

Schlumberger

COMPENSATED NEUTRON-FORMATION DENSITY

PROVINCE YUKON TERRITORY
 FIELD COLUMBIA GAS ET AL
 WELL KONTANELEE YT, H-38
 COMPANY COLUMBIA GAS DEVELOPMENT OF CANADA LTD.

PROVINCE YUKON TERRITORY
 LOCATION 60° 07' 16" N LAT
 124° 06' 03" W LONG
 FIELD *Marked for Top*
 WELL COLUMBIA GAS ET AL KONTANELEE
 COMPANY COLUMBIA GAS DEVELOPMENT OF CANADA LTD.
 Permanent Datum RL Elev. 2225
 Log Measured From KB 25 R Above Perm. Datum
 Other Services BHC-GR
 DIL
 ELEV. KB 2250
 CL 2225
 CR

Date	10 SEPT 77
Run No.	TWO
First Reading	10804
Last Reading	3020
Feet Measured	7784
Depth Reached	10805
Bottom Driller	10850
Cip. SOC	3020
Cip. Driller	3021
Mud Nature	KCL
Dens. Visc.	9.7 40
Mud pH	10.0
Water Loss	53.6
Res.	6.27 65
Ref.	6.19 63
• BHT	270 7
• Rmc	0.321 63
• ppm-Cl	
Bit Size	12 1/4"
Equipment Type	CNT-A, PGT-E
Op. Rig Time	8 HRS
Tool No.	OSU-C-339 FRONT
Recorded By	NICKERSON
Witness	DORTCH

REMARKS
 Drilling Stopped 0845 / 7th ; Circulation Stopped 2345 / 7th ; Tool on Bottom 1745 / 10th ; 1st Run Service Order # 20085
 B.H.T. 1 270
 2 270

EQUIPMENT DATA							Decent. Spg. Used	LOG TAPED
Run No.	CNP.	CNC.	CNB.	NSR.	SGC.	CAL.		
TWO	AB 287	A 286	-	-	-	-	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
							<input type="checkbox"/> Yes <input type="checkbox"/> No	
							<input type="checkbox"/> Yes <input type="checkbox"/> No	

EQUIPMENT DATA									
Run No.	PGP	PGC	PGS	PDH	GSR	PND	NSR	SFT-116	SFT-106
TWO	EA 188	173	E 312	1159	-	-	-	-	522

CALIBRATION DATA							
Run No.	Gamma Ray			CNL—Before Log—ACPS		CNL—After Log—ACPS	
	API Scale	Background CPS	Total CPS	Long Spacing	Short Spacing	Long Spacing	Short Spacing
TWO	165	83	470	194	452	196	450

CALIBRATION DATA									
Run No.	Before Log—SNP—After Log				Before Log—FDC—After Log				
	Drawer-in	Drawer-out	Drawer-in	Drawer-out	P1	P2	P1	P2	
TWO	-	-	-	-	346	600	346	600	

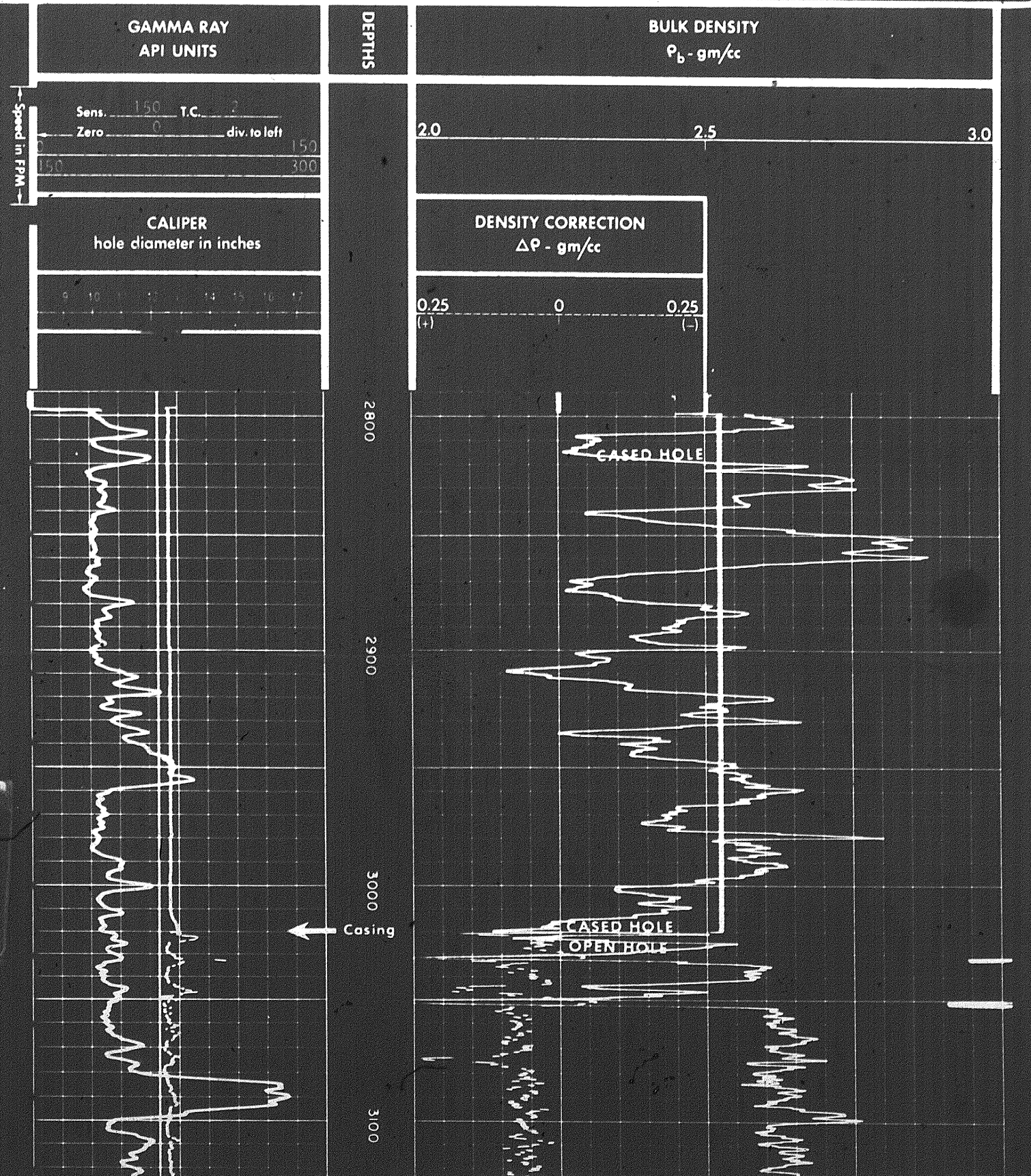
LOGGING DATA									
Run No.	General		Speed Ft./Min.	Tc	Gamma Ray		CNL Selectors		
	From	To			API Scale	Matrix	Auto Hole Size Corr.	Hole Size Setting (If not auto)	Porosity Scale
TWO	2800	5614	30	2	0-150	SANDSTONE	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		45-15--15
	5614	9905	30	2	0-300	LIMESTONE	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		45-15--15
	9905	TD	30	2	0-300	SANDSTONE	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		45-15--15
	REPEAT		30	2	0-150	SANDSTONE	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		45-15--15

TWO						346	600	346	600
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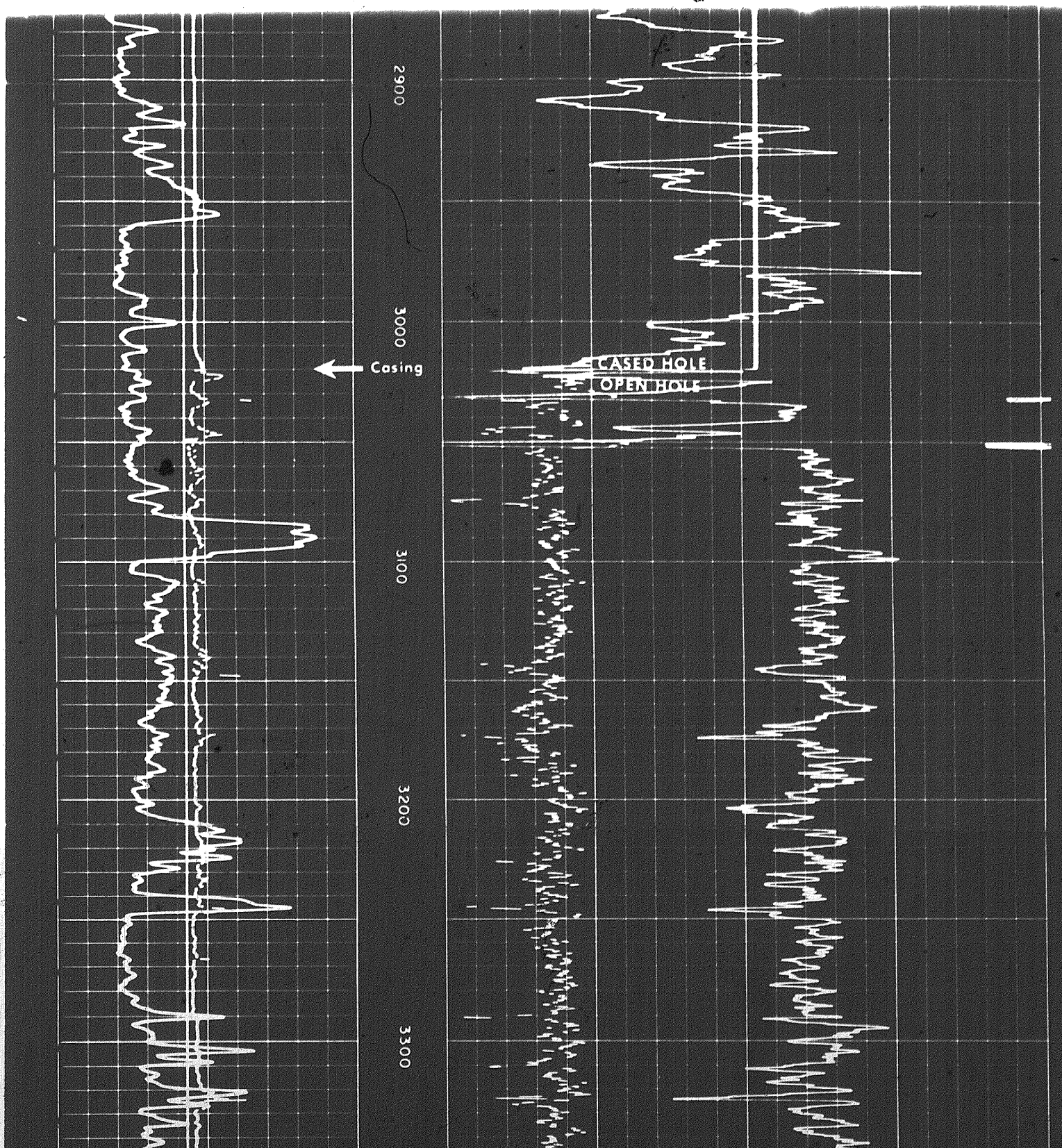
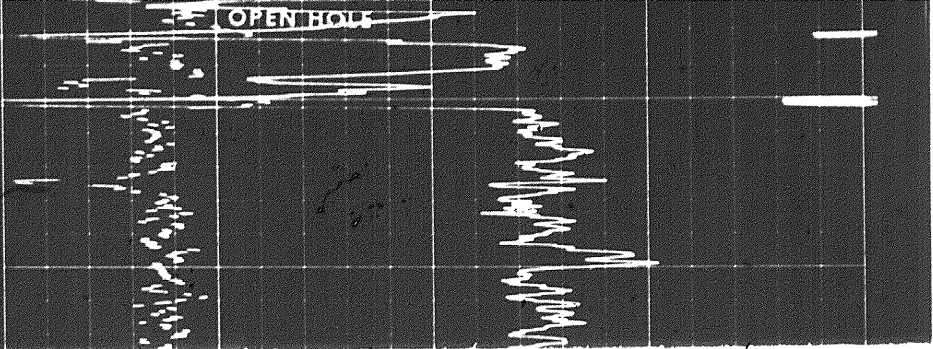
LOGGING DATA

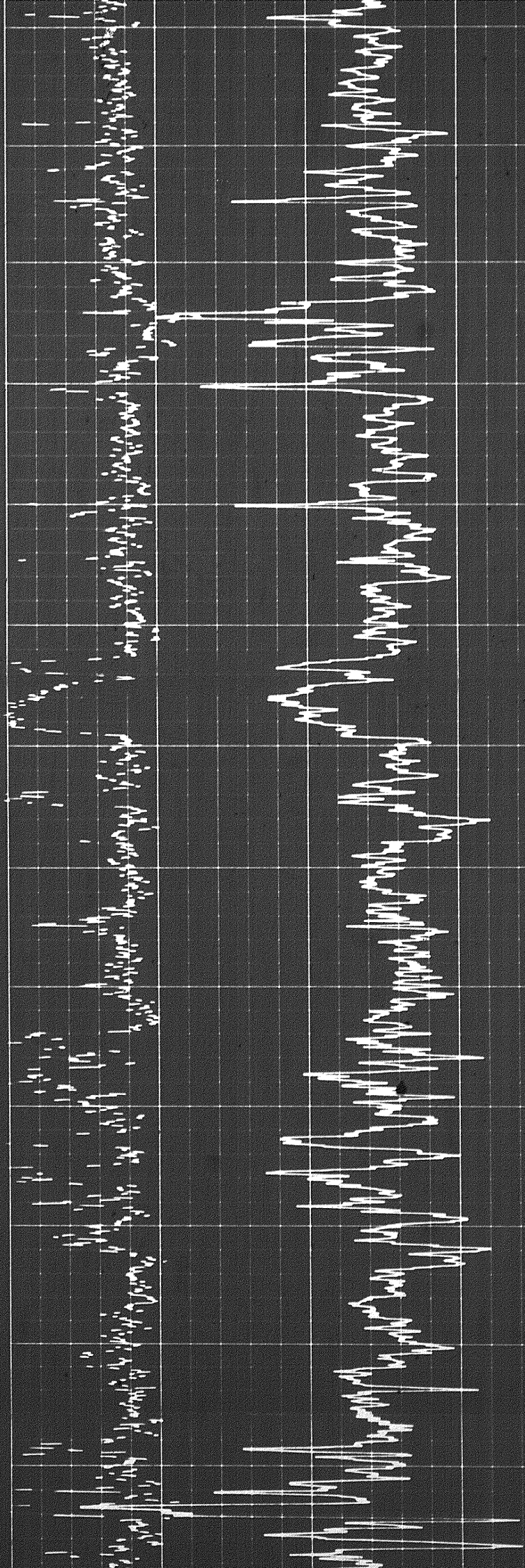
Run No.	General		Speed Ft./Min.	Tc	Gamma Ray		CNL Selectors		
	From	To			API Scale	Matrix	Auto Hole Size Corr.	Hole Size Setting (If not auto)	Porosity Scale
TWO	2800	5614	30	2	0-150	SANDSTONE	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		45-15--15
	5614	9905	30	2	0-300	LIMESTONE	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		45-15--15
	9905	TD	30	2	0-300	SANDSTONE	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		45-15--15
	REPEAT		30	2	0-150	SANDSTONE	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		45-15--15
							<input type="checkbox"/> Yes <input type="checkbox"/> No		

All interpretations are opinions based on inferences from electrical or other measurements and we cannot, and do not, guarantee the accuracy or correctness of any interpretations, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, agents or employees. These interpretations are also subject to Clause 4 of our General Terms and Conditions as set out in our current Price Schedule.



10/1





3300

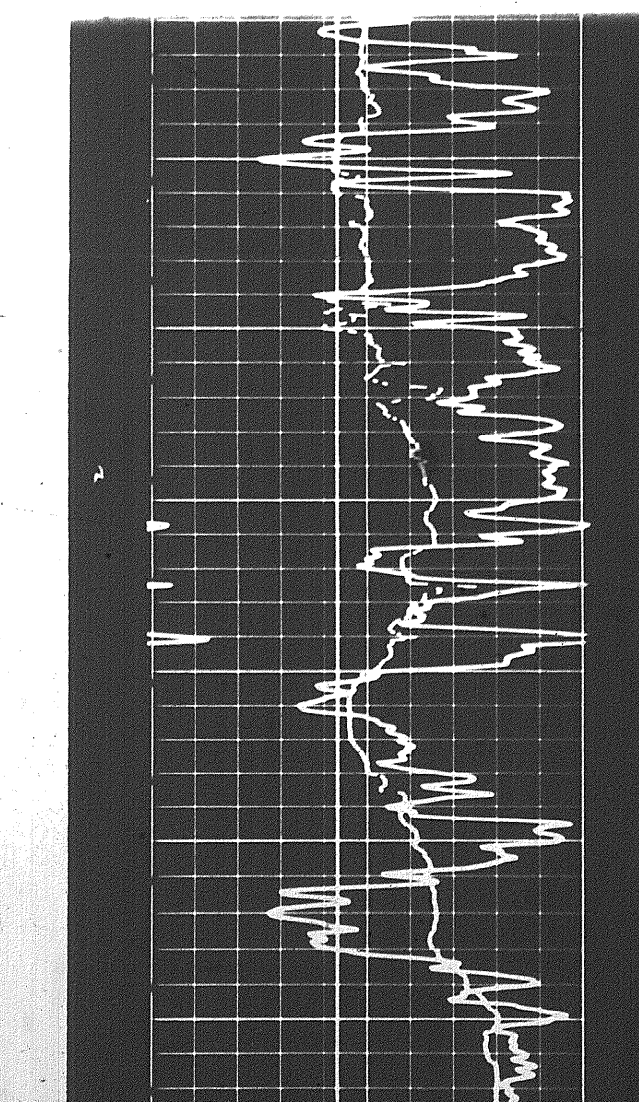
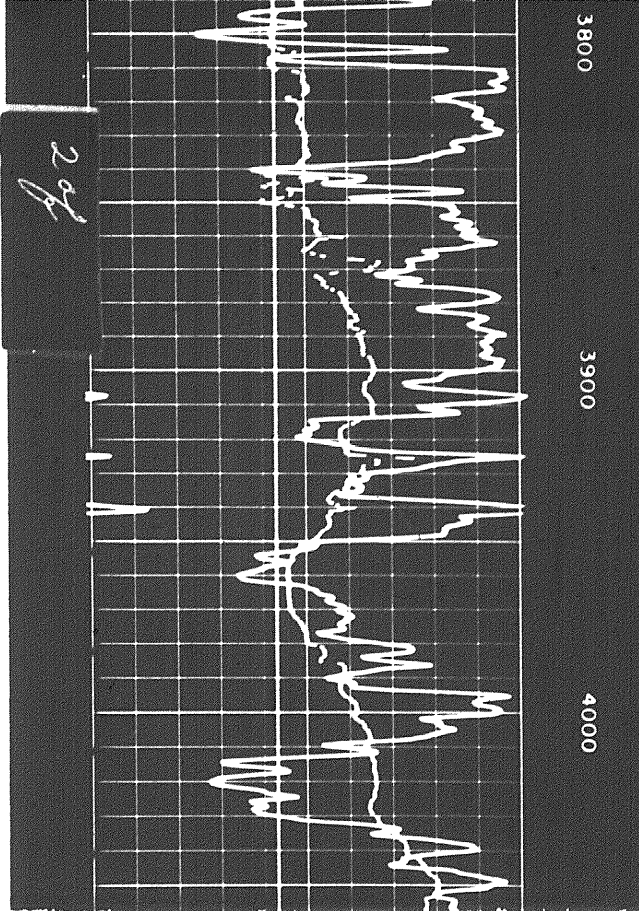
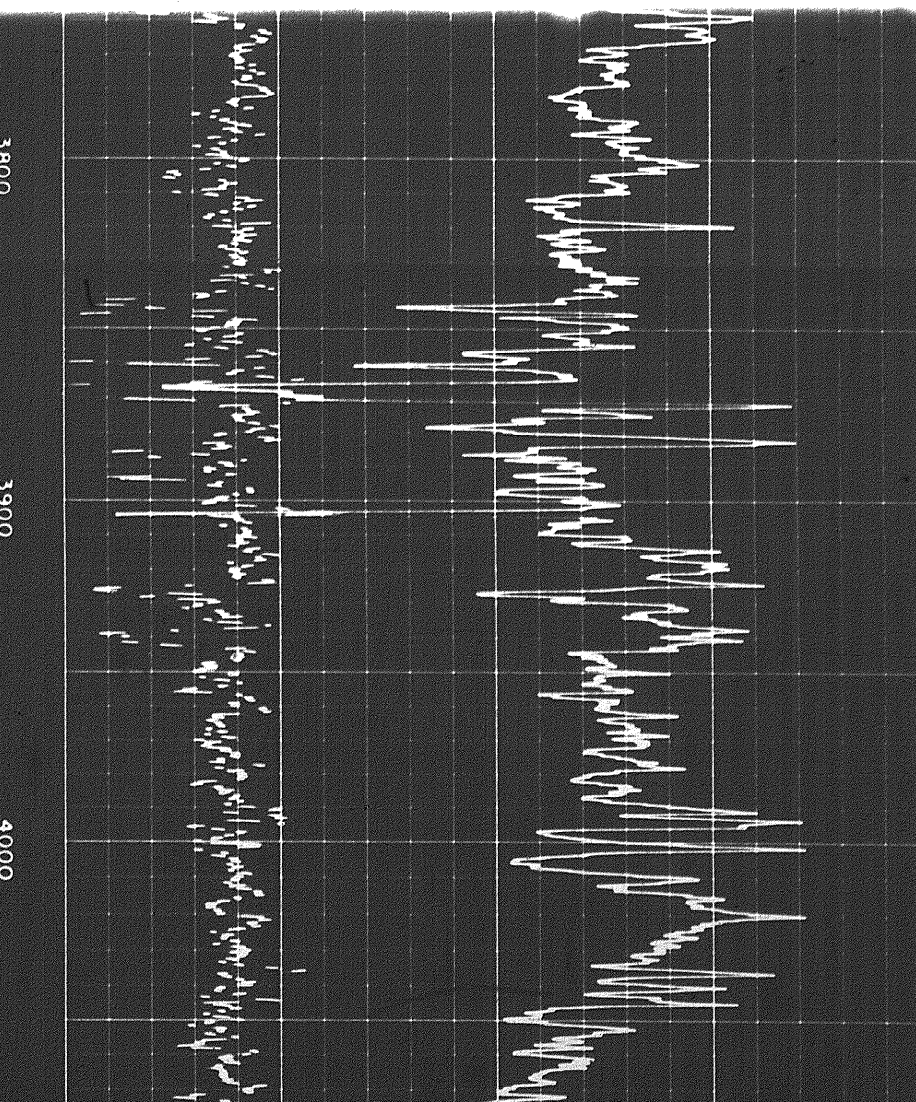
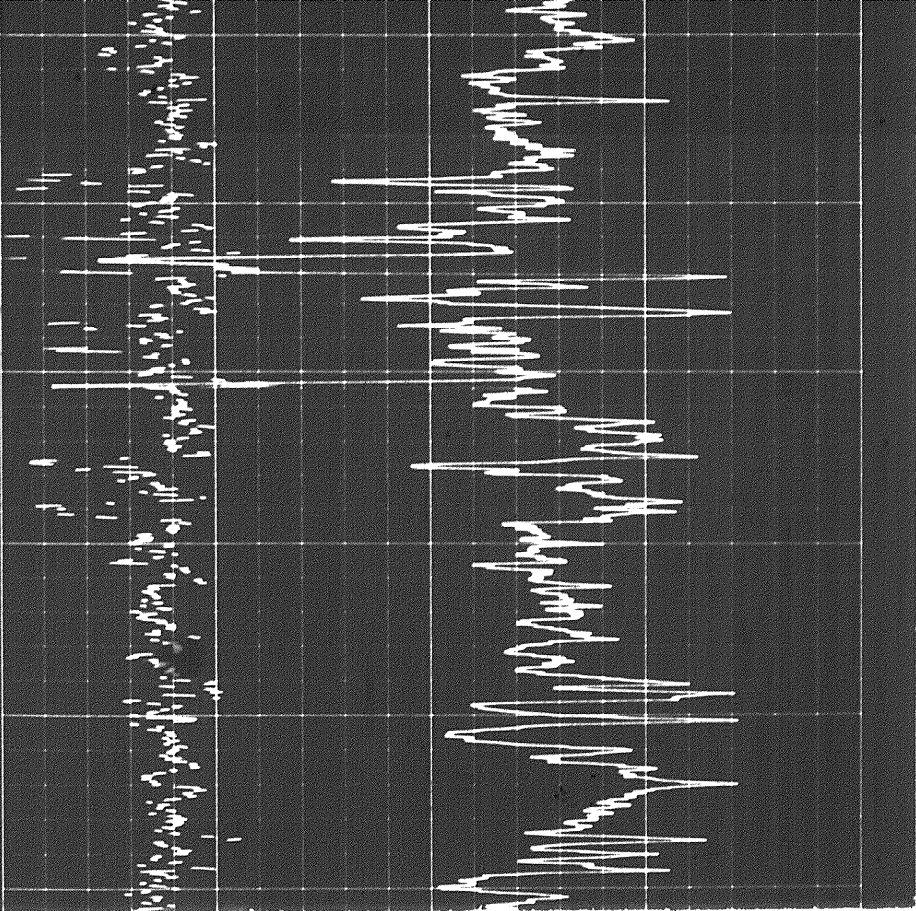
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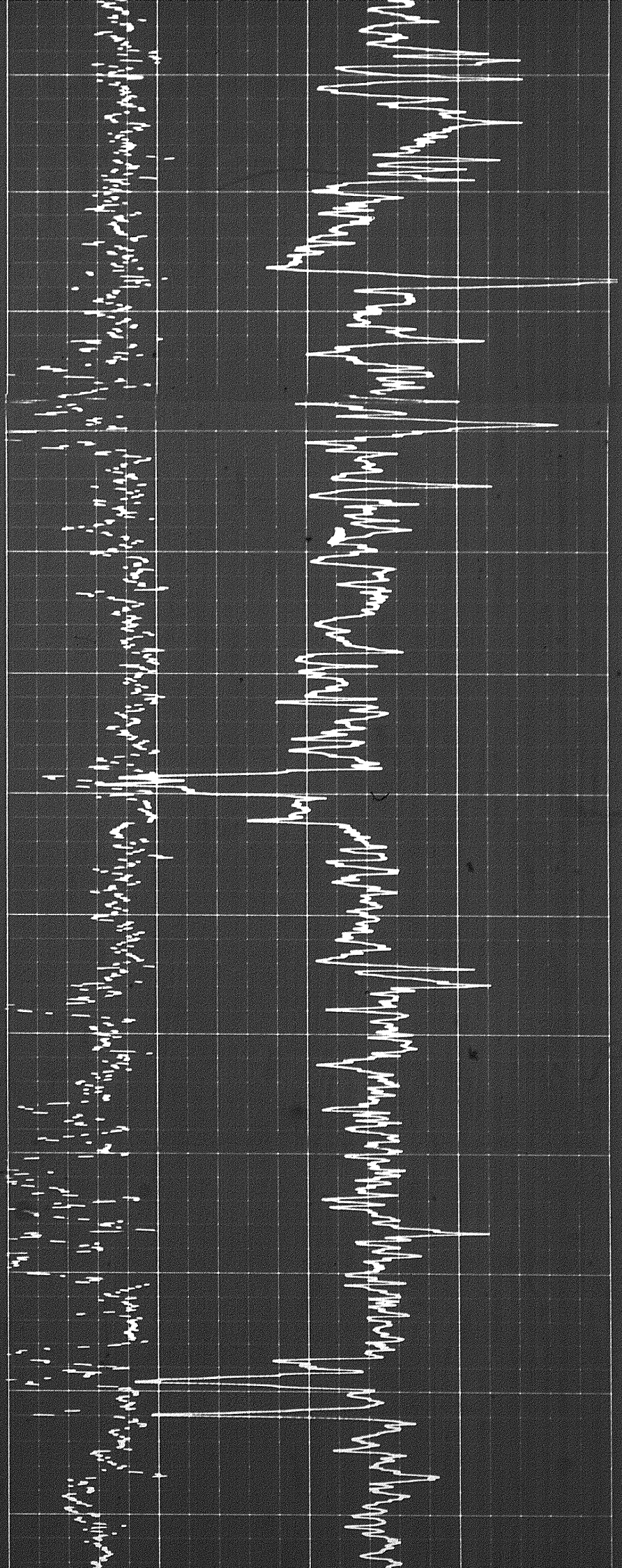
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3700

3800





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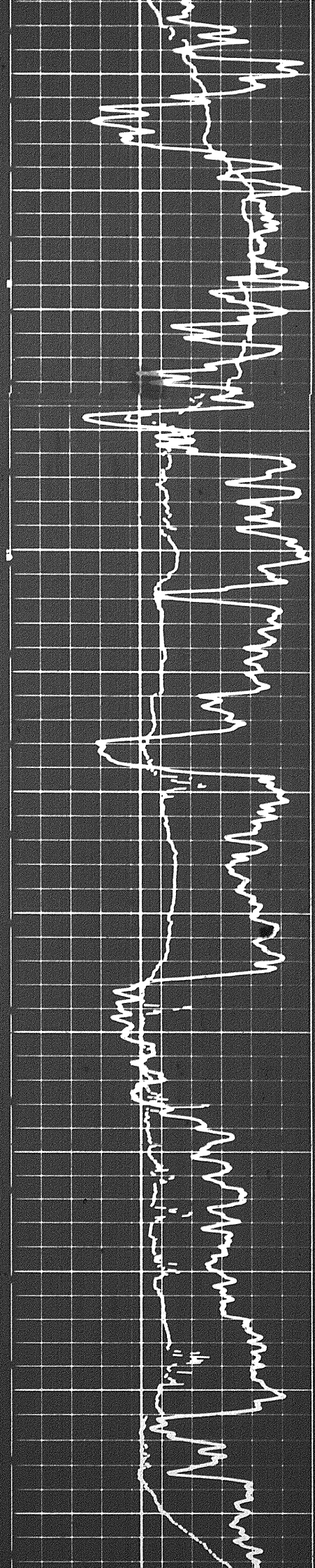
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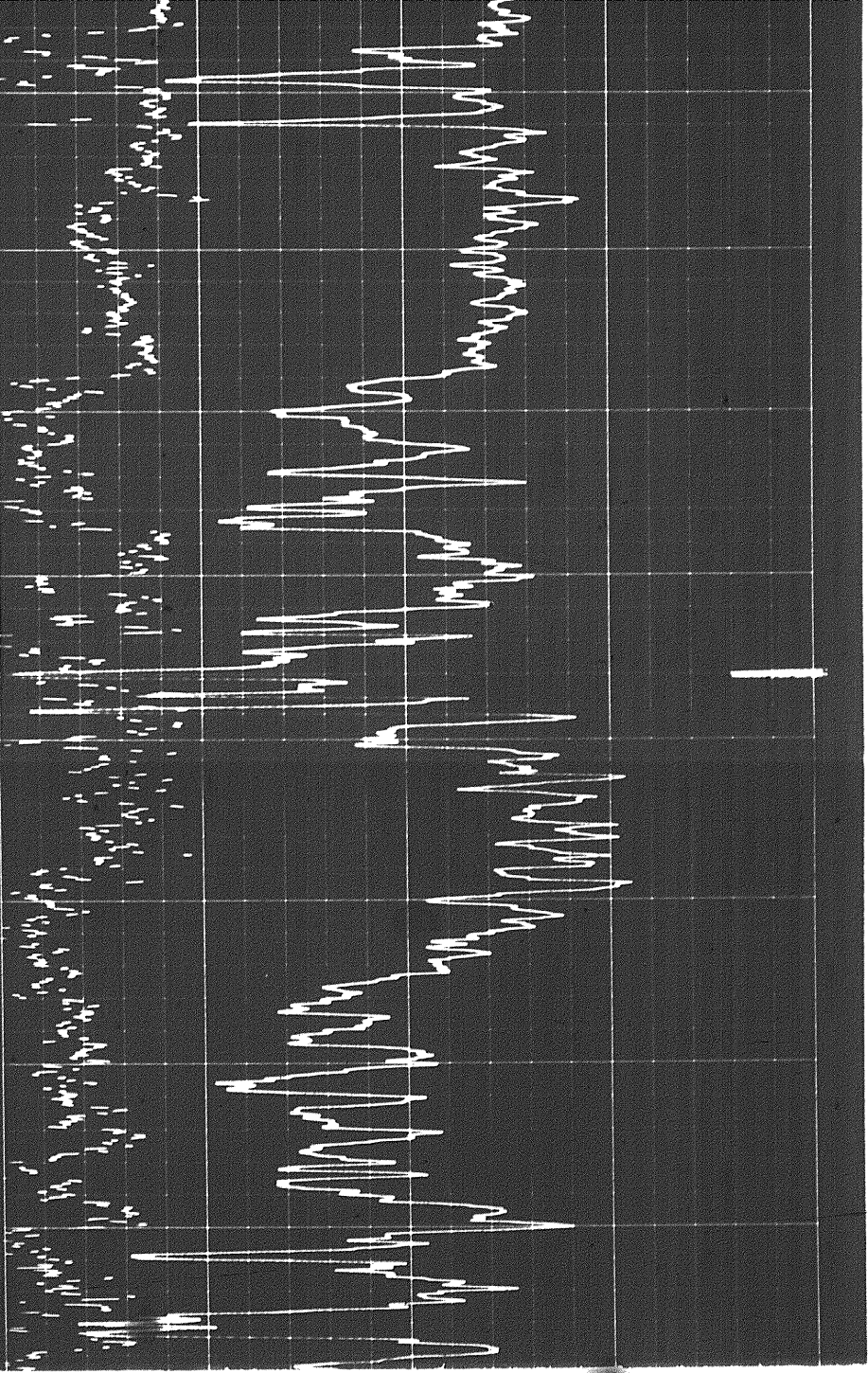
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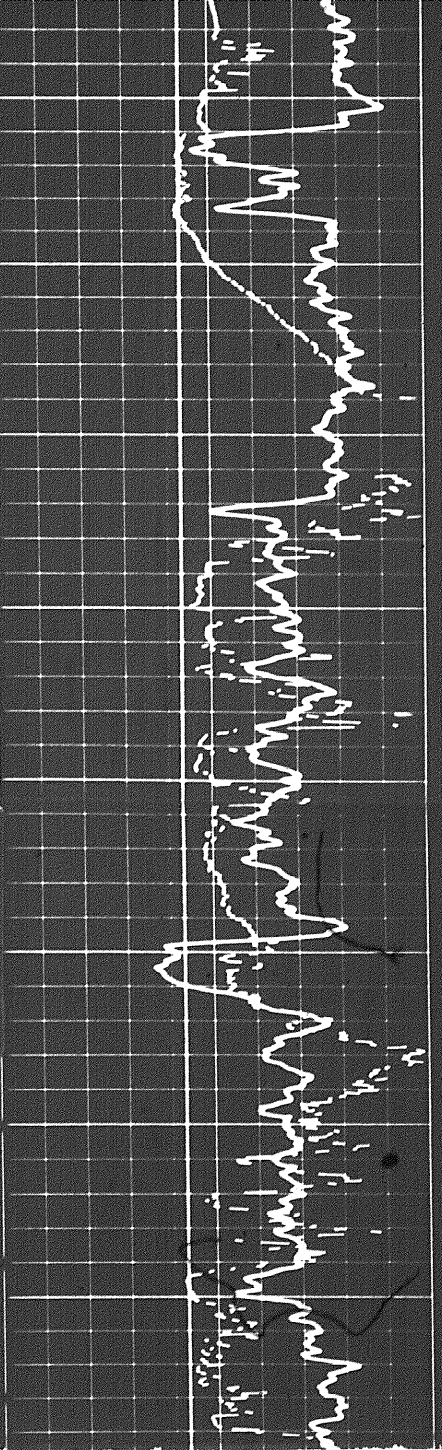


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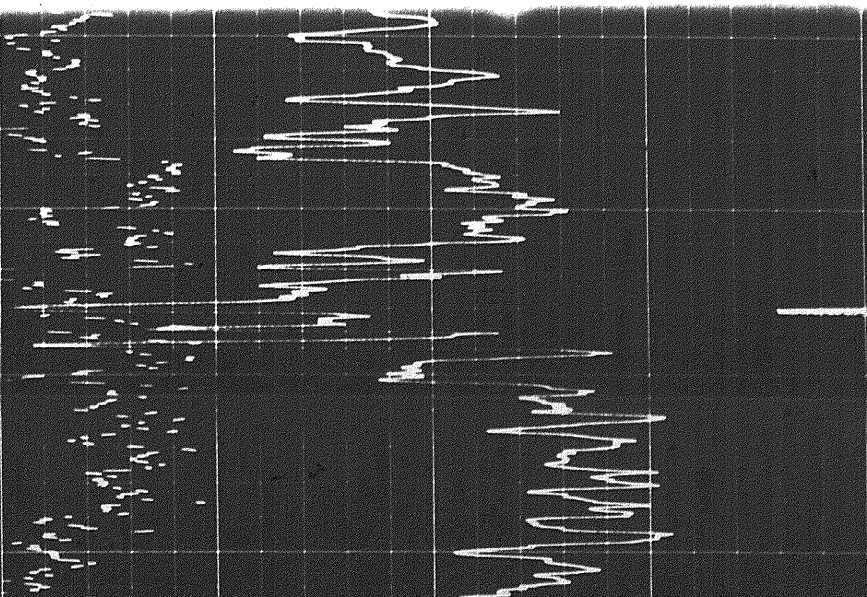
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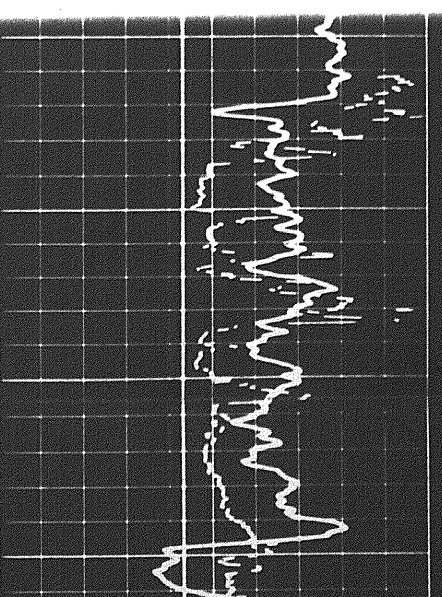


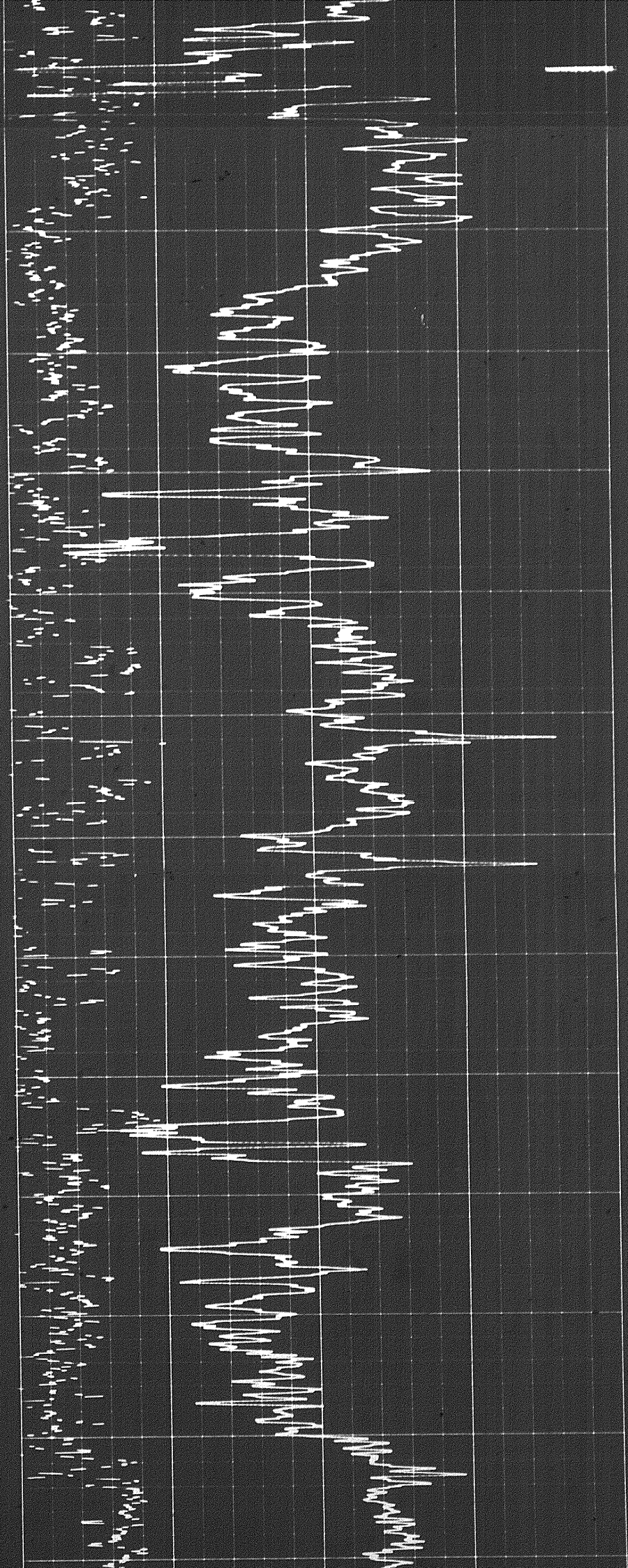
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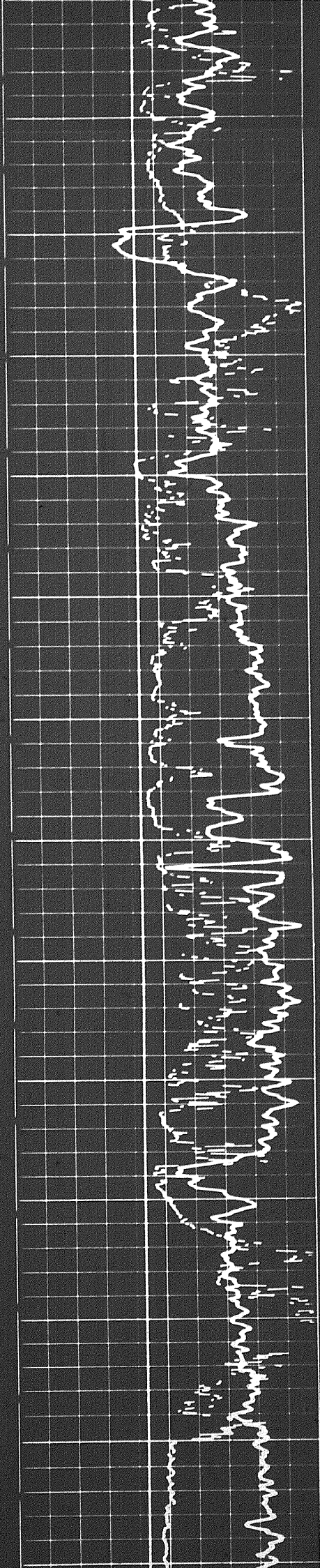
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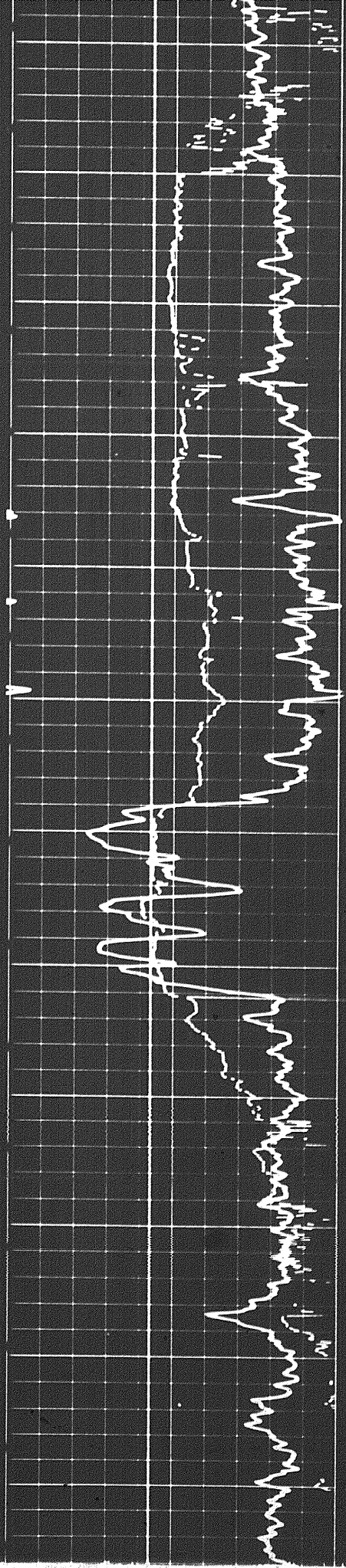




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4 of 4



5300

5400

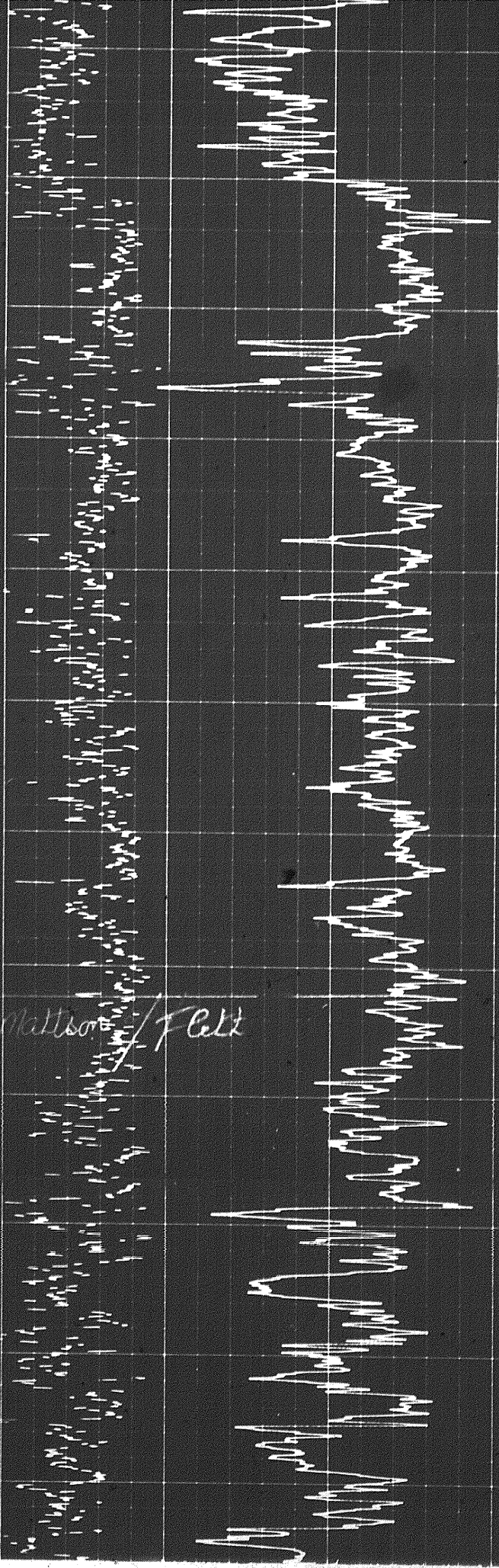
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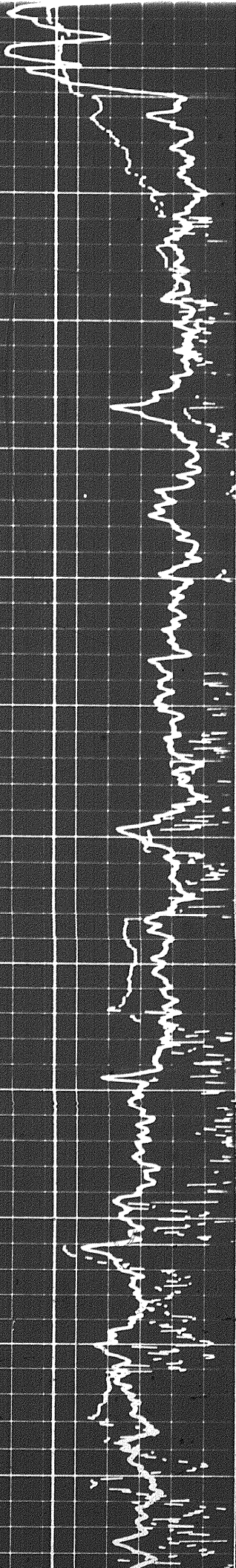
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5700

5800

Base Mattson / Felt





5600

500 mV / 100 ms

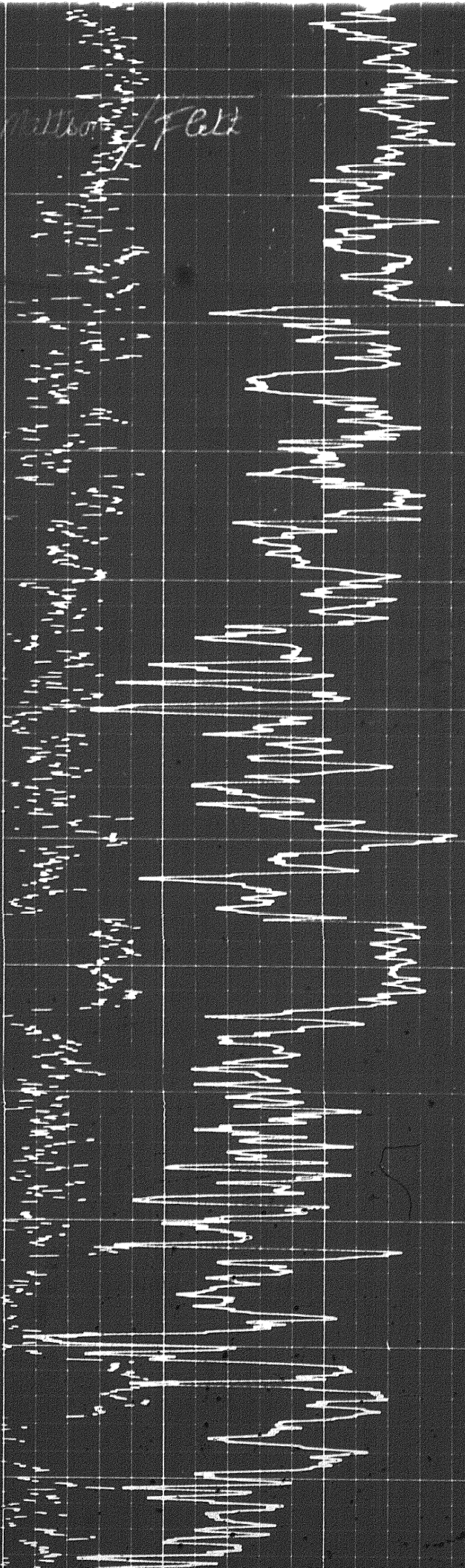
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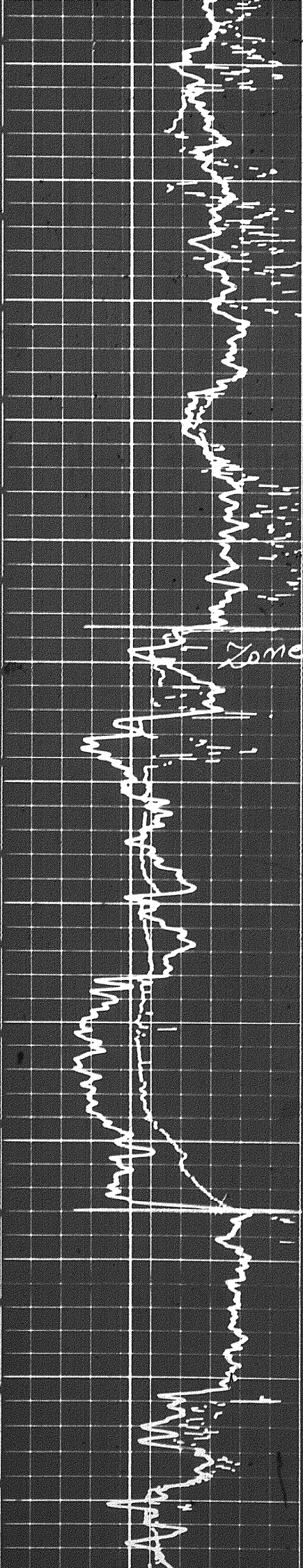
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5900

