

AD-A043 838

AIR FORCE ACADEMY COLO

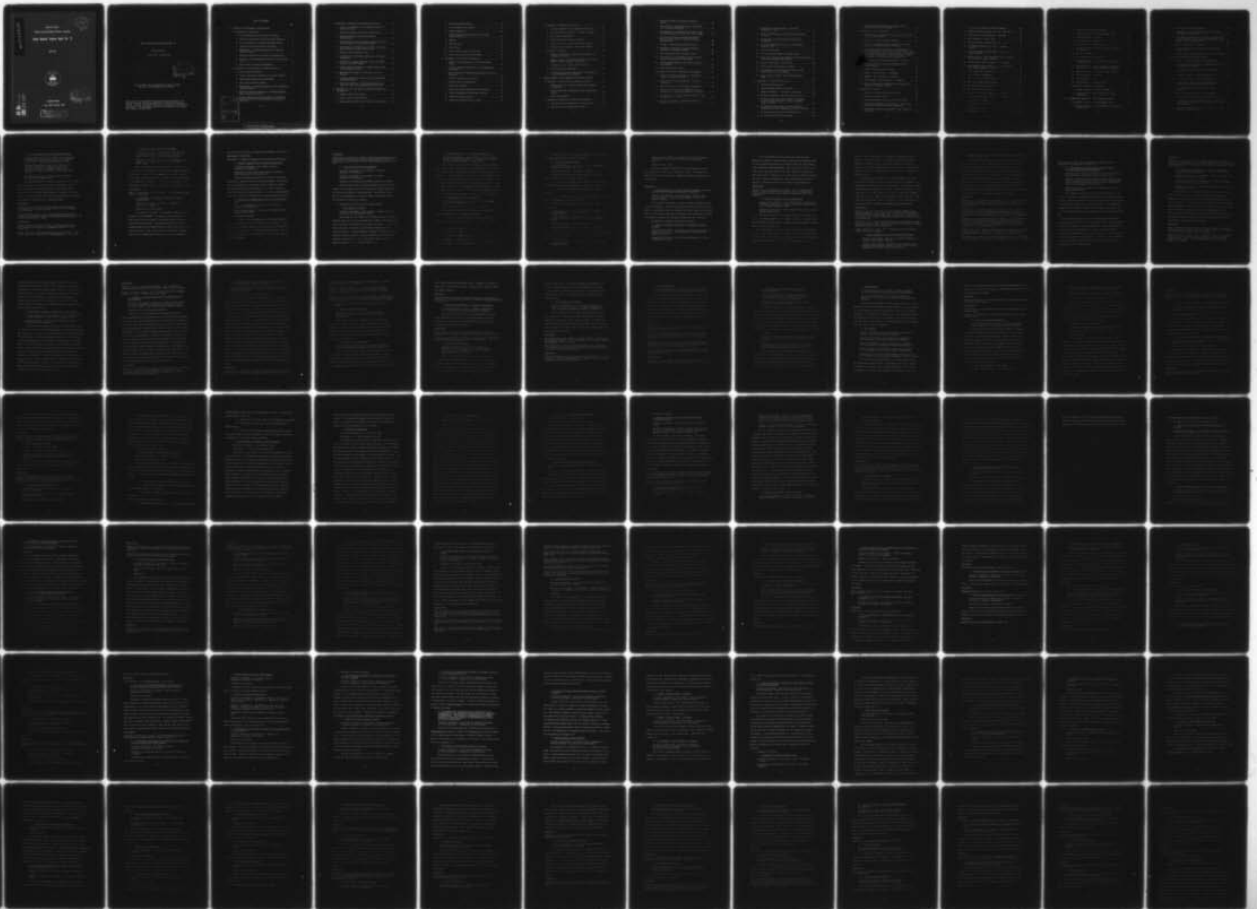
F/G 5/1

ANNUAL RESEARCH PROGRESS REPORT NUMBER 12 COVERING PERIOD 1 JUL--ETC(U)  
JUL 77

UNCLASSIFIED

NL

1 OF 2  
ADA043838



AD A 043838

12  
NW

DEAN OF FACULTY  
UNITED STATES AIR FORCE ACADEMY, COLORADO

Annual Research Progress Report No. 12

July 1977



AD No. \_\_\_\_\_  
DDC FILE COPY

DDC  
RECEIVED  
SEP 8 1977  
REGISTRY  
JTB

COVERING PERIOD  
1 July 1976 - 30 June 1977

DISTRIBUTION STATEMENT A  
Approved for public release;  
Distribution Unlimited

6

Number

Annual Research Progress Report No. 12

Covering Period

1 July 1976 - 30 June 1977

Final rept.

31 Jul 77

12 116p.

DDC  
RECEIVED  
SEP 8 1977  
B

This document has been approved for public release  
and sale; its distribution is unlimited

011 550

This is the fifth published Annual Research Progress Report; the  
editions previous to 1972 were published as Semi-Annual Progress  
Reports. Further information desired on any project may be obtained  
by writing to the department listed for the principal investigator,  
USAF Academy, Colorado 80840

68

TABLE OF CONTENTS

	Page
I. SCIENTIFIC AND ENGINEERING INVESTIGATIONS	
A. Department of Aeronautics . . . . .	1
1. Drag Characteristics of Missile Nose Shapes . . . . .	1
2. Flow Field Disturbance Created by Porous Spoilers . . . . .	1
3. The Flow Dynamics of Unsteady Separating Regions . . . . .	2
4. Improved Airplane Maneuvering Performance . . . . .	3
5. AERO464RPV: A Computerized Approach to Teaching Aircraft Design . . . . .	3
6. Productive Applications of Dynamic Aeroelasticity . . . . .	4
7. Estimation of Instantaneous Distortion for the YF-12C Inlet . . . . .	4
8. Plume Effects on Missile Aerodynamics . . . . .	5
B. Department of Astronautics and Computer Science . . . . .	5
1. Test Generation Software . . . . .	5
2. Visual, Interpretive Execution of an Algol Program . . . . .	6
3. Computerized Inverted File Concordance . . . . .	6
4. Basic Cadet Evaluation System . . . . .	7
5. Development of an Operating System for the GT40/PDP-11 Graphics Computer . . . . .	7
6. Host-Slave Interface Design for a Microprogrammable Remote Emulation Facility . . . . .	7
7. Another Simple Way to Present Computer Programming, presented at the SIG-CSE Conference in Atlanta, GA 2 Feb 1977 . . . . .	8

ACCESSION for	7.	Another Simple Way to Present Computer Programming, presented at the SIG-CSE Conference in Atlanta, GA 2 Feb 1977 . . . . .	8
NTIS	White Section	<input checked="" type="checkbox"/>	
DDC	Buff Section	<input type="checkbox"/>	
UNANNOUNCED		<input type="checkbox"/>	
JUSTIFICATION			
BY			
DISTRIBUTION/AVAILABILITY CODES			
Dist.	Avail.	and/or	SPECIAL
A			

C.	Department of Chemistry and Biological Sciences . . . . .	8
1.	Lead as an Indicator of Environmental Quality in Airport Environs. . . . .	8
2.	Detonation Property Prediction and Modeling . . . . .	9
3.	Thermal Decomposition/Structure-Bonding Relationships . . . . .	10
4.	Pattern Analysis and Correlation of Weather and Air Pollution Data in the Pikes Peak Region . . . . .	12
5.	Determination of Parameters for a Model of Environ- mental Quality for USAF Installations . . . . .	13
6.	Chemical Laser Reactants: $XeF_2$ . . . . .	14
7.	An Evaluation of Worldwide Capabilities in Genetic Engineering . . . . .	14
8.	Comparison of Stress Responses in Male and Female Cadets at the USAF Academy. . . . .	15
9.	Ultrastructural Evaluation of Tissues Removed from Animals Exposed to TCDD . . . . .	15
10.	Radiochemical Bioassay of TCDD Uptake in Plant Material. . . . .	16
11.	Disposal of Herbicide Orange by Soil Incorporation and Biodegradation . . . . .	17
12.	Ecological Studies of a Herbicide-Equipment Test Area (TA C-52A), Eglin AFB Reservation, Florida . . . . .	18
D.	Department of Civil Engineering, Engineering Mechanics, and Materials . . . . .	19
1.	Composite Stress Distribution . . . . .	19
2.	Elastic Waves in Layered Media . . . . .	19
3.	Equilibrium and Stability of Circularly Towed Cables . . . . .	20

4.	Explosive Impulse Welding . . . . .	20
5.	Finite Element Cable Studies. . . . .	21
6.	Fracture Mechanics. . . . .	22
7.	Load-Deformation Relationship for Split-Ring Timber Connections. . . . .	23
8.	Masonry . . . . .	23
9.	Mesh Generator . . . . .	24
10.	Solar Energy. . . . .	24
11.	Tensile Testing Machine Controller . . . . .	25
12.	Wind Energy Conversion System (WECS). . . . .	25
E.	Department of Electrical Engineering. . . . .	26
1.	Effects of Weightlessness on the Cardiovascular System . . . . .	26
2.	Study of Composite Materials in an Electromagnetic Environment . . . . .	27
3.	Bulk Properties of Annealed High Resistivity Gallium Arsenide . . . . .	27
4.	Digital Filtering on the IMP-16 . . . . .	28
5.	Tensile Tester Instrumentation . . . . .	28
6.	Tropo-Link Simulator . . . . .	28
7.	Space Test Program Experiment Prioritization . . . . .	29
8.	Digital Communications Performance Monitor . . . . .	29
9.	USAFA Solar Energy Program . . . . .	30
10.	Parachute System Radio Relay (PSRR) . . . . .	30

F.	Department of Mathematical Sciences . . . . .	31
1.	Strategic Command Control Communications (SC <sup>3</sup> ). . . . .	31
2.	An Encke Method in Poincare' - Similar - Elements . . . . .	32
3.	Shock Waves in Explosives . . . . .	33
4.	Network Evaluation Through Simulation . . . . .	34
5.	Uses of the SR-52 in Cadet Navigation Programs . . . . .	35
6.	Terminal Homing Program - Urban Scene Generation . . . . .	35
G.	Department of Physics . . . . .	36
1.	Computer Simulation of Cloud Droplet Growth by the Condensation Process . . . . .	36
2.	Adaptive Optics: Laboratory Simulation of Various Adaptive Optics Techniques and Systems . . . . .	36
3.	Properties of the Image on the Turin Cloth . . . . .	37
4.	Proton Prediction Techniques . . . . .	38
5.	A Pinhole-Scintillator X-Ray Camera for Diagnostics of the AFWL SHIVA S-Ray Simulator . . . . .	39
II.	GENERAL RESEARCH IN THE HUMANITIES AND SOCIAL SCIENCES	
A.	Department of Astronautics and Computer Science . . . . .	41
1.	Improved Validity of Officer Effectiveness Reports by Computer . . . . .	41
2.	Special Education Information Storage and Retrieval System . . . . .	41
3.	Cadet Wing Research . . . . .	42
B.	Department of Behavioral Sciences and Leadership . . . . .	42
1.	Reacquisition and Maintenance of Flying Skills . . . . .	42
2.	Analysis of Soviet Behavioral Sciences . . . . .	43

3. Improving Methods of Evaluating Simulator Systems . . . . .	43
4. The Validity of Various Measures in Predicting Pilot Training Performance. . . . .	43
5. An Assessment of the Motivational Values of the Aviation Programs at the U.S. Air Force Academy . . . . .	44
6. The Effects of Anxiety and Auditory Noise on Receiver Sensitivity in a Signal Detection-Vigilance Task . . . . .	44
7. A Study of Secondary Reinforcement Theory . . . . .	45
8. Assessment Procedures for Stress Management Training in an Academic Setting . . . . .	46
9. Pilot Performance with Peripheral Vision . . . . .	46
10. The Effects of Job Enrichment and Goal Setting on Work Satisfaction and Performance . . . . .	47
11. Attitudes Toward Women at the United States Air Force Academy . . . . .	48
12. USAFA MMPI Research Project . . . . .	49
Department of Economics, Geography and Management . . . . .	50
1. Political Overboundedness and the Urbanization of Rural Settlement Patterns . . . . .	50
2. Crime in El Paso County Colorado: A Spatial Perspective . . . . .	51
3. 1976 Proceedings of the Academy of Management . . . . .	51
4. Estudio Longitudinal de la Comunicacion en la Investigacion: Influencias Techias y de Gestion . . . . .	52
5. An Appraisal of Partial Recovery & Disaster: The Lice Earthquake of 1975 . . . . .	52
6. The Lice Earthquake in Southeastern Turkey: A Geography of the Disaster . . . . .	52



7.	Reconstruction After Disaster: The Gediz Earthquake of 1970 . . . . .	53
8.	Toward an Understanding of Opium Poppy Production in Turkey . . . . .	53
9.	Determination of True Elevations from Aerial Photographs . . . . .	54
10.	Locational Analysis of Crime in El Paso County, Colorado, 1975. . . . .	54
11.	Energy Resource Maps . . . . .	55
12.	Colorado Springs Chamber of Commerce Maps . . . . .	55
13.	Soviet Naval Strategy and Deployment of Maritime Forces: A Selected Annotated Bibliography . . . . .	55
14.	Disaster and Change in Rural Turkey . . . . .	56
15.	High Yielding Mexican Wheat in Turkey . . . . .	56
16.	Site Analysis for the Hacking of Falcons at the United States Air Force Academy . . . . .	57
17.	Vista Grande Bus Route: Rider Characteristics Study . . . . .	57
D.	Department of English and Fine Arts . . . . .	57
1.	Practical College Writing . . . . .	57
2.	James Whitehead and Mary Lee Settle . . . . .	58
3.	Robert Penn Warren: A Collector's Checklist . . . . .	58
4.	O'Conner and Warren: Christian Points of View . . . . .	58
5.	The Earl of Bute and George Germain: Machiavels of the American Revolution as Seen by London's Poets, 1763-1783. . . . .	59
6.	An Annotated Bibliography of Technical Writing Textbooks for 2-Year, Secondary, and 4-Year Programs. . . . .	59
7.	The Old English $\bar{a}e$ from the Indo-European $\bar{e}$ . . . . .	60
8.	Air Force Effective Writing Program . . . . .	60

9.	The Admission and Integration of Women into the United States Air Force Academy . . . . .	60
E.	Department of Foreign Languages . . . . .	61
1.	Some Preliminary Hypotheses on the Semiotic Microcosm of Gottfried's Tristan . . . . .	61
2.	Computers in Foreign Language Research. . . . .	61
3.	The Case for Reassessing the Treatment of the Modal Particles in German Language Instruction. . . . .	62
4.	Die Pragmatische Interpretation der "Fullwörter" in der Umgangssprache: Ein Beitrag zur Beschreibung ihrer Funktionen in Sprechakten. (The Pragmatic Interpretation of the Modal Particles in Colloquial German: On the Description of Their Functions in Speech Acts . . . . .	62
5.	Oral History of the Hispanic American of Colorado . . . . .	62
6.	Perceived Cultural Values and Academic Success in Higher Education . . . . .	63
7.	Spanish Language Culture Materials . . . . .	63
8.	FRANCE - Land and People: A Handbook . . . . .	64
9.	GERMANY - Land and People: A Handbook . . . . .	64
10.	LATIN AMERICA - Land and People: A handbook . . . . .	64
11.	Computer Management of Grading and Test Analysis in USAFA Foreign Language Courses . . . . .	65
F.	Department of History . . . . .	65
1.	A History of the United States Air Force . . . . .	65
2.	USAFA Oral History Program . . . . .	66
3.	The Harmon Memorial Lectures in Military History . . . . .	67
4.	The American Military on the Frontier: The Proceedings of the 1976 Military History Symposium . . . . .	67
5.	Establishing Yeoman Farmer Regions in the Antebellum Deep South . . . . .	68

6.	Origins of the National Science Foundation . . . . .	68
7.	American Military Missions to Korea: 1882-1896 . . . . .	68
8.	Yun Chi-Ho, A Korean Modernizer, 1864-1945 . . . . .	69
9.	East and West in Ceylon, 1884 . . . . .	70
10.	American Forces in Foreign Cultures . . . . .	70
11.	The Marquess Wellesley in Irish and British Politics . . . . .	70
12.	Crown and Castle: British Administration in Ireland 1800-1830 . . . . .	71
13.	Stalag Luft III: The Allied Experience in a World War II German Prisoner of War Camp . . . . .	71
14.	Timothy Walker and the Growth of American Law . . . . .	72
15.	Laser Weapons Research and Development at the Air Force Weapons Laboratory, 1967-1972 . . . . .	72
16.	The Airborne Laser Laboratory, 1963-1972 . . . . .	73
17.	General Hoyt S. Vandenberg . . . . .	73
18.	The Divergence of Policy and Power . . . . .	73
19.	US Military Operations in Vietnam . . . . .	74
20.	The Creation of the GHQ Air Force . . . . .	74
21.	US Defense Policy Since 1945 . . . . .	74
G.	Department of Political Science and Philosophy . . . . .	74
1.	The American Military -- Theirs to Reason Why . . . . .	75
2.	The Ethics of Leadership . . . . .	75
3.	The Evolution of Philosophical Thought . . . . .	75
4.	Managerial Integrity . . . . .	76
5.	Ethics for Commanders . . . . .	76

6.	Ethics and the Military Profession . . . . .	77
7.	Ethical Issues of Military Leadership Today . . . . .	78
8.	The North Atlantic Alliance . . . . .	78
9.	Politico-Military Expertise . . . . .	79
10.	The Dismissal of Teng Hsiao-p'ing . . . . .	79
11.	The Chinese People's Liberation Army and Minority Nationalities . . . . .	80
12.	The Thai Insurgency . . . . .	80
13.	Counterinsurgency in Thailand . . . . .	80
14.	A Comparative Study of Indonesian and Philippine Military Elites . . . . .	81
15.	How Military Elite Role Perceptions in Southeast Asia Conflict With The Civil-Military Paradigm . . . . .	81
16.	Soviet Political and Military Elements of Power . . . . .	82
17.	Soviet and NATO Capabilities . . . . .	82
18.	SALT and Arms Control . . . . .	82
19.	The Organization of Defense Policy . . . . .	83
H.	Department of Mathematical Sciences . . . . .	83
1.	Computer Graphics for Math Classrooms . . . . .	83
2.	A Personalized System of Instruction in Core Mathematics . . . . .	84
III.	RESEARCH AND ANALYSIS OF SPACE AND WEAPONS SYSTEMS	
A.	Department of Astronautics and Computer Science . . . . .	86
1.	Research Support for the NAVSTAR Global Positioning System (GPS) . . . . .	86

2.	Air-to-Air Fire Control Research . . . . .	89
3.	Epoch When a Given Sun Elevation Angle Will Exist At Any Specified Site On Earth . . . . .	91
4.	Interplanetary Navigation In Presence Of Random Thrust Errors For Solar Electric Propulsion Spacecraft Using Photon Counting Star Trackers . . . . .	92
B.	Department of Mathematical Sciences . . . . .	92
1.	Feasibility Study on the Simulator for Air-to-Air Combat (SAAC) . . . . .	92
2.	Boundary Layer Acoustic Monitor (B.L.A.M.) Calibration. . . . .	93
IV.	MANPOWER, PROCUREMENT AND LOGISTICS STUDIES	
A.	Department of Economics, Geography and Management. . . . .	94
1.	Forecasting Wage Escalation at Arnold Engineering and Development Center (AEDC) . . . . .	94
2.	An Expenditure Pattern Evaluation of Alternates T, L, & J . . . . .	94
3.	A Parametric Model for Nuclear Warhead Costs. . . . .	94
4.	A General Technique for R&D Cost Forecasting . . . . .	95
5.	An Econometric Study of Aerial Interdiction in Southern Laos, 10 October 1970-30 June 1971 . . . . .	95
6.	Performance Incentives Versus Prices Versus Quantities . . . . .	96
7.	The U.S. Versus the Soviet Incentive Models . . . . .	96
8.	The Use of Statistical Sampling in Contract Pricing . . . . .	97
9.	A Search for a Set of Performance Criteria for Use in a Government Internal Audit Management Control System (PhD dissertation) . . . . .	98
10.	Accounting Power, The Political Element and the Cost Accounting Standards Board . . . . .	98

11. Study of Free Assets . . . . .	99
12. Performance Incentives and Planning Under Uncertainty . . . . .	99
13. Games Contractor's Play . . . . .	99
14. You, Your Job and Your Future . . . . .	100
15. Calculating the Cost of a Civilian Public College Education . . . . .	100
16. An Economic Investigation of Expected Returns Across Occupations in the U.S. Non-Supervisory Labor Force (PhD dissertation) . . . . .	101
17. The Critical Link . . . . .	101
18. Organization Theory: A Conceptualization . . . . .	101
B. Department of Mathematical Sciences . . . . .	102
Aircraft Modification Study . . . . .	102

## I. SCIENTIFIC AND ENGINEERING INVESTIGATIONS

### A. Department of Aeronautics

#### 1. Drag Characteristics of Missile Nose Shapes

Principal Investigator: Lt Col William A. Edgington

Associate Investigator: Capt Fred T. Gilliam, Jr.,  
Department of Aeronautics

Sponsored by the Air Force Armament Laboratory, Eglin AFB,  
Florida

A wind tunnel investigation of the Aerodynamics missile nose shapes was conducted to determine the associated drag characteristics. The Mach numbers of interest range from 0.2 to 4.5. The results will be summarized in a report that is to be completed by October 1977.

