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LONG RANGE SEISMIC MEASUREMENTS

HALF BEAK

3 JUNE 1966

Prepared for:

AIR FORCE TECHNICAL APPLICATIONS CENTER

Washington, D. C.

21 NOVEMBER 1966

By

EARTH SCIENCES DIVISION
TELEDYNE INDUSTRIES, INC.

Under

Project VELA UNIFORM

Sponsored by

ADVANCED RESEARCH PROJECTS AGENCY

Nuclear Test Detection Office

ARPA Order No. 624

803760

**BEST
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LONG RANGE SEISMIC MEASUREMENTS
HALF BEAK

30 June 1966

SEISMIC DATA LABORATORY REPORT NO. 171

AFTAC Project No.:	VELA T/6702
Project Title:	Seismic Data Laboratory
ARPA Order No.:	624
ARPA Program Code No.:	5810
Name of Contractor:	EARTH SCIENCES DIVISION TELEDYNE INDUSTRIES, INC.
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AVAILABILITY

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TABLE OF CONTENTS

	Page No.
EVENT DESCRIPTION	1
INTRODUCTION	2
INSTRUMENTATION AND PROCEDURE	3
DATA AND RESULTS	5

TABLES

- 1 Station Status Report - HALF BEAK
- 2 Principal Phases - HALF BEAK

FIGURES

- 1 Recording Stations and Signals Received
- 2 Unified Magnitudes
- 3 Travel-Time Residuals, $T-\Delta/8.1$; T-JB
- 4 Maximum Amplitudes of Pn and P
- 5 Maximum Amplitudes of Pg
- 6 Maximum Amplitudes of Lg
- 7 Maximum Amplitudes of LQ
- 8 Maximum Amplitudes of LR

LIST OF APPENDICES

- I(A) Recording Site Information
- I(B) Unified Magnitudes from Pn or P Waves
- II(A) Seismic Analysis Diagram
- II(B) Instrument Response Curves - LRSM

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HALF BEAK
EVENT DESCRIPTION

DATE: 30 June 1966

TIME OF ORIGIN: 22:15:00.1Z

YIELD:

MAGNITUDE: 6.02 ± 0.60

LOCATION:

SITE: Nevada Test Site, Area U19b

GEOGRAPHIC COORDINATES:

Lat: $37^{\circ}18'57.0''$ N

Long: $116^{\circ}17'56.0''$ W

ENVIRONMENT:

GEOLOGIC MEDIUM: Rhyolite

SURFACE ELEVATION: 6791 ft.

SHOT ELEVATION: 3907 ft.

SHOT DEPTH: 2884 ft.

COMPUTED EPICENTER:

ALL STATIONS

GEOGRAPHIC COORDINATES:

Lat: $37^{\circ}13'12.0''$ N

Long: $116^{\circ}24'36.0''$ W

TIME OF ORIGIN: 22:15:04.9Z

DEPTH: 52.6 km

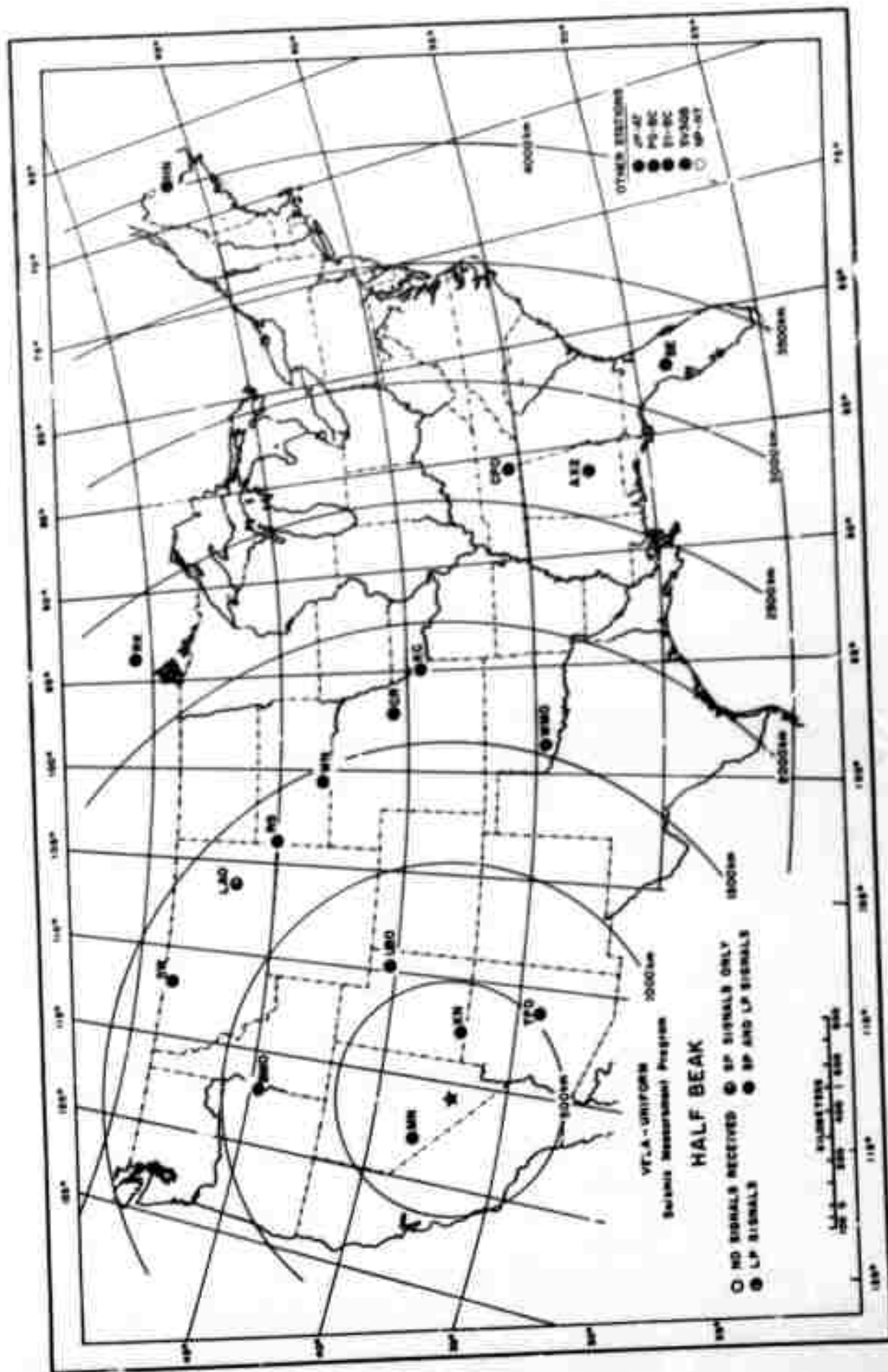
EPICENTER SHIFT: 14.4 km, S 43° W

Code	Station	Final						Tape	Timing
		SPZ	SPK	SPT	LPZ	LPR	LPT		
ME-NV	Mina, Nevada	•	•	•	•	•	•	•	P
KN-UT	Kanab, Utah	•	•	•	•	•	•	•	S
TPSO-ZI	Tonto Forest Observatory, Arizona	•	•	•	•	•	•	•	P
UBSO-ZIO	Uinta Basin Observatory, Utah	•	•	•	•	•	•	•	P
BMSO-ZI	Blue Mountain Observatory, Oregon	•	•	•	•	-	•	•	P
LAO	Subarray AO-10, Montana	•	M	M	M	M	M	•	P
SW-MA	Sweetgrass, Montana	•	•	•	•	•	•	•	P
RG-SD	Redig, South Dakota	•	•	•	•	•	•	•	P
WM-SD	Winner, South Dakota	•	•	•	•	•	•	•	P
WMSO-Z6	Wichite Mountain Observatory, Oklahoma	•	•	•	•	-	•	•	P
CR-NE	Crete, Nebraska	•	•	•	•	•	•	•	P
JP-AT	Jasper, Alberta, Canada	•	•	•	•	•	•	•	P
KC-MO	Kansas City, Missouri	•	•	•	•	•	•	•	P
PG-BC	Prince George, British Columbia, Canada	•	•	•	•	•	•	•	P
SI-BC	Smithers, British Columbia, Canada	•	•	•	•	•	•	•	P
RK-ON	Red Lake, Ontario, Canada	•	•	•	•	•	•	•	P
CPSO-Z8	Cumberland Plateau Observatory, Tennessee	•	•	•	•	•	•	•	P
AV2AL	Alexander City, Alabama	•	•	•	•	•	•	•	P
BE-FL	Belleview, Florida	•	•	•	•	•	•	•	P
HN-ME	Houlton, Maine	•	•	•	•	•	•	•	P
SVY, Q	Schefferville, Quebec, Canada	•	•	•	•	•	I	•	P
NP-WT	Mould Bay, Northwest Territories, Canada	I	I	I	I	I	I	•	P

I	Inoperative	S	Secondary Timing
M	No Instrument	•	Signal
P	Primary Timing	-	No Signal

Station Status Report - HALF BREAK

Table 1



Recording Stations and Signals Received

Figure 1

INTRODUCTION

A long range seismic measurements (LRSM) program and several larger seismographic observatories were established under VELA-UNIFORM to record seismological data resulting from natural seismic activity and a planned series of U. S. underground nuclear tests. The LRSM teams are mobile and occupy locations selected to provide optimum data from events of special interest; the observatories are permanent installations as follows:

Wichita Mountains Seismological Observatory (WMSO)
Lawton, Oklahoma

Uinta Basin Seismological Observatory (UBSO)
Vernal, Utah

Blue Mountain Seismological Observatory (BMSO)
Baker, Oregon

Cumberland Plateau Seismological Observatory (CPSO)
McMinnville, Tennessee

Tonto Forest Seismological Observatory (TFSO)
Payson, Arizona

Large Aperture Seismic Array (LASA)
Billings, Montana

The purpose of this report is to provide an analysis

of data resulting from the HALF BEAK event recorded by the LRSM teams and the VELA observatories and a preliminary summary of data reported by other permanent and temporary seismographic stations.

INSTRUMENTATION AND PROCEDURE

The instrumentation at each of the LRSM locations consists of three-component short-period and three-component long-period seismographs. In general, data are recorded on 35 millimeter film and on one-inch 14 channel magnetic tape although recently more portable instrumentation has been incorporated which records only on magnetic tape. The stations are all equipped to record WWV continuously to provide accurate time control and calibration is accomplished once each day and just prior to each shot at the operational settings. Pertinent information useful for analysis of LRSM data is available to qualified users of this data and is contained in Technical Report 65-43, "Interpretation and Usage of Seismic Data, LRSM program." General information on LRSM van and portable system equipment and operation is given in Technical Reports 66-27, "The LRSM Mobile Seismological Laboratory," and 65-74, "A Portable Seismograph." Copies of

these reports may be obtained from DDC. The AD control number of Technical Report 66-27 is 480343. All the observatories have both long-period and short-period, three-component instrumentation, in addition to their other specialized facilities.

Station information is presented in Appendix I. This includes the station name and code; the geographic coordinates, distances and azimuths involved; the station elevations; and the type of instruments in use at each location. Representative instrumental response curves are shown in Appendix II(B).

The procedures used in measuring amplitudes reported herein is illustrated in Appendix II(A) and the unified magnitude is calculated as shown in Appendix I(B). The distance factors (B) beyond 16° are from Gutenberg and Richter*. For distances less than 16° values were read from a curve in the Gutenberg and Richter paper back to 10° and then extrapolated to 2° , using an inverse cube relationship.

A standard hypocenter location program for a digital

*Gutenberg, B. and Richter, C. F., Magnitude and Energy of Earthquakes, Ann. Geofis., 9 (1956), pp. 1-15

computer is used to determine the location using data from all stations analyzed. Best-fit values of latitude, longitude, depth of focus, and time of origin are determined statistically by a least squares technique. This utilizes a Jeffreys-Bullen travel-time curve as modified by Herrin in 1961 on the basis of Pacific surface-focus recordings. Precision of the computation is limited primarily by the accuracy of arrival times, the validity of the standard travel-time curve, and by local velocity deviations. Since the method is based on P-wave arrivals, this particular program does not make use of later phases such as pP and S in the determination of depth or location.

DATA AND RESULTS (LRSM and VELA OBSERVATORIES)

The parameters of the HALF BEAK event and a summary of the seismic evaluation is shown on the Event Description page. The operational status of the 22 LRSM stations and observatories is given in Table 1 and illustrated in Figure 1.

Table 2 summarizes the measurements made of the principal phases from the HALF BEAK event at the LRSM and VELA stations. Included are the Pn and P arrival times, the maximum amplitudes (A/T) of Pn or P motion and other phases

as seen on the short-period vertical instruments. Long-period Love and Rayleigh wave motion are also tabulated in (A/T) form. In addition, individual station Rayleigh wave areas (mm^2) is indicated as measured on the LPZ only. Although reduced to 1K magnification, they have not been normalized to any magnitude. Twenty-one stations recorded short-period signals. Long-period signals from this event were recorded by 20 stations.

The unified magnitudes determined from the LRSM and VELA observatories is shown in Figure 2. The average magnitude is 6.02 ± 0.60 .

The travel-time residuals from the Pn and P phases are shown in Figure 3. Figures 4 through 8 illustrate plots of the amplitude of P, Pg, Lg, LQ, and LR.

Attached to the report are illustrative seismograms showing the signals recorded at 4 stations. The most distant station analyzed that recorded HALF BEAK was SV3QB at a distance of 4187 kilometers.

Principal Phases
HALF BEAK
30 June 1966
22:19:00.12

Code	Station	Distance	Inet.	Magni- fication (k) Film x 10	Phase	Observed Travel Time		Period T (sec)	Maximum Amplitude A/T	Magni- tude (m)	Area (mm ²) LPS
						(min)	(sec)				
NM-NV	Mine, Nevada	205	SPE	0.32	Pn	0	12.7	0.5	13575		
			SPE	0.11*	Pg	0	34.1	0.65	185741		
			SPT	0.15	Lg			0.7	51450		
			LPT		Lj			---	---		
KM-UT	Keneb, Utah	110	SPE	0.294	Pn	0	64.2	0.4	10369	6.62	
			SPE	0.294	Pg	0	52.6	0.6	27878		
			SPT	0.295	Lg			0.9	24212		
			LPT	1.12	LQ			12.0	1828		1609.76
			LPT	1.02	LR			12.0	5250		
TBSO	Tonto Forest Observatory, Arizona	565	SPE-1	5.0	Pn	1	19.1	0.65	525	4.16	
			SPE-1	5.0	e	1	21.9	0.45	698		
			SPE-1	5.0	e	1	26.1	0.7	360		
			SPE-1	5.0	e	1	26.6	0.4	658		
			SPE-1	0.8	Pg	1	33.4	0.7	2997		
			SPE	0.8	Lg			1.3	3744		
			SPE	0.7	Lg			1.1	2226		
			LPE		LQ			---	---		
			LPE		LQ			---	---		
			LPS	(0.3)	LR			16.0	(7194)		6483.33
USBO	Uinta Basin Observatory, Utah	673	SPE-10	1.0	Pn	1	(34.4)	1.15	3125	7.11	
			SPE-10	1.0	(Pg)	1	(43.1)	1.0	1425		
			SPE-10	1.0	Pg	1	(51.4)	0.9	5141		
			SPE	0.97	Lg			1.2	4934		
			SPE	0.9*	Lg			1.3	6013		
			LPH	9.3*	LQ			14.0	149		
			LPH	9.3*	LQ			14.0	249		
			LPE	8.4*	LR			(14.0)	(212)		149.52
BMEO	Blus Mountain Observatory, Oregon	841	SPE-3	17.5*	Pn	1	54.7	0.5	(50.1)	(5.47)	
			SPE-3	17.5*	e	2	02.3	1.15	564		
			SPE-3	17.5*	e	2	06.9	1.0	571		
			SPE-3	17.5*	Pg	2	14.5	1.0	2284		
			SPE	9.94*	Lg			1.6	2144		
			SPE	5.43*	Lg			1.45	2857		
			LPE	0.60*	LQ			18.0	965		
			LPS		LR			---	---		
			SPE	28.7	Pn	2	52.5	(1.15)	(368)	(4.47)	
			SPE	24.7	Pg	3	(34.4)	1.2	(877)		
LAO	Zubarry A0-10, Montana	1123	SPE	33.2	P	2	54.2	1.1	646	6.90	
			SPE	33.2	e	3	03.1	0.9	240		
			SPE	33.2	PP	3	05.6	1.1	726		
			SPE	33.2	Pg	3	(46.7)	1.0	437		
			SPE	50.5	Lg			(1.4)	(1339)		
			SPT	39.8	LQ			1.3	647		
			LPT	8.15*	LQ			(16.0)	(268)		
			LPE	2.94	LR			12.0	1937		990.51
RD-BD	Radig, South Dekote	1381	SPE	54.1	P	2	58.5	0.8	34.0	5.59	
			SPE	54.1	e	2	59.8	0.8	78.1		
			SPE	54.1	e	3	01.5	0.6	109		
			SPE	40.0*	PP	3	16.2	1.3	2158		
			SPE	40.0*	(Pg)	3	(27.3)	1.1	938		
			SPE	40.0*	Lg	4	05.6	1.0	456		
			SPE	45.3	Lg			1.4	928		
			SPT	54.8	LQ			1.4	515		
			LPT	7.93	LQ			12.0	532		
			LPT	4.75	LQ			12.0	252		
			LPE	1.075	LR			12.0	2286		1418.60
WM-BD	Winner, South Dekote	1517	SPE	43.3	P	3	15.7	1.0	341	4.27	
			SPE	43.3	(PP)	3	22.9	1.2	730		
			SPE	43.3	e	3	(44.9)	1.2	1500		
			SPE	18.41*	Pg	4	06.4	1.0	813		
			SPE	40.0	Lg			(1.1)	(938)		
			SPT	67.2	LQ			1.2	670		
			LPS	8.72	LQ			14.0	360		
			LPT	7.45	LQ			15.0	195		
			LPE	3.62	LR			14.0	325		713.45
NMBO	Nichite Mountain Observatory, Oklahoma	1620	SPE-6	340	P	3	(29.7)	1.35	53.5	5.10	
			SPE-6	340	e	3	37.5	1.2	27.7		
			SPE-6	340	Pg	4	32.7	---	---		
			LPE	52.0	(E)	4	25	22.0	10.9		
			LPH	51.0	(E)	6	25	21.0	13.6		
			SPE	70.0	Lg			1.5	47.6		
			SPE	70.0	Lg			(2.1)	(173)		
			LPH	27.6*	LQ			(16.0)	(195)		
			LPE	1.9	LR			17.0	730		1089.47
CR-ME	Crata, Nebraska	1722	SPE	24.9*	P	3	(41.2)	1.0	1225	4.20	
			SPE	24.9*	e	3	46.8	1.1	2236		
			SPE	33.4	Pg	4	(68.9)	1.0	591		
			SPE	16.35	Lg			1.2	1581		
			SPT	14.39	LQ			1.2	1343		
			LPR	7.61*	LQ			(16.0)	(451)		
			LPT	7.76*	LQ			17	585		
			LPE	4.1	LR			2.0	(3242)		1208.54
JP-AT	Jasper, Alberta, Canada	1738	SPE	69.5	P	3	43.5	1.0	82.7	6.97	
			SPE	69.5	e	3	45.8	1.0	227		
			SPE	69.5	e	3	47.2	1.1	487		
			SPE	49.5	PP	3	(55.5)	1.2	445		
			SPE	69.5	e	4	02.8	1.0	410		
			SPE	69.5	e	4	24.5	1.2	251		
			SPE	69.5	e	4	35.7	1.2	257		
			LPR	10.8	E	6	47	15.0	54.4		
			LPT	12.45	E	6	47	14.0	(37.5)		
			SPT	72.0	Lg			(2.0)	(1026)		
			LPT	68.6	LQ			(2.8)	(1177)		
			LPR	10.8	LQ			18.0	672		
			LPT	12.45	LQ			(20.0)	(216)		1620.41
			LPS	1.86*	LR			15.0	961		

