



**Dr Ian Mudway**

# London's Air: The 70th Anniversary of the Great London Smog



EST. 1597

**GRESHAM**  
COLLEGE







# Meuse River Valley Smog (1930)

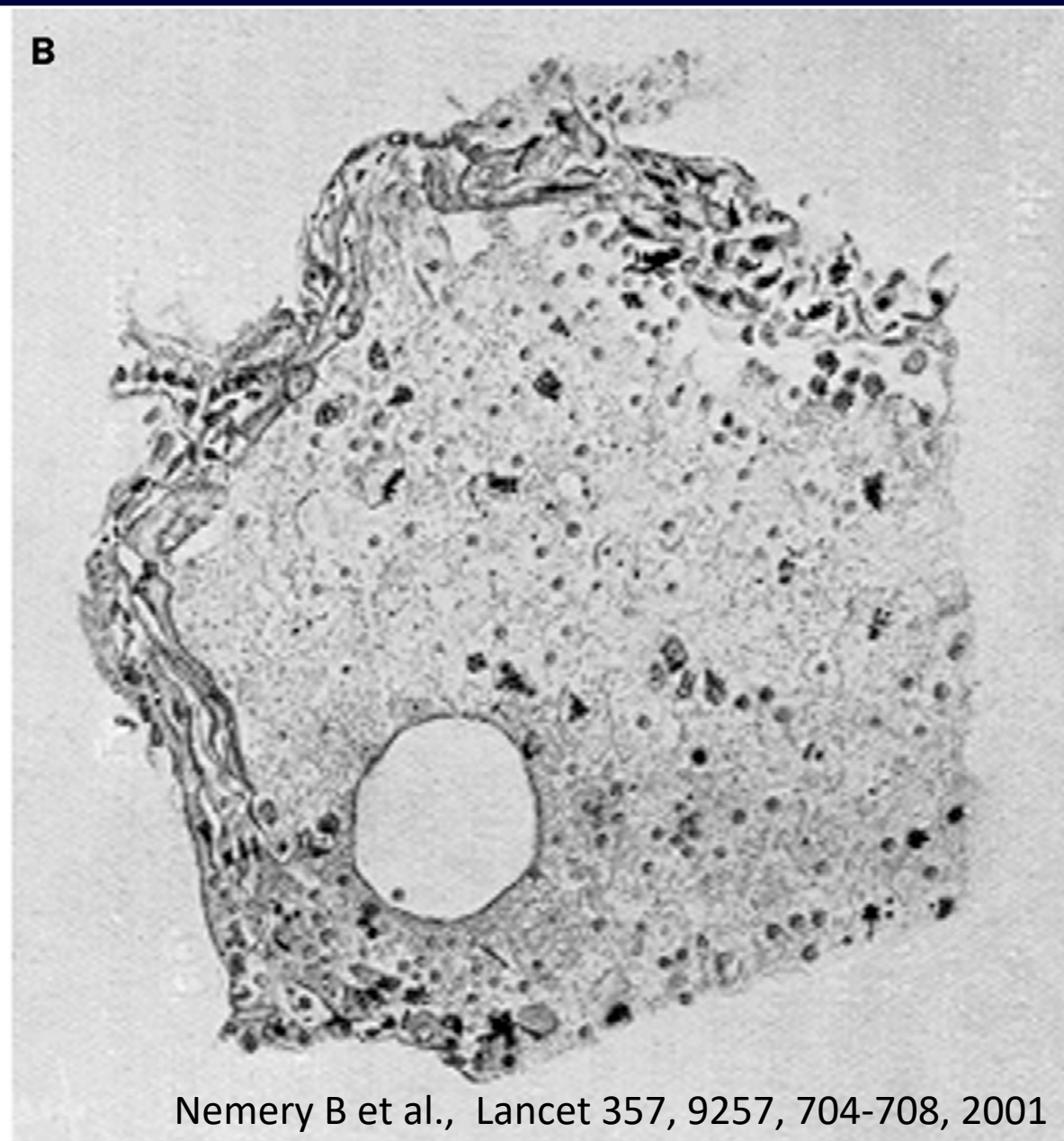
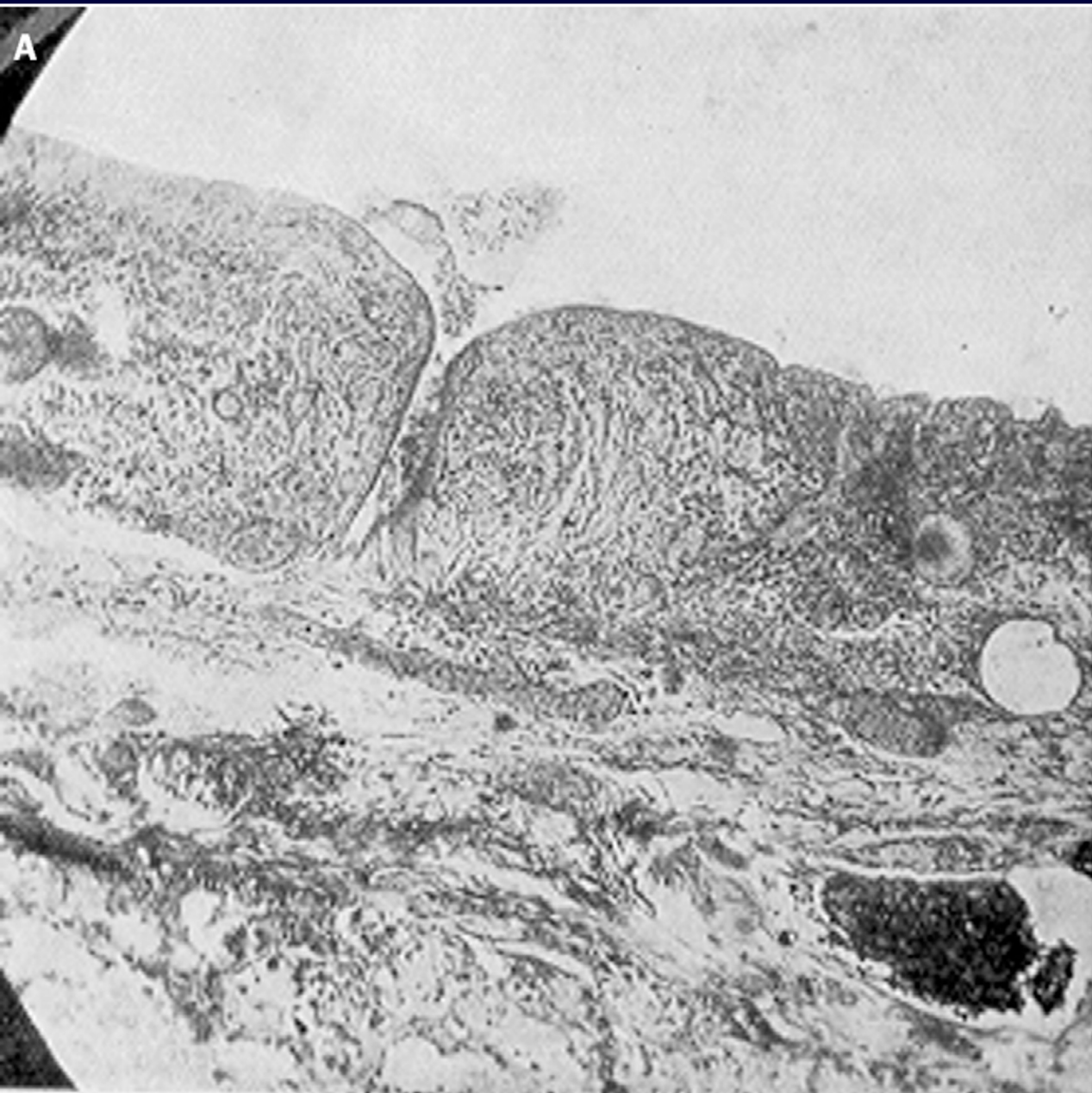


*Louise était jolie,  
Louise avait vingt ans,  
Elle revenait du bal,  
Elle était une enfant...*

• A la mémoire de la soixantaine de morts ,  
jeunes et âgés, d'Amay, d'Engis, de Némalle et de Seraing  
victimes de l' accident atmosphérique de décembre 1930  
dans la grande région engissoise.

