THE UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

AN INVESTIGATION INTO THE PROCESS OF ESTABLISHING AMBIENT AIR QUALITY STANDARDS

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

degree of

DOCTOR OF PHILOSOPHY

BY

JAMES JOSEPH STANKO, A.B., M.S.

Oklahoma City, Oklahoma

1970

AN INVESTIGATION INTO THE PROCESS OF ESTABLISHING

AMBIENT AIR QUALITY STANDARDS

APPROVED BY

Carl A Nau

Raymond C. Hill

Robert N. Thompson

John B. Bruce

DISSERTATION COMMITTEE

DEDICATION

For Dianne, my wife, without whom this work would not have been completed

and

For Mary, my Mother, who will never hear of the existence of this work

ACKNOWLEDGMENTS

Carl A. Nau, M.D., Committee Chairman, hopefully, a first installment on a very large debt.

Raymond A. Mill, Ph.D., Committee Member, whose constant guidance and encouragement to write this dissertation caused me to meet deadlines I would otherwise have missed.

To the members of my Committee, John B. Bruce, Ph.D., Joseph L. Rodgers, M.R.C.P., P.E. and Robert N. Thompson, Ph.D., P.E., whose efforts in my behalf are deeply appreciated.

To the members and students of the Marketing Department whose suggestions facilitated the design of the questionnaire used in this study and to my many colleagues whose imprint I acknowledge and to whom I express my thanks.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

AN INVESTIGATION INTO THE PROCESS OF ESTABLISHING AMBIENT AIR QUALITY STANDARDS

CHAPTER I

INTRODUCTION

If you visit American city you will find it very pretty
Just two things of which you must beware: don't drink
the water and don't breathe the air
Pollution - Pollution
They got smog and sewage and mud
Turn on your tap and get hot and cold running crud

See the halibuts and the sturgeons being wiped out by detergents
Fish gotta swim and birds gotta fly
But they don't last long if they try
Pollution - Pollution
You can use the latest toothpaste
And then rinse your mouth with industrial waste

Just go out for a breath of air
And you'll be ready for Medicare
The city streets are really quite a thrill
If the hoods don't get you the monoxide will
Pollution - Pollution
Wear a gas mask and a veil
Then you can breathe long as you don't inhale

Lots of things there that you can drink
But stay away from the kitchen sink
Throw out your breakfast garbage and
I've got a hunch that the folks down-stream
Will drink it for lunch
So go to the city see the crazy people there
Like lambs to the slaughter
They're drinking the water and breathing the air.

Environmental pollution is the unfavorable alteration of our surroundings, wholly or largely as a by-product of man's actions, through direct or indirect effects of changes in energy patterns, radiation levels, chemical and physical constitution, and abundances of organisms. These changes may affect man directly or through his supplies of air, water, agricultural and other biological products; his physical objects or possessions; or his opportunities for recreation and appreciation of nature.

The production of pollutants and an increasing need for pollution management are an inevitable concomitant of a technological society with a high standard of living. Pollution problems will increase in importance as our technology and standard of living continue to grow.

Ever since man has attempted to satisfy his basic needs by seeking ways to manipulate his immediate environment more efficiently, one form or another of air pollution has been present to threaten his well being. The various periods of human history--the ages of fire, stone, copper, bronze, iron and atomic--testify to the fact that man has always engaged in air polluting activities (1). Initially these activities undoubtedly were isolated in small groups and later in communities and probably were treated as individual cases of smokes and fumes affecting only those persons living close to the sources.

History of Air Pollution

Prior to the Twentieth Century

People have been complaining about air pollution for many centuries. The history of air pollution is the history of fuel, of increased industrialization, and of growing urban populations (2). An early

prophetic clue of things to come was given in 361 B.C., when Theophrastus noted that "fossil substances called 'coals' burn for a long time, but the smell is troublesome and disagreeable." By 65 B.C., the poet Horace was lamenting that the shrines of Rome were blackened by smoke. In 1273, the first smoke abatement law was passed in England by Edward I. This law was passed because of the fears of the people that the air pollutants were detrimental to health. During this period it was believed that food cooked over burning coals would cause illness and even death. In 1306, the people became so concerned that a Royal Proclamation was signed, prohibiting the burning of coal in London. Because an owner of an industry was caught disobeying this Royal Proclamation, he was tried, found guilty, and subsequently beheaded (1, 2). This is the first recorded penalty given as a result of violating an air pollution code.

Several pollutants are the waste products of various human activities. Smoke is the first pollutant to have attracted community attention and its history goes back to the thirteenth century. The immediate cause of the production of smoke in such quantities as to constitute a hazard to well being was the exhaustion of the supplies of wood fuel (charcoal) in Europe and the introduction of coal as a substitute. Since that time communities have lived with smoke and soot without relief, until comparatively recent times.

Sulfur dioxide is the second pollutant to cause community discomfort, for it is produced at the same time as smoke, from the burning of coal. For almost 300 years this component was not recognized as a separate pollutant because of the inadequate chemical knowledge available. All that was known was that smoke was accompanied by an unpleasant smell

and an irritation to the nose and throat. By 1600 it was evident that the sulfur in soft coal was responsible for this distress. Methods of cooking coal to remove some of the sulfur and volatile components were already being developed (3).

Sulfur dioxide in much higher concentrations than are normally encountered as the result of the combustion of soft coal has become a pollutant wherever the metallurgical industry has developed. Many sulfur containing metallic ores are the raw inputs of the metallurgical industry, thus many processes for producing pure metals often produce large quantities of sulfur dioxide (4).

The metallurgical industry introduced the community to a variety of poisonous or noxious fumes from such metals as lead, arsenic, zinc and copper. In very recent times the use of beryllium for a number of industrial purposes has created a fresh hazard in the form of finely divided beryllium particles.

The chemical industry introduced such pollutants as hydrogen sulfide from crude oil and tar distillation, nitrogen dioxide from the chamber process for sulfuric acid, hydrogen fluoride from the production of superphosphate fertilizer and later from the manufacture of aluminum.

Hydrochloric acid first became a recognized atmospheric pollutant some time after 1800, with the development of the chemical industry. In the production of sodium carbonate from common salt, for example, an emission of strong hydrochloric acid is produced that does great damage to both property and vegetation (5).

With the impact of the industrial revolution in the eighteenth and nineteenth centuries, cities grew and air pollution nuisances

increased in frequency and complexity, giving rise to severe pollution episodes of entire metropolitan air spaces. The belching of black smoke from chimneys and stacks over residential and industrial areas, the blackening of the countryside with smoke and soot, symbolized not only the Victorian faith in industrial progress and the "smell of money" but also, the choking gloom and squalor of the cities. Therefore, it is reasonable to assume that in the future new industrial techniques will bring with them their own types of hazardous pollutants which will first be experienced by the industrial worker and may later become part of the pollution of metropolitan air.

An over-all view of the hundred years since the first steps were taken in understanding the nature of air pollution indicates that two processes have been in operation. On the one hand, developing production techniques have introduced new forms of pollution into the atmosphere and, on the other, urban populations have become more intolerant of the types of pollution they were having to breathe. With this growing dislike of pollutants, interest has spread to the effects of these materials not only upon man himself but also on vegetation and animals, upon buildings, clothing, works of art and other articles of property.

It therefore appears that atmospheric pollution consists of that material, gaseous or particulate, which is commonly found associated with the oxygen and nitrogen of the atmosphere and which is (a) toxic, (b) irritating, (c) in the nature of a hardship to man, either directly or because of its toxic or harmful effects upon animals, vegetation or human property.

It was not until the twentieth century that the resources of

science and technology began to be applied to the control of air pollution emissions with any degree of directed concentration. From what has been said above one fact emerges which should be remembered--that pollution of the air of the city is an extension of the pollution of the air of the factory, so that the science of air pollution control is an extension of the science of industrial hygiene. The methods of measurement are similar in principle but not in practice.

The Modern Era

The fourth decade of the Twentieth Century can be taken as the start of the modern era in the study of air pollution. First, it is the decade in which general activity increased so rapidly that the number of publications appearing in 1947 was four times greater than in 1944 (6). Secondly, by 1945 the Los Angeles smog, which first attracted attention about 1940, had developed to serious proportions and the Control Office, which had been established in 1945, was reorganized as a County Control Office, in an endeavor to meet the crisis. Thirdly, in 1948 the Donora, Pennsylvania disaster aroused the U. S. Public Health Service into intensive activity and convinced a very large percentage of U. S. scientists that if even clear evidence could not be presented that pollutants such as sulfur dioxide in low concentrations produced physical damage to the human body, there was at last proof that under some circumstances air pollution in a town could be accompanied by a death rate high enough to frighten public health officials. The London disaster of 1952 confirmed this fact. But even before that date the whole tenor of air pollution research in the United States, Great Britain and on the continent of Europe had changed (7). Research activity was heightened, money grants

for study and city control schemes were enormously increased. A conviction grew that the pollutants of the air in the modern era were not only smoke, sulfur dioxide, fly ash and the chemically known gases which make up the common effluents of modern industry, but a number of substances which had never before been suspected to exist in the normal urban atmosphere and which possibly had not existed there before the year 1900. These substances, whose presence was first detected in Los Angeles, are now thought to exist at low concentration in all modern cities. In addition, in about 1946 the realization had come that air pollution is an area problem, not a city problem. The control techniques therefore began to change from city limits to county limits in the United States, and planners in Great Britain turned to national legislation as the only way of dealing with the situation.

Thus it may be said that the years 1940 to 1955 were a time of mental reassessment of the whole problem of air pollution. While the years since then have been a period during which a move has been made to marshal the forces of all branches of science into a concerted attack upon what is now realized to be a problem concerned with highly complex chemical reactions and a multiplicity of physiological reactions produced by chemical by-products.

The first attempt to marshal scientific manpower in the United States was the federal government sponsored technical conference on air pollution which was held in Washington, D.C. in 1950 (8). Others are represented by the national air pollution conferences which were sponsored in California by the Stanford Research Institute in cooperation with the California Institute of Technology, the University of California, the

University of Southern California, the Air Pollution Control Association and the Air Pollution Foundation (National Air Pollution Symposia, 1949, 1952, 1955). The most important move was the passage by Congress in 1955 of the Air Pollution Research Act. This Act provided five million dollars annually for the promotion of research on air pollution. It authorized the creation of the first research division on air pollution in the administrative structure of the U. S. Public Health Service located at the Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.

By 1960, sufficient progress had been made, and enough problem areas defined, to justify combining all federal programs into the Division of Air Pollution, U. S. Public Health Service. The passage of Public Law 86-493 in 1960 provided a particular stimulus to research, accelerating the development of facilities and personnel for the study of motor vehicle pollution problems (8).

The Clean Air Act of 1963 broadened the role of the Federal Government in air pollution control. This act provided for the following:

1. A directive for the development of air quality criteria.
2. Authorization for Federal assistance grants to the states.
3. Authority for limited participation in legal regulation of pollution.
4. New authorities relating to the conduct and support of research.

Subsequently, it was felt that to effectively control air pollution in our large metropolitan areas regional programs were needed. The airshed, similar to the watershed, might encompass all pollution sources in an area. It was proposed that the Clean Air Act of 1963 be amended

to authorize the Secretary of the Department of Health, Education, and Welfare to establish such airsheds throughout the country and to work with states and municipalities to establish air pollution control programs in these regions. The control programs would involve participation by the Federal government, as well as by state and local governments. These proposals were to become embodied in the 1967 Air Quality Act. This Act is a legislative blue print designed to translate scientific knowledge into responsible social and political action in the control of air pollution.

The Act calls for the Secretary of Health, Education, and Welfare to define the broad atmospheric areas of the nation in which climate, meteorology, and topography, all of which influence the capacity of air to dilute and disperse pollution, are generally homogeneous (Figure 1).

Further, the Act requires the Secretary to define those geographical regions in the country where air pollution is a problem whether interstate or intrastate. These air quality control regions will be designated on the basis of meteorological, social, and political factors which suggest that a group of communities should be treated as a unit for setting limitations on concentrations of atmospheric pollution. At the same time, the Secretary is required to publish air quality criteria for those pollutants he believes may be harmful to health or welfare, and tc publish related information on the techniques which can be employed to control the sources of those pollutants.

