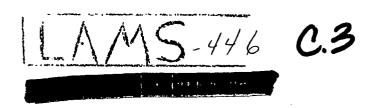
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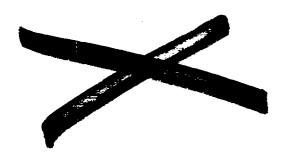




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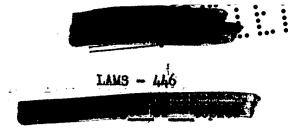
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October 15, 1946

This document contains 9 p. 15 p. figs.

\$BOSSROADS TECHNICAL INSTRUMENTATION REPORT:

FASTAX PHOTOGRAPHY

By

Berlyn Brixner

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CROSSROADS TECHNICAL INSTRUMENTATION REPORT TESTS A & B

15 October 1946

From: Los Alamos Field Group (013 H)

To: Technical Director, JTF 1

Project No.: IX - 1

Subject: Fastax Photography

Prepared by: Berlyn Brimer

Approved: MA Holloway

M. G. Holloway

ABSTRACT

No photographic record of the nuclear explosion was obtained for test A because of the delay in starting the cameras.

A satisfactory photographic record of test B was obtained from cameras at the Enyu tower station. The space-time relations for the water jet and cloud formation were obtained from these films.

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FIG. 12		lelay Rack for Camera Control
FIG. 18	**************************************	iming Signal Receivers
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I. Introduction:

1.1 Test Able. The amount of energy released by the Atomic Bomb explosion was to be determined. The velocity of the shock wave provides a measure of this energy. A photographic record obtained from high speed motion picture cameras operating at 1000 frames per second or faster provides the necessary data.

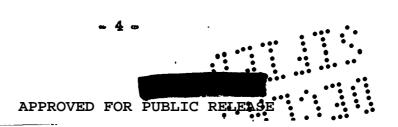
1.2 Test Baker. The energy released during the explosion could not be determined by a shock wave velocity measurement because of the difficulty of under-water photography. A photographic record was to be obtained of the part of the explosion visible above the water surface.

II. Instruments and Equipment:

2.1 A group of Fastax 16mm and 35mm cameras were installed in towers on Bikini and Enyu Islands. See Tables 1A and 1B with detailed specifications for each of the cameras used. Modak Cine E 16mm cameras were also installed at the Enyu station to obtain a two hour record of the explosion and subsequent cloud. The possibility of a large error in dropping the bomb for Test Able 1ed to the installation of a wide angle camera with moving film. This camera could record the explosion if it occured as much as 1-1/2 miles from the target center and had a time resolution better than 1/10 millisecond. A Mitchell 35mm camera was also installed in each of the towers.

Fastam and wide angle, continuous moving film cameras were also installed and operated in AAF photo planes by Army personnel.

Normal speed 16 and 35mm cameras were installed on board the AV-17 to obtain a pictorial record of both explosions.



2.2 Power for all cameras and control equipment at the tower stations was obtained from storage batteries since gasoline powered generators were found to be unreliable. A relay rack at each station controlled the operation of the cameras. The camera control relays were closed by means of a circuit to a contact in the radio timing signal receiving box and were opened by switches which were actuated when the film receiving magazines were properly filled with exposed film. Camera operation was independent of the timing signal box after the initial contact was made except that recycling could be accomplished at any time prior to the starting of the first exmera.

The cameras ran for various periods of time from 1.5 sec to fifty minutes depending on running speed and film capacity. Cameras rore started at -5 sec, -2 sec, or -0.7 sec depending on the total running time.

III. Results:

3.1 Test Able:

All cameras operated properly but the timing signals were such as to start all the remotely controlled cameras about 15 accords after the start of the nuclear explosion. The developed films from the high speed cameras showed no trace of an image since the exposure was not for the brilliant early stages. The Cine E film gave a satisfactory record for the period of 15 sec to 1-3/4 hours. The cameras on the AV-17 were manually started and gave a satisfactory pictorial record of the explosion. As far as known none of the high speed cameras operated by the AAF obtained a satisfactory record. No satisfactory record was obtained of the expansion of the ball of fire.

