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Period v. Yield Data

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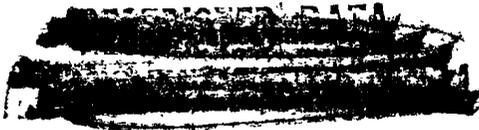
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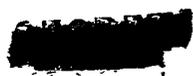
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Folder MEMORANDUM FOR THE RECORD:

17 August 1956

SUBJECT: ~~(S)~~ Revised Acoustic Signal Period vs. Yield Data

1. General. Subsequent to the Teapot series (February - May 1955), TD-2 reviewed all acoustic data and revised the signal period vs. yield curves. This memorandum presents the latest information regarding determination of bomb yield from acoustic periods.

2. Background.

a. Period vs. yield curves shown in Figure 1 were used prior to 1 February 1956. These curves were obtained using data from Greenhouse, Buster-Jangle, Tumbler-Snapper, Ivy, Upshot-Knothole, and Castle. An average period at maximum amplitude was obtained by averaging data from all cross-wind and down-wind stations for each shot. Regression lines and standard errors of estimate were obtained without weighing. Two power-law curves were computed, one using data from shots of 0.2 to 550 KT and the other using data from shots of 100 to 15,000 KT. The equation for the lower yields follows:

$$\log Y \pm 0.2787 = -2.00316 + 2.84612 \log P \quad (1)$$

where Y = yield in kilotons.

P = period in seconds.

This can be written approximately,

$$Y = 1.0 \times 10^{-2p2.8} \quad (2)$$

The equation for the higher yields follows:

$$\log Y \pm 0.16352 = 3.43646 + 4.05216 \log P \quad (3)$$

This can be written approximately,

$$Y = 3.7 \times 10^{-4p4.0} \quad (4)$$

A correction was made for small sample in computing the error of estimate for the higher yields.

b. Several factors made it desirable to revise the period vs. yield data.

(1) The Teapot data became available and needed to be added to other data.

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- (2) The need for a single curve to cover the whole yield range was recognized.
- (3) It was necessary to review the records for the megaton shots in order to take into account the frequency response of the equipment.
- (4) It was felt desirable to weigh the data according to the number of stations used in obtaining the average period for each shot.

3. Revised Yield Data.

a. Tables 1 through 7 give the periods at maximum amplitude selected for each station for each U.S. shot.

b. The mean of the periods from all down-wind and cross-wind stations was computed for each shot in winter and summer. The mean of all periods was used in spring and fall.

c. Only the acoustic portion of the wave train was used in selecting the periods. That is, the dispersive wave train was eliminated from consideration as far as possible.

d. On the larger shots where signal periods exceeded about 25 seconds an attempt was made to take into account the frequency response of the equipment in selecting the period at maximum amplitude.

e. A power-law curve was fitted by the method of least squares to all the data. The standard error of estimate was also computed.

f. Figure 2 gives the curve for period vs. yield and the 1, 2, and 3 standard error lines. The equation for this curve is given below.

$$\log Y \pm 0.27955 = -3.14049 + 3.85977 \log P \quad (5)$$

where Y = yield in kilotons.

P = period in seconds.

This equation can be written approximately,

$$Y = 7.2 \times 10^{-4} P^{3.9} \quad (6)$$

4. Discussion.

a. The data points plotted on Figure 2 show that the power-law given by equation (6) fits the data very well for yields down to 5 KT. Below 5 KT

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the data points fall below the curve - that is, the indicated yield is less than the actual yield.

b. There is no known theoretical reason for a fourth-power relation between period and yield. A third-power would be expected. As a matter-of-fact, a third-power law curve does fit the data somewhat better than a fourth-power for yields lower than about 100 KT.

c. The question has been raised several times whether the height of burst affects the yield estimate. Table 8 gives the pertinent data for each U.S. shot. Table 9 presents the actual yield and the estimated yield for shots within a series which appear most significant toward revealing any altitude effects. For example, compare Jangle-Surface with Jangle-Underground. These shots had the same yield, 1.3 KT, and were within 10 days of each other but one was on the surface and the other was 17 feet underground. The estimated yield was 0.75 KT for each - about 1- too low. Or, compare Buster Baker with Jangle Surface. These shots were 1.3 KT and 3.5 KT, respectively, and Baker was at 1118 feet above ground. Both yield estimates were low - Baker by 1.5- and Surface by 1.0-. Finally, note the remarkable similarity of Teapot Wasp 2 and HA. Both were 3.1 KT and they were fired within 8 days of each other but Wasp 2 was at 800 feet and HA was at 36,000 feet. Both gave the same estimated yield of 0.75 - about -2.0- error. From all of these comparisons it is concluded that the existing data shows no effect of altitude on the acoustic yield estimates up to altitudes of 36,000 feet.

d. Another question frequently raised concerns the change in period with distance from the explosion. Plots of period vs. distance for each shot are shown in Figures 3 through 9. Within the limitations of the measurements, no major trend is apparent.

e. The question has also been raised regarding the applicability of the period vs. yield curve for explosions at different locations. Data from U.S. shots is limited to Nevada and the Pacific Proving Ground. There is not too much overlap of data from these locations since yields of Nevada shots were all less than 60 KT and yields of PPG shots were all [REDACTED] up through the Castle series. About all that can be said at present is that there is no obvious difference in results at Nevada and at PPG. Preliminary data from Redwing support this conclusion for yields as [REDACTED]

5. Conclusions.

a. Figure 2 presents a single yield vs. period curve for yields from 5 KT to 20 MT. Even down to 1 KT the curve fits the data fairly well.

b. Estimated errors in the high yield range (500 KT and above) based on the data from shots of all yield probably err on the high side. Note in Figure 2 that all of the points fall within the ± 1 standard error range for the higher yield shots.

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c. The present period vs. yield curve is applicable for shots up to 36,000 ft altitudes.

d. Available evidence, though not exhaustive, indicates that the present period vs. yield curve is independent of source geographic location.

