

CLEAN AIR

by

Kenneth W. Nelson
Director of Hygiene and Agricultural Research
American Smelting and Refining Co.
Salt Lake City, Utah

Clean air is a subject requiring 2100 pages for discussion in a three-volume work published recently. "Air Pollution" rather than "Clean Air" is the title -- which suggests negative thinking. In any case "Clean Air" is a large subject to dispose of in about 30 minutes. My remarks will necessarily be limited to but a few parts of the whole picture.

The aspect of clean air which probably concerns most of us today is regulation - regulation which may restrict further the limited freedom industry has, and regulation which will increase operating costs with little or no contribution to income. I doubt that many of you are seriously worried about imminent effects of air pollution on your health. If you are, please relax. What I have to say later may be comforting.

Programs to achieve cleaner air in our major cities date back many years - into the twenties. In 1947 California passed a law authorizing air pollution control districts. It was the first state law dealing specifically with air pollution although several states had previously permitted city activities and all states had laws against nuisances. Then in 1951 Oregon created the first statewide air pollution control program and other states followed.

Except for a few studies done by the Bureau of Mines and the Public Health Service and federal government had no regular activity in pollution control until 1955. Then Congress passed a law providing for research and technical assistance. The Department of Health, Education and Welfare established programs to provide technical assistance and training and to undertake research into the sources, nature, concentration and control of pollutants and into their effects on health.

In 1963 the Clean Air Act provided authority for federal abatement in certain situations and, more importantly, provided direct financial aid to state and local government control programs. Under the stimulus of more dollars state programs developed quickly. But HEW and Congress were not satisfied, apparently, so the Clean Air Act was amended by the Air Quality Act of 1967, passed in November of that year.

The Air Quality Act as originally proposed included the establishment of national emission standards and broad new authority for the Secretary of HEW. At this point industry, which had entered only minor objections to prior legislation, objected vigorously. Its strong reaction was in part a response to a preposterous document, issued in March, 1967, containing air quality criteria for sulfur oxides. The net results of industry opposition were the withdrawal of the sulfur oxides criteria for reconsideration and the deletion from the Act of national emission standards in favor of ambient air quality standards. (An emission standard refers to the mass or concentration of a pollutant being emitted from a source like a smokestack. An ambient air standard refers to the air at ground level - the air we live in.) The broad powers of the HEW Secretary remained in the Act. And the issue of emission standards will arise again, for by November 21st of this year the National Air Pollution Control Administration is required to report to Congress on the need for and feasibility of such standards.

Because different communities in different states may share each others' pollution, the Act requires the establishment of air quality regions. Some have been established and all will be by May 21, 1969.

In the last few months the revised sulfur oxides air quality criteria and criteria for particulates have been issued along with reviews of control technology. As criteria appear, they set in motion the adoption by states of ambient air quality standards and development of control plans on a definite timetable. Standards and plans must be finally approved by HEW.

That is about where we are today. There is much hard work ahead for control officials who must grapple with ambient air standards and control regulations. There is equally hard work ahead for industry's engineers and scientists, for industry must follow developments closely and seize upon every opportunity to participate. Cooperation between government and industry is essential if reasonable judgements are to be made.

Ambient air standards alone are enough to challenge the wisdom of Solomon. Should they be based on possible health effects? If so, what is a health effect? Is it an odor, pleasant or unpleasant? Is it a momentary irritation?

Should standards be set based upon the preponderance of evidence? Or should they be the minimum suggested by a single, unconfirmed laboratory study? Should standards be designed to protect the most sensitive individual? What about the one person in a thousand who might not like the smell of broiled steak?

In the case of particulates which affect visibility in low concentrations without any health effect at all, what is the background level? How much should human activity be permitted to increase the background level? What about allowing for the weather, the uncontrol-

table variable which may affect pollution concentrations by a factor of five or ten? Careful consideration must be given to all these questions. And industry must furnish advice on technology and economics so that realistic standards, not idealistic goals, are adopted.

A number of states have already adopted air quality standards and presumably will submit them to HEW for approval at the required time. If the standards are unreasonable, as are some of the sulfur dioxide standards derived from the first, discredited criteria, industry should take now whatever steps may be necessary to have the standards modified before submission to HEW.

