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RESEARCH PROJECT INITIATION

Date: 12 September 1972

Project Title: Georgia Tech Air Quality Control Training Program

Project No: E-19-509

Principal Investigator: Dr. Clyde Orr

Sponsor: Public Health Service

Agreement Period: From July 1, 1971 Until June 30, 1973

Type Agreement: Grant No. 5 T01 AP00086-02 - (New Number) - No. T 960499

Amount: \$262,036

Reports Required: Interim Progress Report with application for continuation.

Sponsor Contact Person (s): Robert N. Parrette, Acting Chief
Extramural Programs Branch
Office of Manpower Development
Office of Air Programs
Public Health Service
Bethesda, Maryland 20014

NOTE: This project is more than halfway through its period of performance. This initiation sheet is being issued to establish a project file in the Office of Research Administration.

Assigned to: School of Chemical Engineering

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RESEARCH PROJECT TERMINATION

Date: June 12, 1975

Project Title: Georgia Tech Air Quality Control Training Program

Project No: E-19-509

GRANT

Principal Investigator: Dr. Clyde Orr, Jr.

Sponsor: Environmental Protection Agency

Effective Termination Date: 12/31/74

Clearance of Accounting Charges: 12/31/74

Continued as E-19-546

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PROGRESS REPORT

The Air Quality Control Training Program at Georgia Tech has experienced rapid growth in number of student participants over the past two years, and has provided a significant number of trainee graduates for professional employment with federal and state air pollution control agencies.

The program found acceptance among a much greater number of students than those supported by stipends; to show that the program has a broader impact than would be reflected by the stipend supported trainees only, names of students who were enrolled in the training courses and who are now engaged in air quality control related employment are included in Table 1.

By bringing students together from a variety of disciplines the courses succeeded in providing a representation of the several viewpoints from which the problems associated with air pollution are approached. The students were motivated both through assignments and joint projects to present, orally, their findings on specific term projects. This served to give the engineers a better understanding of how the biologist, chemist, or physicist looks at a problem and vice versa.

A description of the courses offered in the Air Quality Training Program is presented in Table 2, and enrollments are given in Table 3.

The classes attended pertinent lectures at Georgia Tech and in the Atlanta Area presented by prominent invited speakers on air pollution related topics. Table 4 lists speakers and topics presented over the past two years.

A strong effort was made throughout the courses of instruction to put the material on as practical a basis as possible. Stack sampling equipment was displayed and demonstrated, and particle size analyses were performed on actual locally discharged pollutants. Training aids obtained from APCO such as handbooks, workbooks, pamphlets, slides, and films were integrated into the training program and utilized whenever practicable.

TABLE 1

Former Students who Completed Air Quality Training in Two or More Program Courses and are now Engaged in Air Quality or Air Pollution Related Work.

<u>Name</u>	<u>Degree Earned</u>	<u>Affiliation</u>
Baskerville, Jesse*	M.S., Chem.	EPA, Office of Air Programs Region IV, Atlanta
Busbee, W. L. (Capt.)	M.S., Ch.E.	U. S. Army, Newport Army Depot Newport, Indiana
Church, J. C.*	None	State of Georgia, Air Quality Control
Collins, F. A.*	M.S., I.E.	EPA, Office of Air Programs Research Triangle Park
Fletcher, J. R.	None	Fulton County (Georgia) Air Quality Control
Lowry, M. M.	M.S., C.E.	State of Georgia Air Quality Control
Miller, N. C.	M.S., C.E.	City of Philadelphia, Air Quality Management
Neal, R. C.*	M.S., Biol.	EPA, Office of Air Programs Research Triangle Park
Pyles, H. E.	M.S., C.E.	State of Georgia, Dept. of Public Health
Sedman, C. B.	M.S., Ch.E.	EPA, Office of Air Programs Research Triangle Park
Segars, Roy A.	M.S., Ch.E.	EPA, Office of Air Programs Region IV, Atlanta
Stringer, H. L. (Capt.)	M. S., Ch.E.	Rocky Mt. Arsenal, U.S. Army Denver, Colorado
Tice, J. J.*	M.S., Chem.	Monsanto Chemical Co. Air Quality Control

*Supported by EPA Training Grant AP-00086-01/02.

