The Superfund Basic Research Program

&

The Worker Education and Training Program

Working Together to Protect Vulnerable Populations from Toxic Chemicals

Philip J. Landrigan, MD, MSc
Mount Sinai School of Medicine
New York City

NIEHS Superfund Annual Meeting
Bethesda, Maryland
April 3, 2008

SBRP and WETC
Common Goals and Interests

- A shared base in science - toxicology, exposure assessment, epidemiology
- A shared interest in education and training
- A shared interest in translating research to policy makers and the public

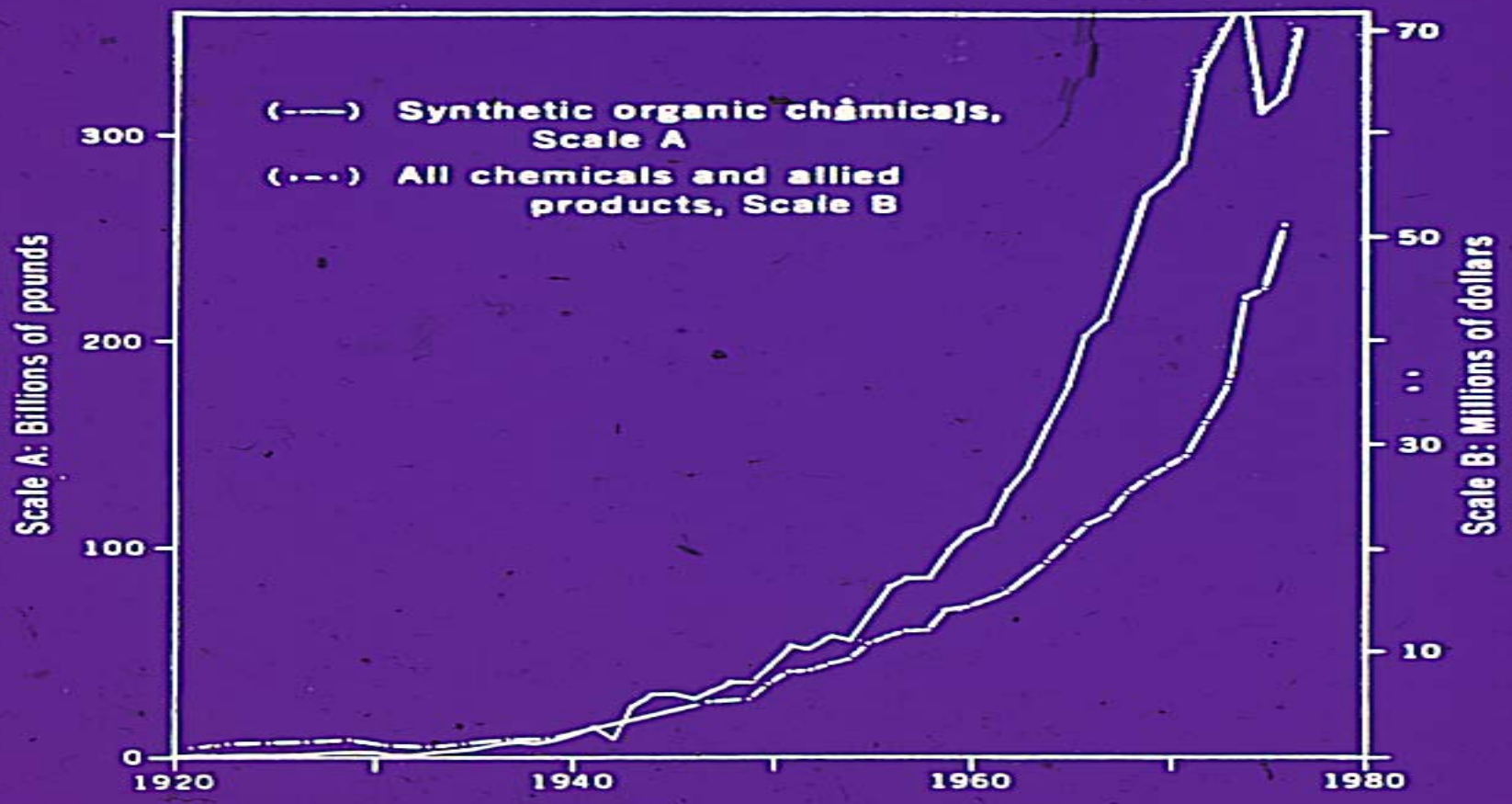
- Most Important – A shared goal of protecting the health of vulnerable populations – hazardous waste workers and children, in particular - from toxic chemicals

Vulnerable Populations and Toxic Chemicals: What We Know

- Waste workers and children are surrounded by a large and ever increasing number of synthetic chemicals.
- Many of the chemicals to which waste workers and children are at risk of exposure have not been tested for their possible toxicity
- Waste workers and children are more heavily exposed and more vulnerable to many environmental chemicals than the general population

Waste Workers and Children Today are Surrounded by an Ever Increasing Number of Chemicals

Synthetic Organic Chemical Production



. Total synthetic organic chemicals production (excluding tar, tar crudes, and primary products from petroleum and natural gas). Total chemicals and allied products, annual value added.

Most of the Chemicals to which Waste Workers and Children are Exposed Have Not Been Tested for Toxicity

- 80,000 + chemicals in commerce
- 2,863 produced or imported in quantities of 1 million pounds or more per year (high production volume [HPV] chemicals)
- No basic toxicity information is available for fewer than half of HPV chemicals
- Information on developmental toxicity is available for fewer than 20% of HPV chemicals