Emotion and politics have provided much of the impetus for air quality control programs. There have been distortions of fact, unfounded condemnations of industry, and in general an adversary system of government against industry has been fostered. Not the least of the causes of problems is the fact that air pollution is a technical, complex subject. Some individuals, simply because they were physicians, engineers or professors, were assumed to have adequate training and were appointed to control or advisory boards. But titles do not guarantee qualifications. I recall particularly one professor, a biologist and a strong and vocal proponent of strict controls for industry. He told me in all seriousness that a plant of my company could reduce sulfur dioxide emission by enlarging the electrostatic precipitator in the system! We should remember the words of another professor, a chemist, who wrote: "A reputable scientist speaking in his own field deserves careful attention - a scientist speaking out of his field should be given one vote, just as anyone else."

It is regrettable to me that some scientists use their prestigious positions as platforms from which to expound publicly their unproved speculations about air pollution. Scientists are supposed to doubt unconfirmed findings and to search for truth - or so I was taught. They are expected to draw conclusions based upon sound data, not to extrapolate without reservation. But that kind of thing is being done. Let me cite two examples.

A well-known analytical chemist found minute quantities of selenium in cigarette paper and other types of paper. It wasn't really a surprising discovery. With our advanced micro-analytical techniques today we can trace many elements in ordinary items. But in this particular instance the finding of selenium in cigarette paper was promptly translated, in the university news releases, into a possible cause of lung cancer among smokers. There is no sound basis for any such inference. Actually, traces of selenium in our bodies are considered normal and essential.

A year or two ago in the British scientific journal, "Nature", there was a report of mutations produced among fruit flies as a result of laboratory exposures to high concentrations of nitrogen oxide gases. A few months later a famous chemist, famous especially in the chemistry

of air pollutants, publicly warned of possible genetic changes in people exposed to traces of nitrogen oxides in city air. There ought to be a code of ethics for scientists that would prohibit such fear-mongering.

So it's not surprising that people get frightened about air pollution. It is heresy to say so, but I believe that fear has been a weapon deliberately used to promote air pollution control and that the public has been sold something of a bill of goods. Surely government has a duty to present all of the facts fairly to the public which will ultimately bear the costs of cleaner air. Regulation for regulation's sake and unnecessary expenditures are not in the best interests of the people.

Is air pollution undesirable? Of course it is! Can we have our kind of city living without it? We cannot, for some air pollution is inevitable in our cities. Is it getting worse by the minute as all the publicity media and certain publicity-seeking scientists say it is? It is not - surprising as that may seem.

Air pollution is commonly defined as the presence of contaminants in the air in large enough quantities for a long enough time as to cause injury to life or property or to interfere unreasonably with enjoyment of life and property. Immediately we get into some sticky questions of what constitutes injury and what is meant by unreasonable interference with enjoyment. Ultimately the courts will have to decide some of these questions. Meanwhile there are the obvious cases of sootfall or dustfall on and in our homes so as to make cleaning a daily chore. There is the annoying eye irritation of photochemical smog as in Los Angeles. Clearly, efforts must be made to eliminate these nuisance conditions or to reduce their frequency and severity.

Unfortunately, however, some zealous air pollution control advocates have gone far beyond necessary and reasonable goals in setting air quality standards that must be met in their areas. They are saying that a momentary odor is an effect on health. They are reaching for the elimination of hazes and fogs, even though such phenomena exist without man-made pollution. They are emphasizing esthetic effects even more than nuisance or possible health effects and - in the manner of idealists - they forget about the costs.

I would have no quarrel with idealists if the costs were ones we could bear and if there were no more pressing problems facing us. But I find it somewhat inconsistent and ridiculous to be concerned about a visible atmospheric haze, outdoors, caused mostly by moisture, when we sit in smoke-filled rooms, eat in odorous, smokey restaurants, and breathe air in theaters and schoolrooms much more contaminated than outside air. I find it odd that large sums of public money are spent in fruitless searches for health effects from air pollution, when 10 million or more of our citizens suffer from hay fever or asthma caused by natural airborne pollens. (So far as I know, federal air pollution control grants have not cut a single ragweed.)

Where does air pollution come from and can we eliminate it? If I may have the first slide please. Here we see the government's estimate of the contributions from various sources. And we see at once that automobiles lead with 60% of the total. In Los Angeles the contribution from automobiles is 85 to 90% instead of 60%. You are aware I'm sure that crankcase emission controls have been mandatory on cars for several years and that exhaust-emission controls have been required beginning with the 1968 models.