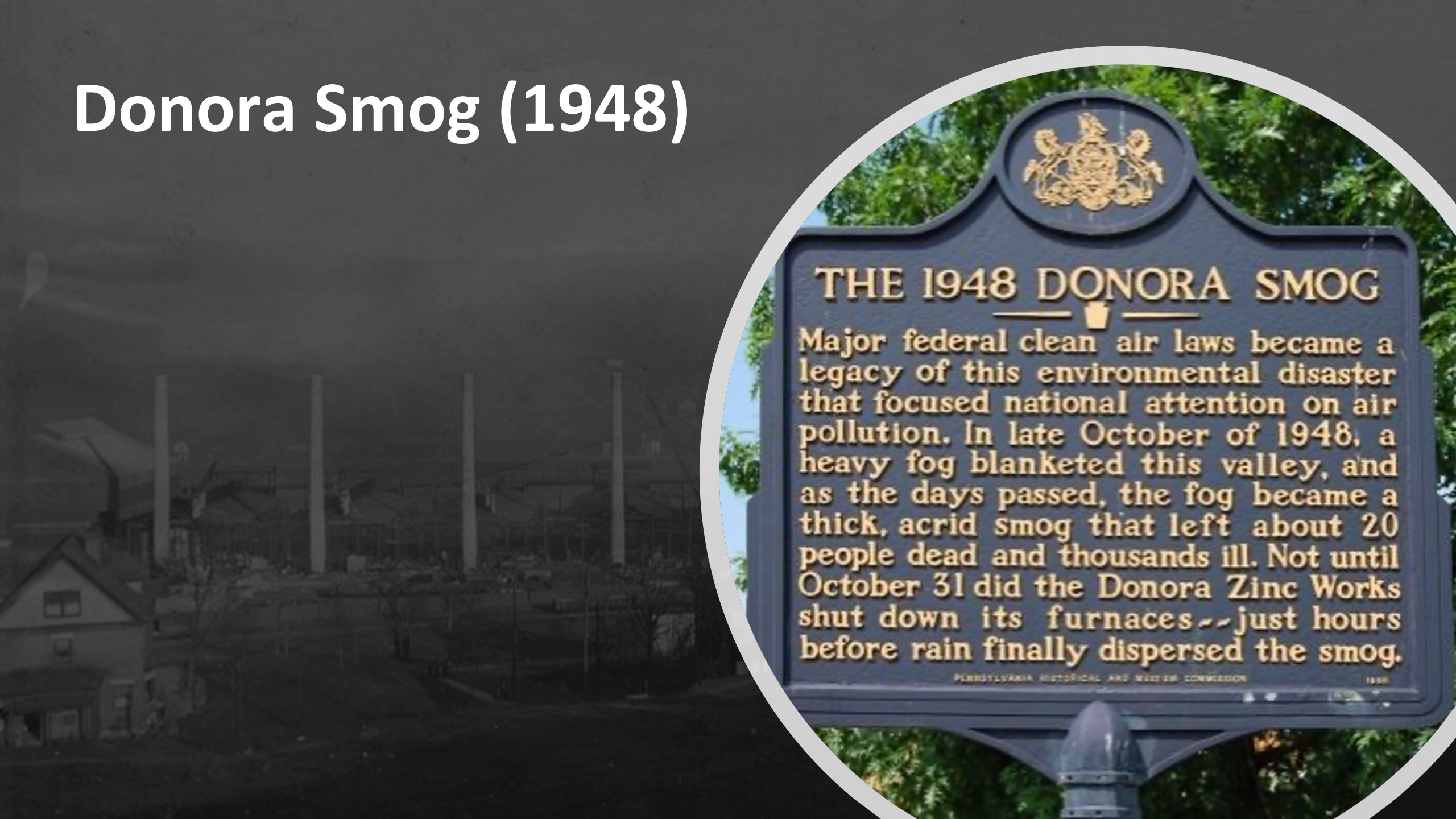
*'Toute entreprise humaine fût-elle industrielle,  
est susceptible de perfectionnement!*







# Donora Smog (1948)



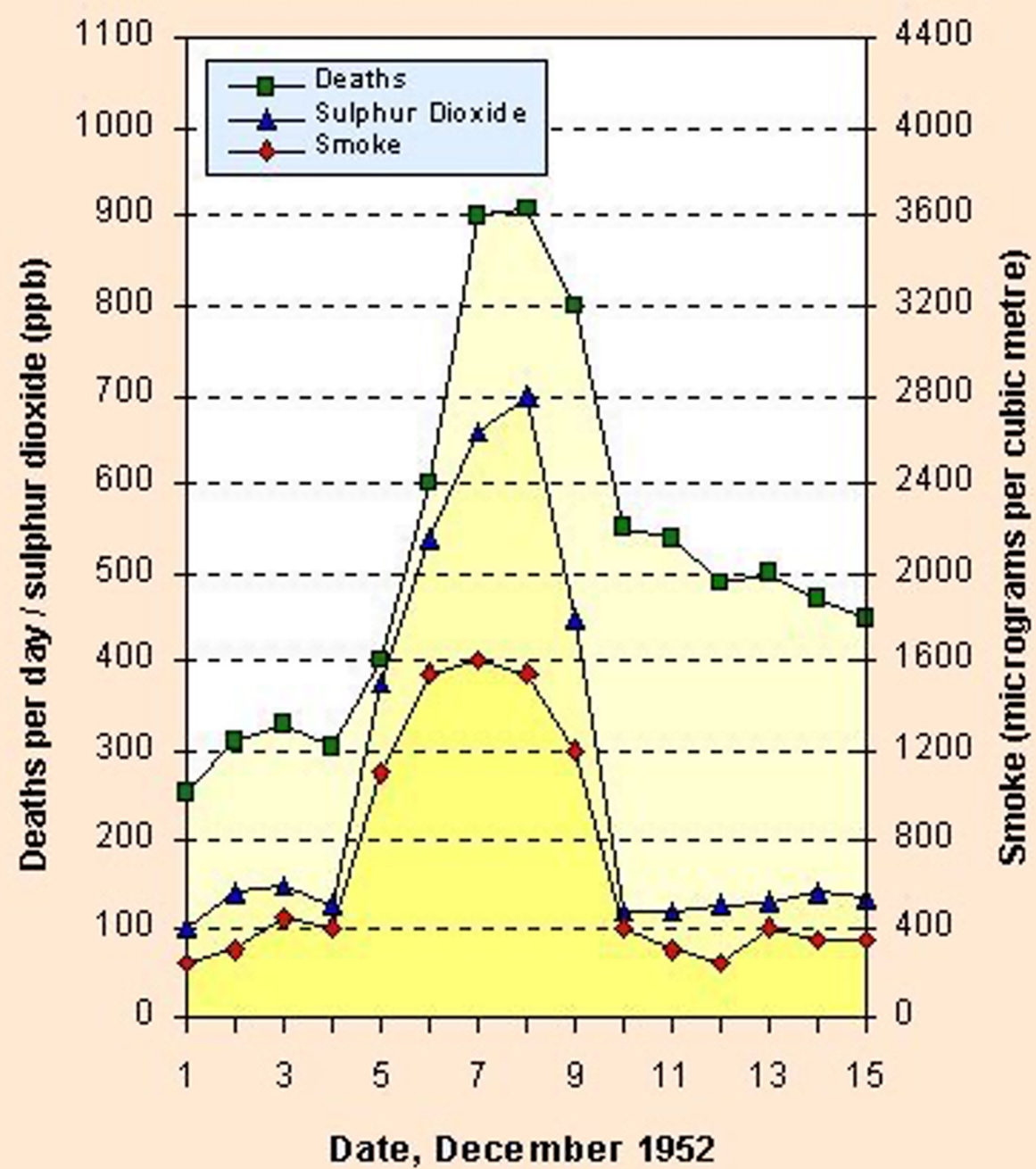
## THE 1948 DONORA SMOG

Major federal clean air laws became a legacy of this environmental disaster that focused national attention on air pollution. In late October of 1948, a heavy fog blanketed this valley, and as the days passed, the fog became a thick, acrid smog that left about 20 people dead and thousands ill. Not until October 31 did the Donora Zinc Works shut down its furnaces -- just hours before rain finally dispersed the smog.

PENNSYLVANIA HISTORICAL AND NATURE COMMISSION

1988







FOURTH NIGHT OF FOG

# THIRD DAY OF A LONDON PARTICULAR

## Busy Time for Thieves: Traffic Disrupted

FROM OUR LONDON STAFF

FLEET STREET, SUNDAY.

London is still suffering from the worst fog for many years which has brought road traffic almost to a standstill, disrupted and delayed railway

ALL AT STATION

Sir Hubert Parker, a judge of the Queen's Bench Division, was taken

equipment which are brought out by fog every year. Research workers have condemned yellow fog lights as less penetrative than white ones yet the driver is unquestionably in favour of the yellow light, which does not seem to reflect so much into the eyes. The

