HAROLD E. EDGERTON

PAPERS

MC 25

Series III

Laboratory Notebooks

Number 18

Dated Jan 28, 1948 to July 1948

Notebook # 18

Filming and Separation Record

9 unmounted photograph(s)

____ negative strip(s)

18 unmounted page(s)
(notes, drawings, letters, etc.)

was/were filmed where originally located between page ____ and ____.
inside front cover

Item(s) now housed in accompanying folder.

Calibration of PM 931 Tube with
Napthalene Using a Radio Active Source

A A one curie radio active source from Los Alamos was used to make a direct calibration of the 931-Napthalene combination. With the source at a six inch distance from the Napthalene, a current of 25 microamperes was measured. The number of gamma rays per second from the radio active source was assumed to be 3.7×10^{10}.

We will now calculate the gamma ray flux density that is necessary to produce a 5/8 inch deflection on the cathode ray tube screen. A voltage of 125 is required across a 1000.ohm input resistor for the above condition. Thus the PM current must be 125 milliamperes. The necessary gamma ray flux density can then be calculated from the calibration data.

$$\text{Sensitivity} = \frac{25 \times 10^{-6}}{3.7 \times 10^{10}/4\pi(6 \times 2.54)^2} = 20 \times 10^{-13} \text{ amp/Gamma ray/cm}^2$$

then for 125 ma the pickup will require

$$\frac{.125}{20 \times 10^{-13}} = 6.3 \times 10^{10} \text{ gamma rays per second per cm}^2$$

The corresponding gamma ray intensity for the 935 photo electric cell is a million times larger.

The absorption and scattering of the gamma rays reduces the flux as it goes from the bomb to the pickup. Assuming a m.f.p. of 300 yards, this reduction factor is computed to be

$$e^{-1300/300} = 0.013$$

This is the factor that was used in calculating the gamma ray flux that comes from the bomb. For example with the 931 PM tube;

$$\text{Flux} = 6.3 \times 10^{10}\ 4\pi(1300 \times 36 \times 2.54)^2 \times \frac{1}{.013} = 8.32 \times 10^{23} \text{ gamma rays per second.}$$

The corresponding figure for the 935 photo electric ell is a million times larger.

There is considerable uncertainty about the 300 yard mean free path value that is used above. Should any other value be found later to be more accurate, recalculation of the bomb flux output can be made to correspond.

Sensitivity estimates are based upon these assumed sensitivity values from the ~~hand books, etc.~~ R.C.A. tube Handbook.

935 Photocell. 40 microamperes/lumen.
cathode area = 0.6 square inches.

931 Photomultiplier, 40 amperes/lumen
cathode area = .25 square inches.
(Estimated for 150 volts per stage).

Searchlight factor = 600 (measured)

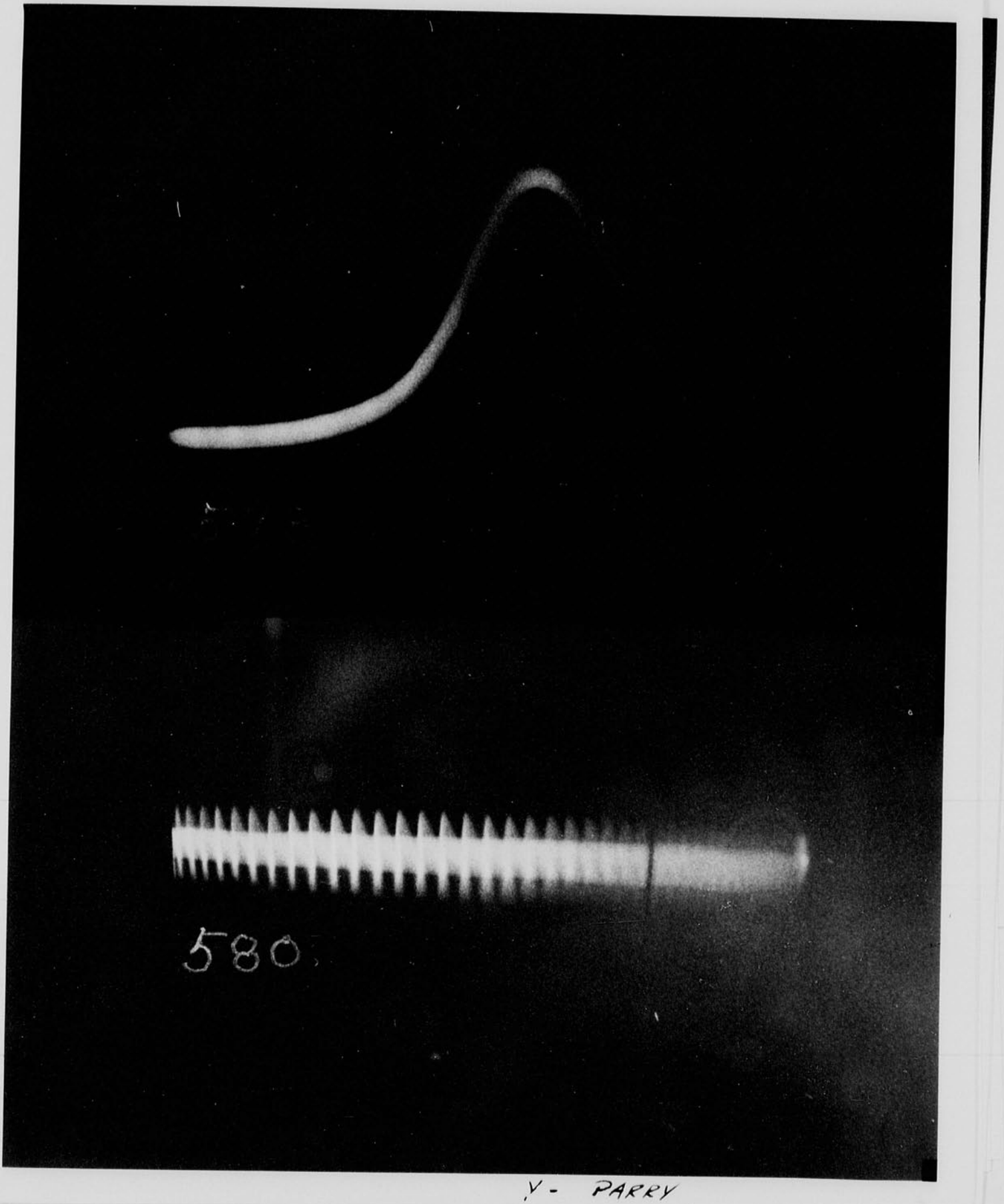
931 Naphthalene, ~~20 microamperes~~ 8.6×10^{-13} amperes. per gamma ray per second per square cm.
(Calibrated with a Curie radium source which is assumed to emit 8.5×10^{10} gamma rays per second)

935 Naphthalene, assumed to be 10^6 ~~+ 10 that of~~ less sensitive than the 931 Naphthalene combination.

~~Distance~~
Light ~~+ reduction~~ transmission per mile = ~~82~~ 80 per cent
(Values given by O'Brian ~~in Ref~~)

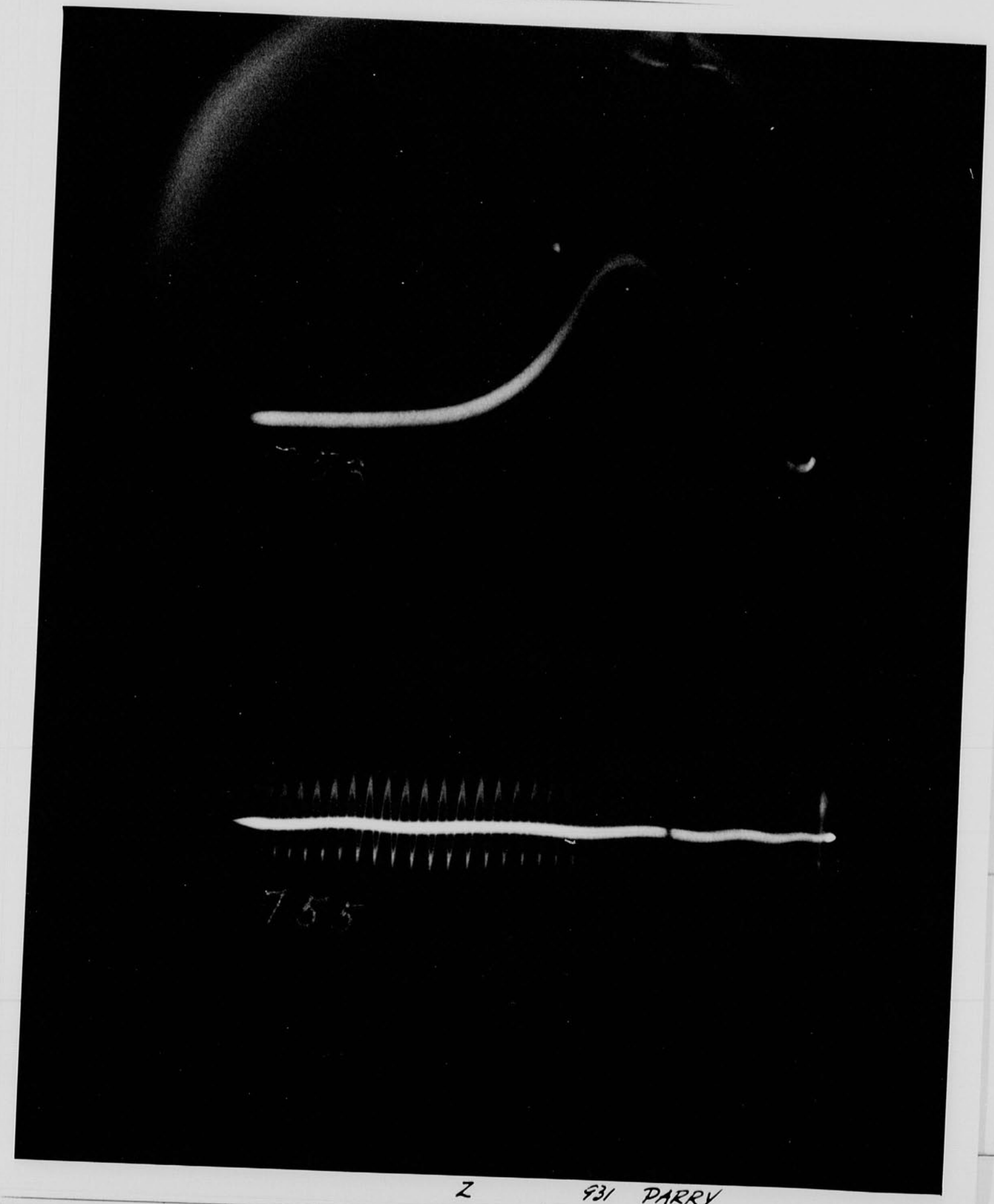
Total Light ~~reduction~~ transmission Rangebi-Parry = $.8^{20.2}$ = 1.4%
" " Aomori-Parry = $.8^{16.1}$ = 3.32%
" " Kumit-Parry = $.8^{10.3}$ = 10.1%

Coil current in Amps.



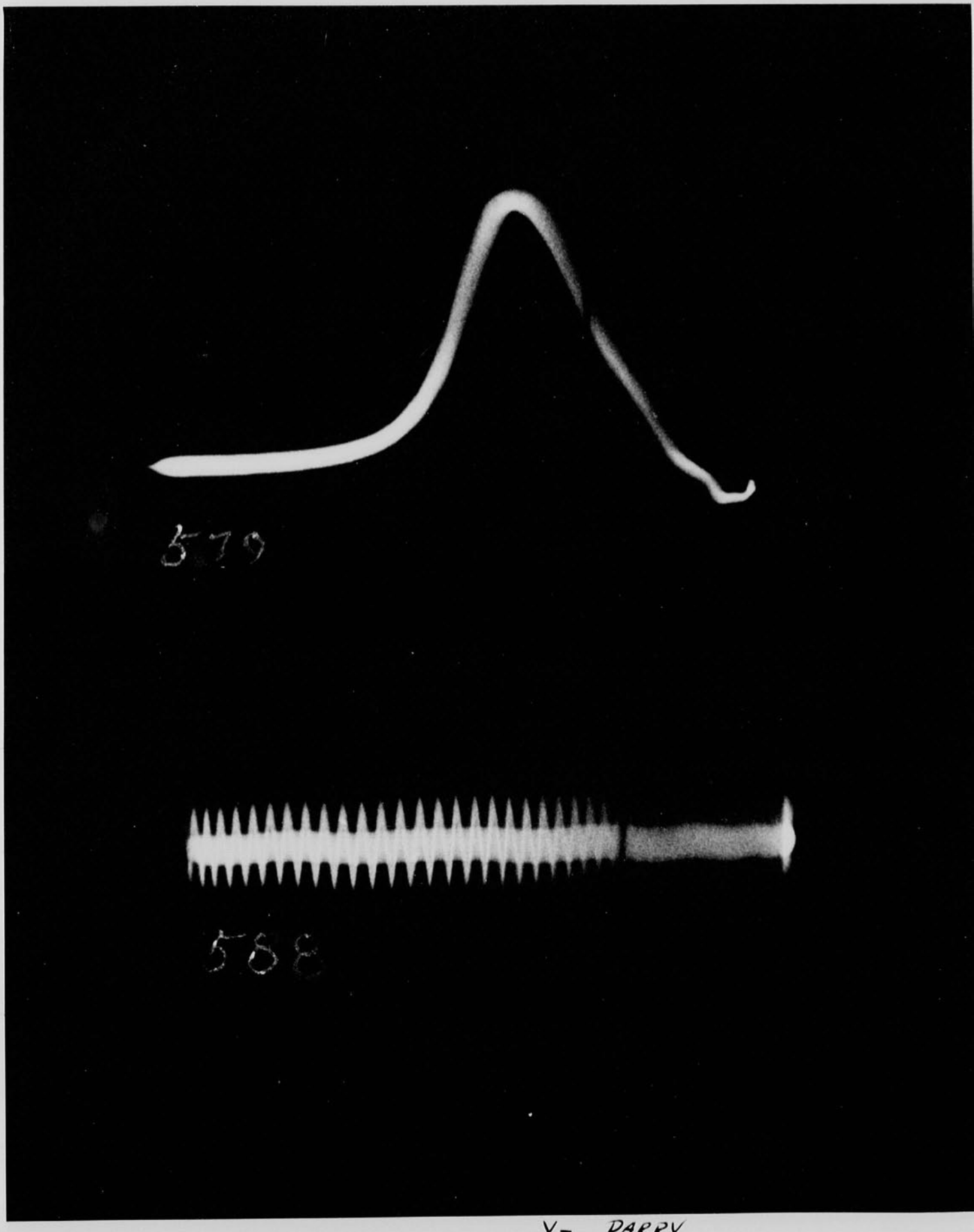
Y - PARRY

Coil current in 4 amp.



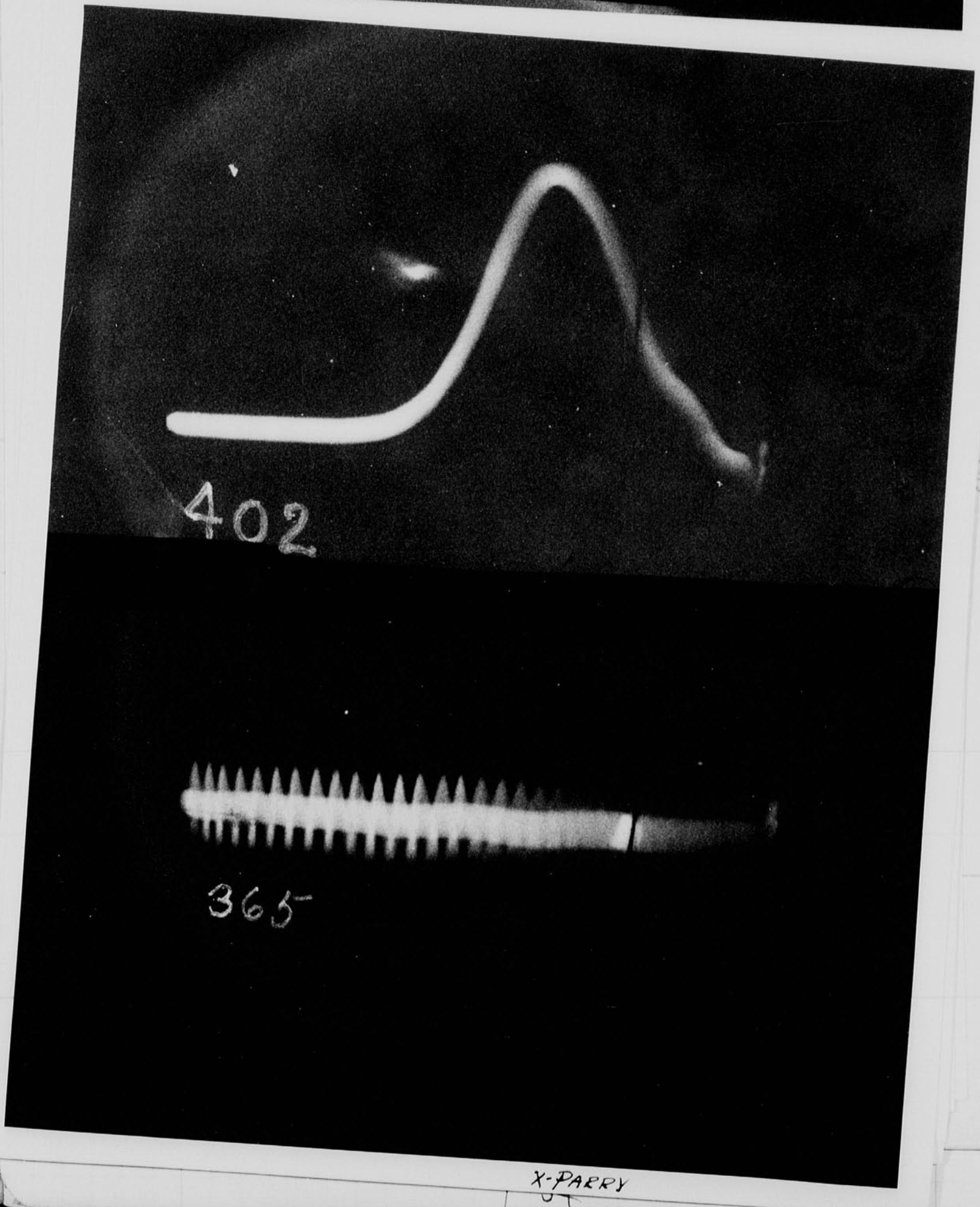
Z 931 PARRY

Coil current in 4 amp.



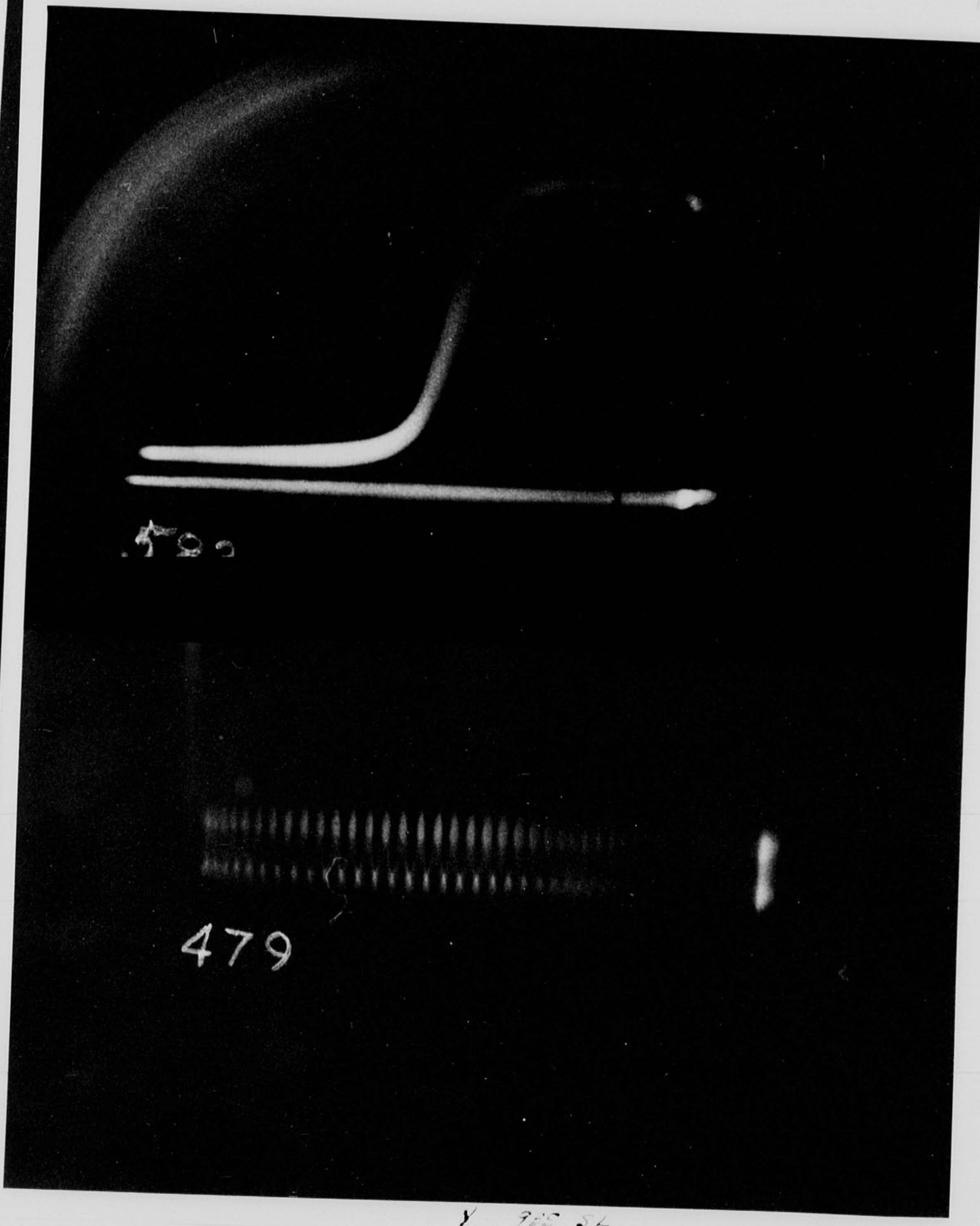
Y- PARRY

Coil current in 4 amps.



X-PARRY

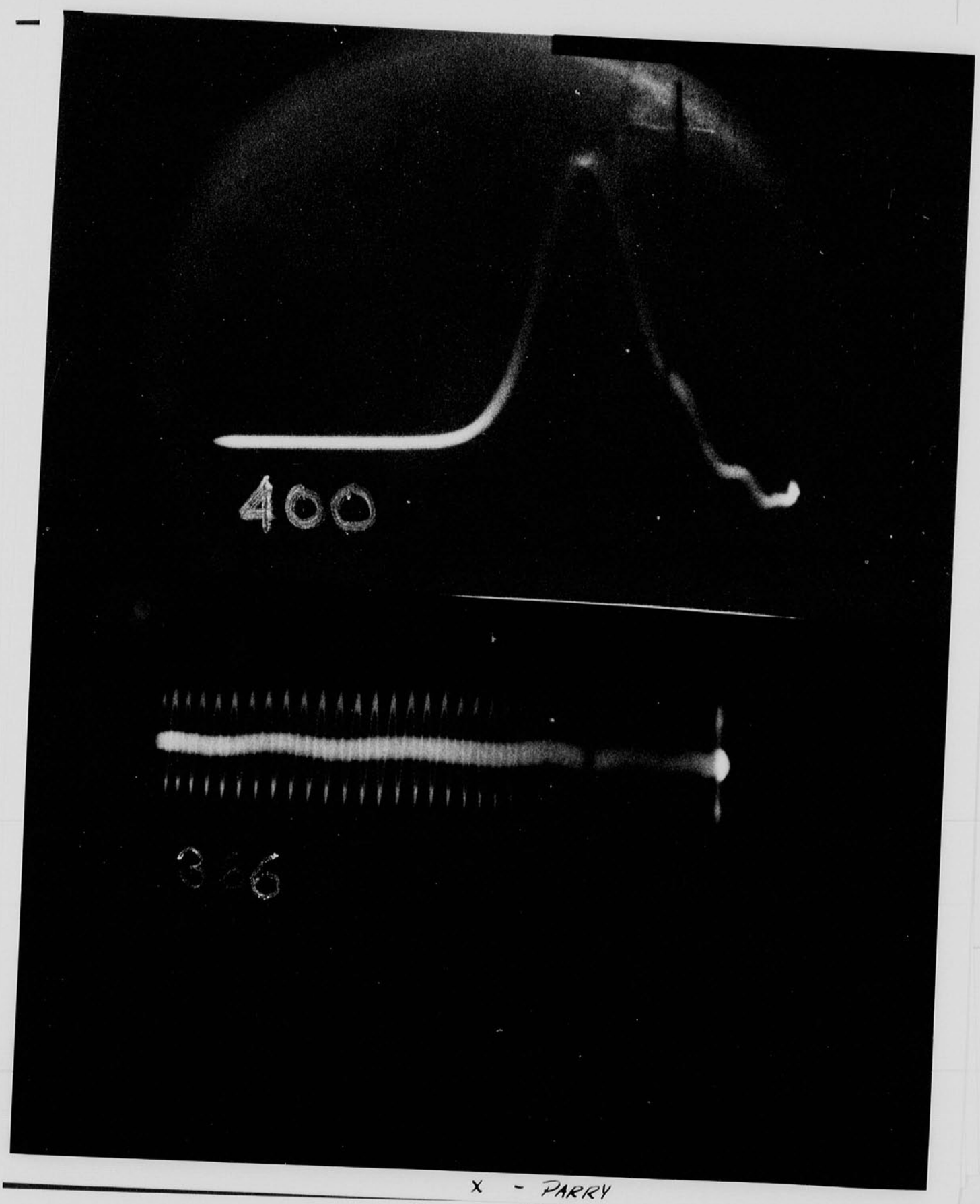
Cell current in 4 amp.



89
91

785 S.L.

Coil current in Amp.

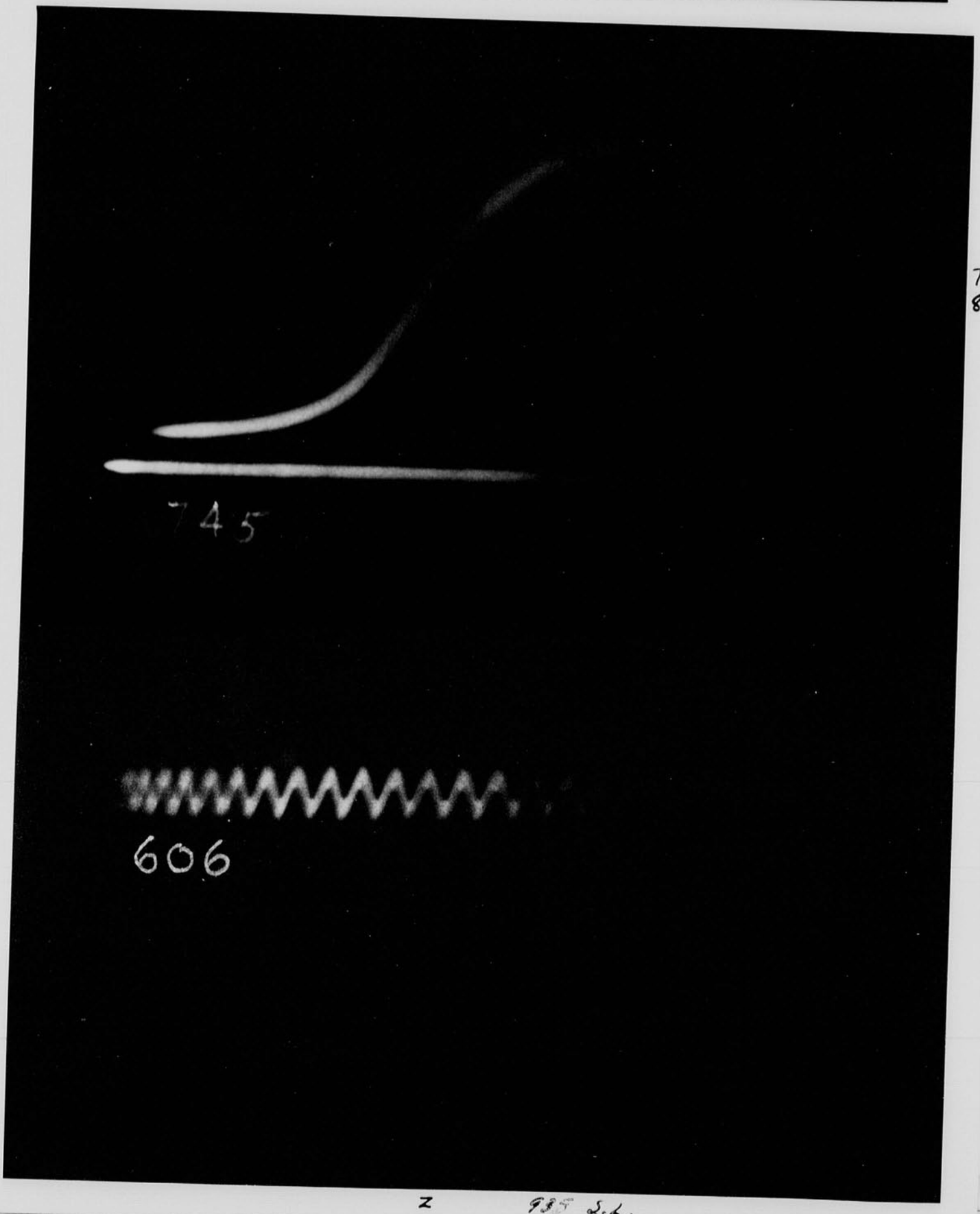


X - PARRY

Z 98.5 S.L.

Coil current in Amp.

0 20 40 60 80 100 120 ...



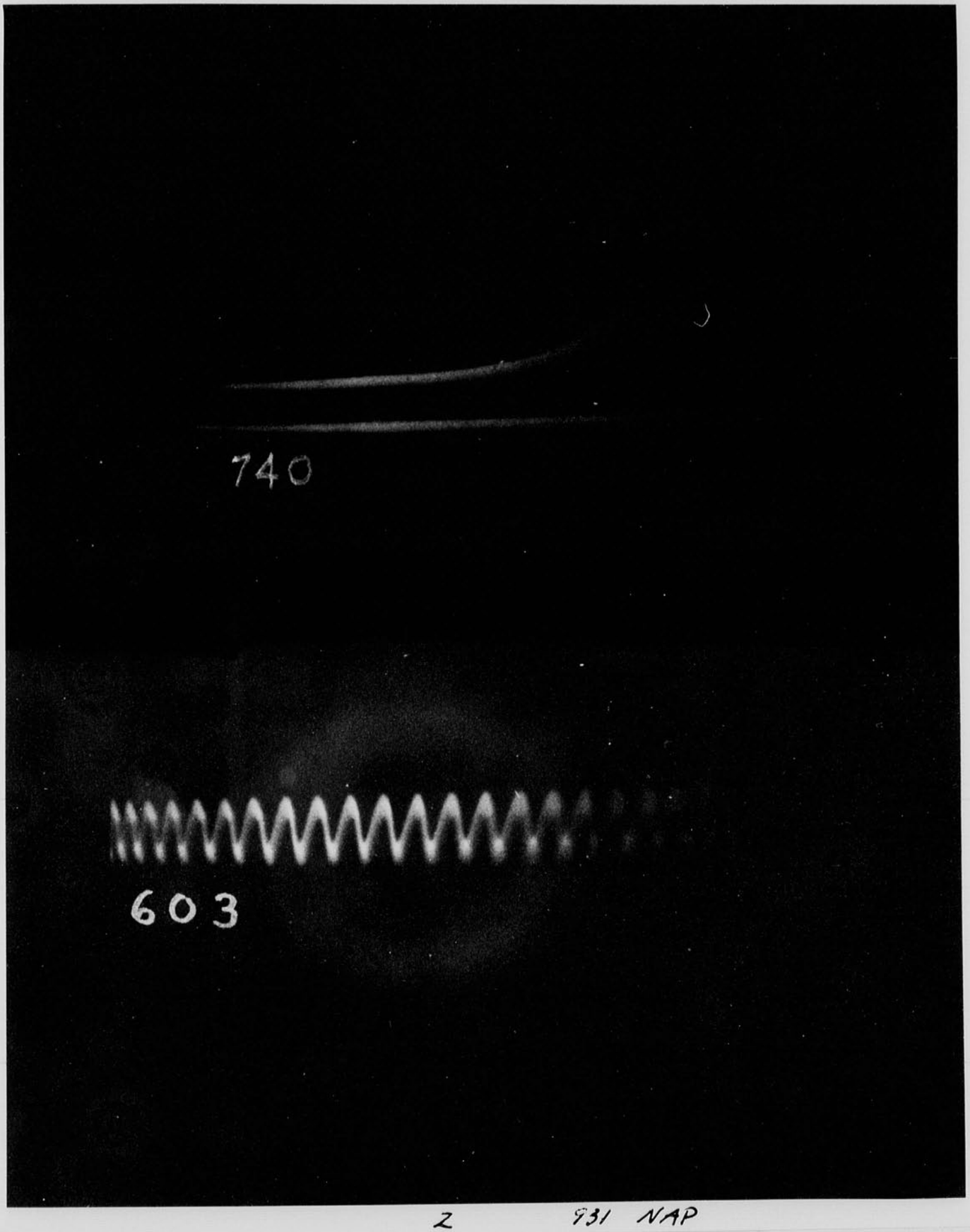
76
87

z 98.5 S.L.

2/24

Coil current in Amp.

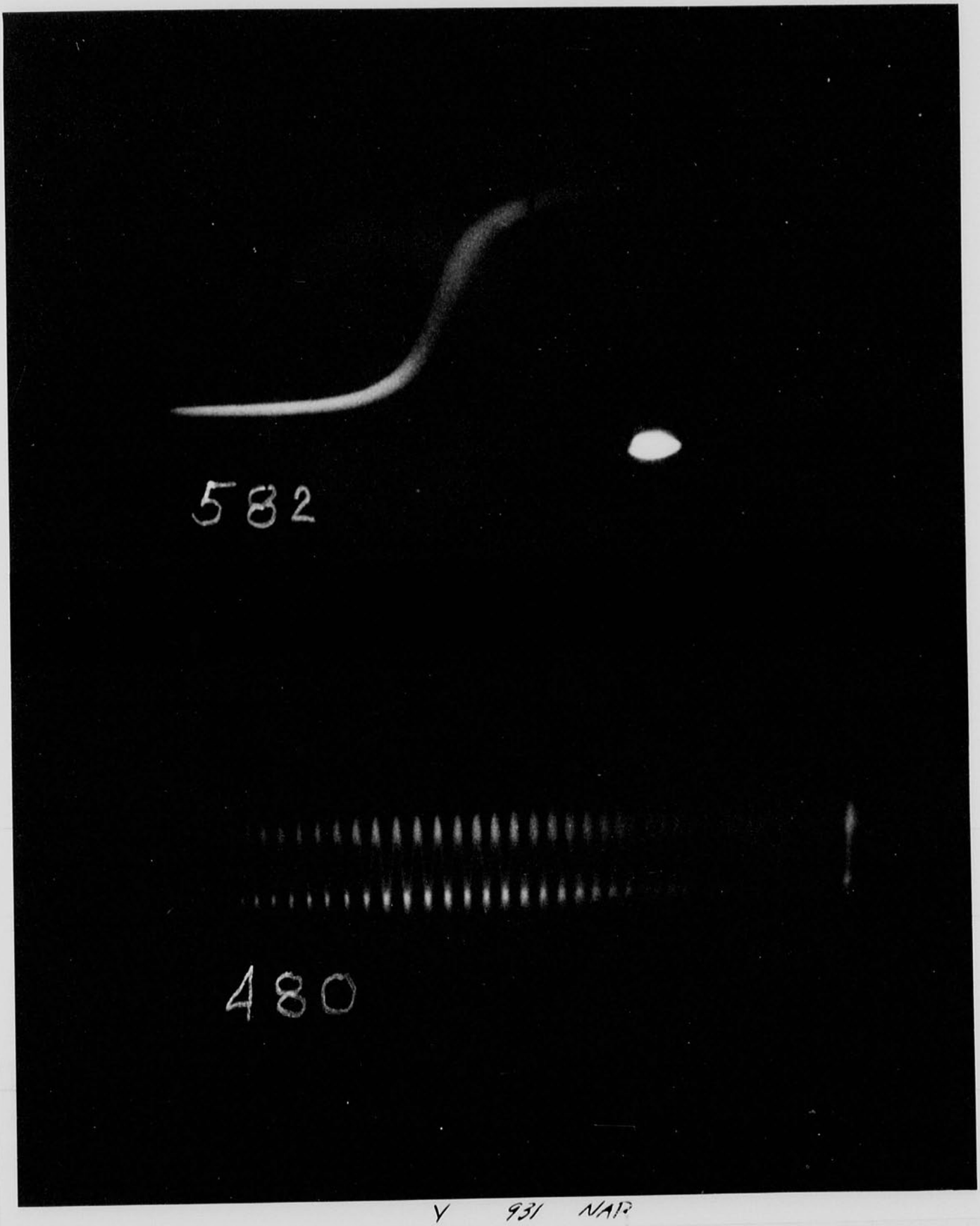
0 20 40 60 80 100 120 140 160 180 200



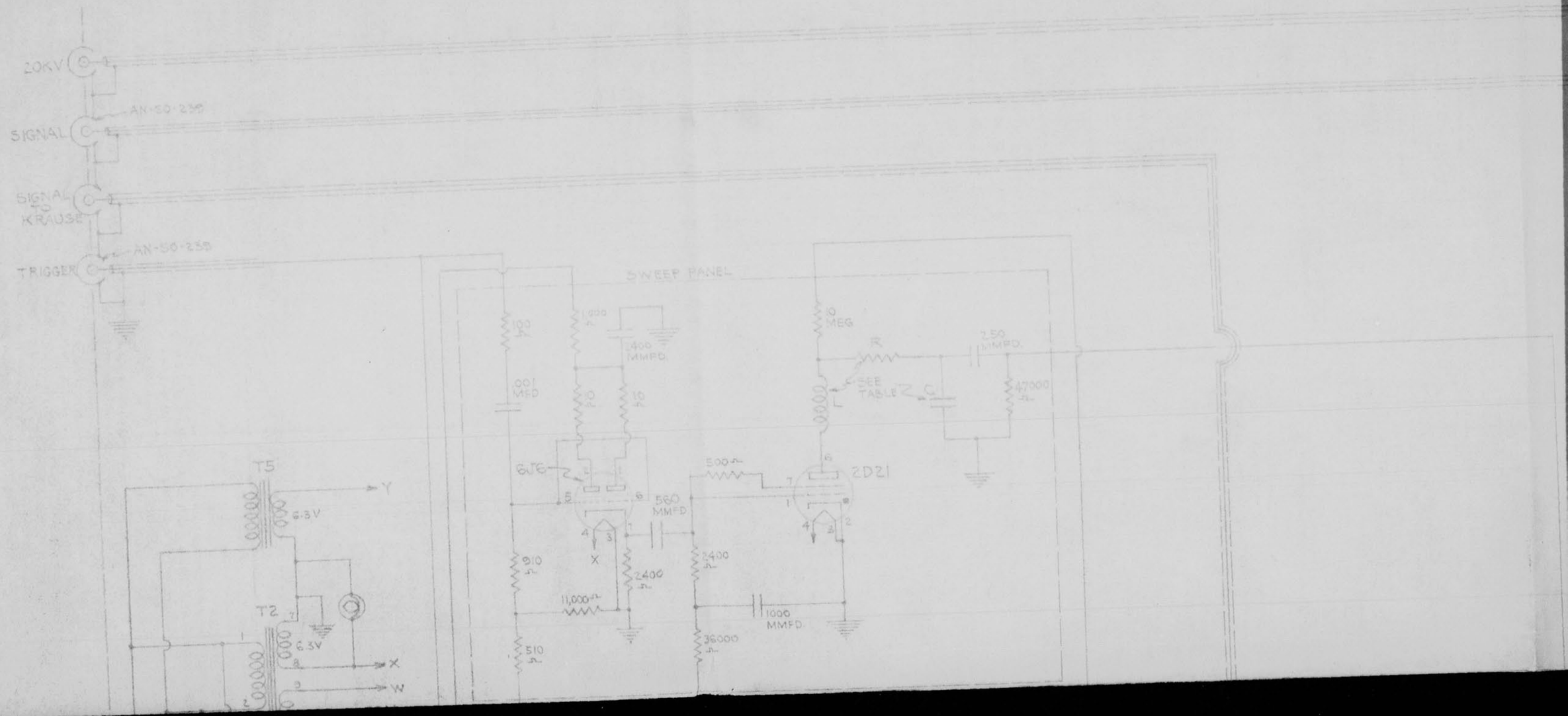
Z 931 NAP

Coil current in Amp.

0 20 40 60 80 100 120 140 160 180

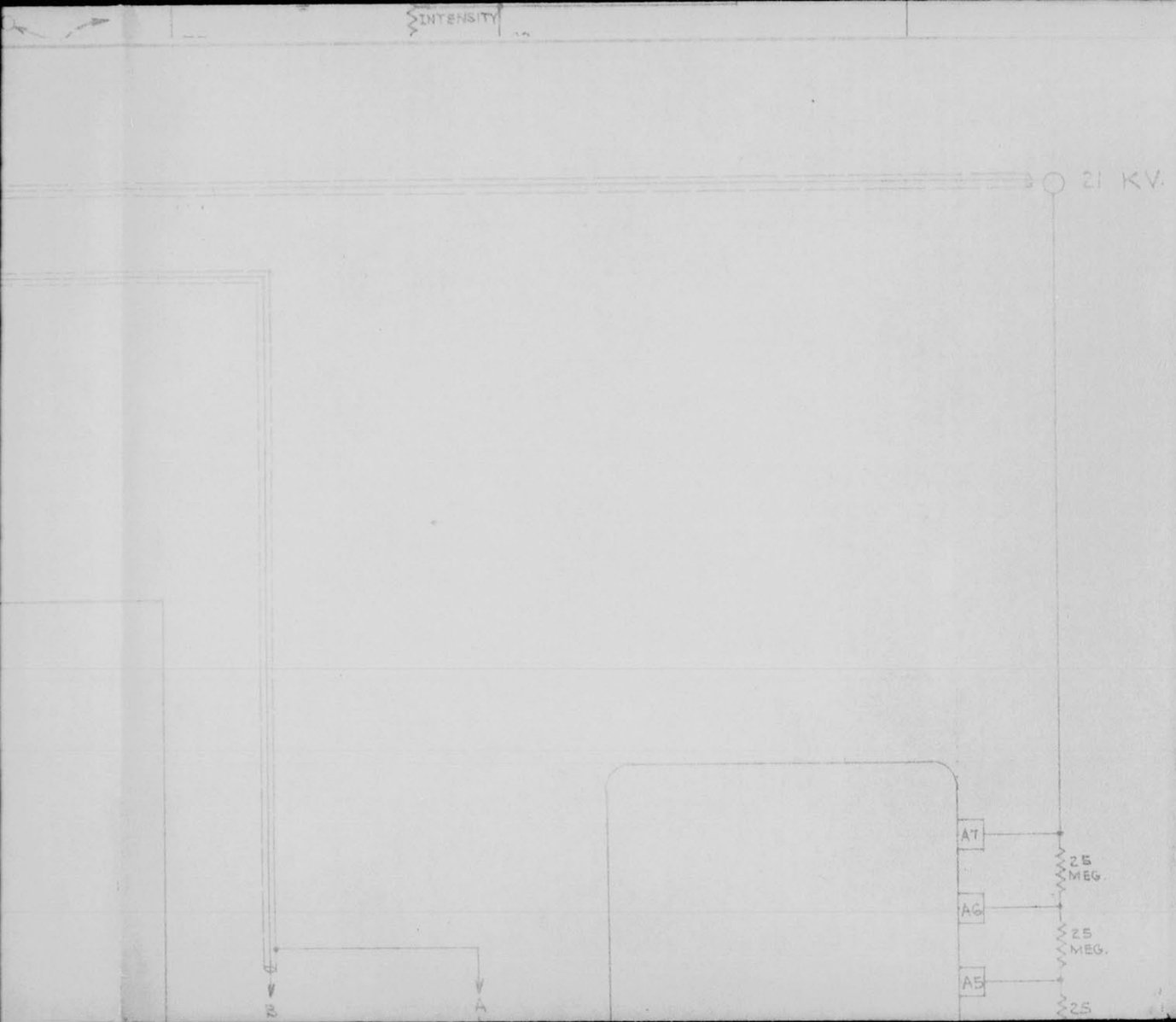


V 931 NAI?


20KV
AN-50-238
SIGNAL
SIGNAL TO KRAUSE
AN-50-238
TRIGGER
SWEEP PANEL
T5
6.3V
Y
T2
6.3V
X
W
100
1000
2400 MMFD.
.001 MFD
10
10
6J6
560 MMFD.
910
2400
11,000
510
500
2D21
2400
1000 MMFD.
36000
10 MEG
R
250 MMFD.
SEE TABLE
L
C
47000

INTENSITY

21 KV.

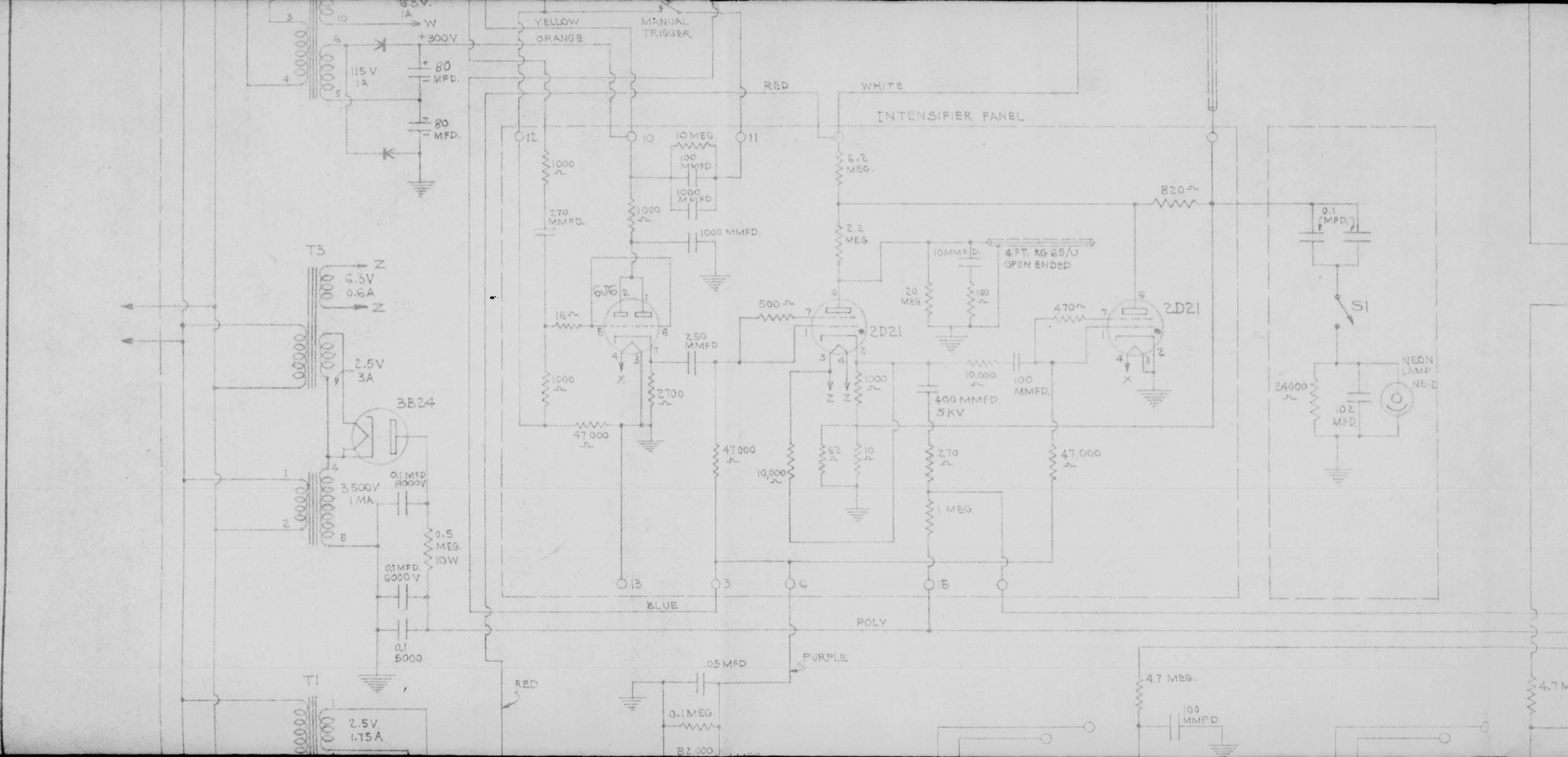


POINTS A-B-C-D ON SOME SCOPES.

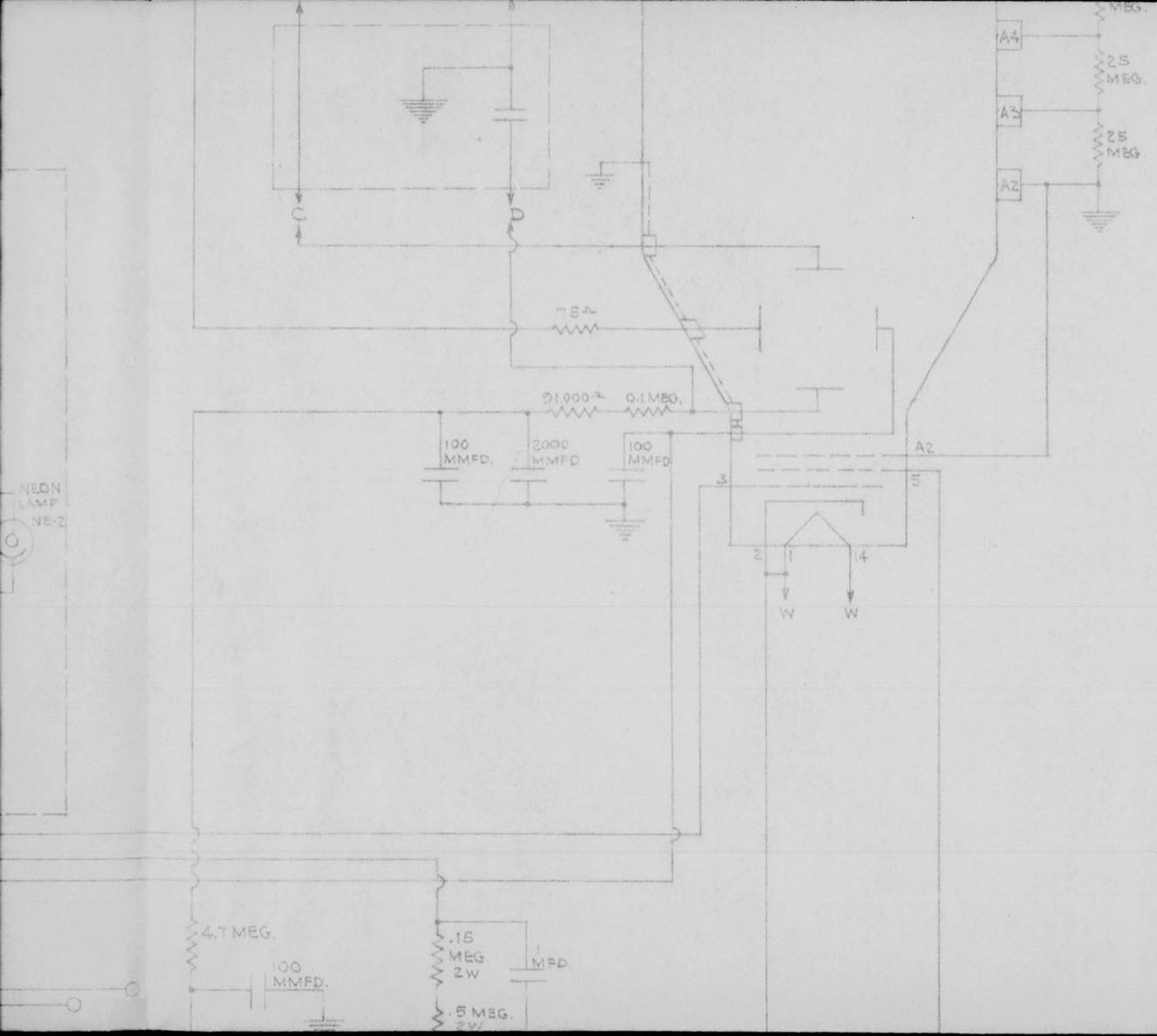
SHOT	X-RAY			YOKE			ZEBRA		
COMPONENT	R	L	C	R	L	C	R	L	C
SCOPE 113 ENGEBI-RUNIT	134	46T	700	—	—	—	91	46T	500
SCOPE 105 PARRY	130	46T	700	130	46T	700	130	46T	700
SCOPE 106 PARRY	130	46T	700	130	46T	700	130	46T	700
SCOPE 111	130	46T	700	—	—	—	91	46T	500
SCOPE 122	—	—	—	130	46T	700	130	46T	1300
SCOPE 119	—	—	—	130	46T	800	—	—	—
SCOPE 121	—	—	—	130	46T	700	—	—	—

NOTE - TABLE ABOVE -

1. VALUE OF R GIVEN IN OHMS.
2. VALUE OF L GIVEN IN TURNS # 24 WIRE CLOSE-WOUND ON 3/8" DIA. BAKELITE ROD.
3. VALUE OF C GIVEN IN MICRO-MICROFARADS

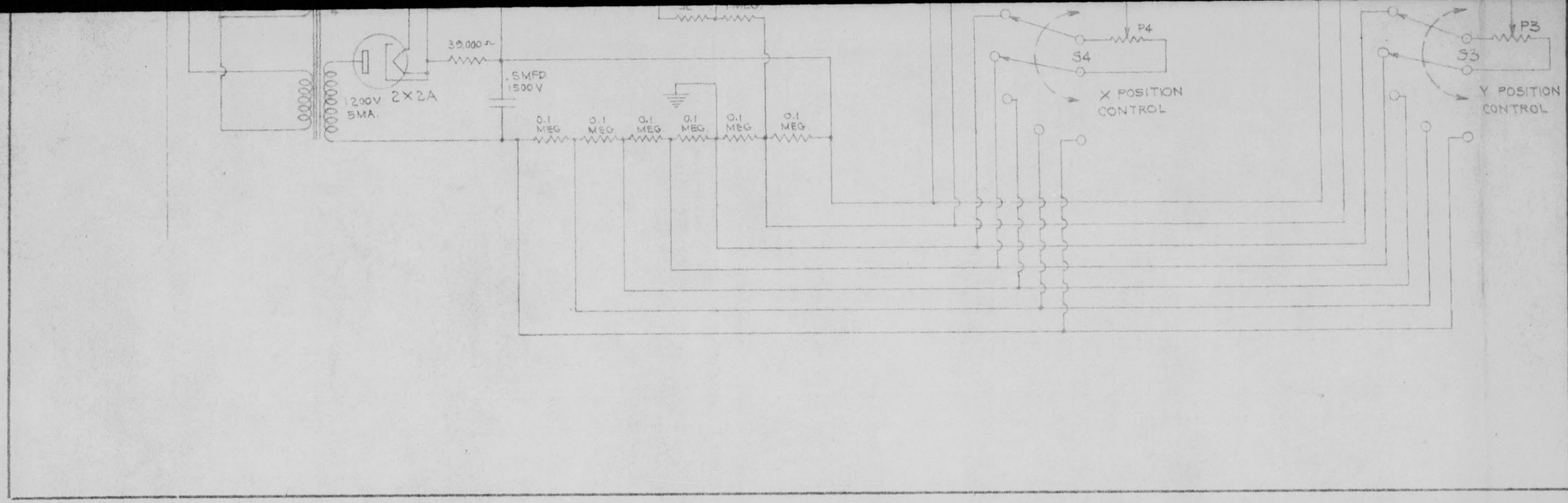


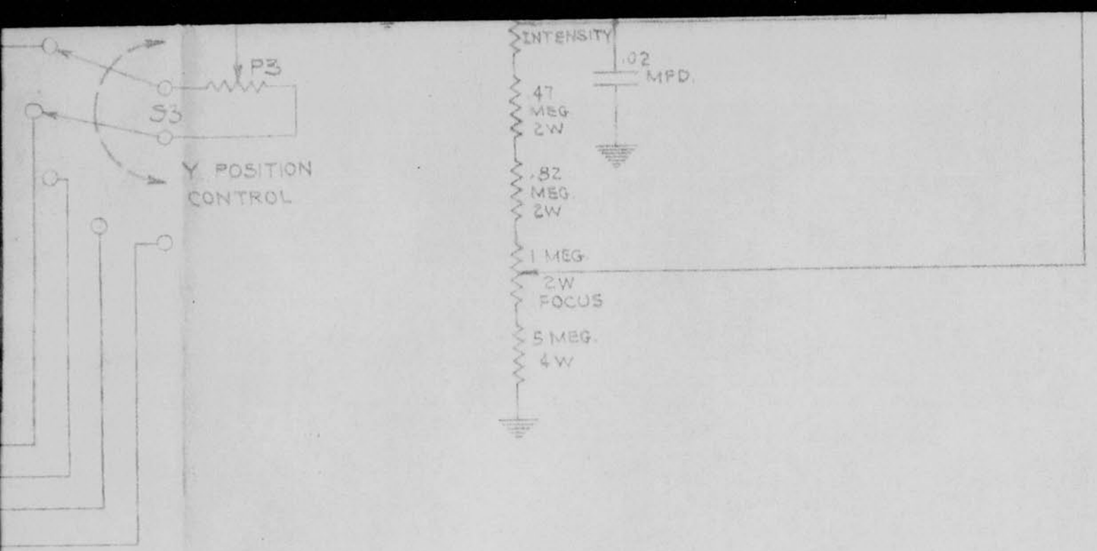
YELLOW
ORANGE
MANUAL TRIGGER
+300V
115 V 1A
80 MFD.
80 MFD.
RED
WHITE
INTENSIFIER PANEL
10 MEG.
100 MMFD.
1000 MMFD.
1000 MMFD.
6.2 MEG.
820
0.1 MFD.
1000
270 MMFD.
1000
2.2 MEG
10 MMFD.
4 FT. RG 65/U OPEN ENDED
20 MEG.
100
T3
6.3V 0.6A
6J6
16
500
2D21
470
2D21
S1
2.5V 3A
250 MMFD
10,000
100 MMFD.
1000
400 MMFD 5KV
NEON LAMP NE-2
24000
.02 MFD.
3B24
1000
2700
47,000
47,000
62
10
270
47,000
10,000
1 MEG.
3500V 1MA.
0.1 MFD 8000V
0.5 MEG. 10W
0.1 MFD. 6000 V
BLUE
POLY
0.1 5000
PURPLE
.05 MFD
T1
RED
4.7 MEG.
100 MMFD.
0.1 MEG.
2.5V 1.75A



NOTE -

1. PULSE TRANS. SHOWN ABOVE SUBSTITUTED AT


39,000Ω
.5MFD
1500V
1200V 5MA.
2X2A
0.1 MEG
0.1 MEG
0.1 MEG
0.1 MEG
0.1 MEG
0.1 MEG
P4
S4
X POSITION CONTROL
P3
S3
Y POSITION CONTROL



POINTS A-B-C-D ON SOME SCOPES.

