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Air Pollution Control and Abatement Proceedings of a Symposium

Allen D. Kartchner

Utah State University

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AIR POLLUTION CONTROL AND ABATEMENT

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Allen D. Kartchner, Symposium Chairman
Assistant Professor
Utah Water Research Laboratory

PROGRAM

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Welcome . . . . D. WYNNE THORNE, USU

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The Air Pollution Problem in the United States . . . . . .GEORGE JUTZE, NAPCA
The Air Pollution Problem in Utah . . . . . GRANT WINN, Utah State Div. of Health

Panel Discussion: Air Pollution Problems (GENE W. MILLER, USU, Moderator)

GEORGE JUTZE, NAPCA . . . . NAPCA
GRANT WINN, Utah State Div. of Health . . . . .State Regulatory Agency
CLYDE A. HILL, Univ. of Utah . . . . University
LLOYD TRANSTRUM, U. S. Steel Corp., Geneva . . . . Industry

Luncheon Keynote Speaker . . . . SHELDON SAMUELS, NAPCA

Afternoon Session (Thursday): Air Pollution Legislation

The Air Quality Act of 1967 . . . . EARL PORTER, NAPCA
Air Pollution Legislation for Utah . . . . MRS. PHILIP FREDERICK, USACC

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EARL PORTER, NAPCA . . . . NAPCA
MRS. PHILIP FREDERICK, USACC . . . . Citizen
G. D. CARLYLE THOMPSON, Utah State Div. of Health . .State Regulatory Agency
ALBERT BOTT, Weber County Commission . . . . Municipality
CALVIN BEHLE, Attorney-at-law . . . . Business

Morning Session (Friday): Air Pollution Control

Attacking the Air Pollution Control Problem . . . . . RONALD WEST, Univ. of Colo.
Industrial Air Pollution Control . . . .ROBERT HEANEY, Kennecott Copper Corp.

Panel Discussion: Air Pollution Control (ELLIOT RICH, USU, Moderator)

ROBERT HEANEY, Kennecott Copper Corp. . . . . Industry
RONALD WEST, Univ. of Colo. . . . . University
CASPER NELSON, UISA . . . . .UISA
GRANT BORG, Univ. of Utah . . . . University
LYNN THATCHER, Utah State Div. of Health . . . . .State Regulatory Agency

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THE AIR POLLUTION PROBLEM IN THE UNITED STATES

by George Jutze*

While it is probable that the new technologies—when fully applied—are capable of satisfying our unmet need for cleaner air, there is no doubt at all that technological change is primarily responsible for the gravity and present nature of the problem of air pollution.

To be sure, there was air pollution when the eyes of our cavemen ancestors reddened and wept from the smoke of the big bonfires which they used not only for heating and cooking but also to ward off the terrors of the night. But it was not until the Industrial Revolution and the start of our ever-increasing combustion of fossil fuels that air pollution in the modern sense began to blacken the air of our cities and the lungs of our citizens.

The next big magnifier was the invention—and phenomenal proliferation in this country—of the internal combustion engine. Now the fumes from almost 100 million motor vehicles are added to those from the stacks of our factories and power plants.

Then came the technological "explosion" of the past two decades. During and following World War II, new processes created new kinds of chemical pollutants—often invisible and odorless—far faster than their power for harm could be accurately assessed. Tomorrow, there will be many more.

Already the pollutants which soil and spoil our vital air resource have increased faster than any other hazard of our modern environment. And unless the same technological skills which have given us the many new amenities of modern living are promptly and effectively directed toward curbing this ugly byproduct of our technological progress, it threatens to exact an ever more exorbitant toll on public health and welfare.

Nature and Sources of Air Pollution

Air pollutants may be solids such as dust or soot particles, liquid droplets such as sulfuric acid mist, or gases such as sulfur dioxide, carbon monoxide, hydrogen sulfide, and the oxides of nitrogen. They include metallic fumes and dusts from lead, vanadium, arsenic, beryllium, and their compounds, and fluorine and phosphorus compounds. In addition, new pollutants are created in the air by the interaction of these and other substances under the influence of sunlight. This is the origin of so-called photochemical smog, which is suffused with ozone, a highly irritant gas.

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*George Jutze is Deputy Chief of Field Operation Activities, Abatement Program, National Air Pollution Control Administration.

Although they overlap, air pollution sources may conveniently be classifed as: (1) Industrial and commercial, (2) municipal, (3) transportational, (4) agricultural and natural, and (5) individual.

The first group is not limited to the effluents from the stacks of "big industry," exemplified by oil refineries, power plants, steel mills, and other large factories; it also includes pollutants from such commercial sources as drycleaning and restaurant kitchens, which make up by their greater numbers for their smaller size.

Municipal sources include the burning of auto bodies, waste from building demolition, and city dumps; cement mixing and asphalt-paving operations; and municipally owned power plants.

Transportational sources include not only the exhaust pipes, carburetors, crankcases, and gas tanks of automobiles, trucks, and buses, but also the jetstreams of modern aircraft and, in some localities, smoke and soot from river, lake, and ocean vessels.

Volcanoes, forest fires, and dust storms are largely of natural origin, although the last are aggravated by man's road building and agricultural activities. Such airborne substances as pollens, spores, rusts, and smuts—known as aeroallergens because they cause allergic responses in sensitized individuals—come in part from natural vegetation and in part from cultivated crops. Other agricultural activities which may pollute the air are the seasonal burning of stubble, the handling and storage of grain, and the spraying of crops and forests with pesticides.

Individuals are involved, of course, in nearly all the sources so far mentioned, and particularly in the operation of their family cars. Other individual sources, important because they are so numerous, include home and apartment house heating and incinerators, and the backyard burning of leaves and trash.

In those source categories where reliable estimates may be made, we find that motor vehicles annually discharge to the atmosphere of the United States:

66 million tons of carbon monoxide
12 million tons of hydrocarbons
6 million tons of nitrogen oxides
1 million tons of sulfur oxides
1 million tons of particulate matter

Industrial stationary sources contribute:

2 million tons of carbon monoxide
4 million tons of hydrocarbons
2 million tons of nitrogen oxides
9 million tons of sulfur oxides
6 million tons of particulate matter

Power plants discharge annually

1 million tons of carbon monoxide
3 million tons of nitrogen oxides
12 million tons of sulfur oxides
3 million tons of particulate matter

Space heating of our homes, apartments, and offices, coupled with refuse disposal, annually emit:

3 million tons of carbon monoxide
2 million tons of hydrocarbons
2 million tons of nitrogen oxides
4 million tons of sulfur oxides
2 million tons of particulate matter

In a special separate category are radioactive materials in the air, which may become more important with the increasing use of atomic energy for industrial and power purposes.

Extent and Distribution of Air Pollution

How far do all these pollutants travel? Because the sources are now so widespread (with the motor vehicle practically ubiquitous), this question may not be of primary importance any more. But the forests in the Great Smokies are apparently being damaged by pollutants emitted by Tennessee Valley Authority installations in Knoxville and Chattanooga, and in at least one authenticated case, aerial contaminants originating in Texas and Oklahoma were identified in Cincinnati after traveling over 1,000 miles. It is certain that they freely cross municipal and state and national boundaries, thereby greatly complicating legislative and administrative measures for controlling them.

A recent study indicated "major" air pollution problems in approximately 325 places, an increase of almost 100 in a single decade. About 7,300 American places, including all cities of 50,000 or more and accounting for approximately 70 percent of the nation's population, are faced with air pollution problems of greater less severity.

Economic and Social Effects of Air Pollution

Most often overlooked in any catalog of the money losses chargeable to air pollution is the enormous wastage of fuel and sacrifice of efficiency associated with it. Yet in cold dollars and cents, this is probably the costliest of all the economic effects of air pollution. Whenever we see a dense black plume rising from a chimney or jetting from the exhaust pipe of a motor vehicle, it is prima facie evidence of incomplete combustion. The fuel, whether coal or gasoline, is not providing the full measure of heat or power of which it is capable. Considering that not only every factory and power plant chimney and every motor vehicle of every kind but also the space heating requirements of every home and store and public building in the land contribute to the total, the annual dollar cost to the Nation in wasted fuel alone, while incalculable, undoubtedly runs into the billions.

One of the visible results of incomplete combustion, soot, is also responsible for much of air pollution's soiling effect. As President Johnson emphasized in his message to Congress on the natural beauty of our country, air pollution destroys beauty. Our esthetic senses are affronted first of all simply by the dirt in the air. It not only soils the clothingwe wear and the laundry on the line, our rugs and draperies, the paint on our houses, and the finish on our cars; it also mars the beauty of our buildings, our monuments, and even rare books and priceless works of art in our libraries and museums. As the President mentioned in his message, not even the White House is immune. Some air pollutants further affront our senses by their acrid or nauseous odors.

Air pollution also decays and corrodes. Certain air pollutants have caused nylon stockings to disintegrate, turned white housepaint black almost overnight, crumbled the marble in New York's City Hall, and decayed the solid stonework in London's Houses of Parliament.

Reduction of visibility and sunlight is another of the adverse effects of air pollution. As long ago as 1927, a Public Health Service study in New York City showed that loss of light due to smoke was sometimes greater than 50 percent, and throughout the entire year almost a quarter of the sunlight was lost. It has been reported that Chicago's sunlight is reduced by 40 percent because of air pollution. Besides increasing lighting bills and making transportation hazardous, darkness in daylight generates gloom.

Agricultural losses alone in this country because of air pollution, including damages to livestock as well as to growing crops and other plants and trees, are estimated at approximately $500 million a year. While this may be no more than 4 or 5 percent of the total economic damage attributed to contaminated air, it deserves emphasis for at least two reasons: (1) Until recently, air pollution has been thought of, and dealt with—or ignored—by many lawmaking bodies as if it were exclusively an urban problem; and (2) evidence of its harmful effects on more and more kinds of vegetation and in more and more localities is accumulating with exceptional rapidity.

As indicated earlier, air pollution also accelerates the deterioration of materials, structures, and machines of all kinds. This, in turn, greatly increases maintenance and replacement costs. Metals corrode, fabrics weaken and fade, leather weakens and becomes brittle, rubber cracks and loses its elasticity, paint discolors, concrete and building stone discolor and erode, glass is etched, and paper becomes brittle. Even when only soiling of materials is involved, the removal of the deposited grime is often costly and shortens the life of the materials.

Estimates of economic losses due to air pollution are often overly conservative. Rarely are the costs identified for using expensive materials that are resistant to pollutants in place of cheaper material that would be satisfactory in clean air. For example, gold and other precious metals are widely used for electrical contacts because of their low chemical reactivity. The present cost of gold used annually in the United States for electrical contacts is approximately $15 million. If silver could replace gold, the saving would be $14.8 million, based on equivalent volumes of metal.

While exact data are not available on the full extent and total cost of air pollution's damage to property, various cost estimates have been made. The one most frequently used is $65 per capita per year, representing an annual cost to the nation of over $12 billion. It is clearly evident that the dollars-and-cents cost alone is far greater than the amounts devoted to the abatement of pollution by industry and all levels of government combined.