3.2 Test Baker:

All cameras at the Enyu station operated properly but name. operated

when Bikini station. The expect of the signal was not externined since it was found, an recitive that the entire essembly of apparatus was still in readiness to function. The signal lines were actuated manually to operate the cameras. The timing boxes were also found to be in perfect operating condition, though test signals were not available for this test. If the recycle connection had been operate by local interference at the time the -2 minute signal was received to would have left the relay panel inoperative, and subsequent signals would not start the cameras.

The photographic record obtained was partially obscured by the normal cloud cover above 500 meters altitude. The irregular water jet and cloud fronts made accurate measurement difficult. In every case the maximum velocity was measured. The data is presented in the form of a nest of profiles. No correction was made for camera tilt or perspective since this was found to be less than 2%. All velocity plots were obtained from the slopes of the space time curves.

5.2.1 Water Jet:

curves of Fig. 6. Direct measurements on the original film give a value of about 1900 meters/second relocity for the luminous front when it first appears above the water surface. The luminous front persisted for about 0.15 second. The jet is dome shaped up to about 1/2 second and gradually changes to what appears to be a flat ring shape in about 2 seconds.

3.2.2 Water Level Cloud:

A large circular cloud of mist or spray spreads out over the water surface from the explosion center. The cloud remains on the water surface for several minutes and then lifts to the prevailing cloud level, the bottom being at about 500 meters altitude. When the water jet spray falls back to the lagoon it undoubtedly carries along with it a large mass of air. This mass of air probably carries the finely divided water particles in a suspension and spreads over the water surface radially from the explosion center to form a circular cloud about four miles in diameter. As the cloud lifts it is seen that a heavy rain prevails under it and this persists for an hour or more as the cloud drifts to the north with the prevailing winds. Figure 3 shows successive profiles of this cloud formation. Plots of growth and velocity of growth are shown in Figures 8 and 9. The cause of the irregular velocities of the north-east cloud front is not apparent.

3.2.3 Cloud Chamber Effect:

About 0.75 second after the start of the explosion a ring shaped fog cloud is seen to develop around the water jet at an altitude of about 350 meters. This fog cloud continues to grow at a fairly constant velocity of about 350 meters per second (sound velocity in air) until it has formed a cloud of about four miles diameter in eleven seconds. During the initial stages this cloud is hemispherical in shape with its base about 200 meters above the lagoon surface. At 1.2 seconds fog

the homisphere base and this rapidly tills the space beneath the existing cloud and merges with it so as to be indistinguishable after 3 seconds. As the fog cloud grows radially it appears to lift from the water surface, probably by evaporation of the fog, to an altitude of about 400 meters. The maximum altitude for fog formation is not less than 800 meters but is difficult to ascertain because of the obscuring clouds. Profiles of this fog formation are shown in Figures 4 and 5.

IV. Conclusions:

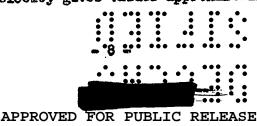
4.1 Test Able:

No information was obtained for determination of the rate of the expansion of the ball of fire.

4.2 Test Baker:

A good photographic record of the explosion was obtained from the Enyu Island station. The initial vertical velocity of the water jet is 1900 ± 100 m.p.s. The jet is luminous and resembles a shock wave front at first but later the luminous surface is very spotty as it darkens and resembles the burning of inflammable material. Perhaps the iron in the LEM 60 was the source of this flame. The jet becomes bulbous and appears to vent at its top center. This causes it to assume a cone-like appearance. Within 50 seconds the upper portion of this cone has expended to form a cloud 2000 meters in diameter and has reached a height of over 1400 meters. A portion of the water descends to form a surface cloud, 4 - 5 miles in diameter, which starts to rise in 5 - 4 minutes and gives rise to an intense rainstorm.

The shock wave in air gives rise to a cloud chamber fog. Measurement of the fog formation velocity gives values approximating air sound velocity



at all points.

