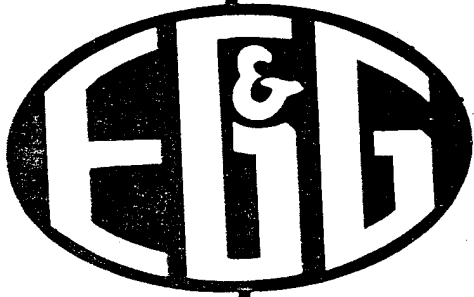


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EDGERTON, GERMESHAUSEN & GRIER, INC.

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**FIREBALL CALCULATIONS  
SHOT HAMILTON  
OPERATION HARDTACK PHASE II  
PROJECT 15.1**

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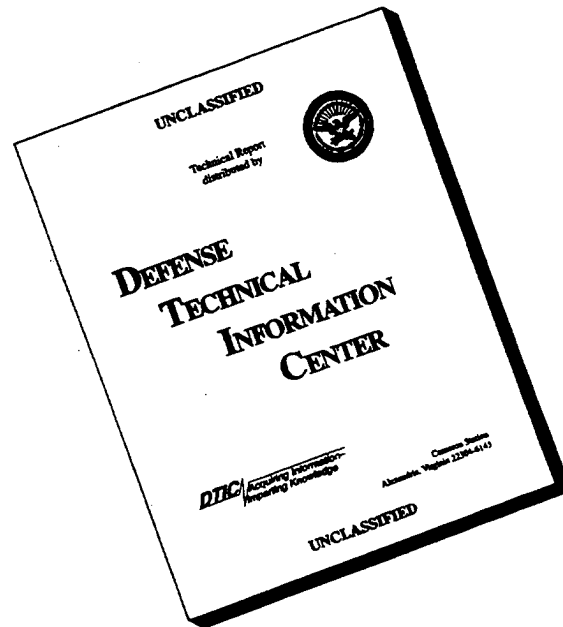
DISTRIBUTION STATEMENT A APPLIES  
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REPORT NO. B-2013  
29 JANUARY 1960

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29 May 1996

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ATTENTION: OCD/Mr. Bill Bush

SUBJECT: Documents for DTIC System

There is no record of your office receiving the following reports:

EGG-B-2024 (29 January 1960)  
Fireball Calculations Shot Sanford  
Operation Hardtack Phase II  
Project 15.1

EGG-B-2013 (29 January 1960)  
Fireball Calculations Shot Hamilton  
Operation Hardtack Phase II  
Project 15.1

Both documents are now approved for public release.

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*Arndith Jarrett*  
ARDITH JARRETT  
Chief, Technical Support

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FIREBALL CALCULATIONS  
SHOT HAMILTON  
OPERATION HARDTACK, PHASE II  
PROJECT 15.1

Report No. B-2013  
29 January 1960

Prepared by *R. C. Schneiderhan*  
R. C. Schneiderhan

Approved by *D. F. Seacord, Jr.*  
D. F. Seacord, Jr.

EDGERTON, GERMESHAUSEN & GRIER, INC.  
Boston, Mass.                      Santa Barbara, Calif.                      Las Vegas, Nev.

## FIREBALL CALCULATIONS: SHOT HAMILTON

### 1.0 INTRODUCTION

Shot Hamilton, a 50-foot tower shot sponsored by LRL, was detonated at 0800 PST, on 15 October 1958 in Area TF-1 of the Nevada Test Site. The fireball yield was  $0.43 \text{ ton} \pm 0.09 \text{ ton}$ .

### 2.0 CAMERA INSTRUMENTATION AND OPERATION (Table 1)

Photographic coverage of Hamilton fireball growth was provided by two high-speed Eastman cameras and one high-speed 16 mm Fastax camera at Station 527.01 (6 x 6 No. 2) and a similar camera complement at Station 527.02 (6 x 6 No. 3). In addition, two Rapatronic cameras were located at Station 527.01 to record early fireball growth. The EG&G framing camera, running at an approximate speed of 15,000 frames per second, was located at Station F-732 (6 x 6 No. 1) to record additional early fireball behavior. One Eastman camera from Station 527.02 did not record the complete fireball. All other cameras obtained records suitable for analysis.

The station locations and the burst location are shown in Fig. 1. Figure 2 contains a summary of the survey data.

### 3.0 RESULTS

Because the yield of Hamilton was well below the range of constant  $\phi^5$  scaling<sup>1</sup>, the  $\phi$  comparison technique as defined in EG&G Report No. B-1869, "Fireball Calculations - Shot Eddy", was employed to determine the yield. A yield of  $0.43 \text{ ton} \pm 0.09 \text{ ton}$  is indicated.

<sup>1</sup>  $\phi^5$  scaling is usually applicable only for yields greater than 2 kt.

An air density of 1.098 grams per liter was used in the yield calculations. The air density value was based upon a pressure of 910 millibars, a temperature of 15.0°C, and a relative humidity of 30 percent at shot time.

The table below gives the comparison shots, and the Hamilton yield obtained by the  $\emptyset$  - comparison.

Comparison Shot	Hamilton Yield (tons)
<u>Balloon</u>	
La Place	0.495
Wheeler	0.374
Santa Fe	0.499
Lea	0.452
Hidalgo	0.450
<u>Air Drop</u>	
Buster B	0.404
Wasp'	0.408
Ranger A	0.398
Wasp	0.419
Ranger E	0.423

Comparison Shot	Hamilton Yield (tons)
<u>Tower</u>	
Hornet	0,422
UK-3	0.419
Rio Arriba	0.456
Quay	<u>0.431</u>
	$\overline{W} = 0.432$

Diameter vs time and  $\phi$  vs time plots are shown in Figs. 3, 4, and 5.

The following data sheets are included for each film:

- (a) Photo Plan and Photo Loading Chart
- (b) Camera Data and Calculation Sheet
- (c) Diameter Measurement Sheet
- (d) E102 print-out sheet of D, t, and  $\phi$ .

Selected frames of fireball films are contained in the Appendix.

The zero-frame times of the motion picture camera records were determined by comparing these records with the Rapatronic diameter vs time data.