6000

6100

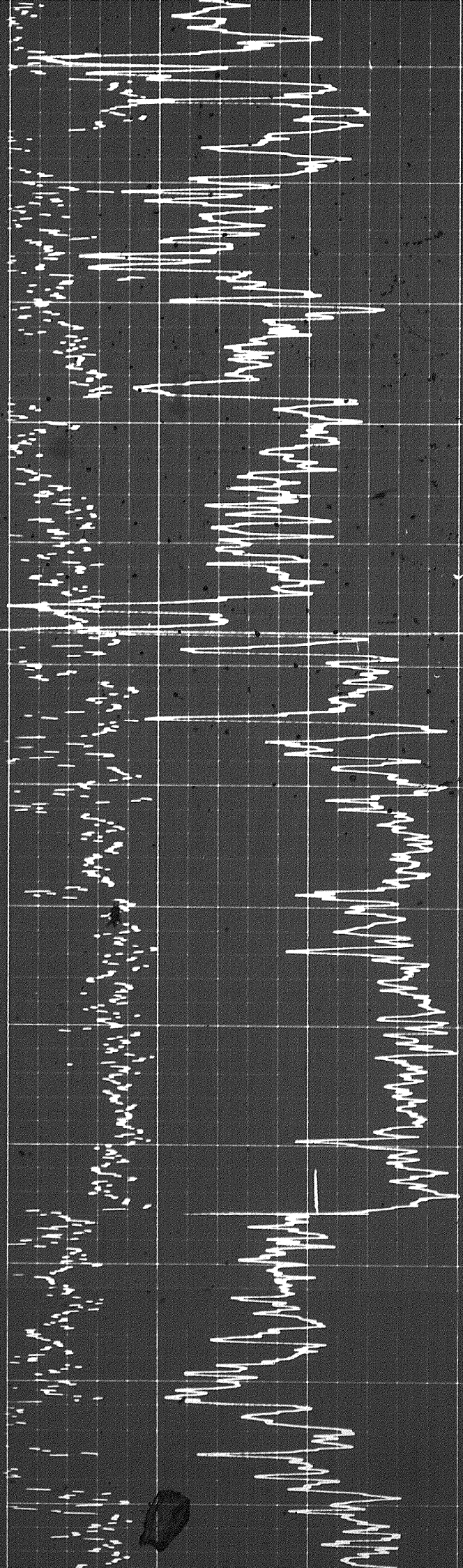


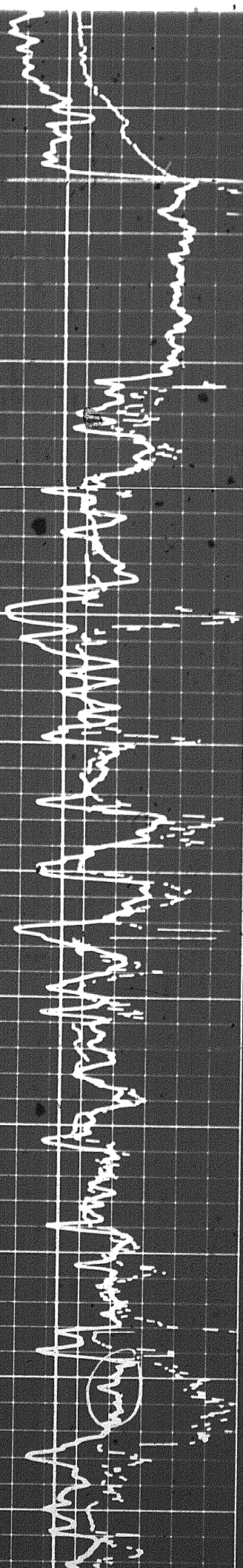


6100 6200 6300 6400 6500 6600 6700

Zone A

PKR





6600

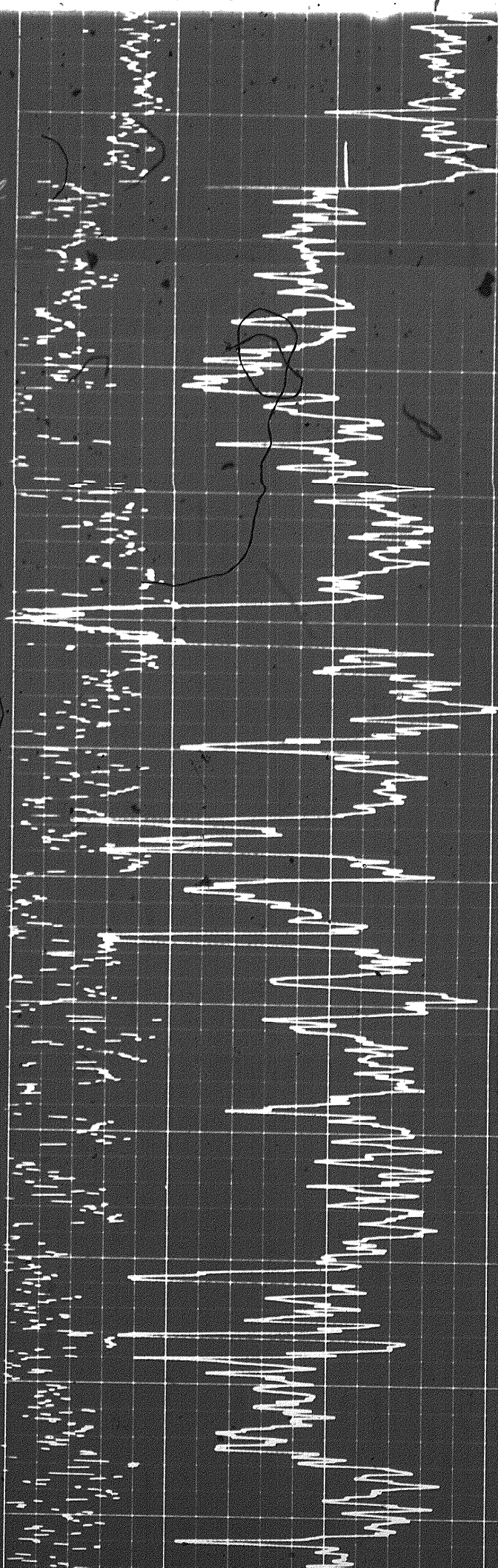
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6800

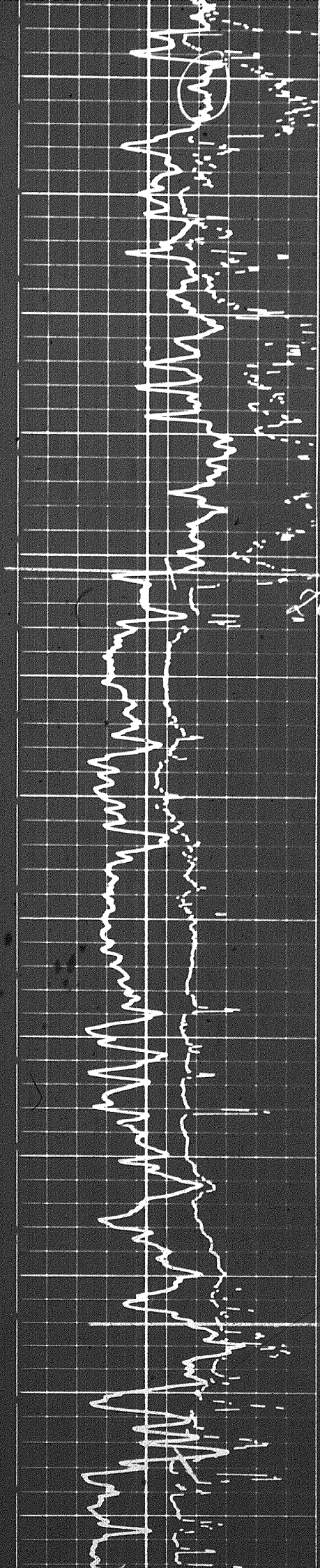
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7000

7100



6 of



7100

7200

7300

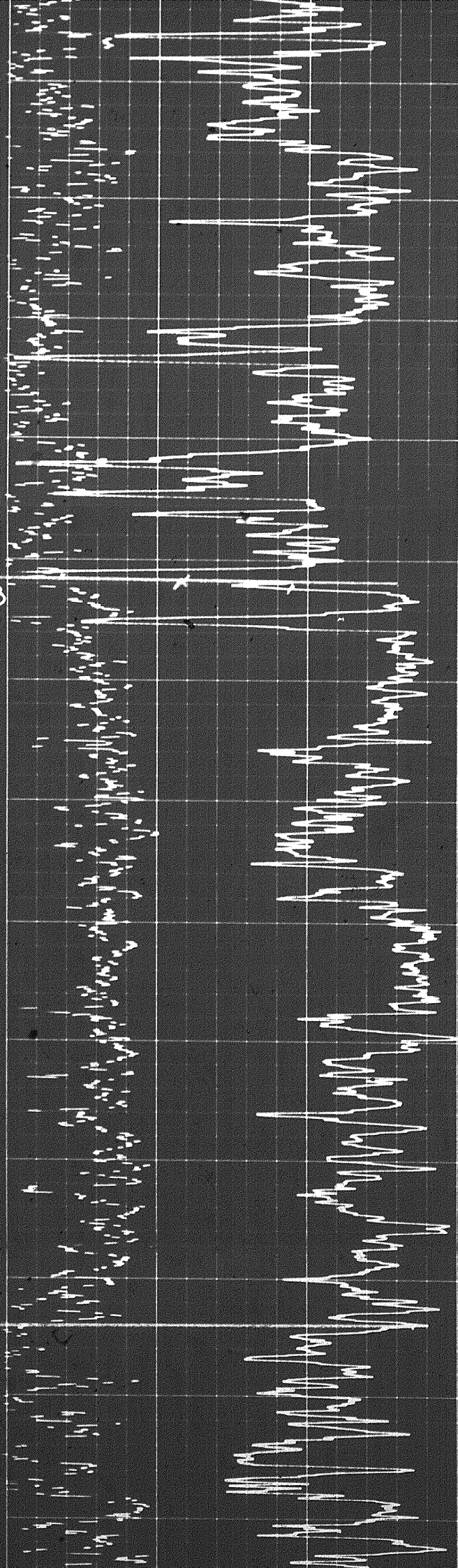
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7500

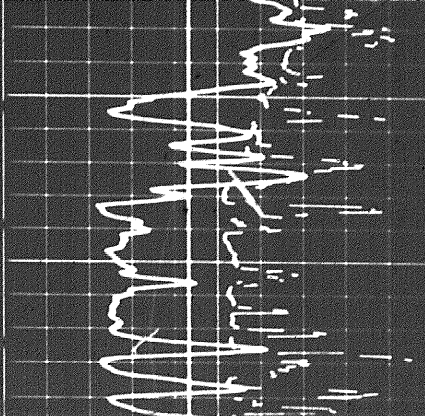
7600

Zone B

MKR

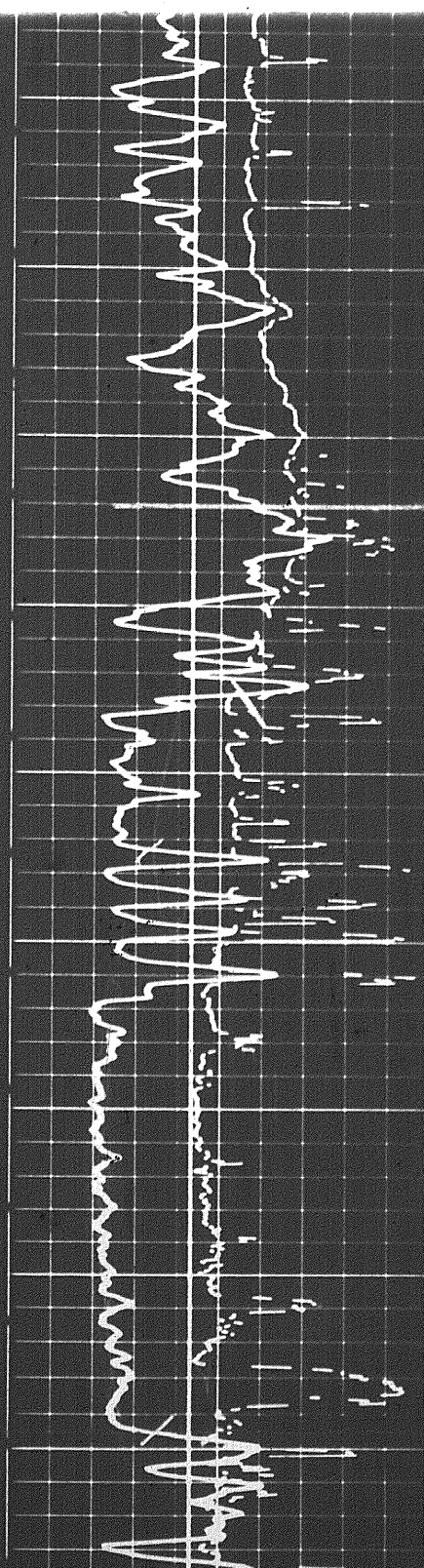
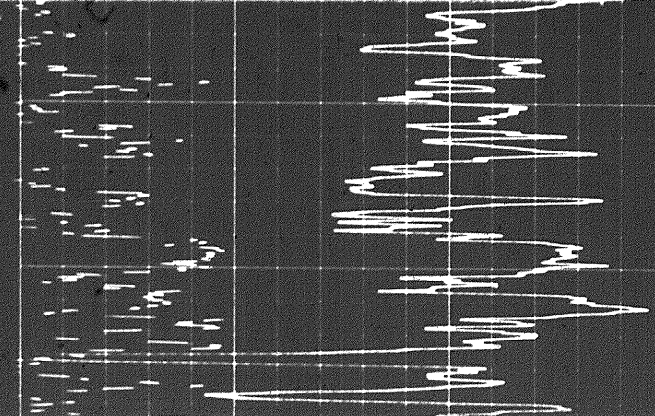


2



MKR

7600



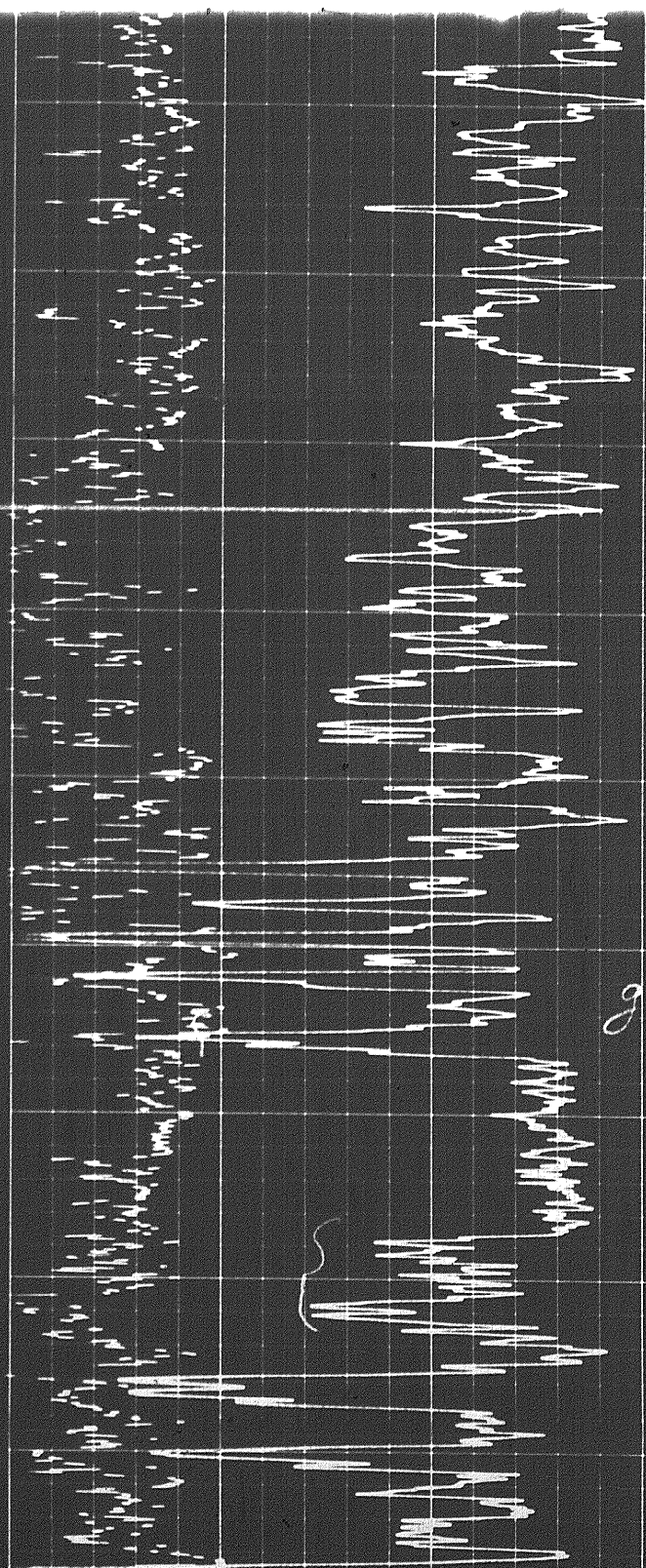
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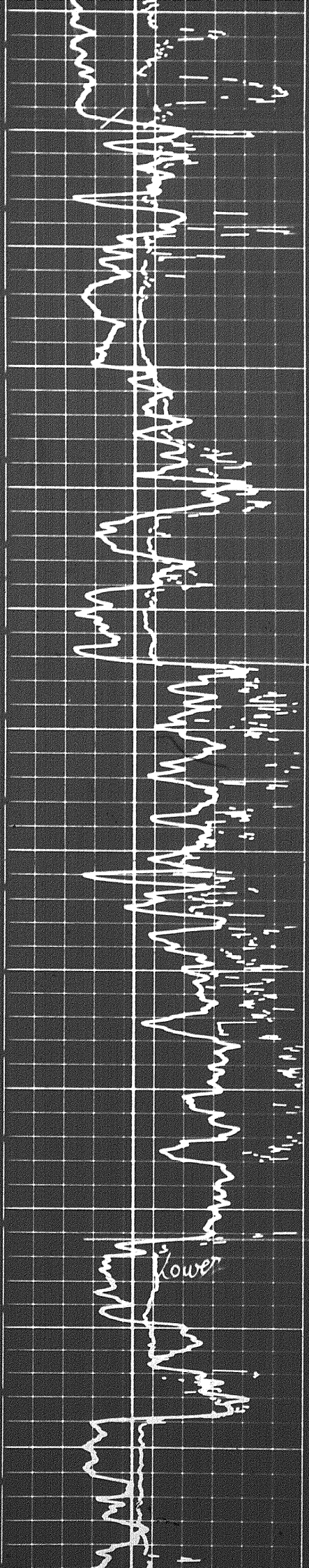
7600

7700

7800



gas zone



7800

7900

8000

8100

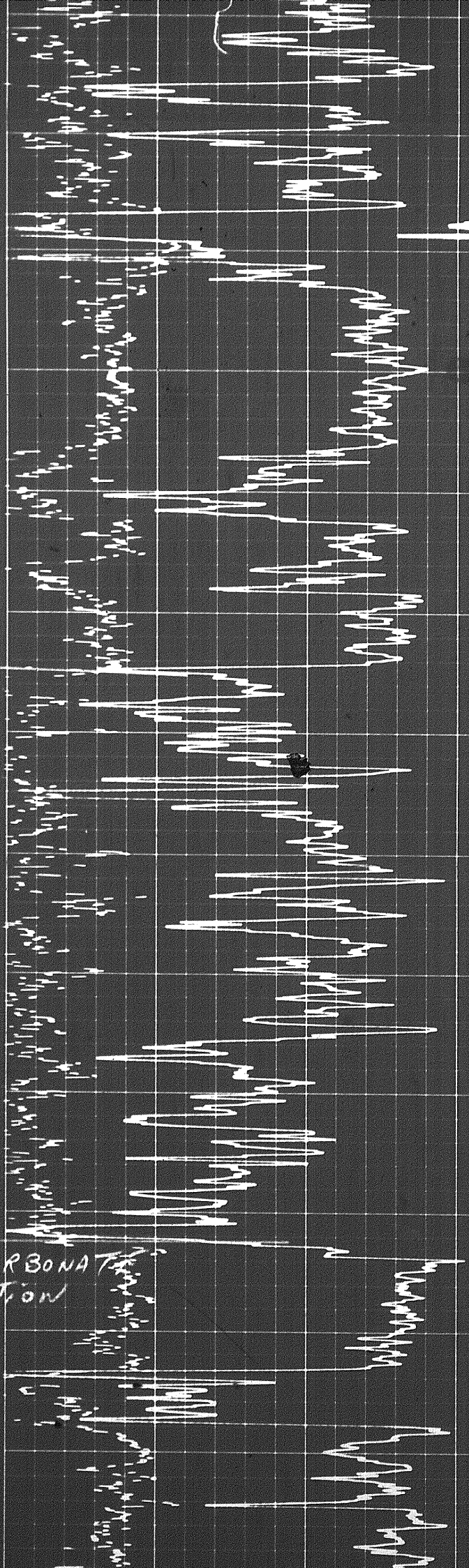
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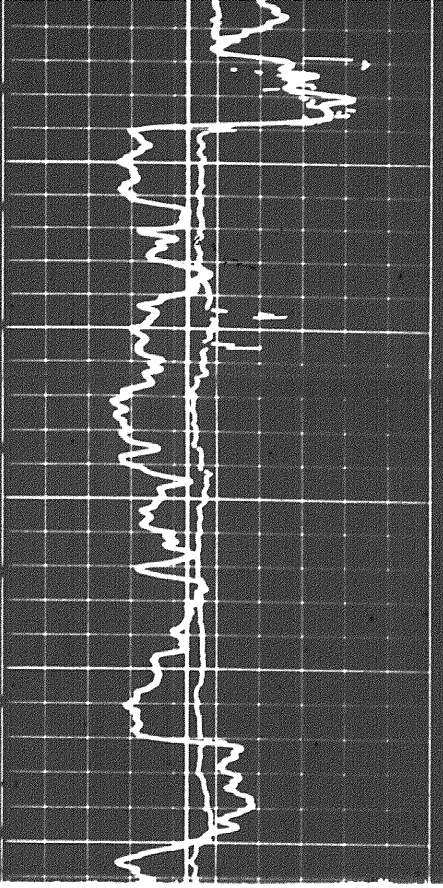
8400

1 CARBONATE SECTION

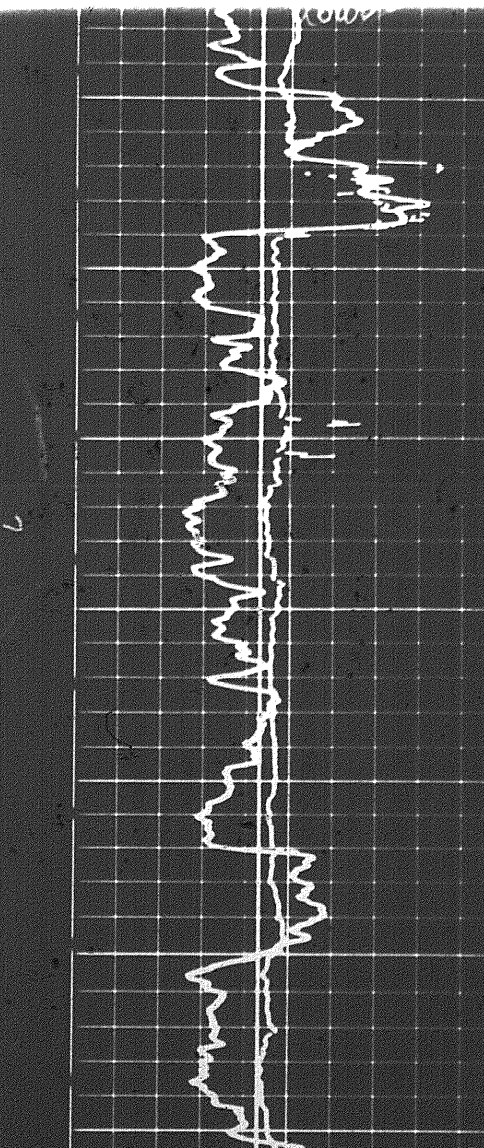
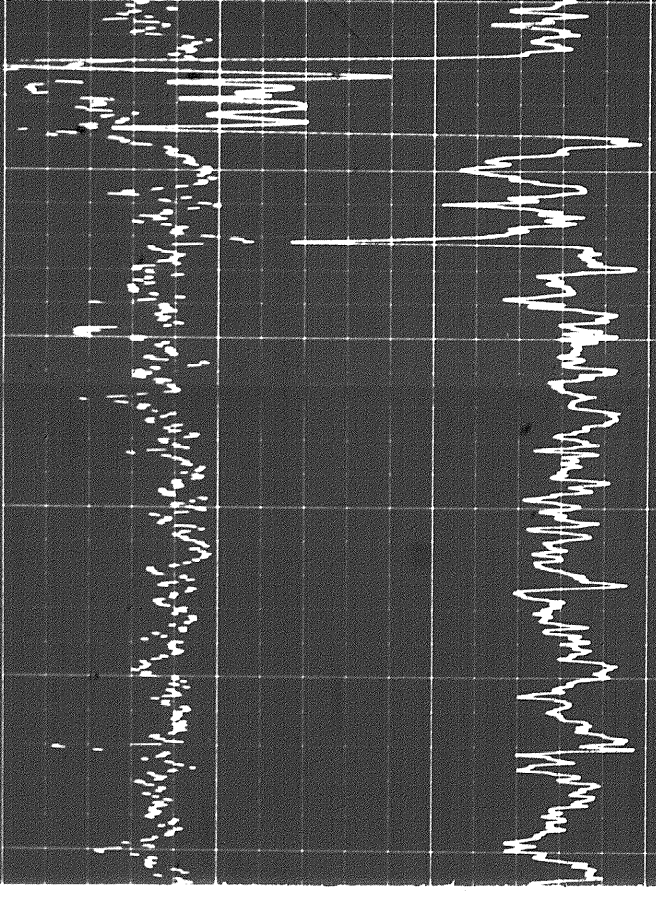
Lower



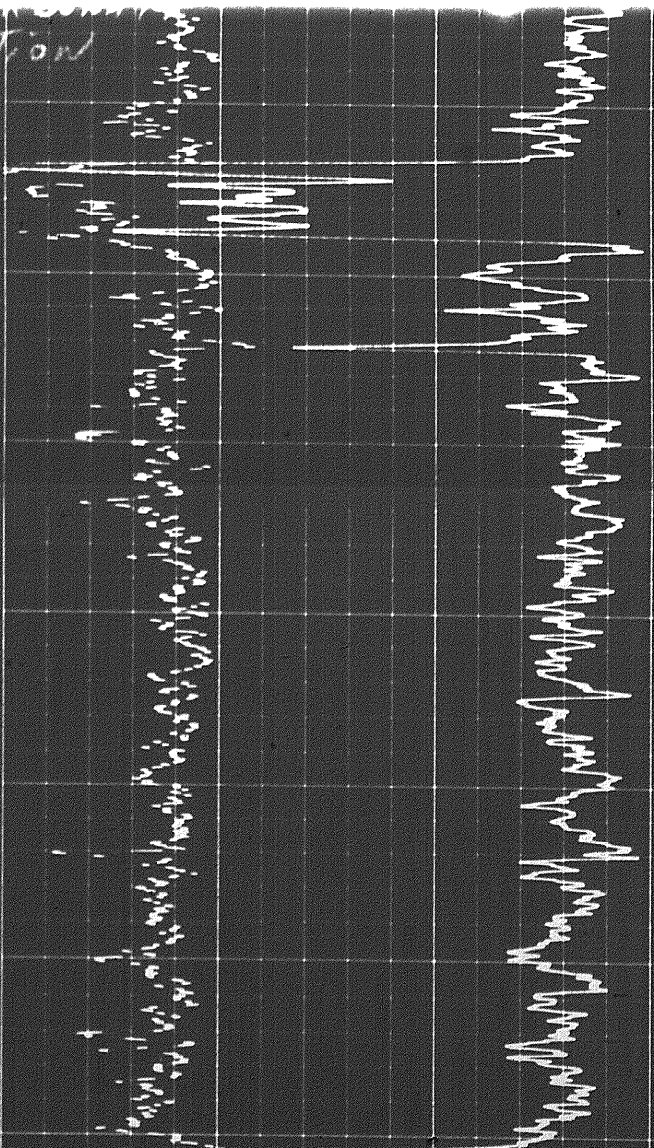
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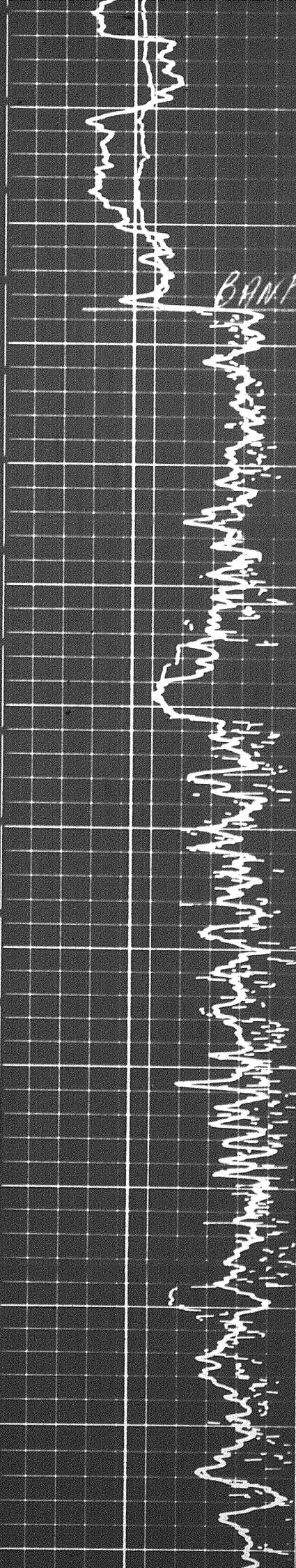


8400 8500 8600



SECTION
8400 8500 8600





BANFF / BSA River

8600

8700

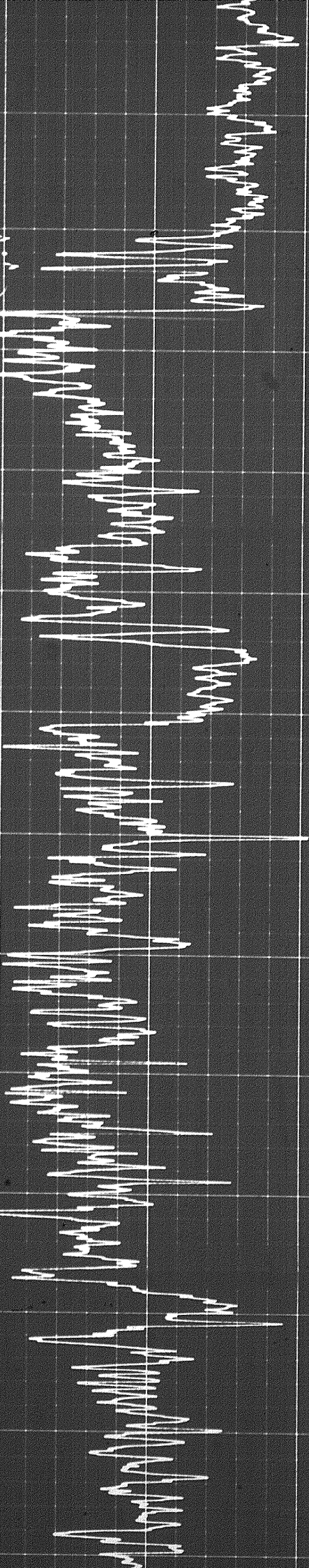
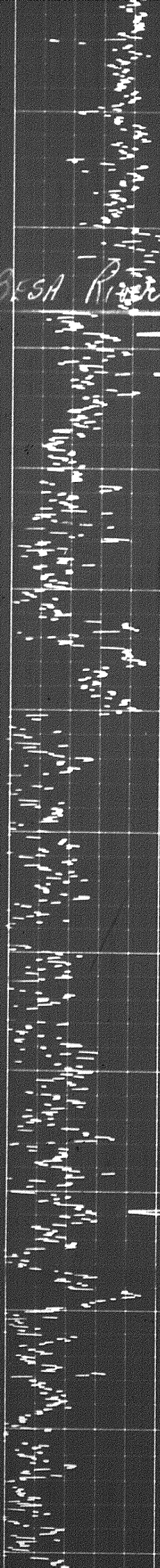
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8900

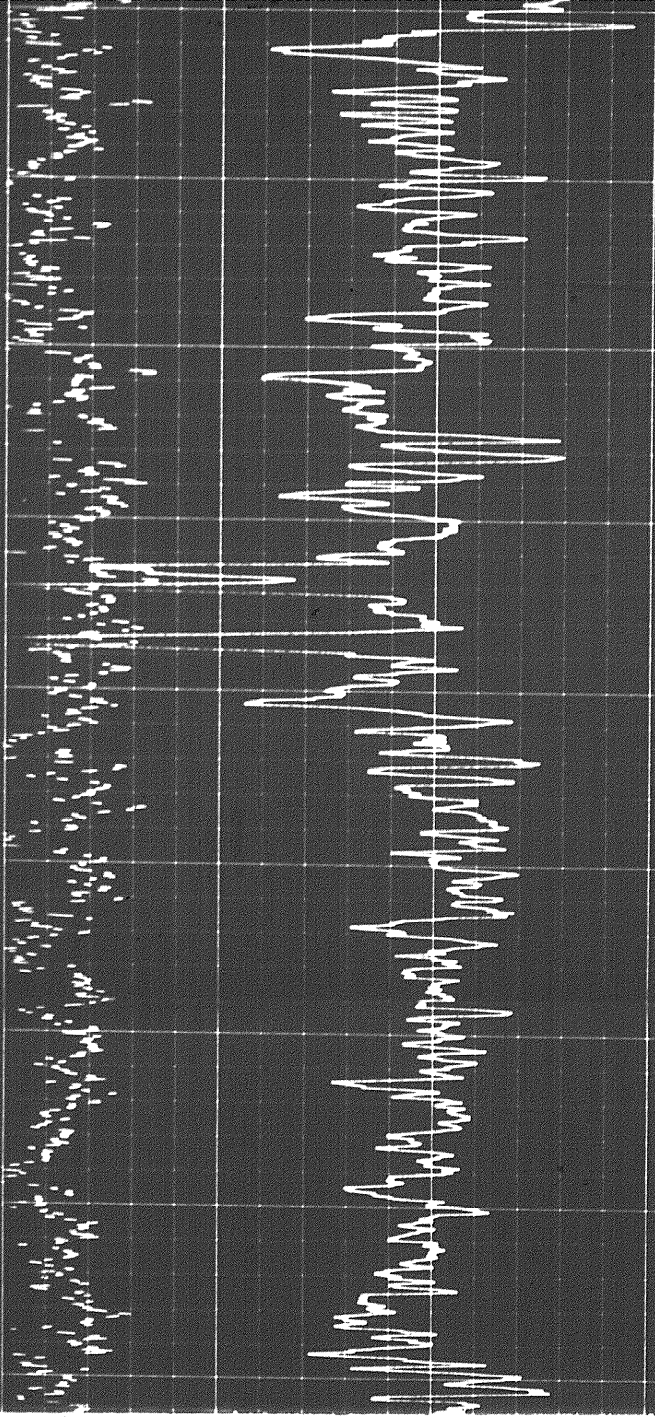
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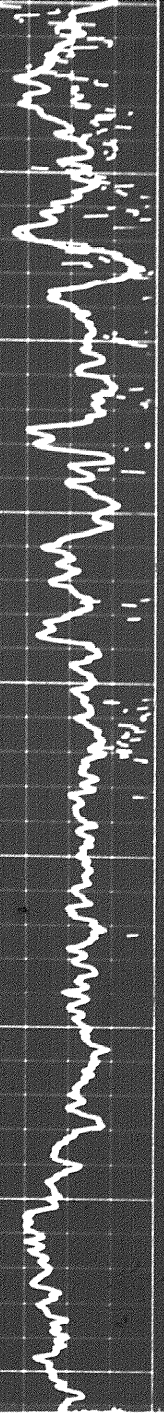
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11

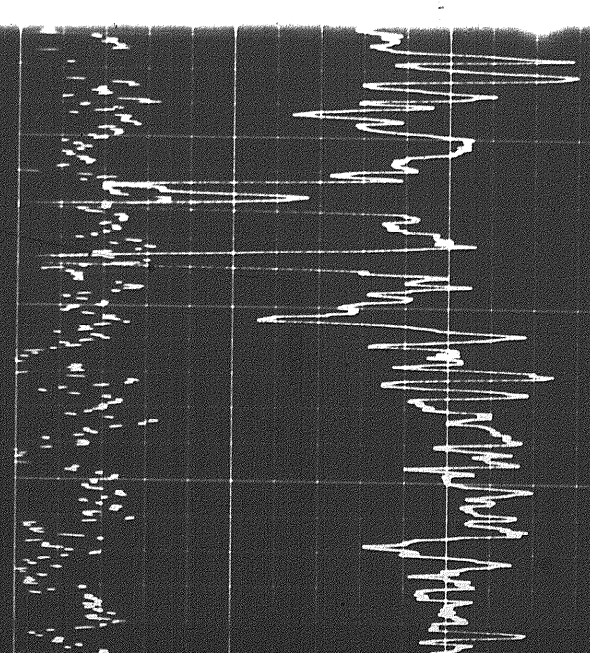


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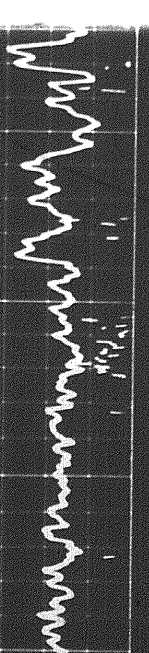


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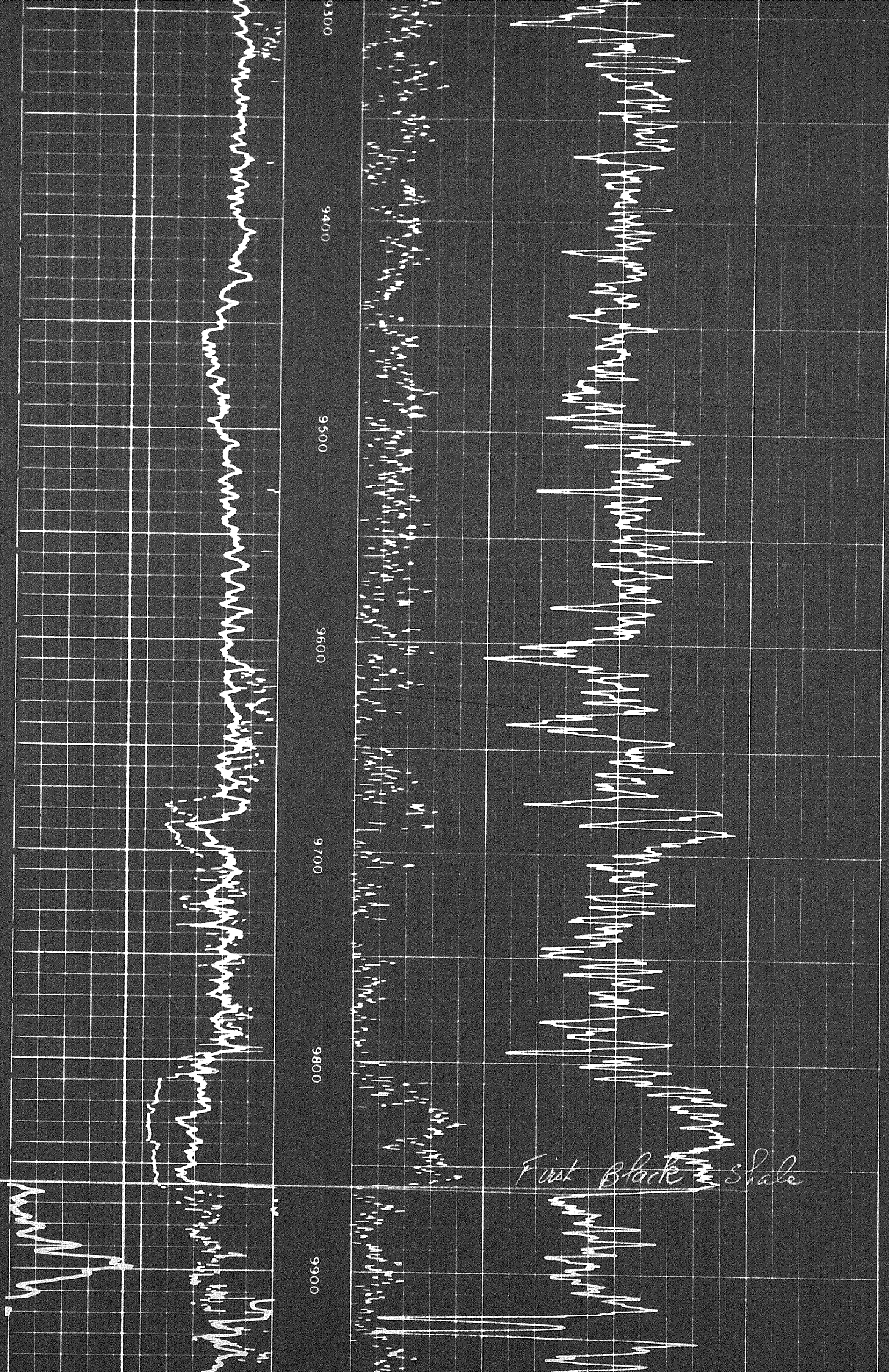
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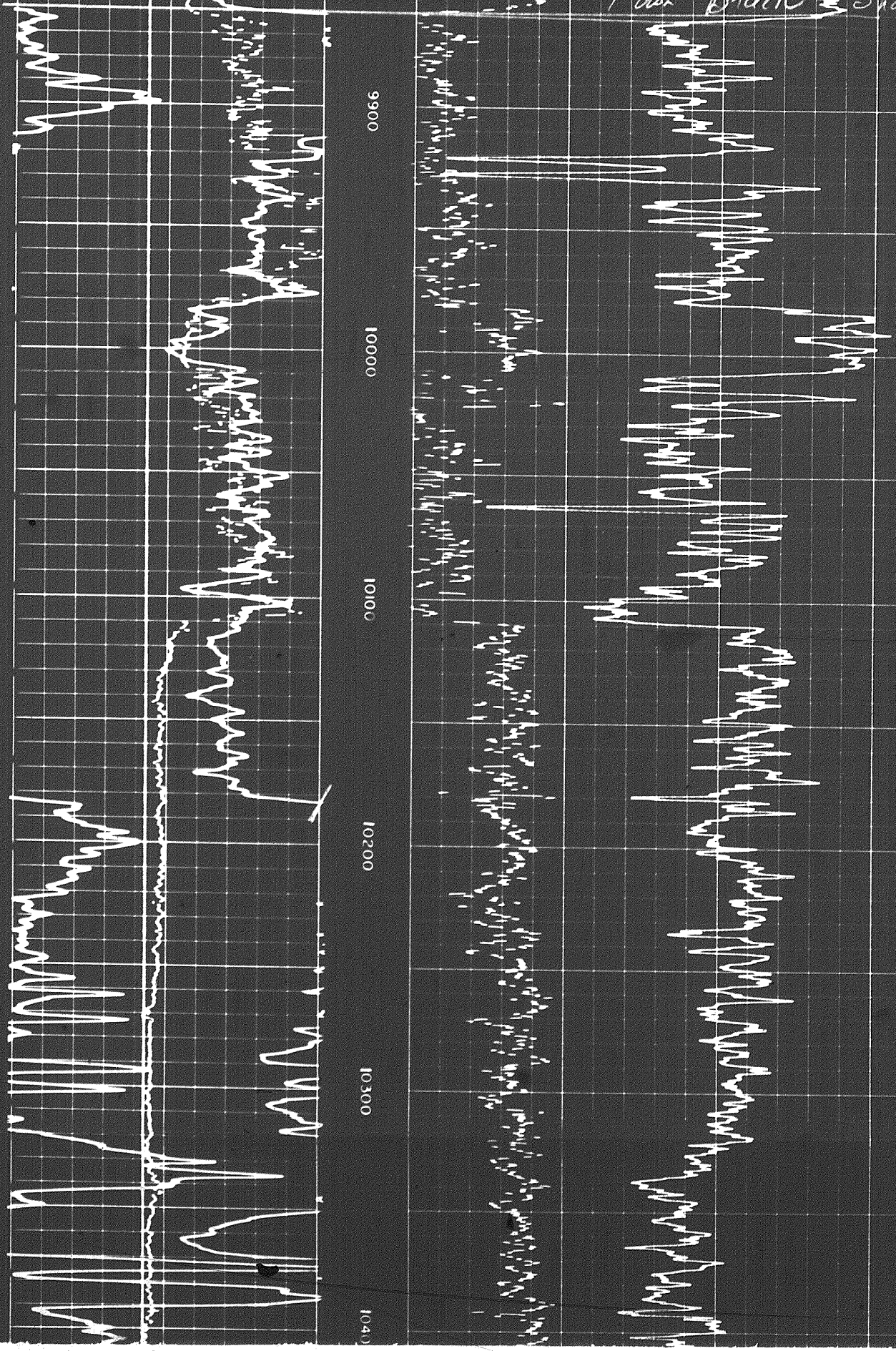
9300 9400



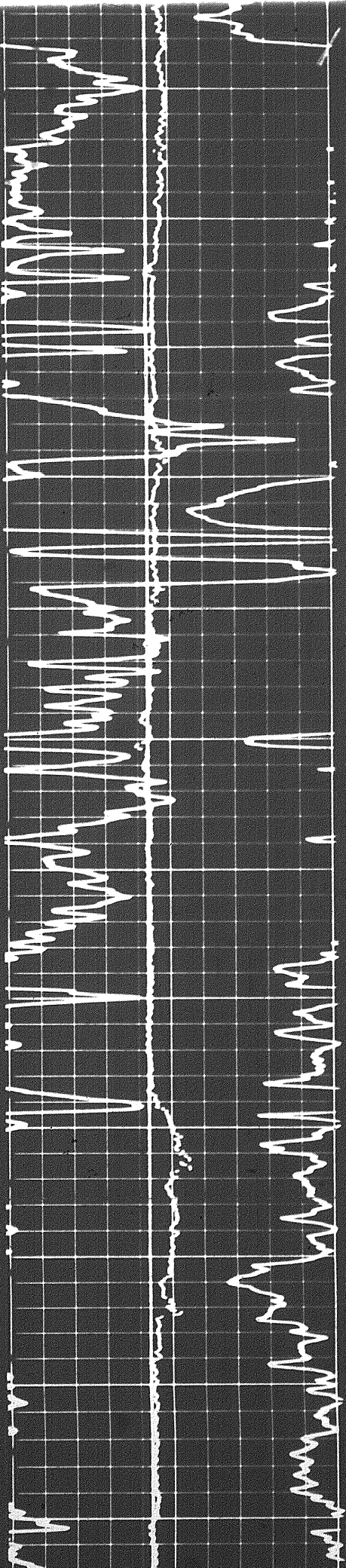
8



First Black shale



906



10200

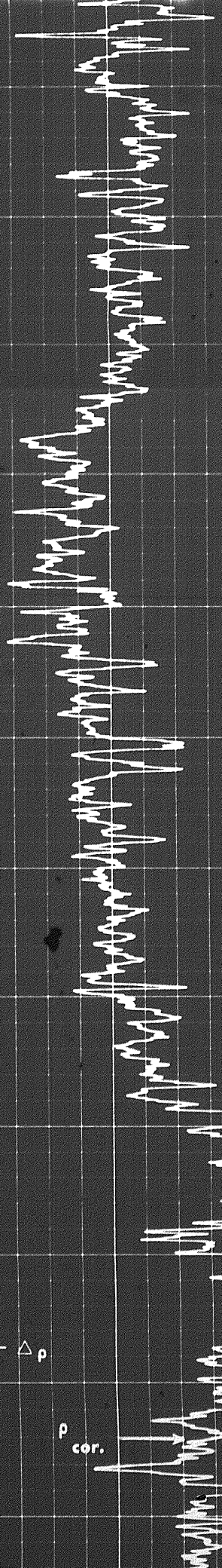
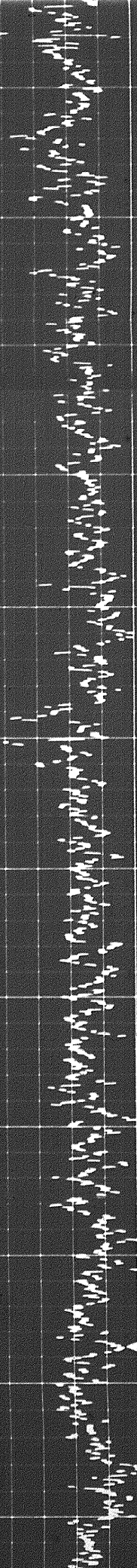
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10400

10500

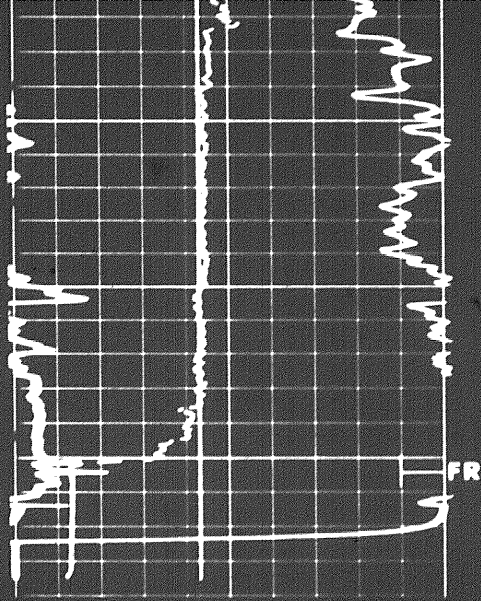
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10700



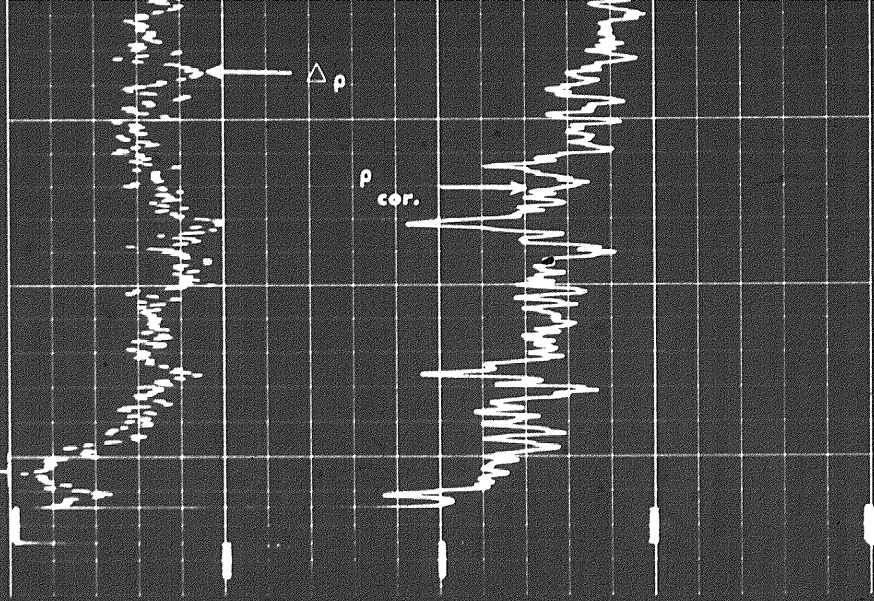
Δp

p
cor.

