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IN THE NAME OF GOD

Inhalation of Air Contaminants: Diagnostic Approach

1. **describe** recent and remote inhalational exposures: smoke, chemicals, mineral dusts and organic/biological

2. **assess** symptoms, signs, chest radiograph, spirometry, and blood gases

3. **identify** the level(s) of the respiratory tract that are likely involved, and any systemic effects

4. **consider** occupational lung disease in your diagnosis (refer to Table in Core Document)

History

In addition to a general medical history, ask about:

- the patient's respiratory *symptoms*
- current and past *exposures* to air contaminants
- the *temporal relationship* between exposure and symptoms
- other persons with similar symptoms
- the impact of symptoms on the patient's activities

Physical Examination

Examine the patient (inspection, percussion, auscultation, palpation) for key findings associated with respiratory diseases.

Investigations

- chest radiograph
- spirometry (FVC, FEV1, FEV1%)
- arterial blood gases

- lung volumes
- diffusion capacity
- peak flow monitoring
- methacholine challenge testing
- bronchoalveolar lavage (BAL)

Differential Diagnosis

Based on the type of air contaminant and the level(s) of the respiratory tract involved, consider occupational causes in the diagnosis

Differential Diagnosis of Occupational Lung Diseases

	Type of Air Contaminant			
Level of injury	*smoke & fumes*	*chemicals*	*organic & biological*	*mineral dusts*
large airways	tracheobronchitis	tracheobronchitis	irritant and allergic rhinitis	n/a
small airways	bronchiolitis & asthma	bronchiolitis & asthma	asthma	chronic bronchitis
parenchyma	chemical pneumonitis, emphysema	chemical pneumonitis	HP, infection	pneumoconioses
systemic	CO, cyanide, inhalation fever	CO, H2S, cyanide, inhalation fever	H2S, low O2, inhalation fever, infection	advanced pneumoconiosis

Case Presentation #1

Acute Inhalational Exposure

Occupational Lung Disease: Case Presentation #1

Hank is a 36 year old man who presents to the Emergency department at 9 PM.

He is usually quite healthy, but over the past few hours he has felt progressively ill, with occasional chills, myalgia, and cough.

He has worked at local metal recycling smelter in the 'melting room' for the last two years.

Ongoing problems with ventilation - smokes and fumes can get 'pretty thick' at times.

Occupational Lung Disease: Case Presentation #1

How would you describe the air contaminants?

What level of the respiratory tract is involved?

What are possible occupational diagnoses?

Occupational Lung Disease: Case Presentation #1

How would you describe the air contaminants?

Smokes, fumes - possibly chemicals

What level of the respiratory tract is involved?

What are possible occupational diagnoses?

Occupational Lung Disease: Case Presentation #1

How would you describe the air contaminants?

Smokes, fumes - possibly chemicals

What level of the respiratory tract is involved?

Cough can originate from all levels of the respiratory tract; note systemic symptoms

What are possible occupational diagnoses?

Differential Diagnosis of Occupational Lung Diseases

Level of injury	*Type of Air Contaminant*			
	smoke & fumes	*chemicals*	*organic & biological*	*mineral dusts*
large airways	tracheobronchitis	tracheobronchitis	irritant and allergic rhinitis	n/a
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parenchyma	chemical pneumonitis, emphysema	chemical pneumonitis	HP, infection	pneumoconioses
systemic	CO, cyanide, inhalation fever	CO, H_2S, cyanide, inhalation fever	H_2S, low O_2, inhalation fever, infection	advanced pneumoconiosis

Findings 1.1

Physical Examination

- mild fever (38.5 C)
- mild pharyngeal redness
- chest clear, no distress or tachypnea
- HR 90, no murmurs or bruits

Investigations

- mild increase in WCB
- normal spirometry
- normal blood gases

Chest Radiograph
1.1

International Labour Organization

Differential Diagnosis of Occupational Lung Diseases

Level of injury	*Type of Air Contaminant*			
	smoke & fumes	*chemicals*	*organic & biological*	*mineral dusts*
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Inhalational Fevers

Self-limited syndrome of mild fever, leukocytosis, myalgia; onset usually 4-6 hours after exposure, resolves 24-48 hours; no apparent sequelae in regards to lung pathology or function.

Metal Fumes	zinc, copper, manganese
Organic Dusts	grain dust, moldy silage
Plastics	Teflon (fluorinated)
Endotoxins	contaminated humidifiers

Findings 1.2

Physical Examination

- occasional wheezes, afebrile
- scant phlegm, black specks, no blood

Investigations

- chest radiograph normal, normal WBC
- blood gases - mild respiratory alkalosis
- FVC 104% predicted; FEV1 81% predicted; FEV1/FVC = 62%

Occupational Lung Disease: Case Presentation #1

How would you describe the air contaminants?

What level of the respiratory tract is involved?

What are possible occupational diagnoses?

Occupational Lung Disease: Case Presentation #1

How would you describe the air contaminants?

Smokes, fumes - possibly chemicals

What level of the respiratory tract is involved?

Wheezing and obstructive pattern on spirometry suggests small airway involvement

What are possible occupational diagnoses?

Differential Diagnosis of Occupational Lung Diseases

Level of injury	*Type of Air Contaminant*			
	smoke & fumes	*chemicals*	*organic & biological*	*mineral dusts*
large airways	tracheobronchitis	tracheobronchitis	irritant and allergic rhinitis	n/a
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Airways Injury - Reactive Airways Disease

Symptoms occur with 24 hours after single, high intensity exposure to irritant gas, smoke, fume, or vapour

Cough, wheeze, and dyspnea

Spirometry may show small airway obstruction

methacholine challenge +

If airways reactivity and symptoms persist > 6 months =

Reactive Airways Dysfunction Syndrome (RADS)

Findings 1.3

Physical Examination

- mild distress, tachypneic, tachycardic
- scattered crackles, occasional wheezes

Investigations

- mild hypoxemia on ABG
- mixed obstructive and restrictive pattern on spirometry

Chest Radiograph
1.3

International Labour Organization

Occupational Lung Disease: Case Presentation #1

How would you describe the air contaminants?

What level of the respiratory tract is involved?

What are possible occupational diagnoses?

Occupational Lung Disease: Case Presentation #1

How would you describe the air contaminants?

Smokes, fumes - possibly chemicals

What level of the respiratory tract is involved?

Chest x-ray changes suggest parenchymal involvement, can't rule out small airways.

What are possible occupational diagnoses?

Differential Diagnosis of Occupational Lung Diseases

Level of injury	*Type of Air Contaminant*			
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Chemical Pneumonitis - ARDS

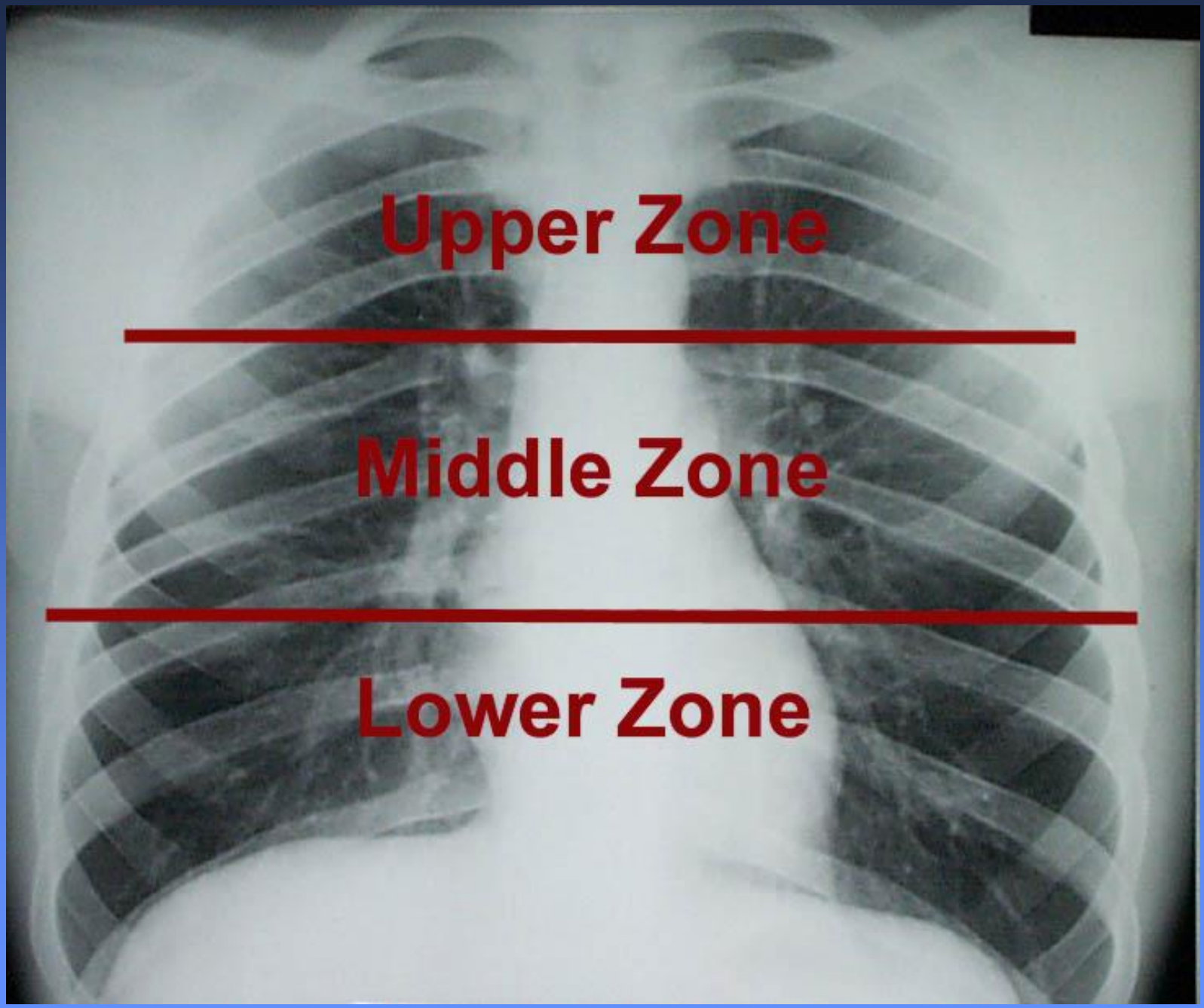
- onset within hours (up to 36 hours) after exposure
- progressive respiratory distress, hypoxemia, diffuse interstitial/air space changes on CXR
- interstitial fibrosis, bronchiolitis obliterans or reactive airways disease may persist after initial recovery
- high index of suspicion required based on intensity of exposure and nature of industrial process