TABLE 2

COURSES OFFERED BY THE GEORGIA TECH AIR QUALITY CONTROL TRAINING STAFF

1. Chemical Engineering 610, Aerosol Technology (3credits) (Dr. Matteson)

The purpose of this course is to present basic concepts describing the behavior of dispersed particles, both natural and man-made, in air. Topics covered include the formation of aerosols by condensation and dispersion techniques; particle size analyses; diffusion, coagulation and settling; kinetics and dynamics of small particles; collection and sampling via filtration, precipitation and elutriation; electrostatic and optical properties; and lung deposition.

2. Chemical Engineering 611, Industrial Emissions, (3 credits) (Dr. Burson, Dr. Matteson, Dr. Orr)

Analysis of air pollution sources and their control by substitution and process change is stressed. Recovery and utilization of waste gaseous and particulate matter is also covered. Control technology and equipment to be discussed includes scrubbing, filtration, precipitation absorption, adsorption and catalytic conversion methods. Low cost equipment for small industry is also considered.

3. Chemical Engineering 612, Atmospheric Reactions, (3 credits) (Dr. Matteson)

The principles of atmospheric reactions, including primary and derived air pollutants, atmospheric assimilation and removal, formation of intermediate reaction products and free radicals, photochemical and photosensitized reactions, heterogeneous reactions, and air ions are covered. Reactions of specific air pollutants--SO₂, NO_x and organics--are stressed.

4. Chemical Engineering 613, Particle Technology, (3 credits) (Dr. Orr)

A study of the characteristics and behavior of fine particles constitutes the essence of this course. Emphasis is placed upon the methods of particle size measurement; packing arrangements and resistance to flow of fluids; physical, chemical, and surface properties as related to problems of chemical engineering; and applications of fluidization, absorption, and catalytic phenomena.

5. Aerospace Engineering 606A, Air Pollution Meteorology, (3 credits) (Dr. Justus)

The principal aspects of meteorology as they pertain to the emission, diffusion, and dispersion of air pollutants are discussed. Mathematical methods are presented to predict plume characteristics and fallout as a function of meteorological and topographical parameters. Meteorological data gathering and sampling procedures are demonstrated as they pertain to stack design and site location.

TABLE 2, CONT'D.

6. Chemistry 613, Analysis of Atmospheric Contaminants, (3 credits)
(Professor Sturrock)

This course is intended to acquaint the student with modern analytical techniques and instrumental methods. It includes applications involving the measurement of air contaminants. Topics include volumetric and titration techniques; solvent extraction; UV, IR and visible spectrophotometry; spectrofluorimetry and nephelometry; emission spectroscopy and flame emission; atomic adsorption and mass spectrometry; ESR and NMR; X-Ray methods; radiochemical techniques; chromatography; and electrochemical methods.

7. Biology 635, Air Pollution Biology, (3 credits) (Professor Kethley)

This is a course designed to acquaint engineers and scientists with the biological aspects of air pollution. Air pollution is considered as one factor in the total environment of living systems. Animals and plants are examined as receptors of air contaminants, as indicators of the effects of air pollution, and also as sources of air pollution. Airborne microorganisms are considered as air pollutants and their sources, distribution, and effects are examined.

8. Civil Engineering 653, Air Pollution, Measurements and Control, (4 credits)
(Professor King)

Analyzed are the air pollution problems of cities and industries; methods of evaluating the problems; the description, design and use of air sampling equipment; and methods for control of air pollutants.

TABLE 3

Course Offerings in the Air Quality Training Program for Academic Year 1970/71 and 1971/72 with Total Enrollments.

