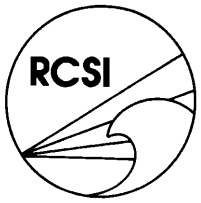

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Introductory Bulletin, Air Pollution

By: Herman S. Forest
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Air Pollution
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Introductory Bulletin

by
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Summary:

This report defines the chemicals and the physical conditions identified as air pollution. Air pollution produces enviornmental damage. The problem is most critical in urban areas when air is trapped by adverse weather conditions. However, mixing by winds is no longer an adequate means of abatement, since all the earth's atmosphere already has become polluted to some degree.

Sources:

Almost all man-made air pollution is a result of his burning of fossil fuels: coal, oil, gas. Manufacturing, electric generation, automobiles, and aeroplanes contribute major portions of metropolitan totals. The proportions vary. For example, in Los Angeles, automobiles are the greatest polluters and the contribution by aeroplanes is considerable (total for both-47%). In contrast, the production of electricity releases the biggest single part of New York City's pollution of air (26% closely matched by industry's 24%), while general industry produces most in St. Louis.

Critical Weather - The Inversion

The production of air pollutants is concentrated in metropolitan areas, and these areas rely on natural air movement to dispose of pollution. Tall stacks are the traditional device for spilling the pollutants into a moving wind. However, existing cities were not located with regard to air pollutions. Quite the contrary, many of them are located in a basin of some sort with high ground on one or more sides. As long as there are strong surface winds, or hot air rising from the surface to higher levels where winds are blowing, mixing occurs. When there is a relatively cool layer near the ground and a warm layer above it, the air is almost still, and little rising occurs. The warm-on-cool layer is called an "inversion". This is the condition in which air pollutants become concentrated in metropolitan air basins.

Kinds of Pollutants:

1. Particulate matter. The familiar types are the visible carbon or hydrocarbon particles called smoke or soot, and small bits of minerals, such as silicates, called fly ash or simply ash (fine dusty sand).

2. "Nuclei". Invisible small particles of many kinds of matter act as centers for adherence of water and other material, hence mists, fogs, and more indirect weather changes can be produced by increase in the concentration of nuclei. Nuclei are the natural ingredients of rain-making, but their production by man upsets natural regulation.

3. Sulfur. Usually as SO_2 (sulfur dioxide), occasionally as H_2S (hydrogen sulfide, the "rotten egg" gas). Sulfur dioxide reacts with water to produce sulfuric acid, and is a strong corrosive chemical. Particulate pollutions speed this reaction.

4. Nitrogen compounds. NO (nitrous oxide) and NO_2 (nitrogen dioxide). These undergo complicated chemical reactions in the upper atmosphere because of sunlight.

5. Chemical oxidants. In simple language these produce "burning". The "smog factor" that irritates eyes and throats is an oxidant.

6. Hydrocarbons. There is a multitude of these hydrogen-carbon compounds. The simplest is the gas CH_4, methane. Gasoline is a mixture of longer chain hydrocarbons.

7. Carbon oxide. CO (carbon monoxide) is poisonous in small quantity. However, CO_2 (carbon dioxide) is a necessary and critical ingredient of our atmosphere, being the raw material for photosynthesis. High CO_2 concentrations change the rate of human physiological processes (such as breathing rate) and the amount of CO_2 in the earth's atmosphere may have profound effects on plant and animal life. It is one of the factors controlling the temperature of the earth's surface.

The following are not usually considered under the conventional classification of air pollution, but they qualify as pollutants; that is, they produce disruptions in the environment which cannot be routinely managed by the regulatory or cleaning mechanisms of nature.

8. Water vapor. Large amounts of water vapor probably produce measurable environmental effects in many industrial areas. However, the effects become obvious only when huge amounts of vapor begin to be put out by cooling towers from nuclear power plants. It is highly probable that the danger of vapor to the Saratoga National Monument influenced the cancellation of plans to build the proposed Easton plant on the Hudson. Without cooling towers, the plant would have badly overheated the river so that either the air or the water pollution would have been serious. The case was quietly decided, not in an official decision, but its environmental threats had been well publicized, and must have affected the decision.

9. Radioactive fallout. Radioactive pollution is customarily studied separately from air pollution. However, radioactive materials are released both from fossil fuels and nuclear fuels at power plants. These are distributed through the air, and may enter organisms by way of soil, plants or water. It may be recalled that atmospheric nuclear bomb tests produced an alarming increase in air-bourne radioactive materials.

10. Chemical fallout. Poisons are also distributed from the air to soil, plants or water. The most spectacular cases in recent years have involved fluorides from copper smelting or fertilizer manufacture. Outright death of cattle in Montana and severe damage to human health in Ontario are on record. The most widespread pollutions are by DDT and lead from gasoline.

11. Pollen. This is a natural pollutant. Indeed, all air pollutants (except for exotic chemicals like DDT) do exist in nature, but few (dust, water vapor) ever produce major environmental effects. Pollen causes an injurious allergic reaction in many people. Many of man's chemical inventions may trigger similar allergic (antigenic) reactions when inhaled by some people, but the possibility remains unproved.

12. Tobacco smoke. From the viewpoint of how cigarette smoke enters and acts, it is a variety of air pollution. Tobacco smoke produces almost identical results of the standard air pollutants (Numbers 1 - 7); the air pollution effects have even been quantified by comparison to the number of cigarettes. The amount of carbon monoxide inhaled in cigarette smoke is fantastic: 170 times the 300 parts per million which is considered to be serious pollution in the open air!

