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Annual Research Progress Report No. 12

July 1977



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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

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 ³).	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.	USAF A 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, 1968-1972	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 or 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

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) ¹⁴C-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 ¹⁴C activity to be equivalent to 430 ppt TCDD in the plant tissue. Sufficient residue was not available to characterize the ¹⁴C-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/LO

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. 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

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 km² 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