The criteria will describe what is known of the predictable effects of exposures to various concentrations of pollutants for various lengths of time. They will provide the states with the latest scientific

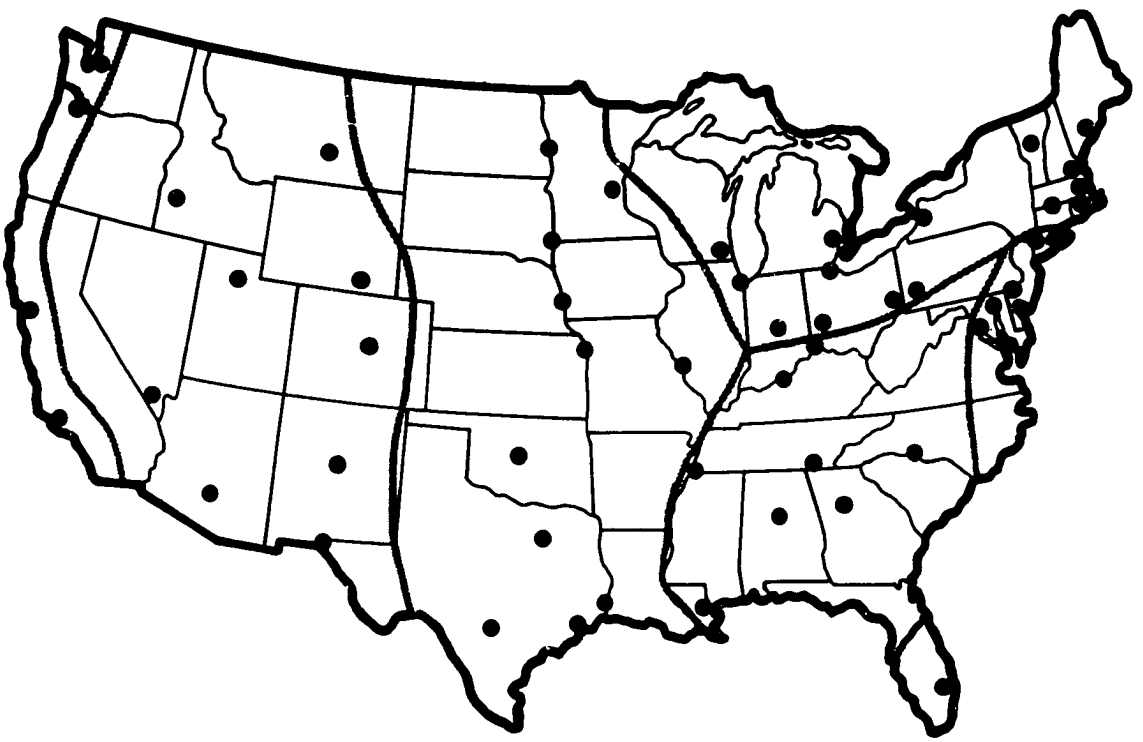

Fig. 1--Atmospheric areas and air quality control regions in the 48 contiguous states.

information for developing their own standards of air purity for the protection of public health and welfare in the regions designated by the Secretary. These ambient air quality standards will become a measure of the control efforts in the regions.

Under the Act, as soon as a region has been designated, criteria on a pollutant have been published, the related control technology information on the source(s) of the pollutant has been published, the state or states responsible for the designated region are on notice to develop standards for the region on the pollutant covered by the criteria and to develop plans for enforcing those standards. The states have ninety days to write the Secretary indicating that they intend to set standards, 180 days to submit proposed standards for the Secretary's review, and a further 180 days to submit plans for enforcing them. If the Secretary finds that the air quality standards and plans for their enforcement are consistent with the criteria and the related control technology information, then those standards and plans will take effect. If he finds that they are not consistent, he has the power to establish appropriate standards and plans for those states concerned (9).

The Need for the Study

The establishment of standards to limit the contamination of man's environment is a well-recognized and accepted activity in public health. They have been accepted and used in areas such as industrial health, radiological health, water supplies, and food products. Ambient air quality standards have not yet been as widely accepted and used. However, the establishment of air quality standards has grown into one of the most important developments in the field of air pollution control

during the past decade (10).

An effective standard setting process should include much more than just the selection of numbers representing the concentration of contaminants. It should also consider the purpose of the standards, what they represent, and how they are intended to be used. The term "standards" has been so widely applied to many elements in society that it means different things to different people. It is often used interchangeably with other terms such as goals, criteria, legal requirements, and recommended procedures. The most common confusion of terms in air pollution control seems to be with the words "standards" and "criteria." By "standards", this writer means concentrations of pollutants officially established by governmental agencies to provide a basis for control of air pollution and the development of restrictions on the emission of contaminants. "Criteria" are defined as statements of the effects to be expected from designated exposures to contaminants. Criteria would then be the basis for judging the consequences of air pollutants and provide the basis for the ambient air quality standards.

If air quality standards are to be of greatest value they should be established on sound data and with clear-cut objectives. A haphazard approach that does not carefully evaluate the data on air pollution effects, objectives and consequences must lead to standards which are not consistent with the data or to standards that are not justifiable. If the standards represent an ineffective gesture, either in the manner the standards are established or the way they are applied, their force and effect will be lost because they will not be taken seriously and they will be discredited (11).

A search of the literature on the manner in which standards are established revealed a paucity of information and suggested a study which might identify certain opinions held by the chairmen of the various state air pollution control boards that might serve as an indication of the process by which standards are established by the individual states. This study, then, was undertaken in the wake of legislative initiative which requires the states to set those standards.

The Value of the Study and the Statement of the Problem

The values which could be derived from the findings of this study are threefold. The first consists of those findings which could influence the Federal Government in its leadership role among the states. The second value is the guidance this study might possibly provide in the adoption of certain pollutant criteria for promulgation among the states. The third value of this study could be its function as a feed-back mechanism with regard to the progress being made by the states in the setting of standards based on Federal criteria.

The research design of this study was adopted by the investigator and his advisors to permit probing and study of the following areas:

1. What is the description of the personal characteristics according to age, education and occupation of the various state air pollution control board chairmen?
2. What are board chairmen opinions on the desirability of the Federal Government promulgating criteria?
3. In the opinion of the board chairmen, when and how could pollutant levels be measured?
4. Which levels of government should take the initiative in setting

ambient air quality standards?

5. In the opinion of the board chairmen, what are some of the acceptable upper and lower limits within which state standards could be set?

These above areas were selected to reduce the study to manageable proportions and it was not the investigator's intent to equate the areas in value or importance. These areas were chosen to permit an evaluation of the opinions of experts by virtue of the role they play and the office they hold. The opinions of this group will attempt to do two things:

1. Serve as an indicator of nationwide understanding of the above five subject areas.
2. Ascertain the degree to which there is unanimity of opinion on the above five subject areas.

CHAPTER II

AIR POLLUTION LEGISLATION: STANDARDS

A REVIEW OF THE LITERATURE

> We are pouring at least 130 million tons of poison into the air each year. That is two-thirds of a ton for every man, woman and child in America. And tomorrow looks even blacker. By 1980, we will have a third more people in our cities. We will have 40% more automobiles and trucks. And we will be burning half again as much fuel. That leaves us only one choice. Either we stop poisoning our air, or we become a nation in gas masks, groping our way through dying cities and a wilderness of ghost towns (12).

Introduction

Gross contamination of the air of many large towns in different parts of the world is part of the price that has, so far, to be paid for the development of industry and the resultant concentration of large numbers of people in relatively small areas. It is mainly from the use of coal and its products that the air of densely populated areas in the industrialized countries is heavily polluted with smoke, grit and dust, and oxides of sulfur, though there are some areas receiving large quantities of pollutants from the manufacture of chemicals, iron and steel, cement, and other materials. Moreover, during the last fifty years there has also been an increasing amount of pollution from the use of petroleum oils for furnaces and transport.

Attempts to set standards to limit the release of pollutants into the atmosphere have traditionally followed an empirical approach,

based on the dual considerations of engineering feasibility and economic acceptability. Following this course, air pollution control programs in several of the larger cities of the world have developed limitations on emissions which affect for the most part the more obvious sources of smoke and, to a lesser degree, other sources of particulate pollution. Admittedly crude, but practical, techniques for measuring the output of visible pollutants were developed for purposes of enforcement. The most widely employed being the Ringelmann chart, a graduated spectrum against which the density of particulate pollution from a single source is estimated (13).

At the same time, standards were established to regulate the use of fuels to help curtail the release into the atmosphere of smoke, fly ash, and other particulate pollutants. These standards were applied to individual sources of pollution but, as sources multiplied and the entire picture of source emissions became more complex, it became apparent that emission limitations which were applied only to certain obvious sources were inadequate for effectively insuring the quality of the ambient air in an entire community.

With few exceptions, air pollution control legislation in the various countries of the world is inadequate (14). A frequent disadvantage is that the first control measures were introduced many years ago. The legislation at present in force takes no account of the enormous growth of industry, new types of contaminant, and new sources of pollution such as motor vehicles, modern power plants and space heating appliances. In several countries, therefore, the need is quite apparent to introduce effective legislation enforcing the adoption of adequate control measures and fixing the maximum permissible concentration of the various contaminants.

United States of America

In the United States, unlike Canada, United Kingdom, European countries and Soviet Russia, there is no nation-wide or blanket legislation directed towards the mitigation or control of air pollution. Control is exercised under state or local police powers and public health and welfare statutes and ordinances. State laws usually give regulatory authority to the counties and cities included in their jurisdiction. For example, California has an Act providing for the creation of Air Pollution Control Districts within its various counties. In the state of New Jersey there is a Smoke Control Code that may be adopted by county or municipal boards of health. Almost every large city in the United States now has a smoke or air pollution regulation of some kind. In some instances there are interstate compacts to improve controls and there are international compacts between the United States and Mexico and the United States and Canada to cover adjacent areas in the three countries.

The measurement of air pollutants quantitatively and qualitatively and the establishment of standards began around the turn of the present century. For the past fifty years Industrial Hygienists have been developing and using atmospheric standards to protect the health of the working population. They have achieved an outstanding record of protecting man albeit permitting industry to expand and use ever increasing toxic substances.

In 1920 Industrial Hygienists recognized the need for establishing desirable atmospheric limits in which people could work safely (15). The American Standards Association, Z37 Committee, published its first standard entitled "Allowable Concentration of Carbon Monoxide" in 1941.

Since that time, the Z37 Committee has prepared guides on many different substances.

In 1943, the Threshold Limits Committee of the American Conference of Governmental Industrial Hygienists was created. In 1947, this group published its first list of recommended Threshold Limit Values. Since 1950 these values have been reviewed and published annually (16).

The Federal Government became involved in air pollution matters and adverse health effects in 1955. National legislation was passed and funds were appropriated, directing the Public Health Service to engage itself in research and development activities. From these initial efforts can be traced the multitude of Federal activities which are in existence today. Additional Federal legislation was passed in 1961 which authorized the Public Health Servide to give grants-in-aid to the individual states for use in developing their own regulatory programs. The Federal Clean Air Act was passed in 1963; an act to improve, strengthen, and accelerate programs for the prevention and abatement of air pollution. This piece of legislation not only provided for grant money but, in addition, directed the Public Health Service to actively assist the states by providing them with equipment and technical manpower. This Act was amended in 1965 and cited as the Motor Vehicle Air Pollution Control Act. The amendments provided for the establishment of national motor vehicle exhaust emissions standards and creation of the Solid Waste Disposal Act.

In 1967 the Air Quality Act was passed by Congress to provide for a systematic, regional effort to combat air pollution. Under the act, the Department of Health, Education, and Welfare must first delineate broad atmospheric areas of the Nation, a task now completed. Next, the

Department must designate air quality control regions based on meteorological and other technical factors, as well as social and political factors. Concurrently, the Department must develop and publish air quality criteria indicating the extent to which air pollution is harmful to health and damaging to property, as well as detailed information on techniques for preventing and controlling air pollution. Provided with this information, states are then expected to develop ambient air quality standards and plans for implementing these standards in air quality control regions. The Department will review and evaluate these standards and plans, and once they are approved, the states will be expected to take action to control pollution sources in the manner outlined in their plans. If a state's efforts prove inadequate, the Secretary is empowered to initiate abatement action and to set appropriate standards.