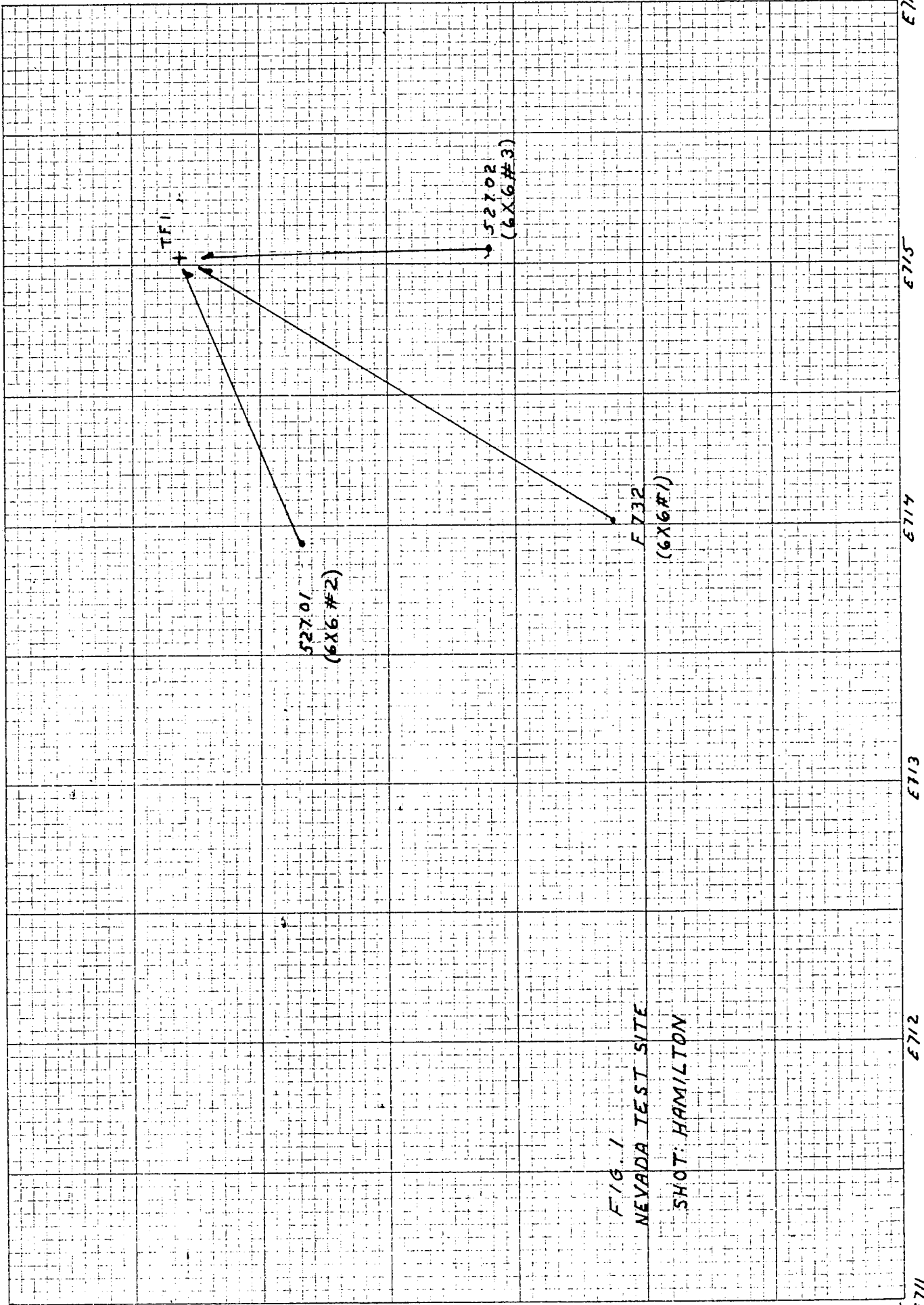


FIG. 1

NEVADA TEST SITE

SHOT. HAMILTON





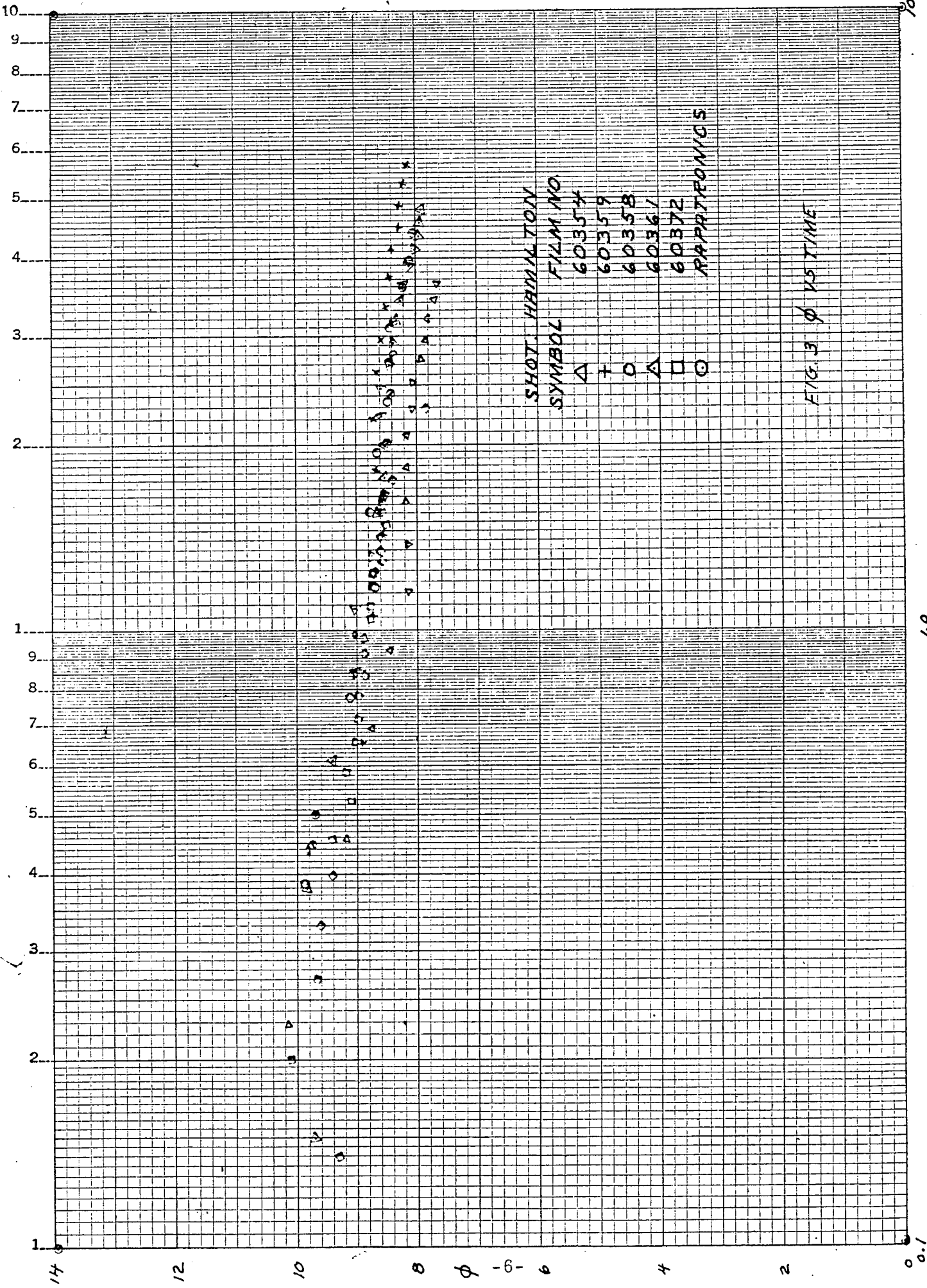


FIG. 3 ϕ VS TIME

1.0  
TIME (msec)

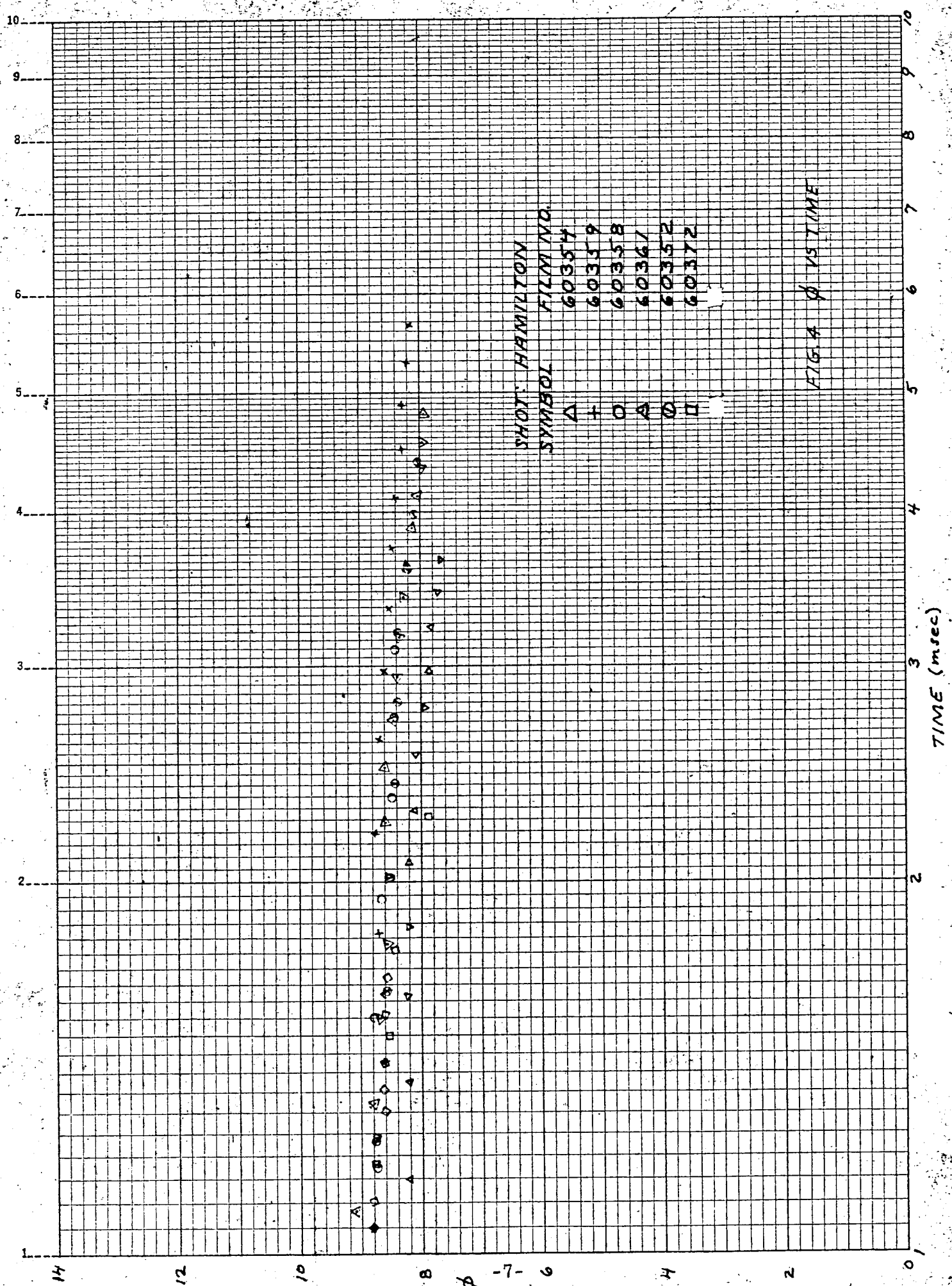


FIG. 4  $\phi$  VS TIME

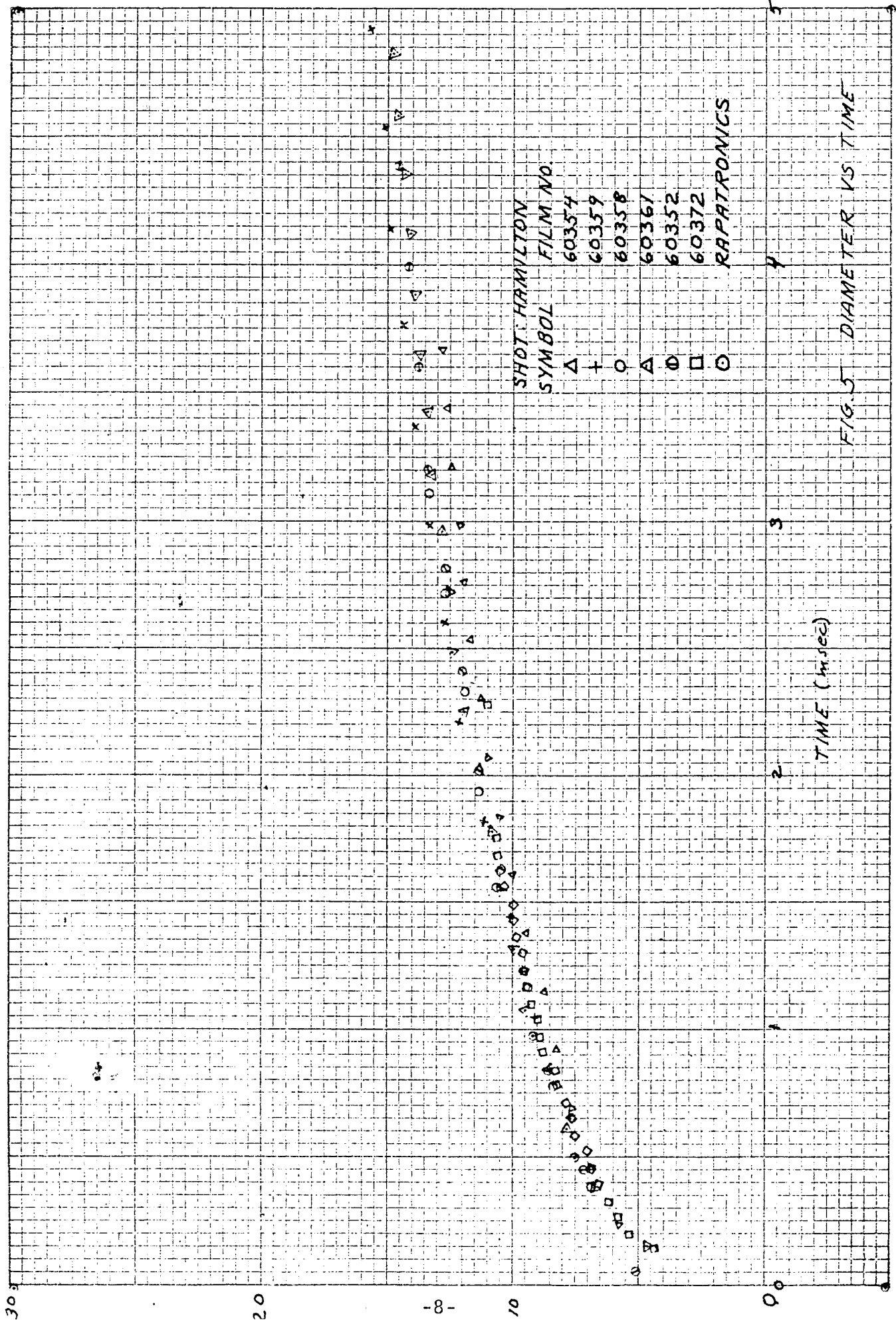


FIG. 5

Table I  
 Hardtack Phase II, Hamilton  
 Fireball Camera Distribution

Station	Camera	Qualitative Functioning
527.01 (6 x 6 No. 2)	E-34	Record
	E-7	Poor Image
	F-16 No. 2	Record
	R-4	Record
	R-3	Record
527.02 (6 x 6 No. 3)	E-25	Part of F. B. Obscured
	E-6	Record
	F-16 No. 1	Record
F-732 (6 x 6 No. 1)	FR No. 1	Record

Table II  
Hardtack Phase II, Hamilton  
Average Diameter vs Time

Time (in msec.)	Diameter(meters) as seen from Stations 527.01, 527.02 and F-732
0.5	7.3
1.0	9.0
1.5	10.3
2.0	11.2
2.5	12.2
3.0	12.8
3.5	13.4
4.0	14.2
4.5	14.7

Table III

Hardtack Phase II, Hamilton

Rapatronic Summary

Station	Film No.	Camera	Horizonal Range (m)	F. L. (mm)	Diameter(m)	Time(msec)
527.01 (6 x 6 No. 2)	60366	R-4	1196.6	477.39	7.37	0.4995
	60365	R-3	1196.6	477.82	8.99	0.9840

# PHOTO LOADING CHART

STATION 527.01 DATE 10-15-58

EVENT HAMILTON

6x6 #2

FILM			CAMERA			LENS		EXPOSURE		REMARKS		
TYPE	EMULS. NO.	SIZE	HOLDER	PERF. NO.	NO.	RACK POS.	NOM. SPD.	FOC. MM.	FILTER		APER	SHUTTER RHEO.