#### 2. Flow Field Disturbance Created by Porous Spoilers

Principal Investigator: Lt Col Richard F. Felton,  
Department of Aeronautics

Associate Investigators: Capt Michael M. Tower, Department  
of Aeronautics; Cadet Stephen G. Wurst, Class of 1977;  
Cadet James W. Foister III, Class of 1977

Sponsored by the Air Force Weapons Laboratory, Kirtland AFB,  
New Mexico

An experimental investigation of the flow field in a cavity located downstream from a porous spoiler is being conducted in the Department of Aeronautics trisonic wind tunnel. Initial tests on flat plate models have been concluded and the present work is associated with a cavity located in a cylindrical model. Various configurations of porous spoilers have been investigated. Results indicate that a comb type spoiler ("snow fence") yields the minimum perturbation on the surface of the model. Future plans are to investigate the pressure variation in the cavity.

### 3. The Flow Dynamics of Unsteady Separating Regions

Principal Investigators: Maj James D. Lang, Department of Aeronautics; Capt Michael S. Francis, Capt John E. Keesee, Frank J. Seiler Research Laboratory (AFSC)

Associate Investigators: Capt John P. Retelle, Jr., Air Force Institute of Technology, University of Colorado; Cadet Neil A. Youtsler, Class of 1977; Cadet John J. Albert, Cadet Davis L. Kluczinske, Class of 1978

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

The unsteady separating flowfield produced by an oscillating fence-type spoiler on an airfoil is being investigated. Surface pressures as well as flowfield velocities, circulation and the vorticity field are measured experimentally. Knowledge of the flow physics is the goal of this study, and during this period measurements were compared to predictions of an analytical model.

#### Publications

"Interaction of an Oscillating Control Surface with an Unsteady Separated Region," Journal of Aircraft, Vol. 13, No. 9, September 1976, pp 687-694.

"Dynamic Loading on an Airfoil Due to a Growing Separated Region," Prediction of Aerodynamic Loading, AGARD Conference Proceedings No. 204, September 1976, pp 26-1 -- 26-12.

#### Presentations

"Dynamic Loading on an Airfoil Due to a Growing Separated Region," AGARD Symposium on Prediction of Aerodynamic Loading, NASA Ames, 29 Sept 1976.

"Dynamic Effects of a Growing Separated Region on an Airfoil," Univ. of Tenn. Space Inst. short course on Flow Separation, 19 April 1977.



#### 4. Improved Airplane Maneuvering Performance

Principal Investigators: Maj James D. Lang, Department of Aeronautics; Capt Michael S. Francis, Capt John E. Keesee, Frank J. Seiler Research Laboratory (AFSC)

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

Improved airplane turn performance was first investigated by calculating turn trajectories for a high performance lightweight fighter when the dynamic stall phenomenon is employed. Improvement to performance depends on the degree to which lift can be sustained at low airspeeds. Further study is devoted towards the practical application of dynamic stall and sustained lift in maneuvering flight.

#### Presentations

"Good, Better and Best Turn Performance," AF Flight Dynamics Laboratory, 11 March 1977.

#### 5. AERO464RPV: A Computerized Approach to Teaching Aircraft Design

Principal Investigator: Maj Garey T. Matsuyama, Department of Aeronautics

Sponsored by the USAF Academy

The purpose of this work is to document a computer program currently titled AERO464RPV. The purpose of the program is to computerize the course methods of conceptual design as taught in the Aircraft Design course. The program was written at the USAF Academy between Jan 1975 through May 1977, and has been used in part since the spring of 1976. Verification of the complete program's capability was accomplished in the spring of 1977. Documentation

and publication of results is expected to be complete in July 1977.

Publications (forthcoming)

"AERO464RPV: A Computerized Approach to Teaching Aircraft Design"

6. Productive Applications of Dynamic Aeroelasticity

Principal Investigator: Capt Stephen M. Batill,  
Department of Aeronautics

Sponsored by the Air Force Flight Dynamics Laboratory,  
Wright Patterson Air Force Base, Ohio

Dynamic Aeroelastic characteristics, such as flutter and aileron buzz, have been considered adverse phenomena. This project has been established to investigate possible beneficial effects associated with unsteady aerodynamics in the areas of energy required for flight and flight performance. Analytic and experimental studies are planned to investigate the unsteady aerodynamic cycles.

7. Estimation of Instantaneous Distortion for the YF-12C Inlet

Principal Investigator: Capt Howard M. Brilliant,  
Department of Aeronautics

Associate Investigator: Carol Bauer, NASA Dryden Flight  
Research Center (DFRC)

Sponsored by NASA/DFRC

A method of predicting expected maximum instantaneous distortion was applied to the inlet of NASA's YF-12C airplane. The predictions have been compared to flight test data with good correlation. The current effort involves comparing wind tunnel data and flight test data to see if wind tunnel data can be used to predict flight performance.

## Publications

"Comparison of Estimated with Measured Maximum Instantaneous Distortion Using Flight Data From an Axisymmetric Mixed Compression Inlet," to be presented at the AIAA/SAE 13th Joint Propulsion Meeting, July 11-13, 1977.

### 8. Plume Effects on Missile Aerodynamics

Principal Investigator: Capt Howard M. Brilliant,  
Department of Aeronautics

Associate Investigator: Capt Randall J. Stiles,  
Department of Aeronautics

Sponsored by the Army Missile Command, Huntsville, Alabama

Exhaust gases of rocket propulsion systems can have delirious effects on the aerodynamic control of missiles by causing separation of the flow field ahead of control surfaces. The purpose of this work is to experimentally evaluate the effects of this phenomena and to find means of avoiding the problem.

### B. Department of Astronautics and Computer Science

#### 1. Test Generation Software

Principal Investigator: Major Kenneth L. Krause, Department of Astronautics and Computer Science

The purpose of this research is to define and create a computer software system to aid in test construction at USAFA. The software will store a data base of questions for a course, keep statistics on the individual questions, and create tests from these questions based on a course director's desires. Several departments (Computer Science, Astronautics, Chemistry, Physics, Behavioral Science, and Foreign Languages) were involved in the definition phase. The research was initiated as a Computer Science 495 class taught by Major Krause.

## 2. Visual, Interpretive Execution of an Algol Program

Principal Investigators: Major Kenneth L. Krause and Major Lawrence E. Druffel, Department of Astronautics and Computer Science, and 2Lt (ClC) Gary D. Hamor, CSq-02.

This research was done as Hamor's Computer Science 499 (Spring 1977) project. The objective is to take an Algol program, insert appropriate terminal display and control statements, and then execute the created code. The new code will demonstrate on a TD 322 remote terminal the execution of the original Algol code by blinking appropriate lines and indicating the resultant value of the executed statement. The software system will be used in the Computer Science 100 classroom to demonstrate basic Algol constructs. In the fall, we will experiment with the student using the package independently to test his own Algol code.

## 3. Computerized Inverted File Concordance

Principal Investigator: Lt Col John A. Zingg, Department of Astronautics and Computer Science

Associate Investigator: ClC Roderick D. Thornton

This project will provide the USAF Academy a computerized Bible concordance with the following capabilities:

- a. Access to specific verses, chapters, and books of regular text by specifying the book name, chapter number, and verse number.
- b. Access to specific locations and texts of verses by specifying a key word (non-noise word) of the verse.
- c. Access to specific locations and texts of verses by specifying multiple key words (up to nine) of the verse, thereby reducing the number of verses to those which contain all key words.

The above on-line features are made possible through the use of a computerized inverted file directory system.

#### 4. Basic Cadet Evaluation System

Principal Investigator: Lt Col John A. Zingg, Department of Astronautics and Computer Science

Associate Investigator: CLC Arthur L. Wachdorf

This project will provide the USAF Academy a Basic Cadet Evaluation System with the following capabilities:

- a. Provide an accurate, concise report to each AOC on his fourthclassmen BCT training achievements in relation to their class.
- b. Attempt to correlate BCT performance factors with attrition.
- c. Attempt to correlate BCT performance factors with the cadet's performance over the next four years.

First use of the evaluation system will be on the Class of 1981 BCT data.

#### 5. Development of an Operating System for the GT40/PDP-11 Graphics Computer

Principal Investigators: Capt Robert H. Toews and Maj Kenneth L. Krause, Department of Astronautics and Computer Science

Associate Investigator: CLC Ernest G. Booch

The project was two-semester Computer Science 499 effort to develop an operating system for the GT40/PDP-11 computers in the Education/Research Computer Center (ERCC). The new system significantly improves the ERCC's graphics capabilities.

#### 6. Host-Slave Interface Design for a Microprogrammable Remote Emulation Facility

Principal Investigators: Maj Lawrence E. Druffel, Department of Astronautics and Computer Science, and CLC Michael T. Devlin

Research Sponsor: RADC

RADC has purchased a Nonodata QM-1 microprogrammable computer, which they want to interface to the MULTICS system. The research considered the interface options and recommended alternative approaches for the interface.

#### Presentation

7. Another Simple Way to Present Computer Programming, presented at the SIG-CSE Conference in Atlanta GA, 2 Feb 1977.

Principal Investigators: Majors Lawrence E. Druffel, Vance A. Mall and Kenneth L. Krause; Captains Robert N. Hawley and Marion A. Pumfrey

Paper describes experiment in teaching computer programming using a multipass approach. Instead of covering each concept in depth the first time it is encountered, only the simplest form of the concept is presented first. A quick pass is made over all concepts, then later passes are used to reinforce and extend the information presented in the first pass.

#### C. Department of Chemistry and Biological Sciences

1. Lead as an Indicator of Environmental Quality in Airport Environs

Principal Investigators: Maj Charles E. Thalken, Capt Michael J. Moran, and Capt Alvin L. Young, Department of Chemistry and Biological Sciences

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

Soil and vegetation from a control area and from areas immediately adjacent to the airfields at USAF Academy and Peterson AFB, CO, were analyzed for elemental lead using a Model 306, Perkin-Elmer Atomic Absorption Spectrophotometer. Mean lead levels in soil of 2.4, 10.2, and 6.2 ppm were found for the three locations, respectively. Mean lead levels in vegetation of 3.4, 25.4 and 40.4 ppm were found for the three locations, respectively. These data suggest the need for studies of indigenous herbivores for possible lead accumulation.

#### Publications

Thalke, E.E., A.L. Young, and M.J. Moran. 1977. A survey of lead levels in soils and vegetation of selected airfield environments. FJSRL-TR-77-0011, Frank J. Seiler Research Laboratory (AFSC), USAF Academy, CO.

#### 2. Detonation Property Prediction and Modeling

Principal Investigators: Capt R. Martin Guidry, Department of Chemistry and Biological Sciences, and Capt Larry Davis, Frank J. Seiler Research Laboratory (AFSC)

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

Work during this period has focused in two general areas: the Jacobs-Copperthwaite-Zwisler (JCZ) Equation of State and the use of the MINDO and MINDO/3 computer codes to evaluate structure/property relationships of energetic materials.

The JCZ equation is a first-principles equation of state developed recently by Dr. Sigmund Jacobs of NSWC/WOL. The equation contains two parameters ( $r^*$ ,  $\epsilon/k$ ) for each gaseous product species and two exponential parameters (attraction and repulsion potential exponentials). The

purpose of this investigation is to improve and parameterize the JCZ Equation of States such that it will adequately predict detonation pressure, detonation velocity and product composition data for any explosive. Available experimental data are being used in the parameterization. At present a computer program is being written to perform the parameterization.

The molecular orbital computer codes MNDO and MINDO/3 have been successfully employed to study the initial phase of the thermochemical decomposition mechanism of 2,4,6-trinitrotoluene. At present the complete TNT thermochemical decomposition mechanism is being investigated. Future plans call for the investigation of the series of energetic compounds 2,4,6-trinitrotoluene (TNT), hexanitrobibenzyl (HNBB), hexanitrostillbene (HNS) and hexanitrotoluene (HNT). The purpose of this study will be to investigate structure/property relationships in these materials.

#### Publications

Guidry, R.M., et al. 1977. The effect of elemental composition on detonation behavior of explosives. University of California Research Laboratory Technical Report, UCRL-78243. Presented at a Poster Session on 22 August 1976 at the 6th Symposium (International) on Detonation held at San Diego, CA.

Guidry, R.M. 1977. Investigations concerning the thermochemical decomposition mechanism of TNT. Presented 20 April 1977 at Ballistics Research Laboratory, Aberdeen Proving Ground, MD.

Guidry, R.M. and L.P. Davis. 1977. A MINDO/3 study of nitrobenzene. J. Amer. Chem. Soc., In Press.

#### 3. Thermal Decomposition/Structure-Bonding Relationships

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

Associate Investigators: Capt Scott A. Shackelford, Frank J. Seiler Research Laboratory (AFSC), and Capt R. Martin Guidry, Department of Chemistry and Biological Sciences



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

A continuing effort has been made toward the elucidation of the chemical mechanism for the thermal decomposition of TNT. The decomposition has been shown to be radical in nature, most likely inter- rather than intra-molecular, and involves as a rate-determining step the rupture of a C-H bond in the methyl moiety. Thermal decomposition studies on hexanitrobibenzyl (HNBB) and its deuterated analog were completed and the data base thereby expanded for drawing correlations between thermal stability and chemical structure. Purification of hexanitrostilbene (HNS) was completed and work initiated on the synthesis of deuterated HNS for future thermal decomposition studies.

#### Publications

Beckmann, J.W., J.S. Wilkes, and R.R. McGuire. 1977. 2,4,6-Trinitrotoluene thermal decomposition: Kinetic parameters determined by the isothermal differential scanning calorimetry technique. *Thermochemica Acta* 19:111-118.

Beckmann, J.W., J.S. Wilkes, and S.A. Shackelford. 1976. Deuterium isotope effects in molten thermochemical decomposition reactions of trinitrotoluene and trinitrobenzyl chloride. Presented at the Pacific Conference on Chemistry and Spectroscopy, Phoenix, AZ, 7-10 November 1976.

Beckmann, J.W., S.A. Shackelford, and J.S. Wilkes. 1976. New method to elucidate polynitroaromatic thermochemical decomposition mechanisms: deuterium isotope effects applied to isothermal differential scanning calorimetry. Presented at the JTCCG/MD/Working Party for Explosives, Pacific Grove, CA, 15-16 November 1976.

Beckmann, J.W. 1977. Induction period analysis in thermochemical decomposition reactions. Presented at the Explosives Research Group Seminar, Los Alamos Scientific Laboratory, Los Alamos, NM, 13 January 1977.

Shackelford, S.A. 1977. Using deuterium isotope effects to study thermochemical decomposition mechanisms and thermochemical stability. Presented

at the Explosives Research Group Seminar, Los Alamos Scientific Laboratory, Los Alamos, NM, 13 January 1977.

4. Pattern Analysis and Correlation of Weather and Air Pollution Data in the Pikes Peak Region

Principal Investigators: Maj Samuel P. Finch and Capt Elroy A. Flom, Department of Chemistry and Biological Sciences

Associate Investigators: Maj Robert C. Schaller and Capt Dee Friesen, Department of Physics, Capt William G. Thorpe, Department of Chemistry and Biological Sciences, and Cadets Dennis Kliza and Karl Schricker, Class of 1977.

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

This research project has four major areas of emphasis. They are (a) the collection and storage of weather and air pollution data in a format suitable for analysis, (b) the statistical analysis for correlations between the weather and air pollution data, (c) the laboratory analysis of high volume air sampler pads for specific pollutants, and (d) the physical modeling of the topographical area of Colorado Springs, CO.

Data collection began in July 1975. Approximately one-third of these data have been stored in the appropriate format. Initial analysis of the first 6 months of data has shown strong correlations between air pollution levels and temperature, wind speed, and wind direction. Techniques for laboratory analysis of air sampler pads and construction of a physical model are currently being investigated. Atomic absorption will be the method of analysis used to detect specific heavy metal pollutants in the air sampler pads.

### Publications

Schricker, K. and D. Klinza. 1977. Pattern analysis and correlation of weather and air pollution data in the Pikes Peak region. Presented at the Rocky Mountain Section, Amer. Chemical Soc. Meeting in Miniature, 30 April 1977, Greeley, CO.

