agents in slurry form with a high percent of agent recovery using the two-fluid atomization principle (E-99 bomb). (SECRET)

Completion of Development, Jan 56, Completion of tests, Jan 57.
Coordination: AMC
Directorate of Supply & Services, MCSWB
AFAC, ACOPP
HADC, HDOR
Department of Army, Chemical Corps

Task 50464: (Secret Title) BW Dry Agent Disseminator (TOP SECRET TASK)

Contractor: Department of the Army, Chemical Corps
CSO&A 53-139, 54-18
Principle Investigator: Mr. Frank Stecker
Biological Labs, Chemical Corps

Objective and Nature of Task: This task will result in the development of a spherical munition capable of disseminating dried BW agent in aerosol form (E-119 sub-cluster). The bomblets clustered in the spherical munition will contain the agent to be disseminated (E-93 bomb). The Spherical Munition will be capable of being released from high-speed, high-altitude aircraft by means of a dispenser. SECRET)

Completion of Development, Jan 59, Completion of tests, July 59.
Coordination: AMC
Directorate of Supply & Services, MCSWB
AFAC, ACOPP
HADC, HDOR
Department of Army, Chemical Corps

Task 50465: (Secret Title) Spherical Two-Fluid BW Aerosol Generator (TOP SECRET TASK)

Contractor: Department of the Army, Chemical Corps
CSO&A 54-81
Principle Investigator: Mr. Ralph Cunningham
Biological Labs, Chemical Corps

Objective and Nature of Task: This task is required to develop a spherical anti-personnel BW munition utilizing the two-fluid atomization principle (E-96 bomb). The end munition will be droppable from a dispenser from high-speed, high-altitude bomber aircraft and will provide an infective aerosol of biological particulates over a large area from a slurry of such agents. (SECRET)

Completion of Development, Jan 57, Completion of tests, Jan 58
Coordination: AMC
Directorate of Supply & Services, MCSWB
AFAC, ACOPP
HADC, HDOR
Department of Army, Chemical Corps

Task 50466: (Unclassified Title) Glide Cluster (SECRET TASK)

Contractor: Department of the Army, Chemical Corps
CSO&A 53-145, 54-17
Principle Investigator: Mr. Frank Trentacosti
Biological Labs, Chemical Corps

Objective and Nature of Task: This task will result in the development of methods and equipment for producing large area bombing patterns from single aircraft when used in conjunction with conventional cluster and the "Deveron cluster. (CONFIDENTIAL)

Completion of Development, Jan 58, Completion of tests, July 59

Coordination: AMC
Directorate of Supply & Services, MCSWB
AFAC, ACOPP
HADC, HDOR
Department of Army, Chemical Corps

Task 50467: (Confidential Title) Deveron Control Cluster (SECRET TASK)

Contractor: Summers Gyroscope Co., Department of the Army, Chemical Corps
Contract No. AF 33-600-22945
CSO&A 54-19
Principle Investigator: Mr. Frank Trentacosti
Biological Labs, Chemical Cor

Objective and Nature of Task: This task will provide a missile for delivery of BW munitions which can be deflected laterally up to five (5) miles (with wing) and then caused to rotate before opening to obtain a maximum dispersion pattern from a single aircraft. (SECRET)

Completion of Development, July 57, Completion of tests, Jan 58

Coordination: WADC
Aircraft Laboratory, WCLS
Equipment Laboratory, WCLC
Materials Laboratory, WCRT
Weapons Systems, WCS
AMC
Directorate of Supply & Services, MCSWB
AFAC, ACOPP
HADC, HDOR
Department of the Army, Chemical Corps

Task 50573: (Secret Title) Ultrasonic Generator (TOP SECRET TASK)

Contractor: None

Objective and Nature of Task: This task is required to develop a munition for aerosol dispersion of BW anti-personnel agents utilizing the ultrasonic or Hartman Whistle method. The munition will be capable of being release by high-speed, high-altitude aircraft by means of a dispenser or by clustering. Development is planned to start in FY 57 assuming satisfactory completion of investigations under Project 5135 during FY 56. (SECRET)

Completion of Development - Jan 59, Completion of Tests, July 59

Coordination: AMC
Directorate of Supply & Services, MCSWB
AFAC, ACOPP
HADC, HDOR
Department of Army, Chemical Corps

Task 50574: (Unclassified Title) Self Dispersing Explosive Type Munition: (TOP SECRET TASK)
Contractor: None
Objective and Nature of Task: This task will result in the development of a spherical munition that is of the self dispersing explosive type (E-94) for the dissemination of BW anti-personnel agent aerosols. The end munition will be droppable from a dispenser or capable of being clustered and dropped from high-speed, high-altitude bomber aircraft. Development is planned to start FY 57, assuming satisfactory completion of investigations under Project 5135 during FY 56. (SECRET)
Completion of Development, Jan 60, Completion of Tests, Sept 60
Coordination: AMC
Directorate of Supply & Services, MCSWB
AFAC, ACOPP
HADC, HDOR
Department of Army, Chemical Corps

Task 50575: (Unclassified Title) Advance Design Munitions and Components. (TOP SECRET TASK)
Contractor: None
Objective and Nature of Task: This task will result in the development of methods and equipment for improved performance as well as increased dispersion and agent-munition ratio for producing large area bombing patterns of anti-personnel biological agents. The task will be more specifically defined as requirements for new designs are evolved during developme nt and test stages of above tasks.
Completion of Development - Continuous, Completion of tests -Cont.
Coordination: AMC
Directorate of Supply & Services, MCSWB
AFAC, ACOPP
HADC, HDOR
Department of Army, Chemical Corps

d. Other Information

The Army Chemical Corps will furnish technical personnel, equipment and facilities to accomplish this project except for Task No. 720W-5139-50467. WADC will furnish guidance and funds to the Chemical Corps. Task No. 720W-5139-50467 will be accomplished by WADC with limited test support from the Chemical Corps. (UNCLASSIFIED)

In view of the fact that the Navy may carry these munitions on their aircraft, they are interested in the progress of this project. (UNCLASSIFIED)

AFAC and HADC will furnish facilities for these munitions for Phase I through Phase VI testing, as prescribed by AFR 80-14. AMC will furnish required funding for service test items procured for the testing phases. (UNCLASSIFIED)

e. Background History

The M-33 cluster was developed for use as an alternate load for the 500-lb GP bomb. With the USAF change in military characteristics, the M-33 no longer was adequate and the M-114 bomblet required modification

and revision. Hence, the tasks established under this project were initiated to meet the requirements of a BW anti-personnel cluster to be usec as an alternate load for the 750-lb GP bomb and to improve the dissemination of BW agents in component bomblets. Task 720W-5139-50462 will be th first completed under this plan.

f. References

(1) Letter from Hq USAF AFDRD-AP/2 to CG, AMC dated 26 October 1950, subject: (Confidential Title) "Assumption of Responsibility for Air Force Ordnance, Chemical Warfare, and Biologi cal Warfare Research and Development". (SECRET LETTER)

(2) Statement of Military Characteristics dated 7 August 1950, subject: (Secret Title) "Generator, Aerosol, Medium/High Altitude, Anti-Personnel Biological Agent Airborne". (SECRET DOCUMENT)

REASON FOR SECURITY CLASSIFICATION

This document is classified Secret since it reveals intent to obtain offensive capability in biological warfare. This is in accordance with t policy expressed in letter from Hq USAF (AFOAT) to all major Commands, dated 16 December 1952, subject: (Unclassified Title) Classification Guide for Matters Concerning Biological Warfare and Chemical Warfare".

