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LONG RANGE SEISMIC MEASUREMENTS

801879
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TAN

3 JUNE 1966

Prepared for

AIR FORCE TECHNICAL APPLICATIONS CENTER

Washington, D. C.

31 OCTOBER 1966

By

EARTH SCIENCES DIVISION
TELEDYNE INDUSTRIES, INC.

Under

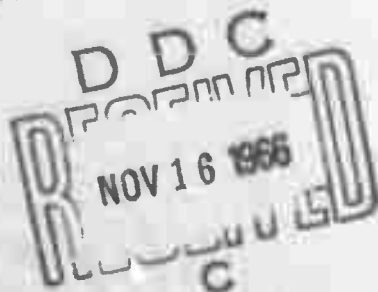
Project VELA UNIFORM

Sponsored By

ADVANCED RESEARCH PROJECTS AGENCY

Nuclear Test Detection Office

ARPA Order No. 624



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LONG RANGE SEISMIC MEASUREMENTS

TAN

3 June 1966

SEISMIC DATA LABORATORY REPORT NO. 169

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Project Title:	Seismic Data Laboratory
ARPA Order No.:	624
ARPA Program Code No.:	5810
Name of Contractor:	EARTH SCIENCES DIVISION TELEDYNE INDUSTRIES, INC.
Contract No.:	AF 33(657)-15919
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Project Manager:	William C. Dean (703) 836-7644

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AVAILABILITY

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TAN
EVENT DESCRIPTION

DATE: 3 June 1966

TIME OF ORIGIN: 14:00:00.0Z

YIELD:

MAGNITUDE: 5.56 ± 0.49

LOCATION:

SITE: Nevada Test Site, Area U7k

GEOGRAPHIC COORDINATES:

Lat: 37°04'06.0" N

Long: 116°02'07.0" W

ENVIRONMENT:

GEOLOGIC MEDIUM: Tuff

SURFACE ELEVATION: 4070 ft.

SHOT ELEVATION: 2230 ft.

SHOT DEPTH: 1840 ft.

COMPUTED EPICENTER: ALL STATIONS

GEOGRAPHIC COORDINATES:

Lat: 36°59'45.6" N

Long: 116°04'48.0" W

TIME OF ORIGIN: 14:00:04.8Z

DEPTH: 46.9 km

EPICENTER SHIFT: 9.0 km, S 26° W

Code	Station	Finel						Tape	Timing
		SPZ	SPR	SPT	LPZ	LPR	LPT		
MN-NV	Mina, Nevada	+	+	+	+	+	+	*	P
KN-UT	Kanab, Utah	+	+	+	+	+	+	*	P
TF80-Z1	Tonto Forest Observatory, Arizona	+	+	+	+	+	+	*	P
UB80-Z10	Uinta Basin Observatory, Utah	+	+	+	+	+	+	*	P
BMS0-Z3	Blue Mountain Observatory, Oregon	+	+	+	+	+	+	*	P
LAO	Subarray AO-10, Montana	+	N	N	N	N	N	*	P
SW-MA	Sweetgrass, Montana	+	+	+	+	+	+	*	P
RG-SD	Redig, South Dakota	+	+	+	+	I	+	*	P
WN-SD	Winnar, South Dakota	+	+	+	+	+	+	*	P
WMS0-Z6	Wichita Mountain Observatory, Oklahoma	+	+	+	+	+	+	*	P
CR-NB	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
CP80-Z8	Cumberland Plateau Observatory, Tennessee	+	+	+	+	+	+	*	P
AX2AL	Alexander City, Alabama	+	+	+	+	+	+	*	P
BE-FL	Bellaview, Florida	+	-	-	+	+	+	*	P
HN-ME	Houlton, Maine	+	+	+	+	+	+	*	P
SV3QB	Schafferville, Quebec, Canada	+	+	+	+	+	I	*	P
NP-NT	Mould Bay, Northwest Territories, Canada	+	+	+	+	+	+	*	P

I Inoperative + Signal
 N No Instrument - No Signal
 P Primary Timing * Magnetic Tape Available

Station Status Report - TAN

Table 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 TAN 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 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

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

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 TAN 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 TAN 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-two stations recorded short-period signals. Long-period signals from this event were recorded by 21 stations.

The unified magnitudes determined from the LRSM and VELA observatories is shown in Figure 2. The average magnitude is 5.56 ± 0.49 .

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 TAN was NP-NT at a distance of 4371 kilometers.

Principal Phases
 750
 3 June 1966
 14:00:00.00

Code	Station	Distance (km)	Dist.	Magnification (h) P in a 10	Phase	Observed Travel Time		Period τ (sec)	Maximum Amplitude A/T	Magnitude (u)	Area (km ²) LPE
						(min)	(sec)				
MS-SV	Wine, Nevada	240	SPZ	1.27	Pn	0	37.3	0.4	2825	5.73	383.90
			SPB	1.27	e	0	37.9	0.3	3948		
			SPD	1.27	e	0	38.4	0.8	3375		
			SPZ	1.27	Pg	0	39.8	(0.8)	(17431)		
			SPT	0.74	Lg			1.0	10970		
			LPT		LQ			---	---		
MS-UT	Kanab, Utah	285	SPB	2.08	Pn	0	42.9	0.5	1653	5.71	257.23
			SPS	2.08	e	0	44.0	0.8	2427		
			SPZ	0.47*	Pg	0	47.9	0.8	14528		
			SPT	1.5*	Lg			1.0	19000		
			LPT	14.1*	LQ			(9.0)	(819)		
			LPS	4.8	LR			12.0	1393		
7760	Yanto Forest Observatory, Arizona	531	SPS-1	14.7	Pn	1	14.5	0.35	317	5.83	201.00
			SPS-1	14.7	e	1	15.9	0.55	220		
			LPS	97.0	e	1	17	20.0	8.7		
			SPS-1	14.7	(P*)	1	19.1	0.8	232		
			SPS-1	1.87	Pg	1	27.0	1.2	2409		
			SPS-1	1.87	e	1	44.8	1.2	1581		
			SPW	1.87	e			1.1	1397		
			SPS	1.87	e			(1.2)	(1355)		
			LPS	14.0	LQ			(13.0)	(55.8)		
			LPT	15.0	LQ			(13.0)	(42.7)		
			LPS	5.0	LR			17.0	233		
			0860	Vinto Basin Observatory, Utah	668	SPS-10	9.2	Pn	1		
SPS-10	9.2	e				1	39.5	1.0	544		
SPS-10	9.2	(P*)				1	44.2	(1.15)	(295)		
SPS-10	21.9*	Pg				1	52.9	1.1	1851		
LPS	13.8	e				2	00	22.0	3.7		
LPM	13.1	e				2	00	22.0	2.6		
SPW	12.31*	Lg						1.2	2744		
SPZ	4.41*	Lg						1.1	7542		
LPS	13.1	LQ						19.0	41.7		
LPE	13.8	LQ						13.0	83.0		
LPS	25.0*	LR						(14.0)	(223)		
0860	Blue Mountain Observatory, Oregon	871				SPS-3	(500*)	Pn	1	58.2	(0.7)
			SPS-3	(500*)	e	2	00.0	1.0	(84.0)		
			SPS-3	(500*)	Pg			---	---		
			SPW		Lg			---	---		
			LPS	14.5	LQ			18.0	82.9		
			LPM	14.5	LQ			(20.0)	(19.3)		
			LPS	1.0	LR			14.0	250		
			LPS								
LAO	Subarray AO-10, Montana	1342	SPZ	320	Pn	2	53.1	1.3	45.7	5.75	79.10
			SPS	30.0	e	2	54.0	1.15	124		
			SPZ	30.0	PP	3	01.4	1.1	94.7		
			SPZ	30.0	e	3	10.5	1.0	188		
			SPZ	30.0	(Pg)	3	41.1	1.1	118		
			SPZ	30.0							
09-MA	Sweetgroe, Montana	1343	SPB	188.5	P	2	(58.2)	1.2	134	6.20	79.10
			SPZ	188.5	PP	3	08.7	1.2	151		
			SPB	168.5	e	3	17.4	0.8	50.8		
			SPZ	166.5	Pg	3	45.8	1.2	138		
			SPB	114*	Lg			1.4	361		
			SPT	110*	Lg			1.2	238		
			LPR	20.4	LQ			(13.0)	(52.1)		
			LPT	21.09	LQ			(13.0)	(10.9)		
			LPS	25.6	LR			13.0	266		
			LPS								
RG-SD	Redig, South Dakota	1383	SPZ	102.5	P	2	(58.4)	1.0	43.9	5.70	139.10
			SPZ	102.5	e	3	01.6	0.8	72.7		
			SPZ	(76.9*)	PP	3	14.2	0.9	(259)		
			SPB	102.5	(Pg)	3	57.1	0.9	110		
			SPR	47.0	Lg			1.2	509		
			SPT	59.0	Lg			(1.2)	(601)		
			LPT	6.81	LQ			24.0	44.7		
			LPS	9.13	LR			13.0	276		
			LPS								
			LPS								
09-SD	Winnier, South Dakota	1511	SPZ	90.4	P	3	(15.0)	(1.2)	(437)	(6.40)	114.63
			SPB	90.4	e	3	23.1	1.1	178		
			SPB	90.4	PP	3	26.8	(1.2)	(867)		
			SPB	90.4	Pg	4	11.9	(1.1)	(266)		
			SPB	90.4	e	5	11.2	1.1	169		
			SPR	84.6	Lg			1.4	481		
			SPT	53.2*	Lg			1.3	491		
			LPS	20.8	LQ			15.0	113		
			LPT	18.7	LQ			15.0	55.4		
			LPS	32.8	LR			13.0	292		
09-SD	Wichita Mountain Observatory, Oklahoma	1594	SPS-8	163*	P	3	(28.1)	1.2	104	5.52	75.71
			SPS-4	183*	e	3	34.9	1.2	93.3		
			SPS-8	163*	PP	3	(18.6)	1.1	72.1		
			SPS-8	163*	a	3	46.2	1.1	49.1		
			SPS-6	163*	Pg	4	30.9	1.1	221		
			SPW	50.0	Lg			1.8	423		
			SPW	50.0	Lg			1.45	161		
			LPR	9.0	LQ			15.0	43.6		
LPS	10.5	LR			15.0	93.2					
CR-NE	Crate, Nebraska	1709	SPB	33.1	P	3	39.1	1.1	204	5.46	112.24
			SPZ	33.1	e	3	44.8	1.0	242		
			SPZ	33.1	e	3	52.3	0.9	127		
			SPB	33.1	(Pg)	5	00.6	0.7	104		
			SPZ	33.1	(PcP)	8	43.0	0.8	108		
			SPR	15.5	Lg			1.2	488		
			SPT	15.6	Lg			1.2	683		
			LPR	9.21	LQ			15.0	125		
			LPT	9.94	LQ			15.0	78.9		
			LPS	3.72	LR			12.0	559		

Principal Phases - TAN
 Table 2 - Page 1

Principal Phases
 TAN
 3 June 1966
 14:00:00.02

Code	Station	Elevation (m)	Dist.	Approx. Elevation (m) 7:14 N 17	Phase	Observed Travel Time		Period P (sec)	Minimum Magnitude M ₀	Height (m)	Area (km ²)
						(sec)	(sec)				
22-01	Casper, Alberta, Canada	2721	070	140	F	2	107.37	11.01	101.0	14.80	107.20
			080	77.49	F	0	00.0	11.1	101.0		
			090	70.17	SA	0	00.0	11.71	100.0		
			100	61.87	SA	0	00.0	11.77	100.0		
			120	41.4	SA	0	00.0	14.0	99.4		
			130	34.0	SA	0	00.0	15.70	771.70		
30-01	Beauregard City, Wyoming	1000	070	48.3	F	2	106.41	11.11	11.01	11.00	100.00
			080	48.2	F	0	00.0	11.11	11.01		
			090	32.0	SA	0	00.0	11.8	100		
			100	21.2	SA	0	00.0	12.0	100.0		
			120	11.8	SA	0	00.0	14.0	92.0		
			130	14.8	SA	0	00.0	15.2	92.4		
40-01	Bygone Heights, British Columbia, Canada	1000	070	172	F	2	98.3	11.1	40.0	4.00	100.00
			080	172	F	4	00.0	11.7	100		
			090	172	F	4	00.0	11.7	100		
			100	172	SA	4	00.0	11.1	87.1		
			120	172	SA	4	00.0	11.1	34.1		
			130	145	SA	0	00.0	11.0	100		
42-01	Beauregard, British Columbia, Canada	1540	070	100	F	4	98.4	9.00	10.0	4.00	100.00
			080	100	F	4	00.0	1.0	100		
			090	100	F	4	00.0	1.0	100		
			100	171	SA	0	00.0	2.0	60.0		
			120	171	SA	0	00.0	3.0	100		
			130	13.9	SA	0	00.0	14.0	44.0		
50-01	Red Lake, Ontario, Canada	2340	070	10.3	F	4	40.0	9.00	100	4.00	100.00
			080	13.3	F	4	00.0	1.0	100		
			090	21.0	SA	4	00.0	1.0	100		
			100	20.7	SA	0	00.0	2.0	100		
			120	14.1	SA	0	00.0	11.0	60.7		
			130	47.2	SA	0	00.0	13.0	10.1		
0700	Cumberland Station Observatory, Tennessee	2720	070-0	41.0	F	8	11.0	9.00	40.0	2.00	100.00
			080-0	41.0	F	8	00.0	0.0	10.0		
			090-0	40.0	F	8	00.0	44.0	10.0		
			100	31.0	SA	8	00.0	10	10.0		
			120	24.0	SA	8	00.0	100.0	10.0		
			130	400	SA	12	00.0	17.0	42.0		
2220	Evanston City, Alabama	2100	070	171	F	8	10.0	8.0	100.0	10.00	100.00
			080	171	F	8	00.0	1.0	47.0		
			090	171	F	8	00.0	49.0	1.0		
			100	171	SA	8	00.0	10.0	10.0		
			120	162	SA	8	00.0	10.0	10.0		
			130	140	SA	8	00.0	10.0	10.0		
30-01	Bellefleur, Florida	2000	070	10.0	F	4	107.43	11.01	11.01	10.00	100.00
			080	21.1	SA	4	00.0	10.0	10.0		
			120	48.2	SA	4	00.0	11.0	10.0		
			070	100	F	4	00.0	8.0	10.0		
			100	100	SA	4	00.0	10.0	10.0		
			120	100	SA	4	00.0	10.0	10.0		
4100	Walla Walla, Washington, Canada	4100	070	100	F	4	17.0	1.0	100	10.00	100.00
			080	100	SA	4	00.0	10.0	10.0		
			090	100	SA	4	00.0	10.0	10.0		
			120	100	SA	4	00.0	10.0	10.0		
			130	100	SA	4	00.0	10.0	10.0		
			130	100	SA	4	00.0	10.0	10.0		
50-01	Walla Walla, Northwest Washington, Canada	4321	070	100	F	7	20.0	11.0	100	10.00	100.00
			080	100	F	7	00.0	1.0	10.0		
			090	100	SA	7	00.0	1.0	10.0		
			100	100	SA	7	00.0	1.0	10.0		
			120	100	SA	7	00.0	1.0	10.0		
			130	100	SA	7	00.0	1.0	10.0		

