ARMED FORCES CHEMICAL JOURNAL

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The Armed Forces Chemical Journal is the official publication of the Armed Forces Chemical Association. The fact that an article appears in its columns does not indicate the approval of the views expressed in it by any group or any individual other than the author. It is our policy to print articles on subjects of interest in order to stimulate thought and promote discussion; this regardless of the fact that some or all of the opinions advanced may be at variance with those held by the Armed Forces Chemical Association, National Officers, and the Editors.

COVER PHOTO

Dan A. Kimball, Secretary of the Navy, will be the speaker at the Dinner at the Annual Meeting in Chicago in May.

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ADVERTISERS

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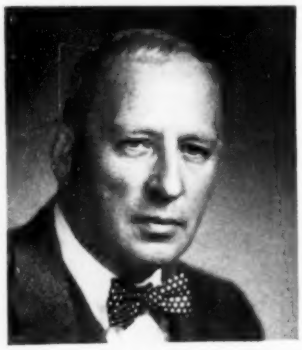
THE MEN BEHIND THE 7TH ANNUAL MEETING

MR. MORTON HAGUE
President, Chicago Chapter

Pictured on this page are the men forming the Advisory Committee of the Chicago Chapter, for the Seventh Annual Meeting of the Armed Forces Chemical Association. The Chicago Chapter has tackled this, the greatest meeting in the history of the Association, with their characteristic enthusiasm. These men are accustomed to successfully accomplish what they set out to do, and they have determined to put on a meeting which will be well worth attending. They urge you to attend, and promise that you will not be disappointed.

MR. JAMES J. DOHENY
Secretary, Chicago Chapter



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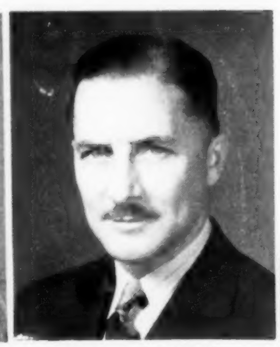


M. R. STANLEY
Industrial Chemicals Committee

LEWIS TERRY
Chairman, Program Committee

W. D. WILKINSON
Chairman, Finance Committee

CHICAGO EXPECTS RECORD ATTENDANCE

The Armed Forces Chemical Association's Seventh Annual Meeting in Chicago is an innovation in that it is the first one which is under the sponsorship and management of one of our Chapters. The first four annual meetings of the Association were held in Edgewood, Maryland, at the Army Chemical Center. The splendid and active cooperation of the Edgewood Chapter contributed to the success of these meetings but the management of the meetings was a composite between the Chapter, the National Association and the committees designated by General Bullene, and thus these meetings were not actually the responsibility of the local Chapter to the extent that will be the case of the Chicago Annual Meeting. The next two annual meetings were held at Virginia Beach, Virginia, and Atlantic City, New Jersey, respectively. These meetings were managed by the National headquarters. The meetings were highly successful, but because they were held at points remote from an active chapter, the attendance was not as great as at the initial four meetings. The meeting in Chicago, with its hundreds of members living there and with so many of our Group Members having activities there, is expected to attract an attendance exceeding any previous meeting.

DISTINGUISHED SPEAKERS ON PROGRAM OF CHICAGO MEETING

The Chicago Chapter has set up a program for the Seventh Annual Meeting in which are presented a distinguished speakers list headed by Secretary of the Navy Dan A. Kimball, who will speak at the dinner. The program follows.

REGISTRATION

The final program of the meeting, together with forms for advance registration, will be sent to all members of the Association well in advance of the meeting. The following charges have been set:

Registration for members and guests, including attendance at all sessions, reception and annual banquet, but not including Saturday trips	$16.50
Registration for ladies, including all events on regular Thursday and Friday programs, reception, and annual banquet	12.00
Saturday trips	
Museum and University of Chicago	1.00
Glenview NAS and Great Lakes NTS	1.25

HOTEL RESERVATIONS

The Sherman Hotel has been selected as convention headquarters. All meetings, the reception and dinner, and all other events will be held in the hotel, and trips for which transportation is furnished will start from that point.

Reservations should be made directly with the Hotel Sherman, Randolph and Clark Streets, Chicago 1, Ill., attention: Miss Catherine Lowery, Reservation Department, *and requests should mention ARMED FORCES CHEMICAL ASSOCIATION MEETING.* Please indicate date and time of arrival, length of stay, accommodations desired, and the names of the persons who will occupy the rooms.

Rates:

Single rooms	$4.95, $5.95, up to $ 9.95
Double bedroom for two	$ 7.95 to $13.95
Twin bedded rooms	$10.95 to $14.95
Alcoves (Sitting room-Bedroom combination)	$17.95 to $19.95
Parlor and one twin bedroom	$16.95 to $29.95
Parlor and two twin bedrooms	$39.95
Two rooms, connecting bath between, for 2, 3 or 4 persons	$11.90 to $19.90

A large block of rooms has been set aside for our members and guests, but early reservations are required. Those who desire to stay in other hotels must make their own arrangements.

PROGRAM

Thursday, May 15

A.M.—Registration—Mezzanine of Hotel Sherman.
Meeting of the Board of Directors.

P.M.—General Session. Bal Tabarin, Hotel Sherman.

2:00 P.M.—Annual report of the President to the Association.

2:30 P.M.—Address of Welcome, Rear Admiral Francis P. Old.

2:45 P.M.—FORUM: The Military Viewpoint. H. S. McQuaid, presiding.
This session will be addressed by three prominent military officers, following which there will be question and answer period.

5:00 P.M.—Adjournment (No further meetings on Thursday).

Friday, May 16

A.M.—Registration—Mezzanine of Hotel Sherman.
General Session. Grand Ballroom, Hotel Sherman.

9:30 A.M.—FORUM: The Civilian Viewpoint. W. E. Lawson, presiding.
Three well-known civilians will present views on topics of current interest to the Association; a discussion period will follow the talks.

2:00 P.M.—GENERAL MEETING. President Walter E. Lawson, presiding.
Maj. Gen. E. F. Bullene, Chief Chemical Officer.
Rear Admiral John A. Snackenberg, USN.

5:30 P.M.—The President's Reception. Louis XVI and Crystal Rooms.

7:00 P.M.—Annual Banquet. Grand Ballroom, Hotel Sherman.
Speaker: Hon. Dan A. Kimball, Secretary of the Navy.

Saturday, May 17

9:00 A.M.—Trip to Museum of Science and Industry.

9:30 A.M.—Trip to AEC Laboratory at the University of Chicago, including betatron and cyclotron.

10:00 A.M.—(tentative starting time) Trip to Glenview Naval Air Station, and Great Lakes Naval Training Station for special demonstrations.
Information about all trips will be sent to the membership with advance registration forms. Reservations must be made in advance for all trips.

LADIES' PROGRAM

Thursday, May 15

A.M.—Registration—Mezzanine, Hotel Sherman.

2:00 P.M.—Trip to Merchandise Mart to see special display, "Design for Living," conducted tour.

Evening—Tickets will be available for various radio and television shows, for both men and women.

Friday, May 16

8:00 A.M.—Don McNiel Breakfast Club broadcast.

9:30 A.M.—Welcome Travelers broadcast.

12:15 P.M.—Fashion show and luncheon, Marshall Field and Company.

2:00 P.M.—Trip to Helene Curtis Industries.

5:30 P.M.—The President's Reception, Hotel Sherman.

7:00 P.M.—Annual Banquet, Hotel Sherman, Grand Ballroom.

Saturday, May 17

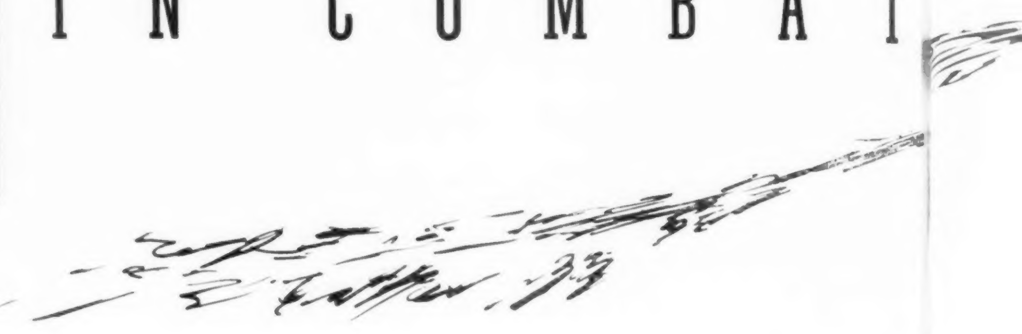
9:00 A.M.—Trip to Museum of Science and Industry and University of Chicago (see general program).

10:00 A.M.—Trip to Glenview Naval Air Station and Great Lakes Naval Training Station (see general program).

Other sightseeing and inspection trips will be arranged and will be conducted in group tours if there is sufficient demand for them.

Major General Egbert F. Bullene, U.S.A.

CHEMICALS IN COMBAT



(Remarks by Major General E. F. Bullene, Chief Chemical Officer, Department of the Army, before "Meeting-in-Miniature" of the New York Section, American Chemical Society, at Hunter College, New York City, Feb. 8, 1952.)

It is indeed a great pleasure and a privilege for me to appear before such a gathering of technical and industrial leaders. I want to tell you of the Chemical Corps' role in present active operations, and, in addition, I feel that we have a mutual problem that should be discussed here briefly.

In times such as these, the part the Chemical Corps plays on our fighting team is apt to be overlooked.

Thus far in the Korean war no use has been made of gas, but just why the Reds have not used it—at least at the beginning and before the United States entered the fighting—is debatable. The Communists must have known that the South Korean troops were totally unprepared to defend themselves against an attack by gas. The Reds, on the other hand, have ample chemical resources and the know-how to use them. The fact that they did not use gas in the initial attack probably means only that the Red masterminds either did not want to tip their hands on what they had, or they didn't think gas would be of any help in an invasion which they expected would be over in a few short weeks. Once the United States, and United Nations forces, did enter the war and stop the Reds at the Pusan perimeter, the Communists became convinced that a gas attack would be too risky, since the rapid growth of our nation's chemical industry to the number one spot on our industrial ladder has not gone unnoticed by other world powers.

Our tactical operations in Korea are, of course, classified. Chemical units were in Korea by 4 July 1950, two weeks after the invasion began, and have been growing in strength ever since. Much of the work carried out by these units has been in the defensive preparation for any enemy attack by gas, but the nongas contributions of these units has been considerable and much of it has been front line action. Figures on Chemical Corps combat casualties in the Korean war are not yet releasable, but they have not been light. Admittedly, some of our units took a beating at the hands of the Chinese Reds, especially our Second Chemical Mortar Battalion which was the first American unit to be hit by the Chinese when they entered the conflict at Unsan. In World War II, Chemical Corps combat casualties—on a percentage basis—were second only to the Infantry itself, which was first.

Let us now consider some of our nongas contributions in Korea on an individual basis:

Incendiaries

Napalm, the gasoline thickener developed through our laboratories at the Army Chemical Center near Edgewood, Maryland, early in World War II, and which proved such a potent factor in the smashing of Japan's industrial might in the B-29 raids of 1945, has also proved to be a top all-purpose weapon in the Korean war. Last spring, the air forces alone were using an average of 70,000 gallons of napalm a day in tactical operations against enemy personnel and supply lines. The Air Force became enamored with the wing-tank napalm bomb early in the war when it was learned that even a near-miss would destroy a T-34 tank, while a rocket probably wouldn't. One official observer (not Chemical Corps) has credited napalm with more tank kills than all other anti-tank weapons combined.

The wing-tank bomb has also been especially effective in flushing Reds from entrenched positions atop and on the reverse slope of hills. A fire bomb will splatter flaming gasoline over an area half as large as a football field, and its use in the tactical support of ground forces has become a routine practice with all of the air forces. Chemical Corps service teams have been kept busy mixing the napalm at air bases in Korea and Japan.

Lately, "fougassies," ingenious and aptly-named napalm land mines, have been giving the Chinese pause for thought before they embark on their characteristic massed night attacks. Fifty-five gallon drums of napalm, booby-trapped to a detonator and three pounds of TNT, are half-buried around allied defense perimeters. When the attacking Reds hit the trip-wires, they find themselves suddenly in the middle of a circle of clinging flame. A more recent innovation is the use of drums of napalm for night illumination. A 55-gallon drum of napalm with the top removed will burn for nearly 10 hours. The Chinese do not like to attack across lighted areas.

The use of incendiaries for strategic bombing in North Korea has been almost nil. No effort has been made to burn out civilian concentrations, as was done in Japan. Several oil dumps and refineries, notably those at Wonsan, were knocked out with 500-pound napalm and magnesium bombs, but for the most part, strategic bombing has been carried out with high explosives.

The 4.2-inch Mortar

We developed the 4.2-inch mortar back in 1924 primarily for the use of projecting gas and smoke shells, but it was adapted to carry high explosives shortly before Pearl Harbor and saw plenty of action in World War II. The light and

mobile piece can throw a shell packing the wallop of a 105-mm. howitzer at ranges between 600 and 4,000 yards. It has been invaluable in the close support of ground forces, especially where tank and artillery support is not available. At the end of World War II, the Infantry and the Marines adopted the 4.2 as a basic weapon. In Korea, they have been using the 4.2 in their heavy weapons companies, while the Chemical Corps' mortar units, because of their high mobility, have supplied heavy fire power for larger units lacking their own artillery, such as the British and ROK troops.

The Second Chemical Mortar Battalion moved into Korea with the Inchon landings and first saw action south of Pyongyang while furnishing artillery support for the First ROK Division, one mortar company to a regiment. At Unsan, near the Manchurian border, the mortarmen, who were the first American troops to meet the Chinese Reds, took the full blow. Companies B and C rolled with the punch and got out, but Company A was completely overrun when the ROK lines crumbled. The company was able to battle its way out but only after suffering heavy losses. Reorganized and re-equipped, the battalion has since fought with the 27th British Commonwealth Brigade, has furnished artillery-type support for two United States Corps, and has been subattached to five divisions and, with its companies, ten regimental combat teams.

Flame Throwers

The portable flame thrower, which gave excellent service clearing enemy fortifications in the Pacific in World War II, has seen increasing use as an anti-personnel weapon in Korea. Improved and waterproof "squirt guns" were shipped to the battlefronts early in the fighting and are being used by the ground forces when the more conventional weapons are ineffective.

Lately, the flame thrower has been frequently called upon for perimeter defense work.

The tank-mounted flame throwers have been used so widely that they are now regularly assigned to armored cavalry units. Their principal use has been in the burning out of villages and fortified positions harboring enemy troops.

White Phosphorus

White phosphorus has seen service in a variety of ways. Rifle-launched grenades, mortar and artillery shells, and rockets fired from spotter planes have been used to mark enemy emplacements for aerial and artillery attacks. WP has also been used for small-scale smoke screening and for incendiary and illumination work, but its primary use has been to kill enemy troops. The Reds have become highly respectful of phosphorus, a respect that was transferred to our own troops not long ago when the Chinese captured a large quantity of phosphorus grenades following the Hungnam evacuation and have been throwing them back at us.

Smoke

Smoke-screening operations, thus far, in Korea have been confined entirely to small-scale tactics in which Chemical Corps smoke generator units have obscured UN installations for short periods of time, and white phosphorus mortar and artillery shells have been used to blind individual enemy positions during attack. Both WP and colored smoke grenades have seen increasing use for marking enemy positions and for signaling purposes.

Large-scale smoke operations, such as were seen in World War II when entire cities and ports were blanketed for days at a time, have not been necessary. This is primarily because of the failure of Communist aircraft to be seen except in one small northern portion of the Korean peninsula. In the two instances where large-scale smoking might have been used, the Inchon landing and the Hungnam evacuation, the weather and lack of enemy airplanes made smoke screening unnecessary. Nevertheless, in Korea we have smoke units which are well-trained and well-equipped ready for large-scale action.

Technical Intelligence

Chemical Technical Intelligence teams have maintained a constant vigilance on enemy operations that might presage an attack by chemical or biological agents. This has been a tough job, in view of the large number of Red guerillas operating behind the UN lines. There have been several gas "scares," but all proved to be of nonmilitary origin. In one instance, a Korean child playfully banged away the corroded plug off a cylinder of chlorine and caused a number of casualties among civilians in recaptured Seoul. It was found that the gas was part of the equipment of the wrecked city waterworks and Chemical Corps teams had to gather up the unused chlorine and dump it in the Han river.

And now, as I stated in the beginning, I have a mutual problem I would like to discuss briefly. As a basis for this, I want to read a short quotation:

"Whether or not gas will be employed in future war is a matter of conjecture, but the effect is so deadly to the unprepared that we can never afford to neglect the question."

Those words were written by General John J. Pershing, and are found in his final report as Commander-in-Chief of the American Expeditionary Forces to the Secretary of War. The report was submitted September 1, 1919.

At the time, America had just emerged from a great war; a war that saw the first modern use of poison gas on the battlefield. The people of the United States had inherited from World War I an abhorrence and a fear of the use of gas in battle. Today that feeling of fear has more or less given way to a feeling of apathy. The cause can be traced to two factors: First, the speculation about atomic weapons, guided missiles and push-button warfare has overshadowed the picture of actual warfare as it will be fought for many years to come. Secondly, we came through World War II as the victor without firing a gas shell. These two factors combined have resulted in a tendency for many to believe that gas warfare, along with other known weapons, is obsolete. To continue thinking in such terms we face possible disaster, for nothing could be further from the truth.

Today we hear much about "moulding public opinion." The phrase is used in connection with everything from cigarette brands to political ideology. We already have a good start in moulding public opinion as regards the needs for a strong national defense. **But we must not disregard any phase of national defense and thereby leave a weak spot. If the present apathy about gas warfare is allowed to continue, the resultant weakness will be great indeed.**

In the research and development of any new weapon, the full offensive capabilities are first explored before the problem of defense is tackled. This is the course we must also take in bringing to public realization the potentialities of toxic warfare, so there can be a complete understanding of the needs for protection against it. Ever since General Pershing wrote the words I quoted, the question of the use of chemicals in war has been aired pro and con in the councils of nations, and by the man in the street. It may still be argued that the future employment of such means is purely conjecture. But General Pershing's words have lost none of their significance.

During recent years there has been a great deal of speculation on the nature of future conflicts. In the mass of theoretical and fictional literature which has appeared on this subject, the mailed fist of Mars is pictured as harnessing to his use all of the forces of science in the shape of hitherto unheard-of engines of destruction. And, it is interesting to note that in all this literature, chemicals are eminently featured.

However, we need not seek justification for adequate protective training in the speculation of dreamers and theorists. We need only to consider a part of General Pershing's message ". . . so deadly to the unprepared."

What the war theorists say may prove to be true.

But, considering General Pershing's message in the light of cold logic, we find it square with facts. These are the facts:

Gas proved itself in World War I.

It caused more than 70,000, or slightly better than 31 per cent, of all our casualties in the AEF.

Approximately 10 per cent of the artillery shells fired by the Germans were gas-filled.

Germany never had more than 6,000 special gas troops in being at one time.

Gas munitions were not employed by aircraft by either side in World War I.

In other words, 10 per cent of the German artillery ammunition which was gas filled, and 6,000 gas troops, accounted for almost one-third of our casualties in that war.

We must also consider the fact that gas put men out of action just as effectively as did bullets—but many of those who were gassed are probably living today, since only 2 per cent of the American gas casualties died as a result. Inasmuch as the death rate was 25 per cent for wounds received by means other than gas, a soldier injured by toxic agents had a 12 times better chance to survive than he did if wounded by shells, shrapnel or bullets.

In building the foundation of our modern national defense we have come to realize that our nation, and its allies, cannot hope to match the massed manpower of the potential enemy in any future war. We must overcome this deficiency by fielding armies that are scientifically equipped and trained. **This nation's greatest offensive weapon is embodied in the scientific and industrial genius of our people, and we must be prepared to take full advantage of this situation.**

Under our form of government, it is inconceivable that the United States would start an undeclared war. It is not our way of life. But an enemy nation under a dictatorship can, and does, initiate undeclared war. In our military planning, therefore, we start with a disadvantage. We must operate on the premise that the opening attack, whether it be war itself, or the use of chemical agents in war, will be made by the enemy. This gives the enemy the initial advantage.

In each of the last two wars we saw instances where the initiating nation failed to follow up an advantage which might have resulted in their being the victors of the conflict instead of the losers.

On the afternoon of April 22, 1915, near the Belgian town of Ypres, the Germans unleashed the first gas cloud in modern warfare. The allies were totally unprepared for such an attack. Within a few minutes the cloud of chlorine had completely demoralized 15,000 troops and left a five-mile gap in the lines. The Germans were also totally unprepared—unprepared to take full advantage of the result. Had they been prepared, they could have driven through that hole in the line and reached the English Channel, thereby splitting the Allied Forces and possibly winning the war.

The second instance happened on the morning of December 7, 1941, at Pearl Harbor. Had the Japanese been fully prepared to follow up their advantage, they might have landed troops on the Hawaiian Islands, and made a sizable landing on the beaches of California.

Some day, some initiating country might follow up such an advantage.

It is our job to insure that we are so well prepared against a gas-type "Pearl Harbor," that we can roll with the punch, suffering as little damage as possible, and strike back immediately. We must make our plans so that we can absorb the initial attack of a strong enemy using the most modern weapons, and still be able to retaliate promptly and overwhelmingly. And we must continually find new ways to overcome this initial handicap.

The most effective way of overcoming the military disadvantage of being the non-aggressor—even though we recognize it as the price we are willing to pay for our democratic way of life—is to make the maximum use of the advantages which our way of life have given us.

Among these great advantages are world leadership in science and industry and the ability to produce quality material in almost unlimited quantity. In no other field is our technical and productive ability shown to a better advantage than in the production of chemical weapons.

Since World War I, when gas caused practically a third of our casualties in the American Army, the potentialities of the chemical weapon have greatly increased.

Gas was a constant threat throughout World War II, but it was not used. This was not because it would have been ineffective. Indeed, as we look back, its use at the proper time and place might possibly have been decisive in certain campaigns for either side. Our policy during the war, in line with that of our Allies, was to be prepared, but not to use gas unless the enemy did. The enemy didn't use it because he was afraid to use it. He was afraid of our overwhelming chemical potential to make more gas and deliver bigger gas attacks than he could; this, despite the fact that he had in his depots and arsenals thousands of tons of toxic gas ready for immediate use.

We cannot delude ourselves with the thought that gas warfare is obsolete. The standard chemical agents which have come down to us from World War I and have stood the test of time are still just as potent casualty-producers as they ever were.

During World War II, chemical agents of far greater toxicity were developed, and studied by both sides. The Germans carried one of their secret developments to large scale production and were ready to use it. We know that other foreign powers also obtained the secrets of this development at the end of the war, and are working on improvements just as we are. There were other related compounds even more potent which the Axis powers knew about but did not produce in quantity. Indeed, we dare not overlook gas in our defense planning.

Our job in the Chemical Corps is to be prepared to implement whatever decisions our government may make.

At this time the only safe procedure to follow in our planning and training is to assume that toxic weapons will be used without restrictions in any future war.