#### 5. Determination of Parameters for a Model of Environmental Quality for USAF Installations

Principal Investigator: Capt Randal A. Gaseor, Department of Chemistry and Biological Sciences

Associate Investigators: Capt Lawrence J. Biever, Department of Chemistry and Biological Sciences

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

This project is a continuation of one initiated in 1976. The major effort of the study has been to determine what effects non-potable sewage effluent have on the terrestrial ecosystem where it is used for irrigation. The non-potable water includes elevated concentrations of phosphate, nitrate, chlorine, salt and many heavy metals. Soil analysis indicated a change in soil chemical composition both as a function of time under irrigation and also as a function of soil depth. This program is being continued to further delineate cause and effect relationships in the biological food chain.

### Publications

Gaseor, R.A. and L.J. Biever. 1977. Studies of the use of non-potable irrigation on the Air Force Academy golf course. Abstract in Proceedings of Colorado-Wyoming Academy of Science, In Press.

Gaseor, R.A. and L.J. Biever. 1977. Studies of the use of non-potable irrigation on the Air Force Academy golf course. Technical Report FJSRL-TR-77-0008, Frank J. Seiler Research Laboratory (AFSC), USAF Academy, CO, In Press.

6. Chemical Laser Reactants: XeF<sub>2</sub>

Principal Investigators: Capt Ronald E. Channell, Department of Chemistry and Biological Sciences, and Capt Larry P. Davis, Frank J. Seiler Research Laboratory (AFSC)

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

Work during this period has been concentrated in two areas:

(1) a literature search to determine the spectral data needed to establish the spectral characteristics of xenon difluoride (XeF<sub>2</sub>), and (2) the experimental determination of the absorption spectrum of XeF<sub>2</sub> in the gas phase from 200 to 4000 angstroms. This information will be used in an attempt to establish the kinetics and mechanism for the photodissociation of XeF<sub>2</sub>. An understanding of the photodissociation kinetics of XeF<sub>2</sub> will lead to the determination of the reaction kinetics for the photo-initiated reaction of XeF<sub>2</sub> with deuterium (D<sub>2</sub>) in the gas phase. This study will culminate in a lasing demonstration to determine the lasing mechanism for the XeF<sub>2</sub>-D<sub>2</sub> system with specific emphasis on determining if the reaction is occurring via a chain mechanism.

7. An Evaluation of Worldwide Capabilities in Genetic Engineering

Principal Investigator: Capt Robert H. Zellers, Department of Chemistry and Biological Sciences, and Capt Larry P. Davis, Frank J. Seiler Research Laboratory (AFSC)

Associate Investigator: Capt Martin D. Zahn, Department of Chemistry and Biological Sciences

Sponsored by the Defense Intelligence Agency

This study is a continuation of a project begun in FY76. Current research in genetic engineering is being monitored through literature

reviews and personal interviews. Baseline data are being accumulated in order to assess trends and progress in genetic engineering research and potential applications. A final report will be submitted in September 1977.

8. Comparison of Stress Responses in Male and Female Cadets at the USAF Academy

Principal Investigators: LtCol Orwyn Sampson, Maj John B. Bomar, Maj M.T. Mason, and Capt Ildiko Andrews, Department of Chemistry and Biological Sciences; LtCol G.E. Robertshaw, USAF Academy Hospital; and LtCol J.C. Thomas and Capt R.W. Cote, Department of Athletics

This research is presently unsponsored. Information is required in the interest of establishing training programs and standards which yield the most beneficial effect for both male and female cadet trainees in the shortest possible time. The proposed study would provide data to document altitude acclimatization and physiological responses to physical training. The study would provide baseline data for comparison with future cadet populations. During the summer of 1976 a pilot study was conducted in a population of 50 female cadets. Partial results of the pilot study indicated improvements in cardiovascular fitness similar to that noted in previous male populations.

Publications

Cote, R.W., J.B. Bomar, Jr., G.E. Robertshaw, and J.C. Thomas. 1977. Maximal aerobic power in women cadets at the U.S. Air Force Academy. *Aviation, Space, and Environmental Medicine* 48(2):154-155.

9. Ultrastructural Evaluation of Tissues Removed from Animals Exposed to TCDD

Principal Investigator: Maj Glenn M. Buchanan, Department of Chemistry and Biological Sciences

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

*Peromyscus polionotus*, chronically-exposed to low levels of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) in the laboratory. Post mortem examination of control and treated animals (exposed for 9 weeks to 2.5 ppb TCDD applied to the pelage) revealed no observable differences in organs or in total body weight. Analyses of photomicrographs of adrenal cortex tissues will be completed by 1 July 1977. Although tissue preparation is complete, the photomicrographs of testes, liver, and kidney have not been taken.

10. Radiochemical Bioassay of TCDD Uptake in Plant Material

Principal Investigators: Capt James M. Cupello and Capt Alvin L. Young, Department of Chemistry and Biological Sciences

Sponsored by Frank J. Seiler Research Laboratory (AFSC), and Air Force Logistics Command/DS

In laboratory experiments using specially designed growth boxes, cut and intact roots of sorghum [*Sorghum bicolor* (L.) Moench] seedlings were exposed to a 1 cm layer of soil containing 14 parts per million (ppm) <sup>14</sup>C-labeled TCDD (2,3,7,8-tetrachlorodibenzo-p-dioxin). Radioisotopic and gas chromatographic mass spectrometric (GC-MS) analysis of extracts from leaf tissue collected after 64 days of root exposure indicated the absence of TCDD (detection limit was 100 parts per trillion/ppt). However, radioisotopic analysis of the non-extractable residue indicated the presence of sufficient <sup>14</sup>C activity to be equivalent to 430 ppt TCDD in the plant tissue. Sufficient residue was not available to characterize the <sup>14</sup>C-labeled molecule. However, if the activity is from unaltered TCDD, the maximum possible uptake into the leaves of sorghum would be 0.00003% by weight of that applied to the soil.

### Publications

Cupello, J.M., A.L. Young, and J.C.H. Smith. 1977. A method for simulating subsurface disposal of herbicides. *Weed Science*, In Press.

Cupello, J.M. and A.L. Young. 1977. Possible TCDD uptake in Sorghum bicolor (L.) Moench. *Agronomy Journal*, In Press.

#### 11. Disposal of Herbicide Orange by Soil Incorporation and Biodegradation

Principal Investigators: Capt Alvin L. Young and Capt William J. Cairney, Department of Chemistry and Biological Sciences, and Lt Col Eugene L. Arnold, USAF School of Aerospace Medicine

Sponsored by Air Force Logistics Command/10

Four years of field data have been collected from Herbicide Orange biodegradation plots established in Utah (AFLC Test Range Complex) and Florida (Eglin AFB Reservation) in 1972. The herbicide, a mixture of 2,4-D and 2,4,5-T was soil incorporated at rates as high as 4,480 kg/ha. Periodic sampling was conducted on soil levels of 2,4-D, 2,4,5-T and the contaminant 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) as well as for the soil levels of microorganisms. Significant reduction in the level of herbicide occurred; the estimated half life appeared to be in the range of 150 to 210 days (Florida and Utah, respectively). The degradation of TCDD followed a similar pattern; the estimated half life appeared to be in the range of 225 to 275 days (Florida and Utah, respectively). The microbial studies have shown that the application of 2,4-D and 2,4,5-T at massive rates (5,000-40,000 ppm) not only did not sterilize the soil, but indeed stimulated the growth of certain microflora.

### Publications

Young, A.L., C.E. Thalcken, E.L. Arnold, J.M. Cupello, and L.G. Cockerham. 1976. Fate of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) in the environment: summary and decontamination recommendations. Technical Report USAFA-TR-76-18, USAF Academy, CO

12. Ecological Studies of a Herbicide-Equipment Test Area (TA C-52A), Eglin AFB Reservation, Florida

Principal Investigators: Capt Alvin L. Young, Maj Charles E. Thalken, and LtCol Lorris G. Cockerham, Department of Chemistry and Biological Sciences

Sponsored by Air Force Logistics Command/DS

Six years of field study have been completed on the ecosystem of Test Area C-52A, Eglin AFB, FL, a military test area of approximately 2.6 km<sup>2</sup> that received 73,000 kg 2,4,5-T and 76,780 kg 2,4-D herbicide during the period 1962-1970. Although the herbicides degraded rapidly in the soil (e.g., the last detectable residue was found in December 1970), the residue of the highly toxic contaminant 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) has persisted. It is now apparent that (1) although TCDD may persist in the environment for long periods of time (greater than 12 years) when initially present at high concentrations on the soil surface, it may be degraded by soil microorganisms; (2) TCDD may accumulate in the tissues of rodents, reptiles, birds, fish, and insects when these organisms are exposed to TCDD contaminated soils (however, the levels of TCDD in the tissues apparently do not exceed the levels of TCDD found in the environment); (3) rodents, reptiles, birds, fish and insects may tolerate, i.e., based on no observed deleterious effects in field studies, soil levels between 10-1,500 parts per trillion (ppt); and (4) movement of TCDD in the abiotic portions of the environment can be by wind or water erosion of soil particles, but leaching by water alone does not appear to occur.

Publications

Young, A.L., C.E. Thalken, E.L. Arnold, J.M. Cupello, and L.G. Cockerham. 1976. Fate of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) in the



environment: summary and decontamination recommendations. Technical Report USAFA-TR-76-18, USAF Academy, CO.

Young, A.L. and J.H. Hunter. 1977. A long-term field study of vegetative succession following repetitive application of phenoxy herbicides. Weed Science Society of America Meetings, 8-10 Feb 77, St Louis, MO, Abstract 18.

Cockerham, L.G., A.L. Young, and C.E. Thalken. 1977. Histopathological and ultrastructural studies of liver tissue from TCDD-exposed beachmice (Peromyscus polionotus). Technical Report, USAF Academy, CO, In Press.

D. Department of Civil Engineering, Engineering Mechanics, and Materials

1. Composite Stress Distribution

Principal Investigator: Capt William J. McClelland,  
Department of Civil Engineering, Engineering Mechanics  
and Materials

The research into stress distribution in a unidirectional filamentary composite sheet with a finite transverse slit has been completed. A technical paper has been written and submitted to the co-author, Dr. Harold Gascoigne of the University of Utah, for his comments. The final draft will be written and submitted for publication before December 1977.

2. Elastic Waves in Layered Media

Principal Investigator: Capt R. R. Gajewski, Department  
of Civil Engineering, Engineering Mechanics and Materials

Exact solution for elastic waves in layered media are obtained using concept of generalized rays and Cagnaird's method for Laplace transforms. Displacement responses for various sources have been numerically obtained. Respose of a layered geology to pressure inside a finite spherical cavity has been used to check performance of large

scale finite difference ground motion codes. Response of a plate to a single point force provides a basis for analyzing the signals recorded in acoustic emissions.

#### Publication

The Generalized Ray-Theory and Transient Response of Layered Elastic Solids with Y. H. Pao, Cornell University, to appear in Physical Acoustics, Vol XIII, 1977.

#### 3. Equilibrium and Stability of Circularly Towed Cables

Principal Investigator: Maj J. J. Russell, Department of Civil Engineering, Engineering Mechanics and Materials

This work has concentrated on the application of the finite element technique to the study of a cable towed behind an aircraft traveling in a circular path. Results predicting the equilibrium shape and its stability were obtained.

#### Publications

"Equilibrium and Stability of a Circularly Towed Cable Subject to Aerodynamic Drag", Journal of Aircraft, Vol 14 No 7, pp 680-686, July 1977.

"Equilibrium and Stability of a Whirling Rod-Mass System", International Journal of Non-Linear Mechanics, Vol 12, pp 91-101, 1977.

#### 4. Explosive Impulse Welding

Principal Investigators: Maj George E. Cannon, Jr., Department of Civil Engineering, Engineering Mechanics and Materials and Lt Col Douglas H. Merkle, Air Force Weapons Laboratory Trestle Project

Explosive impulse welding tests previously conducted at Los Alamos Scientific Laboratory, Denver Research Institute and the Air Force Academy have been analyzed using flash x-rays, high-speed framing camera photographs, velocity and pressure probe records and various strength tests, all made during the time period when the

welds were being made. The data and analysis are presented in an Air Force Technical Report which is to be published by the Frank J. Seiler Research Laboratory. Publication of the technical report represents the conclusion of DFCEM's Explosive Impulse Welding research program.

#### 5. Finite Element Cable Studies

Principal Investigators: Lt Col Joseph D. Morgan, III, Maj W. M. Henghold, and Maj J. J. Russell, Department of Civil Engineering, Engineering Mechanics and Materials

Work continued in the nonlinear finite element analysis of cable structures. A study was performed on the effects of certain parameter variations upon cable natural frequency. The theory was developed and a computer program written for the problem of equilibrium shape and stability of cables under the influence of steady wind. Work will continue in this area.

#### Publications

"Equilibrium and Natural Frequencies of Cable Structures (A Nonlinear Finite Element Approach)", by W. M. Henghold and J. J. Russell, Computers and Structures, Vol 6, pp 267-271.

"Free Vibrations of a Cable in Three Dimensions", by W. M. Henghold, J. J. Russell, and J. D. Morgan III, Journal of the Structural Division, A.S.C.E., Vol 103 NO ST5, pp 1127-1135.

#### Presentation

"Statics and Dynamics of Cable Systems", by W. M. Henghold, J. D. Morgan III, and J. J. Russell (presented by Lt Col Morgan), A.S.C.E. National Convention, Dallas, Texas, 28 April 1977.

## 6. Fracture Mechanics

Principal Investigator: Maj Thomas E. Kullgren, Department of Civil Engineering, Engineering Mechanics and Materials

The finite element-alternating method has been refined and applied to problems of quarter-elliptical cracks in irregular bodies. The method involves the iterative superposition of a finite-element solution for stresses in an unflawed body and an analytic solution for stresses in an infinite solid containing a flat elliptical crack. Mode-one stress intensity factors are presented along the periphery of quarter-elliptical cracks emanating from fastener holes in flat plates.

### Publications

"Surface Cracks Emanating from Fastener Holes", PhD Dissertation, Colorado State University, 1976.

"Theoretical and Experimental Analysis of Surface Cracks Emanating from Fastener Holes", AFFDL-TR-76-104, Air Force Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio, 1976, (co-authored with F. W. Smith).

"Surface Cracks Emanating from Fastener Holes", Computer Program Users Manual, Air Force Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio, December 1976, (co-Authored with F. W. Smith).

"Static Fracture Experiments on Part-Elliptical Cracks Near Fastener Holes", 16 mm movie, Department of Mechanical Engineering, Colorado State University, 1976.

### Presentations

"Final Oral Contract Report", Air Force Contract RFP F33615-74C-3009, presented to the Air Force Flight Dynamics Laboratory, December 1976.

7. Load-Deformation Relationship for Split-Ring  
Timber Connections

Principal Investigators: Maj Dabney S. Craddock III  
and Capt Dennis R. Topper, Department of Civil Engi-  
neering, Engineering Mechanics and Materials

Sponsored by the Air Force Weapons Laboratory (AFWL),  
Kirtland Air Force Base, New Mexico

The project purpose is to develop load-deformation curves for  
varying end-distances on split-ring connections using a special phenolic-  
impregnated wood. Results have been obtained for end distances of 2 1/2",  
3", 3 1/2" and 4" with load parallel to face grain and with load perpen-  
dicular to grain. Best-fit load-deformation curves have been plotted  
for these data. The remaining tests will be for the four end distances  
with load at 45° to face grain. Research will be completed in June 1977.

8. Masonry

Director and Principal Investigator: Capt Richard H. Jolley,  
Department of Civil Engineering, Engineering Mechanics and  
Materials

Coordinated by the United States Department of Commerce,  
National Bureau of Standards and funded by the Air Force  
Systems Command and the National Science Foundation

The final project report was completed and forwarded to the  
National Bureau of Standards (NBS) for review, approval, and printing.  
The results of the research which proposed a modification to existing  
building code allowable masonry strength values was presented to a  
conference held at the NBS, Gaithersburg, Maryland, on 4 May 1977.

#### 9. Mesh Generator

Principal Investigator: Capt Gary J. Butson, Department of Civil Engineering, Engineering Mechanics and Materials

Associate Investigator: Lt Col Joseph D. Morgan, III, Department of Civil Engineering, Engineering Mechanics and Materials

During this past academic year the capabilities of the existing Blending Function (COONS) Surface and Mesh Generator have been extended. It is now possible to model a boundary using a circular arc segment, a polynomial, or a cubic spline (previously the only available technique). The capability to control the cross boundary slope of the surface has also been added. Upon completion of a Tech Memo explaining the computer code, this research will be completed.

#### 10. Solar Energy

Director: Col Wallace E. Fluhr, Department of Civil Engineering, Engineering Mechanics and Materials

Principal Investigator: Capt Anthony Eden, Department of Civil Engineering, Engineering Mechanics and Materials

Associate Investigator: Capt John T. Tinsley, Department of Civil Engineering, Engineering Mechanics and Materials

Resident Engineer: Capt William J. McClelland, Department of Civil Engineering, Engineering Mechanics and Materials

Sponsored by the Air Force Systems Command (AFSC) through the Civil Engineering and Environment Development Organization (CEEDO).

The project, Solar Heating Retrofit of Military Family Housing, has concentrated on the gathering of performance data and its analysis to determine the effects of the various parameters on overall system efficiencies. Work efforts have focused on optimization of the major

controlling variables and solutions to the problem associated with the operation of the solar energy systems. An additional two years of tests and evaluations are planned.

#### Publication

FJSRL Technical Report - 76-0008, September 1976, Solar Heating Retrofit of Military Family Housing.

#### Presentations

A Status Report on the USAFA Solar Energy Program, August 1976, ISES, Winnipeg, Canada.

Improving the Performance of a Solar Energy System, June 1977, ISES, Orlando, Florida.

#### 11. Tensile Testing Machine Controller

Principal Investigator: Capt John T. Tinsley, Department of Civil Engineering, Engineering Mechanics and Materials

The Monterey Dynamics Tensile Testing Machine, as delivered, is capable of producing a tensile test following a single complex waveform at a set frequency and amplitude. Manual intervention is required to change any function. A programmable microprocessor is being added to this machine that will change waveform, frequency, cycle count or amplitude by program command thus alleviating the need for constant supervision. In addition to reducing technician time by 95 percent, the microprocessor based controller has the capability of external interface with x-y plotters, teletype and cassette tapes for entering test data.

#### 12. Wind Energy Conversion System (WECS)

Director: Colonel Phillip J. Erdle, Vice Dean

Principal Investigator: Maj Thomas E. Kullgren, Department of Civil Engineering, Engineering Mechanics and Materials

Associate Investigator: Maj George E. Cannon, Jr., Department of Civil Engineering, Engineering Mechanics and Materials

Sponsored by the Air Force Systems Command (AFSC)

A project to investigate the use of a WECS for supplemental home heating has been funded by the Air Force Civil Engineering Center. A vertical axis wind turbine with associated electrical power generating equipment will be erected and the power output used to heat a small structure. Extensive data gathering and reduction will show the feasibility of WECS in the USAF Academy region.