V. Recommendations for Future Tests:

It is clear that the tight schedule and consequent hasty preparations for Operation Crossroads led to many of the difficulties encountered. In a future test adequate notice should be given so that plans can be carefully executed. A specific time, not less than two weeks before the test, should be set after which no more changes in the installations would be made. Thereafter a series of tests should be started to determine reliability of operation of equipment and time should be allowed to make final adjustments of equipment. It would be desimble to have four camera stations spaced at about 90 degrees around the target so that a better check could be obtained between the various film records.

VI. Group Personnel:

The following people spent part or all of their time on the Fastax Photography Program.

Jack W. Aeby

Berlyn Brimer

J. Carlton Hoogterp

Albert A. Bartlett

Ralph L. Conrad

Willard Waite

Felix E. Geiger

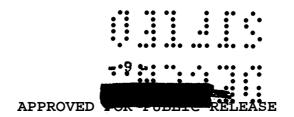


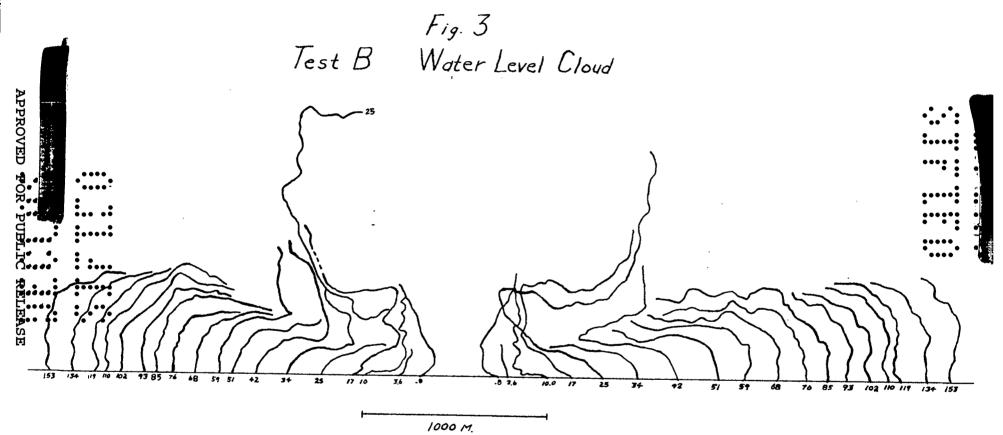
Table 1A Test Able

				•	•						Rel. exp.		Resu	lts	
Location		Inst	rument	Code	Foc.L	Stop	Filter	Film	Speed Shutter		Daylight=1	Image Scale	Starting	Film	
	Bikini	Aero	Smear	B 1	305mm	32	N DS	PanX aero	3m/s	3 e c	1/60000		15 sec lai	te blank	
	Ħ	35mm	Mitchell	B8	152	16	NDL	Pan X	100	1 5°	1/130		4	Ħ	
	Ħ	Ħ	Fastax	B2	254	32	ND3	81	1000		1/40000		#	Ħ	
	**	Ħ	H	B 3	1 52	32	NDZ	Ħ	1000		1/4000		*	W	
	Ħ	Ħ	Ħ	B4	104	32	NDl	*	1000	**	1/400		Ħ	*	
	11	16mm	n	B6	104	32	ND2	SuperX	1000	**	1/4000		Ħ	Ħ	
	Ħ	Ħ	Ħ	B6	50	16	MDS	'n	1000	-	1/1000		*	` #	
	Ħ	W	w	B 7	35	22	ND1	11	1000		1/200		Ħ	Ħ	Α.
	Enyu	Aero	Smear	Nl	305	22	ND3	PanX aero		es	1/20000		Ħ	Ħ.	Ę
	¥	35mm	Mitchell	N8	75	16	ND1	PanX	100	15°	1/180		я	tt	י ל
	**	11	Faxtax	N2	104	3 2	NDS	15	1000		1/4000		#		Ċ
	Ħ	Ħ	41	N3	152	32	ND2	W	1000	~-	1/4000		Ħ	7	è
	Ħ	Ħ	Ħ	N4	254	22	ND2	Ħ	1000	-	1/2000		Ħ	••••	-
١٠.	*****	16mm	*	N5	35	11	ND2	SuperX	1000	40-40	1/500		a	•••• 8	7
•	****	#	w	N6	50	6.3	ND2	*	1000	-	1/160		* • • • • • • • • • • • • • • • • • • •	7	5
F.:	126	Ħ	Ħ	N7	104	22	NDS	**	1000	E)-40	1/200		17	••••••	h
•	. н	Ħ	Cine E	N9	152	4.5	ND3-0	IR Pank	64	10°	1/1000-1	1/6000	Ħ	and the K	Š
••	• • • • • •	Ħ	H	N10	25	4.0	87A	*	16	180°	1	1/36000	Ħ	*	Ľ
١٠.	: 1	Ħ	ff .	Nll	104	5.6	H	17	4	90°	î	1/8800	*	·····n	Ļ
• [• 4•••	Ħ	Ħ	N12	15 .	4.0	tt	#	Ω Q	90°	<u> </u>	1/61000	#	••••	`.
	•	11	Ħ	N13	15	8.0	Ħ	H .	9	90°	1	1/01000	#	**	7
•	н	11	17	N 14	15	11	Ħ	#	2	90°	1	17			Ė
•:	·	Ħ	Ħ	N15	15	4.0	w	ti	7	10°	± 7	tt	*	-	5
	Ħ	11	Ħ	N16	15	4.0	Ħ	*	ī	10°	1	*	n .	· #	Ē
	AV-17	35mm	Mitchell	17-1	231	5.6	A	PanX	24	45°	1	1/15000	O.K.	*	
	H		Cine Spo.			4.5	Ā	IR Pank	32	180°	î	1/35000	a a	*	

