[redacted]

[redacted]

UNCLASSIFIED

SUMMARY OF MAJOR EVENTS and PROBLEMS

United States Army Chemical Corps (U)

Fiscal Year 1959

[redacted]

Authority DA Tam 1525 CmLHO, 22 Jun 61

January 1960

OCMH, S C No. 260003

U. S. Army Chemical Corps Historical Office

Army Chemical Center, Maryland

[redacted] COPY 1 OF 35 COPIES

~~SECRET~~

UNCLASSIFIED

REGRADED UNCLASSIFIED ORDER SEC ARMY BY TAG PER 791334

H0-20-5

UNCLASSIFIED [redacted]

[redacted]

SUMMARY OF MAJOR EVENTS AND PROBLEMS
(Reports Control Symbol CSHIS-6)

UNITED STATES ARMY CHEMICAL CORPS

Fiscal Year 1959

U. S. Army Chemical Corps Historical Office

January 1960

PAGE 1 OF 181 PAGES

[redacted]

COPY / OF 35 COPIES

[redacted]

Tables

Appendix: U.S. Army Chemical Corps Assignments as of June 1959

U. S. ARMY
CHEMICAL CORPS

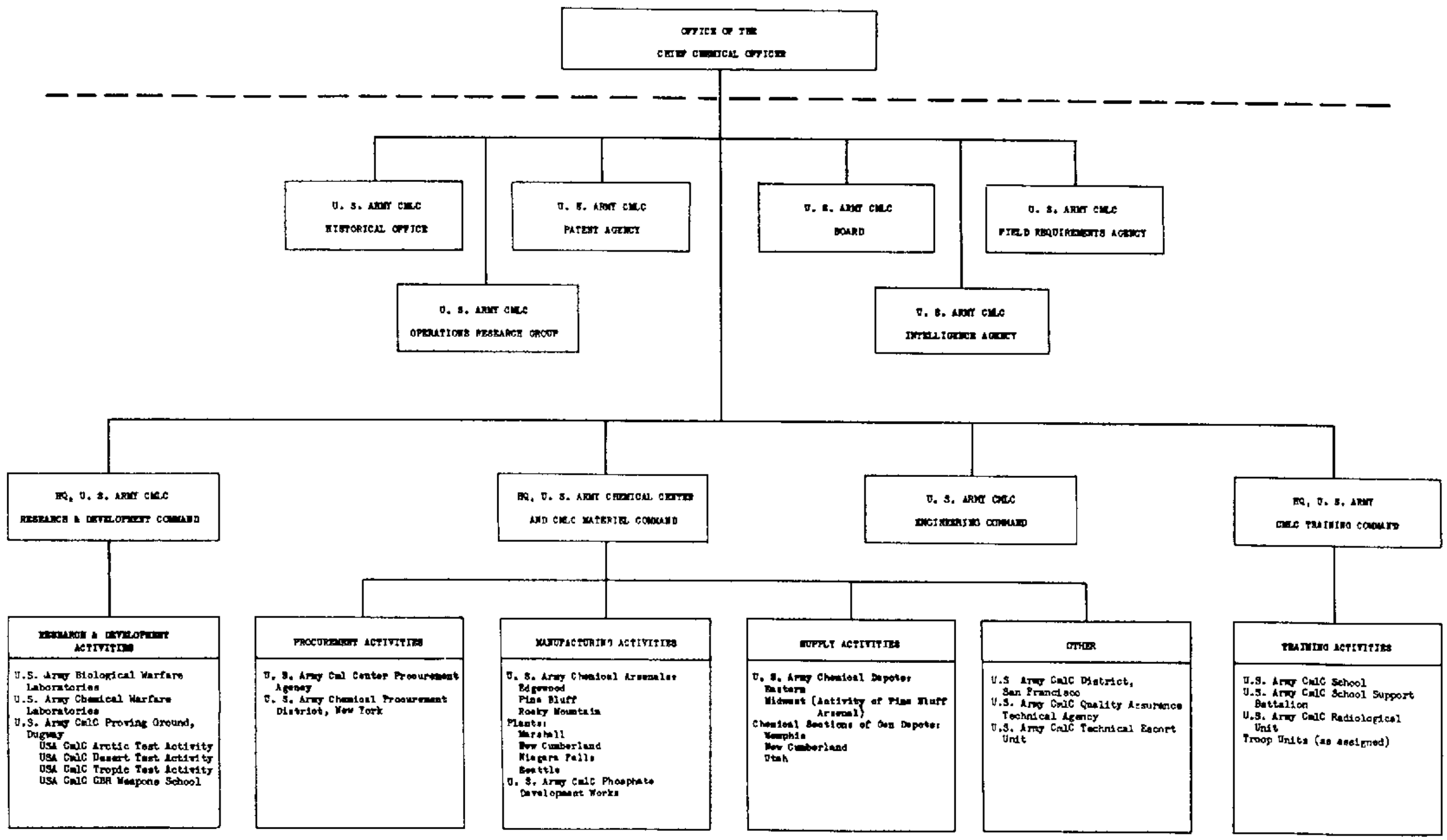


Chart No.1

PAGE 7 OF 181 PAGES

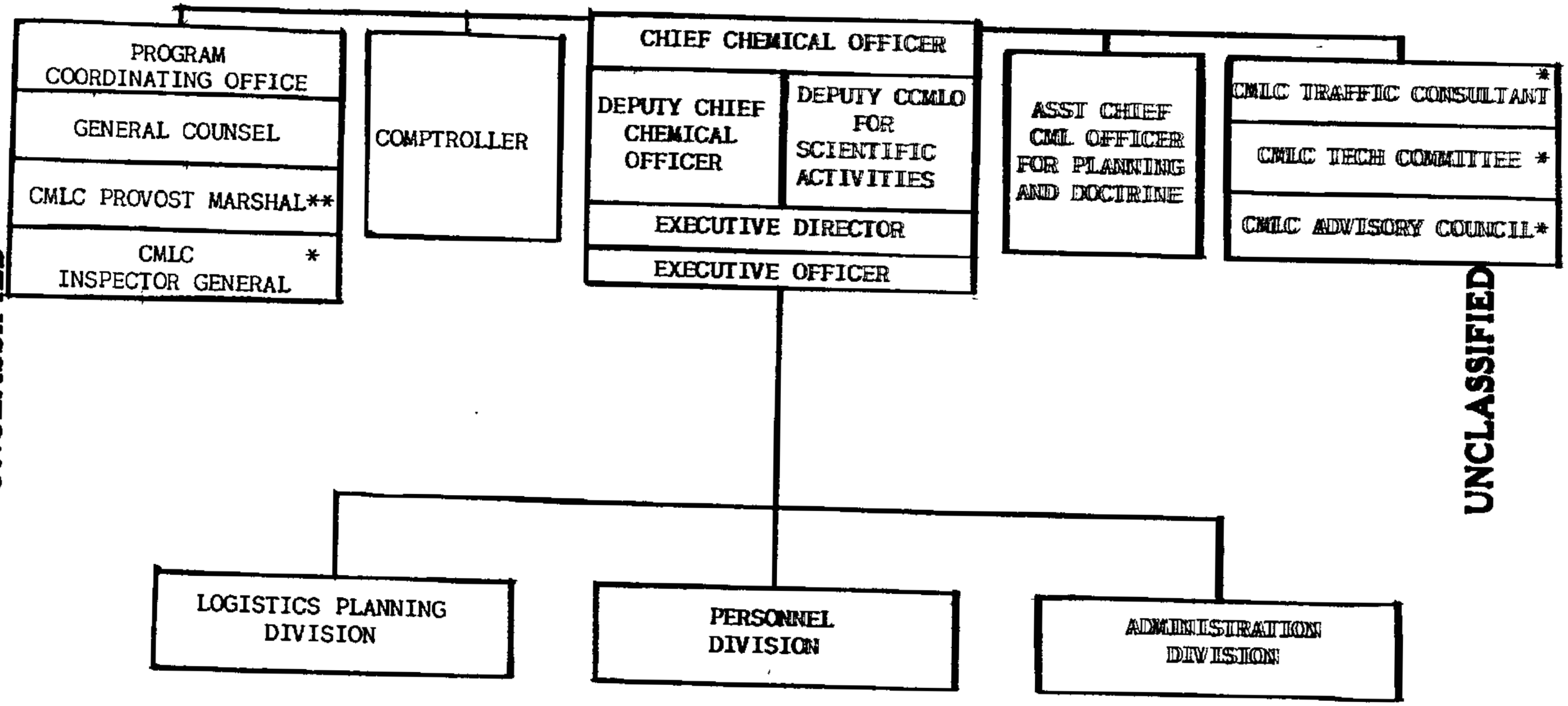
COPY / OF 35 COPIES

DATE: 1 July 1959
PREPARED BY: MANAGEMENT ENGINEERING BR O/COMPTROLLER/CMLC

UNCLASSIFIED

HEADQUARTERS, DEPARTMENT OF THE ARMY

OFFICE OF THE CHIEF CHEMICAL OFFICER



* Located outside Washington
** Located in part outside Washington

Chart No. 2

30 June 1959

PAGE 8 OF 181 PAGES

COPY / OF 35 COPIES

UNCLASSIFIED

OFFICE OF THE ASSISTANT CHIEF CHEMICAL OFFICER FOR PLANNING AND DOCTRINE

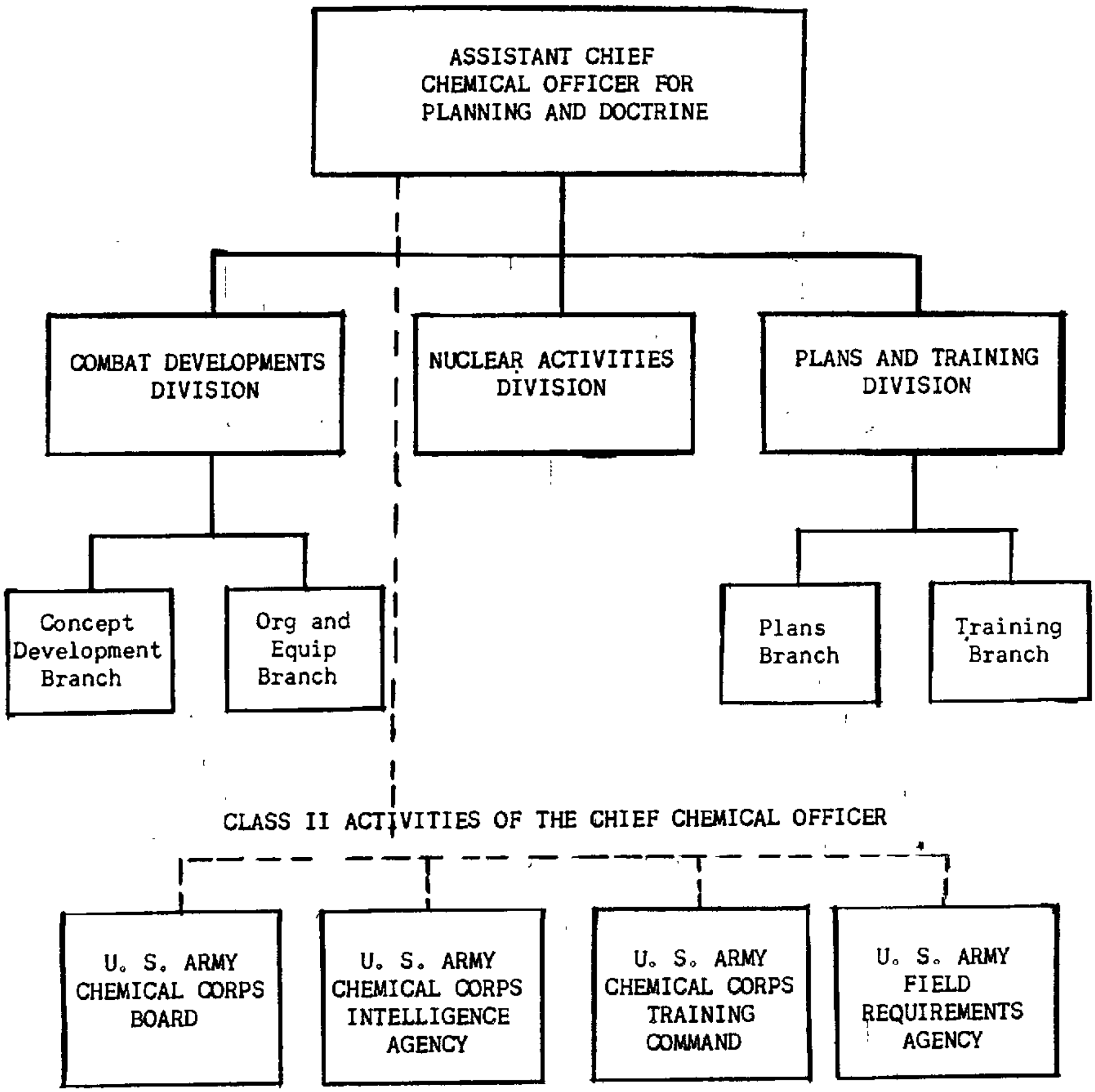


Chart No. 3

COPY / OF 35 COPIES

RESEARCH, DEVELOPMENT AND ENGINEERING

Administration

(U) The Chemical Corps' research, development, engineering, and testing activities were carried on by the Research and Development Command (Charts 7,9 &10) and by the Engineering Command (Chart 8). On 1 January 1959 Col. Graydon C. Essman, Commanding Officer of the R&D Command was elevated to the rank of Brigadier General.

(U) During FY 1959 the Corps received from Department of the Army and other agencies approximately 38 million dollars for R&D funds. By the end of the fiscal year it had obligated 98 percent of this. The proposed budget for FY 1960 was geared to take another jump, this one of more than three million dollars.[152]

(S) On 10 March 1959 the Defense Science Board approved a report prepared by an Ad Hoc Committee (The Reeves Committee). This report concluded, among other things, that "chemical warfare, in its present state of development, can inflict devastating casualties on unprotected personnel, both military and civilian. Biological warfare, although primarily concerned with incapacitating rather than lethal effects, can also present serious problems with respect to both types of personnel." The report recommended that the Secretary of Defense "urge the Services to develop and establish

152 (1) Quart Rev, Apr - Jun 58, p. 90. (2) Quart Rev, Apr - Jun 59, p. 51.