--EPA: Chemical Hazard Data Availability Study, 1998

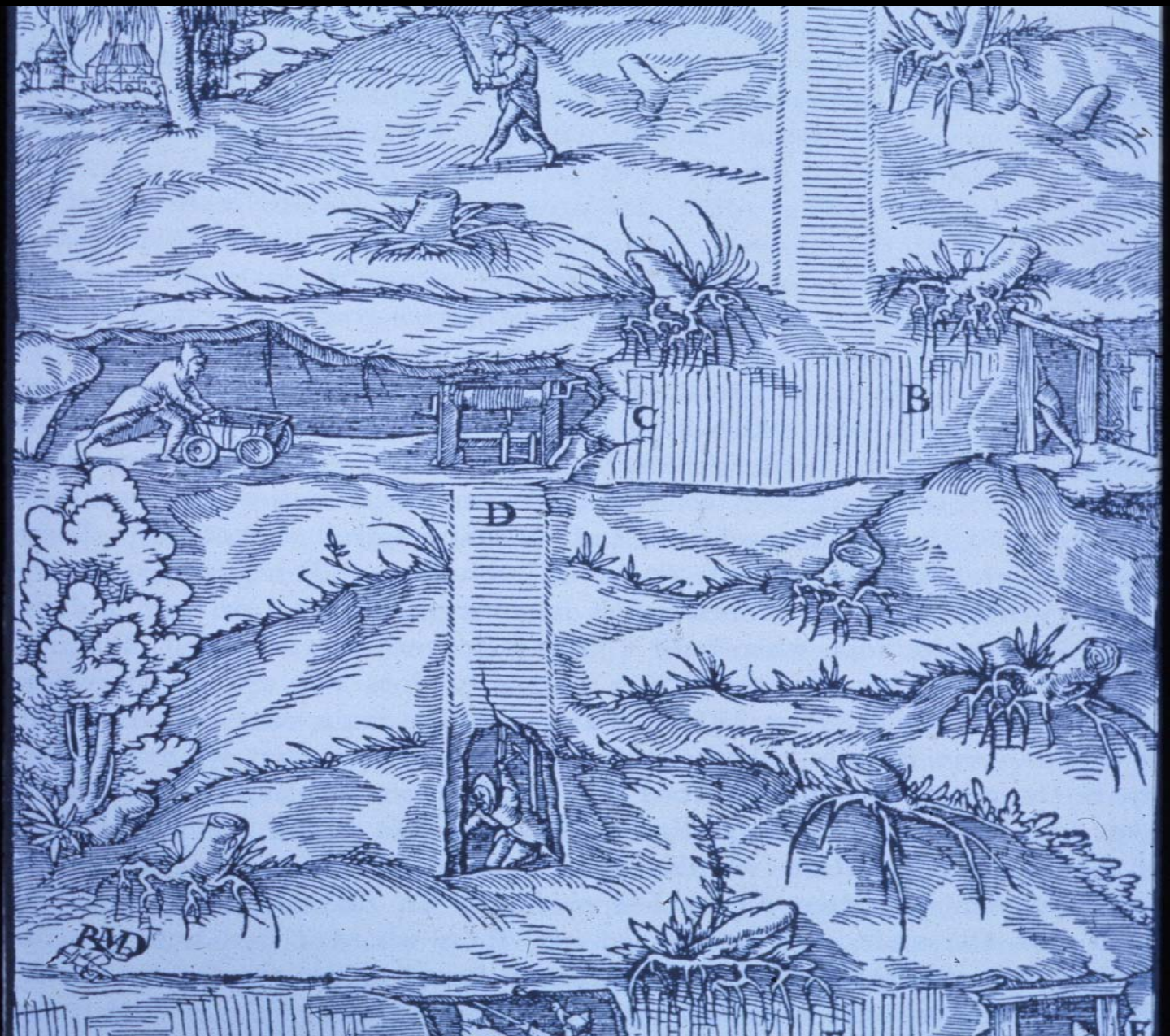
Why are workers uniquely vulnerable to chemical hazards?

- Heavy exposures
- Prolonged exposures
- Exposures under arduous conditions – heat, fatigue, heavy work
- Exposures to new materials before the general population is exposed.

Why are new diseases of chemical origin frequently first recognized in workers?

- Heavy exposures
- Exposures to new materials before the general population is exposed
- Closed populations with good records
- Examples – lead poisoning and the diseases of asbestos

In Antiquity, Lead was recognized to cause Poisoning in Workers, e.g., Miners



And in Smeltermen

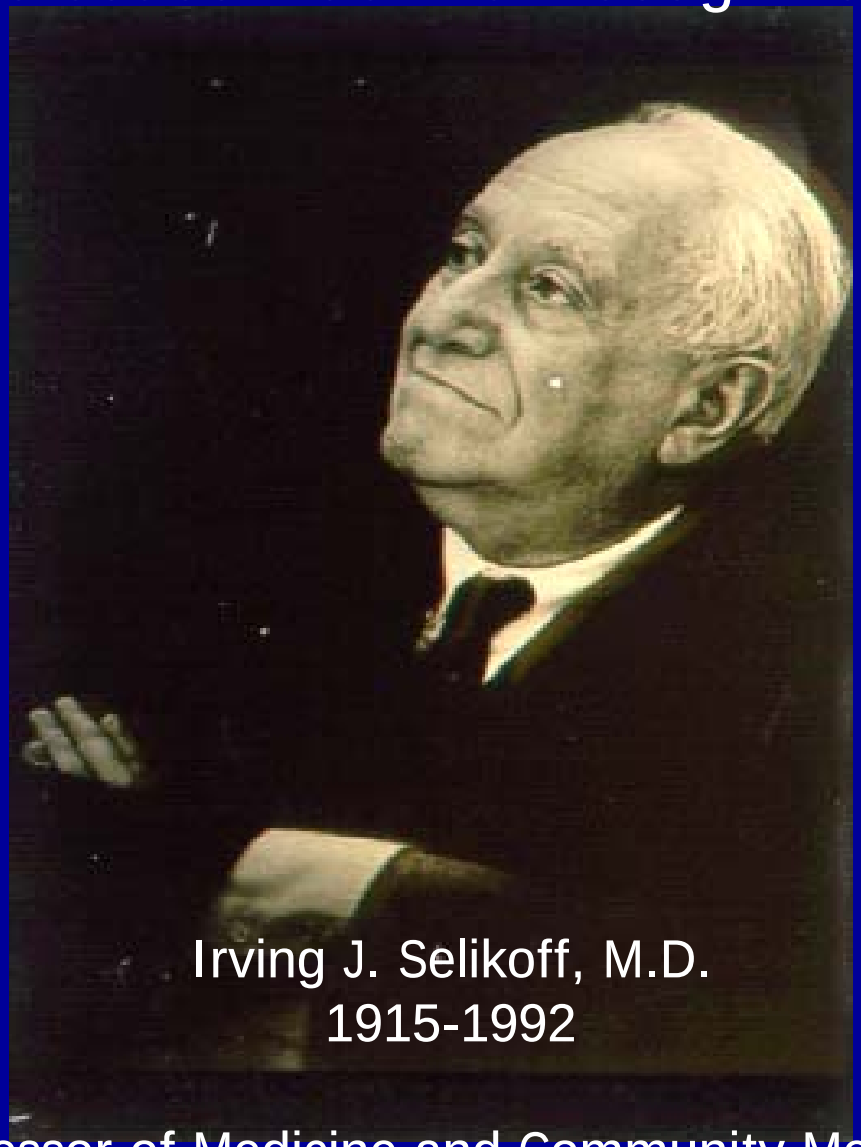
Ramazzini recognized lead poisoning as a disease of workers

"...The potters...when they need roasted or calcined lead for glazing their pots, they melt the lead in marble vessels. During this process, their mouths, nostrils, and the whole body take in the lead poison.

First, their hands become palsied. Then they become paralytic, splenetic and lethargic."