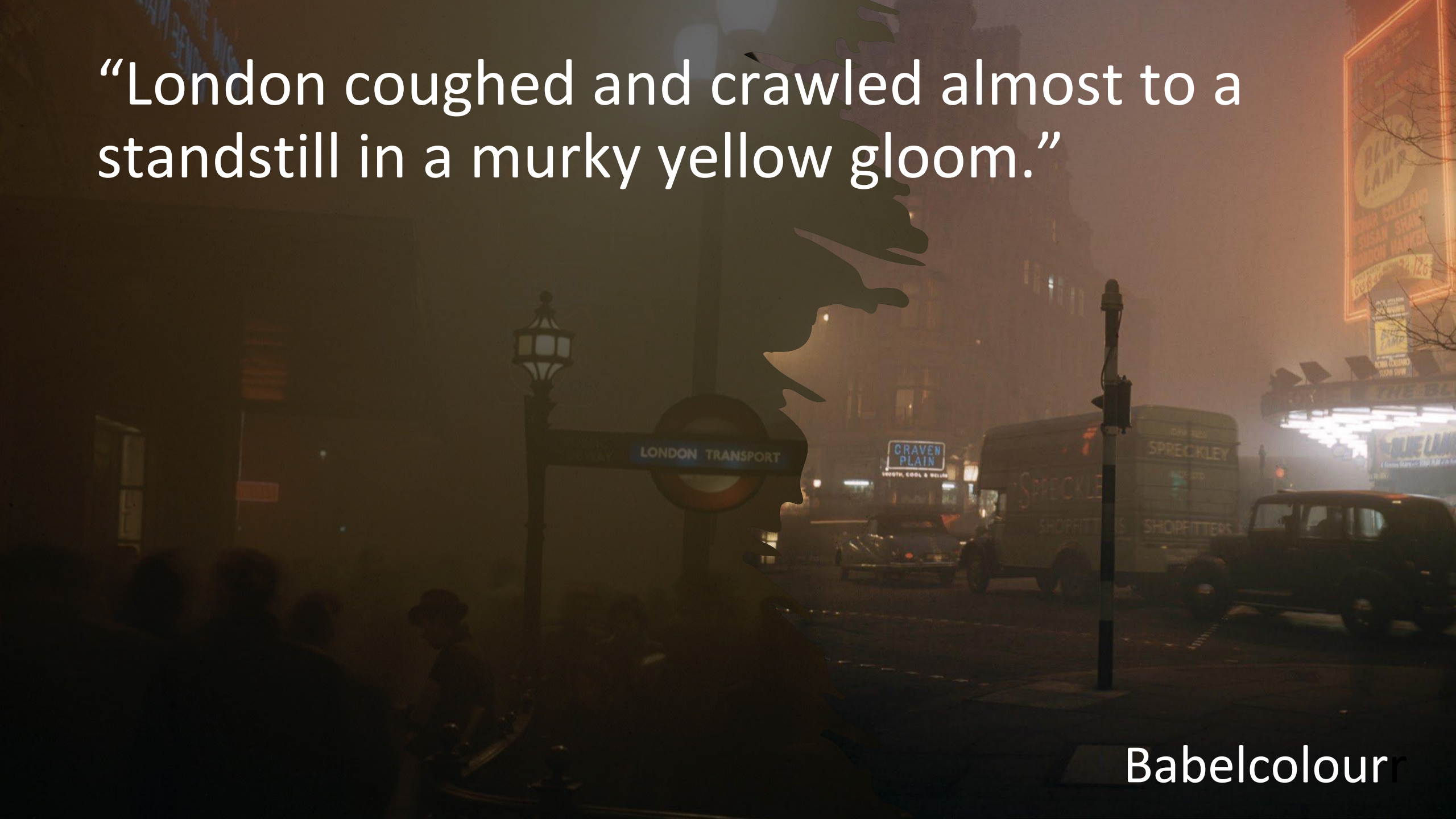
ICE ROADS

Coaches Stop

E



“London coughed and crawled almost to a standstill in a murky yellow gloom.”



Babelcolour



# Who died and of what?

## Changes in death rates

- Bronchitis **10 times** higher
- influenza **7 times** higher
- Tuberculosis **4.5 times**
- Other respiratory diseases **6 times.**
- Disorders of the heart and the circulatory **system 3 times.**

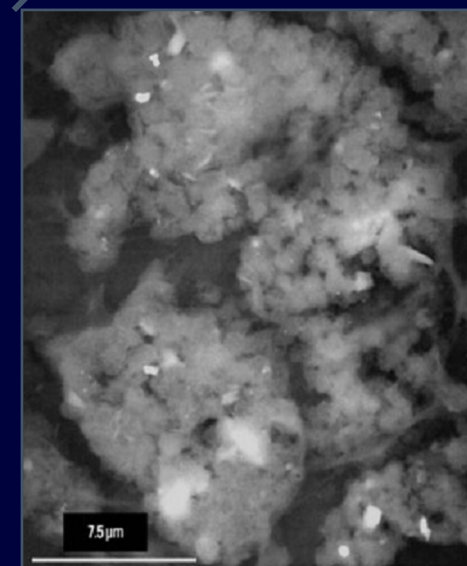
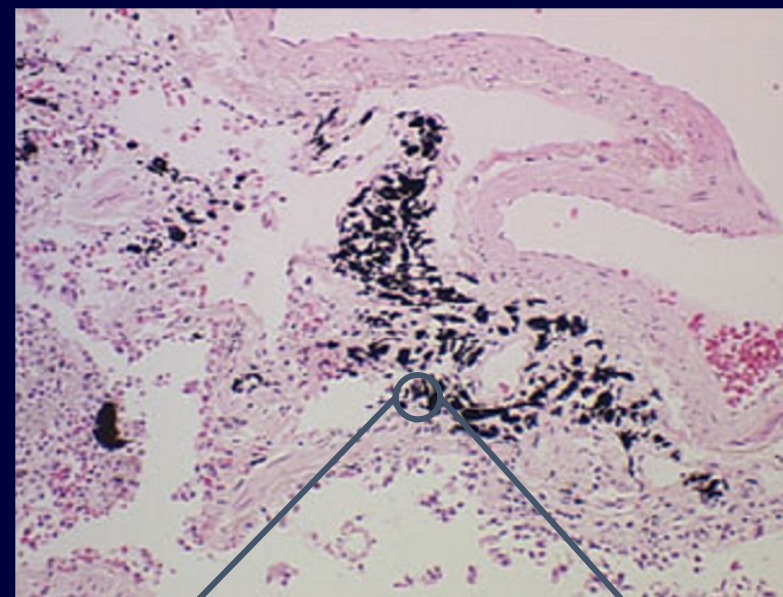
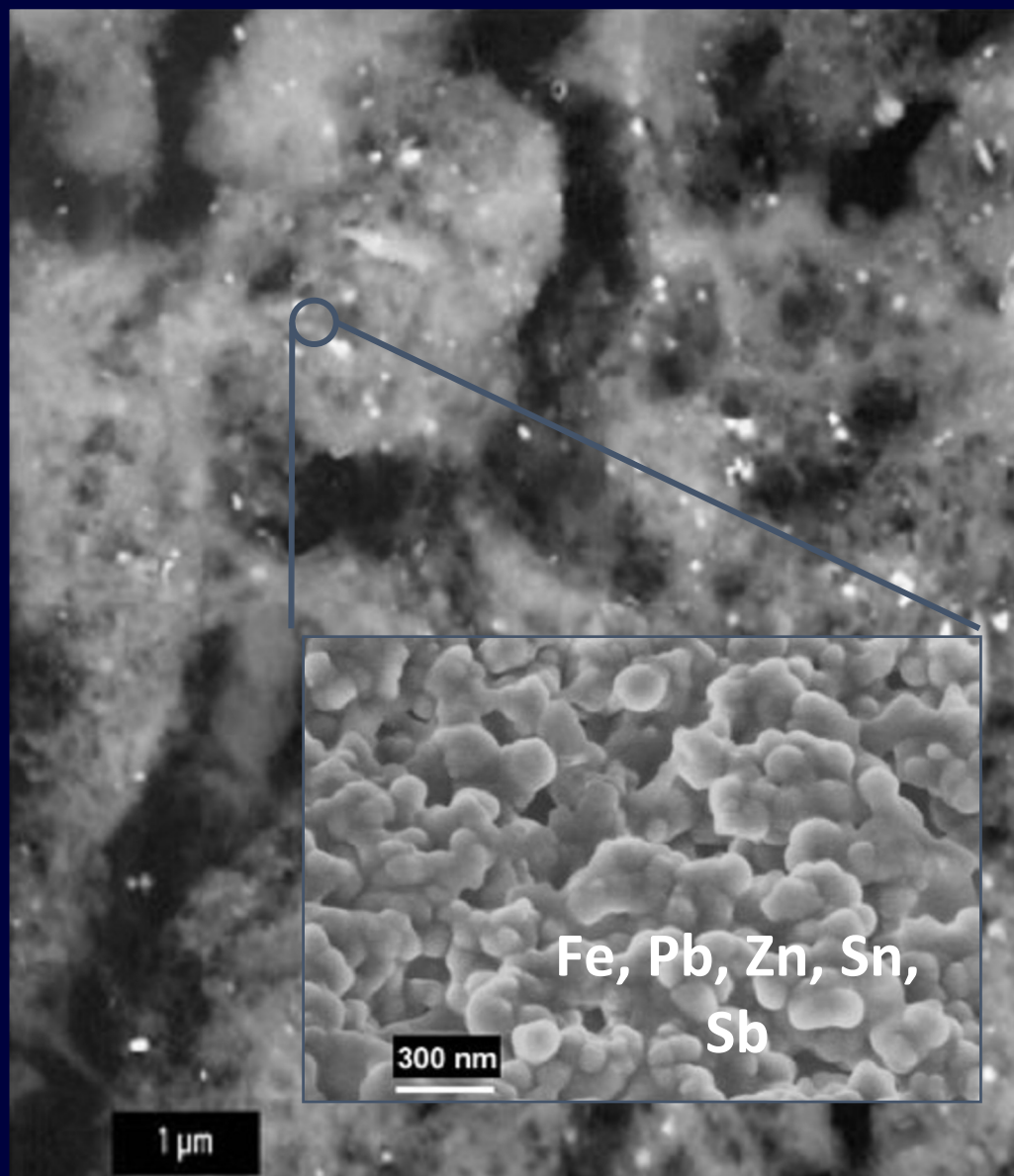
Report to be submitted to the London County Council on Tuesday [3 February 1953]

Deaths Registered in London Administrative County Classified by Age  
(Bates, 1995)

	< 1 Month of Age	1-12 Mo. Old	1-14 Years of Age	15-44 Years of Age	45-64 Years of Age	65-74 Years of Age	75+ Years of Age
Week Before the Episode	16	12	10	61	237	254	335
Week After the Episode	28	26	13	99	652	717	949
Before/ After Episode Ratio	1.75	2.17	1.3	1.62	2.75	2.82	2.83

The greatest relative increase in mortality was from bronchitis, which rose nine-fold





Hunt A et al. EHP, 111:1209-1214,  
2003



# Autumn 1952

*"I suggest we form a committee. We cannot do very much, but we can seem to be very busy and that is half the battle nowadays."*

- *"an enormous number of broad economic considerations that have to be taken into account."*





ANTS WIN  
CASE

POSSIBLE  
N ACT

C., said at Lambeth day, that there might Housing Repairs and and that a firm who at £1,976 on 46 flats three years were not e in the rents, as there ie repairs were to the indirect, of any

County Freehold and Ltd., opposed applica- their Herne Hill estate, iration that the repairs out according to the

f surveyor, Mr. Robert at the estate was made consisting of two blocks side of a street. The ave spent £1,976 on the £1,967 on the Deerdale on the Herne Hill Road

Williams, Q.C., counsel l that for the purposes ought to be considered

In their r Beaver Com that polluti is a social i magnitude tolerated. the convicti ing pure w confident th will secure l conditions l on all coun far less tha the evil to

The objec committee c smoke in all four-fifths b would mean pollution w have not kn Air pollutio human heal

prodigal waste of material resources. The or in case of mechanical breakdown. Secondly, they add, exceptions must be case for preventive action is overwhelming. made in the case of all the smoke in the air for industrial processes in which regard

