Major Environmental Causes of Lung Cancer Through-Out the Ages

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107TH ANNUAL MEETING
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Outline

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Henry D. Tazelaar

- Introduction
- Medieval risks
- Renaissance risks
  - —Uranium-radon
- Modern Risks
  - — Asbestos
  - — Others (too many to name!)
- Conclusions

Cover-ups and Camouflage

Introduction

- **Lung cancer in never smokers is the 7th leading case of cancer mortality**
- **A top ten killer in the US**

RM 42

- Medieval skeleton from Schleswig, Germany
- Among 250 exhumed well preserved bodies, 11th-12th century cemetery
- Not as well-preserved as some bodies from the cemetery in part due to disease

Grupe G. Am J Phys Anthropol 1988:75;369-74

RM 42

- Gross exam
- Radiographs
- Microscopy
- Trace element analysis and comparison to others
- Hypotheses

Grupe G. Am J Phys Anthropol 1988:75;369-74

RM42

40-50 yr old male

Grupe G. Am J Phys Anthropol 1988:75;369-74 Used with permission

RM 42-

? Prostate- usually osteoblastic
? Myeloma-usually more skull involvement
? Osteolytic lesions? Breast, thyroid, kidney, lung

Grupe G. Am J Phys Anthropol 1988:75;369-74 Used with permission


A
B
C
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D Ä N E M A R K
Rotes Kliff 52
List
Westerland
Sylt
Föhr
Wyk
Amrum
Halligen
Hooge
Pellworm
Nordstrand
Süderoog
Nordfriesland
Niebüll
Rantzau-höhe 45
Flensburg
Glücksburg
Sonderburg (Sønderburg)
Alsen
Ærø
Tåsinge
Langeland
Lolland
Schleswigsche Geest
Angeln
Bredstedt
Husum
Sandes-berg 53
Schleswig
Kappeln
Schlei
Schwansen
Treene
Hüttener Berge
Scheelsberg 106
Eckernförde
Kieler Bucht
Ostsee
Fehmarn
Puttgarden
Burg
Nebenkarte
Helgoland (zu Pinneberg)
Eiderstedt
Friedrich-stadt
Tönning
Sankt Peter-Ording
Wittensee
Probstei
Selenter See
Kiel
Heiligenhafen
Oldenburg
Rendsburg
Eider
Dithmarschen
Heide
Büsum
Meldorf
Nord-Ostsee-Kanal
Nortorf
Wagrien
Holsteinische Schweiz
Preetz
Bungsberg 168
Dahme
Plön
Eutin
Grömitz
Großer Plöner See
Neustadt
Lübecker Bucht
Nordsee
Neumünster
Aukrug
Nehmsberg 87
Timmendorfer Strand
Bad Schwartau
Neuwerk (zu Hamburg)
Marne
Itzehoe
Bad Bramstedt
Bad Segeberg
Stör
Brunsbüttel
Elbe
Cuxhaven
Lübeck
Trave
Stormarn
Glückstadt
Elmshorn
Norder-stedt
Bad Oldesloe
Ratzeburger See
Mecklenburg-
Uetersen
Pinneberg
Ahrensburg
Ratzeburg
Schaal-see
Elbe-Lübeck-Kanal
zu Bremen
Stade
Wedel
Hamburg
Hahnheide
Mölln
Lauenburg
Bremerhaven
Vorpommern
Buxtehude
Geesthacht
Elbe
Lauenburg
Niedersachsen
Buchholz
Winsen
9 km
0 1 2 3
Maßstab 1 : 900 000
Sandbank
Watt

RM 42- Occupational Theory #1

- Sailor?
- Exposed to coal-tar building and maintaining boats?
- Coal-tar rich in polyaromatic hydrocarbons (PAH)

Tarring the Boat 1873 Edouard Manet –In the public domain

RM 42- Trace Elements mg/gm

Element	All Adult Skeletons	Aged Adult Males	RM 42
Co	0.528	0.486	0.289
Cs	0.035	0.011	1.584
Mg^2	1.533	1.629	1.151
Sb	0.186	0.119	13.940
Sc	0.002	0.002	0.001
Zn	165.3	119.4	111.3

Grupe G. Am J Phys Anthropol 1988:75;369-74

RM42- Occupational Theory #2

- **Could he have been a metal worker?**

May be the first autopsy of a patient with an occupationally induced lung cancer

Vulcan Forging the Thunderbolts of Jupiter
Peter Paul Rubens, 1638 in the public domain