Principal Phases - TAN
 Table 2 - Page 2

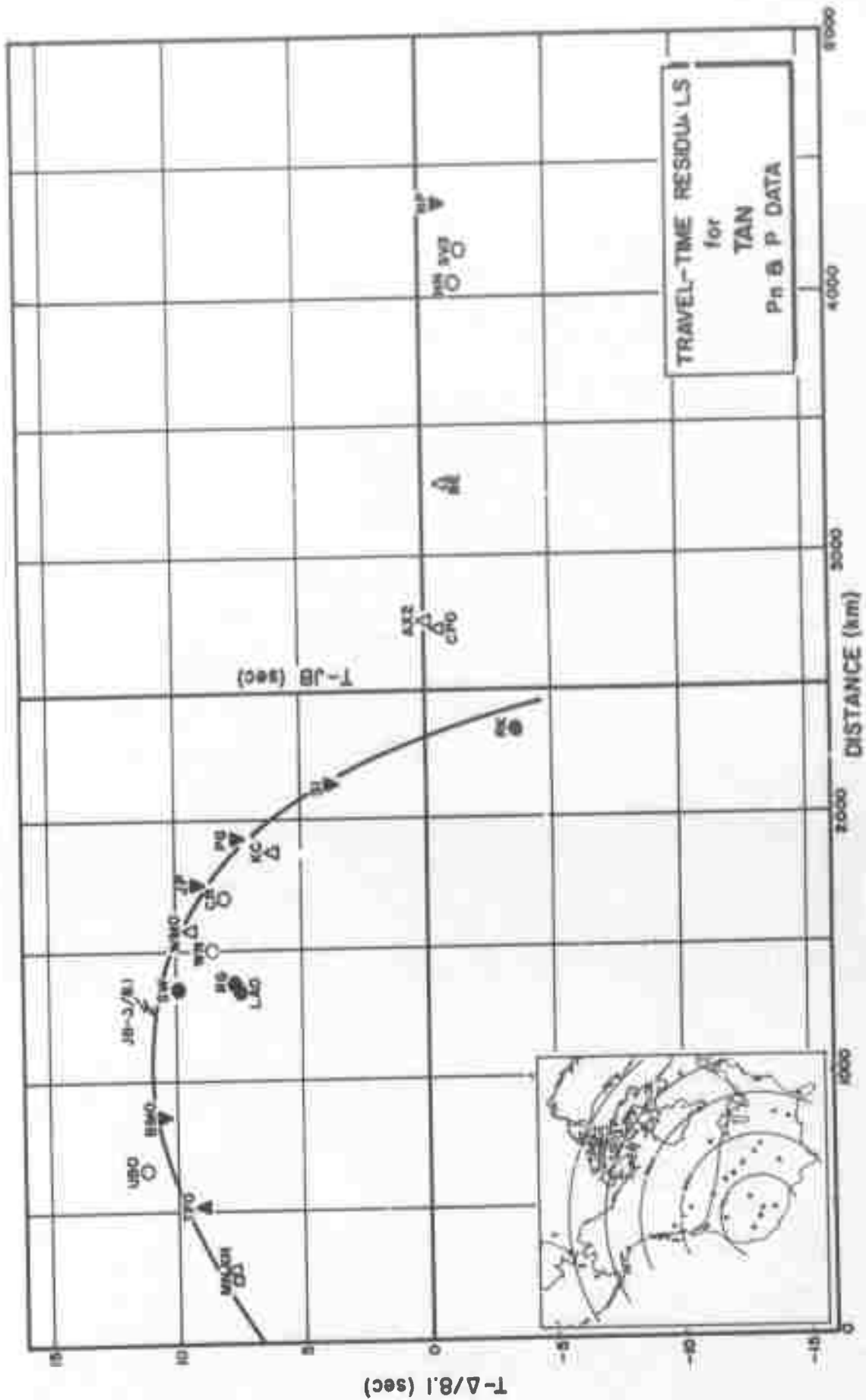


Figure 3

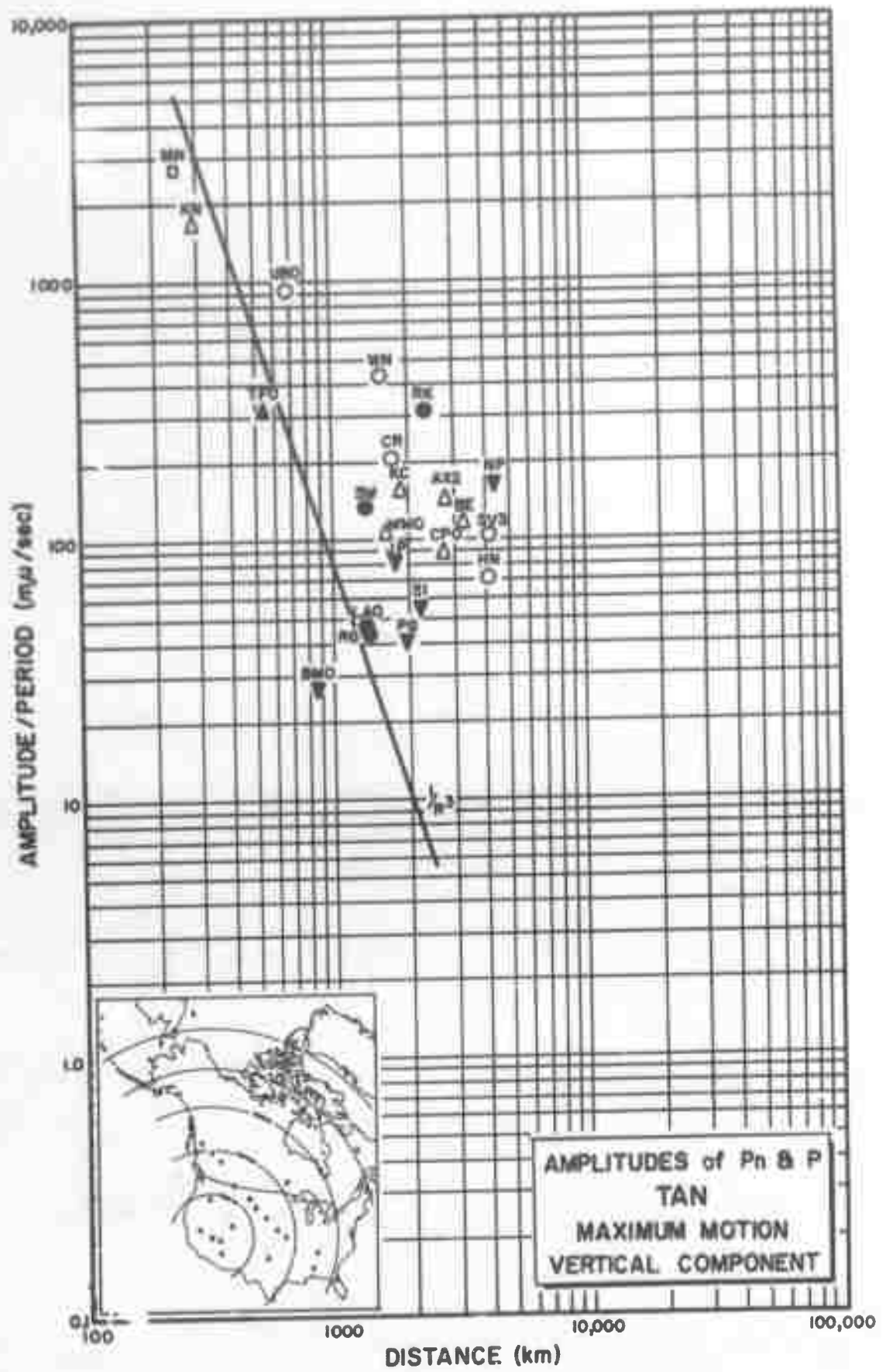


Figure 4

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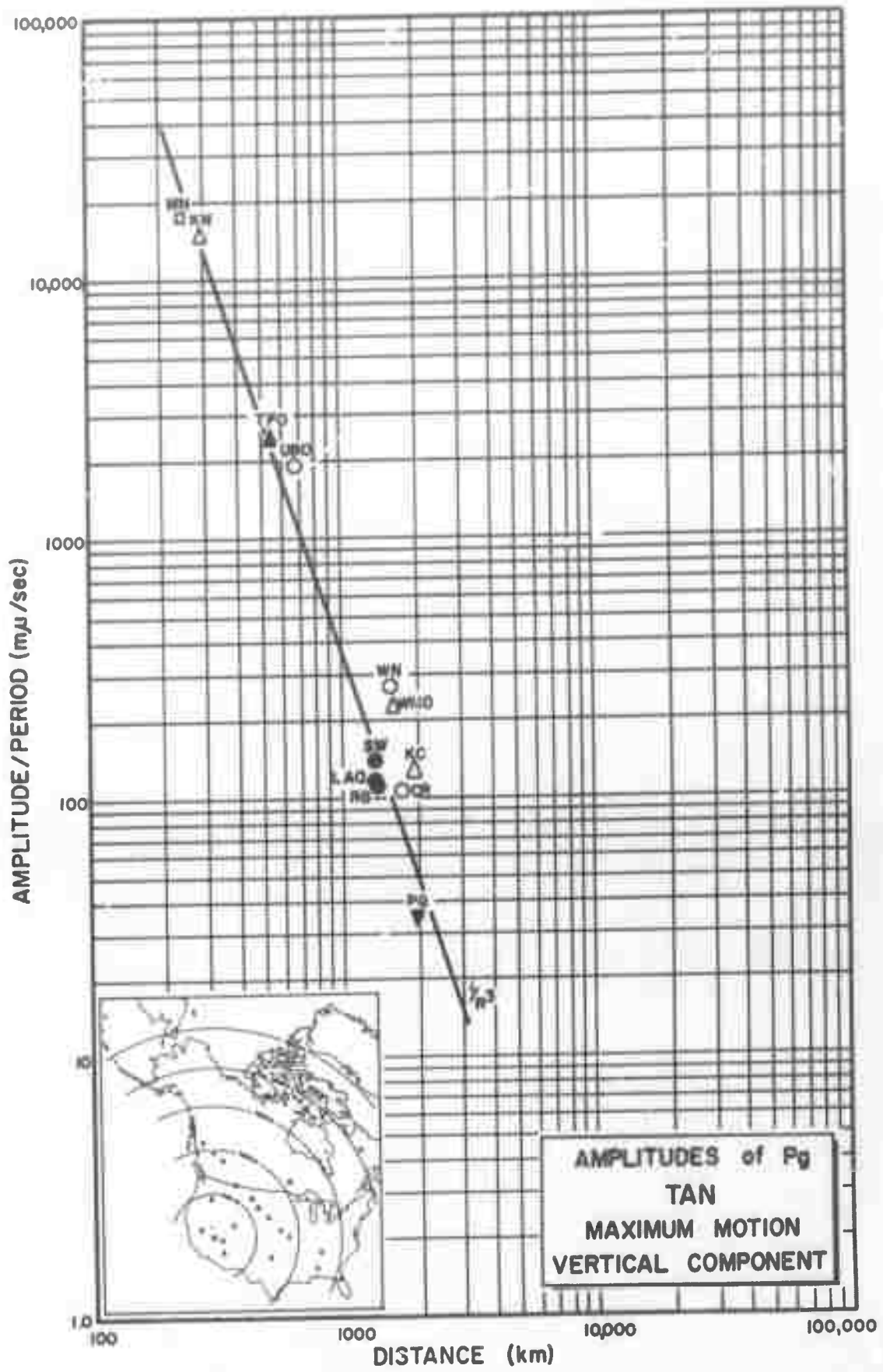


Figure 5

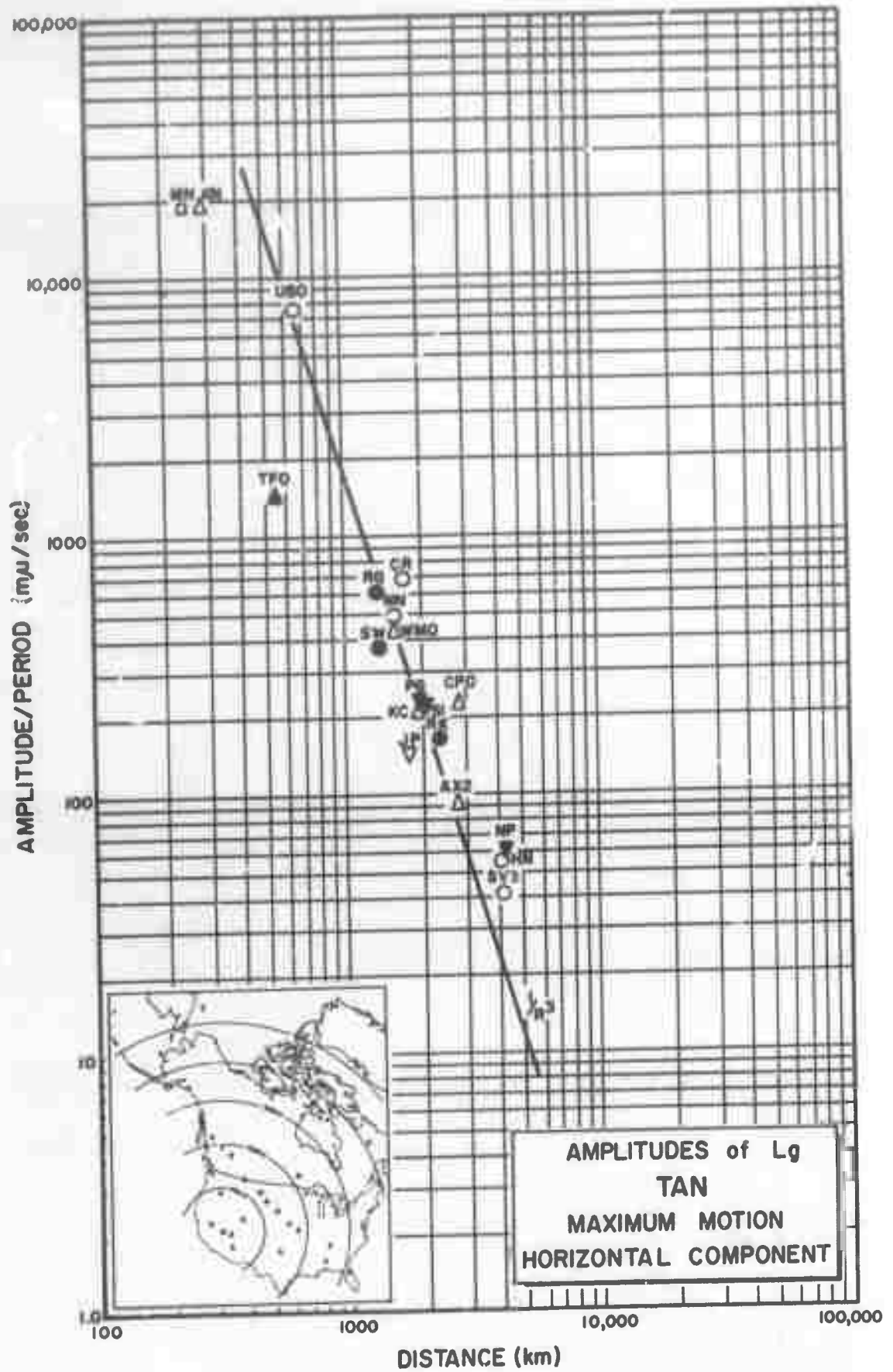


Figure 6

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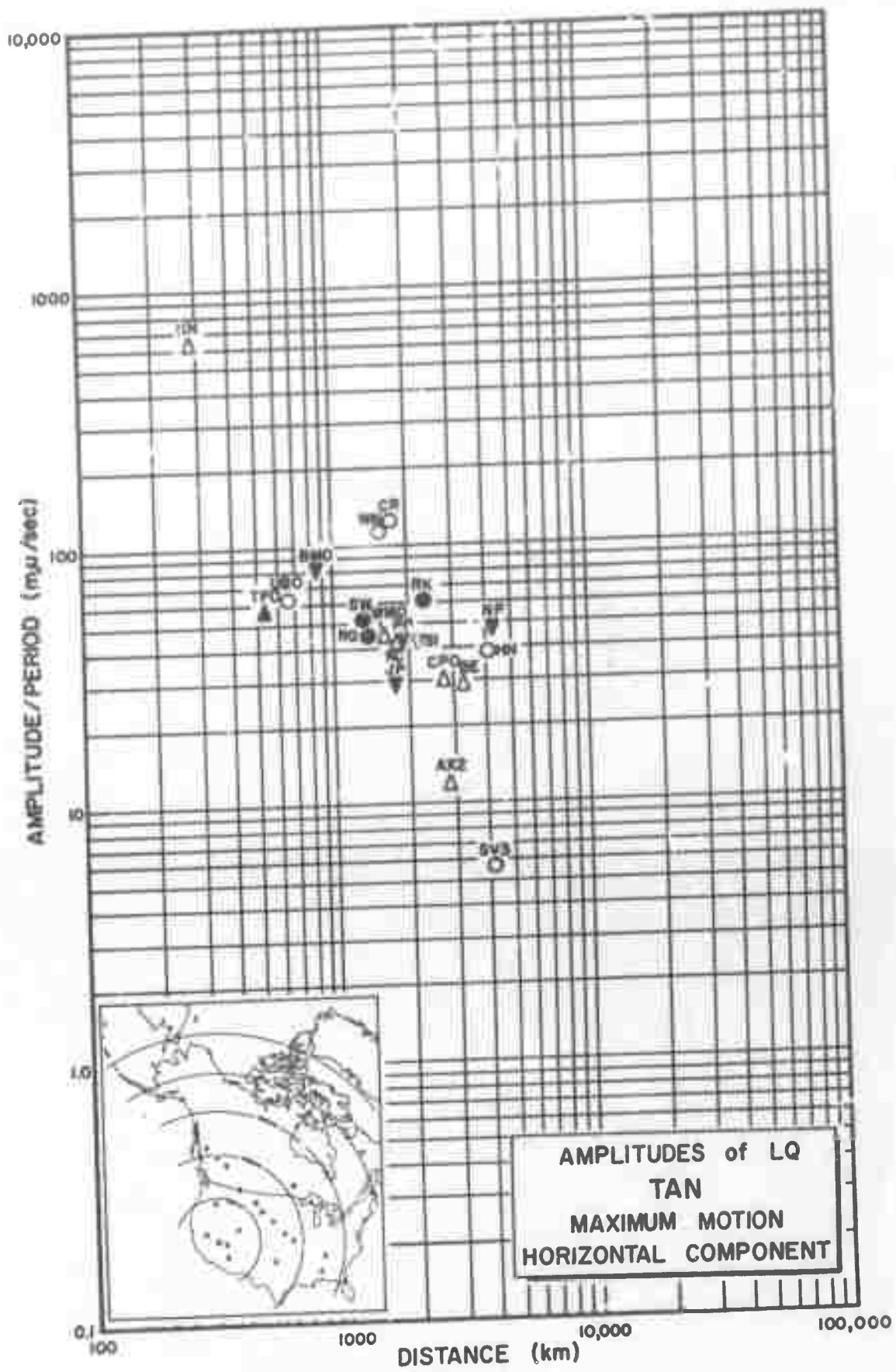