E. Department of Electrical Engineering

1. Effects of Weightlessness on the Cardiovascular System

Principal Investigator: Lt Col Richard J. Gowen

Sponsored by NASA

This research is a continuing program in support of NASA studies of the effects of the weightlessness of space upon the cardiovascular system. Activities during this period were directed toward the completion of the analysis of the Skylab Mission data and the development of a new generation of instrumentation using microprocessors. This microprocess instrumentation is commonly termed "smart instrumentation" and will incorporate the analysis algorithms essential for determining the data from space experiments. The design of a smart instrument to control the lower body negative pressure chamber and to automatically operate the plethysmograph has received the principal emphasis during this report period.



### Presentations

Presentation at the 1977 Aerospace Medical Association - 48th Annual Scientific Meeting - Paper was entitled, "Comparison of an Impedance Device to a Capacitive Plethysmograph For Study of Lower Body Pooling in Man."

#### 2. Study of Composite Materials in an Electromagnetic Environment

Principal Investigators: Lt Col Oscar D. Graham, Maj Jerry D. McCannon, Captains John E. Erickson and Michael J. O'Brien, Department of Electrical Engineering

Sponsored by Rome Air Development Center Post-Doctoral Program, Air Force Systems Command

This research studies the behavior of graphite epoxy composite material as a shield for electromagnetic energies and as a ground plane for communications antennas. The graphite epoxy is being compared with metal both experimentally and using a computer model to determine the relative behaviors and properties.

#### 3. Bulk Properties of Annealed High Resistivity Gallium Arsenide

Principal Investigators: Maj Albert J. Rosa, 2 Lt Randy Frantz, Department of Electrical Engineering

Sponsored in part by the USAF Avionics Laboratory

The intent of this research is to study Hall Mobility, resistivity and carrier contrations in high resistivity samples of Gallium Arsenide after being subjected to a high temperature (700-800<sup>o</sup> C) anneal in a reducing atmosphere (H<sub>2</sub>). Current efforts are directed towards developing a high resistivity, temperature-dependent, Hall effect system.

### Publications

Major Albert J. Rosa and B. G. Streetman\*\*, "Characterization of the Edge Emission in Solum Doped Zinc Selenide",\*

This paper has been accepted for publication in the Journal of Luminescence, North-Holland Publishing Company, Amsterdam.

\* Work supported by the Joint Services Electronics Program under contract DAAB-07-72-C-0259.

\*\* Coordinated Science Laboratory and Department of Electrical Engineering, University of Illinois, Urbana, Illinois.

#### 4. Digital Filtering on the IMP-16

Principal Investigator: Capt Arthur R. Miller, Department of Electrical Engineering

Sponsored by the Frank J. Seiler Research Laboratory

This filtering project was carried out to develop A/D and D/A interfacing for the IMP-16 microprocessor, and to verify the software for the machine. This has been accomplished with the aid of CLC Robert Russel, and the IMP is ready to move on to other projects. In addition, no significant increase in filter speed over the 8080 was noted on the IMP-16.

#### 5. Tensile Tester Instrumentation

Principal Investigator: Capt Charles R. Wells, III, Department of Electrical Engineering

A preliminary design was developed for an instrumentation system to be used by DFCEM in an automatic tensile testing machine. The system included digital to analog conversion, analog processing, and display functions.

#### 6. Tropo-Link Simulator

Principal Investigator: Capt Michael J. O'Brian, Department of Electrical Engineering

Sponsored by AF Communications Service

This project was established to provide a training simulator for a tropo communications link. The simulator provides a carrier signal whose amplitude is controlled by a Rayleigh distributed fading signal.

7. Space Test Program Experiment Prioritization

Principal Investigator: Capt Raymond J. Leopold, Department of Electrical Engineering

Associate Investigator: Capt Steven K. Dingman, Department of Electrical Engineering

Sponsor: Director of Space, Headquarters, USAF

The Space Test Program (STP) involves the launch of DoD sponsored experiments with the Director of Space, USAF, as the executive agent for the DoD. Space test program experiments are secondary payloads that do not have sufficient priority for a dedicated launch. In the past there has been no formal rationale for the method of establishing the order of launch for these STP experiments. This investigation is providing the Director of Space with explicit criteria, procedures, and recommendations concerning STP priorities. During this next year the investigations will be expanded to include updating a history of STP and its value to the DoD.

Presentations

Briefed to Director of Space at Headquarters, USAF, Washington DC, 1 November 1976.

8. Digital Communications Performance Monitor

Principal Investigators: Capt Roy L. Schmiesing and Larry R. Kizer, Department of Electrical Engineering

Associate Investigator: Capt Charles E. Pearsall, Department of Electrical Engineering

Sponsored by the Rome Air Development Center Post-Doctoral Program and AFCS

The goal of this project is to design a prototype performance monitor for digital communication systems performance. An instrument that computes two new performance criteria: Recursive BER and Recursive EFS has been designed, constructed and delivered to the customer. The work this year was documentation and publication.

#### Presentations

"A Recursive Digital Performance Monitor" by Captains Roy L. Schmiesing, Charles E. Pearsall and Larry R. Kizer. Tenth Asilomar Conference on Circuits Signals and Systems, Pacific Grove CA 22-24 November 1976.

#### 9. USAFA Solar Energy Program

Director: Col Wallace E. Fluhr, DFCEM

Principal Investigator: Capt Anthony Eden, DFCEM

Associate Investigators: Capt Tinsley, DFCEM, Capt Roy L. Schmiesing, Department of Electrical Engineering, 1 Lt Tolbert, BCE

DFEE work on the solar programs has been documentation and publication of earlier designs. Consulting services are provided on a regular basis.

#### Presentation

"A Solar House Instrumentation and Control System: by Capt Roy L. Schmiesing, Department of Electrical Engineering, and Maj Richard N. Miller, USAF (Retired). Tenth Asilomar Conference on Circuits Signals and Systems, Pacific Grove CA, 22-24 November 1976.

#### 10. Parachute System Radio Relay (PSRR)

Principal Investigator: Capt Larry L. Burk, Department of Electrical Engineering

Associate Investigator: Lt Col Oscar D. Graham, Department of Electrical Engineering

Research Sponsor: Air Force Weapons Lab (AFSC)

The Parachute System Radio Relay (PSRR) is a test under the auspices of the Air Force Weapons Lab of a potential nuclear-survivable strategic communications system. The AFWL asked that the USAFA participate as a receiving station for the test of a rocket-borne UHF repeater to be launched from the White Sands Missile Range on 29 June 1977. As a receiver site, the USAFA furnished most of the test equipment and fabricated a high gain antenna and an interdigital filter. Technical support was also provided by Lt Col Graham in the form of a fly-over to check out the various receiver sites.

F. Department of Mathematical Sciences

1. Strategic Command Control Communications (SC<sup>3</sup>)

Principal Investigator: Lt Col William T. Hodson, III

Sponsored by AF Weapons Lab, AFSC

The general purpose of the research is to perform project work and render consulting services to the Air Force Weapons Lab in support of their continuing investigation of the nuclear vulnerabilities in the US Strategic C<sup>3</sup> System. To date the following papers have been completed and forwarded to AFWL:

- a. "A New Approach to Launch on Assessment (U)," Secret.
- b. "On Developing an Investment Strategy for Comparing Ground-Based Survivable Communications Systems."
- c. A Conceptual Framework and Program Plan for the US Warning System Study.

In addition, continuing services include:

- a. Coordinating and participating in USAFA support for the AFWL

Parachute/Rocket System Test, to be performed on 15 June. Personnel from DFIT and DFEE are involved.

- b. Consulting in the final phase of the US Warning System Study.
- c. Participating in the design of a survivable system of NUDETS sensors.
- d. Reviewing existing Attack Assessment algorithms to determine their unstated, implicit assumptions, with an eye toward determining the possibility of improving their performance.

## 2. An Encke Method in Poincare' - Similar Elements

Principal Investigator: Lt Col Hayes R. Bryan

Sponsored by F. J. Seiler Research Lab, AFSC

The purpose of this research is to derive and numerically confirm the equations for an Encke-Method (numerically integrating the difference between the full set of differential equations and a simplified but analytically solvable set of differential equations) in the Poincare' - Similar (PS) Satellite Orbital Elements developed by Scheifele. This is an extension of previous research, which was performed on a set of elements having topological singularities at zero eccentricity and inclination. The PS elements, developed in the interim, are topologically regular. This is significant, as the great majority of satellites have near-zero eccentricity and inclination. The Encke method, involving a modified function that may be smoother and of several orders smaller magnitude, has the potential of providing savings in the computer time involved in numerical integration as well as providing a larger number of

significant digits accuracy while still using single-precision integration. The Technology Development Office of NASA's Johnson Space Center is interested in the results of the work, being intimately involved with the development of the PS elements.

### 3. Shock Waves in Explosives

Principal Investigator: Lt Col James E. Wade

Sponsored by F. J. Seiler Research Lab, AFSC

The objective of this project is to model the shock wave traveling in an explosive with the Shock Huguenot equations to yield pressure predictions having better agreement with measured pressures, even though the measured pressure pulses display scatter in many experiments. The work has consisted of an assessment of the Shock-Huguenot equations with a decided emphasis on waves in explosives and the intractabilities of a non-normal shock wave traversing the explosive. Study of various experimental results on the measurement of pressure data in explosive specimen have been accomplished to gain an appreciation of the sources of experimental error and to gain the unique or peculiar manner in which final experimental data were obtained; i.e., matching of the interface conditions as waves travel into media with different specific acoustic impedences or the synthesizing of the recorded electrical signals with a computer code with specific assumptions which the experiment did not reflect: review of the textbook approach to shock waves in chemistry and physics. Pending work will involve taking the experimental data from one type of explosive and modelling it with field equations which will give the same values for pressures as measured in the laboratory.

#### 4. Network Evaluation Through Simulation

Principal Investigators: Majors Jay D. Sherman, Brian E. Esterby, and Joseph C. H. Smith

Sponsored by AF Technical Applications Center

Network Evaluation Through Simulation is a model to simulate the detection and identification of subsurface nuclear explosions by a specified seismic network. The current arms negotiations and test ban treaties place great reliance on this country's ability to detect, identify, and estimate yield of subsurface nuclear explosions worldwide. This model is designed to enable AFTAC to evaluate its detection and identification capabilities under a variety of scenarios. The current effort is the continuation of a research project for the Air Force Technical Applications Center (AFTAC), Patrick AFB, begun in January, 1976. During the Summer of 1976, Majors Sherman and Esterby developed the basic simulation model, which incorporates many aspects of the explosion versus earthquake identification process that were not previously available in the AFTAC library of computer models. The model was validated against existing models insofar as they were compatible. Technical experts at AFTAC verified the model's outputs for new features. Work is now under way to develop closed form probability calculations within the model as an option to the time-consuming simulation repetitions, to modify existing system capability contour plotting routines to be more compatible with data outputs from the simulation model, and to incorporate the latest techniques developed at Geotech for modeling the transmission of seismic waves through the earth.



5. Uses of the SR-52 in Cadet Navigation Programs

Principal Investigator: Maj Gunter E. Ott

Sponsored by the Aviation Sciences Division, USAFA

The calculations involved in the solution of celestial navigation problems are laborious, repetitive and time consuming. Much data is extracted from tables. With the availability of handheld programmable calculators, it is feasible to program the solution to this and other navigation problems on such calculators. Thus far, a working celestial program and a flight-planning program have been completed. Future work includes compressing the celestial program so that it can be accommodated by the 223 step capability of the SR-52 after corrections for motion of the observer, motion of the body and rhumb line, and coriolis corrections are added.

6. Terminal Homing Program - Urban Scene Generation

Principal Investigators: Captains John J. Warner and John D. Maybee

Sponsored by the Defense Mapping Agency Aerospace Center (DMAAC)

The purpose of this project is to develop a method of creating a mathematical model of an urban area given digitized stereo photographs of the scene; although "discontinuities" among objects on the ground produce difficulties in modeling such a scene. To date, the bulk of the work completed has been in the definition of the project and receiving background information on a wide variety of other projects that are being pursued by contractors in conjunction with this project.

G. Department of Physics

1. Computer Simulation of Cloud Droplet Growth by the Condensation Process

Principal Investigator: Capt Dee W. Friesen, Department of Physics

Associate Investigators: C1C Doug E. Atkins (Class of 1977), Maj Bob A. Rappold and Capt Ray Cardaronella, Department of Mathematics, and C1C John Cromwell (Class of 1977)

An area of primary interest to cloud physics is how cloud droplets grow. As an air parcel rises in the atmosphere, adiabatic expansion occurs leading eventually to supersaturation and condensation. This process was modeled on the computer for temperatures above freezing. Calculations were made at various temperatures, pressures, and number densities. The results are similar to those of Mason. The computer model will be used by the Atmospheric Science Division of the Space Science Laboratory of the Marshall Space Flight Center to analyze results of an expansion chamber experiment which will be on board the Space Shuttle.

Presentations

(1) D.W. Friesen and D.A. Atkins, "Computer Simulation of Cloud Droplet Growth by the Condensation Method," presented at the 48th Annual Meeting of the Colorado-Wyoming Academy of Science at the Air Force Academy, Colorado Springs, on 22 Apr 77.

(2) D.W. Friesen, "Growing Clouds by Computer," presented at Taylor University, Upland, Indiana, on 4 Feb 77.

2. Adaptive Optics: Laboratory Simulation of Various Adaptive Optics Techniques and Systems

Principal Investigators: Maj John D. German, Department of Physics

Associate Investigators: Maj John C. Durrett, Department of Astronautics and Computer Sciences, Captain Robert B. Asher, Frank J. Seiler Research Laboratories, Cadet Dale K. Olinger (Class of 1977) and Cadet David C. Wetlesen (Class of 1978).

Sponsor: Air Force Weapons Laboratory, Kirtland Air Force Base, New Mexico through F.J. Seiler Research Laboratories

The use of adaptive optics to reduce atmospheric degradation of propagating laser beams is dependent on the capability to extract control information for the return signal scattered by the target. Since this signal is inherently noisy, sophisticated computerized digital filtering techniques must be used. The purpose of this research was to provide various simulated return signals to test these programs. The first simulated return signal was produced by a single laser beam with a time varying focal distance (called dither) scattering off a ball bearing. This system was used to verify that the digital filter could indeed separate the dither signal from a wide range of noise signals. Next, the ball bearing was replaced by a rotating tube to simulate the return from a rotating missile. This system was used to verify that the filter could operate correctly in the presence of speckle-generated noise (an optical interference phenomena). A third system, consisting of a laser beam passing through steam and striking a beam splitter and two photomultipliers, was used to test another computer program designed to extract wavefront tilt from a return signal.

### 3. Properties of the Image on the Turin Cloth

Principal Investigators: Capt John P. Jackson, Department of Physics and Captain Eric J. Jumper, Department of Aeronautics

Associate Researcher: Cadet Michael McGown (Class of 1977)

Un-sponsored Research

In Turin, Italy, exists a fourteen-foot long cloth imprinted with the clear image of a buried man, front and back. Some believe the image is that of Jesus primarily because the man appears to have been tortured and crucified in a manner identical to that of Jesus. Research by Captains Jackson and Jumper working with non-Air Force resources and on their own time has shown that the image is three-dimensional. This discovery has allowed Captains Jackson and Jumper to make specific conjectures regarding the image formation process as well as to involve cadets on their own time in construction of a full size three-dimensional model of the Man of the Shroud for the Air Force Academy Chapel

#### Presentations

J.P. Jackson and E.J. Jumper, "The Three-Dimensional Image on the Shroud of Turin," presented at the 48th Annual Meeting of the Colorado-Wyoming Academy of Science at the Air Force Academy, on 22 Apr 77 and at the United States Conference for Research on the Shroud of Turin at Albuquerque, New Mexico, on 23 Mar 77.

#### 4. Proton Prediction Techniques

Principal Investigator: Capt Brian Kohn, Department of Physics

Sponsored by the Department of Physics, United States Air Force Academy, Colorado

The purpose of this research effort is to improve existing techniques for predicting the onset of solar "storms" at the earth due to proton production in energetic flare events on the Sun. A computer code to predict the resulting flux of protons at the earth due to solar flares

was obtained from the Air Force Geophysics Laboratory, Hanscom Field, Massachusetts. The code requires Earth-based observables such as x-ray and radio-wave data from solar flare observations (satellite) to generate a proton spectrum at the Sun and ultimately predict a time-resolved proton energy spectrum at the Earth. The initial first-year effort at the Air Force Academy has been to debug the program on the Burroughs 6700 computer and to exercise the code on parameter study. A matrix of computer runs were performed to study the effect of flare location and varying proton energy spectra on the arrival times of the flare induced protons at the Earth. Maximum proton flux delay time as a function of flare location were compared with satellite records. This is a continuing effort to improve solar proton prediction techniques for the primary user, Air Weather Service.

5. A Pinhole-Scintillator X-Ray Camera for Diagnostics  
of the AFWL SHIVA X-Ray Simulator

Principal Investigator: Capt Robert A. Nuttelman, Department  
of Physics

Sponsored by AFWL (DYP), Kirtland AFB, Albuquerque, New Mexico

A computer program was developed to implement the x-ray diagnostic system model developed during FY 76 (FJSRL-76-099). This model enables design of an optimized x-ray diagnostic system to simultaneously obtain energy, spatial, and time resolution of an x-ray source such as the AFWL SHIVA simulator. Many cases of practical interest were run using the computer program varying the parameters for different camera films, energy filters, scintillator thicknesses

and time resolutions. The most favorable parameters used indicate a marginal diagnostic system effectiveness without image intensification. Experiments to determine model accuracy are planned for the near future.

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

### A. Department of Astronautics and Computer Science

#### 1. Improved Validity of Officer Effectiveness Reports by Computer

Principal Investigators: Lt Col George H. Walther, Department of Astronautics and Computer Science, and C1C Jon Spain

On the first page of an OER are ten rating factors which, in spite of their 5-point scale, typically are scored 4 or 5. Although the overall rating must fit a normal distribution, these ten factors need not, thus leaving room for considerable "halo tendency." A paired comparison technique is one in which all possible combinations of factors are presented in pairs and the respondent asked to pick the superior one of the two. This technique was used in two ways: (1) to determine faculty officers' evaluation of the relative importance of each of these ten factors, and (2) to force a rank-order distribution of the ten factors for a given ratee. The relative weights were applied to the rank-ordering and a quantitative value was assigned to each factor for a ratee. Because of the small sample of respondents available here, further validation of this technique is needed. However, pilot study results are extremely promising.

#### 2. Special Education Information Storage and Retrieval System

Principal Investigators: Maj Joseph Monroe, Department of Astronautics and Computer Science, and C1C Gregory Teman, CSq-29

Sponsored by School District 20

This research culminated with the structure and design of an Information Storage and Retrieval System for Special Education students.

Additionally, a preliminary COBOL program has been written in conjunction with this research.