Renaissance period

- At least 27 physicians write about diseases of miners from 15-17th century (“Bergsucht”)
- 1567- On the Miner’s Plague and Other Illnesses (Paracelsus)

Schneeburg Lung Disease

- Saxony region: Schneeburg, St. Joachimsthal (thaler)
- First mines 1410
- Silver, nickel, cobalt, bismuth, arsenic
- Initially described a combination of COPD and pneumoconiosis

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Schneeburg circa 1975

St. Wolfgang Church, 1515

Schuttmann W. Am J Ind Med 1993; 23:355-368 (used with permission)

Schneeburg Lung Disease

- Early 19th century mine shafts were going deeper
- Young aged men, cough, expectoration, SOB
  — 60-80-% of miners died of lung cancer

Schneeburg Lung Disease- A multidisciplinary discovery

- FH Harting-miners' doctor at Schneeburg
- W Hesse-physician in neighboring Schwarzenberg
  - — Autopsies on miners-1860's
- K Schiffner-Freiberg Mining College
  - —Measured radiation in and around mines (1890)
- HE Muller- "union rep"- suspected lung cancer in miner while he was still alive

Wolfgang-Massen Mine Bldgs circa 1900

Schuttmann W. Am J Ind Med 1993; 23:355-368 (used with permission)

(Aus dem Pathologischen Institut des Friedrichstädter Krankenhauses, Dresden.)

Über den Schneeberger Lungenkrebs.