<u>Course</u>	<u>Enrollment</u>	
	1971/72	1970/71
Fall Ch.E. 610 Aerosol Technology	21	17
C.E. 652 Air Pollution, Measurements and Control	28	15
C.E. 746 Seminar, Sanitary Eng.	31	44
Winter Ch.E. 611 Industrial Emissions Control	18	19
Ch.E. 612 Atmospheric Chemical Rxns.	11	23
Ch.E. 613 Particle Technology	10	10
A.E. 606A Air Pollution Meteorology	13	--
C.E. 746 Seminar, Sanitary Eng.	23	35
Spring Ch.E. 610 Aerosol Technology	5	7
Chem. 613 Analysis of Atmospheric Contaminants	11	13
Biol. 635 Air Pollution Biology	23	18
C.E. 746 Seminar, Sanitary Eng.	23	19
CH.E. 611 Industrial Emissions Control	18	8
Summer C.E. 652 Air Pollution, Measurements and Control	13	--
	248	228
TOTAL		

TABLE 4

INVITED SPEAKERS ON ENVIRONMENTAL AIR QUALITY

<u>Speaker/Affiliation</u>	<u>Topic</u>
Dr. Raphael B. Levine, Director Metropolitan Atlanta Council on Health	Population Growth and the Environment
Dr. Gene Willeke, Assoc. Professor Environmental Resources Center, Georgia Institute of Technology	Effects of Perceived Pollution on Recreational Participation
Mr. R. E. Stiemke, Office of Comprehensive Health Planning, Georgia Dept. of Public Health	Land, Air and Water Pollution-- Their Magnitude and Effect
Dr. E. P. Odum, Director Institute of Ecology, University of Georgia, Athens, Georgia	The Theory of the Ecological System to Pollution
Dr. B. C. Dysart, III, Assoc. Professor Environmental Systems Engineering, Clemson University	A Systems Approach to Pollution Control Planning
Mr. Robert H. Collom, Jr., Director Air Pollution Control Branch, Georgia Department of Public Health Atlanta	Air Pollution--Its Cause and Correction
Dr. Othmar Preining Experimental Physics Laboratory University of Vienna, Austria	Developments in Aerosol Physics at the University of Vienna
Dr. Kenneth T. Whitby Mechanical Engineering University of Minnesota	Analysis of Atmospheric Particulates in the Los Angeles Area
Dr. James R. Brock Chemical Engineering University of Texas	Bimodal Distribution of Atmospheric Aerosols
Dr. W. P. Bebbington E. I. DuPont Savannah River Laboratory Aiken, South Carolina	Effects on the Environment from the Operation of a Complex Nuclear Facility

TABLE 4, CONT'D.

<u>Speaker/Affiliation</u>	<u>Topic</u>
Dr. V. A. Mohnen Atmospheric Sciences Research Laboratory SUNY, Albany, New York	Air Chemistry and Atmospheric Reactions
Dr. Helmut Horvath University of Vienna	Light Scattering by Aerosols

RECRUITMENT OF QUALIFIED STUDENTS

A brochure has been printed and distributed nationally to Universities and Colleges with engineering and science programs describing the Georgia Tech Air Quality Training Program, qualifications for stipend support, and the procedure for enrollment in the program. Since the inception of the program, we have had over one hundred inquiries from outside the State of Georgia and well over two hundred from within. As concern for environmental quality grows this number is expected to increase.

Students at Georgia Tech, Atlanta University, Georgia State, and Emory University are informed of the Air Quality Training Program through faculty members involved in interdisciplinary type programs. Lectures are presented at the undergraduate level to incoming freshmen and sophomores on the choice of Air Quality Control as a career. During an "Environmental Concern Week" in the Spring and "Technology Week" in the Winter Quarter, the students are informed of courses and options available in air pollution training. A half-hour interview with Dr. Matteson over WGST, the Georgia Tech operated radio station, explained the details of the then newly initiated training program to citizens in the Atlanta area. Local newspapers have carried articles announcing the formation of the program.