In the last war our potential in chemical warfare was so great that, as I have said, the Axis powers despite all their vast accumulation of offensive gas materiel did not dare to employ it. The war ended with Germany and Japan holding unused in storage, a quarter million tons of toxic ammunition and bulk gas. Germany was fully aware of our offensive strength and recognized the excellence of our defensive equipment. We must continue to hold the qualitative edge in chemical warfare over potential enemies.

Not only is gas a good psychological weapon, but its effectiveness and economy are enhanced by the fact that, unlike bombing with explosive type munitions, it does not destroy physical property.

During the cold, pre-dawn hours of September 1, 1939, the Nazi troops of Hitler invaded Poland and the shooting phase of Europe's most destructive war was on. In April, 1945, the German Madman put a pistol to his head and ended the destruction on the European continent. The Japanese had already seen the handwriting on the wall, but it took two atomic blasts four months later to convince them that their dreams of Pacific area conquest were just dreams after all. And, so, on September 2, 1945, their written surrender ended that war.

In the six years of fighting there had been 22 million lives lost, more than half of them civilians. Thirty-four and a half millions were injured, or maimed for life. For armaments and war materiel alone, the belligerent governments had spent over one trillion dollars. The other materiel costs are immeasurable.

Today, there isn't a country in the world which is not trying to throw off the economic effects of that costly conflict.

We, in America, are pouring millions of dollars into countries ravaged by the war. The destruction of bombs and shells, tanks and ships, ruined the national economy of not only the vanquished nations, but also that of some of the victors. Every world power, or would-be world power, gained an object lesson from that war.

It is clear, that merely achieving a military victory in war is no longer sufficient. Economic stability must be provided for, if a Pyrrhic victory is to be avoided. The extensive use of materiel-destructive weapons against manufacturing plants, power facilities, and transportation networks, would almost certainly achieve such an empty victory.

It seems reasonably certain after the lessons of World War II that any nation planning aggression upon a well-industrialized nation would choose the weapon, or combination of weapons, giving promise of victory with a minimum of destruction. Chemical agents are primarily anti-personnel weapons, but by incapacitating the individual workers, the machinery and facilities needed for defense of the attacked nation would come to a standstill. Thus, we must assume that our great industrial nation could be the object of such an attack.

With this assumption in mind, we continually train military troops in protection against chemical agents.

However, in order that we may gain full measure from the billions of dollars we are spending for national defense, our non-military people must also have a real appreciation of the threats against our security. **The apathetic attitude which is prevalent and to a lesser extent, the exaggerated notions and fears of a small minority about toxicological warfare must be corrected through a program of education. For only through a true realization of the actual dangers which might arise from the use of toxic agents can our people prepare an effective defense. We must call upon the scientific groups and other organizations who have some knowledge of this type of warfare, to help lift the fog of ignorance.**

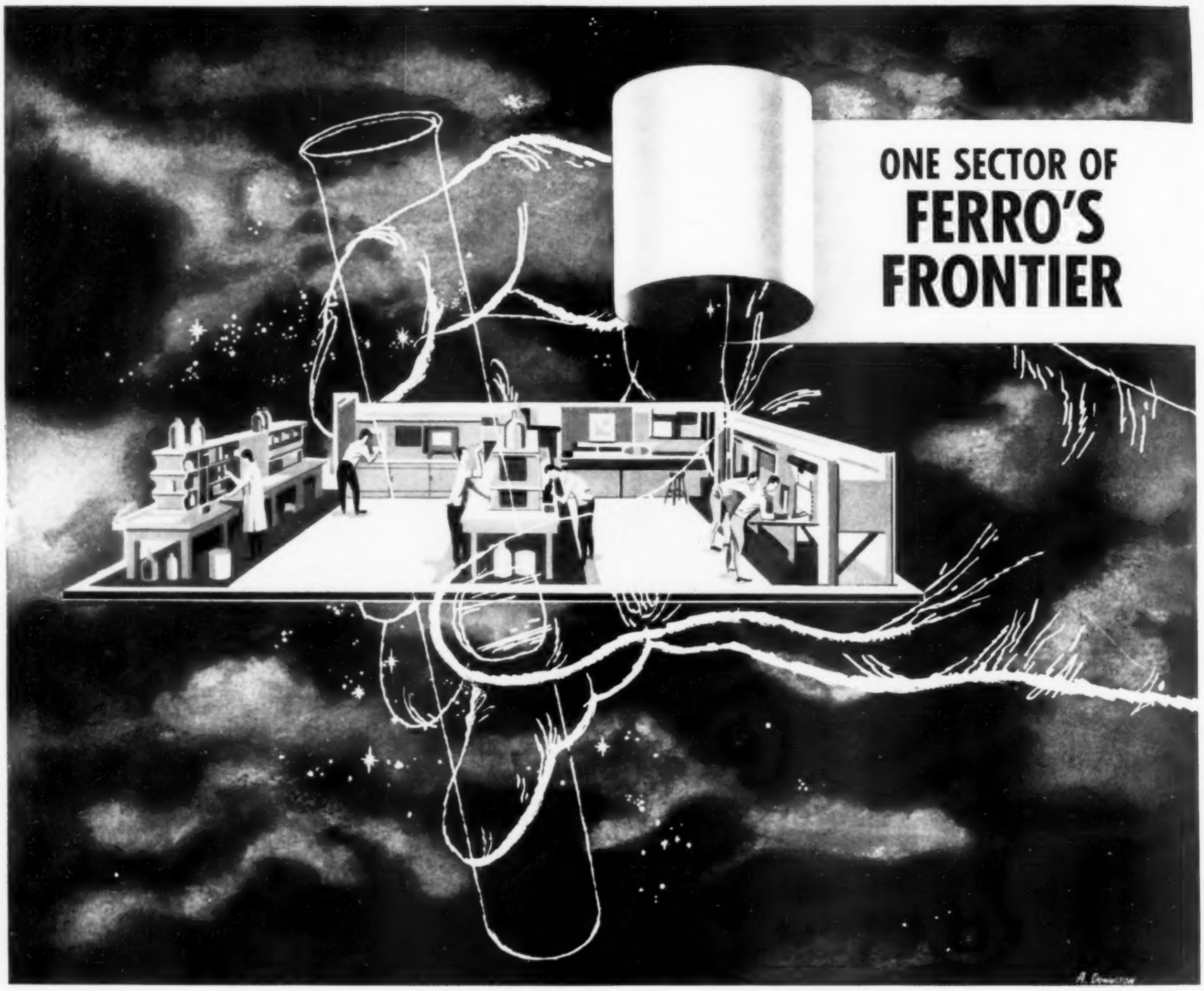
Since we have entered an era in which technical developments mean as much to defense as numbers in manpower, industry and science face a great challenge. The nation that depends upon masses of men, however, brawny and well-trained, but equipped with mediocre or out-dated weapons, can be defeated by a smaller force with superior weapons and equipment of which they are masters. I am confident that our tremendous reservoir of know-how in chemical science will continue to give us the technical means to meet and surmount our possible enemy's greater manpower.

CORPS COUNTY FAIR

On Friday, the 2nd of May, at Fort McNair Officers' Club, the Chemical Corps will sponsor another of its popular COUNTY FAIRS. Last year's proceeds made it possible for the Corps to donate two beds to the Soldiers', Sailors', Marines' and Airmen's Club of Washington. The primary project of this year's Fair will be the maintenance of these beds.

Spearheading the Chemical Corps effort is the Officers' Wives' Club, assisted by personnel of the Office of the Chief Chemical Officer. Heading the Executive Committee for the Fair are Major General and Mrs. Bullene, and Brig. General and Mrs. Loucks.

Everything about the Fair will be country-style—overalls, blue jeans and checkered shirts will be the mode, and fresh-from-the-farm cakes, jams, preserves, etc., will be displayed. Feature of the entertainment is to be an exhibition of square dancing, and throughout the evening a square-dance caller and regular dance band will alternate for "square" and "round" dancing. Prizes and plenty of fun for all are promised by the sponsors.



Platform in the great blue yonder

There comes a time in all new processes when the solution seems to lie somewhere out in the realm of the great uncharted blue.

Perhaps right now something baffles your own product development department. If so, this startling fact about Ferro should give you pause to think: *One out of every seven employees at Ferro is in research or development.*

With such a staff we offer you a sturdy platform out on the blue horizon where chemistry and engineering come together, long Ferro's realm.

For example: Ferro's knowledge of engineering along with chemistry made possible the building of a completely automatic plant for the production of Napalm, substantially reducing its cost to the government.

And again: Ferro chemists and engineers, working side by side with their porcelain enameling customers, have cut finishing costs while actually improving products — helped some customers, with *bad problems,* from red ink to black in a matter of weeks.

Perhaps you, too, can profitably draw on the skill, insight, facilities of a large organization beyond your own. Just long enough to get a problem solved. You can find such help at Ferro Corporation, Cleveland 5, Ohio.

FERRO

OUR FRONTIER IS ENGINEERING TEAMED WITH CHEMISTRY...

THE STORY OF aureomycin

By T. H. Marshall
Manager of Manufacturing
Lederle Laboratories

The life-saving role currently being played by aureomycin in Korea is adding another chapter to one of the most exciting stories in modern medical annals.

Recent figures released by the Army Surgeon General's office state that of every 100 soldiers wounded in Korea who receive medical aid, 98 recover. The death rate among wounded in Korea, as compared with the experience in World War II, has already been cut in half, in spite of the fact that in World War II soldiers received the finest and most successful care then known.

Among the factors contributing to this remarkable decrease in battlefield deaths is the development of the new "wonder" drugs, such as aureomycin. In a recent informational directive put out by the Army Medical Service, aureomycin is listed as the first drug choice in 13 different infections which may follow wound or injury. Aureomycin is the second choice in six other types of infections and mentioned as a useful alternate in 14 others.

Aureomycin is prescribed for thousands of civilians daily, for diseases ranging from boils or carbuncles to "virus" pneumonia and Rocky Mountain spotted fever, all of which adds up to an overwhelming testimonial to this product of medical research.

From almost any angle—discovery, isolation, development, or production—aureomycin is an exciting story. It begins with a former professor of Botany.

Dr. Benjamin M. Duggar retired at the age of 71 from the faculty of the University of Wisconsin. Most men would be content to rest on their laurels after retirement, but not Dr. Duggar. His insatiable quest for new discoveries brought him to Lederle Laboratories Division of American Cyanamid Company in 1943.

Before retirement, Dr. Duggar had established himself as one of the world's outstanding botanists, and was an internationally recognized authority on molds and fungi. Upon arriving at Lederle, he plunged into the never-ending research for newer and better antibiotic drugs for combating human and animal diseases. The discovery of penicillin had started the scientific world on this intensive search for a possible "cure-all" drug.

Since penicillin was produced by a large mold, Dr. Duggar decided to search the smaller molds for newer antibiotic drugs. The small molds are abundant in soil, so hundreds and eventually thousands of soil samples were brought to him at Pearl River, N. Y.

Into the picture then came teams of chemists, bacteriologists, pharmacologists, and other specialists who are important in experimental medicine. For three years, the sci-

Dr. Duggar examines some of the thousands of soil samples which were sent to him from all over the world during his search for a new antibiotic drug with a wider range of activity than penicillin. Soil was used because small molds, which Dr. Duggar chose to investigate, are known to be abundant in it. Samples from the mid-west were the first to turn up the mold which produces aureomycin during its growth.

entists continued their untiring search, testing tens of thousands of cultures, experiencing disappointments, then starting their search anew.

Then one day, an interesting, golden-colored mold appeared. Could this be "it"? Could this be the end of all their tedious searching? This new mold was labeled A-377, a rather unexciting designation, and test tube experiments were begun immediately. The results were absolutely amazing! This new mold very effectively prevented the growth of staphylococci, streptococci, and a variety of rod-shaped germs called bacilli.

This latter observation was the most important, for while other antibiotic drugs were effective against staph and strep germs, here was evidence that this new mold was producing an antibiotic which might have a wider range of action against infectious diseases in man and animals.

These results stimulated the Lederle team to increased activity. The next step was to see if this new antibiotic, named by Dr. Duggar, Streptomyces aureofaciens, could be isolated in a relatively pure, active, and inexpensive form.

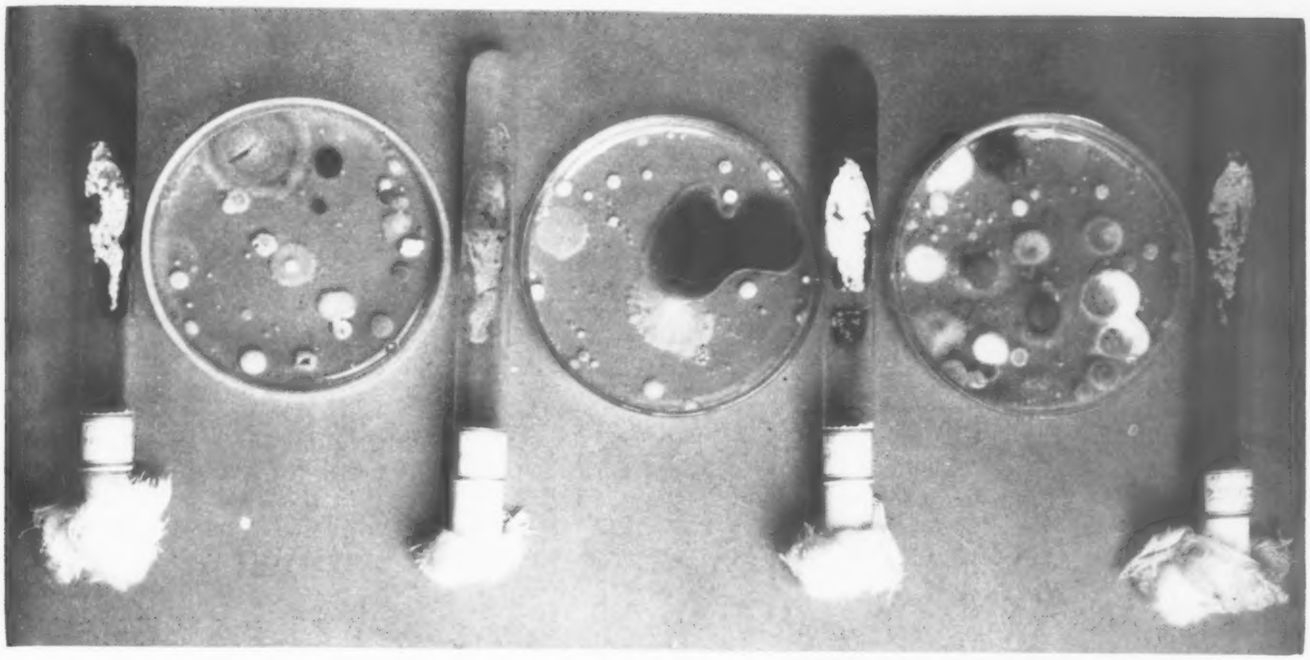
Teamwork and patience, combined with modern equipment and the best technical skill available, soon proved that it was practical to isolate this new drug. Still more encouraging, early experiments showed that it was not toxic to animals. Laboratory tests continued at a rapid rate. It was soon learned that aureomycin had an effective range of action much greater than anyone had anticipated and very wide compared with other antibiotics.

It was then discovered that this new "golden wonder" drug was effective against bacteria, large viruses, and germs which cause typhus and typhus-like diseases. The latter lie, in form, midway between the viruses and bacteria and are known as rickettsia. Aureomycin was the first antibiotic to be effective against the rickettsial group. Lederle scientists also learned that aureomycin was effective when administered orally, eliminating the needle injection method usually used for penicillin.

With all this information in hand, the scientists then began world-wide clinical tests of the new antibotic . . . and

A377 marked on the glass indicates that these "buttons" in the Petri dish are Streptomyces aureofaciens—the technical name for the mold which produces aureomycin.

After the Streptomyces aureofaciens mold which produce aureomycin, has been grown in huge tanks under ideal growing conditions, the resulting material is put through a giant filter in one of the early stages of extracting the antibiotic drug.



Many and varied are the molds which can be isolated from common soil, as shown by the above picture. Lederle is continuing its search into molds of these same general types in hope of discovering new antibiotics.

the results were startling! More and more uses for the drug were uncovered and documented. Paper after paper was written on the uses of this new antibiotic and the material became so profuse that Lederle had to establish a special section of its already immense library for writings on this subject.

Meanwhile, Lederle's production team was moving rapidly to determine if this new antibiotic could be produced at a reasonable cost, for if it could not, all the efforts of the scientists would probably go for naught. Yes, they reported, aureomycin could be produced at a competitive price, after new and very expensive equipment installations were made.

After purification and refining, aureomycin is then packaged in its 16 forms. Here vials containing aureomycin capsules start on their journey to the capping machine. The worker in the foreground checks each vial to see that each contains the proper number of capsules.

After more than a year of further tests, the scientists were ready to give the new drug their approval. In 1948, three years after Dr. Duggar started his quest, the most versatile of all the antibiotic drugs was made available to doctors.

Since that time, thousands of people all over the world have taken aureomycin for an enormous variety of infections. Today, aureomycin is indicated for 60 different types of infection, including: appendicitis; brain, breast, lung and liver abscess; brucellosis, erysipelas, gonorrhea, influenza, oral infections, meningitis, sinusitis, scarlet fever, tonsilitis, all types of pneumonia, parrot fever, rat-bite fever, rabbit fever, Rocky Mountain spotted fever, and boils and carbuncles.

Aureomycin, now marketed in 16 different forms, has proved especially effective against mixed infections following childbirth and is playing a large role in making childbirth safer.

The animal population is coming in for its share of benefit from the new drug. It is the most effective agent yet discovered for combating mastitis, the dairyman's most costly disease, and is recommended for one of the hog raiser's most costly infections, enteritis.

Since aureomycin is produced by the fermentation process, there are large quantities of mash left, Lederle researchers, seeking a use of this by-product, discovered that this mash, when processed, made a remarkable animal feed supplement that stimulates rapid animal growth.

This supplement is now being used by commercial feed manufacturers throughout the nation. Poultry and swine raisers in every state today are able to help their animals reach market size sooner by feeding an aureomycin-vitamin B12-supplemented diet. In addition, it has been proved that animals receiving this antibiotic in their feed show improved feed efficiency.

The speed-up in growth runs as high as 40 per cent in

A helicopter of the U. S. Marines lands somewhere in Korea with a load of wounded U. S. soldiers. Rapid evacuation by air and use of new "wonder" drugs, such as aureomycin, are two of the factors contributing to the remarkable decrease in Korean battlefield deaths.

many cases among swine and the gain is firm flesh and not fatty tissue. Poultry raisers have noted an average of ten to 15 per cent growth increase in chickens and turkeys and some highly promising results have been obtained in tests conducted on dairy calves.

In recent comparative experiments at Missouri College of Agriculture, aureomycin was demonstrated to be better than all other antibiotics when it was added to the diet of weanling pigs. The rate of gain was increased by 29 per cent with seven per cent less feed required.

Aureomycin has assisted in ushering in a new era in animal feed and, combined with improved breeding and good management, will help to bring greater returns to the farmer and to the entire agricultural economy.

However, despite all the wonderful progress that has been made in the last few years, the search for more effective antibiotic drugs for combating diseases of humans and animals goes on night and day at the huge Lederle plant in Pearl River, N. Y.

To understand aureomycin to the fullest extent, one must look into the problems of producing it—and it is quite a problem, as other companies in the antibiotic field know.

The producton of these "wonder" drugs is a delicate and expensive process. Hundreds of highly skilled workers watch the living mold from the time it leaves the test tube until the finished product is packaged and shipped throughout the world. The production process is exciting as the research which led to the discovery of these drugs.

In the first step of aureomycin production, living spores of Streptomyces aureofaciens, the microorganism which produces aureomycin, are suspended in sterile soil tubes and live there in a state of suspended animation for an indefinite period of time. As needed, spores are taken from these tubes and allowed to develop in other test tubes.

The resulting growth is washed into a small flask containing the proper nutrient material. As it grows, it is transferred to a larger bottle and finally into the so-called "seed" tanks. The mold continues to grow in the seed tanks, and from there it is piped into the main fermentation tanks, some of which are five stories high. All during these operations sterile technique is absolutely required.

The main fermenters are charged with media which is based on corn steep liquor, sugar, and minerals. The mixture is aerated and agitated at a constant temperature, and as the mold grows, it produces aureomycin as a product of its growth. The aureomycin is then dissolved away from the mold. It is extracted into solvent, crystallized, and re-crystallized. Then it is dried, ground, and assayed.

At this point, in the form of a golden powder, it is sent to the pharmaceutical department for packaging into various forms, such as capsules, powder, troches, ointment, dental cones and paste, and eye, ear, and nose drops.

The remaining mash, which still contains traces of aureomycin, is then processed to make the animal feed supplement known as Aurofac. The mash is dried, ground, and additional aureomycin is added, if necessary, to make the supplement contain the guaranteed amount of the drug, 1.8 grams per pound. In addition, the vitamin B12 content of the supplement is checked to make certain it contains at least 1.8 milligrams per pound of the growth vitamin.

This, then, is a brief story of aureomycin—from battlefield to civilians to animals—a great triple-play accomplishment by medical science, with its beginning in research and its successful conclusion in better health for all—through the conquest of disease.

DUGWAY PROVING GROUND

By LIEUTENANT ROBERT CINTRON*

Decontamination of butyl protected test personnel following a test which was held at night. The men here are taking turns hosing decontaminant solution on each other.

A casual visitor walking in on a typical early-dawn test at the Dugway Proving Ground would have a strange feeling of having blundered into an Orson Welles fantasy from another world. He would see men so completely shrouded from head to foot in airtight suits that they must bear name tags to identify each other and converse by radio although they might be riding together in the same jeep. These grotesque figures would be checking weather data, setting fuses, placing or checking sampling equipment. All this activity would be a part of a well rehearsed plan and acted out at the direction of a test officer observing the show and giving orders by radio and telephone from a control tower, possibly many miles away.

As the first light of dawn breaks over the horizon, the headlights of the jeeps, some of them 20 miles away, could be seen scurrying back to the main base or to other assigned control points. Actually, an "all ready" signal would have been given by radio and the "goon-suited"—really the Corps' gas-proof impermeable clothing—men would be getting out of the danger area. A few moments later, a giant bomber would take off from an Air Force base miles away to drop its deadly cargo into the testing area.

