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**UNITED STATES AIR FORCE ACADEMY, COLORADO**

**Annual Research Progress Report No. 13**

**October 1978**



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**1 July 1977 - 30 September 1978**

Annual Research Progress Report No. 13

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TABLE OF CONTENTS

Page

I. SCIENTIFIC AND ENGINEERING INVESTIGATIONS

A. Department of Aeronautics

1. Flow Field Disturbance Created by Porous Spoilers . . . .	1
2. The Flow Dynamics of Unsteady Separating Regions . . . .	1
3. Improved Airplane Maneuvering Performance . . . . .	2
4. Productive Applications of Dynamic Aeroelasticity . . . .	2
5. Estimation of Instantaneous Distortion for the YF-12C Inlet . . . . .	3
6. Plume Effects on Missile Aerodynamics . . . . .	3
7. Laser Doppler Velocimeter Development for USAFA Wind Tunnels . . . . .	4
8. Academy Turbine Engine Test Facility . . . . .	4
9. Aircraft Protuberance Drag . . . . .	4
10. Pitot Static Systems . . . . .	5

B. Department of Astronautics and Computer Science

1. Defining the Computer Science Curriculum . . . . .	5
2. Academic Test Generation System . . . . .	5
3. Special Education Data Base Management System . . . . .	6
4. System Enhancements to Provide Visual Demonstration of Algol Programs . . . . .	6
5. Data Base Development for Statistical Research . . . . .	6
6. USAF Academy Computer Graphics System Design . . . . .	7

7.	Survey of Software Engineering Factors . . . . .	7
8.	Burroughs TD820/HP7210A Interface . . . . .	8
9.	USAF Academy Computer Graphics System Development . . . . .	8
10.	GPSS Compiler Enhancements . . . . .	8
C. Department of Chemistry and Biological Sciences		
1.	Pattern Analysis and Correlation of Weather and Air Pollution Data in the Pikes Peak Region . . . . .	9
2.	Photochemical Energy Storage . . . . .	9
3.	Ultrastructural Analysis of Mammalian Tissues Exposed to Depleted Uranium . . . . .	10
4.	Reaction of Mesylate Esters with Energetic Alcohols . . . . .	10
5.	A Spectroscopic Investigation of the Selenium Halides . . . . .	11
6.	Determination of the Effects of Wastewater Reuse . . . . .	11
7.	An Evaluation of Worldwide Endeavors in Genetic Engineering . . .	13
8.	Fate of Herbicide Orange in Soils . . . . .	13
9.	Analysis of TCDD in Biological Samples . . . . .	13
10.	Chemical and Microbiological Monitoring of Sites Previously Used for Storage of Military Herbicides . . . . .	14
11.	The Effect of Hyperbaric Oxygen on Mycotic Disease Agents . . .	15
12.	Chemical Structure/Bonding Decomposition Relationships . . . . .	15
13.	Citizen's Workshop Program on Energy and the Environment . . .	16
14.	Comparison of Stress Responses in Male and Female Cadets at the USAF Academy . . . . .	17
15.	Physical and Electrochemical Measurements . . . . .	18
16.	Chemiluminescent Gas Phase Reactions . . . . .	19

D. Department of Civil Engineering, Engineering Mechanics and Materials	
1. Bio-Engineering . . . . .	19
2. Certification of Side Facing Troop Seats for the UV-18 Aircraft . . . . .	20
3. Development of General Second Order Component Mode Synthesis With Application to Rotor Bearing Systems . . . . .	20
4. Dynamics of Aircraft-Runway Interaction . . . . .	20
5. Elastic Waves in Layered Media . . . . .	21
6. Finite Element Cable Studies . . . . .	21
7. Fracture Mechanics . . . . .	22
8. High Speed Ground Transportation . . . . .	22
9. Hot Corrosion . . . . .	23
10. Load Deformation Relationship for Split-Ring Timber Connectors.	23
11. Metal Joining Techniques . . . . .	23
12. Solar Energy . . . . .	24
13. Tension-Torsion Interaction Strength of Laminated Wood Bolts .	25
14. T-38 Structural Integrity . . . . .	25
15. Turbine Engine Metal Matrix Composite Blade Analysis . . . . .	25
16. Wind Energy Conversion System (WECS) . . . . .	26
E. Department of Electrical Engineering	
1. Space Test Program Experiment Prioritization . . . . .	26
2. Microprocessor System Development for Aircraft Simulation Visual System Control . . . . .	26
3. Portable, Self-Contained, Educational Microprocessor System Development . . . . .	27

