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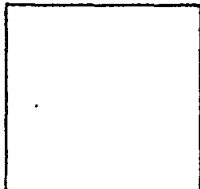
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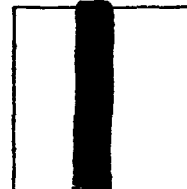
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Report to the Test Director  
  
TECHNICAL PHOTOGRAPHY  
  
Operation Tumbler-Snapper

By  
Herbert E. Grier  
and  
Staff

Classification (Cancelled) (Changed to-  
By Authority of TID 1381 (SOPPL) 3 (Dec 71)  
By *[Signature]* 15 Feb 72

Edgerton, Germeshausen & Grier, Inc.  
Boston, Massachusetts  
April 1954

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15C/M 30 Oct 80

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October 22, 1954

**ERRATUM FOR TUMBLER-SNAPPER  
PROJECT 12.1 REPORT (WT-569)**

Owing to an error made in transcribing information furnished by Test Organization, J-Division, Los Alamos Scientific Laboratory, the Errata (September 30, 1954) for the above report contained an incorrect statement. The last correction listed should read as follows:

Pages 143-144, Appendix E:

Change unit in column heading of last column to read  
"meters/msec" instead of "meters/ $\mu$ sec."

**U. S. Atomic Energy Commission  
Technical Information Service, Oak Ridge, Tennessee**



September 30, 1954

ERRATA FOR TUMBLER-SNAPPER PROJECT 12.1 REPORT (WT-569)

Information received after this report had been printed and bound indicates that the following corrections should be made:

- ✓ Page 6, Illustrations:
  - Delete "Fig. 3.21 Rapatronic Collimator."
  - Change "Fig. 3.22" to "Fig. 3.21."
  - Change "Fig. 3.23" to "Fig. 3.22."
- ✓ Page 38, Section 3.5.2:
  - Change first and second lines in first paragraph to read: "field using the collimator"; delete first part of second line, "pictured in Fig. 3.21. This collimator was." (The revision will then read, "Focal lengths of the Rapatronic cameras were measured in the field using the collimator braced on a stand," etc.)
- ✓ Page 43, Fig. 3.21:
  - Delete entire figure.
- ✓ Page 44, Fig. 3.22:
  - Change to "Fig. 3.21."
- ✓ Page 45, Fig. 3.23:
  - Change to "Fig. 3.22."
- ✓ Page 46, last line in Section 3.6:
  - Change "Figs. 3.22 and 3.23" to read "Figs. 3.21 and 3.22."
- Pages 143-144, Appendix E:
  - Change unit in column heading of last column to read "meters/sec" instead of "meters/ $\mu$ sec."

U. S. Atomic Energy Commission  
Technical Information Service, Oak Ridge, Tennessee

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WT-569

This document consists of 155 pages  
No. 21 of 70 copies, Series A

**Report to the Test Director**

**TECHNICAL PHOTOGRAPHY**

**Operation Tumbler-Snapper**

By  
Herbert E. Grier  
and  
Staff

Classification (Cancelled) (Changed to **UNCLASSIFIED**)  
By Authority *ILD 1381 (SUPPL) 31 Dec 71*  
By *Phil Young 15 Feb 72*

Edgerton, Germeshausen & Grier, Inc.  
Boston, Massachusetts  
April 1954

Classification (Cancelled)  
By Authority *Ed. Rev. DATA/DOX*  
By *R. M. Pest ca. 15C/M* *30 Oct 80*

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## ABSTRACT

For Operation Tumbler-Snapper, the technical photography accomplished by Edgerton, Germeshausen & Grier, Inc. (EG&G), Program 12.1, was as follows:

- (1) Airdrops
  - (a) Position of burst
  - (b) Fireball pictures for yield
  - (c) Ultrashort-exposure-time photography (still)—Rapatronic
  - (d) Pictures for blast studies
    - Mortar-Jato
    - Gun puff
    - Rocket trail
    - Dust, preshock turbulence, light absorption, and mirage
  - (e) Early cloud formation
  - (f) Bomb light as a function of time
  - (g) Cloud tracking (only for the shots detonated in Yucca basin)
  - (h) Consultation on operation of EG&G Disc camera in the bombing airplane
- (2) Tower Shots
  - (a) Fireball pictures for yield
  - (b) Ultrashort-exposure-time photography (still)—Rapatronic and Teletronic (shots 6, 7, and 8)
  - (c) Gun puff (shots 5 and 8)
  - (d) Early cloud formation
  - (e) Bomb light as a function of time

The reader is referred to the Camera Data Sheets, Appendix A, for a condensed listing of the photography which was performed. Complete data are presented in the Film Data Sheets which, because of their bulk, have been issued separately from this report.\* These Film Data Sheets list all data pertinent to cameras, lenses, films, processing, magnifications, and time scales, as well as comments on the content of the record.

Projection prints of the films were made and distributed to those requesting them, usually within a week after the detonation. In addition, a sound film illustrating and describing typical photographic data obtained during the airdrops has been issued. Appendix B is a summary of the films included in this film.

---

\* Tumbler-Snapper, Film Data Sheets, Vols. I, II, and III, EG&G-OUT 1013, 30 October 1952.

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## CHAPTER 1

### INTRODUCTION

Photography was accomplished from four types of stations. The cloud tracking was done from two manned stations located some 25 miles from zero. The dust, preshock-turbulence, light-absorption, and mirage studies were primarily obtained from a series of stations located 200 ft off the blast line and opposite even-numbered blast poles. These stations were concrete cubicles into which a camera rack containing two cameras was inserted from the top. This access hole was sealed with a lead block. One side of the station was provided with a lead-glass window through which the pictures were taken. The cameras in these so-called "dust" stations were only about 3 ft above ground level. In an effort to provide continuing coverage after the dust caused by thermal radiation and shock arrival had obscured the field of view of these cameras, it was decided to operate a few cameras from elevated structures. The three outermost dust stations had steel pipes mounted in their roofs on the top of which a camera was operated (approximately 14 ft above the ground). In addition, use was made of two of the 25-ft towers which had been originally built by the Department of Defense (DOD) for Operation Buster-Jangle. The remaining photography was accomplished from phototrucks and phototrailers, package units that were prewired in Boston and positioned on concrete pads in areas that had been stabilized. These stations were from 2 to 3 miles from Ground Zero.

The details of location and operation of the above types of stations are given in Appendix C.

The reader is referred to the Edgerton, Germeshausen & Grier, Inc. (EG&G), Operations Greenhouse<sup>1</sup> and Buster-Jangle<sup>2</sup> photographic reports for details on cameras, films, exposure calculations, processing and analysis methods, and general operational philosophies.

#### REFERENCES

1. Ball-of-fire Observations, Greenhouse Report, Annex 1.4, WT-101.
2. Technical Photography, Buster-Jangle Project 10.3 Report, WT-417, December 1952.



## CHAPTER 2

### FILM HANDLING

#### 2.1 PRESHOT PREPARATION

All unexposed films were stored at the Control Point (CP) building. For films that were to be used on an actual test, the following procedure was carried out. Starting on the afternoon of D-2 day, the films were removed from the storage refrigerators and allowed to come to thermal equilibrium before the seals were broken. Before loading into cameras, the following steps were taken:

1. An identification number was perforated into the film. This number consisted of five digits. The first two numbers indicated whether the film was to be used for calibration, dry runs, or actual tests; the 13000 series indicated the live runs for Operation Tumbler-Snapper. Since less than 100 films were exposed per shot, the third number was used to designate the particular test. (TS 1 to 5 were the 130-- to 134-- series, the misfire, TS-6, was the 135-- series, and TS 6 to 8 were the 136-- to 138-- series.) The last two numbers indicated in an approximate manner the use for which the film was being exposed. Owing to program changes this can never be adhered to very strictly, although it was found that an attempt at such a system was very useful to those dealing intimately with the handling and programming of the films.

2. Two exposures were placed upon the head of the film. One was a gray scale to be used for sensitometric control and evaluation; the second was an accurate graticule to be used for checking relative film shrinkage during analysis of the records. The position of these exposures on the film had to be such that the region in question would not be light-struck during the camera loading and such that it would not interfere with the record.

3. The films were placed in the appropriate magazines, cassettes, cans, etc., and were carefully marked as to station and camera destination. The actual camera loading was done on the afternoon of D-1 day.

#### 2.2 PROCESSING

All 16- and 35-mm black and white films, as well as sheet films (scope cameras) and glass plates (Rapatronics, phototheodolites, and survey cameras), were processed by EG&G personnel in the mobile unit set up in the CP area (Fig. 2.1). The 9½-in. by 75-ft records from the K-17 cameras were processed by the Inyokern NOTS, and the 16- and 35-mm color films (Eastman Color Negative emulsion) were processed by Consolidated Film Industries—the 35-mm films at their Hollywood, Calif., laboratory and the 16-mm films at their Fort Lee, N. J., laboratory. The order of processing was such as to make the records for position of burst and for yield determination ready as soon as possible; the other records followed in a logical order dictated by consideration of necessary development temperature and the film size.

In running film through the processing machine, it is necessary to group the records according to the contrast or gamma desired. Consequently, each make-up spool for the processing machine contained only records on the same emulsion exposed through the same type color filter and for which the same gamma was desired. In addition to the sensitometric strip

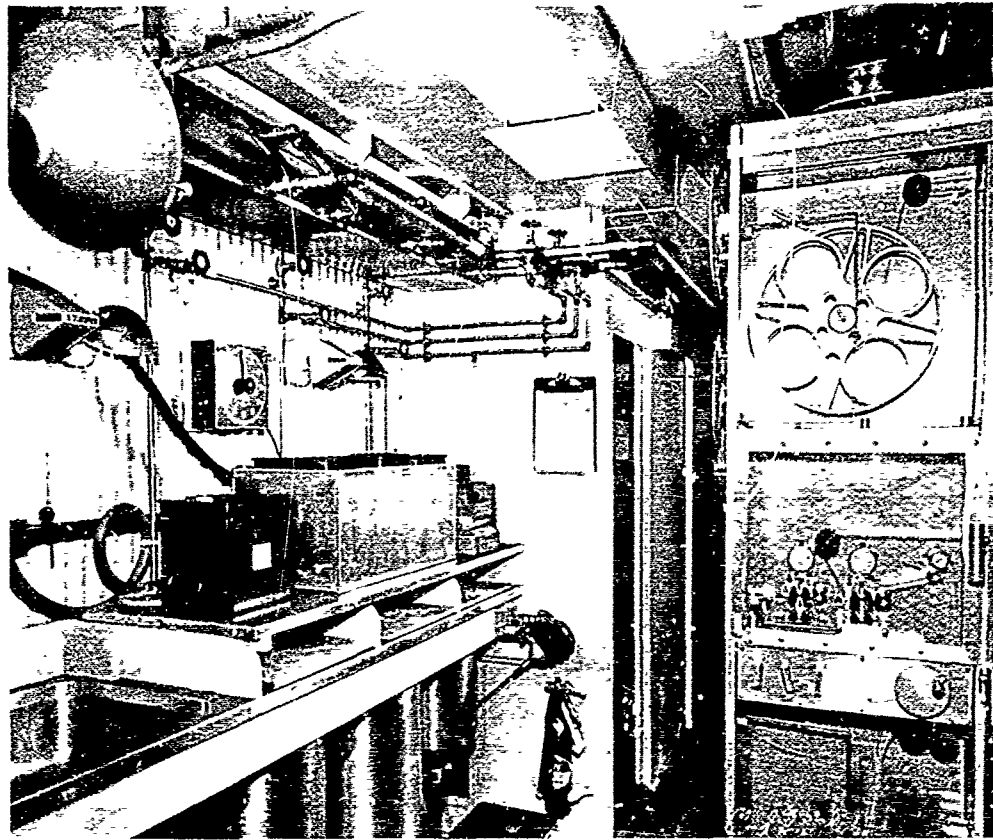


Fig. 2.1—Interior of EG&G phototrailer.

(gray scale) placed on the films themselves, additional gray scales were spliced into the head and tail of the make-up spool. These scales were read immediately after processing to provide constant check upon the acceptability of the development. Development Data Sheets were prepared in advance of the shot to be used as programming guides and to facilitate data recording. A typical data sheet of this type is shown in Fig. 2.2.

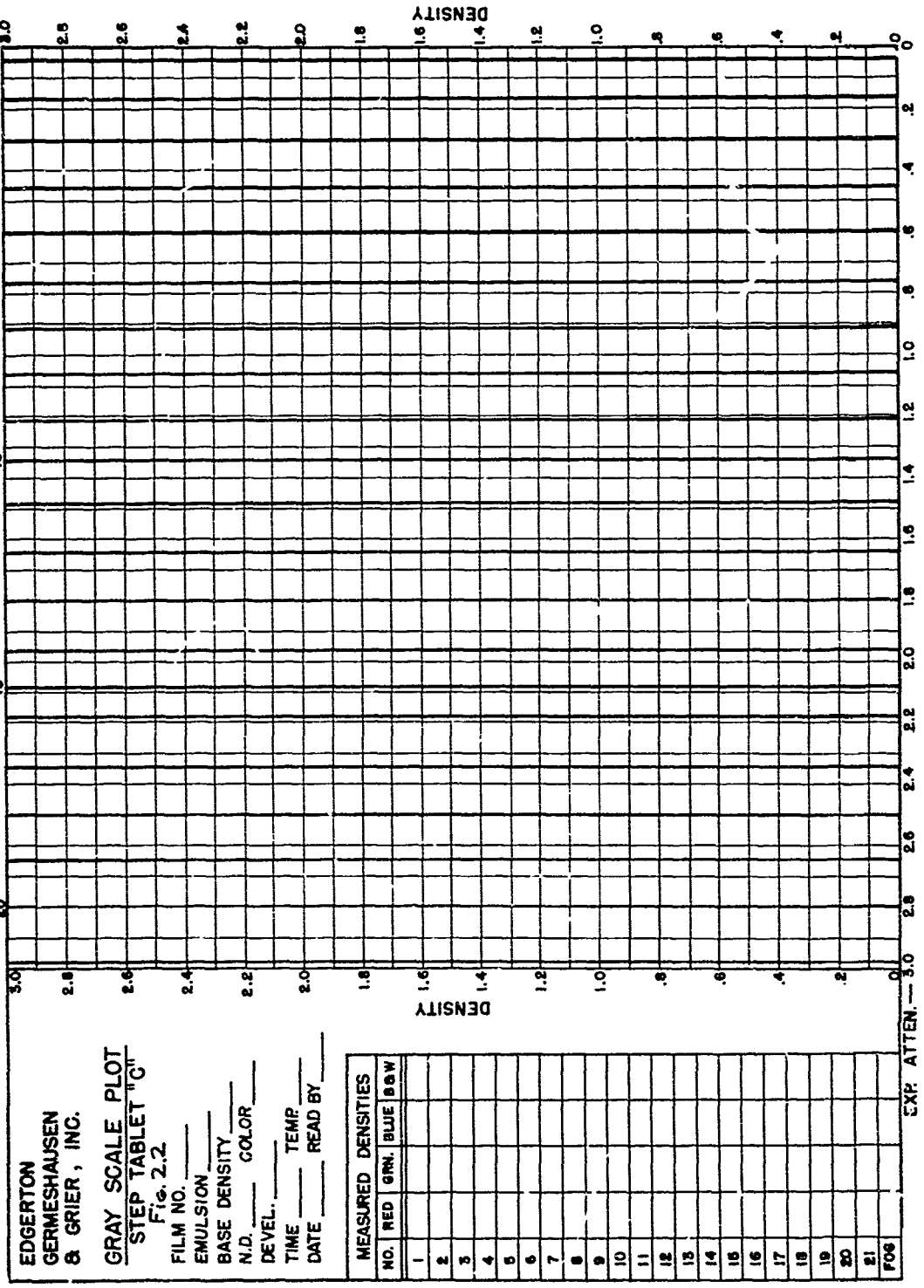


Fig. 2.2—Typical Development Data Sheet.

## CHAPTER 3

# FIREBALL GROWTH MEASUREMENTS FOR YIELD

### 3.1 METHODS OF SCALING

As in previous operations, EG&G used high-speed Eastman cameras and Rapatronic still cameras to determine yield. The methods of fireball scaling have been discussed at some length in reports for Operations Ranger,<sup>1</sup> Greenhouse,<sup>2</sup> and Buster-Jangle.<sup>3</sup>

It has been determined that, for bombs greater than about a 7-KT yield, the shock front expands at such a rate that, at a time prior to minimum, the variation of diameter with respect to time may be expressed as follows:

$$D = \phi t^{2/5}$$

where D = diameter of fireball

$\phi$  = a constant for all times at which the exponent of t equals 0.4

t = time in milliseconds

This may also be written

$$\phi = Dt^{-2/5}$$

The parameter  $\phi$  assumes a constant value prior to the minimum on bombs of yield  $\geq 7$  KT. This allows the use of the scaling laws to determine yield.

It has been found more expedient to plot

$$\log \phi = \log t + K'$$

which is a more sensitive determination of the departures from the theoretical relation of  $D = Kt^{2/5}$ . The plots of  $\log \phi$  vs  $\log t$  as applied to Tumbler-Snapper are shown in Figs. 3.1, 3.3, 3.5, 3.7, 3.9, 3.11, 3.13, and 3.15.

Thus, when the parameter  $\phi$  assumes a constant value prior to minimum, it verifies the  $t^{2/5}$  law and enables scaling of the bomb to determine the yield.

Method 1 of the Sandstone analysis, previously described,<sup>2</sup> compares the yield of a known bomb with that of an unknown bomb.

$$\frac{W_1}{W_2} = \left(\frac{D_1}{D_2}\right)^5 \left(\frac{t_2}{t_1}\right)^2$$

where W = yield  
 D = diameter of fireball  
 t = time at which the diameter is D

Combining these we obtain

$$\frac{W_1}{W_2} = \left(\frac{\phi_1}{\phi_2}\right)^5$$

Accounting for differences in ambient air density,

$$\frac{W_1}{W_2} = \frac{\rho_1}{\rho_2} \left(\frac{\phi_1}{\phi_2}\right)^5$$

By arithmetic averaging of the  $\phi$ 's obtained from Eastman records, a scaling equation may be written

$$W = K\rho\phi^5$$

From previous known bombs the value of K is found to be  $1.294 \times 10^{-8}$ .  
 Therefore, to obtain yield:

$$W = 1.294 \times 10^{-8} \rho \phi^5$$

where W = total energy release  
 $\rho$  = air density of burst  
 $\phi^5$  = (average value of diameter)<sup>5</sup> (meters) divided by (time)<sup>2</sup> (milliseconds) for all times of 0.4 slope

The above method was applied directly to TS 3 to 8. The resulting plots of  $\phi$ 's vs time and diameters vs time may be found in Figs. 3.1 to 3.18.

The first two bombs, TS 1 and 2, were of such low order as to forbid the use of the normal scaling laws. It was therefore necessary to compare the diameters obtained for these tests with those of Ranger A, also a low-order bomb (see Fig. 3.19).

The situation was hampered on TS-1 by the failure of the timing markers to operate. In this case, only Rapatronic camera records were used for measurement, since their absolute times were known. Comparison was then made of diameters obtained from these records and diameters determined from the Ranger A burst, giving a yield ratio

$$\frac{\text{Yield TS-1}}{\text{Yield Ranger A}} = 1.01$$

The same ratio determination was made for TS-2, using both Eastman and Rapatronic films for measurement. This method thus satisfactorily determines yield for small bombs, although reliability of the answer is only  $\pm 10$  per cent.

### 3.2 LOCATION OF CAMERAS

The phototrucks and phototrailers were prewired in Boston and positioned on concrete pads approximately 2 miles from Ground Zero. These areas were stabilized to reduce the interference rendered by dust. On all shots at least two photostations were operated, roughly 90° apart, affording two distinct views for observation of the fireball growth.

Maps showing these various layouts of camera stations are presented in Appendix C

(Text continues on page 35.)

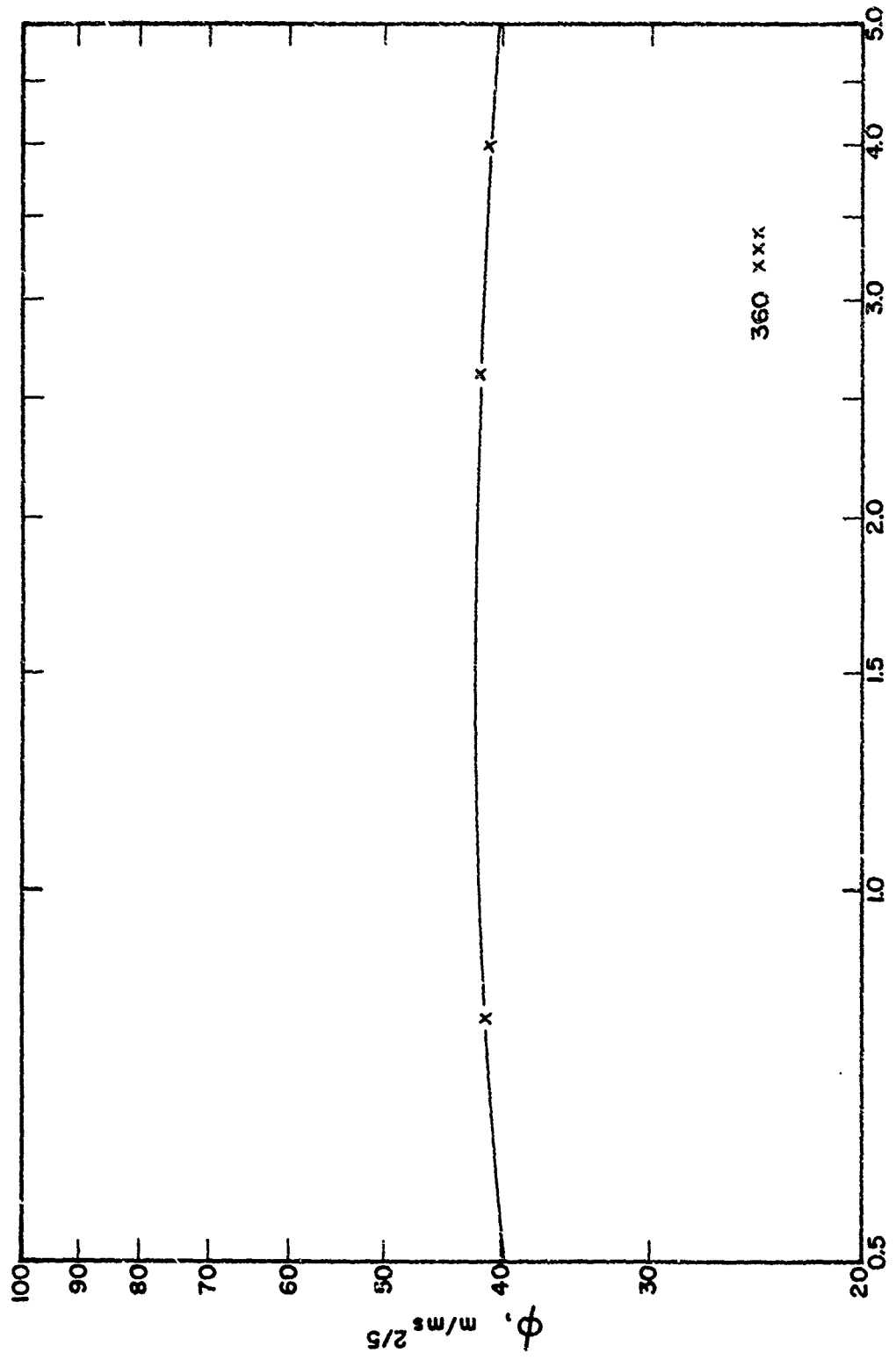


Fig. 3.1 --- TS-1  $\phi$  vs time.

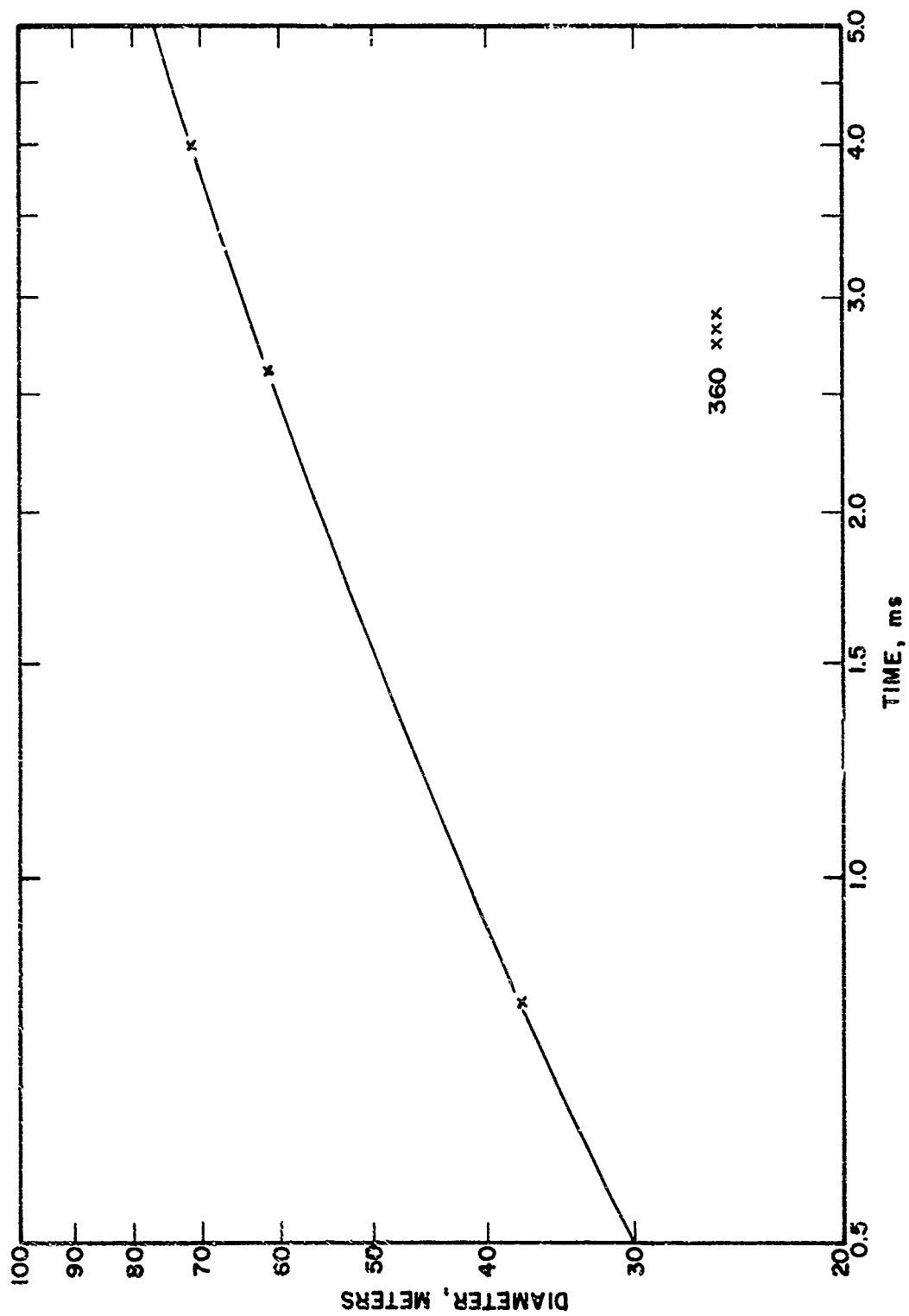


Fig. 3.2---TS-1 diameter vs time.

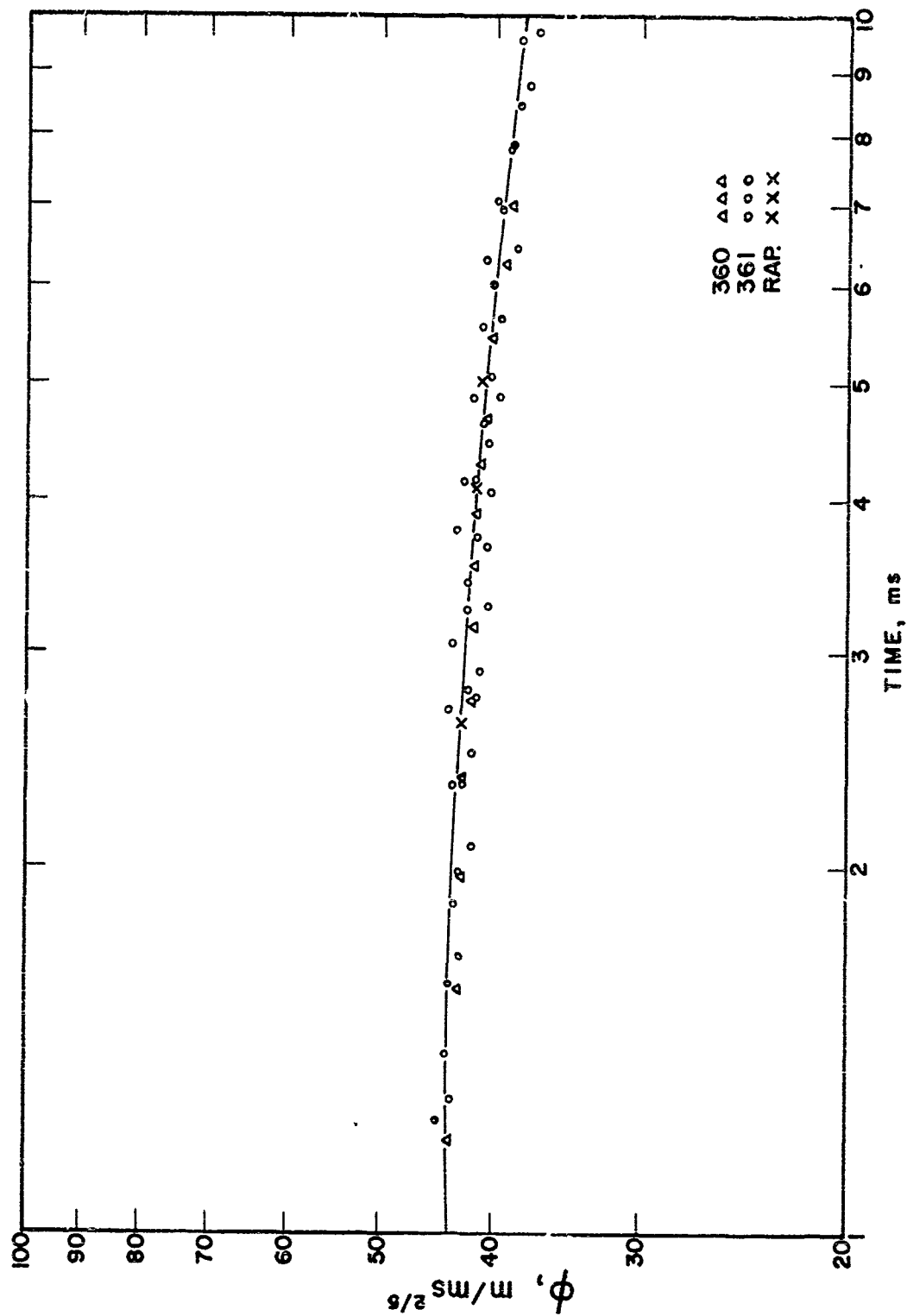


Fig. 3.3 --- IS-2  $\phi$  vs time.



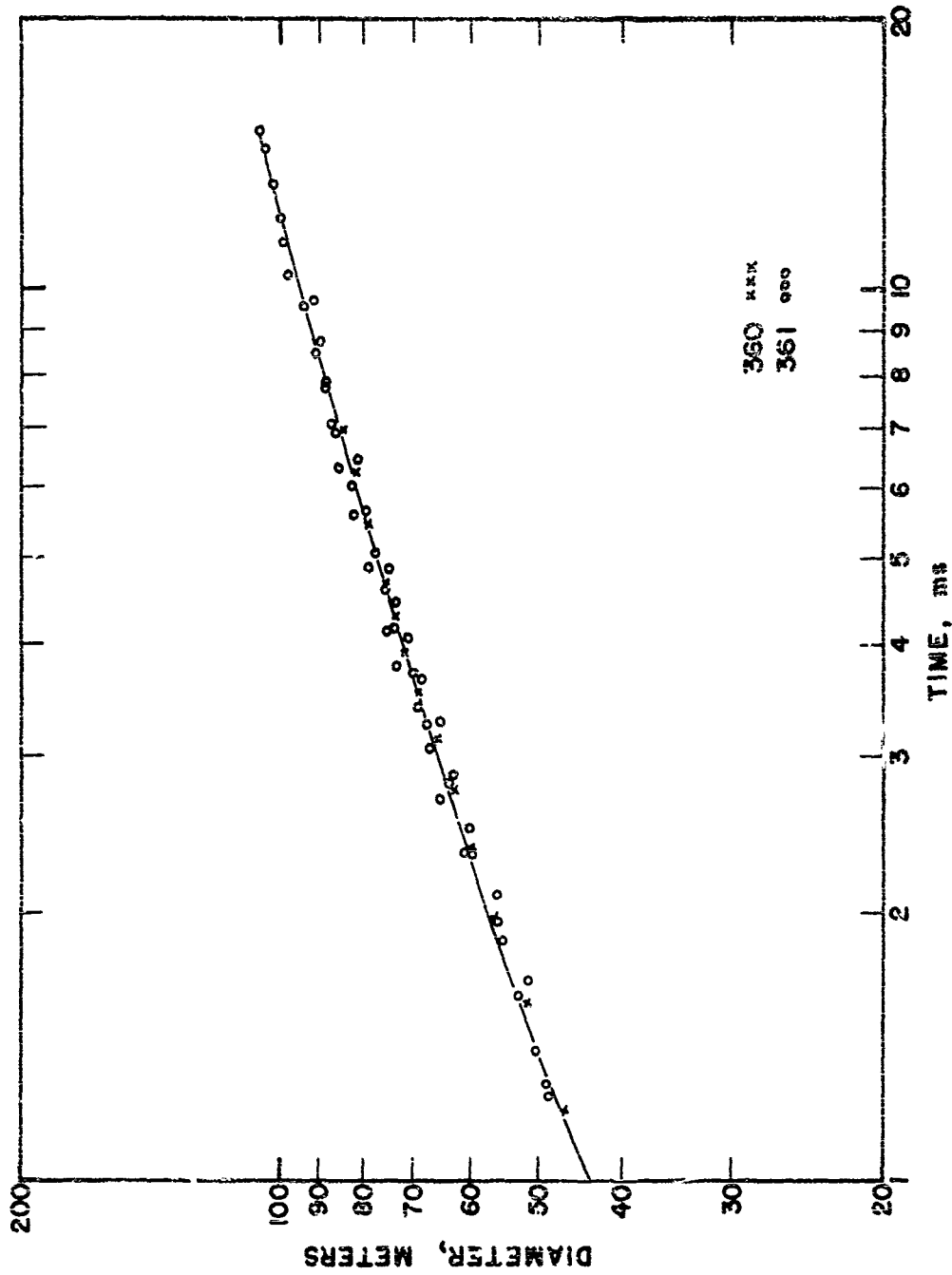


Fig. 3.4—TS-2 diameter vs time.

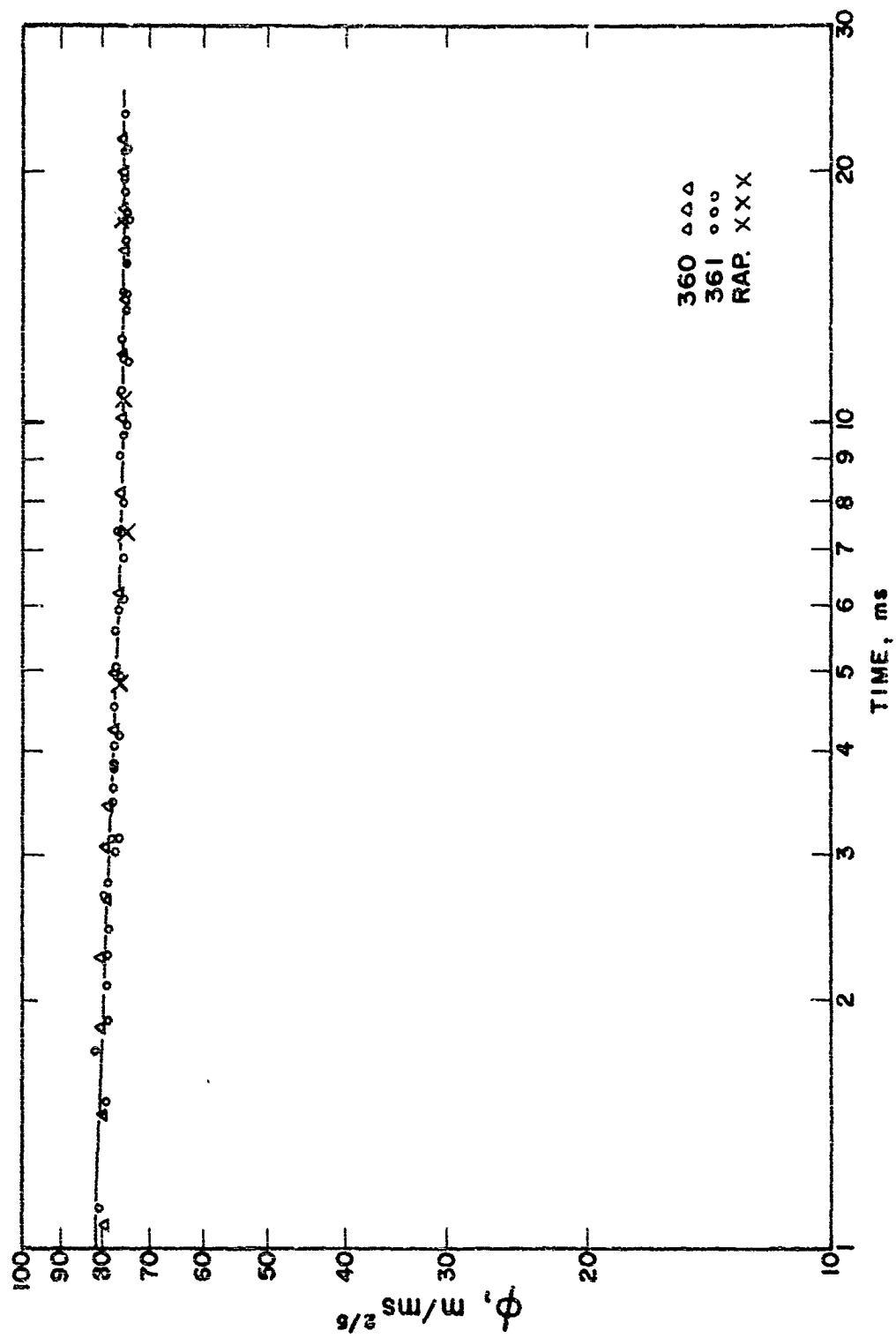


Fig. 3.5 — TS-3  $\phi$  vs time.

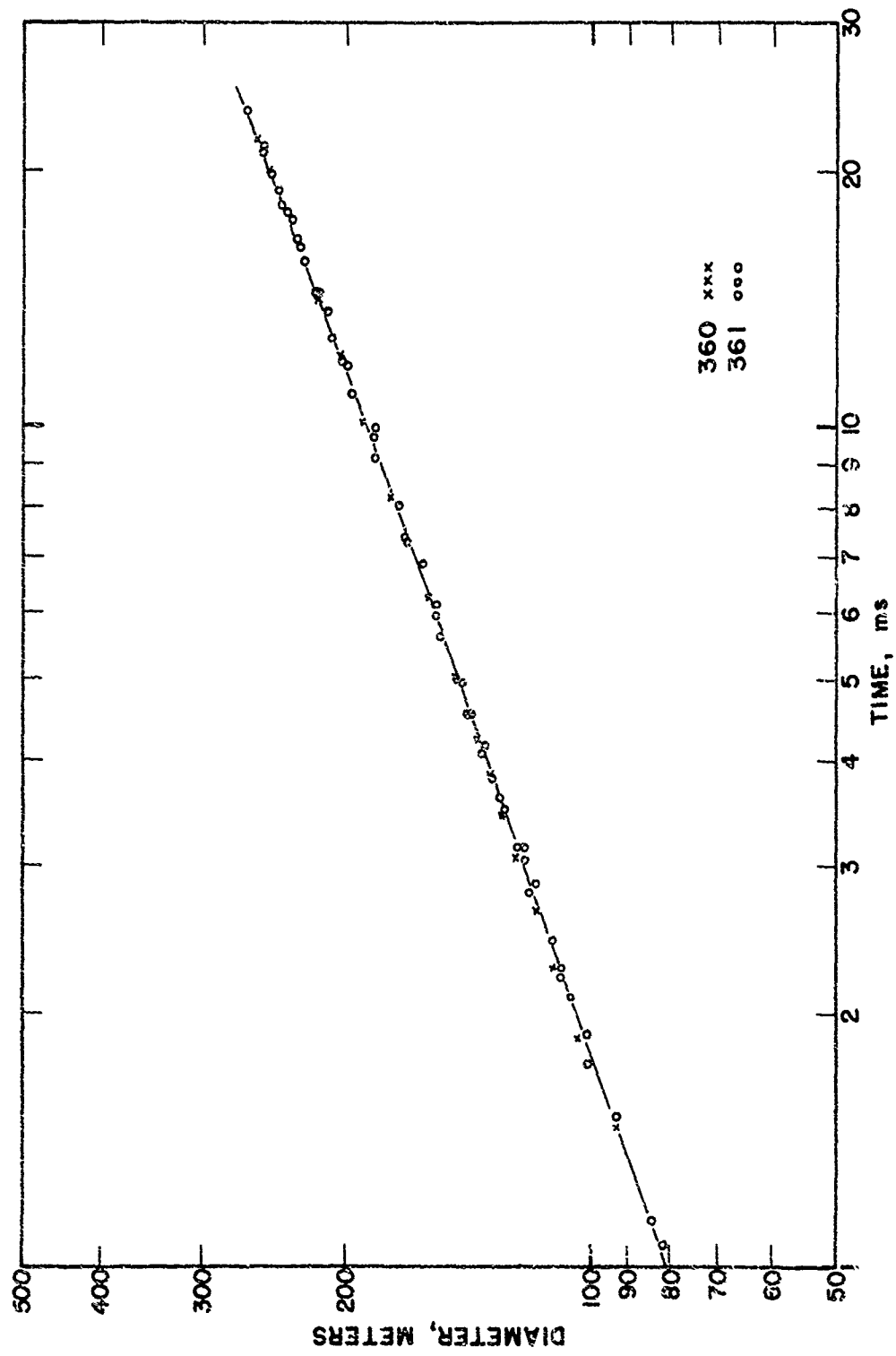


Fig. 3.6—TS-3 diameter vs time.

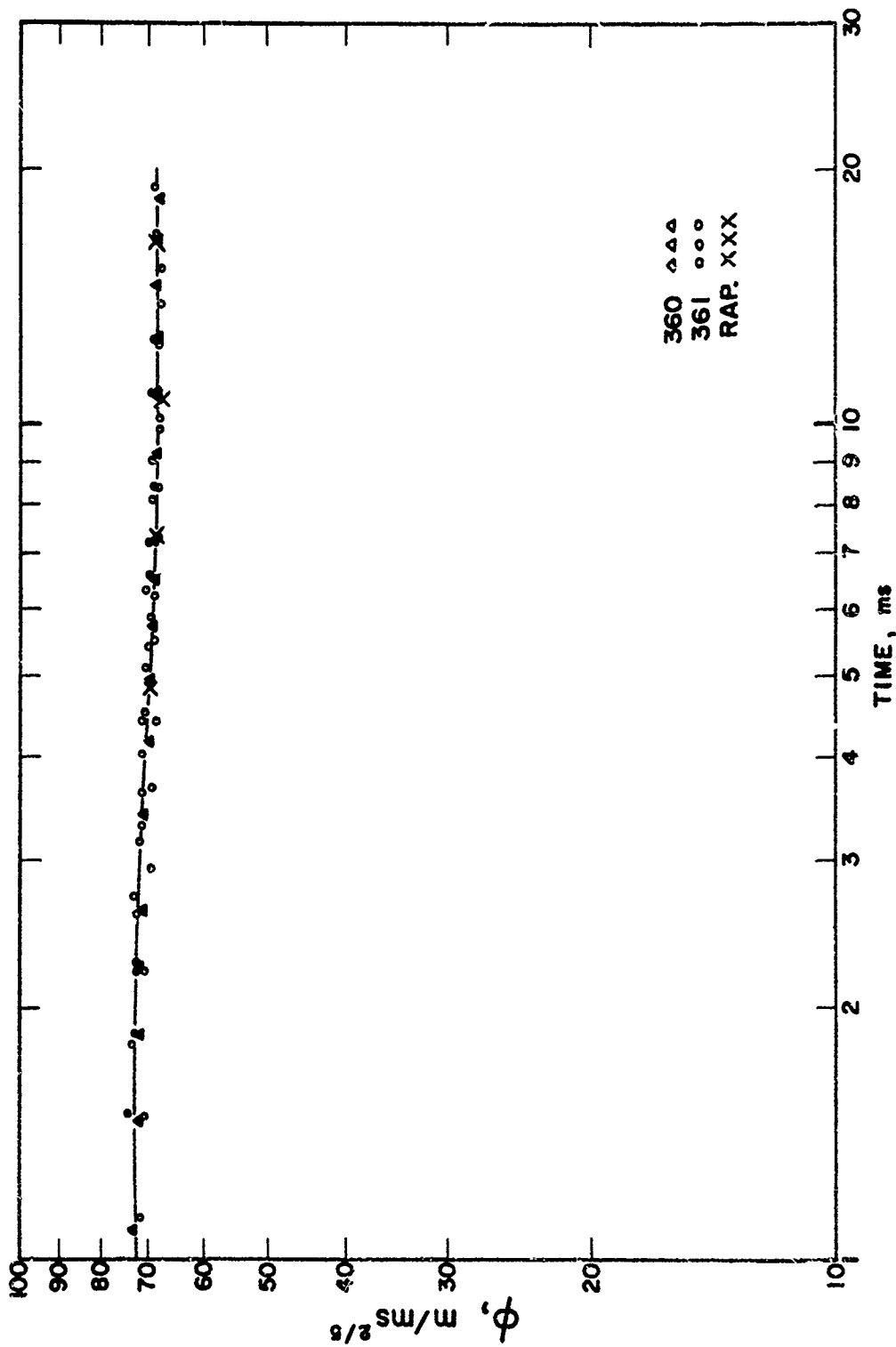


Fig. 3.7---TS-4  $\phi$  vs time.

