INSTRUCTIONAL DEPARTMENT NOTES

DIRECTOR OF INSTRUCTION

New Training Films

The USAFAS is producing four new training films during FY 72. The films will cover Fire Support Coordination, Defense of the Field Artillery Battery, Reconnaissance, Selection and Occupation of Position, and Crater Anaylsis. All four films are expected to be in distribution by the end of the fiscal year. While films are under consideration, readers should note that the School is always soliciting suggestions for new field artillery training films. If you have noted an instructional area which could be supported or augmented by a film, why not forward your thoughts to Commandant, USAFAS, ATTN: Office of the Director of Instruction, TV Division (ATSFA-DI-TV), Fort Sill, Oklahoma 73503.

COMMUNICATION/ELECTRONICS DEPARTMENT

Whiz Wheel

The CIRCE numeral code, commonly known as the "whiz wheel," is being used extensively in Vietnam by US Army units. The code was originally designed and produced by the US Air Force for use by Air Force and Army units engaged in air-ground operations to encode numerals for transmission over nonsecure radio nets. Army commanders were quickly impressed with its speed and simplicity of operation. This lead to a rapid spread of the system to Army ground use. The Air Force believed that high unit density and use would rapidly compromise the system and, as a result, the US Army Strategic Communications Command developed a similar system for Army use.

The present system is used for encrypting TOT (time on target) times, coordinates, altitudes, radio frequencies, and other numerical information in areas where the threat of the enemy's breaking the code is minimal. Its use is presently restricted to Southeast Asia. Use of the code in other areas must be approved by the National Security Agency on a case-by-case basis. In addition to its use as a numeral code, the system may be used for challenge-reply authentication.

The device is called a wheel because of the circular arrangement of three alphabets, one of which is movable, on a plastic circle. The wheel is mounted on a 4- × 5¼-inch plastic sheet with a series of five scrambled alphabets below the wheel. Operating instructions are printed on the back of the plastic insert sheet. This sheet is inserted into an unclassified plastic holder which has a rotating plastic numerical dial.

The code is highly popular because of its simplicity and speed of use in encoding numerals. However, this very simplicity limits the system's security. The system is good for a 24-hour period without change of insert sheets. Information which requires protection for more than 24 hours should **NOT** be encoded in this code. A cryptanalyst could reconstruct the system in 2 hours provided he had a minimum of 200 six-digit messages with which to work. Personnel desiring to use the CIRCE system for either an authentication system or a numeral code must first consider the security protection afforded by the CIRCE system. REMEMBER, it has a limited security capability.

Since the CIRCE system is in wide usage in Southeast Asia, instruction in the system has been incorporated into programs of instruction taught by the Communication/Electronics Department of the Field Artillery School.

GUIDED MISSILE DEPARTMENT

Pershing

With the completion of Project SWAP in the spring of 1970, the field artillery made the transition from the track-mounted Pershing missile system to the improved Pershing 1a missile system, mounted on wheeled vehicles. Modern technology and state-of-the-art improvements have resulted in the development of a new improvement program, referred to as the Pershing Missile and Power Station Development Program.

What exactly is this program and how will it affect the Pershing 1a system? The program, as implied by its name, involves major changes in the Pershing missile and a major redesign of the Pershing power station. Many of the components of the guidance and control (G&C) section of the Pershing missile will be renovated through the use of transistors, electronic cards and modules, and printed circuitry. Many of the bulky, failure-prone parts will be replaced with more durable solid-state parts. The G&C will be improved not only in internal design but also in reliability and maintainability. There are three major changes to be accomplished within the missile improvement portion of the program. Each change pertains to a component of the guidance and control section. These changes are summarized below:

- Digital computer: The G&C sections presently in the inventory utilize both a guidance computer and a control computer. These computers operate on an analog data principle and have contributed to about one fourth of all Pershing missile failures. A digital guidance and control computer (G&CC) in one solid-state unit has been developed to replace the two analog computers. The digital computer will provide a higher reliability factor and an improved on-board fault isolation capability and will be easier to maintain. The computer will have the capability of shutting off all missile power if an in-flight malfunction occurs. This will prevent an inadvertent nuclear detonation over friendly terrain.