Von

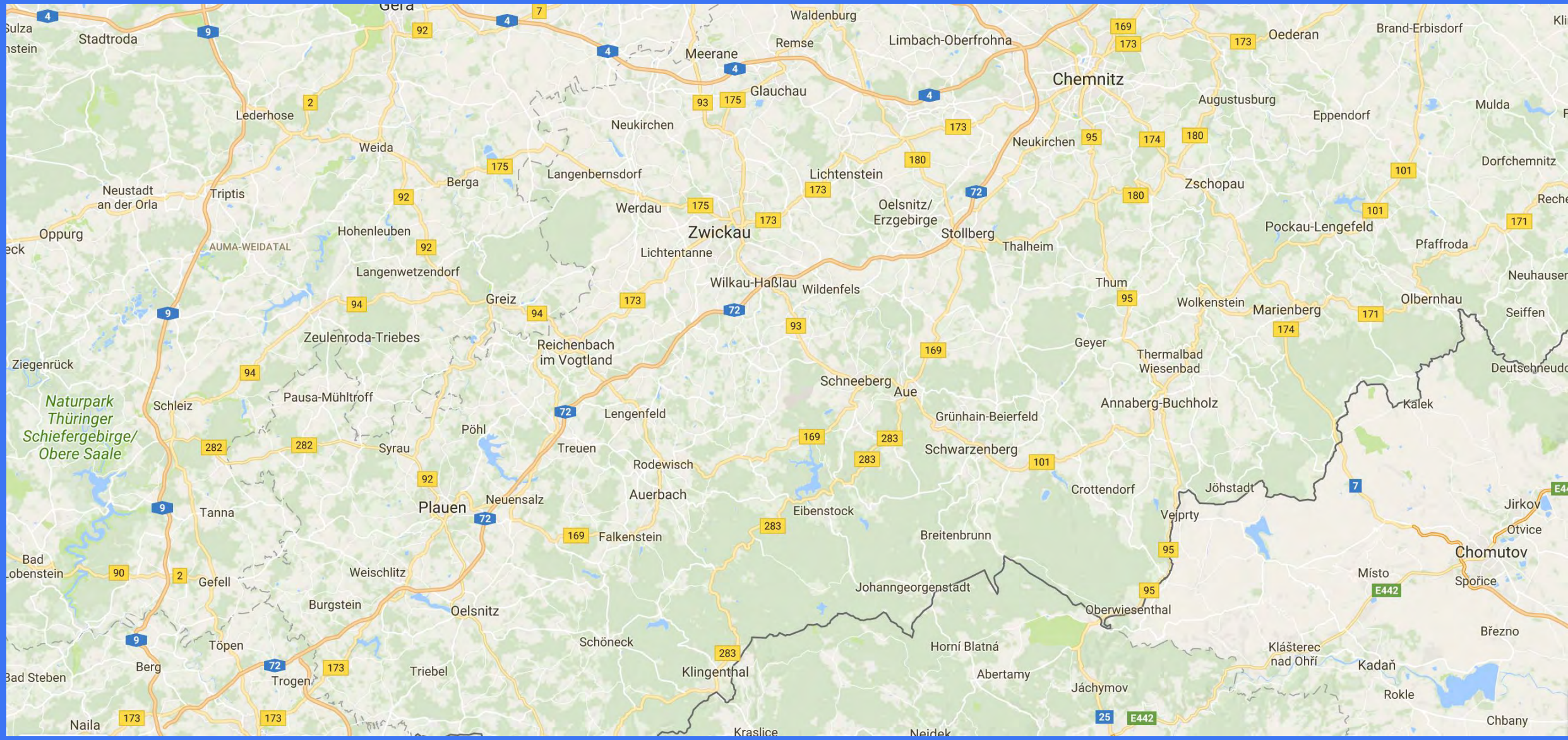
cand. med. **Margarete Uhlig.**

In meiner Vaterstadt, der alten Bergstadt Schneeberg im sächsischen Erzgebirge, hört man des öfteren den Ausdruck „bergfertig". Man bezeichnet damit Bergleute, die mit ihrer Gesundheit so weit fertig sind, daß sie ihrem bergmännischen Beruf nicht mehr nachgehen, nicht mehr „einfahren" können. Meist sind es Leute, die noch im besten Mannesalter stehen und die vielfach als Gartenarbeiter, aber auch zu anderer Arbeit von der Bürgerschaft ihrer Akkuratesse halber, die sie bei ihren Arbeiten erkennen lassen, gern dazu genommen werden.