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1. Table 1
2. Table 2
3. Table 3
4. Table 4
5. Table 5
6. Table 6
7. Table 7
8. Table 8
9. Table 9
10. Figure 1
11. Figure 2
12. Figure 3
13. Figure 4
14. Figure 5
15. Figure 6
16. Figure 7
17. Figure 8
18. Figure 9



TABLE NO. 2

SIGNAL PERIODS - OPERATION BUSTER-JANGLE

<u>Station</u>	<u>Period (Secs)</u>					
	<u>Baker</u>	<u>Charlie</u>	<u>Dog</u>	<u>Easy</u>	<u>Surface</u>	<u>Undergrou</u>
Ft. Lewis	30	16	18	-	22	-
Pyote AFB	8	10	12	13	4	5
Eagle Mt. Lake	5	-	12	-	-	-
Eglin AFB	7	-	9	15	5	5
Breckinridge	7	13	12	-	8	7
Belmar	-	11	-	18	-	-
Washington, D.C.	<u>8</u>	<u>11</u>	<u>-</u>	<u>18</u>	<u>-</u>	<u>-</u>
Mean	7	12	13	16	6	6
No. Stations	5	5	5	4	3	3

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TABLE NO. 3

SIGNAL PERIODS - OPERATION TUMBLER-SNAPPER

<u>Station</u>	<u>Period (Secs)</u>							
	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	
Ft. Lewis	7	11	18	15	18	15	10	
Pyote AFB	-	18	16	15	-	-	-	
Breckinridge	-	-	15	-	-	-	-	
Washington, D.C.	-	18	-	-	-	-	-	
Fairbanks	-	15	14	-	17	-	-	
Oahu	-	-	-	-	15	-	-	
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Mean	7	15	16	15	17	15	10	
No. Stations	1	4	4	2	3	1	1	

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TABLE NO. 4

SIGNAL PERIODS - OPERATION IVY

<u>Station</u>	<u>Period (Secs)</u>	
	<u>MIKE</u>	<u>KING</u>
Hachinohe	70	35
Kyoto	65	?
Oahu	62	36
Fairbanks	?	30
Ft. Lewis	67	33
San Diego	66	35
Gila Bend	63	-
Washington, D.C.	68	35
Belmar	68	?
Thule	<u>85</u>	<u>—</u>
Mean	68	34
No. Stations	9	6

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TABLE NO. 5

SIGNAL PERIODS - OPERATION UPSHOT-KNOTHOLE

<u>Station</u>	<u>Period (Secs)</u>										
	<u>Annie</u>	<u>Nancy</u>	<u>Ruth</u>	<u>Dixie</u>	<u>Ray</u>	<u>Badger</u>	<u>Simon</u>	<u>Encore</u>	<u>Harry</u>	<u>Grable</u>	<u>Clima</u>
San Diego	10	-	-	-	-	-	-	-	-	15	-
Dateland	10	19	3	8?	17	?	14	?	F	-	25?
Ft. Lewis	?	28	-	17?	-	18	18	16	14	10	?
Pyote	16	12	3	?	-	12	20	22	-	45	N.C
Barksdale	13	8	-	-	-	-	20	17	44	-	32
Washington, DC	18	13	-	-	-	11?	-	?	31	31	30
Belmar	?	-	-	-	-	-	-	-	-	-	-
Fairbanks	?	?	-	?	-	12	18	-	?	23	18
Oahu	-	-	-	-	-	-	26	20	20	15	25
Thule	16	16	-	18	-	13	16	21	-	-	?
Kyoto	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>19</u>
Mean	14	15	3	14	17	13	19	19	17	16	22
No. Stations	6	4	2	3	1	5	7	5	2	4	4



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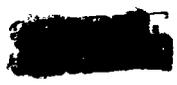


TABLE NO. 6

SIGNAL PERIODS - OPERATION CASTLE

Station	<u>Period (Secs)</u>						
	<u>Bravo</u>	<u>Romeo</u>	<u>Koon</u>	<u>Union</u>	<u>Yankee</u>	<u>Nectar</u>	
Hachinohe	71	74	-	55	93	49	
Kyoto	71	77	-	56	82	47	
Oahu	72	73	23	?	68	47	
Clark Field	N.O.	85	22	69	70	40	
Fairbanks	?	55	27	59	67	?	
Ft. Lewis	80	?	-	?	?	?	
Low Fre- quency {	(Los Angeles	(73	(95	-	(77	(85	-
	{ San Diego	{ 66	{ 95	-	{ 74	{ 85	-
	{ 29 Palms	{ 71	{ 95	-	{ 82	{ 85	-
	{ Gila Bend	{ 73	{ 97	-	{ 72	{ 82	-
Washington, D.C.	?	22	-	?	?	?	
Belmar	?	?	-	?	?	?	
Thule	?	68	-	60	?	40	
TAG DAY	109	63	-	73	95	51	
Ankara	?	?	-	43	?	39	
{	{ Hanau	{ ?	{ ?	-	{ 64	{ 72	{ 52
	{ Zweibrucken	{ N.O.	{ 71	-	{ 68	{ 78	{ 55
Scotland	<u>?</u>	<u>66</u>	<u>-</u>	<u>68</u>	<u>77</u>	<u>43</u>	
Mean	81	70	24	61	78	46	
No. Stations	5	9	3	9	8	9	

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TABLE NO. 7

SIGNAL PERIODS - OPERATION TEAPOT

<u>Station</u>	<u>Period (Secs)</u>												
	<u>WASP</u>	<u>MOTH</u>	<u>TESLA</u>	<u>TURK</u>	<u>HORNET</u>	<u>BEK</u>	<u>APPLE 1</u>	<u>WASP 2</u>	<u>HA</u>	<u>POST</u>	<u>MET</u>	<u>APPLE 2</u>	<u>ZUCCHINI</u>
Ft. Lewis	-	-	-	-	-	-	-	-	-	-	-	-	-
Washington, D.C.	5	8	8	15	10	-	12	6	10	7	15	-	-
Belmar	-	10	-	-	-	-	10	-	-	10	-	-	-
Fairbanks	-	-	-	-	-	-	-	-	4	-	-	30?	19
Thule	-	11	-	-	-	11	15	-	7	-	11	-	13
Feltwell	-	10	-	16	-	-	-	-	4	-	-	-	-
Zweibrucken	-	-	-	17	-	-	-	-	-	-	-	-	15
Ankara	-	-	-	23	-	-	-	-	-	-	-	-	23
Asmara	-	-	-	13	-	-	-	-	-	-	-	-	-
Mean	5	10	8	17	10	11	12	6	6	8	13	30?	18
No. Stations	1	4	1	5	1	1	3	1	4	2	2	1?	4

