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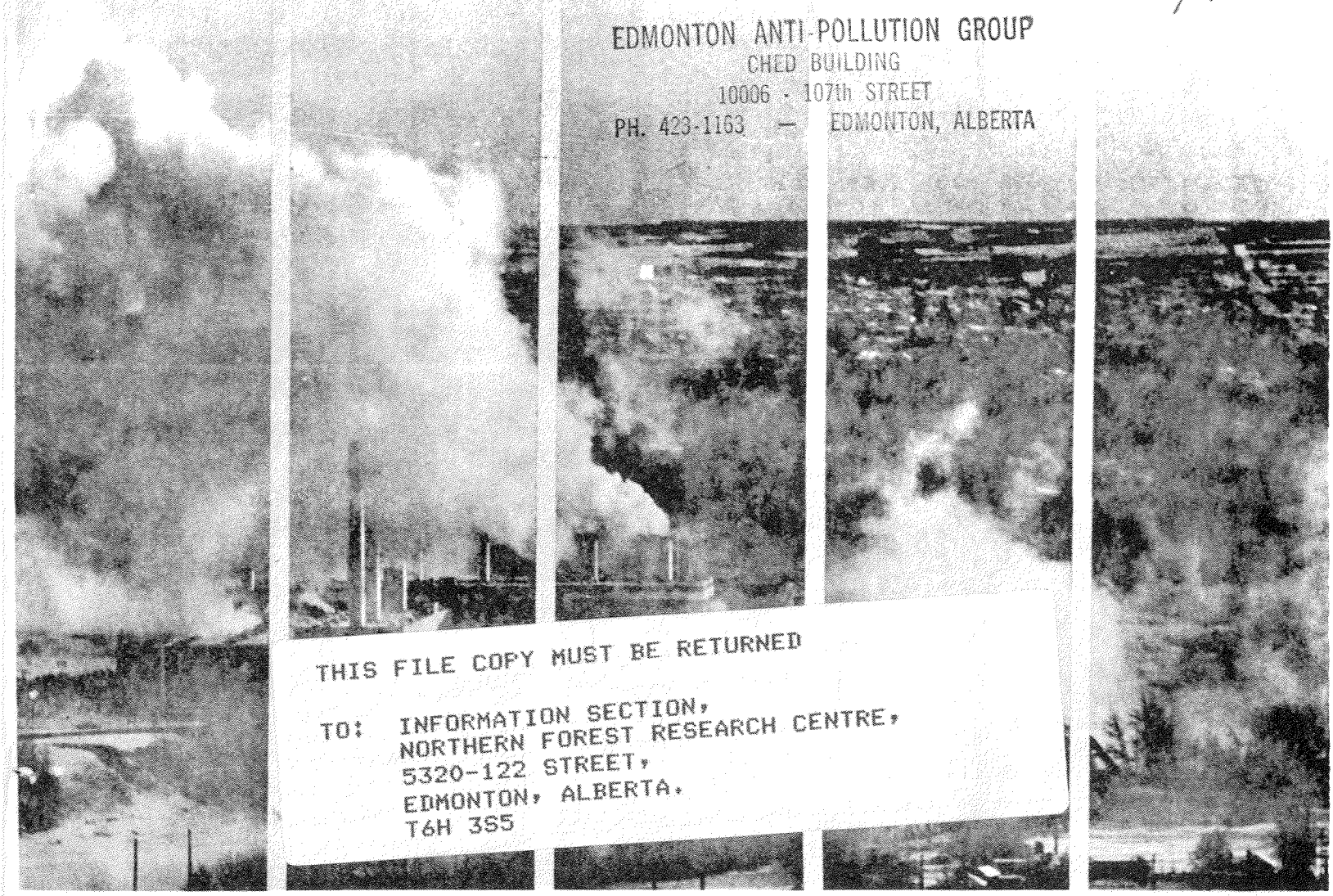

AIR POLLUTION in EDMONTON

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Trends, Monitoring, and Recommendations

Edmonton Anti-Pollution Group

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November, 1970.

C O N T E N T S

AIR POLLUTION IN EDMONTON

Purposes of this Report:

Our objects have been first to set out briefly the problems arising from air pollution, emphasizing those aspects likely to apply to Edmonton; second to outline some of the principles which should underlie any air pollution monitoring system, third to summarize the meteorological phenomena in Edmonton which are likely to have an impact in air pollution problems; fourth to analyse the present monitoring system in Edmonton in terms of measurements of general pollution levels and of particular local problems; fifth to summarise "enforcement" procedures of the Provincial Dept. of Health in respect of alleviation and prevention of air pollution; sixth to draw conclusions about the effectiveness of the present monitoring and enforcement procedures, and finally to recommend some necessary and desirable changes. Although the original intent was to compile an exhaustive report, our early findings suggested serious and urgent problems exist and demanded reporting without delay.

Procedures:

We have based this report on analysis of the Air Pollution Summaries for Edmonton for the past three years, on air pollution monitoring data and 'approval' information from the Alberta Dept. of Health about Imperial Oil Refinery, Gulf Oil Refinery, Texaco Oil Refinery, Chemcell and the Clover Bar Generating Station. We have also had much additional helpful information supplied by the City of Edmonton about the Rossdale Power Generating Plant. One of us has visited several of the Edmonton air pollution monitoring stations. All of us have had many of our questions courteously and patiently dealt with by Mr. S. L. Dobko, Head of the Air Pollution Control section of Environmental Health Services Division, Alberta Dept. of Health.

The table of air quality standard recently issued by the Dept. of Health, although dated Sept. 1970, was made available to us only Nov. 20, 1970; and the standards themselves have not been evaluated in this report. In any event, it is relevant only if enforcable and enforced; and no information is provided concerning these aspects. In addition, instruments are not in operation which can check the given air quality standards for carbon monoxide, H_2S and SO_2; also no standard was proposed for hydrocarbons.

Acknowledgements:

We are obliged to the Alberta Dept. of Health for much information. Help in respect to drafting several of the sections in this report has been provided by many experts. However the authors are responsible for the accuracy of any facts or interpretations provided, within the limits that in some areas we have been dependent on information supplied by the Provincial Dept. of Health which we take to be accurate and complete.

SUMMARY OF RECOMMENDATIONS

1. Staff and facilities for planning, data collection, interpretation, and distribution should be greatly increased.

2. Metropolitan Air Pollution Control Units should be set up to assume local monitoring and enforcement roles.

3. Industries in violation of the Public Health Act should be required to comply.

4. A plan for assessment and analysis of air pollution in Edmonton should be drawn up and executed according to an urgent timetable.

5. Following assessment and analysis, a plan for air pollution control should be drawn up and implemented, especially during adverse meteorological conditions.

6. Motor vehicle emission standards should be established forthwith.

7. Consideration should be given to limiting growth of Edmonton in favor of satellite towns with green belts.

8. Consideration should be given to enabling citizens to sue directly for damages and/or injunctions.

I. AIR POLLUTION PROBLEMS

A. Types of air pollutants:

Air pollution sources fall into two general classifications: natural, and man-made. The former includes windblown dust, pollen, sea salt nuclei, smoke from forest fires, airborne microorganisms, swamp gases, volcanic eruptions, natural radioactivity, and natural hazes - in general these are uncontrollable, but fortunately rarely of major significance in air pollution.

Man-made pollution includes at least 6 major types:

1. *dust-producing processes
2. *combustion a) *fuel burning
   b) *motor vehicles and jets
   c) *refuse burning
3. *manufacturing processes
   a) metallurgical
   b) *chemical
   c) waste recovery
4. agricultural activities
   a) *crop spraying and dusting
   b) field burning and cultivation
   c) frost damage control
   d) *harvesting and storage handling operations (particles)
5. processes involving solvents
   a) *spray painting
   b) inks
   c) *solvent cleaning
6. nuclear energy activities
   a) fuel fabrication
   b) nuclear fission
   c) spent fuel processing
   d) nuclear device testing

Of these 6 major types, Edmonton's possible polluters (see *) lie mainly in either the combustion category with motor vehicles and jets, fuel burning processes such as the power plants and home heating units, refuse burning with incinerators and dumps; or in the manufacturing processes category which would include the refineries, cement plants, chemicals etc.

Air pollution is a by-product of a high standard of living. It affects property, plants, and animals including man.

B. Damage to Property:

Air pollution causes the accelerated deterioration of materials, structures and machines of all kinds. This in turn increases maintenance and replacement expenditures. In addition, air pollution is responsible for a general depreciation in property values which affects neighborhoods and even entire communities. Specifically, "metals corrode, fabrics weaken and fade, leather weakens and becomes brittle, rubber cracks and loses its elasticity (in Los Angeles, measurement of crack depth in rubber is used as a method for determining ozone concentration in the air), paint discolors, concrete and building stone discolor and erode, glass is etched and paper becomes brittle" (Rept. to U.S. Congress, 1963).

The primary effect of airborne solid particulates is soiling; removal of deposited grime is often costly and may shorten the life of materials.

C. Damage to Vegetation:

Damage to field crops, trees and flowers from very low concentrations of such contaminants as fluorides, ethylene, sulphur dioxide, and photochemical smog (ozone, peroxyacyl nitrates) have been documented.

Recent plant pathology research has demonstrated that the kinds of plants affected and the nature and extent of injury produced vary with the type of air pollutant, other environmental conditions and the age and stage of plant growth. In some cases plants have been injured and entire forests killed 100 miles away from the source of the pollutant.