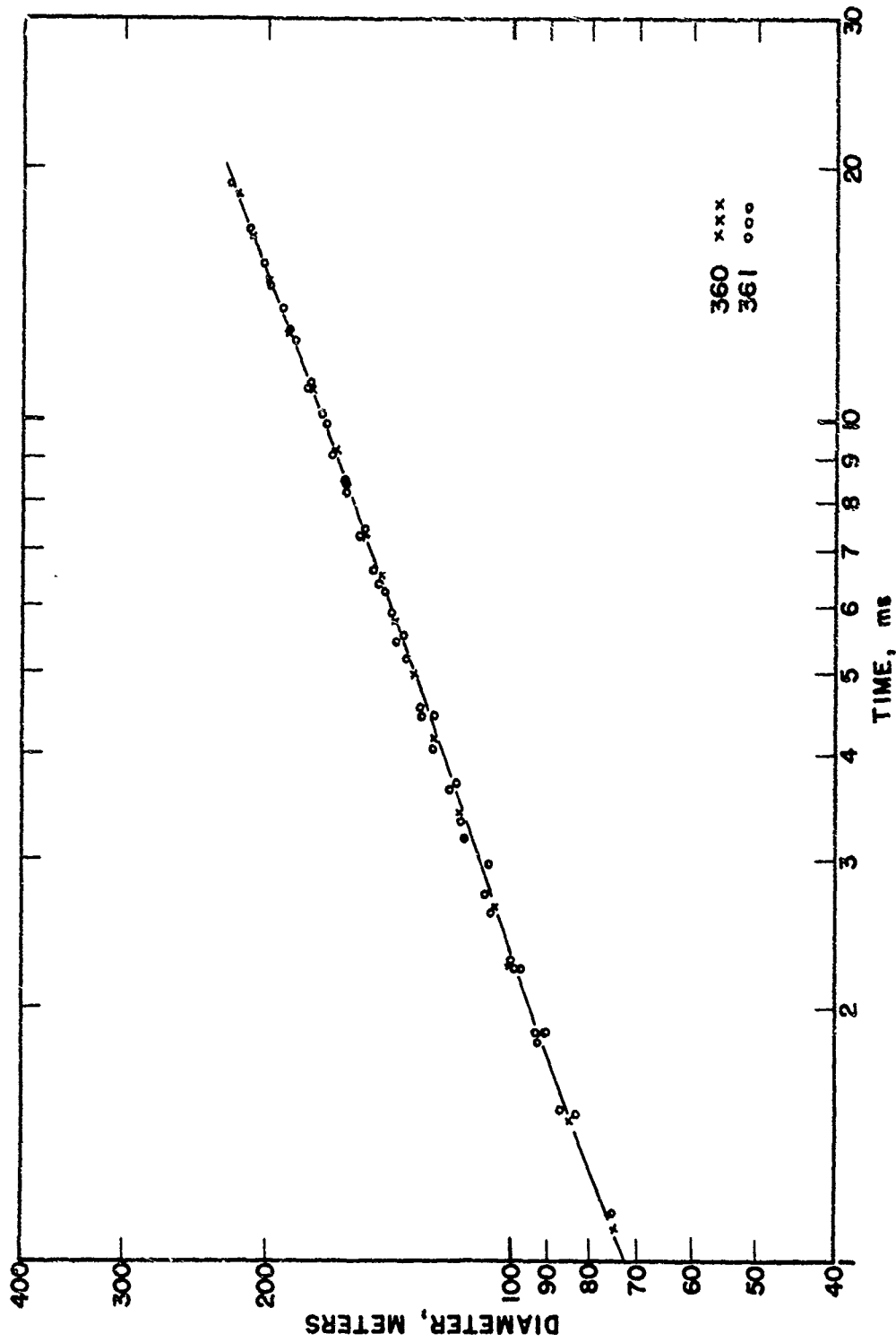


Fig. 3.8—TS-4 diameter vs time.

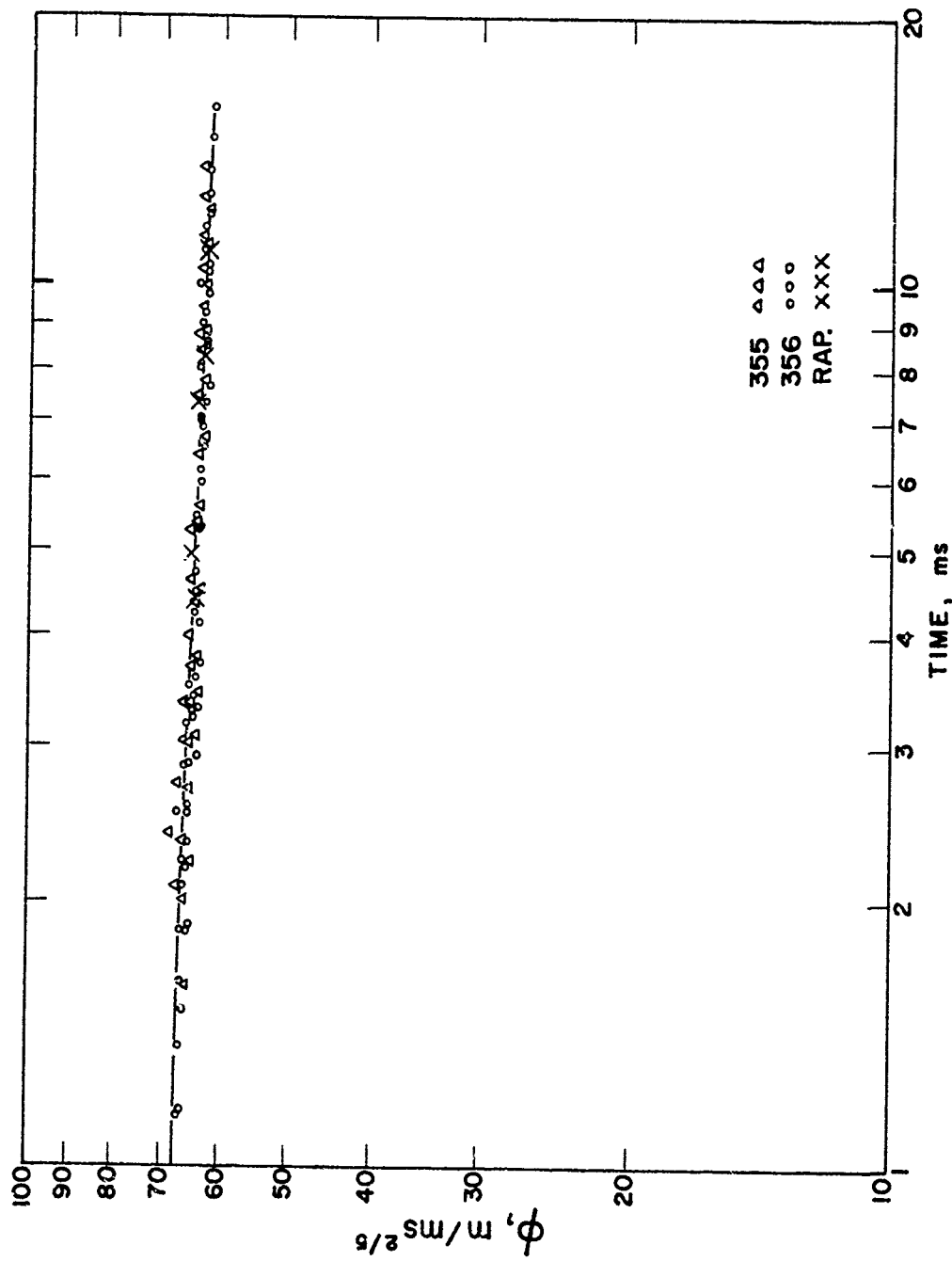


Fig. 3.9—TS-5  $\phi$  vs time.

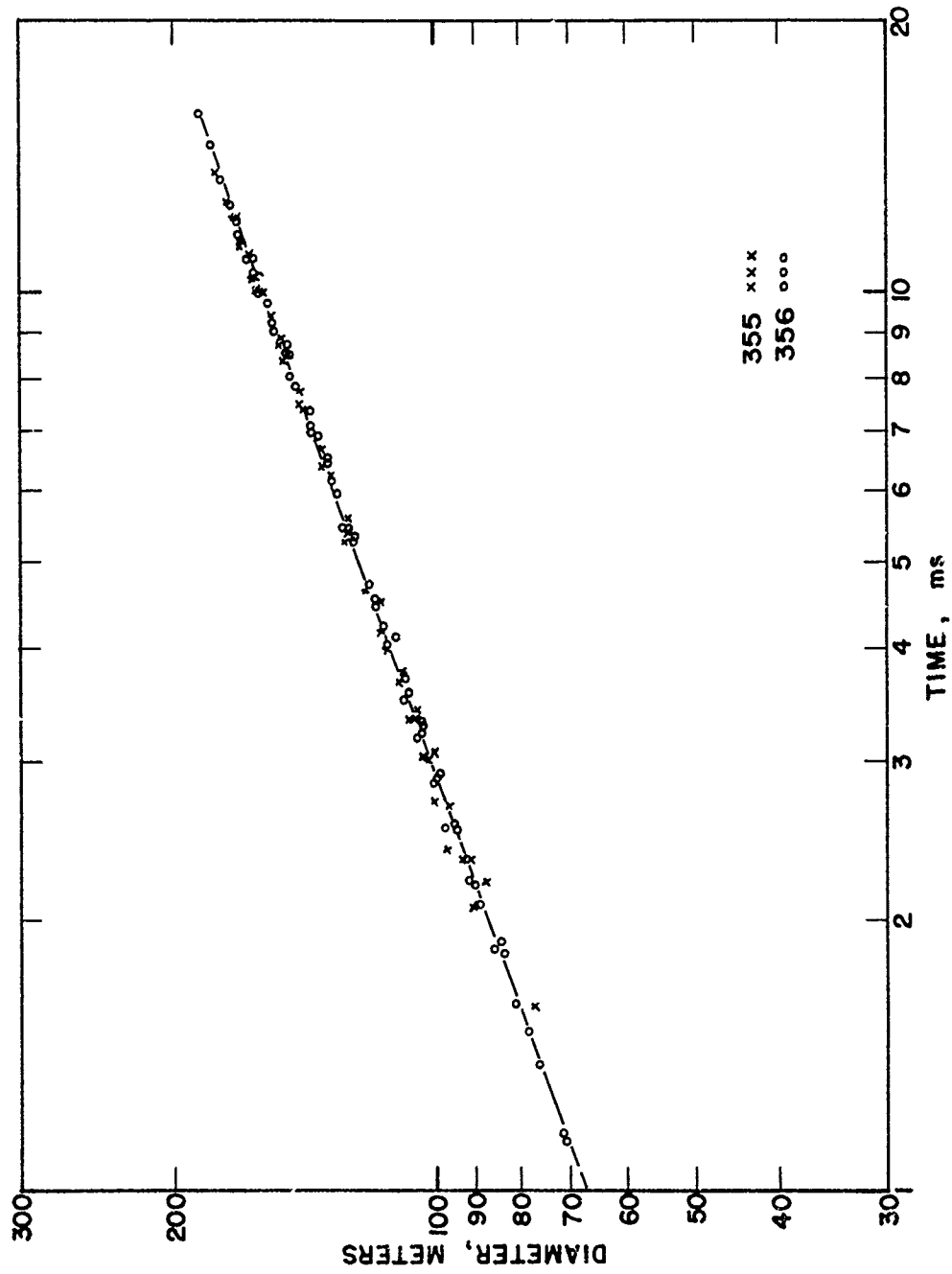


Fig. 3.10—TS-5 diameter vs time.

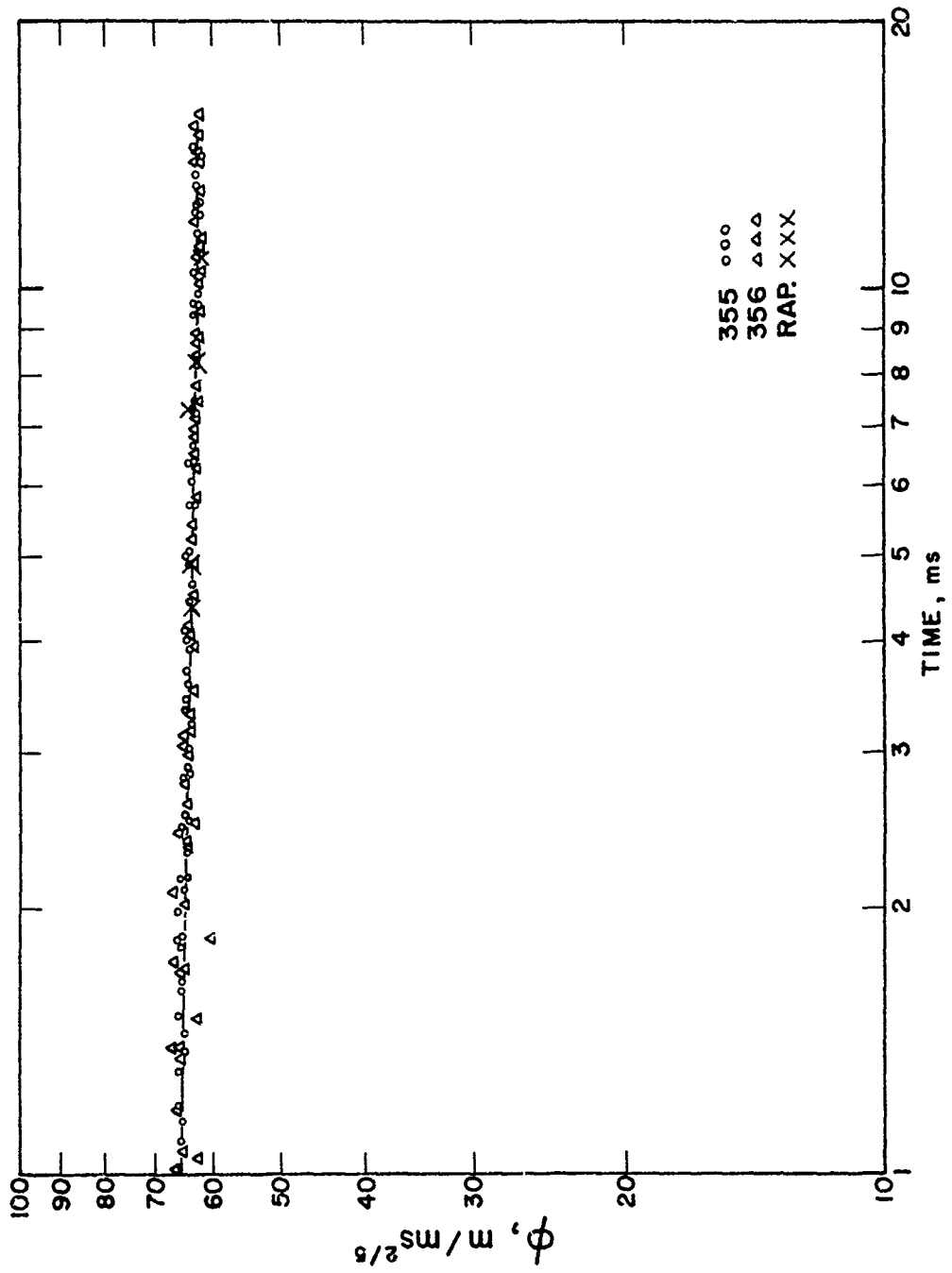


Fig. 3.11—TS-6 φ vs time.



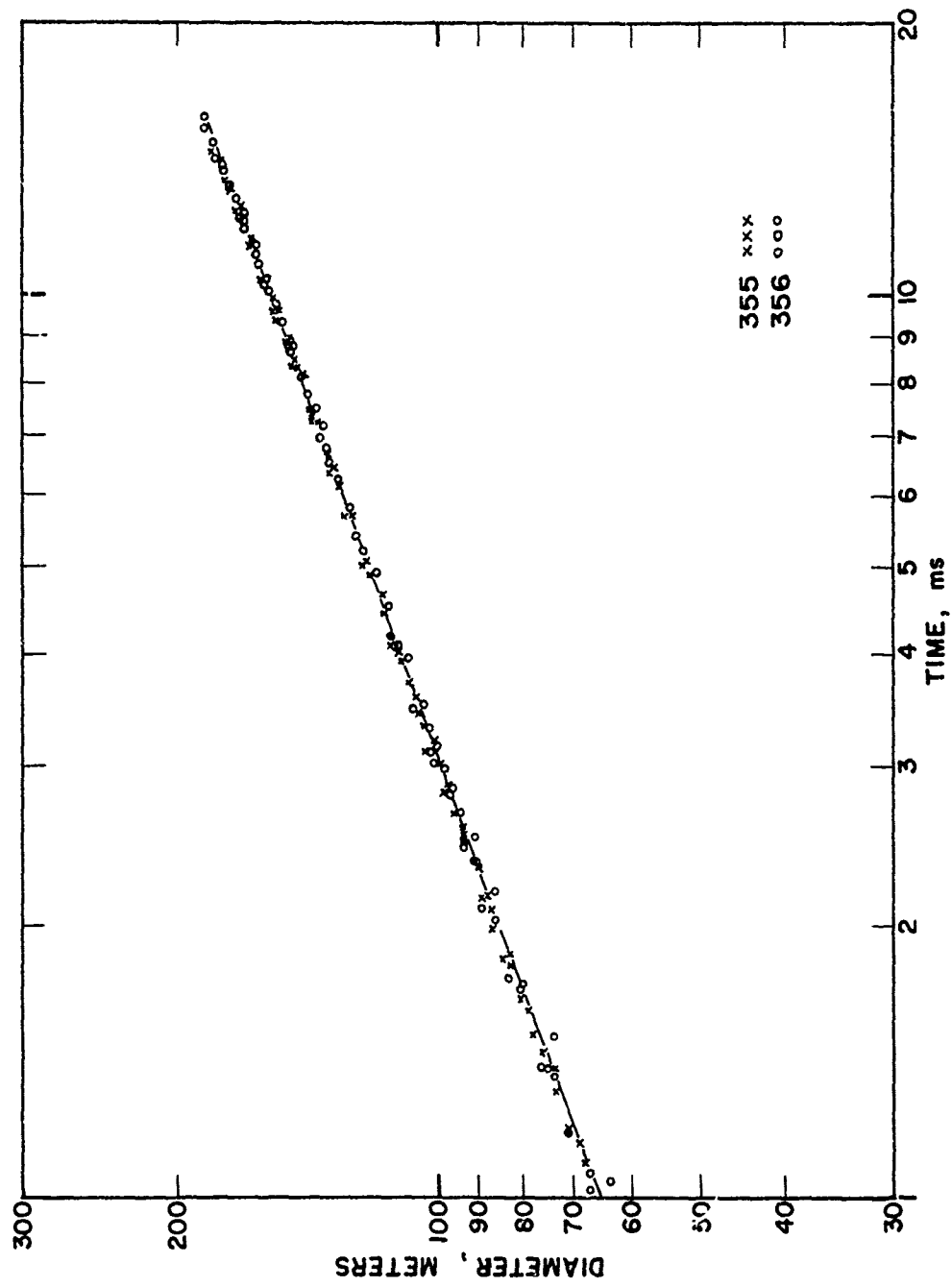


Fig. 3.12—TS-6 diameter vs time.

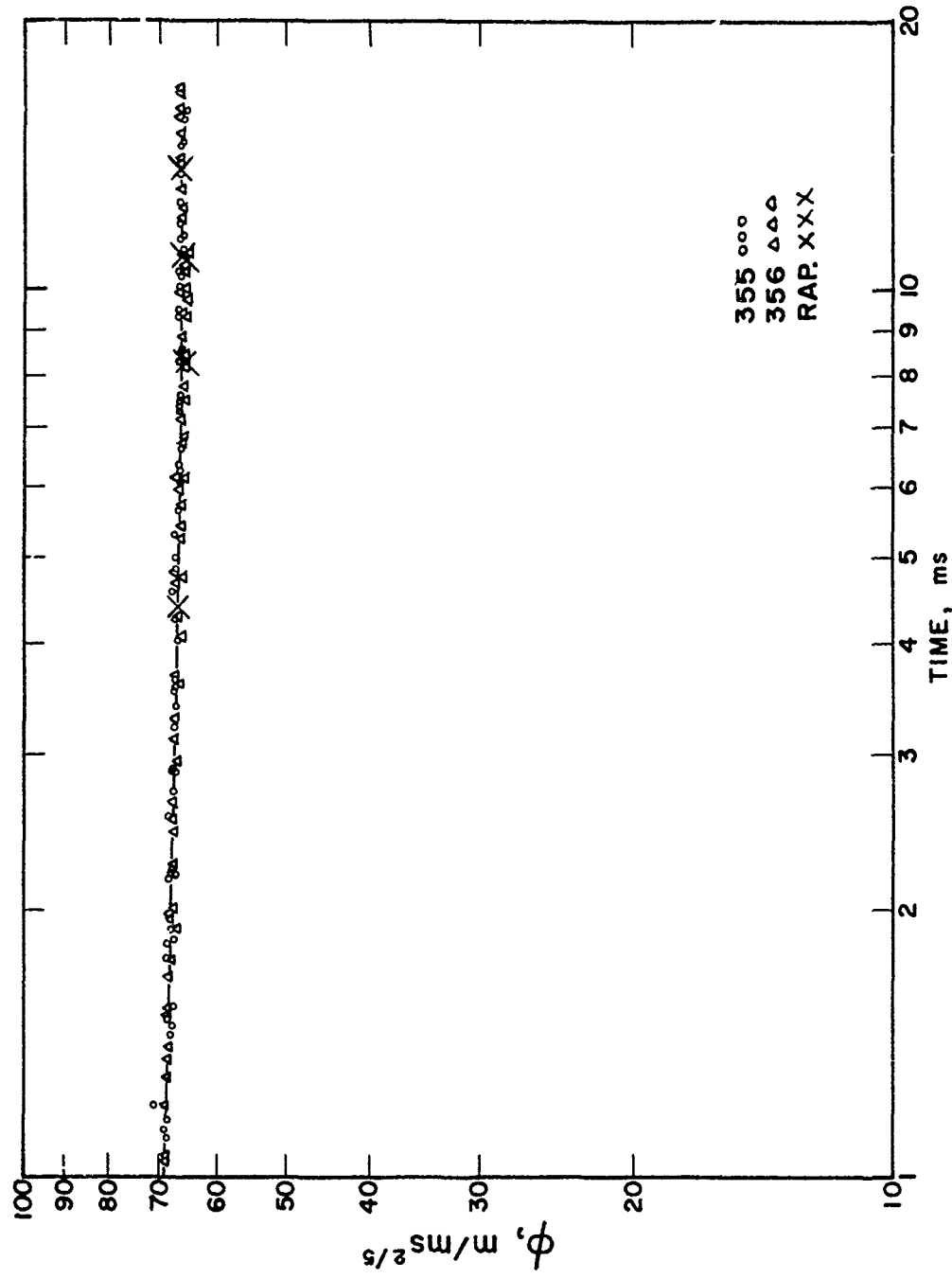


Fig. 3.13—TS-7  $\phi$  vs time.

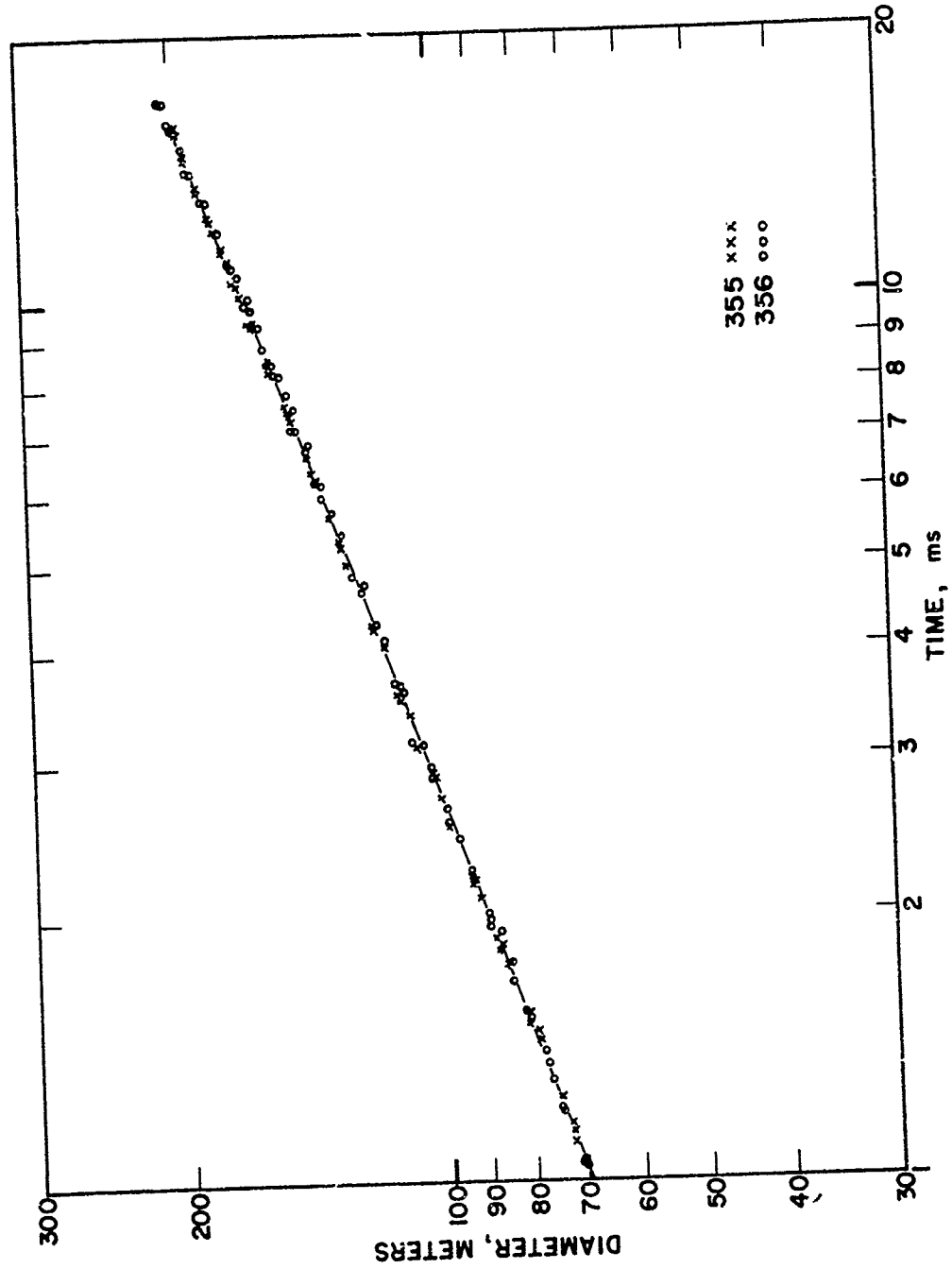


Fig. 3.14—TS-7 diameter vs time.

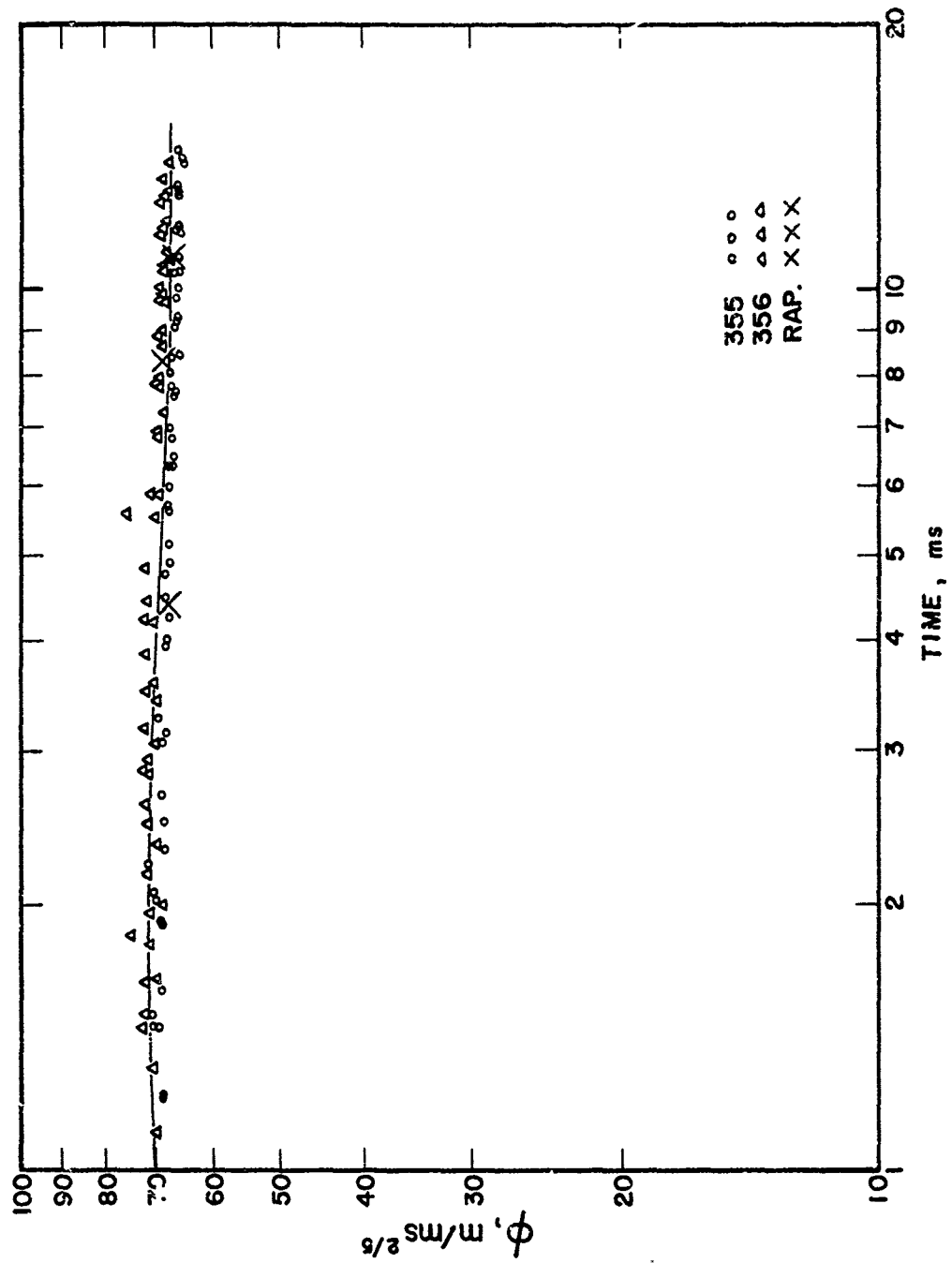


Fig. 3.15—TS-8  $\phi$  vs time.

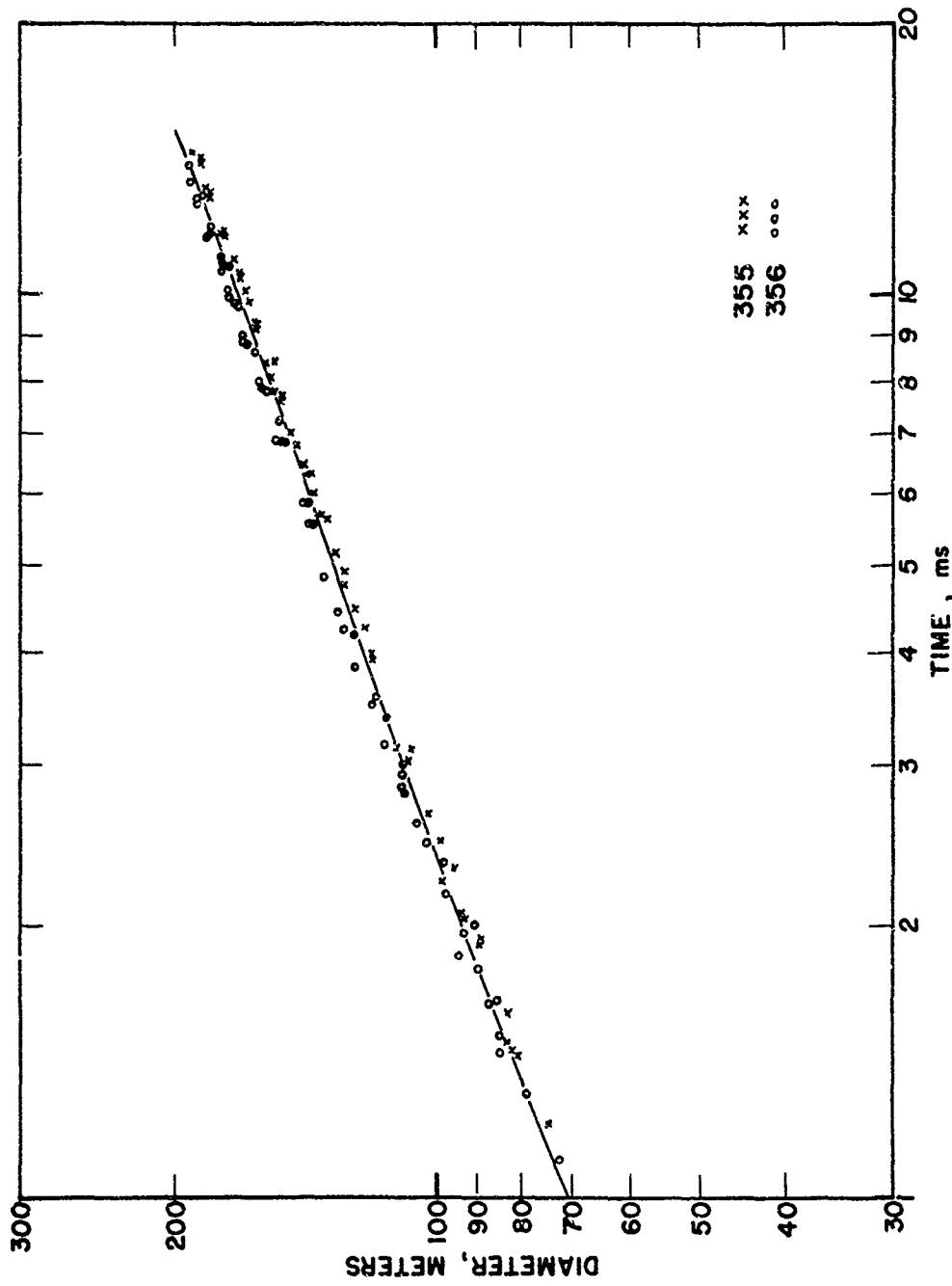


Fig. 3.16—TS-8 diameter vs time.

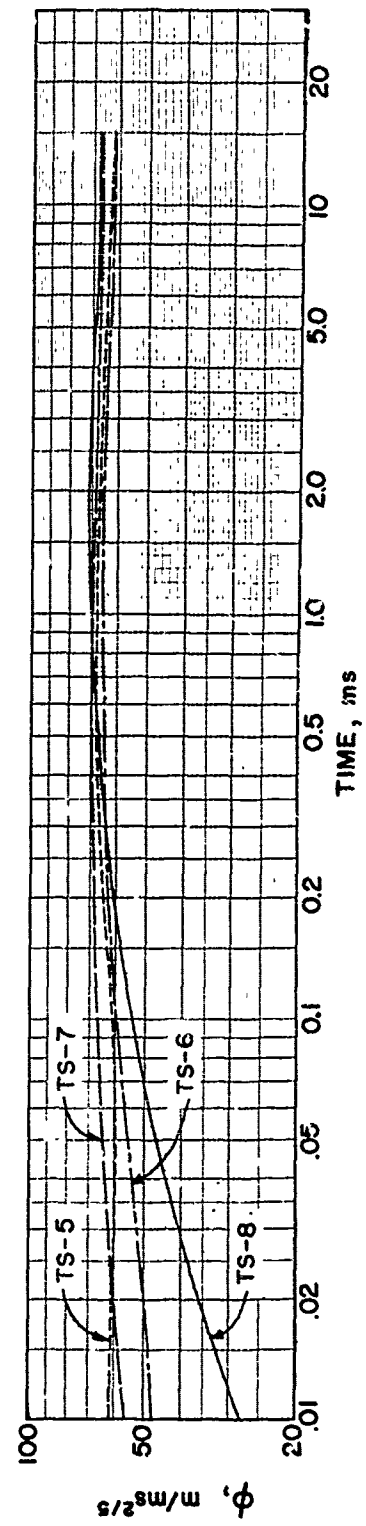
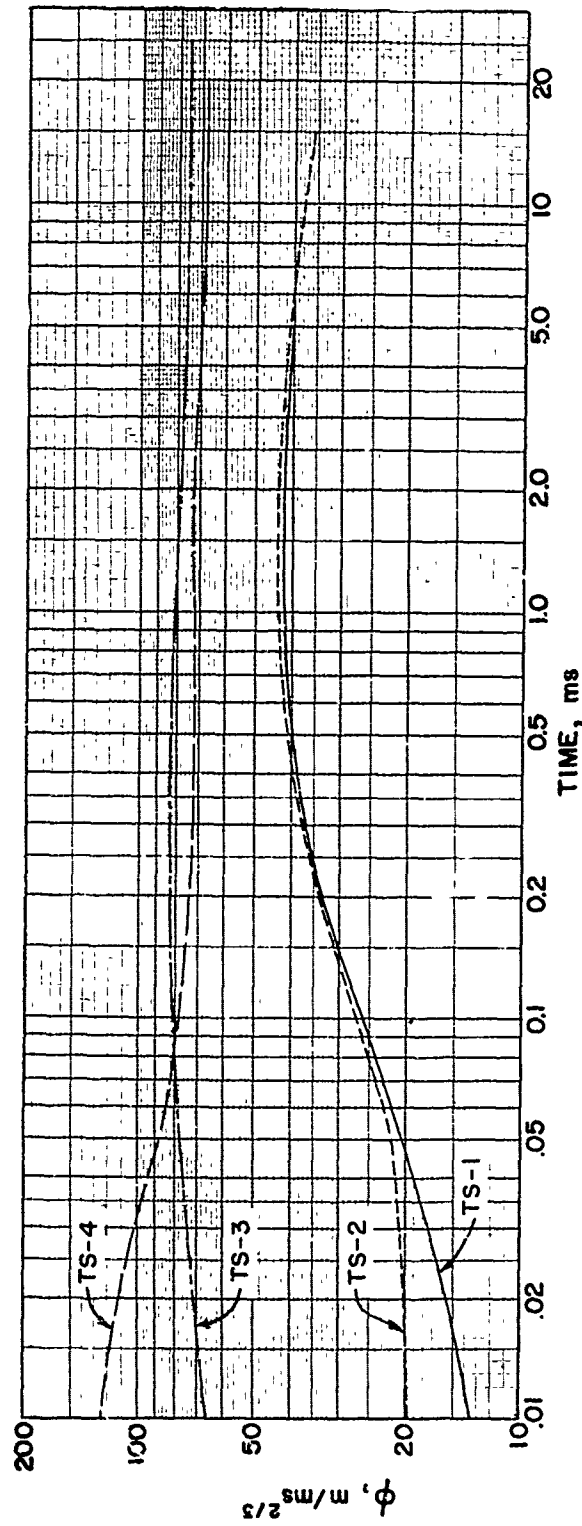


Fig. 3.17—TS 1 to 8  $\phi$  vs time.

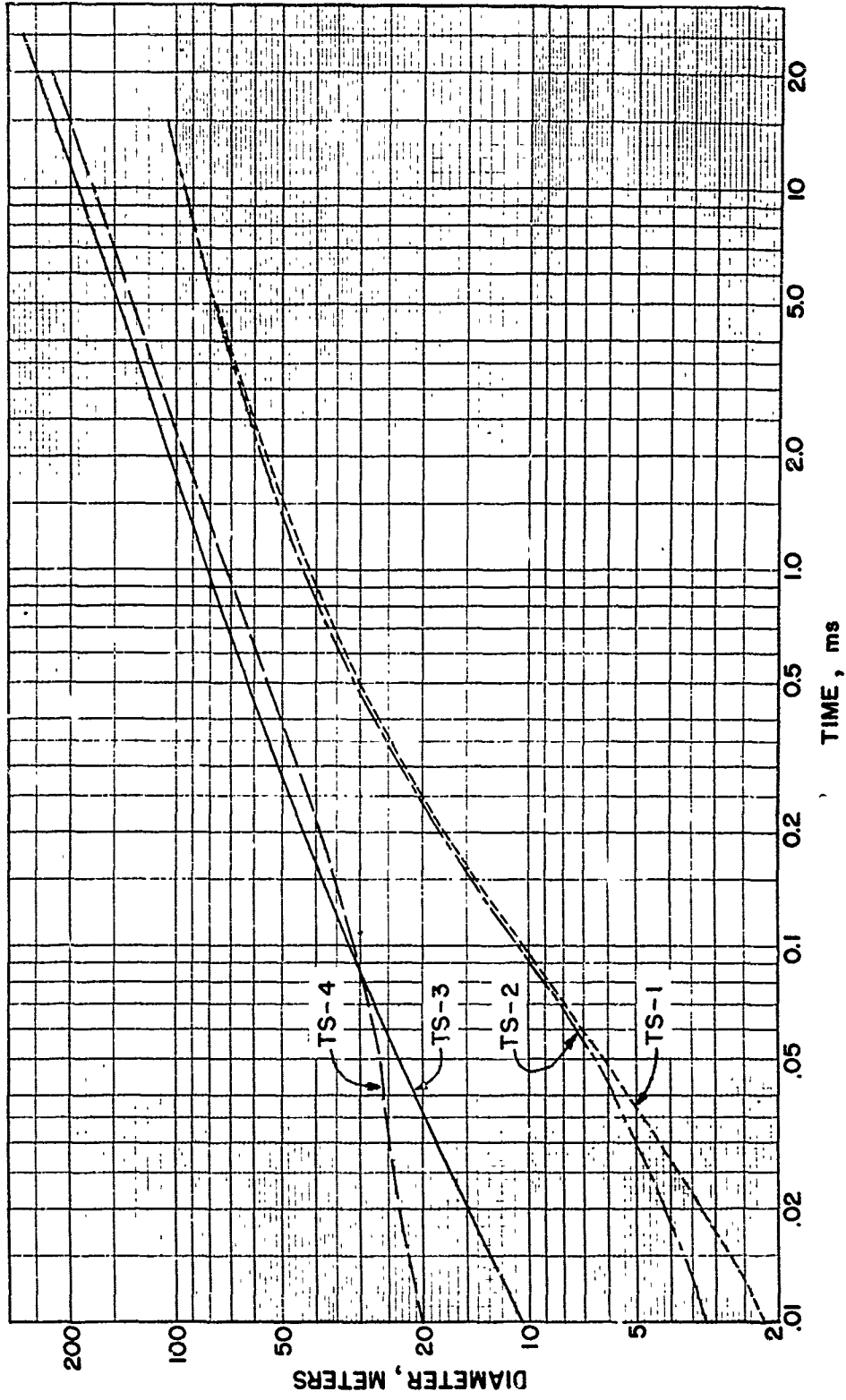


Fig. 3.18a—TS 1 to 4 diameter vs time.