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TABLE NO. 8

U. S. SHOT DATA

Shot	DTG (GMT)	Location		Yield (KT)	Condition
		Lat. (deg.min.sec)	Long. (deg.min.sec)		
Crossroads A	1 July 1946		Bikini Atoll	19	Air - 520' HOB*
Crossroads B	24 July 1946		Bikini Atoll	20	90' underwater
Sandstone X	151817 Apr '48		Eniwetok	37	200' tower
Sandstone Y	011809 May '48		Eniwetok	49	200' tower
Sandstone Z	151804 May '48		Eniwetok	18	200' tower
Ranger 1	272145 Jan '51		Nevada	1.3	Air - 1100' HOB*
Ranger 2	282151:33 Jan		Nevada	7.8	Air - 1100' HOB*
Ranger 3	012146:33 Feb		Nevada	1.0	Air - 1100' HOB*
Ranger 4	022148:47 Feb		Nevada	8.0	Air - 1100' HOB*
Ranger 5	062147:15 Feb		Nevada	12.2	Air - 1435' HOB*
Greenhouse D	071833:58 Apr '51		Eniwetok	47	300' tower
Greenhouse E	201827:00 Apr		Eniwetok	47	300' tower
Greenhouse G	082130:01 May		Eniwetok	47	200' tower
Greenhouse I	241816:59 May		Eniwetok	47	1200' tower
Euster B	281520:09 Oct '51	37°05'18.7"N	116°01'11.0"W	3.5	Air - 1118' HOB*
Euster C	301500:31 Oct	37°05'04.8"N	116°01'11.0"W	14	Air - 1132' HOB*
Euster D	011530:00 Nov	37°05'11.8"N	116°01'18.6"W	21	Air - 1417' HOB*
Euster E	051629:58 Nov	37°05'31.5"N	116°01'25.6"W	32	Air - 1314' HOB*
Jangle S	191700:00 Nov '51	37°07'53.0"N	116°02'20.1"W	1.3	Surface
Jangle U	292000:00 Nov	37°10'14.9"N	116°02'35.5"W	1.3	17' underground
Tumbler- Snapper 1	011700:08 Apr '52	36°47'35"N	115°55'57"W	1.1	Air - 793' HOB*
Tumbler- Snapper 2	151729:57 Apr	37°05'03.4"N	116°01'10.0"W	1.2	Air - 1109' HOB*
Tumbler- Snapper 3	221730:10 Apr	37°05'04.0"N	116°01'12.5"W	30	Air - 3447' HOB*
Tumbler- Snapper 4	011629:59 May	37°05'03.4"N	116°01'12.7"W	20	Air - 1040' HOB*
Tumbler- Snapper 5	071214:59 May	37°03'10.0"N	116°06'09.2"W	12	300' tower
Tumbler- Snapper 6	251200:00 May	37°05'42.5"N	116°06'10.8"W	11	300' tower
Tumbler- Snapper 7	011155:00 June	37°02'52.5"N	116°01'14.2"W	14	300' tower
Tumbler- Snapper 8	051155:00 June	37°03'16.5"N	116°07'06.1"W	14	300' tower
Ivy-Mike	311915:00 Oct '52	11°40'N	162°12'E	12,000	Surface
Ivy-King	152330:00 Nov	11°35'N	162°22'E	550	Air - 1480'
Upshot-Knot- hole Annie	171320:00 Mar '53	37°02'52.3"N	116°01'15.7"W	16	300' tower
Upshot-Knot- hole Nancy	241310:00 Mar	37°05'43.9"N	116°06'09.9"W	24	300' tower

*Height of Burst

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Shot	DTG (GMT)	Location		Yield (KT)	Condition
		Lat. (deg.min.sec)	Long. (deg.min.sec)		
Upshot-Knot-hole Ruth	311300:00 Mar	37°04'57.9"N	116°01'25.7"W	0.2	300' tower (10,216' MSL)
Upshot-Knot-hole Dixie	061529:38 Apr	37°05'04.7"N	116°01'11.3"W	11	Air - 6022' HOB*
Upshot-Knot-hole Ray	111245:00 Apr	37°05'56.2"N	116°05'32.9"W	0.2	100' tower
Upshot-Knot-hole Badger	181235:00 Apr	37°08'18.4"N	116°07'04.0"W	28	300' tower
Upshot-Knot-hole Simon	251230:00 Apr	37°03'11.1"N	116°06'09.5"W	52	300' tower (5493' MSL)
Upshot-Knot-hole Encore	081529:55 May	36°47'52.7"N	115°55'44.1"W	26	Air - 2423' HOB*
Upshot-Knot-hole Harry	191205:00 May	37°02'25.4"N	116°01'31.4"W	32	300' tower (3595' MSL)
Upshot-Knot-hole Grable	251530:00 May	36°47'52.7"N	115°55'44.1"W	15	Air - 525' HOB* (5523' MSL)
Upshot-Knot-hole Clinax	041114:57 June	37°05'04.7"N	116°01'11.3"W	65	Air - 1334' HOB*
Castle-Bravo	281845:00 Feb '54	11°41'28.9"N	165°16'24.8"E	15±0.5	Surface - land
Castle-Romeo	261830:00 Mar	18 ft N 204 ft W of Bravo		11±0.5	Barge
Castle-Koon	061820:00 Apr	11°29'48.0"N	165°22'03.4"E	0.130±0.020	Surface - land
Castle-Union	251810:00 Apr	11°39'58.5"N	165°23'13.7"E	7.0±0.3	Barge
Castle-Yankee	041810:00 May	Same as Union		13.5±1.0	Barge
Castle-Nectar	131820:00 May	11°40'13.9"N	162°11'46.8"E	1.7±0.3	Barge
Teapot-Wasp 1	181959:59.2 Feb '55	37°05'11.7"N	116°01'18.7"W	1.1	Air - 800' alt
Teapot-Moth	221345:00.0 Feb	37°02'52.3"N	116°01'15.7"W	2.5	300' tower
Teapot-Tesla	011330:00 Mar	37°07'31.6"N	116°02'51.0"W	6.5	300' tower
Teapot-Turk	071320:00 Mar	37°08'18.5"N	116°07'03.2"W	43	500' tower
Teapot-Hornet	121320:00 Mar	37°02'25.4"N	116°01'31.4"W	3.6	300' tower
Teapot-Bee	221305:00 Mar	37°05'41.4"N	116°01'25.5"W	8.1	500' tower
Teapot-Ess	232030:00 Mar	37°10'06.1"N	116°02'37.6"W	1.2	67' underground
Teapot-Apple 1	291255:00 Mar	37°05'43.9"N	116°06'09.9"W	15	500' tower
Teapot-Wasp 2	291759:55 Mar	37°05'11.7"N	116°01'18.7"W	3.1	Air - 800' alt
Teapot-HA	061800:04 Apr	37°01'43.4"N	116°03'28.3"W	3.1	Air - 36,000' alt
Teapot-Post	091230:00 Apr	37°07'19.7"N	116°02'03.9"W	1.8	300' tower
Teapot-Net	151915:00 Apr	36°47'52.7"N	115°55'44.1"W	27	400' tower
Teapot-Apple 2	051210:00 May	37°03'11.1"N	116°06'09.5"W	27	500' tower
Teapot-Zucchini	151200:00 May	37°05'41.4"N	116°01'25.5"W	30	500' tower
Wigwam	142000:00 May	28°39'34"N	126°10'22"W	30	2000' underwater