Ozone, a contaminant associated with motor vehicle pollution, has been found to cause a) post emergence tipburn in white pine (W. Va), b) death of ponderosa pines (California), c) lesions in grape leaves (California), d) flecking of tobacco leaves (Eastern U.S. and S. Ontario). It also causes damage to spinach (N.J.), alfalfa, rye, barley, orchard grass, petunia, radish, red clover, bean, parsley, grape and possibly chickory, endive, broccoli, orchids, carnation (in many localities). In some sensitive plant species (pinto bean) damage may occur if the 8 hour average concentration of ozone exceeds 0.02 part/million.

Fluorides are emitted from smelters (such as the one at Trail, B.C.), brick and ceramic kilns, and any operation in which earth is fired at high temperatures. Livestock foraging on vegetation (Alfalfa often) on which airborne fluorides had been deposited, suffered serious adverse effects. Corn and peach are susceptible to hydrogen fluoride damage; as are also several species of forest trees. Some gladiolus plants have been injured by concentrations as low as 1 part per 10 billion parts of air.

Sulphur Dioxide from production, transport, processing and combustion of fossil fuels injures especially cotton, barley, alfalfa, and pine trees. Sulphur dioxide fumes from the great copper smelters of Montana and Tennessee ruined large areas of farming country, and fumes from the smelters at Trail, B.C., severely damaged farms and forests.

Peroxyacyl Nitrate (PAN), a product of photochemical transformation of automobile emissions , causes silvering, glazing or bronzing on the underside of many leaves. This damage has recently occurred on fruit and vegetable farms in central California, and on ornamental evergreens in several urban areas.

D. Damage to Animals, including Man:

Effects of air pollution on man can range from aesthetic insult, to discomfort, illness or death. Lave and Seskin (Science 169 (3947): 723) estimate "the total annual cost that would be saved by a 50% reduction in air pollution levels in major urban areas, in terms of decreased morbidity and mortality, to be $2,080 million." Aesthetic effects include loss of atmospheric clarity due to smoke, photochemical fog etc. and objectionable odors. Economic losses include soiling by smoke or soot, damage to field crops, injury to livestock and deterioration of exposed materials. A level of 6 parts/million ozone in air will kill practically any laboratory animal in 4 hours. A safety hazard occurs with restricted visibility. Carbon monoxide can impair lung ventilation and even at low exposures can reduce visual acuity and increase reaction time - these may reduce driving safety, especially at night. During periods of high air pollution, accidents at airports and on highways have increased; and the increases are attributable to both restricted visibility and impaired skills and judgement. Personal discomfort is a common complaint with eye, ear, nose and throat irritations.

Health hazards to man include surface damage of man's upper respiratory tract and toxicity created by pollutants that enter the lungs and dissolve in the blood and body tissues, e.g. carbon monoxide, and lead, both of which are cumulative poisons. Usually surfaces and internal tissues require exposure of an hour or more before much damage is caused. Damage such as cancer (caused by carcinogenic pollutants) may result from a lifetime of accumulated exposure to persisting low levels. Some particulates (e.g. lead, asbestos and silicates) are toxic. To the average home owner, pollution damage brings a need for more frequent painting of the exterior and interior walls and more frequent cleaning of clothing, rugs, draperies, etc.

There is strong evidence that air pollution is associated with a number of respiratory ailments. These include: 1) nonspecific infectious upper respiratory disease such as the common cold, 2) chronic bronchitis, 3) chronic constrictive ventilatory disease, 4) pulmonary emphysema, 5) bronchial asthma, 6) lung cancer.

Statistical evidence from cities with high incidence of air pollut on indicates that a 50% reduction in air pollution would reduce mortality from lung cancer by 25% from cardiovascular diseases by 20%. Mortality from bronchitis would be reduced by about 50% if city air pollution were lowered to levels currently prevailing in urban areas with relatively clean air.

Although occasional peaks of air pollution such as the 1952 London smog with 4,000 deaths are spectacular, long term exposure to low levels of air pollution also has deleterious effects on human health.

II. PRINCIPLES OF AIR POLLUTION MONITORING.

A. General:

An urban centre with a population in excess of 50,000 which maintains that it has no air pollution problem may justly be suspected of not maintaining an adequate air-quality monitoring program. The type of program necessary to ensure satisfactory air quality depends upon the quantity, type and distribution of emission sources and the local climatic conditions, particularly micro-meteorological phenomena near major pollutant sources.

A systems analysis of the problem of air pollution may be made in terms of the three components: sources, atmospheric dispersion, and receptors.

Dependent upon the resources available, the degree of pollution may be measured in two ways. First, the emission sources can be sampled directly and in conjunction with meteorological data predictions made concerning the concentrations of constitutents at specific times and locations. Second, monitoring sites may be established at strategic locations to obtain a representative evaluation of the ambient air quality. Ideally a network of continuous emission and ambient monitoring stations capable of testing a wide range of substances should be established following the completion of a source inventory and a detailed meteorological study.

One important function of a continuing monitoring system is to detect the unusual event; the sudden change in concentration of a pollutant in the air. Using detectors and with a knowledge of source locations, an ideal control agency will be able to curtail emissions in the presence of transitory weather conditions which result in air quality falling below desirable standards. In the case where an operator consistently emits pollutants to the atmosphere and thereby contravenes quality standards, the possession by the control agency of monitoring data collected at the source will be accepted as competent evidence upon which to base a prosecution of the offender.

The following factors must be considered in establishing a community ambient monitoring system:

B. Source Inventories:

A complete knowledge of all sources of emissions within its area of jurisdiction should be the aim of any community control agency. Not only should the distribution be known but the processes, inputs and outputs at each source should be documented. Such a source inventory must be continually reviewed and updated to take account of any changes or modifications to plant which may affect the type and quantity of materials released to the atmosphere. In the ideal situation a control agency will have legal powers to dictate the location of any source and the quality of its emissions, so as to maximise the use of the atmosphere as a dispersant medium whilst at the same time maintaining a satisfactory air quality for the residents of the community.

C. Instrument Location:

A primary criterion in siting instruments is that a representative sample of the ambient air be obtained. It may not be possible to utilise only a single intake point because concentration of substances in the air varies with height above ground and air movements in the vicinity. Sample intakes should not be located in the lee of tall buildings, nor in close proximity to one specific source.

One factor which may receive undue priority is the need for all instruments to be accessible for maintenance and calibration. Whilst it is true that the more complex, automatic equipment does require regular servicing this should not be allowed to dictate the location to the exclusion of other considerations.

In those instances where the source being checked is mobile an equally mobile testing device may be necessary if an adequate assessment of the concentrations is to be obtained. In most cities some sixty percent of emissions come from mobile sources.

Lack of ready accessibility should not deter proper location of sampling instruments, particularly with modern data communication systems.

D. Instrument Type:

It is imperative that continuous sampling devices be employed as these will provide information about temporary high levels of pollutants. In all such devices, there is a greater or lesser time lag between sampling and recording of data. The length of the time lag depends upon the type of measuring process employed. In those instruments where direct sensing exists, the time which elapses between the intake of ambient air and the response by the detector is quite short. A much longer time lag occurs in devices dependent upon some chemical reaction to assess the level of a compound, and in some cases the equipment may better be described as dosimetric and is thus capable of giving only averaged results. An ideal monitoring instrument will relay the occurrence of peaks above a predetermined level to the control centre,

thereby allowing action to be taken to curb the emissions producing the response.

E. Indicators of Air Pollution:

An economical method for adding to the picture provided by sophisticated instrumentation is the use of certain metals, materials and plant species to give indication of the existence of certain pollutants in an area. The use of these indicators rarely allows quantification of concentrations nor does it provide instantaneous evidence of pollution, as there is usually a delay in the occurrence of pollution and the appearance of visible effects.

F. Field Monitoring:

An important element of the functioning of an air pollution control agency is the handling of citizen's complaints. Many of these reports refer to a specific suspected source and it is important that these be checked, thus requiring that field staff be equipped with some form of portable testing equipment. Further, incidents provoking complaints are often transitory, so some form of rapid inspection is needed, such as radio-equipped patrol cars.

In the model case, a mobile laboratory capable of detecting and measuring pollutants should be employed, which should also have provision for assessment of the important meteorological parameters. However, it is more usual to find that field inspectors rely heavily upon their own sensory receptors in assessing and substantiating complaints. Both sight and smell are employed and can produce a reasonably high level of accuracy provided the inspectors are highly trained. In both Britain and the United States such findings have been accepted in the courts as competent evidence of air pollution.

G. Conclusion:

As financial constraints will dictate a less than optimum monitoring system, it is important to accept the necessity for a thorough knowledge of local meteorological phenomena before designing a sampling program. Such information will provide an understanding of air flow patterns which in large measure control the rate of intensification or attenuation of air pollution. If statistically justified inferences are to be drawn from the data collected in the monitoring program, these meteorological data must be utilised in interpreting air quality measurements. With the rapid increase in use of automobiles, steps should be taken to ensure that these mobile sources are adequately monitored, particularly in locations where these are concentrated at certain times, e.g. major traffic arteries and intersections.

A community which has not taken steps to assess the true magnitude of its air pollution problem may undertake a survey which employs a number of approaches in addition to that of instrumental monitoring. A model survey should include the following:-

1. Source factors - types, numbers and distribution of emissions.
2. Meteorological parameters - wind speed, wind direction, stability and the affects of local terrain on these parameters.

