

the engineer

SUMMER 1972



the engineer

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CHIEF'S BRIEFS.....

Etienne Nicholas Marie Bechet, Sieur de Rochefontaine, later known as Lieutenant Colonel Stephen Rochefontaine, lies buried in the churchyard of St. Paul's chapel of Trinity parish in New York City. This French officer, the fourth Chief Engineer of the United States Army, is probably the most distinguished of his nationality who actually took part in the military operations of the War for American Independence and who is interred on American soil.

He was born on February 20, 1755, the son of a wine merchant, on the right bank of the Marne River in a town famous for its production of sparkling wines---the town of Ay.

Little is known of his early military training, although conjecture has it that he possibly had been to the Royal Military School of Brienne-le-Chateau, transferring later to the Military School of Paris---the usual routine at that time. He was just 23 years of age when he arrived in America and volunteered for service in General George Washington's Army. On September 18, 1778 he was appointed a Captain in the Corps of Engineers, and was one of two engineers recommended for promotion during the Siege of Yorktown. On November 16, 1781 he was brevetted a Major by Congress for his distinguished service during that conflict.

In 1783 Rochefontaine returned to France and re-entered the service of King Louis XVI as a Captain in the provincial troops. The king subsequently appointed him Adjutant General of the Army of Santo Domingo. He escaped to America shortly after the king was executed, and was appointed a civilian engineer to fortify the New England coast by President Washington. When the Corps of Artillerists and Engineers were organized on February 26, 1795, Washington made Rochefontaine a Lieutenant Colonel and Commandant of the new Corps. He established a military school at West Point in 1795, but the building and all of his equipment were burned in 1796. Colonel Rochefontaine remained as Commandant of the Corps until he retired on May 7, 1798, "to enjoy in the midst of friendship an esteem justly acquired and a repose worthily merited." He lived in New York City until his death January 30, 1814.



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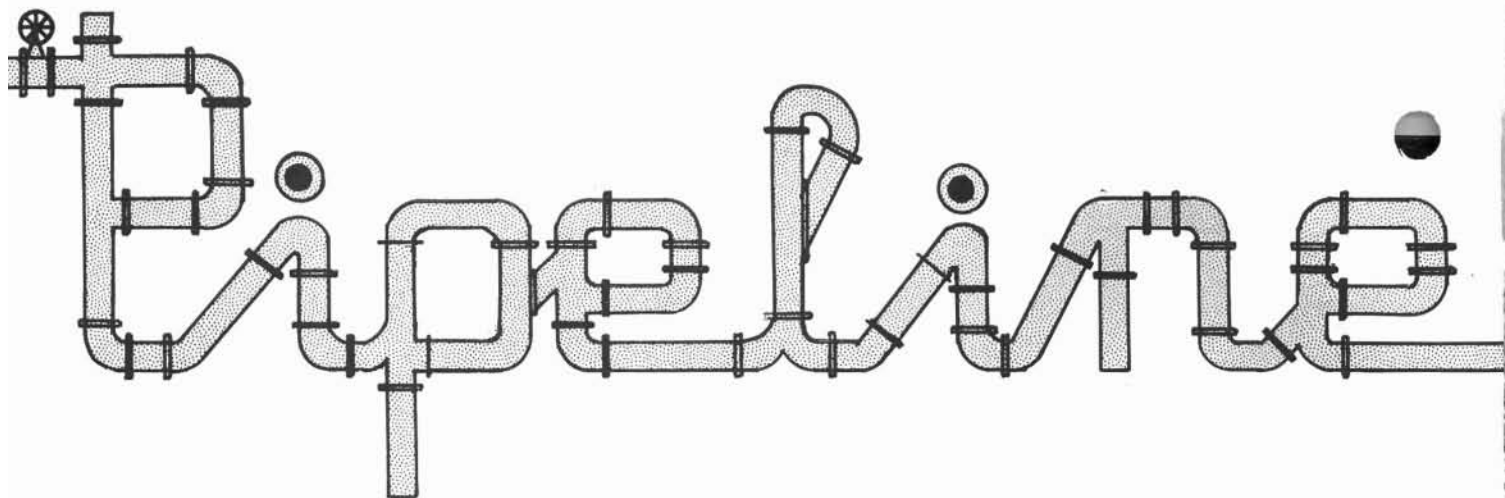
Art Director
John W. Savage, Jr.

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ABOUT THE COVER

Art Director John W. Savage, Jr., uses a scale model on the cover to point up the seriousness of man's battle to save his environment from the pollutants and waste that threaten the very air, water, and land on which he lives. The Corps' effort to do something about the problem is told in this issue.



ENGINEER OFFICERS MOBILIZED TO ASSIST AGNES FLOOD VICTIMS

In response to an emergency situation in five states resulting from the worst and most extensive flooding on record for the East coast, the President directed the Department of the Army to mobilize approximately 100 engineer officers.

More than 60 company grade officers from the Engineer Officer Advanced Course and about 20 field grade officers from the First Army area were alerted on Sunday afternoon, June 25, for departure on temporary duty to flood ravaged Pennsylvania, New York, North Carolina, Maryland, and Virginia the following morning.

According to Major General John W. Morris, Director of Civil Works for the Corps of Engineers, who briefed the alerted officers, action directed toward preventing the loss of human life was the priority mission. Disaster relief in the form of restoring lines of communication and removing debris left by Agnes comprised the mission for the remainder of the operation.

Officers who were selected for the task returned to their duties here at Fort Belvoir weeks later, after which local efforts were applied independently to restore life to its normal activity.

IMPACT STATEMENTS ON ENVIRONMENT PUBLISHED BY OCE

The Office, Chief of Engineers, has published a compilation of draft and final environmental impact statements prepared by the Corps of Engineers and filed with the Council on Environmental Quality during the first calendar quarter of 1972.

Copies of the current compilation (Vol. II, Jan.-Mar., 1972) and Volume I (1970-1971) are available upon request to: Public Affairs Office (DAEN-PA), Office of the Chief of Engineers, Washington, DC 20314.

SHORELINE EROSION COULD BECOME ALARMING PROBLEM

Current shore protection programs are not keeping pace with needs, according to a U.S. Army Corps of Engineers study of the National Shoreline.

This first study ever by the Corps of shoreline erosion has produced some startling findings.

- Erosion of about 43 percent of the 37,000 miles of U.S. shoreline outside of Alaska causes widespread loss of land and property. Life can be endangered within five

years in the most threatened areas.

- Measures to halt erosion appear justified for 2,700 miles of shoreline at an estimated cost of \$1.8-billion. The critically affected areas are 1,090 miles of North Atlantic coast, 1,110 miles on the South Atlantic and Gulf coasts, 220 miles of the Great Lakes, 80 miles in California, 70 miles of the North Pacific, 100 miles in Alaska, and 30 miles in Hawaii.

The report says first priority erosion control should be given to about 190 miles of shoreline where, if erosion is allowed to continue, public safety is likely to be threatened as early as 1976.

The coastal zone is growing more rapidly in population than other parts of the nation. In the past 10 years, 90 percent of the national population growth was in coastal states. The 30 coastal states have 75 percent of the nation's population and 12 of the 13 largest cities.

There are about 12,000 miles of beach frontage in the United States outside of Alaska. About one-fourth of the beach frontage has been developed for public recreation. Because many hundreds of millions of Americans visit the beaches each year, they are overcrowded and cannot satisfy foreseeable recreation demands.

This report by the Corps is the first over-all national appraisal of

shore erosion problems. After three centuries of focus on the interior of the nation, attention is coming back to the coastal zone.

In his annual report to Congress on marine resources and engineering development last year, President Richard M. Nixon said, "During the past few years no single body of marine problems has attracted as much attention as those encompassed in the U.S. coastal zone."

The study points out the importance of the shoreline by underlining the fact that it is the heart of the coastal zone. This is where, according to the report, land, people, and sea meet.

NUCLEAR POWER PLANT IS SLATED FOR DEACTIVATION

The Chief of Engineers has announced that the SM-1 Nuclear Power Plant at Fort Belvoir, Virginia, will be deactivated in May of 1973.

The SM-1 became operational in April, 1957, as the first of a family of nuclear power plants developed under a joint Atomic Energy Commission-Department of Defense program. It was built to train plant operators and accomplish research and development tasks for the three services.

The Army expects to continue

training for specific needs on a small scale using the existing reactor simulator and fuel handling facility at Belvoir, but in-plant operation will be conducted subsequently at the MH-1A site in the Canal Zone.

EIRs CAN SOLVE PROBLEMS WITH BAD HAND TOOLS

An Equipment Improvement Recommendation (EIR), prepared on DA Form 2407, may be the answer to problems you experience with hand tools when they don't hold up under normal use or just don't seem properly designed for the job the book says they can do.

The U.S. Army Mobility Equip-

ment Command (MECOM), the folks who are responsible for correcting these problems, cautions that you should not be misled by the title of the form into thinking it has application to major items of equipment only. If used properly, they say, you may never have to use your self-service supply money again to replace a new tool that has disintegrated in your hand the first time out of its box.

Stock up on DA 2407's and help MECOM keep you supplied with quality hand tools. Send your completed forms directly to: Commanding General, U.S. Army Mobility Equipment Command, ATTN: AMSME-MAO, 4300 Goodfellow Blvd., St. Louis, Missouri 63120.



This soldier from Company B, 79th Engineer Battalion, Karlsruhe, Germany, is at the controls of some real heavy equipment. Normally a five-ton driver, he can't say he is working outside his Military Occupational Specialty. But where do you get Army training for a pachyderm permit? The company is felling trees and doing earthmoving work at the Saarbruecken Zoo as part of a "Helping Hand" project. Why the elephant? Guess he wanted to pitch in too. After all, this is a project to enlarge the zoo complex and everyone knows elephants need all the room they can get.

engineer interview:

with major general Willard Roper

Now, more than at any other time in its long and impressive history, the U.S. Army Corps of Engineers is directing its considerable technical talents and professional expertise toward the mounting problems posed by pollution in the environment.

One of the most important aspects of the national effort to clean up the environment is effective management of waste water.

Proper waste water management will provide a source of added water supplies through recycling, permitting re-use by industry and agriculture and many other uses.

The Corps initiated its Waste Water Management Program last year, charging its Board of Engineers for Rivers and Harbors with responsibility for the program.

To find out first-hand the extent of the program and the progress being made in waste water management, the engineer interviewed Major General Willard Roper, Chairman of the Board of Engineers for Rivers and Harbors, who assumed that position in August, 1970. Prior to that, General Roper served for one year as Division Engineer of the Ohio River Division, U.S. Army Corps of Engineers, from 1966 until October, 1967, when he was assigned to Vietnam as Commanding General of the 18th Engineer Brigade and later as Commanding General, U.S. Army Construction Agency, Vietnam. He returned to the Ohio River Division in November, 1968.

During his more than 28 years of

military service, General Roper has held posts as Area Engineer on civil and military projects both here and abroad, as Engineer Staff Officer for the Chief of Engineers, as Commanding Officer of an Engineer Combat Group and with the U.S. Air Force Headquarters and SHAPE Headquarters in Paris.

General Roper is a graduate of the Massachusetts Institute of Technology, the Army Command and General Staff College, the Industrial College of the Armed Forces, and is a registered Professional Engineer in the District of Columbia.

Answers to a number of probing questions follow in this exclusive interview.

enr: General Roper, as Chairman of the Board of Engineers for Rivers and Harbors, you are heading up one of the most important projects the Corps of Engineers has ever undertaken. Would you give our readers an overview of the waste water management program?



"We should design systems . . ."

ROPER: Yes. Waste water management is a program of studies we were asked to undertake to examine the waste water problems of some of the metropolitan areas of the United States on a regional basis. We have started with five so-called pilot studies, which include the Merrimac Basin in New Hampshire and Massachusetts, the Cleveland-Akron area in Ohio, metropolitan Detroit, metropolitan Chicago and the San Francisco Bay area. As of now, we have produced feasibility studies of each. Although rather hastily done, they have demonstrated that a high level of treatment was obtainable by a number of alternative means. Since then, we have proceeded in accordance with the wishes of Congress and the administration, with detailed studies of four of these—all but the Merrimac area. In response to a specific request from the ad-



... to meet the needs of 1990."

ministration, we have produced a special report on the Chicago area. However, I don't want to imply that we are through with the Chicago study in saying this. We intend to finish the detailed survey reports, as we term them, by the end of 1972. These reports, in each case, should recommend a system for managing the waste water of the metropolitan area in sufficient detail to permit its authorization---presumably by certification to the Environmental Protection Agency and the allocation of matching funds under that agency's grant program.

enr: Was there any specific reason for choosing these five study areas?

ROPER: There were several factors influencing the decision. First, we wanted major metropolitan areas because we've always looked at water on a regional as opposed to a local basis. So it appeared that we could provide a regional approach to this problem. In addition, we had undertaken to do a detailed study of alternatives which would include land treatment as one. That's really how we got into the study. These considerations were certainly major factors in the initial selection of these specific areas. Secondly, these areas had major problems. And third, we had studies already underway on related problems in these areas. So we already had the necessary funds and authority to study water problems. Congress, through committee action and the administration, through Office of Management and Budget (OMB) action, authorized us to redirect the ongoing studies to look at this particular aspect.

enr: What sort of a connection do you have with the Environmental Protection Agency? Is there an inter-relationship between the Corps and EPA?



ROPER: Yes, in the conduct of the feasibility studies, we had a memorandum of agreement with the agency whereby we agreed to consult with them, work together and to accept their views on certain things. I think that it has worked out reasonably well, although the degree of coordination was less than we would have liked because we had to produce the feasibility studies in such a short period of time. We had to work them up between February and the first of August, 1971. In the conduct of the detailed studies, we are working with the Environmental Protection Agency in each of our field offices. We are also coordinating our activities with the states, which is equally important. Obviously, if we come up with a plan that is going to be carried out, it must be acceptable both to the state and to the EPA.

enr: How large a budget have you to run this program?

ROPER: We're talking in terms of study costs for a major metropolitan area in the order of \$1-million. So you can figure about \$5-million, roughly, for the five metropolitan areas. We will proceed with more as a result of action subsequent to the original direction. We are only referring to study activities now, so

when we speak about budget, we're talking about the budget to do the studies. The budget to carry out the actual work is something else again.

enr: How does the Federal money fit into the state plan?

ROPER: Well, let me touch on the five pilot studies. These are financed for planning by appropriations to the Corps of Engineers, and the outcome of the studies should be a report which will serve primarily two purposes. First, it will be a report which the state can use in seeking design and construction financing through normal channels---certification to the Environmental Protection Agency, and the receipt of a Federal grant under existing law. Secondly, it will constitute a report to Congress on what we have done---what plan we generated and recommended to the state. It will indicate also, as best we know it at the time, what the state intends to do with it.

enr: Has your assistance been requested by local communities?

ROPER: Well, in the original five, there was no initiative on the part of the localities to ask for assistance. The initiative, I think, really came from Washington---Congress and the OMB. Obviously, if the Congress asked us to do this, it reflected some interest on the part of local areas. However, on the subsequent studies and on the continuation of these studies, we have had resolutions in each case from the Public Works Committees of both houses of Congress which were initiated through the Congressional delegate and therefore reflect the desires of the local people or state interest.

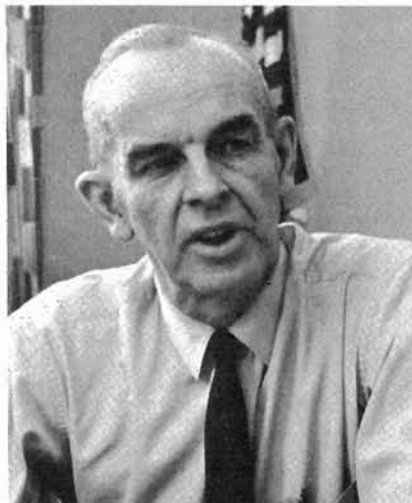
enr: What type of treatment process will be used in these areas? Are you leaning toward the chemical process, or land-fill?

ROPER: I wouldn't say that I had any preference. Philosophically, what we have said is that we are looking for a very high level of treatment. People have described this in many different ways. Some have said we want zero discharge, but zero discharge is a difficult term to interpret. If what is meant is zero as an absolute quantity---nothingness---then use of the term is meaningless. It's not attainable. Even if it could be attained, I doubt that it would be desirable, for the end product would be distilled water. I don't think we want distilled water in our streams, even if we could produce it at any kind of a sensible cost. So what we are talking about really is a high level which approaches zero, but without being absurd---and there are several different ways to do that, based on the existing treatment plants. Present treatment plants involve the primary treatment which, for the most part, is the removal of grit and debris and that sort of thing. Secondary treatment is a biological process which reduces the oxygen demand on streams and in the process takes out some other things too. This, basically, is the kind of treatment that we have in this country today. To achieve a higher degree of quality in waste effluent, chemical processes can be incorporated into that system. Some people refer to this as a tertiary treatment which results in a very high quality product. The same end can be attained by starting fresh, eliminating the biological process as a secondary, and just treating the waste water in a chemical-physical plant which provides a high level of treatment through a series of chemical and physical processes. The third alternative is to treat waste water up to a point and then, rather than run it through the advanced physical-chemical processes, put this water on land. Let it filter through the surface of the land to a depth of five or 10 feet---or

whatever depth is appropriate depending on the soil---, collect it in a system of under-drains and bring it somewhere for appropriate re-use. This also achieves a high level of quality. In the case of our Chicago study, in fact, it showed that we achieved a higher level of quality at lower cost by the land treatment than we did by the other two. In using a treatment plant approach, chemicals are mined from the earth, processed, then put into a plant somewhere to treat the water, leaving the problem of disposing of the solid residues. On the other hand, in a land treatment situation, the chemicals already exist in place, so all that is necessary is to get the waste water to the location where the chemicals exist and let the land---or nature---take its course, as it were.

enr: General, regarding this "living filter" system---has it been programmed and used in the past? We understand that it was used overseas. Is that correct?