Some agents that produce chemical pneumonitis:

- acrolein
- cadmium
- chlorine
- fire smoke
- hydrogen chloride
- hydrogen sulfide
- nitrogen dioxide
- ozone
- phosgene
- sulphur dioxide

Case Presentation # 2

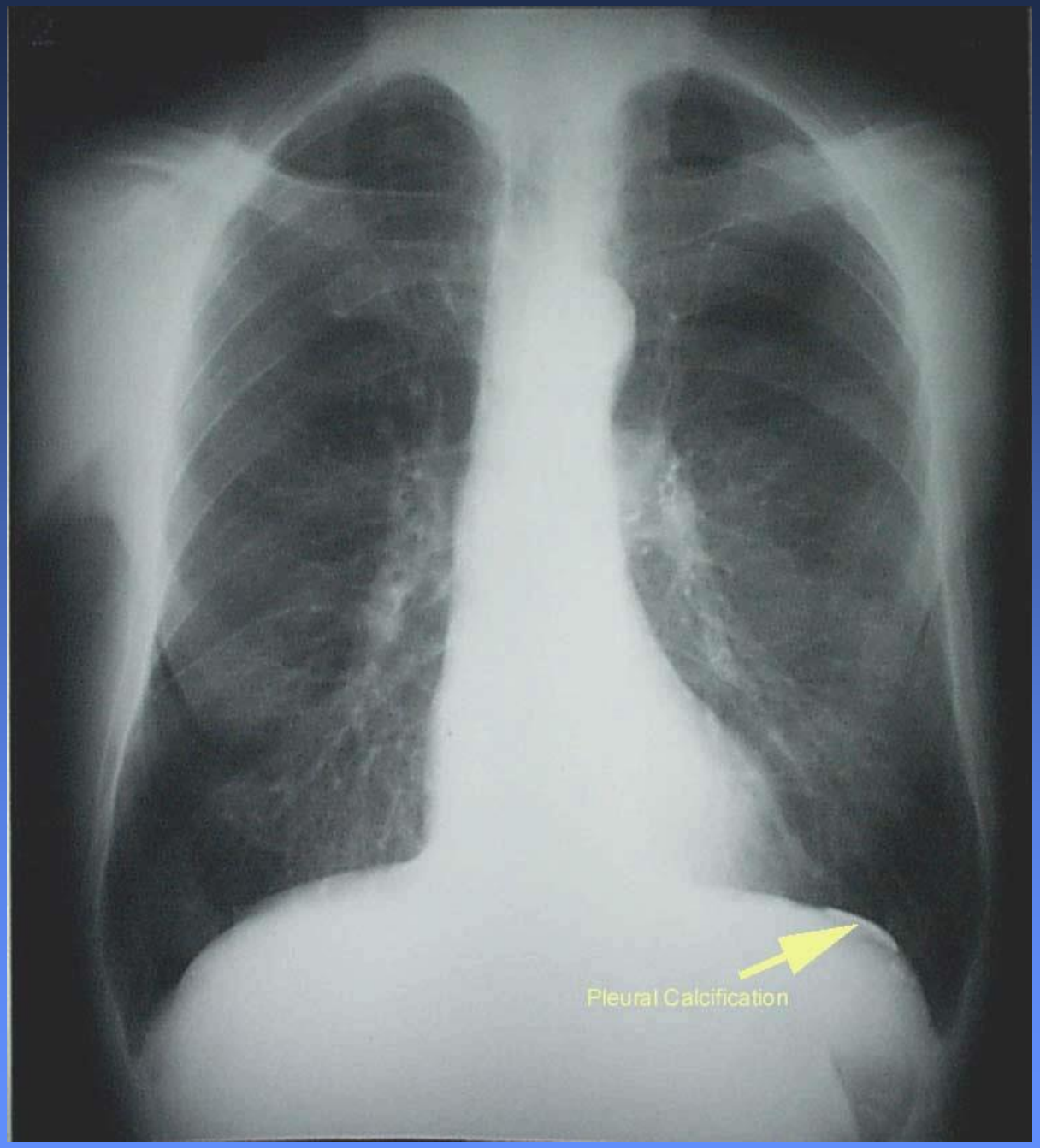
Abnormal Chest Radiograph


Upper Zone
Middle Zone
Lower Zone

Occupational Lung Disease: Case Presentation #3

Bill is a 65-year-old retired accountant who presents for a periodic medical exam. He reports only slight dyspnea on exertion, no cough or sputum; he has never smoked.

For each of a series of possible chest radiographs, what is a possible occupational cause, and what would you ask Bill on a more detailed history?



Chest Radiograph

2.1

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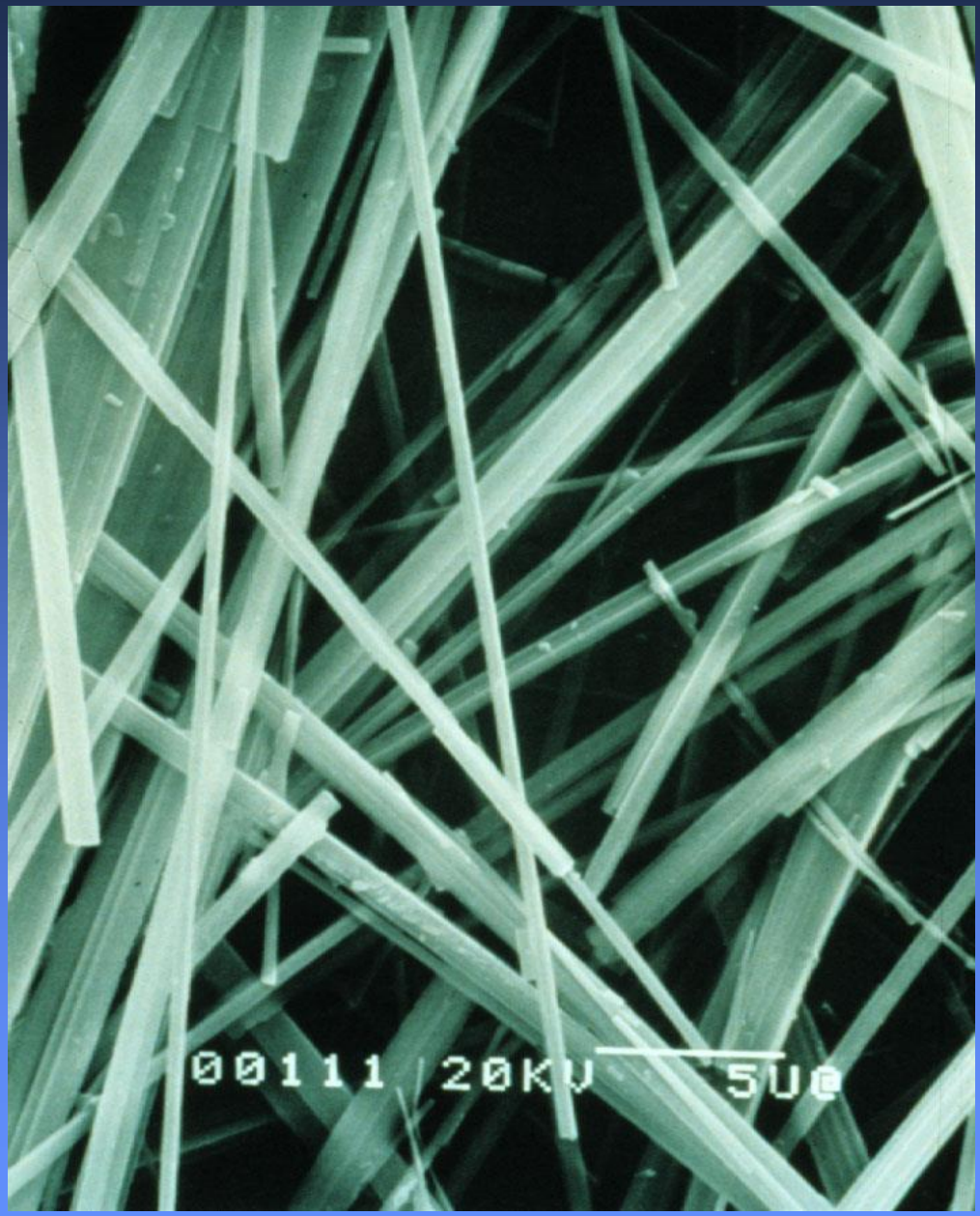
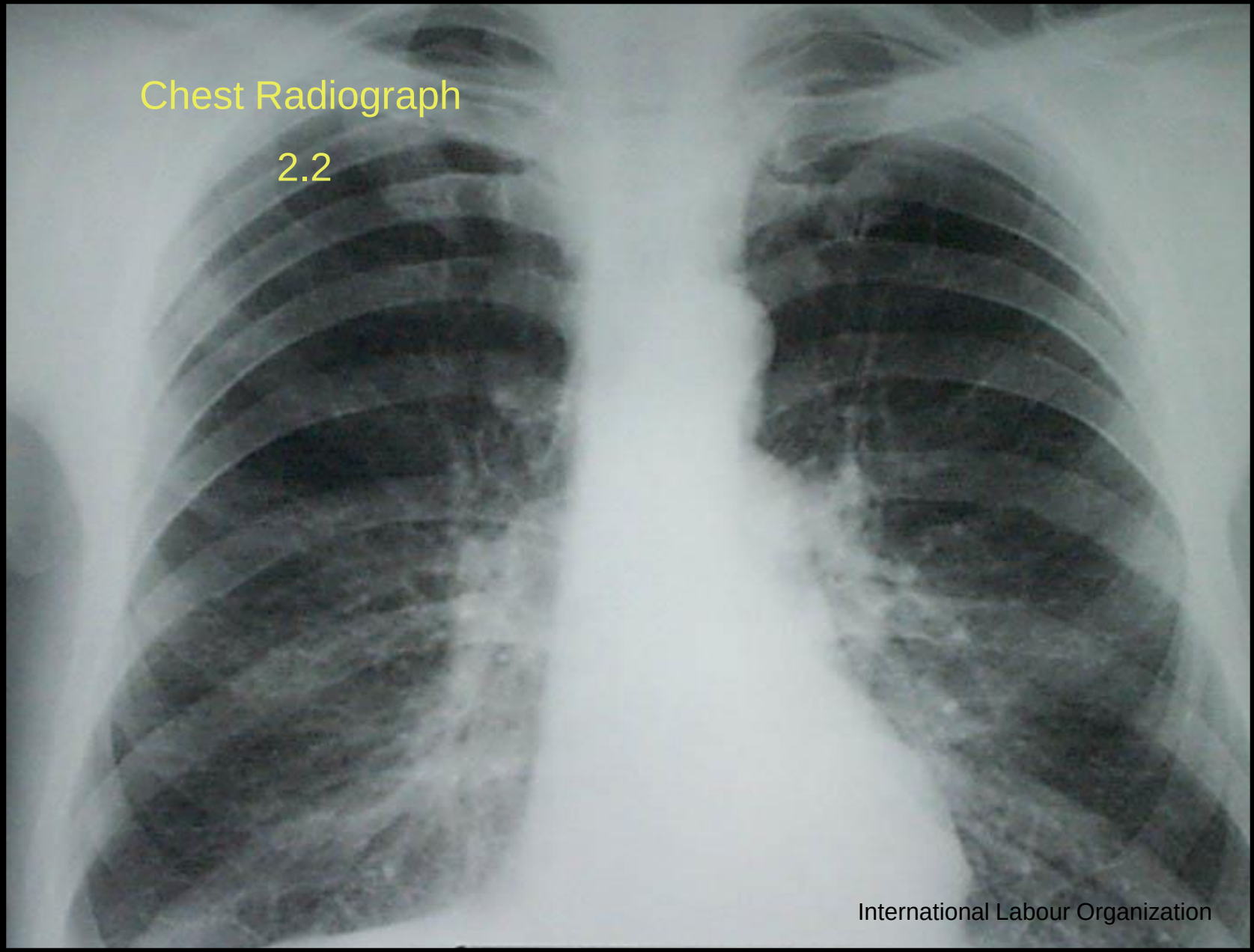
Asbestos Fiber