- Main distributor: The centralized point within the missile for distribution of electrical signals, AC and DC power throughout the missile, and return of supervision and monitoring signals to the ground support equipment (GSE) is the main distributor. The current main distributor, which has undergone numerous modifications, will be replaced by a newly designed main distributor.

- Static inverter: The G&C section presently uses a rotary inverter to convert the DC power into AC power. The rotary inverters have experienced a high failure rate and have required frequent depot level maintenance. A solid-state static inverter, utilizing printed circuits and transistors, will replace the rotary inverter. The static inverter, without any moving parts, converts 28-volt DC power into regulated 115-volt, 400-hertz, 3-phase power. The static inverter provides a greater missile reliability factor and, in addition, can be maintained at the direct support unit (DSU) level.

The capabilities of the Pershing power station will not change; however, several of its components will be relocated within the power station structure. The purpose of the changes is to provide greater accessibility and ease of maintenance for the operator. Engineering studies have resulted in relocation of the nickel-cadmium batteries, redesign of the fuel tank, repositioning and redesign of the electrical control panel, and relocation of the air purification unit. To achieve a longer life for the power station air compressor, the rpm ratio is to be reduced. The primary reason for power station failures has been the loss of the air compressor or one of its stages due to wear and tear. These changes will increase the height and width of the power station but will not change its overall length.

Also included in this improvement program is the development of the power station test set. This device will allow the general support unit to perform checks and measurements of the high-pressure air and conditioned-air systems. At the present time the unit has no means of checking the air output of the power station to insure that the missile is receiving the required pressure and temperature of air.

The trajectory accuracy prediction system (TAPS) is an independent project which will be included in the overall Missile and Power Station Improvement Program. Through the use of on-board telemetry and ground receivers, the personnel within the battery control central will be able to compare events along the trajectory with the computer predicted printout. This will enable the unit to ascertain how close to the programmed trajectory actual events occurred.

The improvement program also contains necessary instructions for operators, instructors, maintenance personnel, and equipment technicians. The training programs have been scheduled to coincide with completion of work on the equipment (FY 72-73). Prior to beginning the worldwide improvement program, both the improved guidance and control section and the repackaged power station will undergo field testing by the U. S. Army Test and Evaluation Command to include actual Pershing missile firings at White Sands Missile Range.

GUNNERY DEPARTMENT

Status of Firing Tables and FADAC Tapes

The use of the correct and current firing data source is essential for the accurate and safe delivery of artillery fires. Numerous materiel developments and product improvements have been introduced in recent years which have vastly expanded the possible weapon/ammunition combinations. Many of these combinations are ballistically dissimilar, resulting in a large number of different firing tables. In addition, published tables and tapes are subject to frequent changes which must occur with each materiel or procedural improvement.

The list of GFT's and TFT's on the following pages is published to assist personnel in the selection of the correct and current firing table. Unless otherwise noted, tabular firing tables are requisitioned through normal AG Publication channels. Graphical firing tables are requisitioned as authorized by each applicable TOE.

