

ILLINOIS POLLUTION CONTROL BOARD

September 19, 1974

IN THE MATTER OF: )  
 )  
LEAF BURNING )  
 )  
PROPOSED AMENDMENT TO CHAPTER 2 AIR ) R73-5  
POLLUTION, PART V OPEN BURNING OF )  
THE ILLINOIS POLLUTION CONTROL BOARD )  
RULES AND REGULATIONS )

OPINION OF THE BOARD (by Mr. Henss):

In 1970 the Illinois Legislature enacted the Environmental Protection Act. Section 9(c) of the Act states: "No person shall cause or allow the open burning of refuse". Refuse is defined by the Legislature as "any garbage or other discarded solid materials". (Section 3[k]) Opinions differed as to whether leaf burning was thereby prohibited in Illinois.

On September 2, 1971 the Illinois Pollution Control Board laid all doubts to rest with the adoption of a statewide ban on open burning of landscape waste. The ban on open burning of landscape waste was in effect during the Fall of 1971 for those communities which had a refuse collection service, but authorities apparently did not take action to enforce the leaf burning ban during that season. In July 1972 the Environmental Protection Agency filed a proposal requesting a relaxation of the ban for the smaller communities. In November 1972 the Board did relax the ban against the burning of landscape waste in rural areas and in the smaller communities which are not within a major metropolitan area. This was done since smaller municipalities have a greater financial problem in disposing of leaves and generally have a better air quality. The Board said that leaf burning in those areas could be conducted without harm to the public. The relaxation of the ban affected about 5% of the population of Illinois.

The prohibition against leaf burning remained in effect in municipalities over 2500 in population and in their adjoining municipalities, and within unincorporated areas which are within 1,000 feet of a municipality where the open burning of landscape waste was banned. The open burning of landscape waste remained prohibited in

all municipalities regardless of size located in the Chicago metropolitan area and the E. St. Louis metropolitan area.

This relaxation of the ban did not terminate the controversy in Illinois. On March 30, 1973 the Board in Newsletter #63 published a proposed amendment which would have based the leaf burning ban on a determination of actual air quality rather than the number of people living in a municipality. This proposal would have placed the burden on the State to determine air quality by using sampling equipment and air test data. The proposal was to prohibit the burning of leaves only in those municipalities which had poor air quality. Two hearings were held on this proposal. When it became apparent in June 1973 that the Legislature would pass legislation affecting leaf burning the Board decided to hold in abeyance any further action on the proposal (R73-5).

On August 13, 1973 legislation amending Section 10(g) of the Environmental Protection Act was signed into law. This legislation (Public Act 78-243) added the following language:

"The Board may not adopt any regulation banning the burning of leaves throughout the State generally. The Board may, by regulation, restrict or prohibit the burning of leaves within any geographical area of the State if it determines based on medical and biological evidence generally accepted by the scientific community that such burning will produce in the atmosphere of that geographical area contaminants in sufficient quantity and of such characteristics and duration as to be injurious to human, plant or animal life or health".

In a written opinion dated October 16, 1973, the Illinois Attorney General stated: "I conclude that Public Act 78-243 is in conflict with the current Regulations of the Pollution Control Board regulating open burning. The conflict runs only to leaves and not other forms of landscape waste or refuse. Therefore, the specific impact of Public Act 78-243 is to exclude leaves 'from the definition of landscape waste' currently found in Rule 501(d)". The Attorney General also said: "It is the clear intention of the General Assembly in Public Act 78-243 that the burning of leaves is to be permitted". Therefore on October 1, 1973 the effective date of the legislation, the open burning of leaves in many areas of Illinois was legally permitted for the first time in over two years.

Less than one month after the new Statute had been signed into law the Environmental Protection Agency filed its new proposal for the control of leaf burning. The proposal was an attempt to reinstate the

ban on leaf burning for those parts of the State which do not meet the Primary Air Quality Standards. Under the proposal the Environmental Protection Agency would determine air quality by using air measurement equipment or mathematical forecasting techniques and by its projections would determine which areas violate the Primary Standards. Leaf burning would then be prohibited for certain areas of the State in which projections have revealed that the air quality standards are not being met. The Acting Director of the EPA stated that the Agency was prepared to present at a public hearing "sufficient medical and biological evidence generally accepted by the scientific community that open burning of leaves may produce contaminants in the atmosphere to be injurious to human, plant or animal life or health".

The Agency's new proposal was published in Board Newsletter #72 on September 6, 1973. At that time the Pollution Control Board also formally requested the Agency and the Institute for Environmental Quality to undertake studies of the environmental effects of leaf burning.

Public hearings were held on the newest proposal in Peoria, Chicago and Urbana during November 1973. At the outset the Board made it clear that the testimony produced during the two earlier hearings would be a part of the total record but it would be essential for the participants to now address the requirements of the new law regarding leaf burning. This Opinion will discuss the testimony and the exhibits under the limitations imposed by the new Statute.

Testimony was received from members of the Legislature, from the Illinois Environmental Protection Agency, the Institute for Environmental Quality, the Sierra Club, the Illinois League of Women Voters, the American Association of University Women, Households Involved in Pollution Solutions, the Illinois Lung Association, the Illinois Municipal League, the Environmental Health Resource Center, the Quad-City Regional Air Pollution Control Agency, the cities of Decatur and Moline and a number of private citizens. Forty exhibits were entered in the record during the hearings, and additional materials were received during the comment period following conclusion of the hearings.

During the development of this record there were several changes made in the language of the proposed regulation. A copy of the final proposal, as amended December 6, 1973, is attached to this Opinion. Under the final proposal leaf burning would be prohibited in Illinois municipalities if an episode control stage is in effect, or if Agency projections indicate that Federal or State Primary Air Quality Standards have been exceeded or if the municipality adjoins another municipality which is prohibited from burning leaves. Air quality determinations

would be made and published semi-annually by the Agency with written notice being given to each affected municipality.

