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CHEMICAL WARFARE BULLETIN

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CHEMICAL WARFARE BULLETIN

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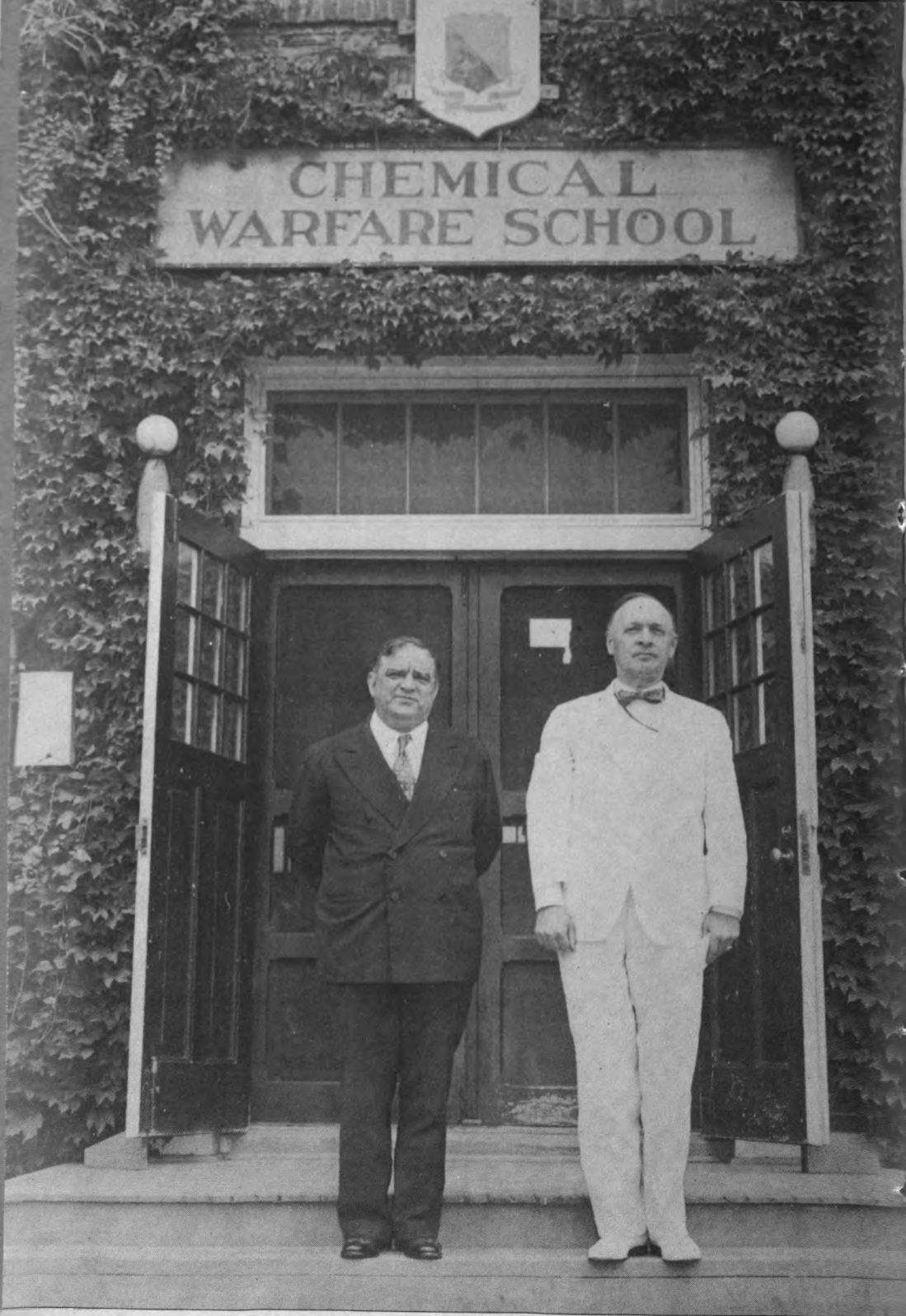
by
The Chief of Chemical Warfare Service

A review of developments in the
application of chemicals
to military effort.

REPRODUCTION PLANT
CHEMICAL WARFARE SCHOOL
EDGEWOOD ARSENAL, MARYLAND



Mayor Fiorello H. LaGuardia
Director Civilian Defense

Major General William N. Porter
Chief of the Chemical Warfare Service

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Views expressed in signed articles are those of the writers and should not be construed as official.

Original articles and discussions are welcomed.

Address all correspondence to "Editor, Chemical Warfare Bulletin, Edgewood Arsenal, Md."

Major General William N. Porter

TOTAL FIRE*

John A. West, Jr.

How many implements of destruction will be put to test on the proving grounds of World War II remains to be seen. The first year of the war produced magnetic mines, dive bombers, incendiary bombs, and many others. All have been destructive. Perhaps none has the potentialities of being so completely destructive and paralyzing as the incendiary bomb.

Incendiary bombs serve two major purposes. First, objectives are made visible to raiding planes, thus minimizing the effectiveness of blackouts. Second, sweeping conflagrations, more devastating than tons of explosives, may result from the fires that are kindled by such bombs. For although a single explosive bomb can result in a tremendous amount of damage, such damage is localized. Fire, on the other hand, is propagated readily and rapidly.

A single small incendiary bomb may result in the destruction of an entire city, particularly when the factors which tend for conflagrations are all working together as they usually are in times of war. Factors which contribute to the spread of fire and conflagration are numerous and include wooden shingle roofs, high wind velocities, lack of exposure protection, hot or dry weather, failure of water pressure, fracturing of water mains, and inadequacy of fire department.

The effectiveness of any type of bomb depends to a large extent upon the efficiency of the bombing plane. In World War I, the bomber was insufficiently developed to make mass raids possible. Now, the situation is changed. With nearly two years of World War II already behind us, bombing has been done on a large scale. The mere fact that the use of incendiary bombs is not only being continued but also accelerated, would seem to indicate that such bombing is effective. To substantiate that indication, are the numerous reports and pictures that reach us through strict censorship. Facts concerning the

Reprinted by courtesy of Quarterly of the National Fire Protection Association.

construction of such bombs, and the methods of protection against them, however, have filtered through very slowly.

All types of bombs are capable of setting fire to flammable materials. But explosive bombs are heavy. The number of such bombs that can be carried in the racks of the average bomber is not large, usually well under fifty. On the other hand, an incendiary bomb which has been developed and which weighs, in smaller sizes, only one kilogram or approximately 2.2 pounds, makes it possible for a single bomber to carry 2,000 bombs. This small incendiary bomb is called the electron bomb.

The one-kilogram electron bomb makes use of its thick-walled 80 percent magnesium shell to spread its fire. This shell is approximately 9 inches in length and 2 inches in diameter and contains within it several ounces of a thermite mixture. Unlike the thermite type incendiary bombs used during the last World War, however, this thermite serves only to ignite the magnesium shell; it is not the main incendiary material.

The thermite reaction within the shell is set off by an igniter on either the nose or tail of the shell. This igniter consists merely of a needle which is driven into a small percussion cap by the impact of the bomb.

Unlike other types of bombs, the electron bomb does not explode upon impact, but rather, the thermite reacts violently for nearly a minute at a temperature of about 2500 degrees C. (4532 degrees F.). Jets of flame emit from vent holes in the shell and bits of molten magnesium which are forced through these holes scatter in every direction for a distance of about fifty feet. This scattering of incendiary material ends when the thermite reaction has been completed and the pressure within the bomb has been decreased. However, the magnesium shell has been ignited by that time and will burn for 10 or 15 minutes at a temperature of approximately 1300 degrees C. (2372 degrees F.), setting fire to any combustible material within a radius of a few feet.

The number of these one-kilogram electron bombs that a single bombing plane can carry ranges all the way from 1,000 to 2,000. Assuming that only 15 percent of the average urban district is built over, the number of bombs out of 1,000 that would probably make direct hits upon buildings is only 150. Of this number, it is likely that half would either glance off the roof or fail to penetrate because of the construction of the roof. Of the 150 bombs striking a building then, perhaps not more than 75 would actually be capable of starting serious fires.

The area over which these 75 fires would be scattered would depend upon the speed and height at which the plane was flying and the distance covered while it was dropping its load of bombs. At 5,000 feet, flying 200 m.p.h. and dropping 20 electron bombs a second, the bomber would spend its cargo of 1,000

bombs while traveling only three miles, and set fires in every sixty yards approximately.

Although the power of penetration of the one-kilogram electron bomb is relatively poor, such a bomb will ordinarily penetrate an ordinary wood roof deck and covering material when dropped from a height which allows for maximum velocity upon impact. The possibilities of the bomb penetrating to lower floors,however, are not very great,and therefore, it is likely that when a fire occurs as a result of an incendiary bomb, it will do so in the attic floor of the building. And inasmuch as the attic is usually less accessible than the floors below, the fires which will occur there will be that much more difficult to extinguish. Tests have shown that a one-kilogram incendiary bomb will penetrate three-and-a-half to four inches of reinforced concrete, about six inches of sand or earth, or one-quarter inch of mild steel plate.

Owing to the lightness of the one-kilogram electron bomb and its awkward streamlining, any degree of accuracy in dropping it is impossible. The contents of a single container (ten or twenty bombs) dropped at the same instant from a height of 5,000 feet, for example, might disperse as they dropped and strike anywhere within an area of 10,000 sq. yards.

The use of the one-kilogram bomb is reserved for indiscriminate bombing only, while heavier bombs of similar construction are used when specific targets are sought,as for example, factories, supply bases, and munitions dumps. These other electron bombs range in weight from two to twenty-five kilograms, or from 4.5 to 55 pounds.

The electron bomb is undeniably one of the most if not the most efficient bomb that has ever been devised. For outside of its sheet iron tail and the mechanical igniting mechanism, it is constructed entirely of incendiary material. The heavier electron bomb sometimes has a steel nose to increase penetrating power and bombing accuracy.

Unless preventive measures are taken, the electron bomb once it has penetrated the roof of a building will burn its way through the flooring of the roof space within a relatively short time and spread fire on the floors below. The initial problem, then, is to find some suitable fire-resistive material with which to cover the flooring of the roof space. Tests have shown that some degree of protection is afforded by a two-inch layer of dry sand over some type of building paper to keep the sand from running through the cracks between the boards.

Because sand and other granular materials will be scattered by the impact of the bomb and because the heat and fire escaping from the vent holes of the bomb will eat passages through such granular materials to the flooring below, either some plaster or sheet material which does not have the objection-

able properties of granular materials is preferred. In addition to protecting the flooring of the roof space, the timbers and other combustible construction above should be protected by a coating of fire-resistive paint or plaster, for otherwise such material will surely be ignited by the intense heat of the bomb.

The electron bomb can be extinguished in any one of several ways, and of course, the idea is to extinguish it or bring it under control before it has been the beginnings of a major fire. While the thermite reaction is in progress, the bomb cannot be smothered because the oxygen that enters into the reaction comes not from the outside atmosphere, but from the iron oxide. When the thermite reaction has been completed, however, and the magnesium shell is burning, the bomb is dependent upon the outside atmosphere for its oxygen and can be smothered.

Although water accelerates the burning of magnesium, the acceleration cuts the burning time of from 10 to 15 minutes down to two or three minutes. Therefore, water can be used to combat the bomb if properly used. The reaction between the hot magnesium produces the hydroxide of magnesium and free hydrogen. The latter ignites and will burn without any real damage so long as the water is applied sparingly. If, however, water is put on too fast, the hydrogen may accumulate faster than it can burn, and explode violently.

To prevent an explosion and to keep the bomb under control at the same time,a jet surrounded by a spray of water has been found most satisfactory. To produce this jet and spray, a one-eighth-inch nozzle supplied by hose from a bucket hand pump at least 30 feet away is also recommended. The delivery from this system should be not more than one and three-quarters gallons a minute. The main jet of water should be played into the seat of the fire and not indiscriminately into the smoke and flames. The spray serves to wet down the area surrounding the bomb and thus prevents the spread of fire.

Since the water will cause scattering of bits of burning magnesium, it is best that the person directing the water stream use extreme caution while doing so and that he neither stand up nor exert himself physically. Although two persons can manage the work, three persons should be on hand, two at the pump and one at the nozzle. Water should never be poured onto an electron bomb from a pail or bucket. A common garden hose would probably serve the purpose if the water supply could be depended upon.

Sand and other granular materials, such as slag, pumice, ash and kaolin can be used effectively to bring the electron bomb under control, but such materials will not extinguish the bomb. The bomb should be thoroughly covered with the material until the glare and heat have been reduced, and it is possible

to coop up both covering material and bomb and remove the whole into the open where the bomb can burn itself out without any great danger.

To remove the bomb in this manner, certain apparatus is required. The granular material should be poured over the bomb from a long handled scoop shovel, and when the heat and glare of the bomb have been reduced sufficiently, the shovel should be used again to pick up the bomb and its covering. Granular material and bomb should then be placed in a suitable container filled with sand for transportation from the building. Once the bomb has been removed, any resulting fires can be extinguished by ordinary methods.

Numerous other materials and compositions have been discovered which can be used to combat the electron bomb and probably others will continue to be discovered as the use of the bomb increases. Those discovered so far are either inferior to water and sand, or are materials which are extremely expensive or difficult to store. Of the various types of chemical extinguishers, only those of water solution type would be effective against the electron bomb, and probably more than one extinguisher would be required. The solution should be played upon the bomb in the same way as water from a hand-pump or hose.

Still another method that has been used to extinguish the incendiary bomb makes use of a "snuffer". This device is a large cup-shaped instrument which, when placed over the bomb, smothers it. The time required to complete the operation is said to be about 30 seconds. Although the heavy electron bombs are more difficult to combat than those of the one-kilogram type, these fires can be extinguished by the same methods.