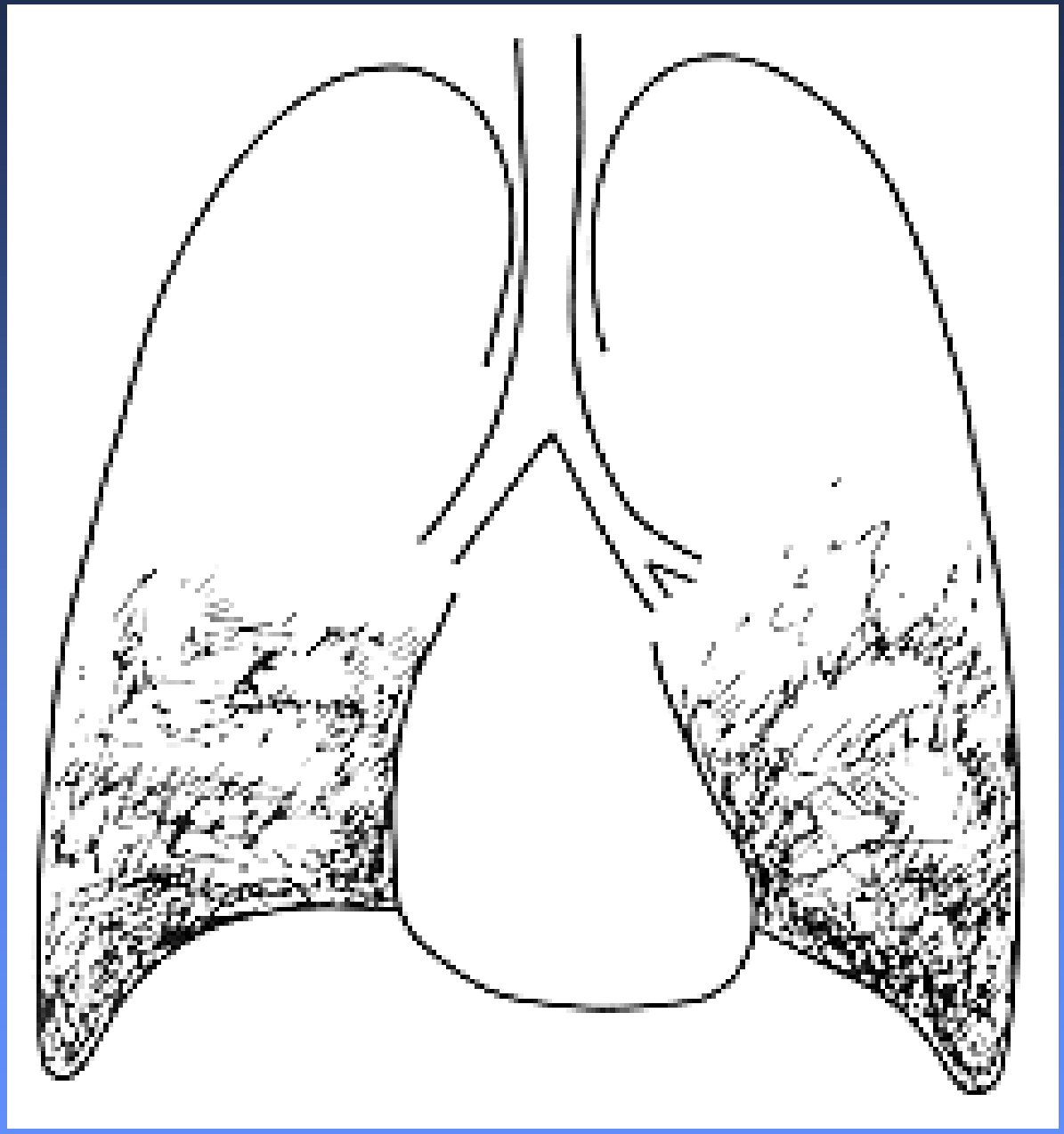


Courtesy of Dr. Francis Green

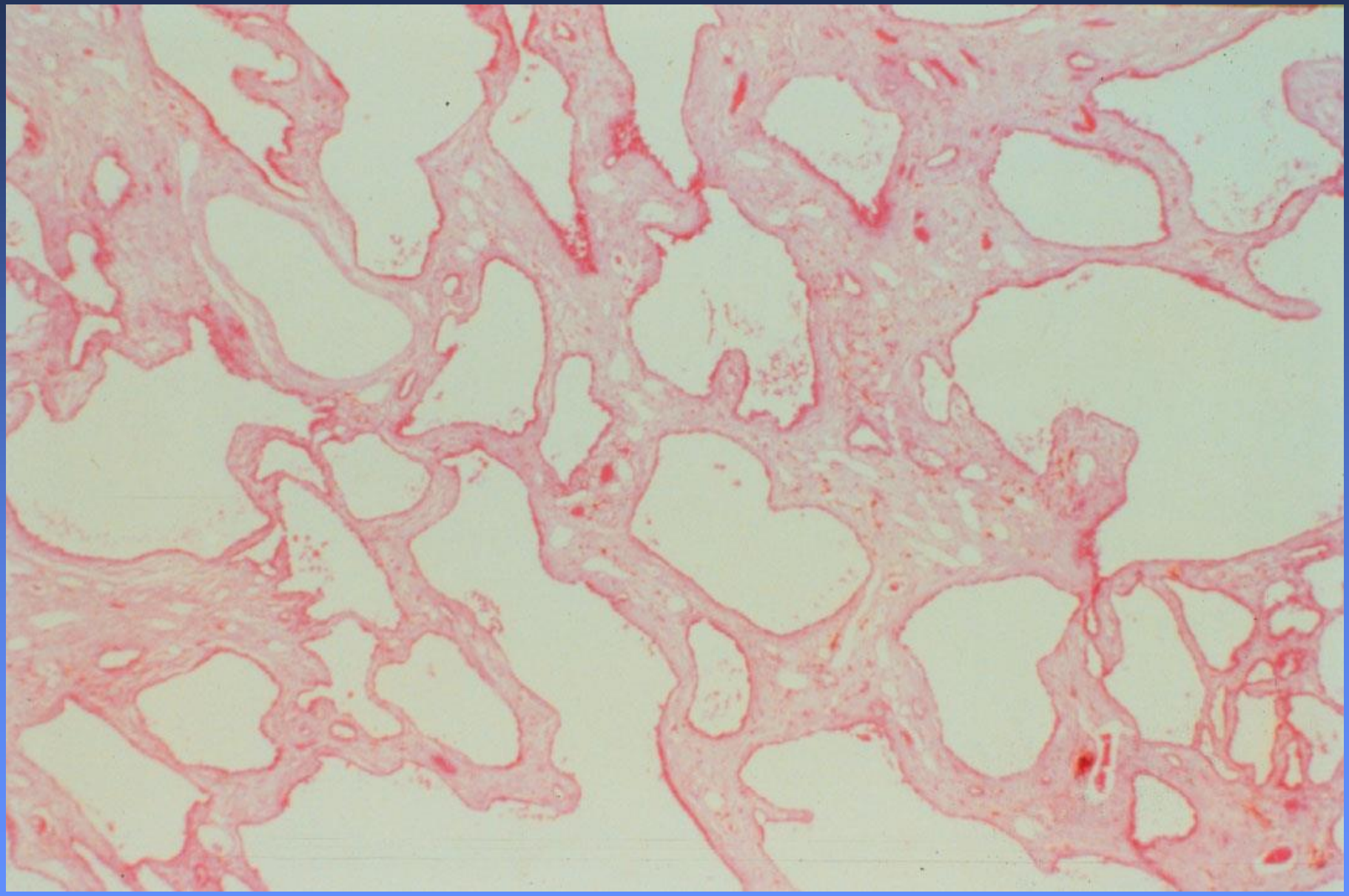

Chest Radiograph
2.2
International Labour Organization

Distribution of Irregular Opacities

In Asbestosis

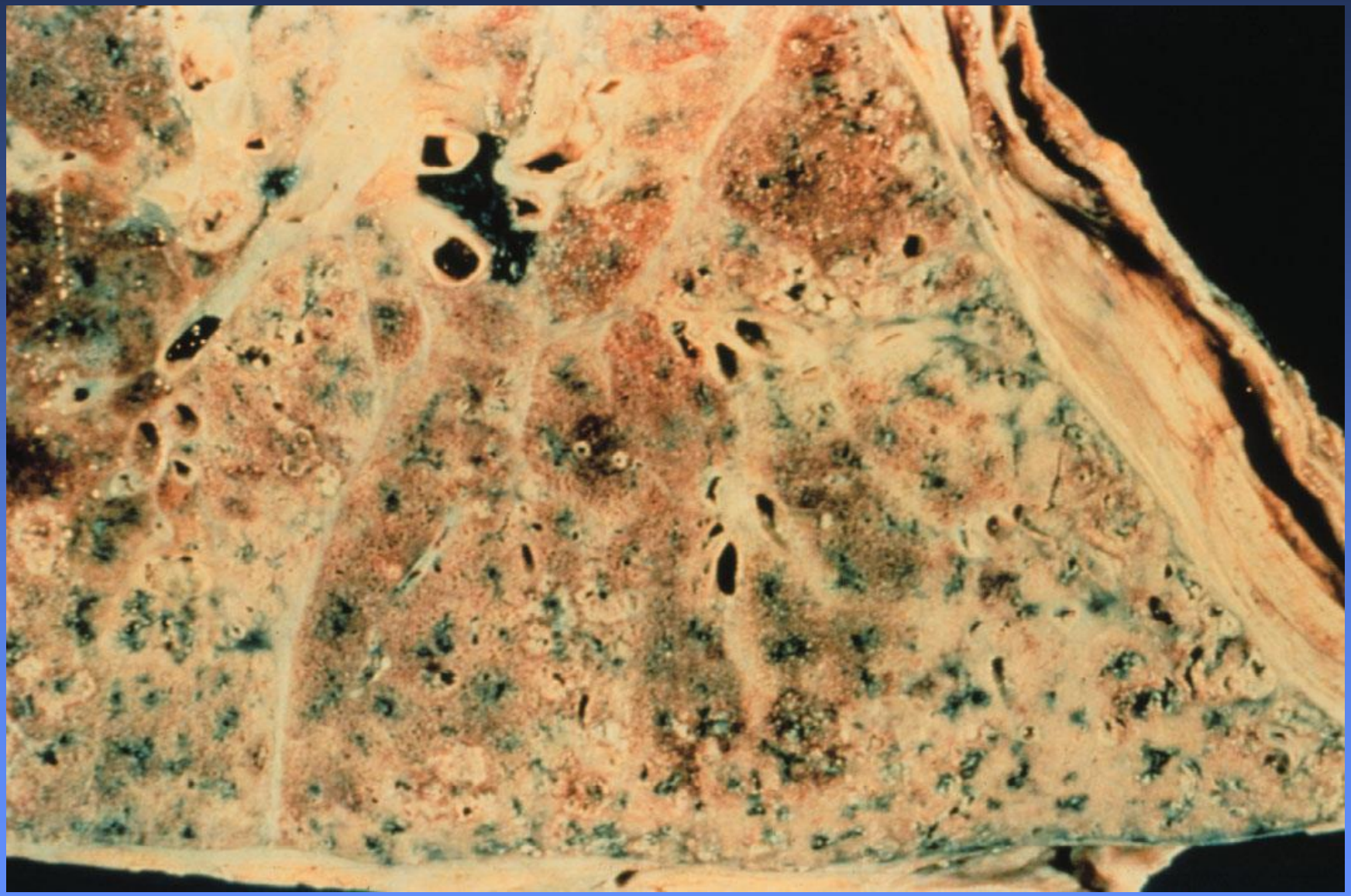