4.	Microprocessor Instrumentation of the F-15 APG-63 Radar . . . . .	27
5.	Data Acquisition System Development . . . . .	28
6.	Bulk Properties of Annealed High Resistivity Gallium Arsenide . . . . .	28
7.	6502 Microprocessor Emulator System . . . . .	28
8.	Space Experiment Integration . . . . .	29
9.	Educomm - An Analog Communications Trainer . . . . .	29
10.	Microcomputer Controlled Event/Alarm Scanner . . . . .	29
11.	Measurement of Surface Change and Currents Utilizing Infrared Technology . . . . .	30

F. Department of Mathematical Sciences

1.	Transshipment/Allocation Algorithm for Cadet Summer Transportation Requirements . . . . .	31
2.	Safe Escape . . . . .	31
3.	Digital Signal Sorting . . . . .	32
4.	Development of a Fix Computation Algorithm for Use in High-Frequency Direction-Finding Systems . . . . .	32
5.	Mathematical Modeling and Identification . . . . .	33
6.	Network Evaluation Through Simulation . . . . .	33
7.	USAFA/DMA R&D Program . . . . .	33
8.	Shock Waves in Explosives . . . . .	34
9.	An Encke Method in Poincare'-Similar Elements . . . . .	34

G. Department of Physics

1.	A Study of Proton Range "Straggling" Due to Initial Beam Energy Distribution . . . . .	35
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2.	Determination of 14 MeV Neutron Fluences Using Copper Activation Foils and Gamma Coincidence Counting . . . . .	35
3.	Soft X-Ray Emission from Coronal Loops . . . . .	36
4.	Chemical Structure/Bonding Decomposition Relationships and Chemiluminescent Gas Phase Relationships . . . . .	36
5.	Laser Isotope Separation - Economics and Applications . . . . .	37
6.	Aircraft Engine Oil Analysis by Neutron Activation Techniques.	38
7.	Diurnal Variation of Total Electron Content of the Ionosphere.	38
8.	Optical Detection of Damage in Solids . . . . .	38
9.	Analysis of Photometric Data on the Massive Eclipsing Binary Star V382 Cygni . . . . .	39
10.	Design and Fabrication of a Current-Technology Flywheel-Electric Vehicle . . . . .	40
11.	A Physics Model of a Runner for Possible Use in Athlete Training and Education at the United States Air Force Academy.	40

## II. GENERAL RESEARCH IN THE HUMANITIES AND SOCIAL SCIENCES

### A. Department of Behavioral Sciences and Leadership

1.	Pilot Performance with Peripheral Vision . . . . .	41
2.	The Effects of Job Enrichment and Goal Setting on Job Satisfaction and Organizational Effectiveness . . . . .	41
3.	Stress Management Research . . . . .	42
4.	Male and Female Anxiety During Survival, Evasion, Resistance and Escape (SERE) Training . . . . .	42
5.	Reacquisition and Maintenance of Flying Skills . . . . .	43
6.	Personal and Environmental Factors Contributing to BCT and Fourth Class Year Attrition . . . . .	43
7.	Similarities of Men and Women in Perceptions of Their Work and Their Affective Responses: An Empirical Test . . . . .	44

8.	Analysis of Soviet Behavioral Sciences . . . . .	44
9.	Analysis of Information Sources Within the Air Force . . . . .	44
B.	Department of Economics, Geography and Management	
1.	Preferential Tariff Reductions: The Philippine Response, 1900-1940 . . . . .	46
2.	The Rent-Buy Decision for Military Families . . . . .	46
3.	The Utilization of Side-Looking Airborne Radar (SLAR) in the Analysis of Karst Topography . . . . .	47
4.	Change After an Earthquake Disaster in Western Anatolia . . . . .	47
5.	Analysis of Crime in Manitou Springs, Colorado (1976- June 1977) . . . . .	48
6.	Energy Atlas of Montana . . . . .	48
7.	Energy Atlas of Utah . . . . .	49
8.	Energy Atlas of Wyoming . . . . .	49
9.	Energy Atlas of Colorado . . . . .	49
10.	Climate, Soils and Vegetation of the Rampart Range, Colorado. .	50
11.	Natural and Man-Induced Soil Pollution . . . . .	50
12.	Future Patient Demand in the USAF Academy, Colorado Hospital Catchment Area . . . . .	50
13.	Avalanche and Non-Avalanche Talus Slope Comparison Colorado Front Range . . . . .	51
14.	Preparation of Maps for Use by the FEA . . . . .	51
15.	Predicting Casualties and Damages Caused by Earthquakes in Turkey . . . . .	51
16.	A Model for Public Education on Earthquake Hazard Minimization.	52
17.	Perspectives on Turkey . . . . .	52