Adverse Health Effects

The adverse effects of air pollution are usually considered as of three general kinds: Economic effects, social effects (esthetic, psychological, and recreational), and health effects. But there is a great deal of overlap among these. For example, the civic edifice or memorial soiled or corroded by sulfurous pollutants in the air must be expensively renovated . . . or remain an eyesore until it reduces nearby property values and hastens the deterioration of a neighborhood. And illness and absenteeism because of pollution-induced respiratory disease involve the patient's money as well as his health.

There is ample evidence today that contaminated air can aggravate our illnesses, deplete our strength, and shorten our lifespan. Most publicized have been the acute episodes in which exceptionally high concentrations of pollutants brought sudden death. An episode in New York City in 1953 was not recognized until a study of vital statistics nine years later revealed that there had been some 200 deaths in excess of normal during a brief period of weather stagnation with unusually high levels of sulfur dioxide and smoke. The most recent such episode on a large scale was the London smog December 1962. Largely because of the intervening passage in Britain of a Clean Air Act, deaths officially attributed to this cause numbered only about 750, as against 4,000 in the 1952 London smog. In all these acute episodes, it was the aged and infirm, and especially the respiratory cripples, who were likeliest to be struck down.

The report of the Health Panel at the 1962 National Conference on Air Pollution was positive and unequivocal on this point. "The evidence," it concluded, "that air pollution contributes to the pathogenesis of chronic respiratory disease is overwhelming."

This evidence applies to at least six different respiratory ailments. They are (1) nonspecific infectious upper respiratory disease, including the common cold, (2) chronic bronchitis, (3) chronic constrictive ventilatory disease, (4) pulmonary emphysema, (5) bronchial asthma, and (6) lung cancer.

Actually, the cost of pollution-induced illness, including absence from work, may constitute the most significant economic loss of all, even though it may never be possible to estimate this loss in dollars and cents.

The Federal Program

About 14 years ago, when the federal program was initiated, a prime prerequisite for air pollution control was more exact knowledge of the kinds, quantities, and movements of pollutants in the air. During the past decade we have learned a great deal about all three.

With the inception of the federal program, modest but steadily increasing funds have been made available to the Public Health Service for four principal activities in the air pollution field: research, technical assistance to states and communities, training of personnel (for industry as well as for control agencies), and the development and dissemination of information.

In 1963, two wholly new areas of federal action were authorized: Financial assistance to states and communities, and, in certain circumstances, federal initiative in abatement actions. The Act provides for grants by the Department of Health, Education, and Welfare to pay up to two-thirds of the cost of setting up or improving state and local control programs, and up to three-fourths of the cost in the case of interstate or other regional programs. As of June 30, 1968, 182 grants had been awarded, totalling $18,500,000 to 42 states, 48 municipalities, and 92 regional jurisdictions. The current operating grant to the State of Utah is approximately $120,000.

On interstate air pollution problems, the department was authorized to hold conferences leading to abatement action. If corrective steps are not taken after such conferences, public hearings can be called and, if necessary, the U. S. Attorney General may be asked to file suite in federal court. Similar measures were authorized on intrastate problems, but only at the request of the Governor of the state concerned. Later today you will hear in detail about the newest federal legislation, The Air Quality of 1967, from Mr. Earl Porter.

The point I am trying to make here is the definition of another nation-wide air pollution related problem. Because of its extreme complexity, air pollution calls for skills in an exceptionally large number of professional disciplines. These disciplines include, but are not limited to, physicians, engineers of many specialities, chemist physicists, veterinarians, plant pathologists, toxicologists, meteorologists, biologists, economists, lawyers, statisticians, public health nurses, health educators, information and public administration specialists, and city planners. Many of these must know more than a little about the specialties of their colleagues in other disciplines, and all of them must have, or acquire, a good working knowledge of technical factors peculiar to air pollution.

Openings for these experts--in almost every instance, greater in number than the number of qualified applicants—exist at every governmental level and in nearly all of the largest industries. (For example, the steel industry is concerned as air polluters and the telephone companies are concerned as receptors of pollutants.) For the foreseeable future, these openings are expected to increase in number steadily and rapidly.

New markets are also opening rapidly. A clue to industry's present expenditures for air pollution control equipment is provided by a report dated September 2, 1968, on the industrial gas cleaning equipment industry. The total value of 1967 shipments by some 65 manufacturers of electrostatic precipitators, fabric filters, mechanical collectors, and scrubbers amounted to $110 million. The annual value of such devices will increase greatly as control regulations are expanded and strengthened; and these are by no means the only kinds of control devices that will be required.

New Manpower Needs—and Possible Shifts

Some of the needs and shifts in manpower that will be required because of better air pollution controls were indicated above. Not only will more scientists, technicians, and administrators have to be trained or diverted from other fields; it will take a lot of man-hours in our factories to manufacture and install the new control devices and in our machine shops and garages to service and maintain them.

According to the authoritative Gross report, there were in 1961 approximately 1,600 specially trained individuals in the field of air pollution associated with control agencies, industry, research and teaching. The same report stated that, "assuming satisfactory progress," the estimated needs for air pollution personnel by 1970 would total 18,100, of whom 5,600 would be specially trained. The latter figure was raised in a later study to 7,120 for 1975. Especially in view of the fact that many of the needs apply to highly skilled professionals, these figures are not inconsiderable, and the projected growth rate is impressive.

I hope my remarks have served their anticipated purpose—to summarize the air pollution problem areas facing the country today. It is particularly fitting that the solutions of these problems must come from groups such as this meeting here today; representatives of education, industry, technical associations, and regulatory agencies, all working together.

THE AIR POLLUTION PROBLEM IN UTAH

by Grant S. Winn*

My topic is "The Air Pollution Problem in Utah." I would like to say that we could summarize this in a certain fashion by means of five statements.

1. Really, we are talking about the air conservation problem in Utah.

2. We can define air pollution as that which the other fellow does.

3. We can state that everyone, every single person, and every industry in the State of Utah is strongly in favor of the most strict air pollution control as long as they have an exemption.

4. We can say that all the problems concerning air pollution in the State of Utah would already be solved providing that we who are responsible for the program would only run it the way that all of those with no responsibility would run it if they were in the driver's seat.

5. And, finally, the real summation of the whole problem is the universally heard remark during certain periods of the year which is: "just *look* at what is outside!" Now, this tends to be somewhat facetious but actually is somewhat basic also.

The air pollution problem in Utah results from those very things which make Utah a pleasant place to live. These are the mountains, our wide temperature differential between daylight and dark hours, and the people that live here. The results and combination of these factors create our problem. Because of the mountains, every evening we have our pleasant canyon breezes. Unfortunately this cold air from the tops of the mountains which rolls down into the valley also lifts the warm air up and we experience an inversion which consequently traps all of the material which is generated at ground level and holds it there until the inversion is broken. People are partly to blame for the airborne garbage that accumulates under the inversion by the characteristics relative to humidity and large temperature differentials frequently produce fog which contributes markedly to the lack of visibility commonly identified as "air pollution."

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Basically, of course, our problem is one of preventing man-made pollutants from getting into the air. This can be accomplished, but will require time, effort, and patience.

We are all anxious to achieve this goal but there are those who are unduly impatient. They feel that since the Clean Air Act was passed in 1967, the Air Conservation Committee appointed soon after that all our problems should be solved by now. I would like to point out to these people that even after all the controlling that is possible is in effect there will still be days when lack of visibility will be very noticeable in our valleys due to conditions which are beyond our control. To reiterate, our problem of lack of visibility is only partially amenable to control because it is only partially due to man-made air pollution.

Now, just what is the basis of a good air pollution control program or air conservation program?

First, one needs to determine what pollutants are in the air and how much. Second, one must determine where these are coming from. Third, one must determine how much pollutant each source is producing and how it can be controlled. Fourth, one must inform the public of actions necessary to be taken, how this is to be accomplished to insure public support of the program. By "public" I mean not only individual citizens, but industry management, and public authorities and organizations—everyone working together, must be back of the program to make it successful. Finally, the fifth one is the need for a sound enforcement procedure for those recalcitrants—few in number, we hope—who don't want to obey the law.

How are we approaching this? First, to determine what is in the air we have been conducting a monitoring program—not a complete one because we have had neither sufficient funds nor staff to operate a complete program. In this regard when I say "we" and when I speak of the state program, I mean a truly statewide program—one in which the authority and general direction stems from the State Air Conservation Committee and State Health Division, but which has been able to function and is now functioning because of the participation of many, many organizations, industries, agencies, and individuals. The local health departments, where they exist, have been deeply involved in the air conservation program since its inception on a state level and some even before. The schools in the state—universities, high schools, and grade schools have been part of this program. So when I say "we" I am speaking of all these people, not just the State Health Division.

Even prior to 1962 we recognized that an air conservation program was essential for Utah. With consultation from the U. S. Public Health Service a plan for a statewide monitoring program was outlined. (For many years before this time Salt Lake City had been conducting a rather extensive monitoring and control program.) In 1962, our attention was diverted from a general assessment of the air pollution problem and focused on radiological fallout. Atmospheric testing of nuclear devices in Nevada and abroad created an urgent problem in Utah so our efforts were diverted to establishing a network of 18 air monitoring stations, which still function continuously with daily readings to measure radiological fallout. These are located in Logan, Ogden, Salt Lake City, Provo, Parowan, Cedar City, St. George, Garrison, Wendover, Delta, Dugway, Roosevelt, Price, Moab, Monticello, Bryce Canyon, Richfield, and Milford.

Also in 1962 we were able to set up a partial monitoring station for other air pollutants in Salt Lake followed within a year or so by similar monitoring in Ogden and Provo. At these three stations we have monitored continuously for total particulate and sulfur dioxide. Weather stations are also included at each location. We are in the process of establishing similar stations at Bountiful, Magna, and Orem.

All of these stations will be capable of measuring the most important pollutants recognized at the present time with very sophisticated equipment and will include measurements for hydrocarbons, ozone, carbon monoxide, and oxides of nitrogen.

We have, in addition to this network, a network of static samplers, less sophisticated equipment that has no moving parts but which gives measurements of effects that are useful in comparing one area with another. These at the present time are located in Logan, Ogden, Salt Lake, Bountiful, Magna, Price, Bryce Canyon, Provo, Cedar City, and within the next few months will be extended to include Kaysville, Brigham City, Kearns, South Salt Lake, Vernal, Richfield, St. George, Tooele, Delta, and Orem. And, surprising enough, there is one operating at Bullfrog Basin on Lake Powell. (This has been placed there by the Public Health Service in cooperation with the state and is for determining background data prior to the establishment of the very large coal burning electric plant which will be established on Warm Creek in Utah, and another one just across the lake in Arizona.)

These static samplers measure ozone by the rubber strip method, hydrogen sulfide, particulate fallout, sulphur dioxide (by lead peroxide candle), the effects of pollutants on nylon, steel, and zinc.

We have, in addition to this, three networks which monitor beryllium when the industries involved are working with this material. There is a five-station network in Box Elder County, a seven-station network in Salt Lake County, a four-station network in Tooele County, a beryllium network is to be established to include 16 locations as a statewide monitoring network to determine the level of beryllium in the state as it is now and to determine whether or not the newly developing industry near Delta and out at Topaz Mountain as well as continued rocket industry activities will influence significantly beryllium levels in the state.

Second, we are conducting a source inventory which at the present time is nearing completion for Salt Lake City itself and will be expanded to Salt Lake County and then moved both north and south and eventually cover the entire state. This will tell us where the major sources of pollutants are, how much is produced at each of these locations, and what type of pollution it is.