“ 4 & 5 ELIZ. 2

Clean Air Act, 1956

CH. 52

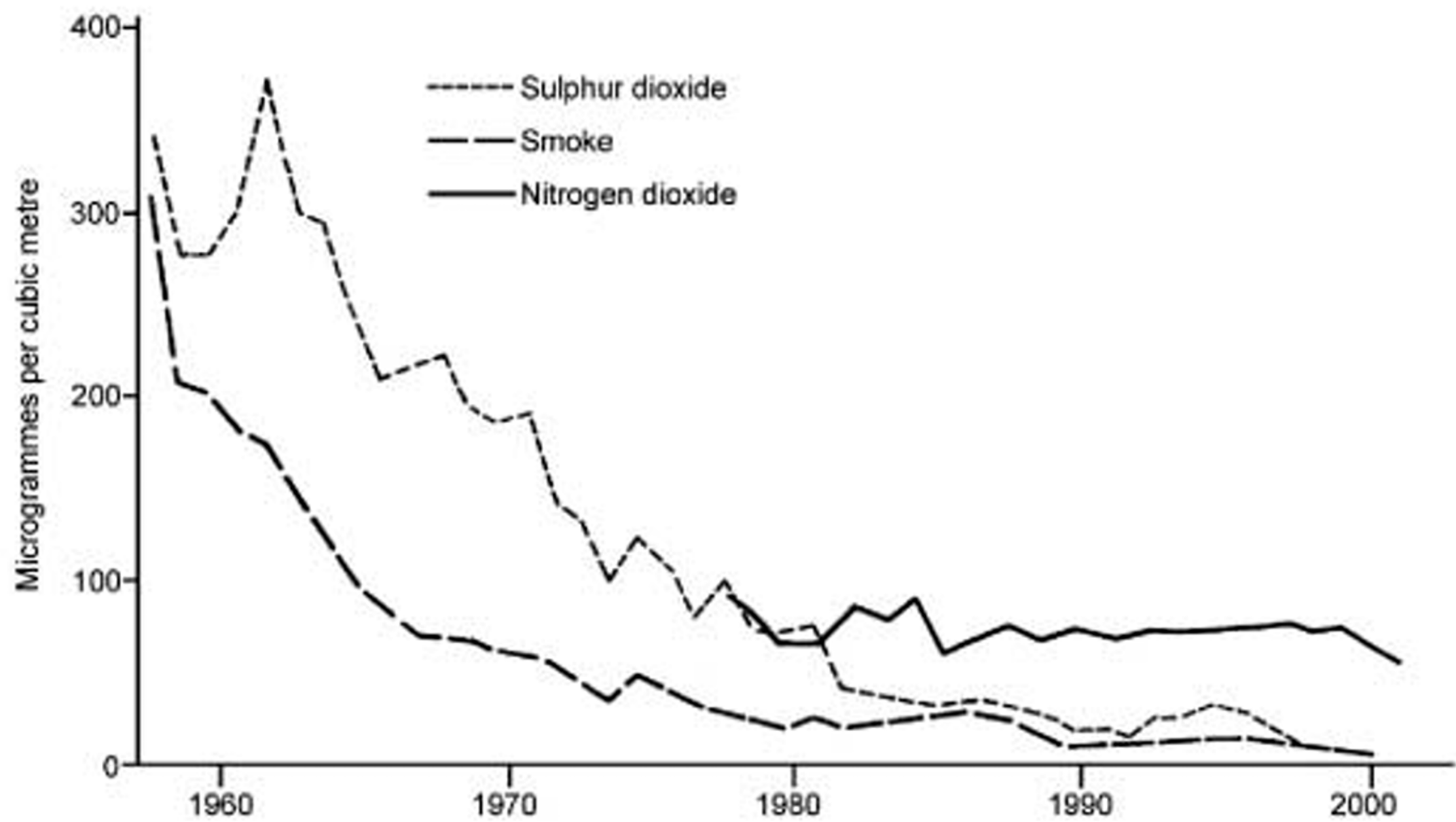


CHAPTER 52

An Act to make provision for abating the pollution of the air. [5th July, 1956]







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Volume 329

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Number 24

## AN ASSOCIATION BETWEEN AIR POLLUTION AND MORTALITY IN SIX U.S. CITIES

DOUGLAS W. DOCKERY, Sc.D., C. ARDEN POPE III, Ph.D., XIPING XU, M.D., Ph.D.,  
JOHN D. SPENGLER, Ph.D., JAMES H. WARE, Ph.D., MARTHA E. FAY, M.P.H.,  
BENJAMIN G. FERRIS, JR., M.D., AND FRANK E. SPEIZER, M.D.

**Abstract Background.** Recent studies have reported associations between particulate air pollution and daily mortality rates. Population-based, cross-sectional studies of metropolitan areas in the United States have also found associations between particulate air pollution and annual mortality rates, but these studies have been criticized, in part because they did not directly control for cigarette smoking and other health risks.

**Methods.** In this prospective cohort study, we estimated the effects of air pollution on mortality, while controlling for individual risk factors. Survival analysis, including Cox proportional-hazards regression modeling, was conducted with data from a 14-to-16-year mortality follow-up of 8111 adults in six U.S. cities.

**Results.** Mortality rates were most strongly associated with cigarette smoking. After adjusting for smoking and

other risk factors, we observed statistically significant and robust associations between air pollution and mortality. The adjusted mortality-rate ratio for the most polluted of the cities as compared with the least polluted was 1.26 (95 percent confidence interval, 1.08 to 1.47). Air pollution was positively associated with death from lung cancer and cardiopulmonary disease but not with death from other causes considered together. Mortality was most strongly associated with air pollution with fine particulates, including sulfates.

**Conclusions.** Although the effects of other, unmeasured risk factors cannot be excluded with certainty, these results suggest that fine-particulate air pollution, or a more complex pollution mixture associated with fine particulate matter, contributes to excess mortality in certain U.S. cities. (N Engl J Med 1993;329:1753-9.)