### 3. Cadet Wing Research

Principal Investigator: Capt Ronald E. Joy, Department of  
Astronautics and Computer Science

Associate Investigators: Majors William J. Lucas, CWDS-15, and  
Phillip W. Loper, CWDS-29

Sponsored by CW

On a continuing basis, research is accomplished concerning the Military Order of Merit (e.g., research on the feasibility of making a cadet's physical fitness test score part of his MOM. Information pointed to no correlation between PFT and MOM, yet the project was accomplished anyway.) Additional research was accomplished to change MOMs from a score to word picture.

## B. Department of Behavioral Sciences and Leadership

### 1. Reacquisition and Maintenance of Flying Skills

Principal Investigator: Maj Jefferson M. Koonce, Department of  
Behavioral Sciences and Leadership

Associate Investigator: Maj Norman L. Komnick, DOXI, Aerospace  
Defense Command

Sponsored by the Air Force Office of Scientific Research

This new project has begun and will continue for approximately two and one-half years. Two hundred fifty-five rated supplement pilots in the local area will be invited to participate as subjects. Purpose is to quantify the loss of psychomotor and cognitive skills associated with flying as a function of time out of the cockpit, and to determine the type and amount of training required to regain the flying skills and maintain them at a near operational level using simulators and training texts.



## 2. Analysis of Soviet Behavioral Sciences

Principal Investigator: Maj Valentin W. Tirman, Jr.,  
Department of Behavioral Sciences and Leadership

Associate Investigators: Lt Col Eugene H. Galluscio and Maj  
James R. Knight, Jr., Department of Behavioral Sciences and  
Leadership

Sponsored by the Defense Intelligence Agency

Purpose of this effort is to evaluate the Soviet "state of the art" in various areas of the behavioral sciences, to include psychopharmacology, individual behavior modification, population behavior modification, and parapsychology.

## 3. Improving Methods of Evaluating Simulator Systems

Principal Investigator: Maj Jefferson M. Koonce, Department  
of Behavioral Sciences and Leadership

Sponsored by the Air Force Test and Evaluation Center

Instrument developed to assess pilot attitudes toward flight simulators. On-going effort is to develop a relatively objective standardized method for evaluating simulator systems in the Operational Test and Evaluation Phase and attempt to moderate the evaluator's ratings as a function of the evaluator's attitudes.

## 4. The Validity of Various Measures in Predicting Pilot Training Performance

Principal Investigators: Maj Jefferson M. Koonce and Lt Col  
Eugene H. Galluscio, Department of Behavioral Sciences and  
Leadership

Sponsored by Frank J. Seiler Research Laboratory (AFSC)

This was the data analysis and report submission phase of an effort funded the previous year by FJSRL. Final research reports are to be submitted for publication as technical reports.

5. An Assessment of the Motivational Values of the Aviation Programs at the U.S. Air Force Academy

Principal Investigator: Maj Jefferson M. Koonce, Department of Behavioral Sciences and Leadership

Un-sponsored

A sixty item questionnaire, dealing with attitudes towards the Academy's aviation programs, was given to a random sample of the cadet wing (N=652) in the Fall Semester 1976. Results indicated that, although the programs are not a primary reason for the cadets to come to the Academy, the programs significantly add to the reasons for cadets staying at the Academy, may be a factor in reducing attrition, instill self confidence in the cadets, and increase cadet interest in becoming Air Force flight crewmembers. Some differences in classes were noted and subsequent administrations of the questionnaire will indicate whether the differences were in characteristics of the classes themselves or a temporal change in attitudes.

6. The Effects of Anxiety and Auditory Noise on Receiver Sensitivity in a Signal Detection-Vigilance Task

Principal Investigators: Captains John F. Swiney, Jr., Donnell M. Washington and William P. Marshak, Department of Behavioral Sciences and Leadership

Sponsored by the United States Environmental Protection Agency

This research project has been conducted to determine the effects of moderate intensity household noise on performance in a signal detection task. Subjects, male and female, were divided into high and low anxiety groups and exposed to intermittent, continuous, or no noise while monitoring a display scope for an infrequent event embedded in a series of frequent events. Additionally, subjects were instrumented to record heart rate.

The general question to be answered is whether moderate noise levels interact with anxiety level and sex differences to effect performance on a signal detection-vigilance task.

### Publications

"Behavioral and Physiological Correlates of Varying Noise Environments: Annotated Bibliography", Environmental Health Effects Series (EPA-600/1-76-038).

"Behavioral and Physiological Correlates of Varying Noise Environments", To be published by the Environmental Protection Agency.

#### 7. A Study of Secondary Reinforcement Theory

Principal Investigator: Major James E. Klusman, Department of Behavioral Sciences and Leadership

Associate Investigators: CLC Jon T. Reilman and CLC Steve A. Simon

Un-sponsored

Two experiments were designed which provided differential predictions of experimental outcomes by the traditional view of secondary reinforcement and Longstreth's cognitive view of secondary reinforcement. In the first experiment, a control group of kindergarten children played a two-choice discrimination game in which they could win candy for a correct response. Two experimental groups of children, playing the same game, received copper tokens and pennies, respectively, for a correct response; these tokens and pennies were immediately exchanged for candy. The second experiment was a replication of the original design, utilizing first-grade children. Results of the experiments indicate non-support of the traditional view of secondary reinforcement; however, the data are not clearly supportive of Longstreth's position. The results are discussed in terms of an information theory of secondary reinforcement.

#### Publication

Klusman, J.E. & Hautaluoma, J.E. The Validation of Dissonance vs Impression-Management Theories. The Journal of Social Psychology, 1976, 100, 199-206

## Presentation

Klusman, J.E., Reilman, J.T., & Somon, S.A. "A Study of Secondary Reinforcement Theory." Presented at the 48th Annual Meeting of the Colorado-Wyoming Academy of Science, 23 April 1977.

### 8. Assessment Procedures for Stress Management Training in an Academic Setting

Principal Investigator: Capt Richard L. Hughes, Department of Behavioral Sciences and Leadership

Associate Investigator: Capt Ronald LaScala, Department of Behavioral Sciences and Leadership

Sponsored by Frank J. Seiler Research Lab

The effectiveness and cost efficiency of academic and technical training can be impeded by student anxiety. This program investigates the use of electromyographic biofeedback to reduce test anxiety and improve academic performance. Subjects selected on the basis of high scores on a test anxiety questionnaire are placed in one of three groups: (1) biofeedback training; (2) a group emphasizing a cognitive/educative approach; (3) a group using biofeedback and cognitive approaches. These intervention procedures are evaluated on the basis of change scores on GPA, the Test Anxiety Scale, the Nelson-Denny Reading Test, and a specialized performance test of general academic skills.

### 9. Pilot Performance with Peripheral Vision

Principal Investigator: Lt Col Jock C. H. Schwank, Department of Behavioral Sciences and Leadership

Associate Investigators: Maj John M. Bermudez and Captains Thomas M. Longridge, Thomas M. McCloy, and Bruce A. Smith, Department of Behavioral Sciences and Leadership

Sponsored by AMRL/HEA, Wright-Patterson AFB, OH

The purpose of this phase of the study was to determine baseline performance standards for pilot peripheral visual processing in the GAT-1 simulator. Twenty-four cadets who had completed T-41 flight training flew the "Vertical S-A" maneuver in GAT-1 instrument flight conditions. Heading information was provided by a normal heading indicator or by command lights located at 55° in the visual periphery or by both types of indicators simultaneously. All other instrumentation was normal. A preliminary data analysis found that average heading deviations were less in both the redundant condition and the peripheral light only condition when compared to the heading deviations found when a standard heading indicator was used to maintain aircraft heading. After a complete data analysis of the baseline study, follow-on experiments will investigate the effects of various stressors on the use of visual peripheral signals in a variety of flying tasks.

10. The Effects of Job Enrichment and Goal Setting on Work Satisfaction and Performance

Principal Investigators: Maj William E. Rosenbach, Department of Behavioral Sciences and Leadership; Lt Col Denis Umstot, AFIT/SLGR; Maj Valentin W. Tirman, Jr. and Capt Jack Hannig, Department of Behavioral Sciences and Leadership

Sponsored by the Air Force Office of Scientific Research

Designing work so that it is both more satisfying to the employee and more productive for the organization is a major concern of organizational managers and researchers. This research which began in March 1977 examines two major aspects of job design, job enrichment and goal setting, and their effects on job satisfaction and productivity. A remote nonequivalent control group design with multiple control groups and repeated measures is employed to test the research hypothesis. The experiment will last two years. The focal jobs will be those of vehicle main-

tenance mechanics, vehicle operators, and transportation management specialists at two Air Force bases in the Southeastern United States.

11. Attitudes Toward Women at the United States Air Force Academy

Principal Investigators: Dr. Lois DeFleur Nelson and Captains David C. Gillman and William P. Marshak, Department of Behavioral Sciences and Leadership

Sponsored by the Frank J. Seiler Research Lab

A number of issues resulting from the integration of women at the USAF Academy are being examined to determine their sociological, psychological and mission impact upon the Academy. This is being accomplished by three distinct programs of social research. The first program consists of a series of brief projects which continue to provide the institution's administration with empirical data to serve as a basis for decisions. A second program was the summer (1976) study, which sought the effects of Basic Cadet Training on the attitudes of all the cadet participants. The third effort consists of a longitudinal study designed to monitor the effects of female integration into the Academy and to unravel the implications important to the individuals and the institution.

Presentations

"Male and Female Perception of Basic Cadet Training at the USAF Academy", briefing presented to the Congressional Committee on Women's Affairs in DoD, September 1977 and to the Military Operations Research Society (MORS), October 1976.

"Patterns of Accomodation for Female Cadets at the U.S. Air Force Academy", paper presented at the Colorado-Wyoming American Academy of Sciences, April 1977.

"The effect of Combat-Oriented Training on the Perceptions of Femininity in Women Cadets", paper presented at the Colorado-Wyoming Academy of Sciences, April 1977.

"Attitudes Towards Women as a Function of Personality Factors", paper presented at the Colorado-Wyoming Academy of Sciences, April 1977.

"Sex Integration at the U.S. Air Force Academy - Changing Roles for Women", paper presented at the Pacific Sociological Association Meeting, April 1977.

"Cadet Attitudes During the Admission of Women to the United States Air Force Academy", paper presented at the American Psychological Association Convention, August 1977.

"The Beginning Months of Co-Education", paper presented at the American Sociological Association Meeting, September 1977.

"Tradition and Innovation - Military Professionalism Among Female USAFA Cadets", paper presented at the Inter-University Seminar on Armed Forces and Society, October 1977.

12. USAFA MMPI Research Project

Principal Investigator: Lt Col L. Ralph Chason, Department of Behavioral Sciences and Leadership

Associate Investigators: Lt Col Lawrence F. Sharp and Maj Valentin W. Timan, Jr., Department of Behavioral Sciences and Leadership

Un-sponsored

In the March 1971 recommendation of the Advisory Council to the Superintendent of the Academy, the Subcommittee on Attrition Studies recommended psychological evaluation of Basic Cadets using the MMPI (Minnesota Multiphasic Personality Inventory). The purpose of this testing would be twofold: (1) to flag those cadets who might have difficulty in adjusting to the environment of the Academy; and (2) to provide experimental data to apply to the question of whether or not the MMPI holds predictive potential for the various criteria of success both at the Academy and during later commissioned service.

The use of the MMPI to flag potential adjustment problems allows

the Academy to identify basic cadets who can profit from additional supportive counseling during the early phases of their training. These cadets receive help in understanding and adjusting to their new way of life from professional counselors, psychologists and psychiatrists.

The research portion of the project is designed for longitudinal analysis and evaluation beginning with the entry of the Class of 1975. Data collected during this period will be used to establish normative profiles for USAFA cadets and to evaluate the usefulness of the MMPI in predicting success at the Academy and during later commissioned service.

#### Presentations

Chason, L.R., Sharp, L.F., and Tirman, V.W. "Psychological Factors Associated with Early Attrition from the USAF Academy," Proceedings, Colorado-Wyoming Academy of Science, April 1977.

#### C. Department of Economics, Geography and Management

##### 1. Political Overboundedness and the Urbanization of Rural Settlement Patterns

Principal Investigator: Maj A. Paul Tribble, Department of Economics, Geography and Management

Metropolitan political overboundedness influences the direction and rate of urban residential growth in Texas. In overbounded and non-overbounded cities, development was similar in the zone immediately adjacent to the built-up area of the city. In the more distant areas, however, the density of dwellings per square mile was significantly greater in overbounded-city samples, contributing to a difference between city types in the process of residential development.

#### Publication

USAFA-TR-76-22, USAF Academy Technical Report, November 1976.



2. Crime in El Paso County Colorado: A Spatial Perspective

Principal Investigators: Maj A. Paul Tribble, Department of Economics, Geography and Management and Maj Charles L. Smith, Department of Economics, Geography and Management

Analyzes the spatial separation of the residences of criminals and locations of crimes for six crime categories. Data pertain to El Paso County, Colorado, (exclusive of Colorado Springs) for 1975. Examines social, economic, demographic and distance variables in a multiple regression model in an effort to isolate causes of El Paso County crime.

Publication

USAFA-TR-77-2, USAF Academy Technical Report, February 1977

3. 1976 Proceedings of the Academy of Management

Principal Investigator: Maj Robert L. Taylor, Department of Economics, Geography and Management

Associate Investigators: Michael J. O'Connell, USAF Academy; Robert A. Zawacki, University of Colorado, Colorado Springs; D.D. Warrick, University of Colorado, Colorado Springs

This book is a compilation of the 100 best papers presented at the Thirty-Sixth Annual Meeting of the Academy of Management, Kansas City, August 1976. Reporting the most current management research and theory, the book covers topics in organization theory, management education, production management, organizational behavior, social issues in management, etc., and is a valuable reference tool for scholars, libraries, and consultants.

Publication

Academy of Management, Mississippi State, Mississippi, August 1976.

4. Estudio Longitudinal de la Comunicacion en la Investigacion:  
Influencias Techias y de Gestion

Principal Investigator: Maj Robert L. Taylor, Department of  
Economics, Geography and Management

Associated Investigator: James M. Utterback

Communications patterns in a research and development laboratory are studied. The effects of changes in technical assignments and work group composition do not change appreciably, the two-step flow of information into the work group. However, the study shows that it takes nearly 18 months to reestablish group networks after changes in technical assignment or group composition while the key communicators re-emerge regardless of the changes.

Publication

Escuela Superior de Administracio y Direccion de Empresas, Barcelona, Spain, September 1976.

5. An Appraisal of Partial Recovery & Diasaster: The Lice  
Earthquake of 1975

Principal Investigator: Maj William A. Mitchell, Department  
of Economics, Geography and Management

Publication

USAF-TN-77-1, USAF Academy Technical Note, January 1977.

6. The Lice Earthquake in Southeastern Turkey: A Geography of  
the Disaster

Principal Investigator: Maj William A. Mitchell, Department  
of Economics, Geography and Management

On September 6, 1975, an earthquake of Richter magnitude 6.9 occurred near the town of Lice in southeastern Turkey. Two thousand and eighty-five people were killed and 3,339 were injured in the disaster. The earthquake had a disastrous effect in 193 villages and towns, demolishing 7,713 homes and damaging 8,453 others. Soon after the earthquake the

Turkish government implemented a vast restoration program which included rebuilding the town of Lice and building 5,805 homes throughout the area. This report is a comprehensive systematic analysis of the nature and extent of the Lice disaster. Recommendations for future reconstruction practices are offered.

Publication

USAF-TR-76-24, USAF Academy Technical Report, December 1976

7. Reconstruction After Disaster: The Gediz Earthquake of 1970

Principal Investigator: Maj William A. Mitchell, Department of Economics, Geography and Management

Analyzes human adjustment to the 1970 Gediz earthquake in western Turkey. Provides policy implications for restoration after future disaster.

Publication

Geographical Review, Vol. 66, No. 3, July 1976.

8. Toward an Understanding of Opium Poppy Production in Turkey

Principal Investigator: Maj William A. Mitchell, Department of Economics, Geography and Management

Associate Investigator: Lt William H. Brundage

Analyzes the Turkish decision to resume opium poppy production. Suggests that several miscalculations contributed to the unsuccessful U.S. attempt to encourage the cessation of opium poppy production in Turkey.

Publication

Journal of Asian and African Studies, December 1976.

9. Determination of True Elevations from Aerial Photographs

Principal Investigator: Maj Charles L. Smith, Department of Economics, Geography and Management

There are many problems involved in the determination of accurate elevations from tilted photographs. Plotting machines such as the Wild A-7 are able to compensate for tilt and provide accurate elevations, however, these machines are expensive and not available to many researchers. This report describes a set of procedures and a computer program for the determination of ground elevations to the same general degree of accuracy as that obtained with plotting machines. The procedures involve parallax measurements and location of points within a stereoscopic model.

Publication

USAFA-TR-77-3, USAF Academy Technical Report, March 1977

10. Locational Analysis of Crime in El Paso County, Colorado, 1975

Principal Investigators: Maj Charles L. Smith, Department of Economics, Geography and Management and Maj A. Paul Tribble, Department of Economics, Geography and Management

Crime data for El Paso County, Colorado, for 1975, in which the criminal was apprehended, are used in a plotting of the locations of selected crimes and the residences of associated criminals. The residence in many cases is the Ft Carson military post. The relative influence of proximity location to this military base on the county's crime rate is examined in relation to traditional social, economic, and demographic variables generally associated with crime.

Publication

USAFA-TN-77-2, USAF Academy Technical Note, February 1977

11. Energy Resource Maps

Principal Investigator: Maj Charles L. Smith, Department of Economics, Geography and Management

Associate Investigators: TSgt J. Richard Wagner, Department of Economics, Geography and Management and 34 cadets enrolled in Geography 340

Using procedures produced by an earlier project, maps depicting the water resources of the six states and combined area of FEA region VIII were produced. Stream flow in Cfs and the volume of reservoirs were also shown. Data was also obtained and utilized to prepare maps indicating the energy production, consumption as well as exports and imports for all states of region VIII.

Presentation

FEA Region VIII Office, December 1976.

12. Colorado Springs Chamber of Commerce Maps

Principal Investigator: Maj Charles L. Smith, Department of Economics, Geography and Management

Associated Investigators: TSgt J. Richard Wagner, Department of Economics, Geography and Management; CLC Steven Jonak; and CLC Craig Weibel

Based upon data provided by the Chamber of Commerce a series of maps were prepared for inclusion in a Chamber of Commerce Publication. The maps presented the air and ground transportation networks centered on Colorado Springs and the available office space in the Colorado Springs region.

13. Soviet Naval Strategy and Deployment of Maritime Forces:  
A Selected Annotated Bibliography

Principal Investigators: Maj William A. Mitchell, Department of Economics, Geography and Management and Maj A. Paul Tribble, Department of Economics, Geography and Management

This annotated Bibliography was compiled as an initial phase of research for RAND project number 4204, Soviet Maritime Reaction to Third World Crisis. As such, it is a special purpose bibliography, with strong emphasis on the selection of materials addressing strategy and deployment of Soviet maritime forces.