INTERSTITIAL FIBROSIS - ASBESTOSIS

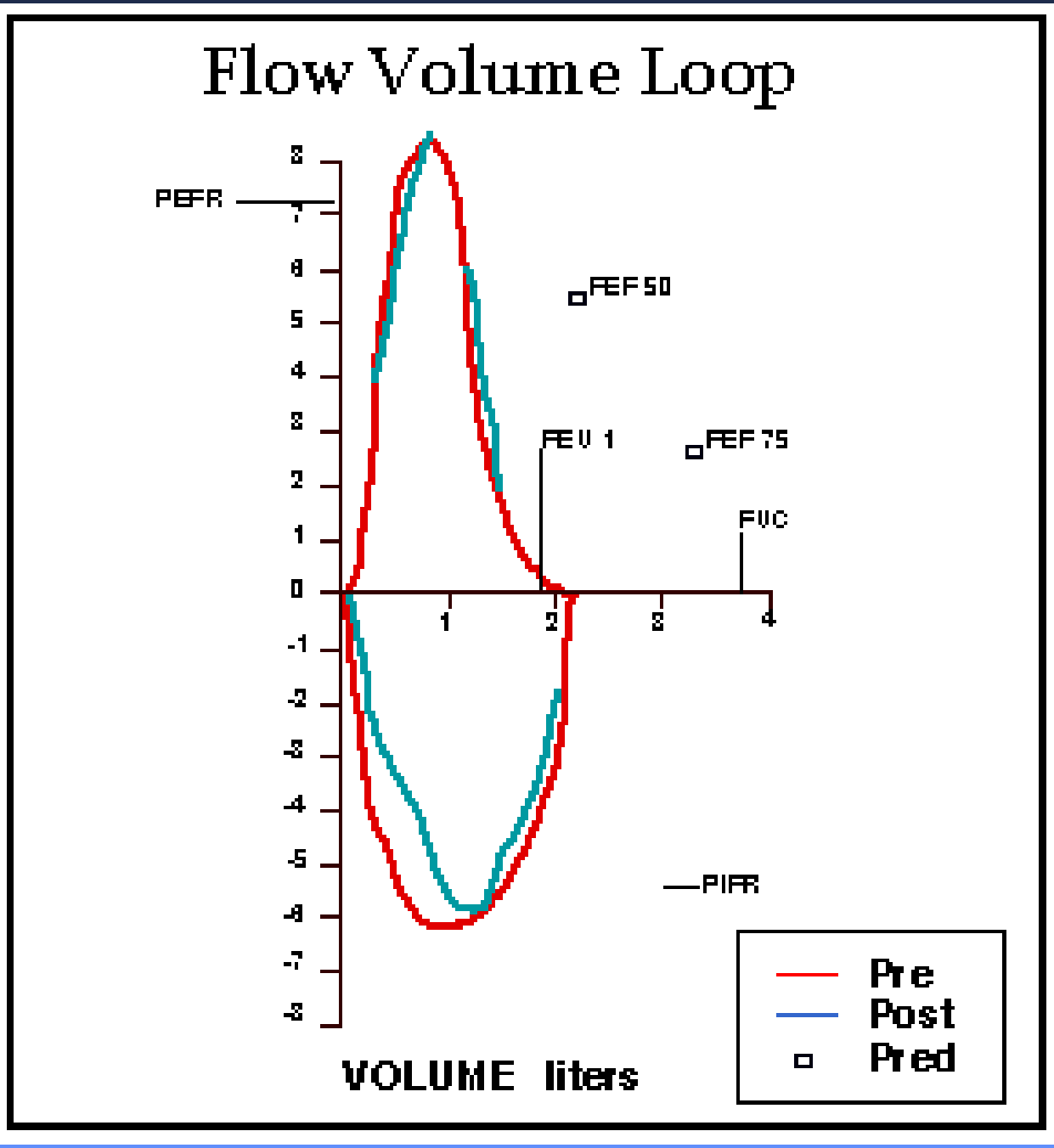


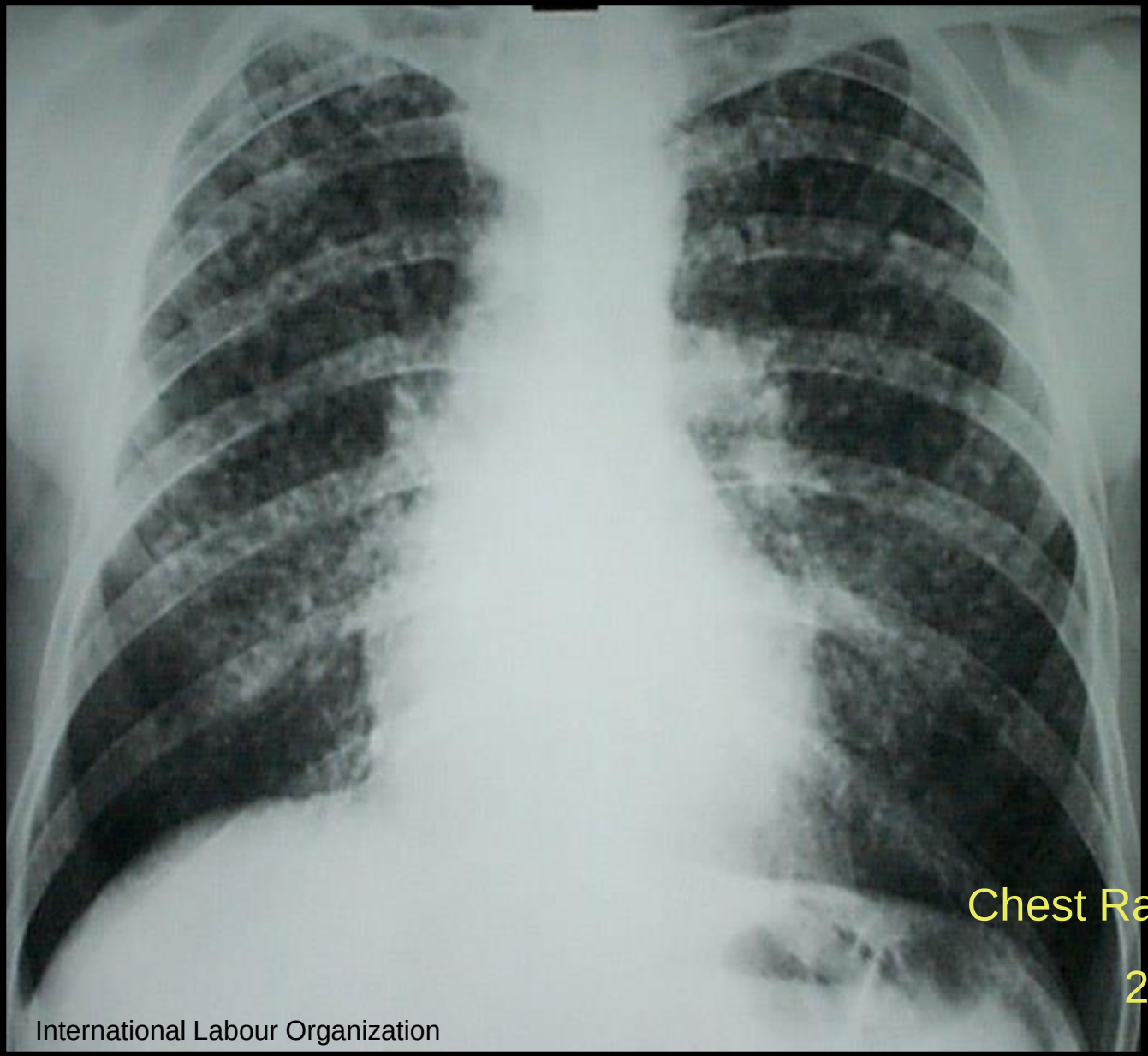
Courtesy of Dr. Francis Green

ASBESTOSIS



Courtesy of Dr. Francis Green

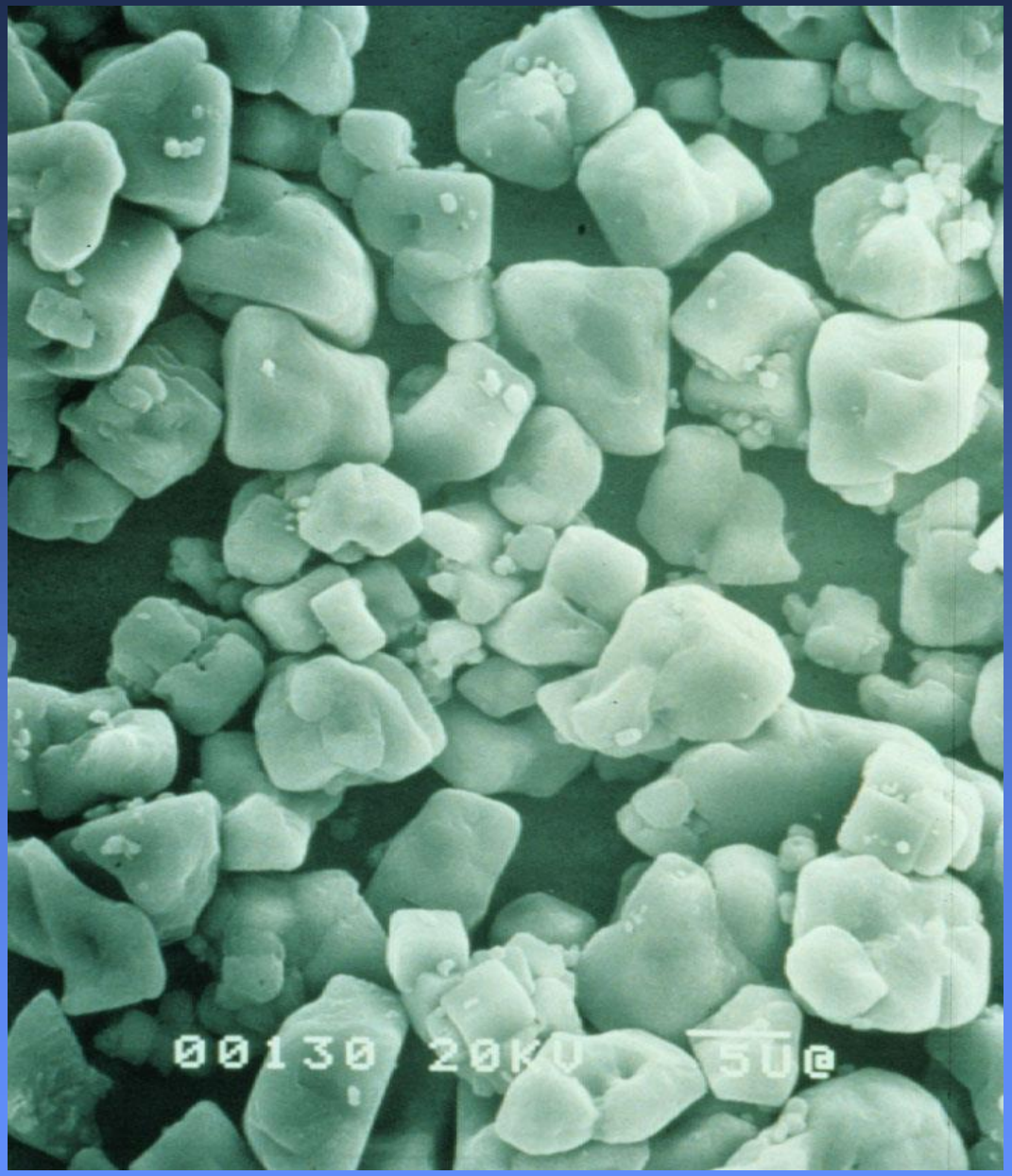