ROPER: I suppose it's been used for eons. Even before man inhabited the earth, the natural fall of water contained some things which could be called contaminants. And those were filtered through the soil as they reached down into the ground water and into the rivers. So the soil has,



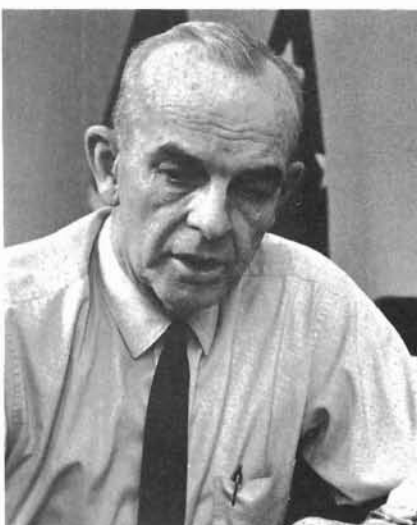
since the earth's creation, performed a cleaning or a cleansing function. But as to deliberate systems, trace can be found back in ancient history. Modern man has gone to something more sophisticated---namely, a plant arrangement of some kind. A few people have departed from that philosophy and have used, or are using land systems. Probably the largest one---and the one which has been in operation the longest period of time, at least that we know of---is in Melbourne, Australia. It handles the entire metropolitan waste from that city. Yet it is relatively primitive compared to the kind of systems that we're thinking about. But it has performed extremely well, and the land on which the waste is disposed has proved to be the basis for a very productive farming operation. There are other installations---some pilot work at Penn State University, for instance; and, more recently, a contract has been awarded for the construction of a major land disposal system at Muskegon, Michigan. Tallahassee, Florida uses a land disposal system which takes care of about 60 percent of that city's waste. So there are some systems in use here, but it has not been used on a large scale in the United States. There are a number of small ones---Golden Gate Park in San Francisco, for instance. A lot of golf courses around the country use them. There is a farm in Pennsylvania which operates on this basis. The largest that we know of, however---as I mentioned previously---is the one in Melbourne, Australia.

enr: General, would you describe briefly just how this filter system works? And what part lagoons have in its operation?

ROPER: Let me describe the concept that we developed for the Chicago area---and while this would not be precisely the same for any

other community, it would have many characteristics in common.

First, the system in the Chicago metropolitan area collects the waste. Included in that waste, as we define it, would be that from municipal sources, industrial sources and storm run-off. Rather than processing this waste water through a plant system, it is channeled into a tunnel and finally brought into one central tunnel which takes it out into a rural area about 50 miles south of the Chicago Loop. The total length of the main tunnel is about 100 miles. This waste water flows by gravity all the way to the terminus, which in this study is the Kankakee River Basin. At the terminus, the waste water is 1,100 feet underground in a tunnel about 25 feet in diameter in rock. At that point, a one million horsepower, or larger, pumping plant raises the water to the surface, after which it is put through what is called an aerated lagoon. Two of those are contemplated in Chicago. These are relatively small lagoons in which there is a device which bubbles air through the waste water. This, in turn, creates a situation which is equivalent to normal secondary treatment. From there the water is moved to eight storage lagoons. These are three miles on a side. So you have a total of 72 square miles of surface area, about 25-30 feet deep. The lagoons will handle storage for about 150 days of flow, which is necessary because it cannot be disposed on land in the winter or when it is raining. The next step involves removal of the water from the storage lagoons, chlorination and transmission out into the land disposal area where big, low-pressure spray irrigation rigs of the kind that may be seen out west are employed to spray it onto the ground. It filters through the soil to a depth of from five to 10 feet where it gathers in underdrains and is brought back to the other side of



the area and channeled into a conduit so that it flows back into the Chicago metropolitan area by gravity. At that point it enters the Little Calumet River. Part of it is diverted into Lake Michigan and part of it down the river system.

enrg: After that water is filtered through the ground---is it potable?

ROPER: Oh yes, it's better---within drinking water standards. The amount of phosphorous in it, for example, is so minute that it's about equivalent to that found in natural ground water that has not been tampered with in any way by man. It has no viruses, no pathogens, no trace of metals. It has a few things---residues---which might be called contaminants, but they are at levels that are minimal. It is an extremely high quality product. In fact, it's a higher quality product than can be obtained from any plant-type treatment system that we know of today.

enrg: Then this a much more economical system than the chemical process which you mentioned previously?

ROPER: In the Chicago study it shows up quite favorably from a cost viewpoint---not only with respect to capital cost, but also with

respect to operating and maintenance costs. I wouldn't guarantee that it would always be the most economical solution. I can conceive of situations where perhaps the distance this water would have to be moved for disposal would run the cost up to an unacceptable figure. Or difficulty in finding proper soil would create problems. I think we really have to study each area on its own merits and look at the alternatives, or combination of alternatives, to see which is the best solution for that particular area.

enrg: General, there have been a number of solutions advanced as to how to dispose of sludges---dump them in deep water---bury them in landfills---but such methods are being frowned on today. What are you doing about them? Is it true that they are being used for soil conditioning and fertilizer?

ROPER: First, you must recognize that we are not really doing anything with them at all. We are doing some planning for what we think should be done with them. Sludges from any one of the systems---whether it's a land disposal system which has sludge, or a treatment plant system of either type I mentioned earlier---contain solid material which must be disposed of, and I think it's foolish to waste it by burning it, dumping it at sea or by burying it deep in a land fill. There are many very valuable assets in that sludge and the logical thing to do is to make use of it. The best way is to use it on top soil in qualities that permit beneficial use. What it amounts to, and again I use the Chicago study as an example---the sludge from the advance biological system would be taken to the same area we envision using for the land treatment system, disposed of on the ground and cultivated for crops. The area, of course, would be much smaller than that required for a

complete land disposal system in which the land is irrigated with waste water after having removed some sludge. Identical procedures are used in the physical-chemical system. The sludge is taken to the same area, spread on the ground and used. One difference does enter the picture here. The sludges pose more problems because of the type of treatment, and the rate of application therefore has to be much less which necessitates a much larger area. For land treatment systems, the storage lagoons previously mentioned accumulate sludge on the bottom very slowly. After a number of years---probably 10 to 15---a hydraulic dredge would be required to remove the sludge from the bottom of the lagoon and dispose of it again on land. In the interest of economy, it would be disposed of in the area immediately adjacent to the lagoon so as to reduce transmission costs. I think it's been but very recently that people have given serious considerations to making some really beneficial use of sludges. I think it's an excellent material for agricultural purposes if used properly. So it just seems only sensible that's the way it should be used. In fact, if you want to get down to a kind of basic philosophy, a pollutant is just an asset out of place. If you can collect these pollutants and do something useful with them, it just makes good economic sense, and good ecological sense to do so.

enr: Would this sludge have to be mixed in a ratio with other material to make it useable?

ROPER: Only with soil, I would say, as a general observation. It would have to be applied to the soil at such a rate whereby it wouldn't build up beyond the point where it would be useable. Heavy metals, for instance, can be accommodated in the soil and in the plant life, provided there isn't too high of a con-

centration. So for each type sludge, the disposal system would have to be designed accordingly.

enr: How long have you been conducting these in-depth studies?

ROPER: We began with the feasibility studies in February, 1971. Feasibility reports went forward in August, 1971, and we embarked on the more detailed studies beginning in December. We intend to complete the detailed studies in the four areas in which we are proceeding by the end of this calendar year.

enr: Do you have a five-year plan in which you expect to have your universal type system in effect?

ROPER: Well, at the moment there is no precise timetable. Bills have been enacted in both the Senate and the House, which set some dates for completion of planning, for example, but obviously the rate at which we accomplish plans depends on many factors. One would be the number of studies we are called upon to do. Another, of course, is the amount of funds made available to us. For any given study, we are thinking in terms of from two to two and one-half years for completion of a sufficiently detailed study which would permit somebody to use that plan for translation into de-



tailed engineering construction. Regarding the total program we have right now, I mentioned the five pilot studies, of which four are proceeding into the detailed stage. The fifth one will do so eventually, although probably in a somewhat different form---perhaps I should say a bit different area coverage. The other four are in a detailed study stage and will continue. More or less concurrently with those studies, we undertook two others in response to appropriate authorization. One was a study of the Cuyahoga River which flows through Cleveland, Ohio, a river which has caught fire a couple of times. Basically, we have authority to establish a plan, subject to the approval of the Secretary of the Army, to restore that river to good quality. Actually, the waste water study of the Cleveland-Akron area has taken over the authorization that was originally in the Cuyahoga study to a great extent, although we are doing both concurrently. The Cuyahoga study will be somewhat of a peripheral study to the central one, which is Cleveland-Akron. Another small study we re-oriented involved the Codorus Creek, a tributary of the Susquehanna. That study is essentially complete and will be available for review by the Board of Engineers for Rivers and Harbors within the next month or two. It is a waste water study, undertaken as a part of the Susquehanna study. During the Fiscal 1972 appropriation hearings, two additional studies were added by Congress---a waste water study of the Colorado River in Texas, and an urban study for Omaha. Both are in the pilot study stage at the moment. An urban study is a bit different than a waste water study in that it includes a wider range of water problems. Waste water is, however, an integral, and in some cases, the dominant component. Confining a study to waste water alone is somewhat difficult because it has a bearing on

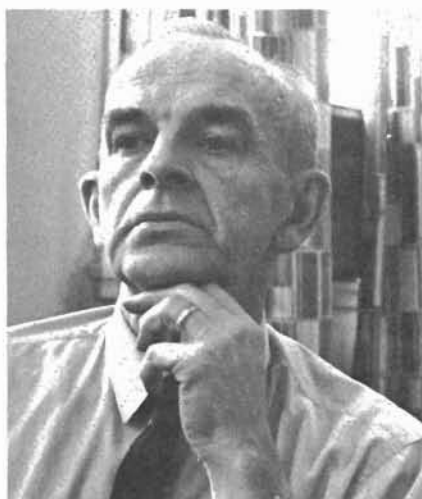
storm water and this, in turn, bears on storm water design for flooding, which relates to water supply and perhaps recreation---the whole range of water problems for any metropolitan area. The newer studies, therefore, are broader in scope, but retain waste water as a central feature. The President's budget for Fiscal Year 1973 proposes seven more studies---at Seattle in Puget Sound, Spokane, Boise, Duluth, St. Louis, Kansas City and Denver.

enr: These are all in your new starts?

ROPER: These are in the proposed new starts in the President's budget. In addition, we have received resolutions from the Congressional Public Works Committees for quite a number of others. Of course, a resolution carries no money with it, but we have resolutions on Atlanta, New Orleans, Baton Rouge, Miami, Louisville, Lexington and Frankfort, Kentucky. As we have gotten into this program it has appealed to many people---they see that it is logical for an agency that's been in the water business for a long time to come in and try to come up with something a little different than the conventional processes which so many people have found unsatisfactory under today's standards.

enr: How will the Corps fit in to this over-all picture? Will you provide the expertise for each of these local or state communities?

ROPER: I would say not necessarily. A lot is going to depend on what the local people want. Right now, they have three options if they want to plan a system. They can do it themselves. So long as they meet the established standards, no one will question that. Another alternative is to seek a grant through the Environmental Protection Agency



for planning. Today a grant can be obtained to cover as much as 50 percent of the planning costs. If they proceed in either of these ways, they will get some technical assistance of some type from the Environmental Protection Agency. The third alternative is to seek a necessary appropriation from the Congress for the Corps to come in and do a study. In cases involving the waste water management element, the local community must contribute to the effort so that it thus becomes a truly joint Federal/non-Federal undertaking. So those are their choices---they can go it alone, they can get a grant from EPA, or they can come to the Corps. I think more and more people feel that we have something extra to offer. I think that they are attracted to the kind of planning we are prepared to do. I don't mean to say that everybody is going to ask us to do it---I'm sure there will be some who would rather do it themselves for a number of reasons---with a grant preferably or without a grant if necessary. But the way this program planning seems to be catching on around the country, it would appear that we are going to have a pretty large and diverse undertaking for future studies.

enr: Don't you think this program is long overdue?

ROPER: Oh, I do. I think that in this country we have not really been aware until very recently what we were doing to our waters. We have tended to let economics dominate our thinking without realizing that if the problem was considered in the light of true economics the old way of doing things is no longer satisfactory. In other words, it makes good economic sense to try to produce a much higher quality in our streams than we have allowed to be created in recent years.

enr: Do you think this problem will be solved within the next five year period?

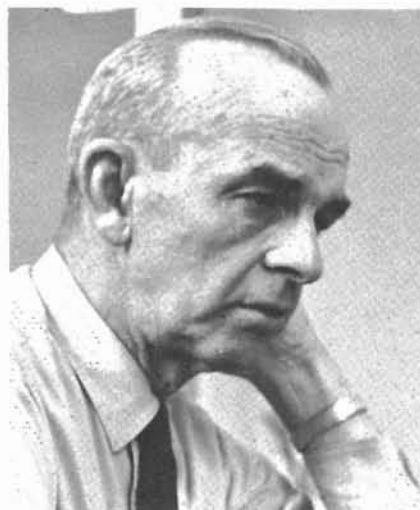
ROPER: It's hard to say. It is rather difficult to predict what studies we'll be asked to do, or what appropriations we will get. One of the foremost questions in my mind is when will somebody do something with one of these plans after we produce them? This is not within our control. I would say that within a few years we could cover at least the major problem areas in this country with plans of the kind I've been describing. But how long it would take to cover the entire country, and how long it would take the country to pick up these plans and translate them into effective action, I wouldn't venture to guess.

enr: What about the poor sewage? You have waste flow triggered by storms or heavy rains, and there are many poor sewage systems throughout the country---in Chicago or Los Angeles, for instance. How do you intend to tackle this problem? Will you ask for new sewage systems? Exactly how do you propose to improve that situation?

ROPER: Again, let's take the Chicago metropolitan area for example. Under these systems for which we have tentative designs, we

would design the plans for the land treatment facility to accommodate the municipal flow, which is pretty predictable---the industrial flow, which is also pretty predictable---the suburban, urban and rural storm water run-off up to the 100-year frequency storm. Beyond the 100-year frequency, if you have a storm of greater magnitude than that some of this storm run-off would have to be diverted to by-pass the treatment facility. However, at that point in time in a rainstorm the storm run-off is not very contaminated. It's relatively clean and, from drinking water standards, it is still a pretty acceptable product. It's the first couple of inches that really give you difficulty. Now---how do you do that? The concept in Chicago is to establish what, in effect, would be reservoirs at each of the the treatment plants or at each of the major intakes for the land treatment system. Also, abandoned quarries have been identified in each location as being quite suitable for this---except in one place, where it would be proposed to use an existing mine. When the storm water begins to come in and the capacity of the plant is exceeded, it would be put into this holding area rather than diverted to streams and then processed through the plant as the loads gradually increase. For the rural areas, we have suggested creation of a system of 400 small reservoirs or ponds or detention bases in the existing streams which would collect the storm water run-off and hold it. It could then be used for recreation, fishing and wild-life purposes, and so on. When the lands begin to dry out during the summer, the water would be put back on the farms from which it came by means of an irrigation process, or a spray irrigation system. The system which is described in the special study for Chicago collects all of the municipal waste, plus all of the storm run-off from the urban, suburban and rural

areas up to the 100-year figures. In speaking of the industrial component of this waste, it should be realized that there will be a few things which none of these systems could accommodate. An example would be some of the toxics which industry would have to remove before putting that waste into the system. What we're talking about are minute loads in terms of volume. One other thing I'd like to point out is that if the water is cleaned up more is accomplished than just the cleansing. It provides an opportunity for re-cycling and re-use---which might better be called water supply. I can visualize, for example, in the middle portion of the Colorado River in Texas, that the most sensible way to create additional water supply there would be to clean up the waste water and then use it for the water supply, rather than bringing water in from some unknown and distant source. This would be true anywhere. If there is good clean water in the effluent returning to streams and lakes, then it is there to use and, of course, it could be used for many things. A land treatment system offers some other possibilities. I mentioned the storage lagoons in the land treatment area---there's an awful lot of water in those. In fact, there's enough water there to support the cooling of eleven 5,000



megawatt nuclear power plants, which would meet the needs of the Chicago area to the year 2,000. Speculate on the introduction of those power plants for a moment. They wouldn't be in a location that would bother anyone. They wouldn't be on the lake front. They wouldn't be on the rivers. They would be in a location accessible to plenty of water for cooling purposes, which would preclude the necessity of cooling towers and comparable systems. Actually, some improvement to the sewage treatment program would be realized, because by having that water warmer at the land treatment site it could be put on colder ground and perhaps prolong the season for irrigation. This could result in a beneficial digestive process. Finally, revenues would be derived from taxes for land use and water supply which would go a long way toward paying for the construction, operation and maintenance of this entire system. There also may be possibilities for incorporating solid waste disposal. Some of the old treatment plants, for instance, could be abandoned if these new systems were adopted---whether it be a land type system or a plant type system. In addition, it may very well be that some of those abandoned plants could be put to other uses for the benefit of the community. There are also other possibilities. By bringing this clean water into Lake Michigan a basis for using it later on would be established. In other words, use Lake Michigan as a reservoir. Put more water in there than is required under the law, keep it there, and take it out when needed for some other purpose. I also think there are some significant economical opportunities associated with this system that are not readily identified and which we did not try to cost in any way in our Chicago study. We identified them and gave some order of magnitude in a couple of cases to

what it might be, but we didn't expect a reduction in the cost of the system to be realized from power revenues. There is still another factor which should be considered in the land disposal system. Several hundred acres of highly productive farm land will be created in an area which presently has very low productivity. This has some rather significant economic value.

enr: What would have happened had you identified these problems? How long do you think it would have taken for these large metropolitan areas to really deteriorate?