I am certain that controls on automobiles are improving, and will improve further, the quality of air over our cities. I believe that the improvement will be shown by air quality measurements and that it will even be noticeable to the average citizen. The particulate emissions directly from automobiles and those resulting from subsequent photochemical reactions of exhaust gases markedly affect visibility.

Emission control devices are costing the auto-buying public, at \$25 per car, about 200 million dollars a year. Many cities do not have significant auto smog problems and certainly the rancher in Wyoming or Nevada is not concerned. He still must pay the extra cost, however, for the benefit of the city dweller. There simply isn't any reasonable alternative to factory installation of control devices on the ubiquitous, mobile, American car.

Let's focus on industry for the moment. We see that industry's estimated contribution is considerably less than we would think, judging from newspaper articles and television programs. People tend to overlook the automobile, which is a small individual pollution source, and to point the finger at one industrial smokestack, perhaps the only one in a square mile. Its contribution may be negligible in the overall scheme, but it is seen and is automatically damned. We should remember that control officials whipped the wrong horse in Los Angeles for years before they identified the auto as the principal problem.

In the next slide is shown a graph taken from a report of the Daddario subcommittee of the U. S. House of Representatives. Here we see that pollution levels in our cities correlate almost perfectly with city populations. The larger the population, the greater the concentration of people, automobiles, heating units, garbage burners and the like. The greater the concentration of pollution sources - units per square mile, we could say - the greater the concentration of pollutants in the air.

Let me define some terms. Concentrations of particulate pollutants such as dust, smoke, metal fume, and liquid droplets are usually expressed in micrograms per cubic meter of air. Concentrations of gaseous pollutants, like carbon monoxide or nitrogen oxides, are expressed as parts per million parts of air by volume.

