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LONG RANGE SEISMIC MEASUREMENTS

NASH

19 JANUARY 1967

Prepared for

AIR FORCE TECHNICAL APPLICATIONS CENTER

Washington, D. C.

2 JUNE 1967

By

TELEDYNE INC.

Under

Project VELA UNIFORM

Sponsored By

ADVANCED RESEARCH PROJECTS AGENCY

Nuclear Test Detection Office

ARPA Order No. 624

**BEST
AVAILABLE COPY**

LONG RANGE SEISMIC MEASUREMENTS

NASH

19 January 1967

SEISMIC DATA LABORATORY REPORT NO.184

AFTAC Project No.:	VELA T/6702
Project Title:	Seismic Data Laboratory
ARPA Order No.:	624
ARPA Program Code No.:	5810
Name of Contractor:	TELEDYNE, INC.
Contract No.:	F 33657-67-C-1313
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Project Manager:	William C. Dean (703) 836-7644

P. O. Box 334, Alexandria, Virginia

AVAILABILITY

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TABLE OF CONTENTS

	Page No.
EVENT DESCRIPTION	1
INTRODUCTION	2
INSTRUMENTATION AND PROCEDURE	2
DATA AND RESULTS	4
<u>TABLES</u>	
1 Station Status Report - NASH	
2 Principal Phases - NASH	
<u>FIGURES</u>	
1 Recording Stations and Signals Received	
2 Unified Magnitudes	
3 Adjusted Unified Magnitudes	
4 Travel-Time Residuals, $T-\Delta/8.1$; T-JB	
5 Maximum Amplitudes of Pn and P	
6 Maximum Amplitudes of Pg	
7 Maximum Amplitudes of Lg	
8 Maximum Amplitudes of LQ	
9 Maximum Amplitudes of LR	
<u>LIST OF APPENDICES</u>	
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	
II(C) Instrument Response Curves - LASA	
II(D) Instrument Response Curves - Other Short Period	

NASH

EVENT DESCRIPTION

DATE: 19 January 1967

TIME OF ORIGIN: 16:45:00.1Z

YIELD:

MAGNITUDE: 5.25 ± 0.50

LOCATION:

SITE: Nevada Test Site, Area U2ce

GEOGRAPHIC COORDINATES:

Lat: $37^{\circ}08'37.0''$ N

Long: $116^{\circ}08'07.0''$ W

ENVIRONMENT:

GEOLOGIC MEDIUM: TUFF

SURFACE ELEVATION: 4764 ft.

SHOT ELEVATION: 3564 ft.

SHOT DEPTH: 1200 ft.

COMPUTED EPICENTER: ALL STATIONS

GEOGRAPHIC COORDINATES:

Lat: $37^{\circ}03'18.0''$ N

Long: $116^{\circ}14'42.0''$ W

TIME OF ORIGIN: 16:45:00.6Z

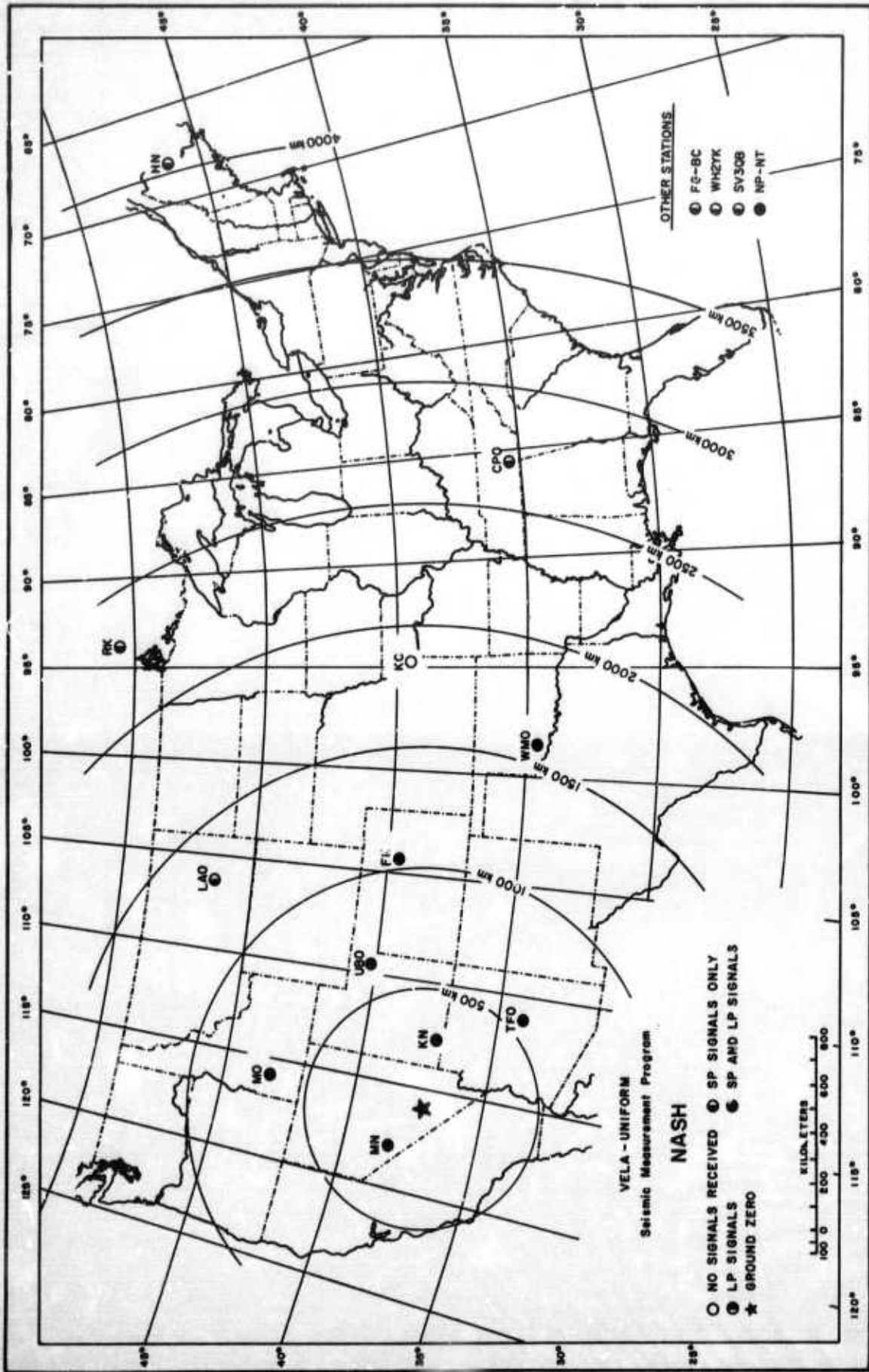
DEPTH CONSTRAINED TO: 0 km

EPICENTER SHIFT: 13.9 km, S 45° W

Code	Station	Final							Tape	Timing
		SPZ	SPR	SPT	LPZ	LPR	LPT			
MH-NV	Mina, Nevada	+	+	+	+	+	+	+	*	P
KH-UT	Kanab, Utah	+	+	+	+	+	+	+	*	P
TFSO	Tonto Forest Observatory, Arizona	+	+	+	+	-	-	-	*	P
MO-ID	Mountain Home, Idaho	+	-	-	+	+	+	+	*	P
UBSO	Uinta Basin Observatory, Utah	+	+	+	+	-	-	-	*	P
FK-CO	Franktown, Colorado	+	+	+	+	+	+	+	*	P
LAO	Subarray AO-10, Montana	+	N	N	-	N	N	N		P
WMSO	Wichita Mountain Observatory, Oklahoma	+	+	+	+	+	+	+	*	P
KC-MO	Kansas City, Missouri	M	M	M	M	M	M	M		
PG-BC	Prince George, British Columbia, Canada	+	+	+	-	-	-	-	*	P
RK-ON	Red Lake, Ontario, Canada	+	+	+	-	-	-	-	*	P
CPSO	Cumberland Plateau Observatory, Tennessee	+	+	+	-	-	-	-	*	P
WH2YK	Whitehorse, Yukon Territory, Canada	+	+	+	-	-	-	-	*	P
HN-ME	Houlton, Maine	+	+	+	-	-	-	-	*	P
SV3QB	Schefferville, Quebec Canada	+	+	+	-	-	-	-	*	P
NP-NT	Mould Bay, Northwest Territories, Canada	+	+	+	+	+	+	+	*	P

M Moving
N No Instrument
P Primary Timing
* Magnetic Tape Available
+ Signal
- No Usable Signal

Station Status Report - NASH
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

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 NASH 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. 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 Report 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; the 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), II(C), and II(D).

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 distance 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. An additional magnitude for less than 16° was computed using a method described by Evernden**. (Figure 3).

A standard hypocenter location program for a digital 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. This method is based on P-wave arrivals with depth constrained to zero.

DATA AND RESULTS (LRSM AND VELA OBSERVATORIES)

The parameters of the NASH event and a summary of the seismic evaluation is shown on the Event Description page. The operational status of the 16 LRSM stations and observatories is given in Table I and illustrated in Figure 1.

- 4 -

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

**Evernden, J. F., Magnitude Determination at Regional and Near Regional Distances in the United States, AFTAC/VEAL Seismological Center Technical Report VU-65-4A, (1965), pp. 6, 13.

Table 2 summarizes the measurements made of the principal phases from the NASH 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. Fifteen stations recorded short-period signals. Long-period signals from this event were recorded by eight stations.

The unified magnitudes determined from the LRSM and VELA observatories is shown in Figure 2. The average magnitude is 5.25 ± 0.50 . The adjusted unified magnitude is 4.94 ± 0.55 and is shown in Figure 3.

The travel-time residuals from the Pn and P phases are shown in Figure 4. Figures 5 through 9 illustrate plots of the amplitude of P, Pg, Lg, LQ and LR.

Attached to the report are illustrated seismograms showing the signals recorded at four stations. The most distant station analyzed that recorded NASH was NP-NT at a distance 4363 kilometers.

Principal Phases
 NASH
 19 January 1967
 16:45:00.18

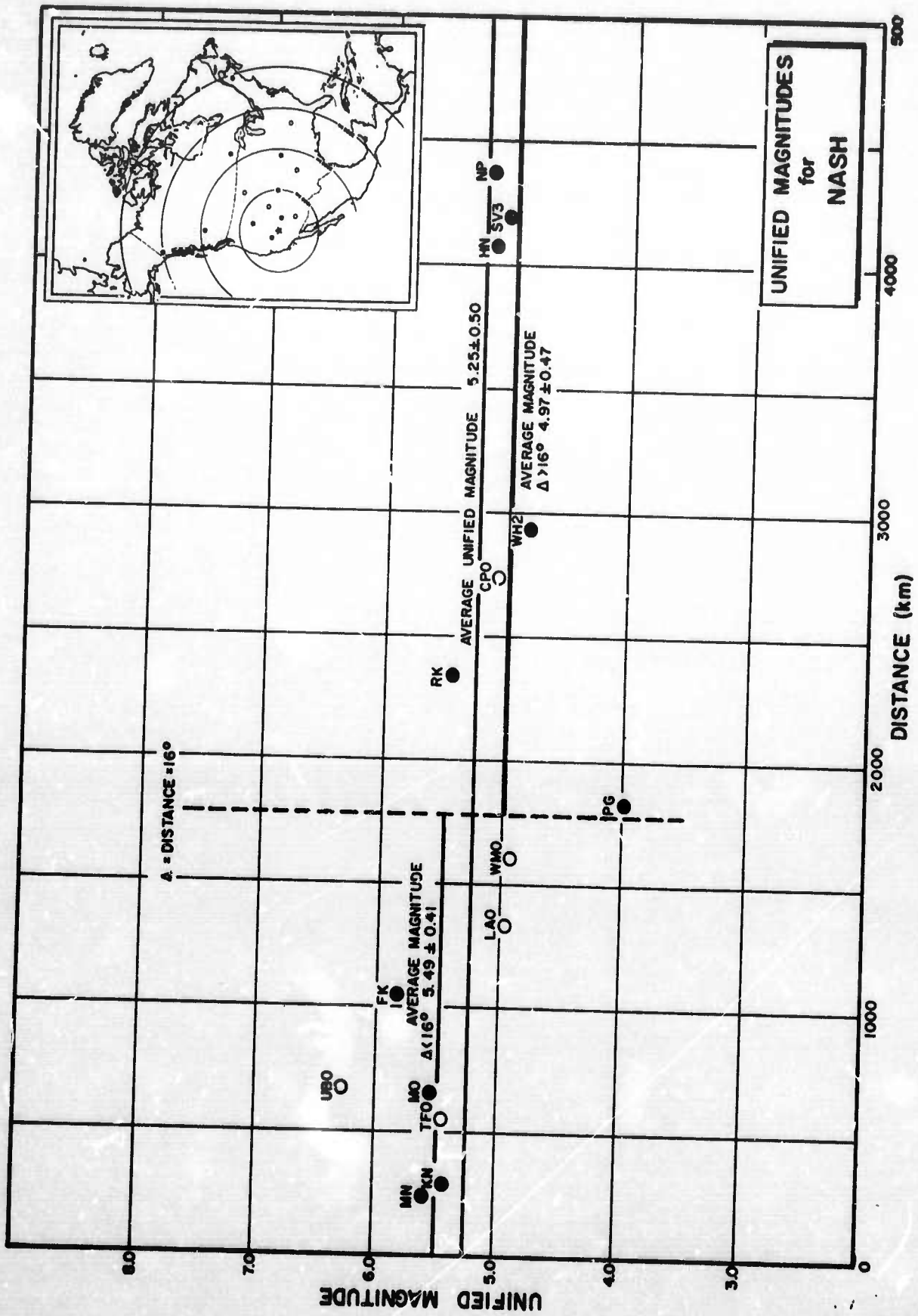
Code	Station	Distance (km)	Inat.	Magnification (x) Film x 10	Phase	Observed Travel Time		Period T (sec)	Maximum Amplitude A/T	Magnitude		Area (mm ²) LPS		
						(min)	(sec)			mb	me			
MM-NV	Mina, Nevada	228	SPB	4.86	Pn		35.5	0.4	2293	5.59	5.19			
			SPB	.896*	Pg		38.1	0.5	(8484)					
			SPT	2.22	Lg			0.7	10043					
			LPT	45.1	LQ			(10.0)	(169)					
RN-UT	Sanab, Utah	294	LPZ	4.3	LR			(13.0)	(777)	5.42	5.05	141.28		
			SPZ	10.3	Pn		44.1	0.4	796					
			SPB	2.59*	Pg		48.9	0.6	6329					
			SPT	2.05*	Lg			0.8	6633					
TFBO	Tonto Forest Observatory, Arizona	543	LPT	44.1	LQ			11.0	434	5.45	5.02	48.20		
			LPZ	5.55	LR			12.0	397					
			SPZ-60	33.8	Pn	1	16.1	0.4	124					
			SPZ-60	16.6*	Pg	1	30.9	0.8	492					
NO-ID	Mountain Home, Idaho	659	SPN	16.6*	Lg			1.2	560	5.45	5.02	147.72		
			SPB	23.0*	Lg			1.2	465					
			LPH	38.5	LQ			10.0	(130)					
			LPE	37.0	LQ			10.0	(142)					
MO-IO	Mountain Home, Idaho	659	LPZ	3.0	LB			15.0	799	5.45	5.02	147.72		
			SPB	15.8	Pn	1	31.0	0.4	(93.1)				(5.55)	(5.20)
			SPB		Pg	1	(48.9)	---	---				---	---
			SPT		Lg			---	---				---	---
USBO	Uints Basin Observatory Utah	671	LPT		LQ			---	---	6.17	5.95	55.26		
			LPZ	7.6	LR			16.0	58.6					
			SPZ-10	5.3	Pn	1	(33.9)	0.8	363					
			SPZ-10	5.3	a	1	44.5	0.65	159					
PK-CO	Franktown, Colorado	1055	SPZ-10	5.3	Pg	1	52.3	0.9	1113	5.04	4.36	29.81		
			SPN	5.3	Lg			1.4	708					
			SPZ	5.3	Lg			1.4	1281					
			LPE		LQ			x x x	x x x					
LAO	Subarray AO-10 Montana	1340	LPZ	26	LB			(15.0)	(31.2)	5.04	4.36	29.81		
			SPZ	133*	Pn	2	(20.9)	0.8	38.7					
			SPZ	133*	a	2	36.1	0.9	85.4					
			SPB	133*	Pg	2	55.5	0.8	149					
WSCO-2	Wichite Mountain Observatory, Oklahoma	1-04	SPT	142*	Lg			1.8	710	5.04	4.36	29.81		
			LPT	37.4	LQ			13.0	203					
			LPS	6.48	LB			10.0	385					
			SPB	325	Pn	2	(57.0)	(0.8)	(7.1)				(4.95)	(3.84)
PC-BC	Prince George, British Columbia, Canada	1938	SPZ	325	a	2	55.5	0.8	37.2	5.04	4.36	29.81		
			SPZ	37.5	(PP)	3	01.0	0.8	58.3					
			SPZ	37.5	(PPP)	3	08.2	0.9	80.3					
			SPB	37.5	a	3	19.9	0.9	67.9					
PC-BC	Prince George, British Columbia, Canada	1938	LPS	52.5	LR			x x x	x x x	5.04	4.36	29.81		
			SPZ	52.5	P	3	(27.8)	1.2	29.4					
			SPB	52.5	o	3	37.7	1.2	24.1					
			SPZ	52.5	Pg	4	29.9	1.0	52.4					
PC-BC	Prince George, British Columbia, Canada	1938	SPN	52.5	Lg			1.9	227	5.04	4.36	29.81		
			SPZ	47.5	Lg			1.8	146					
			LPH	11.0	LQ			14.0	52					
			LPZ	12.3	LB			18.0	35.9					
PC-BC	Prince George, British Columbia, Canada	1938	SPZ	158	P	4	06.1	1.0	(11.9)	5.04	4.36	29.81		
			SPB	158	a	4	08.1	1.0	71.2					
			SPZ	158	a	4	11.2	0.9	63.9					
			SPZ	158	PP	4	22.1	1.0	48.3					
PC-BC	Prince George, British Columbia, Canada	1938	SPB	149	Lg			(2.2)	(92.6)	5.04	4.36	29.81		
			SPT	169	Lg			(2.1)	(103)					
			LPT		LQ			x x x	x x x					
			LPZ		LR			x x x	x x x					

Principal Phases - NASH
 Table 2 Page 1.

Principal Phases
 19 January 1967
 16:45:00.13

Code	Station	Distance (km)	Inst.	Magni- fication F ₁₀ x 10	Phase	Observed Travel Time		Period T (sec)	Maximum Amplitude A/T	Magnitude		Area (m ²) LPZ	
						(min)	(sec)			mb	ms		
NK-OW	Red Lake, Ontario Canada	2343	SPZ	57.2*	P	4	45.7	0.8	218	5.45			
			SPZ	57.2*	e	4	49.0	0.9	103				
			SPZ	57.2*	e	4	53.6	0.9	80.9				
			SPZ	57.2*	e	5	16.4	0.9	62.5				
			SPT	250	Lg			1.6	55.9				
			LPT		LQ				x x x				
			LPZ		LR				x x x				
			SPZ-8	40	P	5	22.6	0.8	(48.1)			(5.09)	
			SPZ-8	40	e	5	42.0	0.8	39.0				
			SPZ-8	390	(PP)	5	51.2	0.9	17.0				
HE2YK	Whitboras Yukon Territory, Canada	2938	SPZ-8	390	PCP	9	09.1	(0.7)	(6.8)				
			SPW	430	Lg			1.4	33.2				
			SPZ	420	Lg			1.4	19.6				
			LPW		LQ				x x x				
			LPZ		LR				x x x				
			SPZ	195.5	a	5	39.4	0.9	25.1			4.84	
			SPZ	196.5	a	6	13.7	0.9	6.4				
			LPT		LQ				x x x				
			LPZ		LR				x x x				
			BP-HE	Boulton, Maine	4070	SPZ	85.6	P	7	08.3	0.95	43.2	5.17
SPZ	85.6	PCP				9	31.1	0.8	9.7				
SPT	89.4	Lg						1.6	32.6				
LPT		LQ							x x x				
LPZ		LR							x x x				
SPZ	127	P				7	(16.2)	1.2	37.9			5.08	
LPZ		LR							x x x				
SPZ	240	P				7	30.6	0.9	61.4			5.19	
SPZ	240	a				7	36.3	0.8	29.0				
SPZ	240	a				9	12.6	1.5	13.9				
BP-FT	Mould Bay, Northwest Territories, Canada	4363	SPZ	240	PCP		39.7	0.8	10.0				
			SPT	303	Lg			2.5	91.7				
			LPZ	10.8	LR			16.0	37.1				
												58.33	

m/sec
 A/T
 () Doubtful values or phases
 * Measurements made from playouts
 --- Maximum Amplitude clipped on film & tape
 x x x Signal, if present, observed by earthquake