Presentation

RAND Corporation, December 1976

Publication

USAF-TN-76-3, USAF Academy Technical Note, October 1976

14. Disaster and Change in Rural Turkey

Principal Investigator: Maj William A. Mitchell, Department of Economics, Geography and Management

Associate Investigator: Capt C. Taylor Barnes, Department of Economics, Geography and Management

Describes and examines the socio-economic changes that occur when an unplanned disruptive natural force confronts a rural area of Turkey. Relative change over a three year period is measured in forty-seven Turkish villages.

Publication

Middle East Journal, 1976

15. High Yielding Mexican Wheat in Turkey

Principal Investigator: Maj William A. Mitchell, Department of Economics, Geography and Management

1

Associate Investigator: Maj A. Paul Tribble, Department of Economics, Geography and Management

Addresses the introduction of high yielding Mexican wheat into Turkey, A Southwest Asian Country seldom considered to be associated with the green revolution. Interprets the social and economic consequences to Turkey of adopting this new strain of wheat.

Publication

Review of the Geographical Institute of the University of Istanbul (In Turkish), 1976.

16. Site Analysis for the Hacking of Falcons at the United States Air Force Academy

Principal Investigators: Capt C. Taylor Barnes, Department of Economics, Geography and Management and Lt Donald P. Higgins

This research investigates alternative sites for falcon training at the United States Air Force Academy.

Presentation

Regional Meeting of the Association of American Geographers, 29 October 1976, Manhattan, Kansas

17. Vista Grande Bus Route: Rider Characteristics Study

Principal Investigator: Captain C. Taylor Barnes, Department of Economics, Geography and Management and Lt Clarke R. Hinkel

Rider characteristics on the Vista Grande Bus route as investigated in an attempt to arrive at a more appropriate routing procedure.

Presentation

Regional Meeting of the Association of American Geographers, 29 October 1976, Manhattan, Kansas

D. Department of English and Fine Arts

1. Practical College Writing

Principal Investigators: Capt Edward P. Bailey, Jr., Capt Philip A. Powell, Col Jack M. Shuttelworth, Department of English and Fine Arts

Sponsored by the Department of English and individuals

A textbook which teaches organization of the one paragraph essay, the theme, and the research paper. Contains sections on punctuation and expression.

2. James Whitehead and Mary Lee Settle

Principal Investigator: Maj James A. Grimshaw, Jr.,  
Department of English and Fine Arts

Sponsored by the University of North Carolina at Chapel Hill  
and individual

Biographical sketches with a brief bibliography of each author's writings.

Publication

To be published in A Biographical Guide to Southern Literature. Edited by Louis D. Rubin, Jr., et al. Baton Rouge: Louisiana State University Press. Tentative publication date is 1978.

3. Robert Penn Warren: A Collector's Checklist

Principal Investigator: Maj James A. Grimshaw, Jr.,  
Department of English and Fine Arts

Sponsored by B-C Research and individual

A descriptive checklist of the first printings of Warren's works.

Illustrated.

Publication

"Robert Penn Warren: A Collector's Checklist." In First Printings of American Authors. Edited by Matthew J. Bruccoli. Detroit: Gale Research, 1977.

4. O'Connor and Warren: Christian Points of View

Principal Investigator: Maj James A. Grimshaw, Jr.,  
Department of English and Fine Arts

Sponsored by Georgia College and individual

An article comparing religious themes and techniques in the



fiction of Flannery O'Connor and Robert Penn Warren.

Publication

To be published in the O'Connor Bulletin. Date Unknown.

5. The Earl of Bute and George Germain: Machiavels of the American Revolution as Seen by London's Poets, 1763-1783

Principal Investigator: Maj James C. Gaston, Department of English and Fine Arts

Sponsored by individual

Throughout the American Revolution, poets who wrote for London's major periodicals struggled to make complex issues and disturbing events comprehensible. One of their favorite explanations for the unfavorable trend of events was that a highly placed villain was responsible. Precedents for such a villain were the many Machiavellian figures who had populated English drama since Elizabeth's day. To transform the popular dramatic type into a plausible excuse for Britain's troubles, London's poets pictured two real men in the role of Machiavel. These men were John Stuart, third Earl of Bute, and Lord George Germain, Secretary for the American Colonies.

Presentation

Presented at the Annual Convention of the South Central Society for Eighteenth-Century Studies, Houston, Texas, 4 March 1977.

6. An Annotated Bibliography of Technical Writing Textbooks for 2-Year, Secondary, and 4-Year Programs

Principal Investigator: Maj Robert B. Donovan, Department of English and Fine Arts

Sponsored by the National Council of Teachers of English and individual

A bibliography accomplished for the NCIE Committee on Technical and Scientific Writing.

7. The Old English  $\bar{a}e$  from the Indo-European  $\bar{e}$

Principal Investigator: Maj Donald E. Ahern,  
Department of English and Fine Arts

Sponsored by individual

A linguistics article which posits the existence of a West Germanic long "e" instead of the widely-accepted long "a".

8. Air Force Effective Writing Program

Principal Investigators: Maj Thomas A. Murawski, Capt Philip A. Powell, and Capt Blaine M. Rockwell, Jr., Department of English and Fine Arts

Associate Investigators: Capt Edward P. Bailey, Jr., Capt Michael D. Richards, Capt Robert S. Staley, II, Capt Dennis J. Stanley, Department of English and Fine Arts

Sponsored by USAF/DA and the Department of English and Fine Arts

A series of three half-hour films and exercises to replace the current slide program. The films discuss how to write conversationally, organize conveniently, and revise effectively.

9. The Admission and Integration of Women into the United States Air Force Academy

Principal Investigator: Maj William J. Wallisch, Jr.,  
Department of English and Fine Arts

Sponsored by individual

A dissertation dealing with the integration of women into the Air Force Academy. Traces the legislative process that broke the all male tradition of service schools, then presents the planning and actions that took place at USAFA. Includes a study of the first summer and academic year to determine the results of the planning and its implementation.

E. Department of Foreign Languages

1. Some Preliminary Hypotheses on the Semiotic Microcosm of Gottfried's Tristan

Principal Investigator: Capt James W. Hutchison, Department of Foreign Languages - sponsored by the USAF Academy

Research into the applications of recent insights in the theory of semiotics (the study of signs and sign systems). It resolves the major ambiguities of an enigmatic medieval work of great significance in European literature and provides a more satisfactory explanation of apparent contradictions in the work and the values which underly it. The work is revealed as the product of a courtly universe whose value system is in an advanced state of decay, where inversions of the (then) normal value polarities have begun to apply. (Accepted for publication by Semiotica, the Journal of the International Association for Semiotic Studies).

2. Computers in Foreign Language Research

Principal Investigator: Capt James W. Hutchison, Department of Foreign Languages - sponsored by the USAF Academy

Research focussed on a problem of applied descriptive linguistics in German using the computer and the state of the art in machine translation. A major obstacle to the acquisition of a broad capability in this area was identified. Techniques of textual analysis were developed from recent findings in discourse analysis and were employed in the identification of new factors which must be considered in working toward a viable machine translator/interpreter.

Research was presented in a series of lectures to Computer Science 100 classes at USAFA during the Spring Semester 1977.

3. The Case for Reassessing the Treatment of the Modal Particles in German Language Instruction

Principal Investigator: Capt James W. Hutchison, Department of Foreign Languages - sponsored by the USAF Academy

Research on colloquial German conversation using analytical tools from the field of speech act theory reveals that a number of highly frequent lexemes function in ways which have not previously been described in the linguistic literature. The case is made for the inclusion of these heretofore neglected words and their newly discovered functions in courses of instruction in the German language. An article (subject as above) will appear in 1978 in Unterrichtspraxis, the journal of the American Association of Teachers of German.

4. Die Pragmatische Interpretation der "Fullwörter" in der Umgangssprache: Ein Beitrag zur Beschreibung ihrer Funktionen in Sprechakten. (The Pragmatic Interpretation of the Modal Particles in Colloquial German: On the Description of Their Functions in Speech Acts)

Principal Investigator: Capt James W. Hutchison, Department of Foreign Languages - sponsored by the USAF Academy

Research on the modal particles in German and the application of Pragmalinguistik (speech act theory) and Textlinguistik (discourse grammar) to the interpretation of these words in colloquial German discourse. A paper on the subject will be presented to a colloquium at the Free University of Berlin, September 1977.

5. Oral History of the Hispanic American of Colorado

Principal Investigator: Capt Culberto Maldonado, Department of Foreign Languages - sponsored by the USAF Academy

The main objective is to collect the autobiographical and historical recollections of the Spanish-speaking people. Since there is a lack of written history about this ethnic group, tape recorded interviews are being conducted in the field in the Spanish language. Potential inter-

viewees include survivors of the Ludlow Massacre, cattle drive participants, Penitentes, miners, and others that lived during the late 1800's. Although this is a continuing project, the bulk of the interviews and their classification should be concluded by March 1978.

#### 6. Perceived Cultural Values and Academic Success in Higher Education

Principal Investigator: Capt Culberto Maldonado, Department of Foreign Languages - sponsored by the USAF Academy

Cultural values are often cited as a primary cause in the academic success or failure of students of Hispanic background in college. Yet, there is no general agreement on what these specific cultural values are. This research attempts to identify these cultural values as they are perceived by four major groups: (1) Hispano college students, (2) educators and counsellors working with Hispano students, (3) traditionally-oriented Hispano adults, and (4) existing literature on previous research. Written questionnaires and oral interviews are used to collect the data. The population to be sampled resides in Colorado. The project will be completed by December 1978.

#### 7. Spanish Language Culture Materials

Principal Investigator: Capt Mary A. Marks, Department of Foreign Languages - sponsored by the USAF Academy

The purpose of this research project is (1) to identify the most common situations and cultural themes which would be encountered in traveling to a Spanish-speaking country and (2) to obtain recorded materials based on these situations for use in the classroom. The materials collected through this project will be used in the development of culture

capsules and other audio materials such as aural comprehension exercises for classroom use. Materials will supplement textbooks and provide students with an exposure to the language as it is used by native speakers. Actual research will be carried on in Mexico by recording conversations with natives in that country.

8. FRANCE - Land and People: A Handbook

Principal Investigator: Capt Donald C. Scott, Department of Foreign Languages - sponsored by the USAF Academy

Second revised edition. This 174-page handbook provides the French language students at USAFA with an introduction into the culture and civilization of France. The handbook is also used by the Defense Language Institute in their French courses.

9. GERMANY - Land and People: A Handbook

Principal Investigator: Col William Geffen, Department of Foreign Languages - sponsored by the USAF Academy

Revision of the two-volume handbook on German culture and civilization into a one-volume version. New edition will be used by the Defense Language Institute and U. S. Air Forces Europe. Completion date: October 1977.

10. LATIN AMERICA - Land and People: A Handbook

Principal Investigators: Capt Walter J. Gomez and Col William Geffen, Department of Foreign Languages - sponsored by the USAF Academy

This 200-page handbook provides the Spanish language student at USAFA with an introduction into the culture and civilization of Latin America. Upon completion, it will be incorporated into the curriculum

of the Defense Language Institute's Spanish courses. To be completed in October 1977.

11. Computer Management of Grading and Test Analysis in USAFA Foreign Language Courses

Principal Investigator: Capt Michael D. Bush, Department of Foreign Languages - sponsored by the USAF Academy

The grading process in DFF involves evaluation of the student's learning in several skill areas. In order to properly assess student performance in each area, multi part examinations comprising several different testing techniques are administered. Traditionally the administrative details required by each examination have entailed substantial expenditures of time and effort on the part of the DFF instructors.

The research is evaluating the increased use of optical scanner forms, marked by the student for multiple-choice type questions and by instructors as the subjectively graded portions of the examinations (Graded Reviews and Final Examinations) are scored. A computer program for the reporting of student performance on the examination is under development. It has already been used on a limited basis in order to investigate the evaluation (best analysis) possibilities of these new methods. The final outcome of the research will be improved grading and reporting procedures while bringing about a substantial savings in man-hours.

F. Department of History

1. A History of the United States Air Force

Principal Investigator: Col Alfred F. Hurley, Department of History

Sponsored by the USAF Academy and the John S. Guggenheim Foundation

Research and writing on the development of the Air Force as an institution with emphasis on its origins from 1890 to 1947. Makes use of primary sources among records of the Air Force and its predecessors, Air Force Archives at Maxwell AFB, National Archives in Washington D.C., and papers of such founders as Foulois, Mitchell, Spaatz, and Arnold. Results to be published in a book by Macmillan Company for its series on Wars and Military Institutions of the United States. During 1976-1977, performed research and writing on this topic as a Fellow, Smithsonian Institution, Washington, D. C.

## 2. USAFA Oral History Program

Principal Investigator: Maj Robert S. Bartanowicz, Department of History

Sponsored by the USAF Academy

The Oral History program conducted several taped interviews which were typed into manuscripts. The manuscripts will serve as "original source" historical documents and will be deposited in the Special Collections Division of the USAFA Academy Library; Butler Library, Columbia University; and the USAF Historical Research Division, Maxwell AFB, Alabama.

The interviews covered a total of some fifteen hours and were all related to aviation, Air Force, US Air Force Academy, or military history. During 1976-77, a substantial amount of research was directed toward recording the integration of women at the Air Force Academy. In this regard, interviews were conducted with the following personnel: Colonel James P. McCarthy, former Vice Commandant of Cadets, on his role as the overall project officer for the integration of women at the Academy; Lieutenant Colonel James C. Thomas and Captain Robert E. Lushbaugh, on their research and development of physical standards for



women cadets; Captain Judith M. Galloway, on her role as the initial project officer for integration of women at the Academy. The Department of History anticipates concluding research on this particular project sometime during early 1978. Other interviews which were conducted included Major General Leigh Wade, USAF (Ret), discussing his early World War I aviation experiences, and Mr. Prosper E. Cholet, discussing his World War I experiences as a French infantry officer and aviator.

3. The Harmon Memorial Lectures in Military History

Principal Investigator: Major Charles W. Specht, Department of History

Sponsored by the USAF Academy and the Association of Graduates

The first nineteen annual lectures in the Harmon Memorial Lecture Series have been published separately. Plans call for publication in the future of a volume containing all lectures presented to the date of publication.

4. The American Military on the Frontier: The Proceedings of the 1976 Military History Symposium

Principal Investigator: Maj James P. Tate, Department of History

Sponsored by USAF Academy and the Association of Graduates

Editing a series of papers presented at the 1976 Military History Symposium by prominent military and civilian historians. The proceedings of this symposium are to be published by the Government Printing Office in 1978.

5. Establishing Yeoman Farmer Regions in the Antebellum Deep South

Principal Investigator: Maj John M. Allman, III, Department of History

Sponsored by AFIT

This research is for the dissertation for a Ph.D. in Historical Geography. Planter lifestyles and regions have long been identified and analyzed in the Antebellum Deep South (Alabama-Mississippi). This research is dedicated to illuminating and explaining the socio-economic lifestyles of the millions of white farmers in the Antebellum South, who were not closely associated with planter economics. This Southern farmer seems to resemble the classical yeoman of other portions of the Antebellum United States. However, his economic endeavors are less successful because migration and inter-regional trade processes rob him of capital and markets.

6. Origins of the National Science Foundation

Principal Investigator: Maj Donald R. Baucom, Department of History

Sponsored by USAF Academy

Investigates the influence of the military on the formation of the National Science Foundation.

7. American Military Missions to Korea: 1882-1896

Principal Investigator: Capt Donald M. Bishop, Department of History

Sponsored by USAF Academy

Analysis of the role of American Military and naval officers in the period which followed the opening of Korea by Commodore Shufeldt in 1882. The investigation emphasizes the modernization impact of the American missions on the political order of the late Yi dynasty and the failure of the Korean armed forces to reform.

Two phases of this research have been published; see "Navy Blue in Old Korea," Journal of Social Sciences and Humanities (Seoul), No. 42 (December 1975), pp. 49-63, and "Policy and Personality in Early Korean-American Relations: The Case of George Clayton Foulk," in The United States and Korea, Andrew C. Nahm, ed. (Kalamazoo: Western Michigan University, forthcoming).

The investigation was briefed to the Korean government's War History Compilation Committee in Seoul during July 1976.

8. Yun Chi-Ho, A Korean Modernizer, 1864-1945

Principal Investigator: Donald M. Bishop, Department of History

Sponsored by USAF Academy

Materials on the Korean reformer Yun Chi-Ho were gathered in Korea and the United States. Yun, who earned a degree in 1893 at Georgia's Emory College while in exile in the United States, became a key reformer, government official, and Christian statesman in Korea after 1895.

2

The research has been published; see "A Korean at Oxford," The Emory Magazine 52, no. 3, Winter 1976, pp. 8-13.

9. East and West in Ceylon, 1884

Principal Investigators: Donald M. Bishop, Department of History and FSO-5 Edward P. Brynn

Sponsored by USAF Academy

A detailed manuscript letter written by Ensign George Clayton Foulk, USN, describing the visit of three Korean diplomats to Ceylon in 1884 has been edited and annotated. Foulk's observations of Ceylon form a valuable supplement to the history of the island in the 1880's.

10. American Forces in Foreign Cultures

Principal Investigator: Donald M. Bishop, Department of History

Sponsored by USAF Academy

The investigation examines the impact of American military forces in overseas garrisons on the host country and the factors which influence the behavior of American servicemen overseas--culture shock, ethnocentrism, ignorance, prejudice, and family separation.

A portion of the research has been integrated into a required reading for cadets in History 101, entitled "Officers in a Foreign Culture."

11. The Marquess Wellesley in Irish and British Politics

Principal Investigator: FSO-5 Edward P. Brynn

Wellesley is known to history as the eldest brother of the Duke of Wellington, a remarkably unjust diminution of his importance over a period of sixty years. As a friend of William Pitt and William Grenville, he established Arthur in the army and as viceroy in India secured British ascendancy there. He was foreign secretary from 1809 to

1812, twice viceroy in Ireland. He fashioned a family political interest which secured Arthur his position as head of British forces in the Iberian peninsula and promoted the fortunes of other members of the family. This research and writing is related to a Ph.D. dissertation in Irish history at Trinity College, University of Dublin.

12. Crown and Castle: British Administration in Ireland 1800-1830

Principal Investigator: FSO-5 Edward P. Brynn

In 1801 the independent Irish parliament was abolished and plans were laid to reduce the island to the status of an "English county." These plans were disrupted by intense and widespread opposition among Catholic nationalists, who launched the drive for independence which culminated in the twentieth century. Crown and Castle analyzes problems posed for Britain by Irish nationalism in its first phase and suggests that devices such as passive resistance, moral suasion and guerrilla activity common to later colonial uprisings can be detected in Ireland's contest against a powerful imperial system.