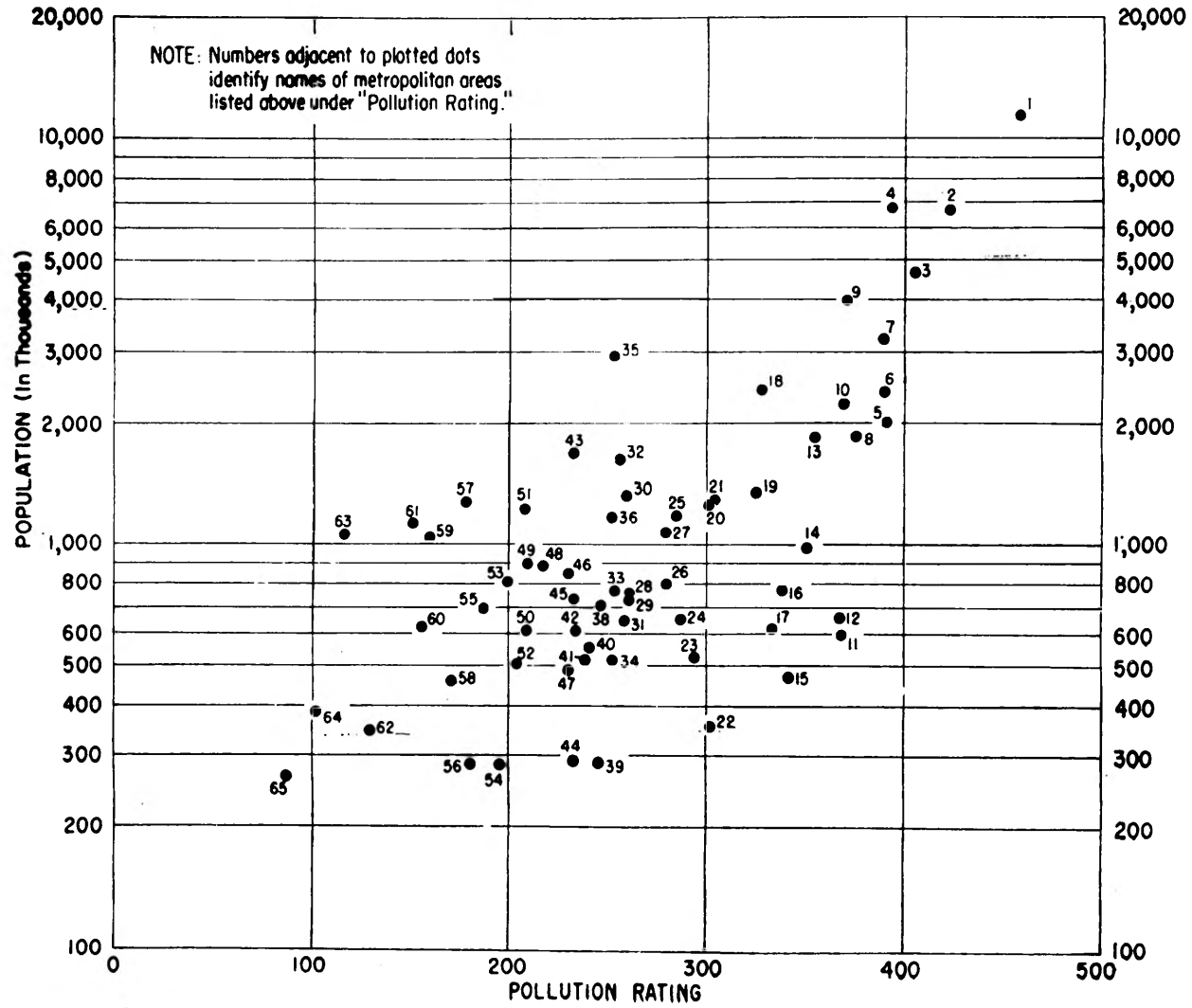
TOTAL U.S. AIR POLLUTION BY SOURCE-1966

SOURCE	TONS/YEAR	% OF TOTAL
INDUSTRY	23,000,000	16.8%
POWER PLANTS	20,000,000	14.1%
MOTOR VEHICLES	86,000,000	60.6%
SPACE HEATING	8,000,000	5.6%
REFUSE DISPOSAL	5,000,000	3.5%
	142,000,000	

Source THE SOURCES OF AIR POLLUTION AND THEIR CONTROL
Department of Health Education and Welfare, 1966

	TONS YEAR
CARBON MONOXIDE	66,000,000
OXIDES OF NITROGEN	6,000,000
HYDROCARBONS	12,000,000
SULFUR OXIDES	1,000,000
LEAD COMPOUNDS (as lead)	190,000
PARTICULATES	1,000,000





A microgram is an exceedingly small quantity. One ounce weighs about 28 million micrograms. An ordinary aspirin tablet weighs about 400,000 micrograms.

A cubic meter is somewhat larger than a cubic yard.

Less than one cubic foot of carbon monoxide would produce a part per million concentration in this room.

In the next slide we see a number of major metropolitan areas ranked in a table according to pollution and population. Again we see that, with few exceptions, correlation between pollution and population is excellent. St. Louis for example, is 10th in population and also 10th in pollution. As the Daddario report says, it is clear that pollution is an unavoidable consequence of the agglomeration of people, cars and industry. A conclusion is suggested that clean air for very large cities is inherently difficult to attain.

Now what about my earlier statement that pollution is not rapidly getting worse. What evidence do I have?

Again I use the government's own figures, not its public information releases, to make a point. In the next slide we see a bar graph of average particulate concentration - micrograms of particles per cubic meter of air - for 65 cities in which samples were collected every year from 1957 thru 1965 as a part of the National Air Sampling program.