*Height of Burst

TABLE NO. 9

ESTIMATED YIELD VS. ALTITUDE

<u>Shot</u>	<u>DTG</u>	<u>Height of Burst</u>	<u>Actual Yield</u>	<u>Est. Yield</u>	<u>Error</u>
<u>Jangle</u> - S	191700 Nov '51	Surface	1.3	0.75	-1 ~
	U 292000 Nov	17' Underground	1.3	0.75	-1 ~
<u>Buster</u> - B	281520 Oct '51	1118 feet	3.5	1.3	-1.5 ~
	C 301501 Oct	1132 feet	14	10	-0.5 ~
	E 051630 Nov	1314 feet	32	32	0
	D 011530 Nov	1417 feet	21	14	-0.7 ~
<u>Tumbler-Snapper</u> - 5	071215 May '52	300' tower	12	20	+1.2 ~
	4 011630 May	1040 feet	20	30	+0.7 ~
	2 151730 Apr	1109 feet	1.2	1.3	+0.1 ~
	3 221730 Apr	3447 feet	30	25	-0.2 ~
<u>Ivy</u> - Mike	311915 Oct '52	Surface	12,000	8,500	-0.6 ~
	King 152330 Nov	1480 feet	550	590	+0.1 ~
<u>Upshot-Knothole</u>	181235 Apr '53	300' tower	28	14	-1.0 ~
	Badger 251530 May	525 feet	15	29	+1.0 ~
	Grable 041114 June	1534 feet	65	110	+0.7 ~
	Climax 081529 May	2423 feet	26	60	+1.3 ~
	Encore 061530 Apr	6022 feet	11	21	+1.0 ~
<u>Teapot</u> - Wasp 2	291800 Mar	800 feet	3.1	0.75	-2.1 ~
	HA 061800 Apr	36,000 feet	3.1	0.75	-2.1 ~