# Health impact of fine particulate pollution

Steubenville

St. Louis

Harriman

Watertown

Topeka

Portage

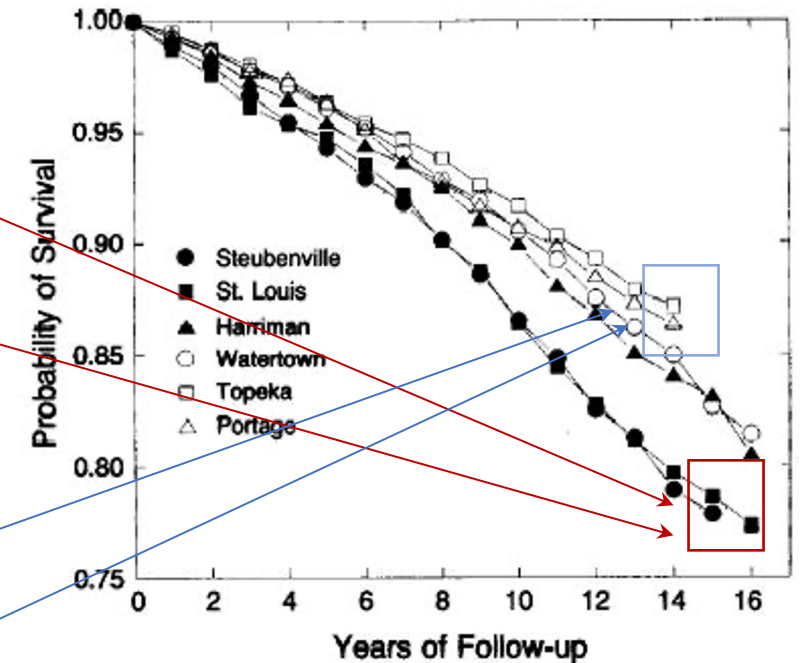
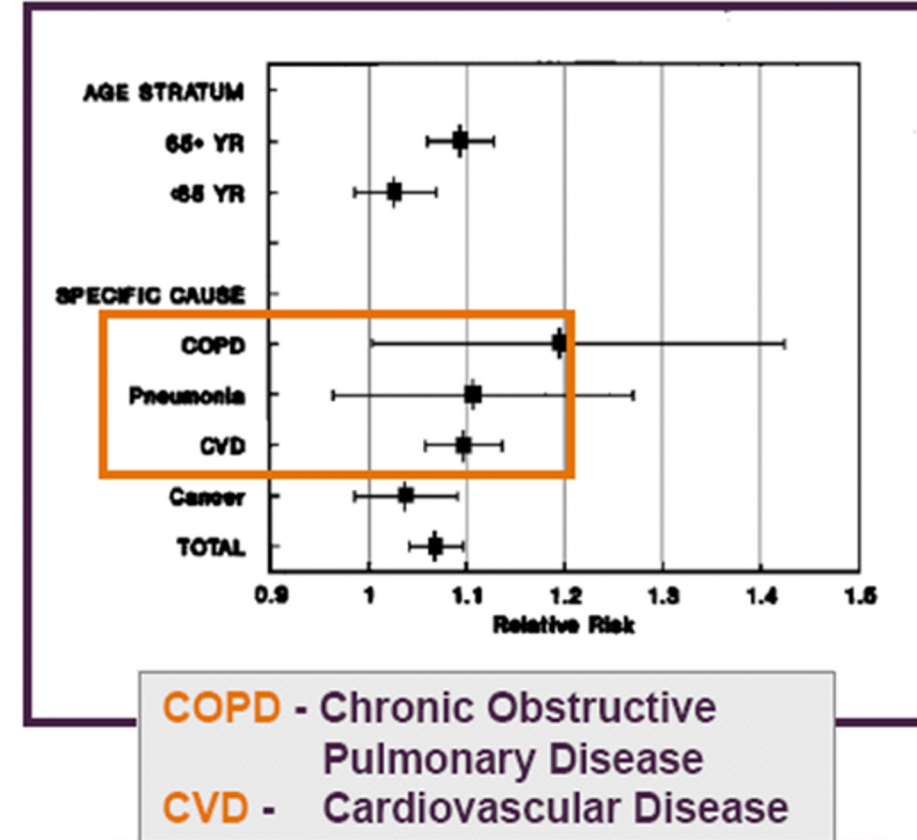
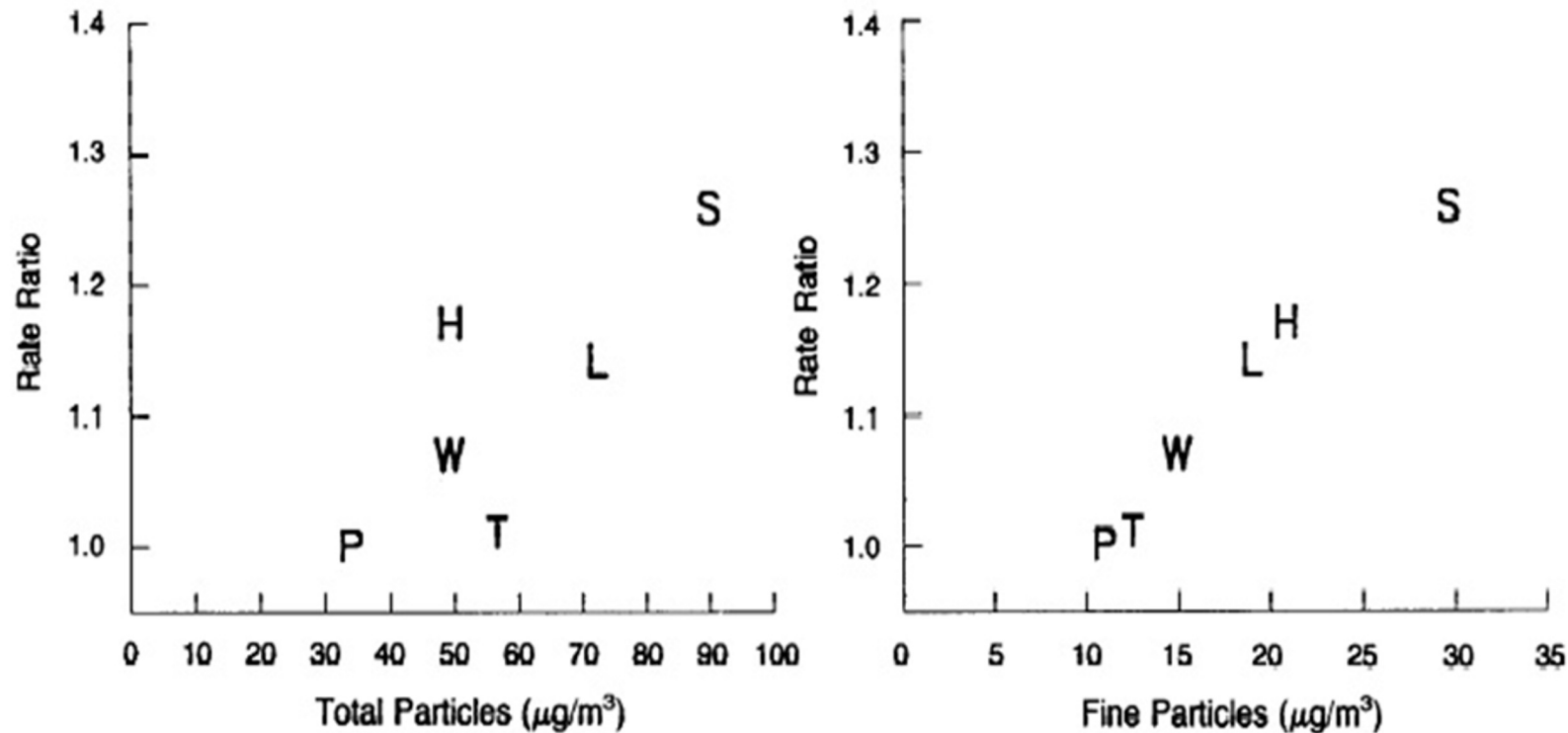


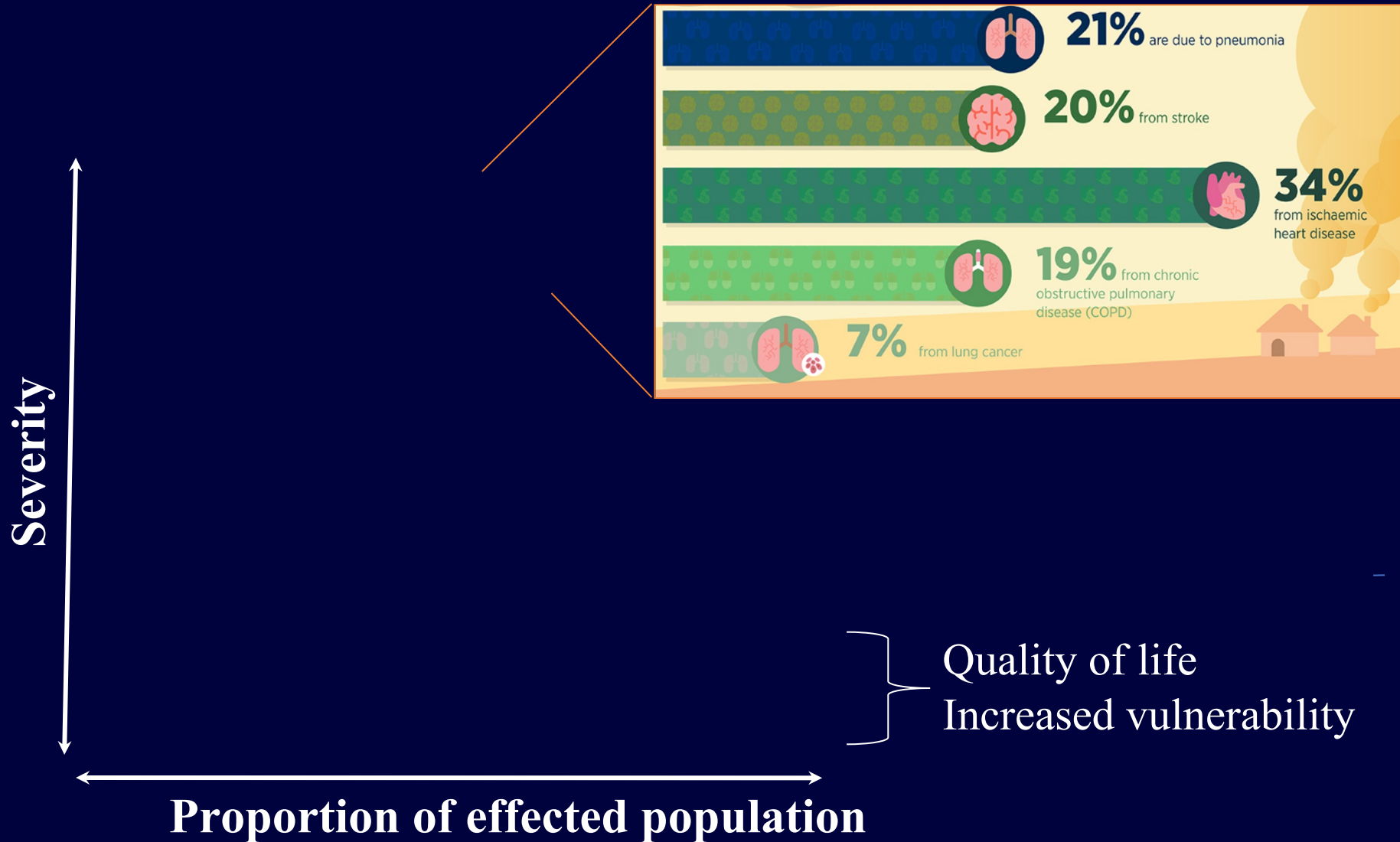
Figure 2. Crude Probability of Survival in the Six Cities, According to Years of Follow-up.



