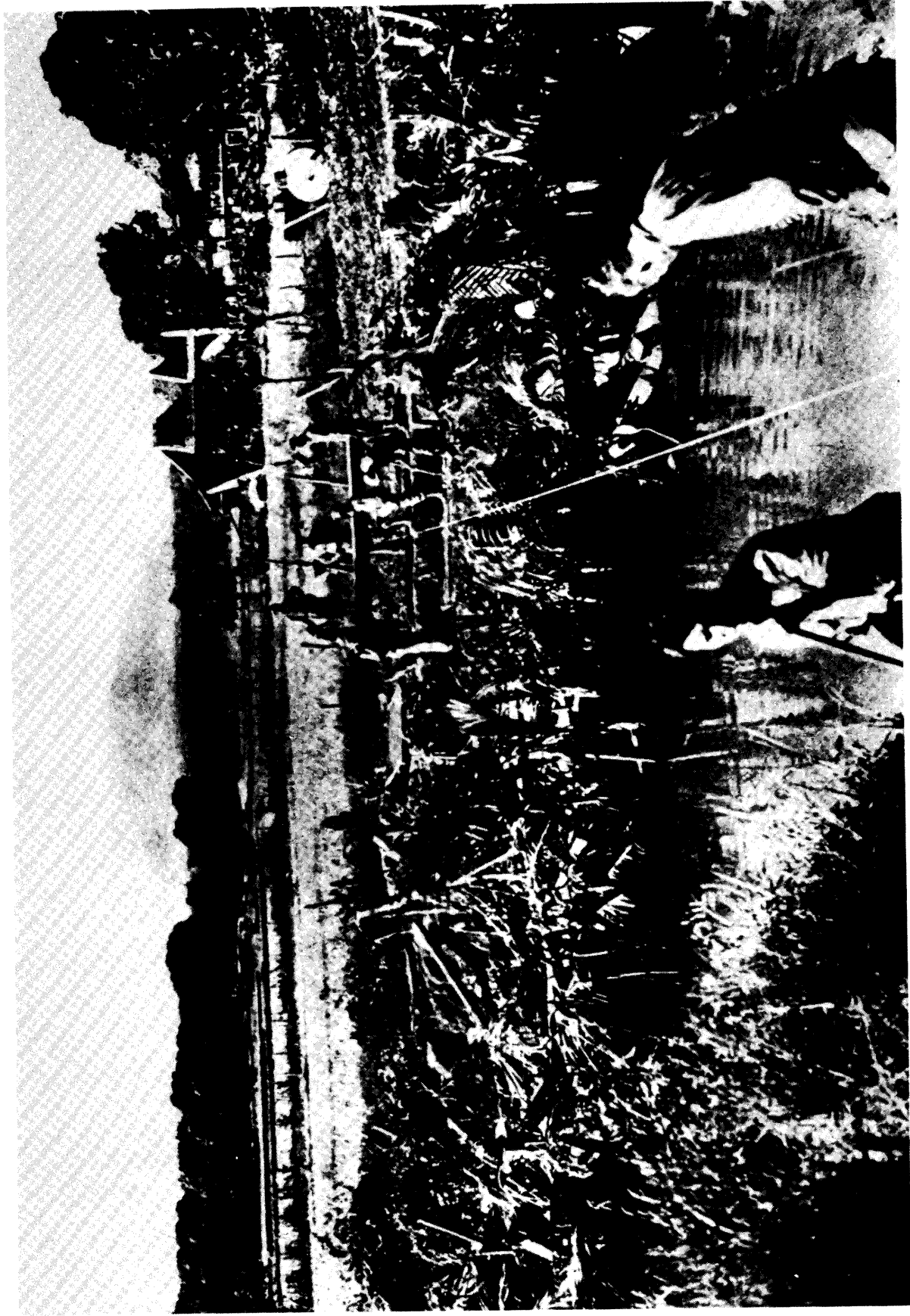


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**Appendix H**  
**“Military Engineers in War”**  
*The Military Engineer*

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Engineers Building a Temporary Bridge across a River in Bataan

# The MILITARY ENGINEER

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Tanks are Massive, Requiring Heavy Bridges for Their Movement

## Military Engineers in War

HUGH J. CASEY

Brigadier General, United States Army  
Chief Engineer, Southwest Pacific Area

OUR Society publication is THE MILITARY ENGINEER. We members are Military Engineers or are interested in promoting the efficiency of the military engineering service. It seems appropriate at this time, in view of the thousands of Military Engineers now engaged in and continually joining our forces, to define and analyze the specifications for a Military Engineer and by critical introspection to X-ray ourselves to determine to what degree we meet these specifications.