ROPER: I think the nation generally began to get concerned about this in the last five to 10 years. In some areas of the country, some things were done prior to that time. The fact that we have primary and secondary treatment would indicate that there has been some interest. But the present high intensity of interest has developed relatively recently. Of course, some progress has been made. It wasn't many years ago that most of the discharges into the Ohio River were completely untreatable while today more than 90 percent of the discharges get some kind of treatment. The Ohio River today is a better river than it was 10 years ago. On the other hand, I don't think our progress in putting treatment facilities on line, whether industrial or municipal, has kept pace with our population and economic growth. As a result, we're doing a better job of treatment than we did in the previous generation. We now have a lot more people and much more material to treat. We were, at best, holding our own, which people came to realize was not enough. This can be seen in certain specific cases. For instance, Lake Erie has been called a dying lake---which it isn't by any manner of means. There are a lot of prob-



lems in Lake Erie caused to a very considerable extent by nutrients such as phosphorous and nitrogen that get into the lake in too large a quantity as a result of the treatment system. Here then, is another case where the land treatment in Chicago looks awfully good because there, for all practical purposes, phosphorous is eliminated as a problem. The treatment plant alternative, although satisfactory, does not accomplish that degree of elimination. When we first started working with water, people were interested primarily in navigation. Our first undertaking, I suppose, was the clearing and snagging work that was started on the Ohio River back in 1824. We stayed with nothing but navigation for many, many years. Then people started worrying about flood control. The worry started in the lower Mississippi Basin where the problem was most severe. It gradually became identified as a national problem because of a bigger concentration of people and the tendency to build in the flood plain and so on. Actually, we got into flood in some places fairly early. But the big push for us to get involved in flood control started in 1930 after the big floods---particularly on the Ohio. We picked up hydroelectric power as sort of an adjunct to flood control. If you build a reservoir, why

not generate some power while you're at it to help pay for it? And I suppose when the Bureau of Reclamation came into the picture, irrigation became a purpose which we also included among our projects. After World War II, we began to develop a real interest in recreation. We found that these reservoirs which we had built without any recreational facilities suddenly became magnets and attracted millions of people. So the Congress gradually responded to the desires of the people and enacted legislation which allowed us to incorporate the recreation feature. Now the national interest has moved into another area---the purity of water in the streams. What we are doing today is in response to that national demand just as back in 1924 it was responsive to navigation improvement.

enr: The environment today is one of the big programs and we would think that the waste water program is going to be a large factor in cleaning up the environment.

ROPER: There's no question about that. It certainly is a major aspect of the environment.

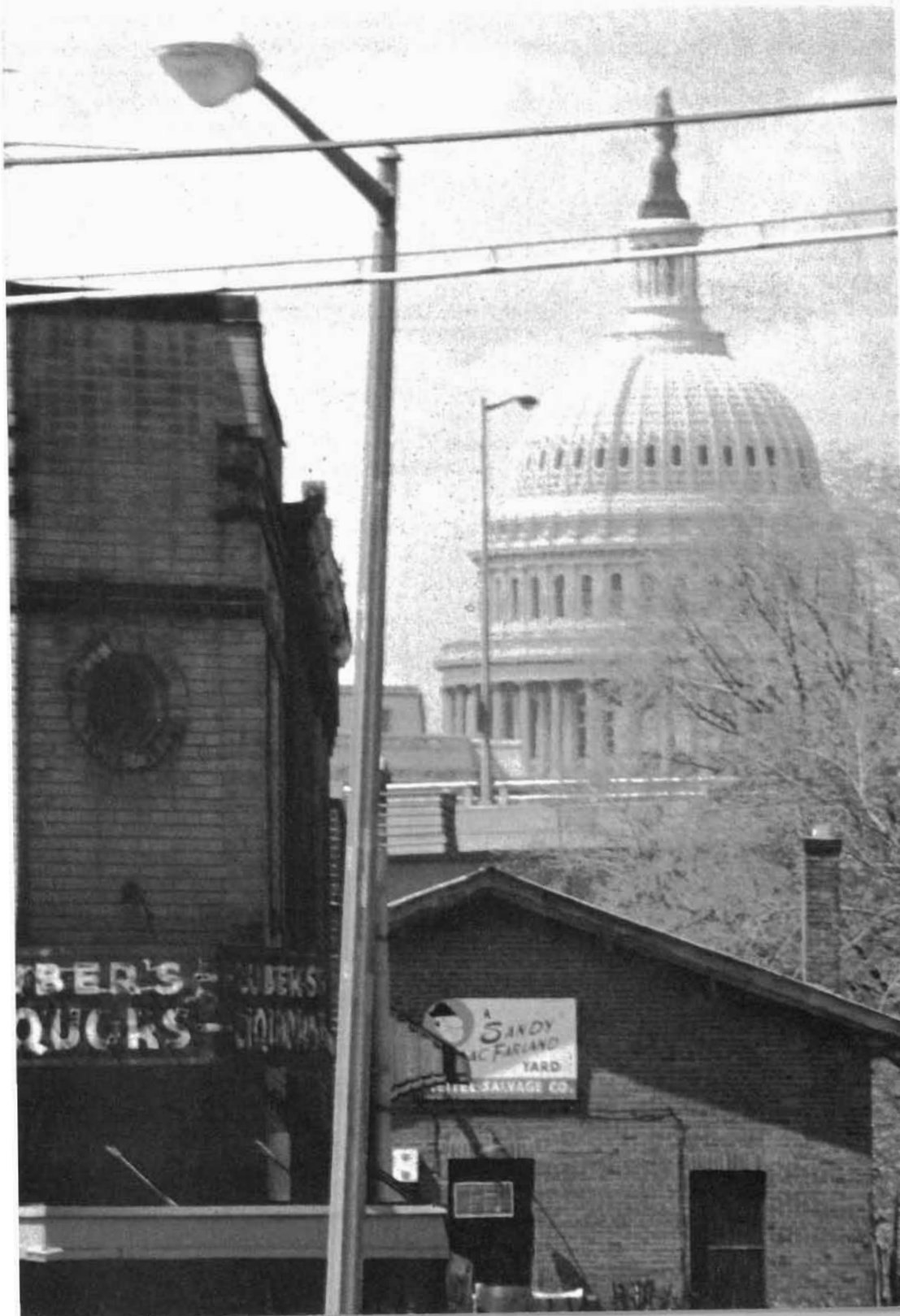
enr: Is there any major area in the United States where you really do not have a waste water pollution problem right now? If the answer is no, do you have any kind of hopeful time schedule that we can expect positive action?

ROPER: The answer is no. We will produce studies for four of those troublesome areas by the end of this year and even before that we'll produce a study for a small troublesome area and put it on the street. From then on it's up to others as to how fast they want to go. We can't control that. What we have said was that we should design systems to meet the needs of the year 1990, but with components which would fit the most urgent character. 

America the Beautiful---

Oh beautiful...

for spacious skies...



for purple mountains

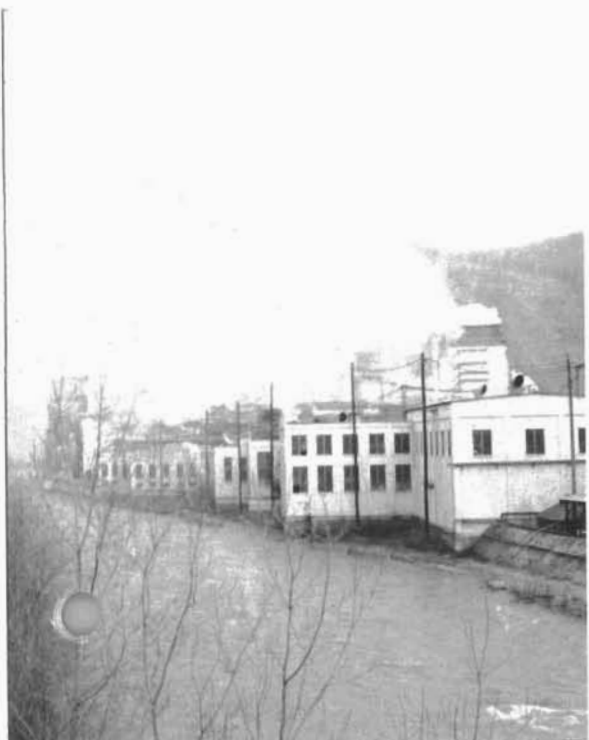




ENGINEER STAFF

in retrospect

for amber waves of grain...



majesty...

above the fruited plain.



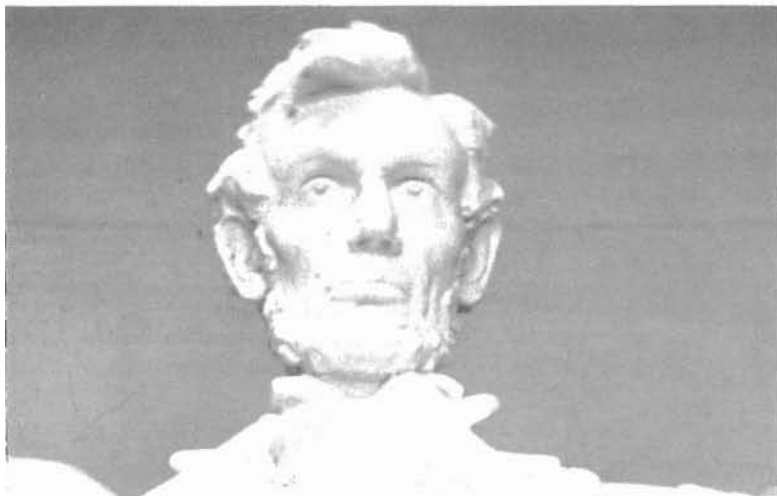
America, America...



God shed His grace on thee...



and crown thy good with brotherhood...



The alarm has been sounded. It has been heard by all and as the debate rages over how badly man's technological advances have damaged the environment, the engineer has taken an objective approach. It has been said that man has terribly upset the ecological balance of his planet with his "soft living" habits. It also has been said that the so-called "environmental emergency" is nothing more than poor management of scientific and technological problems. These photos were taken by engineer staffers within a 200-mile radius of the Nation's Capitol. They prove that there is a pollution problem and that we must act---NOW! e

from sea to shining sea.



AMERICA'S LEANING TOWER OF PISA

Capt. Mark W. Miller

One of the most famous European landmarks still stands today in all its splendor in Pisa, Italy. But the "Leaning Tower of Pisa," as any engineer knows, is the premier example of foundation failure. Completed in the 14th century on an uneven subsoil of volcanic ash, the tower is now more than 17 feet out of plumb in a height of 179 feet.

And the United States almost compounded this engineering imperfection with an infamous landmark of its own—the Washington Monument. Needless to say, if the monument that was erected in the Nation's capital to honor the "Father of our Country," today had a tilt comparable to the "Leaning Tower of Pisa," the structure not only would be degrading to the man it purports to revere but embarrassing to the country and engineers who condoned its construction.

How many persons know that the Washington Monument had, in fact, moved out of plumb before it was even one-third completed? Not many! And how many engineers realize that the difficult task of completing the "leaning" monument was assigned to the U.S. Army Corps of Engineers?

The construction of the monument originally was launched in 1848 by civilian engineers under the direction of the Washington National Monument Society. Within six years, however, the Society had exhausted all of its funds and had to stop construction at the 156-foot-level. In 1876, some 22 years later, Congress appropriated the necessary funds to resume the construction under government ownership and by the direction of the Corps of Engineers.

Before beginning construction, the Corps examined the sufficiency of the foundation and found three major problems: One, the foundation rested upon a compressible layer of fine sand and clay that was already loaded to its limit. Two, the foundation was out of plumb and this was causing the top of the monument to tip 1.4 inches to the northwest. Three, additional weight, naturally, would increase the total amount of the inclination.

The first construction the Corps undertook, therefore, was to strengthen and enlarge the original foundation. To accomplish this task, 70 percent of the earth upon which the monument stood was removed from around the perimeter of the old foundation and replaced with a concrete slab 13.5 feet thick.

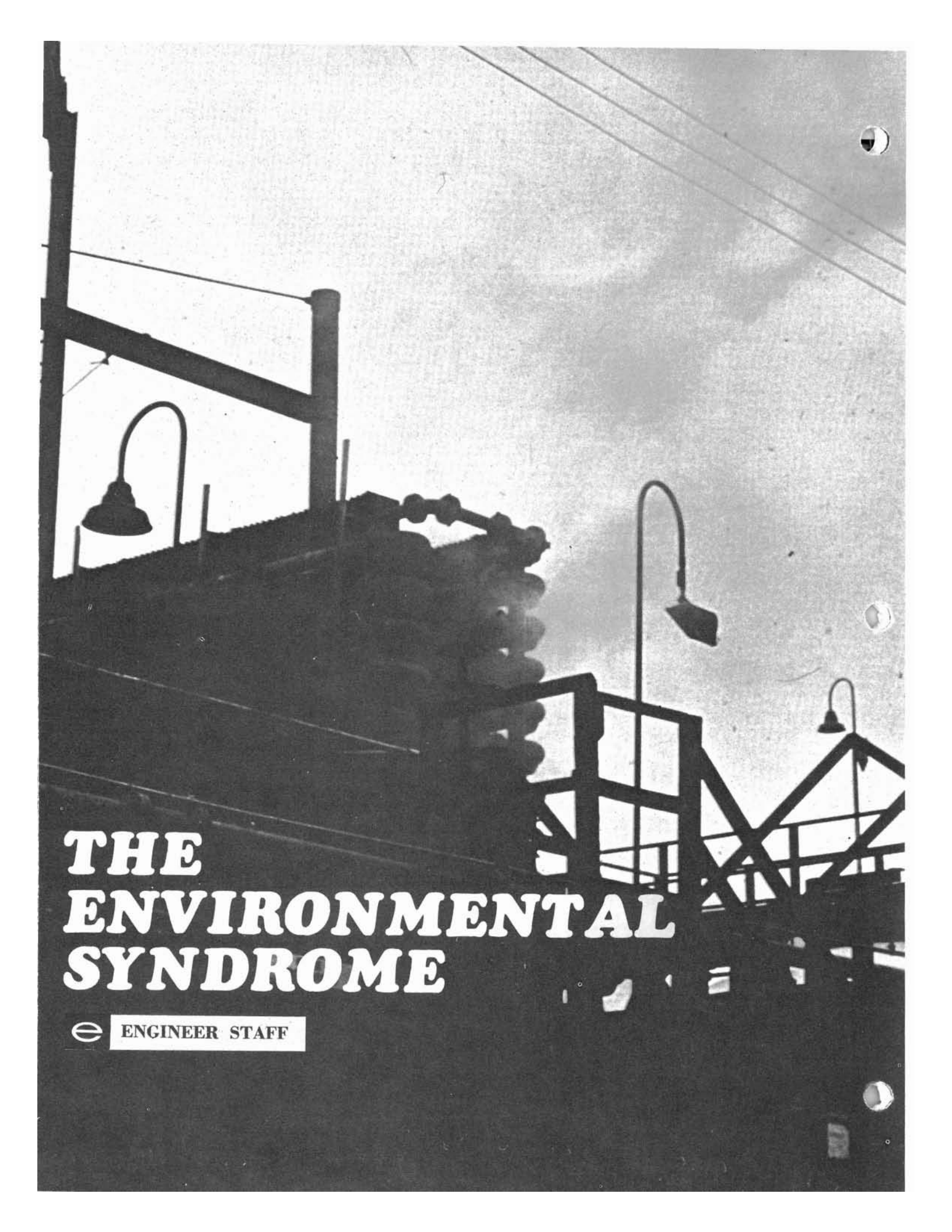
The effect of this effort was to enlarge the pyramidal shaped base from 80 to 126.5 feet square and from 23.33 to 36.83 feet deep. Next, concrete underpinnings were built out onto the new slab, requiring the removal of 51 percent of the old foundation. These buttresses served to distribute the weight of the monument over the entire surface area of the enlarged foundation base.

This difficult and delicate excavation work was not completed without some disturbance to the 156-foot in-place column. The entire column settled an average of two inches, with the southeast corner settling almost .5 inches more than the northwest corner. This uneven settlement, however, was completely controlled by the engineers and actually served to straighten the monument from its known deflection of 1.4 inches northwest into a vertical position. Furthermore, this truly remarkable engineering achievement did not cause the slightest crack in any joint of the monument.

In 1880, after three years of diligent effort, the foundation work was completed. The remainder of the monument's construction was accomplished quite rapidly, except for occasional delays caused by material shortages.

When the engineers placed the capstone at the 555-foot-5⅞-inch level in December of 1884, the Corps completed a distinguished chapter in its growing history. It is perhaps not so surprising to note that Lieutenant Colonel Thomas L. Casey, the officer responsible for strengthening the foundation and completing the structure to its full height, became the U.S. Army's Chief of Engineers only four years later. 

Captain Mark W. Miller is a recent graduate of the Engineer Officer Advanced Course at Fort Belvoir, Virginia. A graduate of the United States Military Academy, he was recently presented the Henry Larcom Abbot Award for excellence in writing based on his presentation of "America's Leaning Tower of Pisa."



THE ENVIRONMENTAL SYNDROME



ENGINEER STAFF

Therefore shall the land mourn, and everyone that dwelleth therein shall languish with the beasts of the field, and with the fowls of heaven; yea, the fishes of the sea also shall be taken away.

Holy Bible Hosea 4:3

Once again the bugler's call for help has been sounded to the U.S. Army Corps of Engineers. Neither is the enemy armed nor will the fight be waged in some remote corner of the world 10,000 miles away. The enemy is pollution and the battle will be fought "in our own backyard."

The fight is on to save the environment of this nation, and the Corps has been tasked to draft a battle plan. The Department of Defense and the Environmental Protection Agency will lend all possible assistance, but the onus for actual work has been placed directly in the able hands of the Corps of Engineers.

Some experts, however, regard this action as being about 70 years too late. They regard America as already being in an advanced state of environmental decay because of negligence. At some point in time over the past three-quarters of a century, those charged with care of the patient began to pay less and less attention to its health. Now the remedial measures that are expected to provide some relief may well prove to be ineffective. The underlying cause of the illness has been diagnosed as "environmental neglect." Many are responsible.

At one time the air was pure, the earth was fertile and water was sparkling clean—long ago, before man inhabited the land. As we now move into "the environmental decade," we do so with the realization that pollutants have begun to threaten man's very existence.

The natural environment has suffered from technological progress and modern man's "instant" life style. The true culprit is man. The Corps must find the answers to many complex questions in this ecological struggle for survival. In the process, it may well be determined that man himself has only himself to blame.

The battle plan calls for two Corps of Engineers directorates—Military Construction and Civil Works—to carry the fight on all fronts against pollution.

