THE ENGINEER

SPRING 1974

THE ENGINEER

VOLUME 4 NUMBER 1 SPRING 1974

FEATURES

DEPARTMENTS

CHIEF'S BRIEFS

Alexander Macomb, the U. S. Army's ninth Chief Engineer, was born April 3, 1782, in Detroit, Michigan.

He entered the Army as Cornet of Cavalry in 1799 and was appointed as a second lieutenant in the Infantry in 1801. He was promoted to first lieutenant in the Corps of Engineers in 1802 and rose to the rank of lieutenant colonel in eight years — 1810. In 1812 Macomb became the Adjutant General of the U. S. Army and a colonel in the 3rd Artillery.

Later, as a Brigadier General, he commanded the Lake Champlain Frontier Army and defeated the Duke of Wellington's Veterans at Plattsburg, N. Y. in 1814. The Congress voted its thanks to Macomb, awarded him a Gold Medal for his leadership and shortly after breveted him a Major General.

In the reorganized Army, constituted by the act of March 1821, Maj Gen Macomb was appointed Colonel in the Corps of Engineers and named Chief Engineer in that same year. It was during his tenure as Chief of the Engineers that the birth of civil functions took place as part of the many other jobs undertaken by the military engineers. The act of April 1824 assigned civil functions to the Engineers to procure the necessary surveys, plans and estimates upon the subjects of roads and canals.

On May 24, 1828, General Macomb relinquished command of the Corps of Engineers to become General-in-Chief of the Army as major general.

Wearers of the Engineer insignia may be intrigued to learn that Macomb made the earliest known drawing to resemble the Engineer Button in 1807.

It also is interesting to note that Macomb was the Army's General-in-Chief when the castle insignia was designed 32 years later.

Macomb died on June 25, 1841, at Washington and was buried with the highest military honors in the Congressional Cemetery.

U.S. Army Engineer School
Fort Belvoir, Virginia

Commandant
MG H. R. Parfitt

Assistant Commandant
BG Ernest D. Peixotto

Executive Officer
COL E. J. Williams, Jr.

Secretary
James A. Velezis

Editor
Robert G. McClintic

Art Director
John W. Savage, Jr.

The Engineer is an authorized quarterly publication of the U.S. Army Engineer School. It is published to provide factual and in-depth information of interest to all Engineer units. Articles, photographs and art work of general interest may be submitted for consideration to: Editor, The Engineer, USA Engineer School, Fort Belvoir, Virginia 22060. Views and opinions expressed herein are not necessarily those of the Department of the Army. Use of funds for printing of this publication has been approved by Headquarters, Department of the Army, January 1, 1974.

Subscriptions to THE ENGINEER are available through The Engineer School, Book Store, Fort Belvoir, Virginia. Annual rates are $6.00 for mailing to a domestic or APO address and $6.75 for mailing to a foreign address. Individual copies of the magazine are $1.50 each. Checks should be made payable to the Fort Belvoir Book Store.

ABOUT THE COVER

No more bitter example of brother pitted against brother can be found than during our own Civil War. Art Director John W. Savage, Jr., depicts the awful hour when Union troops rushed across engineer constructed ponton bridges during the "Battle of Fredricksburg." See associated article "It Was A Gallant Work" beginning on page 22.

.PIPELINE.PIPE

FAIR BOOSTS ENLISTMENTS FOR RESERVES

"Popcorn, Peanuts, Crackerjacks — Try the Elephant Ride — Three darts for a Quarter, Every one a winner! — Join the Army Reserve."

Sure enough, on the Midway of the Mid-South Fair in Memphis, Tennessee, wedged between an eating stand and an elephant ride, was an Army Reserve Recruiting Booth.

"We go where the people are. If we wait for them to come to us, we're not doing our job," was First Sergeant Rick Keene's explanation of the incongruous location of the 467th Engineer Battalion's Recruiting Booth. "If I were sitting in the USAR center I wouldn't have a chance to talk to the 50 or 60 people a day that I'm averaging here."

Sergeant Keene's feelings were echoed by Major Ronald Slayton, who was also assisting the recruiting effort. A full-time technician with the unit, Slayton explained, "In the 467th, recruiting is everybody's business. We're all ready to come out to the Fair or any other gathering to tell the Army Reserve story."

The story must be well told if recruiting figures are any indication. Since its formal activation in November, 1971, the Memphis based Combat Engineer Battalion, part of the Army Reserve's 412th Engineer Command, Vicksburg, Miss., has reached 85 percent authorized strength. This means that in less than two years, the unit has recruited 600 personnel.

First Sergeant Keene, a full-time recruiting technician for the Army Reserve, led the crew at the fair and insured that the recruiting booth was manned as long as the Midway was open. This meant many 14 and 15 hour days for the recruiters of the 467th, and for the personnel manning the other recruiting booths. For, in addition to the Army Reserve, the National Guard (Army and Air), Navy, Navy Reserve, Marines, Marine Reserve and Active Army were all represented on the Midway.

When questioned about the competition, Chief Warrant Officer Bobbie Coleman, full-time Staff Assistant with the 467th replied, "The more recruiters there are the better the business is. We refer young men and women to other branches and other units if we see that they have experience in areas that we can't use and where they desire to work. Likewise, we receive referrals from the other recruiters when they find out that someone wants to be in an Engineer unit. Don't get me wrong. We don't give up anyone without trying to sell the benefits of our program, but we do keep the individual's interests at heart."

First Sergeant Keene seconded Chief Coleman's motion for fairness. He said, "If we don't do what's right for an individual he's going to be unhappy. If he's unhappy with our unit and his job he's going to be a negative influencer and hurt morale and retention. We know that we're fighting for numbers, but we have the full backing of everyone from our battalion commander to General Hamner (412th Engr Bde Cdr), in seeking quality. To us doing the recruiting, quality starts with satisfied individuals. This may sound strange coming from a recruiter, b we've been successful and our recruiting figures speak for themselves."

All prospects receive equal attention but some receive more attention than others. First Sergeant Rick Keene tells Jean Davis about the benefits of Army Reserve service.

Major Slayton added, "It's like this Fair duty. We talk to a lot of young kids and to a lot of young women. They may not be ready to join our unit, but they do have older brothers and boyfriends. If they see us out here, meet us, talk to us and find out that we have their interest at heart, and that we won't pressure them into signing, we make friends, and cultivate future prospects. We're recruiting for the long haul, not to fill up with anyone who can see lightning, hear thunder and eat jello."

The week-long fair gave the Reservists a chance to display their equipment and tell their story to many prior servicemen and to those with no service experience.

LINE. PIPELINE.

The results may be meaured in enlistments, a prospect list or the broader good extolled by all three of the men interviewed; the chance for the Reserve to tell its story and show itself to the public in a positive manner.

By any standard the operation should be labeled successful.

CRREL SCIENTISTS MAKE GOOD USE OF SKYLAB PHOTOS

The Skylab crew took photos of the Connecticut River and Merrimack River basins in 1973 as part of a study conducted by the U. S. Army Cold Regions Research and Engineering Laboratory and the New England Division of the Army Corps of Engineers.

The photographs taken by Skylab will be used to study the flood plain, vegetation distribution and land use of the two river basins.

Information obtained will be used to characterize the environmental factors which are critical to the New England Reservoir System. Based on the imagery, flood plain, vegetation and land use maps will be developed for selected watershed areas. In conjunction with the Skylab photographs images will be obtained by aircraft flying at 3,000 and 5,000 feet. Correlation will be made with Earth Resources Technology Satellite imagery taken during the same period.

Ground level information will be obtained from 25 automatic data platforms throughout New England which are operated by the New England Division. These platforms, which transmit their information through the Earth Resources Technology Satellite twice daily, give data on river stage, precipitation and temperature.

LIGHT NAMED TECH DIRECTOR AT DMS

Donald L. Light has been named Technical Director for the Defense Mapping School (DMS), according to an announcement made by Lieutenant General Howard W. Penney, Director of the Defense Mapping Agency.

At the present time, Mr. Light is attending the Naval War College, Newport, R.I., and will assume his new duties upon graduation in June of 1974. Prior to leaving for the War College, Mr. Light had been detailed to DMS. At that time his specific task was establishing top level technical and professional positions needed for development and execution of an improved mapping, charting and geodesy curriculum. Additionally, he has formulated a broad guidance on the probable impact of technology on the DMS curriculum.

Mr. Light, prior to his new appointment, served with the Defense Mapping Agency Topographic Center (DMATC), Washington, D. C. Before that he was with the U.S. Army Topographic Command from 1966 until it was incorporated into the Defense Mapping Agency in 1972.

He is a graduate of George Washington University, with a B.S. in Geodetic Science, and has attended courses at the University of Illinois, and UCLA, in California.

ENGINEER DINNER DATE SET

This year marks the 107th Anniversary of the traditional Annual Engineer Dinner. The event will take place at 6:30 pm, April 26, 1974, at Mackenzie Hall, Fort Belvoir, Virginia. The theme for this years dinner is "THE CORPS-SUPPORTING THE ARMY AND SERVING THE NATION."

Request for reservations must be made not later than April 15, 1974 by writing to The 107th Annual Engineer Dinner, Post Office Box 107, Fort Belvoir, Virginia 22060 or calling Fort Belvoir 664-3939 (Autovon 354-3939)

The Army is undergoing a period of time in which its strength is being reduced to a lower more austere figure. The force structure is being lowered by the deactivation of units to meet a major portion of this reduction. The implications are varied and obvious to all. They range from the hardships of managing with fewer resources to the benefits of increasing stability in long-tour assignments. One facet is not so obvious and is being used to meet a significant portion of the strength

AUSTERITY FACES ENGINEERS

Major Douglas K. Lehmann

reduction. It is austerity within individual TOE. Less known now, it will become obvious and remain with us long after the initial force reductions have been made.

Austerity is being ushered in by development and publication of the H-series TOE from the current G-series TOE. The full impact will be felt as units are required to submit MTOE based on these new H-series TOE. These conversions have started. After being reorganized under an H-series TOE, organization austerity will no longer be obscure, but a keyword of the Seventies. For example, the H-series TOE was published in November 1970, for the Engineer Battalion in the Infantry and Armor/Mechanized Infantry Division and the Engineer Company organic to each of the five type separate brigades. The strength changes of the two battalions were:

	G-Series	H-Series
Engr Bn, Armd/Inf Mech Div, TOE 5-145	1017/1019	984/1001
Engr Bn, Inf Div, TOE 5-155	988/990	776/793

(The two strengths within each series depend on the bridging version authorized — either MAB or M4T6).

Before examining other TOE facts of austerity, it is important to understand the basic philosophy about the current austerity program. Austerity is not new and has been prominent at the end of every wartime mobilization period. What makes organization austerity unique for the Seventies is its interaction with the Volunteer Army concept. Each concept had separate origins, but now shares branches of the same tree. The underlying drive behind the Volunteer Army is improving significantly the quality and professionalism of the Army.

The new TOE austerity is geared to reducing the number of positions and specialties requiring unique training, knowledge and experience. This results in organizations with only the personnel needed to accomplish the mission and stated capabilities. It can only be done with quality personnel who have increased opportunities, challenges and satisfactions. When the latter is obtained, Volunteer Army goals are complimented as service is more attractive beyond initial obligations. A "grassroots" explanation might be easier to understand.

The Volunteer Army concept removes service irritants and "make-work" details to provide meaningful training and duty. The TOE previously absorbed this non-productive effort. Any effort that cannot be transferred from non-productive time to productive time (which includes dynamic training) is organizational "fat" and must be trimmed. This is the why of TOE austerity. In order to work, it must have full support of the Army's leadership in concert with the goals of the Volunteer Army concept.

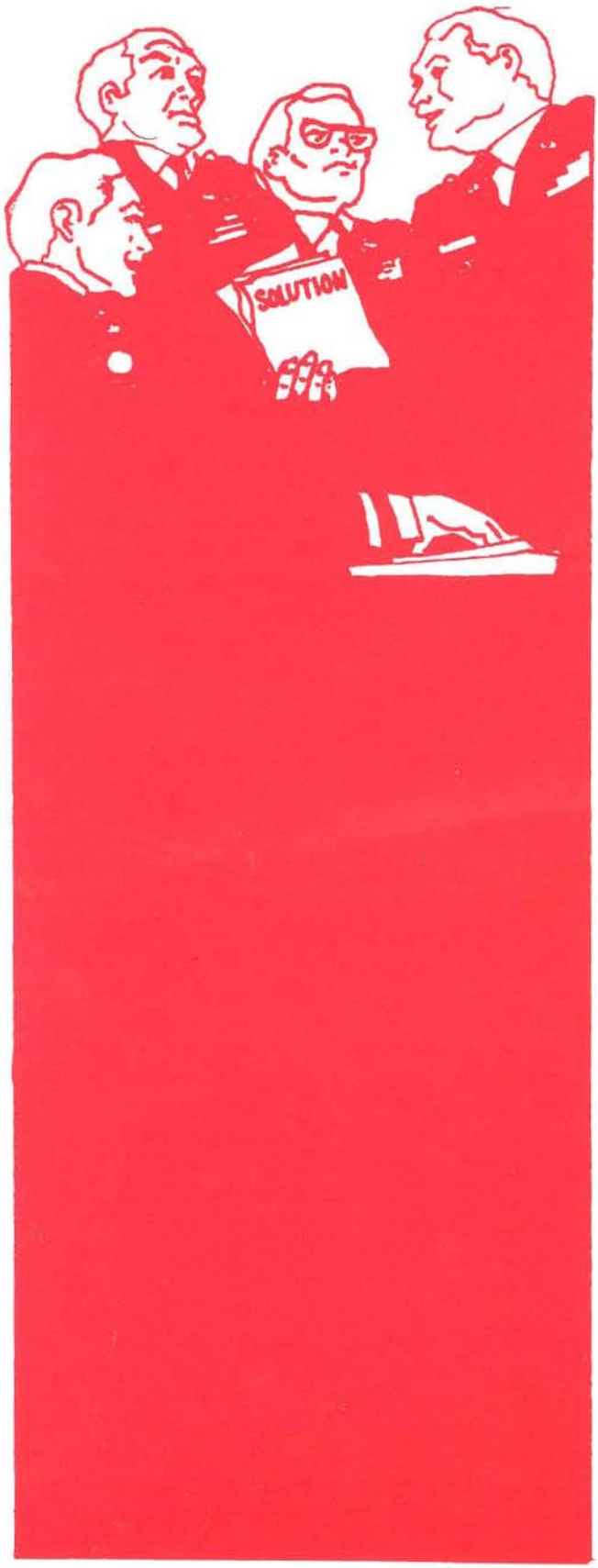
What is the methodology of TOE austerity? The traditional peacetime method is to organize under reduced strength levels of two (90%) or three (80%). The H-series divisional TOE have been carefully tailored in level two for realistic reduction and reflect actual experience.

The H-series has inaugurated the use of placing in augmentation paragraphs entire capabilities completely divorced from Levels 1, 2 and 3 of the basic TOE. These paragraphs are designed only for wartime use or special MTOE applications. TOE 5-115H, Engineer Construction Battalion should see the entire second shift construction capability placed in augmentation. Variation 30, TOE 5-148H Bridge Company, Engineer Battalion already has the 3rd crewman of each MAB unit in augmentation. Certain individual positions are also being removed from all H-series TOE and placed in augmentation paragraphs. Unless your unit receives DA approval to use augmentation paragraphs, you will no longer have:

- Cooks Helper, E-3, MOS 94A10 in Company Mess Sections.
- Chemical Staff NCO, E-6, MOS 54E40, in Battalion Operation Sections.

Additionally the Unit Supply Technician, WO, MOS 761A0 in Battalion Supply Sections has been placed in augmentation and will no longer be authorized when the Division Logistics System (DLOGS) has been implemented. This system removes the property book from battalion and consolidates it at division level.

Another aspect of TOE austerity directly attacks the organizational "fat" previously mentioned. The best example of this can be shown in the communication personnel authorized a line company. The H-series are standardized at no more than three or four men, usually a "commo" chief, radio mechanic, and wireman. The company radio NCS and switchboard must be co-located and 24-hour operation forces all personnel to hold 8 to 12-hour shifts with no room for non-productive time. The G-series engineer TOE are in the process of being updated to authorize no more than four or five "commo" personnel. In those units where only one or two commo personnel are authorized, the commander must seriously question the requirement for 24-hour operation or devise an alternate arrangement utilizing other CP personnel.



What is on the drawing board? The following list does not represent approved doctrine but indicates vividly the trend for future austerity —

• The development of a light (10,000 man), heavy (12,000 man) and experimental divisio (similar to TRICAP). The first two envision engineer battalion with no organic bridging (lo cated at Corps) or ADM (located at Brigade) and a strength as low as 425-532 men. The latter's forerunner is being evaluated at Fort Hood, Texas. This is the most versatile and complex division ever fielded. Yet its engineer battalion of 844 men is 140-175 below the strength of its counterpart in the Armored Division. The battalion is organized under TOE 5-185T (Tentative) with two of its four line companies converted from armored to airmobile under TOE 5-227T. These three divisions would replace the current six — Armored, Infantry, Mechanized Infantry, Airborne, Airmobile and TRICAP.

• The development of an engineer equipment support company. This will revise TOE 5-58G to include an airmobile equipment platoon and a 20 ton dump truck platoon to replace two of the existing three equipment platoons. This would delete the normal requirement for a (5 ton) Dump Truck Company in a type Corps. The result in a type Corps would increase capability and decrease strength by 194 (2 companies).

• The development of a new panel bridge company. This envisions replacing the curre Bailey Bridge with the British inspired Mediu Girder Bridge. When developed, and company with two or three sets, each 100 feet long, would replace two existing Panel Bridge Companies, TOE 5-77. In a type Field Army this would save 375 personnel spaces (3 companies).

How can you help to see that austerity measures are properly identified in TOE? First an understanding of the TOE/MTOE system is required. The basic structure is only modified to achieve a quality product incorporating restraints and additional austerity measures as appropriate. Since 100 percent of Army units are organized under an MTOE, how do TOE changes affect the Army in the field? The answer lies in the TOE/MTOE relationship. TOE are developed under a concept which visualizes wartime employment of a unit anywhere in the world. MTOE may be used during wartime or peacetime situations for adaptation to a specific geographical area of the world or to meet special missions or operational requirements. About 10 percent of MTOE are the same as the basic TOE; the other 90 percent, while different, must follow line by line the format of the basic TOE. MTOE increases and decreases must be documented, justified and forwarded to th Department of Army. The impact of the basi

TOE is therefore considerable since changes are few in number for most units.

Supplementary information in this article shows examples of constraining regulations of the TOE/MTOE system. In brief, personnel authorizations are based upon AR 570-2 and operational requirements. Grades for all personnel are found in the AR 611 series. Equipment requirements are based upon AR 310-34, basis of issue plans (BOIP) and operational needs. BOIP are not available at unit level.

Certain equipment is not shown as required in TOE. For example, expendable equipment is generally not included and is found in SB 700-50, Expendable Items (Except Medical, Class V, Repair Parts and Heraldic Items) and SB 8-100, Army Medical Department Expendable Supplies. Common Tables of Allowances (CTA) authorize certain other types of equipment your unit would need. For example, CTA 50-914, authorizes Individual Safety and Protective Clothing and Equipment. This CTA is the authorization to get your wireman or electrician a set of tree and pole climbers. Likewise, AR 840-10, Description and Use of Flags, Guidons, Tabords and Automobile Plates authorizes your unit guidon.

These documents are all listed in Section I of your TOE. MTOE documents will not repeat information in Section I, but will list significant changes from the basic TOE. Both documents are required to get a clear picture of the mission and capabilities of your organization.

Army Regulation AR 310-31, Management System for Tables of Organization and Equipment (the TOE System) gives general guidance on all other areas of the TOE. This includes the provision that suggestions for changes be submitted through command channels. An "ad" in Section I of the TOE extends this prerogative.

People who work with TOE are receiving suggestions on improvements that add people and equipment. This information is required but of an equal need is information on what is not needed.