Principal Phases - HALF BEAK

Principal Phases
HALF BEAK
30 June 1966
22:19:00.13

Code	Station	Distance	Inst.	Magni- fication (k)	Phase	Observed Travel Time		Period T (sec)	Maximum Amplitude A/T	Magni- tude (m)	Area (m ²) L ₁
						(min)	(sec)				
KC-MO	Seneca City, Missouri	1900	SPS	35.8°	P	4	1.0	(1.0)	(251)	(5.30)	904.76
			SPS	35.8°	e	4	1.0	0.8	436		
			SPS	35.8°	PP	4	1.2	0.8	462		
			SPS	35.8°	Pp	5	(11.3)	(1.2)	(403)		
			LPS	8.3	s	7	15	11.0	75.1		
			LPS	7.1	s	7	15	12.0	53.2		
			SPS	35	Lq			(1.3)	(349)		
			SPT	37.0	Lq			1.8	813		
			LPS	0.50°	LQ			(14.0)	(1287)		
			LPT	7.1	LQ			15.0	753		
			LPS	1.26°	LS			13.0	2394		
PO-BC	Prince George, British Columbia, Canada	1914	SPS	112	P	4	03.7	1.3	339	5.43	1336.85
			SPS	31.9°	a	4	07.2	1.3	1564		
			LPS	4.64	s	7	34	10.0	453		
			LPT	10.2	s	7	34	10.0	155		
			SPS	115	Lq			2.4	447		
			SPT	115	Lq			1.7	179		
			LPS	4.64	LQ			14.0	2103		
			LPT	10.2	LQ			14.0	734		
			LPS	8.00	LS			15.0	757		
SI-BC	Smithers, British Columbia, Canada	2109	SPS	55.1°	P	4	25.0	0.8	320	5.51	1805.54
			SPS	55.1°	e	4	27.9	0.8	427		
			SPS	55.1°	a	4	31.4	1.3	862		
			SPS	55.1°	e	4	(35.7)	1.0	327		
			SPS	114	a	5	02.0	1.2	276		
			SPS	114	(Pg)	5	(31.1)	1.2	305		
			SPS	122	Lq			2.3	208		
			SPT	136	Lq			2.8	404		
			LPS	0.68°	LQ			15.0	741		
			LPT	1.54°	LQ			15.0	727		
			LPS	1.42	LS			13.0	2259		
BK-ON	Red Lake, Ontario, Canada	2339	SPS	13.0°	P	4	45.2	0.9	2070	6.42	513.21
			SPS	13.0°	a	4	47.8	0.6	1839		
			SPS	51.7	(PP)	5	04.4	1.1	323		
			SPS	51.7	a	7	24.9	1.0	42.9		
			SPS	51.7	e	7	31.7	1.2	106		
			SPT	43.8	Lq			2.1	642		
			LPT	32.3	LQ			15.0	101		
			LPS	4.92	LS			13.0	930		
CP90	Cumberland Plateau Observatory, Tennessee	2774	SPS-3	45.0	P	5	23.4	0.9	131	5.57	1750.00
			SPS-3	45.0	e	5	24.7	1.1	197		
			SPS-3	45.0	e	5	36.2	1.2	206		
			SPS-3	45.0	(Pg)	7	(31.8)	1.3	84.1		
			LPS	15.5	s	9	45	17.0	58.5		
			LPS	14.5	s	9	45	13.0	88.3		
			LPS		Lq			---	---		
			SPT		Lq			---	---		
			LPS	0.75	LQ			21.0	48.0		
			LPS	0.75	LQ			14.0	1144		
			LPS	0.50	LS			14.0	3289		
AN2AL	Alexander City, Alabama	2784	SPS	25.8°	P	5	27.4	1.1	772	6.38	1771.43
			SPS	98.4	e	5	47.3	1.1	202		
			SPS	98.4	PP	4	09.4	1.2	147		
			SPS	98.4	PcP	9	00.9	1.1	506		
			LPS	10.4	s	9	55	15.0	99.6		
			LPT	25.2	s	9	55	14.0	52.5		
			SPS	89.4	Lq			2.0	146		
			SPT	3	Lq			2.2	261		
			LPS	4.3°	LQ			20.0	154		
			LPT	5.0°	LQ			14.0	543		
			LPS	4.65	LS			19.0	368		
SE-FL	Selleview, Florida	3308	SPS	37.1	P	4	09.4	1.2	259	4.01	2109.45
			SPS	37.1	e	4	31.5	(1.3)	(139)		
			SPS	37.1	e	4	55.7	1.3	171		
			LPS	10.2	s	11	11	13.0	116		
			LPT	15.9	s	11	11	14.0	56.2		
			LPS	14.2	e	14	15	10.0	520		
			LPS	15.9	e	14	15	10.0	264		
			SPS	33.2	Lq			1.8	174		
			SPT	35.4	Lq			(1.8)	(142)		
			LPS	14.2	LQ			17.0	292		
			LPT	15.9	LQ			19.0	109		
			LPS	2.01	LS			16.0	1074		
NH-ME	Newton, Maine	4073	SPS	29.0°	P	7	08.3	(1.0)	(750)	(6.41)	508.74
			SPS	123	a	7	17.8	0.7	47.4		
			SPS	123	e	7	20.3	0.9	70.1		
			SPS	123	PP	8	29.6	1.1	72.7		
			SPS	123	PcP	9	31.0	0.9	59.8		
			SPT	120	Lq			2.8	244		
			LPT	4.3°	LQ			(18.0)	(174)		
			LPS	4.85	LS			14.0	234		
BVXOS	Schofferville, Quebec, Canada	4187	SPS	142°	P	7	14.0	1.2	315	6.00	222.75
			SPS	142°	e	7	23.7	1.1	107		
			SPS	142°	e	7	30.8	1.1	103		
			SPS	142°	e	7	39.5	1.1	88.7		
			SPS	142°	PP	8	39.5	1.2	208		
			SPS	138°	Lq			(1.2)	(50.4)		
			SPT	151°	Lq			(1.2)	(31.9)		
			LPS	3.88°	LQ			12.0	240		
			LPS	2.11°	LS			(16.0)	(348)		