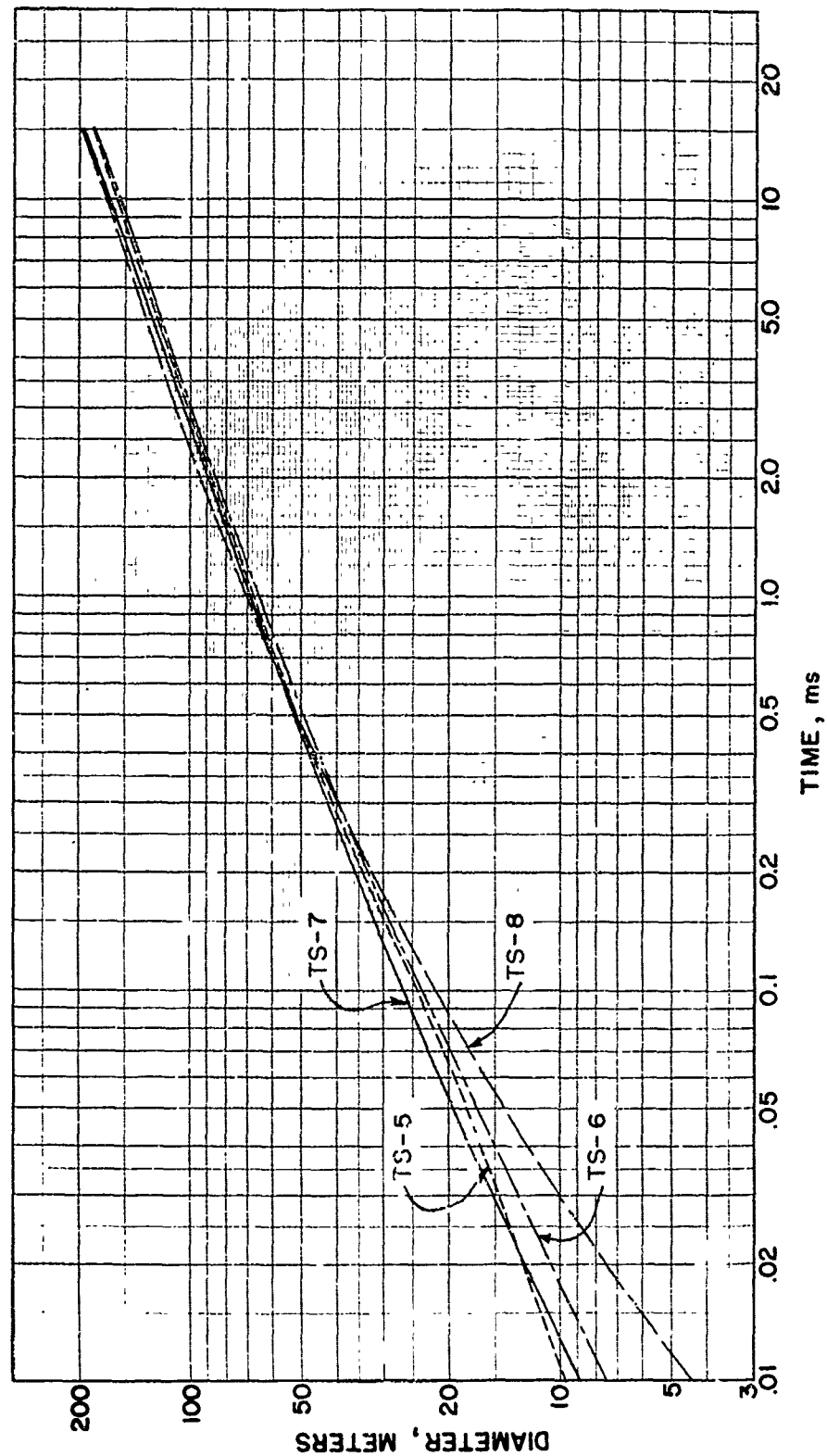


Fig. 3.18b—TS 5 to 8 diameter vs time.



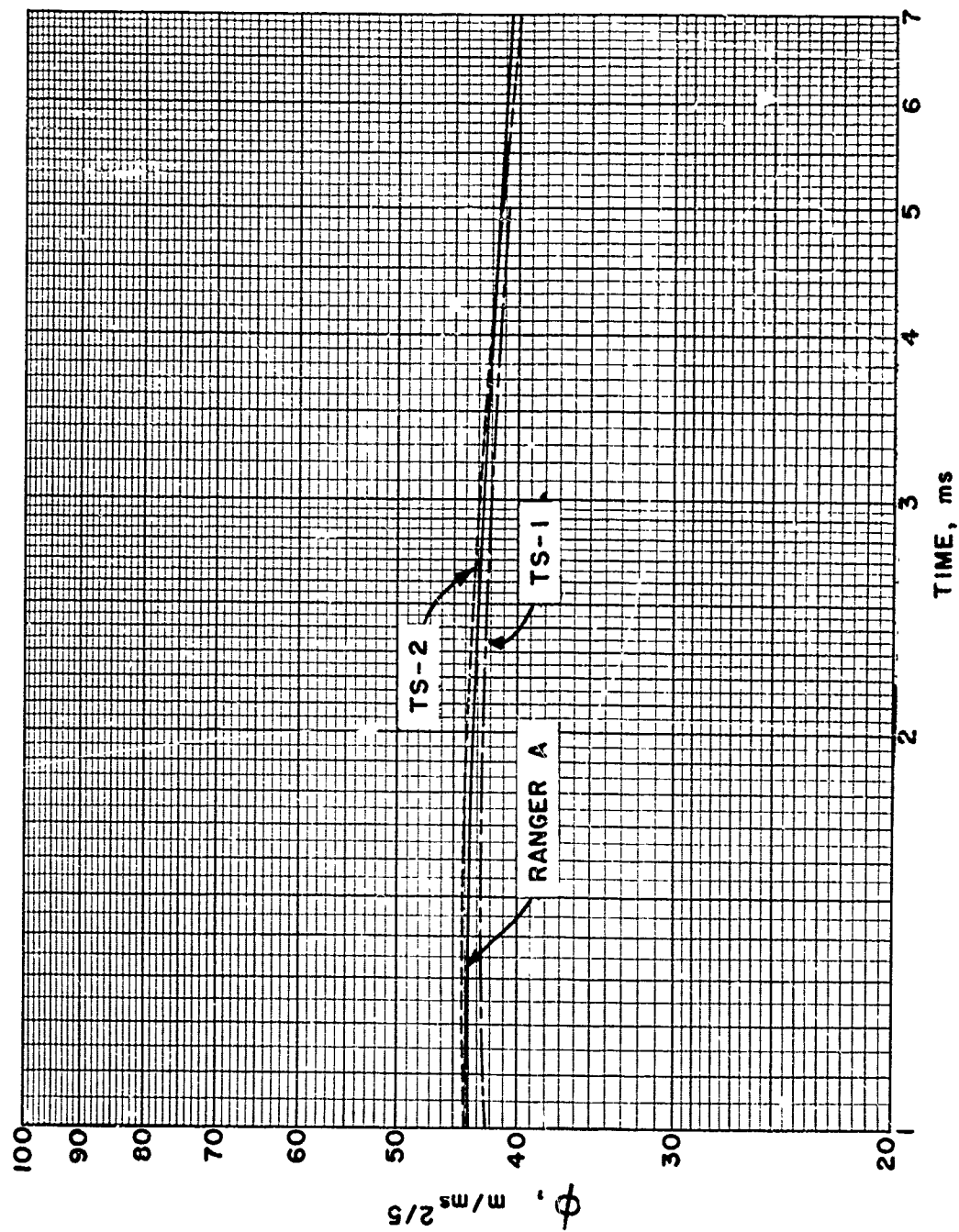


Fig. 3.19—Comparison of  $\phi$  vs time on Ranger A and TS 1 and 2 (Eastman data).

### 3.3 PREPARATIONS

Before the operation, all cameras were collimated and the focal lengths were determined, as described in Appendix D. The films used for this purpose were exposed to constant temperature and relative-humidity conditions for several hours before being read. Likewise, all shot films were analyzed after being maintained under stable temperature and humidity conditions overnight.

### 3.4 EASTMAN PHOTOGRAPHY

The Eastman cameras were operated from the phototrucks as shown in Fig. 3.20. The films ran at between 2000 and 3000 frames/sec, the time scale being determined by a marker placing pips on the film at the rate of 200/sec. Use was also made of a fiducial mark placed on the film at zero time. A discussion of the methods of finding zero time and the time scale has been presented previously.<sup>2</sup> Data from all Eastman films read are summarized in Tables 3.1 to 3.3. Detailed calculations for the individual films have been issued as EG&G Report 1093, Tumbler-Snapper Fireball Data, EG&G-OUT 1177, 4 September 1953.

### 3.5 RAPATRONIC PHOTOGRAPHY

In addition to the 16-mm high-speed Eastman camera records, the Rapatronic camera served as an invaluable aid in the determination of yields.

The magneto-optic shutter allows an exposure time of only a few microseconds at a pre-set time. This then provides a sharp image of the shock front and fireball edge at a precisely known time. As many as 16 such cameras were used on each test, and the points obtained were weighted in with the points established by the Eastman records. These are plotted in Figs. 3.1 to 3.18, the Rapatronic points being plotted with X's. A summary of data from Rapatronic records is also presented in Table 3.4.

Not only were these points valuable as a check on the Eastman films but they also provided a much more accurate measure of diameters at early times, since the time resolution for an Eastman frame is of the order of 70  $\mu$ sec and the Rapatronic 4  $\mu$ sec and 40  $\mu$ sec, depending on the shutter used. The 480-mm focal length allows a much larger image to be obtained, a distinct advantage at the early times. These large images at an early time also supply a means of determining the time of the "zero" frames on the Eastman records.

#### 3.5.1 Eastman Zero-frame Time Determination from Rapatronics

From these early Rapatronic plates, time of the "zero" frame (i.e., the first exposed frame after detonation) on the Eastman films could be readily determined merely by a comparison of diameters. A graph of diameter vs time was drawn from the Rapatronic data. The first and second, and in some cases the third, Eastman frame diameters were measured. From the Rapatronic graph it was then easy to determine the respective times for these diameters. Since the velocity of the film was known, the zero-frame time could be obtained by subtracting from the time of each frame the corresponding time elapsed between it and the zero frame.

EXAMPLE: At times determined from Rapatronic diameter vs time graph.

Diameter at zero frame	25.5 meters at 0.125 msec
Diameter at 1 frame	46.2 meters at 0.435 msec
Diameter at 2 frames	57.7 meters at 0.720 msec

Subtracting elapsed time:

Frame 0	$0.125 \text{ msec} - 0.0 \text{ msec} = 0.125 \text{ msec}$
Frame 1	$0.435 \text{ msec} - 1 \text{ (frame)} \times 0.3203 \text{ msec} = 0.115 \text{ msec}$
Frame 2	$0.720 \text{ msec} - 2 \text{ (frames)} \times 0.3203 \text{ msec} = 0.080 \text{ msec}$

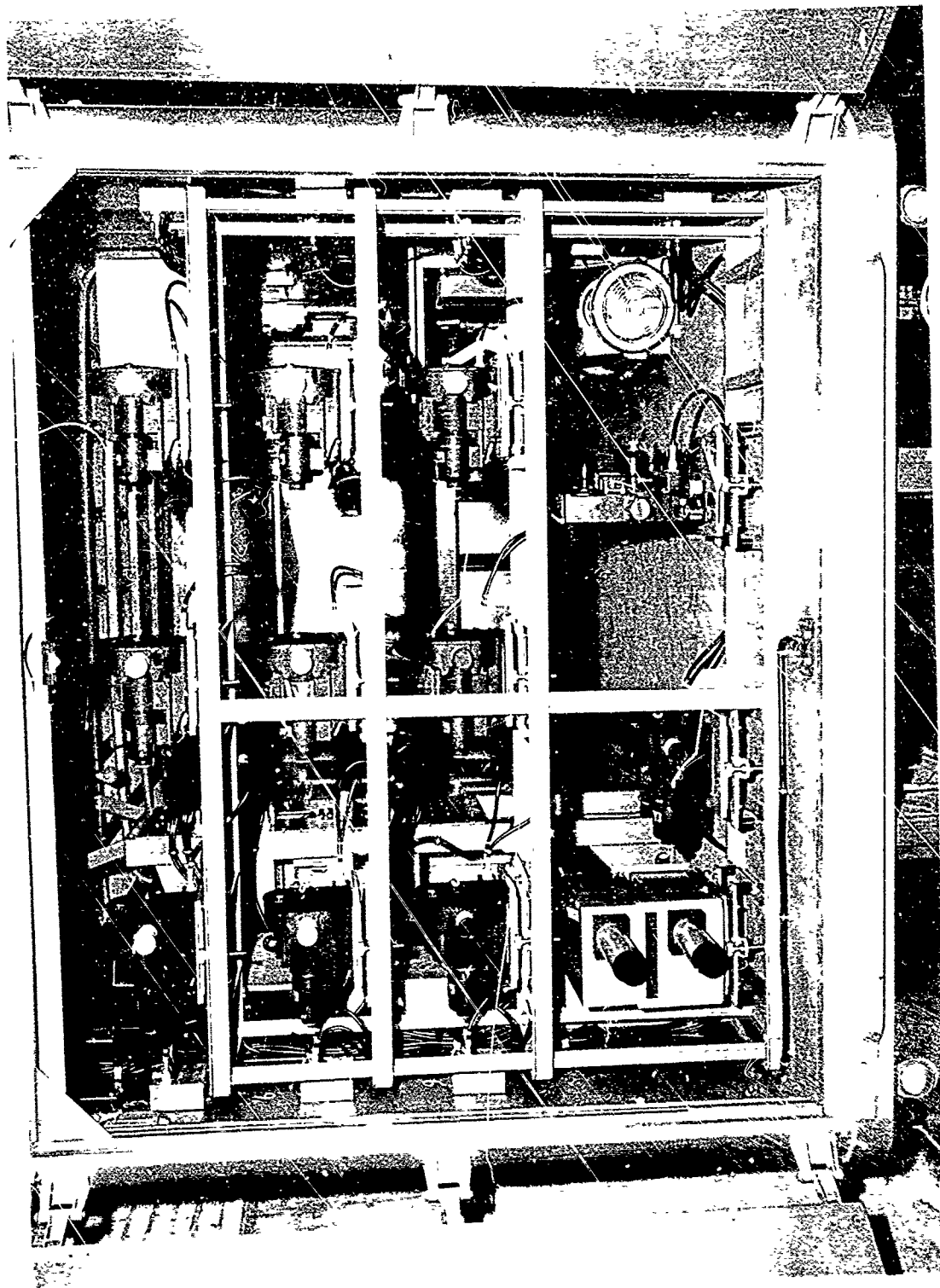


Fig. 8.20—EG&G photoruck — camera racks.

Table 3.1--SUMMARY OF EASTMAN DATA FOR FIREBALL

Shot	Film No.	Sta. No.	Total No. frames read	$\bar{\phi}$	$\eta$	$\sigma^2$	$\sigma$
TS-3	13201	7-360	19	75.49	9	0.1243	0.352
	13203	7-361	18	75.37	9	0.4272	0.654
	13205	7-361	16	75.25	9	0.2268	0.476
	13206	7-361	16	74.74	8	0.1442	0.380
TS-4	13301	7-360	19	68.63	11	0.4414	0.664
	13303	7-361	15	69.79	7	1.9274	1.388
	13305	7-361	16	69.25	11	0.6877	0.829
	13306	7-361	19	68.27	11	0.3874	0.622
TS-5	13400	1-355	13	63.09	9	0.2479	0.498
	13401	1-355	14	63.66	9	0.2482	0.498
	13403	1-355	15	63.96	9	0.7655	0.875
	13404	1-356	15	63.19	7	0.5642	0.751
	13406	1-356	16	63.58	10	0.3330	0.577
	13407	1-356	15	62.96	15	0.4856	0.697
	13410	1-356	19	63.51	9	0.4195	0.648
TS-6	13600	4-356	21	62.30	12	0.1309	0.362
	13601	4-356	17	62.49	11	0.3135	0.560
	13602	4-356	19	62.59	8	0.5954	0.772
	13603	4-356	20	62.50	11	0.5604	0.749
	13605	4-355	16	63.13	11	0.3859	0.621
	13606	4-355	21	62.67	12	0.6072	0.779
	13607	4-355	18	62.93	10	0.3659	0.605
	13610	4-355	18	63.35	8	0.2588	0.509
TS-7	13700	3-355	18	66.24	10	0.0701	0.265
	13701	3-355	16	66.48	7	0.0231	0.152
	13702	3-355	20	66.13	9	0.1989	0.446
	13703	3-355	19	66.23	8	0.0745	0.273
	13705	3-356	16	66.19	9	0.0403	0.201
	13706	3-356	20	66.00	12	0.1476	0.384
	13707	3-356	18	65.93	8	0.0364	0.191
	13710	3-356	20	65.58	8	0.0669	0.259
TS-8	13800	2-356	16	68.82	8	0.2139	0.462
	13801	2-356	15	69.15	7	0.8615	0.928
	13802	2-356	15	67.81	8	0.5372	0.733
	13803	2-356	17	68.72	8	0.3453	0.588
	13805	2-355	12	66.21	8	0.2995	0.173
	13806	2-355	16	65.91	10	0.6756	0.822
	13807	2-355	13	66.20	7	1.0848	1.042
	13810	2-355	18	66.93	9	0.3923	0.198

The average of these times was then considered the best value for the time that the zero frame was exposed.

0.125 msec

0.115 msec

0.080 msec

0.320 msec or an average of 0.107 msec

Table 3.2—DIAMETER VS TIME DATA

Time	$t^{-2/3}$ (msec <sup>-2/3</sup> )	Diameter, meters							
		TS-1	TS-2	TS-3	TS-4	TS-5	TS-6	TS-7	TS-8
10 $\mu$ sec	6.310	2.2	3.2	10.5	20.0	9.7	7.5	8.9	4.4
20 $\mu$ sec	4.782	3.3	4.2	14.8	23.4	12.7	10.5	12.6	7.5
50 $\mu$ sec	3.314	6.2	6.5	23.4	28.4	17.9	16.6	19.4	14.1
100 $\mu$ sec	2.512	10.4	10.7	32.2	31.4	24.2	23.7	26.6	21.7
200 $\mu$ sec	1.904	17.4	17.9	43.2	39.0	34.1	33.1	35.9	32.1
500 $\mu$ sec	1.320	30.2	31.2	62.2	54.6	50.9	49.3	52.7	51.1
1 msec	1.000	41.9	43.6	81.2	72.5	67.2	65.3	69.3	70.3
2 msec	0.7579	55.4	57.4	104.6	95.5	87.6	85.5	89.7	94.0
5 msec	0.5253	76.7	77.1	145.4	132.3	123.0	120.5	126.6	131.4
10 msec	0.3981		94.9	189.1	170.8	158.2	155.7	166.1	168.3
15 msec	0.3385		105.8	222.5	200.9	183.2	183.2	195.3	197.9
20 msec	0.3017			249.6	225.4				
25 msec	0.2760			272.9					

Table 3.3— $\phi$  VS TIME DATA

Time	$\phi$ , meters/msec <sup>2/3</sup>							
	TS-1	TS-2	TS-3	TS-4	TS-5	TS-6	TS-7	TS-8
10 $\mu$ sec	13.6	19.9	66.3	126.4	61.0	47.5	56.3	28
20 $\mu$ sec	15.7	20.2	70.8	112.0	60.8	50.0	60.2	36
50 $\mu$ sec	20.6	21.7	77.7	87.5	59.3	55.0	64.3	46.7
100 $\mu$ sec	26.2	27.0	80.8	78.8	60.7	59.5	66.7	54.4
200 $\mu$ sec	33.2	34.1	82.2	74.3	64.9	63.0	68.4	61.2
500 $\mu$ sec	39.9	41.2	82.1	72.1	67.2	65.1	69.5	67.4
1 msec	41.9	43.6	81.2	72.5	67.2	65.3	69.3	70.3
2 msec	42.0	43.5	79.3	72.4	66.4	64.8	68.0	71.3
5 msec	40.3	40.8	76.4	69.5	64.6	63.3	66.5	69.0
10 msec		37.8	75.3	68.0	63.0	62.0	66.12	67.0
15 msec		35.8	75.3	68.0	62.0	62.0	66.12	67.0
20 msec			75.3	68.0				
25 msec			75.3					

### 3.5.2 Collimation

Focal lengths of the Rapatronic cameras were measured in the field using the collimator pictured in Fig. 3.21. This collimator was braced on a stand on the ground at the rear of the vehicle containing the camera rack.

The collimator contains the target, which is a series of fine wires placed obliquely to the collimator focal plane. The middle wire is in the focal plane. The wires are then photographed by the Rapatronic, the wire in sharpest focus showing the point of infinity focus for the Rapatronic. The wires have been arranged so that each one represents a change of 0.01 in. in the Rapatronic focal length. By inspecting the photograph, the amount of adjustment necessary to bring the Rapatronic into best focus for infinity is easily determined. Positioning the focal plane to an adjustment of 0.01 in. results in very sharp pictures.

Table 3.4—SUMMARY OF RAPATRONIC RECORD DATA

					NAME			DATE		JOB NO.
FILM #	CAMERA #	STATION	TIME (μS)	EMULSION	FILTERS			Φ	DIAM (M)	REMARKS
					ND	COLOR	EFF. APERT.			
<u>IS-1</u>										
13041	R-9	F-361	100	MF	-	-	150	26.1	10.4	
42	R-33	"	403	"	-	-	150	39.1	27.2	
43	R-19	F-362	50	"	-	-	150	20.2	6.1	
44	R-18	"	212	"	-	-	150	33.9	18.2	
45	R-26	F-361	11	HRHS	-	-	150	13.4	2.2	
46	R-31	"	32	"	-	-	150	17.4	4.4	
47	R-24	F-362	2632	"	-	-	150	41.7	61.4	
48	R-4	"	18	"	-	-	150	16.1	3.2	
49	R-5	F-361	30	Ektar	-	CC40M	70			Color-Overexposed
50	R-6	"	50	"	-	CC40M	70			" "
51	R-12	F-362	36	ECP	-	-	70			" - no balance
52	R-17	"	80	"	-	-	70			" " "
53	R-8	F-361	5040	Tri X	-	-	150	40.3	77.0	
54	R-10	"	4000	"	-	-	150	41.1	71.6	*
55	R-14	F-362	3000	"	-	-	150			
56	R-29	"	180	HRHS	-	-	150	41.2	37.3	
<u>IS-2</u>										
13141	R-9	7-361	103	MF	-	-	150	27.1	10.9	
42	R-33	"	411	"	-	-	150	39.95	28.0	
43	R-19	7-362	50	"	-	-	150	20.63	6.2	
44	R-18	"	205	"	-	-	150	34.30	18.2	
45	R-26	7-361	12	HRHS	-	-	150	20.75	3.5	
46	R-31	"	32	"	-	-	150	21.43	5.4	
47	R-24	7-362	2615	"	-	-	150	42.57	62.5	
48	R-4	"	18	"	-	-	150	19.45	4.0	
49	R-5	7-361	7495	Ektar	-	-	70			
50	R-6	"	53	ECP	0.5	85B	220			
51	R-12	7-362	40	"	0	85B	70			
52	R-17	"	84	"	0.5	85B	220			
53	R-8	7-361	5025	Tri X	-	-	150	41.16	78.5	
54	R-10	"	4075	"	-	-	150	41.45	72.8	
55	R-14	7-362	2990	"	-	-	150			*
56	R-29	"	773	HRHS	-	-	150	42.93	38.7	
* Fired early and oscillated due to an unshielded transformer.										

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Table 3.4—(Continued)

FILM #	CAMERA #	STATION	TIME (YS)	EMULSION	NAME		EFF. APER.	Φ	DATE	DIAM (M)	REMARKS	JOB NO.
					ND	COLOR						
TS-3												
13241	R-9	7-361	100	MF	-	-	150	81.20		32.3		
42	R-33	"	403	"	-	-	150	82.25		57.2		
43	R-19	7-362	49	"	-	-	150				Blank	
44	R-18	"	4860	Tri X	-	-	150	76.40		143.8		
45	R-26	7-361	10	HRHS	-	-	150	66.14		10.4		
46	R-31	"	30	"	-	-	150	71.86		17.7		
47	R-24	7-362	7335	"	-	-	150	75.75		168.1		
48	R-4	"	17	"	-	-	150	72.62		14.2		
49	R-5	7-361	134	ECP	-	CC10M	70				Color	
50	R-6	"	31,675	Ekt+	-	CC40M	70				Color	
51	R-12	7-362	215	ECP	-	86+ CC10M	70				Color	
52	R-17	"	80	"	-	86+ CC10M	70				Color	
53	R-8	7-361	20,130	Tri X	-	-	150	-		-	Faded - warped camera back	
54	R-10	"	17,455	"	-	-	150	75.94		238.4		
55	R-14	7-362	10,756	"	-	-	150	75.54		195.4		
56	R-29	"	785	HRHS	-	-	150	81.19		73.7		
TS-4												
13341	R-9	7-361	100	MF	-	-	150	78.6		31.3		
42	R-33	"	403	"	-	-	150	72.4		50.3		
43	R-19	7-362	49	"	-	-	150	87.3		26.2		
44	R-18	"	4860	Tri X	-	-	150	69.4		130.7		
45	R-26	7-361	10	HRHS	-	-	150	126.2		20.0		
46	R-31	"	30	"	-	-	150	99.9		24.6		
47	R-24	7-362	7335	"	-	-	150	68.2		151.4		
48	R-4	"	17	"	-	-	150	115.8		22.7		
49	R-5	7-361	26,650	Ekt+	-	CC40M	70				Color - light leakage thin single cell	
50	R-6	"	155	ECP	-	86+ CC10M	70				Color	
51	R-12	7-362	215	"	-	86+ CC10M	70				Color	
52	R-17	"	80	"	-	86+ CC10M	70				Color	
53	R-8	7-361	20,130	Tri X	-	-	150				NG	
54	R-10	"	17,455	"	-	-	150	68.6		215.5		
55	R-14	7-362	10,756	"	-	-	150	67.8		175.4		
56	R-29	"	785	HRHS	-	-	150	72.1		65.4		

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Table 3.4—(Continued)

					NAME			DATE		JOB NO.
					FILTER					
FILM #	CAMERA #	STATION	TIME (μs)	EMULSION	ND	COLOR	EFF APERT.	Φ	Diam (m)	REMARKS
<b>TS-5</b>										
13441	R-9	1-355	95	MF	-	-	150	60.23	23.5	
42	R-33	"	403	"	-	-	150	66.21	46.0	
43	R-19	1-356	49	"	-	-	150	57.21	17.1	
44	R-18	"	210	"	-	-	150	67.15	36.0	
45	R-22	1-355	10	HRHS	-	-	150	60.86	9.6	
46	R-31	"	28	"	-	-	150	60.82	14.5	
47	R-24	1-356	7335	TriX	-	-	150	64.13	142.3	
48	R-4	"	4400	"	-	-	150	64.85	117.3	
49	R-5	1-355	16,800	Ektar	-	CC40M	70			Color
50	R-6	"	152	ECP	-	86+ CC10M	70			Color
51	R-12	1-356	40	"	-	-	70			Color
52	R-17	"	82	"	-	-	70			Color
53	R-8	1-355	4940	TriX	-	-	150	65.14	123.4	
54	R-10	"	8300	"	-	-	150	63.13	147.2	
55	R-14	1-356	10,900	"	-	-	150	62.65	162.9	weak exposure
56	R-29	"	785	HRHS	-	-	150	66.57	60.4	
<b>TS-6</b>										
13641	R-9	4-356	95	MF	-	-	150	60.3	23.5	
42	R-33	"	403	"	-	-	150	63.0	43.8	
43	R-19	4-355	49	"	-	-	150	50.4	15.1	
44	R-18	"	210	"	-	-	150	64.8	34.7	
45	R-26	4-356	10	HRHS	-	-	150	47.7	7.5	
46	R-31	"	28	"	-	-	150	54.3	12.9	
47	R-24	4-356	7335	"	-	-	150	64.0	142	
48	R-4	"	4400	"	-	-	150	63.0	115	
49	TR-B	"	~0	BX	-	-	20			
50	TR-A	"	~0	Lin Pan	-	-	30			
53	R-8	4-356	4940	TriX	-	-	150	63.3	120	
54	R-10	"	8300	"	-	-	150	62.2	145	
55	R-14	4-355	10,900	"	-	-	150	61.5	160	weak
56	R-29	"	785	HRHS	-	-	150	67.3	61.1	
57	R-5	"	~0	TriX	-	-	70			NG } Dark slides
58	R-6	"	~0	"	-	-	70			NG } not pulled
59	R-12	"	~0	"	-	-	70			NG
60	R-17	"	~0	"	-	-	70			NG

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Table 3.4—(Continued)

					NAME			DATE		JOB NO.
FILM #	CAMERA #	STATION	TIME (μs)	EMULSION	FILTER	ND COLOR	EFF APER.	Φ	DIAM (M)	REMARKS
<u>IS-7</u>										
13741	R-9	3-355	95	MF	-	-	150	66.4	25.9	
42	R-33	"	403	"	-	-	150	69.3	48.2	
43	R-19	3-356	49	"	-	-	150	50.4	15.1	
44	R-18	"	210	"	-	-	150	68.0	36.4	
45	R-26	3-355	10	HRHS	-	-	150			
46	R-31	"	28	"	-	-	150	61.9	14.7	
47	R-24	3-356	7335	TriX	-	-	150			NG-Transformer
48	R-4	"	4400	"	-	-	150	66.85	120.9	
49	TR-B	"	~0	BX	-	-	20			
50	TR-A	"	~0	Lin Pan	-	-	10			
53	R-8	3-355	13,650	TriX	-	-	150	66.19	189.3	
54	R-10	"	8300	"	-	-	150	65.96	153.8	
55	R-14	3-356	10,900	"	-	-	150	66.17	171.9	
56	R-29	"	785	HRHS	-	-	150	69.50	63.1	
57	R-5	7-248	~0	TriX	-	-	70			
58	R-6	"	~0	"	-	-	70			
59	R-12	"	~0	"	-	-	70			
60	R-17	"	~0	"	-	-	70			
<u>IS-8</u>										
13841	R-9	2-356	95	MF	-	-	150	53.8	21.0	
42	R-33	"	403	"	-	-	150	66.1	46.0	
43	R-19	2-355	49	HRHS	-	-	150	46.4	13.9	
44	R-18	"	210	MF	-	-	150	61.4	32.9	
45	R-26	2-356	10	HRHS	-	-	150	22.9	3.6	
46	R-31	"	28	"	-	-	150	40.0	9.5	
47	R-24	2-355	7335	TriX	-	-	150			NG-Transformer
48	R-4	"	4400	"	-	-	150	57.7	122.5	
49	TR-B	"	~0	BX	-	-	20			
50	TR-A	"	~0	Lin Pan	-	-	10			
53	R-8	2-356	13,650	TriX	-	-	150			NG-Transformer
54	R-10	"	8300	"	-	-	150	68.7	160.1	
55	R-14	2-355	10,900	"	-	-	150	66.6	173.1	
56	R-29	"	785	HRHS	-	-	150	69.5	63.1	
57	R-12	"	~0	TriX	-	-	50			
58	R-6	"	~0	"	-	-	50			
59	R-17	"	5.5	HRHS	-	-	50			
60	R-5	"	3160	ECN	-	-	50			

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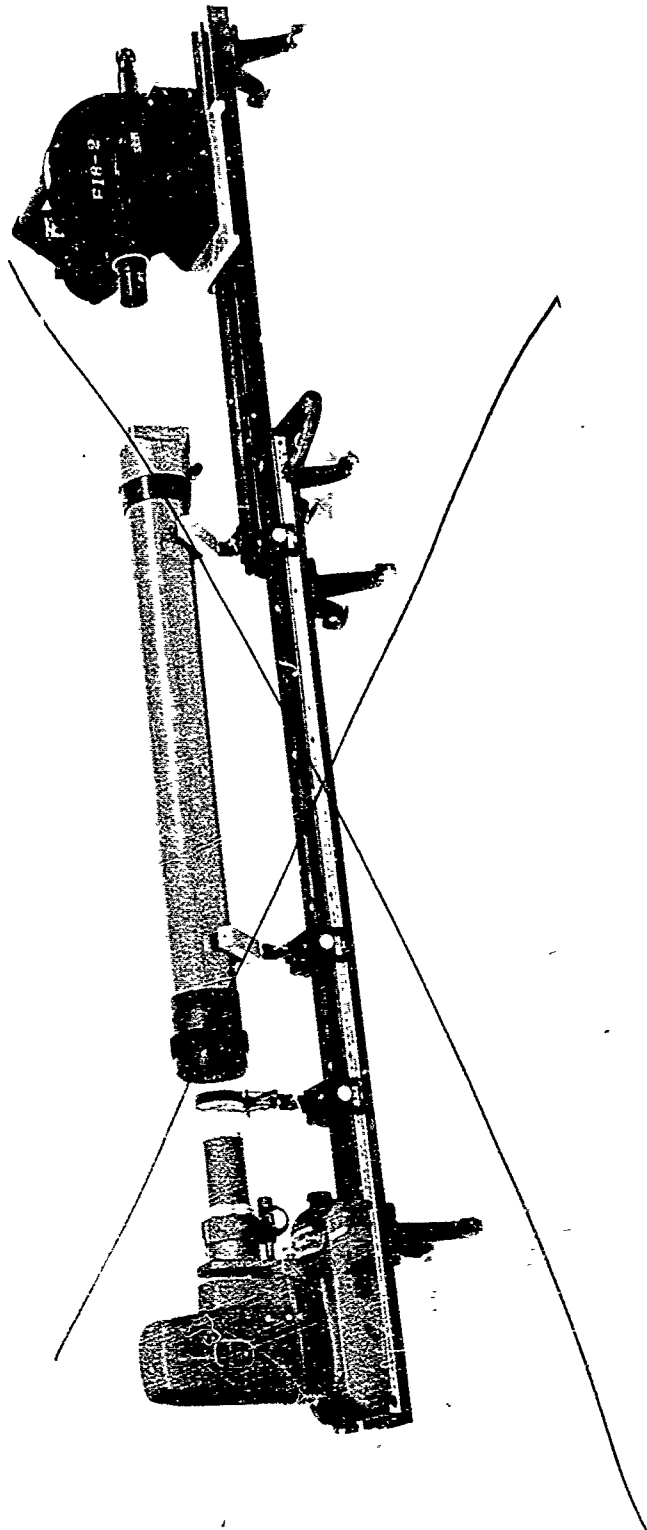


Fig. 3.21—Rapatron collimator.

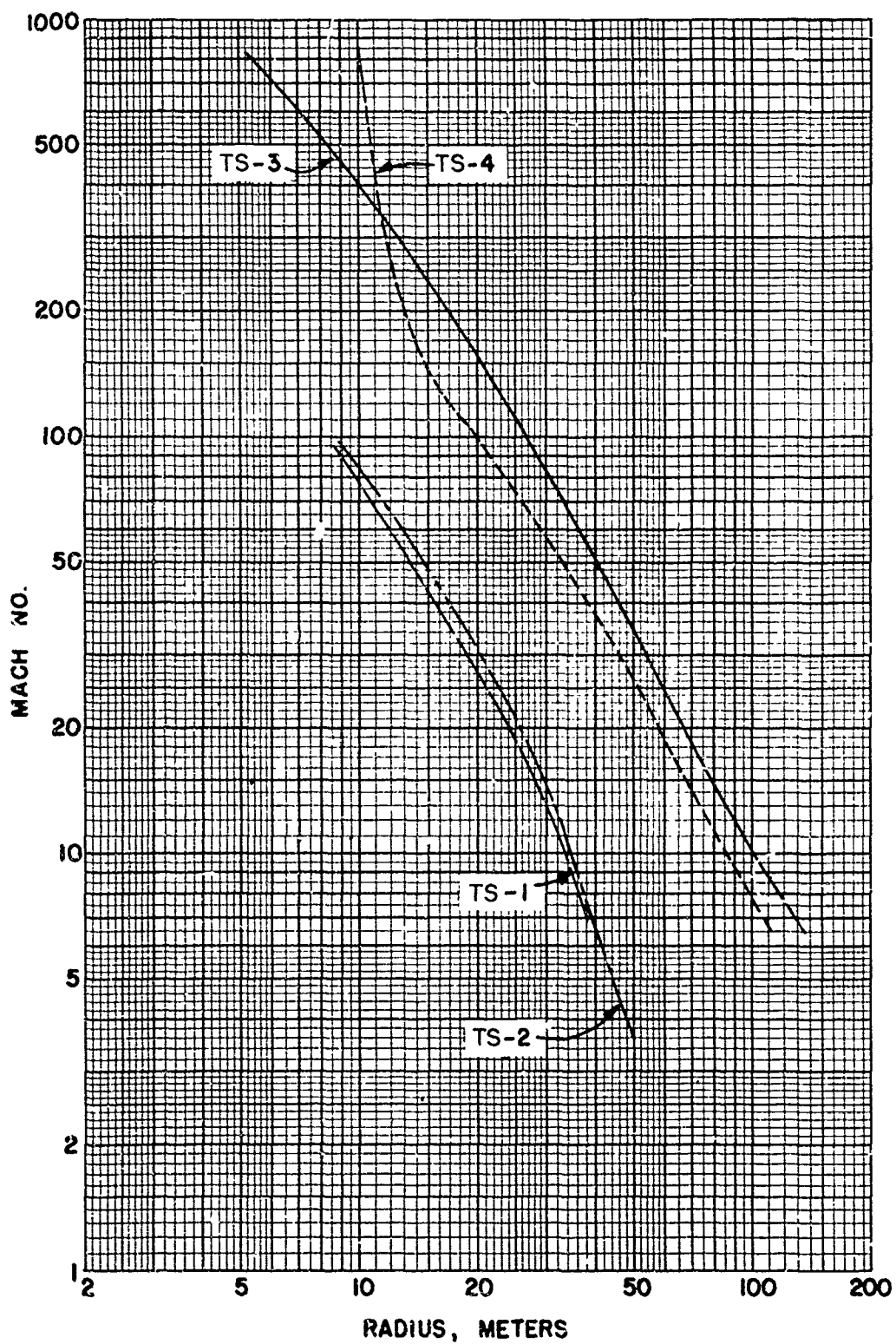


Fig. 3.20 — Mach number vs radius, TS 1 to 4.  
3.21

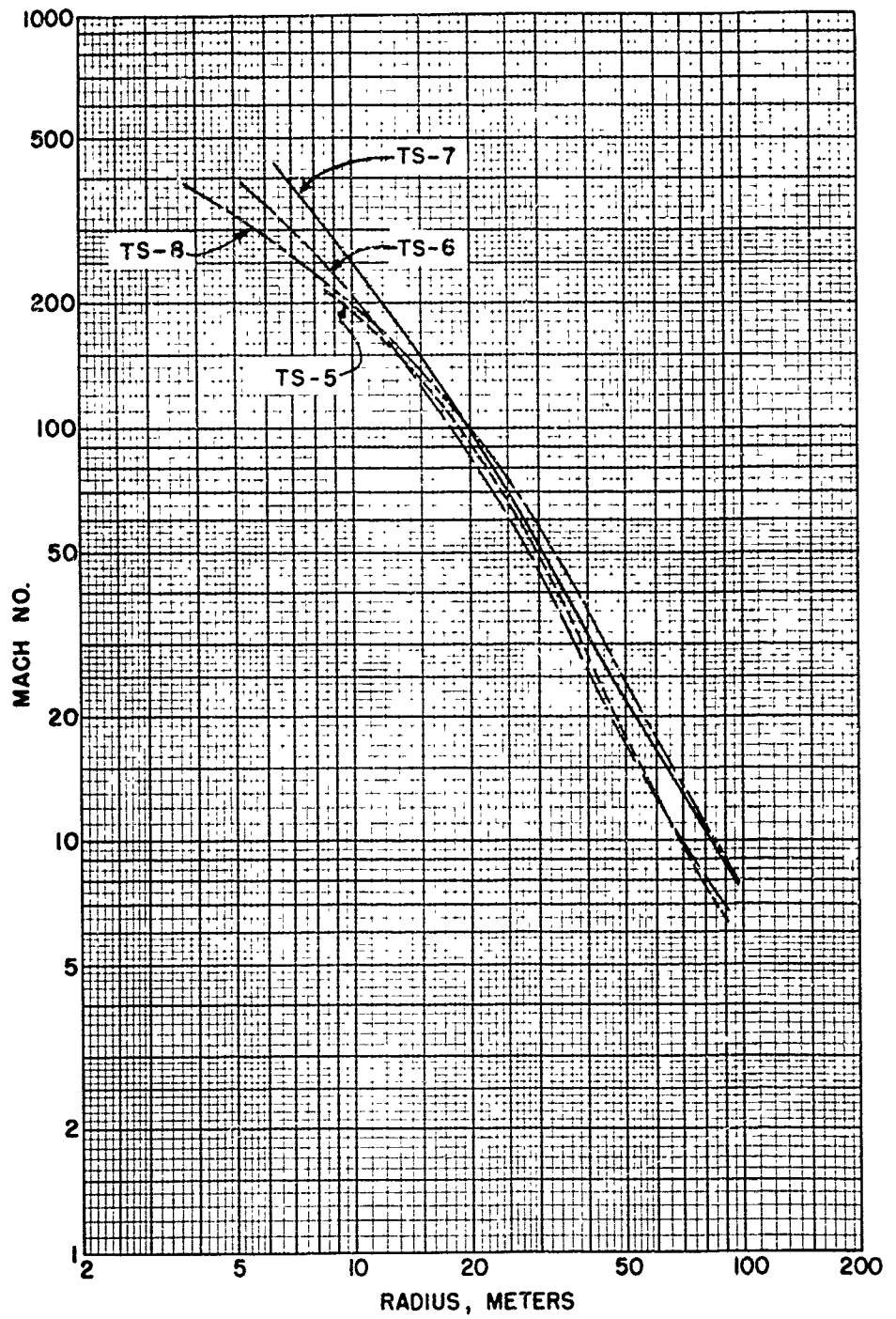


Fig-3.22 Mach number vs radius, TS 5 to 8.

3.22

### 3.5.3 Time of Exposure

The exact time desired for the Rapatronic plate to be exposed can be set by means of a delay circuit connected to the camera. A Potter counter can then be used to calibrate this time interval between the zero-time signal and triggering of the camera shutter. A push button on the camera is connected to the input signal from the fiducial (which is actuated by bomb light). Thus a push on this button simulates zero time. The Potter counter indicates elapsed time from zero to the beginning of the exposure. The total delay is then the sum of the Potter counter reading and half the exposure duration of the film.

A pictorial report, Rapatronic Photography on Operation Tumber-Snapper, EG&G-OUT 1034, 29 December 1952, shows the views of each fireball from the two stations in time sequence.

### 3.6 MACH NUMBER AS A FUNCTION OF TIME

It is possible to calculate velocity of the shock front from the  $\phi$  and diameter vs time relations. From the equation

$$D = Kt^n$$

let

$$U = \frac{1}{2} \frac{dD}{dt} = \frac{1}{2} \frac{nD}{t}$$

where U = velocity of shock front

D = fireball diameter

t = time

n = time exponent

The Mach number is the ratio of the velocity of the shock front, U (which is coincident with the edge of the fireball before breakaway), and the velocity of sound,  $C_0$ , which varies according to the formula

$$C_0 = 331.5 + 0.607T$$

where  $C_0$  is velocity in meters per second and T is temperature in °C. Values of  $C_0$  are tabulated for each shot in Appendix E. The Mach number is plotted as a function of fireball radius in Figs. ~~3.22~~ and ~~3.23~~:

3.21 3.22

### REFERENCES

1. Richard A. Houghten, Analysis of Fireball Growth at Ranger, Ranger Report, Vol. 3, WT-203.
2. Ball-of-fire Observations, Greenhouse Report, Annex 1.4, WT-101.
3. Technical Photography, Buster-Jangle Project 10.3 Report, WT-417, December 1952.

## CHAPTER 4

### TELETRONIC CAMERA

In order to study the appearance of a detonation at approximately zero time, it is necessary to obtain a small field of view from a considerable distance and to have an exposure duration of the order of  $1 \mu\text{sec}$ . This was attained by a teletronic camera on Greenhouse.<sup>1</sup> The same camera with minor adjustments was used on Buster-Jangle. These cameras are similar in operation to the Rapatronic.

Two such cameras were employed on the last three shots of Tumbler-Snapper. One utilized a Cassegrainian telescope and the other a Newtonian telescope to produce a good size image of only the region near the cab.

Preshot photos of the zero tower for TS-8 taken with the Newtonian type and with the Cassegrainian type telescopes are shown in Figs. 4.1 and 4.2, respectively. Figures 4.3 and 4.4 are photographs taken of the TS-8 zero tower at approximately zero time with the Newtonian type and the Cassegrainian type, respectively.