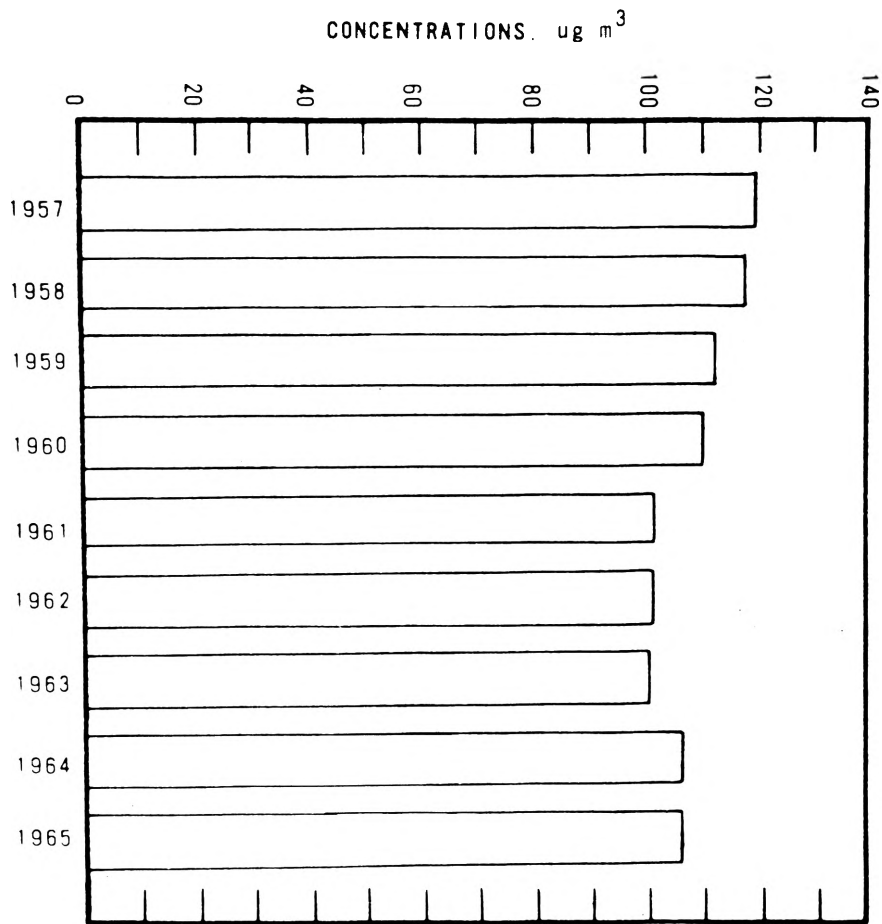
Sampling the air is an exacting business, but it is the only reasonably dependable way we have of measuring air quality. Our vision alone is too easily fooled. In any case, as we see from the slide, there is no doubt that particulate pollution has not increased from year to year. There are slight variations but there is no distinct upward trend.

In the next slide we see the same graph to which I have added bars for 1966 and 1967, using figures yet unpublished but made available to me through the courtesy of Dr. John Middleton, Commissioner of the National Air Pollution Control Administration. Here we see a drop in particulate levels that seems to be real. It may indeed be real and it may be caused by auto emission controls. If that is so, 1968 and '69 should show further reductions as newer cars replace older models without controls. Compare, by the way, these levels with the results of air pollution studies in 1931 and 1932. Average particulate concentration in 14 major cities then were found to be 510 micrograms per cubic meter, five times the concentrations shown on the graph.

In the final slide are shown particulate levels monitored continuously at my laboratory in suburban Salt Lake City since 1945. Here again a decline over the years is indicated. And that in spite of a doubling of the population in the metropolitan area and a four-fold

POLLUTION vs. POPULATION
 MAJOR METROPOLITAN AREAS

<u>Metropolitan Area</u>	<u>Pollution Rating</u>	<u>Population Rank</u>	<u>Metropolitan Area</u>	<u>Pollution Rating</u>	<u>Population Rank</u>
New York	1	1	St. Louis	10	10
Chicago	2	2	Baltimore	13	12
Philadelphia	3	4	Washington	18	8
Los Angeles	4	2	Kansas City	25	22
Cleveland	5	11	Denver	27	25
Pittsburgh	6	9	Minneapolis	32	15
Boston	7	6	San Francisco	35	7
Newark	8	13	Seattle	36	23
Detroit	9	5	New Orleans	59	27
			Miami	63	26