# The Six Cities study



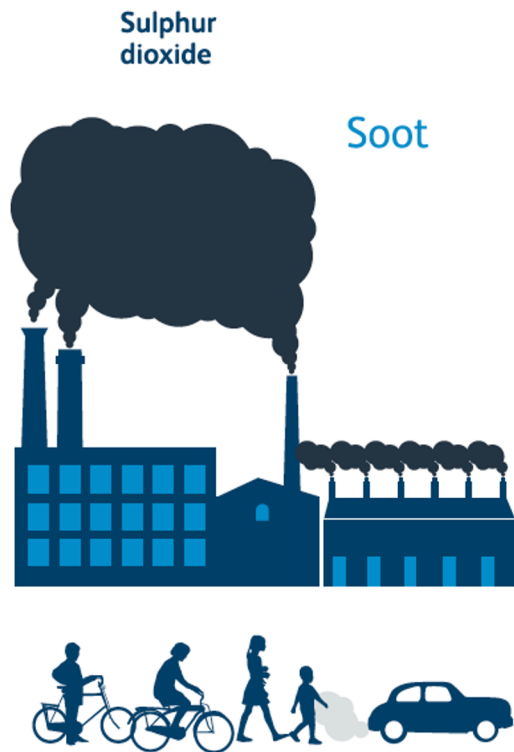
# Illness and quality of life



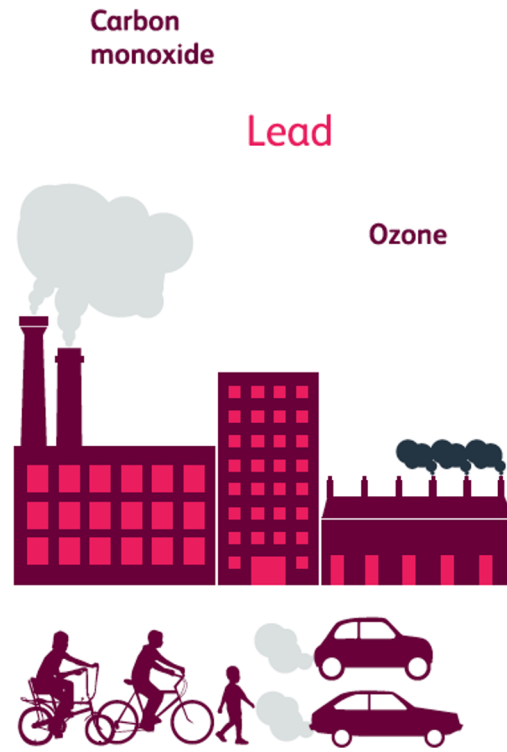


# The changing face of air pollution

1940s–1950s



1960s–1980s



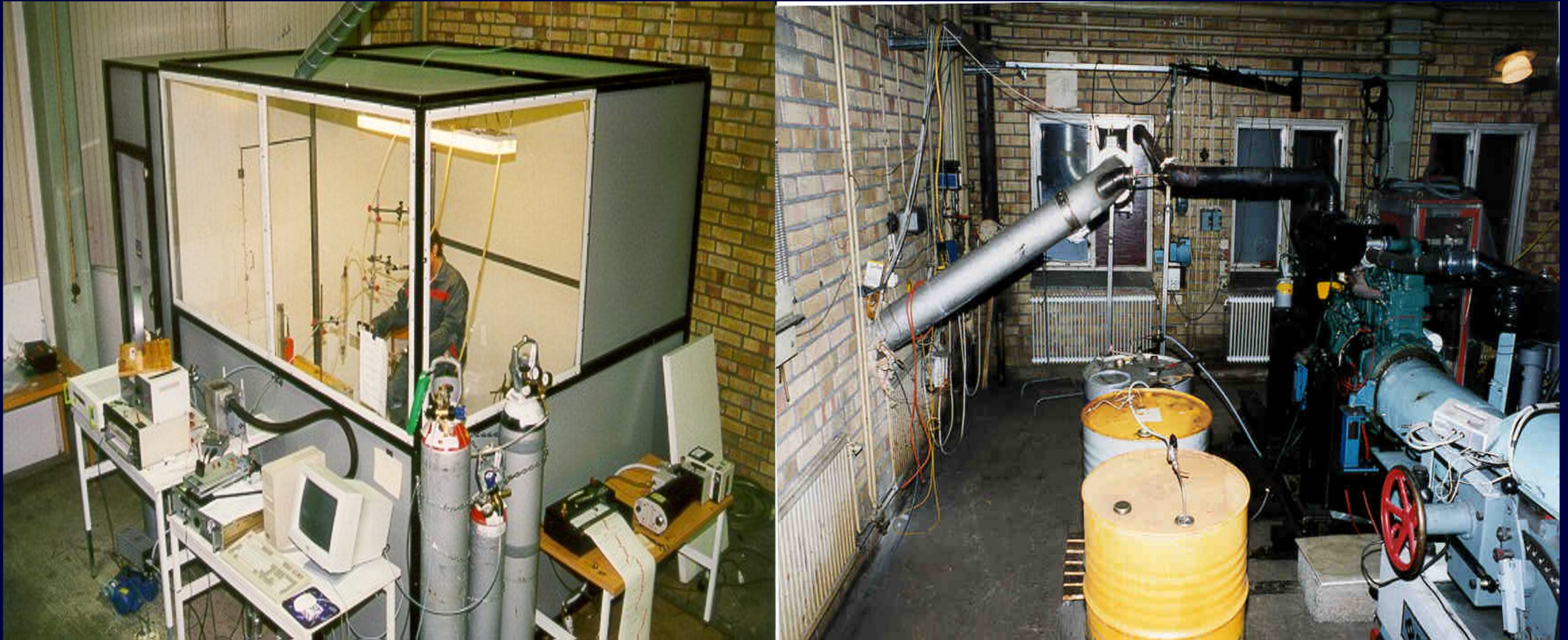
1980s–2000s



Across this period in time:

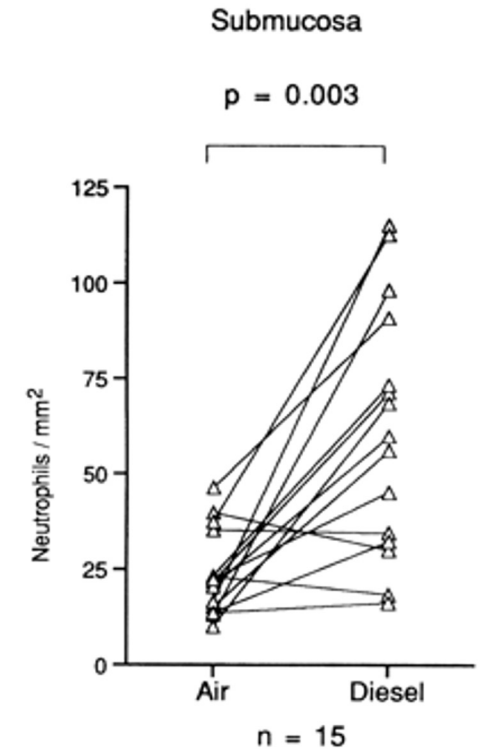
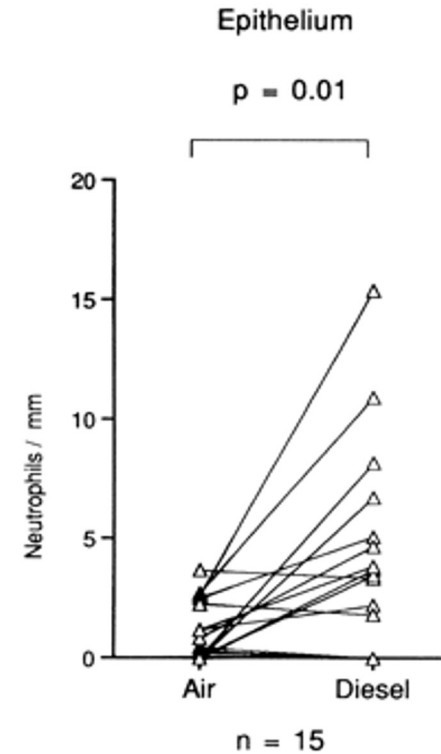
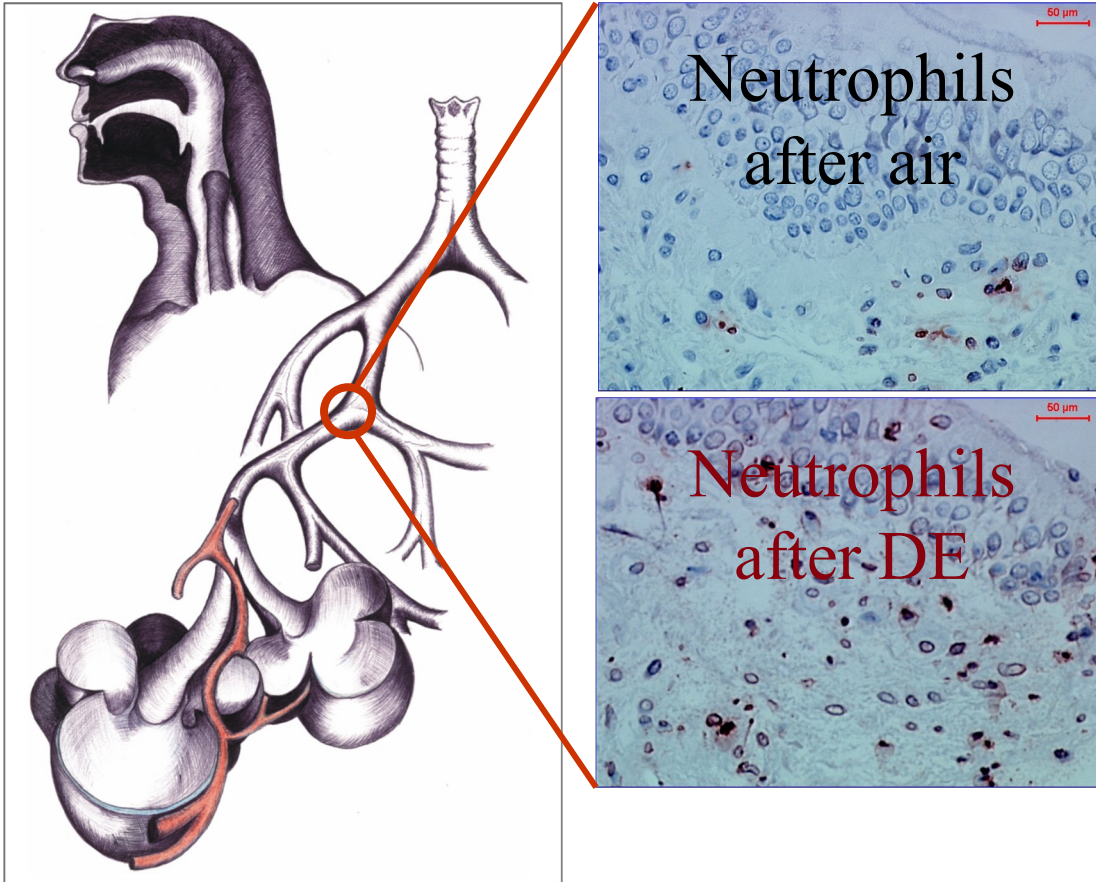