DOWNGRADING OF SECURITY CLASSIFICATION

This document shall retain the security classification of Secret until such time as equipment developed under this project has been used in wa time operations for a period of 90 days at which time classification will be reduced to Confidential or until such time as policy expressed in the BW-CW Security Guide mentioned above has been revised.

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CONFIDENTIAL

Item 2860

READ FOR RECORD
Copy No. ___
(7 Pages)

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF CHEMICAL OFFICER
Chemical Corps Technical Committee
Army Chemical Center, Maryland

CMLWH

13 July 1954

MEMORANDUM FOR RECORD

SUBJECT: ARDC Project No. 5141, BW Logistic Support Equipment (C)

The attached data sheet for the subject Air Force project is reproduced herewith as information pertinent to portions of the Chemical Corps BW R&D program.

FOR THE CHAIRMAN, CHEMICAL CORPS TECHNICAL COMMITTEE:

T. S. Eckert

Incl
As noted

T. S. ECKERT
Secy, CCTC

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Project Data Sheet
Rewritten Project

1. PROJECT TITLE: BW Logistic Support Equipment (Confidential Title)
2. SECURITY CLASSIFICATION: Top Secret
3. PROJECT NUMBER: 5141
5. REPORT DATE: 20 May 1954
6. BASIC FIELD OR SUBJECT: Common Component Developments
7. SUBFIELD OR SUBJECT SUBGROUP: 36, Chemical and Biological Weapons
7a. TECHNICAL OBJECTIVE: BW-5
8. COGNIZANT AGENCY: ARDC
9. DIRECTING AGENCY: WADC, Armament Laboratory
   Office Symbol: WCLGW. Telephone No. 27139
10. REQUESTING AGENCY: ARDC
11. PARTICIPATION, COORDINATION, INTEREST: Dept of the Army, Cml C (P); Na Bu Aer (I); AFAC (P); AMC (P)
    See Item 21d.
12. CONTRACTOR AND/OR LABORATORY:

	Contract/W.C.No
Brown Trailers Inc.	AF 33(600)24443
East Coast Aeronautics Inc.	AF 33(616)2053
Standard Container Corp	AF 33(616)2106
Steelcraft Manufacturing Co.	AF 33(616)2104
Baker Raulang Co.	AF 33(616)2117

13. RELATED PROJECTS: Essential - 100A, 101A, 310A
14. DATE APPROVED: 8 December 1952
15. PRIORITY: 1-B
17. ESTIMATED COMPLETION DATES: Res -
    Dev - Continuing
    Test - Continuing
    Op. Eval -
18. FY FISCAL ESTIMATE: 53 - 76M 56 - 137M
    54 - 31M 57 - 119M
    55 - 221M A/R - 108M
19. SUPERSEDED REPORTS: This project supersedes project No. R-552-658 dated 8 December 1952 in part. (Unclassified)
20. REQUIREMENT AND/OR JUSTIFICATION:

a. To properly store, assemble and deliver BW munitions to strike aircraft, development of adequate storage and transport equipment is required. To determine that the agents contained in BW munitions are in an effective condition a field laboratory must be developed which will provide a means of testing viability of agent samples. Equipment suitable for the above purposes does not now exist. BW munitions require temperature controlled conditions from the time of fill in the production plant until they are delivered to strike aircraft. Because fresh supplies of munitions must be maintained available for strike missions and because the agent in current types of BW munitions constitutes as little as 1/10 the total weight of the complete cluster, field clustering of new agent in prepositioned cluster hardware provides major savings in air lift in time of emergency. To meet these special conditions and to provide effective and efficient equipment for BW logistic support, development of specially adapted delivery, field clustering, and surveillance equipment is required. (Secret)

b. The BW operational capability requirement has been delineated in ARDC letter to WADC, dated 20 August 1952, Subject: (Confidential Title) USAF Biological and Chemical Warfare Program (ADTS 832)(Top Secret Letter).

21. BRIEF OF PROJECT AND OBJECTIVES:

a. Brief: This project will result in a temperature controlled shipping and storing container for BW clusters or agent containers in C-124 or similar aircraft, an insulated shipping container for BW bombs in C-97 or smaller cargo aircraft, a sealed can for BW bomblet shipment, a BW clustering facility (consisting of a clustering semi trailer, a prefabricated shelter, and a special handling boom for fork lifts) and a BW surveillance facility (Consisting of a laboratory semitrailer, mobile power source, shower and change provisions, and decontamination equipment). This project will further provide for adaptation of above equipment to new types of BW munitions not yet standardized. (SECRET)

b. Approach: It is anticipated that shipping and storage containers now used for M-33 clusters can be modifed for use with E77, E86, E133 and E137 clusters and unclustered BW agent containers. An insulated container and a sealed can will be developed by commercial sources. For the surveillance laboratory, AMC is to buy air conditioned vans, and supply laboratory furniture, appliances, utensils, dishware and chemicals. WADC will arrange and install furnishings and supplies and make such modifications as are necessary. Shower and change facilities will be developed as a knock down type of assembly. Decontamination equipment will be adapted from equipment now available. (SECRET)

c. Tasks: Task No. 50471: (Uncl Title) Shipping Container for Bombs and Clusters (Top Secret Task)

Contractors: East Coast Aeronautics Inc. AF 33(616)2053
Standard Container Corp. AF 33(616)2106

Principal Investigator: R.C. Smith, F.J. Kendell

Objective and Nature of Task: To design and develop a temperature controlled shipping container for large aircraft (C-124) and for ship deck, flat car, or truck shipment and an alternate insulated shipping container for smaller aircraft, reefer ship, box car or trailer, with tie down, internal handling and sealing provisions so that BW agents and BW bomb clusters can be delivered from production plant to strike aircraft with interim storage as required. Development will consist of a hermetically sealed can for the agents, a 30 foot temperature controlled van, and an insulated box with a capacity of 216 M-114 bomblets.