We already have determined the amount of coal consumed in Utah and where it is consumed and by whom; the amount of gas and oil that is used and where it is used. We are now at the stage of determining individual producers of pollution such as heating plants, founderies, smelters, etc., and to determine what materials are put in the atmosphere from these operations and how much.

We have prepared, as you are probably aware, a regulation on open burning which has come to public hearing. The first hearing was held last week in Salt Lake City. There will be six other hearings; one here in Logan on October 15 (which will be the final hearing) to get the public's reaction to this burning regulation. Andthis regulation, I might point out, will in one way or another, either directly or indirectly, affect every person in the State of Utah. In some cases it will curtail your personal activities to some extent. It will cost you money either directly or indirectly because it will cost money to control open burning in community dumps or industries and for individuals and eventually that cost will filter down to you. The only question on regulations such as this is how much are you as a citizen willing to pay for clean air? To get clean air one has to pay for it both in restriction of personal activities as well as in dollars and cents.

We are in the process of preparing emission standards. An ambient air standard for total particulates is nearing completion; others for sulphur dioxide, beryllium, oxides of nitrogen, and other pollutants are in various stages of preparation. We are in the process of preparing other regulations which will further restrict activities and help control the air pollution which is now being produced from various sources. I might point out that actually we will have set the first emission standard with the opening burning regulation because the emission standard for that regulation is really zero—zero emission from open burning. There will be regulations to control incinerators, probably diesel trucks, auto exhaust and crank case emission control inspection. There will be regulations to control emissions of all types.

To summarize, we can accomplish our goal of cleaner air by the basic process: first, determine what is in the air and how much; second, determine where it comes from; third, determine how it can be controlled; and fourth, get everyone supporting a program of control to reduce these emissions to the greatest extent possible by existing technical knowledge and as far as economically feasible.

I might point out that there is a tendency toward a different philosophy in the federal air pollution program which bypasses, to a certain extent, this logical approach of first determining what the problem is, then to solve it. Rather, the tendency is to determine what the sources of air pollution are then immediately apply controls to the extent present technical knowledge permits and to the ultimate extent of economic feasibility regardless of any connection between the source to be controlled and any problem which might exist. This is somewhat of a shortcut procedure, and to some extent might necessitate adjustments to achieve a mutually acceptable procedure if the federal funds are still to be obtained which now are underwriting a good share of the state program.

THE AMERICAN VALUE REVOLUTION AND THE PUBLIC DEMAND FOR AIR POLLUTION CONTROL

by Sheldon W. Samuels*

I feel a little guilty about being with you this afternoon because of the great pleasure I derive from visiting this part of the country. Even though speaking to you is part of my work, it doesn't *feel* like work.

Back in Washington I'm constantly chided about the amount of time I spend out here. But I've made up my mind that I can't avoid a place just to avoid being kidded in the office.

I come to the Rocky Mountains quite often because there are air pollution problems here, both actual and potential. Others on this program will fully amplify those problems in engineering, medical, and legal terms. I accepted this assignment because there is a critical social problem we must face.

I know that it is sometimes difficult to admit that some problems exist. A few months ago several hundred miles southeast of here I stopped at a gas station for some repairs. Right behind me was one of the longer Cadillacs with a bumper sticker from Las Vegas. It was driven by a little man in a tattered Stetson smoking a 12-inch cigar, despite the fact that the car windows were rolled up. When the attendant approached his car, he rolled his window down and a cloud of smoke rolled out. "Gee Mister," the attendant said, "maybe you ought to keep your windows down?" "What," he coughed out, "and let everyone know I can't afford air-conditioning?"

The problem we face is being able to objectively view the big picture—the one in which each of us is painted, whether we live in Portland, Oregon, or Portland, Maine, the Rockies or the Adirondacks. The canvas for this picture is the Air Quality Act, a comprehensive plan for using scientific and technical information in responsible social and political action.

Social and political action—what does this mean in air pollution control? Its meaning is determined by *where* it takes place, because it's a kind of action that is different in every part of the country.

We hear a great deal these days about air quality regions. What are they, *really*? They are extended communities who share a problem, within a discrete environment, and who tend to be guided by cultural values held in common.

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*Sheldon W. Samuels is Chief, Field Services, Office of Legislative and Public Affairs, National Air Pollution Control Administration.

We hear a great deal about regional standards. And what are *they*, really? These are your values of the extended community translated into numbers, values reflected in state-determined standards for federally-designated regions, whose boundaries are drawn in collaboration with the municipalities and states involved. Your state standards, however you calculate them, can no more imitate those of New Jersey than can the values of your communities.

Not only do values vary from place-to-place, but throughout the nation we find ourselves in the midst of a value revolution. This is the basis for the demand for clean air and the high priority given air pollution control by people everywhere.

Air pollution is an old problem. Only the demand for control is new. Every bit of evidence we have points to the thesis that for sometime people saw both the possibility and necessity of control—what has happened is that relatively inferior quality air is no longer socially acceptable.

One root of the value revolution is demographic. By the year 2000, we will have a population of 350 million, and four out of every five of this population will live and work in a metropolitan area. Within a half century some 320 million of our 400 million Americans will live in urban areas.

Between now and the end of the century, more than 80 percent of our population increase will take place in metropolitan areas. Some 34 million people will be added to our cities in the next 15 years. This is the equivalent to the total population of the metropolitan areas of New York, Chicago, Los Angeles, Philadelphia, Detroit, and Baltimore.

Beginning in the next decade, we will add the equivalent of 15 cities of 200,000 population each year. By 1980, we will be adding the equivalent of 20 cities of 200,000 population.

All this, if we are wise in our use of land, will take place in almost the same space—about 10% of the country's land area—as is now occupied by our sprawling megalopolises.

But the other root is buried deep within the American people themselves.

We are turning from a nation obsessed by values of quantity to a nation in which the quality of our lives is becoming of paramount importance, and the values of quality have begun to determine mass, social and political action of the kind blueprinted by the Air Quality Act of 1967.

The chief industry of any American community is no longer agriculture. Nor is it manufacturing. It is education, education for a well-being that has never existed before—here or elsewhere. This is the American passion.

The preoccupation of Americans is not politics, baseball, money, or material things. Education involves more people even than national defense. The percentage of children in kindergarten and youth in universities such as Utah State climbs steeply upward. Even within our pockets of poverty, our youth have a better chance of getting into college than those of any other nation. And there are about 44 million full and part-time adult students pursuing some kind of formalized learning on their own!

"What this guarantees," notes Eric Severeid, "is a great lifting of the massive center, of the 'ordinary' people. This is the premise and the point about America—ours is the first organized dedication to massive improvement, to the development of mass culture, the first attempt to educate everyone to the limit of his capacities." What is our television philosopher trying to tell us? He's saying that the consequence of all this education is an enormous transformation in tastes and comprehension, what we expect in life.

At the turn of the century, we expected our children to live to the age of 50. Today, we expect them to live to 70. Once, a mother feared to give birth. Today, death in childbirth is unexpected. Once, a high school education was a maximum for most. Today, it is the minimum for most. Once we stripped away the forests and topsoil and poured filth into our air and water. Today, the despoilers are confronted by increasingly effective community action.

There is an image of everybody.s life that some of us are still deluded enough to believe exists—if it ever did. This is the image of ice cream socials at the church, band concerts in the park, the senior class trip, Sunday dinner with the family, a drive out in the country to see Granny, and the office wingding the day before Christmas. And last-but-not least—the smoking stack as a sign of prosperity. These elements still exist—at least for some of us. But when we strip off the Gingham wrapper in which we have clothed Columbia we find that we have long since ceased to equate affluence with effluence. In the little mill town at the foot of the Adirondacks, where I come from, soot on the window sill was welcome in 1945. In 1965 it is intolerable.

Air pollution—in the past—was a chronic social disease that had been one of our society's best kept secrets for about 700 years. Today it's front page news.

If today, here, now, there are still some of you who think that air pollution is only a problem for communities that experience so-called episodes, such as New York and Los Angeles, let me tell you that the next time you read about a smog alert, in New York, or any other major city, think about the thousands of smaller communities that share the same stagnant air mass. But don't wait for the headlines. Air pollution exists without publicity everyday. The next time you drive through a filthy mill town or past a stinking village dump—think of those whose well being is thereby continuously insulted. And think of yourself—of what you must breathe—and the fact that you are steering one of the most serious air pollution problems: the family automobile.

I know that what I am saying is familiar. But it must be repeated, because only in this light does the Air Quality Act make sense of the new responsibilities directed for both the public and private sectors.

Within the framework of this legislation, motivated and guided by our changing value systems, every level of government must develop new attitudes towards the problem and towards each other.

We cannot, we need not, compete with each other for tax dollars or public attention and support. The act prescribes roles best suited to what each can do best. We each have an equally significant job to do.

We no longer can ignore the clock. Congress has mandated a timetable for action.

We no longer can judge the success of our programs by the number of our employees, amount of equipment, the size of our laboratories, and the number of complaints "handled." Success is measured by actual reduction or prevention of pollution. At the federal level, we are being judged by how well the states and municipalities we assist actually do. If the safeguards, the coercive mechanisms in the act, are resorted to, then we will be judged as failures. It sounds like a new ballgame—and it is.

And, finally, the states and cities can no longer view the federal effort as separate from their own. We share a tight little island. We cannot become whipping boys for each other.

Political boundaries must become administrative divisions, not barriers to cummunications and walls around our self-interests. *Nor can any of us simply drop out of the scene.* We have no Haight-Ashbury or Greenwich Village to retreat to! The law makes that quite certain. This law is not perfect. Legislators are only men. But it is the best we have; it is the best law we have ever had; it's the law of the land. And we can make it work.

If we fail, we fail together. If we fail, congress will look at what we have done since November when the Air Quality Act was passed, and what we will do for the next 18 months, and re-do a law in which control is left ultimately in the hands of the states—where it should be—it will re-do a law which expresses the current of congress in environmental control.

What have we done under the act that affects you? One example that illustrates the new spirit of team work is the Center for Air Pollution Information in the Rocky Mountains. The center represents the first effort to establish a regional, cooperative air pollution information program involving local, state, and federal organizations.

Participants are the control agencies of the states of Colorado, Montana, Utah, and Wyoming, the City of Pueblo, the Tri-County Health District (Colorado), the City of Denver and the Regional Office of the National Center for Air Pollution Control.

The need for the center has two basis: The nature of air pollution, and the means by which it must be controlled.

The origin, effect, and control of air pollution is a manifold and not usually apparent problem to most publics who associate air pollution primarily with visible community sources. But the unsensed pollutants and those transported from community to community may, in fact, be far more injurious to health and welfare. The public must be alerted to the sources of these less obvious contaminants and the extent to which all pollutants are transported and contribute to the total problem.

Defining the origins and creating methods of air pollution control involves critical topographic, meteorological, land-use, social, and economic factors. Nevertheless, the public must know that existing technology can deal with the problem. But they must also know that technology alone cannot deal with the fact that air pollution cannot be contained by political boundaries.

Air pollution is a regional problem found nationally, for which regional solutions must be applied throughout the nation. Regional solutions require coordinated action by local, state, and federal government, action which begins when key publics become aware and interested in the need for working together on a regional basis. This kind of awareness and interest is developed by concerting leadership and focusing information on air pollution as a regional problem.