Flow Volume Loop
PEFR
PEF50
FEV 1
PEF75
FVC
PIFR
VOLUME liters
Pre
Post
Pred



Chest Radiograph

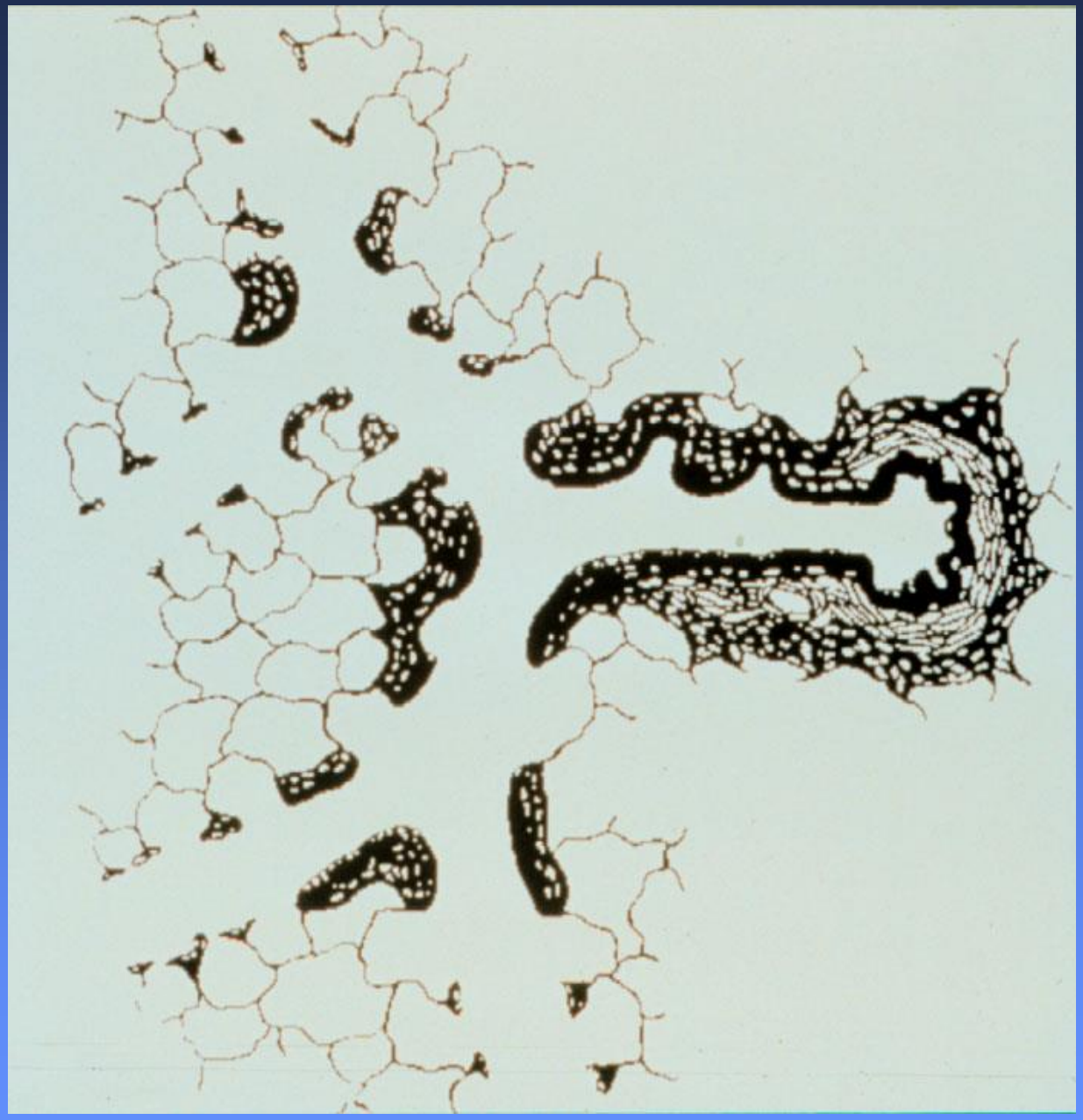
2.3

International Labour Organization



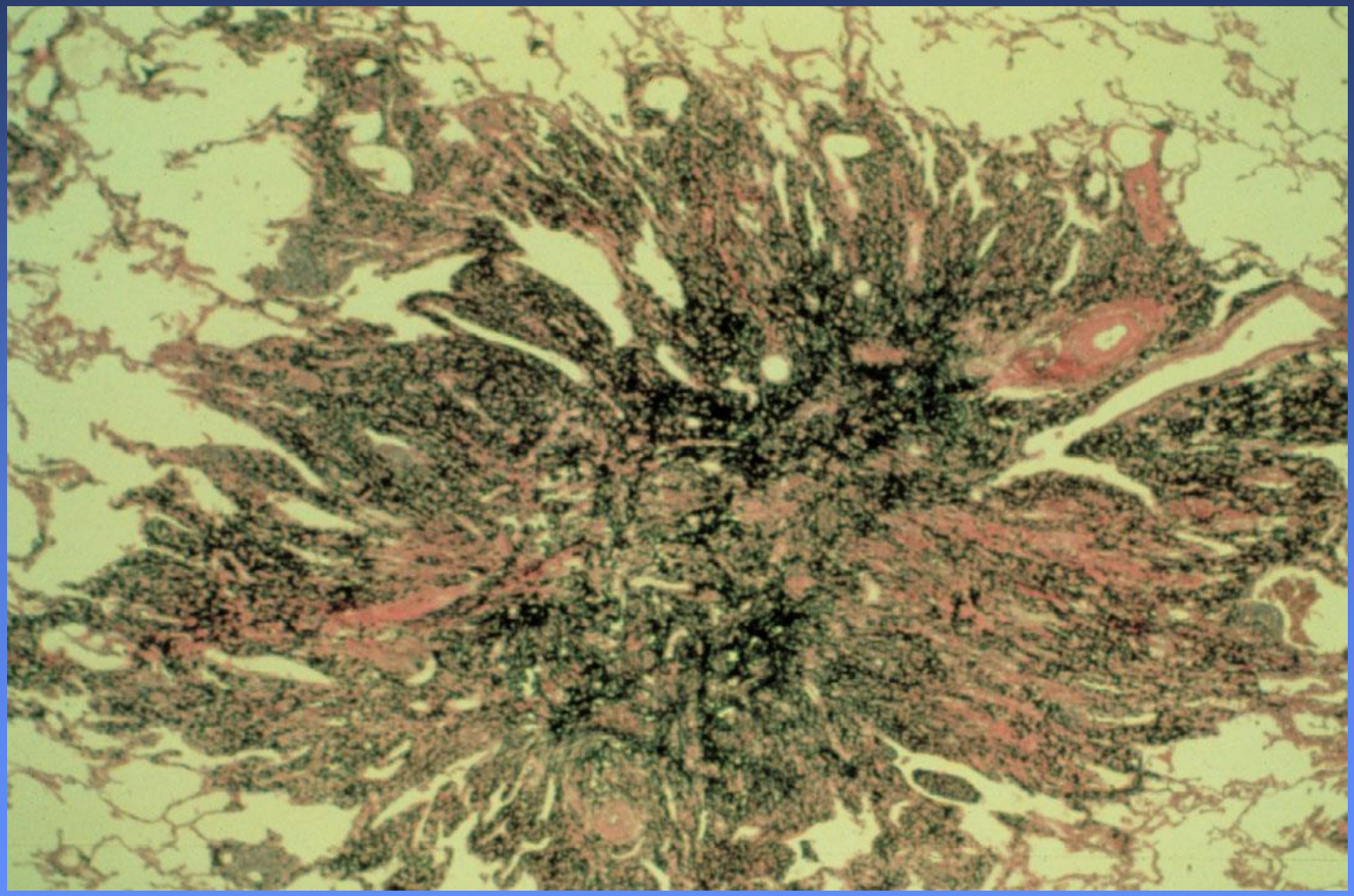