REV. LETTER	CHANGED ITEM WAS	DATE	CH'NG'D BY	CH'K'D BY

REVISIONS

EDGERTON GERMESHAUSEN & GRIER, Inc.

CAMBRIDGE, MASSACHUSETTS

FRACTIONAL	TOLERANCE DECIMAL			ANGULAR
	SIGNATURE	DATE	GROUP REPRESEN.	DATE
ORIGINATED				
DRAWN	DALLER	7-9-48		
CHECKED				
PROJ. ENG.			SCALE	CLIENTS #
APPROVED				

TITLE

CATHODE RAY INDICATOR

Dwg. # 3102D10F

PART NO.

July 12 1948 H.E.G.

POINTS A-B-C-D ON SOME SCOPES.

SHOT	X-RAY			YOKE			ZEBRA		
COMPONENT	R	L	C	R	L	C	R	L	C
SCOPE 115 ENGEBI-RUNIT	134	46T	700	—	—	—	91	46T	500
SCOPE 105 PARRY	130	46T	700	130	46T	700	130	46T	700
SCOPE 108 PARRY	130	46T	700	130	46T	700	130	46T	700
SCOPE 111	130	46T	700	—	—	—	91	46T	500
SCOPE 122	—	—	—	130	46T	700	130	46T	1300
SCOPE 119	—	—	—	130	46T	800	—	—	—
SCOPE 121	—	—	—	130	46T	700	—	—	—

NOTE- TABLE ABOVE-

1. VALUE OF R GIVEN IN OHMS.
2. VALUE OF L GIVEN IN TURNS # 24 WIRE CLOSE-WOUND ON 3/8" DIA. BAKELITE ROD.
3. VALUE OF C GIVEN IN MICRO-MICROFARADS

Time	volts	ya
0515	700	3
	1000	22
	1200	74
	1300	140
0530	700	2
	1000	22
	1200	72
	1300	130
0545	700	2
	1000	14
	1200	24
	1300	78
	1400	130
	1500	200
0600	700	2
	800	4
	1000	9
	1200	25
	1300	45
	1400	70
	1500	110
	1600	155
0615	800	2
	1000	5
	1200	15
1300	1400	29
	1500	43
	1600	64
	1800	92
		180

Time	Volts	ya
0630	800	2
	1000	7
	1200	22
	1300	46
	1400	84
	1500	145
0635	700	2
	1000	20
	1100	40
	1200	76
	1300	140
0640	700	6
	900	35
	1000	74
	1100	190
0645	700	14
	800	43
64?	900	106
0640	700	50
	800	150
0643	800	200
0645	700	200
0659	600	200
0703	500	200

Moon 30° left of LOS

0515 - Scattered horizon clouds & haze - overhead unrestricted - moon bright (nearly full)

0545 - moon brightness reduced by haze - slight overcast at horizon

0600 - Moon beginning to go down behind horizon clouds - slight horizon haze

0615 moon totally obscured by horizon clouds - sky just beginning to perceptably lighten towards the east

0630 - sky perceptably lightening in west - heavy overcast coming up in east

Run #2 - March 25.

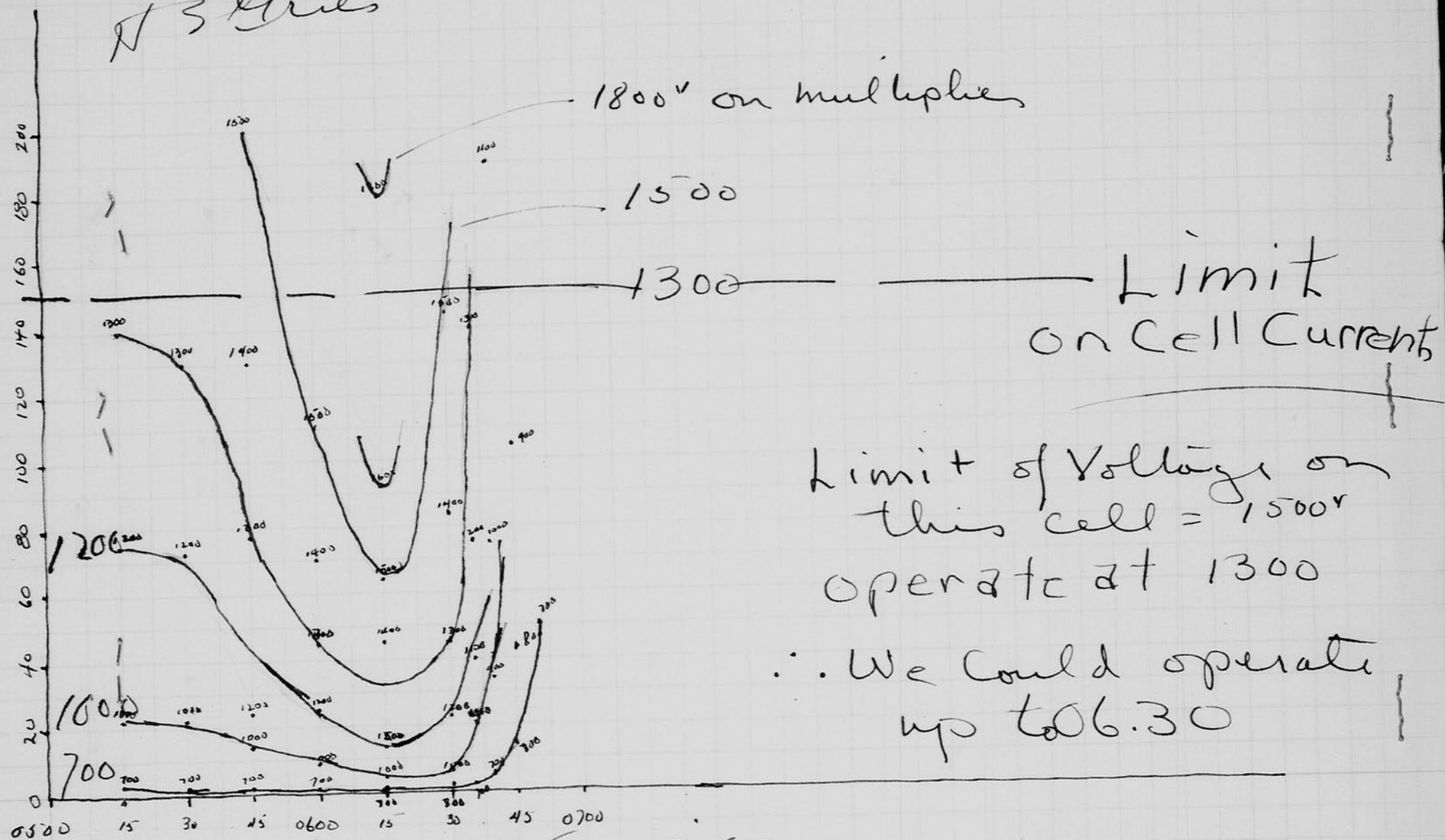
Anode - cathode voltage - 1300 volts

Night light measurement of Photomultiplier:

1200V +		1300V +	
Time	Current μa	Time	Current μa
0500	115	0500	200
0515	95	0515	170
0530	125	0530	>200
0545	125	0545	>200
0600	110	0600	200
0615	70	0615	125
0627	60	0627	115
0630	50	0630	105
0635	95	0635	170
0640	170	0640	>200
0641	200		

0500 - scattered clouds 20-30%
moon full - very faint haze
ring around moon
0515 - scattered clouds 10% at horizon
overhead unlimited except for
haze - moon 45° left of LOS
0530 - Same as 0515
0545 - Same as 0530.
0600 - Scattered clouds 20%
0615 - clouds 50% up to 20° above
horizon
0627 - Taken as comparison before
moon was obscured by large
black cloud
0630 - moon behind cloud - sky
otherwise clear - sky begin-
ning to brighten in east

Harry Smith
N 5 Gries

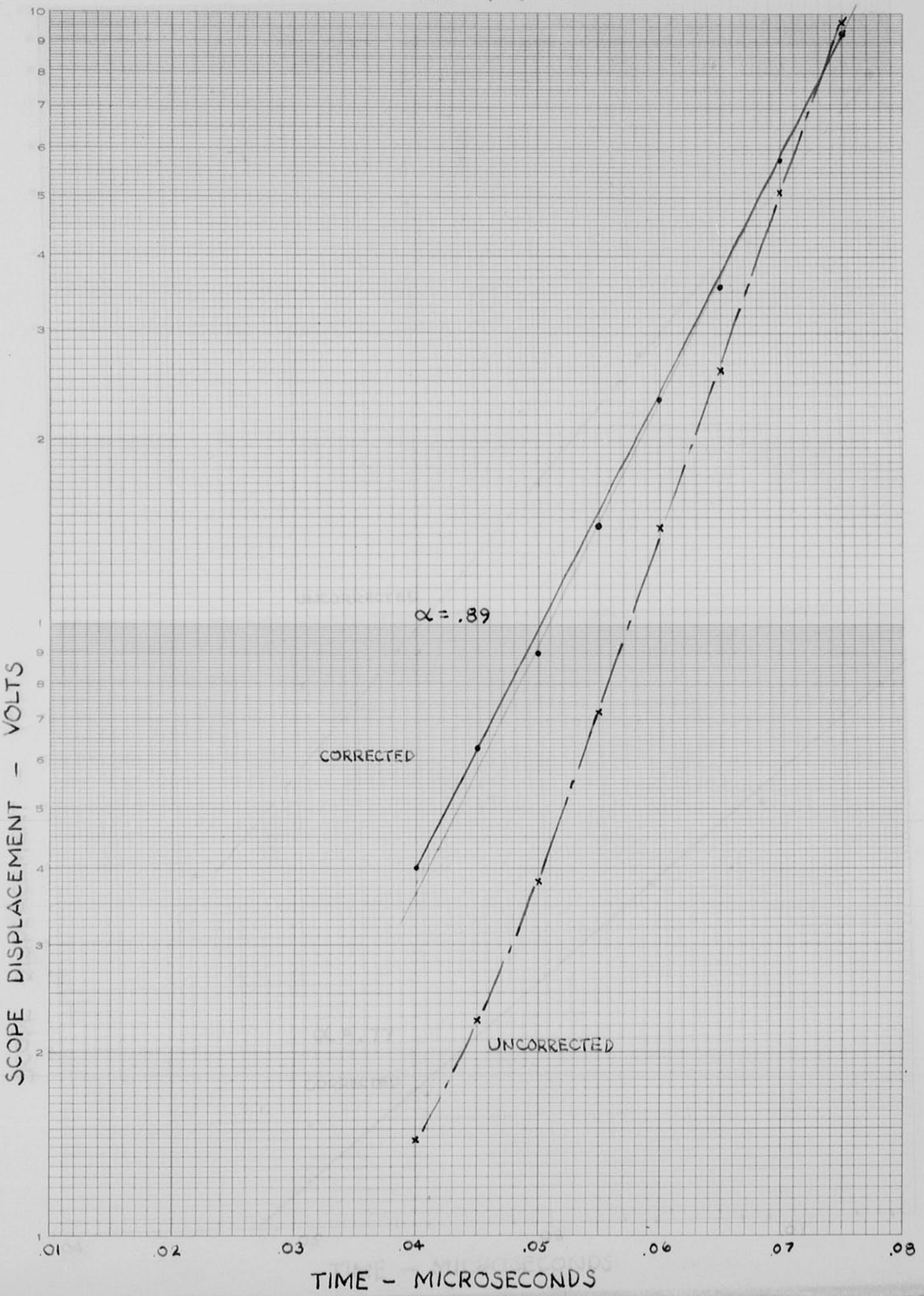


Limit of Voltage on this cell = 1500v
operate at 1300
∴ We could operate up to 06.30

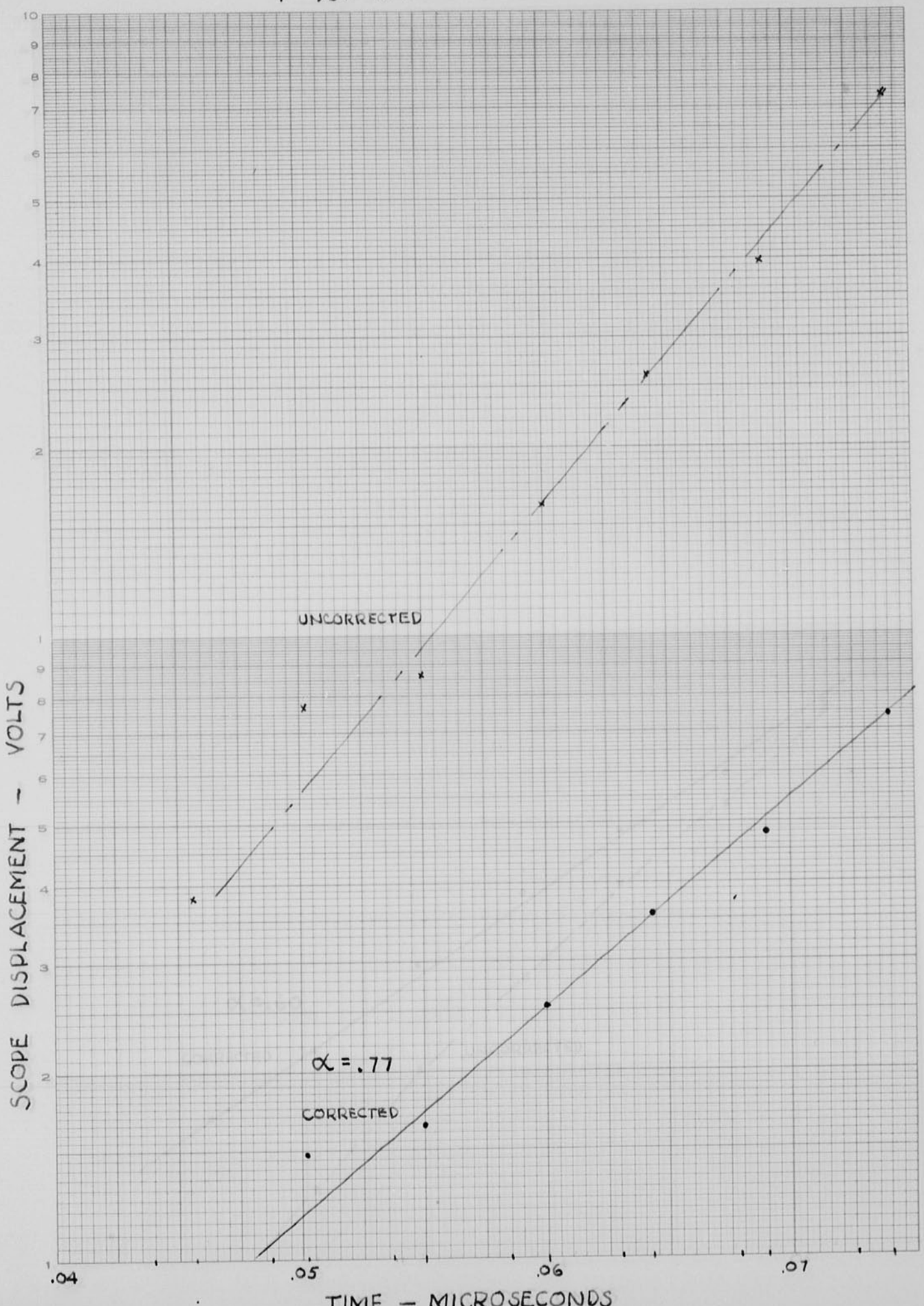
Figure 3 — Photocell Current from Night Sky

3-24-48 Data taken by Harry Smith

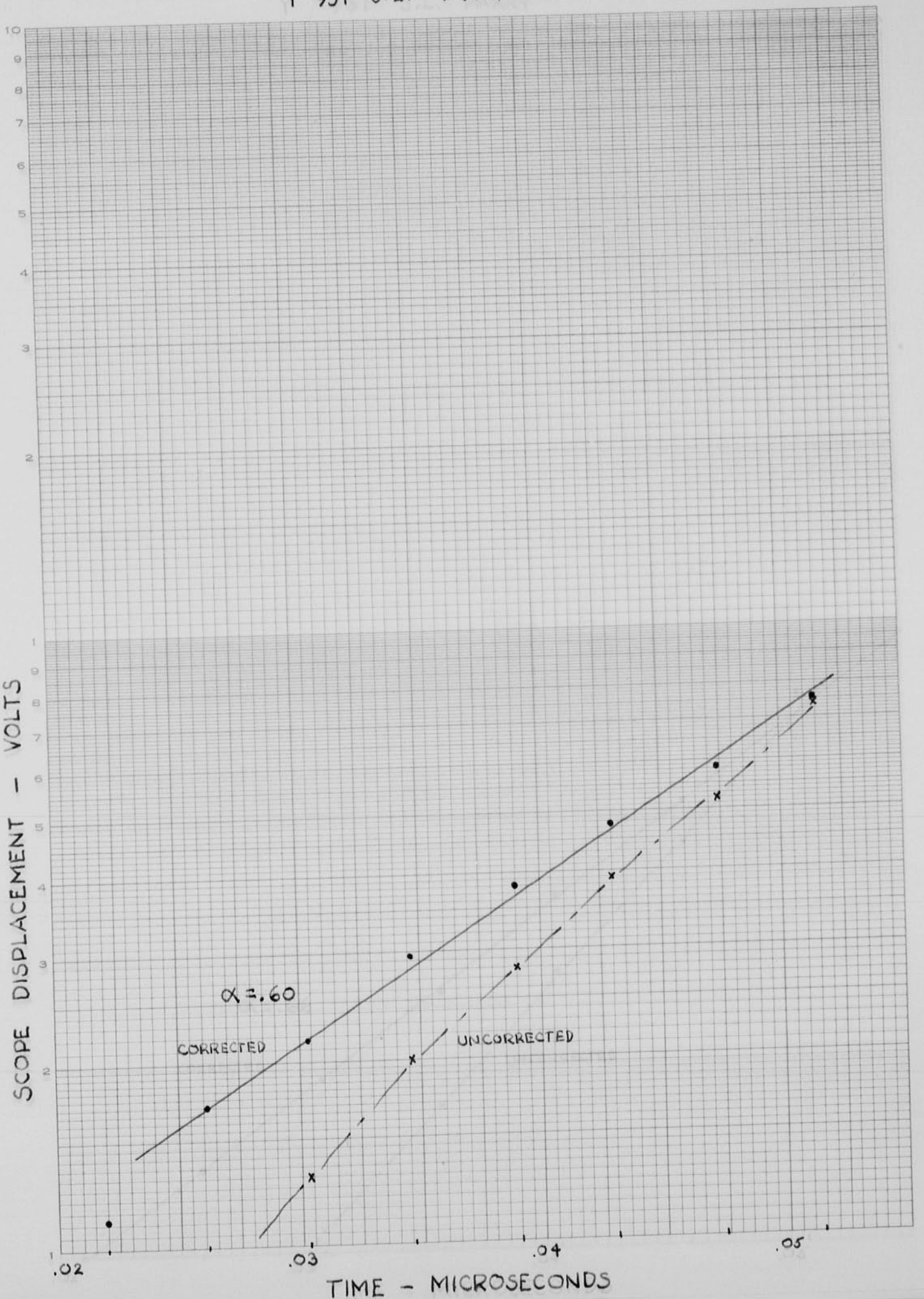
YA121 583 935 S.L.



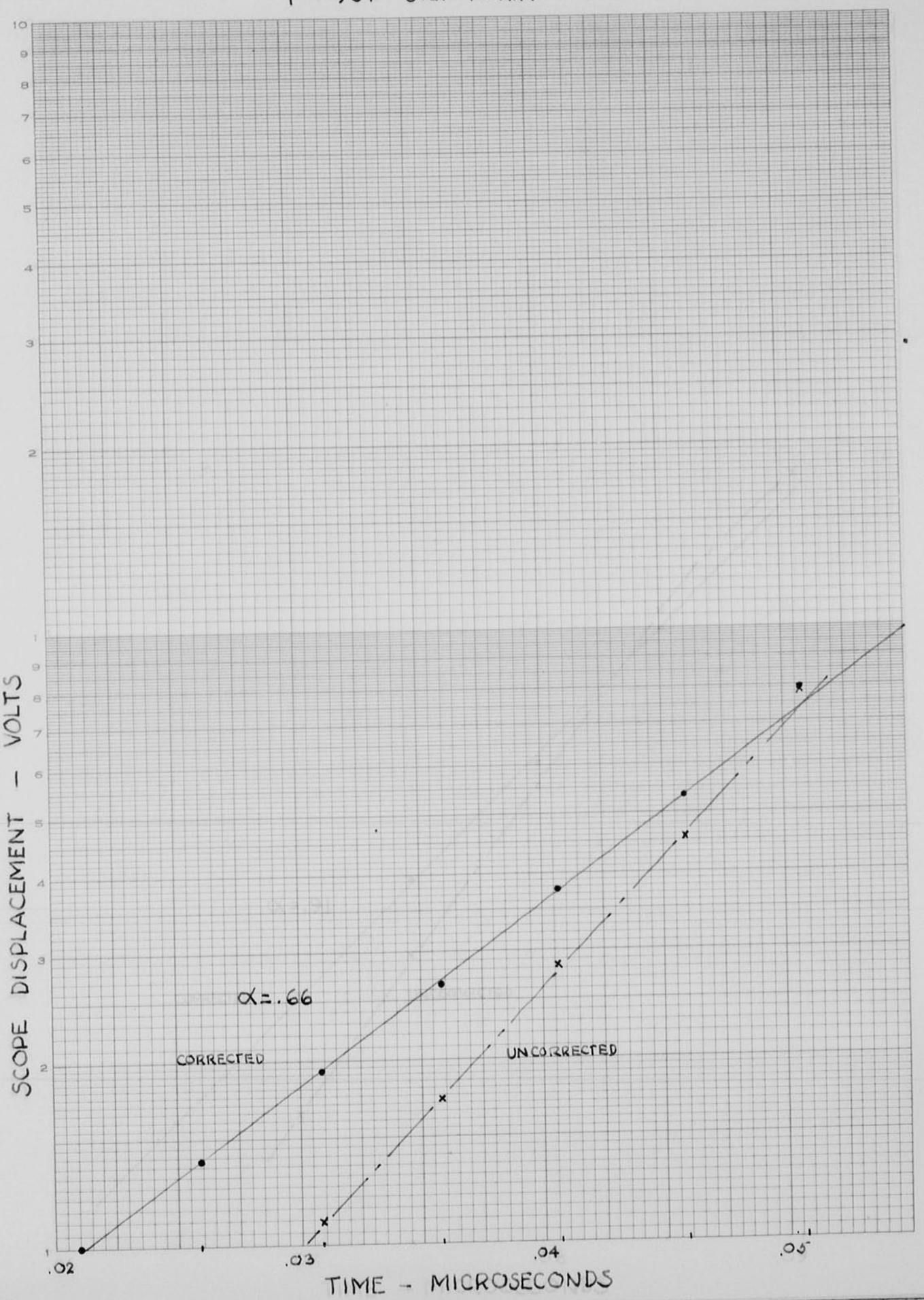
Y 931 NAP



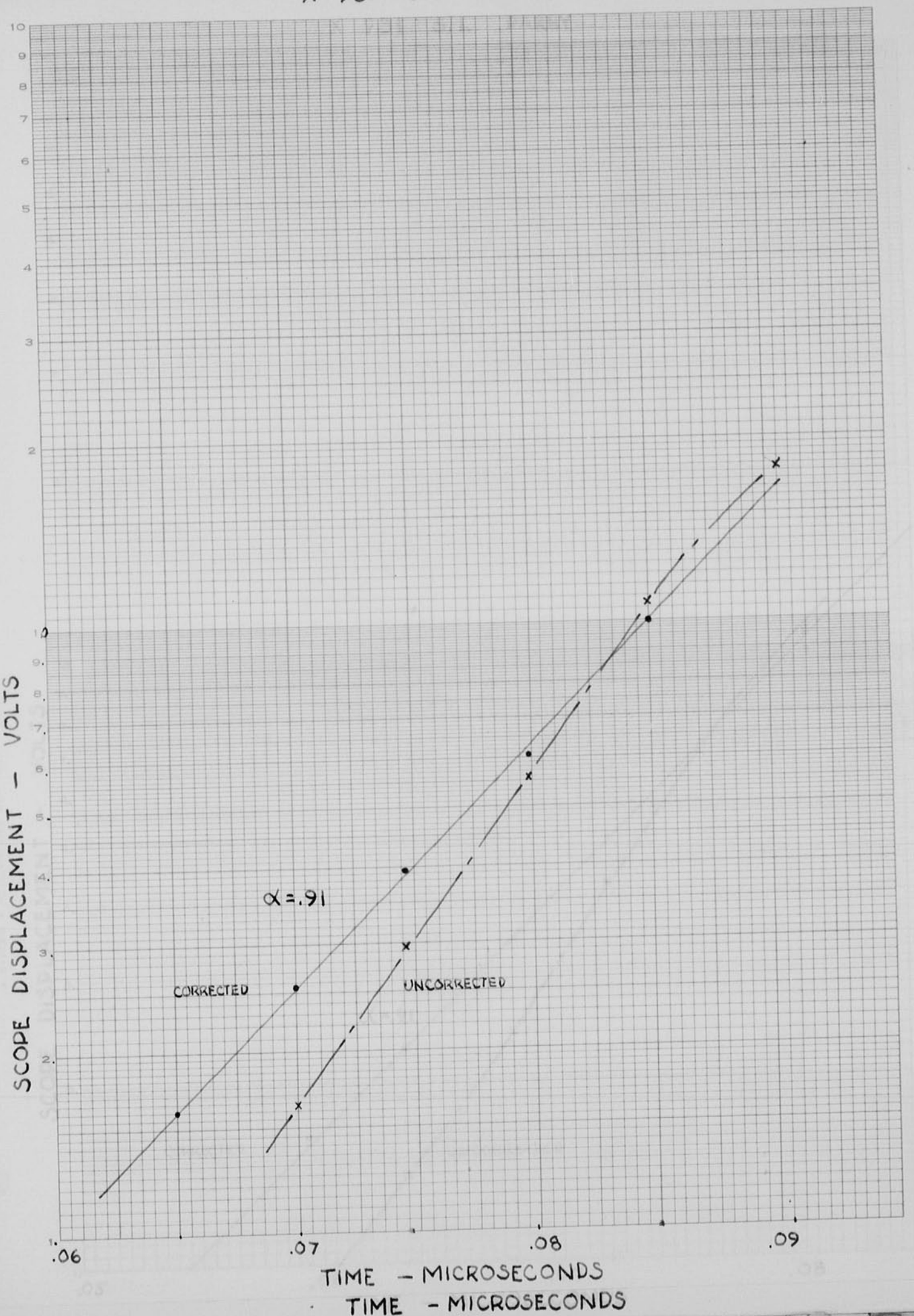
Y 931 S.L. PARRY



Y 931 S.L. PARRY

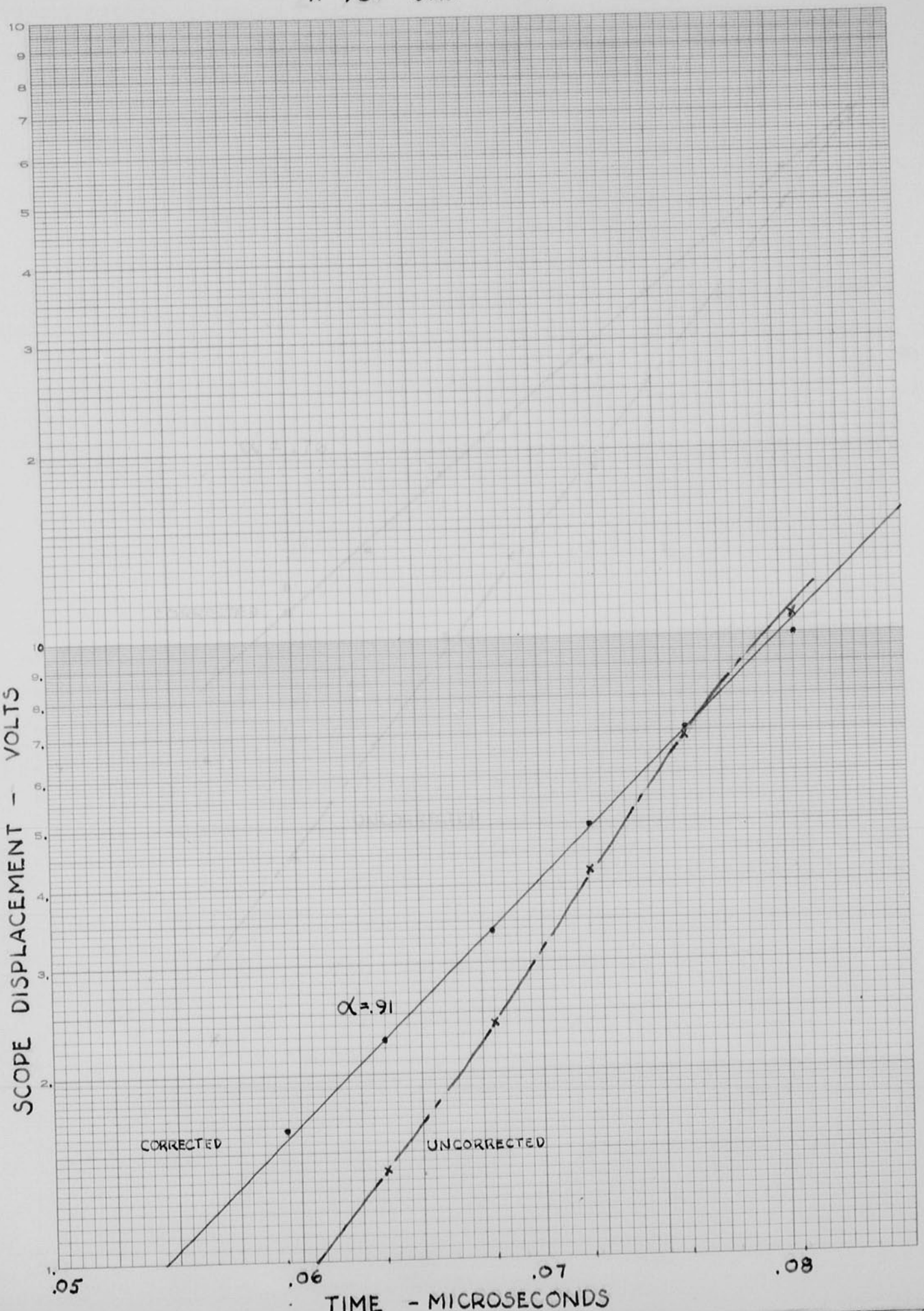


X 931 S.L. PARRY

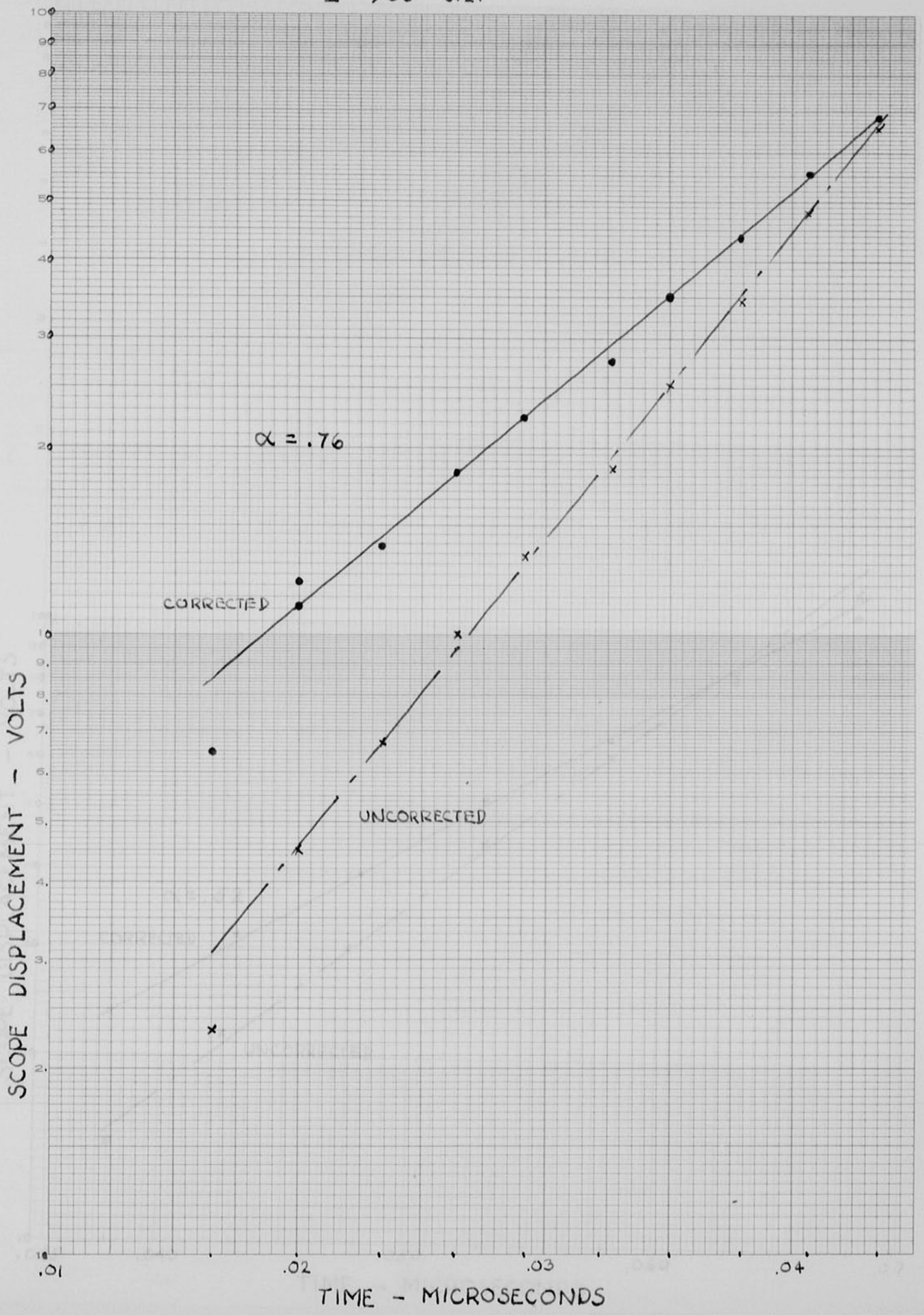


TIME – MICROSECONDS

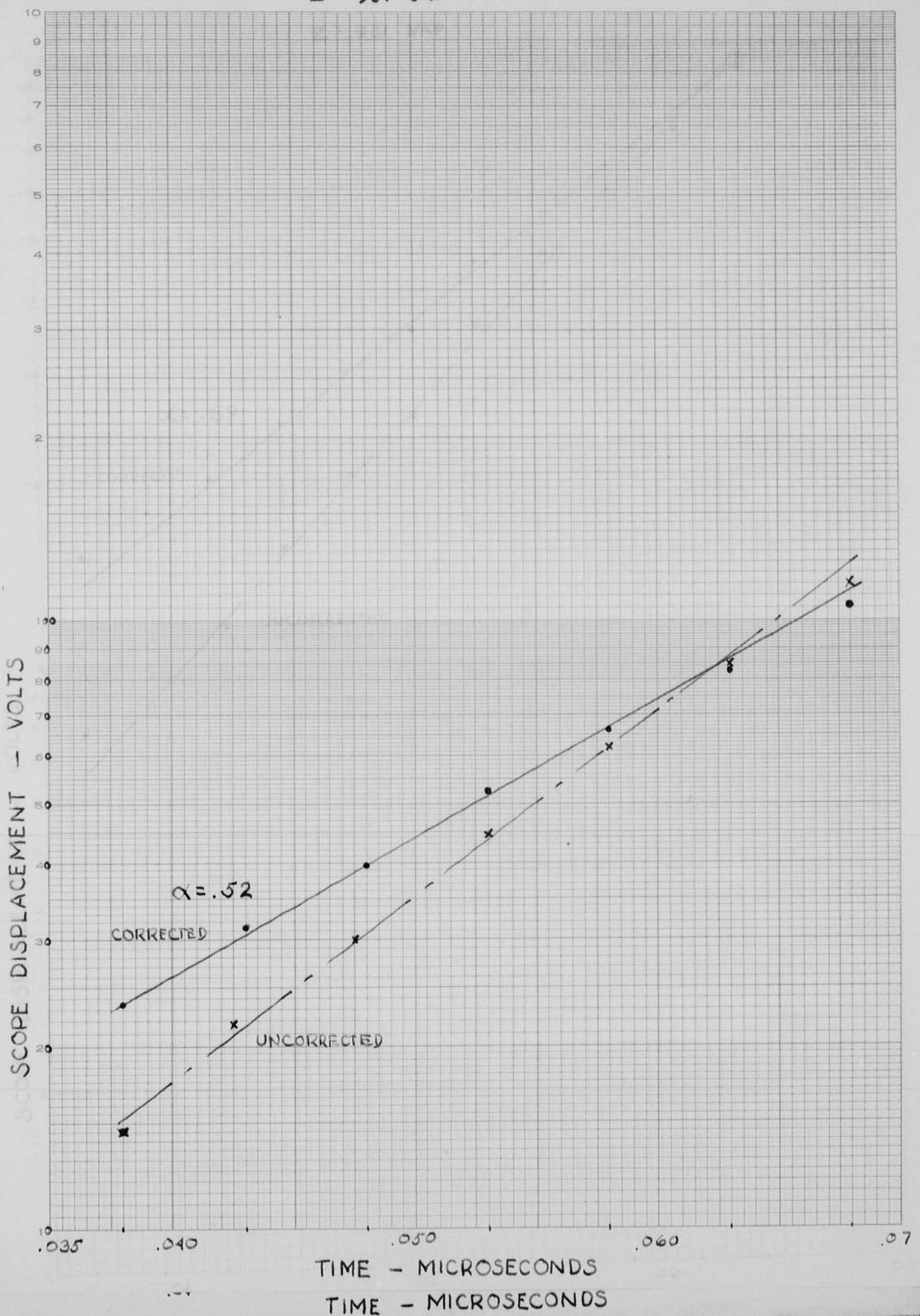
X 931 S.L. PARRY



Z 935 S.L.

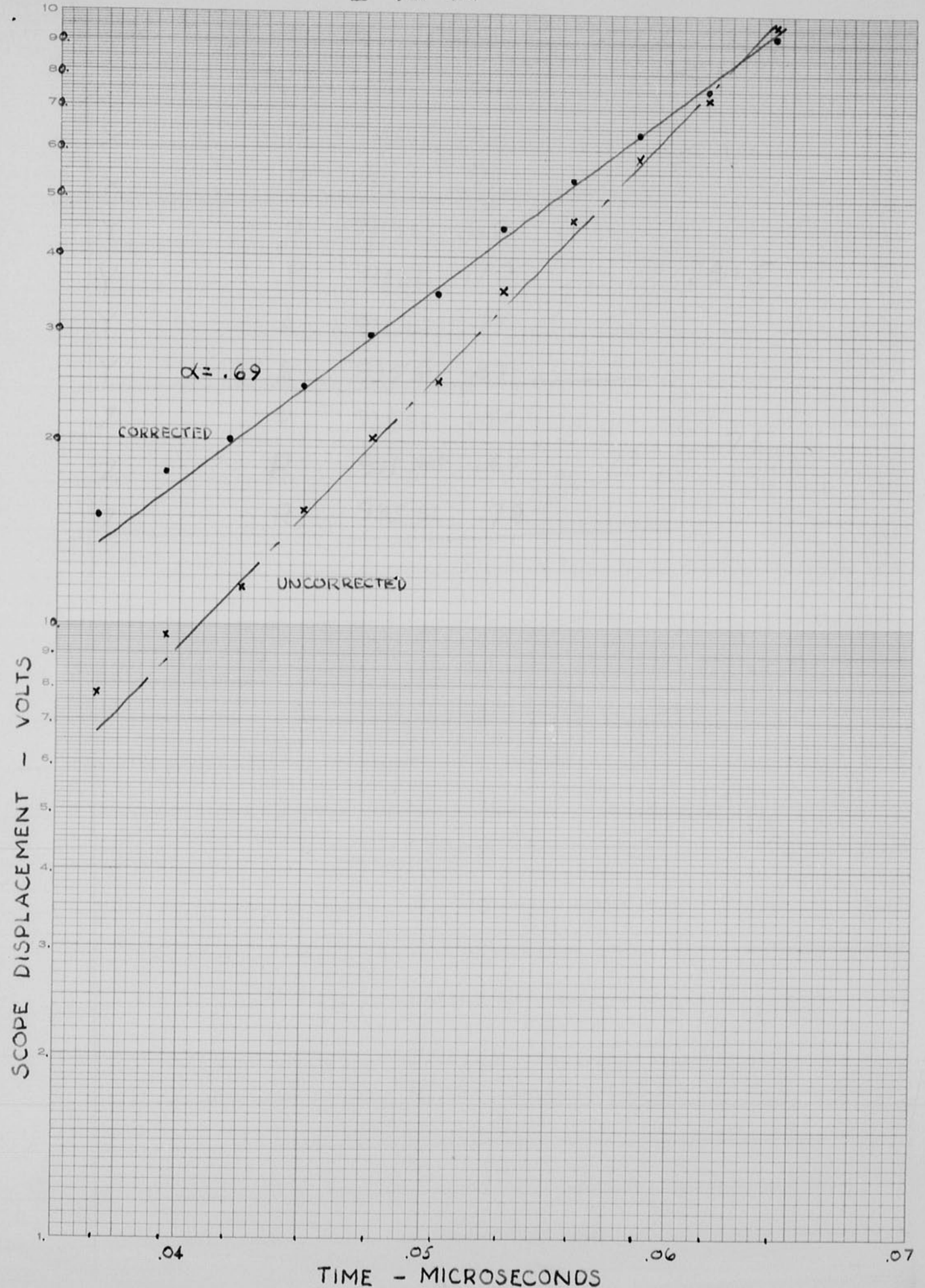


Z 931 S.L. P.



TIME - MICROSECONDS

Z 931 NAP



Shot	Position & tube		α		K
X	P	931 SL	.89		
X	P	931 SL	.91		2.17
Y	P	931 SL	.60		
Y	P	931 SL	.70	.77	.815
Y	A	931 NAP	.77		
Y	A	935 SL	.89		
Z	P	931 SL	.51		
Z	R	931 NAP	.67	.74	.75
Z	R	935 SL	.78		

Please return to

Harold E. Edgerton

Room 20D-102

Mass. Inst. of Tech.

Cambridge, Mass.

449 8-12 afar 15. Group Photo. Braucato

PL 546 7-12. Gagebi P.M. from searchlights. 1/200 f 32.

547 - 1 " " " "

Notebook # 18

Filming and Separation Record

____ unmounted photograph(s)

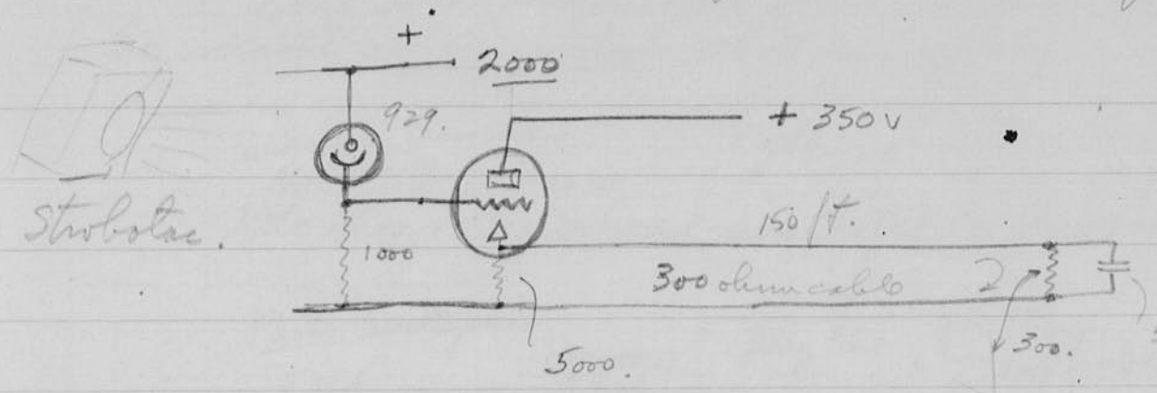
____ negative strip(s)

__1__ unmounted page(s)
(notes, drawings, letters, etc.)

was/were filmed where originally located between page __0__ and __1__.

Item(s) now housed in accompanying folder.

935 phototube. V.A. char.
Cathode follower. 6SN7 parallel.



Strobotac.

$$i = A\varepsilon^{\alpha t}$$

$$e_c = \frac{1}{C}\int i\,dt = \frac{1}{C}\int A\varepsilon^{\alpha t}\frac{d\alpha t}{\alpha}$$

$$= \frac{A}{C\alpha}\varepsilon^{\alpha t} \qquad i_c = C\frac{de_c}{dt}$$

$$= B\varepsilon^{\alpha t} \qquad i_c' = CB\alpha\varepsilon^{\alpha t}$$

$$i_R' = \frac{B\varepsilon}{R}^{\alpha t}$$

$$i_t' = B\left(C\alpha + \frac{1}{R}\right)\varepsilon^{\alpha t} \qquad (i_t' = i_c' + i_R')$$

Let $i_t' = A\varepsilon^{\alpha t}$

$$A\varepsilon^{\alpha t} = B\left(C\alpha + \frac{1}{R}\right)\varepsilon^{\alpha t}$$

$$B = \frac{A}{C\alpha + \frac{1}{R}} = \frac{A}{.0532}$$

$\frac{1}{500} + \frac{1}{300} = 188A$

$\alpha = 10^{+8}$

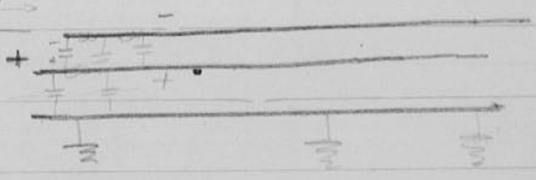
$C = 20\times10^{-12}$

$C\alpha = 20\times10^{-4} = \frac{1}{500}$

$\frac{1}{C\alpha} = .0500.$ ohms.

$\frac{1}{R} = \frac{1}{300}$

$$e_c = 188A\varepsilon^{\alpha t}$$



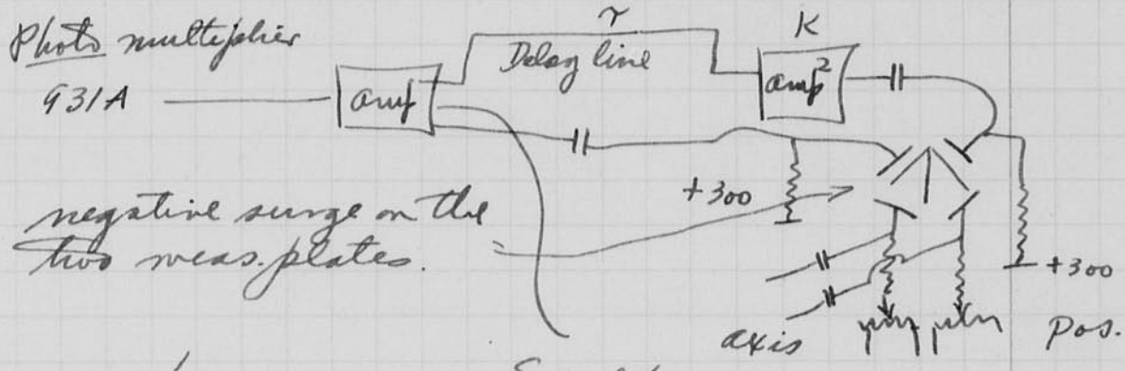
Jan 28 1948

Harold E Edgerton

Conf. with Lew Fussell about measurements to be made at Eniwetok atol in spring.

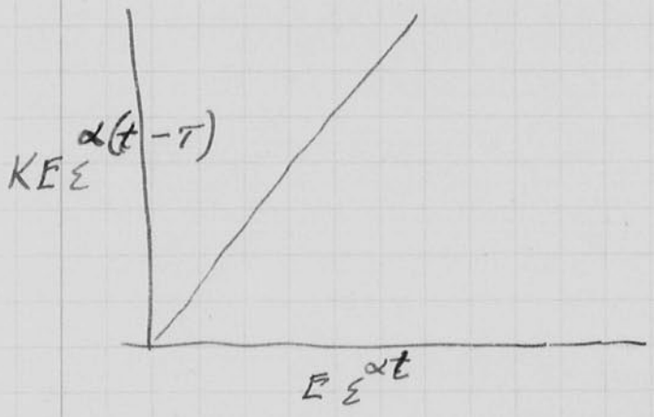
Doral Froman N.R.L. Dr. Krause. Ogle Linnenburger Los Alamos.

Rate meas. by scheme suggested by Fussel



Signal to transit exp.

N.O.L. circular sweep for timing the signal with the -100 μs. trip.

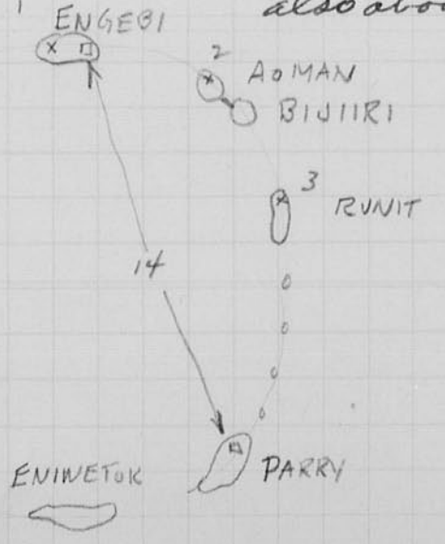


$45° \quad K E \varepsilon^{\alpha(t-\tau)} = E \varepsilon^{\alpha t}$

$\ln K + \alpha(t-\tau) = \alpha t$

$\ln K = \alpha\tau \qquad \alpha = \frac{\ln K}{\tau}$

Distance to observation station is 1300 yards. also about 14 miles.

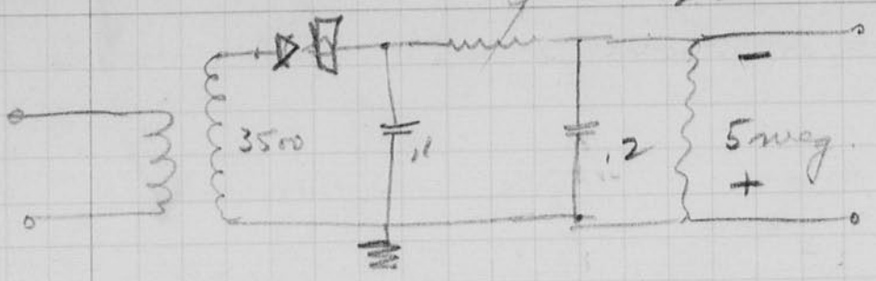


RCA Amplifiers Camden
D. H. Ewing. Telrad Dir.
E. Eberhard Proj. Eng.

Dumont 25. scope
1 - December. Elect. type.
6 - Jan 15 delivery. (4 NRL.)
6 - Jan 24.

Oscillograph Power Supplies. Jan 30, 1948.

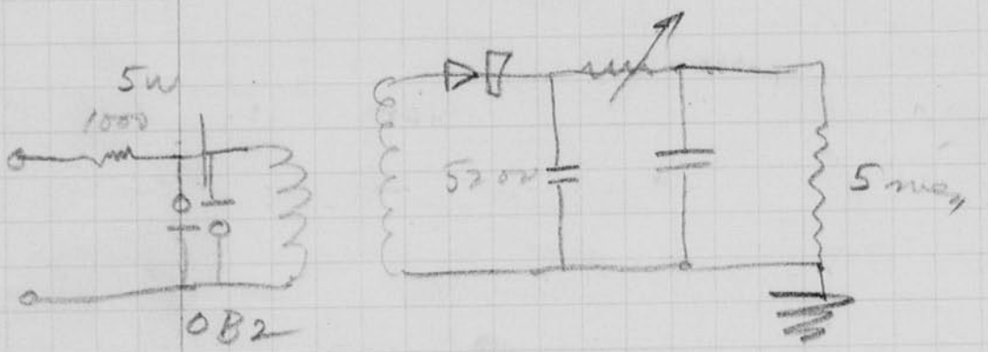
13 × 22000 = 286000 ohms.