The Center for Air Pollution Information in the Rocky Mountains is a means by which the governments in the region can achieve these goals *by pooling their resources, a means consistent with the interests of all its participants.*

Since the beginning of modern air pollution control in the late fifties, leadership in this field has greatly multiplied, public knowledge of the facts and issues has significantly expanded, and consensus on methods of control has grown. As a consequence, legislative action has been taken by most states and the federal government which is surprisingly uniform in intent and concept. This legislation requires unprecedented intergovernmental cooperation. It cannot be implemented if the governments in any region duplicate efforts or compete with each other for public attention.

The task of achieving a regional public information program is assisted by the fact that information is naturally disseminated on a regional basis—by mass media whose "market" is contained only by the extended community served, by organizations who serve and identify within this community, and by the clustering of interpersonal relationships based on regional interests.

Newspapers published in Denver are circulated in several states. Radio broadcasts originating in Salt Lake City are programmed and heard in Wyoming and Montana. Television exhibits a similar pattern. A number of conservation, economic development, and other kinds of organizations function regionally. People play and work within areas limited only by access.

Information—"news"—is initiated, gathered and transmitted by mass and personal media within the extended community of the Rocky Mountains and without significant regard to governmental jurisdiction.

The information center is, therefore, a response to actual conditions both from a communications and from an air pollution point of view.

I can cite other examples of what we have done under the Air Quality Act. But this one is pertinent to what I have to say in conclusion.

I would like to make a simple observation. The gatekeepers, the centers of influence, the key citizens who should be involved in air pollution control are not all in this room. None of us can live with the cozy, private arrangements of the past. A broader segment of the public must become involved in our work, in understanding what both industry and government is doing to manage our air resources.

We must practice the art of communication more extensively than ever before.

THE AIR QUALITY ACT OF 1967

by Earl V. Porter*

It is a pleasure for me to participate with you this afternoon in this first Utah State University Symposium on Air Pollution Control and Abatement and to describe for you the efforts we are making in the National Air Pollution Control Administration to implement the Air Quality Act of 1967.

The Air Quality Act was developed in recognition of the need to protect the public from the long-term and subtle as well as from the immediate and obvious adverse effects of contaminated air, and, further, in recognition of the far-reaching ramifications of adequate corrective action. These, as you know, reach into the very core of the structure of our society. The Act says, in effect, that we must now control air pollution without delay and dalliance. It says, at the same time, that in so doing, we must not create more problems than we solve. It invites all of us, in government and in industry, to take responsible action to control pollution. It thereby offers a very viable alternative to the foolish course advocated by those who seek simplistic solutions, as well as to the equally foolish course advocated by those who seek senseless delay.

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 the disperse pollution, are generally homogeneous. The National Air Pollution Control Administration essentially accomplished this requirement on January 16 of this year, when we marked out eight atmospheric areas covering the 48 contiguous states. Areas covering Alaska and Hawaii will be defined later.

Further, the Act requires the secretary to define those geographical regions in the country where air pollution is a problem—whether interstate of 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.

We are moving rapidly ahead with the task of designating air quality control regions. For each urban area of the country where we believe air pollution is a problem, we are first defining natural boundaries. In most areas we can build the meteorological characteristics of

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the area into a diffusion model, give the model information on the sources of pollution in the area, and as a result obtain estimates of pollution levels at any point. These estimates enable us to draw geographical limits on the impact of the air pollution sources. In some areas we must also factor in land-form characteristics to obtain the pollution level estimates.

Once we have drawn the natural boundaries of the air quality control regions, we consider such realities as existing political boundaries, the jurisdiction of existing air pollution control agencies, existing regional arrangements, and the patterns and rates of urban growth in the region. We then consult with state and local officials on the modified description of the region.

Plans for designation of the first 32 regions in the 12 months beginning July 1968 were announced June 20, 1968. In making the announcement, Secretary Cohen said "The need for regional action to deal with air pollution—a problem which represents no boundary lines—has long been apparent." Now, under the Air Quality Act, we are taking concrete steps to make such action a reality.

"Air Pollution is a serious threat to public health and welfare in all of the 32 areas which we expect to include in air quality control regions during the coming year; moreover, the total population of these areas is approximately 84 million—about 64 percent of the Nation's urban population."

At the same time that he is designating air quality control regions, the secretary is required to publish air quality criteria for those pollutants he believes may be harmful to health or welfare, and to 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 information for developing standards of air quality for the protection of public health and welfare in the regions designated by the secretary. These air quality standards will become the goals of the control efforts in the regions.

We have made considerable progress in developing air quality criteria. As required by the Air Quality Act, we have established a National Air Quality Criteria Advisory Committee, with a membership broadly representative of industry, the universities, conservation interests, and all levels of government. This committee is giving us advice on policies and procedures under which criteria will be issued, and is helping us to review draft criteria documents. At its first meeting the committee formed three subcommittees: A White Paper Subcommittee, which is advising us on the preparation of a policy statement on the development and issuance of criteria, and separate advisory subcommittees for two classes of pollutants—particulate matter and the sulfur oxides—the development of criteria for which is well advanced. Additional advisory subcommittees for individual classes of pollutants will be formed as criteria for these pollutants are developed.

With the help of these subcommittees we are retaining expert consultants to prepare drafts or portions of drafts of criteria documents, and we are having these drafts reviewed. After we have considered the review comments on a draft document, we will print a final document, announce its issuance in the *Federal Register*, and distribute it to the states and to other interested agencies and individuals. We presently plan to review criteria documents at least every five years to determine whether or not they should be modified in the light of new information.

Several criteria documents are in the draft stage. A draft of criteria for total particulate matter has been prepared by the National Air Pollution Control Administration with the help of university consultants working under contract. We expect to publish a final document soon. The sulfur oxides criteria document, originally issued in March 1967, is being looked at again in accordance with provisions of the Air Quality Act which require that any criteria issued prior to the Act be reevaluated. Consultants who assisted in the preparation of the original document are reviewing it, along with additional experts. Literature published since the issuance of the document are being searched for additional information. We expect to issue a revised document on the sulfur oxides at the same time that we issue the document on particulates. It is our intention that the simultaneous issuance of criteria on particulates and sulfur oxides will underscore the importance of the effects that the combination of these pollutants in the atmosphere produces, and will thereby emphasize the need for giving simultaneous attention to controlling them both.

With the help of consulting scientists and the California State Department of Public Health we have had prepared a preliminary draft of criteria for photochemical oxidants, and we are having draft documents prepared on nitrogen oxides and organic compounds, including hydrocarbons, which will complement the oxidant document. This group of criteria, on oxidants, nitrogen oxides, and organic compounds, we expect to issue sometime in 1969. We are also working with the California State Department of Public Health on a draft of the carbon monoxide criterion and we expect to issue a document on that pollutant at the same time that we issue the other criteria primarily concerned with pollution from the motor vehicle.

We are presently negotiating with the Department of Agriculture to help us prepare criteria on fluorides, and we hope to issue a document in 1969. We are considering developing and issuing criteria for several other classes of air pollutants including such diverse substances as carcinogens, metals, odorous compounds, pesticides, pollens, and radioactive materials. We have initiated studies to evaluate the contribution of these pollutants to the overall air pollution problem and, as a result of these studies, we expect to establish a priority schedule which will guide our further efforts in the development of air quality criteria.

Parallel with the development of criteria for various air pollutants, we are preparing reports on the available technology for controlling the sources of these pollutants. These reports will identify the best methods available for reducing pollutant emissions from their various sources—whether these techniques involve the application of control equipment, changes in fuel use or industrial processes, or any other practical approach. The reports will include the costs of applying these techniques. We have prepared a draft of a report on the available systems and devices for controlling particulate emissions from a wide variety of mobile and stationary sources, and we are working on a report which will give a comprehensive evaluation of control systems and techniques that are available for controlling sulfur oxides pollution from fuel combustion processes. These reports will be published at the same time that we issue the criteria for particulates and sulfur oxides.

Under this Act, as soon as we have designated a region, have published a criterion on a pollutant or a combination of pollutants, and have published the related control technology information on the sources of these pollutants, the state or states responsible for the designated region are on notice to develop standards for the region on the pollutants covered by the criterion, and to develop plans for implementing the standards. They have 90 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 implementing them. If the secretary finds that the air quality standards and plans for their implementation 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 can initiate action to insure that appropriate standards and plans are established.

The Air Quality Act continues federal authorities to provide financial and technical aid to state and local air pollution control agencies and for the first time authorizes financial help in developing plans for control programs. One hundred percent planning grants are authorized under the Act to develop plans for implementing air quality standards in the regions designated by the secretary. We anticipate receiving applications for planning grants when we designate the first regions.

The Act retains federal authority to abate interstate air pollution problems, and on request of a governor, intrastate problems. The Act, for the first time, authorizes the Secretary of Health, Education, and Welfare to take steps during an emergency situation to curtail pollution. With the help of a task force of experts in such areas as meteorological modeling and forecasting, the taking of air pollution source emission inventories, and the effects of air pollution on health, we are developing emergency abatement plans for the use of state and local agencies.

The Air Quality Act authorizes a federal expenditure of $125 million over the next two years to stimulate a greatly accelerated research program to develop effective and economical methods for controlling or preventing the discharge of pollution to the atmosphere from the combustion of fuels. To facilitate this program the Act for the first time authorizes the federal government to share in the costs of demonstrating new or improved methods for controlling the sources of air pollution.

The Air Quality Act continues federal authorities to set national emission standards on new motor vehicles. As you all know, in 1966 we published standards applicable to gasoline-powered automobiles and light trucks starting with the 1968 model year. These standards require 100 percent control of hydrocarbons from the crankcase and, for a typical car, required a reduction in emissions of carbon monoxide from the tailpipe by about 55 percent and hydrocarbons by about 65 percent.

In June the secretary published more stringent and far reaching standards for the control of automotive pollution. Starting with 1970 models, the limits on tailpipe emissions from a typical car are set approximately one-third below the limits set for 1968 and 1969 model cars. For the first time, pollution from larger vehicles must also be controlled. Gasoline-powered large trucks and buses will be required to reduce tailpipe emissions of hydrocarbons and carbon monoxide by about one-third, and the smoke from diesels must be considerably limited. The standards also require that evaporation of fuel from the gas tank and the carburetor of automobiles and light trucks be controlled starting with 1971 models.

As you see, the Air Quality Act delineates very clearly the responsibilities of the Federal Government and of State Governments. The Act indicates in concrete terms what the Secretary of Health, Education, and Welfare and the governors' of the nation must do, and in many cases, when they must do it as we move toward the goal of clean air for all of our communities. The Act does not indicate in this same way what industry must do or when it must do it, but I believe it was clear to the Congress, as it is clear to me, that it is the intent of the Act that industry must shoulder its responsibilities in an equally timely and realistic manner also.

AIR POLLUTION LEGISLATION FOR UTAH

by Mrs. Philip Frederick*

Before 1961 the only state legislation pertaining to air pollution was contained in three sections of the Public Health Code. One section authorized the State Department of Health to conduct field investigations of occupational health hazards and air pollution; the second one gave all cities of the state the authority to decide what should constitute a nuisance and to abate nuisances; the third made each local board of health responsible for dealing with all nuisances that they determined were detrimental to health.