Courtesy of Dr. Francis Green

Particle Deposition



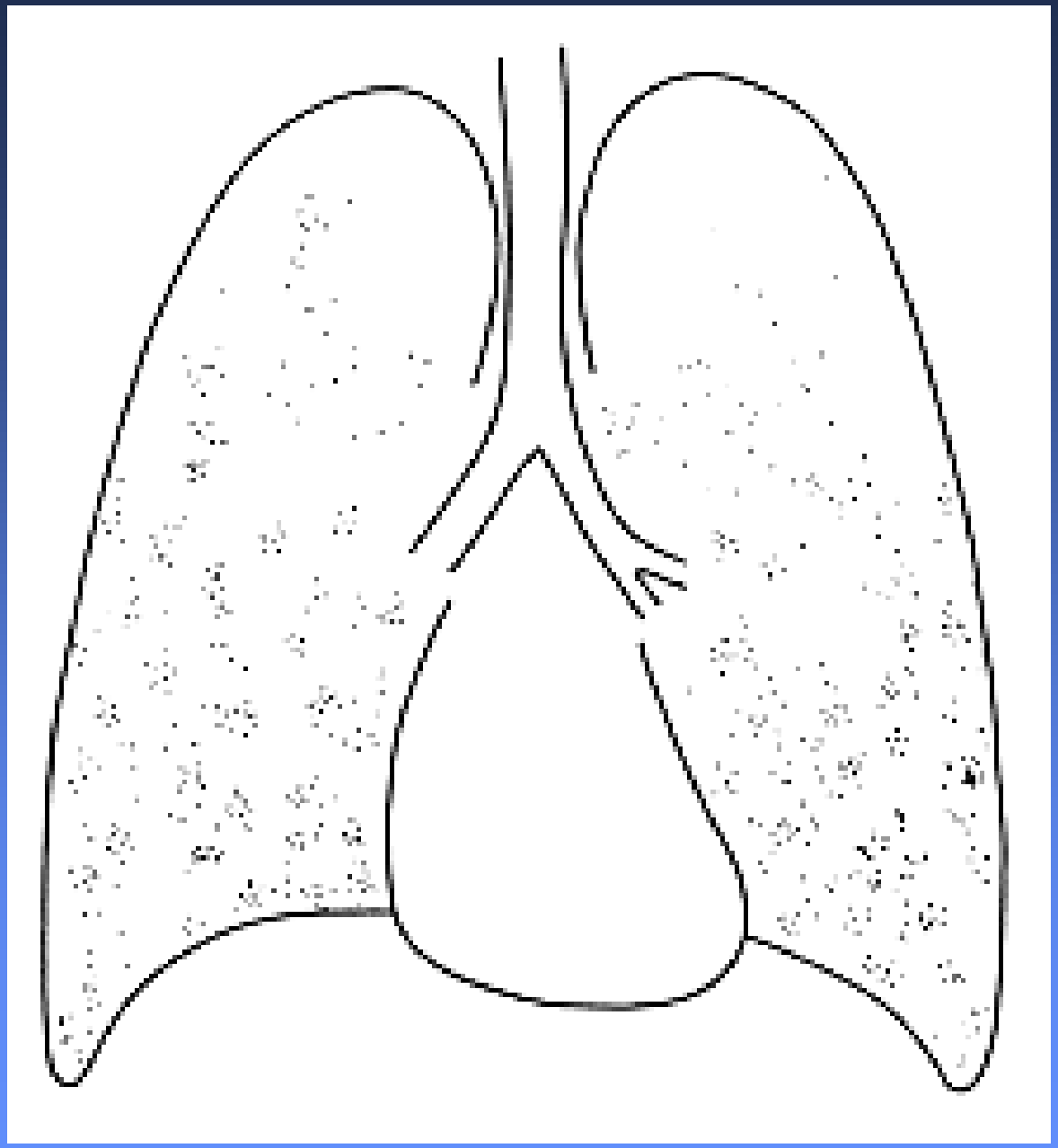
Courtesy of Dr. Francis Green

Dust Nodule



Courtesy of Dr. Francis Green

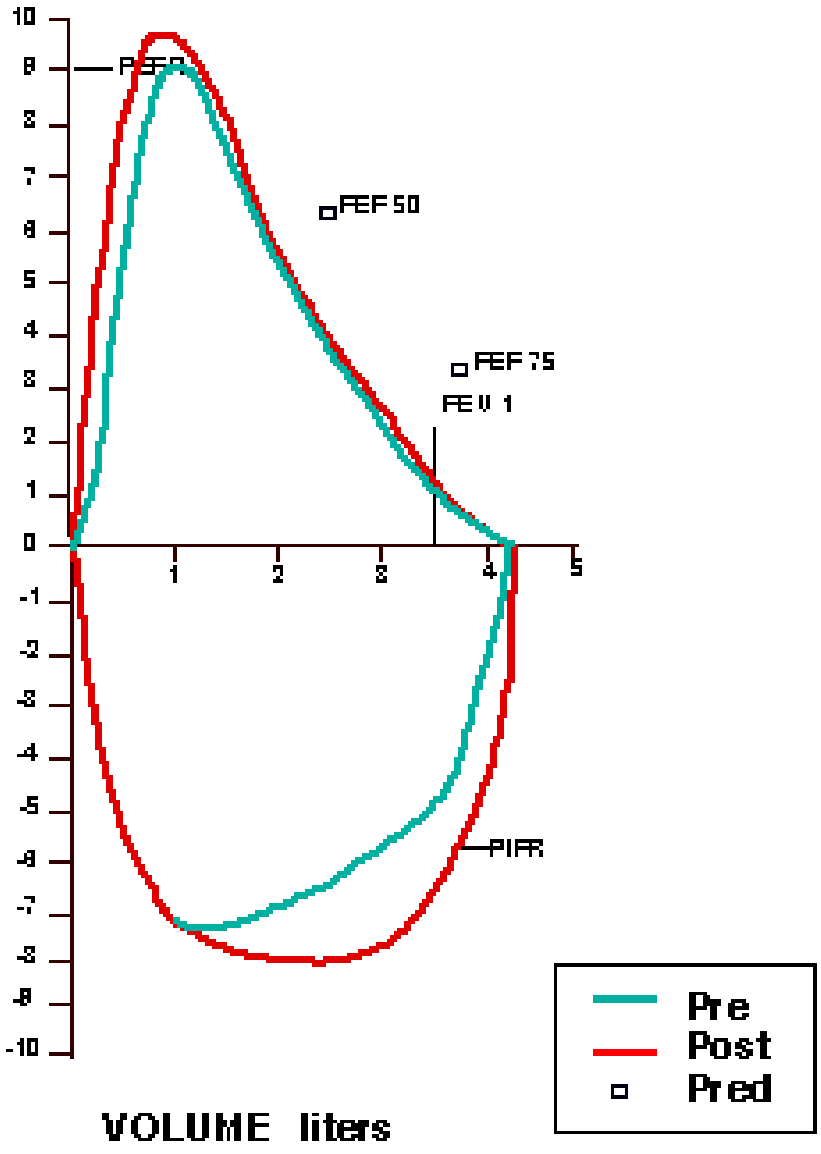
Distribution of Rounded Opacities In Silicosis