In cooperative research and consultation with the Georgia State Health Department, Fulton and DeKalb County Health Departments, and their respective Air Quality Control branches, people working in the agencies are made aware of the program. Classes are now being planned at George Tech in air quality control so that more people from the local government agencies may participate.

Lectures have been presented to concerned civic groups and professional society meetings describing the program. Emphasis is given to the need for well-trained, competent air quality control engineers and scientists working at the various government agencies, and the availability of this program for training in that area.

TRAINING OF STUDENTS TO MEET MANPOWER REQUIREMENTS IN FEDERAL, STATE, AND
LOCAL AIR QUALITY CONTROL AGENCIES

Several students have registered in the training program to further their background in air pollution control so they may return to their respective agencies better equipped to deal with practical control problems. The following are specifically cited:

Mr. Marvin Lowry has been with the State of Georgia Department of Public Health, Air Pollution Control Service since 1965. After educational leave he became Director of the Air Pollution Control Service upon completion of the training program.

Mr. Holmes Pyles, and industrial hygienist with the State of Georgia Department of Public Health, also on educational leave, returned upon completing the program.

Mr. William Miller was an employee of the City of Philadelphia, Air Management Services, Engineering Division, as a Public Health Engineer since June, 1968, and was promoted to head the Permits and Plans Section for Air Pollution Control Equipment before returning to school. He resumed duties in this area when he completed his M.S. degree in Sanitary Engineering.

Mr. James Fletcher worked with the Air Pollution Control Section of the Fulton County Health Department, conducting basic chemical sampling and analysis and emissions inventories. He plans to apply for employment at the Federal level upon completion of his degree requirements.

Mr. Frank Collins has served in the Commissioned Corps of the U. S. Public Health Service since 1968 at the National Air Pollution Control Administration, Division of Economic Effects Research, where his principal duties included estimation of costs of control equipment for mobile sources of pollution. He has resumed work at the federal level upon completing his M.S. degree in Industrial Engineering.

Several other students in the program have indicated interest in entering a career in the air quality control field and have submitted applications to various agencies.

VISITING SENIOR FOREIGN SCIENTIST .

In 1970 Dr. Matteson and the School of Chemical Engineering at Georgia Tech nominated Professor Othmar Preining of the University of Vienna as a candidate for the National Science Foundation Senior Foreign Scientist Fellowship competition. The purpose of these awards is to bring to the United States foreign scientists whose formal training, teaching, and research experience are of sufficient distinction to enable them to make significant contributions to education and research at American Universities.

Professor Preining is a noted international physicist in the field of aerosols and air pollution research. He was awarded the fellowship and began his visit at Tech in the Fall of 1971. Three graduate students have been working on independent areas of thesis research under Dr. Preining's supervision. Each of these research efforts have already yielded a valuable amount of information relating to:

- a) the density distributions among aerosols formed by condensation
- b) the diffusion properties of submicron aerosols
- c) the design and construction of aerosol centrifuges

Dr. Preining has instructed the Aerosol Technology course both Fall and Spring Quarters. Students from at least six major disciplines were enrolled in these courses including Biology, Physics, Chemistry, Mechanical, Nuclear and Chemical Engineering. The subject matter was well received and many ideas were generated to assist the students in their particular research efforts.

Dr. Preining presented several seminars, not only to the School of Chemical Engineering, but also to the Schools of Physics and Chemistry, to the Biology Department at Atlanta University and to the German Department at Emory University. These topics usually related to air pollution monitoring, aerosol science and technology, and information theory. He has been an invited speaker at several scientific colloquia including the Gordon Conference

on Environmental Research in New Hampton, New Hampshire; the International Nucleation Theory Conference in Atlanta, and the American Physical Society Meeting on Atmospheric Science in Washington, D. C.

STUDENT EXTRA-CURRICULAR ACTIVITIES

Terence R. Binion and William S. Bulpitt participated as contestants from Georgia Tech in the MIT/CALTECH Clean Air Car Race, Summer 1970.