Testimony indicates that the proposed regulation would cover 5.8 million persons (which is 52% of the Illinois population) and 1.2% of the State's land area. Local regulations now affect over 6 million persons (57%) and 2.5% of the State's area. (Local communities are not affected by the legislative enactment and are free to ban or restrict leaf burning if they so desire.) The Agency claims that only 518,866 additional persons would be affected above that number now subject to local ordinances. These figures lead the Agency to believe that the proposal conforms with the intent of PA78-243. The Attorney General had said that the prior regulation was invalid under the new Statute since the regulation banned leaf burning "throughout the State generally". This was said to be true even though the prior law covered only a small percentage of the land area of the State and did not encompass all of its population. The Attorney General, however, said that a leaf burning ban was "general", and therefore prohibited, if it covered the State's citizenry "for the most part". The Agency now claims that the current proposal is not a general ban since it would affect only about one-half million persons above that number now affected by local ordinances.

Although we do not adopt the reasoning of the Agency we do agree that the final proposal does not ban the burning of leaves throughout the State generally. It is our opinion that a regulation which affects a bare majority of the population and less than 2% of the land area is not a general statewide ban, especially when one considers that the proposal is not designed to be permanent but only to prohibit the burning of leaves until those areas can be brought within the Primary Air Quality Standards.

However, we find that the record is insufficient for the adoption of the proposal when one considers the limitations of the new Statute. We may not ban the burning of leaves even within these geographical areas of the State, unless we first determine "based on medical and biological evidence generally accepted by the scientific community that such burning will produce in the atmosphere of that geographical area contaminants in sufficient quantity and of such characteristics and duration as to be injurious to human, plant or animal life or health". The record contains much information regarding the injurious impact of the open burning of landscape waste but it is inadequate for our purposes since we are restricted to a consideration of the contaminants produced by the burning of leaves alone. The Agency and the Institute have not responded to our request made almost one year ago that they study the environmental effects of leaf burning.

We make this statement even though the Institute and the Agency did contribute a great deal of information into the record. This

information, however, did not permit us to answer the questions which must be asked under the new Statute: What are the "contaminants" from the open burning of leaves? In what "quantity" are the emissions from leaf burning produced in the "atmosphere" of a "geographical area"? For what "duration" will the contaminants remain under different atmospheric conditions? What are the "characteristics" of these contaminants in those quantities and for those durations -- and are they injurious to human, plant or animal life or health? It is unfortunate that the necessary studies have not been conducted to answer such questions.

The initial ban on leaf burning was in large measure based upon testimony of individuals and allergy specialists regarding the impact of leaf smoke upon persons who suffer from respiratory problems. At that time individuals and physicians did testify in favor of the ban and such testimony was summarized in the Board Opinion adopted in September 1971. However, the Board Order has now been struck down. The new law states that any leaf burning ban must be "based on medical and biological evidence generally accepted by the scientific community". We believe that the Legislature now intends to require a higher degree of proof than that which the Board found sufficient in 1971.

This record contains testimony quite similar to the 1970-1971 record from individuals and physicians. The Agency has requested that oral and written testimony of the medical doctors and citizens be regarded as "medical evidence" within the language of PA78-243. However, we believe the testimony of the citizen witnesses should be considered lay testimony that cannot be utilized to satisfy the requirements of the new law. Testimony in the exhibits from the medical doctors does not appear to be "medical and biological evidence generally accepted by the scientific community" upon which a leaf burning ban could be reinstated, although it was deemed sufficient by the Board prior to PA78-243.

There is substantial testimony that the smoke from leaf burning causes adverse health effects among those citizens who suffer from allergies. Dr. Robert Pogrund, a member of the Environmental Health Resource Center testified that his childhood asthmatic problems were aggravated during the Fall season because of leaf burning. He also thought that leaf smoke was responsible for his attacks of angina. Reactions similar to his could be expected to occur in 10 to 15% of the Illinois population.

Mrs. George M. Larson of Wauconda testified that her daughter, a victim of myotonic dystrophy, began a coughing reaction at about the time leaf burning began in her neighborhood. She stated that the coughing spells continue through the night and will get progressively worse as more leaves are burned.

Mrs. George Felleeson, a registered nurse near Barrington, Illinois testified that the smoke from leaf burning causes her to suffer headaches, irritated and stinging eyes, irritated and stinging nose and breathing passages, throat swelling and respiratory difficulty. She experiences these reactions even if she remains indoors with all doors and windows closed.

On one particular day in May 1972 a neighbor sprayed his trees, trimmed them and then proceeded to burn the trimmings and leaves. The wind carried the smoke to Mrs. Felleeson's home. She became so ill that she was forced to go to bed. Her throat swelled almost blocking any swallowing activity. She experienced difficulty in breathing and began to have severe chest pains for which her only relief was the use of medicine and oxygen prescribed by a doctor. Her husband found her in a semi-stuperous state after the experience.

Mrs. Kathleen A. Blume, Wauconda, testified that her permanent chronic bronchitis condition is aggravated from mild discomfort during light smoke to severe illness during moderate to dense smoke. She experiences shortness of breath, chest pains and fatigue during these periods. Mrs. Marie M. Hicks, Bellwood, testified that she experienced burning eyes, sore throat, headaches and breathing difficulties during a leaf burning incident near Elmhurst in 1969. It took three or four days to recover after she left the burning area.

At the Urbana hearing Dr. Aldon Rarick, Director of Radiology Department at St. Elizabeth Hospital in Danville, testified that his personal reaction to smoke from leaf burning was a burning and soreness in his eyes which lasts for several days after the exposure.

Sharon DeWan, Champaign County League of Women Voters, testified that, while living in Boston, she experienced a stinging nose, headaches swollen eyes and shortness of breath for a period of two to four weeks during the leaf burning season. At one point she was affected to such an extent that she could not get out of bed for two days. She got a reaction from poison ivy on one occasion when a neighbor burned poison ivy leaves with other leaves.

Ruth Walker, Urbana, testified that her son experienced eye problems, nose problems, and coughing whenever neighbors burn their leaves.

Letters introduced as exhibits during the hearings presented additional lay testimony about the effects of smoke from leaf burning. Mrs. Barbara Swanson described an incident that occurred after she drove past a pile of burning leaves. Immediately she experienced a headache, sluggishness, earache and her right arm and leg became so numb that she could not use them. She required oxygen therapy during

the two hour period it took for the reaction to subside (Chicago Exhibit 1). She thought this was caused by smoke.