18.	Construction in Seismic Zones: A Model for Users and Planners . . . . .	53
19.	Seven Years After Disaster: Old and New Gediz in Light of Kates' and Pijawka's Model . . . . .	53
20.	Decision Making and Natural Disasters . . . . .	53
21.	Harmonic Analysis of Precipitation in Turkey . . . . .	53
22.	Hello, Is Anyone Out There? . . . . .	54
23.	Performance Appraisal, Assertiveness Training, Personal Awareness, Management Styles . . . . .	54
24.	Management by Objectives . . . . .	54
25.	Preparing a Budget for Equal Opportunity Programs . . . . .	54
26.	Communication and Motivation: Your Most Important Tools . . . . .	54
27.	Time Management . . . . .	55
28.	The USAFA Management Curriculum . . . . .	55
29.	Communication Workshop . . . . .	55
30.	You, Your Job, and Your Future . . . . .	55
31.	Sergeants Administrative Workshop . . . . .	55
32.	Giants in Management: Jim Webb of NASA . . . . .	56
33.	Organization Climate . . . . .	56
34.	First-Line Management--Police Sergeant's Administrative Workshop . . . . .	56
35.	How Am I Doing, Boss? . . . . .	56
36.	The USAFA Management Curriculum . . . . .	56
37.	Collaborative Goal Setting in Performance Appraisal: A Field Experiment . . . . .	57

C. Department of English

1. Glossary of Poetic Terms . . . . .	57
2. The Good Old Days?: Joel Chandler Harris and Charles W. Chesnutt . . . . .	57
3. John Burgoyne's "Lord of the Manor" and the Beginnings of English Musical Comedy . . . . .	58
4. Cleanth Brooks at USAFA . . . . .	58
5. "Brother to Dragons": A Discussion . . . . .	58
6. Flannery O'Connor: A Companion . . . . .	59
7. Wild Bill Shakespeare Rides Again . . . . .	59
8. Orphans of the Storm: Running a College-Level Theatre Program Without a Theatre Major or Theatre Department . . . . .	59
9. The Paperwork Air Force: Adapting Air Force Writing to Air Force Needs . . . . .	60
10. Human Nature and Four Humorists of the Old Southwest: Hooper Lewis, Warren, and Harris . . . . .	60
11. Henry Clay Lewis (a biographical entry) . . . . .	60
12. Black Literature and the Military Mind . . . . .	61
13. Air Force Effective Writing Course . . . . .	61
14. The Air Mail Emergency of 1934: The Heisenberg Principle Exemplified in Journalism . . . . .	61
15. The Introduction of Televised Instructional Material into the USAF Air Command & Staff College Non-Resident Curriculum: An Experimental Comparison with Existing Methods . . . . .	62
16. Book Review of "Scott of the Antarctic" by Elspeth Huxley . . . . .	62
17. Donne and the Herbert Family . . . . .	63
18. Come Down Out of Your Ivory Tower, Professor: The English Department and the World Outside . . . . .	63

19.	Herman Melville and the Art of Leadership . . . . .	63
20.	Technical Writing and Television . . . . .	64
21.	Competitive Speechmaking . . . . .	64
D. Department of Foreign Languages		
1.	The Cloze Test as a Procedure for Establishing Objective German Prose Readability Standards . . . . .	64
2.	Computer Management of Foreign Language Grading and Test Analysis at the Air Force Academy . . . . .	65
3.	Study Packets to Accompany the Soviet Language Text, Russian for Everybody . . . . .	65
4.	Soviet Thoughts on Military Leadership . . . . .	65
E. Department of History		
1.	A History of the United States Air Force . . . . .	66
2.	USAFA Oral History Program . . . . .	66
3.	The Harmon Memorial Lectures in Military History . . . . .	67
4.	Chinese Perspectives in Selected Western Literature, 1915- 1930 . . . . .	67
5.	Yeoman Regions in the Antebellum Deep South: Settlement and Economy in Northern Alabama, 1815-1860 . . . . .	67
6.	American Military Missions to Korea: 1882-1896 . . . . .	67
7.	Korean Immigration to the United States . . . . .	68
8.	American Forces in Foreign Cultures . . . . .	68
9.	Air Force Atomic Capability from V-J Day to the Berlin Blockage--Potential or Real? . . . . .	69
10.	Strategic Thought to 1945 . . . . .	69
11.	U.S. Foreign Policy and Diplomacy . . . . .	69