What equipment or skill can be removed and pooled at the higher headquarters TOE? Where are over trained personnel functioning in positions in which less skilled personnel would suffice? What positions and equipment can we simply do without?

If the TOE developer doesn't get this information, austerity will force deletions based on the best information available from only a few field users. A requirement that MTOE developers usually must follow is useful knowledge for all. All MTOE additions require an equal number of deletions. Trade offs are the name of the game at DA. For example, if your unit has the PLL Clerk in augmentation, and it is not augmented, you can still place the PLL Clerk in the basic table if you can identify another position for deletion, such as the dispatcher.

Suggestions should be based on the knowledge that the TOE reflects only the normal mission of the unit. Regulations require that only minimum essential personnel and equipment be authorized. Where personnel changes must result in the same or lower strengths, equipment changes also should be less expensive. TOE's must be cost effective. An example is TOE 5-77H which is now approved to delete 19, five-man, Cook Sets w/Stove while adding only one, 70-man Cooking Outfit at a savings of $84. (Prices of equipment can be found in SB 700-20, Army Adopted/Other Selected Item and List of Reportable Items). Nor does the TOE have to be self-sufficient.

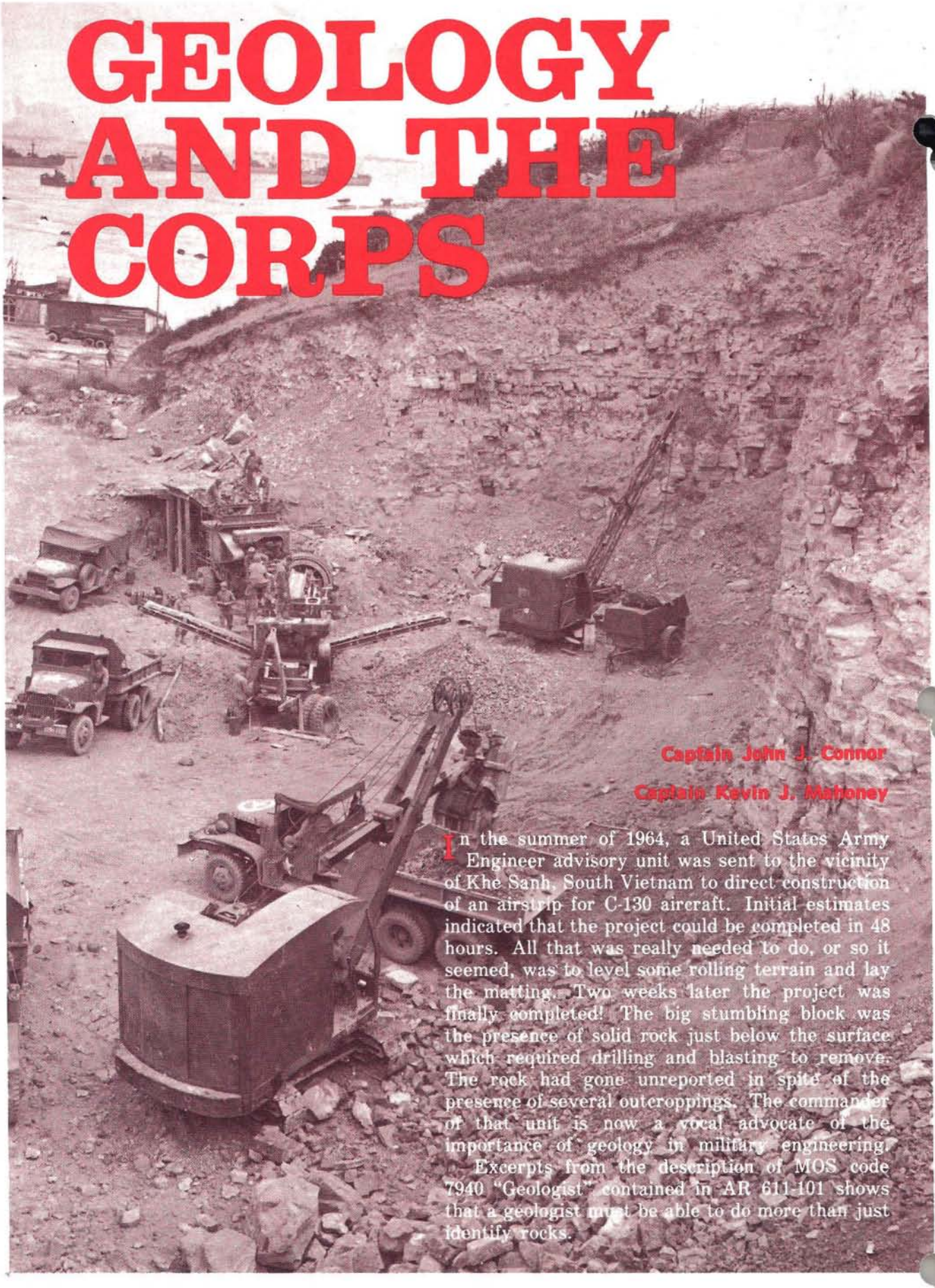
Each new H-series TOE places more dependency upon other units for certain capabilities. For example, TOE 5-157G, Engineer Combat Company is being changed to show tracked vehicle organization maintenance dependency upon TOE 5-156G, HHC, Engineer Battalion, Infantry Division. Recently TOE 5-77H, Engineer Panel Bridge Company, was reduced by 25 spaces since its normal mission requires other Engineer units to erect the Bailey Bridge.

Austerity in Engineer Organizations will be the keyword for TOE development of the Seventies. General Lesley J. McNair (1883-1944), an organizational genius, demanded that all units be functional without excess personnel or materiel, and he questioned everything that went into a TOE. The same is true today and the Volunteer Army concept is embodied in the same terminology of General McNair's time where he strived for "lean and mean" organizations.

The Engineer has always been challenged to use manpower and equipment resources efficiently. He must now do so with even more austere forces than before, using basic management principles that demand no undo strain on a soldier's time as a part of "Today's "NEW" Army."

Major Douglas K. Lehmann holds a BS degree in Forestry from Syracuse University and a MSA degree in Systems Management from George Washington University. He has been a Company Commander in the 97th Engineer Battalion (Construction), Germany and 26th Engineer Battalion (Combat), Vietnam. He also has held additional staff positions in the 8th Engineer Battalion (Combat), Korea, 91st Engineer Battalion (Combat), Ft. Belvoir, and 32nd Engineer Group (Construction), France and Ft. Hood. Since 1969, the major has held successive assignments at Ft. Belvoir of EOAC student; Office of the Director of Instruction, USAES; "Bootstrap"; and USACDC.

GEOLOGY AND THE CORPS



Captain John J. Connor

Captain Kevin J. Mahoney

In the summer of 1964, a United States Army Engineer advisory unit was sent to the vicinity of Khe Sanh, South Vietnam to direct construction of an airstrip for C-130 aircraft. Initial estimates indicated that the project could be completed in 48 hours. All that was really needed to do, or so it seemed, was to level some rolling terrain and lay the matting. Two weeks later the project was finally completed! The big stumbling block was the presence of solid rock just below the surface which required drilling and blasting to remove. The rock had gone unreported in spite of the presence of several outcroppings. The commander of that unit is now a vocal advocate of the importance of geology in military engineering.

Excerpts from the description of MOS code 7940 "Geologist" contained in AR 611-101 shows that a geologist must be able to do more than just identify rocks.

"Prepares military geologic maps; . . . acts as consultant on . . . location and evaluation of natural construction materials, . . . water supplies, . . . (and) foundation conditions; (and) interprets terrain features and aerial photographs for preparation of military intelligence reports."

The use of geology by the U. S. Army under combat conditions began in France in 1917 and has expanded through three succeeding wars. The Corps of Engineers has, however, been involved with geology almost from its beginning, spanning 200 years and millions of miles, from colonial times to the space age, from the western frontiers to the highlands of the moon.

One of the first major applications of geology within the Corps of Engineers came as a result of a $5,000 allocation by Secretary of War John C. Calhoun in 1820 for a survey of the Ohio and Mississippi Rivers from Louisville to New Orleans. Although the primary concern of the expedition was steamboat navigation, it also included an evaluation of the stratigraphy and geologic formations encountered along the way. Soon another expedition set out to survey Michigan and the Upper Mississippi. Engineer officers were joined by civilian scientists, among them a mineralogist, Henry R. Schoolcraft who documented the rich lead deposits of the Upper Mississippi and the vast copper reserves of the Lake Superior region.

Amid this increase in western exploration, a separate Corps of Topographical Engineers (1838-1863) was formed to survey western rivers, locate wagon routes, build roads, and investigate geologic resources. The work of Army Engineers, including a series of expeditions led by Lieutenant George M. Wheeler, greatly increased the knowledge of the geology, zoology, and botony of the growing nation. These and other early surveys revealed the importance of geology in America's future and led to the creation of the United States Geological Survey in 1879.

The construction of the Panama Canal stands as perhaps the greatest engineering feat of the past century, and geology and the Corps of Engineers are two integral elements in that story. Geologic considerations were, in fact, very instrumental in the selection of the canal's route, and were of great significance throughout its construction.

For years a worldwide debate had raged among isthmian canal advocates as to whether to build it across Nicaragua or at its ultimate location across Panama. International politics effectively resolved the argument. But the unstable geologic conditions along the proposed Nicaraguan route were also influential. Geologists pointed out that Nicaragua was an "active" geologic region and that on its eastern coast 169 earth tremors had been recorded from January 1901 to April 1904. They classified 35 of these tremors as "strong." During the same period only 10 movements were recorded in Panama; none of them of significant force. Additionally, the Nicaraguan route passed close to an active volcano, Ometepe, which had violently erupted as late as 1883.

Even after the choice of route was made, and construction begun, geology was still of prime concern to the American engineers in charge. Major General George Goethals, Chief Engineer of the Isthmian Canal Commission, gave ample treatment to geologic problems in his treatise that was published in 1916.

The most awesome element in the construction of the Canal was the excavation of the immense Culebra Cut through the Continental Divide. Officially designated the Gaillard Cut by Executive Order in 1915, its eight and one-half mile length required 26 years of work and the removal of 100 million cubic yards of material, mostly solid rock that required drilling and blasting. Excavation of "The Cut" was plagued by frequent and massive rock slides that accounted for nearly 30 percent of the material which was removed. In order to solve this unanticipated problem, geologists were asked to recommend ways of stopping the slides. But there were complex geologic conditions which required a variety of measures at various locations since the slides were the result of four different conditions.

Some slides were caused by saturated clay sliding on inclined layers of hard rock, while other slides occured where rock was broken by faults. Still others were the result of ordinary weathering and erosion. A fourth type of slide, called a "break," was the result of the weight of overlying rock acting on weaker rocks which were exposed in the cut far below the surface. This caused banks to slide and forced the bottom of the excavation to rise. Geologists felt the only way to overcome this latter situation was to remove additional material from upper levels and check the other slides by driving piles through the troublesome material into solid ground or by dumping large pieces of blasted rock on loose surfaces.

The first ship passed through the Panama Canal on August 3, 1914, six days after Austria's declaration of war against Serbia which triggered the beginning of World War I. Less than three years later, the United States entered the war, and for the first time American geologists were on the front lines overseas. At home, geologists were busily engaged in finding mineral resources needed

for the war effort. And overseas, because of the very nature of trench warfare, geologic considerations often proved to be a factor. In many cases, however, the geologists' efforts were directed toward overcoming ignorance and prejudice.

Few high-ranking officers on either side had an adequate conception of the applications of geology to military problems and the results of geologic investigations were very often ignored. For example, at one point during the Battle of Verdun, French troops were ordered to "dig-in" on a plateau where less than a foot of soil covered the bed rock. The task was impossible and resulted in a large and needless loss of life.

British engineers shipped road aggregate from England, even though geologists could have found available sources in the theater of operations. German troops used water witches to locate well points. And right after its arrival in France, the American Expeditionary Force used no method at all to locate well points. However, because of the earlier follies of her Allies, the AEF soon learned to pay heed to organized geologic work. A geology section comprised of two officers was established as a part of the Office of the Chief Engineer of the AEF in September 1917. In July 1918, positions for geologists were authorized on the staffs of the Chief Engineers of each of the Field Armies, and in August the section at AEF headquarters was increased to six. This brought the total of authorized geologist positions to 18, although only nine were ever filled at any one time.

Major applications of geology in the war included the construction of field fortifications, trenches and tunnels, and the location of sources of water and road aggregate. In the construction of trenches, knowledge of geologic conditions proved to be a vital necessity. The type of material to be expected dictated what equipment and how much time would be needed if revetments would be required and if drainage would present a serious problem. Therefore it was of great value to know if one would encounter hard rock, impervious clays, or sand and gravel.

In the Moselle Valley a military geologist pointed out that bedrock was generally covered by just a foot or two of soil, making trench construction impossible except where the so-called Limon Formation was found. Therefore this formation was marked on tactical maps and used accordingly. Knowledge of the depth of the ground water table was also important, and when excavations were made without due regard for it, flooding often resulted.

Tunnelling was used in World War I to a degree never equalled before or since, and in this regard, geology again proved most helpful. At the battle of Sebastopol, the Allies quickly tunnelled through a layer of soft shale after being initially slowed in their advance as they began the gallery in a layer of tough sandstone. It was by accident that the softer layer was discovered because a geologic study had not been employed. Such a study could have avoided the initial waste of time and effort. All along the western front, allied geologists identified areas where horizontal sedimentary layers would afford easy tunnelling and warned against areas where tough igneous rock would form a barrier or where ground water would be a problem.

As the war progressed, the Americans prepared new geologic maps to supplement older French and Belgian issues. Some of the maps showed only the general geology and the distribution of various types of rocks. Others were specifically designed to delineate areas where trench construction or tunnelling would be feasible. Before the end of the war, the American geologists had prepared 1:50,000 scale geologic maps of the entire western front to include much territory behind enemy lines. Additionally they were called upon to evaluate areas for troop movement, determine river bottom and bank conditions, fluctuation of stream levels, and for the first time, choose routes for advancing tanks (the forerunner of the modern trafficability studies). They also located urgently needed natural resources such as water and rock for macadam roads.

The American geologists produced eight special maps showing the surface distribution of suitable hard rock, the location of existing pits and quarries, as well as potential sources of sand and gravel. Due to the limited manpower and the broad scope of the task, maps and reports on locations of both surface and sub-surface water were scant in detail and covered only a portion of the theater. However, when possible, the geologists furnished information on the location of springs, areas feasible for shallow dug wells, areas of deeper sub-surface water, as well as available data on stream flow. Their maps also showed known wells and reservoirs and included data on water supplies developed by local towns.

By their performance on the western front, the geologists of the AEF and the other waring nations showed the vital role the knowledge of geologic conditions would play in modern warfare.

Just twenty-three years later when the United States once again went to war, American geologists again went with her. A total of 88 of our best found themselves working along with soils scientists and other specialists in a newly created organization, the Military Geology Unit. It was formed in June 1942 by a special agreement between the U.S. Geological Survey and the Corps of Engineers.

The complexities and geographic extent of the war made such an agency a necessity. It was charged among other things with identifying terrain suitable for use of armor and with selecting sites for new airfields. It was, in short, in the business of terrain intelligence. The bulk of the unit's work was done from Washington but in 1944 small teams went overseas and accompanied the Army into combat to assist in finding water, siting and constructing roads and airfields, and locating construction materials. These teams also checked the accuracy of predictions made in the rear before U.S. forces entered the hostile areas.

The main product of the unit was a series of "Strategic Engineering Studies" consisting of information and maps on rock types, soils, vegetation, water resources, rainfall, and locations of possible airstrips, roads, and construction materials. Most of this information came from library research and air photo interpretation. Immediate attention centered on the Pacific islands for which more than 120 studies were prepared. Later attention was shifted to North Africa and Europe. In addition to the generalized SES's, the unit prepared very detailed material, including terrain diagrams, trafficability studies, in-depth airfield site selection, water supply maps, and construction materials maps.

Terrain diagrams, which give a true-to-life perspective of terrain features, were used to guide pilots bombing the oil center at Ploesti, Romania. Using only ordinary topographic maps, the bombers could not locate the heavily camouflaged facilities, but on a second attempt the realistic drawings enabled them to locate and destroy the site.

With the increased use of armor, trafficability studies became a necessity. Their compilation involved geologists, soils engineers, foresters, and others. Very often soil characteristics could only be approximated because they were based on knowledge of geologic conditions. In many respects the unit's work was the same as its World War I counterpart but on a greater scale and with more sophistication.

Learning a lesson from two world wars, the United States kept on with terrain intelligence work after the end of World War II. The Military Geology Unit was redesignated the Military Geology Branch (MGB) of the U.S. Geological Survey and supplied material to the newly formed Central Intelligence Agency for inclusion in a new series of strategic studies that covered the world.

These "National Intelligence Summaries" took nearly 20 years to complete.

The MGB also prepared a series of terrain analyses of selected military reservations in the Continental United States including Forts Benning, Campbell, Hood, and Knox, and an EIS covering the Sixth Army Area. Today the MGB is concerned with small, specific projects for other government agencies that include the Office of the Chief of Engineers for which it recently did a study on permafrost.

The pioneer work done in the field of terrain intelligence during World War II proved to be of great value in our recent experience in Vietnam. The techniques used at the Combined Intelligence Center, in Saigon, were similar to those used 25 years earlier — a combination of research, photo interpretation, and professional judgment. One of the severest tests of this system came in the preparation of terrain intelligence information to support the allied incursion into Cambodia in the spring of 1970.

Geologists, several of them members of the Corps of Engineers, played a significant role in this historic effort. Perhaps less spectacular, but significant, was the day-to-day work of soldier-geologists in the preparation of geologic maps, trafficability studies, and other terrain related items. Terrain Detachments, working out of Long Binh, Nha Trang, and Phu Bai, transferred geologic data from French-made maps of the 1930's to 1:50,000 scale topographic bases. Geologists from these units also went to forward areas to help site airfields and roads, make observations to aid in preparing cross-country movement studies, and to locate quarries and borrow pits.

Again going back to World Was II, during the Allied invasion of Europe, engineers were often called upon to "get the water off and the rocks on." But first someone had to find those "rocks." This mission of locating and exploiting rock deposits more often than not fell to the soldier-geologist. On June 8, 1944, just 48 hours after "D-Day" began, an Armored Engineer Battalion was operating a quarry on Omaha Beach. And 30 days later, other Armored Engineer Battalions were operating quarries all across western France to provide the mobility required by the armored spearhead.

Operations in the Pacific Theater during that period placed even greater demands on geologists because they had to locate sufficient construction material to support the island-hopping advance toward Japan. Conventional construction materials were virtually unavailable on most of th

Pacific islands that were chosen as airbases. So the geologist was called upon to locate coral in sufficient quantity for the massive runways, while the engineer sought methods of improving upon the basic qualities of coral to make it suitable as a construction aggregate. Since reconnaissance aircraft were at a premium, geologists from Aviation Engineer Battalions trained the pilots of single-seat fighters to conduct aerial engineer reconnaissance while on combat missions.

Later, when more aircraft became available, geologists themselves took to the air in an effort to hasten the location of construction material. In one instance, a geologist from the 836th Aviation Engineer Battalion spotted a deposit of 500,000 cubic yards of high grade coral while flying a "recon mission" over Saipan. Construction of a coral runway started there on June 15, 1944, and on November 24, 1944, B-29 heavy bombers took off to raid Tokyo. Similar significant contributions to military engineering by geologists were made during both the Korean and Vietnam Conflicts.

One of the highest priority missions given to the Corps of Engineers in Vietnam was the construction and upgrading of lines of communications (LOC). Vast quantities of rock in the form of aggregate were required, and geologists were tasked with locating, developing, and in many cases, actually operating quarries in support of the LOC mission. The record here speaks for itself — 27 million tons of aggregate was produced and 456 kilometers of highway was constructed!