Figure

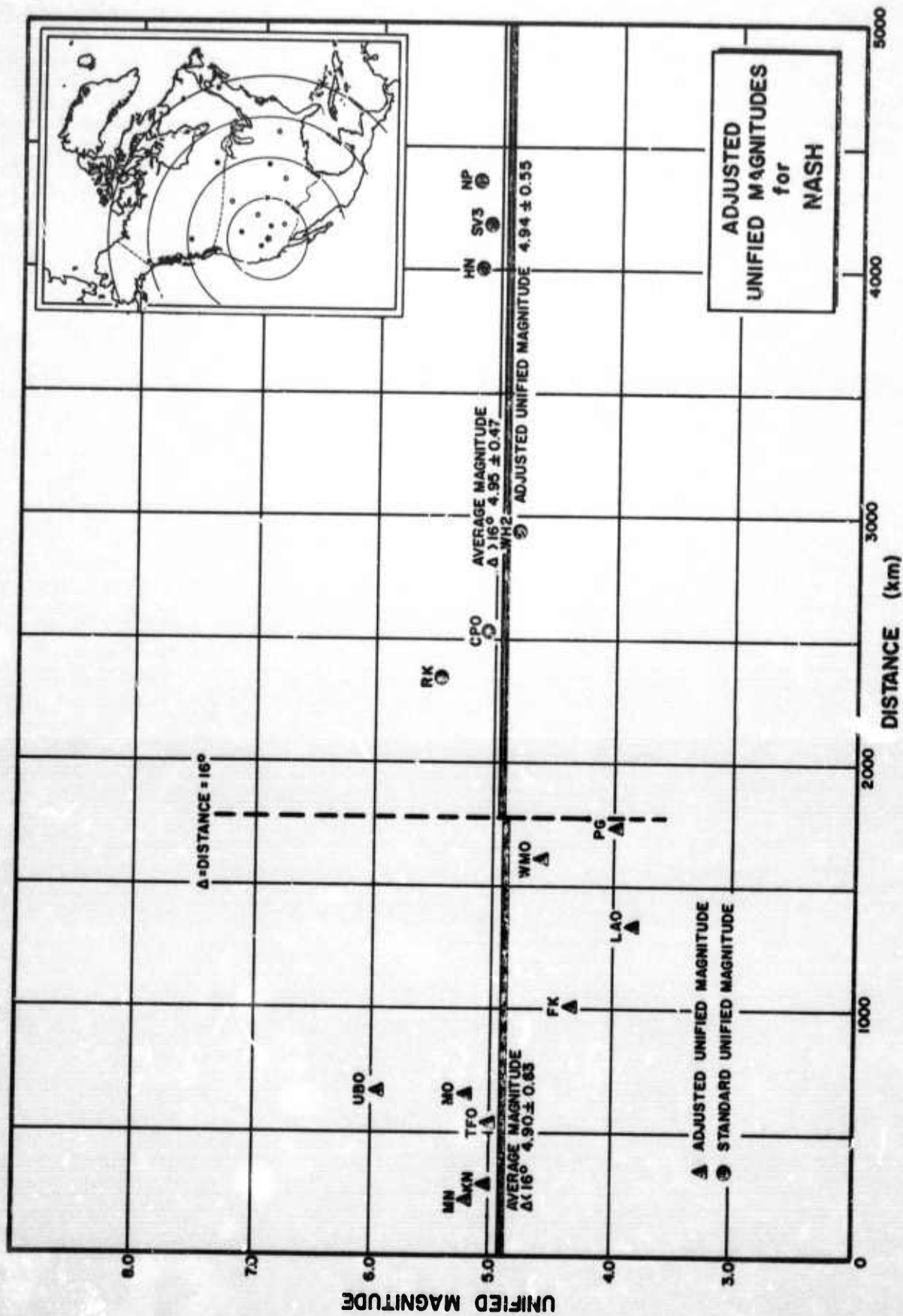


Figure 3

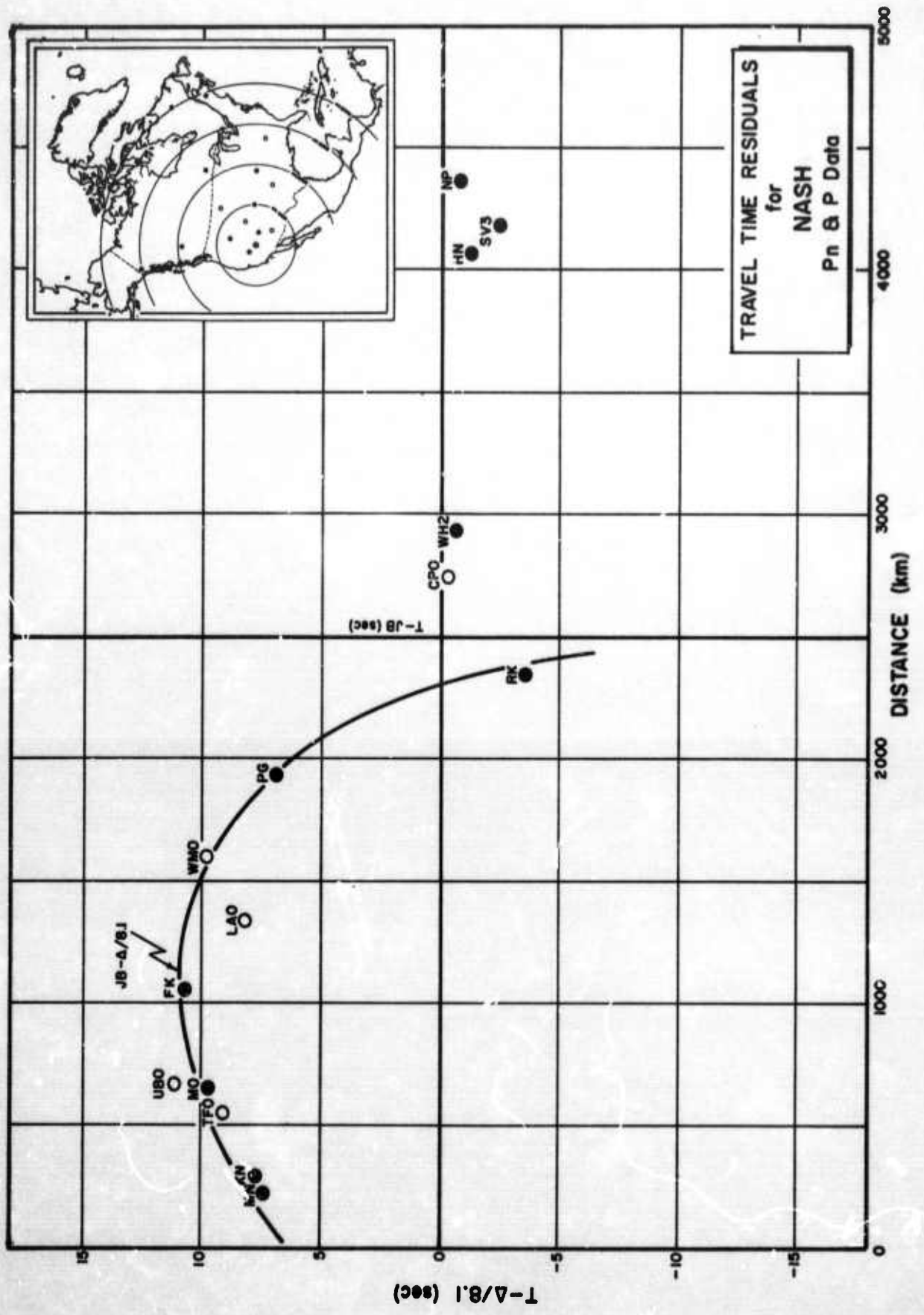


Figure 4

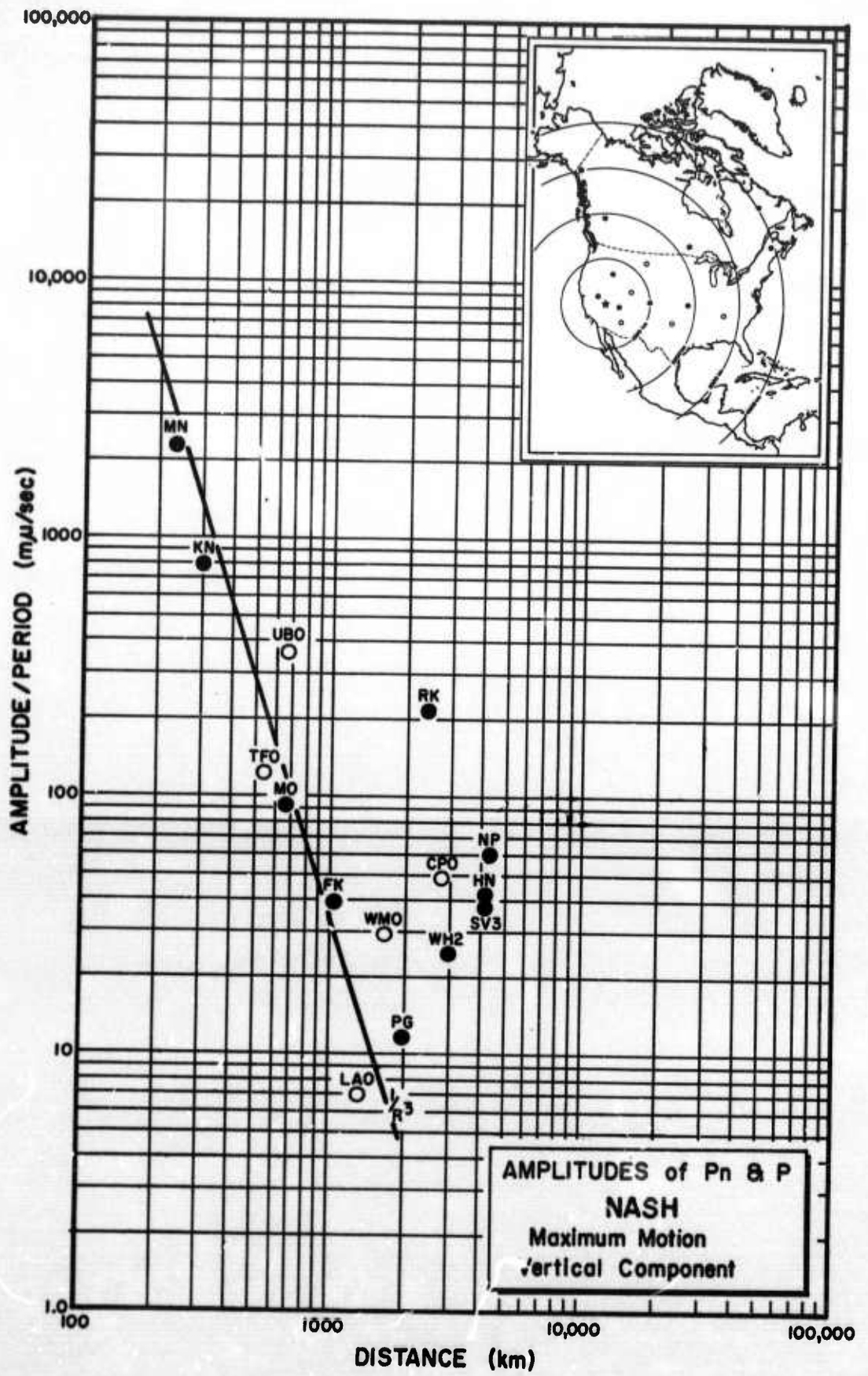


Figure 5

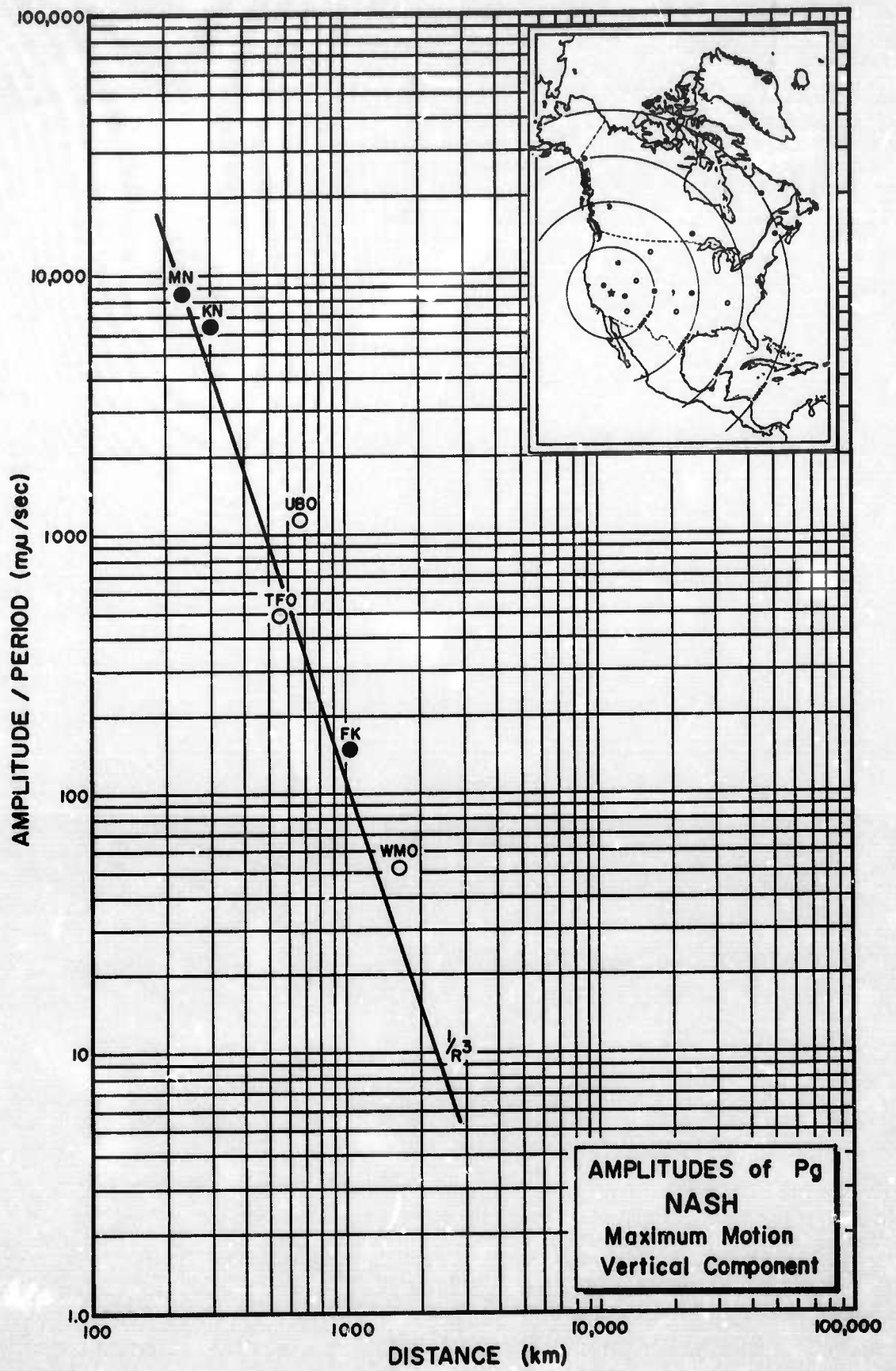


Figure 6

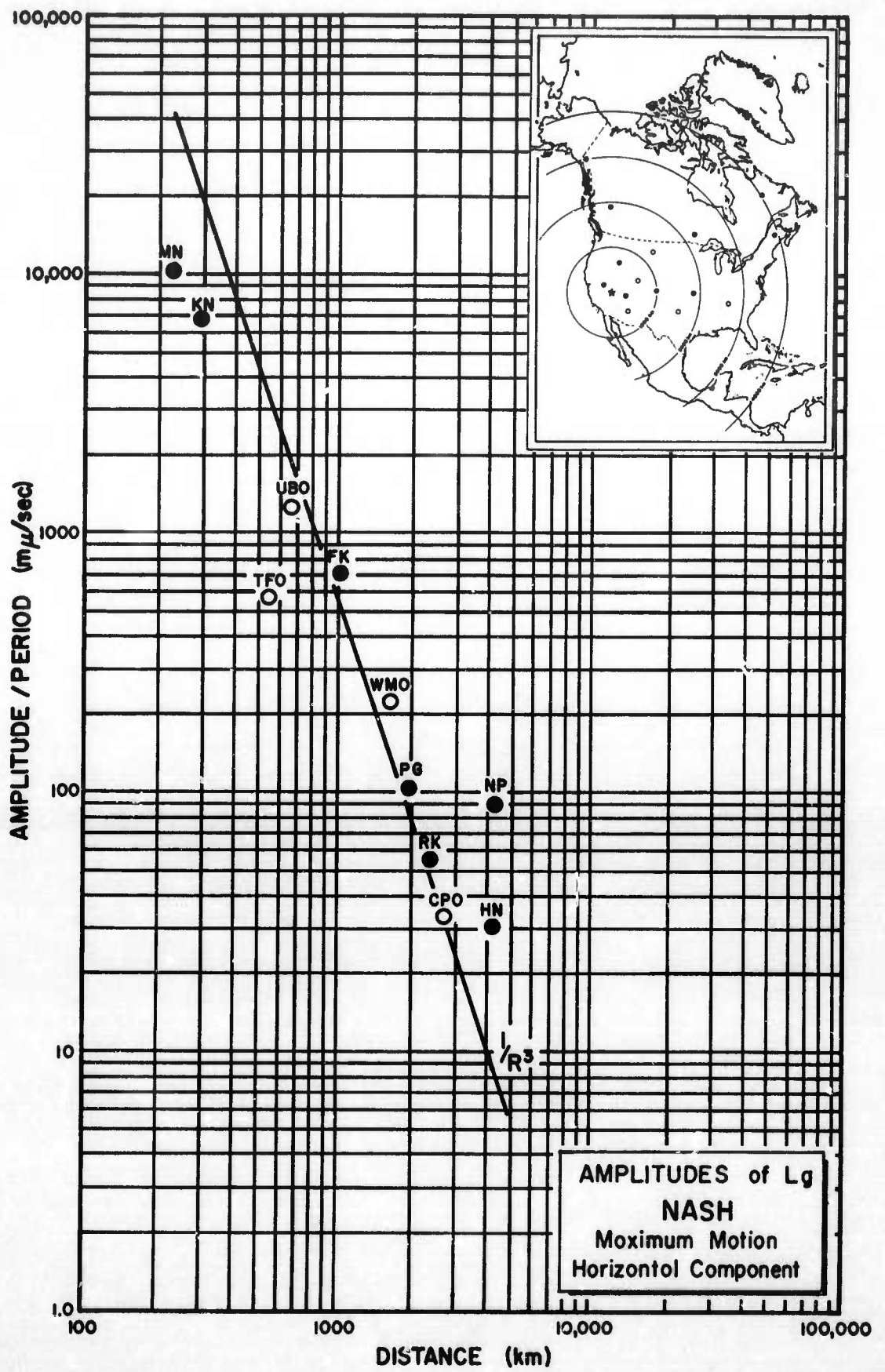


Figure 7

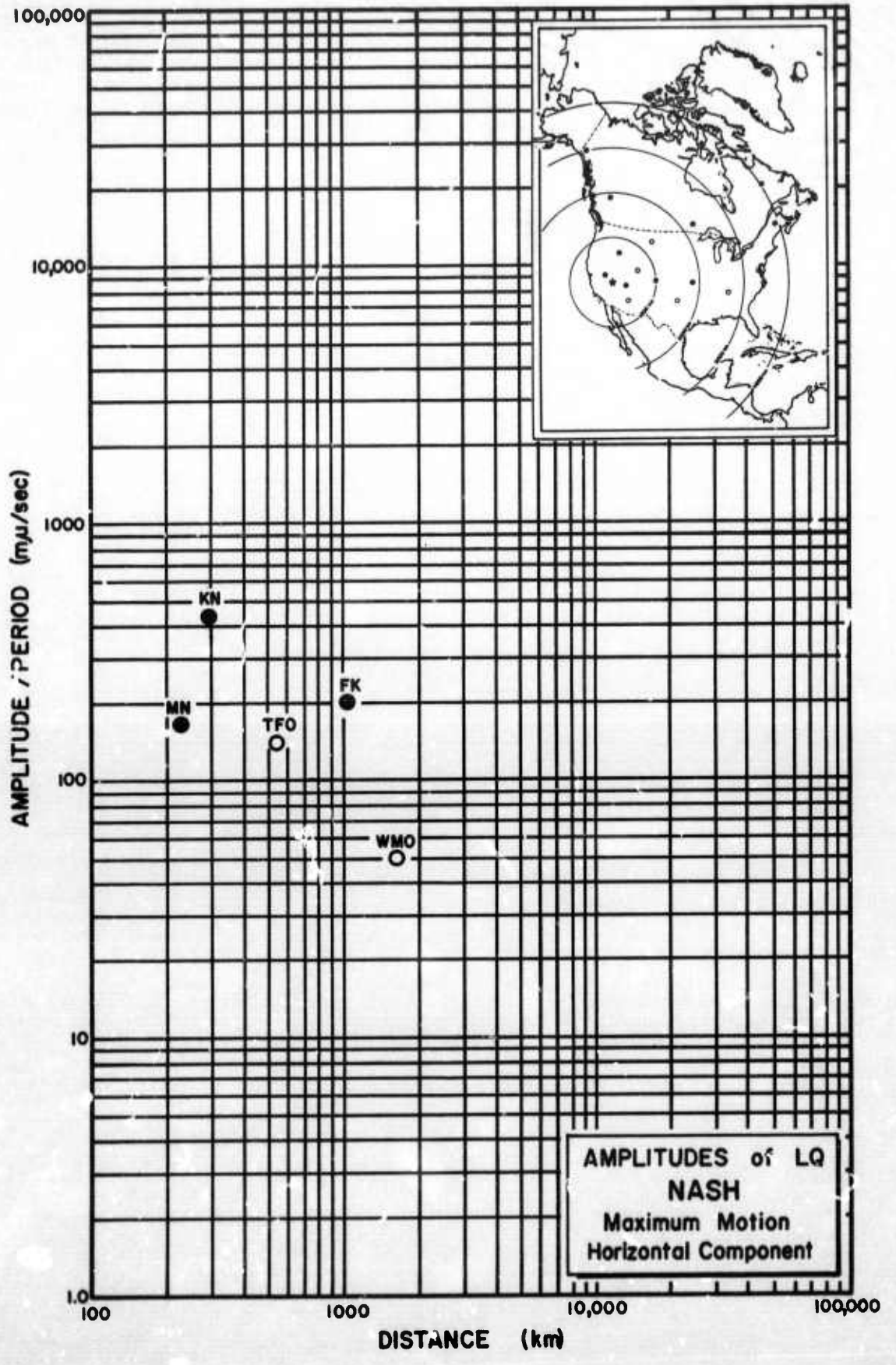


Figure 8

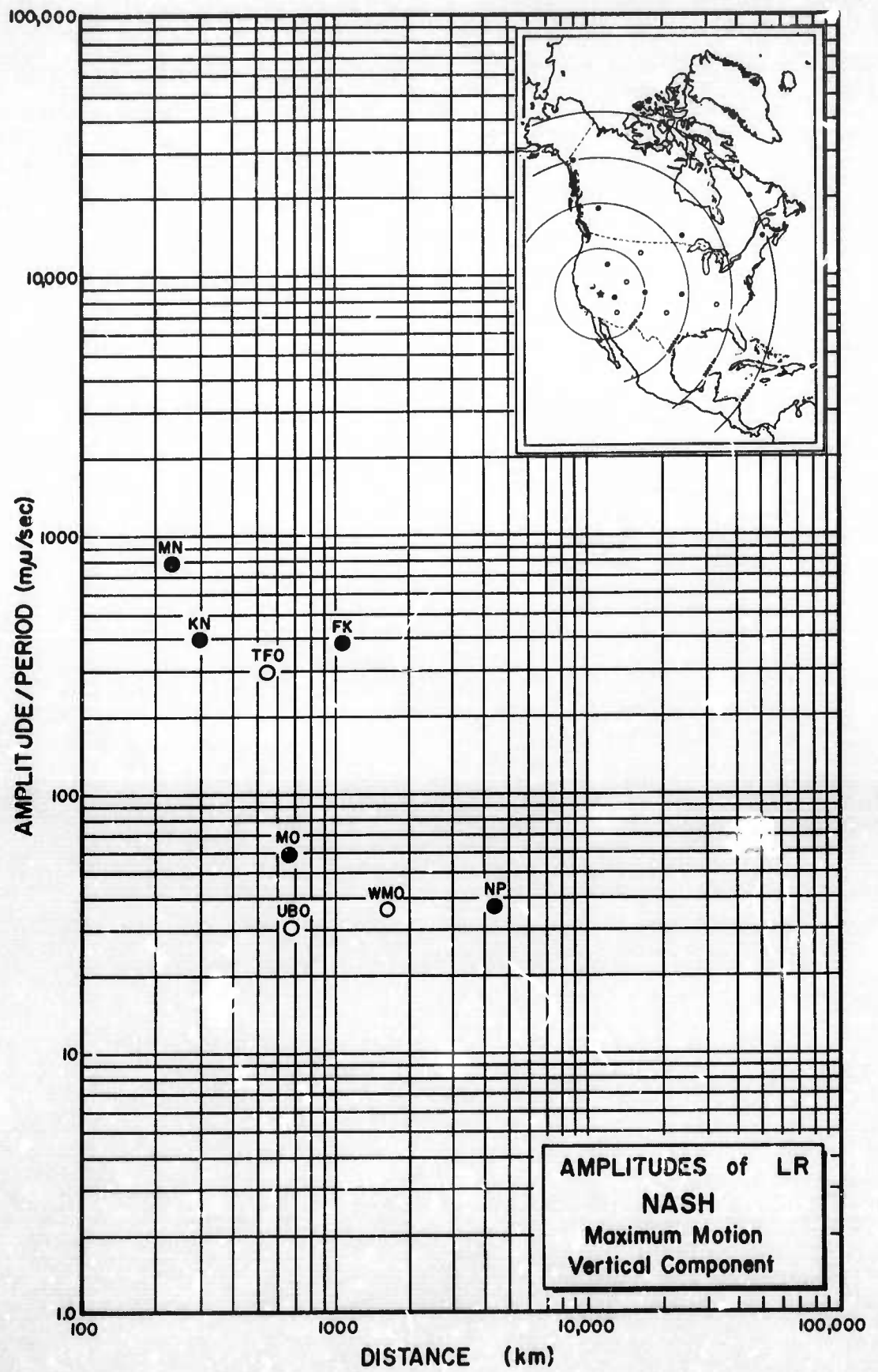


Figure 9

Code	Station	Distance (km)	Geographic Latitude	Geographic Longitude	Elev. (km)	Computed Azimuth		Installed Azimuth		Large or Small SP	LP Inat.
						Epi. Sta.	Sta. Epi.	Radial	Tang.		
*MN-NV	Minz, Nevada	228	38°26'10" N	118°08'53" W	1.52	310°	128°	308°	38°	L	X
*KN-UT	Kanab, Utah	294	37°01'22" N	112°49'39" W	1.74	92°	274°	95°	185°	L	X
TFSO-260	Tonto Forest Observatory, Arizona	543	34°17'12" N	111°16'03" W	1.49	124°	307°	90°	0°	JM	X
*MO-ID	Mountain Home, Idaho	659	43°04'19" N	116°15'56" W	0.79	359°	179°	359°	89°	L	X
UBSO-Z10	Uinta Basin Observatory, Utah	671	40°19'18" N	109°34'07" W	1.66	56°	240°	90°	0°	JM	X
*FK-CO	Franktown, Colorado	1055	39°35'12" N	104°27'42" W	1.80	72°	259°	79°	169°	L	X
LAO	Subarray AO-10, Montana	1340	46°41'19" N	106°13'20" W	.90	35°	221°	0°	90°	HSZ	X
WMSO-26	Wichita Mountain Observatory, Oklahoma	1604	34°43'05" N	98°35'21" W	.51	94°	285°	90°	0°	JM	X
KC-MO	Kansas City, Missouri	1891	39°21'21" N	94°40'17" W	.27	76°	269°	MOVING			
PG-BC	Prince George, British Columbia, Canada	1938	53°59'50" N	122°31'23" W	.91	347°	163°	110°	200°	L	X
*RK-ON	Red Lake, Ontario, Canada	2343	50°50'20" N	93°40'20" W	.37	42°	238°	58°	148°	S	X
CPSO-28	Cumberland Plateau Observatory, Tennessee	2737	35°35'41" N	85°34'13" W	.57	84°	283°	90°	0°	JM	X
*MH2YK	Whitehorse, Yukon Territory, Canada	2938	60°41'41" N	134°58'02" W	.85	339°	145°	325°	55°	L	X
*HN-ME	Houlton, Maine	4070	46°09'43" N	67°59'09" W	.21	60°	273°	93°	183°	S	X
SV3QB	Schefferville, Quebec, Canada	4190	54°48'39" N	66°45'00" W	.50	46°	263°	139°	129°	S	X
*NP-NT	Mould Bay, Northwest Territories, Canada	4363	76°15'08" N	119°22'18" W	.06	359°	196°	356°	086°	JM _S	X

