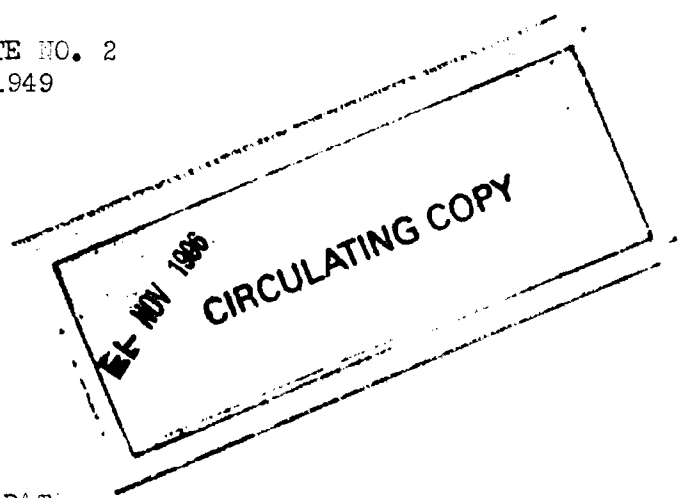




BALLISTIC RESEARCH LABORATORIES

TECHNICAL NOTE NO. 2
8 March 1949



TRAJECTORY DATA
from
MITCHELL THEODOLITE OBSERVATION
of NIKE NO. 30

PROPERTY OF U.S. ARMY
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Aberdeen Proving Ground, Maryland



REPORT DOCUMENTATION PAGE

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15 December 2003

MEMORANDUM FOR Chief, ARL Technical Library, APG

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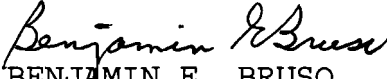
1. Reference: Ballistic Research Laboratory Technical Note No. 2, "Trajectory Data from Mitchell Teodolite Observation of Nike No. 30", dated 8 March 1948, UNCLASSIFIED, enclosed.

2. The Security/CI Office and subject matter experts have reviewed the subject report and have determined that it may be released to the public. Please mark all of your copies of this document with the following distribution statement:

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3. Please contact Douglas Kingsley at 36960 if you have any questions.

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BENJAMIN E. BRUSO
Team Leader
Security/CI Office

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Deimel/mal

TRAJECTORY DATA FROM MITCHELL THEODOLITE
OBSERVATIONS OF NIKE 30

Presented are trajectory data for NIKE 30 launched at White Sands Proving Ground, 12 November 1948, from launcher No. 1. The data were obtained from observations of two Mitchell photo-theodolites at Stations C and E. Station C is about three (3) miles south of the launching site, and Station E is about six (6) miles west. On Station C record, the missile image becomes blurred and dim at about 28 seconds, and it was impractical to determine the missile's position from this film after 31.58 seconds.

Coordinates: Cartesian coordinates (x, y, z) are used, with origin at the launching site; the (x, z) plane is tangent at the launcher to a sphere with surface passing through the site and with center at the earth's center; $x > 0$ north of site; $z > 0$ east of site. Altitudes y_c and y_e are computed from elevation angles of Stations C and E respectively, and y is their average. Altitudes have had approximate corrections applied for earth's curvature.

Velocities in the table are average velocities over one-second intervals.

Trajectory angle θ is the angle between the path of the missile and the vertical.

Accelerations were read graphically from the velocity curve.

Time zero is the time of the Block House signal.

Tabular values of all quantities are unsmoothed. Curves were fitted graphically.

On Station E record, the missile was not visible from 1.58 through 4.08 seconds; from 4.83 through 7.08 seconds; at 24.08 seconds and from 25.08 through 26.08 seconds. Triangulation points in these intervals are based on interpolated values of azimuth angle for Station E.

In the interval 24.08 to 27.08 seconds, the dial readings for site angles of Station C show ~~the~~ reversals of direction, giving rise to possible backlash effects.

Booster separation could not be seen on Station E film, and on Station C film, occurred at approximately 2.6 seconds. Missile burnout was observed on the film at approximately 19.8 seconds.