CURRENT GRAPHICAL FIRING SCALES

WEAPON	BASED ON TFT	DESCRIPTION	FSN	NR OF RULES
105H				
M101A1	105-H-6, w/C7	*GFT HEM1 (LA)	1220-937-8279	3
	105-H-7	*GFT HEM1 (HA)	1220-151-4155	1
	105-H-6, w/C2	GFT ILL M314	1220-978-9585	2
	105-H-6	GST HEM1	1220-815-6190	1
M102/M108	105-AS-2, w/C1	*GFT HEM1 (LA)	1220-937-8280	3
	105-AS-2	*GFT HEM1 (HA)	1220-151-4154	1
	105-AS-1	GFT ILL M314	1220-764-5418	2
	105-AS-1	GST HEM1	1220-764-5422	1
155H				
M114A1	155-Q-4, w/C2	*GFT HEM107 (LA)	1220-937-8281	3
	155-Q-4	*GFT HEM107 (HA)	1220-168-5545	1
	155-Q-3	GFT ILL M118	1220-898-4212	2
	155-Q-4	*GFT ILL M485	1220-133-6219	2
	155-Q-3	GST HEM107	1220-789-2986	1
M109	155-AH-2, w/C4	*GFT HEM107 (LA)	1220-937-8282	3
	155-AH-2	*GFT HEM107 (HA)	1220-133-7435	1
	155-AH-1	GFT ILL M118	1220-764-5420	2
	155-AH-2, w/C1	*GFT ILL M485	1220-442-2444	2
	155-AH-1	GST HEM107	1220-764-5421	2
8″H				
M110/M115	8-J-4	*GFT HEM106 (LA)	1220-937-8283	3
	8-J-4	*GFT HEM106 (HA)	1220-168-6026	1
	8-J-3	GST HEM106	1220-898-6786	1
	8-O-4	*GFT HESM424	1220-937-8284	2
	8-O-3	GST HESM424	1220-876-8573	1
175G				
M107	175-A-O(REVII)	*GFT HEM437 (LA&HA)	1220-937-8285	2
	175-A-O(REVII)	GST HEM437	1220-937-9522	1
**14.5 MM Trainer		*GFT	1220-442-2446	1

* Denotes 18″ GFT

** Requisitioned through local Training Aids Support Center

STATUS OF CANNON TABULAR FIRING TABLES
105MM

M101A1	M102 & M108
CURRENT	**CURRENT**
FT 105-H-6 (Nov 61) BASIC FT	FT 105-AS-2 (Nov 67) BASIC FT
C2 (Apr 62) subzone M89, M314 ILL, M327 HEP	C3 (Jun 69) Beehive XM546 w/Fuze XM563E2, E3 & E4
C6 (Jun 66) M314A2E1 ILL w/Fuze MT, M565	C4 (Aug 70) FZ VT, M13 Series w/Cap XM5, and CTG, SMOKE, HC, BE, M84A1
C7 (Dec 67) Fuze MTSQ M564	[1]PROV SUPP 1 (Nov 67) CS XM629
C8 (Feb 69) Fuze VT, M513 Series w/Cap XM5	FT 105 ADD-F-1 (Aug 68) M444
C9 (Jun 69) Beehive XM546 w/Fuze XM563E2, E3 & E4	C1 (Sep 68) close-in support card
[1]PROV SUPP 1 (Nov 67) CS XM629	[1]FT 105-AU-O (REV 1) (Jun 70)
FT 105 ADD-B-2 (Nov 68) M444	RAP XM548E1
C1 (Nov 68) close-in support card	
FT 105 ADD-A-O (REV) (Mar 68)	
M413	
[1]FT 105-AV-O (REV 1) (Jun 70)	
RAP XM548E1	
TO BE PUBLISHED	**TO BE PUBLISHED**
FT 105-H-7 (1st Qtr FY 72)	FT 105-AS-2, C5 (1st Qtr FY 72)
BASIC FT C1 (4th Qtr FY 72) XM546E2 w/Fuze XM563E4 C2 (4th Qtr FY 72) XM622 HEAT-INTERIM FT	Corrected per data, additional velocity data C6 (4th Qtr FY 72) XM546E2 w/Fuze XM563E4 C7 (4th Qtr FY 73) HEAT, XM622 INTERIM FT
FT 105-AV-1 (2d Qtr FY 73) RAP XM548-INTERIM FT	FT 105-AU-1 (2d Qtr FY 73) RAP XM548 INTERIM FT

[1]Requests for these tables should be made to:

Commanding Officer
US Army Aberdeen Research and Development Center
ATTN: AMXRD-BEL-FT
ABerdeen Proving Ground MD 21005