Another type of bomb that has been used to a considerable extent during the present war is called a multiple-effect bomb and is employed against specific and important targets. The bomb contains numerous separate incendiary units of either magnesium or phosphorus which are thrown from the bomb upon impact and ignition, and which scatter over a wide area. Such bombs usually have pointed steel noses instead of flat noses such as are used on the one-kilogram electron bomb, and thus have great powers of penetration. The burning magnesium units can be handled in the same manner as the electron bomb. The phosphorus can be treated with water also, but should be removed to a safe place before being allowed to dry. Phosphorus ignites upon coming in contact with air. In addition, phosphorus is extremely poisonous and produces burns which are difficult to heal. Multiple-effect bombs weigh approximately 12 kilograms.

Phosphorus, already mentioned in connection with the multiple-effect bomb, is rather ineffective as an incendiary agent because of its cool flame and slow burning properties. It has

also been used in another type of fire weapon of the present war. This weapon is a moist card which is small enough to fit into the palm of the hand. In the center of these cards is a mixture of guncotton and phosphorus. When the cards become dry, they burst into flame. Thousands of these cards can be carried by a single raiding plane and dropped indiscriminately from considerable heights.

To extinguish incendiary bombs and the fires which result from the use of incendiary bombs, the belligerent nations have found it necessary to make a number of changes in their fire department organization.

To combat the large number of fires which would ordinarily occur when enemy planes drop as many as 2,000 incendiary bombs each, the home defense in Great Britain has found it necessary to augment the firefighting forces by organizing an auxiliary fire service. The members of this auxiliary service have been given specialized training in extinguishing incendiary bombs and in fighting the resulting fires.

In most countries of the continent, the firefighting forces are a division of the regular armed forces. This is true in both Germany and Italy. Although it is known that numerous precautions have been taken to fight fires which result from incendiary bombing, just what precautions have been taken and with what result to peace-time organization of the firefighting forces, is relatively unknown outside of these countries.

* * * * *

Officers following a course of instruction must be amply trained to act by themselves, in order to develop their ability to utilize their theoretical knowledge in the practice of life . . . .To grasp a scientific truth does not mean that one is able to find it again later on by means of reasoning. There is a long distance between an intellectual conception and that priceless faculty which allows a man to make acquired military knowledge the basis for his decisions in the field . . . . .

- de Peucker

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AS CHEMICAL WARFARE CHIEFTAIN*

Col. Edward B. Clark, USA

In the spring of 1917, immediately after the United States had declared that a state of war existed with Germany, Brigadier General William L. Sibert was promoted to the rank of Major General in the Regular Army and was ordered to the East to take command of the First Division of American troops designated for overseas service. Sibert sailed with his division for France in June, 1917, and he remained in command of it throughout virtually the entire time of its training. He was with it when its members shed the first American blood on the field of France.

Just before sailing for France, General Sibert was married to Miss Juliette Roberts, of Pittsburgh. She died after a short illness in September, 1918, during the flu epidemic.

General Sibert had a service flag with six stars upon its field. Five sons went with him into the war: Lieutenant Colonel Franklin C. Sibert, Infantry; Major William O. Sibert, Chemical Warfare Service; Major Harold W. Sibert, Corps of Engineers; Lieutenant Edwin L. Sibert, Field Artillery; and Corporal Martin D. Sibert, Infantry.

It became evident in the early days of American participation in the war that chemicals were to hold a chief place as weapons of offense. The chemical field was a scientific one. The need of speed of supply and transport was pressing. Notwithstanding the fact that the first gas attack in the World War, made by the Germans against the Canadians at Ypres, occurred early in 1915, about two years before the United States entered the conflict, nothing had been done in this country in the way of preparation of chemical warfare.

General Sibert was ordered from France to the United States and shortly after his return was charged with the duty of organizing the Chemical Warfare Service.

When the First Division sailed for France in June of the first year of the war, no gas masks of American make were

**Chapter XVIII, from the book "William L. Sibert".*

available for its use. It was necessary to call on the French for a supply. Not long after the Division landed 25,000 "provisional" masks were sent to France; these, however, never were used. French masks were supplied continually to the Americans until the day came when suitable ones could be made in the home country. The order for the first 25,000 American masks was given on May 15th, 1915, about a month before the sailing of the First Division. It is to the credit probably of American ingenuity that any type of gas mask could be designed,made and forwarded for use within the space of a month. These masks, however, were crude and not entirely serviceable.

From the day the World War started until June, 1918, more than a year after the United States entered the war, no organization existed in this country that covered the entire field of the Chemical Warfare. The research and experimental work had been carried on by the Bureau of Mines, largely at the American University Experiment Station in Washington; the task of furnishing toxic gases, material for smoke screens and incendiary bombs had been assigned to the Ordnance Department; the manufacture of gas masks had been undertaken by the Medical Department; the Chemical Warfare troops were organized as an Engineer Regiment and were sent to France as a component part of the Engineer troops. There was no coordination. Each agency was working independently.

The War Department was alive to the futility of the existing disarrangement. None of the agencies connected with gas service with the exception of the chemical warfare troops and the Ordnance Department had any understanding of the military value of the work that they were doing. The condition verged on the chaotic. The Secretary of War and his advisers knew that something must be done and done quickly. The needs in the case caused the creation of a distinct service into which were brought all the elements entering into chemical warfare, its offensive, its defensive, and its medical features. On May 11, 1918,General Sibert was assigned to the task of unifying the various working branches and was given full charge of all the different elements. He received the title of Director, Chemical Warfare Service.

The duties which Sibert performed as Chief of the Chemical Warfare Service in time of war afterward became those of the officer who succeeded him in time of peace. In the Army Reorganization Act of June 4, 1920, these duties were set forth as follows:

> "The Chief of the Chemical Warfare Service under the authority of the Secretary of War shall be charged with the investigation, development, manufacture, or procurement and supply to the Army of all smoke and incendiary materials, all toxic gases, and all gas-defense appliances;the research, design, and experimentation connect-

ed with chemical warfare and its material; and chemical projectile filling plants and proving grounds;the supervision of the training of the Army in chemical warfare, both offensive and defensive, including the necessary schools of instruction; the organization, equipment, training, and operation of special gas troops and such other duties as the President may from time to time prescribe."

From a book called *Chemical Warfare*, published by McGraw-Hill Book Company,Inc., New York, and written by Amos A. Fries and Clarence J. West, this is said of the service of General Sibert as the first Chief of the unified service:

"In order to improve these conditions (lack of coordination) Major General Wm. L. Sibert, a distinguished Engineer Officer who built the Gatun Locks and Dam of the Panama Canal and who had commanded the First Division in France, was appointed Director of the Chemical Warfare Service on May 11, 1918. . . .

"General Sibert brought with him not only an extended experience in organizing and conducting big business, but a strong sympathy for the work and an appreciation of the problem that the American Army was facing in France. He very quickly welded the great organization of the Chemical Warfare Service into a whole, and saw to it that each department not only carried its own duties but cooperated with the others in carrying out the larger program, which, had the war continued, would have beaten the German at his own game."

Major General Amos A. Fries, from whose book this quotation is taken, was the Chief of the Chemical Warfare Service in the American Expeditionary Forces. After the war he succeeded General Sibert as Chief. Clarence J. West was a Major in the Chemical Warfare Service and a member of the national Research Council.

There was a thorough appreciation by the military authorities that the United States absolutely was unprepared, insofar as chemical industries were concerned, to prosecute successfully a modern war. Sibert knew this before he undertook the task of making effective that which not only was ineffective but which lacked the means of generating efficiency. The country was unable to meet its own peace demands for chemical products.

It became necessary, in order to meet the situation, to quadruple the chlorine supply of the country and to increase the supply of phosphorus to a point ten times greater than that necessary in peace time. It soon became evident to Sibert that the use of lethal gas in the conflict had created a demand on chemical ingenuity and chemical resources that was virtually insatiable. Before the war Germany had control of

the world's market in coal tar products, particularly in dyestuffs. The products and by-products of the plants producing these materials are necessary to the making of high explosives, gases, and fertilizers.

The lack of a supply of proper materials in the United States put a burden upon the Chemical Warfare Service greater than that borne by any other war activity. It met it, General Sibert has said, largely through the ability and ingenuity of its chemists and chemical engineers "all of whom flocked to the colors and gave a service which the country never should forget."

On Armistice Day there were being produced in the United States more of the lethal gases than in England, Germany and France combined. In addition to this a new gas more deadly than any in existence was discovered and had reached the stage of volume production when the day of peace came.

The General Order providing for the Chemical Warfare Service authorized the following organization:

Director	Maj. Gen. Wm. L. Sibert
Administration	Brig. Gen. H.C. Newcomer
Overseas	Brig. Gen. Amos A. Fries
First Gas Regiment	Col. E.J. Atkisson
Research Division	Col. G.A. Burrell
Development Division	Col. F.M. Dorsey
Gas Offense Division	Col. Wm. H. Walker
Gas Defense Division	Col. Bradley Dewey
Proving Division	Lt. Col. W.S. Bacon

The personnel authorized consisted of 4,066 commissioned officers and 44,615 enlisted men. Provision was made for three gas regiments of eighteen companies each. The Service, however, never reached its full strength because the Armistice put a stop to further enlistments and the granting of further commissions.

In the popular mind the use of gas in warfare is inhumane, and one of the first questions to be discussed in the United States after the Armistice was whether or not the Chemical Warfare Service should be continued as a permanent branch of the Army. Coincidently with an attempt of the Military Affairs Committee of Congress to find an answer to this question, General Sibert made a public statement on the subject, which essentially is as follows:

"While the use of toxic gases was one of the instruments of warfare it was responsible for from twenty-five to thirty percent of our Army casualties. This shows it to have been one of the most effective weapons of war. In view of this no argument for its retention for offensive purposes is needed.

"The records show also that when the armies were provided with masks and other defensive appliances, something less than four percent of the gas casualties were fatal. These fig-

ures,I think, meet one of the chief objections brought against the use of gas -- that of inhumanity. So far from being inhumane, it has been proved that it is one of the most humane instruments of warfare, if we can apply the word humane to the killing and wounding of human beings which, of course are the objects and aims of war.

"Of the casualties which resulted in death, far fewer were caused by gas than by bullets, and of the remainder of the gas casualties the greater number were left without permanent injury. This, I think, helps further to prove that the argument that gas as compared with other of war's weapons is inhumane, is not sound.

"Another objection that has been made to the use of gas is that it is likely to cause casualties among non-combatants, populations behind the lines. It is true that gas does drift with the wind for considerable distances and in the future use of it this would mean simply that greater areas must be given over for battle purposes. Anything that makes an enemy yield more territory for war purposes takes just that much from agriculture, or it may be from manufactures. Additional sacrifice of territory for war uses is therefore another element of the weapon's effectiveness. It will be necessary, of course, to remove the non-combatant population from a greater depth of territory immediately in the rear of the fighting forces than formerly was the case. This effectively will prevent the gassing of women and children and of non-combatants generally.

"Surprise is one of the main elements sought for in warfare. There is no weapon that contains greater possibilities for surprise than gas. A single substance, the nature of which had been kept secret, might determine the tide of battle --- something that would penetrate gas masks would make an enemy as helpless as the English were at Ypres when the Germans sent over their first cloud of chlorine."

When General Sibert was asked if he thought that gas would be used in future wars, he said:

"Based on its effectiveness and humaneness, it certainly will be an important element in any future war unless the use of it should be prohibited by international agreement. As to the probability of such action, I cannot venture an opinion.

"The United States, singularly enough, did not join the leading world powers in signing the agreement entered into at The Hague Conference of 1899 to refrain from the use of projectiles whose only object was to give out suffocating or poisonous gases. German representatives signed the agreement and their Government ratified it in September, 1900. The United States, as has been said, took no action. The declaration was not binding in case of war in which a non-signatory power was a belligerent."

Seemingly the tales of the destructiveness of gas as a wea-

pon of warfare have led people generally to believe that it is not only the most deadly of all weapons but that it causes more suffering when its effects are not fatal than wounds from bullets or high explosives. Officers who served in the Medical Corps in the field during the great war have testified that ten times as many men die from missile wounds as from gas wounds. A national organization of former Army surgeons has gone on record as favoring the retention of gas in warfare because it is the most humane weapon in the use of the armies.

There are lethal gases and non-lethal gases. The tear gas is used by police of many American cities to put an end to riots and to capture barricaded and armed criminals. The more ignorant a class of people is the more likely it is to lose self-control and to be thrown into a panic by gas, with its elements of mystery. It is hard for leaders of a mob to maintain anything like order in the ranks if there is a suspicion of gas in the air.

Concerning this matter of the panicky feeling so easily produced by the "mystery of gas", General Sibert tells the following story:

"No gas was made at the big Army plant at Edgewood, Maryland, until all the buildings were up and all the machinery installed, but such a veil of secrecy was thrown over the operations that the civilian laborers employed believed that chlorine, phosgene, mustard and all the other poisonous things had been generated in large quantities. They were constantly on the alert to escape the sudden death that might be their fate in case some kind of leak occurred.

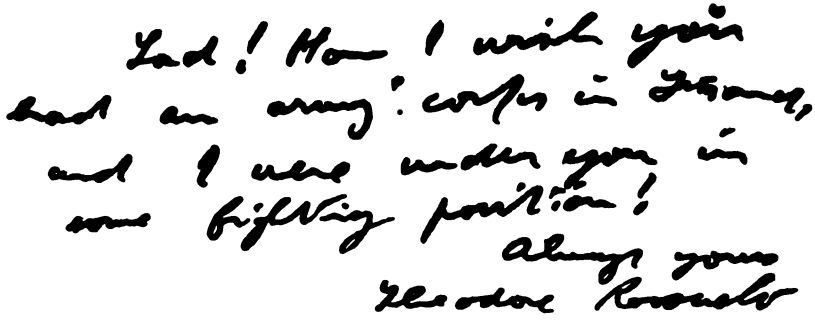
"One day one of the employed chemists who had a small amount of chlorine in his possession threw it over some raw lime. A workman near by detected the odor and yelled, 'The gas is loose!' He started down the road screaming warnings as he went. The drivers of several horse-drawn trucks turned their teams and lashed them into flight. The drivers yelled and the running horses raised clouds of dust. There were hundreds of employees and others in the immediate vicinity. The dust cloud was taken for a gas cloud and there was a wild stampede.