In Peoria three letters from doctors were introduced as Peoria Exhibit No. 2. In the first letter, Dr. Henry J. Dold, an allergist practicing in Skokie, wrote that he and his office partner treat "a number of patients whom the smoke created by burning leaves aggravates". Dr. Dold stated that smoke from leaves had long been known in allergic circles to aggravate people with chronic respiratory diseases. In the second letter, Dr. Truman G. Esau, a psychiatrist practicing in Park Ridge wrote that several of his patients have been adversely affected by smoke from leaf burning. Dr. Esau also related how leaf burning in the Fall of 1970 had been responsible for illness in his two children that caused them to miss ten days of school collectively. Both children are allergic and have "petrochemical sensitivity" (sic). The third letter was from Dr. H. F. K. Mitchell, a dermatologist and allergist in Park Ridge, who wrote in general terms about the need for a leaf burning ban. No specific medical knowledge about leaf burning was contained in this letter.

Seven other letters introduced at the Peoria hearing specifically referred to medical problems allegedly caused by the smoke from leaf burning (Peoria Exhibits 3 and 4). The remaining "medical evidence" found in the exhibits was a solicited letter (Urbana Exhibit #7) from Dr. Dean A. Emanuel of the Marshfield Clinic in Marshfield, Wisconsin. Dr. Emanuel wrote to Chairman Dumelle that while he knew of no specific research regarding the chemical properties of leaf smoke, it was generally held that patients with chronic obstructive lung disease tolerate inhaled irritants very poorly.

We have a great deal of sympathy for those persons who have such adverse reactions from the smoke of burning leaves. Such evidence was, at one time, considered adequate by the Illinois Pollution Control Board to sustain a statewide ban upon leaf burning. However, we are now operating under different statutory language. If we were to base a ban upon such testimony and attempt to protect asthmatic persons wherever they may be located, it would not be in keeping with the intent of the Legislature which is obviously to prevent a statewide ban. The proposal which we have before us does not, and under the law cannot, give complete protection to asthmatic persons. It seeks to ban leaf burning only in those communities which have the poorest air quality as measured by instrumentation or calculated from mathematical data. Under the law we cannot impose a statewide ban. We cannot impose a ban in all municipalities. We cannot impose a ban in those municipalities which exceed 2500 in population. The proposal does not and cannot adequately address the problem of asthmatics.

In recognition of the fact that a new type and higher quality of data is now required for the reinstatement of a limited ban the Agency

did submit several scientific studies. No studies have been conducted in any Illinois community to determine the increase in particulates or other emissions from leaf burning. There are indications that measurements of air quality will not be greatly affected by leaf burning. Emissions from leaf burning are small when compared to the contaminants in the air from all sources. Carbon monoxide is emitted but does not contribute significantly to air quality as measured. The particulates emitted from leaf burning apparently do not significantly affect the air quality as measured outside the zone of burning.

Nevertheless, leaf burning might have a significant affect on health especially when found in areas of high particulates or sulfur dioxide. One basic question is whether leaf burning causes emissions of polynuclear hydrocarbons which would create a greater health hazard in areas which already have high particulates or high SO<sub>2</sub>. The polynuclear hydrocarbons are higher in an urban area. Also particulates and SO<sub>2</sub> are higher in urban areas which are the areas of larger threat from lung cancer. The death rate from lung cancer increases 5% for each increment of 1 microgram per 1,000 cubic meters of air of benzo (a)pyrene (National Academy of Sciences). Benzo(a)pyrene (BAP) is emitted from the burning of leaves and also comes from other sources including the burning of auto parts, from incinerators, municipal refuse, coal burning, cigarette smoke and automobile exhaust -- in short the combustion of any organic fuel. It can come in minute quantities from the toasting of bread and from the use of barbeque pits.

In 1959 the BAP in the urban atmosphere averaged 6.6 micrograms per 1,000 cubic meters of air. Rural air was 0.4 micrograms per 1,000 cubic meters of air. By 1967 the BAP in urban atmosphere had dropped to 2.5 on average as compared to 0.2 for rural air. This drop was caused primarily by control of coal burning.

The most significant arguments in support of a ban against leaf burning were found in a letter written by Dr. Bertram W. Carnow, Director, Environmental Health Resource Center. The letter was written March 15, 1973 and was amended April 27, 1973.

In view of the very exacting requirements of PA78-243 and because of the profound and positive statements contained in the Carnow letter, many of Dr. Carnow's statements were traced to the original source work for verification. This verification process revealed certain discrepancies.

Citing the document Compilation of Air Pollution Emission Factors, (U.S. EPA Office of Air Programs, AP-42, February 1972) Dr. Carnow stated that 20 lbs. of particulates, 0.1 lb. of sulfur oxides, 130 lbs. of carbon monoxide and 11 lbs. of hydrocarbons are produced per ton of material burned. A review of this reference

reveals an unexplained discrepancy in numbers. Table 2-5 at page 2-7 of AP-42 lists emissions from the open burning of landscape and pruning refuse as: 17 lbs./ton particulates, negligible sulfur oxides, 60 lbs./ton for carbon monoxide and 2 lbs./ton for nitrogen oxide.

The emission factors in AP-42 were based on studies\* involving lawn clippings, leaves and tree branches<sup>1</sup>, land clearing debris<sup>3</sup> and grasses and straw such as fescue, rye, etc.<sup>4</sup> and forest debris that remains after logging operations. One of these studies (the Gerstle-Kemnitz study) did identify several organic contaminants in smoke from the combustion of landscape refuse. These materials were fluoranthene pyrene, crysene (or) chrysene, benz(a)anthracene, benzo(a)pyrene, benzo(e)pyrene, perylene, benzo(g,h,i) perylene and anthanthrene. These organic compounds, the importance of which will be discussed later in this Opinion, were produced at the rate of 0.3 grams per ton of landscape waste burned. Another study (Feldstein) did not specifically mention leaves or leaf burning. However, the combustion of land clearing debris was found by Feldstein to emit the following types and quantities of contaminants:

	<u>lb/Ton Burned</u>
Total organic gasses (excluding CH <sub>4</sub> )	166
Total olefins	30
Total oxygenates	59
Total aromatics	11
Ethylene	30
Carbon Monoxide	600
Particulates	24

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- \*1. Gerstle, R. W. and D. A. Kemnitz, Atmospheric Emissions from Open Burning, J. Air Pollution Control Association, 17:324-327, May 1967.
  2. Unpublished data: Estimated Major Air Contaminant Emissions, State of New York, Department of Health, Albany, New York, April 1, 1968, Table A-9
  3. Feldstein, M. et al, the Contribution of the Open Burning of Land Clearing Debris to Air Pollution, J. Air Pollution Control Association 13:542-545, November 1963.
  4. Boubel, R. W., E. F. Darley, and E. A. Schuck, Emissions from Open Burning Grass Stubble and Straw, J. Air Pollution Control Association, 19:497-500, July 1969.
  5. Waste Problems of Agriculture and Forestry, Environmental Science and Technology, 2:498, July 1968.