The Directorate of Military Construction, headed by Major General D. A. Raymond, is charged with the tremendous responsibility of eliminating pollution from within the Army establishment. The Civil Works Directorate, under the leadership of Major General John W. Morris, is deeply concerned with and involved in conservation-related fields.

President Richard M. Nixon has called this the "environmental decade," and has taken definitive ac-

tion to counteract many of the harmful practices that are responsible for the alarming deterioration in the environmental and ecological condition of America.

When the President signed the National Environmental Policy Act (Public Law 91-190) into law on January 1, 1970, the national policy governing environment changed. The new law directed the U.S. Army, among other Federal agencies, to carefully consider factors having possible influence on the environment in their decision-making process or in making a determination as to a course of action. Federal agencies can no longer slight environmental concerns in pursuit of accomplishing their primary missions without definitive plans to offset the development of possible harmful side effects. In the past, traditional quantitative factors such as costs involved and engineering feasibility for a project, usually took precedence over in-depth consideration of the environmental impact. This is no longer true.

It is anticipated that controls for the protection and enhancement of the human environment—Federal, regional, state, and local—will, in the near future, become more and more rigid.

President Nixon has proposed a number of pollution control measures which are applicable to Army posts, camps, and stations. He has asked for an improved program to cleanse our waters, and to recycle wastes into useable materials. Under his recommended program, the use of pesticides will be restricted. Precipitate poisons will be banned on public lands, and toxic wastes will be regulated. By 1976, sulphur oxide expelled from smokestacks will be curtailed and the monies available for research into noise abatement will be increased.

The Corps of Engineers will play a major role in implementing, in detail, the broad guidelines set forth by the President. In fact, the Department of Defense and the Army, through the Chief of Engineers, Lieutenant General Frederick J. Clarke, already have taken steps to upgrade the operation and design of existing Army facilities by providing for research in support of master planning, design, construction, operation, maintenance, and disposition of such facilities. These activities are in various stages of planning and implementation today.

Concurrently with this program of qualitative improvement of existing military facilities to conform to current air and water pollution standards, the Chief of Engineers also faces the need for identifying the Army's role in environmental protection and enhancement in connection with short, intermediate, and long-range military construction.

The Corps is continually engaged in construction projects to insure that existing Army facilities conform

Petroleum contamination of open streams, such as this one, leaves damaging effects on the woody vegetation around the banks. The effects have been verified by analyzing tree ring growth over periods of time, ranging as long as 15 years.



to current water and air pollution safeguards. In these two vital areas, the Army has more than doubled monies spent on water pollution control safeguards—from \$16-million in FY 1968, to almost \$35-million in FY 1972. In FY 1972, fund expenditures for air pollution control safeguards were 15 times those of FY 1968.

The water pollution control program involves a number of various types of projects, such as secondary sewage treatment, industrial waste treatment, washrack grease interceptors, separation of storm and sanitary sewers, and waste neutralization.

Air pollution control embraces such projects as fuel conversion, substitution of land fills for incinerators, precipitators for boilers, and fume scrubbers. Most of these pollution control measures are state-of-the-art applications. Quite recently, however, the Army came up with a solution to a nagging pollution problem which it anticipates will have a far-reaching impact on—and prove to be advantageous to—industrial firms.

A forthcoming project, sponsored jointly by the Army and the Environmental Protection Agency, is designed to demonstrate to industry a means of controlling nitrogen oxide emissions from nitric acid plants. The Army has several such plants and is deeply concerned with the latest developments in nitrogen oxide control. One such plant is at the Holston Army Ammunition Plant at Kingsport, Tennessee.

The planned project involves the demonstration of a molecular sieve which has been developed by the U.S. Army Construction Engineering Research Laboratory to control nitrogen oxide emissions from nitric acid plants.

The molecular sieve process involves a catalyst bed which absorbs the oxides of nitrogen. It is regenerated periodically by driving off the nitrogen oxide with heated air and returning its concentrated steam to the manufacturing process.

Engineer experts in the field say the demonstration should prove it possible to meet current emission standards promulgated by the Environmental Protection Agency and, hopefully, will enhance future standards by achieving emission of one-quarter of that being expelled into the atmosphere today.

The Corps recognizes that one of the more important aspects of the battle against pollution is the necessity of educating those in positions of responsibility where corrective measures can be initiated. The Office of the Chief of Engineers has embarked upon a program designed to insure that all possible information available is disseminated to engineering personnel through a series of five-day environmental workshops conducted at field and headquarters activities for those actively involved. In these workshops, students and instructors exchange information on environmental problems, new technology, and possible solutions to the problems which pollution imposes. They also review current Federal laws and guidelines, and particular emphasis is placed on the requirements for Corps "Environmental Impact Statements." Thus far, the workshop approach has been acclaimed a success because it has brought into sharper focus problems connected with the improvement of environmental pollution as related to the planning, designing, constructing, and operation of military installations.

The Chief of Engineers has been constant in his



Stream pollution is often caused by the structural failure of the storm drain and outlet energy dissipator. When this happens, as pictured here, the unstable downstream channel is scoured.

efforts to keep abreast of such problems involving Army construction. A modest research effort was made in 1970 to determine the immediate, mid-range and long range needs of Army construction. For these categories, the objectives established were—

- Immediate—to provide assistance in meeting present standards.
- Mid-Range—to provide the means with which to apply the “best Practical Technology” by 1976.
- Long-Range—to provide a way to reach zero pollutant emission by 1981.

The Corps also is trying to provide all possible practical means of enhancing the quality of the human environment on military installations. New information will be reflected as guidance in appropriate Engineer design and construction manuals, guide specifications, and directives.

At the installation level, the Facilities Engineer is tasked with the responsibility of influencing the quality of the environment. How well his organization collects, treats, controls, and disposes of such forms of waste as domestic sewage, industrial wastes, solid waste in the form of garbage, stack emissions and fly ash from heating plants, and vehicle exhaust emissions, will have a direct bearing on the quality of both the environment at the facility as well as the environment immediately surrounding it.

The Engineer Research Systems Laboratory has been busy too. In 1971, the laboratory program was directed primarily toward assisting management in defining the environment and in the preparation of environmental impact statements. To date, the Corps has filed 542 environmental impact statements (236

drafts and 306 final statements) with the Council on Environmental Quality. Steps were also taken to find ways to abate pollution by classifying effluent characteristics, by defining impacts associated with all categories of construction operations and by developing criteria for separation of housing and noise sources.

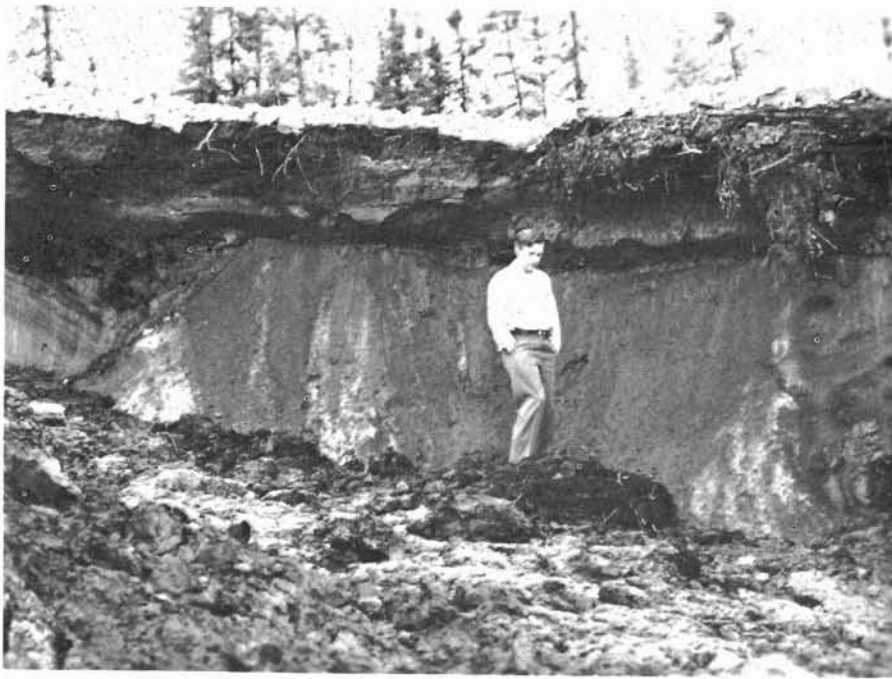
The Corps has initiated contracts with two schools that may have interesting results. One was initiated in 1970 with the Florida Institute of Technology to conduct basic studies of the effects of gamma radiation. Hopefully, these basic studies will determine the economics and effectiveness of radiation for sewage treatment or the recycling of waste water.

The second significant contract was initiated in 1971 with the Virginia Military Institute Research Laboratories. Its purpose was to develop detailed information and to analyze environmental impacts associated with all known categories of construction operations such as large scale land clearing, burning, excavation, blasting, paving, and building. Information generated by this contract is expected to define areas in which the Army can take corrective action in those troop and contract construction activities which introduce air and water pollution or adversely effect the quality of the human environment in other ways.

Corps of Engineers plans for Calendar Year 1972 include increased efforts in environmental quality management, pollution abatement, and utilities conservation.

The expanded program in environmental quality management will—

- Define environmental decision points associated with planning.



Permafrost degradation is common in Arctic and sub-Arctic regions. It takes only one summer season in those areas for exposed ice and permafrost to melt enough to cause the erosion that has severely lowered the surface of the embankment pictured here to this degree. In this particular case, it is hoped that the vegetative mat will eventually slump over the bank to control further degradation.

- Develop sources of information and procedures for environmental impact assessment.
- Develop automated environmental data.
- Review and exploit technology developments.
- Develop methods of defining site environmental characteristics or base line data.

The expanded pollution abatement program will—

- Complete definition of effluent characteristics now and in the future.
- Evaluate construction activity impacts and means for controlling them.
- Evaluate performance and cost of existing abatement systems and define any needed revisions.
- Develop advanced abatement systems.
- Define solid waste management techniques for theater of operations.

The expanded utilities conservation program will—

- Develop overall installation (community) concepts for reducing the magnitude of pollution sources such as fuel combustion, solid and liquid waste, and water consumption.
- Review and improve operating and maintenance procedures.
- Evaluate potential of low pollution energy sources.

All of these programs are being planned and conducted at the U.S. Army Construction Engineering Research Laboratory, the U.S. Army Cold Regions Research and Engineering Laboratory, the U.S. Army Engineer Waterways Experiment Stations, and the U.S. Army Engineer Power Group.

After seeing an overview of the Military Construction Directorate mission in the pollution firefight, let's take a look at the other side of the coin. The Civil

Works Directorate has a tremendous task ahead in its quest to arrest pollution and clean up the environment. The Civil Works people currently have more than 300 ongoing environmental protection projects in the mill—dam building, navigation, flood control, estuary preservation, and recreational facilities.

Highlights of some of the Civil Works projects are—

- Item. The Corps, as the principal planner and developer of America's water resources, has responded to the changing needs of the nation for the various benefits of water resources development. Planning techniques are being scrutinized and revised to insure that they accurately reflect concern for environmental values.

- Item. Many Division and District Engineers have established internal and ad hoc advisory committees to screen all laws, executive orders, regulations, and directives to assure compliance and to identify environmental problems. And right now District Engineers are modifying their planning procedures to insure early and continuing public participation, early and continuing consideration of environmental factors, and vigorous exploration of a full range of project alternatives.

- Item. Environmental specialists have been added to the staffs of the Planning Division of the Civil Works Directorate, the Board of Engineers for Rivers and Harbors, the Waterways Experiment Station, the Institute for Water Resources, and the Coastal Engineering Research Center.

- Item. The program to provide new water supply and sewage treatment facilities at public use areas on Corps projects has been accelerated and expanded.

- Item. Provisions have been made for sanitary dump stations for holding tanks in travel trailers and boats at Corps recreation areas.

- Item. The reservoir operation schedule has been reviewed and changed to enhance fish spawning, hold higher water levels during the recreation seasons, minimize later summer exposure of mud flats, and to provide additional flows for downstream water quality.

- Item. Civil Works has conducted, sponsored, and participated in many litter clean-up campaigns on Corps projects.

- Item. Civil Works has instituted procedures and actions to dress up the appearance and make better utilization of soil banks, borrow pits, and quarry areas to include landscaping and sodding with grasses.

- Item. Civil Works has eliminated open pit burning on Corps projects through conversion of waste disposal to sanitary land fills.

- Item. Field offices have expanded their efforts in preparing and implementing forest management plans and ecological vegetative management plans on complete projects.

- Item. Civil Works has incorporated leases, licenses, and concession agreements of stringent conditions regarding environmental quality standards and activities that may degrade the quality of the environment.

- Item. Civil Works has modified all Corps of Engineers' floating plant installations to provide adequate facilities for the treatment or retention of sewage.

- Item. Civil Works holds pre-construction conferences with the contractor to review and discuss environmental aspects of the work, the plant layout, location of construction roads and living areas to minimize their impact on the environment.

- Item. Civil Works continues to expand vector and pest control programs.

- Item. Civil Works continues to expand tree planting programs.

One of the major programs of the Corps, of course, is the entire water resource development planning process. Many steps are being taken to involve the public in the program and to keep it apprised of the processes and mechanisms through which water resources problems are investigated and solved by the Corps. The Institute for Water Resources, for instance, is continuing the development of communication skills and techniques and consultant services for training and application by field planners to increase the effectiveness and scope of public involvement in planning.

And speaking about water, there is a story about our present water resources posture. It seems that a distinguished scientific researcher was participating in a panel discussion with other learned scholars recently to report on the results of a comprehensive study of

the nation's future water supply in which he and his colleagues had been involved.

"Gentlemen," the scientist said, "I have some good news and some bad news for you. Our study shows that by the year 2020 everyone in the United States will be drinking recycled sewage from his home water tap."

"Great Scott!" came a response from one of the panel members. "Quick, tell us the good news." "My friend," responded the scientist, "that was the good news. The bad news is that there won't be enough to go around."

It probably is not all as bad as the scientist would make one believe, but the facts are clear that water, the resource—local, regional, or continental—may no longer be treated as an off-the-shelf item in great supply.

The Corps is working from the set of Environmental Guidelines developed by the Institute for Water Resources and adopted in 1970, to solve the ecological dilemma. These guidelines now constitute both the policy and the working regulations on the environmental aspects of all phases of the civil works program.

There are four basic objectives in the Environmental Guidelines toward which the Corps' environment-related activities are being directed. They are: to preserve important ecological, esthetic, and cultural values; to conserve resources and use them wisely; to maintain and enhance the quality and attractiveness of the environment; and to create new opportunities for the use and enjoyment of the total natural heritage.

The guidelines actually provide a detailed check list of measures that are to be taken in pursuance of the policies and objectives through all stages of project formulation.

With the guidelines to help it along, the Corps has been instrumental in the development of the Water Resources Council's multiple objective planning approach. Also five regional waste water management planning feasibility studies (see interview beginning on page 4) have been initiated in major metropolitan areas around the country under present authorities and funds and in close cooperation with the Environmental Protection Agency.

The Corps faces a long, hard grind in its battle to arrest pollution on all fronts and lead the way in bringing environmental considerations into the resource allocation and development process. It has met the challenge head-on and expects to come out the winner.

There might be another guideline for the Corps of Engineers to consider in the herculean attempt to protect and enhance the environment of this great nation—Davy Crockett's wise observation of 150 years ago: "Make sure you're right, then go ahead." 

RECYCLING FOR SURVIVAL

Captain Lawrence D. Allwine

Practically every day we read, hear, or smell something concerning pollution. One of the least mentioned forms of pollution but one receiving more attention each day is solid waste---garbage, wrecked cars, cans, newspapers, and bottles. Current estimates indicate that about 250 million tons of household, commercial, and municipal refuse are annually generated in our nation.

We have turned into a "Use It-Throw It Away" society thanks to a remarkable technology that has made a throw-away container the most desirable way to package things. The amount of solid waste collected from each person daily has increased from 2.75 pounds in 1920 to 5.3 pounds in 1968 and is expected to reach eight pounds by 1980. What will happen to it?

The sanitary landfill is presently the recommended method for the disposal of solid waste. It is a simple procedure which involves placing successive layers of compacted waste and fill dirt in prepared excavations or open areas until a predetermined fill elevation is reached.

Ingenious schemes for using the land after fills are completed have been devised, such as building parking lots, golf courses, parks and housing developments. Other methods of disposal also are being tried. A Japanese firm has compressed solid waste into blocks which are then coated with asphalt or cement and used as construction material. Some United States firms have shredded solid waste and used it as a soil conditioner in an attempt to make our desert areas bloom. Others have tried burning solid waste to supply heat for power plants. And some of our larger cities have built incinerators to reduce the total volume of solid material going into their landfills.

If we continue to rely on the sanitary landfill method to meet our future needs we will be limited by the availability of land. It has been estimated that the landfill method requires one acre of land for every 10,000 people each year for disposal of their solid waste. Also, the increasing use of packaged products in non-returnable containers (prepackaged meats and vegetables, milk cartons, bottles, and cans) multiplies the amount of solid material that is thrown away each year.

Experts have estimated that the current available land in New York City will be exhausted by 1975. When the available land is depleted other methods of disposal will have to be used. These other methods, unfortunately, have few beneficial qualities. Abandoned

glass, metals and other inorganic waste do nothing for soil enrichment or contribute little for the conversion of water to steam or powerplants. Incineration just delays the inevitable---exhaustion of our available land.

The Corps of Engineers plays a significant role in solid waste disposal because of the hundreds of military installations that the U.S. Army operates worldwide. Each of these installations share the common problem of solid waste disposal. This problem, of course, is of primary concern to the Facilities Engineer at each post, camp, or station. At the Army Engineer Center, Fort Belvoir, Virginia, for example, more than 40,000 cubic yards of loose solid waste is deposited in the sanitary landfill each month. So, it is easy to see that the Corps of Engineers has a personal interest in finding new and better ways to dispose of solid waste.

