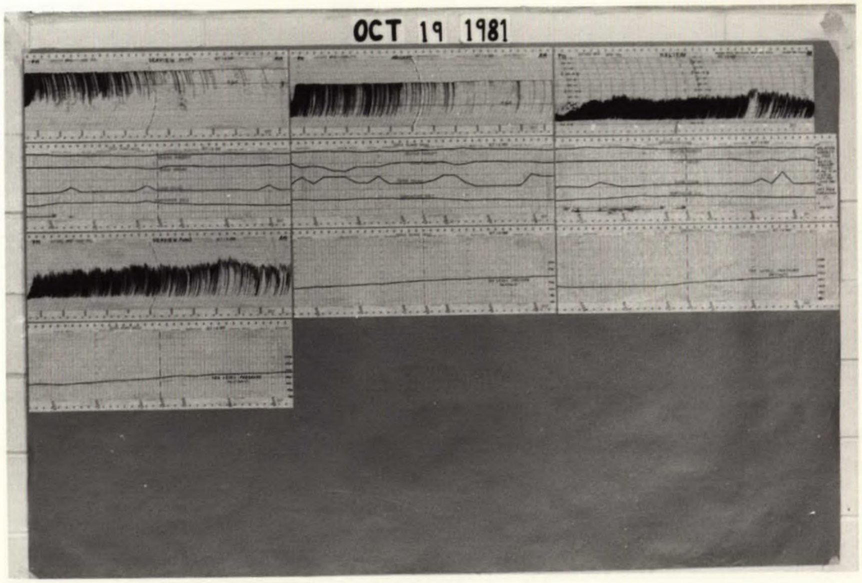

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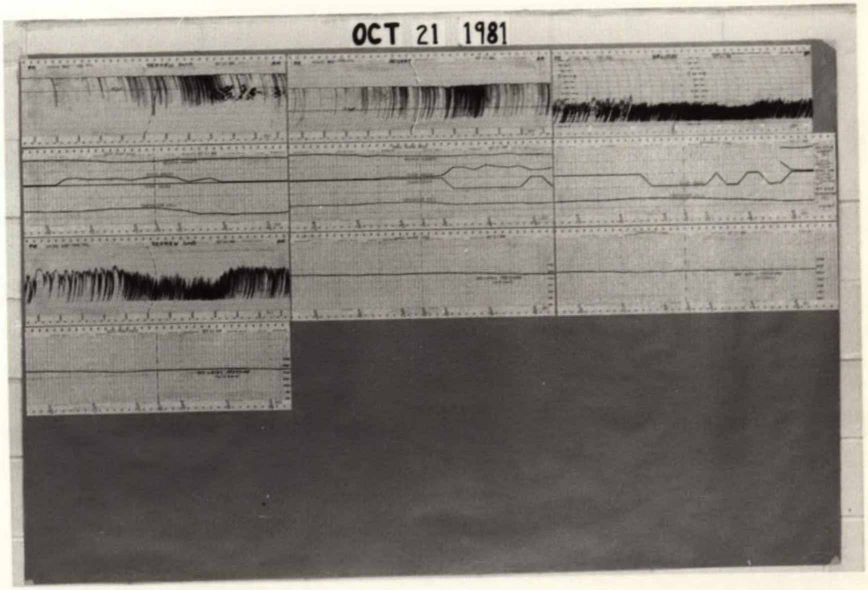

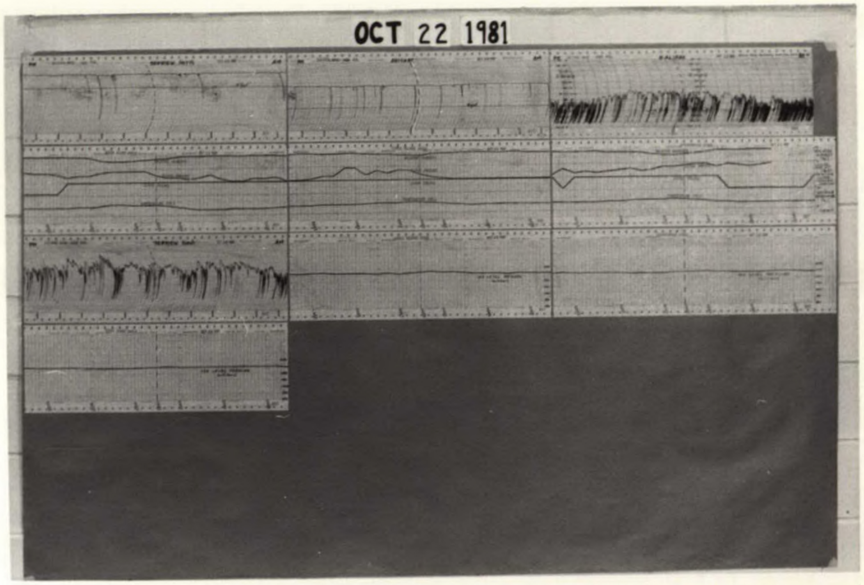
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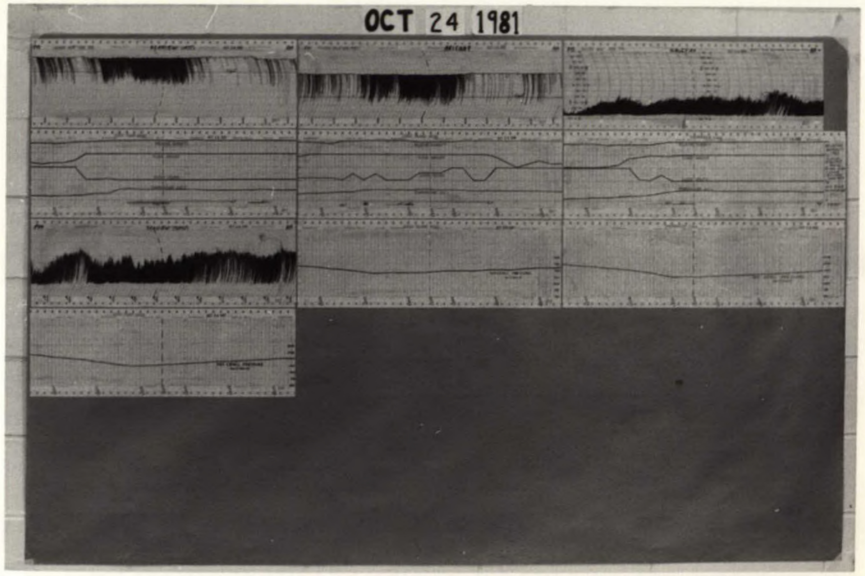
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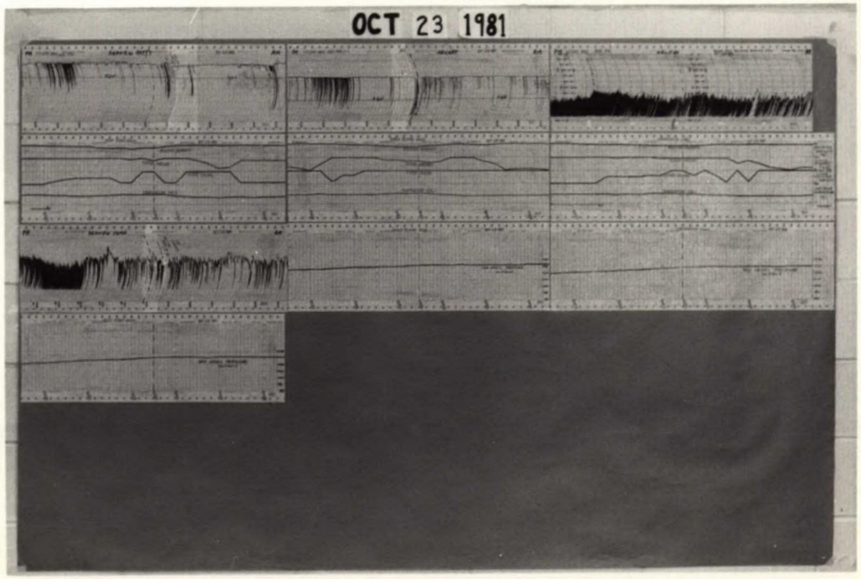
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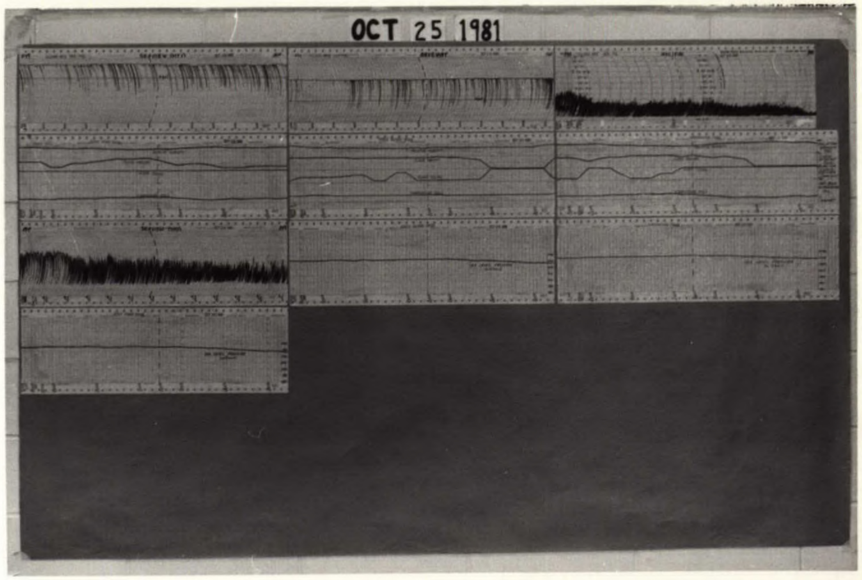
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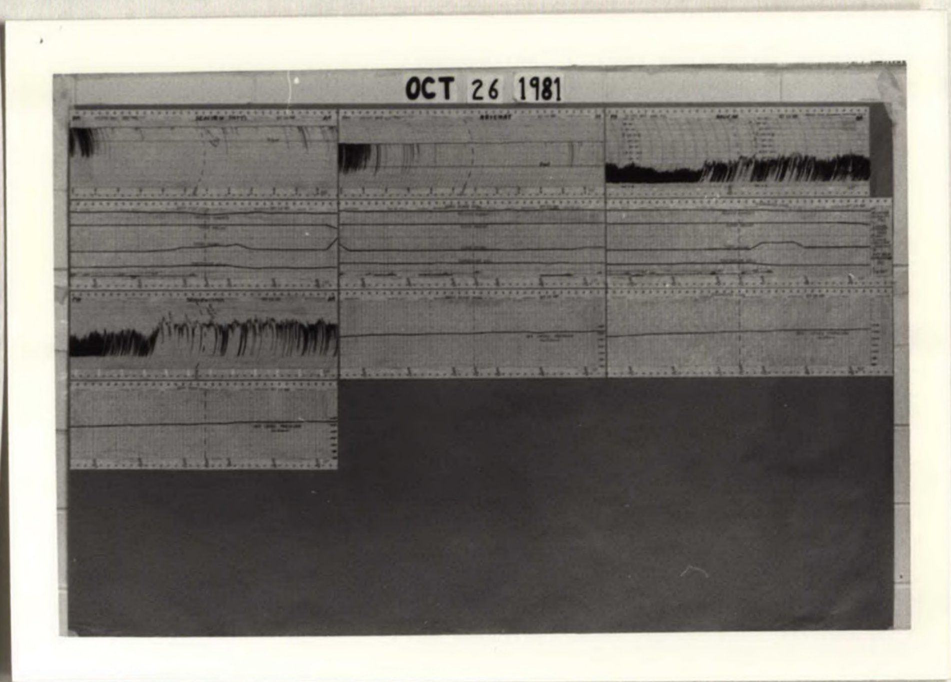
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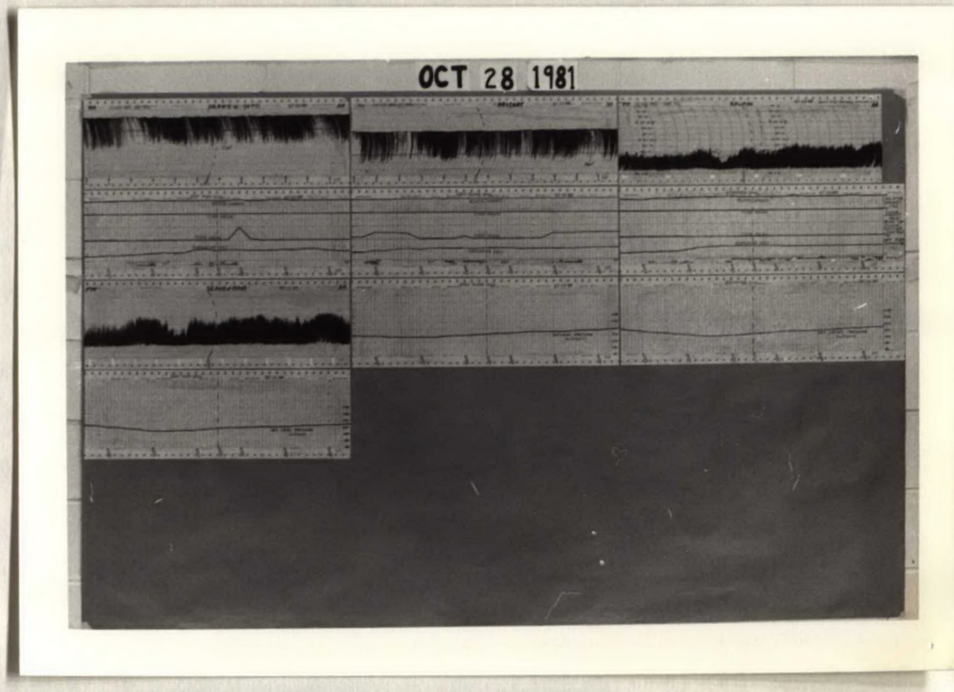
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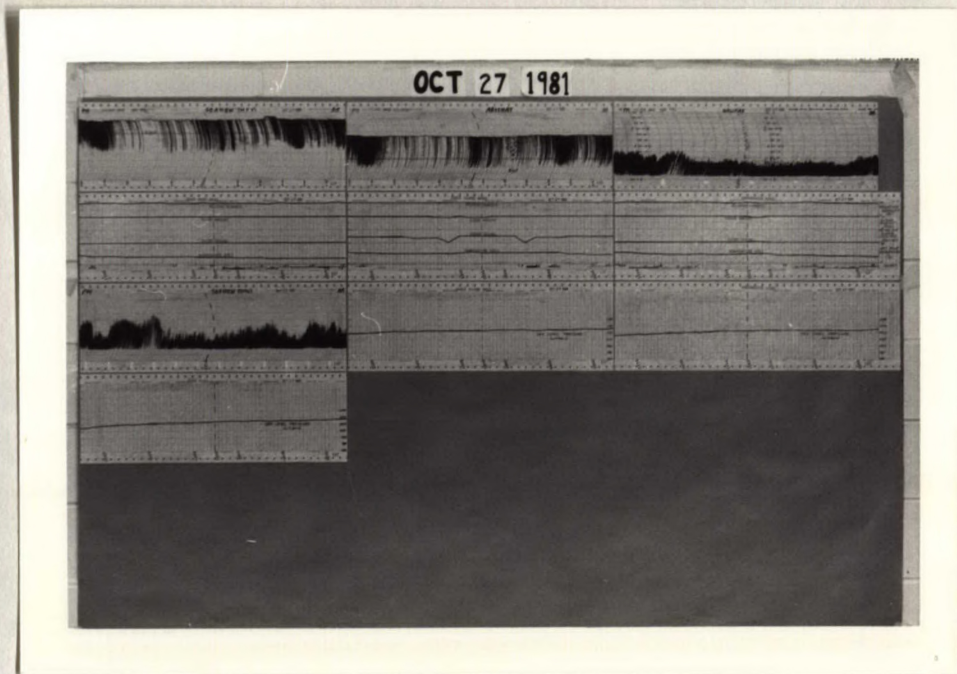
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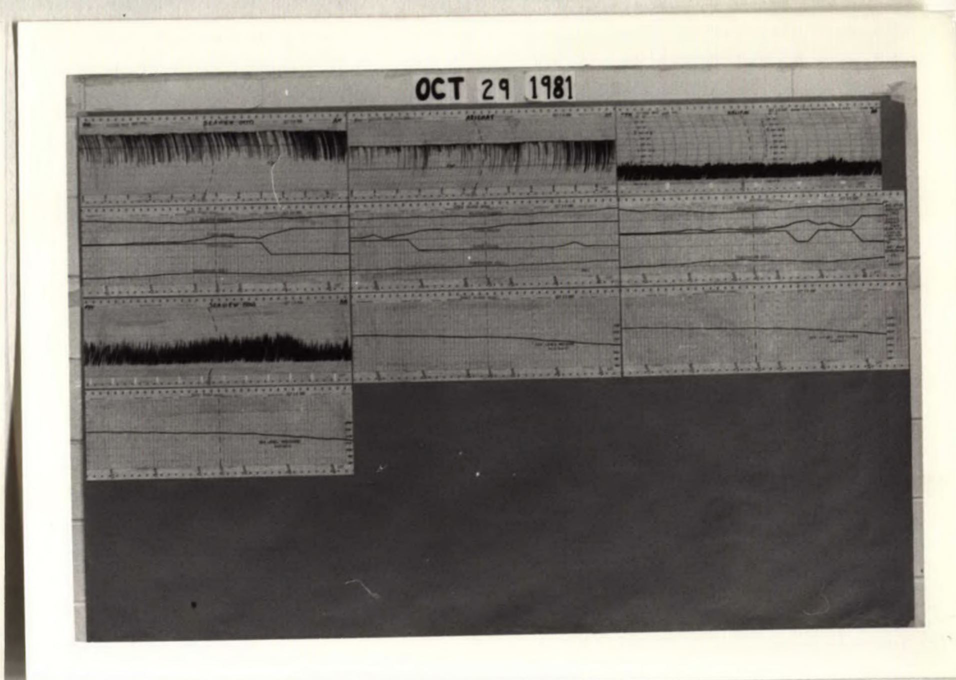
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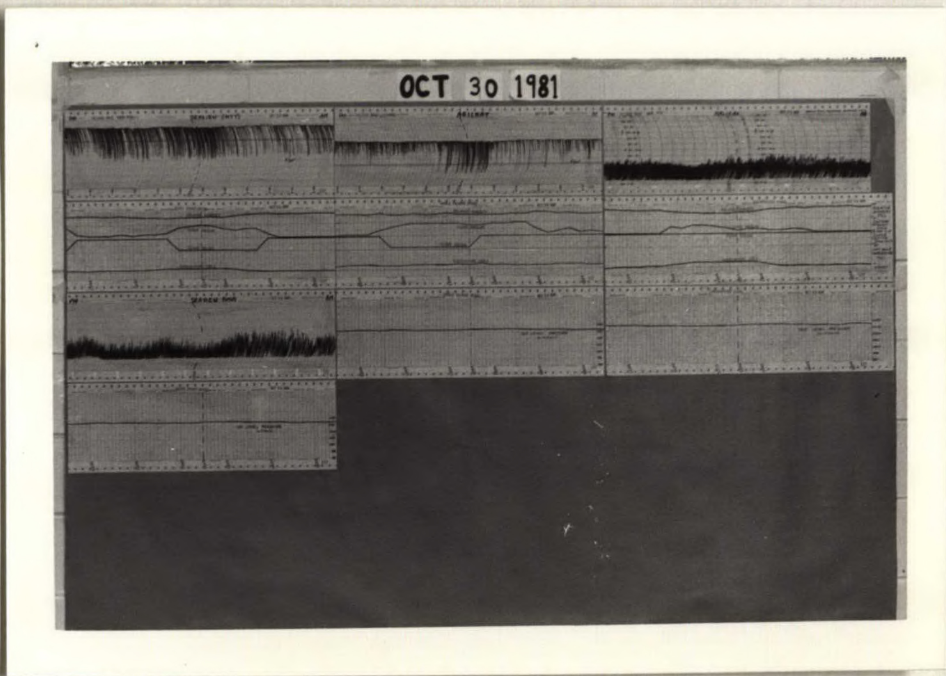
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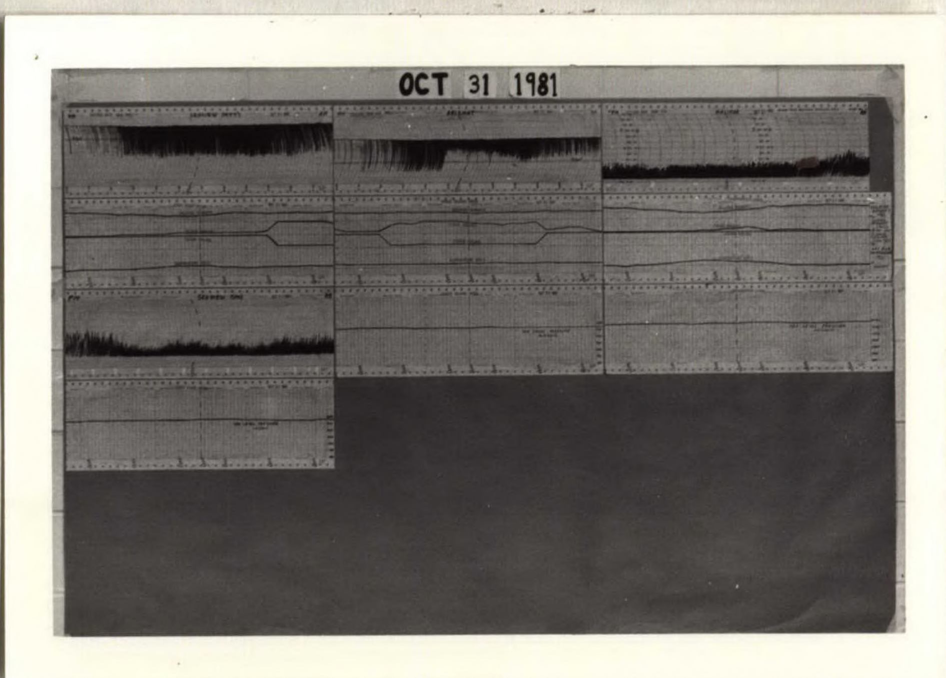

