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**EDGEWOOD ARSENAL
TECHNICAL REPORT**

EATR 4709

**AN ANALYSIS OF CHEMICAL AGENT TESTS AT
CARROLL ISLAND, MARYLAND, IN RECENT YEARS**

by

F. Prescott Ward

Carlos F. A. Pinkham, CPT, MSC

Biomedical Laboratory

March 1973



**DEPARTMENT OF THE ARMY
Headquarters, Edgewood Arsenal
Aberdeen Proving Ground, Maryland 21010**

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Task 1W662710AD6302

**DEPARTMENT OF THE ARMY
Headquarters, Edgewood Arsenal
Aberdeen Proving Ground, Maryland 21010**

FOREWORD

The work described in this report was authorized under Task IW662710AD6302, Chemical Safety Investigations, Test Area Ecology. This work was started in December 1971 and completed in March 1972.

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DIGEST

Tests of chemical agents and other compounds at Carroll Island, Maryland, from 1 July 1964 to 31 December 1971 were analyzed. During the study period, nearly 6-1/2 tons of chemicals were disseminated on the test area including 4,600 pounds of irritants, 655 pounds of anticholinesterase compounds, and 263 pounds of incapacitants. Simulant agents, incendiaries, decontaminating compounds, signaling and screening smokes, mustard, and herbicides were also released. All measures of testing intensity indicated that the use of Carroll Island for agent disseminations decreased markedly during the latter portion of the study period. This decline in the environmental burden of chemicals released on the test area could alter many ecological parameters currently being studied.

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AN ANALYSIS OF CHEMICAL AGENT TESTS AT CARROLL ISLAND, MARYLAND, IN RECENT YEARS

I. INTRODUCTION.

Carroll Island, Maryland, has been Edgewood Arsenal's primary outdoor test area for chemical agents and munitions for more than 20 years. Anticholinesterase compounds, tear agents, blister agents, incapacitants, emetic agents, choking agents, blood agents, chlorine, simulant and training agents, screening and signaling smokes, and incendiaries have been disseminated on this 855-acre tract on the western shore of the upper Chesapeake Bay.¹ In response to rising public and Congressional concern about the existence of the testing program, the Army initiated a continuing and comprehensive ecological survey in August of 1969. The design of this research program was guided by several pertinent recommendations of a committee of scientists from outside the Department of Defense who were appointed by the Secretary of the Army to review testing procedures and safety precautions.²

Tests of agents are conducted at four sites on the eastern half of the island: Grid 1, Grid 2, the Spray Grid, and the Wind Tunnel (figure 1). Ward¹ presented a detailed background of tests at Carroll Island including: acquisition and development of the test site; the mission of Edgewood Arsenal; the rationale for testing agents in the field; the topography, soils, dominant tree species, vegetative cover, mean climatological data from 1959 to 1968, and other physicochemical parameters of the test area; descriptions of test facilities, types of agents tested, and safety procedures; and a judgment of the scope of environmental contamination resulting from the testing activities. Progress in all ecological studies conducted at Edgewood Arsenal during fiscal years 1971 and 1972 was also presented by Ward.³

Choking agents, blood agents, and chlorine were not released on the test area after 1 July 1964. Dissemination of lethal agents (anticholinesterases) was suspended in July 1969 and has not been resumed. Field tests with incapacitants were discontinued in March 1971. Only irritants, simulant agents, and screening and signaling smokes have been released on Carroll Island in recent months.

The purpose of this report is to examine in detail the changes in the past 7-1/2 years in types or quantities of agents tested at Carroll Island. This analysis is an integral part of the environmental investigations because the reason for studying the ecosystems of Carroll Island and the surrounding Chesapeake Bay is to measure the ecological impact of the field tests.