Figure 7

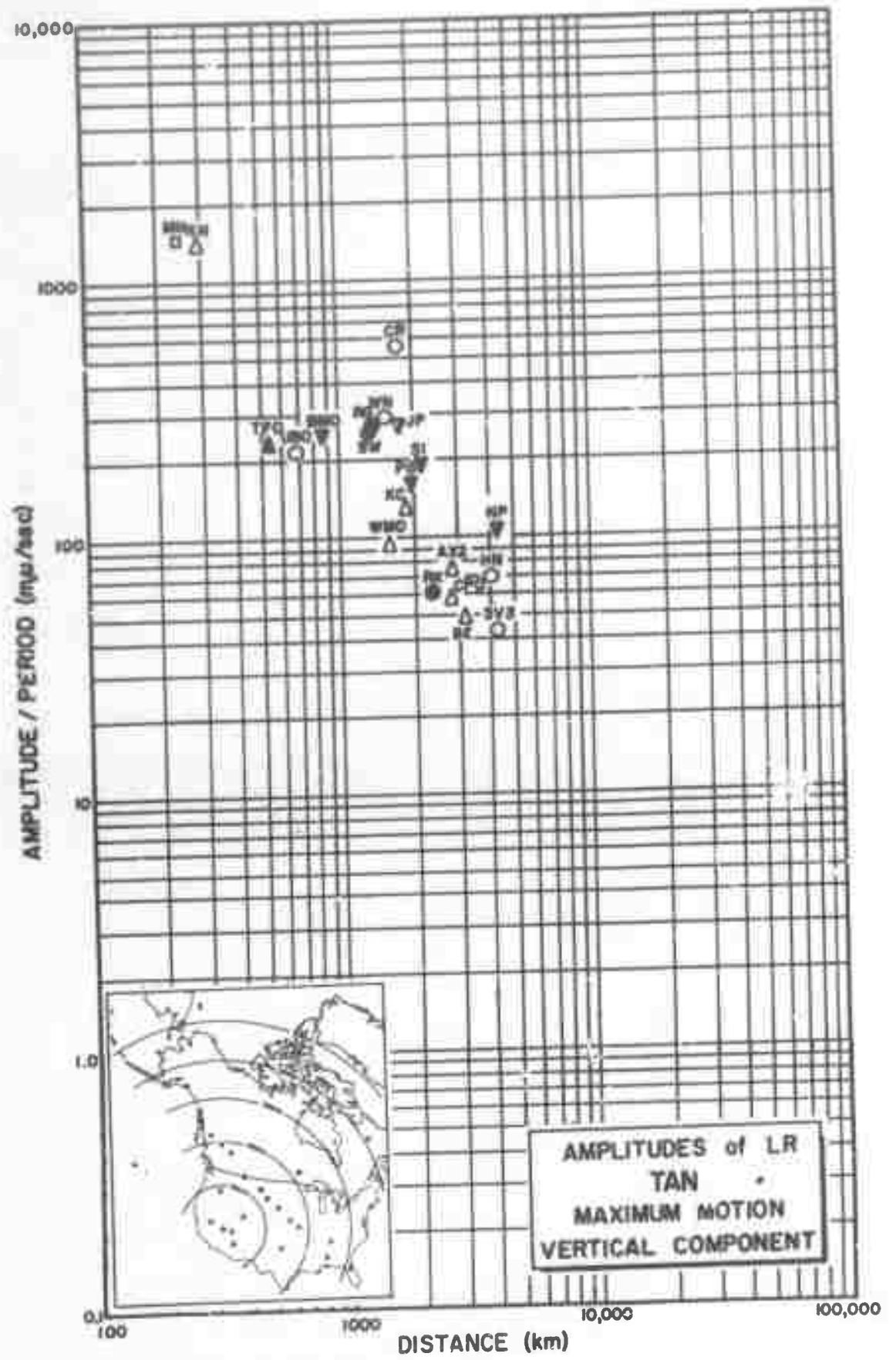


Figure 8

Code	Station	Distance (km)	Geographic Latitude	Geographic Longitude	Elev. (km)	Compared Azimuth		Installed Azimuth		Large or Small SP	LP Inst.
						Dpl. Sta.	Sta. Dpl.	Radial	Tang.		
MH-NV	Mina, Nevada	240	38°26'10" N	118°00'53" W	1.52	210°	129°	308°	38°	L	X
KN-UT	Kanab, Utah	285	37°01'27" N	112°49'39" W	1.74	90°	277°	95°	185°	L	X
TFPO-ZI*	Tonto Forest Observatory, Arizona	531	34°17'12" N	111°16'03" W	1.49	124°	307°	90°	0°	JM	X
UBSO-ZIO	Uinta Basin Observatory, Utah	668	40°19'18" N	109°34'07" W	1.60	55°	239°	90°	0°	JM	X
BMSO-E3*	Blue Mountain Observatory, Oregon	871	44°50'56" N	117°18'20" W	1.19	353°	173°	0°	90°	JM	X
LAO	Subarray AO-10, Montana	1342	46°41'19" N	106°13'20" W	.90	34°	221°			MSZ	
SW-MA*	Sweetgrass, Montana	1363	48°50'00" N	111°57'46" W	1.11	13°	196°	121°	211°	B	X
RG-SD*	Redig, South Dakota	1383	45°12'59" N	103°32'05" W	.95	45°	233°	127°	217°	L	X
WN-SD*	Winnar, South Dakota	1511	43°15'00" N	100°11'46" W	.79	58°	248°	129°	219°	L	X
WMSO-Z6*	White Mountain Observatory, Oklahoma	1594	34°43'05" N	98°35'21" W	.51	94°	284°	90°	0°	JM	X
CR-NE*	Crete, Nebraska	1709	40°39'52" N	96°31'15" W	.44	71°	263°	131°	221°	L	X
JP-A1	Jasper, Alberta, Canada	1767	52°53'50" N	118°05'25" W	1.13	355°	174°	114°	204°	L	X
KC-MO*	Kansas City, Missouri	1884	39°21'21" N	94°40'17" W	.27	76°	269°	133°	223°	B	X
PG-BC*	Prince George, British Columbia, Canada	1948	53°59'50" N	122°31'23" W	.91	347°	263°	110°	200°	L	X
SI-BC*	Smithers, British Columbia, Canada	2143	54°47'18" N	127°04'17" W	.54	340°	152°	107°	197°	L	X
RK-ON	Red Lake, Ontario, Canada	2343	50°50'20" N	93°40'26" W	.37	42°	238°	98°	148°	B	X
CPPO-SS*	Cumberland Plateau Observatory, Tennessee	2723	35°35'41" N	85°34'13" W	.57	04°	282°	90°	0°	JM	X
AX2AL*	Alexander City, Alabama	2762	32°46'38" N	86°07'48" W	.23	91°	288°	138°	220°	L	X
SE-FL*	Sellew, Florida	3282	28°54'19" N	82°03'52" W	.82	96°	295°	140°	236°	B	X
HM-ME	Houlton, Maine	4066	45°09'43" N	67°59'09" W	.21	60°	273°	93°	183°	B	X
EV3QB*	Schefferville, Quebec, Canada	4189	51°48'39" N	66°45'00" W	.58	46°	263°	139°	229°	B	X
WP-NY	Mould Bay, Northwest Territories, Canada	471	76°15'08" N	119°22'18" W	.04	359°	176°	334°	86°	JM2	X

*Seismometers Not Orientated Toward Nevada Test Site

Recording Site Information - TAN
Appendix I(A)

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

where

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

T = signal period in seconds

B = distance factor (see Table below)

a = record amplitude in millimeters zero to peak

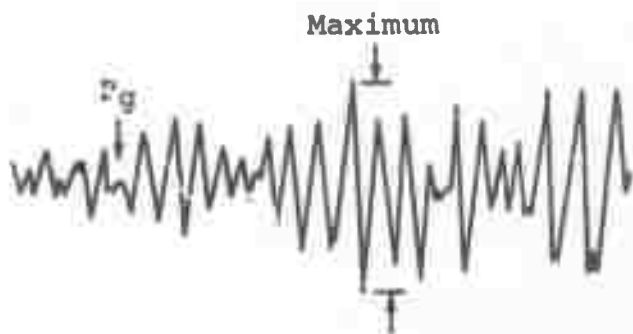
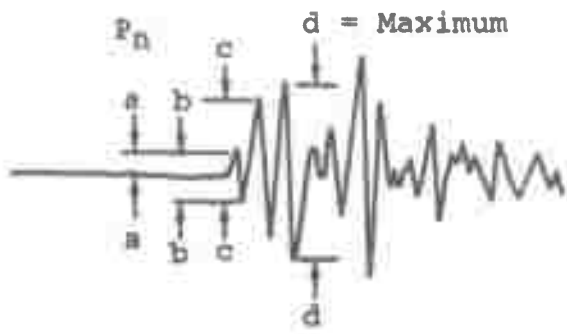
K = magnification in thousands at signal frequency

Table of Distance Factors (B) for Zero Depth

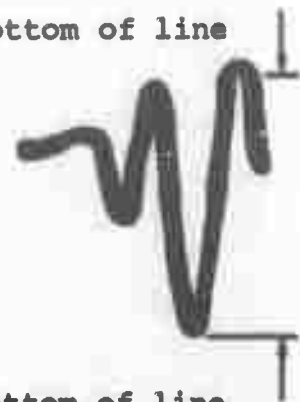
Dist (deg)	B	Dist (deg)	B	Dist (deg)	B	Dist (deg)	B
0°	-	27°	3.5	54°	3.8	80°	3.7
1	-	28	3.6	55	3.8	81	3.8
2	2.2	29	3.6	56	3.8	82	3.9
3	2.7	30	3.6	57	3.8	83	4.0
4	3.1	31	3.7	58	3.8	84	4.0
5	3.4	32	3.7	59	3.8	85	4.0
6	3.6	33	3.7	60	3.8	86	3.9
7	3.8	34	3.7	61	3.9	87	4.0
8	4.0	35	3.7	62	4.0	88	4.1
9	4.2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

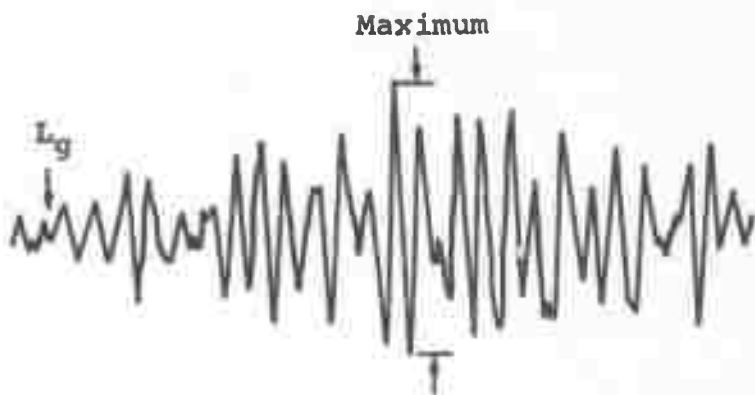


Bottom of line



Bottom of line

Detail Showing Allowance
For Line Width



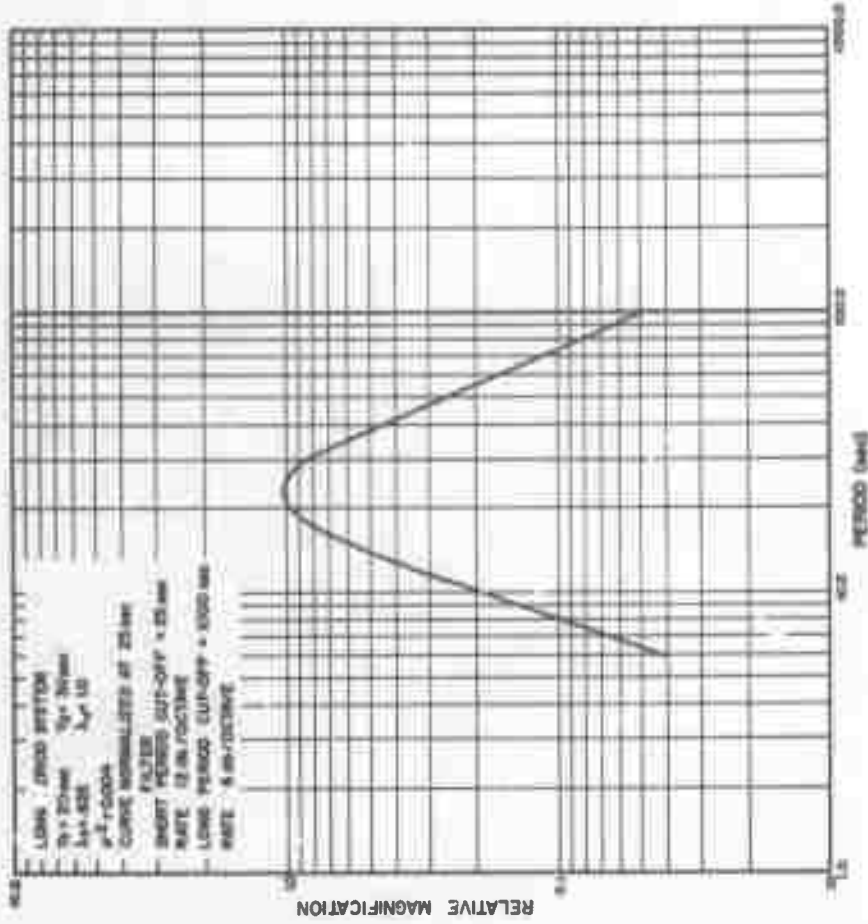
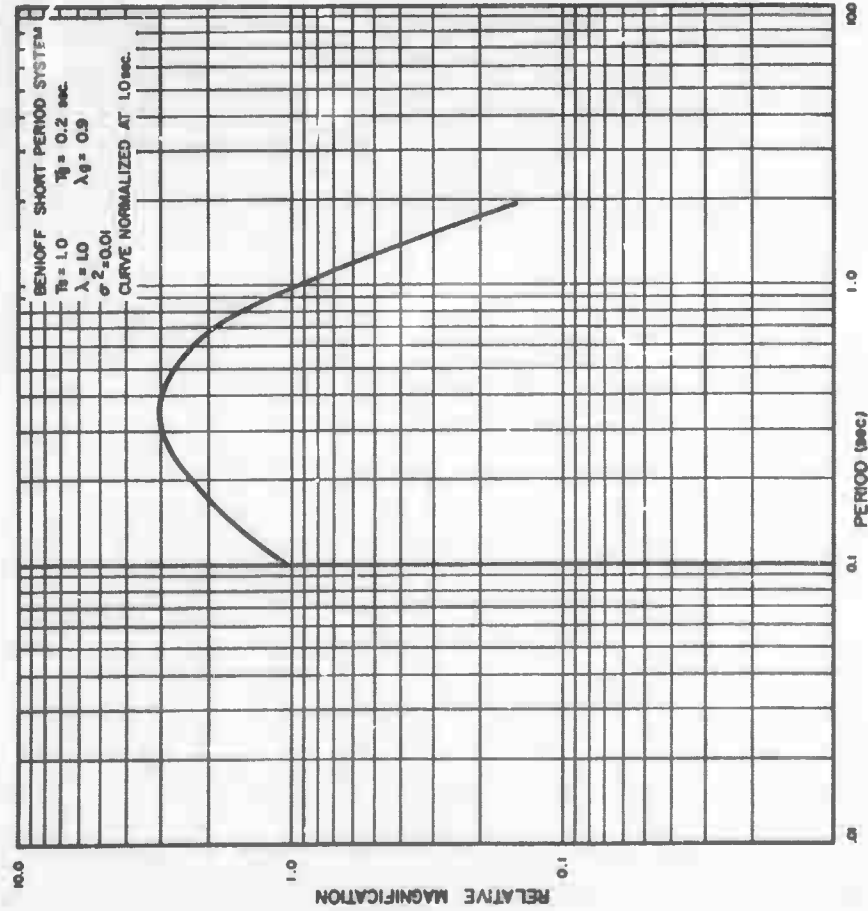
Pick time of P_n at beginning of "a" half cycle.

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

Pick amplitudes of P_g and L_g at maximum of corresponding motion.

Seismic Analysis Diagram

APPENDIX II(A)



INSTRUMENT RESPONSE CURVES - LRSM

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 INDUSTRIES, INC. EARTH SCIENCES DIVISION ALEXANDRIA, VIRGINIA 22314		2a. REPORT SECURITY CLASSIFICATION Unclassified	
		2b. GROUP ---	
3. REPORT TITLE Long Range Seismic Measurements - TAN			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific			
5. AUTHOR(S) (Last name, first name, initial) Clark, Don M.			
6. REPORT DATE 31 October 1966	7a. TOTAL NO. OF PAGES 20	7b. NO. OF REFS 1	
8a. CONTRACT OR GRANT NO. AF 33(657)-15919	8a. ORIGINATOR'S REPORT NUMBER(S) SDL Report No. 169		
b. PROJECT NO. VELA T/6702	8b. OTHER REPORT NC(S) (Any other numbers that may be assigned this report) ---		
c. ARPA Order No. 624			
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 <p>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.</p>			