"A man in a Pennsylvania Railroad watchtower, catching the panic, stopped traffic on the road for forty-five minutes in order not to kill the fleeing mob that was crossing the railroad tracks. An officer on duty who was caught in the full tide of the stampede was seized with symptoms of gas poisoning. He fell down and almost instantly gave every sign of illness of the various types that he had been studying in a printed pamphlet, including violent seasickness. Fear sometimes does queer things to a man.

"The panic in a more or less acute form involved about three thousand persons. They all saw gas, smelled gas, and

were affected by gas, but there was no gas to see, to smell, or to affect. Imagination did the whole thing. After this stampede of three thousand civilians it was impracticable to employ them in this plant and the officer in charge at Edgewood was forced to call for soldiers to complete the work."

In early September, 1918, just two months to a day before the war ended, former President Theodore Roosevelt wrote a long letter to General Sibert touching on a Chemical Warfare subject. The last paragraph in the letter was this:



The Chemical Warfare Service exists today. It is a separate branch of the Army and is commanded by a Major General. It has thus far survived all the attempts of the pacifists and of those who have misunderstood its mission in war, to destroy it, and today it is a healthy institution. The Service has proved its value to the civil life of the country. Gas under its direction is now used to destroy insect pests and to support the arm of the authorities in enforcing the laws. It is now generally understood by the masses that it is better to meet gas than high explosives on the field of battle.

General Sibert was awarded by the United States Government the Distinguished Service Medal for the part that he played in the World War. He was also appointed by the French Government, Commander in the Legion of Honor, Napoleon's Legion.

TRAINING AIDS

First Lt. C. V. Burke, CWS

For effective training the instructor should have on hand materials for use as training aids which will help him to get across the instruction he desires. To those giving instruction in defense against chemical warfare, usually there are available certain standard training materials, film strips, and texts. Other effective materials may be used to round out this instruction and in certain cases to substitute for standard items not available.

Standard Training Materials

This class of material is listed in Table of Basic Allowances for the Chemical Warfare Service. At present, the following are standard.

Set of 16 colored drawings, chemical warfare materiel.

Set, gas identification, *instructional*, MI.

Set, gas identification, *detonation*, MI.

Set, instructional chemical warfare. (This set consists of various sectionalized materiel and 66 lantern slides.)

Expedients
(Substitute materials)

In carrying out training in chemical warfare, as in other types of training, it is frequently necessary to improvise and to simulate. Following are suggestions that may be used in those cases where real or standard items are not available.

Mustard gas (HS) may be simulated on the ground by the use of old crankcase oil. The color and oily consistency are reasonably like true mustard, and the pattern on the ground and vegetation is clear.

If it is desired to impart an odor to the used oil to make the area more clearly defined, butyric acid may be used. In the case of one division now in training *ammonium valerate* was used. These substitutes may be obtained commercially at little cost.

To show the action of bleach on liquid mustard, and the ne-

cessity for mixing the bleach with sand, ordinary Prestone (ethyleneglycol) may be used. If the unmixed bleach is thrown on the Prestone a flash of flame similar to that occurring with HS is produced. When the bleach is properly mixed with dirt or sand no such action results.

Should it ever be necessary to carry out a gas chamber exercise without an adequate supply of CN, it is possible to obtain the same results by burning a little sulfur in the chamber. A small handful of sulfur will generate enough sulfur dioxide for the average chamber 15 or 20 feet square. The gas has a very pronounced odor and gives a choking sensation when breathed and in addition is a mild lacrimator. There is no danger from its use *in small quantities*. A little formaldehyde or oil of wintergreen, if vaporized, may also be used.

It is desirable to have a standard type gas chamber. However, it is not absolutely necessary that such a building be available to carry out effective gas chamber instruction.

In the field, when tactical exercises are being held, chemicals may be injected into the problem when their use is tactically sound. Persistent gases may be shown by use of the standard simulated agents, AS or MR, or by the use of old oil as above. Nonpersistent gases are indicated by means of tear gas or other harmless substance. The CN may be laid down in a semipermanent manner ahead of the advancing troops by dissolving in benzine and then spraying it on the area, or by the use of CNB which is a standard training agent. The advancing troops come on the area suddenly and without warning--a warning which they would get if opposing team members were seen tossing CN grenades over the ground. Should no CN be available, 5-gallon cans may be used as generators by knocking two or three holes in the sides near the bottom for purpose of creating a draft and by lacing wires across the can about one-third of the way from the bottom to form a grate. By building a wood fire on the grate, and then by feeding sulfur to it at the rate of about one pound per minute, a good concentration of gas may be set up. To cover an area a batter of these must be used.

In the classroom it is highly desirable to have a blackboard. In garrison, regular blackboards are scarce. These may be substituted very well by painting plywood (or beaver board) with a regular prepared blackboard paint or slating which costs about fifty cents per can. If the above cannot be had, it is usually possible to secure wide, heavy brown wrapping paper such as is used in hardware stores. Cut in lengths about six feet long and if four or five sheets are nailed to a wall, one has a very excellent blackboard which may be written on with ordinary wax crayon or marking crayon.

Charts are always desirable. These can be quickly made on wrapping paper mentioned above. Even free-hand printing, how-

ever unskilled it may be, is better than no chart at all. The point here is to print in *large* letters, and to make lines *thick*.

Publications and Texts

It is to be remembered that all training must be *based* on official publications. Generally these are Field Manuals, Technical Manuals, and Field Service Regulations. Others may be Technical Regulations, Training Regulations, Training Manuals, Circulars, and so forth. Related information, or a more exhaustive study of the principles laid down in the above may be found in service school texts, pamphlets, service journals, and similar publications.

Field Manual 21-6, List of Publications for Training, should be at hand at all times, and an effort must be made to keep up with its changes. This manual, listing all publications and films, is basic for instructors.

At this time chemical-warfare publications applicable to general training in defense against chemical attack are as follows:

FM 21-40, Defense Against Chemical Attack.
FM 3-5, Vol. I, Tactics and Technique, Chemical Warfare Service.
TM 3-305, Use of Smokes and Lacrimators in Training.
TM 3-240, Meteorology.
TM 3-215, Military Chemistry.

There are two motion picture films available, one sound and one silent. Others are being made now and will be released soon.

TF 3-2, Defense Against Chemical Warfare (16-mm. and 35-mm., silent).
TF 3-10, Tactical Employment of Chemical Troops in an Attack (16-mm. and 35-mm., sound).

Film strips now available are:

FS 3-1, Defense Against Chemical Warfare; Chemical Agents; and First Aid.
FS 3-2, Effects of Weather, Terrain, Weapons and Tactics.
FS 3-3, Protection and Protective Equipment.
FS 3-4, Nomenclature and Air Flow System of the Service Gas Mask.
FS 3-5, Nomenclature and Air Flow System of Training Gas Mask.

Conclusion

No training, however excellent the working materials, will be totally effective unless properly presented. In the field of instruction the details, small in themselves, are the important units on which successful training is built. Pay attention to them at all times. Never slight them. A period so

arranged that its physical facilities and training aids are excellent may be ruined by so small a thing as a voice too low or too rapid.

* * * * *

The attack upon the world and the threat to our nation come from armies which have had seven years of able, efficient, and tireless preparation. They are guided by methods which are as shrewd as they are ruthless. They are veterans trained by actual and successful combat in many and varied theatres of action. Not only that, but their young soldiers have been by false teaching inculcated with a spirit of fanaticism which makes them willing to sacrifice their all in a cause which we know to be evil. Such men and such armies cannot be successfully resisted without equal intelligence, equal effort, and superior devotion.

- Honorable Henry L. Stimson

* * * * *

Gas mask drill:
Nurses training in gas defense, Camp Lee, Va.

CN Chamber

FIRES FROM INCENDIARY BOMBS

Major Carl E. Otto, CW-Res

Just as a cigarette butt flicked from the window of a passing car may start a forest fire destroying thousands of acres, a single incendiary bomb weighing no more than a couple of pounds may initiate a fire that will destroy block after block of buildings. The damage caused by an incendiary bomb depends upon the nature of the material upon which it falls and the time which elapses before firefighting begins.

The use of incendiaries in battle is not a recent innovation. Our own colonial pioneers were frequently menaced by the flaming arrows of hostile Indians and by fires built against the exterior of their log dwellings. Tubs of water were always kept ready for extinguishing these fires and blockhouses were built with overhanging second stories in order that fires at the bases of the exterior walls could be taken care of without the defenders exposing themselves. A hundred years ago red hot shot were fired through the sails and onto the decks of wooden ships in the hope of starting fires and blowing up the powder supplies. The Greeks catapulted lumps of burning sulfur over the walls and onto the roofs of the cities they were attacking for the purpose of setting them afire and thus originated the term "Greek fire". Incidentally, they also gave the defenders a gas attack from the sulfur dioxide evolved. The only novelties in the present situation are the materials used and the means of putting them on the target.

Incendiary bombs may be classified in two general types --- (1) intensive and (2) scatter. The intensive type strikes and burns in one spot. The heat evolved by the combustion of the material in the bomb is concentrated and is capable of igniting material which is relatively hard to ignite or of penetrating thin layers of noncombustible material such as a tin roof, to ignite combustible material beneath it. The scatter type contains a small bursting charge which detonates upon impact throwing fragments of burning material in all directions. The heat furnished by the bomb material is thus divided among

the various spots where the fragments fall and only the more readily combustible materials are ignited. There are,however, more chances of starting fires, for the impact may have been in an area containing no combustible material. An innovation in scatter type incendiaries is the so-called incendiary leaves or calling cards which have been reported used in Europe. These are loosed from their bulk container shortly after it drops from the plane and flutter in all directions. They are so constructed that they become spontaneously inflammable after some time and are then capable of igniting very readily combustible materials. Their light weight permits thousands to be carried on a single plane and when conditions are right they may start innumerable fires.

Cursory observation shows that the percentage of combustible roofs and their degree of combustibility varies in different localities. In countries where thatch roofs predominate the calling cards would be very effective. A thousand would weigh no more than one medium sized intensive bomb and yet would be capable of starting one thousand fires instead of one. Similar damage could be done to ripe grain fields or dry forests. No single fire would be difficult to extinguish if attended to promptly, but the enormous number of them would make the job an almost unending one. Noninflammable roof surfaces like tile, slate, tin,etc. would probably not be affected by them. To be effective on such roofs a bomb must penetrate to the combustible parts of the building. Penetration will depend upon the weight of the bomb, the height from which it is dropped and the strength of the roof. Bombing from high altitudes is largely a hit or miss proposition, especially at night, and the percentage of effective hits in an area is practically proportional to the ground area covered by buildings. For this reason aviators intent only on setting fire to buildings will aim at the more closely built-up urban rather than the suburban areas in order to obtain a greater number of hits. Also slum districts of poorly constructed combustible houses will be more favored targets than those of the better constructed fireproof structures. A combination of high explosive (for opening up) and incendiary bombs (for ignition) would be expected on areas containing gasoline and oil storage tanks.

The combustible materials of the bombs may be (1) white phosphorus, which is spontaneously inflammable when exposed to the air; (2) combustible oils like gasoline or fuel oil, which require both air and separate ignition; (3) mixtures like thermite, which after ignition evolve tremendous heat even in the absence of air; and (4) active metals like magnesium,which have a very high heat of combustion. When burning these may be distinguished by certain characteristics. White phosphorus evolves large quantities of white smoke and burns with a pale

yellowish flame. Oils evolve a more or less sooty smoke and, unless highly gelatinized, spread over the surface and drip through cracks and holes. Thermite burns with little flame or smoke, glows at red heat and is capable of burning through thin metal surfaces. Magnesium burns with a brilliant white light giving off a fair amount of white smoke.

Burning white phosphorus is easily extinguished with water, but reignites as soon as it is dry. When recognized it may be better to allow it to burn itself out than to have it start a fire later when unwatched. While this is occurring the spread of the fire should be controlled with water. White phosphorus may be removed to a safe place by being transferred with a shovel to a bucket containing water.

Municipal firemen are familiar with the problem of fighting oil fires. Fires from oil bearing incendiary bombs are no different from those to which they are accustomed, except that the active metal sodium may be in the bomb to react with any water thrown on it and reignite the oil. The presence of this substance may be recognized by a hissing and boiling action as hydrogen gas is evolved by the reaction of sodium with water. With an abundance of water on only small pieces of sodium, reignition may not occur, but with a limited amount of water it will probably ignite and burn with a bright yellow flame. Foamite is better than water in fighting industrial oil fires, but the advantage which it has over water in such cases is largely lost when dealing with incendiary oil bombs because the amount of oil involved is relatively small.

Putting water on hot thermite is like putting it on a hot stove. It sputters and spatters around. However,with a spray of water a person is able to chill the bomb and control the spread of the fire. Covering with sand will decrease the radiated heat, but naturally the heat thus held in will have a greater charring effect on the floor where the bomb lays. If sand is used, a long handled implement should be employed to work sand in under the bomb and prevent its possible dropping through to the space under the floor or to the floor below.