A/T m/sec

() Doubtful Values
or Phases

* Measurements Made
from Playouts

--- Maximum Amplitude
Clipped on Film
& Tape

Principal Phases - HALF BEAK

Table 2 - Page 2

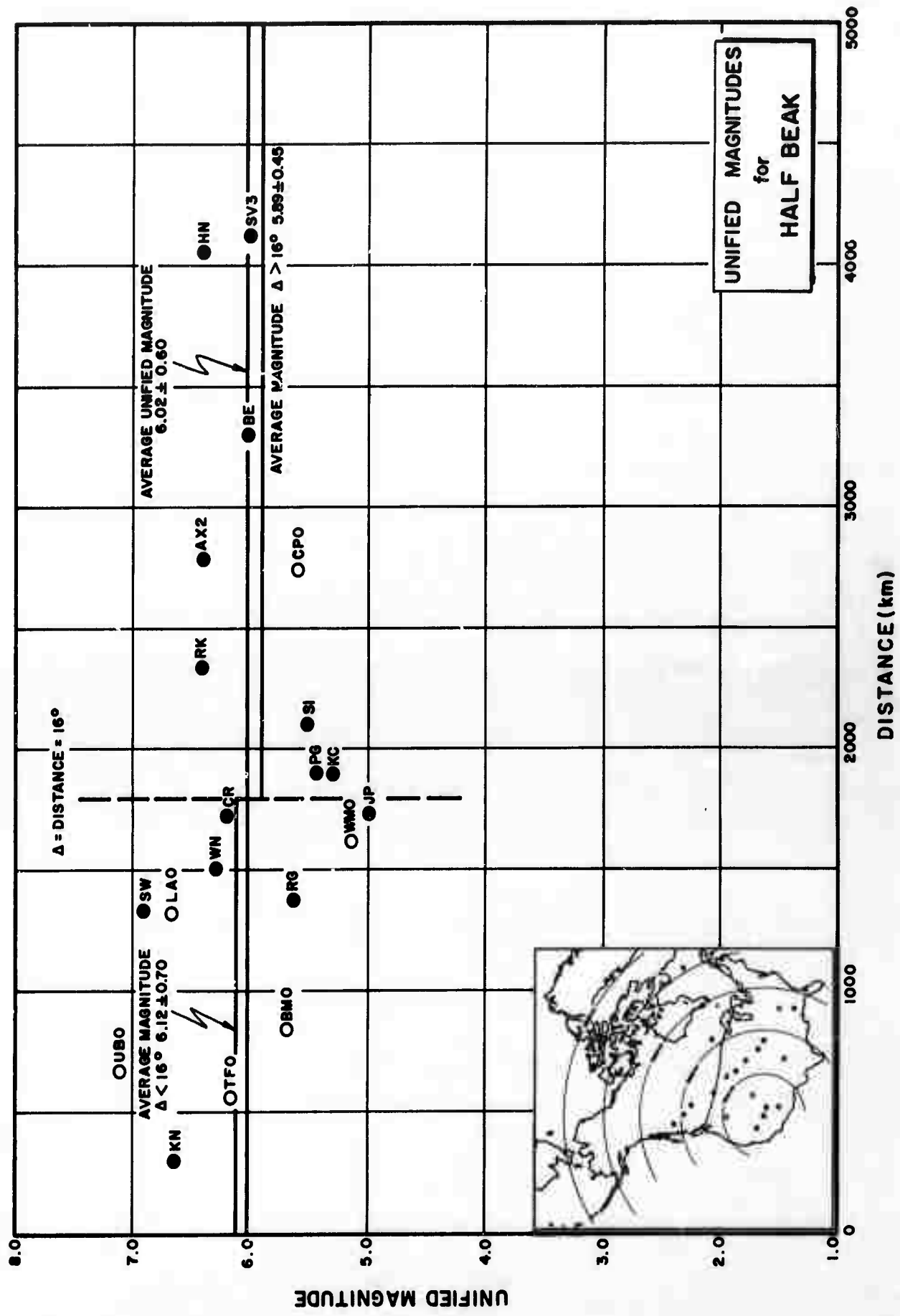


Figure 2

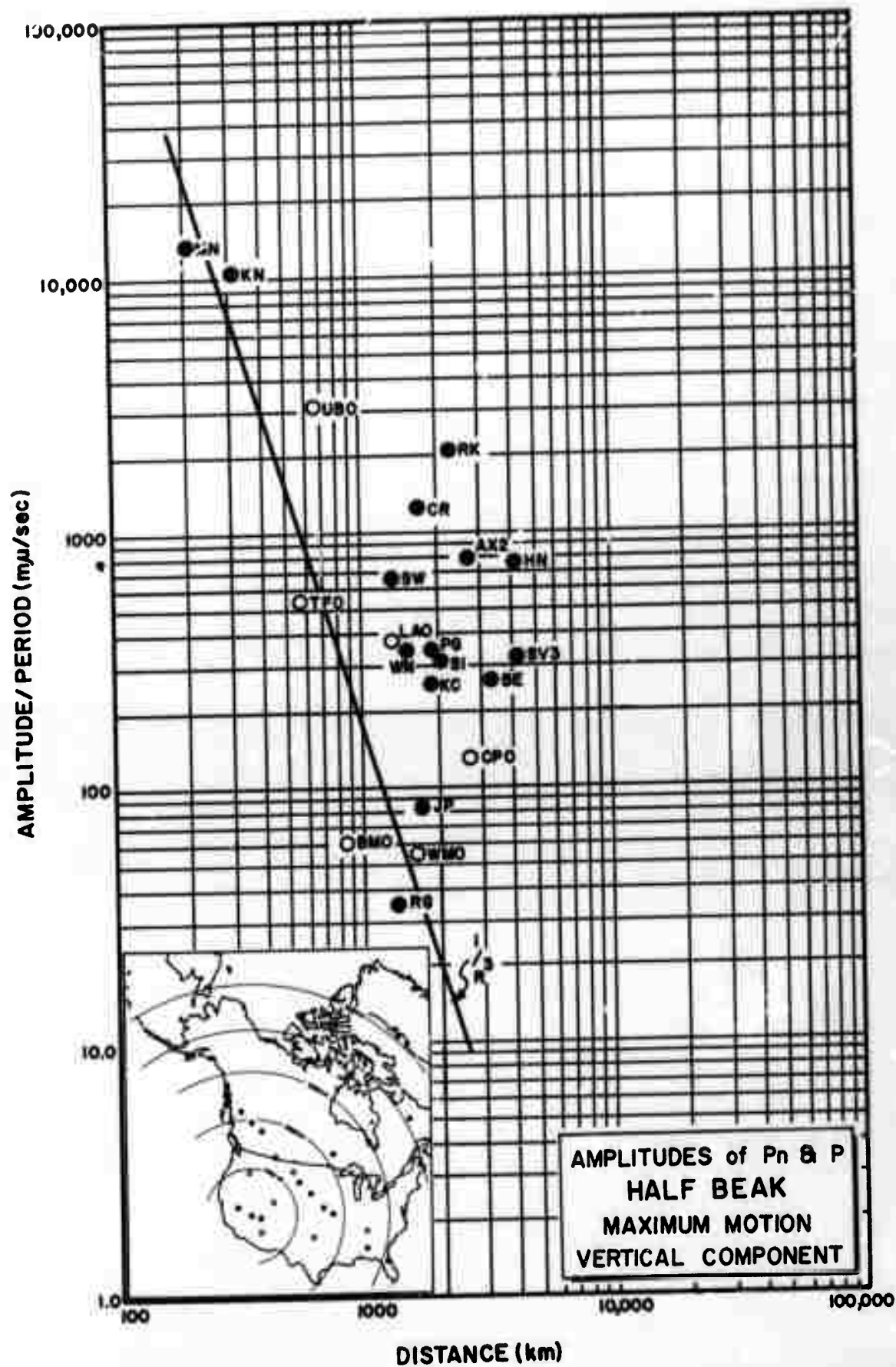


Figure 4

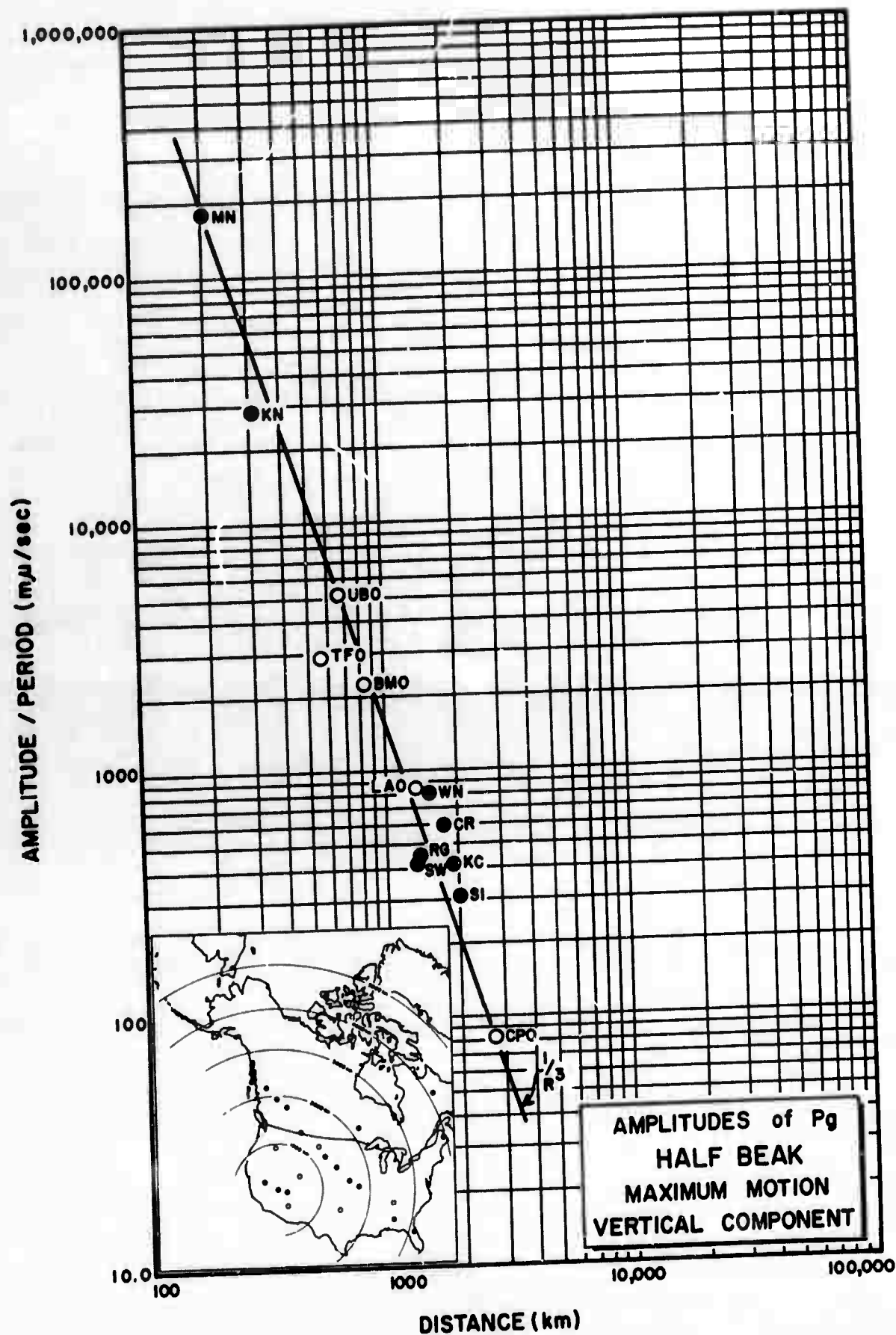


Figure 5

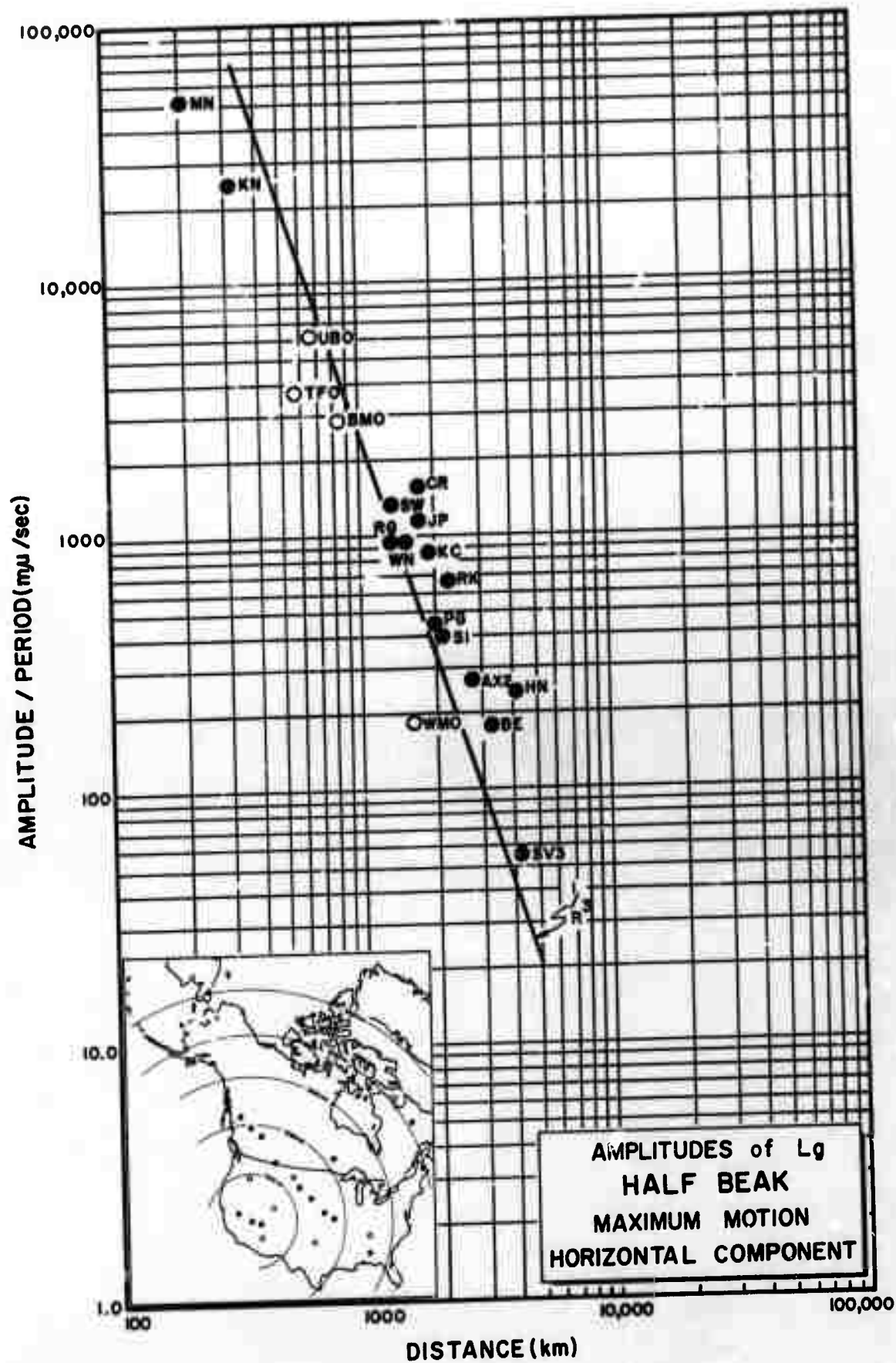


Figure 6

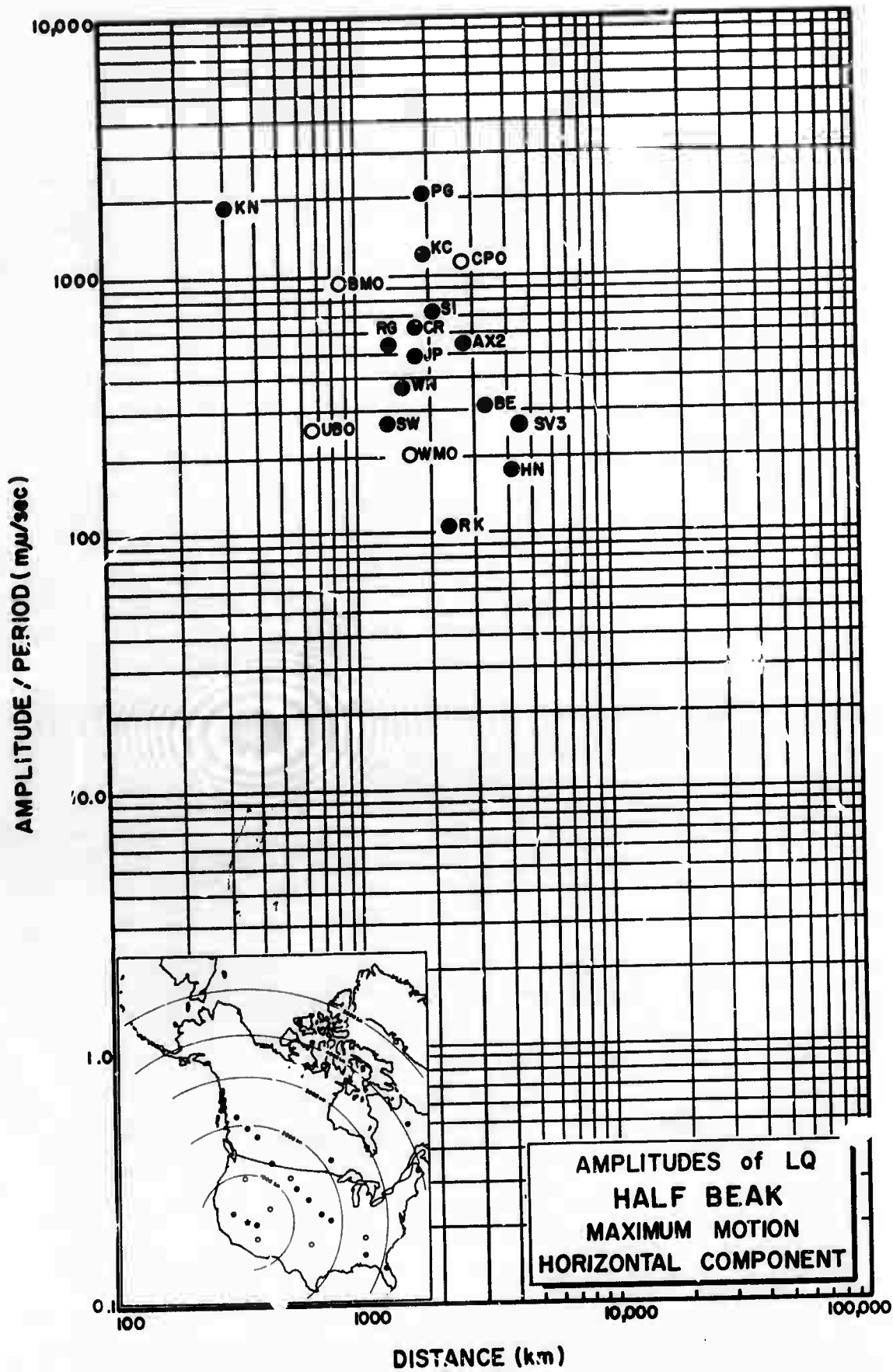


Figure 7

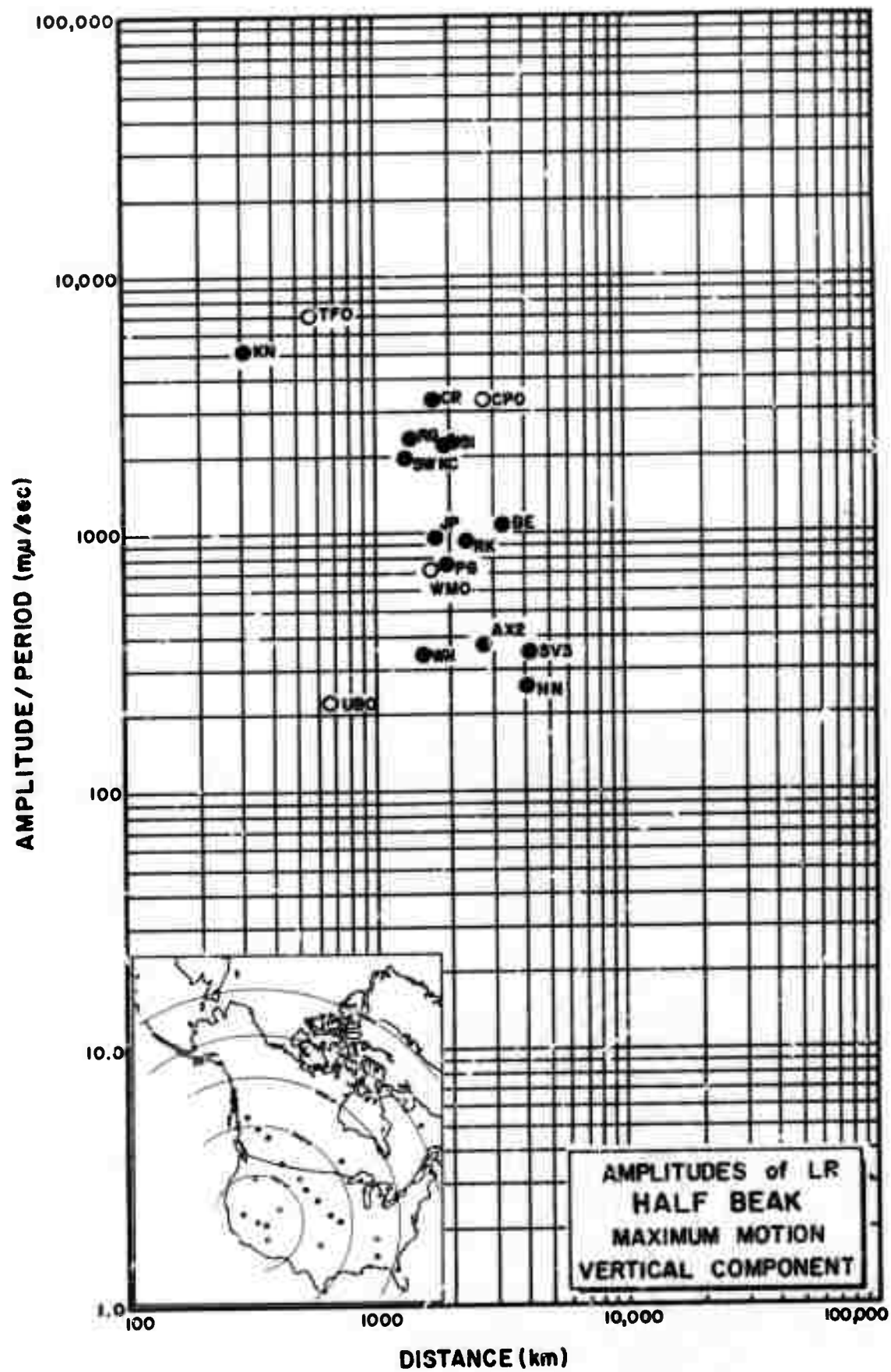


Figure 8

Code	Station	Distance (km)	Geographic Latitude	Geographic Longitude	Elev. (km)	Computed Azimuth		Installed Azimuth		Large or Small SP	LP Inst.
						Epi. Sta.	Sta. Epi.	Radial	Tang.		
MI-NV	Mina, Nevada	205	38°26'10" N	118°08'53" W	1.52	308°	127°	308°	38°	L	X
KN-UT	Kanab, Utah	310	37°01'22" N	112°49'39" W	1.71	95°	277°	95°	185°	L	X
TF80-Z1*	Tonto Forest Observatory, Arizona	565	34°17'12" N	111°16'03" W	1.49	125°	308°	90°	0°	JM	X
UB80-Z10*	Uinta Basin Observatory, Utah	673	40°19'18" N	109°34'07" W	1.60	58°	242°	90°	0°	JM	X
BM80-Z3*	Blue Mountain Observatory, Oregon	841	44°50'56" N	117°18'20" W	1.19	355°	174°	0°	90°	JM	X
LAO	Subarray AO-10, Montana	1333	46°41'19" N	106°13'20" W	.90	35°	222°			HSZ	
SW-MA*	Sweetgrass, Montana	1342	48°58'08" N	111°57'46" W	1.11	14°	197°	121°	211°	B	X
RG-SD*	Radig, South Dakota	1381	45°12'59" N	103°32'05" W	.95	47°	235°	127°	217°	L	X
WN-SD*	Winnar, South Dakota	1517	43°15'08" N	100°11'46" W	.79	59°	250°	129°	219°	L	X
WM80-Z6*	Wichita Mountain Observatory, Oklahoma	1620	34°43'05" N	98°35'21" W	.51	95°	285°	90°	0°	JM	X
CR-NE	Crata, Nebraska	1722	40°39'52" N	96°51'15" W	.44	72°	264°	131°	221°	L	X
JP-AT*	Jasper, Alberta, Canada	1738	52°53'50" N	118°05'25" W	1.13	356°	175°	114°	204°	L	X
KC-MO*	Kansas City, Missouri	1900	39°21'21" N	94°40'17" W	.27	77°	270°	133°	223°	S	X
PG-BC*	Prince George, British Columbia, Canada	1916	53°59'50" N	122°31'23" W	.91	348°	163°	110°	200°	L	X
BI-BC*	Smithers, British Columbia, Canada	2109	54°47'18" N	127°04'17" W	.58	341°	153°	107°	197°	L	X
RK-ON	Red Lake, Ontario, Canada	2339	50°50'20" N	93°40'20" W	.37	43°	239°	58°	148°	S	X
CP80-Z8*	Cumberland Plateau Observatory, Tennessee	2749	35°35'41" N	85°34'13" W	.57	85°	283°	90°	0°	JM	X
AX2AL*	Alaxandar City, Alabama	2786	32°46'38" N	86°07'48" W	.23	91°	289°	138°	228°	L	X
BE-FL*	Belleview, Florida	3308	28°54'19" N	82°03'52" W	.02	96°	295°	140°	230°	S	X
HN-ME	Houlton, Maine	4073	46°09'43" N	67°59'09" W	.21	60°	274°	93°	183°	B	X
SV30B*	Schaffarville, Quebec, Canada	4187	54°48'39" N	66°45'00" W	.58	46°	263°	139°	229°	S	X
NP-NT	Mould Bay, Northwest Territories, Canada	4343	76°15'08" N	119°22'18" W	.06	359°	176°	356°	86°	JMZ S	X

*SEISMOMETERS NOT ORIENTATED TOWARD NEVADA TEST SITE

Unified Magnitude: $m = \log_{10} (A/T), + B$

where

A = zero to peak ground motion in millimicrons
 $= \frac{(\text{mm}) (1000)}{K}$

T = signal period in seconds

B = distance factor (see Table below)

mm = record amplitude in millimeters zero to peak

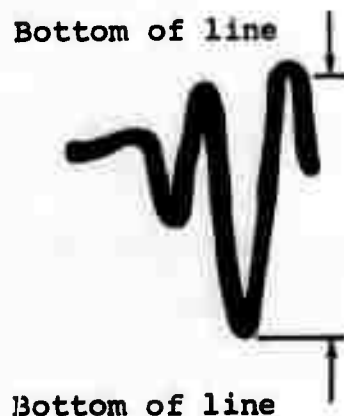
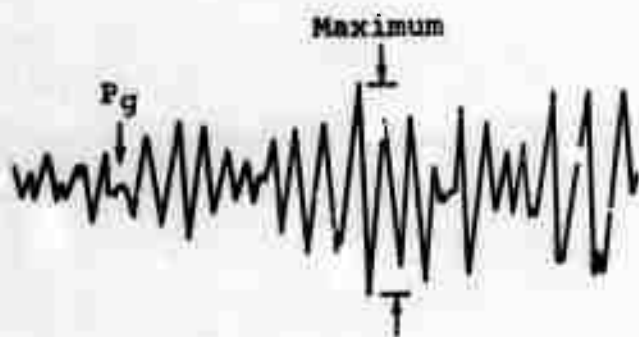
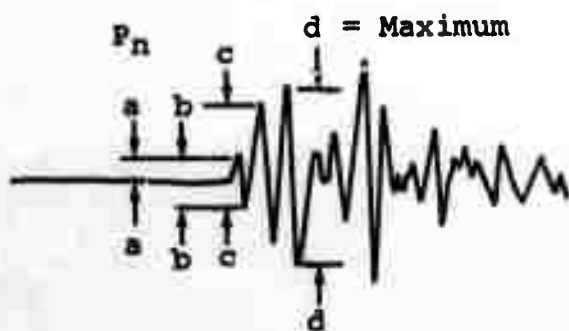
K = magnification in thousands at signal frequency

