Particles in the air (smoke, dust, soot, haze) are more dangerous to humans as the size of the particles decreases. Particles are produced by the combustion of fossil fuels (especially coal, but also oil and gasoline), and by burning garbage or hazardous waste. In July, 1987, the U.S. Environmental Protection Agency (EPA) officially recognized that small particles are more dangerous than larger particles when the agency established air quality standards for particles smaller than 10 micrometers in diameter. A micrometer is a millionth of a meter and a meter is about 39 inches.

Now, just two years later, an extensive medical study has shown that human illness can result from particles in the air at levels that fall within EPA guidelines. In other words, an area may meet the federal requirements and yet still make residents sick.

The EPA standard is called PM-10, meaning it is an air quality standard for "Particulate Matter" 10 micrometers or less in diameter. (See FEDERAL REGISTER July 1, 1987, pgs. 24634-24669.) The older standard was for total suspended particulate [TSP] and it did not take into account the size of particles. The new standard specifically recognizes that particles smaller than 10 micrometers in diameter are not filtered out by the nose and throat and can pass into the large airways below the trachea. The smallest particles, which are less than 2.5 micrometers in diameter, are known as fine particles and they are the most dangerous because they pass all the way to the bottom of the lungs where they can move directly into the blood stream. (See RHWN #131 [revised] and RHWN #132.) The federal air quality standard does not distinguish fine particles from others, though the existence of the PM-10 standard is recognition that small particles are more dangerous than large ones.

The federal standard says that, averaged over a year's time, an area's air should not contain more than 50 micrograms of PM-10 particles in each cubic meter of air; the 24-hour average is not supposed to exceed 150 micrograms per cubic meter of air. A microgram is a millionth of a gram and there are 28 grams in an ounce.

For the past decade, researchers at Harvard University have been studying the relationship of human health to particles in air; their work has been supported by the federal Department of Energy (DOE) which plans to burn coal on a massive scale (since nuclear power is, deservedly, on the ropes). For a free reprint, write: Dr. D.W. Dockery, Department of Environmental Science and Physiology, Harvard School of Public Health, 665 Huntington Ave., Boston, MA 02115.

The Harvard researchers have issued periodic reports on their work; the most recent one appeared in March, 1989. This study examined 8131 grade school students in six U.S. cities during the period 1974-79, and examined the same students again in 1981-82. To avoid complexities of age and race, only 5422 white students aged 10 to 12 were the final subjects of study. The cities were Steubenville, Ohio; St. Louis, Missouri; Kingston, Tennessee; Portage, Wisconsin; Topeka, Kansas; and Watertown, Massachusetts.

The students were asked about bronchitis, persistent cough, chest illness, wheeze and asthma. Bronchitis required a doctor's diagnosis within the last year; chronic cough was defined as being present for three months during the past year; chest illness required restriction of activity for 3 days or more; wheeze was defined as wheeze apart from colds or for most days and nights during the past year; and required the reporting of a doctor's diagnosis. The Harvard researchers also asked about three symptoms they didn't expect to be related to air pollution: earache, hay fever, and nonrespiratory illness or trauma that restricted activities for 3 days or more.

The Harvard researchers did not collect data specifically on particles below 10 micrometers in diameter; they collected data (starting in 1978) on PM-15 (particulate matter less than 15 micrometers in diameter). The annual average PM-15 readings were as follows:

The least polluted city was Portage, WI (10 micrograms, or ug); then came Watertown, MA (26 ug), Topeka, KS (33 ug), St. Louis, MO (38 ug), Kingston, TN (42 ug), and finally Steubenville, OH (59 ug), the most polluted. Boys and girls in the more polluted cities were twice as likely to have bronchitis, compared with youngsters in the less polluted cities. Similar results were apparent for chronic cough and chest illnesses.

These results are important because in the most polluted city (Steubenville) the annual average particle count was 59 micrograms per cubic meter and this was a PM-15 measurement; if only particles 10 micrometers or smaller had been counted, the readings would have been substantially lower. In every other city in the study, the measured [PM-15] pollution levels were below the allowable federal PM-10 standard, yet children in those cities reported excessive disease rates. "We found health effects occurring at levels below the current annual average PM-10 standard," of 50 micrograms per cubic meter, says Douglas Dockery, leader of the Harvard study. This study provides unmistakable evidence that the federal standard for particles is inadequate to protect public health and safety.

The Harvard researchers say their results are important for another reason: there is some evidence that chest ailments during childhood predispose a person to permanent, serious breathing problems, like emphysema, in later life.

The study revealed that the 571 students (10.5% of the total) with asthma or persistent wheeze were particularly susceptible to bronchitis. Bronchitis was reported among 25.5% of the children with asthma or wheeze versus 4.0% of those without; for chronic cough the rates were 29.5% versus 3.2% and for chest illness 36.5% versus 7.6%.

When compared separately, those children without asthma or wheeze in the most polluted city were 2.2 times as likely to have bronchitis as non-asthmatics in the least polluted city; those children with asthma or wheeze in the most polluted city were 3.8 times as likely to have bronchitis, compared to asthmatics in the least polluted city.

An important point of this study is that it confirms that the relationship between particles in the air and childhood disease is "linear," which means that the more particles in the air, the more disease there is. This means that ANY increase in particles in the air is likely to cause disease in someone, somewhere. Thus, an incinerator proposing to spew particles into the air is very likely doing so at the expense of some innocent bystander somewhere. The defense, "I'm meeting all applicable state and federal standards" isn't sufficient to prevent illness. Even when a polluter meets those standards, someone will most likely get sick. Who gave polluters the right to make us sick? We, the people, didn't. It must have been someone else. Let's find out who and go after them.


--Peter Montague

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Descriptor terms: EPA; PM10; children; regulations; health effects; air pollution; air quality standards; asthma; lung disease; particulates;