#### REFERENCE

1. Ball-of-fire Observations, Appendix C, Greenhouse Report, Annex 1.4, WT-101.

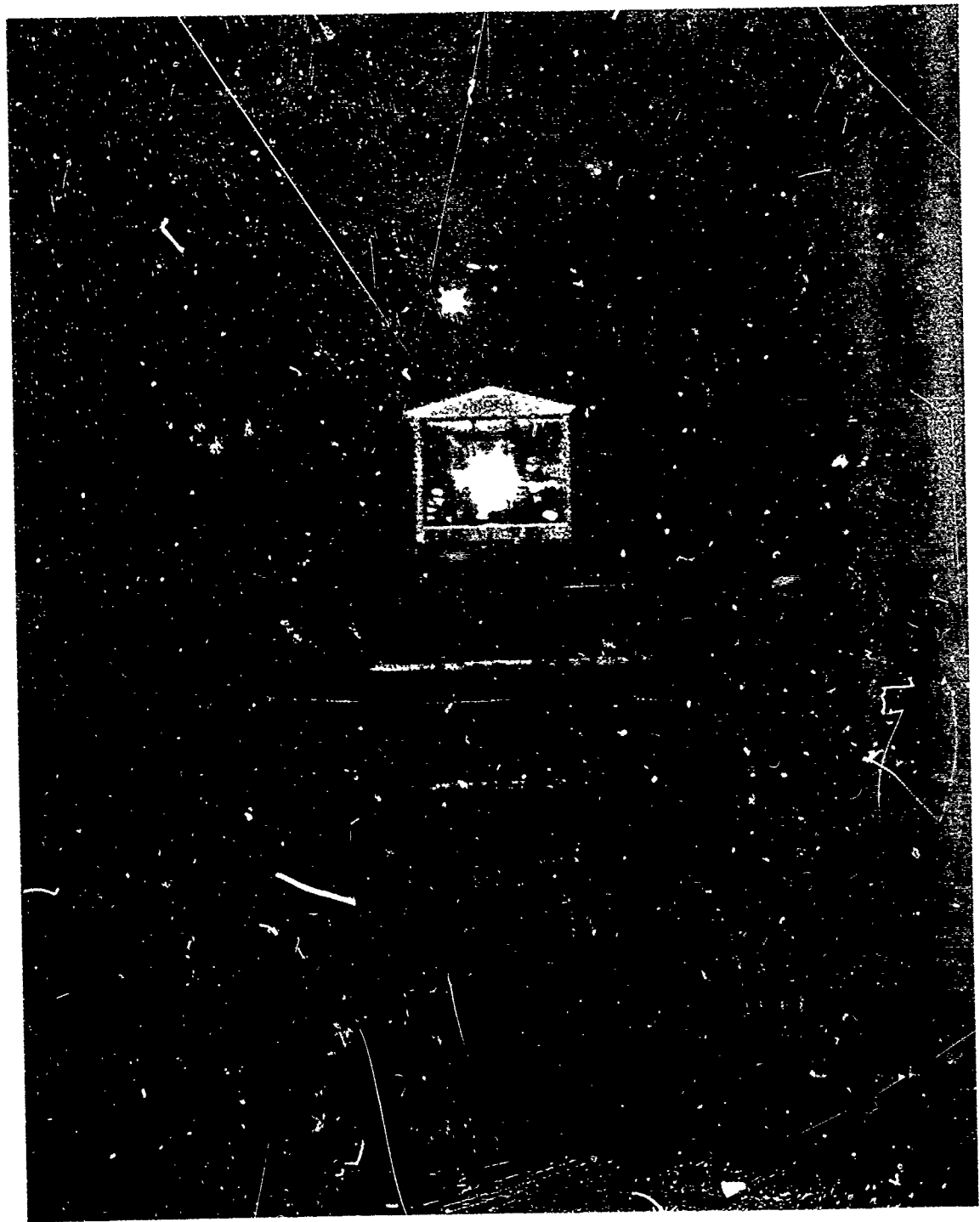


Fig. 4.1—Preshot photograph of TS-8 tower, New. onian type camera.



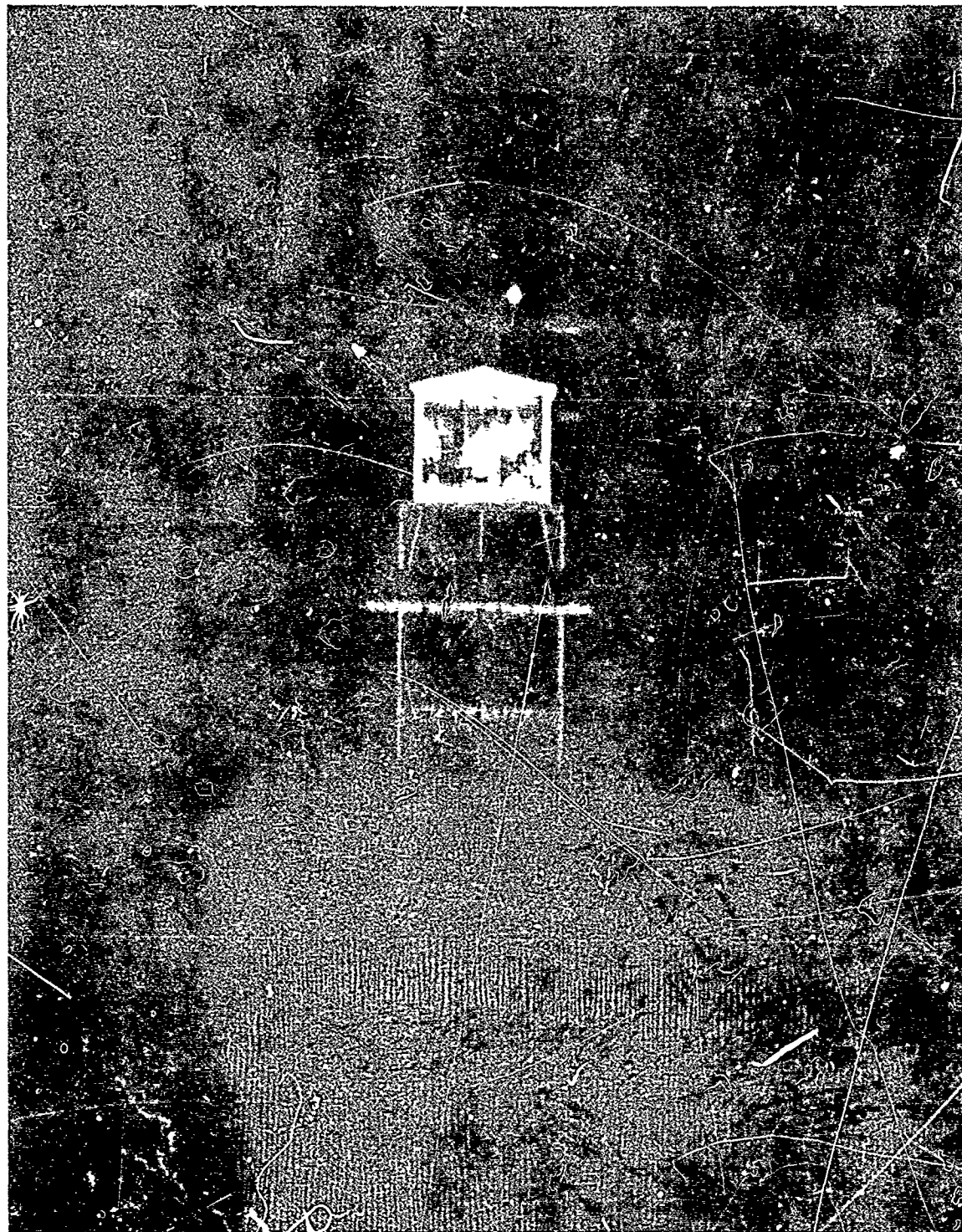


Fig. 4.2—Preshot photograph of TS-8 tower, Cassegrainian type camera.





Fig. 4.3—Approximately zero time photograph of TS-8 tower, Newtonian type camera.





Fig. 4.4— Approximately zero time photograph of TS-8 tower, Cassegrainian type camera.

## CHAPTER 5

### POSITION OF BURST

Position-of-burst determination was required for the four airdrops (TS 1 to 4) of the Tumbler-Snapper series. Two Wild phototheodolite cameras and two modified K-17 cameras were used for each shot, one camera of each type being set up at two of the standard photostations on a concrete platform adjacent to the truck or trailer.

Shadow images of battery-operated fiducial markers were placed on the film in an exposure made the day before the shot, and the fireball image was superimposed in a second exposure. A typical example taken with a Wild phototheodolite is shown in Fig. 5.1. Each camera was triggered by the closing of a relay by means of a signal from a photocell (Blue Box) at zero time. The phototheodolite exposure time was set at  $\frac{1}{200}$  sec and the K-17 at  $\frac{1}{150}$  sec. Thus exposures were made during the time when the edges of the fireball were still sharp and clear, and the exact center of the fireball, which was assumed to be the initial burst position, could be accurately determined. Coordinates of the burst were found by triangulation from the two photostations.

Two Mitchell camera records intended primarily for data on rockets were used to determine burst position for TS-1, because the theodolite solenoid pulsers failed to operate. Silvered glass globes at known distances in the field of view of the cameras were used as reference markers in this case.

All survey cameras operated satisfactorily for the other three airdrops. A summary of burst positions and aiming errors is presented in Table 5.1.

Inasmuch as TS 5 to 8 were tower shots, it was not necessary to use the theodolite cameras for determination of burst.

Table 5.1—POSITION-OF-BURST DATA SUMMARY

Shot	Area	Coord. of detonation, ft			Aiming error, ft			
		N	E	Z (burst ht.)	$\Delta N$	$\Delta E$	Circular error	$\Delta Z$
TS-1	F	746372	714067	793	122	67	140 $\pm$ 20	-7 $\pm$ 10
TS-2	7	850281	688769	1109	-143	84	165 $\pm$ 20	+9 $\pm$ 10
TS-3	7	850344	688561	3447	-80	-124	148 $\pm$ 20	-3 $\pm$ 10
TS-4	7	850282	688532	1040	-140	-153	205 $\pm$ 20	-10 $\pm$ 10

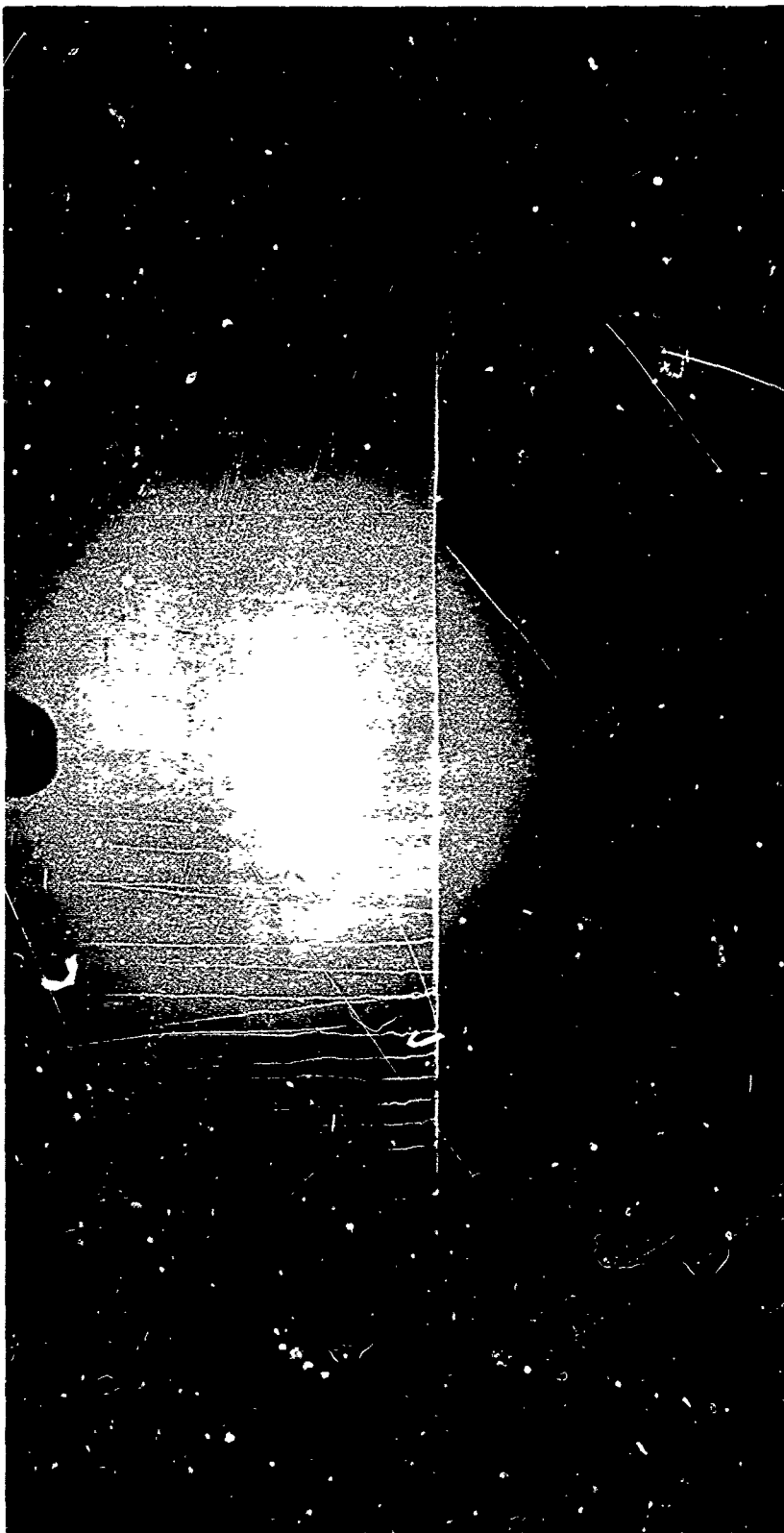


Fig. 5.1—Typical photograph of burst taken with the Wild phototheodolite.

## CHAPTER 6

### BLAST STUDIES

EG&G was asked to supply certain information which would aid in the various studies of blast. On the airdrops this was accomplished by photography of mortar puffs, Jato plumes, and rocket trails, and on the tower shots by gun puffs and shock studies.

In most instances the services of EG&G were those of obtaining the photographic record and developing and processing of films. These films, with the necessary data for interpretation, were transferred to the various groups concerned for their own analysis. The only exception to this procedure was the measurement of motion of the mortar puffs by EG&G personnel. These measurements were made at the request of J-Division, Los Alamos Scientific Laboratory (LASL), and were turned over to them without further analysis. This report will concern itself with the plan by which EG&G obtained the desired pictures.

To show individually all of the camera-station layouts for each study for all shots would prove too lengthy. Therefore the separate layouts for each study, such as rockets, mortars, etc., have been broken down for TS-1 only and are shown in Appendix C. Layouts for TS 2 to 4 have been combined in three master maps and also appear in Appendix C.

#### 6.1 AIR-MASS MOTION

In order to study the effect of blast on free air, a new technique was devised. Particles of smoke from inverted Jato columns and from mortar-shell smoke puffs were considered to behave in the same manner as particles of air, and the actual motion of a smoke particle was used for measurement.

The "Jatos" were smoke generators located along a line 500 ft from the blast line and parallel to it. These were timed so as to set up a column of smoke before arrival of the shock wave. The mortar puffs were essentially a type of commercial fireworks, sometimes known as aerial salutes, the only change being that the yellowish smoke burst was replaced by a white smoke for better visibility. The inverted Jatos, reaching a height of about 200 ft, showed the trajectory of the triple point, and illustrated, in a general way, the shape of the shock front as it passed by and deflected them. By measuring the motion of the mortar puffs, 200 to 300 ft above ground, the velocity of the shock wave and, hence, overpressure can be calculated.

A series of 10 mortar-Jato stations was set up for each of the four airdrops. Six Eastman cameras and three Mitchells were located at two of the normal photostations as indicated in Fig. 6.1. Cameras were aimed so that each camera would view one or two of the Jato stations, several of the stations being viewed by two cameras with overlapping fields of view.

Preliminary measurements of mortar-puff motion were made from the Eastman films, but EG&G made no attempt to analyze the results in Boston other than to plot displacement vs time in two dimensions only. These measurements were sent to J-Division, LASL, who were to conduct any further analysis.

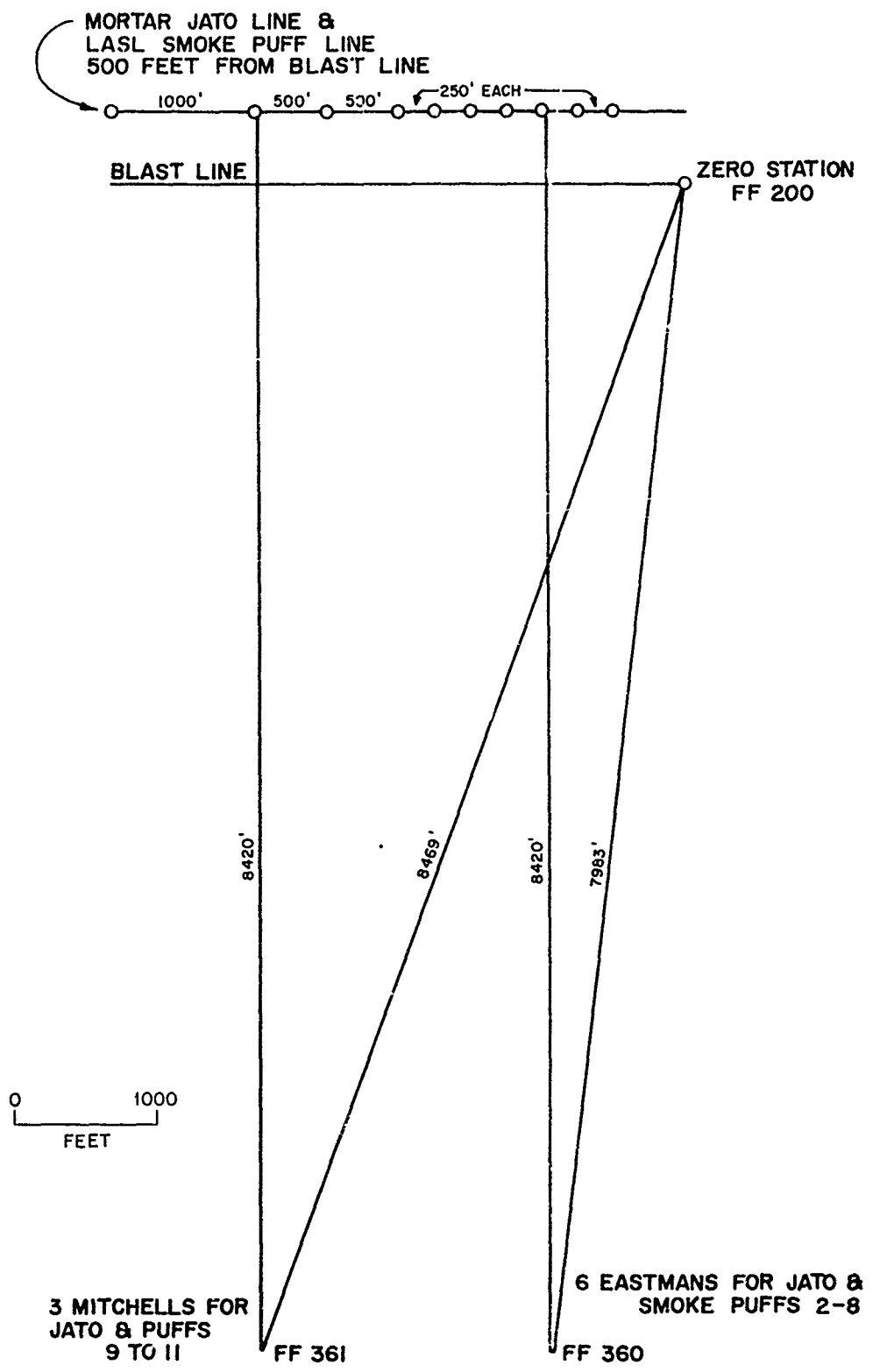


Fig. 6.1--Camera layout for TS-1 blast.

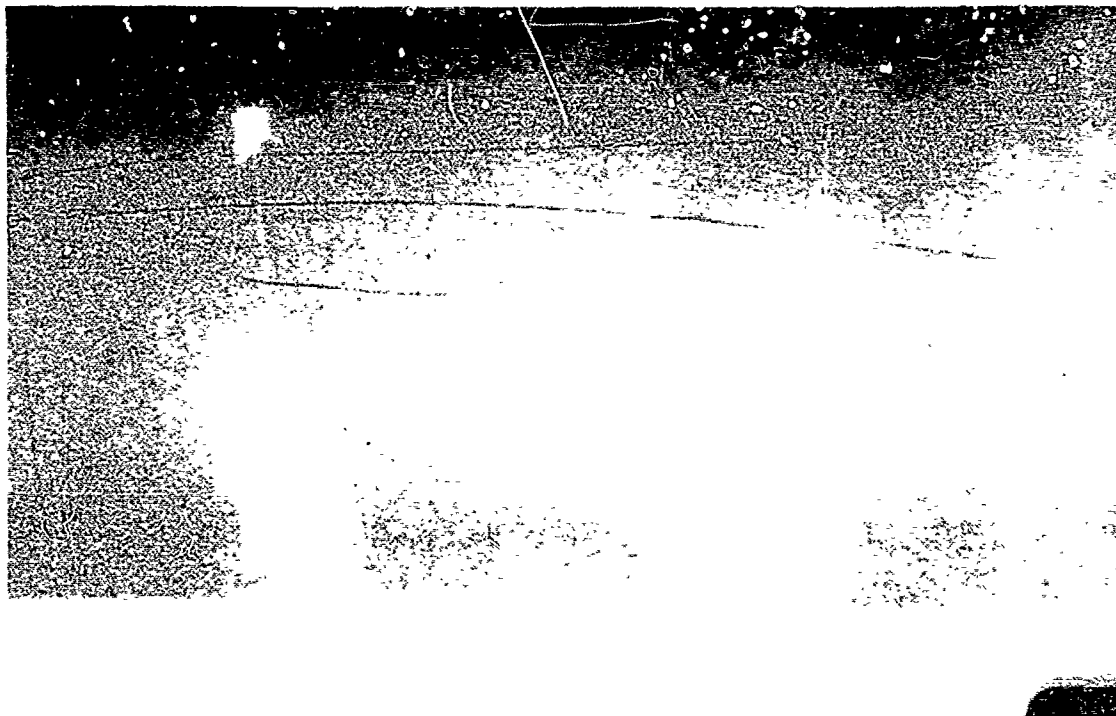


Fig. 6.2—Eastman photograph of shock wave crossing field of view of camera. Note position of triple point.

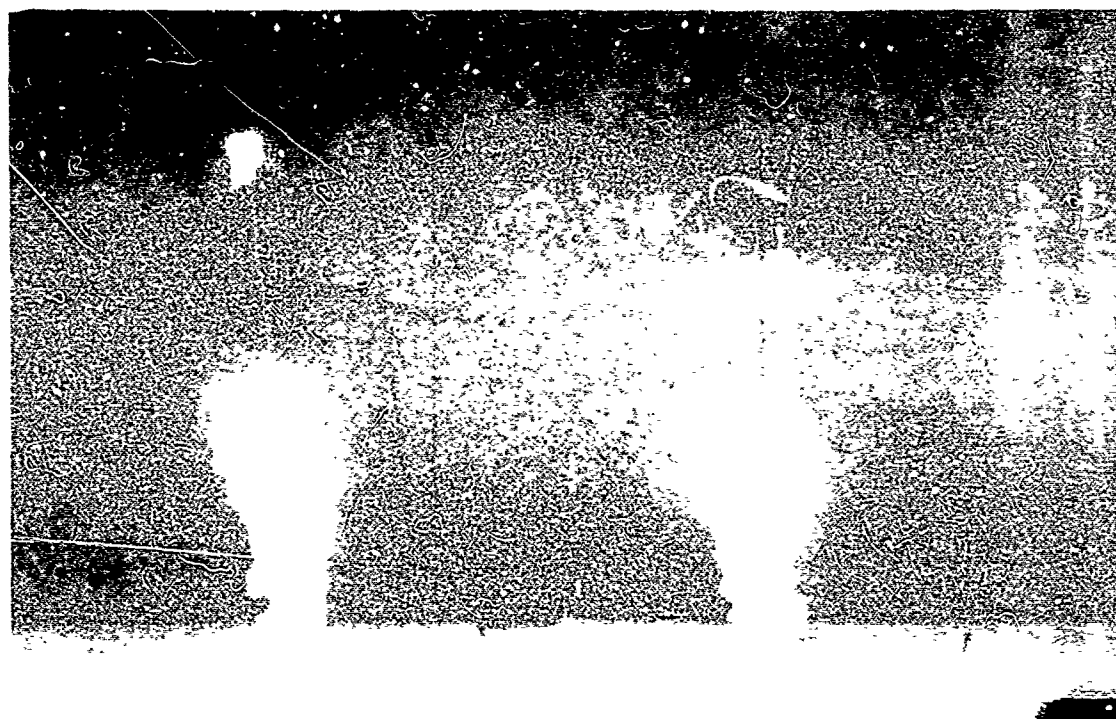


Fig. 6.3—Eastman photograph of shock wave crossing field of view of camera. 40 frames after Fig. 6.2. Right plume has shifted, and triple point has moved to a position between the two plumes.

Rocket trails were also used on the airdrop for the determination of particle velocity and as backup for the mortar-Jato stations. Here again a particle of smoke was assumed to behave identically with a particle of air. This was the first time rocket trails had been used for this purpose.

For two tower shots, TS 5 and 8, gun puffs of black smoke were photographed by three Mitchell cameras to record mass motion of the air. These records were not as successful as the white-smoke photographs, since all films were underexposed and showed weak positive motion only. Gun puffs were not used on TS 6 and 7.

Since no rocket trails were employed on the four tower shots, an attempt was made to photograph the visible shock wave leaving the fireball and also the formation of the stem and dust skirt. For this purpose, three Eastman cameras using microfilm were employed. Several of the films showed the shock wave clearly as it passed across the field of view of the camera. Figures 6.2 and 6.3 are excellent examples of the results of this technique. In these photographs, taken from a 16-mm Eastman record on the first shot, both the incident and reflected shock waves are clearly visible, first approaching one Jato and then, 40 frames later, between the two Jato plumes. The motion of the Jato which has been passed by the shock wave is evident from a comparison of the two pictures.

## 6.2 SHOCK-WAVE PROPAGATION

In order to study the velocity of the shock front on the four airdrops of Tumbler-Snapper, rocket trails were located perpendicular to the line of sight of the cameras, and the shock wave was photographed as it passed in front of these trails. The progress of the shock wave was then followed by observing the "hooks" in the rocket trails at the shock front. These hooks are due to the change in the index of refraction of the air at the shock front. This same system had previously been employed on Greenhouse.

The rockets were fired at  $85^\circ$  angles radially away from their respective photostations in order that the trails would appear as straight lines on the film.

High-speed Mitchell cameras, running at 100 frames/sec, obtained the film records which were then sent to the Naval Ordnance Laboratory for analysis.

The physical layout of the cameras with respect to the blast line and rocket trails is shown in Fig. 6.1.



## CHAPTER 7

### ADDITIONAL PHOTOGRAPHY

#### 7.1 THERMAL EFFECTS

This program was initiated by AFSWP to provide supplementary data to the general blast-measurement program. The study was to indicate the presence of "thermal dust" and "temperature gradients" near the ground. These dust, preshock-turbulence, light-absorption, and mirage effects were recorded with A-5 cameras running at approximately 35 frames/sec, located 200 ft off the blast line (see Fig. 7.1). These stations consisted of concrete cubicles 18 in. from the ground, into each of which a rack containing two cameras was inserted from the top. The access hole was then sealed with a lead block, and the pictures were taken through a glass window located on one side of the station.

Smoke generators were started prior to zero time, and the smoke pattern was photographed to show the behavior of pressure laminar and turbulent air flow.

Spotlights hung in the field of view at  $1\frac{1}{2}$ , 3, 6, and 12 ft from the ground were used to determine the amount of light absorption and air turbulence.

Temperature gradients were observed by noting air turbulence and the total reflection or refraction such as that associated with mirage conditions.

These pictures also provided a study of the thermal dust created before shock arrival from the intense heat which literally causes the ground to explode. All such films were turned over to AFSWP for analysis.

#### 7.2 CLOUD STUDIES

During Tumbler-Snapper the cloud formations associated with the various shots were photographed from various angles with cameras running at a variety of speeds for the purpose of studying cloud drift and rate of rise.

The cloud-rise program was designed to record the dimensions and altitudes attained by the cloud and stem following breakaway of the shock wave. High-speed Mitchell and Bell & Howell cameras and low-speed Eastman cameras were operated from two photostations for the three airdrops in Yucca Flat and from only one station for TS-1 and the four tower shots.

The cloud-tracking program utilized one station only. It was located at Mt. Charleston. This station was equipped with low-speed Mitchell and K-17 cameras. This study was undertaken for the three Yucca Basin airdrops only.

Results of analysis of these films by EG&G are listed in a memorandum issued as EG&G-OUT 996. A summation of these data is presented in Table 7.1. Cloud height and size are shown at 5, 15, and 30 sec after detonation for the first four shots. Owing to the fact that the tower shots were all predawn, no data could be obtained later than 5 sec on any of these. No films could be measured on TS-6.

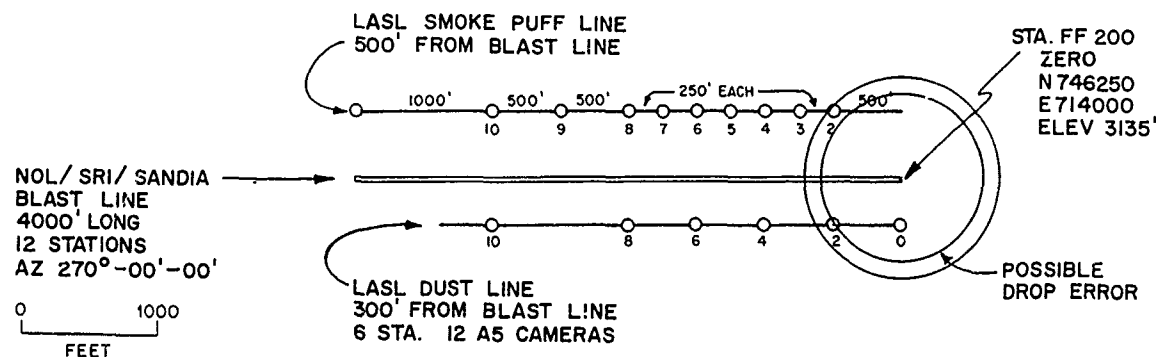


Fig. 7.1—Blast and dust station arrangement, TS-1.

### 7.3 LUMINOUS EMITTANCE AS A FUNCTION OF TIME

General Radio slit cameras using continuously moving 35-mm film were again employed during Tumbler-Snapper in an attempt to determine the range of bomb-light levels and the curve of this light as a function of time. The basic method of obtaining these records has been described previously.<sup>1</sup> To ensure at least one usable record for each degree of light intensity, a series of neutral-density filters in steps ranging from 0.5 to 3.0 was placed across the slit. Band-pass filters covering the blue, yellow, and infrared band were also used to permit determination of the spectral quality of the light emitted by the bomb.

An attempt was made to analyze these slit records using the Jarrell-Ash microphotometer pictured in Fig. 7.2. This instrument consists essentially of a moving film transport which passes across a slit. Light is projected through the slit onto a photocell which is, in turn, connected to a chart recorder. The trace thus obtained on chart paper shows variations in density along the strip of film. The film spools and chart spools may be adjusted so as to give a time resolution of about 10  $\mu$ sec.

The evaluation of the data thus obtained has run into several trouble areas which will require more extensive research, mainly in the study of emulsion sensitivities. It is not felt advisable to present the data obtained to date from the General Radio slit records until a more thorough study has been undertaken. It may be reported, however, that slit-record data coupled with density readings taken from Rapatronic plates have aided in obtaining the general shape of the light curve as a function of time. The data have also been helpful in predicting camera exposures required for operations following the Tumbler-Snapper series.

### 7.4 DISC CAMERA

Instrumentation suitable for yield determination from aircraft was again required on this operation. Accordingly, the Special Weapons Command installed an EG&G Disc camera in B-50 #7169 for use on TS 2 to 4. This aircraft was used as the drop aircraft on TS 2 and 3 and accompanied the drop aircraft on TS-4.

The principle and the operation of the Disc camera have been discussed generally in a previous report<sup>1</sup> and will be discussed in more detail in a forthcoming report.<sup>2</sup>

The Disc camera operated satisfactorily in all cases, giving measurable traces from all three streaks. Tables 7.2 to 7.4 summarize data obtained from these records. Separate curves of diameter vs time for each trace are shown in Figs. 7.3 to 7.5, indicating the close agreement of all three traces. Plots of  $\phi$  vs time, comparable to those for the Eastman records previously discussed, are presented in Figs. 7.6 to 7.8. It may be observed that very close agreement exists between Eastman and Disc camera records in all cases.

### REFERENCES

1. Technical Photography, Buster-Jangle Project 10.3 Report, WT-417, December 1952.
2. Airdrop Instrumentation, Disc Camera, Greenhouse Report, Annex 1.9, Part III.

Table 7.1—SUMMARY OF CLOUD-TRACKING DATA

				NAME TUMBLEE-SNAPPER			DATE	JOB NO.
SHOT	BURST HEIGHT (METERS)	TIME (SEC)	HEIGHT ABOVE BURST (METERS)	HORIZ DIAM (METERS)	VERT. THICK (METERS)	STEM WIDTH (METERS)		
1	242	5	155	300	195	70		
		15	415	430	169	40		
		30	738	640	205	115		
2	338	5	139	270	237	—		
		15	393	400	385	—		
		30	799	570	295	83		
3	1051	5	265	720	270	—		
		15	692	990	410	—		
		30	1390	1255	250	—		
4	317	5	276	540	345	190		
		15	733	818	284	135		
		30	1390	1090	280	200		
5	96	5	26	505	230	185		
		15	—	—	—	—		
		30	—	—	—	—		
6	96	5	No DATA AVAILABLE					
		15	"	"	"	"	"	"
		30	"	"	"	"	"	"
7	96	5	131	485	250	240		
		15	—	—	—	—		
		30	—	—	—	—		
8	96	5	6	470	375	—		
		15	—	—	—	—		
		30	—	—	—	—		

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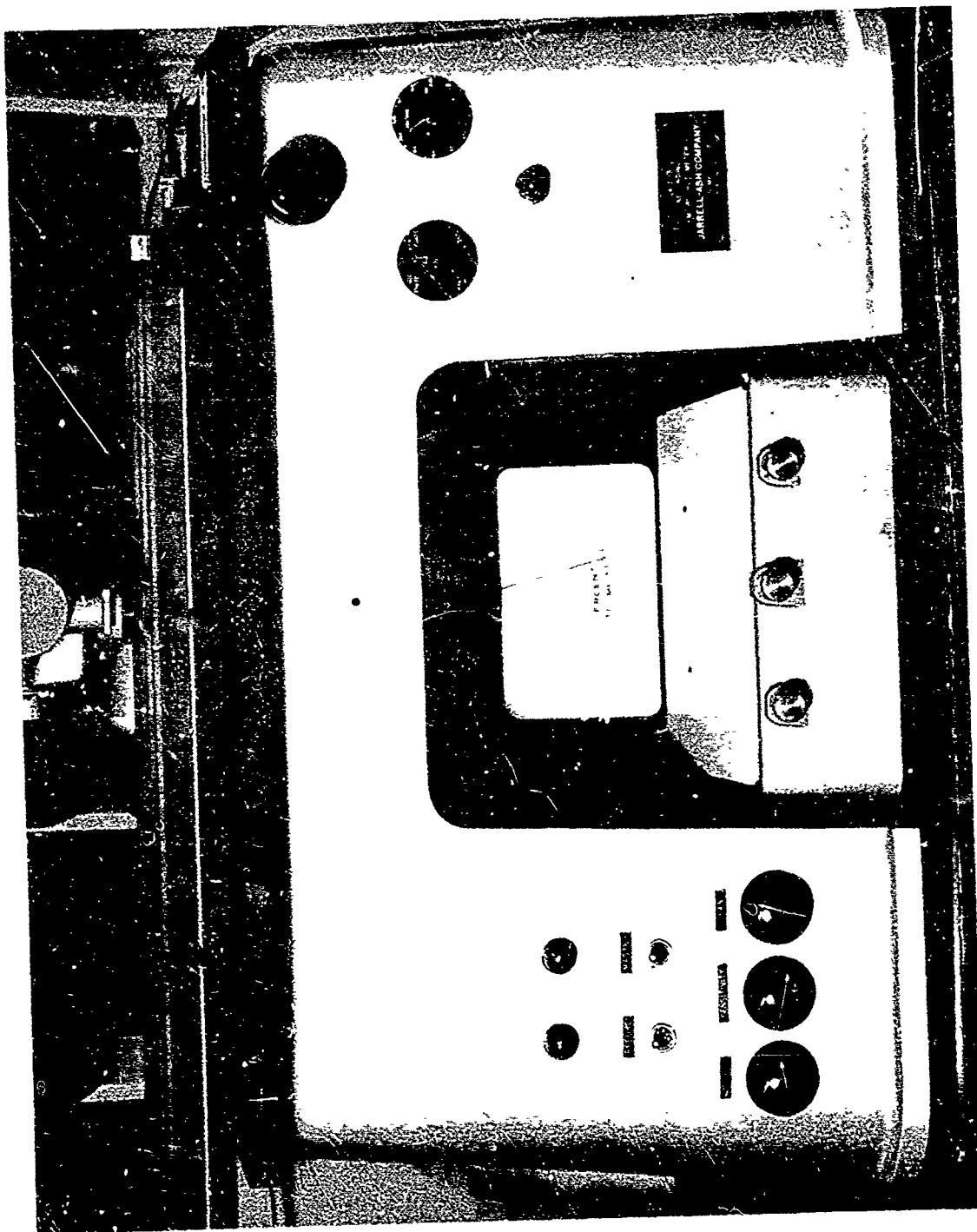


Fig. 7.2—Jarrell-Ash microphotometer.

Table 7.2—DISC CAMERA SUMMARY, TS-2

Time (ms)	t <sup>2/5</sup>	NAME			DATE			JOB NO.
		Diameter (meters)			$\phi$ (m/ms <sup>2/5</sup> )			
		Outer Trace	Middle Trace	Inner Trace	Outer Trace	Middle Trace	Inner Trace	
1.01	.9960	48.60	47.61	48.38	48.40	47.42	48.19	
1.52	.8458	58.62	54.19	54.41	47.04	45.83	46.02	
2.03	.7733	60.99	59.24	59.57	45.94	44.63	44.87	
2.53	.6898	44.39	62.75	63.74	44.42	43.28	43.97	
3.04	.6410	68.56	67.25	67.25	43.95	43.11	43.11	
4.05	.5715	74.82	73.39	73.28	42.76	41.94	41.88	
5.06	.5228	80.52	78.44	78.22	42.10	41.01	40.89	
6.08	.4858	84.58	83.04	83.37	41.10	40.34	40.50	
7.09	.4568	89.08	86.66	87.32	40.69	39.59	39.88	
7.60	.4443	90.94	88.53	89.30	40.40	39.33	39.68	
8.10	.4331	92.17	89.73	90.50	40.05	38.86	39.20	
8.61	.4227	93.90	91.38	92.15	39.69	38.63	38.95	
9.12	.4130	95.33	92.70	94.02	39.37	38.29	38.83	
9.62	.4043	96.76	94.56	94.67	39.12	38.23	38.28	
10.13	.3960	97.96	95.33	95.55	38.79	37.75	37.84	
10.63	.3885	99.29	96.65		38.57	37.51		
11.14	.3813	101.3	98.18	98.07	38.63	37.44	37.94	
11.65	.3745	101.9	99.39		38.16	37.22		
12.15	.3683			99.72			36.73	
12.66	.3622	104.1	101.6		37.71	36.80		
13.17	.3566			101.6			36.23	
13.67	.3513	106.2	103.9		37.31	36.50		
14.19	.3413	110.4	106.0		37.68	36.18		
15.19	.3368			106.4			35.50	
15.70	.3324	111.3	107.9		37.00	35.87		
16.71	.3242		109.5			35.50		
17.22	.3203			109.4			35.04	
18.23	.3131	115.4			36.13			
18.74	.3096		112.8			34.92		
19.24	.3064			112.0			34.32	
19.75	.3032	117.9			35.75			
21.27	.2944		114.2	114.8		33.62	33.80	
21.78	.2916	121.8			35.55			
23.29	.2839			117.2			33.27	
24.81	.2768	125.6			34.77			
25.32	.2746			118.9			32.65	
26.33	.2703	126.7			34.25			
27.35	.2662			121.1			32.24	

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Table 7.3—DISC CAMERA SUMMARY, TS-3

Time (ms)	t <sup>-215</sup>	NAME			DATE			JOB NO.	
		Diameter (microns)	Outer Trace	Middle Trace	Inner Trace	φ (m/ms <sup>215</sup> )	Outer Trace		Middle Trace
1.02	.9921	89.60	87.88	89.60		88.89	87.19	88.89	
1.53	.8436	100.7	99.90	99.90		84.95	84.27	84.27	
2.04	.7519	102.6	109.1	110.8		77.14	82.03	83.31	
2.56	.6866	109.4	116.8	119.4		75.11	80.19	81.98	
3.07	.6385	123.9	123.6	126.9		79.11	78.92	81.03	
3.58	.6004	130.0				78.05			
4.09	.5693	135.5	136.0	139.9		77.14	77.42	79.65	
4.60	.5431	140.8				76.47			
5.11	.5207		146.7	149.7			76.39	77.95	
5.62	.5013	150.0				75.20			
6.13	.4842		156.6	160.6			75.83	77.76	
6.64	.4690	158.9				74.52			
7.15	.4553	163.6	166.2	169.8		74.49	75.67	77.31	
7.67	.4427	168.0	171.7			74.37	76.01		
8.18	.4314	173.0	175.1	177.8		74.63	75.54	76.70	
8.69	.4211		179.4	183.9			75.55	77.44	
9.20	.4116		183.1	186.5			75.36	76.76	
9.71	.4029		186.1	190.3			74.96	76.65	
10.22	.3946		190.4	195.1			75.13	76.99	
10.73	.3870		193.3	197.6			74.81	76.47	
11.24	.3799		192.8	201.8			73.24	76.66	
11.75	.3732			204.5				76.32	
12.26	.3670			208.5				76.52	
12.78	.3609			211.8				76.44	
13.29	.3553			213.4				75.82	
13.80	.3500								

EDGERTON, GERMESHAUSEN & GRIER, INC.  
BOSTON, 15, MASSACHUSETTS

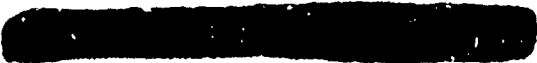


Table 7.4—DISC CAMERA SUMMARY, TS-4

		NAME			DATE			JOB NO.
Time (ms)	$t^{-2/3}$	Diameter (microns)			$\phi$ (m/ms <sup>2/3</sup> )			
		Outer Trace	Middle Trace	Inner Trace	Outer Trace	Middle Trace	Inner Trace	
1.01	.9960	72.5	73.3	74.9	72.2	73.0	74.6	
1.52	.8458	83.8	84.0	85.6	70.9	71.0	72.4	
2.02	.7548	92.7	92.8	94.6	70.0	70.0	71.4	
2.53	.6998	99.6	100.9	102.4	68.7	69.6	70.6	
3.04	.6410	107.0			68.6			
3.54	.6031		113.4	114.9		68.4	69.3	
4.05	.5715	118.6			67.8			
4.55	.5455		123.8	125.4		67.5	68.4	
5.06	.5228	127.9			66.9			
5.57	.5031		131.7	134.7		66.8	67.8	
6.07	.4861	136.3			66.3			
6.58	.4707		140.3	142.6		66.0	67.1	
7.09	.4568	143.4	144.2		65.5	65.9		
7.59	.4445		148.6	150.6		66.1	66.9	
8.10	.4331	152.9	150.7		66.2	65.3		
8.60	.4229			157.8			66.7	
9.11	.4132	159.9			66.1			

EDGERTON, GERMESHAUSEN & GRIER, INC  
 BOSTON, 15, MASSACHUSETTS

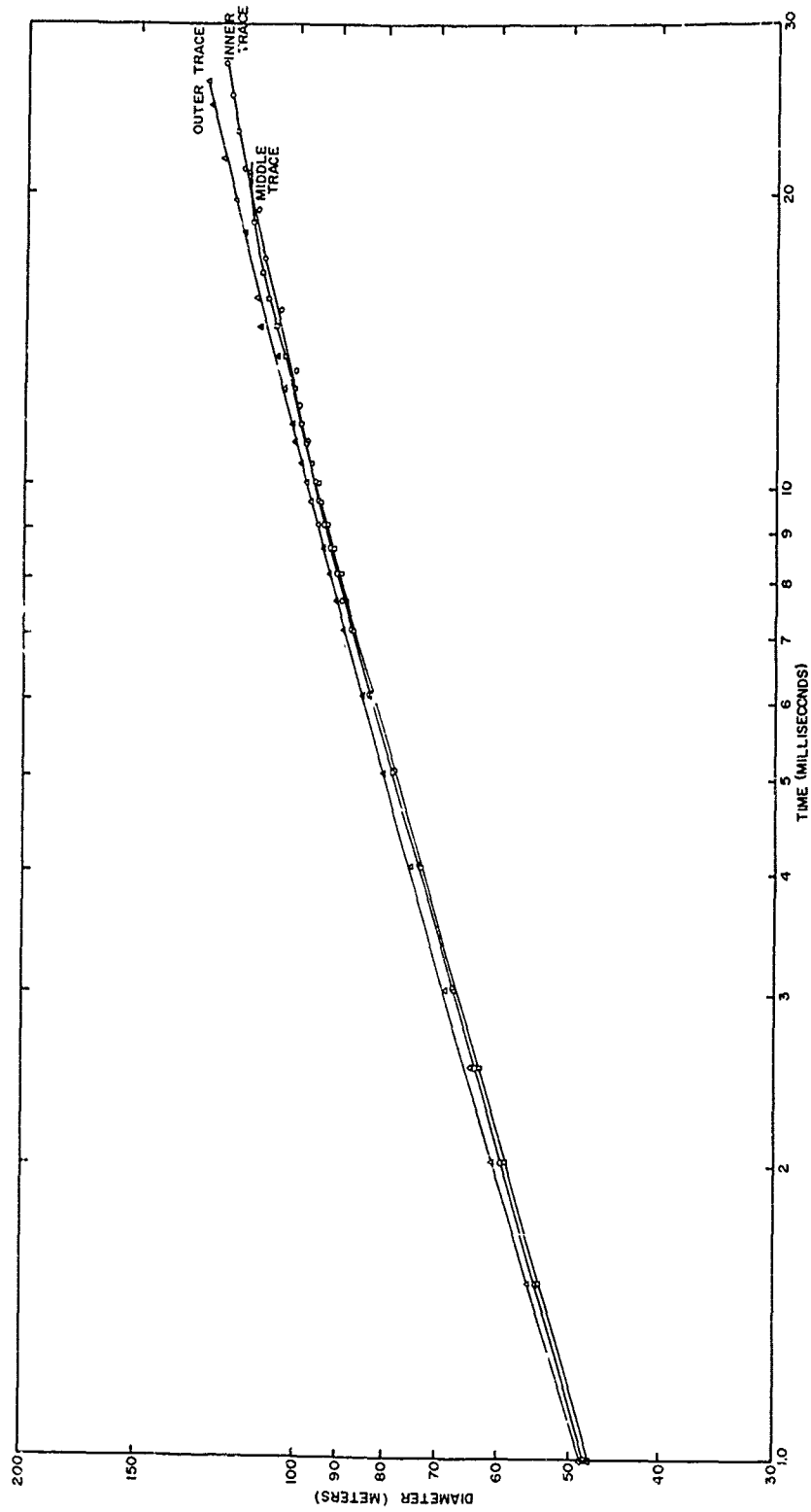


Fig. 7.3—Disc camera record of fireball diameter vs time, TS-2, 15 April 1952.