Table of Distance Factors (B) for Zero Depth

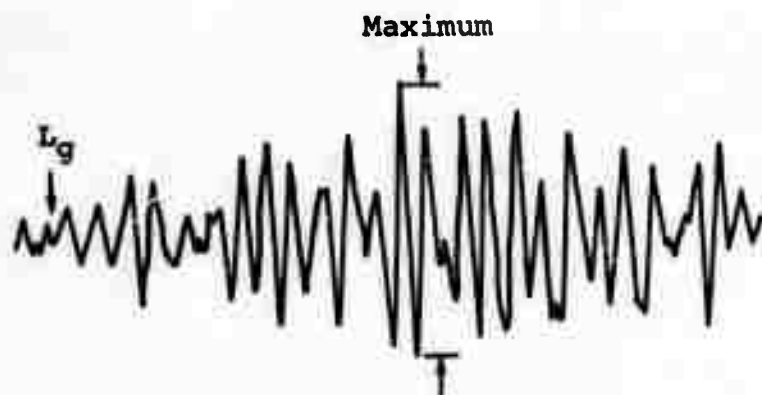
Dist (deg)	B	Dist (deg)	B	Dist (deg)	B	Dist (deg)	B
0°	-	27°	3.5	54°	3.8	80°	3.7
1	-	28	3.6	55	3.8	81	3.8
2	2.2	29	3.6	56	3.8	82	3.9
3	2.7	30	3.6	57	3.8	83	4.0
4	3.1	31	3.7	58	3.8	84	4.0
5	3.4	32	3.7	59	3.8	85	4.0
6	3.6	33	3.7	60	3.8	86	3.9
7	3.8	34	3.7	61	3.9	87	4.0
8	4.0	35	3.7	62	4.0	88	4.1
9	4.2	36	3.6	63	3.9	89	4.0
10	4.3	37	3.5	64	4.0	90	4.0
11	4.2	38	3.5	65	4.0	91	4.1
12	4.1	39	3.4	66	4.0	92	4.1
13	4.0	40	3.4	67	4.0	93	4.2
14	3.6	41	3.5	68	4.0	94	4.1
15	3.3	42	3.5	69	4.0	95	4.2
16	2.9	43	3.5	70	3.9	96	4.3
17	2.9	44	3.5	71	3.9	97	4.4
18	2.9	45	3.7	72	3.9	98	4.5
19	3.0	46	3.8	73	3.9	99	4.5
20	3.0	47	3.9	74	3.8	100	4.4
21	3.1	48	3.9	75	3.8	101	4.3
22	3.2	49	3.8	76	3.9	102	4.4
23	3.3	50	3.7	77	3.9	103	4.5
24	3.3	51	3.7	78	3.9	104	4.6
25	3.5	52	3.7	79	3.8	105	4.7
26	3.4	53	3.7				

Unified Magnitudes From P_n or P Waves

Appendix I(B)



Detail Showing Allowance
For Line Width



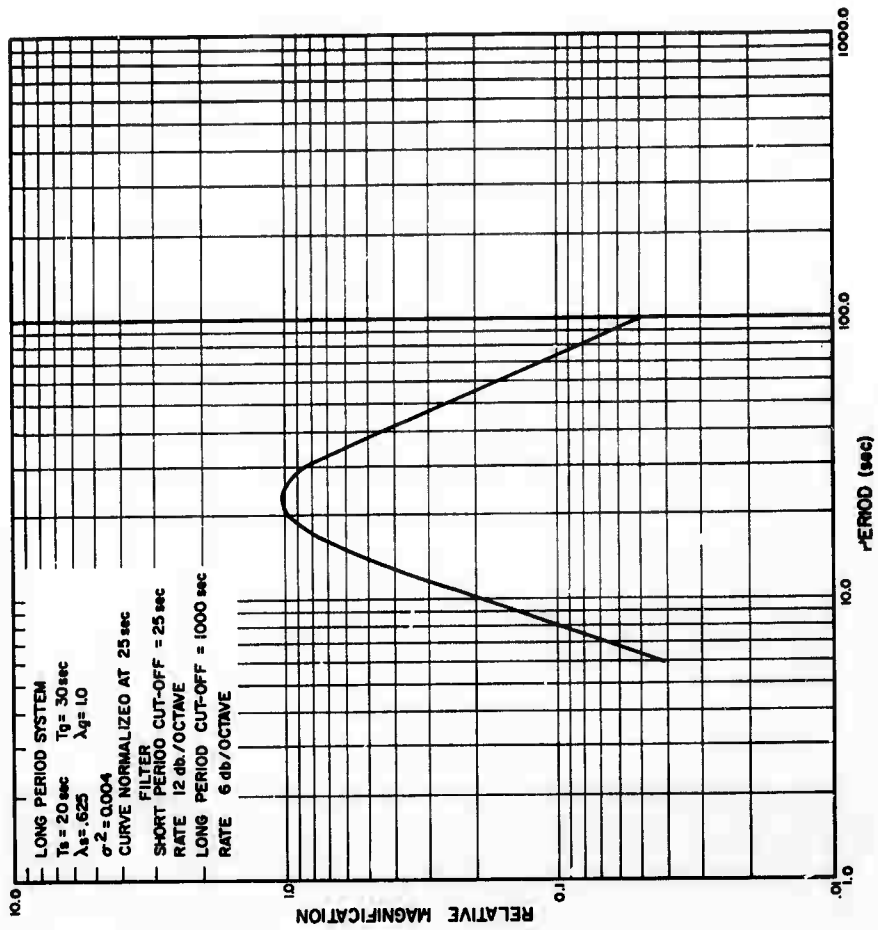
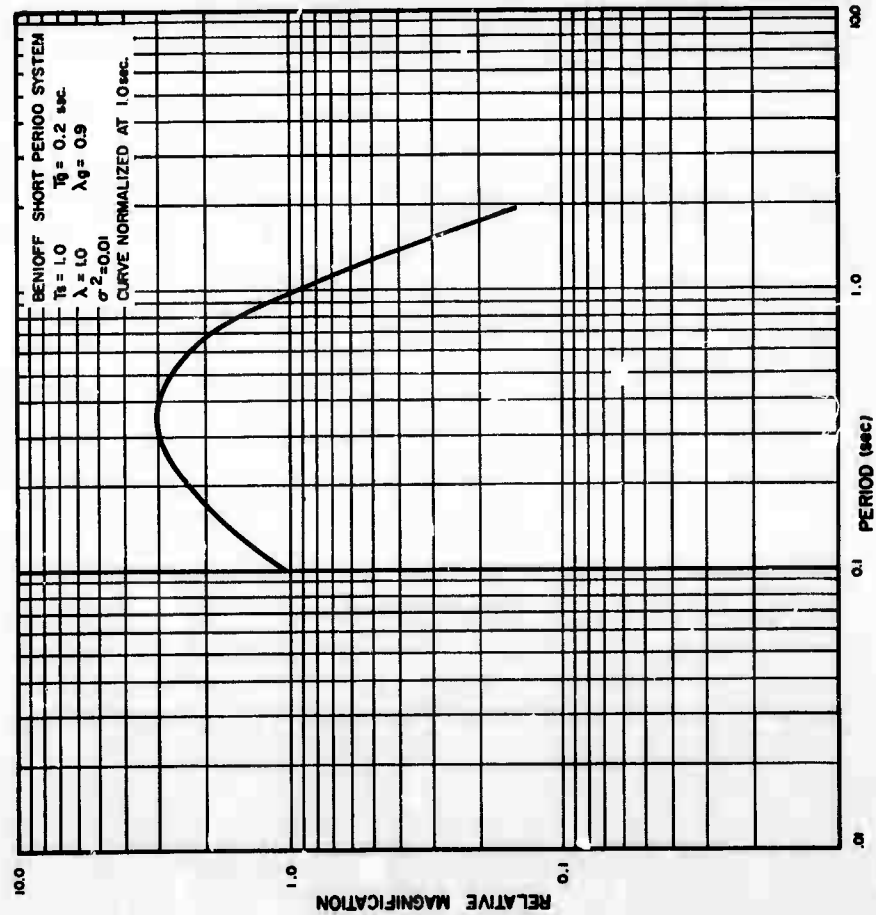
Pick time of Pn at beginning of "a" half cycle.

Pick amplitude of Pn as maximum " $d/2$ " within 2 or 3 cycles of "c".

Pick amplitudes of Pg and Lg at maximum of corresponding motion.

Seismic Analysis Diagram

APPENDIX II(A)



INSTRUMENT RESPONSE CURVES - LRSM

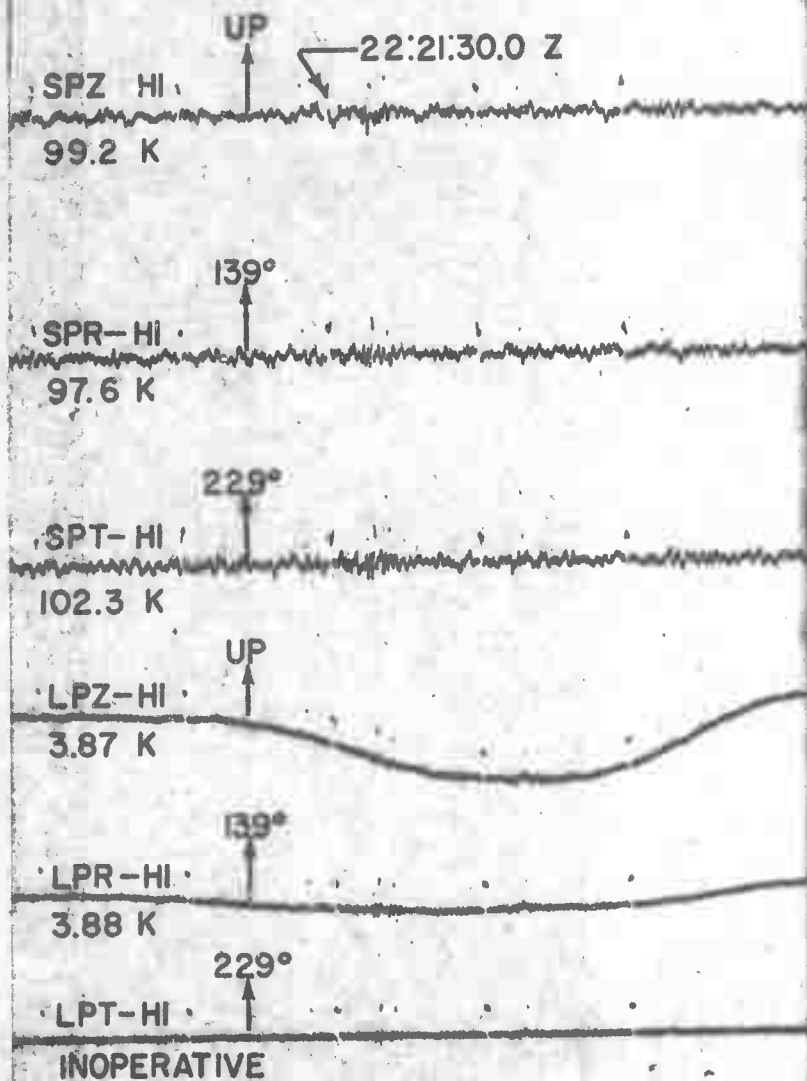
HALF BEAK

SV3QE

SCHEFFERVILLE, QUEBEC

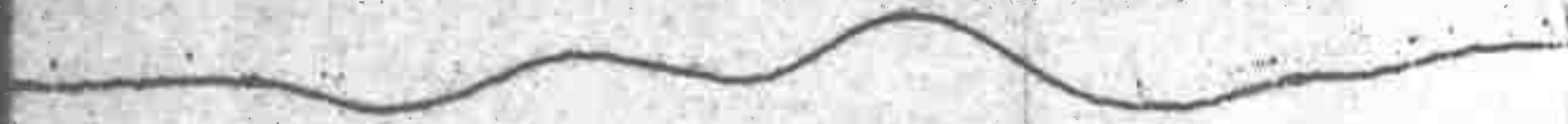
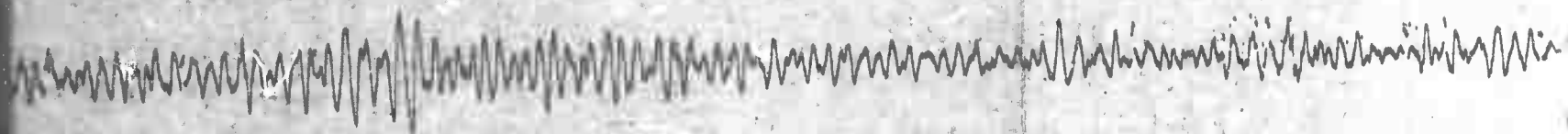
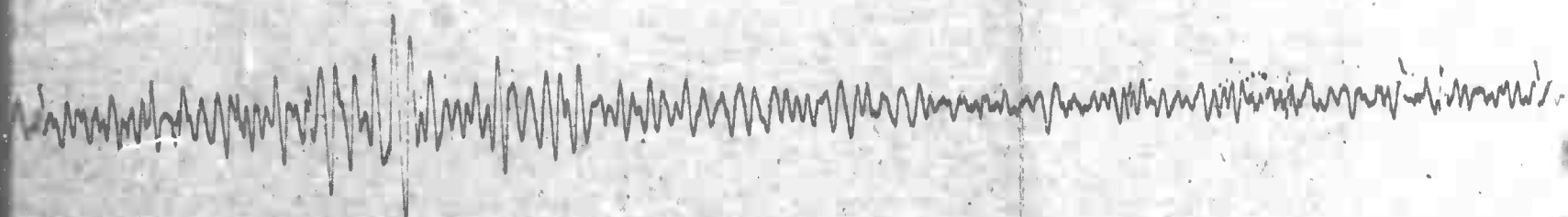
30 JUNE 1966

$\Delta = 4187$ km





B



C



Handwritten wavy line.

Handwritten wavy line.

Handwritten wavy line.

Handwritten wavy line.

Handwritten wavy line.

Handwritten wavy line.

Handwritten wavy line.

D



Handwritten wavy line across the page.

Handwritten wavy line across the page.

Handwritten wavy line across the page.

Handwritten wavy line across the page.

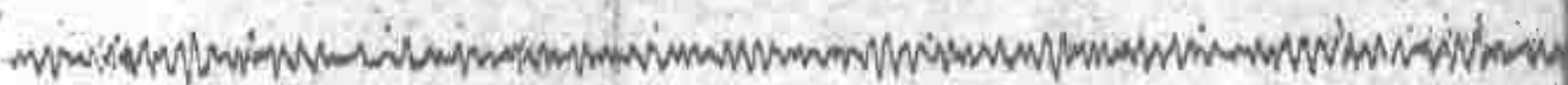
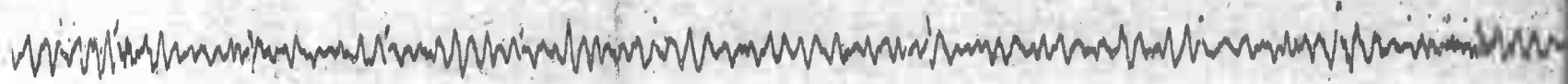
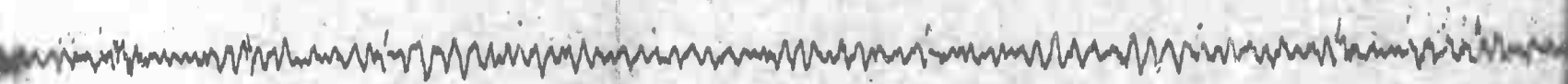
Handwritten wavy line across the page.

Handwritten wavy line across the page.

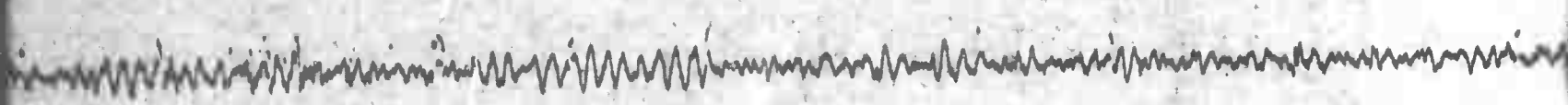
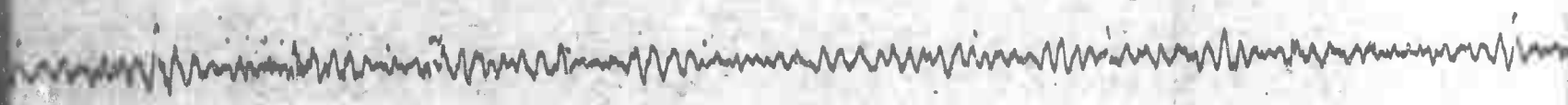
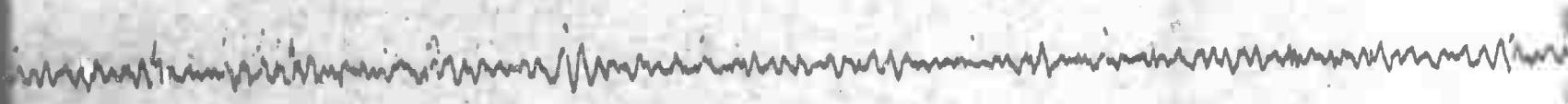
E



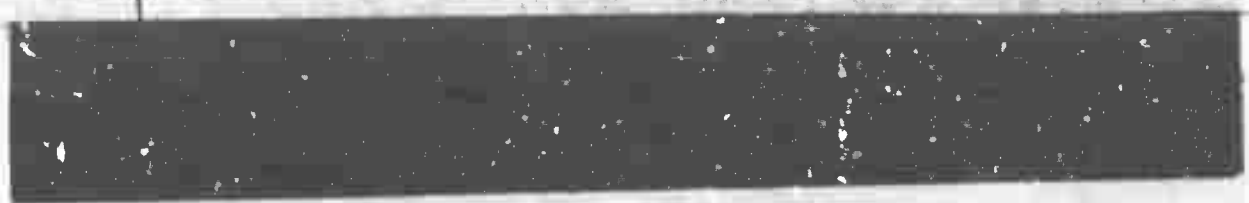
R



F



G





Handwritten wavy line.

