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Measurement of Ambient Air Quality in Monroe County*

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Air Pollution

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Summary

One way to compute air pollution is to test the air periodically (once every six days in Rochester) for pollutants such as particulates, sulfur dioxide, nitrogen oxides, and to compute a yearly average. Using this technique the Rochester air at the Fire House on North Street does not meet the New York State ambient air standard for particulates, for sulfur dioxide and particularly for nitrogen dioxide.

The County of Monroe has been keeping a record of general air contamination (suspended particulate matter) since 1958. In that time particulates in the air have not increased, although their composition may have changed. At the Fire House at North Street and at Kodak Park the yearly average for suspended particulate matter is at least 25% higher than the current standard for pure air.

One specific pollutant currently measured by the County is sulfur dioxide. At the Fire House sulfur dioxide was over the State's permitted 24 hour high 5% of the time in 1968, 7% in 1969 and not at all in 1970.

Nitrogen dioxide has been measured in Rochester by the County as part of the Federal Sampling program. In 1968 and 1969 the yearly average amount of nitrogen dioxide in the air was at least 30% over that recommended in the Federal standard even on top of the Fire House roof. On the basis of the available data, which is sparse, Rochester may have a problem in the Inner City; the automobile seems to be a major contributor of nitrogen oxides.

Five air pollutants including carbon monoxide, sulfur dioxide and nitrogen oxides are now being systematically measured by the Continuous Air Monitor which is run by the State, but yearly data are not yet available.

¹ This Bulletin was written by the Environmental Quality Committee of the League of Women Voters, Olga Berg, Chairman, as part of their study of air quality of Monroe County. The study was undertaken to help League members to establish a consensus position on the need for air quality control. It could not have been done without the full cooperation of the Air Pollution Control Office of the Monroe County Department of Health who supplied the data, and the New York State Department of Environmental Conservation Regional Office at Avon.

The RCSI favors additional monitoring of the air to detect places where people are exposed to specific pollutants such as carbon monoxide, asbestos dust or airborne oxidants at the times when the exposures are highest. This is in contrast to the present procedure which concentrates on long time (24 hour) averages at roof level.

Sampling by the County

Particulate matter: There are nine sampling sites throughout the County; six more were expected to be in operation by the summer of 1971, but their sites have not yet been chosen. The County stations were set up primarily to measure settleable particulates (dustfall) and suspended particulates (small solid or liquid particles which remain in suspension in air for varying periods of time). The samplers for particulate matter are on roofs of buildings 20 to 50 feet in the air (the machines were placed on roof tops to avoid vandalism, not to mask the seriousness of pollution at street level). The location of the monitors, the year that they were installed and the ambient air quality level of the area are listed in Table 1. The stations were sited to measure general air quality, they were carefully not placed in positions where they would pick up evidence of high pollution from individual sources.

Table 1.

Site of County Monitoring Station	Year of Installation	State Classification Level of Area
Fire Headquarters, North St.	1958	III
East High School	1966	III
Building 135, Kodak Park	1966	III
School 44, Genesee Park Blvd.	1970	
Bishop Kearny High, Irondequoit	1966	II
South Avenue High, Webster	1966	II
Churchville-Chili Central School	1966	I
Hilton High	1969	I
Honeoye Falls High	1970	I

Table 2. New York State Air Quality Classifications

- Level I - Predominantly used for timber and agricultural crops, dairy farming and recreation. Habitation is sparse.
- Level II - Single and two family residences, small farms, and limited commercial services and industrial development or sparsely inhabited land near a large metropolitan complex.
- Level III - Densely populated, primarily commercial, office buildings, department stores, and light industrial development in small and medium metropolitan complexes.
- Level IV - Densely populated, primarily commercial, in large metropolitan complexes, or limited areas of heavy industry.

Air is sampled every sixth day. Collecting filters are left in the high volume air samplers for 24 hours during which time 72,000 cubic feet of air passes through them. When air is measured this way general pollution is recorded from industrial stacks, incinerators, household furnaces, automobiles, shoe leather, etc., all diluted by distance and air conditions, particularly wind pattern. Particulate data for all the stations in Monroe County for the last 13 years is summarized in Table 3.

Table 3. Suspended Particulates - Yearly average expressed in $\mu\text{g}/\text{M}^3$ (a)

Station	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	NY State Standard
North Street	<u>113</u>	131	152	115	90	94	108	112	106	99 ^(b)	116	110	88 ^(d)	65
East High									<u>90</u>	79 ^(b)	80	79	69 ^(c)	65
Kodak							93	107	<u>97</u>	86	98	107	90 ^(c)	65
Irondequoit									<u>76</u>	65	72	76	66 ^(c)	55
Webster									<u>49</u>	41	40	52	43	55
Churchville									<u>53</u>	45	47	58	45	45
Hilton												<u>53</u>	44	45
Honeoye Falls													<u>48</u>	45
School 44													<u>(e)</u>	

(a) Data from the Monroe County Health Department

(b) Average for more than 10 months but less than a year

(c) State has noted that its standard is violated

(d) State has noted that its standard is violated by more than 26%

(e) Data is not yet available

Year of first measurement by County. Kodak made its own measurements prior to this