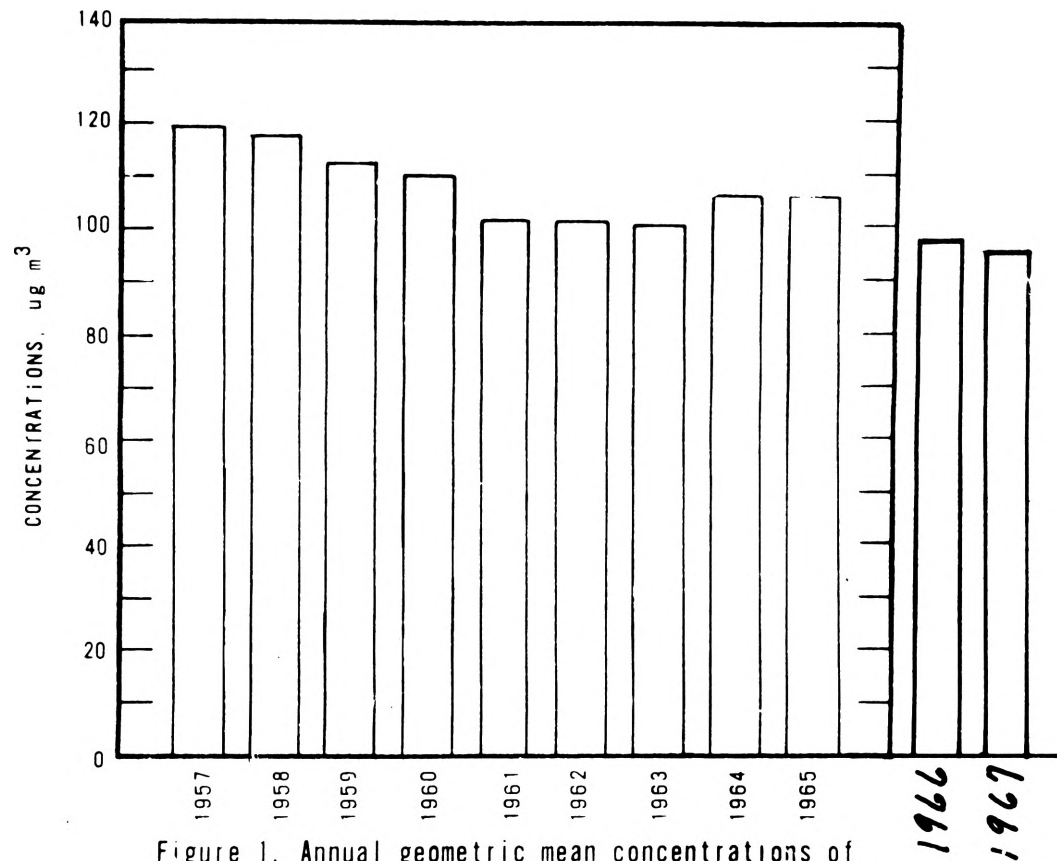
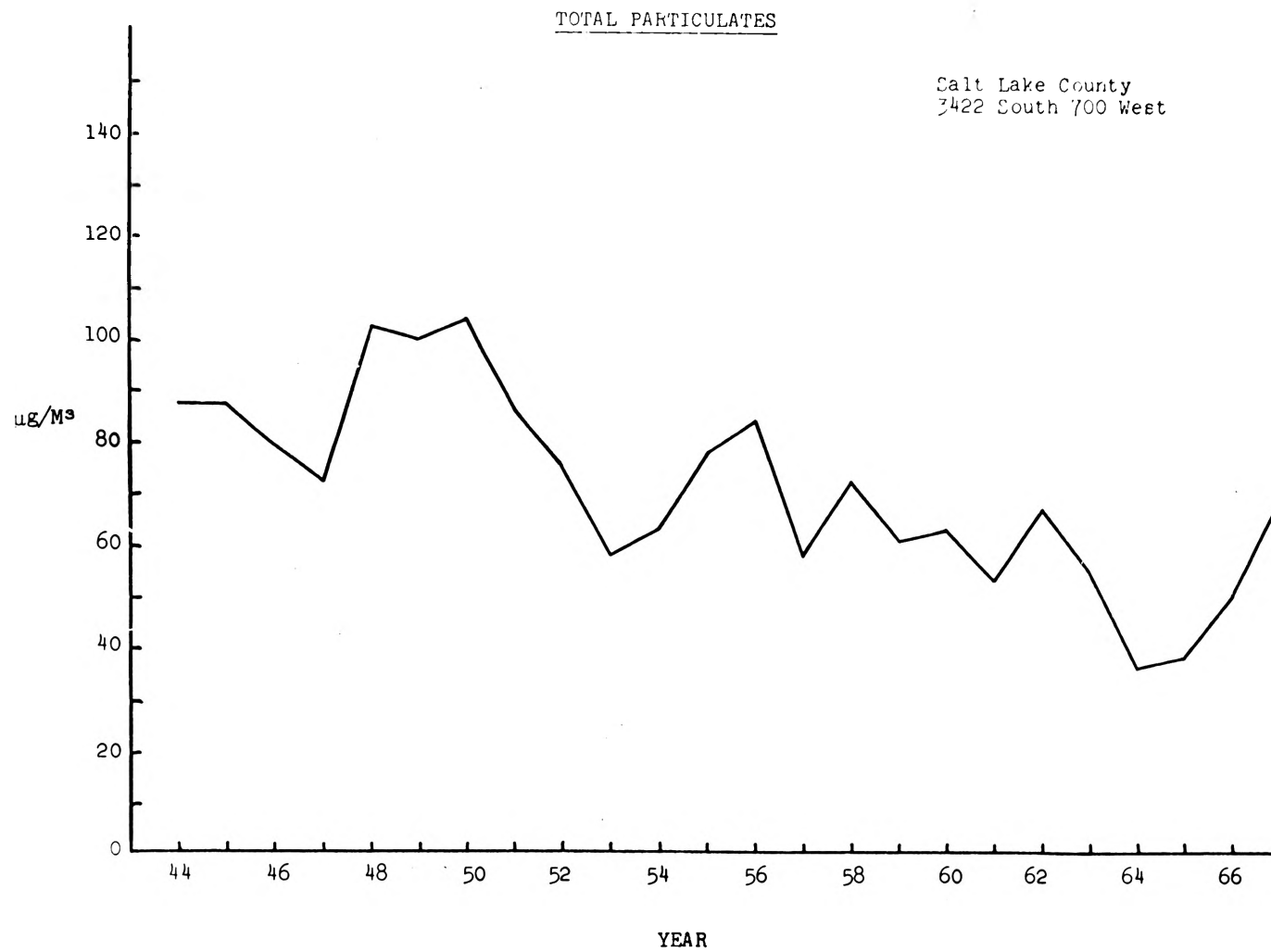