OCT 31 1981

Appendix C

Appendix C

Differential Time-dependence of fading at Seaview and Arichat

(preliminary report)

Principal Investigator: W.P. Lonc, (Saint Mary's University)
assisted by Mr. P.Fougere (M.T.&T, New Glasgow)

Date of Observations: May 8, 1981

Duration of Observations: one hour(from noon to 1pm)

Abstract: Time-occurence of fading events in a VHF(142.605MHz) carrier from Sable Island as received at Seaview and Arichat were measured simultaneously at the two receiving sites,). It was observed that there is a clear difference both in the number of fades and in the time-of-occurence of the fades between the two sites during this observation period.

Introduction: The objective of the experiment was to obtain statistics on the fading events occurring at both Seaview and Arichat, associated with a VHF signal originating at Sable Island. The observation period was one full hour, from noon to 1pm, on May 8, 1981. Significant differences in the fading between the two receiving sites could lead to the conclusion that diversity reception could be useful.

Experimental Details:

1. The radiation was vertically polarized at Sable, and the antennas at both Seaview and Arichat were also vertically polarized.
2. The Arichat site is some 30 km closer to Sable than is Seaview.
3. The two receivers are identical, except that the one at Seaview has a preamplifier, producing some 6db additional gain, with full limiting beginning at about 4.5 uV. Hence, it is expected that the Seaview receiver will show fewer fades than the one at Arichat, even allowing for the path difference(i.e. path attenuation). In this sense, the Seaview system is taken to be the 'better' system. With a view to possible diversity configurations, any fades at Seaview which are not simultaneously accompanied by fades at Arichat will constitute support for a diversity configuration between Seaview and Arichat.
4. During the observation, telephone contact was maintained between Seaview and Arichat, with the observer(Lonc) at Seaview verbally signalling a number of calibration points. There were eleven of

these points, and are so numbered on the attached chart recordings. The time-uncertainty in these calibration points is no more than about 1 second. The chart--recorders(Esterline-Angus, galvanometer type) were operated at a chart speed of 3/4" per minute.

Observations: 1. The two chart-recordings are combined so that the calibration points coincide, Fades at Seaview are labelled A-1, A-2, etc. on the Seaview recording, and these fades are then extended onto the Arichat recording, where they are enclosed in rectangular outlines. The fades at Arichat are labelled B-1, B-2, etc., and are enclosed in round outlines. The following fades are observed to coincide in time:

#1. A2 and B2
#2. A4 " B5
#3. A9 " B14
#4. A10 " B16
#5. A15 " B26

Note: simultaneity of fades does not imply that the same event is causing the two fades.

2. Of these five coincident fades, only two of them(#3 and #5) took the Seaview receiver below 0.2uV, for a total time-out of approximately 40 seconds. Note that the Seaview receiver is being taken as the reference system.

3. The total time-out due to fades in the Seaview receiver(i.e. during which the receiver went below 0.2uV) is approximately 100 seconds. The total time-out in the Arichat receiver was significantly higher; however, the Arichat receiver showed limiting on several occasions when the Seaview receiver was fading(eg. A-1, A-3, A-5, A-6, A-7, A-12, A-13, A-14, and A-16), which means that the Arichat receiver could have supplied a satisfactory signal during those times.

Conclusions: On the basis of the observations contained in this Report, it is concluded that diversity reception could decrease the net amount of time-out associated with fading.

Recommendations:

1. From the point of view of radio-physics, it would be more informative to have the full dynamic range of the received signals rather than the currently available 'limited' range. Hence, it is recommended that a test-point be located or established in the receivers ahead of the first-limiter stage for purposes of recording.

2. From the point of view of comparing relative performance between the two sites, it would be preferable to have the two sites equipped with identical receiver systems. Hence, it is recommended that the Arichat receiver be equipped with a preamplifier. This step would then enable a more meaningful comparison between the two sites.

3. It would be of interest to proceed with a diversity experiment involving the two vertically-polarized antennas at Seaview, which are separated vertically by about 35 meters(the upper antenna is the Seaview antenna mentioned in the Report). The only hardware required to proceed with this experiment is a preamplifier and a crystal for the receiver associated with the lower antenna. This experiment could show a fading behaviour which could be used to advantage in the overall communications link.

CHART No. 512411
BENDIX FRIEZ, BALTIMORE, MARYLAND, U.S.A.
"DIVERSITY" EXPERIMENT
SABLE TO ARICHAT
& SABLE TO SEAVIEW
MAY 8, 1981
1 MINUTE
0.2μV
SEAVIEW
OBSERVER: W. LONG
DISREGARD THESE CALIBRATIONS
ARICHAT
OBSERVER: D. FUGERE

Appendix D

Appendix D

May 13/81

Comparison of received signal strength from horizontal and circular polarization at VHF(147.850 and 147.950 MHz)

(preliminary memorandum)

Principal Investigator: W.P. Lonc, Saint Mary's University

Abstract: semi-quantitative observations were made on fast fading (~1 sec. duration) associated with reception of two beacons on Sable Island, as received at Halifax. The two beacons were feeding horizontally and circulrly polarized antennas respectively; the receiving antenna was horizontally polarized. It was observed that there was much less of this fast fading in the signal originating from the circularly polarized radiation.

Introduction: The objective of this particular experiment was to obtain preliminary observations of the time-dependent signal strength from two VHF(approx. 148MHZ) beacons on Sable Island; the significant difference between the two radiation sources was assumed to be primarily in the polarization: one of the beacons(147.950MHz) was driving a horizontally polarized antenna(yagi) whereas the other beacon(147.850 was driving a circularly polarized antenna(crossed yagis). At the receiving site, only a horizontally polarized antenna(yagi) was available for this preliminary observation, and it was assumed that this arrangement would suffice to detect any significant differences (associated with polarization) between the two signals.

Experimental Factors:

1. On Sable Island: Both beacons produce about 10W into the transmission line, and both antennas have about 10db gain. The circularly polarized system consisted of two crossed yagis with appropriate phasing harness(sense of rotation not noted).
The beacon for the horizontally polarized antenna was FM modulated, whereas the one for the circular polarization was a keyed carrier. Both antennas have a clear view of the ocean.

2. At Halifax(roof of the Admin. building, Saint Mary's). A single horizontally polarized yagi, of about 10db gain, fed two receivers. The FM receiver had both audio and chart-recorder outputs; the chart-recording attached to this memo are associated with this

particular receiver. The AM receiver had only an audio output. The receivers were operated simultaneously, and it was possible to obtain an aural comparison between the two signals. It was found

that the two signals could be compared in a more comprehensive manner by also watching the pen-recorder associated with the FM receiver(this pen-recorder was operating at a chart-speed of 3/4" per min.). Hence, the data in this memo is semi-quantitative in the sense that the output from one of the receivers was not being recorded on a chart.

3. Procedure: As implied above, the procedure was 'geared' to look for any differences in fast fading between the two receivers. The observations were carried out sporadically; each observation period lasted for approximately 5 minutes. The observations took place during the latter part of April and the first few days of May.

Observations: On the basis of approximately 20 of these brief observations, it was usually observed that over any of the 5 -minute observation intervals, the fading in the signal associated with the circularly polarized radiation was quite clearly less than in the other signal. By way of clarification, the fading in the FM receiver was observable both in the loudspeaker as well as on the chart-recorder. A few of the observation intervals indicated fading on both signals, but this was usually a rather longer fading (i.e. more than 30 or so seconds). In short, when the fading was of the 1 second(or shorter) kind, then the signal from the circularly polarized antenna quite clearly showed much less fading than did the other signal. In addition to the fading mentioned above, there were intervals, some lasting for several days, during which there was no detectible signal from either beacon. However, the significant feature of the observations in this memo remains:ie, the clearly fewer number of fades in the circularly polarized radiation as compared with the horizontally polarized radiation.

Conclusion: On the basis of the observations in this preliminary experiment, steps are being taken to produce chart-recordings on the circularly polarized channel, so that a more quantitative comparison may be made. In addition, a circularly polarized antenna is to be installed at Saint Mary's, so that the comparison between the two situations(ie, horizontal versus circular polarization) will be less ambiguous.

Addendum: Essentially the same observations as above were made at a site near Mt. Uniacke, NS, by Mr. R. Schultz. There is no chart-recorder at this site, the observations being on the basis of loud-speaker output only.

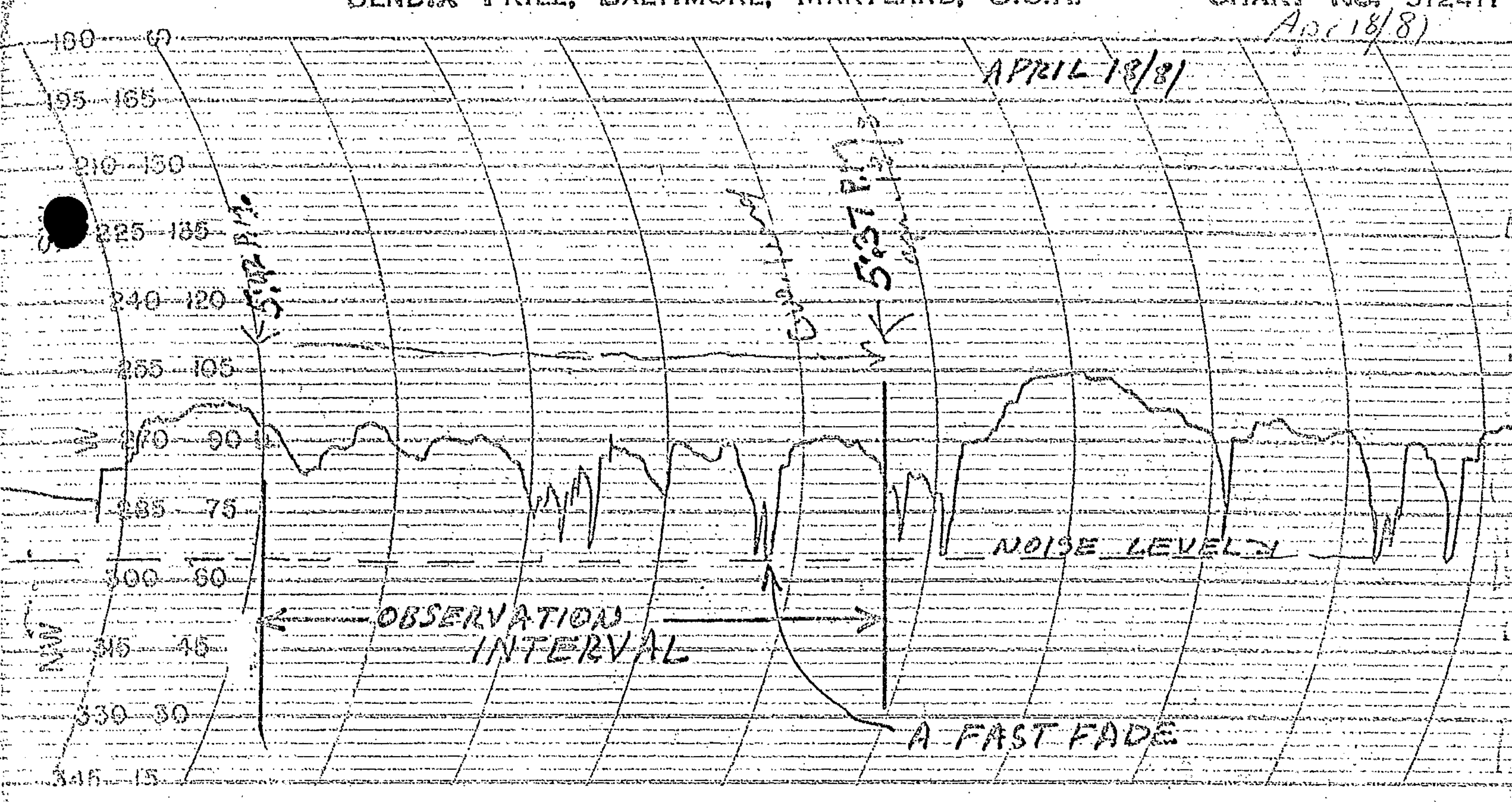


FIGURE: Segment from a chart-recording of received signal-strength on the FM receiver, receiving from the horizontally polarized antenna on Sable Island. In the 5-minute interval from 5:37 to 5:42 pm, there are several definite fast fades. During this entire interval, the signal from the circularly-polarized antenna on Sable was practically constant(as determined by listening to the loudspeaker). During the fast fades on the FM receiver, the tone-modulation, as heard on a loudspeaker, was heard to drop right down to the noise level. The horizontal and vertical printed calibrations on the chart paper are to be disregarded.