According to the Federal Government Criteria (1) when the air is so dirty that 60 μg of particulate matter is sampled on the filter 50% of the time, there will be a gradual corrosion of steel, particularly if sulfur dioxide and moisture are in the air. In cities, when there is an increase in particulate matter in the air, there is usually an increase in specific pollutants such as hydrocarbons, nitrogen oxides and sulfur dioxides. Under such conditions decreased sunlight and an increase in respiratory difficulties have been reported. Such an epidemiological study has not been made in Rochester but the particulate matter figures suggest that in 1969 at Fire Headquarters and at Kodak there may have been some decrease in sunlight. In other areas in the County that were tested there is not a serious problem with particulate matter in the air.

Suspended particulates have been measured at Fire Headquarters on North Street for many years but precise data are available only from 1958. Early records show dustfall in Rochester to be very high. This stopped gradually as the stores and industries in the area stopped individual heating and started to buy gas and electricity from Rochester Gas and Electric Co. Since 1958 the yearly mean concentration of suspended particulates has remained constant. In the same period cars and people in the area have increased greatly. This suggests that furnaces must be running cleaner than they were, which means, in its turn, that cleaner fuels are being burned or that antipollution devices have been put in.

Sulfur dioxide: For the last five years the County has sampled the air at Fire Headquarters for sulfur dioxide and has made sporadic measurements at East High School and Kodak Park. According to Mr. Bouley, Monroe County is the first county in the State outside New York City to have made such measurements. Sulfur dioxide gets into the air primarily when fossil fuels containing sulfur are burned. The concentration of sulfur dioxide in the air is more difficult to measure than particulate matter and changes greatly from day to day depending upon wind pattern and the energy demands of the area, which in turn depend upon such variables as temperature, and day of the week (down on Sunday). Since most houses burn fossil fuel for heating, the concentration of sulfur dioxide in the air in densely populated living areas tends to be greater in winter than summer. Unfortunately, fossil fuels are also burned for air conditioning, the use of which is increasing, and so in some areas the summer concentration is gradually approaching that in winter.

The effect of sulfur dioxide on people is enhanced by an increase in the particulate matter in the air. There are not many detailed studies on year round exposure. One, done on school children in Britain (2), indicates that respiratory problems increase in frequency and severity when the yearly average of sulfur dioxide in the air rises to 0.046 parts per million (ppm). On the basis of such studies New York State has held hearings on a proposal to set its standard for a yearly average at 0.02 ppm for levels I and II and 0.03 ppm for levels III and IV. Levels are set by the State, I being rural and IV heavy industrial. Since 1971 the National Government also sets standards. The National Primary Standard (3) is defined as "allowing an adequate margin of safety to protect the public health"; the Secondary Standard protects public welfare, as opposed to health. The National Primary sulfur dioxide standard is approximately .03 ppm. This will cause some injury to sensitive plants.

Monroe County has year round data (sampled for 24 hours every six days) for sulfur dioxide at the Fire House and Kodak Park for 1968-70 and at East High for 1969 and 1970. The amount of sulfur dioxide in the air varies so much from one day to the next, that a great many samples are needed to make an average meaningful. That many samples are not available, so the figures cannot be averaged to compare one year with another. However, it can be seen from Table 4 that the average sulfur dioxide concentration at the Fire House has been higher than today's permitted level since 1968. Average levels at East High and Kodak Park have been within the standards.

Table 4. Yearly Averages for Sulfur Dioxide in the Air

	1968	1969	1970
Fire House	0.040	0.036	0.031
Kodak	0.021	0.019	0.018
East High		0.023	0.024

The State recognizes that weather conditions may cause an extraordinary rise in pollutants in the air, so the regulations say that 99% of the values on an annual basis must be less than 0.14 ppm (measured over 24 hours) - 1% of the values may be above. Table 5 shows the frequency that sulfur dioxide was over the permitted level at the Fire House station.

Table 5. Days of High Sulfur Dioxide Contamination

Year	% of time over 0.14 ppm	dates of violations	no. of days sampled
1968	5%	3/13, 4/30, 10/21	60
1969	7%	1/7, 2/24, 3/8, 3/14	56
1970	0%		58

The dates in violation of standards in 1968 and 1969 correlate with adverse air conditions, such as inversions, but not with time of year. Inversions occurred in Rochester in 1970, too, but they did not result in extraordinarily high sulfur dioxide. Presumably the peak concentrations of sulfur dioxide in Rochester have decreased because the fuel burned contains less sulfur.

To put the state of the sulfur dioxide in the Rochester air in perspective, it should be noted that the sulfur dioxide in New York City has exceeded 0.50 ppm (24 hour average) at least once. When the sulfur dioxide content of the air reaches 0.60 ppm (24 hour average), a stage 3 emergency is declared. The Health Department may then ask for emergency measures to be taken.