Fuels used for the Boubel, Darley, Schuck study consisted solely of grasses and straw such as fescue and rye. The report compared emission data from field studies in the Willamette Valley of Oregon to laboratory studies conducted by the University of California using similar grasses and straw. This report did not pertain to leaf burning.

Based on this review of source material used to compile the emission factors in AP-42 it must be concluded that neither the emission factors nor the source materials can be construed to be adequate leaf burning "evidence".

Several of the references contained in the Carnow letter appear to be questionable, a fact which must affect the weight given this particular exhibit. However, one of the references -- reference #4 -- is of unusual importance.

Since one of the requirements of PA78-243 is that the medical and biological evidence be "generally accepted by the scientific community", it is significant at this point to note that 51 panel members, consultants, contributors and committee members prepared the book cited as Carnow reference #4. The fact that the report was critically evaluated in toto by the entire Panel On Polycyclic Organic Matter prior to approval and distribution by the President of the National Academy of Sciences would be significant if it is determined that any of the material can be construed to be leaf burning "evidence".

Dr. Carnow's reference #4, Biological Effects of Atmospheric Pollutants -- Particulate Polycyclic Organic Matter, was reviewed for information that might be directly relevant to the leaf burning issue. The following is a condensation of that information:

"Polycyclic organic material (POM) has been reported in many plants and plant products such as plant tissues (p.160). The increased concentrations of POM in organic soils and in sediments and large bodies of water suggest that many of the polycyclic compounds are produced in decayed organic matter (page 165). The POM content of soil is also increased by exposure to industrial effluent, products of oxygen deficient burning of vegetative matter, deposits of petroleum products, and exhaust gasses from the automobile (page 160).

Mallet and Heros detected benzo(a)pyrene in tree leaves and in decaying organic matter under the same trees. They suggested that the benzo(a)pyrene was absorbed through the tree roots and was translocated through the transportation stream to the leaves (page 161). Benzopyrenes are among the pyrolytic products of wood and they also occur in the trans-

formation of plant organic matter to peat and lignite (page 161). Burning of vegetation and some plant products may produce significant quantities of several carcinogenic hydrocarbons (page 165). Data show a benzo(a)pyrene emission factor of about 150 ug/lb. of charged refuse for open burning of municipal waste as well as for grass clippings, leaves, etc. (page 24).

Combustion of almost any organic material produces polycyclic organic compounds and their partial oxidation products in trace amounts to the environment for probable contamination of every receptive surface (page 160). POM can be formed in any combustion process involving fossil fuels or, more generally, compounds containing carbon and hydrogen. The amount of POM formed will vary widely; efficient controlled combustion favors very low POM emissions whereas inefficient burning favors high emissions (page 13).

Although several polycyclic compounds generated by burning of vegetation are known to be carcinogenic when applied externally to particularly susceptible animal tissue, few have been adequately tested by ingestion by experimental animals (page 160). Because anthropogenic (relating to the impact of man on nature) POM is identified with combustion, it is likely that such material is emitted as vapor from the zone of burning. If it enters the atmosphere as vapor, it will undoubtedly be adsorbed on existing particles while undergoing condensation (page 38).

Present knowledge indicates that fractions of particulate POM contain only two classes of compounds that are known animal carcinogens -- the polycyclic aromatic hydrocarbons and their neutral nitrogen analogs, the aza-arenes (e.g., indoles and carbazoles). (page 2) Although dose-response studies have been carried out with many chemicals and the problem of quantitative carcinogenesis has been extensively studied for a few selected carcinogens, it has not been possible to reach agreement as to whether there is a threshold dosage above which carcinogenesis is produced (page 91).

To gain insight into this situation it should be remembered that there are probably at least two events involved in chemical carcinogenesis. The first is the primary insult induced intracellularly by the carcinogenic chemical. This molecular process is (according to the available evidence) rapid and irreversible. This phase is followed by the biologic process or processes involved in

the conversion of the pre-malignant cell(s) to malignant cell(s) or clone(s) of cells which in turn results in a tumor. With some carcinogens, the amount of materials required to bring about the primary molecular event is so small that it is experimentally difficult to determine on apparent no-effect dosage (page 91-92). Neither epidemiologic nor experimental data are adequate to fix a safe dosage of any chemical carcinogen below which there will definitely be no tumorigenic response in humans. With regard to air pollutants, which contain a variety of defined and undefined carcinogens, the lowest possible exposure must always be insisted on (page 93).

Bioassays on mouse skin, subcutaneous mouse tissue and mouse cervix and new born mice have shown that the particulate matter of city air can be carcinogenic to experimental animals.

Fractionation studies on urban pollutants suggest that polycyclic aromatic hydrocarbons may play an important role in the overall carcinogenicity and tumor initiating activity of urban pollutants in experimental animals (page 95). There are relatively few reports of induction of tumors by administration of carcinogenic polycyclic compounds via the airway. Because of the attendant difficulty, there have been few studies in which exposure of the respiratory tract has been carried out in a manner relevant to the problem of air pollution (page 110).

Purified polycyclic compounds such as benzo(a)pyrene have produced tumors of the tracheobronchiolar tree or lung parenchyma only when absorbed on particles and delivered below the larynx. In inhalation experiments, the addition of an irritant, such as sulfur dioxide, to an aerosol of benzo(a)pyrene has induced lung carcinomas in rats (page 113).