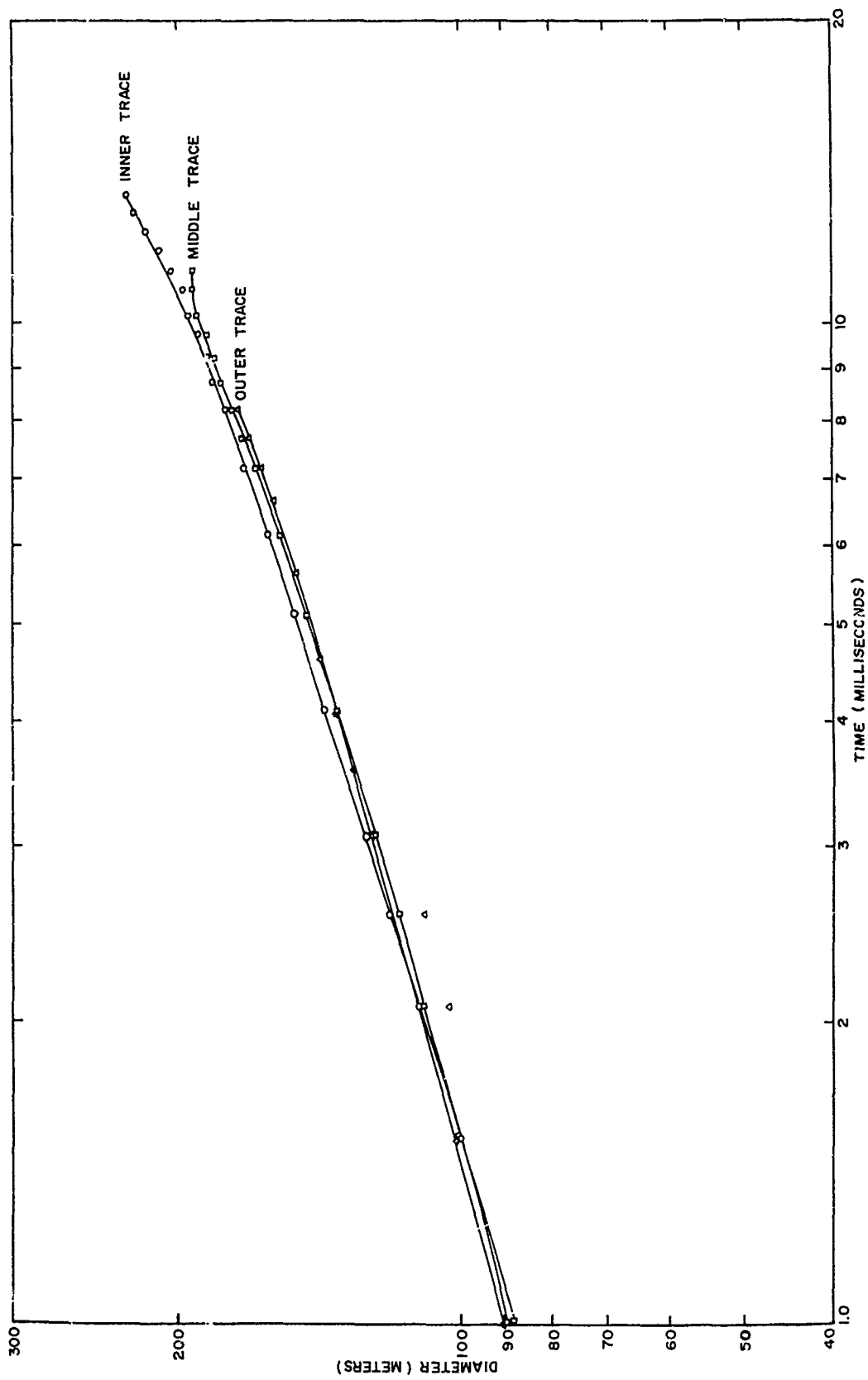


Fig. 7.4—Disc camera record of fireball diameter vs time, TS-3. 22 April 1952.

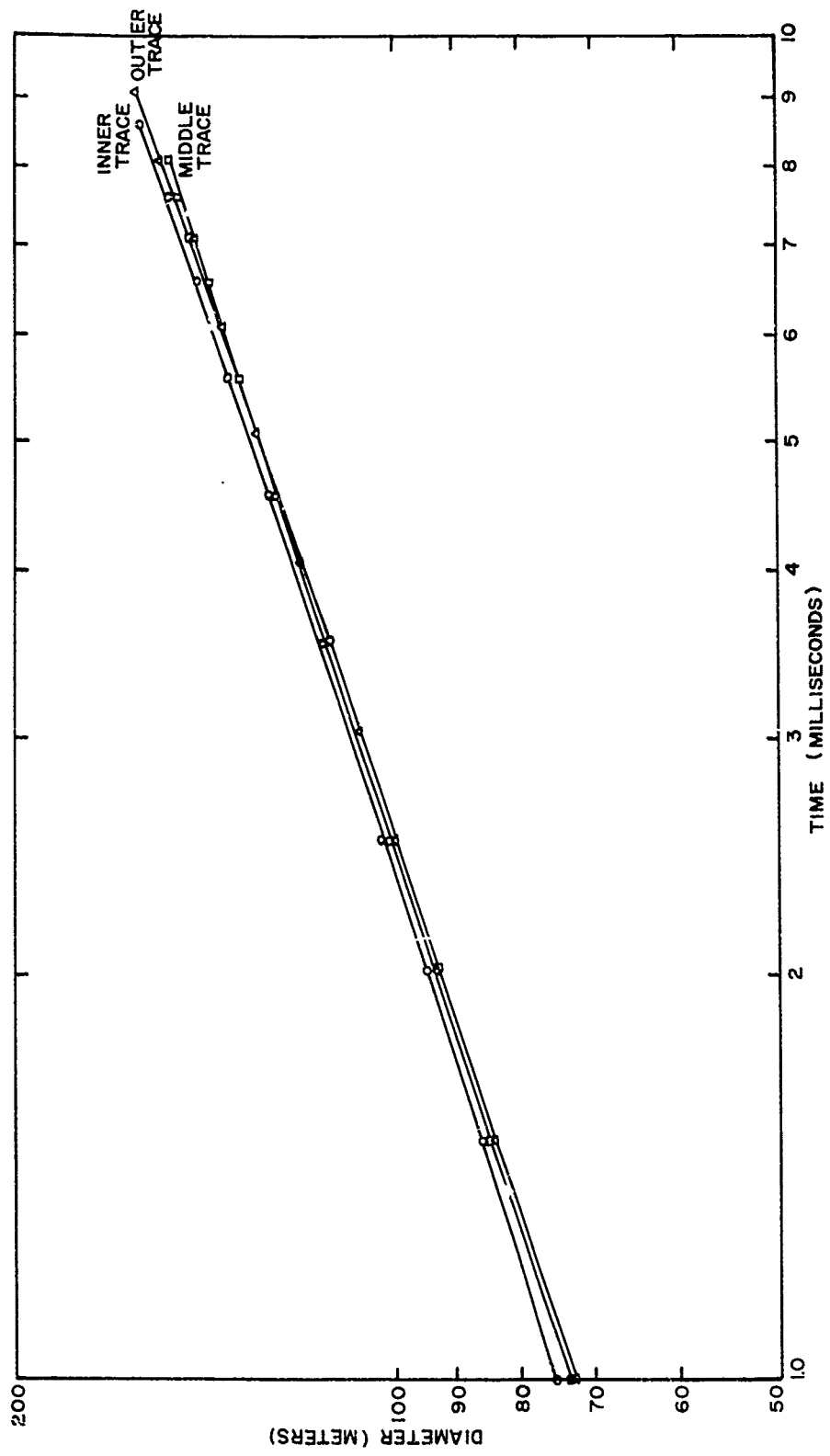


Fig. 7.5—Disc camera record of fireball diameter vs time, TS-4, 1 May 1952.

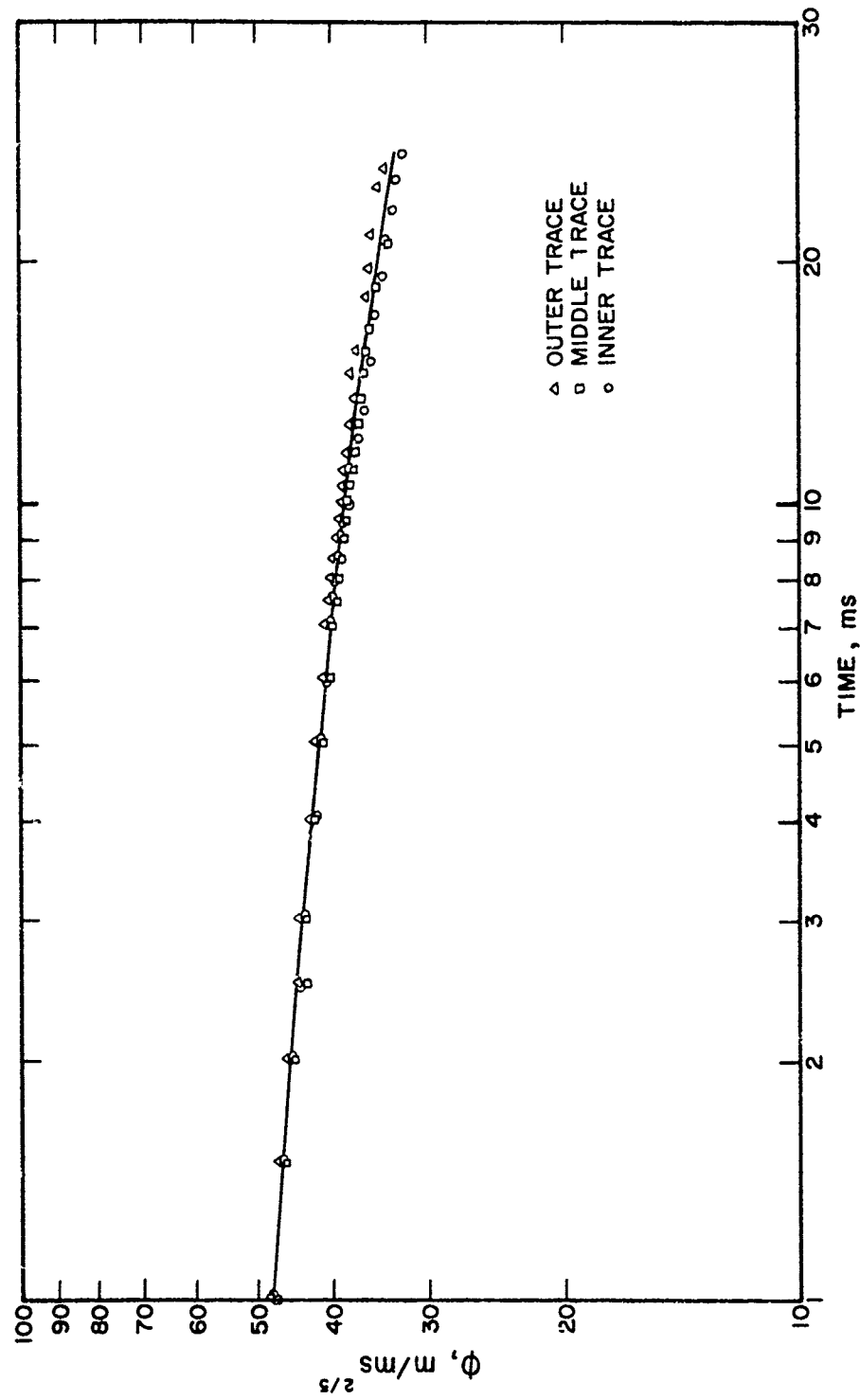


Fig. 7.6—Disc camera record of  $\phi$  vs time, TS-2.

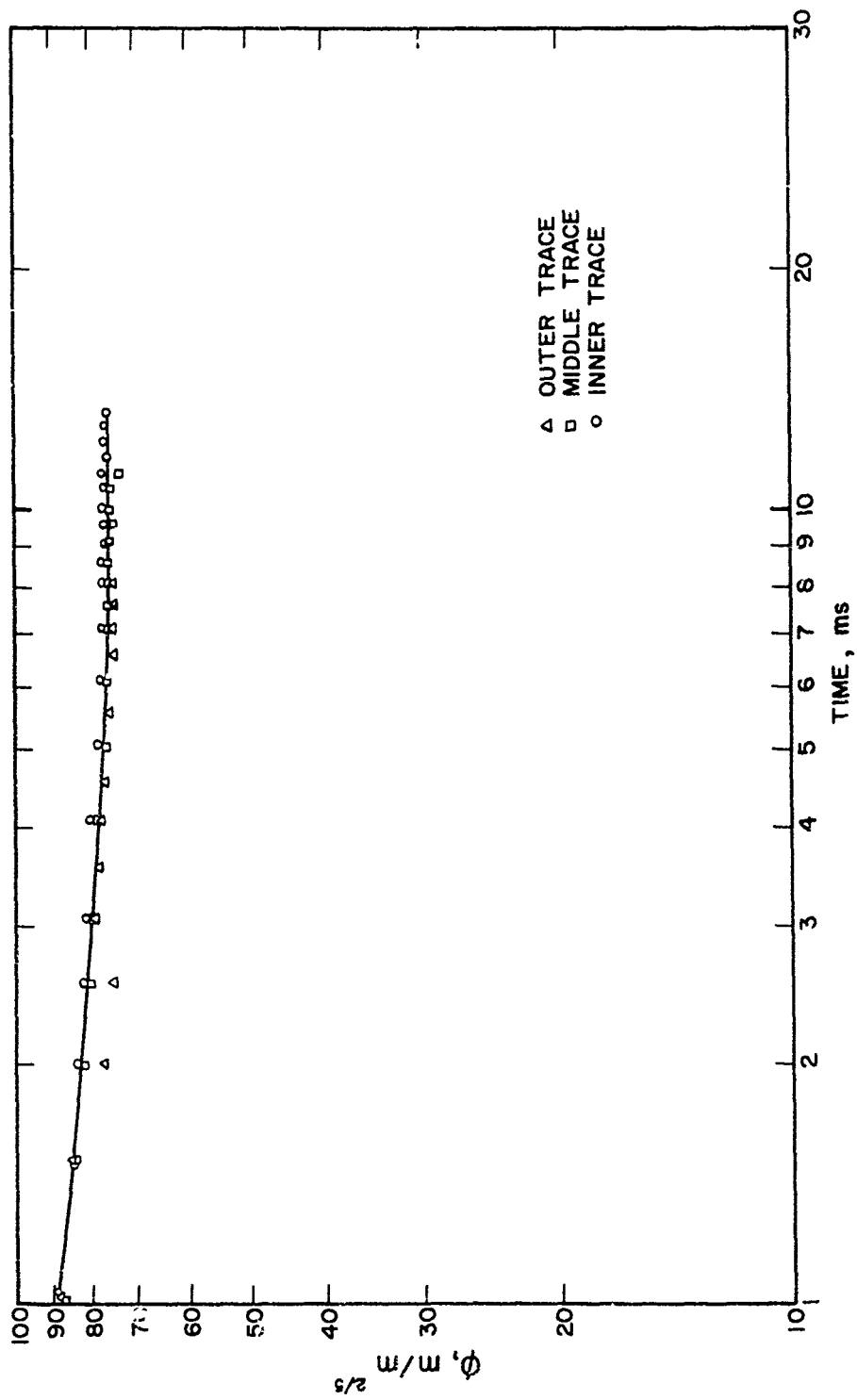


Fig. 7.7—Disc camera record of  $\phi$  vs time, TS-3.

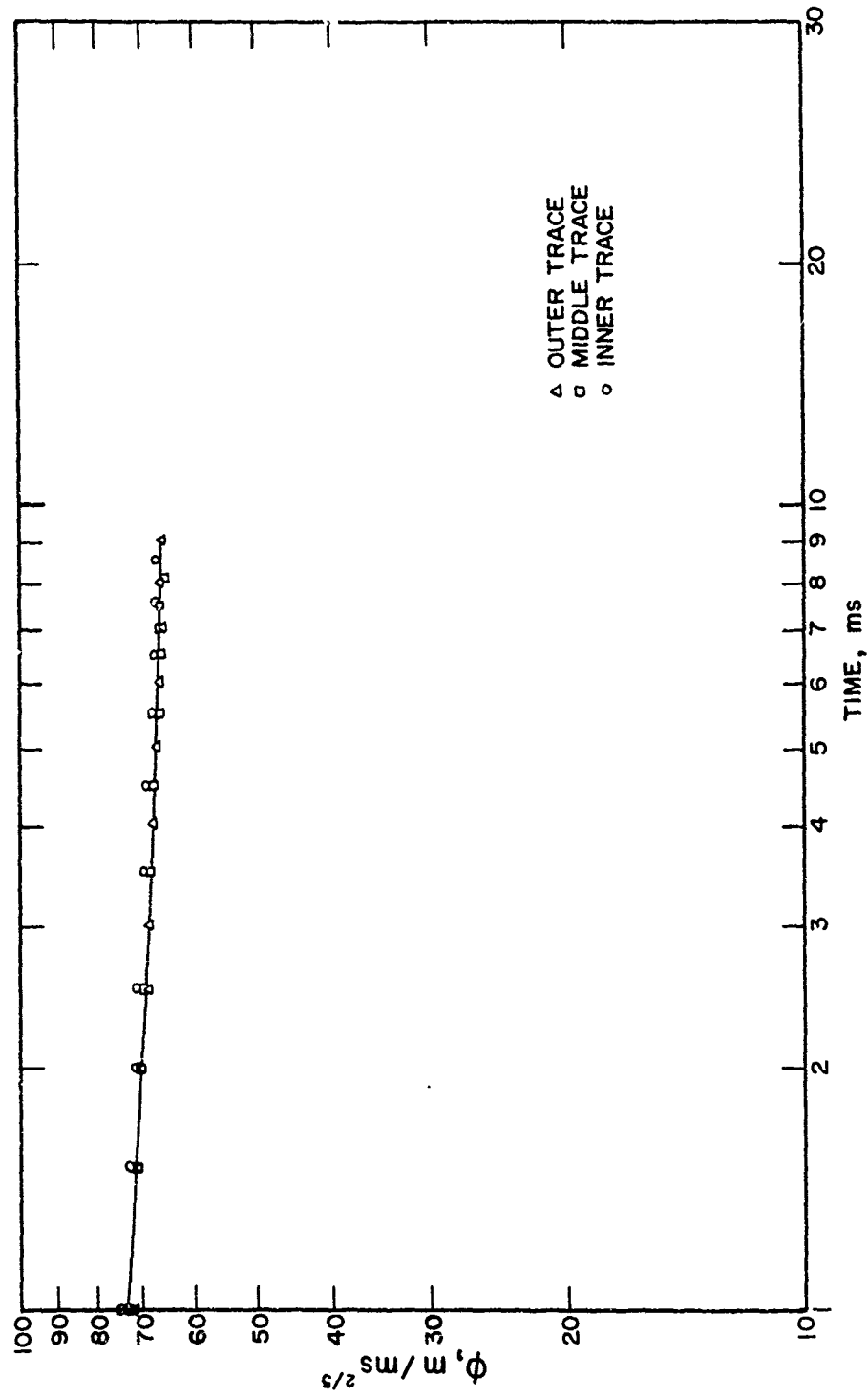


Fig. 7.8 --- Disc camera record of  $\phi$  vs time, TS-4.

APPENDIX A

**CAMERA DATA SHEETS**



EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST HE. Drop DATE 3/30/50 STA. F360

Tumbler

Truck 1

PERF. CODE	EMULS.	FILTERS		APER. SET.	AIMING		POWER	TIMING		MARKERS, SERIALS			RACK POS.	CAM NO.
		ND	COLOR		HORIZ.	VERT.		ON	OFF	FM.	VEL.	ZERO		
12278	S-XX	0	0	4	13°-07'	0°-36'	120VDC 135	-2.55	self	25	200-4	4	A	E-17
77	BX				11-27						10	10	B	20
76	S-XX				9-45						9	9	C	21
75	BX				8-03						4	4	D	10
74	MF				6-21						10	10	E	26
73	"				4-39						9	9	F	27
00	Neg. Pan				0-00	5°-07'	40/80				4	4	G	7
01	"								-1.5		10	10	H	12
02	"								-0.5		9	9	I	18
13	ECN	↓	↓	28	↓	↓	↓	13.5	-2.5	↓	10	10	L	11
12235	MF	C	12	32	0-00	Level	24VDC	BB	self	4	-	-	Apron	W-148
37	"	"	0	22	"	"	"	"	"	1	-	-	"	K-528



EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST HEAD DATE 3/30/52 STA. F-361  
 Tumbler 09:30 Trailer 4

REMARKS & NOTES	~ FR./SEC.	CAMERA			TIME OPER.	LENS		
		NO.	SERIAL	MAG.		FOC. LGH.	SERIAL	
Raise front 15% frgn. ↓	100	MH-7	742			400	52236	
			3	734			"	52237
			2	747			"	52238
			4	745			75	B51712
			B	744			"	B51984
		BH-5				25	279097	
		R-8	8		5040ms	480	173944	
		10	10		4000		3961	
		26	26		10		4696	
		31	31		30		3948	
		9	9		100		4694	
		33	33		403		3950	
		5	5		30		3956	
		6	6		50		3949	



EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST H.E. Jimp DATE 2/20/52 STA. F-361  
 Tumbler 09:30 Trailer 4

PERF. CODE	EMULS.	FILTERS		APER. SET.	AIMING		POWER	TIMING		MARKERS, SERIALS			RACK POS.	CAM NO.
		ND	COLOR		HORIZ.	VERT.		ON	OFF	FM.	VEL.	ZERO		
12270	MF	0	0	5 170°	17-21'L	Level	120VAC	-155	+455	-	100-3	-	Q	MH-7
71					14-00								P	3
72					0-00	1/2 Front							O	2
81				23		2 Front							N	4
82													PP	8
19	↓	↓	↓	↓	↓	16°30'	↓	↓	↓	↓	↓	↓	QQ	BH-5
NONE	NONE	0	0	11	0-00	5'00"	115AC 24DC	-15m	+35	24	-	-	R	R-8
								-255		24			S	10
										10			T	26
										24			U	31
										24			V	9
										10			W	33
										10			X	5
										10			Y	6

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST 4E100 DATE 3/30/52 STA. F-342  
Tumbler 09:30 Vehicles 2 & 5

REMARKS & NOTES	CAMERA			TIME OPER.	LENS		
	~ FR./SEC.	NO.	SERIAL		MAC.	FOC. LGH.	SERIAL
	3000	E-8	1445			63mm	ET1254
	"	15	1494			"	RC606
	770	1	1454			152	RC245
	3000	16	1513			63	ET1245
	"	9	1493				RC622
	770	2	1317				RC549
	3000	25	1520				ET1223
	"	24	1522				RC539
	770	4	1321			25	RY165
	"	6	1318			"	RY187
	30 FT/S	GR-2				--	--
		W-47	147			165	147
		K-529				480	774529
	100	MH-1	748			75	BS1764
	↓	5	743			75	BS1805
		BH-2	1093			25	281674
	↓	3	1095			100	282354
	30 FT/S	GR-5	667			NONE	NONE
	"	6	669			"	"
		R-14	14			480	
		24	24				
		4	4				
		19	19				
		18	18				
		29	29				
		12	12				
		17	17				

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST HE DROP DATE 2/30/52 STA. F-362  
Tumbler 09:30 VEHICLES 215

PERF. CODE	EMULS.	FILTERS		APER. SET.	AIMING		POWER	TIMING		MARKERS, SERIALS			RACK POS.	CAM NO.
		ND	COLOR		HORIZ.	VERT.		ON	OFF	FM.	VEL.	ZERO		
12203	MF	0	0	2.8	0°-00'	4°-30'	120V 40/80	-2.5S	SELF				A	E-8
04				"		"	"	"					B	15
14				4		1°-06'	13.5Ω	"					C	1
05				2.8		4°-30'	40/80	-1.5					D	16
06						"	"	"					E	9
15						2°-50'	13.5Ω	-2.5					F	2
07						4°-30'	40/80	-0.5					G	25
08						↓	"	"					H	24
16					6°51'L	↓	13.5Ω	-2.5					I	4
17	↓	↓	↓	↓	"	↓	"	"	↓				L	6
27	S-XX	step	↓	—	0-00	LEVEL	↓	—	"	+3S			K	GR-2
12236	MF	0	12	24	0-00	LEVEL	24VDC	BB 1/200	SELF				Apron W-147	
38	"	"	0	22	"	"	"	"	"				"	K-29
12283	MF	0	0	23 170°	6°51'L	LEVEL	120V	-15S	+45S		100-5		P	MH-1
84						RAISE FRONT							PP	5
20						17°-00'							Q	BH-2
21	↓	↓	↓	↓	0-00	3°-00'		↓	↓				QQ	3
28	S-XX	step		—		LEVEL		-25S	+3S		200-2		N	GR-5
29	"	"		—		"	↓	"			↓		O	6
NONE	NONE	0	0	11		4°30'	115VAC 24VDC	-15m					R	R-14
								-2.5S					S	24
													T	4
													U	19
													V	18
													W	29
													X	12
													Y	17



EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST Dry Run DATE 3/27/52 STA. F-DUST  
H.E. 10:00

PERF. CODE	EMULS.	FILTERS		APER. SET.	AIMING		POWER	TIMING		MARKERS, SERIALS			RACK POS.	CAM NO.
		ND	COLOR		HORIZ.	VERT.		ON	OFF	FM.	VEL.	ZERO		
12096	MF	0	0	2.3	F200	LEVEL	24VDC	-45	+175	-	2-5	-	F363	MAS-27
81					"						5		"	22
92					F202						6		364	19
91					"						6		"	6
94					F204						3		365	18
97					"						3		"	3
98					F206						7		366	17
93					"						7		"	9
95					F208						8		367	23
84					"						8		"	16
89					F210						9		368	25
98	↓	↓	↓	↓	"	↓	↓	↓	↓	↓	9	↓	"	20
12285	MF	0	0	2.5	F208	LEVEL	24VDC	-45	+175	-	2-8	-	F208	MAS-28
86	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	5
87	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	16

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST TS-1 DATE 4/1/52 STA. F-361  
09:00 TRAILER 4

REMARKS & NOTES	~ FR./SEC.	CAMERA			TIME	LENS	
		NO.	SERIAL	MAG.	OPER.	FCC. LGH.	SERIAL
Raise Front 15% FROND	PURPOSE S.P. 9 100	MH-7	742			400mm	52236
	S.F. 8	3	73A				52237
	UNDEREXPOS. ~ 12 FR.	2	747			↓	52238
	GND. STRIKE	4	745			75	BS1712
	ROCKETS	8	744			"	BS1984
TILT ↓	CLOUD ↓	BH-5	1096			25	279097
	YIELD	R-8	8		5040 μs	480	773994
	"	10	10		4000		3961
	F.B.	26	26		11.0		4696
	↓	31	31		32.2		3948
	↓	9	9		99.8		4694
	↓	33	33		403		3950
	SPECTR.	5	5		29.7		3956
	"	6	6		50.3	↓	3949

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST TS-1 DATE 4/1/58 STA. F-361  
09:00 TRAILER 4

PERF. CODE	EMULS.	FILTERS		APER. SET.	AIMING		POWER	TIMING		MARKERS, SERIALS			RACK POS.	CAM NO.
		ND	COLOR		HORIZ.	VERT.		ON	OFF	FM.	VEL.	ZERO		
13070	MF	0	0	6.3 170°	17° 21'	0° 17'	120VDC	-155	+455	-	100-3	-	Q	MH-1
71	ECN	"	"	8 170°	14-06L	0° 11'					3		P	3
72	MF	1	12	11 15°	0-00	0° 33'					1		O	2
81	↓	0	↓	8 15°		LEVEL					3		N	4
82	↓	↓	↓	4 15°		"					3		PP	8
19	ECN	↓	0	4 120°	↓	16° 20'		↓	↓	↓	1	↓	QQ	5
13053	Tri-X	0	0	11	0-00	5° 02'	115AC ↑	-15M ↑	+35	24	-	-	R	R-8
54	"						24DC	-255		24			S	10
45	HRHS									10			T	26
46	"									24			U	31
41	MF									24			V	9
42	"		↓							10			W	33
49	EKTA		CC40M							10			X	5
50	"	↓	"	↓	↓	↓	↓	↓	↓	↓	↓	↓	Y	6



EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST TS-1 DATE 4/1/52 STA. F-360  
09:00 Truck 1

REMARKS & NOTES			CAMERA			TIME	LENS	
PURPOSE	~ FR./SEC.		NO.	SERIAL	MAG.	OPER.	FOC. LGH.	SERIAL
TOO HEAVY EXPOS.	S.P. 7+8	B-105 RUNNING	E-17	1496		1-2-3+	152	RC273
" "	6+7		20	1525				313
Too	" "	5+6	21	1519				257
" "	" "	4+5	10	1515				358
O.K.	" "	3+4	26	1518				334
" "	" "	2+3	27	1514				253
	F.B.	3000	7	1443		1 <sup>st</sup> SEQ.	63	ET1229
	F.B.		12	1512		2 <sup>nd</sup> "		1207
	F.B.		18	1517		3 <sup>rd</sup> "		1253
	SHOCK	B-105 RUNNING	11	1521		1-2-3+	25	RY175
	SURVEY	SHUTTER 1/2005	W-148	148			165	148
	"	" 1/505	K-528				480	774528

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST TS-1 DATE 4/1/52 STA. F-360  
09 03 TRUCK 1

PERF. CODE	EMULS.	FILTERS		APER. SET.	AIMING		POWER	TIMING		MARKERS, SERIALS			RACK POS.	CAM NO.
		ND	COLOR		HORIZ.	VERT.		ON	OFF	FM.	VEL.	ZERO		
13018	S-Xx	0	0	4	13°-07'	0°-36'	120DC Shunt	-2.5S	SELF T45	23	200-4	4	A	E-17
77	BX		0		11-27						10	10	B	20
76	S-XX		12		9-45						9	9	C	21
75	BX				8-03						4	4	D	10
74	MF				6-21						10	10	E	26
73				↓	4-39	↓					9	9	F	27
00				8	0-00	5°-07'	40/30	↓			4	4	G	7
01								-1.5			10	10	H	12
02	↓			↓				-0.5			9	9	I	18
13	ECP	↓	0	4	↓	↓	Shunt	-2.5	↓		10	10	L	11
13035	MF	0	12	32	0-00	LEVEL	24VDC	BB	SELF	TSP +	-	-	Apron	W-148
37	"	1	12	22	"	"	"	"	"	TSP	-	-	"	K-522

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST IS-1 DATE 4/1/52 STA. F-362

09:00 Truck 2 + Trailer 5

REMARKS & NOTES	FR./SEC.	CAMERA			TIME OPER.	LENS	
		NO.	SERIAL	MAG.		FOC. LGH.	SERIAL
YIELD	3000	E-8	1445		1 <sup>st</sup> SEQ.	63 mm	ET1254
"	"	15	1494		"	"	RC606
STEM	8-10s RUNNING	1	1454		1-2-3+	152	RC245
YIELD	3000	16	1513		2 <sup>nd</sup> SEQ.	63	ET1245
"	"	9	1493		"		RC622
COLOR	8-10s RUNNING	2	1317		1-2-3+		RC549
YIELD	3000	25	1520		3 <sup>rd</sup> SEQ.		ET1223
"	"	24	1522		"		RC539
SHOCK	8-10s RUNNING	4	1321		1-2-3+	25	RY165
"	"	6	1318		"	"	RY187
ND 0, 0.5, 1.0, 1.5, 2.0, 3.0 LIGHT (T)	30 1/5	GR-2	581		"	-	-
SURVEY	SHUTTER 1/200S	W-147	147		-	165	147
"	" 1/150S	K-529	41-1194		-	480	774529
ROCKETS	100	MH-1	748		-	75	BS1764
"		5	743			75	BS1805
CLOUD		BH-2	1093			25	281674
STEM		3	1095			100	282345
ND 0, 0.5, 1.0, 1.5, 2.0, 3.0 LIGHT (T)	30 1/5	GR-5	667			-	-
"	"	6	669			-	-
YIELD		R-14	14		3000μs	480	773951
"		24	24		2632		3958
F.B		4	4		17.7		3947
"		19	19		49.9		2890
"		18	18		212		3955
"		29	29		780		3954
SPECTR.		12	12		36.3		3960
"		17	17		80.0		3951

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST TS-1 DATE 4/1/52 STA. F-362  
09:00 Truck 2 Trailer 5

PERF. CODE	EMULS.	FILTERS		APER. SET.	AIMING		POWER	TIMING		MARKERS, SERIALS			RACK POS.	CAM NO.
		ND	COLOR		HORIZ.	VERT.		ON	OFF	FM.	VEL.	ZERO		
13003	MF	0	12	4	0°-00'	4°-30'	120V 40/80	-2.55	SELF	22	200-8	B	A	E-8
04	"	1	12	5.6	"	"	"	"	"	"	7	7	B	15
14	ECP	1	0	5.6	"	1°-06'	SHUNT	"	"	"	12	12	C	1
05	MF	0	12	4	"	4°-30'	40/80	-1.5	"	"	8	8	D	16
06	"	1	12	5.6	"	"	"	"	"	"	7	7	E	9
15	ECP	2	0	5.6	"	2°-50'	SHUNT	-2.5	"	"	12	12	F	2
07	MF	0	12	4	"	4°-30'	40/80	-0.5	"	"	8	8	G	25
08	"	1	12	5.6	↓	"	"	"	"	"	7	7	H	24
16	ECN	1	0	4	6°-51' L	"	SHUNT	-2.5	"	"	12	12	I	4
17	"	2	0	4	"	↓	"	"	↓	"	8	8	L	6
27	S-XX	Step #4	12	—	0-00	LEVEL	↓	—	"	+33	↓	12	12	K GR-2
13036	MF	0	12	24	0-00	LEVEL	24VDC	B.B	SELF	TSP 5	—	—	Apron	W-147
38	"	1	12	22	"	"	"	"	"	TSP 3	—	—	"	K-59
13083	MF	0	12	4 15°	6°-51' L	LEVEL	120VDC	-15s	+45s	—	100-5	—	P	WH-1
84	"	"	"	8 15°	"	"	"	"	"	"	"	"	PP	5
20	ECN	"	0	11 170°	"	17°-00'	"	"	"	"	"	"	Q	BH-2
21	"	↓	"	11 30°	0°-00	4°-40'	"	"	"	"	"	"	QQ	3
28	SXX	Step #10	47	—	"	LEVEL	"	-2.55	+3s	"	200-2	"	N	GR-5
29	IR	Step #12	89B	—	"	"	"	"	"	"	"	"	O	6
55	TRI-X	0	0	11	"	4°-30'	115WAC 24VDC	-15m	"	"	16	—	R	R-14
47	HRHS	"	"	"	"	"	"	-2.55	"	"	"	"	S	24
48	"	"	"	"	"	"	"	"	"	"	"	"	T	4
43	MF	"	"	"	"	"	"	"	"	"	"	"	U	19
44	"	"	"	"	"	"	"	"	"	"	↓	"	V	18
56	HRHS	"	"	"	"	"	"	"	"	"	29	"	W	29
51	ECP	"	"	"	"	"	"	"	"	"	"	"	X	12
52	"	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	Y	17

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET  
 TEST TS-1 DATE 4/1/52 STA. F-DUST  
 09:00

REMARKS & NOTES	CAMERA			TIME	LENS		
	~ FR./SEC.	NO.	SERIAL	MAG.	OPER.	FOC. LGH.	SERIAL
ALL SHUTTERS AT 60° - (1/3 FR. INTERVAL EXPOSURE)	MAS-	27		27-i		35mm	765260
		22		22-1			764794
		6		18-2			764805
		19		19-1			763975
		18		18-1			764810
		3		3-2			318
		9		9-1			765257
		1		1-1			763770
TOWER		26		26-2			763970
FILM JAMMED - DID NOT RUN		5		5-1			995
		16		16-1			764793
		25		25-1			788
FILM JAMMED - DID NOT RUN		20		20-1			
POLE		17		17-1			763977
VELOCITY MARKER CALIBRATION							
MARKER*	VELOCITY (CPS)						
3	1.95						
5	1.95						
6	1.93						
7	1.95						
8	1.97						
9	1.97						

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST TS-1 DATE 4/1/52 STA. F-DUST  
09:00

PERF. CODE	EMULS.	FILTERS		APER. SET.	AIMING		POWER	TIMING		MARKERS, SERIALS			RACK POS.	CAM NO.
		ND	COLOR		HORIZ.	VERT.		ON	OFF	FM.	VEL.	ZERO		
13085	MF	0	0	2.3	F200	+1°	24VDC	-14s	+7s	-	2-5	-	F363	MA3-27
86				11	"	"					"		"	22
87				2.3	F202	0					2-6		F364	6
88				11	"	"					"		"	19
89				2.3	F204	+1°					2-3		F365	18
90				8	"	"		↓	↓		"		"	3
91				2.3	F206	0		-4s	+17s		2-7		F366	9
92				8	"	"					"		"	1
94				2.8	F208						2-8		F367	26
93				5.6	"	"					"		"	5
95				2.3	"	"					"		"	16
96				2.3	F210						2-9		F368	25
97				5.6	"	"					"		"	20
98	↓	↓	↓	2.6	"	↓	↓	↓	↓	↓	"	↓	"	17

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET  
 TEST TS-2 DATE 4-15-52 STA. 7-360  
 09:29 5705 TRUCK 1

REMARKS & NOTES			CAMERA			TIME	LENS	
FT	PURPOSE	~ FR./SEC.	NO.	SERIAL	MAG.	OPER.	FOC. LGH.	SERIAL
0	GND. STRIKE	500	E-17	1496		1-2-3+	152 mm	RC273
750	MJ 1		20	1525		↓	↓	313
3750	5		21	1519		↓	↓	257
3000	4		10	1515		↓	↓	358
2250	3		26	1518		↓	↓	334
1500	2		27	1514		↓	↓	253
	YIELD	3000	7	1443		1 <sup>st</sup> SEQ.	63	ET1229
	↓	↓	12	1512		2 <sup>nd</sup> "	↓	1207
	↓	↓	18	1517		3 <sup>rd</sup> "	↓	1253
	COLOR	500	11	1521		1-2-3+	25	RY175
	SURVEY	1/200 SEC	W-148	148			165	148
	"	1/150 SEC	K-528	—			480	774528

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST TS-2 DATE 4/15/62 STA. 7-360

09:29:57 05 TRUCK 1

PERF. CODE	EMULS.	FILTERS		APER. SET.	AIMING		POWER	TIMING		MARKERS, SERIALS			RACK POS.	CAM NO.
		ND	COLOR		HORIZ.	VERT.		ON	OFF	FM.	VEL.	ZERO		
13178	MF	0	12	4	0°00'	LEVEL	120DC SHUNT	-2.55	SELF	23	200-4	4	A	E-17
77	"			"	3-20L						10	10	B	20
76	BX			5.6	16-00L						9	9	C	21
75	"				12-48L						4	4	D	10
74	"				9-25L						10	10	E	26
73	"				6-30L						9	9	F	27
00	MF			8	0-00	3°37'	40/80				4	4	G	7
01	"							-1.5			10	10	H	12
02	"							-0.5			9	9	I	18
13	ECN	1	0	E.6	4°30'		SHUNT	-2.5			10	10	L	11
13135	MF	0	12	32	0-00	LEVEL	24V DC	TSP	SELF	TSP	—	—	APRON	7-143
37	"	1	"	22	"	"	"	"	"	TSP	"	"	"	K-528



EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST TS-2 DATE 4-15-52 STA. 7-361

09:29:57.05 TRUCK 2 + Trailer 4

REMARKS & NOTES		CAMERA			TIME	LENS	
PURPOSE	~ FR./SEC.	NO.	SERIAL	MAG.	OPER.	FOC. LGH.	SERIAL
YIELD	3000	E-8	1445		1 <sup>st</sup> SEQ.	63mm	ET1254
"	"	15	1494		"	"	RC606
STEM	500	1	1525		1-2-3+	152	RC245
YIELD	3000	16	1513		2 <sup>nd</sup> SEQ.	63	ET1245
"	"	9	1493		"		RC622
(ROCKETS) SHOCK	500	2	1317		1-2-3+		RC549
YIELD	3000	25	1520		3 <sup>rd</sup> SEQ.		ET1223
"	"	24	1522		"	↓	RC539
SHOCK	500	4	1321		1-2-3+	25	RY165
COLOR	"	6	1318		↓	"	RY187
N.P. 006, 101, 5, 23, 30	LIGHT (T)	30 1/5	GR-2	581	↓	-	-
RAISE FRONT	ROCKETS	100	MH-4	745	-	100mm	BF8525
"	"	↓	8	744	↓	75	851984
	CLOUD	↓	BH-E	1096	↓	25	279097
	YIELD		R-8	8	5025	480	773944
	"		10	10	4095		3961
	FIREBALL		26	26	11.8		4696
	↓		31	31	31.7		3948
	↓		9	9	103		4694
	↓		33	33	411		3950
	SPECTR.		5	5	7495		3956
	"		6	6	53.2	↓	3949

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST TS-2 DATE 4-15-52 STA. 7-361

09:29 57.05 Test 2 Filter 4

PERF. CODE	EMULS.	FILTERS		APER SET.	AIMING		POWER	TIMING		MARKERS, SERIALS			RACK POS.	CAM NO.
		ND	COLOR		HORIZ.	VERT.		ON	OFF	FM.	VEL.	ZERO		
13103	MF	0	12	4	0°00'	3°30'	120DC 40/80	-2.5s	SELF	22	800-8	8	A	E-8
04		1		5.6		"	"				7	7	B	15
80		0		8		0°40'	SHUNT				12	12	C	1
05		0		4		3-30	40/80	-1.5			8	8	D	16
06		1		5.6		"	"	"			7	7	E	9
79		0	47	4	3°28L	0-40'	SHUNT	-2.5			12	12	F	2
07		0	12	4	0°00'	3-30	40/80	-0.5			8	8	G	25
08		1		5.6		"	"	"			7	7	H	24
14		0		4		5-10	SHUNT	-2.5			12	12	I	4
15	ECN	1	0	4	5°56L	"	"				8	8	L	6
27	S-XX	12			0°00'	LEVEL			+3s		12	12	K	HR-2
13181	MF	0	12	3 30°	0°00'	LEVEL	120DC	-15s	+45s		100-1		O	MH-4
82	"			4 45°		"					6		N	8
19	ECN		0	4 120°		16°					6		P	BH-5
53	TRI-X			11		3°30'	115AC 24DC	+5m	+3s	24			R	R-8
54	"							-2.5s					S	10
43	HRHS									10			T	26
46	"									24			U	31
41	MF												V	9
42	"									10			W	33
49	EKTA												X	5
50	ECP	0.5	85B										Y	6



EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST TS-2 DATE 4-15-62 STA. 7-362