MF	1112-9-02	16-100	HS Reel	60358	E-34	C-1	2500	102	ND2+ W-12	f7.5	40/80	3x10 <sup>6</sup>
FX	5240 604-02	16-100	HS Reel	60359	E-7	C-2	2500	63	ND-1+ W-12	f5	40/80	1.5x10 <sup>5</sup> Weston 700
FX	5240 624-3	35-200	MIT MAG	60360	M-26	B-2	100	18.5	W-12	f7.5	170°	1x10 <sup>5</sup>
MF	1112-f-02	16-400	Daylight Spool	60361	#2 F16/4	B-1	4000	75	ND-1 W-12	f5.6	=	Weston 700
FX	5240-626-2	70-50	Betty MAG	60414	CL-70	B-3	1/2	105	W-12	f9.0	1/100	Weston 700
D	263368N	16-50	L-MAG	60363	#22 BSP	B-4	64	9.5	=	f4.5	133°	Weston 800
KDC	263368N	16-50	A-MAG	60364	#5 GSP	B-4	64	9.5	=	f5.0	133°	3x10 <sup>5</sup>
RP	6141-662C7	2 1/4 x 3 1/4	RAP Holder	60365	R-4	A-1	40µs Coil	480	=	f11	B	500µs delay
RP	6141-662C7	↓	↓	60366	R-3	A-2	40µs Coil	↓	=	f11	B	1000µs delay
					Actual		RAP		Delays			
					R-4		479µs					coil delay
					R-3		964µs					coil delay

DATE FILM LOADED Rev #1 10-9-58 DATE CAMERA LOADED Rev #2 10-14-58 DATE EXPOSED 10-15-58

REMARKS FINAL



STATION NO. 527.01 EVENT HAMILTON  
 STATION TYPE 6x6 #2 BRG 66°18' GZ STA. IF1  
 DISTANCE GZ 1196.6' STATION GZ 247 820 DIFF. 481 TILT +0°00' DATE 10-15-58  
 DISTANCE OBJECT 1197.7' N 713 933 E 715 029 Z 3 129 OBJ 2°24' POSTED 10-15-58