As Engineers we accustom ourselves to ensuring and enforcing compliance with specifications and terms of any contract. It is essential, therefore, that we define and know that contract and do all humanly possible to meet its terms.

The characteristics and requirements for a Military Engineer given here are based on recent observations of our military engineering activities in the Philippines and in the Southwest Pacific Area. It is hoped that their enunciation may prove of some value to our Military Engineers already in the Service and the thousands of others who are joining our ranks.

Modern warfare is highly mechanized. It has placed even greater demands than ever on our Engineers. Engineers are required for the design, production, and upkeep of our tanks, planes, ordnance, and numerous other technical requirements of National Defense. Our planes are heavy and fast, requiring extensive airfields through all types of operations areas. Our tanks are massive, requiring heavy bridges for their movement. Our supply requirements run to astronomical totals, placing heavy demands on docks, railroads,

roads, and all transportation arteries. A vast quantity of storage for these supplies is also needed. Shelter, water supply, and utilities must be furnished for our men and for hospitalization. Millions of copies of maps of all types must be produced and furnished to our military forces. The job of the Engineer is to provide all of these facilities *on time* with whatever limited forces, plant, and materials are available. To perform that task the Military Engineer must be an animal possessing the following general characteristics.

He must have ENERGY. He should have the ability to carry on continued hard physical effort, oftentimes with lack of sleep, and still remain mentally and physically active. He must have the ability to pick up quickly in relatively short periods of rest after a period of hard exhaustion. This means that our field engineers particularly, must be young, able to climb mountains and tramp through tropical swamp and jungle with heavy equipment, live in wet clothing, without exhaustion and undue lowering of resistance, and still carry on.

He must possess INITIATIVE. A Military Engineer without initiative can not perform his job. It is impossible for higher headquarters to assign to all lower echelons the many engineering tasks which must be performed. The Engineer in the field and on the job must be continually seeking out and executing those tasks essential to advance the whole show.

The Military Engineer should have IMAGINATION. This factor is very important. Our Engineer must have the ability to visualize a situation which has not yet happened, but which may occur, and out-

line plans and measures necessary to meet it. He must be able to put himself in the position of those whom he and his unit are to assist. He must visualize their needs and requirements. He must be able on occasion to detach himself from himself sufficiently to review critically his own operations instructions, plans, and directions in order to ensure that they are what are needed and that they are understandable and clear to those to whom directed. Instructions issued which may initially appear perfectly clear to himself with his full background of information on the particular situation, may not be sufficiently complete and understandable to those to whom issued. He should, therefore, be able to put himself in the position of the other man and critically review his possibly incomplete opus to check if it will be clearly understood by the man to whom directed. He should, in any case, have sufficient imagination to visualize the numerous problems and difficulties which may and will arise, and check that appropriate planning or procurement measures are being taken to meet these contingencies.

He should have **INTELLIGENCE**. He should be capable of quickly grasping a situation and be alert in his mental processes and reactions to determine promptly a reasonable solution and measures neces-