14. 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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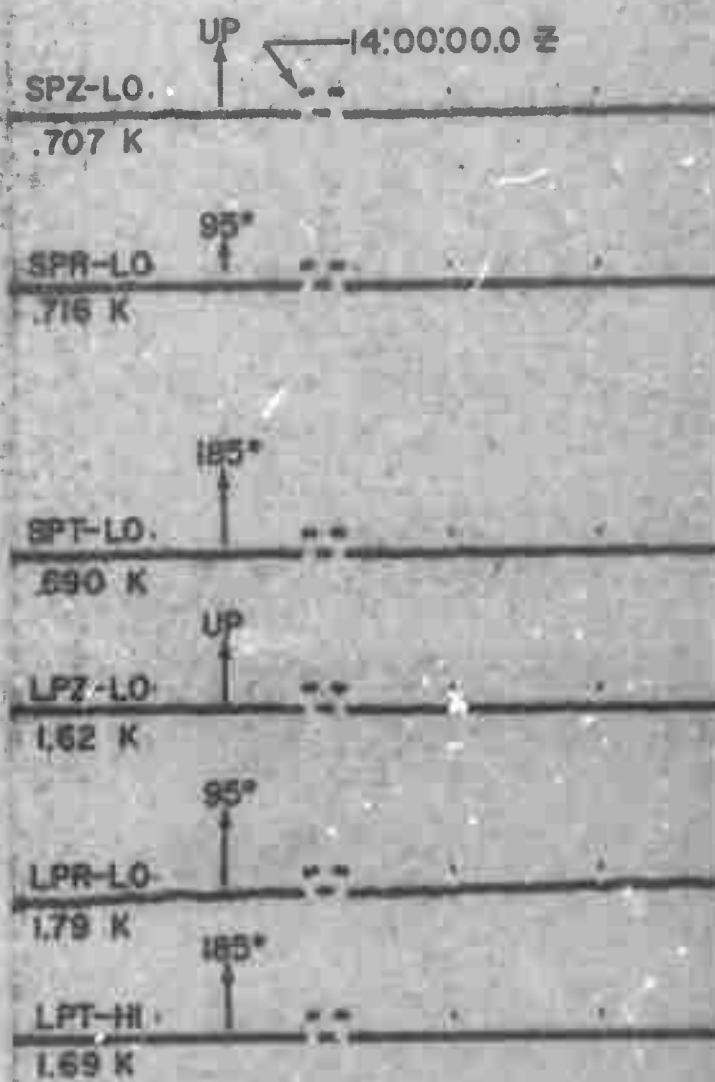
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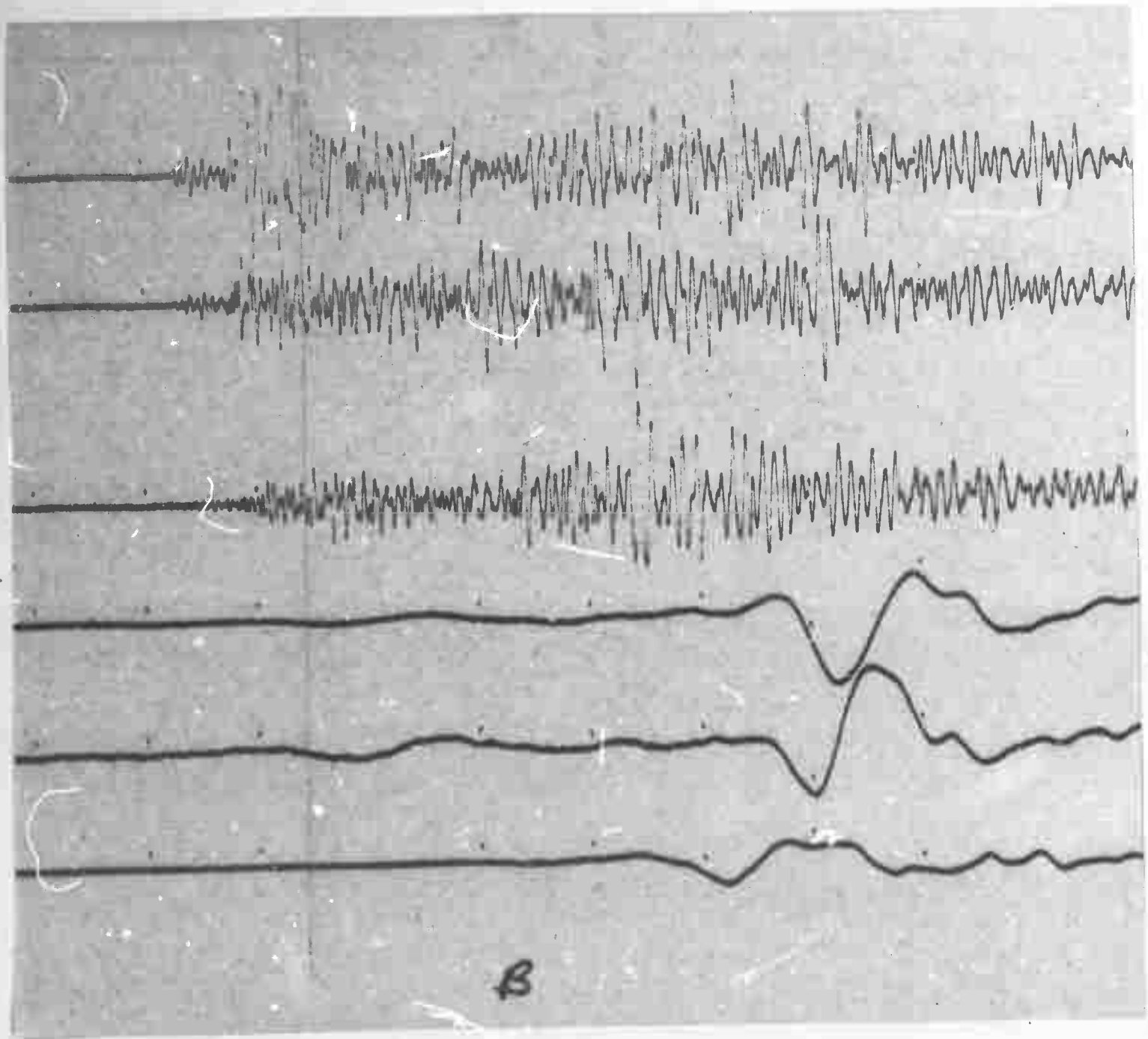
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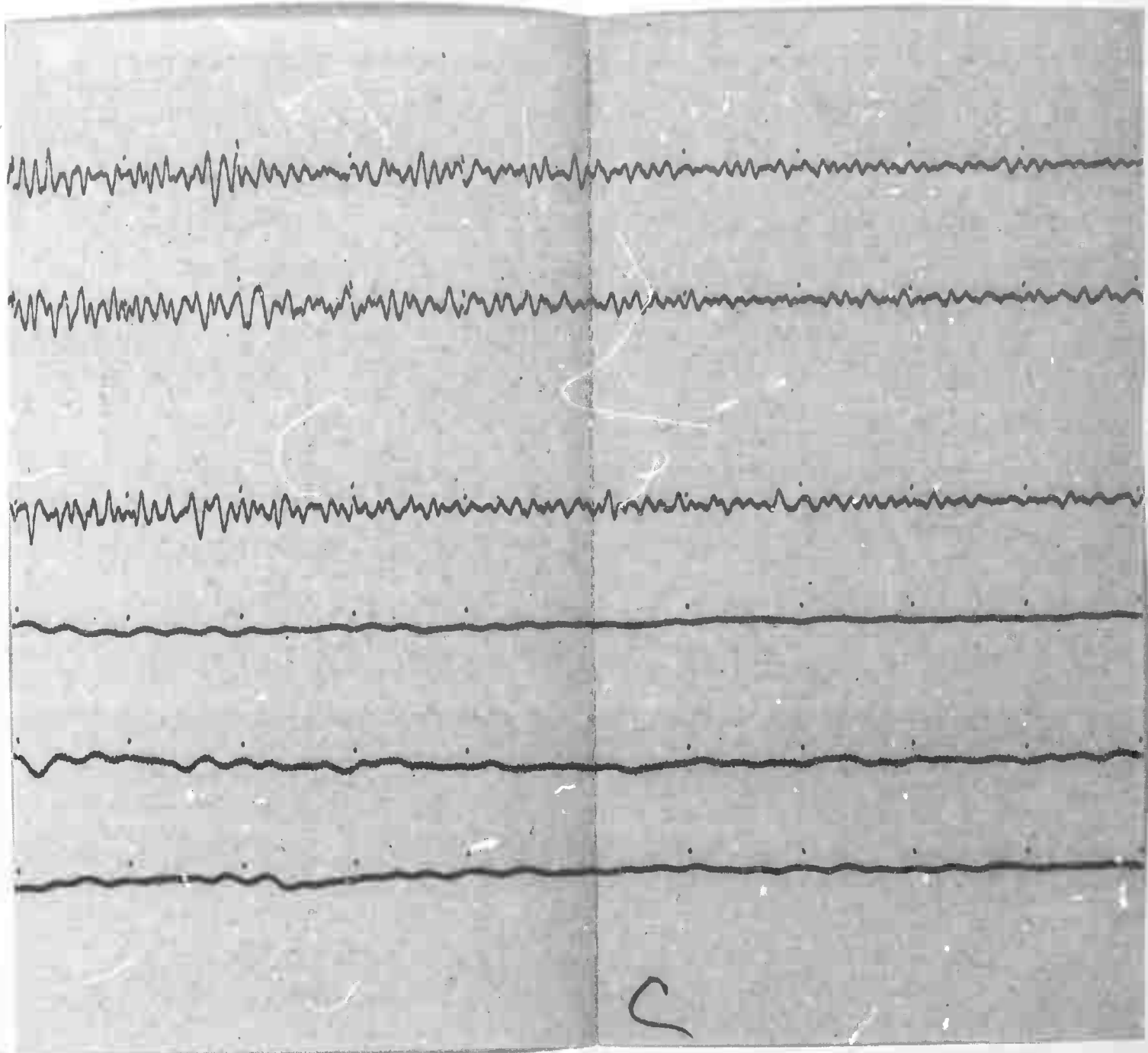
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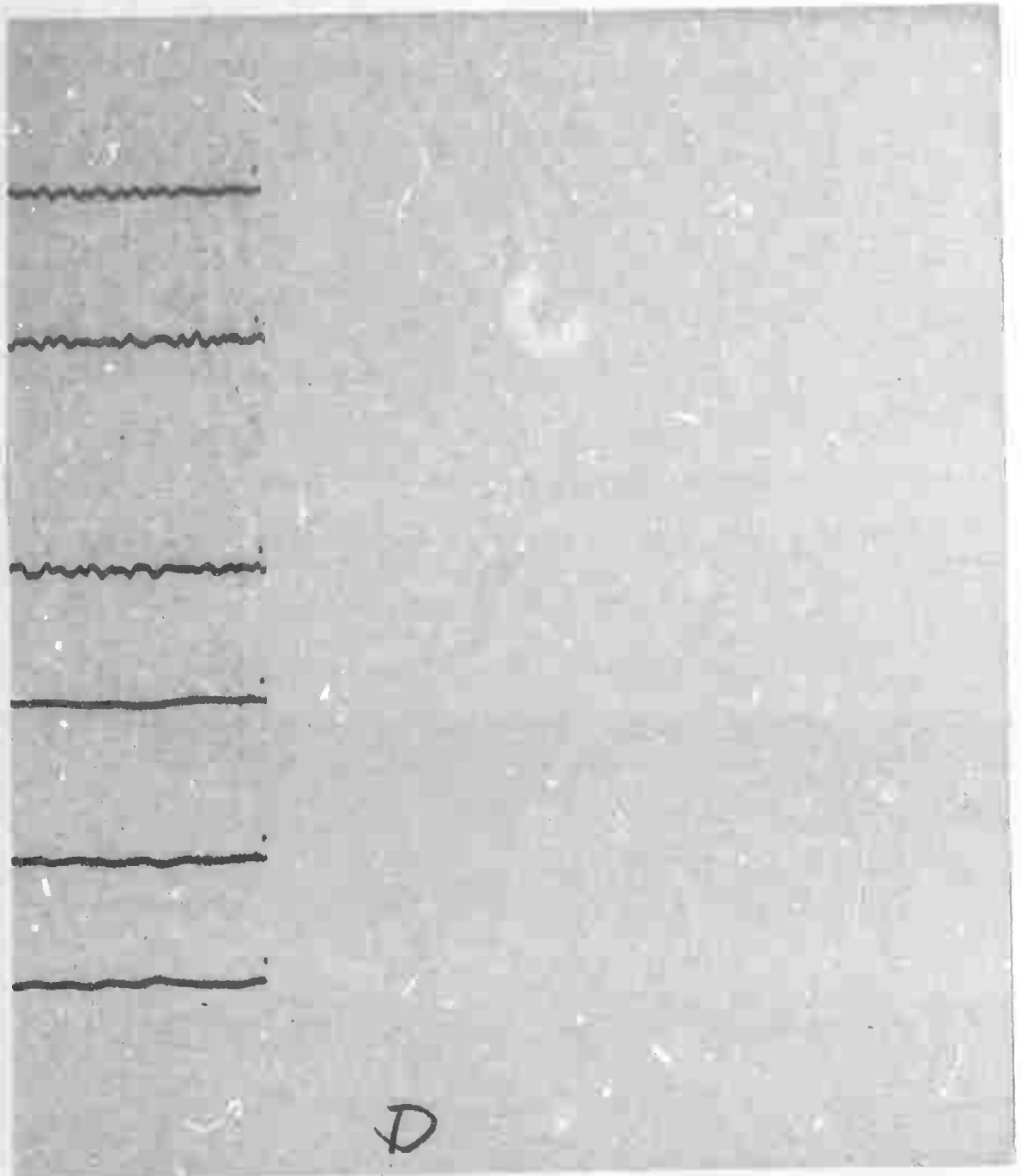
$\Delta = 285$ km