# PHOTO PLAN

CAMERA NO.	NOM. SPD.	RACK POS.	LENS		FIELD TARGET H/W	AIMING			POWER		MARKER		DELAY	FILM	PUR-POSE	REMARKS	
			FOC. MM	S/N		OBJECT	H	V	VOLTS	SHUT RHEO.	TIME ON/OFF	TYPE					S/N
E-34	2500	C-1	102	RC 128	.107 .084	FB	0°00'	24'	120DC	40/80	-1.5/+1.5	200	=	MF	15.1		
E-7	2500	C-2	63	ET 1207	.176 .136	FB	0°00'	24.5'	120DC	40/80	-1.5/+1.5	200	=	FX	15.1		
M-26	100	B-2	18.5	201105	1.630 1.238	Cloud	0°00'	19°	120DC	170°	-5/+30	200	=	FX	1.7		
#2	5000	B-1	75	617086	.147 .097	FB	0°00'	20.5'	120DC	=	-1.5/+1.5	200	=	MF	15.1		
#5	1/2	B-3	105	RM 163	.166 .555	Cloud	0°00'	10.30'	240DC	1/100	-5/+6M	Clock	=	FX			
22	64	B-4	95	240190	1.336 .903	Doc	0°00'	15.90'	240C	133°	-5/+30	=	=	D			
#5	64	B-4	95	240259	1.336 .903	Doc	0°00'	15.10'	240C	133°	-5/+30	=	=	D			
R-4	40ms	A-1	480	773952		FB	0°00'	2.12'	115AC 24DC	B		FM	500 ms	RP	15.1	CAN # 32	
R-3	40ms	A-2	480	774699		FB	0°00'	2.12'	115AC 24DC	B		FM	1000 ms	RP	15.1	CAN # 29	
						ACTUAL	RAP	Delays									
						R-4	479.5	ms + 20	ms	half	coil	delay					
						R-3	964.0	ms + 20	ms	half	coil	delay					

REMARKS Rev #1 10-5-58 Rev #2 10-14-58  
 \* Includes 50' height of tower  
 FINAL



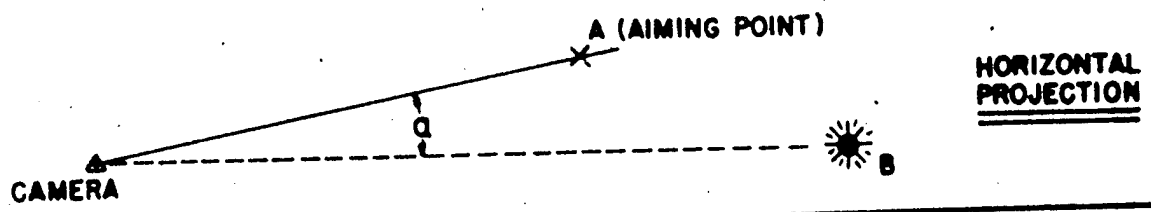






# CAMERA DATA & CALCULATIONS

FILM NO. 60366	STATION NO. <sup>527.01</sup> 6x6 #2	TEST HAMILTON	CALCULATED BY: 660
CAMERA NO. R3	EQ. AP.		DATE: 10/15/58



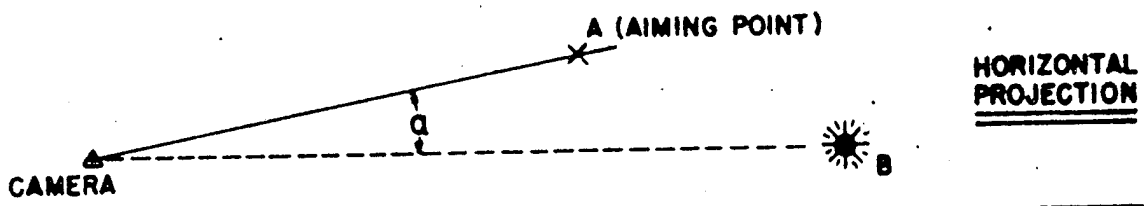
A. $R^{\circ}/A = CB_h \cos \alpha \cos \beta + (H_B - H_C) \sin \beta$		
$\alpha = 0^{\circ} 00'$	$\beta = 2^{\circ} 12'$	$H_B = 3129 \text{ ft}$
$\cos \alpha = 1.0000$	$\cos \beta = 0.99926$	$H_C = 3079 \text{ ft}$
$CB_h = 364.7 \text{ m}$	$\sin \beta = 0.03839$	$\Delta H = 50 \text{ ft} = 15.2 \text{ m}$
$CB_h \cos \alpha \cos \beta = 364.4 \text{ m}$	$\Delta H \sin \beta = 0.6 \text{ m}$	$R^{\circ}/A = \boxed{365.0 \text{ m}}$
B. FOCAL LENGTH 477.39 mm (774699)		

C. MAGNIFICATION FACTOR (meters/in.) 19.43

D. ZERO TIME CORRECTION 0.9840 ms delay

## CAMERA DATA & CALCULATIONS

FILM NO. 60365	STATION NO. <sup>527.01</sup> 6x6 #2	TEST HAMILTON	CALCULATED BY: GGO
CAMERA NO. R4	EQ. AP.		DATE: 10/15/58



A.  $R^{\circ}_A = CB_h \cos \alpha \cos \beta + (H_B - H_C) \sin \beta$

$\alpha = 0^{\circ} 00'$	$\beta = 2^{\circ} 12'$	$H_B = 3129 \text{ ft}$
$\cos \alpha = 1.0000$	$\cos \beta = 0.99926$	$H_C = 3079 \text{ ft}$
$CB_h = 364.7 \text{ m}$	$\sin \beta = 0.03839$	$\Delta H = 50 \text{ ft} = 15.2 \text{ m}$
$CB_h \cos \alpha \cos \beta = 364.4 \text{ m}$	$\Delta H \sin \beta = 0.6 \text{ m}$	$R^{\circ}_A = \boxed{365.0 \text{ m}}$

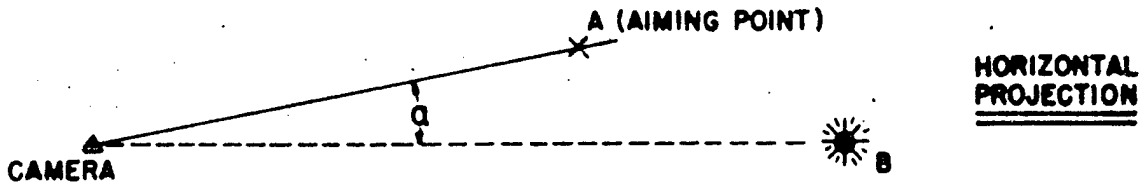
B. FOCAL LENGTH 477.82 mm (773952)

C. MAGNIFICATION FACTOR (meters/in.) 19.41

D. ZERO TIME CORRECTION 0.4995 ms delay

## CAMERA DATA & CALCULATIONS

FILM NO. 60359	STATION NO. 527.01 6x6 #2	TEST HAMILTON	CALCULATED BY: GGO
CAMERA NO. E7	EQ. AP.		DATE: 10/15/58



A. $R^{\circ}_A = CB_h \cos \alpha \cos \beta + (H_B - H_C) \sin \beta$		
$\alpha = 0^{\circ} 00'$	$\beta = 2^{\circ} 45'$	$H_B = 3129 \text{ ft}$
$\cos \alpha = 1.0000$	$\cos \beta = 0.99885$	$H_C = 3079 \text{ ft}$
$CB_h = 364.7 \text{ m}$	$\sin \beta = 0.04798$	$\Delta H = 50 \text{ ft} = 15.2 \text{ m}$
$CB_h \cos \alpha \cos \beta = 364.3 \text{ m}$	$\Delta H \sin \beta = 0.7 \text{ m}$	$R^{\circ}_A = \boxed{365.0 \text{ m}}$
B. FOCAL LENGTH 64.1 mm (ET-1207)		