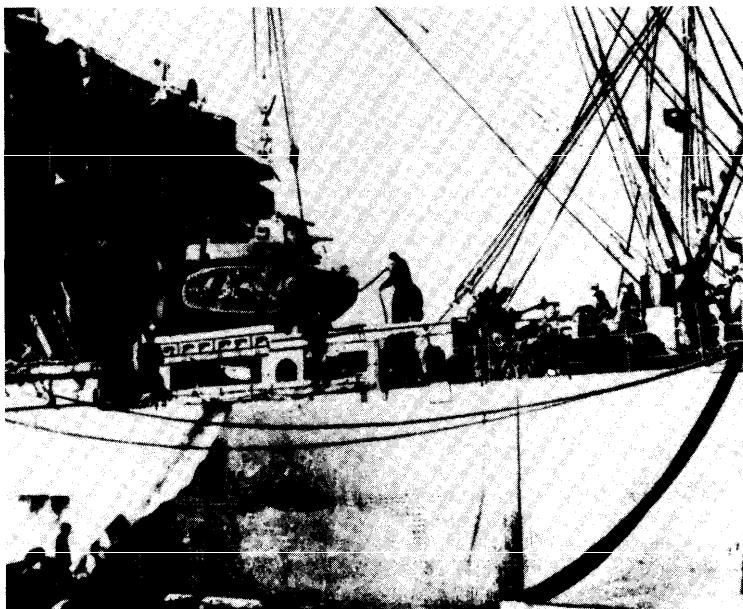
tail pertaining to any problem that he loses sight of the two, three, or four basic fundamentals of that problem. He should exercise great care to determine what these basic fundamentals are and to stick to them.



Field Engineers Must be Young and Physically Active

He should be capable of **SEEING THE BIG PICTURE**. As our Commander-in-Chief has so aptly put it, he should not lose sight of the forest for the trees. His perspective should be such as to ensure a proper balance of effort commensurate with the real importance of each task. On a construction job it is not enough to see that every man is busily engaged. He should constantly review that construction job to determine the bottle-neck which is the control on total output and concentrate his energy on opening up that bottle-neck control for greater production results. When that bottle-neck has been cleared, he should determine the next controlling factor and concentrate on it until it in turn is cleared if maximum production is to be attained.

He should have a proper sense of **BALANCE**. He should not regard each man, problem, and piece of plant as a routine succession of items for equal consideration and treatment. He should appreciate, for example, that if a D-8 dozer can perform the output of 200 men, the care and nursing of that individual piece of plant merit a degree of consideration comparable to the thought applied to the care and handling of the equivalent 200 individuals, rather than as merely



Supply Requirements Place Heavy Demands on Transportation Facilities

sary to handle the problem.

He should be capable of reducing any problem to its **BASIC FUNDAMENTALS**. Too often the average individual becomes so enmeshed with the mass of de-

another single item to add to the 200 individual cases. Too often our engineers regard their plant, which, in the final analysis, may be the key to their productive capacity, as an inanimate something unworthy of their

keen personal interest. A marked difference in production results will be noted between those units where balanced consideration is given to the varying importance of the individual problems which constantly prevail.

The Military Engineer must **LOOK AFTER HIS MEN**. He must defend them against all others. He must look after their wants and requirements. He should give them the praise that is their due. He should exercise special effort to get them such food, comforts, and whatnot as can be procured. He should let them know that they are the best working outfit in the forces, in which case they will strain themselves to merit the confidence placed in them and perform a job of which we shall all be proud. Men will take any degree of driving from their officers and leaders if they in turn know that they and their interests are being taken care of by those in their charge.

Our Engineers, in addition to their normal engineer functions, may also be engaged in **COMBAT**. They represent a strong potential combat reserve which has been and will be utilized in critical phases of the operations. The situation is always critical when a commander has to pull his Engineers from their normal engineer mission into combat. A Military Engineer must, therefore, ensure that his men have been given a sufficient degree of combat training to give his men a reasonable chance for their lives, wholly aside from the fact that such training may represent the difference between success and defeat or failure.

The Military Engineer must be able to **WORK**. Just as nothing beats fun, so nothing takes the place of work. I repeat, nothing takes the place of **WORK**. There is always far more to be done than can be done within the time, with the forces, plant, and materials available. No Military Engineer can say at any time during an all-out war effort that he has nothing to do. He should have plans on tap for the utilization of his men for many jobs ahead. Whenever he and his unit are seen, outside of their limited rest periods, they should be seen actively at work. They should engender the thought in the commands of which they form a part that **Engineers and Work** are synonymous.