*Seismometers Orientated Toward Nevada Test Site

Recording Site Information - NLSH
Appendix I(A)

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

where

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

K

T = signal period in seconds

B = distance factor (see Table below)

mm = record amplitude in millimeters zero to peak

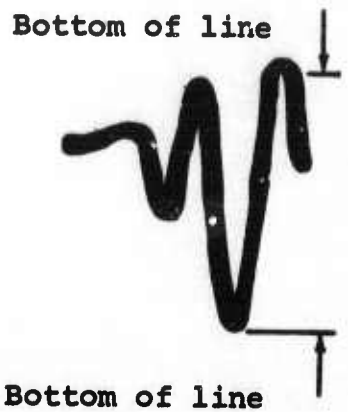
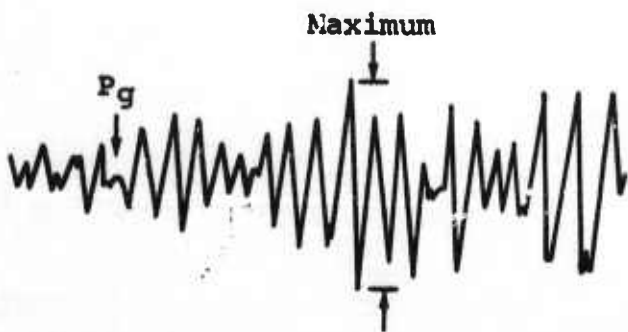
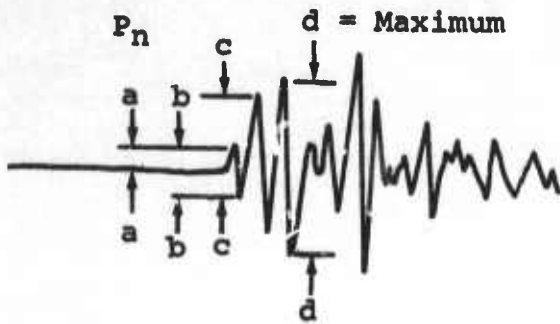
K = magnification in thousands at signal frequency

Table of Distance Factors (B) for Zero Depth

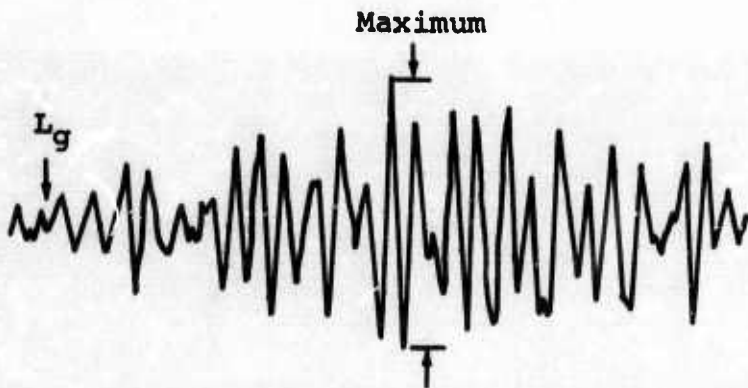
Dist (deg)	B	Dist (deg)	B	Dist (deg)	B	Dist (deg)	B
0°	-	27°	3.5	54°	3.8	80°	3.7
1	-	28	3.6	55	3.8	81	3.8
2	2.2	29	3.6	56	3.8	82	3.9
3	2.7	30	3.6	57	3.8	83	4.0
4	3.1	31	3.7	58	3.8	84	4.0
5	3.4	32	3.7	59	3.8	85	4.0
6	3.6	33	3.7	60	3.8	86	3.9
7	3.8	34	3.7	61	3.9	87	4.0
8	4.0	35	3.7	62	4.0	88	4.1
9	4.2	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



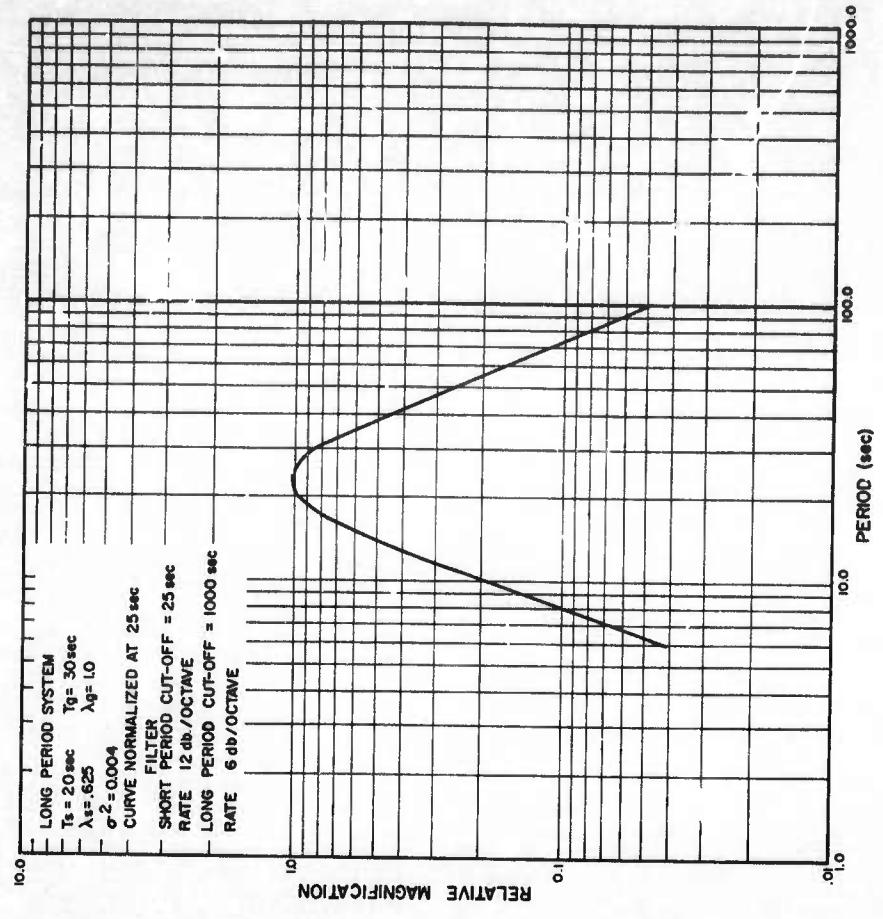
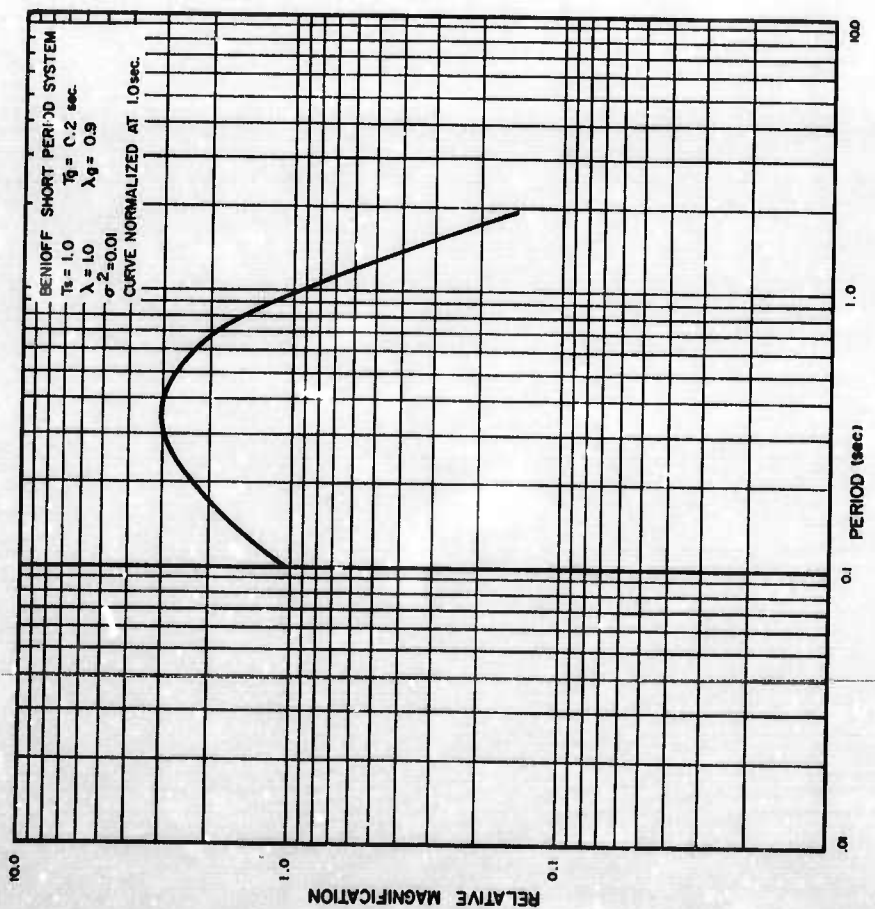
Pick time of Pn at beginning of "a" half cycle.

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

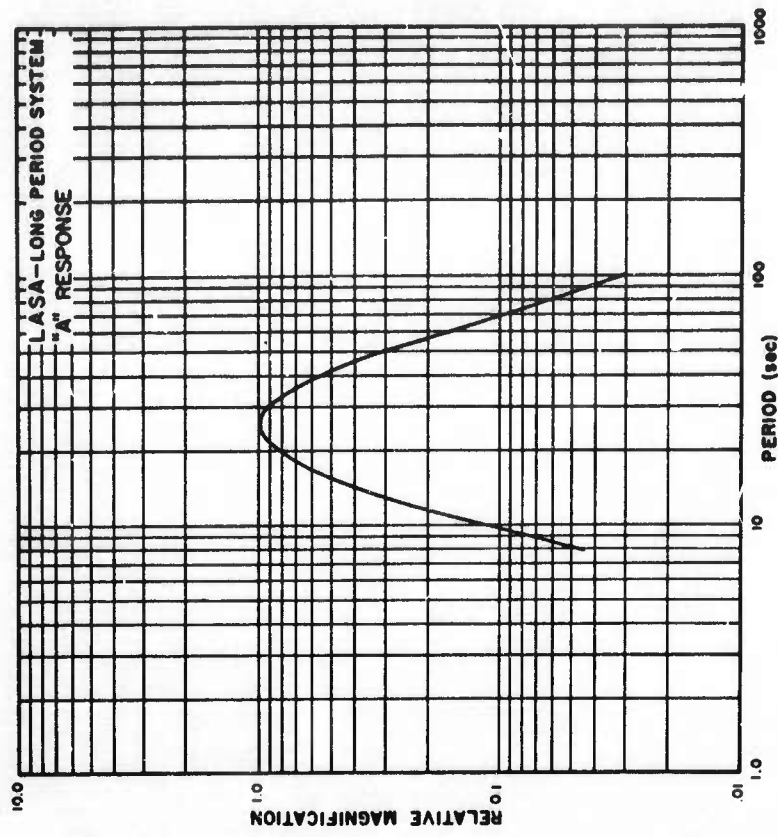
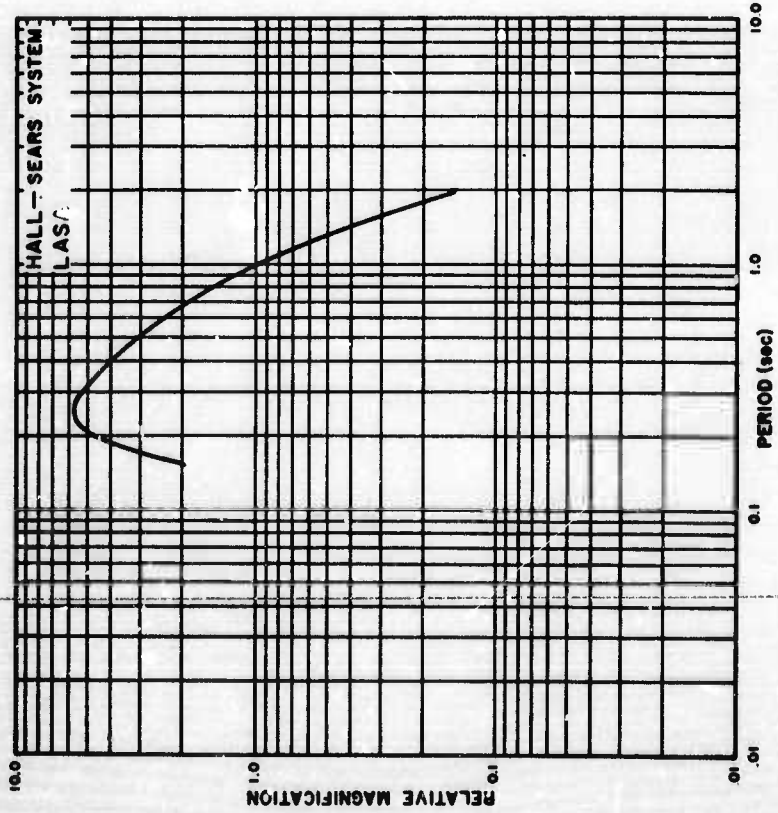
Pick amplitudes of Pg and Lg at maximum of corresponding motion.

Seismic Analysis Diagram

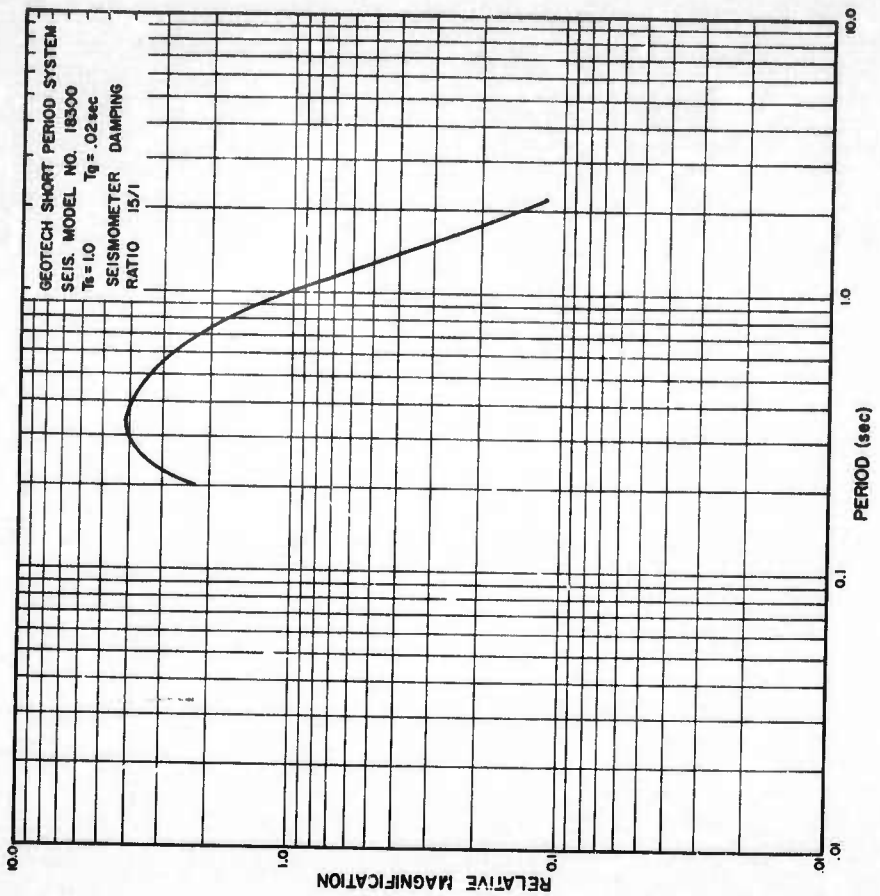
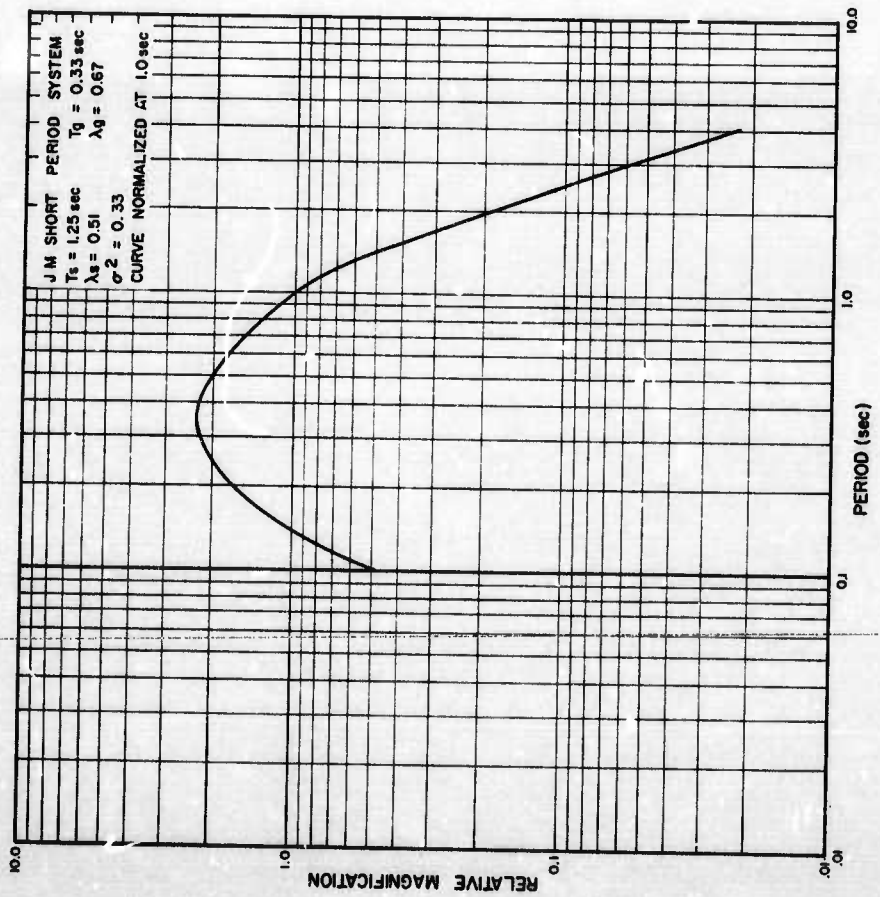
APPENDIX II(A)



INSTRUMENT RESPONSE CURVES - LRSM



INSTRUMENT RESPONSE CURVE -- LASA



INSTRUMENT RESPONSE CURVES - OTHER SHORT PERIOD

Unclassified
Security Classification

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) TELEDYNE, INC. ALEXANDRIA, VIRGINIA		2a. REPORT SECURITY CLASSIFICATION Unclassified	
		2b. GROUP ---	
3. REPORT TITLE LONG RANGE SEISMIC MEASUREMENTS - NASH			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific			
5. AUTHOR(S) (Last name, first name, initial) Clark, Don M.			
6. REPORT DATE 19 January 1967		7a. TOTAL NO. OF PAGES 23	7b. NO. OF REFS 2
8a. CONTRACT OR GRANT NO. F 33657-67-C-1313		8b. ORIGINATOR'S REPORT NUMBER(S) 184	
a. PROJECT NO. VELA T/6702			
c. ARPA Order No. 624		8c. OTHER REPORT NO(S) (Any other numbers that may be assigned to report)	
d. ARPA Program Code No. 5810			
10. AVAILABILITY/LIMITATION NOTICES This document is subject to special export controls and each transmittal to foreign governments or foreign national may be made only with prior approval of Chief, AFTAC			
11. SUPPLEMENTARY NOTES --		12. SPONSORING MILITARY ACTIVITY ADVANCED RESEARCH PROJECTS AGENCY NUCLEAR TEST DETECTION OFFICE 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.			