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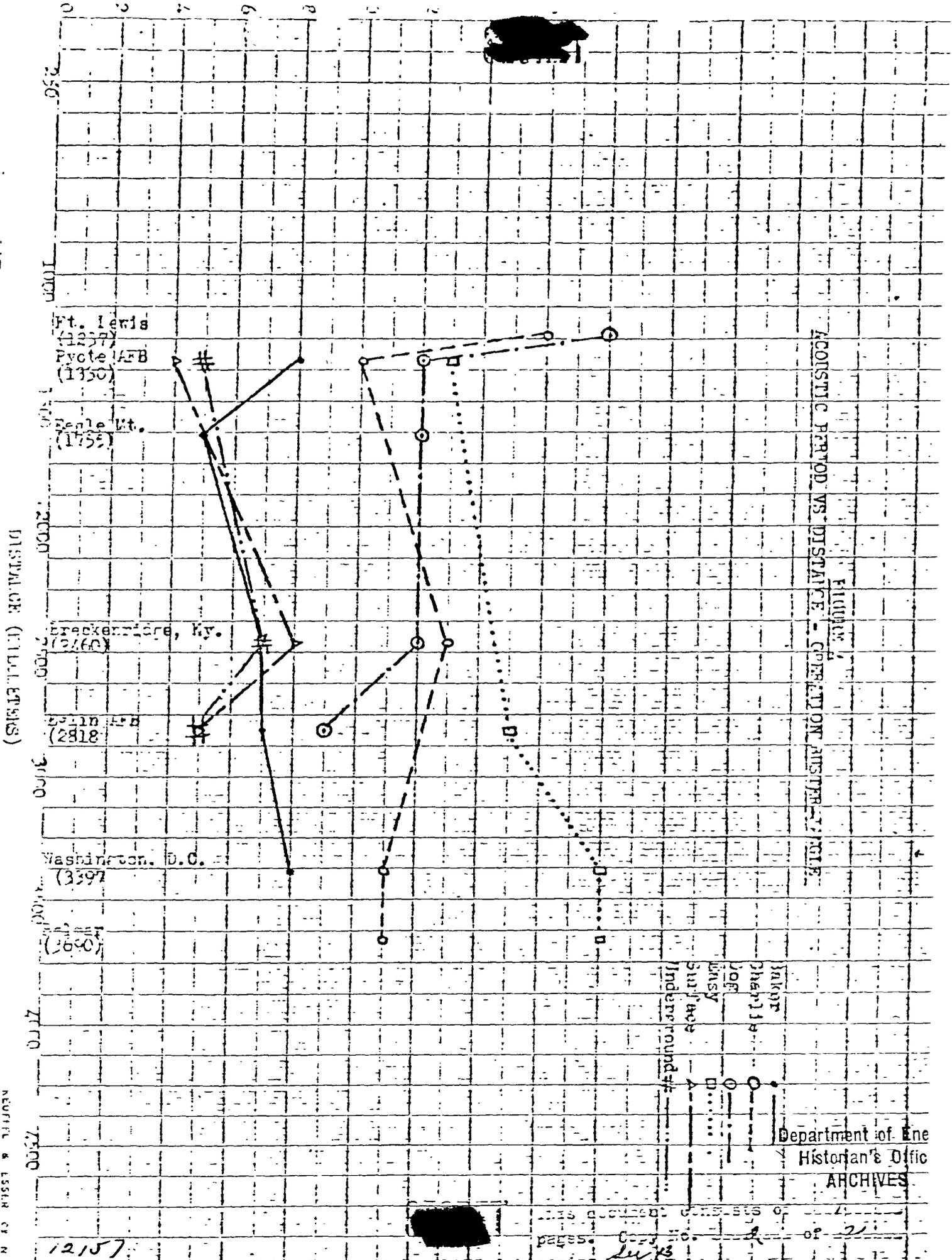
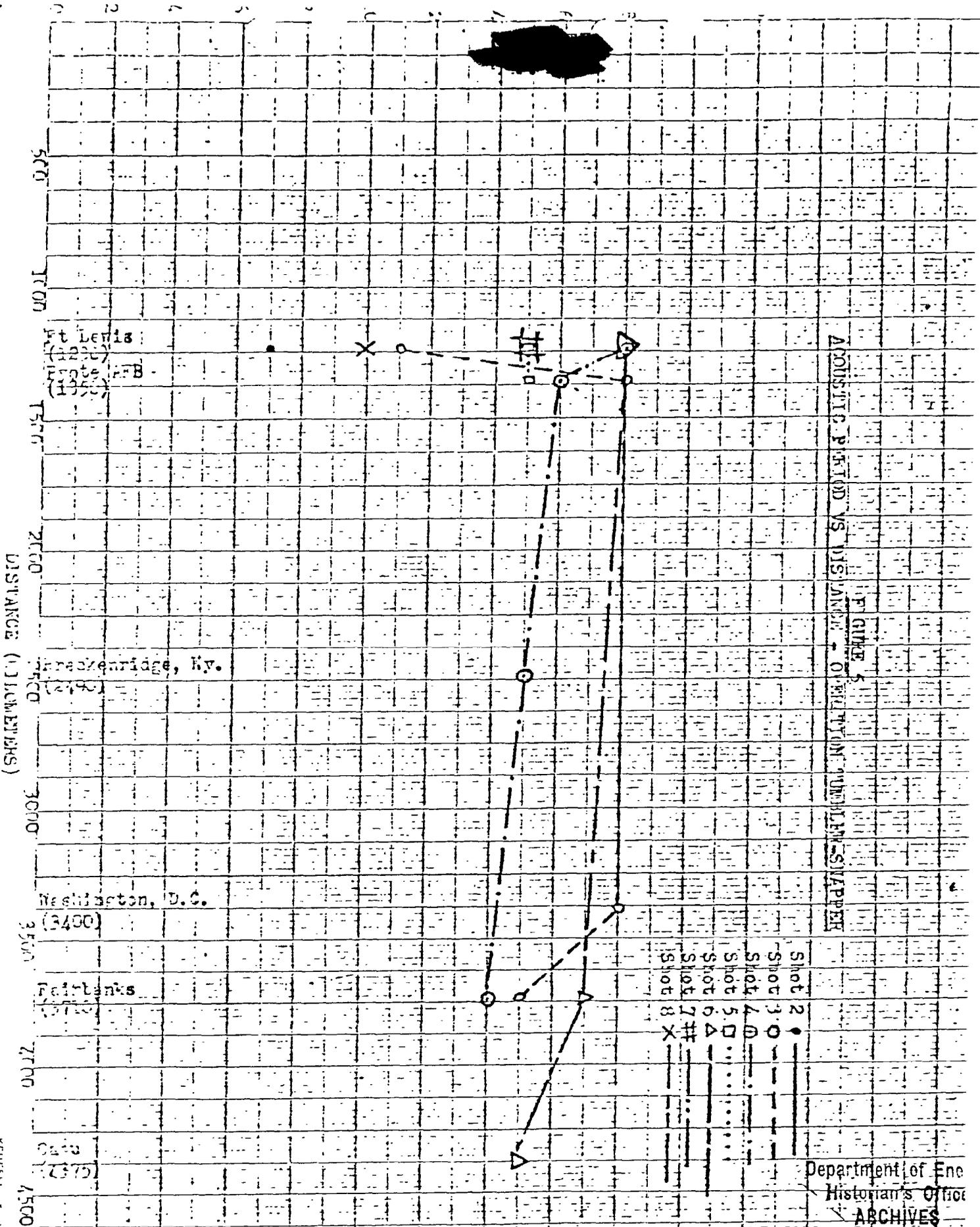