U.S. ARMY CHEMICAL CORPS RESEARCH AND DEVELOPMENT COMMAND

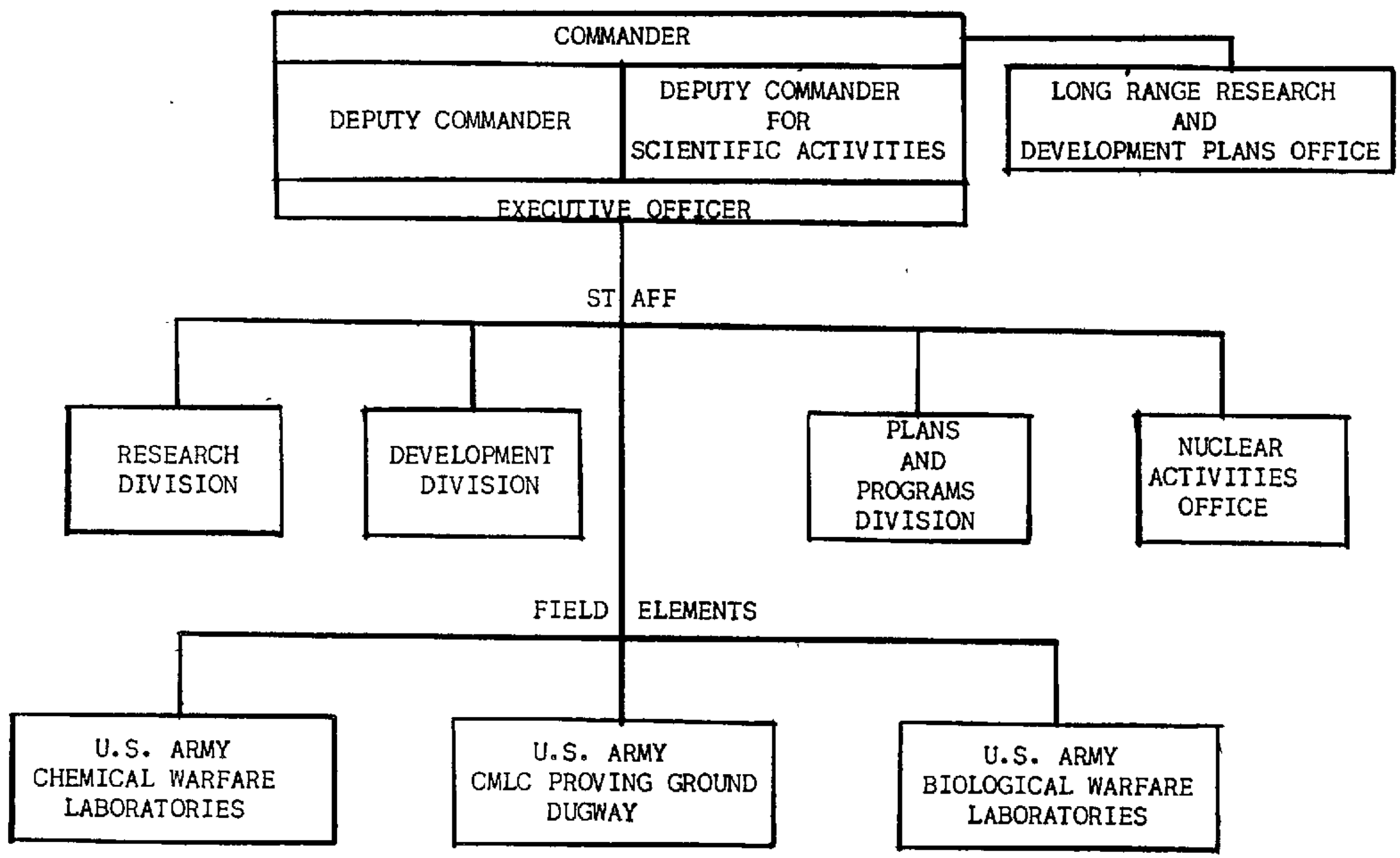
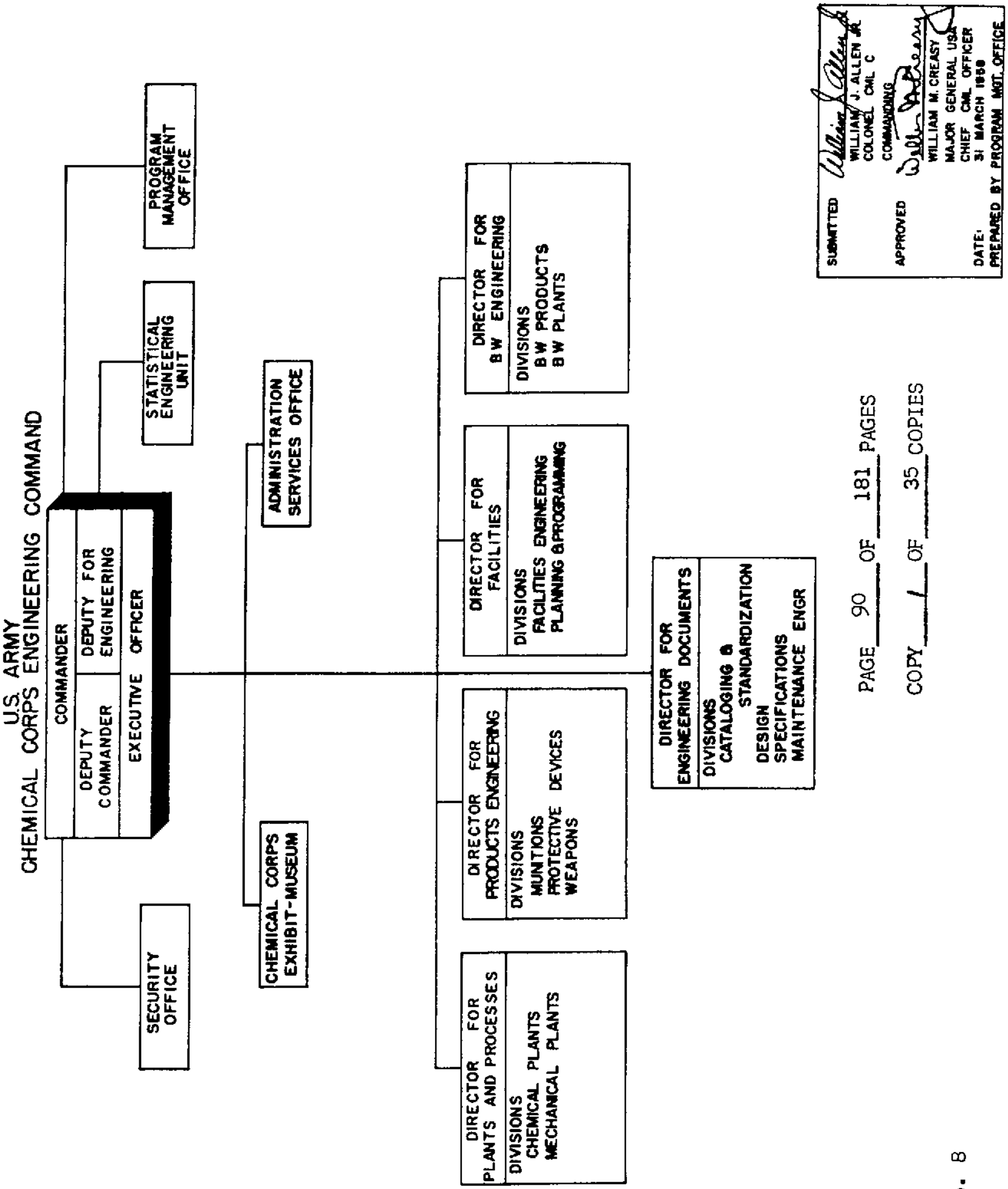