C. MAGNIFICATION FACTOR (meters/in.) 144.6
--

D. ZERO TIME CORRECTION 0.28 ms
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FIREBALL CALCULATIONS

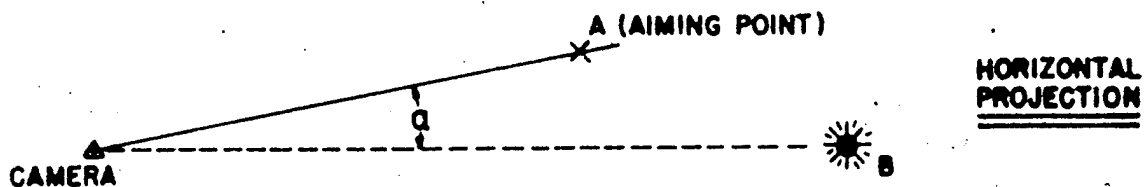
SHOT Hamilton FILM NO. 60359

DATE 1-22-59

D	t	ln D	Int	$t^{2/5}$	$\phi$
7.58	.66	2.025 51	415 59 -	8 468 45	89 50
8.95	1.05	2 191 72	48 76	10 196 97	87 77
9.95	1.44	2 297 50	364 69	11 570 56	85 99
11.10	1.82	2 406 87	598 87	12 706 78	87 35
12.08	2.21	2 491 49	792 93	13 732 43	87 96
12.73	2.60	2 543 94	955 43	14 654 68	86 86
13.33	2.98	2 590 03	1 091 89	15 476 80	86 12
13.88	3.37	2 630 48	1 214 94	16 257 63	85 37
14.40	3.76	2 667 28	1 324 48	16 985 85	84 77
14.88	4.14	2 700 09	1 420 77	17 652 78	84 29
15.23	4.53	2 723 34	1 510 77	18 299 89	83 22
15.73	4.91	2 755 65	1 591 29	18 898 85	83 23
16.05	5.30	2 775 79	1 667 68	19 485 25	82 36
16.40	5.69	2 797 36	1 738 65	20 046 33	81 81

# CAMERA DATA & CALCULATIONS

FILM NO. 60358	STATION NO. <sup>527.01</sup> 6x6 #2	TEST HAMILTON	CALCULATED BY: GGO
CAMERA NO. E34	EQ. AP.		DATE: 10/15/58



A.  $R^{\circ}/A = CB_h \cos \alpha \cos \beta + (H_B - H_C) \sin \beta$

$\alpha = 0^{\circ} 00'$	$\beta = 2^{\circ} 04'$	$H_B = 3129 \text{ ft}$
$\cos \alpha = 1.0000$	$\cos \beta = 0.99935$	$H_C = 3079 \text{ ft}$
$CB_h = 364.7 \text{ m}$	$\sin \beta = 0.03606$	$\Delta H = 50 \text{ ft} = 15.2 \text{ m}$
$CB_h \cos \alpha \cos \beta = 364.5 \text{ m}$	$\Delta H \sin \beta = 0.55 \text{ m}$	$R^{\circ}/A = \boxed{365.1 \text{ m}}$

B. FOCAL LENGTH 101.6 mm (RC 128)

C. MAGNIFICATION FACTOR (meters/in.) 91.27

D. ZERO TIME CORRECTION 0.004 ms



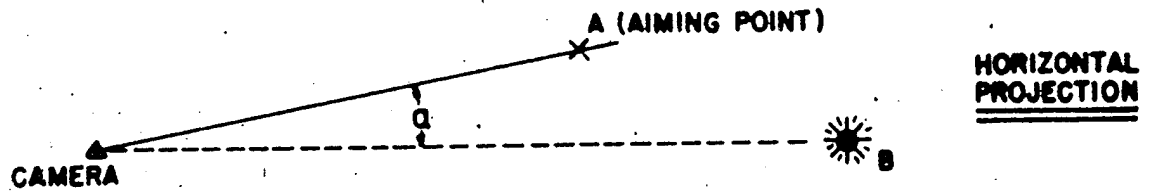
FIREBALL CALCULATIONS

SHOT Hamilton FILM NO. 60358  
 DATE 1-22-59

D	t	ln D	Int	$t^{2/3}$	$\phi$
6.80	.39	1.91685	.94153 -	.686180	99.09
8.32	.78	2.11872	2.4844 -	9.05399	91.89
9.32	1.17	2.23221	156.93	10.64784	87.52
10.55	1.56	2.35609	444.75	11.94711	88.30
11.31	1.94	2.42561	662.69	13.03533	86.76
11.94	2.33	2.47983	845.79	14.02588	85.12
12.63	2.72	2.53604	1000.56	14.92163	84.64
13.32	3.11	2.58927	1134.61	15.74355	84.60

# CAMERA DATA & CALCULATIONS

FILM NO. 60361	STATION NO. 527.01 6x6 #2	TEST HAMILTON	CALCULATED BY: GGO
CAMERA NO. F-16 #2	EQ. AP.		DATE: 10/15/58



A. $R^{\circ}/A = CB_h \cos \alpha \cos \beta + (H_B - H_C) \sin \beta$		
$\alpha = 0^{\circ} 00'$	$\beta = 2^{\circ} 15'$	$H_B = 3129 \text{ ft}$
$\cos \alpha = 1.0000$	$\cos \beta = 0.99923$	$H_C = 3079 \text{ ft}$
$CB_h = 364.7 \text{ m}$	$\sin \beta = 0.03926$	$\Delta H = 50 \text{ ft} = 15.2 \text{ m}$
$CB_h \cos \alpha \cos \beta = 364.4 \text{ m}$	$\Delta H \sin \beta = 0.6 \text{ m}$	$R^{\circ}/A = \boxed{365.0 \text{ m}}$
B. FOCAL LENGTH 78.06 mm (617086)		

C. MAGNIFICATION FACTOR (meters/in.) 118.8

D. ZERO TIME CORRECTION 0.15 ms



FIREBALL CALCULATIONS

SHOT Hamilton FILM NO. 60361

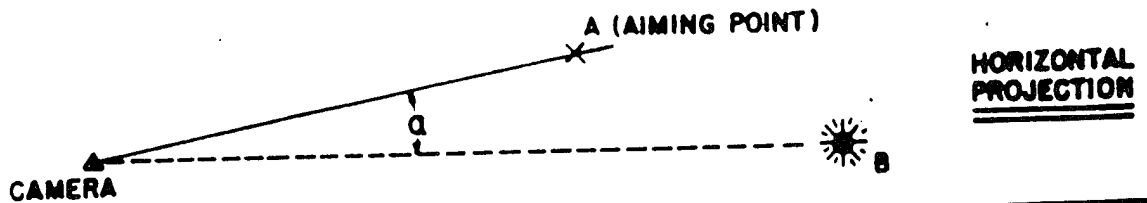
DATE 1-22-59

D	t	ln D	Int	$t^{2/5}$	$\phi$
4.58	.15	1.52174	1.89705 -	.468217	9.781
6.74	.38	1.90799	.06751 -	6.79086	99.25
7.79	.61	2.05285	49437 -	8.20574	94.93
8.53	.85	2.14366	16245 -	9.37085	91.02
9.39	1.08	2.23968	7690	10.31239	91.05
9.86	1.32	2.28844	27763	11.17454	88.23
10.36	1.55	2.33795	43833	11.91642	86.93
10.79	1.78	2.37856	57666	12.59438	85.67
11.34	2.02	2.42826	70308	13.24763	85.60
11.94	2.25	2.47983	81086	13.83128	86.32
12.41	2.48	2.51846	90818	14.38027	86.29
12.64	2.72	2.53684	100056	14.92163	84.70
12.93	2.95	2.55954	108177	15.41426	83.88
13.25	3.18	2.58400	115688	15.88441	83.41
13.54	3.42	2.60567	122967	16.35373	82.79
13.81	3.65	2.62542	129478	16.78525	82.27
14.02	3.88	2.64053	135591	17.20068	81.50
14.18	4.12	2.65188	141592	17.61863	80.48
14.39	4.35	2.66659	147024	18.00558	79.91
14.67	4.58	2.68587	152174	18.38039	79.81
14.94	4.82	2.70411	157280	18.75959	79.63



## CAMERA DATA & CALCULATIONS

FILM NO. 60352	STATION NO. 527.02 6x6 #3	TEST HAMILTON	CALCULATED BY: GGO
CAMERA NO. E 6	EQ. AP.		DATE: 10/15/58



A. $R^0/A = CB_h \cos \alpha \cos \beta + (H_B - H_C) \sin \beta$		
$\alpha = 0^\circ 00'$	$\beta = 2^\circ 10'$	$H_B = 3129 \text{ ft}$
$\cos \alpha = 1.0000$	$\cos \beta = 0.99929$	$H_C = 3083 \text{ ft}$
$CB_h = 372.0 \text{ m}$	$\sin \beta = 0.03781$	$\Delta H = 46 \text{ ft} = 14 \text{ m}$
$CB_h \cos \alpha \cos \beta = 371.7 \text{ m}$	$\Delta H \sin \beta = 0.5 \text{ m}$	$R^0/A = \boxed{372.2 \text{ m}}$
FOCAL LENGTH 63.91 mm (ET 1254)		