100	3.46 K
110	3.77
115	3.95
120	4.12
125	4.25.

Sorensen Regulator

Vac Variac	DC. on Scope
100	4550
110	4520
120	4500
130	4600
100	4540
115	4490



Dumont CR type 319 Serial 111 Sensitivity tests,
Variac control on anode.

V_1	V_2	Deflection for 112 VRMS.
3400 volts.	0	8.6 cm
3500	0	9.6 D_3 D_4
4000	0	8.3 cm
4000	500	7.2
4000	900	6.3
4000	0	8.8 cm
4000	0	10.5 other axis (D_1, D_2)

Sens. v/cm. 63. 160 v/inch.

With R.F. Supply.

4	25 KV±	5 cm	
3.6	25 "	5.8	
4.4	25 "	4.5	
4.0	10	7.2	
4.0	13	6.5	

DuMont information per call Koch to Colom

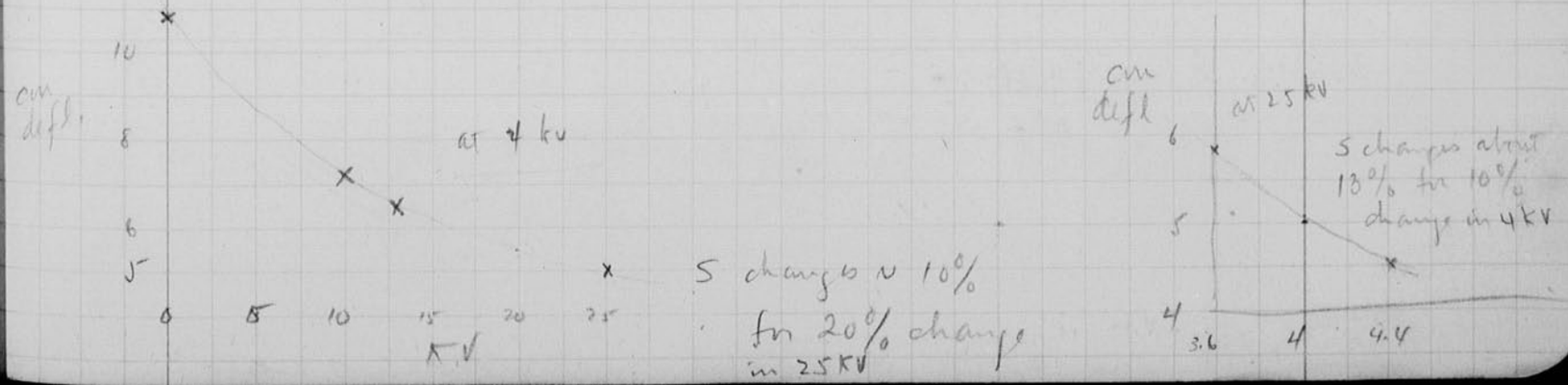
A_2 kv	A_3 kv	v/in	
4	25	225	(D_1D_2 - facing screen)
4	22.5	215	
3.6	25	215	
3.6	22.5	205	

i.e. 10% change in either voltage gives a 5% change in sensitivity, and both changing together cause a 10% change

---

Our data

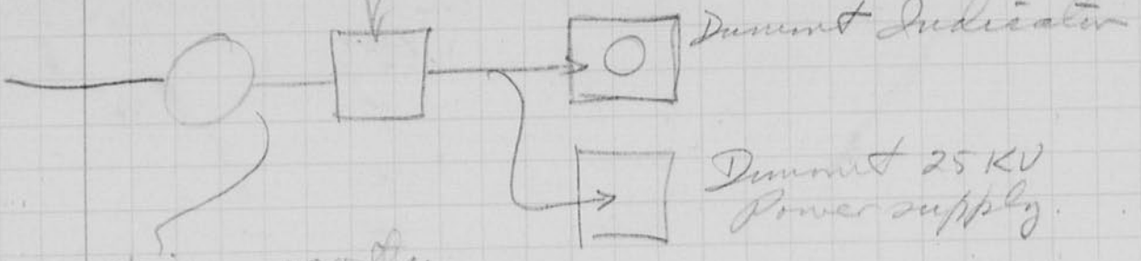
If line voltage goes up 10% we can expect a 5% change in sensitivity because of change in 25 KV, and 13% because of change in 4 KV. These are in the same direction so total change is 18% or about 3/8" at 2" deflection. If we let positioning voltage vary directly with line voltage the net change in deflection would be only 8% or about 1/6" at 2" deflection. OK?



Regulator tests.

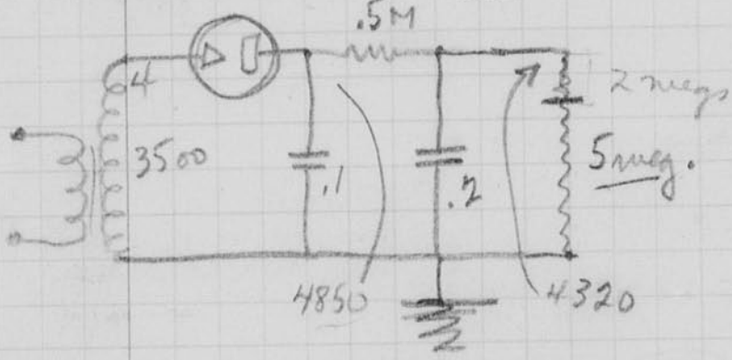
Jan 31, 1948
Daniel G. Edgerton

Serial no. 464 Sorensen Regulator.
Model 250. watts.



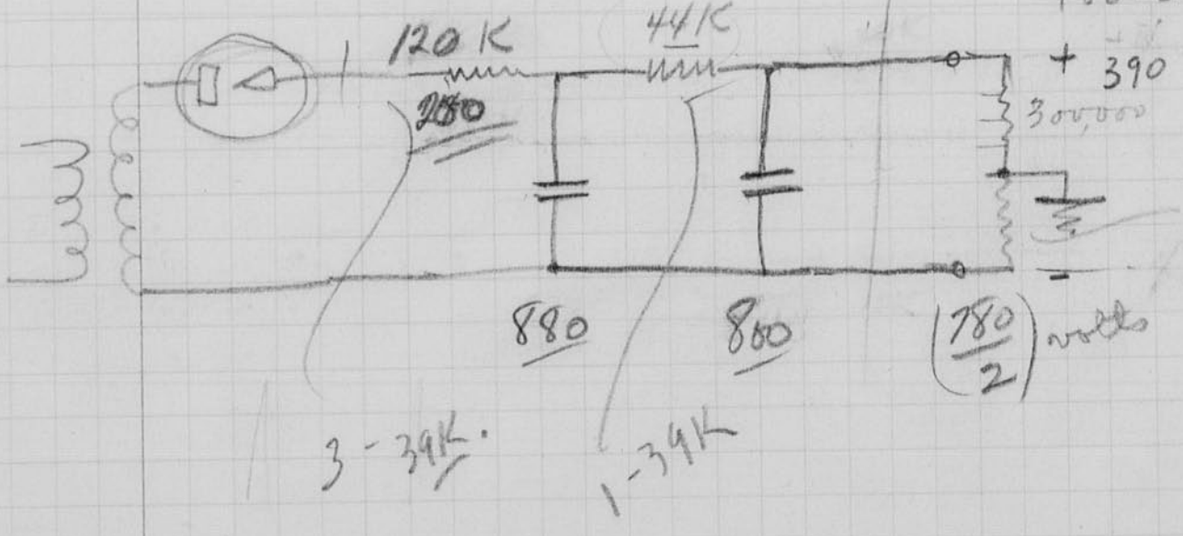
Variac	DC Volts.
105	4650
110	4650
115	4650
120	4650
125	4640
106	4650
100	4660

C.R. circuit 112 volts

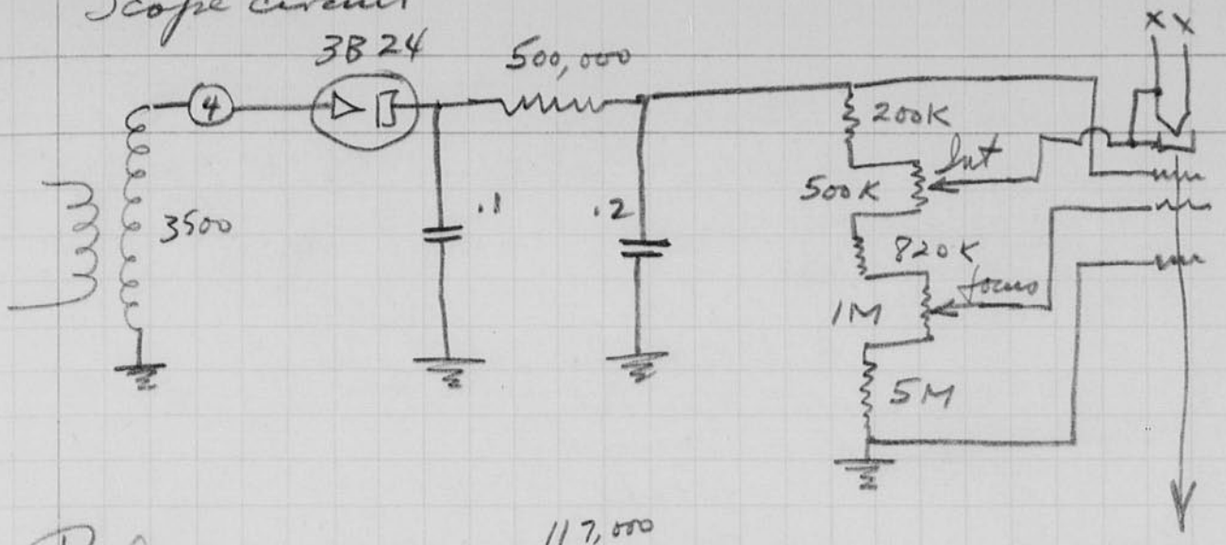


Main def circuit.

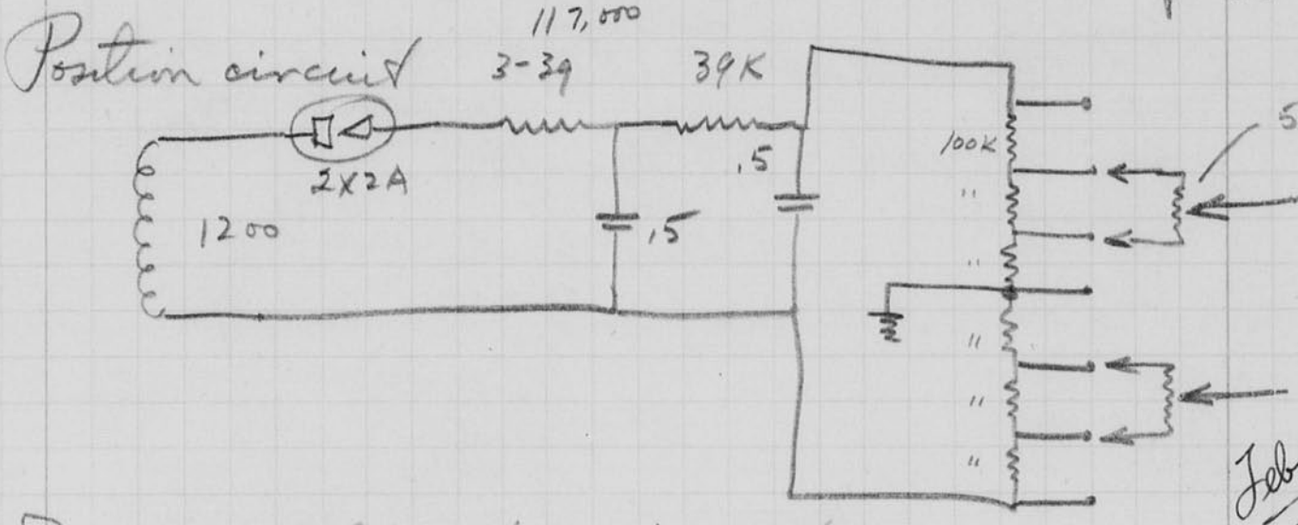
Positioning def.



Scope circuit

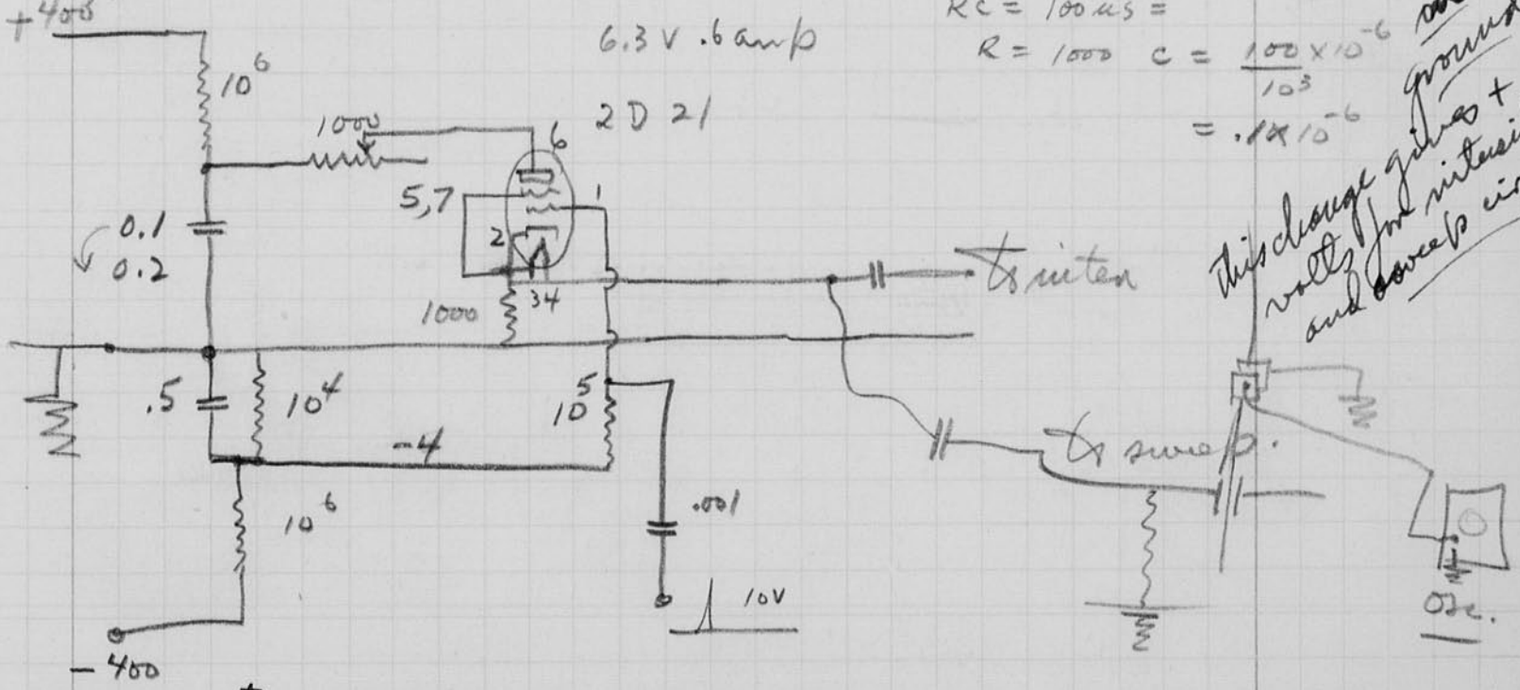


Position circuit



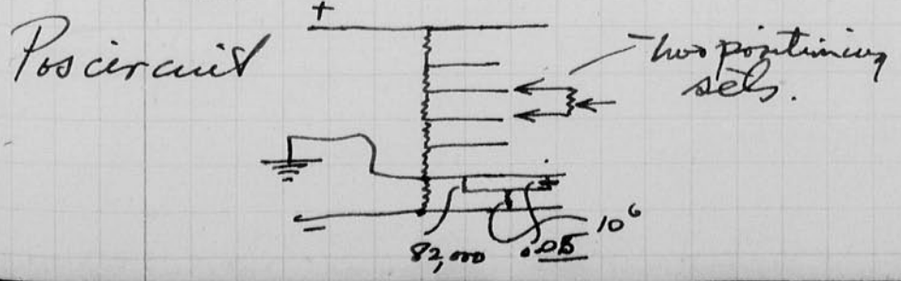
Feb 21, 1948
Will change below in ground.
This change gives + volts for intensifier and sweep cir.

Suggested Intensifier circuit.



$RC = 100\,\mu s =$
$R = 1000 \quad C = \frac{100 \times 10^{-6}}{10^3}$
$= .1 \times 10^{-6}$

Pos circuit



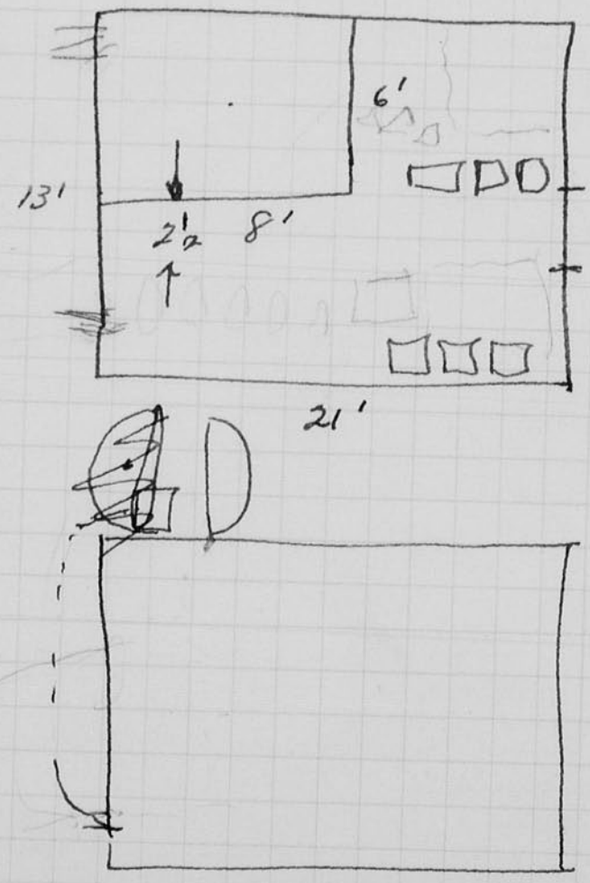
6 Feb 2, 1948
H.E. Edgerton.

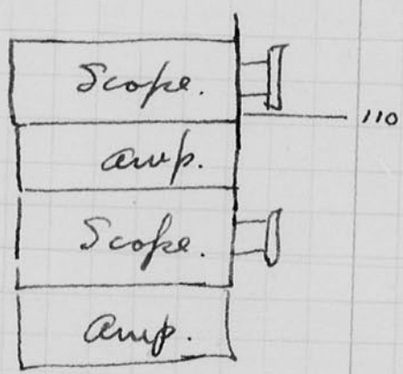
21 Feb. Leave Boston for AVS.
20-28 Feb H. Allen – shipping. (Fossil) proc.
└ Close.
10 March air lift.

14 Feb.
21 Feb.

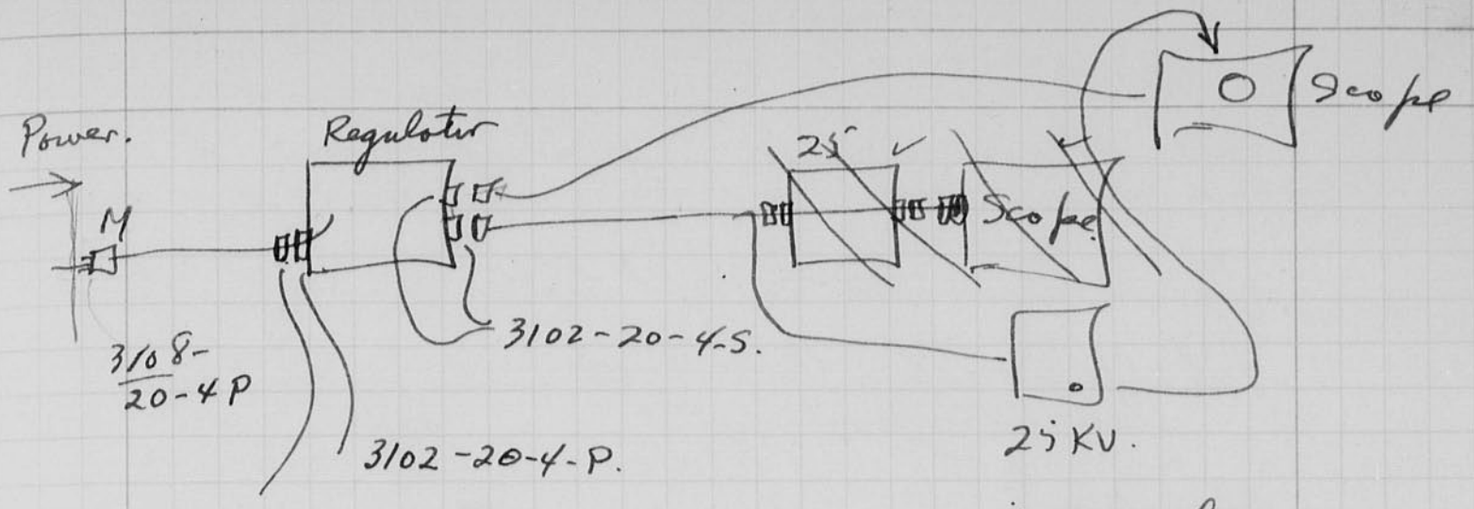
P. J. O'Keefe
M.F. Warchel
R. N. Morris
Drake
Armstrong.
Didesao.

25 Feb – Boat. – AVS. H. Grier
Ed Colson
Harry Smith
Army. –
Army. –
Eberbrandt.
H.E. Edgerton.

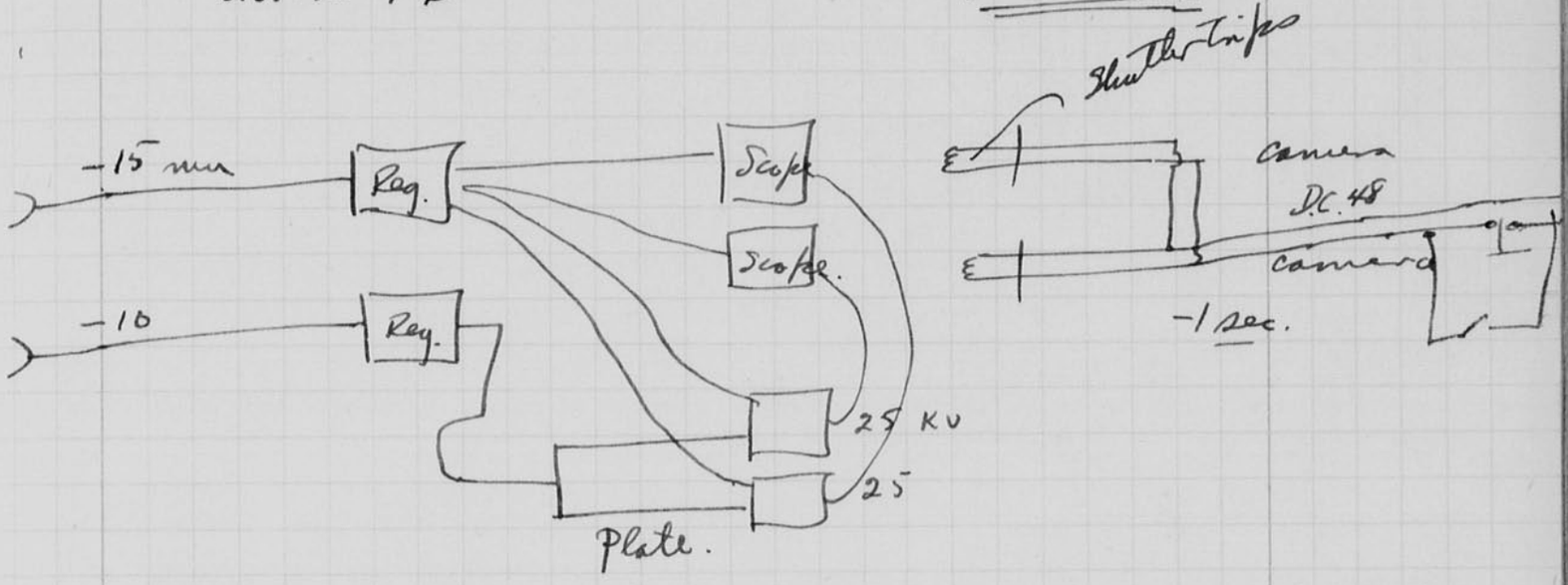




21" available.



30 seconds.



4 March control wiring aircond.
1 mar AVS sails.

Mar. 4-12 Bizerte

Mar. 12-19. Beirut

16 March - unload -

16-23. Photo electron Os Card
16-27. control station.
[redacted] Two weeks delay.

Leave by air at last minute

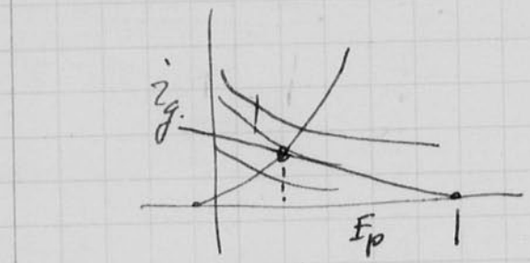
Mar. 10 Mar 15 arrive.

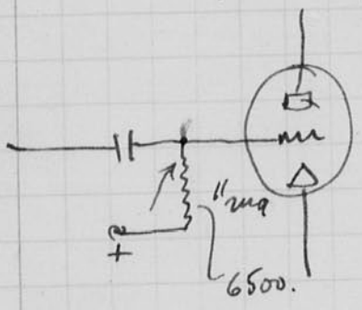
CR Indicator. #111.

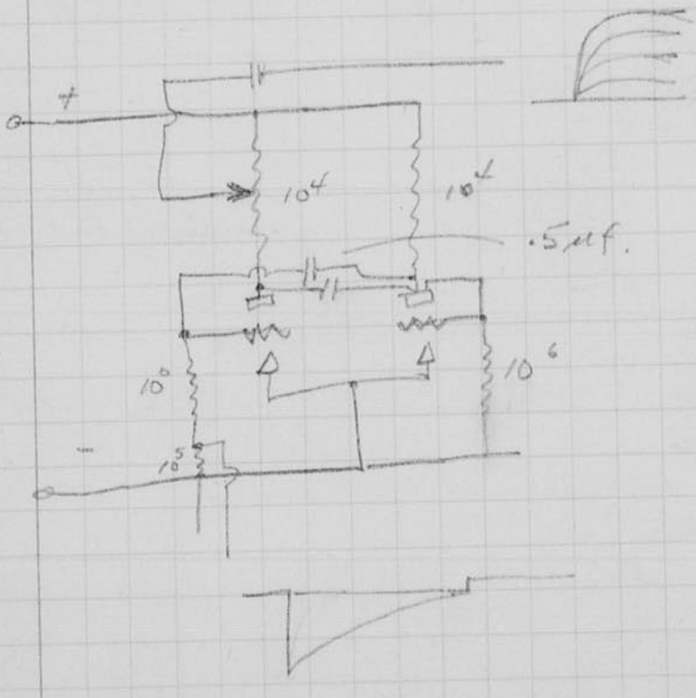
-102 volts on intensity grid cutoff 4000 V.
106 " " " " " 4000 + 25,000

Defocus blur with 300 volt pulse on

Spot appears ok with 250 volt intensity pulse with -250 on the grid..



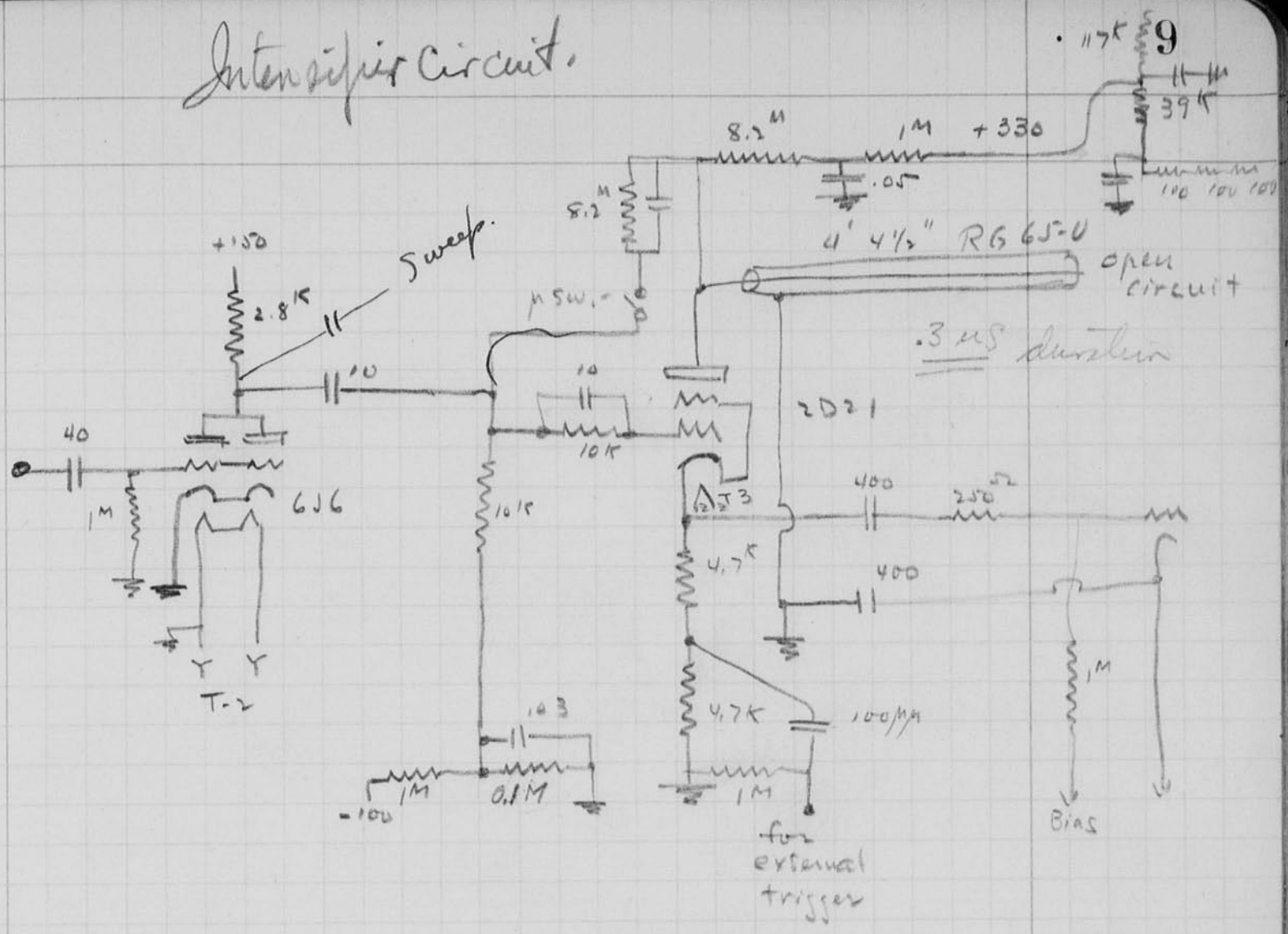




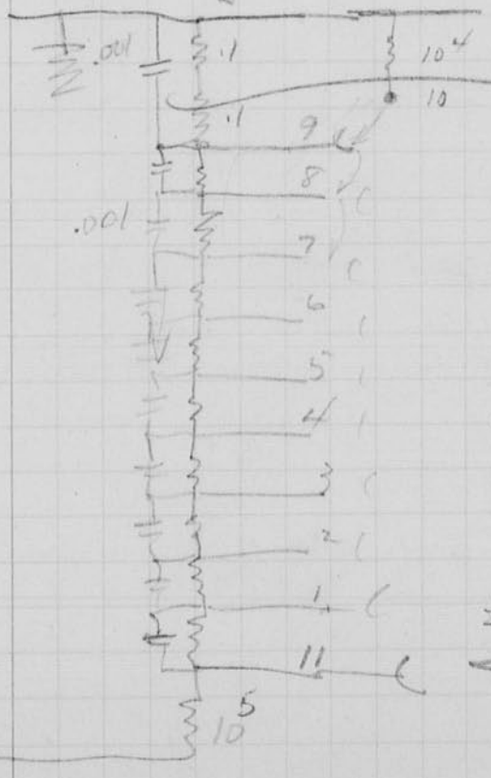
Multivibrator

Signal generator

Intensifier Circuit.



Feb 8 Sunday 1948 Photomultiplier circuit



increased to .03 mf.

$i' = c\frac{de}{dt}$ $dt = 10^{-6}$ $de = 10$ $c = .001 \times 15^{6}$ gr to dynode 9.

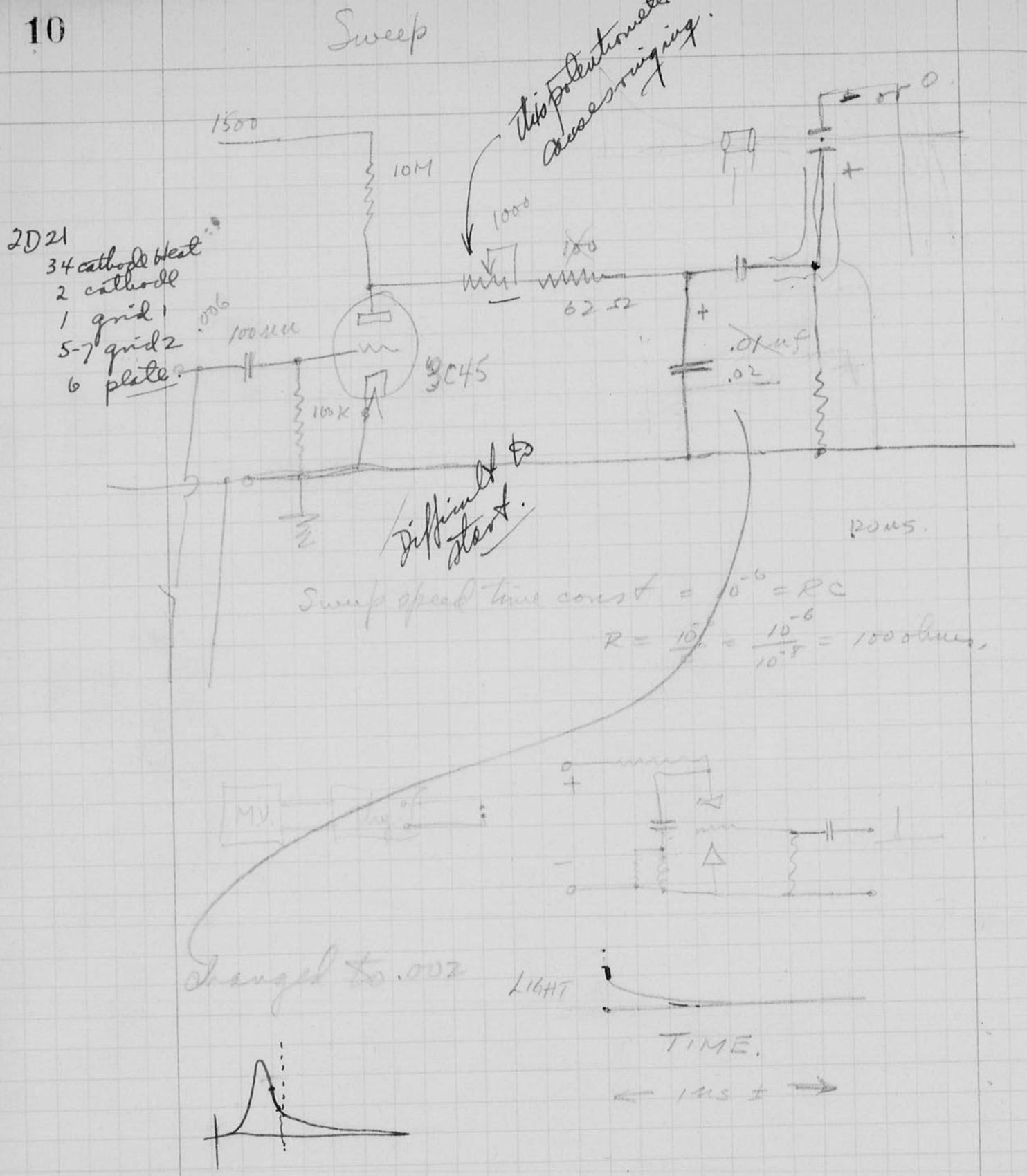
$i' = 10^{-9}\frac{10}{10^{-6}} = \frac{10^{8}}{10^{7}} = 10^{-2} = .01$ amp.

output $= 10^{-2} \times 10^{4} = 100$ volts.

900 volts total on string.

Spark from 50 ft cable at 5 ft gives 1/2" deflection when scope has 4KV + 25 KV.

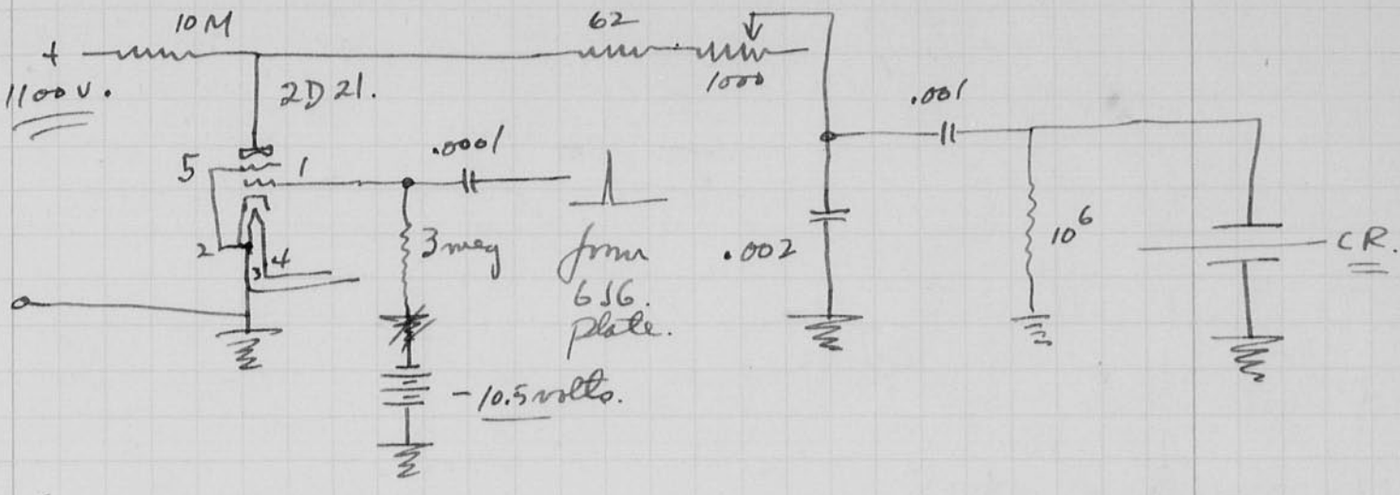
Sweep

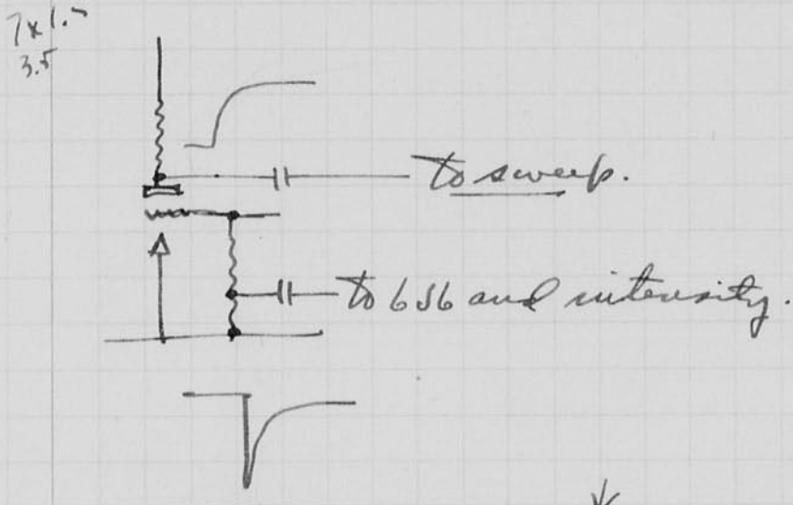

1500
10M
1000
100
62-Ω
.006
100 MM
100K
3C45
.01 mf
.02
+
2D21
3 4 cathode heat
2 cathode
1 grid 1
5-7 grid 2
6 plate
Difficult to start.
200 V.
Sweep speed time const = 10⁻⁶ = RC
R = 10⁻⁶/10⁻⁸ = 100 ohms.
MV
Changed to .002
LIGHT
TIME.
← 1 ms →

Harold Edgerton.
Feb. 9, 1948.

27 mm per ft. 54 A/U.

~~Spec~~ Sweep table changed to 2D21.

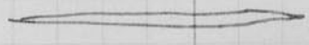




Scope shows that intensity is on first since a dot is shown.

TIME.

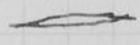
Bias battery on 2D-21 (Sweep) changed from -10.5 to -4.5 gave the sweep on the screen showing the start of the intensity.



TIME.

After a few minutes the intensity came later.

TIME.

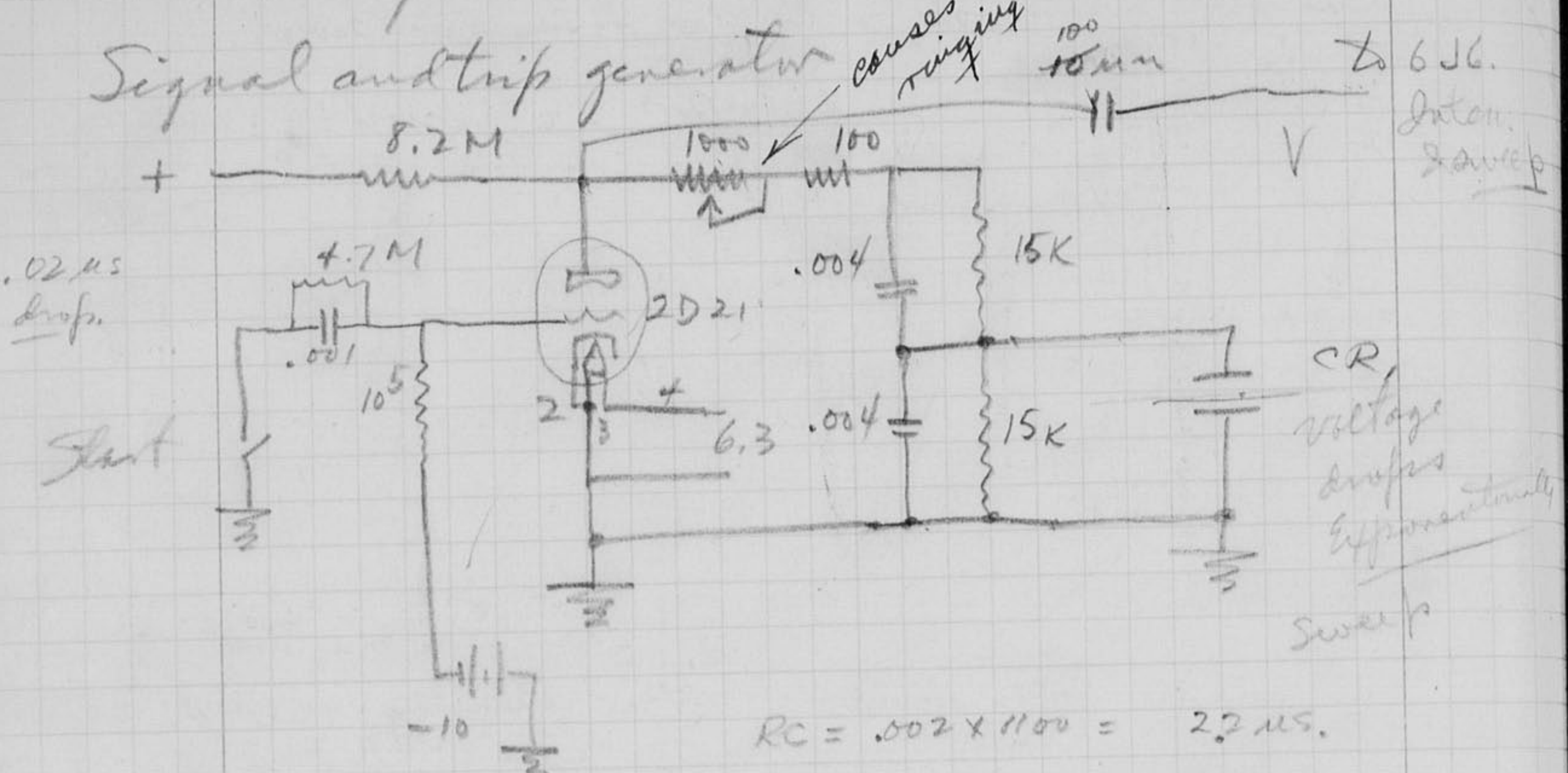


Sweep voltage changed to 100 volts with -4.5 bias.
Delay time is a function of bias and plate voltage on 2D-21

 Feb 10 1948

[illegible] Tassel Colson Hood Bldg.

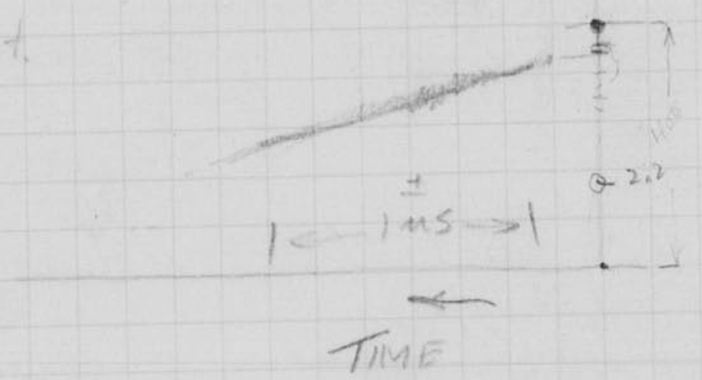
Signal and trip generator



RC = .002 × 1100 = 2.2 µs.

$e = E\,\varepsilon^{-\alpha t}$

$\frac{e}{E} = .8 = \varepsilon^{-\alpha t}$



$\varepsilon^{-\alpha t} = .8$

$t = ?$ $\frac{1}{RC} = \alpha = \frac{1}{2.2}$

$-\frac{t}{2.2} = \ln .8$

$t = 2.2 \ln .8$

$= .484$

n	ε^{-n}
0	1
.1	.9
.22	.8
.35	.7
.51	.6
.69	.5
.91	.4
1.2	.3
1.6	.2
2.3	.1

.002

$2\times10^{-3} \times 8\times10^{6} \times 10^{-6}$

16×10^{-3}

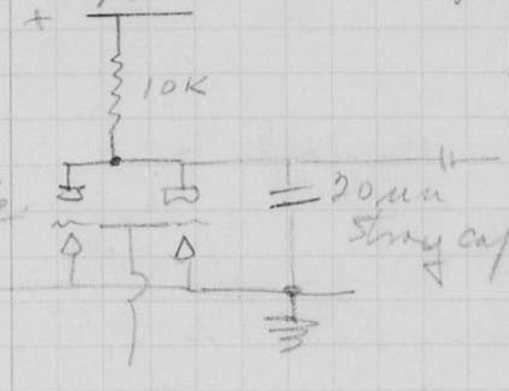
200×10^{-12}

10^{7}

.002 [illegible]

the 6J6 (page 9) plate supply voltage was varied from 100 to 300 volts. The delay increased with 100 to .2 of RC. With 300 volts the delay was smaller.

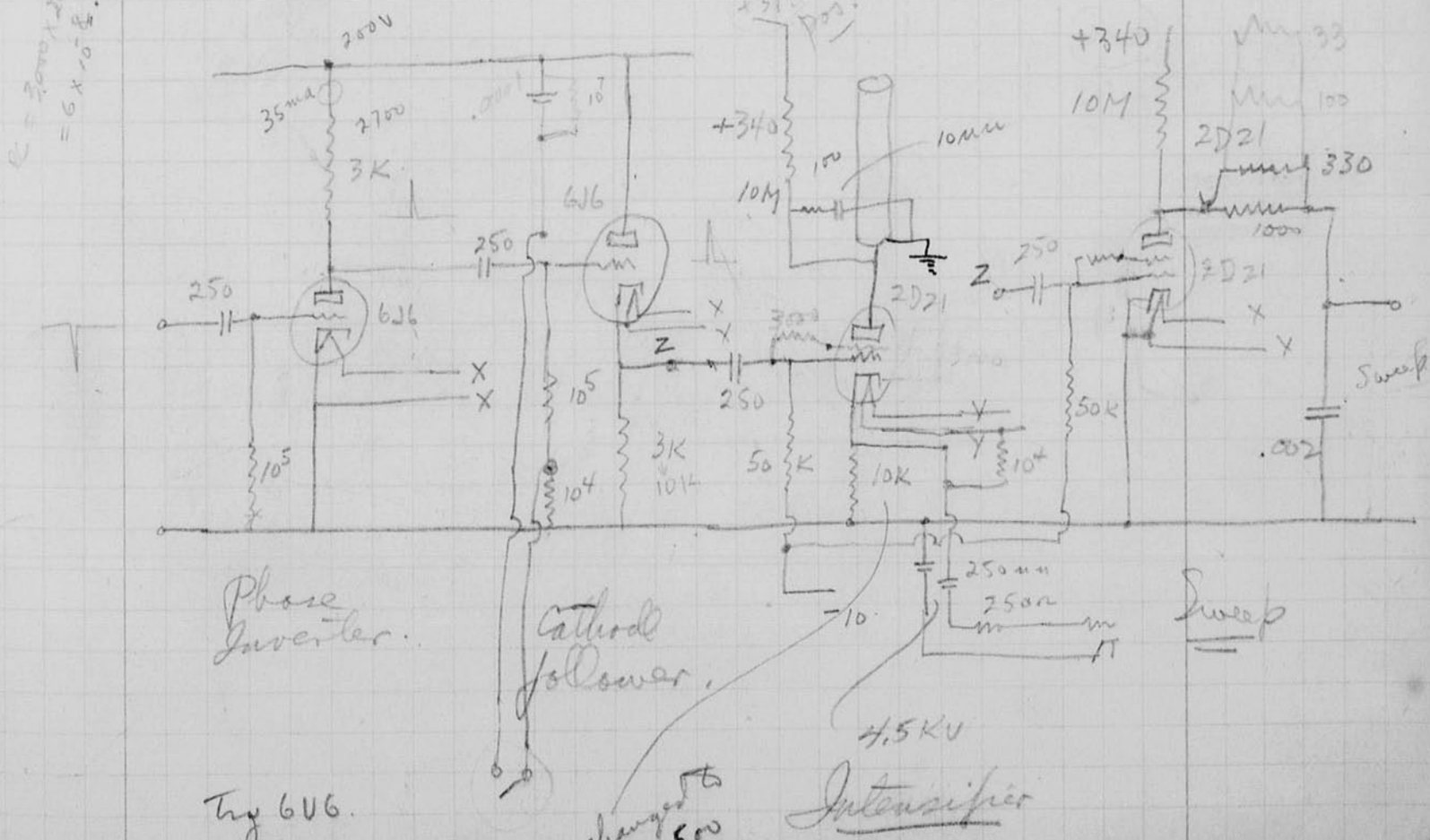
decreased plate resistance to 10K with 300 volts no appreciable improvement.

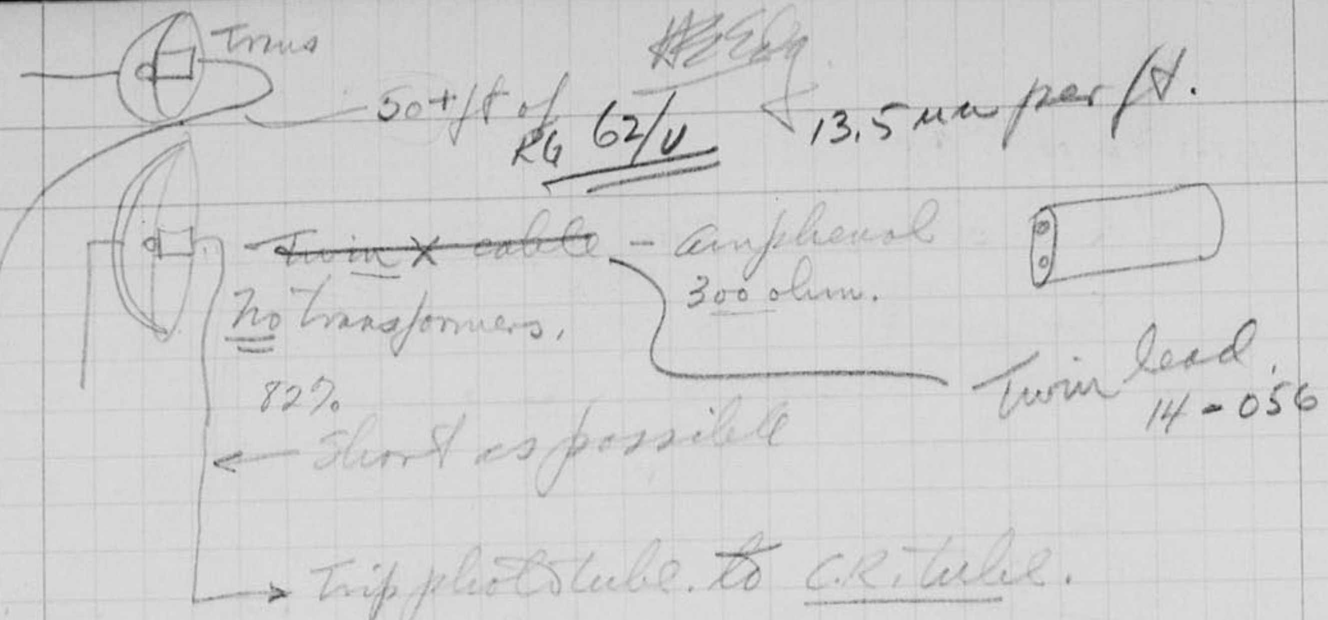


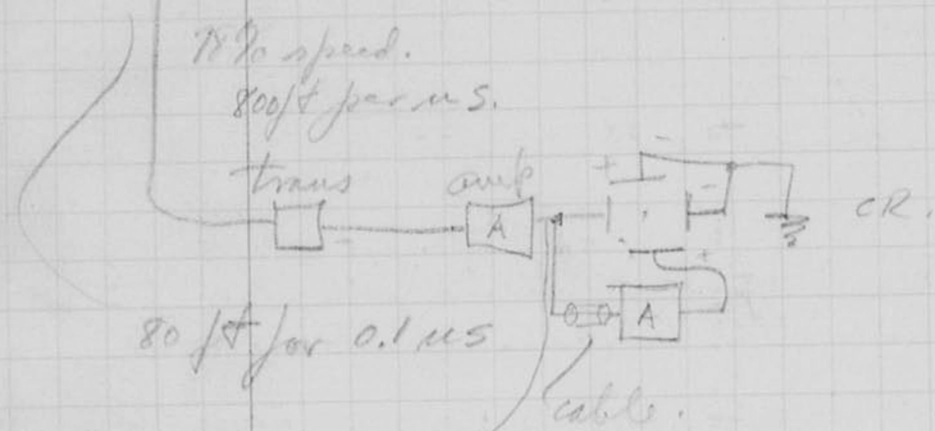
$RC = 10^4 \times 20 \times 10^{-12} = .2 \times 10^{-6}$

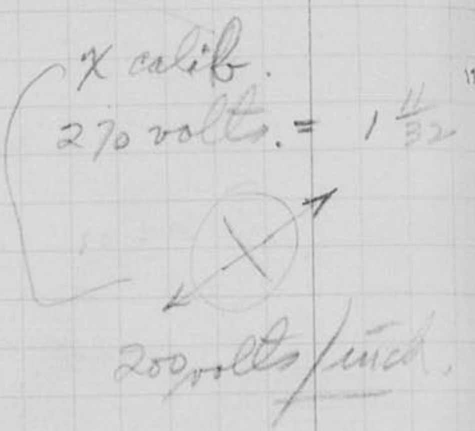
Feb. 11, 1948. Conclusions of last night. The 6J6 and the 2D-21 give a delay of about .2 m.s. Most of the delay is in the plate voltage rise of the 6J6.

