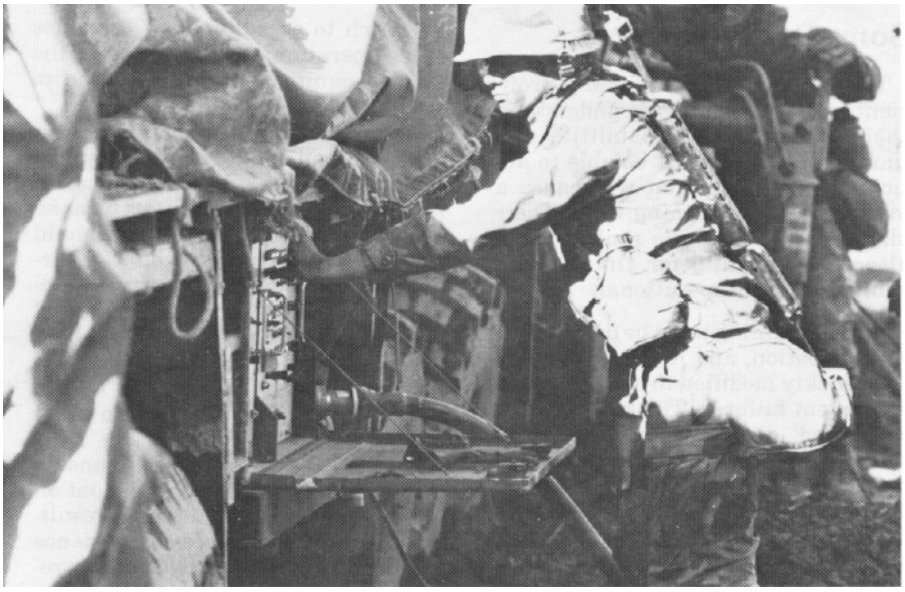

Lieutenant Colonel L. Kirk Lewis, FA, is the Chief of the Field Artillery Concepts and Studies Branch, US Army Field Artillery School, Fort Sill, Oklahoma. He received his commission from the Officer Candidate School and is a graduate of the Command and General Staff College. His past assignments include command of the 3d Battalion (Pershing) 9th Field Artillery, operations research system analyst, and chief of Special Actions for the Adjutant General at the Pentagon.

Lieutenant Colonel George H. Stinnett, FA, is the S3 for III Corps Artillery at Fort Sill, Oklahoma. He was commissioned through ROTC at Oklahoma State University and has completed the Command and General Staff College. Lieutenant Colonel Stinnett's past command and staff assignments include command of a firing battery in Vietnam and S3 of a Pershing battalion in US Army Europe. He also served as an action officer in the Office of the Chief of Public Affairs, Headquarters, Department of the Army; and executive officer of the 3d Battalion (Pershing), 9th Field Artillery.

• Be flexible and innovative. Create training opportunities *around* whatever obstacles exist!

• Don't waste time waiting. Switch quickly to a different training mode.

• Plan for maximum use of multiechelon training. It's the only way to do business—with or without equipment failures.

Training remains our Army's top priority, and time is still the unit commander's most finite resource. Commanders and trainers who aggressively apply their authority and skills to executing the principles mentioned above will keep their priorities in perspective, their resources under control, and, most importantly, never miss the opportunity to train soldiers.

View from the Blockhouse

FROM THE SCHOOL

Journal Notes

Many *Journal* readers were understandably grieved to learn of the retirement of Mrs. Mary Corrales, the magazine's managing editor since 1975. Fortunately, your professional periodical has acquired the services of yet another eminently capable editor—Ms. Tammy D. Hawthorne. The daughter of an airborne gunner, Ms. Hawthorne grew up among Redlegs of every persuasion. Following her graduation from the University of Oklahoma in 1983, this Phi Beta Kappa key holder rejoined the ranks when she went to work as a technical editor in the Field Artillery School's Directorate of Training and Doctrine. An accomplished writer and an extremely knowledgeable member of Fort Sill's doctrinal team, she is a splendid addition to your *Journal*'s staff.