Appendix E

June 20/81

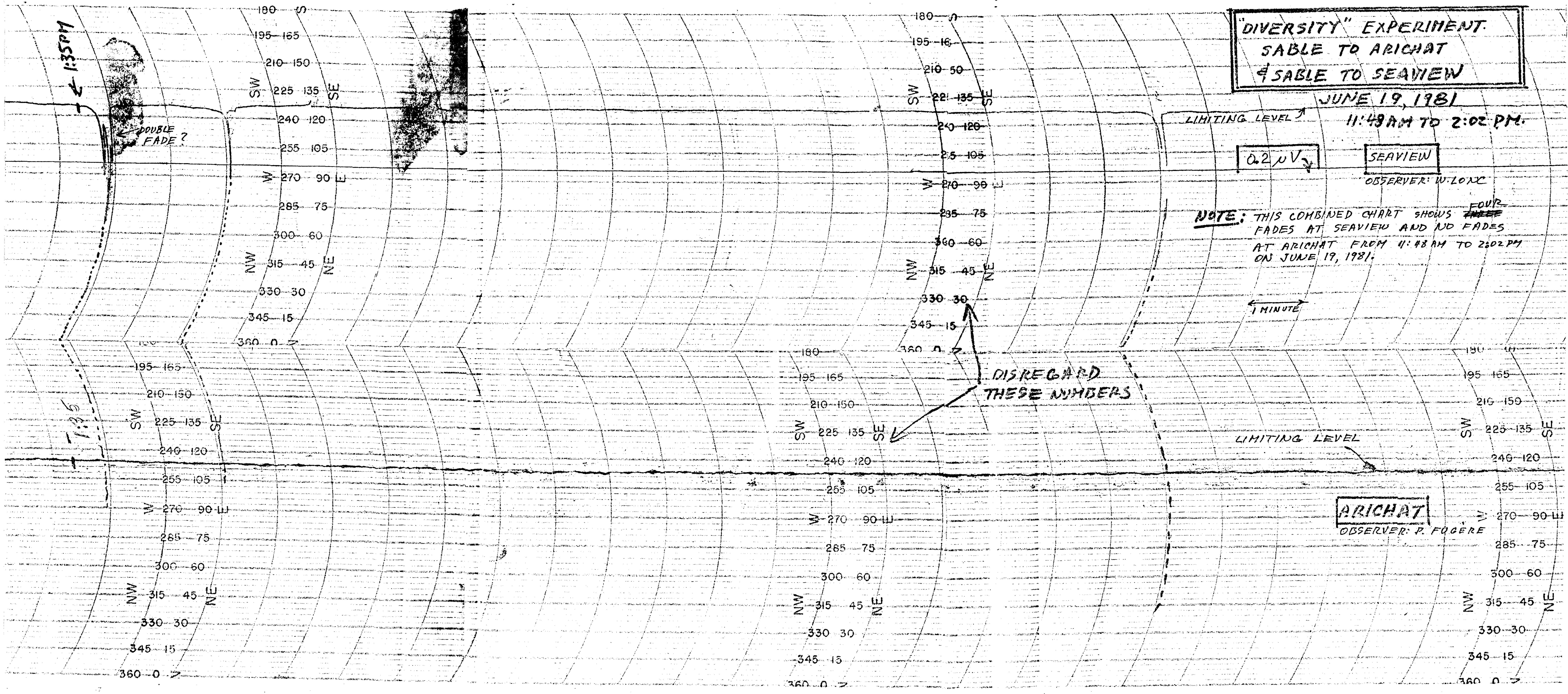
Supplement to: Differential Time-dependence of fading at Seaview and Arichat (preliminary report)

Date of Observations: June 19, 1981
Duration of Observations: 11:48 AM to 2:02 PM

Observations: Only 4 fades were observed(assuming that the double fade just prior to 1:35 PM is, in fact, two fades), and these all occurred at Seaview. All four fades took the receiver below 0.2 microvolts, and all were less than 10 seconds in duration.

Conclusions: The conclusion in the preliminary report (dated May 8, 1981) is confirmed.

Note: All experimental conditions in this supplement are similar to those outlined in the report of May 8, 1981. The Introduction of the May 8 report applies to the supplement, with the obvious changes taken into account. In addition, the duration of the observations was dictated by considerations of convenience only.



"DIVERSITY" EXPERIMENT
SABLE TO ARICHAT
& SABLE TO SEAVIEW
JUNE 19, 1981
11:49 AM TO 2:02 PM.
LIMITING LEVEL
0.2 μV
SEAVIEW
OBSERVER: W. LONC
NOTE: THIS COMBINED CHART SHOWS ~~THREE~~ FOUR FADES AT SEAVIEW AND NO FADES AT ARICHAT FROM 11:48 AM TO 2:02 PM ON JUNE 19, 1981.
1 MINUTE
1:35 PM
DOUBLE FADE?
1:36
DISREGARD THESE NUMBERS
LIMITING LEVEL
ARICHAT
OBSERVER: P. FOGÈRE
180 S
195 165
210 150
SW 225 135 SE
240 120
255 105
W 270 90 E
285 75
300 60
NW 315 45 NE
330 30
345 15
360 0 N

Appendix F

Comparison of 147.950 MHz and 431.990 MHz reception at Halifax originating at Sable Island (a preliminary report)

Principal Investigator: W.P. Lonc (Saint Mary's University)
Co-operating Observer: Mr. Elmer Naugler, VE1OD (50 Clayton Pk Dr, Halifax)

Dates of Observations: July 9/81 (2000 local time) to July 12/81 (0600 local time)

Abstract: Comparison of received signal-strength from two beacons located on the west end of Sable Island, one beacon on 147.950 MHz and the other on 431.990 MHz, showed marked differences in time-dependent behaviour. In particular, there were several well defined enhancements on the lower frequency beacon, but apparently none on the higher frequency. At least two of the enhancements were coincident with noticeable fading on the higher frequency. On the other hand, the higher frequency channel showed no signal drop-out, whereas the lower frequency showed frequent drop-out.

Introduction: The objective of this preliminary experiment was to verify the existence of propogation differences as a function of frequency in the case of 147,850 and 431.990 MHz, both horizontally polarized. The two beacons are located within a hundred meters of each other on the west end of Sable Island, and the two receiver sites are within 5km of each other in Halifax. In particular, the objective was to verify that radiation at 70cm could propogate over the Sable-to-Halifax path for purposes of long-term monitoring, and then to verify that there are noticeable time-dependent differences in the signal strength with a resolution in the order of a few minutes.

Hence, absolute values of signal strength are not at issue in this particular experiment; rather, it is the relative behaviour between the two signals.

Observations: On the basis of the chart recordings shown in Figure 1, the following features are noticed:

1. There is a fast fading(on a time scale of at least 1 second) in both channels, and this fast fading is characteristic of the behaviour of the signal-strength in the two channels.
2. There are two clear instances of stable enhancement in the 147.950 signal. In one case, beginning shortly after 0700 on July 11, there is coincidence with a stable depression in the 431.990 signal. There is a less clear case of the same kind of behaviour beginning around 0030 on July 10; in this case, the depression is not as stable as it is in the former case. Another less clear case begins around 0400 on July 12. Enhancements in the 431.990 signal are not as clear as in the lower frequency channel, but there appear to be several noticeable enhancements nonetheless, such as at 2000 and 2300 on July 11, and 0530 on July 12. The presence of enhancements in this channel is masked by onset of limiting in the receiver.
3. There is a clear instance of a depression in the 431.990 channel which is not accompanied by a corresponding enhancement in the 147.950 channel. This depression begins around 0330 on July 11.
4. Over the two-day period of this experiment, the 431.990 signal was never lost; its lowest level was still about 10db above the receiver zero-signal level. This is in contrast with the behaviour of the 147.990 signal, which frequently dropped out completely (although for only a second or so). The depression in the 147.950 recording beginning around 1700 on July 11(and marked 'ignore') is considered to be an artifact. Hence, over the two-day period, the signal from the 431.990 beacon was always detectable, whereas the signal from the 147.950 beacon was often, but briefly, not detectable at all.

Experimental details:

1. Both beacons located at the west end of Sable Island. The 147.950 beacon antenna is about 16m above the ground, and about 20m above sea level, with a clear(visual) view of the horizon. The 431.990 beacon antenna is on a tower located about 100m from the tower supporting the 147.950 antenna, and almost due south. The 431.990 antenna is about 25m above the ground, and about 30m above sea-level.

2. 147.950 beacon: 15W(nominal) FM, driving a 6-element yagi, horizontally polarized, etc., as discussed in more detail in paragraph 1-5 of the Report for 1980-1.

3. 431.990 beacon: 15W(nominal) FM with small average value of 100% AM modulation(for the I.D.) driving a 2.5m parabolic reflector via a 5m length of foam-filled heliax. The optic axis points approximately along 280°. With an estimated beamwidth of some 15°(FWHP), it is estimated that the receiving site is near the 3db point on the beam pattern(3db below the maximum power). The orientation of the optic axis was constrained by mechanical features of the tower. The antenna is extimated to have about 18db gain.

4. 147.950 receiver system: 10-element yagi at Saint Mary's, as per paragraph 1-3 in the 1980-1 report. The decoder functions to record only the signal from Sable.

5. 431.990 receiver system: located at the residence of Mr. Elmer Naugler(see map of Halifax on p.5 of this report). The antenna is a quad of 21-element yagis, constructed according to NBS specifications. Discounting losses associated with harnessing, etc., it is estimated that the gain is around 20db. The array is about 18m above the ground, and about 105m above sea level. The antenna has a clear view(visual) of the horizon in the direction of Sable Island. The transmission line consists of about 21m of ½" heliax and 2m of RG-214. The receiver consists of a GaAs-fet preamp driving a down-converter which in turn drives a short-wave receiver(part of an FT-101 transciever). The noise figure is measured to be about 1db. The system routinely shows a power level of some 6.5db sun-noise. In the experiment dis-

cussed in this report, the receiver was operated with the AVC disabled. The audio output of the receiver was fed into a VTVM/ amplifier(HP-400), and the output of the VTVM/amplifier was rectified and then fed the recorder(Esterline-Angus, 1 volt full deflection at 1mA) with about a 1second time-constant.

Conclusions:

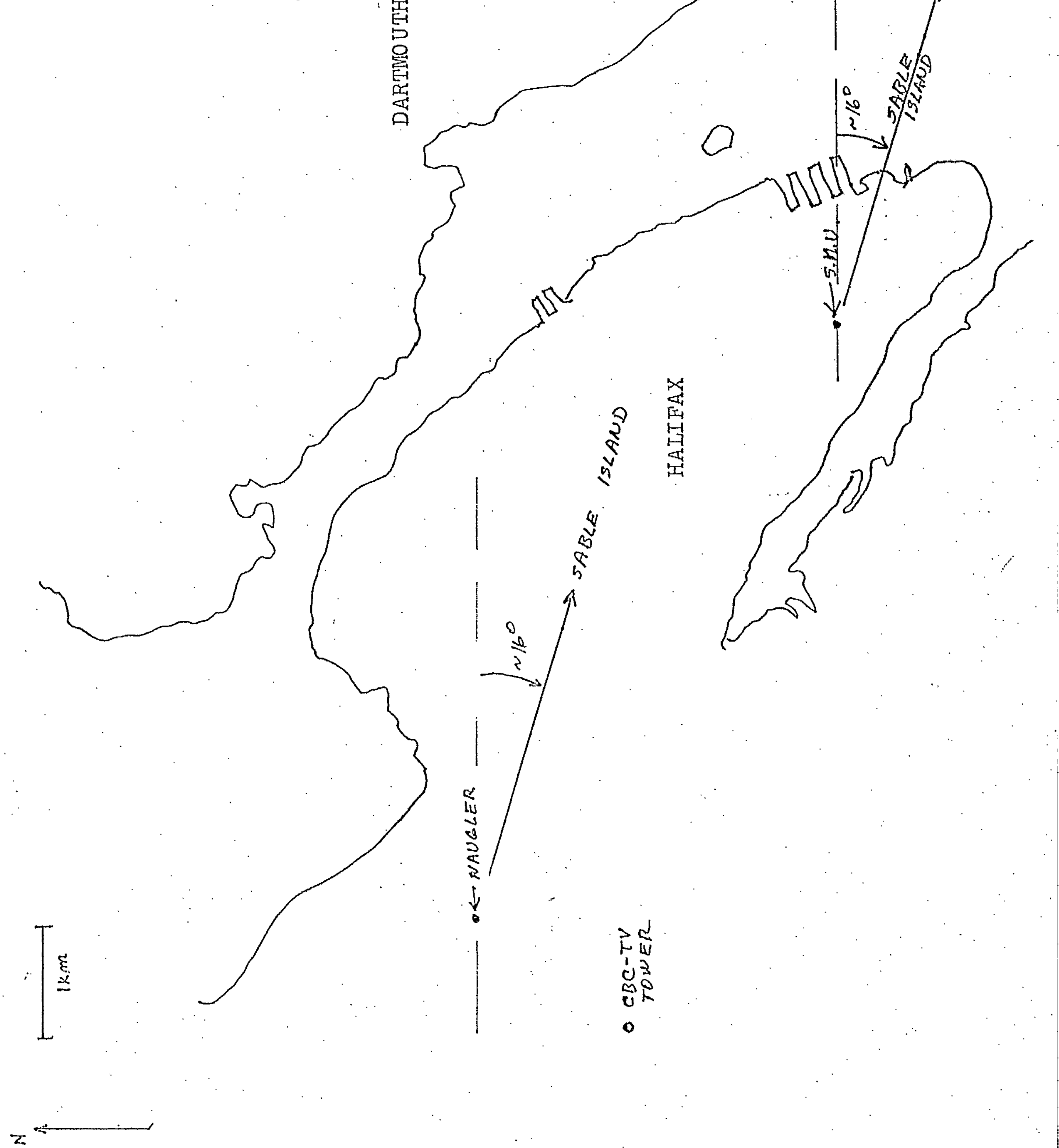
1. The existence of time-dependent differences in propogation over the Sable-to-Halifax path at 147.950 and 431.990 MHz has been verifed, and the signal from the 431.990 beacon is, indeed, strong enough to enable long-term monitoring. In fact, it would appear(on the basis of this two-day experiment along with informal observations both prior to and after the two-day period) that the propogation of the 431.990 signal is clearly more favourable for communications purposes than is the lower frequency.

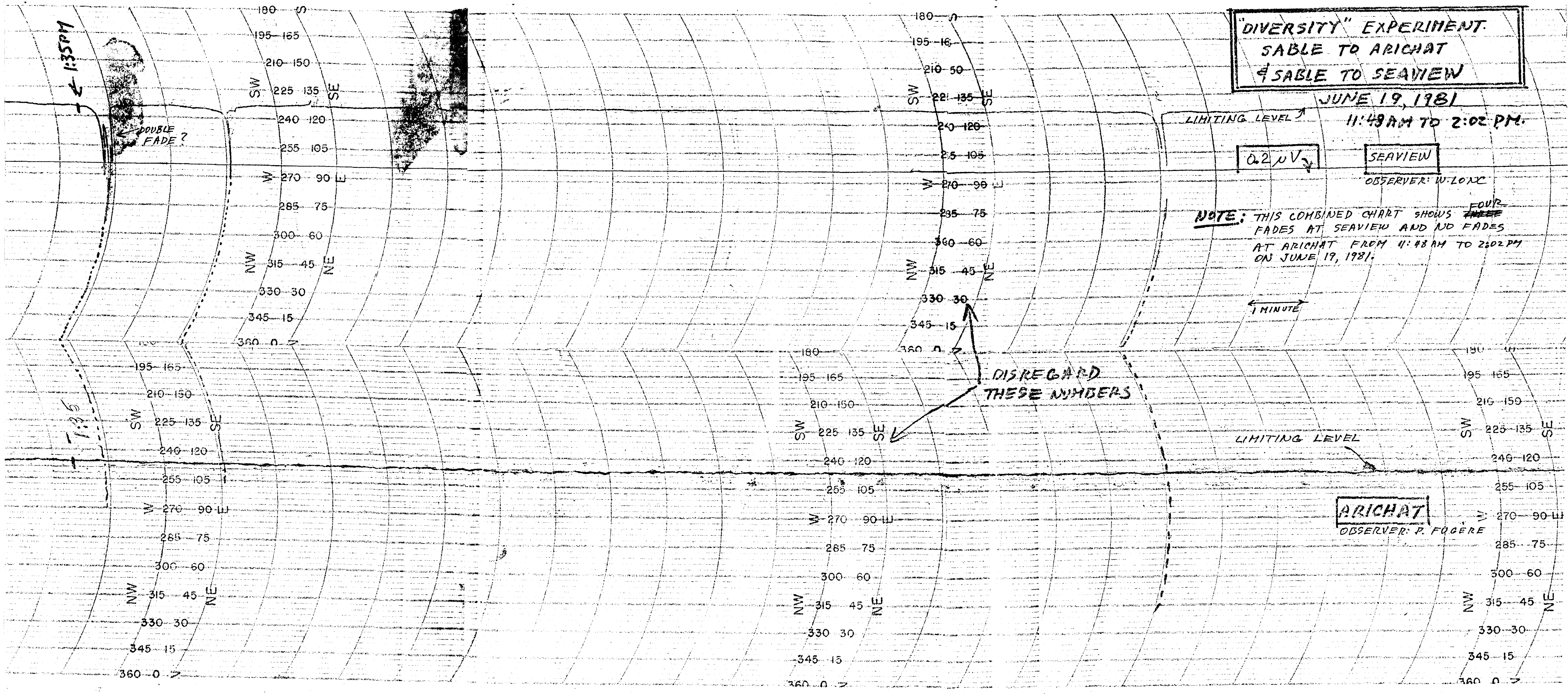
Recommendations:

1. On the basis of the conclusions above, it is recommended that a long-term monitoring program be established for the 431.990 beacon, at least for a 1-year period. Steps are being taken at SMU to install the necessary equipment, and continuous monitoring should commence around the middle of September of this year. It is understood that there would be an attempt to correlate this information with weather factors, as in the case of the 2-meter program already underway.

