Conservation of the Surface of the Acropolis Monuments

Committee for the Preservation of the Acropolis Monuments

AIR POLLUTION

A. London

B. Athens

A. London

Extract from *AIR POLLUTION*

by

Henry C. Perkins, U.S., 1974

Pages 332, 341, 342, 343

14

EFFECTS OF AIR POLLUTION ON HUMAN HEALTH

We are in somewhat the same position in regard to polluted air as the fish are to polluted water. We live in it.

A. V. Kneese[1]

Because of the large number of variables involved in studies of air pollution and human health, it is difficult to prove that air pollution has a clearly demonstrable effect on human health at "normal" urban concentrations. We shall see that several studies show (but do not prove) such effects. Of course it is clear at the elevated levels occurring in air pollution disasters that air pollution effects can cause severe health changes and a quick death. It is also clear that air pollution has adverse effects on those who already have respiratory disease; it is more difficult to show that air pollution is the basic cause of the disease. We shall discuss in this chapter some epidemiological studies which indicate the adverse effects of ambient levels of air pollutants.

There are a large number of studies of effects of gaseous pollutants and particulates on animals (the so-called lower animals as contrasted to man). Most of these have been done at very high concentrations and thus have no direct meaning for humans living in lower urban

[1] H. Wolozin, (ed.), "The Economics of Air Pollution," Norton, New York, 1966.

TABLE 14.2 Survey of selected acute air pollution episodes in Greater London

	Dec. 1952	Jan. 1956	Dec. 1962	Dec. 1957	Dec. 1956	Jan. 1955	Jan. 1959
Duration of the cumulation period in days	5	5	5	5	10	11	5
Number of days with maximum pollution	2	2	1	1	5	1 X 3*	1
SO_2 level preceding episode	500	300	400	300	300	300	300
SO_2 maximum	4000	1500	3300	1600	1100	1200	800
SO_2 increase per day	1200	500	1000	325	400	450	250
Soot level preceding episode	400	500	200	400	400	500	400
Soot maximum	4000	3250	2000	2300	1200	1750	1200
Soot increase per day	1200	1300	600	500	400	600	400
Number of excess deaths	3900	1000	850	800	400	240	200
Number of days with excess mortality	18	10	13	10	6	6	6
Daily mortality expected under normal circumstances	300	330	310	300	270	320	325
Average daily mortality in the period (excess mortality as a percent of normal)	170	130	120	125	125	112	110

Remark: The SO_2 and soot concentrations mentioned are average values over 24 hours expressed in $\mu g/m^3$
*Maximum pollution values of one day's duration occurred three times.
Source: AP-50.

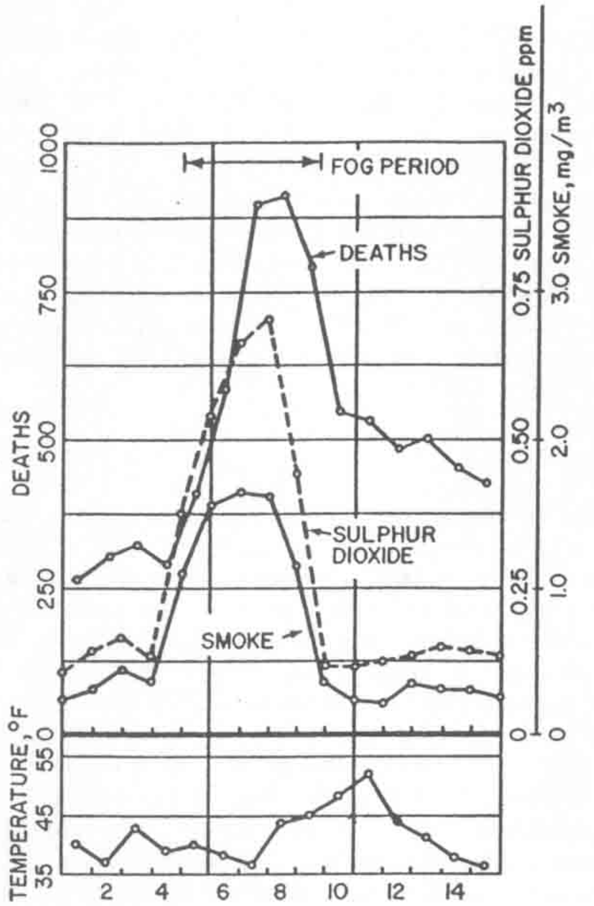

Fig. 14.6 Deaths, air pollution and temperature during December, 1952, in Greater London. (*Reprinted by permission from "Interim Report of the Committee on Air Pollution," Cmd. 9011, 1953. Crown Copyright reserved.*)

affected. The fog lifted on December 9. Figure 14.6 indicates the deaths, sulfur-dioxide level and "smoke" level during the episode. The maximum *daily* SO_2 concentration was 1.34 ppm (about 4,000 $\mu g/m^3$). Smoke levels were 4.46 mg/m^3. These figures are in agreement with those of Brasser et al. (1967) but are substantially higher than those of Fig. 14.6. This may indicate that different locations in London had substantially different concentrations. AP-49 indicates that British "smoke" and American "suspended particulate" are not exactly the same. The report notes that "limited data indicates that the American values may be higher in the same situation."