The Act continues the Department's authority to provide grants to assist state and local control agencies, and it broadens this authority to include grants for planning of control activities and regional air quality control programs. It retains the Secretary's authority to abate interstate air pollution problems and, on request from a state, intrastate problems, and it provides for Federal measures to abate air pollution when episodes threaten. It continues the authority for setting of national standards for control of motor vehicle pollution and adds authority for grants to assist states in developing suitable inspection programs. It provides for the registration of fuel additives and for continued efforts to control air pollution from Federal facilities. It calls for the establishment of advisory groups to assist the Department in carrying out its activities and it also requires a number of special studies in

specific problem areas, including jet aircraft emissions, the need for national emission standards, and manpower and training needs in the field of air pollution. Finally, it calls for the establishment of a fifteen-member Presidential Air Quality Advisory Board.

The reader can refer to Appendix A for ambient air quality standards adopted by the individual states pursuant to the 1967 Air Quality Act.

Soviet Russia

In the U.S.S.R. an order issued in 1949 stipulates that no electric power station may be constructed without the simultaneous installation of equipment for dust and fly ash absorption. Factories processing non-ferrous metals must likewise be equipped with devices for the absorption of dusts and gases containing compounds of sulfur, arsenic and fluorine. Coal-tar distilleries are required to install apparatus necessary for the absorption of hydrogen sulfide and other sulfurous gases. In iron and steel works provision must be made for the filtration of flue gases from blast furnaces and for the utilization of these gases as fuel. Factories using solvents must be equipped with recovery units. Instructions issued in 1951 and amended subsequently indicate the maximum permissible concentrations of noxious substances in urban air (17). In many cases the concentrations are at least an order of magnitude less than those permitted by authorities in Los Angeles county.

The organizational structure of air pollution control in the U.S.S.R. was approved in 1950. Among the authorities responsible for supervision are the services of the State Sanitary Inspectorate and the local stations of the Sanitary and Epidemiological Department. These

Russian Sanitary Inspectorates are comparable to state and local Health Departments in the United States.

The Order of 1950 makes the approval of building plans subject to the submission of particulars of the production methods envisaged, raw materials to be used, quantity and composition of liquid, solid and gaseous emissions, height of chimney stacks, etc. In its examination of projects the supervisory authority must consider, among other things, protected areas, meteorological conditions and topography, the efficacy of control apparatus, and possible changes in the quantity and quality of the pollutants. The sanitary authorities give their final sanction only after having ascertained that all their observations have been taken into account in the drawing up of plans. Regular sanitary inspection is carried out by the local stations of the Sanitary and Epidemiological Department (18).

United Kingdom

In the earlier years of the nineteenth century, when the great acceleration in industrial development began, the large coal burning furnaces and boilers were not very efficient. Large quantities of dense smoke must have been emitted from every ton of coal burned. By 1819, the smoke nuisance was increasing to such an extent that Parliament appointed a committee to inquire if persons using steam engines and furnaces could erect them in a manner less injurious to public health and comfort. In 1843 a select committee of Parliament recommended legislation to deal with smoke nuisances (19).

In relation to air pollution by discharges from chemical and other special manufacturing processes, it should be mentioned that in the

middle of the nineteenth century there was a public outcry as a result of the pollution emitted from processes for converting common salt into alkali. From these processes large quantities of hydrochloric acid were discharged into the atmosphere. A Royal Commission was appointed, and following its first report the first Alkali Works Regulation Act was passed in 1863. Later the Act was extended on several occasions to cover a number of special processes including many that are not related to the manufacture of alkalis.

In 1953, after the disastrous smog in December 1952, which caused the death of about 4,000 people in the London area, a Committee on Air Pollution was appointed by the Government "to examine the nature, causes and effects of air pollution and the efficacy of present preventive measures; to consider what further preventive measures are practicable; and to make recommendations." Many of the recommendations formed the basis of the British 1956 Clean Air Act (20).

Under the 1956 Clean Air Act, which is administered by local authorities, it is an offense to emit dark smoke from a stack or chimney for longer than such periods as may be specified by the Minister of Housing; likewise, Local Government by regulatory decree. Dark smoke, which includes soot, fly ash, grit and gritty particles emitted in smoke, is defined as being as dark as, or darker than, shade #2 of the Ringelmann chart. Regulations in relation to permitted periods for the emission of dark smoke, and black smoke which is defined as smoke as dark as shade #4 of the Ringelmann chart, have been issued.

The 1956 Clean Air Act also provides that no furnace, except small furnaces designed mainly for domestic purposes, shall be installed

unless it can be operated, so far as practicable, continuously without emitting smoke when burning fuel of a type for which it was designed. Notice of the proposal to install the furnace must be given to the local authority which may or may not approve the plans and specifications. A local authority may, by order confirmed by the Minister, declare the whole of a district or any part of it to be a smoke control area in which only approved applicances or approved fuels or both may be used (21).

In addition, the Act specifies that the height of any chimney to be constructed to carry smoke, grit, dust or gases will be sufficient to prevent, so far as is practicable, the discharges from becoming prejudicial to health or a nuisance. In reaching a decision, account must be taken of such local conditions as the levels of the neighboring landscape and the position and description of nearby buildings. A provision states that the owner of a mine or quarry from which coal or shale is obtained shall employ all practicable means for preventing combustion of the tailings and for preventing or minimizing the emission of smoke or fumes. However, the Act does not apply to motor vehicle exhaust emissions (21).

Control of the emission of noxious and offensive gases from other chemical processes not mentioned previously is exercised under the Alkali Works Regulation Act of 1906. This Act is not administered by local authorities as in the case of the Public Health Acts and the 1956 Clean Air Act. Rather, it is administered by Alkali Inspectors who are Government Officers appointed by the Minister of Housing. The Act includes a schedule of processes and a list of noxious and offensive gases. The schedule and list can be modified by such orders as seem necessary to keep pace with the developments and changes in industry. Local authorities

cannot take proceedings under the Public Health Acts and the Clean Air Act in relation to the scheduled processes, without first obtaining the consent of the Minister (22).

The Alkali Act includes the following requirements:

1. Scheduled processes must be registered annually.
2. A condition of registration is that the scheduled processes must be provided to the satisfaction of the Chief Inspector with the "best practical means" for preventing the escape of noxious or offensive gases to the atmosphere and for rendering such gases harmless and inoffensive.
3. The best practical means must thereafter be maintained in efficient working order and must be used continuously.
4. For certain processes, upper limits are specified for the concentration of total acidity in waste gases discharged to the atmosphere.

In the schedule are included processes concerned with the manufacture or production of such materials as sulfuric acid, hydrochloric acid, nitric acid, picric acid, hydrofluoric acid, chlorine, bromine, fluorine, ammonium sulfate, other chemical fertilizers, sulfides, bisulfites, carbon bisulfide, sulfocyanide, pyridine, tar benzene, paraffin oil, arsenic, aluminum, lead, zinc, cement and others. Electricity generating stations burning liquid or solid fuel, gasification and coke works, and metallurgical processes are also included in the schedule (23).

Canada

The Canadian 1958 Air Pollution Control Act gives the Minister and municipalities a variety of powers. The Minister may engage in the

promotion of research on air pollution problems as well as in the framing of control measures. Municipalities are empowered to pass laws, subject to certain limitations, for prohibiting or regulating the emission from any source of any class or type of air contaminant. In particular, the Act defines and determines degrees of density, in accordance with which the emission of air contaminants may be prohibited or limited for certain periods of time by municipal laws. Municipalities may also prohibit certain combustion operations likely to produce offensive or harmful pollution. In addition, subject to certain limitations, they are empowered to regulate the installation, alteration, maintenance and operation of structures and equipment from which air pollutants may be emitted. In order to administer and enforce the policy of air pollution abatement, laws may be passed for the appointment of municipal officers with powers of entry, inspection, inquiry and regulation. All the proposed municipal laws must first be submitted to the Minister for approval (24).

Western Europe

Activity towards the mitigation of air pollution in most of the countries of Western Europe, in general, has not kept pace with that in the United States and the United Kingdom. There has been little effective legislation though realization of the importance of reducing air pollution is steadily increasing. Recently, Belgium, the Federal Republic of West Germany and the Netherlands have enacted legislation which establishes certain air quality standards and sets maximum emission rates for selected pollutants under specified conditions. It should be noted that these countries are highly industrialized with industry tightly concentrated in specific locales (25).

It can be said that although there have been considerable advances in dealing with problems of air pollution with many legislative measures adopted in some countries, particularly in the United States of America and the United Kingdom, excessive and often unnecessary pollution is prevalent in many of the world's industrial areas. But, legislative measures have not always been effective because there has been insufficient public insistence on the abatement of air pollution. It appears likely that world-wide improvement will only be attained by better legislation more effectively administered, increased knowledge based on intensified research and development work, and a more determined public opinion.

CHAPTER III

RESEARCH DESIGN

"Scientific research is not itself a science;
it is still an art or craft" (26).

Introduction

Early man knew fire, smoke and soot
and so air pollution had its roots.
Man developed and he grew
and as his companion pollution knew.

Pollution! Pollution! Oh, what to do?
Environmental standards are all too few.
Help! Help! Who to the rescue?
Why, none other than you! (27)

This research investigation is the outgrowth of an environmental health research project conducted during the summer of 1969. The investigator undertook a comprehensive examination of the air pollution control laws and regulations of the fifty states. All fifty states were found to be active in controlling air pollution. However, many chairmen indicated that their respective state legislatures had not yet passed enabling legislation. Also, the Governors of other states had not yet appointed their respective air pollution control boards. Those states that had, at the time of this study, promulgated rules and regulations forwarded copies for the investigator's use.

It soon became apparent that confusion was evident among the states with no semblance of orderly progression toward the development of

a realistic approach in establishing air quality standards. Therefore, this study was suggested as a possible way in which some valid conclusions might be drawn with regard to the impact of the provisions of the Federal 1967 Air Quality Act on the individual states. This Act requires the states to establish their own ambient air quality standards subject to Federal approval.

While there is no single expert opinion on quality of the air environment, there are the opinions each expert holds, the opinions he thinks other experts hold, and the opinions he thinks they should hold. Many public administrators get confused about this. Perhaps the greatest confusion arises from their not knowing what other opinions the experts hold and from lacking the means of finding out.

Selection of the Population Universe

Early in the study the decision was made regarding the population or Universe to which the findings were to apply. The term Universe is defined as the total population from which any sample is drawn and which it is supposed to represent. For purposes of this study the Universe was designed as all of those individuals serving as chairmen during the fiscal year 1969-1970 of the respective state air pollution control boards.

Random sampling of this Universe was not adopted as the procedural method of choice. It was certain that the maximum possible size of the Universe could not exceed fifty by virtue of previous definition. Random sampling procedures have limitations; not the least of which are the determination of the size of the sample to be drawn and its representativeness of the entire Universe. Because of these considerations it

was decided that a complete count or census was, in this particular case, the logical and preferred procedural method to employ.

Accordingly, the regional program directors for air pollution within the nine U. S. Public Health Service Regions that administratively divide the country were asked to supply the names and addresses of those individuals serving during fiscal 1969-1970 as chairmen of the air pollution control boards of the respective states within their regions. The names and addresses were then checked for validity by means of personalized individual letters identifying these individuals as participants in the forthcoming study.

At this point in the experimental design it became apparent that only thirty-four states had, at the time of the study, functioning air pollution control boards with identifiable chairmen. This considerably simplified the design problem and in so doing now made it feasible and practicable to survey each of the above thirty-four Board Chairmen.

Design of the Instrument

> Discovery should come as an adventure rather than as the result of a logical process of thought. Sharp, prolonged thinking is necessary that we may keep on the chosen road, but it does not necessarily lead to discovery." (28)

The instrument was of the close-ended mail-out questionnaire type and consisted of two parts (see Appendix B). The parts were physically separate and were mailed out at different times during the quarter for reasons that are discussed herein.