Today, the principal domain of geologists within the Corps of Engineers is in the Civil Works area. Still others are engaged in research and development efforts for the Waterways Experiment Station, the Cold Regions and Engineering Laboratory, the Nuclear Cratering Group, and other activities. Within OCE's Directorate of Civil Works, Engineering Divison, is the Geology Branch from which a vast array of geologic talent is managed, The 15 men who occupy the Corps' top geologists' positions across the country have an average tenure with the Corps of better than 23 years. Their areas of expertise include such fields as arctic geology and permafrost, clay mineralogy, environmental geology, explosives excavation, formation design, remote sensing, and seismology and earthquake engineering.

The Corps' Civil Works activities continued, though at a reduced pace, even during the war years, but have steadily grown since the end of World War II. One estimate is that by 1980 as many as 500 geologists might be required to meet the Corps' needs.

The Civil Works program is presently or was recently engaged in more than 4,300 projects at a total authorized cost of 35-billion and appropriations for new work totalled 16-billion dollars at the end of 1972. Geologists are frequently called upon during the course of these projects; especially when they involve stratigraphic of subsurface investigations. Recently, nearly 100 Corps geologists were involved in one single project; the Atlantic-Pacific Interoceanic Canal Study (1964-1971) which investigated 23 possible routes for a new sea-level canal across the American isthmus.

The Corps of Engineers has been an active participant in the new field of lunar geology. As early as 1960, the Military Geology Branch, under the direction of the Office of the Chief of Engineers, prepared a study and map of the surface geology of the moon. The text included a concise description of the various materials, information of landing and movement characteristics, as well as excavation and construction potential. Other geologic work progressed through the unmanned Ranger and Surveyor programs and continues today with the evaluation of the data from Apollo and the new Earth Resources Technology Satellite.

So we see that geologists of the Corps of Engineers have been a vital force in both war and peace. As we look to the future, we hope that their talents will be called upon to aid peaceful, construction pursuits. We must however be prepared for all possibilities. Therefore, because of the expanded use of geology in military applications over the last 50 years, the United States Army Engineer School presents instruction in this subject to various officer, non-commissioned officer, and enlisted specialist courses. A total of 11 hours of instruction is given to all students of the Engineer Officer Advanced Course, while enlisted Soils Analysts receive 22 hours of instruction which includes eight hours of field work.

Whatever the future may hold in store, geologists of the Corps of Engineers stand ready to meet the challenge!

Captain Kevin J. Mahoney is currently assigned as Commander, Company A, 30th Engineer Battalion (Topo) and was formerly an instructor at the Engineer School at Fort Belvoir, Virginia. He is a Vietnam veteran, a 1968 Engineer OCS graduate and holds a BS in Geology from Villanova.

Captain John J. Connor is a graduate of Engineer OCS, and has a degree in Geology from Boston College. He is a former instructor in the Department of Engineering Sciences, Foundations and Materials Division, Soils and Geology Branch at the Engineer School. He is currently assigned as Project Manager for the Pacific Ocean Division, Corps of Engineers, on Majuro Atoll in the Marshall Islands in the Pacific.

Captain Guy E. Miller

Murphy's Law states simply, "If anything can go wrong, it will." This natural law is one of the irrefutable facts of life. Murphy is the gremlin present in every human undertaking, always looking for some opportunity to disrupt a smooth operation. The military profession, primarily concerned with administering violence, is especially susceptible to Murphy and his law. In the military, with far more consistency than in the civilian world, when things go wrong the results can be tragic.

If we don't want to join Murphy, we have got to beat him. For this purpose, safety rules have been devised to frustrate his law. These rules have two main origins — experience and foresight. While experience may be the most effective teacher, in the demolition business it is also the most expensive. We just can't afford to let our people learn demolitions by their own mistakes.

In demolition training, safety is always given maximum emphasis. Right from the very beginning, everyone is taught the safety rules, and proper procedures are stressed throughout the training phase. Because of this attention, school and training environments have maintained almost perfect safety records. So our main concern is Murphy's success outside the school situation.

Murphy has two favorite victims for his dirty work — inexperienced personnel and the very experienced — hence overconfident ones. In the military demolitions field inexperienced personnel are seldom a critical safety problem, primarily because of the tremendous emphasis on safety in their training. If anything, the inexperienced soldier is far more likely to be overly cautious.

However, in the combat support mission, inexperience and unfamiliarity can become a critical factor, not for the personnel handling the demolitions as much as for the troops they support. All too frequently in Vietnam, Infantry commanders, unfamiliar with the dangers of demolitions, failed to brief or account for their personnel properly, resulting in needless friendly casualties.

By far Murphy's favorite victims are the so-called "experienced" personnel. Why is this so? The safety rules are made to beat Murphy and they work. For the most part, everyone knows what the rules are and how to apply them. So every time someone gets hurt unnecessarily it is because an individual who should have known better ignored one or more of the rules.

Safety procedures are made to be completely Murphy-proof, closing off every loophole open to him. As people gain more experience they begin to learn that there is much more safety built into the rules than is required and they start cutting corners. But the often heard words, "It wi

probably be OK," take on a special spine-chilling significance when the name of the game is "You Bet Your Life." The word "probably" announces an invitation to disaster.

If anything can go wrong, it will, but not necessarily immediately. Since Murphy frequently takes his time catching up, the practice of cutting corners grows into a habit. People decide they can get away with ignoring the rules and begin cutting more corners, compounding Murphy's opportunities. And sooner or later he takes advantage of this and strikes.

One particularly gruesome case happened at Fort Bragg, North Carolina, several years ago when a large number of experienced Special Forces personnel were training in a "demo" pit as 40 pounds of C-4 detonated, killing and wounding several men. Although the resulting investigation never conclusively established exactly how the accident occurred, the fact remains that if all the safety procedures had been followed properly, there would have been no such disaster.

The combat experience our soldiers rolled up in Vietnam has provided innumerable examples of the old adage that "familiarity breeds contempt." Many safety conscious, new arrivals, coming in-country for the first time, received the traditional, combat veteran's code from the old-timers. "No sweat. We don't bother with doing it that way here." But with Murphy around all the time waiting for his chance to strike, it is best to play it safe -- by the book. For instance, a freak accident happened at a quarry near Cam Ranh Bay during the early years of the war that would never have happened if safety rules had been followed. A trooper was killed by a large rock when he stuck his head up to photograph an enormous blast.

As leaders, how can we go about beating Murphy's Law? Anything we can do to keep the odds in our favor rather than his will help frustrate him. Our first responsibility, obviously, is to insure that safety rules and procedures are properly followed. How many times in a tactical situation have leaders ignored safe principles by carrying caps and explosives together? It is true that usually nothing happened. But considering the possible consequences and the sad fact that Murphy was certainly lurking close by, was this a reasonable side to take?

Some procedures may seem silly in a combat operation but if they can prevent unnecessary friendly casualties there is no justification for disregarding them. For example, shouting, "Fire in the hole!" three times is never wrong.

Getting back to Murphy, another way to beat him is to use systems with maximum reliability. One example is to avoid the use of the time fuse wherever possible to set off an explosive charge. Numerous techniques are available but perhaps the most reliable is to use detonation cord and electric caps as far as possible from the charge when setting it off.

Probably the most important thing for leaders to do if they are to beat Murphy is to constantly be aware of their troops and what they are likely to be doing or not doing. A good example of this involves an Engineer unit that was clearing a road of mines in Vietnam. As mines were located, they were blown in place and the resulting craters were filled before the unit could continue up the road. After several hours of this tedious procedure, the unit commander was horrified to see one of his men carry a mine he had just dug out of the road over to a vehicle and drop it on the hood, saying "Sir, we're tired of filling up those damn holes."

Not so fortunate was the troop who threw an ammunition crate into a pile of burning C-4. The resulting detonation unnecessarily added more personnel to Murphy's casualty list. Just as in the case of the soldier who was killed while photographing the quarry blast, the lesson shown here is that personnel are likely to get themselves hurt when they are not always made conscious of the dangers of demolitions.

Follow the safety rules and Murphy will never get his chance at you. Many safety rules are so obvious that to disregard them is ridiculous. Example: some time ago at Fort Belvoir, Virginia, a small automobile was damaged when its owner disregarded clearly posted warnings about minimum safe distance from a demolitions demonstration. Result: debris from the detonation crushed the parked car. Fortunately no one was near it when disaster struck.

Demolitions is considered to be a dangerous business. However, if proper procedures are correctly followed, there is no reason why "demo" should be any more dangerous than any other military program. If leaders will enforce established safety rules, employ systems with maximum reliability, and stay one step ahead of the troops, then Murphy will never have the opportunity to use his law to hurt our personnel or jeopardize our mission.

Captain Guy E. Miller is a recent graduate of the Engineer Officer Advanced Course at Fort Belvoir, Virginia. He received a Regular Army commission in Armor from the USMA in 1969. Following Airborne and Ranger schools and AOBC, he served as a Platoon Leader in 1/17th Cavalry of the 82d Airborne Division. He graduated from the Rotary Wing Flight School in 1971, and following a branch transfer to the Corps of Engineers, completed a tour in Vietnam with the 1st Aviation Brigade.

MAN: KEY TO COUNTERMINE WARFARE

Captain Richard Kanda

Data released by the Office of the Surgeon General and R. H. Stolfi, Ballistic Research Laboratory (1972), indicates mines and boobytraps caused two percent of all U. S. casualties in World War II, four percent in Korea and more than 13 percent in South Vietnam. The percentage for Vietnam may be conservative.

A U. S. Army Mobility Equipment Research and Development Center office memorandum states that, "Many combat units in RVN had casualties (attributable) to mines and boobytraps of 30 to 50 percent, and approximately 80 percent of all vehicles destroyed were due to mines."

The literature about the seriousness of the mine threat faced by U. S. forces is replete with such statistics. So what has the United States Army done to counter this ever increasing problem?

In 1970, Department of the Army established a more formal, long term countermine systems development program. As part of this program, the United States Army Mobility Equipment Research and Development Center (USAMERDC) was designated Lead Laboratory for coordination and implementation of the entire program.

The USAMERDC response to this obligation consists of many ongoing research and development projects — all of which are oriented and controlled through use of systems analysis techniques.

This program is known as "Countermine System Definition and Analysis." It provides for the systematic organization and processing of all facets of the countermine effort. Previously, countermine hardware, doctrine and personnel were not systematically considered **en toto.** The total systems approach surfaced a new question concerning the mine detection hardware/personnel (equipment/equipment operator) interface. Just how much impact does the man using a portable mine detector have on the effectiveness of that mine detector? The fact that an interface exists is obvious; but, how does one quantify it?

USAMERDC needed this information to truly evaluate its research and development projects dealing with hardware. It is an easy matter to measure the intelligence and state of training of the man. However, are these the only parameters worthy of investigation?

Before delving further in the countermine man/equipment interface, consider past experience where development of hardware was treated in a relatively singular manner.

Historically, countermine research and development has been predicated on the detection and/or neutralization of mines through use of hardware. In the mine-countermine confrontation, the miner has the advantage.

To illustrate, examine the family of man portable mine detectors. Detectors have been developed which sense metallic mines, nonmetallic mines, or the trace gases emanating from the explosive content of the mine itself.

The viability of the metallic mine detector is negated by nonmetallic mines. In turn, use of the nonmetallic detector is disrupted by enemy use of inert material which duplicates the signature of nonmetallic mines. Why not "sniff 'em out" with the trace gas detector? The miner just sprinkles the mined area with particles of explosives. The operator of the gas detector is then confronted with a veritable sea of mines. Will this vicious cycle of graduated technical response be broken? Realistically, probably not.

There has been no appreciable gain in U. S. countermine effectiveness since World War II. Field commanders need not hold their breaths for that single technological breakthrough. The enemy miner will always have the advantage. He may be forced to use a technically inferior mine. However, just the knowledge that the mine is

emplaced at a certain location assures the miner of his historical edge.

Reliance on perceptual detection of mines by man is empirical fact. Reports from South Vietnam and previous conflicts indicate that 70 percent to 80 percent of all mine detections are attributable to unaided personnel.

In the past, combat troops have received a modicum of training in countermine techniques. This training was based on techniques proven by past experience. However, no concerted or formal effort was made to identify and train specific individuals with exceptional ability to detect mines. Such individuals do exist.

Query any combat soldier who operated in an area the enemy actively mined. He will invariably relate a war story concerning some individual who was most adept at locating mines.

What makes some individuals more effective? Is it basic intelligence or innate practicality? Is it an inherent or acquired skill? Is it his visual search mode? Exactly what are the parameters embodied in a man who is an effective mine detector? Is it possible to quantify those parameters?

USAMERDC commissioned the Human Resources Research Organization (HumRRO) in 1972 to answer these questions. The initial scope of the task was to derive a more formal empirical base.

The HumRRO approach was to test and interview 78 combat veterans. Criterion for selection was based on the proven proficiency of the test subjects as mine detectors. They were nominated by peers and superiors who verified proficiency during personal association with the men in combat. The test subjects came from infantry, armor, mechanized infantry and engineer units.

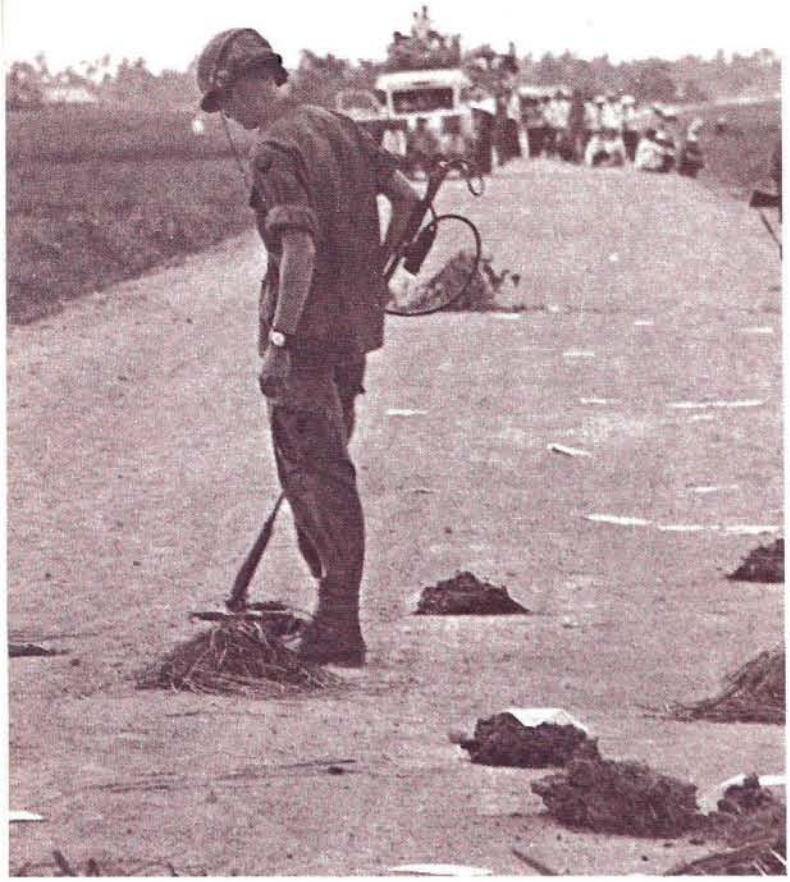
Evaluation of the emprical base established by HumRRO (August 1972) indicates the following for highly expert subjects: They relied on unaided means (visual or tactile) 80.6 percent of the time to detect mines. Use of a mine detector accounted for only 5.6 percent of the time. A very high number, 97.2 percent of the subjects, reported use of a "special feeling" (emotional reaction) which seemed to warn them of danger. Interestingly, subsequent detections or enemy contact confirmed the validity of the special feeling 65 percent of the time. While moving at the normal speed of their unit, over 80 percent felt confident or very confident of their ability to detect mines. Infantry subjects indicated that dogs (40 percent) or a small, light mine detector (27 percent) would be the best way to augment unaided means of detection. Significantly, they wanted dogs or detectors only as a supplement — not as a replacement for the unaided method of mine detection.

All subjects were requested to make recommendations or comments concerning mine detection. A high percentage felt that individuals with exceptional aptitude for mine detection could be identified. They recommended more realistic training be instituted. They felt that tracker-type training would be beneficial.

In late 1972, on request and contract by USAMERDC, HumRRO turned from its study of experienced personnel. A total of 104 combat naive individuals (recent AIT graduates) were investigated to develop, quantify and validate parameters involved in the human detection of mines. Results were identification and validation of human characteristics indicative of high aptitude for unaided detection of mines.

The conduct of this research was prefaced by extensive questioning and testing of the subjects to develop theoretical predictive measures. Predictive measures were preconceived to be grouped as follows: physical characteristics, personal history, personality characteristics and native aptitude.

The following factors were considered in detail. Visual acuity was tested. A personal history was taken with emphasis on prior countermine knowledge and level of civilian education. Personality characteristics were noted by formal testing of individual dogmatism, manifest anxiety, team orientation and stress resistance. Individual awareness factors or native aptitudes in the area



of visual stimulation/reaction were tested.

After the inventory of information was completed, the subjects were taken to a field site for proficiency testing. Prior to going through the test lanes sown with all types of mine and booby trap simulaters, the individuals were given a briefing. They were reminded of previous training received in AIT on detection procedures. Next, specific information on the devices and employment techniques used in the test lanes was given.

The specifics given were an approximation of the intelligence a soldier would likely receive prior to a combat operation. The subjects were then allowed to proceed individually down the lanes. They proceeded at their own speed. HumRRO observers evaluated the performance of each test subject.

Test result evaluation by HumRRO (May 1973) indicates that, "the highly proficient (combat naive) detector can be characterized in the following manner: During the test he spent more time and expended more effort; he graduated from high school (and) completed more civilian education; he was less dogmatic (more open-minded); finally, his visual acuity was better than that of less proficient detectors."

What conclusion can be drawn from the preceding? Man is the key to countermine warfare. Man in this context is not the operator of a sophisticated detection device. Unaided man has been and will continue to be the most efficient, cost effective mine detector in our inventory. With judicious application of recently acquired knowledge, new orientation in doctrine and training should be developed.

A recent change in doctrine fits nicely. Countermining effort has been a traditional responsibility of the Corps of Engineers. Revised doctrine now states that the combat arms as well as their supporting combat engineers must take deliberate countermine measures in the field.

What about the soldier? Individual soldiers should be identified early in their careers as possible mine detectors of high effectiveness using the HumRRO battery of tests as a basis.

Once the individual is identified, he should receive detailed, realistic training. The end result would be an individual with high detection proficiency who was not developed through a bloody trial and error process on an actual battlefield. This soldier should be awarded recognition in the form of a specific military occupational specialty (MOS). The MOS should be secondary in nature or be a suffix much like those awarded to airborne qualified personnel. He should be assigned a primary MOS in the combat or combat support arms. Developmental work should be initiated to specifically equip him for his duties. Possibilities are special vision devices, more compact detectors, lighter weapons, more use of dogs and better body armor.

It is not proposed that unaided man displace the other elements of countermine warfare, i.e., materiel and technique. It is proposed that his presence be optimized — that his role be upgraded from that of an equipment operator or visual observer endowed only with broadbrush training and that he be selected and trained through use of definitive criterion statements. In this way the historical edge of the enemy miner may be trimmed to an acceptable limit.

Captain Richard Kanda is a recent graduate of the Engineer Officer Advanced Course At Fort Belvoir, Virginia. Commissioned in the Army after graduation from the Colorado School of Mines in 1967, he has served both overseas and in the U. S. Captain Kanda was first assigned to the 24th Engineer Battalion, 4th Armored Division in Germany as a demolition platoon leader and as a company commander from 1967 to 1969. He also served in Vietnam later in 1969 and 1970 as a Company Commander with the 20th Engineer Battalion (Combat), and the 937th Engineer Group (Combat) as Assistant S3. A graduate of the Colorado School of Mines, he was an Instructor and Senior Instructor, Nuclear Weapons Employment Division, at the U. S. Army Field Artillery School Fort Sill, Oklahoma, from 1970 to 1973.