II. METHODS.

Daily records of field tests are maintained in log books by the test engineer at Carroll Island. Complete records were available from 1 July 1964 to 31 December 1971. The following data

- ¹ Ward, F. P. EASP 100-101. A Summary of Ecological Investigations at Edgewood Arsenal, Maryland: Fiscal Year 1970. June 1971. UNCLASSIFIED Report.
- ² Report of the Ad Hoc Advisory Committee for Review of Testing Safety at Edgewood Arsenal, Maryland, and Fort McClellan, Alabama. Department of the Army, Washington, DC. September 1969. UNCLASSIFIED Report.
- ³ Ward, F. P. EASP 1100-13. Progress in Ecological Research at Edgewood Arsenal, Maryland: Fiscal Years 1971 and 1972. February 1973. UNCLASSIFIED Report.

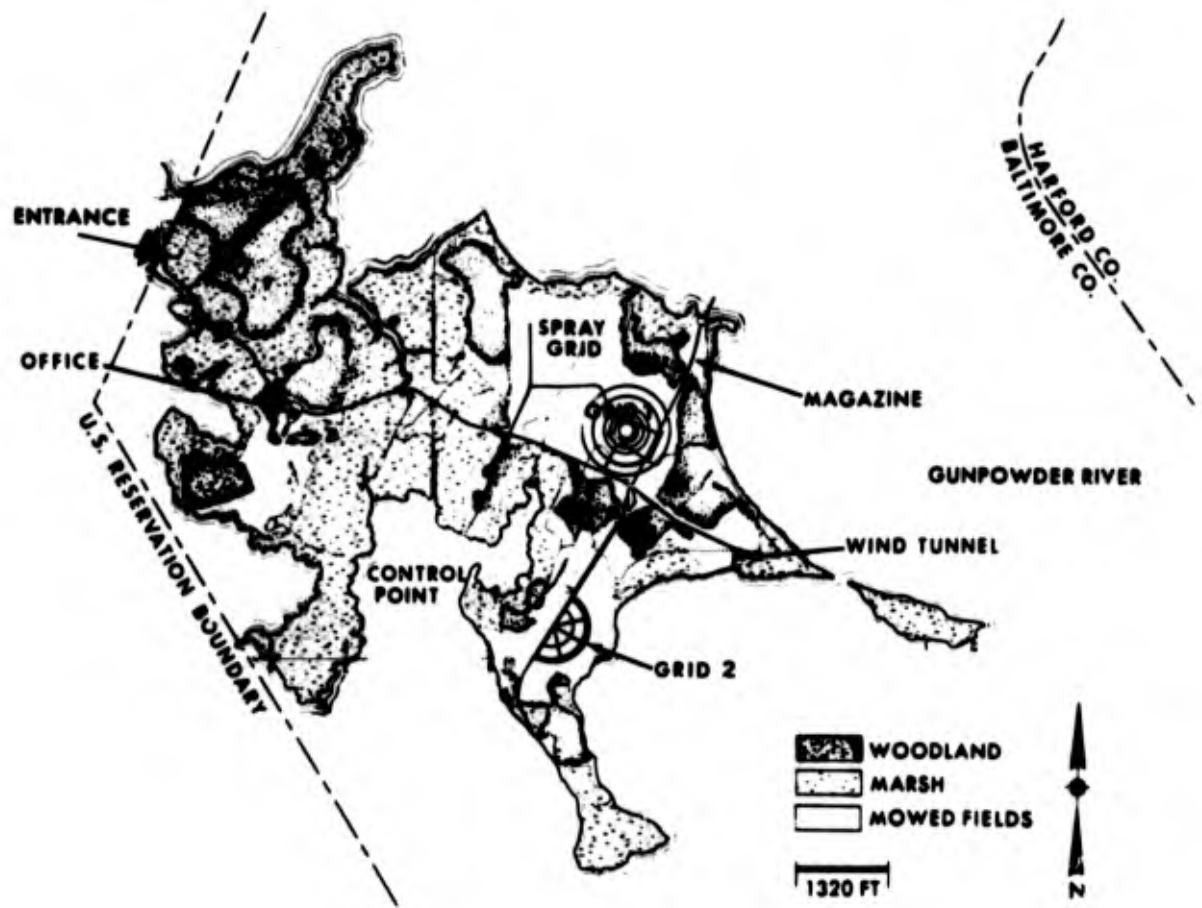


Figure 1. Locations of Carroll Island Test Sites and Support Facilities.

were tabulated for each test and were entered on computer punch cards: date of test, agent, munition, quantity of agent contained in each munition, number of munitions fired (equivalent to the number of trials), total quantity of agent disseminated, and location of test. A computer program was written to collate the above parameters in quarterly, semiannual, and annual increments as well as for the total period.