Chart No. 7

UNCLASSIFIED



PAGE 90 OF 181 PAGES

COPY 1 OF 35 COPIES

Chart No. 8

UNCLASSIFIED

U. S. ARMY CHEMICAL CORPS RESEARCH AND DEVELOPMENT COMMAND

U.S.ARMY CHEMICAL CORPS PROVING GROUND

DUGWAY PROVING GROUND

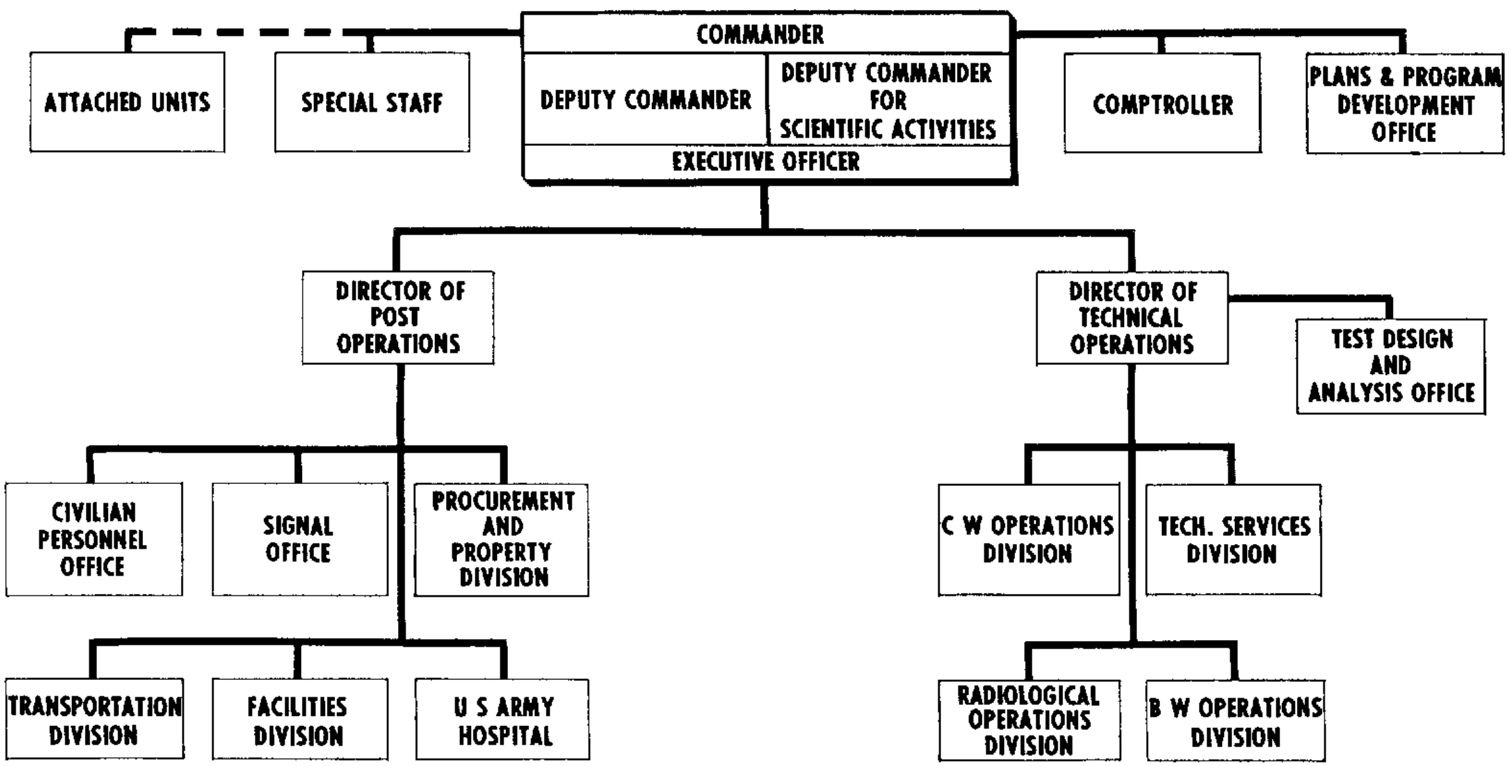


Chart No. 9

PAGE 91 OF 181 PAGES

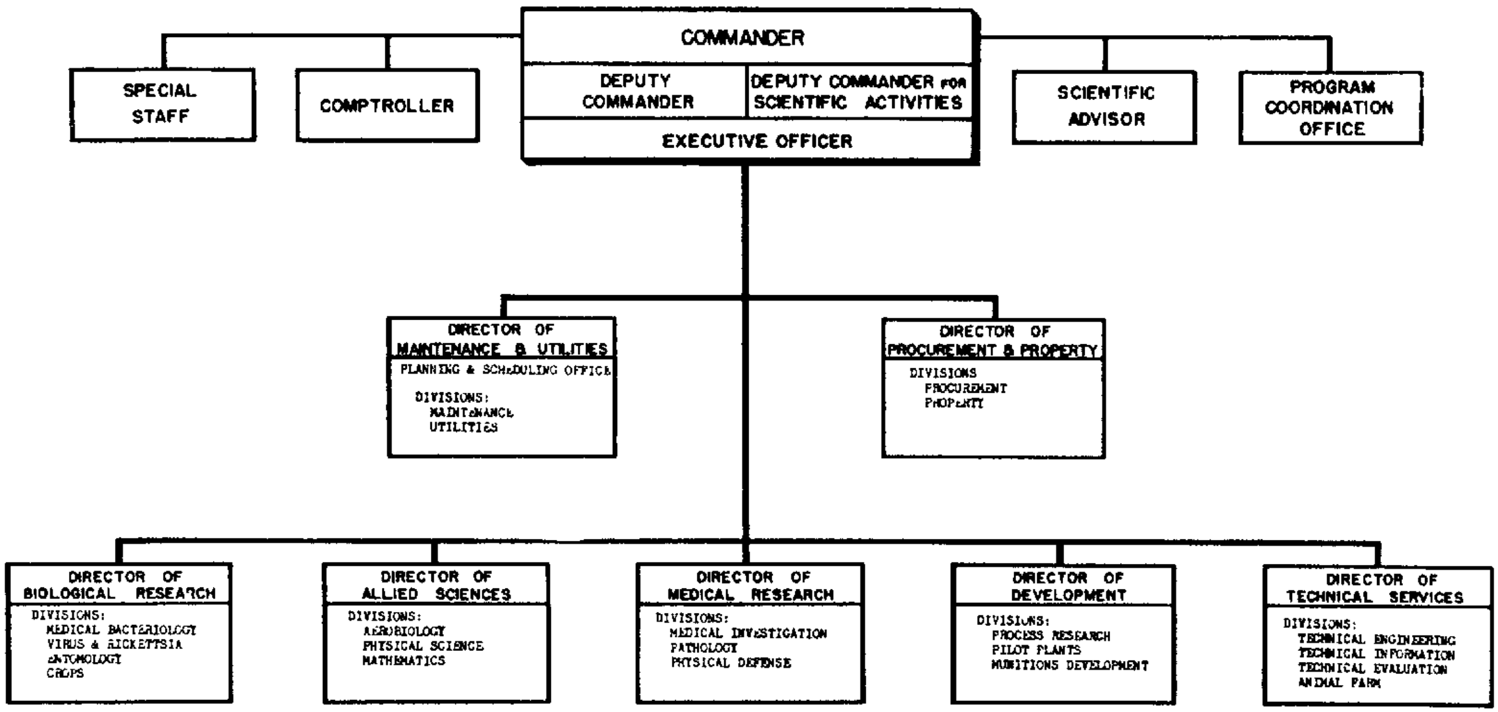
COPY 1 OF 35 COPIES

UNCLASSIFIED

U.S. ARMY CHEMICAL CORPS RESEARCH AND DEVELOPMENT COMMAND

U.S. ARMY BIOLOGICAL WARFARE LABORATORIES

FORT DETRICK



PAGE 92 OF 181 PAGES

COPY 1 OF 35 COPIES

Chart No. 10

SUBMITTED: D. G. GROTHAUS
COLONEL, CmlC
COMMANDING

APPROVED: GRAYDON C. ESSMAN
COLONEL, CmlC
COMMANDING, CMLCRDCOM

DATE: 1 December 1958

requirements for chemical and biological warfare weapons systems," and to take steps "to provide an appreciably increased effect on chemical and biological warfare research, particularly with respect to: (a) non-lethal agents, (b) agents not protected against by masks, and (c) effective defensive measures." The report also urged the development of parallel programs for R&D, War gaming, and combat development field trials, and for securing public acceptance and support for chemical and biological warfare.

(S) Two days later Dr. Herbert York, Director, Defense Research and Engineering, DOD, appointed an Ad Hoc B&C Group to recommend the action that the Secretary of Defense should take to implement the recommendations of the Defense Science Board. Based upon the advice of the Group, Dr. York briefed the Secretary of Defense and Joint Chiefs of Staff on BW and CW. As a result of this activity the Corps, at the end of the fiscal year, looked forward to an increase in funds, and to playing a large role in the U.S. defense effort.[153]

(U) In May, Dugway Proving Ground received funds to construct a radioactive test facility. The first test area, planned for completion during calendar year 1959, was to be 210 yards in diameter and contaminated

---

153 (1) Ltr, John L. Schwab, CmlC representative to DOD Ad Hoc B&C Group, to distribution, sub: York Committee, 27 Mar 59. (2) OCCmlO, CmlC Info Memo, 10 Aug 59. (3) Presentation by Maj Gen Marshall Stubbs at AFSC, Norfolk, Va, 30 Sep 59.

with sufficient cobalt^{60} to give an intensity of 100 roentgens per hour. Dugway planned two other fields of the same size, contaminated with cesium^{137} chloride, for technical experiments, and one large area of from one to ten miles square suitable for operational units to solve doctrinal and tactical problems. The Navy, Air Force, AFSWP, AEC, and Civil Defense were all interested in the possibility of using the facility.[154]

(C) In June the Army awarded an 8 million dollar contract to Food Machinery and Chemical Corporation for the construction of a VX agent plant at the inactive Dana heavy water plant of the Atomic Energy Commission at Newport, Indiana. Shortly thereafter the Corps supplemented the contract to provide for a filling line for shells and missiles. The Corps has set a target date of July 1961 to go on stream with the plant. The Engineering Command had technical supervision for the design of the VX Plant.[155]

(U) During FY 1959 the Corps received permission to engage in the Army's polar research program. At Dugway a Polar Environmental Test and Research Team, consisting of an officer and two enlisted men, was established in March 1959. The Team was based at Camp Tuto, Greenland, and scheduled to start operations in July. The team's first task was to learn

---

154 (1) *Quart Hist Rpt, Dugway Proving Ground*, Apr - Jun 59. (2) CmlC Info Memo, 16 Feb 59.

155 Interv, Hist Off with Mr Charles J. Helmer, Prog Mgmt, ENCOM, 16 Nov 59.

if a number of Chemical Corps items could be stored and operated in a polar environment.[156]

Thirteenth Tripartite Conference

(S) During the period 15 - 26 September 1958 the Thirteenth Tripartite Conference on Toxicological warfare, between the United Kingdom, Canada, and the United States, was held in Canada. Col. Graydon Essman headed the U.S. delegation. The three nations agreed on several major points, including the following: (a) research should be continued on organophosphorus compounds, specifically in areas where there is a possibility of marked enhancement in speed of action and resistance to treatment; (b) all three countries should concentrate on the search for incapacitating and new type lethal agents; (c) high priority should be given to improved prophylaxis and therapy of anticholinesterase poisoning; (d) work should be continued on BW warning devices; (e) studies should be continued on aerosols. The conferees planned to hold the Fourteenth Conference at Army Chemical Center, Maryland, 14 - 26 September 1959.[157]

156 (1) Quart Hist Rpts, Dugway Proving Ground, Jan - Mar 59, Apr - Jun 59. (2) CCTC Item 3597, The Chemical Corps' Polar Research Program for CY 1959, 30 Jun 59.

157 CmlC Info Memo, 5 Mar 59.

CS

(C) In FY 1959 the Corps added another compound, o-chloro-benzal malononitrile, symbol CS, to its list of irritant agents. The military story of CS goes back to 1956 when the British War Office established a requirement for a new riot control agent. Previously the British and the Americans had depended largely upon chloracetophenone, CN, because of its lachrymatory properties, low cost, and ease of dispersion. The disadvantage of CN in riot control, as the British and Americans learned in Korea and the British again on Cyprus and at other places, was that it would not drive back fanatical rioters.