FIGURE 4
ACUSTIC PERIOD VS. DISTANCE - CORRELATION AMPER-TIME

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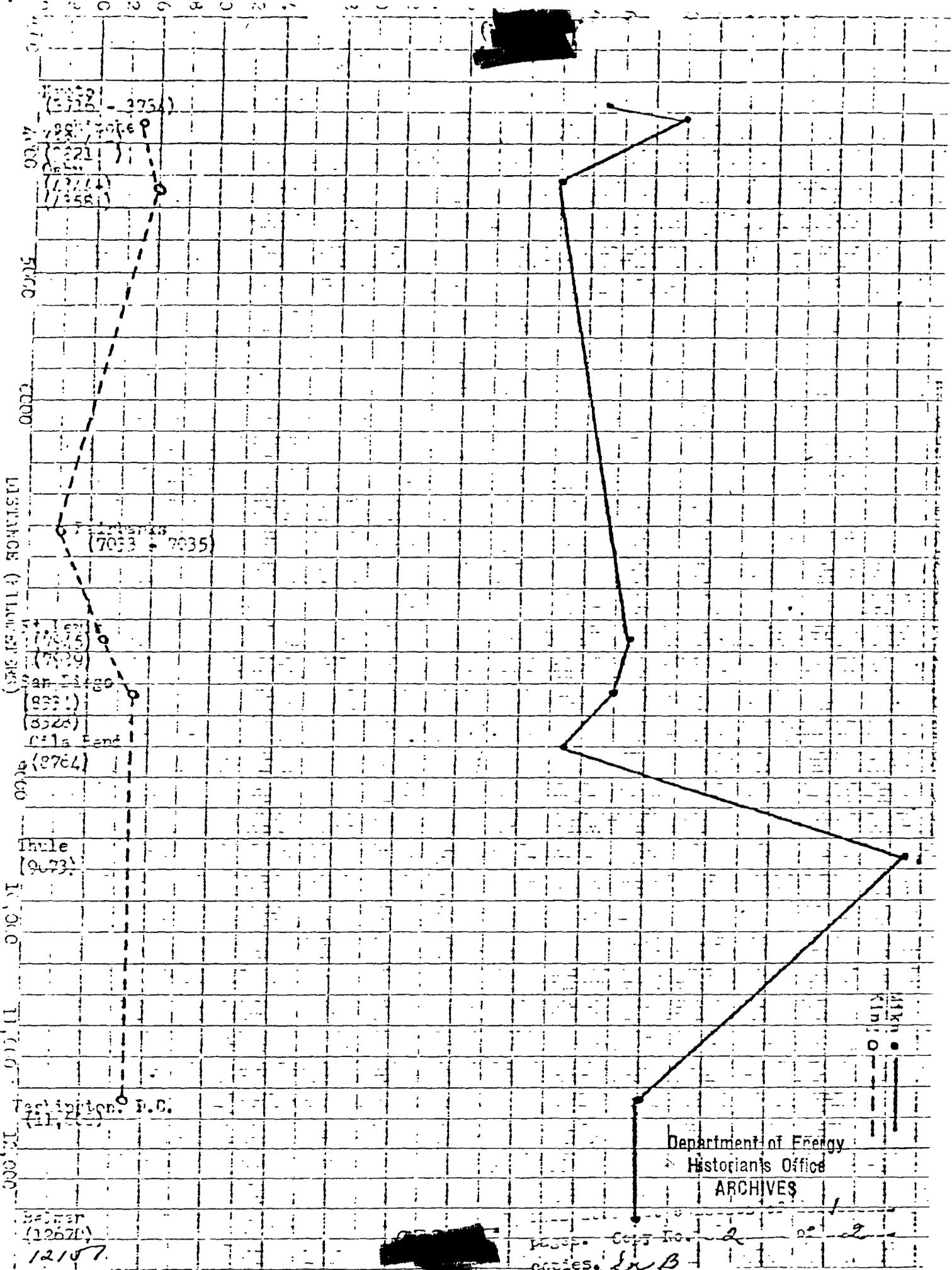
ACQUISITION PERIOD VS. DISTANCE

- Shot 2 ●
- Shot 3 ○
- Shot 4 ◻
- Shot 5 ◻
- Shot 6 △
- Shot 7 #
- Shot 8 X

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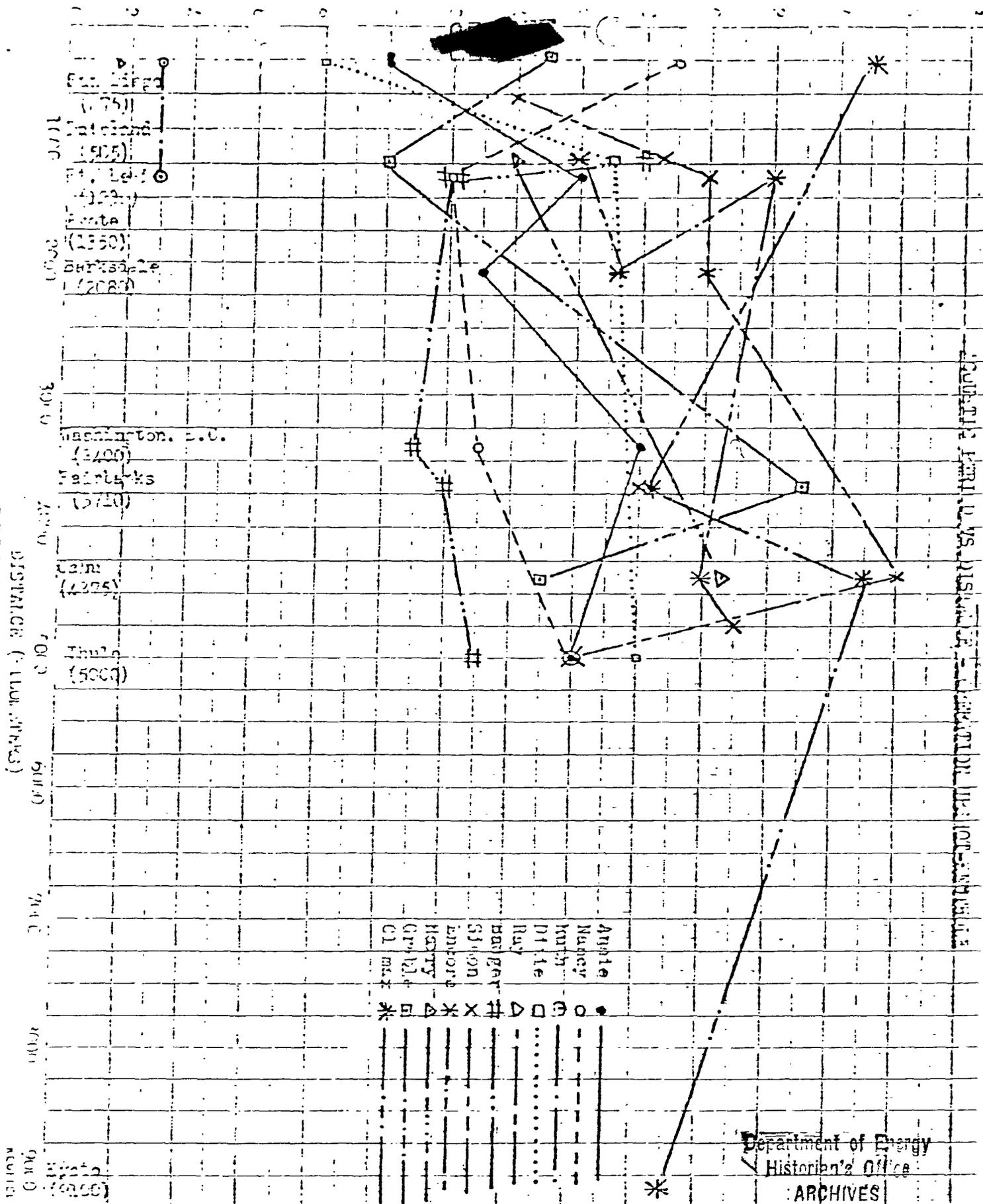