In 1963 the Legislature defined air pollution, declared it a nuisance, and declared any person causing air pollution to be guilty of a misdemeanor.

The 1965 Legislature considered two bills, but both were defeated. One would have broadened the definition of air pollution to include anything interfering with comfort and enjoyment of life; the other would have authorized a tax exemption to businesses that installed control equipment which was to be used exclusively for air or water pollution control.

The 1967 Legislature passed the Air Conservation Act. Section 2 defines 11 words and phrases used in the act. "Air contaminants" is defined as "any particulate matter or any gas, vapor, suspended solid or any combination thereof, excluding steam and water vapors." "Air pollution" is defined as "the presence in the ambient air of one or more air contaminants in quantities, or characteristics and under conditions and circumstances, and of a duration sufficient to cause or contribute to injury to human, plant, or animal life or health or to property or which unreasonably interfere with the enjoyment of life or use of property, as determined by the standards, rules and regulations adopted by the Air Conservation Council."

The Act creates the nine-member Air Conservation Committee within the State Department of Health. It was called a council in the act as passed, but a later bill changed the name to committee. The Committee consists of the Director of the State Department of Health and eight other members appointed by the Governor. The law specifies what segments of the economy or professions they shall represent.

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*Mrs. Philip Frederick is Chairman, Utah Air Conservation Committee.

The present members are:

Dr. J. LeGrande Shupe, USU, a veterinarian, representing agriculture
Mr. E. V. Chettle, an engineer not connected with industry
Dr. Preston Cutler, a practicing physician, not connected with industry
Mr. George Bishop, Phillips Petroleum Corp., representing manufacturing
Mr. Lloyd Transtrum, Geneva Steel Corp., representing the mining industry
Mr. Joe Allen, Mountain Fuel Supply Co., representing the fuel industry
Dr. G. D. Carlyle Thompson, Director of the State Division of Health
Mr. Fred Malan, Weber County surveyor and engineer, representing local government
Mrs. Philip Frederick, representing the public

The terms of appointment are four years, except for four of those first appointed who will serve for two years. No more than four can be of the same political party.

The duties of the Committee are described as follows:

1. To adopt air quality standards, on a regional basis where applicable. This includes standards for ambient air (which means the moving outside air), and also emission standards, that is, the contaminant limits for individual sources of pollution.

2. To adopt rules and regulations to implement these standards. These standards and rules should include prevention of air pollution as well as abatement of existing pollution.

3. To require pollutors to file "periodic reports containing information relating to the rate, period of emission and composition of the air contaminant."

4. To hold hearings, require attendance of witnesses, and submission of documents and other information it deems necessary.

5. To institute legal proceedings to secure compliance.

6. To grant variances for a specified period if it finds that compliance will place an unreasonable burden on a business without sufficient corresponding benefit to the people.

7. To appoint an executive secretary with the approval of the Director.

The Committee is required to meet at least four times per year. Since our appointment in May of 1967 we have met monthly except for three months. In addition numerous meetings of the five subcommittees have been held.

The law requires seven members to constitute a quorum.

Section 8 of the law states that the Executive Secretary shall serve under the direction of the committee and lists his duties:

1. To develop the program for abatement and control of existing and prevention of new air pollution.

2. To employ staff as needed.

3. To cooperate with other government agencies to carry out the purposes of the Act.

4. To inspect the premises and records of suspected pollutors at reasonable times and after reasonable notice.

5. To make any necessary studies of air pollution, including an inventory of sources, and to collect and disseminate information.

6. To enforce the rules and standards adopted by the Committee by means of the issuance of orders. These orders may prohibit the discharge of contaminants, or they may require construction of new control equipment or alteration of existing equipment to reduce pollution, or "adoption of other remedial measures to prevent, control or abate air pollution."

7. To review plans, specifications, or other data relative to control systems and advise as to their adequacy.

8. To represent the state, with concurrence of the Director, in interstate matters dealing with air pollution.

The State Division of Health is made responsible for administration of the law, including acceptance and administration of grants, and it must furnish staff and laboratory services upon request of the Committee or the Executive Secretary and within the limitation of available funds. Although the Committee is under the Board of Health, the law gives the board authority to amend the action of the Committee *only* when necessary to protect the public health.

The law then lists some specific provisions. Causing air pollution, as defined in the act, is declared a misdemeanor for each day of violation. Further, no person may increase the amount or strength of pollution which has been permitted under the rules, nor may he operate any new pollution source, without first submitting a report to the Secretary containing whatever information the Committee shall require about the source. The law then states that "nothing in this act shall be construed to authorize the Executive Secretary, the council, the director, the department, or the board to specify type, design, method of installation or type of construction of any equipment which is integrated to the manufacturing process or registration or licensing thereof."

Section 10 states that the Committee shall hold public hearings prior to adoption of ambient air standards, and the requirements for notification to the public of these hearings are outlined. After the Committee has formally adopted the standards they become effective by order of the Secretary. This order must be published in a newspaper of general circulation in the area to be affected by the order.

The steps which the state may take to enforce the rules and standards are outlined in Section 11. It provides that when the secretary has determined on reasonable grounds that a violation has occurred, he must first attempt to secure complicance of mediation. If this fails the alleged violator must appear before the Committee which shall then decide the action to be taken. All hearings must be conducted by the committee, or by an officer appointed by the committee. Decisions require a majority vote of the quorum. The Secretary must issue a written notice of the Committee's orders to the person charged, and also to any persons who testified at the hearing and requested notice of the orders. The alleged violator then has 30 days in which to apply for rehearing, and another 30 days to comply after the rehearing is either granted or denied. He may further appeal to a district court and finally to the Utah Supreme Court. Other persons who will be adversely affected by the Committee's orders, if they appear at the hearing or were not given notice of the hearing, also have the right to seek judicial review of the decision. The final step in securing compliance is an injunction, and failure to comply with the injunction is punishable as for other civil contempts, except that legal entities shall be fined $1000 per day.

Section 16 provides for protection from disclosure of secret manufacturing processes and makes it a felony for any employee of the state or member of the Committee to disclose any confidential information.

Political subdivisions of the state are given authority to institute their own control programs or to combine their programs, provided they do not conflict with the Air Conservation Act.

I am not, of course, qualified to evaluate the law as such, and it is too early in our program to know from experience whether any changes will be needed. Our law follows very closely an outline of basic provisions of state air pollution law which was prepared by the Air Quality Committee of the Manufacturing Chemists Association from studies of a number of state laws. An analysis of the Utah law was published in the Utah Law Review, Volume 1967, No. 3, and I would like to mention just a few of their conclusions. The article states that placing administrative power in a body, such as the Committee, which is concerned solely with air pollution control would seem wiser than giving it to prosecuting officials who probably are not trained in the scientific aspects of air pollution and who have other duties in addition. This concept is somewhat confusing to me—that is, the use of the term "administrative power." The law specifically places administration of the law in the State Health Division; the Committee considers itself a policy-making body.

One question raised by the authors is the legality of placing law-making power, such as setting of standards, in an administrative body. The authors' opinion is that this delegation is defendable because of the checks on the Committee that are present in the law. These checks are that the Committee is appointed by the Governor with the consent of the Senate, that the Board of Health may override decisions of the Committee which affect public health, and, finally, that persons adversely affected by the Committee's decisions do have the right of appeal to the courts.

From a number of articles I have read I believe I am right in concluding that it is generally agreed among air pollution experts, including the U. S. Public Health Service Air Pollution people, that standards should not be written into the legislation. The reason for this is that the legislative process is too slow to permit necessary changes as fast as new technological knowledge becomes available. I believe that by far the largest majority of states with legislation do not write the standards into the law.

One potential weakness is the composition of the Committee. There has been some apprehension in many areas because three of the members, who are from industry, are in a "conflict of interest" position, that is, that they will be in a position of having to make regulations which will directly affect their own companies. The Utah Law Review article points out, however, that there is some advantage to placing this duty in the hands of those who have thorough knowledge of the subject. Three members of the quorum of seven are a minority. I will say that I believe long and careful thought went into the choosing of men for these positions who will make every effort to be unbiased in their decisions and who are sincerely concerned about the welfare of the entire state.

One very effective tool present in some other state laws which our law omits is the permit system for controlling contaminant sources. Under this system no pollution source may be constructed without first submitting plans and specifications to thecontrol agency and receiving a permit to build, nor may it be operated without a permit to operate. An alternate method is the registration system, under which persons are required only to register air pollution sources and submit certain information about them. Experts disagree about which method is best. Los Angeles County uses the permit system; San Francisco uses the registration system. Under the permit system the control agency must maintain a sizable engineering staff to process the plans and specifications submitted to it. However, enforcement can be accomplished very promptly when a violation occurs by revoking the permit. The Utah Law Review article points out that, although the enforcement procedure by injunction in the Utah law could mean delays, pressure of public opinion can be used effectively against violators.

This article concludes that if vigorous proponents of air pollution control are appointed to the Air Conservation Committee they will be able to function effectively under the powers provided in the law. I believe that a great deal of the success of our program will depend also on the cooperation we receive from those who will be controlled, individuals as well as businesses. If we propose well-tested and reasonable controls, I anticipate no problem in this area. Under the Clean Air Act control can no longer be avoided anwhere in the country—it is now no longer a matter of whether, but a matter of when.

ATTACKING THE AIR POLLUTION CONTROL PROBLEM

by Ronald E. West*

The purpose of these remarks is to present a brief introduction to some technical aspects of the control of air pollutants from fixed, industrial-type sources. An excellent source of technical information on all aspects of air pollution is the three volume book, *Air Pollution,* edited by H. C. Stern and published by Academic Press in 1968 (2nd edition).

The existence of an air pollution problem may be recognized from complaints by neighbors or regulatory agencies, but it is better for the emitter to recognize the problem first, and better still to anticipate a potential problem. Having recognized an air pollution problem, its nature and quantity must be defined, and appropriate control methods sought.

A knowledge of some general air pollutant characteristics helps in determining the nature of a problem or in anticipating potential problems. There are two general classes of pollutants: aerosols and molecular pollutants. Aerosols are particules of liquids or solids small enough to remain suspended in air but too large to be in solution in air. Molecular pollutants are individual molecules in solution with air.

Visible air pollution, in nearly all cases, is due to aerosol-type pollutants. That is, visible contamination in air is due to the presence of particles of solids or droplets of liquids, such as dust, smoke, or fumes, in the air. A few gases are colored and thus visible, such as nitrogen dioxide (brown) and chlorine (green), but it is rather rare that such gases are present in sufficient concentration in air for the color to be visible. So, when air pollution is visible, it can be concluded rather safely that it is due to aerosol-type pollutants.

Several important features of aerosol pollutants are conveniently summarized in Fig. 1. The information in Fig. 1 is abstracted and adapted from a more complete chart which is shown in the book *Air Pollution* by Stern, Vol. I, pages 50-51.