12.	International Politics and Strategy . . . . .	69
13.	The Periodical Press and the London Naval Conference . . . . .	70
14.	The American Military Establishment and the Creation of a Postwar Overseas Military Base Network, 1942-1948 . . . . .	70
15.	Modern Warfare and Society . . . . .	70
16.	Timothy Walker and the Growth of American Law . . . . .	71
17.	Family Structure in a Colonial New England Town . . . . .	71
18.	The Role of the Colorado National Guard in Civil Disturbances .	71
19.	General Hoyt S. Vandenberg, Sr. . . . .	71
20.	The Creation of the GHQ Air Force . . . . .	72
21.	General Benjamin Foulois and His Air Corps . . . . .	72
22.	The 1934 Air Mail Fiasco . . . . .	72
23.	The Military Profession in America . . . . .	73
24.	The Air Corps-Navy Struggle over the Coast Defense Mission, 1920-1941 . . . . .	73
25.	The Career of the Reichswehr Officer . . . . .	73

F. Department of Law

1.	Personal Estate Planning . . . . .	74
2.	Copyright in Works Prepared Using Government Resources . . . .	74
3.	The Vagueness Doctrine and Cadet Disenrollment for Other Misconduct under AFR 53-3 . . . . .	74
4.	Disclosure of United States Air Force Academy Library Patron Records to Law Enforcement Agencies . . . . .	74
5.	Public Access to Oral History Interview Tapes and Transcripts .	75
6.	Publication of Article Prepared for Classroom Use at USAFA . .	75

G.	Department of Mathematical Sciences	
1.	Math Achievement Test Analysis . . . . .	75
2.	Core Math Data Base . . . . .	76
3.	An Individualized Mastery System of Instruction in Core Mathematics . . . . .	76
4.	Cost Containment in Military Medical Care . . . . .	77
H.	Department of Philosophy and Fine Arts	
1.	On the Nature of Man . . . . .	77
2.	Managerial Integrity . . . . .	78
3.	Professionalism in Military and Federal Service . . . . .	78
4.	Ethics and Institutions . . . . .	78
5.	Become the Ethical Dream . . . . .	78
6.	Christian Morality and the Cadet Honor Code . . . . .	79
7.	Ethics and the Military Profession; War and Morality . . . . .	79
8.	Whatever Happened to Sin . . . . .	80
9.	Lanka: A Visual Diary . . . . .	80
10.	Managerial Ethics . . . . .	80
11.	Practicum in Ethics . . . . .	81
12.	Professional Ethics . . . . .	81
13.	War, Morality, and the Military Profession . . . . .	81
I.	Department of Political Science	
1.	American Defense Policy . . . . .	82
2.	Counterinsurgency: The Thai Case . . . . .	82
3.	The Politics of East Asia . . . . .	83

4.	The Political Element in Professional Military Expertise . . . . .	83
5.	The Ideology of Preparedness . . . . .	83
6.	Defense Decision-making in the Organizational Bureaucratic Context . . . . .	84
7.	Public Administration and the Military . . . . .	84
8.	In Case of Deluge: Where Nuclear Proliferation Meets Conventional Arms Sales . . . . .	84
9.	How Military Elite Role Perceptions in Southeast Asia Conflict with the Civil-Military Paradigm . . . . .	85
10.	Trends in Constitutional Development . . . . .	85
11.	Legislative Liaison in DOD . . . . .	85
12.	The National Security Council System . . . . .	86
13.	Analyzing Chinese Factions . . . . .	86
14.	Understanding China . . . . .	86
15.	Panama Canal Treaties . . . . .	87
16.	Congressional Elections: Incumbency and Service to Constituents . . . . .	87
17.	President Carter's Foreign Policy . . . . .	87
18.	Military Roles in Southeast Asia . . . . .	87
19.	The Central Mystery of Political Science and the Study Canadian Defense Policy--Is It Time For a New Approach? . . . .	88
20.	Hot Spots in Today's World . . . . .	88
21.	POW Experiences . . . . .	88
22.	NATO Defense Planning . . . . .	88
23.	Presidential Memorandum #10 . . . . .	89
24.	President Carter's Foreign Policy . . . . .	89