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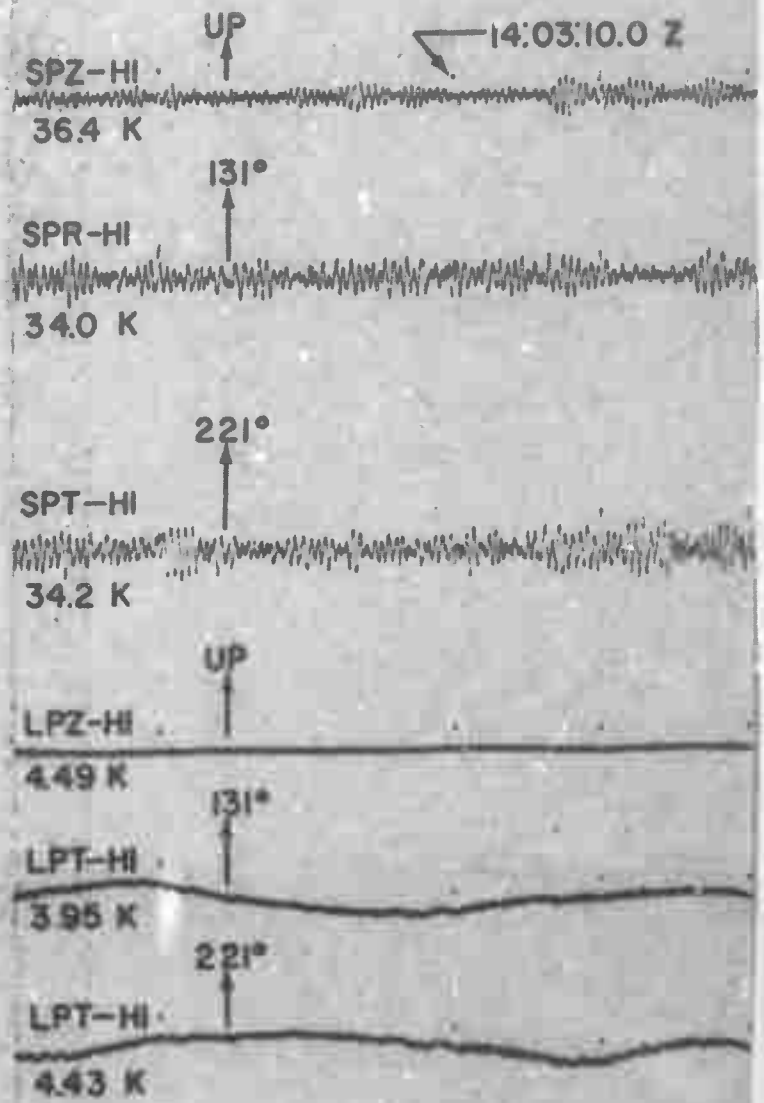
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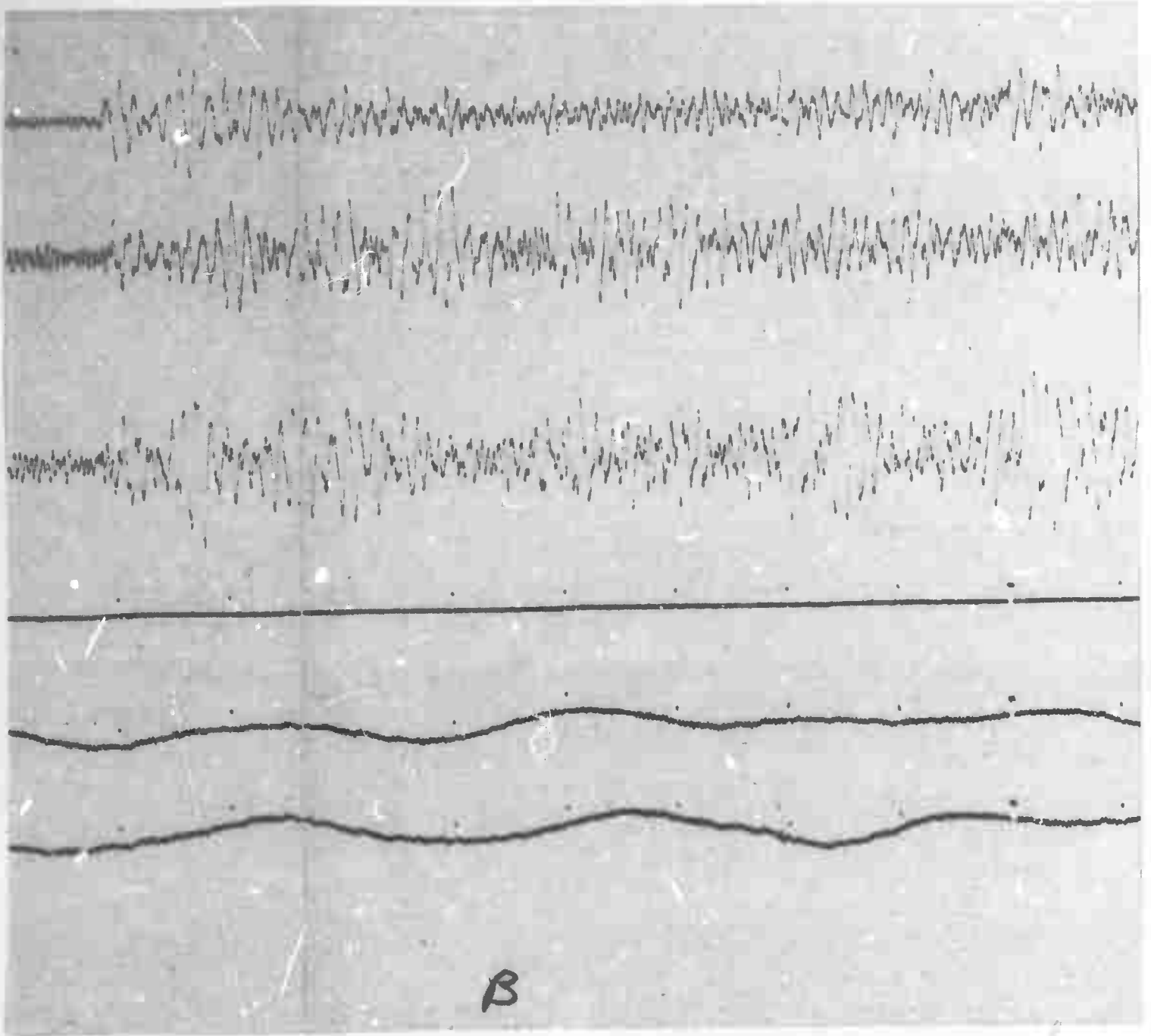
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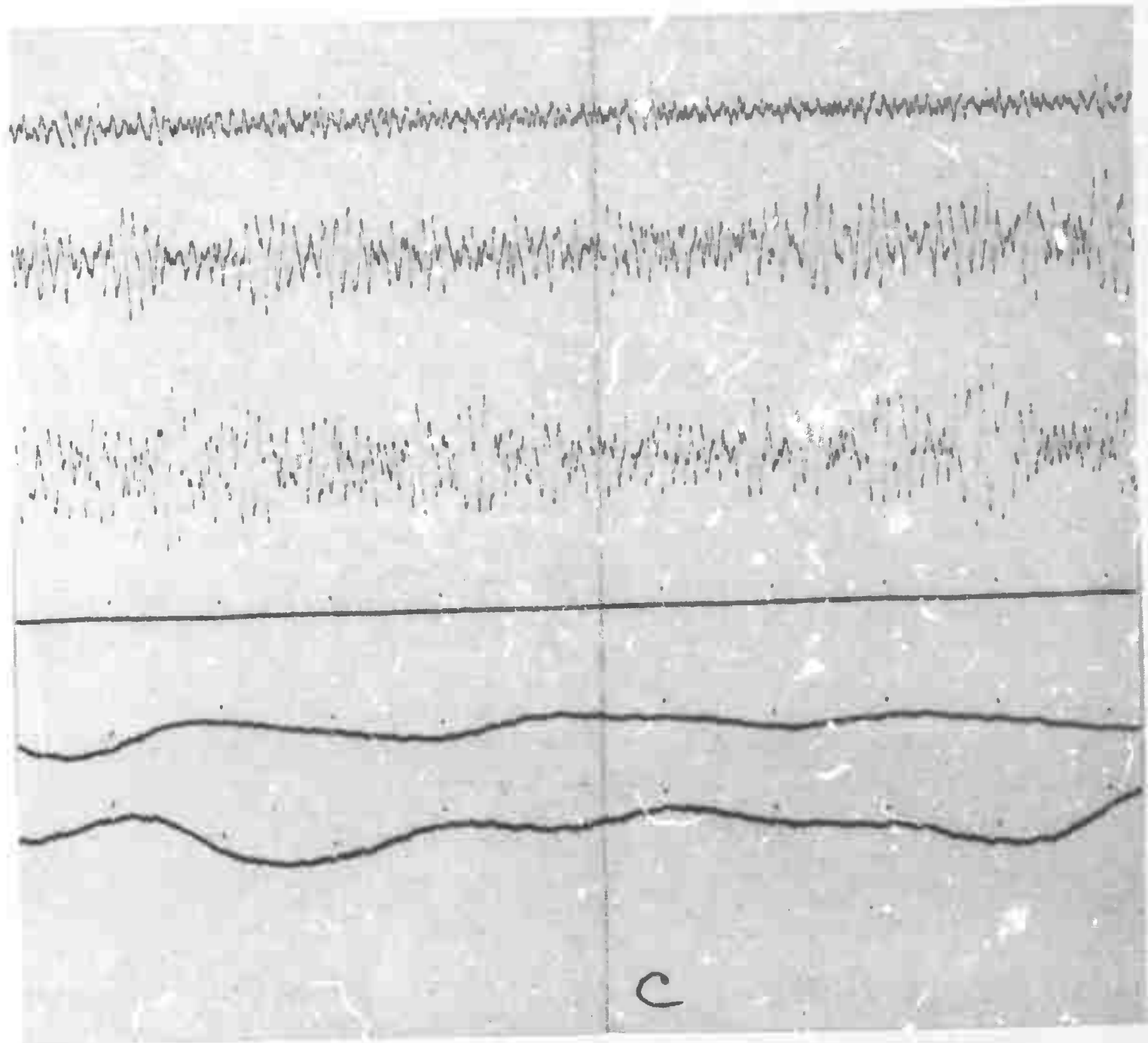
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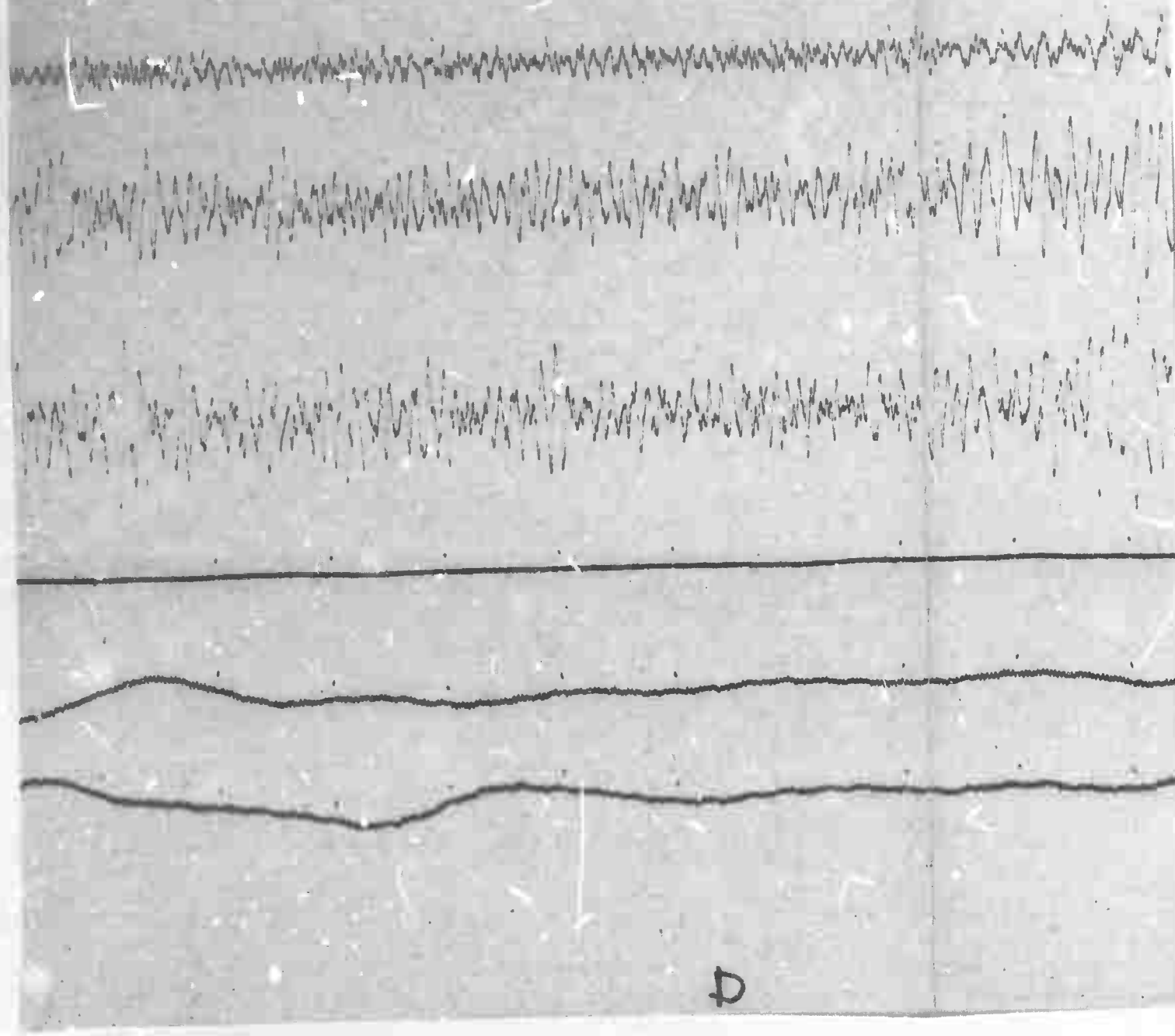
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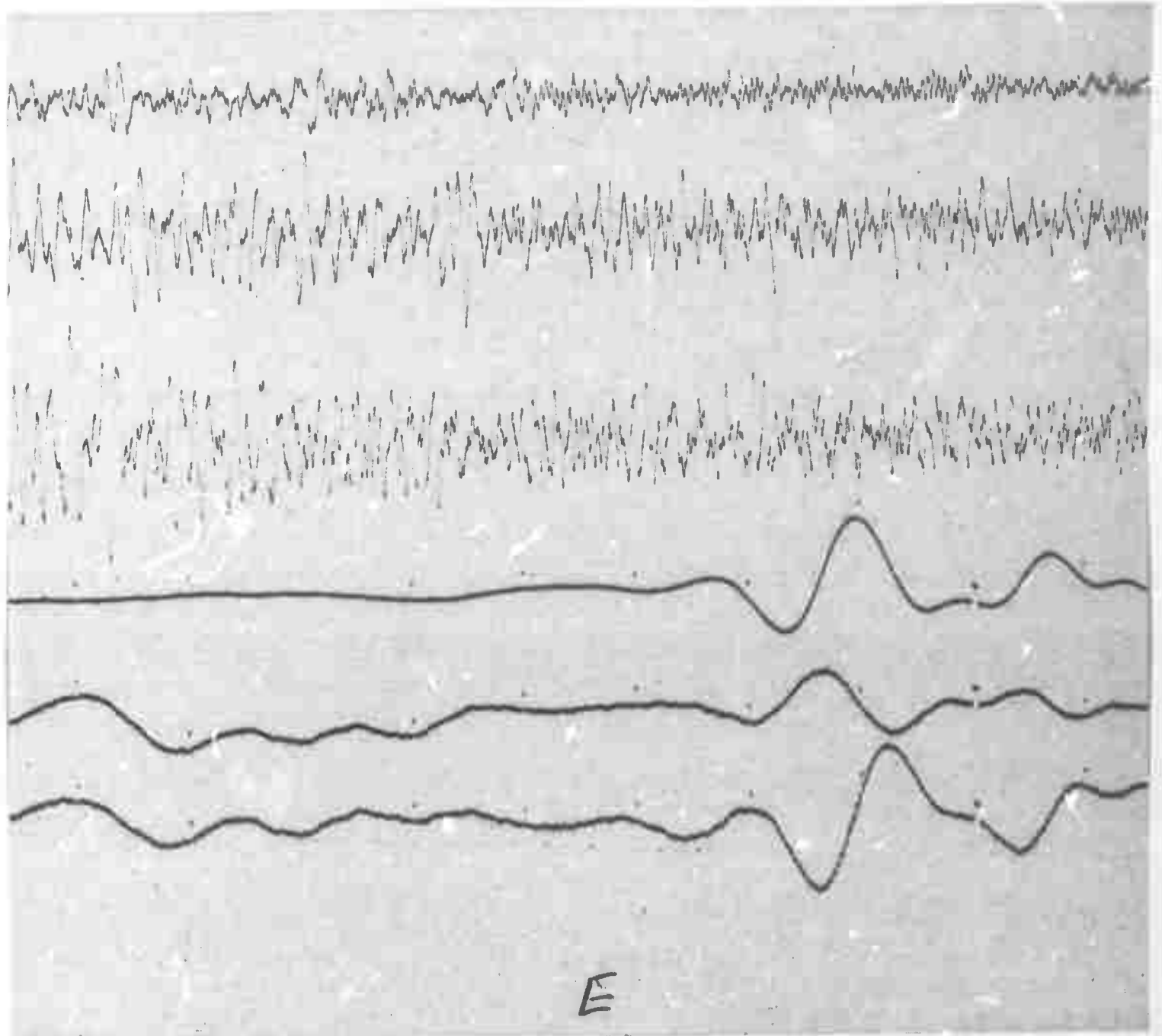


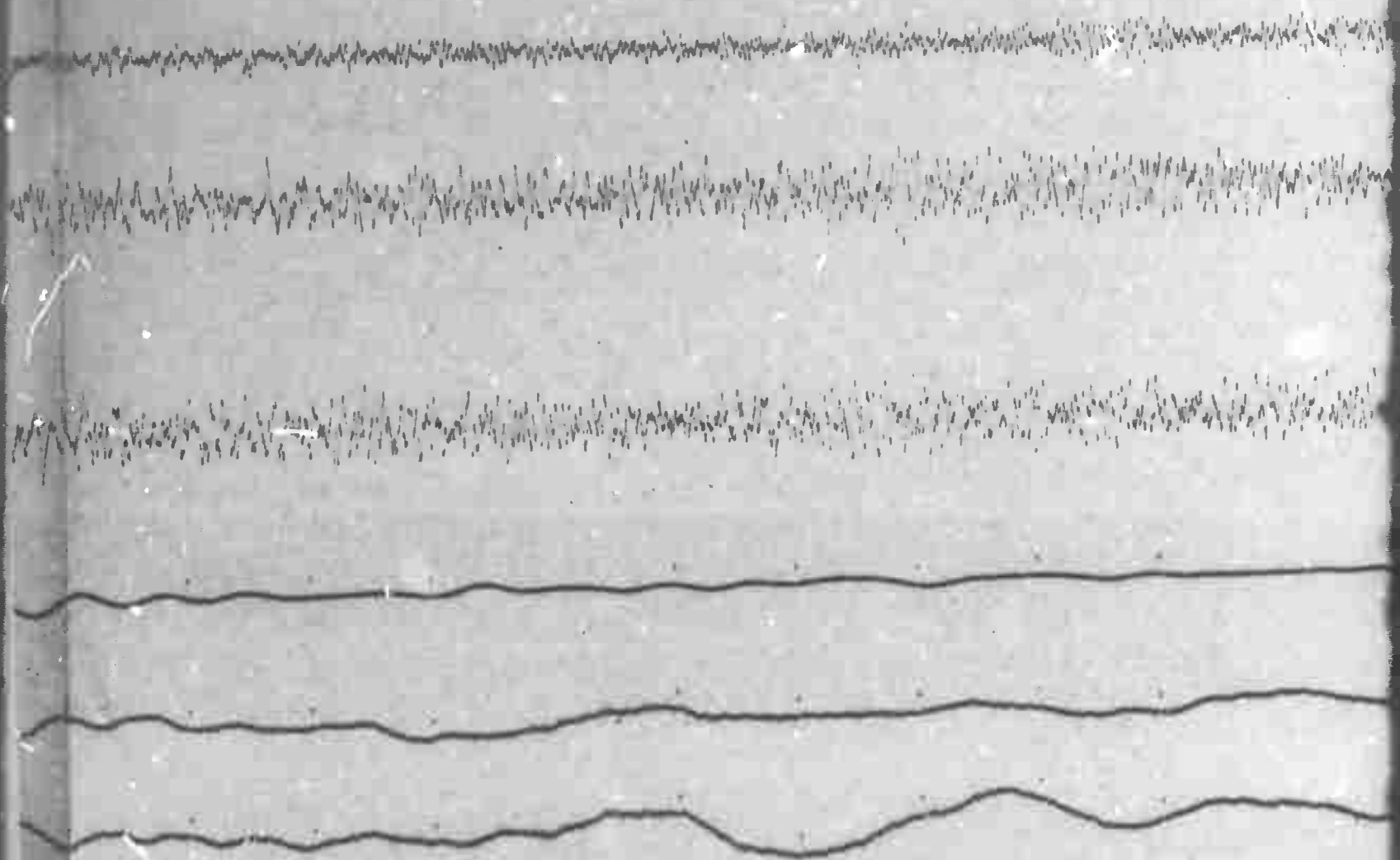
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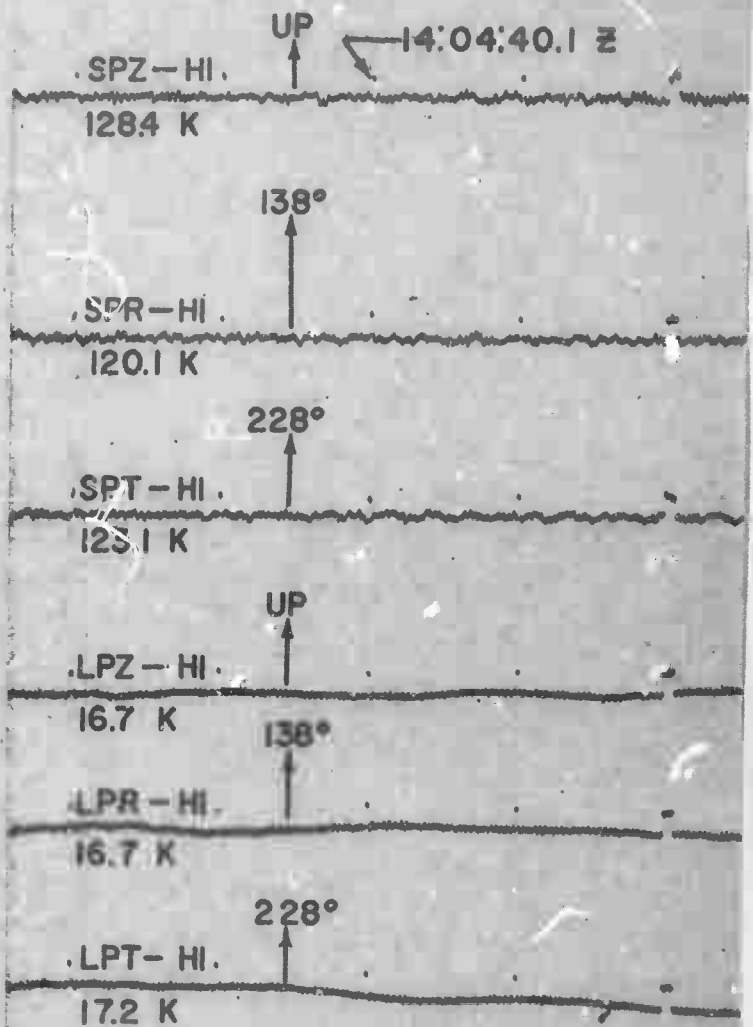
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AX2AL