Completion of Development: September 1956

Completion of Test: March 1957 (SECRET)

Coordination: WADC Development Operations Division, WCOES
Aircraft Laboratory, WCLS
Equipment Laboratory, WCLE
Department of the Army, Chemical Corps
AMC Directorate of Supply and Services, MCSWB

Task No. 50472: (UNCLASSIFIED TITLE) Mobile Field Surveillance Laboratory Facility (Top Secret Task)

Contractor: Brown Trailers Inc., AF 33(600)-24443 S.A. #1

Principal Investigator: Robert Flagan

Objective and Nature of Task: To develop methods and equipment which will provide a means of maintaining field surveillance on agents contained in

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BW Munitions. Methods will include viability count and investigation of other assessment procedures to obtain a system of proven reliability. Facility will consist of a 30 foot air-conditioned trailer, equipped with necessary laboratory equipment, electrical power supply in the form of a 30KW generator mounted on a suitable trailer, a shower and change facility for operating personnel, and decontamination equipment. The facility will be self sufficient, designed for remote location, and operative under -20° to +120°F temperatures. (SECRET)

Completion of Development: June 1954
Completion of Test: January 1955
Coordination: WADC
Development Operations Division, WCOES
Aero Medical Laboratory, WCRD
AMC
Directorate of Supply and Services, MCSWB
Air Surgeons Office, MCDI
Department of the Army, Chemical Corps
ARDC
USAF Field Office, Camp Detrick, Maryland,
AFAC ACOPP

Task No. 50473: (Unclassified Title) Mobile Field Clustering Facility (TOP SECRET TASK)
Contractors: Steelcraft Mfg. Co. AF33(616)-2104
Baker Raulang Co. AF33(616)-2117
Principal Investigator: L. A. Prusiner, R. T. Tiebout

Objective and Nature of Task: To develop equipment required for bomblet assembly and field clustering of the BW bomb cluster. The equipment consists of a properly outfitted air-conditioned semi-trailer, a portable insulated building measuring 32 x 40 feet, and a special fork lift boom for handling the cluster. All equipment will be air transportable and quickly erected for field operation. (SECRET)

Completion of Development: July 1955
Completion of Test: July 1956

Coordination: WADC
Development Operations Division, WCLES
Equipment Laboratory, WCLE
Aero Medical Laboratory, WCRD
AMC
Directorate of Supply and Services, MCSWB
Air Surgeons Office, MCDI
Department of Army, Chemical Corps
AFAC, ACOPP

Task No. 50559: (Unclassified Title) Adaptation of Logistic Equipment for New Munitions.
Contractor: None
Principal Investigator: N/A

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Objective and Nature of Task: To develop modified equipment for use in storage, transport, field assembly, and agent viability surveillance on new BW agents and munitions. The equipment will consist of modified shipping and storing containers for 2-fluid types and dry agent types of spherical and cylindrical bombs, field filling, assembly and clustering equipment for these bombs, and surveillance equipment for determining viability and other characteristics of the agents used therein. (SECRET)

Completion of Development: Continuing
Completion of Test: Continuing
Coordination: WADC
Development Operations Division, WCOES
Equipment Laboratory, WCLE
Aero Medical Laboratory, WCRD
AMC
Directorate of Supply and Services, MCSWB
Air Surgeons Office, MCDI
Department of the Army, Chemical Corps
AFAC, ACOPP

d. Other Information: Design of the mobile field surveillance facility is being developed with the coordination of AMC (MCSWB), the Air Force Field Office at Camp Detrick, and the Chemical Corps. Selection of laboratory appliances and layout in the trailer are being determined with the assistance of these offices on the basis of results of tests conducted at APGC (see Item 21f below, reference No. 3). (Unclassified)

Shipping container development is being coordinated by the Chemical Corps to assure suitable cluster shipping rings are installed at the plant, and to insure proper loading and tie-down arrangement. (Unclassified)

Field clustering facility development will be coordinated by the Chemical Corps to insure compatibility of equipment with bombs and clusters being handled. (Unclassified)

Funds required by the Chemical Corps for participation in this development will be derived from the USAF weapons development funds.

AMC funds of $190,000 will be required in FY 1954 to cover purchase of surveillance laboratory trailer, laboratory furnishings, shipping containers for support of tests, inert clusters and bombs for test fitting, live clusters for surveillance tests, portable electric power supply, shower and change provisions, decontamination equipment, and M-108 type hoist truck. Approximately 20 to 25 percent of these funds will cover expendable items. The main items listed here will not be expended, but, upon completion of tests, will be available for service use.

Also, $30,000 of AMC funds will be required in FY 1955 for laboratory equipment, electric fork lift, portable electric power supply, and an air-conditioning unit for a prefabricated building. In FY 56, $110,000 will be required for shipping containers, live agent clusters, and inert clusters. In FY 57 and beyond $25,000 will be required annually for inert agents and materials for adaptation of containers and laboratory. AFAC and APGC will be called on to perform and support engineering tests. (SECRET)

e. Background History: The logistical support problem for BW was first presented to WADC in March 1952 in a request by Ho ARDC to prepare military characteristics covering necessary items of support equipment.

WADC complied by forwarding, in June 1952, military characteristics covering equipment to provide transport of agent filled bomb cases and field assembly and clustering of munitions, and equipment to provide transport of bulk agent and field filling, assembly, and clustering of the munitions. The latter system was not recommended by WADC. The above military characteristics were later expanded in a WADC letter to Hq ARDC calling out specific items and production schedules, and also covering transport means for the complete BW cluster. Hq USAF directed adoption of transporting the assembled cluster, so far as the M33 cluster capability was concerned. No further guidance has been received from Hq ARDC. (SECRET)

f. References:

1. Document ADTS-1199 (TS-3517) dated 9 April 1953, from MCSWB to WCO, (Subject omitted because of Top Secret Classification).
2. (Secret Title) Minutes of Biological Warfare Logistics Conference at Hq ARDC on 14-15 May 1953, Document No. T-3-384 (ADTS-1472). (TOP SECRET CORRESPONDENCE)
3. APGC Report, Project No. APG/SAS/69/A-1 dated 19 March 1953 (APGC-TS-712-6) (ADTS-1382) Subj: (Secret Title) "Operational Suitability Test of the Agent Filled 500-lb Biological Cluster Bomb, M33". (TOP SECRET REPORT)
4. Letter from Hq USAF to Hq AMC dated 24 June 1953, Subj: (Uncl Title) "Procurement Directive No. 27-222-53 (Mobile Surveillance Trailers)". (UNCLASSIFIED CORRESPONDENCE)
5. Letter from Hq ARDC to WADC dated 20 August 1952, Subj: (Uncl Title) "USAF Biological and Chemical Warfare Program", (ADTS-832). (TOP SECRET CORRESPONDENCE)
6. Letter from Hq, USAF to Hq AMC dated 12 March 1953, Subj: (Uncl Title) "Procurement Directive No. 15-222-53 (Semi-trailer Assembly)" (UNCLASSIFIED CORRESPONDENCE)
7. DF from Hq AMC to WADC dated 19 March 1953, subj: (Unclassified Title) "Engineering Evaluation of BW Support Equipment". (SECRET CORRESPONDENCE)
8. AF Field Office, Camp Detrick, Md. letter to Hq ARDC dated 17 March 1952, Subj: (Secret Title) "Overseas Filling and clustering Facilities". (SECRET CORRESPONDENCE)
9. Letter from Hq USAF to Hq ARDC dated 17 March 1952, Subj: (Unclassified Title) BW Munitions Logistic System Projects, 1st Ind to WADC dated 25 March 1952, and 2d Ind to Hq ARDC dated 16 June 1952, Control No. 52WC-8637. (SECRET CORRESPONDENCE)
10. Letter from WADC to Hq ARDC dated 13 December 1952, Subj: (Unclassified Title) "BW-CW Support", Control No. 52WC-47560. (SECRET CORRESPONDENCE)
11. Message from Hq ARDC to WADC dated 24 July 1953, Cite No. RDDDR-6-7-65-E. (CONFIDENTIAL CORRESPONDENCE)
12. Message from WADC to Hq ARDC dated 30 July 1953, Cite No. WCLG-2098. (CONFIDENTIAL CORRESPONDENCE)
13. Letter from Cml Corps Biological Laboratories, Camp Detrick, Md., to WADC dated 11 August 1953, Subject: (Unclassified Title) "Recommended Changes for Mobile Surveillance Laboratories". (CONFIDENTIAL CORRESPONDENCE)

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REASON FOR SECURITY CLASSIFICATION

Since this document reveals intent to obtain offensive capability in BW Warfare, it is classified Secret in accordance with policy outlined in letter from Hq USAF (AFOAT) to all major Commands, dated 16 December 1952, Subject: "(Unclassified) Classification Guide for Matters Concerning Biological Warfare and Chemical Warfare".

DOWNGRADING OF SECURITY CLASSIFICATION

This document shall retain the security classification of Secret until such time as equipment developed under this project has been used in wartime operations for a period of 90 days at which time classification will be reduced to Confidential or until such time as policy expressed in the BW-CW Security Guide mentioned above has been revised.

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Item 2861

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DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF CHEMICAL OFFICER
Chemical Corps Technical Committee
Army Chemical Center, Maryland

CMLWH

13 July 1954

MEMORANDUM FOR RECORD

SUBJECT: ARDC Project No. 5058, Special Aircraft Equipment for BW Munitions (C)

The attached data sheet for the subject Air Force project is reproduced as information pertinent to certain portions of the Chemical Corps BW R&D program.

FOR THE CHAIRMAN, CHEMICAL CORPS TECHNICAL COMMITTEE:

T. S. Eckert

Incl
As noted

T. S. ECKERT
Secy, CCTC

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Project Data Sheet
Rewritten Project

1. PROJECT TITLE: Special Aircraft Equipment for BW Munitions (Conf)
2. SECURITY CLASSIFICATION: Top Secret
3. PROJECT NUMBER: 5058
5. REPORT DATE: 21 May 1954
6. BASIC FIELD OR SUBJECT: Common Component Development 100A, 101A
7. SUB FIELD OR SUBJECT SUB GROUP: 36, Chemical & Biological Weapons
7a. TECHNICAL OBJECTIVE: BW-5
8. COGNIZANT AGENCY: ARDC
9. DIRECTING AGENCY: Armament Laboratory, WADC
WCLGW Tp 28252
10. REQUESTING AGENCY: Hq ARDC
11. PARTICIPATION, COORDINATION, INTEREST: Navy (I), Army Chemical Corps (P)
AFAC (P)
12. CONTRACTOR AND/OR LABORATORY: None
13. RELATED PROJECTS: Essential - 100A (B-47) and 101A (B-52)
Related - 307A(B-57B) and 308A(B-66B)
14. DATE APPROVED: 4 December 1952
15. PRIORITY: 1-B
17. ESTIMATED COMPLETION DATES: See Tasks, Item 21c.
18. FY FISCAL ESTIMATES: 51-53 - 222M 56 - 412M
54 - 356M 57 - 206M
55 - 109 T - 1305M
19. Supersedes projects R555-862 and R555-820.
20. REQUIREMENT AND/OR JUSTIFICATION: This project is required to develop an improved method and new equipment for the dissemination of temperature sensitive, spherical, BW munitions over enemy territory using sub and supersonic bombardment type aircraft. The authority for this project is contained in letter from Hq, ARDC to Hq WADC, ADTS-832, dated 20 Aug 52, Subj: "(Unclassified) USAF Biological and Chemical Warfare Program". (Top Secret Document)(SECRET)
21. a. Brief: This project will result in the development of a means for providing proper temperature environment for the delivery of certain temperature sensitive BW munitions to the target area. An interim method and a final production method will be developed. The interim method will consist of space heaters easily installed or removed from the bomb bays of B-29 and B-50 aircraft. The final method will utilize standard electrical equipment to supply electrical power for the internal heating of the munitions. (SECRET)

This project will also result in the development of a bomb bay dispenser suitable for the suspension and release of large quantitites of small spherical BW bombs. Equipment will be developed to provide proper release for best dispersion of large quantities of these munitions. (SECRET)

It is the object of this project to design equipment for use in B-47 and later high speed bombardment type aircraft to effectively deliver these type munitions. (SECRET)

b. Approach: Development models of bomb bay heaters were procured from the Hayes Aircraft Corp. as an interim method of providing proper bomb

bay temperatures for delivery of temperature sensitive munitions. For a long range approach, the aircraft electrical system will be adapted for supplying electrical power to individual munition electrical heaters. The feasibility of insulating individual munitions is also being studied. (CONFIDENTIAL)

For the delivery of spherical munitions to the target area, ballistic and dispersion data have been obtained from flight tests at Hill AFB using bucket type hoppers and clusters. A test dispenser developed by the Rheem Mfg. Co. for the Chemical Corps will be used for obtaining additional ballistic data. As a long range development, the Boeing Airplane Co. will be requested to develop equipment for release of spherical munitions from sub and supersonic bombardment type aircraft. (CONFIDENTIAL)

c. Tasks:

Task 50189 (Unclassified Title) Munition Temperature Control. (SECRET TASK)

Contractor: Not established.
Contract: None
Principal Investigator: Not established
Completion of Development: January 1956
Completion of Test: June 1956

Object: To provide the engineering and coordination necessary to assure compatibility between bomb heating provisions as incorporated in different temperature sensitive viable agent munitions and the electrical heating provisions required to be installed in applicable aircraft. (SECRET)

Nature of Task: To assure that bomb heating requirements are maintained within the limits of the aircraft electrical system capabilities and that adequate provisions are installed in applicable aircraft.