The original quantity of chemicals contained in each munition was used for all computations, even though large proportions of agents are often decomposed by the heat of detonation. Thus the quantities of chemicals reported represent the maximum possible amounts of agents released on Carroll Island. Amounts of herbicide used by personnel at the test site are included in the totals. However, quantities of insecticide applied aerially to Carroll Island for mosquito control are not included; application rates and frequency of insecticide use are reported elsewhere.¹

III. RESULTS.

All data are presented in tabular and graphic form. The total quantity of chemicals released on Carroll Island and the number of trials performed during the 7-1/2-year study period are shown in figure 2. The separate amounts of each agent or chemical disseminated during this period are delineated in table I.

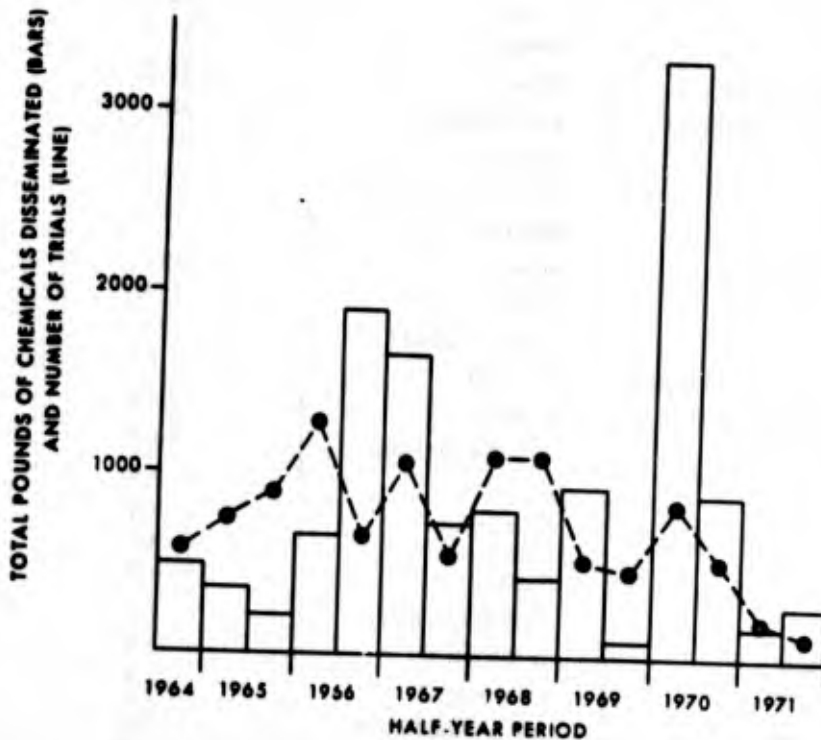


Figure 2. Total Pounds of Chemicals Disseminated and Number of Trials During Six-Month Intervals From 1 July 1964 to 31 December 1971 on Carroll Island.

Table I. Total Quantities of Agents and Simulants, Screening and Signaling Smokes, and Other Chemicals Disseminated on Carroll Island, Maryland, from 1 July 1964 to 31 December 1971