Distribution - G. M. List, Parts A, C, DA and DG

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[REDACTED]

TRAJECTORY OF NIKE 30

Time Sec.	x Feet	z Feet	y_c Feet	y_e Feet	y Feet	$y_c - y_e$ Feet	V Ft/Sec	θ Deg.
.33	8	- 6	63	54	58	9		
.58	10	- 6	136	132	134	4		
.83	14	- 4	268	259	264	9	595	2.1
1.08	16	- 1	440	432	436	8	803	3.0
1.33	22	10	654	652	653	2	990	3.5
1.58	* 31	30	936	-	-	-	1207	4.1
1.83	* 40	51	1252	-	-	-	1416	4.0
2.08	* 52	77	1640	-	-	-	1574	3.9
2.33	* 67	92	2065	-	-	-	1726	3.5
2.58	* 82	123	2506	-	-	-	1783	3.8
2.83	* 100	138	2975	-	-	-	1812	4.2
3.08	* 121	172	3419	-	-	-	1817	4.0
3.33	* 142	202	3872	-	-	-	1806	4.6
3.58	* 164	220	4319	-	-	-	1805	4.4
3.83	* 187	255	4774	-	-	-	1800	4.3
4.08	* 208	280	5219	-	-	-	1817	4.8
4.33	236	300	5675	5660	5667	15	1805	4.4
4.58	257	337	6134	6105	6120	29	1811	4.8
4.83	* 285	354	6574	-	-	-	1818	5.0
5.08	* 312	391	7023	-	-	-	1829	4.8
5.33	* 340	420	7478	-	-	-	1821	5.1
5.58	* 365	444	7942	-	-	-	1809	4.5
5.83	* 389	478	8388	-	-	-	1796	4.2
6.08	* 414	491	8827	-	-	-	1795	4.4
6.33	* 438	525	9270	-	-	-	1808	4.4
6.58	* 466	539	9732	-	-	-	1816	4.4
6.83	* 491	571	10190	-	-	-		
7.08	* 515	587	10637	-	-	-	1829	4.6
7.58	568	643	11566	11545	11555	21	1826	4.3
8.08	612	685	12478	12438	12458	40	1820	4.0
8.58	658	733	13390	13351	13370	39	1864	4.4
9.08	706	793	14334	14299	14316	35	1881	4.0
9.58	740	837	15264	15229	15246	35	1875	3.5
10.08	775	884	16202	16173	16188	29	1891	3.6
10.58	822	923	17155	17112	17134	43	1904	4.0
11.08	870	980	18106	18068	18087	38	1932	4.2
11.58	927	1018	19083	19037	19060	46	1964	4.0
12.08	981	1061	20057	20035	20046	22	1975	4.4
12.58	1045	1117	21045	21013	21029	32	1978	4.6
13.08	1112	1154	22033	22003	22018	30	1988	4.2
13.58	1169	1195	23009	23015	23012	- 6	2009	4.0
14.08	1242	1214	24037	24006	24022	31	2060	4.7
14.58	1319	1270	25074	25057	25065	17	2080	5.2

*Station E film could not be read.

[REDACTED]

TRAJECTORY OF NIKE 30

Time Sec.	x Feet	z Feet	Yc Feet	Ye Feet	y Feet	Yc-Ye Feet	V Ft/Sec	θ Deg.
15.08	1417	1286	26106	26079	26093	27	2094	5.6
15.58	1516	1324	27166	27132	27149	34	2134	5.8
16.08	1625	1352	28247	28183	28215	64	2157	6.4
16.58	1755	1362	29332	29252	29292	80	2176	7.1
17.08	1892	1388	30415	30334	30374	81	2184	8.0
17.58	2054	1403	31512	31442	31455	70	2219	9.7
18.08	2228	1396	32623	32500	32562	123	2261	9.0
18.58	2406	1396	33735	33641	33688	94	2345	9.4
19.08	2610	1404	34874	34877	34875	- 3	2319	10.8
19.58	2839	1398	36040	35942	35966	98	2335	11.6
20.08	3078	1381	37212	37112	37162	100	2391	12.3
20.58	3343	1353	38362	38244	38303	118	2337	13.2
21.08	3613	1344	39502	39372	39437	130	2258	11.9
21.58	3810	1321	40553	40472	40512	81	2263	15.2
22.08	4206	1302	41663	41577	41620	86	2302	18.3
22.58	4533	1284	42735	42659	42697	76	2250	17.8
23.08	4891	1251	43800	43726	43763	74	2211	18.8
23.58	5242	1214	44820	44760	44790	60	2127	19.5
** 24.08	* 5600	1195	45768	-	-	-	2079	21.8
** 24.58	6010	1158	46702	46740	46721	- 38	2102	23.6
** 25.08	* 6435	1106	47694	-	-	-	2172	23.3
** 25.58	* 6865	1065	48716	-	-	-	2132	24.0
** 26.08	* 7301	1038	49641	-	-	-	2019	26.1
** 26.58	7752	999	50524	50532	50528	- 8	1985	28.0
** 27.08	8231	958	51385	51401	51393	- 16	1901	30.7
27.58	8717	903	52140	52186	52163	- 46	1895	32.1
28.08	9239	854	52960	53035	52997	- 75	1936	32.8
28.58	9762	815	53761	53820	53790	- 59	1930	34.2
29.08	10319	761	54556	54633	54594	- 77	1915	35.6
29.58	10872	705	55319	55374	55346	- 55	1863	37.1
30.08	11436	648	56065	56096	56080	- 31	1846	38.9
30.58	12026	581	56782	56782	56782	0	1785	41.7
31.08	12615	508	57386	57441	57414	- 55	1744	43.1
31.58	13209	452	57991	58121	58056	-130		

* Station E film could not be read.