Updating Doctrine

A recent revision of TRADOC Regulation 11-7 has resulted in changes to the doctrinal literature management system. These modifications will not only affect doctrine writers at Fort Sill but also soldiers in the field. One particularly significant change requires manuscripts that heretofore were sent to units for review as coordinating drafts to now be sent as field circulars. Such field circulars will be clearly marked with a suspense for review and comment. The first manual to be staffed under this revised procedure is FM 6-20-1, *The Field Artillery Battalion*. It should arrive in the field by the end of August.

Another change in the system is the method used to send literature packages containing manual purpose, scope, and topic outline statements to units. A letter rather than an electronic message will convey the packet. In fact, the US Army Field Artillery School (USAFAS) recently mailed the first such letter to announce the revision of FM 6-2, *Field Artillery Survey*. It arrived in the field during March.

The Doctrine Management Office would also like to alert units to another significant departure from standing operating procedures. The field circulars developed to support the fielding of the backup computer system were distributed differently than other publications because of new equipment fielding requirements. To ensure units would have the training materials on hand when the equipment arrived, USAFAS made two separate distributions. The School not only made a normal unit mailing but also provided sufficient copies to the US Army Armament,

Munitions, and Chemical Command to be packed with each piece of equipment. Both distributions were completed in June.

Other letters and manuscripts should reach units in the month shown in parentheses.

Letters Announcing Topic Outline

FM 6-121 (Change 1)	Field Artillery Target Acquisition (September)
FM 6-999I	Remotely Piloted Vehicle (October)

Coordinating Field Circular

FM 6-2	Field Artillery Survey (October)
FM 6-11 (Change 1)	Pershing II Battery Operations (September)
FM 6-20-1 (Change 1)	Division Artillery, Field Artillery Brigade, and Corps Artillery Headquarters (September)

The Doctrinal Management Office will continue to develop creative methods to ensure that field artillery literature is dynamic and reliable. However, field artillerymen serving in units must also provide impetus to improve artillery employment doctrine. Become a part of the process by responding to the outlines and circulars mentioned above; or send your comments, suggestions, or questions regarding doctrinal literature to the Department of the Army, Commandant, US Army Field Artillery School, ATTN: ATSF-DD, Fort Sill, OK 73503-5600. You may also call at AUTOVON 639-4225/4240.

Bringing BUCS to Battle

Current field artillery data systems provide artillerymen with rapid and accurate solutions to the gunnery problem. These systems take advantage of huge quantities of stored information, and they provide users technical answers which enable them to support highly mobile, modern forces. In fact, technical problems which took several minutes or even hours to solve using manual computations and hand-held calculators (HHC) can now be solved in a matter of seconds.

To date, the weak link in the automated system has been the lack of a suitable backup. Despite impressive technological advances, the specter of equipment failure or loss looms larger over equipment operators. They need redundancy. Unfortunately, the levels of sophistication required in artillery data systems give rise to high costs. Moreover, the need to field as many primary systems as possible has precluded the luxury of fielding more backup systems.

Nowhere was the need for technical backup more apparent than in the development of the technical fire direction system (TACFIRE) including the battery computer system (BCS). With BCS the battery fire direction center can compute individual weapon solutions using modified point-mass equations which correct for a variety of nonstandard conditions. Furthermore, the costly BCS computes zone-to-zone conversions and can assign individual aimpoints to each of 12 weapons.

But what happens when the BCS "goes down"? The temporary solution for backup data to the BCS has been a combination of manual and TI-59 calculator techniques. Unfortunately, to provide accuracy approaching that of the BCS, the manual backup system would have to employ a met-to-target computation from each weapon to its manually determined aim-point. While such solutions are possible, they are unresponsive. In order to provide a semblance of adequate backup, manual procedures have been augmented with the TI-59. This allows platoon solutions and piece corrections. But such hand-held calculator solutions still do not agree with the battery computer system solution.