3. Air quality over time and space.

4. Adverse effects on receptors associated with certain conditions of air quality.

5. Photographic study of the area and its sources.

6. Study of the complaints system - analysis of complaint data.

7. Opinion survey in the community to assess awareness of the air pollution problem.

8. Consideration of public relations and information services available with respect to air pollution.

III. METEOROLOGICAL ASPECTS OF EDMONTON'S AIR POLLUTION

Edmonton is in a sub-arctic climate, with a long winter. The city is situated on a plain, with a small part of its area in the valley of the North Saskatchewan river. There is stable air (temperature inversion) over the city nearly every night, and in winter on over half the days as well. In stable air, little mixing of upper and lower layers takes place, and pollutants remain near the level at which they have been released. The city often creates a 'heat island', in which the air is unstable in the low levels. Unfortunately this heat island has vertical as well as horizontal limitations, so that the amount of air into which pollutants become uniformly mixed is still limited. Statistically, the heat island is shallowest with southerly and southeasterly winds, so that pollutant sources in those sectors would have the worst effect on the center of the city when such winds occur. Our very cold winters result in formation of an "ice-fog" arising from large volumes of water vapour emitted from all combustion processes. This "ice fog" tends to increase and extend temperature inversions.

Edmonton has light winds on the average, with only infrequent spells of strong winds, so there is no great amount of air 'flushing' as in some parts of Alberta.

The type of weather likely to increase air pollution problems in Edmonton should be studied on both the time and space scales. Bad air pollution weather situations of short duration should be given particular consideration.

In general, Edmonton has in full measure the meteorological conditions liable to concentrate air pollutants; and has conditions promoting the formation of photochemical smog, except during very cold weather.

IV. AN ASSESSMENT OF AIR POLLUTION AND MONITORING IN EDMONTON

A. Introduction:

General area problems in Edmonton almost certainly will arise in respect of pollution from automobiles and from space heating with natural gas. This implies the need to monitor for carbon monoxide, nitrogen oxides, hydrocarbons and various specific organic materials such as PAN and ozone which are dangerous products of the photo-oxidation of air pollution products from the internal combustion engine.

In addition, it implies the need to monitor for nitrogen oxides which are products of internal combustion engines, space heating, and any coal-combustion - indeed, from any combustion process in which temperatures are achieved which allow the oxidation of nitrogen in the air.

There are also large numbers of private incinerators operated by stores, apartments, schools etc. which produce variable amounts of ash and soot, generally well distributed. These and other sources of particulates lead to a serious dust problem.

Specific local problems which should be taken into account are (a) the hydrocarbons, hydrogen sulfide and other sulfur-containing compounds in addition to other products arising from Refinery Row in Southeast Edmonton (see map p.30), (b) the organic materials and other products from Chemcell's plant at Clover Bar; (c) the nitrogen oxides from the Clover Bar power generating plant and the Rossdale power generating plant; (d) dust from the Inland Cement plant in Northwest Edmonton (156 St. and 125 Ave.), and (e) problems arising from high-volume incinerators such as those of the City and the University and hospitals.

In view of the possibility of a large pollution problem from the internal combustion engine there is likely to be a need for mobile monitors which can go to areas of potential high pollution. A careful correlation of air pollution data with meteorological data, not only the general temperature inversion data but also air mixing data in local and general terms would seem necessary.

B. General Area Problems:

1. Internal Combustion Engines:

No consistent or continuous program of monitoring has been carried out for carbon monoxide. It is reported that casual measurements have been made from time to time. There are plans in the air pollution division to obtain a continuous carbon monoxide monitor, and we have been informed that this will be placed on the third floor of the Administration Building (see below).

No consistent or continuous monitoring has been carried out for lead except by analysis of deposits on filter paper from intermittent runs of the high volume samplers. One such sampler is placed on the roof of the Alberta-Jasper Building at 98th St. and Jasper Avenue. Other high volume samples may also contribute to these data, but we are uncertain of this. These data were not available to us.

No monitoring is carried out for PAN and related products of photochemical changes in automobile pollutants.

Other pollutants from internal combustion engines which are monitored are hydrocarbons, oxidants and nitrogen oxides. Total hydrocarbons and total oxidants (mainly ozone) are monitored on the third floor of the Administration Building. The air intakes for these two machines are on the south face of the building. Nitrogen oxides are monitored on the eighth floor of this building, and the air intake is on the north side of the building.

Comment:

From the information available it appears that the above readings have no significance as indices of air pollution of the City of Edmonton from automobiles (hydrocarbons, total oxidants, nitrogen oxides) and from other combustion processes (nitrogen oxides).

First, the locations of the collection stations in the Administration Building on the third floor (hydrocarbons and total oxidants) and on the eighth floor (nitrogen oxides) have not been chosen in relation to the criteria mentioned in section II. No information is available relating the values for these indices at the third and eighth floors respectively of the Administration Building to anywhere else in the City, nor are there any data which would support the hypothesis that these indices are representative of any area.

Automobile pollution originates at street level, and its distribution is affected by temperature inversion, local air currents, traffic density and other factors. There is a marked gradient of automobile pollutants vertically in addition to marked alterations in distribution dependent upon local factors controlling distribution in the horizontal plane (including such things as buildings, tunnels, air currents, etc.).

The measurements obtained on the third and eighth floors of the Administration Building are of some intrinsic interest, but provide no insight into the levels of automobile pollution either in the general area of the City of Edmonton or in any possible danger spots, where traffic density is high and exposure is greatest.

Additional problems exist with respect to the interpretation of data about nitrogen oxides obtained on the eighth floor of the Administration Building. Presumably these data are intended to provide area sampling for the City of Edmonton, since they represent the only sampling carried out. However, they are influenced by nitrogen oxides emitted by the Rossdale Power Station (see map). Correlation of high hourly nitrogen dioxide readings with winds blowing from the southeast and in calm conditions suggests that there was considerable influence of emissions from the Rossdale plant on the values recorded. The placement of the air intake for these readings on the north side of the building may diminish the effect of local high NO_2 emissions from the power plant

on the values obtained. It seems likely that the NO_2 readings are neither representative of the area of the City of Edmonton, nor measures of the local emissions from the power plant. As with the other measures made at the Administration Building, there is no way of connecting the values obtained there with values anywhere else in the City, since no area measurements have been made, and no vertical or horizontal comparisons of nitrogen oxides distribution attempted.

Finally, the measurements of oxides of nitrogen which were made in 1968-69 cannot be compared to those of preceding years (1961-68) in which measurements were carried out over only a portion of the year (four months). Similarly, with respect to total hydrocarbons, the data for the year 1968-69 are incomplete, data for three months being missing. In the preceding year only five months of data were available.

Despite this lack of information, it is worth pointing out that the levels for hydrocarbons and for total oxidants on the whole increased in 1968-69 compared to 1967-68. Furthermore, there were two peak hourly readings greater than 15 parts per hundred million of oxidants, which is considered to be the maximum allowable concentration laid down in the recently-issued Alberta Air Quality Standards, which in this respect correspond to standards in, e.g., California.

As oxidants and hydrocarbons were probably present in much higher concentrations near street level than at the third floor of the Administration Building, and as higher concentrations certainly existed in congested areas with poor air circulation, it seems impossible to justify the conclusion given in the 1968-69 report, "that there is not a general pollution problem in the City of Edmonton." The correct conclusion is that we do not know the extent of this problem, but high levels of oxidants and increasing levels of hydrocarbons suggest it may be serious.

2. Dust Fall:

Five of the eight stations measuring dust fall and its percent calcium content are positioned around Inland Cement in northwest Edmonton, and should be considered to be measurements in respect to a local problem - the pollution produced by the Inland Cement plant. The other three are located at City Hall, at Hardisty(54 St. and 101A Ave.) and on the Engineering Building at the University campus (see map).

Data from these three stations show little correlation between the monthly or yearly averages. Apparently no investigations have ever been undertaken to examine the reasons (e.g. different sources and wind conditions) for this apparent lack of correlation. Thus it is uncertain whether these three stations provide any index of dust fall problems in the general area of the City of Edmonton. Two of these stations are classified Residential, and in 1969, respectively 10% and 5% of the monthly totals exceeded the standard of 15 tons per square mile per 30 days.

3. Hydrogen Sulfide:

Hydrogen sulfide is measured at the City Hall, at Hardisty, at 135 St. and 132 Ave. and at the junction of 101 Ave. and the Interprovincial Pipeline (see map). This last station is not an area sampling station but is intended to be related to particular problems from hydrogen sulfide pollution from the pipeline and refineries, and indeed it does show higher hydrogen sulfide values than any of the other three stations. The levels of hydrogen sulfide at the other 3 stations were very low except in March of 1969 when all three stations recorded unexplained relatively high values.

However, hydrogen sulfide is measured by exposing zinc acetate candles for one month. By this technique, very high temporary concentrations of hydrogen sulfide will be missed by being averaged out in the monthly mean. Thus annoying or even dangerous levels could be present for brief periods, but not appear in the recorded data. Indeed the recently issued Alberta standards are in terms of short term (1 hr and 24 hr maximum average) concentrations which cannot be measured by this method.