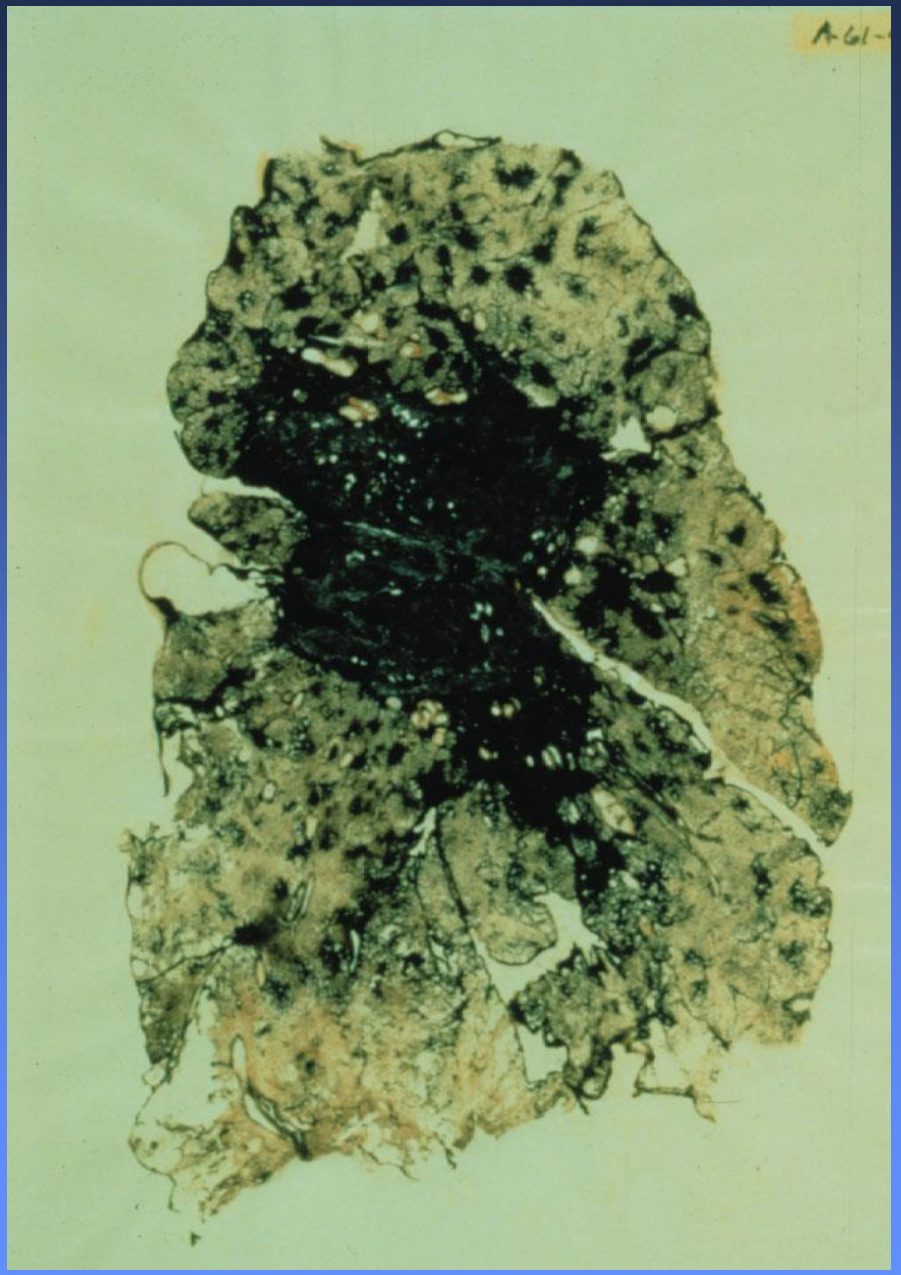
Parenchymal Dust Deposition

Courtesy of Dr. Francis Green

Flow Volume Loop



Progressive Massive Fibrosis



Courtesy of Dr. Francis Green

Progressive Massive Fibrosis

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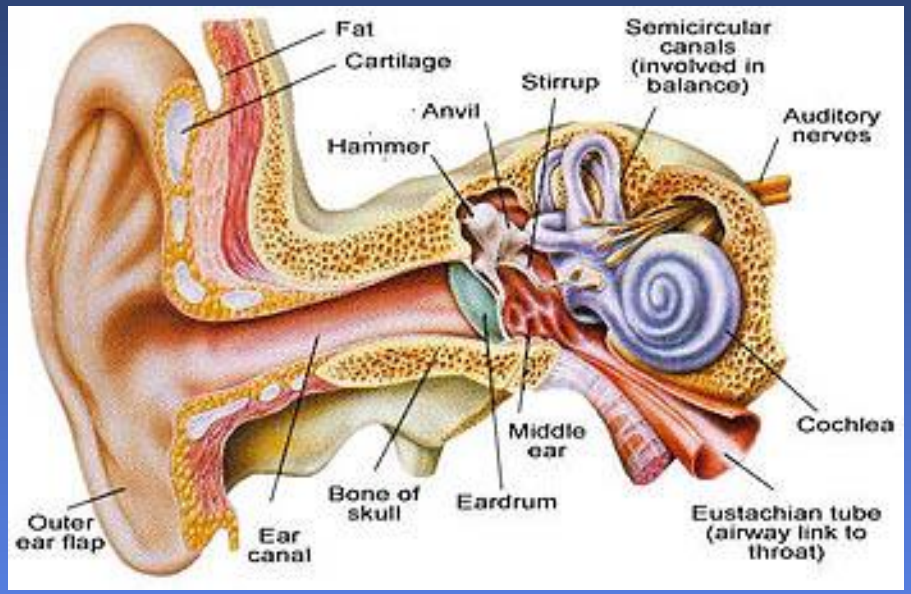
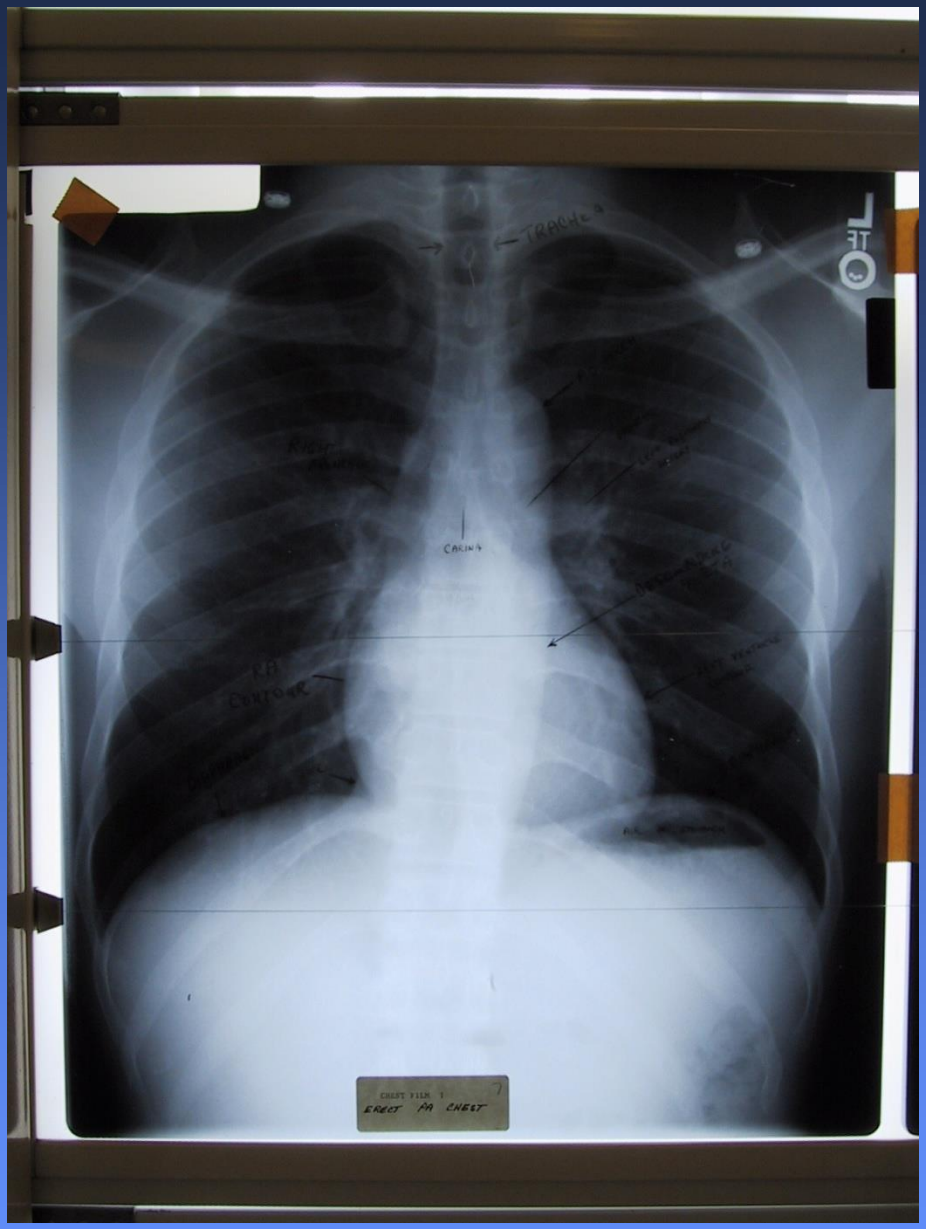


Courtesy of Dr. Francis Green



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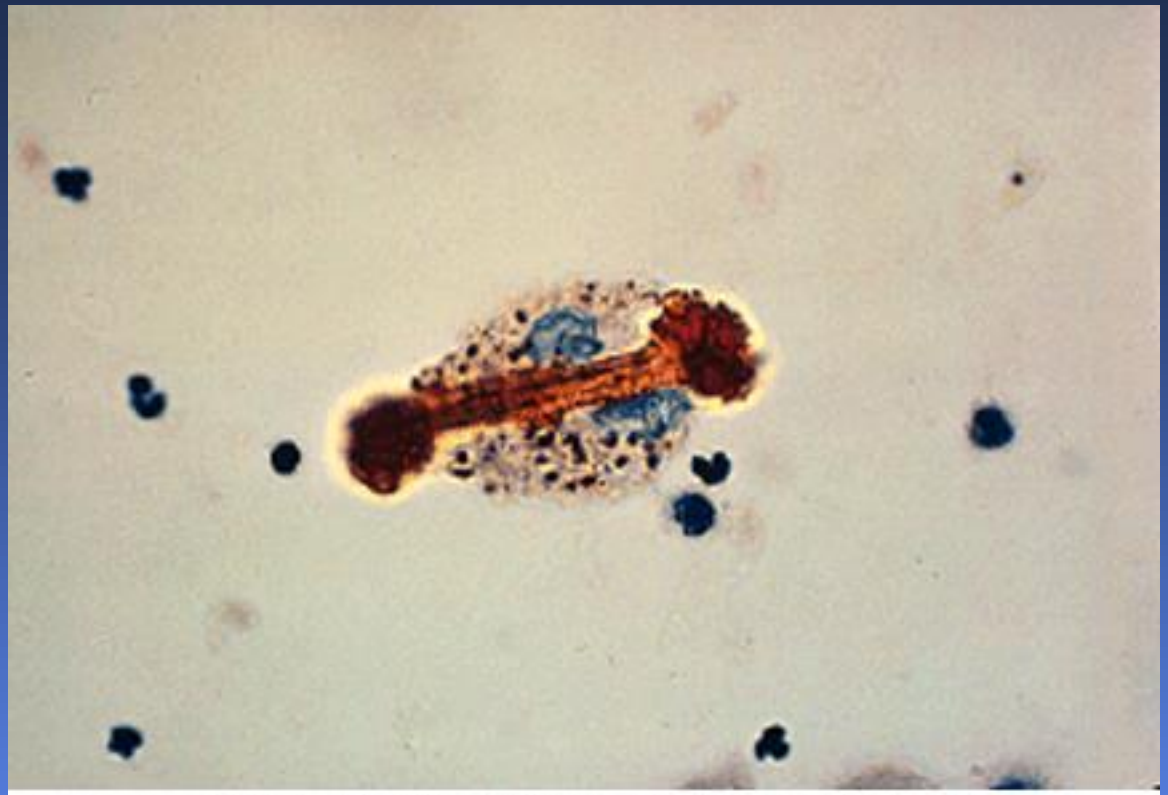

Asbestos body Photomicrograph shows a dumbbell-shaped asbestos body in a bronchoalveolar lavage specimen from a