Photo by Jill Ponto

The backup computer system features the Hewlett-Packard 71-b hand-held computer as its hardware.

The field artillery needed a permanent solution; it needed a backup system that was:

- Low-cost.
- Accurate.
- Responsive.
- Easily assimilated and used.

The advent of increasingly sophisticated hand-held or lap computers with programable capabilities provided the breakthrough needed. Such small, inexpensive computers allow a broad application throughout the artillery environment.

The initial proposal for the cannon application of this emerging technology was reported in the March-April

1983 issue of the *Field Artillery Journal.* The original program was developed by Mr. Don Giuliano of the Research and Analysis Division of the Gunnery Department at Fort Sill. Using a Hewlett-Packard 75 hand-held computer, Mr. Giuliano demonstrated the feasibility of the cannon application, and he dubbed the program the backup computer system (BUCS). The Armaments Research and Development Center (ARDC) at Picatinny Arsenal continued the development of the software which still retains its original name.

Figure 1. Backup computer system General.

Photos by FED Daily Bulletin and FED Lori Miller

Figure 2. Backup computer system Special.

Hardware

BUCS uses the Hewlett-Packard 71b hand-held computer as its hardware. As with the TI-59, the HP-71b is commercially available. The characteristics of the computer include:

Size:	8″×4″×1/2″
Weight:	12 ounces
Power:	Four 1.5V AAA batteries
Operating Temperature:	32°F to 113°F
Memory:	Up to 256K Read Only Memory (ROM); 17.5K Random Access Memory (RAM)

BUCS will be issued in two configurations—the BUCS General shown in figure 1, and BUCS Special shown in figure 2. The only difference between the two is that the Special includes a printer with all the necessary interface devices. BUCS Specials will be issued to Lance units and survey information centers at division and corps artillery levels. Other units desiring a printer will have to order it from the additional authorizations list (AAL).

The printer for BUCS is the Hewlett-Packard 2225B Inkjet. It is a 150 character per second, bidirectional printer that can use 8-1/2 × 11 inch computer fanfold or single sheets of paper. It prints using a small ink bladder that sends a stream of ink onto the paper.

Cannon Application

In its cannon application, BUCS will replace the TI-59 hand-held calculator as well as the Field Artillery Digital Automatic Computer (FADAC) in those units that have received the battery computer system. It will also function as the primary and backup computer system until the battery computer system is received.

Once the appropriate programed module is installed in BUCS, the system will provide the following functional capabilities for the specific weapon system:

- Conduct area fire missions.
- Locate targets using grid coordinates, polar coordinates, laser polar coordinates, and shift from a known point or target techniques.
- Compute firing data for high- and low-angle trajectories.
- Compute firing data for all current shell and fuze combinations (with the exception of Copperhead).
- Conduct precision, high-burst/mean-point-of-impact (HB/MPI), and radar (Firefinder and Q4) registrations.
- Perform zone-to-zone transformations.
- Update M90 average muzzle velocities to account for nonstandard projectile weight and propellant temperature (replaces MVCT M90-1).
- Convert a computer met into a ballistic met.

In addition, BUCS can store:

- Eight howitzer locations.
- Sixty targets or known points.
- Thirty observers.
- Eight sets of registration corrections.
- One ballistic met and one computer met.
- Muzzle velocity variations (MVV) for each howitzer for each projectile and powder family combination.
- Twenty six projectile lots.
- Twenty six propellant lots.
- Map information (MAPMOD).

The system does have a number of limitations:

- No communications interface.
- Only one active mission capability.
- Cannot execute fire plans.
- Cannot store no-fire areas.
- Cannot maintain ammunition accountability.
- Uses a ballistic met rather than a computer met in its technical computations.

Furthermore, BUCS will not currently compute data associated with the Copperhead projectile. This capability will become available with the issue of an M109/198 revision subsequent to initial fielding.

Survey Application

In the survey application BUCS will replace the TI-59 hand-held calculator. Unlike the TI-59, BUCS will make maximum use of operator prompts in order to simplify survey computations.