4. Total Sulfation:

Sulfur dioxide and other sulfating compounds are measured at the same stations as those for hydrogen sulfide. Again, there is a cumulative exposure technique using lead peroxide candles. As previously mentioned, this technique does not take account of or provide any information about temporarily high concentrations, although it is the peak levels that determine the health hazard of SO_2. The new Alberta standards are in the same terms as for H_2S.

In 1968-69 there was a marked increase in the SO_2 levels recorded by this technique at Station No. 3 (2 miles west of Refinery Row) and at Station No. 4 (near the Interprovincial Pipeline). There was also a marked increase in SO_2 levels at Station No. 2 in northwest Edmonton. The annual report of the Air Pollution Survey in Edmonton suggests that this is owing to high prevalence of east winds during 1968-69. No data supporting this explanation were provided.

5. Soiling Index (Coefficient of Haze):

There are six stations measuring this particular index of pollution: one at the CN Tower on the 7th floor, one in the Administration Building on the 3rd floor, one at the CN Telecommunications Repair Depot (147 St. and 116 Ave.) one near ground level at Sherwood School (96 Ave. and 153 St.), one near ground level at Sherwood School (96 Ave. and 153 St.), one in north Edmonton at the CN station (125 Ave. and 66 St.) and one in the Ritchie district at 73 Ave. and 95 St. Thus these measurements provide the most extensive area survey carried out, but from the above site descriptions, it is obvious that no thought has been given to the problem of vertical distribution. Data are obtained continuously and reported on a basis of a mean 2-hour value. On a monthly average basis, there may be some correlation between the values obtained at various stations. High mean values occurred at all stations in either December or January, and low mean values occurred at all stations

except one in the period July through September. However, this does not establish whether the day to day values obtained at these stations do or do not correlate. It would be valuable to analyse the data on hand to determine correlation on a 2-hourly basis or other appropriate interval. Comparison of such correlations with meteorological data might indicate the value of the soiling index or coefficient of haze information as a general measure of pollution in Edmonton.

However, the coefficient of haze provides little or no information about pollution from internal combustion engines. Therefore, even if analysis proves that the network of measuring stations for this index does provide a valid area assessment, the significance of this in respect to the major pollution problem of Edmonton is limited.

6. Suspended Particulate Matter:

Samplers for suspended particulate matter are operated in cooperation with the federal government. Data from only one station (the Alberta - Jasper Building) are available. Between 1964 and 1969, particulate matter collected exceeded the recently introduced standards for Alberta in 45% of the monthly means and for 73% of the monthly peaks. No consistent trends over time were apparent, but prevailing levels constitute a problem.

7. Conclusions in Respect to General Area Surveys:

We must conclude that the data available provide little insight into either the general area pollution from the internal combustion engine or local problems which may arise in areas of high traffic congestion and low air turnover. Studies of the vertical or horizontal distribution of the relevant pollutants (nitrogen oxides, hydrocarbons and total oxidants) have not been made. Some important pollutants (carbon monoxide, PAN and lead) are not sampled on a regular basis.

The location of the measuring site for nitrogen oxides should be re-examined. The present location may provide neither an area determination since the readings may be affected by emissions from the City power plant, nor a local determination of the effects of the City power plant since the intake valve is located at a place which partly screens it from the power plant emissions.

The reason why other indices such as dust fall are not correlated from station to station should be examined. The most complete survey seems to be done in respect to soiling index. Studies should be carried out to determine the correlation between the soiling index at various times for the various stations, and the effect on this of meteorological conditions.

SPECIFIC LOCAL PROBLEMS

1. Areas of High Traffic Density and Possible Poor Air Exchange:

We think that there are no mobile units for determining pollution from internal combustion engines in areas of possible high local danger. We believe that such determinations are urgently needed. In addition, it would be desirable to determine the effects of air pollution, including blood levels of carbon monoxide and carboxymethemoglobin, in individuals such as traffic policemen exposed for long periods to such high concentrations. Among possible danger points which should be investigated are 97 St. & 118 Ave., 109 St. tunnel, Jasper Ave., Groat Road, 109 St. and 87 Ave., 99 St. & Whyte Ave., 99 St. & Argyle Road.

The contribution of traffic to NO_x levels may be estimated from a report prepared by Western Research & Development Ltd. and Stanley Associates Engineering Ltd. in April 1967.

They state, "Amongst the few samples gathered to get some indication of the contribution from motor vehicles, the highest concentration was 0.95 ppm. This sample was obtained on 99th St. near Jasper Ave. during the morning traffic rush. The average of eight grab samples taken in heavy traffic was 0.66 ppm - from these samples it is estimated that this type of concentration would occur on most cold winter days when surface wind velocities are low".

If these findings are correct, downtown ground level concentrations of NO are considerably higher than those recorded at the 8th floor of the Administration Building, and exceed the acceptable Standard for ambient air quality.

2. Refinery Row (see Map)

Special problems arising from the Texaco, Gulf and Imperial Oil refineries on Highway 16A East include emissions of hydrogen sulfide, SO_2 and hydrocarbons.

There are at least two ways in which these problems could be monitored and controlled: either by (1) appropriately positioning monitors for SO_2, hydrogen sulfide and hydrocarbons around the area and within it and correlating data obtained from these with meteorological data about inversion and wind conditions, or (2) monitoring effluents from the various plants and laying down limits on effluent emissions. There may be other effluent problems from this area, as there are no emission data and ambient monitoring is fragmentary.

(a) Monitoring of levels of H_2S and SO_2 in the Local Area

There are two stations at which hydrogen sulfide and total sulfation is measured, which might be considered local monitors. These are Station #3 located in Mardisty at 54 St. and 101A Ave. approximately two miles east of the refineries; and Station #4 located at 101 Ave. at the Interprovincial Pipeline, approximately one block south from the Gulf refinery.

In addition to data obtained at these stations, there have been two special studies made: (1) from November 14, 1968 to April 30, 1969, at the Calgary Power office just east of the Texaco refinery, and (2) from December 22, 1969 to January 12, 1970, just across Highway 16 from the previously men-

tioned special survey carried out at the Shell Pipe premises between the Imperial Oil refinery and the Transmountain Pipeline site. Attempts have been made to correlate these data with wind direction, but to quote the summary of the special survey carried out at the Calgary Power office, "However the wind direction was recorded at the Edmonton Industrial Airport, and applicability to the sample location, is questionable."

The data collected from Stations #3 and #4 for both the total sulfation and hydrogen sulfide are expressed in SO_3 milligram equivalents per day per 100 cm^2.

Unfortunately, most information about toxic effects of SO_2 and H_2S are given in terms of parts per million concentration, and the methods of measurement in Edmonton do not provide this information, and will miss temporarily high concentrations. Sulfur dioxide concentration per se is not presently measured in Edmonton; and no standard exists for total sulfation, which is measured. To give some idea of the significance of determinations of this sort, it is necessary to keep in mind that the State of Montana permits 0.25 mg SO_3 equivalents per 100 cm^2 per day as a maximum annual average, and 0.5 mg SO_3 equivalents per 100 cm^2 per day as a maximum monthly average. Ontario sets 0.4 mg SO_3 equivalents as the monthly maximum.

At Station #4, located at the junction of 101 Ave. and the Interprovincial Pipeline, during 1969, the monthly averages exceeded 0.5 mg SO_3 per 100 cm^2 per day 10 months out of the year. In addition, this station recorded in 1969 the highest yearly average and in 7 of the 12 months, the highest monthly average ever reported in Alberta.

Two miles west, at Station #3 in Hardisty, the monthly average exceeded 0.5 in June. At this station, too, the 1969 yearly average and the monthly averages in 8 of the 12 months, were the highest ever reported.

It is a reasonable presumption that the levels of SO_3 equivalent were greater at distances closer to the source of emission than at the station in Hardisty. We know of no monitoring in areas such as the area north of the river and west of Fourth Street within the city limits or in nearby areas to the east, such as Sherwood Park, etc.

Station #4 recorded the highest monthly averages of H_2S in 5 of the 12 months, and Station #3 in one month.

Mention should be made of the two special air pollution surveys noted earlier. The first was made at the Calgary Power office located just east of the Texaco refinery and just south of Highway 16. This survey was carried out from November 14, 1968 to April 30, 1969. Two pollutants were monitored, using a portable monitor: H_2S was monitored on a 3-hour spot cycle with a tape sampler, and total oxidizable sulfur compounds were monitored using a Titrilog Model 26103B-2. This gives results in SO_2 equivalents, and is primarily a measure of sulfur dioxide. It can make measurements of quite short duration.

A summary of this report notes that the total oxidizable sulfur compound measurements gave readings greater than 0.20 ppm 41% of the time. Furthermore, throughout November to March a significant number of instances occurred when the average total oxidizable sulfur compound readings were greater than 0.20 ppm for periods longer than 10 minutes. The summary also states, "The results of this survey indicate than an air pollution problem in the form of odors (H_2S) or relatively high total oxidizable sulfur compound readings can persist in the east Edmonton industrial area for varying periods of time. Future industrial expansion made there could conceivably cause further air quality degeneration if emissions are not controlled." This should be read in the light of current refinery expansion, underway at Gulf and Texaco.

The other survey made from December 22, 1969 to January 12, 1970, is of little significance. The measuring devices in this case were the total sulfation and hydrogen sulfide exposure cylinders, the deficiencies of which were described above. The report concludes, "that possibly location of the trailer and prevailing meteorological conditions throughout the survey restricted H_2S and SO_2 detection to below the general area levels." Possibly the method also is deficient.