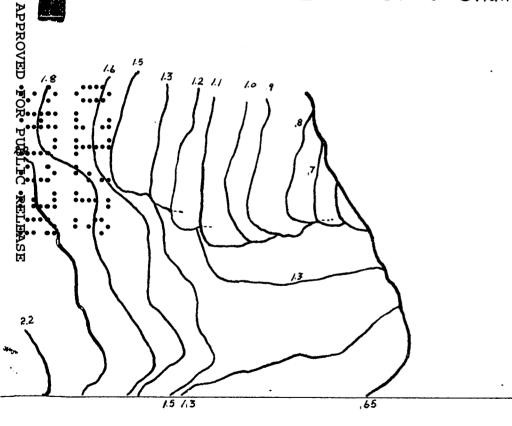
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Table 1 B Test Baker

					TAC	TO T D	1680 20	KOT						
										Rel. exp.				Results
Location	Inst	rument	Cede	Foc.L	Stop	Filter	Film	Sp eed	Shutter	Daylight=1	Image Scale	Ste	rti	ng Film
Bikini	35mm	Mitchell	B 9	25mm	4.0	G	PanI	100	4 5°	1		Dia	not	N.G.
#	W	Fastax	B2	381	32	No	Ħ	1000		1/40		**	Ħ	•
₩	*	*	B 3	50	11	¥	**	200	-	í		#	*	W
79	Ħ	Ħ	B4	152	4.5	#	¥	1000		1		Ħ	Ħ	#
Ħ	16mm	Ħ	B 5	104	22	Ħ	SuperI	4000	-	1/80		Ħ	*	**
*	**	A	B7	35	8	IT	- *	200	***	ž		Ħ	*	#
19 -	#	Ħ	B8	254	4.5	×	#	1000	-	1		Ħ	Ħ	
#	8mm	*	B 6	152	32	75	Ħ	8000	4740	1/330		n	M	*
Enyu	35mm	Kitchell	Nl	35mm	4.0	Aero 2	Panx	100	30°	1	1/30000	Ό,	X.	
~	π 	Fastax	N2	104	11	No	47	200	-	1	1/8800	•	•	
H	**	Ħ	N3	152	4.5	H	11	1000	-	1	1/6000	1	H	First part
π	æ	et	N4	381	5.6	Ħ	tt	1000	(20-47)	1	1/2400	1	•	0.4
**	16mm	#	N5	50	4.0	Ħ	SuperX	10 00	****	2	1/18000	•	ı	
"	#	#	N6	104	32	#	#	4000		1/160	1/8800		t	7. 41.1
*****	Ħ	77	N7	254	26	11	4	4000	-	1/110	1/3600		•	**************************************
*	8mm	*	N8	152	45	Ħ	Ħ	8000		1/650	1/6000	•	t	the second
• .	16mm	Cine E	N9	15	11	8 7A	Aero IR	1	10°	1	1/61000	•	t	Poor
••••	Ħ	17	N 10	152	5.6	Ħ	11	64	180°	1	1/6000	•	•	Photo
• "	Ħ	Ħ	Nll	15	4	Ħ	11	64	90 °	1	1/61000	1	7	Quality
v	Ħ	Ħ	N 12	15	16	R	Ħ	4	180°	1	1/61000	1	•	W
	**	Ħ	N13	104	11	R.	n	1	10°	1	1/8800	1	t	Ħ
•	**	98	N14	104	11	Ħ	Ħ	1	10°	1	1/8800	•	•	*
***	Ħ	Ħ	N15	25	5.6	17	Ħ	32	80 °	1	1/36000	,	•	#
₩		Ħ	N16	15	11	Ħ	*	8	30°	1	1/61000	•	t	*
AV-17	35mm	Nitchell	17-1	104	8	17	*	24	60°	1	1/22000	•	,	o.k.
Ħ		Cine Spc.			11	A	11	32	180°	ī	1/22000	1	1	H