Supplementary Note: Reception of both beacons has been monitored on a daily basis by Mr. R. Schultz, VE1IF, at his location near Mt. Uniacke, N.S.; the general conclusion is that the 431.990 signal is more consistently detectable than the 147.950. Moreover, Mr. Schultz undertook a 1-day observing trip from his location to Bear River(near Digby), following as much as possible the higher roads. In general, the 431.990 signal was heard all along this path, whereas the 147.950 was not as consistently detectable. In addition, the signal was maximum in the New Ross area, confirming the estimated orientation of the optic axis for the 431.990 beam.

Outline map of Halifax, showing approximate locations of the receiver sites at VE1OD(Naugler) and VE1SMU(Saint Mary's).




"DIVERSITY" EXPERIMENT
SABLE TO ARICHAT
& SABLE TO SEAVIEW
JUNE 19, 1981
11:49 AM TO 2:02 PM.
LIMITING LEVEL
0.2 μV
SEAVIEW
OBSERVER: W. LONC
NOTE: THIS COMBINED CHART SHOWS ~~THREE~~ FOUR FADES AT SEAVIEW AND NO FADES AT ARICHAT FROM 11:48 AM TO 2:02 PM ON JUNE 19, 1981.
1 MINUTE
1:35 PM
DOUBLE FADE ?
1:36
DISREGARD THESE NUMBERS
LIMITING LEVEL
ARICHAT
OBSERVER: P. FOGÈRE

p.6

Figure 1: Chart recordings of received signal strength at Halifax from beacons on Sable Island.

Appendix G

"Time-occurrence of Fading in Three Separate Receiving Channels at Seaview"---a preliminary report.

Principal Investigator: W.P. Lonc (Saint Mary's University) assisted by Mr. P. Fugère, (MT.&T, New Glasgow)

Date of Observation: Sept.9, 1981, from approximately 11:30 AM to 2 PM local time.

Abstract: VHF signals from Sable Island were received and monitored on three separate receiver/antenna systems at the Seaview MTT microwave site. The major observation was that during a 2¼-hr interval during which 22 noticeable fades occurred in the premium receiver channel, full coincidence between noticeable fades on all three channels occurred just once, and partial coincidence occurred perhaps no more than 5 times.

Introduction: A preliminary experiment was conducted at the MTT microwave site at Seaview to ascertain the existence of coincidences in fading in three different receiver/antenna systems. The three systems monitored two signal sources on Sable Island; two of the three monitoring a MTT transmitter ...., while the third monitored a SMU beacon a few meters from the MTT transmitter.

The experiment was intended to be preliminary in nature, and took place between approximately 11:30 AM and 2 PM on September 9, 1981. It is intended to conduct a more comprehensive experiment at some future date, when a longer observation time and more accurate timing of the fading events is available.

Since the objective of this preliminary experiment was to study only the coincidences(or lack of them)between fading events in three different receiver/antenna configurations, there was no intention or attempt to measure amplitudes of the signal levels. For the purposes of this particular experiment, the fades of primary interest were the ones in the receiver system associated with the MTT telephone link ; this receiver system(or channel) will be called the premium channel.

The specific objective of the experiment, therefore, was to ascertain if any fades occurring in the premium channel were in coincidence with fades in one or both of the other two channels. A semi-quantitative estimate is made of the number of fades which are completely or fully coincident across all three channels, as well as an estimate of the number of fades which are partially coincident across all three channels. The distinction between 'complete'('full') and 'partial' is based on a visual inspection of the chart recordings. Secondly, a similar semi-quantitative estimate is given of the number of fades which are completely coincident across the two MTT channels(both vertically polarized and operating at the same frequency), as well as the number of fades which are partially coincident in this case. Finally, a semi-quantitative estimate is given of the number of fades which are completely coincident across the non-premium MTT channel and the SMU channel, and then the number of fades which are partially coincident.

Hence, the experiment should yield some information regarding fading at Seaview which is a function of several variables(i.e. antenna location, polarization, and frequency), as well as some information on fading at Seaview which is a function of only one variable(i.e. antenna location).

Experimental details

1. MTT#1 system(premium channel): a Micor transceiver(with preamp) at 142.605 MHz, fed from a dual yagi, vertically polarized; the antenna is at the very top of the microwave tower at Seaview. The system has a sensitivity in the order of 0.2 microvolts.

2. MTT#2 system: a similar Micor transceiver(no preamp) at 142.605 MHz, operating in the receive mode only. It is fed from a dual yagi, also vertically polarized, located at about the mid-point on the tower mentioned above. The system sensitivity has not been determined, but appears to be in the order of 0.5 microvolts. Both MTT systems are tuned to a similar Micor transceiver on Sable.

3. SMU system: a special-design DOC receiver, equipped with a GaAs-fet preamplifier, fed from a single, horizontally polarized yagi. The antenna is located within 2 meters of the MTT#2 antenna. The signal is at 147.995 MHz, originating at Sable from a 15W transmitter driving a 6-element yagi(horizontally polarized).

4. Recording system: two dual-channel strip-chart recorders(HP model 7100B's) modified for collinear operation of the pens. The output of the MTT#2 receiver was fed into each recorder, thereby facilitating subsequent alignment of the two charts. However, there was some difference in the chart-speeds, resulting in some uncertainty in the timing. This uncertainty was taken into account when the data was analyzed.

Observations:

1. Taking into account all three systems, it was observed that some 22 well-defined fades occurred in the MTT#1 system from about 11:45 AM to 2 PM, of which perhaps 18 or so could have resulted in an outage of the signal(lasting perhaps 1 or 2 seconds). In reference to these fades in the premium channel, it is estimated that only one of these fades occurred in full coincidence with strong fades in both of the other systems. In addition, it is estimated that 5 of these 22 fades were in partial coincidence with fades in both of the other two channels. Note that only 22 of the total 30 fades in the premium channel are being considered here because observations on the SMU system began at a later time.

2. Taking into account only the two MTT systems, it was observed that of the 30 fades occurring in the premium channel, perhaps 5 of these were in full coincidence with strong fades in the MTT#2 system. In addition, perhaps another 10 of the fades in the premium channel were in partial coincidence with strong fades in the MTT#2 system.

3. Taking into account only the MTT#2 and the SMU systems, where the antennas are within 2 meters of each other, there is a significant difference in the occurrence of fading events in the two channels. A cursory visual examination of the charts suggests that perhaps no more than 50% of the fades in the two systems coincide significantly.

Note: The above estimates result from a visual inspection of the chart-recordings, and are meant to indicate semi-quantitative rather than fully quantitative information.

Conclusions and Recommendations:

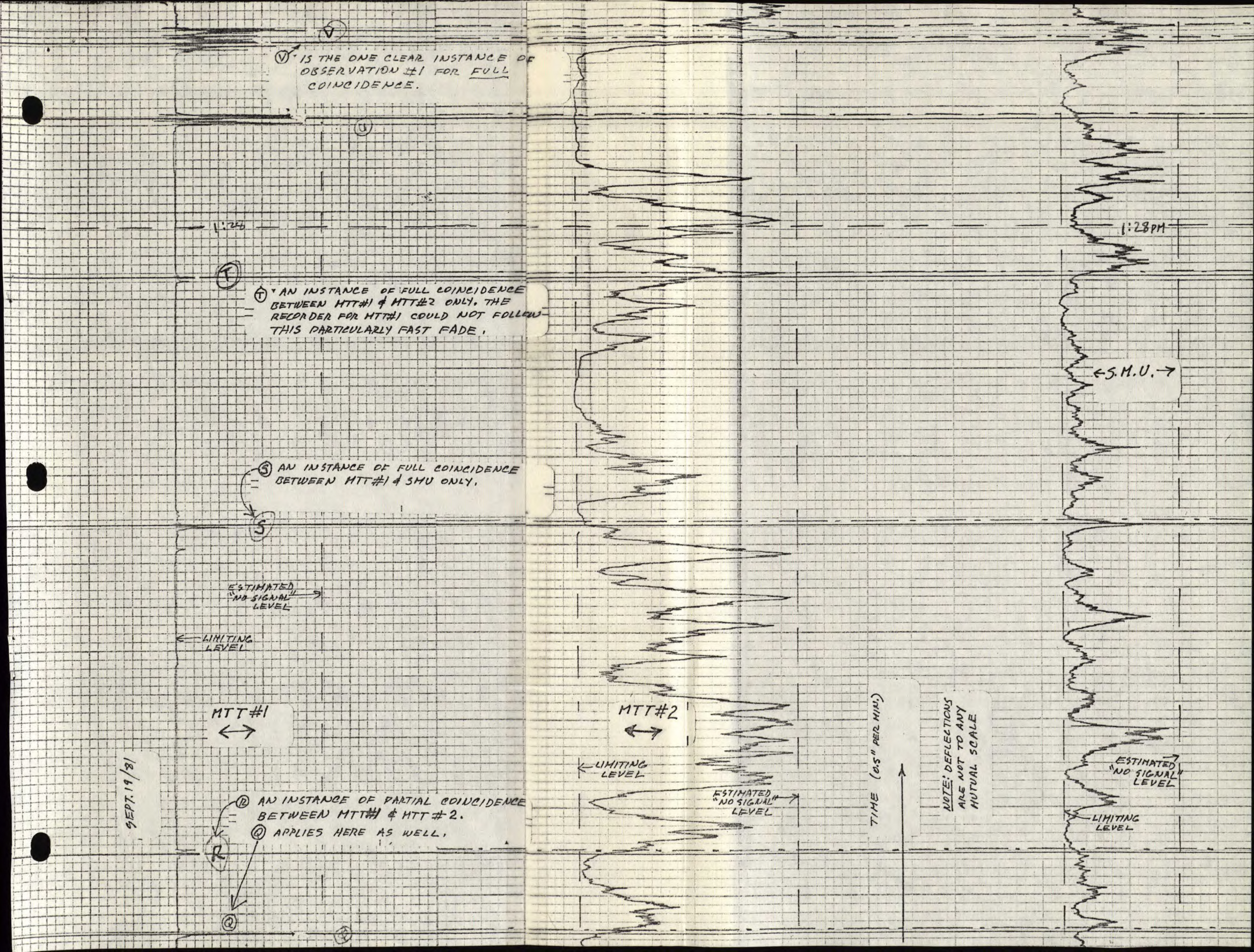
1. The observations clearly indicate that the fading events at Seaview associated with Sable Island signals depend on some combination of antenna location, polarization, and frequency. This conclusion stems from Observation #1. In addition, it could be inferred that a diversity-arrangement among all three systems could lead to a noticeable reduction in outage associated with this type of fade(i.e. with a duration of 1 or 2 seconds).

2. On the basis of observation #2, it is concluded that there is a clear dependence of fading-occurrence on just one variable, namely the difference in height of the two MTT antennas. Here again, it could be inferred that a diversity-arrangement between these two systems could also lead to a noticeable reduction in outage(but not as favourable as in Conclusion #1 above).

3. On the basis of observation #3, it is concluded that there is a clear dependence of fading-occurrence on some combination of frequency and polarization, where the slight difference in height is deemed to be insignificant.

4. It is recommended that a more prolonged version of this experiment be performed, with improved time-calibration. In addition, installation of a preamplifier in the MTT#2 system would render comparison more informative between the two MTT systems.

5. Action to be taken: It is planned to perform the recommended experiment on the occasion of the next trip to Seaview, on or about Oct.23, 1981.


V
"V" IS THE ONE CLEAR INSTANCE OF OBSERVATION #1 FOR FULL COINCIDENCE.
U
1:26
1:28PM
T
"T" AN INSTANCE OF FULL COINCIDENCE BETWEEN MTT#1 & MTT#2 ONLY. THE RECORDER FOR MTT#1 COULD NOT FOLLOW THIS PARTICULARLY FAST FADE.
S.M.U.
S AN INSTANCE OF FULL COINCIDENCE BETWEEN MTT#1 & SMU ONLY.
S
ESTIMATED "NO SIGNAL" LEVEL
LIMITING LEVEL
MTT#1
MTT#2
LIMITING LEVEL
ESTIMATED "NO SIGNAL" LEVEL
TIME (0.5" PER MIN.)
NOTE: DEFLECTIONS ARE NOT TO ANY MUTUAL SCALE
ESTIMATED "NO SIGNAL" LEVEL
LIMITING LEVEL
SEPT. 19/81
R AN INSTANCE OF PARTIAL COINCIDENCE BETWEEN MTT#1 & MTT#2.
Q APPLIES HERE AS WELL.
R
Q
P

Appendix H

November 23, 1981

Differences in Propagation Statistics on 147.950MHz and 431.950MHz from Sable Island to Halifax, NS
(a preliminary report)

Principal Investigator: W. P. Lonc
Physics Dept.
Saint Mary's University

Observation Period: Oct. 11 to Oct. 15, 1981.

Abstract: Horizontally polarized radiation from two beacons on the west end of Sable Island were monitored on a relatively random basis at Halifax, (Saint Mary's) on 16 occasions of approximately 15 minutes per occasion over a 5-day period. On the basis of the chart recordings, it is estimated that the 431.950 beacon was received at a level of 0.2uV or more approximately 90% of the time, whereas the 147.950 was received approximately 36% of the time for the same conditions.

1. Introduction:

This investigation constitutes a preliminary look at differences in propagation at 147.950MHz and 431.950MHz on the maritime path between Sable Island and Halifax, and continues from the earlier preliminary observations made in collaboration with Mr. Elmer Naugler and reported in a separate report (also preliminary).[1] The present investigation differs significantly from

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[1] "Comparison of 147.950MHz and 431.990MHz reception at Halifax, originating at Sable Island" (a preliminary report), Aug. 13, 1981.

the earlier one in that the monitors in this experiment are both located at one site (within several meters of each other). Hence, assuming that the separation between the two beacons on Sable (amounting to some 100 meters) is insignificant, this experiment appears to provide data which is primarily a function of frequency only.

In summary, a visual inspection as well as some processing of the recordings (reproduced in the Appendices) indicates that the UHF beacon exceeded 0.2uV at the antenna approximately 90% of the time, whereas the VHF beacon only exceeded this level approximately 36% of the time. These percentages are thought to have a maximum uncertainty of perhaps 10%.

2. Experimental Details:

VHF beacon:

Approximately 15W, FM, feeding a 6-element horizontally polarized yagi with a design gain of 10db. The antenna is located on a tower (designated SMU #1) approximately 16 meters above the ground, and approximately 20 meters above sea-level.

UHF beacon:

approximately 15W, FM, feeding a horizontally polarized dipole (with reflector) which in turn illuminates a 2.5 meter parabolic reflector calculated to have approximately 18db gain at this frequency. The antenna is located on a tower (designated SMU #2) approximately 25 meters above ground, and approximately 30 meters above sea-level. Tower SMU #2 is approximately 100 meters due south of Tower SMU #1. This beacon was formerly on 431.990 MHz.

VHF monitor:

8-element yagi (horizontally polarized) driving a low-noise preamplifier (GaAs-fet), etc., as described elswhere .

UHF monitor:

antenna system identical to the beacon; driving a low-noise preamplifier (GaAs-fet), which in turn drives a crystal controlled AM receiver system with a bandwidth in the order of 1kHz.

Calibration:

Both monitors were calibrated using a Boonton Model 102D synthesized generator, in which the output level has a maximum uncertainty in the order of 1db.

Precautions:

To ensure that no spurious recordings were being made, both receivers were monitored aurally for the entire duration of each 15-minute 'occasion'. Hence, the pen excursions represent actual signal levels. The 15-minute occasions were chosen on the basis of convenience, rather than out of consideration of possible propagation effects which might favour one frequency over another, leading to the supposition that the observations constitute a relatively valid random sample.

3. Conclusions and Recommendations:

Although no calculations have been made to enable a comparison between 'expected' and 'observed' signal levels for the parameters in this experiment, it is thought that the UHF signal is noticeably stronger than expected. Moreover, on the basis of additional qualitative observations since Oct. 15/81, it is thought that the UHF signal will consistently surpass the VHF in the given experimental arrangement.

By way of recommendation, it appears to be of interest to pursue this experiment futher. For example, it would be interesting to have the comparison made over a longer period of time.