A Military Engineer must have a **SENSE OF HUMOR**; otherwise he is likely to go mad. Blunders are going to be made, confusion will be met and untold difficulties will be encountered. A major league batter who makes three successful hits out of ten times at bat, not to count the strikes called against him, is considered an excellent performer and big-league caliber. Perfection in any human field is not attainable. Errors will be made. Impossible, unintelligible, and conflicting orders will occasionally be re-

ceived. Tough situations will be encountered. In such situations, the Military Engineer must not lose his sense of humor. A joke or laugh in a tight spot may save the day. A message to the President: "Please send us a new P-40 as ours is full of holes," relieved the nervous strain and tension in a tight situation. Similarly, a message to the Governor of California from Bataan, when it was learned that an enemy submarine had shelled a small dot on the thousand miles of California coastline, urging them to hold on until the BBB's\* could send him aid, gave some hard pressed boys a pickup when they needed it most. A Military Engineer taut with nervous tension under difficulty is unqualified to perform his task. Turn that hang-dog expression in for one of good cheer. It will help both you and your men.

A Military Engineer must have the ability to **IMPROVISE**. He will have to do his job with what is

available on the spot. There is no corner hardware shop to get the supplies, or industrial establishment to turn out the tools that he needs for the job immediately ahead. He must do it with what is on hand. If hand grenades are not available, a cookie (most appetizing to serve) can be made from a piece of bamboo, a stick of dynamite, some nails, mud, a cap and fuse with cellophane-wrapped match attached. A larger cookie with a piece of automobile spring for a catapult or with a bow and arrow arrangement made of discarded inner tubes may make a workable even though less capable substitute for lacking mortars. In the absence of tank mines, a tiny wooden coffin with ten pounds of dynamite, an electric cap, a flashlight battery with contacts operated by erushing in the top, secured by only sufficient brads to sustain a 400-

pound load, will give reasonably satisfactory results. At least the tanks don't like it. The use of boiler plate properly emplaced will make a small cruiser out of a large-size row boat. Piers and bridges can be built out of discarded gasoline drums. The job, no matter what it is, must be done with whatever is available. The Military Engineer will never say he can't do the job because he lacks the means.

**COOPERATION** is another essential characteristic of the Military Engineer. He must be ready in every way to help our troops advance or hold. He should never fail to do any job required merely because it is the responsibility of someone else, if that someone else is not there. If other service elements are not forward at the site, the engineers should take on the job within the relative priority of importance of the various tasks to be performed.

**ADVANCE PLANNING** is most important. A Mil-

\* (Battling Bastards of Bataan.)