Magnesium, being an active metal, when hot, reacts not only with the oxygen, and with less vigor the nitrogen, of the air, but also reacts vigorously with water. Hence putting water on burning magnesium will increase the intensity of the flame and there is great danger of spattering molten metal. Throwing any volume of water on a magnesium bomb from too near at hand should be avoided as the operator is then close enough to be badly burned by the scattered metal. The best extinguishing agent to use is a fine *spray* of water. Although this accelerates the burning of the bomb, the spread of the flames can be controlled and there is not sufficient water localized on the hot magnesium to cause the explosive spattering of the metal. As with thermite bombs, dry sand may be used.

Commercial fire extinguishers of the soda acid type may be used on incendiary bomb fires. Their portability and the ease of getting water under pressure at any place are to their advantage, but their small capacity limits their usefulness to the fires caused by small bombs of two pounds or less and these only when firefighting starts promptly. Volume for volume the liquid in them is only about as effective as water on burning wood and the greater cost may offset their advantages. Due to the fact that the carbon dioxide evolved on heating promotes rather than retards the combustion of magnesium they probably are not so useful on magnesium as they are on wood.

Liquid carbon dioxide extinguishers increase the rate of burning of magnesium bombs, while smothering the combustion of common combustible substances. Carbon and possibly carbon monoxide are reaction products. The question of relative costs and availability of refills when many fires are expected should be considered in providing this type of extinguisher for fighting incendiary fires.

When carbon tetrachloride is thrown on burning magnesium, phosgene, a gas which was a great casualty producer in the World War is generated. Hence, extinguishers using this substance should not be employed.

In dealing with incendiary bombs foreign experience indicates that the city fire departments cannot take care of all the possible fires, especially if the discovery of the fires is left more or less to chance as at present. Extinguishing the greater number of fires is beyond the capability of the regular city firemen. Every endeavor is made to prevent the growth of little fires into big ones. Just as it is easy to extinguish a match or cigarette butt by stepping on it, but very difficult to extinguish the roaring infernos that they may cause, so does the quickness with which work is started on an incendiary bomb, facilitate its extinguishing and minimize the destruction it may produce. England now requires that the roofs of all buildings, particularly commercial buildings vacant at night, be kept under surveillance. The watchers of the buildings are provided with portable firefighting equipment to deal with small bombs and incipient fires. No dependence can be placed on pressure in the municipal water system for bombs may break the mains, or the pumpers of the fire department may reduce the water available at domestic outlets to negligible amounts. Arrangements are made for these watchers to call helpers from the bomb proof shelters. The fire department is called on to deal with the fires beyond the control of the local fire wardens.

It may be possible that a mechanical contrivance, such as a net stretched over a roof which will ring a bell when the net is struck, may be devised to take the place of the watchers.

For the safety of the city the device would have to operate without fail and firefighters would have to be ready to move at its signal. The warning carved in stone at the entrance of the Archives Building in Washington, "Eternal Vigilance is the Price of Liberty", may be applied to such a situation with the greatest exactitude.

* * * * *

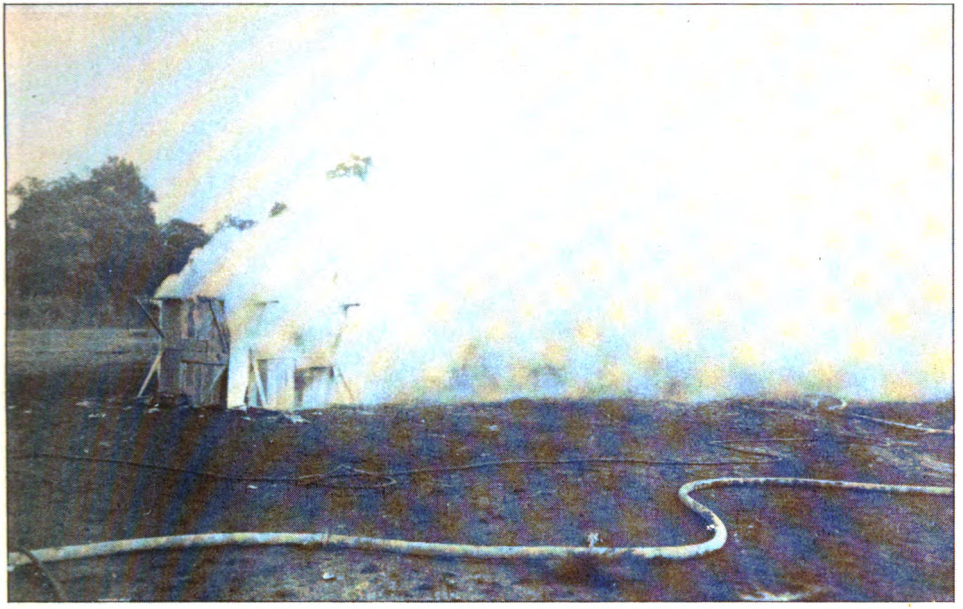
What is necessary is, in the midst of particular cases, to discover the situation, such as it is, in spite of its being surrounded by the fog of the unknown;then to appreciate soundly what is seen, to guess what is not seen, to take a decision quickly, finally to act with vigour, without hesitation.

One has to take two elements into account,the first a known one: one's own will; the other one unknown: the enemy's will. But one has also to add factors of a different kind, which escape prevision, such as temperature, sickness, railway accidents, misunderstandings, mistakes, in a word all the elements of which man is neither the creator nor the master, be they called luck or fatality or be they treated as providential. This does not, however, imply that war is to be conducted arbitrarily or blindly. The calculation of probabilities shows that these chance events must necessarily turn out as often to the good as to the bad for either party.

Therefore any general who, in each particular case takes, if not the best possible decisions, at least rational decisions, has always a chance of reaching his goal. . .

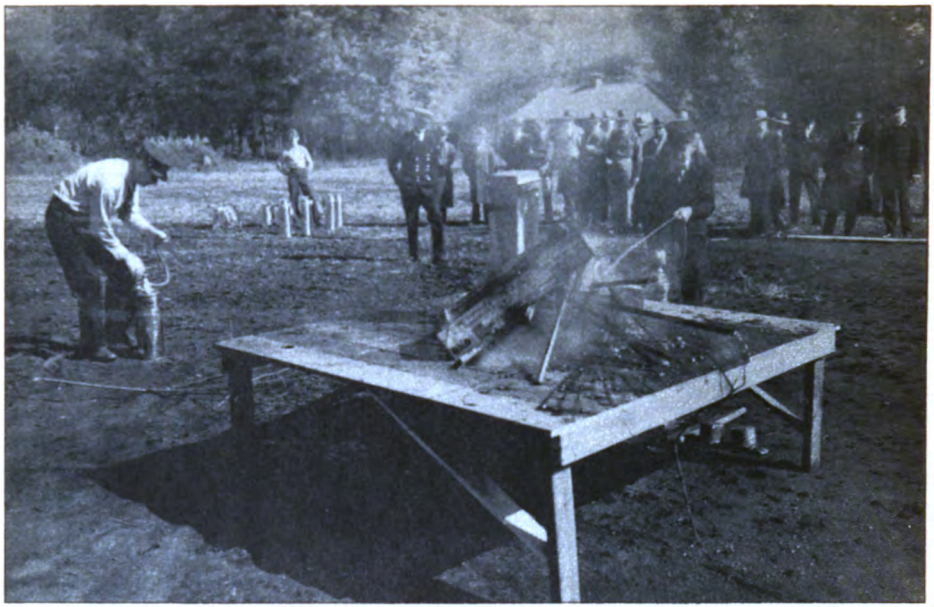
- von Moltke

* * * * *

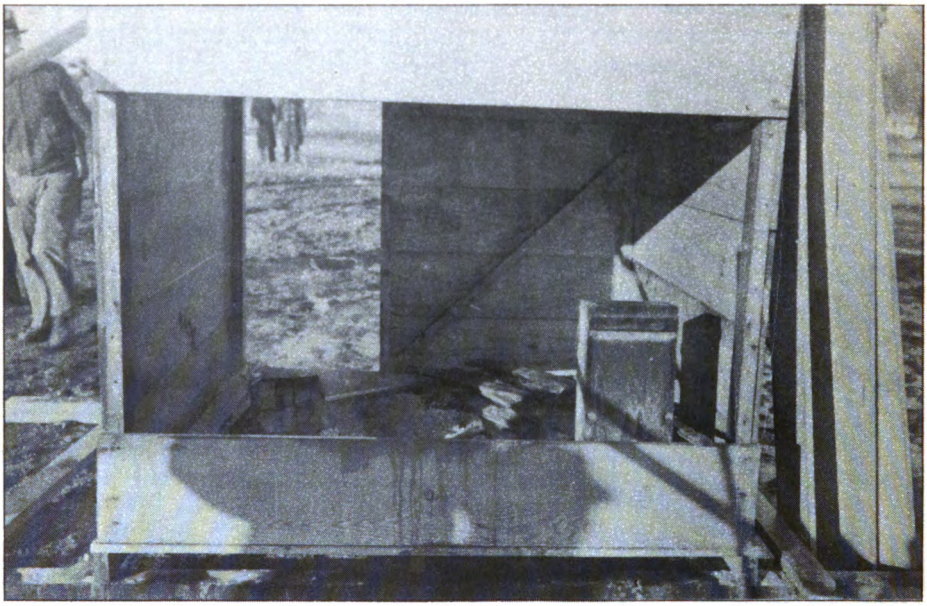


A 25-lb. magnesium bomb is burning in an improvised structure-40 sec. after ignition.

Same fire as previous picture. Water started at 64 sec. after ignition resulted in a minor explosion causing roof to fall in. Picture at 94 sec. Fire out at 120 sec.



A fire was produced in a pile of kindling and shell boxes by an 8-lb. thermite incendiary bomb. This picture was taken after three 2½-gal. extinguishers had been used.



A 25-lb. magnesium bomb was ignited in an improvised structure equipped with an automatic sprinkler head. Sprinkler head opened at 20 seconds. Only a slight explosion occurred. Fire out at 10½ minutes. Boards removed to permit photographing. Small hole burned in floor. Some excelsior on floor remained unburned. No charring of walls or ceiling.

ODOR IDENTIFICATION OF CHEMICAL WARFARE AGENTS

Capt. E. M. Hoshall, CWS

In order to protect against the first principle of war, that of surprise, it is essential that every soldier in the combat area and possibly also every civilian within enemy range, be instructed in the identification of chemical warfare agents.

Much time and effort has been expended in pure research and practical application to obtain a reliable, simple, and sensitive (less than 4 milligrams per cubic meter) method for the detection of toxic chemical warfare agents. Many methods have been investigated. Chemical reactions based on color change, development of acidity, production of turbidity, and precipitate formation have been studied. Physical detection includes methods based on spectrographic interferometry, Graham's diffusion law, and measurement of physical constants. Physicochemical methods such as change in pH and conductivity, measurement of heat from an exothermic reaction, and catalytic reactivity have also been applied to the solution of the problem. Biological detection methods, excluding the human sense-detection, include blood reactions visible under the microscope, and reactions on small animals, birds and fishes.

Many of these methods have proven exceedingly sensitive in the laboratory but their adaptation to field requirements have been unsuccessful. Shocks, tremors, and jarring are the chief reasons for mechanical failure. Atmospheric conditions affect many of the physical detection methods. The chemical methods fail in the presence of high concentrations of toxic agents, mixtures of agents, and in an atmosphere of various gases, dusts, and vapors that might be encountered in combat. Then too many of the devices are too complicated for use in the field by soldiers with limited technical training.

Detection of the toxic agents by the human senses of sight, hearing, and smell, embody the only methods which can as yet be considered reliable, simple and sensitive.

We may dismiss the hearing sense as lacking specificity although we must remember the hiss of cylinders, the earthshak-

ing tremor of a projector "shoot", the "whoosh" of a mortar shell, the dull explosion of a gas shell or a landmine, and possibly the momentary patter of a liquid or adsorbed liquid vesicant from a plane. It is claimed also that an experienced ear can detect the difference between a gas shell and a high explosive shell in flight.

In daylight we may see a phosgene haze, the canary yellow dust of diphenylaminechlorarsine, the dark splotches of mustard or lewisite on vegetation and the oily globules in pools of water, and the burst of shells. A gas shell bursts with a low order of detonation and a small cloud of dirt or dust, while a high explosive shell bursts with a high order of detonation and in addition is usually accompanied by black smoke. At night the sight sense is of little value and the eyes, except for their high sensitivity to irritation by many of the chemical warfare agents, become useless. HS for instance causes eye irritation when present to the extent of 1 part in 2,000,000 of air while CDA irritates 1 part in 125,000,000 of air. Regardless of the sensitivity of the eyes to irritation which is usually equal or greater than that obtained by the odor stimulus, irritation is not a specific test and then too some of the agents have little or no effect on the eyes.

No external sense is believed to be so intimately connected with the internal sense of perception as that of smell, and none is more capable, except as noted above, of receiving such delicate impressions. The physiology of the sense of smell is less perfectly known than that of any of the other special senses and the same remark holds true of its psychology.

In order to receive an odor stimulus it appears necessary that the odorous particles must be in direct contact with the nervous organs. In man these organs, commonly termed "receptors", are situated in the nasal cavities. The lateral walls of these cavities are thrown into a series of more or less horizontal folds, the nasal "conchae". A layer of epithelial tissue containing olfactory nerve fibre cells covers the conchae.

The modern view of the theory of reflex action may be applied to the physiology of olfaction. Thus an inhaled vapor produces a chain of nervous activity that is transmitted from the source of sensory stimulation (the receptors), by impulse, to the central nervous system where suitable conscious or unconscious action results.