**Station C dial readings for site reversed direction.

TRAJECTORY DATA OF NIKE 30
 SPACE COORDINATES AND TRAJECTORY
 ANGLE VERSUS TIME

θ
 DEG

40

20

0

X AND Z
 1000'S
 FEET

10

6

6

4

2

0

Y
 1000'S
 FEET

56

40

32

24

16

8

0

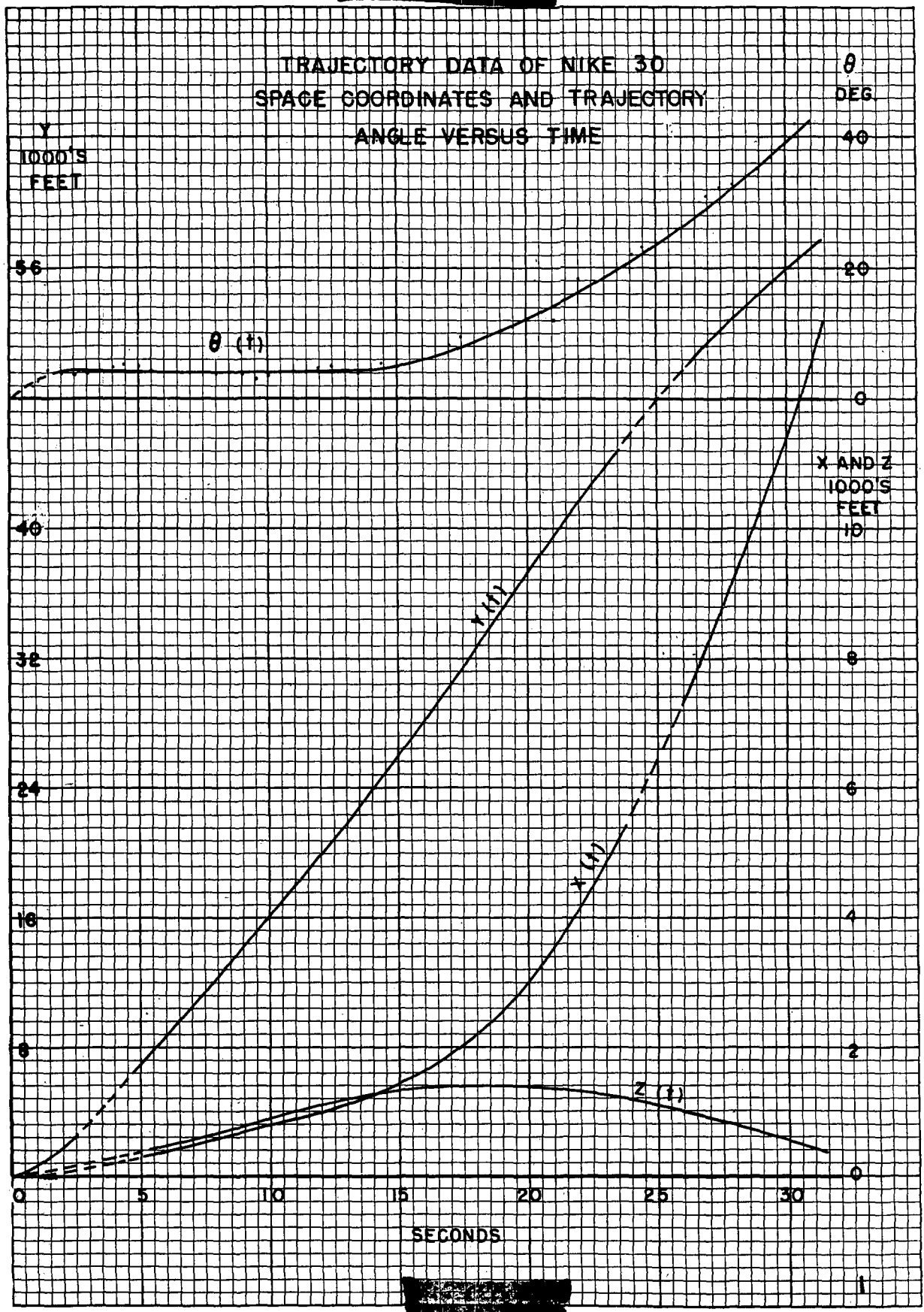
θ (t)