Uhlig M. Virchows Archiv 1921; 230: 76-98 (in the public domain)

Schneeburg Lung Disease

- Uranium emits Radon-222 (α particles)
- "A single bronchial epithelial cell that has sustained genetic damage can initiate lung cancer"
  (Field RW, Withers BL. Clin Chest Med 2012;33:681-703)
- Silicosis necessary?
- Led to some improvements in mine ventilation
  - 1925: "First Ordinance on Occupational Diseases of the German Reich"



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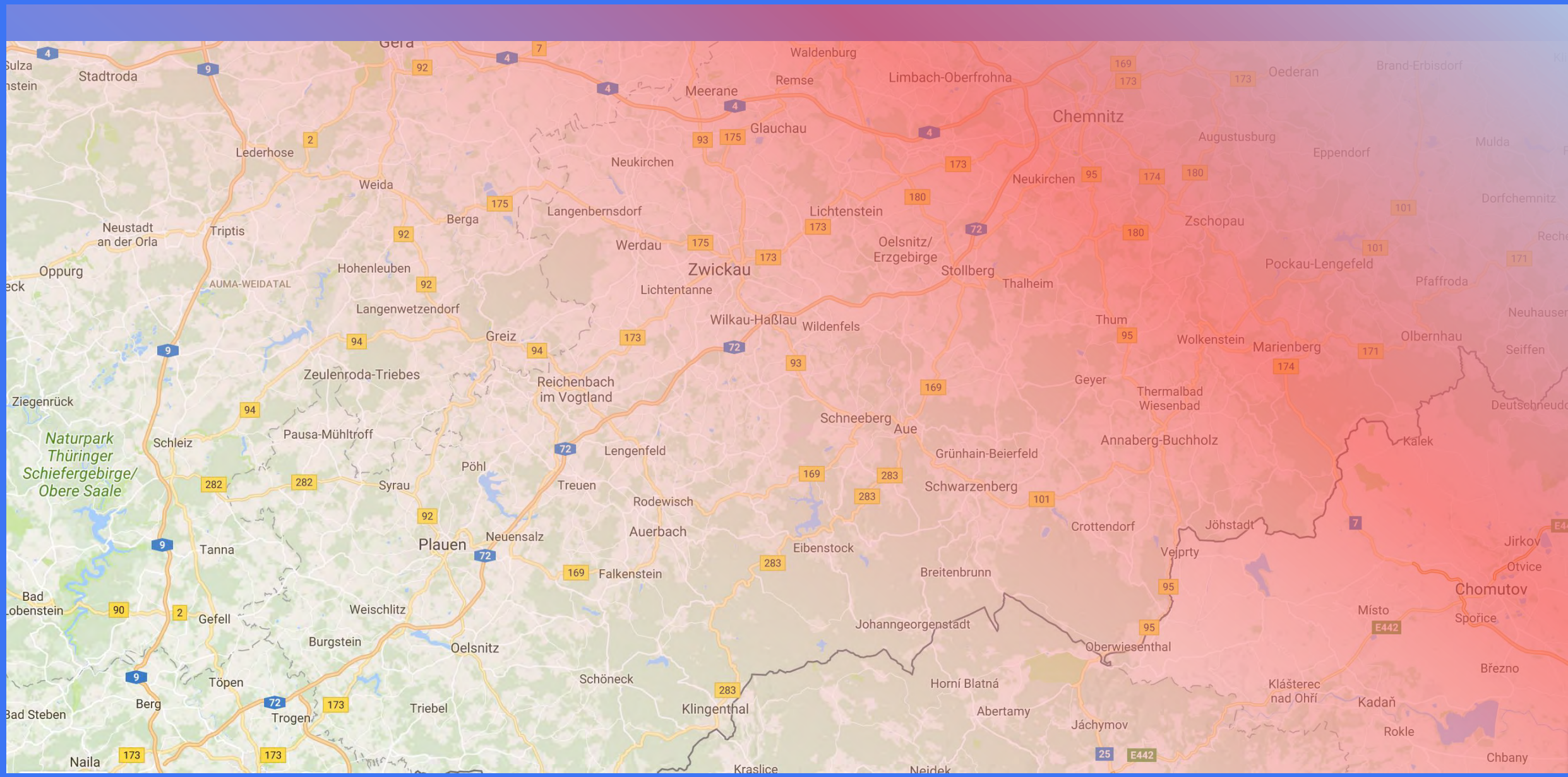