William C. Miller presented a paper at the 64th APCA Meeting in Atlantic City, June 27 - July 1, 1971 entitled "Reduction of Emissions from Gray-Iron Foundry Industries".

Randy S. Swartz will participate in the Urban Vehicle Design Competition, August 1972, in Detroit. He will enter with a natural gas driven rotary engine as developed under the guidance of Dr. Sam Shelton of the Mechanical Engineering Department at Georgia Tech.

TABLE 5

MASTER'S THESES COMPLETED BY TRAINEES

<u>Name</u>	<u>Title</u>
Baskerville, Jesse M.S., Chem.	Adsorption of Atmospheric Trace Gases on Natural Graphite
Boscoe, G. F. M.S., Ch.E.	Density Distributions in Aerosols Formed by Condensation
Bulpitt, W. S. M.S., M.E.	A Comparison Study of the Exhaust Emissions of a Wankel Engine Using Gasoline and Natural Gas as Fuels
Collins, F. A. M.S., I.E.	State Inspection of Automobiles to Monitor the Performance of Exhaust Gas Emission Control Systems
Davis, J. L., Jr. M.S., Physics	Absorption of Sulfur Dioxide by Charged Aqueous Droplets
Dodge, L. G. M.S., Physics	Optical Methods for the Detection of Nitrogen Dioxide as a Pollutant
Fritchman, D. A. M.S., Biol.	A Study of the Lichen Distribution on Selected Trees in Western Metropolitan Atlanta as Influenced by the City Environment
Glass, S. J. M.S., Ch.E.	Ion Enrichment in Aerosols Generated by Bursting Bubbles
Neal, R. A. M.S., Biol.	A Study of the Lichen Distribution on Selected Trees in Eastern Metropolitan Atlanta as Influenced by the City Environment
Pendergrass, L. M.S., Biol.	Myxomycetes from Bark of Living Trees in Panola Mt. State Park -- Environmental Effects
Sandlin, C. W. M.S., Ch.E.	Diffusion of Aerosols at Various Temperatures
Salters, C. R. M. S., Biol.	Distribution of Lichens on Trees Along Transect Lines in the Landing Approach to the Atlanta Airport
Tice, J. J. M.S., Chem.	Trace Analysis of Some Heavy Metals in the Presence of Phosphate and Arsenic

TABLE 6

STUDENTS PRESENTLY TRAINING UNDER AP-00086-03

<u>NAME</u>	<u>DISCIPLINE</u>
Basile, F. J.	M.E.
Blackshaw, A. L.	M.E.
Bock, E. B.	Ch.E.
Boxcoe, G. F.	Ch.E.
Cronk, R. N.	Inf. Comp. Sci.
Dodge, L. G.	Physics
Ellison, T. W.	Ch.E.
Finley, C. W.	Biol.
Fitzpatrick, S.	Biol.
Fortune, M. P.	Chem.
Giardina, P. J.	Ch.E.
Glass, S. J.	Ch.E.
Jones, A.	Biol.
Lewis, L.	Physics
Moore, D. W.	Ch.E.
Patterson, R. A.	Physics
Salters, C. R.	Biol.
Sandlin, C. W.	Ch.E.
Swartz, R. S.	M.E.

TABLE 7

STUDENTS SUPPORTED BY TRAINING GRANT AND AFFILIATED WITH UNIVERSITIES WHICH
ARE MEMBERS OF THE UNITED NEGRO COLLEGE FUND

<u>NAME</u>
Baskerville, J.
Finley, C. W.
Fitzpatrick, S.
Fritchman, D. A.
Jones, A.
Lewis, L.
Neal, R. A.
Pendergrass, L.
Salters, C. R.

STAFF ACTIVITIES

Clyde Orr, Jr., Chemical Engineering

Program Director and Instructor for courses, "Fine Particle Technology" and "Industrial Emissions Control."