MAGNIFICATION FACTOR (meters/in.) 147.9

ZERO TIME CORRECTION 0.05 ms

FIREBALL CALCULATIONS

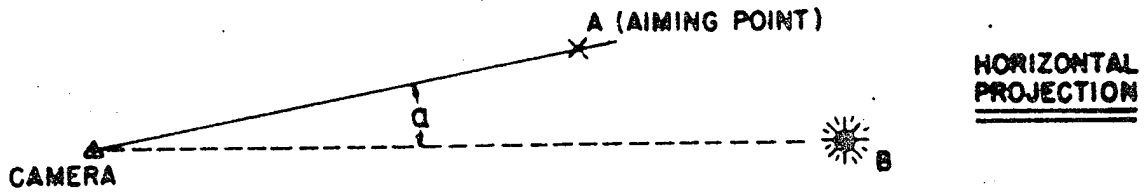
SHOT Hamilton FILM NO. 60352

DATE 1-22-59

t	ln D	ln t	t <sup>2/3</sup>	φ
.05	1.61343	2.09572 -	.301722	16637
45	1.96286	79845 -	726597	9799
84	2.14248	17429 -	932657	9135
123	2.25342	20696	1086309	8763
163	2.34563	48865	1215873	8586
202	2.42384	70308	1324763	8522
241	2.48568	87955	1421653	8447
281	2.54158	103313	1511726	8400
320	2.59452	116315	1592432	8408
360	2.62252	128099	1669287	8249
399	2.65047	138386	1739412	8140
438	2.68040	147711	1805514	8080

## CAMERA DATA & CALCULATIONS

FILM NO. 60354	STATION NO. <sup>527.02</sup> 6x6 #3	TEST HAMILTON	CALCULATED BY: GGO
CAMERA NO. F16 #1	EQ. AP.		DATE: 10/15/58



A. $R^{\circ}/A = CB_h \cos \alpha \cos \beta + (H_B - H_C) \sin \beta$		
$\alpha = 0^{\circ} 00'$	$\beta = 2^{\circ} 10'$	$H_B = 3129 \text{ ft}$
$\cos \alpha = 1.0000$	$\cos \beta = 0.99929$	$H_C = 3083 \text{ ft}$
$CB_h = 372.0 \text{ m}$	$\sin \beta = 0.03781$	$\Delta H = 46 \text{ ft} = 14 \text{ m}$
$CB_h \cos \alpha \cos \beta = 371.7 \text{ m}$	$\Delta H \sin \beta = 0.5 \text{ m}$	$R^{\circ}/A = \boxed{372.2 \text{ m}}$
B. FOCAL LENGTH 77.96 mm (617071)		

C. MAGNIFICATION FACTOR (meters/in.) 121.3

D. ZERO TIME CORRECTION 0.002 ms



FIREBALL CALCULATIONS

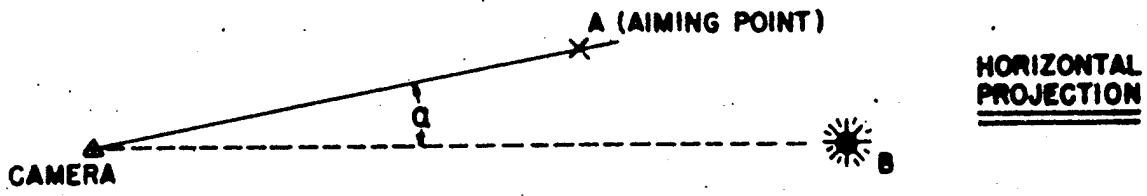
ton FILM NO. 60354

DATE 1-22-59

ln D	Int	$t^{2/5}$	$\phi$
233 36	1,469 74 -	.5 554 93	10.1 89
112 43	776 48 -	7 330 11	92 35
128 14	371 12 -	8 620 42	88 16
06 62	83 32 -	9 672 19	84 98
59 94	139 68	10 574 64	81 98
35 42	322 11	11 375 14	82 19
02 66	476 31	12 098 84	82 65
47 54	609 80	12 762 43	81 95
96 01	727 52	13 377 76	82 07
26 49	832 84	13 953 38	81 12
62 93	928 14	14 495 55	80 99
80 67	1 015 17	15 009 04	79 61
01 38	1 091 89	15 476 80	78 82
25 69	1 166 27	15 944 22	78 39
40 00	1 235 51	16 391 94	77 35
50 31	1 300 25	16 821 99	76 92

# CAMERA DATA & CALCULATIONS

NO. 60372	STATION NO. <i>F-732</i> <i>6x6 #1</i>	TEST <i>HAMILTON</i>	CALCULATED BY: <i>GGO</i>
ERA NO. <i>FR #1</i>	EQ. AP.		DATE: <i>10/15/58</i>



$R^{\circ}/A = CB_h \cos \alpha \cos \beta + (H_B - H_C) \sin \beta$		
$0^{\circ} 00'$	$\beta = 1^{\circ} 23'$	$H_B = 3129 \text{ ft}$
$\alpha = 1.0000$	$\cos \beta = 0.99971$	$H_C = 3081 \text{ ft}$
$= 604.1 \text{ m}$	$\sin \beta = 0.02414$	$\Delta H = 48 \text{ ft} = 14.6 \text{ m}$
$\cos \alpha \cos \beta = 603.9 \text{ m}$	$\Delta H \sin \beta = 0.4 \text{ M}$	$R^{\circ}/A = \boxed{604.3 \text{ m}}$