In the public domain

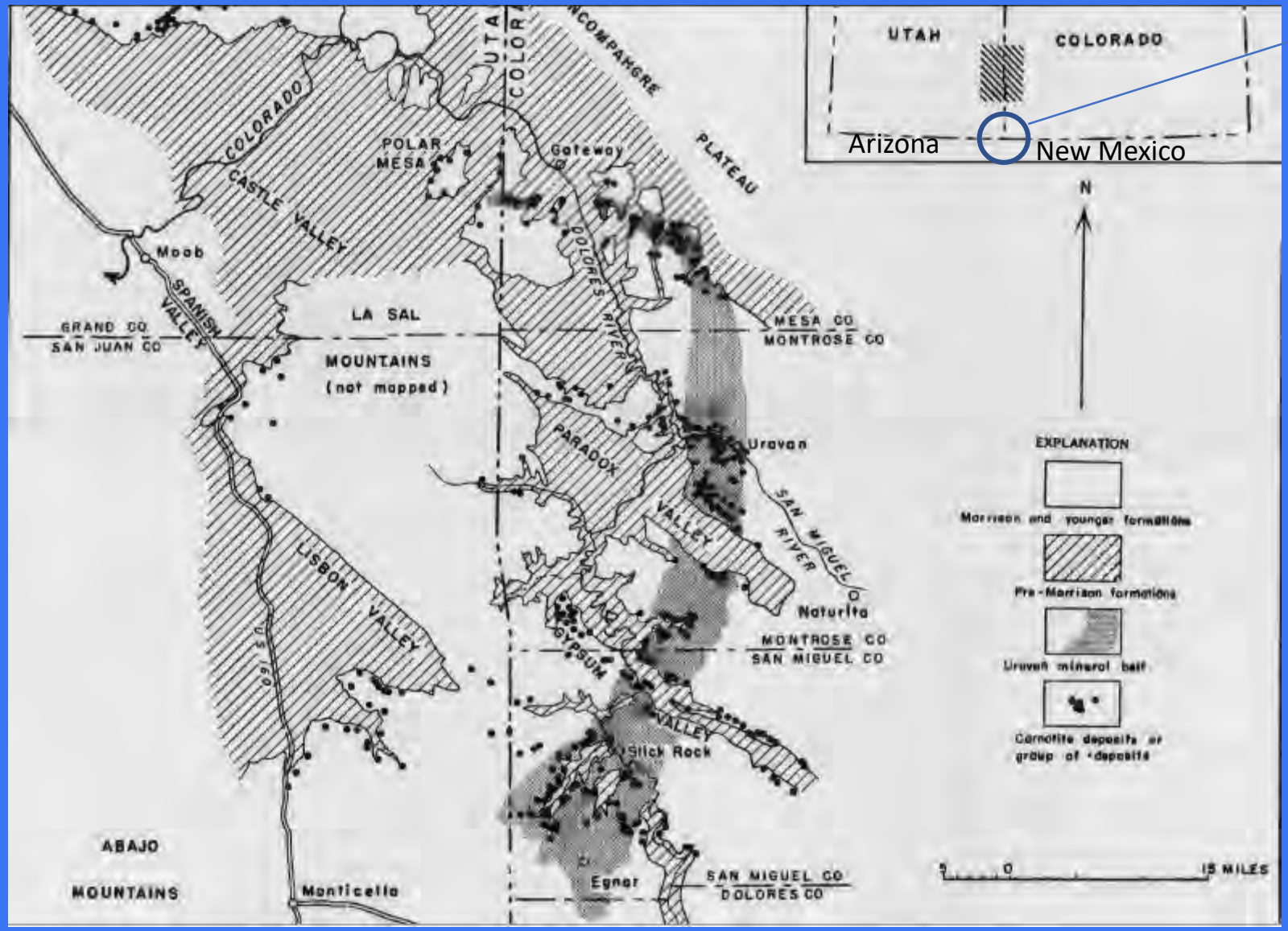
Camouflage

- **USSR**
  - **Wismut (Bismuth) Corporation 1946-1990**
  - **100,000 workers, 400 shafts, 15 mills**
  - **> 9000 deaths**

- Wismut mine shafts, 1948
- Oberschlema (radium spa)

Schuttmann W. Am J Ind Med 1993; 23:355-368 (used with permission)

Uravan Mineral Belt



Four Corners Region of Southwest USA

(in the public domain)

UNDERGROUND URANIUM MINING in Nucla (Montrose county, Colorado; In the public domain)

The Manhattan Project

“Ventilating the mines is unnecessary and too expensive.”
Witschi H.
Toxicol Sci 2001;64:4-6.

Holding ponds at Uranium processing mill in Uravan, Montrose county, Colorado (in the public domain)

Cover-ups

- **USA**
  - **—> 4000 deaths**

Hessler P. The Uranium Widows, The New Yorker Sept 13, 2010 Photo by B Lowry, used with permission

Development of Carcinoma of the Lung as Reflected in Exfoliated cells. Saccomanno G et al. Cancer 1974; 33:256-270.

An Epidemiological Analysis of the Relationship between Exposure to Rn Progeny, Smoking and Bronchogenic Carcinoma in the U-Mining Population of the Colorado Plateau--1960-1980. Saccomanno G et al. Health Physics 1986;50:605-18.

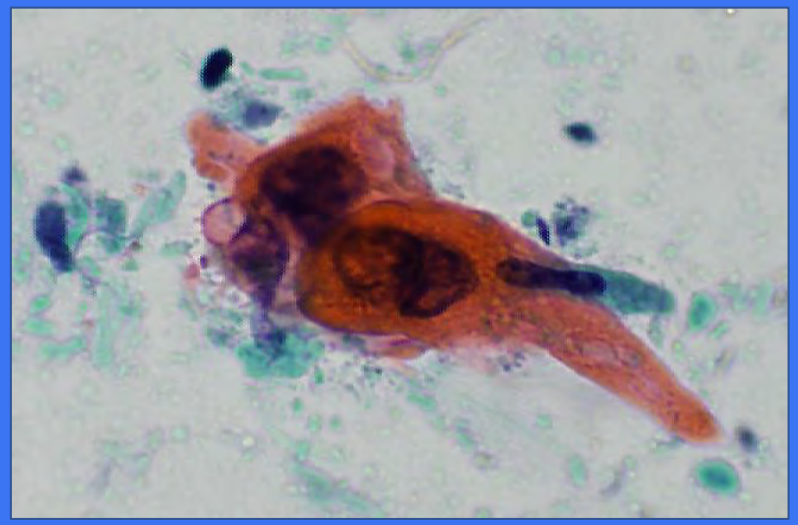


Photo of Dr. Saccomanno courtesy of Saccomanno Research Inst. Grand Junction, Co.

Chimney Sweeps

- **Exposed to soot**
  - **—Carbon, other inorganic material and PAH's**
- **Standardized incidence ratio of 1.49**
- **Also in firefighters, masons, heating and ventilation workers**

In the public domain

Pukkala E et al. Acta Oncol 2009: 48:636-790

Silica and Lung Cancer

- Sandblasters
- Glass manufacture
- Construction
- Denim
- Oil and gas extraction
- Agriculture