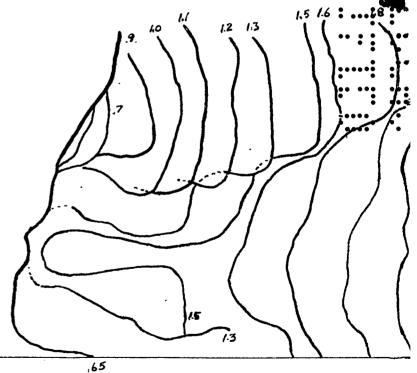
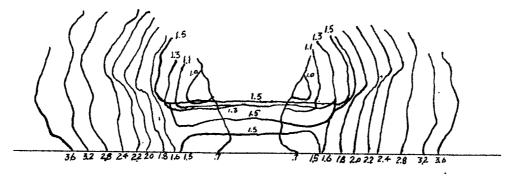
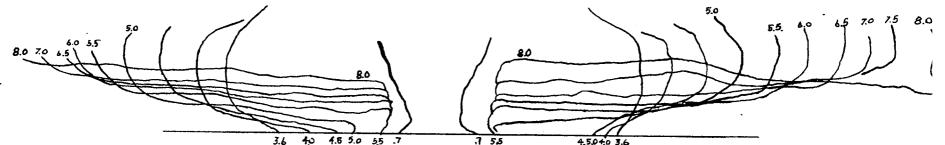
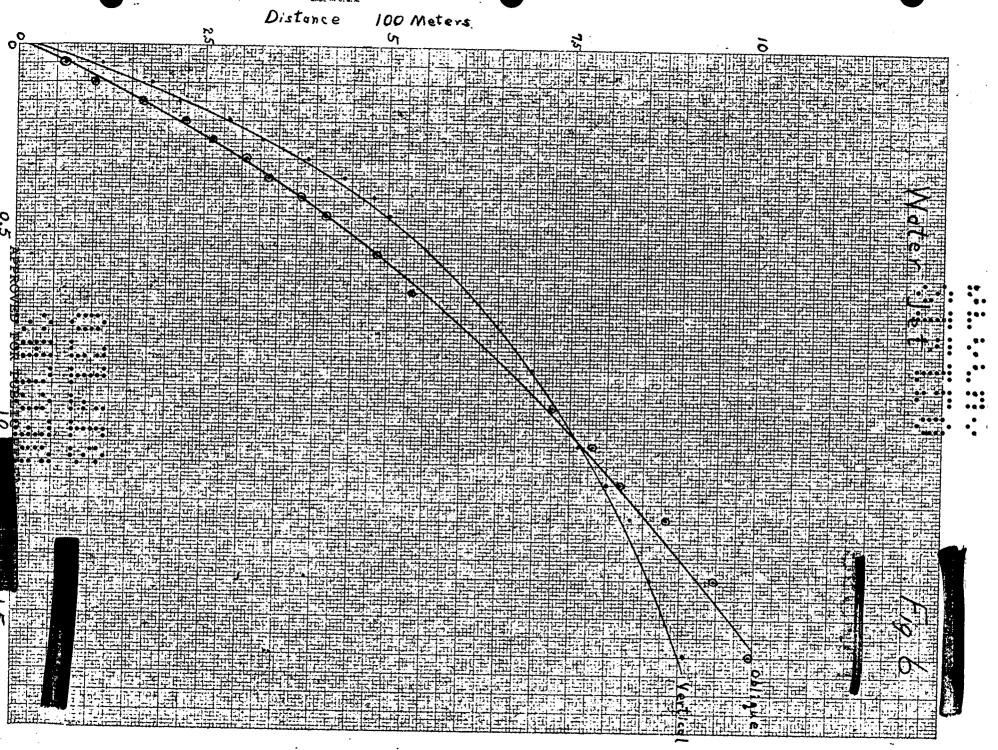