Coordination: WADC - Equipment Laboratory, WCLE
Weapons Systems Directorate, WCOW
AMC - Procurement Division, MCP
Maintenance Division, MCM
AFAC, ACOPP
Dept. of Army, Chemical Corps Biological Labs (SECRET)

Task 50190 - (Uncl Title) Bomb Bay Dispenser (SECRET TASK)

Contractor: Not Established.
Contract: None
Principal Investigator: (Not Established)
Completion of Development: December 1956
Completion of Tests: July 1957
Object: To provide equipment for delivery of spherical munitions over the target area from subsonic and supersonic aircraft.
Nature of Task: Development of a bomb bay dispenser for suspension and release of spherical FW munitions from subsonic and supersonic bombardment type aircraft.

Coordination: WADC - Directorate of Support, WCU
Aircraft Laboratory, WCLS
Equipment Laboratory, WCLE
Materials Laboratory, WCRT
Weapons Systems Directorate, WCOW
AFAC, ACOP
Dept. of Army, Chemical Corps Biological Labs.
(SECRET)

d. Other Information:

(1) Reference Item 11, since the Navy may carry and disseminate these munitions, that agency will be interested in this project. The Army Chemical Corps, Biological Laboratories will participate in the development of the dissemination and temperature control equipment. AFAC will participate in the testing of prototype articles. (Uncl)

(2) The following support will be required from the Air Materiel Command:

(a) Furnish funds for modification of aircraft to provide prototype installation of munition temperature control equipment for service test. Expenditure of approximately $15,000 in FY 1955 is anticipated.

(b) Furnish funds for procurement of prototype bomb bay dispenser (1 ea.) for service test. Expenditure of approximately $50,000 in FY 1957 is anticipated. (Uncl)

e. Background History: Development of bomb cluster adapters with internal heating and insulating equipment to reduce heat loss from certain temperature sensitive unit bombs which are clustered and carried in cluster adapters has been carried out under prior projects R555-731, R555-732, and R555-777. (Conf)

Certain BW munitions have a definite temperature range within which the viable agent remains effective. It is, therefore, necessary to control the munition temperature during flight if maximum effectiveness is to be realized. The Army Chemical Corps will provide internal electrical heaters in the individual cluster munitions for production items. Electrical heaters plus insulating material will be used to maintain the required temperature for a typical combat mission. As an interim, for present operational readiness, space heaters for B-29 and B-50 bomb bays are being developed. The long range task will be to provide an electrical system with power receptacles at each bomb station with sufficient capacity to supply the required cluster heating power. Cold chamber tests of the M-115, M-33, and E-133 BW munitions and flight tests of B-47 and B-50 aircraft have indicated that the temperatures of the munitions after a normal flight, without munition temperature control, would result in a large quantity of the viable agent being destroyed in some cases. A prototype bomb bay heater was tested in a B-50 airplane. The major difficulty encountered was operation at altitudes above 25,000 feet. At this altitude the rarified air would not support combustion. The proper design may overcome this difficulty. Data was obtained from these tests as to the required BTU output of the heaters at various altitudes up to 30,000 feet. (SECRET)

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With the inception of requirements to obtain a capability for delivery of BW weapons, investigations were made as to the effects of temperature and altitude on the viability of BW elements. In March 1951, the problem of temperature control was presented to WADC in a letter from Hq USAF, Subj: "(SECRET TITLE) Temperature Control for Airborne BW Munitions". (SECRET DOCUMENT) In October 1951, WADC presented a prepared report on the study, subj: "(SECRET Title) A Preliminary Study of Temperature Requirements for the Protection of BW Munitions During Airborne Delivery to Target Areas", (SECRET DOCUMENT). (Memorandum Report No. WCEG R-555-1350). During the period October 1951 to April 1952, bomb bay heaters were installed in a B-29 airplane for the purpose of determining the adequacy of heating bomb bays with gasoline heaters. Tests were made at varying altitudes from 10,000 to 40,000 feet. It was determined that presently available heaters, properly controlled would operate satisfactorily up to altitudes of 27,000 feet. Exhibit WCEEM-2-50 dated 20 May 1952, subj: "(Confidential Title) Bomb Bay Heating Kit for B-29 and B-50 Aircraft", (CONFIDENTIAL REPORT) covers the requirements for heaters for bomb bays for these aircraft. On the basis of the above a contract was let to the Hayes Aircraft Corp., Birmingham, Alabama, for the design and development of bomb bay heaters for service use in B-29 and B-50 aircraft. These heaters were functionally tested by the contractor and found to operate satisfactorily within the required design limitations. Development will be considered finished upon completion of final test report.(CONFIDENTIAL)

From a survey of aircraft electrical power availability for munition heating, it was determined that 150 watts per unit munition cluster could be made available. The Army Chemical Corps has been advised to design the unit munition cluster with heaters and insulation, such that under combat conditions on a typical combat mission the temperature of the unit bombs will not rise or fall beyond the allowable temperature range.(CONFIDENTIAL)

Other studies on temperatures of aircraft in flight have been made and reported in the following:

(1) Memorandum Report No. WCSE-127 dated January 1952, (Uncl Title) "Study-Design Temperature Requirements for Operation of USAF Aircraft and Equipment Phase C Aircraft Compartment and Equipment Temperature (B-36 Aircraft)". (UNCLASSIFIED DOCUMENT)

(2) Technical Report 206.03 WADC-TR53-119 dated May 1953, (Uncl Title) "Aircraft Temperature Requirements Research Division Project 206". (UNCLASSIFIED DOCUMENT)

Early in FY 1952 the Army Chemical Corps under MIPR 52-702-WADC Amendment I, conducted experimental tests with spherical munitions proposed for use with BW agents. Dispersion of spherical munitions was studied. Various diameters, surface contours, moments of inertia, and other factors entering into the dispersion of the sphere were investigated. Numerous drops of various test spheres were made to determine which shape gave the best dispersion pattern. (SECRET)