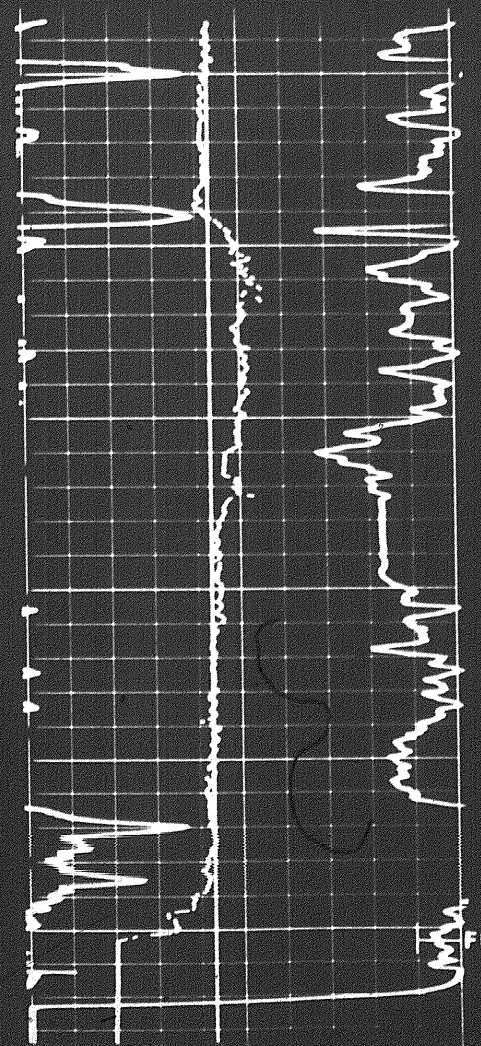


10700

10800



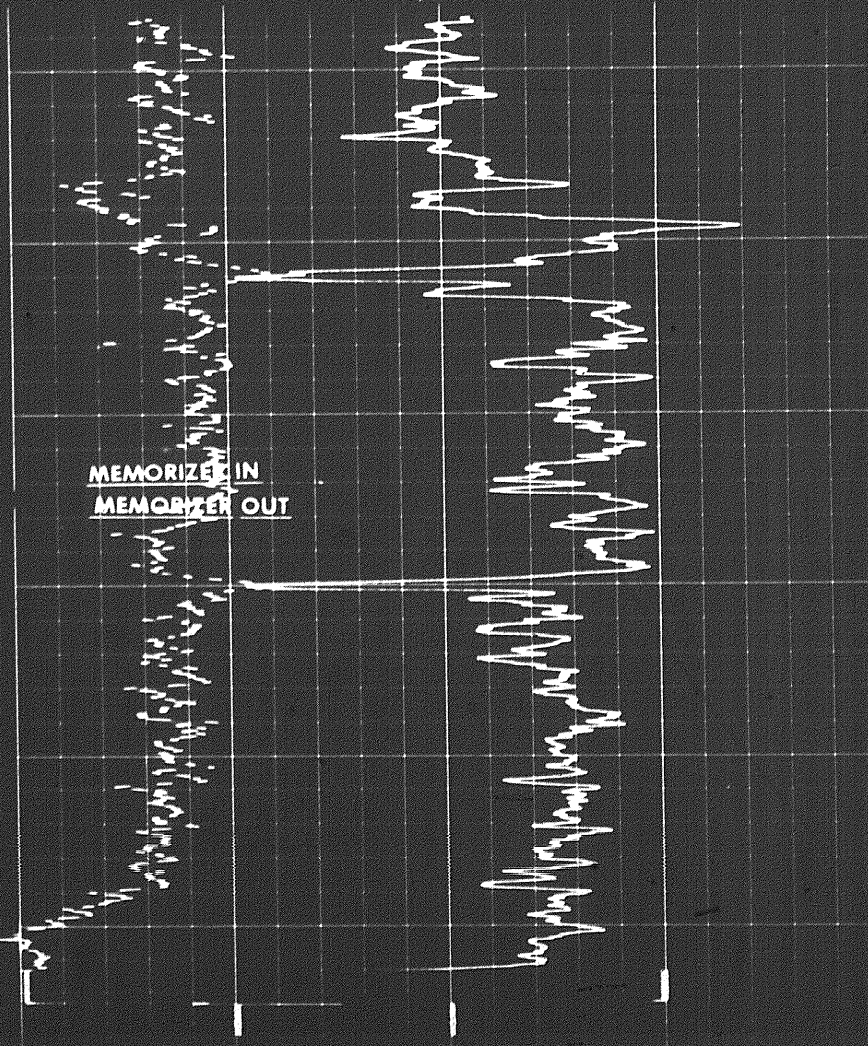
REPEAT SECTION



10600

10700

10800



(+) 0.25 0 (-) 0.25

CALIPER

hole diameter in inches

DENSITY CORRECTION

Δp - nm^2/hr

1001

MEMORIZE IN
MEMORIZE OUT

10700

10800

FR

(+) 0.25 0 (-) 0.25

DENSITY CORRECTION
 $\Delta\rho - \text{gm/cc}$

2.0 2.5 3.0

CALIPER
hole diameter in inches

Sens. _____ T.C. _____
Zero _____ div. to left

GAMMA RAY
API UNITS

DEPTH

BULK DENSITY
 $\rho_b - \text{gm/cc}$

DETAIL LOG
5' = 100'

CALIPER
hole diameter in inches

DEPTH

POROSITY (%)

SANDSTONE DENSITY

GAMMA RAY
API UNITS

NEUTRON

Sens. _____ T.C. _____
Zero _____ div. to left

Speed in RPM

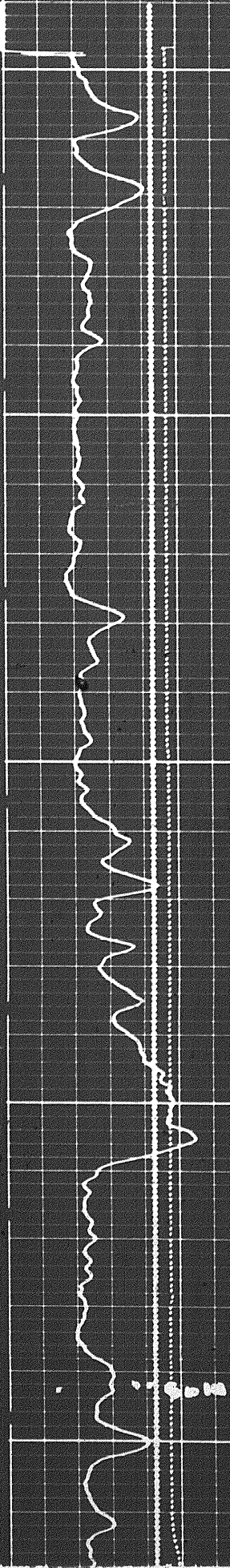
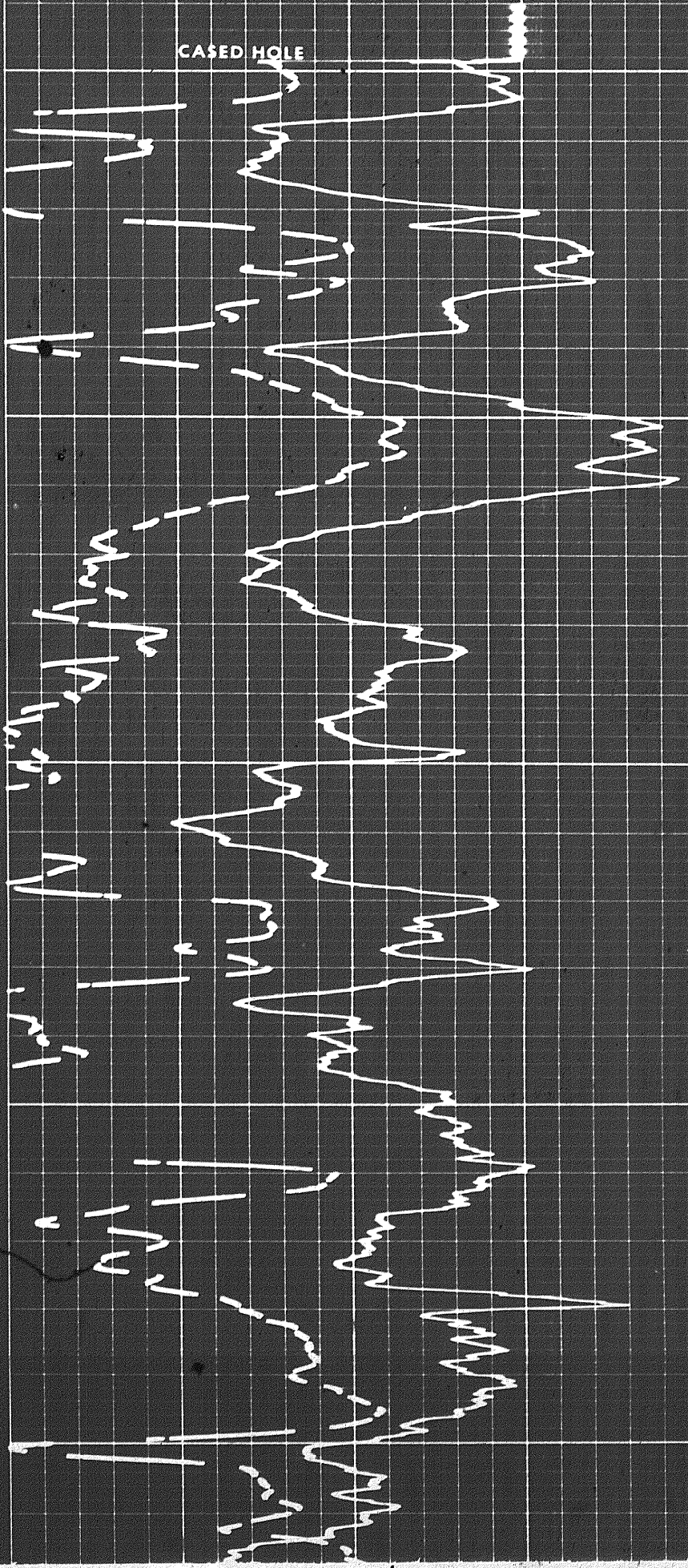
Speed in RPM

CASED HOLE

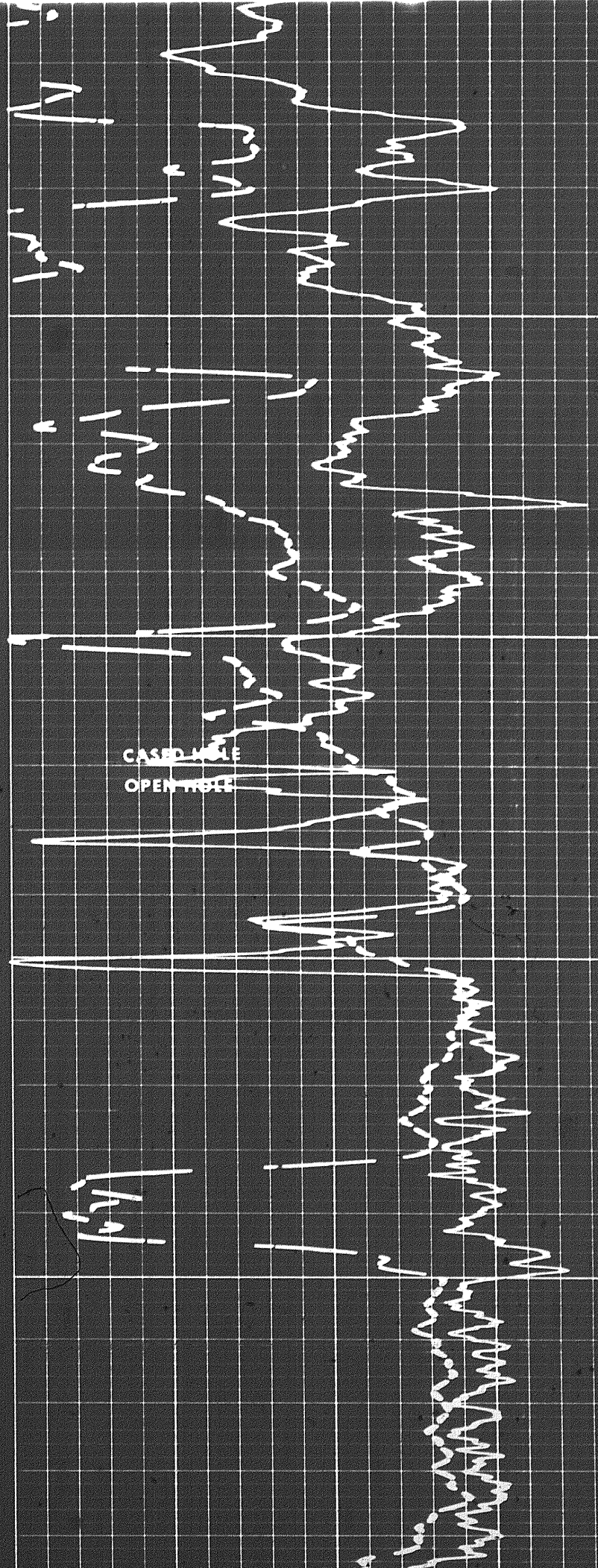
2800

2900

3000



1107

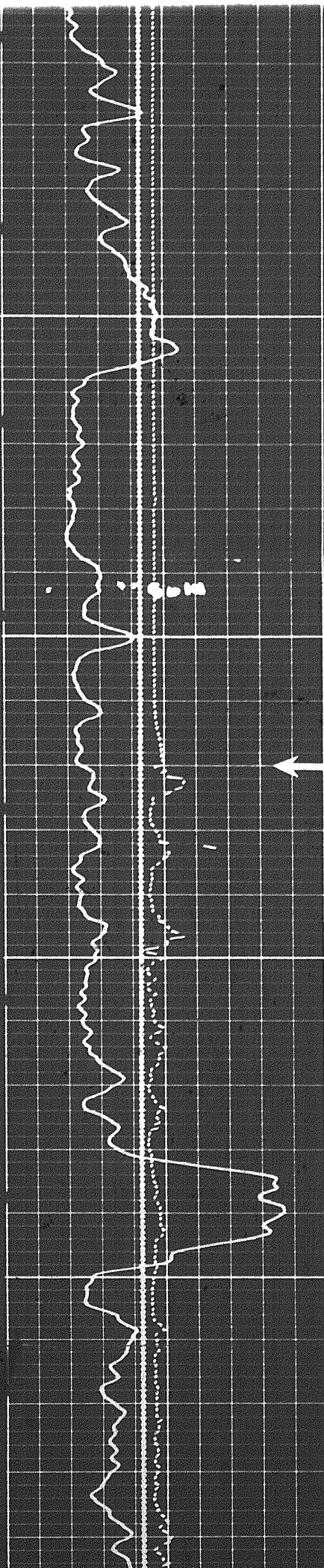


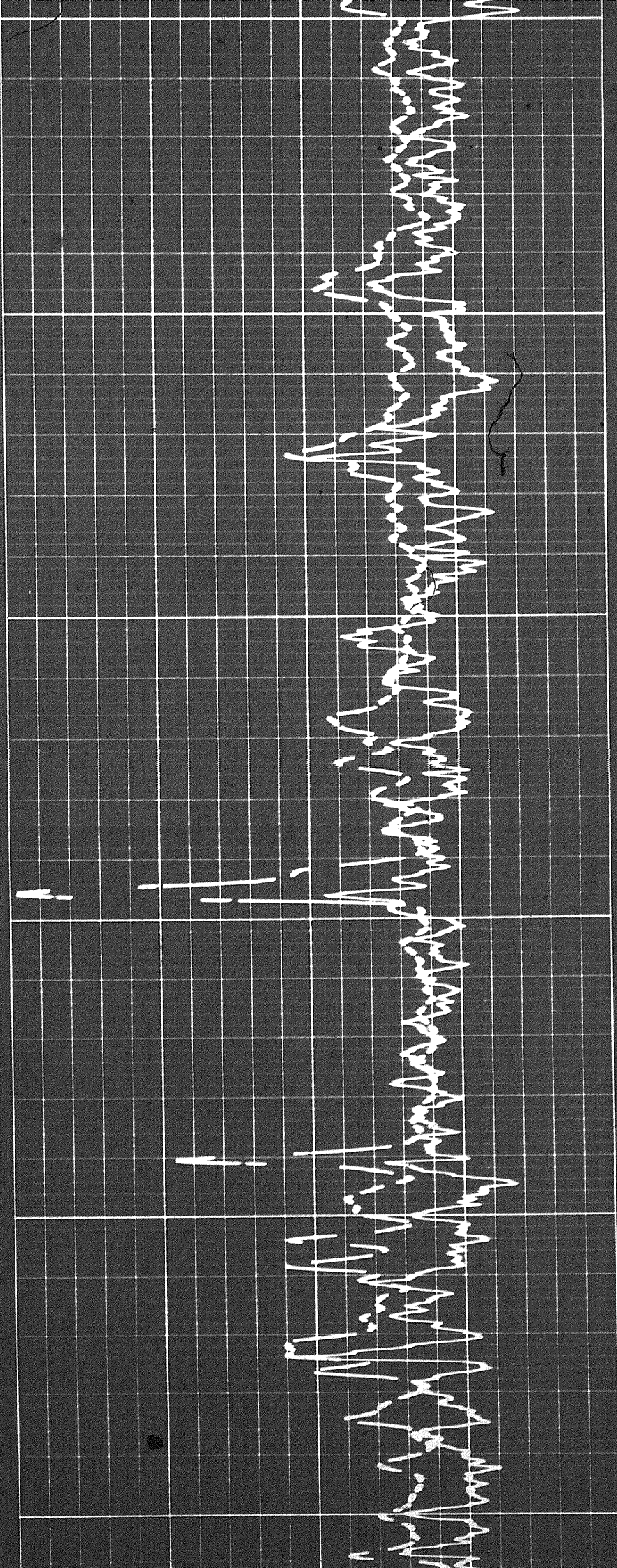
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3000

3100

Casing

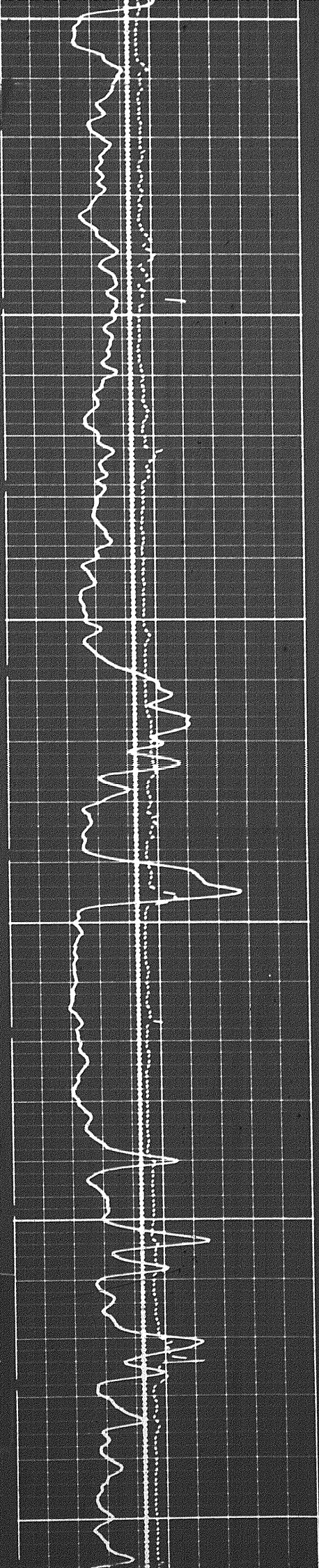




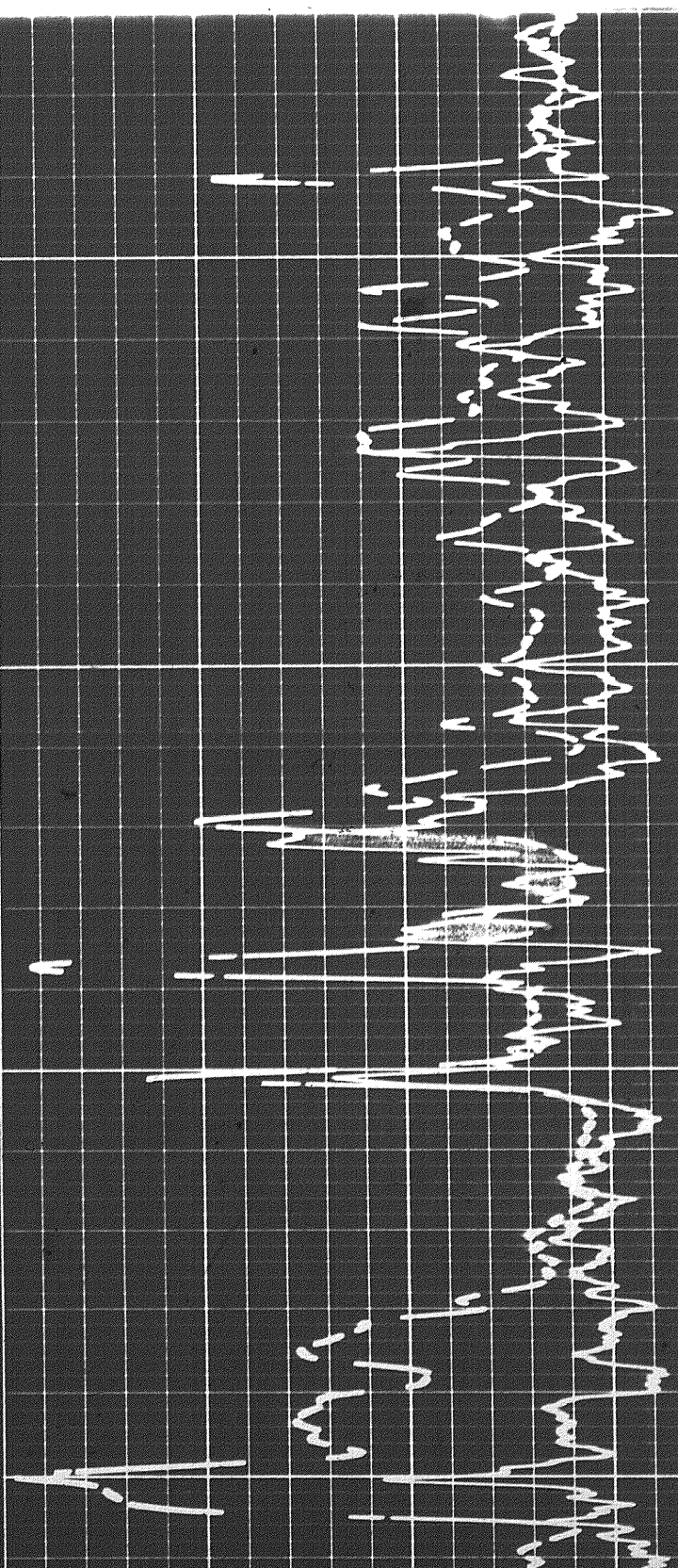
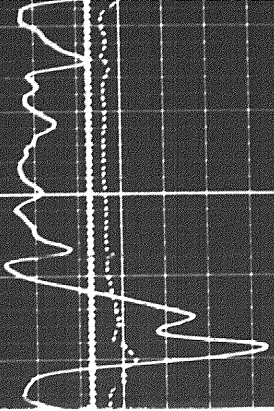
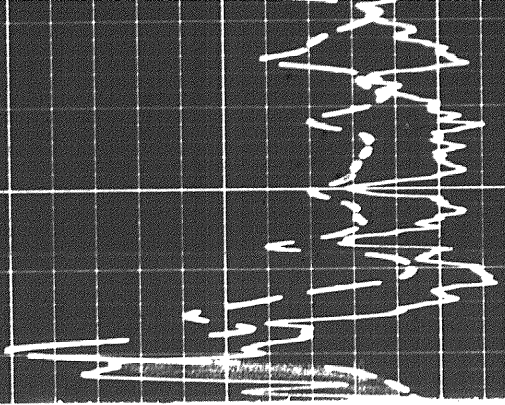
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3200

3300

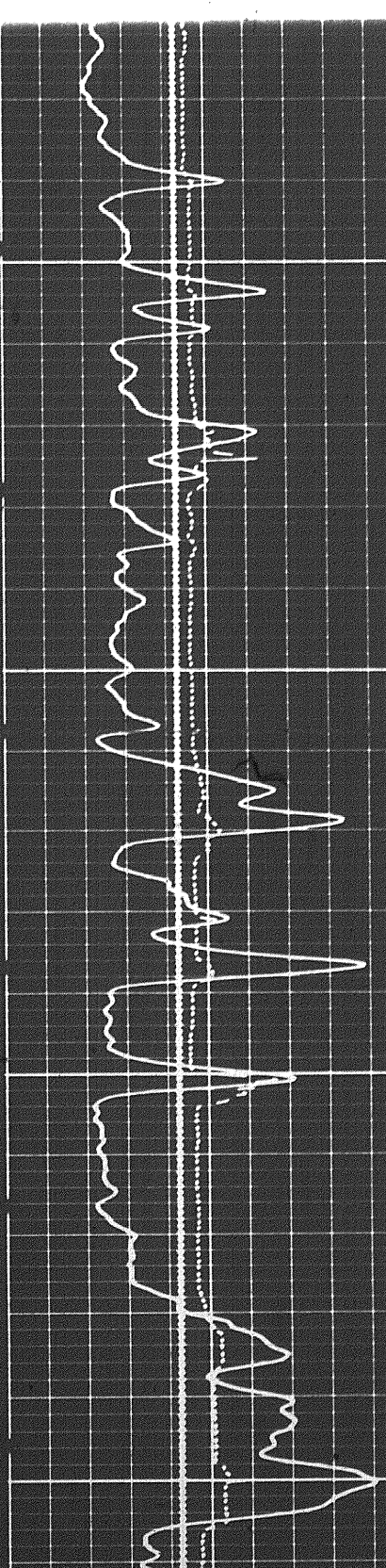


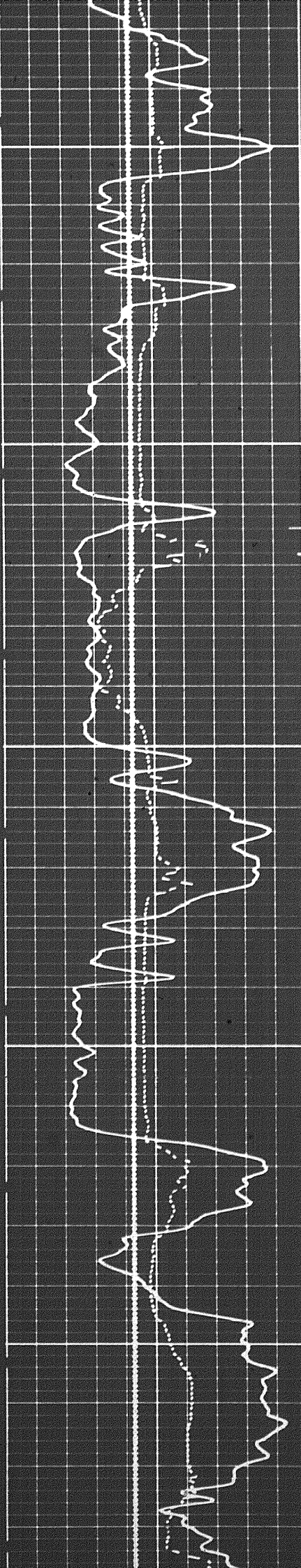
12-21



3300

3400

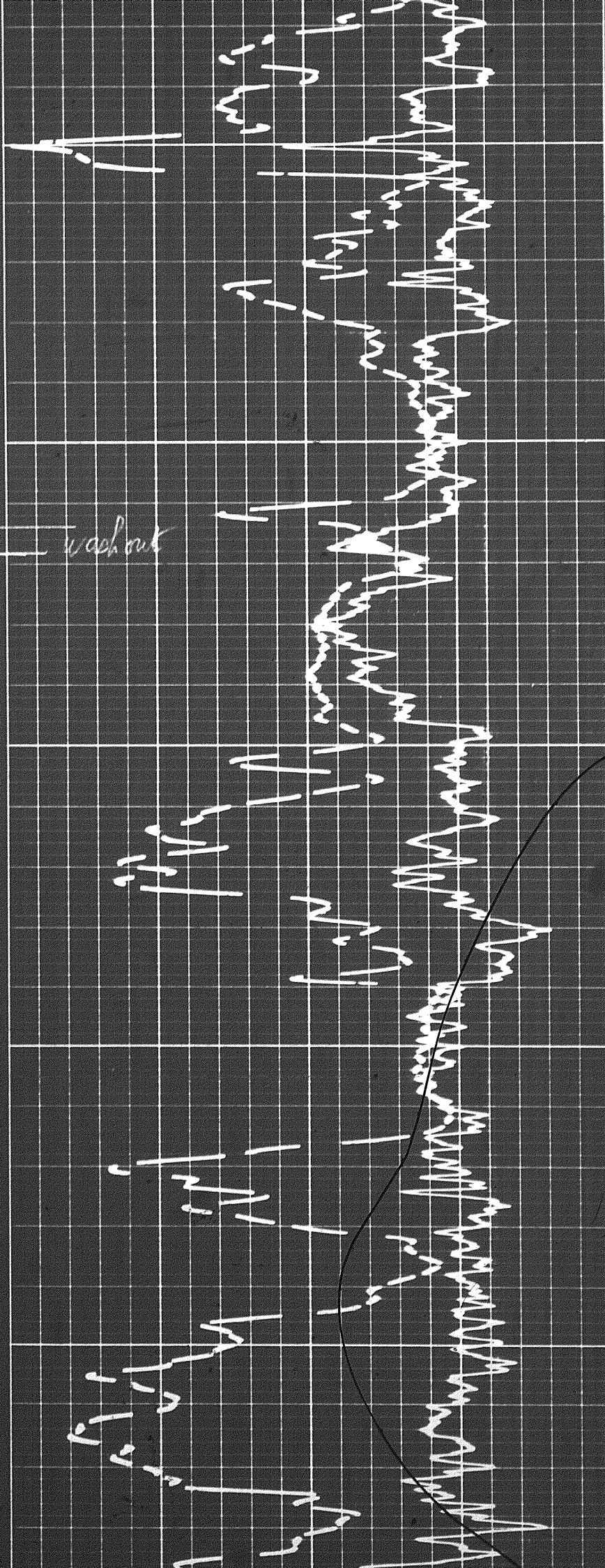




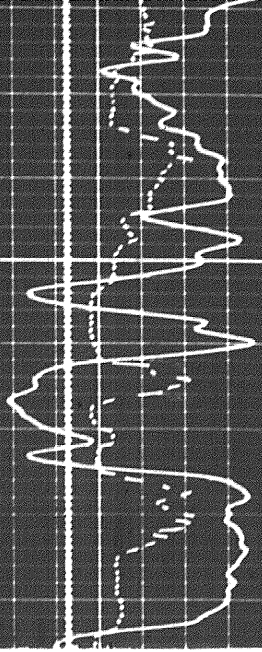
3500

3600

↑
wash out

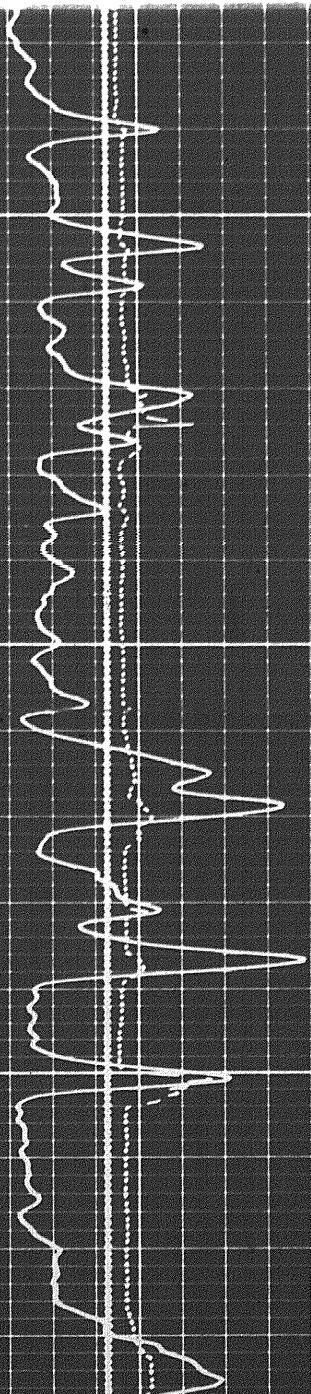
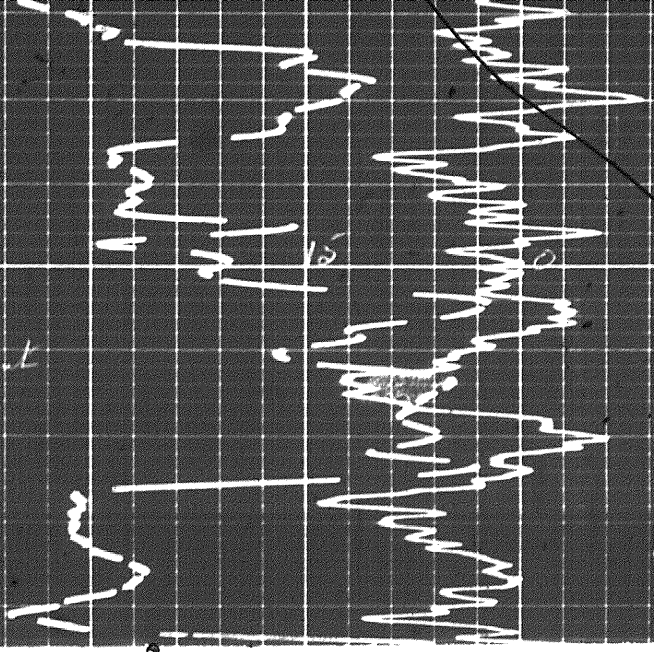


1304



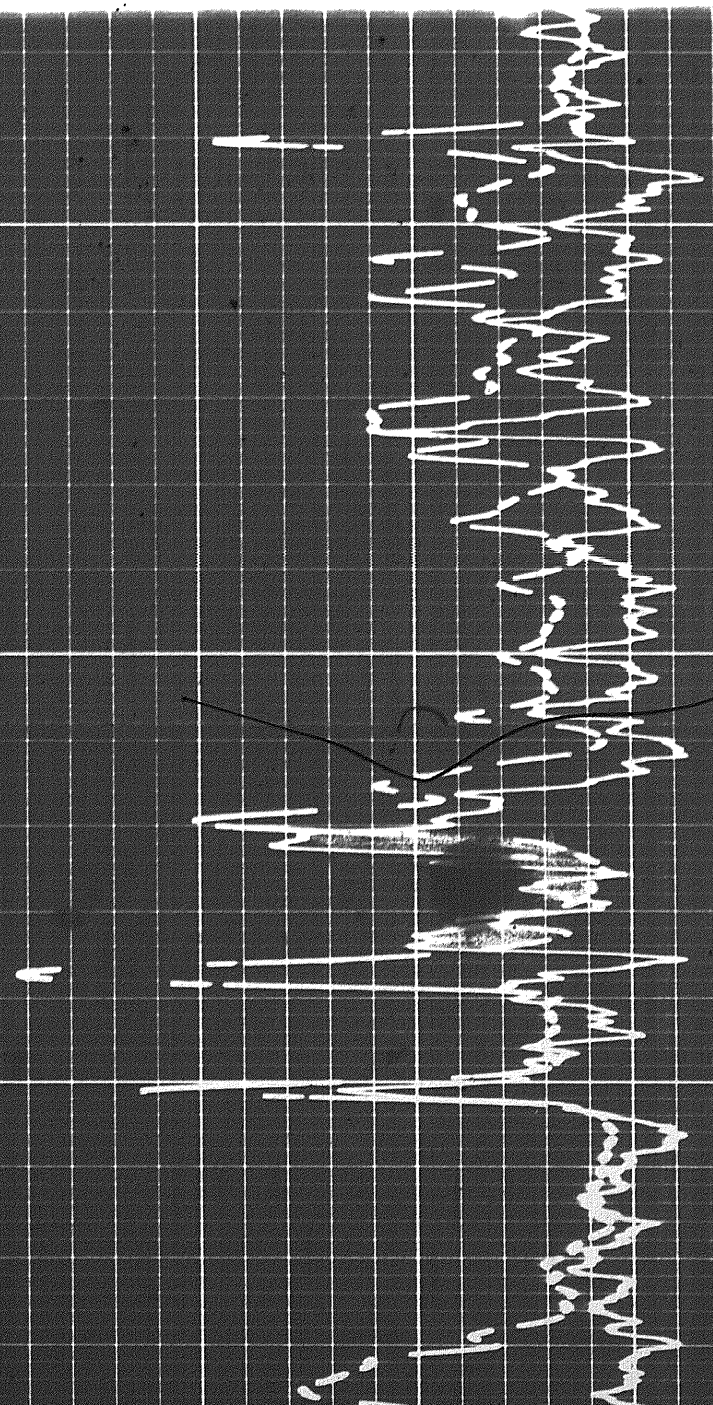
3700

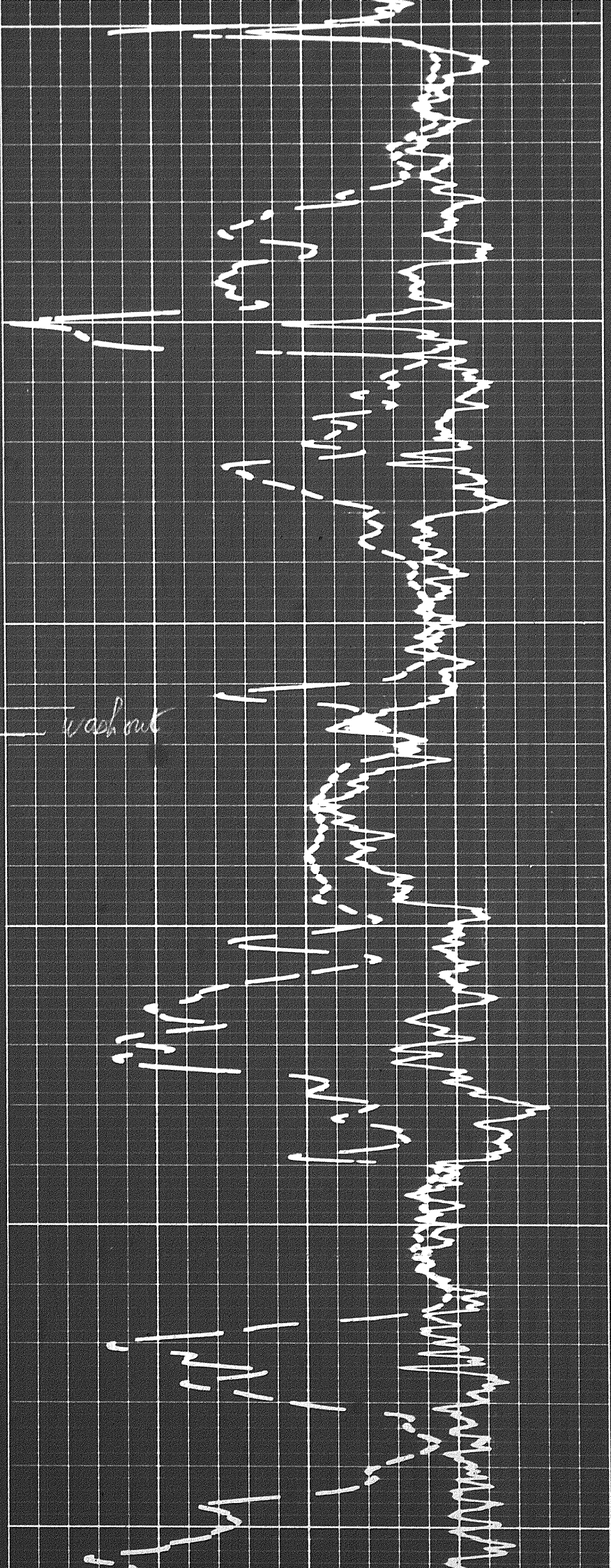
? wash out



3300

3400



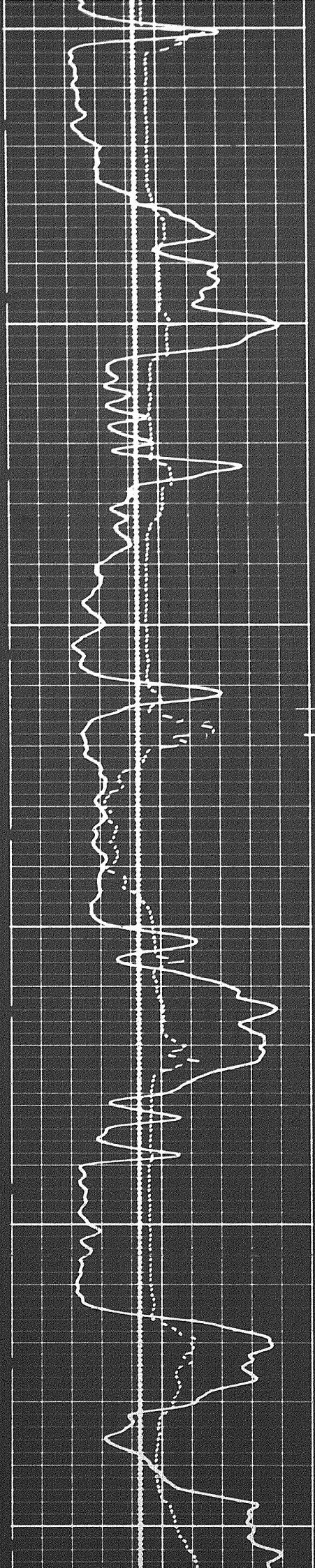


3400

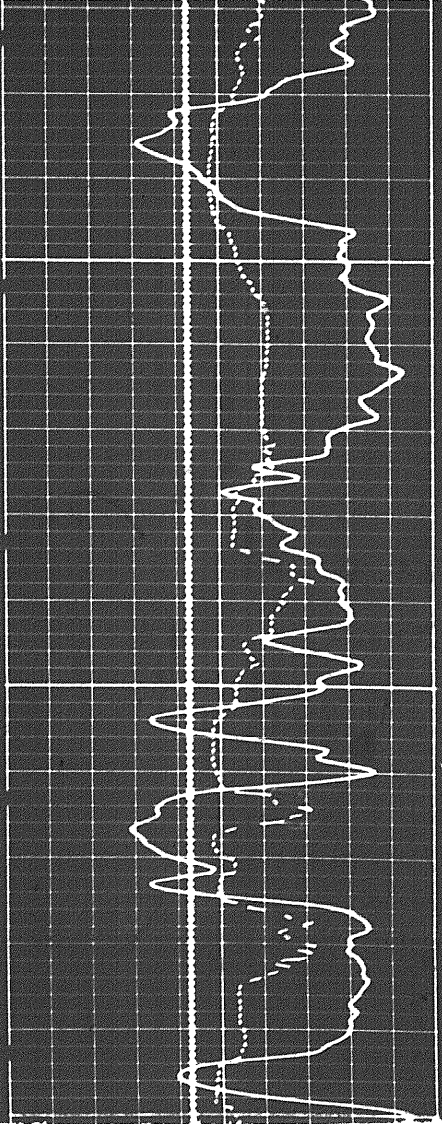
3500

3600

wash out

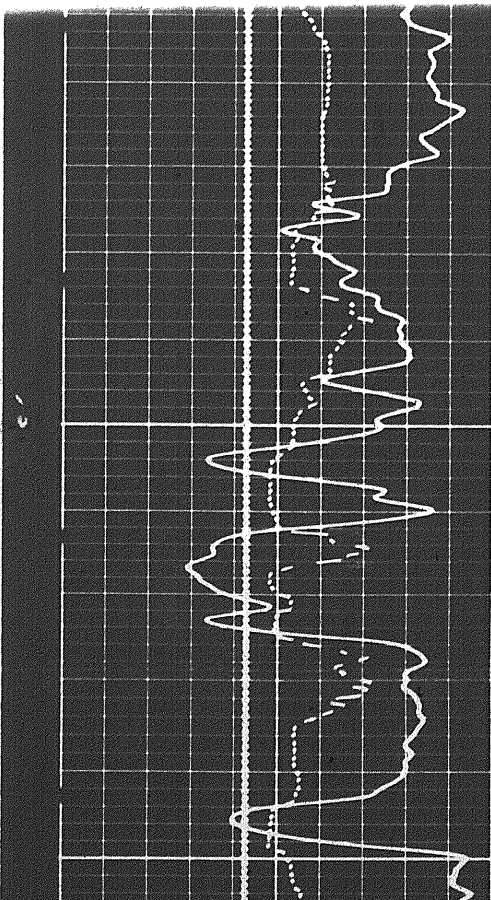
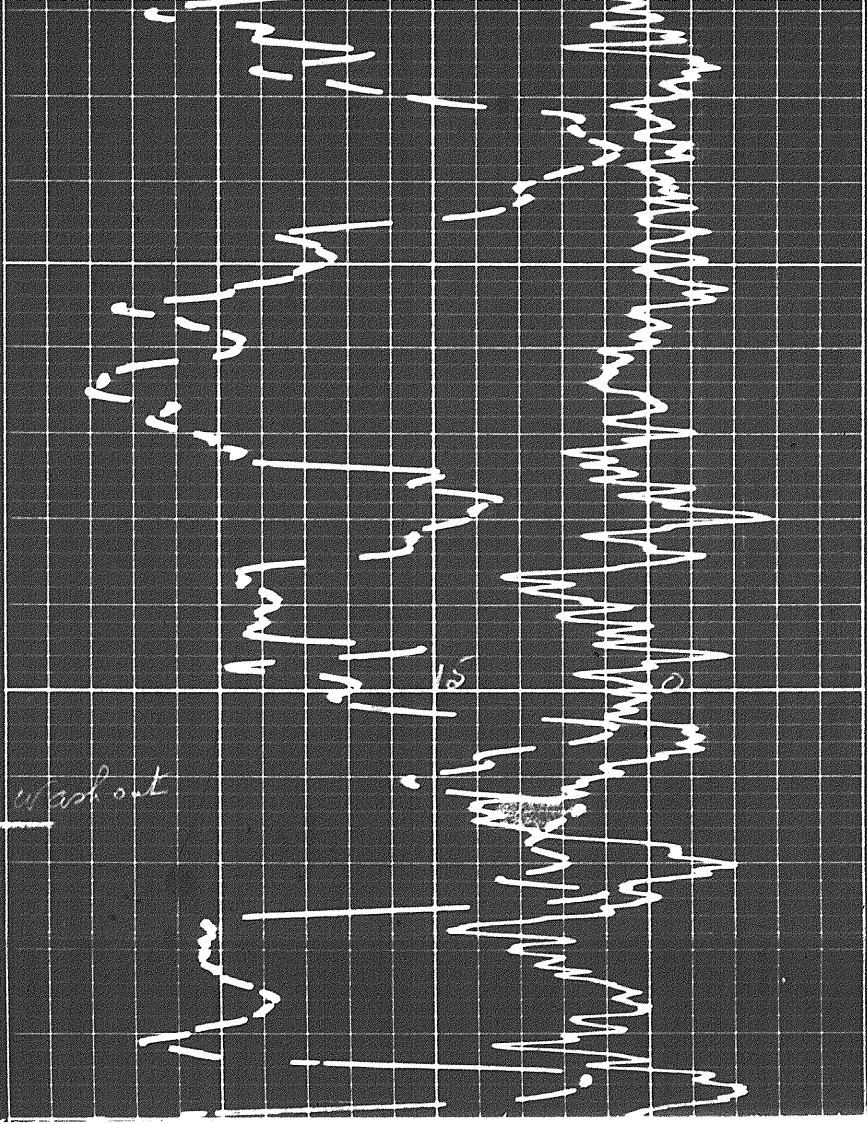


1384



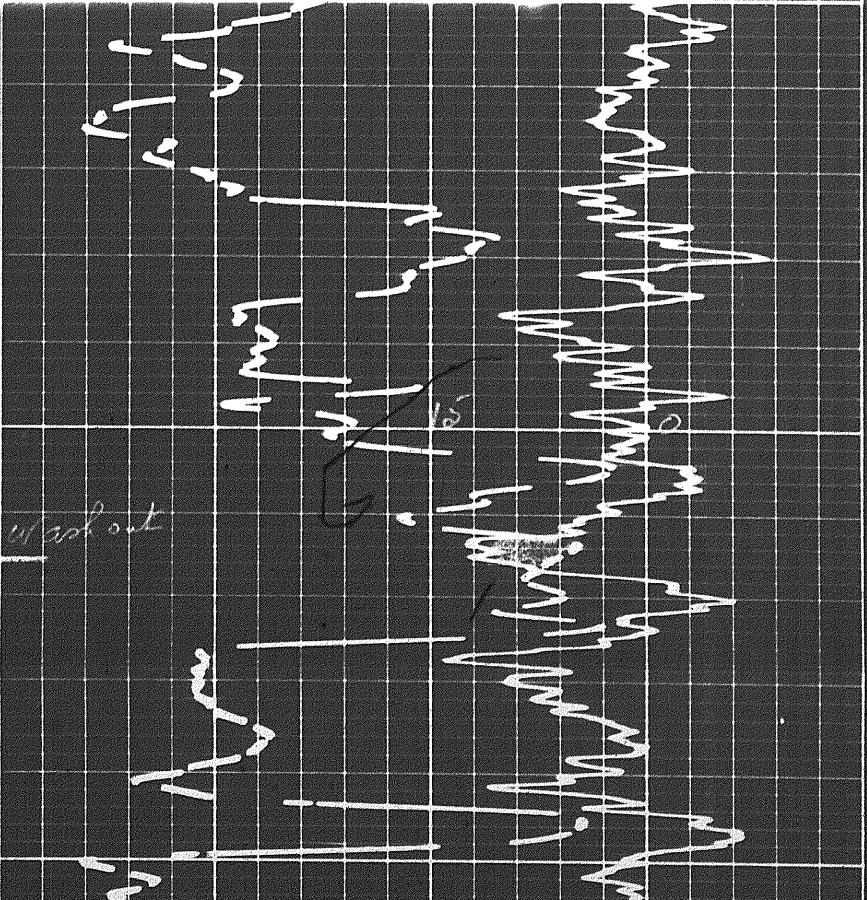
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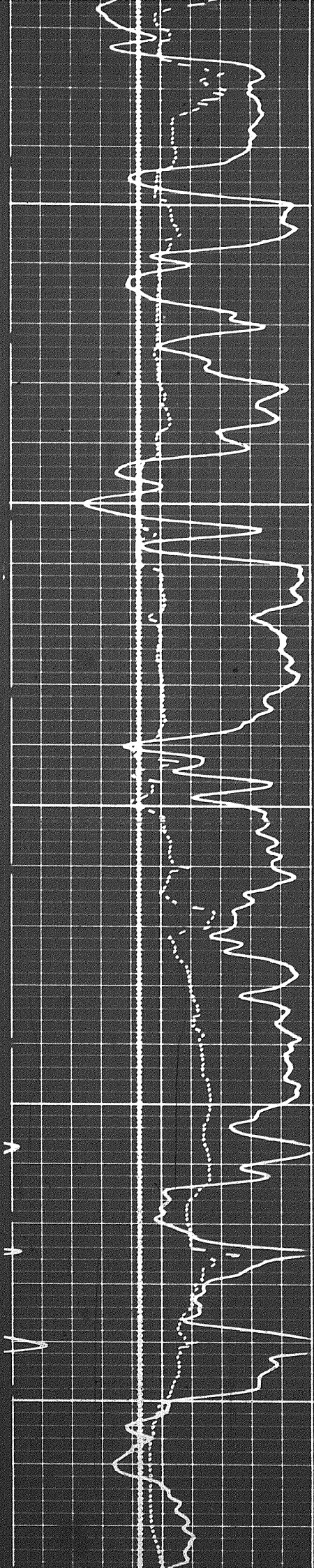
? wad out