**FOCAL LENGTH**

**MAGNIFICATION FACTOR (meters/in.)**

**ZERO TIME CORRECTION *0.006 ms***



FIREBALL CALCULATIONS

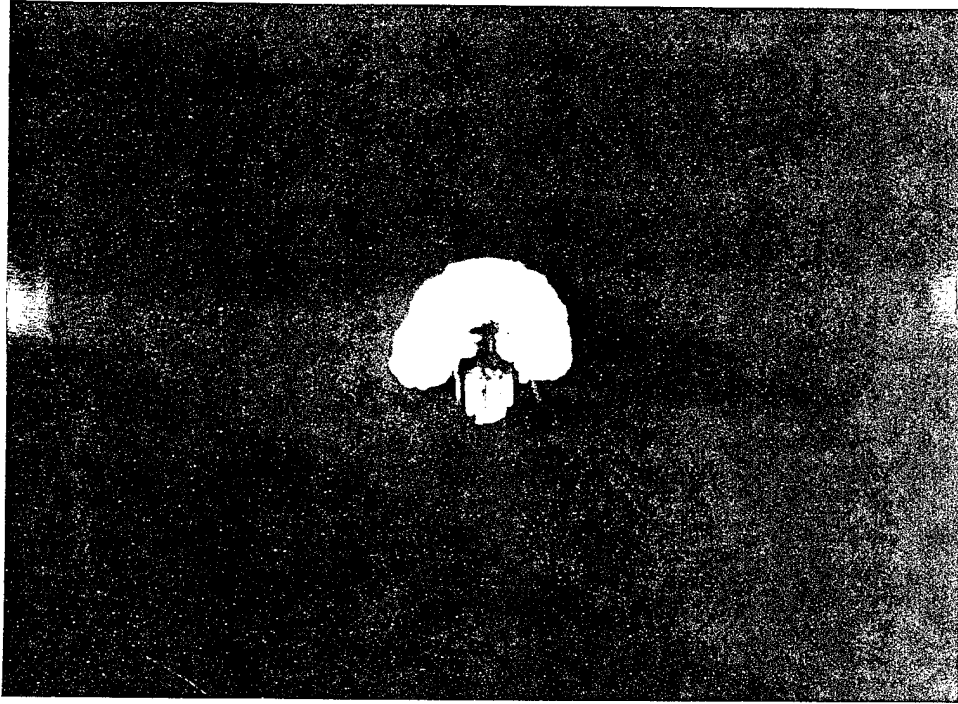
SHOT Hamilton FILM NO. 60372

DATE 1-22-59

D	t	ln D	Int	t <sup>2/5</sup>	φ
4.26	.14	1.44934	1.96607 -	.455467	93.53
5.31	.20	1.66956	1.60945 -	5.25303	101.08
5.77	.27	1.75260	1.30940 -	5.92288	97.41
6.19	.33	1.82285	1.10864 -	6.41812	96.44
6.56	.40	1.88091	.91621 -	6.93164	94.63
6.94	.46	1.93724	.77648 -	7.33011	94.67
7.10	.53	1.96005	.63490 -	7.75720	91.52
7.49	.59	2.01355	.52770 -	8.09707	92.50
7.67	.66	2.03732	.41559 -	8.46845	90.57
7.89	.72	2.06562	.32854 -	8.76851	89.98
8.19	.79	2.10296	.23569 -	9.10028	89.99
8.34	.85	2.12112	.16245 -	9.37085	88.99
8.65	.92	2.15763	.08332 -	9.67219	89.43
8.87	.98	2.18275	.02023 -	9.91939	89.42
8.97	1.05	2.19396	.04876	10.19697	87.96
9.18	1.11	2.21709	.10428	10.42596	88.04
9.36	1.18	2.23649	.16544	10.68416	87.60
9.53	1.24	2.25446	.21506	10.89836	87.44
9.58	1.31	2.25969	.27002	11.14057	85.99
9.81	1.37	2.28337	.31483	11.34208	86.49
9.96	1.44	2.29851	.36469	11.57056	86.08
10.02	1.50	2.30465	.40553	11.76111	85.19
10.33	1.57	2.33505	.45115	11.97769	86.24
10.46	1.63	2.34754	.48865	12.15873	86.02
10.55	1.69	2.35609	.52479	12.33578	85.52
10.56	1.76	2.35704	.56537	12.53761	84.22
10.99	2.28	2.39692	.82411	13.90473	79.03