STATUS OF CANNON TABULAR FIRING TABLES
155MM

M114A1

CURRENT

FT 155-Q-4 (Mar 68) BASIC FT

C2 (Apr 69) Prop Chg M3A1 & M4A2

FT 155-AI-2 (May 69) XM454 NUC

FT 155-ADD-F-1 (Jul 70) M449A1, M449, M449E1

C1 (Jul 70) Close-in support card

TO BE PUBLISHED

FT 155-Q-4, C3 (1st Qtr FY 72)

M114A1 w/M107, w/3A1 and M4A2 Propelling Charges (Final Table)

C4 (1st Qtr FY 73) XM396

BEEHIVE

M109

CURRENT

FT 155-AH-2 (Jul 65) BASIC FT

C1 (Jun 67) M485 Series Illum

C2 (Oct 67) Fuze MTSQ M564 & MT M565

C4 (Apr 69) Prop Chg M3A1 & M4A2

FT 155 ADD-E-1 (May 70) M449A1, M449, M449E1

C1 (Jul 70) Close-in support card

FT 155-AJ-2 (May 69) XM454 NUC

[1]Aiming Data for RAP XM549 (Nov 68) (C)

TO BE PUBLISHED

FT 155-AH-2, C5 (1st Qtr FY 72) M109 w/M107, w/M3A1 and M4A2 Propelling Charges (Final Table)

C6 (1st Qtr FY 73) XM396

BEEHIVE

FT 155-AL-1 (2d Qtr FY 72)

RAP XM549-INTERIM FT

FT 155-AL-2 (2d Qtr FY 73)

RAP XM549-FINAL FT

FT 155-AK-1 (4th Qtr FY 72)

XM483E1-INTERIM FT

FT 155-AK-2 (4th Qtr FY 73)

XM483E1-FINAL FT

FT 155 ADD-G-1 (4th Qtr FY 72)

XM483E1/XM483E1-INTERIM FT

FT 155 ADD-G-2 (4th Qtr FY 73)

XM483E1/XM483E1-FINAL TABLE

FT 155 ADD-H-1 (4th Qtr FY 72)

M107/XM483E1-INTERIM FT

FT 155 ADD-H-2 (4th Qtr FY 73)

M107/XM483E1-FINAL FT

FT 155-AM-1 (4th Qtr FY 72)

M109A1 w/CANNON

XM185 w/Proj M107

FT 155-AJ-2, C1 (1st Qtr FY 73)