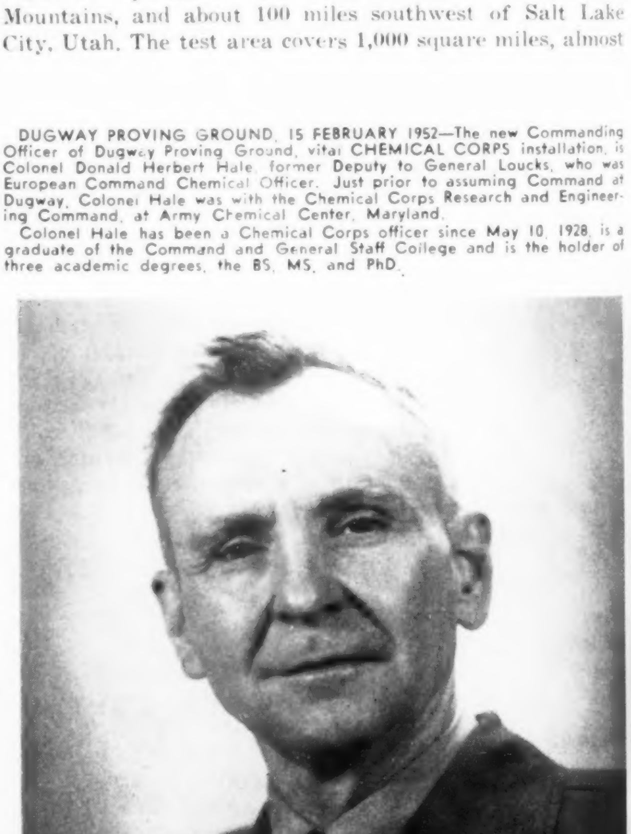
The actual test, whether it be by bomb drop or electrical static release, would probably be anti-climatic, in view of all the weeks of preparation. Unlike the more spectacular atomic tests in nearby Nevada, the toxicological agent tests go off soundlessly and frequently cannot even be seen. Results of the tests will be assessed by arduous laboratory checking of the sampling equipment over a period of days —even weeks—as the gases are tracked across the desert. From the data compiled from the test, technicians will determine whether a specific toxic agent will or will not be suitable for tactical combat use.

Dugway, now the Army Chemical Corps' main base for the large-scale testing of chemical, biological and radiological weapons, is situated on the edge of the Great Salt Flats of dry Bonneville Lake, just east of the Dugway Mountains, and about 100 miles southwest of Salt Lake City, Utah. The test area covers 1,000 square miles, almost

* Lt. Cintron is a member of the Headquarters Staff, Dugway Proving Ground, Utah.

DUGWAY PROVING GROUND, 15 FEBRUARY 1952—The new Commanding Officer of Dugway Proving Ground, vital CHEMICAL CORPS installation, is Colonel Donald Herbert Hale, former Deputy to General Loucks, who was European Command Chemical Officer. Just prior to assuming Command at Dugway, Colonel Hale was with the Chemical Corps Research and Engineering Command, at Army Chemical Center, Maryland.

Colonel Hale has been a Chemical Corps officer since May 10, 1928, is a graduate of the Command and General Staff College and is the holder of three academic degrees, the BS, MS, and PhD.



as large as the state of Rhode Island. Here officers and men of the Chemical Corps, the Sixth Army and the Air Force collaborate in the various environmental tests of strategic and tactical chemical weapons. The base operates under the recently-established Chemical Corps Research and Engineering Command headed by Brig. Gen. William M. Creasy, and with the construction and rehabilitation that has been carried out since its reactivation as a Class II installation in 1950, is worth more than $33,000,000.

Living and working conditions at Dugway at this time are somewhat on the "rough" side. However, a multi-million dollar construction program now underway will provide adequate housing, working, recreational and educational facilities in the near future. These improvements, plus others which are contemplated, will make Dugway a first-class Class II installation in all respects.

The creation of the test base dates back to World War II when the tremendous expansion of testing requirements rendered the main test facilities at the Chemical Center at Edgewood, Md., inadequate. In January of 1942, Lt. Col. (now Colonel) John R. Burns was sent west to find a suitable location. Col. Burns ultimately became the first commanding officer at Dugway. Working in conjunction with the Army Corps of Engineers and the U. S. Grazing Service, Dugway, in Tooele County, was finally selected.

The lands surrounding Dugway, as well as the reservation itself, abound in folklore, history, and geological phenomena. Dugway is actually situated on the bed of the inland sea that once covered an area almost as large as the state of Utah. Fish and snail fossils may be found in excavations. The area is of extreme interest to students of mineralogy and geology. Some of the minerals found are: agate, obsidian, quartz, jasper, picture rock, topaz, garnet, fluorspar, calcite, mica, gold, silver, tungsten, arsenic, copper, lead, zinc, and iron.

Mining in the vicinity of Dugway has never reached large-scale proportions, principally because of the lack of transportation facilities. The original mines used mule pack and wagons to haul the ore away. The curious traveler can visit many of the abandoned mining claims staked out around the base.

Dugway is in one of the numerous sheep grazing areas of Utah. A great part of the 60,000 head of sheep that annually are driven to winter pastures pass by the reservation on their way to the great Skull Valley grazing area. The climate of Dugway is especially favorable for testing purposes. Temperatures range from minus 25 to plus 106, but the extremes in temperature occur for very short periods. Since the elevation is rather high and the relative humidity is low, the weather is never particularly uncomfortable. There are normally only three to five days of non-flyable weather each year, with a ceiling of 20,000 feet 65 percent of the time.

Lake Bonneville, more appropriately described as an inland sea, extended in prehistoric eras, over most of the western part of what is now the state of Utah, to the southern part of Idaho and eastern Nevada. The lake rose to an all-time high crest of 5,200 feet above sea level; this is known as the Bonneville Level. It maintained this level for several thousand years. Bonneville Lake finally broke through its banks in the vicinity of Red Rock Pass, through the Snake River and Columbia River to the Pacific Ocean. The level receded to the Provo Level of 4,825 feet, at which it remained for another several thousand years. Further change in climatic conditions dried up many of the sources of water and the lake receded again to the Stansbury Level of 4,530 feet. From then on there was continual lessening of the water supply and increased evaporation.

The water had been fresh but during the latter evaporational stage, the mineral content in the immense body of water became highly concentratec and as evaporation proceeded, the famous Bonneville Salt Flats were formed. These are the flats which have acquired renown as the fastest speed course in the world. Forming part of Tooele County, the home of Dugway, Bonneville Salt Flats has seen the setting of the world's highest land speed records. All that is now left of the prehistoric lake is the Great Salt Lake. This is where the swimmer "floats like a cork." The salt content varies between 24 per cent and 26 per cent as the volume of the lake increases and decreases. The average depth is 13 feet and because of its elevation (4,200 feet

Colonel Donald E. Yanka, CmlC, who was C.O. of Dugway until January of this year.

—Dugway Proving Ground Photo Lab

The new Commanding Officer of Dugway Proving Ground, soon after assuming command at this vital Chemical Corps Installation. Colonel Donald H. Hale, Cml C is shown with his staff, (left to right), Lt. Col. J. Ivan Martin, Executive Officer, Col. Hale, Lt. Col. Speers G. Ponder, Technical Director, (standing) Dr. William F. Talbot, Scientific Coordinator and Mr. W. K. Hodgkinson, Administrative Assistant.

—Dugway Proving Ground Photo Lab

TOP: The Author and Public Information Officer: 1st Lt. Robert Cintron, CmlC
ABOVE: Here a technician has just set-off another munition as part of the testing program on the desert wastes of Dugway. The protective clothing he is wearing is Standing Operating Procedure during tests involving toxic agents.

above sea level), it is the highest lake of its size in the world.

The Overland Stage went through Dugway, taking the route of the Lincoln Highway (some of whose dilipidated road signs are still to be seen), and later changing to the Pony Express trail through Simpson Springs and Dugway Pass to Nevada and California. Parts of the walls of the Overland Stage Station are still standing. At one Pony Express Station, the graves of the last occupants, a mother, her child and their three dogs, lie in mute testimony of some unknown event.

The Civilian Conservation Corps (C.C.C.) established a Camp near Dugway—about 15 miles southeast—at Simpson Springs in 1942. The personnel of the camp assisted considerably in the original construction by putting in concrete floors for buildings, constructing sidewalks and working on Dugway roads.

The first access road from Dugway to Tooele, the county seat, was by way of Simpson Springs and Look-out Pass. The present Johnson's Pass road was a shepherd's trail at that time and Dugway vehicles were not permitted to use it. The present road was constructed over Johnson's Pass and rerouted in 1943. During the past year both these routes have been improved by the Utah State Road Commission.

The second access road of Dugway is the recently finished Skull Valley Road, which is the level route north to Salt Lake City, via US 40-50. Using the old Skull Valley trail, surveying for the new road began less than a year ago and its construction was accomplished by the Utah State Road Commission under the Federal Defense Highway Program. This modern highway extends for about 38 miles and is the best road for passenger traffic to Salt Lake City.

Dugway is probably unique among army bases in the U. S. in that it is not near a railroad. The nearest railheads are at Timpie, on the Western Pacific, and St. John, on the Union Pacific, both more than 35 miles away. All supplies and passengers are moved to and from the base by truck and auto.

The Proving Grounds used to supply its own power for lighting and industrial use, but only recently was linked to the local commercial power system. The generators, however, are being kept on a stand-by basis for use in emergencies.

The first limited scale tests were undertaken at the newly constructed proving ground in the summer of 1942. Since then and throughout the war period, the proving ground operated as a major establishment under the Technical Division of Army Chemical Center at Edgewood. It was at Dugway Proving Ground that the type of incendiary bombs used by the Air Force to gut many enemy cities and production centers, were dropped for the first time by aircraft in experimental bombings.

In order to duplicate our future targets, exact, life-size, replicas of German and Japanese dwellings were constructed on the reservation. These buildings were designed by top notch architects to the most minute detail, even down to furnishings and materials. Bamboo, rattan, mats, and other typical materials used by the Japanese in their dwellings were flown in from as far away as Hawaii. Standing incongruously in the desert, the replicas have the appearances of transplanted Japanese and German city blocks. The effectiveness of various types of incendiaries were tested here before they were sent to the combat theaters. During these tests, the technicians became highly adept at putting out fires in Japanese and German-type buildings and learned a lot of techniques that would probably have been highly useful to both the Japanese and the Germans during World War II.

Here also were staged a series of tests of the flamethrowers and various fuel thickeners that were later used so effectively in the Pacific theater. The weapons were thoroughly tested against each type of target likely to be encountered in combat.

The life-saving and all-concealing smoke screening agents and smoke generators which assured the success of many tactical operations in the war were painstakingly tested at Dugway.

The pride of the Chemical Corps, our 4.2-inch chemical mortar, was subjected to most extensive proving at Dugway. This mortar, often referred to by our troops as the "infantrymen's personal artillery support," proved to be one of the most feared, respected and versatile weapons of the war. The fact that the weapon is now part of the permanent armament of the Infantry and the Marines is in itself evidence of its usefulness.

Just as exact replicas of enemy buildings were constructed, so were caves—like those in which the Japanese took refuge on Bouganville and other Pacific Islands—dug in the mountains, in order that the effect of chemical munitions, flamethrowers, and various 4.2-inch mortar high explosive shells could be studied. The results of these tests paid off in combat. For instance, it has been recorded that in the siege of Mountbourg, during the fighting in Germany, four of these standard, rifled, mobile, 300 lb. mortars lobbed more than 17 tons of shells into the city in 90 minutes. In other test situations the 4.2 inch Chemical Mortar was found to be unsurpassable in throwing explosive shells a few hundred yards ahead of advancing infantry, where larger guns were not suited for this purpose. As in Europe, this most effective use of the "4.2" is paying off in Korea.

The testing programs during World War II also included field study and laboratory investigation into the toxicity of various gases and chemicals as well as research into antidotes and remedies. Closely related to this work was the testing of various types of impregnated clothing as protection against gases.

During the war period of accelerated testing, Dugway was an independent installation. However, in 1946, because of a lack of personnel, it was combined with the Deseret Chemical Depot and designated as the Dugway-Deseret Command, under Colonel Adrian St. John. Subsequently, the Secretary of War established the twin bases as the Western Chemical Center. Colonel Patrick F. Powers was the Commanding Officer, with Captain Lawson H. Naler in charge of Dugway.

Dugway maintained this satellite status until 1 July 1950. This period was one of relative inactivity. Dugway was retained by the Chemical Corps as a proving ground where tests of practically unlimited scale could be conducted safely. While on this stand-by status, the station was manned by a detachment of troops under Captain Naler and a caretaker group of Post Engineer personnel from Western Chemical Center, who operated the facilities. Mr. A. M. Salisbury was then Superintendent of Maintenance and Utilities.

The testing fields and buildings still served research and development groups from Army Chemical Center and Camp Detrick. From time to time these mobile test teams (one of which was aptly called "Safari"), journeyed West to Dugway and completed their assigned projects.

With the outbreak of war in Korea, Dugway was ready to serve once more as a Chemical Corps activity for the Department of the Army. An expansion of facilities and an intensification of activities was essential, if the proving ground was to effectively fulfill the testing programs.

Satellization to Deseret Chemical Depot and Tooele Ordnance Depot for supply and services activities was a necessity for Dugway during the first six months after reactivation, because of lack of personnel, facilities and funds. The de-satellization process took place gradually as these handicaps were overcome, and Dugway is now self-sufficient in every major respect.

The acquisition of additional acreage brought the total from 256,000 acres in March 1942, to its present 460,000. The acquisition tract register for this reservation, indicates three major sources: The Department of the Interior, The State of Utah, and the Department of the Air Force.

Notwithstanding the scarce labor market of the area, the installation has met with remarkable success in labor recruitment. The campaign has resulted in an increase in civilian strength greater than ten-fold since activation. A similar increase in assigned military strength is shown in current reports.

The administration, housekeeping and supply services of Dugway follow the normal procedures of any Class II industrial installation, with one exception: these organizational divisions exist solely as the supporting agencies of the Technical Operations of the proving ground. It is the Technical Operations which accomplishes the testing program and it is that organization which is the benefactor of the combined efforts of the rest of the post. In every respect the highest priority is assigned to all their requirements.

Thus, Technical Operations is the organization within Dugway Proving Ground whose mission is the mission of Dugway Proving Ground. Technical Operations has the responsibility for the conduct of all technical tests. The

ADMINISTRATIVE AND HOUSING AREA SCALE MODEL: This photo is the architect's conception (a scale model) of the "Easy Area," showing how the Dugway Proving Ground Headquarters building (in the foreground) the housing area (in the background) and other buildings will appear when construction is finished. This $16,000,000 construction project is more than 75% completed. Other buildings include: A modern enlisted men's barracks, scientific bachelor's quarters, men's dormitories, women's dormitories, nurses quarters, hospital, gymnasium, high school, elementary school, post exchange, theater, bowling alleys, two swimming pools, fire stations, enlisted men's club, officer's club, vehicular maintenance building, a fully equipped machine and instrument repair shop, chapel, track and field stadium, warehouses, and an auditorium. Some of these buildings are still in the category of contemplated: pending fiscal appropriation.

Among the multitude of details entering into a fully coordinated test at Dugway are proper interpretation of data and surveillance of recording instruments. Here a highly qualified technician carefully monitors a test instrument.

Command Post at the testing site. In this shot two experts are carefully taking down appropriate data and making necessary calculations.

mission of Technical Operations is field testing as requested for all other organizations within the Chemical Corps and the evaluation of the operational suitability of all Chemical Corps equipment and material. In addition, the facilities of Dugway are made available to other agencies within the Department of Defense for testing as requested.

To permit such testing, Dugway Proving Ground maintains and has under construction a series of extensive laboratories and test areas. For safety's sake the laboratories are sometimes many miles apart. Each laboratory and work area is a small town in itself; comparable in size to many of the civilian communities in the surrounding mountains and desert.

A look in on one of the Dugway Proving Ground tests would give the observer the feeling of being in a strange world. The Command Post of the test is the heart and control of that strange world. Personnel are completely covered in heavy "Men from Mars" clothing, masks, hoods, and gloves, for protection against the agent. Every inch of their body is covered; they wear name tags on their chest and back for even best friends may have difficulty recognizing one another in these clothes.

From the Command Post, phone and radio nets spread to all the working parties preparing for the test. The location of each working party is plotted and their movements controlled by the Test Officer at the Command Post. From the tower of the Command Post the headlights of test working party vehicles can be seen frequently, many miles across the desert, moving to the radioed commands from the Command Post. As dawn appears, when the air is still and best suited for such tests, the working parties begin to clear out of the central test area and to congregate at control points well back from the release or firing location of the agent or weapon to be tested. Radioed and phoned coordination establishes the "all ready" in amazing time; amazing, until one remembers that much of this has been rehearsed before, using a simulant of the toxic agent. Such rehearsals, or "dry runs," are essential to the safe and effective conduct of the test. The "all ready" sign means the munition or agent disperser is in place, wired and fuzed, or that a bomb or cluster drop from the aircraft is ready. In that case, the plane, a B-29, B-50, B-36 or another type, will be circling far overhead, perhaps many miles away, waiting to swing in on its bomb run.

The "all ready" call also will mean that the sampling equipment is ready. These samplers are stations located around the target at distances of a few yards to perhaps several miles away. From instruments located there, and the later analysis of the samplers by the appropriate laboratory, the effectiveness of the toxic agent dispersed may be determined.

The actual firing seems anti-climatic to all the preparation. With little or no fuss or noise, the toxic is released. Invisible, or nearly so, it is only by the data from the meteorological crews that its probable location at this time can be determined. Later the sampling stations will yield their data. However, the obtaining of data from the samplers is a difficult task and will take hours or even days.

Following the field test comes the laboratory's job: analysis of the contents of the samplers. Then the task becomes one of evaluation of the assembled mass of data.

Security at Dugway consists of normal procedures applicable to any sensitive installation but with certain unique improvements. The security guard is responsible for enforcing security measures, and in order to assist in patrolling the sensitive part of the reservation boundary, the guard is provided with horses. This mounted patrol, reminiscent of the Canadian Mounties, is thus available for the purpose of keeping out stray cattle and sheep, for the purpose of preventing unauthorized entry, and the reporting of the condition of the exclusion fence.

Since the bulk of the work done by Dugway is of a classified nature, security precautions are constantly maintained. The entire test area is fenced and the boundaries are constantly patrolled by mounted guards to curb any illegal trespass by people or stray cattle and sheep that might unwittingly wander into a gas cloud. This patrol is augmented by light planes which cruise over the base on security, weather and transport missions.

The servicemen's club at the reservation deserves recognition as an oasis within an oasis in the desert. It is humourously called "the Taj Mirage Club," and provides library, lounge, game room, and dance floor facilities for after-duty recreation and relaxation.

The University of Utah provides college courses on the post for personnel stationed here, and the Information and Education section is cooperating in the project.

The Commanding Officer of Dugway is Col. Donald H. Hale, former head of the radiological defense branch at the Chemical Center at Edgewood and more recently Chief Chemical Officer of the Seventh Army in Germany. He went to Dugway in January of this year, replacing Col. Donald E. Yanka, who is now attending the Armed Forces Staff College at Norfolk, Va. He headed the proving ground through its re-activation period.

Chief Assistant for Technical Operations is Lt. Col. Speers G. Ponder, former technical director of the Army Chemical Corps' San Jose project. Chief of the Supply and Services Division is Lt. Col. Harold F. Shartle, who formerly held the same post at Edgewood. Executive Officer is Lt. Col. Joseph I. Martin, formerly CO of the 757th Chemical Depot Company in the Pacific during World War II.

Delicate, precision instruments being monitored by DPG expert during an experiment late at night on the sand dunes of the great desert.

Dugway technician in communication with the test team preparatory to giving the order for Zero-hour and "Fire." An idea of the barren topography is seen in this photo.

Major Elmer E. Dye, former Post Chemical Officer at Fort Leavenworth, Kan., is Chief for Administration and Personnel.

Heading the long list of top civilian technical personnel is Dr. William F. Talbot, Scientific Coordinator for Technical Operations, formerly assistant Director of Research and Development for the war-time Office of Strategic Services.

Joined in the Common Defense

The Chemical Corps offers the Dugway Proving Ground to all the agencies of the Government and its Allies as a facility geared for action and available as an installation for them to use in the common defense.

The skilled technicians and efficient facilities of this proving ground are here at the disposal of the Government. The United States Navy and Air Force, as well as the Army Field Forces and the Technical Services are effectively using Dugway, or have used it in World War II, in accomplishing certain projects and tests.

The Chemical Corps has also benefited from the cooperation that these agencies have freely given toward the successful advancement of the Dugway technical mission. Thus, is seen at this Chemical Corps installation, an outstanding example of the teamwork existing in the national military establishment. By working together with mutually advantageous objectives, with a firm determination that the job will be done and done well, Dugway Proving Ground vigorously collaborates in the Defense Program of the Nation.

BRIGADIER GENERAL CHARLES E. LOUCKS
Deputy Chief Chemical Officer

SCIENCE IN MODERN WARFARE

by BRIG. GEN. CHARLES E. LOUCKS
Deputy Chief Chemical Officer

This evening I will speak for a few minutes on the technical subject "Science in Modern Warfare" but in rather non-technical language. I hope to emphasize to you the close relationship between effective and efficient military power and science, pure and applied.

During the past decade and a half we have seen a new meaning brought to the words "National Defense." The world has seen what happens to those nations which are not prepared industrially and scientifically to resist aggression. They disappear—as free nations! Our own Nation learned much in World War II about these requisites among others, for an effective national military defense.

World War II gave us a clear picture of a new concept of war—total war. War that spares no man, woman or child in its scope of operations, and which demands the active participation of whole societies, rather than just the members of the Armed Forces.

We saw, at the same time, science come into its own on the battlefield and we have come to realize that from now on, our national security and military success will depend more and more on the use of scientific methods and devices.

Today, as the Korean operation approaches the end of its second year, the lessons of World War II are becoming more and more apparent.

Today the citizen can no longer regard the defense of the Nation as something remote from his daily life—something to be delegated to the military and then forgotten, or something that can be left undone until the last minute. It is a problem that we must solve if our great Nation is to endure and retain its freedom as inherited from our forefathers.

Individually, it is to our best interests to achieve personal security. However, before that can be obtained, we, as a society of individuals, must achieve National Security.

Of just what does National Security consist right now in 1952?

I think that it consists of two things: One is a thoroughly trained military defense force, with up-to-the-minute weapons, and capable of rapid expansion in emergency. The other is an ever-ready set of carefully prepared plans for quickly converting our technical abilities and our industrial potential from the service of peace to the service of war.

Events during the months since June, 1950, when the Communists, without the slightest provocation, invaded south Korea, have shown that we have learned some of this lesson in National Security. At the beginning we were unprepared for the emergency. However, on a battlefield limited to one geographical area, we were subsequently able to stop this particular aggression. We now appear to be well on the road toward preparing ourselves to meet any possible further aggression.

Possibly this battle between the forces of freedom and slavery will be settled in Korea. Authoritative spokesmen of the Department of Defense certainly do not believe that total all-out war is inevitable. This is in contrast to what some of those who would like to mold American public opinion would have us believe. But we do believe it is necessary to build a strong military potential at this time, and to maintain it for some time to come. To this end we are doing everyhing in our power to build up our technical and scientific strength for war, while at the same time we are working, not only to preserve the peace, but to make it possible for free men to live a decent life in this country and, so far as our abilities permit, in all the world.

Whether we wish it or not, this Nation has been thrust into the position of leadership of all the Free World. Under our democratic system, our Nation has become the world's greatest power — industrial, scientific and military. Our Nation has assumed new responsibilities.