Handwritten wavy line.

Handwritten wavy line.

Handwritten wavy line.

Handwritten wavy line.

Handwritten wavy line.

H





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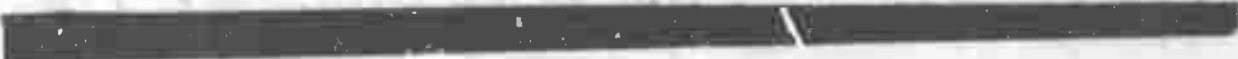
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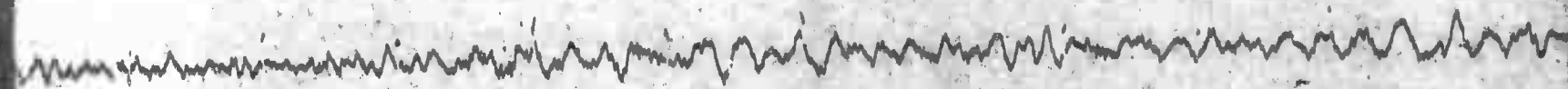
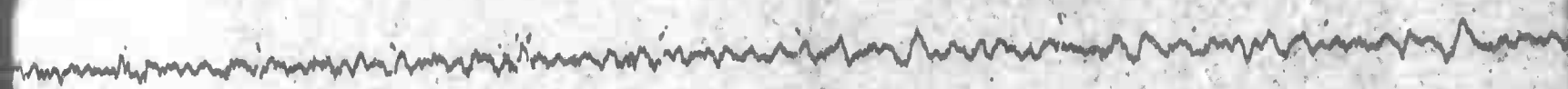
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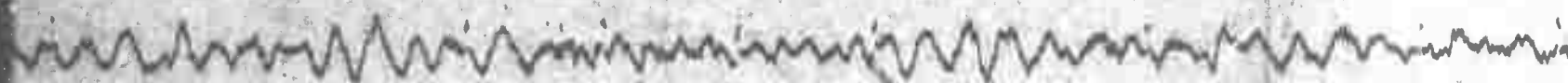
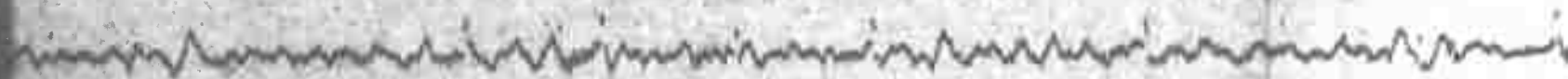
I





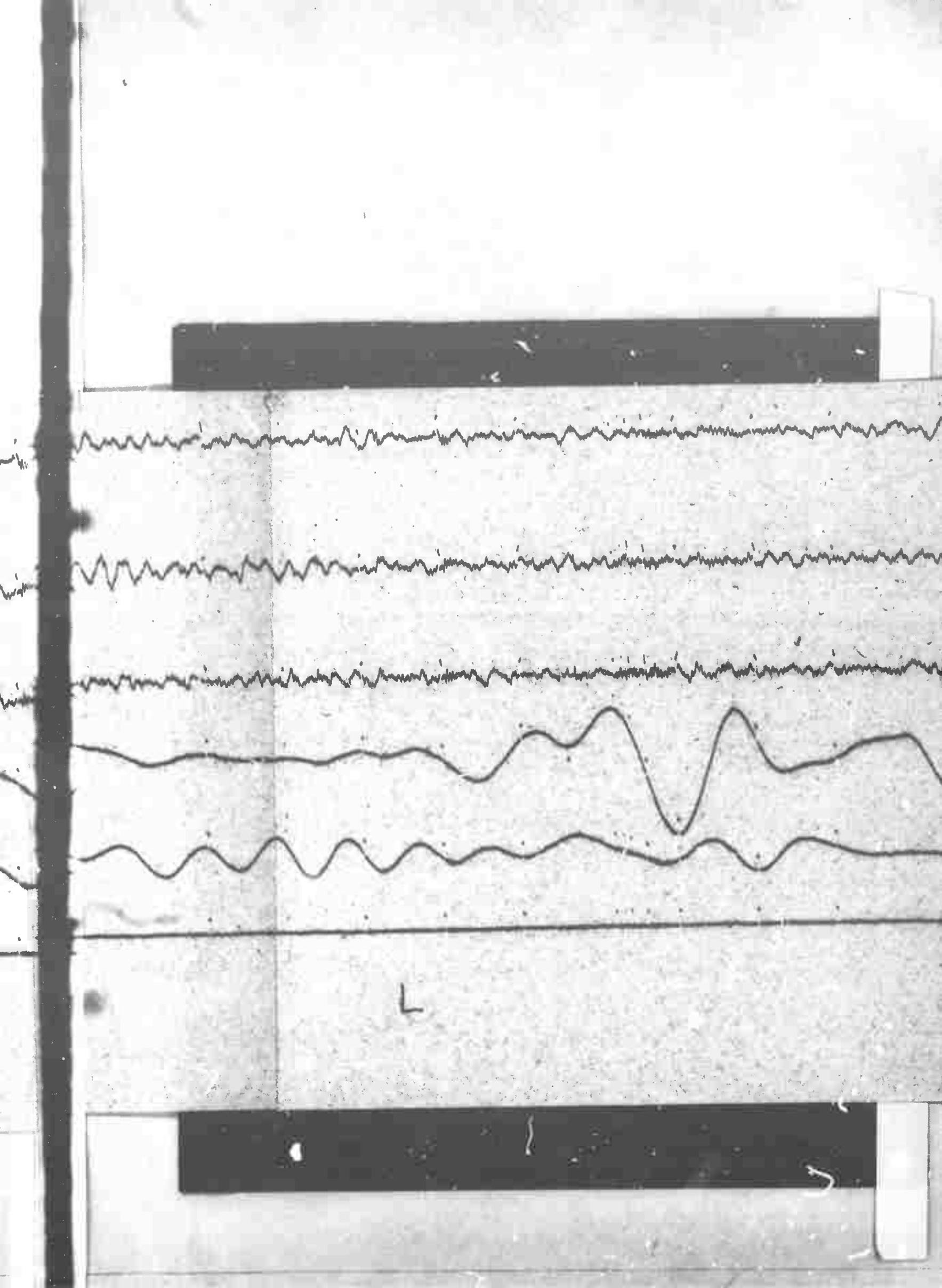
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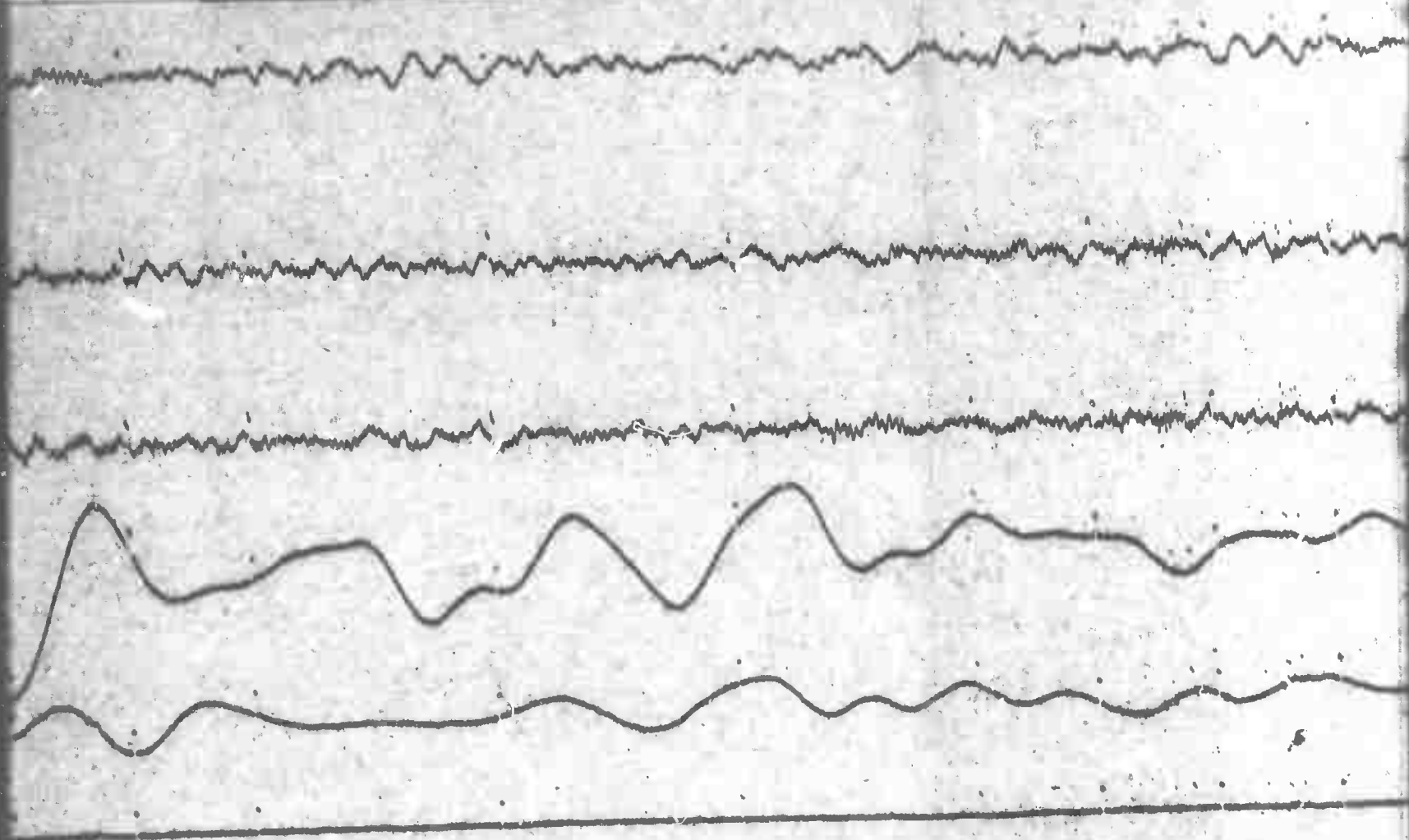




K

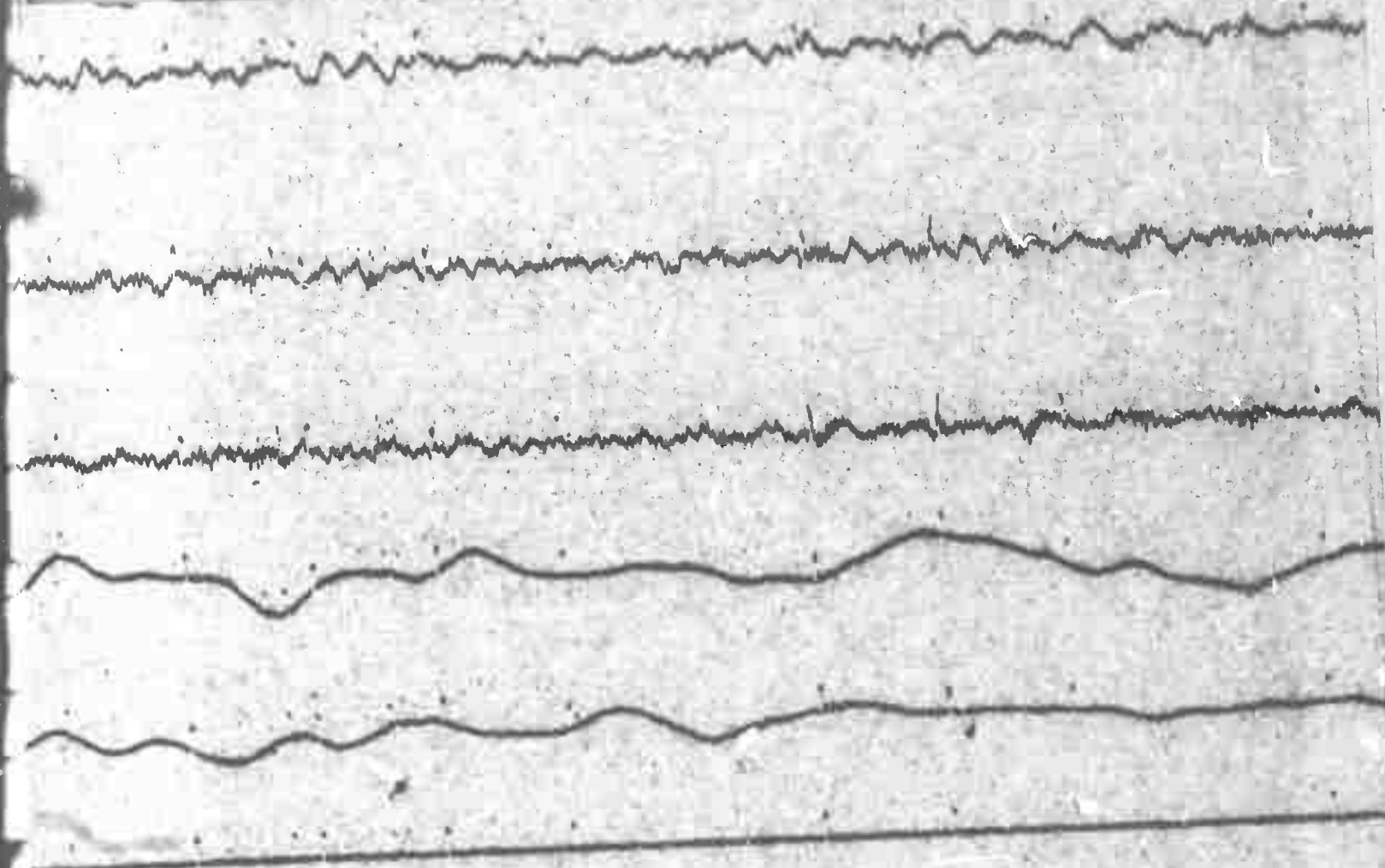






M





N

HALF BEAK

HN-ME

HOULTON, MAINE

30 JUNE 1966

$\Delta = 4073$ km

SPZ-LO
35.9 K
UP $\swarrow$ 22:21:29.9 Z

SPR-HI
35.8 K
93°

SPT-HI
37.5 K
183°

LPZ-HI
5.49 K
UP

LPR-HI
6.13 K
93°

LPT-HI
5.86 K
183°

A



Handwritten wavy line of text on the first line of the ruled section.

Handwritten wavy line of text on the second line of the ruled section.

Handwritten wavy line of text on the third line of the ruled section.