Once the appropriate programed module is installed in the BUCS the survey functions will enable the following computations:

- Azimuth and distance between two known stations.
- Grid coordinates, height, and azimuth for 40 consecutive (main scheme) traverse stations.
- Total height correction, total traverse distance, azimuth error, radial error, and accuracy ratio of any traverse scheme.
- Traverse adjustment of any traverse scheme.
- Conversion to common control.
- A single or chain of triangles.
- Triangle closure.
- Three-point resection.
- All field artillery methods of astronomic observation, and provide rejection data with conversion to grid azimuth.
- Fourth or fifth order specifications in all programs.
- Conversion from geographic to universal transverse mercator (UTM) coordinates.
- Conversion of UTM coordinates to geographic coordinates.
- Zone-to-zone transformation.
- Distance by trig traverse or subtense.
- Any number of targets (intersection) from two observation posts.

Each subprogram carries the operator through the survey computations with user friendly display prompts. Moreover, the capability to page backwards or recall previously entered data and correct errors is integral to each program as is the capability to abort.

BUCS will be issued to conventional survey parties and to survey information centers at division and corps artilleries. The basis of issue will be two BUCS Generals for each survey party and one General and one Special for each survey information center.

Lance Application

BUCS will also be issued to Lance units to replace the TI-59 hand-held calculator and to provide backup for the Lance fire direction system (FDS). In the Lance application, BUCS will have the following capabilities:

- Provide a nuclear and nonnuclear fire mission technical solution.
- Store and recall a MAPMOD.
- Maintain the status of six fire units.
- Maintain ammunition accountability.
- Store 36 firing points.
- Store 20 targets.
- Store and use met data.
- Automatically compute zone-to-zone transformation during fire mission computation.

The basis of issue for Lance will be three BUCS Specials for the battalion fire direction center and two BUCS Specials for each battery fire direction center.

Fielding

BUCS will be fielded using the total package/unit materiel fielding (TP/UMF) concept. This is a "push-package" procedure under which a team will go to the gaining unit and "hand-off" all the equipment needed to include the authorized stockage list and prescribed load list spares. In the case of the Active Component, units will be fielded by division artilleries and field artillery brigades. For the National Guard, equipment will be handed-off to each state property officer.

Training

The fielding of BUCS will include a modified new equipment training team (NETT). Because of the user friendliness of BUCS, a lengthy training period is not necessary. The BUCS NETT for the Active Component will consist of an 8-hour block of instruction that will cover:

- Care and maintenance of the system.
- Operation of the system in cannon, survey, and Lance modes as appropriate.
- Conduct of sample problems.
- Question and answer periods.

The anticipated size of each class is 30 students (15 for cannon, 15 for survey). This approach should allow one person from each firing battery and one person from each survey section to attend the new equipment training. Those receiving the training will receive training packets to take back to their units to assist in the training of other soldiers. Furthermore, the field circular that comes with BUCS will contain sample problems and explicit operating instructions for the system.

National Guard and Reserve personnel from the various readiness regions will come to Fort Sill for

training on the system. They will then provide training to the units in their geographical areas of responsibility.

At Fort Sill, BUCS will be incorporated into a wide variety of programs of instruction. However, the training will require no additional curricular hours. In fact, manual gunnery will be curtailed, and the hours currently given to TI-59 will be reallocated to BUCS.

Future Applications

Several enhancements have already been planned to increase the capabilities of BUCS. Foremost among these is the addition of Copperhead to the M109/198 software. Software modules are also planned for the L119 British Light Gun (BLG) which will be used in the light divisions. Both of these improvements will be available approximately 1 year after the initial fielding of BUCS. Planners also envision a safety program. Using this routine, BUCS will contribute to unit training even more.

Conclusion

Initial fielding of BUCS began in June. The current timetable calls for the Total Force to receive the system by the end of December. BUCS will allow BCS-equipped units to have a reliable, accurate backup, and it will allow non-BCS equipped units to achieve a greater degree of accuracy. It will also allow them to exploit more advantageous terrain gun positions and thereby enhance survivability. Easy to use, easy to maintain, and easy to train, BUCS will provide a standardized, automated system throughout the force and will provide it now!