25.	The Other Wiseman . . . . .	89
26.	Ethical Considerations of Nuclear War . . . . .	90
27.	The Role of the Military in Arms Limitation . . . . .	90
28.	NATO's Long Term Defense Plan . . . . .	90
29.	Strategic Balance and Arms Control Talks . . . . .	90
30.	Political Analysis of Soviet Intentions . . . . .	91
31.	Elements of Soviet Power - Strengths and Weaknesses . . . . .	91
32.	Dilemmas of World Energy . . . . .	91
33.	The Politics of Energy . . . . .	92
34.	NATO Strategy . . . . .	92
35.	The President's Commission on Military Compensation Proposals: A Legislative Strategy . . . . .	92
36.	The Evaluation of the U.S.-Canadian Defense Economic Relationship and Its Applicability to NATO Standardization . . . . .	92
37.	NATO and Oil: Conflict and Capabilities . . . . .	93
38.	Justifying the MX . . . . .	93
39.	Independent Review and Assessment of Space and Missile Systems Organization Test and Evaluation Architecture . . . . .	93
40.	Recent Trends in Administration and Congressional Attitudes Impacting on Reentry Technology . . . . .	94

### III. RESEARCH AND ANALYSIS OF SPACE AND WEAPONS SYSTEMS

#### A. Department of Astronautics and Computer Science

1.	Research Support for the NACSTAR Global Positioning System (GPS) . . . . .	95
a.	GPS Magnetic Momentum Dumping Control Program . . . . .	95

b.	GPS Constellation Studies . . . . .	96
c.	GPS User Navigation During the Limited Operational Capability Phase (Phase II) . . . . .	96
2.	Air to Air Fire Control Research . . . . .	97
3.	Independent Review and Assessment of SAMSO Test and Evaluation Architecture . . . . .	97
4.	Automation of the AF Form 1537 . . . . .	98
5.	Software Development for Drones . . . . .	99
6.	Economic Price Adjustment Model . . . . .	99
7.	Data Compression and Display Techniques . . . . .	99
B.	Department of History	
	The X-15's Role in Aerospace Progress . . . . .	100
IV.	MANPOWER, PROCUREMENT AND LOGISTICS STUDIES	
A.	Department of Economics, Geography and Management	
1.	A General Technique for R&D Cost Forecasting . . . . .	101
2.	Management Science Applications in the Arena of the Operational Air Force . . . . .	101
3.	A General Model for R&D Cost Forecasting . . . . .	101
4.	Forecasting Air Force Expenditures in the 3600 Category .	101
5.	Observable Preference for Public Goods . . . . .	102
6.	Nursing Cost Prediction for Budgeting and Control . . . .	102
7.	The Evaluation and Utilization of Tanker Cargo Aircraft .	102
8.	Replacement Cost Accounting: Its Possible Effects on Government Contracts . . . . .	103
9.	Review of the Application of the O&S Cost Model to the A-10 Program Contractor Incentive Award Fee . . . . .	103

10.	Follow-up Recommendations Presented in A-10 O&S Model Review . . . . .	.104
11.	Forecasting Retail Sales in AAFES, Conus at Headquarters Army and Air Force Exchange Service . . . . .	.104
12.	A Model for Management of USAFA Cadet Uniform Inventory . . . . .	.104
13.	Performance Incentives and Planning Under Uncertainty . . . . .	.104
14.	Optimal Subsidy Functions . . . . .	.105
15.	Strategic Stockpiling and Substitution . . . . .	.105
16.	Technical Communication in Research and Development: A Longitudinal Analysis . . . . .	.106
17.	A Model for MBO in the Air Force . . . . .	.106
B.	Department of Mathematical Sciences	
1.	Aircraft Modification Study . . . . .	.107
2.	Statistical Analysis of Demand and Leadtime Data for the Air Force Standard Base Supply System . . . . .	.107

## 7. An Evaluation of Worldwide Endeavors in Genetic Engineering

Principal Investigator: Captain Robert H. Zellers, Department of Chemistry and Biological Sciences

Associate Investigators: Captain Martin D. Zahn and Captain Robert A. Peterson, Department of Chemistry and Biological Sciences

Sponsored by the Defense Intelligence Agency

This is an on-going evaluation that was begun in FY76. Current research in genetic engineering is being monitored through literature reviews, personal interviews, and attendance at appropriate symposia. Collection of information results in an analysis of trends and progress in genetic engineering efforts with emphasis on potential applications. A final report will be submitted in October 1978.