Courtesy of Dr. Andrew Churg

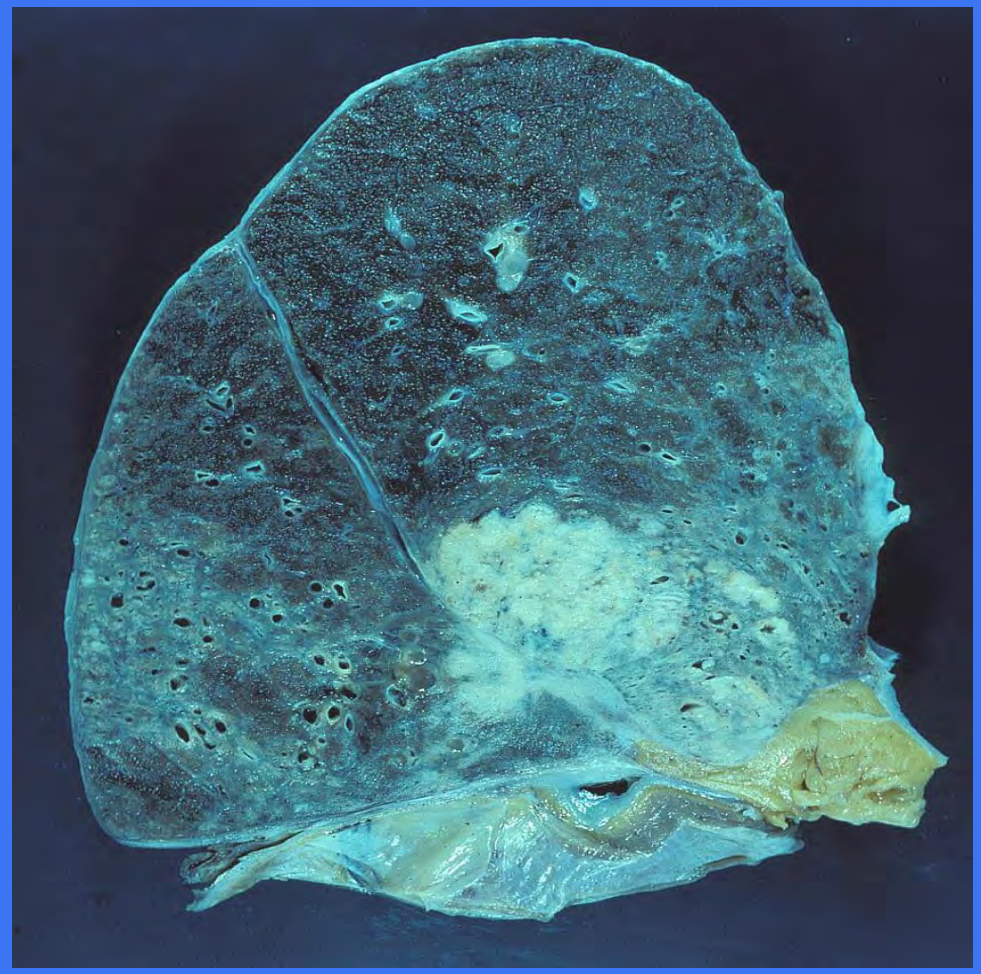
Relationship of Silica Exposure to Carcinoma of the Lung

- **Disputed topic**
- **There most likely is an association when silicosis is present**
- **Whether silica exposure without silicosis causes lung cancer is unresolved but attribution of a cancer to silica exposure in an individual case is dubious**
- **There may be dust type (ex, cristobalite) and industry specific associations**

Courtesy of Dr. Andrew Churg

Asbestos Associated Lung Cancer

- 1935-1953
- England, Germany and US
- 1943 - German consensus was that there was causal relationship
- 1953 Dr. R Doll (UK) studies the link among workers at Turner Bros. Asbestos, publishes over objections of the company…
- 1989 EPA ban most asbestos containing products-somewhat overturned in 1991 court case



Courtesy of Dr. Andrew Churg

Other Environmental/Occupational Causes of Lung Cancer

Toxin	Environment/Occupation
Diesel exhaust	Drivers, loader
PAH	Coal gasification, coke production, foundry workers
Benzene, lead, phthalates, chromates, Ni	Painters
Nitrosamines, asbestos contaminated talc, PAH, phthalates	Rubber workers
Arsenic	Glass and ceramic workers, fireworks manufacturing, textile production
Beryllium	Aircraft, space vehicles and defense industries

Conclusions- Environmental Causes of Lung Cancer

- Associations between environmental and occupational exposures often difficult to prove
- Companies and countries have been masters at camouflage and cover-ups
- Earliest occupation assoc with lung cancer may be builders of pyramids but little surviving proof
- Much work continues today
- Pulmonary pathologists continue to contribute

THANK YOU