It has been found that the olfactory organs are normally stimulated by material particles and not by disturbances of a nonmaterial character. Some odorous bodies are known to give out these material particles for a very considerable time without appreciably changing weight. From the standpoint of the receptor this indicates that olfaction is called forth by an infinitesmally small amount of substance, and measurements

directing towards testing this question justify the conclusion. Many units have been used for expressing the minimum concentration for olfaction. Zwaardemaker suggested an "olfactie" which represented the minimum stimulation from a sliding tube olfactometer which he described. The modern expressions for concentrations of odorous substances are:

(1) Milligrams of agent per liter of air, mg./l.
(2) Milligrams of agent per cubic meter, mg./cu.m. or mg. per cu.m.
(3) Parts of agent per million parts of air by volume, parts/million or p.p.m.
(4) Ounces per one thousand cubic feet, oz./1,000 cu.ft. or oz. per 1,000 cu.ft.
(5) One part of agent per a given volume of air, 1:1,000,000 (one part per million of air)

The following relationship holds between the various expressions:

oz. per 1,000 cu.ft. = mg. per l. (approximately)

$$\text{mg. per l.} = \frac{0.0000161\ MP}{T} \times \text{p.p.m.}$$

$$\text{p.p.m.} = \frac{T}{0.0000161\ MP} \times \text{mg. per l.}$$

Where M = molecular weight of the agent
P = barometric pressure in mm. of mercury
T = absolute temperature

A more convenient conversion, approximated for normal conditions (25°C. and 760 mm. pressure) is as follows:

$$1\ \text{p.p.m.} = \frac{M}{24{,}450}\ \text{milligrams per liter}$$

$$1\ \text{mg./l.} = \frac{24{,}450}{M}\ \text{parts per million}$$

Many methods have been used to determine the "threshold odor" or the concentration of the agent where minimum odor stimulation occurs. Of the newer methods that of Allison and Katz consists of a number of Venturi-type flowmeters so arranged that a known volume of air can be passed at a uniform rate through or over the agent. The concentration of the agent in the air is measured by determining the loss in weight of the agent after the measured volume of air has passed over or through it. The odor-laden air may be further diluted with known amounts of air and the mixture passed through a glass tube with a glass funnel at its open end. The person testing the concentration places his nose in the air stream issuing from the funnel. The funnel may be replaced by an open pair of glass bulbs which fit into the nostrils or by a gas mask facepiece. Although the threshold odor may vary markedly from individual to individual, the use of a large number of determinations and of many persons give remarkably concordant results. Some substances yield identifiable odors at extremely

low concentrations. Thus artifical musk can be detected at 1 part per 20,000,000,000 parts of air. It will be seen later that the threshold concentration of many of the chemical warfare agents are known. When however, we attempt to classify or describe the actual odor, we must adopt what seems to be an extremely artificial method.

Recent studies have shown that the classification is more or less associative and subjunctive, and certainly not based on any chemical similarity of composition.

The latest studies of odor classification are based upon the chemical composition of the substances yielding odors. Some of the investigators suggest that the odors of many substances depend upon the number and arrangement of certain chemical radicals called "osmophoric" groups, within the odorous molecule.

No practical scientific odor classification system exists as yet, and odor definition and classification of chemical warfare agents must, as with any new substance, be based on experience. Involuntarily we associate a new odor with a previous odor or mixture of odors,and if we memorize the new odor by the association with the particular agent, we should with a little practice be able to recognize the agent when it is present in sufficient concentration.

In Table I there is presented a compilation of odor characteristics of chemical warfare agents and related chemicals. The least detectable odor (threshold odor) is from modern workers, and where two different values have been found in the literature for a particular agent, the lowest has been given. For comparison purposes the lethal concentration for a 30 minute exposure is given for the agents when such data is available. Rather than to destroy the continuity of listing of the chemical warfare agents nonavailable data is indicated by blanks. The odors given are those reported in the literature for the chemical warfare agent, and not for the pure chemical compound.

As was previously pointed out, the odor laden air is aspirated through the nostrils and directed up over the conchae, the nerve cells of which receive and transmit the impulses requisite for the identification of odors. It may be seen therefore that only a very small volume of odor-laden air (probably 10 to 20 ml. or about a cubic inch) is required for testing. This is obtained by *sniffing* - and not by deep inhalation. The danger of one or two deep inhalations, in a surprise phosgene attack for instance, is apparent. One or two sniffs should be sufficient to establish the identity of the agent.

The olfactory organs in man are quickly and easily fatigued by continuous exposure to odorous materials. It is easy to see that continuous sniffing or testing for gas is to be

avoided if a delicate sense of perception is to be retained. If an agent is not detected when the odor perceptive power is at a maximum, a slightly leaking gas mask may, over a period of time, result in a casualty, since no agent can be detected after fatigue or exhaustion sets in. Several workers have shown that complete exhaustion to odor sensation can be obtained in from 2 to 10 minutes for a number of widely different substances.

Bodily and mental fatigue also give rise to greatly impaired odor perceptive ability.

Certain anesthetizing substances may induce temporary odor exhaustion. One of these, nitric oxide is frequently encountered in the field, resulting from the use of explosives. Hydrochloric acid, a product of the hydrolysis of phosgene renders the olfactory sense less keen.

Some odors may cause fatigue more rapidly than other odors and when completely fatigued for one odor, the nose may become insensible to other odors. This principle may have an important bearing on "odor camouflage".

Many substances encountered in combat areas give odors which interfere with the detection and identification of chemical warfare agents. Gases from high explosives may have in addition to their characteristic odor, an anesthetizing action previously mentioned. The chlorate explosives may give rise to oxides of chlorine,which while not particularly toxic, have characteristic and penetrating odors. Odors arising from swampy terrain, pinewood, vineyards, floral areas, orchards and like features of the terrain, may conceal or camouflage chemical warfare odors, or may cause olfactory exhaustion and preclude all odors. Such establishments as dumps, field kitchens, hospitals, motor parks, and the presence of garbage, feces, and other putrefactive material may give rise to odors which may be more than local in character.

Smoking causes the odor sense to decrease rapidly, and a steady smoker usually has an inferior odor sense. Gas sentries should, therefore, be nonsmokers, and should not be posted with smokers since tobacco smoke may interfere with detection.

The possibility of unknown gases being used should not be overlooked. So-called "new gases", mixtures of known gases, or camouflaged agents all present a challenge to those who would identify them and the enemy should be expected to mix, conceal,and confuse his chemical warfare agents at every step.

"If two distinct odors are mingled under experimental conditions there often results, not a fusion of the two into a blended odor as occurs with tastes, colors or tones, but the stronger will supplant the other completely or there will be an oscillation between the two. With some odors again, there appears to be true compensation. Thus if two different olfactory stimuli of unequal strength are applied simultaneously,

one will usually overpower the other completely, but if the stronger scent be diminished while the weaker is strengthened a point may be found where the two blend into a single mixed odor while in other cases *a point is found where there is no odor!*" According to Herrick, "The odors are said to be perfectly compensated. An increase of either stimulus results in the sensation appropriate to it and there is no mixture whatsoever."

Although appearing highly theoretical, the possibility of the application of this little known odor principle should not be overlooked.

Some persons are totally devoid of true olfaction, a condition which is caused by deficiencies of the olfactory apparatus, and which is designated as anosmia. This state may be congenital or acquired, and acquired anosmia may be permanent or temporary. For those engaged in and entrusted with the identification of agents it would appear that olfactory tests should be an integral part of their physical examination, just as color-blindness tests are required.

Many individuals are incapable of smelling a certain class of odors, and are perfectly capable of recognizing odors in other classes.

One criterion of an ideal chemical warfare casualty agent is that it should be odorless or that its least detectable odor should be in a toxic concentration. Of the available agents lewisite (Ml) and mustard (HS) approach most closely to this concept. Ml requires a concentration of 0.014 mg. per l. for detection (Table I) yet its irritating concentration is only 0.0008 mg. per l. and an hour's exposure at a concentration of 0.014 mg. per l. may result in a fatality. HS requires 0.0013 mg. per l. for detection (Table I) but exposed to a concentration of 0.001 mg. per l. for 1 hour, an eye casualty will result. These ideal concentrations (i.e. those too low for odor detection and sufficiently high for casualty effect over a period of time) will seldom be encountered but a study of the above figures and those under the same headings in Table I will demonstrate the necessity for adequate class instruction and field training in the identification of chemical warfare agents by odor. It should be borne in mind that sound basic training in odor identification may deny the enemy the principle of surprise which they seek by their chemical warfare attack, and in the future may guard against the new applications of odor camouflage.

TABLE I
ODOR CHARACTERISTICS OF C.W. AND RELATED CHEMICALS

Classification	CWS Symbol	AGENT COMMON OR CHEMICAL NAME	ODOR IN AIR (Threshold concentration)	LEAST DETECTABLE ODOR mg. per liter	LETHAL CONCENTRATION 30 minutes exposure mg. per liter
Vesicants	HS	Mustard	garlic, horseradish	0.0013 (9)	0.07 (9)
	Ml	Lewisite	geraniums	0.014 (9)	0.048 (9)
	ED	Ethyldichlorarsine	biting, slt. fruity	0.001 (9)	0.10 (9)
Lung irritants	CG	Phosgene	ensilage, fresh cut hay	0.0044 (9)	0.36 (9)
	Cl*	Chlorine	pungent	0.01 (10)	2.53 (9)
	PS	Chlorpicrin	flypaper, licorice	0.0073 (9)	0.80 (9)
	DP*	Diphosgene	suffocating, nauseating	0.0088 (9)	0.36 (9)
Irritant smokes	DA	Diphenylchlorarsine	shoe polish (nitrobenzene)	0.0003 (11)	0.60 (9)
	DM	Diphenylaminechlorarsine	usually smoky (powder)	0.0025 (9)	0.65 (9)
	CDA	Diphenylcyanarsine	garlic, bitter almonds	0.00001(11)	1.00 (9) (10 min.)
Lacrimators	CN	Chloroacetophenone	ripe fruit, apply blossom	0.0001 (12)	0.34 (9)
	CNS	CN - PS - solvents	sweet, flypaper	-	0.70 (est.)
	CA	Brombenzylcyanide	sour fruit	0.00009 (9)	0.90 (9)
	- *	Acrolein	Burning fat, pungent	0.0041 (12)	0.35 (9) (10 min.)
	BA*	Bromacetone	pungent, stifling	0.0005 (9)	3.20 (9) (10 min.)
Systemic toxics	HCN	Hydrocyanic acid	bitter almonds	0.001 (11)	0.15 (9)
	CC	Cyanogen chloride	sharp, sour	0.0025 (9)	0.12 (9)
	- *	Cyanogen bromide	piquant	0.006 (9)	0.40 (9) (10 min.)
	- *	Carbon monoxide	odorless slt. garlic	-	0.69 (10)

TABLE I (Cont'd)

Classification	CWS Symbol	AGENT COMMON OR CHEMICAL NAME	ODOR IN AIR (Threshold concentration)	LEAST DETECTABLE ODOR mg. per liter	LETHAL CONCENTRATION 30 minutes exposure mg. per liter
Systemic toxics	- *	Nitrous fumes	sweet, choking	-	0.23 (10)
	AsH_3	Arsine	rotten cabbage, garlic	-	0.25 (10)
	- *	Phosphine	garlic-like	-	0.14 (10)
	- *	Hydrogen sulfide	rotten eggs	0.0002 (12)	0.14 (10)
Screening smokes	WP	White phosphorus	wet matches	-	-
	FS	Chlorsulfonic acid - sulfur trioxide	acrid	-	-
	HC	Hexachlorethane mixt.	sweet, astringent	-	-
				-	-
	FM	Titanium tetrachloride	acrid	-	-
	CO	Crude oil	oily, smoky suffoc.	-	-
	-	Oleum	acrid, biting	-	-
	-	Sulfur-trioxide	acrid, suffocating	-	-
	-	Stannic chloride	suffoc. sweetish	-	-
	- *	Silicon tetrachloride	-	-	-
Incendiaries	TH	Thermit	-	-	-
	SO	Solid oil	smoky	-	-
Miscellaneous	- *	Carbon disulfide	rotten cabbage		2.24 (10)
	- *	Chloroform	sweet, pleasant	3.30 (12)	-
	- *	Butyric acid	rancid butter	0.009 (12)	-
	- *	Sulfur dioxide	choking	0.008 (10)	1.4 (10)

TABLE I (Cont'd)

Classification	CWS Symbol	AGENT COMMON OR CHEMICAL NAME	ODOR IN AIR (Threshold concentration)	LEAST DETECTABLE ODOR mg. per liter	LETHAL CONCENTRATION 30 minutes exposure mg. per liter
Miscellaneous	- *	Ammonia	sharp, penetrating	0.037 (10)	1.90 (10)
	- *	Pyridine	slt. urine, unpleasant	0.00074(12)	-
	- *	Hydrogen chloride	sharp, suffocating	-	1.5 (4)

**Not a CWS agent.*

* * * * *

This crisis is not the exclusive property of the professional soldier. No crisis in American history ever has been. No matter how large or how small our standing army has been, in a time of emergency it has always served as the core around which we have constructed a force sufficient to meet the emergency, recruited, officers and enlisted men alike, from civil life. Here is one more proof of the fact that in America the armed force is always the servant and instrument of the people.

- Hon. Robert P. Patterson

* * * * *

TRAINING FILMS AND FILM STRIPS

Lt. Col. James W. Rice, CWS

Pictures, charts, maps, and diagrams have long been employed as teaching aids, and the statement has often been made that a good picture is worth a thousand words of explanation. In some subjects, instruction can hardly be given without a chart or some sort of illustration to help in the discussion. One great drawback in the use of such aids as drawings and charts, is that the busy instructor of troops rarely has the time, the materials, or the technical ability to provide these for himself and thus must depend upon improvisations which are often unsatisfactory.