09:29:57.05 TRAILER 5

PERF. CODE	EMULS.	FILTERS		APER. SET.	AIMING		POWER	TIMING		MARKERS, SERIALS			RACK POS.	CAM NO.
		ND	COLOR		HORIZ.	VERT.		ON	OFF	FM.	VEL.	ZERO		
13183	MF	0	12	B 30°	7°57'L	LEVEL	120 DC	-15s	+45s	-	100-5	-	P	MH-1
84	"	"	"	4 45°	"	"	"	"	"	"	"	"	PP	5
20	ECN	"	0	56 120°	"	16°00'	"	"	"	"	"	"	Q	BH-2
21	"	"	"	11 20°	0-00	3-00	"	"	"	"	"	"	QQ	3
28	S-XX	<sup>50</sup> 10	47	-	"	LEVEL	"	-2.5s	+3s	"	200-2	"	N	GR-5
29	IR	<sup>50</sup> 12	89B	-	"	"	"	"	"	"	"	"	O	6
55	TRI-X	0	0	11	"	4°47'	115AC 2+DC	-15mA	"	"	16	-	R	R-14
47	HRMS	"	"	"	"	"	"	-2.5s	"	"	"	"	S	24
48	"	"	"	"	"	"	"	"	"	"	"	"	T	4
43	MF	"	"	"	"	"	"	"	"	"	"	"	U	19
44	"	"	"	"	"	"	"	"	"	"	"	"	V	18
56	HRMS	"	"	"	"	"	"	"	"	"	29	"	W	29
51	ECP	"	85B	"	"	"	"	"	"	"	"	"	X	12
52	"	05	"	"	"	"	"	"	"	"	"	"	Y	17
13136	MF	0	12	24	0-00	LEVEL	24DC	TSP	SELF	TSP	-	-	Apron	W-47
38	"	1	"	22	"	"	"	"	"	TSP	-	-	"	K-52

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET  
TEST IS-2 DATE 4-15-52 STA 7-24B †  
09:29:57.05 Dust † Cloud

REMARKS & NOTES	CAMERA			TIME		LENS		
	PURPOSE	~ FR./SEC.	NO.	SERIAL	MAG.	OPER.	FOC. LGH.	SERIAL
N 1/4 CB. LEFT OF STA 203 FRONT RAISED GND. SHOCK		100	KH-7	742			400	52236
" " between # 203 & 204 FRONT NOT RAISED GUN			3	734				52237
" " # 204 & 205 " " "			2	747				52238
VEL. MARK. CAM. 200		32	MAG-27				35	762260
VEL. MARK. (GPS)			22					764794
STA. 7-576 (J-6) 3	1.95	201	TWR	26				763970
NM AT STA 200 5	1.95	SHOCK	450	"	FiG-3			460592
6	1.93	202	32	MAG-6				764805
8	1.97	"		19				763975
9	1.97	204		18				764810
10	1.98	"		28				762779
11	1.98	206		9				765257
"				24				764807
* ANN 150' LEFT OF STA 204	SHOCK	900	FB-3	8C-12				460406
40 min PRISM - POLARIZED IN TWO DIRECTIONS			FB-14				254	876314
RAISE FRONT CLOUD		24	ML-9	409			50-100	LF6889 BF3469
CAMERA NOT USED 1/200 SEC. EXP.		VARIES	K17-9	AC44 190810			152	MF1629
1/225 SEC.		"	K17-7	AC44 190767			304	EE3019
RAISE FRONT CLOUD		24	ML-10	408			50 100	LF6869 BF3571
1/200 SEC. EXP.		VARIES	K17-10	AC44 191117			152	MF2545
1/225 SEC.		"	K17-8	AC44 190874			304	EC314

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST TS-2 DATE 4-15-52 STAs 7-248

09:29:57.05 DUST & CLOUD

PERF. CODE	EMULS.	FILTERS		APER. SET.	AIMING		POWER	TIMING		MARKERS, SERIALS			RACK POS.	CAM NO.
		ND	COLOR		HORIZ.	VERT.		ON	OFF	FM.	VEL.	ZERO		
13170	MF	0	0	6.3 30	0°40'L	LEVEL	115 AC	-155	+455	-	100-3	-	248	MH-7
71	↓	↓	↓	90	3°21R*	+7°19'	↓	↓	↓	↓	↓	↓	↓	3
72	↓	↓	↓	170	4°45R*	+8°43'	↓	↓	↓	↓	↓	↓	↓	2
13185	MF	0	0	2.3	200	LEVEL	24 DC	-55	+165	-	2-6	-	369	MPS-27
86	↓	↓	↓	11	"	↓	↓	↓	↓	↓	6	↓	"	22
87	↓	↓	↓	8	201	↓	↓	↓	↓	↓	8	↓	375	26
88	↓	↓	↓	5.6	36°L	↓	12 DC	-35	↓	↓	11	↓	"	FIG-3
89	↓	↓	↓	2.3	202	↓	24 DC	-55	↓	↓	3	↓	364	MPS-6
90	↓	↓	↓	5.6	"	↓	↓	↓	↓	↓	3	↓	"	19
91	↓	↓	↓	2.3	204	↓	↓	↓	↓	↓	5	↓	365	18
92	↓	↓	↓	4	"	↓	↓	↓	↓	↓	5	↓	"	28
93	↓	↓	↓	2.3	206	↓	↓	↓	↓	↓	9	↓	366	9
94	↓	↓	↓	4	"	↓	↓	↓	↓	↓	9	↓	↓	24
95	↓	↓	↓	5.6	6°30L*	↓	12 DC	-35	↓	↓	10	↓	↓	FB-3
13109	MF	0	0	6.3	0	1°15'	30 DC	-25	+35	-	200-	-	CP	FB-14
13122	ECN	0	0	8 90	0°00'	LEVEL	116 VAC	-155	BURSTS	-	-	-	358	ML-9
30	S-XX	↓	W25A	8	↓	+30'	24 VDC	-55	20m	↓	CLOCK	↓	↓	KN-9
31	"	↓	"	"	↓	+15°	"	"	"	↓	"	↓	↓	KN-7
13123	ECN	0	0	8 90	0°00'		115 VAC	-155	BURSTS	-	-	-	359	ML-10
32	S-XX	↓	W25A	8	↓	+30'	24 DC	-55	20m	↓	CLOCK	↓	↓	KN-10
33	"	↓	"	"	↓	+15°	"	"	"	↓	"	↓	↓	KN-8

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST IS-3 DATE 4-22-52 STA. 7-360

09:30:10:02 Truck 1

REMARKS & NOTES		CAMERA			TIME	LENS	
PURPOSE	~FR./SEC.	NO.	SERIAL	MAG.	OPER.	FOC. LGH.	SERIAL
MJ7	500	E-17	1496		1-2-3+	152mm	RC273
6		20	1525				313
5		21	1519				257
4		10	1515				358
3		26	1518				337
2	↓	27	1514				253
YIELD	3000	7	1443		1 <sup>st</sup> SEQ.	63	ET1229
↓	↓	12	1512		2 <sup>nd</sup> "		1207
↓	↓	13	1517		3 <sup>rd</sup> "		1253
COLOR	750	11	1521		1-2-3+	25	RY175
SURVEY	1/200 s	W-148	148			165	148
"	1/150 s	K-528				480	774528



EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST T5-3 DATE 4-22-52 STA. 7-360

09:30:10:02 TRUCK 1

PERF. CODE	EMULS.	FILTERS		APER. SET.	AIMING		POWER	TIMING		MARKERS, SERIALS			RACK POS.	CAM NO.
		ND	COLOR		HORIZ.	VERT.		ON	OFF	FM.	VEL.	ZERO		
13278	BX	0	12	5.6	22°-15'	LEVEL	120DC SHUNT	-2.55	SELF	23	200-4	4	A	E-17
77					19-10						10	10	B	20
76					16-00						9	9	C	21
75	↓			↓	12-48						4	4	D	10
74	MF			4	9-35						10	10	E	26
73				"	6-30	↓					9	9	F	27
00				8	0-00	13°30'	49/20	↓			4	4	G	7
01									-1.5		10	10	H	12
02	↓	↓	↓	↓					-0.5		9	9	I	18
13	ECN	2	0	5.6	↓	↓	↓ SHUNT	-2.5	↓	↓	10	10	L	11
13255	MF	2	12	32	0°-00'	+78°18'	24VDC	TSP	SELF	TSP	-	-	Apron	W-148
37	"	"	"	22	"	+4°00'	"	"	"	TSP	-	-	"	K-528



EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST IS-3 DATE 4-22-52 STA. 7-361  
09:30:10:02 Trk 2 & Trailer 4

REMARKS & NOTES		CAMERA			TIME	LENS		
PURPOSE	~ FR./SEC.	NO.	SERIAL	MAG.	OPER.	FOC. LGH.	SERIAL	
YIELD	3000	E-8	1445		1 <sup>st</sup> SEQ.	63mm	ET1254	
"	"	15	1494		"	"	RC606	
MJ9	500	1	1525		1-2-3+	152	RC245	
YIELD	3000	16	1513		2 <sup>nd</sup> SEQ.	63	ET1245	
"	"	9	1493		"		RC622	
MJ8	500	2	1317		1-2-3+		RC549	
YIELD	3000	25	1520		3 <sup>rd</sup> SEQ.		ET1223	
"	"	24	1522		"	↓	RC539	
SHOCK	500	4	1321		1-2-3+	25	RY165	
COLOR	750	6	1318		↓	"	RY187	
ND.0.05,1.0,1.5,2.3,3.0	LIGHT (T)	30 1/3	GR-2	581	↓	—	—	
CHECK 15% FROND.	RAISE FRONT	ROCKETS	100	MH-4	745		CC	LF6855
	"	"	↓	8	748		35	BF4052
		CLOUD	↓	84-5	1096		25	279097
		YIELD		R-8	8	20,130 μs	480	773944
		"		19	16	17,455		3961
		FIREBALL		26	26	9.8		4696
		↓		31	31	30.1		3948
				9	9	99.8		4694
				33	33	403		3950
		SPECTR.		5	5	134		3956
		"		6	6	31675	↓	3949

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST TS-3 DAT: 4-22-52 STA. 7-361

09:30:1082 Truck 2 Trailer 4

PERF. CODE	EMULS.	FILTERS		APER. SET.	AIMING		POWER	TIMING		MARKERS, SERIALS			RACK POS.	CAM NO.
		ND	COLOR		HORIZ.	VERT.		ON	OFF	F.M.	VEL.	ZERO		
13203	MF	0	12	4	0°-00'	11°-57'	120DC 40/80	-2.5s	SELF	22	200-2	8	A	E-8
04	"	1		5.6	"	"	"				7	7	B	15
80	BX	0		"	28°-02L	LEVEL	SHUNT	↓			12	12	C	1
05	MF	0		4	0-00	11-57	40/80	-1.5			8	8	D	16
06	"	1		5.6	"	"	"	"			7	7	E	9
79	BX	0		"	21-56L	LEVEL	SHUNT	-2.5			12	12	F	2
07	MF	0		4	0-00	11-57	40/80	-0.5			8	8	G	25
08	"	1		5.6	"	"	"	"			7	7	H	24
14	↓	1	↓	4	"	5°-54'	SHUNT	-2.5			12	12	I	4
15	ECN	2	0	8	"	11-57	"				8	8	L	6
27	S-XX	STEP 24	12	—	↓	LEVEL	↓	—	↓	↓	12	12	K	GR-2
13281	MF	1	12	8 30°	0°-00'	42°00'	120DC	-15s	-45s	—	100-1	—	O	MH-4
82	"	0	"	5.6 30°		LEVEL	↓	↓	↓	↓	6		N	8
19	ECN		0	4 120°		16-00	↓	↓	↓	↓	6		P	BH-5
53	TRI-X			11		11-57	115AC 24DC	-15m	+35	24	—		R	R-8
54	"							-25s		"			S	10
45	HRHS									10			T	26
46	"									24			U	31
41	MF									"			V	9
42	"									10			W	33
49	ECP												X	5
50	EKTA												Y	6

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST TS-2 DATE 4-22-52 STA. 7-362

09:30'10.02 TRAILER 5

REMARKS & NOTES			CAMERA			TIME	LENS	
PURPOSE	~ FR./SEC.		NO.	SERIAL	MAG.	OPER.	FOC. LGH.	SERIAL
RAISE FRONT	ROCKETS	100	MH-1	148			50	LF6996
" "	" "		5	743			"	LF6935
	CLOUD		BH-2	1093			25	281474
	STEM		3	1095			152	BF2355
IND. 0.0, 0.5, 1.0, 1.5, 2.0, 3.0		LIGHT (T)	30 1/5	GR-5	667		-	-
		"	"	6	669		-	-
	YIELD		R-14	14		10,756 μs	480	773952
	"		24	24		7335		3958
	FIREBALL		4	4		16.9		3947
	↓		19	19		47.2		2890
	↓		18	18		4860		3955
	↓		29	29		785		3954
	SPECTR.		12	12		215		3960
	"		17	17		79.8	↓	3951
	SURVEY	1/200 S	W-147	147			165	147
	SURVEY	1/150 S	K-529	41-1194			480	774529

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST TS-3 DATE 4-27-52 STA. 7-362  
09:30:10 Q2 TRAILER 5

PERF. CODE	EMULS.	FILTERS		APER. SET.	AIMING		POWER	TIMING		MARKERS, SERIALS			RACK POS.	CAM NO.
		ND	COLOR		HORIZ.	VERT.		ON	OFF	FM.	VEL.	ZERO		
13283	MF	1	12	8 30°	7-57L	4°00	120VDC	-15s	+45s	-	100-5	-	P	MH-1
84	"	0	"	5.6 30°		"							PP	5
20	MF		0	2.3 150°		16-00							Q	BH-2
21	ECN		"	4 120°	0-00	3-00							QQ	3
28	S XX	STEP #19	47	-		LEVEL		-2.5s	+3s		200-2		W	GR-5
29	IR	STEP #12	89B	-		"		"			"		O	6
55	TRI-X	0	0	11		13-55	115AC 24DC	-15m			16	-	R	R-14
47	HRHS							-25s					S	24
48	"												T	4
43	MF												U	19
44	TRI-X												V	18
56	HRHS										29		W	29
51	ECO		86 CC10M										X	12
52	"		"										Y	17
13236	MF	2	12	24	0-00	7.0 +0.18	24VDC	TSP	SELF	TSP 3	-	-	Apron	W-147
38	"	"	"	22	"	+4°00	"	"	"	TSP 2	"	"	"	K-529

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST TS-3 DATE 4-22-52 STAS. 7-24B,  
09:30:10:02 DUST & CLOUD

REMARKS & NOTES			CAMERA			TIME	LENS	
TM CALIBRATION	PURPOSE	~ FR./SEC.	NO.	SERIAL	MAG.	OPER.	FOC. LGH.	SERIAL
TM 3 VEL. (CPS) 1.95	200	32	MAS-27				35mm	765260
5	1.95	"	22					764794
6	1.93	202	6					764805
7	1.95	"	19					765975
8	1.97	204	18					764810
9	1.97	"	28					762779
10	1.98	206	9					765257
11	1.98	"	24					764807
* AIM DOWN BLAST LINE	SHOE & DUST	350	POLE	FIG-3				460392
	208	32	MAS-13					765008
				16				764793
			POLE	15				765249
	210			4				763965
				11				765377
* AIM DOWN BLAST LINE			POLE	17			75	764957
	201			14			35	763997
	204			26				763970
* AIM ~180° AWAY FROM 204 - SAGE BRUSH BLAST STA.	DUST			1				763770
* AIM AT BLAST STATIONS EAST OF BLAST LINE	"	64	POLE	GGAP	30825		17	933468
AIM AT 207 DO NOT RAISE FRONT GUN		100	POLE	VH-7	742		400	52236
" 1/2 SEC. L OF 209			STA. 24	3	734			52237
" " " 210				2	747			52238
BURSTS 1,2,3,5min -5 → +30s CLOUD		24	ML-9	409			50 100	LF 6989 BF 9469
DID NOT RUN 1/200 S		VARIES	K17-9	AC44 190810			152	MF1629
1/225 SEC.		"	K17-7	AC44 190767			304	EE3019
BURSTS 1,2,3,5min -5 → +30s CLOUD		24	ML-10	408			30 100	LF 6969 BF 9571
1/200 SEC.		VARIES	K17-12	AC44 191117			152	MF2545
1/225 SEC.		"	K17-8	AC44 190874			304	EC314

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST TS-3 DATE 4-22-54 STAs 7-248  
09:30:10:02 DUST & CLOUD

PERF. CODE	EMULS.	FILTERS		APER. SET.	AIMING		POWER	TIMING		MARKERS, SERIALS			RACK POS.	CAM NO.
		ND	COLOR		HORIZ.	VERT.		ON	OFF	FM.	VEL.	ZERO		
13285	MF	0	0	16	200	LEVEL	24-DC	-5s	+16s	-	2-6	-	363	MAS-21
86				2.3	"						"		"	22
87				8	202						2-3		364	6
88				2.3	"						"		"	19
89				4	204						2-5		365	18
90				2.3	"						"		"	28
91				2.8	206						2-9		366	9
92				2.3	"						"		"	24
93				4.0	*		12DC	-3s			2-10		"	Fl-3
94				2.8	208		24DC	-5s			2-7		367	MAS-13
67				2.3	"						"		"	16
96				2.3	"						"		"	15
97				2.8	210						2-11		368	4
98				2.3	"						"		"	11
99				2.8	*						"		"	17
95				11	201						2-8		375	14
68				4	204						2-5		376	26
69				5.6	*						"		"	1
66				4	*						-		366	CSAP
13270	MF	0	0	8 45°	910' R	11° 05'	115VAC	-15s	+45s	-	00-3	-	7-248	MH-7
71				6.3 120°	1400' R	11° 12'								3
72				5.6 170°	1942' R	11° 22'								2
13222	ECN	0	0	8 90°	0°-00'	15% P60	115AC	-5s	BURSTS	-	-	-	358	ML-9
30	S-XX		25A	8		+30°	24-DC		30m		CLOCK			K17-9
31	"		"	"		+15°	"		"		"			K17-7
13223	ECN	0	0	8 90°	0°-00'	+3°	115AC	-5s	BURSTS	-	-	-	359	ML-10
33	S-XX		25A	8		30°	24-DC		30m		CLOCK			K17-10
32	"		"	"		15°	"		"		"			K17-8



EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST T5-4 DAYE S-1-52 STA. 7-260

09:29 68 6 TRUCK 1

PERF. CODE	EMULS.	FILTERS		APER. SET.	AIMING		POWER	TIMING		MARKERS, SERIALS			RACK POS.	CAM NO.
		ND	COLOR		HORIZ.	VERT.		ON	OFF	FM.	VEL.	ZERO		
13378	BX	0	12	5.6	22° 15L	LEVEL	120DC SHUNT	-2.55	SELF	23	200-4	4	A	E-17
77					19-10						10	10	B	20
76					16-00						9	9	C	21
75					12-48						4	4	D	10
74	MF			4	9-36						10	10	E	26
73				5.6	6-30						9	9	F	27
00				8	0-00	3-37	40/80				4	4	G	7
01								-1.5			10	10	H	12
02								-0.5			9	9	I	18
13	ECN	1	0	5.6		4-30	SHUNT	-2.5			4	4	L	11
13335	MF	2	12	32	0-00	LEVEL	24-DC	TSP	SELF	TSP	-	-	Apert	K-148
37	"	"	"	22	"	"	"	"	"	TSP	"	"	"	K-528



EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET  
TEST 15-4 DATE 5-1-52 STA. 7-361

09:23:58.6 TRUCK 2 & TRAILER 4

REMARKS & NOTES			CAMERA			TIME	LENS	
PURPOSE	~ FR./SEC.	NO.	SERIAL	MAG.	OPER.	FOC. LGH.	SERIAL	
YIELD	3000	E-8	1445		1 <sup>st</sup> SEQ.	63mm	ET1254	
"	"	15	1494		"	"	RC606	
MJ9	500	1	1525		1-2-3+	152	RC245	
YIELD	3000	16	1513		2 <sup>nd</sup> SEQ.	63	ET1245	
"	"	9	1493		"		RC622	
MJB	500	2	1317		1-2-3+		RC549	
YIELD	3000	25	1520		3 <sup>rd</sup> SEQ.		ET1223	
"	"	24	1522		"		RC539	
STEM	500	4	1321		1-2-3+	25	RY165	
AIM AT STA. 202	COLOR	750	6	1318			RY187	
N.D.O.O.S, I.D.S, R.S, S.O	LIGHT (T)	30 1/sec	GR-2	581				
RAISE FRONT	ROCKETS	100	MH-4	745		100	BF8525	
↓	"	↓	8	744		75	BS1764	
↓	CLOUD	↓	6	746		25	VF983	
	YIELD		R-8	8	20,130µs	480	773944	
	"		10	10	17,455		3961	
	FIREBALL		26	26	9.8		4696	
			31	31	30.1		3948	
			9	9	99.8		4694	
			33	33	403		3950	
	SPECTR.		5	5	26,550		3956	
	"		6	6	155		3949	



EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST TS-4 DATES 5-1-52 STA. 7-361  
09:29:58.6 TRUCK 2 TRAILER 4

PERF. CODE	EMULS.		FILTERS		APER. SET.	AIMING		POWER		TIMING		MARKERS, SERIALS			RACK POS.	CAM NO.
	ND	COLOR	HORIZ.	VERT.		ON	OFF	FM.	VEL.	ZERO						
13303	MF	0	12	4	0°-00'	3°-30'	120DC	40/80	-2.5s	SELF	22	200-8	8	A	E-8	
04	"	1		5.6	"	"						7	7	B	15	
80	BX	0		"	28-02L	LEVEL	SHUNT	↓				12	12	C	1	
05	MF	0		4	0-00	3-30	40/80	-1.5				8	8	D	16	
06	"	1		5.6	"	"	"	"				7	7	E	9	
79	BX	0		"	21-56L	LEVEL	SHUNT	-2.5				12	12	F	2	
07	MF	0		4	0-00	3-30	40/80	-0.5				8	8	G	25	
08	"	1		5.6	"	"	"	"				7	7	H	24	
14	"	1		4	↓	5-10	SHUNT	-2.5				12	12	I	4	
15	ECN	0	0	5.6	4°+1'	"	"	↓		↓		8	8	L	6	
27	SXX	STEP #4	12	—	0°-00'	LEVEL	↓	—	↓	+35	↓	12	12	K	GR-2	
13381	MF	1	12	54 60°	0°-00'	LEVEL	120 DC	-15s	+45s	—	100-1	—	O	MM-4		
82	"	0	"	5.6 90°	"	"	↓	↓	↓	↓	6	↓	N	8		
19	ECN		0	4 120°	16°	↓	↓	↓	↓	↓	6	↓	P	6		
53	TRI-X			11	3°-30'	LEVEL	115AC 24DC	-15m	+35	24	—	↓	R	R-8		
54	"							-2.5s		"	↓	↓	S	10		
45	HRHS									10	↓	↓	T	24		
46	"									24	↓	↓	U	31		
41	MF									"	↓	↓	V	9		
42	"									10	↓	↓	W	33		
49	EKTA			CC40M	↓	↓	↓	↓	↓	↓	↓	↓	X	5		
50	ECP			CC10M	↓	↓	↓	↓	↓	↓	↓	↓	Y	6		

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET  
 TEST TS-4 DATE 5-1-52 STA. 7-362  
 09:29:58.6 TRAILER 5

REMARKS & NOTES			CAMERA			TIME	LENS	
RAISE FRONT	PURPOSE	~FR./SEC.	NO.	SERIAL	MAG.	OPER.	FOC. LGH.	SERIAL
"	"	ROCKETS	100	MH-1	748		75mm	BS1984
	"			S	743		50	LF6935
	CLOUD			BH-2	1093		25	291674
	STEM			S	1096		152	3F2355
N.D.	O.D.S.	1, 10, 15, 20, 30	HIGHT (T)	30 1/5	GR-S	667	—	—
"	"	"	"	G	669		—	—
	YIELD			R-14	14	10,756 <sub>μ</sub> s	480	773952
	"			24	24	7335		3958
	FIREBALL			4	4	16.9		3947
				19	19	49.2		2890
				18	18	4860		3955
				29	29	785		3954
	SPECTR.			12	12	215		3960
	"			17	17	79.8	↓	3951
	SURVEY	1/200 S		W-147	147	—	165	147
	"	1/150 S		K-52	41-1194	—	480	774529

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST T5-4 DATE 5-1-52 STA. 7-362

09:29:58.6 TRAILER 5

PERF. CODE	EMULS.	FILTERS		APER. SET.	AIMING		POWER	TIMING		MARKERS, SERIALS			RACK POS.	CAM NO.
		ND	COLOR		HORIZ.	VERT.		ON	OFF	FM.	VEL.	ZERO		
13383	MF	1	12	56 60°	7°57'	LEVEL	120 DC	-15s	+45s	—	100-5	—	P	MH-1
84	"	0	"	56 90°	"	"	"	"	"	"	"	"	PP	5
20	ECN	"	0	4 120°	"	16°	"	"	"	"	"	"	Q	BH-2
21	"	"	"	11 15°	0°00'	3°	"	"	"	"	"	"	QQ	5
28	S-XX	STEP #19	47	—	"	LEVEL	"	-25s	+3s	"	200-2	"	N	GR-5
22	IR	STEP #21	89B	—	"	"	"	"	"	"	"	"	O	6
13355	TRI-X	0	0	11	0°00'	4°47'	115AC 24DC	-15mA	+3s	16	—	—	R	R-14
47	HRHS	"	"	"	"	"	"	-25s	"	"	"	"	S	24
48	"	"	"	"	"	"	"	"	"	"	"	"	T	4
43	MF	"	"	"	"	"	"	"	"	"	"	"	U	19
44	TRI-X	"	"	"	"	"	"	"	"	"	"	"	V	18
56	HRHS	"	"	"	"	"	"	"	"	29	"	"	W	29
51	ECP	"	86 CC10M	"	"	"	"	"	"	"	"	"	X	12
52	"	"	"	"	"	"	"	"	"	"	"	"	Y	17
13336	MF	2	12	24	0°00'	LEVEL	24 DC	TSP	SELF	TSP 3	—	—	Apron	W-147
38	"	"	"	22	"	"	"	"	"	TSP 2	—	—	"	K-529

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST IS-4 DATE 5-1-52 STAS. 7-248,  
09:29:58.6 DUST & CLOUD

REMARKS & NOTES				CAMERA			TIME	LENS	
PURPOSE	~ FR./SEC.	NO.	SERIAL	MAG.	OPER.	FOG. LGH.	SERIAL		
DO NOT RAISE FRONT	GUNS	100	MH-7	742		400mm	52236		
			3	734			52237		
			2	747			52238		
VEL. MARK	VEL. (FPS)	DUST	35	MAS-21	27-1		35	765260	
3	1.95			22	22-1			764794	
5	1.95			6	7-2			764805	
6	1.93			19	19-1			763975	
7	1.95			18	18-1			764810	
8	1.97			28	28-2			762779	
9	1.97			9	9-1			765257	
10	1.98			24	24-2			764807	
11	1.98			8	8-1			764796	
				13	13-1			765008	
				16	16-1			764793	
				15	15-1			765249	
				4	4-1			763965	
				11	11-1			765377	
LOOKS DOWN BLAST LINE				17	17-1		75	764957	
		DUST	35	MAS-14	14-1		35	763387	
		DUST & SHOCK	350	FIG-3				460392	
		DUST	35	MAS-26	26-2			763970	
LOOKS AWAY FROM BLAST LINE AT SAGEBRUSH *				1	1-2			763770	
LOOKS DOWN BLAST LINE				2	2-1			764015	
		DUST & SHOCK	700	FB-3				460404	
		CLOUD	VARIABLE	KIT-9	AC44 190310		152	MF1629	
		"	"	7	AC44 190767		304	EE3019	
-5 → +30s 10 SEC. BURSTS AT 1,2,3,4,5, etc. min.			24	ML-9	409		50 100	LF4989 BF9469	
		CLOUD	VARIABLE	KIT-10	AC44 191117		152	MF2545	
		"	"	8	AC44 190874		304	EC314	
		40 MIN. BEAM-SPLITTING PRISM	CLOUD	FIG-11	16C-15		254	876314	

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST TS-4 DATE 5-1-52 STAs 7-248  
 09:29:58.6 DUST & CLOUD

PERF. CODE	EMULS.	FILTERS		APER. SET	AIMING		POWER	TIMING		MARKERS, SERIALS			RACK POS.	CAM NO.
		ND	COLOR		HORIZ.	VERT.		ON	OFF	FM.	VEL.	ZERO		
13370	MF	0	0	8 45	7°02'R	+4°00'	115AC	-155	+155	—	100-4	—	7-248	MM-7
71	↓	↓	↓	5.6 120°	12-08R	+3°55'	↓	↓	↓	↓	↓	↓	↓	3
72	↓	↓	↓	5.6 170°	17-06R	+3°50'	↓	↓	↓	↓	↓	↓	↓	2
13385	MF	2	0	2.3	200	LEVEL	24DC	-55	+165	—	2-6	—	363	MAS-27
86	↓	0	↓	"	"	↓	↓	↓	↓	↓	"	↓	"	22
87	↓	↓	↓	2.3	202	↓	↓	↓	↓	↓	2-3	↓	364	6
88	↓	↓	↓	2.3	"	↓	↓	↓	↓	↓	"	↓	"	19
89	↓	↓	↓	8	204	↓	↓	↓	↓	↓	2-5	↓	365	18
90	↓	↓	↓	2.3	"	↓	↓	↓	↓	↓	"	↓	"	28
91	↓	↓	↓	4	206	↓	↓	↓	↓	↓	2-9	↓	366	9
92	↓	↓	↓	2.3	"	↓	↓	↓	↓	↓	"	↓	"	24
93	↓	↓	↓	2.8	"	↓	↓	↓	↓	↓	"	↓	"	8
94	↓	↓	↓	"	208	↓	↓	↓	↓	↓	2-7	↓	367	13
95	↓	↓	↓	2.3	"	↓	↓	↓	↓	↓	"	↓	"	16
96	↓	↓	↓	2.8	"	↓	↓	↓	↓	↓	"	↓	"	15
97	↓	↓	↓	"	210	↓	↓	↓	↓	↓	2-11	↓	368	4
98	↓	↓	↓	2.3	"	↓	↓	↓	↓	↓	"	↓	"	11
99	↓	↓	↓	2.8	ZERO	↓	↓	↓	↓	↓	"	↓	"	17
13364	MF	0	0	2.3	201	LEVEL	24DC	-55	+165	—	2-8	—	375	MAS-14
65	↓	1	↓	2.3	"	-5°00'	12DC	-35	↓	↓	2-10	↓	"	FIG-3
66	↓	0	↓	8	204	LEVEL	24DC	-55	↓	↓	2-5	↓	376	MAS-26
67	↓	↓	↓	8	*	↓	↓	↓	↓	↓	↓	↓	↓	1
68	↓	↓	↓	11	202	↓	↓	↓	↓	↓	↓	↓	↓	2
69	↓	↓	↓	2	204	-12°	12DC	-35	↓	↓	—	↓	↓	FB-3
13331	S-XX	0	25A	B	0°-00'	+30°	24DC	-55	30m	—	CLOCK	—	358	K17-9
30	"	↓	"	"	↓	+15°	"	↓	"	↓	"	↓	↓	7
22	MF	↓	12	2.3 120°	↓	+4°00'	115AC	↓	BURSTS	↓	—	↓	↓	ML-9
13333	S-XX	0	25A	B	0°-00'	+30°	24DC	-55	30m	—	CLOCK	—	359	K17-10
32	"	0	"	"	"	+15°	"	"	"	"	"	"	"	8
09	MF	0	47/29	5.6	0°-00'		60VDC	N-25			200-1		CP	FIG-11

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET  
 TEST TS-5 DATE 5-7-52 STA. 1-355  
 TRUCK 1 & TRAILER 4

P <sub>s</sub> W <sup>2</sup> /M <sup>2</sup>	REMARKS & NOTES			CAMERA			TIME	LENS	
	PURPOSE	~ FR./SEC.		NO.	SERIAL	MAG.	OPER.	FOC. LGH.	SERIAL
2x10 <sup>5</sup>	5-7s OPERATION	BREAKAWAY	650	E-17	1496			152mm	RC273
5x10 <sup>5</sup>	"	"	"	20	1525			"	RC313
1.5x10 <sup>5</sup>		YIELD	3000	12	1512			102	RY510
4x10 <sup>4</sup>				18	1517			"	ET415
1.5x10 <sup>5</sup>				7	1443			63	ET1229
4x10 <sup>4</sup>				24	1522			"	RC539
2x10 <sup>5</sup>	5-7s OPERATION	STEM	650	27	1514			25	RY189
3x10 <sup>4</sup>	8-10s OPERATION	COLOR	400	1	1454			"	RY183
	N.D., 0.0, 0.5, 1.0, 1.5, 2.0, 3.0	LIGHT	50 1/8	GR-4	670			—	—
2x10 <sup>5</sup>	RAISE FRONT	BW SHOCK	100	MH-4	745			100	BF8525
10 <sup>3</sup>	"	COLOR		8	744			"	BF9463
100	TILT ~ 16°	CLOUD		6	746			25	VF983
		YIELD		R-8	8		4940	480	773944
		"		10	10		8300		3961
		FIREBALL		26	26		9.8		4696
				31	31		27.5		3948
				9	9		95		4634
				33	33		403		3950
		COLOR		5	5		16,800		3956
		"		6	6		152	↓	3949

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST TS-5 DATE 5-7-52 STA. 1-35J

TRUCK 1 & TRAILER 4

PERF. CODE	EMULS.	FILTERS		APER. SET.	AIMING		POWER		TIMING		MARKERS, SERIALS			RACK POS.	CAM NO.
		ND	COLOR		HORIZ.	VERT.			ON	OFF	FM.	VEL.	ZERO		
13474	MF	1	12	5.6	1°42'L	+2°20'	120DC	SHUNT	-1.55	SELF	23	200-4	4	A	E-17
75				8	3°24'L							10	10	B	20
00		0			0°00'			40/80				9	9	C	12
01				4								4	4	D	18
02				8								10	10	E	7
03				4								9	9	F	24
75		1		5.6		+5°00'		SHUNT				4	4	G	27
13	ECN	1	0	8		"		"				4	4	L	1
26	S-XX	STEP #20	61			LEVEL						9	-	K	GR4
13481	MF	0	12	4 60°	0°00'	LEVEL	120DC		-1.55	+20.5		100-1		O	MH4
13	ECN		0	4 15°		"						6		N	8
20	"			4 170°		16°00'						6		P	6
53	TRI-X			11		+2°20'	115AC	24DC	-15m	+1.5	24			R	R-8
54	"								-1.05					S	10
45	HRHS											10		T	26
46	"											24		U	31
41	MF													V	9
42	"											10		W	33
43	EKTA													X	5
50	ECP													Y	6



EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST IS-5 DATE 5-7-52 STA. 1-356  
TRUCK 2 & TRAILER 5

REMARKS & NOTES			CAMERA			TIME	LENS	
$P_s$ W/m <sup>2</sup>	PURPOSE	~ FR./SEC.	NO.	SERIAL	MAG.	OPER.	FOG. LGH.	SERIAL
$1.5 \times 10^5$	YIELD	3000	E-25	1520			102	ET201
$4 \times 10^4$	↓	↓	15	1494			"	RC185
$1.5 \times 10^5$	↓	↓	9	1493			63	RC622
$10^8$	FIREBALL	8000	F8-3	8C-12			254	876314
$10^7$	"	"	F8-14	8C-6			"	876312
$4 \times 10^4$	YIELD	3000	E-16	1513			63	ET1245
$10^6$	FIREBALL	4500	F6-11	16C-15			100	617363
$10^6$	"	"	F6-R	16-163			"	617367
$2 \times 10^6$	YIELD	3000	E-8	1445			63	ET1254
ND 0, 0.5, 1.0, 1.5, 2.0, 3.0	LIGHT	50 1/SEC.	GR-2	581			—	—
$5 \times 10^3$	RAISE FRONT SHOCK	100	MH-1	748			100	BF9465
$10^3$	"	↓	5	743			↓	BF8507
200	↓	↓	BH-2	1093			↓	282354
ND 0, 0.5, 1.0, 1.5, 2.0, 3.0	LIGHT	50 1/SEC.	GR-5	667			—	—
"	"	"	GR-6	669			—	—
			R-14	14		10900 μs	480	773952
			24	24		7335		3958
			4	4		4400		3947
			19	19		49.2		2890
			18	18		210		3955
			29	29		785		3954
			12	12		40.2		3160
			17	17		82.5	↓	3951

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST T5-5 DATE 5-7-52 STA. 1-356

TRUCK 2 & TRAILER 5

PERF. CODE	EMULS.	FILTERS		APER. SET.	AIMING		POWER	TIMING		MARKERS, SERIALS			RACK POS.	CAM NO.
		ND	COLOR		HORIZ.	VERT.		ON	OFF	FM.	VEL.	ZERO		
13404	MF	0	12	8	0°00'	1°50'	120DC 40/80	-1.0s	SELF	22	200-8	8	A	E-25
05				4							7	7	B	15
06				8							12	12	C	9
08		3		5.6				-1.0s	+1s		8	8	D	FB-3
09		2		4							7	7	E	FB-4
07		0		"			40/80	-1.5s	SELF		12	12	F	E-16
10		1		5.6				-1.0s	+1s		8	8	G	FB-11
11		1											H	FB-R
14	ECN	2	0				40/80	-1.5s	SELF	22	12	12	I	EB
27	BX	STEP #4	12	—		LEVEL					12		K	GR-2
13482	MF	0	12	5.6 30°	0°00'	LEVEL	120 DC	-1.5s	+20s		100-5		P	MH-1
83				5.6 170°	"	"							PP	5
84				23 170°	5°22' L	+3°00							Q	BA-2
28	S-XX	STEP #19	47	—	0°00'	LEVEL		-1.0s	SELF		200-2		N	GR-5
29	IR	STEP #21	B9B	—	"	"		"	"		"		O	6
13455	TRI-X	0	0	11	0°00'	1°50'	115AC 24DC	-15mA	+1s	16			R	R-14
47								-1.0s					S	24
48													T	4
43	MF												U	19
44	"												V	18
56	HRHS										29		W	29
51	ECP		B6 CC10M										X	12
52	"		"										Y	17



EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET  
 TEST TS-5 DATE 5-7-52 STA. 4-248

PERF. CODE	EMULS.	FILTERS		APER. SET.	AIMING		POWER	TIMING		MARKERS, SERIALS			RACK POS.	CAM NO.
		ND	COLOR		HORIZ.	VERT.		ON	OFF	FM.	VEL.	ZERO		
13470	MF	1	0	6.3 15°	3°-03'R	3°-55'	115 AC	-15s	+20s	-	100-4	-	A	MH-7
71	"	0	↓	6.3 170°	5°-06'R	5°-49'	↓	↓	↓	↓	↓	↓	B	3
72	BX	"	↓	6.3 170°	7°-07'R	7°-53'	↓	↓	↓	↓	↓	↓	C	2
13412	MF													E-23

EDGERTON, GERMESHAUSEN & GR'ER, INC.