We recognize that our leadership as a nation cannot be abandoned for the present. There is no going back. To drop back at all means to drop back all the way to the position of a secondary power—yes, a slave state, forced to accept a brutal and alien philosophy. We have seen what has happened to such states in Europe and Asia. Our responsibility is very great and we have no choice but to assume it, politically, economically, industrially and militarily.

We know that the only realistic way to World peace, at this time, is by keeping this Nation strong. Until real unity is brought to mankind, we must use all means at our disposal to establish a strong military posture.

That is why we believe that the Army Chemical Corps, and the other Technical Services, must have the best possible technical research and development organization. The Corps is now, and will continue to be, a very real source of strength to the Nation. It is a part of that military power which we must maintain, not necessarily to wage war, not to strong-arm our neighbors, but to keep the peace in order that reason and peace may prevail while the world sets its house in order.

The United States and its allies can never hope to match the strength in the sheer numbers of manpower available to our possible enemies, but we can provide the technical means for our fighting forces so as to offset that numerical superiority.

Part of this technical means can be contributed by the Army Chemical Corps.

Now the mission of the Chemical Corps can be generally divided into the following three parts:

(1) Research, development, procurement and supply, and training for offensive and defensive aspects of Chemical Warfare. To state it another way, it is the use of chemicals in liquid, vapor or gas phase to obtain a powerful physiological effect when used against enemy soldiers. In addition, we provide a defense against them for our own men.

(2) The second part is the research and development necessary to obtain effective and efficient agents for conducting Biological Warfare and protection against them.

(3) And thirdly, the research and development necessary for defense against Radiological Warfare or radioactivity due to nuclear fission.

Without the wholehearted support of the chemical and related industries with their scientific know-how, we could never hope to fulfill that mission. Thus, we have no compunctions when we publicly call upon the Chemical Industry for assistance.

Since your interests lie principally in the chemical field, I shall discuss only the first part of our mission, generally referred to as CHEMICAL WARFARE.

As you may know, the Chemical Corps not only has responsibility in the field of toxic compounds for military use or chemical warfare, but also for those incendiary and smoke materials and devices useful for military purposes. The effects in all three are brought about by chemical action—and got their start in some chemist's laboratory.

Gas, as a military weapon, was not used by, nor against, our forces in World War II, but that does not mean that it did not play a great part in the war. Consideration of it entered into almost every military plan. It caused a tremendous outlay of time, labor, and money in the preparation of defenses against it, and in amassing quantities of the materials which would have been required had chemical warfare been used.

Throughout the war, both the Allies and the Axis Powers conducted intensive research to devise new and more potent chemical agents. Much progress was made by both sides. The toxic agents that we would probably use in any future chemical warfare could be compared with those used in World War I in about the same relationship as Henry Ford's early Model T with today's sleekest offerings of the motor vehicle industry.

Such great progress has been made in this field that today we are faced with problems of protection against toxic agents far more potent than any which have ever been used in warfare. None of us can afford to delude ourselves with the idea that just because gas wasn't used in the last war, and hasn't been used against us in Korea, that it is outmoded or obsolete. It is a constant threat which we must be continually be prepared to meet.

Both the Germans and the Japanese had many opportunities to use gas in World War II, and under certain circumstances it might have proved a decisive weapon in their hands. Yet they didn't use it. The only rational excuse for their not using it was the fear of retaliation. Both Japanese and German scientists and military men told me after the war that the knowledge of the existence of the American stocks of gas munitions and the belief that we would use them, was the main deterrent to their use against the Allies.

I know from personal observation how well Japan and Germany were prepared for gas warfare. I went to Japan with the occupying forces in 1945 and later I was assigned to the European Command as Chief Chemical Officer. One of my jobs was to complete the disposal of huge caches of toxic chemicals which we had captured. In both Japan and Germany there were large dumps of gas-filled artillery shells and bombs which had been prepared for delivery on allied troops and industrial facilities. The amounts ran into astronomical figures. In Germany, we accounted for some quarter-million tons of gas and gas-filled munitions. In personal talks with German scientists and engineers, I heard much of the story which led to the preparation for gas warfare and the decision later not to employ it.

One of the most interesting observations was that German scientists had been able to do such an exceedingly good job in developing weapons under the Nazi Regime. I recall that during the war, it was occasionally stated in our press that science in Germany was so controlled and stifled that Germany was falling behind in scientific achievements. That was apparently an error, since they came up first with guided missiles, jet propelled aircraft, snorkel equipped submarines, nerve gases and other rather surprising weapons. Also, in the industrial field they developed the mercury chlorine cell and numerous other items good enough to make it worthwhile for us to send numerous teams and individual technologists to Germany right after the war for the purpose of learning their secrets and "know-how."

The lesson that I think we as Americans should learn, is that we have no monopoly on scientific and technological developments, and that we can easily underestimate the scientific and technical competence of Germans, as well as other peoples, including the Russians. Furthermore, we know after the war Communist agents took by force or induced, numerous German scientists and skilled workers to go to Soviet laboratories in Russia. Whole German laboratories and factories, useful for military purposes, were transported behind the Iron Curtain.

On the other side of the world, we heard early in the war that the Japanese were using mustard, lewisite and other gases against the Chinese and had developed and were actually supplying hydrogen cyanide grenades to their troops. Our intelligence forces reported they were working on hydrogen cyanide bombs as well. President Roosevelt found it necessary to warn the Japanese that any use of gas against our Allies would be considered as used against us and that we would retaliate. After the war, our men found fairly large stores of Japanese gas munitions on Okuno Shima, just off the mainland of Honshu, and other places.

A Japanese document captured by our troops on Leyte offers a clue as to why the Japanese did not start gas warfare against us. The document was entitled "Do Not Incite the Allies to Use Gas!" and went on to say that Japan, having made an enemy of America, a country with large gas resources, must not under any circumstances, use any of its gas munitions against American troops.

What was the reason for this hesitancy among our enemies to start chemical warfare?

The answer was simply that they knew we were prepared to retaliate.

A second very good reason was our ability to protect ourselves against gas warfare. Our protective equipment was far better than anything they had, and they knew it.

After September 2, 1945—VJ Day—there were some who believed that when we dropped the atomic bomb, all other forms of warfare automatically became obsolete, including gas warfare. Recently, it was my duty to study on the ground the results of some of the A-Bomb tests in Nevada. I can state here and now that although the A-Bomb is an awesome and terrifying weapon, we must not delude ourselves into believing that it will surely win wars by itself.

After the atom bomb was dropped on Hiroshima, there was much talk about "the bomb," guided missiles, and push-button warfare. However, after a year and a half of fighting in Korea, we have had time to think about these weapons, and I believe we are getting back the true perspective. We know that machines can be used to fight a war, but machines cannot yet fight a war by themselves. They reduce the number of men in combat necessary to get the same result, but machines are expensive and skilled men and time are needed to produce them—and more important, it requires highly trained men to operate them effectively and efficiently. This may be the Atomic Age, but this most certainly is not yet the Age of Robots.

The soldiers of any aggressor nation in any future war are going to be very human and subject to the fears and faults of humans anywhere. That nation is going to send out troops to wage its war, very human and very vulnerable persons.

They will use the most destructive machines and scientific tools that man has ever known. But many men will still be needed and when the final battle is fought, these men, equipped and trained in the use of these weapons on land, in the air, on the sea and under it, will be the victors.

Gas was a tremendously effective anti-personnel weapon in World War I—producing almost a third of the total American casualties. With all the refinements that have been devised since then, gas certainly would have been even more effective had it been used in the last war. As for the future, so long as manpower remains a decisive factor in the winning of military battles and wars, gas will remain one of the most effective of purely anti-personnel weapons.

Chemicals can also be used strategically against war industry centers and, in my opinion, would be extremely effective in drastically reducing production.

No one can forecast accurately whether or not Chemical Warfare will be used in Korea or in any future war. Whether it is used or not, it will always remain a powerful factor that every Army will have to consider in its plans. For the United States, it is a definite part of our national preparedness.

We are inclined to forget how gas-conscious we all were during World War II. But this country had every reason to believe gas would be used. Italy had used it in Ethiopia. The Axis powers were stockpiling great stores of it. Both before and after we entered the war, it seemed only a matter of time before it would be used, especially in Europe.

For that reason, our gas policy throughout the war was to be ready to retaliate the minute either Germany or Japan dropped the first gas bomb.

Even before we entered the war, we had started to build additional arsenals for manufacturing war gases. Large quantities of agents were produced and shipped overseas in bombs, shells, and bulk containers. At the same time, we began to manufacture millions of gas masks, great stores of protective clothing, first aid and treatment kits, ointments, eyeshields, shoe impregnite, and all the other things that had been devised for offensive and defensive gas warfare. These things remained in the theaters of operations until the end of the war.

The point I want to make here is that the failure of Germany and Japan to use gas teaches us a lesson—It pays to be prepared and that the nation that is ready for any emergency and makes that readiness known need not fear enemy atack. Our preparations cost us many millions of dollars, but they discouraged and prevented our enemies from initiating gas warfare. Thorough preparation for gas warfare was, and still is, the only practical policy for us to follow.

Another thing that we must not forget, is how we achieved that state of preparedness that finally carried us to victory in World War II.

We in the Army in recent months, have been thinking a great deal about the close cooperation between industry and the Armed Services during those days.

It was excellent teamwork, perhaps more than anything else that enabled us to produce munitions and all the gear of war faster and in far greater quantities than any other nation in the world.

In the war of supply, we won every batle. As fast as critical shortages developed, industry went right to work to devise substitutes. Often the substitutes were actual improvements over our original materials. As our civilian and military research laboratories ran into seemingly insoluble problems, industry was called in to work with them. A special kind of contract was devised to cover research and development work, especially for military purposes. A strong bond between industry and the military research organizations developed.

That bond between industry and the Chemical Corps has been continued to the present.

This is a double bond, even as the members of our fraternity are joined in the double bond. The first is through the Chemical Corps Research Advisory Council. It is composed of both academic and industrial members who are organized into committees, one of which is engineering and production.We are calling on industry, and will continue to call on the chemical industry for information and guidance. Of course all of our technical problems are not automatically solved by these committees, but they are being solved better and more promptly than ever before.

The second bond is the liaison which has been established through the Department of Defense Affiliation Program. Industries which are considered essential links in our Armed Forces, sponsor fully organized, fully equipped Chemical Corps reserve units within their own organizations. The personnel are composed of the employees of a particular plant and they are also Chemical Corps Reservists—they have a double function—industrial production and preparing themselves as emergency soldiers. These men of industry are trained as technical and military specialists. The better trained and better equipped these units are, the better will be the military establishment.

These Chemical Corps units are located throughout the Nation. Oil Companies sponsor smoke generator units and colleges form laboratory units. Even a mortuary supply firm is sponsoring a service battalion headquarters unit. In Baltimore, there are two smoke generator units that are sponsored by two oil companies (American and Esso). One of these units has already been called into active service, as have eleven others from throughout the country.

One of the things to remember about the Chemical Corps is that it is a combination military-industrial organization. About one-third of our strength is made up of fighting troops and training personnel; about one-third is devoted to research, development and manufacturing; while the remaining one-third is engaged in the procurement of materials from industry and in supplying the Armed Forces of our own country and those of our Allies.

The Chemical Corps is versatile—because it must be. It is the only branch of the Armed Services which is responsible not only for the design and manufacture of weapons and equipment for other combat troops, but also for the training of its own special troops to handle special chemical weapons and equipment. Examples are the 4.2" chemical mortar as a weapon and the smoke generator as a piece of special equipment used in battle and manned by the Chemical Corps troops. The flamethrower and the white phosphorus grenade are weapons used by the Infantryman and the gas mask is a piece of equipment used by everybody.

The Chemical Corps carries on research, design, manufacture, and supply of equipment, ammunition and special materials needed both by its own combat troops, other Army troops, and by the Navy and Air Force.

Now briefly let me tell you about one problem which scientists in industry helped solve during the last war. It resulted in the manufacture of a new gas mask charcoal.

The heart of every gas mask is the canister where incoming air is purified and all solid and gaseous toxic components are absorbed or neutralized by the filling in the canister. The heart of the canister, in turn, is the activated charcoal it contains.

It was only a relatively short time ago that activated charcoal for the gas mask canister was made only from coconut shell—because coconut shell is extremely dense and because we could get the desired amount of purifying effect in a relatively small container. Then came the war, and the Japanese moved in on our major sources of coconut shell. We had to find a substitute.

On a weight for weight basis, we could make a usable charcoal from ordinary oak wood. But we didn't use it because a gas mask canister using oak wood activated charcoal would be too bulky to carry around. Great absorptive capacity is required in our activated charcoal. A poor substitute for coconut shell can be made from anthracite and semi-anthracite coal, but these substances, after they are activated, have too great a percentage of ash. The soldier would be carrying around one-third activated charcoal by weight and two thirds by weight of dead ash. So that would be a poor solution.

When we tried to make activated charcoal from bituminous coal, in the normal manner, it swelled as it does in coking, and we were unable to produce a satisfactory product. However, as a result of a great deal of experimentation, it was found that good quality soft coal could be slightly oxidized prior to carbonization and the oxidized coal then did not swell when it was carbonized. In this way it was possible to maintain the structure of the coal or wood substance quite as well as in coconut shell. Then by further treatment a splendid type of activated charcoal for use in gas mask canisters was obtained.

It was a private firm that was especially successful in producing this high quality gas mask charcoal in large quantities. At a time when coconut shell was critical and obtainable only in inadequate quantities, industry came to the rescue by providing a new and equally good product from readily available domestic raw materials. Industry served the country well in providing this important defensive chemical, for it went into tens of millions of our World War II gas masks.

Now, what of the future? How can the scientist cooperate any better than at present? He can assist directly or indirectly some of the agencies which are cooperating with the Chemical Corps and which I will now describe.

The Chemical Corps is primarily interested in the development of toxic materials as military weapons and in protection against them. That is our special mission in the Armed Forces. What we need are not so much improved agents, but better ones, more powerful by manyfold and capable of use more easily and effectively than those hitherto known. We feel that all is not known about these substances and that either we will develop them or someone else will.

Our research people have come up with many potential agents, and so have the scientists in universities and in industry. It might appear that we haven't done much during the past 30 years. Things are not that bad. We have improved techniques of the use of old agents, and standardized some previously known compounds, and in fields outside of toxic agents, have done much better. In contrast, the Germans synthesized the so-called spectacular "Nerve Gases" during this time.

As we seek new toxic agents, so do we seek better gas masks and other protective equipment—and better and more rapid means of detection of some agents which are relatively odorless and non-irritating to the respiratory tract. There are terrific problems to be solved in this field, but with the cooperation of non-government scientists, we are confident we can solve them.

We must continue work on incendiary bombs, flamethrowers, and screening smoke generators. In short, we shall continue to intensively study every means by which chemicals and the chemical weapon can be enlisted to strengthen our national military potential.

Our research program for the future has been checked and approved by outstanding civilian scientists. Its success, however, will call for the help and understanding of people everywhere. All of us must understand that the study of modern chemical warfare materials and techniques cannot be abandoned while we ourselves are in any danger from their employment by potential enemies.

We have built up a staff of competent scientists and engineers in our laboratories which, incidentally, are almost completely civilian staffed. We have an advisory committee composed of a number of leading scientists and industrialists which provides a most effective check on the work done in our laboratories. We have procurement advisory committees composed of representatives of leaders in industry who are helping with our procurement problems. The American Chemical Society has appointed a committee which maintains liaison with the Corps and assists wherever possible.

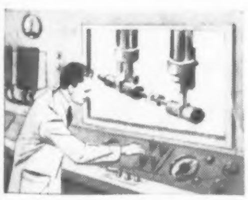
In addition there are hundreds of individual consultants who are recognized specialists in some field and who advise outside of committees and councils.

All of the committees are staffed by scientists and industrialists who feel that they have a definite responsibility for the military security of this nation. They know, and we know, that as long as wars are possible, we must lead the rest of the world in scientific military developments—that if we are properly prepared we shall not have to resort to war and that we must work towards a research and development program that will guarantee us the best national defense possible.

We have entered an era in which technical developments mean more to national defense than numbers of manpower. The military force that depends for its success on masses of men, however brawny and well-trained, but equipped with mediocre or out-dated weapons, has no chance of success against an even smaller force armed with up-to-date weapons and equipment and which they know how to use.

That is why the Army looks to industry today as a means of implementing its forces. Industry is the major source of the men and materials and technology that makes our country strong today.

Look...no hands!



When radioactivity or high temperature makes materials too "hot" for human hands to handle, Greer "mechanical hands" permit an operator to remain many feet away for complete protection.

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Many less dramatic but equally important materials-handling problems have been solved – or are being solved – by Greer research and development engineers. With many years of work in the field, these men offer you specialized knowledge and abilities which are difficult to find elsewhere. If you are concerned with any phase of materials handling, you are invited to bring your problems to Greer. Here you will find *creative engineering* at its best – the kind that is accustomed to meeting and solving the "impossible". An inquiry on your company letterhead will receive prompt attention.

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Battle Monument, Trophy Point, United States Military Academy, West Point, New York.

CHEMISTRY AT

By Woodford T. Moseley, Maj., Cml C
and Robert S. Day, Capt., Cml C

Lt. Col. C. Henry Wood, Cml C, Associate Professor of Chemistry

Major Woodford T. Moseley, Cml C

...ding in Chem

Since 1802 the United States Military Academy has been a part of the national life of America, and its long and colorful history has been a part of our heritage. West Point belongs to the American people. Receiving public support through taxation, it repays the investment many fold in times of crises through its thousands of graduates who have personified the West Point Motto—Duty, Honor, Country.

West Point, the oldest permanent military post in our country, and a place of proud traditions, this year celebrates the 150th anniversary of its founding. During the Revolutionary War the strategic location of West Point on the Hudson River was recognized as the bulwark for preventing the British from severing the American Colonies. It was first occupied in January, 1778, by a section of a Massachusetts brigade which fortified the elevated plateau and surrounding hills overlooking the sharp double bend of the river.

Threats of war in 1794 compelled Congress to authorize the recruitment of a Corps of Artillerists and Engineers which was sent to West Point. During the same year the rank of cadet, which in effect was an apprentice officer, was created and several cadets were assigned to West Point. Five years later President John Adams began seeking a likely superintendent to head a proposed military academy at West Point. Curiously enough, the position was offered to Benjamin Thompson, or Count Rumford as he was better known, who had left his home in Woburn, Massachusetts, to join the British during the Revolution. His investigations of heat and chemistry along with his experience in establishing a military school in Bavaria had placed him in the front rank of men of science. However, the offer was rejected.

On 16 March, 1802, Congress passed the law establishing the United States Military Academy which was to consist of ten cadets. On 12 October of the same year Cadets Joseph Swift and Simon Levy were graduated. The first Superintendent, Major Jonathan Williams, a grand nephew of Benjamin Franklin, was the founder of the United States Military Philosophical Society. He proposed that the Military Academy be enlarged from ten cadets to a full academic and technical school for both the Army and Navy and asked for an adequate staff to teach French, German, mathematics, chemistry, and engineering in all branches. President Thomas Jefferson referred the plan to Congress where it died in committee.

A law of 1812 provided that the cadet was to "receive a regular degree from an academical staff" and was the legal basis for formation of the Academic Board presided over by the Superintendent.

It is appropriate to regard the present United States Military Academy as substantially the work of one man, Colonel Sylvanus Thayer, a graduate of both West Point and Dartmouth College, who was Superintendent from 1817 to 1833 and who is known as the Father of the Military Academy. It was he who initiated the system of small classes at West Point in contrast to the larger classes in other colleges and universities. The system of ranking each cadet in order of merit was found to encourage study at West Point, whereas the ranking system was abolished at Dartmouth and Bowdoin about 1815. However, in 1829, a ranking system was initiated at Harvard but it survived only forty years.

Instruction in chemistry at West Point was begun in 1820 using "Henry's Chemistry" as the text. At this time each cadet paid $5.00 for the chemistry course. The first head of the Chemistry Department was Dr. James Cutbush, Assistant Post Surgeon, who was succeeded by another physician, Dr. John Torrey. Subsequently, Dr. Torrey became Profes-

AT WEST POINT

...ding in Chemistry Laboratory

The Cadet Color Guard on the plain at the United States Military Academy, West Point, New York.

Capt. Robert S. Day, Cml C, instructing in Chemistry Section Room.

sor of Chemistry and Botany in the College of Physicians and Surgeons in New York City. Later in his career he was in turn Professor of Chemistry at Princeton and New York University. Lt. W. N. Hopkins, Fourth Artillery, was the next Professor of Chemistry at West Point. During his tenure the course in chemistry held to the pattern of three lectures a week, textbook study, and "hearing recitations." After leaving West Point, Lt. Hopkins became Professor of Natural and Experimental Philosophy at William and Mary College after which he held the same position at the United States Naval Academy. The next department head, Lt. J. W. Bailey, USMA 1832, published over fifty scientific studies. Lt. Samuel E. Tillman was appointed Professor of Chemistry in 1881 and served until 1917, during which time he wrote six textbooks on chemistry and related subjects. In 1917 Col. Tillman became Superintendent of the Military Academy serving in this position until 1919 when he was succeeded by General Douglas MacArthur. It is of interest to note that at Brigadier-General Tillman's funeral in 1942, Capt. Day, now instructing in chemistry at West Point, was a member of the cadet firing squad which rendered final honors at the committal service.

Many people feel that the Military Academy trains officers whose only skill is to wage war. While history attests to the ability of West Point graduates to do this successfully, its alumni also have served commendably in other capacities. Before the Civil War, the United States Military Academy not only trained Army Officers but also was the national school of civil engineering. Until 1835 it was the only school of civil engineering in the United States. As early as 1829, a group of twenty-four cadets formed a society called the *American Association for the Promotion of Science, Literature and the Arts,* after which *Associate Societies* were then formed at other schools. This society formed at West Point was a direct forerunner of the *American Association for the Advancement of Science.* The founding of Rensselaer Polytechnic Institute, the Lawrence Scientific School at Harvard and the Sheffield Scientific School at Yale were each influenced by the previous experiences of the Military Academy.

After the Civil War the Military Academy changed from the school of science and technology of earlier days to the basic national school for the preparation of professional Army Officers. Contrary to the professional military caste system of Germany, American democratic ideals dictated that cadets, regardless of social position, be selected from all sections of the expanding United States. The first colored cadets entered in 1870 and the first Negro was graduated in 1877. To develop the professional officer, Thayer's idea of every man taking every subject and every man to be proficient in every subject continued at West Point, and made it a separate and unique component of American education.

From the foundation of the Military Academy in 1802 the cadets were imbued with an ideal of honor. The West Point honor system is different both in administration and principle from systems developed at some other schools where such are directed solely toward preventing cheating on exams and enforcing compliance with rules and regulations. In 1860 Rev. John French as Chaplain and Professor of Ethics pointed out to a young cadet: "Truthfulness is part of the honor of a soldier. Strategems to deceive an enemy are lawful and right. But apart from this, a true soldier knows not how to violate the truth. So delicate is the military profession in this respect, that offenses against the truth which public sentiment might mark as trivial in other relations, are there regarded as a lasting stain on honor. Also the whole system of military discipline is deranged, if there cannot be perfect reliance on personal and official statements. Let no one enter on military life as his profession, who is not unfaltering in veracity."