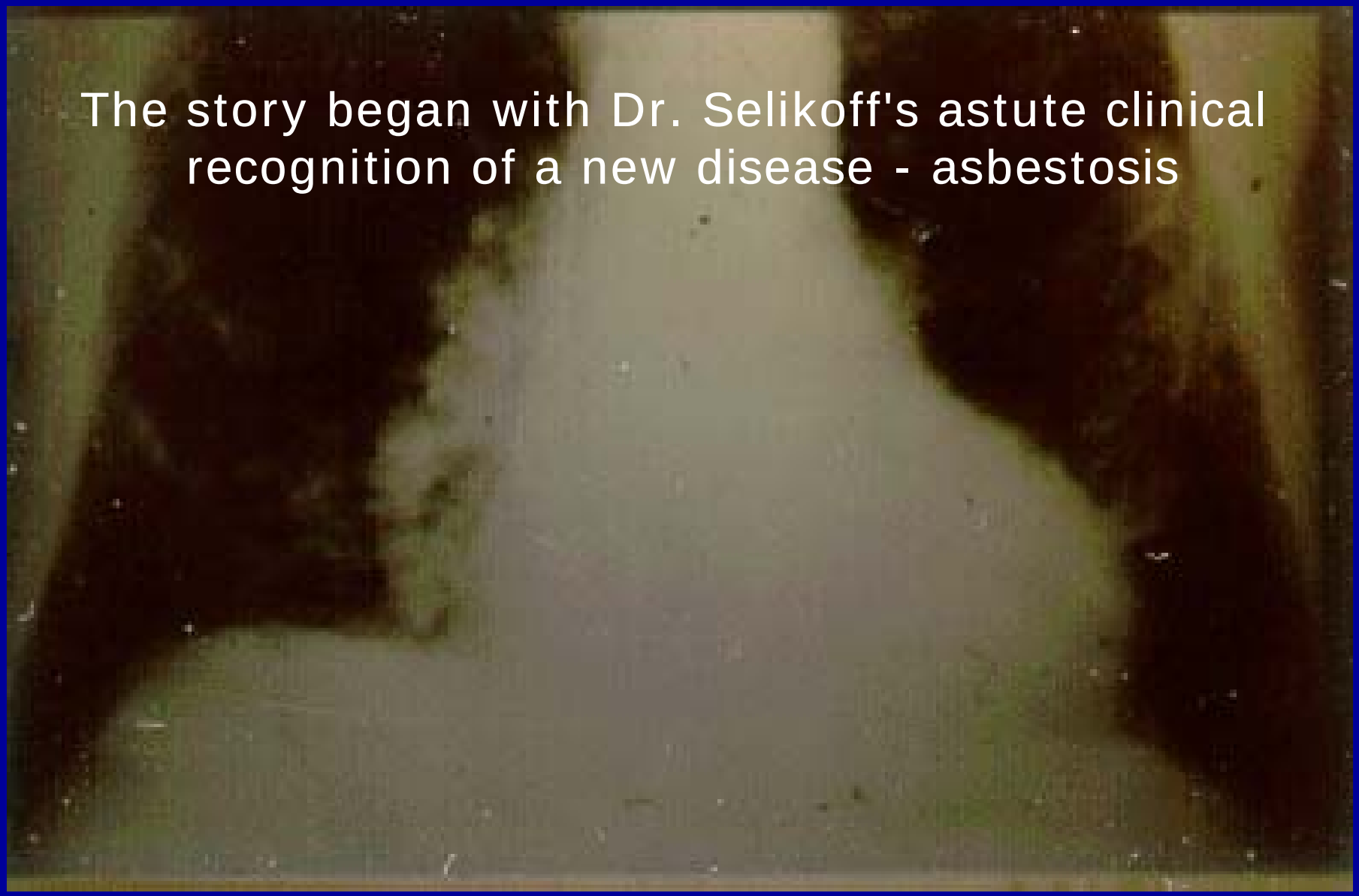
Bernardino Ramazzini, 1713

Asbestos disease was first recognized in workers



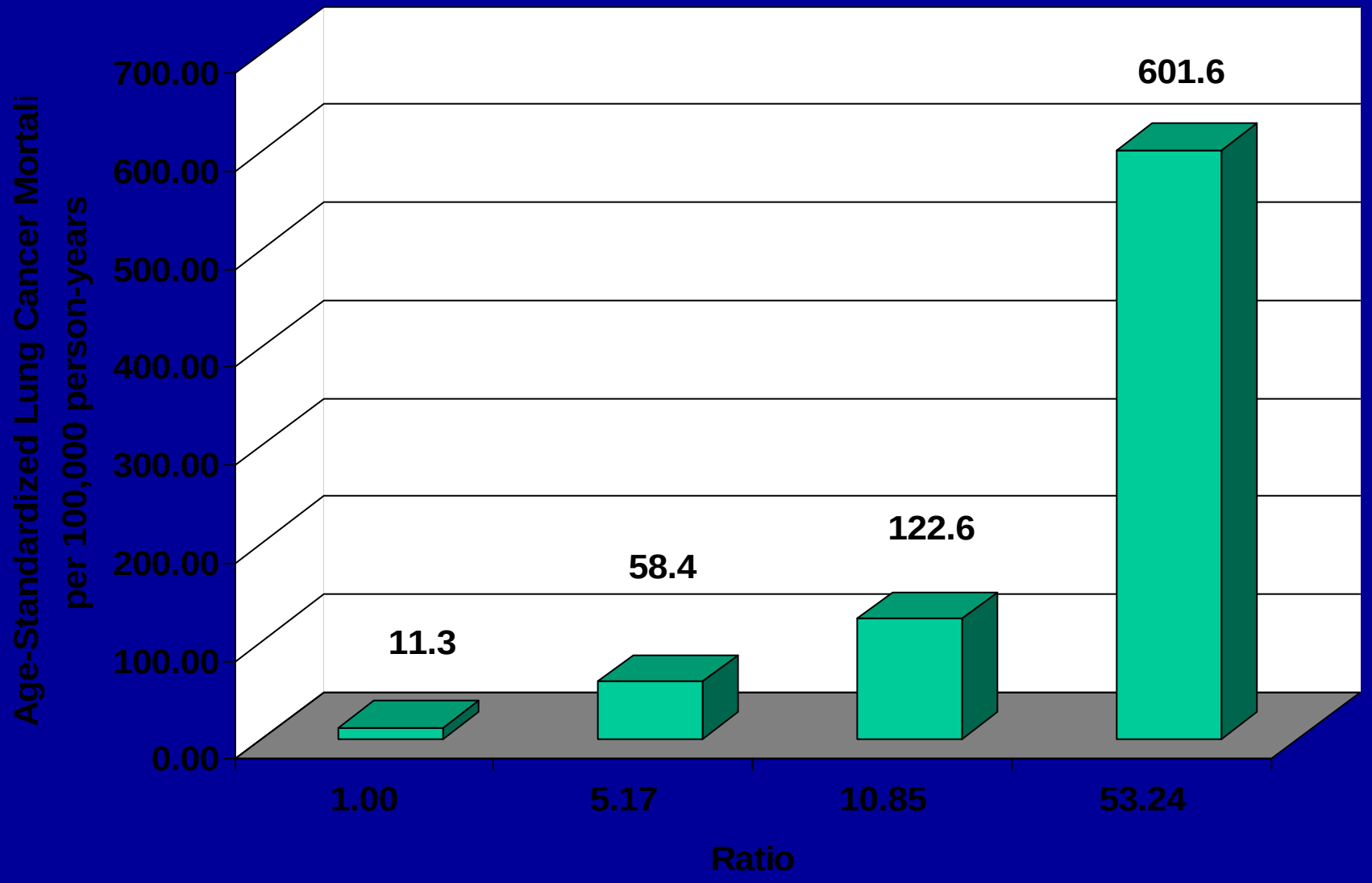
Irving J. Selikoff, M.D.
1915-1992

Professor of Medicine and Community Medicine
Mount Sinai School of Medicine
Father of asbestos research in the United States


The story began with Dr. Selikoff's astute clinical recognition of a new disease - asbestosis

This was followed by recognition of:

Synergy Between Asbestos Exposure and Cigarette Smoking in the Causation of Lung Cancer