An examination of Fig. 1 is instructive about some characteristics of air pollutants. Fig. 1 is arranged by particle size. A characteristic particle dimension is measured by the vertical lines on the scale across the top, with the dimensions in microns (1,000 microns equals one millimeter). The scale is logarithmic, and each vertical line represents a dimension one-tenth that of the preceding line, reading left to right. Atmospheric aerosols virtually always

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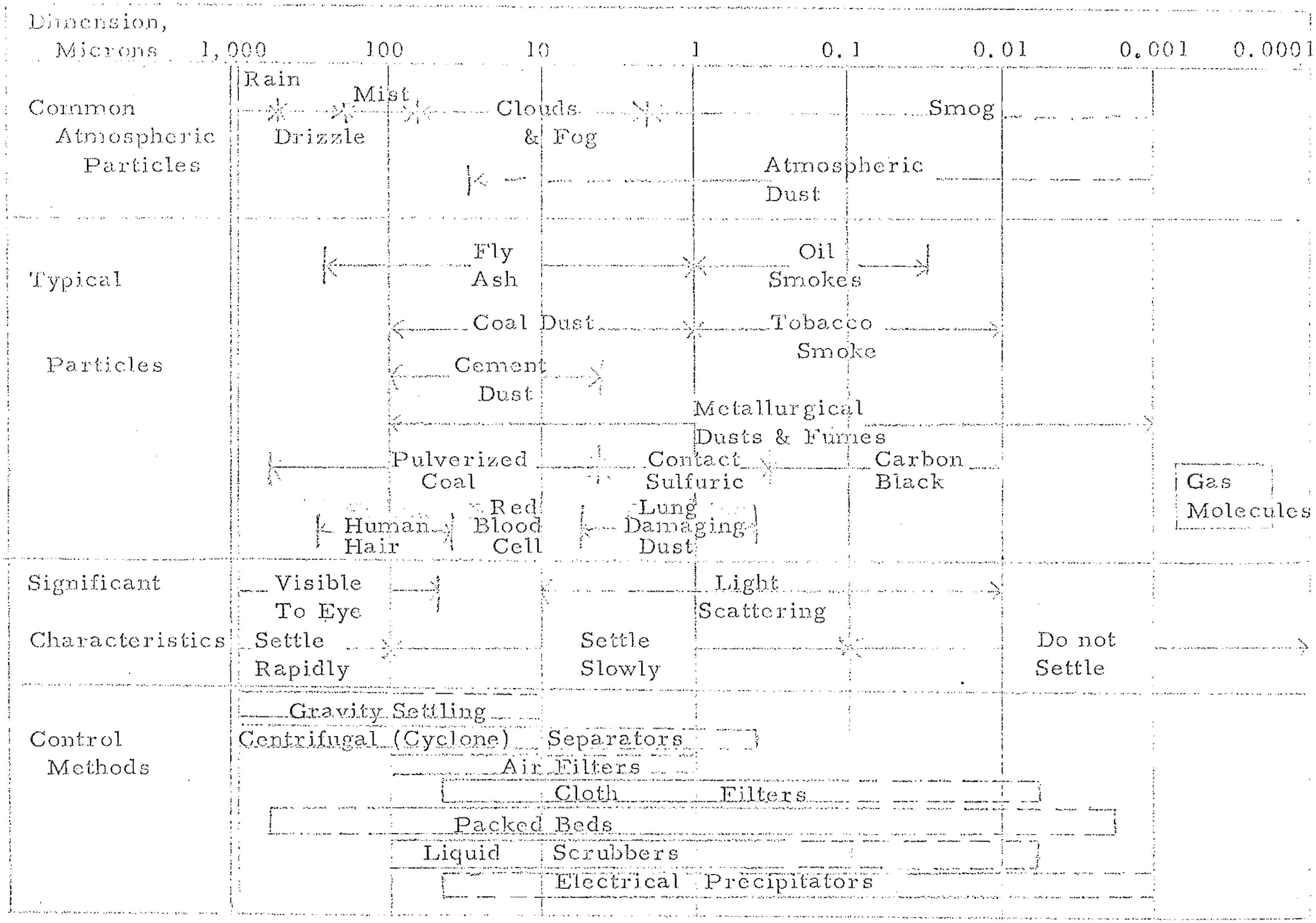

Fig. I. Characteristics and Control Methods for Aerosol-Type Air Pollutants

ATTACKING THE AIR POLLUTION CONTROL PROBLEM

by Ronald E. West*

The purpose of these remarks is to present a brief introduction to some technical aspects of the control of air pollutants from fixed, industrial-type sources. An excellent source of technical information on all aspects of air pollution is the three volume book, *Air Pollution,* edited by H. C. Stern and published by Academic Press in 1968 (2nd edition).

The existence of an air pollution problem may be recognized from complaints by neighbors or regulatory agencies, but it is better for the emitter to recognize the problem first, and better still to anticipate a potential problem. Having recognized an air pollution problem, its nature and quantity must be defined, and appropriate control methods sought.

A knowledge of some general air pollutant characteristics helps in determining the nature of a problem or in anticipating potential problems. There are two general classes of pollutants: aerosols and molecular pollutants. Aerosols are particules of liquids or solids small enough to remain suspended in air but too large to be in solution in air. Molecular pollutants are individual molecules in solution with air.

Visible air pollution, in nearly all cases, is due to aerosol-type pollutants. That is, visible contamination in air is due to the presence of particles of solids or droplets of liquids, such as dust, smoke, or fumes, in the air. A few gases are colored and thus visible, such as nitrogen dioxide (brown) and chlorine (green), but it is rather rare that such gases are present in sufficient concentration in air for the color to be visible. So, when air pollution is visible, it can be concluded rather safely that it is due to aerosol-type pollutants.

Several important features of aerosol pollutants are conveniently summarized in Fig. 1. The information in Fig. 1 is abstracted and adapted from a more complete chart which is shown in the book *Air Pollution* by Stern, Vol. I, pages 50-51.

An examination of Fig. 1 is instructive about some characteristics of air pollutants. Fig. 1 is arranged by particle size. A characteristic particle dimension is measured by the vertical lines on the scale across the top, with the dimensions in microns (1,000 microns equals one millimeter). The scale is logarithmic, and each vertical line represents a dimension one-tenth that of the preceding line, reading left to right. Atmospheric aerosols virtually always

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contain a range of particle sizes. Fig. 1 shows the range of particle sizes by a horizontal arrow. The ranges are approximate and dashed lines indicate considerable uncertainty. The size ranges of some common atmospheric aerosols are shown in the first row so that the scale may be related to common experience.

The third row in Fig. 1 shows some significant characteristics of aerosols as related to particle size. For example, the human eye can see individual particles of diameters greater than about 50 microns but cannot see individual particles that are smaller (note the dimensions of human hair just above the third row for a comparison). Collections of smaller particles, though not individually visible, may still be visible in air because of the scattering and reflection of light. The scattering and reflection of light depend upon the number and surface area of particles. It is unfortunate, but usually true, that in a size distribution of particles, the larger particles include most of the mass but the smaller particles include the greater fractions of the number of particles and the area. It therefore may occur that most of the mass of a size distribution of an aerosol can be removed with very little effect on the visibility of the aerosol in air.

The third row in Fig. 1 also shows the general settling characteristics of aerosols in still air. Particles greater than 100 microns settle rapidly. Between 100 and 0.1 microns, particles settle slowly, and the settling rate decreases rapidly as the size decreases. Particles less than about 0.1 micron diameter will not settle out of still air, but remain suspended due to Brownian motion.

The second row in Fig. 1 shows the approximate size ranges of some common aerosol air pollutants from industrial processes. It should be noted that molecular pollutants fall in a narrow size range of very small particles from about 0.0002 to 0.0008 microns. The control methods in the fourth row of Fig. 1 will be referred to later.

The most significant factor represented by Fig. 1 is that the characteristics of aerosol pollutants are essentially entirely determined by the size of the particles. The composition of aerosols has little effect in their characteristics, the size range is the key factor in determining their behavior, and ultimately, the type of collection device used for their control. Molecular pollutants, on the other hand are all about the same size and their characteristics depend entirely on their composition which determines their chemical behavior.

Some molecular pollutants, while not visible, are detectable by other sensory means. Odor is a common characteristic. Hydrogen sulfide and organic sulfur compounds, for example, have strong, disagreeable odors. Irritation of the eyes, nose, or skin is another means of sensory detection. Acid gases, such as hydrogen chloride, and many oxygenated organics compounds, such as aldehydes, are irritants. Still other pollutants, notably carbon monoxide, however, are not detectable by any sensory means.

The presence of aerosols in air is usually easily detectable by their visibility (indeed this very visibility is the only undesirable effect of some aerosols, in particular "stream" or condensed water vapor). It is frequently more difficult to establish the presence of molecular pollutants by any sensory means and may be especially difficult to identify the specific molecular pollutant by sensory means.

The identity of an air pollutant may frequently be inferred by knowing the materials used and the kinds of operations and/or chemical reactions in a process or plant. For example, any combustion process can result in air pollutants. These pollutants may be aerosols, as smoke or fly ash, or molecular, as carbon monoxide and organic compounds. These materials (except fly ash) result from incomplete combustion. Yet even complete combustion can result in pollutants, namely sulfur oxides (from sulfur in the fuel) and nitrogen oxides (from nitrogen in the air).

Any solids handling operation, such as ore mining and milling, grain milling and cement manufacture, results in solid aerosols. Agriculture results in dusts, odors, and pesticide aerosols. Petroleum refining may produce smoke, catalyst dust, hydrocarbons, and sulfur compounds. Chemical processes may emit solvents, sulfur compounds, and fluorine compounds as well as many other inorganic and organic molecules. Solvents, usually hydrocarbons or chlorinated hydrocarbons, may also result from such operations as printing and dry cleaning.

Before considering specific collection and abatement methods, it is well to consider some more general aspects of the control of air pollutants. "Good housekeeping" to avoid accidental emission of pollutants and to avoid leaks in air handling systems is an important first step in control. The collection of contaminated air and gas streams in ducts is essential before any treatment can be done. It is important to consider whether contaminated gas streams should be kept separated for treatment or mixed together for treatment. There may be advantages to either procedure in any given case, depending mainly on whether the treatments are similar or different. A good general rule to remember is that the more concentrated a contaminant is, the cheaper it will be to treat per unit of contaminant removed. Stacks are the most common way of disposing of pollutants. Stacks, however, provide no treatment or removal of pollutants, they merely provide a better opportunity for dilution and dispersion of pollutants in the atmosphere. Stacks rarely solve a real air pollution problem.

Several of the main types of collectors for aerosol air pollutants are shown in Fig. 1. The bar indicates the approximate range of particle size over which the method is applicable. The collection methods are based on settling, filtration, or interception. The gravity settling devices depend upon gravitational force only and are applicable only to particles larger than about 10 to 100 microns. Cyclone separators use the centrifugal forces developed in the spiral flow of gas to remove particles and are useful for particles above 10 microns and, with special designs, perhaps as low as one micron. Air filters are random fiber mats of the type used in forced-air, home furnaces. Cloth filters are woven clothes similar to a home vacuum cleaner bag and are useful down to 0.1 micron particles and perhaps ever smaller. Packed beds are beds of particles larger than those to be removed which intercept and filter out aerosols. They have a wide potentially useful range, but any one bed would probably collect a much smaller range of particle sizes. Liquid scrubbers use a liquid which wets the aerosol to entrain particles in the liquid. The collection liquid is usually water, so these devices present a potential water pollution problem. Electrostatic precipitators are especially useful for very small particles in the 0.01 to 0.1 micron range. It is in this size range and smaller that the technology of particulate collection is least well developed.