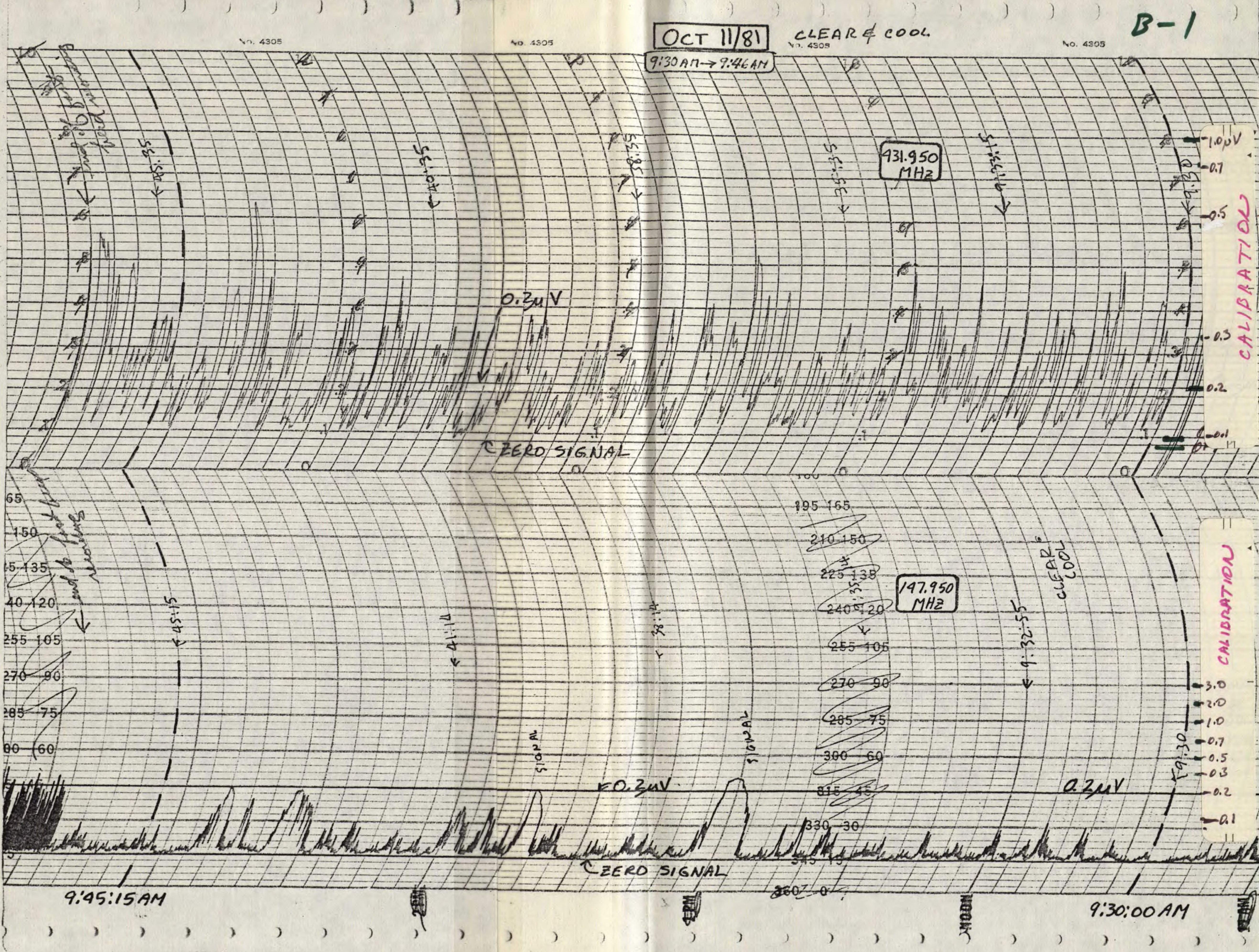
Finally, on the basis of the pleasantly surprising results in this experiment, arrangements are being made to install another UHF beacon, operating in the 1296MHz amateur band, on Sable. It is expected that preliminary observations could be made by the end of this calendar year.

Appendix: A

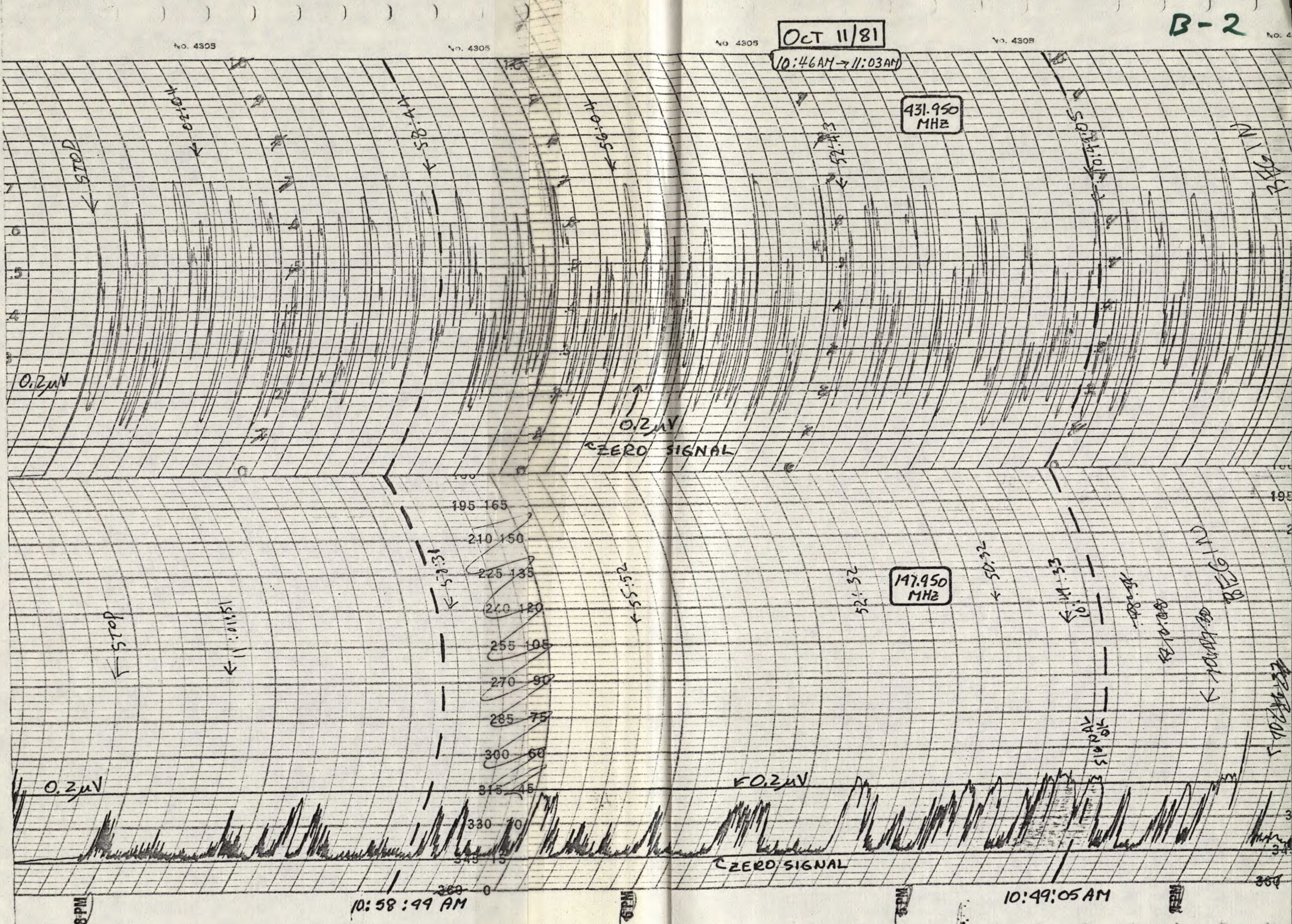
On one occasion, Oct. 15/81 from 10:32 AM to 10:47 AM, the UHF monitor was saturating (saturation occurs at approximately 0.8uV for this monitor), which prompted an attempt to obtain an indication of the signal strength. This was done by inserting 40db attenuation in the signal path, which now produced a deflection corresponding approximately to the 0.4uV level. It was concluded that the signal delivered by the antenna was therefore in the order of 40 µV at this particular time.

Appendix B:

The following pages are photocopies of the chart recording obtained in this experiment. Calibration of received signal strength (i.e., at the input of the GaAS-fet preamp at the antenna) is given at the right-hand end of the first chart (Oct. 11/81, 9:30 AM to 9:46 AM). Each chart has a 'zero signal' level as well as the 0.2uV level indicated to facilitate examination of the records.



B-1
OCT 11/81
CLEAR & COOL
9:30 AM → 9:46 AM
No. 4305
431.950 MHz
147.950 MHz
CALIBRATION
0.2 µV
ZERO SIGNAL
SIGNAL
CLEAR COOL
9:45:15 AM
9:30:00 AM
1.0 µV
0.7
0.5
0.3
0.2
0.1
3.0
2.0
1.0
0.7
0.5
0.3
0.2
0.1
195 165
210 150
225 135
240 120
255 105
270 90
285 75
300 60
315 45
330 30
345 15
360 0