M109A1 w/CANNON XM185, w/PROJ, XH454

STATUS OF CANNON TABULAR FIRING TABLES 8 Inch & 175MM

M110

CURRENT

FT 8-J-4 (Jun 67) BASIC FT

FT 8-O-4 (Jun 67) M424 HES & M422 NUC
  C1 (Jun 70) M424A1 HES

FT 8 ADD-A-1 (Nov 67) M404
  C1 (Nov 67) Close-in Support card

TO BE PUBLISHED

FT 8-P-1 (2d Qtr FY 73)
  RAP XM509-INTERIM FT

FT 8 ADD-B-1 (2d Qtr FY 73) RAP
  XM509/XM509-INTERIM FT

FT 8 ADD-C-1 (2d Qtr FY 73)
  M106/RAP M509-INTERIM FT

M107

CURRENT

FT 175-A-1 (Jan 70) BASIC FT
  C1 (Sep 70) Corrected Erosion Data

TO BE PUBLISHED

FT 175-A-1, C2 (3d Qtr FY 72)
  WP, XM510E1

FT 175-B-1 (4th Qtr FY 72) XM484E1

FT 175-ADD-A-1 (4th Qtr FY 72)
  XM484E1/XM484E1

FT 175 ADD-B-1 (4th Qtr FY 72)
  M437A2/XM484E1

STATUS OF HONEST JOHN TABULAR FIRING TABLES 762mm Rocket, MGR-1A (M31) Series

FTR AND CHANGES	LAUNCHER	WARHEAD	REMARKS
762-E-1 (Apr 59) Change 1 (Sep 59) Change 2 (Jul 60) Change 3 (Feb 61)	M386	 M27 M47 M48	C1—Corrects FTR errors. C2—E1, E2, and LLW tables C3—Conversion of NATO Met to US format.
762-F-1 (Apr 59) Change 3 (Mar 67)	M386	M6A1 M38 M144 M186	C3—Conversion of NATO Met to US format.
762 ADD-A-1 (Nov 60) Change 2 (Mar 67)	M33 M289 M386	M144 M186	Applicable to FTR 762-A-2, FTR 762-D-1, and FTR 762-F-1. Instructions for use and an illustrated example are inclosed in the introduction. C2—Adds warhead M186
762 ADD-B-1 (Feb 61)	M33 M289 M386	M6A1	Applicable to FTR 762-A-2, FTR 762-D-1, and FTR 762-F-1. Instructions for use and an illustrated example are included in the introduction.

762mm Rocket MGR-1B (M50) Series

FTR AND CHANGES	LAUNCHER	WARHEAD	REMARKS
762-G-1 (Jan 64) Change 1 (Jan 68)	M386	M27 M47 M48 M190	C1—Adds propellant weight correction factor table.
762-H-1 (Jul 63) Change 1 (Apr 66)	M386	M6A1 M144 M186 M38	C1—Makes certain corrections and adds M186 and M6A1 warheads to table and changes fuze setting correction table.
762 ADD-C-1 (Aug 63)	M33 M289 M386	M186 M144	For an example illustrating procedures, refer to 762 ADD-A-1. C1—Adds M186 warhead
762 ADD-D-1 (Oct 64)	M33 M289 M386	M190	Applicable to FTR 762-G-1, FTR 762-I-1, and FTR 762-K-1. Instructions for use are contained in the introduction.
762 ADD-E-1 (Nov 66)	M33 M289 M386	M6A1	Applicable to FTR 762-H-1

STATUS OF FADAC PROGRAM TAPES

The following items are contained in Revision 4, Cannon Machine Program Tape Kit, Federal stock number (FSN) 1290-466-0140. The set of addendum tapes is packaged separately and may be requisitioned as a set identified by FSN 1290-466-0142. The basic cannon program tape is packaged separately and may be requisitioned as a separate item identified by FSN 1290-466-0141. The basic cannon program tape incorporates the ballistic data for the 105mm howitzers M102 and M108 and the 155-mm howitzer M109.

Item	Part Number
Basic cannon program tape	8213330-80
Addendum tapes:	
105mm How M101A1/105mm How M102, M108	8213315-81
105mm How M101A1/155mm How M114A1	8213315-82
105mm How M101A1/155mm How M109	8213315-83
105mm How M102, M108/155mm How M114A1	8213315-84
105mm How M102, M108/155mm How M109	8213315-85
155mm How M109/155mm How M114A1	8213315-86
8-in How M110/155mm How M114A1	8213315-87
175mm G, M107/155mm How M114A1	8213315-88
155mm M109/8-inch How M110	8213315-89
155mm M109/175mm G, M107	8213315-90
8-in How M110/175mm G, M107	8213315-91
105mm How M101A1/8-in How M110	8213315-93
105mm How M102, M108/8-in How M110	8213315-93
105mm How M101A1/175mm G M107	8213315-94
105mm How M102, M108/175mm G M107	8213315-95
Clear hot storage tape	8213315-96
Tape, repetitive test routine	8213315-97
Tape, mechanical tape reader test	8213315-98

TARGET ACQUISITION DEPARTMENT

Meteorology Messages

A longstanding debate among artillerymen revolves around the use of an artillery meteorological message that is exactly 24 hours old and the use of a message for more than the 2-hour period specified by artillery doctrine. In tropical climates weather changes are small and slow and each succeeding day's weather appears to be the same as that of the preceding day. Many "redlegs" feel that in such a climate a met message current at 0800 today could be effectively used at 0800 tomorrow. Some feel that if an average 0800 sounding were determined, it could be used at 0800 daily for long periods of time. Some also feel that an average daily sounding could be used all day for a number of days, thus eliminating the need for additional soundings until a monsoonal change occurs.