(C) The British started their search for a new agent by synthesizing almost 100 compounds. What they desired was an agent that would act on the other senses besides the eyes (determined rioters could stand firm against CN by simply closing their eyes), and would be so unpleasant that rioters with high courage and morale would not be able to withstant its effects. In addition they wanted a compound from which the rioter would be slow to recover (to discourage reassembly), would not injure the skin, eyes, lungs, or other parts of the body, would be reasonably inexpensive, stable in storage, and easily dispersed. Out of the screening program came the new agent, o-chloro-benzal malononitrile.[158]

(U) The British informed the American Army of the compound during the 1958 Tripartite Conference. As a result, the Chemical Corps conducted its own evaluation of the compound and found it to be very effective. It has a pepper-like odor, and causes severe burning and lachrymation of the eyes, irritation of the nose, throat, and chest, coughing, respiratory difficulty, and running nose. A person exposed to the material vomits, is overcome by nausea and vertigo, and cannot open his eyes. The agent is effective in very low concentrations, and the effects last from five to twenty minutes after exposure.[159]

(C) The Chemical Corps in the latter part of 1958 set up a crash program, "Black Magic," to produce the agent as a filling for tear and riot grenades, the Irritant Gas Disperser, the Helicopter Disperser, the Portable Gas Disperser, and the All-Purpose Army Aircraft Spray Tank. In June 1959

---

158 Porton Technical Paper 651, Agents for Riot Control, the Selection of T.792 (o-chloro-benzal malononitrile) as a Candidate Agent to Replace CN, 6 Oct 58.

159 (1) CmlC Board Rpt, Evaluation of the Probable Operational Usefulness of the Nonlethal Chemical Agent EA 1779, 20 Oct 58. (2) CWL Technical Memo 5 - 8, Notes on Agent EA 1779, 7 Nov 58. (3) CCTC Item 3556, CS (EA 1779), 30 Apr 59.

the Corps designated the compound as a standard agent. Following the United Kingdom, the Corps adopted the symbol CS to designate the agent. The letters C and S stand for the initials of two American chemists, Carson and Staughton, who first synthesized the compound in 1928.[160]

Tularemia

(S) Ten years ago in its search for biological warfare agents the Chemical Corps established a project to determine the military usefulness of Bacterium tularense. This micro-organism causes tularemia, also known as rabbit fever and deer-fly fever. The disease occurs naturally in many kinds of animals, and is passed along to man by ticks, flies, contaminated water, infected animal meat, or inhalation of infected material. Man comes down with the sickness one to ten days (most commonly three days) after being infected. The victim is prostrated with chills and fever. There are two forms of tularemia, the cutaneous and the typhoidal. The latter is much more dangerous, with the mortality rate in untreated cases about 30 percent. If pneumonia develops the mortality rate jumps to 40 percent. It is this typhoidal form which is of paramount importance as an agent. The new

---

160 (1) CCTC Item 3549, Code letters for compound EA 1779, 12 Mar 59. (2) CCTC Item 3581, Classification of Irritant Agents, CS and CS1 as Standard Types, and authorization for use in M7A1 and M25A2 Hand Grenades, the M2 Irritant Gas Disperser, and CS Capsule, 30 Jun 59.

antibiotics are quite effective in arresting the progress of tularemia infections, but they do not modify the debilitating effects of the disease. This is important because convalescence from the disease is usually slow and may extend for a period of from six months to a year. Troops, therefore, infected with Bacterium tularense could turn into long-term hospital cases, putting a strain on enemy hospital facilities as well as effectively putting soldiers out of action.[161]

(S) The micro-organism Bacterium tularense is approximately .3 micron in diameter and .7 micron long. It grows best around 37°C, the temperature of most warm-blooded animals. It is resistant for months at temperatures around freezing, but is easily killed by heat at 45°C for a few minutes. It can be grown on artificial culture media if care is exercised in controlling the conditions. There are a number of strains of the micro-organism, and the one chosen by the Corps as an agent was a streptomycin-resistant strain.

(S) Fort Detrick's BW laboratories developed and maintain the stock culture of B. tularense from which the organism was grown in large quantity

---

161 (1) Project 4-11-02-19, Bacterium tularense as an Agent for BW, established by CCTC Item 1882, 14 May 48. (2) TM 3-216, Military Biology and Biological Warfare Agents, 11 Jan 56. (3) Project 4-92-02-031, Wet Suspension of Pasteurella tularense, established by CCTC Item 2876, 29 July 54.

by the Directorate of Biological Operations at Pine Bluff Arsenal. At Pine Bluff production of the micro-organism was carried out at a temperature of approximately 37°C. The subsequent processing, storage, and handling was done at 4°C. Four degrees was picked because at this temperature the micro-organisms have a fairly long life (in a batch of the micro-organisms one-half will be alive after 40 days) and it is a temperature that can be readily maintained by standard equipment.

(S) The Corps' CP-120 program, designed to evaluate the effectiveness of E120 bomblets loaded with liquid B. tularense, had indicated that a single aircraft sortie would produce more than 50 percent casualties over an area of 16 square miles. But while the munitions are capable of causing widespread outbreaks of tularemia, they can be transported, stored, and handled logistically with no more hazard than with regular explosive munitions.[162]

(S) Satisfied that the development of B. tularense had reached the point of uniform mass production in a form specified to produce optimum military effects, the Army in August 1958 accepted the suspension of

---

162 Summary Report, Development of Liquid Bacterium tularense as a Biological Warfare Agent, Pilot Plants Division, Fort Detrick.

B. tularense prepared by the Corps as a standard type BW anti-personnel agent.[163]

Yellow Fever

(C) In 1953 the Biological Warfare Laboratories at Fort Detrick established a program to study the use of arthropods for spreading anti-personnel BW agents. The advantages of arthropods as BW carriers are these: they inject the agent directly into the body, so that a mask is no protection to a soldier, and they will remain alive for some time, keeping an area constantly dangerous.[164]

(C) One of the insects picked for the study was the Aedes aegypti mosquito, the carrier of yellow fever virus. This species is widely distributed between latitudes 40°N and 40°S. In the United States it occurs as far north as Norfolk, Virginia, but cannot survive the winters north of this latitude. The mosquito favors human habitations as breeding places. The female mosquito sucks blood from animals or humans, but seems to prefer humans. It takes its first meal two days after emerging from the larval stage and seeks blood again at intervals of about three days. While probing for blood the mosquito transmits yellow fever virus to the unknowing victim.

---

163 (1) Technical Study No. 6, Military Effectiveness of Bacterium tularense, Program Co-ordination Office, Fort Detrick, 6 May 58. (2) CCTC Item 3458, Classification of Bacterium tularense, 27 Aug 58.

164 Cml Corps Board Report, "Insect-Borne Antipersonnel BW," 25 Nov 58.

(U) Yellow fever is a highly dangerous disease. A person begins to show symptoms of the fever from two to ten days (the average is three days) after he has been bitten by the mosquito. The fever appears suddenly causing headache, high temperatures, rigor, vomiting, and even prostration. If the disease is fatal, death usually comes on the sixth or seventh day. If the patient recovers, he is weak for a period of from two weeks to two months. There is no known therapy for yellow fever, other than symptomatic, and in severe cases the patient has a poor chance of recovering. Of the clinical cases since 1900, one-third of the patients have died.

(U) Every few years an epidemic occurs somewhere in the world, primarily in Africa and the Americas, occasionally in Europe. Yellow fever has never occurred in some areas, including Asia, and therefore it is quite probable that the population of the U.S.S.R. would be quite susceptible to the disease.

(S) If military attack were made with <u>Aedes aegypti</u> mosquitos it would be quite difficult to detect the fact, particularly if this type of mosquito ordinarily lived in the area. While there is a possibility that a trained entomologist might realize that an attack had taken place, it would be unlikely. And even if an attack were suspected, it could not be confirmed until symptoms of the disease broke out, which would take two or more days. There is a yellow fever vaccine that has proven to be an effective prophylactic, but it would be impossible for a nation such as the U.S.S.R. to quickly undertake a mass-immunization program to protect millions of people. The difficulties that an enemy would face in detecting infected mosquitoes and protecting their population would make the Aedes aegypti - yellow fever combination an extremely effective BW agent.

(C) The Chemical Corps tested the practicality of employing Aedes aegypti mosquitoes to carry a BW agent in several ways. In April - November 1956 the Corps ran trials in Savannah, Georgia, by releasing uninfected female mosquitoes in a residential area, and then, with co-operation of people in the neighborhood, estimating how many mosquitoes entered houses and bit people. Also in 1956 the Corps released 600,000 uninfected mosquitoes from a plane at Avon Park Bombing Range, Florida. Within a day the mosquitoes had spread a distance of between one and two miles and had bitten many people. In 1958 further tests at Avon Park AFB, Florida, showed that mosquitoes could easily be disseminated from helicopters, would spread more than a mile in each direction, and would enter all types of buildings. These tests showed that mosquitoes could be spread over areas of several square miles by means of devices dropped from planes or set up on the ground. And while these tests were made with uninfected mosquitoes, it is a fairly safe assumption that infected mosquitoes could be spread equally well.[165]

(C) Aedes aegypti mosquitoes were produced in the laboratory by the following method. A colony of 6,000 to 10,000 adult mosquitoes were confined in a cage where they fed on sugar syrup and blood. The colony was

165
(1) BWL Technical Study 7B, Short title XYA - 8121, July 1958.
(2) Fort Detrick Special Report 280, "Operation Drop Kick," 1956.

maintained for two weeks, then destroyed. During their life the mosquitoes laid hundreds of thousands of eggs on moist paper towels. Mosquito eggs, which could be kept for several months under proper temperature and humidity, were hatched in water and the larvae reared in trays. The larvae turned into adult mosquitoes one to two weeks later. Fort Detrick's laboratories were capable of producing a half million mosquitoes a month, and the Engineering Command designed a plant capable of producing 130 million mosquitoes a month.[166]

(C) The yellow fever virus employed by Fort Detrick came in human serum obtained from a person in Trinidad who had been infected with the disease in the epidemic of 1954. Scientists inoculated Rhesus monkeys with the serum, and thus propogated the virus. Approximately 100 ml of plasma containing virus were obtained from a monkey. Fort Detrick found that infected monkey serum would maintain its virulence for at least two years.[167]

(S) Aedes aegypti mosquitoes were infected with yellow fever virus by taking larvae, 3 or 4 days old, and immersing them in infectious Rhesus monkey plasma. The infected larvae were reared in the same manner as uninfected larvae. The virulence of infected mosquitoes was tested by allowing them to bite and infect Swiss mice.