Compound	Type	Pounds Disseminated
Talcum powder	Simulant	5,438.5
CS-1	Irritant	3,608.7
CS-2	Irritant	664.3
VX	Anticholinesterase	422.4
DBHP	Simulant	403.8
Telvar	Weed killer	350.0
Furfural	Simulant	264.0
BZ	Incapacitant	260.4
TEA	Incendiary	221.0
Chloroform & dye	Simulant	208.0
CN/DM	Irritant	181.2
NaOH	Decontaminant	180.0
GB	Anticholinesterase	148.1
WP	Screening smoke	147.5
CS/DM	Irritant	134.2
DMHP	Simulant	48.4
Isopropyl alcohol	Simulant	48.0
Combined anti-ChE's*	Anticholinesterase	40.0
EDA	Simulant	33.8
GA	Anticholinesterase	31.5
TOF	Simulant	27.2
Signaling smokes	Smokes	26.4
DM	Irritant	15.8
FS	Screening smoke	12.0
1,2,3-Trichloropropane	Simulant	11.2
Methylacetoacetate	Simulant	11.2
EA 1356	Anticholinesterase	10.0
Bis	Simulant	9.8
HD	Mustard	7.6
BBC	Irritant	5.7
CN	Irritant	4.0
GD	Anticholinesterase	3.0
EA 3834	Incapacitant	2.3
EA 3528	Incapacitant	1.0
EA 3990	Anticholinesterase	0.7
DEHP	Simulant	0.04
	Total Pounds	12,981.74

*Combined anti-ChE's = old stocks of agents taken to field, dumped, and detoxified (NaOH) on the ground.

The quantities released and number of trials with irritants (riot control agents), anticholinesterases (lethal agents), and incapacitants are shown in figures 3, 4, and 5, respectively.

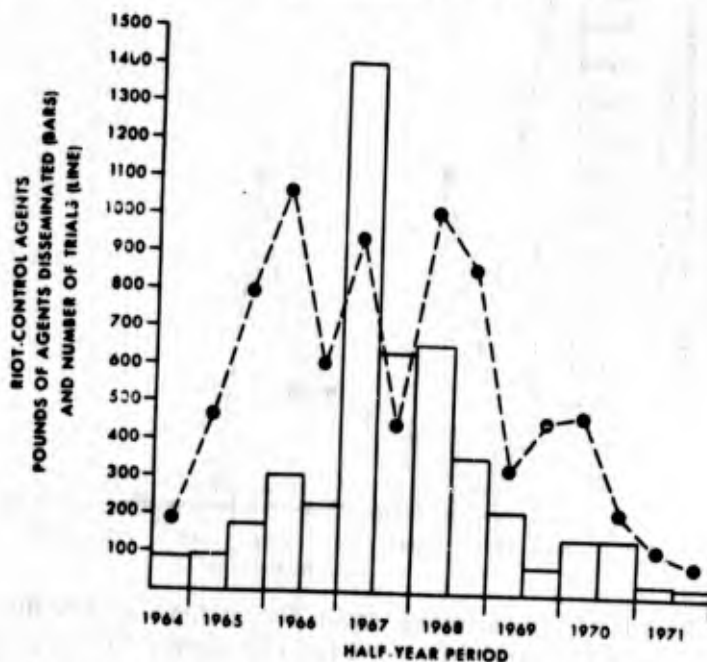


Figure 3. Total Pounds of Riot Control (Irritant) Agents Disseminated and Number of Trials During Six-Month Intervals From 1 July 1964 to 31 December 1971 on Carroll Island.