There is clear evidence that airborne polycyclic organic material found in occupational settings -- especially in relation to the products of burning, refining and distilling of fossil fuels -- is responsible for specific adverse biological effects in man. The effects include cancer of the skin, lung, nonallergic contact dermatitis, photosensitization reactions, hyperpigmentation of the skin, folliculitis, and acne. In concentrations found in urban or nonurban air, POM does not appear to cause any of those skin effects; similarly, there is no clear evidence that such materials as benzo(a)pyrene themselves in polluted air directly influence the pathogenesis of such nonneoplastic lung diseases as bronchitis and emphysema (page 245).

Other considerations warrant caution in accepting benzo(a)pyrene as a major pulmonary carcinogen at current urban atmospheric concentrations. Lung cancer incidence has steadily increased since the 1940's, and yet, qualitatively, the carcinogen content of urban atmospheric pollution caused by combustion products of coal has been on the decline. Recent tissue-culture evidence indicates that the benzo(a)pyrene content of particles recovered from city air accounts for less than 1% of its carcinogenic activity (page 205)".

This condensed citation from the NAS publication provides the Board more information than had previously been available regarding the carcinogenic qualities of the emissions from open burning. Yet even with this information the perplexing question -- does the burning of leaves . . . produce in the atmosphere . . . contaminants in sufficient quantity and of such characteristics and duration as to be injurious . . . -- still remains unanswered.

Clearly the statement that benzo(a)pyrene is present in tree leaves is significant. It has also now been established that benzopyrenes are produced in the burning of wood. The open burning of a mixture of grass clippings, leaves and tree branches yields about 150ug/lb. of benzo(a)pyrene. It is suspected that benzo(a)pyrene and other polycyclic organic materials exiting the burning zone as a vapor are adsorbed on particulate matter while undergoing condensation.

Purified benzo(a)pyrene and other polycyclic compounds such as those found in leaves have been proven capable of producing tumors in the trachea or abnormal growths in the lungs but only when absorbed on particulate matter that is delivered below the larynx.

Although the burning of vegetation releases polycyclic compounds that are carcinogenic when applied externally to susceptible animal tissue, the present atmospheric concentrations of polycyclic organic matter reportedly do not cause any of the skin effects which have been noted on persons who work in occupational atmospheres containing polycyclic organic material. Similarly, according to the report, there is no clear evidence that such materials as benzo(a)pyrene alone in polluted air directly influence the pathogenesis of such diseases as bronchitis and emphysema. Particularly interesting is the indication that the benzo(a)pyrene content of particles in city air accounts for less than 1% of its carcinogenic activity.

One of the references cited in the NAS publication relative to leaf burning was Airborne Carcinogens and Allied Compounds by Eugene Sawicki, as reported in the Archives of Environmental Health,

Volume 14, pages 46-53, January 1967. Sawicki reported that the average urban atmosphere contains about 8 ug of 7-H-benz(de) anthracen-7-one per 1,000 m<sup>3</sup> of air which is in the same range as found for benzo(a) pyrene. He stated that the compound, which has been identified in emissions from the open burning of "leaves and grass", caused tumors of the lung, thyroid gland and jaw of white mice which received a subcutaneous injection of the compound.

In Table II of this reference Sawicki reported the following compounds as urban atmospheric contaminants which have been proven carcinogenic to animals:

1, 2-benzanthracene  
7-H-benz(de) anthracen-7-one  
Chrysene  
Benzo(b) fluoranthene  
Benzo(j) fluoranthene  
3,4-benzopyrene [benzo(a)pyrene]  
dibenz (a,h)acridine  
dibenz(a,j)acridine

From this list of known carcinogens it should be noted that 7-H-benz (de)anthracen-7-one, chrysene and benzo(a)pyrene have been identified in smoke from the combustion of grass and leaves or landscape refuse.

Sawicki's report that certain polynuclear aromatic hydrocarbons had been found in the smoke from the open burning of leaves and grass was based on one of his earlier reports titled Analysis of the Urban Atmosphere and Air Pollution Source Effluents for Phenalen-1-one and 7-H-benz(de)anthracen-7-one.

In Table III of this report Sawicki shows that 0.1 mg/l of phenalen-1-one and 7.1 mg/g of 7-H-benz(de)anthracen-7-one were measured in the emissions from open burning of leaves and grass. However, the report failed to state if the open burning tests were conducted on leaves separate from grass or if a mixture of the two materials was used.

Additional information relative to carcinogenic polynuclear hydrocarbons in leaf smoke was presented as Urbana Exhibit #9. In part 1 of this Exhibit is a section dealing with polynuclear hydrocarbon emissions from the open burning of grass clippings, leaves

and branches. Parts of Tables 2 and 10 from this report have been combined as follows to show the relevant data exhibited for polynuclear hydrocarbon content in smoke from the burning of grass, leaves and tree branches:

<u>Group I</u>			
<u>Compound</u>	<u>Abbreviation</u>	<u>Biological Activity</u>	<u>ug/lb of Refuse Changes</u>
Benzo(a)pyrene (C <sub>20</sub> H <sub>12</sub> ) (3,4-benzopyrene)	BaP	+++	157
Pyrene (C <sub>16</sub> H <sub>10</sub> )	P	-	780
Benzo(e)pyrene (C <sub>20</sub> H <sub>12</sub> ) (1,2-benzopyrene)	BeP	+	70
Perylene (C <sub>20</sub> H <sub>12</sub> )	Per	-	17
Benzo(ghi)perylene (C <sub>22</sub> H <sub>12</sub> ) (1,12-benzoperylene)	B(ghi)P	-	73
Anthanthrene (C <sub>22</sub> H <sub>12</sub> ) (dibenzo[cd,jk]pyrene)	Anth	-	12

<u>Group II</u>			
<u>Compound</u>	<u>Abbreviation</u>	<u>Biological Activity</u>	<u>ug/lb of Refuse Changes</u>
Fluoranthene (C <sub>16</sub> H <sub>10</sub> )	Fluor	Not reported	505

(NOTE: In the above Table the compounds are listed in two separate groups for the reason that the relative reliability of the analytical determinations was affected by interferences that occur during chemical analysis. Therefore, values for the compounds in Group II are of lower quantitative reliability than those from Group I. The biological activities shown are the relative activity on mouse epidermis: +++ active, +weak, - inactive.)