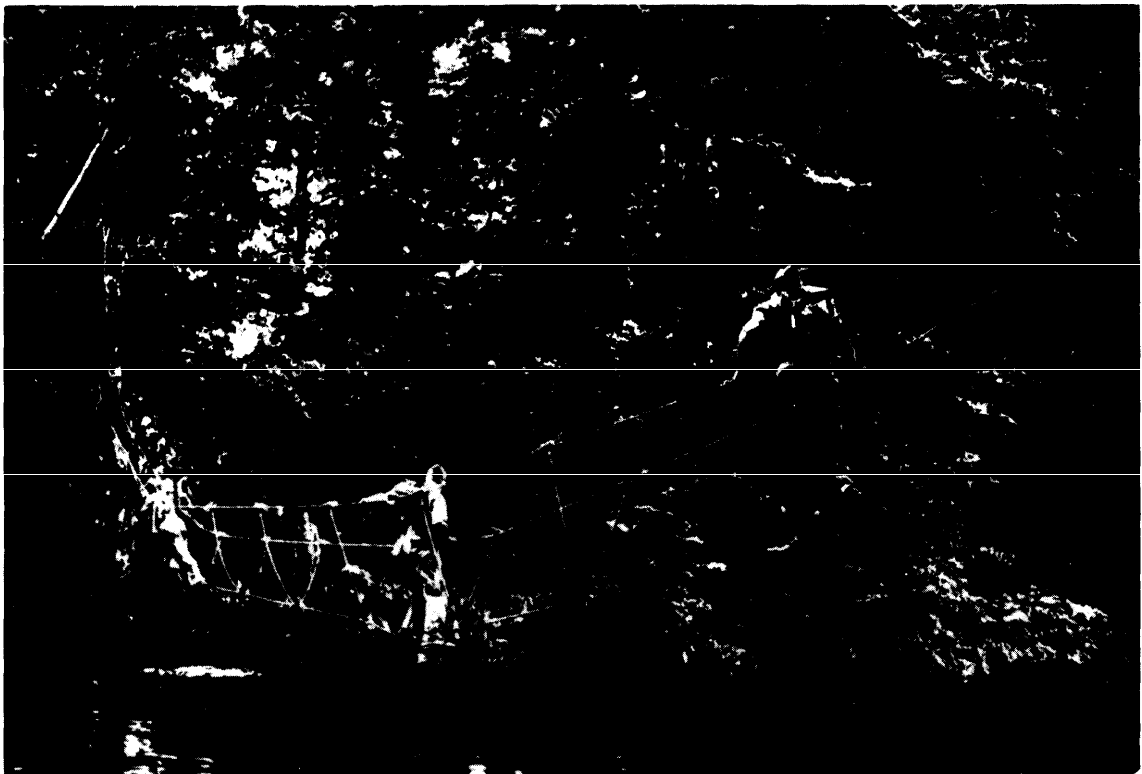
The Engineer Must Have Ability to Carry on Continued Hard Physical Effort

itary Engineer should never be caught with his "trousers drooping," (a more elegant expression for "pants down"). He should constantly be visualizing his future problems and requirements and making necessary provision therefor. His tools, plant, men, and materials should be provided or arranged for insofar as possible well in advance to ensure that they will be available at the point where needed, when needed. Relatively little effort expended on advance planning will save much effort and frantic confusion later in trying to procure the means which, if properly planned for in advance, would be already available. If these requirements have generally been adequately provided in advance, additional emergency needs will be relatively few and will actually receive more prompt and complete consideration with greater assurance of their being furnished than if they form part of a vast number being screeched for. The need for careful advance planning can not be overstressed.

The Military Engineer should be possessed of a reasonable degree of **PROFESSIONAL OR TECHNICAL KNOWLEDGE**. What is even more important, he should be currently and continuously improving himself in learning what he can from the various references and training literature available on the problems he is currently meeting. He should observe and profit not only from his own experience but also from that of others. He should exercise special pains to cull out the basic fundamentals of each subject rather than to overtax his mind with a vast accumulation of detail. He should, for example, with respect to the construction of a landing strip, appreciate that sufficient drainage must be provided around the island strip to pre-

vent water entering the subgrade as well as to afford drainage relief to what water does get through. If, because of lack of drainage the subgrade to a landing strip is soup or mud, a surface layer of 6-inch steel would still sink and be incapable of supporting planes. He must also appreciate that a surface of such lateral strength must be provided as to distribute the 20-ton-per-square-foot impact of heavy bombers over such 10 or 20 square feet of area as would reduce the unit loading to one which the subgrade can support. As a final desirable element, a raincoat or seal coat which would prevent surface water from penetrating into the subgrade will further protect the strip from deterioration. These are the basic essentials which he should keep in mind. It is of course essential that he also know the limitations of slope and crown and degree of variation in longitudinal slope as dictated by the operating characteristics of our planes. In any case he should know where he can get this information in the limited reference texts that form his bible. Technical libraries are just out of reach.

His **WORK SHOULD BE PLANNED**. In the execution of the job he should make such quick preliminary investigations of soil, sources of materials, distance of haul, possible methods of construction, et cetera, as will ensure that the job will be done satisfactorily with a minimum of expenditure of time, labor, and plant. A source of material on a slope where a chinaman can be provided for quick gravity loading of trucks with material fed to the chinaman by a bulldozer will be far more effective than resorting to power shovel loading. A reasonable amount of effort given to the consideration and evaluation of the



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He Must Have Intelligence to Grasp a Situation and Handle it Promptly

Here is shown a method of destroying a bridge against the invader in Bataan. Straw was piled on the bridge and later set on fire.

various possible methods of construction, and determination of the most efficient method, will effect a great savings in time as well as in physical effort on the part of his men and plant. Too often there is a loss of time and effort due to a failure to spend a day on planning the job. A few hours of proper planning may save many days of actual work.