SOVIET RIVER CROSSING TACTICS

Captain Richard E. Ashby

The Russians are not at all inclined to look upon rivers as insurmountable barriers that limit a commander's freedom of action. On the contrary, they attach remarkably little importance to the difficulties that are involved in crossing rivers with troops and equipment during combat operations.

It would be fallacious to assume that this attitude is adopted only toward rivers with special characteristics that tend to facilitate crossing operations. This was demonstrated when the Russians crossed the flooded lower reaches of the Oder, a typically Central European river and on other occasions during the winter of 1941-42 and the fall of 1943.

The Russians never use a river as a phase line in offensive operations. Even if they are unable to carry the attack forward across the river, they immediately send forces ahead to assure the establishment of small bridgeheads for subsequent operations. By moving mobile troops rapidly forward, they endeavor to cross the river before the enemy has had a chance to bolster his defenses.

These tactics did not originate with the Russians. It has always been the aim of attacking forces to cross a river prior to or simultaneously with the defeated enemy troops, unless it has been preplanned to halt operations upon reaching the river.

The distinguishing feature of Russian tactics is the fact that as a result of their mass commitment of troops, they are in a position to launch attacks simultaneously on a wide front and to over-run all undefended areas. This technique enables them to quickly discover and swiftly cross any sectors that are not defended or are held by weak enemy troops.

Tactically speaking, the Russians are adept in all types of crossing operations that include infiltration to major offensives, moving forward of advance attachments, and large-scale nighttime crossings.

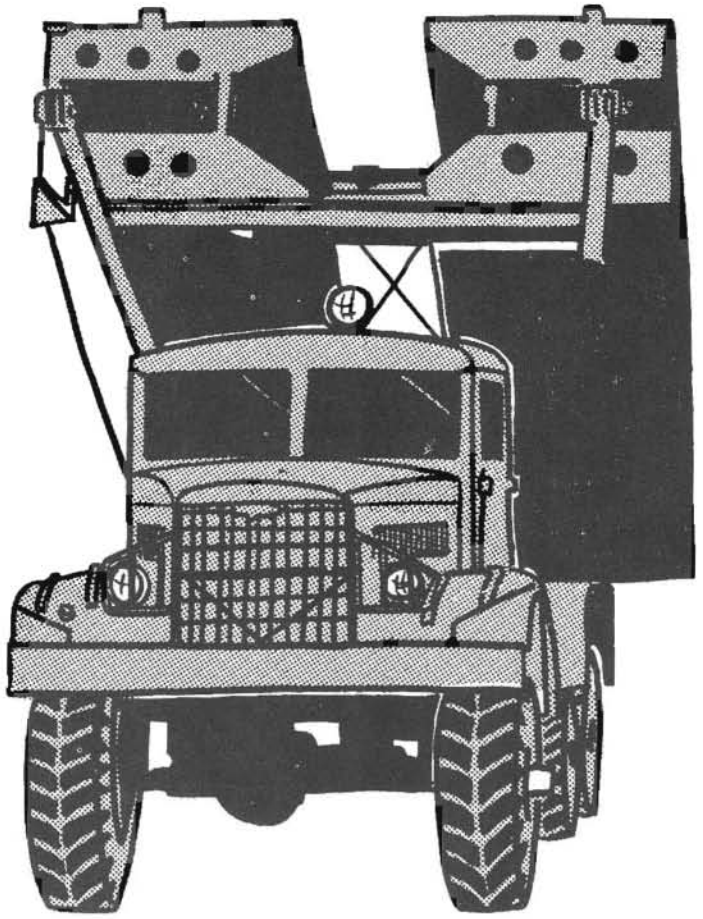
The Russians are no more deterred by difficult terrain and river conditions than by unfavorable weather and seasonal changes.

In World War II, the Russians did not employ any startling technical innovations in crossing large rivers. The devices they used were relatively primitive, but effective.

It is reasonable to assume, however, that the Russians have since perfected their crossing equipment to such an extent that they can cope with the problems presented by Central European Rivers.

Special attention should be called to the fact that the troops are resourceful and well-trained in crossing techniques.

All in all, it is imperative for defenders of a river line to remember that the Russians are able



to recognize and exploit. This evaluation of Russian river crossing capabilities was the result of a post-World War II study that received the full endorsement of Generaloberst A. D. Franz Halder, Chief of the German Army General Staff.

As a result of successful broad-front, river crossing operations during WWII, the Soviets have concentrated on the development of bridging equipment that would enhance this technique. Today, more than ever, it is vital that armored and mechanized infantry mobility be restricted as little as possible by terrain features. Therefore, the Soviets place emphasis on the co-development of armored and engineer equipment. This ensures that sophisticated and advanced engineer equipment is available to properly support their newer, armored and mechanized vehicles.

Soviet Engineer Tactical Bridging has emphasized three basic design principles: 1) speed of construction, 2) simplicity of design and, 3) minimal additional construction support.

With these concepts in mind, in 1961, the Soviets developed and introduced the Heavy Folding Ponton Bridge, PMP, into their engineer inventories.

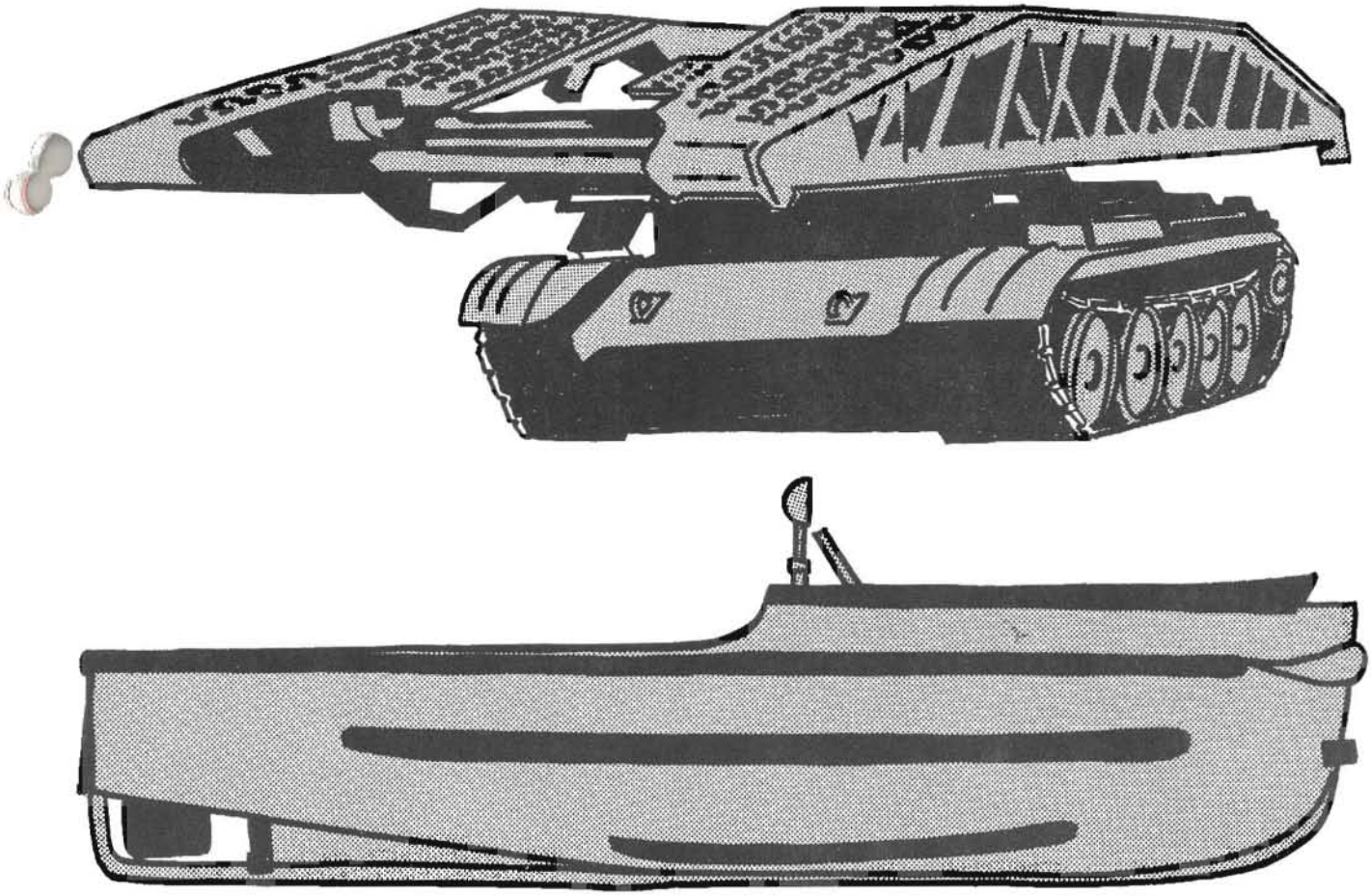
Designed to carry Class 60 loads, the PMP float bridge has a construction rate of 60 feet per minute and requires a construction crew of approximately 35 personnel. Consisting of 16 center pontons, two end or ramp pontons, and one anchor/repair truck, the PMP Set has a spanning capability of more than 320 feet. Each ponton is a self-contained, mechanically operated unit with the ponton superstructure serving as the roadway surface.

The KRAZ-214 Truck transports, launches, and retrieves the folding ponton.

To minimize the requirement for additional supporting construction equipment such as cranes, the Soviets developed the BMK-150 Power Boat with integral travel struts! These struts are folded along side after the boat is afloat.

The Bridge Erection Boat is used in conjunction with PMP bridging and rafting operations. Using a traveling arm connected to the AFT section, the BMK-150 is towed to the bridge site by a KRAZ-214 vehicle. Upon arrival, the truck backs up to the river's edge and pushes the boat out into the water. A crew member disconnects the traveling arm which releases the integral strut-locking devices. The wheels swing forward into storage wells and the boat is ready for operation.

While the U. S. has eliminated the need for a crane in bridge construction by developing a ribbon bridge. A crane or lifting vehicle is still required for our sectionalized bridge erection



oats. Perhaps we should consider developing a new bridge erection boat that would compliment our Ribbon Bridge set.

To provide Engineer support during the assault phase, the Soviets have developed and introduced the Tank-Launched Bridge MTU. This class 60 bridge span consists of two box-truss treadways mounted on and launched from the T-54 tank chassis.

The cantilever launching technique was specifically used to minimize the bridges exposure to enemy fire. In addition, the span is launched by a mechanical drive system rather than a hydraulical one. The primary short coming of this bridge is its limited spanning capability of only 40 feet. Therefore, the Soviets will probably develop a similar bridge with a greater spanning capability.

To improve their bridging versatility, the Soviets have developed and introduced into their Engineer Inventory the Heavy Truck-Mounted Scissors Bridge. This bridge consists of at least three (3), class 60, 30-foot spans mounted on a modified KRAZ-214 Truck. Using a mechanically driven launching arm and cable system, the span is raised to the verticle position. The cable system unfolds the bridge and begins to lower it into lace. While the bridge is being lowered, the adjustable trestles that are mounted beneath the span, are released and locked into position. When the lowering operation is completed, the span is married to a previously emplaced bridge section. The intergal trestles can be adjusted up to 10 feet in height. However this limitation could be overcome easily by cribbing beneath the footers.

With a construction crew of 12 personnel, this set can be erected over a 100-foot dry or wet gap within 45 minutes. To increase this spanning capability, two TMM Sets could be employed together.

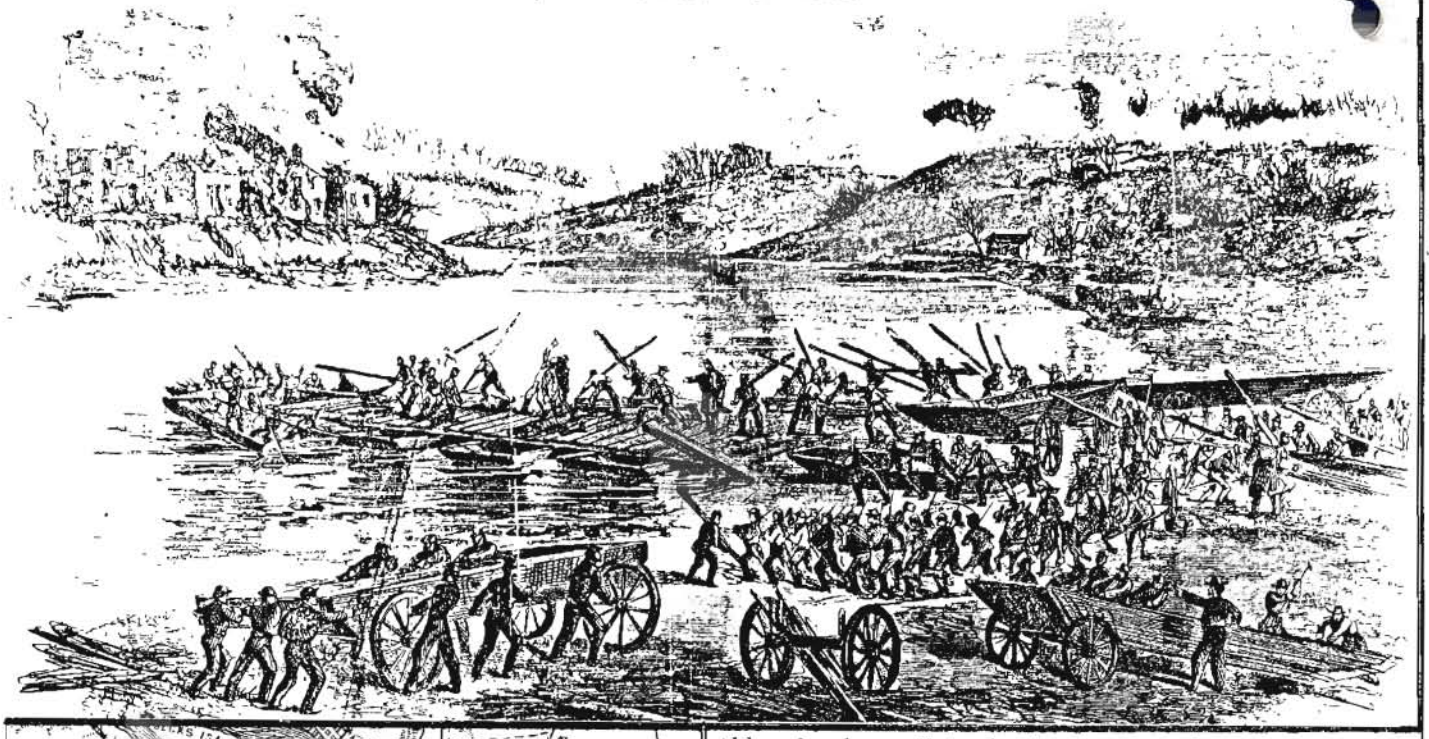
As you can see, the Soviet Army Engineer units are equipped with modern, sophisticated, tactical bridging to ensure that they can provide the necessary support to their armored and mechanized infantry units. They have had more than 10 years to gain the necessary experience to understand its capabilities and limitations. Therefore, the Soviet Engineer's capability cannot be passed over lightly.

With the modern concept of nuclear tactics and its emphasis on battlefield mobility the advantages of having this type of bridging equipment available is self evident.

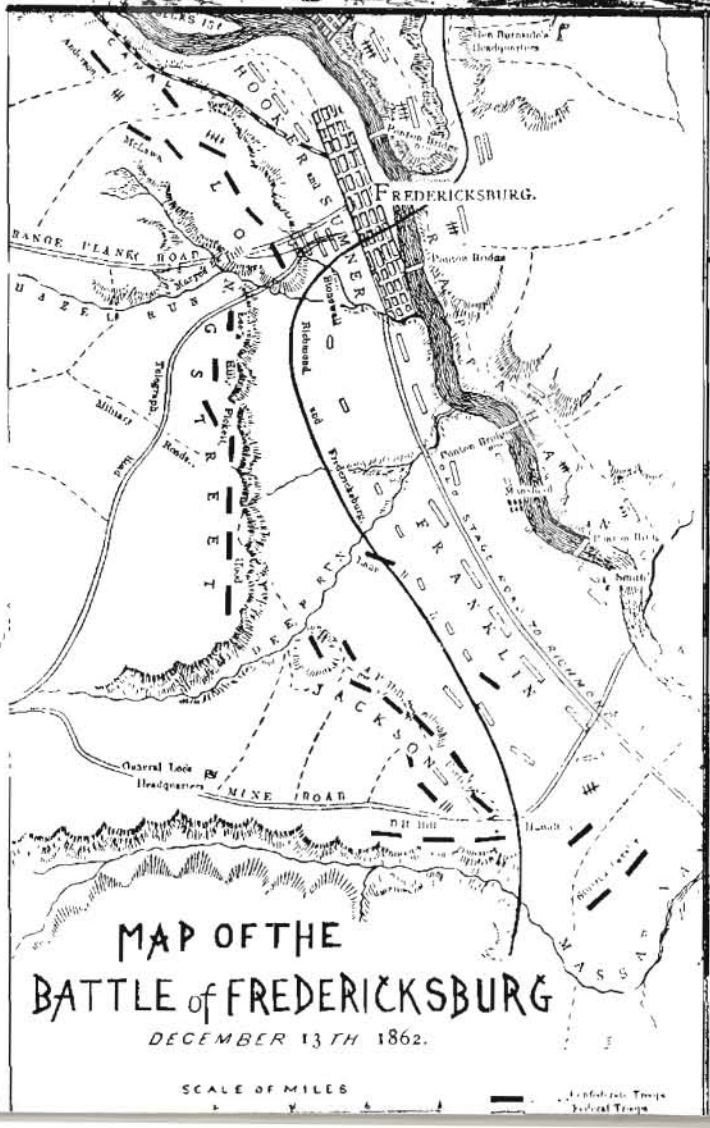
Captain Richard E. Ashby is a former graduate of the Engineer Officer Advanced Course at Fort Belvoir, Virginia.

IT WAS A GAL

Major Alfred H. McDonald



Although a heavy Union bombardment sets houses afire in the town of Fredericksburg, across the Rapahannock River, Confederate riflemen cling tenaciously to their positions and pour deadly volleys into the ranks of Federal engineering troops building a pontoon bridge to span the icy stream. After suffering many losses, Burnside's troops managed to complete the bridge. Volunteers drove the Confederates out so that mass crossings could be accomplished.



The Battle of Antietam (Sharpsburg), September 17, 1862, brought an unsuccessful end to the Confederate invasion of Maryland, and the Army of Northern Virginia retreated into Virginia to recuperate. The Union Army also was in need of reorganization, recruitment, and refitting and did not resume the offensive until the end of October.

In early November of 1862, the Army of the Potomac under General George B. McClellan was concentrated about Warrenton, within 20 miles of General Longstreet's corps at Culpepper, and still nearer the shortest road where General Jackson's corps could unite with Lonstreet. Jackson was at this time in the Shenandoah Valley near Winchester some 40 miles from Longstreet. McClellan planned to strike at once toward Culpepper, separate the wings of the Confederate Army and beat them in detail.

On November 7, before McClellan's plan materialized, he received an order from the President relieving him and appointing General Ambrose E. Burnside as commander. After Burnside had

LANT WORK!

taken formal command on the 9th, General Halleck, General-in-Chief, requested that he submit a plan of operations — that same evening Burnside forwarded his plan. He was going to give up the Orange and Alexandria Railway as his line of communications; make Aquia Creek his base for supplies; make the enemy believe he was going to attack Culpepper but instead move his whole force to Falmouth; cross the Rappahannock River and take Fredericksburg before the Confederate force could concentrate, and then continue to his objective — Richmond.

For this operation Burnside requested that a wagon train of subsistence stores, preceded by a train of pontons, "enough to span the Rappahannock with two tracks," be dispatched from Alexandria to Falmouth. He also requested that provisions and forage be sent to Aquia Creek.

Burnside's plan received Presidential approval on November 14. His first step was to reorganize the Army of the Potomac into three Grand Divisions and a Reserve Corps. Each Grand Division was made up of two Army Corps.

On the morning of the 15th, the Right Grand Division under General Sumner started for Falmouth and arrived there on the 17th. The other two Grand Division followed a day or two later. But the Army could not cross Rappahannock — there were no pontons!