(S) By action of the Chemical Corps Technical Committee the yellow fever virus - Aedes aegypti mosquito was classified as a standard type in June 1959.

---

166 ENCR No. 24, Engineering Concept Report, Project X-701, Feb 1959.

167 BWL Report, Short Title XYA - 9286, 1 Apr 59.

The Corps proposed to construct a large-scale facility for production of the agent-vector combination as part of the Industrial Mobilization Program. If employed, it could be disseminated in $2\frac{1}{2}$-lb containers of the 750-lb cluster; 4.5-inch spherical bombs for aircraft dispensers; and 3.4-inch spherical bombs of the BW SERGEANT warhead.[168]

Anticrop BW

(S) During World War II the Chemical Corps started research on anticrop agents as a part of its mission in biological warfare. Scientists at Fort Detrick made a search for chemical compounds that could injure or kill plant life, and began study of micro-organisms that were deadly to plants. In 1957 the Army decided that it had to stop research on anticrop warfare because of a shortage of funds. Maj. Gen. William M. Creasy, Chief Chemical Officer, protested, pointing out that the action would be practically irreversible once it had commenced. The Chief of Staff reviewed the Army's proposal to cut funds, and decided that no other alternative was available. The Corps thereupon phased out the research program, maintaining only limited facilities for agents already developed and standardized.[169]

(S) In October 1958, the Chief of Research and Development, DOD, requested the Corps to resume anticrop warfare research. This had been made

---

168 CCTC Item 3582, Classification of Yellow Fever....as a Standard-A Type (S).

169 (1) Summary of Major Events and Problems, FY 58, pp. 104 - 06. (2) CCTC Item 3363, Anticrop Warfare Program, 12 Dec 57.

possible because sufficient unobligated balances of prior year R&D funds existed on 30 September 1958 to support anticrop BW research for a six month period, 1 January 1959 to 30 June 1959.[170]

(S) The Corps reactivated its anticrop warfare research project and began work at Fort Detrick. The funds available for the six month period in 1959 amounted to $200,000. The funds needed for the next three fiscal years were estimated at $500,000 each year.

(S) The objects of the revived anticrop program were: (1) research on biological and chemical anticrop agents effective against cereal and broad-leaf crops of economic importance; (2) conduct of epidemological studies in suitable climatic analogues of potential target areas; (3) screening of new biological anticrop agents, including viral types; (4) search for new chemical anticrop agents by screening and synthesis of new compounds and by liaison with the chemical industries; (5) research on promising chemical and biological agents in the laboratory and greenhouse, and on field-grown crops to establish agent potential prior to large-scale testing; (6) research to determine practical anticrop dissemination techniques and equipment suitable for field testing and possible operational applications; (7) to maintain close contact with the United States Department of Agriculture, universities and other agricultural institutions in order that information of military value may be properly correlated; and (8) to conduct target analysis

---

170 D/F, CRD/A, CofR&D, to CCmlO, sub: Anticrop BW Research, 29 Oct 58.

studies to include estimation of the economic and military impact of anticrop operations on selected target countries.[171]

BW Spray Tests

(C) On 16 December 1957 the Biological Warfare Laboratories awarded a contract to North American Aviation, Inc., to determine the feasibility of conducting large-area biological warfare attacks by means of spray tanks carried on low flying aircraft. North American modified a 275-gallon fuel tank to act as the spray dispenser. In the bow of the tank was a pressure source to force the liquid BW agent, contained in the middle section, through a nozzle in the tail of the tank. A critical point in the work was the development of a nozzle that would spray out liquid particles 5 microns or less in size, so that minute drops of the liquid agent would float in the air over a wide area. North American and Battele Memorial Institute assessed various nozzles in wind tunnels to find the effect of air velocity, ejection pressure, fluid composition, and nozzle design.

(C) After completing and testing the spray system, North American shipped it to Dugway Proving Ground. There, in August and September, 1958, Dugway ran six trials at night, flying the spray tanks on wings of an F-100A airplane. The pilot flew the craft over a triangularly shaped area, approximately 15 miles long and 12 miles wide. In the area were 72 sampling

---

171

(1) Project Data Sheet, Project 4-11-01-004. (2) CCTC Item 3521, Reactivation of Project 4-11-01-004, Anticrop Warfare Research, in the FY 59 R&D Program, 12 Feb 59.

devices, while at one end was a tower 300 foot high with sampling devices every five feet. The Corps contracted with Stanford University's Aerosol Laboratory to analyze the aerosol cloud behavior during the tests. The flight trials proved the feasibility of spray attacks, and showed that an area 10 miles or better could be covered downwind. While five trials were made with simulants, one flight was made carrying the agent that causes Q fever. Guinea pigs were placed at the sampling stations. Results indicated that if human beings had been in the area, 99 percent of them would have been infected. Other important results from the tests were these: that a spray device would disseminate BW aerosol more effectively than bombs, shells, or special BW munitions; and that the tank held a much larger quantity of liquid agent, in regard to the weight of the spray system, than other BW dissemination devices.

(C) The contract proved that airborne BW attacks could be carried out at low levels, and that a properly designed spray system could contaminate 50,000 square miles with BW aerosol in a single sortie. The significance of this lies in the remarkable efficiency of this means of attack. For example, on a night when the wind was blowing ten miles per hour, three large aircraft, each carrying 4,000 gallons of liquid BW agent, and flying at a speed of 500 knots, could spray an area of 150,000 square miles, causing more than half the people in the area to become ill.[172]

172

(1) North American Aviation, Inc, Airborne Biological Warfare at Low Altitudes, 2 volumes, contract No. DA-18-064-404-CML-338, 16 Jun 59. (3) Interv William L. Jacobs, Program Co-ordination Office, Fort Detrick, 30 Nov 59.

Mask, Protective, Field, M17

(U) Two years after World War II ended the Chemical Corps standardized a new type mask, known as the M9 series, in which the canister was fastened directly to one side of the facepiece. The latest version of the mask, Model M9A1, was adopted in 1951. This mask was the culmination of three decades of development and it represented an excellent protective device. The Corps, however, wanted to go further in increasing the protection available to the soldier and it began development of a mask intended to be even more reliable, on any face size and skin texture, and more comfortable in any climate, than the M9 type.

(U) Among the new masks designed was the canisterless type, in which special pads of material, inserted in both cheeks of the facepiece, took the place of a canister. These pads weighed less than a canister, gave less resistance to breathing, and could be easily replaced when they were exhausted.[173]

(U) Tests in the temperate zone by the Infantry Board at Fort Benning in 1957 gave the mask a good grade, but the Arctic Test Board found that the mask was not suitable in cold climates. When the arctic wearer began to sweat, the lens on the mask fogged or even frosted. Furthermore, frost and ice gathered on the air inlets, caused by moisture in warm exhaled air freezing as it hit the cold incoming air.

(U) The Chemical Warfare Laboratories then made several changes in the mask, including the substitution of low-temperature rubber compound to

173 CWLR 2203, Final Design Report on Field Protective Mask, E13R9, Dec 1957.

keep the mask from stiffening, improvement of valves, use of double-paned glass in the eyelens with a dead air space between, and provision for an outside eyelens to act as a "storm-window." The Chemical Corps Arctic Test Team at Fort Greely, Alaska and the Arctic Test Board found the improved mask satisfactory. The Corps standardized it as the M17 in March 1959.[174]

Gas Mask Vulcanizer

(U) Originally when a soldier discovered a small hole or cut in his protective mask he repaired it by means of a gas mask repair kit. This kit contained rubber cement, an adhesive patch, and emery cloth. Deciding that a more effective way of having masks patched was by field maintenance units, the Army finally discarded the kit in 1956.[175]

(U) At the maintenance unit masks were repaired by vulcanization. In the repair process developed by the Corps the area to be repaired was cleaned with solvent and dried. Then a hole 3/16 of an inch in diameter was punched out around the tear or pin hole and a plug of uncured rubber ¼ inch in diameter was inserted. The mask was placed in a device that heated and compressed the rubber plug, curing the plug to a tough, resilient state and joining it firmly to the facepiece.