A Military Engineer need not be a reckless hero but should display a moderate degree of COMPOSURE under enemy action. If he himself can not set such a standard, he can not expect his men to perform normally under enemy fire and bombing. In the final analysis, it should be relatively easier for an engineer to conduct himself normally under enemy fire. With an analytical mind and a knowledge of the theory of probability, he is in a better position to gauge the relatively slight chance he is taking and control himself accordingly. It is normal and human for individuals to fear enemy rifle and machine-gun fire and bombing activity. The engineer should appreciate, however, that it is most difficult for a bomber moving several hundred miles per hour at great height to drop its bomb at the exact spot at which the pilot or bombardier is aiming. We should also be aware that a bomber is not going to waste an expensive and important bomb on a single *homo sapiens*, irrespective of the high value and importance which we as individuals attach to ourselves. We should appreciate first, therefore, that that particular bomb is not out to get us individually. It is only the one marked "To Whom It May Concern" that we need worry about. If we as-

sume that we occupy a square yard of space, we should appreciate that there are 3,097,599 other similar areas in the square mile surrounding us. If we buy a ticket for a lottery in which that number of tickets is sold, we assume we have tossed that dollar away, as we know we are not going to win. We should similarly feel that the bomb which is dropped into that area is not pointed in our direction and has an insignificant chance of hitting us. This does not mean, of course, that it is recommended safe practice to place oneself in the middle of an airfield when they are bombing a drome; but we should feel that there is a reasonable degree of security in a fox hole or on the ground, even though in the general proximity of the target area, and by our own composure we should be capable of engendering that same feeling in our men.

We should also appreciate the difficulties the average soldier or new recruit has in putting all of his bullets into a fixed bull's-eye at any moderate range even under conditions when he knows the exact range, the windage, and he is in a secure firing position, is merely shooting holes in paper, and with no one disturbing him other than an over-anxious sergeant or lieutenant. We, as Engineers, should, therefore, be able to evaluate the reduced chances of being hit when we are a moving, indistinct target at an unknown range being fired at by a wheezy, little yellow slant-eyed

(censorship prevents). We should also appreciate that only a small percentage of those engaged in any combat actually become casualties and that of that small percentage only a still smaller per-

centage die. In fact if you talk to yourself long enough on these lines, you can feel that war is a relatively safe proposition. But seriously, a full consideration of the probability phases of combat, insofar as fear of our permanent loss to the military establishment is concerned (wholly aside from the natural and selfish instinct for life, family, and the pursuit of happiness and other earthly comforts), can instill in the Military Engineer a degree of composure under fire which others may fail to understand. It will, in any case, be helpful toward adopting that attitude which the Military Engineer must have if his men are to carry on under him under all conditions that will have to be faced.