Under the Army Chemical Corps contract DA-18-064-CML-2028, the Rheem Mfg. Co. was given the task of evaluating the results of previous experimental tests. They were also given the task of developing a test

dispenser for use in B-50 and B-47 aircraft for determining the effects of controlled orientation and forced ejection on the dispersion pattern of the sphere selected as having the optimum shape. The shape selected was approximately 4 3/4 inches in diameter with 9 raised, equally spaced ribs and weighing approximately 2.7 pounds. (Conf)

In order to marry the dispensing of spheres with the applicable aircraft, WADC prepared Exhibit WCLG-539 dated 19 November 1952, (Uncl Title) "Missiles, Spherical, Dispenser For" (Confidential Document) covering four (4) envisioned phases of the task. As the aircraft affected are Boeing designed and built, the Boeing Airplane Co. was recommended for sole source procurement. Due to freeze of R&D funds in late FY 1953, the purchase request was recalled and was resubmitted for procurement purposes in October 1953. (Uncl)

Ballistic drop tests were made during the fall of 1953 from a B-50 airplane using the Chemical Corps hoppers and the four inch ribbed spheres. Additional tests using the E-19 Dispenser (Rheem Dispenser) will be made during the summer of 1954. (UNCLASSIFIED)

Work has been done by the Army Chemical Corps in the dissemination of dry agents. During March and April 1952, the Army Chemical Corps, using a Navy ship, in a series of five trials disseminated between 200 and 450 pounds of inert tracer powder along a 105-135 nautical mile line. The object was to test the possibility of achieving long range aerosol cloud travel and consequent coverage of large areas at ground level under meteorological conditions in which inversions of temperature were present at low levels of the atmosphere. Details of the test program are contained in the Army Chemical Corps Biological Laboratories FT&M Division Report dated 22 September 1952, Subj: (Conf Title) Long Range Aerosol Cloud Travel Phase II". (SECRET DOCUMENT) In October 1952, the WADC, at the request of the Army Chemical Corps, modified a B-26 airplane to install equipment for aerial dispensing of dry agent powder. This equipment has been used by the Army Chemical Corps with indications that the performance of the device is satisfactory. (SECRET)

f. References:

(1) Letter Hq ARDC to Hq WADC, ADTS-832, dated 20 August 1952, Subj: (Unclassified Title) USAF Biological and Chemical Warfare Program". (TOP SECRET LETTER)

(2) Contract, Hayes Aircraft Corp., AF 33(600)22098, PR388659. (CONFIDENTIAL)

(3) Contract, Army Chemical Corps, MIPR 52-702-WADC (SECRET DOCUMENT) and Amendment I. (CONFIDENTIAL DOCUMENT)

(4) Letter Hq USAF to Hq WADC, dated March 1951, Subj: "(Secret Title) Temperature Control for Airborne BW Munitions". (SECRET LETTER)

(5) WADC Memorandum Report No. WCEG-R-555-1350, dated October 1951, Subj: "(Secret Title) A Preliminary Study of Temperature Requirements for the Protection of BW Munitions During Airborne Delivery to Target Areas". (SECRET REPORT)

(6) WADC Exhibit No. WCEEM-2-50, dated 20 May 1952, Subj: "(Conf Title) Bomb Bay Heating Kit for B-29 and B-50 Aircraft". (Conf Exhibit)

(7) WADC Memorandum Report No. WCSE-127, dated January 1952, Subj: (Uncl Title) "Study-Design Temperature Requirements for Operation of USAF Aircraft and Equipment Phase C Aircraft Compartment and Equipment Temperature (B-36B Aircraft)". (UNCLASSIFIED REPORT)

(8) USAF Technical Report No. 206.03 WADC-TR53-119, dated May 1953, Subj: (Uncl Title) "Aircraft Temperature Requirements Research Division Project 206". (UNCLASSIFIED REPORT)

(9) Contract - Between Army Chemical Corps and Rheem Mfg. Co. - No. DA-18-064-CML-2028. (CONF DOCUMENT)

(10) WADC Exhibit No. WCLG-539, dated 19 November 1952, Subj: (Uncl Title) Dispenser for Spherical Missiles". (CONFIDENTIAL DOCUMENT)

(11) Report: Army Chemical Corps Biological Laboratories, FT&M Division, dated 22 September 1952, Subj: (Conf Title) Long Range Aerosol Cloud Travel, Phase II". (SECRET REPORT)

(12) WADC Exhibit No. WCLG-539A dated 11 March 1954 Subj: (Uncl Title) Release System for Spherical Bomblets". (CONFIDENTIAL DOCUMENT)

REASON FOR SECURITY CLASSIFICATION:

Since this document reveals intent to obtain offensive capability in BW warfare, it is classified Secret in accordance with policy outlined in letter from Hq, USAF (AFOAT) to all major Commands, dated 16 December 1952: Subj: (Unclassified) Classification Guide for Matters Concerning Biological Warfare and Chemical Warfare". (SECRET)

DOWNGRADING OF SECURITY CLASSIFICATION:

This document shall retain the security classification of Secret until such time as equipment developed under this project has been used in wartime operations for a period of 90 days at which time classification will be reduced to Confidential or until such time as policy expressed in the BW-CW Security Guide mentioned above has been revised.

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CONFIDENTIAL

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF CHEMICAL OFFICER
Chemical Corps Technical Committee
Army Chemical Center, Maryland

Revised
Report "G"
Copy No.____
(16 Pages)

CMLWH

TSE/5190/mm
20 May 1954

SUBJECT: Establishment of Four (4) Secret Projects in the Cml C FY 55 Program and Termination of Three (3) Consolidated Projects

TO: Chairman, Chemical Corps Technical Committee

1. References:

a. CCTC Items 2703 and 2730 (S/RD), Chemical Corps R&D Program for FY 54, Approved 11 Sep 53.

b. CCTC Item 2810 (S), Security Classification Review of Chemical Corps R&D Projects, 8 Apr 54.

c. SR 705-5-1, Research and Development of Materiel, 10 Feb 54.

d. Ltr (S), CMLRE-P-1 R&E Command, 14 May 54, Recommendations for Chemical Corps Technical Committee Action, to Chm, CCTC, w/2 Incls.

2. Discussion:

a. Reference a. identifies action of this Committee which reviewed the Chemical Corps research and development effort anticipated for FY 54 and indicated that this program consisted of 196 projects established and continued in force in accordance with applicable regulations and directives. This project listing has been revised during the fiscal year by additions and deletions by action of this Committee so that the program currently includes a total of 180 projects within the scope of the three major areas of Chemical Corps responsibility. The security classification of all of these projects was recently reviewed as recorded in reference b. to meet Staff requirements originating with the change in security procedures and abolition of the Restricted category authorized by DA Circular 127, 23 Dec 1953.

b. Reference c. identifies the basic regulation pertaining to the establishment of R&D projects in which paragraph 14 indicates that timely and periodical reviews of R&D programs should be conducted by the Technical Committees to assure conformity with the over-all Army R&D program and to eliminate any unproductive and duplicating activities. In consonance with this directive this Corps has annually reviewed its research and development effort in order to insure a completely integrated program fulfilling Chemical Corps responsibilities in the CBR area within the Department of Defense. As previously noted reference a. identifies the review conducted at the beginning of the current fiscal year.