DD FORM 1473
1 JAN 64

Security Classification

KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Seismic Magnitude Seismic Travel-Time Seismic Amplitude VELA-UNIFORM Nuclear Tests						

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NASH

MN-NV

MINA, NEVADA

19 JANUARY 1967

$\Delta = 228$ km

UP
↑
SPZ-LO.
1.0 K
16:45:00.0 Z

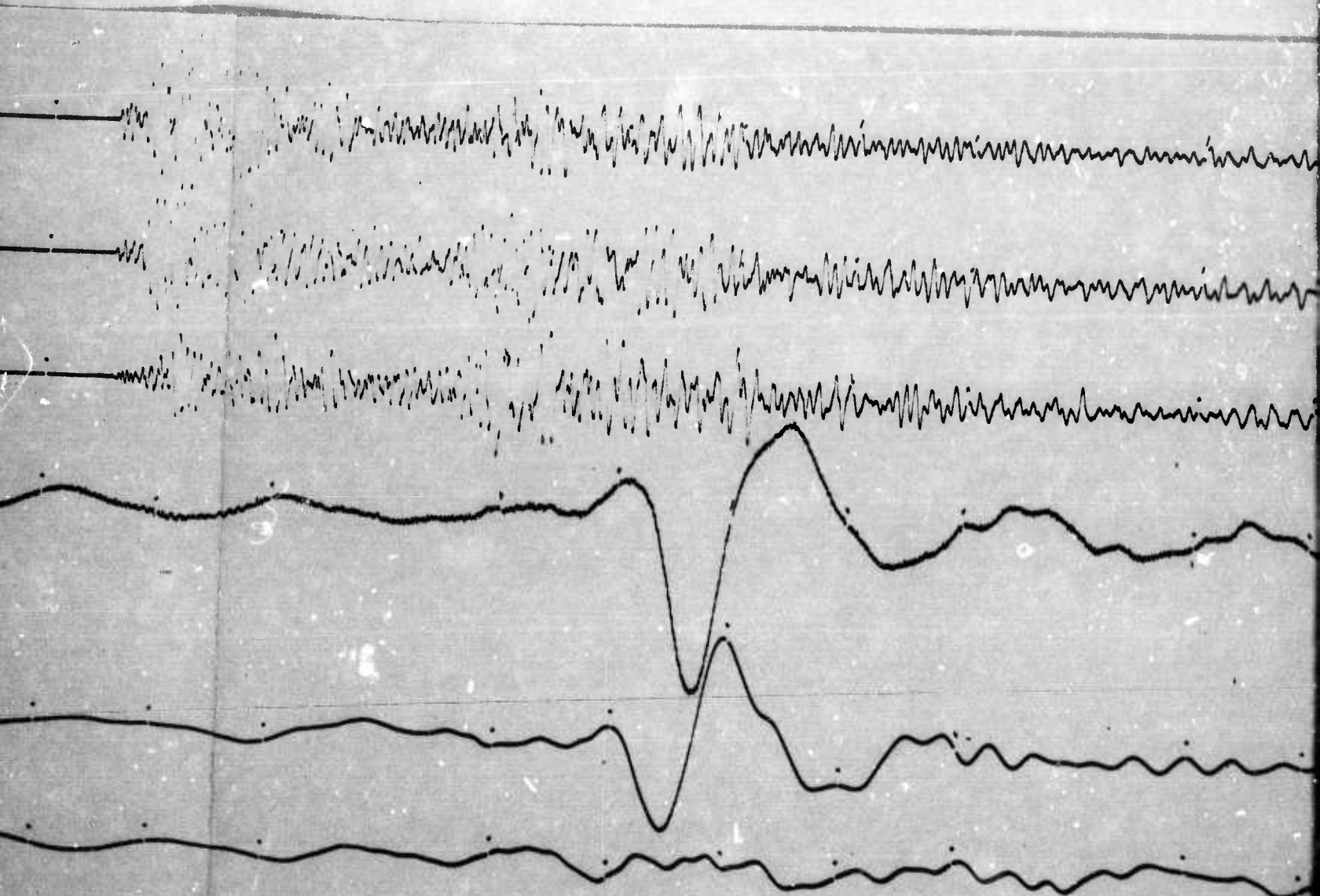
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SPR-LO.
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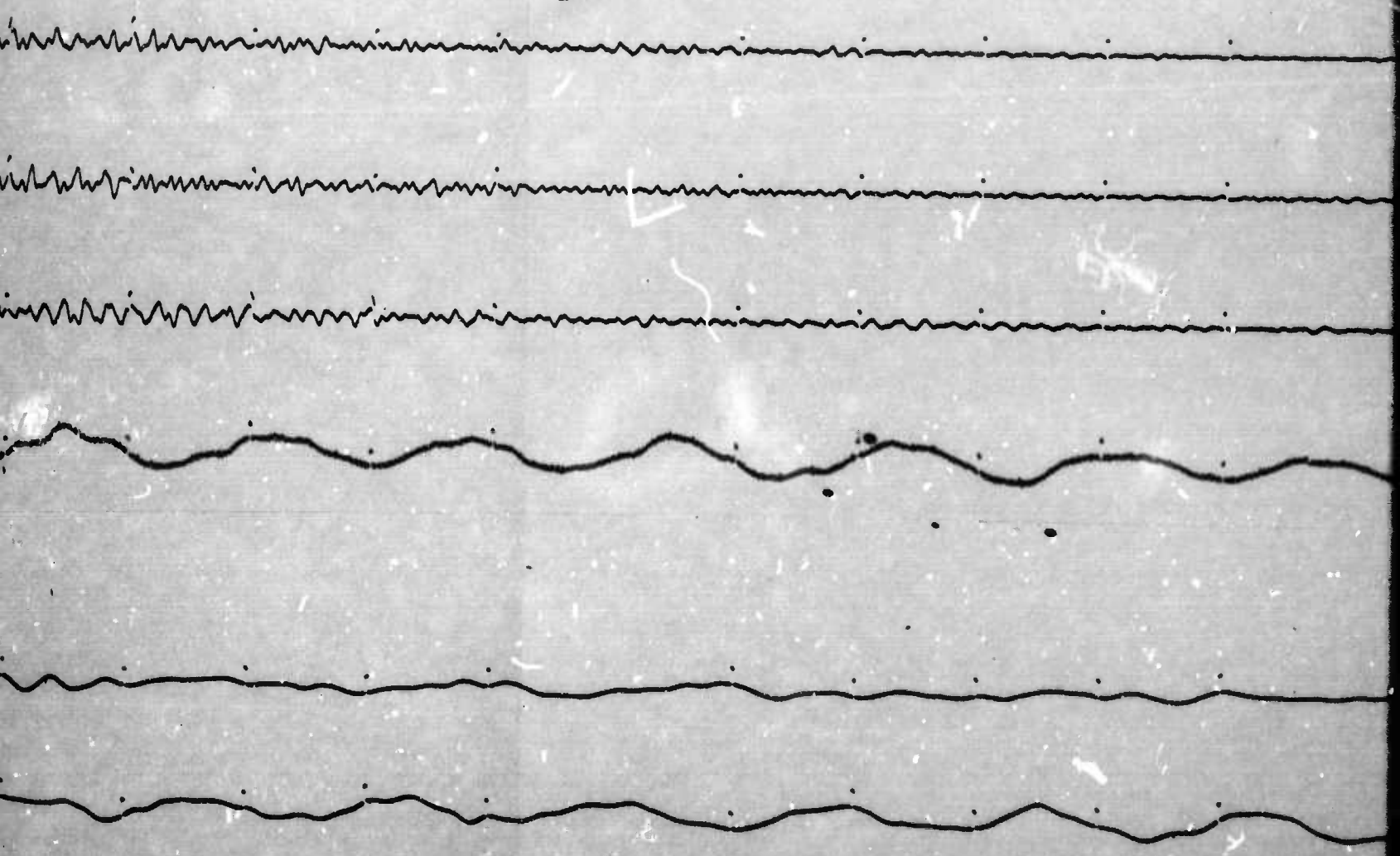
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LPZ-LO.
5.1 K

308°
↑
LPR-HI.
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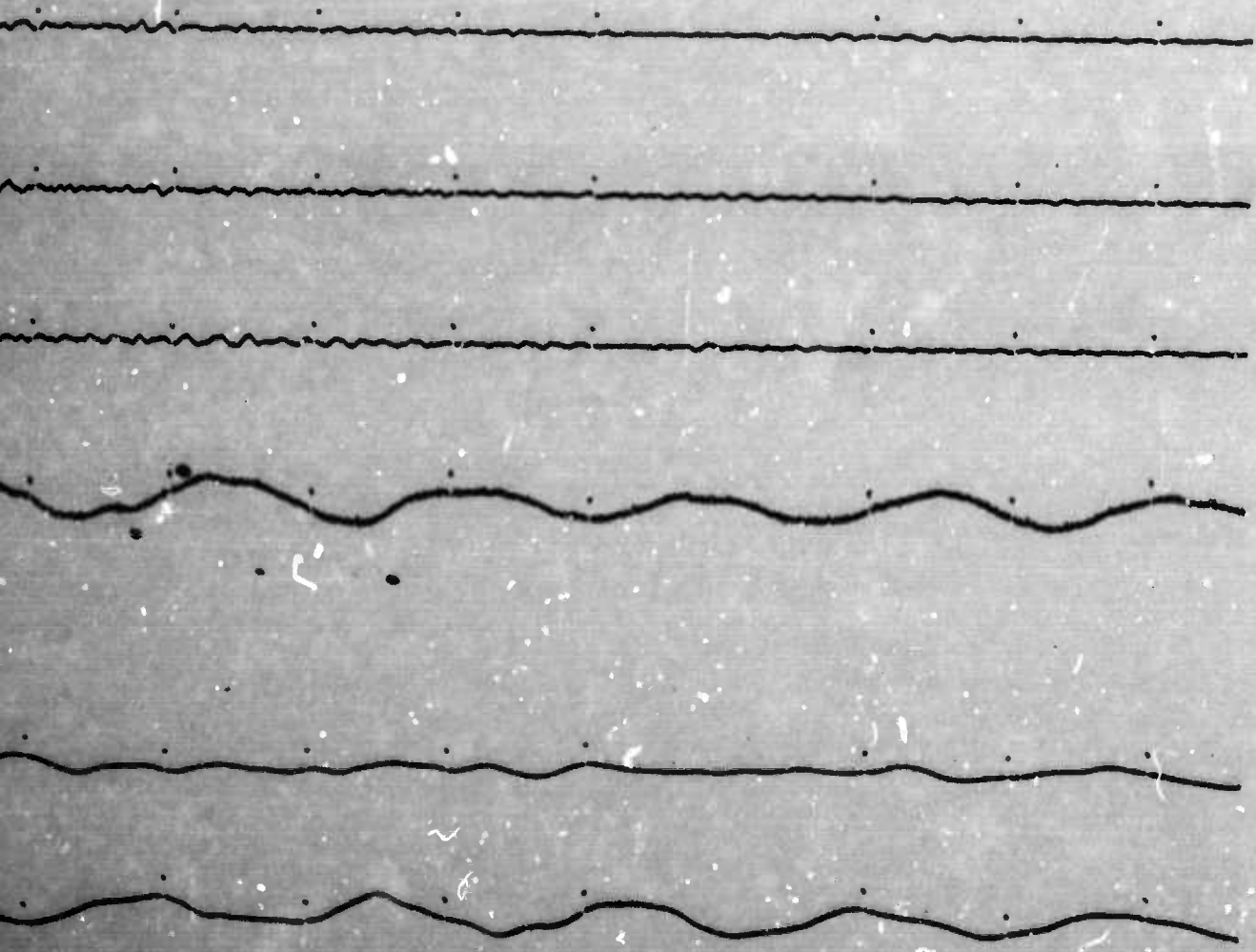
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↑
LPT-HI.
5.1 K



2



3



3

4

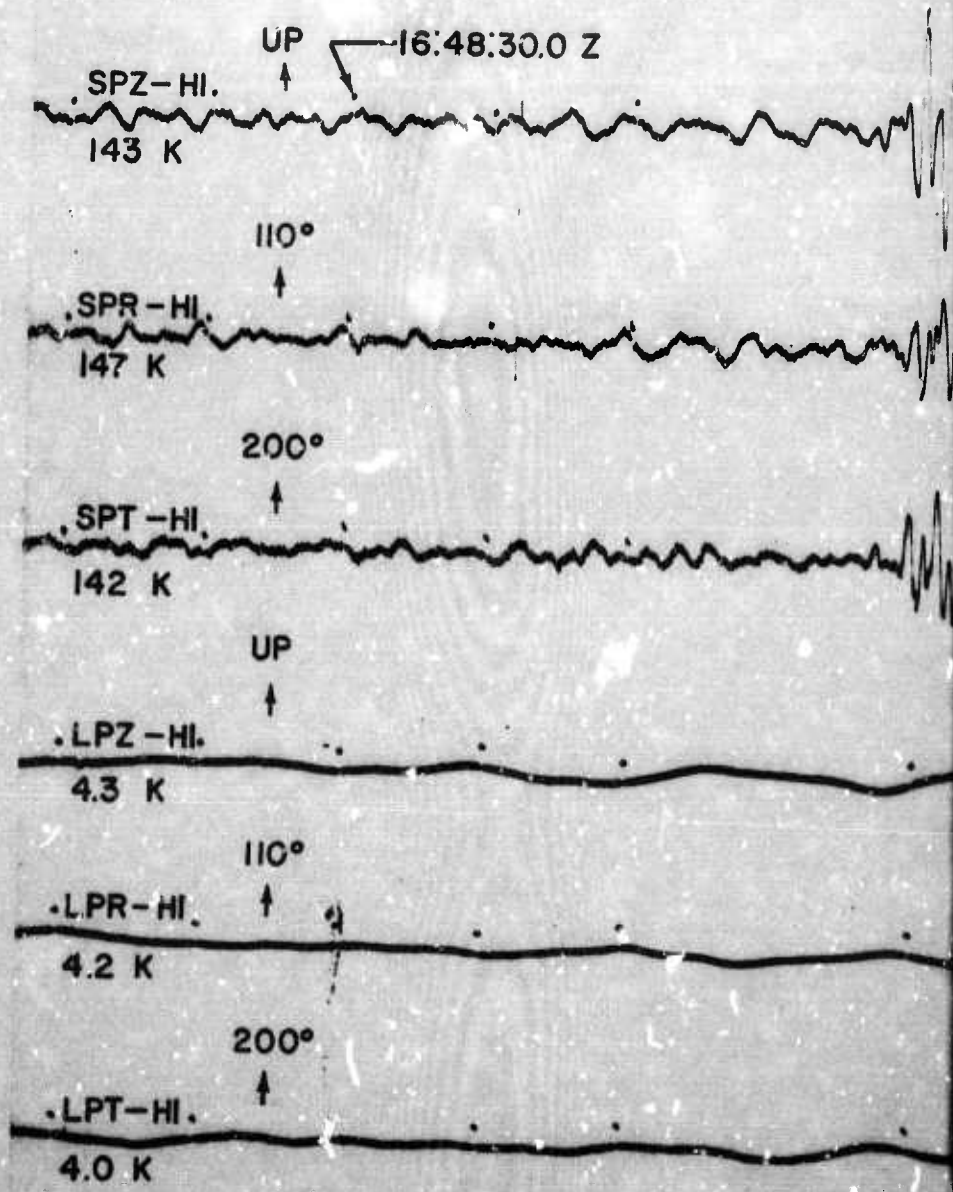
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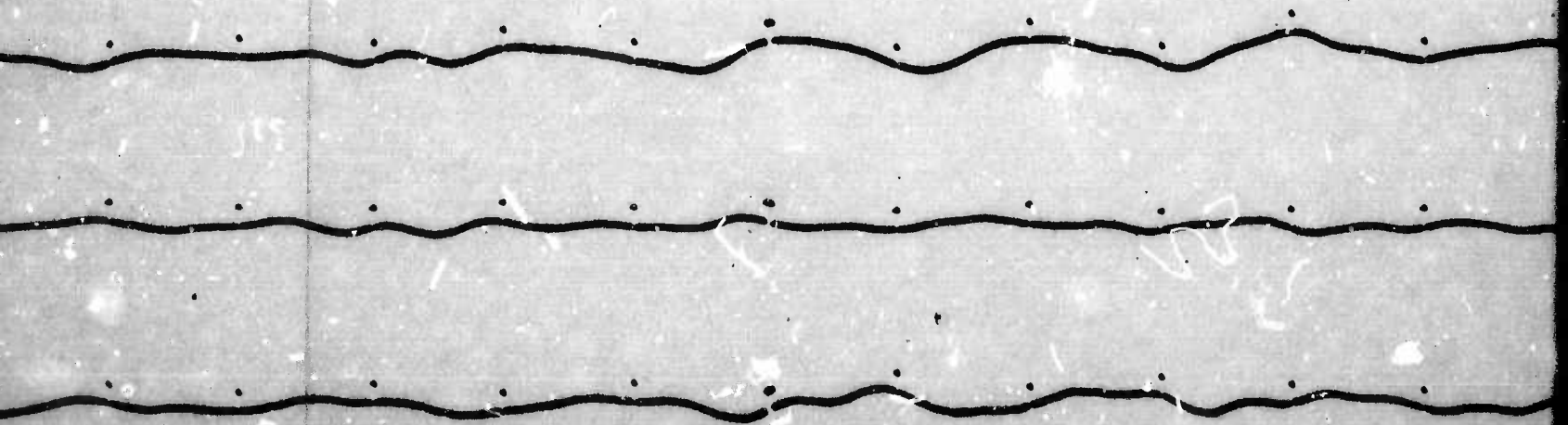
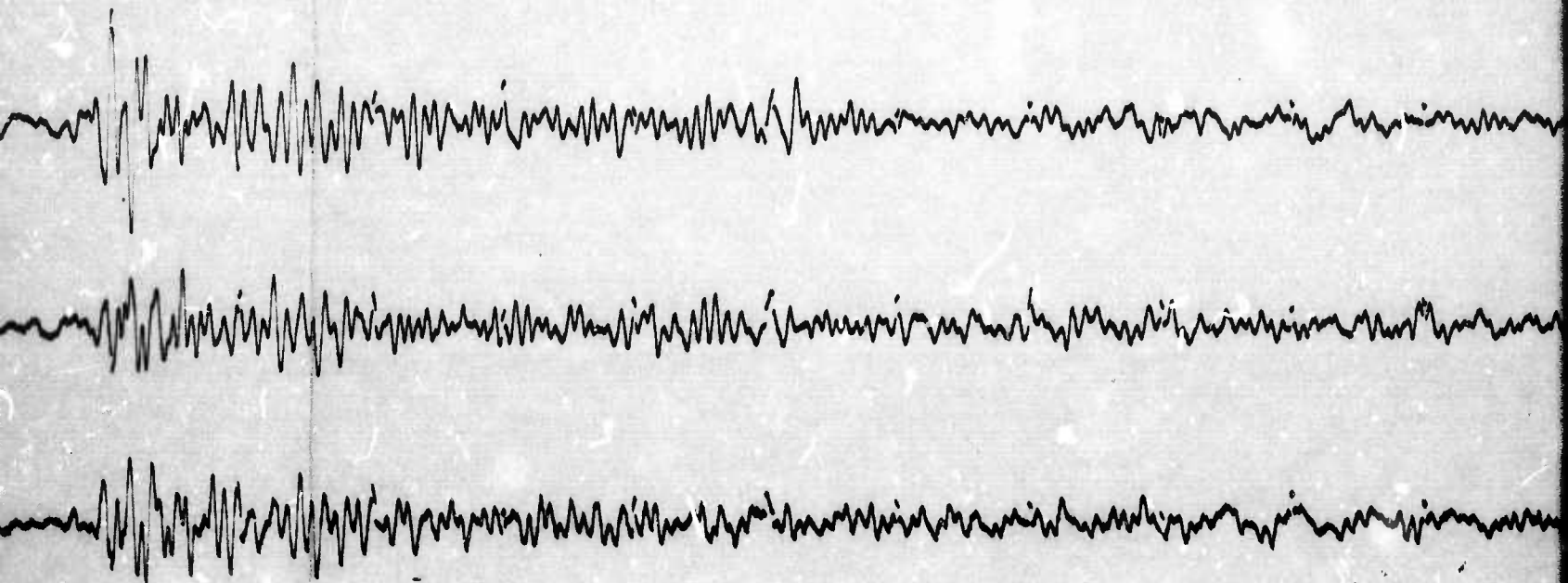
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PRINCE GEORGE, BRITISH COLUMBIA

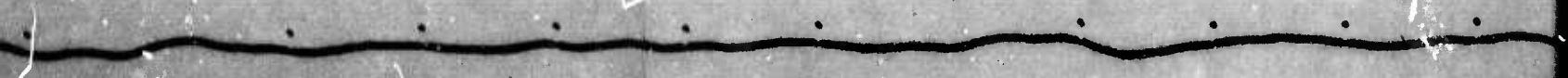
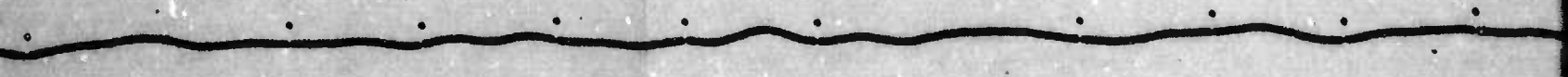
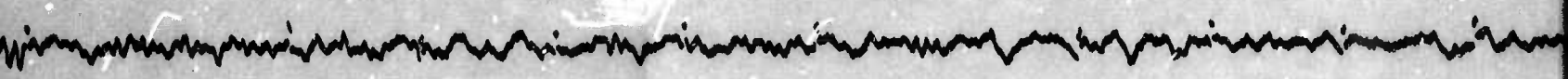
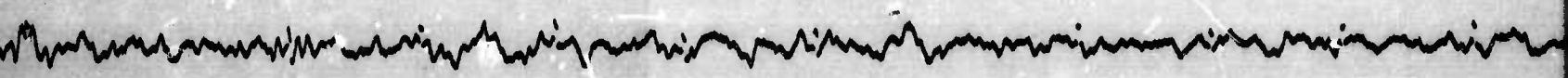
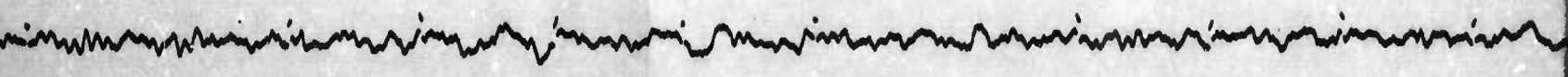
19 JANUARY 1967

$\Delta = 1938 \text{ km}$

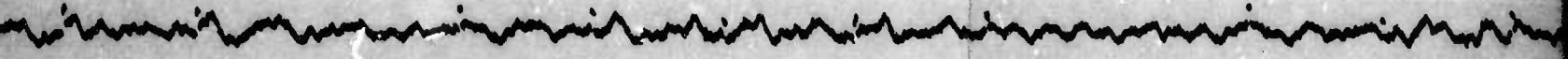
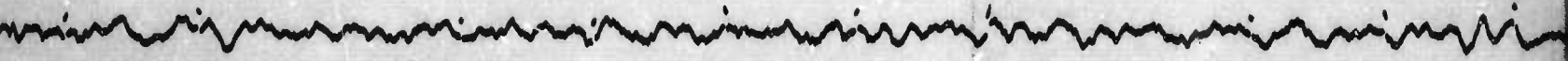