The War Department and its several branches has recognized the value of visual aids in easing the teaching problem and for this reason it has recently embarked upon a program of furnishing prepared illustrations to the instructor in the field. These are expected to be technically correct and will provide material around which instruction can be built. In the preparation of these visual aids, the various arms and services provide the subject matter, while the Signal Corps produces the finished product in the form of training films and film strips. Training films may be either sound or silent moving pictures which illustrate some phase of training, chiefly action or motion. Film slides are a series of prepared still pictures, charts, drawings, diagrams, maps, tables of data, graphs and other visual information printed on a section of 35-mm. film for showing on a screen in connection with some course or lesson.

Training films, in general, are used to teach drills and procedures which otherwise might require hours of verbal explanation or pages of tedious written textual material. By means of the training film, it is possible to provide exact standards of performance of some task or movement, as for example, the correct way to put on a gas mask. In others, the work of some particular unit or part of the military team as a whole, may be taught in order that all may be better acquainted with how each may do its job. An example of this is the

training film *The Rifle Squad in Combat, TF 7-21.*

In preparing and filming the subject, there are many and varied technical tricks which can be used to put the lesson across, such as by a story, by animation, by dialogue, and natural or faked sound, or by off-stage narration. Thus, it is possible to maintain interest by a wide choice of changes in presentation technique. Two sizes of training films are furnished, the 16-mm. and the 35-mm., and nearly all are reproduced and issued in both sizes.

A second type of official visual instructional aid is the film strip. These can be made invaluable for describing equipment in the form of still pictures, drawings, charts and the like. Obscure parts can be emphasized for teaching nomenclature and functioning, and motion can be arrested for detailed study. It is furthermore possible, by means of printing and retouching technique, to produce effects or accentuate details for specific purposes. As an example, the accompanying illustration titled *Showing a Film Strip* is made up of no less than three different photographs, namely, one on the subject matter, one of the class, and still a third of the instructor.

Besides photographs, it is also possible to employ charts, drawings and even cartoons to good advantage. These latter are especially useful and a sample of ways of putting over a very difficult point to illustrate is shown in the picture of the film strip *Cartoons are Emphatic,* where odors of chemical agents are described.

The film strips as issued are photographic prints on a short length of standard motion picture film, and like magic lantern slides and moving pictures, are projected on a screen in a darkened room. One disadvantage is that the instructor cannot select views or scenes to suit his own particular style or order of presentation, but must follow the order as visualized by the original author or composer. However, the lecturer has much latitude as to timing and can place as much emphasis on individual pictures as he may see fit.

In sets of separate glass slides, the user is given more choice for selection and arrangement, but the greater cost and bulk of the latter type outweighs these apparent advantages.

All the most recent training films are coordinated either with an off-stage lecture, dialogue by actors, or other means of obtaining sound effects. Because of this, there is a tendency to let the film do the work. However, the topnotch instructor will always add to the lesson by introductory remarks or discussion and comments afterwards.

The film strip differs in that the instructor must develop his own patter to augment the very sketchy and brief mimeographed notes which accompany the small container in which it is shipped. Thus, a lot of preparation, a knowledge of the

subject, and a considerable amount of thought ahead of time is necessary if the film strip is to fully serve its purpose. The instructor cannot expect the film strip to run itself as might be possible in the case of the training film.

A system, wherein both the training film and the film strip are used to supplement one another can be advantageously employed in teaching some general subjects. The Chemical Warfare Service visual instruction aids have been deliberately planned and produced with a view to making both of these kinds of illustrative matter interdependent within a narrow subject. For example, instruction on the training gas mask is illustrated by a film strip and two separate training films. If any one of these is not shown, the teaching program for the particular subject will not be complete. Early in the course of training in the use of the use of the gas mask, a film strip, *The Nomenclature and Air Flow System of the Training Gas Mask (FS 3-5)* is shown the trainee. As its title implies, this film strip is expected to help teach the soldier the names of the parts mentioned later in the drills and adjustment procedure, and also to show him how the mask works. An experienced instructor should be able to show and explain the lecture material for this film strip in about twenty minutes to one-half hour running time.

Teaching of the adjustment procedures and drills for this gas mask is helped by the training film entitled, *The Adjustment of the Training Gas Mask.* This particular moving picture consists of two reels which will run about twenty minutes. Another and separate lesson on the training gas mask is contained in a one-reel training film called *The Inspection of the Training Gas Mask.* This runs about ten minutes.

An example of coordinated utilization of training films, film strips and drill field instruction is illustrated in the suggested schedule of recruit gas mask training, wherein the time for teaching how to adjust the training gas mask should be distributed as follows:

First day of gas mask instruction -	
Issue of gas masks	10 minutes
Show film strip *Nomenclature and Air Flow System, Training Gas Mask (FS 3-5)*	20 minutes
Simple review test of nomenclature (test to be found on last frame of the film strip)	10 minutes
TOTAL	40 minutes
Second day of gas mask instruction -	
Instruction in gas mask adjustment	
Drill by squad and section leaders	40 minutes

Third day of gas mask instruction -	
Show training film *Adjustment of the Training Gas Mask;*	20 minutes
Review of all previous gas mask drills	20 minutes
TOTAL	40 minutes
Fourth day of gas mask instruction -	
Repeat and review gas mask drills	40 minutes
Fifth day of gas mask instruction -	
Show training film (TF 3-2a Part II) *Inspection of the Training Gas Mask;*	10 minutes
Review and actual instruction in inspection procedure by the individual	30 minutes
TOTAL	40 minutes
Sixth day of gas mask instruction -	
Formal inspection of gas masks in ranks in connection with usual weekly equipment inspection	30 minutes
Seventh day of gas mask instruction -	
Review of drills	10 minutes
Test gas mask for fit in gas chamber	30 minutes
Test soldier for training in gas chamber	30 minutes
TOTAL	70 minutes
TOTAL TIME - - - - - - - - - - - - - - - -	5 hours

The nomenclature, drill, and inspection of the standard service gas mask are likewise covered in a similar group consisting of a film strip and two training films. Subjects such as decontamination equipment and procedure, and other convenient subdivisions of chemical defense instruction are also being produced in supplementary sets.

It would be a grave mistake to consider any of the training films or film strips mentioned above as *rainy day* or *fill-in programs*. They are designed as positive parts of the whole problem of teaching the soldier how to put on, wear and inspect the training gas mask. Neither can these visual aids be expected to take the place of actual drill. They will, however, save much time and put the instruction over more thoroughly, providing they are intelligently employed in addition to adjustment practice.

There are a few empirical rules which the instructor should

know and follow when using the film strip or training film.

In the first place, a rehearsal should be held prior to using the instructional aid. This is necessary so that power, lighting and seating arrangements in the classroom can be checked. Also in the case of film strip showing, the operator must know when to change the frames. The 16-mm. training film projector and sound reproducer must be tried out so as to make sure that there is no sound distortion.

Seating arrangements and capacity in the classroom should be such that the image on the screen is clear and recognizable to the average man in the rear row of seats. This distance will, of course, depend upon the size of the screen. At any rate, no student should have to peer, or to guess what the point of the frame or scene may be. In general, a narrow classroom is much better for showing pictures than a broad one, because the screen images are likely to appear out of focus and vague at angles greater than about 30 degrees to the right or left of a line perpendicular to the screen.

When using film strips, the instructor should augment the pictures and illustrations by models whenever possible. As an example, when teaching the nomenclature of the training gas mask, the instructor might have his class follow through the explanation and the pictures by looking at the various parts of the gas masks which they have just received, as each component is shown on the screen. In conducting such an exercise the instructor might very well arrange to turn on the classroom lights between frames, so as to permit examination of the gas mask.

Since the darkened room is an incentive to drowsiness, it is necessary that the average individual force himself to keep his attention on the subject. The changes suggested just above, together with reducing the time of darkness in the room, may serve to combat this tendency. Another good instructional trick, is to have a short quiz, either oral or written,to wind up the period. If it is known beforehand that a quiz is likely, the student has an additional incentive for remaining alert.

In using the training films for teaching of drills or procedures, it is well to bear in mind that the moving picture will be much more valuable if the student has already had a little instruction, enough so that he begins to recognize the drills, but not enough to set any false habits. Thus, it is best to have at least one period of instruction in adjusting the gas mask before the training film on that subject is shown.

Both training films and film strips, as already indicated, are produced jointly by the Signal Corps and the various branches under which the subject may logically be placed. Their reproduction and supply, however, are functions of the

Signal Corps, and it is from that branch that they must be requisitioned. The Signal Corps also furnishes the projectors and equipment for showing the illustrations.

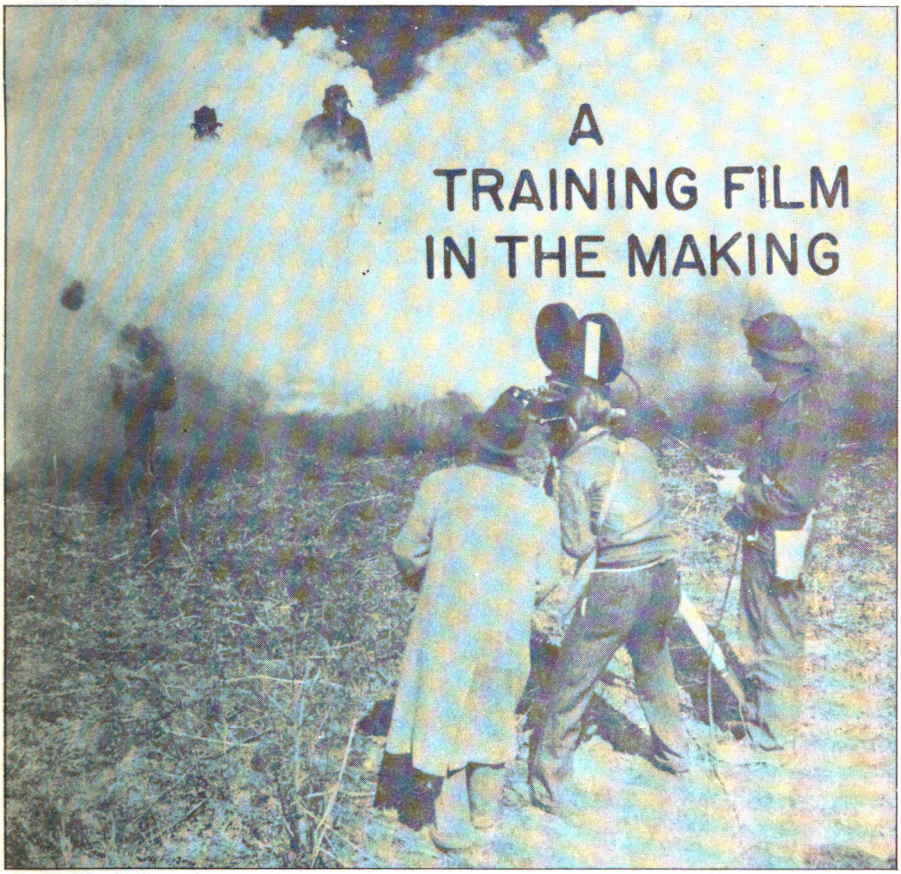
Film strips and training films are considered as training literature and as such are listed in FM 21-6. Changes are published from time to time in Training Circulars. Thus, the replacement training center officer and troops instructor should consult these documents in order to keep abreast of the latest visual instructional aids before he makes up his final plans and lessons for any course he may be called upon to give.

* * * * *

The general must know how to get his men their rations and every other kind of stores needed in war. He must have imagination to originate plans, practical sense and energy to carry them through. He must be observant, untiring, shrewd, kindly and cruel, simple and crafty, a watchman and a robber, lavish and miserly, generous and stingy, rash and conservative. All these and many other qualities, natural and acquired, he must have. He should also,as a matter of course, know his tactics; for a disorderly mob is no more an army than a heap of building materials is a house.

- Socrates

* * * * *

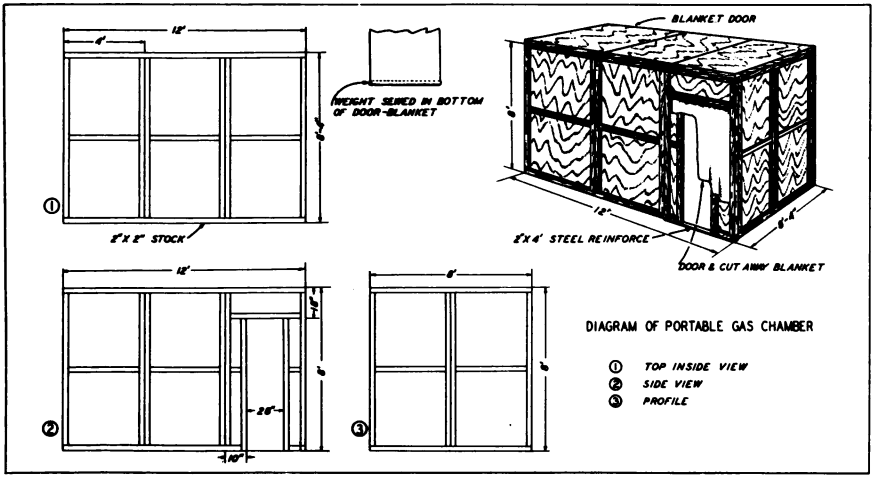


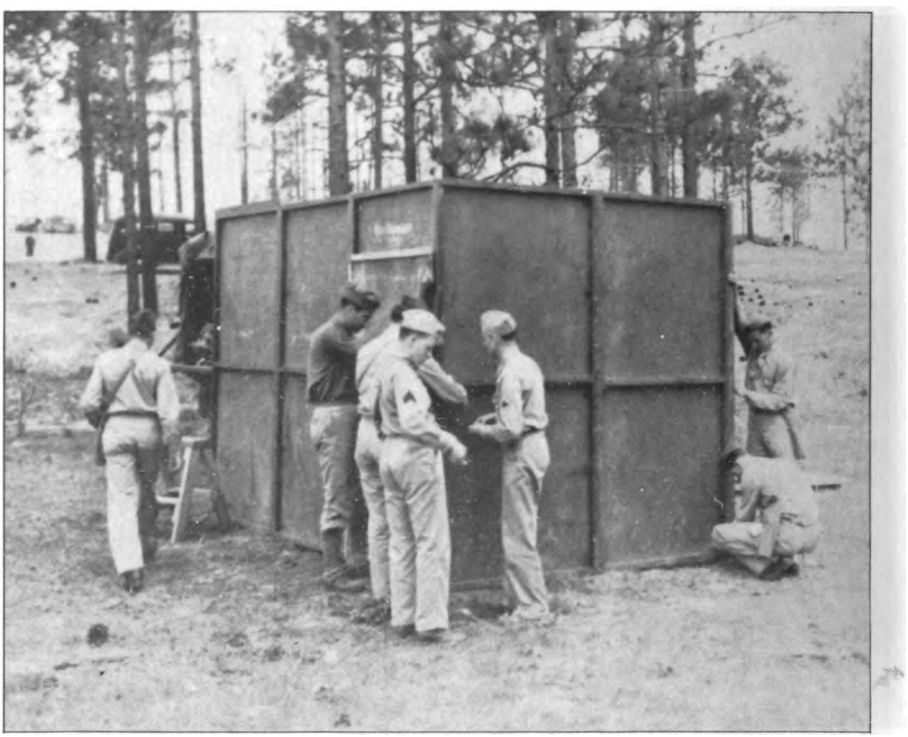
A PORTABLE GAS CHAMBER

For the benefit of readers of the Bulletin who may be charged with field training in chemical warfare, photographs and a diagram to scale of the portable gas chamber used by the 32d Division at Camp Livingston, Louisiana are reproduced herewith. The chamber was designed primarily with a view to taking chemical warfare training to the regimental area rather than obliging troops to march long distances to a permanent structure.