One might rightly say that it was here that the Battle of Fredericksburg was lost; however, I am of the opinion that the battle was lost when Burnside made his request for pontons. He, like McClellan, had been under political pressure to move at once. Without requesting the bridging to be forwarded to him at Warrenton or either waiting to be sure that it was on its way to Falmouth, he started his move, a move entirely based on surprising the enemy and which required the ability to rapidly cross the Rappahannock. In other words, this was an operation wholely dependent upon the bridging capability of his engineers; a capability impossible without pontons.

The story of the pontons is an interesting one to investigate. In General Halleck's report, he wrote:

> *"It has been inferred from the testimony of General Burnside . . . that his plan of marching his whole army from Warrenton to Falmouth had been approved by the authorities in Washington, and that he expected, on his arrival there, to find supplies and pontoons . . . That plan was never approved . . .*
>
> *"It was alleged at the time that the loss of this battle resulted from neglect to order forward the pontoon trains from Washington. This order was telegraphed by me from Warrenton to Brigadier General Woodbury, then in Washington, on the 12th of November, and was promptly acted on by him. General Burnside had supposed that the pontoon train was then in Washington or Alexandria, while it was still on the Potomac, at Berlin and Harper's Ferry . . . General Burnside had only allowed time for transporting his pontoons from Alexandria . . . "*

General Burnside stated in his report that when his plan was submitted to Washington, General Halleck telegraphed him to meet for a conference on the 12th of November, at Warrenton. At this meeting, General Halleck agreed to give his attention to everything required for the operation; and "that he would at once order, by telegraph, the ponton trains spoken of in the plan, and upon his return to Washington, see that they were promptly forwarded." On the 14th Burnside received a telegram from General Halleck stating that the President had approved his plan.

On that same day, November 14, Burnside was notified that Captain Ira Spaulding had arrived in Washington with 36 pontons and 40 more were expected the next day. One ponton train was scheduled to start overland toward Falmouth on the 16th or 17th. Apparently, this notification was what prompted Burnside to start his move on the 15th from Warrenton to Falmouth.

On November 17, the same day that General Sumner arrived at Falmouth, Burnside was notified that the ponton train had not been able to leave Washington.

The following day, November 18, Burnside was notified that "Major Spaulding (apparently he had been promoted) has been delayed in obtaining harness, teamsters, and etc., for 270 new horses. He expects to leave tonight." However, the train did not get off until the afternoon of the 19th.

As Major Spaulding pushed his overland train, it commenced raining and the roads became very bad. Upon arriving at Occoquan Creek he decided to raft his boats toward Aquia Creek and send the animals overland. He arrived at Aquia Creek with the pontons on the 24th, teamed the wagons, and by nightfall of the 25th arrived at General Burnside's headquarters.

When General Sumner arrived at Falmouth (17th), Fredericksburg was weakly defended. General Lee was surprised at Burnside's move, but had considered it a possibility and previously

ordered the bridge from Aquia Creek destroyed. On November 18, Lee confirmed the movement of Burnside's entire army by a report from General Stuart, and ordered McLaw's division of Longstreet's corps to Fredericksburg. The next day the remainder of Longstreet's corps headed for Fredericksburg and the entire corps closed there on the 21st, while Burnside's Army watched from the north side of the river.

To the military student it is interesting to note how Lee combined his army for the battle and the fact that he had not originally intended to resist at Fredericksburg. In a letter to General Jackson on November 19, Lee wrote:

> *"It is certainly important to deceive the enemy as long as possible as to our position and intention, provided it is rendered certain that a junction can be made before a battle; and this latter point we must always keep in view as necessary to enable us to resist the large force now on the Rappahannock. As to the place where it may be necessary or best to fight, I cannot now state, as this must be determined by circumstances which may arise . . . Longstreet's corps is moving to Fredericksburg, opposite the place where Sumner's corps has arrived. As before stated, you can remain in the Valley as long as you see that your presence there cripples and embarrasses the general movement of the enemy, and yet leaves you free to unite with Longstreet for a battle . . . I shall wait to hear again from Stuart today and will then start for Fredericksburg if circumstances warrant."*

Had Burnside's plan succeeded in surprising Lee, the general would probably have made his main defense behind the North Anna. Because of Burnside's hesitation, Lee resolved to stop him on the north bank of the Rappahannock and cause him to make another change of base, or to stand fast until winter suspended his operations. I believe either of these events would have caused great dissatisfaction in the North, as well as a retreat.

In consolidating the Confederate army, Lee had given Jackson the extreme limits of discretion; not ordering him to join Longstreet until November 27. Jackson displayed, once again, his dependability and swift movement by joining Longstreet on the 30th, while Burnside still hesitated. At this point, the Army of the Potomac, containing approximately 122,000 men, faced Lee's army of 78,000 Confederates over a river 400 feet in width.

As previously mentioned, the pontons had arrived on November 25, but Burnside seeing his surprise plan defeated, hesitated and searched for another place to cross. He had to do something as the press and political pressure demanded action. He figured he must force a crossing at Fredericksburg, or, by maneuvering, turn Lee's position and cross the river elsewhere. He made preparations, on December 1, for a turning movement by way of Skinker's Neck (12 miles south of Fredericksburg), but the appearance of D. H. Hill's division on the southside of the river caused him to abandon this project. Burnside finally decided to cross at Fredericksburg in front of Lee. He reasoned that Lee's line was too far away from the river to make any effective resistance to the actual passage of the river and that the real fight would be made after his army got across. Another factor in this decision seems to have been misinformation, some of which was obtained by balloon observation, whereby Burnside thought Lee's army was stretched over a long distance, guarding the river crossings below Fredericksburg.

Burnside's plan of crossing was to span the river with five ponton bridges, three opposite Fredericksburg, and two just below the mouth of Deep Run. To accomplish this mission, two engineer organizations were available to Burnside: the Engineer Battalion, a Regular Army unit commanded by Lieutenant Charles E. Cross, and the Volunteer Engineer Brigade commanded by Brigadier General Daniel P. Woodbury. (General Woodbury was also the Army Chief of Engineers having served in that capacity since 1836. He would continue to serve as the Chief until he was killed near the end of the war in 1864). The Volunteer Brigade consisted of two regiments, the 15th and 50th New York. The Engineer Battalion (Regulars) and detachments of the 15th New York Regiment, under Major James A. Magruder, were directed to construct the two bridges downstream with the upper three bridges to be thrown by detachments of the 50th New York Regiment, under Major Ira Spauling.

Ponton bridges are built by placing decking (balk to engineers) between floating pontons (boats). The balk spans from ponton to ponton and is secured to the pontons by lashings. The pontons used during the Civil War were simple wooden row boats transported by flat-bed wagons. Balk was undressed lumber two inches or greater in thickness. The pontons were launched and floated into position and the balk was laid. The bridge was built by consecutive float from near shore to far shore and anchors were used on every second or third ponton to hold the bridge in place.

Construction of the bridges was not an easy task, particularly the three bridges opposite the town. Lee's artillery was placed on the hills above and to the rear of Fredericksburg and could not sweep the upper bridging sites without damaging the town. However, General Barksdale's Mississippi Brigade had been positioned in houses, cellars, and rifle pits in front of the three crossing sites. Although the Rappahannock River was only 400 feet wide and the Confederate artillery could not fire through the town, Barksdale's troops would make the crossings costly. General Hunt, Burnside's Chief of Artillery, massed 147 guns on the high bluffs above the Rappahannock to support the crossings and a regiment of infantry was assigned to each of the bridge detachments as a security force.

During the early cold hours of December 11, the operation commenced. By 3 a.m., bridge trains were in position along the east bank of the river. At 6 a.m., it looked as though the upper crossings would be a success. Major Spauling and his 50th Engineers had two of the bridges two-thirds of the way across and the other one-fourth of the way. Suddenly, the Confederates, from their well-concealed positions, opened up with terrific fire upon the engineers who were working approximately 80 feet from the water's edge.

Burnside covering forces were ineffective due to the range of the infantry fire and a thick fog that made targets difficult for the artillery. Although several barrages were laid by the artillery batteries, the Confederates would emerge from cellars and trenches after each barrage and pick off the engineers as they resumed their work. General Barksdale told one of his messengers to "tell General Lee that if he wants a bridge of dead Yankees I can furnish him with one." Until Barksdale's men could be driven off, the work would remain at a standstill.

Work on the lower bridges at the mouth of Deep Run had been hampered by the cold and ice, but by 7 a.m. when the bridges were nearing the far shore, the Confederates opened fire. Lieu-

tenant Cross lost three men — one wounded and two taken prisoner. As Major Magruder's men were laying the balk in the last bay of their bridge, they also were attacked. This resulted in six casualties and damage to several pontons. Then Hunt's artillery opened fire on the Confederates and repelled further attacks. By noon, both bridges were completed with neither the Regular battalion nor the 15th New York receiving serious opposition.

At this time, with the upper bridges still at a standstill and Major Spauling's engineers suffering 50 casualties, Burnside called a staff meeting with Woodbury and Hunt. At this meeting, it was decided to ferry infantry across in the ponton boats to pry the Confederates loose from their strong holds. The engineers ferried 120 infantrymen of the 7th Michigan across the river, followed by 100 men of the 89th New York. As the infantrymen landed ashore, a scrapping fight took place that forced the Confederates to fall back through the town. The bridges were then quickly finished by the engineers, and that evening Burnside's Grand Divisions marched across.

On the morning of December 12, Fredericksburg was occupied and by nightfall the Army of the Potomac was ready for battle. Burnside attacked Lee the next day but failed to dislodge him. After several futile charges against Lee's position on Marye Heights and 12,600 casualties, Burnside ordered his troops to recross the bridges on the 11th. When they had crossed, the engineers dismantled the bridges.

Fredericksburg had been a testing ground for the combat engineers. The mission was accomplished in spite of cold weather, ice, and enemy fire. The casuality rate had been relatively high, particularly in Major Spauling's unit. In the opinion of several of the high ranking officers, the 50th Engineers had not stood up to the Confederate fire as they should. Even General Woodbury was displeased at first but after he visited the far shore and had a better understanding of what the situation, he wrote:

> *"I was greatly mortified in the morning to find that the pontoniers under my command would not continue at work until actually shot down . . . Perhaps I was unreasonable. I found a loop-holed blockhouse, uninjured by our artillery, directly opposite our upper bridges, and only a few yards from their southern abutment. I also found in the neighborhood a rifle-pit behind a stone wall, some 200 feet long, and cellars inclosed by heavy walls, where the enemy could load and fire in almost perfect safety. There were many other secure shelters . . . It is generally considered a brave feat to cross a bridge of any length under fire although the time of danger may not last more than a minute or two. How much more difficult to build a bridge exposed for hours to the same murderous fire, the danger increasing as the bridge is extended."*

Burnside's report of the battle included the following statement about his engineers: "No more difficult feat has been performed during the War than the throwing of these bridges in the face of the enemy by these brave men. It was a gallant work."

In my opinion, Burnside's decision to send infantry across in ponton boats to secure the far shore has lead to present military river crossing doctrine. No bridging effort could now be attempted as Burnside attempted it in the Civil War. A small unit of well concealed men with modern weapons could prevent any amount of men from building any type of bridge across a 400 foot gap in this day and time, if attempted as Burnside did initially.

Present day river crossings are conducted in two phases —

- Infantrymen are ferried across in pneumatic assault boats by engineers to secure a bridgehead. It is hoped that the first wave will surprise and catch the enemy off guard. However, this is not always possible. Once the infantrymen have secured the bridgehead, the engineers begin building footbridges to allow more infantrymen to deploy across. Small vehicle rafts also are used to carry support vehicles and ammunition across the water.
- As the infantry continues the fight and expands the bridgehead, the engineers begin the second phase — that of constructing the large ponton bridges capable of carrying the heaviest divisional loads.

The Combat Engineer of today is the same soldier as his counterpart at Fredericksburg. The type of bridging equipment has changed but he still works with pontons and balk and must expose himself to fire.

Combat Engineers are some of the U. S. Army best soldiers. They performed many courageous feats throughout the Civil War and have continued to perform them throughout the years. Of many tasks that they have performed, words like General Burnside's have been said again and again — "IT WAS A GALLANT WORK."

Major Alfred H. McDonald has served in a number of engineer positions in this country and overseas. He was with the 70th Engineer Battalion (Combat), the Second Republic of Korea Army, 9th Log Command (Thailand), Electronics and Special Developments Branch, U. S. Army Combat Developments Command Infantry Agency, Headquarters, Long Binh Post, and the 4th Infantry Division. He has attended the Engineer Officers Career Course and holds a Masters Degree in civil engineering from Texas A&M University.

Guardians of the Past

CPT John R. Mullin

The Cathedral, the Danube and Albert Einstein are the features and characters that come to mind when speaking about Ulm and Neu Ulm, Bavaria.

Yet there is a unique feature in these twin cities that is of monumental scale and of which U. S. Army Engineers serving there are virtually unaware.

This is the group of historic fortresses that ring the two cities. From their construction between 1841 and 1859 and in the present day engineers, these forts have played an important role in the life of the two communities.

They have served as garrisons for the Bavarians and Germans and prison camps housing French and Russians. The forts have also served as detention camps for ex-Nazis, centers for the socially deprived, homes for the modern Bundeswehr and havens for "hippies."

One of these fortresses, Ludwigsvorveste, is at Wiley Barracks which is used for ammunition storage. To the privates who guard this site, the fortress means a night of coldness, weariness and boredom. But to the historian of military arcitecture, the site is of great significance because of its design, history and perfect structural condition.

In late 1969 the German Government proposed a highway plan which would have partially destroyed the fort at Wiley Barracks. The author in his capacity as a community planner for HQ-USAENGCOMEUR was responsible for developing an alternate scheme which would allow for rehabilitation of the fort. It was accepted.

There are several legends and stories concerning this particular fort and the entire system of

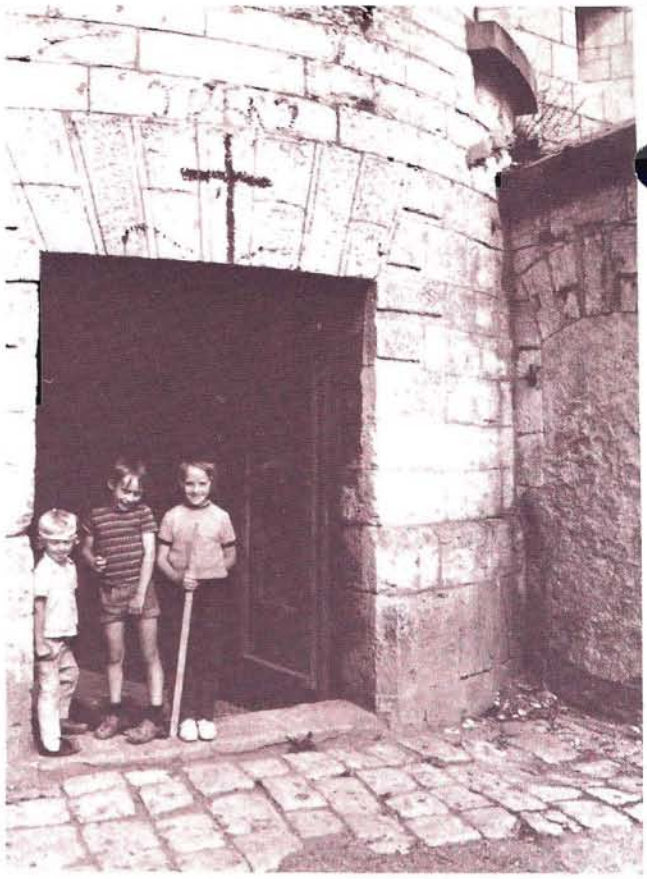
forts in general. Americans who have followed the Bavarians, French, Prussians and Germans as occupants of "Ludwigsvorfeste," have the impression that the fort is Napoleonic. "Yep," said a master sergeant, "Old Napoleon came right through here on his way to the Battle of Ulm against General Mack and the Austrians."

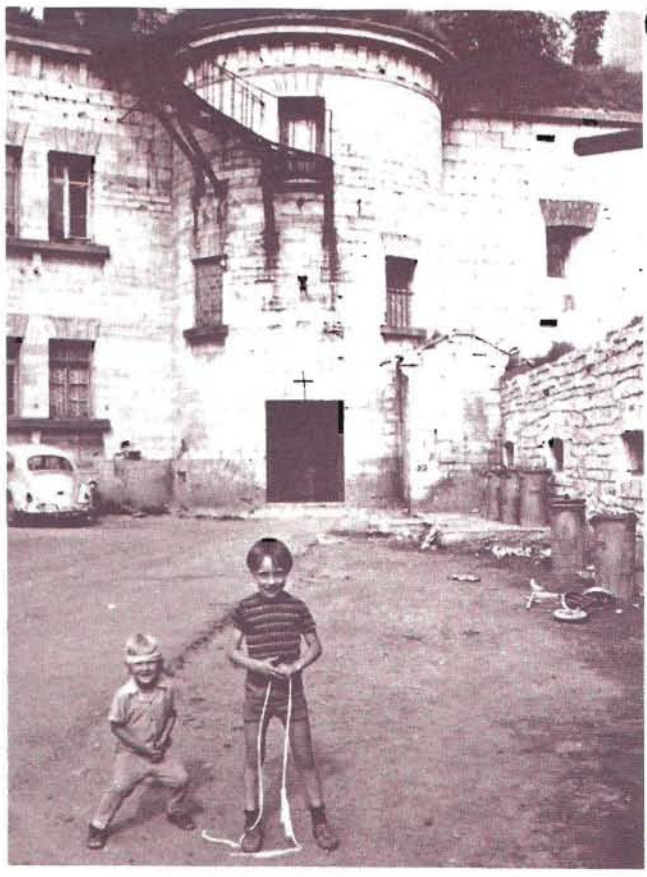
Actually, the fort was built by Ludwig I of Bavaria in 1848 as part of a common defense agreement among the German states. The agreement was aimed at thwarting a possible future French offensive against southern Germany. The German strategists felt that all attacks would be aimed at Munich and the easiest approach to the city lay between Karlsruhe and Strasbourg toward Ulm, and the defenses of Ulm and New Ulm grew out of this planning.

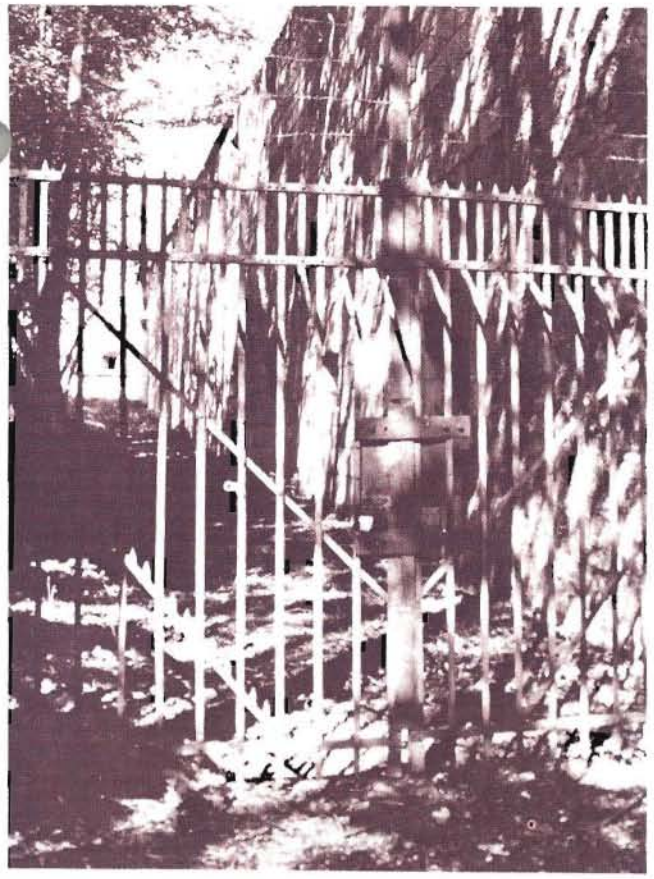
Miles of tunnels run beneath these forts and they are the source of several legends. Rumors circulate about the "booby trapping" that the Germans supposedly arranged during the last days of World War II. But an investigation of five miles of tunnel uncovered no evidence that this was a fact. Nevertheless, the tunnels are not the safest place in the world. The gate guard at Wiley commented, "There ain't no way I would volunteer to go down there." The tunnels are crumbling in some parts and maze-like in others.