Missing from this section of Part I were references that could be used to verify the data or determine if any of the testing was conducted on leaves alone. Two references (nos. 21 and 22) were found in the reference listing that could have been the source of data for this material. The first was the previously discussed Gerstle and Kimnitz

Study which has already been shown to have probably involved the burning of a mixture of grass, leaves and tree branches. The second reference was cited as unpublished research by Sawicki which is not available for review.

In Part II of Urbana Exhibit #9 it is reported that polynuclear aromatic hydrocarbons are the most extensively studied trace components in polluted air. The great interest in polynuclear aromatic hydrocarbons lies in the fact that several are known carcinogens for experimental animals and some are suspected carcinogens for man. However, the only human carcinogens so far identified in air pollutants are aromatic hydrocarbons with 4, 5 and 6 rings.

Table 2 of Part 2 of Urbana Exhibit #9 lists polynuclear aromatic hydrocarbons which have been found in the urban atmosphere. Also in the Table is a column showing the relative degree of carcinogenicity for each polynuclear aromatic hydrocarbon as determined from tests on the skin of ICR (Institute of Cancer Research) female mice. Of the polynuclear aromatic hydrocarbon compounds listed as having been detected in the smoke from leaf and landscape burning in either the Gerstle-Kimnitz report or Part 1 of Urbana Exhibit #9, Table 2 of Part 2 cited the following compounds as carcinogenically active:

Chrysene  
Benz(a)anthracene  
Benzo(a)pyrene  
Benzo(e)pyrene

The following compounds identified in smoke from burning landscape waste were listed as carcinogenically inactive:

Anthanthrene  
Benzo(g,h,i)perylene  
Fluoranthene  
Perylene  
Pyrene

The record discussed thus far indicates that a new type of contaminant known as polycyclic organic matter (POM) or polynuclear hydrocarbons (PNH) must now be considered in the leaf burning issue along with emissions of particulate matter, carbon monoxide and nitrogen oxide. POM is not newly discovered.

Evidence shows that concern about the health effects of these materials has existed since at least 1775. POM is known to be in emissions from fossil fuel combustion, petroleum industries, carbon black manufacturing, steel and coke manufacturing, motor vehicles and refuse burning. For the first time, however, POM has been introduced during leaf burning regulatory hearings as an allegedly dangerous component found in the smoke from burning leaves.

As has been shown earlier, almost every reference cited by Dr. Carnow was found to have involved the burning of landscape waste, agricultural waste, or a mixture of leaves, grass and tree branches. The single significant exception appears to be the detection of benzo(a)pyrene in tree leaves. Dr. Robert Pogrud, Associate Professor of Occupational and Environmental Medicine, University of Illinois Medical Center, testified that to the best of his knowledge benzo(a)pyrene would be emitted from the burning of leaves unchanged (Chicago, page 289).

The Agency states that the numerous studies conducted on agricultural or vegetation burning constitute medical and biological evidence within the framework of PA78-243. The proponents of a leaf burning ban argue that the data taken from the burning of various mixtures of grass, leaves and tree branches is indicative of types and quantities of emissions from the burning of leaves alone. This could be true, but there is simply no evidence in the record to permit that parallel to be drawn. Jack Paxton, a plant pathologist at the University of Illinois, testified on behalf of the Sierra Club. He said there can be quite a difference in chemical composition between different species of plants, and his absence of study relative to any similarity in emissions would not allow him to make such a correlation.

It is the Board's opinion that the "evidence" thus far discussed shows only that:

- a) leaves contain a substance known as benzo(a)pyrene.
- b) the burning of leaves would emit benzo(a)pyrene unchanged,
- c) benzo(a)pyrene is a known carcinogen to certain susceptible test animals and is a suspected carcinogen in man,
- d) a mixture of benzo(a)pyrene and sulfur dioxide has induced lung carcinomas in rats,
- e) there is no clear evidence that benzo(a)pyrene in polluted air directly influences the pathogenesis of bronchitis and emphysema, and
- f) present urban atmospheric levels of benzo(a)pyrene containing particulate matter account for less than 1% of its carcinogenic activity.

An additional requirement of PA78-243 is that the contaminants from leaf burning be of "sufficient quantity and of such characteristics and duration . . ." Even if it could be assumed that the data derived from the burning of a mixture of vegetation was the same as for the burning of leaves alone, the evidence would show that over 25,000 micrograms of particulate matter are produced for every microgram of BAP produced. The issue would be whether this amount of POM is of such quantity and duration as to adversely affect health.

AP-33 lists the emission rate for benzo(a)pyrene from leaf and grass burning as just 4.8 tons per year for the entire nation. However, the National Academy of Sciences states "more recently, significantly higher emissions from these sources (refuse burning) have been suggested, reflecting higher estimates of total nationwide refuse burning, rather than appreciably different emission factors". The NAS estimates that 600 tons of benzo(a)pyrene is emitted annually from refuse burning of which possibly 140 tons or more may be attributable to landscape waste, including leaves.

NAS thus postulates that benzo(a)pyrene emissions are 30 times higher for landscape waste burning (including leaves) than investigators thought only seven years ago.

Evidence of the "significant quantity" and "duration" of leaf burning emissions was presented by Jack Coblenz, Manager of Technical Services for the Agency's Air Pollution Control Division. Using the City of Evanston as an example, Coblenz reported that the 25,000 Evanston trees would each produce about 1 cubic yard of leaves per year which, when burned, would emit 21,250 lbs. of particulates. In comparison a nearby power plant emits 17,000 lbs. of particulates each day of operation. For this reason Coblenz testified "we are really not concerned with the particulate standards but with some other emissions" (Peoria, page 196).