Figure 1. Annual geometric mean concentrations of suspended particulates at 'every-year' urban stations.



increase in numbers of automobiles. The only explanation I can offer for this phenomenon is that pollution due to home heating, which used to be done with small, inefficient coal-burning stoves and furnaces, has been eliminated by conversion to natural gas or electric heat. Most coal-burning is done now in large, efficient units for power production. Another factor may have been a reduction in dust from decreased farming activities.

We have seen on the slides only particulate levels. The data on polluting gases are more limited, but there is no indication that overall gas concentrations have increased.

I cannot emphasize too strongly the word "concentration". While it is probably true that the total amount of air contaminants released in the nation each year is increasing as our population increases, the concentrations of air contaminants at any given point determine the effects, if any. And it is evident, from the best figures we have available, that concentrations of various pollutants are not increasing.

President Johnson, in a message to Congress last year, missed the point completely. He said: "From the great smokestacks of industry and from the exhausts of motors and machines, 130 million tons of soot, carbon and grime settle over the people and shroud the nation each year." The President neglected to mention that, at any given moment, not a year, the air over the 48 contiguous states weighs about 100 million, million tons, air which dilutes and disperses the pollutants. This vast reservoir is constantly changing and being renewed by the west to east air movement over the continent. The President made one good point, however. The soot, carbon and grime do settle out or are washed out of the air. They do not accumulate endlessly. Other mechanisms take care of polluting gases. Carbon dioxide, for example, is used up by growing plants or is absorbed in the oceans. Some scavenging mechanisms are not understood. We don't know what happens to all the carbon monoxide, one of the most abundant pollutants of all. But it does disappear.

Much has been said in publicity media about the terrible consequences to health of breathing airborne particulates. So far as soot, carbon, and grime are concerned President Johnson could have stated that most of it is in the form of particles too large to be inhaled. I'm sure you are aware from your studies of accident and occupational disease prevention in mining that only the very smallest microscopic particles get into our lungs, that most of them are then rapidly swept out or are otherwise cleared by the lung's protective mechanisms. We inhale particles literally all our lives, and unless our protective mechanisms are overwhelmed, there are no apparent harmful effects.