Most of these ideas are based on personal experience. Until recently because of the lack of a set of controlled experimental data, no actual tests had been conducted to verify or refute these ideas.

Upon request from USAFAS through command channels, the met sections supporting the 1st Battalion, 92d Artillery, and the 7th Battalion, 15th Artillery, at Pleiku and LZ Two Bits, RVN, respectively, consented to conduct a limited experiment in time validity of a ballistic met message. During the period 7 through 14 May 1970, each section sounded the atmosphere every 3 hours. Balloons from each location were released at identical times starting at 2400 hours Greenwich mean time. The data were forwarded to the Target Acquisition Department, USAFAS, where a thorough check was made on the accuracy of each sounding. Time validity computations were then made, using the IBM 1620 computer.

Met corrected data for representative cannon, charges, and ranges computed from the current met were compared with met corrected data for the representative cannon, charges, and ranges computed from the average met. The Target Acquisition Department constructed numerous tables and graphs to aid in this comparison, which are too voluminous for inclusion in this article; however, the magnitude of errors which artillerymen would experience can be summarized by picking a mid-range and a charge for each of a number of weapons and computing the miss distance caused by errors in each of the averaged meteorological parameters. To illustrate these results, let us assume that during the 8-day period 7-14 May 1970, the artillery met section at Pleiku or LZ Two Bits had used the average values of ballistic temperature, density, and wind speed, averaged over the 8-day period for each hour, 3 hours apart, and at each NATO line number, instead of making actual soundings at these times; 32 percent of the time an FDC would run the risk of being in error by as much as the values shown below for specific gunnery problems. These examples were not selected to maximize the error. Also it should be borne in mind that these errors are indeed smaller than those that would occur in temperate latitudes. As is illustrated later in this article, in CONUS these errors may double or triple because of frontal weather activity.

105-mm Howitzer Charge 5 Range 7,200 meters

WIND	TEMPERATURE	DENSITY	TOTAL
23.9 meters	3.9 meters	10.6 meters	38.4 meters

155-mm Howitzer Charge 5 WB Range 9,900 meters

WIND	TEMPERATURE	DENSITY	TOTAL
71.3 meters	25.1 meters	19.3 meters	115.7 meters

8-inch Howitzer Charge 5 Range 9,000 meters

WIND	TEMPERATURE	DENSITY	TOTAL
68.2 meters	20.9 meters	15.0 meters	104.1 meters

175-mm Gun Charge 2 Range 14,000 meters

WIND	TEMPERATURE	DENSITY	TOTAL
51.8 meters	13.8 meters	47.8 meters	113.4 meters

Five percent of the time, FDC's run the risk of errors double the amounts shown. If the met sections had elected to broadcast only one message per day (24 hr) using each day's average values for wind speed, temperature, and density for each NATO line, 32 percent of the time the errors could have been as great as those shown below.

105-mm Howitzer Charge 5 Range 7,200 meters

WIND	TEMPERATURE	DENSITY	TOTAL
24.8 meters	2.6 meters	8.8 meters	36.2 metehs

155-mm Howitzer Charge 5 WB Range 9,900 meters

WIND	TEMPERATURE	DENSITY	TOTAL
73.9 meters	15.1 meters	16.0 meters	105.0 meters

8-inch Howitzer Charge 5 Range 9,000 meters

WIND	TEMPERATURE	DENSITY	TOTAL
70.7 meters	14.0 meters	12.5 meters	97.2 meters

175-mm Gun Charge 2 Range 14,000 meters

WIND	TEMPERATURE	DENSITY	TOTAL
46.5 meters	9.3 meters	39.7 meters	95.5 meters

Once again, 5 percent of the time the risk would be double the amounts shown.