It is sometimes suggested by the Air Pollution Control Section of the Department of Health, that measurement of hydrocarbons at the Administration building site provides an index of air pollution from the refineries. On other occasions it is suggested that this same measurement monitors pollution from the Chemcell Clover Bar Plant. Obviously it cannot be an index of either of these and of area pollution from automobiles simultaneously.

We are aware of no data that suggests that the present sampling provides an adequate index of the extent and nature of the problem either in Eastern Edmonton or for individuals working in the area of the three refineries.

(b) Control of Emissions from the Three Refineries.

From the information available to us, it appears that a final air pollution approval for emissions of sulfur dioxide and other pollutants has been granted only for the Texaco Canada Limited refinery. Their final air pollution approval (number 763-EDM-P-053) states that the total sulfur dioxide emission rate from all units shall not exceed 7.7 short tons of SO_2 per day during all operating days, except for a two-week period during either December, January or February, at which time the maximum SO_2 emission rate shall not exceed 9.1 short tons of SO_2 per day. The reason for this exception is not made clear, and as no data have been provided by Dept. of Health regarding emission from this plant, no suggestions nor excuses can be made for this dispensation clause.

In addition, the terms of the approval in other respects are vague in the extreme, for example, item #4 states "that odor and hydrocarbon emissions from the A.P.I. separator must be minimized as much as practical"; and #5 states that "a vent scrubbing system which virtually removes all mercaptans from the two spent phenolic caustic tanks and the deep well disposal charge tank must be installed as soon as possible, but in any event not later than the next plant turn-around" (our emphasis).

Item #6 of the approval states that a network of six hydrogen sulfide and total sulfation cylinder stations will be set up and maintained, and the results of these stations will be forwarded to the Provincial Board of Health before the end of the month following a one-month exposure period. We have not been given any data from these stations, if they exist.

A final air pollution approval (#653-EDM-P-072) exists for the product storage tanks and pipeline at the Edmonton refinery of the Imperial Oil Company but this provides no standards for emissions from the refinery.

Thus it appears that there is no approval for emissions of H_2S, SO_2 and other materials from either Imperial Oil or the Gulf refineries. No reasons for the lack of these approvals have been provided to us, but on the basis of our experience (see below in respect to Chemcell) this suggests that the companies concerned have not met standards acceptable to the Provincial Board of Health. In any case, in the absence of approval from the Provincial Board of Health, and in the absence of any evidence that there is any continuous or intermittent monitoring of emissions from these three refineries, it is manifestly impossible to control pollution from them by the device of emission approval. Yet expansion is underway of the Gulf and Texaco refineries.

3. The Chemcell Clover Bar Plant:

(a) Area Monitoring: The only data supplied to us by the Department of Health as relevant to air pollution from Chemcell were levels of hydrocarbons and total aliphatic aldehydes from measurements at the Administration Building and analyses from the high volume samplers. The lack of relevance of such measurements as indices of local sources of pollution problems has been discussed earlier.

(b) Source Monitoring: This plant is located north of Refinery Row on the Saskatchewan River near the Beverly bridge. No Provincial Board of Health approval has been issued to Chemcell defining air effluent limits. In this regard, it is essential to quote a paragraph of a letter from Dr. P. E. Rose, M.D., Deputy Minister of Health, dated October 23, 1970. The letter states, "With respect to approval levels as to air effluents by Chemcell, an approval has not been issued at this time. We have a number of submissions from the subject firm, have met with them on a number of occasions to discuss their operation and have toured their operations. However, until such time as we are satisfied with their operations and the resulting atmospheric emissions (our emphasis), a final air pollution approval will not be issued. We are well aware of the work the firm has carried out to eliminate the emission of materials to the atmosphere and feel that substantial improvements have been made over the years." This despite an apparent complete absence of any data.

In a letter dated 2nd November 1970, addressed to Dr. Rose, some clarification was requested as follows: "With regard to the air quality samples that are relevant to Chemcell, I take your letter to mean that up to now Chemcell has not achieved a satisfactory standard with respect to effluents yet the

data you submitted contain no information about the effluent concentrations from Chemcell stacks, and contain only data quoted as being from the "vicinity of Chemcell". Does this mean that no stack sampling has been done, and that the Provincial Board of Health is unaware of the nature of the effluents from the stacks of Clover Bar plant?"

This letter was turned over to Mr. S. L. Dobko of the Air Pollution Control Section for reply. He stated in a letter dated November 16, 1970, "We are unaware how you were able to read the letter of October 23, 1970, to mean that 'up to now Chemcell has not achieveda satisfactory standard with respect to effluents'. It is true that samples were taken in the 'vicinity of Chemcell' which are used to ascertain the resultant ambient conditions of emission from the plant stacks. No stack sampling has been carried out, but the Provincial Board of Health and the Air Pollution Control Section of the Division of Environmental Health is well aware of the nature of the effluents". This again despite the complete absence of supporting data.

Thus the reader will have to draw his own conclusions about the significance of the absence of a final air pollution approval in respect to Chemcell emissions. It appears to us that either the emission control procedures instituted at Chemcell are so far unsatisfactory, or that the Provincial Board of Health has no or inadequate data relevant to them. Clearly there is no basis for assuming that measurements made at the Administration Building or at the high volume sampler, bear any relation to Chemcell emissions since they include contributions made by automobile pollution, the oil refineries, and many other sources.

4. Edmonton Power Rossdale Generating Station:

(a) Area Monitoring: Colorless nitrogen oxide (NO) is formed whenever a sufficiently high temperature is reached during a combustion process in air. Brown, nitrogen dioxide (NO_2) will be formed if there is sufficient oxygen, and when the temperature is not too high. In any case it will be formed after the NO is emitted into the atmosphere. It is worth pointing out that NO_2 is much more toxic than NO. From time to time, much has been made of the fact that the levels of NO are low at the point of emission from the power plant stacks into the atmosphere. Various far-fetched attempts have been made to attribute the brown color emitted from the Rossdale plant to some source other than NO_2. In fact, as pointed out in an excellent report submitted January 6, 1965, by Mr. E. Kupchanko, it is probable that the brown smoke occurs when the gas turbines at the Rossdale plant are operating. They would appear likely to be the largest source of NO_2, since they operate under oxidizing conditions which would favor its formation. They, however, are operated chiefly in times of heavy load, thus resulting in intermittent emission of brown smoke containing NO_2. The NO emitted by the other stacks will ultimately be oxidized to NO_2 but the color will not be observed owing to dilution in the atmosphere.

A study in 1967 by Western Research and Development Ltd. and Stanley Associates Engineering Ltd., recommended that the problems of emission from the Rossdale plant could be solved by raising the stack heights of the three high-

pressure boilers by 100 feet. The anticipated result of this, of course, would be to disperse the nitrogen oxides more widely over the City of Edmonton. The data collected on the eighth floor of the Administration Building could be interpreted as consistent with this suggestion.

The stack heights were increased in the summer of 1968. If we compare the data for December 1968 through May 1969 to the corresponding data for the preceding year, we find that monthly and hourly averages have increased in every case except one in which the averages were the same, while the peak values have decreased in every case except one which was increased slightly. However, peak values were up again in October and November 1969.

If the peak values obtained at the Administration Building resulted from wind conditions which blew the fumes toward the Administration Building, then lower peak levels should be found after the stacks were raised. However, for reasons discussed earlier, these measurements cannot be taken as specifically indicating NO_x emission from the Rossdale plant, from automobiles, or from any other single source, or NO_x levels at any other single point.

(b) Source Monitoring: The Rossdale power plant has six low-pressure boilers, three high-pressure boilers, and the two gas turbines mentioned above. When operating at near capacity, the two gas turbines provide not only the largest source of NO_2, but also the largest source of mixed nitrogen oxides (NO_x) per hour, particularly (as of 1965) turbine #6. At that time turbine #6 produced 233 pounds of NO_x per hour; turbine #7 produced 148. The two high-pressure boilers then in operation (#8 and #9) produced respectively 139 and 145 pounds per hour. The concentration of NO_x in ppm in the emissions from the gas turbines is less, averaging 150-180 ppm compared to 200-350 ppm for the high-pressure boilers.

Insofar as we can determine, no public Provincial Board of Health approval level has been laid down for the Rossdale Station. However, approvals have been given for the new Clover Bar Generating Station. These are in terms of average and maximum NO_x emission in ppm. The values for one of the new units operating at 100% load are set at a maximum of 470 ppm and an average of 397 ppm. The data we have for the emissions from the Rossdale plant suggest that the emission from each unit is 350 ppm or less.

(c) Relevance to General NO_x Levels: Standards for safety in Alberta as well as in other areas such as California are based on NO_x concentrations at ground level. No measurements are made of this sort in the City of Edmonton. It does seem likely that dangerous concentrations of NO_x at ground level do occur because 5-minute peak readings above 0.30 ppm (the maximum 1 hr average in the Alberta standards) are frequently encountered in the data collected on the 8th floor of the Administration Building.

Automobile traffic during rush hours contributes a substantial portion of NO_x. The Western Research and Development Ltd. and Stanley Associates Engineering Ltd. report states (page 33) that "observations made at the power plant

property with a continuous recording instrument indicated that concentration levels correlated with traffic pattern. High concentrations were observed between 8:00 and 10:00 a.m., 4:00 and 6:00 p.m., and generally on Thursday and Friday nights," (nights of evening shopping in Edmonton).