The Mail-Out Questionnaire - Rationale

In the mail survey a number of questionnaires are sent to individuals through the mail. With random sampling the proportion of replies

seldom exceeds twenty to twenty-five per cent and these replies are tabulated on the assumption that they are representative of the list to whom the mailing was made. This study was a total count and so the above limitations do not apply.

Some of the advantages of the method are:

1. A low per unit cost (as against a similar personal interview study).
2. A wide geographic distribution of respondents is possible.
3. It is useful in reaching a specific class of people (e.g., board chairmen).
4. There can be no interviewer bias.
5. No identification of respondents is necessary; hence, it is possible to obtain more honest replies than with the short answer type of personal interview.

Some of the disadvantages of the method are:

1. The questionnaire must be short.
2. It is difficult to obtain detailed qualitative answers or to know precisely what the verbal responses mean.
3. It is impossible to know whether the intended person answered and whether or not he consulted others.

The mail-out questionnaire does not use an interviewer. This means that the questionnaire must be so constructed that it will provide all possible means of inducing the respondent not only to reply, but to reply fully to the questioning. The questions must be clear and precise the first time since there is no one present to interpret their meaning to the person replying. The questions must be so constructed that they

will arouse the immediate interest of the respondent; otherwise he will not take a second look at the questionnaire.

Description of Part A of the Questionnaire - Board Profiles

The investigator and his advisors recognized the need at this point in the experimental design to further define and describe the population Universe and to characterize it by using certain standard sociological parameters. It was also felt that some information was needed on the number and quality of responses which could be expected from this highly selected population. Accordingly, the decision was made to mail out at that time only Part A (see Appendix B). It was appropriately tested and mailed out in the fourth quarter of 1969, prior to the final printing of Part B.

A one hundred per cent response was achieved which required only one follow-up letter mail-out. The tabulated results are given in CHAPTER IV. As a result, confidence was gained in the choice of procedural method. On the basis of the tabulated results the task of evaluating the quality of the data in order to detect sources of possible bias was begun.

The evaluation showed that the investigator had indeed conducted a census of the population Universe which had been previously defined. It was concluded that little, if any, bias could arise because of faulty counting. Next poor question framing as a possible source of bias was considered. A careful examination of the data showed some confusion on the part of the respondents in regard to the intended meaning of one question. It was concluded this could be a source of bias and that the failure to communicate was due to faulty construction. Subsequently it was determined this question could be eliminated from the study without loss

to the quality of design. The possibility of bias arising from the untruthful respondent was reviewed. From the quality of the data received, it was concluded that this source would provide little, if any, bias due to the nature and framing of the questions asked. The data was examined to determine what, if any, bias might result from the refusals and omissions. The data contained no refusals and the omissions were satisfactorily explained by marginal notes. The omissions accounted for less than two per cent of the total data obtained. It was concluded that refusals and omissions would not be a source of bias nor present a problem in interpretation and evaluation due to the excellent cooperation that could be expected from the respondents. At this point the investigator and his advisors were satisfied that everything was ready to proceed with the final work-up and printing of Part B.

Description of Part B of the Questionnaire - Census of Opinions

From the knowledge and experience gained with Part A, Part B was constructed, appropriately tested, and mailed out in November, 1969 (see Appendix B). The final series of questions which went into the make-up of Part B was chosen from among many which had been drafted and proposed for inclusion and which found their genesis in the literature. The criteria used to judge each question were generated by the investigator and his principal advisor. These criteria recognized the need of the investigator's principal advisor for certain selected information pertinent to his role as Board Chairman of the State of Oklahoma's Air Pollution Council. The criteria also stipulated that all final questions be pertinent to the study, help answer the basic problem of the study, be timely with regard to current thinking and be answerable by the

respondents.

Each question (please refer to Appendix B for a statement of each question contained on Part B of the questionnaire) included on the mail-out copy of the questionnaire was chosen because the investigator and his principal advisor believed it represented the current "thinking in the field." That is, each question contained a value, a definition or a statement of principle believed to be current in the minds of the board chairmen and that a majority opinion would substantially be in agreement with these concepts. The questions were worded in the manner suggested by the results of the face validity tests. That is, consideration was given to validity and reliability in the construction of each question.

The position of each question in the list of questions was predetermined to prevent the respondent from answering the questionnaire based upon fixed prior attitudes and opinions. That is, the investigator and his advisors felt the need for a spacial arrangement of the questions which would offer the respondent the opportunity to contradict himself, should he respond in a perfunctory manner. Questions two and five, four and nine were included on the mail-out copy not only to gather data on opinions, but also to serve the purpose of detecting inconsistency in the logic of the individual's responses. It was felt that such type questions were needed to serve as indicators of the quality of the responses to the individual questionnaires. The data which resulted from Part B are discussed at length in CHAPTER IV.

The Pre-Test

> "Error is all around us and creeps in at the least opportunity. Every method is imperfect." (29)

The literature gives ample warning of the dangers and pitfalls one can encounter by not first taking the precaution of pre-testing his questionnaire in some logical manner. The logical manner usually consists of a test for reliability and a test for face validity. One definition statisticians use for reliability is the instrument's ability to elicit identical responses to the same questions over a number of repeated trials. Davis (30) defines face validity as indicating "the extent to which an instrument appears on casual inspection, especially by examinees or laymen, to measure what it is intended to measure."

Payne (31) and Blankenship (32) provide some information on particular points when pre-testing a questionnaire. Payne feels that there are many possible ways of opening a questionnaire. The best way, though, is to lead off with a question that gets a quick, unembarrassed yes or no. He feels wording of questions must be reasonable with no abstract thought required, concrete and unambiguous. Blankenship recommends that questions always be adapted to the type of person who is to be queried and that they take into account the important factor of pride. He also feels it is essential that the position of each question in the list of questions be carefully considered.

Upon the advice and with the guidance of his advisors the investigator tested for reliability Parts A and B of the questionnaire. This was accomplished by submitting both parts on separate occasions to five different people knowledgeable and associated with activities having a direct bearing upon air quality standards. The number five was chosen as it represented nearly fifteen per cent of the total number of respondents. Their responses to three different trials fell well within the

ninety-five per cent confidence interval and exhibited a variance of less than one per cent about the mean. The face validity test on both parts employing three separate trials was performed by an undergraduate class of marketing majors. The results of these trials were such as to satisfy the investigator's advisors that the quesionnaire was indeed valid.

CHAPTER IV

AN ANALYSIS OF THE RESULTS

> Knowledge once gained casts a faint light beyond its own immediate boundaries. There is no discovery so limited as not to illuminate something beyond itself (33).

Introduction

The contents of this chapter were organized to correspond and be consistent with Parts A and B of the questionnaire. The statistical description of the national profile of existing air pollution control boards comprises section one. Section two contains the tabulated census of opinions expressed as percentages as determined by the responses to Part B of the questionnaire. Because postage cancellation marks appeared on all of the return envelopes (thereby identifying the state of origin) and many of the respondents elected to identify themselves, it was decided the states would be tabulated randomly. This was due primarily to the fact that the investigator was personally acquainted with some of the respondents and desired to avoid unintentional bias in the analysis of the tabulated results. Respondents' reactions to selected opinion testing questions expressed as percentages are presented in section three.

Section One: Part A of the Questionnaire - Description of the Profile of Existing Air Pollution Control Boards

The mail-out of Part A of the questionnaire went to thirty-four

states. This was the total number of states which had functioning control boards with identifiable chairmen. The investigator received thirty-four responses for a one hundred per cent response to the mail-out.

For all of the individual states (N = 34), where N is the total number of states from which responses were received, the total number of statutory board members was 302. This is an average of nine members per state. It should be pointed out that the above figures reflect the composition of the various boards as of the fourth quarter of 1969. Also, the average is a simple arithmetic average rounded off to the nearest whole number. Of this number, N = 302, there were fourteen vacancies; this was a vacancy figure of 4.6 per cent.

It is evident that the various state boards were functioning at nearly full capacity. Therefore, any rules and regulations promulgated by these boards during this time period would seem to be representative of the composition of the various boards. In all cases the composition of each board is defined by statutes originating within the respective states.

Tables 1 through 4 give a description of the profile and present a listing of the percentages computed from the data.

It is evident from Table 1 that the Bachelor degree level is the mode for this distribution. While this may at first seem to be an unusually high level of educational attainment for a citizen's board, one must bear in mind that representation on these boards is defined by statute. For the most part representation comes from the various professions and occupations which require a college degree at the entry level.

While slightly over ten per cent of the total number of members'

TABLE 1

BOARD MEMBERS' EDUCATIONAL BACKGROUNDS
QUESTION THREE - PART A OF
QUESTIONNAIRE - 1969

Highest Degree Attained	Number of Active Members	Per Cent
1. High School	21	7.6
2. Bachelor	105	36.5
3. Master	35	12.0
4. Doctor	63	21.8
5. Unknown	30	10.3
6. No Response	34	11.7
Totals	288	99.9[a]

[a]Does not add to 100 due to round-off error.

TABLE 2

BOARD MEMBERS' OCCUPATIONAL OR PROFESSIONAL BACKGROUNDS
QUESTION FOUR - PART A OF QUESTIONNAIRE - 1969

Occupation or Profession	Total Number of Board Members	Per Cent of Total Members (N = 298[a])
1. Academic	15	5.2
2. Agriculture	18	6.2
3. Business	37	12.3
4. Engineering	45	15.0
5. Healing Arts	51	17.0
6. Industry	32	10.6
7. Law	8	3.0
8. Local Government	25	8.4
9. Other	51	17.0
10. Unknown	0	0.0
11. No Response	15	5.0
Totals	298	100.0 (Rounded Off)

[a]N = 298 rather than N = 288 is due to overlapping of occupations or professions.

TABLE 3

ANALYSIS OF "OTHER" CATEGORY - BOARD MEMBERS' OCCUPATIONAL OR PROFESSIONAL BACKGROUNDS - QUESTION FOUR - PART A OF QUESTIONNAIRE - 1969

Occupation or Profession	Total Number of Board Members	Per Cent of Total Members (N = 298)
1. Architecture	1	0.3
2. Banking	1	0.3
3. Conservation	3	1.3
4. Forestry	1	0.3
5. Housewife	3	1.0
6. Labor	4	1.3
7. Pharmacy	2	0.7
8. Public (General)	5	1.7
9. Public Utility	1	0.3
10. Recreation	2	0.7
11. Research (Basic)	1	0.3
12. Social Work	2	0.7
13. State Government	22	7.3
14. Wildlife Management	3	1.0
Totals	51	17.0

TABLE 4

AGE OF BOARD MEMBERS - QUESTION FIVE -
PART A OF QUESTIONNAIRE - 1969

Age Group	Total Number of Board Members	Per Cent of Total Members (N = 288)
1. 20-30 years	1	0.3
2. 31-40 years	26	10.0
3. 41-50 years	78	27.0
4. 51 and above	148	51.0
5. Unknown	11	3.8
6. No Response	24	8.3
Totals	288	100.0

educational backgrounds is unknown, one should not infer a lack of educational achievement. Given the statutory makeup of the Boards, and for the most part their nonpartisan character, and this day and age of mass education, one probably can say that this figure is the result of error in reporting or simply a lack of complete information on those members who make up this ten per cent. Likewise, with regard to the "no response" category, one can infer that the question of educational attainment is most probably considered "too personal" and not likely to be reported.

It is clear that on a national basis the educational attainment is quite high with 70 per cent of the members possessing at least one college degree. Many undoubtedly possess two or more degrees as evidenced by the fact that 12 per cent have Master's degrees and nearly 22 per cent have Doctor's degrees. In fact the data show that the Doctor's degree ranks second only to the Bachelor's degree in educational level attained. The figures contained in Table 1 represent the highest level attained for each board member and do not contain any "double counting" of academic degrees. It is obvious from the data, therefore, that these members are qualified to serve in a policy-making capacity.

As is shown in Table 2 the majority of members, nearly 55 per cent of the total, represent Healing Arts, Engineering, Business and Industry in that order. In terms of the "quality of the data" in this table it is noteworthy that each member's occupation or profession is identified. While there were fifteen "no responses" for a figure of five per cent of the total, the investigator regards this as not meaningful. He concludes this most probably is due to error in reporting or simply a lack of complete information on those members who make up this five per

cent.