In 1871, three cadets of the Fourth Class (Plebes) broke the regulations in some minor offense, an easily understandable minor infraction of a rule. But in order to protect themselves they compounded their offense by an intentional falsehood, and thereby became involved in the problem of honor. After the facts became known the First Class gathered spontaneously, gave the delinquent cadets some civilian clothes and money and told them to leave the post. Since then the routine handling of honor cases has been entrusted to the Corps of Cadets.

In 1925 the Military Academy was listed by the Association of American Universities as an "approved technological institution" and in 1927 was admitted to the Association of American Colleges. A 1933 Act of Congress, amended in 1937, conferred the degree of Bachelor of Science retroactively on all (qualified) living graduates. At present the B.S. degree is conferred upon each graduate.

The curriculum at the Military Academy has been examined each year since 1815 by a Board of Visitors consisting of outstanding civilian citizens and educators. The report of these examiners in the year 1889 stated: "As the college of liberal arts in civil education lays broad foundations for the future students of law or medicine or theology, so should this military academy be but preparatory to the post-graduate studies of advancing students in the art of war."

At the end of World War II a Board of Consultants consisting of Dr. Karl Compton, President of Massachusetts Institute of Technology; Dr. James P. Baxter, President of Williams College; Lt. General Troy H. Middleton, President of Louisiana State University, and a group of Regular Army Officers examined the course of study and methods of instruction at West Point. This Board approved the following present-day curriculum: mathematics; a foreign language selected from French, Spanish, Portuguese, German, or Russian; English, which includes English and American Literature, a course in military instructor training, and military correspondence; military topography and graphics; physics, chemistry, and mechanics based on standard college texts; electricity including electronics and communications; military hygiene; military law; social sciences including economics of war; international relations, political and economic geography, history of Europe and the Far East, government of the United States, foreign governments and military government; ordnance; military history and army engineering; and military tactics including physical education.

Although the Military Academy has undergone many changes down through its 150 years, it has always had a specific mission to perform. This mission is stated in appropriate regulations by the Department of the Army:

"The mission of the Military Academy is to instruct and train the Corps of Cadets to the end that each graduate shall have the qualities and attributes essential to his progressive and continued development throughout a lifetime career as an officer of the Army. In general, courses of instruction and training will be designed to develop character and the personal attributes essential to an officer, to provide a balanced and liberal education in the arts and sciences, and to provide a broad basic military education rather than that individual proficiency in the technical duties of junior officers of the various arms which is of necessity a gradual development, the responsibility for which devolves upon the graduates themselves and upon the commands and schools to which they are assigned after being commissioned."

As a stepping stone toward providing the cadet with a balanced and liberal education in the arts and sciences, the fundamentals of general chemistry are taught during the Third Class (Sophomore) year. The course in chemistry equips the student for the study of other scientific subjects which he will subsequently pursue at West Point, as it also teaches him to use and apply the processes of accepted scientific thinking which are just as valuable to the army officer as to the scientist.

Chemistry is taught under the supervision of the Department of Physics and Chemistry. The department is headed by Colonel Gerald A. Counts, USMA 1917, Professor of Physics and Chemistry. On alternate class days 682 cadets attend elementary physics and general chemistry. The two science courses are presented in the same academic department with the chemistry section directed by Colonel Edward C. Gillette, Jr., USMA 1920, Professor of Physics and Chemistry, who is assisted by Lt. Col. C. Henry Wood, a Chemical Corps officer, Associate Professor of Chemistry.

Cadets are arranged in sections according to their standing in a subject, those with the highest academic average being in the first section. In accordance with this general policy which permits observation of individual progress daily, the present class of 682 cadets taking chemistry, one quarter attending each recitation, is divided into eleven sections with an average of fifteen men per section. The lower sections are deliberately made slightly smaller than the higher ones so that a cadet who has demonstrated by his standing that he has difficulty in comprehending the fundamentals of chemistry may receive more individual instruction. Sections in chemistry are rearranged periodically on the basis of current academic averages in the course, thus assuring a homogeneous group of cadets in each section-room.

In keeping with the number of sections in chemistry, the department has eleven instructors assigned in addition to the Professor and Associate Professor previously named. The Military Academy teaching staff is largely drawn from its graduates who have received specialized civilian schooling; however the faculty also includes many graduates of other colleges and universities. The Chemistry Department contains four officers who are not graduates of West Point. The instructors are chosen for a three-year tour of duty and are specially selected from various branches of the services. The present staff of instructors in chemistry consists of five Air Force officers, one Artillery officer, one Infantry officer, two Engineer officers and two officers of the Chemical Corps. Each instructor is assigned a chemistry section, which assignment is changed at the time of cadet resectioning. Cadets, therefore, profit from the knowledge and experiences of several instructors.

The two Chemical Corps officers who are now teaching chemistry at West Point are the co-authors of this article. In addition to these two officers and Lt. Col. Wood, a fourth officer of the Chemical Corps, 1st Lt. Clyde B. MacKenzie, is also assigned to the Military Academy as an instructor in French.

The course in General Chemistry at West Point is taught in ninety lessons, about ten of which are general lectures delivered to a quarter-class group, twenty are laboratory experiments, and the remainder section-room recitations. The time devoted to a regular section-room recitation or to a general lecture is one hour and twenty minutes, while two hours are allowed for the completion of a laboratory exercise. A standard College Textbook is used supplemented by a printed study guide and comprehensive problem book prepared by the department.

Normal college lecture procedures are not used in the chemistry section-room, but rather the text assignment for the lesson is carefully discussed by the instructor with the section. Optimum use is made of demonstrations in the classroom by the instructor displaying chemical reactions or equipment designed to emphasize the important points of the day's lesson. Each section-room is equipped for the performance of these demonstrations and is also supplied with a commercial device such as a Vu-graph or Visual Cast for showing slides or computing answers to the numerical problems of the day.

Laboratory periods are conducted in a well equipped chemistry laboratory. Although several sections are present in the laboratory at one time (usually one-eighth of the class) the same degree of individual instruction is maintained as in the section-room. Each instructor supervises the students of his section during the experimental operations in the laboratory. Individual sets of glassware and materials are not assigned to the cadets, as is the vogue in most colleges, since in the laboratory at the Military Academy eight students use the same desk position although attending lab at different hours. Sharing the use of equipment is accomplished with a minimum loss and breakage, because the cadet is continuously taught conservation of public property.

General lectures must necessarily be delivered four times as only one-quarter of a class (11 sections) is in attendance at any period. The Professor, Associate Professor, or a specially qualified chemistry instructor delivers the lecture. These are designed to emphasize and coordinate the more important principles and concepts of the course and to present demonstrations not adaptable to the small section-room.

Additional instruction is made available each day for those cadets who request it. For this purpose no more than four cadets are assigned to one instructor. This instruction, which is given for one hour late in the afternoon each day, is not conducted as a regular recitation period, but the time is spent in answering questions and in clearing up points that have not been understood by the students during the regular classroom attendance.

The Chemistry Course continues to plague cadets who are allergic to science. When he failed chemistry, James McNeill Whistler, best known in America for his portrait of his mother, explained that "Had Silicon been a gas, I would have been a Major General." Edgar Allen Poe, ex-cadet, Class of 1834, chided "Science" which preyed upon the poet's heart like a vulture.

A cadet deficient in chemistry, or any subject, at the end of general reviews is required to take a comprehensive examination on the work of the semester. If he fails this examination his case is referred to the Academic Board for action. He may be either discharged or, in certain instances, turned back to join the next class. Cadets discharged for deficiency in only one subject are permitted to take a reexamination at the end of sixty days. Those who pass the reexamination are given a leave of absence without pay and allowances, to rejoin the next lower class. Cadets discharged for deficiency in more than one subject may reenter the Military Academy only by means of a reappointment.

Military Training takes but forty per cent of a cadet's time—mostly in the summer months—and is designed to prepare an officer for service in any branch of the Army or Air Force. The overall military training of the cadets is under the direction of the Department of Tactics, with the actual instruction of the Third and Fourth Classes usually being conducted by the First Class cadets under the watchful supervision of battle-experienced officers from all branches of the service. Instructors from the academic departments are detailed to assist in this summer program of training in modern warfare.

The new Plebes arrive at West Point the first part of July each year. The months of July and August are devoted to orienting the new cadet and to a program of basic military instruction very similar to the basic training given Army enlisted men.

At the completion of his Plebe year, the cadet is given a leave of absence of one month. After his first visit home since arriving at the Military Academy, the cadet returns to the summer training site at Camp Buckner located west of the Point proper. Here he receives rigid and thorough training and practice in the tactics and technique of war. He is afforded the opportunity of actually firing and handling artillery, tank weapons and weapons of the infantry regiment. The program also includes practical work in military engineering, signal communications, quartermaster operations, field exercises, tank-and-wheeled-vehicle driving, tactics of armor and anti-aircraft artillery.

The Second Class (Junior) summer training period, following a one-month leave, consists of a three-week indoctrination course on the Air Force, one week of airborne training, and two weeks of training in amphibious operations. The Air Force training is conducted at various Air Bases and the amphibious operations are performed at Little Creek, Virginia, in conjunction with the Second Class from the United States Naval Academy.

The first part of the summer finds the First Class cadet taking an air trip to Army and Air Force installations for advanced instruction. During the remainder of the summer he generally is called upon to assist in the administration and training of the underclasses.

Four years of academic study and military training bring the cadet to his cherished goal of Second Lieutenant in the United States Army or Air Force. But the story of West Point does not end here. As the late Judge Robert P. Patterson, ex-Secretary of War, expressed his opinion of West Point: "It is the work of West Point to give us Military Leadership in time of need. It also gives us by the conduct of its graduates a standard of valorous devotion to the nation's cause. West Point is the existing embodiment of the patriotism of its spiritual founder, the Army's first and foremost leader, General Washington." *

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* For detailed information concerning the history and curriculum of West Point see: Forman, Sidney. WEST POINT: A HISTORY OF THE UNITED STATES MILITARY ACADEMY; New York: Columbia University Press, 1950.

Wood, C. H. THE GENERAL EDUCATION MOVEMENT AND THE WEST POINT CURRICULUM; New York: Columbia University Teachers College Library.

SESQUICENTENNIAL BOOKLET; West Point: Sesquicentennial Office.

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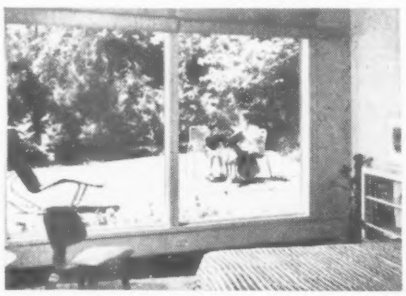

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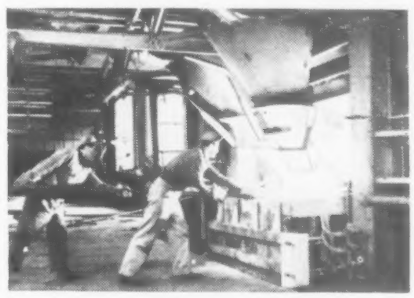

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A South Korean laborer opens cans of powdered napalm thickener, the Chemical Corps' biggest contribution in the Korean effort.

Another South Korean laborer pours the mixture into a 55-gallon drum for transportation to the front lines. An empty napalm powder can serves as a funnel.

ng drums of
ots of grun
ean laborers

Into each 55 gallons of gasoline approximately 14 pounds of napalm are poured. Lacking a mechanical mixer, a wooden paddle serves the purpose.

Napalm

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The drums of "Foo Gas" then become camouflaged "Booby-Traps" for the Reds. These particular drums were placed in front of 24th Infantry Division positions.

For minutes after the explosion a sea of flame engulfs the area.

Comes the Chinese Communist attack, and an electrical charge sets off the TNT blocks. In turn the white phosphorous shell explodes . . .

g drums of the napalm-jelled gasoline calls ots of grunts and groans from the South ean laborers. Filled, the drums weigh 380 lbs.

A shovel-wielding soldier sinks the drum of napalm-jelled gasoline — the Infantrymen have started calling it "Foo Gas"—into a hole.

A thin layer of dirt goes on top of the drum, then a couple of small TNT blocks and an 81-mm white phosphorous shell are set in place to set the stuff afire.

Developed during World War II by the Chemical Corps, Napalm has been called "The Best All Around Weapon in Korea." It's used in the manner shown here, as fuel for portable and mechanized flamethrowers, and as the filling for "Hell Bombs"—mainly jettisonable airplane wing and belly tanks filled with napalm-jelled gasoline—The Chemical Corps procures all the napalm used by the Army, Navy, Marines and Air Force.

double explosion rips open the ns of "Foo Gas," sending the sear- flame over a wide area in the face of the enemy.
—U. S. Army Photo

The Plans, Training, and Intelligence Division

Office of the Chief Chemical Officer

By Col. Hugh W. Rowan*

To the fighting man, the preparations for any military operation, be it a simple training maneuver or a full-scale offensive, can be stripped down to a few simple but highly essential steps. When a military problem arises, first determine the exact nature of the problem; second, make plans for meeting the problem; third, give the man the equipment he will need; four, be sure he knows how to use the equipment; five, carry the man and his equipment to the scene; and six, put the plan into effect.

Reduced still further, these six steps involve four basic military functions: intelligence, planning, training and materiel. The field of materiel and supply, with its attendant factors of transport and research and development, is so broad and so all-important as to justify separate treatment. This article will concern itself with the other basic aspects of military operations, namely: military and technical intelligence, military plans and operations, and military training and education.

Each of these operational functions is a distinct entity in itself, each with clearly defined lines of responsibility. Yet the three are so closely related that it is almost inevitable that they should be grouped together for operational purposes. A weakness in any one of these functions will weaken — may possibly destroy altogether — the effectiveness of the other two. If, in any military operation, each of these three responsibilities are carried out properly, then the operation itself must inevitably be a success.

In the early stages of World War II, the organizational set-up of the Office of the Chief Chemical Officer grouped the Training Branch and the Plans and Operations Branch together under the Division of Field Operations. The Intelligence Branch was set up as a separate unit under the Executive Officer. In mid-1943, presumably as a result of lessons learned in the war, Intelligence, Training and Field Requirements, and the Plans and Operations Branch (then called the War Plans and Theaters Division) were grouped together under the office of the Assistant Chief of the (then) Chemical Warfare Service for Field Operations.

In the years since the war, the Chemical Corps has undergone several reorganizations, occasioned primarily by the sharp retrenchments and demobilization of officer personnel in the immediate post-war period, coupled with a later broadening of the Corps' responsibilities incident to new developments in chemical and biological warfare and the inclusion of radiological defense within the scope of its activities.

* Chief, Plans, Training and Intelligence Division, office Chief Chemical Officer.

COL. HUGH W. ROWAN, CHIEF
P. T. & I. Div., Chemical Corp.

ABOUT THE AUTHOR

Col. Hugh Williamson Rowan was born in 1894 at Newport, R.I. and was graduated from Yale in Chemistry in 1915. After two years of post-graduate work in Chemistry at Harvard, he entered the Chemical Warfare Service of the Army in 1917 and was cited for service at Toul, St. Mihiel and Meuse-Argonne campaigns. He served with the U.S. Army of Occupation in Germany until 1919 when he was returned to the United States and was stationed at the Chemical Center at Edgewood, Md. and at the Office of the Chief of the (then) Chemical Warfare Service in Washington. In 1928 he was assigned to the Office of the Assistant Secretary of War as an industrial mobilization planner.

Col. Rowan was named assistant military attache in Berlin in 1931, a post he held until 1934 when he was returned to the Chief's Office in Washington. Shortly after the outbreak of World War II, he was named Chief Chemical Officer of the European Theater of Operations and was promoted to temporary brigadier general in 1944. In 1946 he was appointed president of the Chemical Corps Board. He became Chief of the Plans, Training and Intelligence Division of the Chemical Corps in May, 1951.

He holds the Legion of Merit, the Bronze Star Medal, is a Commander of the British Empire, and a Chevalier of the Legion d'Honneur.

Col. Rowan today is one of two officers still in active service with the Chemical Corps who have been with the Corps since its creation in 1917 (the other is Col. Hubert B. Bramlet, now Chemical Officer of the Fifth Army), and is the only officer in the Chemical Corps who has had actual field experience in the planning and carrying out of large-scale offensive gas shoots and of defensive measures against enemy-employed shoots.

Chief of P. T. & I. Division confers with members of his staff. From left: Col. Rowan, Chief; Lt. Col. Hutchinson, Chief of Training; Lt. Col. Lane, Chief of Plans and Operations; and Lt. Col. Arthur, Executive Officer. Col. Gillet, Intelligence Chief, was not available for the photo.

After the outbreak of fighting in Korea, the Chemical Corps was placed on a limited mobilization status which called for the reactivation of many of the functions that had been "retrenched" after the last war. Except for the problem of obtaining trained military and civilian personnel, reactivation of these jobs was relatively simple, since they had been kept "on the drafting boards" and were provided for in the tables of organization. However, the reactivation process did necessitate a realignment of inter-departmental functions. Despite the recurrent reorganizations, plans, training and intelligence have continued to be treated as a single coordinated unit within the Office of the Chief Chemical Officer, and today constitute the Plans, Training and Intelligence Division of the Chemical Corps.

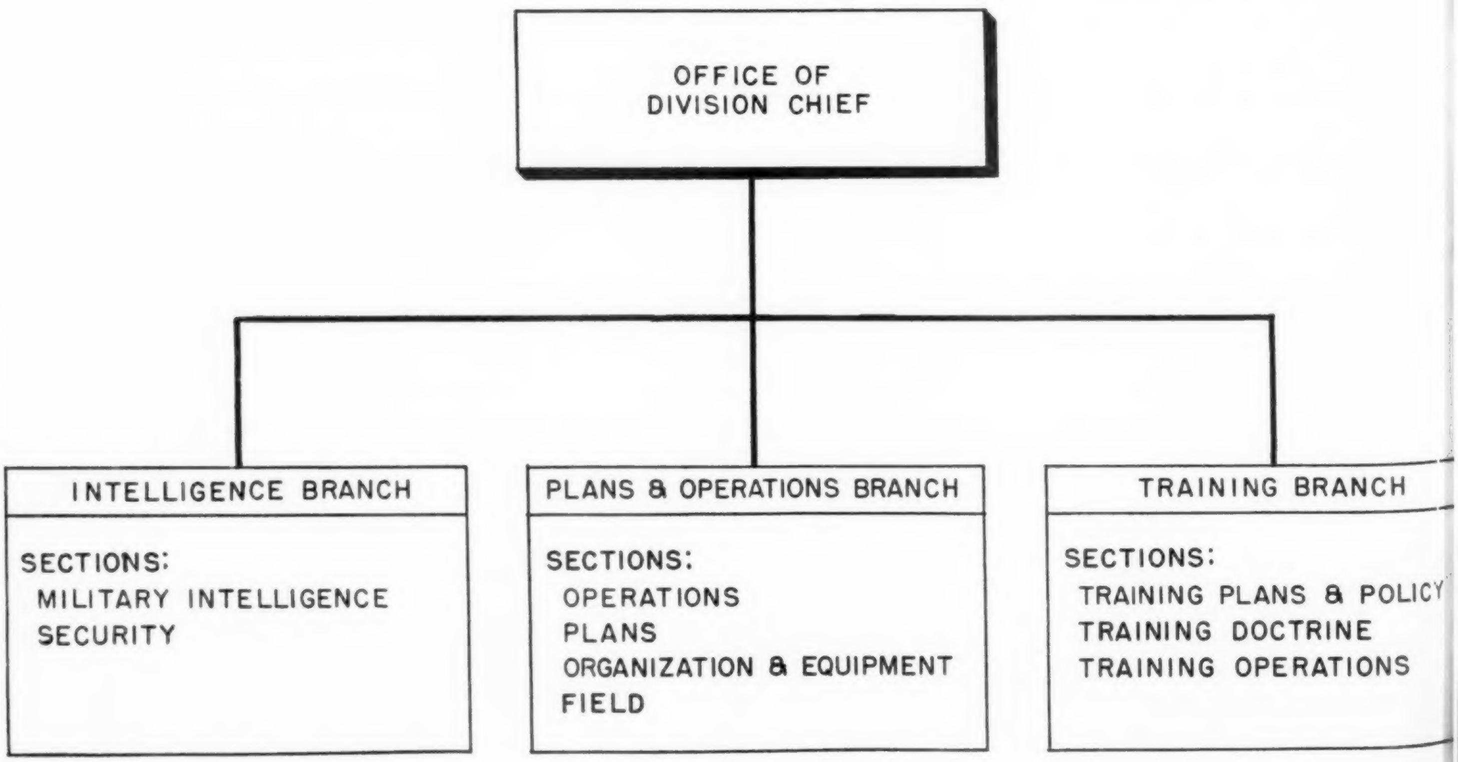
In recent months, as a part of the reorganization incident to the placing of the Corps on a limited mobilization basis, and also as a step toward the decentralization of strictly operational activities of the Corps away from Washington, the operating functions of Research and Development; Procurement and Supply; and Training have been removed from the direct supervision of their respective division heads in the Chief's Office and set up as separate commands in the field, each under a general officer.

As a part of the realignment, jurisdiction over all of the Chemical Corps training activities on the operational level has been placed under the Training Command, with headquarters at the newly-created Chemical Corps Training Center at Fort McClelland, Ala., Brig. Gen. Leonard J. Greeley, commanding. Training plans, policy drafting and control functions at the staff level remain with the Chief's office in Washington as a branch of P.T.&I. Effects of the change will be discussed briefly under the later discussion of the Training Branch itself. The Intelligence and the Plans and Operations Branches were not affected in the reorganization because their activities do not lend themselves to decentralization.

The accompanying organization chart shows the functional set-up of P.T.&I., with as nearly an accurate breakdown of sectional responsibility in the various branches as

Organization set-up of the Plans, Training and Intelligence Division

OFFICE OF CHIEF CHEMICAL OFFICER
PLANS, TRAINING & INTELLIGENCE DIVISION



can be given within the bounds of military security. Admittedly, the chart does not give the complete functional picture. In the event of a total mobilization, this organizaional plan would, of course, be subject to considerable expansion immediately.

Before embarking on a fuller discussion of the functions and responsibilities of the several branches and their respective subordinate sections, it may be well to remember that the primary duty of the Chief, P.T.&I. Div., is to keep the Chief Chemical Officer—and, through him, the Army Chief of Staff constantly advised on developments in the field of P.T.&I. activities as they affect the Chemical Corps. He also makes specific recommendations as to how these developments can best be dealt with. Since practically all of the activities of P.T. and I. Division stem originally from the Intelligence Branch, it may be well that it be considered first.

Speaking—necessarily—in broad and general terms, the function of the Intelligence Branch is to assemble, collate, interpret and distribute information, in peace and in war, about foreign powers and their chemical, biological and radiological forces, and also the countering of foreign powers' efforts to obtain similar intelligence about our own operations in those fields. All this is directed primarily toward the prevention of a surprise attack upon this country or upon our allies with chemical, biological or radiological weapons and to prepare plans and conduct operations for the defeat of the enemy in the event of such an attack.