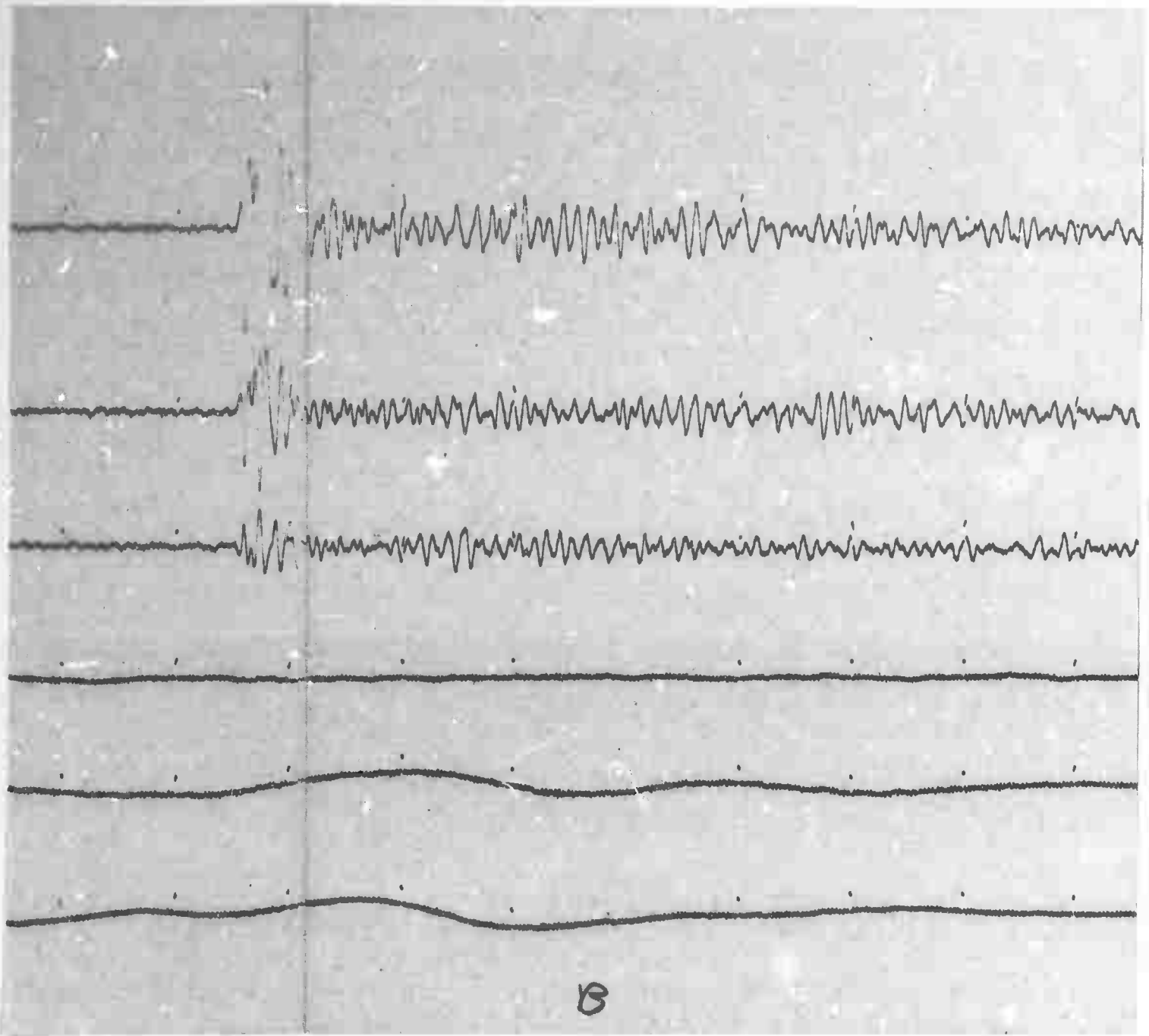
ALEXANDER CITY, ALABAMA

03 JUNE 1966

$\Delta = 2762$ km



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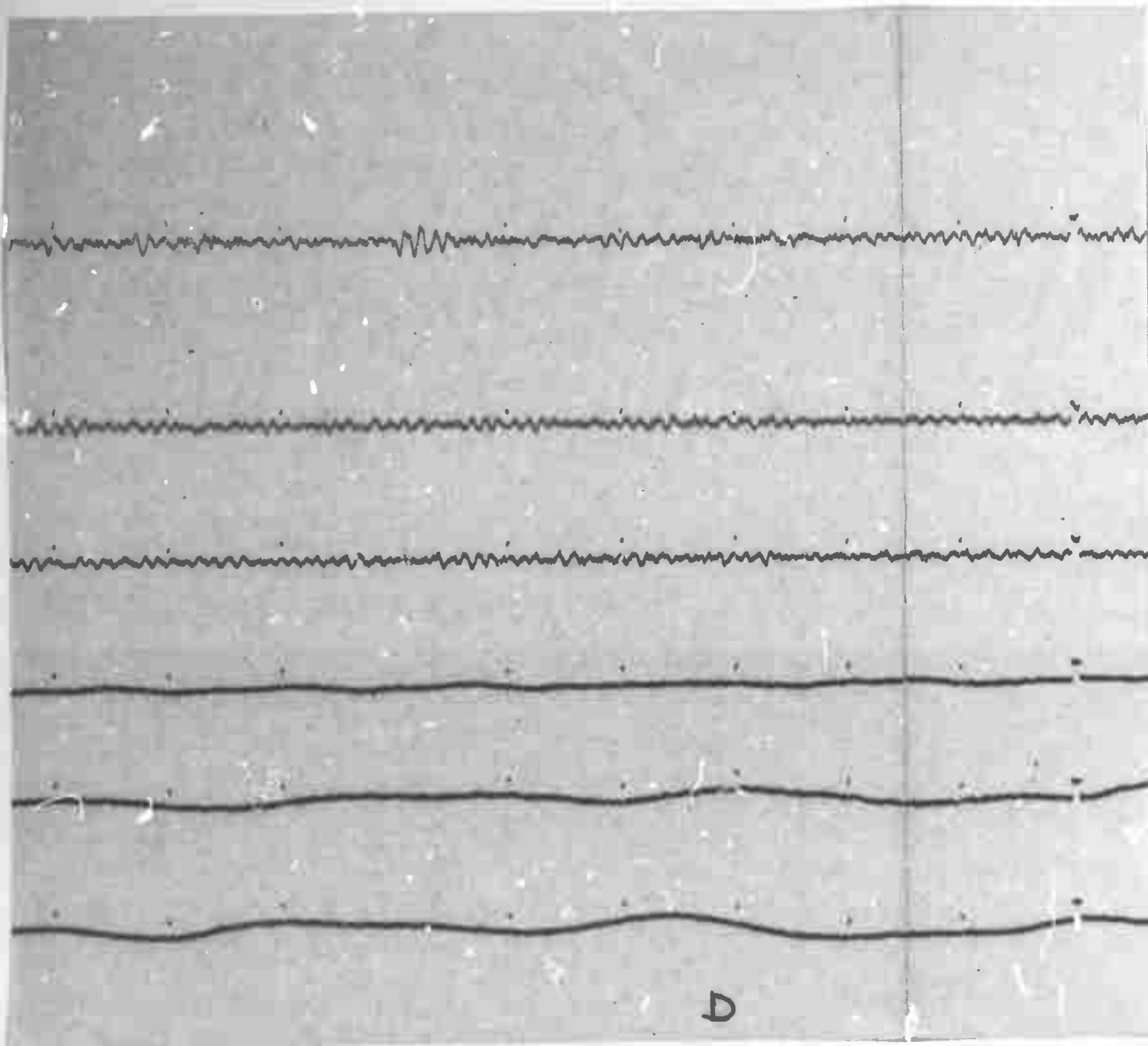
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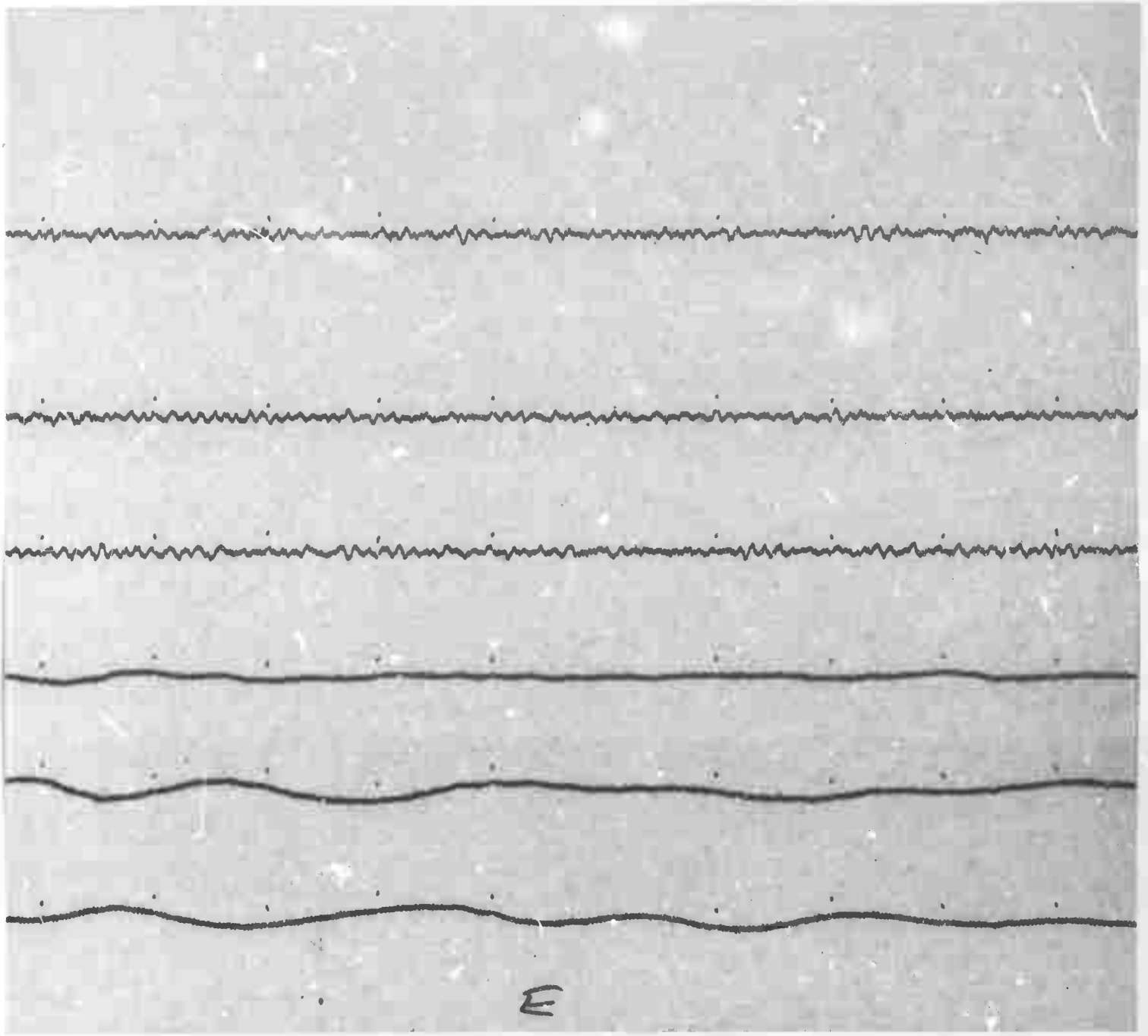
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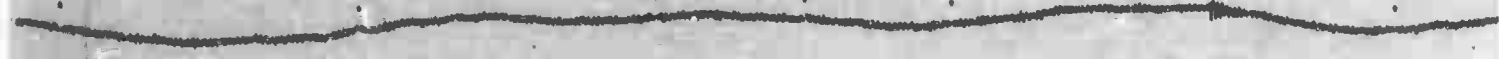
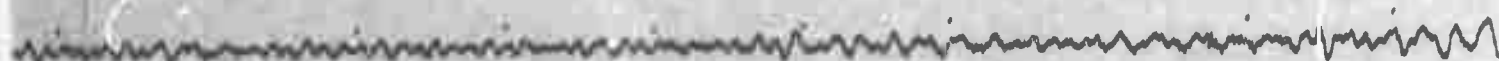
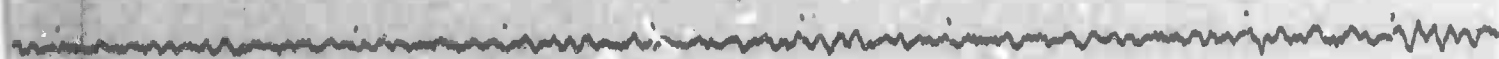
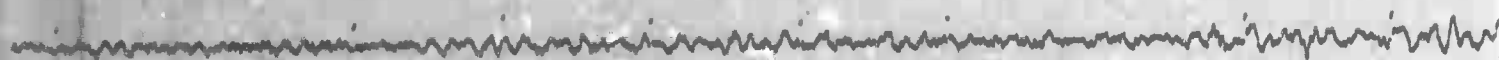
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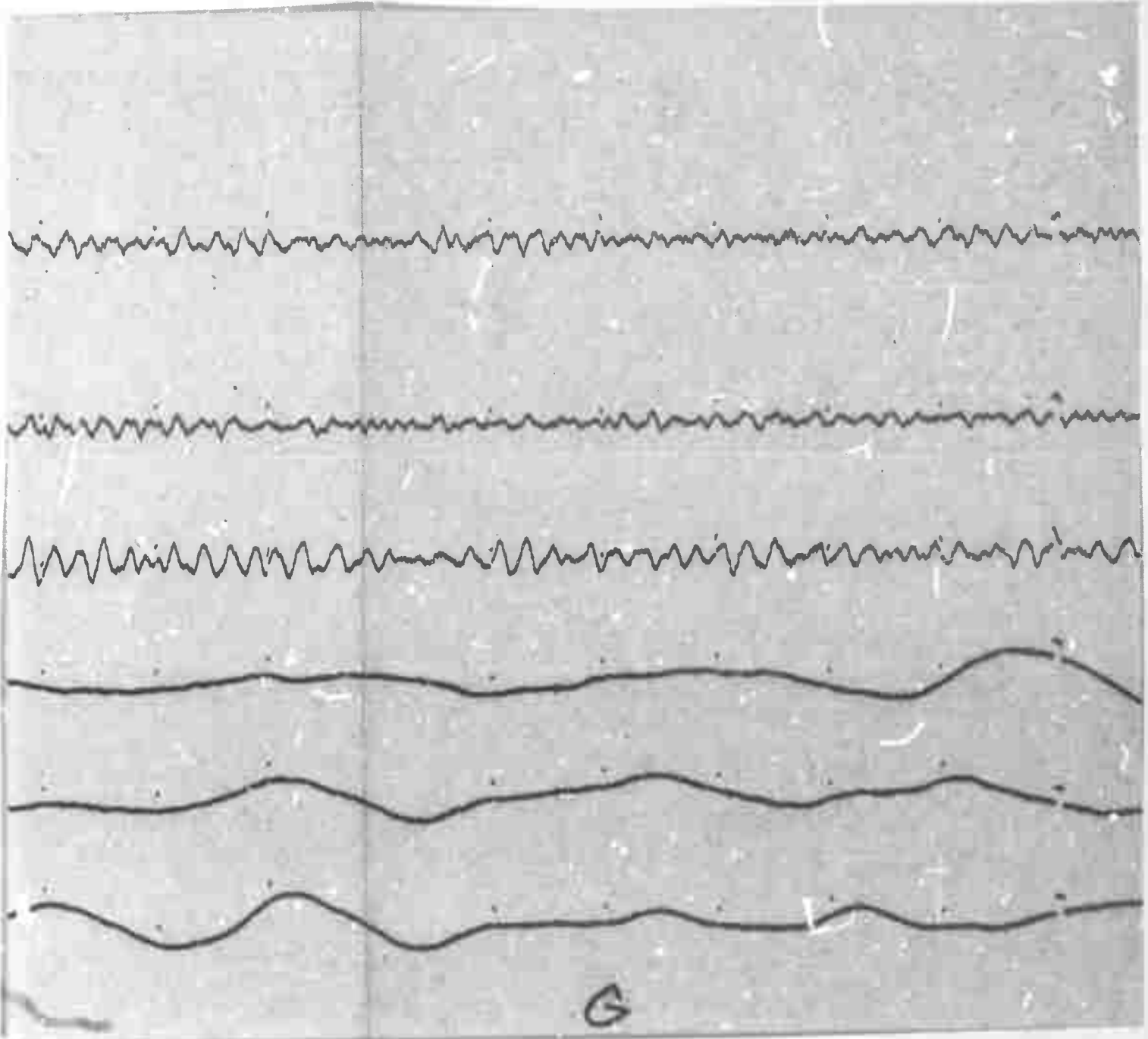


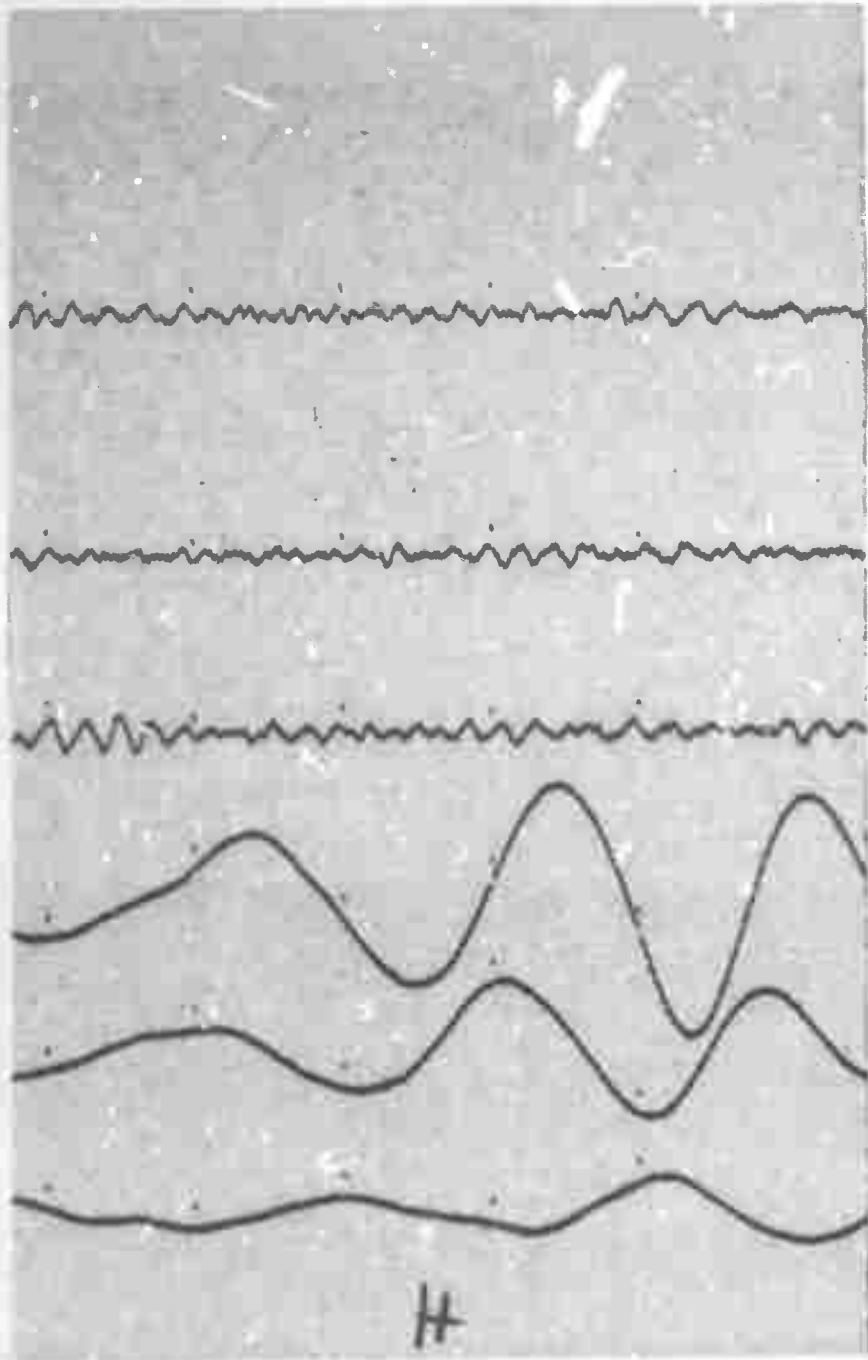


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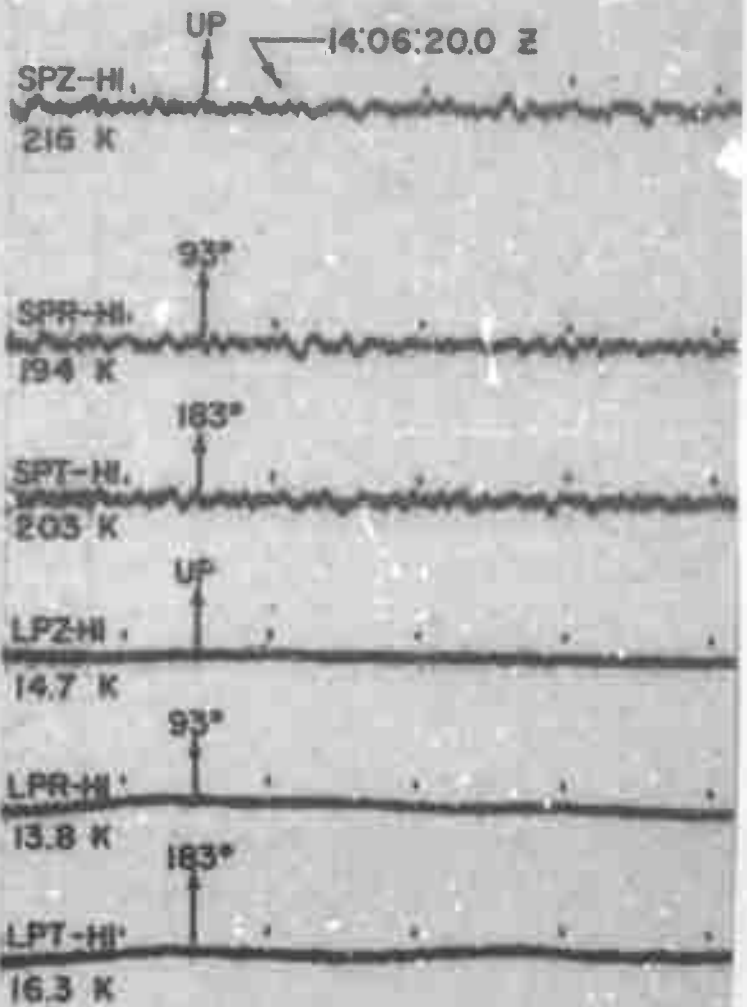
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HN-ME