CAMERA DATA SHEET

TEST TS-6 DATE 5-25-52 STA. 4-355  
TRUCK 2 & TRAILER 5

REMARKS & NOTES			CAMERA			TIME	LENS	
PURPOSE	~ FR./SEC.	NO.	SERIAL	MAG.	OPER.	FOC. LGH.	SERIAL	
CORE	3000	E-25	1520			102	ET201	
YIELD		15	1494			"	RC185	
"		9	1493			63	RC622	
FIREBALL	8000	F8-3	8C-12			254	876314	
YIELD	3000	E-16	1513			63	ET1245	
FIREBALL	4000	F16-11	16C-15			100	617363	
"	"	F16-R	16-16B			"	617367	
COLOR	3000	E-8	1445			63	ET1254	
N.O.O.D.S.I.O.1.5.2.0.3.0	LIGHT	50 1/2 sec.	GR-2	581		—	—	
5μs	RAP SHUTTER WITH NEWTONIAN MIRROR		TR-A	3427		0	1829 NEWTONIAN	
150μs MECH. SHUTTER			KODAK 35	EDG. MIT		152	DOUBLET	
RAISE FRONT	SHOCK	100	MH-1	748		100	BF9465	
"	"		5	743			BF8507	
"	"		BH-2	1093			282354	
N.O.O.S.I.I.S.2.3	LIGHT	50 1/2 sec.	GR-2	667		—	—	
"	"	"	6	669		—	—	
	YIELD		R-14	14	10,900μs	480	173952	
	"		24	24	7335		3958	
	"		4	4	4400		3947	
	"		19	19	49.2		2890	
	"		18	18	210		3955	
	"		29	29	785		3954	
3μs	FM TELLER LIGHT		12	12	0		3960	
5	X-UNIT PULSE DELAYED 95μs (TR=98.1)		17	17			3951	
5	" " " " " "		5	5			3956	
3	FM TELLER LIGHT		6	6			3949	
1	FM TELLER-SPECIAL		TR-B	3149-B	~ 0	4064	CASSEGRAIN	

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST TS-6 DATE 5-25-52 STA. 4-355  
TRUCK 2 & TRAILER 5

PERF. CODE	EMULS.	FILTERS		APER. SET.	AIMING		POWER	TIMING		MARKERS, SERIALS			RACK POS.	CAM NO.
		ND	COLOR		HORIZ.	VERT.		ON	OFF	FM.	VEL.	ZERO		
13604	MF	2	12	5.6	0°-00'	+2°-25'	120DC 40/80	-1.05	SELF	22	200-8	8	A	E-25
05		0		8							7	7	B	15
06		0									12	12	C	9
08		2						-1.05	+15		8	8	D	F8-3
07		1		5.6			40/80	-1.55	SELF		12	12	F	E-16
10		1						-1.05	+15		8	8	G	FIG-11
11		1						"	"				H	FIG-R
14	ECN	2					40/80	-1.55	SELF	22	12	12	I	E-B
27	BX	STEP #23	12			LEVEL		-1.05	"		12	12	K	GR-2
50	LIN-PAN	0	0	10		2°-25'	115AC 24DC	-15m, -15	+15	22			J	TR-A
13651	ECN	0	0	50	0°-00'	+2°-26'		88+5m6	SELF	TSP 4			P+	KODAK 35
82	MF		12	23 170°		+4°-30'	120DC	-155	+206		100-5		Y	MH-1
83				4 60°									PP	5
84				8 45°	5°-22'L								Q	BH-2
28	S-XX	STEP #19	47+INT		0°-00'	LEVEL		-1.05	SELF		200-2		N	GR-5
29	IR	STEP #21	89B					"	"		"		O	6
55	TRI-X	0	0	11		+2°-25'	115AC 24DC	-15m, -15	+15	16			R	R-14
- 47													S	24
48													T	4
43	MF												U	19
44													V	18
- 56	HRMS												W	29
59	TRI-X					MIRROR					29		APRON	12
60											TV			17
57											"			5
58											29			6
49	BX			20	0°-00'						5		QQ	TR-B

FILM SWITCHED IN LOADING

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST IS-G DATE 5-25-52 STA. 4-356

TRUCK 1 & TRAILER 4

REMARKS & NOTES			CAMERA			TIME	LENS	
PURPOSE	~FR./SEC.	NO.	SERIAL	MAG.	OPER.	FOC. LGH.	SERIAL	
SHOCK	650	E-17	1496			152	RC273	
"	"	20	1525			"	RC313	
YIELD	3000	12	1512			102	RY510	
		18	1517			"	ET415	
		7	1443			63	ET1229	
		24	1522			"	RC539	
STEM	650	27	1514			25	RY189	
COLOR	400	1	1454			"	RY183	
ND 0, 0.5, 1.0, 1.5, 2.0, 3.0	LIGHT	50/5	GR-4	670		—	—	
WR25 + BAIRD #7-2019-B G490±125A°								
RAISE FRONT	SHOCK	100	MH-4	745		100	BF8525	
10°	"	"	8	744		"	BF9463	
200	"	"	6	746		25	VF983	
			R-8	8	4940	480	773944	
			10	10	8300		3961	
			26	26	9.8		4696	
			31	31	27.5		3948	
			9	9	95		4694	
			33	33	403		3950	
VIEWS TOWER AREA 2			MH-3	734		400	52237	
W47 ON LEFT	3000	FB-14	8C-6			254	876312	
		CINE- THEOD.	66			305	—	

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST TS-6 DATE 5-25-52 STA. 4-256

TRUCK 1 & TRAILER 4

PERF. CODE	EMULS.	FILTERS		APER. SET.	AIMING		POWER	TIMING		MARKERS, SERIALS			RACK POS.	CAM NO.
		ND	COLOR		HORIZ.	VERT.		ON	OFF	M.	VEL.	ZERO		
13674	MF	1	12	5.6	1°-42'L	+1°-47'	120DC SHUNT	-1.53	SELF	23	200-4	4	A	E-17
75		0	47	"	3°-24'L		"				10	10	B	20
00			12	4	0°-00		10/80				9	9	C	12
01				8							4	4	D	18
02				"							10	10	E	7
03		1		5.6							9	9	F	24
73				"	+4°-00'		SHUNT				4	4	G	27
13	ECN		0	8		"	"				4	4	L	1
26	LIN-PAN	STEP 2B	25+INT	—	↓	LEVEL	↓	-1.03	↓	—	9	—	K	GR-4
13681	MF	0	12	2.8 170°	0°-00'	3°-30'	120DC	-155	+305	—	100-1	—	O	MH-4
19	ECN	1	0	4 15°		"					1		N	8
23	"	0		4 170°		16°-00'					6		P	6
53	TRI-X			11		+1°-47'	115AC 24DC	-15m-15	+15	10	—		R	R-8
54	"										24		S	10
45	HRMS										10		T	26
46	"										24		U	31
41	MF										"		V	9
42	"										10		W	33
85	S-XX	↓	↓	5 170°	TOWER	2	120 DC	-155	+30	—	100-6	↓	EXT.	MH-3
13609	ECN	2	29/47	11	CAB	+0°-00' CAB	GOAC	-25	+35	—	200-1	—	CP	FB-4
23	LIN-PAN	0	—	5	TRACKING		115AC 12DC	0	7'15"	—	—	—	"	CINE THEOB



EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST 15-7 DATE 6-1-52 STA. 3-355  
TRUCK 1 & TRAILER 4

REMARKS & NOTES			CAMERA			TIME	LENS	
PURPOSE	~ FR./SEC.	NO.	SERIAL	MAG.	OPER.	FOC. LGH.	SERIAL	
SHOCK	650	E-17	1496			152	RC213	
"	"	20	1525			"	RC313	
YIELD	3000	12	1512			102	RY510	
		18	1517			"	ET415	
		7	1443			63	ET1229	
		34	1522			"	RC539	
STEM	650	27	1514			25	RY189	
COLOR	400	1	1454			"	RY183	
ND 0.05, 1.0, 1.5, 2.0, 3.0	LIGHT	80 1/2 SEC.	GR-4	670		—	—	
W25 + BAIRD. INT #7-20798 6490 ± 125 A'								
RAISE FRONT	SHOCK	100	MH-1	748		100	BF9465	
	"		4	745			BF8525	
	CLOUD		8	744			BF9463	
	"		6	746		25	VF983	
			R-8	8	13,650 μs	480	773944	
			10	10	8300		3961	
			26	26	9.8		4696	
			31	31	27.5		3948	
			9	9	95		4694	
			33	33	403		3950	
W47 ON LEFT			FB-14	BC-6		254-	876312	
			CINE- THEOD	66		305	—	

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST TS-7 DATE 2-1-52 STA. 3-355

TRUCK 1 & TRAILER 4

PERF. CODE	EMULS.	FILTERS		APER. SET.	AIMING		POWER	TIMING		MARKERS, SERIALS			RACK POS.	CAM NO.
		ND	COLOR		HORIZ.	VERT.		ON	OFF	FM.	VEL.	ZERO		
13774	MF	1	12	8	1°42'L	1°45'	120DC SHUNT	-1.5s	SELF	23	200-4	4	A	E-17
75		0.5	47		3°24'L		"				10	10	B	20
00		0	12		0°-00'		40/60				9	9	C	12
01		1		5.6							4	4	D	18
02		0		8							10	10	E	7
03		1		5.6							9	9	F	24
73				"		4°00'	SHUNT				4	4	G	27
13	ECN		0	8		"	"				4	4	L	1
26	LIN-PAW	STEP #20	25+INT			LEVEL		-1.0s			9		K	GR-4
13782	MF	0	12	5.6 60°	0°-00'	2°30'	120DC	-15s	+30s		100-6		PP	MH-1
81	"	0	"	8 45°	5°-22'L						1		O	4
19	ECN	1	0	4 15°	0°-00'						1		N	8
20	"	0		4 17°		+2°00'					6		P	6
63	TRI-X			11		1°45'	115AC 24DC	-15m, -15	+15	10			R	R-8
54	"									24			S	10
45	HRHS									10			T	26
46	"									24			U	31
41	MF									"			V	9
42	"										10		W	33
13709	ECN	2	29/47	29/47	CAB	+0°17'	60AC	-25	+35		200-1		CP	FB-14
23	LIN-F-44	0			TRACKING		115AC 12DC	0					"	CINE-TRAC

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET 7-248,  
 TEST TS-7 DATE 6-1-52 STAS 3-356  
 TRUCK 2 & TRAILER 5

REMARKS & NOTES		CAMERA			TIME	LENS	
PURPOSE	~ F. SEC.	NO.	SERIAL	MAG.	OPER.	FOC. LGH.	SERIAL
CORE	3000	E-25	1520			102	ET201
YIELD		15	1494			"	RC185
"		9	1493			63	RC622
FIREBALL	9000	FB-3	8C-12			254	876314
YIELD	3000	E-16	1513			63	ET1245
FIREBALL	4000	FIG-11	16C-15			100	617363
"	"	FIG-R	16-168			"	617367
COLOR	3000	E-8	1445			63	ET1254
ND 0.0, 0.5, 1.0, 1.5, 2.0, 3.0 LIGHT	80/SEC	GR-2	581			-	-
3 μs RAP SHUTTER TELLER LIGHT		TRA	3427		0	1829	NEWTONIAN
RAISE FRONT SHOCK	100	MH-5	743			75	B51805
"	"	BH-2	1093			100	282354
BAIRD 7-206 ND 0.0, 0.5, 1.0, 1.5, 2.0, 3.0 4381 ± 75A° LIGHT	80/SEC	GR-5	667			-	-
"	"	6	669			-	-
		R-14	14		10,800 μs	480	773952
		24	24		7335		3958
		4	4		4400		3947
		19	19		49.2		2890
		18	18		210		3955
		29	29		785		3954
1 μs SPECIAL FM.		TR-B	3149 B		~ 0	4064	CASSEGRAIN
3 μs FM TELLER LIGHT		R-12	12		0	480	773960
5 X UNIT PULSE DELAYED 95 μs (TT 97.6 μs)		17	17				3951
5 " " " " " " " " " " " "		5	5				3956
3 FM TELLER LIGHT		6	6				3949

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

7-248

TEST T3-7 DATE 6-1-52 STAS. 3-35

TRUCK 2 & TRAILERS

PERF. CODE	EMULS.	FILTERS		APER. SET.	AIMING		POWER	TIMING		MARKERS, SERIALS			RACK POS.	CAM NO.
		ND	COLOR		HORIZ.	VERT.		ON	OFF	FM.	VEL.	ZERO		
13704	MF	2	12	5.6	0°00'	+0°33'	120DC 40/80	-1.5s	SELF	22	200-B	B	A	E-25
05		0		8							7	7	B	15
06		0									12	12	C	9
08		2						-1.0s	+1s		8	8	D	F8-3
07		1		5.6			40/80	-1.5s	SELF		12	12	F	E-16
10								-1.0s	+1s		8	8	G	F16-11
11								"	"				H	F16-R
14	ECN	2					40/80	-1.5s	SELF	22	12	12	I	E-8
27	BX	STEP #23	12			LEVEL		-1.0s	"		12		K	GR-2
50	LIN-PAN	0	0	10		+0°33'	115AC 24DC	-15m-1s	+1s	22			J	TR-A
13783	MF	0	12	23 170°	0°00'	+2°30'	120DC	-15s	+20s		100-5		PP	MH-5
84	"	0	"	23 120°		"					5		Q	BA-2
28	S-XX	STEP #19	47+INT			LEVEL		-1.0s	SELF		200-2		N	GR-5
29	IR	STEP #25	89B			"		"	"		2		O	G
55	TRI-X	0	0	11		+0°33'	115AC 24DC	-15m-1s	+1s	16			R	R-14
47													S	24
48													T	4
43	MF												U	19
44	"												V	18
56	HRHS												W	29
49	BX			20							5		QQ	TR-B
13759	TRI-X	0	0	11	MIRROR	1°54'	115AC 24DC	-15m-1s	+1s	29			7-248	R-12
60											TV			17
57														5
58											29			6

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CAMERA DATA SHEET

TEST IS-B DATE 8-5-52 STA. 2-355  
TRUCK 2 TRAILER 5

REMARKS & NOTES			CAMERA			TIME	LENS	
PURPOSE	~ FR./SEC.		NO.	SERIAL	MAG.	OPER.	FOC. LGH.	SERIAL
CORE	3000		E-25	1520			102	ET201
YIELD			15	1494			"	RC185
"			9	1493			63	RC622
FIREBALL	9000		FB-3	8C-12			254	B76314
YIELD	3000		E-16	1513			63	ET1245
FIREBALL	4000		F16-11	16C-15			100	G17363
"	"		F16-R	16-168			"	G17367
COLOR	3000		E-8	1445			63	ET1254
ND 0.0, 0.5, 1.0, 1.5, 2.0, 3.0	LIGHT	80 <sup>1</sup> /sec	GR-2	581			—	—
5 μs RAP SHUTTER	TELLER LIGHT		TR-A	3427		0	1829	NEWTONIAN
RAISE FRONT	SHOCK	100	MH-5	743			75	BS1805
"	"	"	BH-2	1093			100	282354
ND 0.5, 1, 1.5, 2, 3	LIGHT	80 <sup>1</sup> /sec	GR-5	667			—	—
"	"	"	6	669			—	—
	YIELD		R-14	14		10300 μs	480	773952
			24	24		7335		3958
			4	4		4400		3947
			19	19		49.2		2890
			18	18		210		3955
			29	29		785		3954
1 μs SPECIAL FM - "NO DELAY"			TR-B	3149-B		0	4060	CASSEGRAIN
3 μs FM TELLER LIGHT			R-12	12		0	480	773960
5 EARLY BOMB			17	17		5.5		3951
5 COLOR			5	5		3160		3956
3 FM TELLER LIGHT			6	6		0		3949

EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

TEST TS-8 DATE 6-5-52 STA. 2-355  
TRUCK 2 & TRAILER 5

PERF. CODE	EMULS.	FILTERS		APER. SET.	AIMING		POWER	TIMING		MARKERS, SERIALS			RACK POS.	CAM NO.
		ND	COLOR		HORIZ.	VERT.		ON	OFF	FM.	VEL.	ZERO		
13804	MF	2	12	5.6	0°-00'	2°-50'	120DC 40/80	-1.5S	SELF	22	200-8	8	A	E-25
05		0		8							7	7	B	15
06		"									12	12	C	9
08		2						-1.0S	+1S		8	8	D	FB-3
07		1		5.6			40/80	-1.5S	SELF		12	12	F	E-16
10								-1.0S	+1S		8	8	G	FK-11
11													H	FK-2
14	ECN	2	-				40/80	-1.5S	SELF	22	12	12	I	E-8
27	BX	STEP #12	12	-		LEVEL		-1.0S	"		12	12	K	GR-2
50	LIN-PAN	0	0	10		2°-50'	115AC 24DC	-15m, -15s	+1S	22			J	TR-A
13883	MF	0	12	23 170°	0°-00'	3°-45'	120DC	-15S	+20S		100-5		PP	MW-5
84	"	"	"	25 120°		4° 30'		"	"				Q	BH-2
28	S-XX	STEP #10	47+INT	-		LEVEL		-1.0S	SELF		200-2		N	GR-5
29	IR	STEP #14	89B	-		"		"	"		"		O	6
55	TRI-X	0	0	11		2°-50'	115AC 24DC	-15m, -15s	+1S	16			R	R-14
47													S	24
48													T	4
43	HRHS												U	19
44	MF												V	18
56	HRHS												W	29
49	BX			20						5			QQ	TR-B
13857	TRI-X	0	0	11	MIRROR	2°-50'	115AC 24DC	-15m, -15s	+1S	29			Approx	R-12
59	HRHS													17
60	ECN													5
58	TRI-X													6



EDGERTON, GERMESHAUSEN & GRIER, INC.

CAMERA DATA SHEET

4-248

TEST TS-B DATE 6-5-52 STAG. 2-356

TRUCK 1 & TRAILER 4

PERF. CODE	EMULS.	FILTERS		APER. SET.	AIMING		POWER	TIMING		MARKERS, SERIALS			RACK POS.	CAM NO.
		ND	COLOR		HORIZ.	VERT.		ON	OFF	FM.	VEL.	ZERO		
13874	MF	1	12	8	1°42'L	1°36'	120DC SHUNT	-1.5s	SELF	23	200-4	4	A	E-17
75		0.5	47		3°24'L		"				10	10	B	20
00		0	12		0°00'		40/80				9	9	C	12
01		1		5.6							4	4	D	18
02		0		8							10	10	E	7
03		1		5.6							9	9	F	24
73				"		4°00'	SHUNT				4	4	G	27
13	ECN		0	8		"	"				4	4	L	1
26	LIN-PAN	STEP 1/4	25+INT.	—		LEVEL		-1.0s			9	—	K	GR-4
13882	MF	0	12	5.6 60°	0°00'	+2°00'	120DC	-15s	+30s	—	100-6	—	PP	MH-1
81	"	"	"	8 45°	5°22'L						1		O	4
19	ECN	1	0	4 15°	0°00'						1		N	8
20	"	0		4 17°		12°00'					6		P	6
53	TRI-X			11		1°36'	115AC 24DC	-15s, -1s	+1s	10	—		R	R-8
54	"										24		S	10
45	HRHS										10		T	26
46	"										24		U	31
41	MF										"		V	9
42	"										10		W	33
13872	SXX	0	0	6.3 60°	13°28'L	15°11'	115AC	-15s	+20s	—	100-4	—	A	MH-7
71	MF			6.3 170°	9°30'L	12°10'							B	3
70	"			6.3 30°	5°20'L	7°8'							C	2



APPENDIX B

**FILM LISTING "BLAST STUDIES ON OPERATION  
TUMBLER-SNAPPER"**

A sound movie concerned primarily with the study of blast effects on Tumbler-Snapper has been made and distributed. Table B.1 lists films contained in this movie in the order of their appearance.

In addition to the films listed in Table B.1, this movie contains Rapatronic photographs and descriptive footage shot especially for this picture.

Table B.1 -- FILMS CONTAINED IN SOUND MOVIE  
 "BLAST EFFECTS ON TUMBLER-SNAPPER"

				NAME	DATE	JOB NO.
Film #	Shot #	Station	Nominal Speed			
13021	1	F-362	100 FR/sec.			
1322	3	7-362	100			
13206	3	7-361	3000			
13381	4	"	100			
13321	4	7-362	100			
13383	4	"	100			
13071	1	F-361	100			
13121	2	7-362	100			
13273	3	7-360	500			
13275	3	"	500			
13276	3	"	500			
13277	3	"	500			
13278	3	"	500			
13280	3	7-361	500			
13366	4	376	36			
13321(repeat)	4	7-362	100			
13373	4	7-360	500			
13374	4	"	500			
13085 pre	1	F-363	36			
13086 post	1	"	36			
13091 pre	1	F-366	36			
13092 post	1	"	36			
13094	1	F-367	36			
13096	1	F-368	36			
13098	1	"	36			
13286 pre	3	363	36			
13285 post	3	"	36			
13198	2	7-375	300			
13288 pre	3	364	36			
13287 post	3	"	36			
13290 pre	3	365	36			
13289 post	3	"	36			
13269	3	7-248	36			
13292 pre	3	366	36			
13291 post	3	"	36			
13296	3	367	36			
13298 pre	3	368	36			
13297 post	3	"	36			
13299	3	"	36			
13220	3	7-362	100			

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APPENDIX C

CAMERA-STATION LAYOUTS, TS 1 TO 8

Table C.1 — CAMERA-STATION SUMMARY, TUMBLER-SNAPPER

			NAME			DATE	JOB NO.
Shot #	Area	Photo Station	COORDINATES			Photo Vehicle	
			N	E	Elev (FT or Meters)		
1	FF	F-360	738,350	713,000	3162	Truck #1	
		F-361	738,330	711,000	3133	Truck #4	
		F-362	745,826	703,937	3088	Truck #2 & Trailer #5	
2, 3 & 4	7	7-360	845,192	701,169	4394	Truck #1	
		7-361	839,282	700,134	4289	Truck #2 & Trailer #4	
		7-362	835,898	666,857	4018	Trailer #5	
5	1	1-355	831,633	678,359	4103	Truck #1 & Trailer #4	
		1-366	846,551	671,736	4163	Truck 2 " 5	
6	4	4-365	846,580	671,736	4163	Truck 2 + Trailer 5	
		4-356	863,886	668,746	4283	" 1 " 4	
7	3	3-365	829,564	695,882	4019	Truck 1 & Trailer 4	
		5-356	844,491	695,882	4236	" 2 " 5	
8	2	2-355	863,916	668,730	4283	Truck 1 & Trailer 4	
		2-356	878,577	665,909	4507	" 2 " 5	
			Ground Plane Coordinates				
Shot #	Area		N	E	Z (Burst # or Ground)		
1	FF		746,372	714,067	793		
2	7		850,291	688,769	1109		
3	7		860,344	688,561	3447		
4	7		850,284	688,532	1040		
5	1		838,780	664,589	300 (Tower)		
6	4		854,234	664,464	300 "		
7	3		837,026	688,416	750 "		
8	2		869,836	659,889	300 "		

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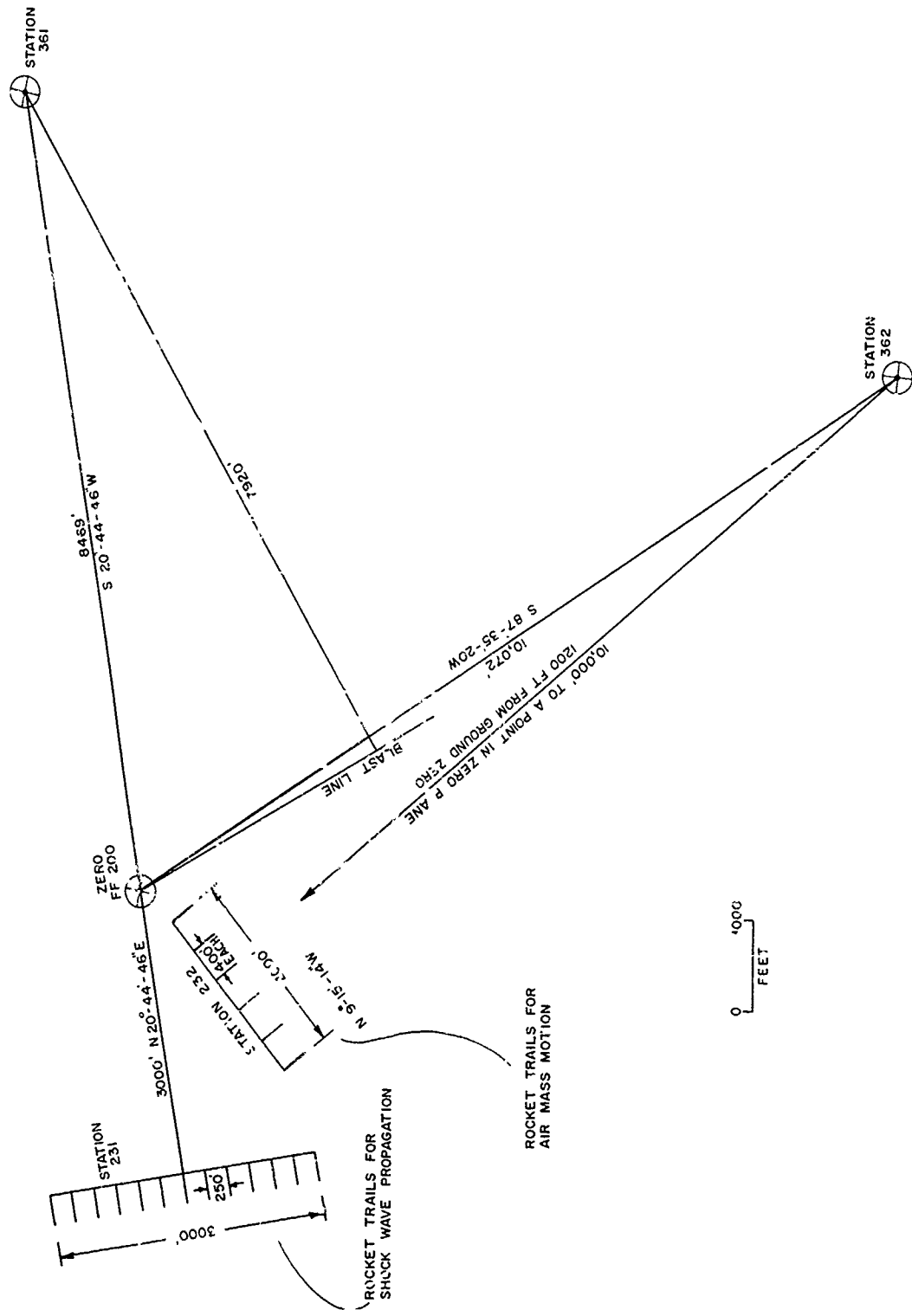


Fig. C.1—Arca F layout, TS-1. Note NOL rocket stations and EG&G camera stations.

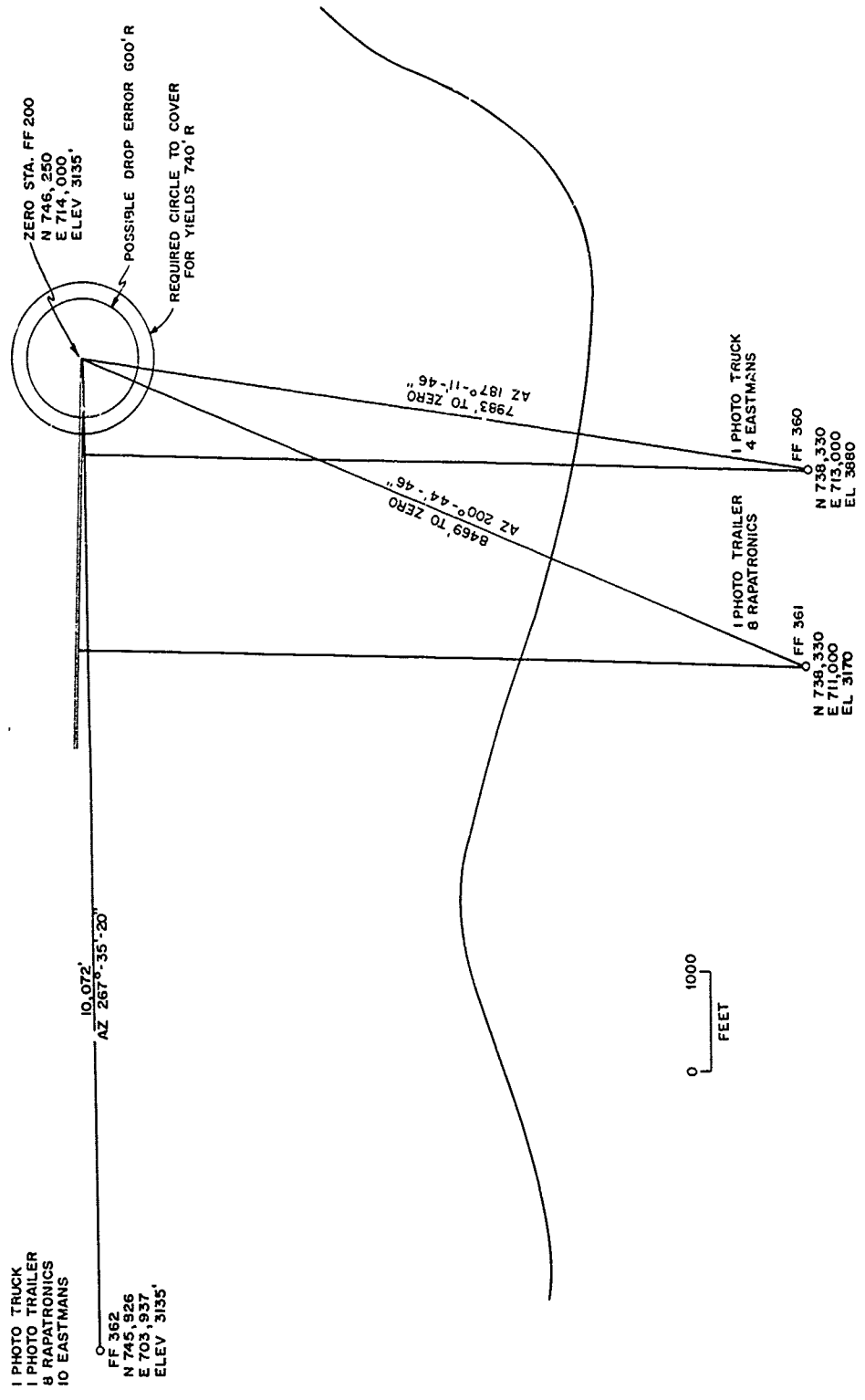


Fig. C.2—Photostation layout for yield, TS-1.

○ STA. 7-201  
(BUSTER PHOTO STA.)

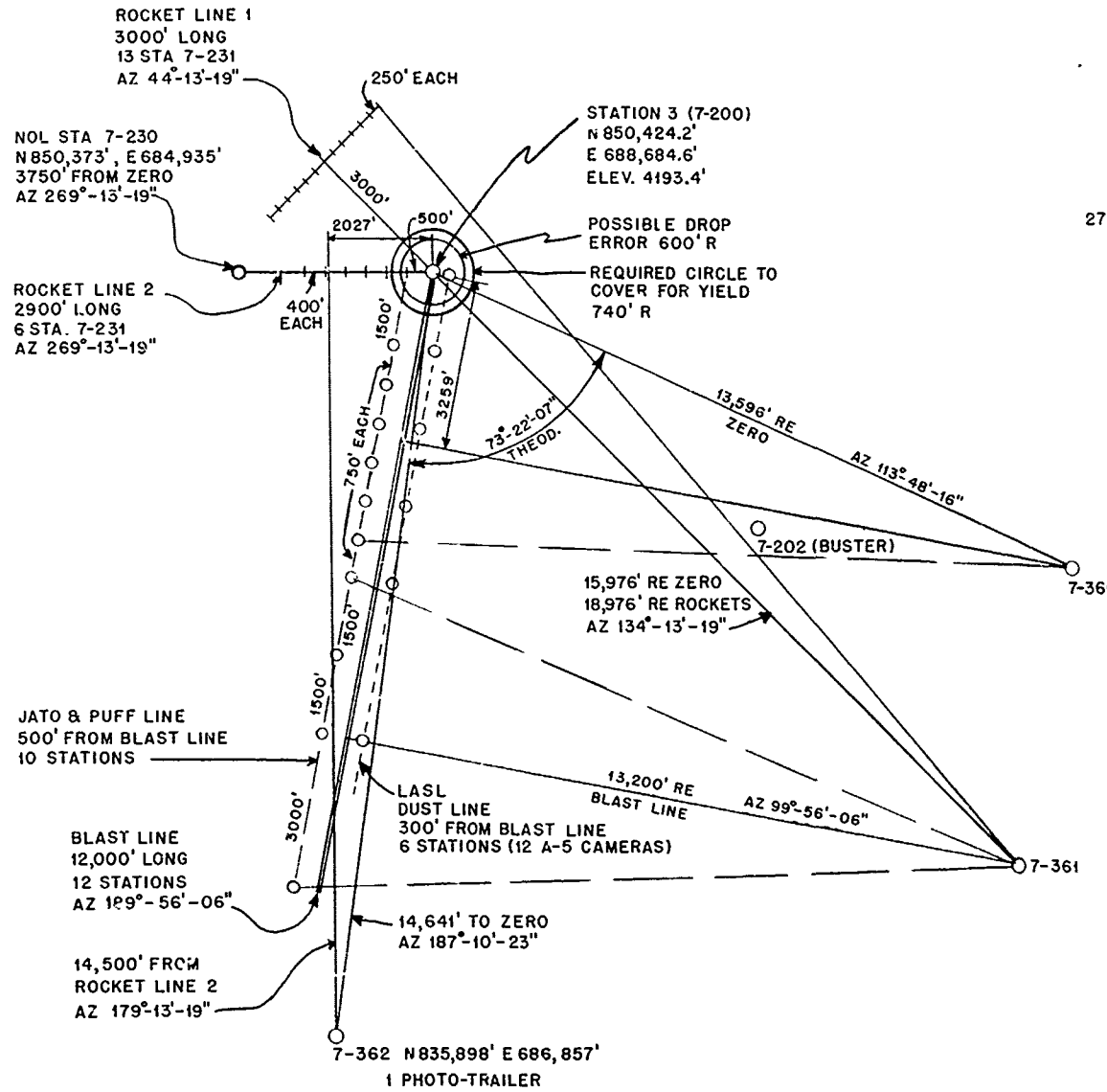


Fig. C.3—Photostation layout, TS-2.

○ STA. 7-201  
(BUSTER PHOTO STA)

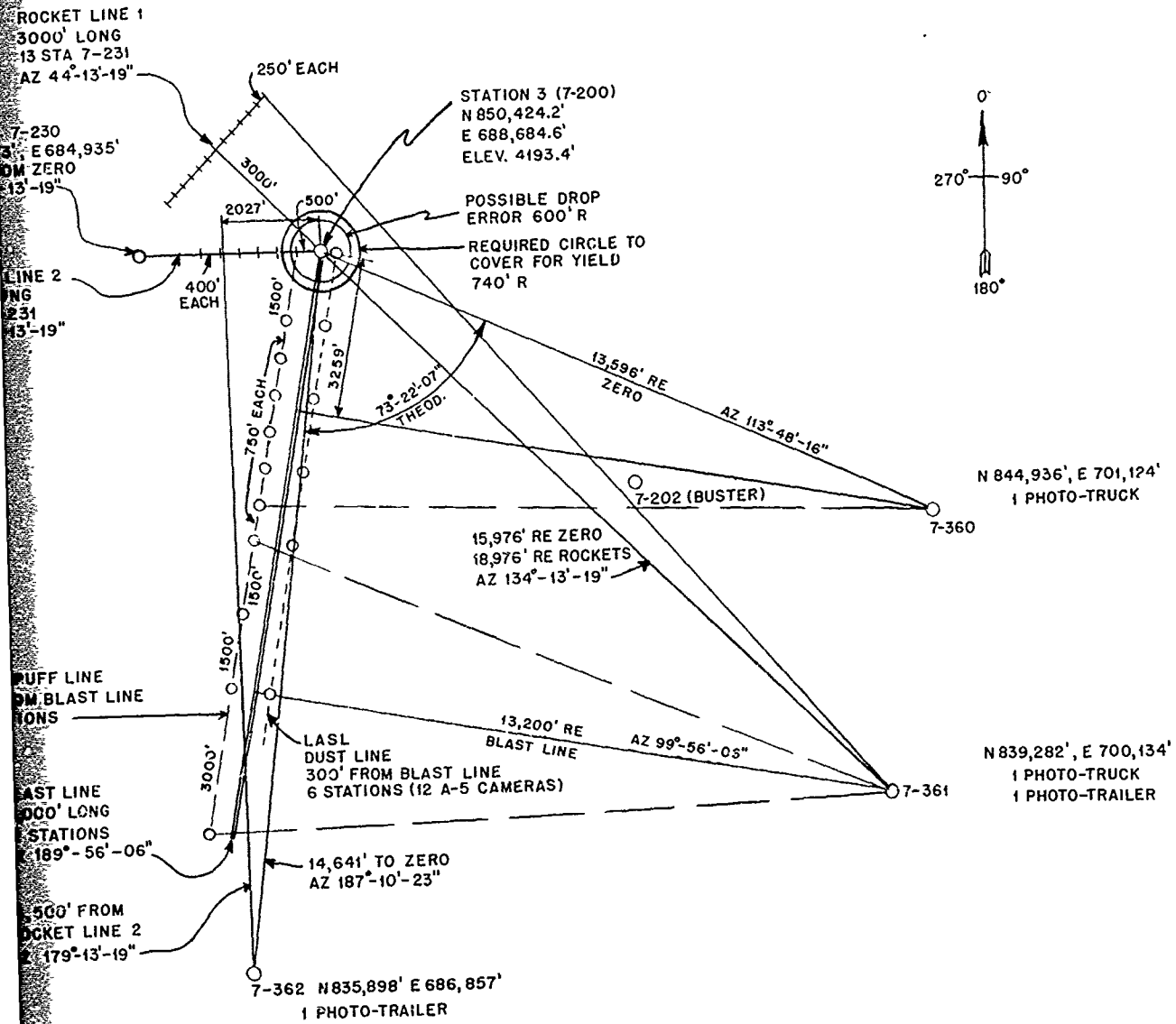


Fig. C.3—Photostation layout, TS-2.



○ STA. 7-201 (BUSTER  
 N 860,589.7' PHOTO  
 E 694,967.7' STA.)  
 ELEV. 4515.9'

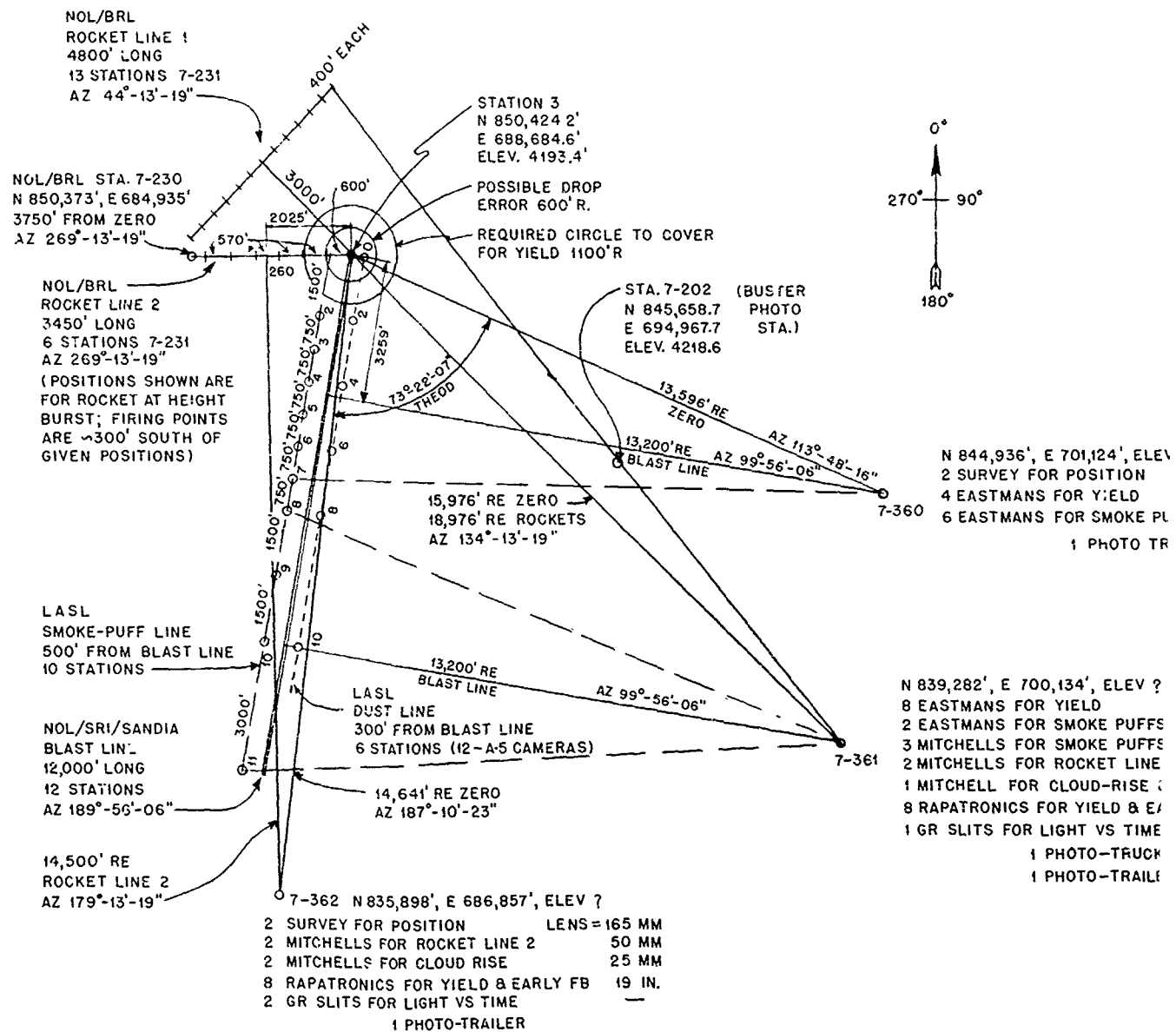


Fig. C.4—Photostation layout, TS 3 and 4.

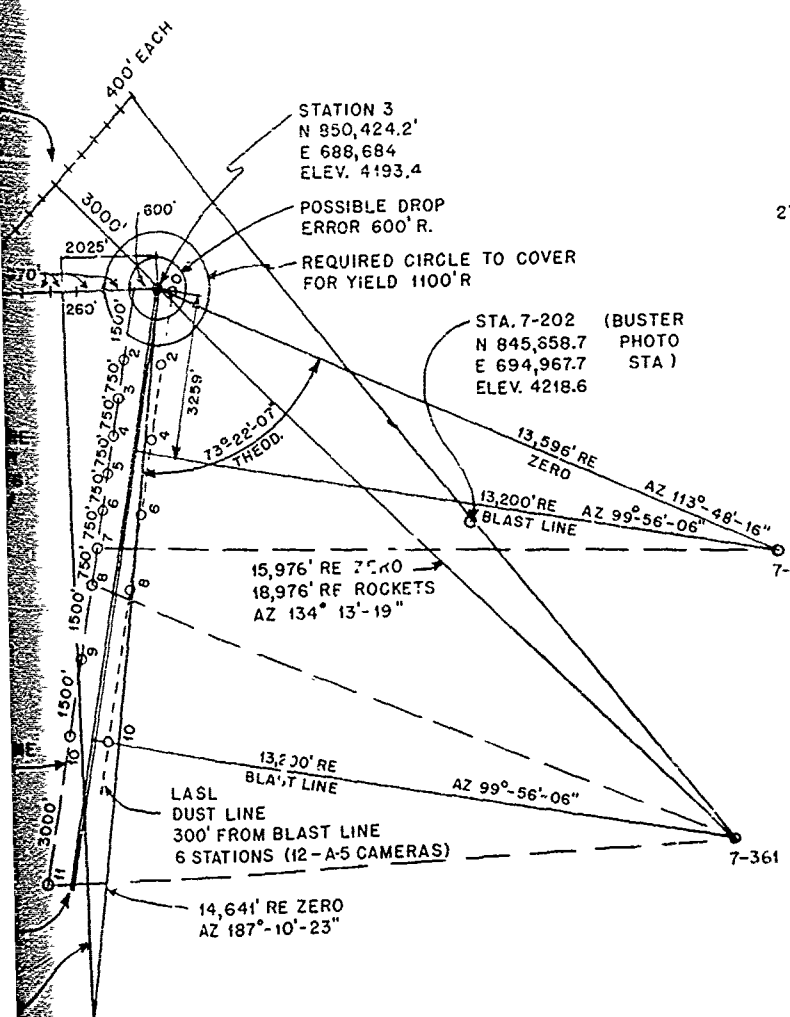
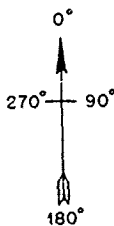
○ STA. 7-201 (BUSTER  
 N 860,589.7' PHOTO  
 E 694,967.7' STA.)  
 ELEV. 4515.9'

STATION 3  
 N 850,424.2'  
 E 688,684  
 ELEV. 4193.4

POSSIBLE DROP  
 ERROR 600' R.

REQUIRED CIRCLE TO COVER  
 FOR YIELD 1100'R

STA. 7-202 (BUSTER  
 N 845,358.7 PHOTO  
 E 694,967.7 STA.)  
 ELEV. 4218.6



N 844,936', E 701,124', ELEV ?  
 2 SURVEY FOR POSITION LENS = 165 MM  
 4 EASTMANS FOR YIELD 63 MM  
 6 EASTMANS FOR SMOKE PUFFS & JATOS 152 MM  
 1 PHOTO TRUCK

N 839,282', E 700,134', ELEV ?  
 8 EASTMANS FOR YIELD LENS = 63 MM  
 2 EASTMANS FOR SMOKE PUFFS & JATOS 152MM  
 3 MITCHELLS FOR SMOKE PUFFS & JATOS 15 IN.  
 2 MITCHELLS FOR ROCKET LINES 1 & 2 50 MM  
 1 MITCHELL FOR CLOUD-RISE & ROCKETS 25 MM  
 8 RAPATRONICS FOR YIELD & EARLY FB 19 IN.  
 1 GR SLITS FOR LIGHT VS TIME  
 1 PHOTO-TRUCK  
 1 PHOTO-TRAILER

7-362 N 835,898', E 686,857', ELEV ?  
 2 SURVEY FOR POSITION LENS = 165 MM  
 2 MITCHELLS FOR ROCKET LINE 2 50 MM  
 2 MITCHELLS FOR CLOUD RISE 25 MM  
 8 RAPATRONICS FOR YIELD & EARLY FB 19 IN.  
 2 GR SLITS FOR LIGHT VS TIME  
 1 PHOTO-TRAILER

Fig. C.4—Photostation layout, TS 3 and 4.

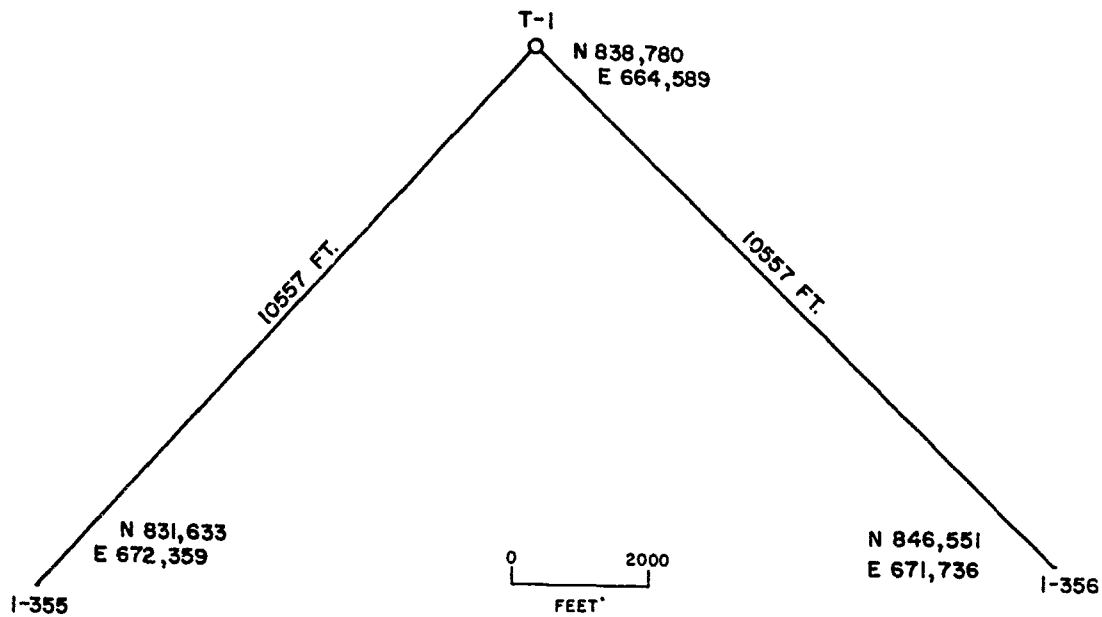


Fig. C.5—Photostation layout, TS-5.

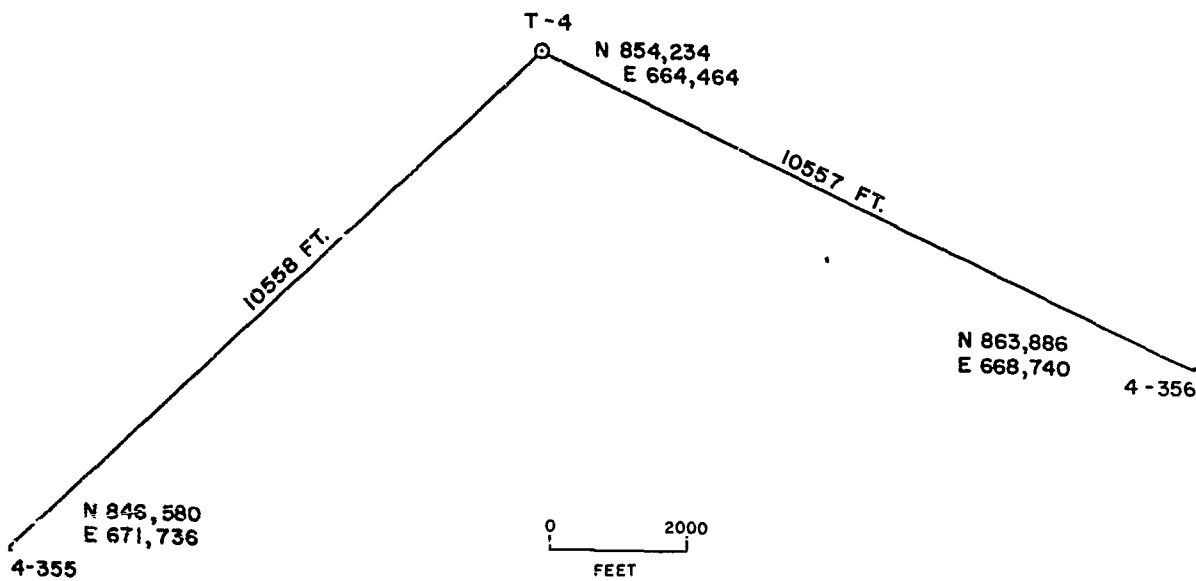


Fig. C.6—Photostation layout, TS-6.