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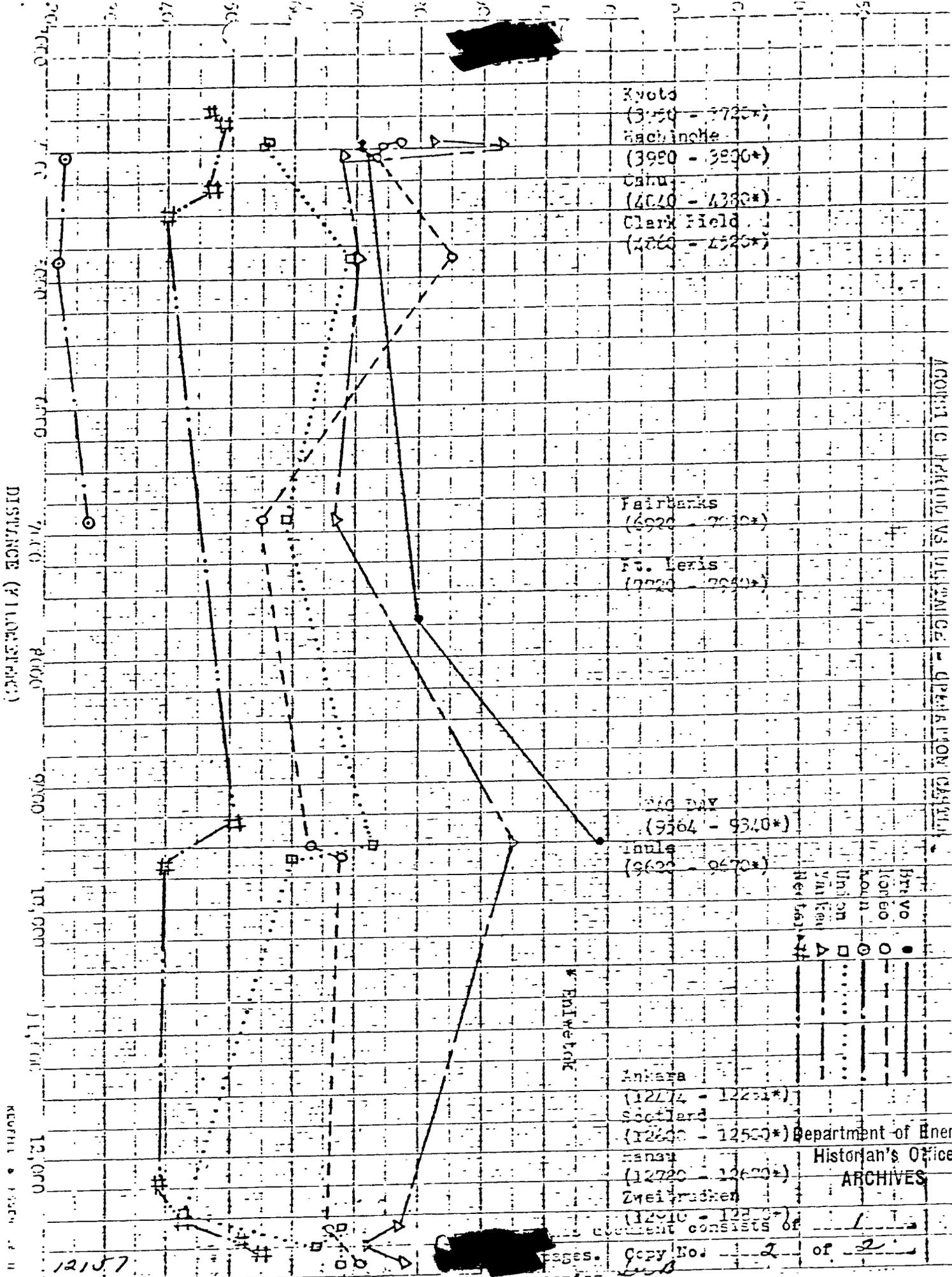


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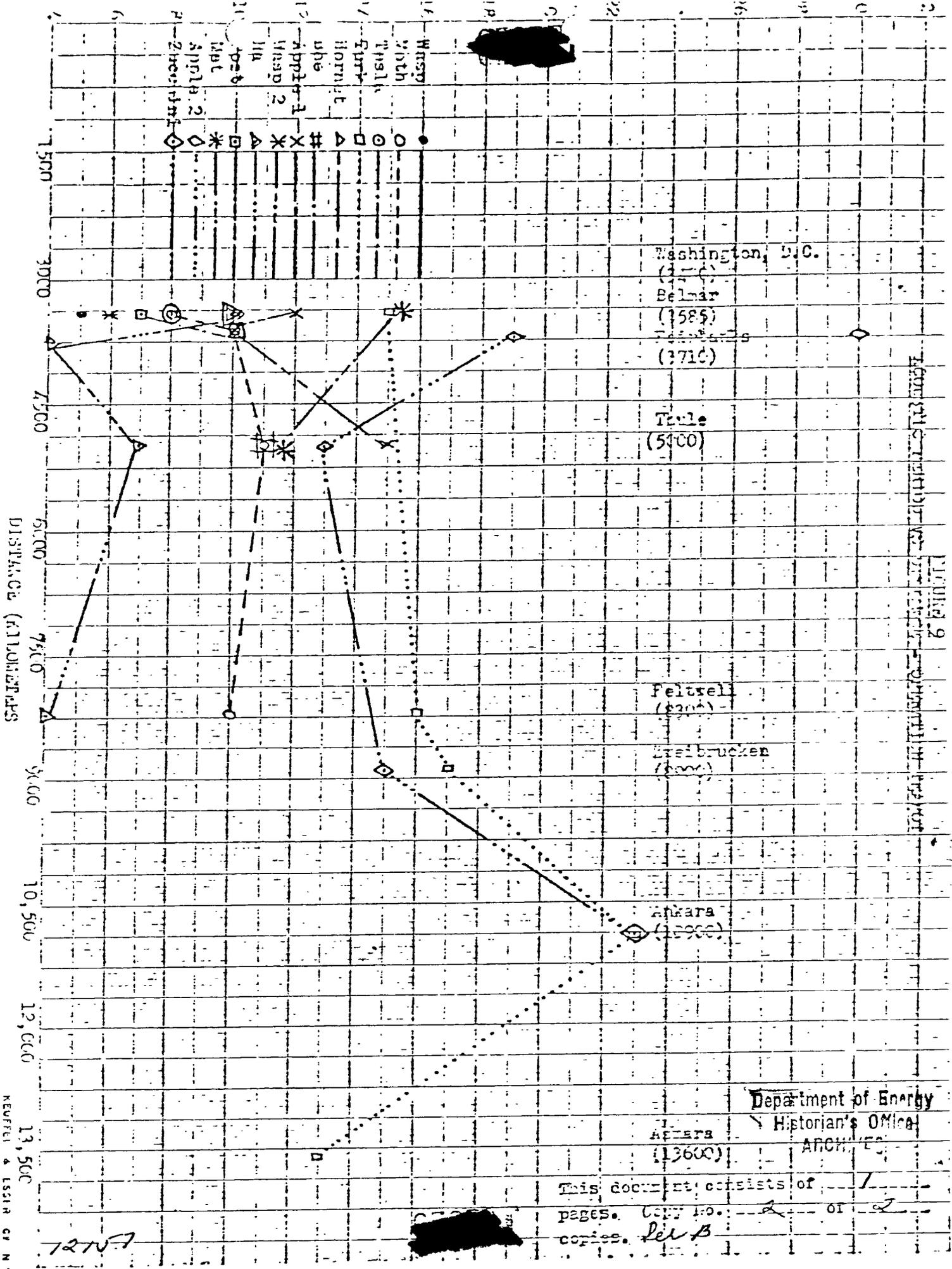