The London disaster of 1952 is charged with causing 4,000 deaths. Similar atmospheric conditions have occurred since 1952, in particular in December, 1962, with similarly high levels of SO_2. However, the smoke levels were markedly lower because of the clean up effected by the British Clean Air Act. Deaths in 1962 were much lower than in 1952. Whether this is because of the lower smoke levels or because of a population with fewer respiratory cripples left to be exposed is not clear. It is generally presumed that the lower smoke lèvels are responsible for the improvement. (The story of the 1952 episode is available in the book by Wise, 1971.)

New York

New York also has had several episodes of air pollution which have been responsible for excess deaths, for example, November, 1953 (Greenburg, 1962) and November, 1962 (McCarrol and Bradley, 1966). The 1966 Thanksgiving weekend episode is possibly the best known. The meteorology for this period has been described in Chap. 7. The maximum 24 hour average of hourly SO_2 values was 0.51 ppm (electroconductivity measurement) on November 23. On the 24th the value was 0.47 ppm, and on the 25th it was 0.41 ppm. The maximum *hourly* concentration was 1.02 ppm on November 25 and the smoke shade values were at or above 5 cohs on the three days (daily mean). The maximum hourly smoke shade was 8.2 cohs on the 25th. Glasser et al. (1967) have examined mortality data from this episode as compared to other control periods and conclude that there were 168 deaths. The excess was highest for older people but was observed in each of the three age groups studied: under 45, 45 to 64, and 65 and over. They also studied mortality by cause and investigated the effect of temperature, which was unusually high during this period with maximums in the 60s. Temperature effects were shown not to be the cause of the deaths.

The usefulness of studies of air pollution disasters is that they clearly indicate levels of pollution which cause immediate health effects even though the concentrations exist for only short periods of time, that is, a few days. From studies of these and other air pollution episodes we may conclude that:

1. Excess mortality is detectable in large populations if the concentrations of SO_2 rise abruptly to levels at or near 715 $\mu g/m^3$ (≈ 0.25 ppm) in the presence of smoke at 750 $\mu g/m^3$ (Lawther, 1963).

B. Athens

"The Air Pollution in Athens"

by

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The Air Pollution in Athens

The atmospheric pollutants which affect the marble surface of the monuments are the sulfur dioxide (SO_2), the carbon oxide (CO), the nitrogen oxides (NOx) and the smoke. Greece has adopted and follows the Air Quality Limits of the European Union.

Since 1985 anti-pollution actions and drastic control measures have been taken resulting in the reduction of the pollution levels significantly under the European limits.

The Greek Ministry of Environment has installed a dense network of automatic recorders all over the city for the monitoring of all the pollutants' concentrations. The measurements are published in an annual detailed report. A special recorder for the sulfur dioxide monitoring has been installed on the Acropolis hill.

The **sulfur dioxide** of which the main source is the liquid fuel used in the industry and the central heating is now fully under control and the values are in low levels. The decrease of the sulfur dioxide values is attributed to the replacement of the fuel oil by diesel oil, to the establishment of very strict specifications in the oil products, to the reduction of the sulfur content in diesel oil and other oil products by the desulfurisation process at the Greek refineries and the import of low sulfur crude oil.

The gradual introduction of the industrial and domestic use of the natural gas since 1995 is expected to decrease further the sulfur dioxide values.

The **nitrogen oxides** coming from the mobile sources are also under control and under the European limits. This is attributed to the anti-pollution measures regarding the gradual substitution of the old vehicles with new vehicles equipped with catalyst, the implementation of a system for controlling the car emissions, the improvement of the fuel quality, the support of the mass transport media and the prohibition of the car circulation in the trade center of the city .The underground railway is already in operation and will be expanded during the next years. A large scale project is in progress which includes the pedestrianization of the streets in the Historical Center of Athens and around Acropolis as well as other circulation measures for further restriction of the cars.

The **smoke** values are in very low levels since 1980 mainly due to the technological improvements and control measures in any kind of combustion (industry, central heating, vehicles).

The **carbon oxide** values rarely exceed the target values of the World Health Organization (WHO).

Measures for the Conservation and Protection of the Acropolis Monuments and Sculptures

Since 1975 the project of the Preservation of the Acropolis Monuments is in progress. Among the tasks of the project are the rescue operations and the structural conservation and restoration works as well as a major surface conservation operation including cleaning, consolidation and protection.

Many studies and research were carried out in order to develop safe materials compatible to the marble and effective methods for the interventions according to the principles of the Venice Chart.

The conservation project which is being executed on the Acropolis Monuments today includes *active conservation* consisting of consolidation interventions on the monuments themselves or on detached members either in the site workshops or in the conservation laboratory of the Acropolis Museum; and *passive conservation* consisting of interventions mainly of preventive nature, such a transferring architectural sculptures from the Monuments to the museum and placing some of them in an inert nitrogen environment. The slabs of the West Frieze of the Parthenon are placed in a separate room of the Museum under humidity and temperature control.

Since 1998 an air conditioning system with filters for the pollutants has been installed in the Acropolis Museum.

E. Papakonstantinou