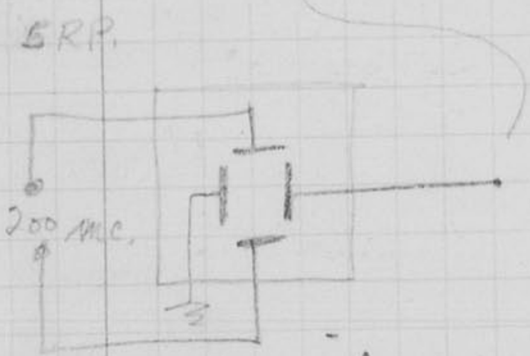
Conf. with Brier, Russell, Colson, Williams.
New circuit to try. 6J6 amp into Cathode follower then to 2D-21 for intensity

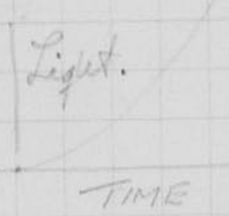




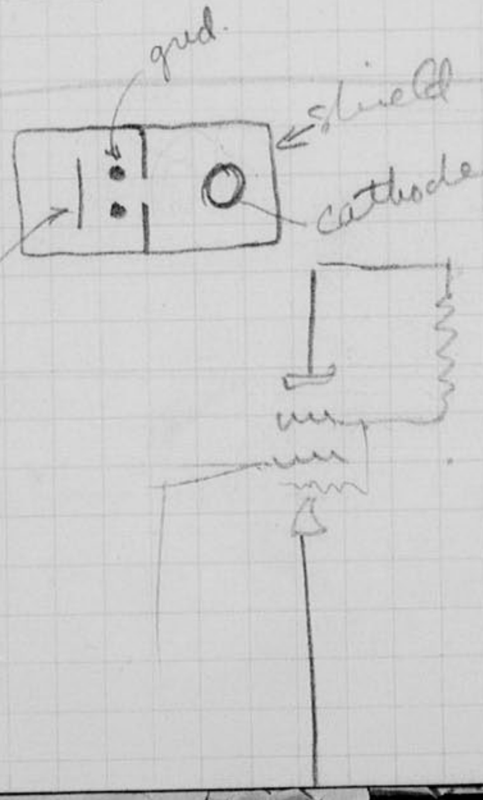




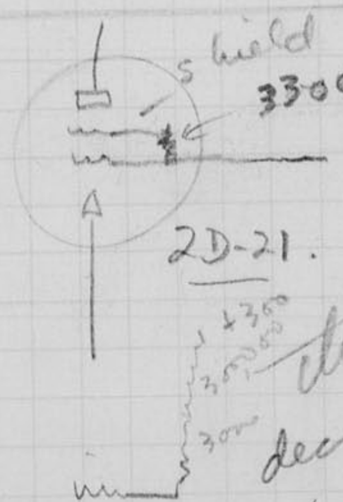




300000



Genius suggested



$C = 10^{-11}$ R = .03 .2

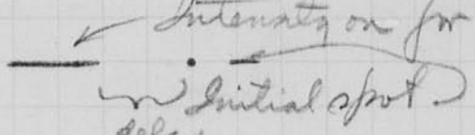
this connection decreases the time delay from .2 µs to about .05 µs.

Feb 12 1948

B Shapiro & E Colson.

Time delay of intensifier

Sweep (exponential) RC = .002 x 100 x 10^{-6} seconds.



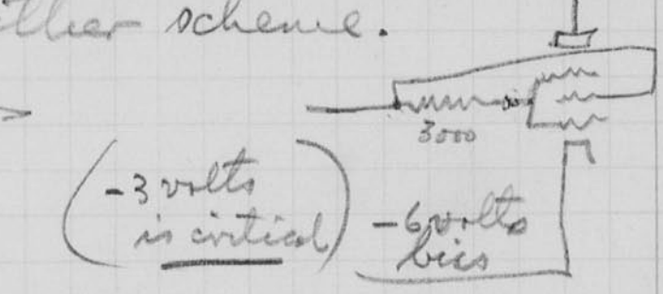
Bias adjustment on thyratron 2D21 has no effect on delay.

636 voltage varies the delay about 10% ± the delay is smallest with 350+ volts on the 636 circuit

The screen grid of the 2D21 was connected + with 300 V and 300,000 ohms to see if this would decrease the time. No decrease

Resistance was decreased to 150,000. Same result.

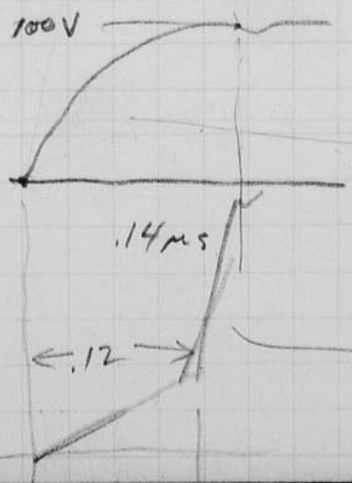
We plan to use the other scheme.



Estimated delay time is 0.2×10^{-6} ms.

Cathode follower 90 volts in .8 x .2 = .16 ms.

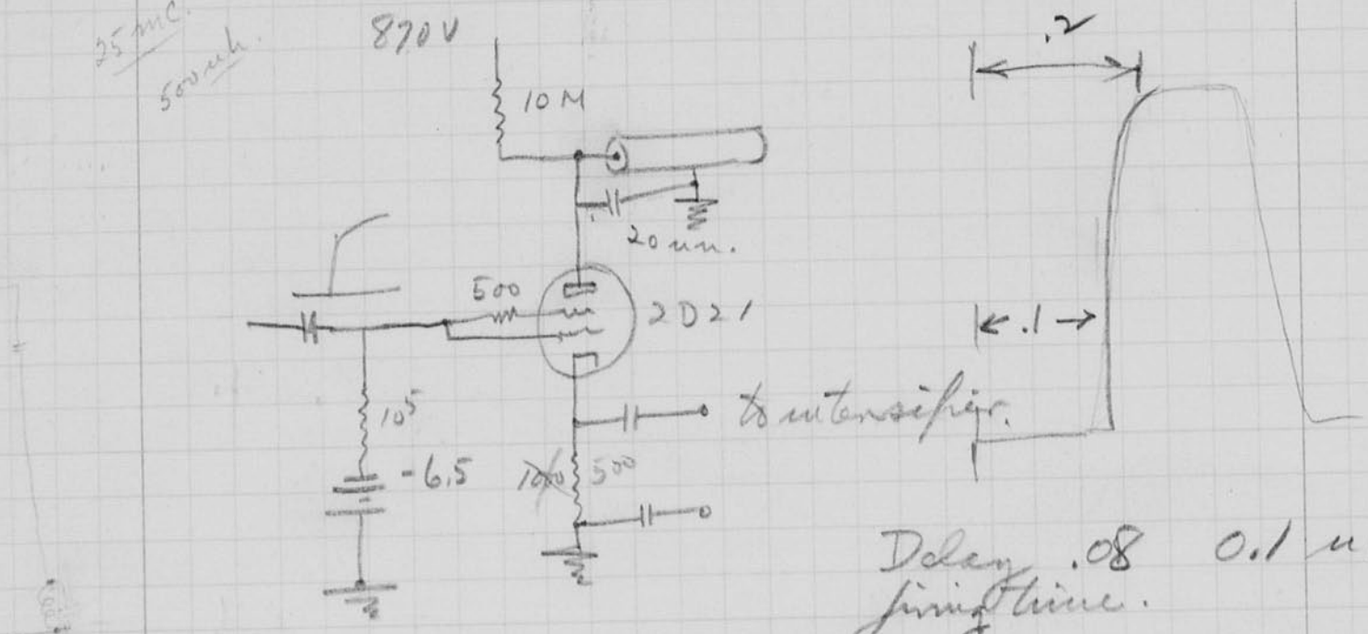
Intensity thyratron fires in .14 ms.



No comment??

Plate voltage increased to 870 volts on 2D21.

Time delay slightly less 5x2 = 0.1 μs.

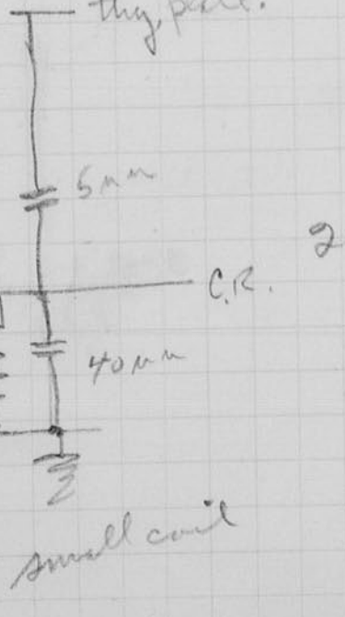


Delay .08 0.1 μs,
firing time.

$RC = 10 \times 10^{-12} \times 10^{5} = .001$ μs

20 mm - some lash on front of intensifier.

10 mm better. 10 mmf with 100 ohms.



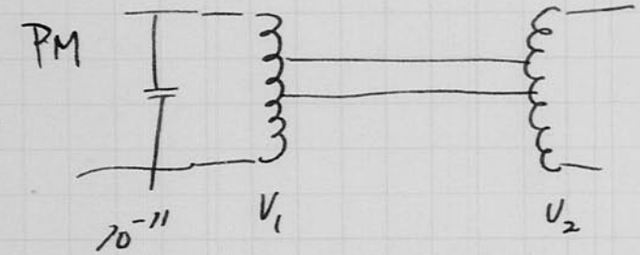
20 mc tuning wave.

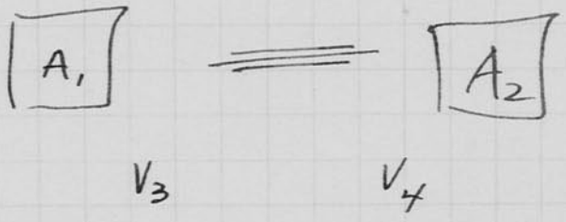
Feb 14 1948 Ziegler, Eberhard (Everett.)
M.I.T. Edgerton

100 ma from the photo multiplier.

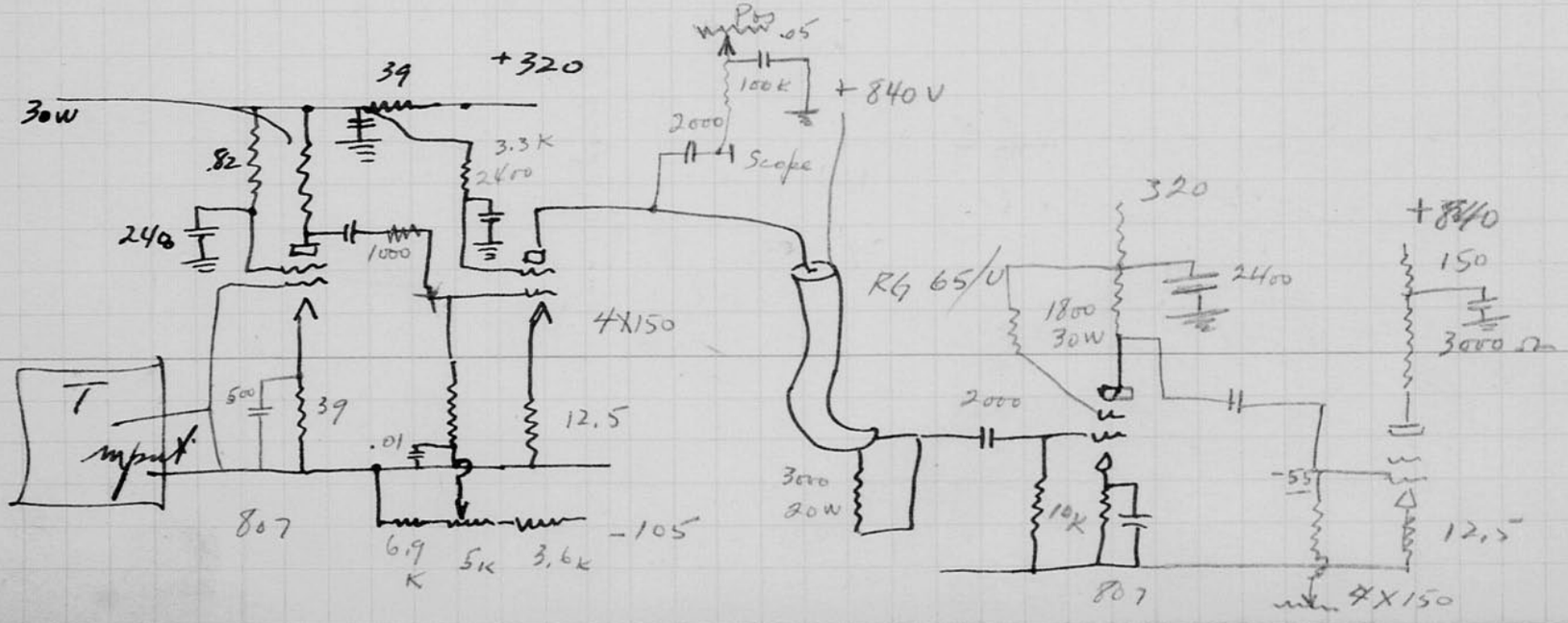
807+
4X150

f eq mc.	$\alpha \times 10^8$	$1/\alpha$	Z.	V_1 when P.C saturates	V_2	Gain.	V_3 out of 1st amp.	2nd Limit	Time reduction.	V_4	V_5
10	.5	2000	670	67	50	25	1200	A_1	5	240	6000
20	1.	1000	500	50	35	10	350	A_1	10	35	350
40	2.	500	330	33	20	3	60	all	20	3	9.





807 120 ma, 100 volts.
4X150 60 ma, 720 volts.

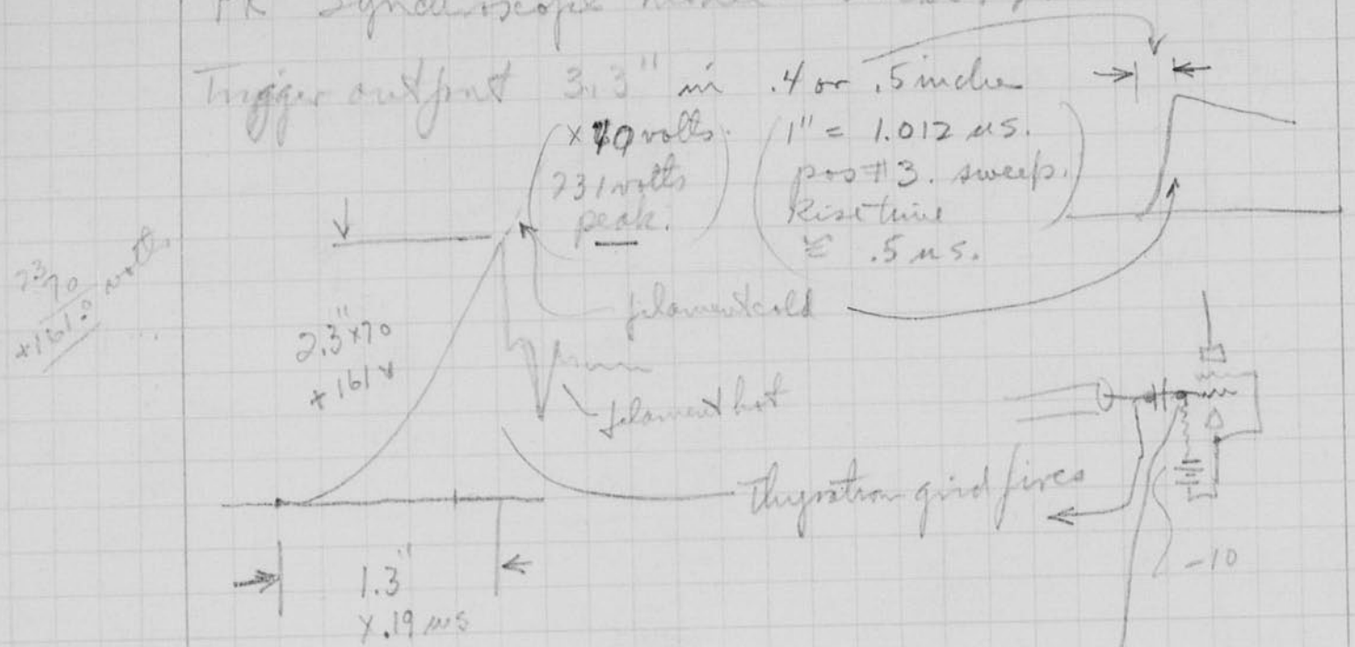


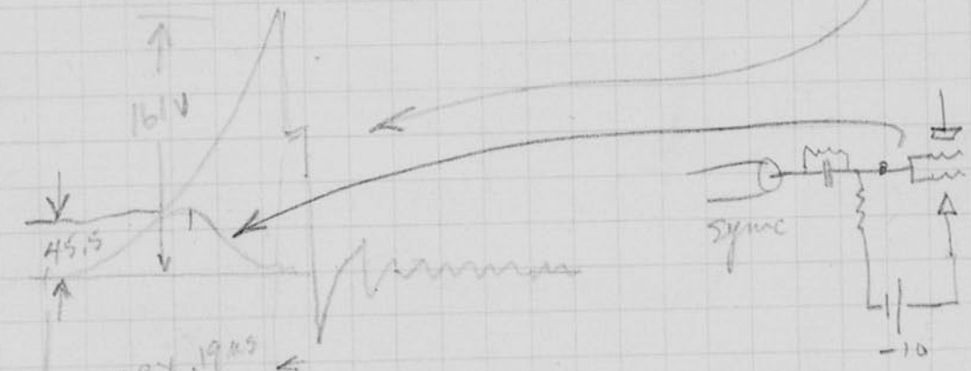
#6 Eckert
Feb 16 1948

Starting characteristics of the 2D21 thyratron.

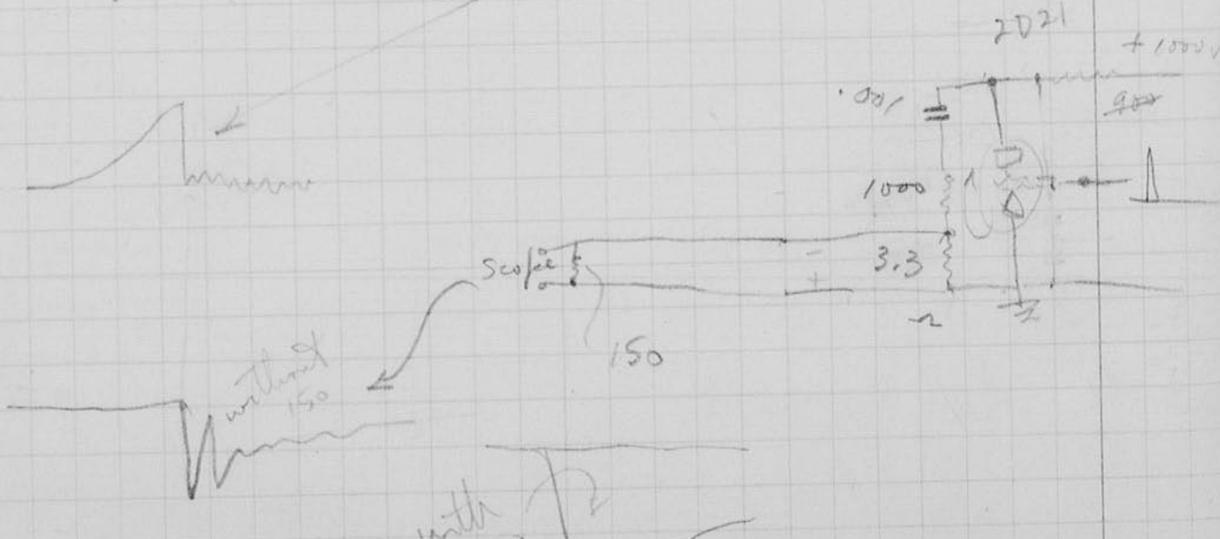
PR Synchroscope model 5 Serial #7.

Trigger output 3.3" in .4 or .5 inches
(×70 volts 231 volts peak.)
(1" = 1.012 ms. pos #3. sweep. Rise time ≤ .5 ms.)



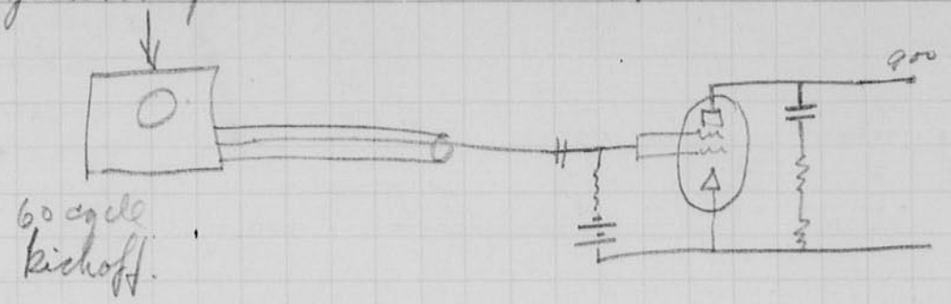


with plate supply connected.

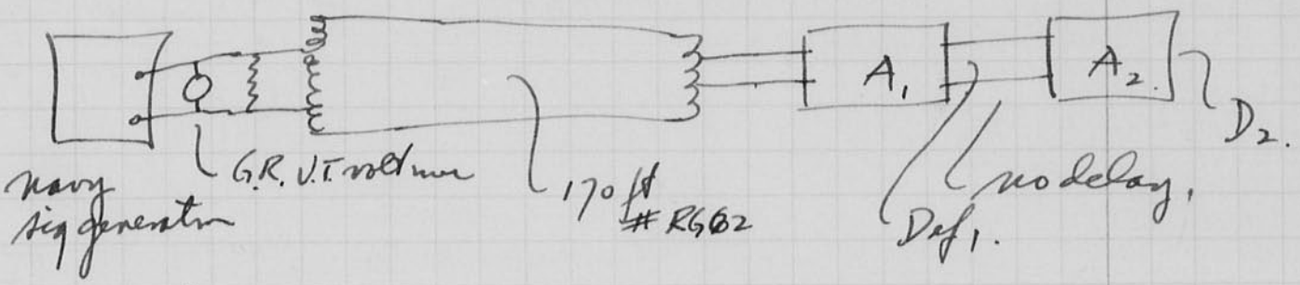


H. Edgerton Jussel
Herb Grier Colson.

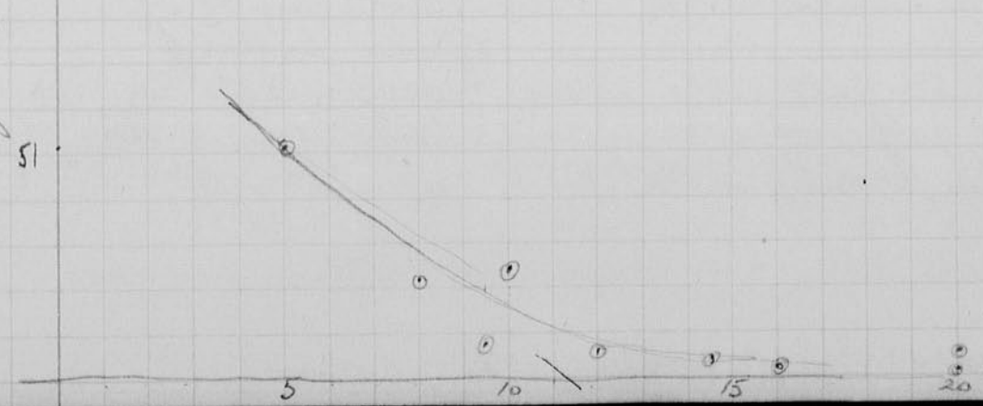
Synchroscope Model 5 Serial 47.



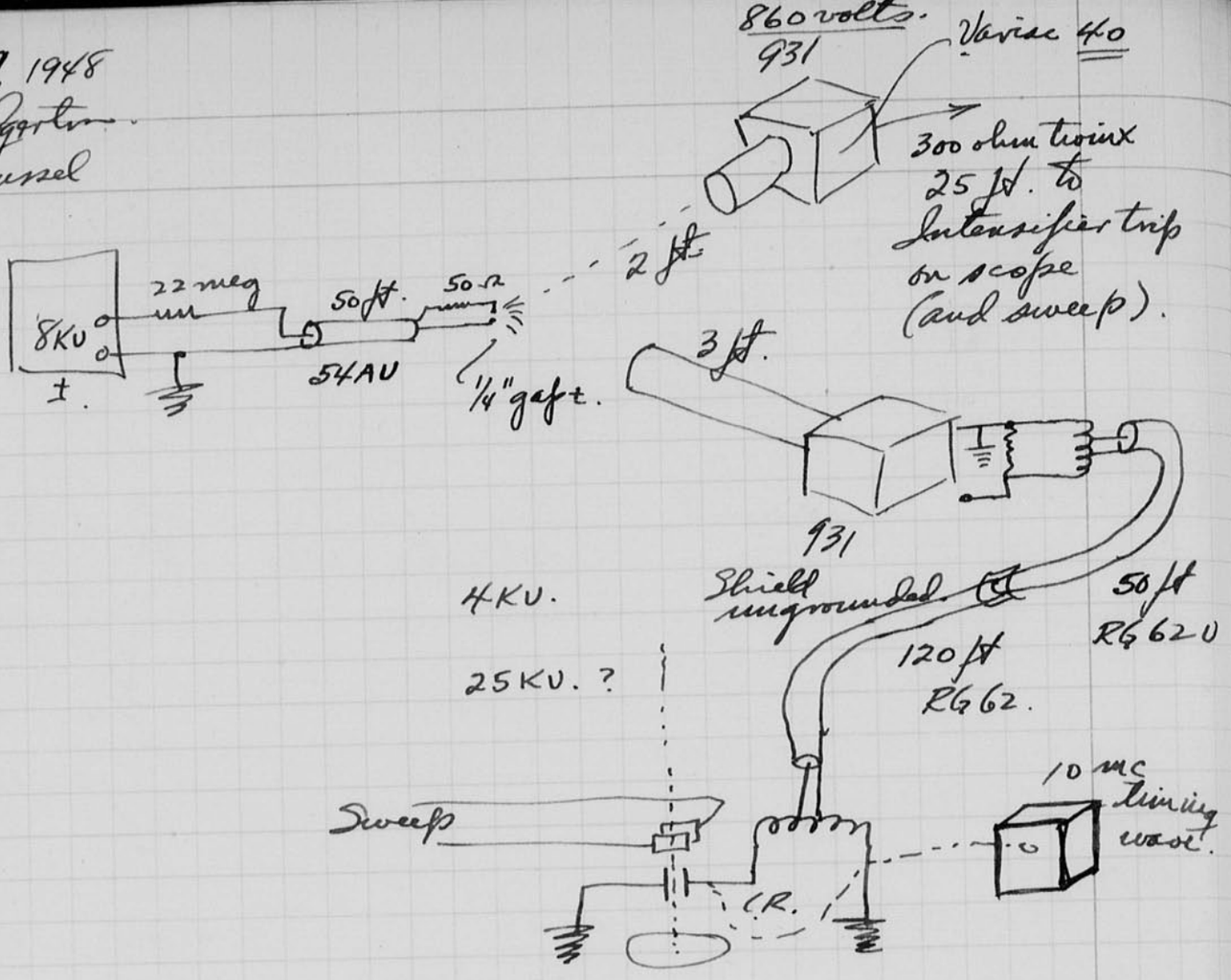
Feb 18, 1948. Edg & Jussel. Freq-gain curve of photocell to CR tube limit



f mc.	Volts input.	V_s	I_s.	I_p.	D_1 mm.	D_2. mm peak to peak. on CR tube		
20	.3	320	~~60~~			3.		10.
10	.25	320	~~60~~			6.		24
5	1.00	320	~~60~~		2.7	51.		51
8.	.8	320	~~60~~ 232	78	1.1	17.		21
9.5	.7	320	232		~~1.~~	5		7.
20	1.	320			0.	2.		2.
15.								
12.	1.5 V	320	232	60-65	~~1.~~	8.		5.3
14.5	1.35 V.	320	232	58.	—	4.6		3.4
16.	1.0	320	232			2.5	25 KV on.	2.5
16	1.0	320	232			6.0	4KV only on scope.	6.0
20	0.45	320	232			3.		6.6
24	.33	320	232	58.		3.3		10.0



20 Feb. 29, 1948
H.E. Edgerton
Lew Hurzel



Film No.
2019 as above. Two sparks recorded on same film.
Two timing waves recorded.

2020. Spark gap from .001" at 4400 x √2 volts.
1. Light trace.
1. Zero trace
1. Offset 10 mc timing trace.

2021 (5) 1st stage 807 to scope plate. Set just same as 2020.
10 mc timing.
2 Zero traces with D.C. Photo mult off.
(Some pickup).

2022 (18) 807 + 4X150 full volts 70 ma. 300V screen
Dilto gap. 4 exposures with Y axis shifted.
Pickup only with P.T. circuit off.

2023 (17) 807 + 4X150 full power as above. One trace and zero
Spark gap dilto.
Trace of input to 807 (with 807 out of socket).

Feb 20 1948
H.E.Duy.

2024. film Spark source .0012 mf at 6000 V±

1. P.M. trans-line-trans plus amp. two stages.
2. Zero trace.
3. Signal direct from P.M.-trans-line-trans.
4. ~~Open~~ Zero trace.

22 Feb 20 1945
H. E. Edgerton

935 photo tube tests.

	V.	ma.	Lumens
Tube No 14.	500	39.5	2240
	1000	79	2240
	1500	110	2240
	2000	132.	2240
no 13	500	48.4	2240
	1000	92.5	"
	1500	123	"
	2000	150	"
	2200	163	"
Burnt Base	500	~~9~~	"
	1000	83.7	"
	1500	145	"
	1000	53	560
"	2000	70	560
	1000	17.6	140
"	2000	17.6	140
	500	13.2	140

Light 10.5 mf 2100 v.
FT-14 no 111 18" from photo cell. No reflector.

Peak lumens 9×10^6

$.9 \times 10^6$ h.c.p.s.

$U = \frac{.9 \times 10^6}{1.5^2} = .4 \times 10^6$ lumens/sq ft.

=

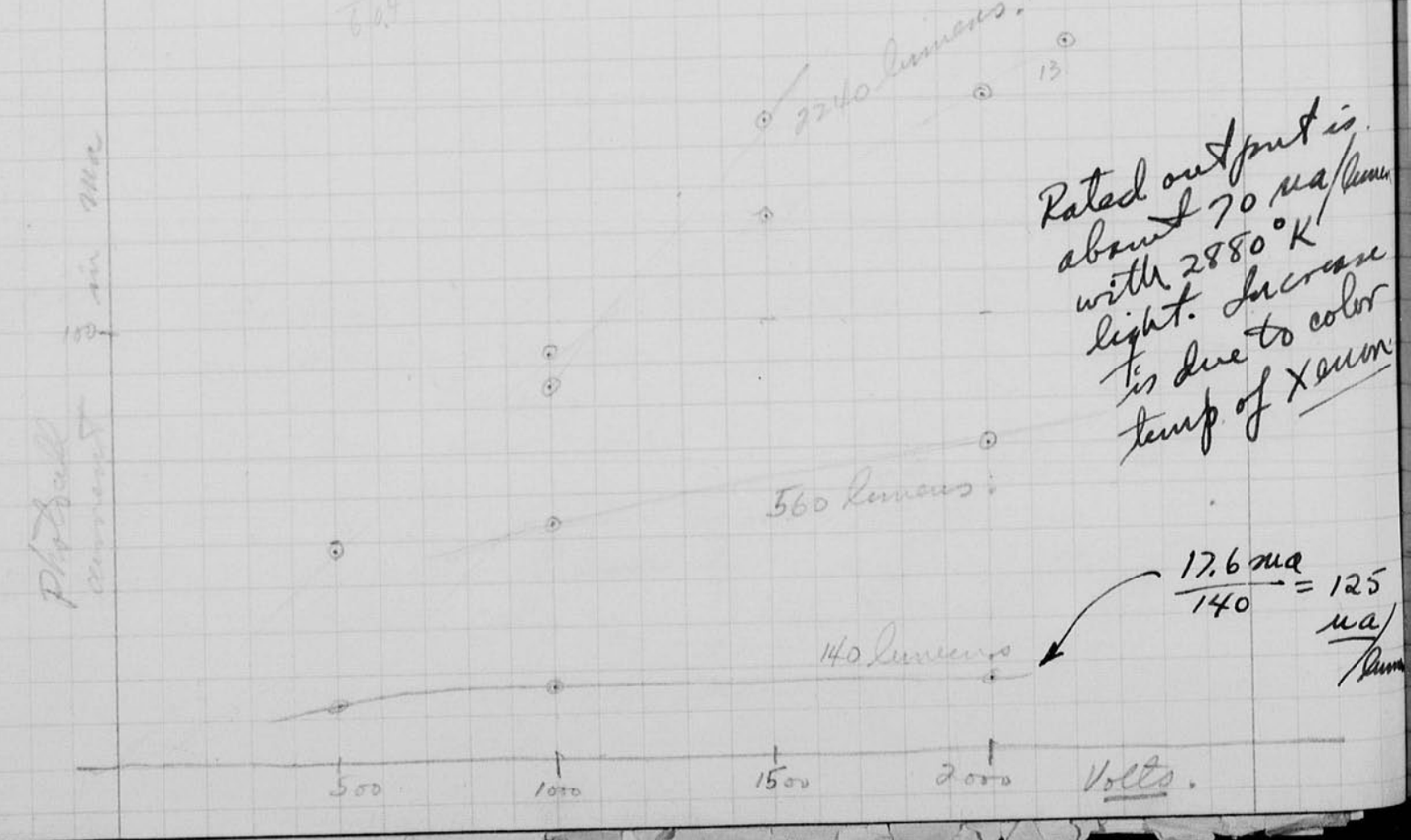
cell area = $1\frac{5}{16} \times \frac{5}{8}$ = 0.82 sq. in.
= .0056 sq ft.

Peak Light on cell = $.4 \times 10^6 \times .0056$
= 2240 lumens.

With Distance = 36" = 3'
Peak light = $\frac{2240}{4}$ = 560 lumens

with Distance = 72" = 6 ft
Peak light = $\frac{2280}{16}$ = 140 lumens

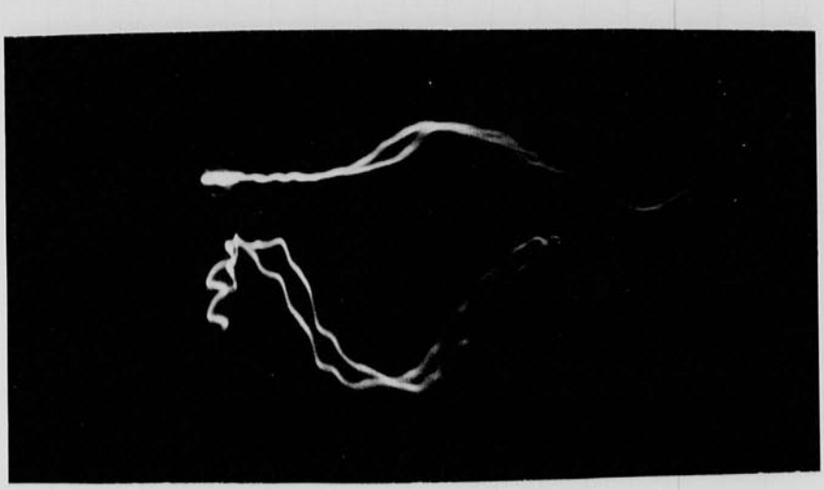
Rated output is about 70 ma/lumen with 2880°K light. Increase is due to color temp of xenon



See page 21

Light

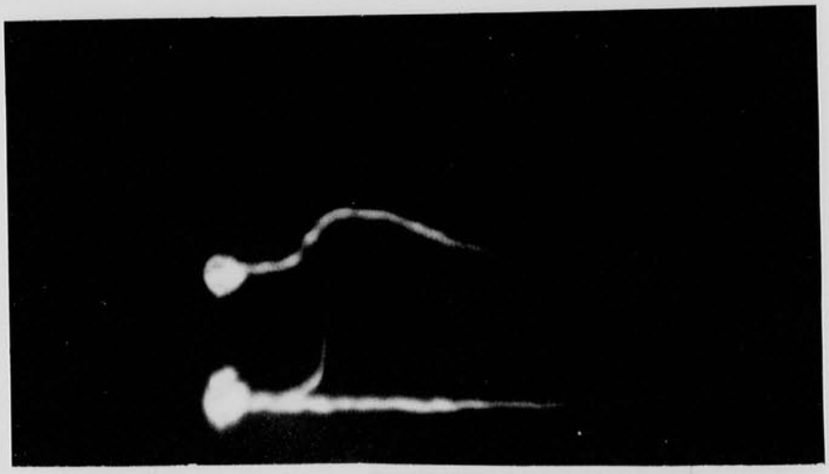
10 mc
timing wave



2019

Spark.

amplifier output.

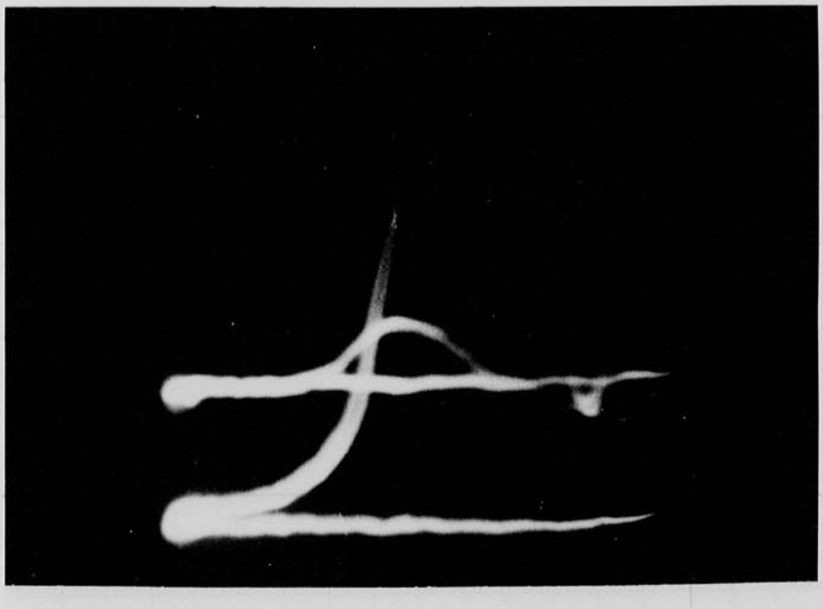


2022

Spark.

amplifier output.

Two records.



2024

#2 Equator
Feb 21. 1948.

Calibration of G.R. light meters with Barstow MacRoberts and al Webb of GR. 69mf 2400 volts on an FT-14 was used. Meter about 2.4 ft from lamp in a velvet housing.

Velocity of light = 186,000 miles/sec.
= 95.4 ft in 0.1 ms.

Data from Fussel, orig from Los Alamos.

P.M. tube gives 15,000 amps at end of active period from moth balls at the P.M. tube at distance 1200 ft. ? yes.

With 935 sens is 1/10⁶ that of P.M. current is then 15 ma.

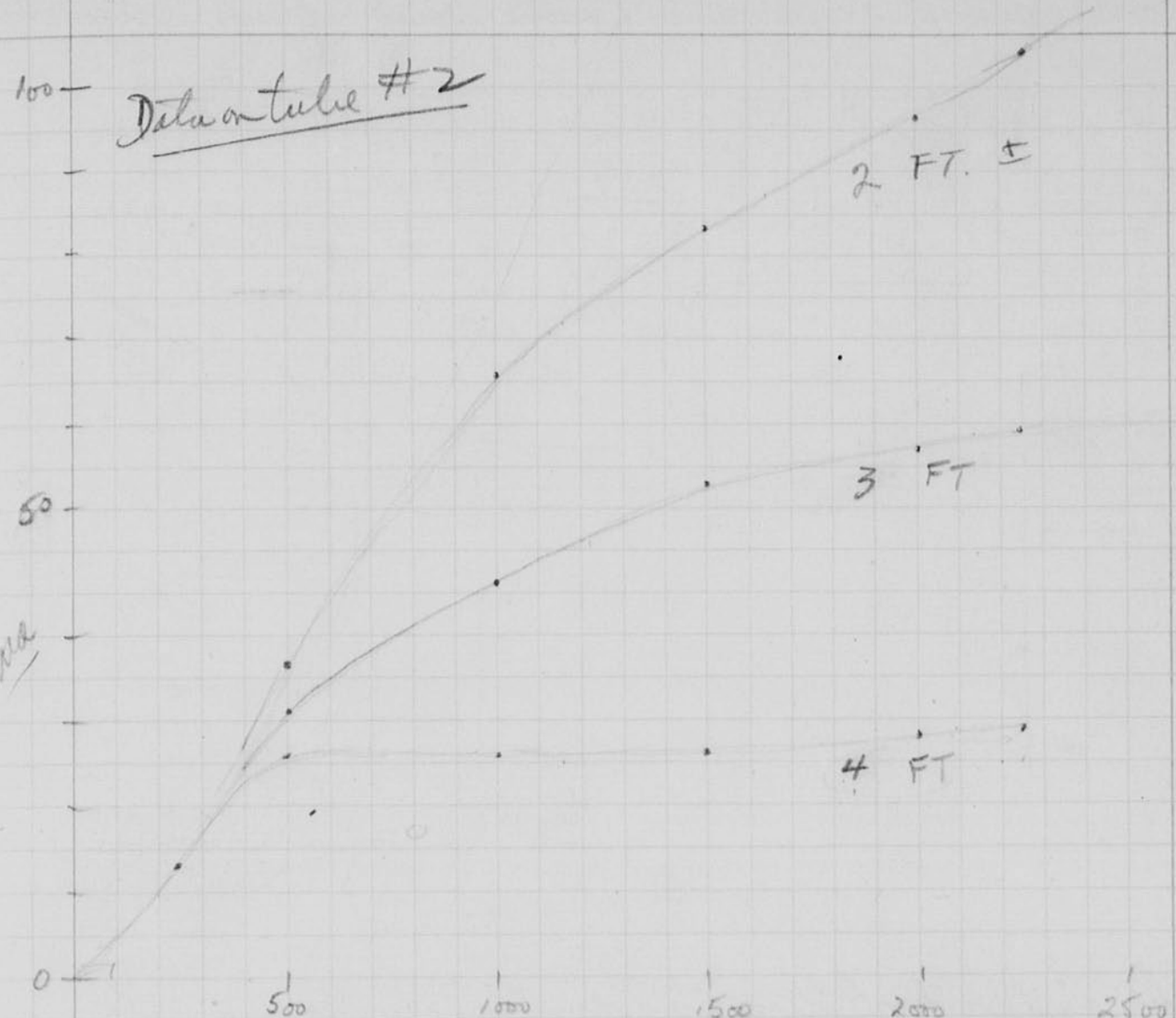
with 10^4 ohms → 150 volts output.
10^3 " → 15 volts output.

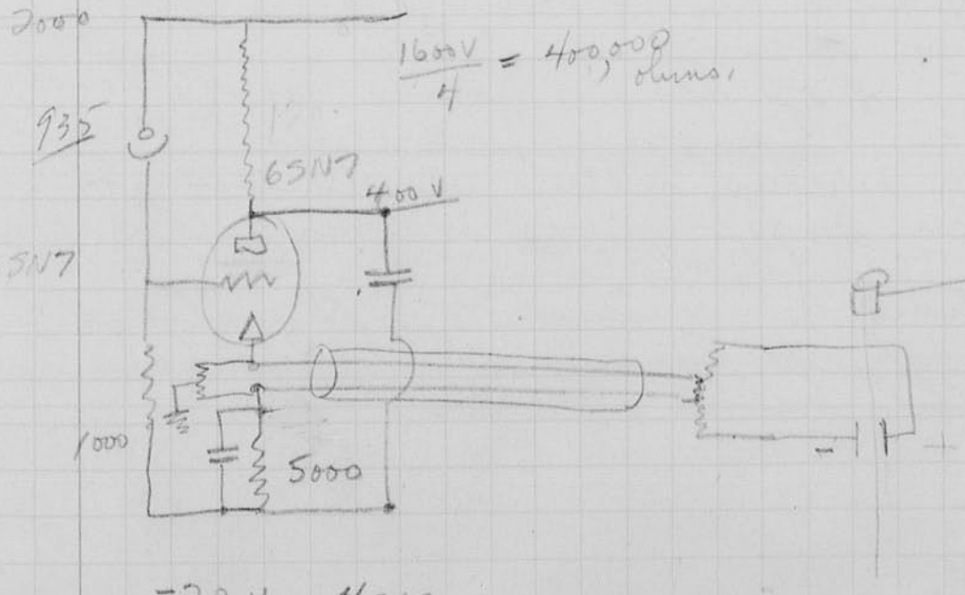
Sensitivity of 935 phototube.

#2	19.7 ma
3	15.4
4	22
5	26.4
6	13.2

5/8 from 10,5 mf at 2000 v
1000 ohm

Data on tube #2



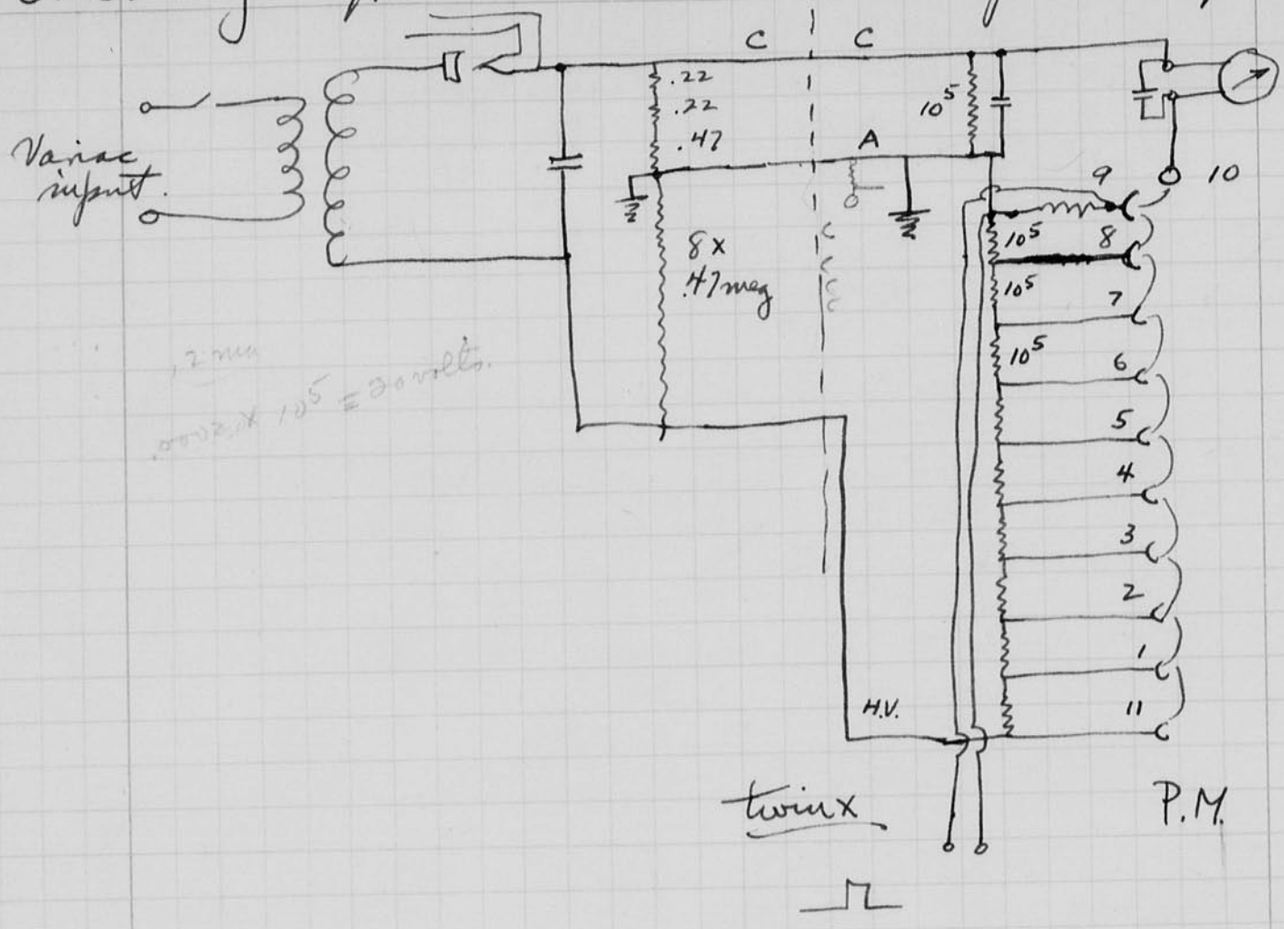


-20 V 4ma.

26 March 2 1948

H. E. Edgerton Ed Colson

Chas Wyckoff. Photo multiplier trip.



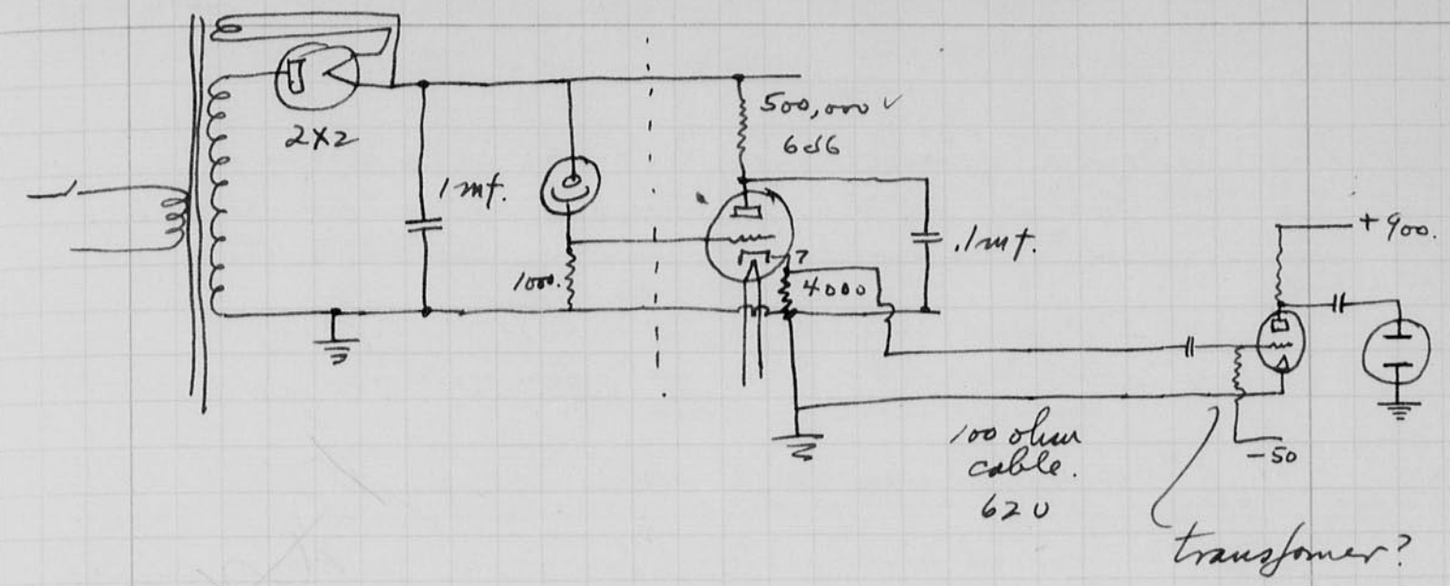
.2 mm
.002 x 10^5 = 200 volts.

the output of this was put directly into the cathode follower stage on the scope intensifier and sweep.

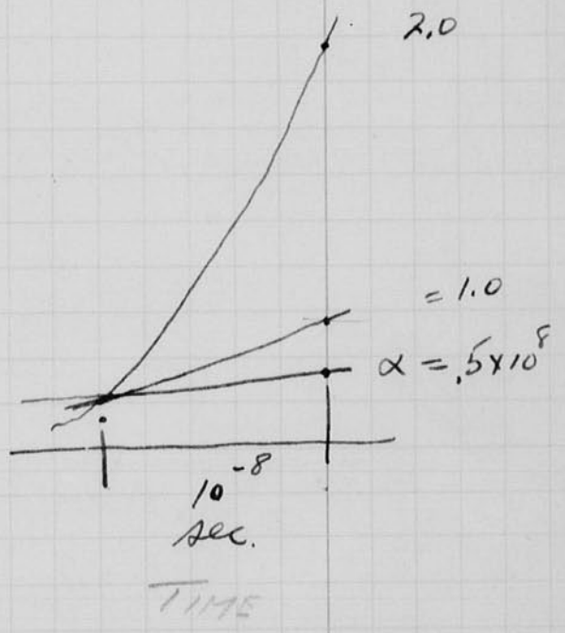
The spark light source and photo multiplier source was then connected and the 150 ft of delay cable installed. The pulse signal was not observed until the input to the photo ~~multiplier~~ trip power supply was increased to 125 volts.

The time delay is in the thyratrons. With the set up shown here the delay is about the same as that shown at page 13.

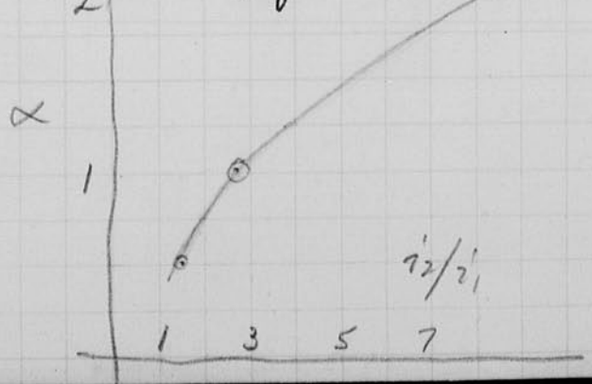
935 Phototube Pickup.



α	i_2/i_1 for 10^{-8} sec.
$.5 \times 10^{+8}$	1.57
1.0	2.73.
2.0	7.7



Log.
Feb. 25 Wed left Boston 210 pm
Feb. 28 Sat. ar. Los Angeles 11 am
Mar. 1 Mon. left Terminal Island. 9 am. on albermarle AV5.