As was mentioned earlier, the errors in higher latitudes could be several times larger than the above errors because of frontal passages, which do not occur in the tropics. To illustrate this, an experiment identical to the ones conducted in RVN was performed by the Target Acquisition Department of the Field Artillery School at Fort Sill, Oklahoma. The weather during this experiment was clear, calm, and warm, very similar to RVN weather, since no fronts or strong winds occurred. Under the same assumptions used to present the Vietnam data, errors which would be experienced or exceeded in 32 percent of the instances using average hourly data at Fort Sill, 16 to 26 May 1971, are as follows:

105-mm Howitzer Charge 5 Range 7,200 meters

WIND	TEMPERATURE	DENSITY	TOTAL
64.8 meters	8.7 meters	23.9 meters	97.4 meters

155-mm Howitzer Charge Sub Range 9,900 meters

WIND	TEMPERATURE	DENSITY	TOTAL
193.1 meters	44.7 meters	43.2 meters	237.8 meters

8-inch Howitzer Charge 5 Range 9,000 meters

WIND	TEMPERATURE	DENSITY	TOTAL
184.8 meters	41.4 meters	33.7 meters	260.0 meters

175-mm Gun Charge 2 Range 14,000 meters

WIND	TEMPERATURE	DENSITY	TOTAL
121.3 meters	27.5 meters	107.4 meters	256.3 meters

Use of one average met message per day at Fort Sill resulted in the following errors 32 percent of the time:

105-mm Howitzer Charge 5 Range 7,200 meters

WIND	TEMPERATURE	DENSITY	TOTAL
45.2 meters	5.0 meters	14.8 meters	66.9 meters

155-mm Howitzer Charge 5 WB Range 9,900 meters

WIND	TEMPERATURE	DENSITY	TOTAL
134.5 meters	28.5 meters	26.8 meters	189.8 meters

8-inch Howitzer Charge 5 Range 9,000 meters

WIND	TEMPERATURE	DENSITY	TOTAL
128.8 meters	26.4 meters	20.9 meters	176.0 meters

175-mm Gun Charge 2 Range 14,000 meters

WIND	TEMPERATURE	DENSITY	TOTAL
84.6 meters	17.5 meters	66.5 meters	168.5 meters

It can be readily seen from the above examples that, in many instances, errors can get too large to be acceptable by artillery, especially in close or unobserved fire. Failure to account for these errors could create a hazard to friendly troops or could cause hits in no-fire zones. In addition, such a failure could negate the application of surveyed data, the careful plotting and computations of the fire direction center, and the accurate settings of the gun crew. The artilleryman must remember that the weather he experiences at the surface may not indicate the conditions in the atmosphere aloft, where the projectile must travel.

In 1951 Project CRYSTAL BALL, a joint Army and Air Force experiment, was conducted at Fort Sill to determine requirements for ballistic meteorology. An interesting comparison can be made between the results of the recent tests and the mean meteorological accuracy rquired for artillery as determined by Project CRYSTAL BALL.

The table below shows the number of times the test data exceeded CRYSTAL BALL tolerances when hourly average soundings were used.

HOURLY SOUNDINGS

	PLEIKU				LZ TWO BITS				FORT SILL			
WIND	52	out	of	80	36	out	of	80	80	out	of	80
TEMPERATURE	6	out	of	80	24	out	of	80	80	out	of	80
DENSITY	25	out	of	80	68	out	of	80	80	out	of	80
	83			240	128			240	240			240

The table below shows the number of times the test data exceeded CRYSTAL BALL tolerances when only one average met message per day was used. This procedure is very similar to the experience correction procedure.

ONE AVERAGE MESSAGE PER DAY

WIND	29	out	of	80	26	out	of	79	72	out	of	80
TEMPERATURE	16	out	of	80	17	out	of	79	45	out	of	80
DENSITY	41	out	of	80	50	out	of	79	74	out	of	80
	86			240	93			237	191			240

From the foregoing, it can be concluded that the confidence that many artillerymen have in average data or experience corrections is largely unfounded. Use of either procedure would have been unacceptable at Pleiku or LZ Two Bits during the period 7-14 May 1970 and would have been disastrous at Fort Sill during the period 19-26 May 1971.

L1136 Army-Fort Sill, Okla.