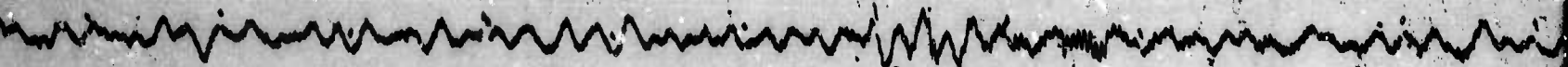
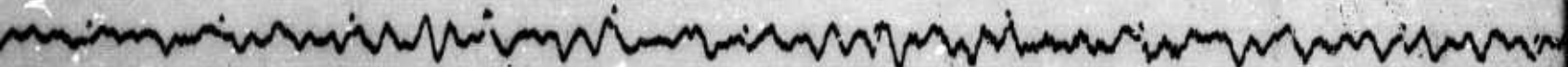
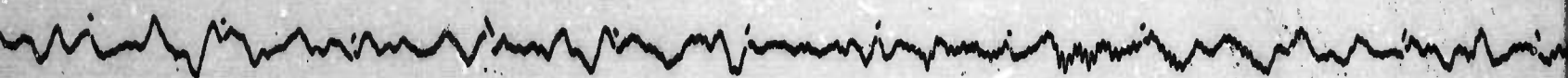
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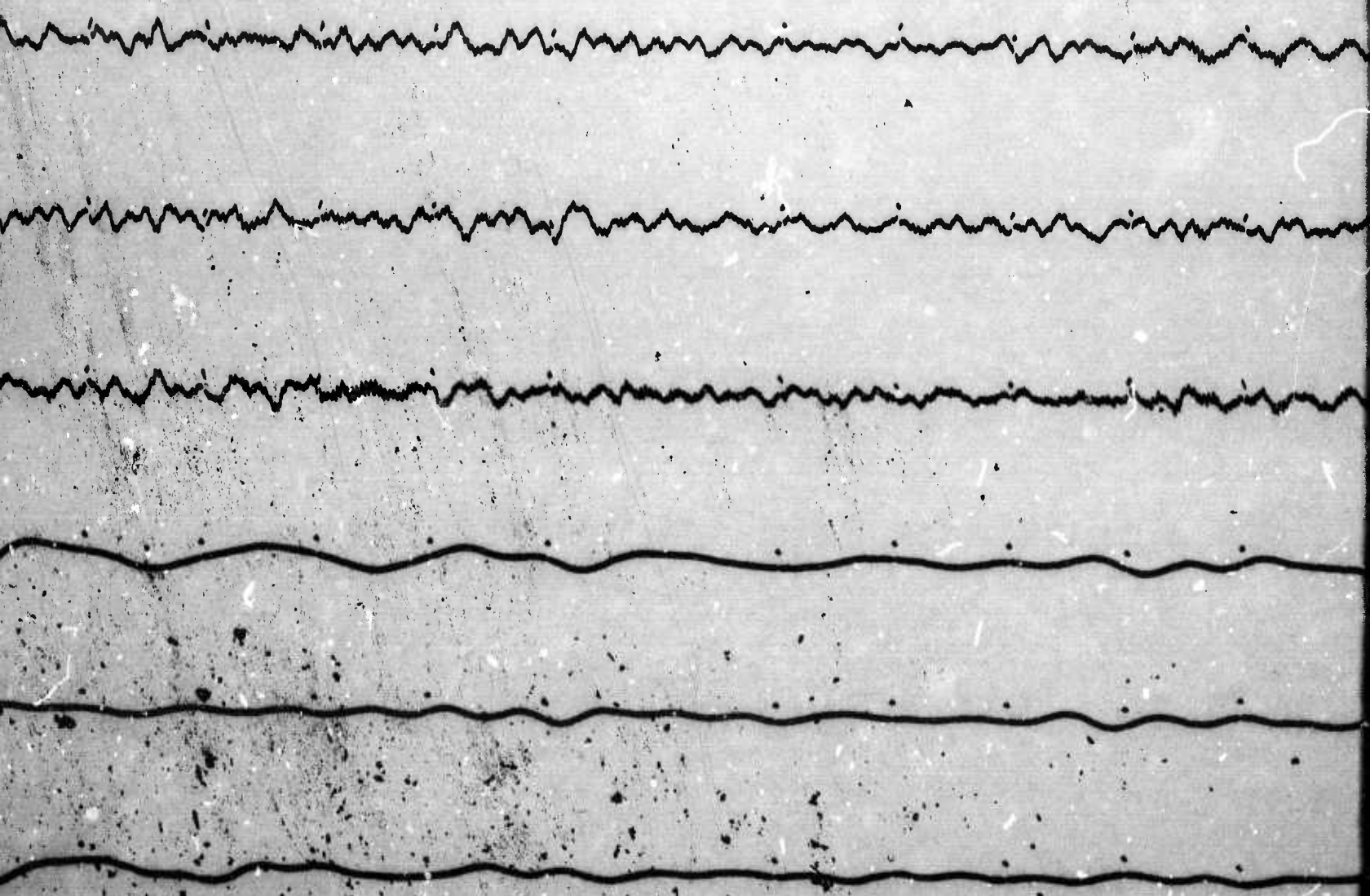
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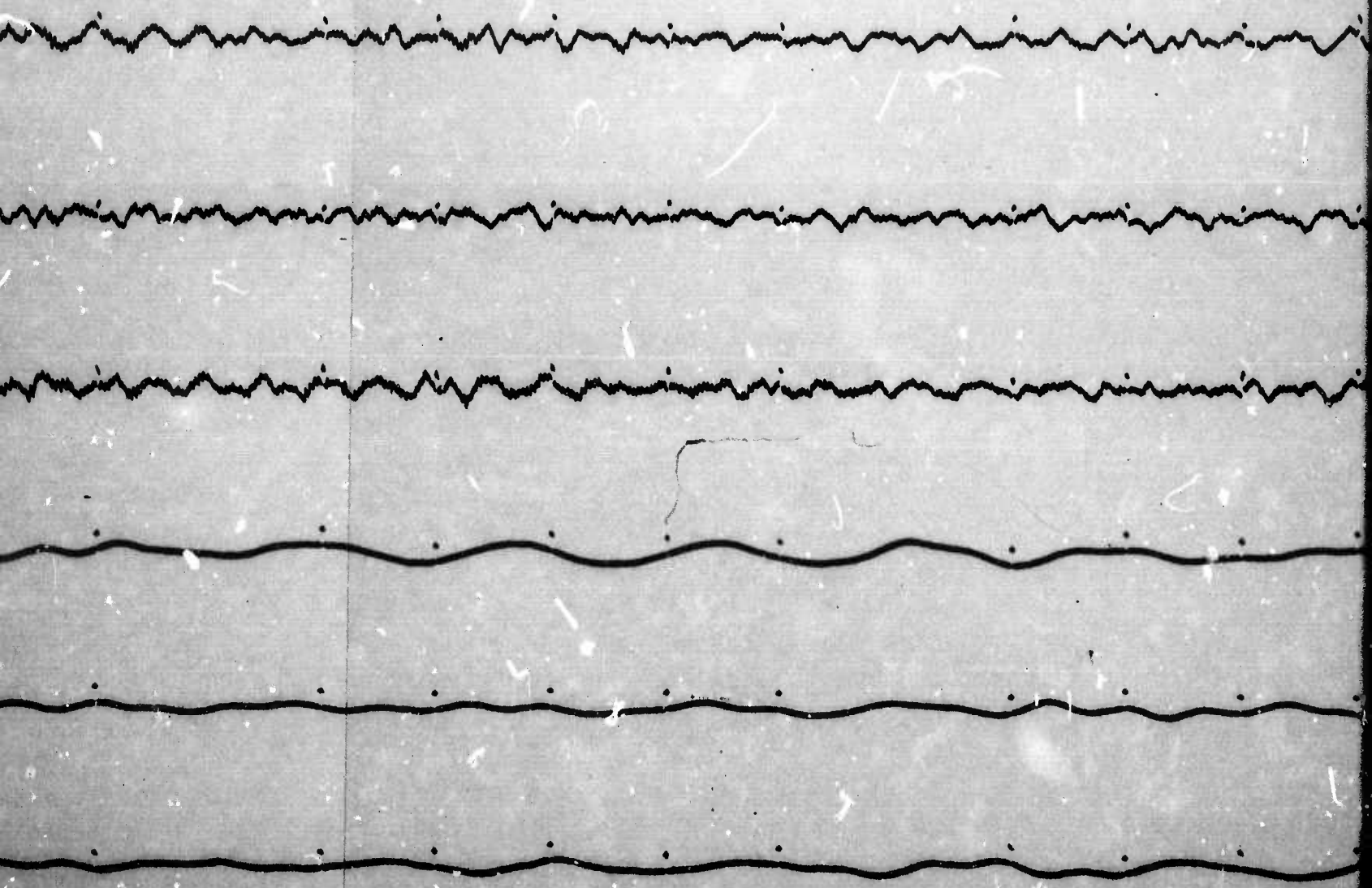
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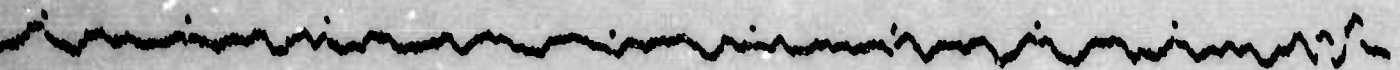
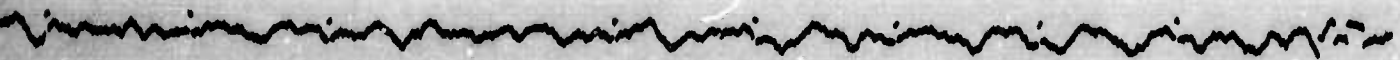
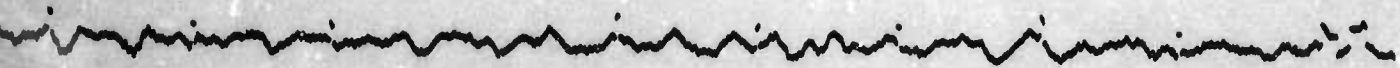
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7



7

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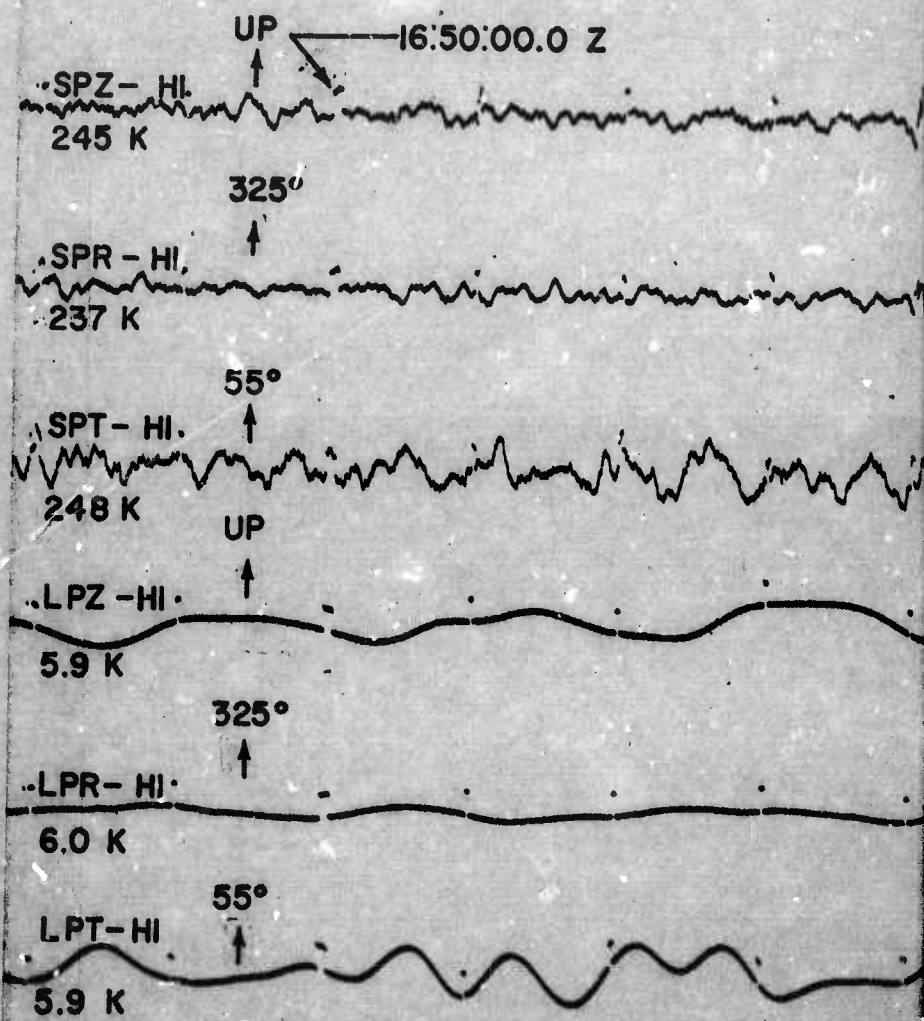
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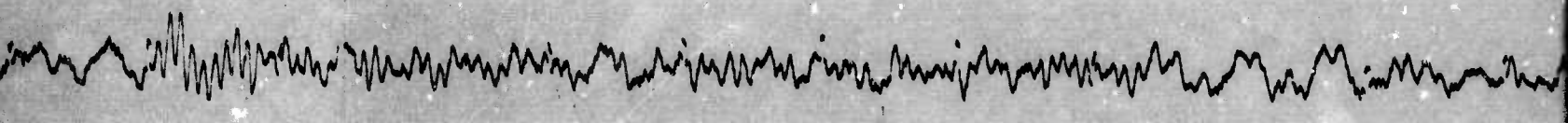
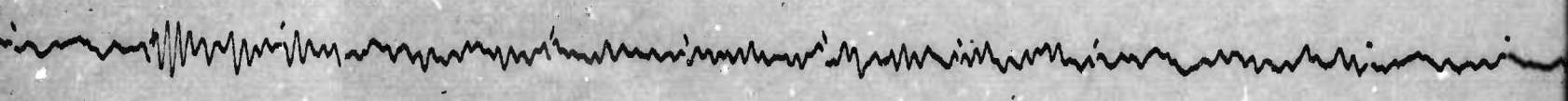
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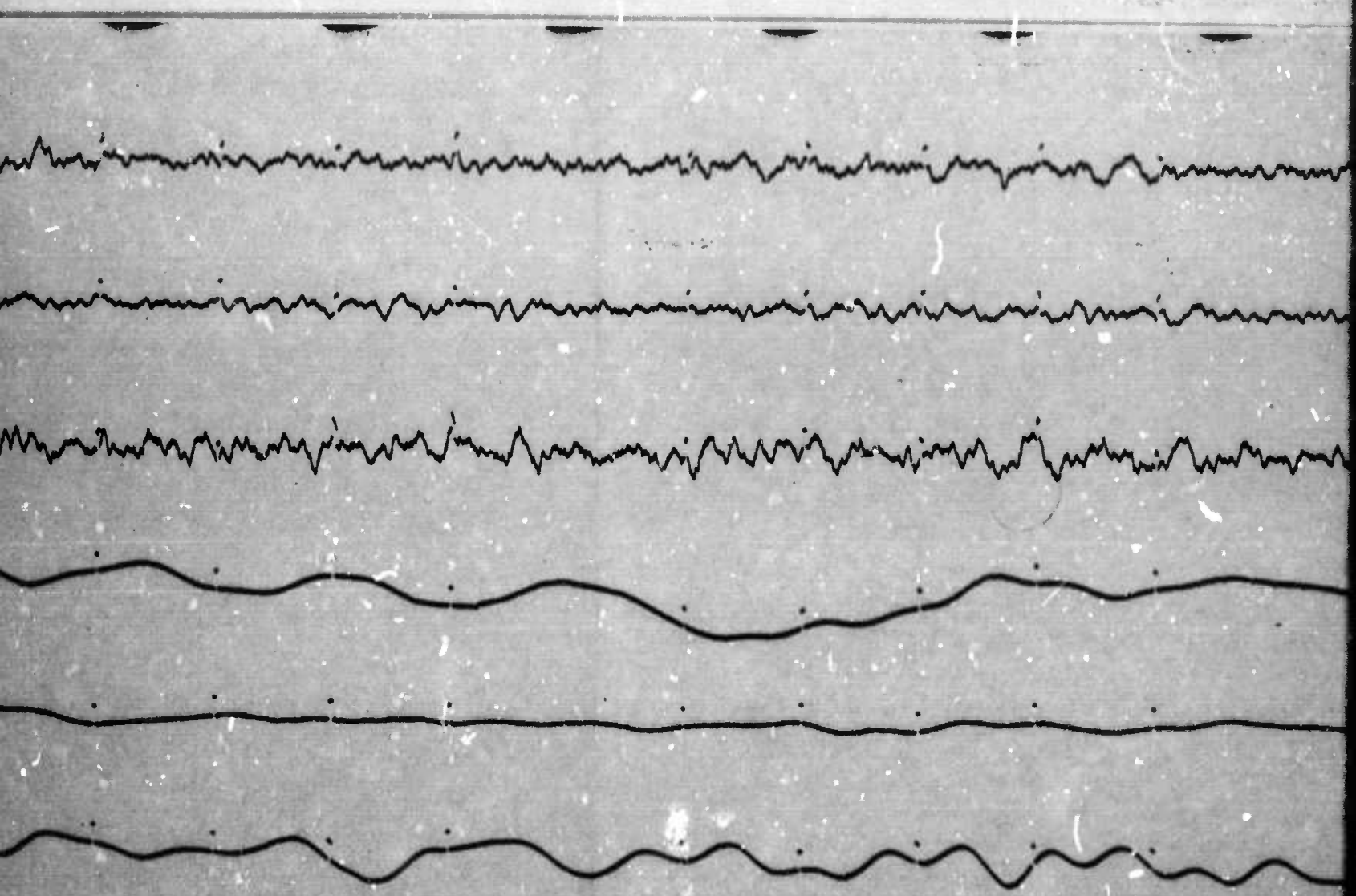
19 JANUARY 1967