3700

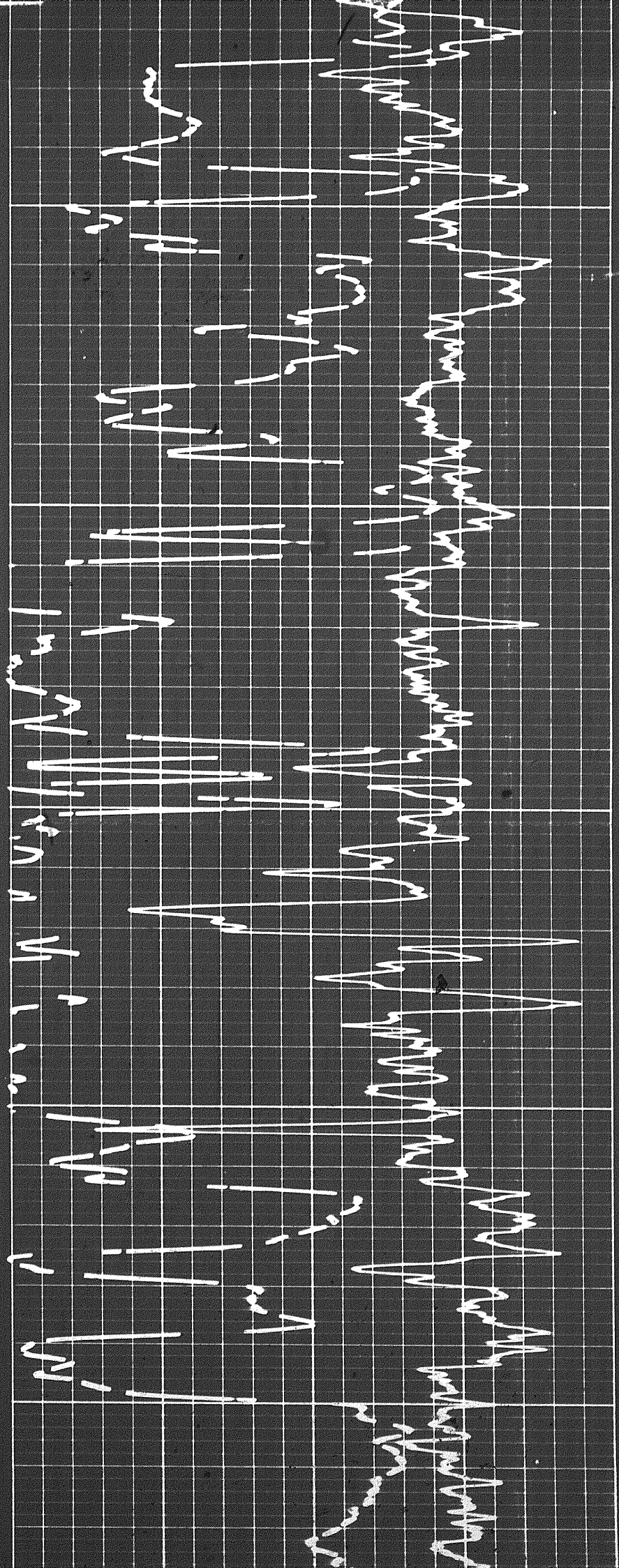
? wad out

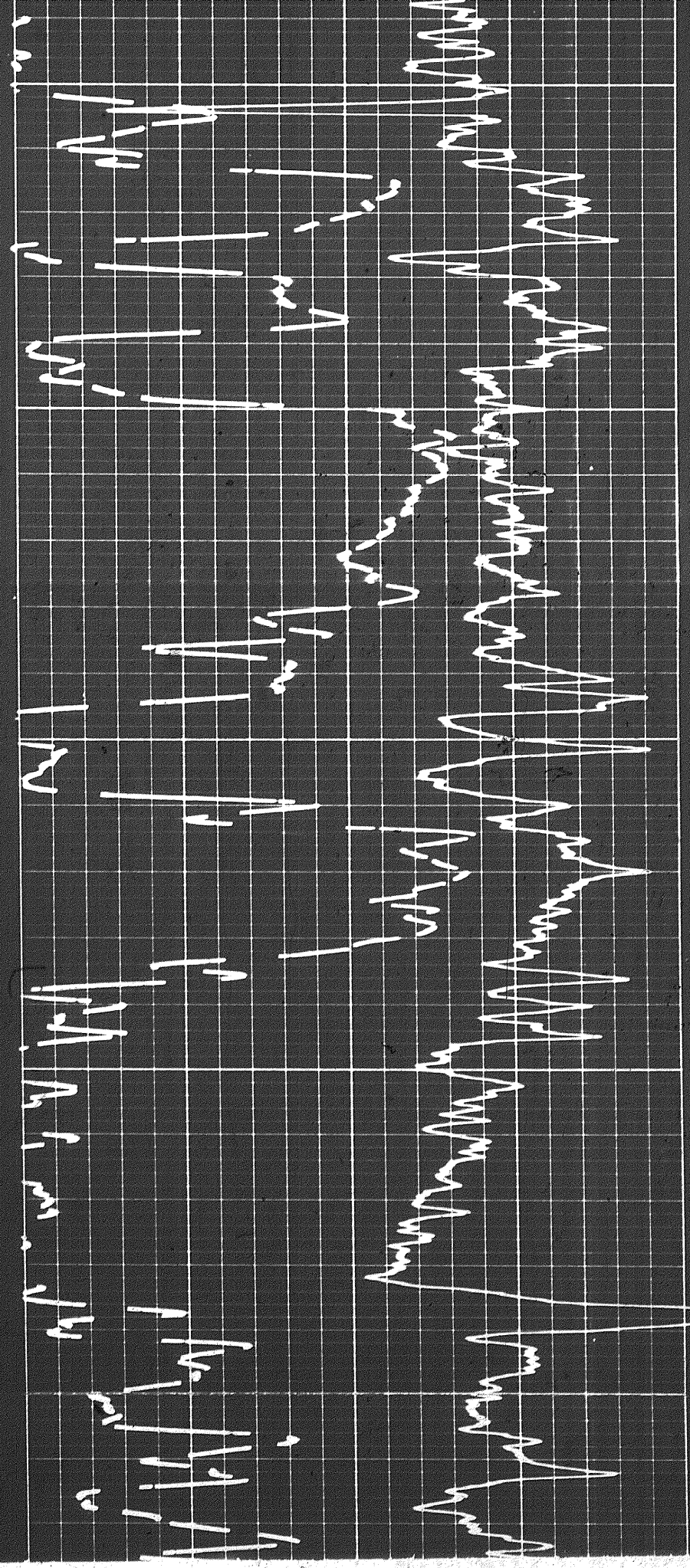




3800

3900

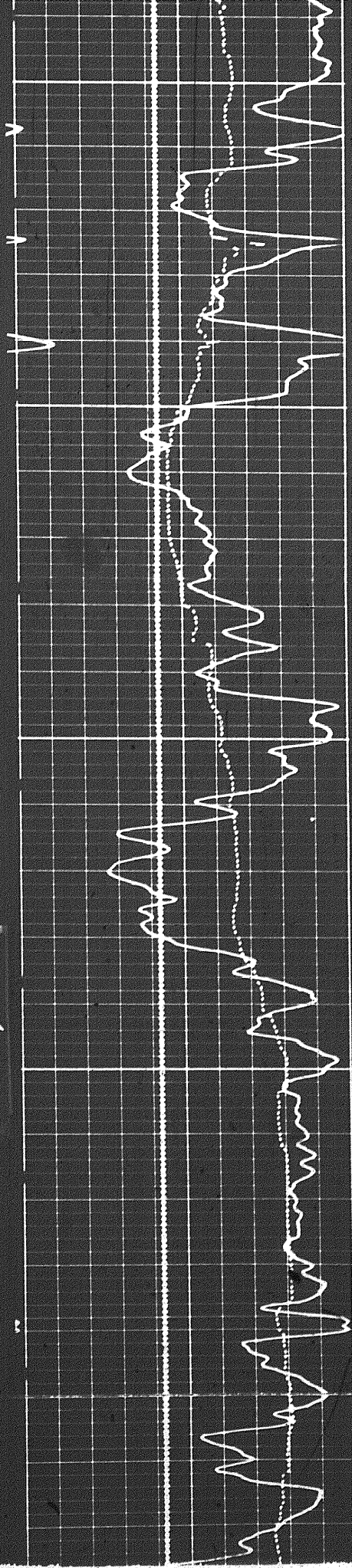




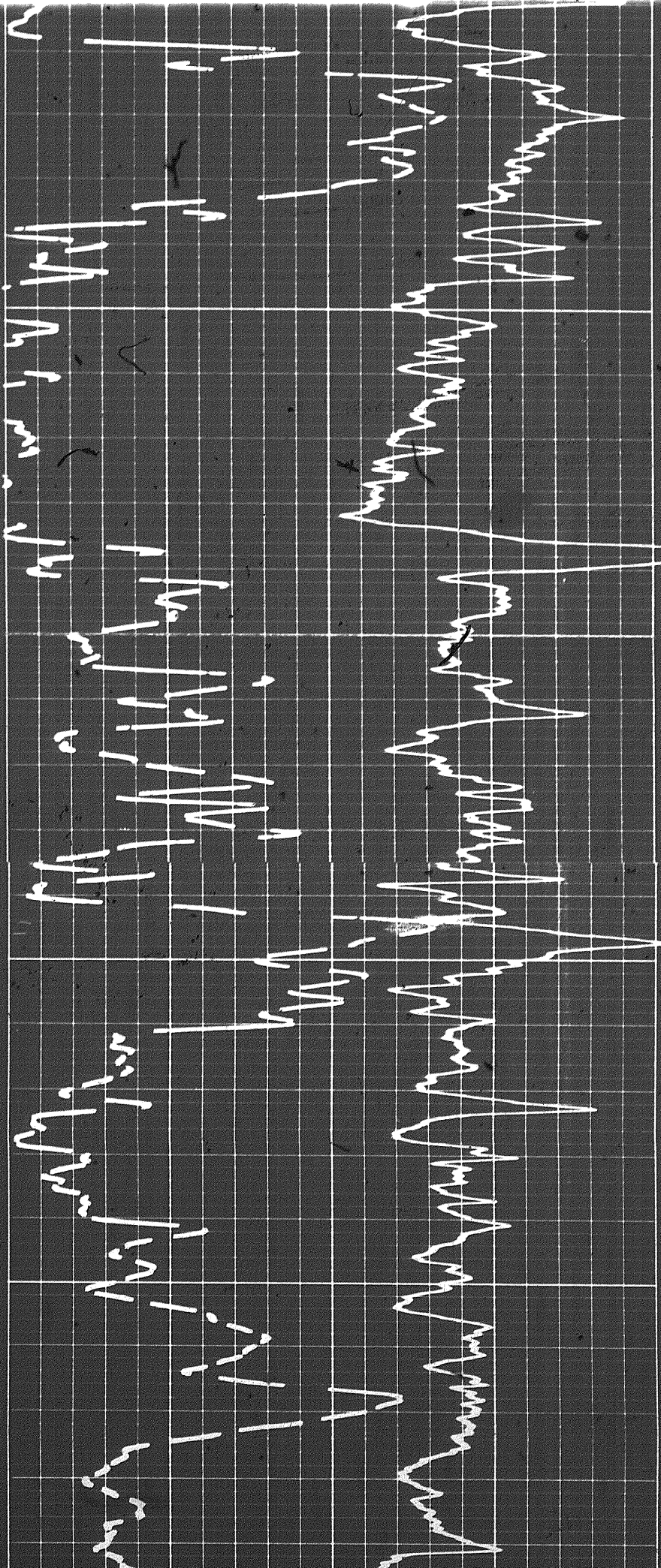
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4000

4100

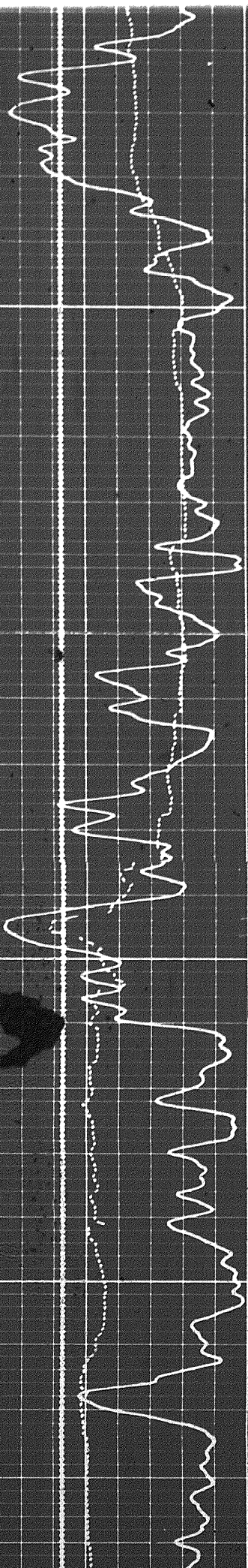


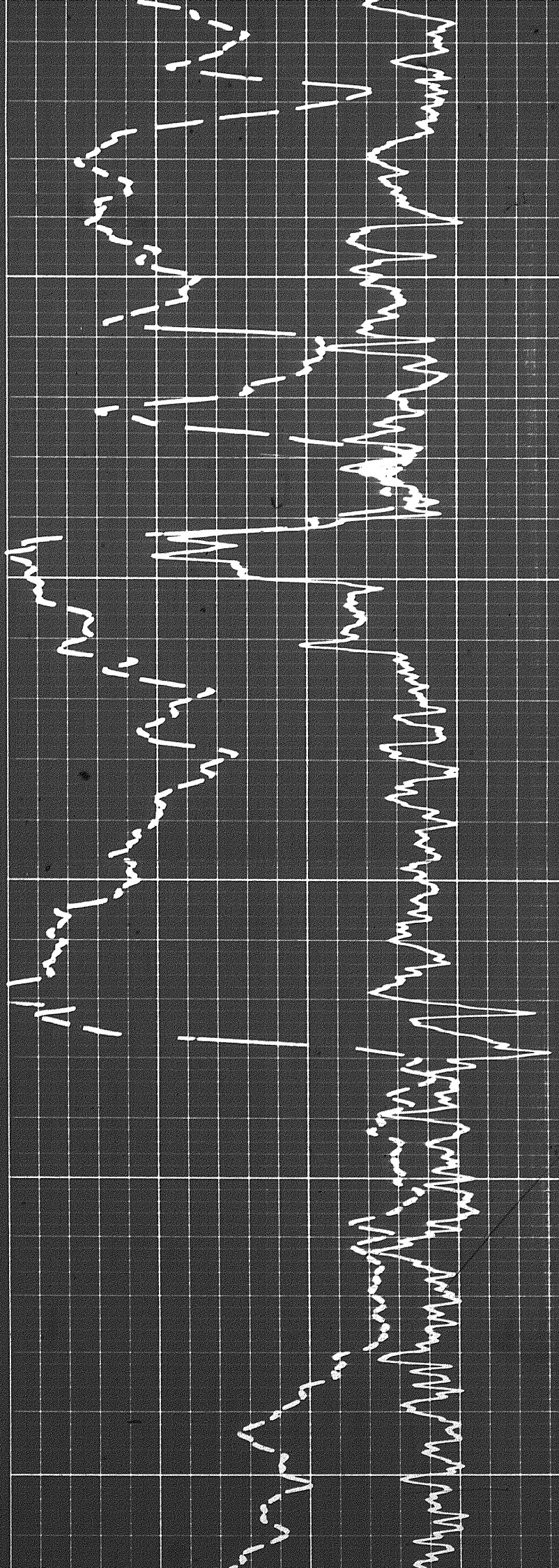
14 of 41



4100

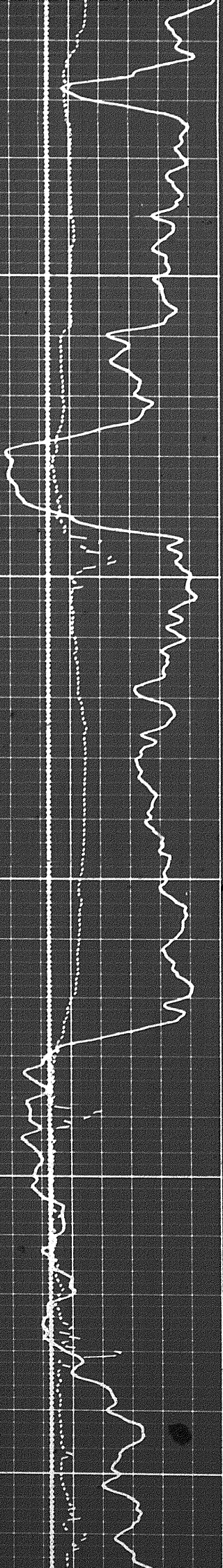
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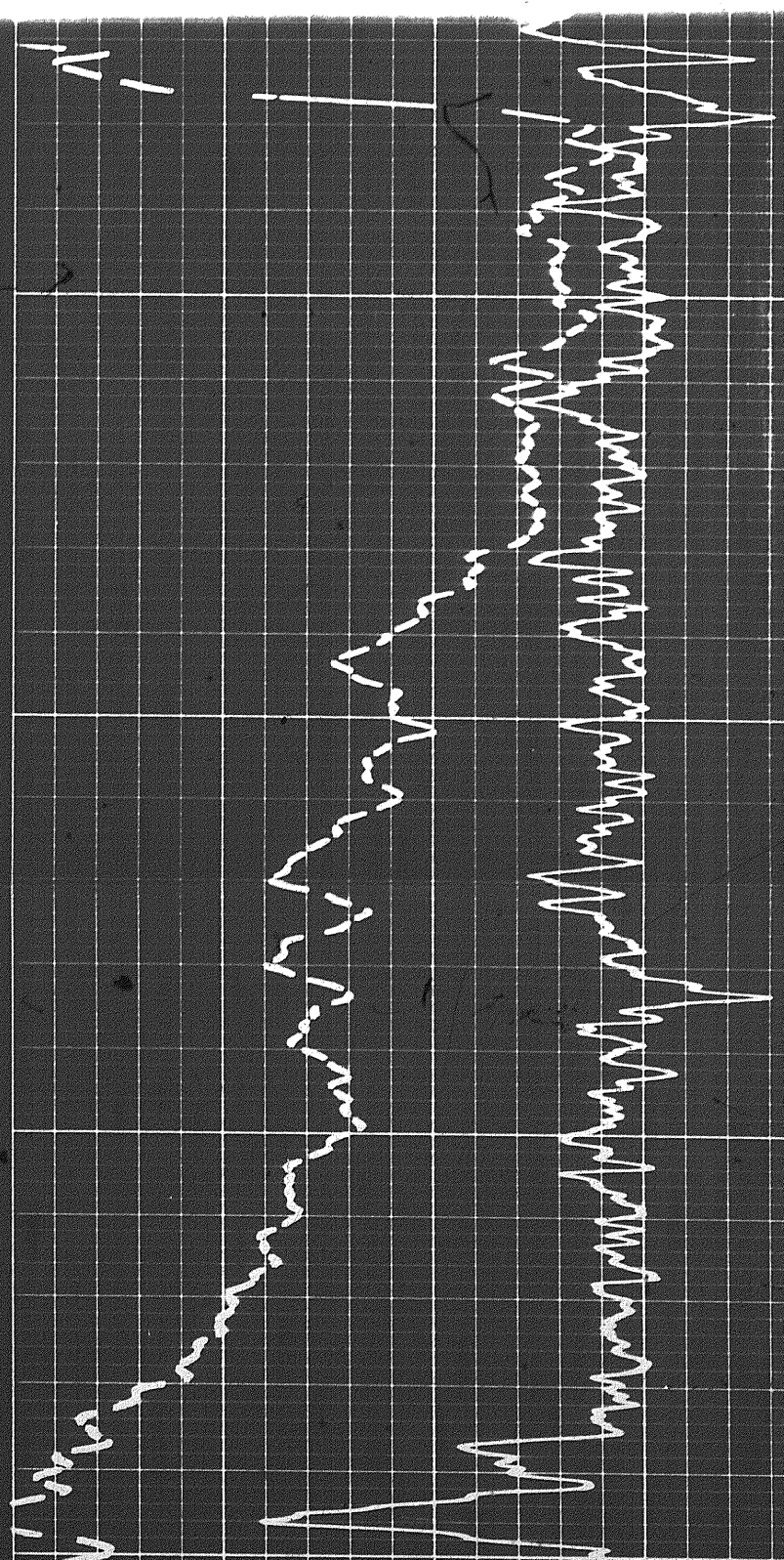
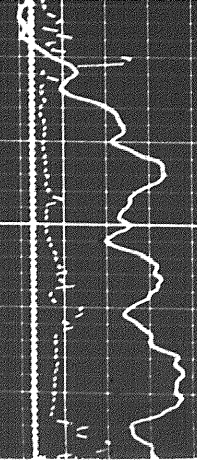
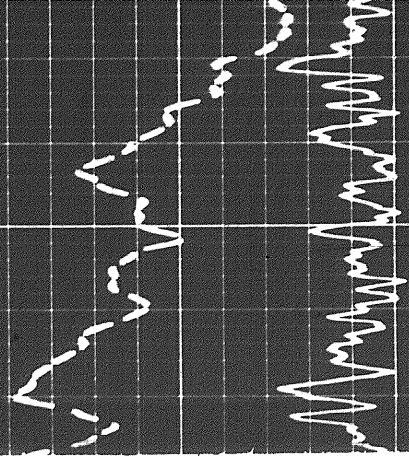


4300

4400

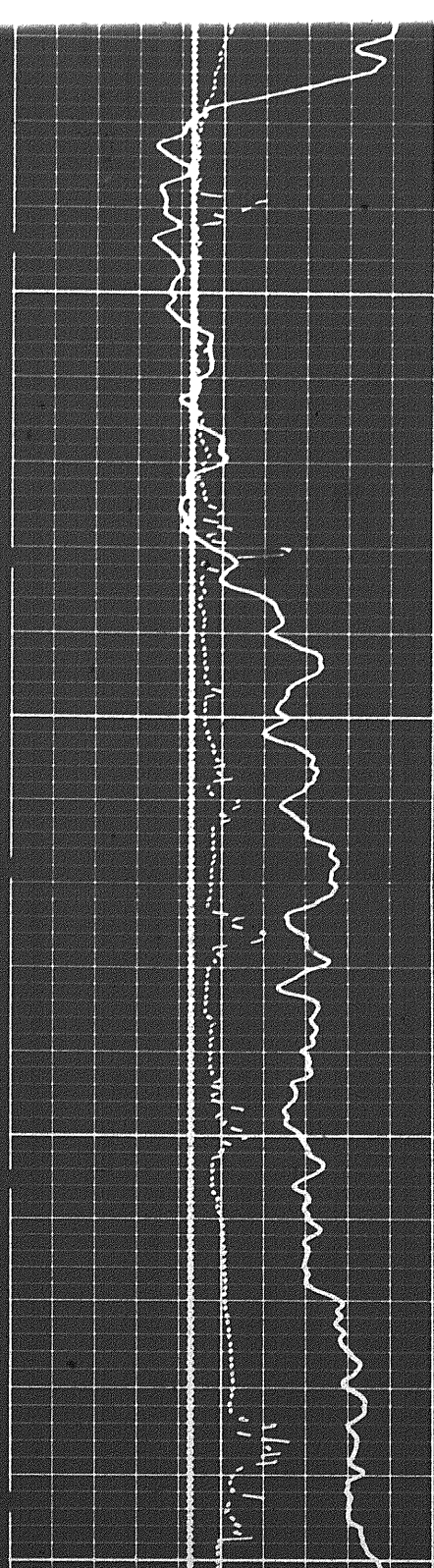


15 of

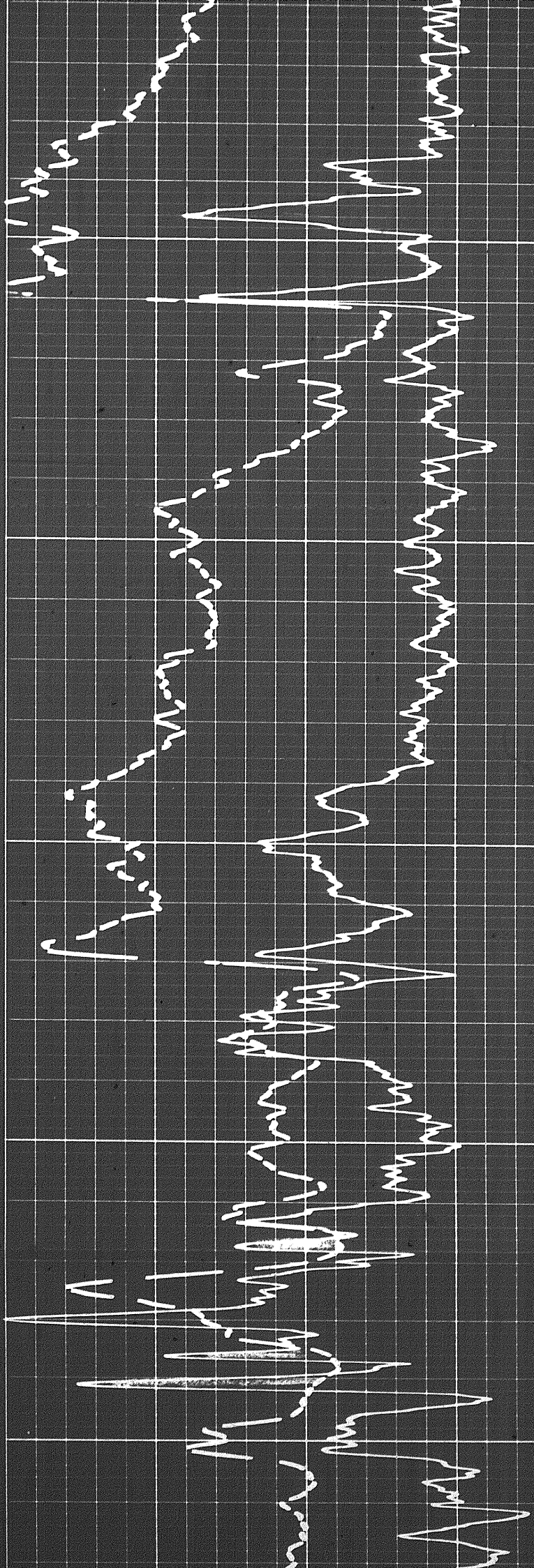


4400

4500

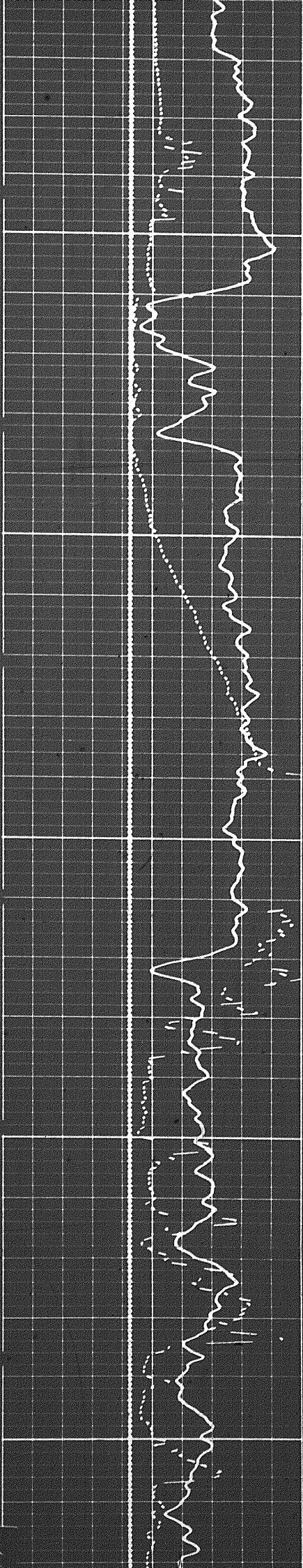


15



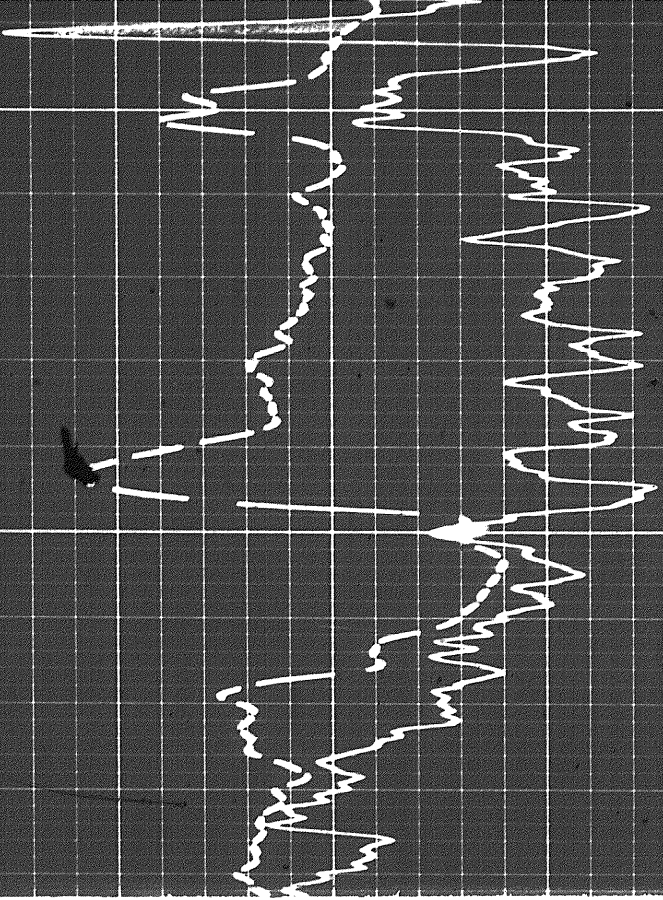
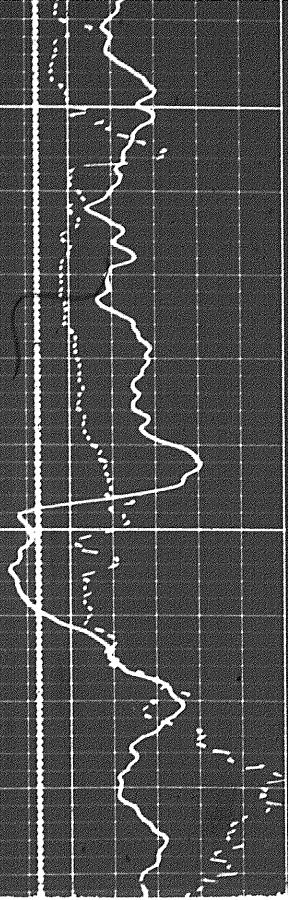
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4700

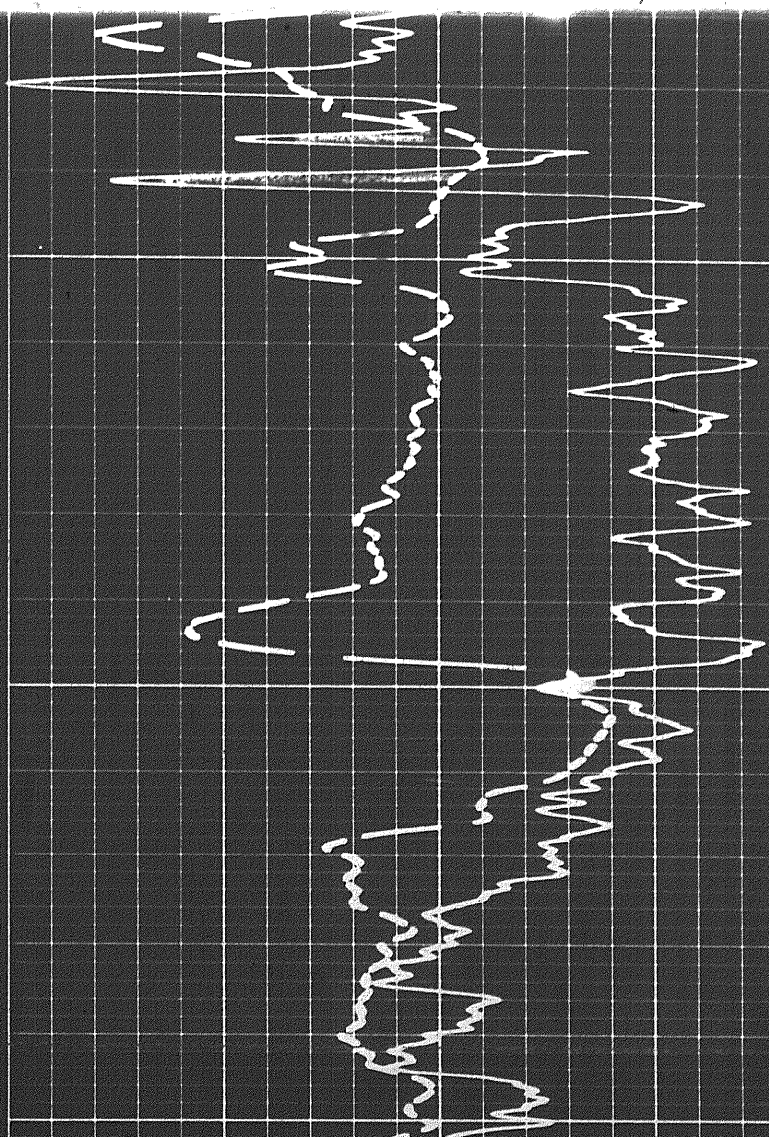
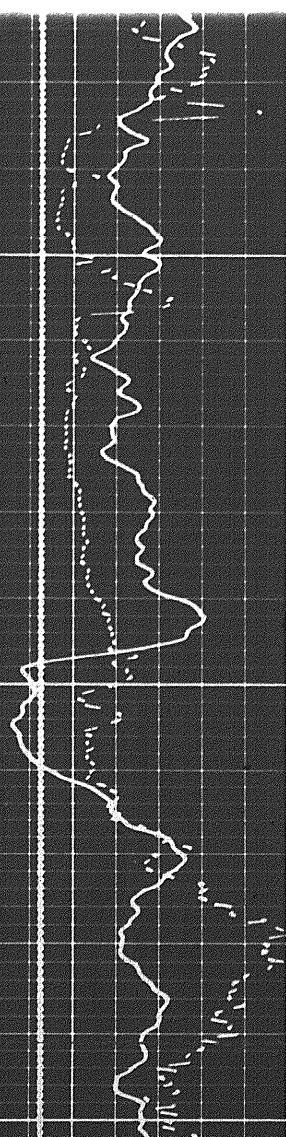


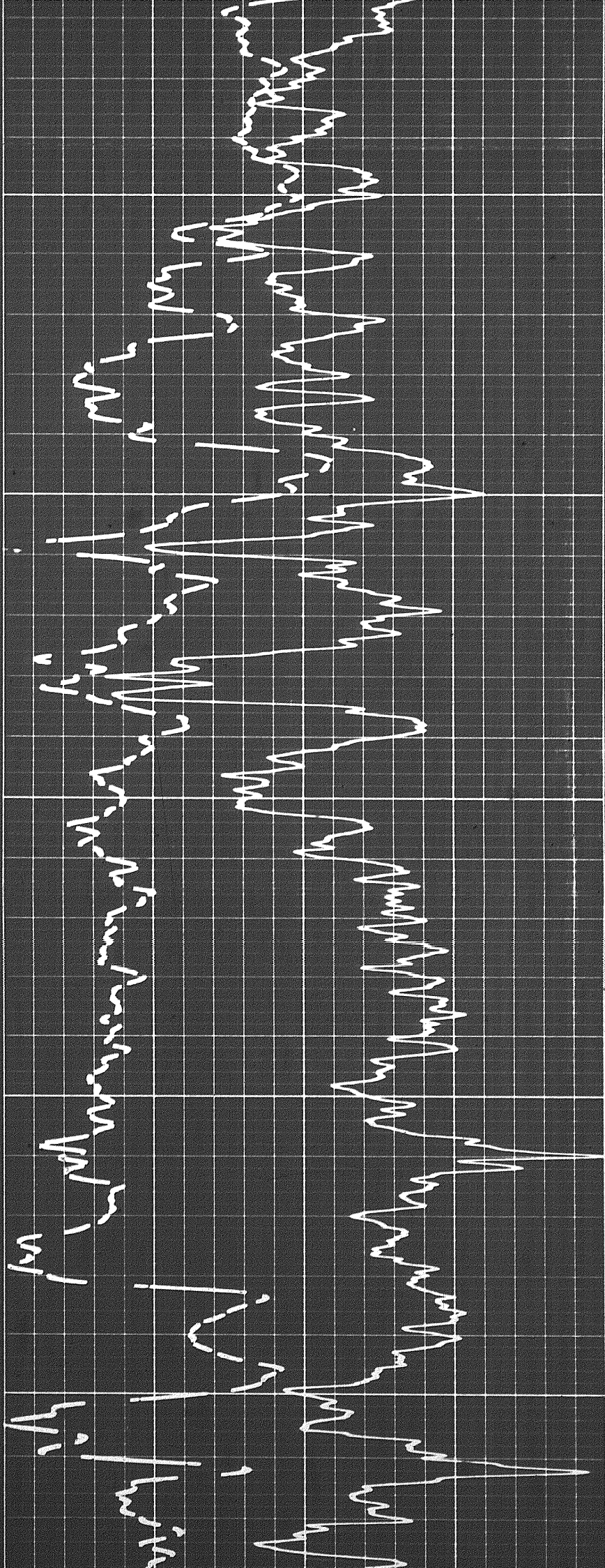
12

169



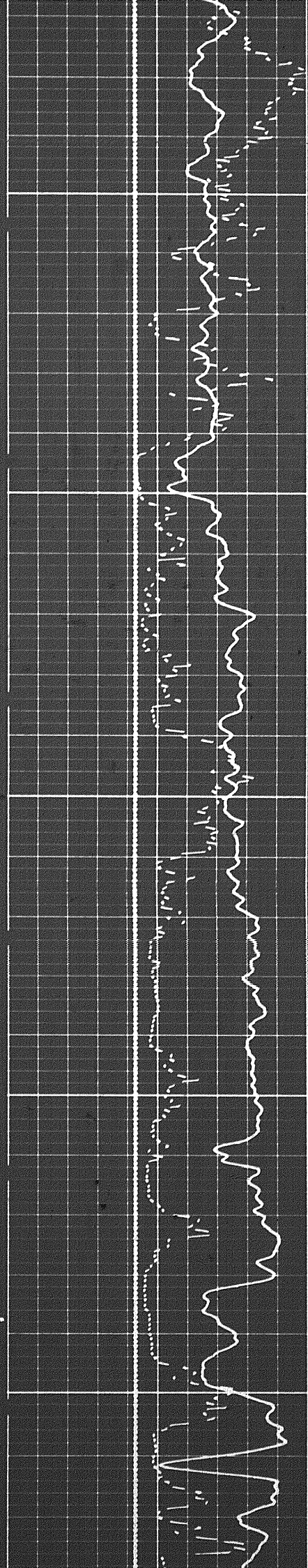
16



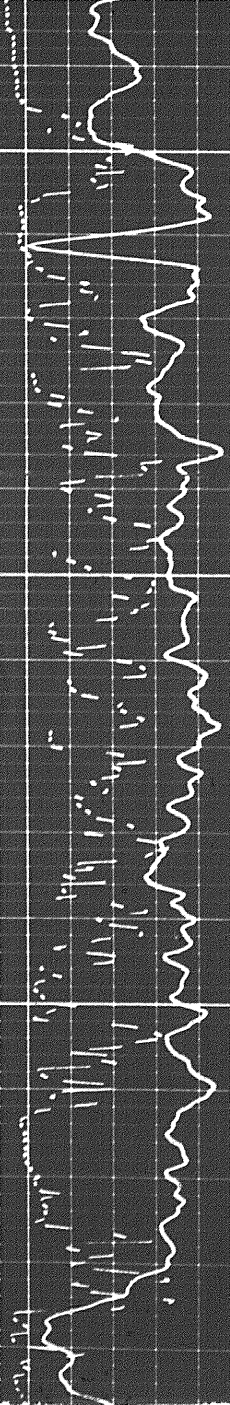


4900

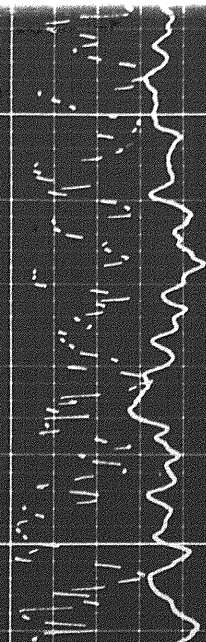
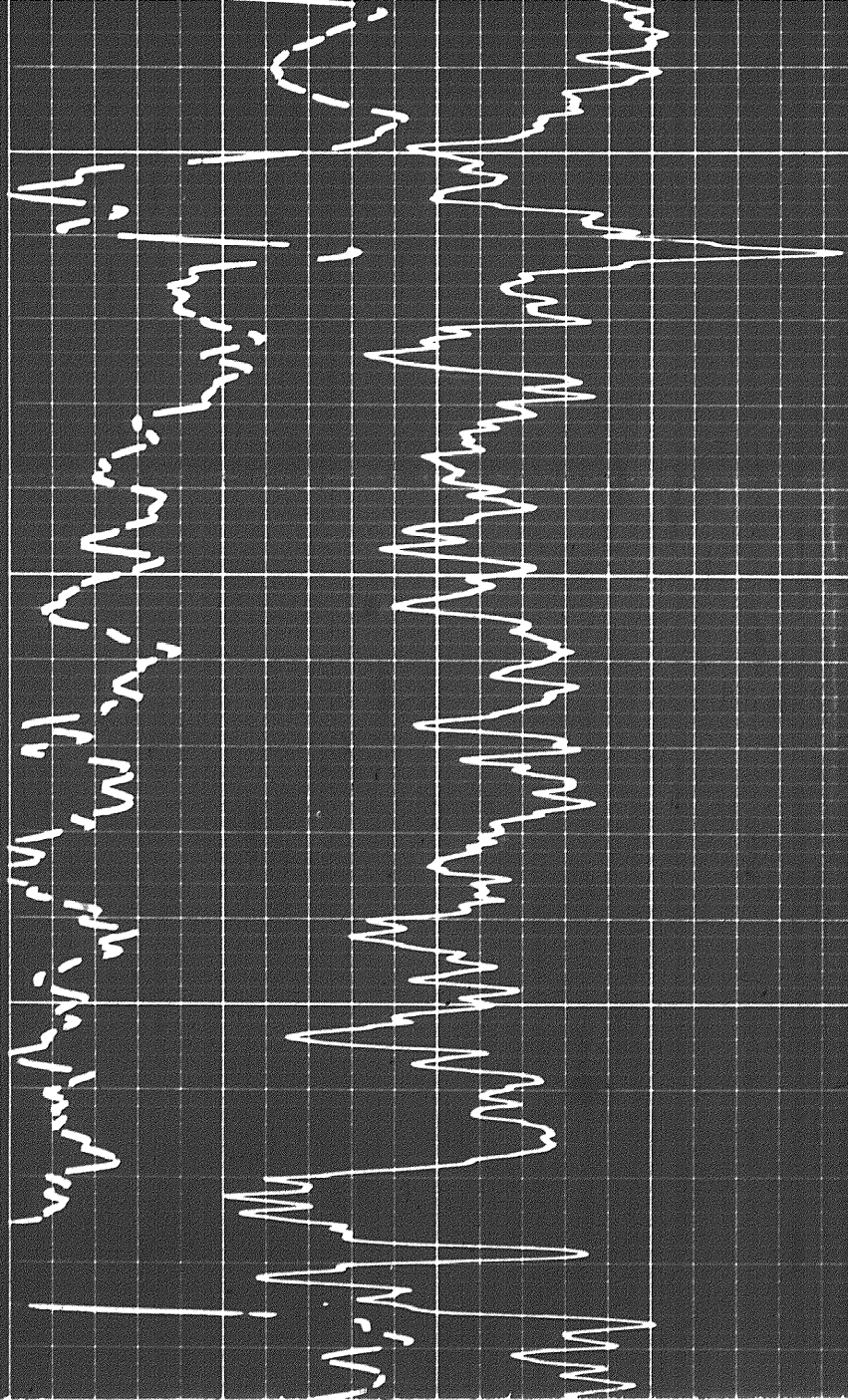
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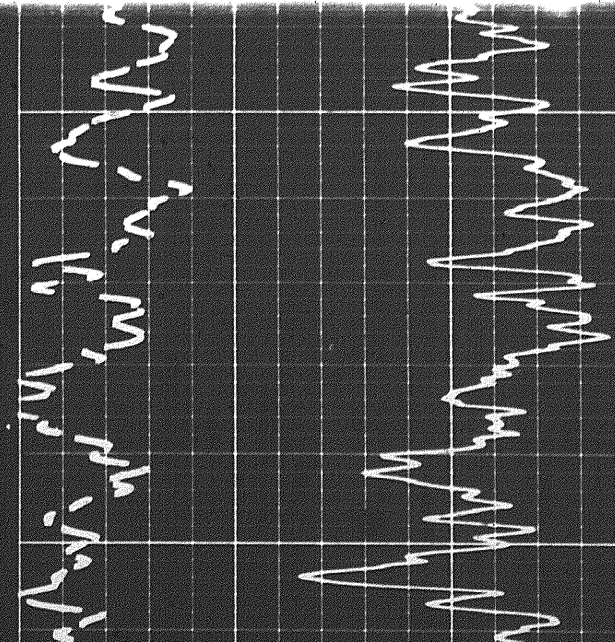
1402

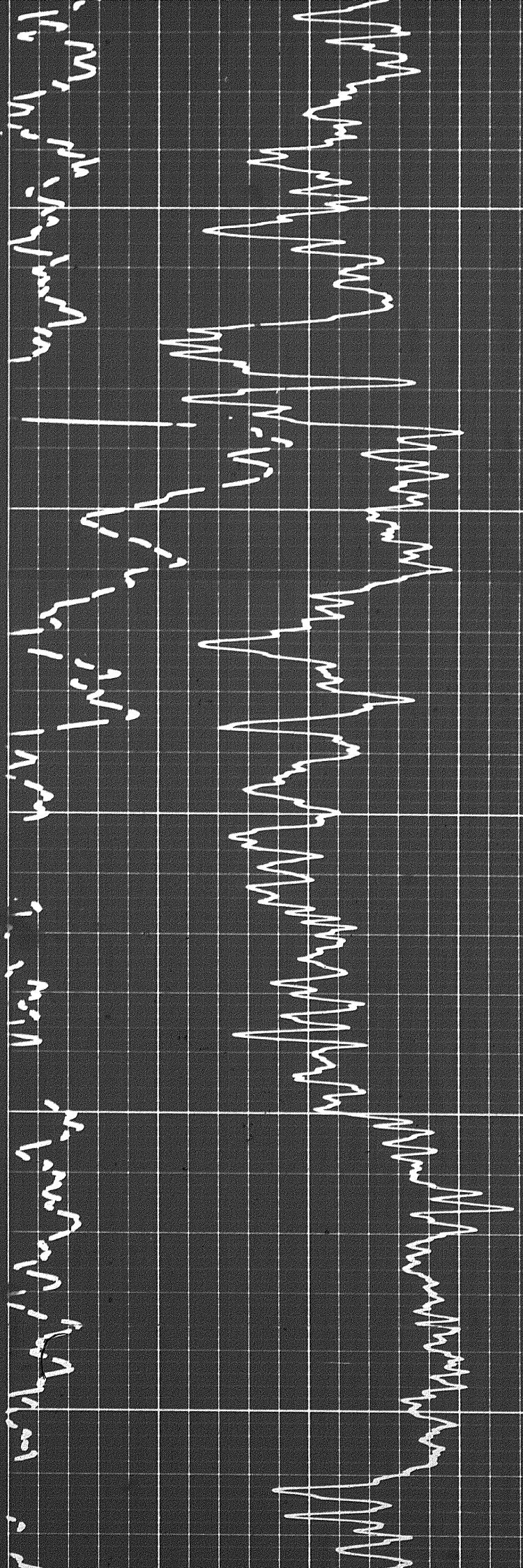


5100



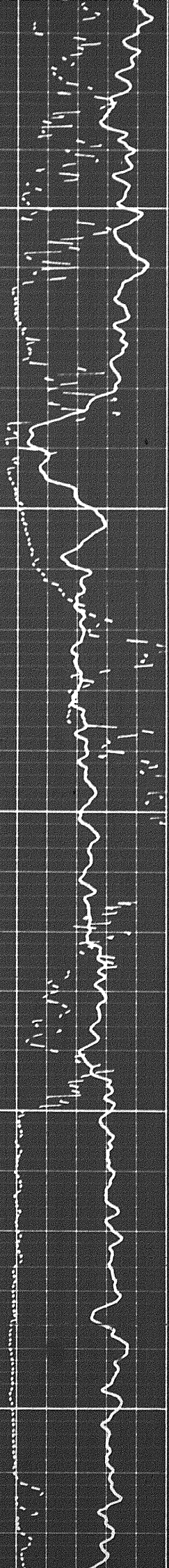
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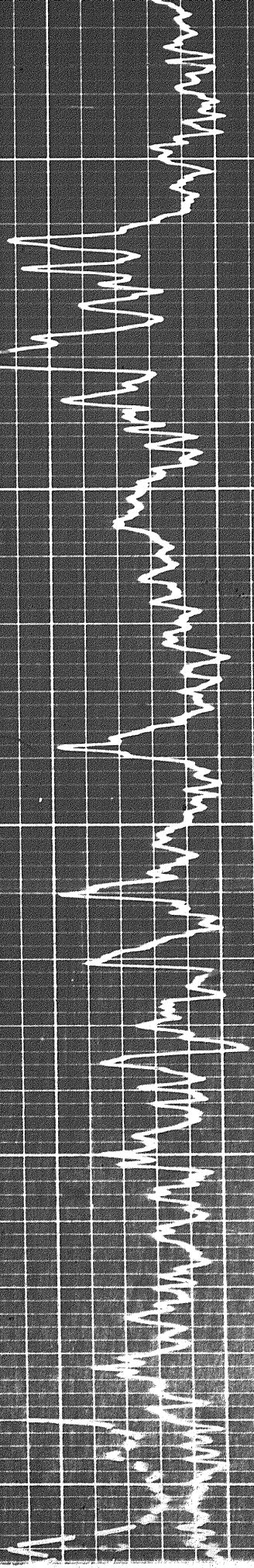




5200

5300

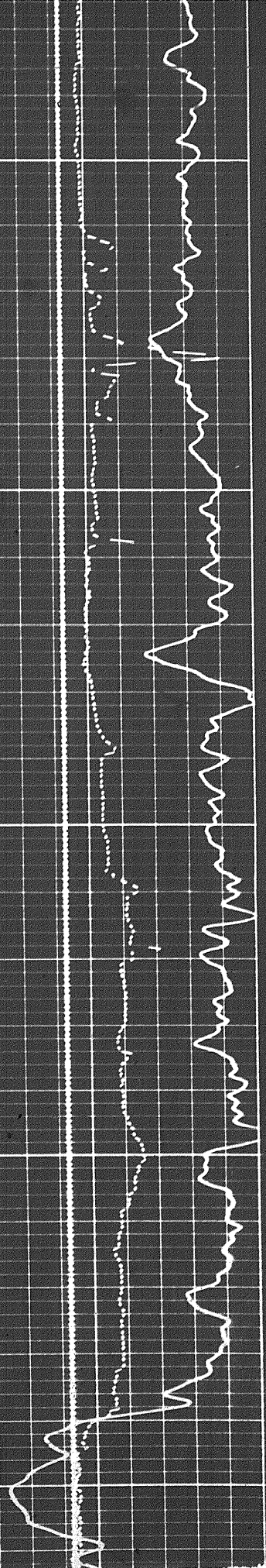




Normal sinus rhythm
Rate 100 bpm
PR 160 ms
QRS 80 ms
QT 360 ms
QTc 380 ms

5400

5500

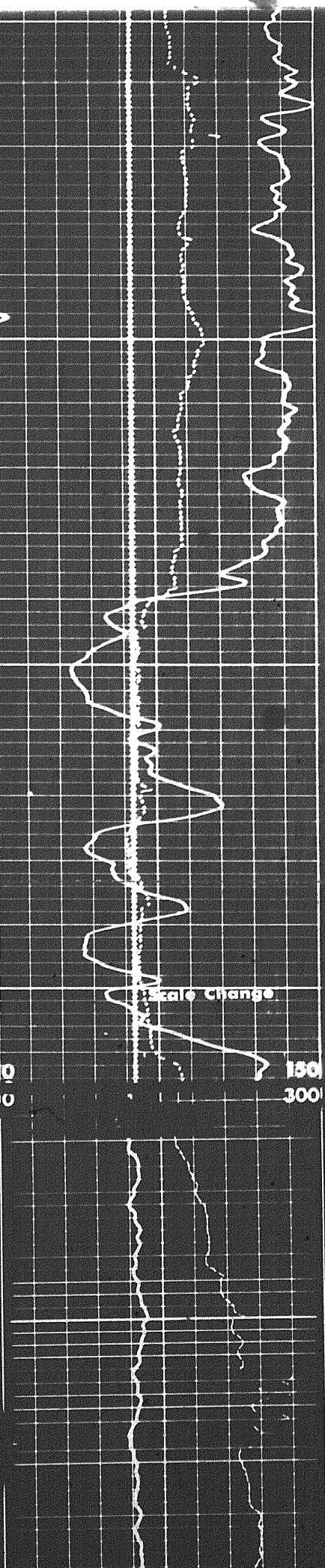


A

1881

A

6.0



5500

5600

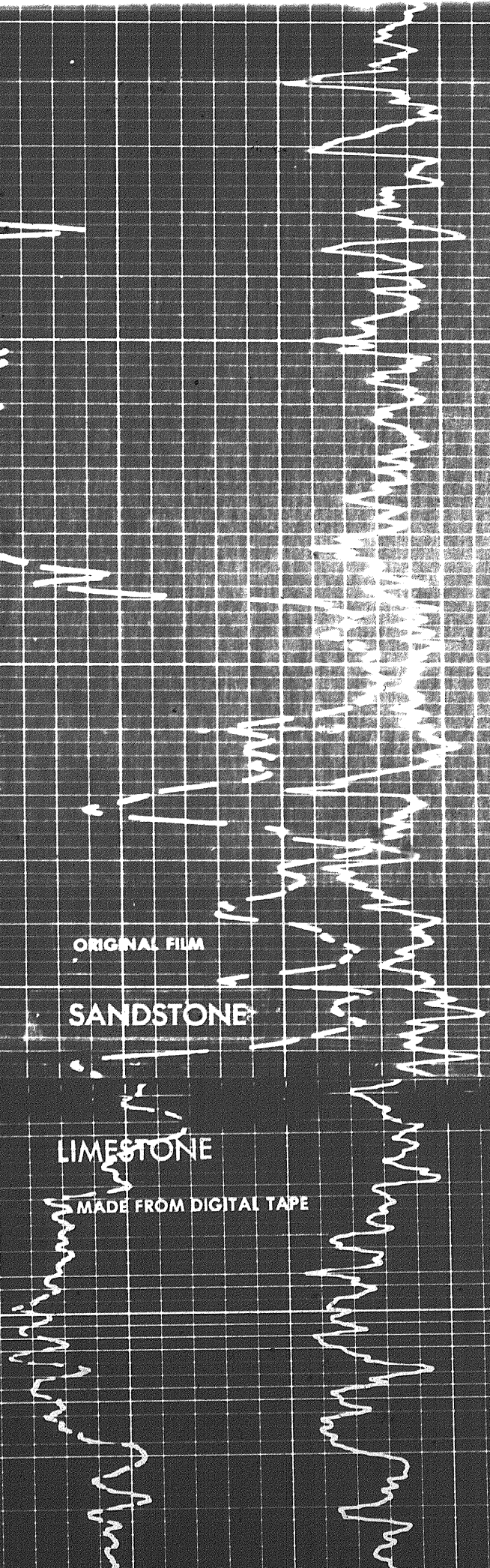
11 1/2 sec
 11 1/2 sec
 11 1/2 sec
 11 1/2 sec