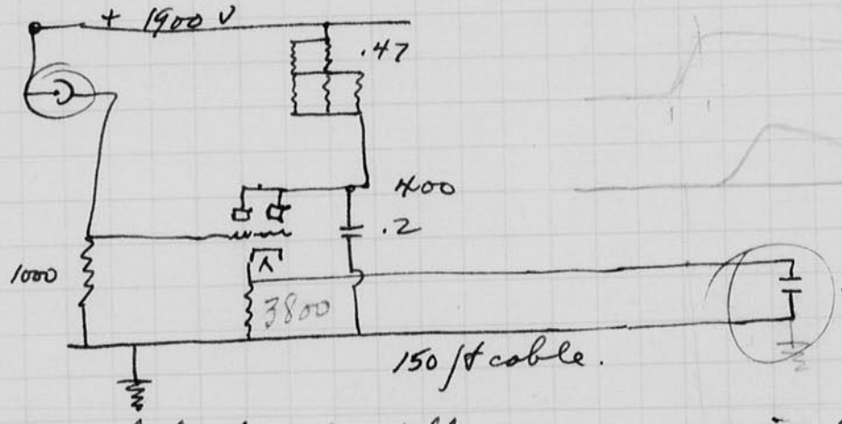
28 March 3 1948
H E Edgerton
Eberhard.

Film No.

1. Source spark gap. 4 or 5 KV into 0.1 mf mica. Pickup. 931a positive surge as per page 26. into cathode follower on ~~thyratron~~ thyratron trans and RCA photo multiplier into 100+50 ft cable as used in cambridge then into transformer and single ended into the scope.

- 10 mc timing ~~wave~~ plus zero. both lower than light trace.
- ground ends on transformer on scope connected together and grounded.

2. Phototube 935



A. Output of spark with P.C. 6 or 7 inches away.

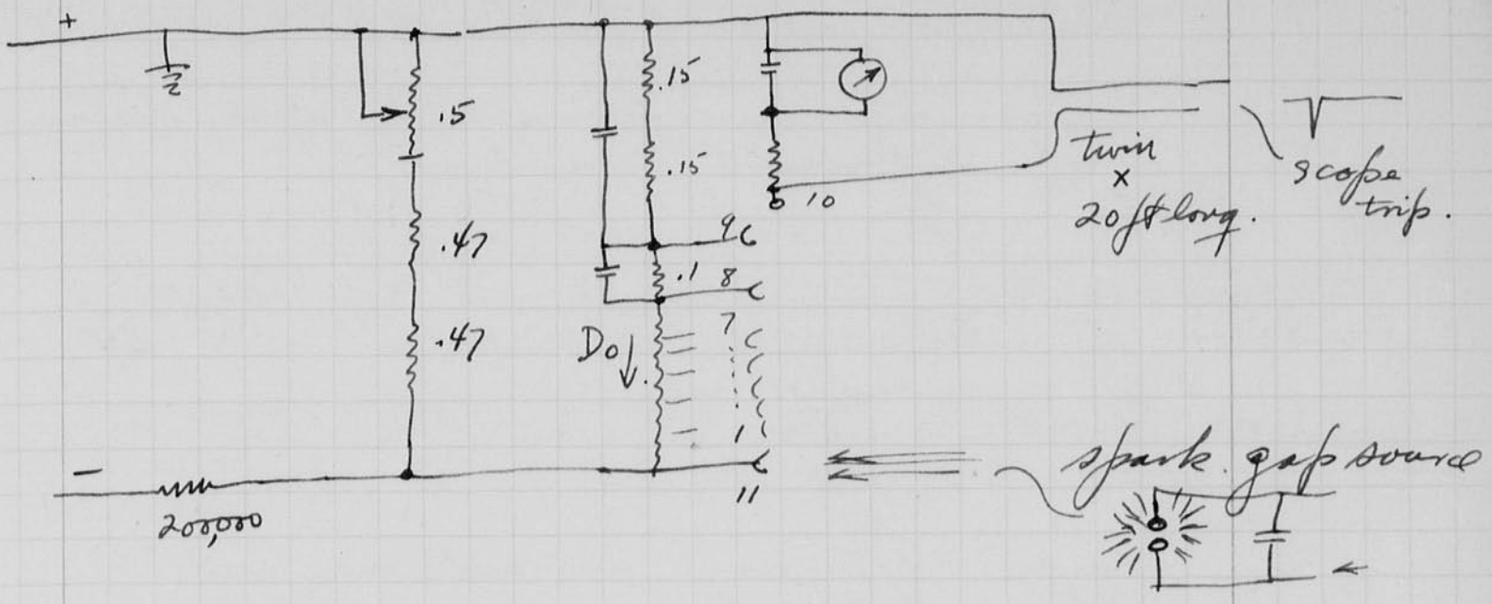
B. Zero.

C. Axis moved 10 mc.

D. Zero.

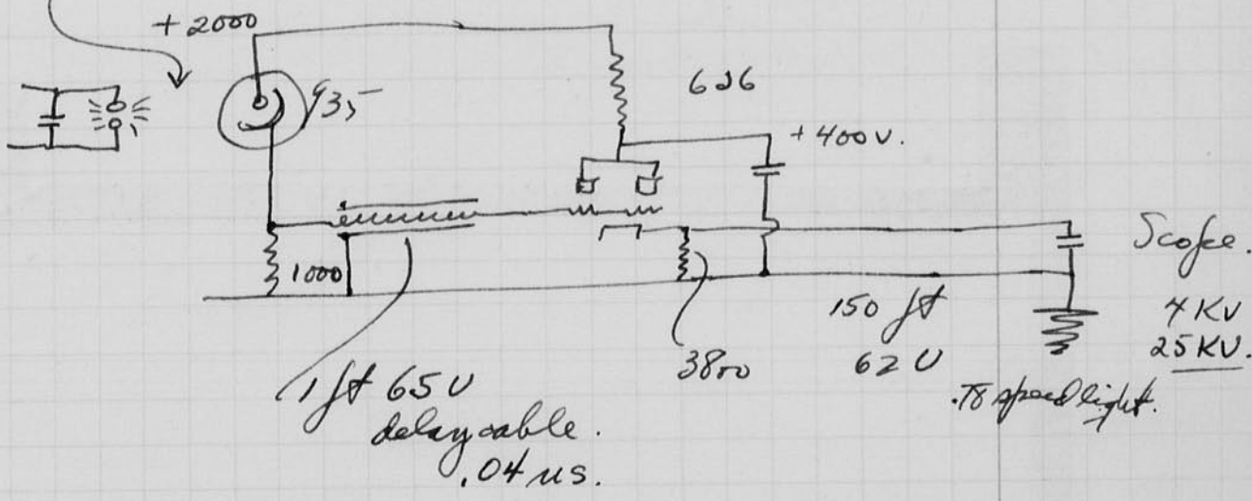
March 1948 Halfway to Hawaii from Los Angeles

Photomultiplier for trip.



Film No.

3. Spark 4.5" from 935 cathode.
3.5 ft to neg ~~00~~ P.M. trigger.



For trigger trip see above and ~~aroun~~ page 13.

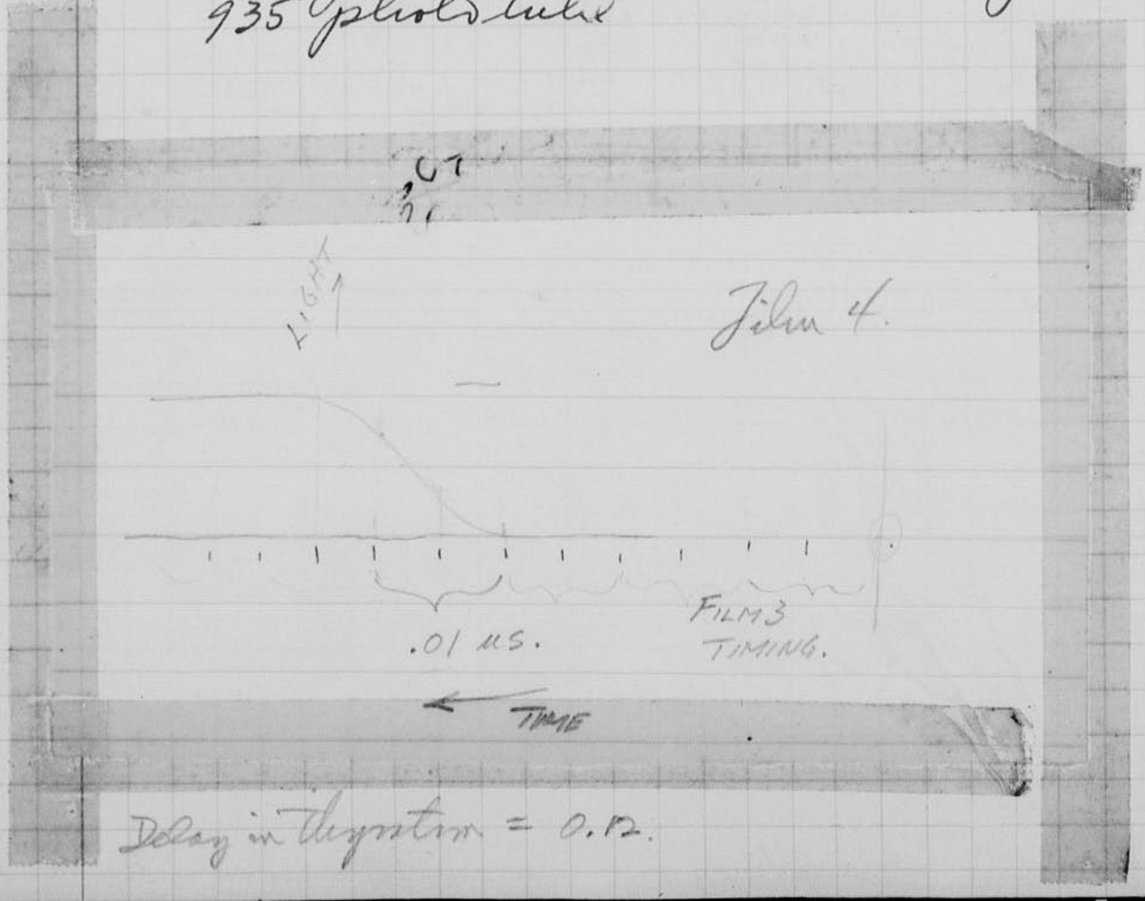
Film No

4. Same set up as 3 without 200 mc pickup.
Several sweeps made for comparison of different sparks.

5. 200 mc timing wave. Several sweeps.
R = 34 ohms in parallel with ~~33~~ 100
and other values.
2.3 = 2 cycles.
2.3 mm = .01 seconds.

6. amp. 4 × 150 amp 45 ma Screen 360 v.
Input about same as 3 and 4.

7. Two records made. One with the transformer and one without. The output ~~without the~~ with the transformer seems lower and there is some delay.
The sparks were the same as photo No 3.
935 photo tube



150 × .78 = 118 ft
186000 miles/sec.
× 5280 / 10^6 = 985 ft per MS.
118 / 985 = .12 MS
additional .04 MS between PC & cathode follower
Total delay = 0.16 MS.

Sweep speed
.2×3 cm = .01 μs
23 cm = 1 μs
10" per μs on film

8

9

10 calibration .28 cm = 70 volts. $\frac{70}{.28}$ = 250 volts per cm or 25 volts/mm

11 1. Output of spark into 935 - 170 ft 62 Ω - ~~transformer terminated in 1000 ohms.~~ to scope plate .75V

2. Ditto but terminated into 100 ohms. 100 ohms 20.V should match 62 Ω cable.

3. Zero for case 2 $\frac{2.1}{2.3}$ X = .01 - μs. = .0091 μs. ✓

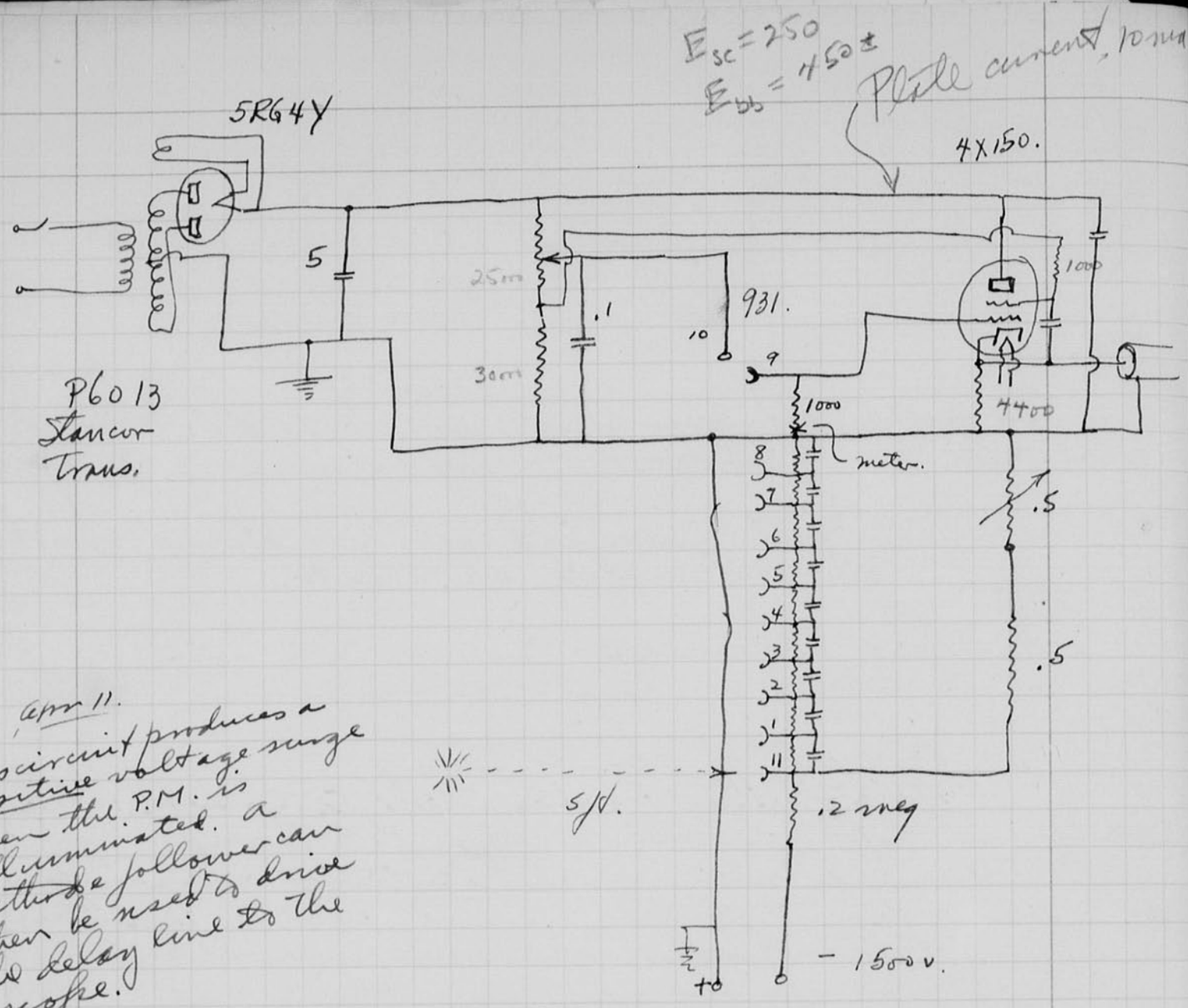
12. 1. Output of spark into 935 - 170 ft 62Ω cable transformer terminated into 1000 ohms. Scope measures input to transformer. .6×25 = 15V
Trans gain = 27.5/15
2. Scope measures output of transformer 1.1×25 = 27.5V
3. Output on scope unterminated. 1.8×25 = 45V
4. Output of line to scope direct. 3.4×25 = 85V

13. 1. Ditto of shot 4 of film 12. Output of 935 and 170 ft of cable after cathode follower.
Was long afterglow time ringing?
2. Same as 1 but with Eimac grid load ~~on~~ in parallel with scope plates on output of cable.

Mar. 6, 1948

14. New photo multiplier circuit just finished by Ed Colson 4×150 amplifier tube as cathode followed. 150 ft of 62 Ω cable then 4×150 amplifier with 3000 ohms to scope.

15. ~~Input~~ Output of cable as per 14 with second 4×150 disconnected (small signal). Sat = 5.2×5 = 130V
Repeat with more light on P.M. tube.



note · appr 11.
this circuit produces a positive voltage surge when the P.M. is illuminated. a cathode follower can then be used to drive the delay line to the scope.

Film 16. 5.7×25 = 142.5 v.

931 - 4X150 cathode follower to 150' cable to scope

935 - " " " " " " " "

49×25
122 v

Delay = 5.×.0091 = .046 μs.
2.5 = .023

The 935 phototube has less delay and a steeper rise according to a look.
The 935 was 1/10 the distance of 931.

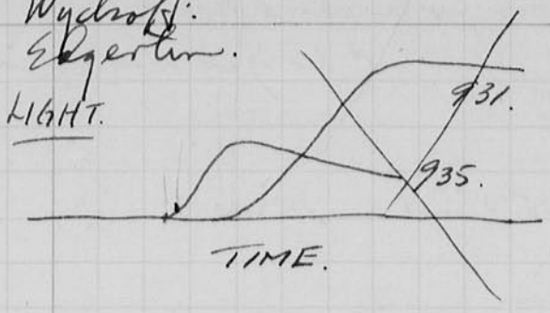
note

a piece of glass was used as a filter for the 935 to cut out the U.V. there was a 60% reduction in amplitude but the form and starting time of the image was the same as without the glass.

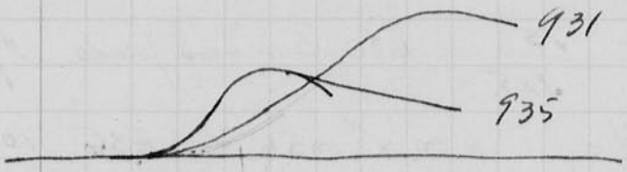
Grier
Eberhard
Colson
Wyckoff
Edgerton.

1 Layout of Hawaii or Albemarle. AVS.
Mar. 6, 1948.

LIGHT.



Visual observation.



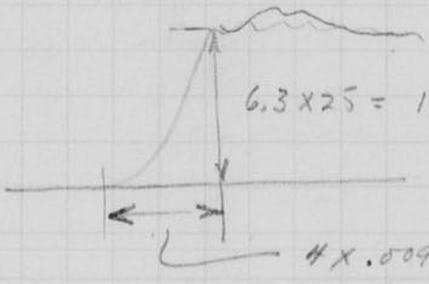
Visual observation.

1000 ft per ms.

.01 .005 = 5 ft.

Film 17. Spark light output measured by 935 into Eimac 4X150 tube (C.F.) 170' 15/16" cable to scope.

The output appears to be about double that of the 935 and 6J6 combination.



Film 18 Spark light output.

① 935 into Eimac 4X150 (CF) 170' 6" cable to scope same as Film No 17.

② Ditto except a 4X150 used as amplifier between cable and scope.
Plate load = 3500 ohms ±

34 March 8, 1948. Pearl Harbor
H. E. Edgerton Oahu

Off ship yesterday at noon for a three hour tour of the island. Then had supper at Royal Hawaiian Hotel and saw concert.

935 photocell Light output. $\frac{75 V.}{1000} = 0.075$ amp = 75 ma.

125 ma per lumen

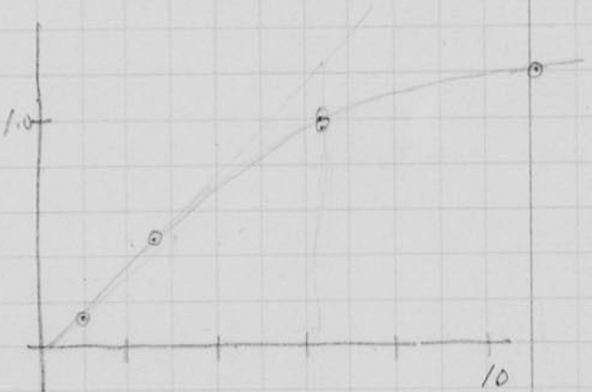
lumens = $\frac{75}{.125}$ = 600 lumens peak at p.c.

600 00 lumens/sq ft = 600 x .0056 = ~~3.36~~ 107,000 lumens/sq ft.

Source candle power = $\frac{107{,}000}{3.36} \times .5^2$ = ~~26,800~~ 26,800 C.P.

935 driving 4X150 cathode follower 170' cable (62 V) to scope.
1000 ohm load resistor.

C.R. Deflection	.1"	.45	.15	.95	1.2
935-Sp distance	4"	6"	10"	4"	3"
d^2	16	36	100	16	9
$1/d^2$	.0625	.278	1	.0625	.0111
	6.25	2.78	1	6.25	11.1



$10^3 \times 8 \times 10^{-12} = 10^{-8}$ sec

931 photomultiplier + surge 1000 ohms anode & 4X150 PM tube and 150 ft of 62 V cable.

distance to light = 21'
a curtain over the light reduced the light to about 1/25 th or less.

Deflection on scope about 1/2 inch.

Mar. 9, 1948

Harold Edgerton. Mike Eberhard.

1 ~~Boat~~ Day out of Hawaii west

P.M.	Rating.
28	6.6
28	12.2
52	24.
76	5.7

Further visual tests of photo multiplier tubes. The light output from the spark source was measured with the scope and small circuit. All 6 PM tubes showed the same type of output signal. There seems to be a delay. Change of final anode voltage from 330 to 440 makes no appreciable difference in the final saturation current.

9.30 Abandon ship drill

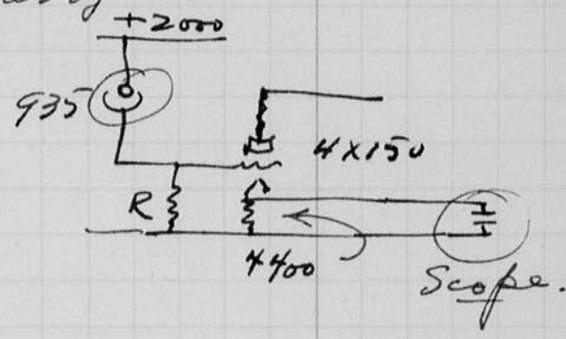
10.00. Conference on method of meas of α.

Filter No 19.

270 ohms and 1000 ohms.

Spark source now has double the capacity it previously had.

$C = .008 \times 4 = .032$



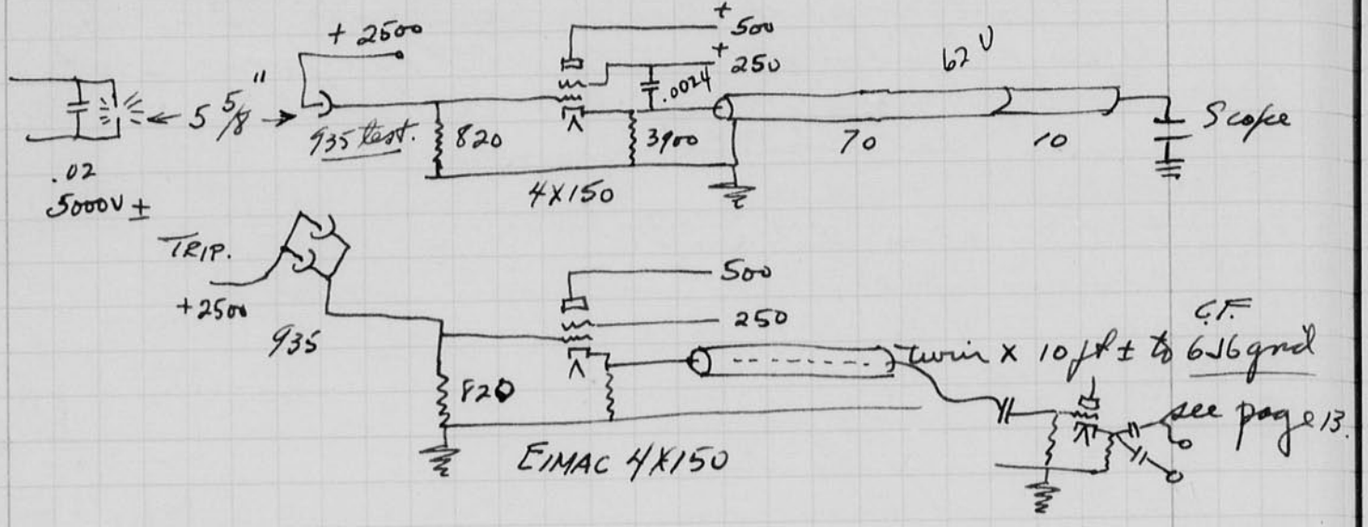
Method of obtaining extra voltage is to use another cathode follower and open ended line. This was discussed at length with Brier and Eberhard. The gain will be less than 2 for each combination of C.F. and line.

Mar 9 1948

Harold E. Edgerton. Eberhard.

935 tube tests.

TUBE No	6.	12	3	1	2	9	E5 ✓	E2 ✓	7	8	E3 ✓	10	11	5	4.
DEF. IN"	.4	.66	.3	.35	.45	.45	.25	.2-	.25+	.5	.2-	.3	.4	.45	.3



Film 32. Study of spark sources with above arrangement using # 2, 6, 11 photo tubes in parallel.

Top. 1. Rounded gap electrodes

2. Pointed neg. grounded

3. .. .. .. 1 ohm in series

4. 200 mc timing wave.

Film 33. Top Spark with Inductance 1" diam
single turn of #14 wire. Capacitance is .008 mf.
voltage about 4 or 5 thousand .032 mf
Middle No inductance
Bottom timing wave 200 mc.

NOTE. all osc taken today N.G. because of
faulty connection in the delay cable near
the scope 20 ft.

Film 34 Output of spark .032 at 4000 v.
200 mc timing wave.

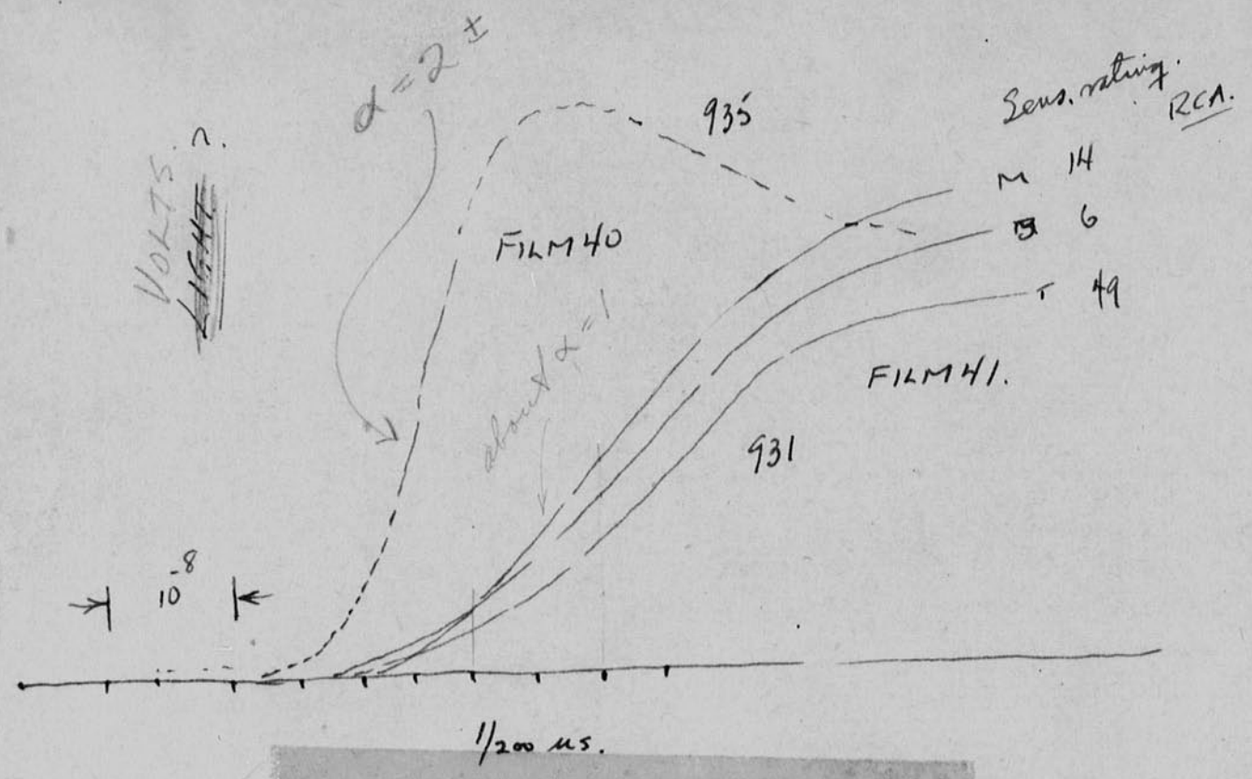
35. Spark output.
200 mc timing wave

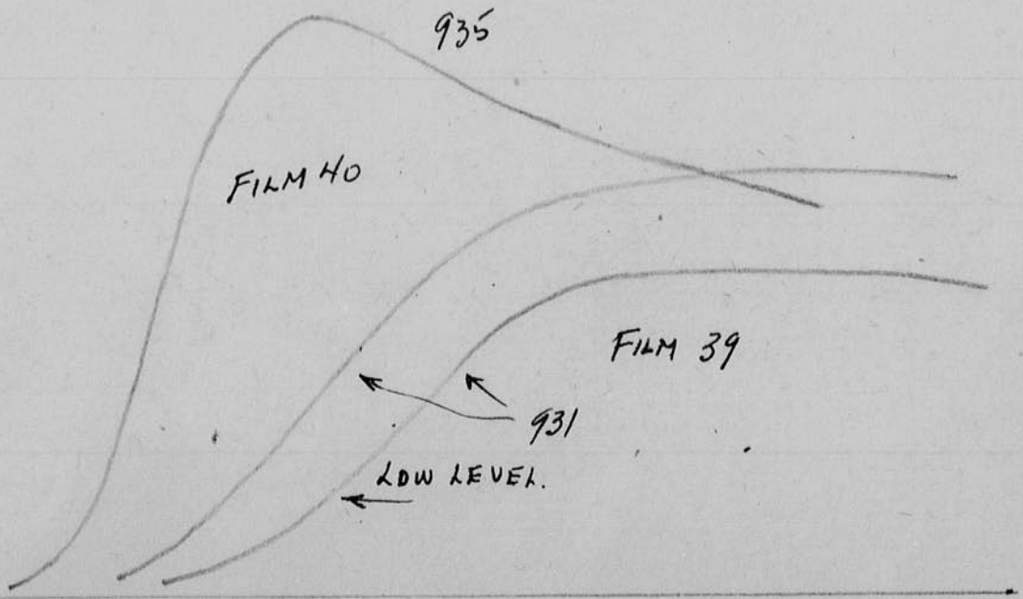
36. This record was made to show the effect
of an additional 50 ft of 62U cable.
two records were made, one had
80 ft of cable, the other 80+50.
50 ft of 62U was used in the trip circuit
for the second case.
200 mc timing wave.

40. 3 parallel 935 photocells 4x150 C.F. 80 ft 62U. Spark light
about 10".

41. Three 931 cells with ratings 49 Top 14 mid and 6 Bot.
into colson C.F. circuit.

4-12-48 — N5 Edgerton
Mabee Eberhard N5 Grier





Notebook # 18

Filming and Separation Record

____ unmounted photograph(s)

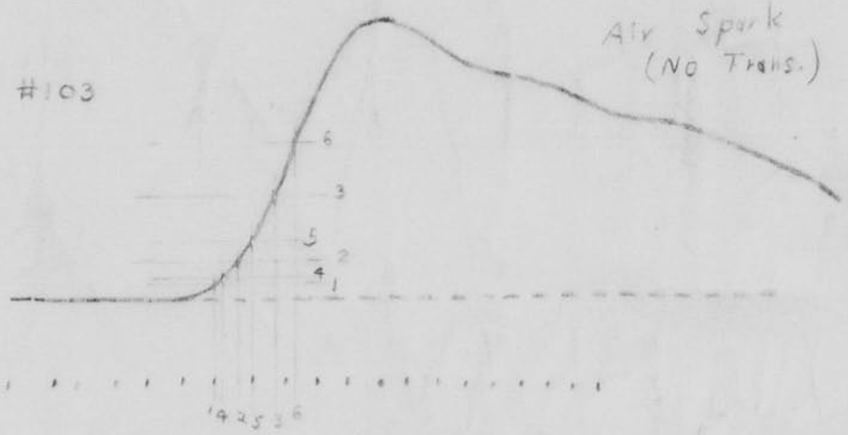
____ negative strip(s)

2 unmounted page(s)
(notes, drawings, letters, etc.)

was/were filmed where originally located between page 38 and 39.

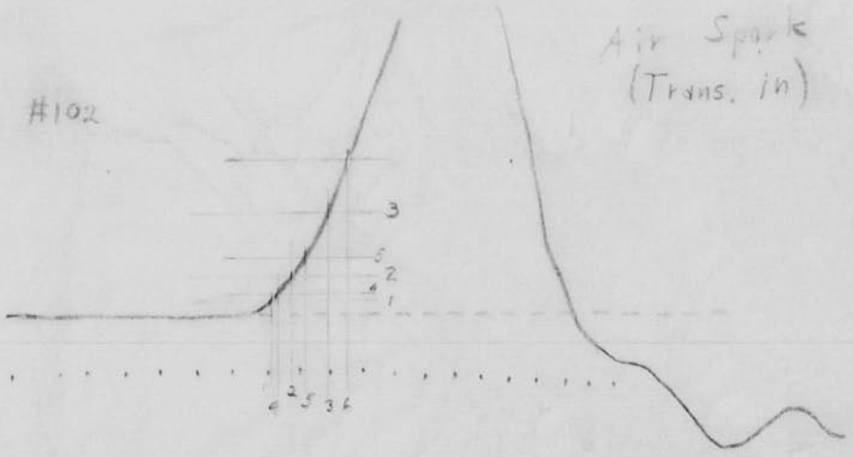
Item(s) now housed in accompanying folder.

Analysis of transformer Response to Air Spark



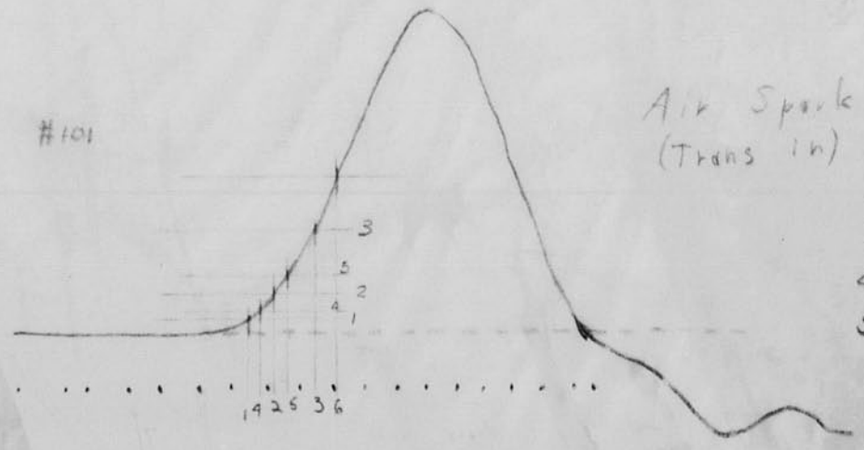
1-2 = .035 α = 2.85
2-3 = .052 α = 1.92

4-5 = .04 α = 2.5
5-6 = .06 α = 1.67



1-2 = .035 α = 2.85
2-3 = .055 α = 1.82

4-5 = .047 α = 2.13
5-6 = .067 α = 1.49



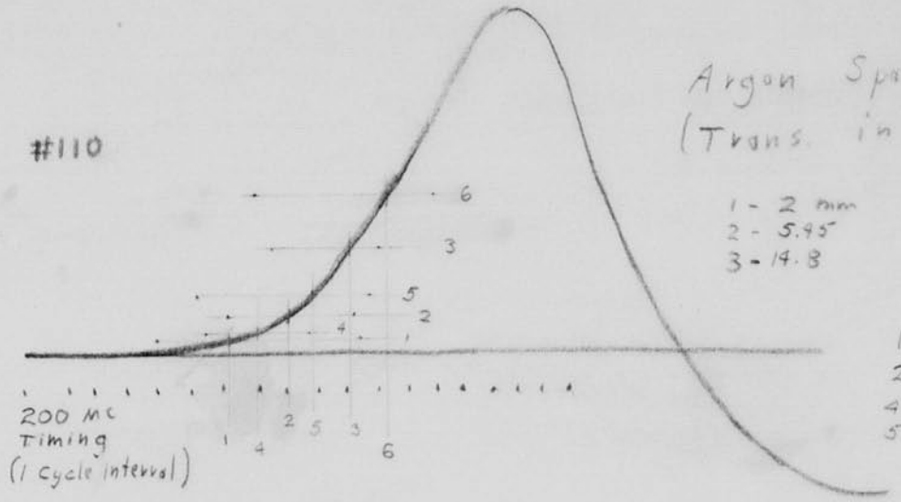
1-2 = .042 α = 2.38
2-3 = .06 α = 1.67
4-5 = .045 α = 2.22
5-6 = .075 α = 1.33

E. Eberhard
Mar. 20 '48

March 13 1948 Crossed date line at 7 22 this morning.

Analysis of Transformer Response to Argon Spark

#110

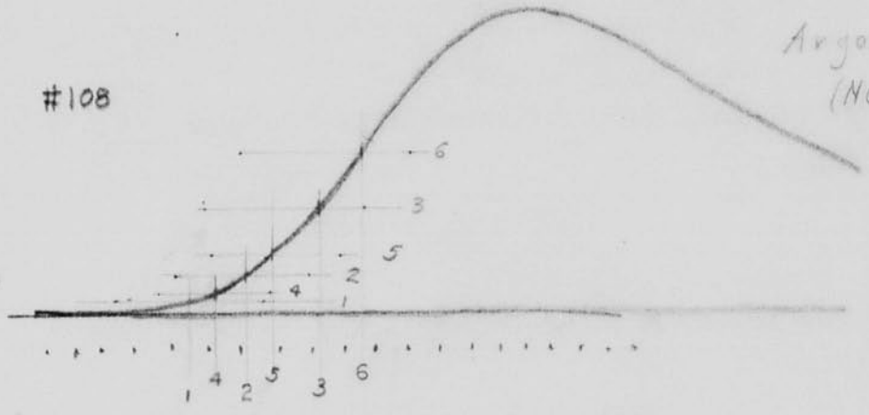


Argon Spark
(Trans. in)

1 - 2 mm
2 - 5.95
3 - 14.8
4 - 3 mm
5 - 8.15 mm
6 - 22.2 mm

1-2 = 0.95	α = 1.05
2-3 = 1.00	α = 1.00
4-5 = 0.95	α = 1.05
5-6 = 1.17	α = 0.855

#108

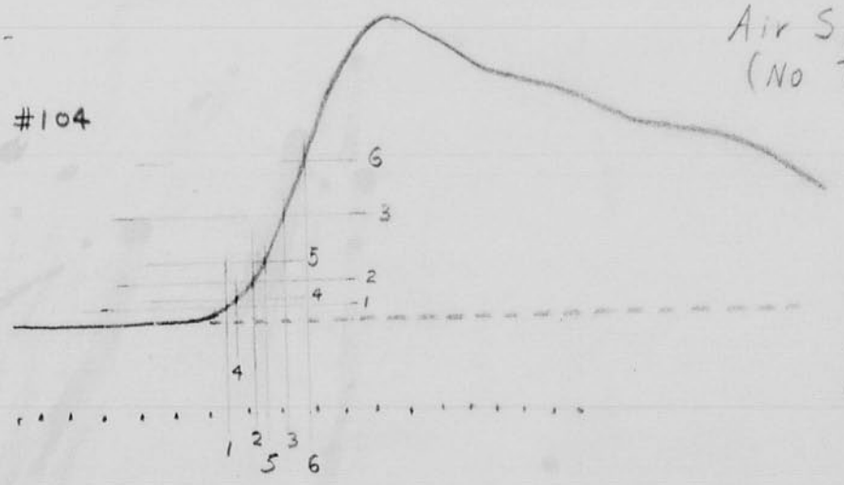


Argon Spark
(No Trans)

1 - 2 mm
2 - 5.95
3 - 14.8
4 - 3 mm
5 - 8.15 mm
6 - 22.2 mm

1-2 = 0.90	α = 1.11
2-3 = 1.02	α = 0.895
4-5 = 0.92	α = 1.09
5-6 = 1.4	α = 0.715

#104



Air Spark
(No Trans)

1-2 = 0.04	α = 2.5
2-3 = 0.048	α = 2.09
4-5 = 0.043	α = 2.32
5-6 = 0.06	α = 1.67

E. Eberhard
Mar. 20 '48

March 13, 1948. Crossed date line at 7 22 this morning.
or 12

H E Edgerton.

Conference with Grier Frohman Graves Ogle Eberhardt etc. concerning 935 and 931 tubes.

Conclusions. (1) 931 photomultiplier has delay in starting and slow buildup. Not useful for determining α

(2) not sufficient light for 935 phototube at 1300 yard station until 100 ton level. At this stage the α may be down by 10% and ready to drop rapidly.

3. A test method of varying the buildup of light for α = 3 to α = 0.5 is needed for testing 931 and 935. We plan to vary gas and pressure for this purpose

20×10⁶
2×10⁶

Film 46. 931 trip. 935 meas CF 110 ft 62 V cable.
Spark - photocell distance
10 3/16 14 1/2 and 7"
three traces to show effect of intensity.

47. Argon - air comparison Trip and meas same as 46.
Air 10" +
Argon 14" ±
~~Air~~ argon 9/32" gap.

48. Argon 20-14-10" gaps to phototubes (3 type 935)
Trip and meas same as 46.

Film 49 Argon Gap 1/2" in stream of argon.
9" from gap to Photocells (3-935).
931 - trip.
935 - C.F. 70 ft 62/U cable to scope.

Mar. 14, 1948
Film 55. Test of R.C.A. transformer with double ended scope connection.
Spark at 10 3/4" to 3 935 photo tubes.
top record
Cathode follower 4 x 150
50 ft of 62 U cable.
cathode follower 4 x 150
70 ft of 62 U cable.
RCA transformer
open circuited on end.

bottom record Ditto except last C.F. feeds directly into the C.R. plate.

200 mc timing wave.

Mar 14 1947

Film 57.

Edgerton.
Eberhard.

This film was to show the buildup rate of a spark in CO_2 gas. We set the gap slightly longer than required for a breakdown in air. When CO_2 gas was blown in the gap a spark would result.

Three CO_2 records were made. the top one had a zero axis.

the fourth record was on air spark at the same distance reducing the gap until self firing resulted.

200 mc timing wave.

IMPORTANT

H. Grier
Everett Eberhard
H. Edgerton.

The sweep circuit irregularities are due to the trip signal.

Apparently the current from the trip circuit driving the 6N6 cathode follower and thyratron cause a time variation in the discharge rate of the sweep circuit.

We found this while trying to use a new scope, No 122 tonight. As tested, the sweep is excellent with hand trip. However the light signal causes a very irregular time sweep.

We decreased the coupling capacitor to the 6N6 from 250 to 40 mm. There was very little effect of this change.

The screen grids of the thyratrons were connected to ground. No appreciable difference.

The 15 ft twin x 300 ohm line from the

plate cable to the 6J6 was terminated in 600 ohms, no appreciable effect. This overheated the 4 x 150 CF tube. Eberhard thought that ringing in the 15 ft of cable was responsible for the time variations.

Mar 15. 1948. One day out of Enivetok.
Harold Edgerton.

Discussed sweep trouble with Colson & Eberhard. Decided to investigate thyratron drop and grid drop when the light signal was used.

Film 59. Plate voltage of the 2D-21 with the hand trip switch.

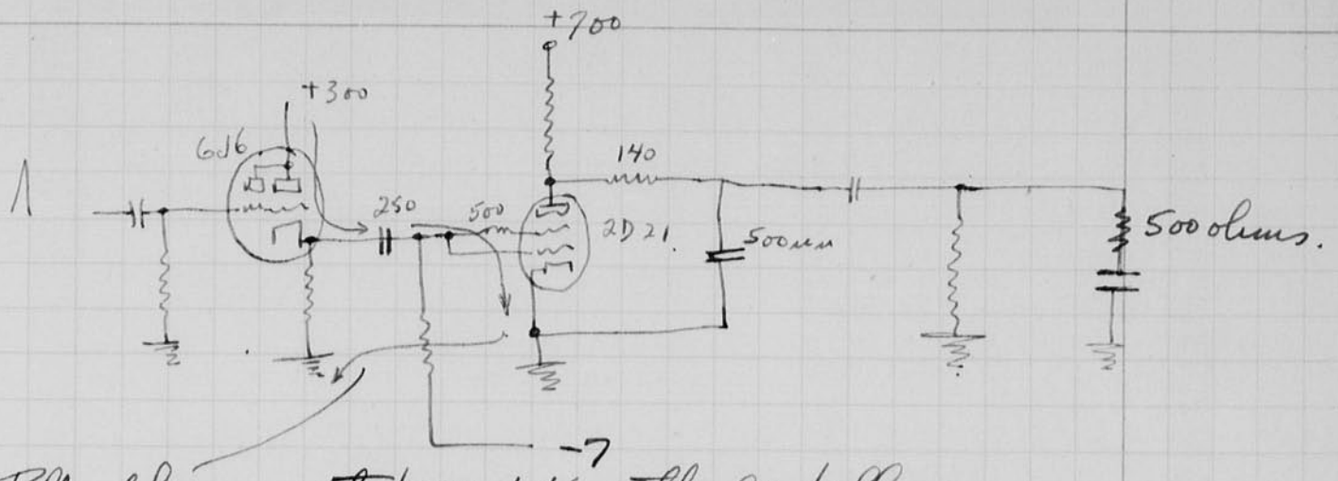
Considerable time is required for the plate voltage to drop to a low value. Some ringing is apparent.

Film 60 Plate voltage of the 2D-21 with the light-signal trip. 200 mc signal for timing.

The scope was used to measure the thyratron-cathode to ground voltage. This was found to be quite high and oscillatory of the same frequency as noted in the ringing shown in Film 59 and 60.

The large current out put of the 6J6 cathode follower tube through the cathode impedance causes the voltage to ground which then appears in the sweep circuit.

A short ground wire from the thyratron to the real ground helped to reduce the pickup. A capacitor bypass will also be used.

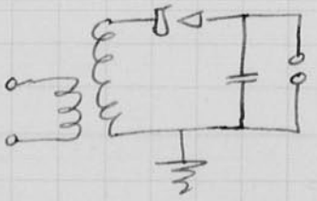


Path of large currents from 6J6 cathode follower.
Ground circuit were shielded so that odd voltages would not appear in the sweep.

Scopes 111 and 122 were worked on by Grier, Colson, Eberhard and me.

March 16, 1948 Due at Eniwetok about noon today.

Last night and this morning we took many oscillograms of sparks in air, argon, and CO_2. The spark circuit consists of a transformer rated 4400 volts which charges a capacitor through a half wave rectifier.

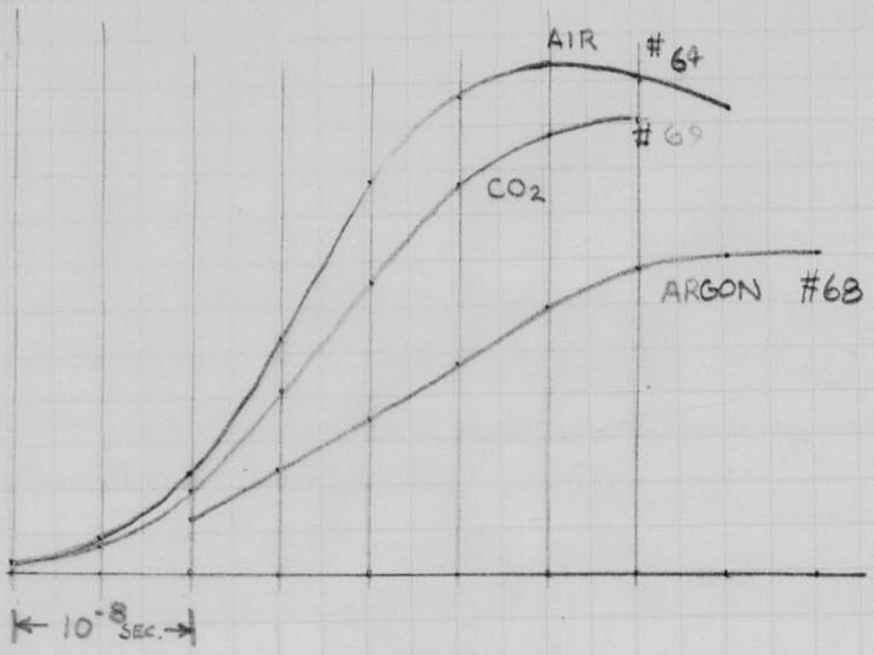


The capacitor consists of 4 mica capacitors .008 mf each making a total of .032 mf. The voltage as measured on a Simpson meter 5000 v scale was 4000. On open circuit it probably is 5 or 6 thousand.

In air, the gap is adjusted to about 1/8" so that the discharge frequency is about 1 per second.

Argon: The gap was made about 7/16" inches and the gas blown through the gap to start the sparks.

CO_2 With CO_2 the gap was made slightly longer than required for air. a spark would result when the gas entered the gap.



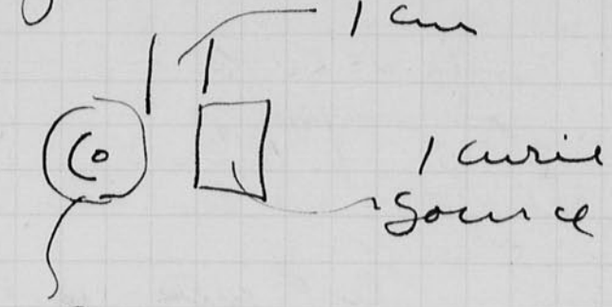
AIR $\frac{33.5}{5} = 6.7$ $\alpha = 1.75$ (2.79α)

CO_2 $\frac{26}{3.6} = 7.2$ $\alpha = 1.75+$

$\rightarrow$ Argon $\frac{22}{7.5} = 2.93$ $\alpha = 1.1$ (1.37α)

3-16-48 Kings

Kings data



67½ volts / stage

background I without naphthalene

1.5 μ amperes.

with naphthalene 90 μμ.

estimated gamma strength

3.7×10^{10} / second.

---

at 1 ton gamma ray intensity is known. ~~See Boots Book.~~

too classified to write down

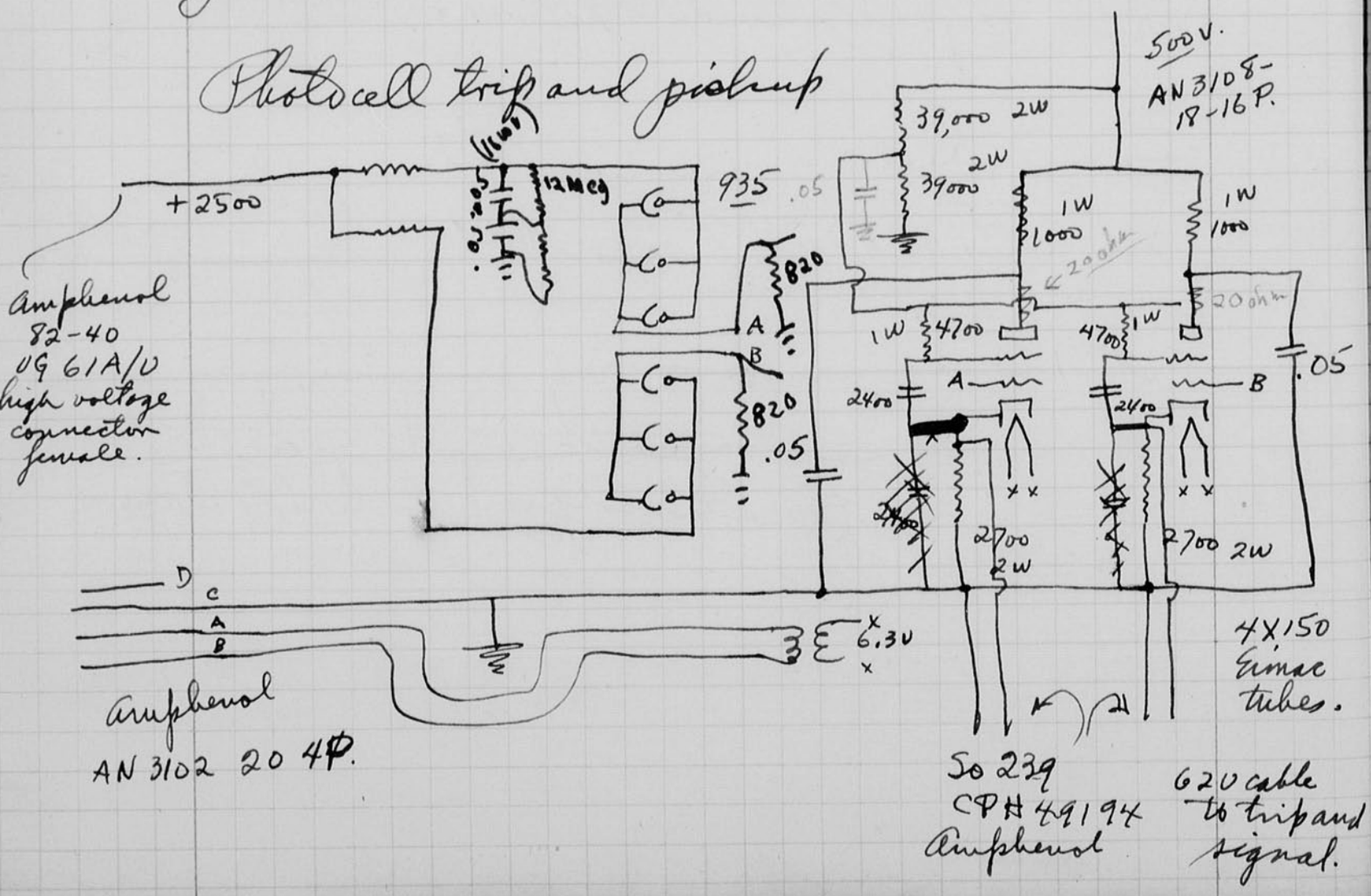
Mar 17 1948
Harold Edgerton.

Dawson and Smith from the AV4 came aboard and took the
Dumont Scope with tube.
Dumont Scope 25 KV Power Supply.
Sweep Power supply
Camera No 15 f 1. lens
6-4 x 5 Fidelity film holders.
6- Film Hangers.
1- Stainless steel water jacket & tanks.
6- boxes film (24 each).
1- shutter tripper 110 ac.

Mar. 19, 1948. Surveyed situation on Eniglei island. everything looks O.K.

We are busy rewiring and making a mockup of the layout in Shop 2 on the AV5 for use on the island.

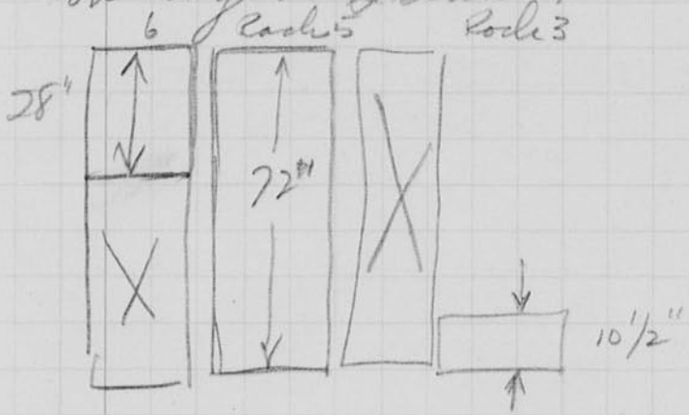
Photocell trip and pickup



Sgt. E. Deusch photographer.