B



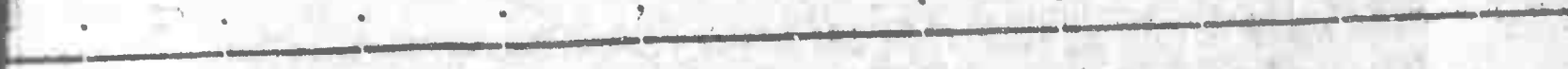
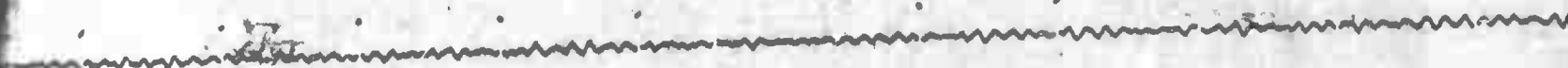


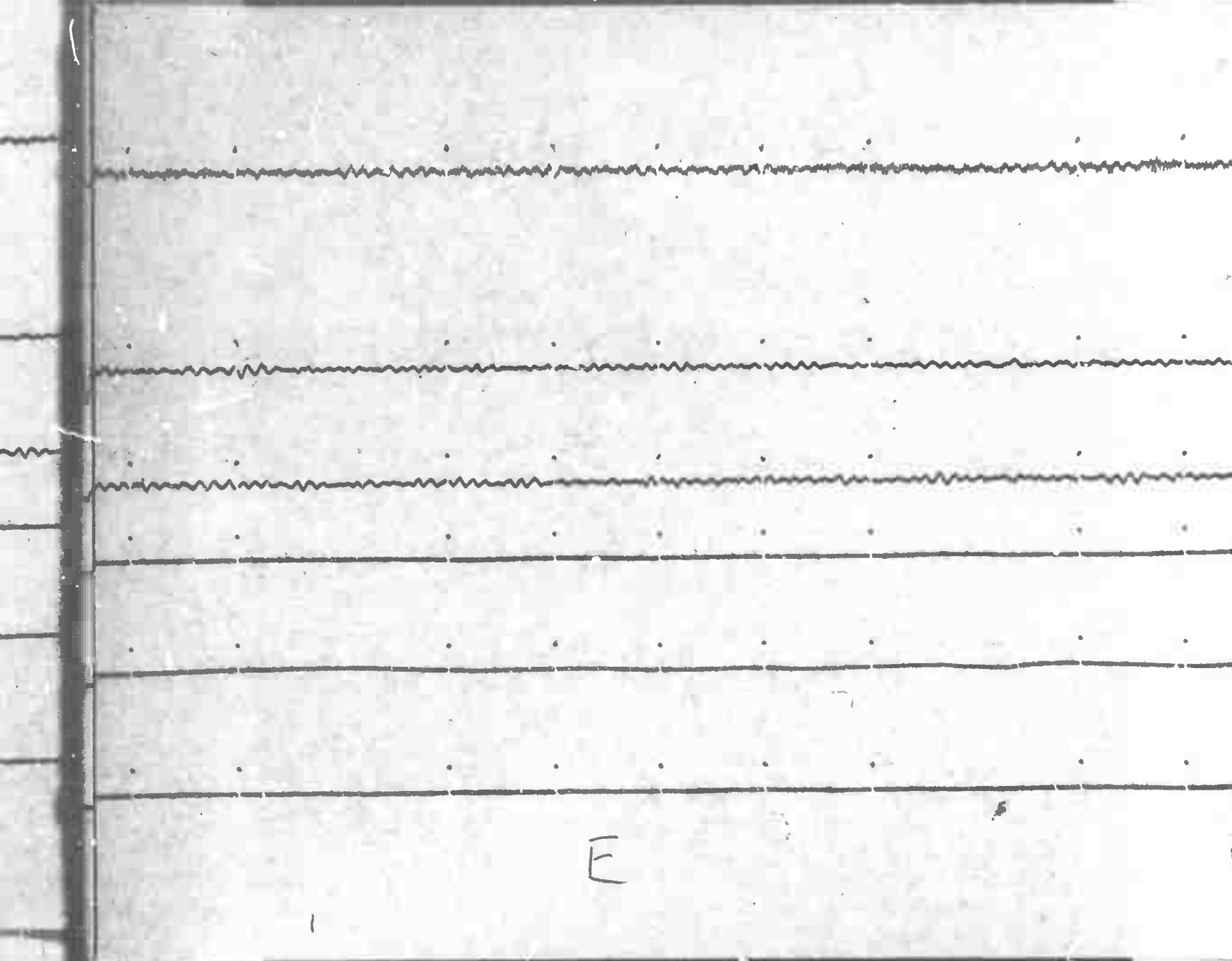
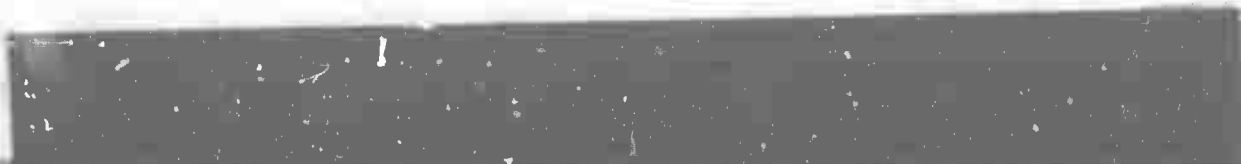
Handwritten wavy lines, possibly representing a signature or scribbles, spanning across the top half of the page.

Four horizontal lines, likely representing a signature or scribbles, spanning across the middle section of the page.

C

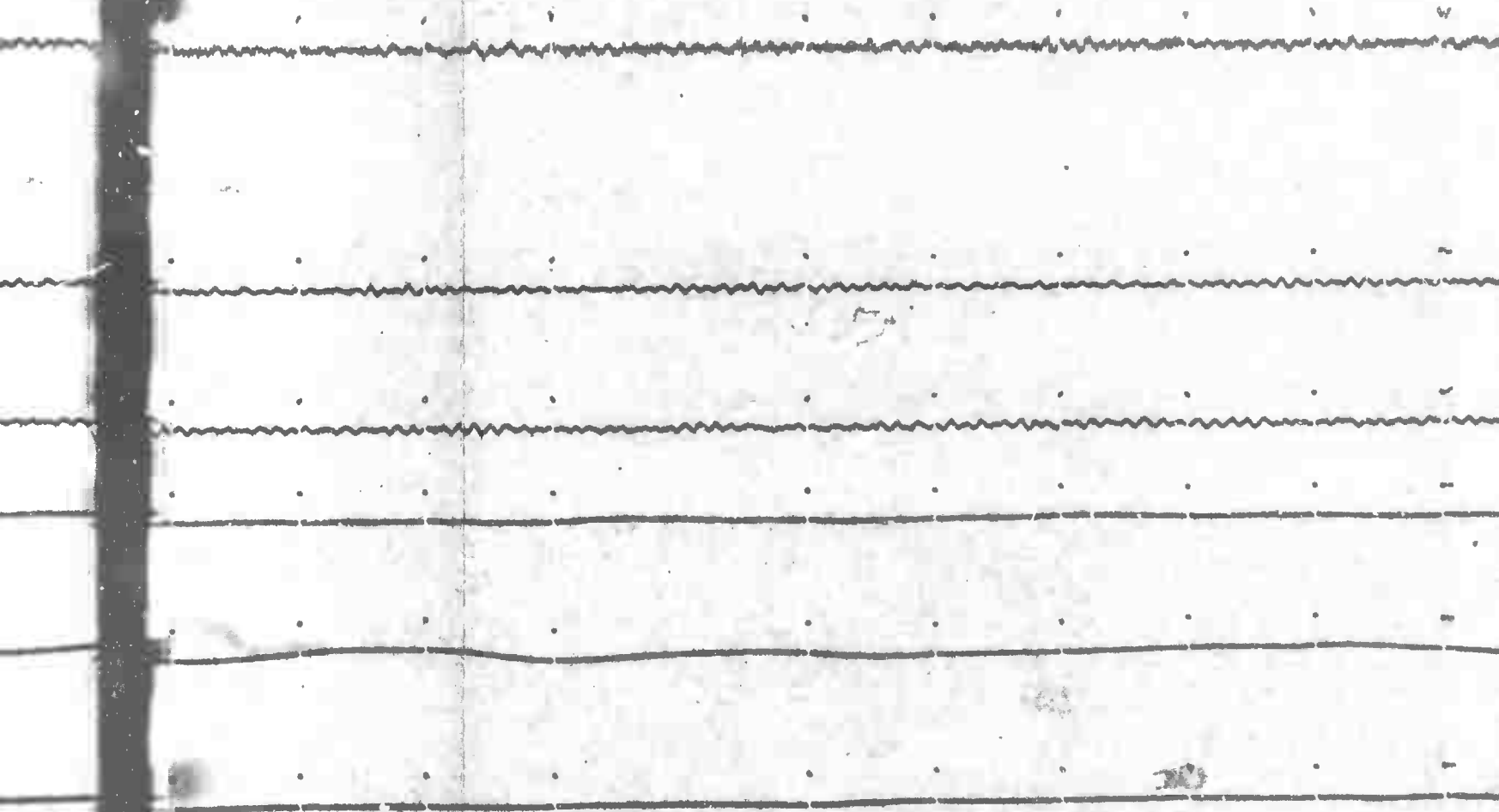






E





F



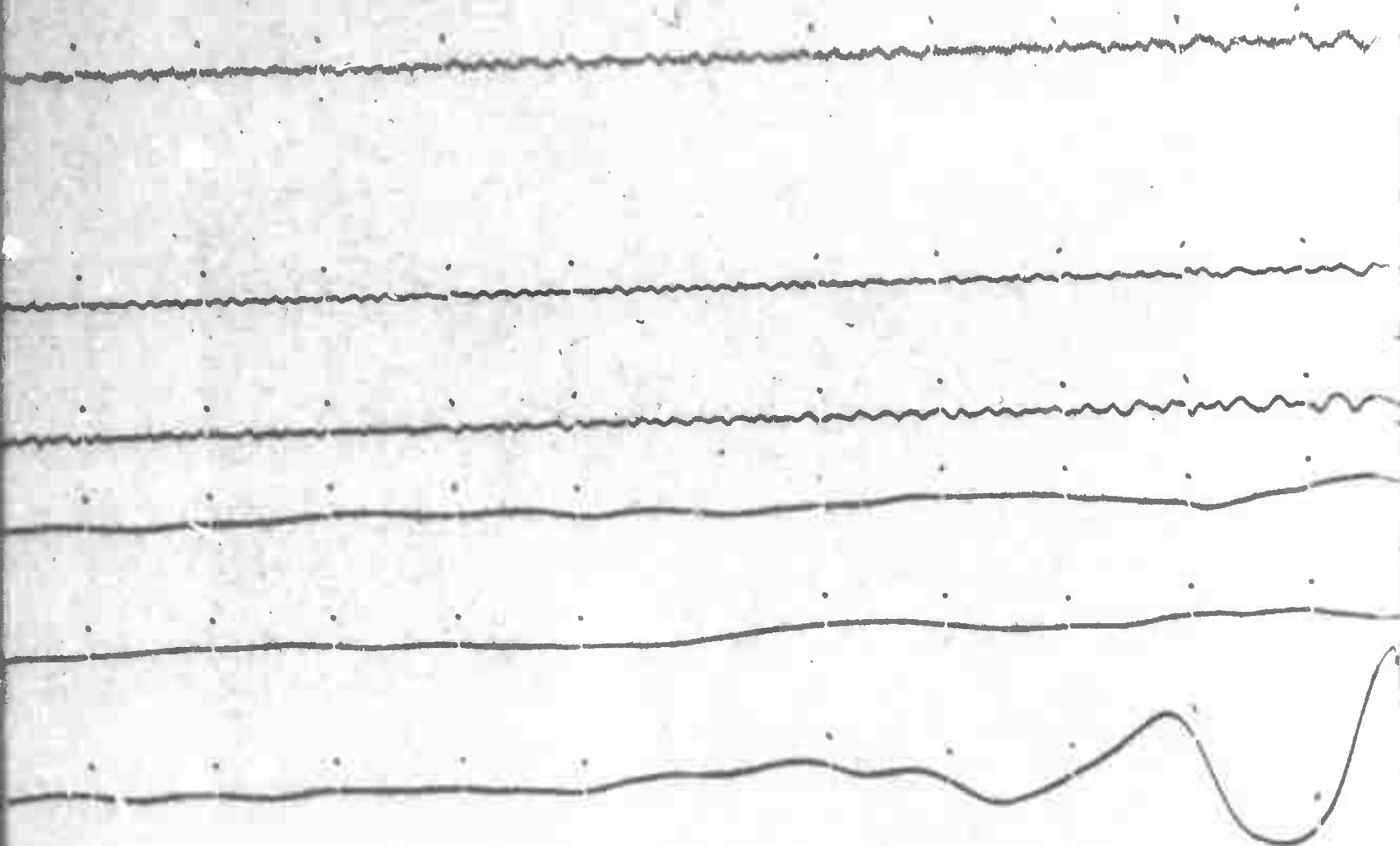


Handwritten text on lined paper, consisting of several lines of cursive script. The text is mostly illegible due to the quality of the scan and the handwriting. There are some faint, scattered characters and marks throughout the section.