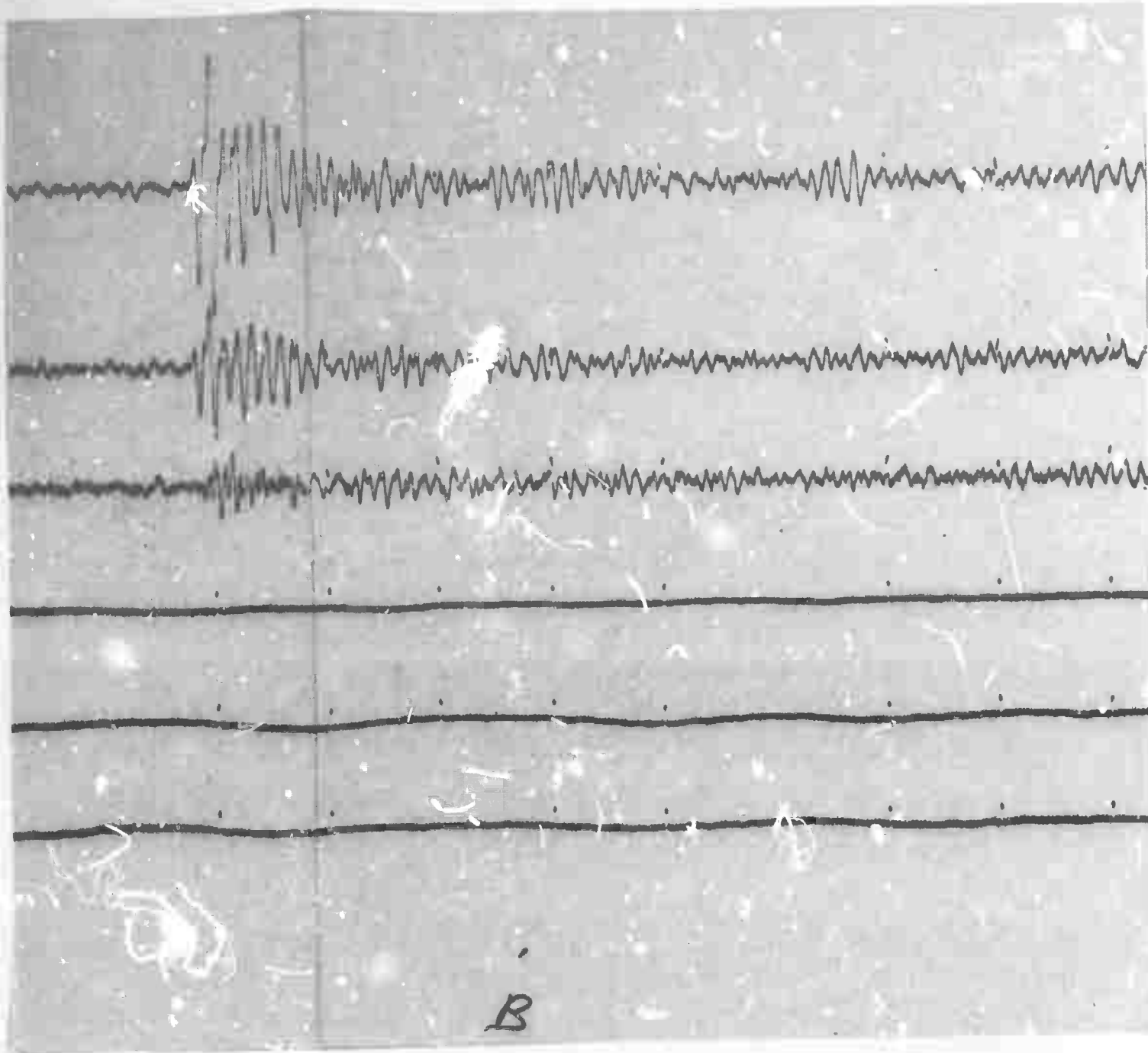
HOULTON, MAINE

03 JUNE 1966

$\Delta = 4066$ km



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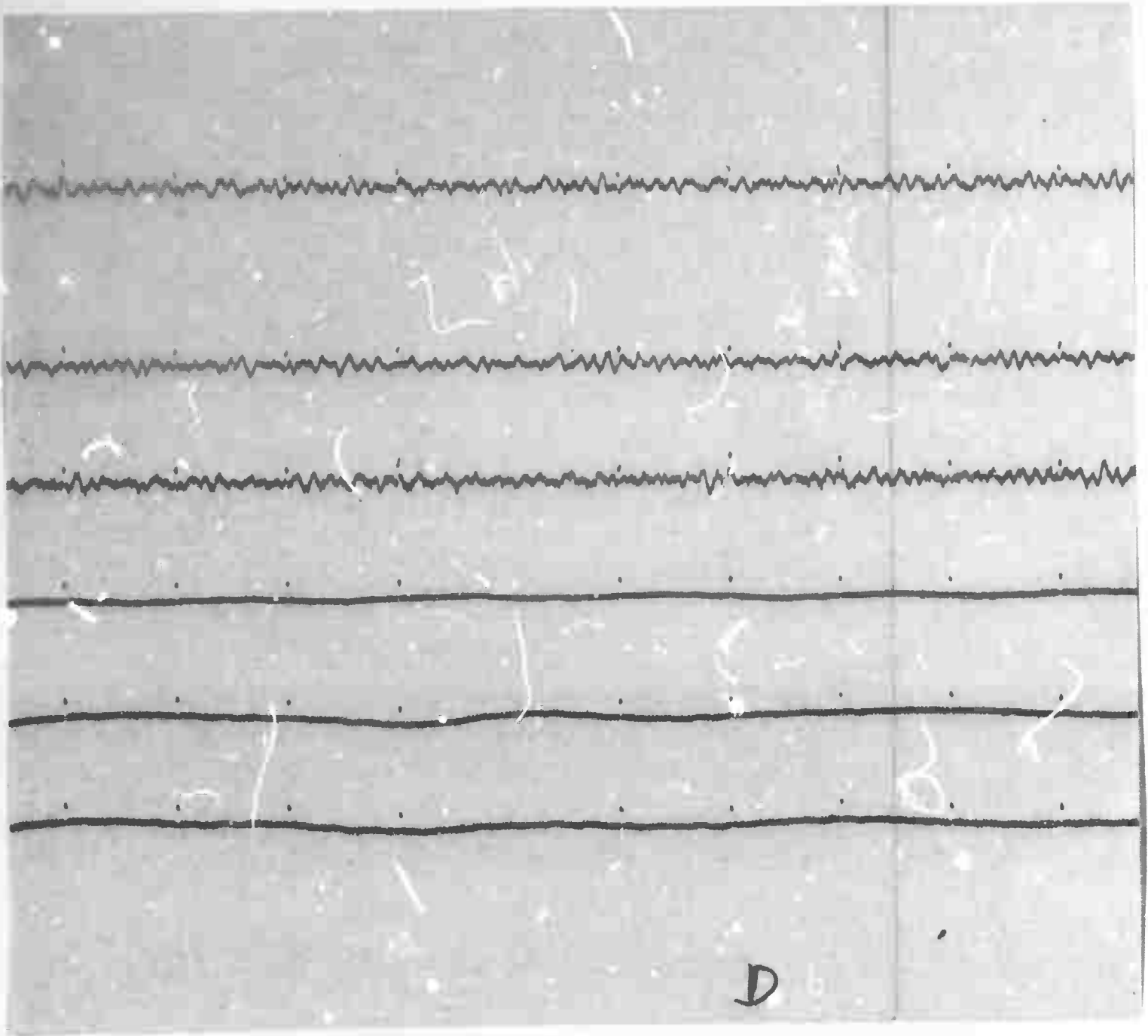
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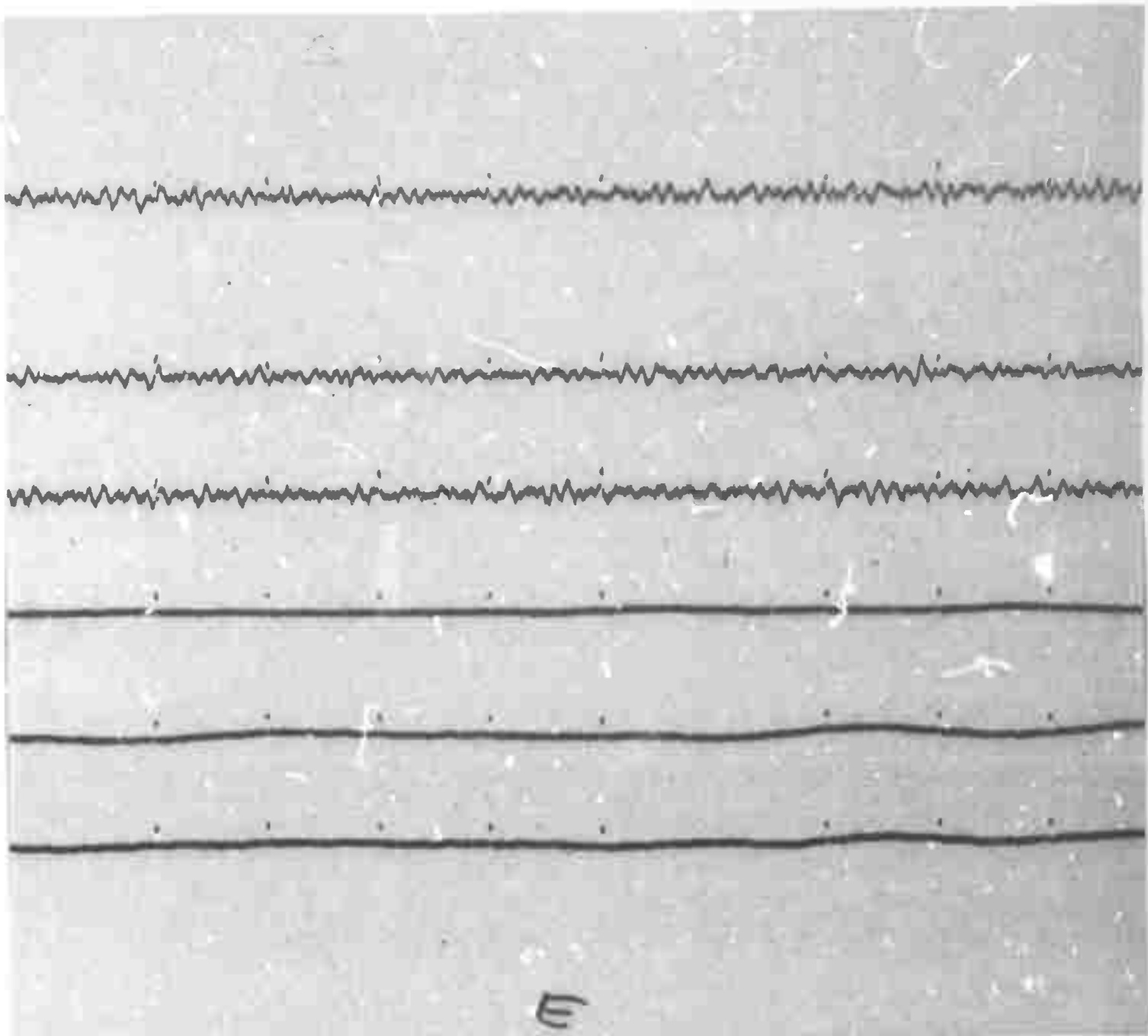
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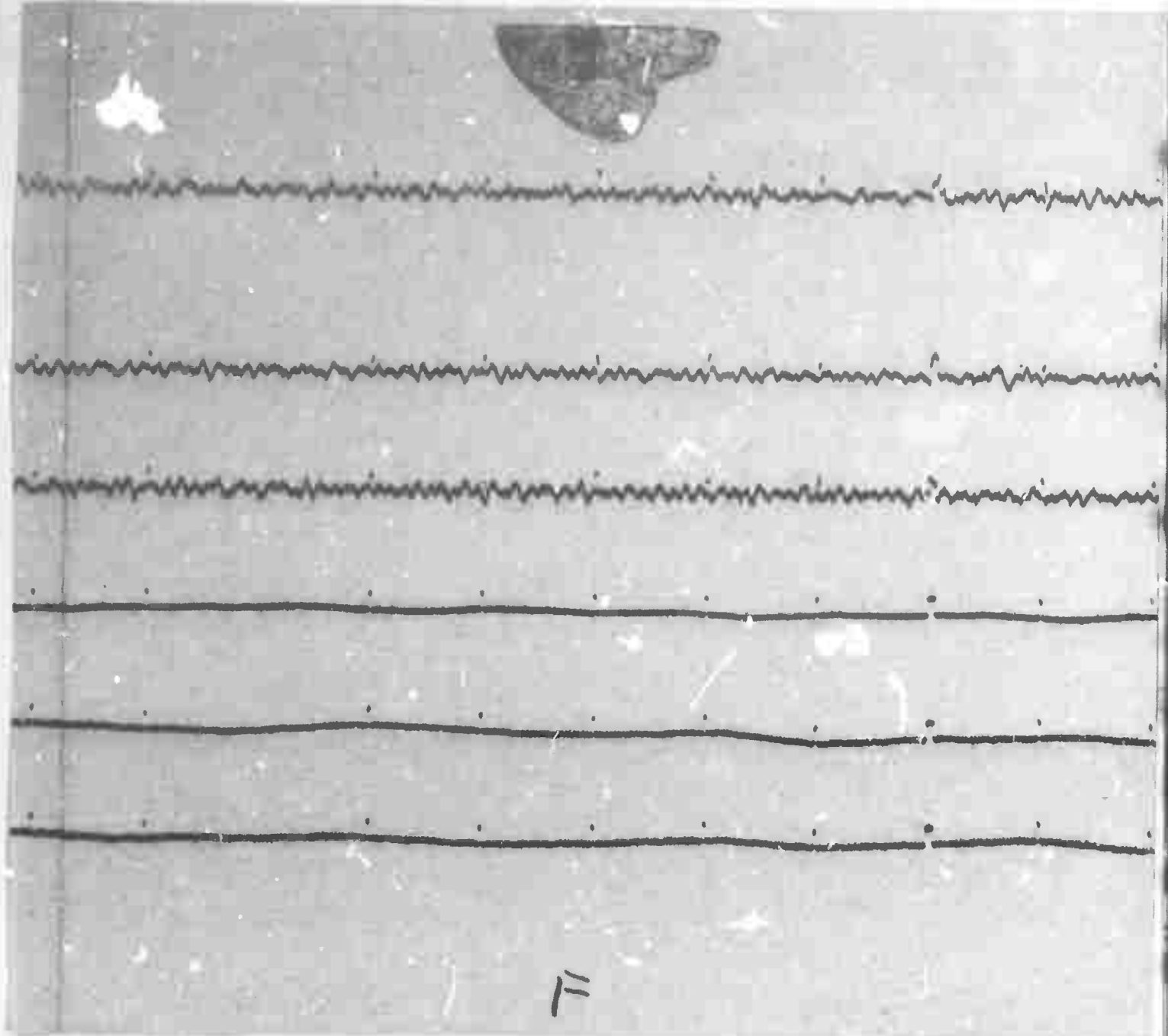
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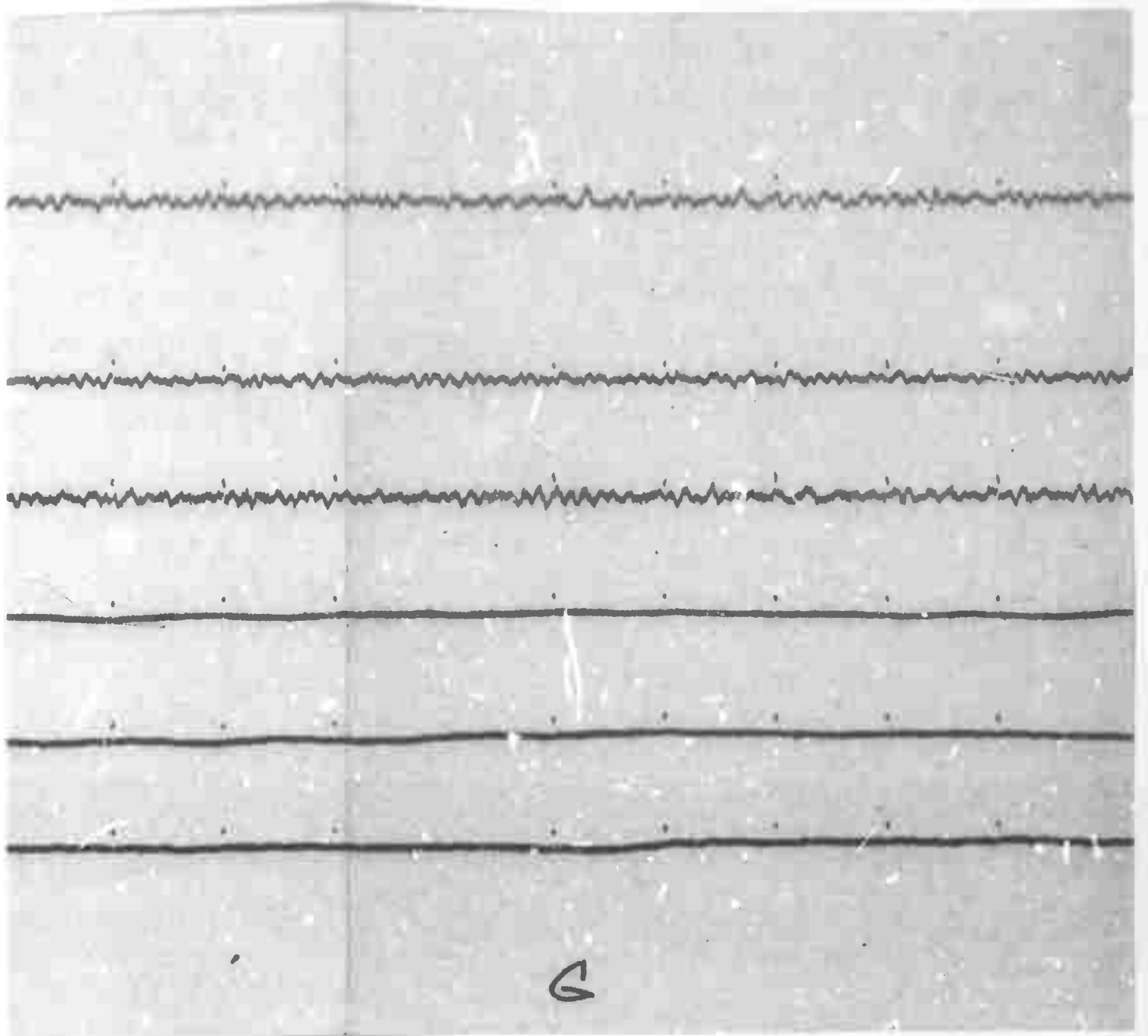
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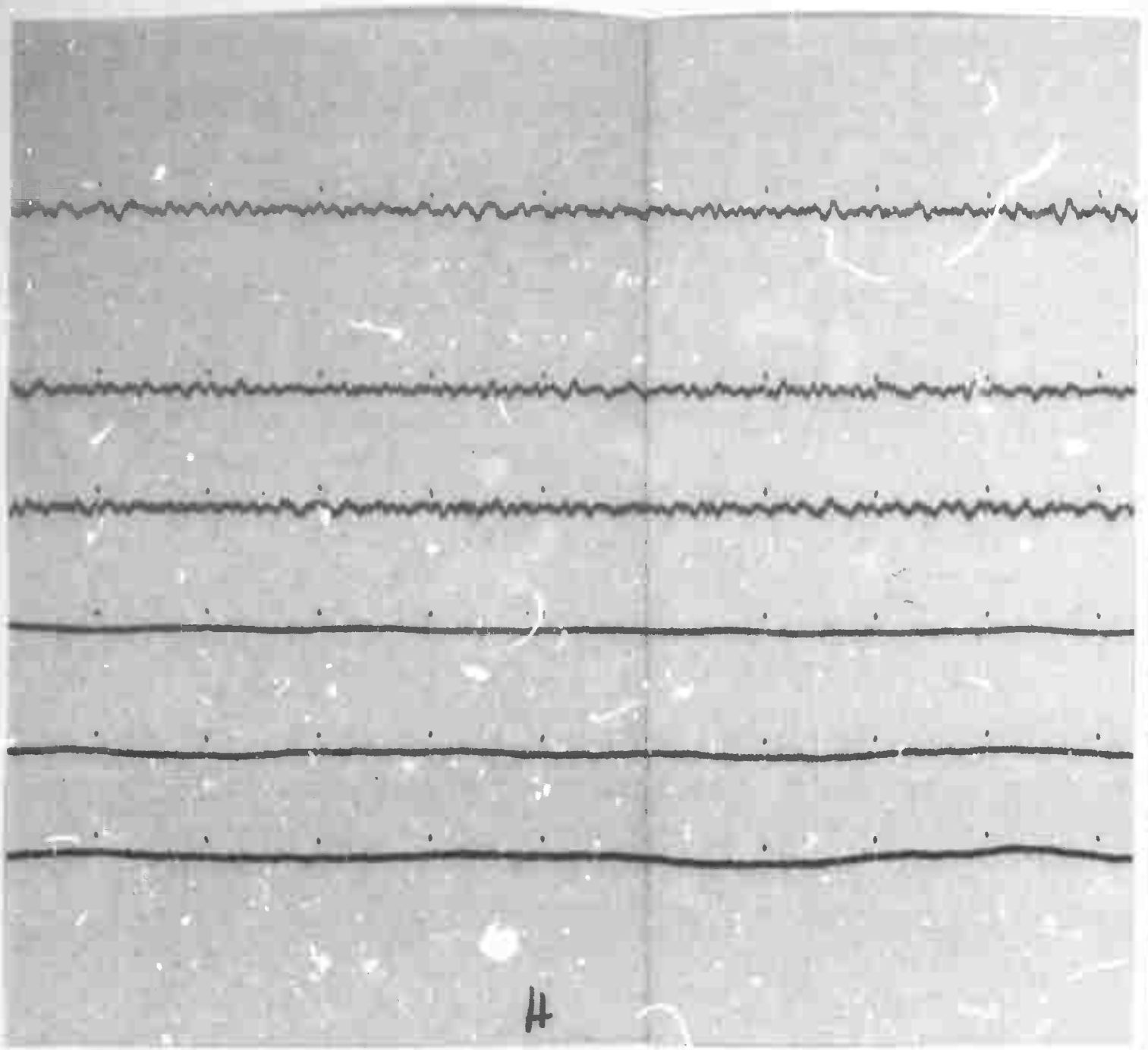
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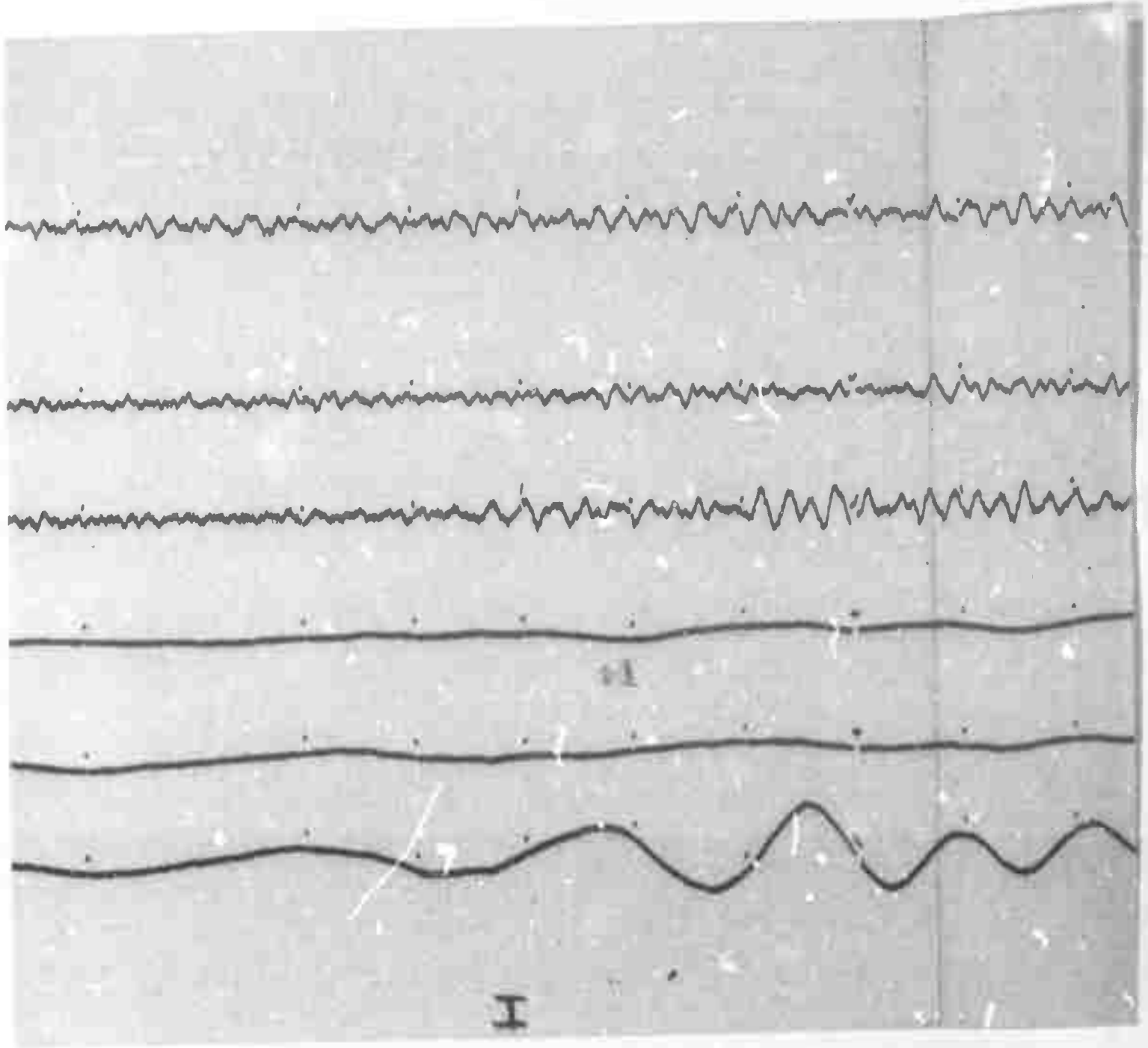