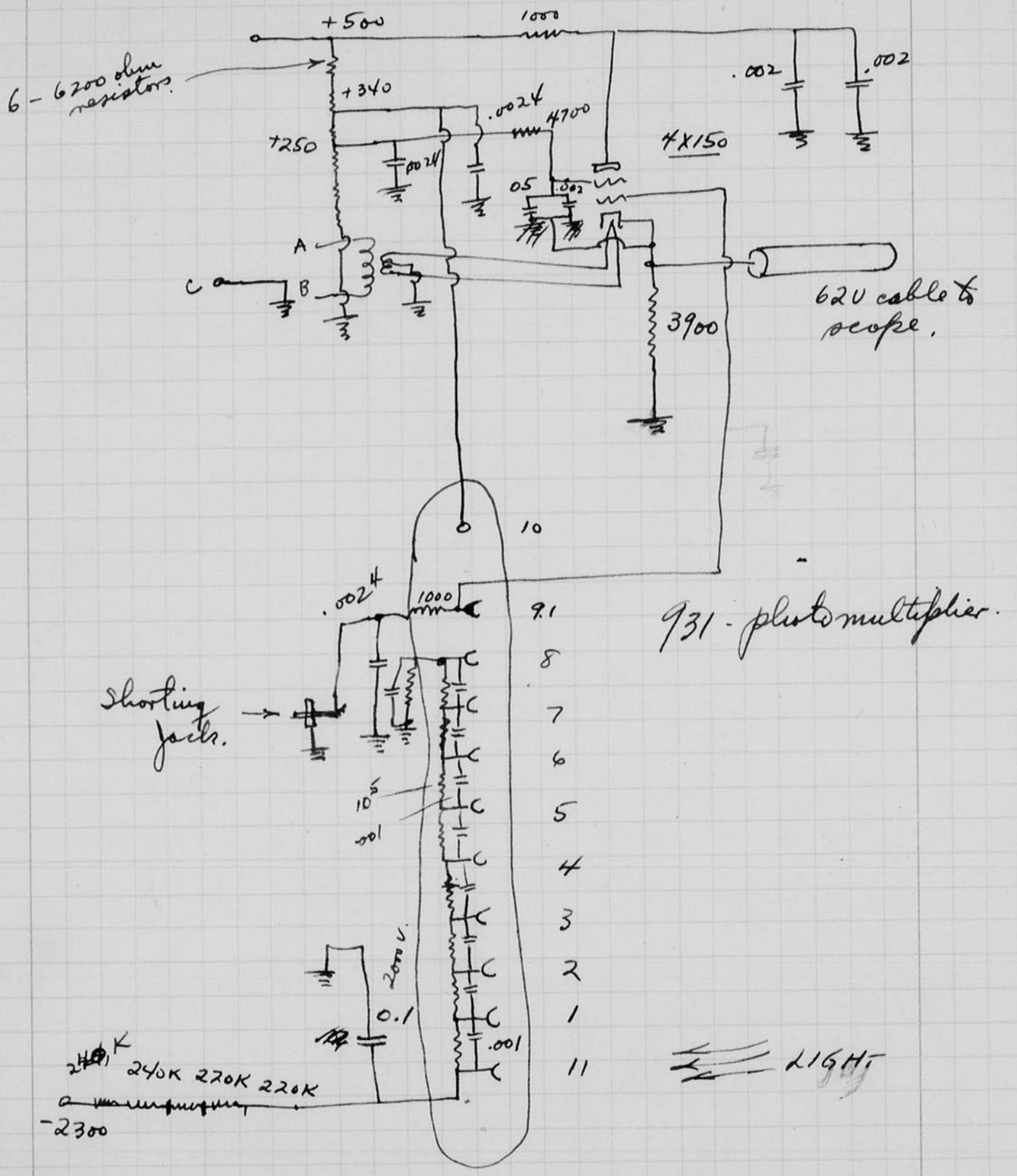
Photo 245-1 Back view Photo cells and spark.
-2 Back view .. .. .. Argonne
-3 Front view .. ..
-4 Closeup of Photo tube 935 & naphthalene.
5 Photo multiplier
6 .. .. Bottom view

Available space in concrete ~~[illegible]~~ bomb proof house on Angebi Island.



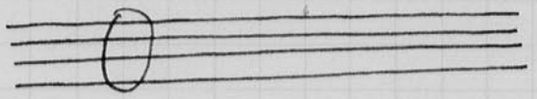
Mar, 20. 1948
Harold Edgerton
Ed Colsar
Miles Eberhard.

Photo multiplier Circuit.

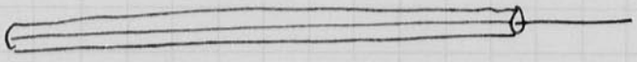


cables.

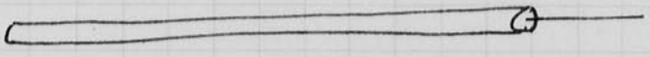
amphenol.



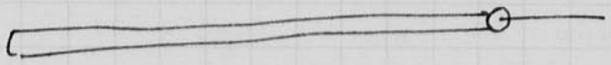
A - B 110 volts.
C - ground.
D - open.



UG 61AU +2300.



AN 3108-18-16P. +500 volts.



SO 239. 62U cable signal.

Half of the Photo multiplier circuits have parallel plugs for the first three listed above so that a second photo multiplier can be connected.

Unpacked gazzle lights with help of Mike Warchol and Lt. Gilbert. Prepared to install cables in trench leading from coffin.

Data on 81-101 and 81-103 cable from Fussel.

10 mc	0.37 db/100'
30	1.4
100	2.4

Photo multiplier test.

15 Watt lamp	1000 V	210 ma	20 ft	7 ua dark.
40 " "	800	125	20 ft	2 ua.

March 22 1948

David E. Edgerton.

Intensity and Sweep circuits for Dumont Scopes to be used at Eugebi and Parry Islands.

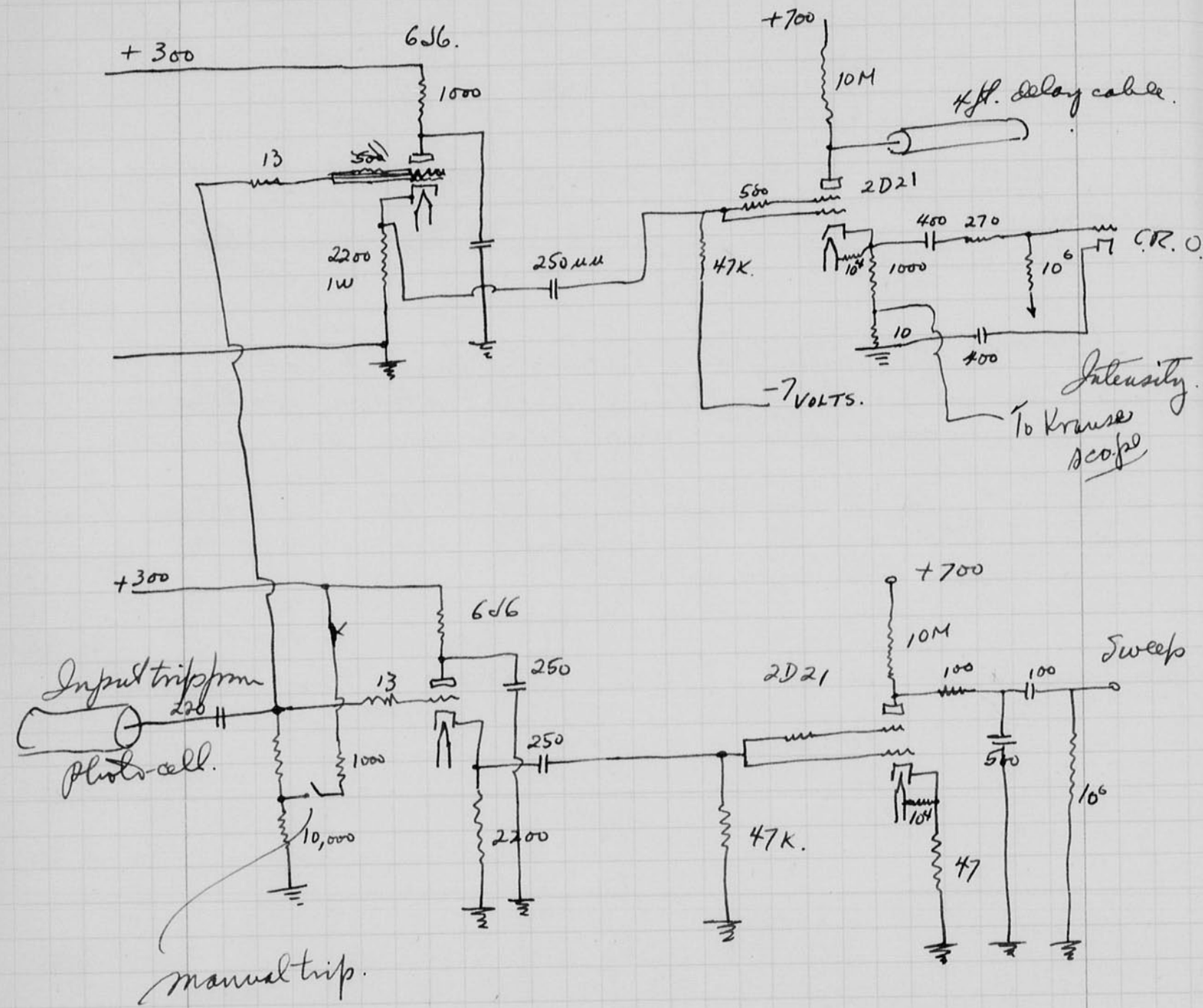


Photo multiplier V-A characteristics under ~~spark~~ pulsed operation.

931 No 14 (Rating 17.5 RCA)

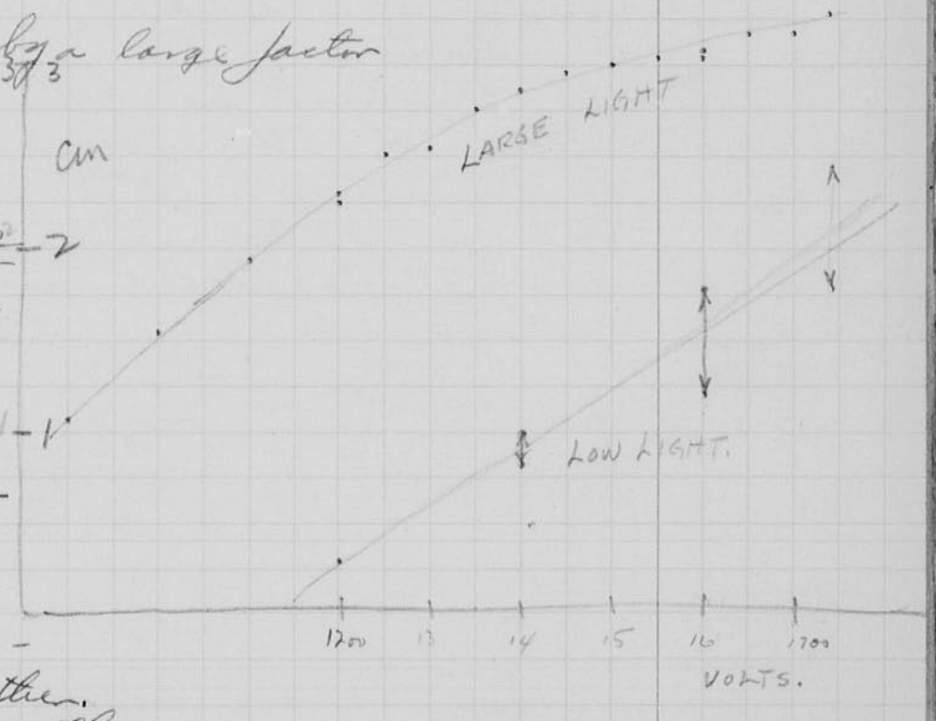
Final anode voltage 340

Large light pulses were used which saturated the cell.

Deflection cm.	V_{1-9}	I ma. Steady.
.45	750	7
.65	800	7
.8	850	9
1.1	900	11
1.3	950	14
1.55	1000	18
1.7	1050	23
1.8	1100	26
2.2	1150	33
2.3	1200	46

Ambient light level reduced by a large factor

1.9	1100	12
2.25	1200	19
2.5	1250	19
2.6	1300	22
2.75	1350	28
2.8	1400	34
2.9	1450	38
3.0	1500	46
3.1	1550	56
3.1	1600	65
3.2	1650	80
3.2	1700	95
3.3	1730	130 -



Ambient light reduced still further.
also signal reduced greatly.

1.8 - 2.4	1730	22
1.2 - 1.8	1600	10
.8 - 1.	1400	10
.3 ±	1200	8.

March 28 1948

Harold E. Edgerton.

Easter Sunday. in Eniwetok atol.

Yesterday two scopes and all the equipment to operate them was taken ashore in an M boat. Brier met us at the shore with a 3/4 ton weapons carrier and took everything to the bomb shelter at the 1300 yd station. (3900 ft)

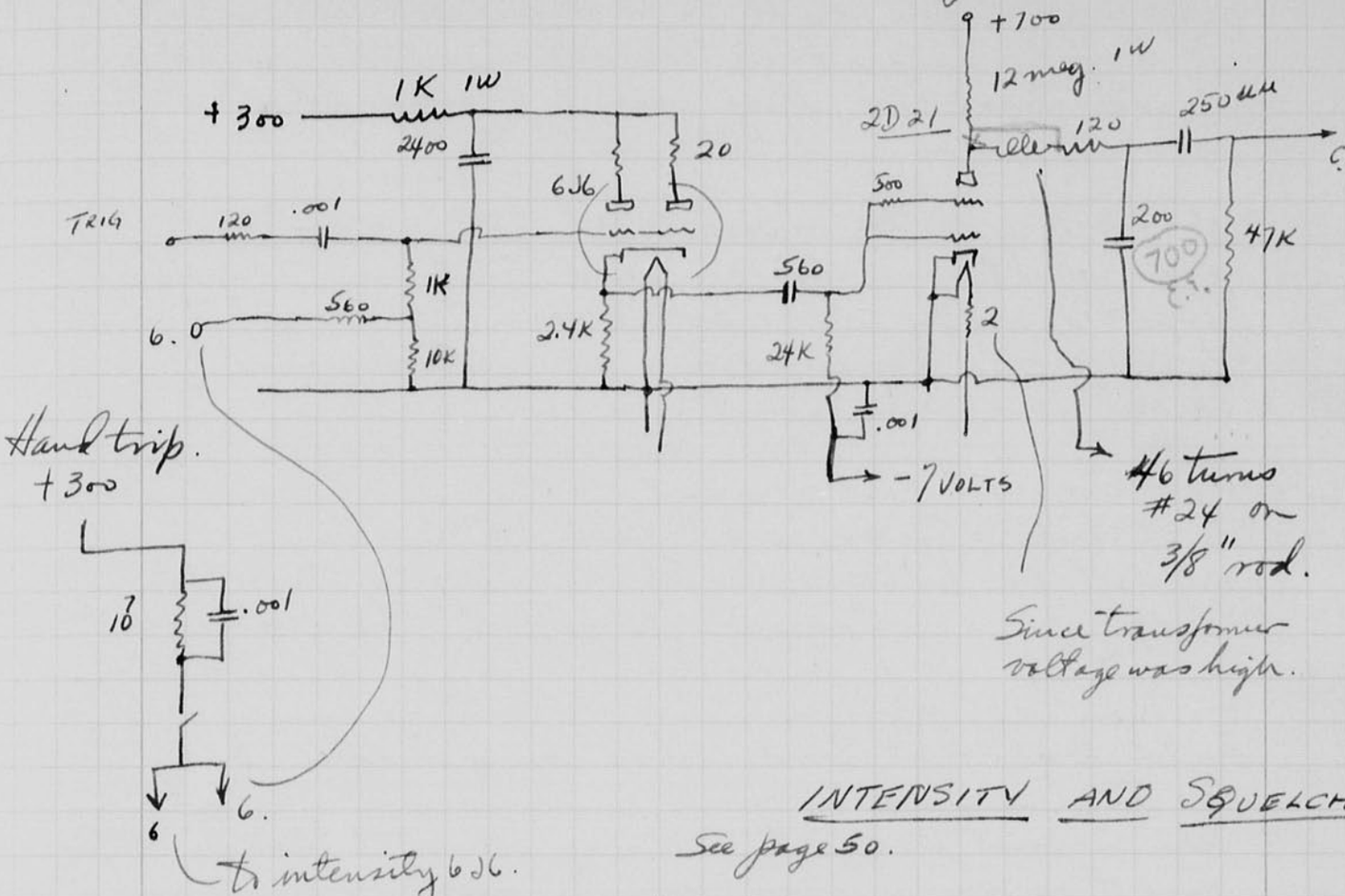
Other than trouble with two Sorensen regulators every thing worked fine.

I spent the night with Barney O'Keefe in a quonset hut on Engebi Island. and Drake assisted with the cables.

I returned to the Albemarle AV5 at noon today so that Brier and I could check the equipment without regulators.

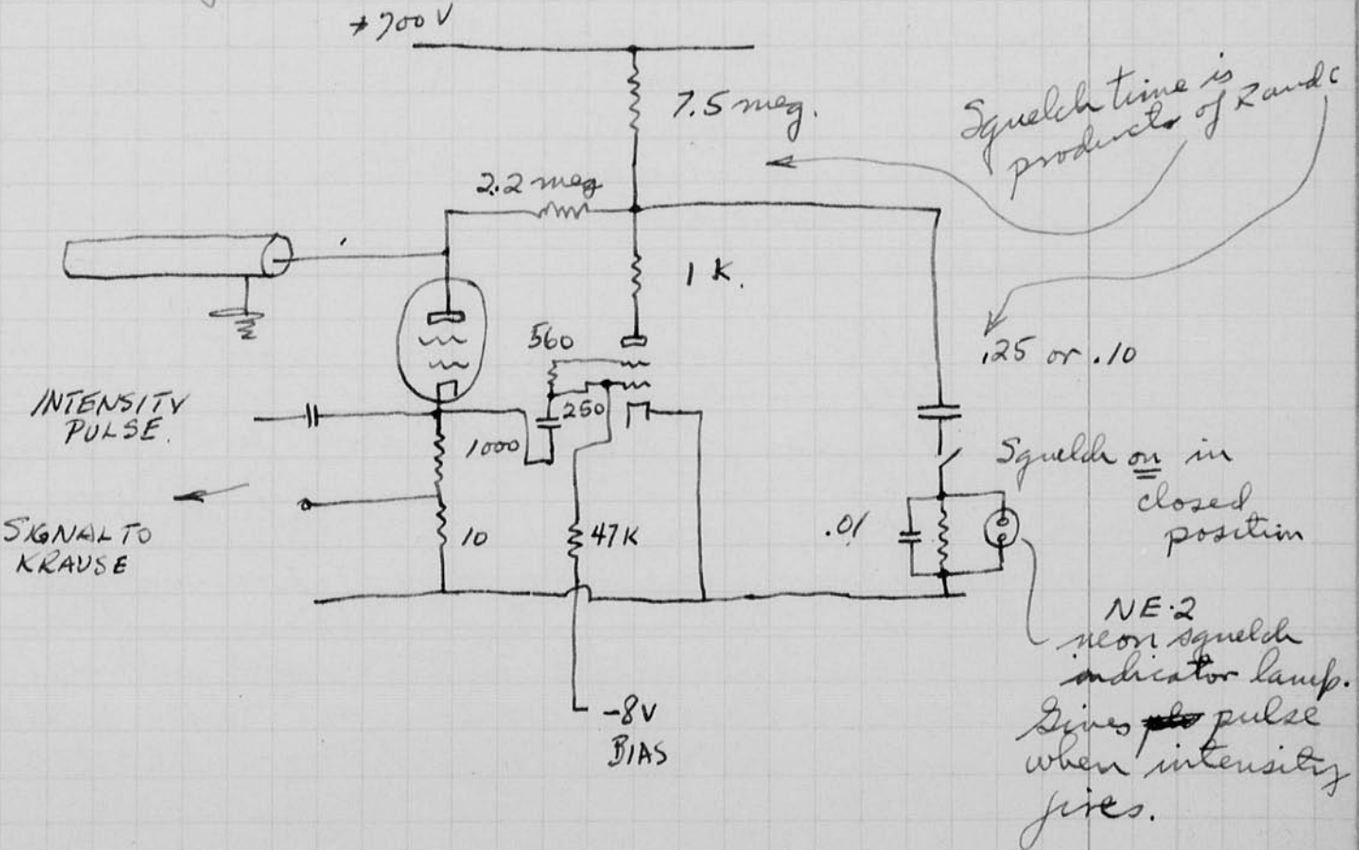
Eberhard has been working on a relayout of the sweep circuit and a switching circuit to prevent multiple tripping of the intensity. The final models of these circuits were tried yesterday in one of the scopes. The circuits are shown in this book on the following page.

Sweep circuit as used at Engelhi



INTENSITY AND SQUELCH CKTS.

See page 50.



54 April 1 1948 Eniwetok Atol
Harold E. Edgerton At anchor near Engebi Island.

Tests were made last night on the set ups at Engebi island in the shelter. The night was dark since the sky was 90% overcast and there was no moon.

There are two search lights, 36" mirrors, on top of the shelter at the 1300 yard station. These both point directly at the bomb position. A photo multiplier type 931 is ~~located~~ at the focal point of each search light.

Time of tests. 22 ±

The out put current of the photo multiplier tube due to pick up light at the tower was about 50 micro amperes (1300 volts on the ~~first~~ nine stages). At first the current went to 100+ μa but then settled back within 10 seconds. The circuit may have been switched several times. This may helps to bring the initial current down to normal.
The current drops to 20 μa when the search light is swung away from the tower.
The current dropped to less than 10 μa when the mirror was taken away.

The current was more than 250 μa when the landing lights were at the focus of the search light.

After the tests the iris of both search lights were left open for a day test. These had been closed most of the time before for two days.

The spark (air) at 25 ft had ample signal 4 x .006 = .024 mf 5000 volts ±.
a signal 1/100 as much appeared to be ample.
We plan to test the entire set up with the spark at the tower tonight. There should be enough light to trip the scope and get a record.

8100.
.007

area of searchlight = $\pi R^2 = \pi \frac{36}{4} = \frac{4000}{4}$ square miles.

= 1000 square miles.

area of photo mult. = 0.5 sq. inch.

Effective distance of spark light without reflector =
25 x 10 = 250 ft.

Increase of light with reflector = $\frac{1000}{0.5}$ = 2000.

Increase of distance = $\sqrt{2000}$ = 43.

Distance of spark from searchlight = 43 x 250

= 10,750 ft.

= 3500 yds.

April 2 1948.

Tested 935 tubes in setup on roof of Engelr shelter last night with help from Eberhard and Drake. Out of 14 tubes we found one that glowed. this tube was # 21 and it seemed to be the most sensitive.

Tube no.	11	16	17	18	19	20	21	22	6	2	10	8	9	12
Deflection	1	1	1	.5	.75	.4	1.2	.6	1.1	1.1	.8	1.1	1.1	1.0

Final selection for circuit Trip tubes # 8, 9, 12.
Signal 2, 6, 11.

Photo multiplier circuit. The performance of this equipment was the same as before so apparently the exposure of the photo multiplier tube to the light has no bad effects.

When aimed at the top of the tower the trip tube # 59 reads 45 ua on an overcast night. Tube # 57 reads 25-30 ua. after the initial surge.

We were unsuccessful at tripping the scope from the 400 yard station. There were some operations

which may have been caused by some instability in the plots multiplier circuit.

April 4, 1948. #2 Elgerton. Engebi Enewetok Atol.

John Donald Armstrong
capt. Keller
Andrews.

I went to Parry Island yesterday afternoon to help Ed Colson and Parry Smith finish off the 931 plots multiplier set up.

One search light 36" is on the top of the control tower. Two other search lights are on top of a wooden structure about 50 ft to the south.

Light from the bomb strikes the trigger search light 40 ft before it strikes the signal searchlights.

40 ft of distance is equivalent to 32 ft of 62U cable. We then used two delay cables of 88 and 100 ft from the search lights to the scope signal connection.

Night light in Search light after tower lights and others were extinguished at Parry. = 25 ua
Darkcurrent with Iris closed = 10 ua.
Increment from Engebi tower 500 watt bulb in flood reflector = ±1 ua.
This search light was not accurately aligned.

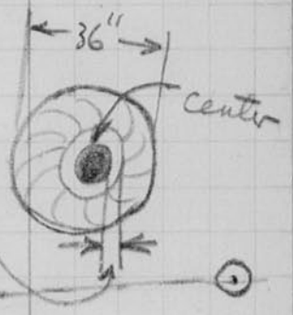
the ~~closest one~~ trigger search light was accurately trained on Engebi 500 watt bulb.
Night light gave 20 to 37 ua.
Increment Engebi 15 ua.

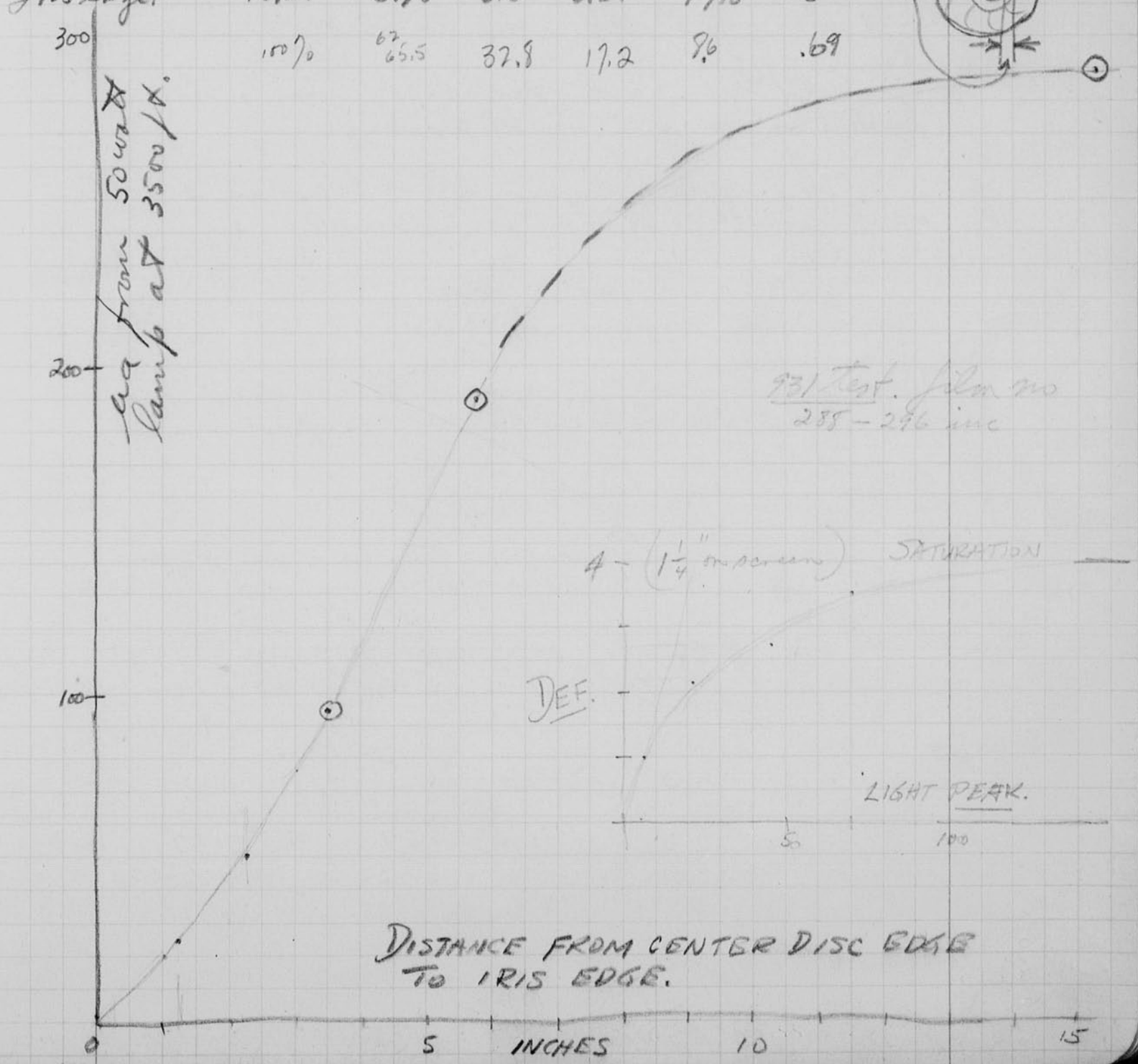
Tests made tonight at Engebi for light leaks from tower. Henderson and Gilbert. Eberhard.
11 ua night light with floods and red light off.
5 ua with Iris closed.
no light from 4 - 100 watt bulbs in tower.
no sweep trip from transportable in tower house even with the trap door open.

A sequence of oscillograms were taken of the 930 signal as a function of distance from the standard spark .008 mf. 5000 V. For this we used a 931 as a trip for the scope with 108 + 33 = 141 ft of 62 ω delay cable

Iris calibration for smith Searchlight at Engebi

ma	290	180 / 190	95	50	25	2
Iris edge.	15.25	5.75	3.5	2.25	1 5/16	0
	100%	67 / 65.5	37.8	17.2	8.6	.69





1000 ma in the trigger P.M. tube has no visible effect on the triggering with the spark at 3500 ft.

900 ma reduces the signal about 1/4 or 1/3. a photo # 290± was taken to show this.

The signal PM was plugged into the trig. scope 113 and the diaphram iris cranked shut to 1 5/16". This caused the intensity to delay until the start was half way to the zero marker line.

At the zero marker line, the Iris was 2 1/4" opening.

The searchlights were trained at the red light and the following readings made.

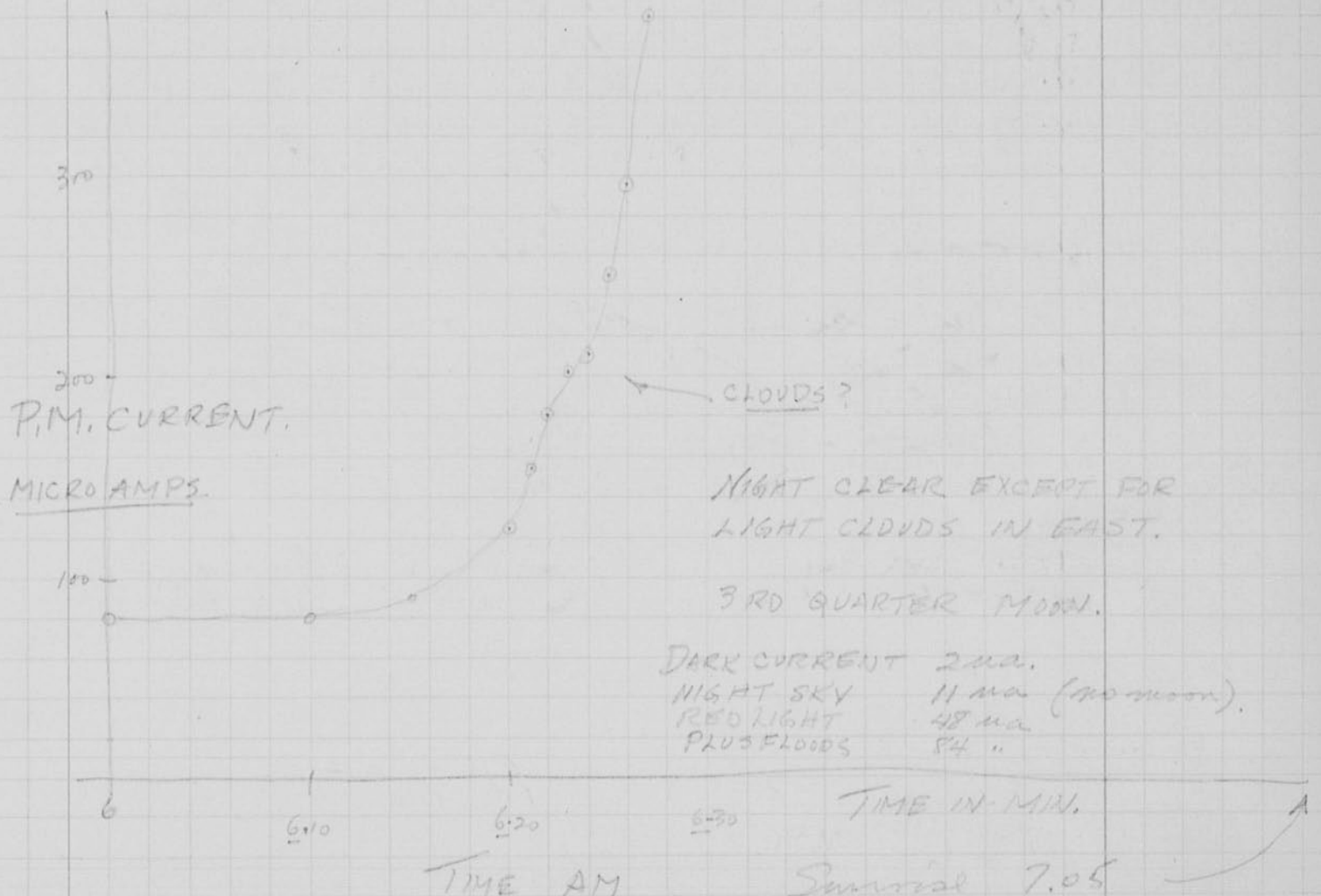
North - Trigger 48 ma
South Signal 38 ma.

These readings increased to 84 and 76 when the flood lights were put on.

April 5 1938. 5:15 am Night light Test. Edgerton & Everhart.

6. am.	Trigger	96 (110 surge) after 1/2 sec.			
	Signal	86 ? more often 100 ma			
6:05	Trig.	78,80,82	(Moon last Quarter		
6:10	"	80	1/3 across sky, to rear)		
6:15	"	90	Clear night - few very low		
6:20	"	125	Clouds		
6:21		155			
6:22		180 (175-190)	6:31	610	
6:23		195-210	6:32	700	(Thin - behind
6:24		210	6:33	740	Clouds - Tree
6:25		250	6:34	720	" -
6:26		295	6:35	650	"
6:27		380	6:36	620	Clouds
6:28		420	6:37	600	Storm Sea
6:29		480	6:38	600	
6:30		540	6:39	600	

6:40	610
6:41	590
6:42	550
— 6:43½	920. (first opened other cell)
. 6:45	620 first cell
6:46	660
6:47	680

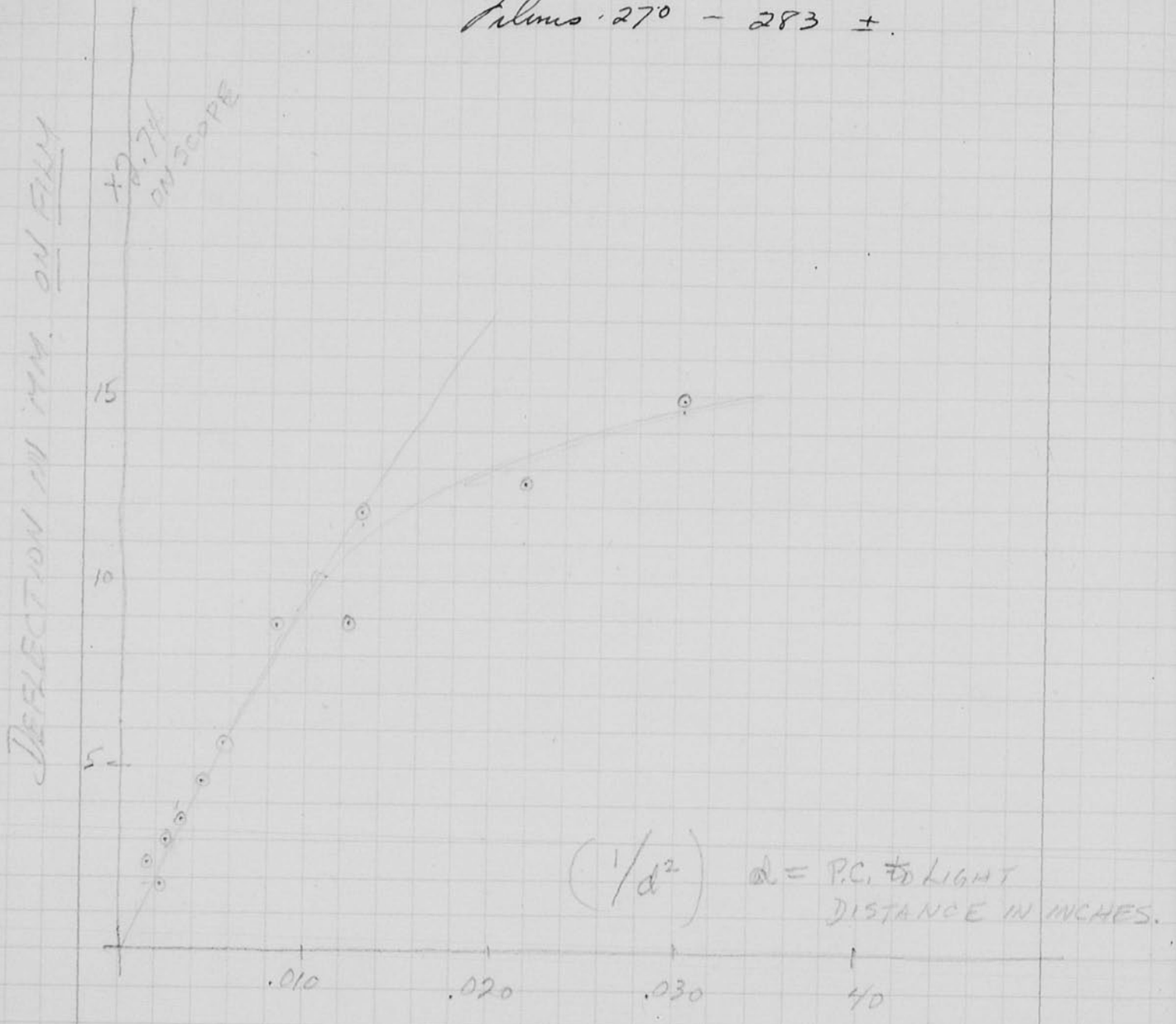


60 April 5 1948

Harold E. Edgerton Engebi. Eniwetok.

Inverse square test of 935 photocell arrangement on top of Engebi shelter.

Films 270 - 283 ±.



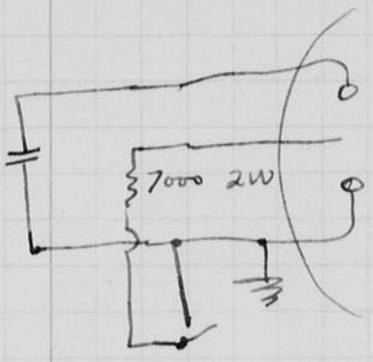
April 6 1948 - 45 today.

April 8 1948
Harold Edgerton

A triggered spark is desirable for testing the photo multiplier setup from the tower.

We have had trouble with air (open) sparks due to humidity and wind.

I now have a sealed beam lamp as a source. This was made by burning out a trucks headlight that I found on Engebi island. 28 volts was used to flash the filament. The arc was left on for about 1 second to fuse the ends of the wires into spheres. Without this procedure the sparking breakdown voltage was about 1500 volts. After arcing, the breakdown was about 7000 between the most distant terminals.

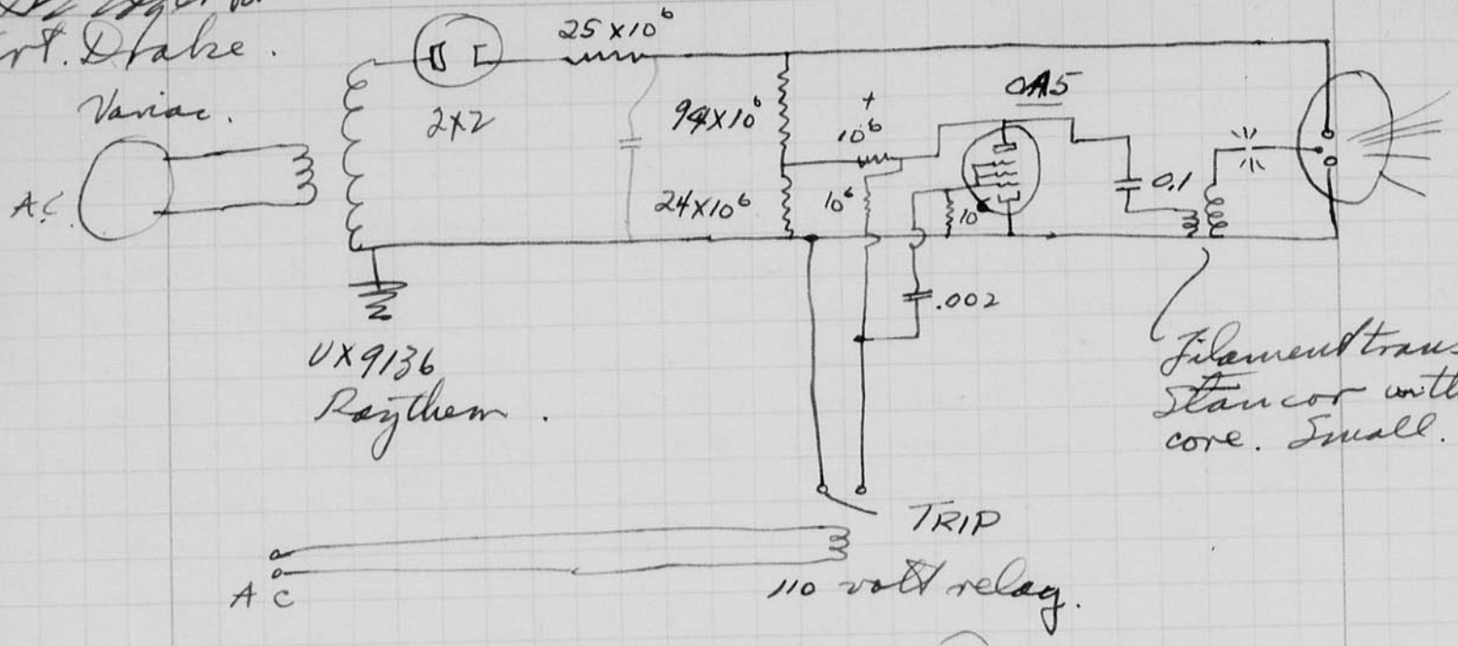


I found that I could trigger the discharge with a relay as shown. The third electrode reduces the gap and causes the ionization to start.

Sealed beam lamps are filled with argon gas at about 1 atmosphere. Some nitrogen may also be present.

April, 9. 1948 Argon source for flash light.

Dr Edgerton
art. Drake.



The above was wired and tried for use as a triggered source.

Evening Engebi Island - Timing station with Eberhard & Drake.

The scopes 111 and 113 were put through the -15, -10, minute cycle and then calibration shots, 325 and 324 respectively, were taken. 200 mc oscillator.

an air sparkgap 7.5" from the 935 photocell.

Trigger search light Angular variations when directed at red light. with floods on

Diam 2X15

Azmuth	0	N 1/8"	N 2/8	N 3/8	N 4/8	5/8	
μa	110	115	55	28	26	24	
Azmuth.	0	S 1/8"	2/8	3/8	4/8"	5/8	0
μa	114	106	110	60	92	140	105

3.1416/30 = 360°
1242/480 = 360/124 1" = 360/124 x 1/8 °
2 1/2° 1/8" = 2 1/2 Floods are now off. about 9 p.m.

Azmuth.	0	N 1/8"	N 2/8"	3/8	4/8	5/8	2/8 ✓	1 1/8	1/8	1/8	0
μa	50	68	16	8	7		16	46	68	70	56

S 1/2	S 1	1.5	2	2.5	3	4	5
48	68	61	50	28	11	10	9

The photo multiplier took about 200 ma when started at 9 or 8 30 pm due mainly to sky light. apparently the flash bombs and the two days of gun did not affect the photo multiplier greatly.

Signal search light directed at 50 watt lamp ~~120 ft~~, 1200 yds.

1/8" = 1	0	N .5	1	1.5	2	2.5	3	4
	95	140	165	145	100	45	21	8

	0	S .5	1	1.5	2
		~~58~~	25	11	8

Altitude of signal search light.
Set at N 1/8" mark.

	Depressed									
1/8" marks.	3	2.5	2	1.5	1	0	3	3.5	4	4.5
or 4"	110	40	56	62	31	7	145	160	50	4.

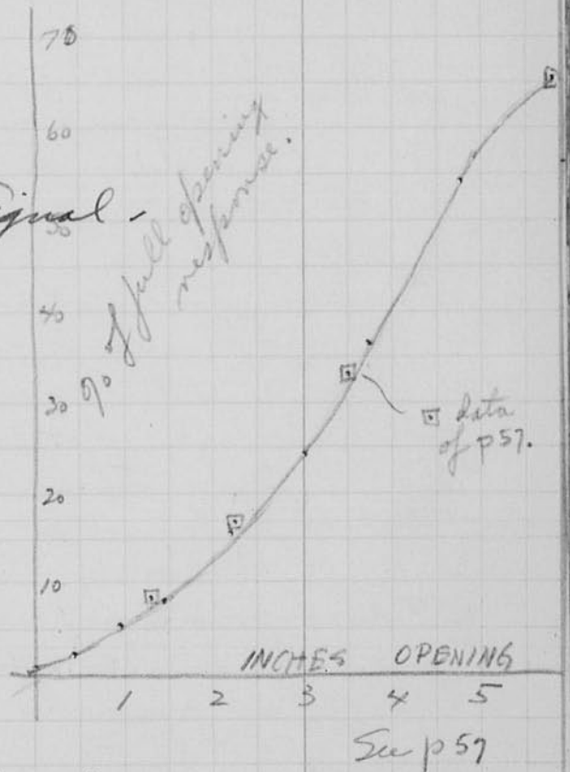
Radius.

~~Elevated~~ 3.5
~~3.5~~ 165

Iris calibration check.

Signal.

Window open	ma	%
15"	195	100
6.5"	152	78
4.75	105	54
3.75	72	36.9
3.0	47	24.1
2 3/16	30	15.4
1 7/16	17	8.72
15/16	10 -	5.1
7/16	4.5	2.3



See p57

Apr. 15, 1948.

Dark current at Engebi 931 trip = about 2 ma.
Current " " " " = 100 to 150 ma with tower lights and red light on.

The signal 931 photo multiplier gives the same values when the shutter is about half open. Brier is to open the shutter to this value tomorrow for the shot.

 April 14 1948

Harold E Edgerton.

Eniwetok atol. Conditions at Eugebi timer station.

The timer station is located 1300 yards from the X tower which is about 200 ft high. The station is of concrete with a double door capable of withstanding considerable pressure. The oscillographs are surrounded by 12 inches of lead.

Gamma-Ray Intensity measurement.

The circuit for this test is shown on page 46. A cast napthalene half cylinder of about 1 cm wall thickness is ~~tapp~~ taped to each of the six 935 phototubes. The 935 tubes are used in two groups of three in parallel. One set of three serves as a trigger combination to start the sweep and the intensity. The other set ~~starts the~~ puts a signal on the deflection plates after going through a 620 delay cable of 108 ft in length. The 620 cable in the trip circuit is 18 ft in length.

A cardboard box and a wooden box are mounted over the photocells to exclude visual light. Gamma rays striking the napthalene will produce light and trip the scope if intense enough. According to recent estimates the napthalene will not produce enough light to make this experiment a success.

The 935 phototube requires about 10^6 times as much light as the 931 photomultiplier tube. However the 931 tube ~~does~~ does not apparently have ~~accept~~ the ability to follow rapid rises of light. Apparently the transit time or some delay in secondary emission causes a time error.

Thus the 935 is desired because it makes possible rapid rise time experiments. This ability is obtained at the expense of sensitivity.

The scope for the Gamma ray intensity measurement is a Dumont type K1033 with 4 KV for the first acceleration and ~~20~~ 21 KV for the post acceleration.

Scope no. 111 in the lower position in the center of the lead coffin was used to record the output of the 935 tubes.

There was no transit-time scope available for this experiment. Thus if a record is obtained it will not be known when it occurs in time with respect to other events.

The scope sweep length has a total time of about 0.17 microseconds of which 0.1 is the useful portion. There is a slight compression of the sweep at the beginning and at the end. Timing records for calibration have been made many times, in particular, last night.

Light Intensity measurement.

An attempt is to be made to record the light from ionization in the air caused by early gamma rays from the nuclear reaction. The house surrounding the bomb has been lined with paper to exclude any light that may come from the initial primer explosion.

For this test the 931 photomultiplier tube has been selected because of its great sensitivity. The photomultiplier is mounted at the focus of a 36" navy search light which is trained at the bomb house.

Two searchlight - photomultiplier combinations are used; one to trip a Dumont Scope and the other to produce a signal on the scope. Details of the circuitry are on page 48 of this note book. There is 125 ft of 62 U cable in the signal circuit and 25 ft in the trip.

The dark current of the two photomultiplier tubes is about 2 μa with the iris closed. The red tower lamp and the floods produce about 100 to 150 μa. The signal tube will give the same current when the iris is about half closed as will be set

for the experiment.

The voltage per stage is about 150 V which is very high for this type of tube. The purpose of using a high value of voltage is to get as rapid a rise as possible from the signal. The pm tube response is faster with high voltage.

A signal from the intensity circuit of the scope is fed into one of Krauss' transit-time spiral sweep cathode ray scopes. Thus it will be possible to measure the absolute time between the X signal and the instant that light can be detected by the P.M. tubes.

A 50 watt lamp (tungsten) produces about 300 ma of current. The scope requires about 50 ma in the scope circuit for a fast trip. $\frac{50}{3+1} = 13$ times. Thus the light level should correspond to that of a $50 \times 13\frac{1}{3} = 665$ watt lamp. for a 10^{-8} or 10^{-9} second operation.

April 15 1948

Harold Edgerton

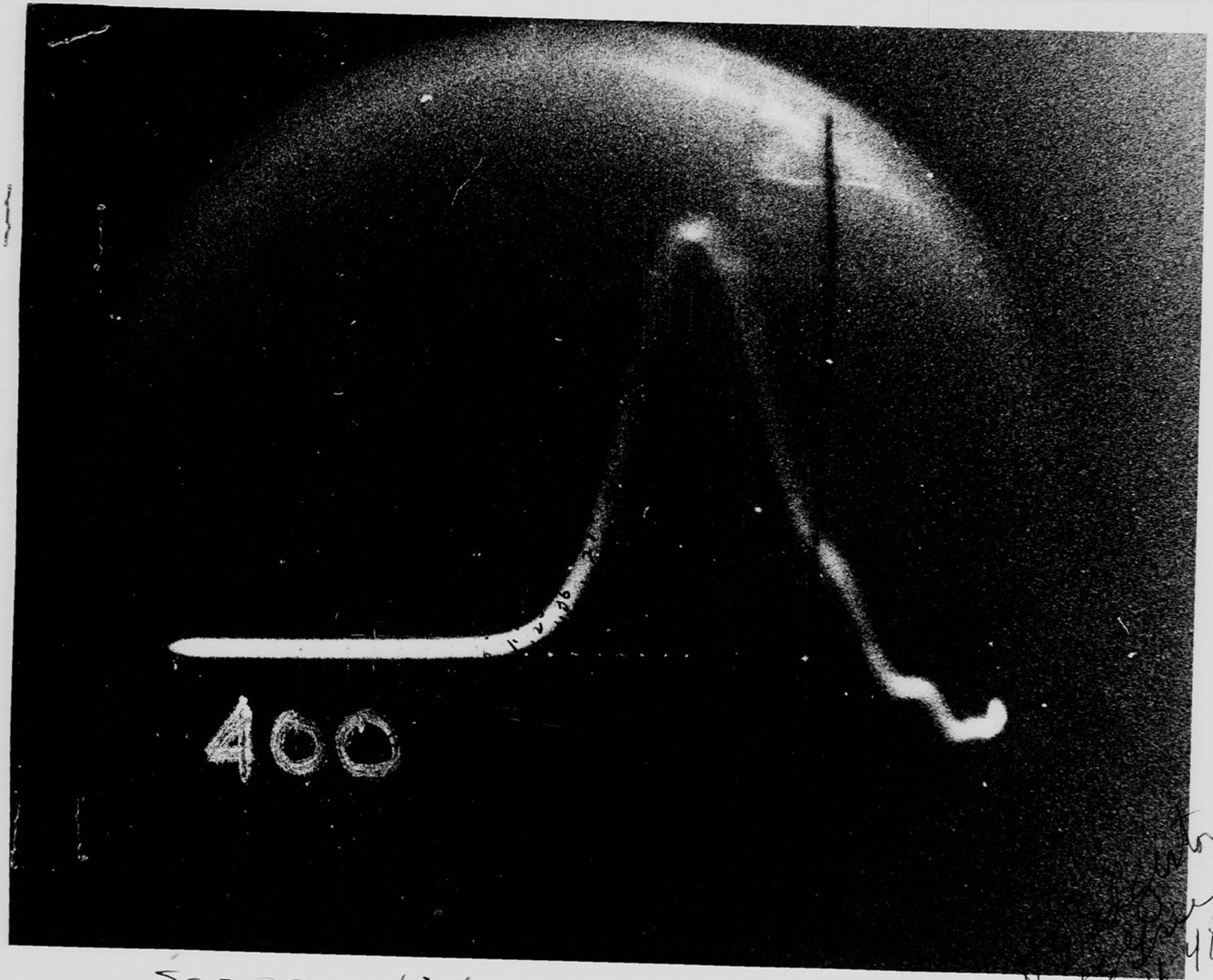
The Albemarle pulled anchor at Engebi island shortly after lunch and proceeded to Eniwetok. From the new anchorage I went ashore with Eberhard on Parry Island in order to see the rises of the search lights just before the flash. We slept in one of the barracks until 3 am at which time Barney O'Keefe joined us in going to the dock to meet Herb Grier, Al Graves, Bob Henderson upon their return to Parry from Engebi in an AVR.

The sky was clear at 3 am. To the south at Eniwetok island we could see the air planes take off. Drone B-17 planes each had a pair of mother planes to take over control as soon as the drones were off the ground. To the east we could see the freighter ships as they stood at anchor outside of the atoll. Across the entrance patroled a destroyer.

At 6 am the rain started and it rained quite hard until 6:10 on Parry. This was a local squall which came up suddenly from the East. It was decided to continue with the explosion due at 6:17 am.