G

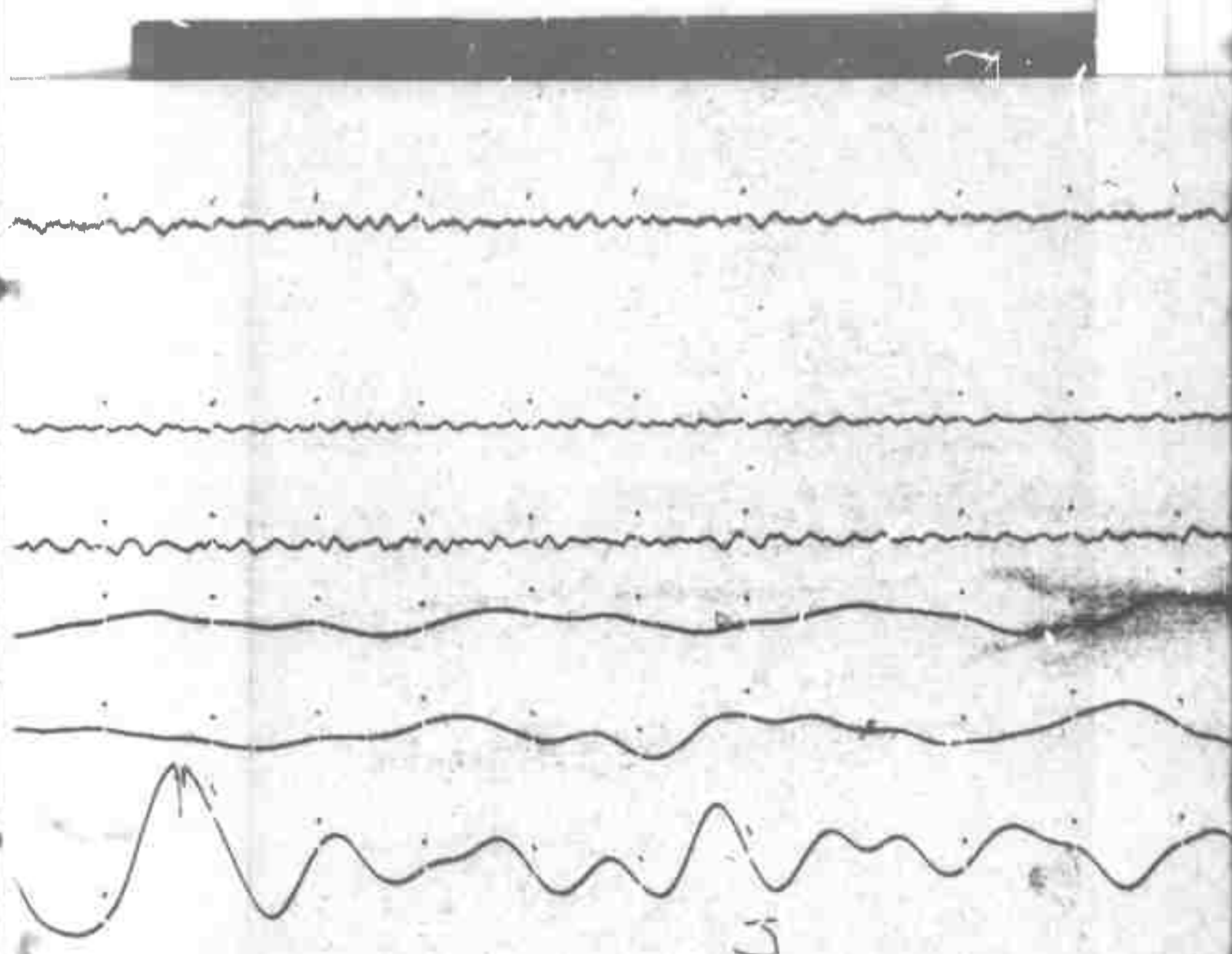






I

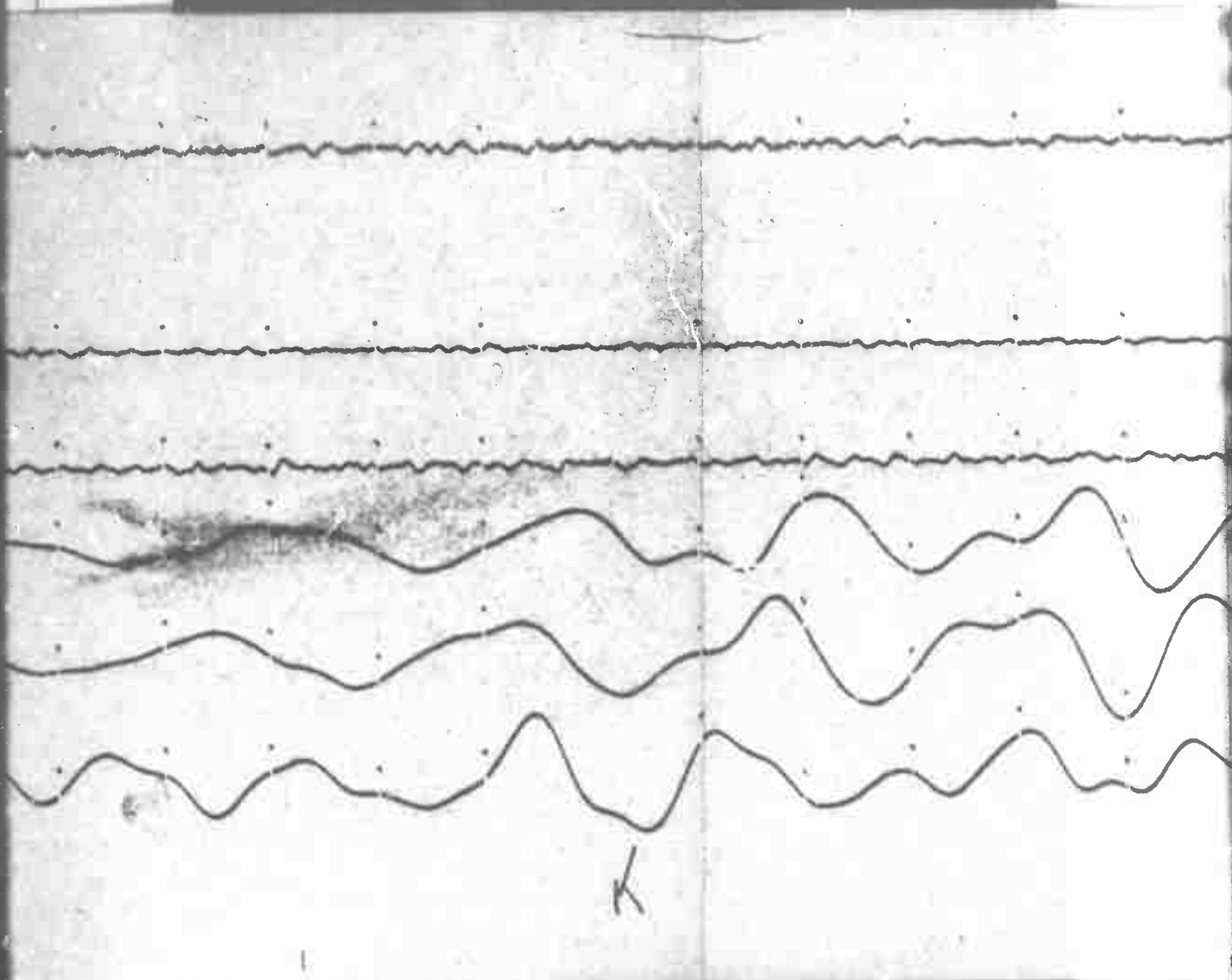




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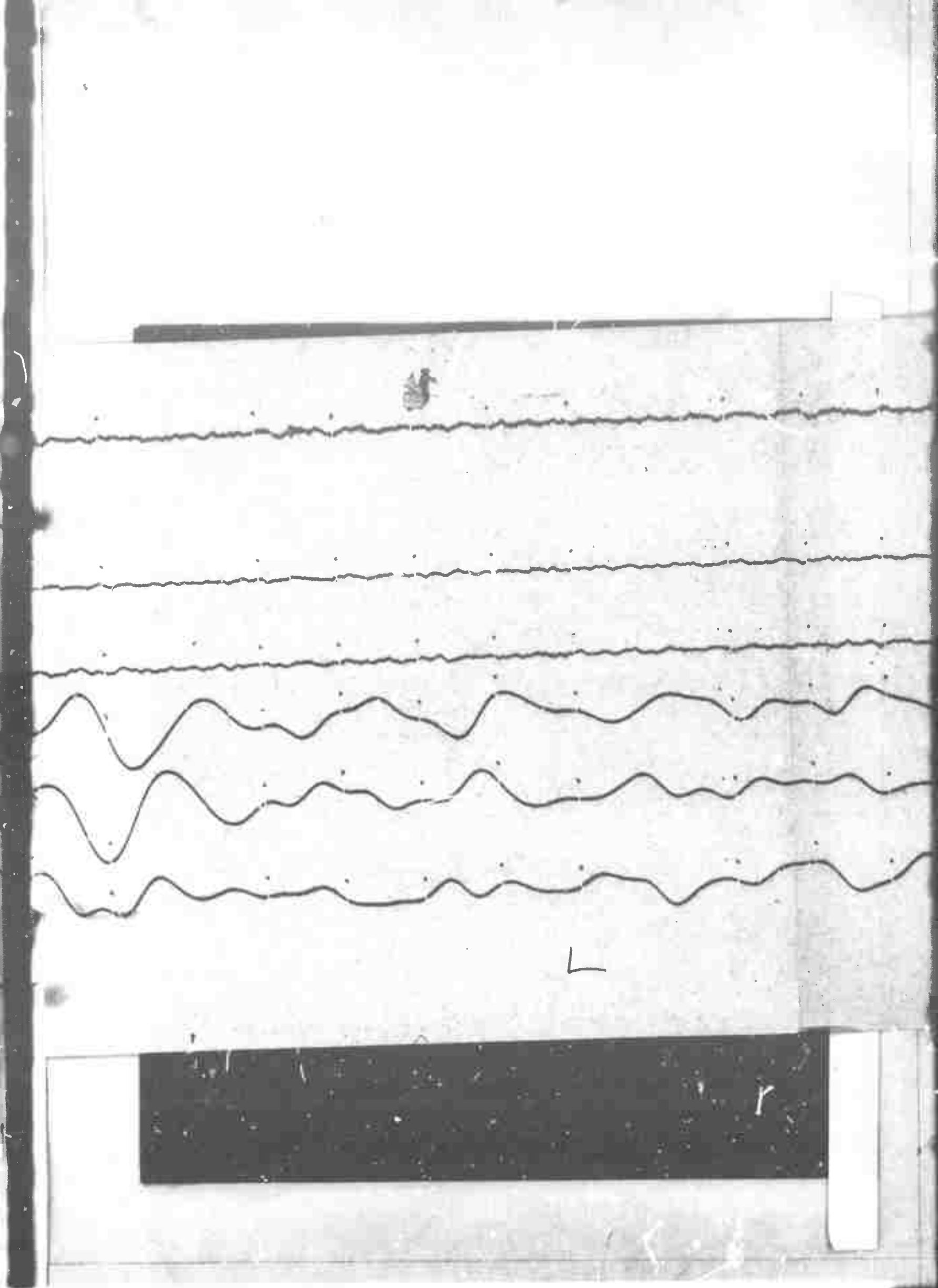
1

2



K







Handwritten notes on lined paper. The notes are organized into five horizontal rows, each starting with a small dot. The handwriting is cursive and somewhat faint. The first row appears to be a date or time entry. The second row contains a single word, possibly "and". The third row contains a single word, possibly "the". The fourth row contains a single word, possibly "of". The fifth row contains a single word, possibly "in".

Handwritten number "13" in the bottom right corner of the page.



HALF BEAK

PG--BC

PRINCE GEORGE, BRITISH COLUMBIA

30 JUNE 1966

$\Delta = 1916$ km

A

SPZ-LO · UP 22:18:20.0
18.8 K

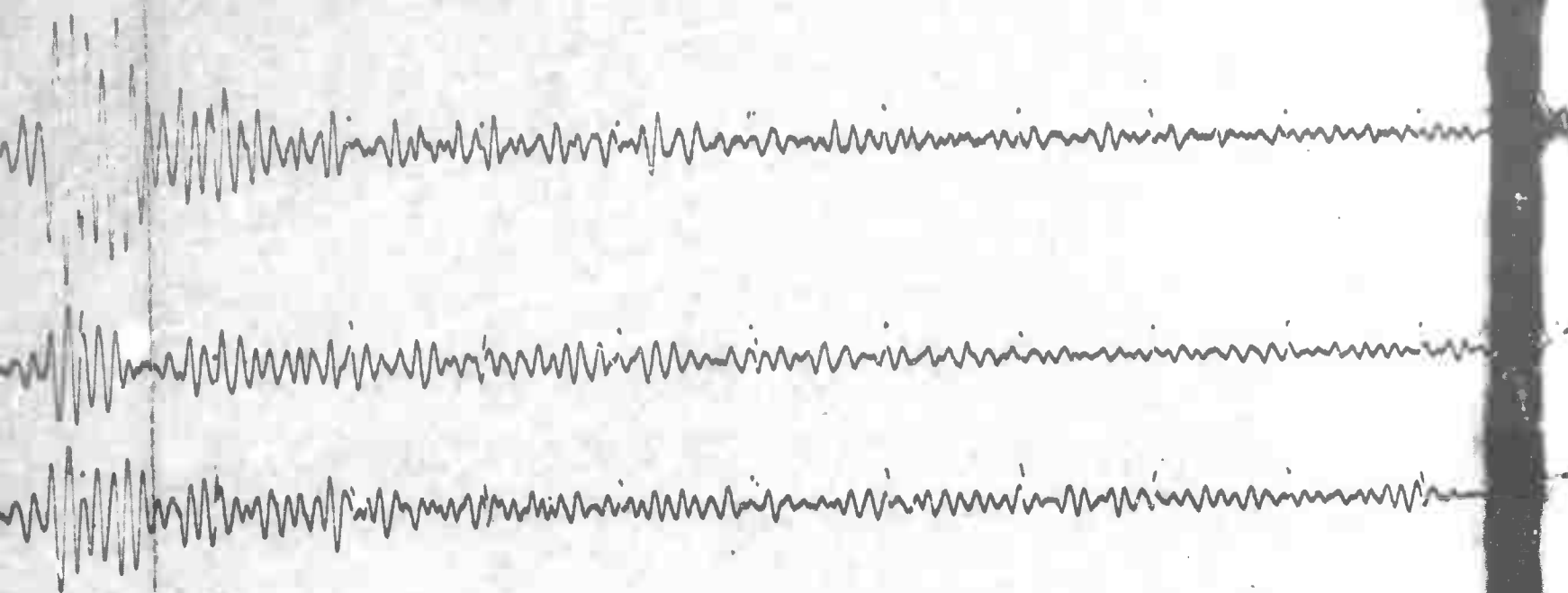
SPR-HI · 110°
19.1 K

SPT-HI · 200°
19.0 K

LPZ-HI · UP
1.10 K

LPR-HI · 110°
1.19 K

LPT-HI · 200°
971 K



B



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C

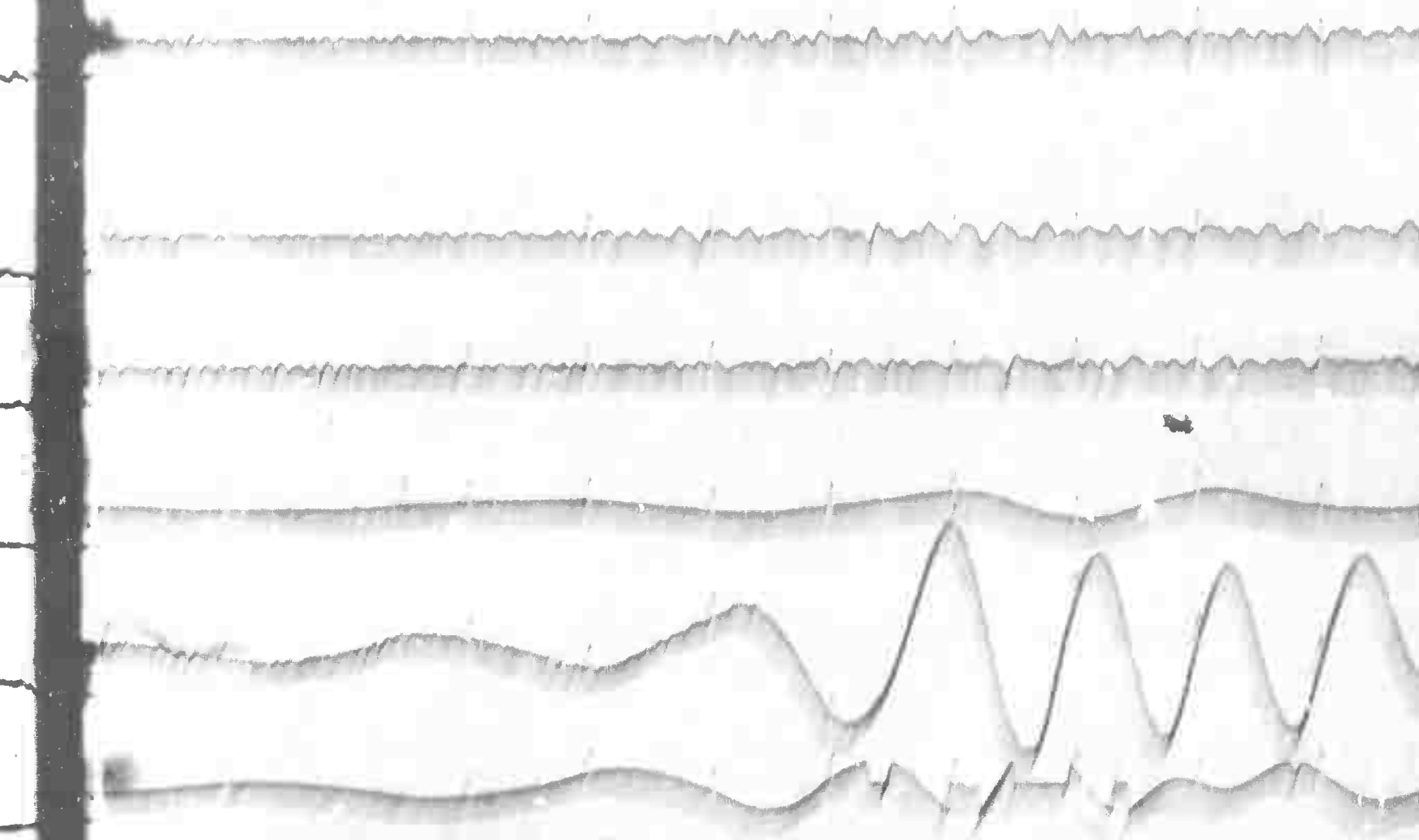


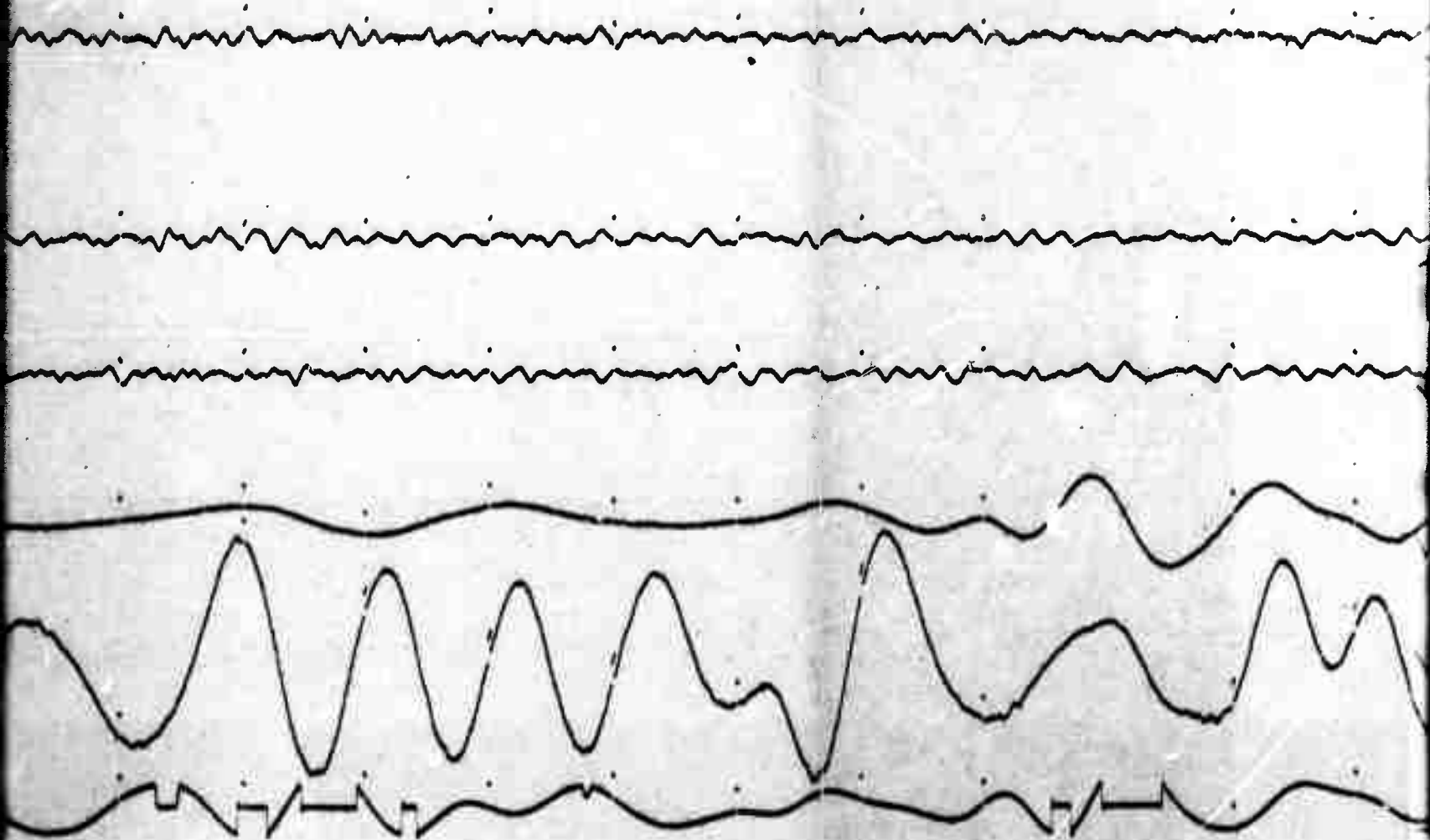


Handwritten text on lined paper, consisting of several lines of cursive script. The text is mostly illegible due to the quality of the scan and the cursive style. The lines are separated by horizontal ruling lines.