Other contaminants: The County makes several other general measurements, such as the sulfation index (the amount of sulfur in the air, regardless of the form that it is in). These measurements were started before there were techniques for specific pollutants and they will gradually be replaced by more specific measurements. There are no Federal Criteria or State Standards for them. We need, and do not yet have, data on pollution from automobiles in various parts of the County. Sampling is difficult, partly because it should be done at nose level, and partly because exposures to auto exhaust fumes are transient; most people drive through or walk through the zones of peak pollution, and only a few remain exposed all day long. Our sampling system relies on averages (24 hour average) and does not record brief peak values. It is not known whether the peaks are more or less important than the sustained values.

Measurements by the Federal Government in the County

The Federal Government has a National Air Sampling Network (NASN). It sends measuring equipment and needed chemicals to each station throughout the country, and the measurements are made by local (in our case, County) personnel. Federal measurements are made on samples collected at Fire Headquarters, only. Sulfur dioxide is the one pollutant measured in both Federal and County programs.

Table 6. Comparison of Federal and County Sulfur Dioxide Measurements

	1968		1969		1970	
	mean	high	mean	high	mean	high
Federal	0.017	0.058	0.024	0.102		
County	0.040	0.209	0.036	0.197	0.031	0.125

As can be seen from Table 6, the Federal measurements of air pollution in our County are much lower than measurements made by the County at the same station. (The County thinks this may happen because of poor measuring procedure. The Federal reagents are shipped in several weeks in advance of the required sampling date, and are not fresh when used.) The Federal measurement shows the sulfur dioxide in the air to be well below the State standard, while the local measurements are well above it. The Federal measuring procedure is standardized and is useful for national comparisons, but Monroe County would be considered not to have had a sulfur dioxide problem in 1968, according to the Federal records. County data are preferable for County comparisons, and probably more accurate.

NASN measures nitrogen dioxide (which comes mainly from cars). When nitrogen dioxide reaches a concentration of 0.062 - 0.109 ppm in the air (24 hour sample) it can be correlated with an increase in respiratory diseases (4). The first nitrogen dioxide standard has just been published. It is a primary Federal standard and has been set at 0.06 ppm, yearly average.

In Rochester, according to the NASN data on nitrogen dioxide in the air, the mean for 1968 was 0.095 ppm and for 1969 it was 0.086 ppm. So, once again, on the roof of the Fire House, nitrogen dioxide pollution is worse than the Federal standards allow, but at the time the measurements were made no standard had been established. Since then a large number of vehicles have been equipped with air pollution control devices and thus the amount of nitrogen oxides is expected to have decreased.

The Federal Program measures aldehydes, ammonia, and total oxidants in the air, but these measurements have been discontinued in Rochester because they were so low.

In 1960 the NASN program measured 27 airborne metals (5). Some of these are essential for life, and some are probably inert. Five (nickel, cadmium, lead, beryllium, antimony) present a potential hazard to human health. Nickel was exceedingly high in Rochester air. In fact, Rochester air was second highest in the nation. New York City was highest in at least 15 metals, including nickel.

Table 7. Airborne Nickel in Rochester (NASN report 1966)

Year	No. of Samples	Readings, in micrograms/cubic meter			
		<u>Median</u>	<u>Average</u>	<u>Peak 10%</u>	<u>Maximum reading</u>
1960	26	0.029	0.052	over .063	0.360

This measurement was done in only one year. Because of this the County is retesting in 1971, and preliminary data show the airborne nickel to be very low. Nickel in the air is of concern because some nickel compounds, such as nickel carbonyl, are highly toxic and are known to cause lung cancer in laboratory animals. There is neither a Federal nor a State standard for nickel.

Measurements made by the State in the County

In a new program, started in June 1970, the State Department of Environmental Conservation installed a Continuous Air Monitor at Farmington Road east of the city near the Irondequoit town line. Prevailing winds are west most of the year, so much of the time that station should pick up some of the city's pollution. It is the data from this constant air monitor that appears in the daily papers. The State station monitors weather conditions (wind, radiation, atmospheric pressure, humidity) and many individual pollutants (oxidants, aldehydes, nitrogen oxides, carbon monoxide, sulfur dioxide). It has an instrument for measuring hydrocarbons, which are important automotive pollutants, but as of April 1971 it was not running. Although the station does not measure the amount of particulate matter in air as such, it does record a "soiling index". There is a lag between the recording of data (on County, State and Federal levels) and its availability, so there is, as yet, no way to compare the State's measurements of air pollution with those of the County or Federal Government.

Conclusions

Additional monitoring stations are needed in Rochester to detect places where people are exposed to specific pollutants at times when the exposures are highest.

It is apparent that the air in urban areas, including Rochester, does not yet meet the Federal nor the New York State yearly average air purity standards. From the available data, it seems that downtown Rochester may have an air pollution problem, particularly with pollutants from automobiles. Methods of decreasing the contaminants in the ambient air are the use of fuels with a low sulfur content, enforcing the laws concerning emissions from smoke stacks, and instituting an inspection program for emission from automobiles. The ambient air standards represent a goal and a major effort will be required if we are to reach that goal in our cities.

Literature Cited

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