2. Discussion (continued):

c. Reference d. identifies correspondence which indicated that the program for FY 55 had been reviewed in accordance with all existing directives and, as a result, a total of four new projects in the CW area classified Secret were recommended for initiation at this time. Appropriate project data sheets for these projects are inclosed herewith and the tabulation below indicates the title, technical objective, and security classification for each. In connection with project 4-98-05-026, it is to be noted that this consolidates three currently approved projects, namely, 4-08-05-021, 4-98-05-022, and 4-36-07-001.

Project No. & Tech Obj.	Title & Classification	Security Class. of Project	Priority
4-04-15-027 CW-3	Gas Artillery Shell (U)	S	1-C
4-08-03-015 CW-1a	Agent SS (U)	S	1-
4-08-06-025 CW-4a	Area GB Alarm (U)	S	1-A
*4-98-05-026 CW-3	CW Field Testing & Technology, DPG (U)	S	1-B
	* Supersedes the following projects:		
4-98-05-021 CW-3	CW Field Test Technology, DPG (U)	S	1-B
4-98-05-022 CW-3 CW-4b	CW Field Testing, DPG (U)	S	1-B
4-36-07-001 IC-14	Climatological and Meteorological Factors Affecting Field Test Operations. (U)	S	2

d. The foregoing discussion indicates that timely review of the current Chemical Corps project program has shown the desirability of establishing four new projects and deleting three related projects as a result of consolidation. Each of these new projects is described in the respective project data sheet attached herewith.

3. Recommendations:

It is recommended that:

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3. Recommendations (continued):

a. The following projects be established in the Chemical Corps FY 55 project program:

(1) 4-04-15-027, Gas Artillery Shell

(2) 4-08-03-015, Agent CS

(3) 4-08-06-025, Area CB Alarm

(4) 4-98-05-026, CW Field Testing & Technology, DPG

b. The military characteristics if applicable, objectives, approach, and scope of the subject projects as listed in paragraph 21 of the pertinent project data sheet attached herewith be approved.

c. Each of the subject projects be assigned to the Technical Objective and be accorded the priority and classification indicated in the applicable project data sheet.

d. The following currently approved projects be deleted from the FY 55 program as a result of consolidation into project 4-98-05-026:

(1) 4-98-05-021, CW Field Test Technology, DPG

(2) 4-98-05-022, CW Field Testing, DPG

(3) 4-36-07-001, Climatological and Meteorological Factors Affecting Field Test Operations.

e. The Chemical Corps FY 55 project program and related documents be revised in accordance with this action.

4 Incls
Project Data Sheets for
4-04-15-027
4-08-03-015
4-08-06-025
4-98-05-026

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~~SECRET~~ 4-04-15-027

PROJECT DATA SHEET

1. PROJECT TITLE: Gas Artillery Shell (U)
2. SECURITY CLASSIFICATION: Secret
3. PROJECT NUMBER: 4-04-15-027
5. REPORT DATE: 14 May 1954
6. BASIC FIELD: Ammunition
7. SUB FIELD OR SUBJECT: Munitions, Chemical
7a. TECHNICAL OBJECTIVE: CW-3
8. COGNIZANT AGENCY: Cml C
9. DIRECTING AGENCY: Cml C R&E Comd, A Cml C, Md.
10. REQUESTING AGENCY: AFF
11. PARTICIPATION AND/OR COORDINATION: (AR) Army; Ordnance Corps
12. CONTRACTOR AND/OR LABORATORY: Cml C Cml & Rad Labs, A Cml C, Md.
13. RELATED PROJECTS:
14. DATE APPROVED: 29 July 54, CCTC Item 2868
15. DEPT OF ARMY PRIORITY: 1-C
17. ESTIMATED COMPLETION DATES: Res (Cont)
Dev
Test
Op Eval
18. FISCAL YEARS ESTIMATES: FY 55 1COM
FY 56
20. REQUIREMENT AND/OR JUSTIFICATION: Ordnance Corps is at present developing new toxic ammunition for the 110-mm and 156-mm Howitzers and 175-mm guns under projects TA1-1464, TA1-1756 and TA1-1770, D/A projects 504-03-063, 504-03-064, 504-03-065, respectively. The projects presently contemplate development of thin wall, high explosive shell, and efforts will be made to develop equivalent shell for non-persistent agent munitions. If this is found to be feasible, these shell will have greater capacity for toxic agent than the 105-mm and 155-mm non-persistent gas artillery shell which have been developed. Further studies are also required to provide greater assurance against leakage on non-persistent gas artillery shell. A requirement for a large caliber HD Artillery Shell has been stated by the Army Field Forces. To meet this requirement Ordnance is developing Shell, Chem. 8-inch, T19 (series) under project TA1-1876, D/A 504-03-074 for HD gas filling.
21. BRIEF OF PROJECT AND OBJECTIVE:
a. Brief: The objectives of this project are:
(1) To review work previously undertaken under Cml C Projects 4-04-15-012, GB Artillery Shell, 155-mm and 4-04-15-020, GB Artillery Shell, 105-mm with a view towards improvement of the dissemination and leakage characteristics of these weapons.
(2) To conduct investigations relative to the application of new artillery shell developments by the Ordnance Corps as Chemical Munitions.
(3) To assist the Ordnance Corps to develop an 8-inch HD Artillery Shell based on the M106 Artillery Shell.
(4) Since this is a general project, appropriate projects will be established as investigations and/or requirements indicate a need for specific end items.

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b. Approach: The following tasks will be undertaken:

(1) Improvement of the artillery shell with regard to leakage. This work will involve a study of a one-piece shell with a dual closure system, in coordination with Ordnance Corps development.
(2) The persistency and non-persistency tests being conducted at Dugway Proving Ground with the 105- and 155-mm GB Artillery Shell will be evaluated and the data obtained will be utilized in further dissemination studies and new shell developments.
(3) Close coordination with the Ordnance Corps will be maintained so that all new shell developments can be investigated and evaluated as possible future chemical weapons.
(4) Conduct necessary coordination with the Ordnance Corps on development of Shell, Gas, HD, 8-inch, T19 Series.

c. Subtasks: None

d. Other Information:
(1) Reference is made to Project 4-04-15-012 approved 19 Nov 1948, CCTC Item 1928 and Project 4-04-15-020, approved 25 May 1951, CCTC Item 2325.
(2) Reference Ordnance Corps Committee Item 34933, subject: "Shell, Chemical, 8-inch, T19 for 8-inch Howitzer" dated 2 June 1953.