X (t)

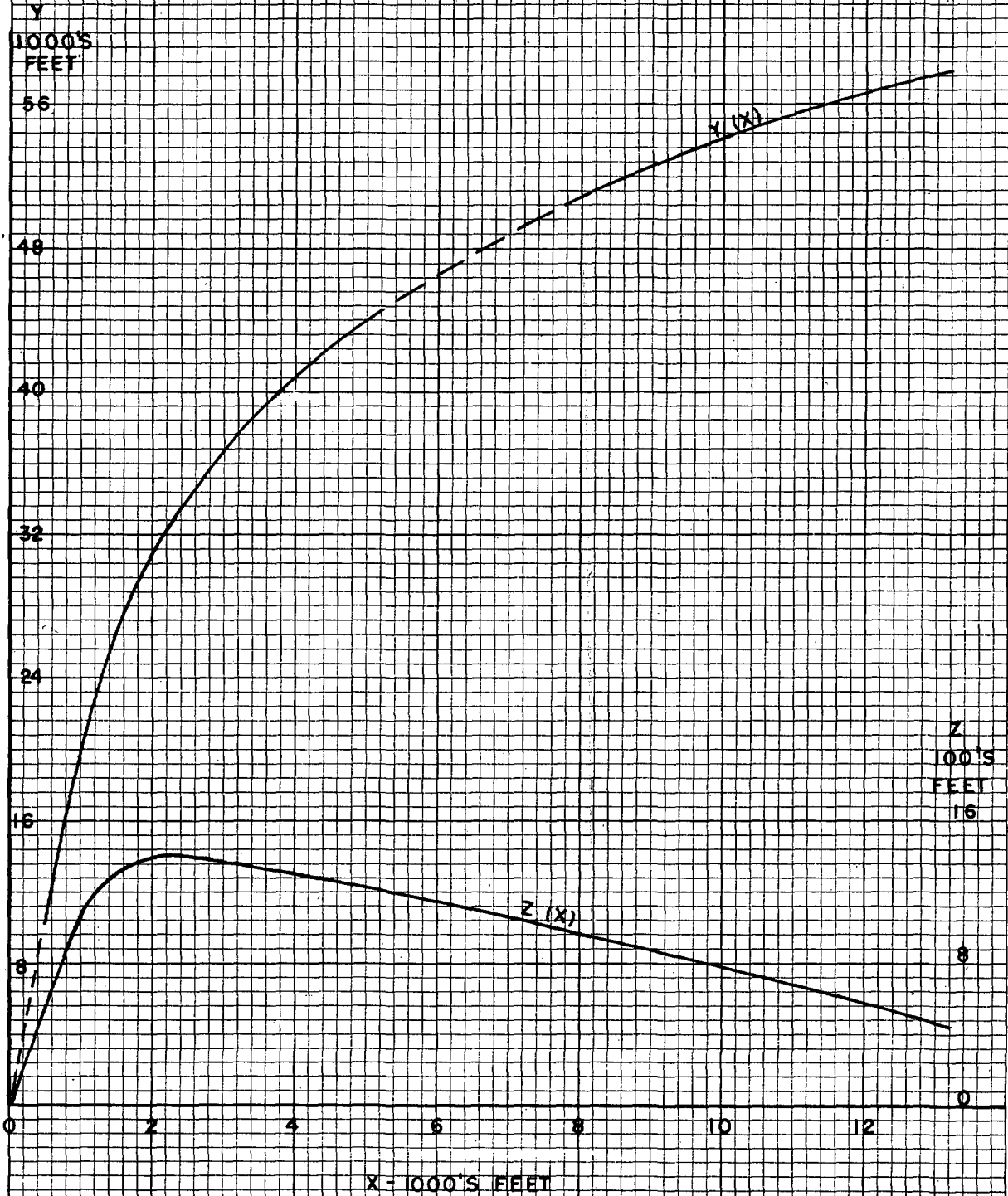
X (t)

Z (t)

SECONDS



TRAJECTORY DATA OF NIKE 30
SPACE COORDINATES



TRAJECTORY DATA OF NIKE 30
VELOCITY AND ACCELERATION CURVES

a
FT./SEC.²

v
100'S
FT./SEC.