It is comprised of 13 four by eight foot plywood sections which are reinforced by two by two inch strips. Two 28 by 78 inch canvas covered openings serve as doors. The chamber can easily be transported by a 1½-ton truck and can be erected in the area where it is to be used in about 15 minutes.

Ten men may be taken into the chamber at one time making it possible to instruct an entire regiment in gas chamber exercises in one day.





Almost set!

Emerging from CN

Lt. Col. William W. Wise, CWS

LT. COL. WILLIAM W. WISE, CWS

Lt. Col. William W. Wise was born in Pontiac, Ill., April 14, 1885, and died at Station Hospital,Fort Sam Houston, Tex., May 26, 1941.

Colonel Wise served in the Illinois National Guard from December, 1905 to January, 1913,as first lieutenant and captain. He attended the Second Officers' Training Camp at Fort Sheridan, Ill.,from August to November, 1917, was commissioned captain, Infantry Section, O.R.C., November 27, 1917, and called to active duty the same day. In September, 1918, he was appointed captain, Chemical Warfare Service, National Army, was later promoted to major, Chemical Warfare Service, U. S. Army, and served in this latter capacity until September, 1920, when he was appointed to the Regular Army. He reached the grade of lieutenant colonel on November 29, 1940.

Colonel Wise arrived in France with the A.E.F. on January 17, 1918; his first assignment was in connection with troop classification at Blois. Later he served as division gas officer, 35th Division, and chief gas officer, VIII Army Corps. He took part in the battles of Soissons, St. Mihiel, Meuse-Argonne, Vosges Sector, and Sommedieu Sector.

Colonel Wise returned to the United States in 1919 and was first stationed at Edgewood Arsenal. His later details included duty as chemical officer, Southeastern Department, Charleston, S. C.; chemical instructor, Infantry School, Fort Benning, Ga.; secretary and instructor, Chemical Warfare School; instructor, Air Corps Tactical School, Langley Field, Va.; chemical officer, 1st Cavalry Division, Fort Bliss, Tex.; commanding officer, Hawaiian Chemical Warfare Depot; executive officer, Pittsburgh Chemical Warfare Procurement District; assistant technical director, Edgewood Arsenal; and at the time of his death he was again holding his wartime assignment as chemical officer of the VIII Army Corps, with station at Brownwood, Tex.

Colonel Wise was a graduate of the A.E.F. School in 1918; the Chemical Warfare School, 1923, (Line and Staff Course) and 1934, (Field Officers' Course); the Infantry School, Advanced Course, 1923; and the Air Corps Tactical School, 1928.

- Photo by Caldwell

GENERAL OFFICERS, CHEMICAL WARFARE SERVICE

Maj. Gen. Wm. N. Porter, Chief of the Chemical Warfare Service, (left) and Brig. Gen. R. L. Avery, commanding general, Edgewood Arsenal, pose informally following review of chemical troops on June 6, 1941.

CURRENT COMMENT

The Chief of the Chemical Warfare Service.

The swearing in of Col. William N. Porter as major general and Chief of Chemical Warfare Service for a term of four years makes him the fifth officer to serve in that important capacity since the Chemical Warfare Service was made a permanent branch of the Army by the National Defense Act of June 4,1940. He succeeds in that high position Maj. Gen. Walter C. Baker, who retired from active service on his own application on April 30, 1941.

The first Chief of the Chemical Warfare Service, Regular Army, was Maj. Gen. Amos A. Fries,who served two terms in that capacity. Following the conclusion of General Fries' term of office, a medical officer, Col. Harry L. Gilchrist, was appointed major general and Chief of Chemical Warfare Service. Upon the conclusion of General Gilchrist's 4-year term of office, Maj. Gen. Claude E. Brigham was appointed Chief of Chemical Warfare Service,and he in turn was succeeded by Maj. Gen. Walter C. Baker, who was placed on the retired list of the Army on April 30, 1941.

Born in Ohio, March 15, 1886, General Porter graduated from the U. S. Naval Academy in 1909, but was appointed the next year, March 8, 1910,as a second lieutenant in the Coast Artillery Corps of the Army. He advanced to the several grades and during the World War was a major of Coast Artillery in the National Army, May 17, 1918; lieutenant colonel September 18, 1918; and full colonel on October 5, 1918. At that time he was 32 years of age and one of the youngest colonels in the Army.

General Porter is a graduate of the Army Industrial College, 1926;a distinguished graduate of the Command and General Staff School, 1927; Army War College, 1938; Field Officers' Course of the Chemical Warfare School, 1931; and the Air Corps Tactical School, 1937. He was made permanent captain, May 15, 1917; major, July 1, 1920; transferred as major to Chemical Warfare Service on August 18, 1921; promoted to lieutenant colonel, October 1, 1934; and to colonel on December 1, 1938.

Retirement of General Baker.

Maj. Gen. Walter C. Baker was retired from active service upon his own application on April 30, 1941. General Baker's four year term of office as Chief of Chemical Warfare Service would have expired May 23, 1941.

General Baker has a distinguished military record extending over 43 years. Entering the Federal service in 1898 as a corporal,6th Pennsylvania Volunteer Infantry, he was commissioned second lieutenant, Artillery Corps in June, 1902 and served with the Coast Artillery in the several grades until December, 1920.

At that time he transferred to the Chemical Warfare Service, serving in the office of the Chief; the office of the Assistant Secretary of War; as commanding officer, Edgewood Arsenal, and First Corps Area chemical officer, until May, 1937, when he was appointed Chief of Chemical Warfare Service with the rank of major general.

General Baker is a graduate of the Coast Artillery School; the Chemical Warfare School; Command and General Staff School; Army Industrial College; and Army War College.

For outstanding service during the first World War he was awarded the distinguished service medal. In February, 1941, he received the degree of Doctor of Military Science from the Pennsylvania Military College, Chester, Pa.

By his genial personality and his unflagging efforts to further chemical features of national defense, General Baker long since endeared himself to all ranks of the Chemical Warfare Service.

His title to join the distinguished group of officers who have previously served the branch as Chief is assured by the fact that under his direction, an unprecedented expansion of the Chemical Warfare Service was accomplished in an orderly and expeditious manner.

To General and Mrs. Baker a host of comrade's and friends extend a fond aloha.

Military Gas Masks.

The War Department recently announced that nearly two million gas masks have been produced in the last six months. About half of these are training masks. Thousands more are being turned out each day as whirring machines and modern production lines are operated in various factories which, for strategic reasons, are scattered throughout the country. As soon as a selectee begins his year of training he is furnished a new training gas mask as part of his individual equipment.

The training gas mask has a machine moulded rubber facepiece which is pliable and fits accurately the face of the wearer. Fastened to the lower part of the facepiece is a cylindrical canister through which passes the air which is

breathed.

The canister is a splendid example of American inventive genius and technical skill. At the bottom of the canister is a one-way valve that opens readily when the wearer inhales but shuts tightly when the breath is exhaled. The canister contains special activated charcoal and filtering material which remove all the known war gases from the inspired air.

For centuries it has been known that charcoal has the remarkable property of being able to adsorb various gases on its surface. However, chemical research in the Chemical Warfare Service has succeeded in producing a grade of charcoal that is many times more adsorptive than ordinary wood charcoal. Thus a few ounces of this material are sufficient to purify the air breathed by the soldier for an extended period.

The training gas mask is a fully serviceable piece of equipment that fills a need in the training program of the Army, making it possible to provide every soldier with his own mask at a moderate cost to the Government. Gas masks, like other equipment, wear out in use. For training purposes in the zone of the interior the more costly service gas mask is not required; therefore a considerable saving is made by issuing the less expensive training mask to troops at various army posts.

The service gas mask is of heavier construction and is intended for field service in time of war. The larger canister of the service mask is carried in the canvas carrier under the left arm and is connected to the facepiece by a corrugated hose. The more rugged construction of the service mask insures that it would stand the rougher usage which might be met in the combat zone. The canister of larger size will also protect the soldier for a longer period in use. Hundreds of thousands of these masks are being manufactured each month. They are not being issued but are being stored, for the present, after careful inspections throughout each stage of their manufacture.

Research Facilities at M.I.T.

Immediate construction of a large new laboratory to house the department of chemical engineering of the Massachusetts Institute of Technology has been announced by Dr. Karl T. Compton, president of the Institute.

"Expansion of facilities for the department of chemical engineering, now the largest in the Institute, has long been an urgent need," Dr. Compton said. "The executive committee of the Institute has authorized erection of the new laboratory at this time because of increasing opportunities for the Institute to use its facilities for research and for training programs relating to national defense.

"The full potentialities of the chemical engineering de-

partment for technical training and research have been retarded by a lack of more adequate laboratories and more convenient grouping of its various activities. This condition has been pointed out year after year by the departmental visiting committees of men distinguished in the chemical and oil industries who have studied the operations and needs of the department. It was the recognition of this long-felt want in the regular educational program of the Institute, combined with the fact that such facilities, if available, could be immediately used for the national welfare during this emergency which induced the executive committee of the Institute to authorize construction of the laboratory at once."

The new laboratory will be located behind and adjacent to the main educational building, east of the central dome. The building will be 200 feet long and 125 feet wide and will be a two-story structure, permitting the introduction of large areas of skylight for effective natural lighting. It will have an exterior finish of buff face brick to harmonize with the surrounding buildings.

Honorable Mention.

Master Sergeant George E. Wittman was retired on April 30, 1941, at Fort Sam Houston, Texas, after a long and honorable Army career. He enlisted in the Infantry on June 9, 1904, serving with the 29th Infantry in the United States, and with the 12th Infantry in the Philippines from February, 1908 to January, 1911.

Wittman entered the Reserve Officers' Training Camp at Fort Niagara, New York, in August, 1917, was commissioned second lieutenant, Infantry, December 15, 1917, and promoted to first lieutenant on November 4, 1918, serving at Vancouver Barracks and Camp Lewis, Washington, prior to his discharge on December 19, 1918.

After the World War, Sergeant Wittman returned to the Infantry as a corporal; he was transferred to the Chemical Warfare Service on March 23, 1921, and promoted to sergeant March 31, 1921. He was appointed staff sergeant February 3, 1922; technical sergeant November 10, 1927; master sergeant November 8, 1939. His first service with the Chemical Warfare Service was with the 1st Gas Regiment at Edgewood Arsenal; he served at the Hawaiian Chemical Warfare Depot from January, 1923, to January, 1926; then returned to Edgewood Arsenal where he was on duty in the office of the Officer in Charge of Reserve Affairs for two years, when he was transferred to the Office of the Chemical Officer, Headquarters, Eighth Corps Area.

As an officer of Infantry, Lieutenant Wittman attended the School of Gas Defense at Camp Lewis in 1918; in 1922 he completed the Noncommissioned Officers' Course at the Chemical Warfare School.

Sergeant Wittman was appointed captain in the Infantry Reserve March 24, 1919, and was transferred to the Chemical Warfare Reserve August 27, 1924, which commission he still holds.

Sergeant Wittman reached the age of 58 on May 25th. He has been advanced on the retired list to the grade of first lieutenant, in recognition of his World War service.

* * * * *

In all combat operations of the IX Corps the offensive spirit must be dominant. Current military campaigns again demonstrate the old truth that all advantage lies with the army that prepares adequately and then takes and maintains the rapid offensive. With this aggressive action goes the priceless asset of the initiative. The attacking force thrusts and the defending force must parry; an operation most difficult for the defender in this day of fast movement and mechanized warfare. The initiative with its attendant choice of action is more important now than ever before. Its value has been greatly enhanced by modern combat equipment and it therefore should be seized and maintained at all costs.

The defensive must be looked upon only as a temporary expedient which should be terminated as soon as the offensive can be taken. An active defense sometimes serves a useful purpose, but a passive defense rarely accomplishes anything except ultimate defeat. The defensive spirit is the defeatist spirit and never wins in war.

- Combat Doctrine, IX Army Corps

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FOREIGN NOTES

The Break-Through Into Greece*.