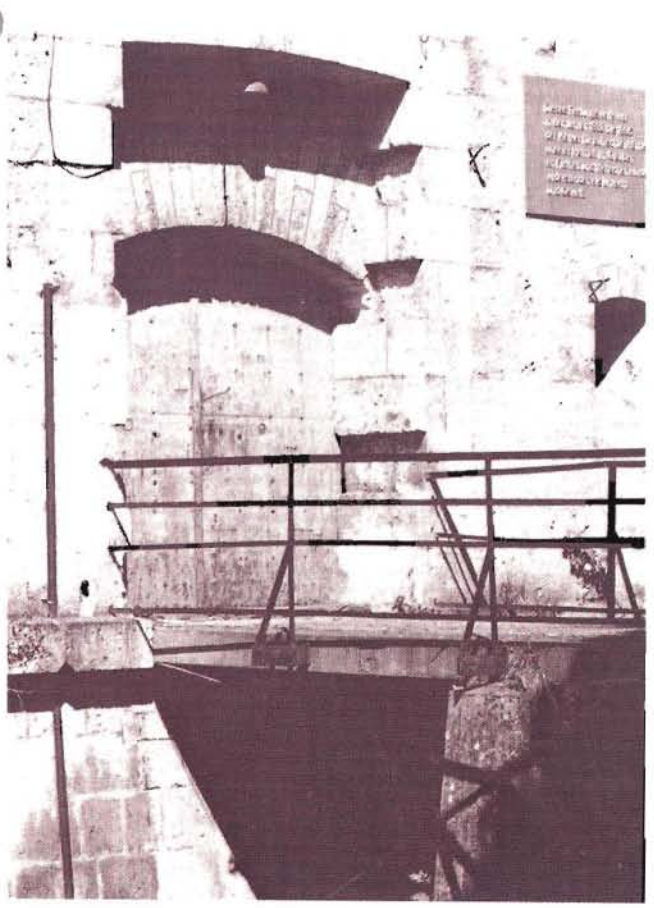
Other rumors concern the extent and design of the passageways. Most of the German community believes that they were interconnected at one time or another. Since the aerial bombardment of the war caused many of the tunnels to collapse and plans of the complex are incomplete, proof is hard to come by. The Bundeswehr post engineer at Fort Wilhelmsberg, one of the nine original forts, insists they were connected. Herr Helmut Pflueger, the city historian and expert on fortifications, feels this was impossible because of the sharp differences in land forms at relatively short distances. These tunnels are so wide in some parts that a platoon could march en masse without difficulty.

Herr Pflueger, based on 25 years of research in the area, suggests that the tunnels were to have been used by engineer sapper troops to set explosive charges under the advancing enemy. The massive tunnels were constructed from the center of the fort in a star-shaped pattern 100 meters into the fields of fire beyond the moats. During the periods when a battle was about to begin, the sappers would be sent into the tunnels to listen. When they could hear the enemy, a new tunnel, perpendicular to the main tunnel, would be dug about 10 yards deep. After the charge was set, they fled as far as possible, for with the problems of timing charges then, the risk of injury was quite high. Then too, you could never be sure









that the enemy might not be countermining your own tunnel.

These tunnels extend for miles under the forts. Some are filled with bats and vermin. In the deepest tunnel, stalactites are growing on the ceiling. On the same level as the stalactites, a room carved out of rock was found with a CARE package dated 1947, evidently left by displaced persons who used these tunnels for shelter.

Of the nine forts, Wiley Barracks is in the best condition, while others, including the Illir Kanal Fort and Fort Albeck, have been allowed to deteriorate. Fort Albeck probably has the most interesting heritage of the complex. Built on the site of an earthen fort occupied by the Austrians during the battle against Napoleon, it was partially destroyed by Allied airpower in World War II. After the war, it served as a detention camp for Nazi officials, a home for displaced persons, a home for the socially deprived and as a safe harbor for the "down and out." Coupled with the still visible war damages, the drifters, hippies, bums and alcoholics give this fort a surreal aura.

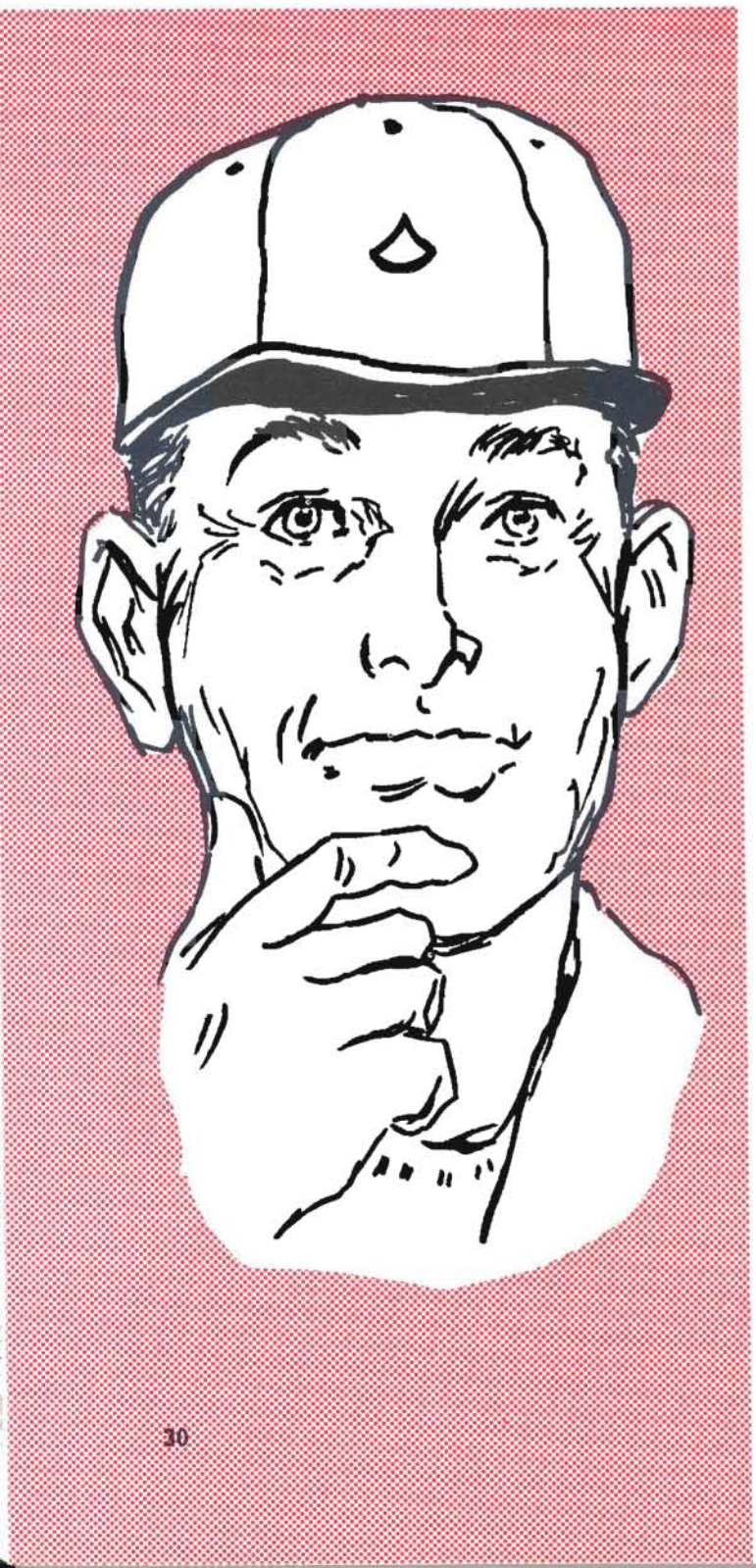
What a story one of these forts could tell of the history of Europe in the last 170 years. If we can give one of them, Fort Albeck, a voice for a moment . . . "I am Albeck. Built on the grave of another fort that was razed by Napoleon, I have protected, destroyed, served as a haven and a hell.

"I have commanded this hill against Frenchmen, Italians, Prussians, Austrians, Englishmen and Americans . . . occupy me and I will serve. My walls have muzzled the outspoken, aided the oppressed, sheltered the poor, protected my occupants and forced my enemies to go elsewhere.

"I, the previous fort on this site, and my brother forts have served Napoleon, Ludwig, Hindenburg, Kaiser Wilhelm, Bismark, Hitler, Patton Adenauer and Brandt. I, created for death, have lived. I am happy now for I am more needed than ever. I still hear crying, but now it is crying born of relief and joy, for today I house those who have no other place to go. I am their new beginning."

Captain John R. Mullin is a professional city planner who served as chief of master planning at HQUSAENGCOMEUR from June 1970 through July 1972. During that period he researched the 14 post-Napoleonic Forts that surround Ulm, Bavaria and found they have been at least peripherally involved in wars from Napoleon through the Cold War. He left active duty as a captain in December, 1972 and is now both in the Reserves in Buffalo, New York and a Ph.D. candidate at the University of Waterloo, Ontario, Canada

TROOP TRAINING



Captain Leonard J. Jagoda, Jr.

Recent legislation has introduced new laws and government agencies to protect our environment. These new tools will help curb the disastrous effects of poor management and help protect our country from being destroyed by its own enthusiasm. But for many areas of our country these efforts have come too late. An example of this is the effects of strip mining on our environment. As of 1965 the United States Bureau of Mines estimated that surface mining had used 3.2 million acres of land. At least ninety per cent of this acreage had been mined using the 'strip-mine' method. Two-thirds of this acreage requires reclamation. These 2.1 million acres are not only unsightly but an even more alarming consequence has been imposed on our critical water resources. Many of these abandoned mines leave iron sulfide exposed. When these sulfides mix with water they form sulfuric acid, which drains into our streams. The hazardous affects on these streams are not 'immediate' in terms of time or location. The tributaries which have not as yet, will eventually disturb our larger water sheds.

The mining industry has, in certain locations, reclaimed some of the land. However, even if they reclaim all the acreage they are presently using, what about the 'pre-law' land? "Substitution" laws indicate some stability but certainly not progress!

This situation appears on the surface to be beyond hope, but it may be an opportunity for Corps of Engineers troops to receive some truly meaningful training of significant value not only to the Ecological State-of-the-Union', and to the U. S. Army, but to the Corps of Engineers in particular.

The training of heavy equipment operators requires a great deal of experience if the operator is to become capable of successfully accomplishing his required tasks in combat. Current Military Occupational Skills (MOS) training teaches the individual soldier the basic required skills, but experience is still lacking and necessary if the operator is to meet required Corps of Engineers standards. This 'experience' frequently referred to

as "stick-time" must come from our unit training.

Unit training seldom provides the number and magnitude of worthwhile earthmoving projects due to restrictions limiting the use of military construction units in CONUS. The next logical question that arises is: Can the Corps of Engineers use engineer troop units for land reclamation projects, allowing the projects to serve as teaching vehicles? This question stimulates a series of questions, some of which are: Does the Corps of Engineers want to get involved in land reclamation? Can selected land reclamation projects provide an adequate teaching vehicle? Which policies, laws, and regulations need be investigated? What are the cost considerations? What coordination problems would be created? What are the techniques being used by industry in this field? Certainly there are many advantages and disadvantages and each of them would require a detailed investigation, but let us speculate on some of the advantages and identify one technique in land reclamation.

From the cost aspect it may be worthy to note who is paying for land reclamation.

> A more popular approach currently being considered by some companies is that reclamation costs be borne as a portion of their public relations and advertising costs.

A second interesting item is that on April 10th, 1972 the state of Ohio passed a severance tax on coal. The tax charges four cents per ton, and the monies are to be applied toward the reclamation of 'pre-law' surface mined land.

Clearly the most significant expenses for land reclamation are the wages of the equipment operators and the costs of the necessary equipment. On the other hand the MOS trained operator/soldiers will be paid whether they are operating their equipment or not.

Would the state and federal governments agree to use federal troops with funding assistence from appropriate state taxes for land reclamation?

One technique used for land reclamation could influence the cost and possibly provide another ecological benefit. This method makes use of fly ash, an industrial waste, to neutralize acidic surface mined areas.

> Experiments in reclaiming acidic surface-mined coal lands with raw fly ash were conducted over a three-year period by the Bureau of Mines at two sites in Northern West Virginia. Plots at both sites were treated with varying tonnages of fly ash from three area power plants and were planted with a variety of grasses, legumes, trees and shrubs. The greatest promise for growth under harsh soil conditions were shown by Kentucky 31 fescue, rye and red top grasses and bird's foot trefoil, a legume. The fly ash was alkaline by nature and as a result tended to neutralize the acidic soil which was treated. The fly ash also improved the texture of the soil and improved the available water of the resulting mixture.
>
> The experiments demonstrated the feasibility of disposing of large quantities of the fly ash on surface mine spoil to reclaim these areas. Gross yields on this reclaimed land equalled or exceeded the average values for the state of West Virginia.

The use of the land after reclamation would indicate the agencies that need be involved during the planning phases. Some of the concerned agencies might be the local chapters of the: Chamber of Commerce, Fish and Game and/or Wildlife Commission, Forestry Service, Future Farmers of America, Boy Scouts, and Community Governments. By the nature of their involvement, these agencies could influence the impact of this type of undertaking on society, and perhaps allow the Army, specifically the Corps of Engineers, to reflect the favorable image that has been so elusive in this decade. Additionally the Corps of Engineers might be able to influence communities to use appropriate sites as sanitary land fills, if the Corps were granted final site selection approval authority.

Projects of this nature would show the Corps of Engineers "active" in conserving our environment and fulfilling the necessary development of combat ready forces in a peace time situation. Training in this mode could be a vehicle to fulfill even other goals as this endorser suggests.

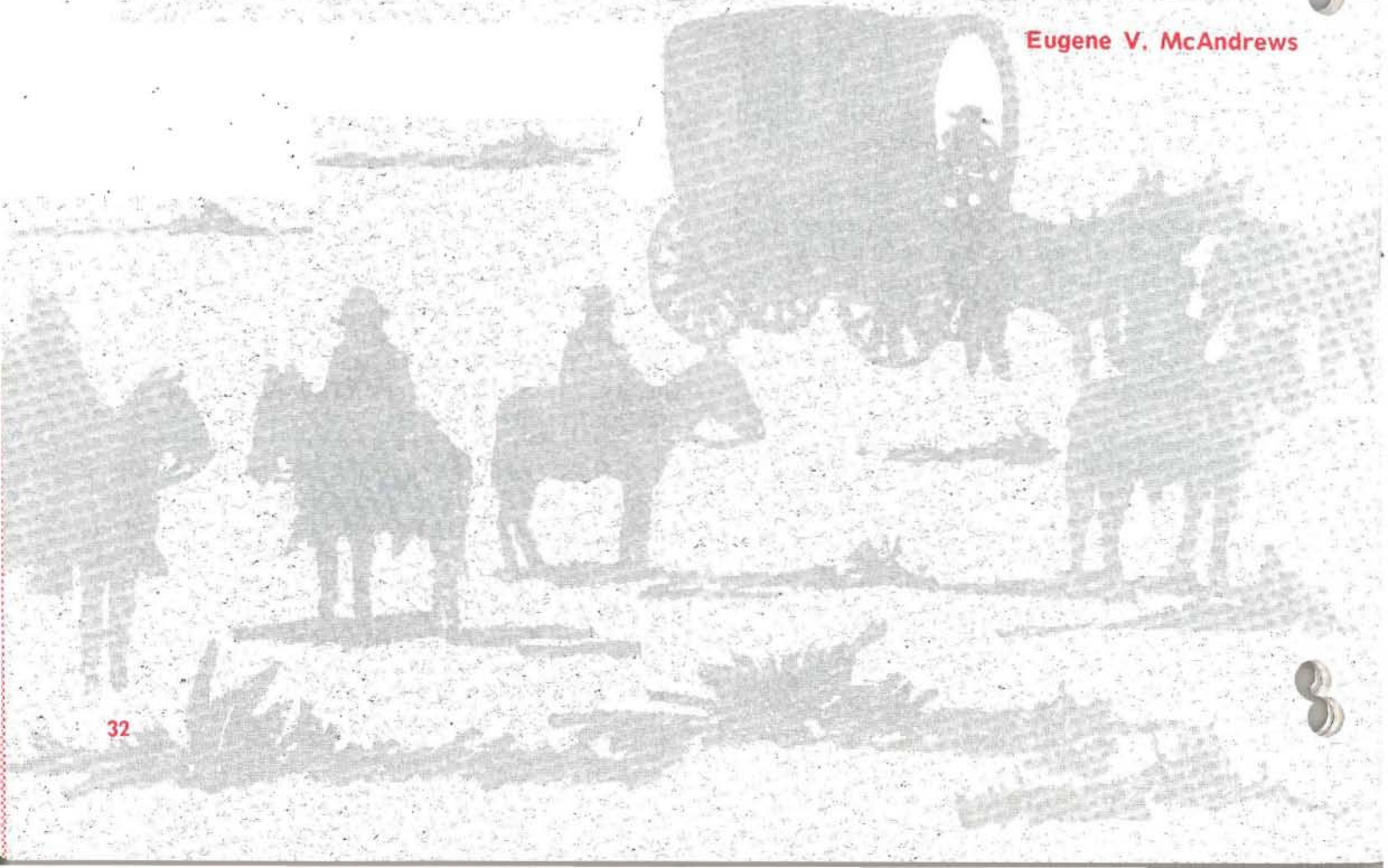
> If our volunteer Army Concept is to be a success we must initiate programs that will make service life more attractive and serve to enhance the Armies image. This program is among other things, an attempt to difuse the anti-military feeling that seems to have permeated our society. This anti-military feeling has served to reduce reenlistments, morale, and overall, military proficiency. One major problem that everyone is concerned with is the environment. This program certainly can be considered an environmental endeavor and as such would give a great deal of meaning to the young men working on these projects. The realistic training value would be tremendous, and reenlistments might certainly skyrocket, at least in the concerned units.

This is the type of training that should be welcomed with enthusiasm. In the words of L. Edwin Coate, P.E., White House Fellow, Exectuve Office of the President, Council on Environmental Quality, "If Engineers are to stay relevant we must get involved."

Captain Leonard J. Jagoda, who only recently completed the Engineer Officer Advanced Course, USAES, Fort Belvoir, Virginia, is a former instructor in demolitions at the Infantry School, Fort Benning, Georgia. He served in Vietnam with the 34th Engineers (Construction) and the 26th Engineers, 23rd Infantry Division (AMERICAL). The captain is a 1968 graduate of the Engineer Officer Candidate School program at Fort Belvoir.

AN ENGINEER IN THE BLACK HILLS

Eugene V. McAndrews



Captain William Ludlow, chief engineer officer for the Department of the Dakotas from 1872-1876, was skeptical about what others labeled "Custer's Luck." Ludlow, the second son of General William Ludlow's six children, was an 1864 West Point graduate who in only one year of fighting with Sherman in the South attained the rank of brevet lieutenant-colonel. His frontier assignment was the result of Generals Alfred Terry's and Custer's request for trained Army engineers to assist in defeating the Plains Indians. Engineers were needed to build forts, determine exact map positions, and overcome engineering feats posed by the rugged frontier.

Ludlow served as chief engineer on Custer's famous Black Hills Expedition, recording his own views on the landscape, the Indians, and Indian policy. He also later explored and charted parts of Yellowstone National Park, urging that it be protected from frontier folk who ravaged its natural wonders. In 1874, he suggested that forts in Indian country would deter the hostiles. These forts did not become important until after Custer's defeat at the Little Big Horn in June 1876.