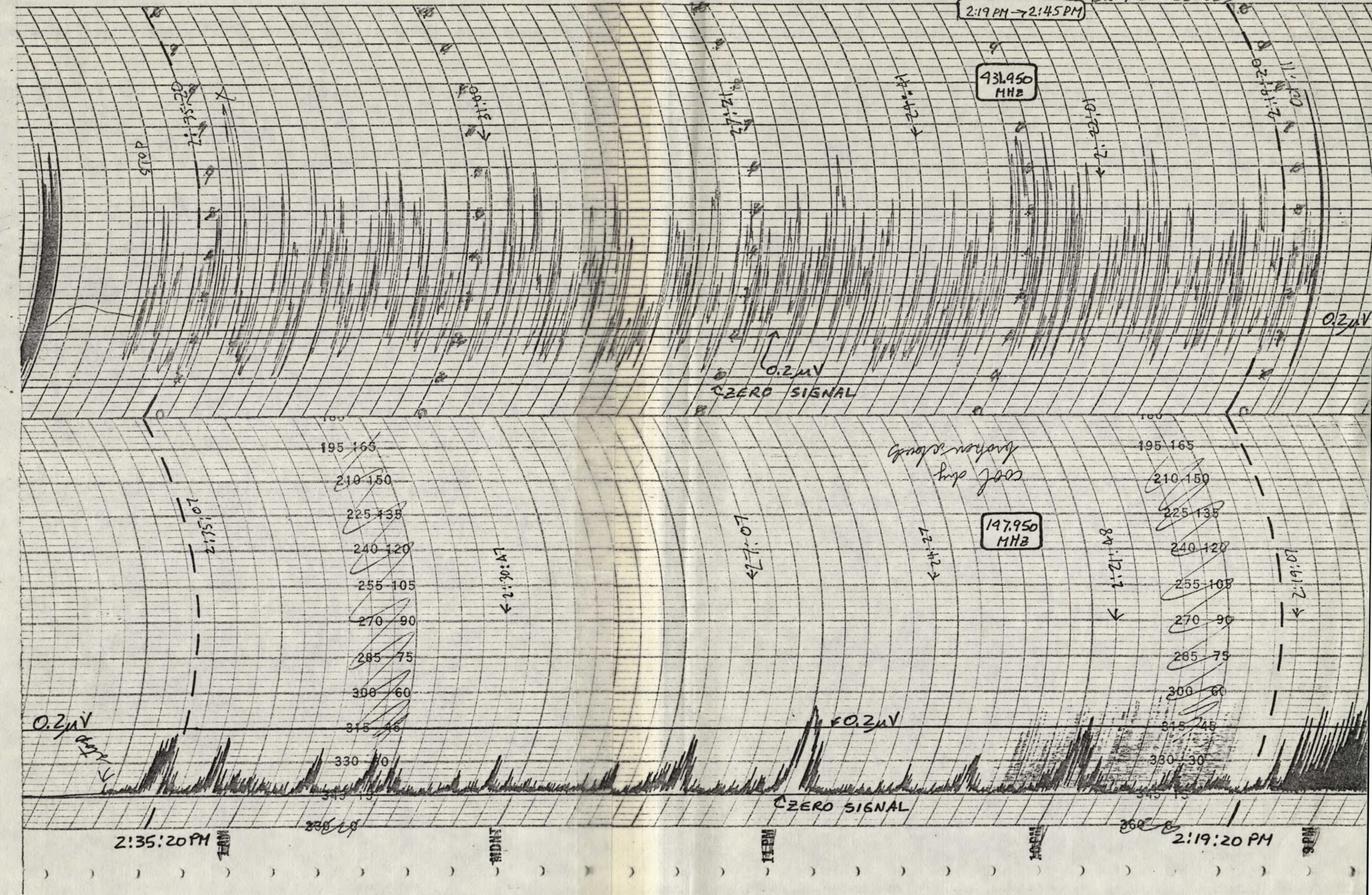

B-2
Oct 11/81
10:46AM → 11:03AM
No. 4305
431.950 MHz
147.950 MHz
STOP
0.2μV
ZERO SIGNAL
BEGIN
10:58:44 AM
10:49:05 AM

B-3

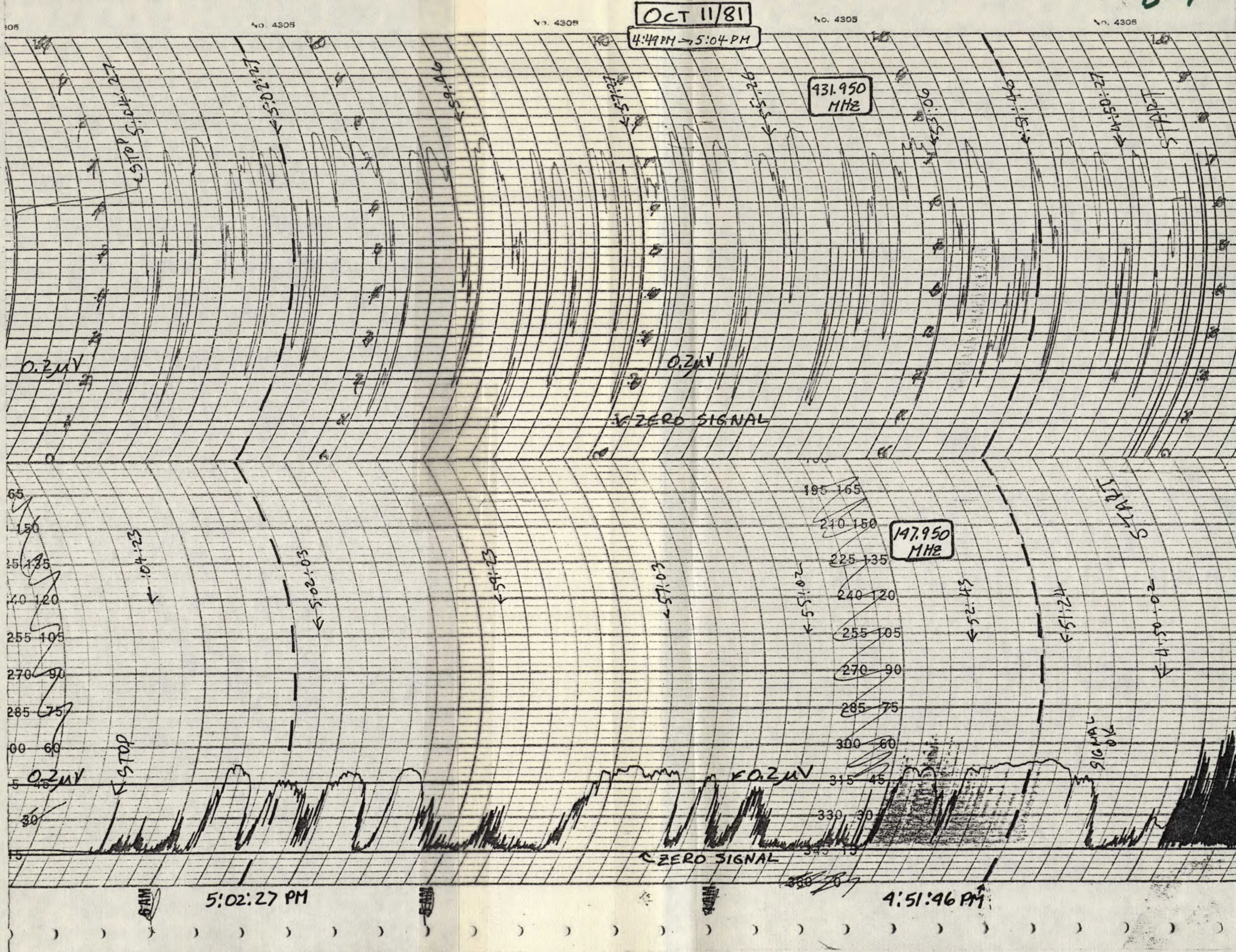
OCT. 11/81

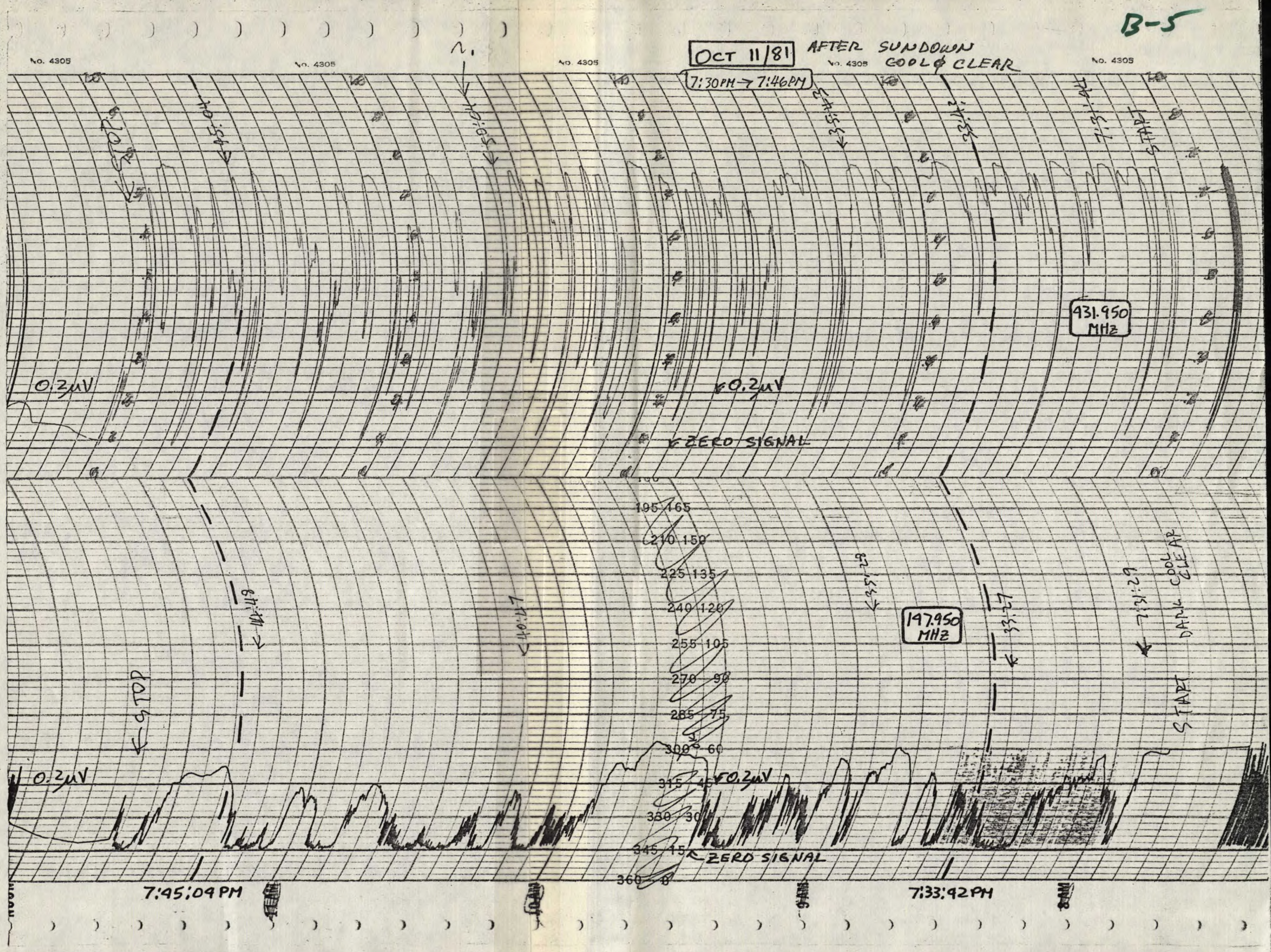
2:19 PM → 2:45 PM

COOL, DRY, & BROKEN CLOUDS



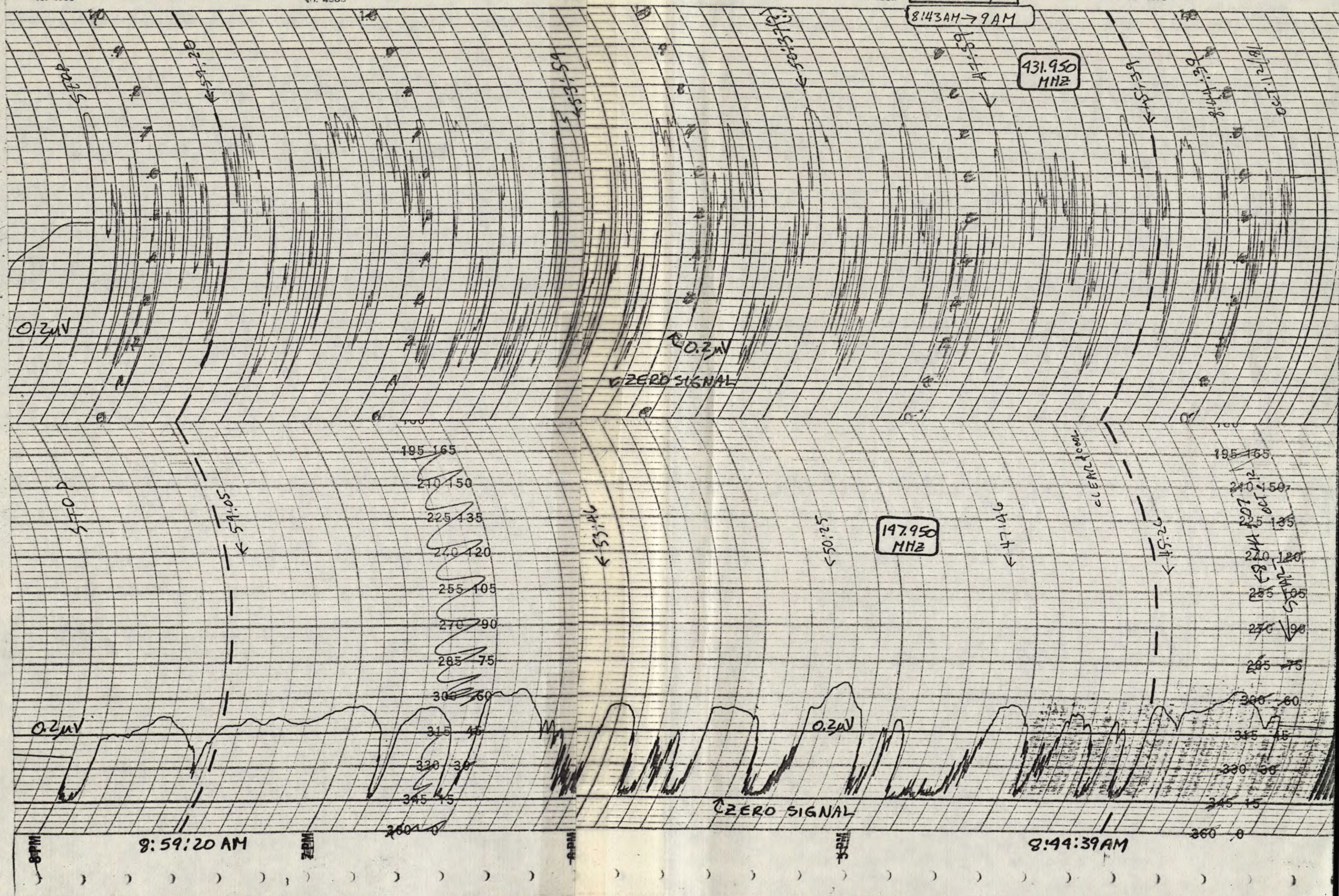
B-4

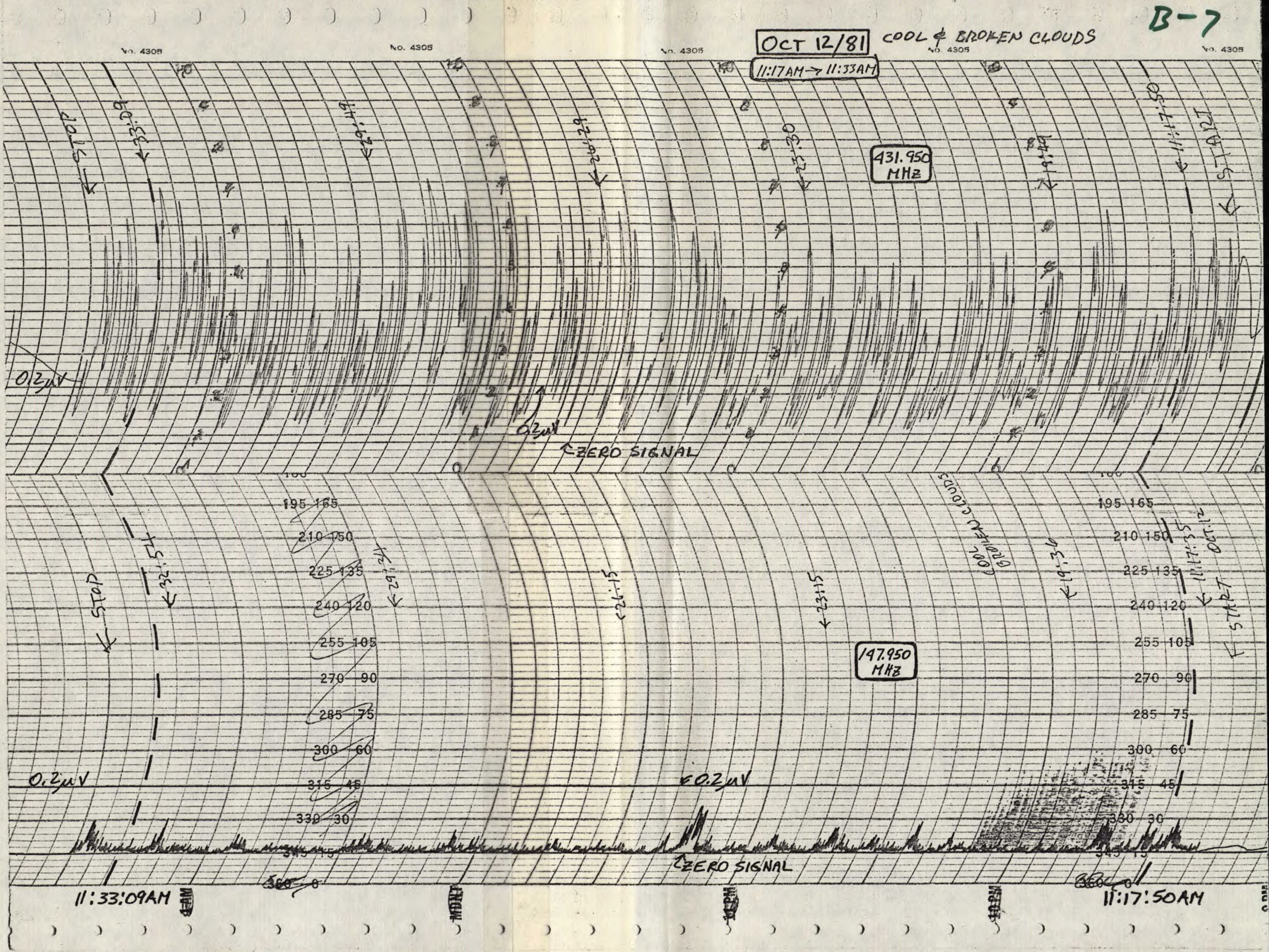

Oct 11/81
4:49 PM → 5:04 PM
No. 4305
431.950 MHz
147.950 MHz
STOP 5:04:27
5:02:27
START
4:50:27
0.2μV
ZERO SIGNAL
STOP
START
SIGNAL ON
5:02:27 PM
4:51:46 PM


B-5
Oct 11/81
AFTER SUNDOWN
COOL & CLEAR
7:30PM → 7:46PM
No. 4305
STOP
START
431.950 MHz
0.2µV
ZERO SIGNAL
147.950 MHz
DARK COOL CLEAR
7:45:04PM
7:33:42PM

B-6

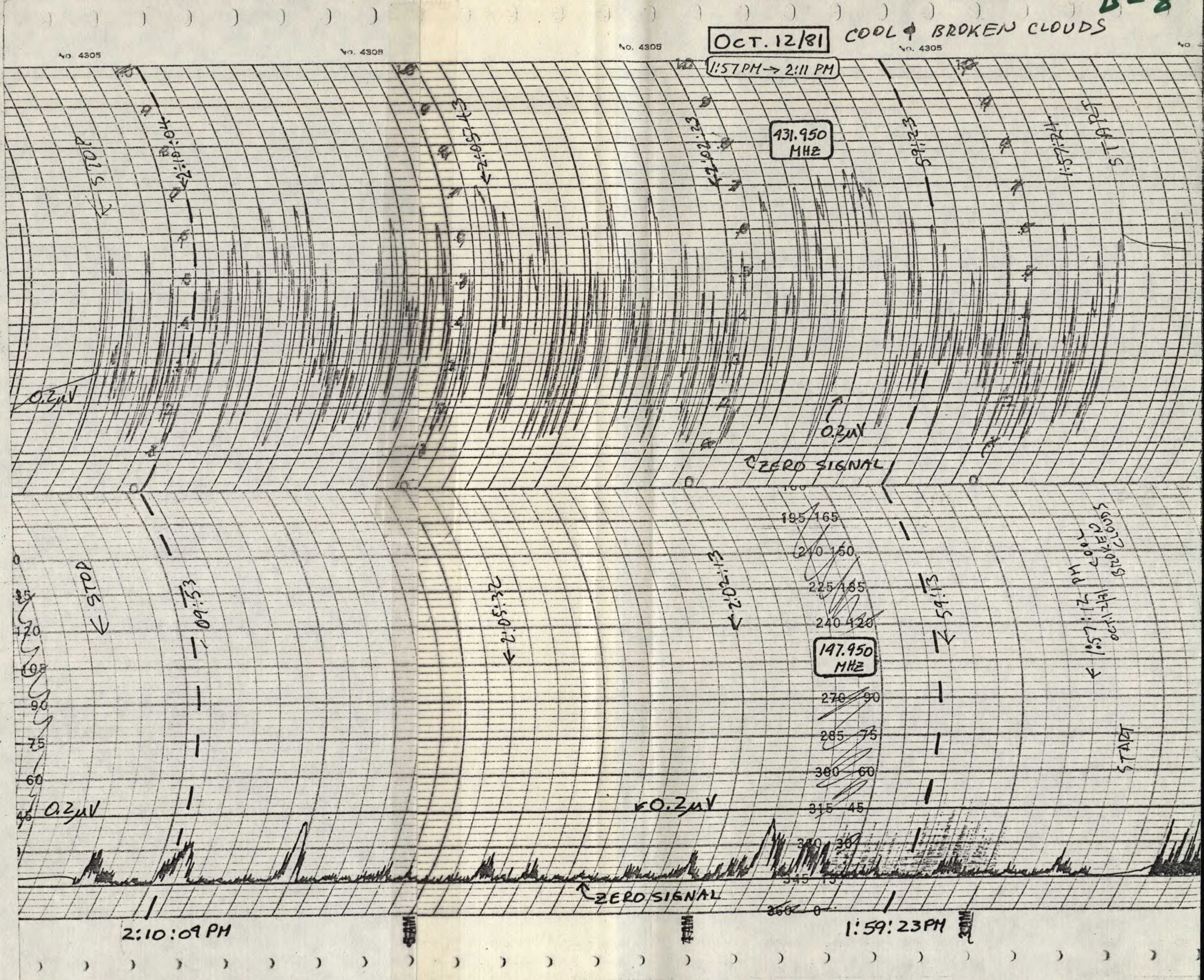
OCT. 12/81 CLEAR & COOL



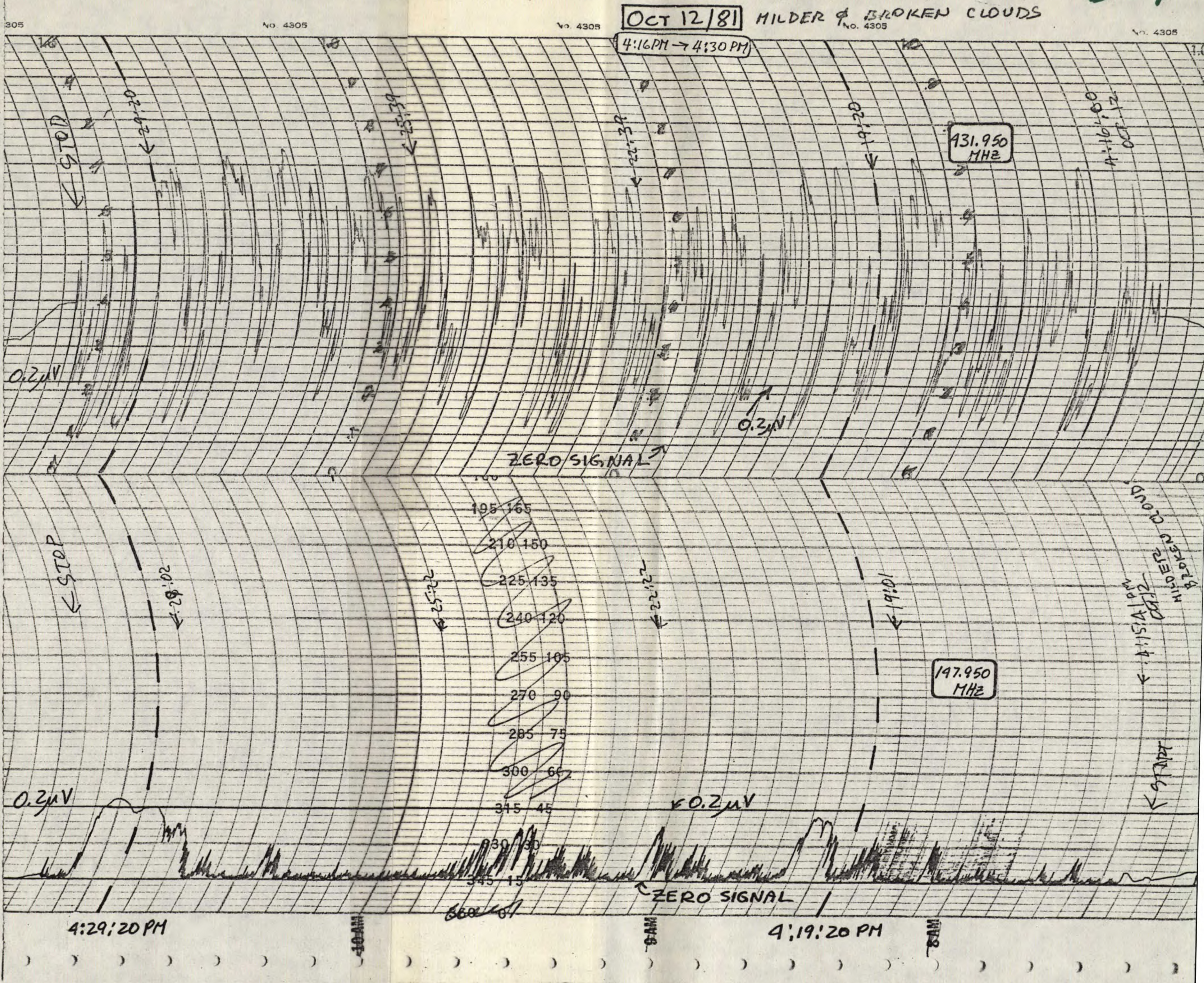


B-7
OCT 12/81
COOL & BROKEN CLOUDS
11:17AM → 11:33AM
No. 4305
431.950 MHz
147.950 MHz
STOP
START
0.2μV
ZERO SIGNAL
11:33:09AM
11:17:50AM
COOL BROKEN CLOUDS
195 165
210 150
225 135
240 120
255 105
270 90
285 75
300 60
315 45
330 30
345 15
360 0