Professor Orr is principal investigator on Air Force Project: "Jet Exhaust Reactions: A Theoretical Study"(Contract No. F19628-72-C-0353). His other current research activities include: "Radiation - Induced Particulates from Organic Vapors", "Kinetics Of Crystal Growth Within Supersaturated Droplets", "Diffusion in Particle Sedimentation", and "Aerocolloids from Common Substances in Sunlight". He has presented a course on particle surface area measurement at the Aredon House Conference (Jan. 30 to Feb. 4, 1972) on "Pharmaceutical Micromeritics" sponsored by Columbia University and the Academy of Pharmaceutical Sciences. He will present the paper "Specific Surface Area by Knudsen Flow" at the Engineering Foundation Conference, Vermont Academy, Saxtons River, Vermont, August 20-25, 1972; and will serve as session chairman for the Filtration Symposium at the 73rd National A.I.Ch.E. Meeting, Minneapolis, August 27-30, 1972.

Professor Orr has served on a number of academic and government committees including the Air Pollution Research Grants Advisory Committee of the Environmental Protection Agency and is a member of A.I.Ch.E., (also a program subcommittee chairman); ACS; Fine Particle Society, Sigma Xi, and the Editorial Board of the journal, "Powder Technology", published by Elsevier. His current publications include:

Brock, J.F. and Orr, C., Jr., "Permeametry in the Knudsen-Flow Regime", accepted for publication in Analytical Chemistry.

Orr, C., Jr., "Specialization in Fine Particle Technology", Chem. Eng. Education 5, No.1, 52 (1971).

Orr, C., Jr., and Weaver, E. E., "Sample Extractor", U. S. Patent No. 3, 584, 765, June 15, 1971.

Orr, C., Jr., and Hendrix, W. P., "Apparatus for Collecting Particulate Matter from a Gas Stream", British Patent No. 1, 228, 318, April 15, 1971

Keng, E. Y. H., Chu, R. R. C., Knight, J. A., Jr., and Orr, C., Jr., "Aerosols Produced by X-Rays", J. Coll. Interface Sci. 39, 94 (1972).

Orr, C., Jr., "Solid-Gas Aerosols" accepted for publication in The Encyclopedia of Chemistry, 3rd edition, Van Nostrand Reinhold Co., N.Y.

Michael J. Matteson, Chemical Engineering

Program Co-Director and Instructor for the courses "Aerosol Technology" and "Atmospheric Chemical Reactions."

Dr. Matteson's current research involves:

- a) Absorption of SO_2 and other Gases by Charged Aqueous Droplets
- b) Absorption of SO_2 by Aqueous Solutions of Manganese and Ammonia
- c) Ion Enrichment from Bursting Bubbles
- d) Aerosol Diffusion at Various Temperatures
- e) Density Variations in Aerosols formed by Condensation

Dr. Matteson is presently serving on the executive board of the Southern Section APCA; he is vice-chairman, Atlanta Chapter A.I.Ch.E. and is a member of ACS, AAUP, Fine Particle Society and Sigma Xi.

Dr. Matteson has served as session chairman at the second Annual Pollution Control Conference, University of Tennessee, April, 1972, and will also be a session chairman at the Third Annual Meeting of the Southern Section, Air Pollution Control Association, Atlanta, September 21, 22, 1972. Among meetings attended in the past year were the Gordon Research Conference on Environmental Air Quality, New Hampton, New Hampshire, September 1971, and the International Conference on Nucleation Theory, Atlanta, April, 1972.

Dr. Matteson has presented the following papers during the past year:

"Air Pollution Training in the Southern Section Area", presented at the Second Annual Meeting, Air Pollution Control Association - Southern Section, Chattanooga, Tenn., September 23, 1971.

"Sulfuric Acid Mist Formation in Electrical Fields", presented at the 4th Aerosol Technology Meeting, New York, October 14, 1971.

"Reactions between SO_2 and Atmospheric Aerosols", presented at the 4th Aerosol Technology Meeting, New York, October 15, 1971.

"Ion Enrichment in Aerosols Generated by Bursting Bubbles", Presented at Spring Meeting, American Physical Society, Washington, D. C., 24-27 April, 1972.