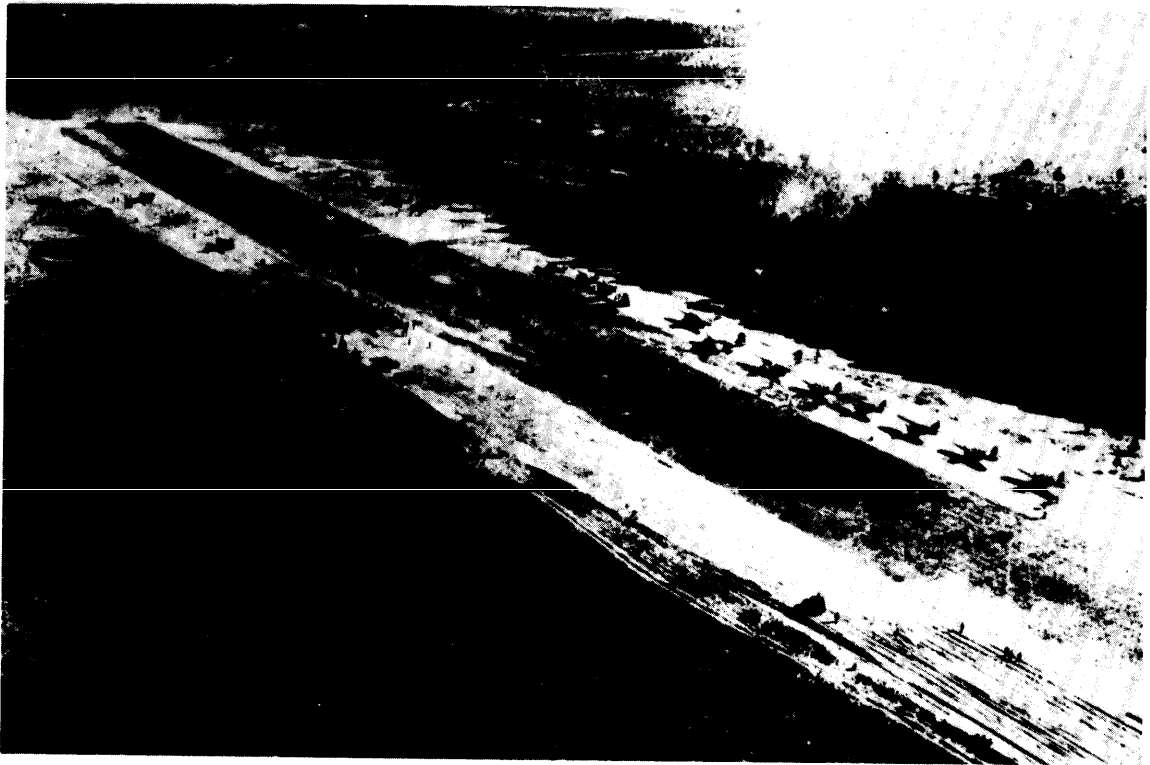
The Military Engineer must continuously exercise ACTIVE RECONNAISSANCE. He must reconnoiter the area in which he is engaged, evaluate the difficulties which may be encountered, and determine and know the engineering resources that are available in that operations area. He should know the condition of roads, bridges, and railroads and their potential sources of trouble. He should devise plans *beforehand* as to what he must, can, and will do to handle those problems. He should know where sources of timber, gravel, water, barbed wire fences, stocks of engineer tools, plant or supplies are available. Only by continuing reconnaissance will he remain a jump ahead of such problems and contingencies that will be continually arising.

The Military Engineer who is full of "book larnin" but who lacks the personality, vigor, forcefulness, leadership, and driving energy to put that knowledge across will fail.

There is a time and place for everything. In per-

manent peacetime engineering, the construction of a large bridge, a dam, a power plant, or similar permanent massive structures merits and requires detailed and thorough planning to ensure the most economical and efficient structure. In time of war the relative importance of the various factors entering military construction varies. The most important criterion is to get the job done on time to a degree adequate to meet the requirements of the situation, even though temporarily, irrespective of cost. This does not mean that the cost factor is completely disregarded, as cost is but another measure of materials, plant, and labor which should, of course, be conserved to the greatest degree possible in order to execute a greater extent of work. It is important, however, that the Military Engineer appreciate that high cost or utilization of valuable materials, if such are the only ones available, which must be thrown into a job in order to get it done as and when required, or destruction of valuable installations which might otherwise fall into enemy hands, should at no time bar or handicap his operations. A Military Engineer should be prepared to throw in all of his resources of whatever nature in order to get whatever job is assigned to him done on time. An airfield not available on schedule to meet tactical requirements, or roads, bridges, or trails not provided in time to sustain an attack represent failures of the engineer mission. They must be provided in the face of any obstacle.

The engineers are among the first ones in and the last ones out. The Military Engineer in time of war is rough, tough, and fast. His whole mental make-up and characteristics must be adjusted to that tempo if he is to accomplish his job.



He Must Have Professional and Technical Knowledge to Carry Out Large Construction Projects