The information thus collected enables other branches of the Division to prepare and to keep up to date detailed plans for offensive and defensive operations of the Chemical Corps, together with estimates of strength, composition, weapons, and supplies necessary for their execution against any power or combination of powers. Condensed into usable form, it constitutes the essential information concerning a possible enemy that would be required by the Chief Chemical Officer and the General Staff in the event of war.

Under the impact of the Korean conflict, activities of the Intelligence Branch have been greatly expanded. A large part of the additional burden has been in the digesting of Chemical Corps activities reports from the fighting fronts and the technical studies and evaluations of captured equipment for possible implications of foreign preparations to wage a chemical, biological or radiological war, either offensive or defensive.

—Department of Army Photo

Major General E. F. Bullene, Chief Chemical Officer, Department of Army, pins a Commendation Medal on Lt. Col. William S. Hutchinson (left) awarded him by the Secretary of Army for his participation in the Eniwetok Atoll atomic weapons tests in 1950-1951. Col. Hutchinson, now serving as Chief of the Training Branch on General Bullene's staff in Washington, D. C. earned the Commendation Medal for designing, testing and operating highly complex and critical equipment connected with the firing of atomic weapons during Operation Greenhouse. Col. Hutchinson commanded a Chemical Corps mortar battalion during the African and Italian campaigns of World War II.

More specifically, and perhaps, more routinely, the Intelligence Branch checks on the "security" of all personnel, either civilian or military, working for the Corps. It also processes requests for clearance by commercial firms doing business or expecting to do business with the Corps.

Intelligence must also maintain a constant check on material prepared by or submitted to the Corps for publication, to insure that no information will be published that might aid a possible enemy. Because a large part of the re-

Officers and Civilian Executives of the Training Branch hold weekly staff conferences to keep abreast of new developments in the training field. At time picture was taken, Major J. D. Servis, the Staff Radiological Defense Engineer, was acting as Radsafe Officer for Operation Desert Rock. The seated conferees are: Major C. O. Duty (on the left), Lt. Col. W. S. Hutchinson, Jr., Captain Donald Bluejacket, Major W. J. McDermott. Standing are: Major James Watts, Mr. Seymour Waxman, Mr. Delbert H. Flint, and Lt. Col. C. A. Cain.

Officers of the Plans and Operations Branch are shown conferring on plans for Chemical Corps support of projected operations. From left: Lt. Col. Martin L. Denlinger, Lt. Col. Jack F. Lane, Chief of the Branch; and Major Milton S. Vaughn. At far left, Miss Dorothy Kott, Secretary, takes notes on the conference.

search and development work carried on by the Corps is of a classified nature, but is at the same time of high scientific interest, there is a constant flow of scientific and semi-scientific papers emanating from the research installations. Again, it is the duty of the Intelligence officers to check such papers to see that there is no violation of the national security.

The Plans and Operations Branch, as its name implies, has the over-all responsibilty of formulating plans and policies for the Chief Chemical Officer to meet current operational and materiel needs of the Corps. It also makes recommendations for revisions in those plans and policies as changing conditions warrant them. These plans are formulated to provide for the fullest possible utilization of Chemical Corps troops and materiel to meet any existing or impending situation based on information received from the Intelligence Branch, the General Staff, the field and from other military and governmental intelligence agencies.

The Operations Section of the Plans and Operations Branch has the specific task of planning both offensive and defensive operations in the event of war, with particular regard to the deployment of Chemical Corps troops and materiel. It makes its recommendations on a basis of studies and analyses of the strategic, tactical and logistical factors involved. It also makes recommendations on the requirements of troops and on the characteristics of weapons and other equipment.

The Plans Section, working in close coordination with Operations, develops the broad planning strategy for the interim (peace-time) and mobilization periods to insure that the Corps will be constantly prepared for any eventuality. It also makes plans for the mobilization itself to insure that all elements within the Corps will expand uniformly and with a minimum of gear clashing.

The Organization and Equipment Section sets up and maintains Chemical Corps personnel and materiel authorization tables, including Tables of Organization and Equipment, Tables of Allowances, Special Lists of Equipment, and Equipment Modification Lists. It also provides staff assistance to other Army administrative and technical services, notably Transportation and Quartermaster Corps', on matters pertaining to the supply and shipment of Chemical equipment and troops.

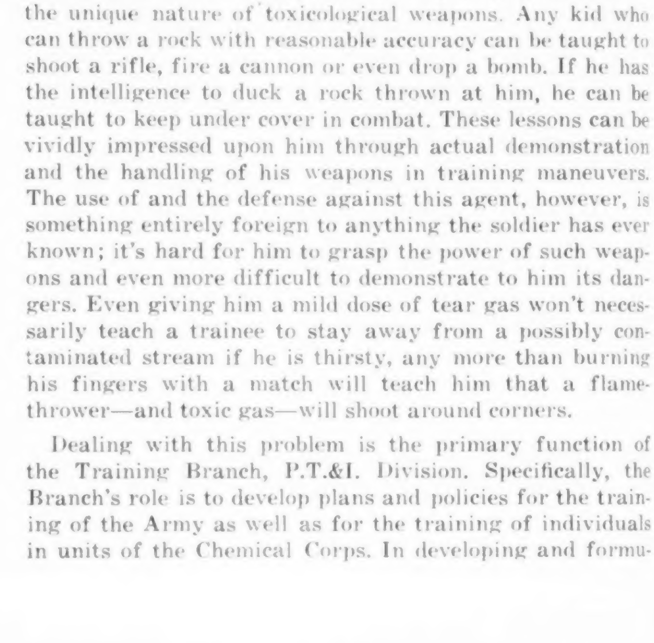
Under the limited mobilization, a Field Section has been set up for the purpose of collecting and evaluating reports from the battlefronts concerning the capabilities and limitations of Chemical Corps weapons and other equipment. These reports are forwarded to the Chemical Corps Board at the Army Chemical Center, Edgewood, Md., along with recommendations from the field for improvements or for other action. It makes recommendations to the Chief Chemical Officer on the suitability for standardization of Chemical munitions and on the establishment of mobilzation reserves and peacetime stockpiles.

Under a full-scale war-time mobilization, the Plans and Operations Branch would assume several additional responsibilities not now operational except on a long-range planning basis. One of these would be the duty of advising the Civilian Defense agencies on measures to be taken in the event of a possible or actual enemy attack with chemical, biological or radiological agents. The Branch now maintains constant liaison with the Federal Civil Defense Administration.

The Training Branch has certainly one of the most important jobs of the P.T.&I. Division and, at the same time, the most difficult to carry out. This is largely because of the unique nature of toxicological weapons. Any kid who can throw a rock with reasonable accuracy can be taught to shoot a rifle, fire a cannon or even drop a bomb. If he has the intelligence to duck a rock thrown at him, he can be taught to keep under cover in combat. These lessons can be vividly impressed upon him through actual demonstration and the handling of his weapons in training maneuvers. The use of and the defense against this agent, however, is something entirely foreign to anything the soldier has ever known; it's hard for him to grasp the power of such weapons and even more difficult to demonstrate to him its dangers. Even giving him a mild dose of tear gas won't necessarily teach a trainee to stay away from a possibly contaminated stream if he is thirsty, any more than burning his fingers with a match will teach him that a flamethrower—and toxic gas—will shoot around corners.

Dealing with this problem is the primary function of the Training Branch, P.T.&I. Division. Specifically, the Branch's role is to develop plans and policies for the training of the Army as well as for the training of individuals in units of the Chemical Corps. In developing and formu-

Army trainee gets his first lesson in the laying of a 4.2-inch Chemical Mortar. Trainee will later fire the weapon at specific targets on the mortar range.



lating Army-wide CBR training, the Branch recommends and coordinates plans and policies with the Chief, Army Field Forces, and with ACofS,G3, at the Department of Army level, both agencies which exercise supervision and jurisdiction over all Army training. The Branch also maintains liaison with the training elements within the Departments of the Navy and Air Force. The Branch, moreover, exercises staff supervision over the training activities within the Corps. The actual Corps training operations is the responsibility of the newly-created Training Command mentioned earlier. The Commanding General of the Chemical Corps Training Command exercises direct command over the Chemical Corps School, Chemical Replacement Training Center, and all units assigned to the Chief Chemical Officer and stationed at Fort McClellan, Alabama. The Commanding General of the Chemical Corps Training Command also has the responsibility of exercising supervision over the military training of individuals and units assigned to the Chief Chemical Officer and stationed elsewhere than at Fort McClellan. Immediately upon acquisition of facilities at Fort McClellan, steps were taken to concentrate all of the operational training activities of the Corps at this center. The accomplishment of the transfer of training activities from various Chemical Corps Class II Installations to the Chemical Corps Training Command at Fort McClellan is nearing completion as this article is written. The establishment of the Chemical Corps Training Center at Fort McClellan in 1951 fulfilled a long-standing need within the Corps for adequate facilities to give realistic and actual training in the field, a need that could not be met with the limited facilities at the Army Chemical Center and other Class II Installations.

Fort McClellan has the equipment and, in particular, the space and terrain for the staging of large-scale maneuvers utilizing chemical weapons and involving troop units of regimental strength. As a part of a recent move to improve the chemical training of the entire army, two-weeks courses in toxicological warfare, both offensive and defensive, are being conducted for the combat arms at each of the Z.I. Armies. Plans are also being mapped to make chemical warfare a part of the future combined arms services exercises and maneuvers. Special training is now being prepared by the Training Branch to prepare Chemical Corps units for participation in these maneuvers with the other services. Since the outbreak of the Korean war, chemical training schools have been established in both the Far East and European Commands.

An indication of the speed-up in troop training made possible by the expanded facilities at Fort McClellan is seen in the fact that the trainee load of the Chemical Replacement Center jumped from a peak of 400 while at Edgewood to 880 in the first three months after the transfer to Fort McClellan.

The new training center will provide educational facilities for both the Organized Reserve Corps and Reserve Officer Training Corps units. Largely because of the additional responsibilities placed on the Chemcal Corps, the number of colleges now maintaining Chemical Corps R.O.T.C. units has been increased. Colleges having chemical units are: Canisius College, Buffalo, N.Y.; St. Peter's College in New Jersey; Wake Forest College in North Carolina; Vanderbilt University at Nashville, Tenn.; Idaho State College, Pocatello; Delaware University at Newark; Georgia Tech at Atlanta; Massachusetts Institute of Technology at Cambridge, Mass.; Purdue University, Lafayette, Ind.; Ohio State University at Columbus; and Texas A. and M., College Station.

The duties of the individual sections of the Training Branch generally follow the descriptive names shown on the organization chart. Since the Branch has always been a staff rather than an operating agency, establishment of the Training Command has been effected with a minimum of interruption in the normal Branch activities.

The P.T.&I. Division as a whole has been handicapped by a shortage of officers, a condition that is, of course, general throughout the service. The Division is performing its functions and meeting its deadlines, but the acquisition of additional qualified officer personnel would enable the Division to pursue its problems to a greater depth and to initiate more planning and research. The direct supervision of training, for instance, would be much more effective if officers were available to make more frequent staff visits to field activities.

Credit for the work that the Division has accomplished should go especially to the chiefs of the three branches and the heads of their respective sections. Space and military security will permit only a brief word about each of the Branch Chiefs, and the Executive Officer of the Division. All are old line Chemical Corps officers who know their jobs, and they have served well. They are:

Col. Norman D. Gillet, Chief of Intelligence, a graduate from the Virginia Military Institute, the Infantry School in 1921, the Chemical Warfare School in 1924, and the Army Industrial College in 1938. In World War II he served as Chief of the Supply Division in the Chief's Office in which capacity he planned, organized and administered the supply and depot system of the Chemical Corps. In 1946 he was appointed Deputy Commander of the Army Chemical Center at Edgewood, and later was named Technical Director of the San Jose Project. He served two years on the staff of the Munitions Board at the Pentagon before becoming Chemical Corps Intelligence Chief in January, 1951.

Lt. Col. Frank M. Arthur, Executive Officer, was originally commissioned in the Infantry in 1938, attended basic Chemical Warfare School in 1939 and was assigned to the (then) Chemical Warfare Service in 1941. He served during the war as Chemical Officer of the 41st Division and the I Corps in the Pacific. He was assigned to the Chief's Office in Washington in 1945 and served successively as Chief of the Training and the Plans and Operations Divisions. After graduating from the Command and General Staff College in 1948, he was appointed Chief of the Training Branch and became Executive Officer of the P.T.&I. Division in 1951.

Lt. Col. William S. Hutchinson, Jr., Chief of Training, graduated from Lehigh University in 1936, was commissioned and was assigned to the Procurement Planning Division of the Chief's office in 1941. In 1942 he attended the Chemical Warfare School and commanded the 83rd Chemical Mortar Battalion serving with the Rangers through the African and Italian campaigns. He returned to the Z.I. in 1944 and was, in succession, Chief of Field Service at the Chemical Corps School, Commandant of the Officers Candidate School at Edgewood, and Staff Chemical Officer at the Infantry School at Fort Benning, Ga. In 1947 he was the Scientific Security Officer on the Manhattan Project, then went to the Massachusetts Institute of Technology where he received his masters degree in Chemical Engineering. He was named a member of the Chemical Corps Board in 1950, served in the Cyrogenics Group on the atomic bomb tests at Enitowok for Operation Greenhouse, and was appointed Chief of Training last July.

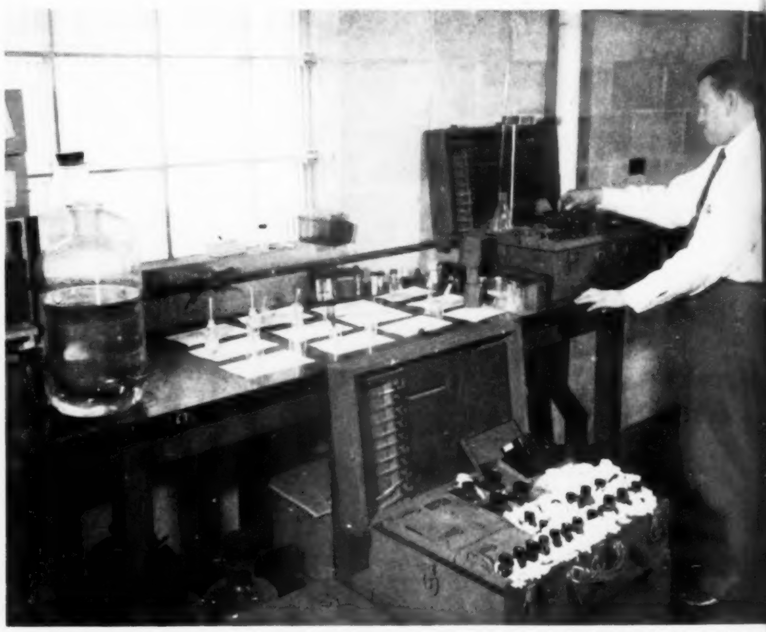
Lt. Col. Jack F. Lane, Chief of Plans and Operations, graduated from Ouachita College in 1938, took the basic course at the Chemical Warfare School in 1939, was commissioned in the Regular Army in 1940 as a result of Thomason Act competition, and was assigned to Edgewood Arsenal until 1941. After serving as Adjutant and Assistant Chief of Production at the Huntsville and Rocky Mountain Arsenals, he attended the Infantry School in 1943 and was assigned to the Southwest Pacific Area. Between 1943 and 1946 he served variously as Commandant of the Theater Chemical Warfare School in Australia; with the Office of the Assistant Chief of Staff, G-4 at Far West Headquarters, was Chemical Officer of the XIV Corps, and commanded the 85th Chemical Mortar Battalion in the Philippines. After the war, he served for two years as Chemical Instructor, ROTC, at the Massachusetts Institute of Technology. He attended the Command and General Staff College in 1948-49 and was named a member of the Chemical Corps Board upon graduation, a post he held until he was assigned his present duty last January.

RESEARCH AND ENGINEERING COMMAND

NERVE CENTER OF CHEMICAL CORPS RESEARCH AND DEVELOPMENT ACTIVITIES

By Lt. Marvin Caplan*

Brigadier General William M. Creasy, Commanding General, Cml C Research and Engineering Commahd.



—Chemical Corps Photo

The Research and Engineering Command is continually working on the improvement of protective devices, such as the field gas identification set shown above.

In these days of hot and cold running wars, only that nation which pursues a vigorous program of military research and development can hope to gain early victory at low cost in both lives and materiel. The quest for advanced and superior means and methods of both offense and protection is as necessary to our national defense as is the availability of trained manpower.

As part of this program, the Chemical Corps has responsibility for research and development in three fields, namely, chemical, biological and radiological warfare. The research, development, and engineering activities of the Chemical Corps are directed toward making available to our troops the best modern weapons, protection, and countermeasures in these fields. The individuals and organizations cooperating with the Chemical Corps in this work are spread throughout the country. Coordination of this multi-million-dollar program requires a nerve center which is both responsive and authoritative. Such is the function of the Chemical Corps Research and Engineering Command, commanded by Brigadier General William M. Creasy, with headquarters located at Army Chemical Center, Maryland. The Commanding General of this Command is directly responsible for all Chemical Corps research, development and engineering in CBR warfare (official Department of Army designation for the three types of toxicological warfare.)

At the present time, although the development of adequate protective measures against CBR attack is an important part of Chemical Corps work, the development of superior offensive potential is believed to be an even greater deterrent to possible aggressors.

Grounds for such a belief can be found in our World War II experience. It is the opinion of many experts that gas warfare was not used by the enemy during World War II largely because we were so well prepared to defend ourselves against it and to retaliate.

Much work in this field was done by Germany during the war, however, and many German scientific experts on toxic chemical warfare are now being exploited in Soviet Russia. It would be foolish to assume, therefore, that we are the sole possessors of the secrets of the new "nerve" gases.

*1st Lt. Caplan is on the Headquarters Staff, Research and Engineering Command, Army Chemical Center, Md.

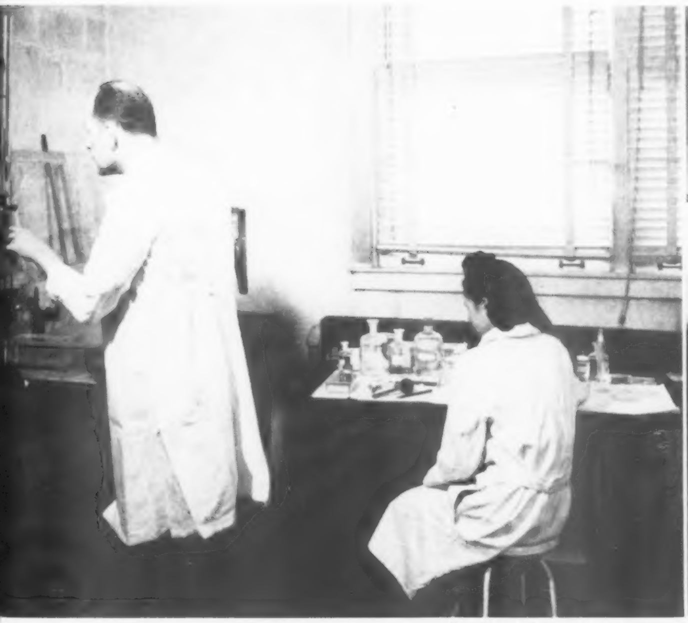
Thus it is clear that the United States must be well prepared. Toward this end, the Chemical Corps must constantly develop new toxic agents and improve old ones. At the same time it must devise increasingly effective means of dissemination. Finally, it must develop equipment for the protection of our own troops, as well as civilian populations, from the effects of similar toxic gases used by an enemy.

This last point is worth noting further. That even the physical devastation of war is no longer confined to the battlefront is one of the indisputable lessons of World War II. The importance of the Chemical Corps' work in developing both individual and collective means of protection against gas attack, therefore, can hardly be overrated. Both on the battlefront and at the rear, the emphasis is upon developing protectors which least impede normal living and working. For individuals, the trend is away from bulky filters in gas masks, and for groups the trend is toward collective protectors for buildings making individual masks unnecessary.

finds many uses in warfare. For instance, a colored smoke round is often used to indicate the proper target for a supporting air strike. A more traditional use for smoke is in screening tactical operations or even in screening nonexistent operations as a feint.

The term "biological warfare" has been the starting point for a good many sensational articles and public statements. But to the Chemical Corps Research and Engineering Command, biological warfare, popularly known as "BW," represents a definite program of research and development not too unlike its program in chemical warfare. As in gas warfare, one of the problems which must be solved is the development of adequate protection against toxic agents.

The protection problem consists largely of filtering noxious particles out of the air which is to be inhaled by human beings. Thus the Chemical Corps is striving to develop protective equipment adaptable to either gas or biological warfare. Such flexibility is important in combat where mobility is essential, and where it is desirable that, upon receiving



—Chemical Corps Photo

Research work at the Medical Laboratories covers a broad field, including the gathering of data on the development of films on minute thickness.

—Chemical Corps Photo

The Chemical and Radiological Laboratories boasts of one of the finest technical libraries in the military service, with some twenty thousand volumes of scientific and engineering books, hundreds of thousands of technical reports, and more than a hundred current technical periodicals.

But not all work in chemical warfare is concerned with noxious gases. Gas warfare is only a threat, but other weapons developed by the Chemical Corps are even now proving themselves on the battlefield. The Chemical Corps Research and Engineering Command has the responsibility for the development and continuing improvement of such weapons.

One such weapon is the flame thrower. The flame thrower gained much prominence during World War II, as it proved in many cases to be the only feasible method of dislodging Japanese jungle fighters from trenches and pillboxes. Since the war, the flame thrower has been improved so that the range and intensity of the flame are much greater. As ground fighting returns to the primitive concept of hand-to-hand combat, the flame thrower, ideally adapted to close range work, becomes more and more an essential infantry weapon.

Making smoke is another Chemical Corps job. It may seem paradoxical that while public-spirited citizens throughout the United States are trying to get rid of the smoke blanketing their cities, the Chemical Corps is trying to find ways of making more smoke than ever before. But smoke

a simple warning, troops can quickly protect themselves against any kind of toxic attack. It is also important to the taxpayer who wants his contribution to be used as efficiently as possible.

The advent of the atomic bomb suggested still another type of warfare against which we must prepare. For, despite the tremendous explosive violence unleashed by the atomic bomb, radiation is also a most lethal aspect of atomic warfare. Radiation in strong enough doses destroys the living cells which make up the human body. The responsibility for developing protection against radiological effects to be encountered in atomic warfare has been assigned to the Chief Chemical Officer. This is also one of the responsibilities delegated to the Commanding General, Chemical Corps Research and Engineering Command. Like the protective aspects of CW and BW, this mission involves the development of means for rapidly identifying the presence of radiation, methods of removing radiologically contaminated material, and means of protecting humans and animals against it.

As can be easily imagined, supervision of a research and development program of this vast scope is not a simple matter. There are several complicating factors to be considered which may not appear on the surface.