It is important to know that the cost of aerosol collection generally increases going down the list of control methods in Fig. 1. Thus as the usefulness of the collection method shifts to smaller particles the cost tends to increase. It should be reemphasized that the type of control device used for aerosols depends almost entirely on the size of the particles to be collected, as Fig. 1 indicates.

Control methods for molecular pollutants depend specifically on the pollutant, but three kinds of methods are used: chemical reaction, absorption into a liquid, and adsorption into a gas. Table 1 shows physiological responses, typical sources, and removal methods for several of the most important kinds of molecular air pollutants.

Chemical reactions of molecular air pollutants are used to convert obnoxious materials into less noxious forms remaining in the air (as the oxidation of carbon monoxide to carbon dioxide and hydrocarbons to carbon dioxide and water) or to convert the pollutant to a form more readily removable by absorption or adsorption (as the oxidation of sulfur dioxide to sulfur trioxide which is readily absorbed by sulfuric acid). Catalysts are frequently necessary to promote the desired reaction. Absorption may be into water or other solvents. The solvent chosen must readily dissolve the pollutant and not itself cause air pollution. The use of adsorption depends upon finding a solid which will take-up the molecules of the pollutant. Usually it is economically necessary that the adsorption be reversible so that the adsorbent material may be regenerated for reuse.

In summary, aerosol-type air pollutants are readily detectable by their visibility. Control methods depend almost entirely on the size range of the aerosol particles. Molecular pollutants are more difficult to identify by sensory means and the methods of control depends entirely on the specific characteristics of the pollutant.

Table 1. Some characteristics and removal methods for several important molecular air pollutants.

MOLECULAR POLLUTANT	POLLUTIONAL CHARACTERISTIC	TYPICAL SOURCE	REMOVAL METHOD(S)
CARBON MONOXIDE	TOXIC	COMBUSTION	OXIDATION TO DIOXIDE
SULFUR DIOXIDE	TOXIC, IRRITANT	SMELTING COMBUSTION	REACT TO TRIOXIDE AND ABSORB REACT TO SULFUR
NITROGEN OXIDES	TOXIC, IRRITANTS ODOR, CONTRIBUTE TO SMOG	COMBUSTION (AUTO)	REACT TO OTHER OXIDES OR TO NITROGEN ABSORB
HYDROCARBONS	TYPICALLY: ANESTHETIC	REFINING AUTOS	OXIDIZE
PARTIALLY OXIDIZED HYDROCARBONS	TYPICALLY: IRRITANT, ANESTHETIC	COMBUSTION CHEMICAL PROCESSES	OXIDIZE OR ABOSRB
ORGANIC SULFUR COMPOUNDS	ODORS, NAUSEA	REFINING	OXIDIZE ABSORB IN ALKALINE SOLUTION

INDUSTRIAL AIR POLLUTION CONTROL

by Robert J. Heaney*

Introduction

The Utah Copper Division of Kennecott is a large industrial complex comprising an open-pit mine, precipitation plant, three concentrators, power plant, ore haulage department, smelter, and an electrolytic refinery. A $100-million plus expansion program was recently completed. The purpose of this expansion was to enhance the division's ability to remain competitive in the free world copper market. As a result of this expansion, the division is now able to process 108,000 tons of copper ore each day on a seven-day schedule.

The very size and nature of the Utah Copper Division operations lends itself to the generation of potential air pollution problems. Over the years the division has maintained a comprehensive air quality surveillance and crop inspection program. This is indicative of the division's concern over pollution long before today's mounting interest, both locally and nationally, to effect greater air pollution controls. We have had, in fact, a continuous program on air monitoring and surveillance for many years. Work in this area has been conducted by the division's Agricultural and Meteorological Research Section.

With the enactment of more stringent air pollution regulations and with the development of more effective and economic control devices, programs are underway to reduce emissions from Kennecott operations to even less than they are now. Studies are underway at each plant to find ways to improve the control of various gaseous and particulate emissions. With the exception of our Bingham Canyon mine, where there are no pollution problems today, all of the operations have air pollution control devices installed and operating. These range from a simple dust control cyclone at the central power plant to five operating sulfuric acid plants at the smelter. As part of the division's recent expansion, a new No. 6 sulfuric acid plant, with a 500 ton-per-day capacity, represents the most recent and important air pollution control facility at the smelter. Installation of a new electric arc furnace and a baghouse collector at the grinding ball foundry will soon reduce the dust emission to practically zero. Study of all potential processes for the treatemnt of low-grade sulfur dioxide gases at the smelter is maintained on a continuing basis. Installation of a pilot plant to investigate a totally new process for sulfuric acid mist control at the smelter is being considered at the present time. At the refinery new or improved control devices are being proposed to eliminate or further control emissions.

The Agricultural and Meteorological Research Section of Kennecott's Utah Copper Division will most assuredly work closely with the State Health Department as more and more air quality and emission standards are developed.

The following is a review of the status of our air pollution problems and controls at each of the aforementioned plant properties.

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Mine

There are currently no air pollution problems at the Bingham mine. We did have a problem sometime ago which was caused by the use of waste acid which we used to acquire from local oil refineries, for acidifying the mine leach solutions. Leaching solutions remove copper from mine waste or overburden and are totally recirculated to the waste dumps. To maintain their leaching ability, after the copper is precipitated with scrap iron, sulfuric acid is added to maintain the proper acidity. Sulfuric acid used by oil refineries in their processing is termed "spent acid" when it has accumulated so much organic material from the petroleum that it is no longer usable. Since it still retains essentially all of its acidification ability, it was used for a period of time for our mine leaching solutions. When "spent acid" is added to leaching solutions, some of the organic substances escape from the solution as disagreeably odorous material. These unpleasant odors caused complaints from residents of Copperton when wind conditions caused them to drift over the town. Various procedures for removing or changing the nature of these odors were investigated. To completely eliminate the problem of citizen complaints, the use of "spent acid" was stopped and only fresh sulfuric acid is now used for mine solution acidification.

Concentrator

The central power plant generates all of the electricity for the entire division. Air pollution problems for this facility are minimal since natural gas is utilized most of the year. On a few days in the winter when natural gas is curtailed, it is necessary to burn coal. The coal used is a low sulfur coal so no sulfur dioxide problem is generated on these infrequent occasions. The plant is equipped with a cyclone collector which collects the fly ash during those periods when coal is burned.

The foundry produces all of the grinding balls for the ball mills at the concentrator plants. The ball mills grind the crushed ore for the flotation process. At the present time this forging operation is uncontrolled and the furnaces give off a brownish smoke primarily of iron oxides. Construction of a new electric arc furnace for this operation will include a baghouse dust collector which will eliminate all of the iron oxide dust.

Tables 1, 2, and 3 summarize the air pollution devices which currently are in operation at the concentrators. The Bonneville concentrator is the newest crushing and grinding facility and is equipped with the most up-to-date air pollution control equipment. The process of crushing and grinding the ore to a fine size generates large amounts of dust. The ventilation points are all equipped with suitable dust collectors to collect the dust and return it to the process. The ore storage bin ventilation system at the Bonneville plant is equipped with baghouse collectors which return the dust to the bin. Other dust generation points such as transfer and dump sections are equipped with baghouses or wet collectors so that the collected materials can be returned to the systems involved.

At the Magna concentrator in addition to the ore crushing and grinding facilities, the

TABLE 1. UTAH COPPER DIVISION BONNEVILLE CONCENTRATOR.

AIR POLLUTION CONTROL DEVICES

Location	Type	Number	Size, CFM
Ore Bin Ventilation	Pangborn-Baghouse	4	8,000
Conveyor Belt Transfer Points	Pangborn-Baghouse	5	5,000
Conveyor Belt Dump Points	Type R Rotoclone	6	16,000 – 40,000

TABLE 2. UTAH COPPER DIVISION MAGNA CONCENTRATOR.

AIR POLLUTION CONTROL DEVICES

Location	Type	Number	Size, CFM
Crushing Building	Utah Air Washers	2	36,000 – 50,000
Conveyor Belt—Symons Crusher	Joy—Microdyne	1	27,000
Molybdenite Roasters	Utah Copper Division Wet Scrubber	1	34,000

TABLE 3. UTAH COPPER DIVISION ARTHUR CONCENTRATOR.

AIR POLLUTION CONTROL DEVICES

Location	Type	Number	Size, CFM
Crushing Building	Utah Air Washer	1	36,000
Junction House	Utah Air Washer	1	20,000
Symons Crusher	Joy-Microdyne	2	37,000
Molybdenite Roaster	Western Precip-itation—Tubulaire	1	48,000

finely ground ore is treated by flotation to recover the copper and molybdenum concentrates. During the separation of the molybdenite from the copper concentrate, it is necessary to roast the combined concentrates to inactivate certain organic reagents. The dust collectors in the main crushing and grinding building are large wet-type scrubbers designed by Utah Copper Division personnel and installed in 1940. The Symons crusher ventilation system is controlled by a Joy-Microdyne. This is a wet cyclone-type collector and dust from this unit is returned to the system. The gases from the molybdenite roasters carry copper and molybdenite bearing dusts from the roasting process. This system is controlled by a Utah Copper Division designed wet scrubber.

The dust control devices at the Arthur concentrator are quite similar to those at Magna. The Utah air washers installed on dust generating points in the primary crushing and grinding operations are of 20,000 and 36,000 CFM capacity and were installed in 1940. The Symons crusher system requires two Joy-Microdynes of 37,000 CFM capacity each. The molybdenite roaster system was equipped with a Western Precipitation-Turbulaire wet scrubber-type collector in 1966. This unit has a rated capacity of 48,000 CFM. A similar unit will be installed at the Magna concentrator if this unit proves to be sufficiently efficient and to have satisfactory maintenance characteristics.

The major air pollution control problem at the concentrators is that of dust blowing from the tailings pond. During each operating day approximately 106,000 tons of finely ground tailings material flow from the two flotation concentrators to the tailings disposal area. This tailings pond covers approximately 5,200 acres and increases in height about 3 feet per year. It is impossible to keep the entire surface of the pond wet or even moist all of the time because the flowing tailings migrate to different parts of the pond. At least in the dry months a total of 200 - 1200 acres of the pond will be dry. With wind velocities of 12 - 15 mph this fine material becomes airborne and can be a nuisance in nearby communities. Every conceivable means of controlling this blowing dust has been investigated. The more important methods tried to date are as follows:

Control Applied	Resultant Effect
Vegetation -	Growth too slow
Snow fences -	Soon buried by shifting tailings
Sprinkling systems—stationary and moving types -	Soon buried by shifting tailings
Irrigation -	Channels form
Macerated paper -	Covered by shifting tailings
Cement plant fines -	Covered by shifting tailings
Chemical encrusting agents -	Covered by shifting tailings
Peripheral distribution -	Restricted to elevation of distribution pipe
Water truck-sprinkling, 12,000 gal. capacity -	Currently in use
Terra-Cruiser—plowing—break up surface -	Currently in use

The most effective means found to date is to discharge the tailings around the periphery of the pond so that they flow over a maximum area. This procedure is limited to the number of times required to build up to the level of the discharge pipes. To control the dry areas which still develop, some benefit is achieved through the use of the large sprinkling truck and plowing with the Terra-Cruiser. The large truck is restricted to those areas where it can gain access. It is too large to cross over wet, soft spots and it cannot go over the two main streams where tailings flow into the pond from the concentrators. Its effectiveness lies in compacting action as well as sprinkling. Work is continuing on the use of various chemical agents which will form crusts over the dry areas. The effectiveness of such agents will be in maintaining a stable surface so that the sprinkling truck can cover more of the dry areas. All of the other methods tried have failed because of the rapid shifting of the tailings flow and the steady increase in the height of the pond.