It is impossible to review here all of the studies made in an attempt to show that significant health effects are being caused by current levels of pollutants - particles and gases - in the air of our cities. Patterns of deaths in the United States have failed to

suggest any differences which could be attributed to air pollution. A recent study on large populations in California similarly have not shown an air pollution-mortality relationship. So far as chronic respiratory disease is concerned, there have been both negative and positive findings relating chronic bronchitis and air pollution. I think it would be a fair statement to say that air pollution in our cities today probably does not cause disease, but that it may aggravate existing disease. We should remember, however, that temperature and humidity, environmental factors surely as important as pollutant levels, have unquestioned effects on health. Further, the elusiveness of provable air pollution health effects strongly suggests they are minor compared with the effects of Asian flu, the common cold, heavy cigarette-smoking, or even hay fever.

Let me sum up my personal views by saying that I appreciate clean air as much as anyone. I believe in industry's obligation to be a good neighbor and I'm sure that better controls of some industrial emissions in certain areas are needed to improve environmental quality. But I know that we don't have feasible solutions to all the emission problems of industry. We must wait for solutions to be developed. Meanwhile I believe our most effective efforts will be those directed toward further reduction of auto emissions.

And I know that even with the best of controls, we're going to have air contaminants in the form of dusts, mists, gases and vapors - even compounds resulting from the action of sunlight on substances evolved from natural vegetation. We'll still have hazes, smazes, fogs and smogs, for there is no such thing in nature as perfectly pure air.

Finally, I cannot subscribe to, nor does the record support, the widely-held opinion that air pollution is an immediate or near-term threat to our existence. There is more nonsense than truth in all the talk about air pollution, and I hope that the facts I've presented to you this afternoon have helped put the problem in proper perspective.

COMMENTS

QUESTION: Mr. Nelson, I happen to have at home a pamphlet. I think it was a digest of an article or lecture of yours in which you discussed more fully than you touched on it today, the actual health affects, if any, of the inhalation of sulphur dioxide. Today you didn't touch on that very fully. I believe this audience would appreciate it if you'd give them just a few of the facts that you set forth in that book.

ANSWER: I'd be happy to do so provided that I wouldn't be infringing on the subsequent speaker's field. Sulphur dioxide is of course of prime interest to us in the smelting industry as we are large emitters of SO₂ but not the largest. I think you all realize that power plants burning high sulphur coals are the largest emitters as a single group in the United States. SO₂ has been unjustly maligned. It first really began with the London episode of 1952, when, as you will probably recall, there were 4000 excess deaths over a period of about 10 days during a real pea souper. It was a stagnation such as London has never experienced in the past and will never experience again, by the way, because of changed fuels. To think that people were literally lost on the streets. They could not find their homes. They were completely disoriented. During this high pollution episode particulars were being made. Particulars that were extremely high in milligrams, not the micrograms. The SO₂ level, as I recall, was something around 1 1/2 or 2 parts per million. Both particulates and SO₂ were being measured. They were the only pollutants that were being measured. So, the thinking then was, well, sulphur dioxide must have done it. A lot of research began to be done on sulphur dioxide and its affects on human beings and a growing impression was that sulphur dioxide was the bad actor in any pollution episode. However, in 1962, there was another smog in London. Now by this time the Clean Air Act had taken affect and coal burning in home fire places was banned. In 1962 the particulates were quite low. I've forgotten the figure but it was around a milligram per cubic meter. The sulphur dioxide strangely was higher than it had been in '52. Now in '62 there were 400 deaths with higher sulphur dioxide concentrations than there were in '52 -- 4000 deaths. This indicates to me that perhaps sulfur dioxide was not so bad as it had been maintained. Now some of our states have passed very low ambient air quality standards. They passed terribly restrictive standards. Levels which no one could detect by odor or taste. And this is tough on the smelting industry.

We have just come from experiments at Salt Lake City and according to our tests in a walk-in exposure chamber we cannot smell SO₂ at under a part and a half per million. Most people can't smell it at that level. The majority smell it at something like 2 parts per million. Now these figures agree with the old Bureau of Mines figures back in 1915. But yet you will find in the literature, odor thresholds at a

a half a part per million and we can't determine that. Yet a half a part per million was the level chosen by California based on odor. We need more tests.

There's a real public policy problem here that involves the gap between injury and simple perception by the population. I have no idea really how we handle this, but it turns up in all of these qualitative environmental problems where you may be learning less of injury than of people's perception of a problem. For example, I don't know why, in St. Louis you can correlate house values with air pollution. It may be people's perception that there is a problem or that they don't like it here or something like that. Nevertheless it is reflected in home values.