Because this distribution was bi-modal, it was decided that a more meaningful presentation of the data would result if the category "other" were analyzed further. This was done in Table 3 which shows fourteen separate and different occupational or professional categories. It is noteworthy that the range of the fourteen categories is somewhat uniform. There is no concentration in any one category with the exception of State Government. The raw data shows this category to consist mainly of both elected and appointed officials. For the most part these officials regularly send a deputy to represent them at each meeting of the various boards. This tends to insure continuity and builds confidence and expertise in the deputies, who generally are technical people.

Table 4 shows that the majority of members, 51 per cent, are in the age group 51 and above. Presumably the upper limit is reached at age 65; however, this may not be true in all cases. The next concentration of members, 27 per cent, falls within the age group 41 to 50 years. This age group is generally considered to contain those people who are "on the way up" and who are most active in their professions and in affairs of State. The rest of the members are ranged nonsystematically. While nearly 4 per cent of the members' ages are unknown, the investigator does not consider this meaningful in view of the fact that there is a clear majority within a specific age group. Although a "no response" was reported for over eight per cent of the members, for the same reason as above, the investigator does not consider this figure meaningful. It most likely can be explained as lack of knowledge on the part of the respondent.

In summary it may be said that the typical board member is fifty years of age or older and possesses at least one college degree. His degree is either in the Healing Arts or in Engineering and he is the spokesman for business or industry.

Section Two: Part B of the Questionnaire - Census of Opinions Expressed as Percentages

The mail-out of Part B followed Part A during the fourth quarter of 1969. It went out to the thirty-four state chairmen previously identified by Part A. Of the thirty-four state chairmen, thirty-two responded which yielded a ninety-four per cent response to the survey. After checking to be certain of the correct identity of the two nonrespondents, three follow-up letters were sent out to each chairman. In both cases each of the three attempts failed to get a response. The investigator and his advisors concluded from this that both nonrespondents would not cooperate and no additional attempts at follow-up were undertaken. For purposes of this investigation an air quality standard is defined as the maximum allowable concentration under specified conditions of a pollutant in the out-of-doors atmosphere. Air quality criteria are human value judgments based on sound scientific evidence as to what the value for the maximum allowable concentrations ought to be.

Figures 2 and 3 show that a majority of the chairmen expressed a "yes" opinion with regard to a majority of the questions asked. Majority in this study is defined as greater than 50 per cent of the responses or greater than six of the twelve questions asked. From the data it is apparent that opinion is strong for the inclusion of both long-term values and short-term values in any ambient air quality standard that

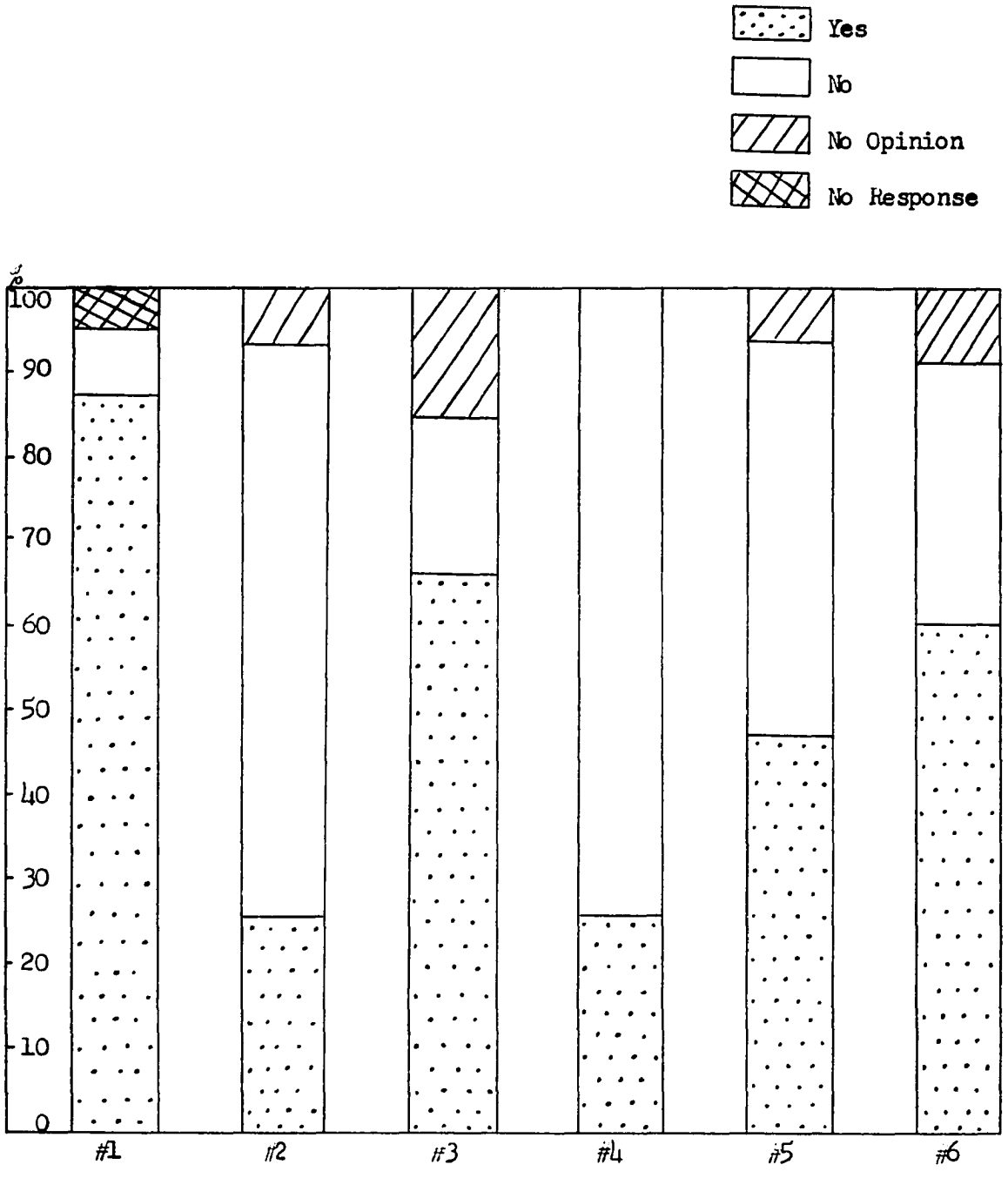

Fig. 2--Percentage of responses to questions 1-6 Part B of the questionnaire.

[a]See Appendix B for a statement of each question

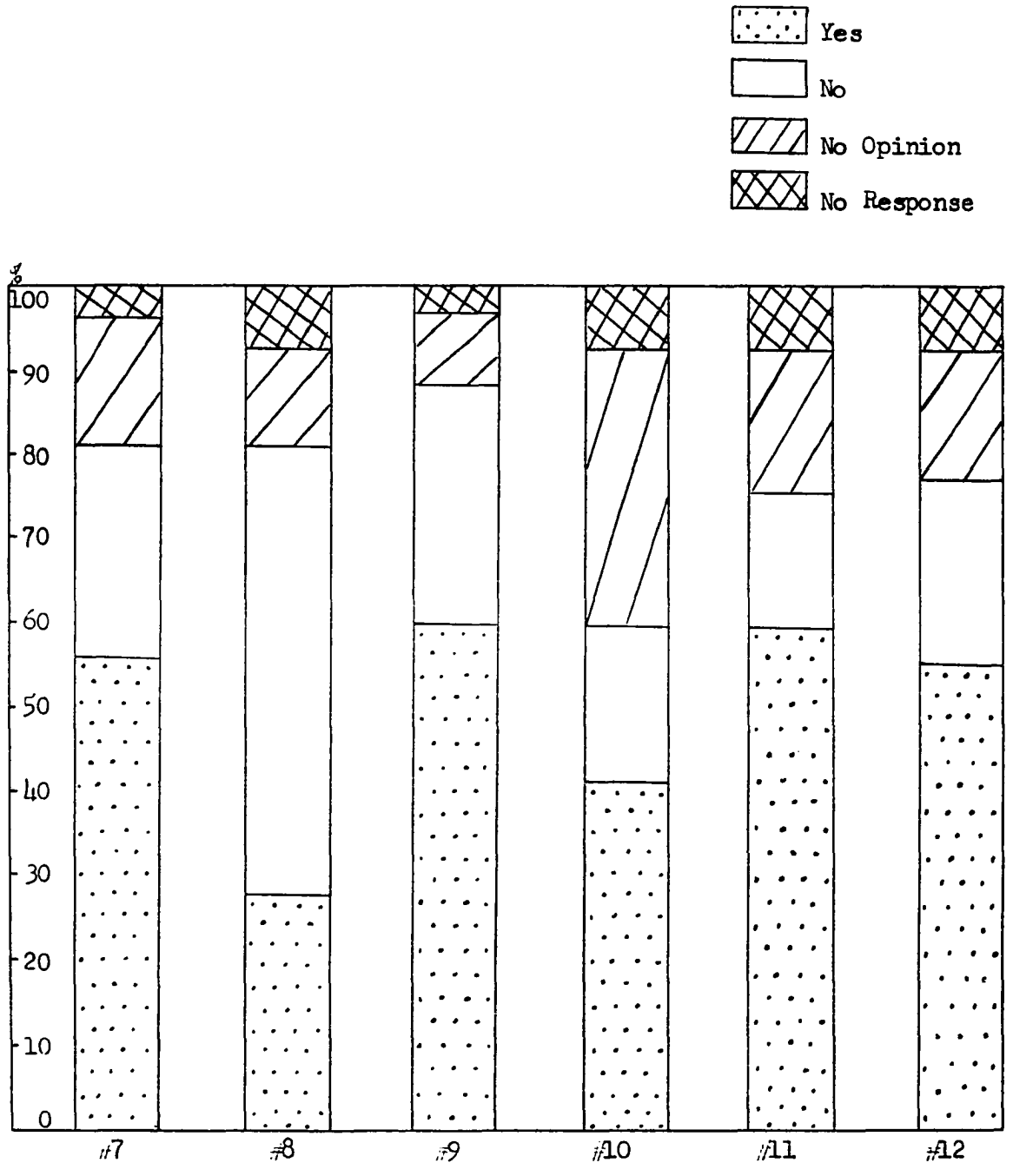

Fig. 3--Percentage of responses to questions 7-12 Part B of the questionnaire.

[a]See Appendix B for a statement of each question.

might be established. A majority opinion favors adopting a subjective method for determining when an odor is to be considered objectionable. However, 19 per cent expressed a negative opinion while a sizable number of 16 per cent expressed no opinion in this matter.

The data also shows board chairmen opinion runs three to one (75 per cent vs. 25 per cent) against the Federal Government taking the initiative in establishing uniform ambient air quality standards applicable to the entire country. However, a majority of the chairmen think that the ambient air quality criteria for total particulate matter and sulfur dioxide promulgated by the Federal Government can be translated into ambient air quality standards at this time. Likewise, a majority of the chairmen think that their respective Boards as presently constituted would support in the affirmative such action. Further, a majority think it essential to the rational management of the air environment that the Federal Government establish uniform air quality criteria.

Presumably, these criteria would serve as guidelines for the setting of standards by the individual states. However, there is no clear cut opinion as to whether or not the various chairmen think their respective boards would support the promulgation of air quality criteria by the Federal Government in a manner that would permit the Federal Government to move rapidly forward in the many areas of criteria. It would seem the figures indicate much uncertainty on the part of the various board chairmen. The data also indicate a favorable opinion in support of more stringent federal automotive exhaust emissions standards.

Lastly, the data indicates that a majority of the chairmen think their activities and the activities of their fellow board members in the

conduct and discharge of their public duty are nonpartisan. Also, they think the present composition of their respective boards adequately reflects the opinions concerning conservation policies of the political party currently in office in their individual states.