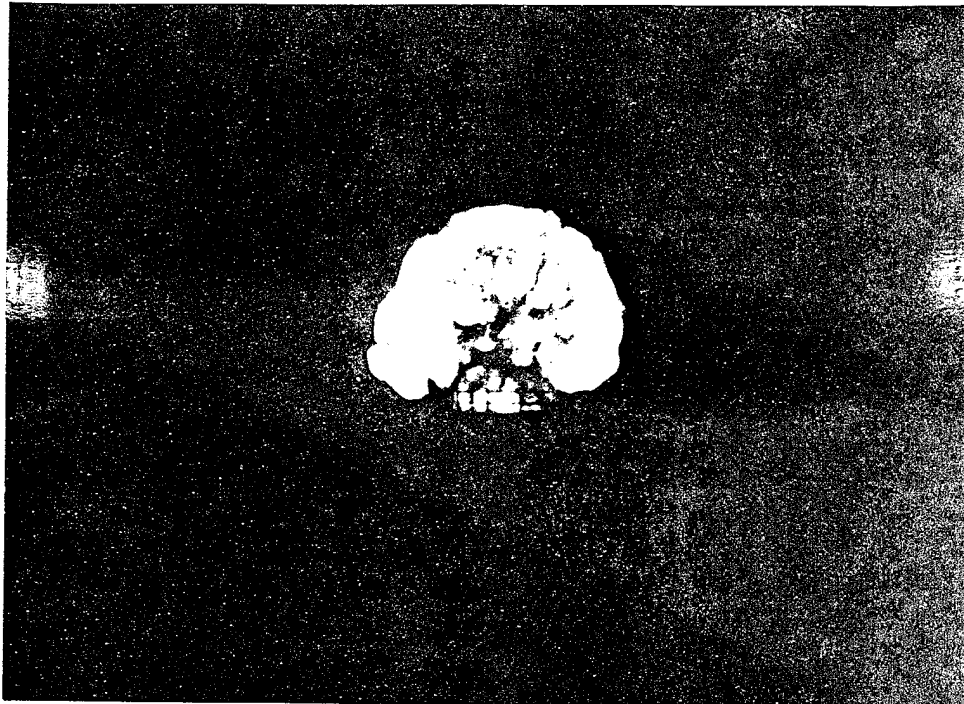
APPENDIX  
HARDTACK PHASE II, HAMILTON  
PHOTOGRAPHIC EXAMPLES



Camera: F-16 No. 2

Station: 527.01

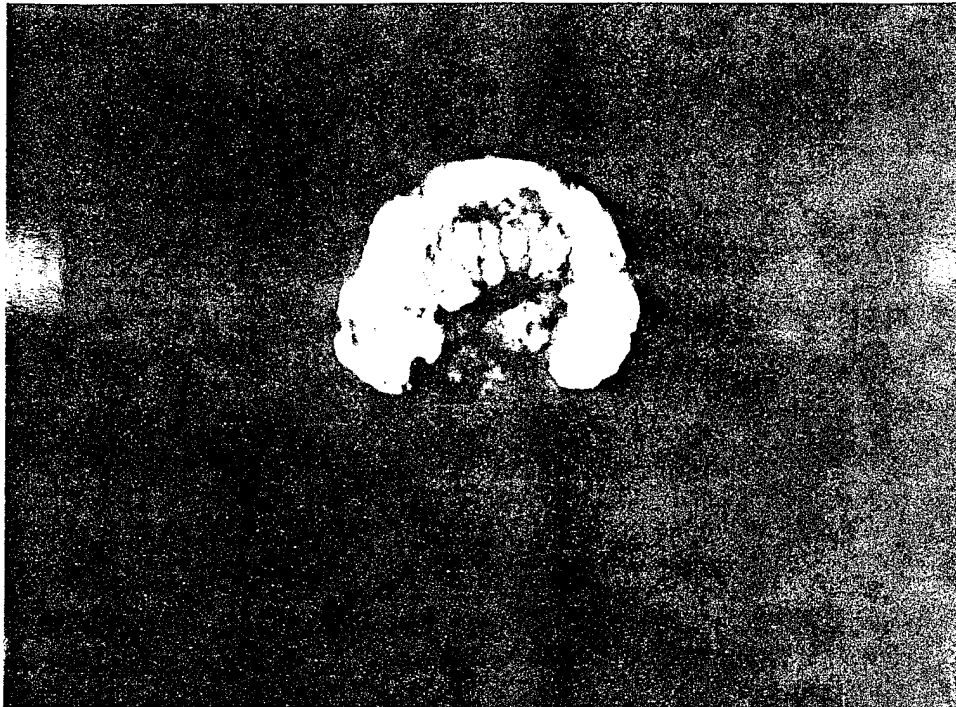
Time: 0.38 msec



Camera: F-16 No. 2

Station: 527.01

Time: 1.08 msec



Camera: F-16 No. 2

Station: 527.01

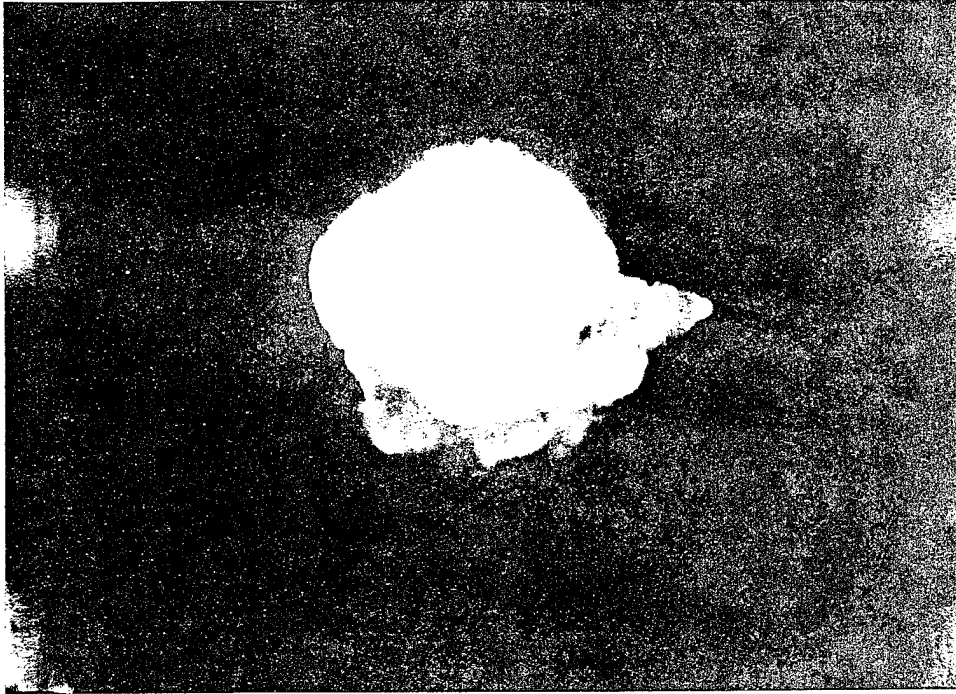
Time: 2.02 msec



Camera: E-6

Station: 527.02

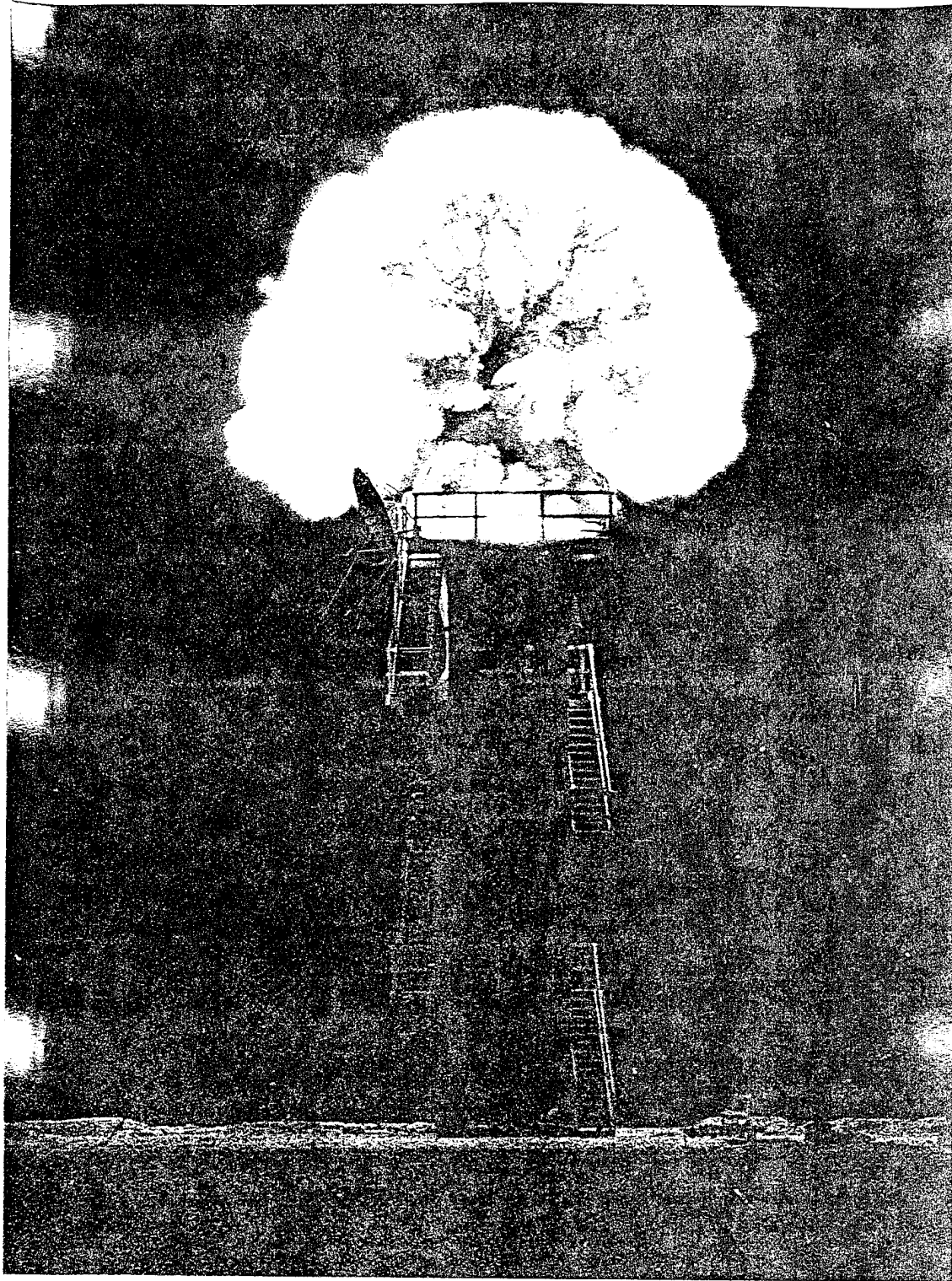
Time: 2.02 msec



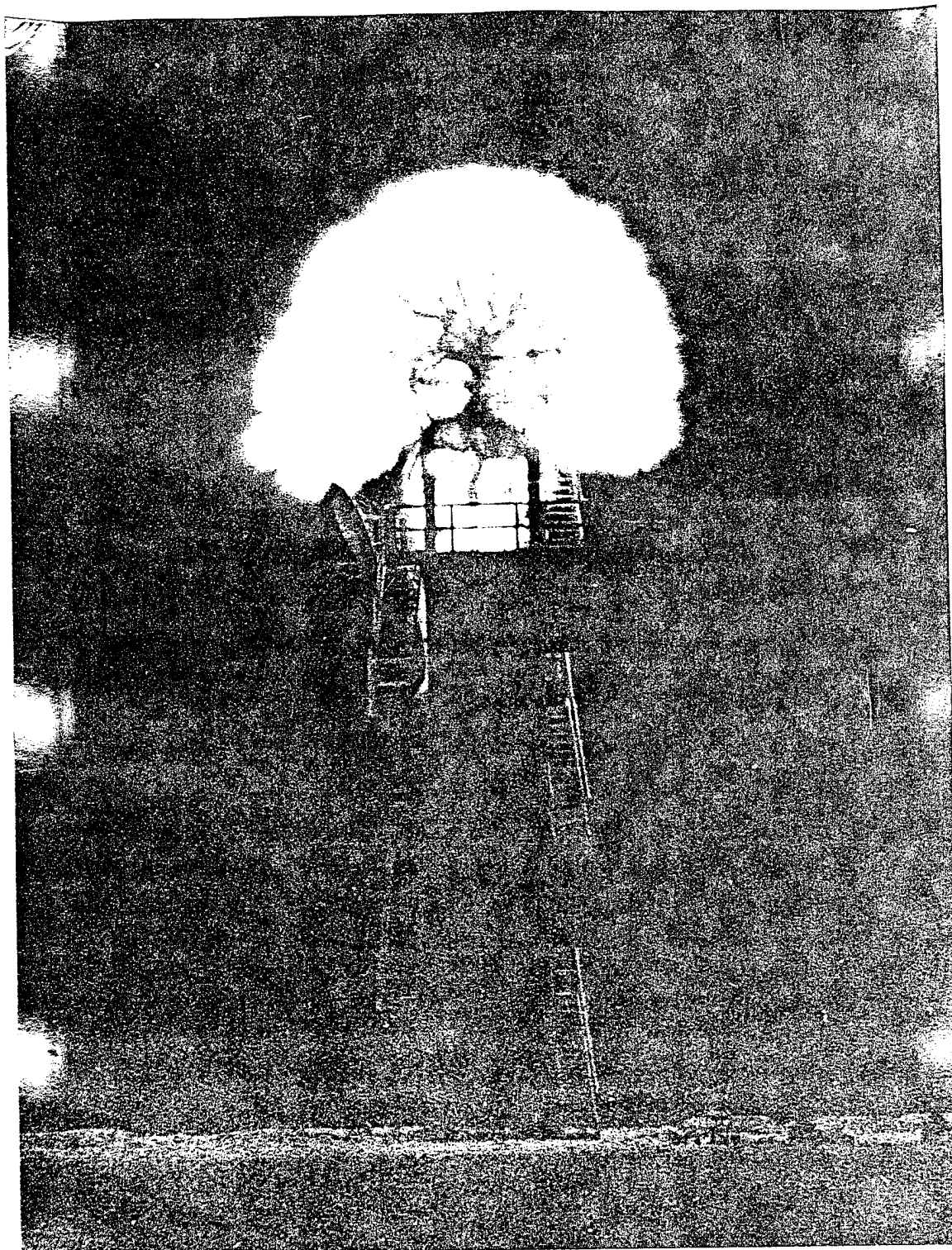
Camera: E-6

Station: 527.02

Time: 6.74 msec



Camera: R-4  
Station: 527.01  
Time: 0.4995 msec



Camera: R-3  
Station: 527.01  
Time: 0.9840 msec



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