ORIGINAL FILM

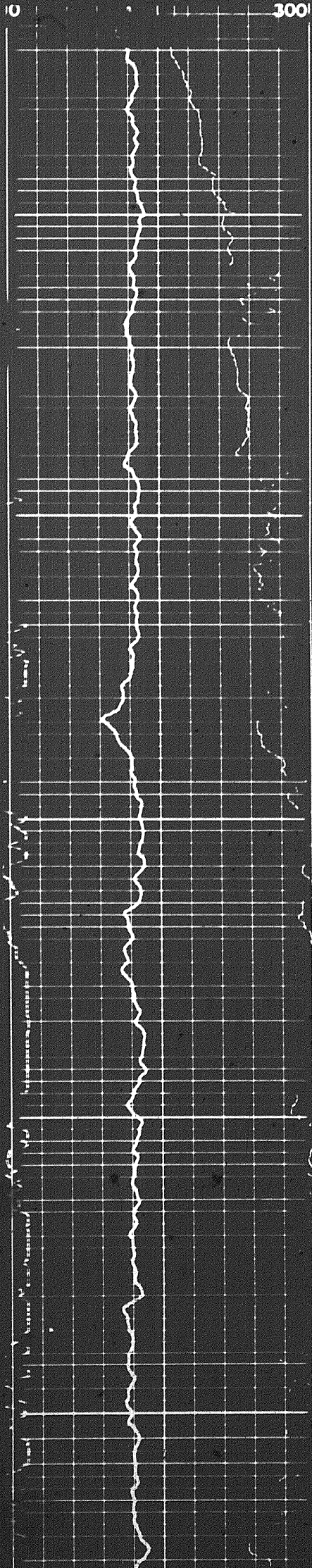
SANDSTONE

LIMESTONE

MADE FROM DIGITAL TAPE



7061

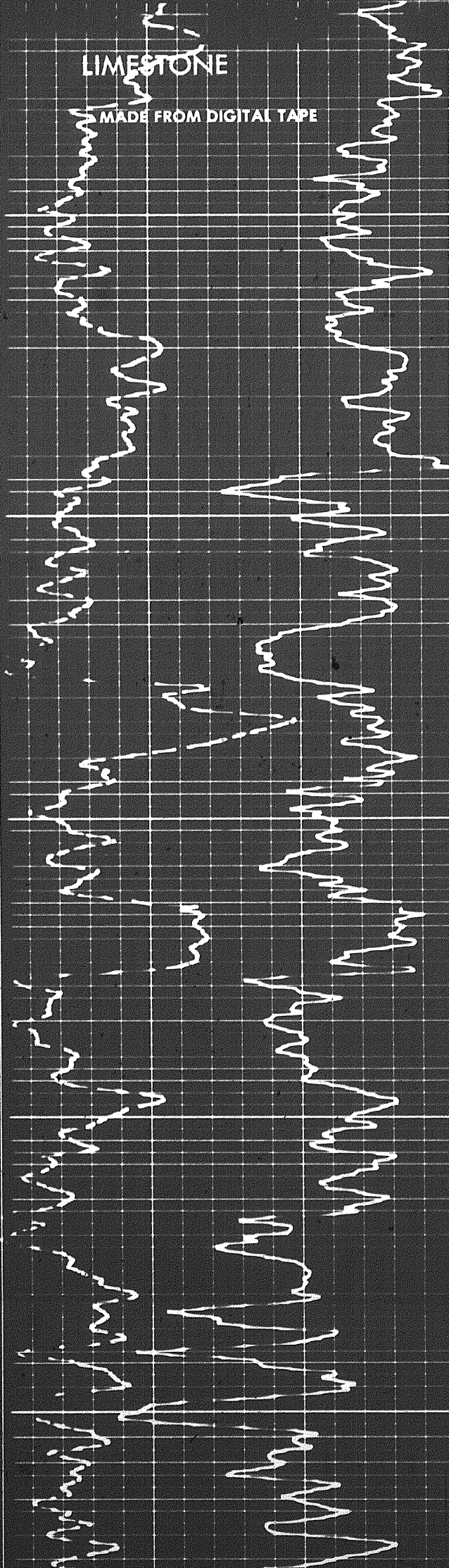


100

300

0075

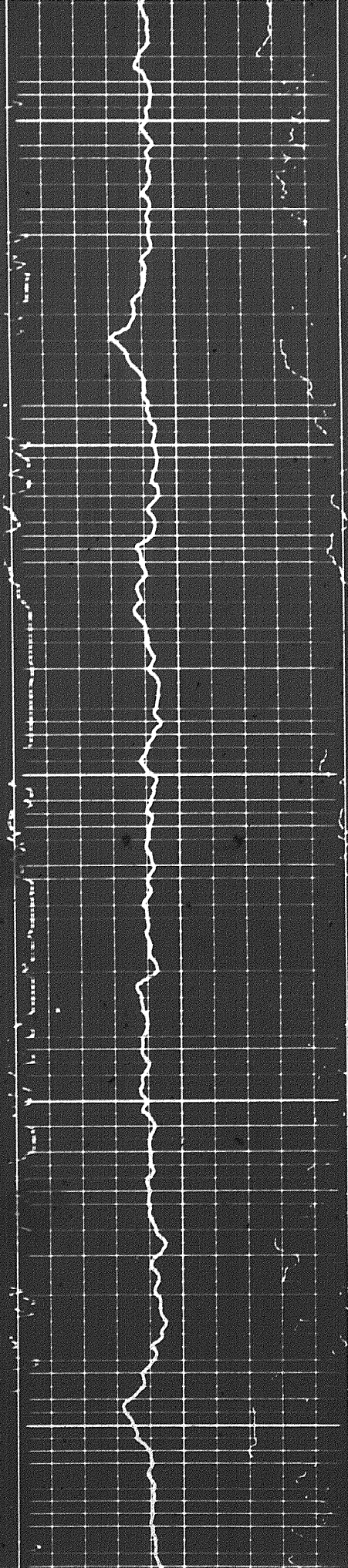
0085



LIMESTONE

MADE FROM DIGITAL TAPE

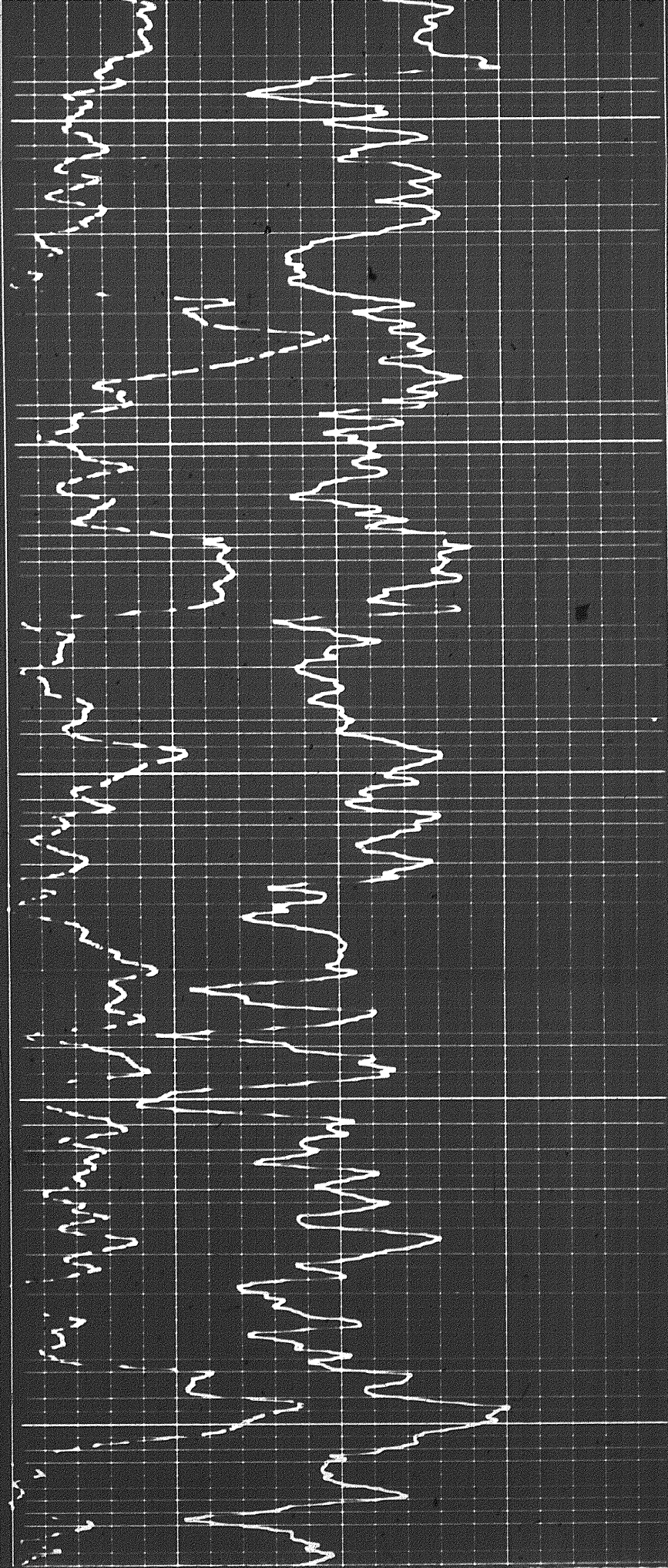
Feb 61

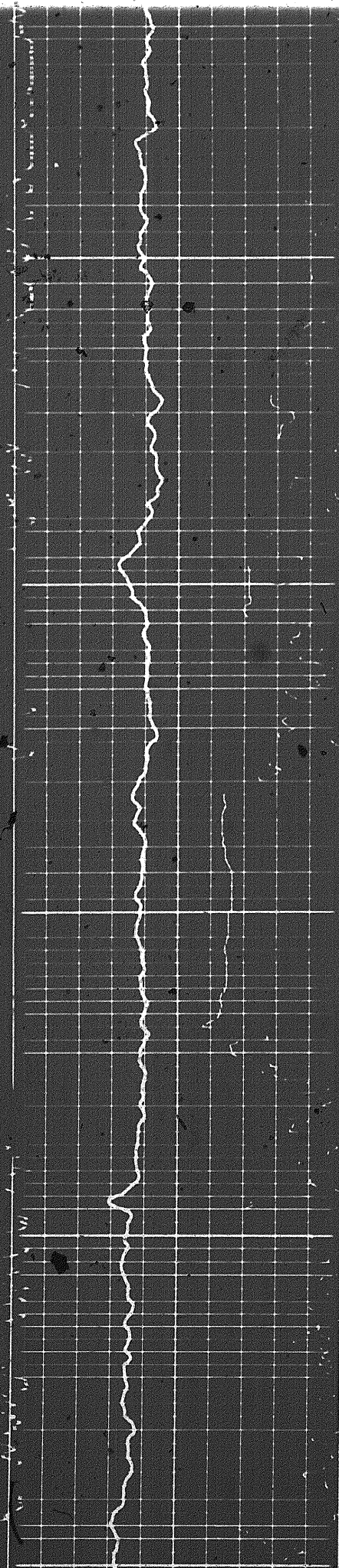


00/5

00RG

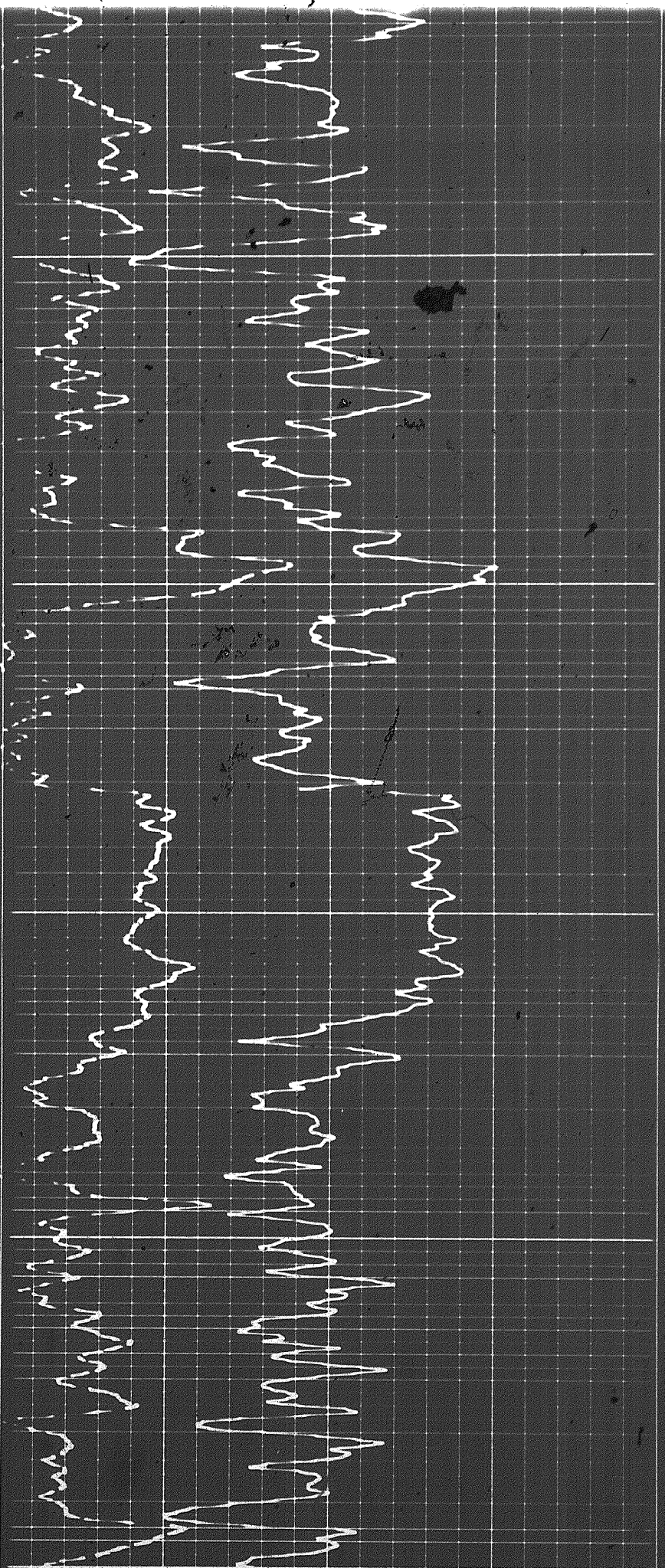
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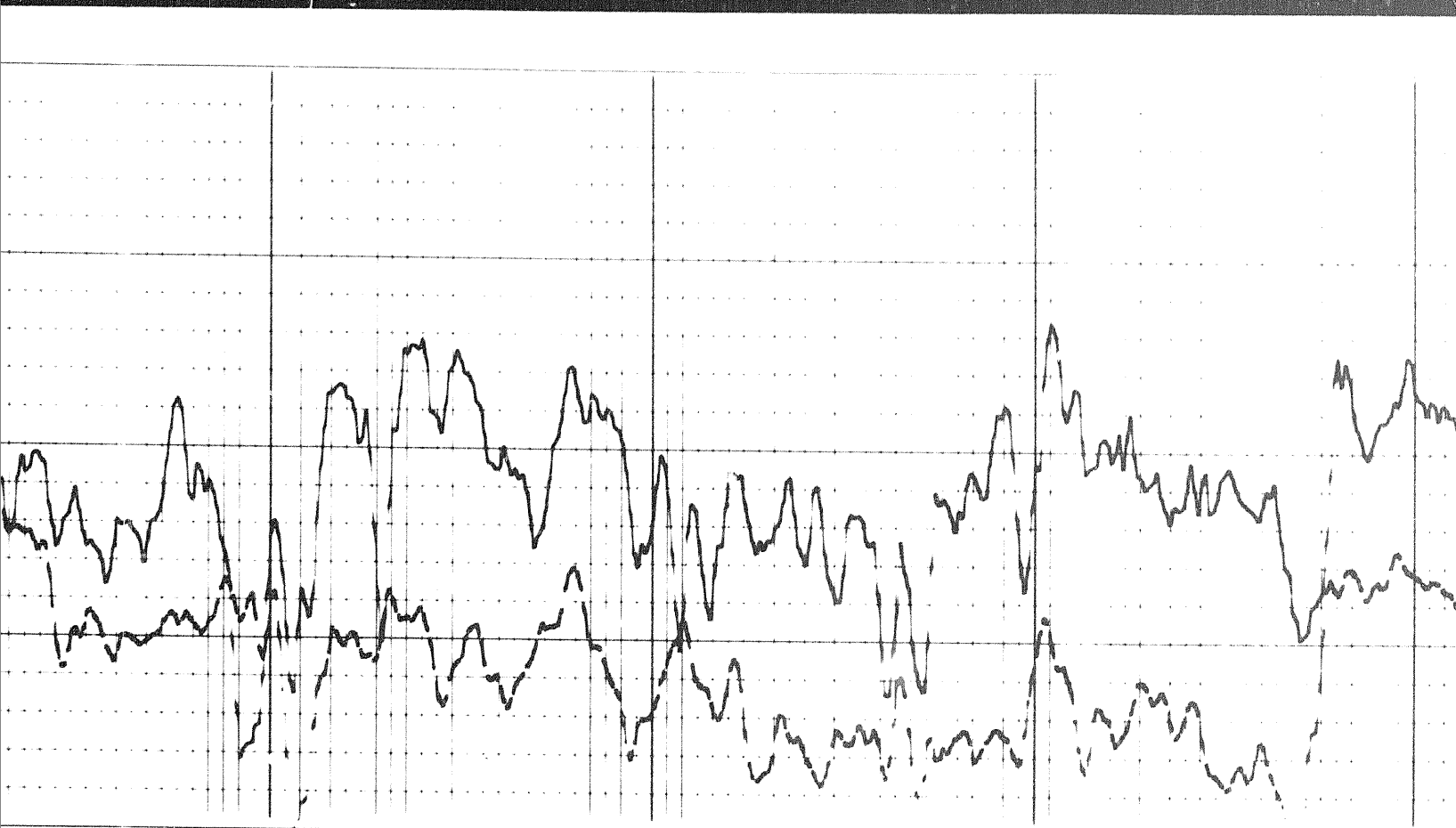




0009

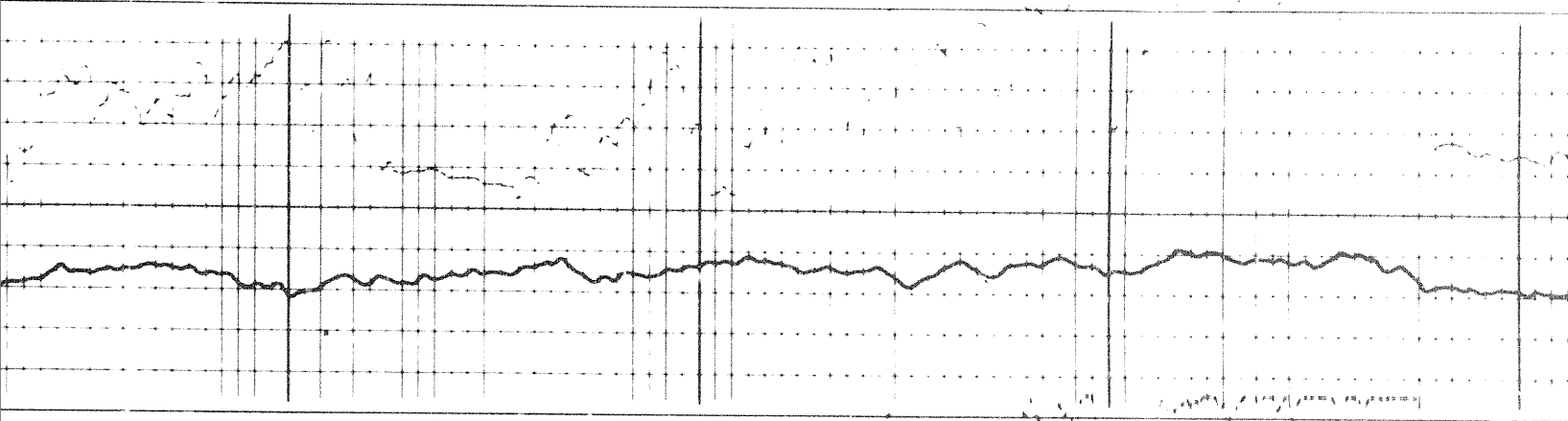
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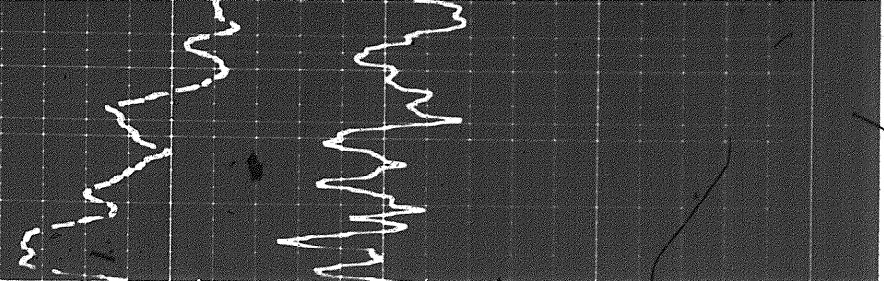


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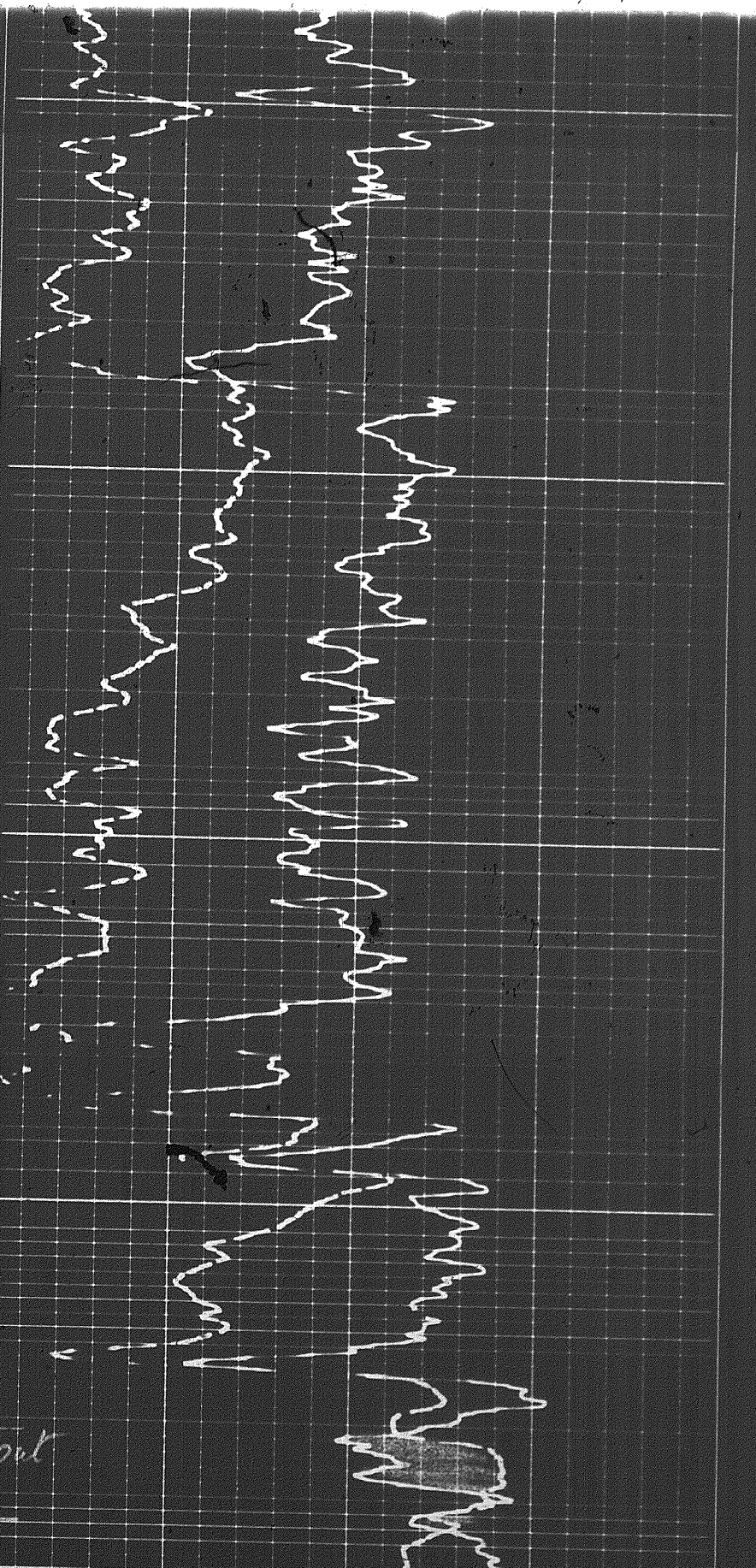
6200



204



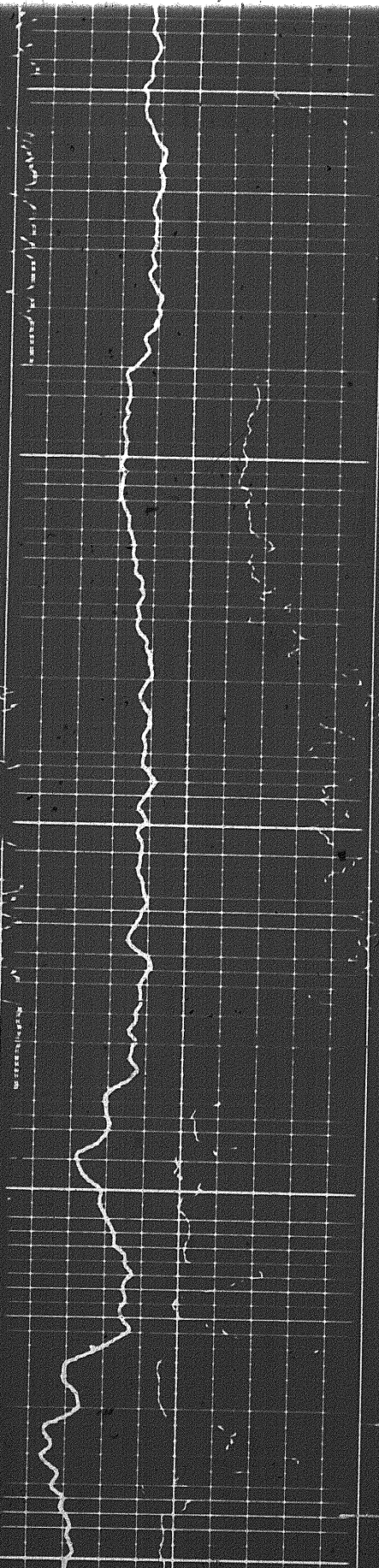
6200



6300

wash out

64



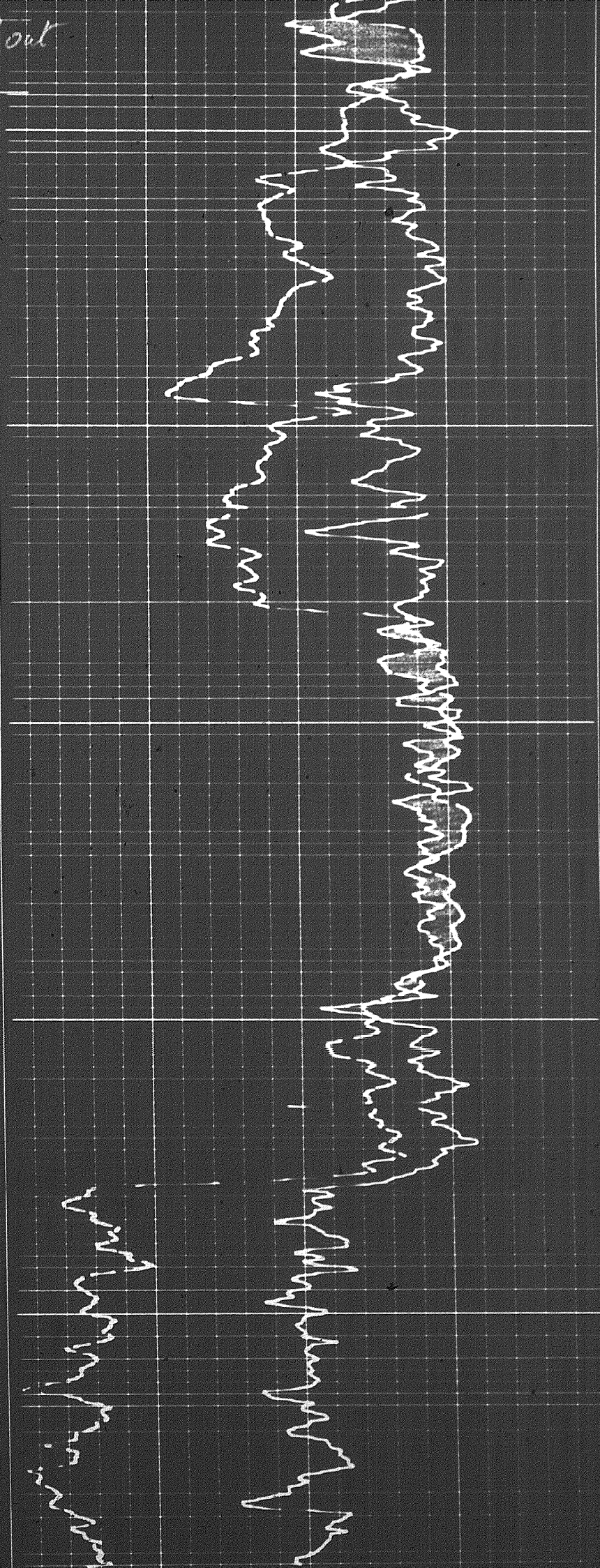
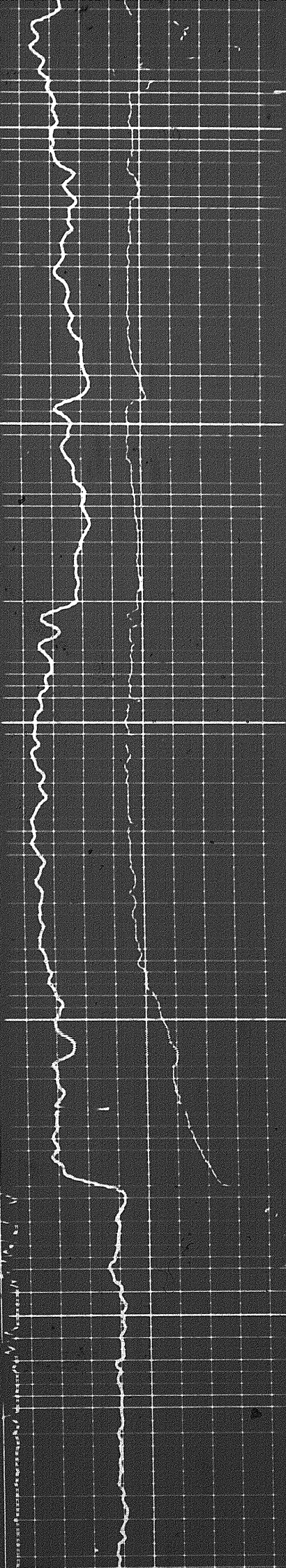
70

wash out

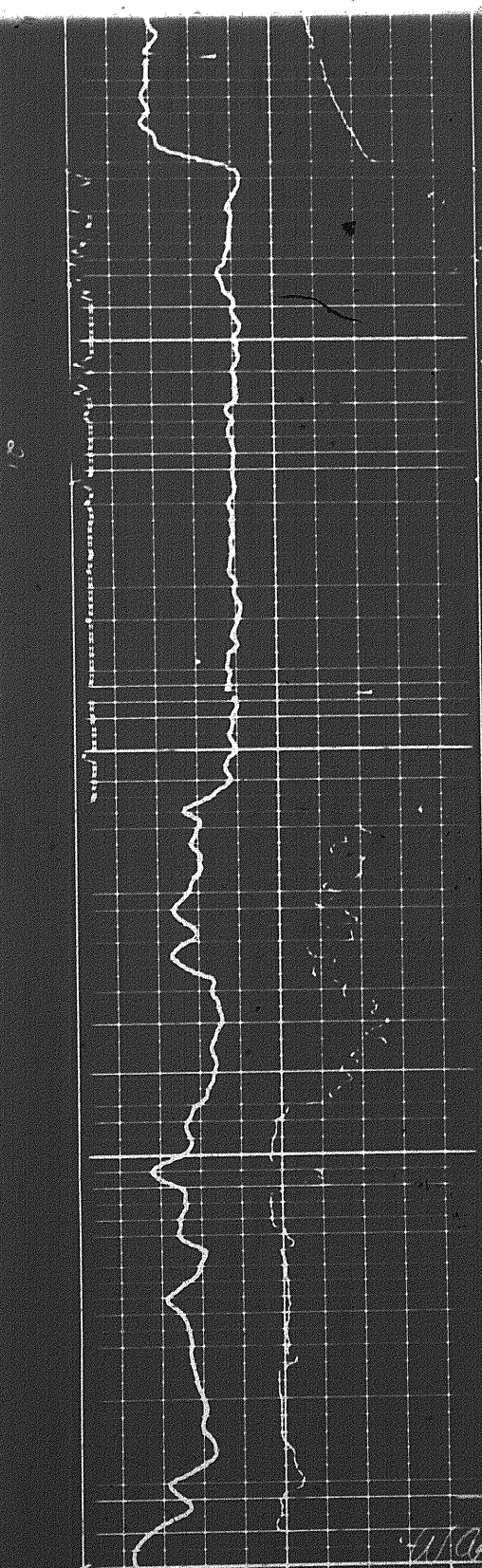
6400

6500

6600



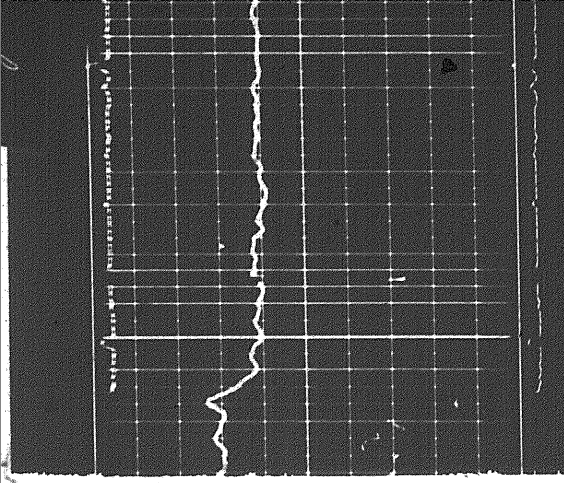
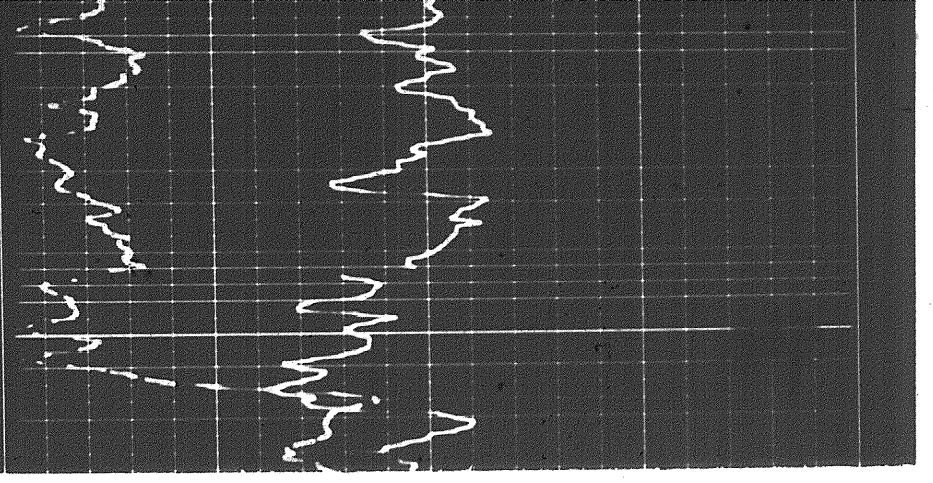
210

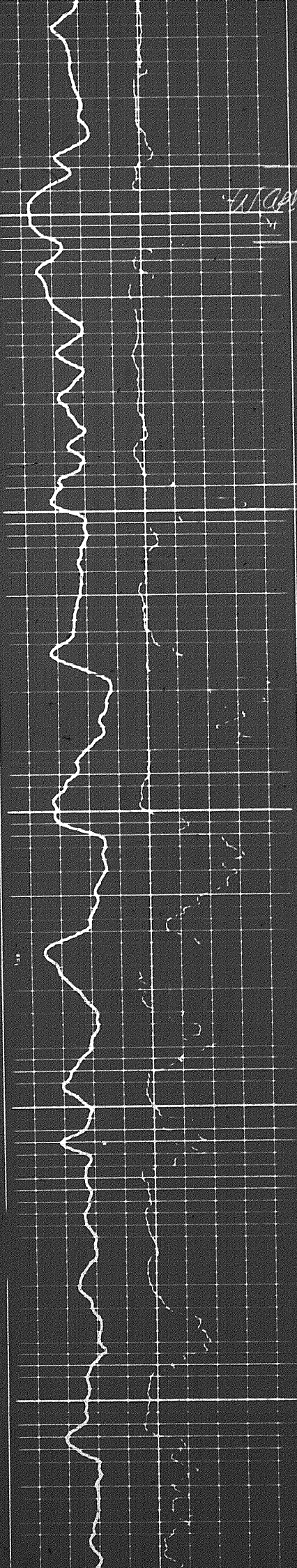


6000

6000

wash out



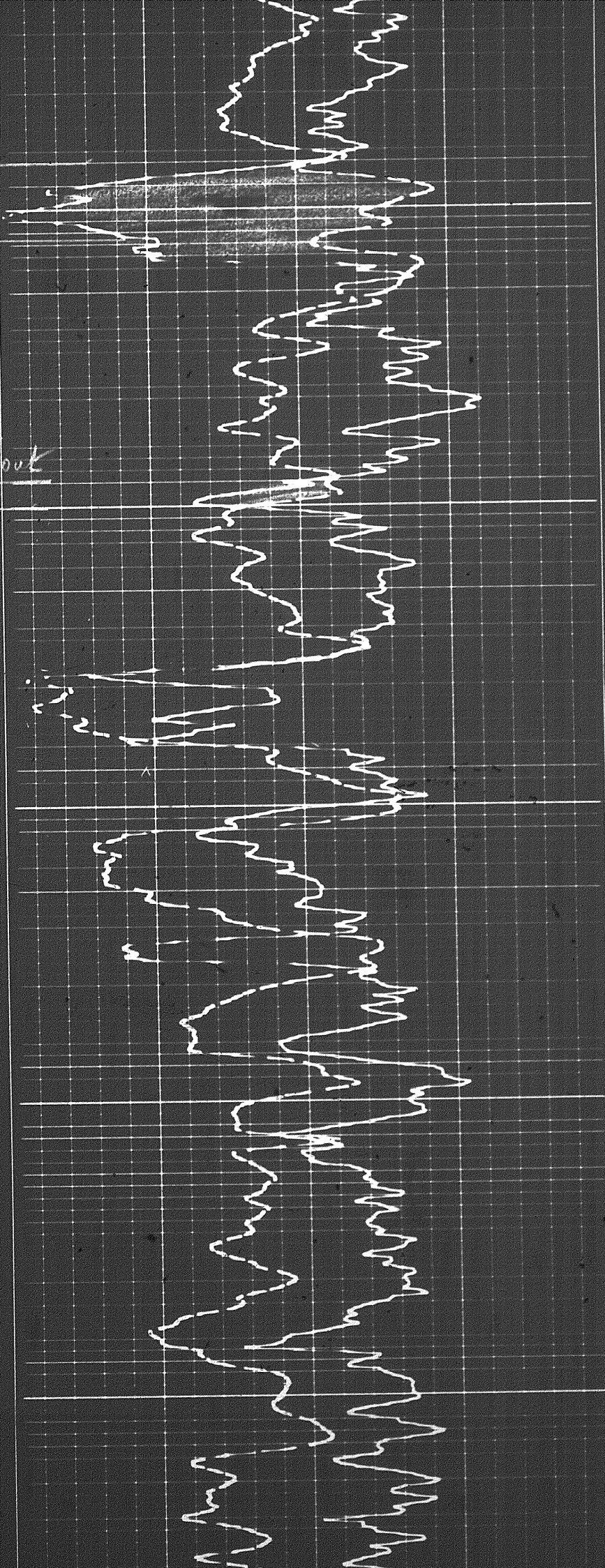


wash out

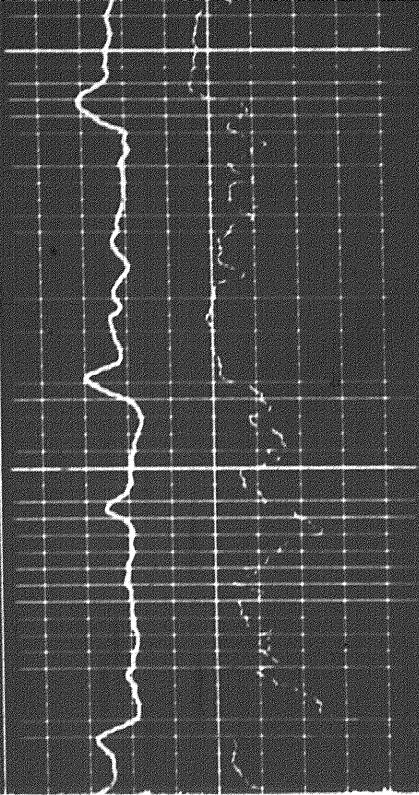
wash out

0000

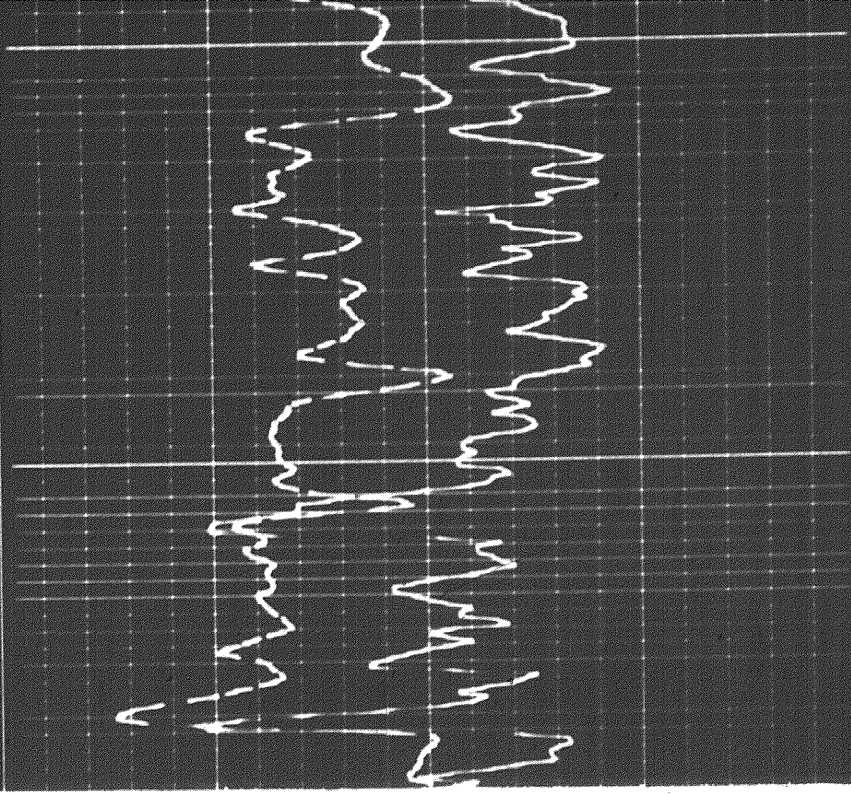
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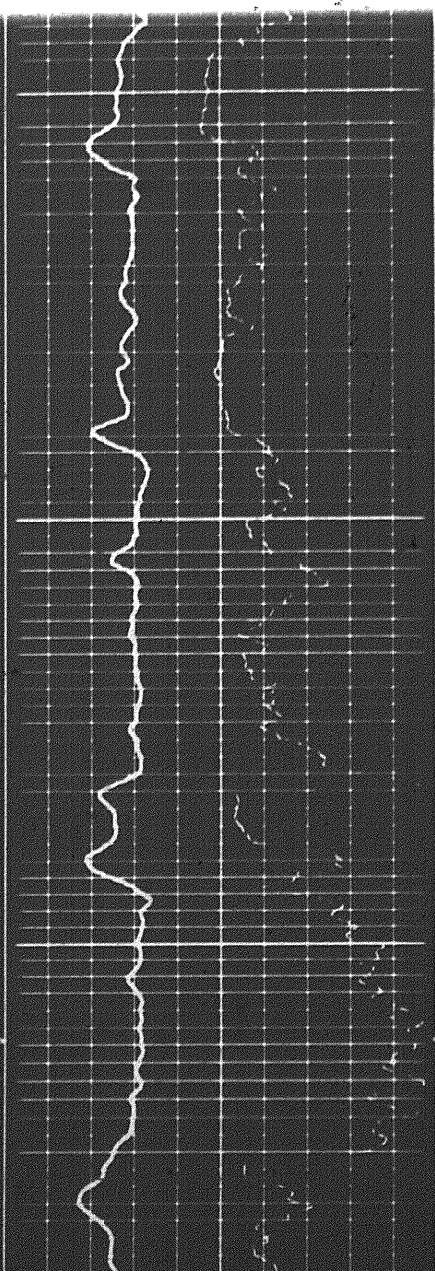
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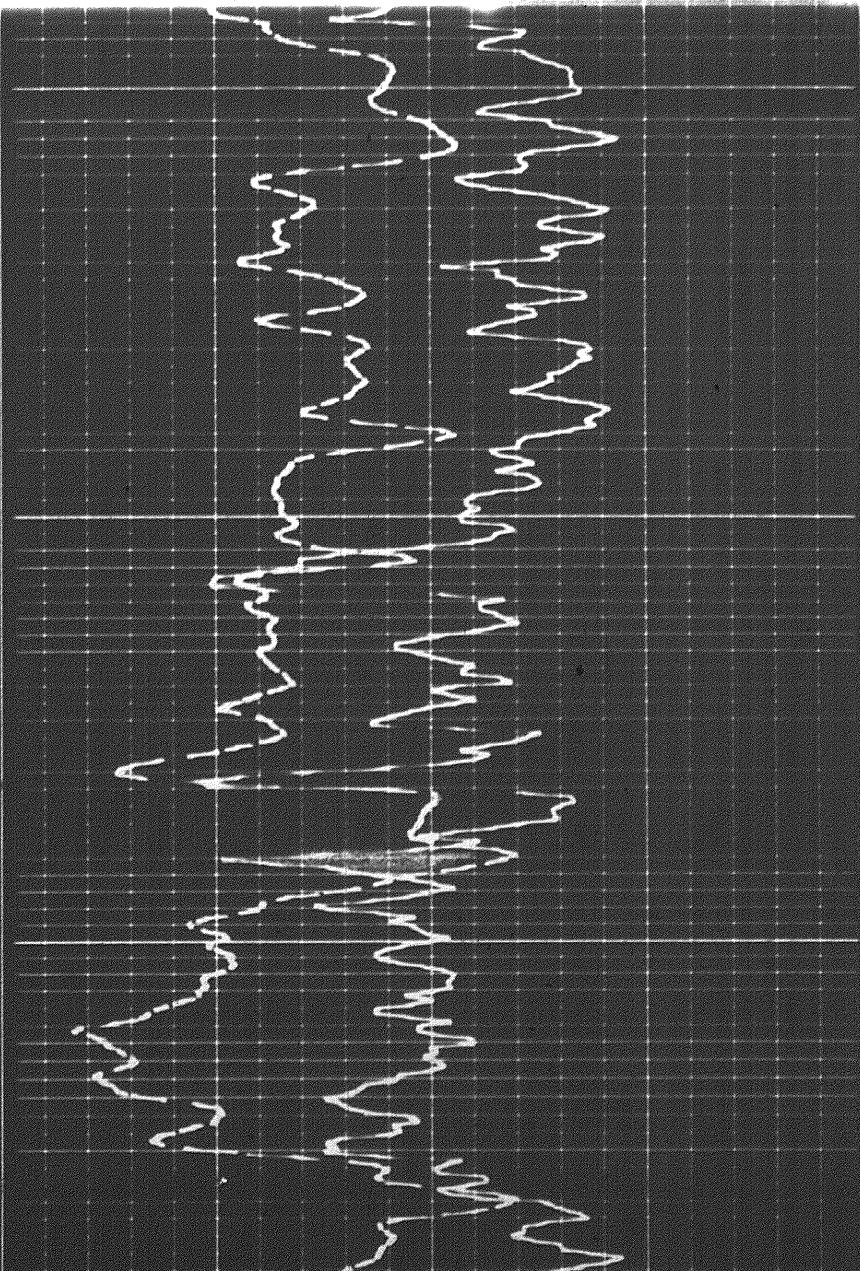
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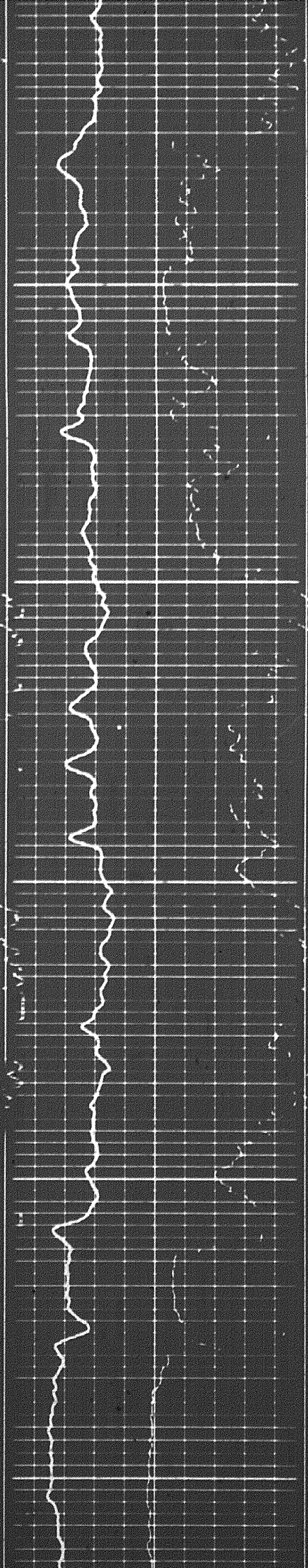