174 CCTC Item 3535, Classification of the Mask, Protective, Field, M17 (E13R10) as a Standard-A Type, 12 Mar 59.

175 CCTC Item 3188, Reduction of Chemical Corps Items in the Supply System, 17 May 56.

(U) The Corps procured 25 of these vulcanizing devices and distributed them to CONUS and to overseas installations. The device proved satisfactory and in August 1958 was standardized by the Corps as Vulcanizer, Hot Patch, Protective Mask Face Blank, M1 (E61).[176]

Automatic G-Agent Alarm

(U) Following the discovery by the American Army at the end of World War II that the Germans possessed a new type of extremely potent chemical agents, the so-called G-agents, the Chemical Corps began to develop an automatic alarm that would detect G-agents in the field. Later, as the Corps began to construct a plant for the production of GB and to plan for the storage of GB containers and munitions, it became evident that automatic alarms would also be needed in plants and warehouses.

(U) The Corps worked on several models of plant alarms and finally concentrated on the E17, procured on an R&D contract from Leeds and Northrup. The heart of this alarm is the Schoenemann reaction in which an indole perborate solution fluoresces when it comes in contact with a G-agent.

(U) Physically, the alarm is in a metal case about 7 foot high and 2 foot square. In one section are two containers of reagents. One container has a solution of indole, isopropyl alcohol, acetone, and water; the other a solution of sodium perborate, isopropyl alcohol, and water.

176. CCTC Item 3460, Classification of Vulcanizer, Hot Patch, Protective Mask Face Blank, M1 (E61) & Rubber Stock, Molding, Uncured, 1-lb can, No. 13417 as Standard-A Types, 27 Aug 58.

The solutions flow slowly through a heater that maintains a constant temperature, and thence to a mixing tee and into an absorption cell. In the absorption cell the solution absorbs some of the surrounding air. If the air contains any G-agent vapor, a reaction takes place. This is detected in the next step when the solution flows through into a cell where it is irradiated with ultra-violet light. Ultra-violet light causes the reacted solution to fluoresce, and the fluorescence is measured by a photoelectric tube. Impulses from the tube are transmitted to a recorder, and to an alarm system. If the amount of G-agent in the air is greater than it should be, the alarm sounds. The device can detect high concentrations of G-agents and sound the alarm in 10 seconds. It can detect extremely minute amounts, too small to be dangerous, in 30 seconds.

(U) The Corps procured 29 alarms, at a cost of approximately $11,000 each and planned to order more as they were needed. Reports from Rocky Mountain Arsenal and other installations indicated that the alarms were performing quite satisfactorily. In August 1958 the Army standardized the E17 alarm as the Alarm, G-Agent, Automatic, Fixed Installation, M5.[177]

GB Bomb

(U) During the year a new chemical munition, the Bomb, Gas, Non-persistent GB, 750-lb, MC-1, was accepted as a standard item. The MC-1 is one of

---

177 (1) Final Engineering Report, CW Labs, Alarm, Gas, Automatic, E17, 11 Jul 52. (2) CRLR 472, CW Labs, Development of the E17 Automatic Plant Alarm for G-Agents, 8 May 56. (3) CCTC Item 3463, Classification of the Alarm, G-Agent, Automatic, Fixed Installation, M5 (E17) as a Standard-A Type, 27 Aug 58.

a new family of bombs being developed by the U.S. Air Force for high speed aircraft, and is longer, slimmer, and more pointed than the World War II bombs. Before the MC-1 was adopted, the standard munition for GB bombing was the M34A1 1,000-lb. cluster, containing 10-lb. bombs. In addition the Chemical Corps had two large bombs for agents besides GB, the 500-lb. AN-M78 for cyanogen chloride or phosgene, and the 1,000-lb. AN-M79 for cyanogen chloride, phosgene, or hydrogen cyanide.

(C) The objection that the Air Force found to the M34A1 cluster was poor aimability from speedy fighter bomber aircraft. Furthermore, the 500-lb. and 1,000-lb. bombs, while found by tests at Dugway Proving Ground to be effective in GB bombing, were not entirely suitable for employment by present day aircraft. The Chemical Corps suggested that the 500-lb. and 1,000-lb. bombs be improved, but the Air Force decided that the best solution was to modify the new 750-lb. GP Demolition Bomb, T-54 series, to hold a GB filling.[178]

(C) The Air Force adapted the Demolition Bomb by replacing the bolted base plate with a welded base plate having a hole for agent filling, and by inserting an axial burster tube. Without the fins the bomb is approximately 50 inches long and 16 inches in diameter. The assembled bomb ready for dropping weighs approximately 700 pounds, including 215 pounds of GB filling.

(C) Dugway Proving Ground ran agent-burster-ratio dissemination tests, and final development trials (dosage and dissemination). The Air Force also

178 (1) DPG Rpt 119, AN-M78 and AN-M79 Gas Bomb Tests, 25 Apr 53. (2) CCTC Item 3150, ARDC Project 5138, Toxic CW Munitions, 21 Dec 1955.

ran tests at Eglin Field using Chemical Corps samplers to obtain data on cloud travel, dissemination under various meteorological conditions, and munition expenditures. Satisfactory results in all tests, including bomb drops from altitudes of 40,000 feet at speeds of 450 knots, led to standardization of the munition in February 1959.[179]

(C) The MC-1 bomb is designed to achieve a relatively high percentage of non-persistent dissemination. However, tests at Dugway showed that sufficient GB lingered over an area to make it dangerous to unmasked personnel for two days after a burst.

(U) The 200 bombs needed for the test program were supplied by the Air Force to Rocky Mountain Arsenal, where the Corps filled them with GB and assembled them. When procurement of the bombs is started, the Ordnance Corps will furnish the complete round assembly, and the Chemical Corps will fill and assemble the munitions.

PTV Incendiary Mixture

(U) During the year the Corps standardized a new incendiary bomb filling, PTV. This filling is a descendant of the original PTI filling devised during World War II containing gasoline, petroleum oil extract, isobutyl methacrylate to gel the gasoline, magnesium to raise the temperature of the burning filling and to leave a hot ash, and oxidizing agents to assist combustion.

179 (1) DPGR 219, Final Development Testing of the MC-1 Bomb, Eglin AFB, Nov 56. (2) Classification of Bomb, Gas, Non-persistent GB, 750-lb, MC-1, as a Standard-A USAF Type, 12 Feb 59.

(U) A disadvantage of the PTI filling lay in the precautions that had to be taken during manufacture. In order to reproduce uniform batches of filling, the isobutyl methacrylate thickener and petroleum oil extract had to be of consistent quality. To find a more easily manufactured and perhaps a superior filling the Corps continued the incendiary project after World War II.

(U) Two of the experimental fillings, PT2 and PT3, developed subsequently contained thickeners of synthetic rubber. During the mixing process vulcanizing agents, such as sulfur monochloride, had to be added to the synthetic rubber. The mixing had to be done under carefully controlled conditions, with watch on the humidity, or else the batches would not be uniform. The problems in manufacture were of such great magnitude that the Corps finally abandoned PT2 and PT3 mixtures.[180]

(U) Incendiary mixture PT5, developed concurrently with PT2 and PT3, was thickened by a synthetic rubber that did not require vulcanization, and therefore did not need to be mixed under controlled humidity. This PT5 mixture was the ancestor of the final mixture, PT5R2, having the following composition:

Polybutadiene XP 268	5%
Gasoline, automotive	61%
Magnesium, granulated	28%
Sodium nitrate	6%
p-Aminophenol	0.1%

180
(1) Subproject 4-09-02-020-04, Flame Fuels and Thickeners. (2) CCTC Item 2926, *Discontinuance of Work on Incendiary Mixture, PT3R1*, 12 May 54.

The use of polybutadiene makes it easy to prepare batches of uniform quality. All of the components of the mixture can be obtained readily from domestic sources, which eases procurement problems.

(U) In 1955 the Corps purchased, under user test procurement, a quantity of PT5R2 to make certain that uniform batches could be produced, in 10-lb. M74 bombs. Different batches of the thickener proved satisfactorily consistent in consistency and elasticity. Blobs formed when bombs were exploded had diameters of two to four inches. Storage tests indicated that the filling would not deteriorate in the arctic, the tropics or the desert. Burning blobs of mixture adhered to wooden surfaces, even when the wood was placed at angles of ninety (90) degrees. Flight tests at 10,000 feet showed the bombs had good ballistic stability.[181]

(U) Following satisfactory tests the Corps produced 36,000 pounds of PT5R2 and loaded the mixture into 9,000 M47 10-lb. bombs, as an industrial preparedness measure. Satisfied with the quality, incendiary power, and ease of production of the new agent, the Army classified it as a standard item, with symbol PTV, in August 1958.[182]

Burster, Incendiary, Field (M4)

(C) During the Korean conflict troops improvised the following flame devices; Flame Land Mine X200, the Flame Illuminator that burned with a

181 CRLR 545, Final Development Test, Incendiary Mixture, PT5R2, 20 Oct 55.

182 CCTC Item 3452, Classification of Incendiary Mixture, PTV as a Standard-A Type, 27 Aug 58.

bright jet three to five feet high, the Flame fougasse, and the Husch Flare, an illuminator in which thickened gasoline could be burned. A weak point in these field expedients was the lack of a suitable incendiary burster. Soldiers used blasting caps, blasting cords, detonating machines, and so on, but these were not entirely suited for the munitions. In 1954, following a study by the Chemical Corps Board, the Corps set up a project to develop an efficient burster.