"The Corona Discharge Catalysis of Sulfur Dioxide", presented at the 72nd National Meeting, AIChE, St. Louis, Mo. May 21-24, 1972.

Dr. Matteson's recent publications include:

"The Separation of Charge at the Gas-Liquid Interface by Dispersion of Various Electrolyte Solutions", J. Colloid and Interf. Sci., 37, 4, 879-890, (1971)

"Aerosol Size Determination in the Submicron Range by Thermophoresis," Aerosol Science, 3, 45-53, (1972) (with E. Keng)

"Ion Enrichment in Aerosols Generated by Bursting Bubbles", Bull. Am. Phys. Soc., 17, 521 (1972).

"Surface-Electrical Phenomena Associated with Bursting Bubbles in Sea-Water", Proc. 2nd Nat. Coastal and Shallow Water Res. Conf. October, 1971.

"Sulfur Dioxide Control", Vol. 2, Chapter 6, Environmental Engineers' Handbook, Chilton Book Company, Philadelphia, in press.

"Analytical Applications of Filtration", Chapter XII, Filtration -- Principles and Techniques, Marcel Dekker, Inc., New York, in press.

"The Corona Discharge Oxidation of Sulfur Dioxide", Environmental Science and Technology, in press. (with H. Stringer and W. Busbee)

"The Density Distribution of Sodium Chloride Aerosols formed by Condensation", Nature, in press (with O. Preining and J. Fox)

"Environmental Impact Analysis, Atlanta Urban Area Tollway Project - Air Pollution Considerations", Vol. III, State Highway Department of Georgia, December 15, 1971.

Thomas W. Kethley, Biology

Training Program Instructor for the course "Air Pollution Biology".

Professor Kethley's current research activities include "Hospital Air Sanitation with Ultraviolet Lamps" (DHEN, PHS, CDC 1-R01-CC00549-01A1). He also directs a number of M.S. Theses students' research in ventilation systems.

In addition to the graduate level course in air pollution biology, Professor Kethley has presented the undergraduate courses, "Biostatistics" and "Introduction to Air and Water Pollution (74 students enrolled). He has taught the course on Industrial Toxicology at the Southern Technical Institutes series on Occupational Safety and Health.

Professor Kethley's recent publications include:

"Ultraviolet Lamps for Room Air Disinfection, Archives of Environmental Health, (in press).

"Biocontamination of the Air: Sampling Procedures" in Proc. First European Symposium on Contamination Control in Clean Rooms, Stuttgart (1971).

Peter E. Sturrock, Chemistry

Training Program Instructor for the course, "Analysis of Air Pollution Contaminants"

Dr. Sturrock's current research activities include:

- a) Application of a modified form of square-wave polarography to the analysis of water for trace amounts of heavy metals.
- b) Application of the digital computer to electro-chemical instrumentation.
- c) Studies on the rates of chelation reactions using inert reversal chronopotentiometry.
- d) Application of phase selective A.C. polarography to the analysis of heavy metals in suspended airborne particulate matter.

Dr. Sturrock attended the Gordon Research Conference on Electrochemistry, Santa Barbara, January, 1972. He is a member of ACS, Sigma Xi, AAAS, and is secretary of the local chapter of AAUP.

Carl G. Justus, Aerospace Engineering

Training Program Instructor for the course "Air Pollution Meteorology".

Dr. Justus' current research involves the meteorology and dynamics of the lower atmosphere, including turbulence and diffusion. Dr. Justus has consulted with Science, Technology And Research on the development and testing of air pollution emission regulations for the State of Georgia. This work involved the use of the Air Quality Display Model program, a complex multi-source atmospheric diffusion model for simulation of regional scale diffusion from all point and area sources with each Air Quality Control Region. He has also consulted with Systems Instruments Research in connection with U.S. Army sponsored atmospheric research and experiment design for a NASA chemical release atmospheric research program.