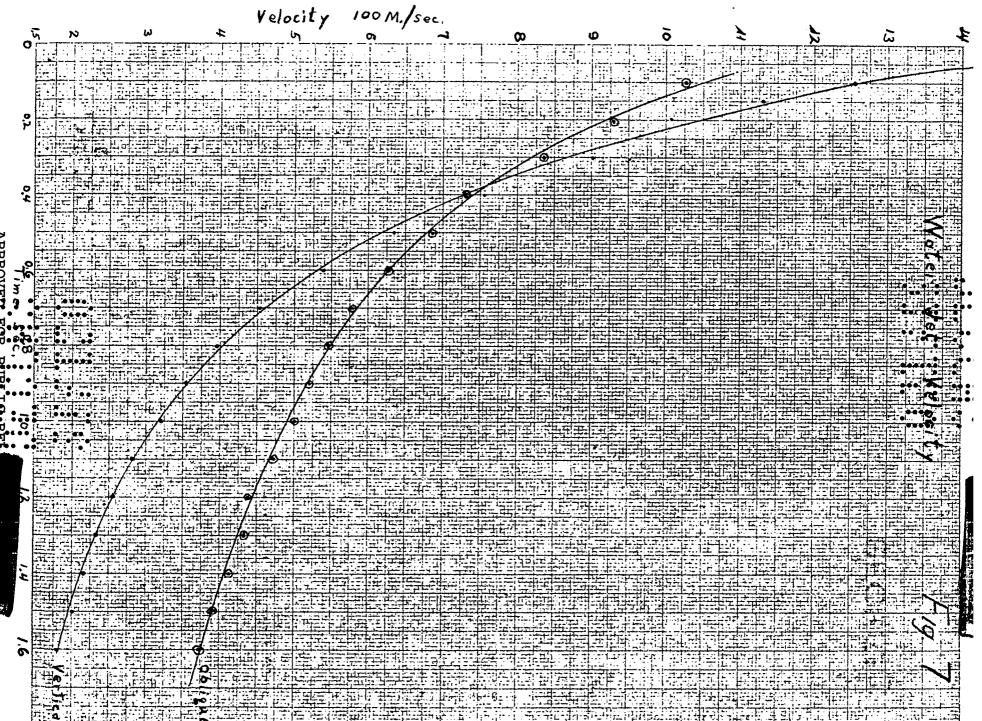
Fig. 5
Test B Cloud Chamber Effect



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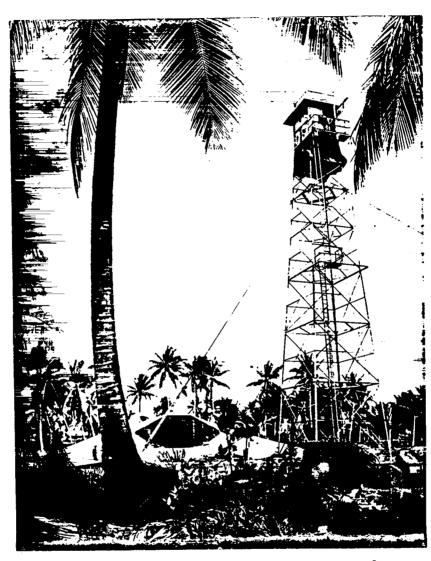


FIG. 10 -- General view of Fastax Photography tower and sand covered quentet storage room and work shop. The tarpaulin just below the tower cab protects storage batteries and chargers. The camera port is in the opposite side of cab.