800

25

600

20

400

15

200

10

0

5

32

0

28

24

20

16

12

8

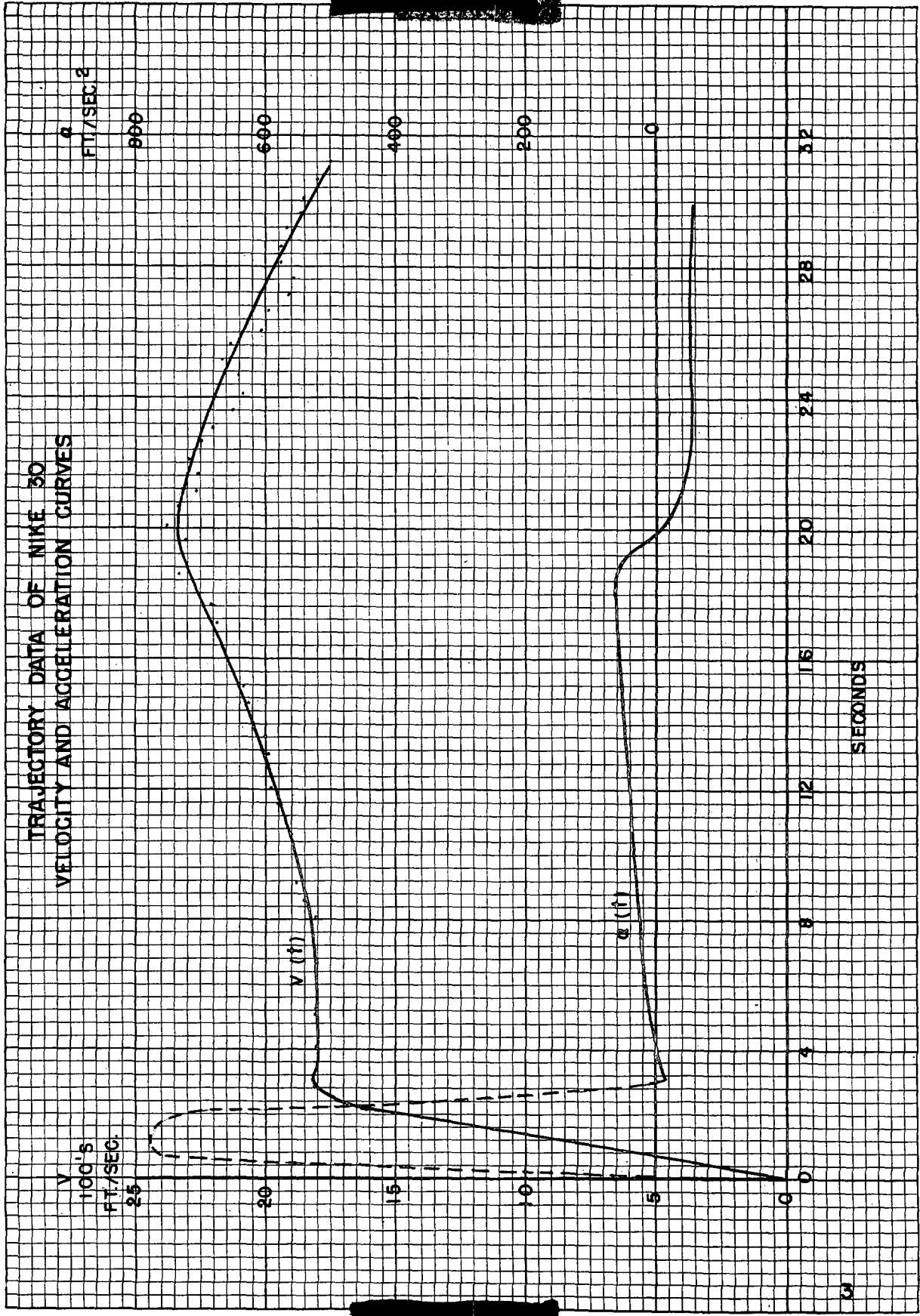
4

SECONDS

01

$v(t)$

$a(t)$



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ABSTRACT:

Flight path data for the Nike 30 guided missile were obtained by means of Mitchell theodolite observations at two stations, one three miles south of the launching site, and the other about six miles west. Cartesian coordinates were used with the origin at the launching site, the (x,z) plane being tangent at the launcher to a sphere with the surface passing through the site and with the center at the earth's center, $x > 0$ north of the site, and $z > 0$ east of the site. The average altitude was computed from elevation angles of the theodolite stations, and was corrected approximately for the earth's curvature. Space coordinates and flight path angles were plotted vs time, and velocity and acceleration curves were plotted.

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(1)

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