You might ask yourself this question. Why should I be concerned with solid waste? You should be concerned even if you are not a soldier because it involves all of us as individual Americans. Local sanitation departments and the Corps of Engineers deal with the problem every passing day. We each contribute our share of the more than five pounds of solid waste per day. In addition, our population continues to increase by leaps and bounds. This increases the burden of handling solid waste disposal in this country each year.

From these simple facts, it should be clear that we are slowly depleting the available supply of ground that is suitable to be used for landfill purposes. When we have run out of available ground, what are our alternatives? The answers are still to come. Facilities Engineers on military installations and their civilian counterparts in the communities across this nation will have to find other ways to dispose of solid waste or we will begin burying ourselves in our own trash. The late Premier of the Soviet Union, Nikita Khrushchev, once stirred the world during an address at the United Nations. He pointed to the representatives of the United States at that historic meeting and said, "We will bury you!" Those strong words never were put to the test but this country could bury itself in trash.

Some things are being done. The Corps of Engineers has been doing limited studies on how to cope with solid waste disposal. But due to the lack of sufficient funding, the Corps has not been able to devote the

necessary effort to properly develop and evaluate its programs. Various commercial industries are conducting their own research in the hope of coming up with workable solutions to the problem of solid waste disposal. Now in the development stage is a promising new technique called recycling. This is a process that separates the basic elements of solid waste—pulp, glass, plastics, ferrous and non-ferrous metals, and other organic materials—into usable products.

The Black Clawson Company has taken a leading step in the recycling field. The company has successfully developed "Hydrasposal" and "Fiberclaim" plants that can separate paper fibers, ferrous and non-ferrous metals, and glass from 40,000 pounds of mixed solid waste each day.

Local industries also have found the "Hydrasposal" and "Fiberclaim" plants valuable sources of raw materials. Other successful applications of the use of recycled products include the composting of organic waste for soil fertilization, use of pulp in paper towels, and use of reclaimed aluminum for making new cans. The eventual successful use of these applications looks very promising at this time. But the experts claim that more research and development must be performed on recycling techniques before we will be able to produce the more efficient separation processes we need.

This places the Corps of Engineers in a challenging position. It already has placed its foot in the door of the problem. Why not open it all the way by placing more emphasis on solving the growing problem of solid waste. Developing more efficient recycling processes would be a giant step in the right direction.

President Nixon in his 1970 message to Congress on the environment said, "As we look toward the long-range future in 1980-2000 and beyond, recycling of materials will become increasingly necessary not only for waste disposal but also to conserve resources. While our population grows, each one of us keeps using more and more of our earth's resources. In the case of many common minerals, more than half of those extracted from the earth since time began had been extracted since 1910. A great deal of our space research has been directed towards creating self-sustaining environments in which people can live for long periods of time by reprocessing, recycling, and reusing the same materials." What the President said means we cannot regard solid waste entirely as something of little or no value, but rather as a resource, something to be recovered and re-used whenever possible and practical.

The secondary material industry is a major and vital part of our economy and, hopefully, is in a logarithmic growth stage. The National Association of Secondary Materials Industries, Inc. (NASMI), has in the past year taken as its theme "Recycling Resources," and

although the organization has not received much public attention, it has been of vital importance to industries with scrap problems. NASMI companies have a gross volume in excess of \$7-billion. These companies annually process more than three million tons of nonferrous scrap metals for consumption by smelters, refiners, and ingot makers. They make available 45 percent of the copper used in new products, more than 50 percent of the domestic lead supply, 30 percent of all aluminum, and 18 percent of all zinc. More than 11-million tons of paper stock are recovered and processed by this industry for reuse. The average company investment is in excess of \$1.3-million, quite a distinct change from the individual collector of many years ago.

Everyone is, or should be aware that the major component of municipal refuse is paper. Approximately half of the waste collected in our cities is paper in varying quality. Paper is already recycled at about a 20 percent level in the U.S.; other nations, notably those with a short supply of wood pulp, do a far better job. Japan recycles about half of its waste paper, and most European countries, such as West Germany, France, Great Britain, and Spain, recycle approximately one-third of theirs. We should hope our Nation increases its percentage of reused fibers.

One final, and possibly the most important reason why we all should be concerned with developing an efficient system of recycling solid waste into reusable products is the fact that we are exhausting our supplies of natural resources. Whenever an oil field is drained, an ore vein is depleted, or a forest is harvested, another one is located and worked until the resources are depleted. If we continue with our present "Use It-Throw It Away" philosophy, we will gradually exhaust our natural resources.

It does not take a mastermind to deduce that we have entered a race for survival. Our opponent, solid waste, is one that we have created and continue to feed with more and more non-returnable bottles and cans. Are we going to allow that enemy to overtake us and bury us in our own affluence? Or are we going to develop what appears to be the only long-range solution to the problems of solid waste disposal and the exhaustion of our natural resources? Someone will have to come up with a winning solution before we find ourselves buried beneath the trash and recycled back to dust. ☹

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IT'S ALL IN YOUR OWN BACKYARD

Captain Lawrence A. Willwerth, III



A group of young long-hairs gathered in front of the White House recently and sounded a clarion note amidst the usual protest invective. They screamed "stop pollution" and their various signs read, "Ban Smog," "Give Us Clean Air and Water," and "Put Sludge In Orbit."

The news media seized upon the situation and thoroughly exploited the issue. In fact, the demonstration and those like it have become a standard bill-of-fare on our evening television news programs.

Reaction to the demonstration was mixed. Some citizens showed little or no concern; others were worried. But at Fort Belvoir, Virginia, the reaction amounted to acute indignation.

"Those blasted kids. What do they want, anyway? Riots! Demonstrations! Everything is going topsy-turvy these days!" responded a Sergeant Major.

"You're right, Sarge," chided a Major. "These kids are tearing this country apart."

And a soft-spoken secretary lamented, "I don't know where it will end. I just don't know what they want."

"They don't know either," added the Sergeant Major. "They are only after the publicity. They don't know how lucky they are to be here today."

It is easy, sometimes, for those of us in the military to subscribe to a little self-righteous indignation based on our spit-shined, close-cropped approach to the grooming of our reservations and camps. And anyhow—can the kids really be right about this pollution thing? After all, what they really want is a youthful leftist takeover of the government—or do they?

Let's take a closer look at pollution and then make an excursion into our own backyard.

Litter, one of the easiest kinds of pollution for the layman to identify, has been a problem for years and a joke to the average American. Water pollution, too, has been with us for decades but is characteristically more difficult to identify. And the list goes on and on.

But we know about all of this now, thanks to the yellow journalism which has sensationalized disasters such as oil spills and widespread incidence of lead poisoning. We are all concerned, military and civilians alike. And as we shall soon see by what may be found in our own backyard, none of us are immune to pollution's infection.

Executive Order 11507, entitled "Prevention, Control and Abatement of Pollution at Federal Facilities," was introduced by President Richard M. Nixon in February of 1970 as an official acknowledgement that the Federal Government shares the indictment as a "polluter" with commercial and private enterprise alike. The order is the culmination of many years of government activity in the field of environmental quality protection and dictates new guidance for all government agencies concerned. The order also extends the existing "Clean Air and Federal Water Pollution Control Acts" and initiates a policy whereby the government provides national leadership in the protection and enhancement of our air and water resources.

Under Section IV, Standards, it states, "Heads of Federal agencies shall insure that all facilities under



Here is a drainage ditch that flows directly into the Potomac River (top photo). Waste oil is constantly dumped in this area from the equipment park, causing permanent contamination of the entire section. The lower photo shows how the improper use of collection cans leads to direct dumping of oil on the ground.



their jurisdiction are designed, operated, and maintained so as to meet specific requirements." Another standard cited was the control, handling, and disposal of waste oil lubricants, a subject with which we will concern ourselves in the examination of pollution in our own backyard.

Executive Order 11507 specified that, "all installations must initiate actions to meet these standards by December 31, 1972." A later and additional Executive Order Number 11514, "Protection and Enhancement of Environmental Quality," added that "all agencies are directed to continually monitor these quality standards."

In view of these directives and existing Federal dictates, each military installation was faced with the enormous task of problem identification and qualitative and quantitative analysis of collected data. Each had to develop a system of reasonable controls and subsequently decide how to minimize or rectify existing damage.

Installation engineers were tasked to determine just what reasonable controls would be needed and decide just how to clean up and rectify whatever damage had been done. The requirements came at a poor time—decreasing Federal funds, reduced manpower resources, and inflated higher costs.

To try to solve the overall pollution problem, the U.S. Army's Corps of Engineers was saddled with the responsibility of cleaning up the environment for everyone. They hoped to do this through a system of controls and inspections that would ensure an end to the pollution problems of the United States and with it an end to the sign-carrying protestors.

So, the Corps went out to inspect the cities, the factories, the rivers, and the commercial concerns. But what about our own backyard? What about the enormous amounts of waste oils and lubricants that are being discarded on the ground at almost every U.S. military installation in the world?

When we look into our own backyard, what do we see? Is it clean? Or do the kids really have something here? For a real close look, let us examine a recent survey that was conducted at Fort Belvoir, Virginia, "Home of the Army Engineers." Fort Belvoir is a picturesque Army post located some 23 miles south of the Nation's capital. Resting securely along the lovely green banks of the Potomac River, it is only about five miles north of historic Mount Vernon, the home of our founding father, George Washington.

The Facilities Engineer at Fort Belvoir had long known of the continued waste oil spillage on the post and tried to control it through supply, fire, and command inspections. The problem was self-evident. Wherever vehicles were stored and maintained, there were oil spills on the ground. All the streams that drained from these areas were murky with oil slick and flowed into

the once beautiful Potomac River. Storm drains showed definite evidence of oil dumpage. Even with strict control and continued inspections, the problem remained. To bring command emphasis to the magnitude of the situation, a physical waste oil survey was conducted for the Facilities Engineer.

The first item on the agenda was to get an accurate assessment of the total gallons of waste oil that contributed directly to pollution. This action had to be completed in order to fully identify the problem.

There were a number of probing questions that had to be explored and answered. What were the results? How large was the quantity of waste oil that was being generated? How much of this waste oil was not being accounted for through property disposal channels or commercial pick-up contracts?

A look at the petroleum supply catalog and the Petroleum Oil and Lubrication POL issue point at Fort Belvoir indicated that the engineer experts needed to consider all of the main lube oils separately.

Engineer personnel selected 41 Federal Stock Number items as indicative of the lube oils being used at Fort Belvoir. Then they made a composite list of all units stationed on the installation. The total lube oil issues for all of the on-post units were collected and tabulated. A one-year time span was used to determine a basis of issue. Also, a physical inventory was conducted to determine an accurate average of the usage of all oil that was being issued to the on-post units.

A tabulation of the oil issue revealed that about 33,000 gallons were being distributed per year. Waste oil turned into the Property Disposal Office (PDO) during the survey period was about 6,000 gallons. Also, some 9,000 gallons of waste oil was collected by commercial contract from major agencies on the installation. The total gallons of waste oil that was turned in still left about an 18,000 gallon differential. Allowing for minimal oil consumption in vehicles and pilferage of stock, it is estimated that about 17,000 gallons of waste oil accumulates on the grounds of the Fort Belvoir complex during a year's time.

To verify the amount of waste oil that was produced at Fort Belvoir, engineers tabulated the equipment density for all the units. Then they determined the oil capacities of each of the types of equipment. Proper maintenance services for each type of equipment was used as a yardstick to determine how much waste oil was being produced.

This type of action initiated by engineers at Fort Belvoir only identifies a portion of the problem of petroleum pollution. To make such information more complete and valuable, a questionnaire should be distributed to all pertinent units. The questionnaire could easily be expanded to include fuels and other pollution



Here waste oil is collected from equipment that was dumped down a storm drain.

items. Thus, armed with information from both the consumer and the supplier, the study would become more valid because it reflects a more realistic situation.

The units should be given the opportunity to present their problem areas in waste oil disposal. For example, at Fort Belvoir it was noted not too long ago that waste oil could only be turned in to the PDO in a yellow, stenciled, 55 gallon drum---a near impossibility. A good part of regular issue lube oil is contained in smaller drums. A unit without access to the larger drum had the problem of how to turn in its waste oil. What could the unit do when it did not have the capacity to store the waste, nor the container with which to turn it in? The PDO specified "yellow" drums but there was a scarcity of that color of paint. And there was still another factor. The PDO had considerable difficulty in selling the containers of used oil to the commercial market.

All the aforementioned difficulties must definitely be considered as major factors that contributed to improper waste oil disposal at that installation. But there also must be an understanding of the situation at both command and unit levels to fully appreciate the problem. Improper waste disposal, it seems, is a breakdown of command emphasis on enforcement and a failure to provide the user with alternatives.

There were still other problems at Fort Belvoir. Military personnel were seen dumping waste oil from their private automobiles in secluded areas of the post. This was noticed primarily at abandoned motor pool grease



Note the color of water and the erosion at this drainage point from two unit areas.

racks. In addition to an apparent lack of control of routine enforcement practices, this points up the simple fact that an individual need is not being met. A soldier needs a place to service his car just like anyone else. The unused racks could be moved to a central location to provide this need. This would eliminate another means of pollution and at the same time provide a needed service for the man in uniform.

Although this study at Fort Belvoir did not consider the outright spillage of fuel oil it confirms that thousands of gallons of waste oil is deposited on the grounds of that installation each year.

Of course, Fort Belvoir is only one of hundreds of military installations located around the globe. But they all have similar problems. The survey indicates that property disposal procedures are inadequate at Fort Belvoir. They have not been able to curtail the used oil portion of the pollution problem on that post. By identifying the problem in its true perspective, however, commands may be able to place specific emphasis in areas that would help eliminate the causes.

In light of this study, it would seem that the overall PDO practices should be re-evaluated and that procedures should be implemented to solve the waste oil problems of turn-in, storage, and collection. None of the using units---the PDO or the individuals involved---can selectively or collectively solve the problem. The solution to the problem and other situations that are detrimental to mankind must be initiated at the top of

the chain of command. It is only up at the top of the ladder that the proper emphasis can be placed to eliminate the pollution situation.

For example, why shouldn't each oil using unit have its own oil storage tank for waste oil? If the post were to provide a tank and a pump with which to periodically drain the waste oil, the units would no longer have a storage and turn-in problem. The waste oil that would be removed from unit tanks could then be stored in a major tank elsewhere on the post or picked up by a commercial firm at a minimal cost (about two cents per gallon).

Pollution---whether it is waste oil, litter, black smoke from factories, eye-searing smog, musty waters of our rivers and lakes, or cigarette smoke---is an individual problem as well. All the guidelines in creation will not work unless someone does something about it. When the military commands begin to take notice that their own installations are causing pollution, as well as the factories, automobiles, sunken oil tankers, and garbage dumps, perhaps we will make some headway.

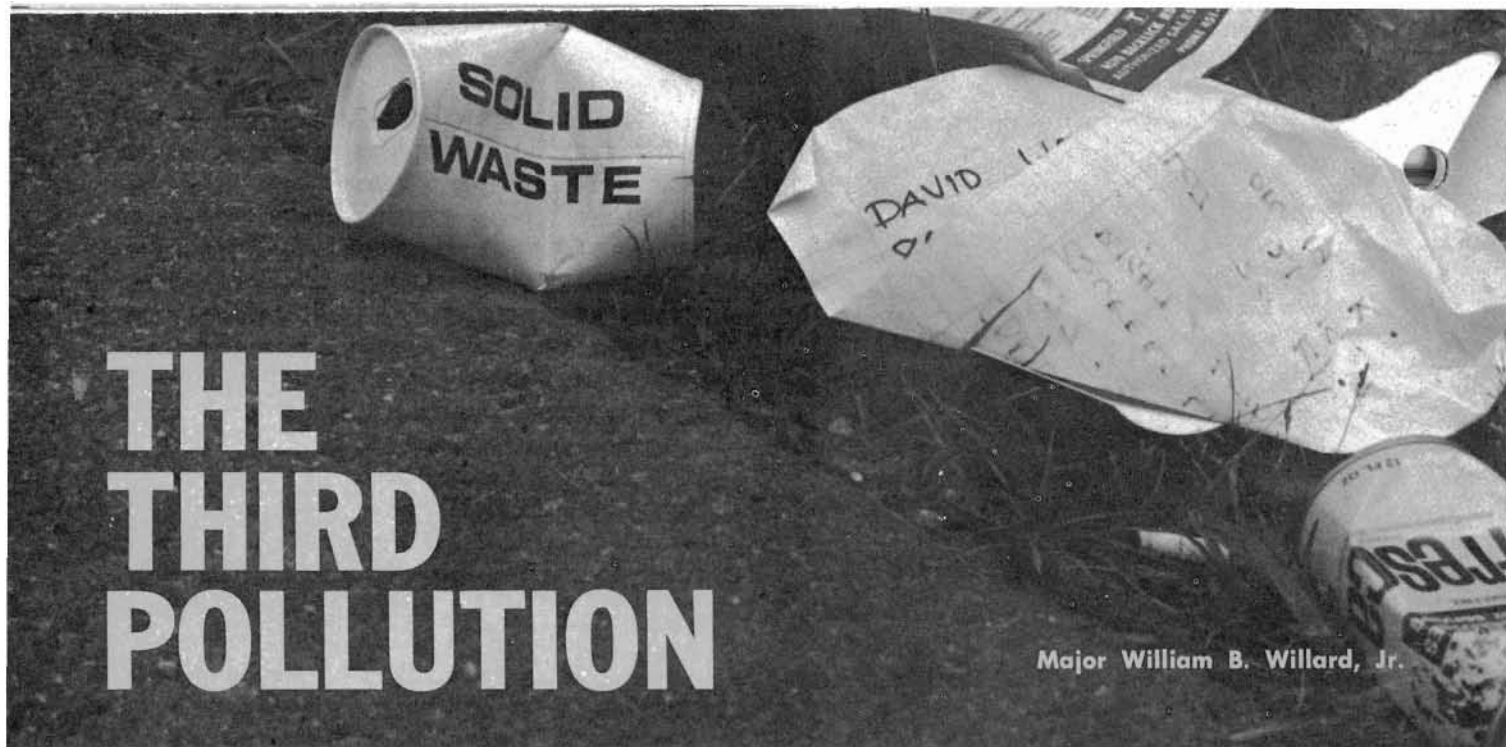
At any rate, we cannot leave the situation as it is today. Definite and positive steps must be taken now if we are to curtail the exorbitant future cleanup costs. With positive action, the chore of reclaiming and restoring polluted streams and lands to their natural state will be minimal.