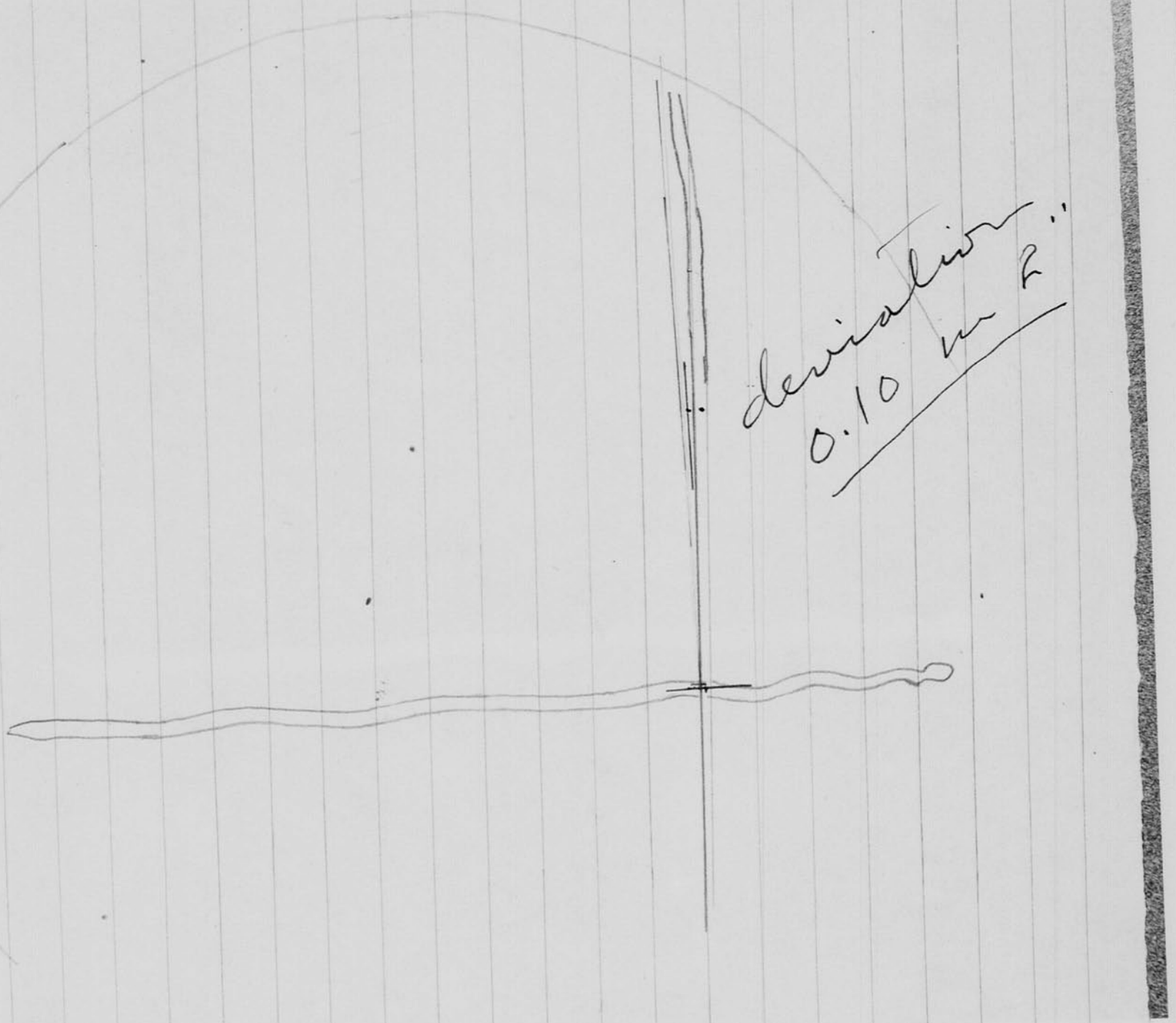
Thirty seconds before the shot we cranked open the diaphrams for the searchlights which contained photo multiplier tubes 631 and which were trained on Engebi tower. I read 250 microamps in my meter while mike read about 300. My dark current was 8 microamperes. We did not have an opportunity to check the P.M. tubes after the shot since we were in a hurry to calibrate the sweeps and catch the boat that took us to the Curtis, sister ship of the Albemarle. After anchoring at aoman about 10 am we took a small boat to the Albemarle.

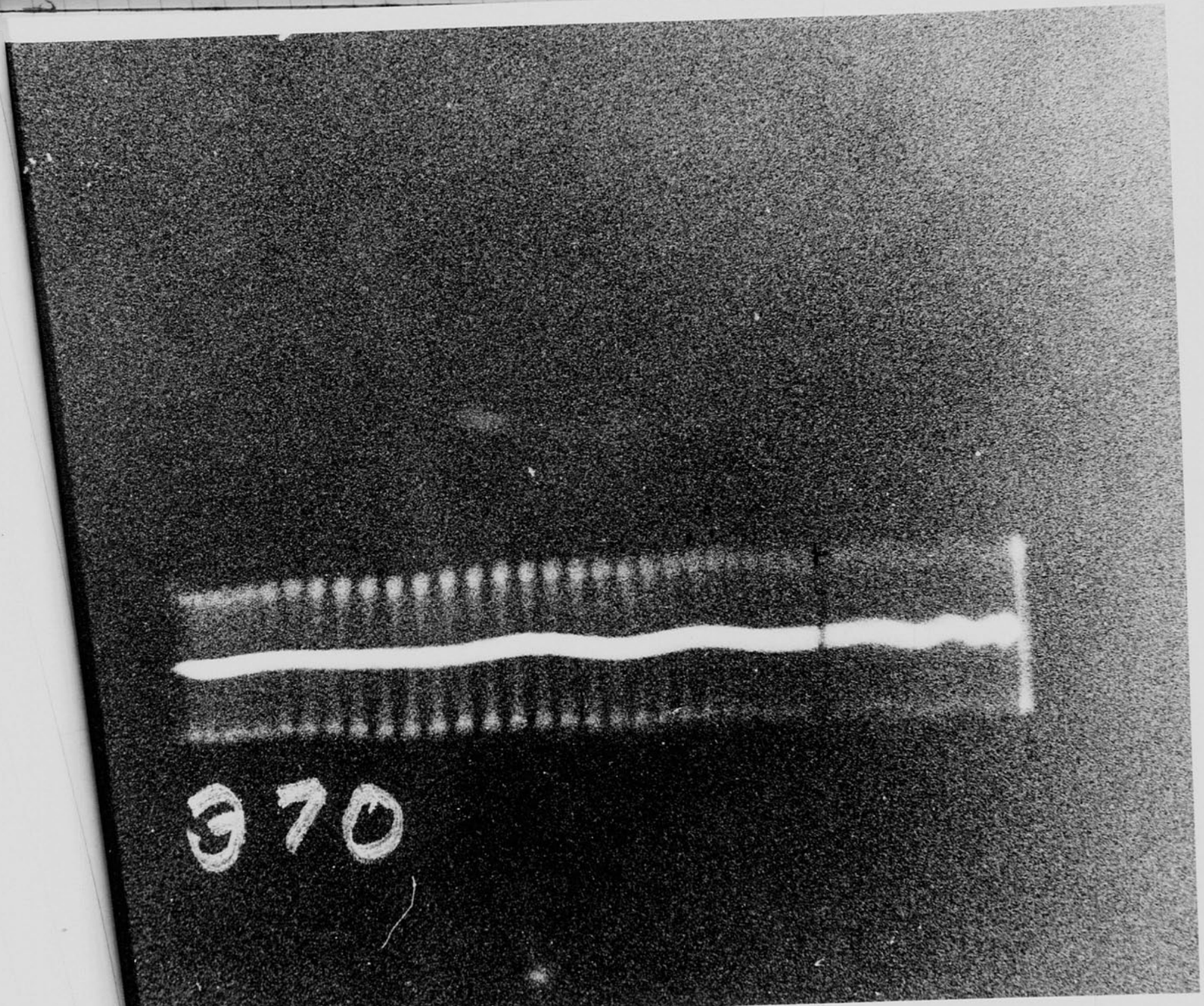
The two films at Parry had records that show that the light from the A Bomb rises as fast as an air spark. Further measurements



Scope 106

k 106
273





scope 106

~~corrections made in the measurements.~~ It has been noted on page 33, the photo multiplier tube lacks the ability of following rapid rises of light.

$$\frac{e^{\alpha t}}{e^{\alpha t + \Delta t}} = \frac{\text{Read 1}}{\text{Read 2}}$$

$$e^{\alpha t - \alpha(t+\Delta t)} = \frac{R_1}{R_2}$$

$$e^{\alpha \Delta t} = \frac{R_1}{R_2}$$

$$e^{\alpha \Delta t} = \frac{R_2}{R_1}$$

$$\alpha \Delta t = \ln \frac{R_2}{R_1}$$

$$\alpha = \frac{\ln \frac{R_2}{R_1}}{5 \times 10^{-9}}$$

4-16-48

Cwillig… / Eg… / Edgerton / E. Eberhard

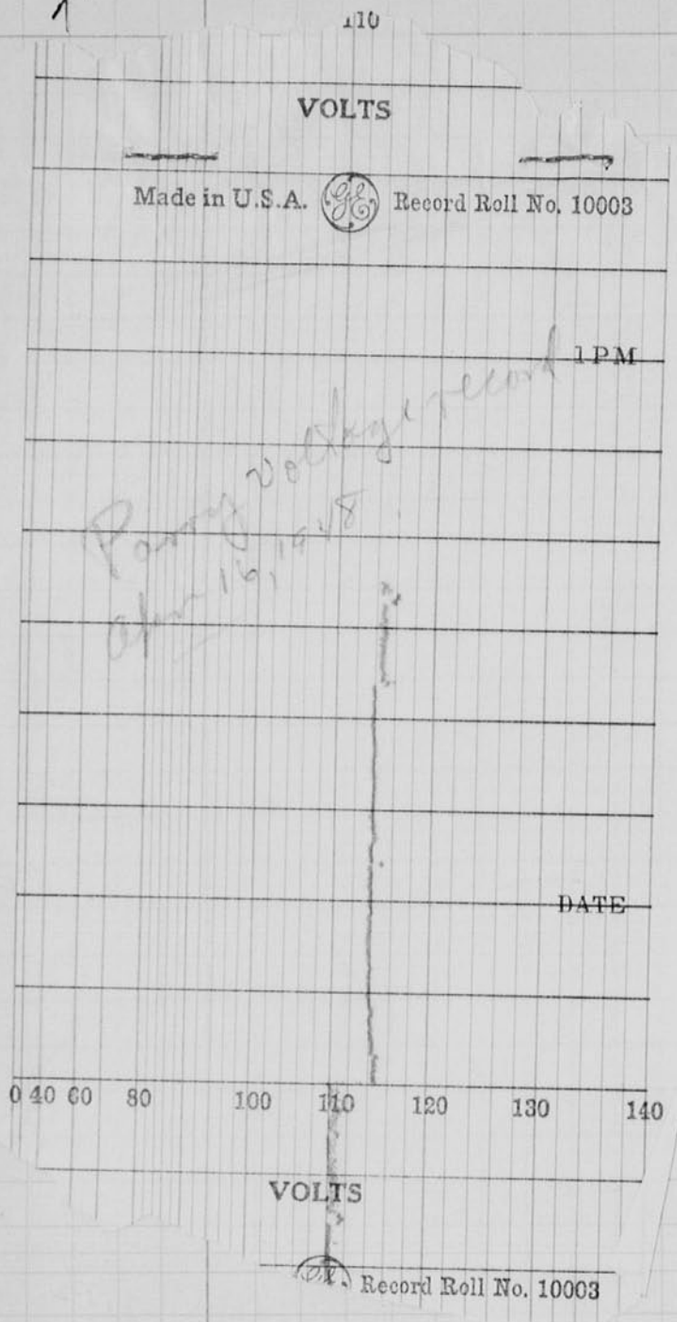
-- X Ray Data from Parry --

Film # 400   Scope # 106

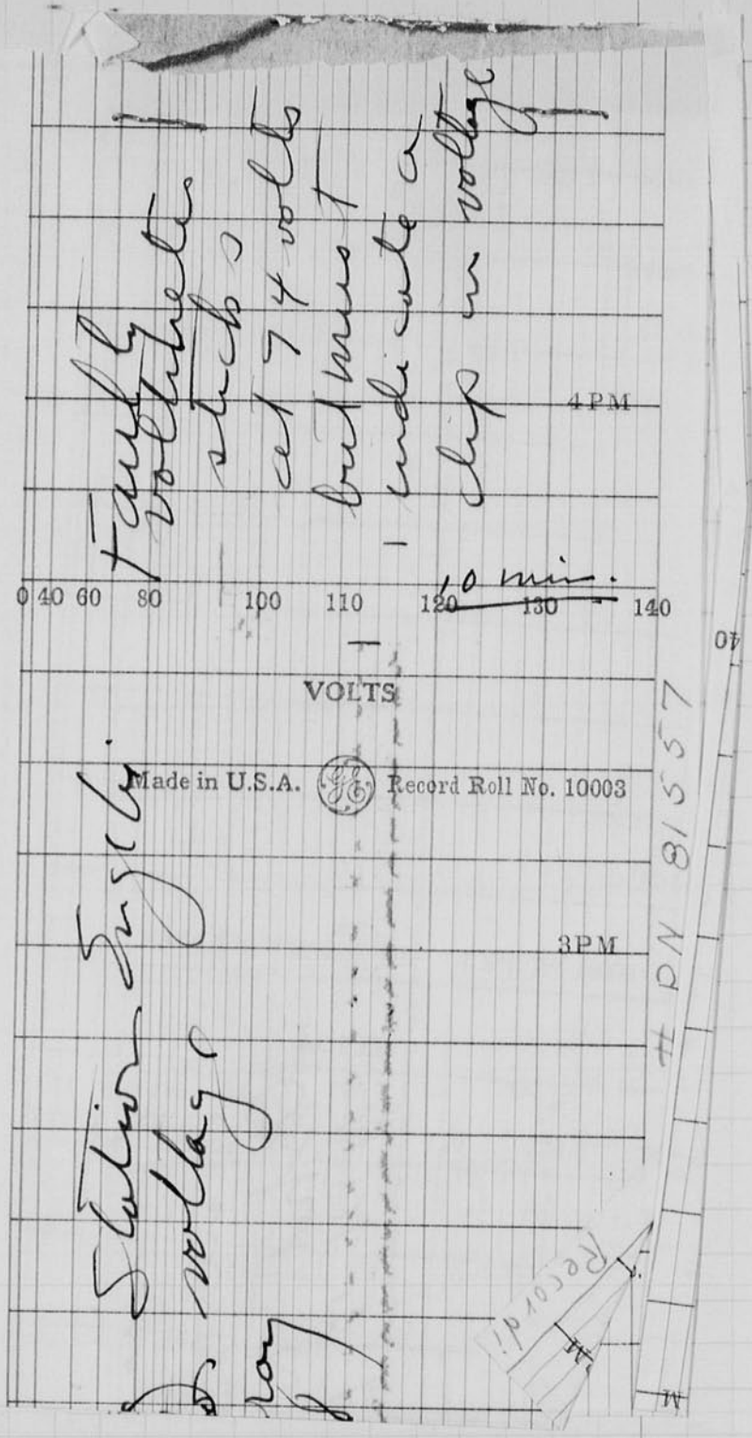
Film corrected for axis angle by Reference 6 film 274 = avg. Calibration

TIME	Y	R_2/R_1	ln Ratio	α	Y×100	ln of Y×100
0	0	α				
	.02	.5			2	
10^{-8}	.01	2.0			1	
	.02	1.25			2	
2×10^{-8}	.025	1.0			2.5	
	.025	1.20			2.5	
3×10^{-8}	.03	1.33	0.285	0.57 $\times10^{8}$	2.5	
	.04	1.25	0.223	0.44	3	1.1
4×10^{-8}	.05	1.60	0.470	0.94	4	1.39
(.07)	.08	1.88	0.631	1.26	5	1.61
5 (.075)	.15	1.87	0.628	1.25	8	2.08
.08	.28	1.97	0.678	1.31	15	2.71
6 .085	.55	1.89	0.636	1.27	28	3.33
.09	1.04	1.60	0.470	0.940	55	4.00
7	1.67	1.47	~~0.048~~ .385	0.770	104	4.64
	2.46				167	5.12
8					246	5.50

f-16-48



Power voltage record
Apr 16, 1948



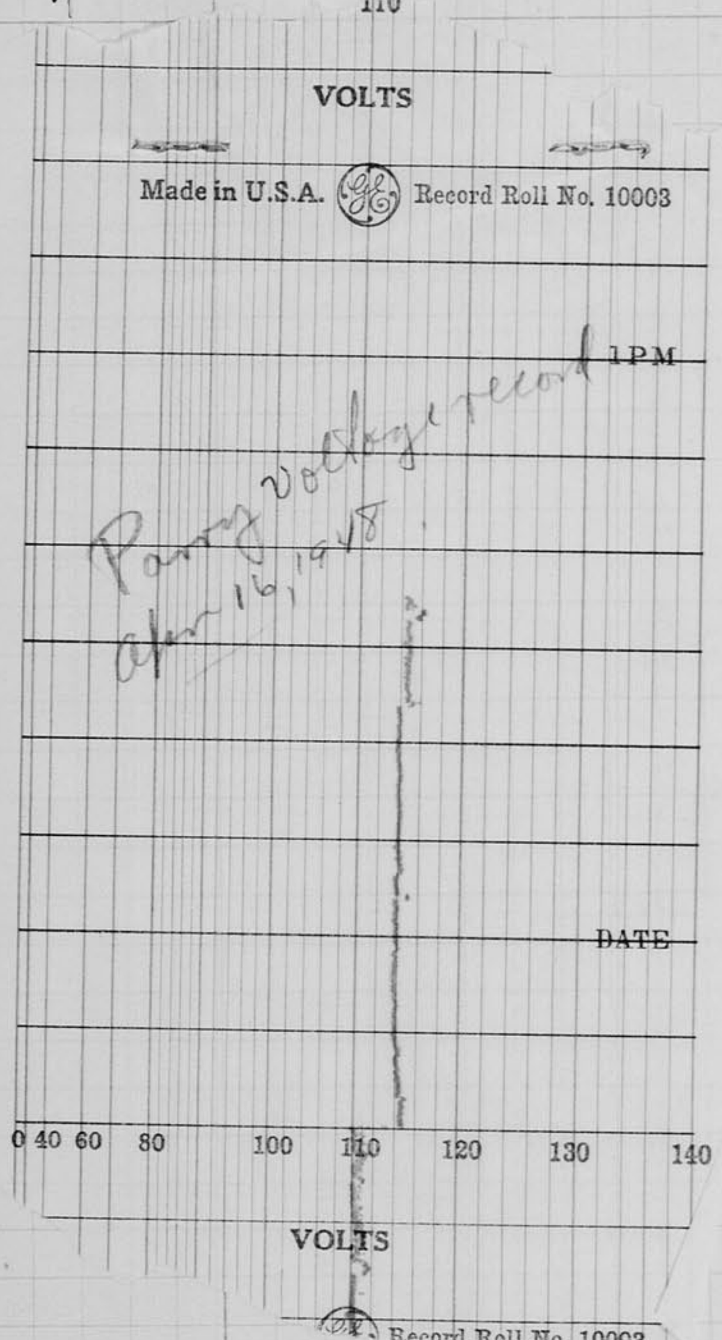
Station Supply voltage

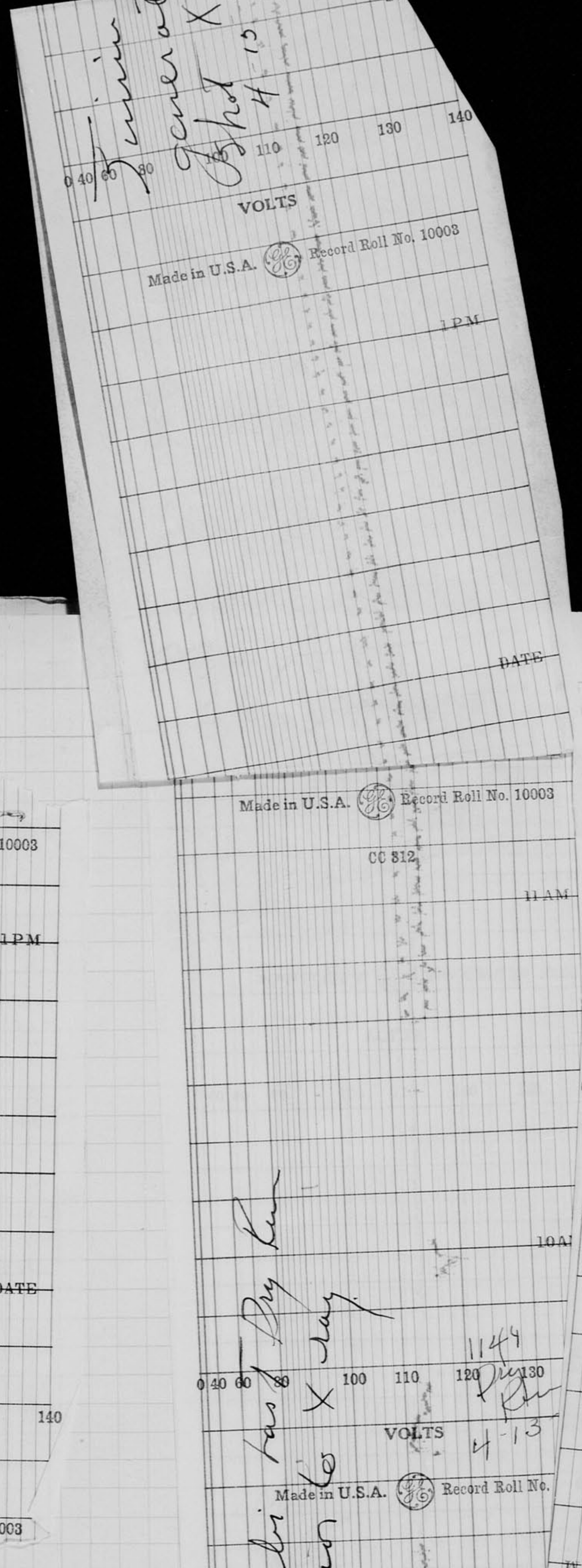
X Ray

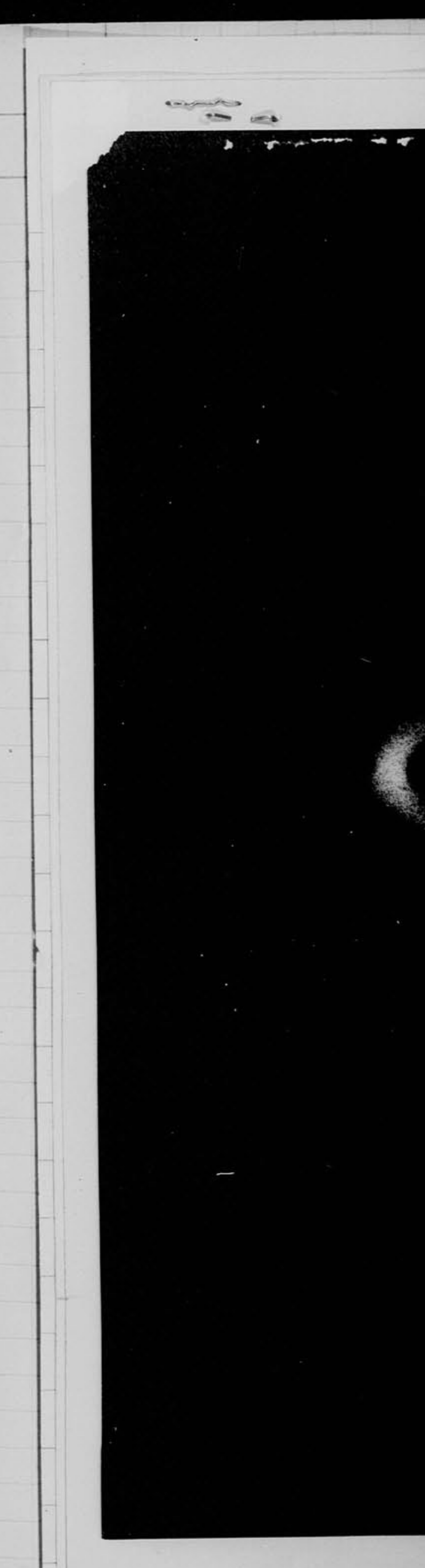
voltage recorder data

X Ray Dept

4-16-48







voltage recorder data
X Ray Day

70

f-16-48

110

VOLTS

Made in U.S.A. Record Roll No. 10003

1PM

Power voltage Tech
Apr 16, 1948

DATE

0 40 60 80 100 110 120 130 140

VOLTS

Record Roll No. 10003

110 120 130 140

LTS

Record Roll No. 10003

1 PM

AM

1

130

120 110 100 80 60 40 0

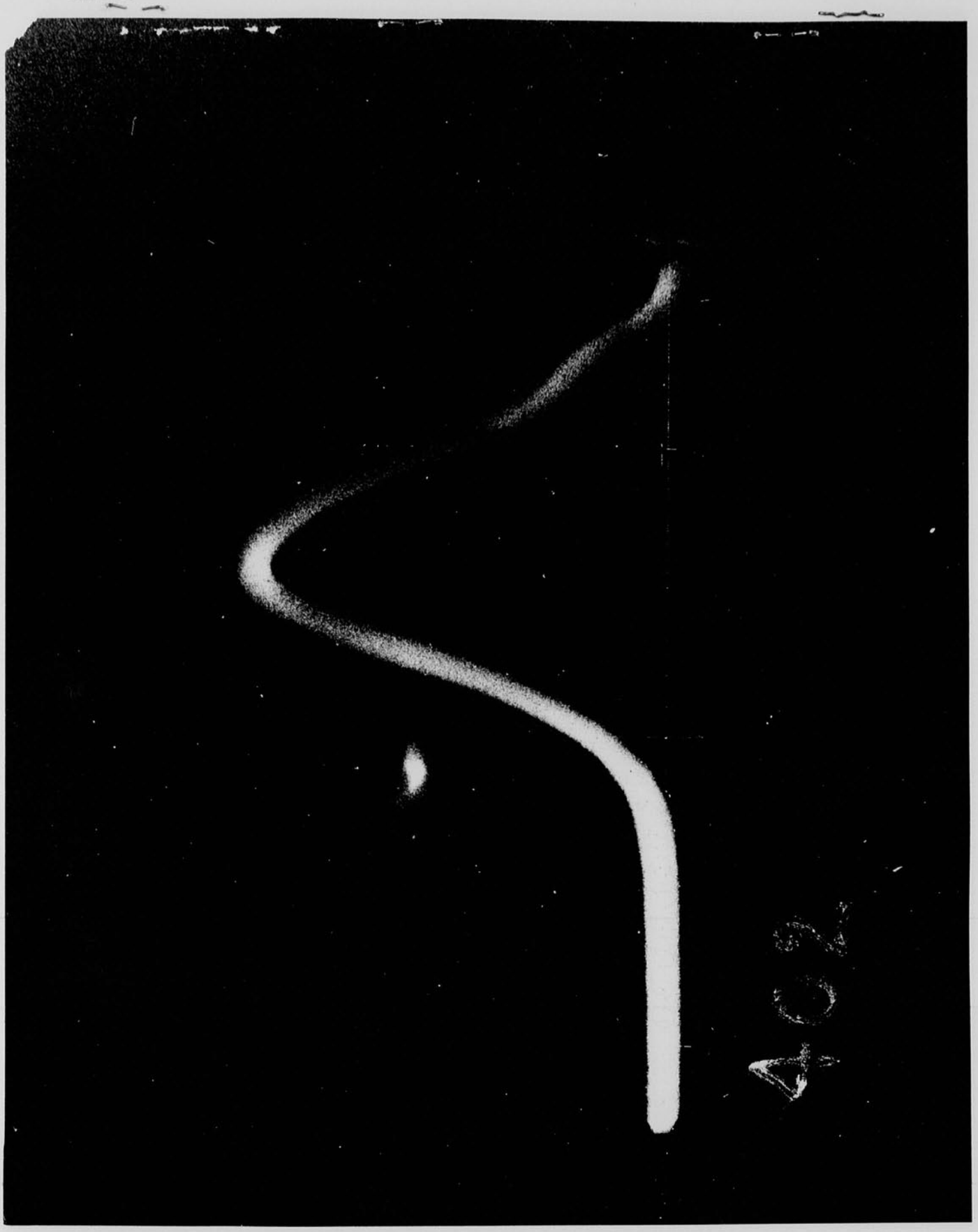
VOLTS

Made in U.S.A. Record Roll No. 10003

7AM

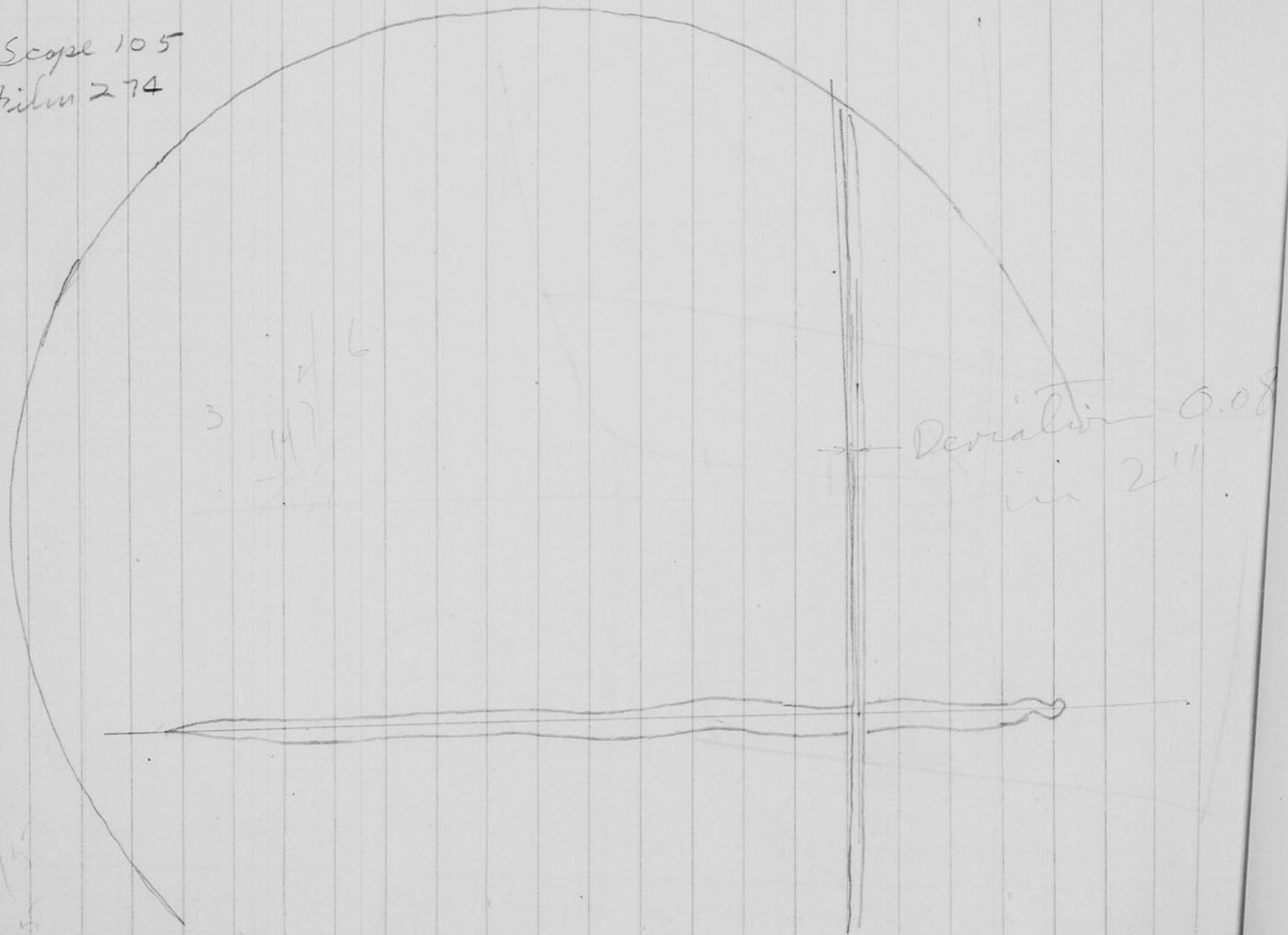
voltage recorder data

X Ray Dept.



Scope 105

Scope 105
Film 274



voltage

Made in U.S.A. Record Roll No. 10003

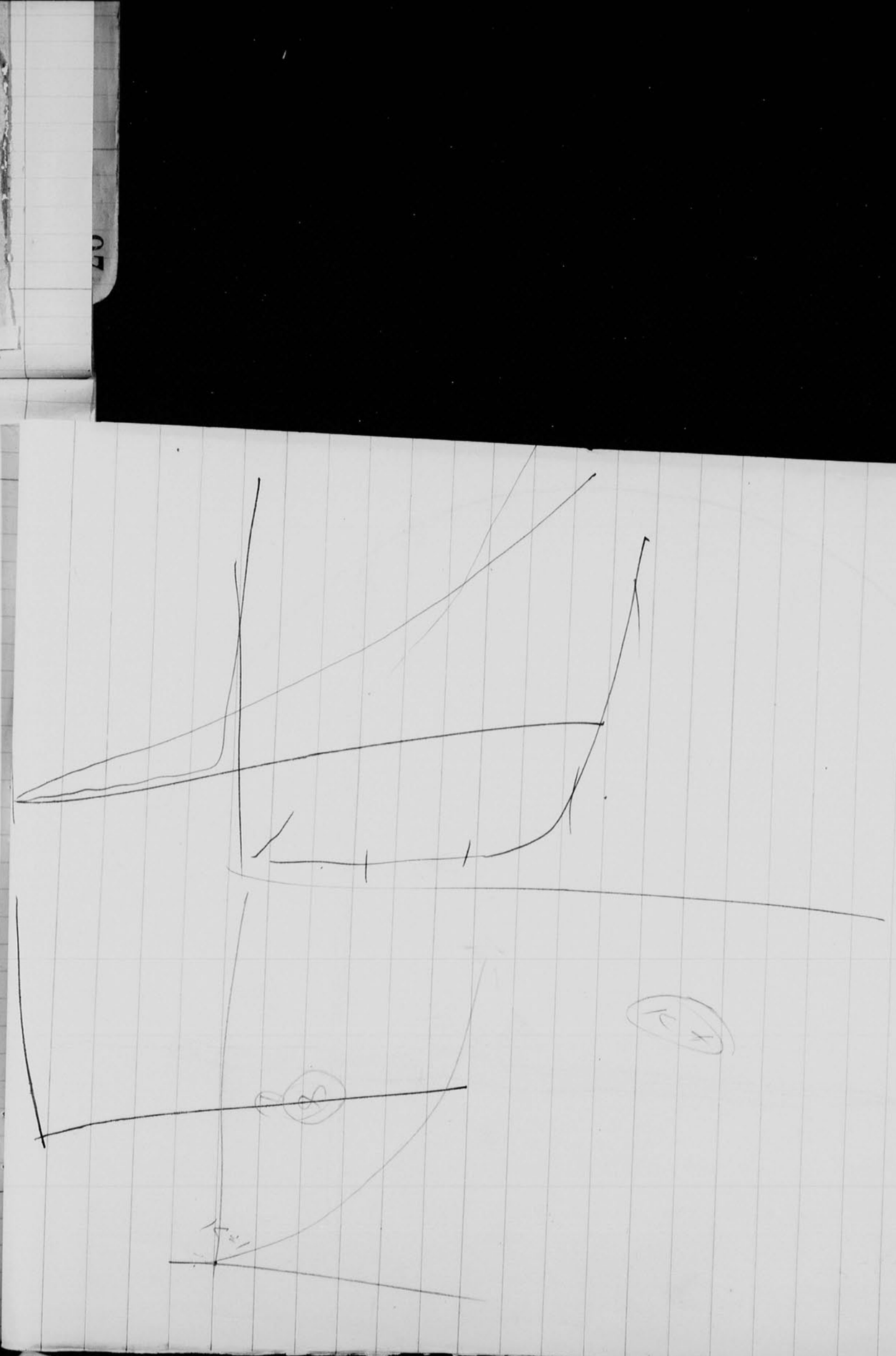
VOLTS

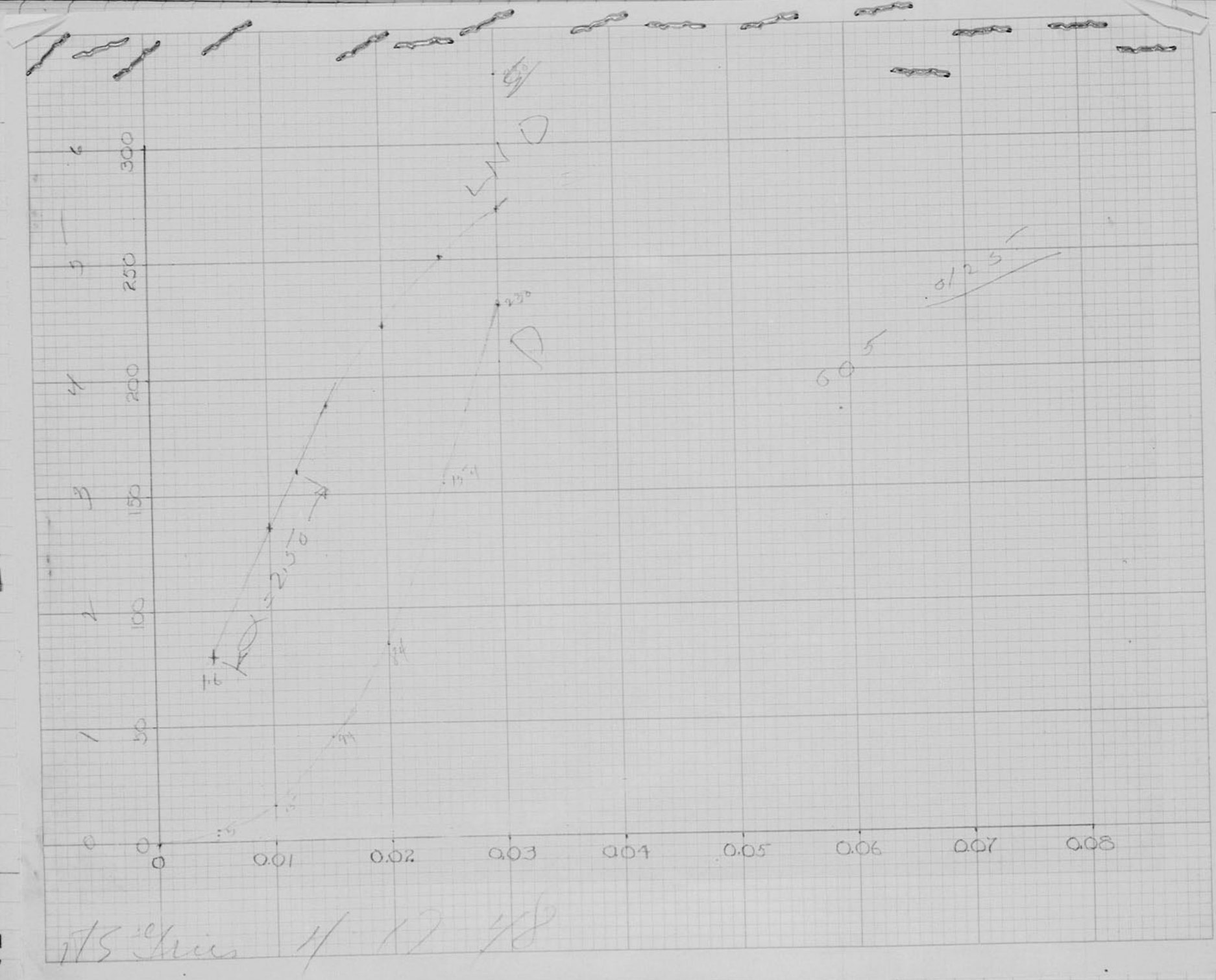
100 110 120 130 140

3 P.M. 4 P.M.

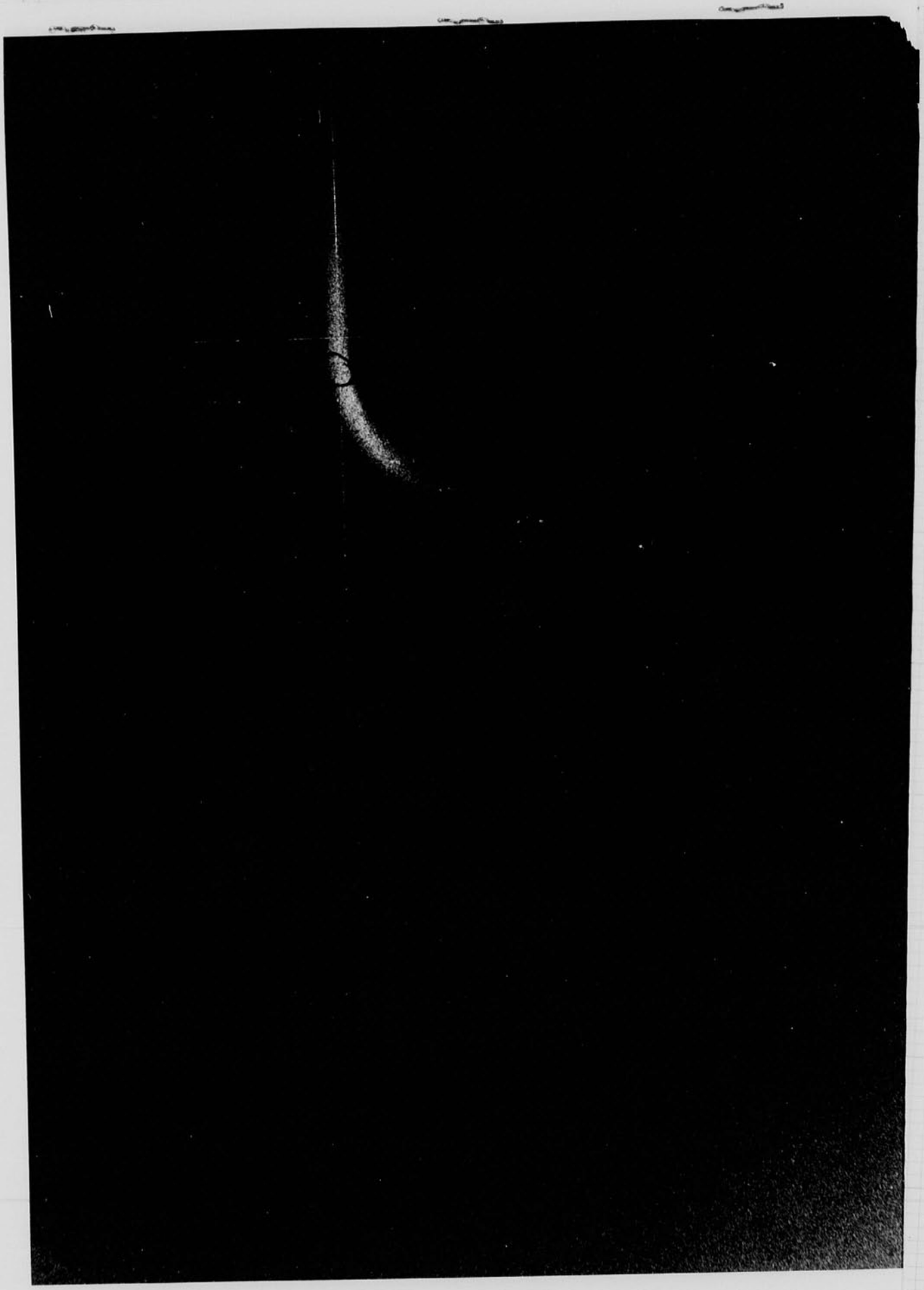
PN 81557

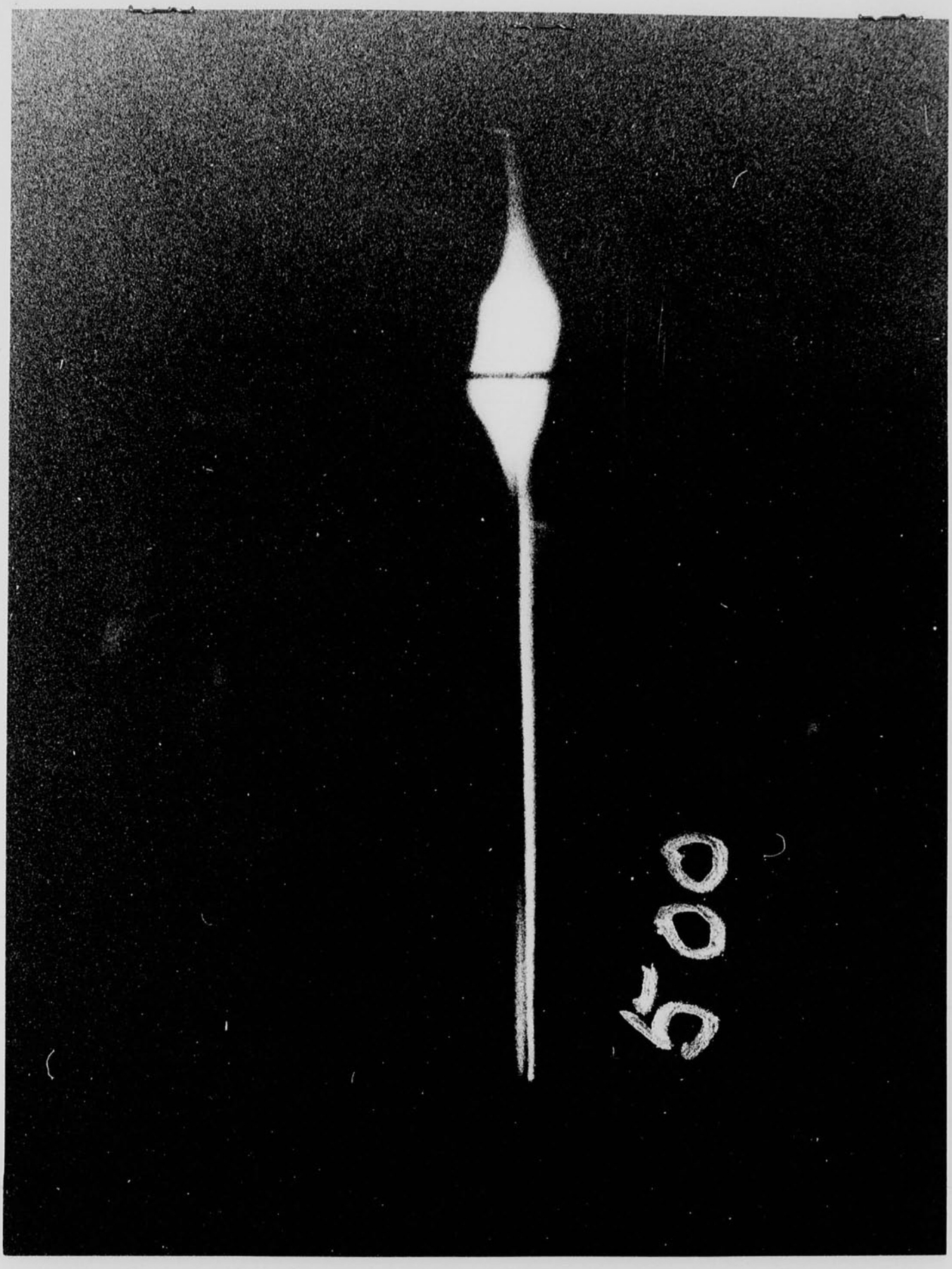
batteries
sticks
at 74 volts
but must
indicate a
dip in voltage





72





Record from 931 setup on Eugebi with Seavak lights. Transit time was ok. with this intensity time.

April 20 1948

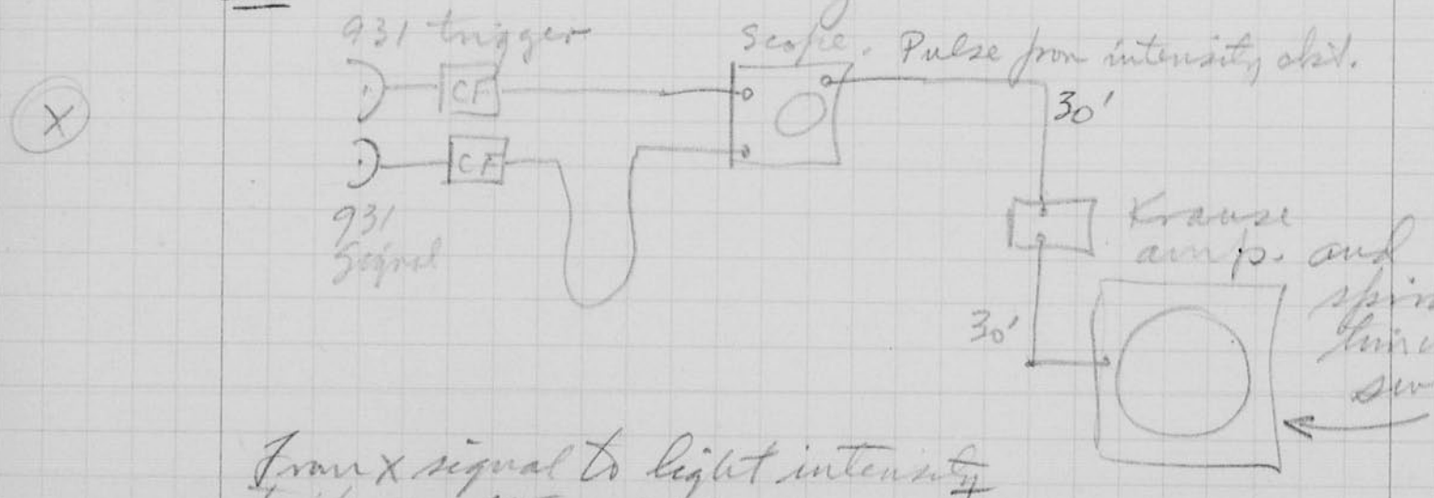
Ashore last night on Aomon Island with Eberhard to check out the 935 photocells in the scintillator.

We used the organ spare (p62) at 100 ∧ but the triggering was marginal. When moved into 70 ∧ the trigger pulse was ample.

W. Rowan and Bill Taylor assisted with this experiment.

The 931 setup is to be used with naphthalene on Aomon island. We have given it each the load resistor to 2400 ohms and the voltage on the last stage to 500 v. (Apply to Aomon and Runit) See oscillogram no 468 and 464(?) for comparison. The new conditions give a longer deflection and a faster rise time.

Transit time Conditions on Eugebi



(X)

From X signal to light intensity trip = 115 mμs ±

Norris Thorson (Los Alamos).

checks ok with Krause data on ionization.

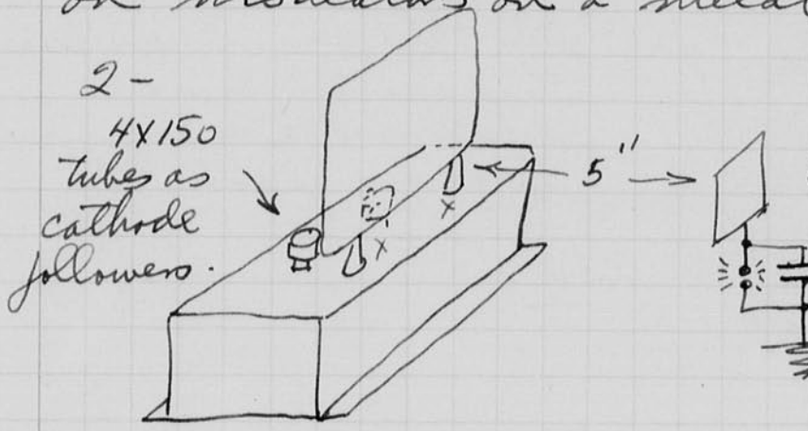
Apr 23 1918

Harold Edgerton. USS Albemarle off Aomon Island Emivelole Celol.

Electrostatic pickup for use with bomb.

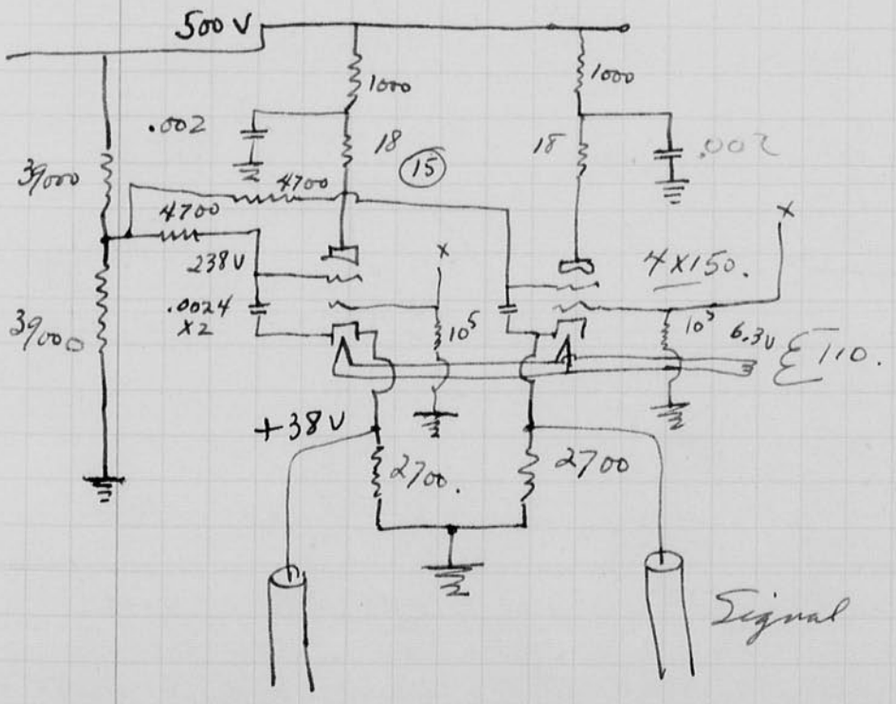
Several experiments indicate that an electric field is present when the bomb explodes. There is no information as when or how this potential is produced.

A metal plate is being tested this morning for use with Bomb No 2 at Aomon Island. The plate is of .04" aluminum 10" x 7½ mounted on insulators on a metal chassis 6 x 17 x 4.



Test sparks.

Osc. No. 504.
505.
were taken with 50 ft in the trip cable and 125 in the signal.



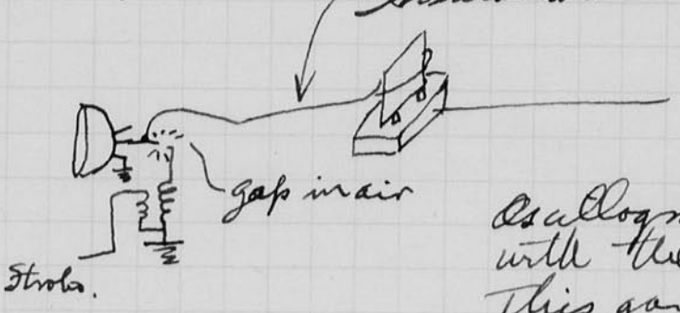
the oscillogram only shows two of positive half cycles. The cathode follower does not give the negative half cycle.

Apr 24 1948
H. E. Edgerton. Aomon

Photos PL 546 7-12
547 1

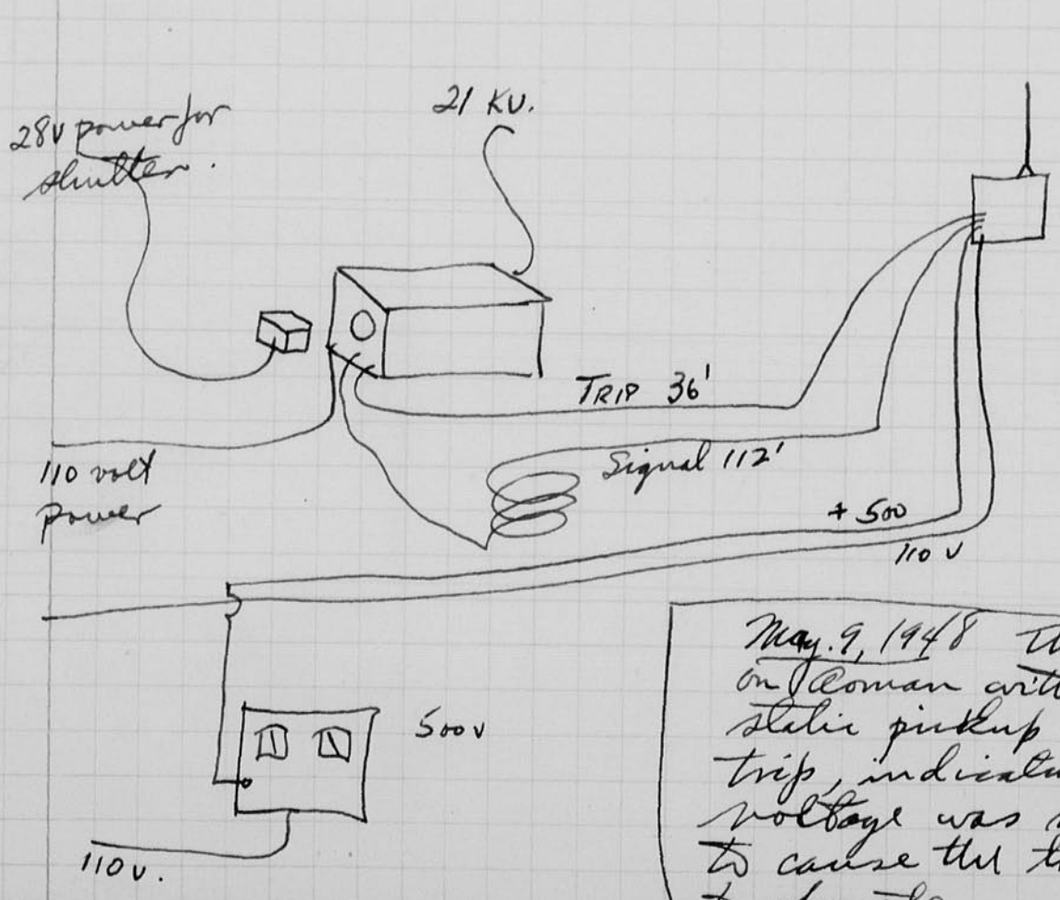
Photos of chassis PM and electrostatic pickup.