The "other emissions", according to Coblenz, are benzo(a)pyrene and benzo(e)pyrene. Emissions of these two polynuclear hydrocarbons based on the Coblenz testimony are shown in the following table:

City:	Evanston, Illinois			
Number of Trees:	25,000			
Quantity of Leaves:	2.5 x 10 <sup>6</sup> lbs.			
PNH Emission Factors:	227 ug/lb. [157 ug B(a)P + 70 ug B(e)P]			
PNH Emissions:	5.675 x 10 <sup>8</sup> ug			
Wind Speed:	2 m.p.h.			
Atmospheric Conditions:	Stable			
Duration of Burn:	<u>1 day</u>		<u>4 days</u>	
Distance from Burn:	0.5 Km	1 Km	0.5 Km	1 Km
24 hr. Avg. PNH Exposure	9.1 ug	2.8 ug	2.2 ug	0.7 ug

Such an occurrence as described above, the burning of all leaves on 1 day or in 4 days, is obviously hypothetical. Coblenz admitted that leaves would never be burned under the conditions shown above. He testified that the purpose of presenting such figures was not to show actual or hypothetical emissions of polynuclear hydrocarbons but rather to show the difficulty of conducting an authoritative or scientific study on the effects of leaf burning.

It is the Agency's opinion that the burning of leaves will produce submicron particles and aerosols incapable of being captured by the filter of a high volume sampler. For this reason the Agency concludes that it would be unable to provide conclusive evidence about quantities of emissions from leaf burning based solely on field studies involving high volume samplers.

This Opinion seems to conflict with the opinion held by the U.S. EPA that the high volume sampler has a particle size sensitivity of 0.1 microns and a concentration sensitivity of 1 microgram per cubic meter. The Illinois Agency argues that the U.S. EPA fails to take into account the separation of fibers allegedly caused by the aerosol which creates enlarged pores. These enlarged pores, according to the Agency, would actually allow one micron and larger particles to pass through thereby creating a false picture of actual ambient concentration.

In Springfield testimony the Environmental Health Resource Center stated that particulate concentrations encountered during a 24 hour period (i.e. weekend leaf burning) may be many times higher than the concentration reported on an annual average basis and it is the higher short-term concentration to which an individual is actually exposed and not the annual average. For this reason the Environmental Health Resource Center recommended that a leaf burning ban should be based on 24 hour air quality standards in lieu of annual standards. However, no mechanism is available for making such quick determinations.

The record is not sufficient for us to determine "quantity" and "duration" of leaf burning contaminants in a geographical area. Nor can we determine what "quantity" and "duration" of such contaminants would or would not be injurious. As previously noted, the NAS asserts that epidemiologic and experimental data are not adequate to set a limit on carcinogenic polynuclear hydrocarbons below which there will definitely be no tumorigenic response in humans. Dr. Pogrund expressed the belief that present scientific information demands that a zero threshold be adhered to for both carcinogenic polynuclear hydrocarbons and aerosol aldehydes. Dr. Pogrund believes that the current Agency proposal represents a compromise and as such, fails to take into account the view held by the Environmental Health Resource Center that there should be a "zero threshold" for carcinogenic polynuclear hydrocarbons independent of established air quality standards. Dr. Pogrund, therefore

argues for a general statewide ban on leaf burning, a thing not permitted by Statute.

Dr. Pogrund further stated that the type of scientific proof apparently required by the new legislation "is practically unattainable within the constraint of adequate research funds". (Chicago P. 240) "In the absence of time or money to conduct such studies as outlined, the alternative is to place the burden of proof on those who wish to burn leaves that such action is safe, rather than prove it is harmful." (Chicago R. 243). This is also not permitted by the Statute.

Expensive and "practically unattainable" as it may seem to some, nevertheless, the Agency and Institute did describe a study which could be performed to supplement the information contained in this record. In the first phase of this study the Agency would select a representative quantity of Illinois leaves and ship them to the University of California's Air Pollution Resource Center. There the leaves will be burned under laboratory conditions in order to determine the types and quantities of contaminants emitted during leaf burning. Cost of this study is estimated to be about \$6,000.

The second phase would involve a field test where leaves would be burned under controlled conditions in an area free from industrial pollution sources. "Household-sized" piles of leaves and "city dump or park district" sized piles of leaves would be burned in order to determine downwind concentrations at distances up to 1 mile from the burn site. This phase would involve two men working six months and a cost of about \$50,000.

Phase 3 of the study would be conducted by the Environmental Health Resource Center after the Agency has developed emission factors. As described in Methodology for Evaluating Health Effects of Leaf Burning Emissions, this phase will: 1) Evaluate biological responses in an animal species, 2) derive a biological definition of the most damaging burning condition and leaf type burned by the acquisition of LD<sub>50</sub> data for each such burning condition, 3) derive a dose-response curve for up to 60 days that determines a graded biological effect while exposure is programmed to range from a minimal concentration to a concentration that approaches that of the predetermined LD<sub>50</sub>, 4) determine biological effects in pregnant animals chronically exposed to selected emission concentrations and exposure duration. Physiological status of litter pups would be determined to elucidate possible mutagenesis and/or teratogenesis.

Contaminants to be investigated tentatively would include particulates, polynuclear hydrocarbons, trace metals, sulfur oxides, carbon monoxide, nitrogen oxide, aldehyde, free radicals, terpenes and olefins and aromatic hydrocarbons. Dr. Pogrund stated that these

contaminants were decided upon "strictly by inference" because "components of leaf burning can be guessed at without reference to concentration or anything else about burning characteristics".

Phase 3 reportedly will cost about \$281,000 and require a minimum of two years for completion. Since the total cost of the three phased study will approach \$350,000, appropriations must be seriously weighed on a cost-benefit ratio. For example, Dr. Pogrund testified that the request for "convergence of scientific opinion" regarding the quantity and duration of contaminants necessary to cause injury cannot be readily fulfilled, "if at all". The expensive research according to Dr. Pogrund is likely to produce scientific controversies rather than agreement. If that be the case then, under the Statute, the burning of leaves cannot be banned. This would hardly justify a ban on the current state of the record.

One of the prime reasons for enactment of PA78-243 was the alleged economic impact of the prior leaf burning ban upon communities. Several municipalities and park districts introduced cost data showing an increased financial burden caused by the ban. However, the most comprehensive testimony about the economic impact of the prior ban was presented by Wallace Koster, a free-lance consultant to the Illinois Institute for Environmental Quality.

Koster conducted a survey of 12 Illinois communities to determine the impact of the regulation on leaf disposal programs. Cities involved in the survey, ranging in population from 1500 to 3,500,000, were Sandoval, Harvard, Marion, Hinsdale, Carbondale, Pekin, Elgin, Evanston, Decatur, Peoria, Rockford and Chicago.