B-8


OCT. 12/81
COOL & BROKEN CLOUDS
1:57 PM → 2:11 PM
431.950 MHz
STOP
2:10:04
2:05:43
2:02:23
59:23
1:57:24
START
0.2µV
0.2µV
ZERO SIGNAL
147.950 MHz
STOP
09:53
2:05:32
2:02:13
59:13
1:57:12 PM OCT. 12/81
COOL BROKEN CLOUDS
START
0.2µV
0.2µV
ZERO SIGNAL
2:10:09 PM
1:59:23 PM
No. 4305

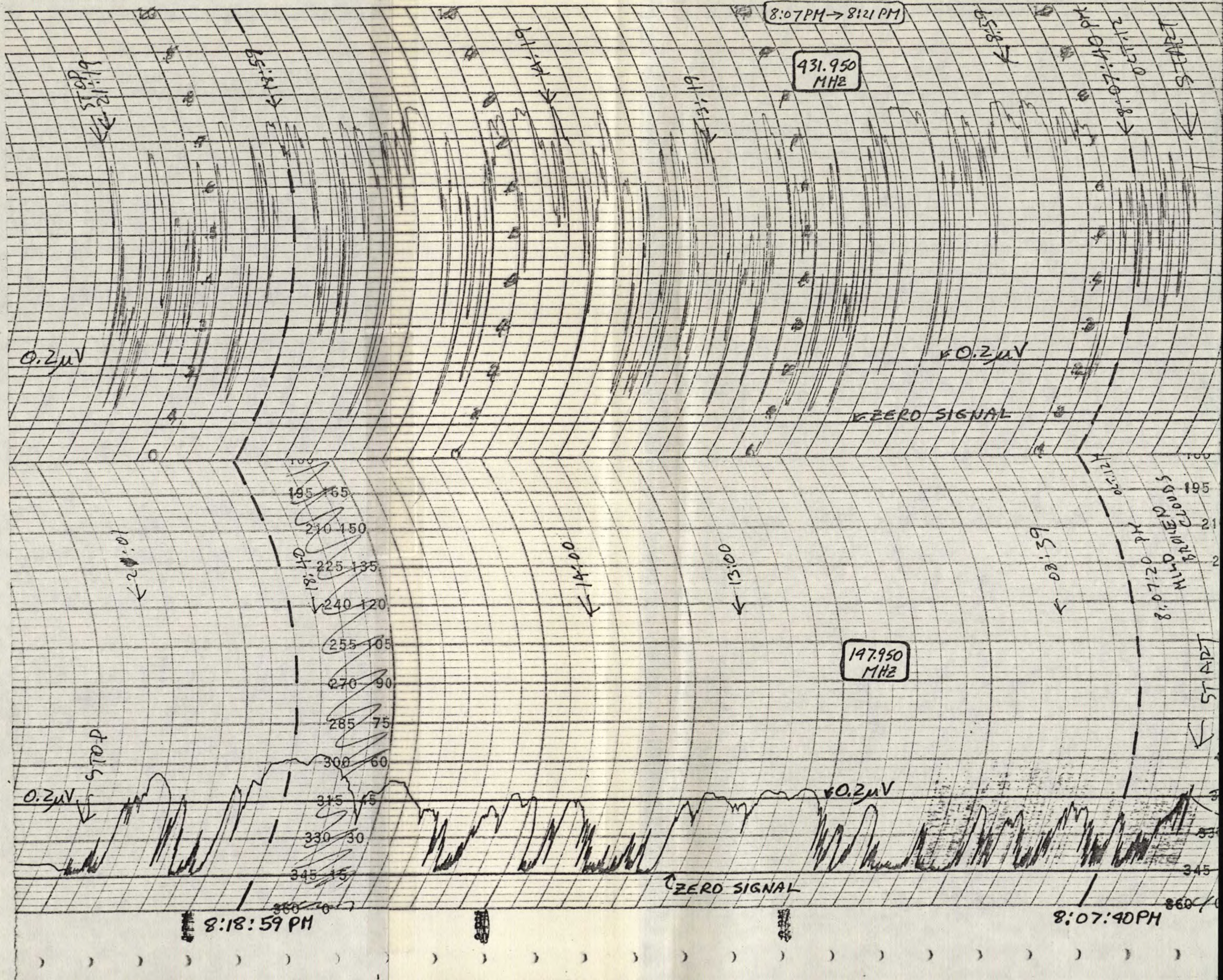
B-9



OCT 12/81
MILDER & BROKEN CLOUDS
4:16 PM → 4:30 PM
No. 4305
STOP
29:20
25:39
22:32
19:20
431.950 MHz
4:16:00 OCT 12
0.2µV
ZERO SIGNAL
STOP
28:02
25:22
22:22
19:01
197.950 MHz
4:15:41 PM OCT 12
MILDER & BROKEN CLOUD
START
0.2µV
ZERO SIGNAL
4:29:20 PM
4:19:20 PM
10 AM
9 AM
8 AM