$\Delta = 2938$ km

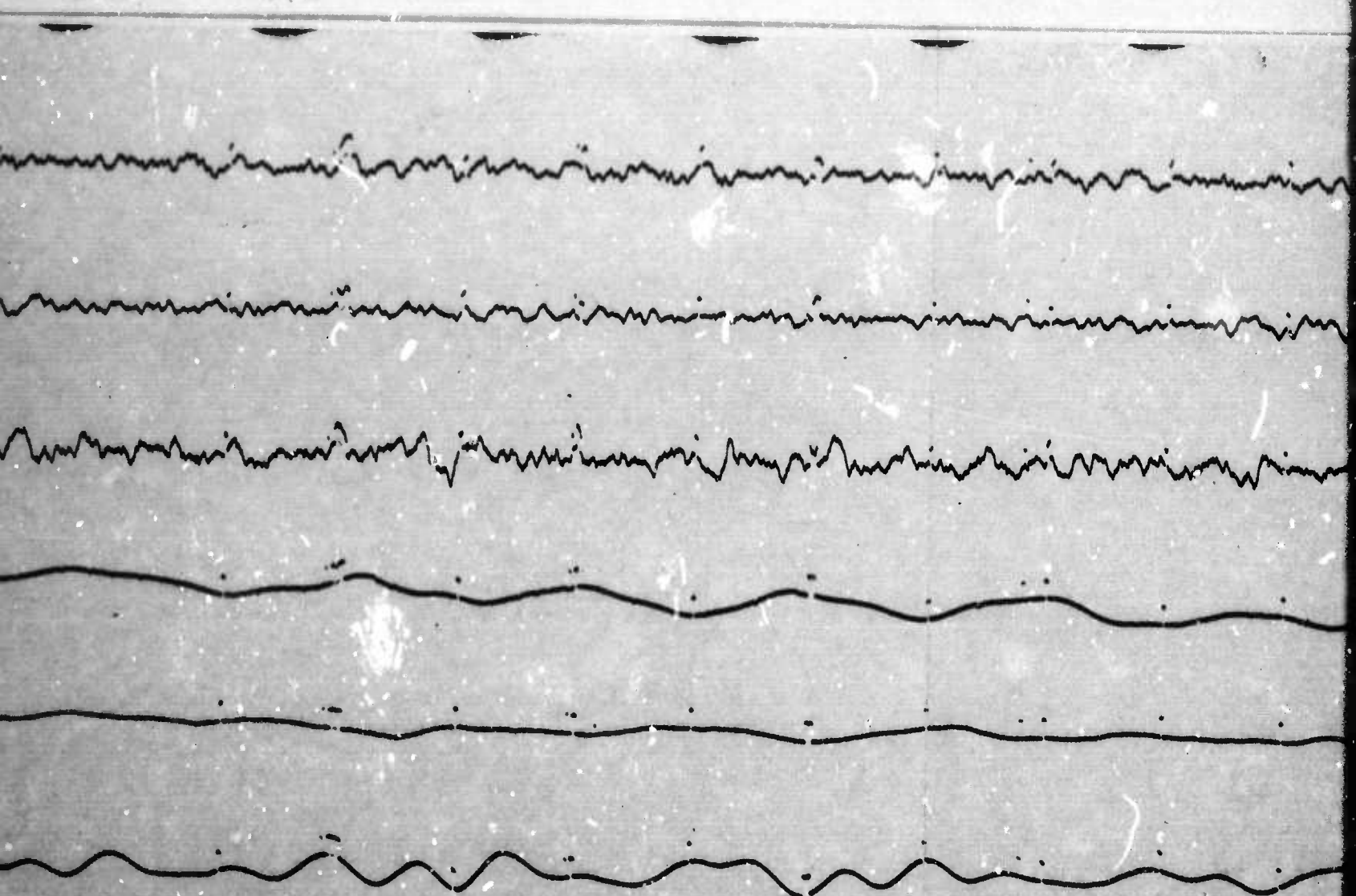




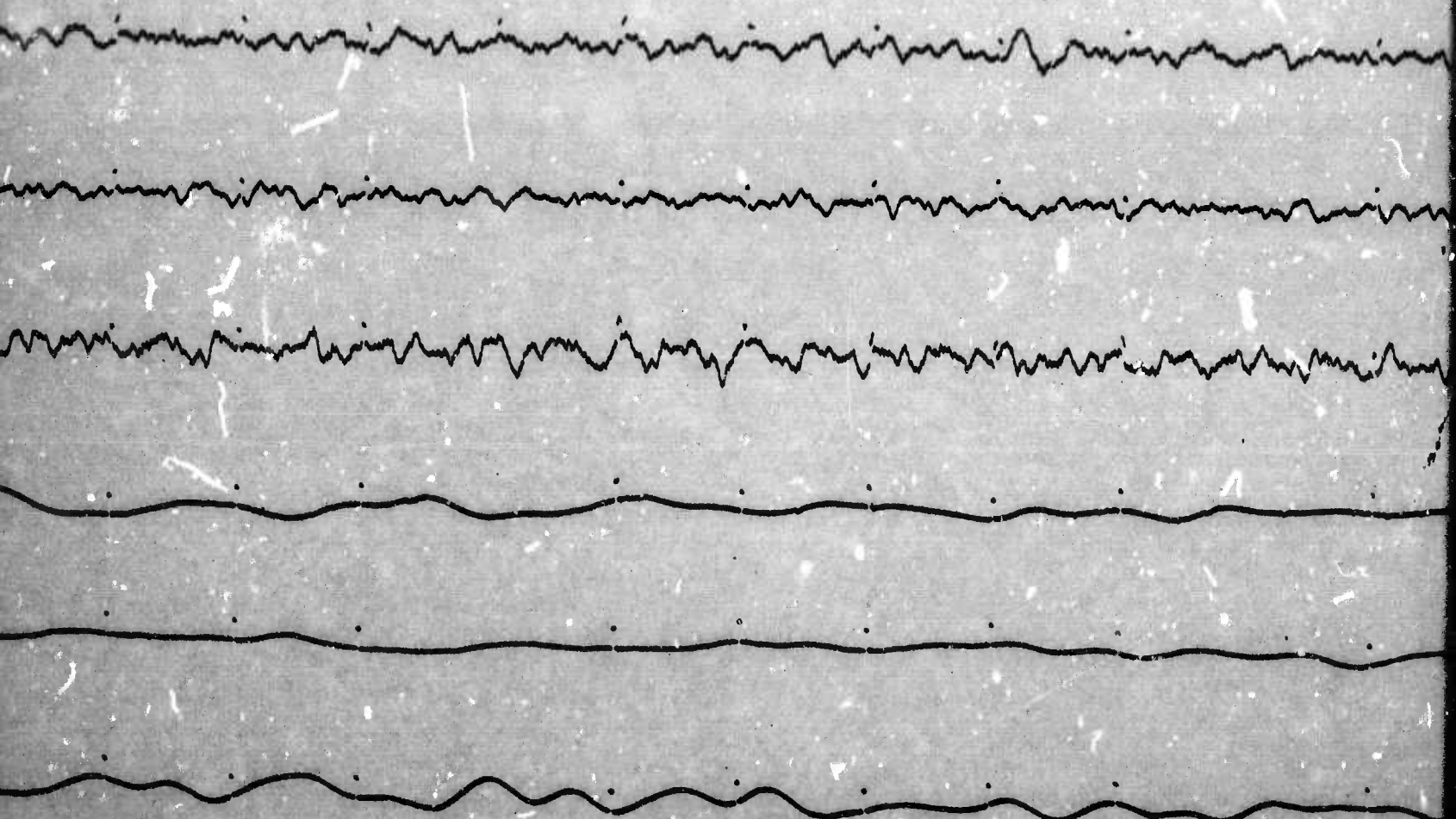
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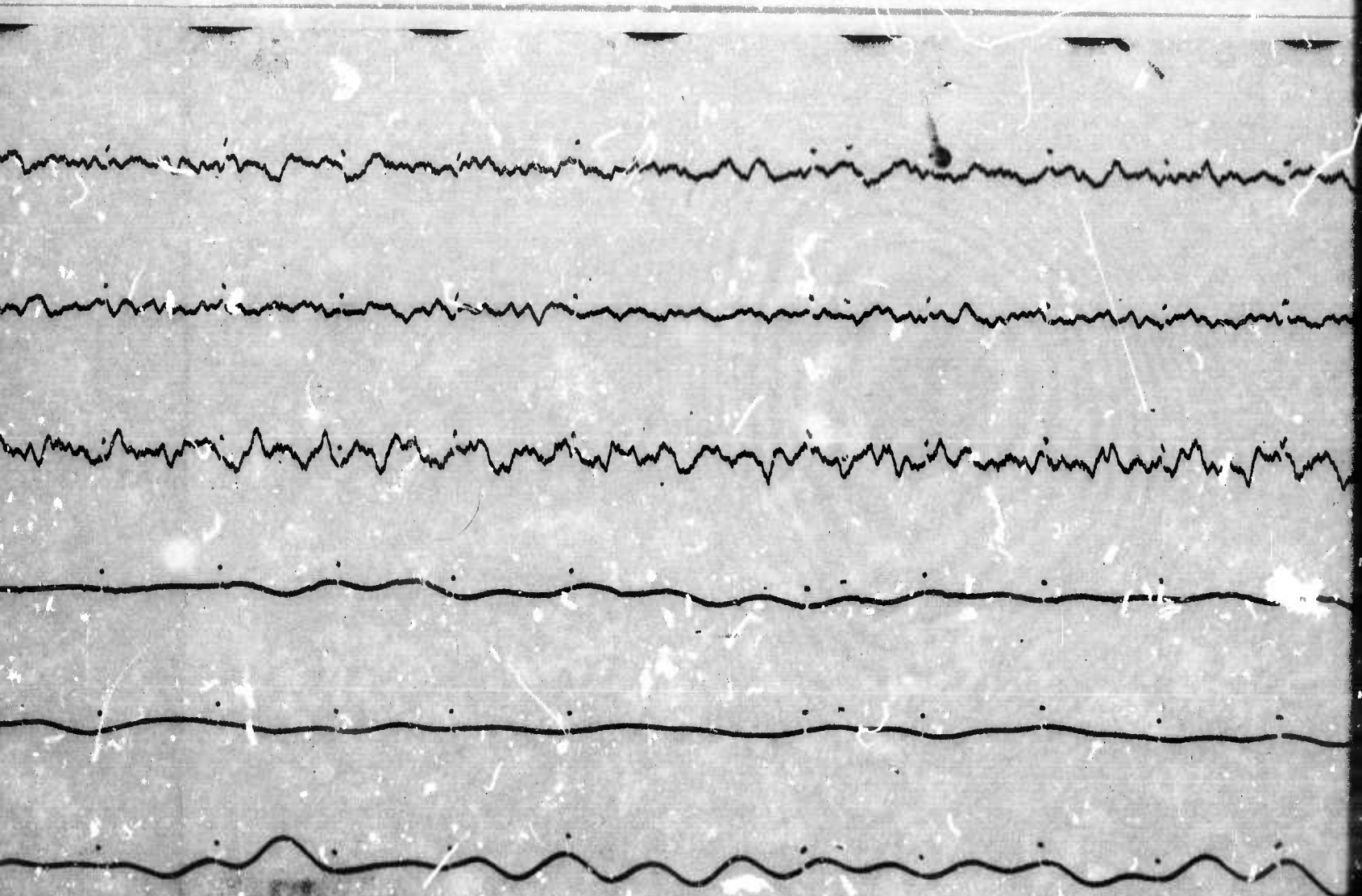
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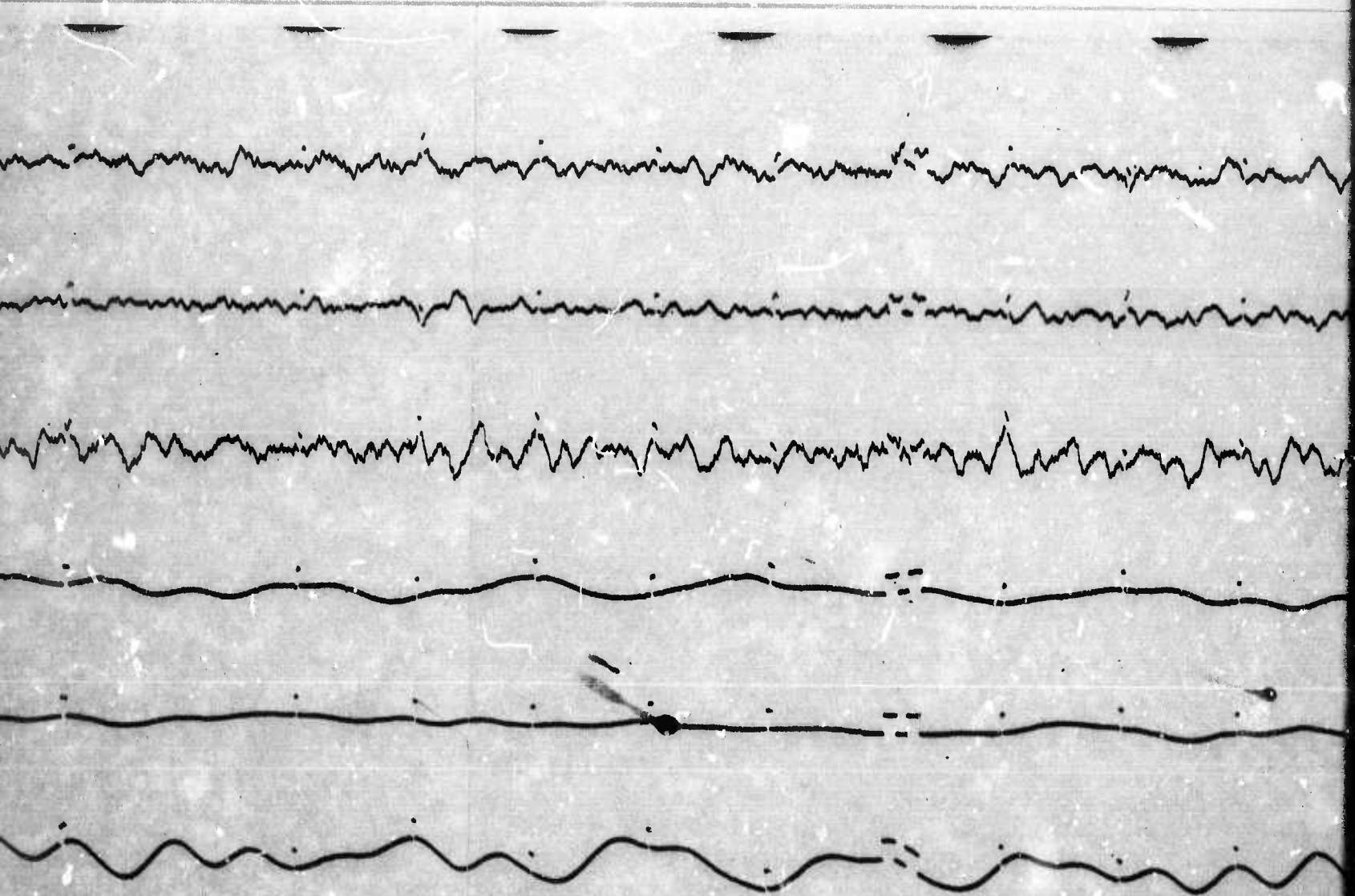
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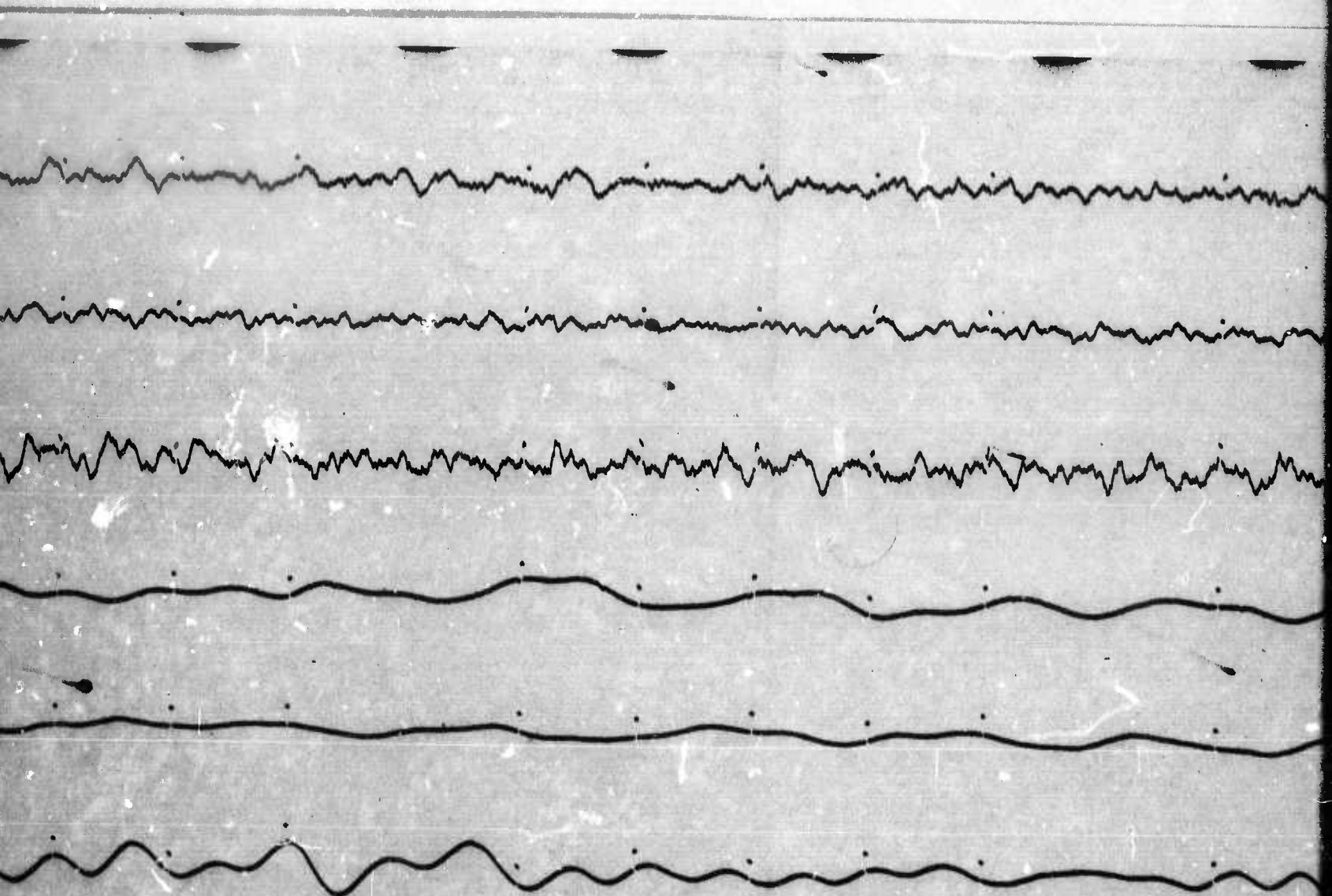
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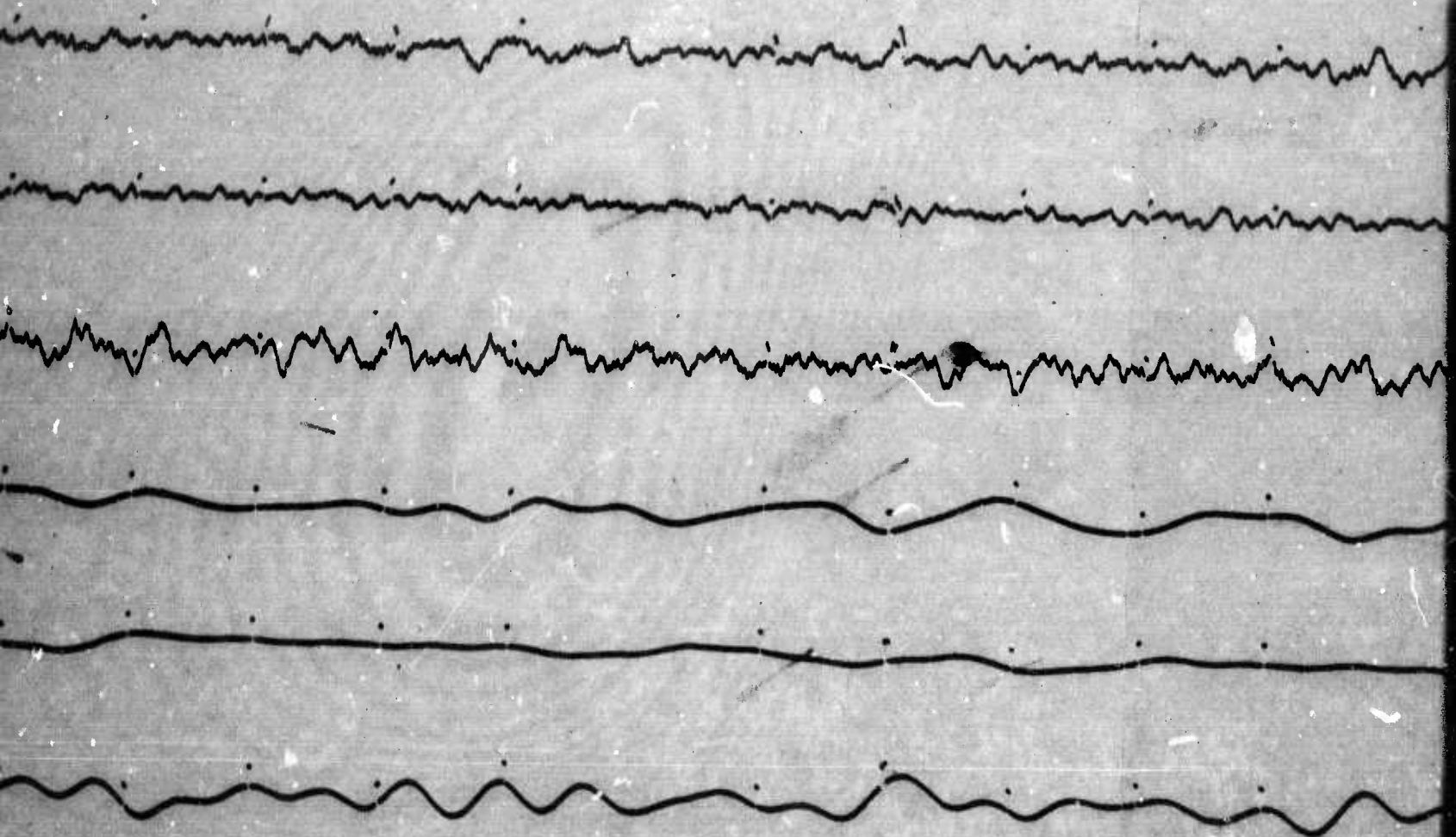
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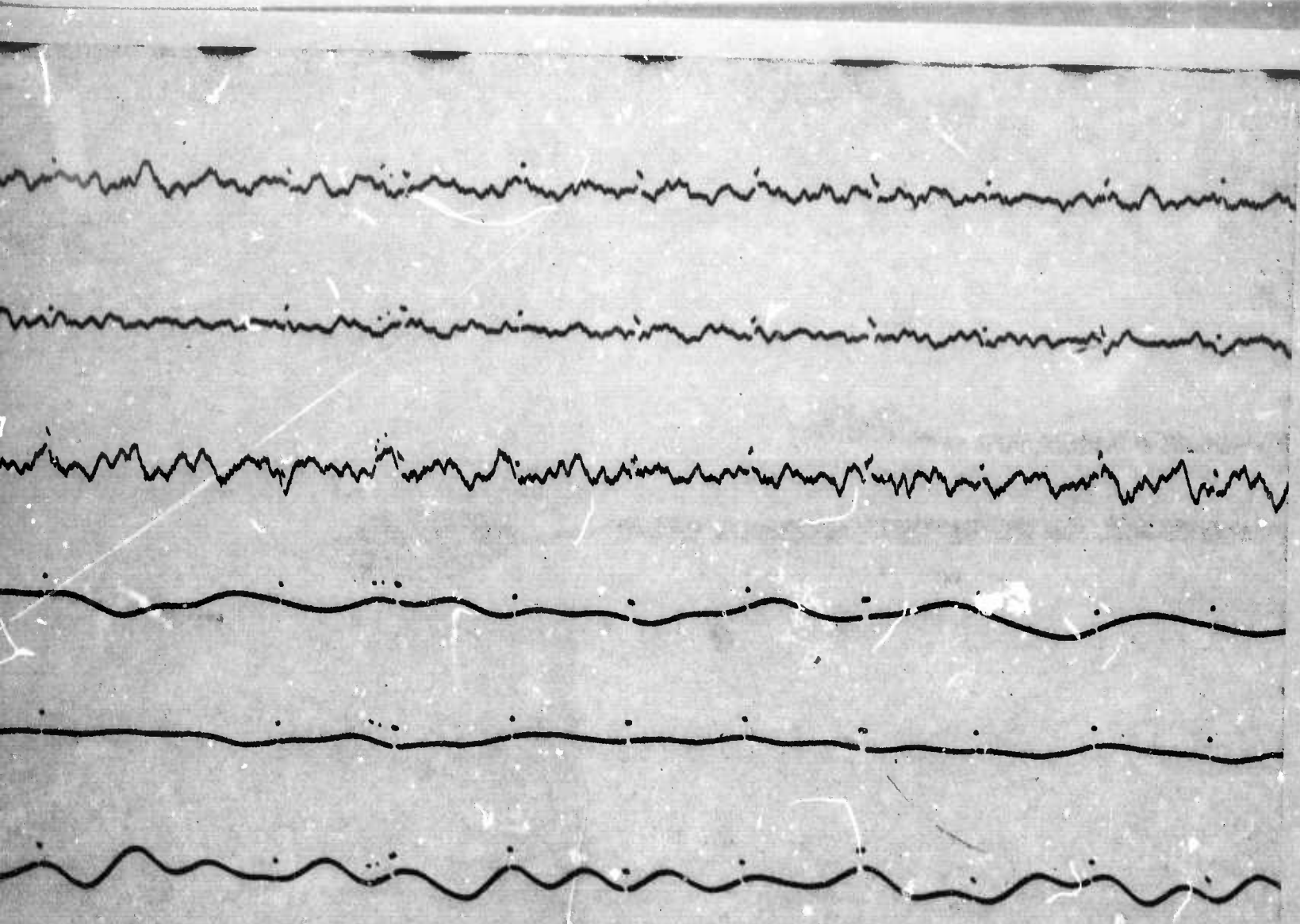
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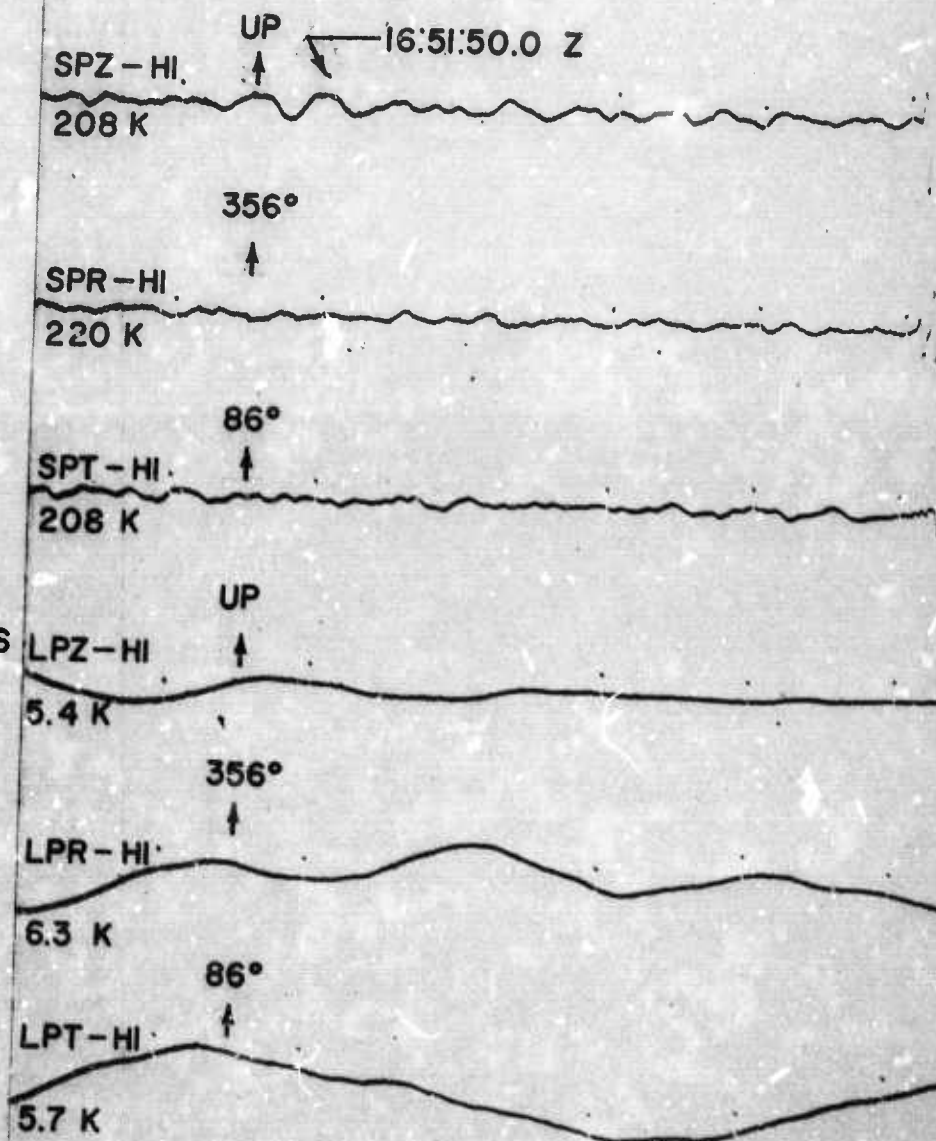
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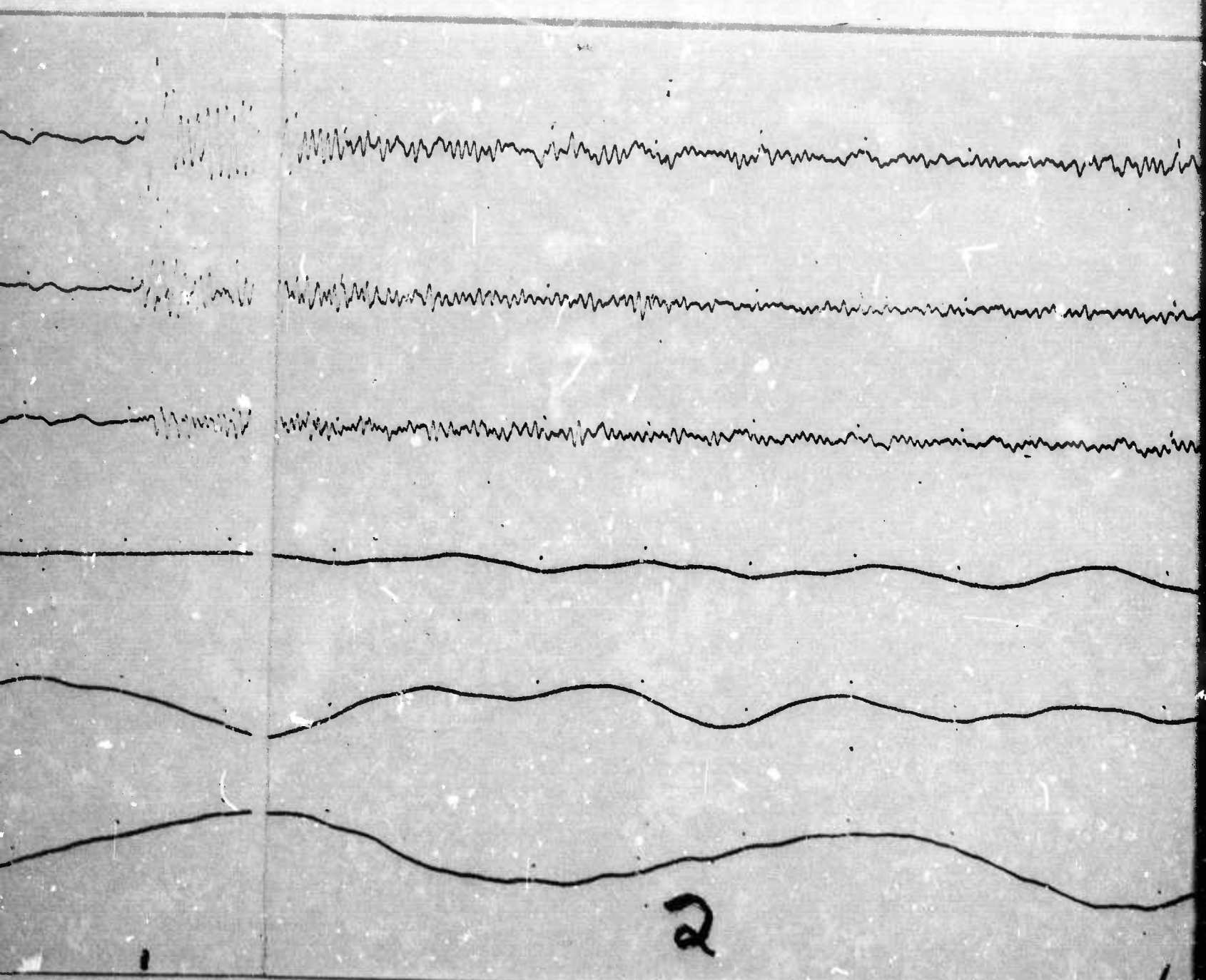
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MOULD BAY, NORTHWEST TERRITORIES