Section Three: Respondents' Choices of Values for Various Ranges Incorporated into Selected Questions

Since a definite no majority was expressed for both question two and question eight it was decided to analyze further the no responses to these two questions. Responses to question five were analyzed as well, due to the fact that the responses split evenly at forty-seven per cent yes and forty-seven per cent no with six per cent no opinion. Thus there was no majority opinion on this question and the investigator felt that this ambiguity of opinion merited additional analysis. Tables 5 through 8, which follow, present the additional data generated as the result of these further analyses.

The figures in Table 5 show that thirty-six per cent of the total of those expressing a no response to question two - Part A, think that a geometric mean concentration for particulate matter in the range of 200 to 225 micrograms per cubic meter of air sampled is desirable as an ambient air quality standard in their respective states. However, forty-six per cent indicated that they would prefer some other ranges of concentrations. Some examples given by the respondents range from less than 200 micrograms down to sixty-five micrograms. There was not, however, any systematic pattern which might suggest a preferred range. Nevertheless, a strong collective opinion was expressed that qualitatively all the ranges as stated on the questionnaire were too high.

TABLE 5

STATED CHOICES OF RANGES EXPRESSED AS PERCENTAGES OF THE TOTAL NUMBER OF NO RESPONSES[a] - QUESTION TWO - PART B OF QUESTIONNAIRE - 1969

Concentration Ranges in Micrograms Per Cubic Meter of Air Sampled	Number of Chairmen	Percentage of Total Number-No Responses[b] (N = 22)
200-225	8	36.0
225-250	1	5.0
250-275	1	5.0
275-300	0	0.0
300 and above	2	10.0
Other	10	46.0
None	0	0.0

[a]See Appendix B for a statement of the question.

[b]Rounded off to the nearest whole number.

TABLE 6

STATED CHOICES OF RANGES EXPRESSED AS PERCENTAGES OF THE TOTAL NUMBER OF NO RESPONSES[a] - QUESTION TWO - PART B OF QUESTIONNAIRE - 1969

Time Ranges in Per Cent	Number of Chairmen	Percentage of Total Number-No Responses[b] (N = 22)
1 - 3	8	36.0
3 - 5	0	0.0
5 - 7	0	0.0
7 - 10	1	5.0
10 and above	0	0.0
Other	10	46.0
None	0	0.0

[a]See Appendix B for a statement of the question.

[b]Rounded off to the nearest whole number.

TABLE 7

STATED CHOICES OF RANGES EXPRESSED AS PERCENTAGES OF THE TOTAL NUMBER OF NO RESPONSES[a] - QUESTION FIVE - PART B OF QUESTIONNAIRE - 1969

Concentration Ranges in Micrograms Per Cubic Meter of Air Sampled	Number of Chairmen	Percentage of Total Number-No Responses[b] (N = 15)
50 - 75	5	33.0
75 - 100	4	27.0
100 - 125	1	7.0
125 - 150	0	0.0
150 - 200	0	0.0
Other	5	33.0
None	0	0.0

[a]See Appendix B for a statement of the question.

[b]Rounded off to the nearest whole number.

TABLE 8

STATED CHOICES OF RANGES EXPRESSED AS PERCENTAGES OF THE TOTAL NUMBER OF NO RESPONSES[a] - QUESTION EIGHT - PART B OF QUESTIONNAIRE - 1969

Concentration Ranges in Parts Per Million for Ambient Air	Number of Chairmen	Percentage of Total Number-No Responses[b] (N = 17)
0.01 - 0.02	4	24.0
0.02 - 0.05	6	35.0
0.05 - 0.10	3	18.0
0.10 - 0.15	0	0.0
0.15 - 0.20	0	0.0
0.20 and above	1	6.0
Other	2	12.0
None	1	6.0

[a]See Appendix B for a statement of the question.

[b]Rounded off to the nearest whole number.

Question two was deliberately chosen and worded to act as an indicator of the possible extent to which intelligent and knowledgeable persons are being confused by statements published by the Federal Government. The geometric mean is defined as the N^{th} root of the product of X_n factors. This is a truncated statistic that cannot be computed when any value of X is zero or negative. All values of X must be positive and greater than zero. Thus, the geometric mean is the appropriate average when the observations are measures of rate of change. The ranges of values were fictitious and consisted of numbers that bore no relationship whatsoever to the numbers contained in questions five and eight. Thus, the only logical answer to question two as stated on the questionnaire would have been no with none as the choice of ranges. Analysis of the responses, as supplied by the chairmen, shows this was not the case in more than fifty per cent of the responses. This varied response clearly demonstrates the confusion that exists among the various states with regard to current technical information upon which to base respective state ambient air quality standards.

The figures in Table 6 indicate that thirty-six per cent of the total of those expressing a no response to question two - Part B think that a time range of one to three per cent of the total days in any one year is desirable. However, forty-six per cent indicated that they would prefer some other time ranges. Some examples of time ranges given by the respondents include a spread of from one per cent to fifty per cent. One respondent is of the opinion that the standard, once determined and adopted, should never be expected. There was not, however, any systematic pattern which would suggest a clear understanding of the values.

Table 7 contains data which suggests that board chairmen opinion is strongly divided with regard to a value for an annual arithmetic mean concentration for particulate matter. Of the forty-seven per cent who expressed a no response to question five, fully one-third of these chairmen indicated that they preferred a range of from less than seventy-five micrograms down to presumably background levels. Another third indicated that they preferred a range of values other than those stated on the questionnaire. Some examples given by the respondents ranged from eighty-five micrograms down to less than fifty. Two respondents preferred an annual geometric mean of seventy-five micrograms rather than an arithmetic mean. One chairman gave no response as his preferred range of values. The remaining third indicated a preference for a range of values that fell between seventy-five micrograms on the low side to a maximum of 125 micrograms. Thus, it would appear from the data that a strong majority opinion exists among board chairmen that a maximum value of 125 micrograms per cubic meter of air sampled, computed as the annual arithmetic mean, is desirable as a standard in their various states. As for a range of values below this suggested maximum, the data indicate a lack of any clear consensus.

The percentage values shown in Table 8 indicate a divided opinion among those respondents who expressed a no answer to question eight. Nearly one-fourth of these chairmen indicated a choice which ranged below the stated value. Almost sixty per cent indicated a choice which ranged above the stated value while seventeen per cent indicated a choice of other or none. But, it should be pointed out, nearly seventy-two per cent of the chairmen chose a range of values which clustered about the

stated value. That is, they indicated a preference for some standard, the value of which would fall within the range of 0.01 to 0.05 parts per million for ambient air. Thus, the data seems to indicate that there is ambiguity and disparate opinion among the various board chairmen as to what specific value they think is desirable in their respective states as a standard for sulfur dioxide concentration in the ambient air.

CHAPTER V

CONCLUSIONS AND SUMMARY

> In Air Pollution Control, whatever is good enough today will not be good enough tomorrow. And whatever is not good enough today will soon be absolutely intolerable. Toward greater population seems to be the way things are inevitably going. We had better get ready, therefore, to make living as pleasant as possible under the circumstances. In this, the greatest burden will continue to fall on industry. It will be another of those challenges that seems to require an ever-growing degree of statesmanship in management. It is vital that enlightened management meet this challenge (34).

Conclusions

The increasing attention being given to the subject of air quality criteria and standards is a result of the expanding efforts to deal with the air pollution problem. Standards suggest air quality in quantitative rather than qualitative terms and establish specific goals when designing control programs involving numerous sources, kinds of pollutants, and their effects. They describe the contaminants of concern, suggest the air quality desired by the community or state, and provide a basis for determining the degree of control over source emissions to achieve this air quality. In the absence of accepted standards, the parties involved in the control of air pollution tend to adopt their own guides for satisfactory air quality which can range from very low to relatively high levels of air pollution. Obviously such an approach produces standards that vary greatly from city to city and from state to

state. As the data generated by this investigation seem to indicate, there is no clear consensus among board chairmen as to what the standards should be for concentrations in the ambient air of total particulate matter and sulfur dioxide. This appears to be due to the confusion now extant among the board chairmen arising primarily from the failure of the Federal Government to impart sufficient information to the states in time for them to adopt their own standards as mandated by the Federal Air Quality Act. Therefore, at this time, standards cannot be expected to bring about complete agreement on needs for air pollution control. They can, if based on sound scientific and economic data, bring about a much closer consensus than if there were no standards. Air quality standards by their very nature are not the answer to all air pollution control problems. Standards suggest a pathway to follow, but do not provide a means of getting to an end; in this case, a solution to air pollution control problems.

The formulation of standards raises many problems and questions. Most of these arise from the difficulty of prescribing precise numbers for contaminant concentrations that cause the various effects and from the lack of adequate scientific data on effects experienced at given concentrations of contaminants or combination of contaminants. Much of the difficulty that state and local agencies face in adopting air quality standards can be traced to the lack of quality scientific data on which to base and support the standards.

The data also seem to indicate that if air quality standards are to be of maximum value to a control agency, they must include all the pollutants that cause the problems in the community, and they must be

based on criteria which are accepted by the scientists and technical people of the community. Standards that appear to be arbitrary will not be accepted as a sound basis for a control program. The investigator is of the opinion that the absence of criteria, until just recently, has been one of the reasons for the failure of state and local agencies to adopt meaningful and consistent air quality standards. It would be interesting to be reviewing the progress in setting of standards, had criteria been available for several years. The data from the investigation show that the various board chairmen want the Federal Government to play the central role and make the greatest contribution in the area of criteria. It is clear the individual states do not want to duplicate the effort and expense of acquiring the data required to develop criteria. The need for criteria and the important role of the Federal Government in this area have already been recognized by Congress as evidenced by the passage and funding of the Clean Air Act and the Air Quality Act and their amendments.

The data also make clear that a strong opinion exists among the various board chairmen that nationwide standards would not be the most effective way to bring about air pollution control. If one considers the nature of the air pollution problem, the purpose and use of air quality standards, and the fact that local agencies have the major responsibility for enforcement of control measures, then standards which include factors of safety and other modifying factors that reflect social, political, economic and technical considerations may better serve the best interests of those communities with air pollution problems. Accordingly, one can infer from the data that standards should be adopted by a level of

government which has the legal authority to see that they are enforced. This being the case, it is not clear how the Federal Government could establish and enforce standards in cases of intrastate air pollution. What happens when a local area fails to establish a control program or even to evaluate its air quality in terms of the nationwide standards? Of course, under the Constitution, the Federal Government exercises Federal authority over air pollution from Federal installations, interstate areas, international borders, and motor vehicle emissions.

In conclusion, if maximum effectiveness in air pollution control is to be achieved through the use of air quality standards, methods must be devised to make their use mandatory rather than optional by communities with air pollution problems. This can best be accomplished by the adoption of standards at the state level of government.

In the opinion of the investigator the technical aspects of air pollution are not receiving the best efforts of the science and engineering community. This is due to several factors: the unglamorous nature of the field relative to electronics, space and weaponry; the interdisciplinary nature and incoherent uncoordinated breadth of the problems; and the lack of a clear-cut research strategy at the Federal level. Consequently, the private sector skills and facilities have not been motivated and brought to bear on the problems because criteria and standards, as yet, have not been firmly established. This investigation has shown that definitive standards (essentially what is wanted in the air) are not being set because criteria (essentially the effects upon animate and inaminate systems) are lacking. This body of fundamental information for use in eventually setting limiting standards involves ecological

studies which are as yet incomplete and in some instances not even started. These measurements of the effects of air contamination on human health and the living environment are a very difficult field of science. Without them, however, argument will continue in a rather uninformed way which will confuse the public and frustrate both industry and public officials. The investigator believes the attachment of a number to a concept, thereby creating a so-called standard, is contrary to the philosophy of the Public Health movement. Although this has occurred in the past and continues today to be practiced, in retrospect, the results of such practice have been less than satisfactory. In the opinion of the investigator, in the "Public's mind" to exceed often a certain numerical value is injurious to health; anything less than this numerical value tends to be salubrious. Such a public attitude toward health cannot be justified by modern science. Since organism and environment are inseparable health is a process of organismic-environmental interaction in a particular ecological context. Health then is not the absence of all disease but the ability of the organism to function effectively in a particular environment.

To improve knowledge of what pollution means to man, scientific activity in ecology and related fields should be expanded to provide:

1. Baseline measurements in plant and animal communities and the environment - an ecological survey.
2. Continued monitoring of changes in the biosphere.
3. Ability to predict the consequences of manmade changes.
4. Early detection of consequences.
5. Knowledge of the environmental determinants of disease.