Later in his career, Ludlow served as Military Attache in London, as Chairman of the 1895 Nicaragua Canal Board, and as Chief Engineer for the District of Columbia. He earned a brevet star and line command during the Spanish American War and became Military Governor of Havana. On January 21, 1900, he received a brigadier general's commission in the Regular Army. After formulating plans for creation of a General Staff, he left for the Philippine Islands following the start of the insurrection against U. S. rule and while there became seriously ill. He died on August 30, 1901.

His journal of Custer's 1874 Black Hills Expedition provides living descriptions of the Plains environment and its changing moods. It presents many of the frontier's dangers and portrays Ludlow as a pensive man not given to rash judgments. Ludlow felt the U. S. was needlessly pushing the Indians into a war. He felt that miners had not discovered quantities of gold in the Black Hills as they claimed — causing the fortune-seekers' stampede into lands the U. S. had granted the Sioux by treaty. The journal presents, in essence, an engineer's view of the frontier, U. S. frontier policy and its ramifications, and military engineering. The Editor.

Brigadier General William Ludlow

Ludlow's Journal follows —

Orders: "Captain William Ludlow, chief engineer of the department, will report to Lieutenant-Colonel Custer as Engineer Officer of the expedition. He will be accompanied by his civil assistant and three enlisted men of the Engineer Battalion."

July 2 — The immense reservation secured to the various bands of Sioux, now the most numerous and warlike of the northern tribes, by treaty of April 29, 1868, lies between the one hundredth and fourth meridian of longitude and the Missouri River.

This immense tract, inclosing nearly 43,000 square miles, the greater portion of which, however, is bare and often arid prairie, destitute of every attraction for the settler, and only capable of supporting a scanty population of hunters, has for its choicest and most valuable portion the Black Hills, which lie on its western border. All reports agreed as describing this as a mountainous, heavily-timbered tract, abounding in game, and containing within its unexplored interior an open, fertile, and well-watered region.

In case, at any future time, complications with the Sioux or the advancing needs of bordering civilization should make it necessary to establish military posts upon this Indian reservation, indications all pointed to the Black Hills as the suitable point . . .

It was therefore considered desirable to gain positive information . . .

Our personnel consisted of 10 companies of the Cavalry, one each of the 20th and 17th Infantry, a detachment of Indian scouts, together with the necessary guides, interpreters and teamsters. There was a total of about 1,000 men. The wagon train consisted of about 110 wagons and ambulances and the artillery had but three Gatlings and a 3-inch rifle.

For surveying purposes my detachment of six engineer soldiers was employed. The two sergeants, John Becker and George Wilson, each with one man as an assistant, kept separate trails, with prismatic compass and odometer — one with an odometer-cart, a two-wheeled vehicle specially constructed for the purpose; the other in an ambulance. Two odometers were read on each vehicle, and the compass-notes were kept as full as possible. Two chronometers were carried by the fifth man in a basket while a record of thermometer and aneroid barometer readings were kept by the sixth man during the day.

The additional instruments were a small Wurdermann transit, No. 94, and a Spencer, Browning & Co. sextant, No. 6536. The general topography during the day was taken as thoroughly as possible . . . and night observations were made whenever practical. The positions of all but 10 of the camps were astronomically determined.

The direct course to Bear Butte, a well-known point north of the Black Hills, is south 391/2° west. The air-line distance is 202 miles. As it was known the intervening country was dry and woodless, General Custer considered that his people would find a better road by inclining westward toward the divide east of the Little Missouri and then turning south, than by pursuing the straight course. Prairie travel resembles travel by sea, which indeed the landscape not unfrequently suggests. With the compass as the guide, the direct course is not always the best, and the probabilities of finding wood, water, and grass, and a good road, compare with those of obtaining favorable and moderate winds and smooth sea.

The Dakota prairies have often described, but their general characteristics may be briefly stated. It is a rolling and at times a hilly country, destitute of wood, except small quantities in the eroded valleys of streams covered with short grass. The horizon is bounded everywhere by some more dominating elevations which constitute the landmarks for the traveler and are called buttes.

The summer sun shines from a generally cloudy sky and the purity of the air gives its rays great power. And the thermometer frequently rises above 100° in the shade. Water is scarce, and almost infrequently alkaline, even in running streams, from the presence of a salt which forms a component of the clay-like soil. The rivers are small streams of great comparative length, which, from absorption and evaporation, shrink in their downward course, and are frequently dry at the mouth while flowing freely a 100 or so miles above.

The whole country was once ranged over by enormous herds of buffalo, whose trails are everywhere visible, but which are now seldom or never found east of the Little Missouri. The only game animals inhabiting the vast waste are antelopes, numbers of which have been seen during every day's march. The grasshopper, having proved himself to be one of the most serious obstacles to the future successful colonization of the country, is worth brief mention.

Previous to the departure of the expedition . . . the grasshoppers were very numerous. I counted 25 one morning on what I judged to be an average square foot of ground. A brief calculation at that rate would add out to over a million to the acre. As they are often much more numerous than then observed, and are exceedingly rapacious, their capacity for destruction to living vegetation may be imagined.

In descending through the slanting rays of the sun, grasshoppers resemble a fall of huge snowflakes. In one of our camps there must have been a hundred to the square foot. They were crowded as thickly as they could stand upon the ground, and every blade of grass bore several.

July 3 — The course pursued by General Custer was successfully pursued.

July 10 — The . . . march was still west, and a little north, up the valley, in which we were camped. The grasshoppers were in immense numbers during these two days.

July 17 — During the night heavy clouds and lightning appeared, and, toward morning, a severe wind-storm routed us from sleep and covered us with sand.

July 19 — The command remained in camp. The distance marched from Lincoln was 292 miles, an average of 18 and a quarter miles per day. Heavy rain fell until 4 p.m., and the huge camp-fires were a luxury all day.

July 20 — The first day's journey was made into the hills. The temperature was delightful; the air laden with sweet wild odors; the grass knee-deep and exceedingly luxuriant and fresh; while wild cherries, blueberries, and gooseberries abounded, as well as many varieties of flowers.

July 22 — The course led southward up the Redwater valley [sic], which is from four to 10 miles in width, bounded by high hills heavily timbered with pine. The gypsum appeared in enormous quantities. One of the guides took m

off to the right to see a huge mass of it, crystalized and shining beautifully in the sun. The Indians, for generations, have, in passing, split off pieces for ornaments, and by degrees cut a shoulder several feet deep on it at the level of the ground . . . A heavy and well-marked pony and lodge trail led up the Redwater valley southeasterly to the Red Cloud and Spotted Tail agencies.

July 23 — The command remained in camp while a party started out to make the ascent of Inyan Kara, about five miles distant. It resembles a lunar mountain, having a rim in shape of a horseshoe, one and a half miles across, with an elevated peak rising sharply from the center. The rim, 1,142 feet in height above the exterior base, has a sharp edge at the summit, and falls steeply on both sides.

July 26 — Still ascending Floral valley, the divide was reached, and we almost insensibly passed into the hills of another stream, falling rapidly to the southeast. The hills became gradually higher and the valley wider. The beaver had made frequent dams, and their labors occasionally added to those of the pioneers in making a road for the wagons. In the afternoon we had our first encounter with Indians. A village of seven lodges, containing 27 souls was found in the valley. The men were away peacefully engaged in hunting; the squaws in camp drying meat, cooking, and other camp avocations. Red Cloud's daughter was the wife of the headman, whose name was "One Stab." General Custer wanted them to remain and introduce us to the hills. However, we had a party of Rees among our scouts who were constantly at war with the Sioux. This made the Sioux very uneasy, and toward nightfall they abandoned their camp and made their escape. Old "One Stab" was at headquarters when the the flight was discovered and was retained as both a guide and hostage.

July 27 — The command remained in camp, to give time to examine the neighboring country. The gold-hunters were very busy all day with their shovels and pans exploring the streams. Several surveying-parties were sent out in various directions . . . The grass in places was as high as a horse's shoulder. This portion of the Black Hills evidently never suffers from drought. No arid places are seen except on the summits of the limestone ledges. Springs are numerous and very cold and pure. The soil is moist, and the vegetation is marvelously luxuriant and fresh . . . The warm currents of air from the plains condense as they ascend the slopes of the hills, and are robbed of their moisture in the fog, rain, and heavy dews that occur nightly. The clouds almost invariably formed in the afternoon and interfered greatly with astronomical observations.

Bloody Knife, General Custer, Captain William Ludlow, and standing is Trooper Private Noonan.

July 28 — The valley below us was almost too marshy for the wagons . . .

Harney's Park was visible from the top of a high, bare hill. The sun had just set and in a few minutes we were well rewarded for the five mile ride . . . A patch of bright blood-red flame was first seen, looking like a brilliant fire, and soon after that there was another so far from the first it was difficult to connect the two. A portion's of the moon's disk soon became visible and the origin of the flame was apparent. While it lasted the sight was superb. The moon's mass looked enormous and blood-red with only portions of its surface visible. On the other hand the clouds just above and to the left, colored by the flame, resembled smoke drifting from an immense conflagration. The moon soon buried herself completely in the clouds, and under a rapidly darkening sky we returned to camp.

July 31 — The command remained in camp, while survey parties were sent out and the gold-hunters redoubled their efforts. Escorted by a company of cavalry General Custer, myself, Professors Winchell and Conaldson and Mr. Wood, set out to ascend Harney . . . Leaving the horses at the foot of the clear granite, the ascent was made on foot. Halting to rest and lunch, we saw another summit, two or three miles west, rising higher than the one we were on. Reaching the summit of this one, still another, several hundred feet higher, and a mile more west, showed that we had more work to do. A stiff climb brought us to the top, whence nothing more lofty could be seen. Here we stood on the most elevated portion of the hills some 9,700 feet above the sea, except that alongside us rose a mass of granite 40 feet in height, with perpendicular sides that forbade an

attempt to scale them without the aid of ropes and ladders . . . The view was superb, extending over the intervening peaks and hills to a broad expanse of prairie from north by east round to southwest.

The course of the forks of the Cheyenne could be distinctly traced, and a dim line visible to the southeast was even thought to be the hills of White River, 50 or 60 miles distant. Bear Butte, 40-odd miles to the north, was again seen over the wooded ranges, and all but Inyan Kara of the principal peaks were in view. Two of the prominent ones I have names for General Terry and General Custer.

The return to camp was a struggle against almost every possible obstacle — rocks, creeks, marshes, willow and aspen thickets, pipe timber, dead and fallen trees, steep hillsides and precipitous ravines. With all the difficulties multiplied by the darkness and only the stars for a guide, we still reached camp at 1:30 a.m.

August 2 — Command is still in camp. There is much talk of gold and the industrious search everyone is making for it. In General Custer's tent I saw what the miner said he had obtained during the day. Under a strong reading-glass it resembled small pin-heads, and fine scales of irregular shape, perhaps thirty in number. The miners were quite condifent that if they could reach bed-rock in the valleys at a favorable place, plenty could be obtained by use of the pan.

General Custer decided to take a scouting party south to the South Fork of the Cheyenne, for the purpose of examining the intervening country and send another party eastward, following the creek where we were encamped to its junction with the same stream. These two explorations would cover considerable country and complete the examination of the south and southeast portion of the hills.

August 3 — The headquarters, with five companies of cavalry and a few pack-mules started on the reconnaissance. Lieutenant Richard Godfrey, with an escort of two companies, left at the same time to follow down the creek. The headquarters trail led south and southwest through park country, until it reached the head of a creek that flowed southwardly. This was pursued all day, leading us at first into a narrow valley, hemmed in by the wooded hills. The character of the country changed gradually as we went south. The valley grew broader, the hills lower, grass drier, and timber more and more scarce . . . Emerging from this into smoother country, we halted for the night a few miles from the South Fork after accomplishing a march of 45 miles. No instruments were taken on this trip, as the column moved without wagons and the sextant was needed in the permanent camp.

George Reynolds, a white scout, was dispatched late at night with the mail. He had about 75 miles in an airline to make it to Laramie alone, through country infested with Indians. He also had the additional disadvantage of crossing their probable routes at right angles where he could suddenly run across them. We were greatly relieved to learn afterward that his trip had been successfully made, though not without privation.

August 6 — Camp was broken for the return trip. General Custer decided that instead of going eastward on the prairie to partly retrace his steps and examine the practicality of trying a route northward through the hills which would bring us out somewhere near Bear Butte. This plan would complete the examination of them . . . A heavy thunder storm came up during the night and the echoes among the hills were exceedingly grand.

August 7 — The storm of the night before had swelled the brooks but the old trail furnished a good road . . . Two grizzly bears were killed near this camp and the first grasshoppers seen in the hills in any numbers were swarming in both creek valleys.

August 11 — While General Custer made exploration for a road eastwardly, I returned to the camp of the day before with a surveying-party to measure a base line and locate the important elevations with a transit . . . Returning to camp, I found that several elk had been killed during the day by the hunters.

August 13 — Lieutenant Godfrey was dispatched down the creek to determine its course and ascertain his position from bearings to Bear Butte and Harney after clearing the hills.

August 14 — The scorching sun and hot, dry breath of the prairie, covered with yellow grass, bore instant witness to the change in our former surroundings. The coolness of air and freshness of vegetation, the abundance of pure, cold water, the noble, camp-fires, and quantities of game that had made our stay in the hills a daily delight, compelled us to contrast it with the dry, dusty journeys, the warm alkaline water, and scanty wood which awaited us on the return march of over 3,800 miles.

August 16 — When crossing the Belle Fourche we found it to be a rapid stream, in a shaley and gravelly bed, 80 feet wide and a foot deep; the banks low, and cottonwood abundant. We met four Cheyenne Indians enroute to the agencies from the hostile camp on Tongue River who reported that Sitting Bull was preparing to intercept us at the Short Pine Hills with 5,000 warriors.

August 20 — Traveled north and west across several heads of Grand River, and over a rolling prairie, which had been burned by the Indians to harrass our march. We could find no camp on the prairie because it was black as far to the northward as the eye could see. This forced us to make a rapid descent into the valley of the Little Missouri, where we found wood, water, and grass among the bad lands.

August 23 — The course was north and east, over a high rolling prairie, until we encountered the Yellowstone expedition trails . . .

August 30 — Fort Lincoln was reached at 4:30 p.m., of August 30, the 60th day of the trip. The wagon-train had traveled 883 miles, and, adding the various reconnaissances, we had surveyed a total of 1,205 miles.

No matter what may ultimately be determined as to how much precious metal is in the Black Hills from the evidence that was gathered on the trip I conclude there is little. The real wealth and value of the country is, beyond doubt, very great. Utterly dissimilar in character to the remaining portion of the territory in which it lies, its fertility and freshness, its variety of resource and delightful climate, the protection it affords both against the torrid heats and artic storms of the neighboring prairies, will eventually make the Black Hills the home of a thronging population.

To this, however, the final solution of the Indian question is an indispensable preliminary. The region is cherished by the owners both as hunting-grounds and asylum. The more far-sighted have anticipated the time when hunting buffalo, which is now the main subsistence of the wild tribes, will no longer suffice. So they are looking forward to settling in and about the Black Hills as their future permanent home. There they will await the gradual extinction of their race which is their fate. For these reasons, no occupation of this region by whites will be tolerated . . . Hostile incursions would not be infrequent, nor an occasional massacre unlikely, and these are conditions unfavorable to a rapid and permanent increase of population. The Indians have no country farther west to which they can migrate . . .

Ludlow had great vision but the Indians have retained much of their land in the Black Hills. And although a century has passed since Ludlow made his observation, the American Indian is far from extinct as a race.

Eugene V. McAndrews, an authoritative source on the history of the Medal of Honor, was a historian, Office of the Chief of Engineers, US Army, Baltimore, Md. Mr. McAndrews considers his collection of historical material, diaries and memorabilia of US Army winners of the Medal of Honor among the most complete in existence. Credited with a B.A. in history from Carroll College, Helena, Mont., and an M.A. from the University of Oregon, Eugene, Ore., he is presently preparing a Ph.D. dissertation for Kansas State University, Manhattan, Kansas.

SWORDS INTO PLOWSHARES!

Captain James L. Keener

"The introduction of power machinery, such as steam shovels during railway construction in the last century and large earthmoving plants, such as D8 tractors and 12 cubic yard scoops in the late 1930's, brought about a change in scale. Excavations of some hundreds of feet in depth became relatively common. In effect, the scale of everyday construction was increased tenfold. The Plowshare devices at present available show up at scales ten times greater again."

Thus was the enhancement of man's ability to change the earth with nuclear explosives as described a decade ago. Two events, the development of a thermonuclear explosive device and the establishment of the Plowshare Program in Livermore, California in 1957, provided the genesis of a testing and evaluation program that has awakened scientists and engineers to the possibility of using nuclear explosives for peaceful purposes. As could be readily imagined, a major limitation on the employment of nuclear devices is their great power potential, not their lack of it.

Engineers today foresee the possibility of using nuclear devices in three general areas: mineral and gas exploitation, vast underground storage areas, and massive construction projects.

By far, the most productive work to date has been in the area of mineral and gas exploitation. It is well known that the United States will face a critical shortage of natural gas within this decade. Already in some areas industries and homebuilders are restricted in their installation of equipment or appliances requiring natural gas as a fuel. Tests have been conducted and are under way that could provide the basis whereby the nation's useable natural gas reserves would be markedly increased. The use of underground nuclear detonations in areas previously too difficult to tap is now economically feasible. Of interest to the military engineer is the possibility of using thermonuclear devices to create quarries large enough to support massive construction projects.

Much investigative work and experimentation has been devoted to determine the feasibility of using nuclear explosives to construct transportation facilities by excavation. Applications of nuclear explosive excavations could range anywhere from a transithsmian canal in Central America to the construction of a deep water harbor on almost any coast. Nuclear devices also could be detonated deep underground to provide reservoirs for water storage or solid waste disposal.

The effects of blast, ground shock, and nuclear radiation limit the employment of nuclear devices in construction projects. The specific limits are fairly well defined, and the information concerning them is available in Atomic Energy Commission publications. The primary limitations to the use of nuclear explosive devices for peaceful purposes are political. The nuclear test ban treaty and local popular concern are two major restrictions. But with the energy crisis mounting each passing day it would seem likely that these restrictions will be lifted.

It is likely that underground nuclear explosions will be used to release natural gas deposits in this decade. Use of nuclear explosives for surface engineering is possible and economically feasible.

Science and engineering have given us the capability of turning our nuclear swords into plowshares.

Captain James L. Keener is a graduate of the Engineer Officer Advanced Course at Fort Belvoir, Virginia.