13. Industrial dusts. In well known conditions of exposure, dusts of coal cause the disease "black-lung", silica dusts kill by "silicosis", and asbestos dust causes lung cancer.

14. Sprays. Not only can harm come from a weapon, such as the chemical mace (see R.C.S.I. bulletins: May, September 1968 and March, 1969), but hair sprays have been implicated in emphysema in reports of the American Medical Association.

What Air Pollution Does:

1. Human. By far the greatest bulk of information is available on humans, because of our preoccupation with health. The most general effect is to increase the frequency and severity of respiratory diseases. The spectacular statistics of death resulting from some severe inversions (London, Donora, Pa.) are probably overshadowed by more widespread and frequent health damage which does not show up in standard public health statistics, but has been demonstrated in special studies.

2. Other organisms. A fair amount of information is known on specific damage to common plants; in fact, landscaping in polluted urban atmospheres must be restricted to more resistant plants. An eco-disaster was produced about fifty years ago by sulfur dioxide fumes from copper smelting in the Ducktown Basin of Tennessee. The countryside was actually laid bare for a radius of ten miles and erosion reduced the landscape to "badlands" while silt choked the streams. The area has not recovered. Ironically, no study was made of effects on human health in the area.

   Little is known about the effects on most organisms (bacteria, worms, fungi, algae, birds, etc.) which make up the intricate environmental web, and all of which function in maintaining a clean natural environment. Chances are good that if man (who is tough) is being adversely affected, many organisms are being damaged.

3. Physical effects. The manifestations are costly and annoying: dampness, peeling of paint, corrosion. However, the most extensive consequences are in modification of weather and climate. Here, we are beginning to add another category of pollutant - disturbance of air movement. One of the dangers of the SST cited by Dr. Vincent Schaefer at the Atmospheric Sciences Research Center (Albany) is the stirring of relatively still air of very high altitudes (50,000 ft.) and seeding of nuclei which may change weather in new, unpredictable ways.

Evidence for Health Damage:

In the practical judgment of air pollution, it is necessary to understand the difference between laboratory evidence and epidemological evidence. In an over simplified explanation, the laboratory must be an artificial situation where uniform conditions are arranged. Epidemological evidence is drawn from the real world with all its variety. Uniformity can be approximated by drawing matching samples out of the world (e.g. 40 year old, non-smoking, caucasian males) - these are then compared in different places (San Francisco - London) or situations (1938-1968) - which can be correlated with air pollution. Air pollution in the quantity found in the environment has no ill effects which could be demonstrated in the laboratory. Indeed, some experimental animals have been known to do a bit better with polluted air: it stimulates them in comparison to control groups in pure air. Any competent experimentalist knows to expect this kind of result in a caged population - this is NOT evidence that air pollution is good; but only that idleness in a cage is bad! What can be demonstrated in the laboratory is that specific pollutants, such as SO_2 and CO_2 have a specific damaging effect in the body when used in rather high concentrations.

When medical records of many, many people, over long periods of time, are analyzed for such changes as increase in respiratory diseases and deaths, then the causal relation with air pollution becomes convincing. Needless to say, some can remain unconvinced: the tobacco companies have had no difficulty in finding staff scientists who do not accept the evidence against cigarette smoking. To the public the choice is between waiting indefinitely for unanimous agreement on damage or acting now for maximum safety against probable cause.

Cataclysmic Air Pollution:

The most serious long-range prospects of air pollution are not local, but global. On the authority of Dr. Schaefer, automobile exhaust can be detected EVERYWHERE in the United States, and air coming into the West Coast from the Pacific still contains East Coast pollution.

During the past 70 years the earth's atmosphere has changed more than in the previous several million years. The combustion of fossil fuels has added enormous amounts of CO_2 to the air. Although increase in carbon dioxide may increase the photosynthesis of plants (evidence from laboratory experiments), this is not the observed result of the actual pollution on a world wide scale.

One suggested result of CO_2 increase is an increase in temperature of the atmosphere. It is quite possible to melt the polar ice, and to flood the coasts of continents, over the course of several centuries. The heating effect may be overbalanced by particulate matter ("dust") in the air, which will reduce the energy reaching the earth. The possibility is equally grim - a new ice age. Finally, pollution of the ocean can result in the ultimate form of air pollution - shortage of oxygen. According to Lamont C. Cole, the United States produces only 60% of the oxygen it consumes (in respiration and combustion) - we are kept alive by the photosynthesis of algae in the Pacific Ocean. Death of enough algae may result in a planet fit only for certain bacteria .... since these were inhabitants of the earth before it had an oxygen atmosphere.

These speculations of serious, respected scientists are not intended to alarm the lay reader, but rather to point out that we may not evade the responsibility for controlling the pollution we produce.

REFERENCE

A single "next source" is suggested:

1970. Nadler, A. A. et al. AIR POLLUTION. A Scientists' Institute for Public Information Workbook. SIPI, New York, N. Y. ($1.00)

It is obtainable either from SIPI at 30 East 68th Street, New York, New York 10021 or from the R.C.S.I.

For the deeper investigator, a bibliography has been obtained for R.C.S.I. from Dr. Paul Morrow of the University of Rochester. Dr. Morrow deserves the acknowledgment and thanks of the R.C.S.I. for much of the content of this bulletin, and for his personal efforts in presenting his knowledge to the public. Dr. George Berg, Dr. A. Francis Turner and Graham Cox were most helpful in editing and reviewing this writing.