(C) The completed burster consisted of three tubes, the outer, of steel, approximately a foot long and one and one-half inches in diameter; the inner two of cellulose nitrate. The inner tubes held pellets of tetryl to blow the device apart. The space between the tubes and the steel jacket was filled with an ignition mixture to start the fire. After tests by the USA Infantry Board at Fort Benning and the Arctic Test Board at Fort Greeley, Alaska, had proven the suitability of the item, the Chemical Corps standardized it in February 1959 as Burster, Incendiary, Field (M4).[183]

Protection and Treatment Set M5A2

(U) As a result of the introduction of G-agents the Chemical Corps had to add a new medicinal to its Protection and Treatment Set. This substance was atropine tartrate, an antidote against G-agent poisoning. Since atropine tartrate has to be injected into the blood stream to overcome the effects of the G-agent, it was packaged in syrettes, small collapsible

---

183 CCTC Item 3520, Classification of Burster, Incendiary, Field, M4 (E4) as a Standard-A Type, 12 Feb 59.

metal tubes filled with a solution of the atropine salt and fitted with a hypodermic needle at one end. In operation the soldier was to jab the needle into his thigh muscle and force the atropine out by squeezing the tube. Many soldiers, however, have a fear of sticking a hypodermic into themselves and for this reason the Army Medical Service developed a new type of injector. This is an aluminum tube, about the size of a small cigar, containing a spring-driven hypodermic full of atropine solution. The soldier simply pushes the tube against his thigh, pulls a safety pin, and the spring drives the needle into this muscle. In June 1959 the Corps officially substituted the new atropine injector for the old syrette and changed the designation of the Protection and Detection Set to M5A2.[184]

Truck-Mounted Decontaminating Apparatus

(U) In 1952 the Army designated as a standard item of equipment the truck-mounted, power-driven, decontaminating apparatus M3A3. With this apparatus, mounted on an Ordnance truck chassis, chemical troops could mix, haul, and disperse all types of decontaminating solutions. The M3A3 was an improved descendent of the World War II decontaminating apparatus, which had proven itself successfully in all the theaters of operation. While the M3A3 served its purpose well, studies by the Chemical Corps Board showed

---

184 CCTC Item 3583, Classification of Protection and Treatment Set, Chemical Warfare Agents, M5A2 as a Standard Type & Reclassification of the M5A1 Set to Standard-B, 30 Jun 59.

faults that needed improvement. For example, parts of the pump wore out rapidly, valves stuck, the clutch slipped, the nozzles did not give a good spray, and the apparatus was too complex, difficult to fill, drain, and repair.

(U) The Corps set about developing a new decontaminating apparatus and by first half of 1958 had the device, E9, ready for presentation to the Army. The E9 was essentially a 400-gallon tank in which solutions could be mixed and then sprayed through hoses. While the primary purpose of the apparatus was to spray neutralizing chemicals onto buildings or grounds contaminated with toxic agents, it could be employed as a field shower bath, a mobile pump, or a fire engine. Like its predecessor it weighed approximately 8 tons, but it was easier to repair, had a more effective spray, would disperse decontaminants faster, and had enclosed piping for winter operations.[185]

(U) The E9, designated officially as the M9 in August 1958, cost approximately $13,100, in contrast to the earlier M3A3 which cost $9,600. The Corps planned to procure 168 M9's for the Army over the following five years.[186]

Decontaminating Slurry Antiset

(U) The materials in the World War II decontaminating slurries would settle out and clog the apparatus unless some substance was added to keep

185 CWLR 2171, Development Testing of Prototype Decontaminating Apparatus, Power-Driven, Truck-Mounted, E9, 3 Sep 57. (2) CWLR 2229. Final Engineering Test of Antiset, Decontaminating Slurry, E4 & Decontaminating Apparatus, Power-Driven, Truck-Mounted, E9, Sep 59.

186 CCTC Item 3469, Classification of Decontaminating Apparatus, Power-Driven, Truck-Mounted, 400-Gallon, M9 (E9) as a Standard-A Type, 29 Aug 58.

the materials in suspension. Sugar was used during the war, and citric acid (known as M1 Antiset) was adopted in 1950. Since the war the Corps had been developing a new portable decontaminating apparatus that would spray bleach slurry better and clog less easily than the old M1 Decontaminating Apparatus. Along with the new apparatus, CWL devised an improved antisettling material containing 48 percent citric acid and 52 percent sodium tripolyphosphate. The new antiset kept slurries in sprayable condition at temperatures from 0^{o} to $125^{o}F$, even after storage for 24 hours at temperatures of 40^{o} to $50^{o}F$. The new material was accepted for military use in February 1959 and designated as Antiset, Decontaminating Slurry, M2.[187]

White Phosphorus Grenade

(U) During World War II the infantry used a tremendous number of white phosphorus hand grenades (the Corps had to procure almost six million to meet the demand) in making smoke, starting fires, signaling, and inflicting wounds on enemy troops. A minor drawback was the fact that the grenades could not be fired from a rifle except when a soldier improvised an adapter.

(U) After the war the War Department Equipment Board requested that a WP grenade, suitable for throwing and for firing, be developed. The Korean conflict emphasized the need for a new design. Under low priority CWL developed a dual purpose WP hand and rifle grenade that was tested in the

---

187 CCTC Item 3516, Classification of Antiset, Decontaminating Slurry, M2 (E4) as a Standard Type and reclassification of Superseded M1 Type, 12 Feb 59.

Arctic during the winter of 1953 - 54. This grenade, after further modification, and a delay occasioned by failure to come to an agreement with USCONARC over the fuze, was standardized in April 1959 as Grenade, Hand and Rifle, Smoke, WP, M34.[188]

Shipping Guard for the 1,000-lb. Bomb Cluster

(U) To protect 1,000-lb. GB bomb clusters during storage and shipment the Corps had devised a case made of four wood-fiber sections strapped together with steel bands. The case was approximately 5 feet long and 2 feet in diameter. The Materiel Command learned from experience that there were difficulties in mass production of wood-fiber cases, and that the material deteriorated rapidly in storage. MATCOM therefore requested the Engineering Command to develop a slatted-wood crate, similar to the crate used for 750-lb. clusters. The new item, made from soft wood lumber, was given vibration, rough handling, drop, and water immersion tests by CWL's Test Division, and was found to be quite satisfactory. In addition the new crate cost less than half of the cost of the previous crate. The Corps in August 1958 declared the earlier model, M2, obsolete and standardized the new model, M5.[189]

188 (1) CRLR 205, Final Engineering Test, Grenade, Smoke, Hand and Rifle, WP, E16, 29 Jun 53. (2) CCTC Item 3553, Classification of Grenade, Hand and Rifle, Smoke, WP, M34 (E16R2) as a Standard-A Type and Reclassification of the M15 Grenade as a Standard-C Type, 30 Apr 59.

189 CCTC Item 3453, Classification of Guard, Shipping, 1,000-lb Bomb Cluster, M5 (E50) as a Standard Type & Obsoletion of the Superseded M2 Guard, 27 Aug 58.

Carbon Monoxide Detector Kit

(U) The M3 assembly for detecting the presence of poisonous carbon monoxide in compressed air breathing apparatus used at NIKE guided missile batteries consisted essentially of a small tube filled with indicator chemicals. This tube was attached to the air line and recorded the quantity of carbon monoxide by means of a change in color of the chemicals. The Engineering Command, however, found that the detector was reliable only when there was a uniform flow of compressed air through the line, which was hardly ever the case in actual operation. As a result the indicator did not give correct results. The Command devised equipment to sample air from compressed air cylinders, giving much more accurate readings. Tests at Fort Meade in March 1958 proved that the new detector device was very sensitive and accurate, and it was later adopted by the Army as the Adapter, Compressed Air Breathing Apparatus, M4 (E32), and Detector Kit, Carbon Monoxide, Colorimetric, M23.[190]

---

190 CCTC Item 3457, Classification of Adapter, Compressed Air Breathing Apparatus, M4 (E32), & Detector Kit, Carbon Monoxide, Colorimetric, M23; & Obsoletion of Adapter-Detector Assembly, Compressed Air Breathing Apparatus, M3, 27 Aug 58.