Since the U.S. Army Corps of Engineers is responsible for policing the commercial firms, checking on the civilian polluting populace, and assuming overall responsibility for the future cleanliness of America, it would seem that it is time they cleaned up their own backyard.

The Army places primary responsibility for pollution abatement with the Deputy Chief of Staff for Logistics but the Corps of Engineers has advisory accountability in this matter. It is the Corps' duty to properly identify the sources of pollution.

Once our military installations are cleaned up, perhaps all the other efforts that are made will be fully justified. And after every backyard is clean and we can all drink clean water and gratefully nourish the clean air in our lungs, perhaps then the kids will take their signs and go home saying, "Well, whadd'ya know? They listened! The generation gap is beginning to close at last!" 

Captain Lawrence A. Willwerth, currently assigned to the 1170 Port Detachment in Boston Massachusetts, graduated from the Engineer Officer Advanced Course at Fort Belvoir, Virginia, with Class 1/72. His article is part of an extensive staff study he submitted to The Engineer School to both accommodate an academic requirement and to address an installation problem area.



THE THIRD POLLUTION

Major William B. Willard, Jr.

Rachel Carson once wrote, "In biological history, no living organism has survived long if its environment became somehow unfit for it, but no organism before man has deliberately polluted its own environment." Today, man's factories and automobiles belch clouds of contaminants into the air; his sewage flows untreated into lakes and streams; and his refuse is strewn along the highways or lies rotting in open dumps.

The planet earth has only three waste repositories---air, water and land. They also are reservoirs for all the essential life resources we possess. Man's habit has been to think of them as limitless. But at the rate the world's human population is growing we can begin to view with real concern the fact that the earth has no more air, water or land today than when man first began to generate wastes. Keep in mind that these reservoirs are interconnected and to pollute one may mean to pollute the other two.

The population of the United States has recently exceeded 200 million, and based on current growth rates is expected to reach 400 million by the year 2000. Refuse created by each man, woman and child in America now approximates five pounds per person per day, and as our affluence increases so will the production of refuse.

Coinciding with the highest standard of living in the world, our nation also produces the largest volume of solid waste. With every purchased commodity item wrapped in cellophane or encased in plastic, the simple act of disposing of these protective wrappers is creating a major problem. Plastic packaging is almost immune to biological decomposition. If plastic packages are bur-

ied, they remain almost indefinitely in their original state. If they are burned, they contribute hydrocarbons and oxides of nitrogen to our atmosphere.

Plastic wrappers, however, are really a negligible portion of the total solid waste problem, but serve to demonstrate some of the difficulties associated with ultimate disposal. By definition, solid waste includes waste products of man, excluding body wastes.

Solid waste examples are food wastes or garbage; rubbish, including such items as discarded paper products, wood, bedding, metals, tin cans, crockery, glass and clothing; ashes and dirt; dead cats and dogs; sweepings and leaves, and abandoned cars and trucks; food processing wastes, lumber and metal scraps. Also cinders from factories and plants; such residues as lumber, masonry, metals, paints, and concrete from demolition and new construction projects; radioactive materials, explosives and pathological wastes from hotels, institutions, stores and industries.

The solid waste list is almost infinite. However, it serves to emphasize the fact that our cities, towns, and villages and great industrial complexes are producing a wide variety of solid waste that eventually must be disposed of in some manner. No longer can refuse be hauled to the edge of the city limits and dumped. It must be disposed of in a safe, sanitary and economic manner. Perhaps history will someday portray America as the nation which put man on the moon while standing knee-deep in its own refuse. Proof that lives can be lost because of the mismanagement of solid waste disposal methods made worldwide headlines several years ago when some 200 lives, mostly children, were lost a coal slag avalanche at Aberfan, Wales.

Lack of concern and education on the part of the public is the primary reason solid waste disposal has become a threat to America's future. The city dweller becomes concerned only when his garbage is not removed. This point can best be demonstrated by the experience in the late 1960's when the garbage collectors of New York City went on strike. Mountains of garbage accumulated on the streets and provided a haven for rats, mice, and flies which created a serious health hazard. New Yorkers lived with the stench of rotting garbage for only a relatively short period of time, but from their brief discomfort came the realization that solid waste disposal should be of concern to every citizen.

Apparently, this lack of concern is not universal, for the Federal government reports that today less than half of the cities and towns in the U.S. with populations of more than 2,500 dispose of community refuse by approved sanitary and nuisance-free methods.

Not only is America's natural beauty being blighted, but health hazards exist everywhere in the form of open dumps, littered streets and highways, smoke from backyard incinerators, and discarded waste from industrial plants. Solid waste disposal is expensive. Federal statistics demonstrate that it is costing the American taxpayer over \$1.5-billion for disposal services—exceeding city expenditures for schools and roads in its magnitude. Yet the existing disposal services are inefficient. There are too many cases of unnecessary bickering between municipal governments resulting in duplication of refuse disposal efforts. Solid waste pollution recognizes no political boundaries and should be treated accordingly. Cooperation between state and local governments is a necessity if the solid wastes pollution problem is to be solved.

By the present "thinking" of environmental engineers, solid waste or refuse is handled in three phases—the storage phase, the collection phase, and the disposal phase. Initially refuse is created by the taxpayer and is temporarily stored in an indoor and then an outdoor container—first the wastebasket and then the trash can. The degree of refuse separation is dictated by the collection agency, which may specify no refuse separation or separation into garbage, rubbish and ashes.

Normally, all storage costs are paid by the household occupants. During the collection phase the municipality provides the necessary personnel and equipment needed to pick up the refuse, usually twice weekly, and the expenses are paid from the city's operating funds. If municipal pick-up is not provided, the scavenger service normally is used, with the resulting inability to meet control sanitary standards. Lastly the refuse is discarded. Generally it is conceded that through misman-

agement during the disposal phase, solid waste causes the most damage to the environment.

There are a number of accepted methods currently practiced in the United States which are recommended for refuse disposal. These include:

- Incineration
- Composting
- Sanitary Land Filling
- Dumping
- Hog Feeding
- Discharge to Sewers

Incineration. This is an expensive means of refuse disposal, but in municipal and urban areas where refuse production exceeds 100 tons per day, this method may be economically feasible. It has been found that incinerators are high in initial cost—usually from \$3,500 to \$5,000 per ton—to build and equip, based on a rated 24-hour plant capacity. Afterwards, incinerator operating and maintenance costs should vary from \$3 to \$7.50 per ton for refuse. Perhaps the main advantage of incineration is the fact that a central location can be used, thereby minimizing haul distances during the collection phase. Incineration also permits flexibility of operation, and may provide a source of income through the sale of waste heat for steam or power. Keep in mind, however, that incineration merely transfers solid waste problems to an air pollution problem. Even the most modern incinerators contribute air contaminants in the form of particulates, hydrocarbons, oxides of nitrogen and carbon-monoxide to the atmosphere and, at best, may be able to achieve a 90 percent reduction in solid waste. The remaining fly ash still must be collected and disposed of by some other means.

Composting. This is a method of refuse disposal that has had considerable success in many European nations. The process is recognized as one of waste recovery, for composted refuse serves as an excellent organic additive for agricultural soils. In some countries it is actually responsible for producing sizeable municipal revenues. Because of the availability of cheap fertilizers in this country, however, a widespread demand for compost has not yet materialized. Until recently, Johnson City, Tennessee, was the only municipality in the United States to practice composting.

The composting process is basically a biological process in which aerobic bacteria reduce shredded and blended organic matter into a stable end product over a three-week period. Initially, inorganic materials such as cans and other metals and glass are removed by either a mechanical or manual process, and subsequently may be sold for reclamation purposes. The remaining organic matter such as food wastes, wood and paper products are shredded to increase the surface area for

bacterial action and blended to achieve an optimum carbon-nitrogen ratio of approximately 35:1 for maximum aerobic bacterial growth. Organic matter deficient in nitrogen---like paper---can be combined with other wastes high in nitrogen, such as fish scraps or sewage sludge. Composting can serve not only as a means of waste recovery, but also as a means of alleviating a special growing form of solid waste pollution---sewage sludge. The possibility of recovering valuable material from the huge volumes of municipal refuse appeals to the imagination. As economic conditions change and technology improves, perhaps the composting process may gain wider use in the United States as a form of waste reclamation and as a solution to the total solid waste pollution problem.

Sanitary Landfilling. Of all methods of refuse disposal, sanitary landfilling is the most widely used. It is the most economical method where land is available and is an excellent means of converting useless real estate into valuable property. The following extract from Henry Still's documentary, "The Dirty Animal," is a dramatic example.

"Henry Soto is a Los Angeles landscape architect who drove several miles each day to his office, and each day passed a forty-foot deep abandoned gravel pit. Then came the bright idea. Soto rounded up several partners, purchased the pit, and converted it into a private garbage and trash dump. The combine charged trash haulers \$8.00 per truckload to use the dump---a low price in the Los Angeles area---and covered each day's collection with a layer of earth, according to approved sanitary landfill practices. Soto also set out a living fence to screen the dump from the highway, and planted a border with flower beds and trees. The area was so attractive that new customers became confused and drove on by until Soto put up a sign which read 'Disposal Gardens.' When the hole is filled, Soto plans to build a swimming pool and tennis courts on the new level ground, and then charge admission to his private recreation area." Mr. Soto is just one of thousands who has used his imagination and initiative in employing the sanitary landfill as a profitable and safe method of refuse disposal.

Another widely publicized example is the approach which the municipality of Virginia Beach, Virginia, took in solving the solid waste problem. Using the sanitary landfill method, the community's trash was used to construct a hill some 80 feet high. On one side an amphitheater has been built, while the other side has been reserved for skiing. The hole from which cover material has been excavated is to be converted to a fresh water lake. Subsequently, the project has been named "Mount Trashmore."

Dumping. This is another method of solid waste disposal, but it has limited applications. Some components of refuse are suitable for open dumping. These include street sweepings, ashes and residue from incineration processes. Serious nuisances and health hazards, however, can develop if garbage or mixed refuse is disposed of in this manner. Dumping is frequently used to reclaim low areas and may permit the construction of a fairly stable fill. Dump locations must be carefully chosen so there will be a minimum chance of complaint from nearby residents.

Hog Feeding. Feeding garbage to hogs has been practical for many years. Some cities formerly operated hog farms, but municipal piggeries at present are few or non-existent. It is estimated, however, that about 25 percent of the total quantity of garbage produced in this country is fed to hogs by private individuals. That garbage feeding is profitable when properly handled is shown by the fact that most hotels and restaurants can dispose of their garbage to farmers who are willing to collect it themselves. Usually they collect daily and furnish clean cans. While garbage is the most potentially valuable element of refuse, it is the most difficult to handle in a sanitary manner and is responsible for the majority of nuisances and health hazards associated with the management of solid waste. Health authorities recognize the danger of contracting trichinosis from consumption of improperly cooked pork products. Hog feeding, like other methods of garbage utilization, still involves the necessity of providing for the proper disposal of other refuse.

Discharging to Sewers. Three methods for the disposal of garbage with sewage are in use in the United States---the installation of individual grinders in homes and commercial establishments, the installation of municipally-operated, centrally located grinding stations, and the installation of grinders at sewage treatment plants. All three subsequently discharge waste into raw sewage lines. Household grinders have been found to contribute no major difficulties to sewage collection systems. At the sewage treatment plant, the load of solids can be expected to increase from 0.07 to 0.10 pounds per person on the dry basis. A few cities have forbidden grinders, and this restriction is justified where existing sewerage facilities are overloaded. Universal adoption of household grinders will be necessary if the process is to have a material effect upon the solid waste problem. The total volume of refuse would not be substantially reduced because garbage constitutes only 10 to 15 percent of the refuse in many cities. A major advantage of discharge to sewers, however, is that by eliminating garbage from the storage phase, the frequency of collection can be reduced by at least 50 percent. Jasper,

Indiana, became the first community in this country to attempt city-wide installation of grinders. Results so far have been favorable.

The location of central grinding stations at convenient points along the sewer system or at the sewage treatment plant is favored in some cities. Both of these methods require initial separation of the garbage from the other refuse by the householder, necessitating an additional municipal pick-up. Ground garbage is then introduced directly into the sewage treatment plant. There have been no reports to date that the discharge of ground garbage into the sewer system has caused any trouble. However, an increase of cockroaches and rats has been noted in some trunk sewers. It has been found that if garbage of all population contributing sewage is ground at a central grinding plant and then discharged into the sewers, the suspended solids may be increased approximately 50 percent, and the biochemical oxygen demand may be increased 30 percent. To accommodate this increased loading, the existing sewage treatment facilities must either have been constructed with a capability of operating at expanded capacities or must possess the capability of being modified structurally. If not, it will result in non-satisfactory sewage treatment.

In taking the first action to control solid waste pollution, authorities should no longer permit open dumping, unsightly automobile graveyards, feeding uncooked garbage to hogs, strewing litter along the highways, dumping refuse at sea and other bad refuse disposal habits. These violations should be prohibited by law, and such laws strictly enforced.

On January 4, 1965, in his State of the Union message, President Johnson said, "I propose that we increase the beauty of America and end the poisoning of our rivers and the air that we breathe." In October of the same year, he signed into law the Solid Waste Disposal Act. This legislation, for the first time in the nation's history, gives responsibility to the Federal Government for developing new methods of solid waste disposal. Emphasis is to be placed upon "conservation of natural resources by reducing the amount of wastes and unsalvageable materials and by recovery and utilization of potential resources in solid waste." Additionally, the act provides for "technical and financial assistance to state and local governments and interstate agencies in the planning, development, and conduct of solid waste disposal programs."

Since its passage, science, technology and the government are moving toward a solution to the solid waste pollution problem. The Congress has authorized the appropriation of more than \$100-million for this area of concern.

A number of universities have received grants to support graduate student training in the field of solid

waste. The Surgeon General of the Public Health Service has established the Office of Solid Wastes. This subsequently started a great number of research programs and demonstrations. Also, the recently created Environmental Protection Agency is developing standards governing solid waste management.

America is now on the "move" to meet the challenge of solid waste pollution. Public concern has been aroused over the degradation of the environment. Now, all across the country, individuals, ecology groups and civic action organizations are combining to "clean-up" the face of America. Numerous recycling centers have been established to serve as focal points for the collection and ultimate re-use of such items as newspapers, bottles and aluminum cans.

Fort Belvoir, Virginia, the "Home of the U.S. Army Engineers," is no exception to the collection plan. Captain Theodore J. Trauner, a student in the 1st Engineer Officer Advanced Course, Fiscal Year 1972, has initiated a trial project with the help of his classmates. Salvable items are deposited by the residents of Fairfax Village in 15 appropriately marked trash cans that are stored in front of the Captain's quarters. Magazines with glossy print are not acceptable for recycling, and all cans must be flattened. To take care of this latter chore, Captain Trauner is relying upon the services of the Boy Scouts. Periodically, the trash cans which have been made available by the Directorate of Facilities are emptied and transported by private haul assets to a commercial recycling center. Revenues in the amount of 30 cents per 100 pounds of newspapers and 8 cents per pound of aluminum cans are the reward. If this concept of solid waste disposal proves successful in Fairfax Village, then it is hoped that plans will be activated to provide a post-wide service. Perhaps salvaging may prove to be an effective means of reducing the Facilities Engineer's operating costs at Fort Belvoir.

New ideas and innovations are required to solve the solid waste pollution problem. As America moves into the decade of the seventies, it seems destined to come to grips with the harsh realities of uncontrolled environmental degradation. Unless the trend of years of environmental neglect is reversed, man may find too late that the ecological balance of nature has been irreversibly altered. 

Major William R. Willard, Jr., presently is assigned as a staff officer with Headquarters, European Command (J-4). He formerly taught environmental engineering at the U.S. Army Engineer School, Fort Belvoir, Virginia. Originally an Infantry officer, he served in Vietnam as a commander of C Company, 19th Engineer Battalion (Combat) and later as Assistant S-3 of the 937th Engineer Group (Combat).

TIPS FROM THE FIELD

Lieutenant Colonel George W. Page

As has been previously stated, Dynamic Training is nothing more than a new approach to an old problem. The underlying philosophy is to revitalize unit training ---to eliminate the apathy which frequently results when training is routinely conducted to comply with relatively rigid requirements imposed by higher echelons of command.

Brigadier General Gordon Peltier, Commanding General, 16th Engineer Brigade (Combat), Ohio National Guard, submitted the following example of Dynamic Training which involved the 16th Brigade's 612th Engineer Battalion.

The 612th, having been recently converted from an armored cavalry squadron, actively sought suitable engineer troop projects to provide effective dynamic basic unit training during its short summer training period. The battalion was given the project of designing and constructing an abandoned township road in the Fallsville Wildlife Area of Southwestern Ohio during its active duty training period, July 11-23, 1971. The State of Ohio requested the assistance to provide access into an otherwise inaccessible part of the wildlife area and furnished the engineer construction materials and bivouac area. The 1,700-foot roadway traversed a





heavily wooded tract of land through which several streams flowed.

Completion of the project required the employment of many combat engineer unit capabilities and skills, such as surveying, land clearing, sub-base, base course and wearing surface (crushed rock) construction, design and construction of two Class 30 timber trestle bridges and several large culverts. Also required was the installation of lateral drainage facilities that included ditches with checkdams to reduce erosion.

The project was divided into two company-sized projects of approximately equal size and scope. Companies A and C of the 612th Engineer Battalion were assigned the projects for construction. Spurred on by a healthy competitive spirit to produce the highest quality product and to maintain the production schedule, Companies A and C of the 612th displayed an esprit-de-corps among their personnel which contributed greatly to the value of the unit training derived from the project, and assured completion right on time.

Obviously proud of their accomplishment, many of the Battalion's personnel visit the wildlife area with their families for recreation, and point out the permanent credit signs which the state installed along the completed road in recognition of the unit's efforts during the two-week training period in July 1971.