If you have any questions about BUCS contact:

Commandant
US Army Field Artillery School
ATTN: ATSF-CT (CPT Mitchell)
Fort Sill, OK 73503-5600
AUTOVON: 639-4867/5607/5960/6067

(Story by CPT Randy Mitchell and CPT Al Cunniff)

The medium combat truck is being considered as the prime mover for the M198 howitzer and the AN/TPQ-36 and AN/TPQ-37 radar systems.

BATTLEKING Projects

BATTLEKING needs input from the field. Ideas on quick-fixes for troublesome equipment, techniques that make a job easier, or concepts about doctrine should be sent to: President, US Army Field Artillery Board, ATTN: ATZR-BDW (BATTLEKING), Fort Sill, OK 73507-6100. The submissions need not be formal, but Redlegs should enclose all details available. If you have a working model, send it or a drawing or photograph. Please identify who took the photographs and who is in them.

Here is another important BATTLEKING project currently underway.

• BK 60-84, Medium Combat Truck Evaluation (Source: Standard Manufacturing Company, Incorporated.) The medium combat truck is a 3½-ton, 8 by 8 vehicle using a trailing arm drive suspension system. It is capable of towing up to 20,000 pounds and has a 7,000-pound payload capacity. The medium combat truck was evaluated by BATTLEKING as a prime mover for the M198 howitzer and AN/TPQ-36 and AN/TPQ-37 radars.

The evaluation results are now being used by the Directorate of Combat Developments at the US Army Field Artillery School to determine the field artillery's use for the vehicle.

The Accident in Heilbronn

On 24 April 1985, the Department of the Army made public its investigation findings concerning the 11 January 1985 Pershing II accident in Heilbronn, West Germany. The accident killed three and seriously injured nine persons. The investigation team's conclusion: That electrostatic buildup in the equipment caused the rocket fuel to ignite. Pershing missilemen may ask: Why was protection against such occurrences not built into the system, and what is the Army doing to prevent another accident of this type?

The weapons development and testing community works hard to protect soldiers from operational hazards. In its development, the Pershing II system was tested by state-of-the-art scientific procedures, to include measuring the electrostatic effects of simulated lightning strikes at levels up to two million volts. Cold, as a factor in rocket motor sensitivity, was also extensively tested without adverse effects. However, the accident investigation team has since discovered properties of the Pershing II rocket propellant not previously known by missile scientists and the propulsion industry. A particular combination of temperature and humidity conditions makes the propellant more sensitive to electrostatic discharge; conditions which, the evidence shows, were created by the field environment in Heilbronn.

Immediately after the accident, the Army imposed precautionary measures and modified its Pershing II training activities, but important operational capabilities were sustained within constraints. During the accident investigation, team members not only sought the cause of the accident but also developed solutions to the electrostatic discharge problem. They were able to develop corrective hardware modifications to Pershing II equipment. These corrections have already been introduced into the missile production line. Fielded Pershing II equipment is being modified in place.

Our Pershing missilemen may be reassured that Pershing II is now and will continue to be as reliable and safe a system as our research, development, and scientific community can produce. Furthermore, the deployment of Pershing II missiles in accordance with the 1979 North Atlantic Treaty Organization dual track decision will not be affected by modifications to training and equipment.

It is tragic that the discovery of the Pershing II propellant phenomenon had to come at such a high cost in human life and individual suffering as occurred in Heilbronn. This event is yet another grim reminder that in the military profession, there is no absolute level of safety. Even conducting oneself with the utmost professional concern cannot preclude every accident. The sacrifices made by the missilemen involved and their families did not result from neglect in the

weapon's development. The Army is doing all that it can with available technology to lessen risks and to make Pershing II even more secure in its role as the most powerful system in the field artillery's arsenal. (Story by Captain Gary A. Green)