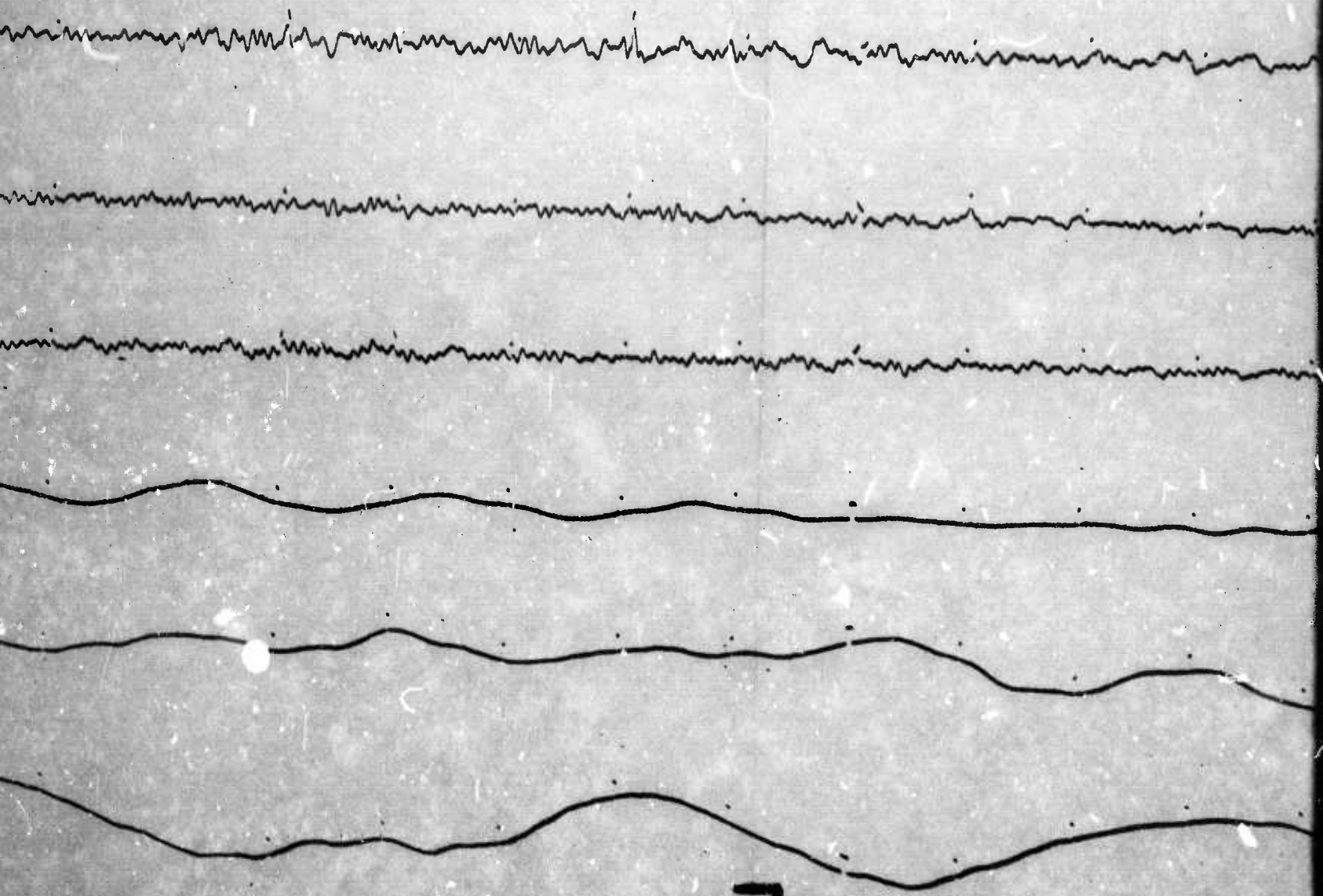
19 JANUARY 1967

$\Delta = 4363\text{km}$

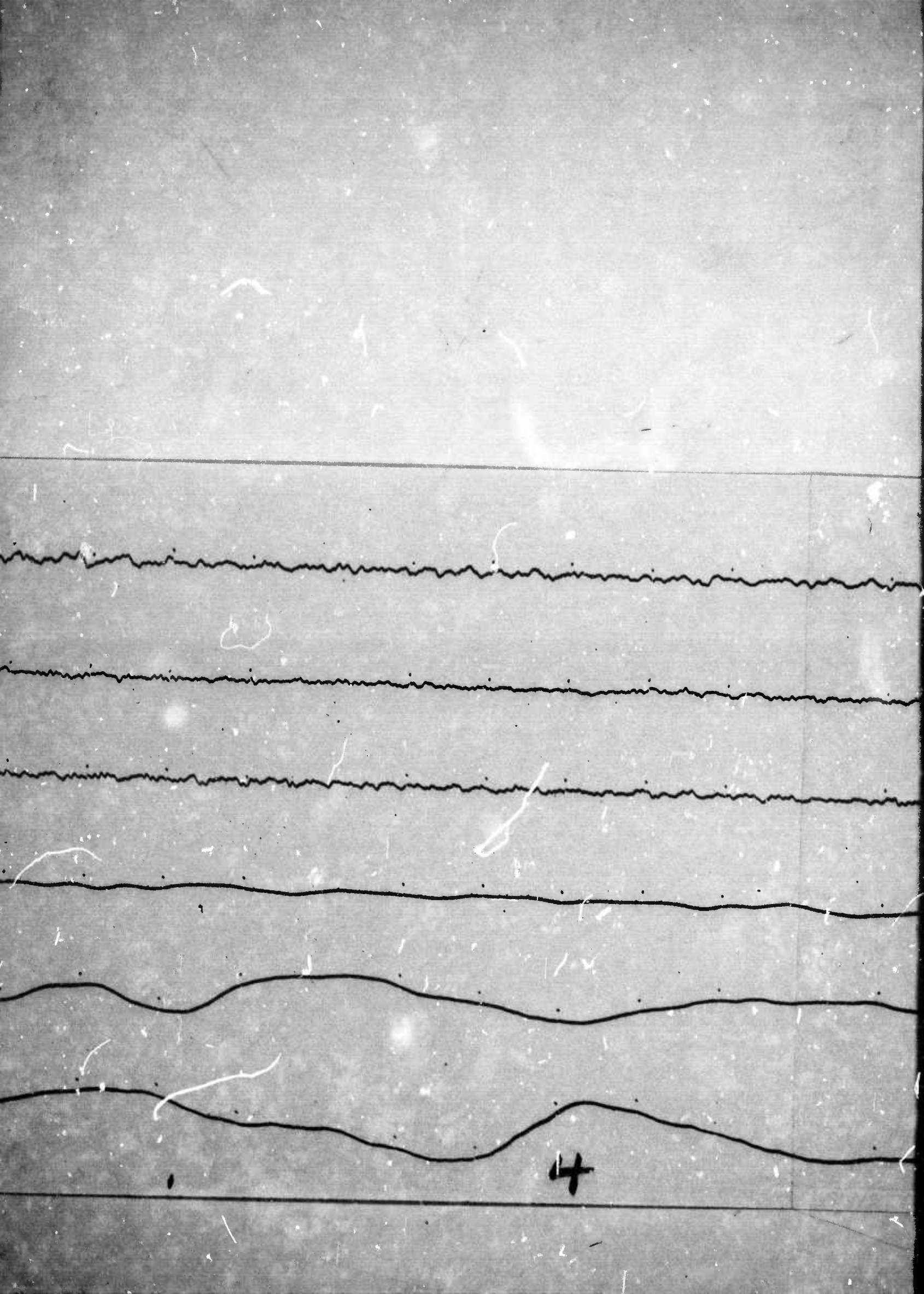


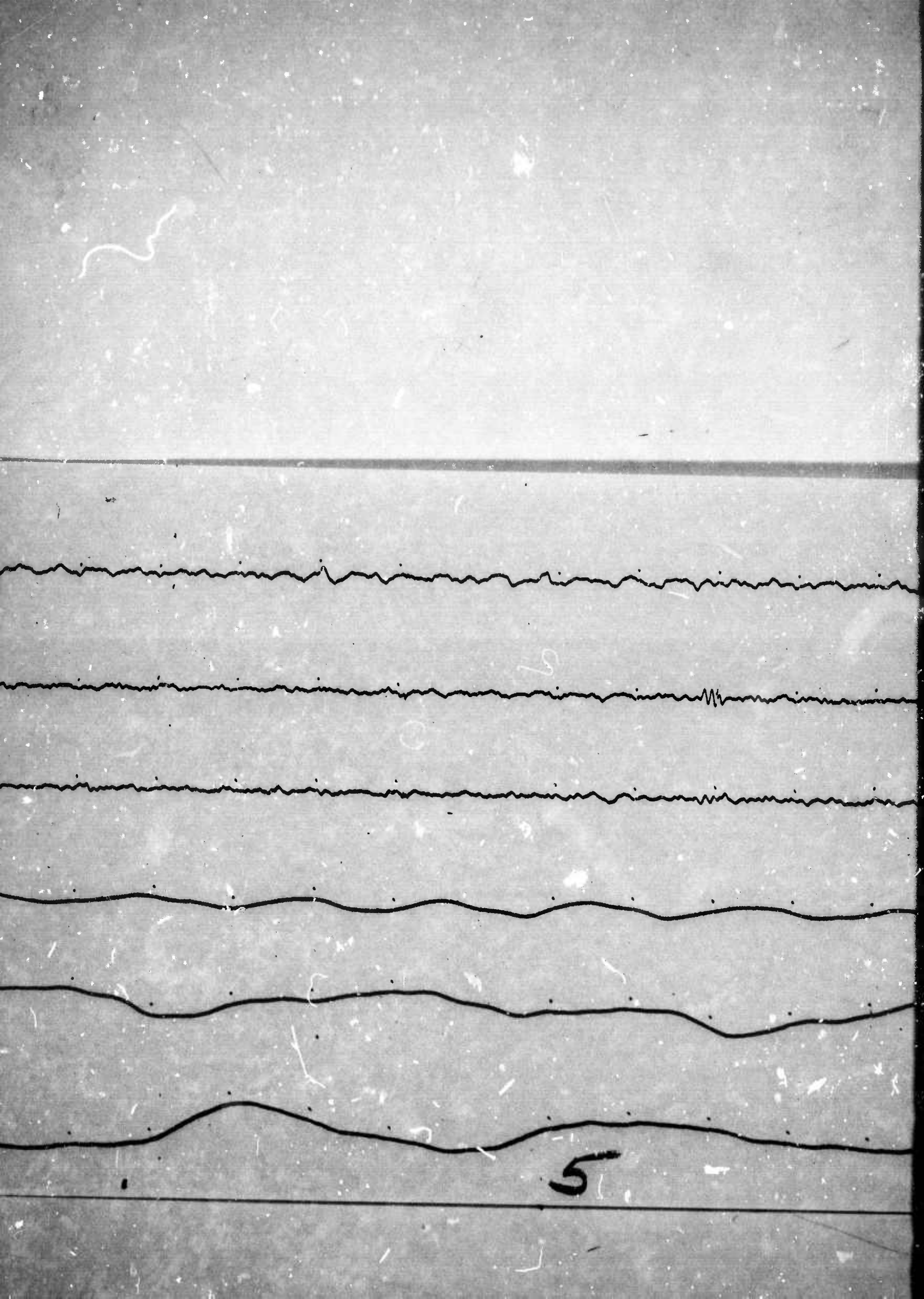


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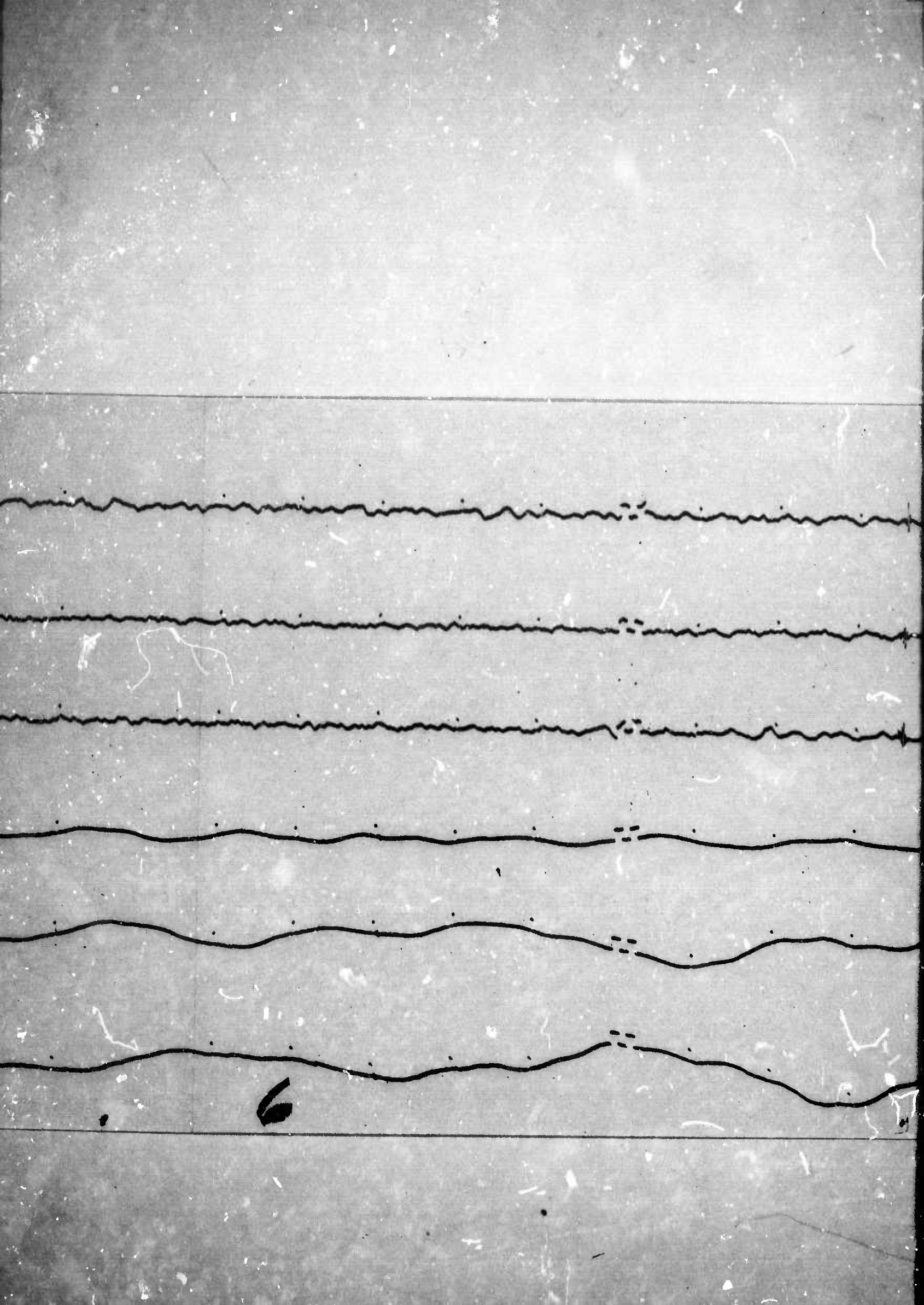