5. Inland Cement Plant, located at 156th St. and 125 Ave. in Northwest Edmonton:

(a) Area Monitoring: The contribution of dust fall from the cement manufacturing process carried out by Inland Cement can be approximated by looking at the total dust fall and percent of calcium in stations in the City of Edmonton, located distant from the source. These include Stations #1, #3, and #10, located respectively at City Hall, in hardisty at 54th St. and 101A Avenue, and at the Engineering Building on the University of Alberta campus. There is an excellent correlation among these 3 stations of the percent calcium in the dust fall on a yearly average basis and this has been increasing since 1964. In 1969 more than 20% of the total dust fall was calcium and presumably related to cement manufacture.

(b) Source Monitoring: Five stations are located peripherally around the Inland Cement plant. These are #2 (135 St. and 132 Ave.), #5 (160 St. and 118 Ave.), #7 (145 St. and 120 Ave.), #8 (149 St. and 115 Ave.), and #9 (156 St. and 129 Ave.). These seem to provide adequate source monitoring. The levels of dust fall at station 2 (residential classification) exceeded the Standard (15 tons/sq.mile/30 days) 60% of 1969. At stations 5 and 7, although dust fall was high, it was generally within the standard for the industrial classification (45 tons/sq.mile/30 days). During 58% and 40% of 1969, respectively, dust fall at stations 8 and 9, however, exceeded even the industrial Standard, often by huge amounts (up to 239 tons/sq.mile/30 days). These trends have been consistent since measurements were started. The reasons for the differences among stations should be investigated.

One surprising and puzzling observation is that the stations with the highest dust fall (i.e. Stations #8 and #9) had a calcium content in the dust fall no greater than those of Stations #1, #3 and #10 which are distant from the Inland Cement plant and may be considered area monitors. The reasons for this should be investigated.

6. Other Local Problems which have not been Assessed:

Air pollution emissions from the city incinerator, the University of Alberta incinerators, the large heating plants of institutions (e.g. hospitals, the University, etc.) emissions from other industries in and around the city, have not been considered in this report. Time, and the delay on the part of the Provincial Government in providing us with information about Provincial Board of Health approvals and monitoring, have made it impossible to include all these sources in our considerations. The seriousness and urgency of the problems already investigated demanded reporting without delay.

7. Conclusions Regarding Local Problems in Air Pollution in the City of Edmonton:

There is no information on the local air pollution problems arising from automobile emissions. There are no emission standards or approvals for several of the industries expected to be large-scale polluters relevant to

the City of Edmonton. There also appears to be little or no effective monitoring of stack emissions of most plants, and little or no effective monitoring of the pollutants in the area or in the nearby regions. The emissions from the Inland Cement plant seem to be an exception to this comment.

In particular, we are surprised that Provincial Board of Health air pollution approvals have not been issued for two of the oil refineries east of the city, for Chemcell, or for the Rossdale generating station. We will return to this matter when dealing with enforcement of air quality standards to be discussed below.

V. ENFORCEMENT PROCEDURES

We have not been referred to any municipal by-law dealing with air pollution. The relevant legislation appears to be predominantly the Public Health Act of the Province of Alberta.

Chapter 255 of the Revised Statutes of Alberta, 155, has section 24 with the heading, "Pollution of Atmosphere." Section 24 of this act gives the Provincial Board of Health the right to inquire into and hear and determine any complaint made by or on behalf of any person that as a result of discharge of air pollution the quality of the air is being impaired or corrupted and the comfort or health of the public or a portion of the public is being injuriously affected. It also empowers the Provincial Board of Health to make a report to the Minister upon such complaint, including a finding as to who is responsible for the condition complained of and what remedial measures are deemed just and which are required in respect to any alleged injury or invasion of right.

It also gives the Provincial Board of Health the right to order any persons held responsible for the alleged injury or invasion of right to submit a report to the Provincial Board of Health describing the different types of equipment available and necessary to eliminate the alleged injury or invasion of right, and its cost.

It also states that a person refusing or neglecting to carry out the requirements of an order under this Section within 30 days of the time fixed for the submission of the report and estimates, is guilty of an offence and liable on summary conviction to a fine of not less than $20 nor more than $50 for each day of default.

All these powers given to the Provincial Board of Health are discretionary. Thus the Provincial Board of Health has sufficient powers to control pollution but is not required to do so. The citizen who feels he has been injured has no right to take action on his own under this section (24), nor power to require the Board of Health to act on his complaints.

We consider that it is relevant to point out that the Board of Health is composed of the Provincial Medical Officer (who is also the Deputy Minister of Health), and two other persons who report to him in the line of authority,

viz., the Director of Environmental Health Services Division, and the Director of the Provincial Health Laboratories.

> A further subsection of this part of the Act states, "Where the report of the Provincial Board recommends the treatment that the person held responsible should apply in order to secure the elimination of the condition complained of, or the degree of treatment to be applied to alleviate the condition, any person directly affected, or the Minister, may apply to a judge of the Supreme Court or to a district court judge by way of originating notice according to the practice of the court for an order (a) for the elimination or alleviation of the injury or invasion of right in terms of the report of the Provincial Board, and (b) to restrain the person found responsible by the Provincial Board from continuing the injury or invasion of right until the order for elimination or alleviation has been complied with."

This provision seriously limits any direct action of citizens against offenders in respect to air pollution. They cannot take action under the Act unless the report of the Provincial Board makes a finding as to who is responsible and recommends a procedure for alleviating the condition, and unless a judge of the Supreme Court or district court will provide an order.

The regulations for the control of air pollution are under Division 14 of the regulations under the Act. Under the heading, "Submission of Plans," Section 14-2-1 states,

> "In order to reduce the possibility of air pollution the Provincial Board of Health may require any person or corporation proposing or planning to construct a pipe line which will contain dangerous or noxious materials or an industrial plant, or other premises, which may be a source of air pollution in the Province of Alberta to submit plans and specifications for the proposed pipe line, plant or other premises to the said Board for review before construction is commenced."

COMMENT:

Notice again that this is a discretionary regulation.

Section 14-2-2 states,

"Without limiting the generality of the foregoing section, plans and specifications shall be submitted in regard to any of the following:

-1 Proposed plants for the manufacture of petroleum products, chemical and allied products, pulp and paper products, stone, clay, and glass products, cement and lime products, fertilizers, animal by-products; and

-2 Proposed plants which shall be engaged in the primary metal industry, metal processing, the processing of wood or wood products, the processing of natural gas or its derivatives, the manufacture of asphalt and ready-mixed concrete, gravel crushing, meat packing plants; and

-3 Proposed incinerators including those for municipal, commercial or apartment use, but excluding those for one family dwellings, and

-4 Proposed pipe lines which will contain dangerous or noxious materials; and

-5 Proposed sewage treatment and disposal plants; and
-6 Proposed hay or forage crop driers, seed cleaning and feed mill plants; and
-7 Proposed thermal electric power and steam generating plants."

COMMENT:

Note that Section 14-2-2 is not discretionary, the operative verb being shall.

Section 14-2-3 states,

"When plans and specifications are required for review under Section 14-2-1 or Section 14-2-2, such plans and specifications shall be in such detail as the Provincial Board of Health may require, but in any event shall show the proposed location of the pipe line, plant or premises and its size, capacity and the nature of the processing, manufacturing or other operation."

Section 14-2-4 states,

"When plans and specifications are required for review under Section 14-4-1 or 14-2-2, no construction shall be undertaken or proceeded with until approval in writing of the proposed construction has been granted by the Provincial Board of Health."

Section 14-2-5 reads,

"The Provincial Board of Health may direct such changes as to the location and in the plans and specifications submitted for review under section 14-2-1 or Section 14-2-2 as the said Board deems necessary in the public interest."

Section 14-2-6 reads,

"The Provincial Board of Health may require additional information in regard to any proposed pipe line, plant or premises."

Section 14-2-7 states,

"Every incinerator, except those for one family dwellings, shall be designed and constructed in accordance with the latest edition of 'Incinerator Standards for the Province of Alberta' as approved by the Provincial Board of Health."

Under Section 14-4 standards are assessed for particulates.

Section 14-4-1 states,

"The concentration of particulates in effluents to the atmosphere resulting from combustion of fuels shall not exceed 0.85 lbs. per 1000 lbs. of effluent, adjusted to 50% excess air for products of combustion."

Then a similar rule applies for products of combustion resulting from incineration.

Section 14-4-3 also places a similar limit on effluents to the atmosphere resulting from industrial processing or manufacturing.

Section 14-4-5 states,

"Every operation shall be conducted in keeping with good particulates control practices to avoid the release or escape of excessive particulates. A particulates fall in the surrounding area of 15 tons per square mile per month in residential areas or 45 tons per square mile per month in industrial or commercial areas shall be deemed to be excessive, except that due allowance shall be made for a normal back-ground level."

(We refer readers to our discussions of dust fall generally and Inland Cement area monitoring in particular).

Section 14-5-1 prescribes that

"odorous materials shall not be released or be permitted to escape to the atmosphere at such a rate as to interfere with the use and enjoyment of property or to endanger the health or safety of the public."

Section 14-6-1 states,

"Toxic or noxious materials shall only be released to the atmosphere after written approval has been obtained from the Provincial Board of Health and then only in such amounts and under such controls and safeguards as may be specified by the said Board."