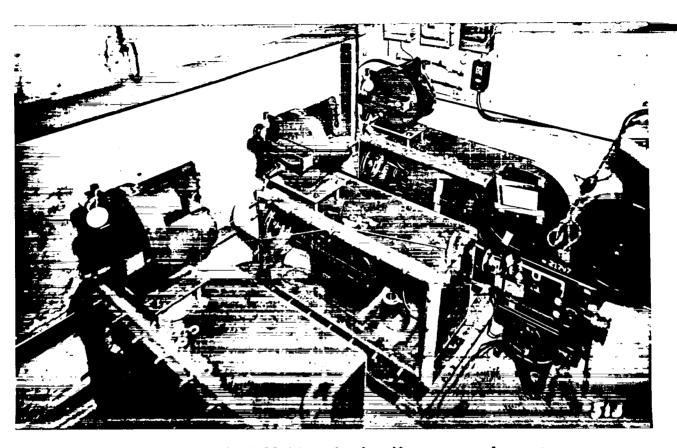


FIG. 11 -- Tower cab camera installation showing three armored camera boxes for 35mm Fastax and 16mm Fastax mounted on top of each.

The Mitchell 100 f.p.s. camera is shown on the right. Cameras face the closed port of the cab.

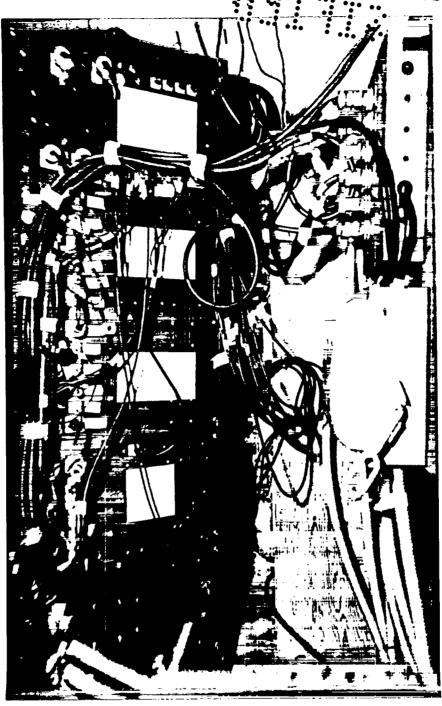


FIG. 12 -- Relay rack for control of all cameras is shown at left.

Timing light pulse generators are in wood cabinet at right
background. Waster power control switch and distribution
box are on right.





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FIG. 13 -- Timing signal boxes are shown on shelf at upper right. Part of the camera installation is shown below.

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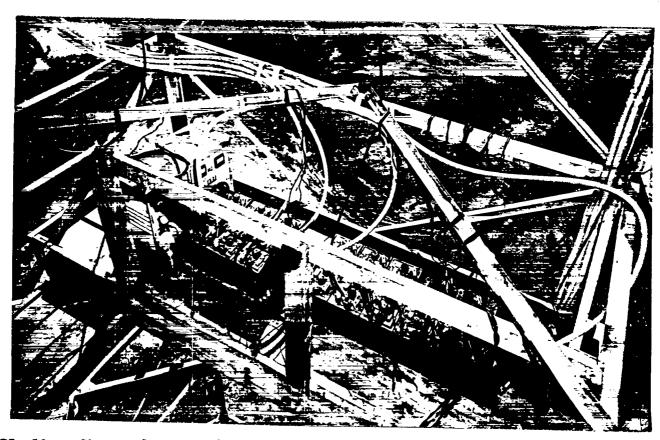


FIG. 14 -- Storage battery platform just below cab. Cables at upper left supply power to cab. Vertical cables at right supply higher voltage power from battery bank on ground.



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