This project demonstrated to a great extent many of

the capabilities and the versatility of a combat engineer unit, and served to develop individual personnel skills. The value of practical "hands-on" training, as used in this particular instance, when compared to a classroom environment of lectures and conferences becomes readily apparent. This technique of instruction provides a much more effective vehicle for speeding the technical proficiency of combat engineer unit personnel.

Favorable publicity and recognition by state and local authorities fostered a public awareness of the positive value of the National Guard Engineer Battalion which, in turn, did much to promote the unit's esprit-de-corps. For its efforts during this training period, a First Army evaluation team recommended that the 612th be designated an "Outstanding Unit," a coveted award.

Dynamic Training, of course, may be accomplished in many ways. One of the better examples of it is the manner in which land navigation is taught—by Orienteering.

In its simplest form, Orienteering may be defined as a timed cross-country map course. It began primarily as a military training method in Scandinavia during the late 1800's to renew the interest of Swedish youth in track and field events.

The first competition consisted of a combination of cross-country running and map course over unknown terrain and was held March 25, 1919. It proved to be a great success. The Orienteering program spread rapidly throughout Europe, and by the late 1950's many international events were being held on the continent. In 1965, a U.S. Army Special Forces group stationed in Germany represented the United States for the first time in Orienteering competition during a meet sponsored by the Conseil International du Sport Militaire (CISM).

Orienteering was first used as a military training vehicle in the United States at the U.S. Marine Corps Physical Fitness Academy and the U.S. Military Academy in 1967. It was added to the Programs of Instruction at the U.S. Army Engineer School, Fort Belvoir, Virginia, in February, 1970, and at the U.S. Army Infantry School, Fort Benning, Georgia, in November of that year. Currently, it is taught at the Engineer School to Officers and Noncommissioned Officers attending the three resident professional development courses.

The Orienteering Program rates quite high as an individual and military unit training technique. The combination of the practical use of maps, compass techniques, terrain orientation, physical fitness, mental alertness, determination, and decisiveness makes every orienteering hour valuable to the participant.

Essentially, the rules applicable to orienteering are relatively simple, and the equipment required is minimal and inexpensive.

At the outset, the competitor reports to the starting line where he is issued a map, clue card and score card. When given the signal by the timer, he consults a master map from which he learns the control points he must visit as he runs the course. At each of these his scoreboard is marked in a manner identifiable only to that particular station. Speed is the all-important factor in the competition, for running the course is a race against time.

There are three types of orienteering courses. In Freestyle orienteering, the competitor runs to all points but may choose his own route to each of the stations. Line orienteering, on the other hand, is similar to a compass course and participants must follow a pre-determined route to the control points. Score orienteering provides several options for the competitor. In this type of course, a number of stations are marked on the map and assigned point values based on the difficulty involved in reaching it. The time limit established for the course usually precludes a participant from reaching all stations. He must then decide which stations to attack and in what sequence. The objective of score orienteering is to acquire the maximum number of points within the time allotted, and if that time is exceeded the competitor is penalized. One tactic used in this course is to run the perimeter stations until time becomes critical then move toward the finish.

Five techniques are used in orienteering---Route Selection, Aiming Off, Attacking Known Points, Collecting Features and Judging Distance.

Route Selection means just that. The competitor must choose between a short, difficult but direct route, or select a longer, easier route to his objective.

Aiming Off involves running to a station located along a stream or road, and purposely taking a route which will assure the competitor that he is off to one side of the station so that he is positive of which way to turn to find it.

When a participant employs the technique of Attacking Known Points, he selects prominent physical or terrain features which he knows from having located such features on the master map are located in the near vicinity of the station being sought, and moves directly to the site.

Judging Distance is the determination of one's pace

for 100 meters when using different strides and traversing varying kinds of terrain.

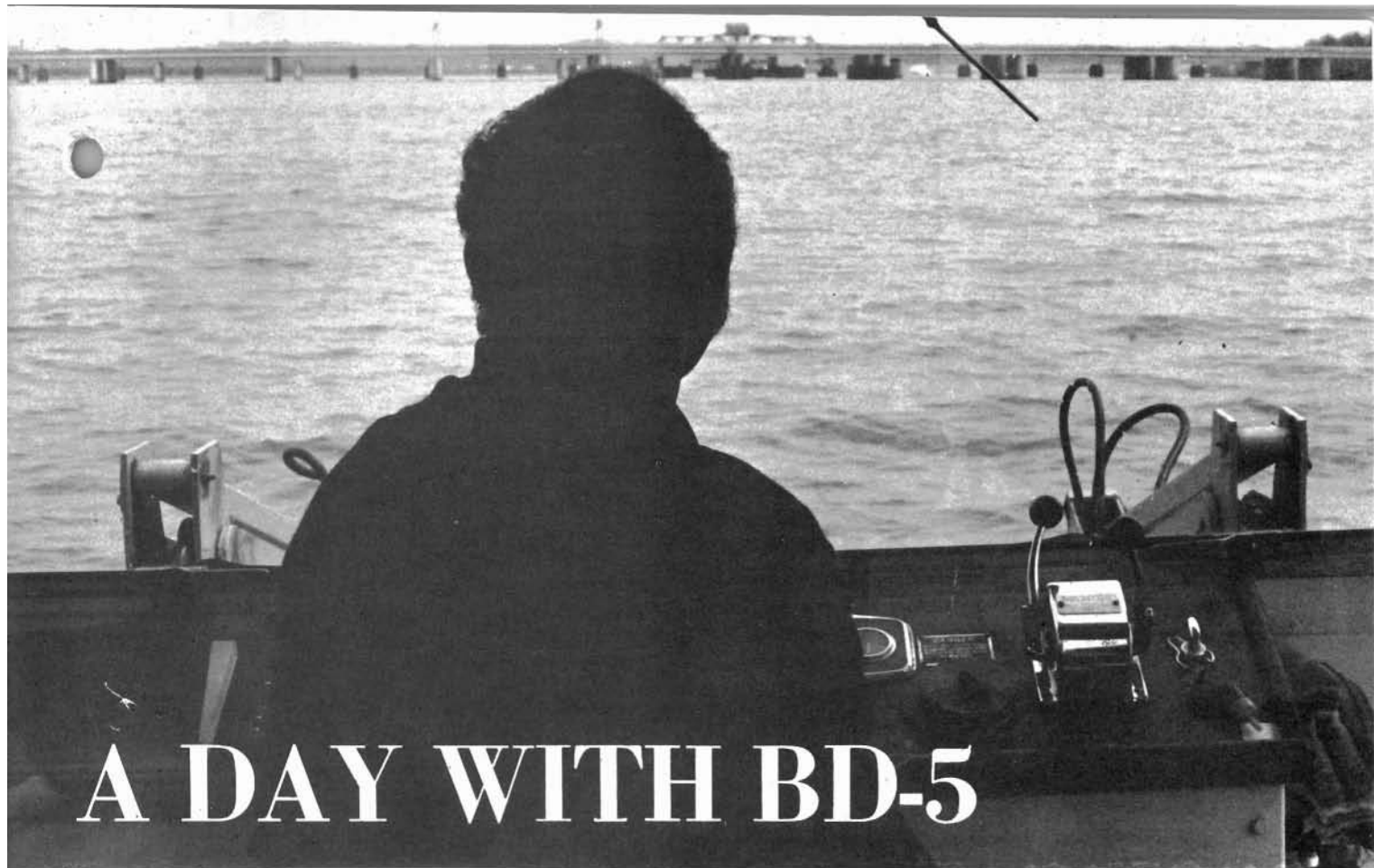
Orienteering as a military training program is quite effective and highly recommended. No elaborate or expensive individual equipment is required---topographic maps, compasses, locally produced clue cards of the stations to be visited and score cards which the competitor marks at each station on the course comprises the complete list. Unit personnel needed to officiate include two each to function as timers, scorekeepers, aidmen and range controllers.

The U.S. Army Engineer School has prepared an Orienteering Instructor's Handbook designed to help interested personnel in setting up and administering this type of training within their own units. It can be obtained by writing the Director, Department of Applied Engineering, U.S. Army Engineer School, Fort Belvoir, Virginia 22060.

Additional information on orienteering may be found in "Be Expert with Map and Compass," by Bjorn, Stackpole Company, Cameron and Kelkenstret, Harrisburg, Pa. 17105, 1967; "Orienteering," by John Disley, Stackpole Books, Harrisburg, Pa. 17105, 1967; and "Orienteering and Aid to Training," by J. R. Chapman, Hillside Printing Company, 230 Woodhouse Road, Finchley, London N. 12, England.

How about you? Have you led or been involved in any particularly interesting and effective training exercises? The Engineer Dynamic Training Council is interested in hearing about what you have done. This department of "The Engineer" will regularly feature ideas that have been submitted. We need your support. So please send a brief account of your training experiences and/or you ideas to: The Engineer Dynamic Training Council, U.S. Army Engineer School, Fort Belvoir, Virginia 22060. 

Lieutenant Colonel George W. Page currently is Director, Department of Applied Engineering at the U.S. Army Engineer School, and also functions as the Deputy Chairman of the Engineer Dynamic Training Council. His assignments have included duty with the 116th Engineer Group (Combat); 542d Engineer Company (Geodetic Survey); Los Angeles Engineer District; IV Corps Advisory Headquarters and Construction Directorate, Headquarters MACV, Republic of Vietnam; Headquarters Central Army Group; and Commanding Officer, 10th Engineer Combat Battalion, 3d Infantry Division in Germany. He is a graduate of the United States Military Academy, the Command and General Staff College, and the British Staff College. He holds Master's Degree in Civil Engineering from the University of California.



It was just another routine day for the two-man crew of BD-5.

Frank E. Hart, who captains the little 30-foot drift collector, and his crewman, John J. Coley, launched their craft about 7 am from its mooring alongside the Washington Navy Yard dock for another bout with the muddy Potomac.

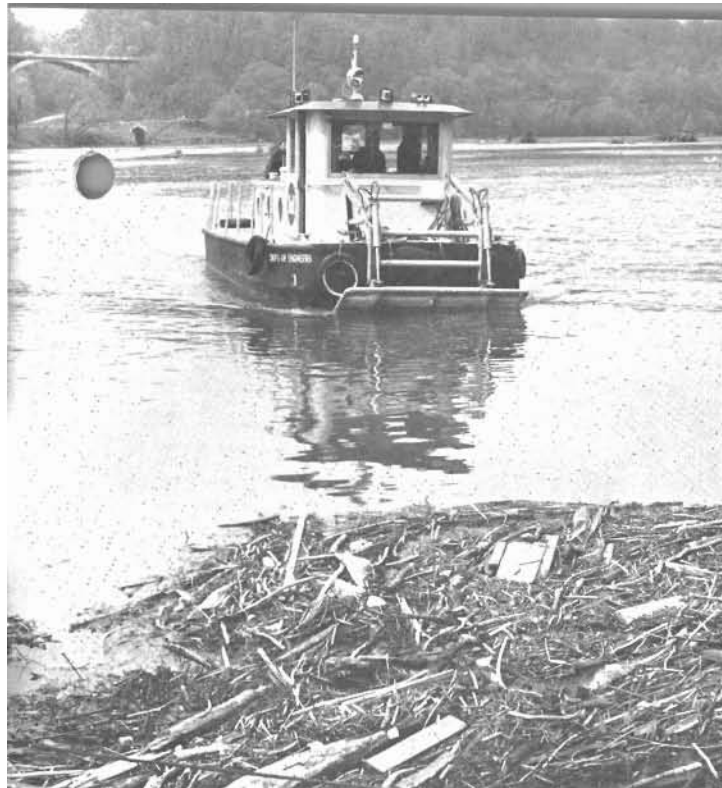
Their mission is simple and they know it by heart. They do it every day, rain or shine, sleet or snow. They have been sweeping the Potomac and Anacostia Rivers, the Washington Channel, and the Tidal Basin to clean up navigational obstacles since 1966.

Hart and Coley are two members of an eight-man Drift Removal Unit that works out of the Baltimore District Navigation Branch of the Corps of Engineers.

The professional crew operates under the direction of Harry Moran, a veteran of 31 years with the Army Corps of Engineers. They get the job done with two 30-foot craft equipped with wire mesh, scoop-type baskets, one 35-footer equipped with an A Frame, one 80-foot crane barge, two 40-foot open deck barges, and a 20-ton crane.

On this clear, bright day, Hart headed BD-5 up the polluted Potomac toward the Three Sisters Bridge site above Georgetown. The tiny craft chugged slowly toward its destination pushing a scow ahead of it.





They tied the scow up to an old abandoned boat that was docked against some pilings at a construction site within eyesight of the skeleton of Three Sisters. Then Hart began to make a methodical sweep of the river around the pilings, near the shore, and further up around the piers of the bridge that may never be completed.

Hart and Coley have a number of ways they can collect the debris. They can get it with the basket which scoops and elevates. They can get large pieces that are too close to the shore for BD-5's basket to scoop up by snagging it with a nylon line, then pulling it out to deeper water where the basket can do the job. They also go ashore as far up as the high water mark and pick up debris with their hands. The craft equipped with the A Frame is used for the real large pieces.

The debris, of course, is loaded onto the scow each time the basket is full. There was plenty of driftwood this day and the scow was full by about 2:30 pm. So Hart headed for home with his load.

Coley pointed out that they sometimes find dead horses, cows, deer, dogs, cats, rats, men, women, and children in the water. They call for a District of Columbia police boat when a body is found. There was only a dead dog this day and it went downstream faster than BD-5.

With their radio dispatch phone tuned in, Hart and Coley are subject to emergency calls from the Coast Guard, the D.C. Metropolitan Police, the U.S. Navy, and all private boat owners.

These craft are keeping 30 miles of Washington's waterways and shoreline free of debris and are helping make the environment picture look a little brighter. Hart said they sweep the river before each President's Cup Regatta is held. Also, they try to keep it as clean as possible so pleasure craft can let the throttle out.

BD-5 finally pushed the scow up to the barge at the Navy Yard and tied up. The crane would take the debris from there, lifting it off and into a 40-cubic-yard portable bin. Its final destination was a landfill at Wayson's Corner. Some 15 million pounds of effluvia has gone into that landfill since the project began six short years ago.

What did the two-man crew of BD-5 accomplish on this day? They traveled about 30 nautical miles from the time they started out in the early morning until they docked at 3:30 in the afternoon. They also collected about 25,000 pounds of debris, mostly driftwood. Was this a big day? No. Hart and Coley both agreed that it was just average---routine. 

 **ENGINEER STAFF**



Planning A Dynamic Training Program

Colonel W. R. Hylander, Jr.

Dynamic Training is catching on more and more, according to our Engineer Dynamic Training Council surveys and the feedback reaching the Engineer School. Elsewhere in this issue you'll find more "Tips From the Field" on ways other engineers have made their training more interesting and effective.

There are some misconceptions about dynamic training, however, that should be erased. Too many engineer trainers are thinking of it only in terms of occasional stunts to be employed when things are dull, or perhaps when the subject is particularly appropriate for an "adventure." Dynamic training includes that, to be sure, but what happens on the days or weeks in between "adventures?" Do you have to carry on with old-style "non-dynamic" training, while the lieutenant works up another idea and persuades the old man to let him try it out?

No, you don't.

A unit can make its entire training program dynamic. It's not hard to do. Here at the Engineer School, we have developed a prototype that may become an official Army Training Program (ATP) for engineer combat battalions. That will take some time. Meanwhile, there is nothing to prevent your unit from developing its own. Several battalions have already begun. Former Army Chief of Staff, General William C. Westmoreland, pointed out in a June 30, 1971 message to the field that your unit commander has the flexibility to do so. All it takes is some planning.

Unit training programs are prepared on an annual basis, and usually culminate in a test which should measure the unit's capability to perform its combat mis-

sion. Called an ATT (Army Training Test) or an ORTT (Operational Readiness Training Test), these tests too often turn out to be three-to-five day convoy and bivouac drills for the troops, while the commanders and their staffs handle engineer projects by paperwork. Rarely are squads and platoons required to physically demonstrate their proficiency in the myriad tasks engineers should be able to do in combat, because ATTs or ORTTs are not prescribed below battalion or separate company level. Despite the sincere efforts of evaluating umpires, many such tests are basically phoney.

The fault lies with the Army's system for training and testing of units. Developed during World War II when all types of units had to be activated, trained, tested, and shipped overseas in the minimum time, the Army's family of ATPs and ATTs is basically sound. For the cyclic annual training of active Army units or those in the reserve components, the system is poor. Get the ATP and ATT from your unit's files and read them critically. Then ask yourself how much help they really provide in your situation. The ATP is little more than a check list of subjects and references. It is merely a guide, but too often it becomes a straitjacket because of readiness reporting requirements. Units must be tested somehow and the system doesn't allow any other way. Here I'm really indulging in self-criticism, for my department of the Engineer School is responsible for writing the ATPs and ATTs for all engineer units. Through the years, however, their style and format and content have conformed to the "system." There has been little criticism of the documents and there was always the proviso that they could be "adapted to local conditions."

Looking for something of more value to modern unit training, we began studying ways to improve the system in 1970. Drawing on our own training experiences, on limited reports from units, and then on the results of our dynamic training survey, we drafted ATP 5-35T (T = Test), for the Engineer Combat Battalion, Army or Corps. Although it was still in draft form, the concept drew favorable responses from the Engineer Center Team and the Combat Arms Training Board. And in March 1972 it was presented to the Chief of Staff's Forum for Center Commanders at Fort Sill, Oklahoma. It now has all the informal support and encouragement we can use from people like General Ralph E. Haines, Jr., CG, CONARC; Lieutenant General Harris W. Hollis, Chief of Reserve Components; Lieutenant General George I. Forsythe, Special Assistant to the Chief of Staff for the Modern Volunteer Army; Major General LaVern E. Weber, Director of Army National Guard, and General Westmoreland. The latter commented, "This sounds like fun for the officers and the troops," and held our engineer proposal up as a model that

other branches could follow. So you commanders who want to try out the concept need not worry about support from the top. You officially have the freedom and flexibility to do so. If you think you need assistance, contact us at The Engineer School.