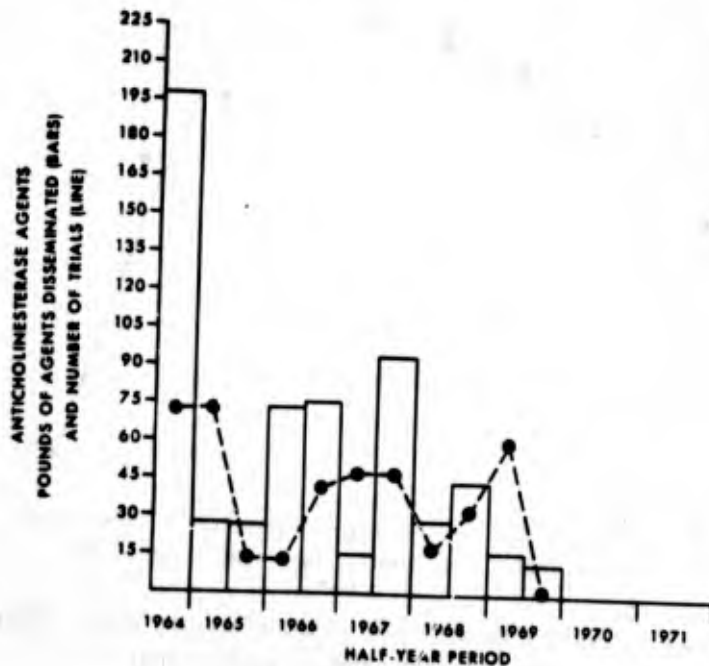


Figure 4. Total Pounds of Anticholinesterase (Lethal) Agents Disseminated and Number of Trials During Six-Month Intervals From 1 July 1964 to 31 December 1971 on Carroll Island.

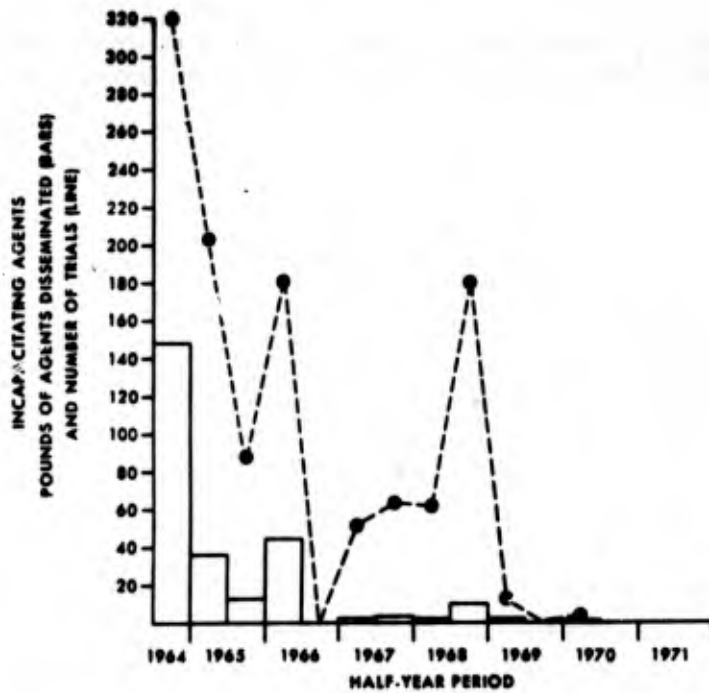


Figure 5. Total Pounds of Incapacitating Agents Disseminated and Number of Trials During Six-Month Intervals From 1 July 1964 to 31 December 1971 on Carroll Island.

Measures of use of the four major test sites on Carroll Island are presented in tables II and III. Plotted in figure 6 are the number of days each year on which chemicals were released.

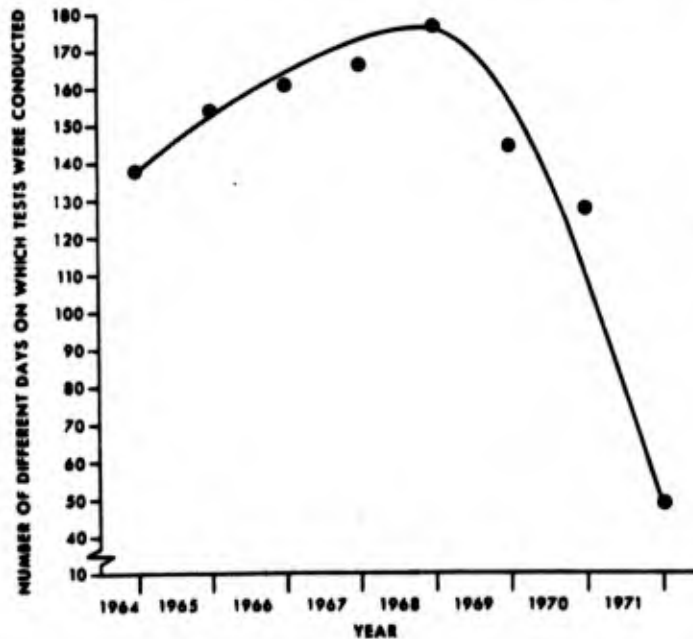


Figure 6. Annual Records of Different Days on Which Chemicals Were Disseminated on Carroll Island.