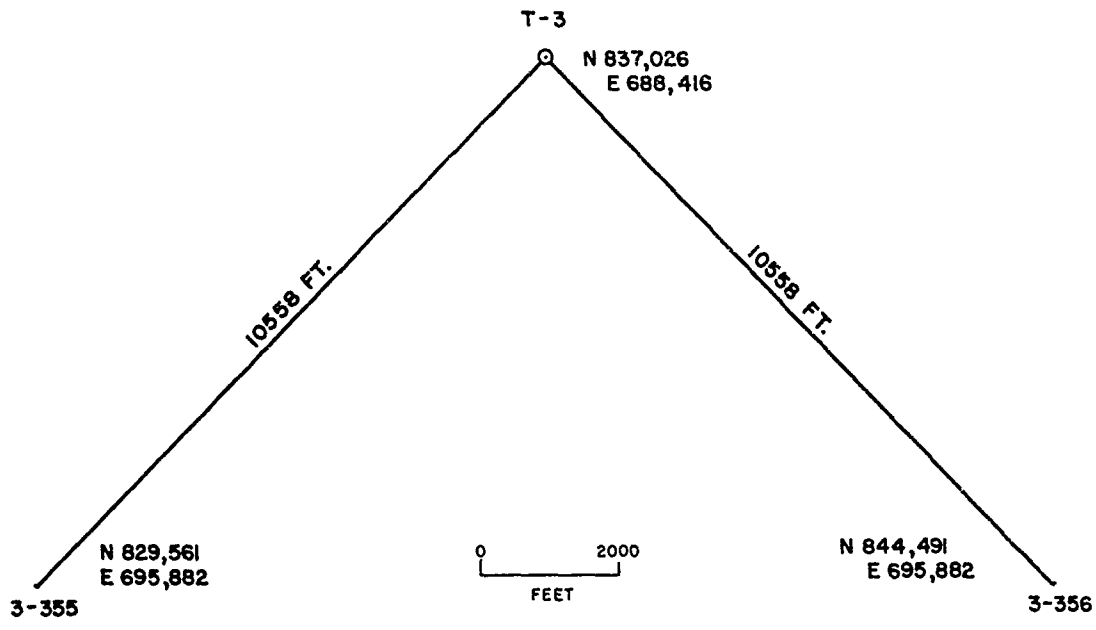


Fig. C.7—Photostation layout, TS-7.

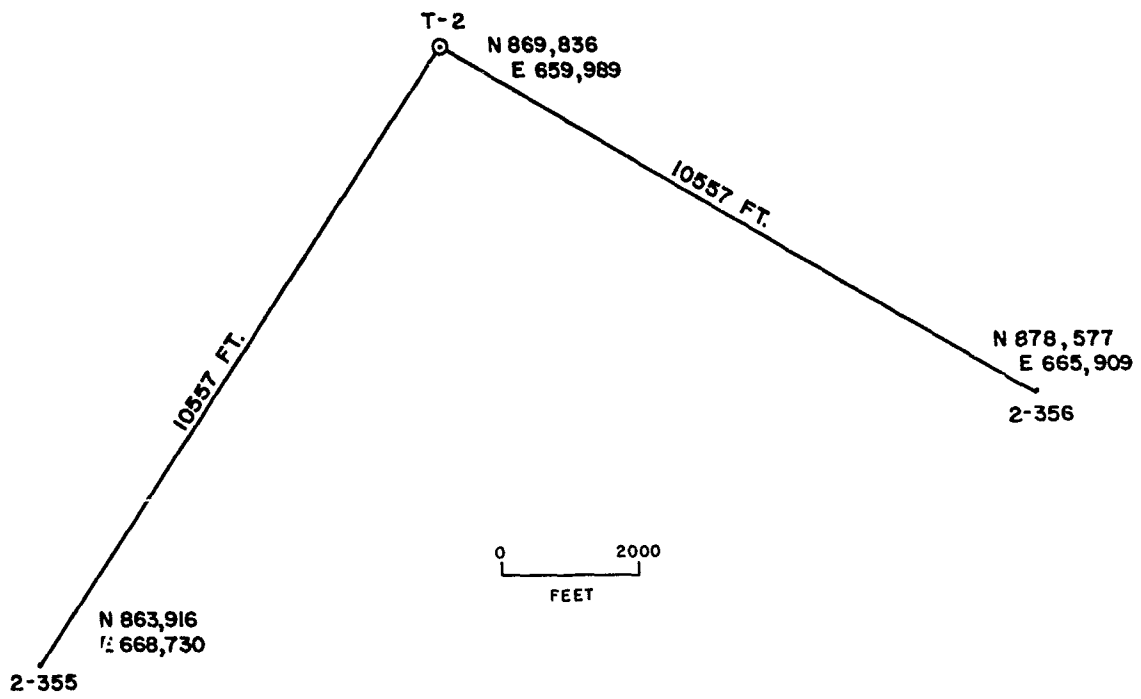


Fig. C.8—Photostation layout, TS-8.

## APPENDIX D

### CALIBRATION OF EFFECTIVE FOCAL LENGTH WITH COLLIMATOR AND PRISM

This section describes the collimator-prism technique which was used to calibrate the effective focal lengths of the lens-camera combinations. The collimator with its single target and prism essentially replaces two targets at optical infinity separated by a known angle. Figure D.1 illustrates the geometrical properties and nomenclature of the system.

In the ideal case it is necessary that the deviated collimator beam be symmetrical about the photographic axis of the lens. For this case we may write

$$r' = f (\tan \eta/2 + \tan \eta/2) = 2f \tan \eta/2 \quad (D.1)$$

where  $r'$  = the distance between target images on the film

$f$  = the effective focal length of the camera-lens system

$\eta/2$  = half the total deviation angle of the prism

In the actual case this perfect optical alignment is not possible. The equation of the inner orientation must be written as

$$\begin{aligned} r' &= f(\tan \eta/2 + \mu + \tan \eta/2 - \mu) \\ &= f[\tan \eta/2 + \tan \eta/2 + \mu(\sec^2 \eta/2 - \sec^2 \eta/2)] \\ &= 2f \tan \eta/2 \end{aligned} \quad (D.2)$$

when  $\mu$  is small with respect to  $\eta/2$ .

If reasonable care is taken in setting up the instrument, i.e., if the two collimator images are centered making  $\mu$  small with respect to  $\eta/2$ , then Eq. D.2 breaks down into the simpler form of Eq. D.1.

For the calculation of focal length it is only necessary to measure the distance between the two images of the collimator target on the film and to divide by the parameter  $(2 \tan \eta/2)$  which is a constant of the particular prism being used. Before measurement the film should be conditioned for 12 to 24 hr in an atmosphere of approximately 70°F and 80 per cent relative humidity. The reason for this is to try to eliminate any effects of differential film shrinkage, that is, the difference in the shrinkage of the calibration films and the shot films. The shot films are conditioned in this same atmosphere.

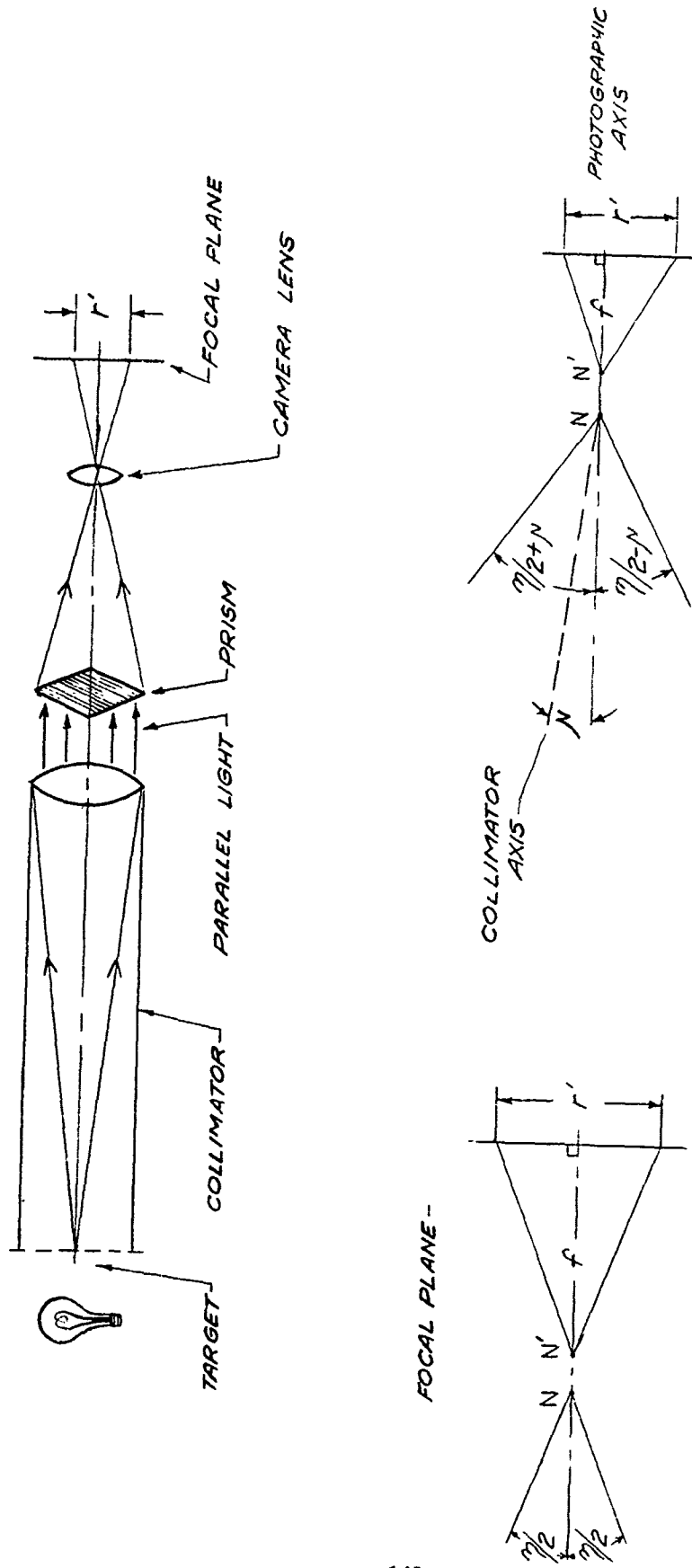


Fig. D.1—Geometrical properties and nomenclature of collimator-prism system.

APPENDIX E

METEOROLOGICAL DATA, TUMBLER-SNAPPER

Shot	Date	Time, PST	Temp., °C	Pressure, mb	Relative humidity, %	Air density	Velocity of sound, meters/ <del>μsec</del> <sup>m</sup> Sec
1	4-1-52	0900:07.5	13.6	888.5	30	1.066	0.3397
2	4-15-52	0929:57.05	9.1	842	30	1.049	0.3370
3	4-22-52	0930:10.02	7.6	770	47	0.9536	0.3361
4	5-1-52	0829:59.1	15.0	845	50	1.018	0.3406
5	5-7-52	0414:59.25	16.6	858	37	1.029	0.3416
6	5-25-52	0359:59.6	19.4	858	41	1.021	0.3433
7	6-1-52	0354:59.8	13.2	865	48.1	1.040	0.3395
8	6-5-52	0355:00.3	20.6	856.5	50.4	1.010	0.3440

APPENDIX F

RAPATRONIC TOWER PHOTOGRAPHY, TS 5 TO 8

Figures F.1 to F.8 are early fireball photographs which create an interesting study, all to the same scale, of the growth of four detonations, TS 5 to 8.



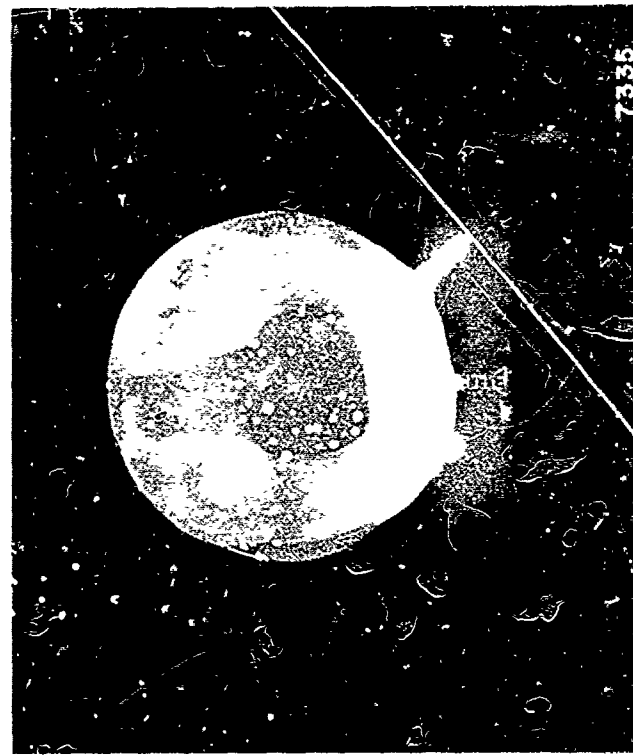
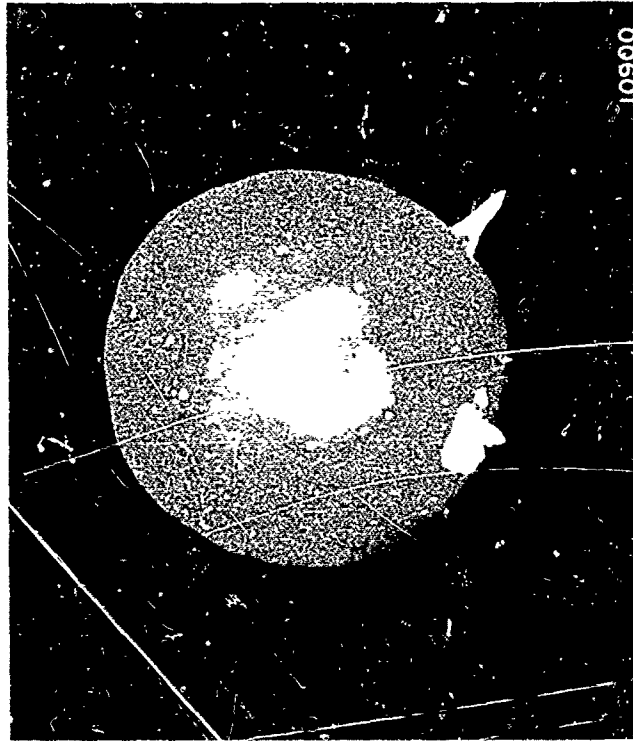
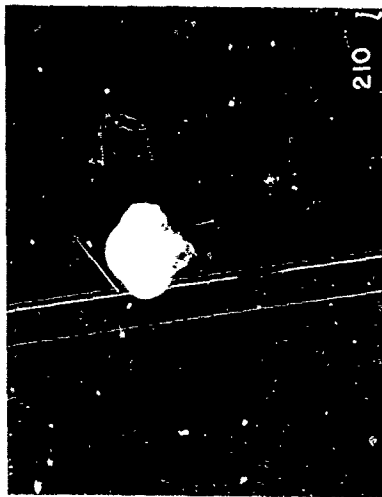
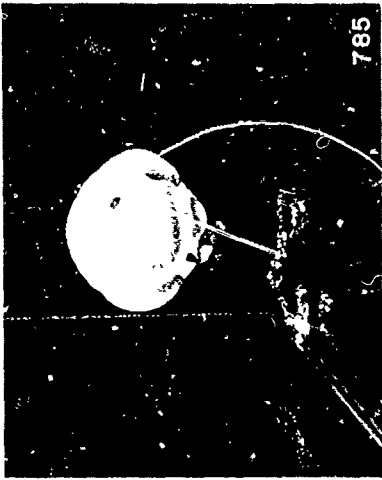


Fig. F 1—Fireball photograph, TS-5, 7 May 1952. Camera 2 miles northeast.

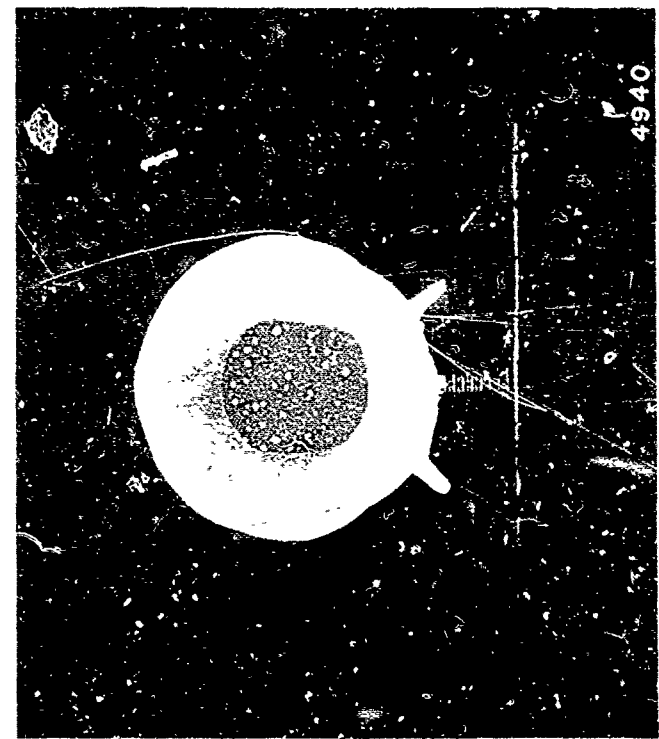
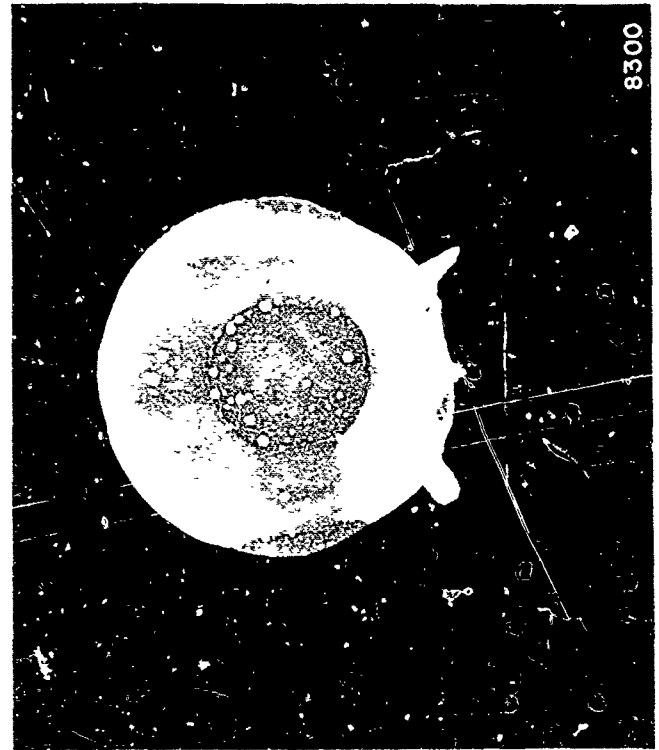
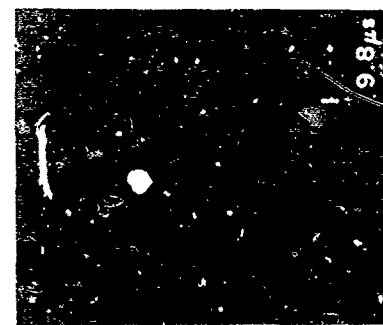
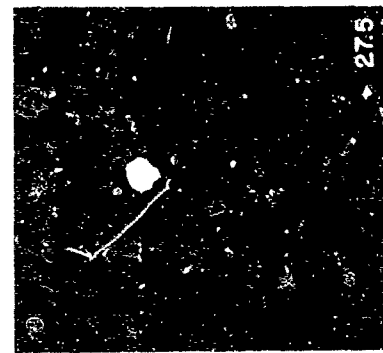
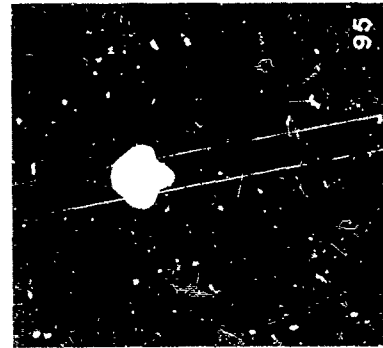


Fig F.2—Fireball photograph, TS-5, 7 May 1952. Camera 2 miles southeast.

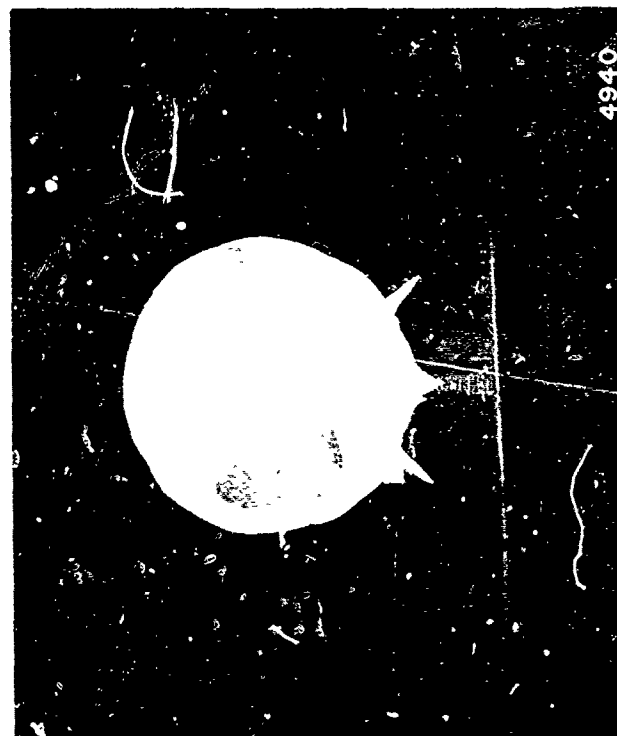
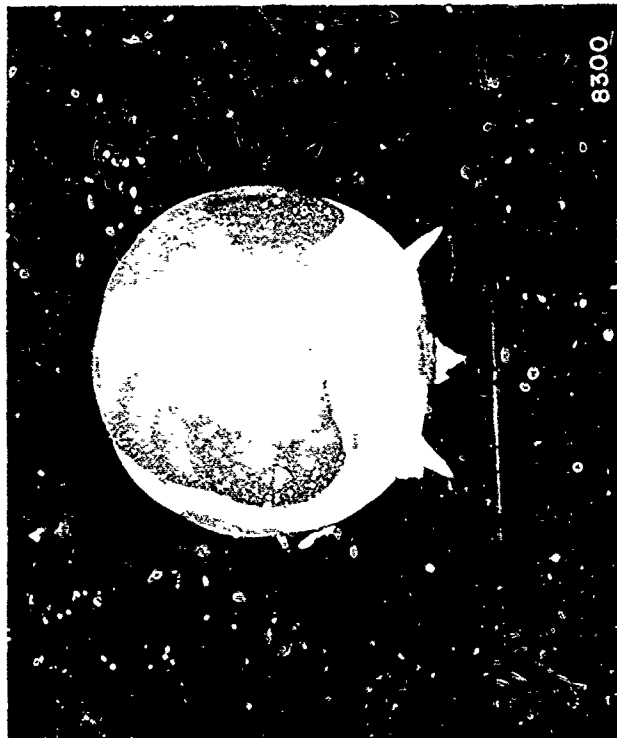
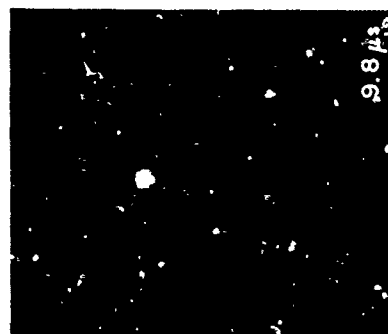
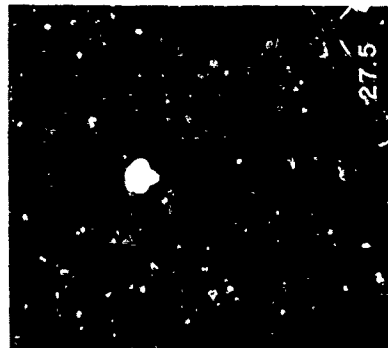
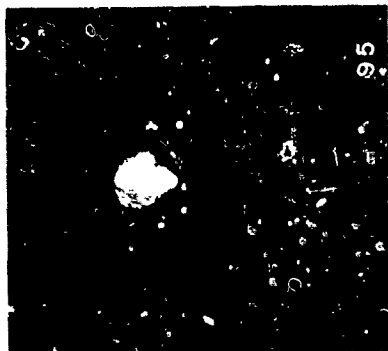
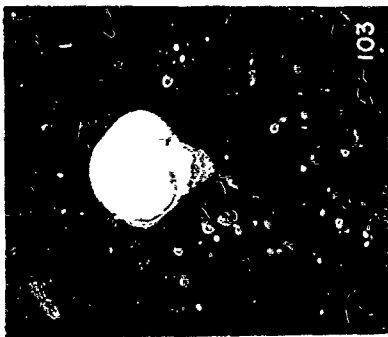


Fig. F. 3—Fireball photograph, TS-6, 25 May 1952. Camera 2 miles northeast.

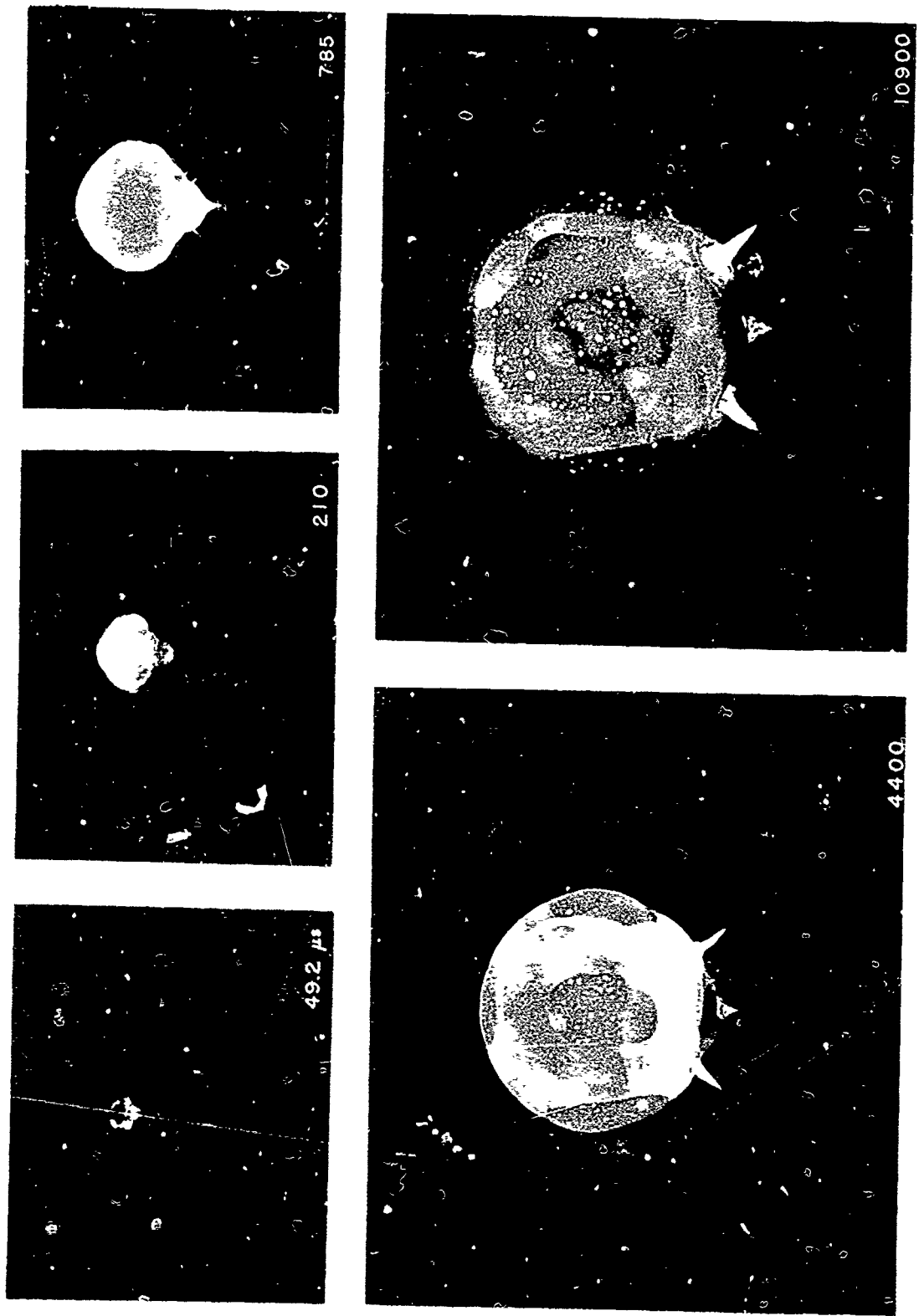


Fig. F.4—Fireball photograph, TS-6, 25 May 1952. Camera 2 miles southeast.

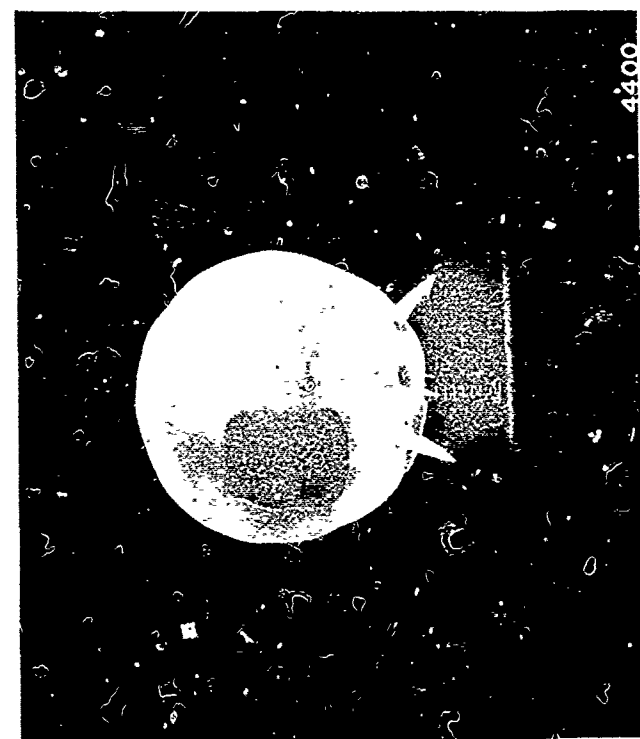
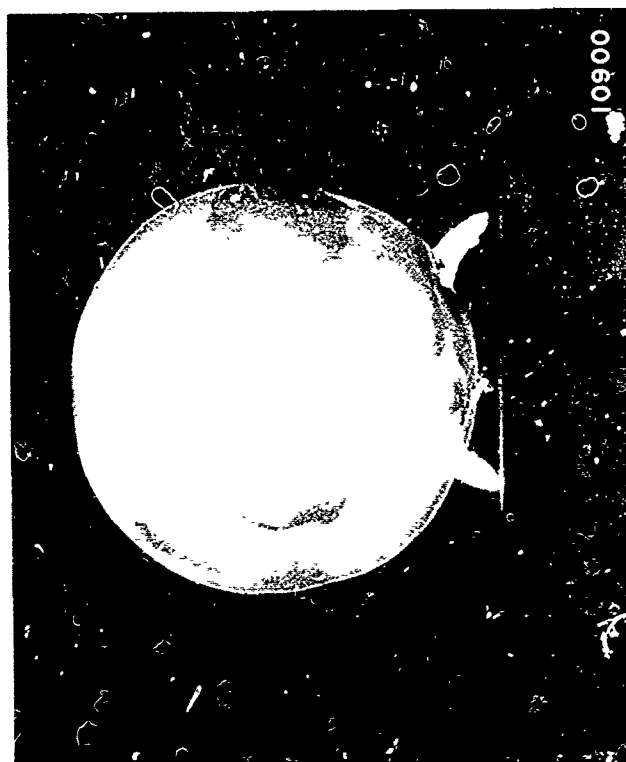
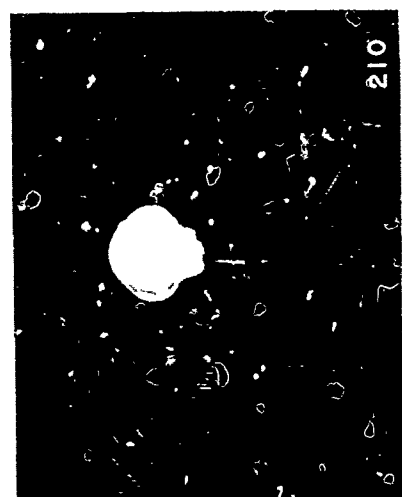
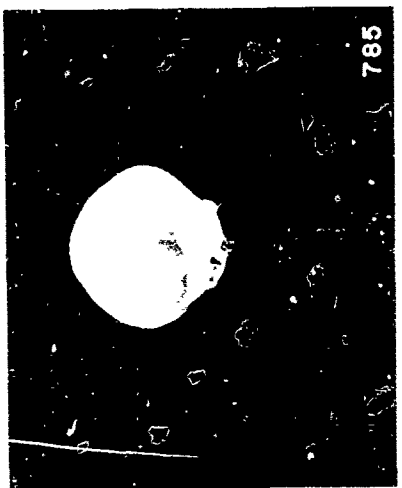


Fig. F.5—Fireball photograph, TS-7, 1 June 1952. Camera 2 miles northeast.

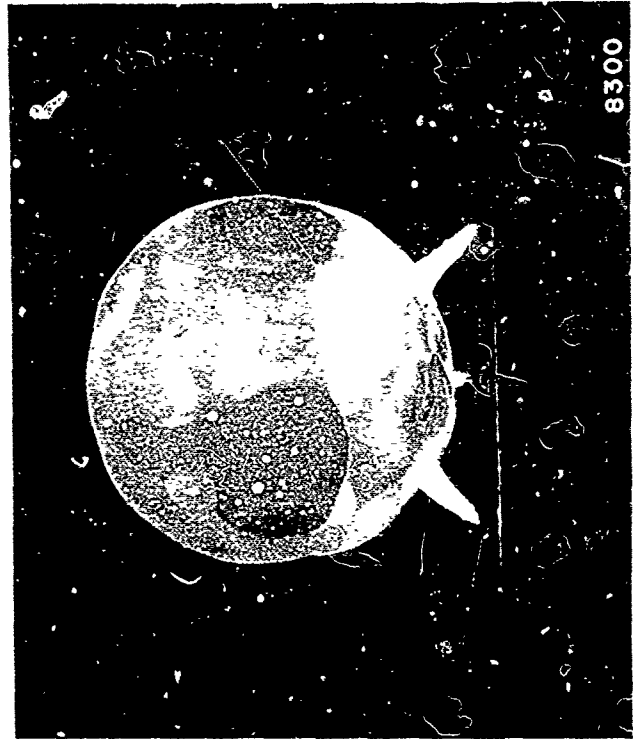
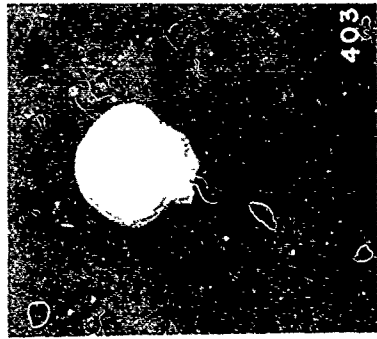
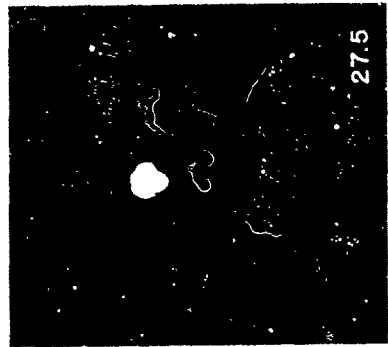
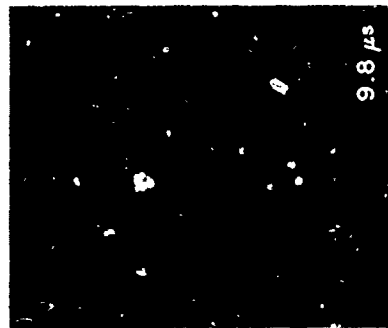


Fig. F.6—Fireball photograph, TS-7, 1 June 1952. Camera 2 miles southeast.

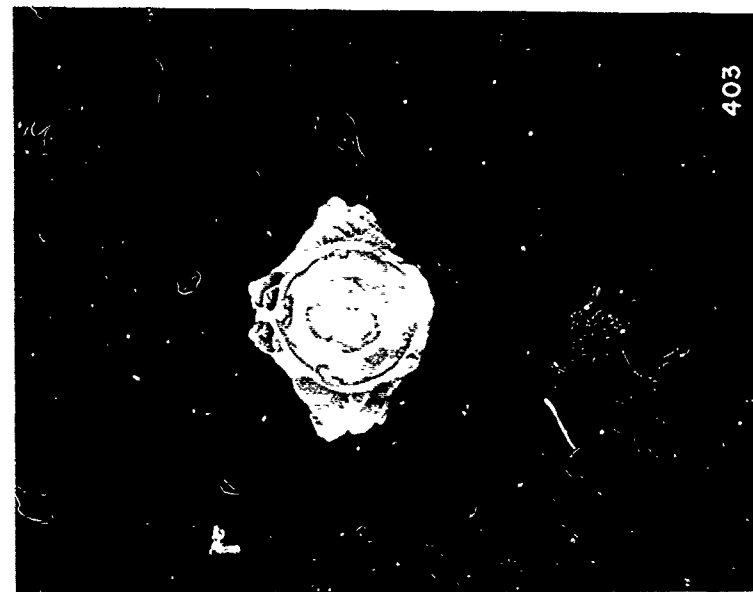
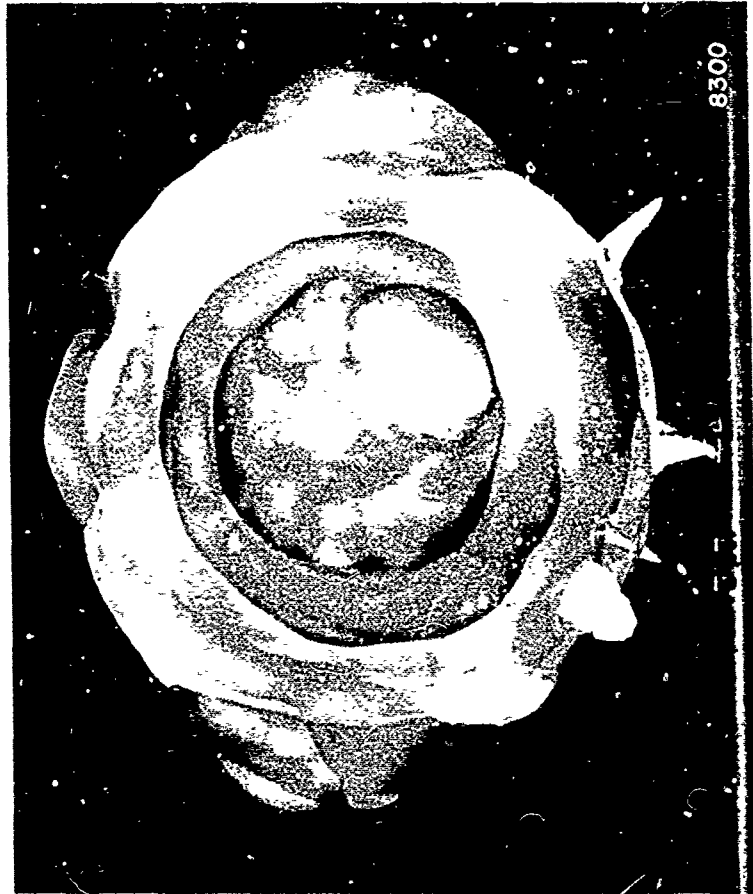
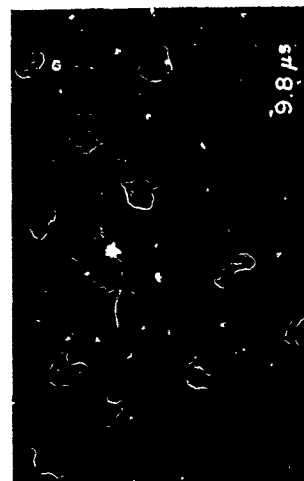
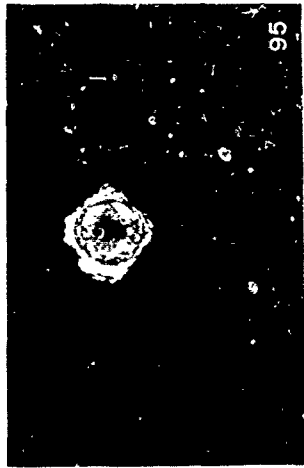


Fig. F.7—Fireball photograph, TS-8, 5 June 1952. Camera 2 miles northeast.

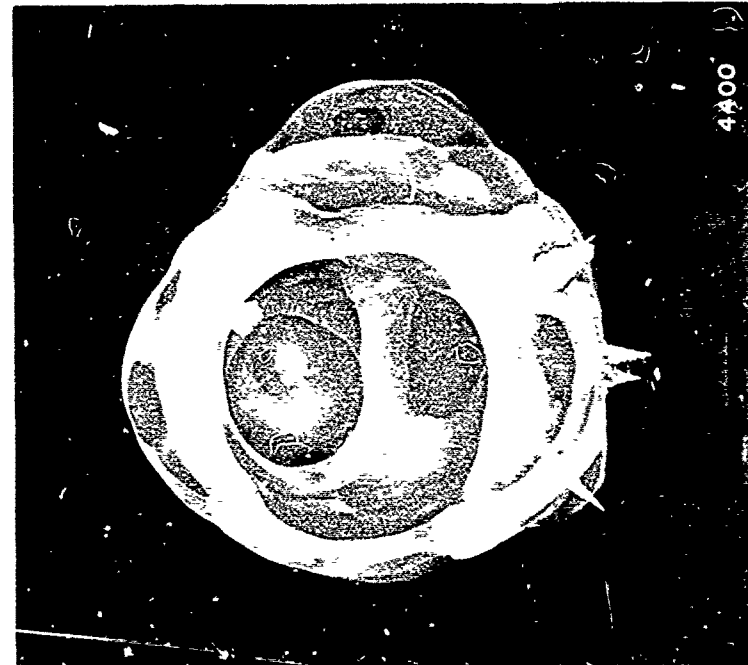
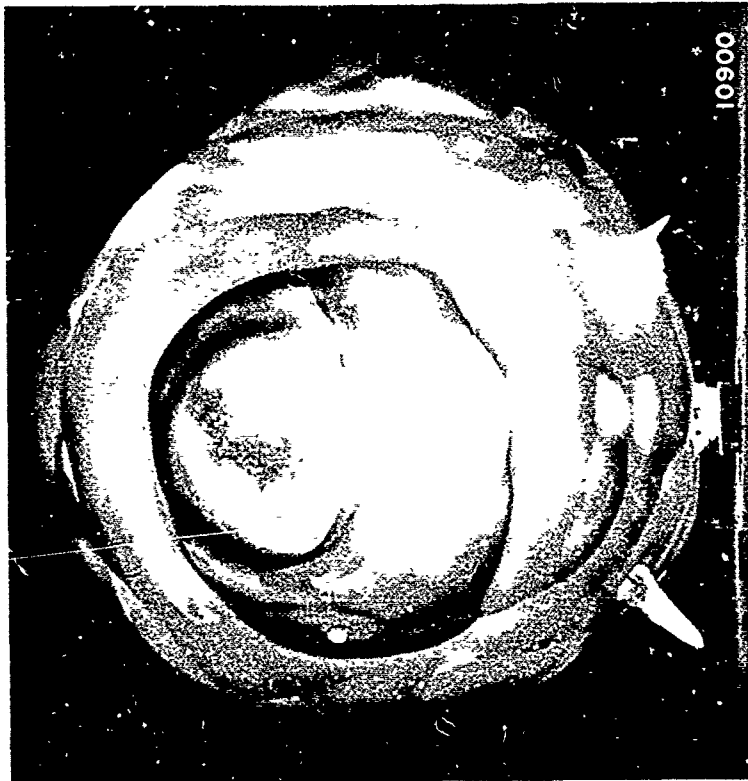
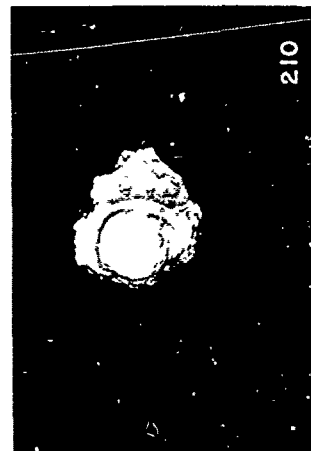


Fig. F. 8—Fireball photograph, TS-8, 5 June 1952. Camera 2 miles southeast.



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