CESPR: FIRST EVER

CPT Walter J. Wells
CPT James L. Campbell

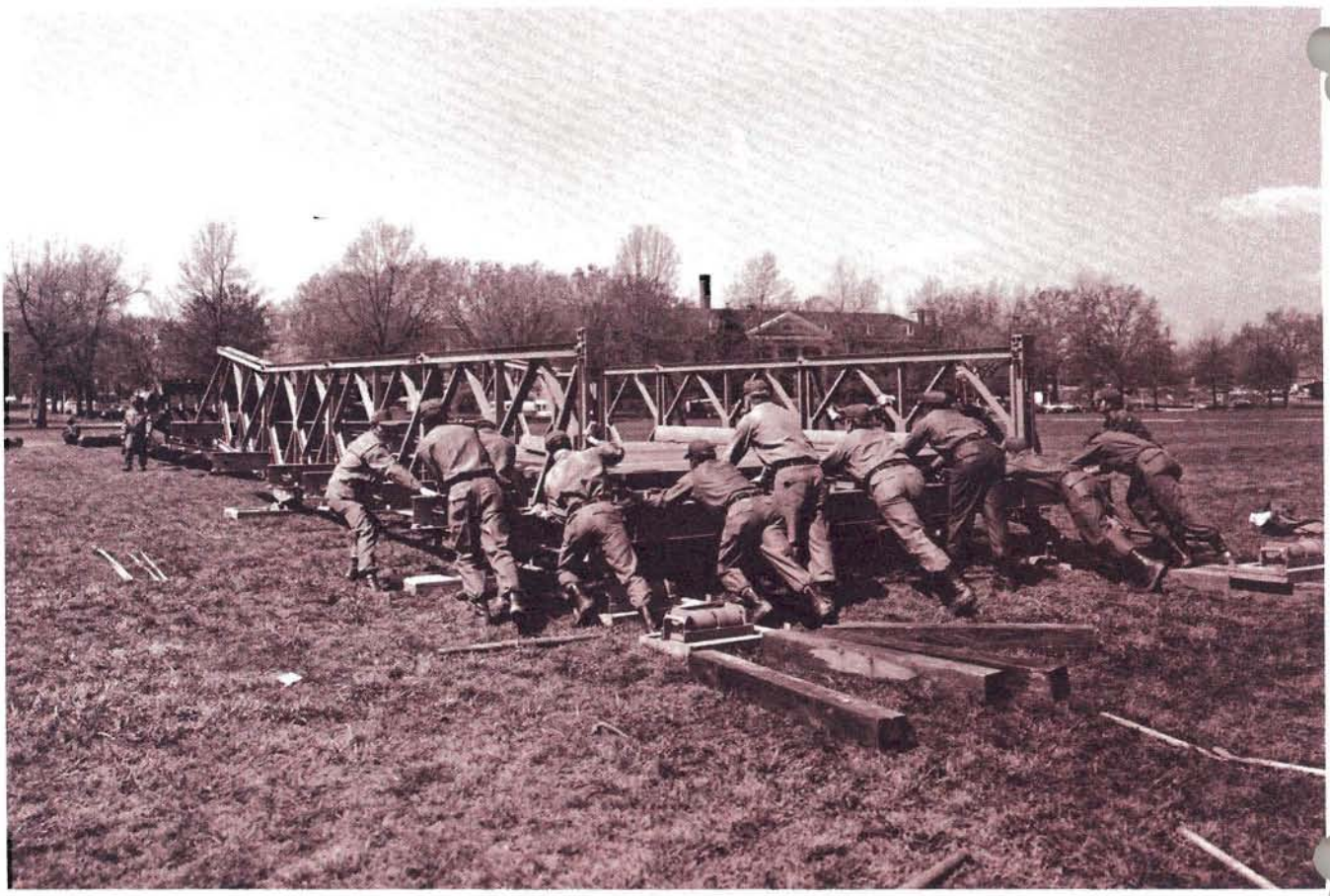
The Combat Engineer System Program Review (CESPR) was conducted at Fort Belvoir, Virginia last April. Each year a series of System Program Reviews are conducted for the Vice Chief of Staff of the Army. These reviews cover specific areas of interest such as aviation, infantry, signal, or artillery.

The purpose of the System Program Reviews is to provide the Vice Chief of Staff and other senior Department of the Army officials an overview of a particular Army system. These reviews are not intended to be decision briefings; rather they provide a forum where attendees can contribute their ideas and air their views on the system under consideration.

The 1973 CESPR was the first review of the combat engineer system. The one-day event was attended by over 40 general officers and key civilian officials. Engineer general officers from the DA Staff and major commands were among those attending the review. The full day of activity at Fort Belvoir included eight formal presentations and two demonstrations.

Lieutenant General Fred E. Clarke then Chief of Engineers, welcomed the participants to CESPR and stated that the objective was to "stimulate discussuion and receive guidance on those engineer actions required to increase the mobility, survivability, effectiveness, and combat power of the Army."

General Clarke indicated that a major concern on the engineers is that "we may not be keeping up with the rest of the Army, particularly in mobility." He pointed out that while strategic



mobility has increased by a factor of 50 and battlefield mobility by a factor of 20, the engineers' capability to enhance mobility has not increased accordingly. He noted that significant advances in tactical bridging have been made with the development of the ribbon bridge and medium-girder bridge, but that countermine warfare capability has not increased significantly.

The thread of resources tied CESPR together. A viewgraph showed the engineer slice of the PEMA (Procurement of Equipment and Missiles, Army) pie to have averaged about five percent over the last decade — not a lot of money for a branch that contributed significantly to improving and maintaining the Army's fighting power and has historically made up over 10 percent of the Army.

Army-wide information and expertise was sought and utilized at CESPR. The directorate of Military Engineering and Topography of the Office of the Chief of Engineers had primary responsibility for the planning and coordination of the many diverse efforts that went into CESPR presentations. The briefers were drawn from outside of OCE as well as from within. Outside agencies included the Assistant Chief of Staff for Intelligence (ACSI), the former Combat Developments Command, now part of TRADOC and the Engineer School, the Deputy Chief of Staff for Personnel (DCSPER), as well as the Army Materiel Command.

The two demonstrations that were conducted during CESPR included a morning demonstration using a combat engineer company with additional supporting equipment from the battalion headquarters, the light equipment and bridge companies assembled in a "U" formation. The demonstration vividly emphasized several points that could not have been so uniquely made in formal briefings. The afternoon equipment display was a roll-by of a construction engineer company and its augmenting equipment from the battalion headquarters.

The acute need to develop and implement an integrated countermine capability doctrine was noted and it was emphasized that doctrine for command and control of scatterable mines remains to be developed. It also was noted that the key to improved camouflage discipline is command interest and individual training. It has been stated that further examination of repair parts support for low-density equipment is warranted.

Experts agreed with a key point made in the base development presentation that more realistic construction standards must be established for the Base Development Plans presently being prepared. The excellent results of the Commercial Constuction Equipment (CCE) program were noted and the continued infusion of this was endorsed as the way to go. Finally, the need to place engineer representation on several of the key Army programing and planning groups such as the Material Procurement Priorities Review Committee (MPPRC) and the Research and Development Board was emphasized.

The first CESPR proved a valuable experience for the Army Engineers. CESPR required considerable preparation and hence compelled the engineer community to come together to define objectives and priorities. CESPR has successfully put engineer concerns and problems before the most important men in the Army, resulting in a better appreciation of engineer problems by Army leaders at the highest levels. Seeds were planted at CESPR and the fruits of the trees to grow will continue to be harvested for many years hence in the form of improved engineer understanding and decision at higher levels. The continuation of Engineer System Reviews is essential to insure exposure of high-level officials to engineer problems as they develop. It is anticipated that the next CESPR will be conducted in April 1975.

Captain Walter J. Wells is presently assigned as a senior analyst in the Engineer Strategic Studies Group (ESSG). While at ESSG he has worked on a number of significant studies which dealt with the organization and equipment for major engineer units in the near future. Prior assignments include command in Korea, Fort Belvoir and Vietnam as well as experience in the Sacramento Engineer District. Captain Wells graduated from West Point in 1965 and served two years in the armor branch before transferring to the Engineers. He is a graduate of EOAC and obtained a Masters degree in Civil Engineering Management from Purdue University in January 1972.

Captain James L. Campbell is currently with the Engineer Strategic Studies Group, Office of the Chief of Engineers. Prior to this assignment, Captain Campbell served with the Lines of Communication Division of the US Army Engineer Command, Vietnam. A previous tour of duty in RVN as a company commander with the 589th Engineer Battalion (Construction) provided him with first hand construction experience. Other highlights of his military career include assignments as a platoon leader and company commander with the 54th Engineer Battalion (Combat) in Germany. He received a B.S. degree from the South Dakota School of Mines and a Masters degree from Texas A & M University. He is also a graduate of the Engineer Officer Advanced Course.

WHEN THE COLD WIND DOTH BLOW!

Captain Thomas J. Quigley

As long as Alaska remains an integral part of the United States of America possessing natural resources and strategic importance, elements of the U.S. Army and the Corps of Engineers will be in direct contact with the debilitating temperatures of the subarctic cold.

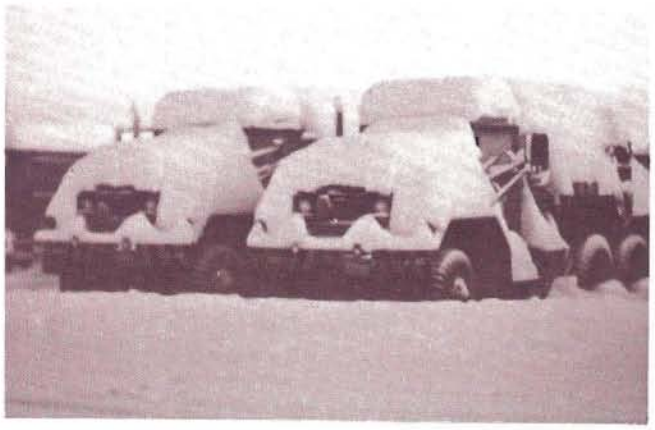
Winter lasts for about eight months in Alaska. During that time, one might experience 166 inches of accumulated snowfall; 156 consecutive days below 32 degrees fahrenheit; temperatures dropping 40 degrees in one hour after a day of two hours sunlight. Longtime residents of these extremes point out that the harsh weather is nothing to fear. However, it is never to be disrespected. With these thoughts in mind, consider the abysmal difference between operating equipment in Alaska as opposed to Fort Belvoir, Birginia. The challenge is peculiar and distinct.

Colder weather brings increasing impact on the importance of maintenance at all levels, particularly operator maintenance. It is no revelation that water freezes at temperatures below 32 degrees fahrenheit. Fluctuating temperatures cause noticably poorer performance in vehicles due to the condensed moisture in fuel lines which subsequently freezes. Failure to drain the fuel filters or fill fuel tanks each night invariably results in inoperable equipment. Antifreeze must be added to the fuel as well as the cooling system. Condensation occurs readily in the engine compartment where temperatures normally reach 200 degrees. The night temperatures often exceed —60 degrees, cooling each vehicle as much as 260 degrees.

Motor vehicles equipped with winterization kits have a gasoline fired heater in the cab. These heaters can direct heat to the engine or the passenger compartment. Prior to starting the engine in the cold the crankcase oil must be heated since its viscosity decreases decidedly in cold weather. The battery's efficiency is also halved. These two factors coupled with the refusal of the fuel to atomize and combust makes starting an engine difficult. Noncumbusted fuel accumulation can result in hydrostatic lock in diesel engines or dilution of the crankcase oil in gasoline engines. Hydrostatic lock ocurs when too much fuel is retained in the cylinder which prevents the piston from traveling to top dead center, possibly breaking the piston or the head. Similarly, in gasoline engines, uncombusted fuel may wash down the cylinder walls and dilute the crankcase oil which reduces proper lubrication when the engine is subsequently started.

Away from the engine, other problems may arise. Wise use of the gas personnel heater must be stressed. Naturally any fuel combusting process produces carbon monoxide. Ventilation is a must. Defrosters cannot be directed on the winshield until it is heated by the ambient temperature of the cab, or the glass will crack due to the rapid change in temperature.

Refueling can present problems to the careless.



A five gallon can of fuel is a definite threat of frostbite to the unaware. This threat was best illustrated to newcomers in the form of a short story of three soldiers who were having a great time administering themselves doses of "anti-freeze" until their supply dwindled. One remembered his bottle under the seat of his car outside. He dashed out in the sub-zero temperatures, retreived the stock and rushed back inside. To the praise of all he uncaped the bottle, took a great swallow, and was abruptly reminded that alcohol does not freeze at —40 degrees, unlike the interior of his mouth. Booze, like fuel, remains liquid at all naturally occuring cold temperatures and can freeze human skin on contact.

While operating in the field in the absence of warm storage facilities the cold and accompanying chill factor tends to "coldsoak" vehicles in approximately three hours, rendering them impossible to start. The only remedy to this lies in a procedure of starting each vehicle on a two hour interval, allowing them to warm up, then shutting them off after 20 minutes. This procedure is a 24 hour task that must be observed to maintain ready vehicles.

Another bothersome phenomenon resulting from frigid temperatures is ice fog, formed at minus 29 degrees by frozen particles of moisture suspended in the air. It is similar to ordinary fog and decreases visibility proportionally. Moisture is readily produced as a by-product of combustion in engines and therefore can be expected to remain in the area of operations and present a hazard to movement. In tactical situations it acts as a dead giveaway of concealed positions. The wind rarely blows in the interior of Alaska during cold snaps making ice fog a problem. Thus, the speed of motor movements must be reduced.

Engineer equipment such as bulldozers must be expecially cared for during nonuse in the field. A living example presented itself when, after the day's clearing operation ceased, the dozer was parked near the bivouac in the muskeg. Next morning a herman-nelson heater was directed on the engine to preheat the D-8. After the engine was started and allowed to warm, the operator engaged the clutch and first gear only to have the engine nearly stall while the dozer remained immobile. During the night the dozer had frozen to the ground! An enterprising squad leader insisted the operator put the transmission and transfer in the lowest combination, raise the idle and pop the clutch. Naturally the weakest link of the chain gave, in this case, the transmission. Similarly reverse gear also failed.

The result of the underestimation of mother natures forces was an immobile dozer stuck to the ground. The situation was eventually solved by erecting a GP medium tent over the dozer, heated and supervised by our favorite squad leader. From that location the D-8 was eventually hauled away to depot maintenance. The waste in time, equipment and money could have been prevented by merely parking the dozer on logs or other non-frost suseptible material.

Armed with the knowledge of these few perils of cold weather operations and a healthy respect for the forces nature has at its disposal, a unit commander or maintenance officer will be able to gauge the capability of his unit and the possible problem areas cold weather may present. Emphasized above all is the fact that the soldier must endure the extreme elements as well as his equipment. Advance planning and thorough forethought will pave the way for successful completion of the mission.

Captain Thomas J. Quigley is a graduate of the Engineer Officer Advanced Course at Fort Belvoir, Virginia. He also is an ROTC graduate of Eastern Washington State College and has served a tour in Korea with the 36th Engineer Group (Combat) and was Detachment Commander of the 109th Engineer Battalion (Combat ROKA). Later the Captain served as Maintenance Officer, S-4 Officer, and Commanding Officer of Company A, 808th Engineer Battalion (Construction) Fort Wainwright, Alaska.

BRIDGING

SENIOR NCOs SUPERVISE 80 PERCENT OF ARMY PERSONNEL RESOURCES

THE REQUIREMENT FOR NCOES stems directly from the basic needs of the U. S. Army for more effective leadership, at all levels. The senior noncommissioned officer supervises or controls approximately 80 percent of the Army personnel resources. He is, therefore, the key man in the military management structure. The success of the NCO depends on his technical knowledge as well as his ability to effectively direct people toward an assigned objective. The senior NCO has been fulfilling his role as "backbone of the Army." Over the years, he has been the doer, and the price exacted has been in terms of his progressive professional development. Today's Modern Volunteer Army cannot deny the importance of tradition in the military service but neither can today's leaders dispute the need for enlightened leadership, personalized to the individual and the situation, balanced by professionalism and confidence.

EOAC OFFERS STUDENTS ELECTIVES FOR PROFESSIONAL DEVELOPMENT

IT HAS LONG BEEN RECOGNIZED that the varied needs and interests of individuals enrolled in each of the professional development courses at the US Army Engineer School cannot be accommodated by an inflexible core curriculum. One partial solution to this problem is the continual modification of a program of instruction to reflect both the generalized changed requirements of a changing student population and the revised job requirements of course graduates. Another solution is the partial individualization of a program of instruction by providing a heterogeneous group of students with a series of elective options; the student is afforded an opportunity to complement a core curriculum with courses or programs which suit his desires.

LEONARD WOOD'S 4TH AIT BRIGADE LAUNCHES TWO NEW COURSES AND CHANGES TWO OLD ONES

THE 4TH ADVANCED INDIVIDUAL TRAINING (AIT) Brigade at Ft. Leonard Wood, Missouri which has long been the major source of highly trained construction engineers has started two new courses and changed two of its old ones. The two courses added are the Plumbers Course, 51K20, and Electricians Course, 51R20. In the past the Army has had to rely on civilian school or on-the-job trained plumbers and electricians. These two new Courses should eliminate the Army's shortage of trained personnel in these MOSs. One of the courses being changed is the CSOC (Crane Shovel Operators Course). The Crane Shovel Operators Course has been split to allow training in two MOSs, 62F20 and 62F30. The 62F20 course trains personnel in handling material using a hook block. These personnel are designated Crane Operators. The other course will orient personnel in handling materials but will train them in the use of construction attachements for the crane. Graduates will be designated 62F30, Crane Shovel Operators. Both MOSs will allow progression through grade of E-5 without change in MOS skill level designation. The other course that is being changed is the Engineer Equipment Maintenance Apprentice Course. The change affects the kind of courses being taught. Instead of being taught the maintenance of each piece of equipment, they are being taught maintenance of engines, power trains, brakes, etcetera as a system. A crawler tractor may be different from a scooploader but the principles will remain the same. All indications are that the new approach will provide a better trained engineer mechanic to the field.

THE GAP

MANY EM ARE ELIGIBLE TO ATTEND ENCOES

MEMBERS OF THE ACTIVE ARMY or of a Reserve Component in the grade of E4 with less than eight years service or E5 with less than 12 years service who have demonstrated leadership potential for noncommissioned officer positions are eligible to attend the ENCOES Basic Course provided they are qualified in one of the listed prerequisite MOS's, have an MOS test score of 100 or more, and 13 months or more of active duty service remaining upon completion of the course. No security clearance is required. There is a one time eligibility as E3 at completion of Advanced Individual Training (AIT). Individuals who are selected for MOS training in an MOS that is a prerequisite for this course and who demonstrate exceptional leadership abilities during Basic Combat Training (BCT) and AIT may be selected to attend ENCOB immediately after AIT. These are the prerequisite MOS for ENCOB: 12A10, 12B20, 12B30, 12C20, 12C30, 12D20, 12E20, 12F20, 51A10, 51B20, 51C20, 51C30, 51D20, 51F20, 51G20, 51J20, 51J30, 51L20, 51M20, 51N20, 51R20, 52A10, 81A10, 81B20, 82A10, 82B20, 62D20, 62E20, 62F20, 62F30, 62G20, 62G30, 62H20, 62J20, 62J30, 62K20, 62L20, 62M20, 64B20, 81C20, 51Q20, 81D20, 81D30, 41B20, 41B30, 82A10, 82D20, 82D30, 82E20, 82E30, 83A10, 83D20, 83E20, 83F20, 41K20, 52B20, 52B30, 52C20, 52D20, 62B10, 62B20, 62B30, 62C20, and 62C30.

EPD ESTABLISHES CAREER ORIENTED MANAGEMENT SYSTEM FOR EM

THE ENLISTED PERSONNEL DIRECTORATE is in the process of establishing a career oriented management system similar to the system that is used by the Officer Personnel Directorate. Within this new career management organization — Management of Enlisted Careerist Centrally Administered — assignments will be made in accordance with specific career management guidlines and objectives for each military occupational specialty. As an integral part of this program three levels of military education have been established under the Non-Commissioned Officer Education System — Basic, Advanced, and Senior. The NCOES Advanced and Senior Courses will be viewed with equal importance for enlisted personnel as the Command and General Staff College and War College courses, respectively, are viewed for officers.

LOSING COMMAND MUST FURNISH EACH OFFICER LOCALLY REPRODUCED COPY OF HIS OER

ONE NEW AND SIGNIFICANT provision of the new Officer Evaluation Report (OER) system is that each officer will receive a locally reproduced copy of his completed OER (DA Form 67-7). In some cases, however, the OER is not completed until after he departs to a new assignment. It is the responsibility of the losing command to forward a copy of the OER to his new address. This system is not perfect because the report can get lost after it is forwarded. Individuals should query their old command after a reasonable time has elapsed to determine if a copy was, in fact, forwarded. If the report was forwarded but "lost" in the mail, the unit personnel officer should be able to furnish another copy. He is required to keep a copy for 120 days after the cutoff date of the reporting period. To minimize the chance of not receiving his copy of the OER, each individual should make sure he provides his personnel officer an accurate forwarding address prior to departing the command. Also, it should be noted that under the new OER system, appeal action must be initiated prior to the second anniversary of that report.

ENGINEERS ARE

HAPPY BIRTHDAY! 1775-1974