## 8. Fate of Herbicide Orange in Soils

Principal Investigators: Major William J. Cairney, Department of Chemistry and Biological Sciences; Captain Alvin L. Young, Occupational and Environmental Health Laboratory, Brooks AFB, TX; Dr. H. H. Cheng, and Mr. Joseph T. Majka, Department of Agronomy and Soils, Washington State University

Sponsored by Air Force Logistics Command

This cooperative field study is being conducted jointly by the Department of Chemistry and Biological Sciences, USAF Academy, and the Department of Agronomy and Soils, Washington State University. The study is attempting to assess breakdown products of both high and low concentrations of 2,4-D and 2,4,5-T n-butyl esters applied at rates comparable to spills in former AFLC Herbicide Storage Sites. A combination of ring and side chain labeled  $^{14}\text{C}$ -2,4-D or  $^{14}\text{C}$ -2,4,5-T n-butyl esters is being used in experiments which will provide data on probable degradation pathways, identification of metabolites, and rates of degradation. Field minilysimeters have been installed at the Washington State University Department of Agronomy and Soils Experiment Station. Corresponding microbial analysis is being conducted at the USAF Academy which will correlate levels of herbicide and herbicide metabolites with microorganism populations and diversity.

## 9. Analysis of TCDD in Biological Samples

Principal Investigators: Major William J. Cairney, Department of Chemistry and Biological Sciences; Captain Alvin L. Young, Occupational and Environmental Health Laboratory, Brooks AFB, TX; Dr. Michael Gross, Department of Chemistry, University of Nebraska

## Sponsored by Air Force Logistics Command

In support of the Air Force Logistics Command project on Disposition of Herbicide Orange, the Department of Chemistry and Biological Sciences has been conducting extensive research on the fate of TCDD (2,3,7,8-tetrachlorodibenzo-p-dioxin, a contaminant of Herbicide Orange) in the environment. Since 1975, personnel of this department have been collecting soil and biological samples from areas exposed to Herbicide Orange and TCDD. One hundred samples have been collected, placed separately in glass jars and maintained in a freezer pending analysis of TCDD at parts per trillion level (ppt). The analysis of TCDD in biological systems requires a complex extraction and cleanup system in addition to highly sophisticated instrumentation. No Air Force laboratory currently has this capability. Two universities currently do have, but only one (The University of Nebraska) is available. The University of Nebraska is currently under contract to the Department of Chemistry and Biological Sciences, USAF Academy, to analyze these biologicals. A technical report is forthcoming which will summarize all of our past data on the fate of TCDD in biological systems and incorporate the results from the University of Nebraska analyses.

### 10. Chemical and Microbiological Monitoring of Sites Previously Used for Storage of Military Herbicides

Principal Investigators: Major William J. Cairney, Department of Chemistry and Biological Sciences; Captain Alvin L. Young, Occupational and Environmental Health Laboratory, Brooks AFB, TX; Dr. B. Mason Hughes, Flammability Research Center, University of Utah

## Sponsored by Air Force Logistics Command

This study is part of an overall effort by Air Force Logistics Command to reclaim, decontaminate, and restore areas formerly used for the storage of Military Herbicides. The two former storage areas are respectively located at the Naval Construction Battalion Center, Gulfport, Mississippi, and on Johnston Atoll in the Pacific Ocean. The initial phase of decontamination is chemical and microbiological site monitoring. Forty-three sites have been selected at each location for analysis. Test sites were selected on the basis of heavy herbicide spill and heavy herbicide odor (designated H/H), light herbicide spill and odor (designated L/L) and no detectable spill or odor (designated O/O). In addition controls were selected from locations adjacent to former storage areas which had never received any herbicide. Testing of these sites for 2,4-D, 2,4,5-T, and associated dioxins is in progress and will continue over a two year (or more) period. Levels and diversity of soil microflora are currently being determined and will be correlated with levels of herbicide to assess the possible effects of herbicide on microflora and possibly provide data on the role of microorganisms in herbicide biodegradation. The Flammability