13. Stalag Luft III: The Allied Experience in a World War II German Prisoner of War Camp

Principal Investigator: Capt Arthur A. Durand, Department of History

Sponsored by USAF Academy

Describes and analyzes the conditions encountered by the captured allied fliers confined in Stalag Luft III and notes the actions taken by the prisoners in terms of internal organization; the fostering of good relations among their own ranks; the structuring of recreational, athletic, educational, and religious programs; and the fostering of

covert intelligence and escape activities. Research initiated as a doctoral dissertation (completed in May 1976) and continuing as preparation for publication by LSU Press in book form in Spring 1979. So far one publication has resulted from the research: Delmar T. Spivey and Arthur A. Durand, "Secret Mission to Berlin," Air Force Magazine (September 1975), 115-120.

14. Timothy Walker and the Growth of American Law

Principal Investigator: Capt Walter T. Hitchcock, Department of History

Sponsored by AFIT

A biography of Timothy Walker (1802-1856), noted legal author, educator, reformer and jurist. Walker, who practiced law in Cincinnati, Ohio, founded the University of Cincinnati Law School in 1833, edited the Western Law Journal and authored a legal textbook entitled Introduction to American Law, which was commonly regarded as the "American Blackstone." This study documents Walker's efforts to elaborate and implement a clear, authoritative national system of law that accommodated English common law to the spirit and condition of the western frontier.

15. Laser Weapons Research and Development at the Air Force Weapons Laboratory, 1967-1972

Principal Investigator: Maj Thomas A. Keaney, Department of History

Sponsored by History Office of the Air Force Weapons Laboratory (AFWL)

Analysis of the management and development of laser weapons research at the AFWL. Research was accomplished in June, 1976; the

report will be published by the History Office, AFWL, and will be classified.

16. The Airborne Laser Laboratory, 1968-1972

Principal Investigator: Capt Thomas F. Menza, Department of History

Sponsored by Air Force Laser Laboratory, AF Systems Command, Kirtland AFB, NM

Examines the development of the Airborne Laser Laboratory

(ALL) which was a fusing step between a ground based laboratory and an airborne weapon prototype. Research was conducted in June and July 1976, the report will be published by the History Office, AFWL, and will be classified.

17. General Hoyt S. Vandenberg

Principal Investigator: Lt Col Jon A. Reynolds, Department of History

Sponsored by USAF Academy

Examines the early life and military career of General Vandenberg.

Special emphasis is devoted to identifying those special factors and qualities which permitted his rapid advancement during World War II and selection as the second Chief of Staff of the US Air Force.

18. The Divergence of Policy and Power

Principal Investigator: Maj John F. Shiner, Department of History

Sponsored by USAF Academy

Explores the growing divergence of US foreign policy and available military power in the 1945-47 period. Major focus is on

military force structure and employment potential. Research resulted in a paper presented at the 1977 Citadel Conference on War and Diplomacy which will be published as part of the conference's proceedings.

19. US Military Operations in Vietnam

Principal Investigator: Maj John F. Shiner, Department of History

Sponsored by USAF Academy

Surveys American military activity in Southeast Asia. Resulted in an article entitled "Vietnam, 1965-73: A Campaign Survey," published in the 1977 edition of Modern Warfare and Society by the Department of History for use in History 202.

20. The Creation on the GHQ Air Force

Principal Investigator: Maj John F. Shiner, Department of History

Sponsored by USAF Academy

Investigates the interplay between the Army General Staff and military aviators which resulted in the creation of GHQ Air Force.

21. US Defense Policy Since 1945

Principal Investigator: Maj John F. Shiner, Department of History

Sponsored by USAF Academy

Explores the changes which have occurred in American defense policy between 1945 and 1965. Resulted in an article adopted for use in History 202.

G. Department of Political Science and Philosophy



1. The American Military -- Theirs to Reason Why

Principal Investigator: Col Malham M. Wakin, Department of Political Science and Philosophy

The article essentially deals with the issue of unquestioning obedience and immoral orders and reflects at some length on stereotyped views of the "military mind."

Publication

A republication of an article which first appeared in Air Force Magazine and is being included this year in the fourth Edition of American Defense Policy.

2. The Ethics of Leadership

Principal Investigator: Col Malham M. Wakin, Department of Political Science and Philosophy

The article evaluates views of the military profession held by such writers as Samuel Huntington, Morris Janowitz, Sir John Winthrop Hackett, and Alfred Vagts. It analyzes conceptions of the military ethos and military honor. It further provides normative considerations of absolute and relative moral principles and examines the values of loyalty, obedience, integrity, and subordination to the military function.

Publication

A republication of an article which previously appeared in the May/June 1976 issue of The American Behavioral Scientist. Republished in 1977 by the U.S. Army War College in their book of readings entitled Selected Readings in Ethics.

3. The Evolution of Philosophical Thought

Principal Investigator: Col Malham M. Wakin, Department of Political Science and Philosophy

This three-hour lecture treated main themes in both Western and Eastern philosophies from the early Pre-Socratics, Buddha, and Confucius down to contemporary existentialism, modern Marxism, and American pragmatism. Metaphysical ideas covered included doctrines of change and substance and general views of the universe. Evolving views of human nature and theories of knowledge were traced from Plato and Aristotle through the Medieval Thinkers, the Continental Rationalists, and the British Empiricists down to Immanuel Kant.

Presentation:

Presented at The Inter-American Defense College on 17 September 1976.

4. Managerial Integrity

Principal Investigator: Col Malham M. Wakin, Department of Political Science and Philosophy

This two-hour lecture deals with principal ethical dimensions of personnel management with special emphasis on assignment actions, OERS, statistical games managers play, and theories of character development. A main theory concerning the nature of human work is proposed and a normative approach to understanding absolute and relative value systems is advanced.

Presentation

Presented four times during the Academic Year at Maxwell AFB for the Advanced Personnel Management Course.

5. Ethics for Commanders

Principal Investigator: Col Malham M. Wakin, Department of Political Science and Philosophy

This two-hour lecture highlights the ethical issues of command, including the moral aspects of superior-subordinate relationships, zero-defects attitudes, statistical reporting, OERs, and evaluation of the concept of leadership by example. It makes use of the results published in the Army War College Study of Professionalism in critically evaluating some command techniques and negative behavior patterns and analyzes in depth the moral concerns of the military profession.

Presentation

Presented twice during this Academic Year at Maxwell AFB for the Base Commanders' Management Course.

6. Ethics and the Military Profession

Principal Investigator: Col Malham M. Wakin, Department of Political Science and Philosophy

This two-hour lecture focused on the theme that "the line between incompetence and immorality is a thinner line in the profession of arms than in almost any other vocation." Conceptions developed included an analysis of stereotypes of the "military mind," the nature of professions, the ethical virtues inextricably interwoven into the military function, comparisons of professions, unquestioning obedience and immoral orders, and the current essential role of the U.S. military profession.

Presentation

Presented in the Creighton W. Abrams, Jr. Command Lecture Series at the U.S. Army War College in Carlisle Barracks, Pennsylvania on 11 January 1977.

## 7. Ethical Issues of Military Leadership Today

Principal Investigator: Col Malham M. Wakin, Department of Political Science and Philosophy

This five-hour workshop was given to Army and Air Force Chaplains and some Army commanders under the sponsorship of the Military Chaplains Association. Issues which were extensively developed included: contemporary ethical concerns in American society, "the success ethic," specific issues in the military today, including ticket-punching, OERs, decorations, uses of statistical reporting, zero-defects, false reporting, honesty with the commander, the special ethical dimensions of the military function, loyalty, obedience, courage, subordination of the individual to the group, conservative vs liberal values, the role of moral example, absolute vs relative value systems, honor codes, war and morality, superior-subordinate relationships, crisis management, and the work ethic.

### Presentation

Presented in workshop format three times -- at Nuremberg (14 Feb 1977), Ramstein AFB (16 Feb 1977), and Frankfurt (18 Feb 1977).

## 8. The North Atlantic Alliance

Principal Investigators: Col Ervin J. Rokke, Maj Michael A. Freney, and Captain Charles L. Fox, Department of Political Science and Philosophy

An analysis of current major issues facing the NATO Allies' force posture and doctrine and strategy.

### Presentation

This research has been presented to Air War College Seminars at the USAF Academy, Air Command and Staff College Seminars at the USAF Academy and at Peterson AFB, Colorado, and to the NATO Staff Course at The Armed Forces Air Intelligence Training Center, Lowry AFB, Colorado.

#### 9. Politico-Military Expertise

Principal Investigator: Maj Michael A. Freney, Department of Political Science and Philosophy

The clear connection between the military profession and politics has been challenged only by normatively inclined scholars, using narrowly functional approaches to understanding the profession, itself. In three Western democracies, formal schooling in political-military affairs has been considered essential for senior officers likely to bear policy-making responsibilities. Comparison of the curricular content of that schooling over a twenty-year base provides interesting insight into the nature of the political component of military expertise in Canada, the United Kingdom, and the United States.

#### Publication

To be published in American Defense Policy, 4th Edition, forthcoming.

#### 10. The Dismissal of Teng Hsiao-p'ing

Principal Investigator: Capt William R. Heaton, Jr., Department of Political Science and Philosophy

Teng Hsiao-p'ing appeared to be Chou En-Lai's successor until a series of events led to his dismissal from all positions. Unlike the purge of Lin Piao, the purge of Teng appears to have had little affect on persons considered to be his proteges in lesser positions.

#### Publication/Presentation

This research was conducted in conjunction with a RAND Corporation Study and is to be incorporated into a larger study. This paper was presented at a RAND Seminar in August 1976 and a revised version was presented at the Western Conference of the Association for Asian Studies in Flagstaff, Arizona, on 9 October 1976.

11. The Chinese People's Liberation Army and Minority Nationalities

Principal Investigator: Capt William R. Heaton, Jr.,  
Department of Political Science and Philosophy

The relationship between the PLA and national minorities in China is related to the overall issue of national integration. The military has fostered national integration in minority regions by promoting political order, economic development, and political socialization. At the same time, minority recruits have been accepted by the PLA as part of the integration strategy.

Publication

Published in the Journal of Asian Affairs, Winter 1976.

12. The Thai Insurgency

Principal Investigator: Capt William R. Heaton, Jr.,  
Department of Political Science and Philosophy

The insurgency in Thailand is relatively small, however, ineffectual government efforts to contain it have enabled it to expand; if Thailand remains unstable, it could pose an increased threat to the regime.

Presentation

This paper was presented at the National War College, Washington, DC, on 5 October 1976.

13. Counterinsurgency in Thailand

Principal Investigator: Capt William R. Heaton, Jr.,  
Department of Political Science and Philosophy

The Thai counterinsurgency effort, as assisted by the United States has been fraught with frustration. It is hampered by a lack of

leadership at the highest echelons and poorly implemented strategies. In spite of this, the insurgency has remained fairly limited in size because of environmental and cultural conditions.

Publication

To be published in American Defense Policy, 4th Edition, forthcoming.

14. A Comparative Study of Indonesian and Philippine Military Elites

Principal Investigator: Capt Harold W. Maynard, Department of Political Science and Philosophy

The article stresses the domestic political roles and threat perceptions of Southeast Asian militaries. Radical Muslims, Communist remnants, corrupt officials, and Western-style democracy appear of greatest concern. Internal security and national development are stressed as major military roles. Intramural factionalism appears well under control.

Publication

To be published in 1978 as a chapter in Military Force and Forces: Prospects for Asia, Africa and Latin America (Boulder: Westview Press)

15. How Military Elite Role Perceptions in Southeast Asia Conflict With The Civil-Military Paradigm

This research paper outlines the West's civil-military paradigm, with emphasis on its conceptual weakness, and then compares the paradigm to indigenous views of the role of the military in Southeast Asia. The paper concludes that the Western model of a subordinate military institution is not appropriate for, nor accepted by, military officers in Southeast Asia.

### Publication

The paper was delivered before the Southwest Conference of the Association for Asian Studies, Oklahoma City, October 1976 and published in Spring 1977 as part of the collection of conference papers.

#### 16. Soviet Political and Military Elements of Power

Principal Investigator: Maj John R. Desiderio, Jr., Department of Political Science and Philosophy

This presentation examined the historical underpinnings and essential elements of the Soviet system.

### Presentation

To the USAF Academy AWC Seminar on Soviet Political and Military Elements of Power, September 1976.

#### 17. Soviet and NATO Capabilities

Principal Investigators: Col Ervin J. Rokke and Maj John R. Desiderio, Jr., Department of Political Science and Philosophy

The presentation highlighted political and military elements of the NATO/Warsaw Pact balance and included discussion and commentary with the foreign officers attending the course.

### Presentation

To the NATO Air Intelligence Staff Officer Course at Lowry AFB, Colorado, 28 January 1977.

#### 18. SALT and Arms Control

Principal Investigator: Maj John R. Desiderio, Jr., Department of Political Science and Philosophy

The presentation focused on the historical perspective, substantive issues, and future prospects for meaningful arms control between the US and the USSR.



### Presentation

To the Armed Forces Air Intelligence Officer class at Lowry AFB, Colorado, 30 March 1977.

#### 19. The Organization of Defense Policy

Principal Investigator: Maj John R. Desiderio, Jr., Department of Political Science and Philosophy

This chapter introduction provided a synopsis and critique of the articles in the chapter dealing with such issue areas as the organization of DOD, the Planning, Programming, and Budgeting System, and the major organizational actors in the defense policy-making arena. It highlighted the interaction of defense organization with other aspects of defense policy presented in the book.

### Publication

To be published as a chapter introduction in the forthcoming 4th Edition of American Defense Policy.

#### H. Department of Mathematical Sciences

##### 1. Computer Graphics for Math Classrooms

Principal Investigators: Captains John J. Warner and John D. Maybee

Sponsored by the Department of Mathematical Sciences, USAFA

This research involves locally produced computer graphics imagery for use in the mathematics classroom. The objective is to be able to produce new graphs, video tape or film pertaining to many topics. This project originated as an exploration of the possibilities for locally generated computer imagery. The Academy has two GT-40/PDP 11-05 graphics terminals available. These terminals tie into the Burroughs B-6700 computer. Some investigation was completed during the Fall, 1976 semester, but the large part of the programs were written during the Spring, 1977. To date, programs for the creation of hard-copy plots of the following types of images are available:

AD-A043 838

AIR FORCE ACADEMY COLO  
ANNUAL RESEARCH PROGRESS REPORT NUMBER 12 COVERING PERIOD 1 JUL--ETC(U)  
JUL 77

F/G 5/1  
JUL--ETC(U)

UNCLASSIFIED

NL

2 of 2  
ADA043838



END  
DATE  
FILMED  
9-77  
DDC

- a. Complex functions
- b. Functions of one variable
- c. Sequences
- d. Space curves
- e. Polar coordinates and functions described in polar coordinates
- f. Differential equation approximations by linear methods
- g. Quadric surfaces and other three dimensional surfaces
- h. Three dimensional surfaces expressed in spherical coordinates

The three dimensional surfaces may be rotated or translated as desired to obtain a particular perspective.

## 2. A Personalized System of Instruction in Core Mathematics

Principal Investigators: Lt Col Jerome A. Michel and Maj Jeffrey E. Schofield, DFMS, USAFA and Capt Samuel B. Thompson, University of Colorado, Boulder

Sponsored by the Department of Mathematical Sciences, USAFA

The objective of this research is to improve the content, the teaching, and most importantly the learning of core mathematics at the USAF Academy. The project began in Spring of 1976 with a feasibility study of an individualized course in basic calculus at the USAF Academy. In April 1976 work was begun on the analysis of development of content and the materials for a three section pilot course in freshman calculus. The course was offered to approximately 60 students in the mid-August to mid-October time period. During the pilot course data was collected concerning student achievement, attitude, and effort. January 1977, the

researchers began to evaluate this data to determine the effects of individualization on the students as a group and to refine course policies, structure, and materials for future use in a large scale comparison of instructional methods. At present work is continuing in the areas of student instructional materials, and instructor training program, and course management procedures for use during the 1977 Fall semester. Investigation of the benefits, costs, and efficiency of a personalized system of calculus instruction will proceed throughout the coming academic year.

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

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

##### 1. Research Support for the NAVSTAR Global Positioning System (GPS)

Principal Investigators: Project Officer, Maj Thomas J. Eller. Majors Kenneth D. Kopke, Roger P. Neeland, Richard C. Walsh, Leonard R. Kruczynski, and Jackson R. Ferguson, Jr.; Captains Paul F. Torrey, George T. Kroncke, Craig A. Baer, and Ronald P. Fuchs

Sponsored by GPS Joint Program Office (SAMSO/YE)

The Department of Astronautics and Computer Science is supporting the Global Positioning System Program by performing varied research as requested by SAMSO/YEE. Honeywell Systems Research, Inc, and USAFA/DFACS are jointly performing an independent verification of the Rockwell International design for the NDS satellite. The following particular topics have been researched by DFACS personnel.

##### a. NDS Mass Properties and Alignment Verification

Principal Investigators: Capt Baer and Maj Eller

##### b. GPS Magnetic Momentum Dumping Feasibility Study

Principal Investigators: Capt Fuchs and Maj Eller

##### Presentation

Presentation on this topic by Major Eller at the Flight Dynamics/Estimation Theory Symposium, Goddard Space Flight Center, Greenbelt MD, 27-28 Oct 1976.

##### Publication

USAFA report on this topic.

##### c. GPS Magnetic Momentum Dumping Control Program

Principal Investigators: Captains Fuchs and Kroncke

The Global Positioning System requires precise ephemeris data. A primary cause of ephemeris errors is the RCS momentum dumping. This research formulated a ground based system to achieve magnetic momentum dumping.

An algorithm for determining the settings for residual field balancing magnets has been devised. Constraints are:

- (1) Only two magnets are available;
- (2) Switches occur within sight of a ground station; and
- (3) Commands cannot be stored on the spacecraft.

The method developed requires changes in the magnets either three or four times in a day occurring at zero degrees, 90 degrees, 180 degrees, and 360 degrees in argument of latitude. Results indicate that the expected momentum buildup can always be dumped magnetically.

d. GPS Constellation Studies

Principal Investigators: Capt Kroncke and CIC Pampel

Associate Investigator: Maj Ferguson

This research was to find a satellite constellation which gives improved earth coverage over the baseline GPS constellation. Simulations were run determining the coverage for about 30 constellations. The coverage was compared against that for the baseline constellation. The comparison was made on:

- (1) fewest number of satellites ever seen;
- (2) percent of the time that the minimum was seen;
- (3) location of the smallest minimums;

- (4) percent of the earth's surface which sees each of the minimums; and
- (5) average number of satellites seen at different locations.

The result was a satellite constellation which gives improved coverage and uses fewer satellites.

e. GPS Satellite Selection Criteria

Principal Investigator: Maj Kopke

Baseline user software proposed by the contractor will require numerous matrix inversions to select the best satellite signals to receive for a given navigation solution. Major Kopke developed a method that requires no matrix inversion, resulting in large savings in computer time for GPS users.

f. Independent Stability and Control Analysis for the Navigation Demonstration Satellite - 1 of the GPS

Principal Investigators: Maj Neeland and Capt Torrey

During the last year, work has been done simulating and studying the nutational characteristics of the GPS satellite during de-spin operations. More recently, the major effort has been concentrated on a study of the noise characteristics of the earth sensor and their effect on system operation.