Finally - and this one is quite important - Section 14-7-1 states,

"This Division of the Provincial Board of Health Regulations shall not apply to any pipe line, plant or premises which was constructed prior to, or which was under construction on September 15, 1961, for a period of five years after that date [1966] except that the Provincial Board of Health may reduce this period in respect of any pipe line or plant where the said Board deems such action to be in the public interest and may extend this period by as much as two years [1968] where the person or corporation has satisfied the Board that there is a justified reason requiring such extension."

COMMENT:

This provision, read together with the mandatory nature of Section 14-2-2, implies that by September 15, 1968, or sooner every existing plant, pipe line or premises which was mentioned above should have received a Provincial Board of Health approval. Thus we are unable to see how the Provincial Board of Health can be following its own regulations and yet permit the operation of plants without final air pollution approvals as of 1970.

According to Mr. S. Dobko no plan of action is available in the event of an unusual pollution problem. No levels of any pollutant have been established which would result in government action to diminish emission. Apparently at some level of pollution determined by unspecified criteria, Mr. Dobko would refer the matter to the Provincial cabinet.

VI. RECOMMENDATIONS IN RESPECT TO AIR POLLUTION CONTROL

1. The Environmental Health Services Division of the Department of Health, or its successor, should be provided with greatly increased staff and facilities for planning, data collection, interpretation and distribution to the public, and for other responsibilities outlined below. Among the increased staff should be professionals with biological training to complement the presently exclusively engineering staff.

2. A Metropolitan Air Pollution Control Unit should be set up, with geographical area of responsibility, enforcement powers and funding provided by the Provincial Government. It would have the duty to assess and control pollution problems that are interrelated by virtue of their contribution to the general and local problems in the City of Edmonton. Similar units should be set up for other areas such as Calgary, centers of oil and gas production and refining, etc.

3. Industries which have so far not received final air pollution approval from the Provincial Board of Health should be required to do so within 6 months, to terminate their flagrant violations of the Public Health Act.

4. In the immediate future and within 6 months, there should be developed a systematic plan for assessment and analysis of air pollution problems in and around the City of Edmonton. The plan should include (a) assessment of the techniques and instrumentation required to measure general and local air pollution problems, (b) an assessment of the emissions from the various sources of air pollution in the City of Edmonton, (c) probable increases with time (e.g. automobile emissions), (d) determination of the vertical and horizontal distribution of important pollutants, (e) the effect thereon of the topography and meteorological conditions prevalent in Edmonton; (f) problems related to local sources of high levels of pollution such as the oil refineries, the Chemcell plant, the Rossdale power plant, areas of high traffic density, etc.

In addition, the plan should estimate the instrumentation required to establish an adequate continuous monitoring system. Since multiple instrumentation will be required to establish gradients of pollutants and to assess local problems, and because it is probable that less instrumentation will be required for long-range monitoring once the above information is in, the plan for the City of Edmonton should be tied into an overall plan for the Province. This would allow costly instruments to be moved from place place, city to city, location to location, in order to assess problems, and would avoid unnecessary expenditure of money for instrumentation which may subsequently not be utilized in the continuous monitoring. This plan should be executed according to an urgent timetable.

5. A further plan should be elaborated and instituted for the control of pollution from such sources, especially during meteorological conditions which increase the problems. There should be established specific levels of certain pollutants beyond which definite action will be taken to curb emissions from specified sources. The plan should include elimination of any local problems.

This plan must include cost-benefit analysis, which has to influence levels of pollution that may be tolerated. The analysis must reflect all costs of air pollution damage and its control. For example, air pollution cost must be adequately assessed against the development of further freeway systems and further expansion of private automobile traffic relative to a similar assessment for costs of automobile emission controls or for rapid transit and the development of public transportation.

6. The Provincial Government should establish forthwith emission standards for motor vehicles at least as low as those established in California. The City of Edmonton should also set standards for all of its own vehicles, and provide equipment for testing their attainment. Additional measures should be taken to minimize pollution from vehicles, including exploration of the possibility of replacing gasoline-fired engines with those fired by natural gas or propane.

7. Consideration should be given to limiting the future growth, direct and continuous, of the City of Edmonton, in respect to the problems of air pollution control which will arise if additional vehicular traffic is to be encouraged, and if further development of industry in this area is to be sought. Expansion of population, and location or relocation of industry, should take place in satellite towns well separated by green belts.

8. Consideration should be given to introducing legislation giving citizens the ability in law to sue for damages and injunctions against polluters, and to require responsible governmental agencies to enforce our air quality standards.

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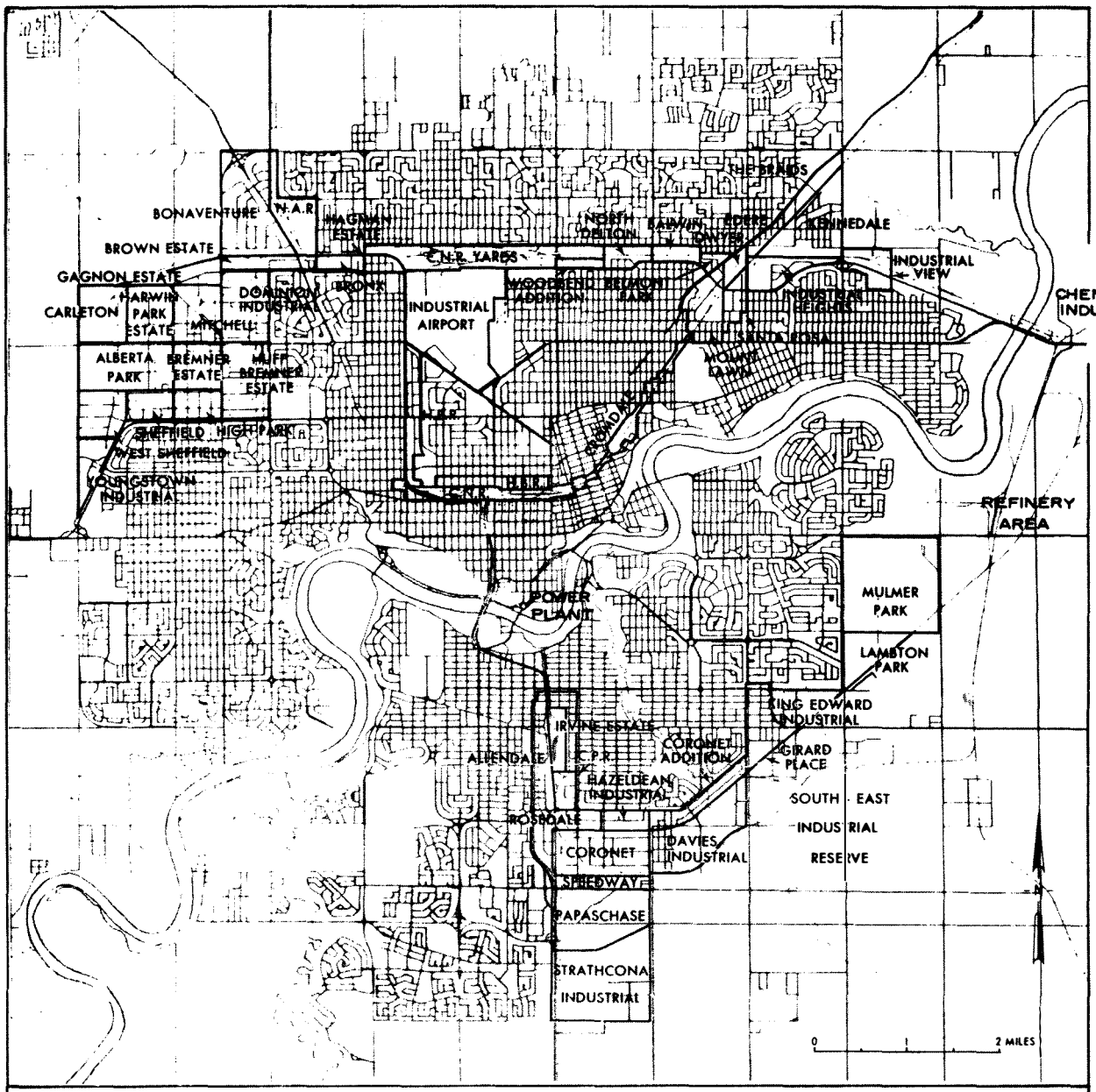


EDMONTON

INDUSTRIAL AREAS

(1966)

Source: *The City of Edmonton Planning Dept.*

Sampling Site Locations and Area Classification:

A) Dustfall and Percent Calcium Content

1. City Hall: 100 Street and 103 Avenue (Commercial).
2. N.W. Edmonton: 135 Street and 132 Avenue (Residential).
3. Hardisty: 54 Street and 101A Avenue (Residential).
5. N.W. Edmonton: 160 Street and 118 Avenue (Industrial).
7. N.W. Edmonton: 145 Street and 120 Avenue (Industrial).
8. N.W. Edmonton: 149 Street and 115 Avenue (Industrial).
9. N.W. Edmonton: 156 Street and 129 Avenue (Industrial).
10. Engineering Building, University Campus: 114 Street and 89 Avenue (Residential).

B) Hydrogen Sulfide and Total Sulfation

1. City Hall: 100 Street and 103 Avenue (Commercial).
2. N.W. Edmonton: 135 Street and 132 Avenue (Residential).
3. Hardisty: 54 Street and 101A Avenue (Residential).
4. 101 Avenue and Interprovincial Pipeline: (Industrial).