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PROJECT DATA SHEET

1. PROJECT TITLE: Agent SS (U)
2. SECURITY: SECRET
3. PROJECT NUMBER: 4-08-03-015
5. REPORT DATE: 14 May 1954
6. BASIC FIELD OR SUBJECT: Chemical Warfare
7. SUBFIELD OR SUBJECT SUBGROUP: Agents
7a. TECHNICAL OBJECTIVE: CW-1a
8. COGNIZANT AGENCY: Chemical Corps
9. DIRECTING AGENCY: Cml C Research and Engineering Command
10. REQUESTING AGENCY: Chemical Corps
11. PARTICIPATION AND/OR COORDINATION: Army (AR)
12. CONTRACTOR AND/OR LABORATORY: Cml C Chemical and Radiological Laboratories
13. RELATED PROJECTS: 4-08-03-001, 4-61-14-004
14. DATE APPROVED:
15. PRIORITY: 1-B
17. ESTIMATED COMPLETION DATES: Research ---------- Continuing
Development ----------
Testing----------
Operational Evaluation -
18. FISCAL ESTIMATES: FY 55 - $ 50M
20. REQUIREMENT AND/OR JUSTIFICATION: There is a continuing need for chemical warfare agents more effective than present agents. In meeting this requirement, it is necessary to uncover specific types of new classes of highly toxic and physiologically active materials. In the continuing search, attention should be given to natural toxic products (flora and fauna).

21. BRIEF OF PROJECT AND OBJECTIVE:

a. Brief. This project deals with the isolation, proof of structure, and finally the synthesis of the toxic principle found in certain shellfish. Preliminary investigation of this toxic indicates that it has a low molecular weight.

b. Approach. The poison is isolated from the syphons of toxic clams by extraction with acidified alcohol and purified by means of ion exchange and chromatographic columns. The structure of the purified poison will be attacked by the application of the methods common to such a problem. After the structure has been proven, the synthesis of said structure and certain analogs will be attempted.

c. Subtasks. None

d. Other Information. The toxic clams used as a source of the poison are obtained in Alaskan waters.

1. Basic Research. Laboratory research is required to determine the structure and synthesize said poison along with certain analogs thereof.

2. Fund Estimate: Technical Operations

Specific Tasks:

A. 01 - $14M - 1 Professional - 1 Non-professional

02 - 1M - Travel to contractors

08 - 2M - Expendable laboratory supplies.

B. 09 - 3M - Laboratory equipment

C. 07 - 30M - Contract for identification of toxin, Mathieson (Squibb)

3. Remarks: This project will carry on that portion of Technical Project No. 4-61-14-004, Technical Objective BW-1, that falls within Research and Engineering Command responsibility.

a. Background. Shellfish poisons have been investigated at the Camp Detrick Biological Laboratories for about five years and, prior to that time, at the University of California and at Northwestern University. The interest in this poison is based on its possible synthesis for use as basis for a new BW agent. The poison has a molecular weight of 327; it is believed that it can be synthesized. It is more toxic than any other known poison of low molecular weight and, as the hydrochloride salt, is stable to boiling in water and to drying in air. It is stable in certain soft drinks, ordinary chlorinated drinking water, and coffee.

The purpose of the research on the poison is to obtain its structure and work out a method of synthesis. Purification was accomplished by the use of cation exchange resins Amberlite IRC-50 and XE-64 followed by chromatography on alumina. The purity of the product has been established and the MLD determinted to be 3 to 4 micrograms per kgm of body weight by intravenous injection into experimental animals. The quantity of purified poison available for study has been extremely small and has necessitated carrying out much of the work on structural determination on a micro scale, but considerable progress has already been made on chemical studies of the poison. The molecular formula is $C_9H_{16}N_6O_3Cl_2$. The compound is optically active and has only end absorption in the ultraviolet region, indicating the absence of aromatic or conjugated unsaturation. Infrared studies indicate the presence of amidic type groups and probably hydroxyl groups. Two titrable functions are present with pK_a values of 8.0 and 11.4. Acidic functions and carbonyl groupings are not present. The presence of at least one guanidine grouping in the molecule has been established and also the presence of an arrangement of atoms capable of giving β-alanine and glycine on alkaline hydrolysis.

Both mussel and clam poisons have been found to take up one mole of hydrogen at atmospheric pressure and 30°C in the presence of platinum or palladium catalysts. The reduction proceeds with about the same facility in acid, neutral, or alkaline aqueous solutions and is accompanied by a loss of 97 to 98 percent of the toxicity. The original poison is not regenerated by any simple oxidative treatment. The dihydro compound differs in qualitative tests from the original poison in that it does not give positive reactions with the Jaffe or Pauly reagents. The optical rotation is about 85 percent as great as that of the non-reduced poison. When treated with periodate, the dihydro compound reacts with only one mole of the reagent, while the non-reduced poison reacts with three moles of the periodate under the same conditions. A study of the infrared spectra for deuterated and non-deuterated samples of the poison and of the dihydro poison suggest that most likely a $>C=N^-$ group has been reduced or a $>C(OH)-N<$ group has been reductively cleaved in the reaction.

It has been shown that the poison takes up one mole of oxygen upon treatment with dilute alkali at room temperature. The presence of oxygen is necessary for the production of the compound with characteristic absorption in the ultraviolet. No reducible unsaturation is produced upon treatment of the poison with mild alkali in an atmosphere of hydrogen. The product of mild alkaline oxidation, after the uptake of two moles of hydrogen by catalytic reduction for each mole of oxygen consumed in its production, cannot be reversibly oxidized to the original substance with characteristic absorption in the ultraviolet. The dihydro poison, upon mild alkaline treatment, also takes up one mole of oxygen. In this case, no characteristic ultraviolet absorption is produced.

One methoxyl group has been introduced into the poison molecule upon treatment with diazomethane. No N-methyl group was found in this product. The strong basic group (pK_a 11.4) present in the poison was lost in this reaction. This may have been a result of the alkaline conditions used for the methylation.

Dehydration of the poison to an aromatic-type compound with concentrated sulfuric or phosphoric acids has not been found possible without excessive destruction of the molecule.

Vigorous acid hydrolysis of the poison has been carried out under several sets of conditions to produce a mixture of products which give characteristics absorption in the ultraviolet region and positive reactions with Weber, Sakaguchi, ninhydrin and P-dimethylaminobenzaldehyde reagents.

The Weygand test for one-diols and 1,3-diketones is negative for the poison and for the dihydro poison.