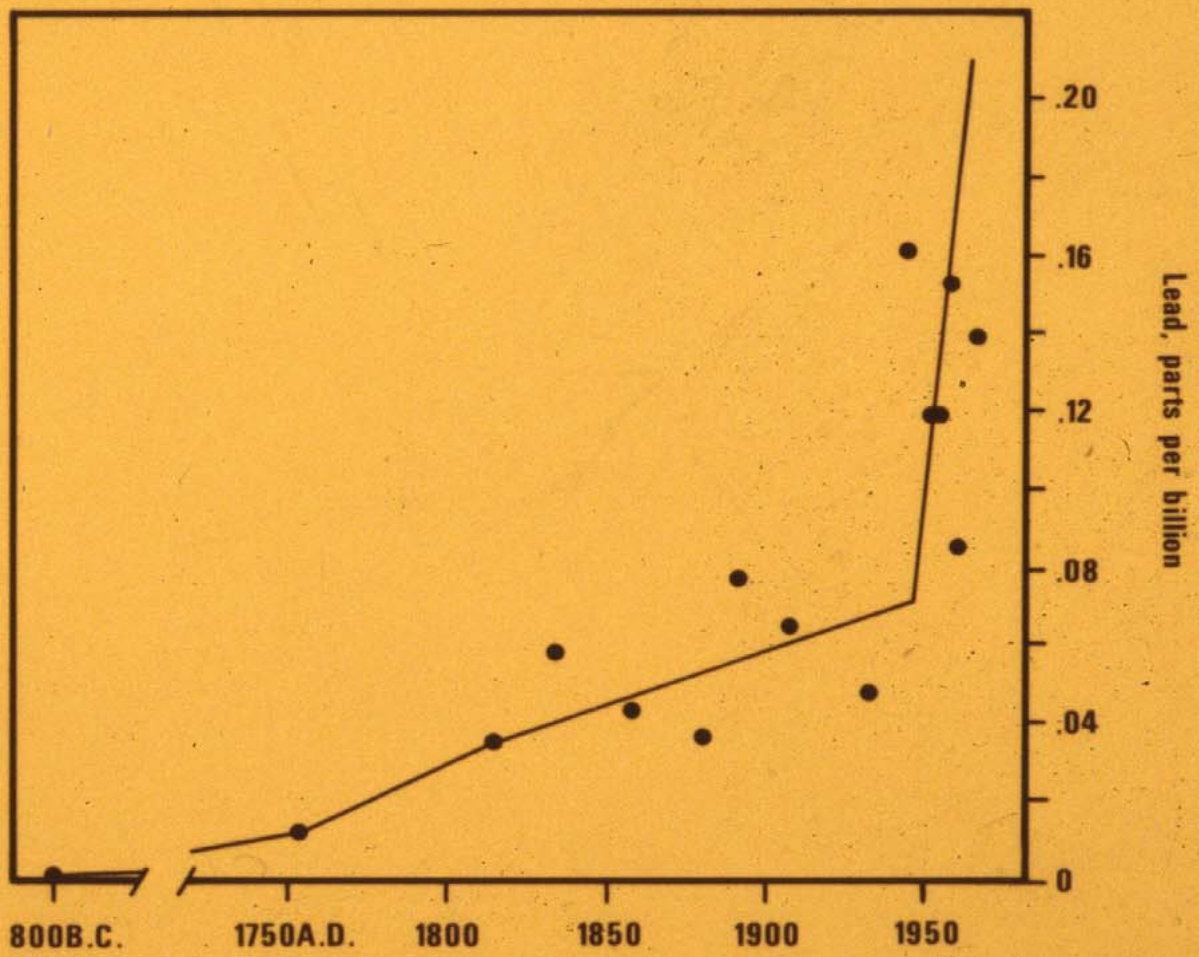
In the 20th century toxic chemicals and the diseases they cause spread beyond the workplace

- Broad environmental dissemination
- Creation of hazardous waste sites
- Exposure of vulnerable populations beyond the traditional workplace

Global Consumption of lead in the Past 100 YearsExceeds that of All Previous Eras

- Mining and Smelting.
- Lead-Based Paint, used since late 1800's. Banned in many nations after 1920's, but not in US.
- Lead in Gasoline, used since 1930's. Peak annual US consumption in 1975 was over 100,000 tons.
- Industrial uses: batteries, radiation shielding.

The Environmental Dissemination of Lead



Murozomi et al

Childhood Lead Poisoning

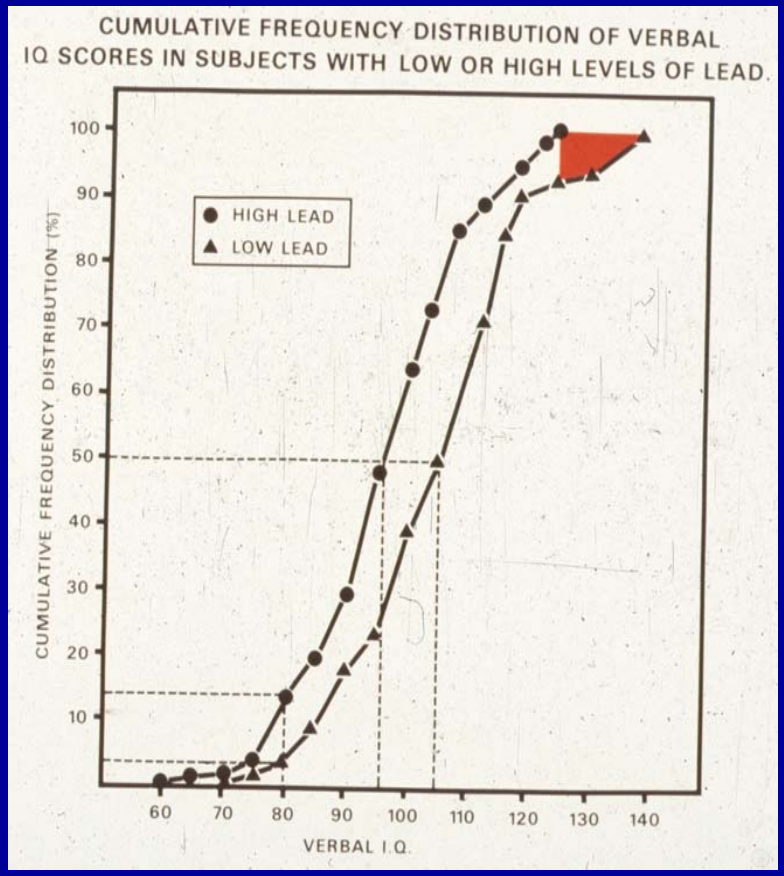
A consequence of environmental dissemination

- First reported cases, Queensland, Australia, Gibson and Turner, 1905.
- Children playing on lead-painted verandahs
- Recognized initially as an acute, often fatal illness

A Child's Exposure to Lead in Paint

The Needleman Study

The concept of subclinical poisoning



Needleman HL et al. *NEJM*, 1979

The Needleman Study Established the Concept of Subclinical Lead Toxicity

… the concept that relatively low dose exposure to lead… may cause harmful effects to health that are not evident with a standard clinical examination.

The underlying premise is that there exists a continuum of toxicity, in which clinically apparent effects of lead have their asymptomatic, subclinical counterparts.