One of the factors entering into supervision of the Chemical Corps research and development activities is the limitations of Chemical Corps facilities. The Corps is a large and currently growing organization. But the emergencies engendered by the tense world situation have resulted in a research and development program far exceeding the capacity of the Corps' present personnel and facilities. Consequently, the Chemical Corps must let contracts to industrial organizations and other institutions. In this way the Corps can take full advantage of excellent laboratory facilities and highly trained scientists throughout the country. However, this large contract program must be meshed in with the work constantly being done by Chemical Corps agencies.

At the center of this complex web of communications and contracts is the Headquarters, Research and Engineering Command. Currently, this Command is headed by Brigadier General William M. Creasy. To this post, General Creasy brings a broad background of technical and military experience. A native of North Carolina, he graduated from the United States Military Academy in 1926 and has completed the entire Army school system including the National War College. He also holds a Master of Science degree in Chemical Engineering Practices from Massachusetts Institute of Technology.

—Chemical Corps Photo

Research and development work calls for many special pieces of equipment which are manufactured in this well-equipped machine shop at the Chemical and Radiological Laboratories.

—Chemical Corps Photo

Field testing is an important function of the Research and Engineering Command as shown here in the testing of the Army's new M9 gas mask under simulated battle conditions, including a smoke screen.

His staff is composed of highly competent civilian and military personnel. It is generally believed that a combination of civilian and military personnel serves to maintain a balanced viewpoint on a military research program. Thus, it is the task of military administrators and planners to see that the efforts of civilian scientists remain directed primarily at the achievement of a particular technical objective of interest to the Army. Since many of the civilians in the Research and Engineering Command and its operating agencies are veterans of military service, a considerable degree of harmony exists.

The research and Engineering Command has been operating since October, 1951. The internal organization of the Research and Engineering Command consists of an operational plans and evaluation office, five "operating" divisions, a comptroller and an administrative division. How these units work together to supervise a multi-million dollar research program will be clear from a slightly more detailed analysis of this structure.

Broadly defined, the mission of the Plans and Evaluation Office is the preparation, coordination and evaluation of the Chemical Corps research and development program. Since this program is actually part of a much broader one encompassing all measures necessary for national defense, this office must also maintain liaison with the Research and Development Board and other arms and services concerning Chemical Corps plans and policies. Specifically, this office plans the project program based on requirements of the combat arms and the Research and Development Board, reviews contract proposals by operating agencies, receives and distributes technical intelligence information to interested agencies, and edits and initiates project reports for the Research and Engineering Command.

Implementation of the project program is the direct responsibility of the five "operating" divisions. The nature of the problems which must be faced in the evolution of a new weapon or defense are easily evident when the different functions of these divisions are considered.

As implied previously, one way to make a potential enemy think twice before launching an attack is to develop a weapon with which he cannot cope. Since the development of defense measures usually lags only slightly behind that of offensive weapons, it is necessary for the Chemical Corps to continually discover new or improved toxic agents. This means the investigation of a large number of candidate agents, involving tests of toxicity, stability, expense and ease of mass production. Methods of detecting these agents must also be examined. This is the kind of work for which the Research Division is responsible.

In a sense, the Development Division takes over where the Research Division lets go. Assuming that a powerful toxic agent has been discovered, there remains the problem of disseminating it. To this end, munitions must be developed; these may be grenades, mortar shells, artillery shells, bombs or rockets. Furthermore, although agencies working under the supervision of the Research Division may have discovered the maximum safe allowable concentration of this agent in air for a given exposure time, it is the Development Division's job to see that filters for gas masks and collective protectors are designed to exclude higher concentrations.

Formerly part of the Development Division, the Proving Ground Division is now established as a separate unit. This change reflects both increased proving ground activity and also recognition of the "proving" function as a separate and distinct one. "Proving" is essentially simulated service testing. The project engineer can check and recheck his calculations and apply all sorts of physical tests to a smoke shell, for instance, but there is only one way to find out whether it really works; namely, to reproduce as nearly as possible the conditions under which it is expected to operate, then fire it and observe the results. It is interesting to note that the importance of "proving," though recognized for many years by the transportation industry as well as the Army, has only since World War II been widely recognized in most of industry.

The remaining problems which must be solved by the Research and Engineering Command in connection with the evolution of a final approved item are primarily engineering problems. The United States has no corner on scientific talent. Consequently the Chemical Corps cannot assume that its research and development program will put it far enough in front of other nations to be comfortable. There is one aspect of defense preparation, however, in which the United States is the acknowledged world leader at the present time, i.e., industrial capacity. The engineering problems relating to both product design and plant design which must be solved before Chemical Corps items can be made available in large quantities are the special responsibility of the Engineering Division. This Division also supervises and directs safety programs at installations under the Research and Engineering Command; the importance of this particular responsibility alone is obvious from the nature of the work done by the Chemical Corps.

By now it must be apparent that the internal organization of the Research and Engineering Command is essentially similar t. that employed by the research and development organization of many large manufacturing concerns. Likewise, when a company decides to enter a field in which it has had little previous experience, generally a new and separate authority is established to "push" this new work. In this way, there is no danger of fresh new enterprise growing stale from neglect in an office where more familiar and equally important problems must be faced. This same working principle has been observed in the Research and Engineering Command with the establishment of a Special Projects Office on the same level as the other operating divisions. Briefly, the mission of this office is to investigate new fields of interest to the Chemcal Corps and to supervise and coordinate operations in new fields pending their complete integration into the structure of the Research and Engineering Command.

Just as the Command divisions are staffed by specialists in particular fields, so the various operating agencies under this Command are organized to perform similarly specialized functions.

For the development of weapons, smoke generators and protective devices for chemical and radiological warfare, there is in the Research and Engineering Command the Chemical Corps Chemical and Radiological Laboratories located at Army Chemical Center. This organization handles all research and development in connection with chemical weapons and with protective devices for chemical, biological and radiological warfare. It is housed principally in a large two-story building and over 100 smaller buildings. It has an excellent technical library of some 20,000 volumes of scientific and engineering books, hundreds of thousands of technical reports and over 100 current periodicals. The equipment and laboratories compare favorably with those of any technical organization of equal size in the world.

—U. S. Army Photo
Continual improvement has produced today's modern flamethrower, a highly efficient, waterproof weapon being put to good use in Korea.

Research on the effects of gas, smoke, flame and radiological weapons on the human organism and on methods for the treatment of injuries from such weapons are conducted in the Chemical Corps Medical Laboratories, also located at the Army Chemical Center. These Laboratories have the most modern scientific equipment and are housed principally in a two-story building nearly as large as the Chemical and Radiological Laboratories. Near this building are found well equipped toxicological laboratories, a large building for the care of laboratory animals and a fair size lecture hall. The Medical Laboratories has a library of its own.

Research and development in the field of biological warfare is conducted in the Biological Laboratories at Camp Detrick near Frederick, Maryland. It has a large and up-to-date scientific library and well equipped laboratories.

When a weapon or a protective device from one of these agencies has passed through the research stage and has been developed to the point where an experimental model is available and has been given preliminary tests, it is referred to the Engineering Agency at the Army Chemical Center for final production of Chemical Corps weapons and equipment. This newly created agency has moved into quarters formerly occupied by the Chemical Corps School. The Agency is staffed largely by people with broad experience in the development of military equipment and with a liberal addition of engineers experienced in the best industrial practices.

When a sufficient number of a weapon or protective device has been procured or manufactured under the supervision of the Engineering Agency, it is then tested either at

(Continued on page 56)

CHEMICAL CORPS KEY PERSONNEL

OFFICE, CHIEF CHEMICAL OFFICER, WASHINGTON 25, D.C.

Chief Chemical Officer, Major General George Egbert F. Bullene

Deputy Chief Chemical Officer, Brigadier General Charles E. Loucks

Executive Officer, Lt. Col. Timothy C. Williams

Comptroller, Lt. Col. Robert E. Stoever

Legal Advisor, Lt. Col. Herbert K. Greer

Chief, Personnel Division, Col. John R. Burns

Chief, Materiel Division, Lt Col. Claude J. Merrill

Chief, Plans, Training and Intelligence Division, Col. Hugh W. Rowan

Chief, Research and Development Division, Col. William J. Allen, Jr.

Chief, Safety Office, Major Ned S. Weathers

CHEMICAL CORPS BOARD, ARMY CHEMICAL CENTER, MARYLAND

President, Col. Ralph C. Benner

ARMY CHEMICAL CENTER, MARYLAND

Commanding General, Brigadier General William M. Creasy

CHEMICAL CORPS RESEARCH AND ENGINEERING COMMAND, ARMY CHEMICAL CENTER, MD.

Commanding General, Brigadier General William M. Creasy

Chemical Corps Chemical and Radiological Laboratories, Army Chemical Center, Md.; Commanding Officer, Col. Fred J. Delmore

Chemical Corps Medical Laboratories, Army Chemical Center, Md.; Commanding Officer, Col. M. W. Bayliss

Chemical Corps Engineering Agency, Army Chemical Center, Md.; Commanding Officer, Col. C. L. Sayre

Edgewood Proving Ground, Army Chemical Center, Md.; Commanding Officer, Lt. Col. John W. Fitzpatrick

Camp Detrick, Frederick, Md.; Commanding Officer, Col. Montescue T. Moree

Dugway Proving Ground, Tooele, Utah, Commanding Officer, Col. Donald H. Hale

CHEMICAL CORPS MATERIEL COMMAND, BALTIMORE, MARYLAND

Commanding General, Brigadier General Henry M. Black

Pine Bluff Arsenal, Arsenal, Arkansas; Commanding Officer, Lt. Col. John J. Hayes

Rocky Mountain Arsenal, Denver, Colorado; Commanding Officer, Col. Crawford M. Kellogg

Edgewood Arsenal, Army Chemical Center, Md.; Commanding Officer, Col. David Armitage

Deseret Chemical Depot, Tooele, Utah; Commanding Officer, Col. Kenneth A. Cunin

Midwest Chemical Depot, Arsenal, Arkansas; Commanding Officer, Lt. Col. E. A. Limbaugh

Eastern Chemical Depot, Army Chemical Center, Md.; Commanding Officer, Col. John P. Youngman

Atlanta Chemical Procurement District, 114 Marietta St., N.W., Atlanta, Ga.; Commanding Officer, Capt. Alvin H. Bowles

Boston Chemical Procurement District, Boston Army Base, Boston, Mass.; Commanding Officer, Col. W. E. R. Sullivan

Chicago Chemical Procurement District, 226 W. Jackson Blvd., Chicago, Ill.; Commanding Officer, Col. Victor C. Searle

Dallas Chemical Procurement District, 114 Commerce St., Dallas 2, Texas; Commanding Officer, Lt. Col. Hans S. Bendixen

New York Chemical Procurement District, 111 E. 16th St. New York City; Commanding Officer, Lt. Col. J. F. Escude

San Francisco Chemical Procurement District, Oakland Army Base, Oakland 14, Calif.; Commanding Officer, Col. George W. Dorn

Chemical Corps Procurement Agency, Army Chemical Center, Md.; Chief, Lt. Col. James H. Batte

Inspection Equipment Agency, Army Chemical Center, Md.; Chief, Capt. John Marrero

CHEMICAL CORPS TRAINING COMMAND, FORT McCLELLAN, ALABAMA

Commanding General, Brigadier General Leonard J. Greeley

Chemical Corps School; Commandant, Col. Ragner E. Johnson

Chemical Replacement Training Center; Commanding Officer, Lt. Col. Lucius F. Lincoln

CHEMICAL CORPS OFFICERS WITH THE ARMY FIELD FORCES

Hqs. First Army, Governors Island, New York:

Chemical Officer, Col. Walter A. Guild

Hqs. Second Army, Fort George G. Meade, Md.:

Chemical Officer, Col. Raymond T. Beurket

Hqs. Third Army, Fort McPherson, Georgia:

Chemical Officer, Col. R. D. McLeod

Hqs. Fourth Army, Fort Sam Houston, Texas:

Chemical Officer: Col. Donald Grothaus

Hqs. Fifth Army, 1660 E. Hyde Park Blvd., Chicago 15, Ill.:

Chemical Officer: Col. H. B. Bramlet

Hqs. Sixth Army, Presidio of San Francisco, Calif.:

Chemical Officer, Col. S. E. Whitesides

CHEMICAL CORPS OFFICERS RESERVE CORPS INSTRUCTORS

FIRST ARMY AREA:

Major Gordon W. Davis, NY ORC Instructor Group, Hqs. First Army, Governors Island, N.Y.

Major Robert G. Lynch, Office of Sr. State ORC Instructor, Kearny Shipyards, Kearny, N.J.

SECOND ARMY AREA:

Major Raymond O. Manker, Delaware ORC Instructor Group, Wilmington, Del.

THIRD ARMY AREA:

Major E. Escudero, South Carolina ORC Instructor Group, Broad and Chisholm Sts., Charleston, S.C.

FIFTH ARMY AREA:

Major John M. Kapp, Illinois ORC Instructor Group, Chicago, Ill.

Capt. G. E. Allard, 310 Federal Office Bldg., Third Ave. and Washington Ave., S., Minneapolis, Minn.

Capt. V. Deptula, Sr. Army Instructor ORC, 463 Federal Bldg., Detroit 26, Mich.

SIXTH ARMY AREA:

Major Gilbert J. Foster, California ORC Instructor Group, Los Angeles, California

THEATER CHEMICAL OFFICERS:

EUROPEAN THEATER: Col. Thomas H. James, Chemical Division, Hqs. EUCOM (Rear), APO 403, c/o Postmaster, New York, N.Y.

FAR EAST COMMAND: Col. Jacquard H. Rothschild, Chemical Section, GHQ, FEC, APO 500, c/o Postmaster, San Francisco, Calif.

PACIFIC THEATER: Lt. Col. James R. Champan, Chemical Officer, U. S. Army Pacific, APO 958, c/o Postmaster, San Francisco, Calif.

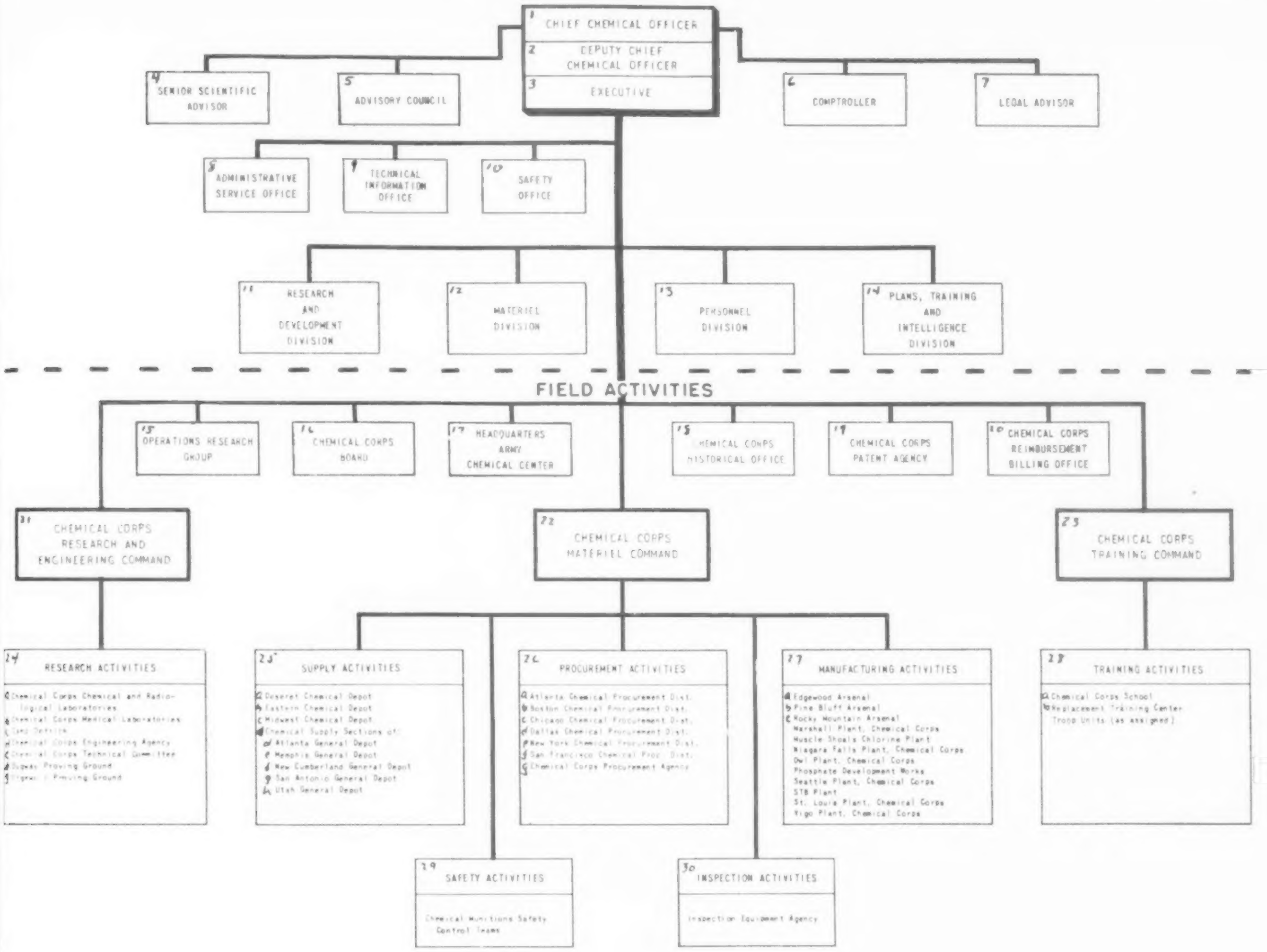
CARIBBEAN THEATER: Col. George R. Oglesby, Fort Amador, Canal Zone.

HQ. U. S. ARMY, ALASKA: Lt. Col. Claude W. White, APO 942, c/o Postmaster, Seattle, Washington.

ORGANIZATION CHART

DEPARTMENT OF THE ARMY

CHEMICAL CORPS



Box No.	Name
1.	Major General E. F. Bullene
2.	Brigadier General Charles E. Loucks
3.	Lt. Col. Timothy C. Williams
4.	Dr. W. Albert Noyes, Jr.
5.	Dr. H. F. Johnstone, Chairman
6.	Lt. Col. Robert E. Stoever
7.	Lt. Col. Herbert K. Greer
8.	Lt. Roger K. Griffin
9.	Captain Earle J. Townsend
10.	Major Ned S. Weathers
11.	Colonel William J. Allen, Jr.
12.	Lt. Col. Claude J. Merrill
13.	Colonel John R. Burns
14.	Colonel Hugh W. Rowan
15.	Dr. W. Albert Noyes, Jr.
16.	Colonel Ralph C. Benner
17.	Brigadier General William M. Creasy
18.	Dr. Paul W. Pritchard
19.	Lt. Col. Herbert K. Greer
20.	Mrs. Florence B. Wilbur
21.	Brigadier General William M. Creasy
22.	Brigadier General Henry M. Black
23.	Brigadier General Leonard J. Greeley
24.	a. Colonel Fred J. Delmore
	b. Colonel Milward W. Bayliss (Medical Corps)
	c. Colonel Montescue T. Moree
	d. Colonel Clifford L. Sayre
	e. Brigadier General Charles C. Loucks, Chairman
	f. Colonel Donald H. Hale
	g. Colonel John W. Fitzpatrick
25.	Lt. Col. Raymond C. Morris
	a. Colonel Kenneth L. Cunin
	b. Colonel John P. Youngman
	c. Lt. Col. Edwin A. Limbaugh
	d. Major Gerald M. Correll
	e. Lt. Col. James S. Chandler
	f. Major Arthur F. Morgner
	g. Captain Douglas P. Hillhouse
	h. Maj. H. D. Sarge, Jr.
26.	Lt. Col. Carl A. Steidtmann
	a. Captain Alvin H. Bowles
	b. Colonel W. E. R. Sullivan
	c. Colonel Victor C. Searle
	d. Lt. Col. Hans S. Bendixen
	e. Lt. Col. Joseph F. Escude
	f. Colonel George W. Dorn
	g. Lt. Col. James H. Batte
27.	Lt. Col. Carl A. Steidtmann
	a. Colonel David Armitage
	b. Lt. Col. John J. Hayes
	c. Colonel Crawford M. Kellogg
28.	
	a. Colonel Ragner E. Johnson
	b. Lt. Col. Lucius F. Lincoln
29.	Major Ned Weathers
30.	Captain John Marrero

Photo by Major John F. Carroll

Chemical Corps Reserve Officers from Mobilization Detachment No. 10, New York Procurement District, visit the machine shops at the Army Chemical Center. Left to right: Capt. Abe Selman, Capt. Solomon Baum, Lt. Col. Selig Levitan, Col. Almon Bowes, Major Ernest Marshall, Capt. Richard Rosen, Colonel Samuel Cummings, Commanding Officer.

NEW YORK CHEMICAL CORPS RESERVISTS VISIT ARMY CHEMICAL CENTER

By Major John F. Carroll, Cml C Res

As a fitting climax to their on-the-job summer training in the offices of the New York Chemical Procurement District, 48 officers of Mobilization Detachment No. 10 under command of Colonel Samuel N. Cummings, recently spent a week-end inspecting the facilities at Edgewood.

This past year instead of the entire unit going on active duty simultaneously, it was arranged, through the cooperation of Lt. Col. Joseph Escude, Commanding Officer of the New York Chemical Procurement District, to have only 12 Reservists on duty at a time. Thus it was possible for the Procurement District to absorb in each section two or three officers for on-the-job training without any appreciable disruption of the normal flow of work. Not only were the civilian employees of the District loud in their praise of the manner whereby each successive group of officers handled their assignments, but the participating Reservists felt that by being actually integrated into the working staff of the District, they were better able to implement and put to practical use the information gained from the regular training sessions.

At the conclusion of the experiment in late September, Colonel Escude wrote in his official report:

> "I can hardly tell you how impressed I am by the speed and facility with which these men were integrated into the office and were able to take a part in the performance of the day-to-day tasks of this office. They certainly speak well for the kind of training they had under the direction of Colonel Sam Cummings."

The week-end training tour began with a train trip from New York at the close of the business day on Friday. For many of the Reservists it marked their first return visit to Edgewood since they received their commission on the completion of the rigorous Officer Candidate Course or the completion of advance training at the Chemical Warfare School. Without a single exception, the Officers were vocal in their praise of the warm welcome and cooperation extended to them by everyone from Generals H. M. Black and W. Creasey, Colonel F. W. Gerhardt, down to Captain John R. Bedford and Lieutenants Mark D. Wilson and William C. Miles. These latter officers did a most efficient job in attending to the billeting, messing and transportation requirements of the group. As one officer put it, "The Chemical Corps certainly made the Reservist feel that he is wanted and welcome at Edgewood."