# Controlled Diesel Exposures





# Diesel Exhaust Causes Airway Inflammation



Inflammation  
Impaired lung function  
Impaired microbial defences

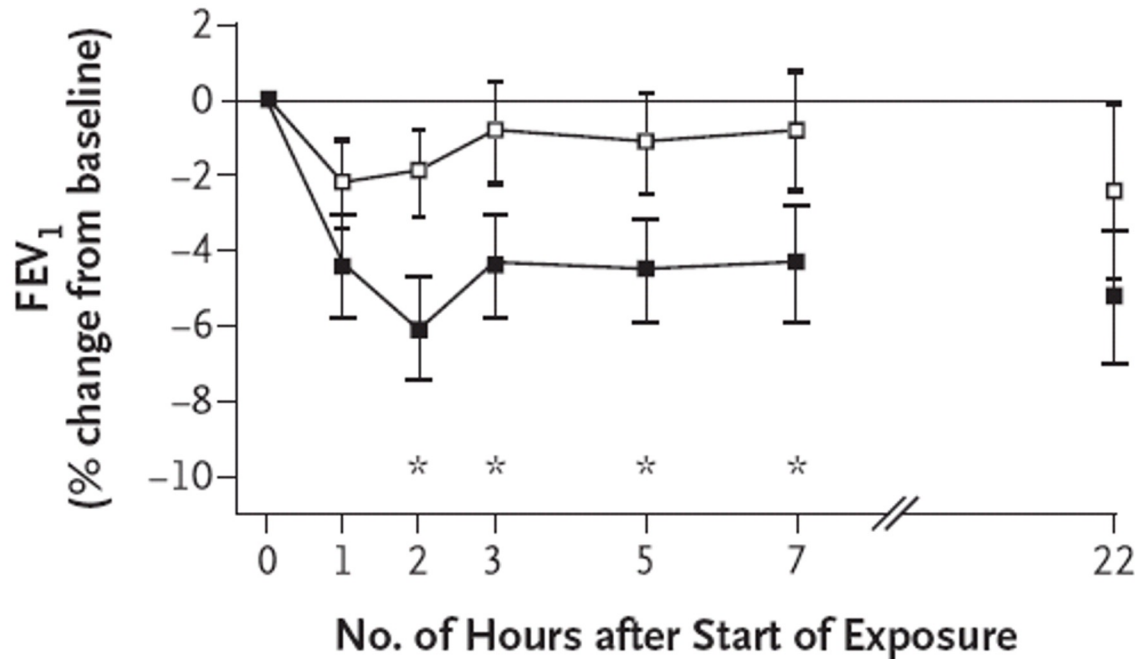


Blood viscosity  
Impaired vascular function  
Ischaemia  
Arrhythmias

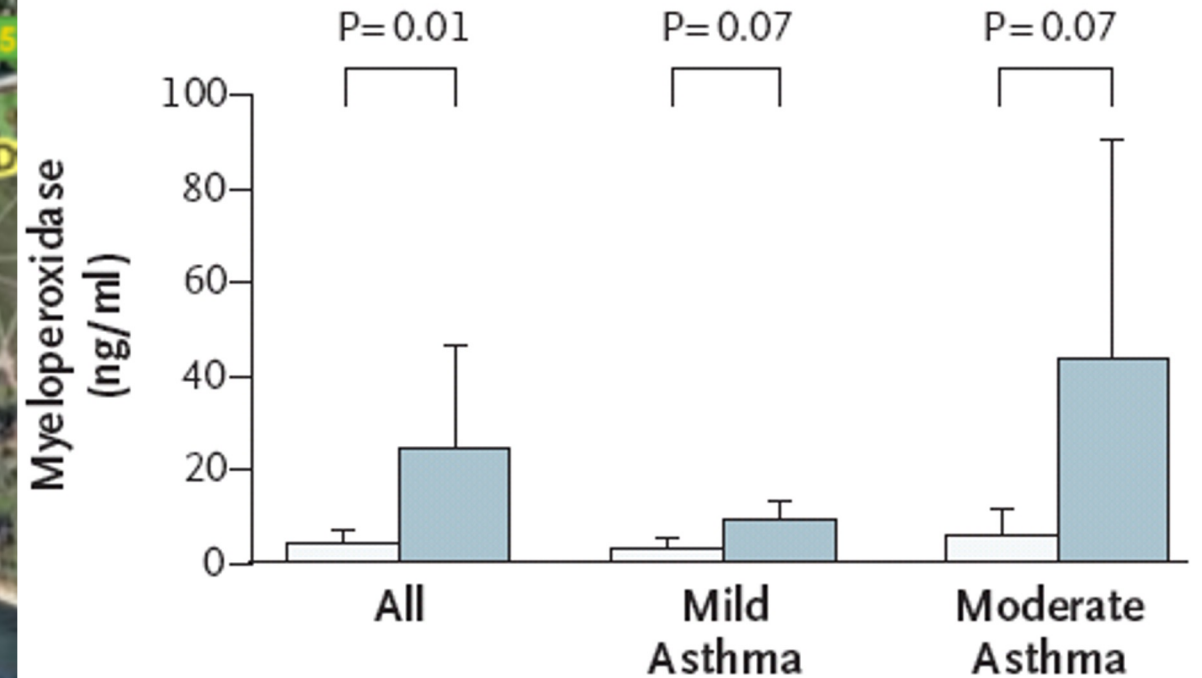
# Responses to PM in the Real World

Does short term exposure to real world atmospheres (diesel traffic and background) cause respiratory effects in asthmatics?

A All Participants



Supernatant Myeloperoxidase



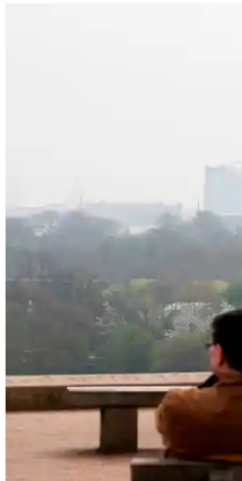






## Air pollution linked to much greater risk of dementia. Small increases in air pollution linked to rise in depression, finds study

Risk in over-50s increased, study shows

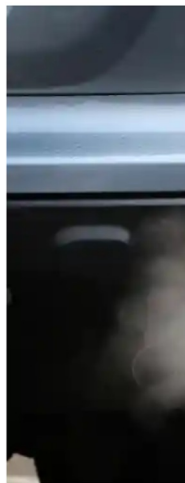


▲ King's College London study confirms that air pollution is linked to a higher risk of dementia. Photograph: Adrian Dennis/AFP/Getty Images

Air pollution may increase risk of depression, study suggests, in fresh evidence from breathing dirty air

## Air pollution spikes may impair older men's thinking, study finds

Exclusive: Cutting mental health problems



▲ The London study found that even small increases in air pollution are linked to a higher risk of common mental disorders.

Small increases in air pollution linked to rises in depression, study finds

Even short, temporary increases in airborne particles can damage brain health, research suggests



▲ There is growing evidence that exposure to fine particulate matter in the air, largely from road vehicles and industry, is harmful to the brain. Photograph: Dominic Lipinski/PA

Temporary rises in air pollution may impair memory and thinking in older men, according to research that indicates even short-term spikes in airborne particles can be harmful to brain health.

## Air pollution linked to 'huge' rise in child asthma GP visits

Exclusive: consultations for asthma and other respiratory infections go up with increased dirty air, finds study



▲ The study found that inhaler prescriptions also increased significantly as a result of higher air pollution. Photograph: Yui Mok/PA

A "huge" increase in the number of visits to doctors by children with asthma problems occurs after a week of raised air pollution, according to a study. The number of inhaler prescriptions also increases significantly.



# Impacts of Air Pollution across the Life Course

Low birth weight



Smaller lungs

Cognitive ability?