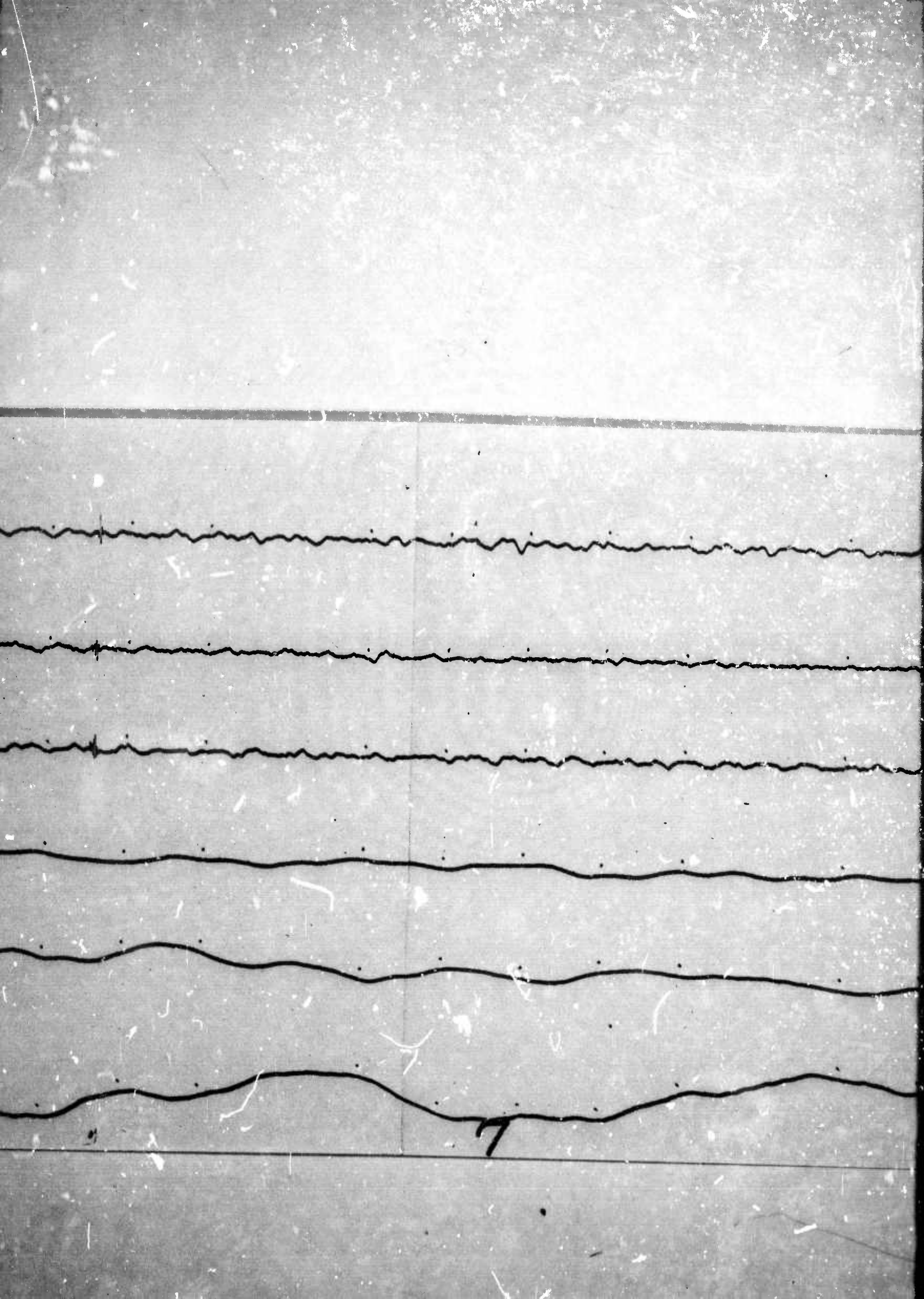
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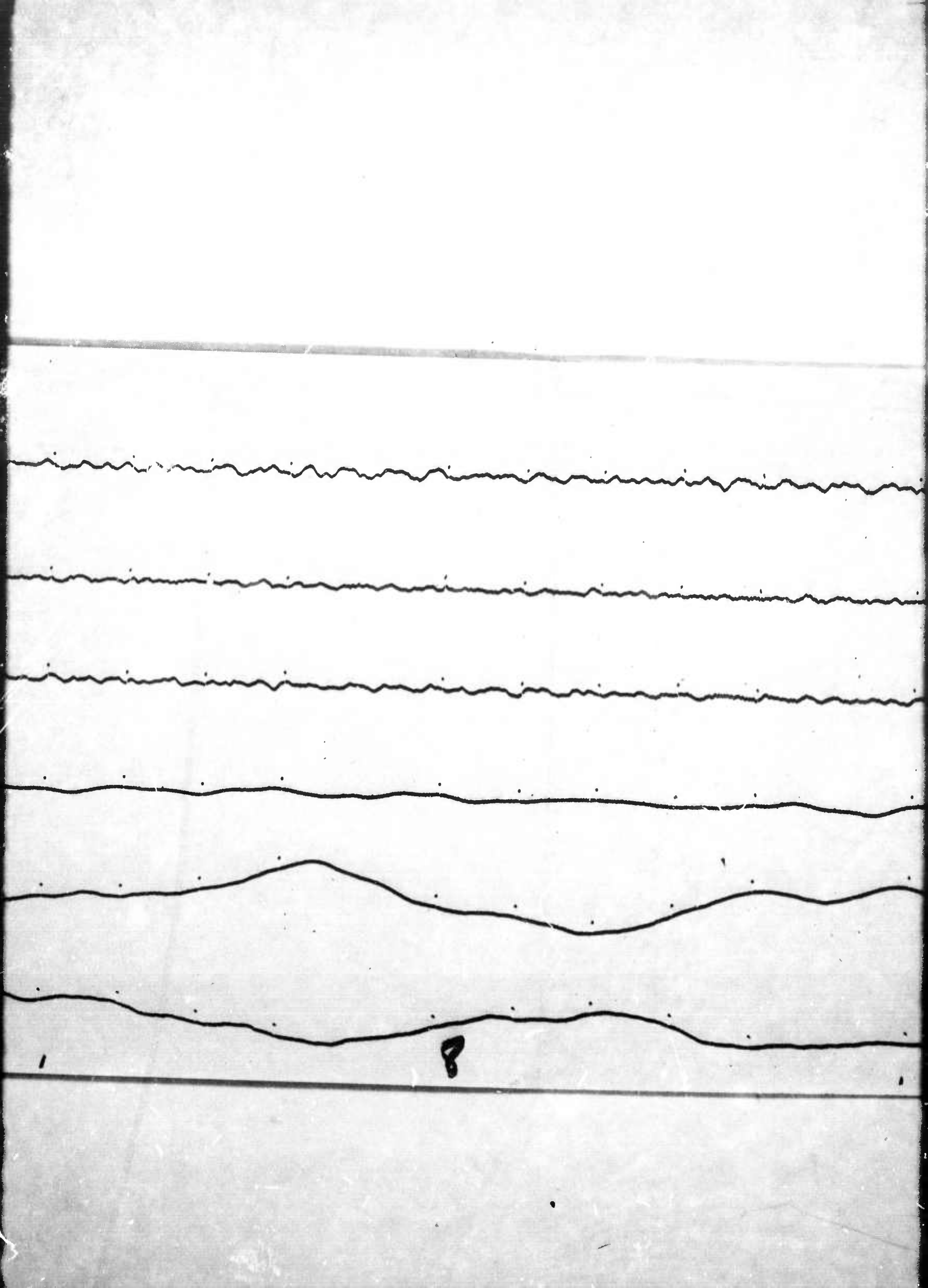


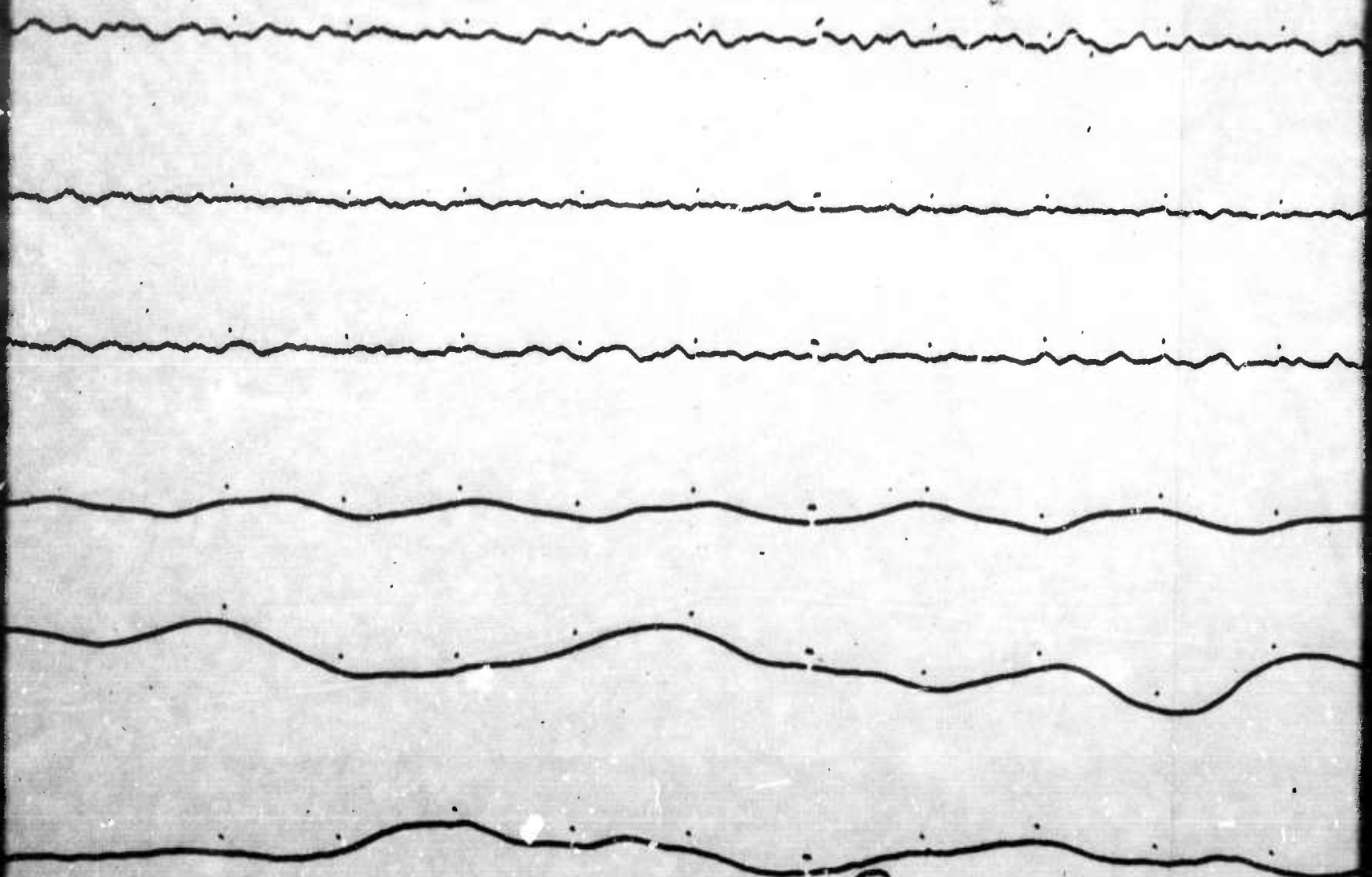


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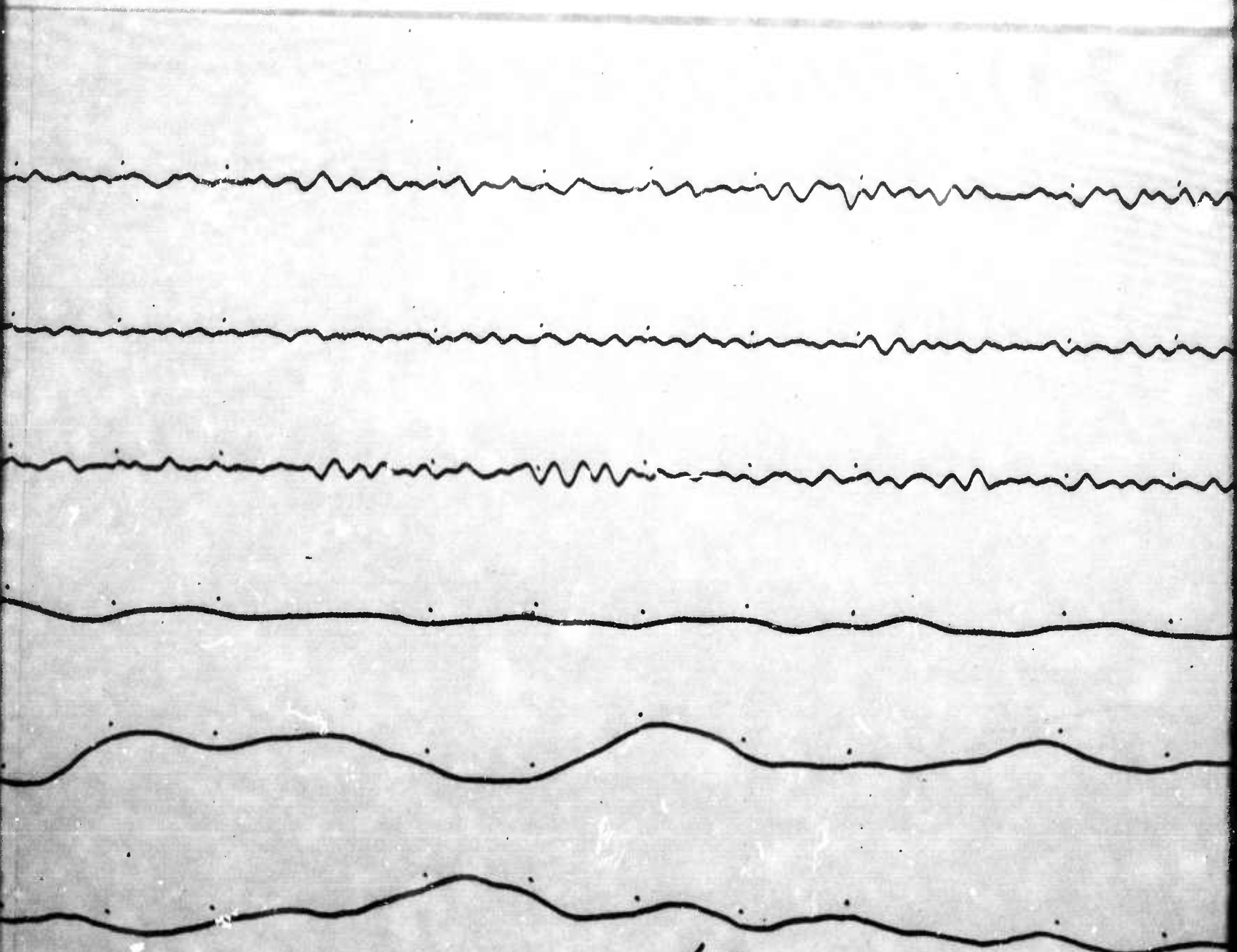




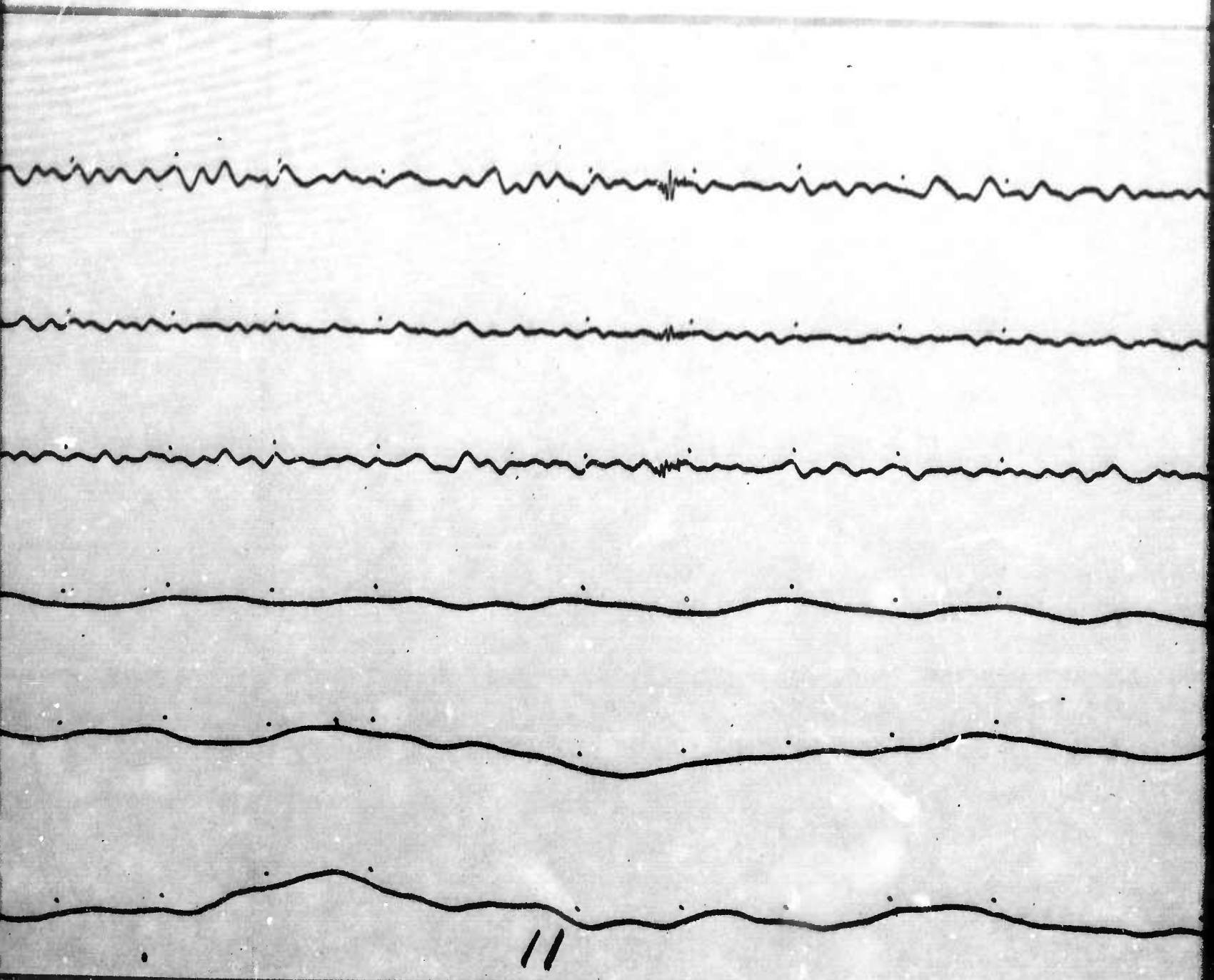




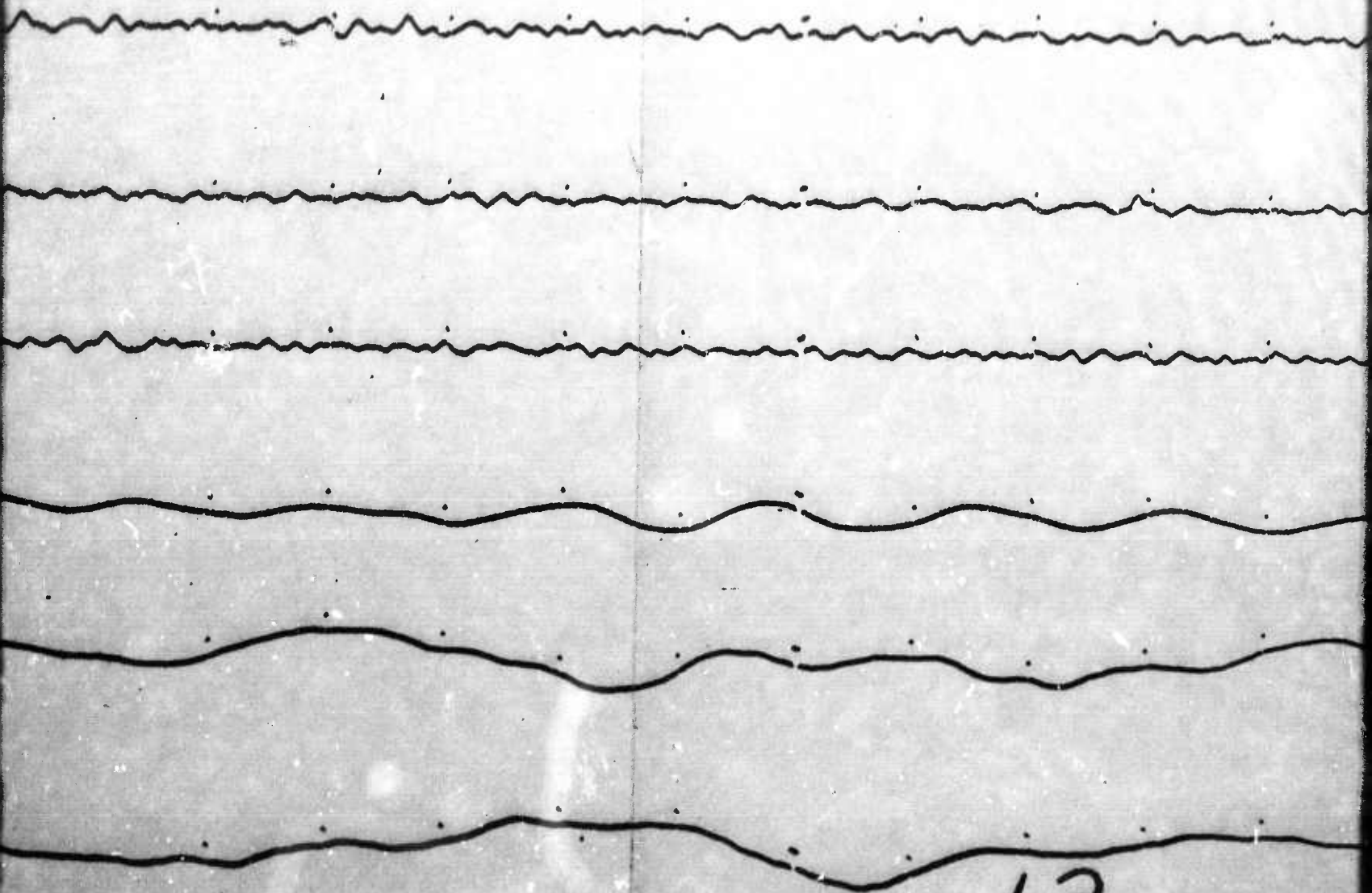
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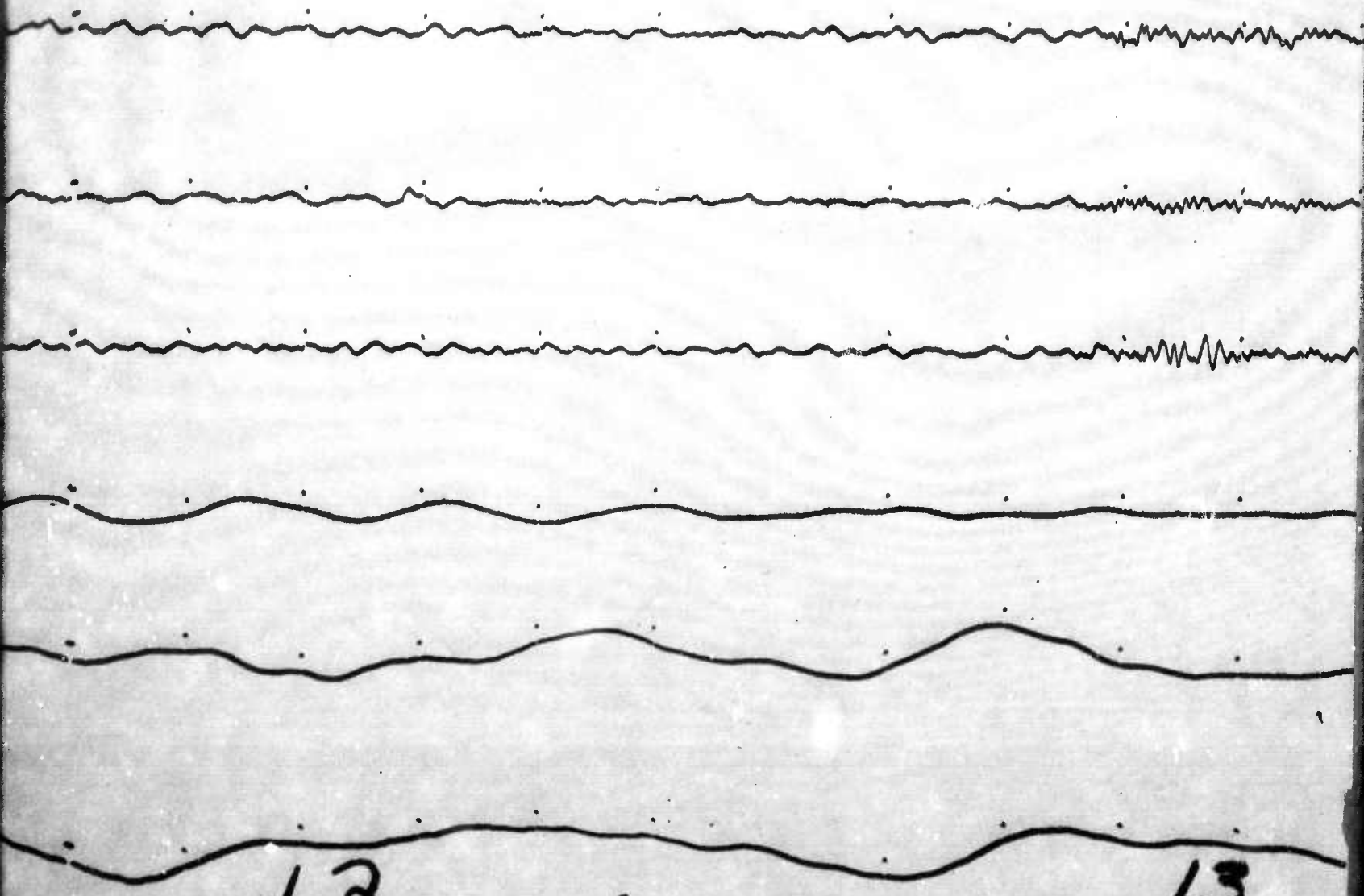
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11



12



12

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