Subclinical Lead Poisoning

Decreased IQ

Altered behavior

Slowed nerve conduction

Subclinical lead toxicity can affect the health, economic well-being and even the security of entire populations

Widespread Subclinical Neurotoxicity Can Affect the Health, Well-being, Intelligence and even the Security of Entire Societies

Lead provides an example

Societal impact of 5-point loss in IQ score

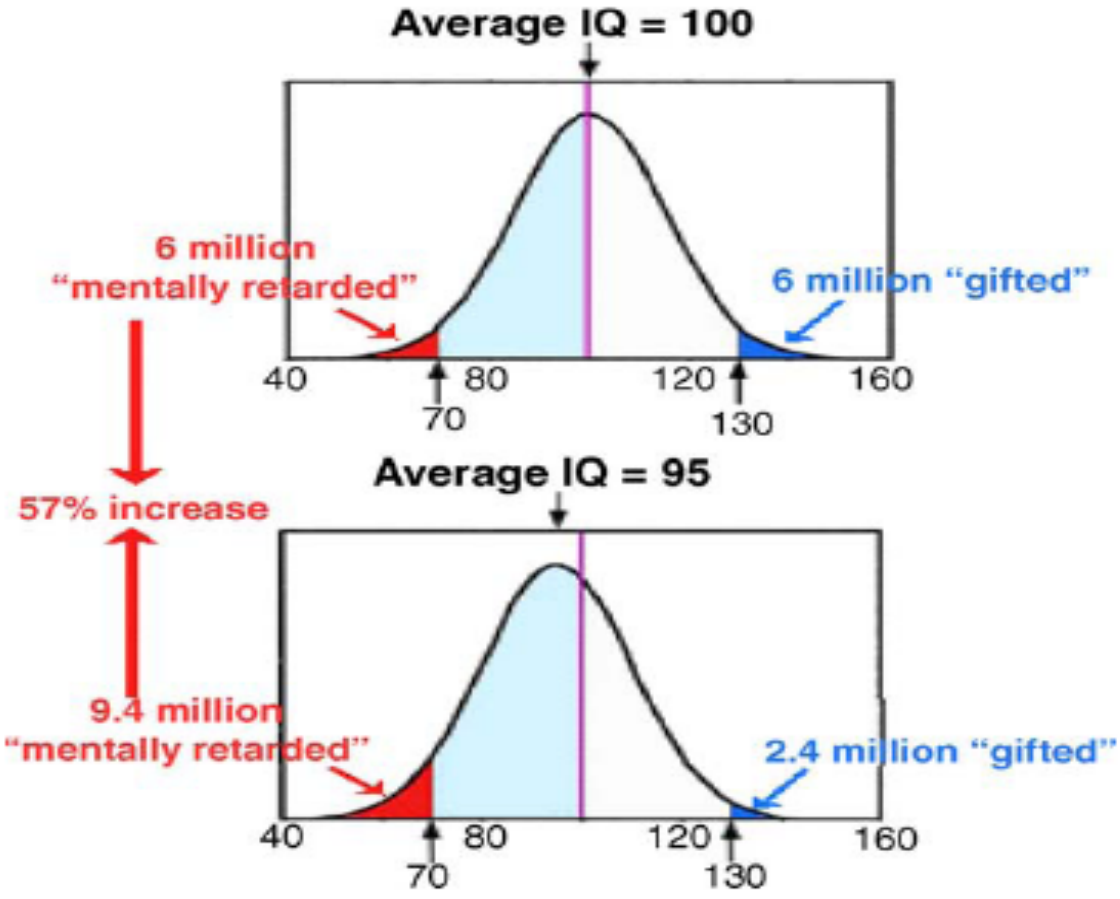


Fig. 3. Losses associated with five-point drop in IQ on a population of 100 million. Based on Weiss (1988) and modified by http://www.ourstolenfuture.-org/NewScience/behavior/iqshift.htm.

Lead and Behavior – Lead Affects more than Intelligence

- At age 7, Needleman et al. found a borderline association between teachers' ratings for aggression, delinquency, social problems and lead levels
- By age 11, increased delinquent and aggressive behavior were clearly evident in children with higher lead levels
- By age 18, young adults with higher lead levels at age 7 were more likely to be dyslexic and to have quit school

Why are Children Uniquely Vulnerable to Toxic Chemicals?

- Greater exposure pound-for-pound
- Diminished ability to detoxify and excrete many chemical toxins
- Heightened biological vulnerability
- More years of future life

"Children are not Little Adults"

--US National Academy of Sciences, 1993

Evidence is strong and accumulating that toxic chemicals contribute to causation of chronic diseases in workers and in children

Diseases caused by toxic chemicals in workers

- Bladder cancer
- Asbestosis, mesothelioma and lung cancer
- Angiosarcoma of the liver
- Heart disease
- Renal disease
- Pulmonary disease
- Mental illness


Dust and smoke from the fires

WTC Medical Screening Program

July 2002- August 2004

Findings

- 69% of all responders reported experiencing either a new or an aggravated respiratory symptom while working at the WTC.
- At the time of examination (12-30 months after starting work), 59% remained symptomatic.
- 27% had abnormal spirometry, a rate twice the US national background
- The prevalence of low FVC (20%), a measure of pulmonary restriction, was 5 times the US background