Smelter

The largest source of potential pollution originates through the treating of copper concentrates in the smelter furnaces to produce anode copper. The acquisition of the Utah smelter by Kennecott from American Smelting & Refining Company in 1959 was followed by a series of changes which have influenced the smelter emission pattern and the necessary control systems. The concentrate handling system was completely modernized and all of the dust-generating points on the conveyor belt system are now controlled by baghouse collectors. The expansion project completed in 1967 resulted in an increase of about 15 percent in the quantity of concentrates treated. This in itself necessitated expanded dust and gas handling facilities. In addition to this increase, the reverberatory furnaces were converted from the conventional type using partially roasted concentrates to the "green feed" type utilizing completely unroasted concentrates. The "green feed" change resulted in a different distribution of dust and the production of additional sulfur trioxide. The latter produces sulfuric acid aerosol in the atmosphere and increases the visibility of stack emissions.

Not related to the expansion project but taking place during the same period was the construction of the molybdic oxide plant. This plant roasts the molybdenite from the concentrator to produce molybdenum trioxide which is sold directly to steel mills. This plant also produces additional sulfur trioxide which adds to the stack visibility. Continuing operational changes which will alter the emission pattern and complexity are the installation of oxygen converting and the smelting of concentrates in the converters. These changes will result in additional dusts and gases entering the converter gas handling system and lesser amounts going into the reverberatory system.

The construction of the molybdic oxide plant necessitated the addition of dust control equipment for this operation. The roasters which convert molybdenite to molybdenum trioxide were originally equipped with dry cyclones and Venturi scrubbers. Since these were not adequate, two wet cottrells are being installed on this system. In addition to these collectors, the gases from the dryers which dry the molybdic oxide after being leached for copper removal are cleaned using a Sly-Dynaclone.

All of the gases from the converters are treated in the plate and wire-type electrostatic cottrell. This unit is designed to remove more than 90 percent of the dust from the converter gases. The dust recovered in this unit is recycled to the operation or sold for outside processing of metal values. The gases are further cleaned in scrubbing towers and mist precipitators before going to the sulfuric acid plants. Prior to the expansion project the five contact acid plants ranging from 100 - 250 tons of sulfuric acid-per-day capacity were capable of treating all of the sulfur dioxide produced in the converter system. With expanded production it was necessary to construct a new 500 ton-per-day unit. The 100 ton-per-day unit has now been inactivated and the five remaining plants are capable of treating all of the converter gases.

All of the converters are currently being modified for oxygen smelting and a portion of the concentrates will be smelted in the converters. This will result in more of the sulfur dioxide gas which will be concentrated enough in sulfur dioxide that it can be treated in the sulfuric acid plants. A new 500-ton capacity sulfuric acid plant will be built to process this additional gas. Both the dust load and quantity of gases will be reduced in the reverberatory system.

The gases from the reverberatory furnaces contain dusts, sulfur dioxide, sulfur trioxide, and large amounts of water vapor. These gases are also treated in a plate and wire-type electrostatic cottrell which is capable of removing over 90 percent of the dust. All of the sulfur dioxide and water vapor and most of the sulfur trioxide pass through the cottrell and are released to the atmosphere through the two tall stacks. These gases are low grade in sulfur dioxide and cannot be treated in standard acid plant installations. Whereas the converter gases must have a sulfur dioxide concentration of over 3. percent and commonly average 4 to 4.5 percent sulfur dioxide, the reverberatory gases contain less than 1 percent SO_2. There is no known technologically feasible process to treat this type of low grade, wet gas for SO_2 recovery at the present time. All of the extensive research currently being carried out in the United States for treatment of power plant gases is being studied carefully for possible application to this problem. In addition Kennecott is evaluating several processes for possible use.

Methods for minimizing the sulfuric acid aerosol in the stack gases are also being studied. A pilot scale mist eliminator is currently scheduled for installation. The effectiveness of this unit will be evaluated prior to further planning on this project.

TABLE 4. UTAH COPPER DIVISION SMELTER.

AIR POLLUTION CONTROL DEVICES

Location	Type	Number	Size, CFM
Reverberatory Furnaces	Cottrell-Plate Type	1	*
Converters	Cottrell-Plate Type	1	**
Converters	Contract Acid Plant	5	1,400 Tons H_2SO_4
Concentrate and Silica Handling-Belt Points	Western Precipitation-Dualaire Baghouses	5	10,000 - 24,000
Molybdenite Roasters	Venturi Scrubbers	2	13,000
Molybdenite Roasters	Cyclone	2 x 4	4,000 (Approx.)
Molybdenite Roasters	Wet Cottrell	2	26,000
Molybdenite Dryers	Sly-Dynaclone	2	3,600

*All gases generated by reverberatory furnaces

**All gases generated by converters

Refinery

The casting furnace systems each have a baghouse installation for collection of the copper oxide dust which is formed in the furnaces. No major changes are planned in this area.

In the silver refinery the kilns in which the tankhouse slimes are treated to a bisulfate fusion are controlled by refinery designed scrubbers and an electrostatic cottrell. These gases are very difficult to control since selenium is volatilized and it tends to precipitate in the scrubbing solutions and to plug up nozzles and pipes. The scrubbers consist of open acid-proof towers through which the gases and scrubbing solutions flow countercurrently. Following the scrubbing towers is the electrostatic cottrell which moves the remaining selenium from the gases. Test work is underway on this system to attempt to find a more efficient scrubbing device which will operate effectively on these difficult gases.

Following the volatilization of the selenium the slimes residues are treated in the Dore furnaces for recovery of gold and silver. The gases from these furnaces are again scrubbed using the open type scrubbing towers and then passed through electrostatic cottrells. As with the selenium recovery system, any improved scrubbing device determined by the test work will be evaluated for use in this system. In addition to the scrubbers and cottrells on the furnace gases, a baghouse collector has been installed on the exhaust of the hood which covers the furnaces.

TABLE 5. UTAH COPPER DIVISION REFINERY.

AIR POLLUTION CONTROL DEVICES

Location	Type	Number	Size, CFM
Anode Furnace	Western Precipitation Multiclone	1	8,000
Anode Furnace	Wheelabrator Baghouse	1	8,000
Refined Copper Furnaces	Western Precipitation Multiclone	1	15,000
Refined Copper Furnaces	Wheelabrator Baghouse	1	15,000
Selenium Kilns	Utah Copper Division Wet Scrubber	3 Systems	5,000
Selenium Kilns	Wet Cottrell	1	5,000
Selenium Kilns—General Ventilation	Doyle Scrubber	1	15.000
Doré Furnaces	Utah Copper Division Wet Scrubber	2 Systems	8,000
Doré Furnace	Cottrell-Plate Type	1	8,000
	Cottrell-Pipe Type	1	
Doré Furnace—Slag Door Hood	Baghouse	1	5,000
Gold Boiling Tank	Packed Tower	1	1,000
Wohlwill Cells	Packed Tower	1	5,000
Slime Leach Tanks	Ducon-Wet Scrubber	1	5,000
Slag Crushing	Wheelabrator Baghouse	1	7,500
KRC Slimes Room	Baghouse	1	9,000

Miscellaneous collectors include packed towers on the gold boiling kettle exhaust, the Wohlwill cell ventilation system and a Ducon wet scrubber on the leach tank exhaust system.

Monitoring Programs

In addition to the various physical control devices on the ventilation and exhaust systems, various groups are concerned with monitoring both the in-plant and atmospheric emissions of the division. At the concentrator most of the measurements are made by the Industrial Hygiene Section of the Safety Department. The main concern here is with the maintenance of minimum dust levels in the plant areas for employee safety. The collectors on the ventilation systems prevent these dusts from becoming atmospheric emissions. At the other plants, the Industrial Hygiene group's activity is primarily in the area of in-plant atmospheric conditions.

At the smelter the Smoke Test Section of the Quality Control Department monitors the dust and gaseous contaminants in the gases treated by all of the control devices. This group determines the efficiency of the cottrells, records the SO_2 going to the acid plants and continuously analyzes the stack emissions for particulate and gaseous materials.

At the refinery the Metallurgical Department personnel make periodic tests on all of the control devices. These tests are primarily on the efficiency of these devices in removing particulate material.

In 1959 when Kennecott acquired the smelter from American Smelting & Refining Company, an Agricultural and Meteorological Research staff was organized. This group is similar to the American Smelting & Refining Agricultural Research Department which carried out air pollution and agricultural research and crop inspection for many years. However, the Kennecott group is concerned with air pollution problems only in the Utah Copper Division whereas the American Smelting & Refining Company group had company-wide responsibilities.

The Agricultural and Meteorological Research Section is staffed by an average of 10 employees to perform research and studies related to pollution problems in the division. Among the group are sampling engineers, instrumentation engineers, field inspectors and chemists. A total of six air monitoring stations is maintained throughout the Magna area. These stations are equipped to maintain a continuous 24-hour record of sulfur dioxide concentrations in the atmosphere and to record the wind direction and velocity continuously. In addition other sampling equipment is maintained to determine the amounts of various dusts and gases in the air on a routine basis. Kennecott field inspectors maintain a regular daily record of the condition of crops in the Magna area. Whenever damage to any crop due to sulfur dioxide occurs, the crop is sampled and the amount of leaf damage measured. The relationship of leaf damage to actual crop loss is then calculated using formulae based on fumigation experiments. At the end of the growing season all farmers who had economic crop loss due to sulfur dioxide are compensated for the actual damage suffered.

Conclusions

The Utah Copper Division has a long history of air pollution control. In the area of the smelter the previous operator, American Smelting & Refining Company, constructed the first electrostatic cottrell to clean the waste gases in the mid 1920's. Research on the effect of SO_2 on crops was initiated during this same period. The first sulfuric acid plant for removing SO_2 from converter gases was constructed in 1937. The programs of acid plant construction to keep up with smelter output, gas cleaning and agricultural research have been maintained and improved to the present time.

At the concentrators the Utah Air Washers on the dust emissions were installed in 1940. Since that time collectors have been installed on all of the major points of particulate emission with the exception of the foundry. As new commerical collectors become available, they are tested for applicability to concentrator systems. The new Bonneville concentrator was equipped with the latest and most efficient type of collector—the baghouse type. Studies are underway to control the gases from the foundry so that these unsightly particulates are eliminated from the atmosphere. The problem of controlling dust blowing from the tailings pond is a continuing one and all new and feasible methods for achieving this are being actively explored. Kennecott people are working closely with the U. S. Bureau of Mines, Solid Waste Liaison Committee, to develop ways to stabilize such waste materials.

The Utah refinery was constructed in 1950 and was equipped with control devices on all of the major emission points. As processes are changed and as new control equipment becomes available, these devices are tested for improved efficiency in collecting the various materials contained in the process gases.

Utah Copper Division personnel will continue to work closely with state and local authorities in the development of air pollution regulations based on realistic air quality values developed from the various air monitoring and surveillance programs.