C) Suspended Particulate Matter Soiling Index

1. C.N. Tower: 100A Avenue and 104 Street (Commercial).
2. Administration Building: 109 Street and 98 Avenue (Commercial).
3. C.N. Telecommunications Repair Depot: 147 Street and 116 Avenue (Industrial).
4. Sherwood School: 96 Avenue and 153 Street (Residential).
5. North Edmonton C.N. Station: 125 Avenue and 66 Street (Industrial).
6. Ritchie District: 73 Avenue and 95 Street.

D) Oxides of Nitrogen, Total Oxidant and Total Hydrocarbons

1. Administration Building: 109 Street and 98 Avenue (Commercial).

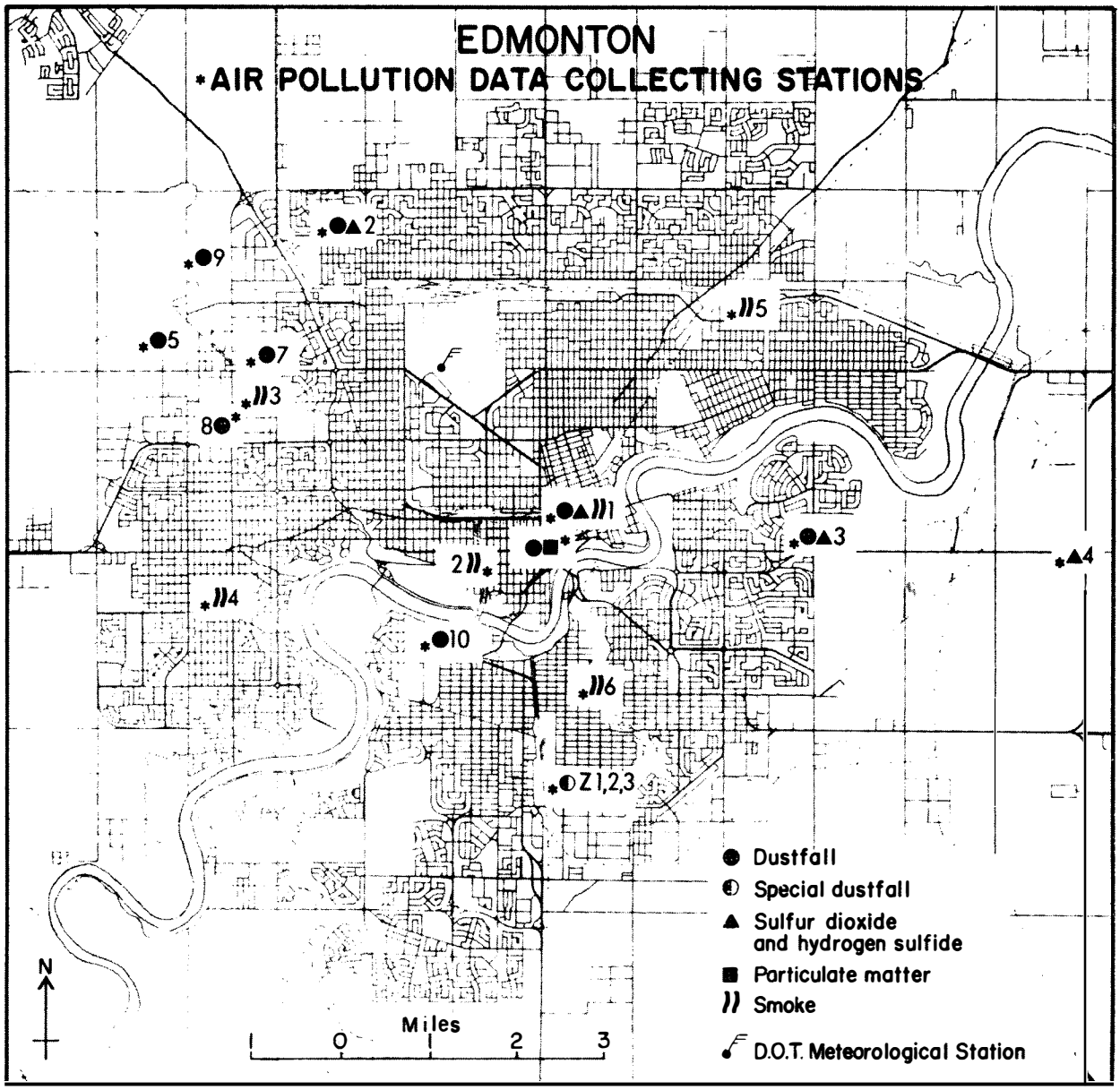
E) Suspended Particulate Sampling - High Volume Sampler

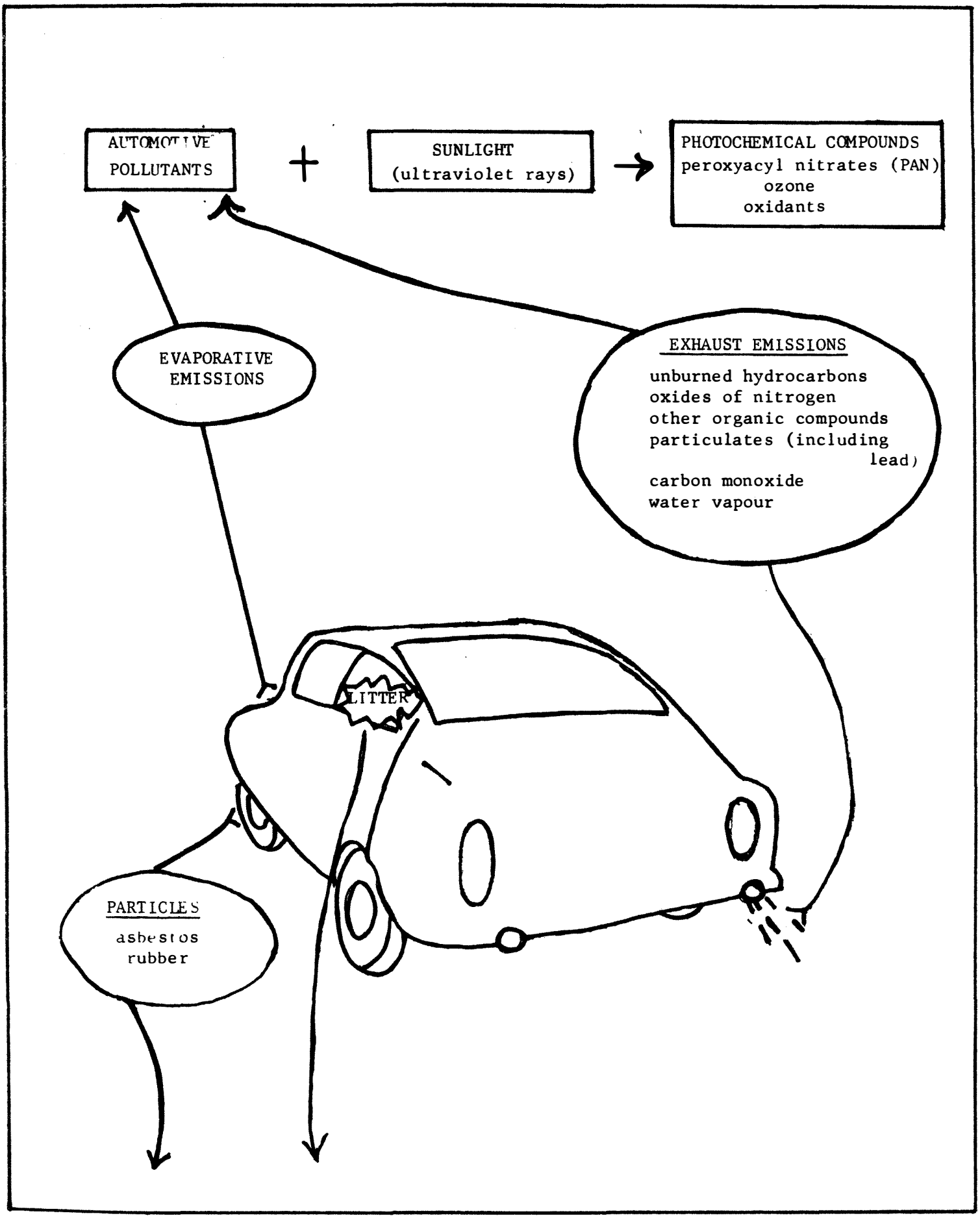
1. Alberta Jasper Building: 98 Street and Jasper Avenue.

Meteorological Data

a) Wind Data: Edmonton Municipal Airport.

b) Inversion Data: C.N. Tower - 100A Avenue and 104 Street.


EDMONTON
*AIR POLLUTION DATA COLLECTING STATIONS
Dustfall
Special dustfall
Sulfur dioxide and hydrogen sulfide
Particulate matter
Smoke
D.O.T. Meteorological Station
N
Miles
0
2
3


AUTOMOTIVE POLLUTANTS
+
SUNLIGHT (ultraviolet rays)
→
PHOTOCHEMICAL COMPOUNDS
peroxyacyl nitrates (PAN)
ozone
oxidants
EVAPORATIVE EMISSIONS
EXHAUST EMISSIONS
unburned hydrocarbons
oxides of nitrogen
other organic compounds
particulates (including lead)
carbon monoxide
water vapour
LITTER
PARTICLES
asbestos
rubber