72



1000

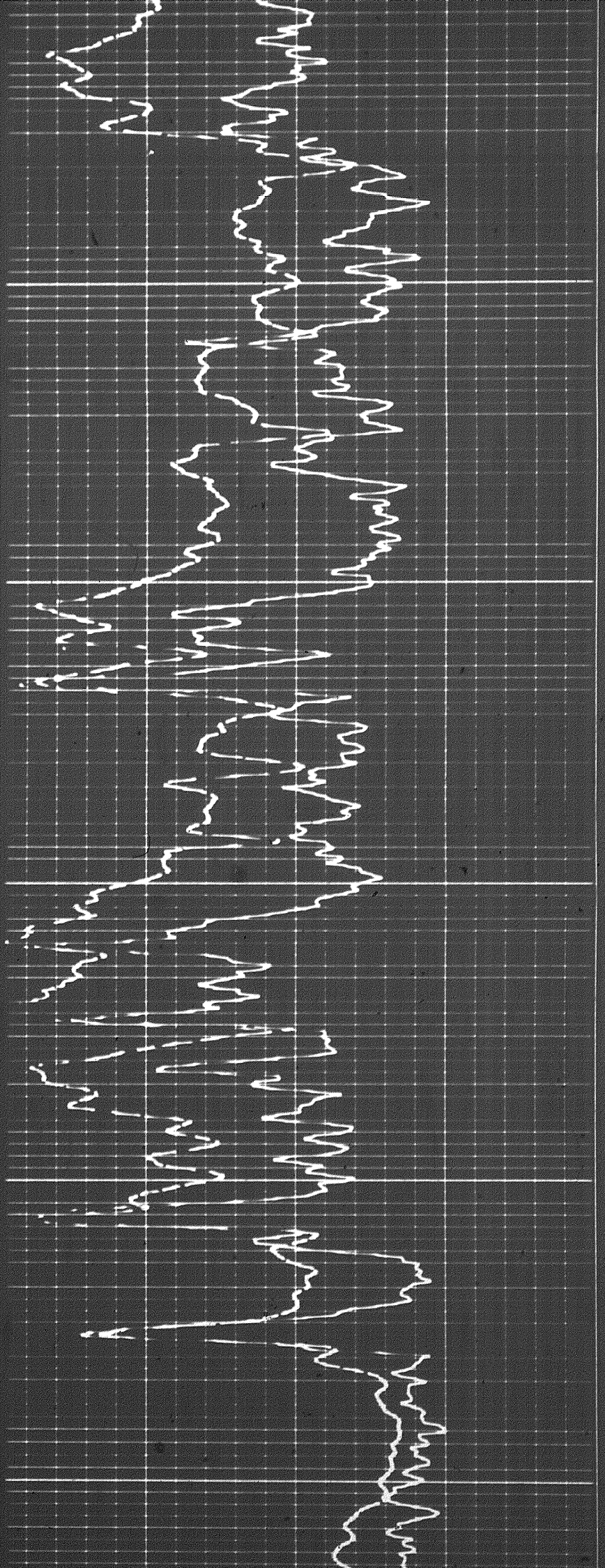




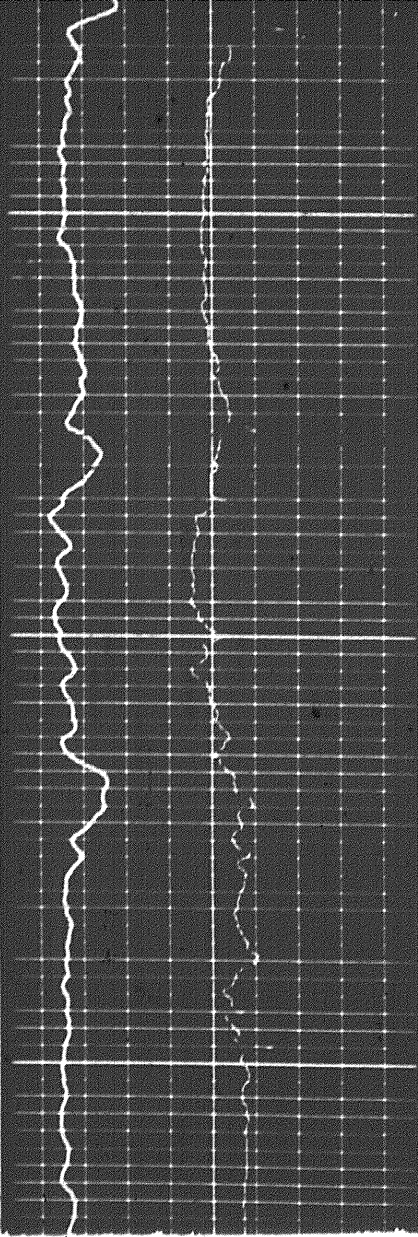
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1021

1031

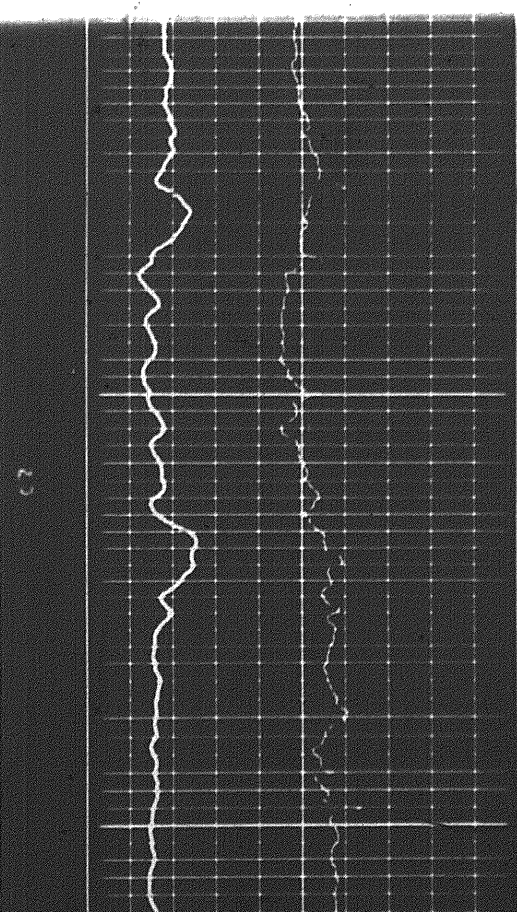
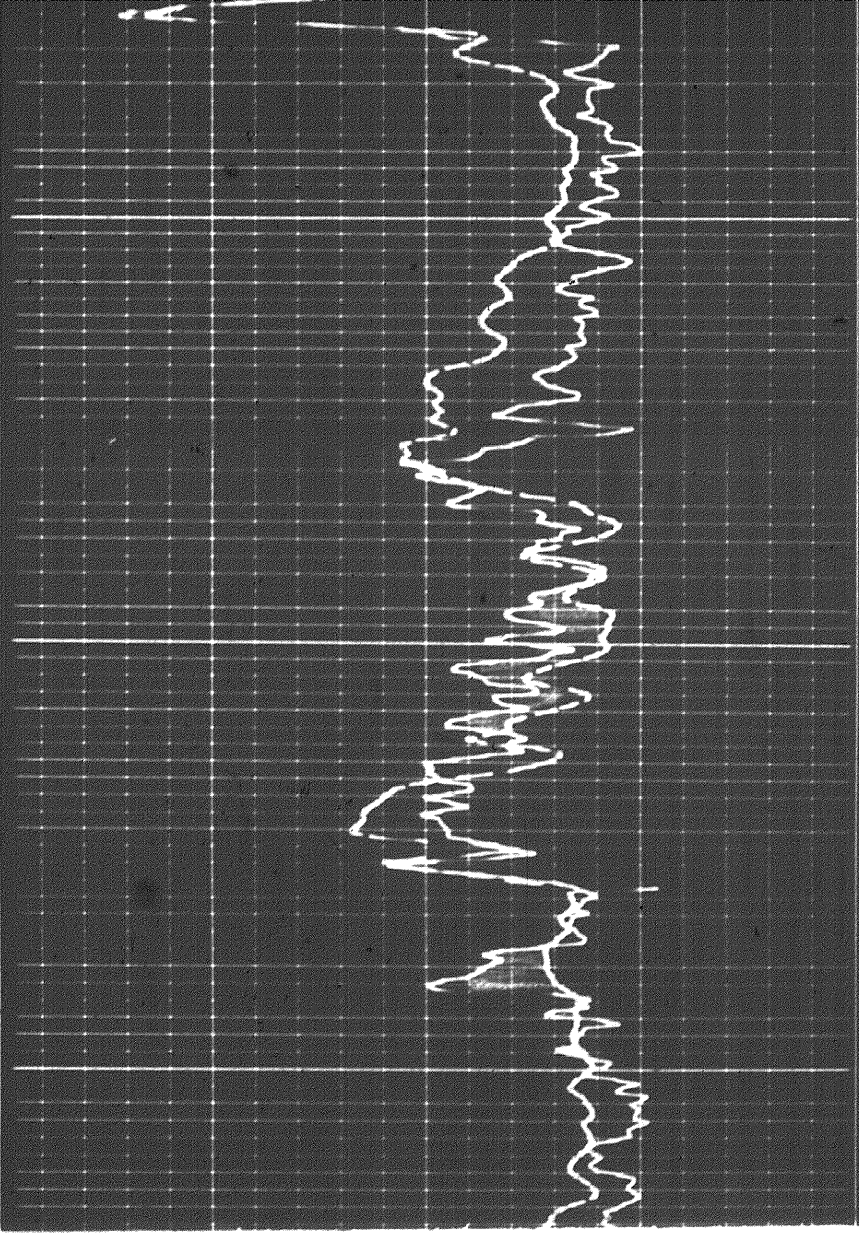


239



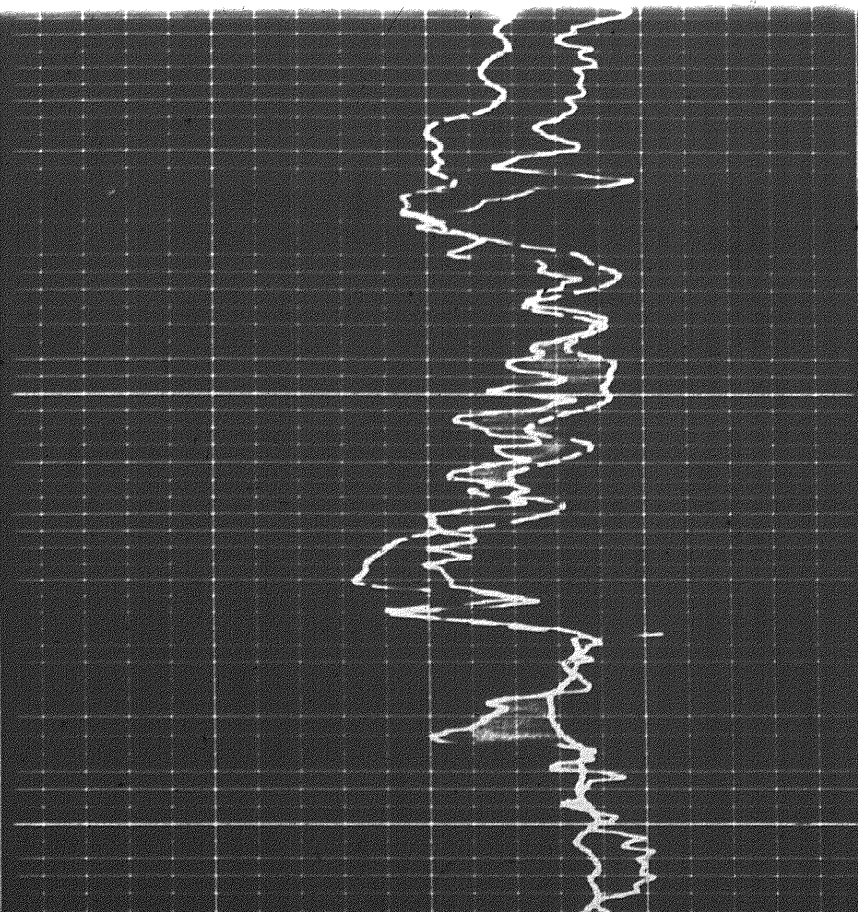
750

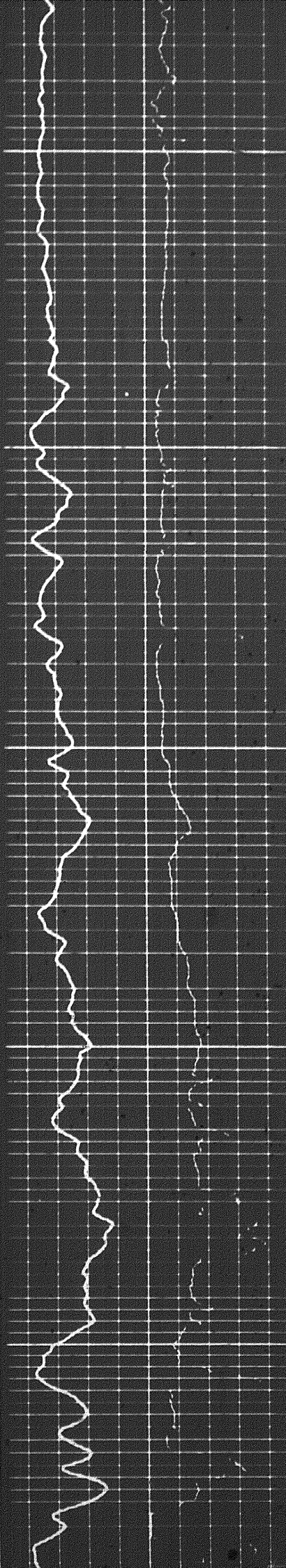
740



23

740



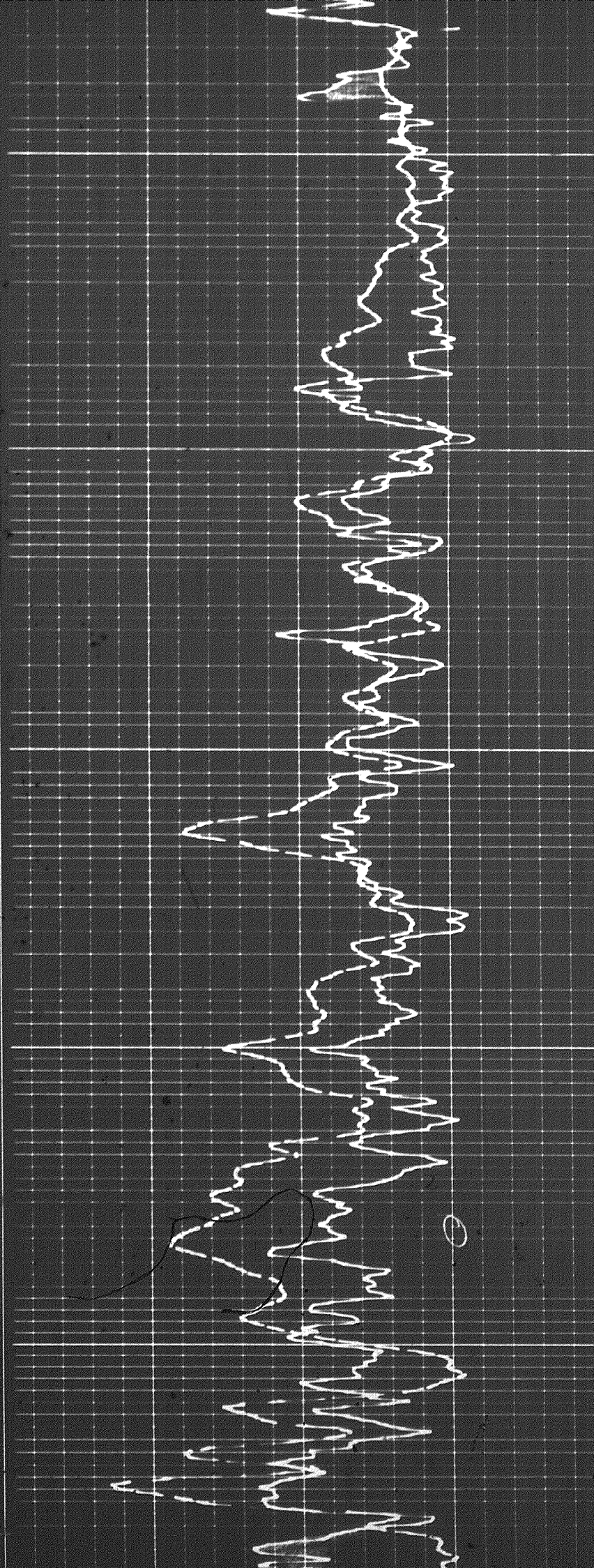


140

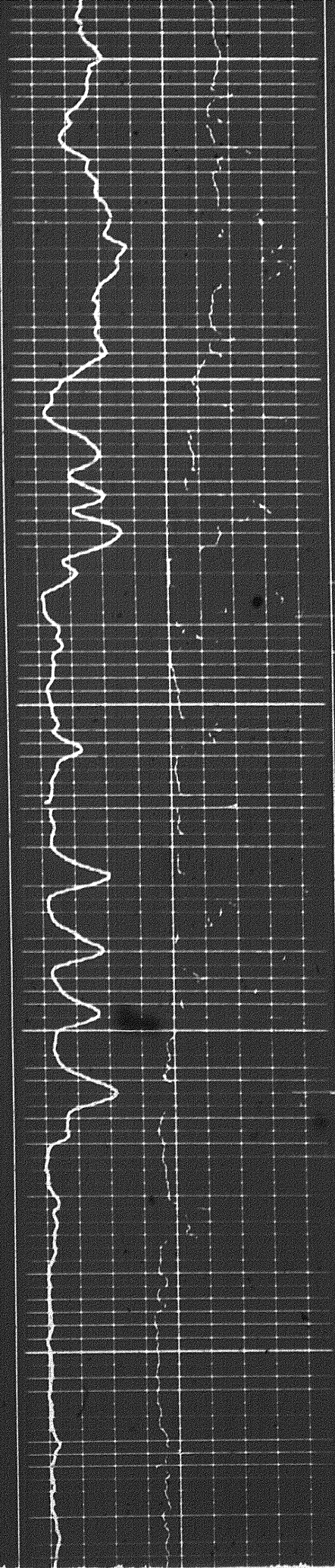
150

160

170



7040

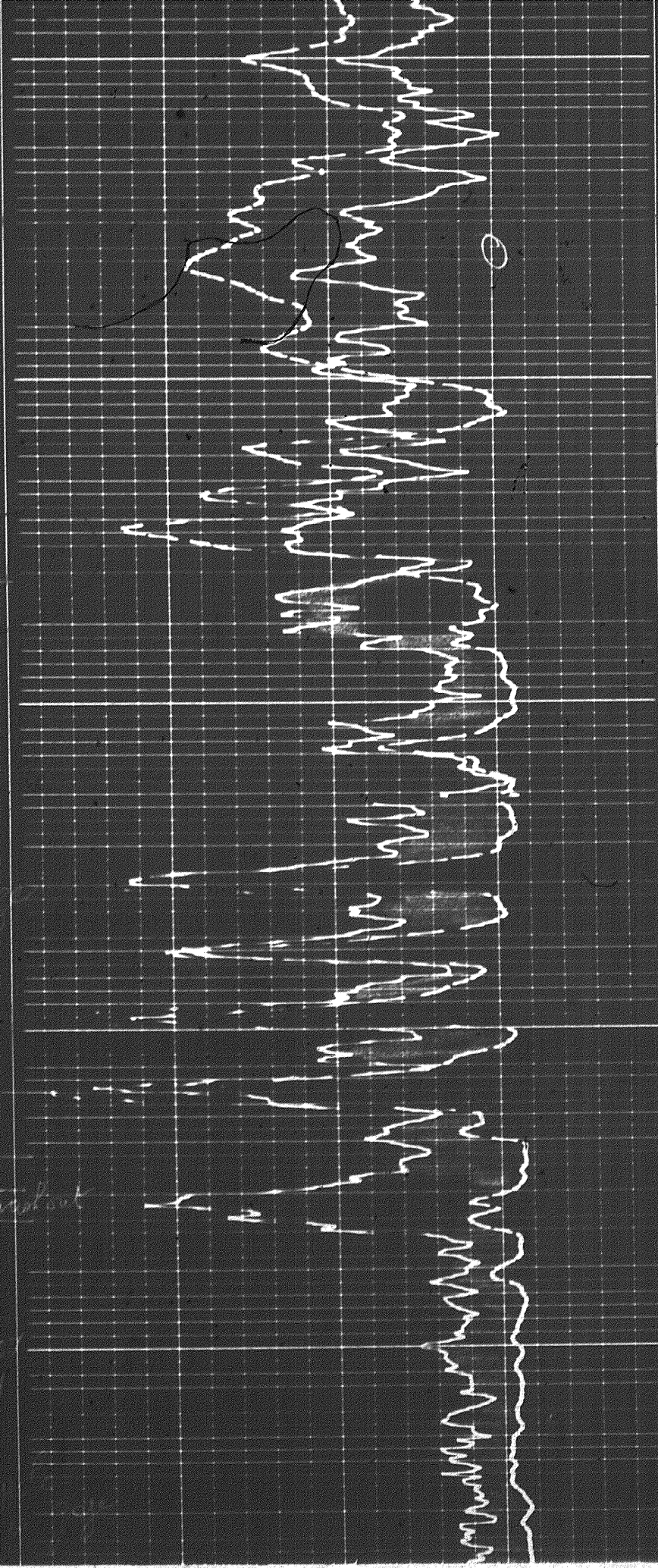


work out

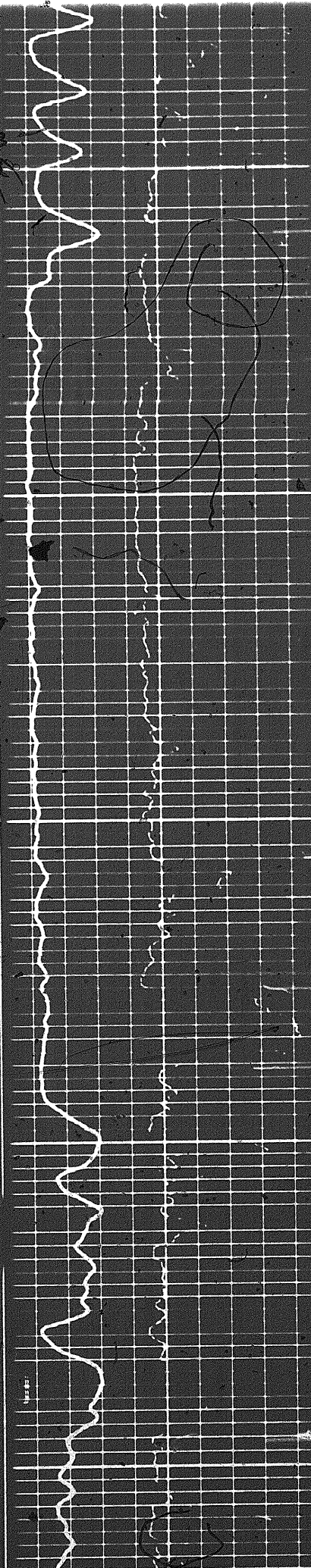
100

100

work out



22



1000

wash out

Dot #1

to page

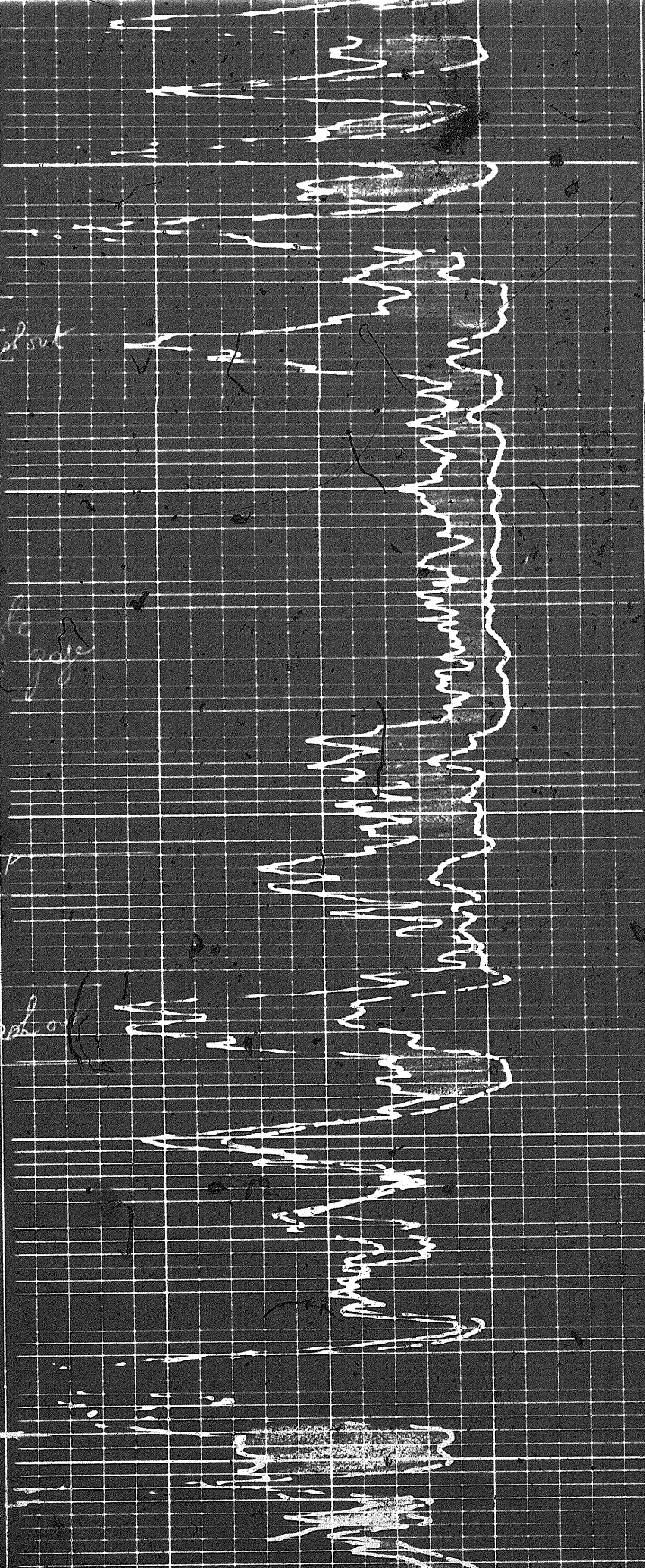
1800

wash out

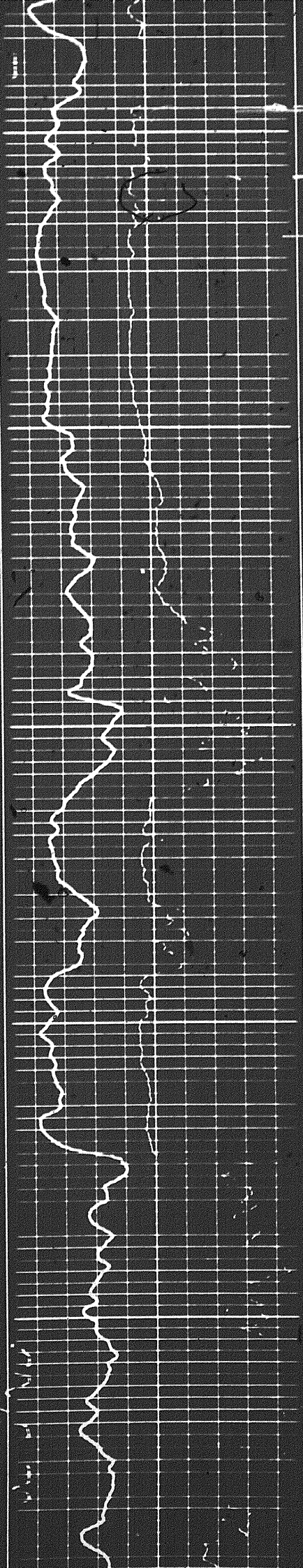
wash out

9

1900



page

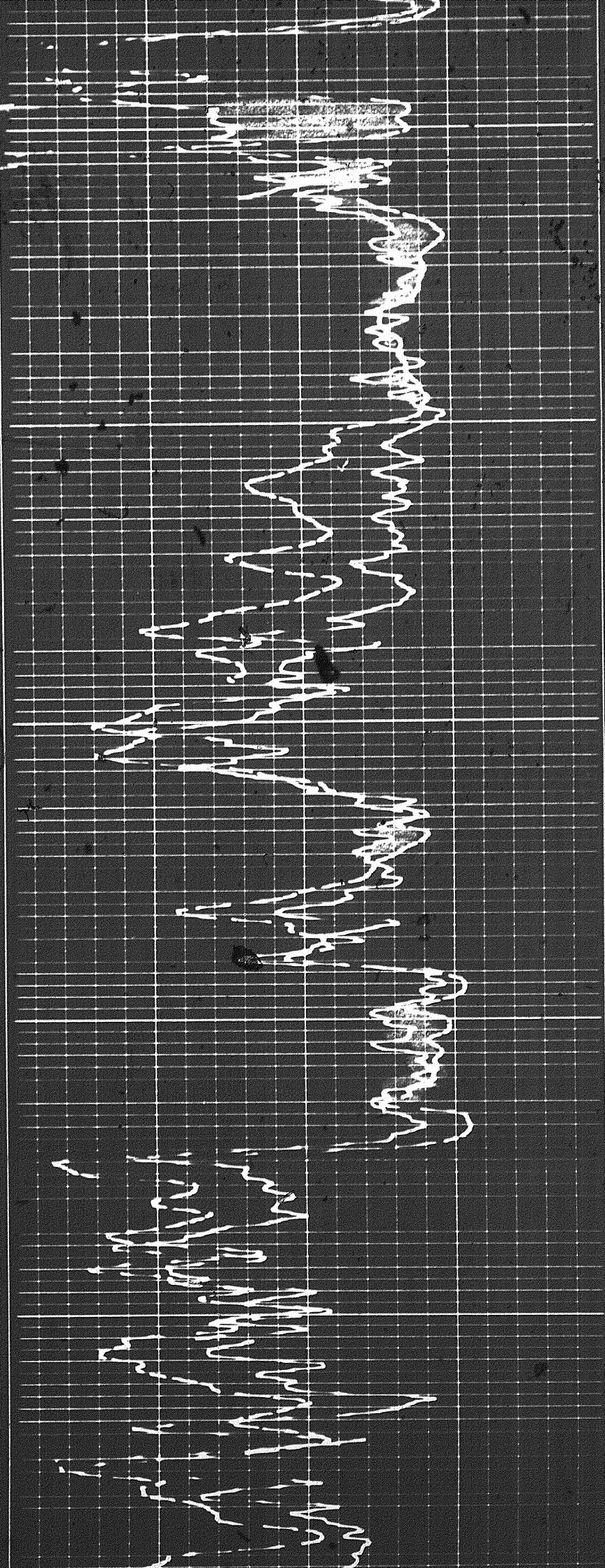


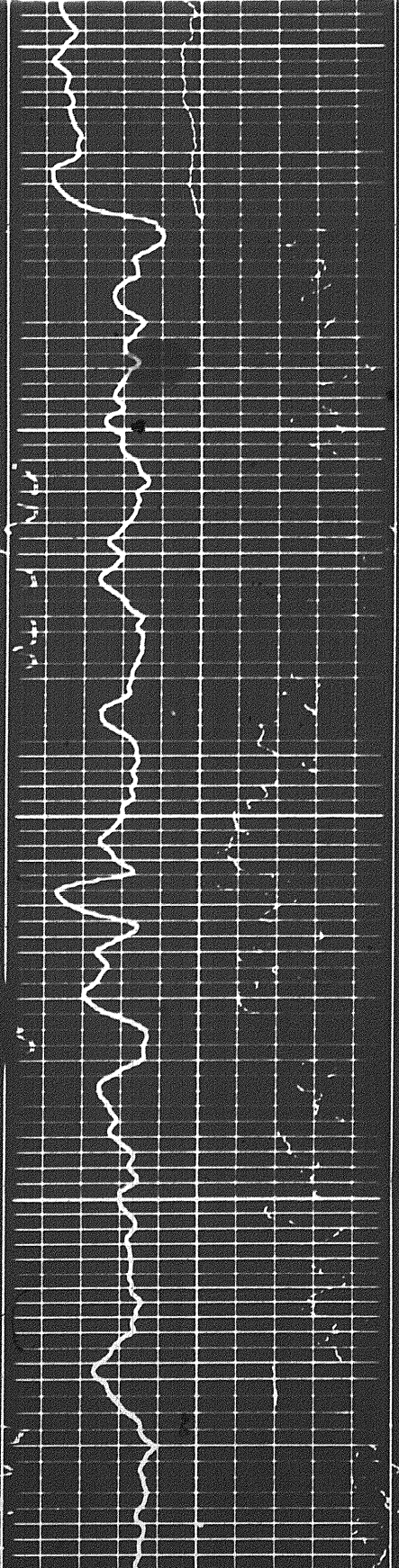
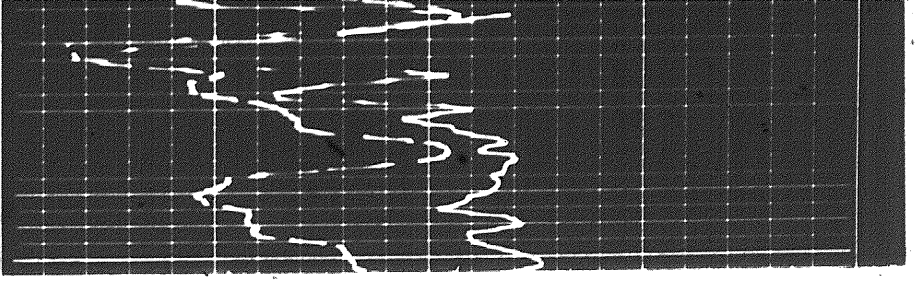
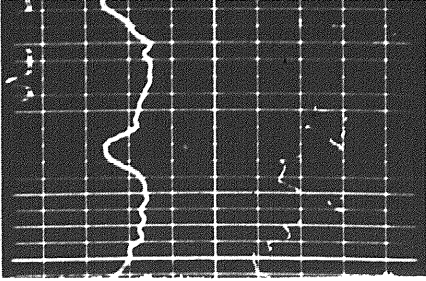
001R

000R

005R

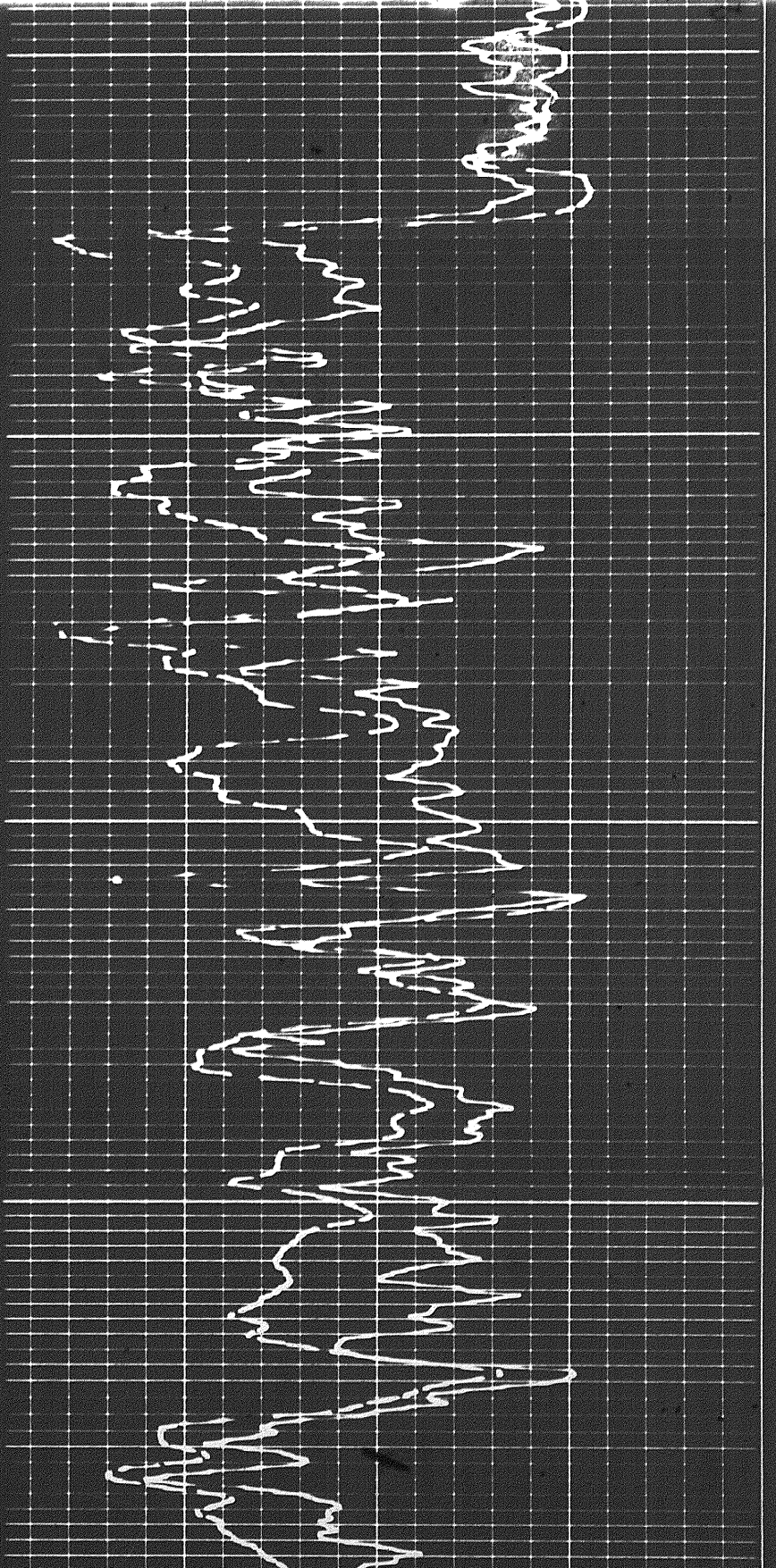
1-9

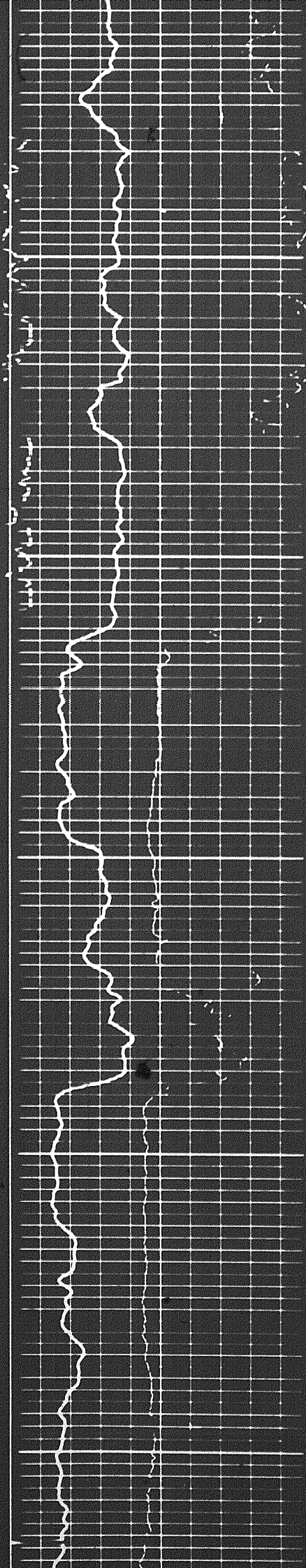




RIII

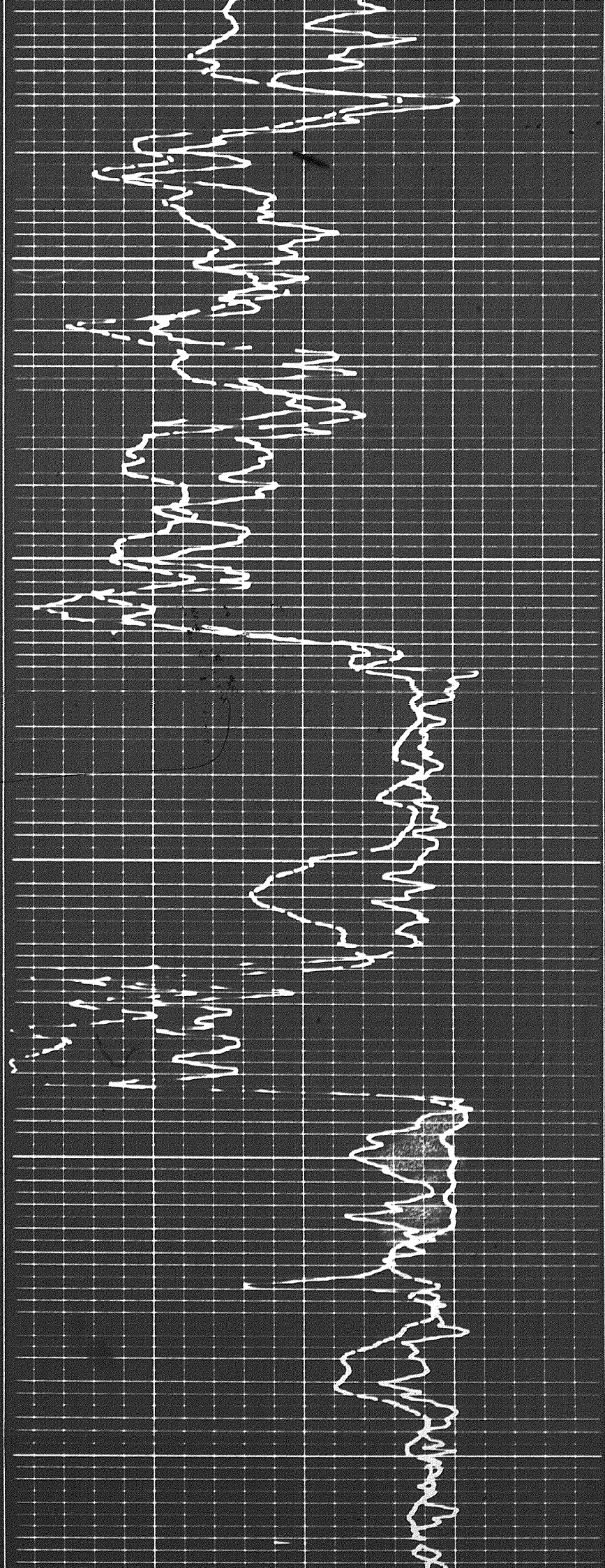
RIII

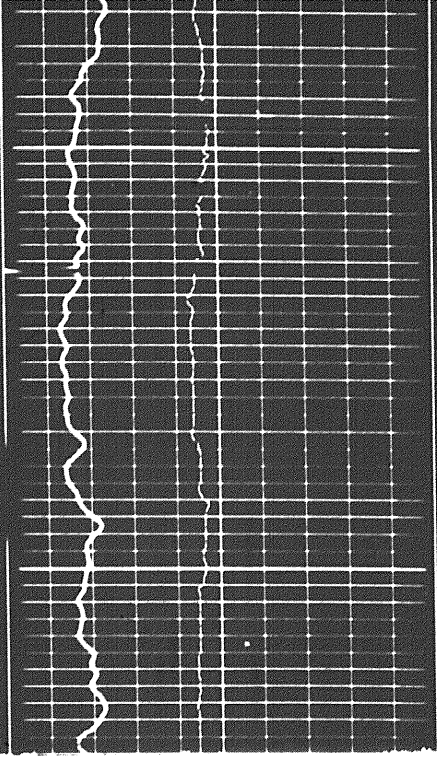




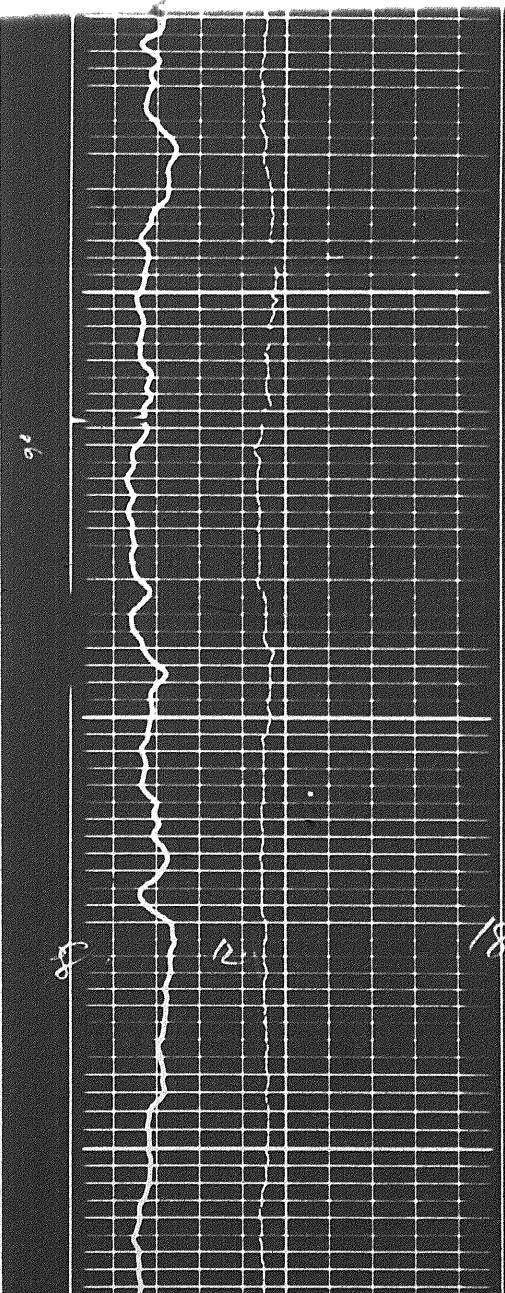
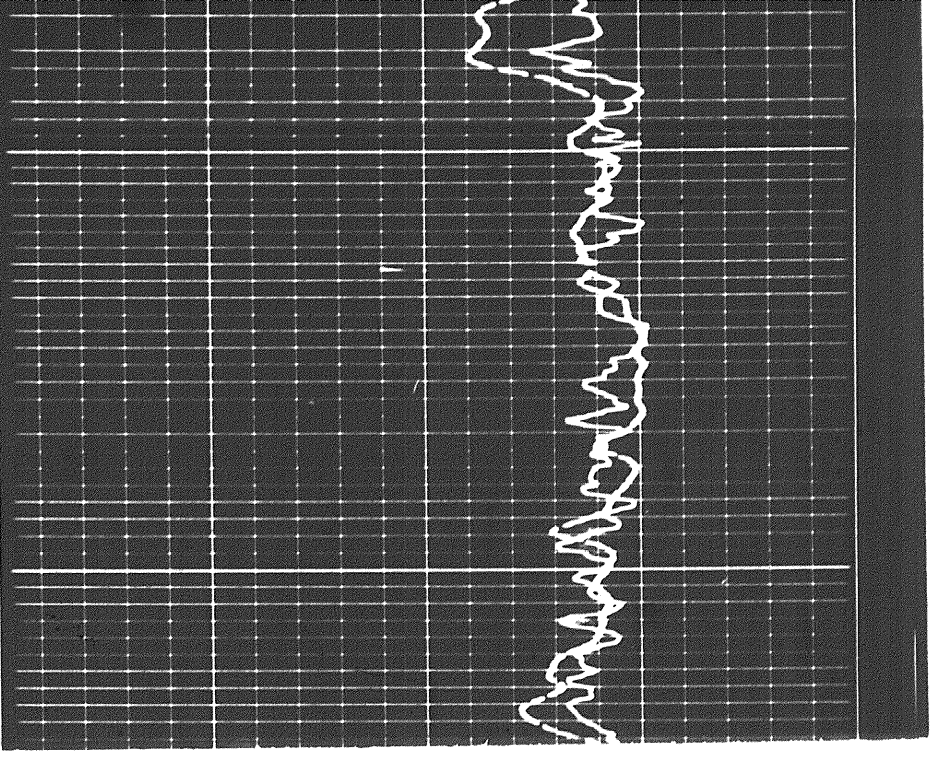
005R