The few roads that lead into Greece run through deep narrow mountain valleys, and there are no other routes over which an invading force can pass. The points at which these approach roads debouch from the mountains are, however, on Greek soil, and at the time of the German march into Greece they were blocked by strong fortifications of all kinds. Figuratively speaking, the Greeks had their barrier forts arranged like stoppers at the end of long, narrow bottlenecks. These stoppers had to be pushed out if the way was to be cleared southward to the Thracian and Macedonian plains, towards Salonika, and to the Aegean. The fight to accomplish this end was the first phase of the campaign in the southeast.

The Greek defense of the mountain exits had been developed into a system representing a continuation of the Metaxas Line. This defense system, organized in the years 1938 to 1940, when our West Wall was built, was a modern system consisting of armored works, concrete bunkers, field fortifications, and searchlight and alarm stations. All these were built in accordance with the latest military experience.

The works were located deep in the rock, and the fact that their checkerboard arrangement enabled one bunker to cover the other made the capture very difficult. In and behind the line of fortifications was the Greek Macedonian Army of approximately 50,000 men - about four active divisions and one reserve division under the command of General Bakopulos.

Nearly all of the Greeks were under 23 years of age. Since all of them had been in the army at least since the spring of 1939 and in the Metaxas Line for at least six months, they were well acquainted with the works, operation of the equipment, and localities. In addition, they had been given plenty of practice in the use of the arms of the fortifications.

**A translation by the War Department Military Intelligence Division of an article which appeared in the authoritative German newspaper, Volkischer Beobachter, on April 18, 1941. Intended propagandistic effect should not be overlooked.- Ed.*

There were very strong fortifications on both sides of the passes. There were no Englishmen found in the first line, but the best of the Greek forces were located in the fortifications.

At 5:20 A.M. on April 6, 1941, German divisions set out over all the approach routes to attack Greece. The first works were captured in hand-to-hand fighting, but we soon found that we had in the Greeks an extremely brave adversary. It was not easy for our Stukas and heavy artillery to get to them, particularly on the right wing and in the well placed mountain fortifications. Bunker after bunker had to be taken, because the separate works, which were so connected that they could cover and assist each other with their fire, threatened to stall the German advance at certain points. They offered a good distant view towards Bulgaria and into the German assembly positions.

From all sides - even from the bunkers that had already been crushed - the advancing Jaegers, riflemen, pioneers, and artillerymen continued to receive heavy fire. The mountain fortifications were arranged, like warships, on the principle of the bulkhead system; they were not decisively neutralized even after a considerable part had been destroyed and burnt out. All the openings had to be filled and blocked and the openings to the works had to be blown up before we finally attained success.

The Greeks defended themselves bravely and stubbornly, but they were eventually forced to give way to the numerical superiority of the Germans, who would not allow themselves to be shaken loose once they got a foothold in the fortifications.

The thick fog and rain that came during the first night and the second day of the attack partly blinded the defense and aided the attackers. When storming one fort, we could not be seen by the artillery of sister forts; thus we could deal individually with one fort after another and even push in between works. During the first night, some of the attacking regiments succeeded in weaving themselves through the Greek lines and in capturing important points to the rear of the enemy - particularly bridges that were still intact. Whole battalions, however, were still fighting in the mountains.

The left wing did not appear to be as well garrisoned, and an attack by weaker German forces soon began to make headway. These forces first captured Komotini, then Xanthi; they later reached the coast of the Aegean.

As a result of resistance in Serbia, German forces concentrating against Greece were confronted with an entirely new situation just before the attack. The whole right flank of the armies marching southward was threatened by the Serbs, and in order to avoid the danger of a Serbian thrust in the very region of the lines of communications, the German divisions,

already deployed,had to be regrouped again a short time before the attack. Tank troops in particular were used for flank protection.

On the same day that they crossed the Greek frontier the mountain Jaegers and the infantry advanced to the attack over the Bulgarian-Serbian frontier. They broke the light resistance of the Serbs on the frontier, pressed on in a westerly direction, made a swing of 90 degrees towards the south, broke through the Greek frontier fortifications, and then made a continuous advance through all of East Macedonia to the Aegean Sea.

While the mountain Jaegers and the infantry were still engaged in a hard fight on the Metaxas Line, Salonika, the Macedonian capital which lay far in the rear of the Greeks, surrendered to our tank and motorized infantry formations. The tank thrust in rear of the enemy cut the Greek supply lines and surrounded their entire East Macedonian Army. Thus a further defense of the Metaxas Line would have been senseless.

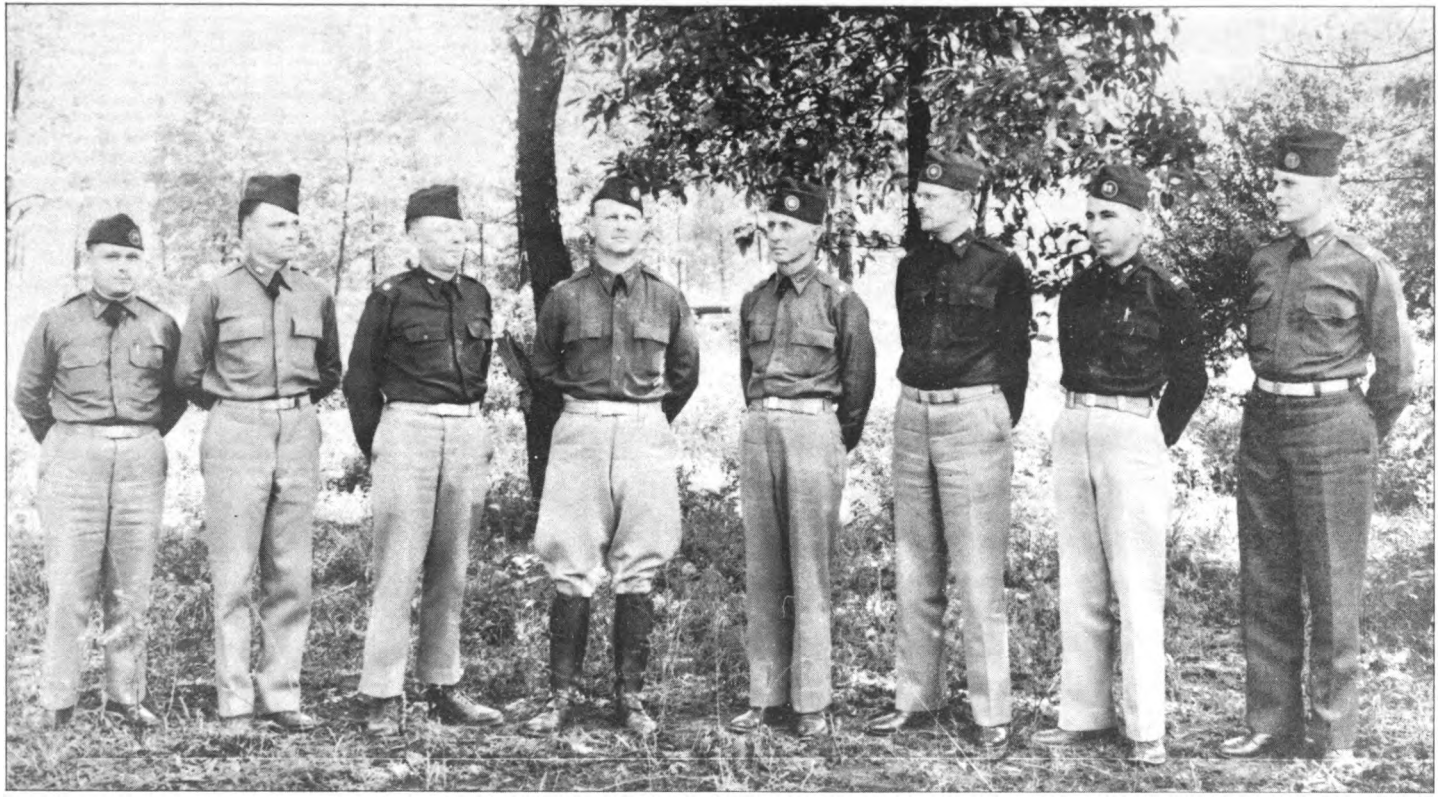
Here in the Southeast we repeated what the world had already looked upon with amazement in the West, when our tank troops, advancing over the Aisne in the rear of the Maginot Line up to Switzerland, made useless a further defense of the French line of fortifications and forced the capitulation of the French in Alsace-Lorraine and in Burgundy. The tank thrust through Macedonia toward the South, carried out with scarcely any losses, resulted in the decision for which troops had been fighting hard in the mountains for three days.

The East Macedonian Army of the Greeks surrendered at about 1:00 P.M. on April 9, 1941, after a fight lasting three and a half days.

Article I of the terms of surrender stated:

> "The parts of the Greek army fighting in East Macedonia are to lay down their arms. There is to be an armistice at once. Greek officers are to be allowed to keep their swords. The area of the East Macedonian Army embraces the part of Greece from the Turkish boundary up to the Vardar River."

Signing of the armistice marked the end of the first phase of the campaign against the British in Greece and those who allowed themselves to be led by the British. The points at which mountain roads from Bulgaria debouch into Greece were in German hands. The break-through had succeeded.



Chemical Officers - Armored Force, Ft. Knox, Ky.
May 10, 1941.

- International News Photo

Attaining proficiency while masked in serving the big guns.

RECENT BOOKS

SUPPLY AND FIELD SERVICE. FIELD MANUAL NO. 3-15. *Washington: War Department, 1941. 104 pages. $.20.*

This manual contains much information not hitherto available in official publications. It carries complete information on the system of supply and field service functions. Included in subjects covered by this text are: general system of supply in the field, chemical warfare services and duties of chemical staff officers, chemical service units, decontamination, chemical warfare services to the air corps, and storage and shipment of chemical munitions.

WINGED WARFARE. *By Maj. Gen. H. H. Arnold and Col. Ira C. Eaker. New York: Harper & Brothers, 1941. 265 pages. $3.00.*

To clarify many of the current misunderstandings about our place in the air armament race, the authors have presented a simple and direct appraisal of air power today and the problems which it presents. Every phase of aerial warfare is considered; fighting planes and weapons, engines and instruments, pilots, the organization of the air force, tactics, strategy, the the problems of current expansion.

General Arnold, former Chief of the Army Air Corps is now Deputy Chief of Staff for Air. Colonel Eaker now commands a fighter group at Hamilton Field, California. Both are pioneers of the Army Air Corps and holders of the Distinguished Flying Cross. Both are experienced writers, so that this work is not only readable but most authoritative - the best exposition of American air potentialities that is available today.

CHEMICAL WARFARE. *By Curt Wachtel. New York: Chemical Publishing Co., 1941. 312 pages. $4.00.*

This book is written in an entertaining style, and, in comparison with most books on this subject, is easy reading. On the other hand there are numerous inaccuracies and misleading statements throughout the work. These range from misprints and misplaced emphasis to statements that are untrue and create a false impression of subject under consideration.

For example, the process of nitrogen fixation is dealt with

in a highly colored and romantic manner. We are informed that in the winter of 1914-15 there was a great and serious shortage of German artillery shell. This was due to the unexpectedly rapid consumption of explosive stores; meanwhile, "There was plenty of nitrogen in the air of the atmosphere, but there was only one man in the world who knew how this nitrogen of the air could be used to produce . . . explosives . . . . "

This is grossly misleading in its inference that nitrogen fixation was developed on an industrial scale after the war began. As a matter of fact the Badische Anilin u. Soda Fabrik had been engaged in research on the problem since 1909, and in September, 1913, a plant using the Haber-Bosch process began production with a capacity of 7,000 tons of fixed nitrogen per year.

In a like way the author deals with the controversial question of whether the German Chemical Warfare Service knew of Lewisite during the World War. He says, "Indeed, I had tested Lewisite in 1916 as to its physiological effects". The record shows that H. Wieland and A. Bloemers' report of their investigation does not place the work prior to 1917.

Among the reasons given by Dr. Wachtel for the Germans' failure to use Lewisite is the statement that its properties "were military disadvantages in comparison with the tactical procedure of 1918, which was called *Bunt Shiessen*, i.e., the simultaneous use of green, blue, and yellow cross shells". This procedure of *Bunt Shiessen* was actually a makeshift substitute for an effective vesicant gas such as the use of Lewisite would have provided.

Again the author asserts, "It (chlorpicrin) penetrated gas masks . . . . . because it does not react with the antiacid chemicals in the canisters". Chlorpicrin is generally used as the standard reagent for testing the absorptive power of charcoal; and the above statement seems to overlook the important fact that the low absorptive power of the charcoal in World War canisters was responsible for their penetration.

On page 89 appears the assertion: "Some poisons cannot even be detected in the air or in the organism of the victims. They would be ideal weapons for individual murder . . . . . most physicians know little about them". This vague statement implies poisoning of a type known only in fiction and movie thrillers.

Dr. Wachtel appears to have had considerable experience in connection with chemical-warfare development in Germany. This fact, together with his interesting style of writing, is sufficient to recommend his present work to students in this field, despite certain obvious technical inaccuracies.

- W.L.G.

CIVILIAN DEFENSE (STRUCTURES SERIES BULLETIN NO. 1). *War Department, Washington: Government Printing Office, 1941. 36 pages. $.25.*

This is a technical bulletin prepared by the War Department with the assistance of other Federal agencies, for the dissemination of information to aid the general public in the problem of building to protect against aerial attack.

A summary of latest information available from European sources, this bulletin covers in detail aerial weapons, ballistics, and effects of bombs. Included also is valuable information on the alteration of existing structures, and modifications to normal building practice for new buildings, to better enable them to withstand bombs.

The subject of air-raid shelters together with detailed drawings for their construction is presented in such a manner as to be of great value to anyone concerned with their fabrication.

Books reviewed in these pages may be obtained through the Book Department, Chemical Warfare School.