The electrical pickup device of p 75 was installed last night with the help of Drake and Rowan. The system was tested with the spark coil output of the strobotron triggered gap. p62.



Oscillograms were taken with the argon lamp on. This gave a larger signal due to energy from the argon flash.

Circuit as set up in Aomon



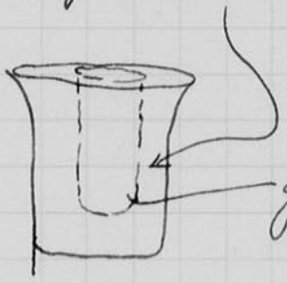
May. 9, 1948 the scope on Aomon with the electrostatic pickup did not trip, indicating that the voltage was not enough to cause the trip thyratron to operate.

The 931 photo multiplier equipment was tested.

	Signal	TRIP.
Initial dark current.	-5 ua	600 jumps 25 jumpy 2 steady after 5 min.

moon light (full.)
Tubes covered with box ~~es~~ lid
had small slits on the bomb side. 20 ua 400 ua jumpy.

Napthalene in beakers for use with the 931 P.M. tubes.



Black tape was put over the outside of the beaker to exclude visual light.

The beaker and glass liner slips over the 931 P.M. tube.

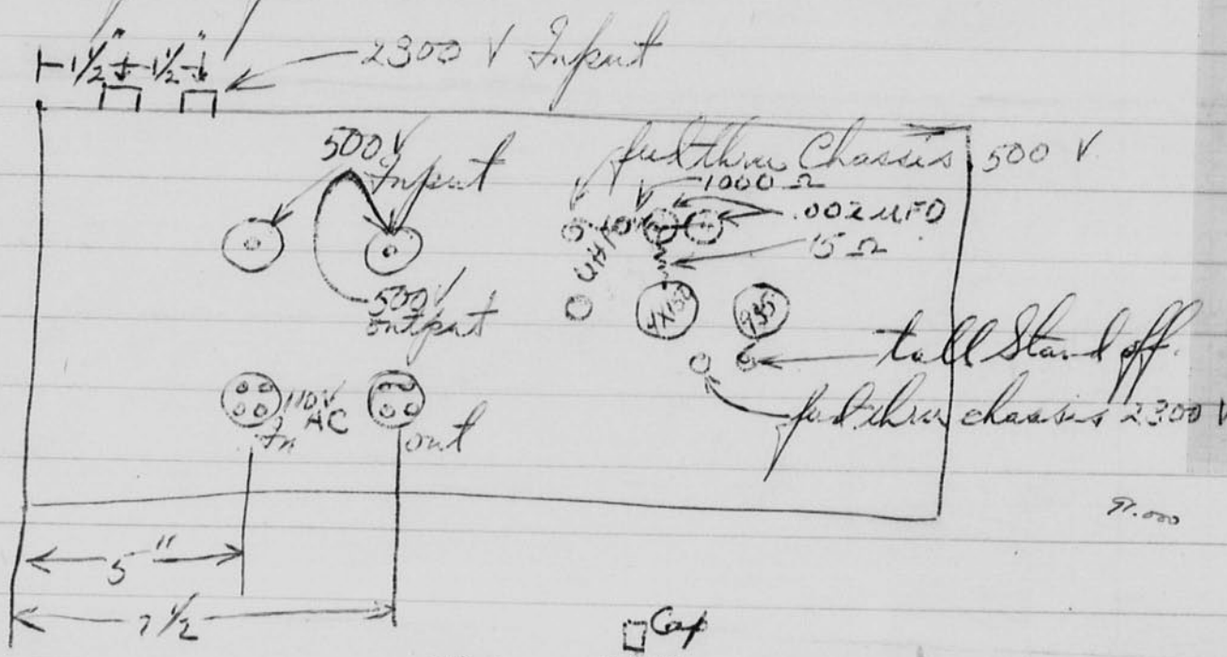
Dark current with tapped beaker over the P.M.

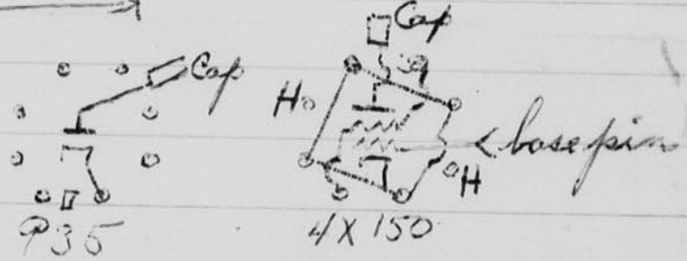
		-3 ua	+1 ua.
Distance from 1 curie source.			
to center of	30"	-1	+2 ua.
P.M. with	24"	0	+3.5
napthalene.	18"	2	5.0
	12	5	11.
	6	19	29
	3	70	95.

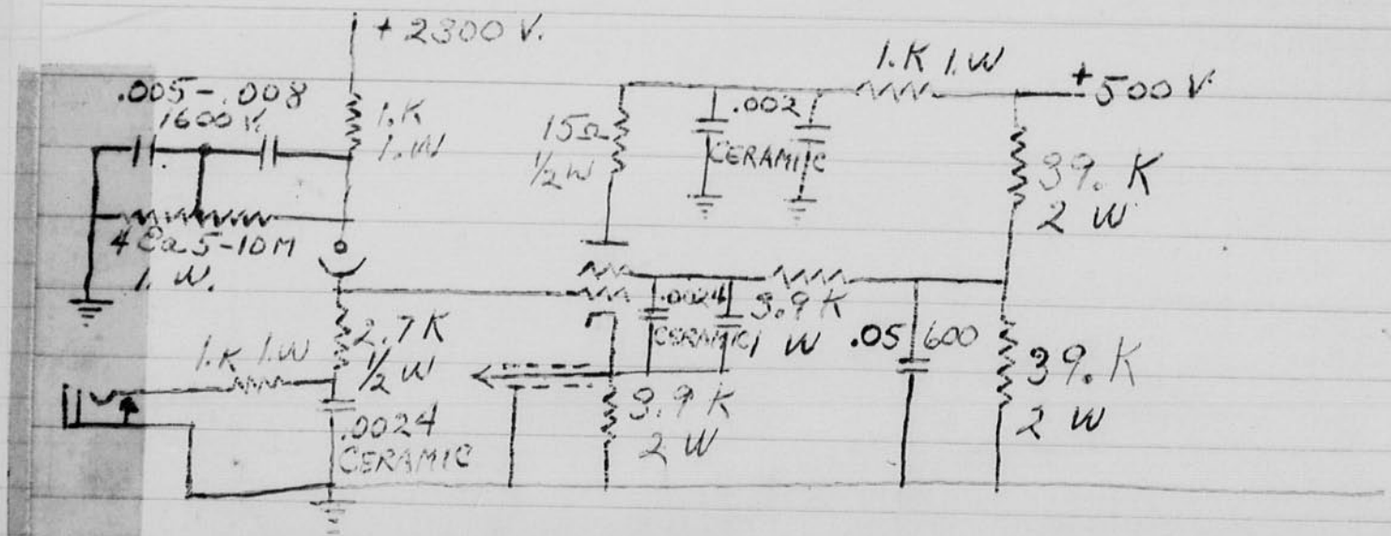
Gamma Source 1 gram Radium 1 curie
~~3.7~~ 3.7×10^{10} disintegrations per second
1-2.7 mev.
$ 20,000.
0.73 R per hour at 1 meter
0.1 R allowable daily dose.

1 ton T.N.T. has 4.2×10^{16} ergs = 4.2×10^{9} joules. Explosion

Duo Chassis Photo tube mounts on Chassis level to Standoffs.
Photo tube 935 mounted 2 7/8" from front of chassis
4X150 mounted 4 7/8" from front. U.H.F. Connector
mtd. 6" from front







Sunday May 2 1948
Eniwetok Atoll. off Runit Island.

Bomb "yoke" went off according to schedule yesterday morning before day breaks. I was at Parry Island some 11 miles away. There was a distinct odor of ozone at the instant of detonation. The light was terrific followed by a luminous blue glowing cloud that continued to glow for a minute or more as it rose into the air. After 10 minutes or more the trail from the bomb to the top of the cloud appeared as a large Z due to variations in the wind currents. Shortly after the bomb went off there was a white glow on the ground due to heated material. This glow died out after a half minute or less.

Eberhard and I had been at Parry island for several days working on our setup there. The only change from bomb "Xray" was

1. the trip photomultiplier tube was replaced with 931 tube #1. which was more stable.

2. The 931 voltage on the first 9 stages was decreased from 1550. to 1400 v. (Trip Cell only)
   ← 470,000 + 110,000 ohms added in series bleeder

3. the diaphrams or irises of the searchlights were only partly open since the moon light was strong. the moon was half and almost directly over head.

Phase 1 117
2 118
3 115
from recorder in shelter.

When the equipment at Parry was turned on for the first time each day, the photomultiplier tubes would usually go into a self sustained glow because of the high voltage per stage. It was found that the tubes eventually would stabilize down to a low value of static dark current, sometimes by themselves and sometimes by simply opening the circuit momentarily.

On the morning of the bomb test we went through this procedure several times during the 1/2 hour prior to the shot. The trip PM tube was particularly bad about the glow

condition when the iris was opened. I went up to 100 ua from the (1 ua) static dark condition several times without incident, but if the current was held at 50 for a minute or so it might suddenly go to a large value, that is off scale on the 100 ua range. On one test I found that it was off scale on the 1000 ua range.

On the morning of the yoke Bomb I was on the roof of the control station with H. Gilbert We opened the iris so that 40 ua resulted from the moon light and early day light.

There was a hole melted in the screen over the cathode of the P.M. tube. Trigger.

At the -30 second gong the meter went off scale (100 ua). I debated whether I should go down below to open the circuit or to take a chance on the tripping. I decided the later because of time. Fortunately the trigger did work even if blocked and two good oscillographic records were made by the signal P.M. tubes that were on the stand back of the control station. Eberhard kept the irises of these so that the current was about 150 ua on each. The iris for this was open some 1/10 to 1/2 of the full reading.?

The records at Parry were ok, showing an α of about $1. \times 10^8$

Aomon Island

Equipment was arranged on Aomon island at the 1300 yard timing station. This shelter is constructed of 18" thick concrete, a lead walled coffin is inside with 2' thick walls. Sand is piled against the shelter, flush with the top giving an additional 20 or 30 ft thickness of sand

1. Visual light. Two 36" G.E. searchlights were placed at the 1300 yard station on the roof with the sights focussed on the bomb house 200 ft above the ground. Each searchlight had a 935 photo tube at the focal point

Notebook # 18

Filming and Separation Record

____ unmounted photograph(s)

____ negative strip(s)

2 unmounted page(s)
(notes, drawings, letters, etc.)

was/were filmed where originally located between page 80 and 81.

Item(s) now housed in accompanying folder.

Party Setup for Bomb Y.
April 25 1948.

3- 36" Searchlights with 931 photo multiplier tubes

Trip photo multiplier on roof of control station.
1400 v on dynodes 11-9 350 - dynode 9-10
Cable length to two scopes in parallel
on input = ".

Signal photo multiplier tubes. (Same tubes as used for Bomb X test).

1400
500
1cm
2400

East Searchlight into scope 106.
West Searchlight into scope 105.
Signal cables about ".
Signal searchlights about 30' back of trip.

Scope

Setup for Romora Island.
April 25 1948
Bomb Y.

1. 36" Searchlight with 935 photo tube and 0.17 μs. sweep. 31' trip cable. 120' signal.

2. 931 photo-multipliers 1400 volts 11-9 dynode. 500 volts 9-10 dynode. Napthalene in beakers over the photo-multipliers. Thickness of napthalene about 1 cm. Sweep time 0.17 μs.
31' 2400 ohms 500 volts last stage.

1400 V 11-
500 V 9-1
1 cm napt
2400 ohm

3. Electrostatic pickup unit with metal plate 7"x10" perpendicular to bomb. Two C.F. tubes for trip and signal. Trip length "
Signal length ".

4. All three record negatives have zero traces displaced downward by 90 volts

Scope 122

40
1500

of the mirror, in fact slightly back of the focal point so that the image of a lamp on the house would throw a circle of light about 1/2" on the 935 photocell cathode.

A Dumont scope no. 121 type K 1013 was used to record the transient voltage on a 0.17 μa (approx) sweep. Timing records of the scope speed had been taken previously.

The above combination gave an excellent trace that shows α to be about $1.2^{\times 10^{5}}$ on the first analysis. Krause shows about $.85^{\times 10^{5}}$ on his ionization chambers. Apparently the light shows a greater α than the ionization? Further data will undoubtedly be inserted in this book later. See page ——.

2. Light in Napthalene from Gamma Rays.

1400 V 11-9 decade.
500 V 9-10 "
1 cm napth.
2400 ohms.

Two Photo-multiplier tubes with napthalene were located in a house on top of the tower station at Oxman. A calibration of the napthalene is given on page 77. One tube was used to trigger Dumont scope no 119 type K1013 while the other was used to supply a signal to the plates. Both PM tubes fed directly to 7X150 tubes and to 100 ohm lines. The circuit terminated in an open circuit on the plates. No transformer (RCA line type) was used for either scope at Oxman.

3. Electrostatic pickup page 76 – No record. Sweep did not trip.

Scope 122

A successful record was made which on first analysis showed $\alpha = .85 \times 10^{5}$ thus checking Krause's figure.

For the last few days there has been much discussion of these results, especially the ones concerning light. All three light records show α to be larger than obtained from the ionization chamber method of Rossi.

In conf. with Brier, Ogle, Eberhard and myself it was decided to set up the following experiments.

H. E. Edgerton
May 3, 1948.

Proposed Runit Set ups.

1. Visual light 935 photo tubes in 36" searchlights. (Same as Roman).

2. Light from Napthalene measured by 931 PM tubes. (Same as Roman).

3. Light from Napthalene measured by 935 photo tubes. This measurement will be a repeat of test made at Eugebi which was unsuccessful. Trigger will be obtained from the case 2 above.

Conditions at Parry.

A 935 will be substituted for one of the 931 tubes now in use. At this position the 935 signal will be about 1/1000 that of the one in the searchlight at Runit.

May 6 1948. I have been on Runit Island for the past few days finishing the set up in the timing station.

Calibration of signal searchlight with 935 tube.

no. 1000 watt lamps on tower	Voltage	ma.
0	—	.05
3	143	.14
6	120	.18
9	100	.12
9	115	.20
		(.25).

Further data taken May, 7. Will Rowen Consider.

P.E.
Bulb P552 mogul base
Clear 1000 watt
120 volts
110 J11

0	0	.06 ma.
3	150	.16
6	150	.28

May 9 1945
HBE

65.

42 mm
25 ft = 1 ms.
950 ± 50 ohms.

Data from Ogle.

935 photo tube 600 V 50,000.

Sunlight (direct) 60 volts.

$$I = \frac{60}{50,000} = 1. \text{ ma.}$$

Sens. 8-70 ~~30~~ ma/lumen. 2650° light.

$$\text{lumens} = \frac{1000 \text{ ma}}{30 \frac{\text{ma}}{\text{lumen}}} \times \text{Eff} = 30 \text{ lumens.}$$

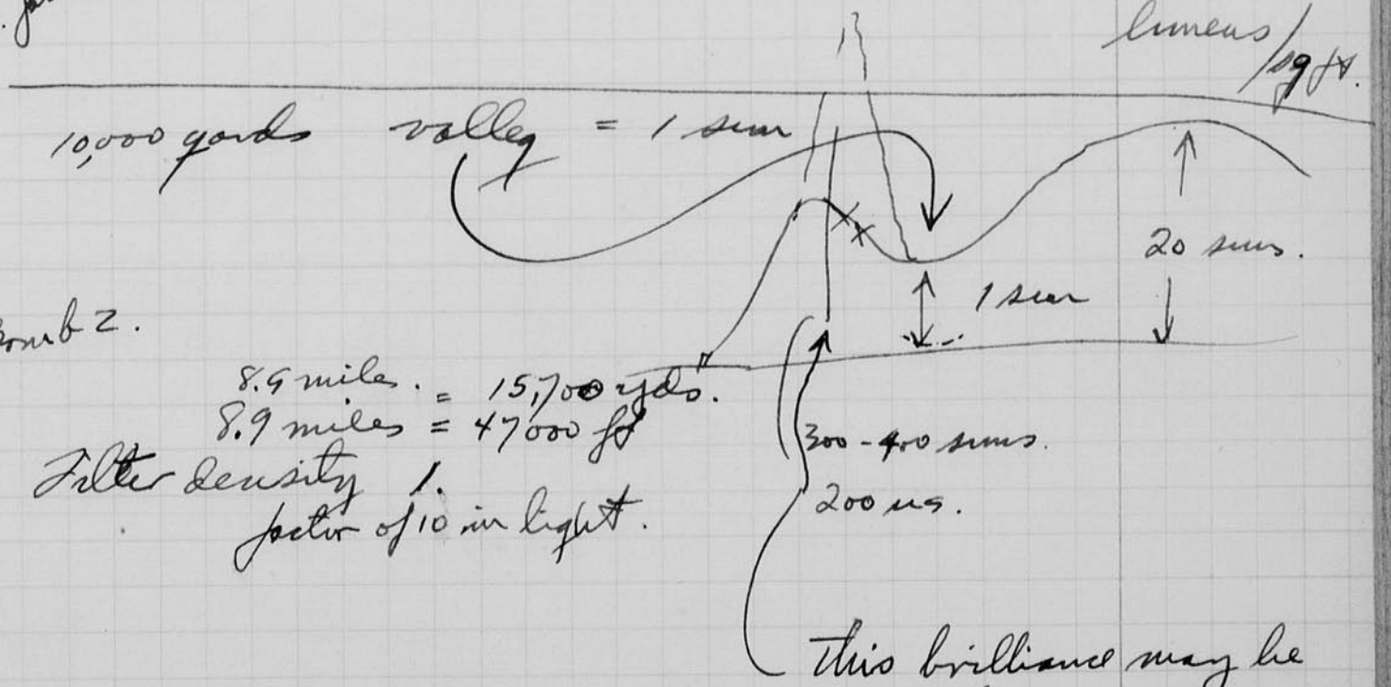
Bomb Y. cathode area 1.5/16" × 5/8" ≅ .6 sq inch

$\frac{20}{2000}$ 100 ma. full scale sat.
600. scale factor
.2 ma at 4000 ft sta.
.0057. ma. at 10,000 yds.

$$\frac{30}{.6} = 50 \text{ lumens/sq inch} = 7000. \text{ lumens/sq ft.}$$

1 sun = 1 ma
Light at 1000 yds ≅ $\frac{1}{200}$ sun ±.
$\left(\frac{35}{10,000}\right)^2$ at 15,000 yds ≅ 1/400 sun.
1740 abs. factor 10 ≅ 1/4000 sun. daylight · 7000° K. × 2

2 × 7000 = 14,000 lumens/sq ft.



Boat to Bomb Z.

8.6 miles. = 15,700 yds.
8.9 miles = 47000 ft

Filter density 1.
factor of 10 in light.

this brilliance may be as much as 1000 suns.
Some photos shows 2 mile diam of first ~~Boom~~ Pulse.
the fire ball has a diam of 2400.

84 May 9, 1945. CM 28.

Harold E. Edgerton

Color Photos of Sea Shells.

Dr. Drager.

Jerry. Broucato.

Parry control station

Photomultiplier #50 in 36" searchlight.

Limit tower bare lamp no reflectors.

Night light = 22 ma. (wide open)

ma.	Lamps	Voltage	shutter	
230	3	149	4 11/16"	
115	1	158	"	15 ma night.
215	1	156	open.	20 ma night.

On the following day the multiplier voltage was changed from 1560 to 1360 volts.

Static reading low light changed from 110 to 42 ma..

May 10 1945 cdc

Sensitivity Limit.

$$\frac{215}{115} \times \frac{230}{.16} = 2690$$

after change $= 2690 \frac{42}{110} = 1030$

Aomori experiment Bonito.

$$\frac{\text{Parry } 931}{\text{Aomori } 935} = 1000 \text{ to } 1200.$$

Limit Setups as of May 9, 1945.

3900' station from Bomb Z.

Photos of searchlight and naphthalene. c/p. PL-341 1- photos Sgt Deutch.

Searchlights.

Trigger 935 Photocell tube - 27' to scope.

Scope 111. Signal 935 Phototube - 100' to scope 93' delay.

Doghouse setup.

Trigger 931 Photomultiplier tube naphthalene. 31'
#7 see page 86 for calib.

Scope 113. Signal 931 Photomultiplier tube naphthalene 142'
#33 see pag 88.

20 removed May 11 122'

Scope 122. Signal 935 Phototube naphthalene. 90'

Parry Changes for Bomb Z.

A 935 has been substituted into one of the signal searchlights in place of ~~the~~ one of the 931 tube. Twenty feet have been taken off the signal cable since ~~signal~~ the signal will be delayed some due to the lower sensitivity of the 935 phototube. These changes were made by Olson and Eberhard about May 7.

Runit calibration of 931 photo mult. with naphthalene

Trigger # 7 PM 931 with naphthalene.

1 curie source 6" distance from PM surface gives 55 ua
+1 dark.
Δ 54 ua.

Signal #33 931 with naphthalene.

1 curie source 6" distance from PM surface gives 35 ua
-1 dark.
26. ua

Cable lengths.

May 11. 1948. Changes in sweep circuit of scope 122

The 700 mm sweep capacitor was changed to 1300 mm.
Osc. 684 shows speed sweep before change Ring.
685 " " " after " Ring.
683 " " " before change 200 mc
687, 686 show argon flash with slow speed sweeps.

The second reflection is noticeable at the end of the sweep with 90 ft of 62 U line. I estimate that 20 additional feet will cause the reflection to come after the sweep is over.

The intensity pulse circuit was not changed. Therefore the duration is about 0.3 us.

Light Sensitivity calculation for Engebi Bomb X.

Distance from tower to Searchlight = 3900 ft.

Sens. of Photomultiplier (Rated value) ~~20~~ ? amp/lumen (estimated)

the tube manual gives a value of 10 amp/lumen with 1250 volts max across the 9 stages.

$1250/9 = 139$ volts per stage.

We used about 150 volts per stage for the Engebi test. From Fig 2 J.O.S.A Vol 37 no 6 June 1947 p 420 Ralph W. Engstrom & estimate that an increase from 135 to 150 volts per stage increases the sensitivity by a factor of ~~11~~ 2 (could be as low as 2).

Area of cathode $\frac{15}{16} \times \frac{5}{16} = .25$ sq inches

Without searchlight.

25 ma output corresponds to about half of saturation value. This is half of the peak deflection.

$\frac{.025 \text{ amp.}}{20 \text{ amp/lumen}} = .00125$ lumens at cell

$\frac{.00125 \text{ lumens}}{.25 \text{ sq inches}} \times 144 = 0.720$ lumens sq. ft.

Estimated Searchlight factor = 600.

$\frac{0.720}{600} = 0.0012$ lumens/sq ft. at liner station.

Required output in candle power at tower =

$0.0012 \times 3900^2 =$

$15.2 \times 10^6 = .0183 \times 10^6$

$= 18,300$ M.C.P.

total lumens output = MCP x 10

$= 180,300$ lumens

0.2×10^6 lumens

Distances

from Simmons May 11 1948.

Tower to Timer Stations on
Engebi Aomon & Rumit = 3900'

20.2 miles	Engebi - Parry Control	=	106,646 ~~yards~~ feet.
16.2 "	Aomon - " "		85,411 "
10.3 "	Rumit " "		54,362 "

Change in Sensitivity from Engebi Searchlight to Parry Searchlight according to square law.

$$\left(\frac{3900}{\text{x } 106,646}\right)^2 = \text{reduction factor.}$$

$$\left(\frac{\text{x } 106,646}{3900}\right)^2 = \text{increase of lumens required at Engebi Tower for half scale.}$$

736

~~6630~~

Light is attenuated about .8 to each mile therefore this factor should be increased by $\frac{106,646}{(5280)}$ miles = 20.2 miles.

$8^{20.2} = \frac{1}{88} = .014$ $\quad 0.8^{20.2} = .014$

$8^{16.1} = \frac{1}{30.7} = .0332$

$8^{10.3} = \frac{1}{9.9} = 0.101$

thus the ratio of light reqd = $\frac{736 \times 100}{\text{Parry record}}$ = 73,600
Engebi record.

Engebi Light reqd for Engebi = 0.2×10^6 lumens.
" " for Parry = $14,700 \times 10^6$ lumens.

Aomon shot "Yoke" May 1 1948.

Light Sens. Calc. for 935 in search light.

Assume 935 sens = 40 ua/lumen
RCA data sheets show 8 to 70 ua/lumen.
Cathode area = 0.6 sq inches approx.

Ratio of 935/931 = $\frac{40 \times 10^{-6} \text{ amp/lumen}}{20 \text{ amp/lumen}} = 2 \times 10^{-6}$

Light required on tower for 931 (p87).

$= .2 \times 10^{6}$ lumens

Light required on tower for 935

$= .2 \times 10^{6} \times \frac{1}{2 \times 10^{-6}}$

$= 0.1 \times 10^{12}$ lumens.

Parry - Aoman distance = 16.2 miles.

$0.8^{16.2} = .027$ ✗

$\ln .8 = -0.223$

$\frac{16.2}{3.61}$ ✗

$\ln^{-1} -3.61 = .027.$ ✗

Limit Bomb Zone May 1948.

From Fed. Tel. Data Book.

54.8 ohms = 1000
49 ohms per 1000 ft.

Cable resistances 62

			17 ~~feet~~	= 1 ohm
935 Searchlights	Trigger	1.4 ohms	23.8'	20.8 = 1 ohm
	Signal	5.3 "	74.2'	18.2 = 1 ohm
931 Naphthalene	Trigger	1.5 ohms.	21'	
	931 Signal	7 ohms	98'	
	935 Signal	6 ohms	84'	
Parry Searchlights.	West	3.4 ohms	47.6'	
	East	5.0 ohms.	70.0'	

measured by Simpson

			935.	Parry. 931
Krause	Y	2.4	—	1.0
	Y	.86	1.1	1.
	Z	0.90	1.5	1.
			X	

Changed later, see page 94.

Gamma Ray Intensity. Calc.

N.G. See page 98

King says 2.3 gammas per disintegration from source. $.7 \times 10^6$ Kwh = 20,000 ton bomb.

At the max. activity the rate of gamma ray output is about 10^{27} gamma rays/sec. (Possibly 10^{28} at peak.).
Assume 10^{28}.

Gamma Ray flux at 3900 yards.

$$e^{-4.34} = \frac{1}{77} = .013$$

Assume λ = 300 yds.

$$G = \frac{10^{28}}{4\pi\, 3900^2}\, e^{-\frac{3900}{900}} = .52 \times 10^{19} \cdot .013 = .0068 \times 10^{20}$$

g/sec/sq ft. at tower station.

Experiment with Radium (1 curie) at Rmit.

Assume 3.7×10^{10} disintegrations gammas/sec. X 2.3

$$\text{Flux at } 6'' = \frac{3.7 \times 10^{10}}{4\pi\, .5^2} = 1.18 \times 10^{10} \times 2.3 \text{ gammas/sec/sq ft.}$$

This flux produces about 25 microamperes in our 931 photo multiplier setup with Naphthalene.

With the 935 the current should be 10^{-6} less.

$$S = \text{Sens of } 935 = \frac{25 \times 10^{-6} \text{ ma}}{1.18 \times 10^{10} \text{ g/sec/sq ft.}} = 21.2 \times 10^{-16} \text{ ma/g/sec/sq ft}$$

Current due to max activity of bomb.

$$T = SG = 21.2 \times 10^{-16} \times .0068 \times 10^{28} = 3.5 \text{ volts.}$$

This will scarcely be visible on the scope.

Gamma intensity for atomic Shot assuming 25 ma for half scale.

931. $1.18 \times 10^{10} \times 10^3$ gamma/sec/sq ft. required

$G = 1.18 \times 10^{13}$ " " " at tower station.

For Engebi Shot. 935 $1.18 \times 10^{13} \times 10^6 = 1.18 \times 10^{19}$ gammas/sec/sq ft.

From 738 Rmit 25 volts deflection at end of record. — means 25 V at C.F. grid

$\frac{25}{2400} = 10$ ma $\quad \frac{10,000}{20 \times 10^{16}} = 5. \times 10^{18}$ gammas/sec/sq ft.

May 15 1948
Harold Edgerton.

Bomb Zebra "Z" went off on schedule at 6.06 am this morning. It was a very clear morning with a few distant ~~clouds~~ clouds in the east to reduce the early morning light.

I was at the trigger 931 photo multiplier station on the top of the control tower at Parry Island. The diaphram of my searchlight was open 10" from the center disc. According to data on page 57. this gives 270/300 = 90% of full sensitivity. The photo multiplier current was 150 ua.

Result voltage records at 0 time
Phase 1 117
2 115
3 116.

Everhard was at the other station on the ~~base~~ tower to the south. The 935 iris was wide open while the 931 iris was at , giving % operation.

The bomb image on the 935 cathode was plainly visible after the shot.

Also the 931 trigger tube had some wires melted in front of the cathode, the other PM did showed a cathode that had been heated, but there was no melting. These tubes were marked and removed for possible further study in Boston.

We took the 7:15 boat to the Albemarle where Charlie Wyckoff developed the negatives.

West Searchlight type 319 Dumont Scope # 105
tube type 148 1223 S.
935 Photo tube.

East Searchlight type 319 Dumont Scope # 106
tube type 148 1192 S.
931 Photo multiplier.

The record on the 931 showed the normal form. the amplitude of the 935 signal was small on the West searchlight. this sweep should have been increased.

Briggner f32 2 Dens filter ($\frac{1}{100}$) $\frac{1}{5000}$ sec shutter 100 - 125 pict/sec.
Mitchell camera.

Parry 200 mc. Oscillator Calib.

G.R. type 620 Heterodyne freq meter.

200 mc → 206.8 mc. on scale.

202.4 mc read on dial.

Real freq = $202.4 \times \frac{200}{206.8}$ =

photographer
E.C. UDEY
Sandia Base
Albuquerque
N.M.

TRANSIT TIME. FROM 931 NAPTHALENE at Runit.

May 15 1948

~~Bob~~ Bomb Zebra

Krause Record 2025.

Data from Dr. Strain and C.H. Smith. 115.45 ± .25 μs.

(This checks 115.46 ± .25 from Krause in chamber ~~Bob~~)

$$T = T_{\text{Spiral Sweep.}} + T_{\text{432}}^{6.34\,\mu s} - T_{\text{air}} - T_{\substack{31' \\ 62.0}} - T_{\substack{0.1 \\ \text{Scope}}}$$

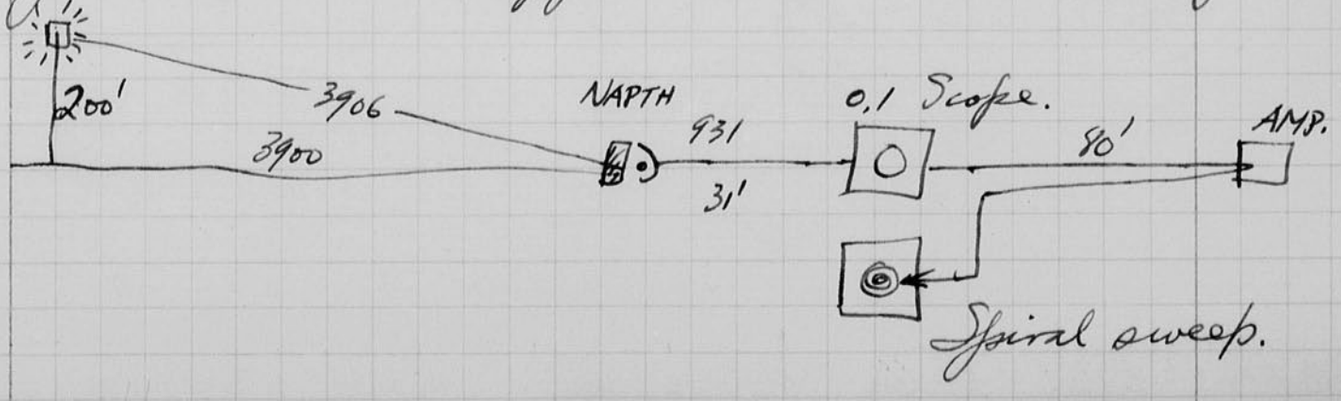
$$- T_{\substack{80' \\ 8\mu}} - 0.12 + .02\ (\pm .02)$$

Spiral Sweep.

Air Path = 3.97 μs for 3906'

Cable from X unit 6.34 μs.

The Spiral sweep intensity ~~signal~~ was turned off about 2 μs after the record was made by the signal from the X unit? This same phenomena happened on shot X ray.



Krause ~~#~~ α values of May 16, 1948.
after replot of data. $\times 10^{8}$

	Krause	Searchlight 3900' 935	Searchlight PARRY 106 931 105 EAST WEST	Napth 3900' 931	Search Parry 935	NAP 935
X	2.17					
Y	0.815	1.12	.955 | .8	1.05		
Z	0.75	1.1	.96	.99	—	0.7

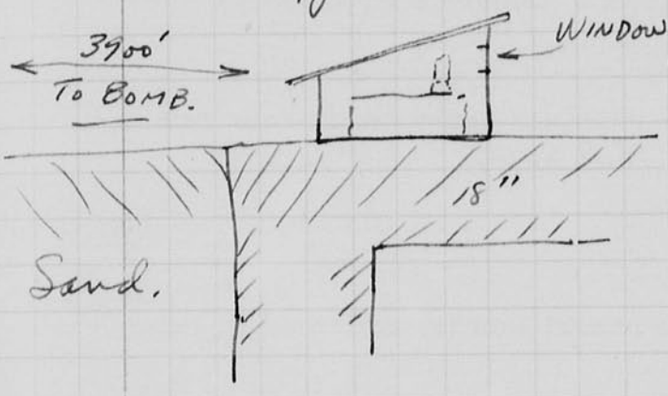
#106. #105

May 20 1948
H.E. Edgerton
Eniwetok.

Comments on Runit Zebra explosion of May 15 1948.

The S.E. 36" searchlights on the roof at Runit were not tipped over or blown away by the blast. At Engebi (x) they were tipped over and slid back to the edge of the shelter. At Aomon they were both blown over and one was even blown off the shelter. This indicated that the Runit explosion was not as violent as the others. The glass was broken in all searchlights for all shots.

The wooden house covering the napthalene experiment was not destroyed or damaged. Ed Colson is going to keep the dimensions of this house. The roof was slanted towards the explosion.



The Albemarle took about 150,000 gal of fuel oil two days ago. At this moment the entire task force 7 is at anchor at Eniwetok awaiting word to start for Hawaii.

Sensitivity calc of Data of p82.84.

Photocell 935 at ~~Gonset~~ Runit 6 Lamps 1000 watt 150 volts .28 ma 3900'

Photo mult. 931 at Parry. 1 " 158 215 54.362'

$$\frac{931 \text{ sen}}{935 \text{ sen}} = \frac{215 \left(\frac{54,362}{3900}\right)^2 \times 10 \times 6}{0.28}$$

neglecting different voltages.

$$= 0.9 \times 10^7$$

should be about 1.0×10^6
R.C.A. data books.

G.E letter says 51,600 lumens at 150 v, color temp 3340° K
or I update 62,500 " " 158 v " " 3410° K

$$\frac{51.6}{62.5} \times .9 \times 10^7 = .75 \times 10^7$$

Notebook # 18

Filming and Separation Record

____ unmounted photograph(s)

____ negative strip(s)

__1__ unmounted page(s)
(notes, drawings, letters, etc.)

was/were filmed where originally located between page 96 and 97.

Item(s) now housed in accompanying folder.

Washington, May 18--(UPO--The U.S. geared up today for production of new atomic weapons whose deadly power is this nation's secret.

This much is known--that whatever their form or dimensions they represent "very substantial progress" in harnessing nature's forces to instruments of terrible destruction.

Those were the words used by the White House yesterday in announcing successful completion of a new series of tests of "three atomic weapons, each of improved design" at Eniwetok island in the far Pacific.

Speculation mounted over what the new weapons may be. Whatever they are--guided missiles, radioactive clouds, an improved bomb or what--the White House announcement indicated no time is being lost in putting them into production. It said:

"The President gave general approval of AEC plans for steps it proposed to initiate at once for further nuclear development, based upon information gained from the tests.

David E. Lilienthal, AEC chairman, added pointed emphasis to this statement. He said the tests, involving some 10,000 military and scientific personnel, were a "milestone in atomic development."

"With the nation thus embarked on a new atomic era, there were indications the armed forces are grooving their plans for using the new weapons.

The Air Force has new sky giants in the making to replace the famed B-29 which dropped the first atomic bomb on Hiroshima three years ago. And the Navy has asked Congressional approval of plans to construct the world's biggest aircraft carrier.

Honolulu, May 18--(UP)--The recent atomic test at Eniwetok atoll consisted of three nuclear explosions that were "completely successful," Lt. Gen. John E. Hull, commander of Joint Task Force Seven, said today.

Hull and other commanders of Operation Sandstone made public further hints as to the form of the latest United States atomic weapons when they said flatly that the tests were centered around explosions.

"It can be said that the bombs worked," Hull said.

Three nuclear explosions were involved, he and the other commanders said in a joint statement. But, they added, none of the explosions were underwater or aerial.

They refused to say how the improved weapons were detonated or whether any weapons besides the bombs were involved.

Hull and his aides returned by plane this morning from the Pacific island and held a press conference a few hours later.

He said the project was being rolled up and the ships of the task force were leaving the Marshalls shortly. A garrison will be kept there for future tests "when they become necessary," he said.

Doctor Darol Froman, scientific director of the tests, said they "involved a series of nuclear explosions carried out under conditions as close to laboratory control as we could make them and with very extensive instrumentation."

The ultimate purpose of the tests, Froman said, "is to insure the efficient utilization of national resources required for the development and application of atomic energy."

Gamma Ray Calc from 935 Naphth.

May 20 1948.

Zebra Run # Scope 122 Film 738 Sig.

The deflection on the film showed an increasing signal at 0.375 micro seconds from the start of the 931 record. See data sheets in envelope on Sig. 738 (film no.).

The current from the photocell is 8.4 ma at the end of the record.

Approx. calibration of photocell in terms of radium source. (See other attempt on page 91).

Experiment 1 curie source of radium at 6" distance gives 25×10^{-6} amps with a 931 PM tube with naphthalene.

Assume 935 - 931 ratio = 10^{-6}

then 1 curie source 6" from 935 should give 25×10^{-12} amp.

Gamma rays per sec. from 1 curie source = 2.3 × disintegrations

$= 2.3 \times 3.7 \times 10^{10}$ gammas/sec.

$= 8.5 \times 10^{10}$ gammas/sec.

$$S = \text{Sensitivity} = \frac{\text{amp.}}{\text{gammas/sec/sq cm}} = \frac{25 \times 10^{-12}}{\frac{8.5 \times 10^{10}}{2.3} / 4\pi (6 \times 2.54)^2} = 8.58 \times 10^{-19} \text{ amp/γ/sec/in}^2$$

$$G = i/S = \frac{.0084}{8.58 \times 10^{-19}} = 0.98 \times 10^{16} \text{ gammas/sec./sq.cm.}$$

Gamma rays from Bomb. no absorption.

$$4\pi R^2 G = 4\pi (3900 \times 12 \times 2.54)^2 \times 1.19 \times 10^{10} \times .98 \times 10^{16} = 1.47 \times 10^{26}$$

assume m.f.p. = 900 ft. then absorption factor is

$\varepsilon^{-3900/900} = .013$ and gammas from bomb are increased by 77. = 1/.013

Bomb Gammas/sec/# $= 1.47 \times 77 \times 10^{26} = 113 \times 10^{26}$ and still going

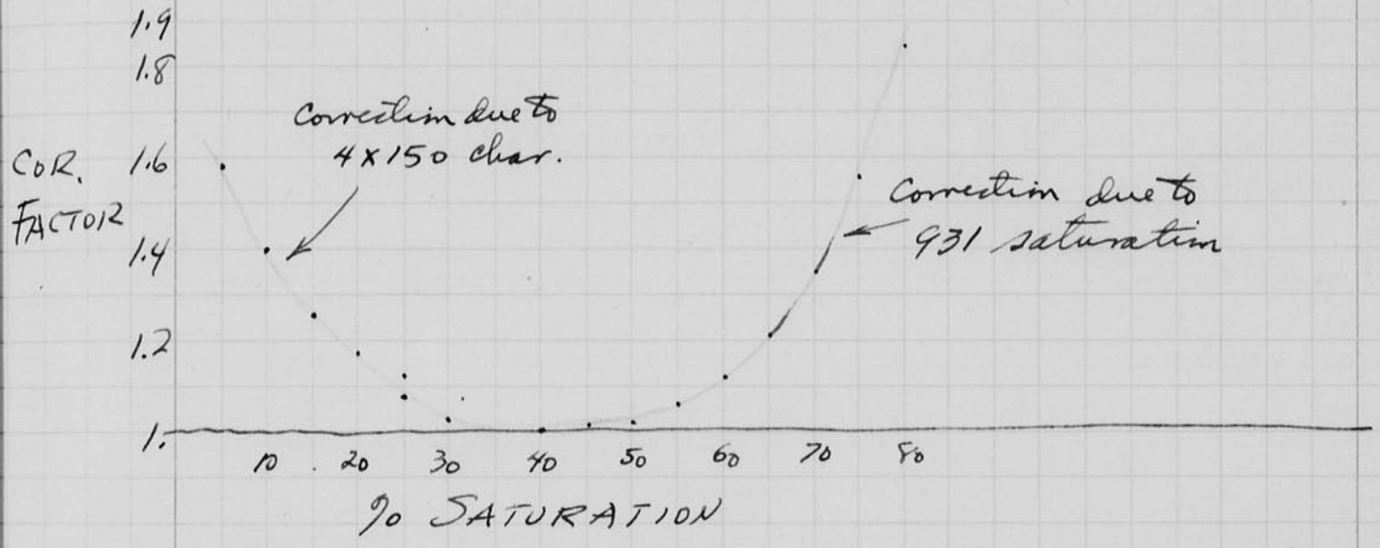
May 24 1945. Halfway from Eniwetok to Honolulu.

H. Edgerton.

Some effort has been expended on the results of our work at Eniwetok.

A correction factor curve is plotted below which corrects for non linearity of the cathode follower and saturation effect in the photo sensitive devices. The tube curvature correction (4X150) was measured statically by Colour, and also the overall gain was measured by light flashes with square law.

931. Correction curve.



For 935 curves - the portion from 0 to 40% was used.

All log plots for curves of X, Y, and Z tests have been corrected from the above and new values of α calculated. A summary of the data appears on the following page. Compare this corrected data to data on page 94. In general, the correction of the 0 - 40% values tend to reduce the value of α by about 10%.

5-7
Friday
[illegible]
Gen. Hull.

	SEARCHLIGHT 935 3900 FT	NAPTHALENE 931 3900 FT		PARRY SEARCHLIGHT 931		KRAUSE (ESTIMATES)
X	—	—		1.07 *	1.01 *	2.17
Y	0.91	0.82	.77	.84 **	.66 **	0.815
Z	0.87	0.77	.64	.73 ***	—	0.75

* 20.2 MILES FROM BOMB

** 16.1 " " "

*** 10.3 " " "

All values to be multiplied by 10^8.

Calculation of flux reqd for 5/8" deflection on scope (1" or prints)

Engelbi 931 Searchlight. Load resistor = 1000 ohms.

Gain of cathode follower at 5/8" defl = 0.5
Gain of transmission line = 2.0
Total gain = 1.0
Sens of C.R. tube = 200 volts/inch.
Thus the 5/8" deflection = 200 × 5/8 = 125 volts.

This corresponds to $\frac{125}{1000}$ = 0.125 amperes.

Sensitivity of 931 = 40 amp/lumen.

Lumens = $\frac{.125}{40}$ = .003 lumens. = .003 lumens.

* → Lumens/sq ft = $\frac{.00312}{.25 \times 144}$ = .00866 = .0000866 = 8.66×10^{-5}

F = Search-light lumens/sq ft. = $\frac{.00312}{.25 \times 144 \times 600}$

F. = 1.44×10^{-7} lumens/sq ft. incident at search light.

$.8^{\frac{3.9}{5.28}} = .8^{.74}$ = transmission = .85

$$\text{Total flux} = \frac{4\pi d^2 F}{\text{transmission}}$$

$$= \frac{4\pi\, 3900^2\, 1.44 \times 10^{-7}}{.74} = 32.4 = 37.2 \text{ lumens.}$$

Parry. flux = $\frac{4\pi (106.646)^2\, 1.44 \times 10^{-7}}{.014}$ = 1.47×10^6 lumens.

$\frac{1.47 \times 10^6}{37.2}$ = 3.6×10^4 = 36,000. = Ratio of sens Engelbi/Parry.

Coman 583 flux = $\frac{4\pi\, 3900^2\, 1.44 \times 10^{-7}}{0.74}$ = $37.2 = 32.4 \times 10^6$ lumens.

Parry 579. flux = $\frac{4\pi\, (85{,}411)^2\, 1.44 \times 10^{-7}}{.0332}$ = 3970 lumens.

* The 144 factor should be in the numerator.

LIGHT TRANSMISSION P88

Light Flux for deflection.

See sample calc on page 101.

TEST.	DISTANCE FT.	PICKUP.	LIGHT FLUX FOR 5/8" DEF. LUMENS/SQ.FT.	BOMB FLUX LUMENS	α X10⁸	
X.500	3900	.85 SL. 931	1.44×10^{-7}	~~37.2~~ 32.4	—	too sensitive.
X 400	106,646	.014 SL 931	1.44×10^{-7}	1.47×10^{6}	1.07	
X 402	106,646	.014 SL 931	1.44×10^{-7}	1.47×10^{6}	1.01	
Y 583	3900	.85 SL 935	0.144	~~37.2~~ 32.4 $\times 10^{6}$	.91	
Y 579	85411	.0332 SL 931	1.44×10^{-7}	397,000	.84	
Y 578	85411	.0332 SL 931	1.44×10^{-7}	397,000	.66	faulty 931?
~~Z 745~~	~~54362~~	~~.101 SL 9~~				
Z 745	3900	.85 SL 935	0.144	~~37.2~~ 32.4 $\times 10^{6}$	.875	
Z 753	54362	.101 SL 931	1.44×10^{-7}	52,700	.73	
Z 751	54362	.101 SL 935	0.144	$52,700 \times 10^{6}$	—	

The above estimates are calculated using the following assumptions.

Sen. of 931 Photomultiplier is 40 amp/lumen.
Surface area of 931 PM is 0.25 square inches.

Sens of 935 Phototube is 40 microamperes/lumen
Surface area of 935 cathode is 0.6 sq inches.

Searchlight factor = 600.

Light transmission = 0.8 per mile (O'Brian data).

Engebi - Parry	20.2 miles	$.8^{20.2} = .014$ transmission
Aomon - Parry	16.1 "	$.8^{16.1} = .0332$ "
Kumit - Parry	10.3 "	$.8^{10.3} = .101$ "

FILM

X	Parry	106	East.	400
X	"	105	West	402

Y	Parry	106	East	579
Y	"	105	West	578
Y	Aoman		931 Nap	582
Y	Aoman	121	935 Search	583

Z.	Parry	106	East	753
	Parry	105		
	Ruin	111	Search	745
	"	113	931 Nap	740

Los Alamos Krause. July 1948 B-225 830

.65 wel of light

X Ray ⊗ copper RG 19U 813 meters to

2 meters 135 213

estimate 10^{16} γ per ton Rossi 2-40 pounds for Rossi meas.

Y -

Z -

Lead house not necessary at 1300 yds with xyz bombs.
Dirt necessary around concrete bomb proof.

α constant as measured ~~to~~ about 475 meters from bomb with ion chan

				475 meter	
X.	2.15	2.08	2.07		
Y.	.18	.76	.74	.76 → .74	
Z	.77	.81		.8-.75	.51 - .12

3×10^{-5} gammas per fission ? might be 10^{-2} " " " " } Considerable argument by Teller and others

Edg →

C. Strain afternoon transit time.

			#1	#2	931
115.4	X Ray	Uncorrected	115.20	115.35	931.
		Corrected	115.0	115.15 (?)	
116.7	Yoke	Uncorrected	116.37	116.23	935.
		Corrected	115.87	115.73 (?)	
115.4	Febra	Uncorrected	115.43	115.54	931 nafp
		Corrected	114.83	114.94	

Richardson

aft

Taschek.

Fry Berg A.M.
Los Alamos. Discussion

Lower limits
Tons.

	Rossi	Teller			NAP 931
X	2.1×10^8	$.9 \times 10^8$	20 mile	1/4	—
Y	$.76 \times 10^8$	$.91 \times 10^8$ / $.89$ / $.63 \times$	935 / 931	17.6 m — 5.4 / .067	.82 - 0.77
Z	$.79 \times 10^8$	.87 } .76 }	935	5.4	
		.64	931	18#	0.77 0.64

5×10^{16} Ds in 2T. $\equiv$ .7 lumen/meter^2

Experiment at Los Alamos. Conversion of gammas to light.

Trinity 2500 ton level α drop to about 1/2.
500 tons α .. ~~90~~ 90%.

Los Alamos

Brixner.

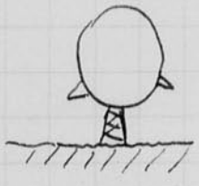
.0001 sec resolution 10 Fastax cameras.
1 - 30,000 reduction on film.
accurate to 1 to 3 meters.

Shock wave growth.
motion of water should show shock wave at later stage.

Fred. Reines analysed films.

Two positions at 90° 75 ft towers for cameras
10,000 frames/sec.

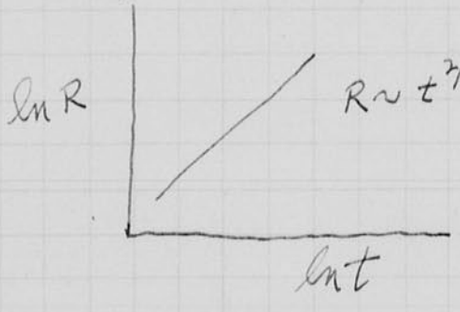
Jets appear to occur where the cables leave the bomb.



Energy of bomb important since

Bethe.

Fuchs



Trinity shows $T^{2/5}$	25 Tons ± 2.5
⊙ Brian - " 10 m.s. record of Bikini	21.5
X, Y, Z, also show $T^{2/5}$	

34 to 18 ratio compared to Trinity.

Ground is hit in 1/2 m.s.

Los Alamos

Reines

Breakaway radii $E = 2.83 \times 10^{-6} D_B$

where soundwave leaves the fire ball. Trinity 100 meter radius.

Radiation is not taken into account in the $R = t^{2/5}$ law.

Reines says radiation is so small as to be not important.

Possible bounce of fire ball at instant of ground?

Microdensity of film across the ball of fire

Brightness of sphere as function of diam.

Transmission as a function of time during bomb.

Greater speed of camera. Initial event.

10^{-7}

Los Alamos

Gamma Ray level for trip.

Discussion with Strain See page 98.
for N.R.L. Report on transit time.

Exp 1 curie 6" dist 25×10^{-6} amps
PM tube,

disint.
Gams/sec = $2.3 \times 3.7 \times 10^{10}$
= ~~8.5 x10^10~~ 3.7×10^{10}

for 0.1 amp.

G = 1 gram

Amp. = 8.58×10^{-13}
Gamma/sec/sq cm.

for 100 ma of current to deflect scope and trip.

G = $\frac{0.1}{8.58 \times 10^{-13}}$ = Gammas/sec./sq cm.

July 12
Note. The factor 2.3 is wrong according to Ogle and Lindenberger.
This was discussed with Strain of NRL just before leaving Los Alamos.

1 curie at 1 ft gives $\frac{25}{4} \times 10^{-6}$ amps = 6 ma.

for .100 amp $1 \times \frac{100\,000}{6}$ = 16,700 curies at 1 ft.
.125 amp. $1 \times \frac{125\,000}{6}$ = 20,800 " at 1 ft.

Gamma ray flux density

$\frac{20,800 \times 3.7 \times 10^{10}}{4\pi}$ = 6130×10^{10}
γ/sq ft.

$(2.54 \times 12)^2$ = 925. or $\frac{6130 \times 10^{10}}{925}$

= 6.62×10^{10}

July 13 1948.

Chas Wyckoff and I left Washington D.C. on ~~Tues~~ Wednesday July 7 for Los Alamos N.M. to present results of the Eniwetok tests of the spring. also with us were a group from the N.R.L. of the Navy. under Krause.
Smith Strain Richardson Butler Sanderson Card Durand

Most of us returned with the plane 854 D 47 from Albuquerque on Sunday July 11 arriving in Washington about 8-30 PM. the night train brought us to Boston.

Sanderson suggested Microcrystaline wax on a sphere as a radiant energy integrator. the stuff will melt at a definate temperature.

Report to see

Julian Mack Trinity.
LA 588 ~~July~~ Sept. 5, 1945.?
~~Prelim~~ report of the Spectrum and Radiation.
S.N. Nicholson
F.E. Berger (Madison).

RESTRICTED

SCHEDULE OF MEETINGS

				Location	Chairman	Secretary	Primary Speaker
1.	Thurs.	0800-0830	General Meeting	B-223		Zadina	Froman
2.	Thurs.	0830-1000	Alpha Rossi	B-223	Froman	Suydam	Krause
3.	Thurs.	1030-1200	Alpha Teller	B-223	Graves	Reines	Edgerton
4.	Thurs.	1315-1445	Transit Time	B-223	Reines	Nereson	Strain
~~5.~~	Thurs.	1530-1630	Coordination of Timing (Operation Sandstone)	B-223	Graves	Taschek	~~Grier~~
6.	Fri.	0800-0930	Combined Alpha Rossi and Teller	B-223	Froman	Suydam	Taschek
7.	THURS. 1530-1630 ~~Fri.~~	~~1030-1200~~	Bolometer Measurements	8-223 ~~B-103~~	Ogle	Zadina	Butler and Richardson
8.	Fri.	1030-1200	Photographic Measurements	B-223	Clark	Mullaney	Brixner
9.	Fri.	1315-1445	Combined Bolometer and Photographic (Optical Radiation)	B-223	Clark	Mullaney	Reines
10.	Fri.	1530-1630	Coordination of Timing (Future)	B-223	Froman	Nedberg	~~Fussell~~

Gamma Ray meas.
Pressure meas.
Seismic meas.

RESTRICTED

Notebook # 18

Filming and Separation Record

1 unmounted photograph(s)

____ negative strip(s)

____ unmounted page(s)
(notes, drawings, letters, etc.)

was/were filmed where originally located between page ____ and ____.
inside back cover

Item(s) now housed in accompanying folder.