The key features of this dynamic training program for an engineer unit are—

- No mandatory hours of training are prescribed. It is up to each commander how much time he devotes to any subject.
- Training objectives are tied to manning levels. At reduced manning levels, only company, platoon, or squad training objectives need to be achieved.
- Testing requirements are specified for each element from squad through battalion.
- Testing is spread throughout the training cycle instead of being concentrated into a three-to-five day period at the end of the cycle.
- Tasks to be tested are designed for two-day accomplishment.
- Achievements are to be evaluated, and validated, within the chain of command, and two levels higher. In other words, the battalion commander validates what his platoons do, and the battalion is validated by the engineer brigade commander or his equivalent. For Reserve or National Guard units, the validator is a Reserve or National Guard officer.

The training cycle varies in length. A newly activated unit that is training full time during wartime mobilization needs about 33 weeks. An active Army unit should follow an annual cycle while a reserve component unit should follow a three-year cycle.

The training program should be designed around a series of tasks, each designed for a two-day block of training. For Reserve and National Guard units, this would fit a weekend multiple drill period at home stations. For active Army units, one 2-day period is about all that should be planned for pure training, considering the normal commitments for guard, housekeeping, maintenance, ash and trash details, and other requirements. For units newly activated under wartime mobilization and operating on a 48-hour week, two 2-day blocks could be accomplished each week. In each case, the time not scheduled for dynamic training is available for commander's time, for details, and for any preliminary instruction the unit leader thinks his men need before undergoing evaluation for real. Each two-day block, is not just exposure to instruction; it is an evaluated demonstration of the unit's ability to perform its combat mission.

A combat engineer squad should be capable of some 76 different tasks that are listed in ATP 5-35T. Several could be combined to make up a two-day training block. For example, a squad might be required

to execute a 40-kilometer engineer reconnaissance on foot. Then it might be required to take an overnight bivouac and turn in oral and written reports upon its return. Don't look over its shoulder all the way. Give that squad the mission and turn it loose. Inspect it once enroute and upon its return, and evaluate its reports. You'll identify the true squad leaders, and you'll help them develop leadership and to fashion their squads into teams.

You can give companion and competing tasks to two elements. For example, have two platoons set up dug-in and camouflaged platoon positions, including a real bunker; then have them switch attack, and clear and level the other's site. There are some 36 different tasks a combat engineer platoon should be able to do.

A typical company task might be a Bailey bridge. Don't just specify so many hours of bridge training. Give the company a mission of crossing a tank or an equivalent load over a designated gap at night. Make the bridge material and the tank available. Give them the first day to prepare, the night to do the job, and the second day to tear it down. If the tank crosses on time, the company passes its test. Every man will see it and know it, and the result will be associated with team work.

The secret of unit training is teamwork. Sometimes an outstanding leader can make even an unskilled crew look good. Sometimes a good crew can even make an incompetent leader look good. But the goal should be to develop both competent leaders and motivated, skilled crews, and to evaluate them as a team. Tasks should be designed to be measured on a go/no-go basis wherever possible, so that every man knows the mission and can see the results. Getting the tank over the bridge is an ideal example. The use of detailed check lists and point-scoring techniques should be avoided as this often degenerates into subjective judgment and becomes a farce that fools no one. If the unit is too noisy at night or has poor light discipline or security, give it remedial training—don't flunk it on bridge-building!

Some of the evaluated tasks should be construction projects. These can be of almost any sort, but they should be evaluated from an engineering standpoint. If possible, incorporate quality control. It's hopeless to pack enough such tasks for every squad, platoon, and company into a battalion ATT. You need to spread them out through the training cycle. With a little initiative and some planning, enough projects can be created. These could be on-post and even under simulated tactical conditions, or they could be off-post for organizations such as the Boy Scouts. If it relates to the unit mission and if it's done for real, evaluate the units performance and validate it for credit.

For a combat engineer unit, about half of the two-day tasks should involve night operations or an overnight bivouac. When the unit is in the field it should be tactical—camouflaged, dug in as appropriate, employing security elements.

Training should be progressive from squad to platoon to company and then battalion. There can be some overlap, since a company can be evaluated while its platoons and squads are engaged in tasks that are also being evaluated. The battalion commander and his staff can best be evaluated when the whole unit is in the field, as in the current ATT period. The difference is that only he and his staff are undergoing evaluation. Subordinate elements can be given makeup training, assigned projects or be retested on subjects they missed or failed.

It is estimated that an active Army engineer unit under such a training program would need to schedule two-day training blocks during only about 27 weeks per year, coupled with a period of two to three weeks when the entire battalion would live and operate in the field. A reserve component unit, on a three year cycle, would require about half of its multiple drill periods for training, and about half of its two-week summer camp periods. Validations, when achieved, would remain valid for 12 months for Active Army units and for 36 months for a reserve component unit.

These are the highlights of the concept for a dynamic training program for engineer units that the Engineer School has proposed for Department of the Army adoption. As pointed out earlier, however, you don't have to wait for it to be adopted. If a unit commander wants to modify it now to his training needs, he has support and encouragement from the Chief of Staff on down. If help is needed in developing your training program, we at the Engineer School will do our best to assist you.

Dynamic training isn't just an occasional adventure for a squad or a platoon. You don't have to wait for the right opportunity to come along. You can plan an entire program of dynamic training, and you can do it now. Some units have already launched their programs. How about you? 

Colonel Walter R. Hylander, Jr., Director of Doctrine and Training Development at the Engineer School and Chairman of the Engineer Dynamic Training Council, maintains he has trained dynamically the 1st, 2nd, 3rd, 138, and 288th Engineer Combat Battalions; the 487th Aviation Engineer Battalion (USAR), and at the Republic of Vietnam Armed Forces Engineer School. He holds a master's degree in Civil Engineering from M.I.T., and is a registered professional engineer in New York and a Fellow, American Society of Civil Engineers.

THE BLOOMING MENACE



ENGINEER STAFF



smiling. They were taking many pleasant memories back to their home in Palatka, Florida. James had the foresight to bring back a few souvenirs. The prize was a few seeds from an exotic floating plant he had purchased. A lavender-blooming, orchidaceous plant with glossy leaves, its flowers, which seemed fragile as butterfly wings, had blooms that lasted only a few days.

James would plant the seeds in their lawn fountain. Later they would overgrow the fountain. After being pulled out of their choked bed, the plants would be dumped into the nearby St. John's River and forgotten . . .

From this gentle and innocent act on a peaceful night in 1884 emerged a biological invasion of the nation's waterways that, over the last three-quarters of a century, cost many millions of dollars in control expenditures and economic losses.

The invading menace is named *Eichhornia Crassipes*—more commonly known as the water hyacinth. The generic title for this botanic wonder honors a Prussian minister, J. A. F. Eichhorn, who lived from 1779 to 1856. His exact connection with these stubborn plants, if in fact he ever saw one, has been lost to history. Likeliest explanation for the name was the practice of European botanists of the time, naming plants for famous men regardless of any association they might have had with the species.

By 1896, Eichhorn's namesake had spread throughout most of the St. John's River Valley. By 1900,

steamboat navigation on the river between Jacksonville, Florida, and Palatka had virtually ceased due to the aquatic infestation. Other gardeners and flower fanciers soon spread the pretty water hyacinth from Florida, through the Carolinas, and finally to Texas.

It was around this time that the U.S. Army Corps of Engineers was directed by Congress to do what it could to control this growth that was overwhelming waterways and menacing shipping. Seventy-odd years later Army engineers are still quietly battling to control this and other channel-clogging infestations. It is not a simple task.

How does one effectively dispose of a plant which is 10 percent or less fibrous substance and 90 percent air? —Plants that grow up to six feet above the water's surface? —Plants with trailing gray roots that appear lacy and fernlike underwater but are a bulky, sodden mass when uprooted? —Plants which multiply so rapidly that each might spawn 60,000 more in a single growing season?

The engineers tried dynamite to blast out the enemy. Oil mixtures were dumped on the plants and set aflame. Also employed were knives, pitchforks and axes in "hand-to-hand" combat. The tenacious water hyacinth seemed undefeatable.

As man began to use the water channels for pleasure by building housing and shopping areas along the canals, he unwittingly became an ally to his old enemy—human waste. It and other sewage were dumped into streams. Fertilizers

The evening sky twinkled with a mixture of stars and sparks from a line of river steamers stretching for miles along the wharves and levees. A lazy river breeze spread odors of jambalaya, shrimp creole, and oyster gumbo across the waterways. Laughter from milling throngs bore witness to the "Business Boom in the South," as Frank Leslie's ILLUSTRATED Newspaper proclaimed.

President Garfield's assassin had been dead for two years. The Brooklyn Bridge had been open for a year, and to most Americans it seemed that all was right with the world. Was there ever a more propitious occasion for an exposition like the New Orleans Cotton Centennial of 1884?

Not as far as James and Estelle Chalmers could imagine. They sat in the parlor car of the southbound evening train, touching hands, and



A sawboat attacks a mass of water hyacinth clogging a once navigable channel (upper left photo). An engineer works over small, isolated patches of "the menace" with defoliant (upper right photo). The target—one water hyacinth plant—is shown in the bottom photo.

running off from lawns and agricultural areas brought more nutrients to the hardy morass that was steadily creeping across the waterways.

The mechanical harvester, sawboat, and similar waterborne lawnmowers churned into the canals. The expensive result was improved conditions in locales where the machines were employed. Even so, nothing prevented the reinfestation.

Engineers fought back with herbicidal chemicals like sodium arsenite and plant hormones. Dumped or sprayed from aircraft, boats and swamp buggies, the chemicals noticeably retarded growth. The Engineers had entered the Chemical Age. But we also had entered an age of environmental concern. Ecologists, naturalists and other citizens viewed chemical treatment with misgivings. Although herbicides have not been

known to be injurious in any way to public health when used, the Corps of Engineers became concerned about this possibility and about side-effects of chemicals that might prove adverse to other elements of the river ecology.

This concern led to de-emphasis of chemical control in favor of developing other methods. These developments produced unusual results. Two thousand Argentine Flea Beetles, for example, were gathered from the Savannah National Wildlife Refuge, which nestles on the Georgia-South Carolina border. Lengthy tests showed the voracious insects considered Alligatorweed—another river-clogging hindrance to boaters and fishermen—a gourmet delight. But they would eat nothing else. Another victory for the water hyacinth!

Experimenters also tested a variety of biological agents that included tiny mites, fungi, moths, grasshoppers and huge manatees—sea cows which have ravenous appetites for the lily-like plant.

A curious candidate for hyacinth control is the White Amur, a weed-eating pan fish. Ranging from five to six pounds, the amur is a fine gamefish with a light, succulent taste. Developed in Russia, China and Thailand, it was used to control vegetation and keep irrigation canals clear. Since Thais must depend on their canals for transportation, bathing, and garbage disposal, large morasses of hyacinths ("Java Weeds" as the Thais call them) can disrupt household routine as well as water traffic.

Other ideas are being explored. A species of plant-eating South



These two photos show the hyacinth's before and after effect on a pumping station.



American snail might prove effective as a deterrent. Harvesting the hyacinth for cattle fodder, though it would be expensive, is being studied. Even the use of lasers are being considered.

Meanwhile the orchid-like scourge continues to grow, damming up normal water flow and causing increased evaporation of water in

channels. It immobilizes water transportation, stifling marinas and depressing waterfront real estate values. It harbors snakes and mosquito larvae within its rounded leaves. Hyacinth roots even sap oxygen from the water, with adverse effects on fish populations.

Yet, even with its treacherous history, the water hyacinth is ille-

gally but commonly sold in certain areas of the U.S. as an ornamental plant for about \$1.50.

At this very moment the offspring of James and Estelle Chalmers could very well be driving home from an enjoyable Northern vacation with a fragile lilac-blooming time bomb nestling comfortably in the back of their station wagon. 



Bridging

ENGINEER SPECIALISTS GETTING NEW SYSTEMS ENGINEERED MOS TYPE MANUALS

A SINGLE, CONSISTENT DOCUMENT which will facilitate school and unit training and correspondence course preparation and serve as a pro-pay refresher and field reference is currently "in the mill" at the U.S. Army Engineer School at Fort Belvoir, Virginia, for each of several military occupational specialties (MOS). These MOS manuals will be numbered for the specific occupational specialty, and each will carry an individual letter designator. Technical Manuals (TMs) 5-62, for instance, will represent Career Group 62, Engineer Heavy Equipment and Maintenance. Within that Career Group, 62B will identify the Engineer Equipment Repairman; 62C the Engineer Missile Equipment Specialist; 62D the Asphalt Equipment Operator, and so on. Each lettered manual will contain the material covering all skill levels for that MOS. For example, Part I of the 62B manual will contain only the material required for grade E-3, MOS 62B10. Part II will be an expansion of that material, plus the additional material required for grades E-4 and E-5, MOS 62B20. Following the same pattern, Parts III, IV and V will satisfy each skill level according to career patterns and data bank demands. However, when the basic skill level is a feeder into more than one MOS within the group, reference will be made to that skill level without repeating the same material. Thus, the 62C manual will not contain material for the 10-skill level E-3, but will refer back to Part I of the 62B manual. As of the moment, manuals for carpentry and plumbing have been completed, with TMs for Construct and Utilities Worker (551A), Electrician (551R), Engineer Equipment Repairman (5-562B/20/30), and NCO Administrative Guide (5-590) expected in the near future.

ARMY PICKS UP TAB FOR TWO FULL YEARS OF COLLEGE UNDER OUDP

IT HAS BEEN LEARNED that many officers still do not know about their undergraduate degree program. The Officer Undergraduate Degree Program, (OUDP, AR-621-1, 17 May 1971) is a funded plan that provides up to two full years of schooling with the tuition and fees paid by the government. Under the program, individuals can get four semesters and two summer sessions of schooling. Warrents can obtain MOS-related associate degrees while commissioned officers are earning branch-related bachelors degrees. Permanent Change of Station moves are authorized under this program. Any officer who does not have a branch related degree should contact the Education Officer at the Engineer Branch, Officer of Personnel Operations, for complete details.

TOE CHANGE ADDS NEW THREE-MAN TEAM TO POWER UNITS

A CHANGE in the TOE of Engineer Construction, Utilities and Electrical Power Teams has added Team HK, Radiographic Welding Inspection. Under Change 6, TOE 5-530G, Engineer Construction, Utilities and Electrical Power Teams, this three-man team provides pipeline radiographic welding inspection with the supervision coming from the supported unit Pipeline Engineer (MOS 7932). The team is equipped with an inspection set Line Item Number N95306. The team welders have MOS 44C20 with the additional skill identifier Z3. The same change also has provided the three utility teams (HE, HF, and HG) with the capability to support insect and rodent control. With this change, the Corps of Engineers' installation R&U responsibilities are the same for both the TOE war time theaters of operations units as the TDA Continental United States and peacetime oversea theater units.

the Gap



ENGINEER BRANCH AND TAGO URGE OFFICERS TO COMPLETE DA FORM 1059 FOR THE FILES

ENGINEER BRANCH urges that officers who have attended civil schools in the past should insure that both the branch and The Adjutant General efficiency files contain a copy of Department of the Army Form 1059 (Academic Report) with complete, official transcripts. This applies to officers who participated in Funded Graduate, DCP, or OUDP, and also to those who attended schooling on any basis but did not complete degree requirements.

INDIVIDUAL WORK PROJECT ADDED TO EOAC COURSE CURRICULUM

COMMENCING WITH CLASS 2, Fiscal Year 1972, of the Engineer Officer Advanced Course, U.S. Army Engineer School at Fort Belvoir, Virginia, the satisfactory accomplishment of an Individual Work Project was established as an additional requirement for successful completion of the course. The projects were introduced into the curriculum as a means of providing meaningful, higher level staff experience which will prove to be invaluable to the student in future career assignments. To recognize excellence, a Commandant's Award for Staff Excellence was established for presentation during graduation. The graduate of each class whose efforts are adjudged to be the best in consideration of the anticipated outcome of the project, the means used to satisfy the outcome, and the professional application of that means in the school's operational environment, will win the award.

NEW CORRESPONDENCE COURSES OFFER SKILL IMPROVEMENT AND ADVANCEMENT OPPORTUNITY

TWO NEW OPPORTUNITIES for enlisted personnel to improve their skills and to advance professionally appear for the first time in the 1972 edition of the U.S. Army Engineer School's "Announcement of Correspondence Courses." Each of these programs offers a means of furthering careers in either the stabilized Army of the future or in the booming construction industry of our civilian economy. The Engineer Skill Training Program (ESTP), which was pioneered at the U.S. Army Engineer Center and Fort Belvoir in 1971 (see **the engineer**, Fall Issue, 1971, page 26), combines correspondence courses with technical and practical training to produce skilled craftsmen in carpentry, masonry, plumbing, and electricity. The program's objective is to make available to all units having a Directorate of Facilities a means of improving their vertical construction skills. The 16-week program has already been adopted at several installations within the United States and overseas. Efforts are being made to obtain recognition by the unions for those who successfully complete the course. Introductory packets of materials are available to interested commands and/or installations and will be sent upon request by the U.S. Army Engineer School. Continuing progress also is being made in improving educational opportunities for enlisted personnel through correspondence courses. The most recent addition is the MOS Correspondence Course Program, which is comprised of a series of courses designed primarily to teach the principles and techniques of special engineer skills. These courses were developed along MOS lines and accomplish a number of purposes: They serve as a basis for learning a skill when coupled with practical on-the-job training; as a review vehicle and refresher for those having had formal training, but who have not practiced the skill recently; and as a means of preparing for promotion or MOS evaluation tests. Courses for 15 common MOS's are now being offered, with additional ones to be added to the list. Submit applications for enrollment on DA Form 145 through unit or activity commanders to the U.S. Army Engineer School, ATTN: DNRI, Fort Belvoir, Virginia 22060.

The Corps of Engineers recognizes the highly complex relationship between nature and man and seeks, as a part of its overall mission, to balance the environmental and developmental needs of the nation. More than that, the Corps has been charged by the President to put a handle on our major ecological problems and then to solve them. "The Environmental Syndrome," beginning on page 16, tells where we're headed, and explains why.