Increased risk of chronic disease

Acute respiratory exacerbations



Acute and chronic  
Premature death  
Dementia



DOOM

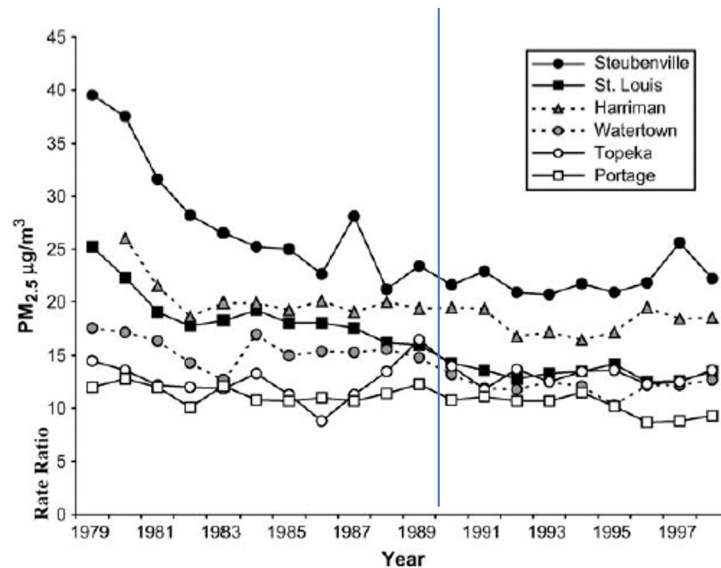


GLOOM



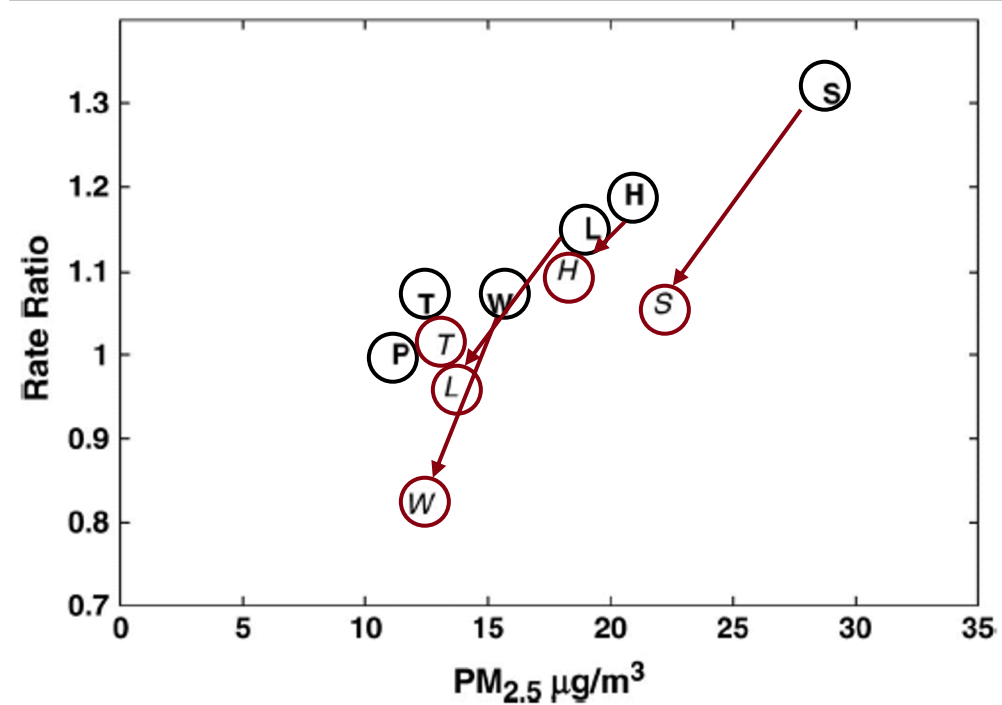


# PM<sub>2.5</sub> Reduction & Mortality: 6 Cities follow-up



Period 1: 1974-89

Period 2: 1990-98



# Improved Lung Growth as Pollution Decreases

*The* **NEW ENGLAND**  
**JOURNAL of MEDICINE**

ESTABLISHED IN 1812      MARCH 5, 2015      VOL. 372 NO. 10

## Association of Improved Air Quality with Lung Development in Children

W. James Gauderman, Ph.D., Robert Urman, M.S., Edward Avol, M.S., Kiros Berhane, Ph.D., Rob McConnell, M.D., Edward Rappaport, M.S., Roger Chang, Ph.D., Fred Lurmann, M.S., and Frank Gilliland, M.D., Ph.D.

**ABSTRACT**

**BACKGROUND**  
Air-pollution levels have been trending downward progressively over the past several decades in southern California, as a result of the implementation of air quality-control policies. We assessed whether long-term reductions in pollution were associated with improvements in respiratory health among children.

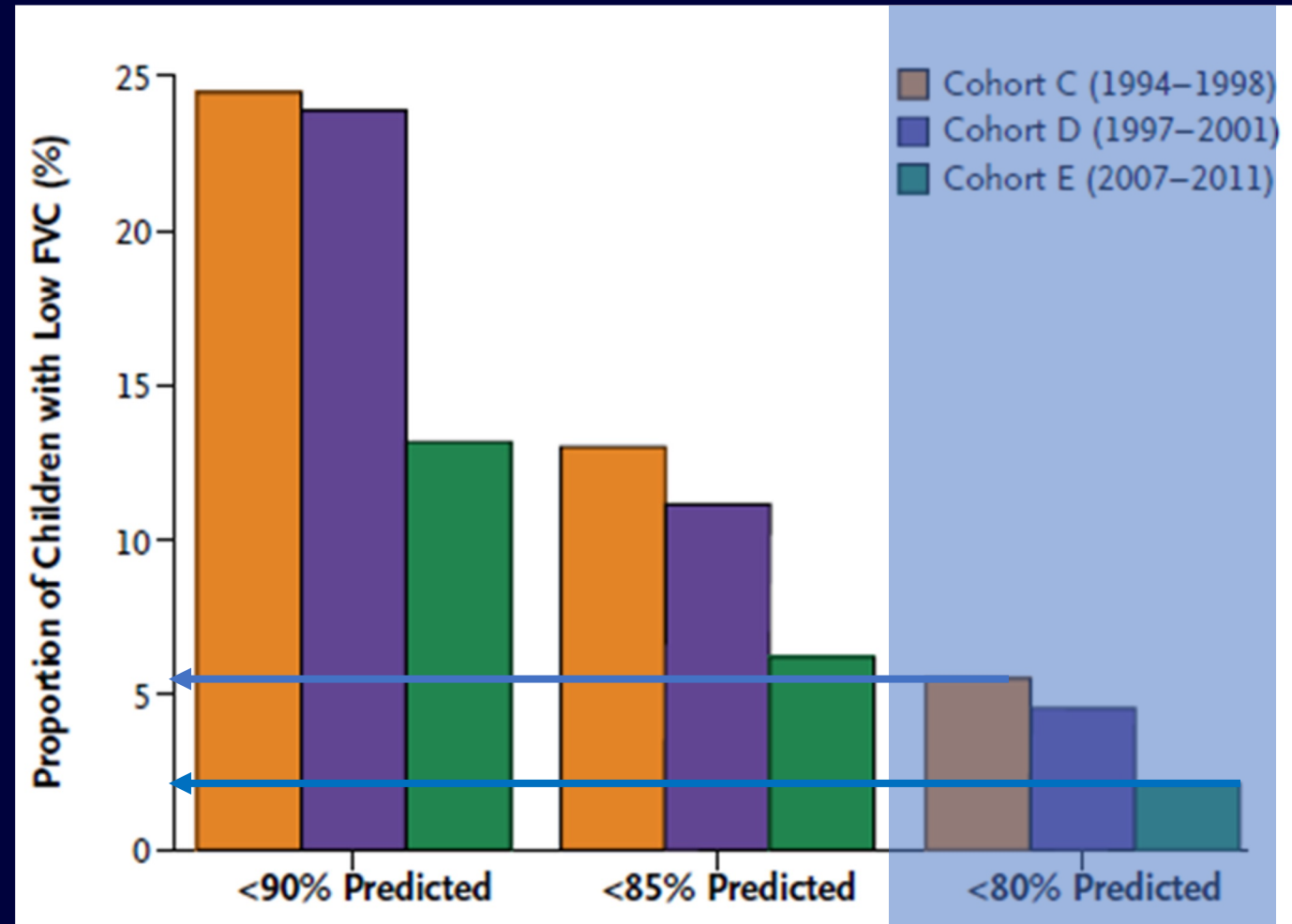
**METHODS**  
As part of the Children's Health Study, we measured lung function annually in 2120 children from three separate cohorts corresponding to three separate calendar periods: 1994–1998, 1997–2001, and 2007–2011. Mean ages of the children within each cohort were 11 years at the beginning of the period and 15 years at the end. Linear-regression models were used to examine the relationship between declining pollution levels over time and lung-function development from 11 to 15 years of age, measured as the increases in forced expiratory volume in 1 second (FEV<sub>1</sub>) and forced vital capacity (FVC) during that period (referred to as 4-year growth in FEV<sub>1</sub> and FVC).

**RESULTS**  
Over the 13 years spanned by the three cohorts, improvements in 4-year growth of both FEV<sub>1</sub> and FVC were associated with declining levels of nitrogen dioxide (P<0.001 for FEV<sub>1</sub> and FVC) and of particulate matter with an aerodynamic diameter of less than 2.5  $\mu$ m (P= 0.008 for FEV<sub>1</sub> and P<0.001 for FVC) and less than 10  $\mu$ m (P<0.001 for FEV<sub>1</sub> and FVC). These associations persisted after adjustment for several potential confounders. Significant improvements in lung-function development were observed in both boys and girls and in children with asthma and children without asthma. The proportions of children with clinically low FEV<sub>1</sub> (defined as <80% of the predicted value) at 15 years of age declined significantly, from 7.9% to 6.3% to 3.6% across the three periods, as the air quality improved (P=0.001).

**CONCLUSIONS**  
We found that long-term improvements in air quality were associated with statistically and clinically significant positive effects on lung-function growth in children. (Funded by the Health Effects Institute and others.)

From the Department of Preventive Medicine, University of Southern California, Los Angeles (W.J.G., R.U., E.A., K.B., R.M., E.R., R.C., F.G.) and Sonoma Technologies, Petaluma (F.L.)—both in California. Address reprint requests to Dr. Gauderman at the Department of Preventive Medicine, University of Southern California, 2001 Soto St., 202-K, Los Angeles, CA 90032, or at jimg@usc.edu.  
N Engl J Med 2015;372:905-13.  
DOI: 10.1056/NEJMoa1414223  
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N ENGL J MED 372:10 NEJM.ORG MARCH 5, 2015 905



Gauderman WJ, et al. NEJM. 2015;372(10):905-913.



Ultra low  
emission



ZONE

At all times

10 pm



**Operating 24/7**

## **ULEZ central London from 8 April 2019**

in the same area as  
the Congestion Charge

## **ULEZ extension to inner London from 25 Oct 2021**

up to North and South  
Circular roads, including  
existing central London zone  
(all vehicles)



## **LEZ London-wide from 26 Oct 2020**

(lorries and other vehicles  
more than 3.5 tonnes)



**Greater London Authority  
Boundary**







# FUMIFUGIUM:

OR

The Inconveniencie of the AER  
AND  
SMOAK of LONDON  
DISSIPATED.

TOGETHER

With some REMEDIES humbly  
PROPOSED

By J. E. Esq;

*J. Evelyn*

To His Sacred MAJESTIE,  
AND  
To the PARLIAMENT now Assembled.

---

*Published by His Majesties Command.*

---

Lucret. l. 5.

*Carbonumque gravis vis, atque odor insinatur  
Quam facile in cerebrum? —*

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