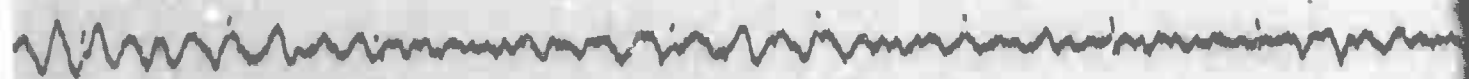
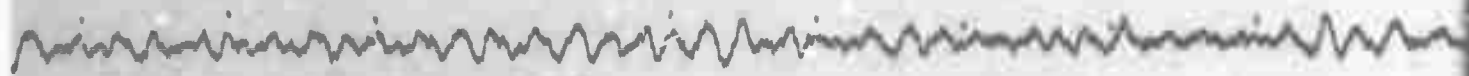




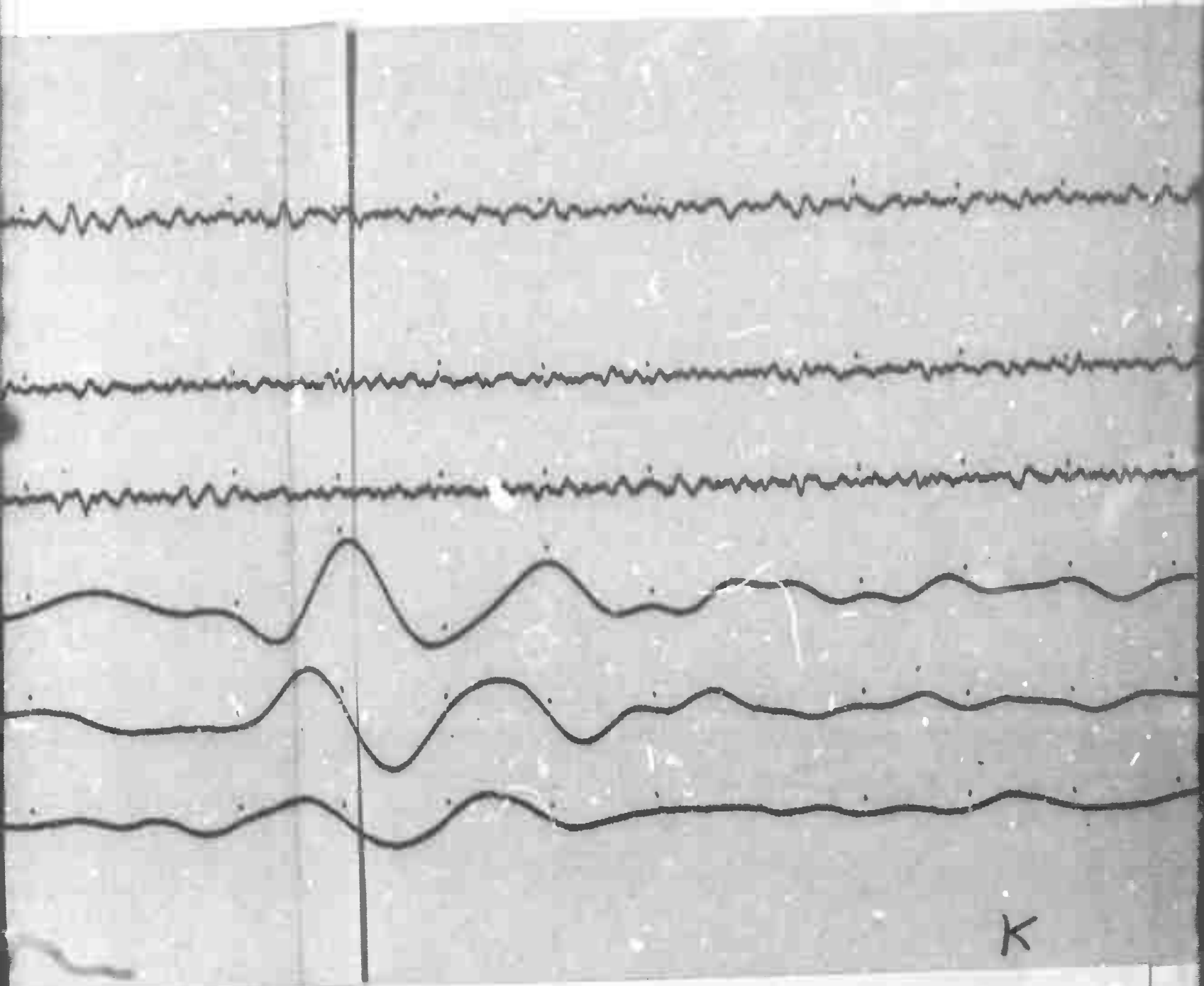




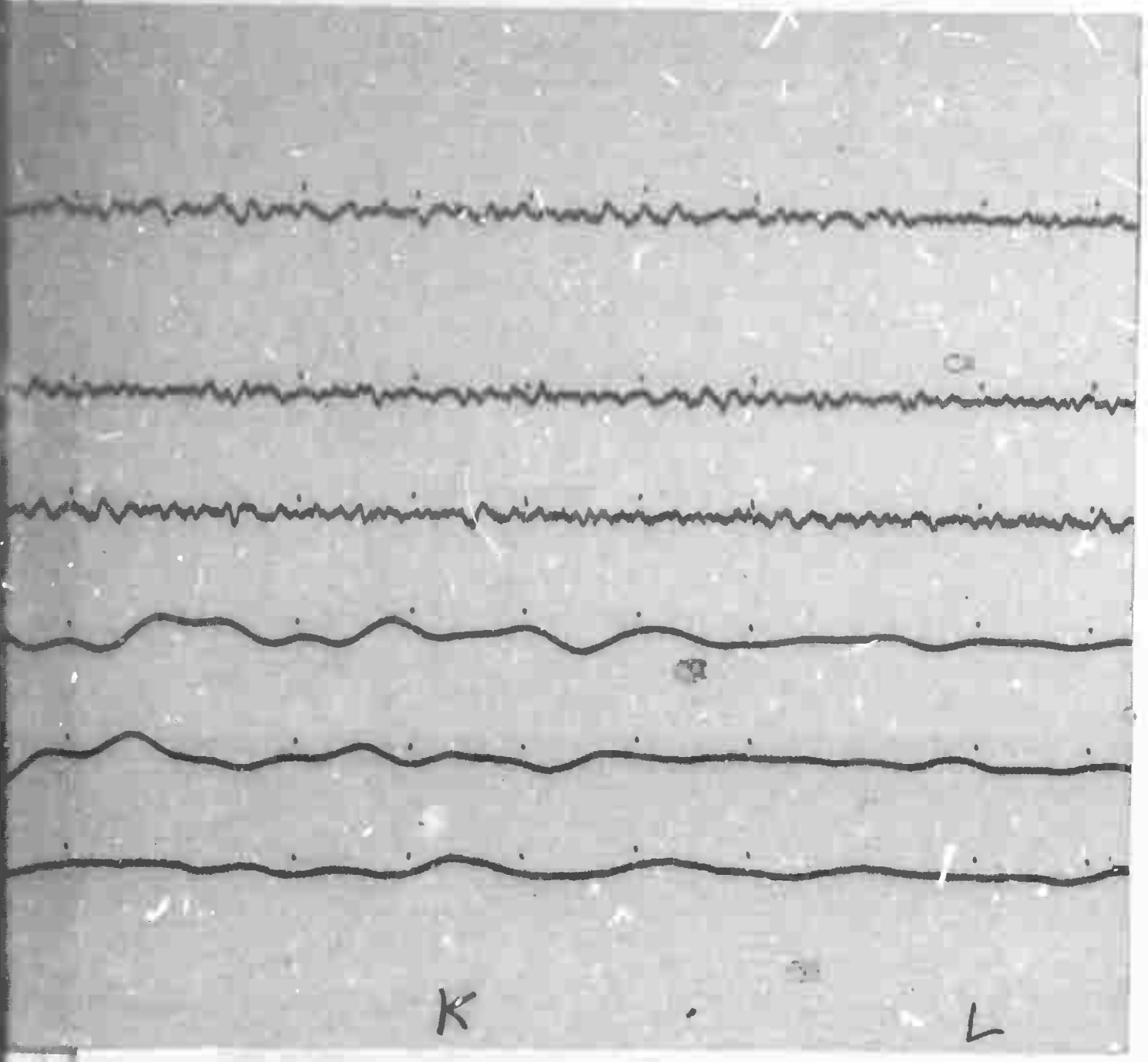




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