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US DOE ARCHIVE	
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RG	
Collection	Former Comm. - Libby
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Folder	Weapons Test Data - AFOAT-1 (CONFIDENTIAL) Acoustic Yield Estimates for REDWING

Mr. Olmsted-61110/gl

Technical Director

TD-2

13 August 19
1

1. Purpose. This memorandum gives the yield estimates for REDWING shots based upon the acoustic signal period at maximum amplitude selected by TD-2 from reproductions of the actual recordings. These results are believed particularly significant in view of the British challenge of our yield estimate for Joe 19.

2. Acoustic Data. Table 1 lists the acoustic stations detecting each shot, the signal period selected at each station, the average signal period for each shot, the acoustic estimate of yield, the actual reported yield, and the error in the yield estimate expressed both in KT and in relation to the standard error. Figure 1 shows the plotted points for REDWING shots in relation to the period vs. yield curves obtained from previous U.S. shots. It should be noted that the yields reported by JTF-7 and the AEC for REDWING have fluctuated considerably and final values are not yet available on the last few shots.

3. Discussion. The only shot which gave acoustic yield estimates greatly in error was LACROSSE - about +2.1 standard errors. This result may be due to the fact that LACROSSE occurred during spring propagation conditions when upper level winds are variable. All stations detecting the shot were in roughly the same direction from the test site (west and northwest). The only station at reasonable distance to the east of the test site was Oahu where the noise level was too high to permit detection. GREENHOUSE results during similar conditions showed that periods at stations west of the test were different from those to the east. The average of all of the GREENHOUSE data gave reasonably accurate yield estimates, but estimates would have been considerably in error had detection been restricted to one direction. The estimate for FLATHEAD is the only other value outside the one standard error range - about +1.2 standard error.

4. Conclusions.

a. It is concluded that the errors in estimating yields from acoustic periods are less than previously supposed for shots about 500 KT yield. Errors greater than a factor of 2 will be rare. IVY, CASTLE AND REDWING data imply that there is probably less than one chance in twenty that an error greater than a factor of two will occur.

b. One word of caution is necessary, however. All of the shots of high yield have occurred at the Pacific Proving Ground and it is conceivable, though not likely, that shots at a different latitude might not fall as exactly on the

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IOM, Subj: (Conf) Acoustic Yield Estimates for REDWING, Cmt 1, dtd 13 Aug 56

same period vs. yield curve. It is encouraging to note that REDWING shots in the yield range [REDACTED] give acoustic yield estimates which fall reasonably close to the data from shots of equivalent yield fired at Nevada. This implies that the yield vs. period curve is not radically changed when the location of the shot is changed.

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2 Attachments

1. (SRD) Table 1
2. (SRD) Figure 1

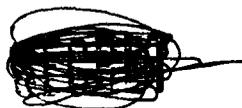


TABLE NO. 1

ESTIMATED YIELDS OF REDWING SHOTS

<u>Shot</u>	<u>Date</u>	<u>Station - Period (Secs)</u>	<u>Average Period (Secs)</u>	<u>Est. Yield</u>	<u>Actual Yield</u>	<u>Error (KT)</u>	<u>Error (%)</u>
1. LACROSSE	4 May	Clark Field - 27 Zweibrucken - 27? Misawa - 22 Kyoto - ?	24	150	39	+111	+2.
2. CHEROKEE	20 May						
3. ZUNI	27 May	Clark Field - 47 Kyoto - 53 Misawa - 72, 51? Thule - 60 TAG DAY - 58 Zweibrucken - 56 Ankara - 40? Asmara - 44 Fairbanks - 75, 35?	53	3,200	3,500	-300	-0.
4. YUMA	27 May						
5. ERIE	30 May						
6. SEMINOLE	6 June						
7. FLATHEAD	11 June						

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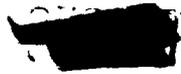
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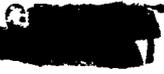
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<u>Shot</u>	<u>Date</u>	<u>Station - Period</u> <u>(Secs)</u>	<u>Average Period</u> <u>(Secs)</u>	<u>Est.</u> <u>Yield</u>	<u>Actual</u> <u>Yield</u>	<u>Error</u> <u>(KT)</u>	<u>(σ)</u>
9. KICKAPOO	13 June						
10. OSAGE	16 June						
11. INCA	21 June	DELETED			DELETED		
12. DAKOTA	25 June						
		DELETED					
13. MOHAWK	2 July		DELETED	DELETED			
		DELETED					
14. APACHE	8 July					DELETED	
		DELETED					
15. NAVAJO	10 July				DELETED		
		DELETED					
16. TEWA	20 July				DELETED		
		DELETED					



<u>Shot</u>	<u>Date</u>	<u>Station - Period</u> (Secs)	<u>Average Period</u> (Secs)	<u>Est.</u> <u>Yield</u>	<u>Actual</u> <u>Yield</u>	<u>Error</u> <u>(KT)</u> (%)
17. HURON	21 July	DELETED	DELETED	DELETED	DELETED	DELETED

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