(Only records for the last 6 months in 1964 were available; the number of days was doubled to approximate the year's total.)

Table II. Amounts of Chemicals Released and Number of Trials Performed at Major Testing Sites on Carroll Island from 1 July 1964 to 31 December 1971

Location	Number of trials	Total pounds of chemicals	Pounds of irritants	Pounds of anti-ChE's*	Pounds of incapacitants
Grid 1	738	1,085.2	283.8	130.5	64.3
Grid 2	756	6,244.7	503.4	251.2	6.3
Spray Grid	2,669	4,081.0	2,527.0	241.5	26.9
Wind Tunnel	6,577	1,400.3	1,203.5	30.6	166.1
Other	8	170.7	96.0	1.7	-
Totals	10,748	12,981.9	4,613.7	655.5	263.6

*Anti-ChE = anticholinesterase agent.

Table III. Quantities of Irritants, Anticholinesterases, and Incapacitants Disseminated Annually at Four Major Test Sites on Carroll Island

Location	Agent type	Pounds of agents released during year							
		1964*	1965	1966	1967	1968	1969	1970	1971
Grid 1	Irritant	-	-	7.0	128.8	58.5	45.7	42.5	1.3
	Anti-ChE	23.0	11.3	27.0	26.3	27.6	15.3	-	-
	Incap	63.4	-	-	-	-	-	0.9	-
Grid 2	Irritant	72.0	-	-	209.7	124.2	8.5	89.0	-
	Anti-ChE	136.0	11.3	37.5	20.0	5.5	40.9	-	-
	Incap	-	6.3	-	-	-	-	-	-
Spray Grid	Irritant	5.6	41.5	185.2	1,406.7	590.8	160.7	118.5	18.0
	Anti-ChE	37.0	22.4	81.5	50.8	38.4	11.4	-	-
	Incap	12.0	8.2	0.4	2.3	3.2	0.8	-	-
Wind Tunnel	Irritant	9.8	229.4	350.5	204.0	250.0	77.0	48.5	34.3
	Anti-ChE	4.0	4.2	3.0	17.2	-	2.2	-	-
	Incap	72.7	35.0	44.2	2.9	9.9	1.4	-	-

* July to December only.

IV. DISCUSSION.

All measures of the testing activity (total pounds disseminated, number of trials, and number of days on which tests were conducted) indicate that the use of Carroll Island as a test facility for chemical agents generally decreased during the latter part of the study period. Open-air tests were dramatically curtailed during 1971. This general decline, and especially the moratorium on anticholinesterase tests, should have measurable beneficial effects on animals in the test zone, particularly downwind from Grid 1, Grid 2, and the Spray Grid where disseminations of anticholinesterases were greatest. Turtle populations will be of special interest because their relatively low biotic potential should create a time lag of several years in returning to stable age distributions (if populations were affected). Ecological rebounds also might occur on the Spray Grid where releases of irritants were heavy in 1967 and 1968 but were reduced to practically zero in 1971.

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13. ABSTRACT
Tests of chemical agents and other compounds at Carroll Island, Maryland, from 1 July 1964 to 31 December 1971 were analyzed. During the study period, nearly 6-1/2 tons of chemicals were disseminated on the test area including 4,600 pounds of irritants, 655 pounds of anticholinesterase compounds, and 263 pounds of incapacitants. Simulant agents, incendiaries, decontaminating compounds, signaling and screening smokes, mustard, and herbicides were also released. All measures of testing intensity indicated that the use of Carroll Island for agent disseminations decreased markedly during the latter portion of the study period. This decline in the environmental burden of chemicals released on the test area could alter many ecological parameters currently being studied.

14. KEYWORDS
Chemical agents
Field testing
Anticholinesterase
Irritants
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Incapacitant
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