In short, to acquire the ability to describe and to predict. These are certainly the fundamental functions of science. For in the words of Marston Bates, "We are a part of nature still, and we cannot escape the uncomfortable question of how much of nature we can destroy without destroying ourselves" (35).

The lack of standards should not be used, however, as an excuse for inactivity by industry. Even if it is not known exactly how to specify ambient air quality, it is known that a downward trend is indicated for almost all emissions. Therefore, while admitting that much more knowledge must be gained, a look to the future must be taken by industry to equip new plants with control equipment and plan investments to modify older plants to abate emissions at their source (abatement is essentially how to keep out the emissions that enter the ambient air). One would think that the laboratories of these same industries would be a primary source of the new devices and techniques to overcome pollution. There is bound to be a tremendous market created in the near future, partly by Government regulations, and partly by normal economics. The true costs of pollution are always placed on price tags, balance sheets and tax bills. It is the general public who ultimately decides what is adopted as the standard, for there are limits on what the general public will tolerate before it reacts and on what it will pay at the market place for the additional costs of pollution control. These costs are usually passed on and seldom absorbed at the source. The clash between money culture and collective desire for aesthetics and health promotes and perpetuates this social discord. It manifests itself, in most instances, as political chicanery that clouds the public's thinking and

confuses and frustrates both industry and public officials in the setting and defending of standards. However, the benefits of known technology can give an immediate start toward the ultimate goals of air quality which will be set, and met, by further research and development. Government should underwrite the demonstration of new abatement methods which must be proved out on a large scale, such as in model cities. But, in the opinion of the investigator, the key to better environmental quality is in the creativity of industrial laboratories and in the profit motive of private sector management.

Man is living well thanks to a fast-paced, highly technical economy. His environmental health is commensurate with an industrial life. His ability to raise the standard of living throughout the world depends on a continued blooming of technology, and the new conservation of wise usage and recycling of resources. Surely man can employ science and engineering to give a balance of benefits at the expense of neither industrial progress nor environmental quality. For in the words of President Nixon, "...the great question of the '70's is: shall we surrender to our surroundings or shall we make our peace with nature and begin to make reparations for the damage we have done to our air, to our land and to our water?" (36).

Summary

This investigation was undertaken to obtain and record the opinions of knowledgeable persons on the nature of an air quality standard and the need for consistent national guidelines. The investigation probed such topics as:

1. What is the description of the personal characteristics according

to age, education and occupation of the various state air pollution control board chairmen?

2. What are board chairmen opinions on the desirability of the Federal Government promulgating air quality criteria?
3. In the opinion of the board chairmen, when and how could pollutant levels be measured?
4. In the opinion of the board chairmen, which level(s) of government should take the initiative in setting ambient air quality standards?
5. In the opinion of the board chairmen, what are some of the acceptable upper and lower limits within which standards could be set?

The results seem to indicate that the typical state board chairman is a college graduate with possibly more than one degree in either the healing arts or engineering and speaks for either business or industry. He is fifty years of age or older. For the most part he is uncertain of what value or range of values and under what conditions such values constitute a desirable standard for total particulate matter concentrations and sulfur dioxide concentrations, in the ambient air. He is strongly opinionated that the Federal Government should promulgate criteria based on hard scientific data but leave the setting of standards, based on these criteria, up to the individual states. He believes his board activities are nonpartisan and in the best interests of the citizens of his state.

In summary, the results of this investigation seem to indicate that there is no meaningful consensus among board chairmen in regard to what value or range of values would be desirable in their various states

as standards for total particulate matter and gaseous sulfur dioxide concentrations in the ambient air. Thus, in the opinion of the investigator, this appears to be due to the confusion now extant among the board chairmen arising primarily from the failure of the Federal Government to impart sufficient information to the states in time for them to adopt their own standards as mandated by the Federal 1967 Air Quality Act. The results further seem to indicate that the various states want to establish their own standards but only after the Federal Government provides the guidelines and suggests those values which constitute ambient air quality criteria. Presumably these criteria would be the goals which the various states would seek to attain.

Implications for Future Research

In the opinion of the investigator the following aspects of this investigation lend themselves to further research. An expansion of this investigation would be desirable to better establish the reliability of the results obtained and to provide additional research findings bearing upon various air quality opinions held by board chairmen. Since much emphasis is placed on participatory democracy by all the members of a board, it would be interesting to determine from similar research investigations to what extent the Air Pollution Control Boards are dominated by their chairmen and thereby make some determination of the quality of leadership exercised by these persons.

The fact that a clear-cut majority of the chairmen involved in the investigation responded with negative opinions toward some of the Federal Government's air quality criteria is important for several reasons. Since large sums of public monies are being expended in developing

criteria, all forms of honest and constructive evaluation of the scientific data and the resulting criteria are needed and are in the public's best interest. Therefore, additional investigations should be undertaken to determine what impact these data and criteria are having upon the individual states in their efforts to establish air quality standards. Investigations should be undertaken to determine the reason(s) for the negative opinions uncovered by this investigation. Such investigations might suggest changes in the rationale of the Federal law and might result in a higher percentage of favorable opinions and speedier progress in the establishment of standards. Such changes would not necessarily have to be of such a nature that they would result in a collapse of the standards already established.

Finally, future investigators should be aware of the fact that technical people in air pollution devote much of their effort to determining what they believe to be correct numerical values. It is inevitable that such will be the pattern of the future. Therefore, the need will surely arise to evaluate the opinions held by the decision makers regarding the numerical values suggested by technical people.

SELECTED BIBLIOGRAPHY

1. Herrmann, Paul. Conquest by Man. New York: Harper & Bros., 1954.

2. Clayton, George. "Considerations in Setting Air Quality Standards", Journal of the American Industrial Hygiene Association, XXI, (October, 1960), 430.

3. World Health Organization. Air Pollution. Monograph Series, No. 46; Geneva: World Health Organization, 1961.

4. Ibid.

5. Ibid., 14

6. Halliday, E. C. "Historical Review", Air Pollution, World Health Organization Monograph Series No. 46; Geneva: World Health Organization, 1961.

7. McCabe, L. C. "The Identification of the Air Pollution Problem", Air Pollution, World Health Organization, Monograph Series No. 46; Geneva: World Health Organization, 1961.

8. Wolozin, Harold. "Setting Criteria for Public Expenditures on Air-Pollution Abatement: Theoretical Foundations and Limitations", The Economics of Air Pollution, Harold Wolozin, Ed., New York: W. W. Norton and Co., 1966.

9. U. S. Congress. Senate. First Report, Progress in the Prevention and Control of Air Pollution. Report No. 92. 90th Cong., 2nd Sess., June 28, 1968.

10. Maga, J. A. "The Setting of Ambient Air Quality Standards", Journal of Occupational Medicine, X, No. 8 (August 1968), 491.

11. Larsen, R. I. "Determining Reduced-emission goals needed to Achieve Air Quality goals - a hypothetical case", Journal of the Air Pollution Control Association, VIII, No. 12, (December, 1967), 823.

12. Johnson, Lyndon B. A Presidential Public Statement issued from the White House, Washington, D. C., November 15, 1967.

13. Ringelmann, M. "A Practical Smoke Chart", Review of Technology, XII, (May, 1898), 268.

14. Stern, A. C. "Emission Standards in Air Pollution", American Journal of Public Health, LV, (July 1965), 1075.

15. Clayton, op. cit., 433.

16. Clayton, op. cit., 437.

17. Supreme Soviet of the U.S.S.R. "Order No. 431 prescribing measures for controlling pollution of the air and for the improvement of health and hygiene conditions in urban districts", Gigiene i Sanitariya, XXII, No. 8, (August, 1949), 62.

18. Ibid., 65

19. British Parliament, "Public General Acts and Measures", International Digest of Health Legislation. LX, (October, 1958), 181.

20. British Parliament, op. cit., XI.

21. British Parliament, op. cit., XII.

22. Parker, A., "Air Pollution Legislation: Standards and Enforcement", Air Pollution, World Health Organization, Monograph Series No. 46; Geneva; World Health Organization, 1961.

23. Ibid., 371

24. Katz, M., Drowley, W. B. "Canadian Activities in Ambient Air Quality Criteria and Development of Standards", Canadian Journal of Public Health, LVII, No. 2 (February, 1966), 71.

25. Organization for European Economic Co-operation (EEC), European Productive Agency, Air and Water Pollution: The Position in Europe and in the United States. Paris: European Productive Agency, 1957.

26. Beveridge, W. I. B. The Art of Scientific Investigation. New York: W. W. Norton and Co., 1951.

27. Stanko, D. "Pollution". Unpublished poem.

28. Beveridge, W. I. B. The Art of Scientific Investigation. New York: W. W. Norton and Co., 1951.

29. Beveridge, op. cit., 107.

30. Davis, F. B. Educational Measurements and Their Interpretation. Belmont: Wadsworth Publishing Co., 1964.

31. Payne, S. L. The Art of Asking Questions. Princeton: Princeton University Press, 1951.

32. Blankenship, A. B. "Pretesting a Questionnaire", Sociometry, III, No. 3 (July, 1940), 27.

33. Tyndall, J. Faraday as a Discoverer. London: Green and Co., 1868.

34. Pendray, Edward G. "Management Aspects of Air Pollution", Mechanical Engineering, LXXVII, (July, 1955), 583.

35. Bates, Marston. Man in Nature. Englewood Cliffs: Prentice Hall, Inc., 1964.

36. Nixon, Richard M. State of the Union Message, January 22, 1970. The White House, Washington, D. C.

APPENDIXES

APPENDIX A

APPENDIX A-1

SELECTED STATE AMBIENT AIR QUALITY STANDARDS
PARTICULATES
FOURTH QUARTER 1969

STATE	LEAD Ug/M^3	H_2SO_4 MIST Ug/M^3	Suspended SO_4 Ug/M^3	SMOKE RINGLEMAN No.	Total Suspended Particulates Ug/M^3
ALABAMA					
ALASKA					
ARIZONA					
ARKANSAS					
CALIFORNIA					
COLORADO					120/ 3 mo.
CONNECTICUT					
DELAWARE					130(25)
FLORIDA					
GEORGIA				2	
HAWAII				2	
IDAHO		12(28)			(32)
ILLINOIS(38)	4.0(1)				125(1)
INDIANA				2,3(8)	100(38)
IOWA					
KANSAS					
KENTUCKY					
LOUISIANA					
MAINE					
MARYLAND					

APPENDIX A-1 - Continued

STATE	LEAD Ug/M^3	H_2SO_4 MIST Ug/M^3	Suspended SO_4 Ug/M^3	SMOKE RINGLEMAN No.	Total Suspended Particulates Ug/M^3
MASSACHUSETTS				2,3(8)	
MICHIGAN				2,3(8)	
MINNESOTA		30(6),(9)	4(1) 12(28)		75(1) 200(39)
MISSISSIPPI(38)				2	
MISSOURI		- St. Louis Metropolitan Area only -			
MONTANA	5.0(2)	4(1) 30(6)	4(1) 12(9)		75(1) 200(2) (1%)
NEBRASKA					
NEVADA					
NEW HAMPSHIRE					
NEW JERSEY				2,3(8)	
NEW MEXICO				1	150(2)
NEW YORK		0.1(4)		1	120(4)
NORTH CAROLINA				2	
NORTH DAKOTA(38)					120(28)
OHIO					
OKLAHOMA					
OREGON					60(1) 100(29) (50%)
PENNSYLVANIA	5.0(2)(12)	(11)			150(2) 500(4)
RHODE ISLAND				2	
SOUTH CAROLINA				2	(31)
SOUTH DAKOTA					
TENNESSEE					

APPENDIX A-1 - Continued

STATE	LEAD Ug/M^3	H_2SO_4 MIST Ug/M^3	Suspended SO_4 Ug/M^3	SMOKE RINGLEMAN No.	Total Suspended Particulates Ug/M^3
TEXAS		30(20) 100 125		1(33)	(32) (2)
UTAH					
VERMONT				2	
VIRGINIA				2	
WASHINGTON(27)				2	
WEST VIRGINIA				2	
WISCONSIN					75(1)
WYOMING					200(28)
U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE					
AMERICAN PETROLEUM INSTITUTE	15(2)				