B-10

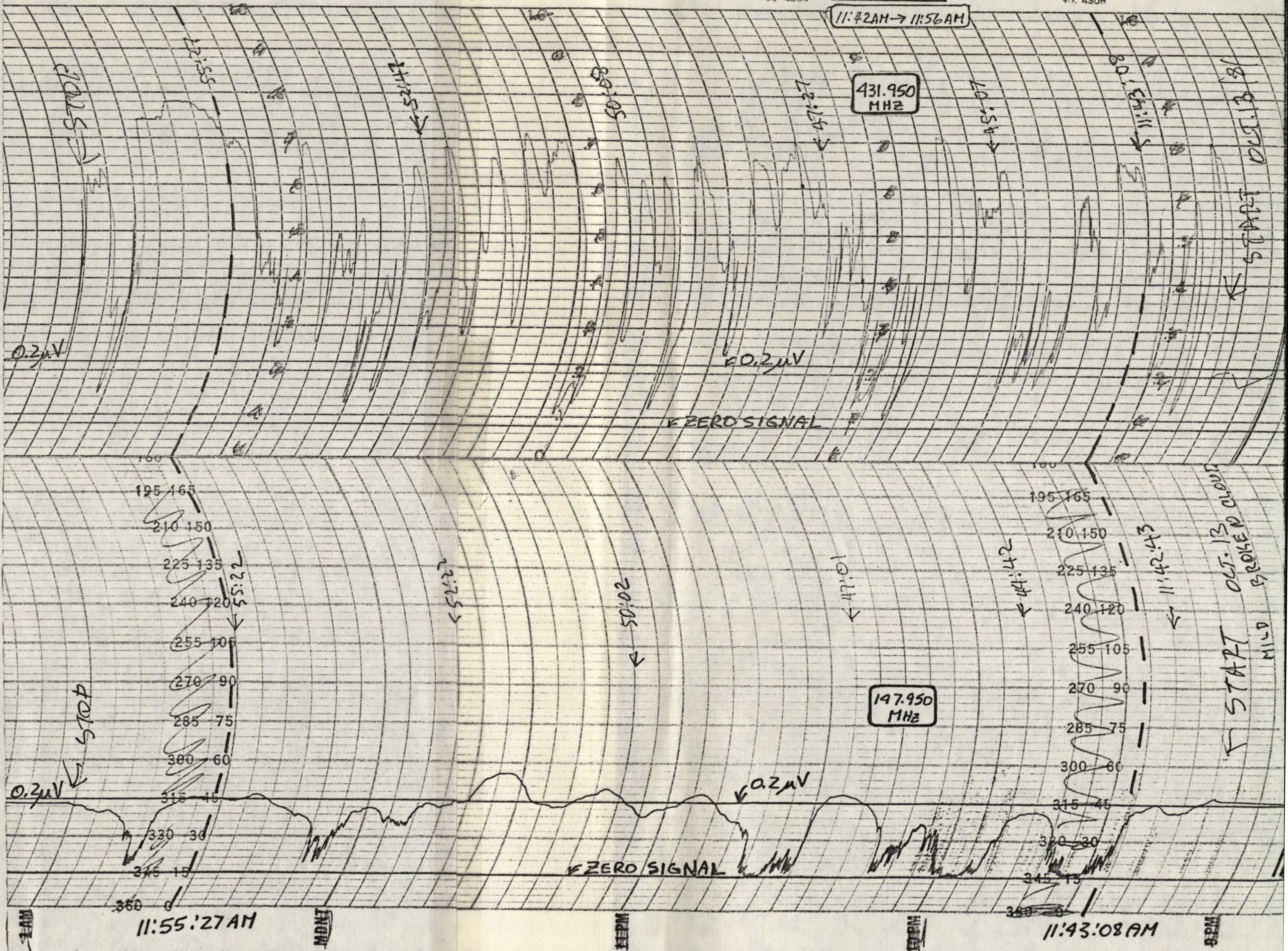
OCT. 12/81 MILD & BROKEN CLOUDS



B-11

OCT. 13/81 MILD & BROKEN CLOUDS

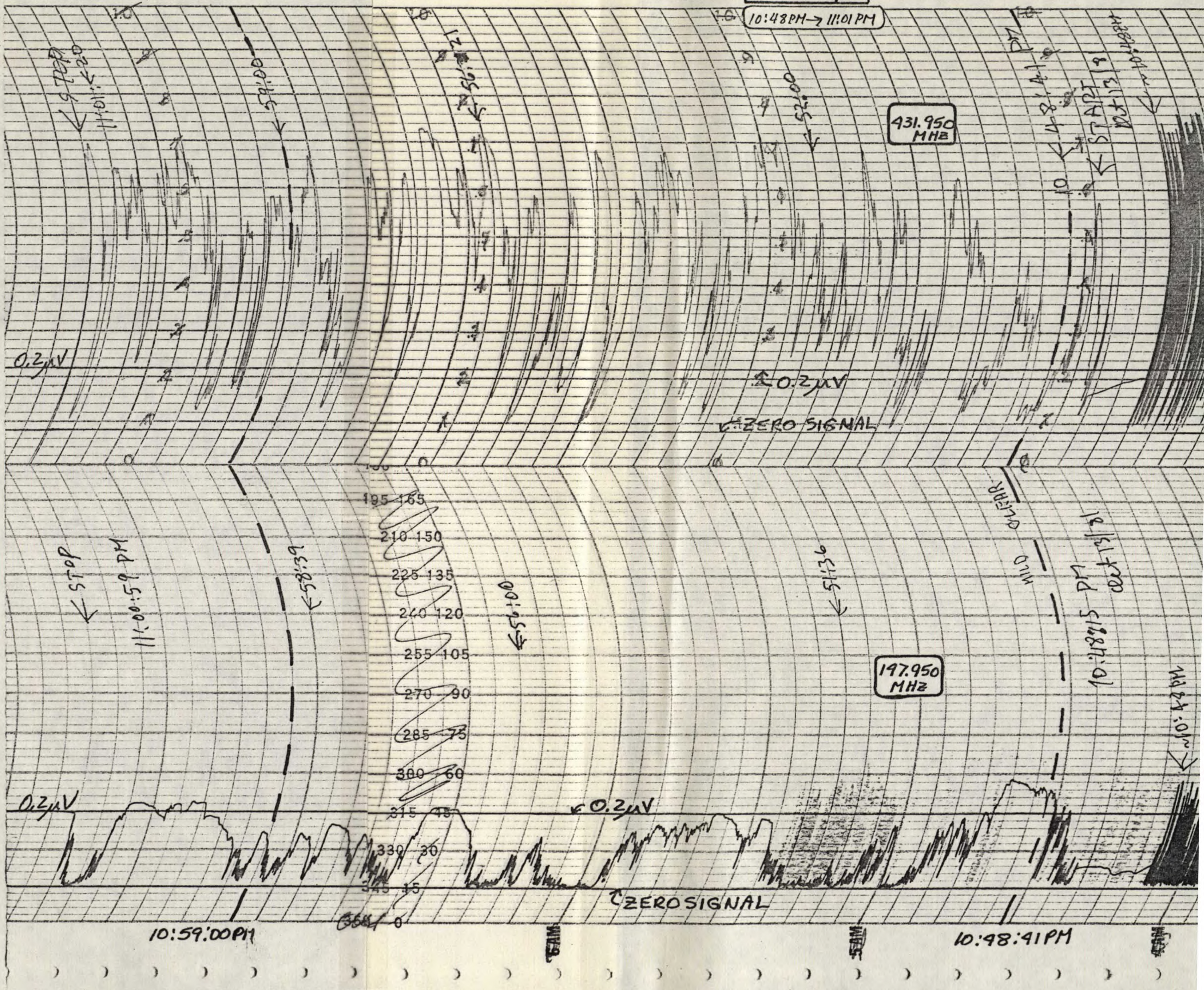
11:42AM → 11:56AM



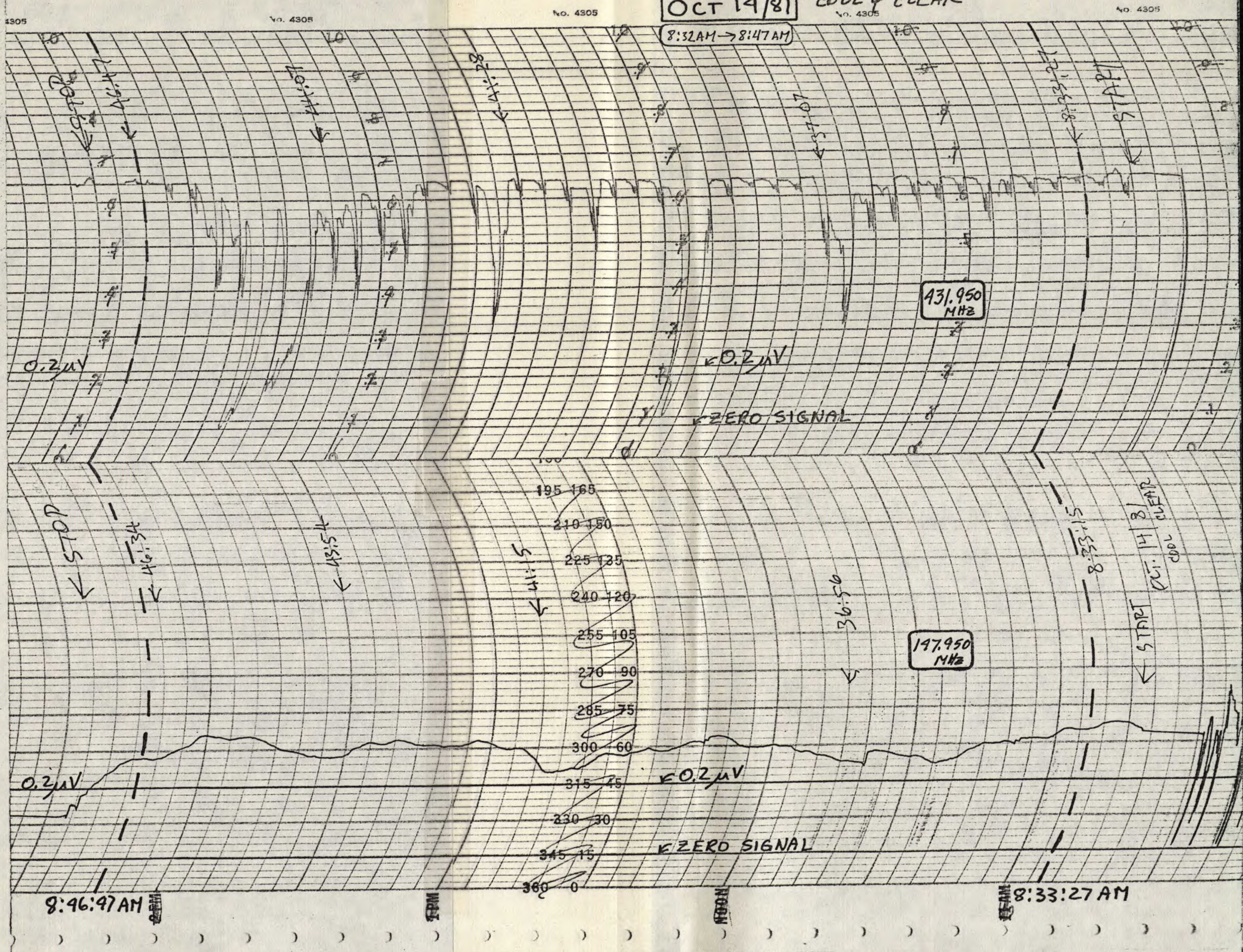
B 12

Oct. 13/81 MILD & CLEAR

10:48PM → 11:01PM

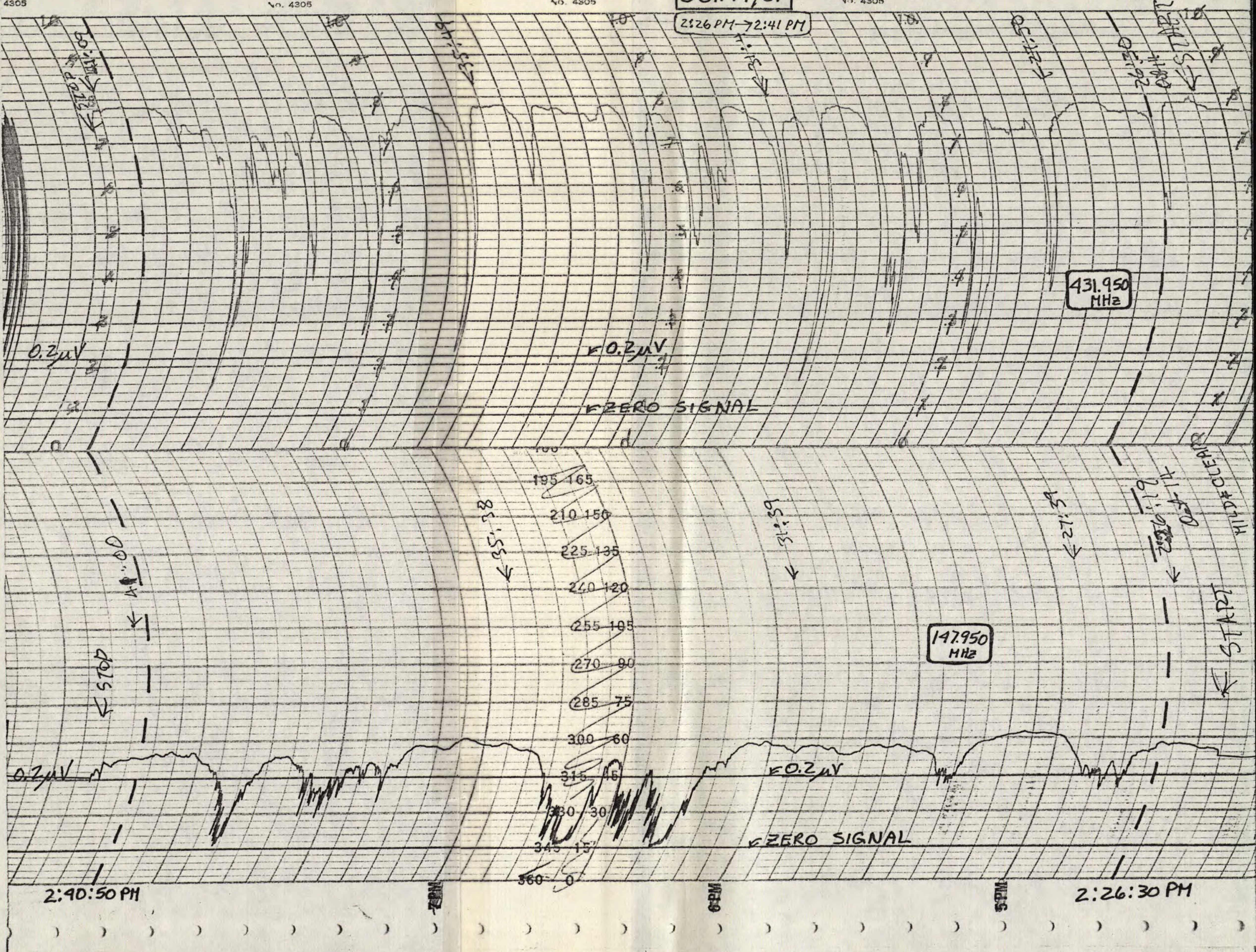


B-13

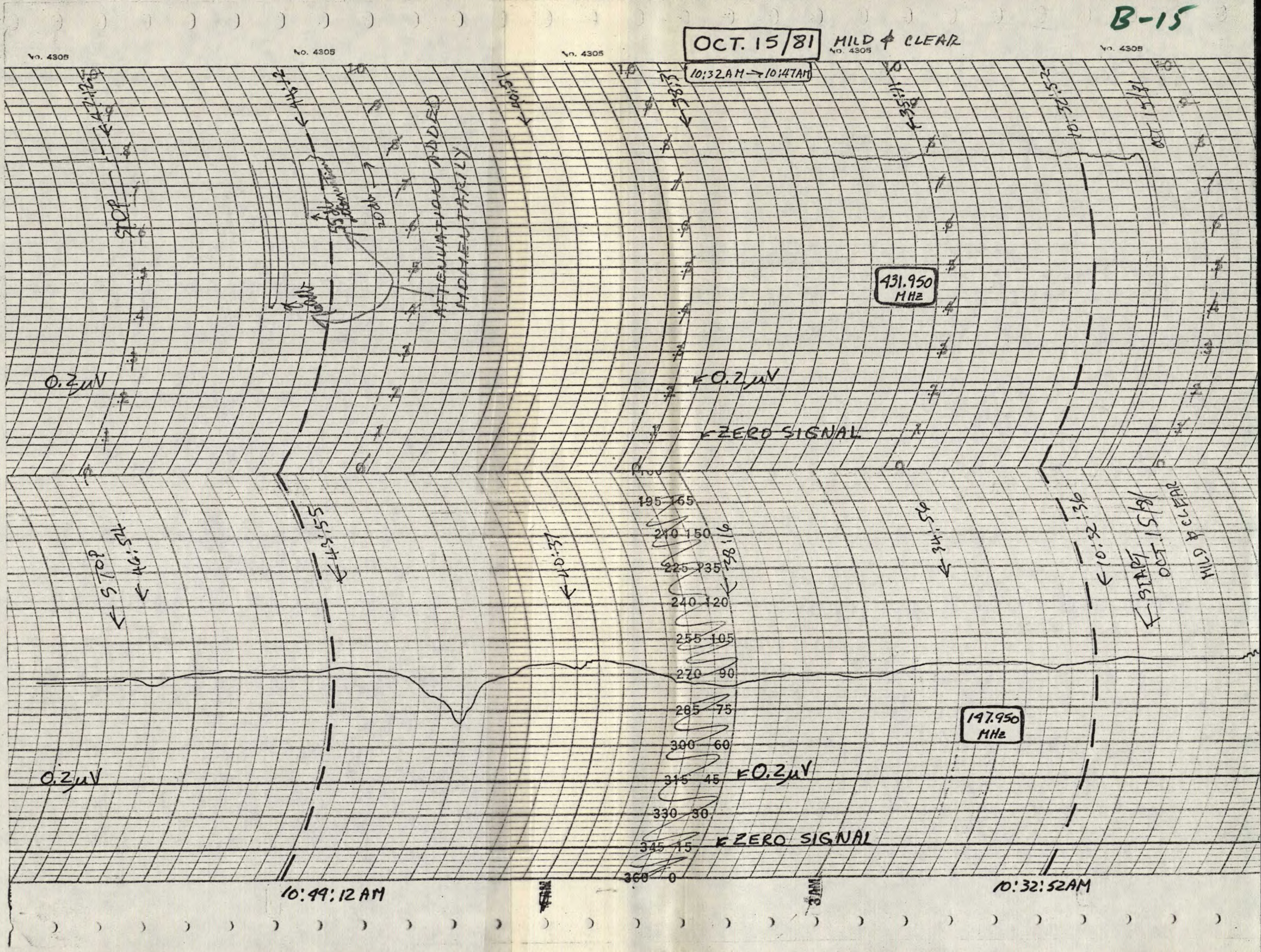

OCT 14/81
COOL & CLEAR
8:32AM → 8:47AM
No. 4305
STOP
46:47
44:07
41:28
37:07
8:33:27
START
431.950 MHz
0.2 µV
← 0.2 µV
← ZERO SIGNAL
STOP
46:34
43:54
41:15
36:56
8:33:15
START
OCT. 14 81 COOL CLEAR
147.950 MHz
0.2 µV
← 0.2 µV
← ZERO SIGNAL
8:46:47 AM
8:33:27 AM
2 PM
1 PM
NOON

B-14

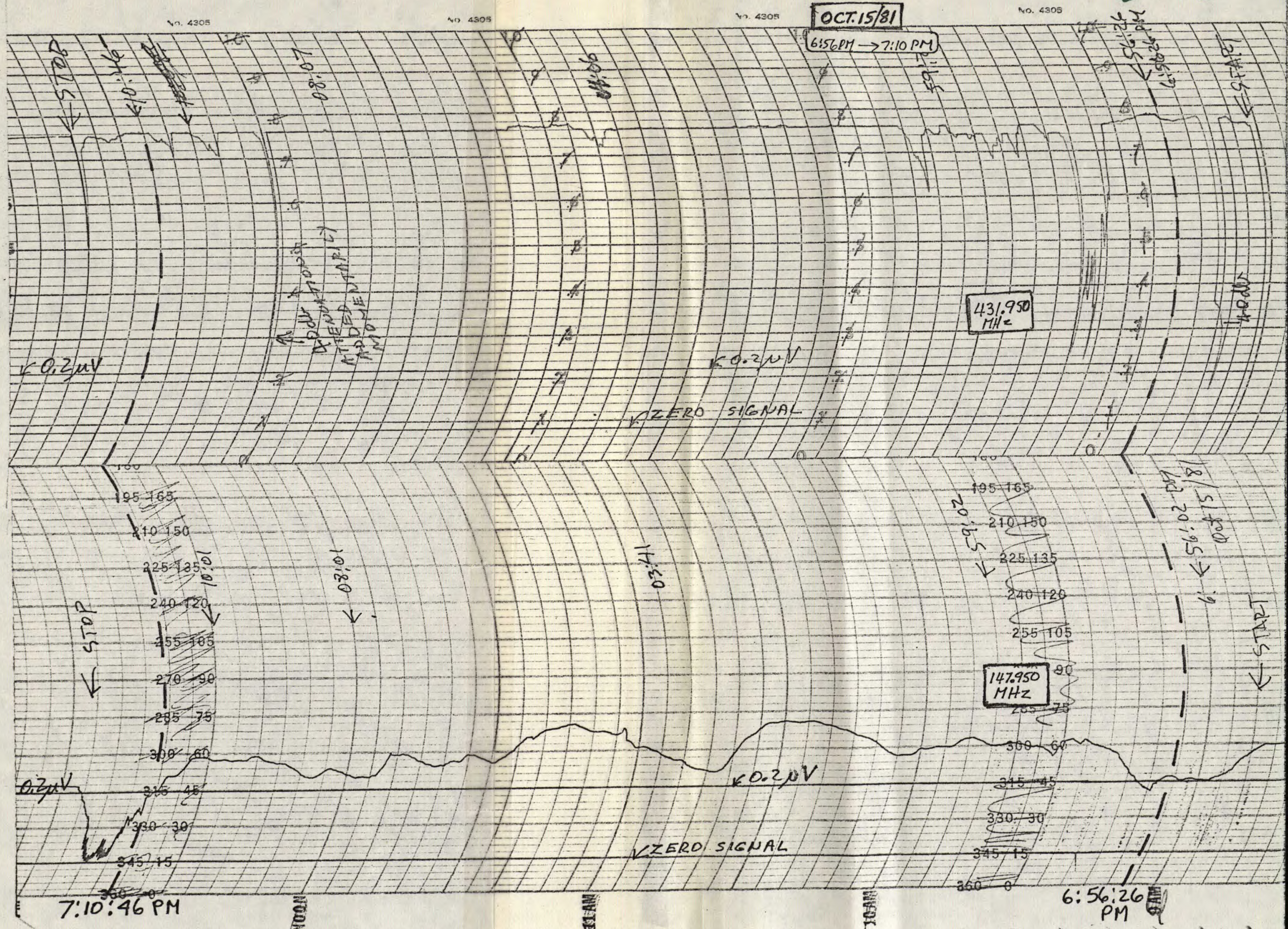
Oct. 14/81 MILD & CLEAR



B-15


OCT. 15/81
MILD & CLEAR
10:32AM → 10:47AM
STOP
ATTENUATION ADDED MOMENTARILY
431.950 MHz
0.2μV
← 0.2μV
← ZERO SIGNAL
STOP
147.950 MHz
← 0.2μV
← ZERO SIGNAL
START OCT. 15/81
MILD & CLEAR
10:49:12 AM
10:32:52 AM

B-16



No. 4305
OCT. 15/81
6:56PM → 7:10 PM
STOP
START
← 0.2µV
ZERO SIGNAL
431.950 MHz
147.950 MHz
7:10:46 PM
6:56:26 PM
NOON
11AM
10AM

Appendix I

Dec.30/81

Supplement(#2) to: Differential Time-dependence of fading at Seaview and Arichat(preliminary report)

Principal Investigator: W.P. Lonc (Saint Mary's University)
assisted by Mr. P.Fougere (M.T.T., New Glasgow)

Date of Observation: Dec.8, 1981

Duration of Observations: 51 minutes, beginning at 11:45 A.M.

Introduction: This experiment(Dec.8/81) constitutes a continuation of observations being made occasionally at both Seaview and Arichat to obtain information on differences in fading at the two sites, with a view to possible diversity configurations. The signal at Seaview is taken to be the 'reference' or 'premium' signal; when this signal drops below 0.2 uV, then the recordings of the signal at Arichat are examined to determine if the signal at Arichat could have been useful in a diversity system. As with the Seaview signal, the signal at Arichat was considered useful if it remained at or above the 0.2 uV level. It should also be noted that the experimental configuration in this particular report differs from the two previous reports on the same subject inasmuch as the Arichat receiver now had a preamplifier, thus making the Arichat receiving system identical to the one at Seaview.

Observations:

1. Of the total observation duration of 51 minutes, approximately 8.6 minutes, or 17% of the time was affected by fading below the 0.2 uV level at the Seaview site. There were 30 of these fades, and are identified as A-1, A-2, etc. on the chart recording.

2. Of the 8.6 minutes total during which the signal at Seaview was below 0.2 uV, the signal at Arichat was <u>simultaneously</u> below 0.2 uV for approximately 1.1 minutes of this time, representing approximately 13%. Hence, a diversity system could have reduced the drop-out due to fading by some 87%. This suggests that the drop-out due to fading during the 51 minute observation period could have been reduced from 17% to approximately 2.2 %

<u>Conclusion</u>: There is a significant difference in fading occurence at Seaview and Arichat in the signal originating on Sable Island, and it appears advisable to repeat this experiment at the earliest opportunity during the winter and spring, during which time significant fading occurs most frequently on this path.

Data reduction of "Diversity Experiment" between Seaview and Arichat, conducted on Dec.8,81

Fade # AT SEAVIEW	Duration of fade	Fade at Arichat OVERLAPPING?	Duration of non-Overlap (SEC.)
A-1	20 SEC	X	—
-2	20	X	—
-3	5	X	—
-4	10	✓	5
-5	25	PARTIAL	5
-6	5	X	—
-7	5	X	—
-8	20	PARTIAL	15
-9	5	X	—
-10	10	X	—
-11	15	X	—
-12	20	X	—
-13	40	X	—
-14	15	✓	10
-15	20	PARTIAL	5
-16	10	X	—
-17	10	X	—
-18	35	X	—
-19	40	PARTIAL	2
-20	10	X	—
-21	5	X	—
-22	5	X	—
-23	30	PARTIAL	15
-24	70	X	—
-25	15	X	—
-26	10	X	—
-27	10	X	—
-28	5	X	—
-29	10	PARTIAL	3
-30	15	PARTIAL	8
TOTALS	8.6 MIN		68 SEC. ≐ 1.1 MIN.

Remarks: "Fades" are defined as drops in received signal level below 0.2uV.

Total observation time: 51 minutes


Signal at Seaview, Dec.8/81
Observer: W.P. Lonc
142.605 MHz
LIMITING
LIMITING
0.2 μV
1 MINUTE
Signal at Arichat, Dec.8/81
Observer: P. Fugere