004R

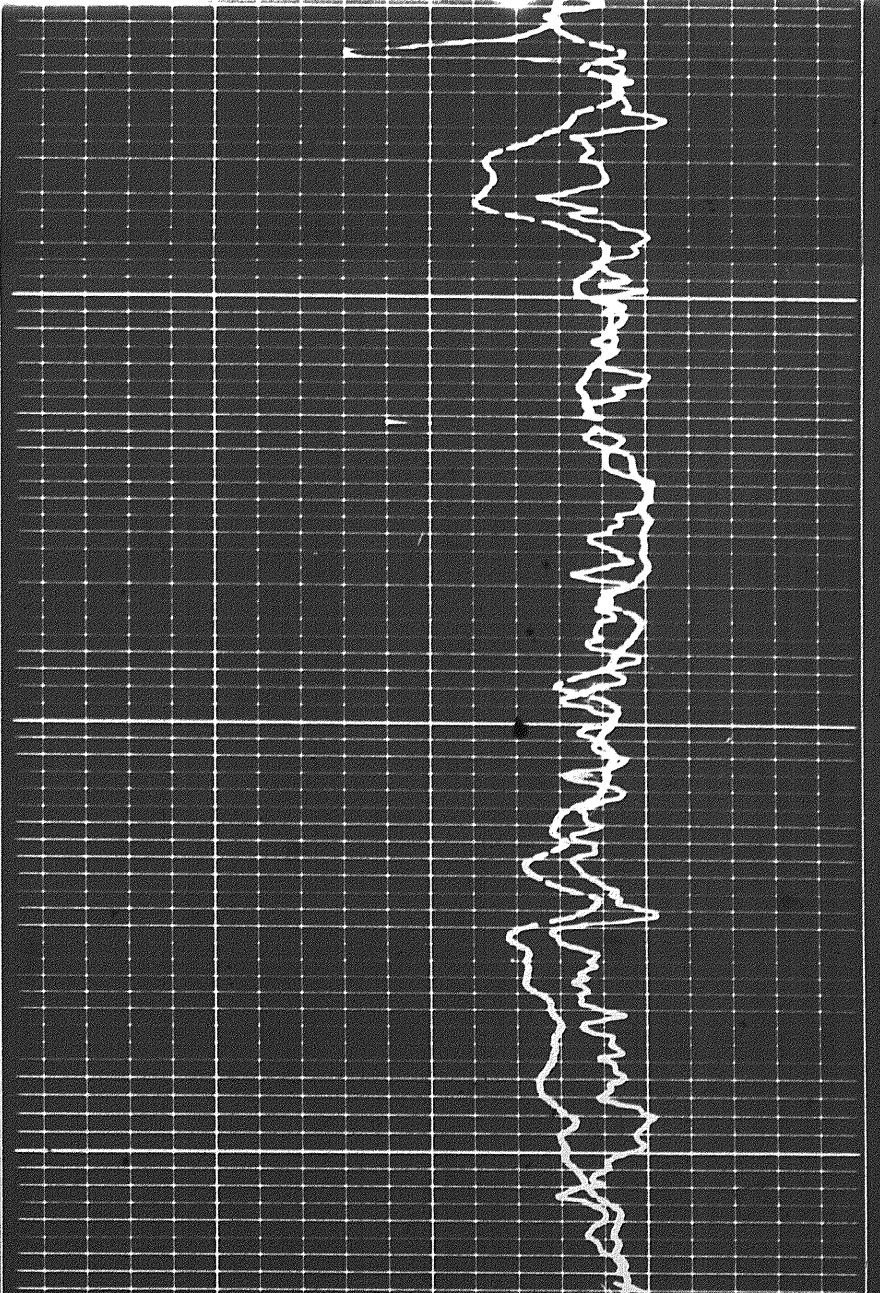


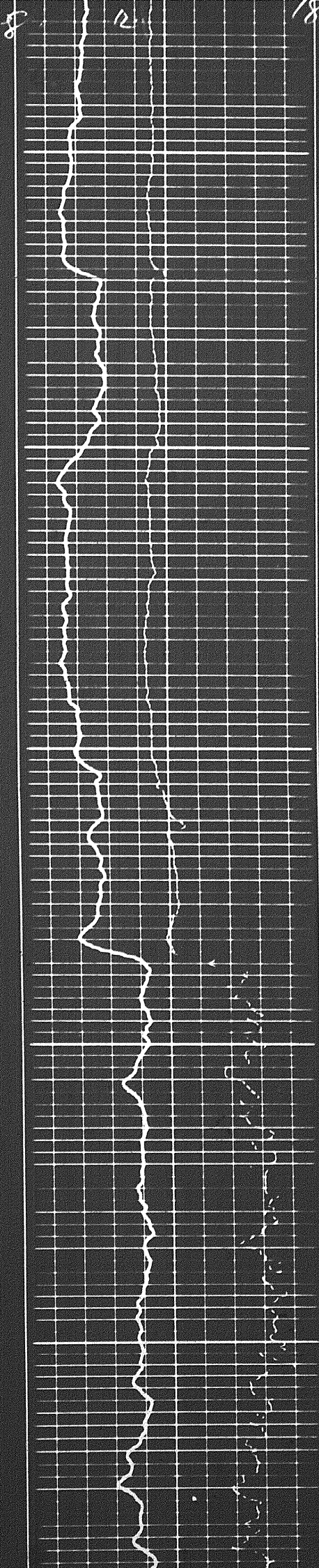


0058



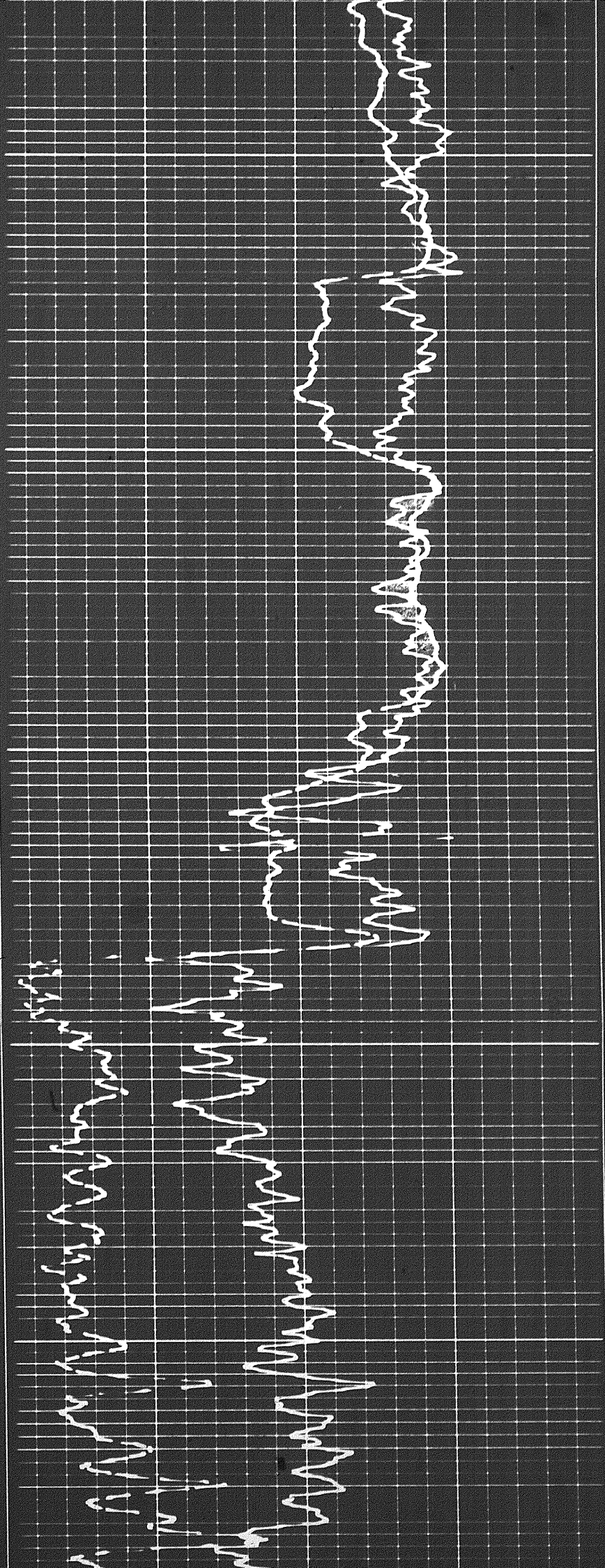
0058



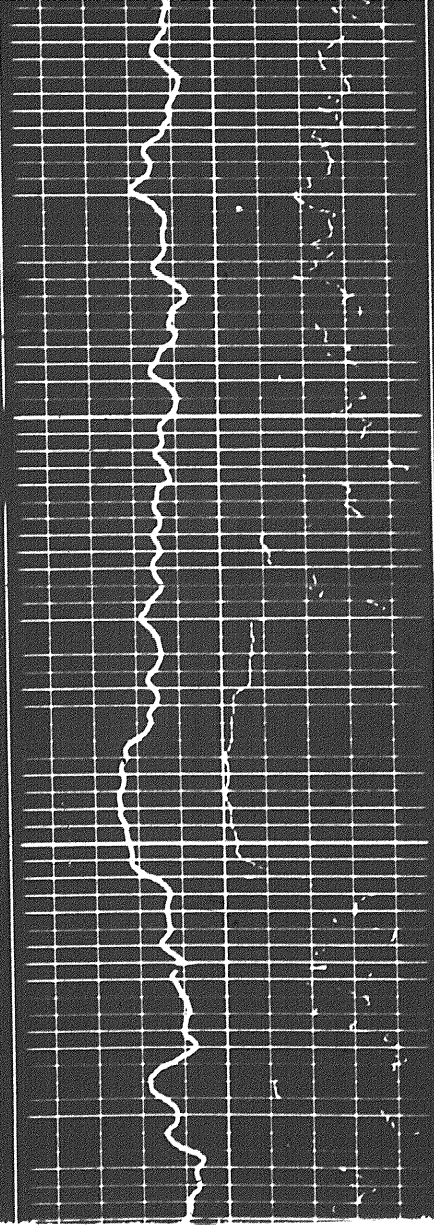


009R

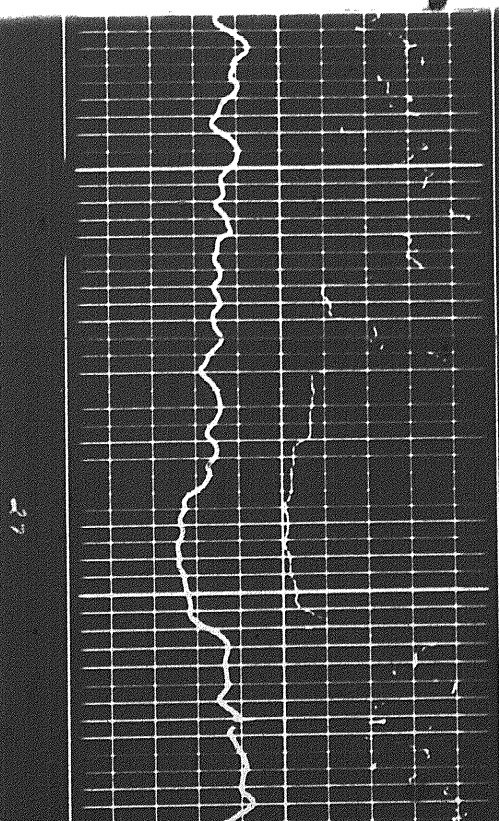
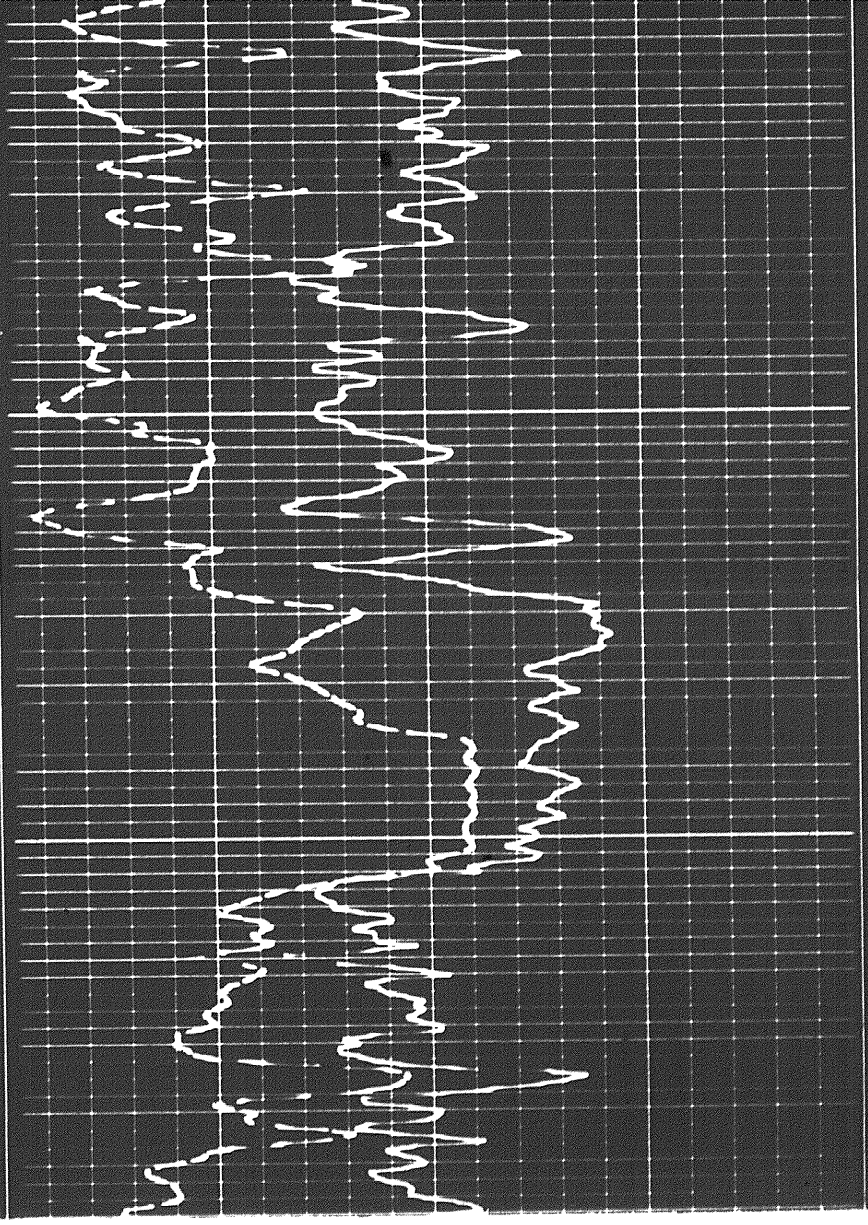
R/00



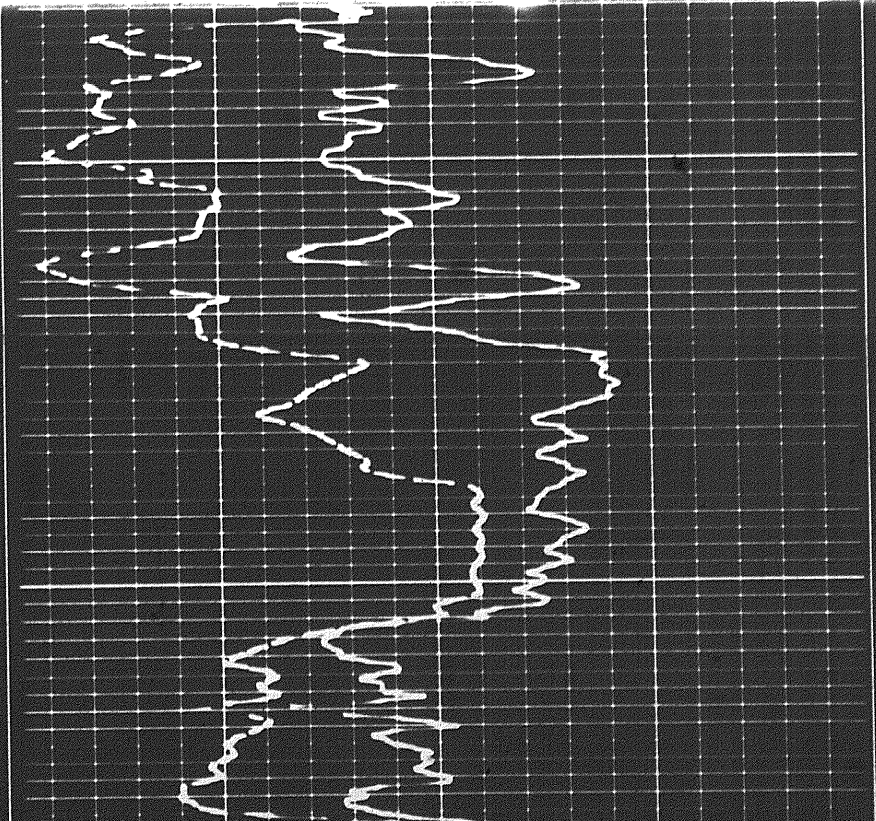
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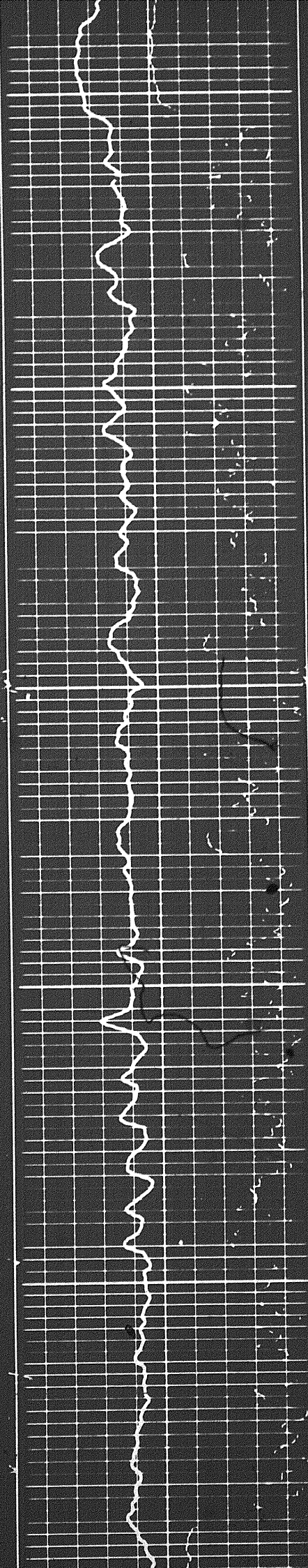


00RR



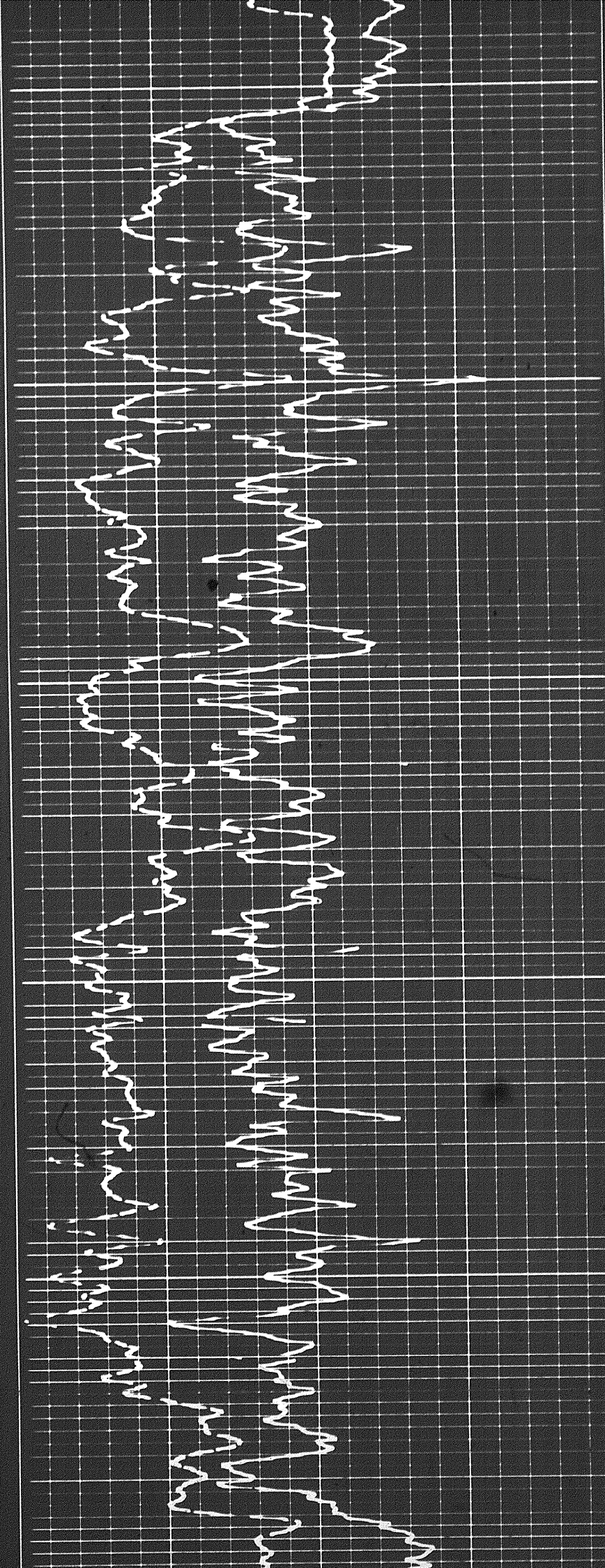
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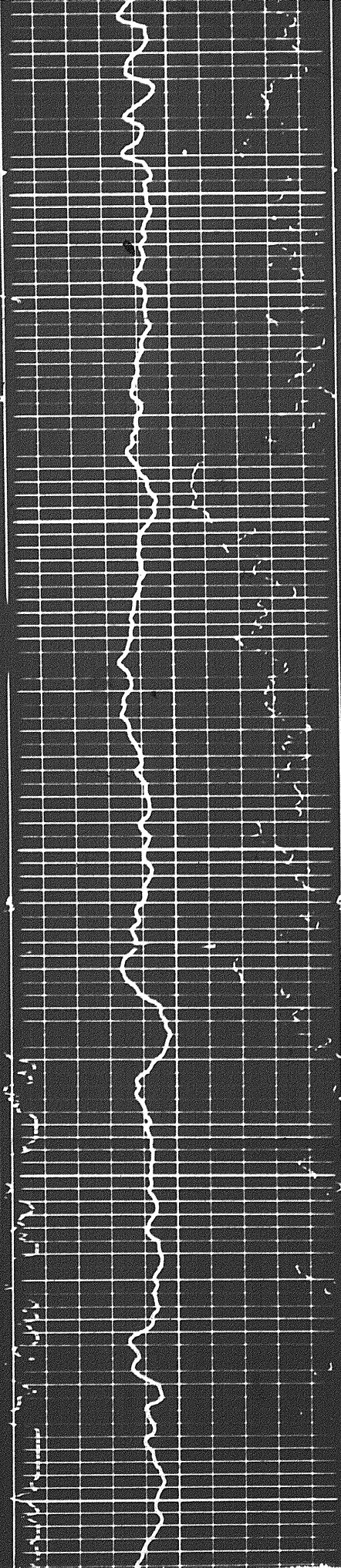


006A

0005

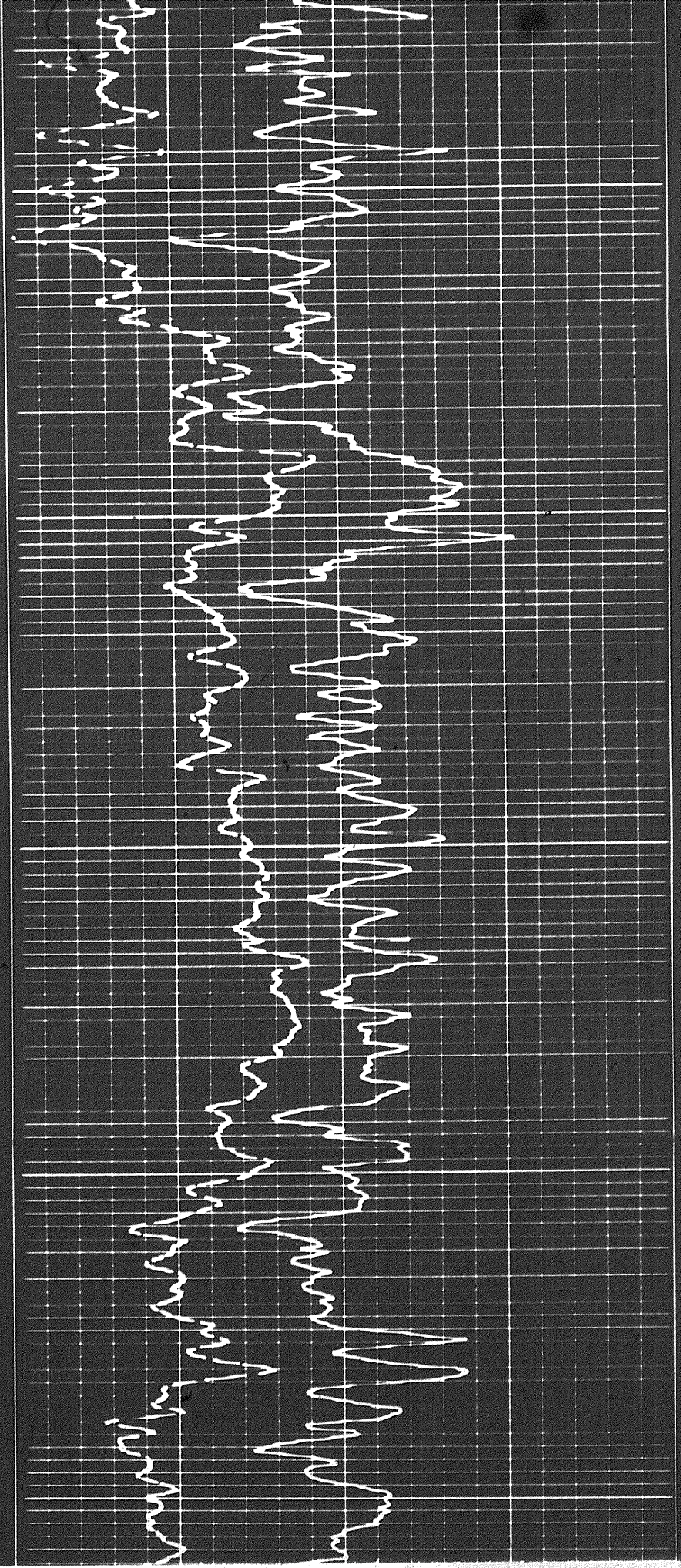


28 of

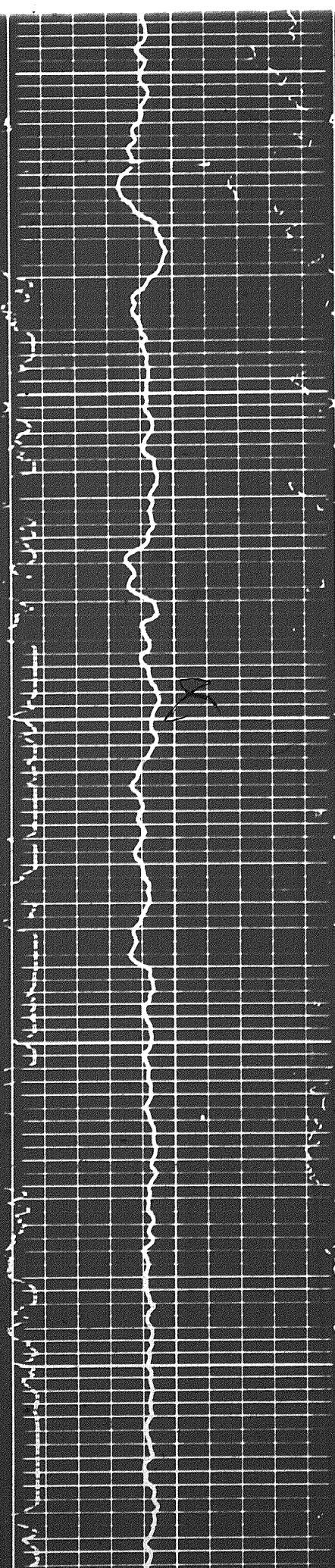


0016

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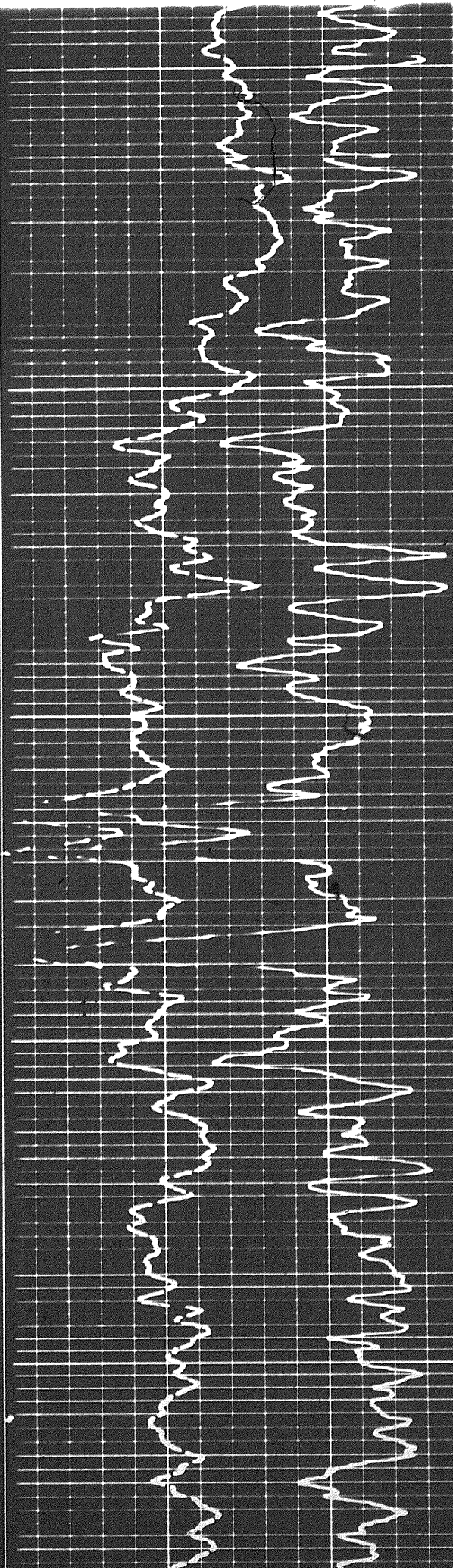


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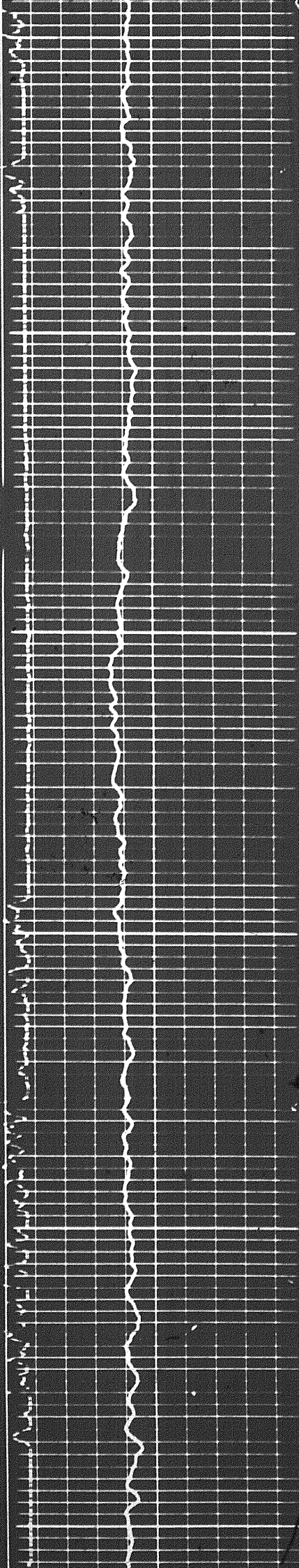


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9300



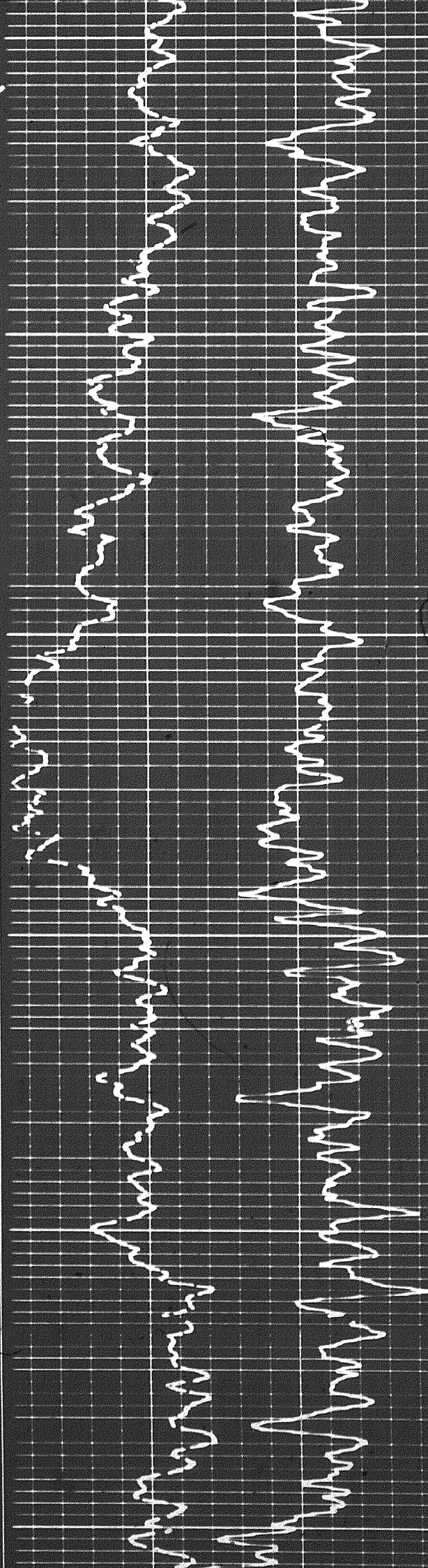
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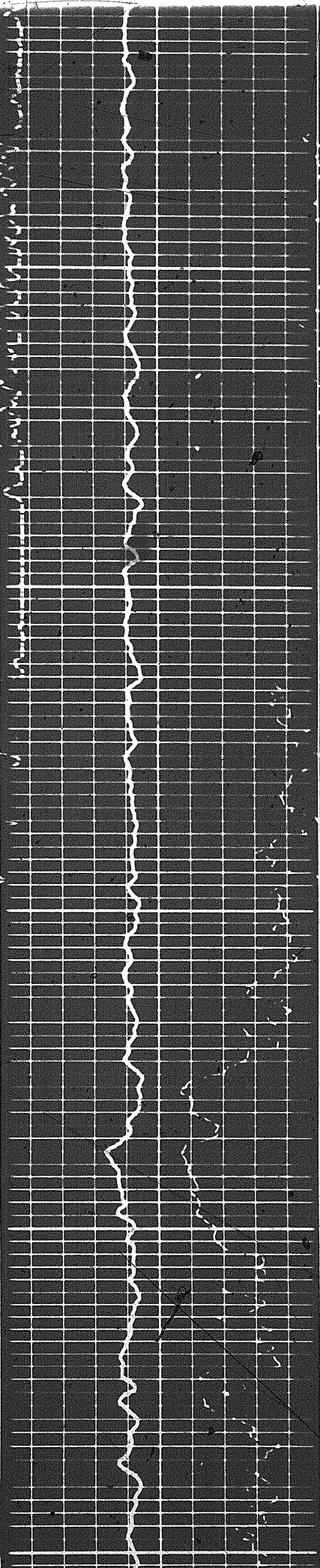
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9500

9600

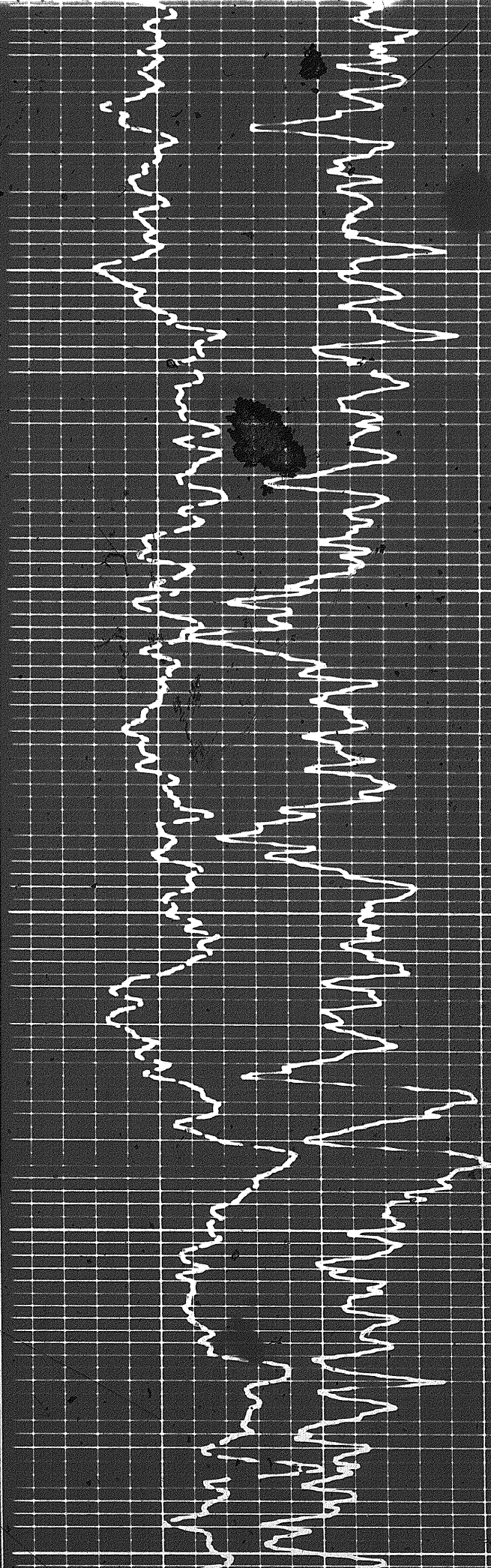


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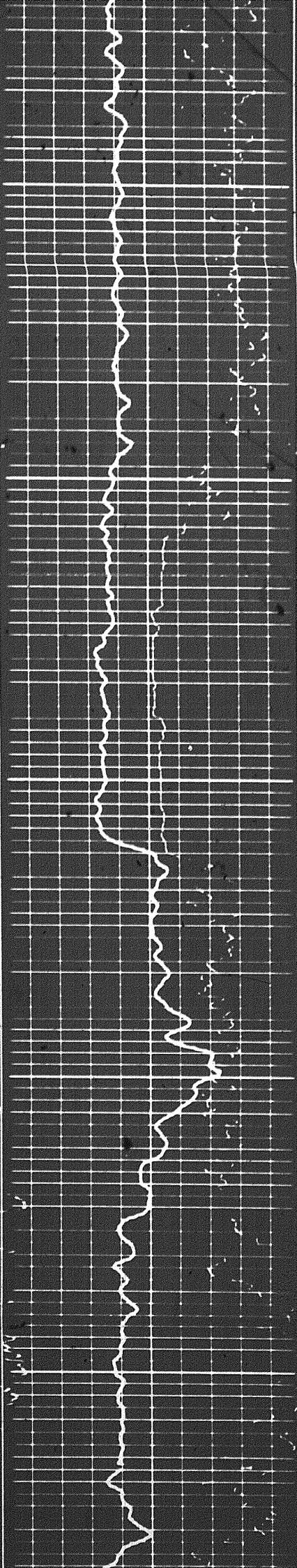


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9700

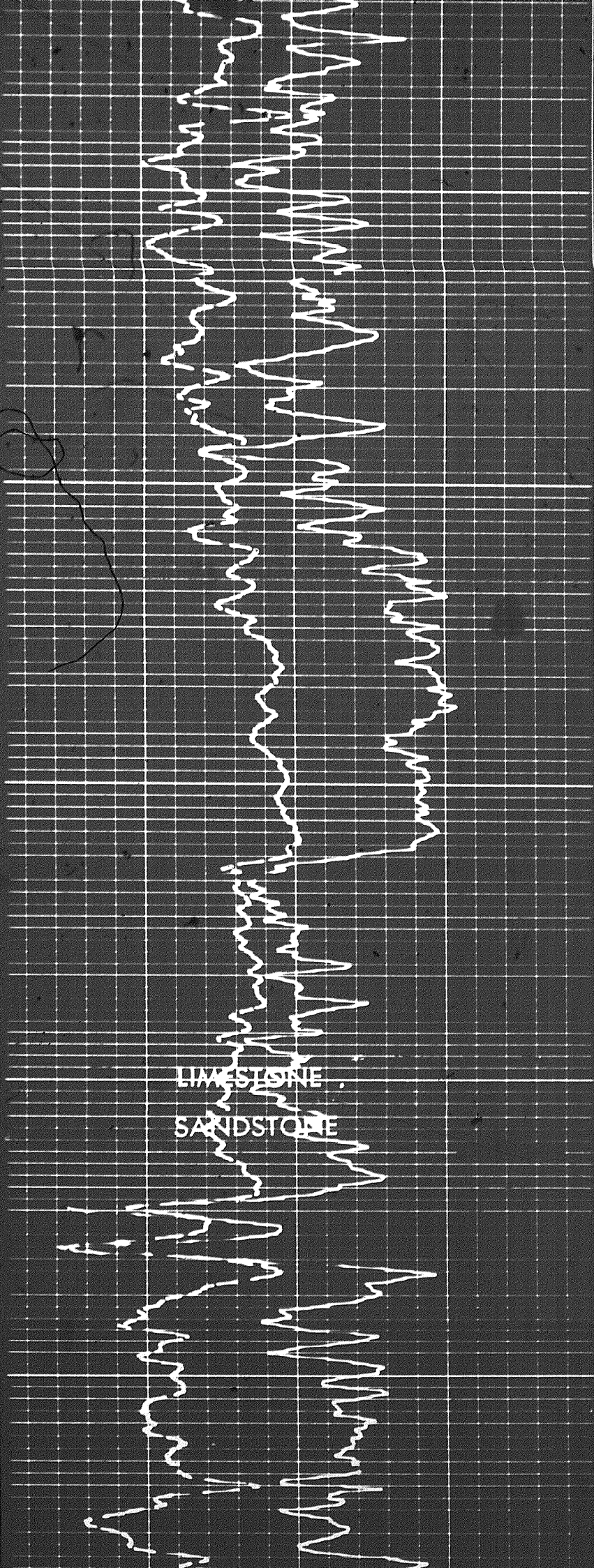
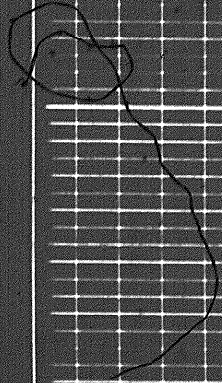


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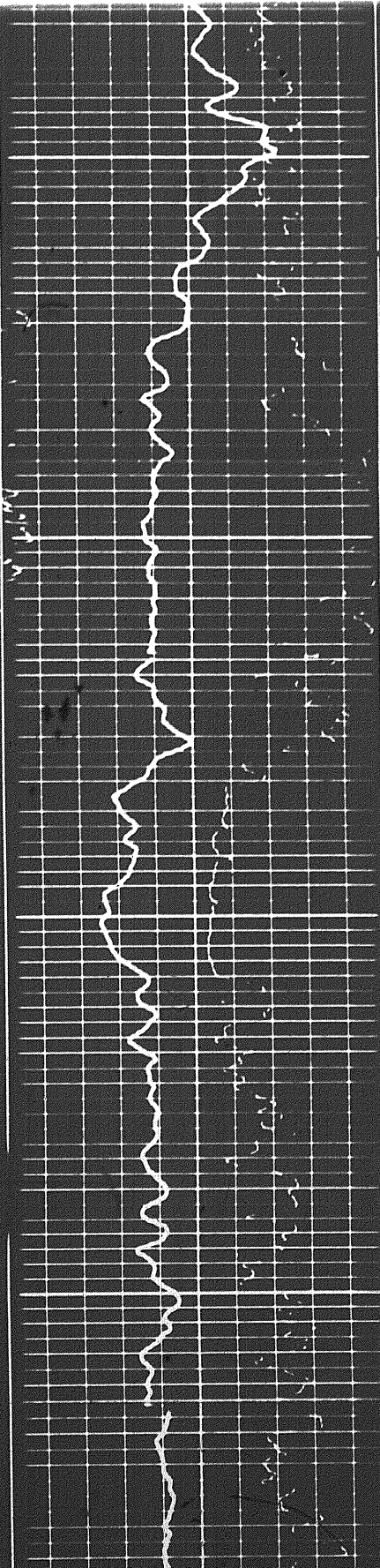
0086

006



LIMESTONE
SANDSTONE

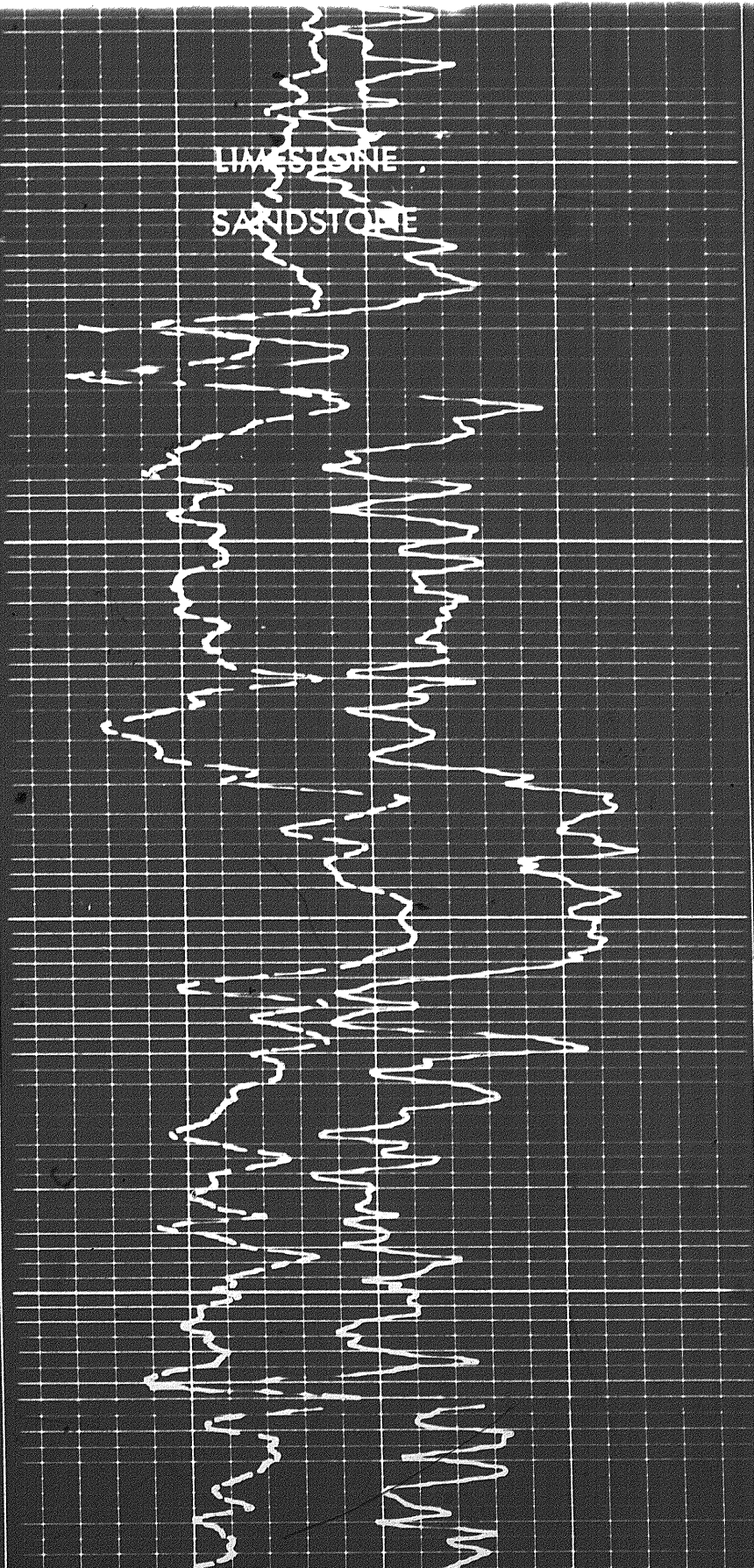
DE



0066

10000

LIAKESSTONE
SANDSTONE

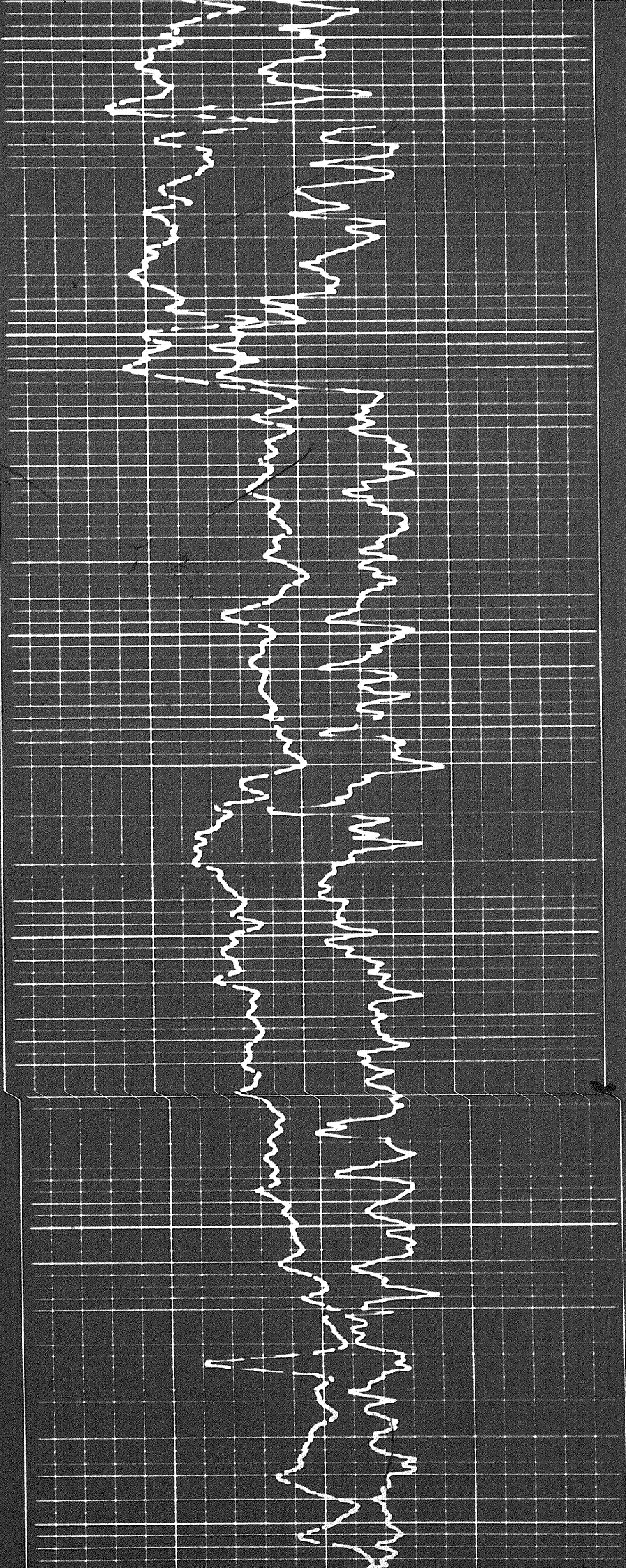
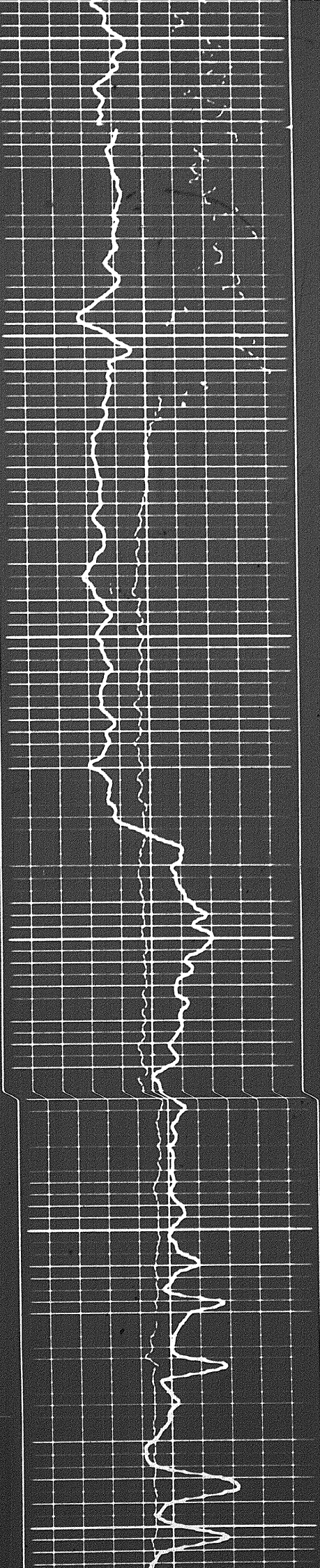


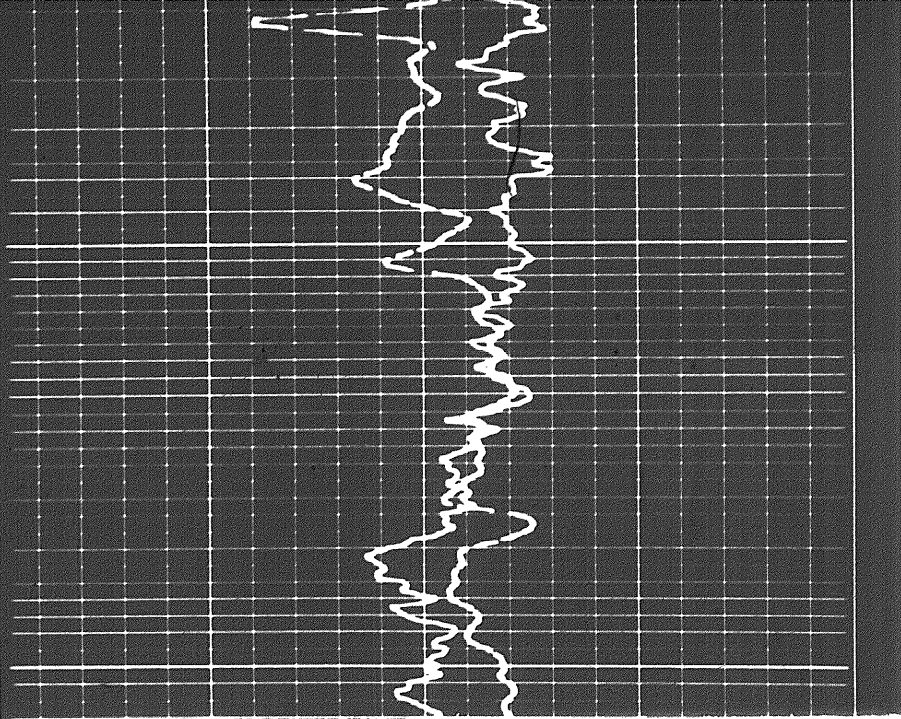
1 0100

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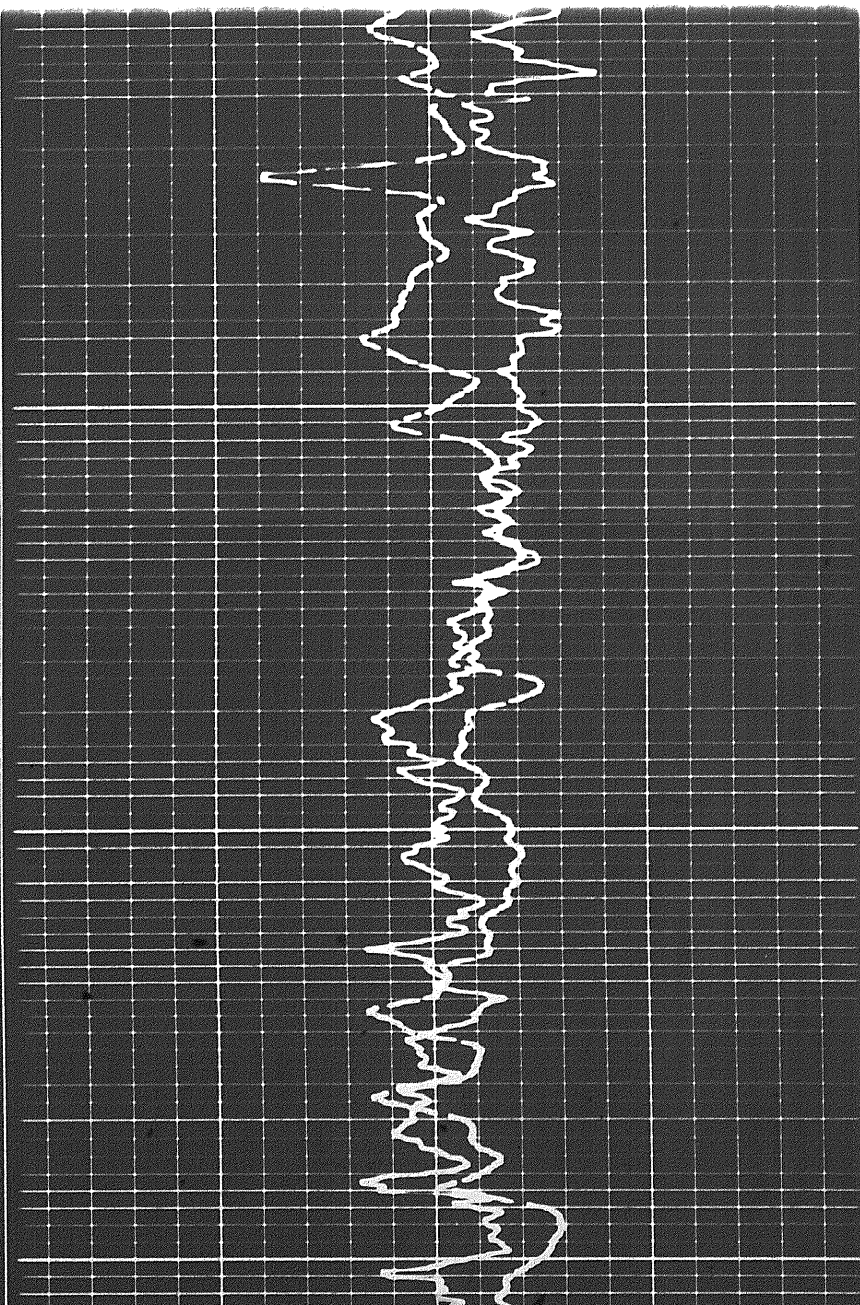
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31