D

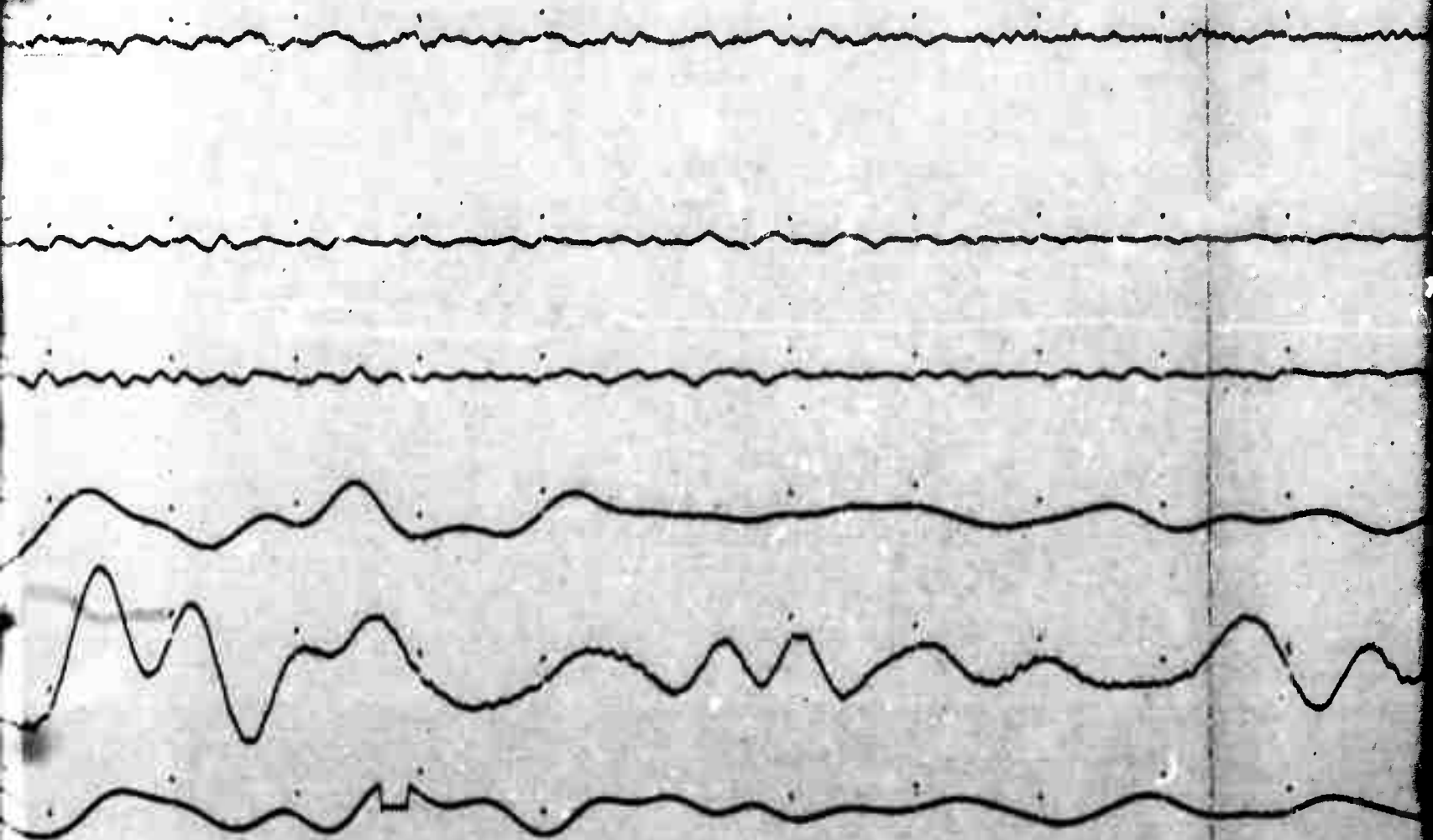






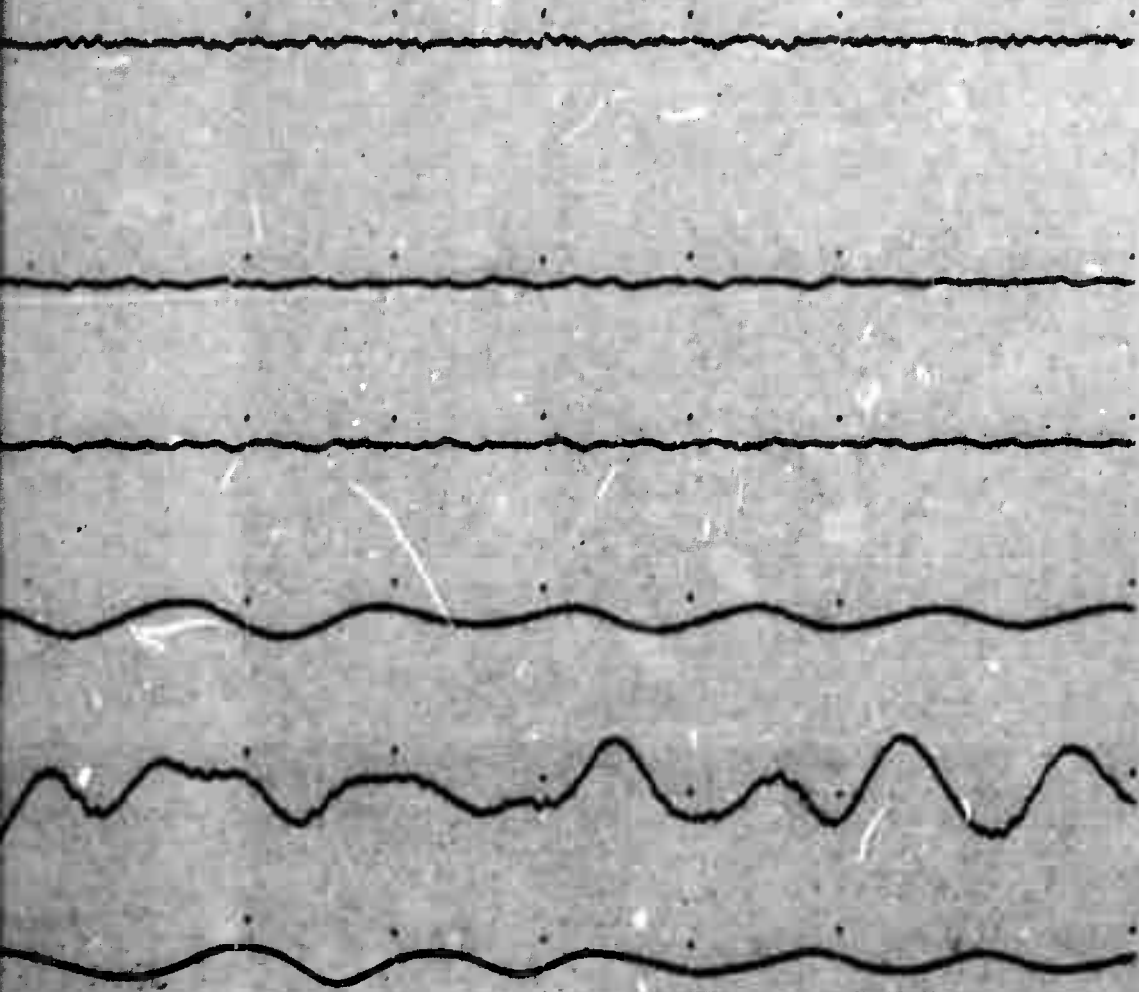
F





C





+



HALF BEAK

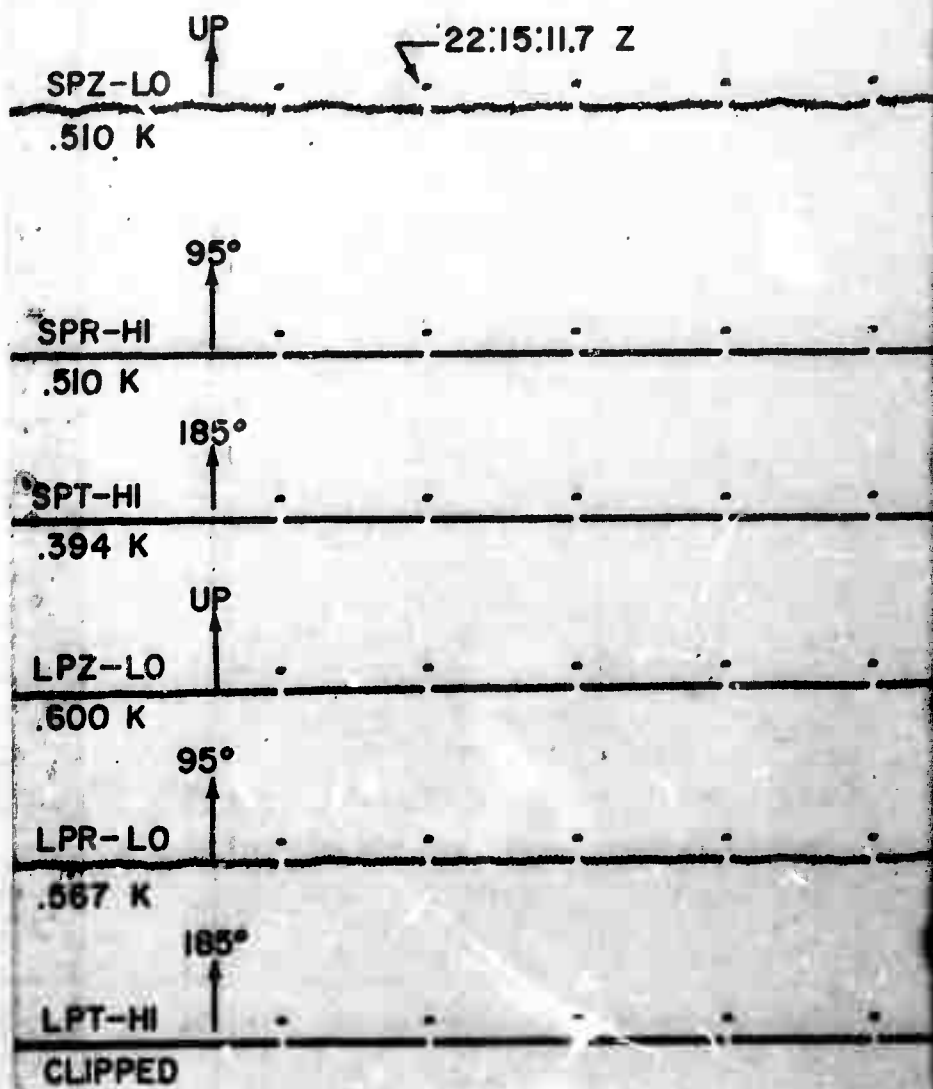
KN-UT

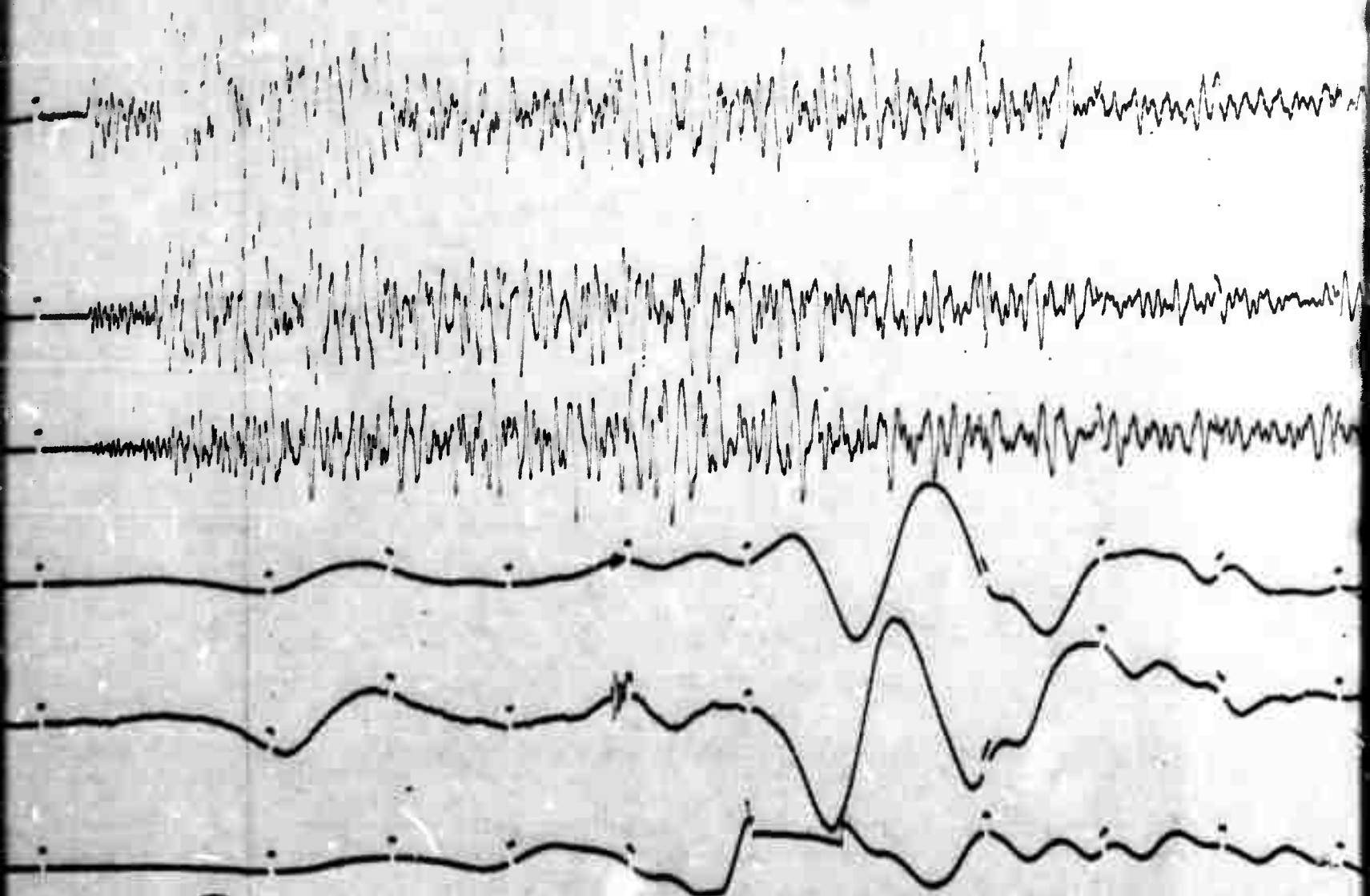
KANAB, UTAH

30 JUNE 1966

$\Delta = 310$ km

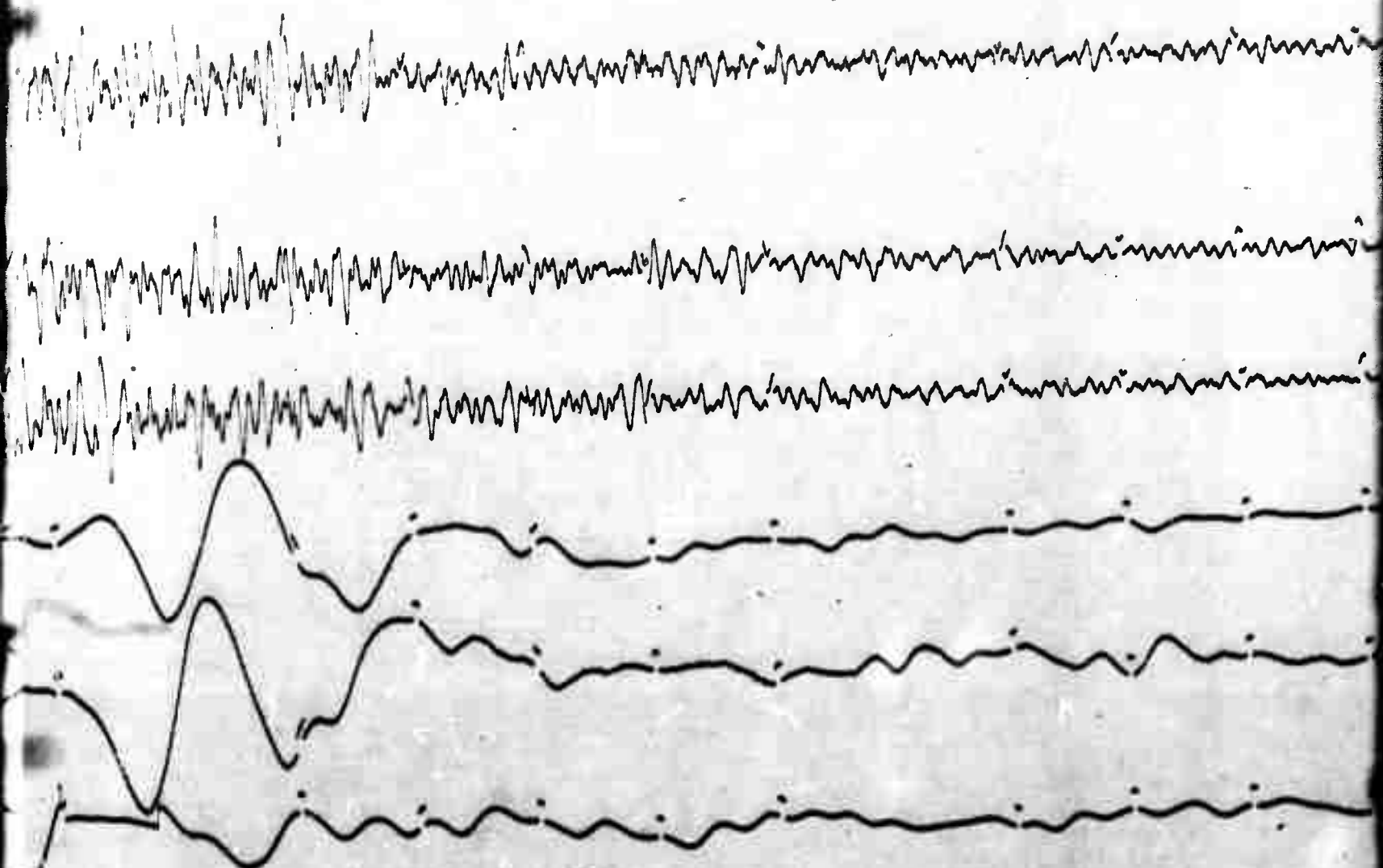
A





B







Handwritten wavy line with small vertical strokes.

Handwritten wavy line with small vertical strokes.

Handwritten wavy line with small vertical strokes.

Handwritten wavy line with small vertical strokes.

Handwritten wavy line with small vertical strokes.

Handwritten wavy line with small vertical strokes.

D



DOCUMENT CONTROL DATA - R&D		
(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)		
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		2b. GROUP --
3. REPORT TITLE Long Range Seismic Measurements - HALF BEAK		
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific		
5. AUTHOR(S) (Last name, first name, initial) Clark, Don M.		
6. REPORT DATE 21 November 1966	7a. TOTAL NO. OF PAGES 20	7b. NO. OF FIGS 1
8a. CONTRACT OR GRANT NO. AF 33(657)-15919	9a. ORIGINATOR'S REPORT NUMBER(S) SDL Report No. 171	
b. PROJECT NO. VELA T/6702		
c. ARPA Order No. 624	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) --	
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11. SUPPLEMENTARY NOTES --	12. SPONSORING MILITARY ACTIVITY ADVANCED RESEARCH PROJECTS AGENCY NUCLEAR TEST DETECTION OFF1 WASHINGTON, D. C.	
13. ABSTRACT An analysis of seismological data from an underground nuclear explosion as a continuing study to provide information to aid in distinguishing between earthquakes and explosions. A table of travel-times and amplitudes of P, Pg, Lg, and surface waves are included along with other unidentified phases.		

14

KEY WORDS

Seismic Magnitude
Seismic Travel-Time
Seismic Amplitude
VELA-UNIFORM
Nuclear Tests

LINK A

ROLE

WT

LINK B

ROLE

WT

LINK C

ROLE

WT

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2b. **GROUP:** Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.

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4. **DESCRIPTIVE NOTES:** If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.

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