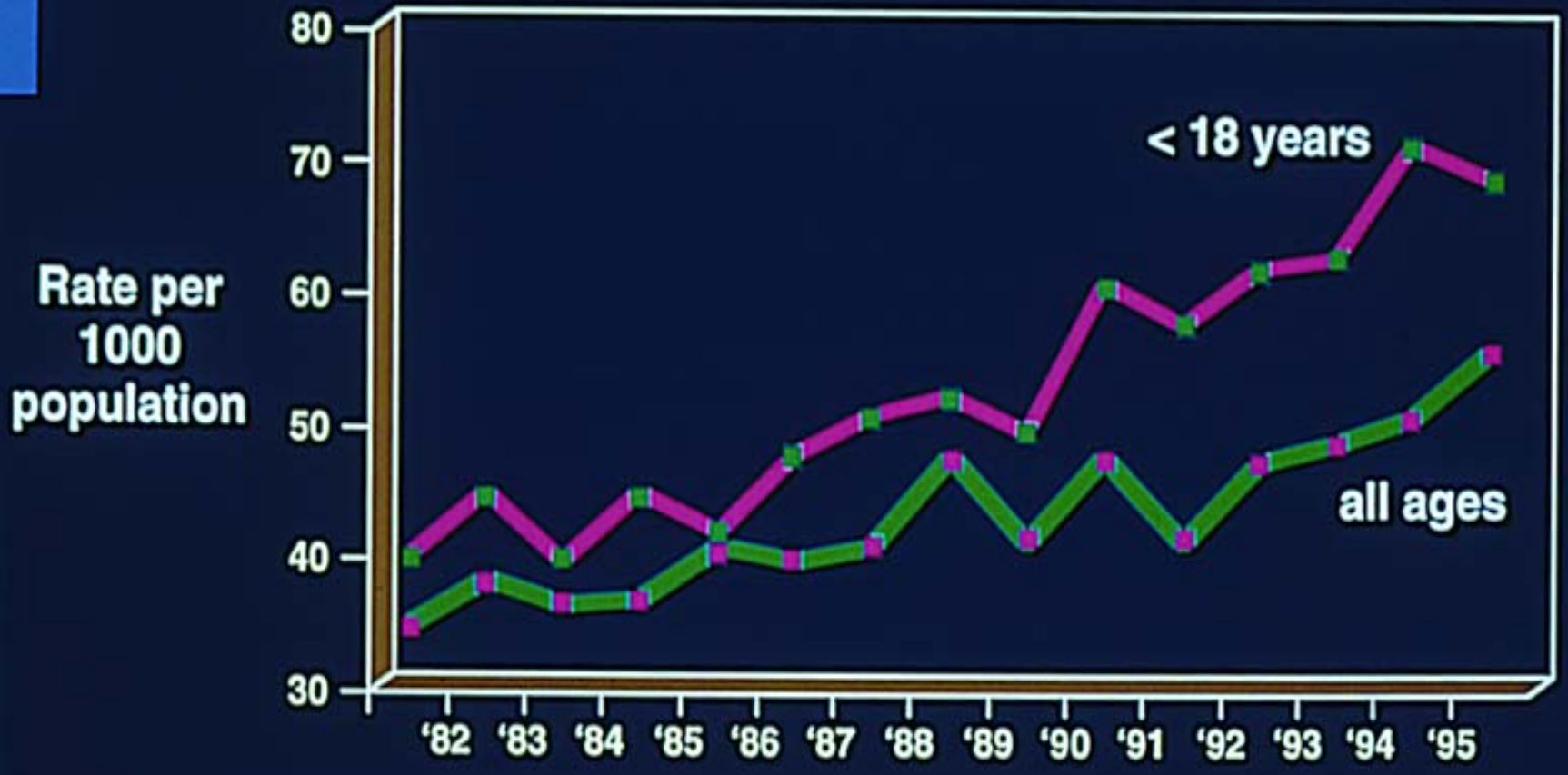
MOUNT SINAI SCHOOL OF MEDICINE

Pediatric Diseases of Current Major Importance

- Asthma
- Cancer
- Birth defects
- Obesity
- Developmental disabilities

Office of Children's Health Protection

Prevalence Rates for Asthma by Age and Year, United States, 1984-1994

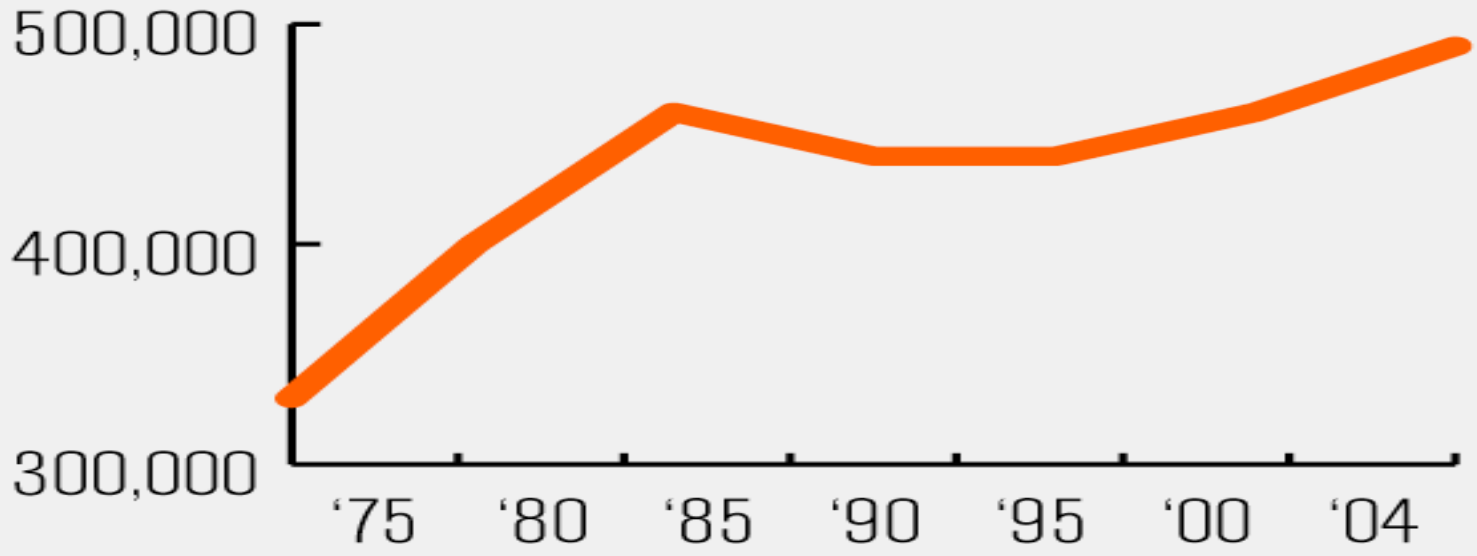


Source: Centers for Disease Control & Prevention

Evidence for Environmental Causation of Asthma

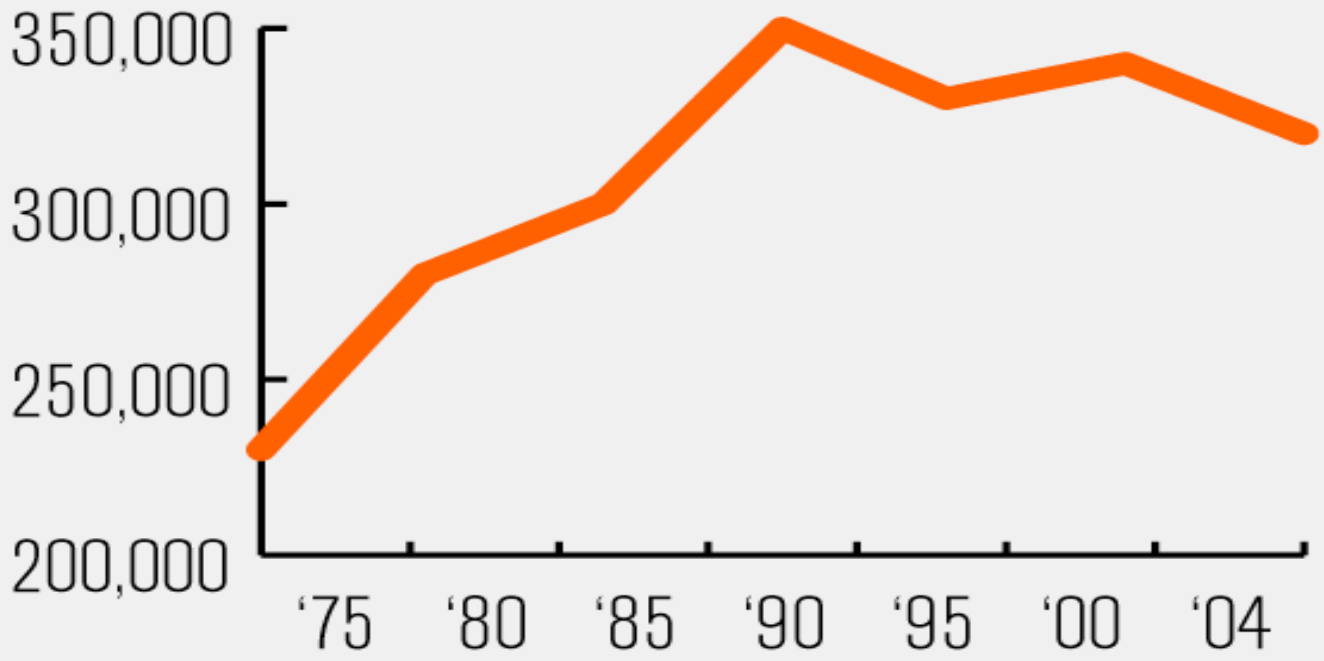
- Known indoor triggers include house dust, second-hand tobacco smoke, mold and mildew, cockroach droppings, certain pesticides
- Ambient air pollution – ozone and particulates. *The story of the Atlanta Olympic games*
- Genetic susceptibility is important and candidate genes have been identified
- Prevention works and is turning the tide. It includes community-wide education, aggressive treatment , smoking cessation, air pollution prevention, and improvements in housing quality