The officers were particularly impressed during their tour of the Gas Mask Plant, the bomb and shell loading operations and the manifold facilities and skill of the civilian employees in the machine shop area. Of noteworthy interest was the visit to the Inspection Headquarters and the gauge testing laboratories. During the course of their Procurement training they frequently heard Colonel Tony D'Angelo stress the importance of proper inspection, the care and rigid requirements to which gauges must be subjected. This was a highly interesting phase of the training program, as with some exceptions, this was really the first time that most of the officers actually encountered and understood the philosophy and importance of Inspection planning and procedures. From the number of Inspection aids, it was apparent that the current Inspection safeguards in existence in the Chemical Corps are the result of many years of constant experimentation and research developed during wartime production.

Unfortunately the tight schedule allowed for only half a day to visit the Chemical, Radiological and Medical Laboratories. Most of the officers felt that this was not only most interesting, but a most vital phase of the Chemical Corps program. Not a few expressed the hope that perhaps in 1952, we might alternate our procurement training, by spending our two weeks in this last mentioned field. It was suggested that if this is approved that we follow the procedure found so satisfactory in going on active duty in small groups.

Although the officers were previously advised during their orientation talks by Lt. Colonel William G. Willman and Major Martin F. Massoglia that, due to their failure to be cleared for "secret," they could not see all that "Tech Command" had to offer, they, nevertheless, were as officers and interested citizens greatly encouraged by the experiments and accomplishments being conducted in the Chemical and Radiological Divisions under Colonel Fred J. Delmore's supervision. The research problems being conducted in the Medical Laboratories of the Chemical Corps, as explained by Major Harold W. Wheeler and Dr. Chambers also proved most interesting.

While the writer sat watching new films, he could not help but think how effective some of the sequences shown would be if they were incorporated into training films for Army and Civilian Defense personnel. It would be particularly good to impress on the G.I.'s the necessity for the proper care and use of protective devices and equipment. Wider dissemination of these findings would bring credit to the Chemical Corps and by showing what is being accomplished would possibly result in greater research appropriations. Such a program would also make for better public relations, and help to educate the general public towards the use and effectiveness of the atomic, biological and chemical weapons for which the Corps is responsible

(Continued on page 55)

A NEW DEVELOPMENT IN GAS MASKS

by G. M. GLIDDEN • ACME PROTECTION EQUIPMENT, INC.

One winter's day in Wyoming, when the temperature was around 40° below zero, the control equipment in a refinery suddenly tripped the alarms, and sirens all over the plant called maintenance men to take care of a break in one of the lines, carrying sour crude to a still. As you know, the crude petroleum in many of the fields of Wyoming is very high in hydrogen sulphide and therefore as classed as an exceedingly hazardous crude oil to handle. Hydrogen sulphide, of course, being the gas which smells like "rotten eggs" and which can very quickly paralyze the nerves controlling the sense of smell; following which, the nerves controling the breathing are paralyzed. If, after a person has collapsed, he is immediately gotten out into fresh air and made to continue breathing by artificial means, the paralysis will gradually be overcome by natural processes and he is all right without any harmful effects. If, however, he is not found and taken into a fresh air atmosphere, he is a "goner."

The men put on Gas Mask equipment and after shutting off valves, immediately attacked the job of taking out the broken gasket from a flange and replacing it — but the job wasn't completed immediately, because Gas Mask valves commenced to freeze open and closed, so that the men were either breathing hydrogen sulphide or couldn't breathe at all and yanked off their masks. On this particular occasion, two men died of the paralysis and the lack of enough men to handle First Aid.

This is not an isolated case, as many men are "under the sod" due to their Gas Masks having ceased to function properly due to the cold weather either opening or closing the valves permanently and, thus, destroying their effectiveness.

This story illustrates a very definite need for some revision in mask equipment to meet this particular condition and, also points up a similar need in the Chemical Industry where masks have to be used in high concentrations of gases from rubber solvents—which, although they attack the facepiece itself, more quickly affect the valves of the Gas Mask which swell and pucker or curl, so that they are open, permitting the man to breathe the harmful gases.

With these needs in mind, considerable experimental work has been carried out and the results which have been obtained from this development should be of real interest to every worker in the Rubber, Chemical and Petroleum Industries.

Many things have been tried in an endeavor to overcome the freezing (which seems to be the worst hazard), such as glycerin, tobacco juice, salt solutions, alcohols, and other means to lower the freezing point of the moisture of exhaled breath against the surface of the valve—but no real success was obtained by any of these methods. Several fellows have placed hoods over their heads, with a certain amount of success, as the radiation from the body and the heat from the exhaled breath was kept around the mask, thus maintaining a higher temperature and reducing the possibility of freezing. However, it has been a very cumbersome method and, in consequence, not considered practical. The idea, however, of giving protection from warm exhaled air is the crux of the method recently developed.

Many difficulties, however, presented themselves in working at the problem, such as making the equipment inconspicuous and of such a nature as to not change the general size or shape of the mask equipment, the necessity of maintaining a low resistance in order to maintain a low fatigue level when wearing mask equipment, the necessity of having it so flexible that the ice formed on the extreme exterior of the equipment could readily be broken and disposed of, and of such a nature that it could be applied to mask equipment already in use without the necessity of throwing away existing and, in many cases, perfectly good equipment.

Desirable results have definitely been achieved in the *Protectavalve* which takes the place of the regular Guard on the Acme #6 Full-Vision Facepiece. The Guard is made of Rubber or Neoprene, secured to the facepiece by a suitable clamp, and is designed so as to form a chamber in which exhaled breath is retained to warm the exterior of the exhalation valve, the same as the interior is warmed by the passage of the air at each exhalation period.

The outlet to the Protectovalve carries a secondary valve which acts like a "storm door" and provides a secondary closure against the flow of air back into the warming chamber and is of such a nature that it is effective even though partially open, which can occur due to the formation of ice on its exterior.

During a normal breathing cycle, air comes in through the central opening up into the facepiece and then is exhaled through the outward peripheral openings, past the primary valve and out into the warming chamber of the Protectavalve, itself. This movement of the warm exhaled air into the chamber, forces out residual breath, which has cooled during the intake period but which still maintains a temperature much higher than that of the outside atmosphere, due to the insulating effect of the rubber and the fact that there is no inward flow of air from the outside. The expulsion of air from the Protectavalve itself is through the secondary valve which actually, in extreme cases, has been frozen open, but its location and the size of the aperture remaining open is such that the warming chamber still maintains its normal function of prevention of freezing of the interior valve.

The action is exactly the same in the case of rubber solvent atmospheres, namely, that the previously so-called "warming chamber" then becomes an inert atmosphere chamber—inert, as far as any content of rubber solvent vapors is concerned—and thus gives complete protection to the primary valve.

Not only is the engineer interested in HOW a thing works, but he is also interested in tests which have been made on equipment to determine its effectiveness in doing the job for which it has been designed.

We felt that these tests were definitely necessary and so arranged with Northwestern University to use their large low-temperature room — which, by the way, is large enough to drive an automobile into, being 18'x22' with a 12' ceiling, and in which temperatures down to —72° have been maintained for continuous testing.

We felt it would be wise to test representative mask equipment manufactured today, including our own, and so started in at a temperature of —40° normal room temperature and —50° at the incoming louvres to the room. We choose to use the lower temperature because of the fact that mask equipment will be worn under most adverse conditions, which will include low temperatures and high wind velocities. Hence, we obtained a step ladder so that we could hold the exhalation valves of these masks definitely in the stream of air off the cooling coils as it passed through the entrance louvres. We endeavored to find the velocity of this air, but due to the fact that available anemometers slowed down to a complete stop in less than twenty seconds due to the low temperatures, we were unable to get an accurate value of velocity. We used strings, etc. to estimate the velocity and determined that they were somewhere in the order of twenty miles per hour.

The diagram shows that in many cases there was a point at which valves stuck (i.e. seemed to freeze closed during the inhalation cycle), but by increasing the "blowing out" pressure, the wearer was able to break this stuck valve and continue to test to the limit shown on the diagram.

Tests on Mask A were carried beyond the limits of normal operation in that during the maximum 17 minutes for which it was worn, the pressures within the facepiece had to be excessive in order to take care of exhaled air and during the last five minutes of the test, the greatest portion of the air actually was going out on the edges of the facepieces, rather than through the exhalation valves. Succeeding tests were not carried to this point, but to the point where the valve was very definitely either closed or open — which would be the point where the person wearing it under actual gas hazard conditions, would be compelled to retire from the area. You will notice that there is considerable variation in the "useful life" under these severe conditions of the various masks tested. The point where "sticking" is indicated is actually the length of the service life of the equipment under these severe temperatures. It was rather interesting to discover that the masks having the highest primary internal resistances, were the ones that showed difficulty the earliest in the tests—and the mask equipment showing the lowest primary internal resistance, gave the longest duration of tests. Probably a reason for this may be deduced from the fact that wherever the internal resistance was high, the valve would seem to be progressively difficult to open on each succeeding exhalation. This meant that the air, when it finally broke through the valve, would rush out rapidly and probably could not give up its heat to the exhalation valve as readily or as uniformly as in the case where the exhalation valve opened more readily at the start of each period of exhalation. The prolonged caressing of the valve by the warmed exhaled air, probably accounts for the increased length of time necessary to finally freeze the low resistance valve either open or closed.

It will also be noticed that the unprotected valves showed differences in reaction to the cold. Some of them definately set closed and others definitely froze open. In either case, a definite hazard was presented due to the fact that in the case of the closed valve, the man would become panicky and yank his mask off—whereas, in the case of the open valve, he would be breathing a toxic atmosphere on each inhalation.

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THE IMPACT OF APPLIED SCIENCE ON SOCIETY

By R. C. Swain, Vice President
American Cyanamid Co.

R. C. SWAIN

We in America are living in an age of unparalleled abundance of all material things. This is, to a great degree, the product of science and it is something that every scientific man and woman should be able to view with pride and satisfaction, both as to the result and its method of accomplishment.

Many nations in the past have enjoyed periods of relative prosperity, but these advantages frequently were obtained at the expense of weaker neighbors. Our growth has been internal and to a large extent catalyzed by the application of the physical sciences.

This country has had no monopoly on the development of pure science, which in its broad sense is the painstaking accumulation of knowledge by men who are intellectually curious. We have been outstanding in our capacity to apply this knowledge of scientific facts to the solution of industrial problems.

The early economic growth of our country was based primarily on the ready availability of raw materials which could be converted by simple processes into useful and salable commodities. We also had large areas of land which permitted the luxury of farming without having to pay much attention to the replenishment of basic soil constituents. When these soil constituents became seriously depleted and crop yields fell off, the simple solution was to move farther West to new ground.

However, by the turn of the century, we had almost run out of new geographical frontiers, and our rapidly increasing population was concentrating in the urban areas. Many of our giant industries were born during this period but in most cases they were overshadowed by their older and more technically competent European competitors. This was especially true of the chemical industry, which existed almost at the mercy of German imports in fields such as dyestuffs, pharmaceuticals, and important intermediates, until our supplies were suddenly cut off by World War I.

The old adage that "necessity is the mother of invention" might well have been coined for this situation, and the industrial and scientific momentum created by this need has never been lost. Our universities and colleges began turning out an ever-expanding number of well-trained scientists and technologists who were soon able to assist industry in satisfying most of our basic requirements. This team of industrial scientists went on to open up entirely new technological frontiers. Many new things were created, often starting as novel luxuries but soon becoming necessary to our expanded scale of living.

All of the natural and physical sciences have contributed to our present stature. Genetics and agronomy, combined with mechanization of the farm, have made it possible for only 12.8 per cent of our total labor force to supply all of our food requirements, whereas, in 1900, this figure was 37.5 per cent. In 1900 one farm worker produced only enough food for himself and 5 others, while last year his grandson supplied crops needed for his own use and 14 additional persons. This does not take into account the huge quantities of our farm surpluses which have been given to other nations in recent times of emergency.

Physics and engineering have given us such things as the airplane, automobile, radio, television, refrigerator, and air-conditioning. More important, perhaps, than the inventions of the things themselves has been the development of production methods and machines, extending back to prime raw materials. These new tools and techniques have made these products available to most of our people at prices they can afford to pay and in the improved quality which they have come to expect from year to year.

The growth of industries based on chemistry has been even more spectacular although perhaps with less public awareness because many of the products of the chemical industry do not reach the consumers as such. Chemists have transformed raw materials from mines, farms, oil wells and the very air we breathe to more useful things with impact on almost every aspect of our living. Today more than 20 per cent of our national product is chemically derived. Synthetic plastics, rubbers, fibers, finishes, pigments, dyes, fuels, detergents, insecticides, fertilizers, explosives, vitamins and drugs are some of the fields of chemical products comprising this large section of the country's total manufacture.

So great has been the development of new products that several of the leading chemical companies find that more than half their output today is on products which were unknown fifteen years ago. This has led to more abundant living for us all. But perhaps the most spectacular result of chemistry has been the revolution in medicine. More medical progress has been made in the last fifteen years than in all previous history. The death rates of most infectious diseases have been more than halved in that period through widespread use of the sulfa drugs and antibiotics. We have every reason to expect that this trend will continue, as there are probably more scientists working directly or indirectly in this field than in any other.

We are, therefore, rapidly approaching in our country the age-old goals of good health, and abundance of material things produced with a minimum of heavy manual labor, and the leisure time to enjoy them. Unfortunately, we are beginning to be aware of reasons why these goals require re-definition. For example, the decline of infectious diseases combined with a rapid increase in the number of automobiles now makes the latter a leading cause of death and disability, trailing only heart disease and cancer. There seems to be little choice between dying from pneumonia or from a traffic accident. And what about this leisure time that the wonders of science have given us—what do we do with it? We are learning that the profitable use of leisure is an art in itself and not something that comes automatically. The disturbing increase in mental illnesses largely based on social complications and frustrations may well be caused by too much rather than too little free time.

The real strength of applied science is its ability to solve material problems *after* the goals are defined. To this extent it might be termed a service division of our national economy. It also has some of the functions of a fire department as it stands ready to assist in smothering flames started by someone else's carelessness or ineptitude. Our present international situation is a case in point.

The growing threat of another world conflict has forced us again to channel many of our best scientific brains into strictly destructive efforts. Our inventive genius is being used to create more efficient atomic weapons, to develop more horrible forms of chemical and biological warfare, and to design more accurate and destructive guided missiles. All this is done at the expense of new knowledge of potential value to our civilization. Who can say whether some of these same scientists, if assigned to other pursuits, might not have discovered ways of combatting cancer, or relieving hypertension!

It is becoming evident that the physical sciences have progressed far more rapidly than their political, economic and social sisters. In fact, it can be questioned whether the average level of moral integrity and social responsibility has changed at all during the past fifty years. False doctrines and superstitions are still accepted without adequate challenge.

There is one false belief which, in the light of our scientific knowledge, should be as dead as the theory that the earth is flat. Scientists have conclusively demonstrated as laws of nature that perpetual motion is unattainable, as are other forms of obtaining something for nothing. Yet this tenaciously held belief, disguised in many forms, is as popular today as ever. At its best, it is wishful thinking—at its worst, the root of much of the evil in the world. It is the lure of gamblers and swindlers. Many politicians are corrupted by it and foster the belief that government can both spend more and tax less. The tactics of a few unscrupulous labor unions which limit output per man-hour while demanding ever higher pay is another of the almost infinite number of variations on the same theme.

We Americans probably are the most sports-minded nation on earth—we understand the meanings of teams and teamwork. And our national progress is dependent on the efforts made by all members of our team. If moral integrity and social responsibility commit errors in the field, the "heads up" play of science may well be dissipated.

Scientists are very often right in their conclusions because they accumulate and profit from facts. Those who are directly concerned with the other phases of our social system may do well to apply such methods to their own problems. If they follow the tried and proved tenets of science—intellectual honesty combined with education, and experience—they may well be on the way to achieving the balance between moral responsibility and scientific progress with which this forum is concerned.

But we will be only *on the way*, because all the efforts of our scientists, our educators, our men of government, our religious leaders, and many others, cannot hope to solve the problem. The solution must, and does, rest with the individual. It is he who must undergo a moral and spiritual revolution. When that is accomplished and we multiply him by the millions of others like him, then—and only then—will we come to the point where we may continue to advance together.

BOOK REVIEWS

THE CHEMISTRY OF HYDRAZINE. L. F. Audrieth and Betty Ackerson Ogg. John Wiley & Sons, Inc., New York, N. Y. 1951. 244 pages. $5.00.

Prior to World War II there was relatively little interest in hydrazine as an industrial chemical. As a result of recearch carried out during the war and in the years since then, this hydronitrogen has found many applications such as its use as a fuel for rockets and jet propulsion, as an explosive, as a photographic developer, as a reducing agent, and as a starting material in the manufacture of resins, coatings, adhesives, and plasticizers. This book, which grew out of a report compiled for the Office of Naval Research, is the first comprehensive treatise to be published on the preparation, physical and chemical characteristics, compounds, and uses of hydrazine.

OPTICAL CRYSTALLOGRAPHY. Ernest E. Wahlstrom. John Wiley & Sons, New York, N. Y. 1951. Second Edition. 247 pages. $4.50.

The First Edition of Professor Wahlstrom's text appeared in 1943. The book has been used to teach a large number of students the principles of optical crystallographic theory, and this teaching experience and the advice of colleagues have been employed as a basis for the complete revision of this text. Many sections were wholly rewritten and approximately 70 illustrations were redrawn. This latter improvement is most significant because three-dimensional drawings are more easily understood than the two-dimensional illustrations used in the earlier edition. These illustrations (line drawings, half-tone reproductions, and stipple-shaded diagrams) take up about 40 per cent of the book. An appendix describing the universal stage method for examining crystals has been added. While the practical aspects of the subject have not been emphasized, the mineralogist, petrographer, and chemist will find this book most helpful in grasping the fundamental concepts of optical crystallography, with particular reference to the immersion method of index measurement and the use of the polarizing microscope.

THERMODYNAMICS. George A. Hawkins. John Wiley & Sons, Inc. New York, N. Y. 1951. Second Edition. 563 pages. $6.50.

This text was intended to provide a well-balanced treatment of the subject of engineering thermodynamics for a two-semester undergraduate course. The First Edition appeared in 1946 and was quite successful. Experience in the use of the text indicated that its value could be enhanced by making a number of major revisions. This work has now been accomplished and it involved rewriting completely six chapters and changing certain significant parts of five others. References are included at the end of each chapter to encourage the student to broaden his viewpoint by collateral reading. All through the text the theoretical presentations are accompanied by simple practical problems to indicate to the student the applications of the subject in professional engineering work. This latter feature renders the text particularly useful for home study.

NEW YORK RESERVISTS

(Continued from page 50)

and could use and protect against in the event it is called upon to do so.

Other Reserve Units across the country might be interested to know that the special packet containing the training program and area maps as prepared by Captain John R. Bedford of Edgewood Headquarters, were rated superior by Colonel Harold W. Cooney, Chief of the O. R. C., New York Military District and Colonel Dale M. Hoagland, Senior Reserve Instructor for the First Army said he would recommend their use to other Branch Reserve Units as a guide in preparing their own weekend training programs.

Members of the Armed Forces Chemical Association will be interested to know that the idea and plans for the weekend training sessions at Edgewood had their origins in conversations held with General Charles E. Loucks at the 6th Annual Conference of the AFCA at Atlantic City in May 1951 and were concluded by General E. L. Bullene and Col. Cummings at the New York meeting in September. All of which goes to prove that the Association can be of vital assistance to members of both the Regular Military and Reserve Components.

RESEARCH & ENGINEERING COMPANY

(Continued from page 47)

the Edgewood Proving Ground or the Dugway Proving Ground. The results of those tests and of the experimental production which preceded them may require modification of the item and corresponding revision of the specifications and drawings for its procurement. The operations at Dugway are covered by an article on page 16.

The Edgewood Proving Ground is located at the Army Chemical Center and its principal function is to test Chemical Corps equipment when these tests can be safely conducted in a limited area and without danger to the nearby population centers.

The scientists and engineers of the Research and Engineering Command are engaged in a most important work. Preparation for the national defense in the field of chemical, biological and radiological warfare has attracted some of the best scientists in the country. Some are consultants and members of important advisory committees. Others participate directly in our program by means of research contracts. Others are on active duty as reserve officers. Still others are now civilian employees in the Office of the Commanding General and the several operating agencies of the Command.

The mission of the Research and Engineering Command makes it necessary not only to utilize scientific specialists but to be constantly on the alert for items developed by private industry which may prove valuable as military items after some modifications.

Whether the basic idea for a new CBR weapon or defense is conceived in a commercial laboratory, in one of the Chemical Corps laboratories or on a distant battlefront, the key role in its transformation to a concrete and useful end item for our troops in the field is played by the Chemical Research and Engineering Command.

NEW GAS MASK DEVELOPMENT

(Continued from page 52)

In placing the Protectavalve on the Acme Masks, the first two tests were made again at the temperatures of 50 and 62 degrees below zero in the air blast. The sticking of the valves in each case was caused by a snow shower coming from the canisters which were worn during the tests. There is a very low moisture content of the chemicals in these canisters, but this was definitely crystallized and broke through in readily visible and felt, snow particles, coming through with a rush at the inhalation period at the time indicated. In both cases, particles of snow lodged underneath the primary, as well as the secondary, valves.

When the snow shower came through, an immediate test for tightness of the mask was made and on determining that the valves were open, the Protectavalve was kneaded in an endeavor to break the crystals free from the valve surfaces which, in both cases, as indicated at "sticking" point on the curve, was effective, so that the time beyond thirty minutes. However, at that time, secondary showers of crystals came through the masks and as the valves could not be cleared this time, the tests were discontinued. The final test was made in the room and not in the incoming blast of air because of the fact that in temperatures below —50°, it is improbable that any great wind velocity will be encountered. This test was made under normal walking conditions, with a rather careful check of the build up of rime ice around the secondary valve at regular minute intervals. There was a continuous buildup of frost and rime ice around the exhalation openings for about twenty-three minutes, at which time there seemed to be no further buildup, indicating that a condition of equilibrium had been obtained. Apparently, the test could have been continued indefinitely under the 54.5°, with no wind, or very little wind—but since, at that temperature, considerable personal inconvenience was experienced by the wearer of the mask due to frost on the soles of the feet, it was thought advisable not to carry on the test any longer.

The types of valves tested were both the old Military-type flutter valve and the present Military-type round exhalation valve, as well as civilian production of somewhat similar and other types. The rubber of which the facepieces were made varied from partial synthetic to almost pure rubber and it was found that although the rubber hardened, it seemed to have a resiliency which made it possible to wear the equipment more readily and to test for tightness by kinking the hose much more satisfactorily than with other types of compounds.

At the temperatures under which these tests were made, very extreme differences in fogging of lenses, transmission of temperatures to the face (both by the rush of incoming air at each inhalation and by the conduction of the facepiece itself), and other factors of design, were more strongly apparent than under conditions of normal temperatures.

In conclusion, the need for protection to gas mask valves in very frigid temperatures and also against the ill effects of rubber solvent atmospheres, having been noted, an endeavor has been made to develop a protective device so as to insure safe use of mask equipment under the most severe conditions. The results have been highly satisfactory and recently the U. S. Bureau of Mines' approval has been given to this type of equipment.

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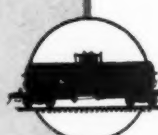

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