Publication

GPS Spin Phase Dynamics and Spin Down Analysis, USAFA TR-76-20.

g. GPS User Navigation During the Limited Operational Capability Phase (Phase II)

Principal Investigator: Maj Kruczynski

During Phase II GPS, a user will not usually see four satellites as desired for accurate three-dimensional positioning. This research investigates the performance characteristics of various algorithms during the Phase II time period. The user is assumed to be a cargo-type aircraft with inexpensive GPS equipment and with a barometric altimeter.

#### Presentations

Navigation with the NAVSTAR Global Positioning System, presented by Major Kruczynski and Dr. Byron D. Tapley, The University of Texas at Austin, at the Flight Dynamics/Estimation Theory Symposium, Goddard Space Flight Center, Greenbelt MD, 27-28 Oct 1976.

Aircraft Navigation with the Limited Operational Phase of the NAVSTAR Global Positioning System, presented by Major Kruczynski at the National Aerospace Meeting of the Institute of Navigation, Denver CO, 13-14 April 1977.

h. Analysis of GPS Interface with the Satellite Control Facility at Sunnyvale CA

Principal Investigator: Maj Walsh

i. GPS Ephemeris Generation and Phase I Launch Window Constraints

Principal Investigator: Maj Ferguson

Computer study for SAMSO to improve chance of a successful launch on any given day.

## 2. Air-to-Air Fire Control Research

a. Laboratory Test of the ASCOT Electro-optical Tracker Aided by a Digital Estimator

Principal Investigators: Lt Col Edward J. Bauman, Majors Anthony L. Leatham and Roger P. Neeland, Department of Astronautics and Computer Science



Associate Investigators: Captains Robert J. Kirkpatrick and Robert H. Toews, Department of Astronautics and Computer Science, and Lieutenants Murray E. Daniels and Richard B. Mintz

The digital six-state estimator developed earlier here for the Bendix ASCOT (Adaptive Scan Optical Tracker) was implemented on a ROLM 1664 airborne minicomputer. Interfaces and control logic for this computer, which will be used in airborne tests of the aide tracker/Director gunsight, were developed in conjunction with Bendix personnel and a consultant, Dr. Charles Fosha. Using the computer, it was possible to estimate target position and aid the ASCOT in tracking through regions of high optical clutter.

An extensive two-dimensional air-to-air simulation was developed to determine accuracies of the filter/ASCOT combination to be expected in actual airborne testing. Various parameter sensitivity studies were performed.

This concept of aided tracking with the ASCOT has now been verified and the Air Force Avionics Laboratory has awarded a large commercial contract to further test this equipment in an F-106 aircraft at Tyndall AFB, FL.

#### Presentations

Aided-ASCOT Tracking-for-Director-Gunsight-Applications, presented by Major Leatham to the Air Force Air-to-Air Fire Control Review, USAF Academy CO, 20-22 Oct 1976.

ASCOT Tracker Capabilities in a Director Flight Test, presented by Major Neeland to Bidders' Meeting for DEFTI (Director Evaluation Flight Test), Tyndall AFB, FL, 31 Jan - 1 Feb 1977.

Final Report on Laboratory Test of ASCOT Tracker, presented by Major Leatham, Dr. Fosha and Major Neeland to Air Force Avionics Laboratory, Wright-Patterson AFB, OH, 16 May 1977.

On Understanding the Director Gunsight System, Part II, presented by Lt Col Bauman to the Air-to-Air Fire Control Review, USAF Academy CO, 20-22 Oct 1976.

Publication

The ASCOT Electro-optical Sensor Employed as a Line-of-Sight Tracker with a Digital Estimator in Air-to-Air Engagements, Charles L. Fosha, Anthony L. Leatham, and Roger P. Neeland, pending publication as USAFA TR.

b. Incorporation of Software for Air Combat Simulator into the PDP-11/45

Principal Investigators: Maj John W. Moore and Capt David A. Willett

Associate Investigators: Captains Ronald P. Fuchs and Robert J. Kirkpatrick, and Cadets Kelly and Peterson

The investigators modified the digital one-on-one aircraft simulation program for use with the optimal compiler of the PDP-11/45, F. J. Seiler Research Laboratory. This program can now be downloaded for real-time simulation to the Astro PDP-11/45. Testing of this simulation is complete. In conjunction with parallel gunsight research and cadet projects in Astro 395, the investigators also aided in the development and incorporation into the basic aircraft simulation of various fire control and visual display subroutines--director gunsight, tracer gunsight, trainable gun, improved horizon display, and display of energy-maneuverability variables. Captain Douglas H. Kirkpatrick is understudying to become proficient in the testing and operation of the air combat simulator.

3. Epoch when a given sun elevation angle will exist at any specified site on earth

Principal Investigators: Maj Thomas J. Eller, Captains Ronald P. Fuchs and George T. Kroncke

Work performed for the 9th Strategic Recon Wing,  
Beale AFB, CA

Computer program written to determine the time of day when  
a specified sun elevation angle will occur at a specified target.

4. Interplanetary navigation in presence of random thrust  
errors for solar electric propulsion spacecraft using photon  
counting star trackers

Principal Investigators: Cadet Mark Shackelford, Capt Robert  
Asher, FJSRL, and Maj Thomas J. Eller

Digital computer simulation of spacecraft enroute from  
Earth to the asteroid Eros. New theory by Captain Asher to do optimal  
state estimation using mixed observables based on additive white  
noise, Doppler, and doubly stochastic process photon counting star  
trackers.

Publication

Paper accepted for presentation at AIAA Guidance and Control Conference,  
August 1977.

B. Department of Mathematical Sciences

1. Feasibility Study on the Simulator for Air-to-Air  
Combat (SAAC)

Principal Investigators: Majors Robert A. Rappold and Roy R.  
Kilgore, and Capt Joseph B. Williams

Sponsored by Tactical Fighter Weapons Center, TAC

The purpose of the research effort was to demonstrate the  
feasibility of incorporating dissimilar aircraft characteristics into  
the SAAC System. The research project started as a joint effort between  
the Astronautics and Computer Science, Aeronautics, and Mathematical

Sciences Departments on 17 October 1975. Due to personnel reassignment and workload participation, the research effort became solely managed and executed in the Mathematical Sciences Department during the Summer of 1976. The research effort has resulted in a training device directly funded by and programmed through the Tactical Fighter Weapons Center (TFWC) at Nellis AFB. The output of the research effort is a computer simulation package permitting air-to-air engagement of an F-4E and a threat aircraft. TAC is currently rotating F-4 crews through Luke AFB for a weeks training on the simulator. In addition to providing a cost effective training device, the developed simulation package affords the potential to examine/develop tactical air engagement doctrine.

## 2. Boundary Layer Acoustic Monitor (B.L.A.M.) Calibration

Principal Investigator: Capt Joseph B. Williams

Sponsored by SAMSO, AFLC

15 The B.L.A.M. is being used on current re-entry vehicles. At present, there is only a small data base for reducing the telemetry data. The current research, sponsored by SAMSO, will provide additional data on the transducer response. The calibration will take place in the USAFA tri-sonic wind tunnel. Tests will be made in the Mach 3 to Mach 4 range. Initial test will be made with the transducers mounted on a flat plate wind tunnel model. A flat plate model instrumented with heat transfer transducers was used to determine if transition would occur within the first six inches of model length. Qualitatively, the data indicated transition occurring between 4 to 8 inches from the leading edge. This work was completed in the fall of 1976.

#### IV. MANPOWER, PROCUREMENT AND LOGISTICS STUDIES

##### A. Department of Economics, Geography and Management

###### 1. Forecasting Wage Escalation at Arnold Engineering and Development Center (AEDC)

Principal Investigator: Maj William J. Weida, Department of Economics, Geography and Management

Associate Investigators: Lt John J. Crowley and Lt Arthur L. George, Department of Economics, Geography and Management

An investigation into a number of alternative wage forecasting models revealed that GNP was the best predictor of future wage rates at AEDC. The GNP model, with high and low estimates of FY 77 and FY 78 GNP figures, was then used to provide wage escalation figures for the three categories of labor at AEDC.

###### Publication

USAFA-TN-76-2, USAF Academy Technical Note, November 1976

###### 2. An Expenditure Pattern Evaluation of Alternates T, L, & J

Principal Investigator: Maj William J. Weida, Department of Economics, Geography and Management

The research analyzes the validity of three contractor proposals for the construction of a major weapon system component.

###### 3. A Parametric Model for Nuclear Warhead Costs

Principal Investigator: Maj William J. Weida, Department of Economics, Geography and Management

This model establishes a first cut at incorporating the various factors which make up nuclear warhead costs.

###### Publication

USAFA-TN-77-3, USAF Academy Technical Note, May 1977

4. A General Technique for R&D Cost Forecasting

Principal Investigator: Maj William J. Weida, Department of Economics, Geography and Management

Presentation

DOD Cost Symposium, 14 November 1976

5. An Econometric Study of Aerial Interdiction in Southern Laos, 10 October 1970-30 June 1971

Principal Investigator: Maj Gregory G. Hildebrandt, Department of Economics, Geography and Management

Associate Investigators: Col Herman L. Gilster, Office of the Assistant Secretary of Defense, Col Richard D. Duckworth, National Defense University

The basic tools of economic analysis are used to evaluate the effectiveness of air resources employed in southern Laos from 10 October 1970-30 October 1971. The primary objective of the campaign--to reduce the amount of enemy supplies reaching South Vietnam and Cambodia--is used as the basic measure of strike sortie effectiveness. Southeast Asia variable cost factors are derived and used in conjunction with production functions estimated by the technique of regression analysis to derive optimal cost-effective sortie allocations. These allocations highlight the role of the gunship team in the interdiction effort and indicate fewer strike sorties against the enemy road network could have been flown. Given the strike resources available, however, the variable cost of tactical air sorties actually flown was within five percent of the estimated least-cost optimum.

Publication

USAF-TR-77-4, USAF Academy Technical Report, May 1977

## 6. Performance Incentives Versus Prices Versus Quantities

Principal Investigator: Maj Gregory G. Hildebrandt, Department of Economics, Geography and Management

Associate Investigator: Laura D'Andrea Tyson, Asst. Professor, Princeton University

There is an analysis of the degree to which performance incentives, prices, or prescribed quantities achieve allocative efficiency. When one good is being controlled, it is proved that a performance incentive function can be constructed which achieves the center's objective and yet which does not require any knowledge by the center of the producer's cost function. The second-best solution achieved with performance incentives when more than one good is being controlled is also discussed.

### Publication

USAFA-TR-76-23, USAF Academy Technical Report, December 1976

## 7. The U.S. Versus the Soviet Incentive Models

Principal Investigator: Maj Gregory G. Hildebrandt, Department of Economics, Geography and Management

There is a discussion and analysis of the actual use of performance incentives in the Soviet Union and the United States. The Soviets have recently introduced an incentive program to motivate state enterprises to select the socially optimal output level and this system is compared with the use of performance incentives by the U.S. government to reward private producers in accordance with cost and performance outcomes. It is also shown that the U.S. incentive system can be extended to solve the target output selection problem.

### Presentation

Fifth Annual Department of Defense Procurement Research Symposium at the

Naval Postgraduate School on 18 December 1976.

Publication

USAFA-TR-76-21, USAF Academy Technical Report, December 1976 and the Proceedings of the Fifth Annual Department of Defense Procurement Research Symposium at the Naval Postgraduate School, 17-19 November 1976.

8. The Use of Statistical Sampling in Contract Pricing

Principal Investigator: Lt Col F. Theodore Helmer, Department of Economics, Geography and Management

Associate Investigator: Capt Harry Utter

This report provides the reader with the results of a study on the use of statistical sampling techniques on pricing cases in one Air Force Plant Representatives Office (AFPRO). The study reveals that 38% of the AFPRO pricing workload is devoted to 1-1/2% of the contractual dollars and that 77% of the workload is devoted to 11% of the dollars proposed. This study was undertaken to help the AFPROs concentrate their skilled manpower on the large dollar proposals by using statistical sampling on backlog proposals under \$100,000. Data was collected at one AFPRO for all pricing cases for a three-year period, and sampling variations (sample sizes, dollar magnitude, etc.) were tested to determine the feasibility of the concept and the appropriate sample size and dollar limitations. The report concludes that for the subject AFPRO, using 25% sample size of backlogged cases less than \$100,000, the analyst can be highly confident that the average percentage reduction recommended for the sample does not statistically differ from the reduction with 100% pricing. Additional data were collected to test the 25%, \$100,000 conclu-



sion, prove to be invaluable for AFPRO and Defense Contract Administrative Services (DCAS) offices doing repetitive pricing from the same contractor under backlog conditions.

Publication

USAF-TR-76-17, USAF Academy Technical Report, August 1976.

9. A Search for a Set of Performance Criteria for Use in a Government Internal Audit Management Control System (PhD dissertation)

Principal Investigator: Maj Leonard E. Berry, Department of Economics, Geography and Management

The research postulates a Management Control Model for a government internal audit organization. It then presents a methodology and empirical data that develops quantitative and qualitative criteria for use in evaluating audit performance within the postulated management control system. The research actually develops a set of criteria that could be used by an audit organization in federal, state or local government.

10. Accounting Power, The Political Element and the Cost Accounting Standards Board

Principal Investigator: Maj Leonard E. Berry, Department of Economics, Geography and Management

The article discussed the concepts of power and politics in setting accounting standards in the public and private sector. It also argued that the establishment of the Cost Accounting Standards Board was an exercise of political power in the public sector and showed the impact of this on setting standards in the private sector.

Publication

Government Accountable Journal, Summer Issue, 1976.

11. Study of Free Assets

Principal Investigator: Capt James B. Streets, Department of Economics, Geography and Management

Presentation

HQ USAF/ACB, 23 July 1976

12. Performance Incentives and Planning Under Uncertainty

Principal Investigator: Maj Gregory G. Hildebrandt, Department of Economics, Geography and Management

Associate Investigator: Professor Laura D'Andrea Tyson, Department of Economics, Princeton University

The use of the performance incentive function by planning organizations when there is subjective or objective uncertainty is discussed. It is proved that a performance incentive function can be constructed which achieves both allocational and distributional optimality, when there is subjective uncertainty about the conditions of production and both the center and the producer are risk averse. When there is objective uncertainty, however, it is shown that it is not, in general, possible for the center to achieve these two objectives simultaneously.

Publication

USAFA-TR-76-16, USAF Academy Technical Report, September 1976

13. Games Contractor's Play

Principal Investigator: Lt Col F. Theodore Helmer, Department of Economics, Geography and Management

The understandable objective of industry is to provide income to employees for the longest period possible and to make a long-run profit. As a result, contractors dealing with the Air Force are playing a number of "games" to obtain these objectives. This talk addressed many of these games that arise, and how to recognize and handle these situations.

#### Presentation

Denver Chapter, National Purchasing Management Association, 21 October 1976

#### 14. You, Your Job and Your Future

Principal Investigator: Maj Robert L. Taylor, Department of Economics, Geography and Management

A management Workshop for Secretaries

#### Presentation

USAF Academy, 17 March 1976, 24 May 1976, and 10 September 1976

#### 15. Calculating the Cost of a Civilian Public College Education

Principal Investigator: Maj G. Knight Boyer, Department of Economics, Geography and Management

How much civilian public education costs cannot be obtained directly. Thus, it is necessary to arrive at estimates based upon propositions and average expenditure figures. Estimates were made of student man-year costs which could utilize figures for civilian colleges' full-time equivalent students. For the year 1974-75, an estimate of \$7,076 per year for public college students can be compared with the USAFA Comptroller's estimate of \$21,216 per student.

#### Publication

USAFA-TN-76-1, USAF Academy Technical Note, November 1976

16. An Economic Investigation of Expected Returns Across Occupations in the U.S. Non-Supervisory Labor Force (PhD dissertation)

Principal Investigator: Lt Col Leslie G. Denend, Department of Economics, Geography and Management

In our society where markets exist, generally risk is not borne without compensation. This proposition is substantiated for 65 broad occupational categories in the non-supervisory U.S. labor force. Tests are performed using BLS and census data. After controlling for education and experience, the relative uncertainty of future earnings does make a difference in expected earnings. Implications for public sector earnings based on comparability are explored.

17. The Critical Link

Principal Investigators: Maj Robert L. Taylor, Department of Economics, Geography and Management; Lt Col F. Theodore Helmer, Department of Economics, Geography and Management; and Capt Thomas J. Salmon, Department of Economics, Geography and Management

A Supervisors' Personnel Management Responsibilities Workshop

Presentation

USAF Academy, 30 September-1 October 1976

18. Organization Theory: A Conceptualization

Principal Investigators: Maj Robert L. Taylor, Department of Economics, Geography and Management and Michael J. O'Connell, USAF Academy

Presentation

Eighteenth Annual Mountain-Plains Management Conference, Boise, Idaho, 14-16 October 1976

B. Department of Mathematical Sciences

Aircraft Modification Study

Principal Investigator: Maj Charles R. Mitchell

Sponsored by AF Acquisition Logistics Division, AFLC

The purpose of this research is to model the change in performance resulting from an aircraft modification designed for reliability improvement (RI). The evaluation of reliability improvement warranty (RIW) options on the F-16 program pointed out a major deficiency related to predicting RI. The potential value to the Air Force of RIW depends to a great degree on the contractor's willingness to invest in equipment modifications to achieve improved reliability. There appears to be very little data to support the estimating methods. Aside from this specific application, the Air Force spends millions of dollars per year on RI modifications and it is of paramount importance to determine the true effects of these actions. Surprisingly, no program exists to systematically verify the need for or the effect of an RI equipment modification. This research should be of interest to reliability engineers and maintenance planners throughout the military and industry.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER Progress Report #12 ✓	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Annual Research Progress Report #12	5. TYPE OF REPORT & PERIOD COVERED Final, 1 Jul 76 - 30 Jun 77	
	6. PERFORMING ORG. REPORT NUMBER	
7. AUTHOR(s) Members of the Faculty and Staff of the United States Air Force Academy	8. CONTRACT OR GRANT NUMBER(s)	
9. PERFORMING ORGANIZATION NAME AND ADDRESS Faculty Secretariat (DFSS) USAF Academy, Colorado 80840 ✓	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS	
11. CONTROLLING OFFICE NAME AND ADDRESS	12. REPORT DATE 1977	
	13. NUMBER OF PAGES xiii + 102	
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15. SECURITY CLASS. (of this report) UNCLASSIFIED	
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE	
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This is the sixth published Annual Research Progress Report; the editions previous to 1972 were published as Semi-Annual Progress Reports. Further information desired on any project may be obtained by writing to the department listed for the principal investigator, USAF Academy, Colorado 80840.		

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)