Incidence of Childhood Leukemia 1975–2004



Source: National Cancer Institute

Incidence of Childhood Brain Cancer 1975–2004

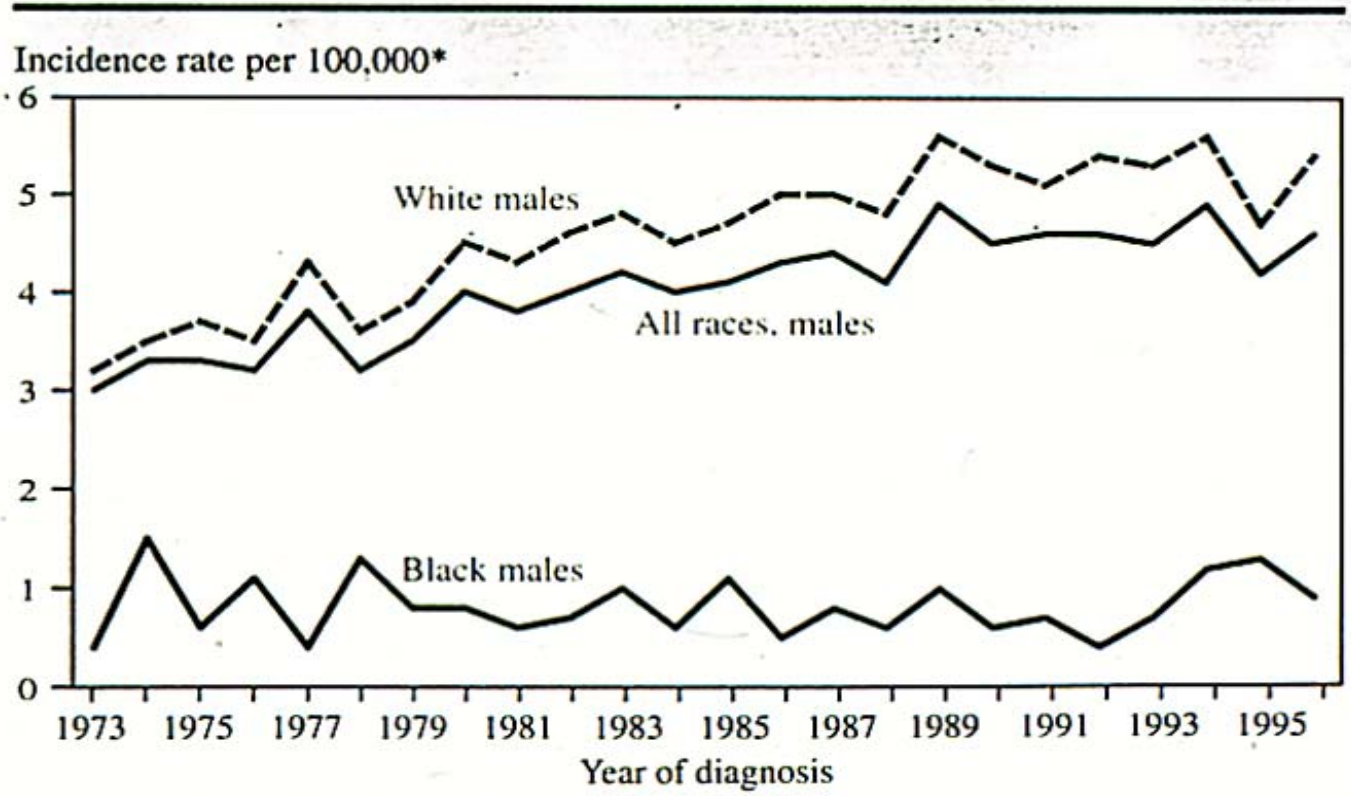


Source: National Cancer Institute

Evidence for Environmental Causation of Childhood Cancer

- Radiation
- Solvents, especially benzene
- Parental employment in industries that use solvents – painting and printing
- Pesticide exposure, especially prenatally

US Incidence of Testicular Cancer



Sources: *SEER Cancer Statistics Review, 1973-1996* (NCI 1999) and *Cancer Rates and Risks, 4th edition* (NCI 1996); access at http://www-seer.ims.nci.nih.gov

Evidence for Environmental Causation of Male Reproductive Disorders

- Falling sperm counts – cause not known
- Rising testicular cancer – cause not known
- Increasing hypospadias – cause not known

Developmental Disabilities

- Affect 3 – 8% of all American children
- Include:
  - Dyslexia
  - Attention Deficit/Hyperactivity Disorder (ADHD)
  - Mental Retardation
  - Autism
- The causation of only 10 – 20% can be explained on familial or genetic grounds

Evidence for Environmental Causation of Neurodevelopmental Disorders

- Lead
- Methyl Mercury
- Polychlorinated Biphenyls (PCBs)
- Certain Pesticides
- Arsenic
- Manganese
- Organic solvents

Steps we need to take to prevent disease caused by toxic chemicals

- Improve toxicity testing – more chemicals; more sensitive test procedures
- Ban certain chemicals, e.g., Stockholm treaty of 2000 on POPs
- Build a strong base of research and education
- Make risk assessment more health-protective
- Invoke the precautionary principle
- Expand right-to-know
- Disseminate knowledge - *EHP*