Some of the more interesting findings in the survey involved cost per capita figures and logistics problems associated with the burning ban. For instance, the cost per capita, excluding any savings from reduction of fire calls and pavement deterioration, ranged from \$0.05 for Peoria to \$1.36 for Sandoval. Rockford experienced an increase of \$0.06 per capita while the cost for Elgin and Hinsdale were \$0.12 and \$0.46 respectively. When the savings of \$10,000 for reduced grass fire calls in Peoria is weighed against the increased cost for leaf pick-up services, the residents of Peoria experienced a net savings of \$0.02 per capita. Although such cost reductions could be expected for the other communities in the survey, the figures for reduced grass fire calls and street repairs were not presented in the report.

Many communities reported that catch basins and storm sewers became blocked with leaves. Most communities noticed a significant increase in the refuse load above the normal annual trend after the

open burning regulations were imposed. In the main, general tax funds paid for the leaf collection programs.

The estimated increase in the cost of leaf collection (excluding any savings for reduced fire calls and street repairs) after the open burning regulations took effect was \$0.53 per capita. We conclude that the economic issue is not controlling. The Koster study refutes the rumors that the financial impact on cities was unreasonably high. Few persons would deprive themselves of a \$.50 per year health insurance policy and that additional economic impact would not in itself be sufficient cause for lifting the ban on leaf burning.

In summary it is the finding of the Board that the record developed in R73-5 lacks certain medical and biological evidence necessary for the adoption of the Agency's proposed leaf burning ban. We do not by this decision condone the open burning of leaves. We give no such stamp of approval. Evidence showing the detection of Benzo(a) pyrene, a known carcinogen, in leaves should raise doubts even among the most adamant proponents of leaf burning. We are encouraged by the local ordinances which spare over half of our populace from the effects of leaf burning and recommend the adoption of such local regulation by more municipalities.

It is important to note that the information presented in these proceedings relates directly to our regulations already in existence controlling the open burning of agricultural and landscape waste. The hazardous emissions from the combustion of these wastes constitute a threat to living organisms. Caution should be exercised by those persons who legally engage in the burning of such waste. The Board believes that the information contained in these proceedings significantly strengthens the underlying rationale applied by the Board when it adopted open burning regulations in 1971.

The Board has carefully studied each statement and each item of evidence in the past months, and we conclude that the record does not meet the requirements of PA78-243. Some will claim that we have been too strict in our interpretation of the new Statute. To this we would answer that the leaf burning issue, distorted as it may have been, has now had the specific attention of the Legislature and we believe we correctly understand the legislative intent.

The Board has not received any indication that the Agency and the Institute are proceeding with their proposed three phase study. Phases 1 and 2 of the study were shown to take only about six months for completion and are quite a bit less costly than Phase 3. The more complicated Phase 3 will take an estimated two years to complete after Phases 1 and 2 have been completed and would probably not be undertaken without legislative approval.

(Proposed but not adopted by the Board)  
AMENDMENTS TO CHAPTER 2, PART V  
OF THE ILLINOIS POLLUTION CONTROL BOARD'S RULES AND REGULATIONS  
OPEN BURNING

Section 501 - Definitions

(i) Episode Control Stage: A yellow alert, red alert, or emergency as declared pursuant to Rules 407(a), 408(a), and 409 (a) of Part IV of this chapter.

Section 503 - Exceptions

(h) The Open Burning of Leaves

(1) Pursuant to Public Act 78-243, and notwithstanding any Rule in this Part to the contrary, the open burning of leaves shall be allowed in those areas of the state which are prohibited areas under Rule 503(c)

(4),

- (i) if no episode control stage is in effect; and,
- (ii) unless projections of the Illinois Environmental Protection Agency pursuant to paragraph (3) of this Rule, indicate that a Federal or State primary ambient air quality standard is exceeded in a geographical area where leaf burning would normally occur.

- (2) During an episode control stage, no municipality or person shall allow the open burning of leaves within the area affected by an episode control stage. The Illinois Environmental Protection Agency shall provide notification of the existence of an episode control stage in conformity with Rules 406, 407, 408 and 409 of this chapter.
- (3) The Illinois Environmental Protection Agency shall, as soon as practicable, implement a program to determine the air quality in those areas of Illinois which are prohibited areas under 503(c)(4), using air measurement equipment or mathematical forecasting techniques based on air measurement. The equipment and procedures used by the Illinois Environmental Protection Agency in determining air quality shall be consistent with any established Standards of the United States Environmental Protection Agency.
- (4) The Agency shall publish its air quality determinations at least semi-annually and shall give written notice

to each affected municipality of the air quality determinations which affect that municipality.

- (5) Nothing in this Rule shall exempt the burning of leaves from applicable local restrictions.

It is our judgment that the record does not support the proposal for the regulation of leaf burning. Therefore, we do not adopt the proposal. However, we retain jurisdiction in this matter for a period of six months in order to provide opportunity for the further development of the record through the studies which have been described by the Agency and the Institute. We do not know whether those studies have been or will be conducted but that possibility does exist and we retain jurisdiction only because of that possibility. If such studies actually take place the additional information should be added to this record and the proposal re-evaluated in light of the new evidence. If the studies are not filed with the Clerk of the Board, all pending proposals shall be dismissed six months from the date of this Order.

This Opinion constitutes the Board's findings of fact and conclusions of law.

ORDER

The Pollution Control Board finds that the record does not support the adoption of the proposed regulation of leaf burning. The proposal is not adopted. The Board retains jurisdiction of this matter for six months to allow opportunity for introduction of such information as may be developed by the Agency or the Institute pursuant to the studies described in this Opinion. If such studies are not filed with the Clerk of the Pollution Control Board within that six month period, all pending proposals shall be dismissed.

Mr. Dumelle will file a concurring Opinion.

I, Christan L. Moffett, Clerk of the Illinois Pollution Control Board, certify that the above Opinion and Order was adopted on this 19th day of September, 1974 by a vote of 5-0.

A handwritten signature in cursive script, reading "Christan L. Moffett", is written over a horizontal line.