He is a member of the American Meteorological Society, the Royal Meteorological Society, the Air Pollution Control Association, the American Geophysical Union, Sigma Xi, and Tau Beta Pi. He serves on the American Meteorological Society national committee on the upper atmosphere.

Dr. Justus' recent publications are:

"Modeling the Anisotropy in Stratified Shear Flow", presented at the Symposium on Air Pollution, Turbulence and Diffusion, Las Cruces, N. M., December 1971 (with J. E. Hicks).

"Latitude Distribution of Irregular Mesospheric Variations", presented at the AGU meeting, San Francisco, December, 1971.

"Diffusion Simulation Results in Stratified Shear Flow", presented at the AMS meeting, New Orleans, January 1972.

"A Numerical Simulation of Nearly Incompressible Stably Stratified Atmospheric Turbulent Diffusion", Georgia Tech Scientific Report NSF Grant GA-29213, September 1971.

"Irregular Atmospheric Variation in the 50-200 Km Region", presented at the AMS meeting, New Orleans, January 1972.

"Atmospheric Pressure, Density, Temperature, and Wind Variations Between 50 and 200 Km", NASA Contract NAS8-26658 Interim Report, January 1972.

"Modification of Wind and Temperature Profiles by Turbulence", presented at the AGU meeting, Washington, D. C., April 1972.

"Tidal Variations of Wind Components and Thermodynamic Variables in the 45 to 60 Km Height Range", presented at the AGU meeting, Washington, D. C., April 1972 (with A. Woodrum).

"The Structure of Irregular Mesospheric Variations", presented at the International Conference on Aerospace and Aeronautical Meteorology, Washington, D. C., May 1972.

"The Georgia Air Quality Implementation Plan", presented at the Air Pollution Control Association Meeting, Miami Beach, Florida, June 1972 (with J. R. Williams).

PROPOSED TRAINING PROGRAM

The funds requested in this application will be used to enlarge and enrich the existing air quality training program over the next three years. This will be accomplished in four areas of activity: additional courses, increased stipend support, more active recruitment, and greater multi-disciplinary involvement.

A. Proposed New Courses

City Planning 755 3 credits

Title: Environmental Aspects of City and Regional Planning

Professor: Dr. Clifford R. Bragdon

Identification and analysis of the major environmental factors influencing urban development including air, water, noise, and spatial pollution. The influence of these pollutants upon urban health are considered. Environmental controls and management programs are evaluated and solutions involving city planning techniques are presented.

Ch.E. 414 3 credits

Title: Air Pollution Control

Professor: Dr. Michael J. Matteson

Application of mass transfer principles to the design of pollution control systems utilizing absorbers, collectors, filters, precipitators, and the like. Air pollution control is stressed. Other topics are combustion process optimization, fuel pretreatment, and cost analysis.

B. Increased Stipend Support

The response to the Air Quality Training Program has been quite gratifying in terms of both numbers as well as quality of students applying for admission into this program. We expect to reach the point at the end of the third year of support, where the amount of available financial support for graduate students from outside and within the State will be insufficient to meet the growing demand. A gradual increase in the number of stipends, 25-30-~~35~~ (we now support 19) over the following three years should enable us

to augment the number of qualified air quality control engineers and scientists graduating from this training program. We should also like to be able to train an increased number of students from Atlanta University Complex to provide a larger number of trainee graduates who represent minority ethnic groups.

C. More Active Recruitment

In addition to the recruiting mentioned earlier in this proposal we would like to place announcements in the various journals (APCA, ES&T, C&EN, AND CEP) describing the air quality training program and inviting applications from qualified individuals.

D. Greater Multi-Disciplinary Involvement

We have proposed that an additional faculty member, Dr. Clifford Bragdon, be included in the Air Quality Training Staff in order to enrich the multi-disciplinary involvement in the area of city planning. We would also like to make stronger ties with such faculties as law (Emory University) and medicine (also Emory University). Greater efforts will be made to establish a working relationship with more of the social science programs at the Atlanta area campuses.