Science- Based Prevention Works

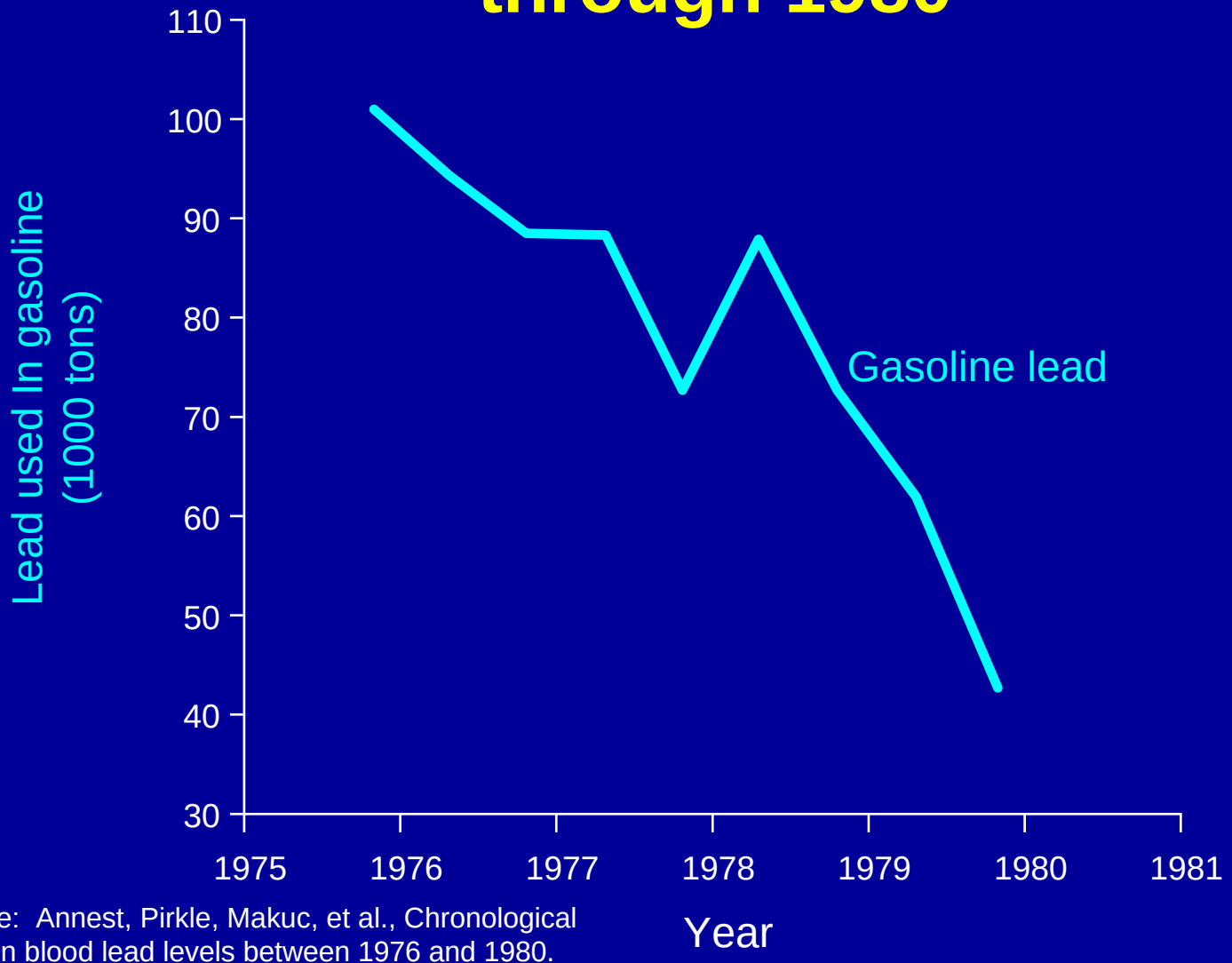
MOUNT SINAI SCHOOL OF MEDICINE

Success Stories in Exposure Reduction / Disease Prevention

- 90% reduction in lead poisoning
- Asbestos
- DDT
- PCBs
- Two neurotoxic organophosphate pesticides

--Chlorpyrifos (Dursban) and Diazinon

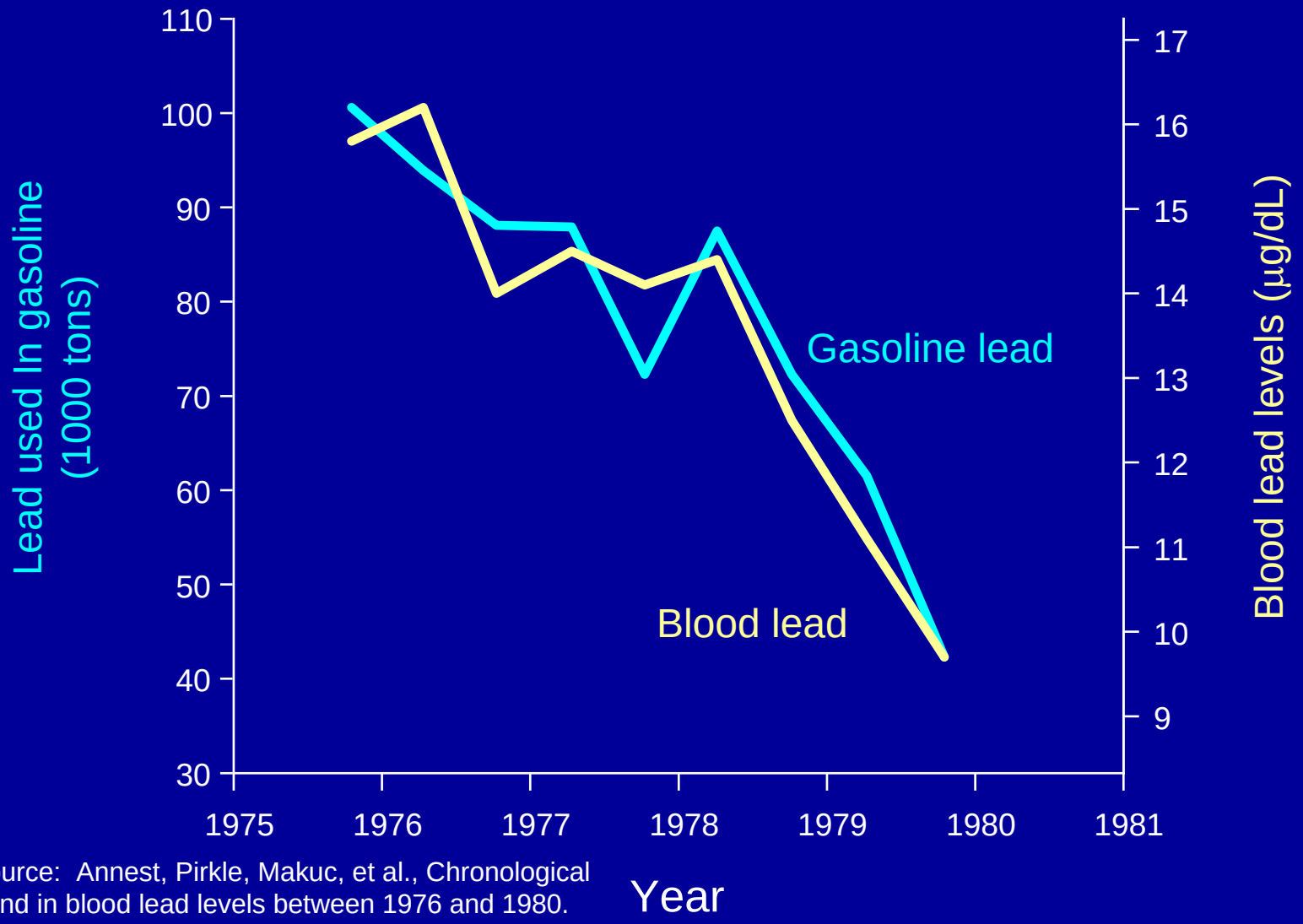
Lead use in gasoline declined from 1976 through 1980



Source: Annest, Pirkle, Makuc, et al., Chronological trend in blood lead levels between 1976 and 1980. NEJM 1983; 308;1373-7.

Lead in gasoline and lead in blood

NHANES II, 1976-1980



Source: Annest, Pirkle, Makuc, et al., Chronological trend in blood lead levels between 1976 and 1980. NEJM 1983; 308;1373-7.

Environmental Disease is Preventable - Declining Blood Lead Levels in the U.S. 1976–1999

Thank You

Protecting Children against

Environmental Threats to Health