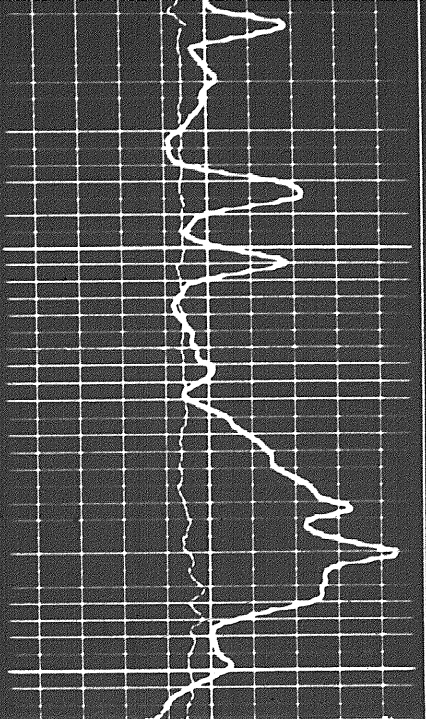


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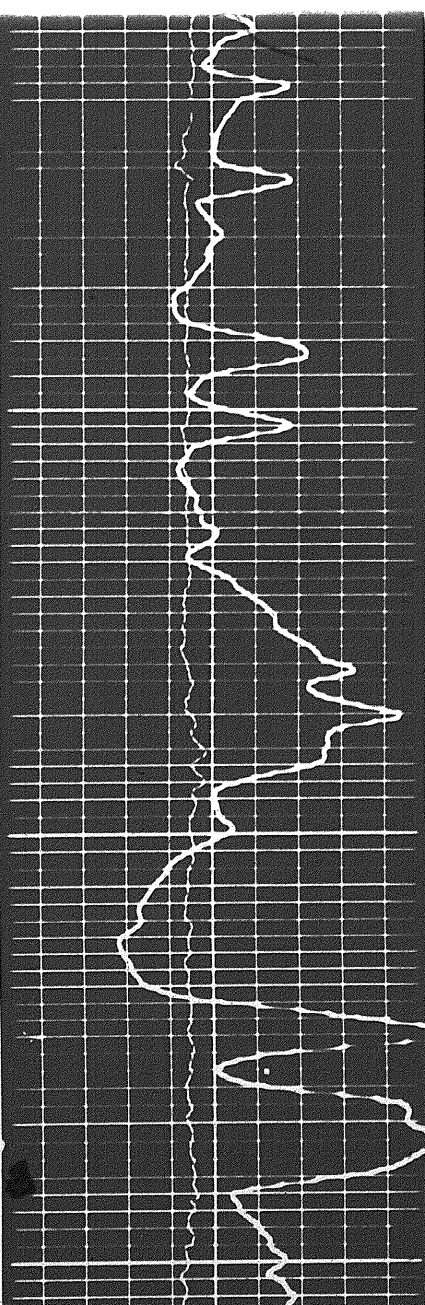


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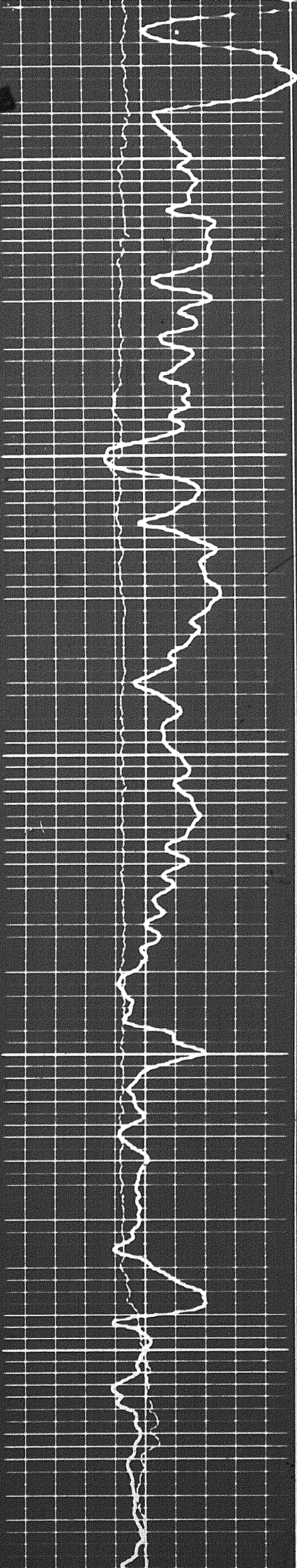
104.00



31/9/



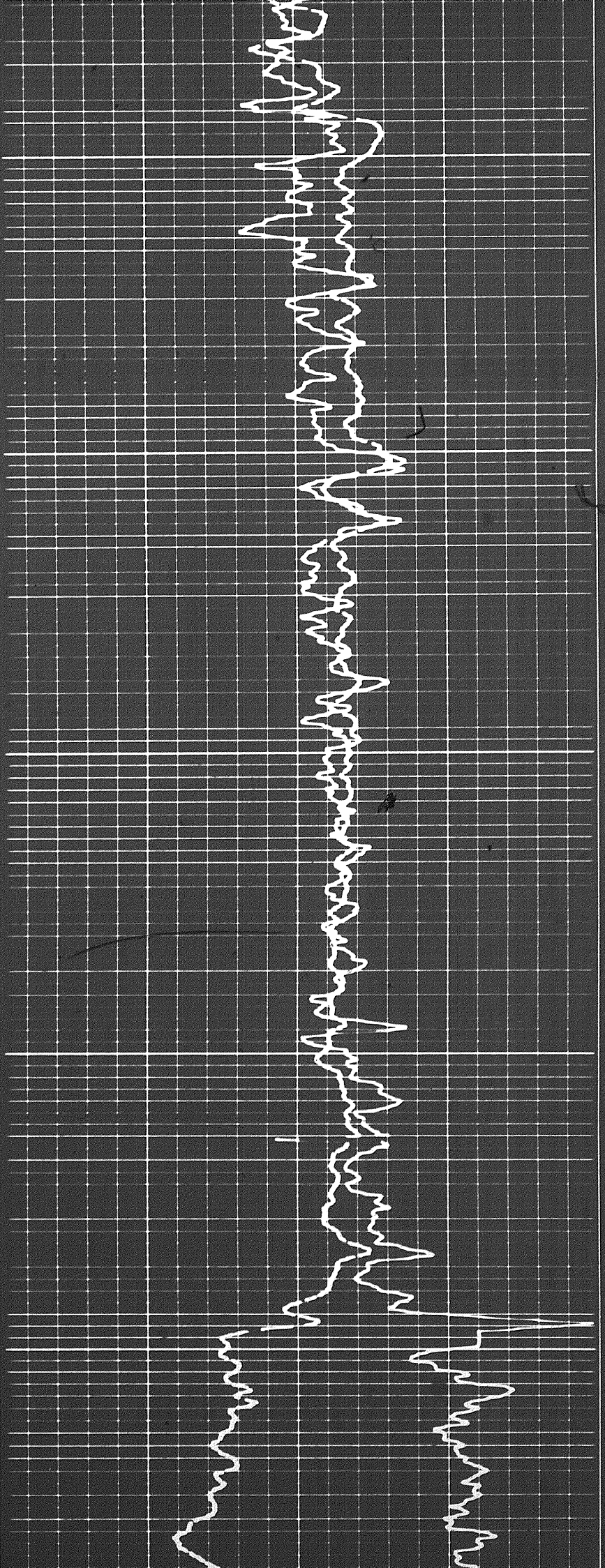
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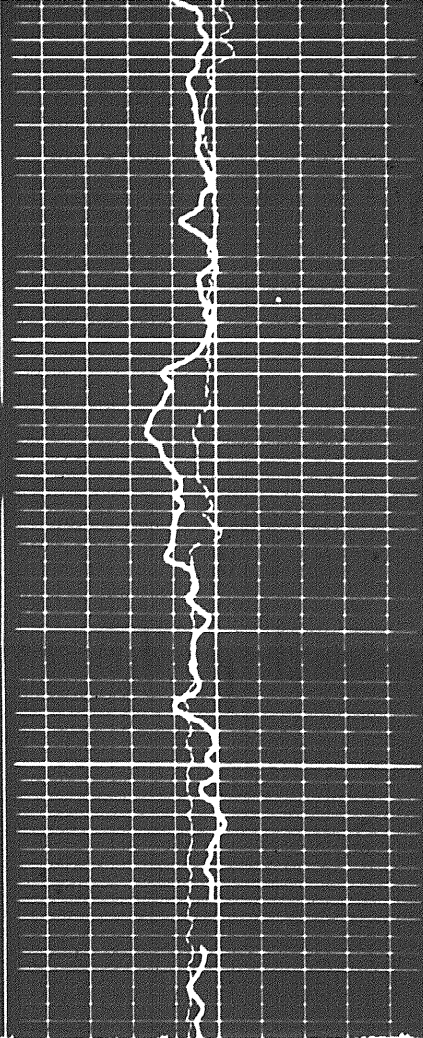
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10500

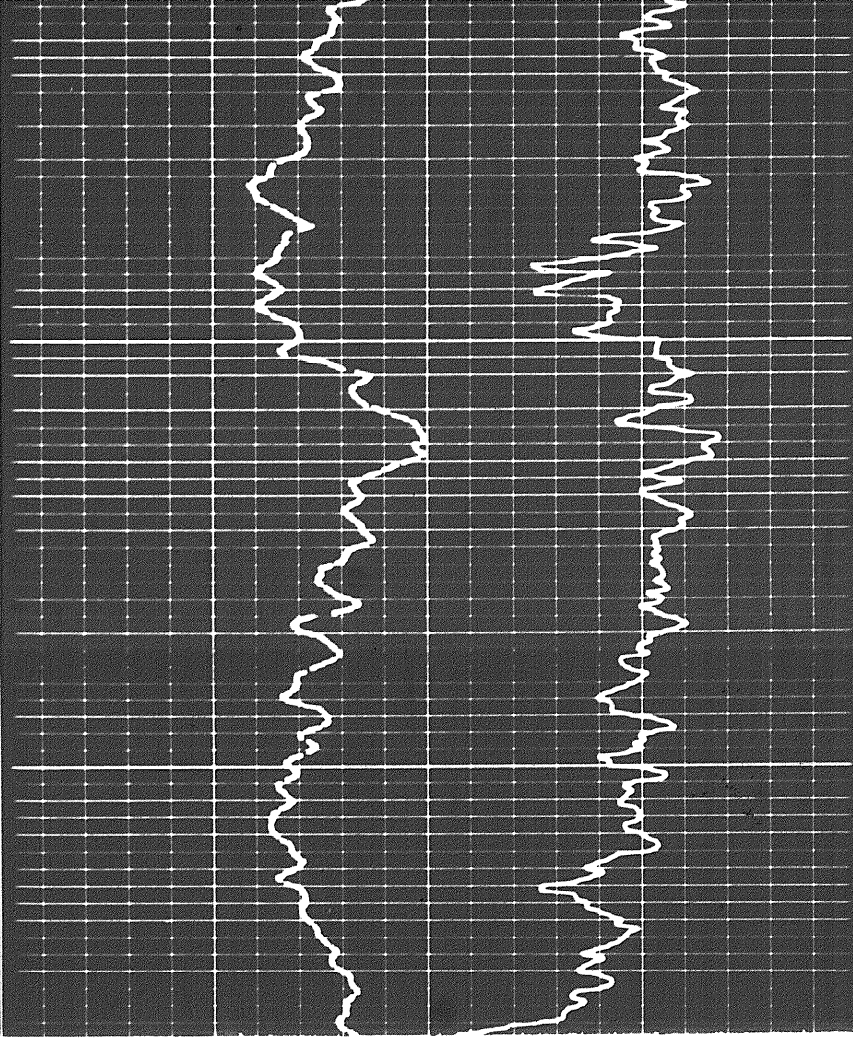
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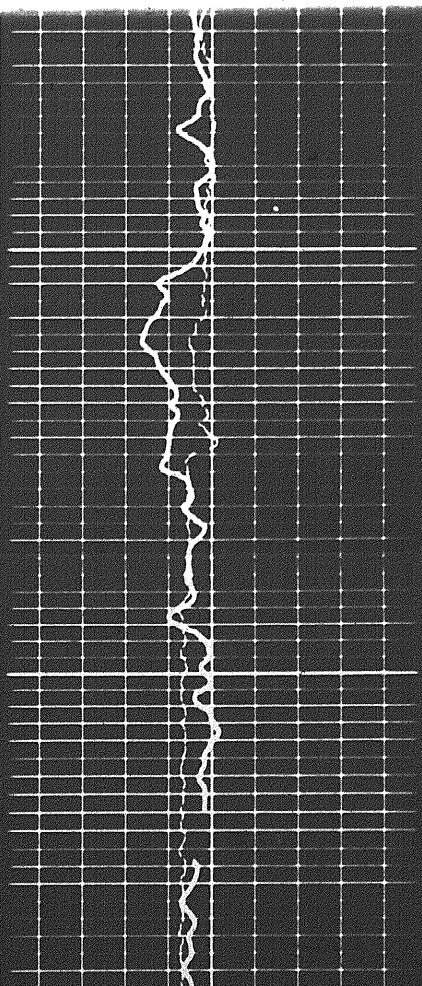
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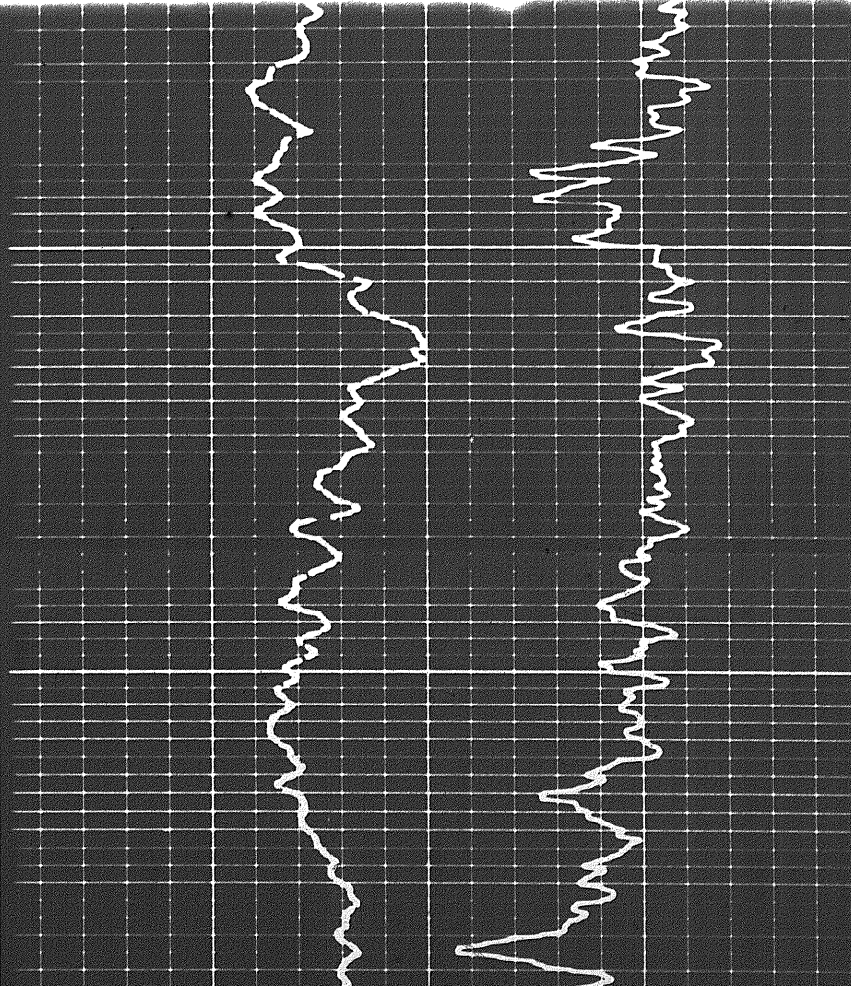
10700



32



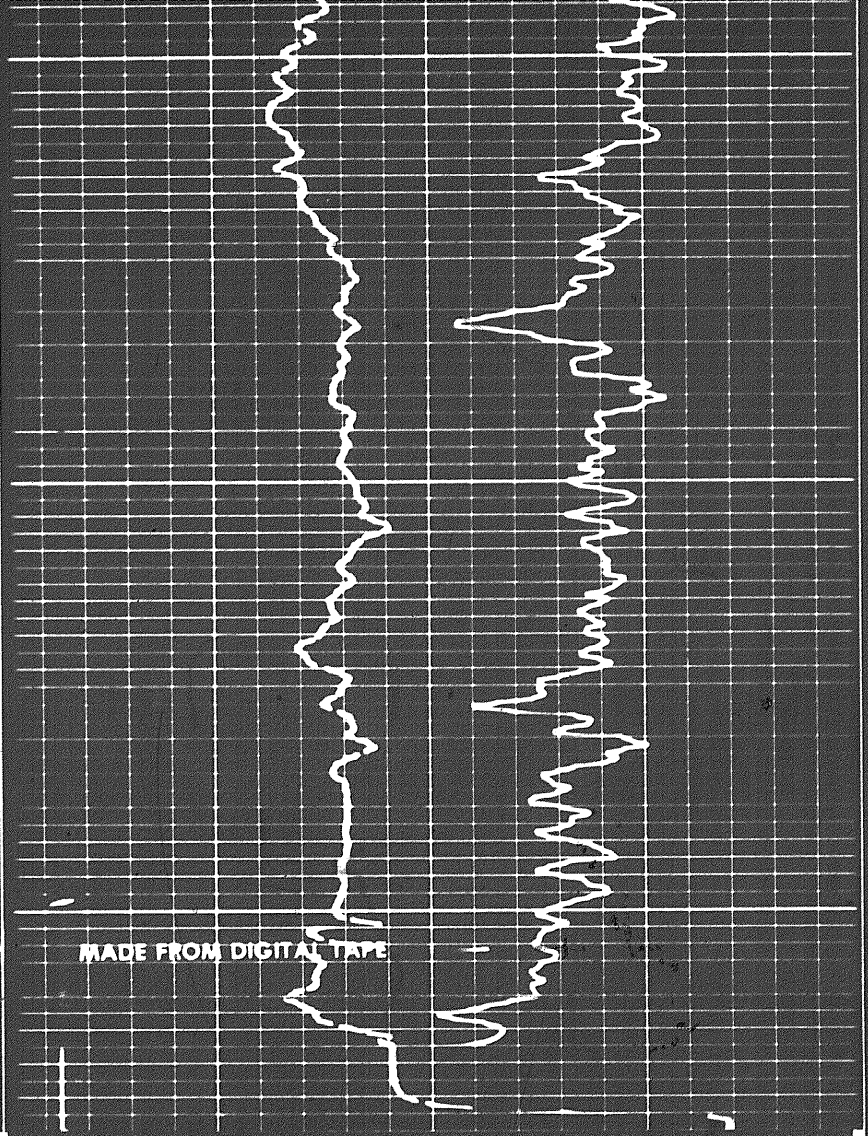
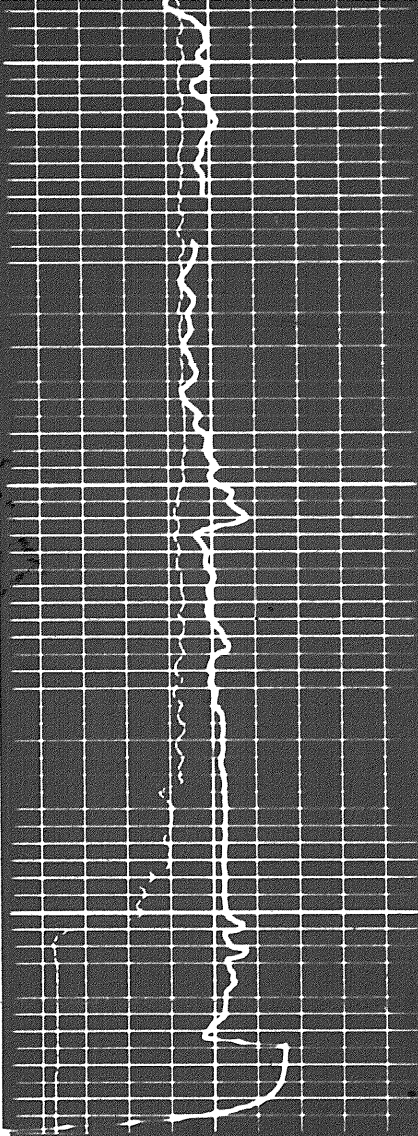
10700



10700

FR 10801

MADE FROM DIGITAL TAPE



Sens. 300 T.C. 2
 Zero 0 div. to left
 0 300
 300 600

GAMMA RAY
 API UNITS

Speed in FPM

9 10 11 12 13 14 15 16 17

CALIPER
 hole diameter in inches

DEPTH

POROSITY (%)

DETAIL LOG
 5" = 100'

CALIPER
 hole diameter in inches

DEPTH

POROSITY (%)

9 10 11 12 13 14 15 16 17

GAMMA RAY

Speed in FPM

5" = 100'

CALIPER
hole diameter in inches

DEPTH

POROSITY (%)

Speed in FPM

9 10 11 12 13 14 15 16

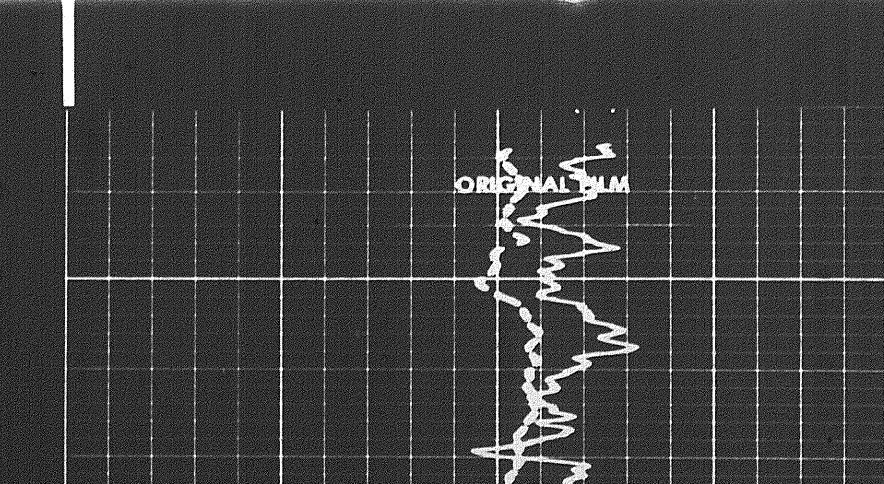
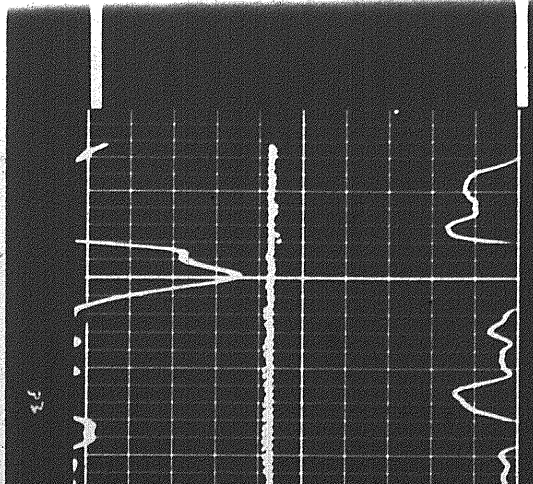
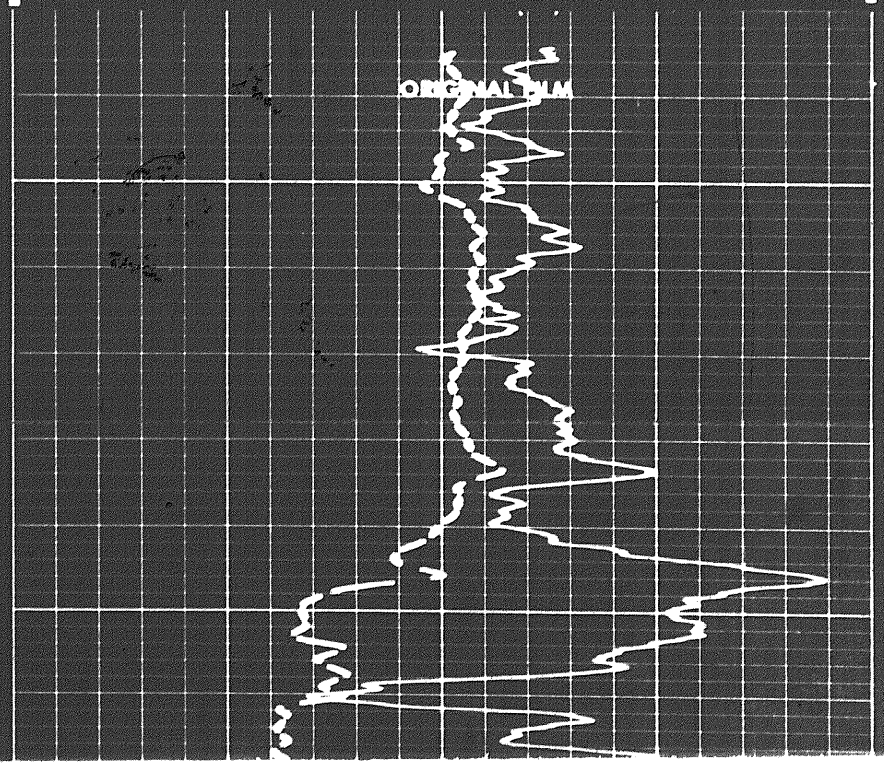
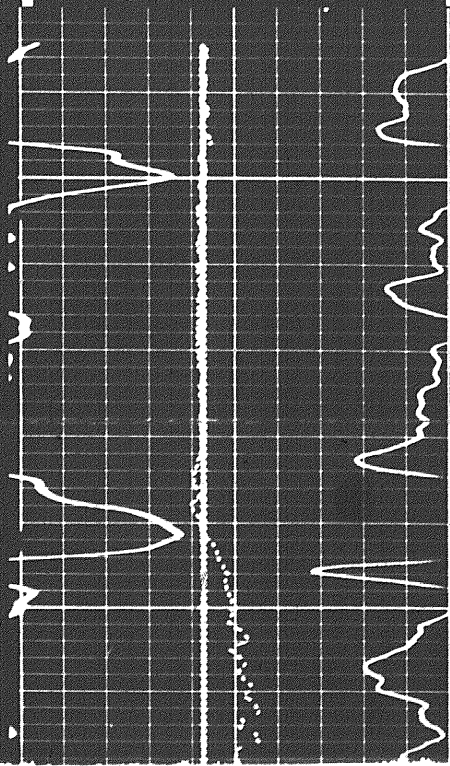
GAMMA RAY
API UNITS

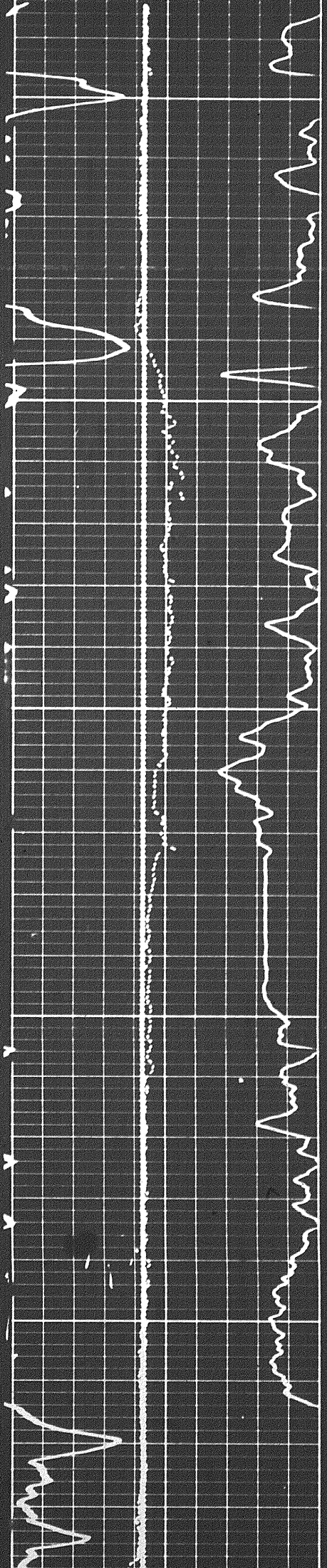
SANDSTONE DENSITY

NEUTRON

Sens. _____ T.C. _____
Zero _____ div. to left

33 of 70



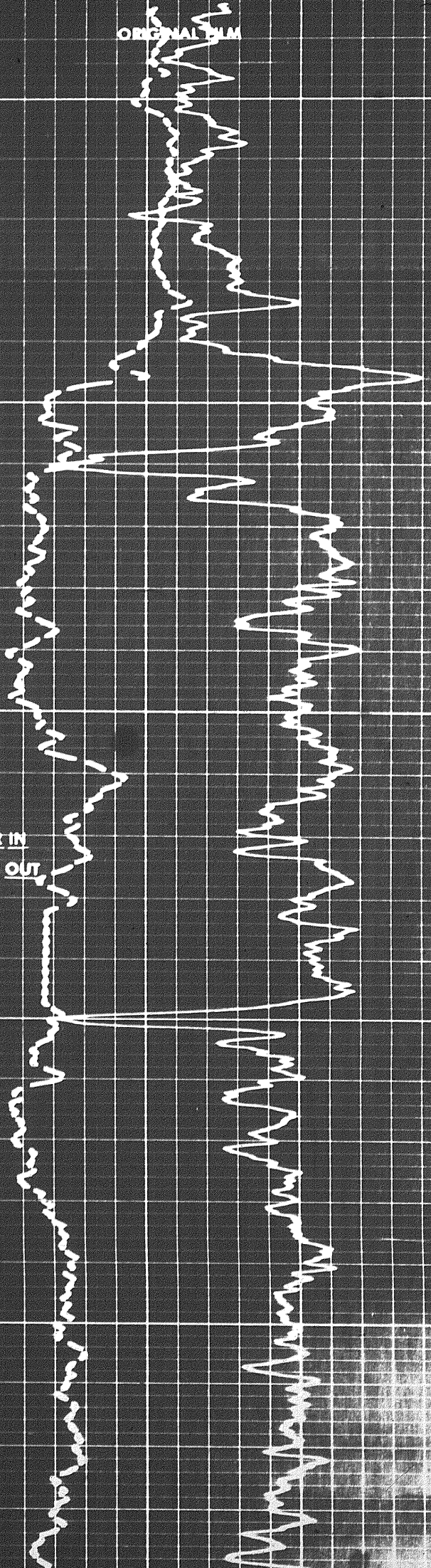


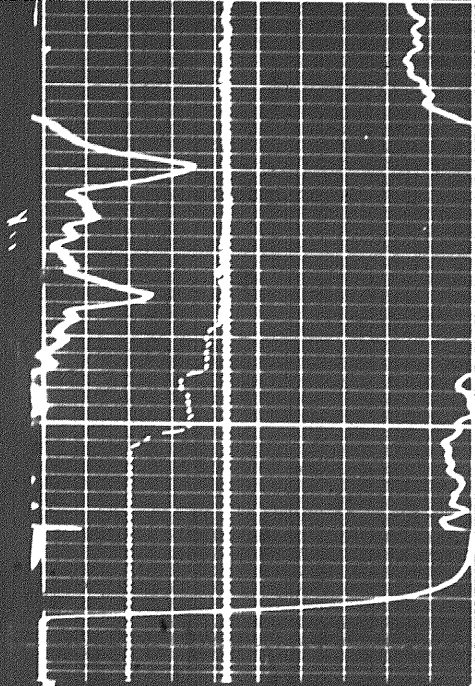
10600

10700

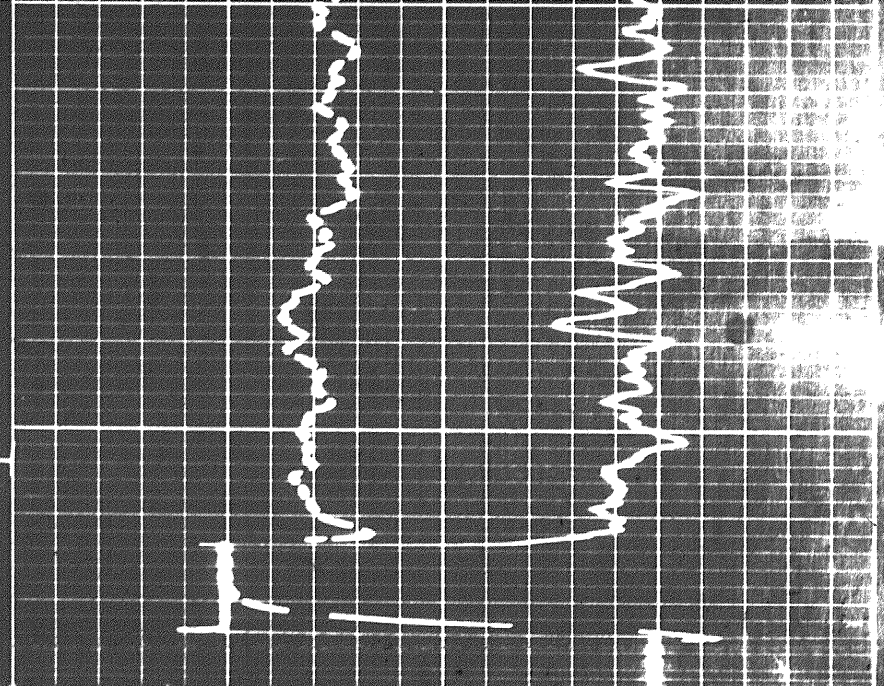
MEMORIZER IN
MEMORIZER OUT

ORIGINAL

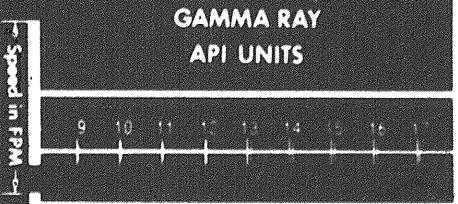




10800



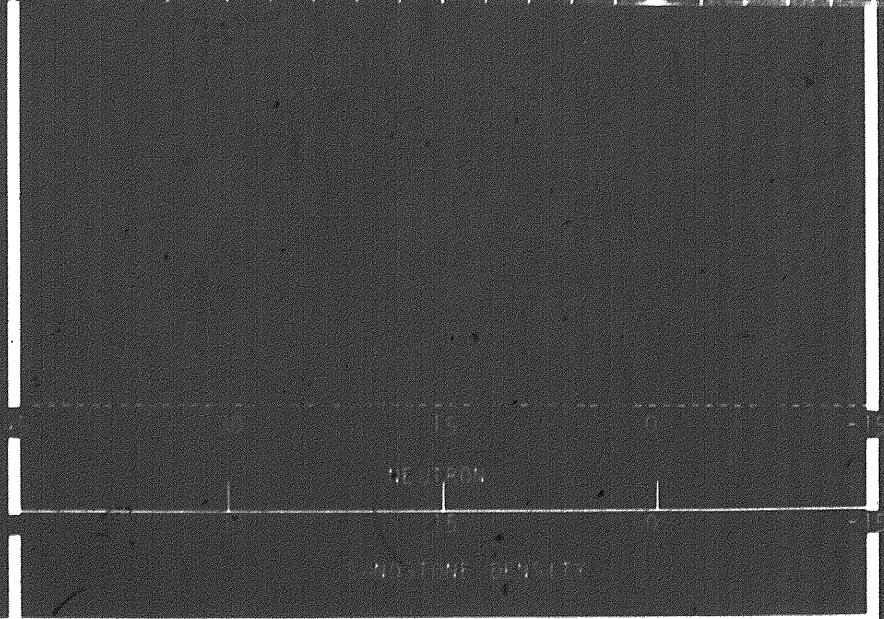
Sens. _____ T.C. _____
 Zero _____ div. to left



GAMMA RAY
API UNITS

CALIPER
 hole diameter in inches

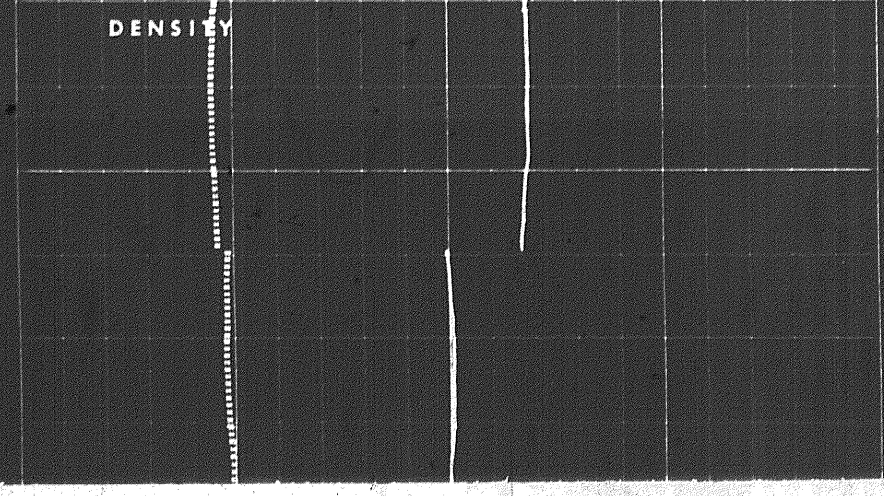
DEPTHS



POROSITY (%)

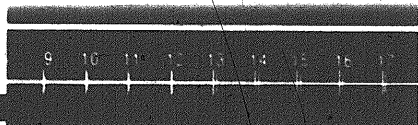
3407

Calibration before Survey



13

Depth in FPM



CALIPER
hole diameter in inches

DEPTH

POROSITY (%)

Calibration before Survey

DENSITY

13

12

11

2

1

10

9

Caliper 12"

Bit Size

Caliper 8"

Calibration after Survey

Calibration after Survey

DENSITY

13

12

11

2

1

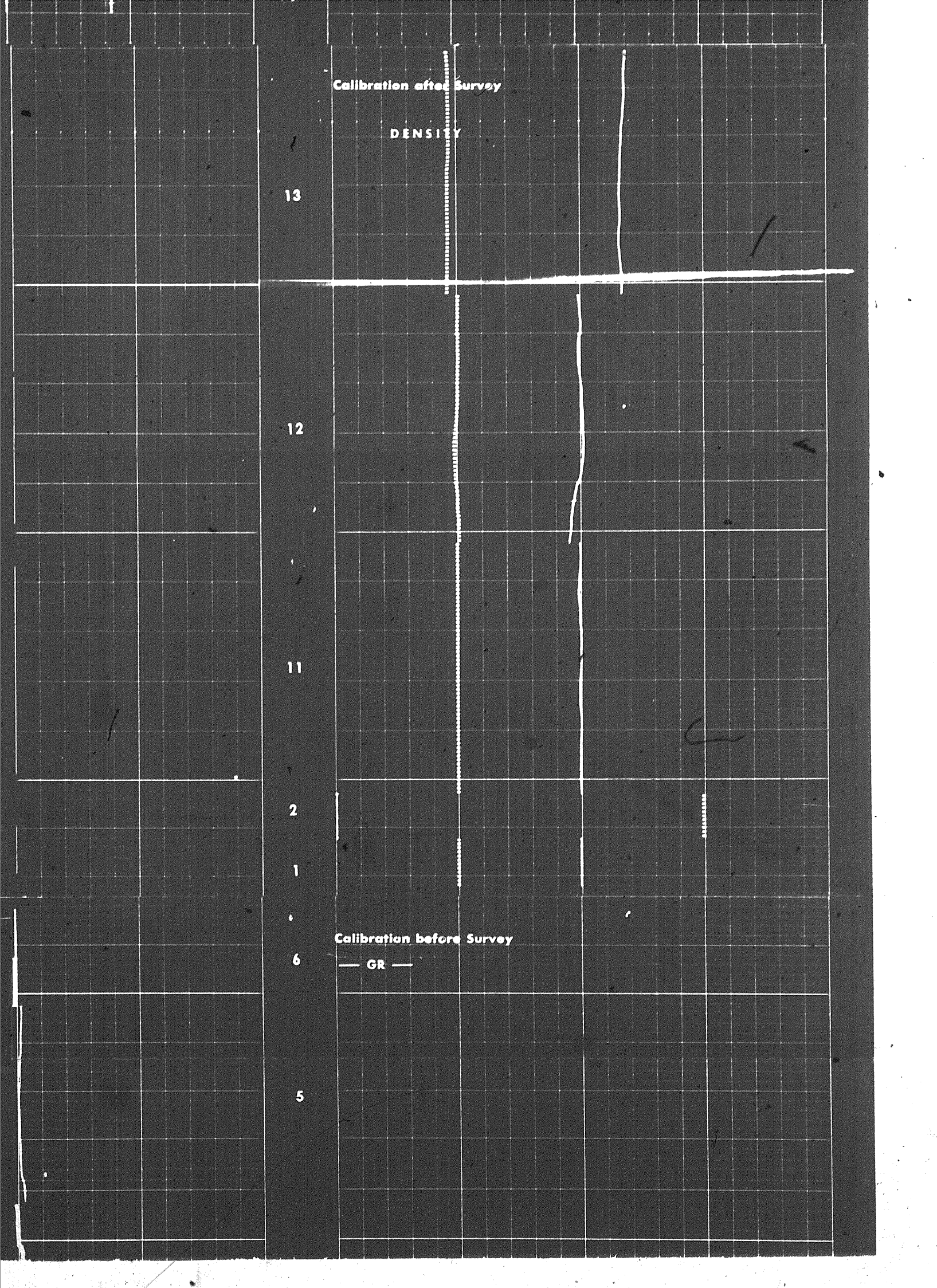
0

6

Calibration before Survey

— GR —

5



2

1

Calibration before Survey

6

— GR —

5

3

1

Calibration after Survey

8

NEUTRON

7

2

1

Calibration before Survey

8

NEUTRON

24

Calibration before Survey

NEUTRON

FORMATION DENSITY COMPENSATED CALIBRATION CODING

1. MECHANICAL ZERO
 2. RECORDER SENSITIVITY
PANEL TEST
FDC LIQUID
- | | <u>POS</u> | <u>ρ</u> | <u>$\Delta \rho$</u> |
|----|------------|--------------------------|---------------------------------|
| 3. | H1 | 2.92 | .00 |
| 4. | H2 | 2.78 | +.14 |
| 5. | H3 | 2.42 | -.10 |
| 6. | H4 | 2.35 | .00 |
| 7. | H5 | 2.08 | .01 |
8. MECHANICAL ZERO CALIPER
 9. 8" RING
 10. 12" RING
 11. TOOL CALIBRATE H1 SET $\rho = 2.50$
 12. TOOL CALIBRATE H2 SET $\Delta \rho = .00$
 13. LOG POSITION $\rho = 2.59, \Delta \rho = .015$

GAMMA RAY CALIBRATION CODING

1. MECHANICAL ZERO
2. ELECTRICAL ZERO
3. RECORDER SENSITIVITY
4. MEMORIZER ADJUSTMENT
5. BACKGROUND
6. CALIBRATE - SOURCE IN PLACE

COMPENSATED NEUTRON CALIBRATION CODING

1. MECHANICAL ZERO
2. RECORDED SENSITIVITY (THRU MEMORIZER IF USED)

RATIO	PANEL TEST			POROSITY		
	OH			CH		
	LS <input type="checkbox"/>	SS <input type="checkbox"/>	DOL <input type="checkbox"/>	SS <input type="checkbox"/>	LS <input type="checkbox"/>	
3.	1	1.6	4.9	0.2	2.4	0.1
4.	2	15.6	19.7	8.1	13.0	9.0
5.	3	30.5	36.0	25.2	29.1	24.1
6.	4	45.4	53.1	47.5	47.4	43.2

7. POROSITY NORMALIZED WITH CNB-A IN PLACE
- 7A. TOOL IN NCT-B
8. LOG POSITION WITH CNB-A IN PLACE
- 8A. LOG POSITION WITH TOOL IN NCT-B

LS SS OH DOL SS CH LS

3.	1	1.6	4.9	-0.2	2.4	0.1
4.	2	15.6	19.7	8.1	13.0	9.0
5.	3	30.5	36.0	25.2	29.1	24.1
6.	4	45.4	53.1	47.5	47.4	43.2

7. POROSITY NORMALIZED WITH CNB-A IN PLACE

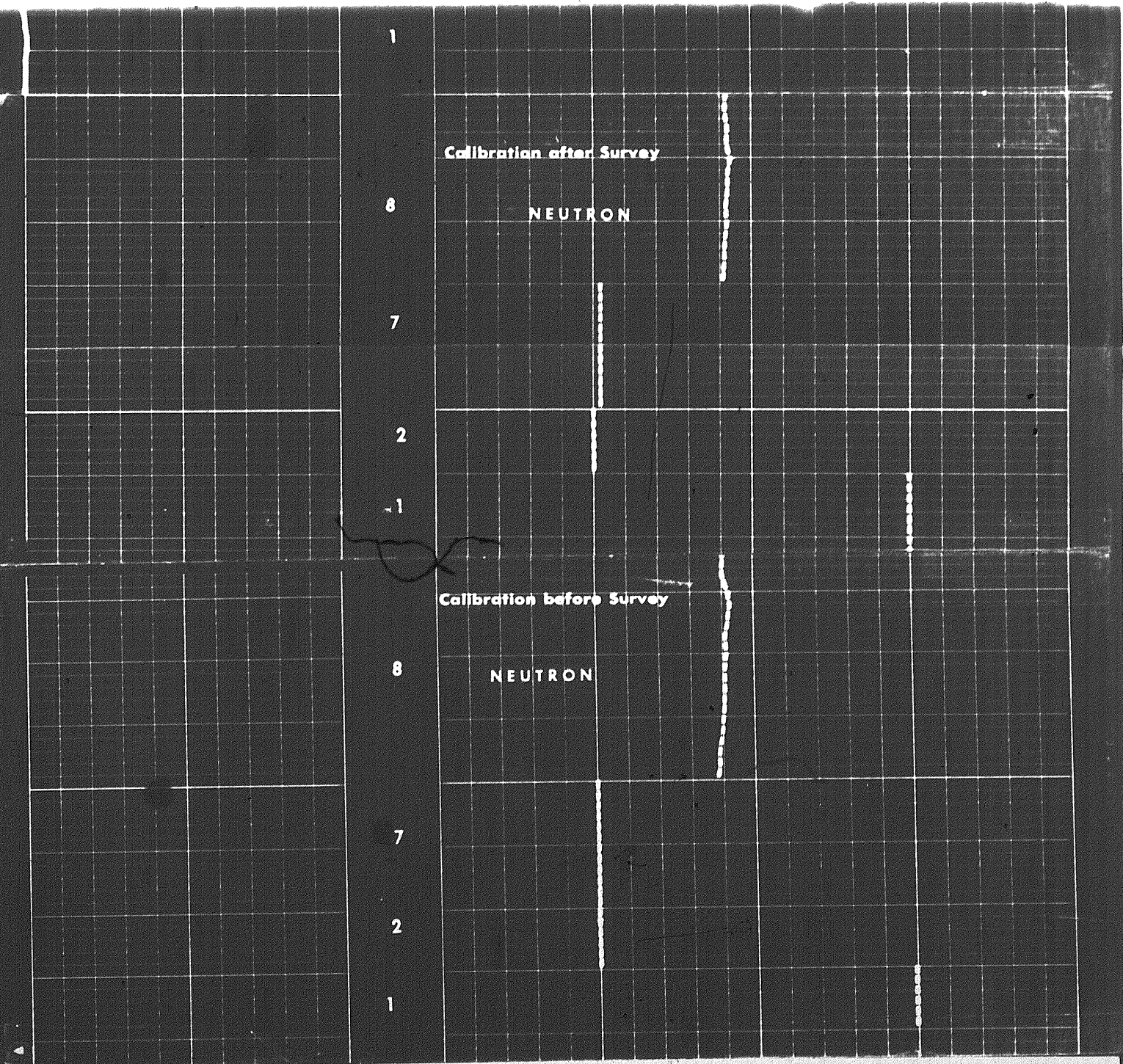
7A. TOOL IN NCT-B

8. LOG POSITION WITH CNB-A IN PLACE

8A. LOG POSITION WITH TOOL IN NCT-B

OH		CH	
LS	SS	SS	LS
18	22.2	15.3	11.2

$$\text{RATIO (NORMALIZED)} = \frac{2.17}{\text{RATIO (NCT-B)}} \text{ RATIO (LOG)}$$



FORMATION DENSITY COMPENSATED CALIBRATION CODING

1. MECHANICAL ZERO
2. RECORDER SENSITIVITY

PANEL TEST

FDC LIQUID

FORMATION DENSITY COMPENSATED CALIBRATION CODING

1. MECHANICAL ZERO
2. RECORDER SENSITIVITY
PANEL TEST
FDC LIQUID

POS	ρ	$\Delta\rho$
3. H1	2.92	.00
4. H2	2.78	+ .14
5. H3	2.42	- .10
6. H4	2.35	.00
7. H5	2.08	.01
8. MECHANICAL ZERO CALIPER
9. 8" RING
10. 12" RING
11. TOOL CALIBRATE #1 SET $\rho = 2.50$
12. TOOL CALIBRATE #2 SET $\Delta\rho = .00$
13. LOG POSITION $\rho = 2.59, \Delta\rho = .015$

GAMMA RAY CALIBRATION CODING

1. MECHANICAL ZERO
2. ELECTRICAL ZERO
3. RECORDER SENSITIVITY
4. MEMORIZER ADJUSTMENT
5. BACKGROUND
6. CALIBRATE - SOURCE IN PLACE

COMPENSATED NEUTRON CALIBRATION CODING

1. MECHANICAL ZERO
2. RECORDED SENSITIVITY (THRU MEMORIZER IF USED)

	RATIO	PANEL TEST					
		OH			POROSITY		
		LS <input type="checkbox"/>	SS <input type="checkbox"/>	DOL <input type="checkbox"/>	SS <input type="checkbox"/>	LS <input type="checkbox"/>	CH
3.	1	1.6	4.9	-0.2	2.4	0.1	
4.	2	15.6	19.7	8.1	13.0	9.0	
5.	3	30.5	36.0	25.2	29.1	24.1	
6.	4	45.4	53.1	47.5	47.4	43.2	

7. POROSITY NORMALIZED WITH CNB-A IN PLACE
7A. TOOL IN NCT-B
8. LOG POSITION WITH CNB-A IN PLACE
8A. LOG POSITION WITH TOOL IN NCT-B

	LS	SS	OH	DOL	SS	CH	LS
	18	22.2		10.4	15.3		11.2

$$\text{RATIO (NORMALIZED)} = \frac{2.17}{\text{RATIO (NCT-B)}} \quad \text{RATIO (LOG)}$$

COMPANY COLUMBIA GAS DEVELOPMENT OF CANADA LTD.
 WELL COLUMBIA GAS ET AL KONTANEELEE YT H-38
 FIELD _____
 PROVINCE YUKON TERRITORY

SCHL. FR 10804
 SCHL. TD 10805
 DRLR. TD 10850
 Elev.:
 KB 2250
 DF _____
 GL 2225

X841

DENSITY

T. 9, 1977

11 9

0-0 274

13

12