Research Center at the University of Utah is uniquely suited to provide Mass Spectrometric chemical analytical support. Dr. Mason Hughes has personally developed all of the protocol being used and is able to analyze for 2,4-D, 2,4,5-T and breakdown products at a resolution unattainable anywhere else in the world. In addition, he has assembled an automated, computer-linked system which provides rapid results. Present experimental results indicate that high levels of herbicide and dioxin are present in storage site spills. Microbial studies have shown that application of 2,4-D and 2,4,5-T at massive rates (5000-40,000 ppm) not only did not sterilize the soil, but actually stimulated the growth of some soil microorganisms. This next set of samples (programmed for October-November 1978) will begin to yield data on breakdown rates in the two storage sites.

#### 11. The Effect of Hyperbaric Oxygen on Mycotic Disease Agents

Principal Investigator: Major William J. Cairney, Department of Chemistry and Biological Sciences

This research is presently unsponsored. The project attempts to determine oxygen toxicity limits for selected mycotic disease agents in an effort to find expanded application for the USAF Compression Chamber Treatment Facilities (i.e., Hyperbaric Chambers). Students in English 330 and Bio Sci 499 are programmed to do literature review and experimental studies on the project. Preliminary results indicate that a number of mycotic disease agents have oxygen toxicity limits within levels readily tolerated by susceptible humans and animals.

#### Publication

Cairney, W. J. 1978. Effect of hyperbaric oxygen on certain growth features of *Candida albicans*. *Aviat. Space Environ. Med.* 49(8):956-958.

#### 12. Chemical Structure/Bonding Decomposition Relationships

Principal Investigator: Major Joel W. Beckmann, Department of Chemistry and Biological Sciences

Associate Investigators: Captain R. Martin Guidry, Captain Larry P. Davis, Lt John S. Wilkes, Frank J. Seiler Research Laboratory; CIC Robert Wheelock, CIC Craig Gilbert, Department of Chemistry and Biological Sciences

Sponsored by the Frank J. Seiler Research Laboratory, Air Force Systems Command (AFSC)

Two areas of study were conducted as Chemistry 499 projects under the supervision of Major Beckmann.

a. The objectives of CIC Gilbert's project were the isolation and identification of the catalytic precursor to the thermal decomposition of Trinitrotoluene (TNT). This project resulted in identification of the catalytic precursor as 4,6-dinitroanthranil. Also, the formation of 4,6-dinitroanthranil fits nicely into a mechanism for TNT thermal decomposition proposed by Capt Shackelford.

b. The objective of CIC Wheelock's project was to investigate the decomposition mechanism of hexanitrostilbene (HNS) via the kinetic isotope effect expected from the replacement of the allytic protons with deuteriums. This effect is used to help determine whether the C-H/C-D bond breakage in HNS and similar compounds such as TNT is rate determining. The kinetic results obtained were inconclusive; however, they provided two major improvements in the current experimental procedure; computer data acquisition and a variation in the synthetic technique for deuterated HNS.

### 13. Citizen's Workshop Program on Energy and the Environment

Principal Investigator: Captain Ronald E. Channell, Department of Chemistry and Biological Sciences

Associate Investigators: Lt Colonel Hugh T. Bainter, Major John H. Birkner, Major James R. Wright, Captain Elroy A. Flom, Captain John A. Klube, Captain James T. Norelius, Captain Donald A. Potter, Captain Ronald E. Watras, Department of Chemistry and Biological Sciences; Dr. Phil Kearney, Colorado State University, Fort Collins, CO; Dr. Mike Lowenstein, Navarro College, Corsicana, TX; Mr. Roger Howard, West Junior High School, Grand Junction, CO

Sponsored by the Department of Energy through Interagency Agreement

Citizen's Workshops are educational programs that give citizens an opportunity to learn more about energy and environmental needs and problems. Participants get a chance to try their hand at solving some of the energy-environment problems facing the nation today by using an Energy-Environment Simulator.

The Energy-Environment Simulator is a specially designed analog computer that simulates real-world conditions. Energy resources, energy demands, and environmental effects are programmed into the electronic device. As the clock speeds time by at the rate of a century a minute, participants must make decisions about the allocation of energy resources. They do this by operating controls on remote panels in response to the changing situation.