APPENDIX A-2

SELECTED STATE AMBIENT AIR QUALITY STANDARDS
GASES
FOURTH QUARTER 1969

STATE	CO PPM	H_2S PPM	OXIDANTS PPM	NO_X PPM	SO_2 PPM
ALABAMA					
ALASKA					
ARIZONA					
ARKANSAS					
CALIFORNIA	30(5)(14)	0.1(6)	0.15(6)	0.25(6)(15)	0.3(5) 1.0(6)
COLORADO			0.1(6)	0.1(6)	0.1(4) 0.3(5) 0.5(6)
CONNECTICUT					
DELAWARE					0.1(4) 0.3(5)
FLORIDA					0.1(5)
GEORGIA					0.2(11)
HAWAII					
IDAHO					1.5(9)
ILLINOIS(38)	30(9)	0.05(7)	0.25(6)(9)	0.5(6)	0.2(4)
INDIANA					

APPENDIX A-2 - Continued

STATE	CO PPM	H_2S PPM	OXIDANTS PPM	NO_X PPM	SO_2 PPM
IOWA					
KANSAS					
KENTUCKY					
LOUISIANA					
MAINE					
MARYLAND					
MASSACHUSETTS					
MICHIGAN					
MINNESOTA		0.05(22)	0.15(6),(9)		0.02(1) 0.10(28)
MISSISSIPPI(38)					0.1(4)
MISSOURI		- St. Louis Metropolitan Area Only -			
MONTANA		0.03(21) 0.05(22)		0.1(11)	0.02(1) 0.10(4) 0.25(6)
NEBRASKA					
NEVADA					
NEW HAMPSHIRE					
NEW JERSEY					0.1(4) 0.25(6)

APPENDIX A-2 - Continued

STATE	CO PPM	H_2S PPM	OXIDANTS PPM	NO_X PPM	SO_2 PPM
NEW MEXICO[27]					
NEW YORK	20[5]	0.1[6]	0.15[6]		0.1[4] 0.25[6]
NORTH CAROLINA					
NORTH DAKOTA[38]		0.1[6][28]	0.15[6][28]	0.1[6][28]	0.1[4] 0.5[6][28]
OHIO					
OKLAHOMA					
OREGON					
PENNSYLVANIA[9]	25[4]	0.1[6] 0.005[4]	(11)	(11)	0.05[2] 0.25[4] 0.5[6]
RHODE ISLAND					
SOUTH CAROLINA					0.1[4] 0.3[7] 0.5[7]
SOUTH DAKOTA					
TENNESSEE					
TEXAS		0.08[23] 0.12[24]			0.2[18] 0.5[19]
UTAH					
VERMONT					

APPENDIX A-2 - Continued

STATE	CO PPM	H_2S PPM	OXIDANTS PPM	NO_X PPM	SO_2 PPM
VIRGINIA					
WASHINGTON[27]					0.2[4]
WEST VIRGINIA					
WISCONSIN					
WYOMING					
U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE	4-6[5]			0.08[6]	0.1[4]
AMERICAN PETROLEUM INSTITUTE	15[5]	0.1[6]	0.15[6]	0.25[6]	0.2[4]

APPENDIX A-3

EXPLANATORY NOTES FOR APPENDIXES A-1 AND A-2

(1) Annual average

(2) 30 day average

(4) 24 hour average

(5) 8 hour average

(6) 1 hour average

(7) 30 minute period

(8) 10 minute period in 12 hours

(9) Maximum value not to be exceeded

(10) Single point measurement

(11) Under study - deferred

(12) Tentative

(13) Not regulatory

(14) Serious level - 120 ppm/hr.

(15) Adverse - serious level - 3 ppm/hr.

(16) 5 ton background

(17) Settled particulates

(18) 24 hr. avg. land areas: residential, commercial, or other - 0.3 ppm industrial; emission standards same with higher values allowed for start-up or upset conditions.

(19) 10 min. 12 hrs. - Residential, business or other - 0.6 ppm industrial; emission standards same with higher values allowed for start-up or upset conditions.

(20) 30 Ug/M^3 - 24 hr. avg. land areas: residential, commercial, industrial - ambient and emissions (see (18)).

100 Ug/M^3 - one hour/day land areas: residential, industrial - ambient and emissions (see (18)).

(21) One half hour - 5 days

APPENDIX A-3 - Continued

(22) One half hour - 6 months

(23) 30 min. period land areas: residential, commercial, or other - ambient and emissions (see (18)).

(24) 30 min. period land areas: industrial, or other - ambient and emissions (see (18)).

(25)

Area	Rural	Resi.	Comm.	Indus.
24 hr. avg. (95%)	130	150	170	200

(26) Residential area with background (see (16)); industrial, 30 ton same background.

(27) Emission standards

(28) Maximum values not to be exceeded more than 1% in 3 month period.

(29) Air basin 30 day average:
Suspended particulate 100 Ug/M^3 total

Settled particulate 1.0 Ug/M^3 total

(30) Monthly for residential; 25 tons/Mo. for industrial.

(31) Maximum 1 pound particulate for 10^6 BTU with 80% efficiency removal.

(32)

Area	Res.	Comm.	Ind.	Other
Ambient	125	150	175	200
Emissions	100	125	150	175

(33) No. 2 for installations prior to 2/1/67 also applies for emissions.

(34) Residential with background (see (16)) - industrial, 20 ton, same background.

(35)

		EFFECTIVE 1/12/68		
F.O.		No. 2	No. 4	No. 5 and No. 6
%S	5/68	0.3	0.7	1.0
	10/70	0.3	0.4	0.5
	10/71	0.2	0.3	0.3

(36)

EFFECTIVE 10/1/69	
0.2 # S /10^6 BTU	0.35 # SO_2/10^6 BTU

(37) Effective 11/69 - 1/70 2.3 # S/2 x 10^6 BTU
1/70 - 1/71 2.0 # S/2 x 10^6 BTU

APPENDIX A-3 - Continued

(38) Proposed

(39) Annual 99th percentile

APPENDIX B

PART A

PROFILE SURVEY QUESTIONNAIRE

1. Number of statutory board members _____.

2. Do vacancies currently exist on your board? Yes ____ No ____

   If yes, please indicate number_____.

3. Educational Background: Please indicate number of members at highest educational level.

   a) High school only_____
   b) Bachelor's degree_____
   c) Master's degree_____
   d) Doctor's degree_____

4. Occupational or Professional Background: Please indicate number of members representing listed fields.

   a) Academic _____
   b) Agriculture _____
   c) Business _____
   d) Engineering _____
   e) Healing Arts _____
   f) Industry _____
   g) Law _____
   h) Local Government _____
   i) Other, please specify _____

5. Age of Board Members

   a) 20-30 years _____
   b) 31-40 years _____
   c) 41-50 years _____
   d) 51 and above _____

PART B

RESEARCH SURVEY QUESTIONNAIRE

1. In your opinion, should an air quality standard include both long term values and short term values:

YES_____ NO_____ NO OPINION_____

2. In your opinion, should a geometric mean concentration for particulates of 225 micrograms per cubic meter of ambient air sampled, as measured by high-volume samplers, not to be exceeded by more than three (3) per cent of days in any one (1) year, be adopted as a standard?

YES_____ NO_____ NO OPINION_____

If you answer no, please (X) your choice of the stated ranges of values:

	Range		Range
a)	200 to 225	A)	1% to 3%
b)	225 to 250	B)	3% to 5%
c)	250 to 275	C)	5% to 7%
d)	275 to 300	D)	7% to 10%
e)	300 and above	E)	10% and above
f)	other_____	F)	other_____
g)	none_____	G)	none_____

3. In your opinion, should an odor be considered objectionable when fifteen (15) per cent or more of the people exposed to it, state it to be objectionable in usual places of occupancy?

YES_____ NO_____ NO OPINION_____

4. In your opinion, should the Federal Government take the initiative in setting ambient air quality standards?

YES_____ NO_____ NO OPINION_____

5. In your opinion, should an annual arithmetic mean concentration for particulates of 75 micrograms or less per cubic meter of ambient air sampled, as measured by high volume samplers, be adopted as a standard?

YES_____ NO_____ NO OPINION_____

If you answer no, please (X) your choice of the stated range of values:

Range	Range-Continued
a) 50 to 75	e) 150 to 200
b) 75 to 100	f) other _____
c) 100 to 125	g) none _____
d) 125 to 150	

6. In your opinion, would the conversion of existing ambient air quality criteria into ambient air quality standards be possible at this time?

YES_____ NO_____ NO OPINION_____

7. In your opinion, would your Board, as presently constituted, support such action?

YES_____ NO_____ NO OPINION_____

8. In your opinion, should an annual arithmetic mean concentration of 0.02 parts per million for sulfur oxides, measured as sulfur dioxide, be adopted as a standard?

YES_____ NO_____ NO OPINION_____

If you answer no, please (X) your choice of the stated range of values:

Range	Range-Continued
a) 0.01 to 0.02	e) 0.15 to 0.20
b) 0.02 to 0.05	f) 0.20 and above
c) 0.05 to 0.10	g) other_____
d) 0.10 to 0.15	h) none _____

9. In your opinion, is the establishment of federal air quality criteria essential to rational management of the air environment?

YES_____ NO_____ NO OPINION_____

10. In your opinion, would your Board, as presently constituted, support the promulgation of air quality criteria by the Federal Government in a manner that would allow the Federal Government to move rapidly forward?

YES_____ NO_____ NO OPINION_____

11. In your opinion, should federal automobile emission standards be more stringent than those to take effect in 1970?

YES_____ NO_____ NO OPINION_____

12. In your opinion, does your Board, as presently constituted, reflect opinions concerning conservation policies of the political party currently in office in your State?

YES_____ NO_____ NO OPINION_____

APPENDIX C

APPENDIX C-1

PERCENTAGE OF YES RESPONSES TO PART B
OF THE QUESTIONNAIRE[a] - 1969

Question Number	Total Number of Chairmen	Percentages of Chairmen[b] (N = 32)
1	28	87.0
2	8	25.0
3	21	66.0
4	8	25.0
5	15	47.0
6	19	60.0
7	18	56.0
8	9	28.0
9	19	60.0
10	13	41.0
11	19	60.0
12	18	56.0

[a]See Appendix B for a statement of each question.

[b]Rounded off to the nearest whole number.

APPENDIX C-2

PERCENTAGE OF NO RESPONSES TO PART B OF THE QUESTIONNAIRE[a] - 1969

Question Number	Total Number of Chairmen	Percentage of Chairmen[b] (N = 32)
1	3	9.0
2	22	69.0
3	6	19.0
4	24	75.0
5	15	47.0
6	10	31.0
7	8	25.0
8	17	53.0
9	9	28.0
10	6	19.0
11	5	16.0
12	7	22.0

[a]See Appendix B for a statement of each question.

[b]Rounded off to the nearest whole number.

APPENDIX C-3

PERCENTAGE OF NO OPINIONS TO PART B
OF THE QUESTIONNAIRE[a] - 1969

Question Number	Total Number of Chairmen	Percentage of Chairmen[b] (N = 32)
1	0	0.0
2	2	6.0
3	5	16.0
4	0	0.0
5	2	6.0
6	3	9.0
7	5	16.0
8	4	12.0
9	3	9.0
10	11	33.0
11	5	16.0
12	5	16.0

[a]See Appendix B for a statement of each question.

[b]Rounded off to the nearest whole number.

APPENDIX C-4

PERCENTAGE OF NO RESPONSES TO PART B OF THE QUESTIONNAIRE[a] - 1969

Question Number	Total Number of Chairmen	Percentage of Chairmen[b] (N = 32)
1	1	3.0
2	0	0.0
3	0	0.0
4	0	0.0
5	0	0.0
6	0	0.0
7	1	3.0
8	2	6.0
9	1	3.0
10	2	6.0
11	2	6.0
12	2	6.0

[a]See Appendix B for a statement of each question.

[b]Rounded off to the nearest whole number.