patient with a history of occupational asbestos exposure. Asbestos bodies differ from other nonasbestos ferruginous bodies in that the central core is thin and colorless and is covered by hemosiderin distributed in a characteristic beaded fashion. Courtesy of Jeffrey L Myers, MD.

Courtesy of Dr. Francis Green

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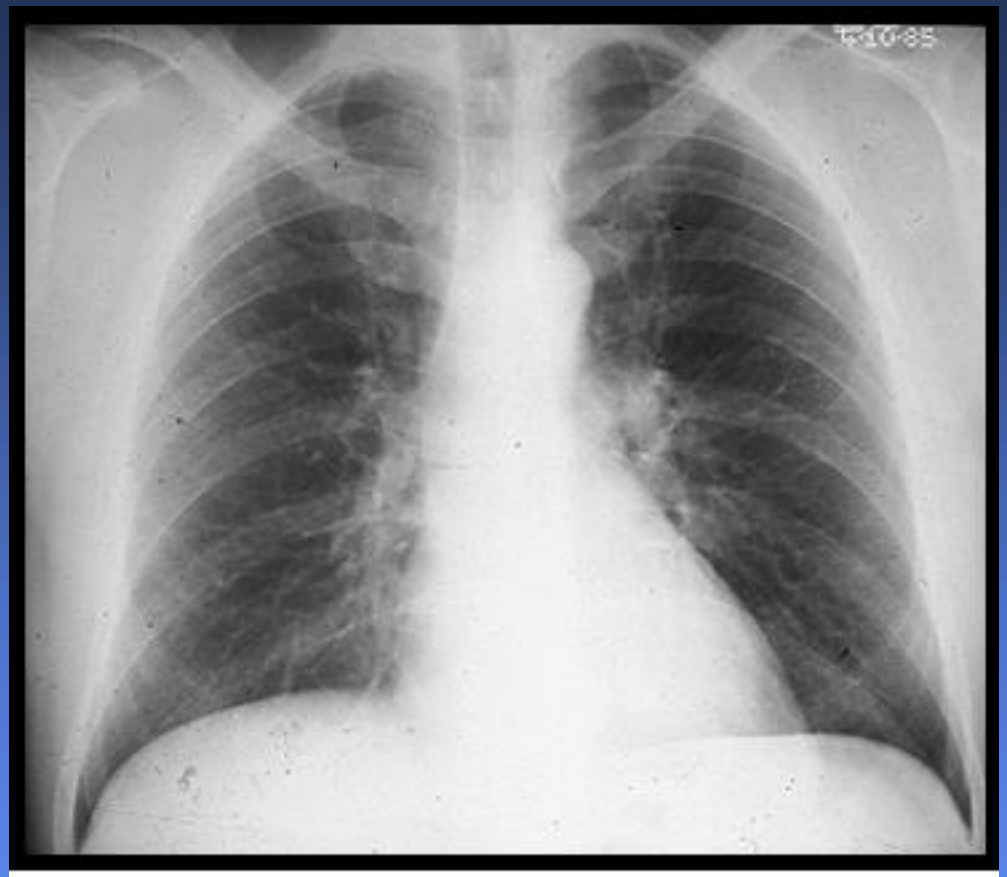

Normal chest film Posteroanterior view of a normal chest radiograph. Courtesy of Carol M Black, MD.

Courtesy of Dr. Francis Green

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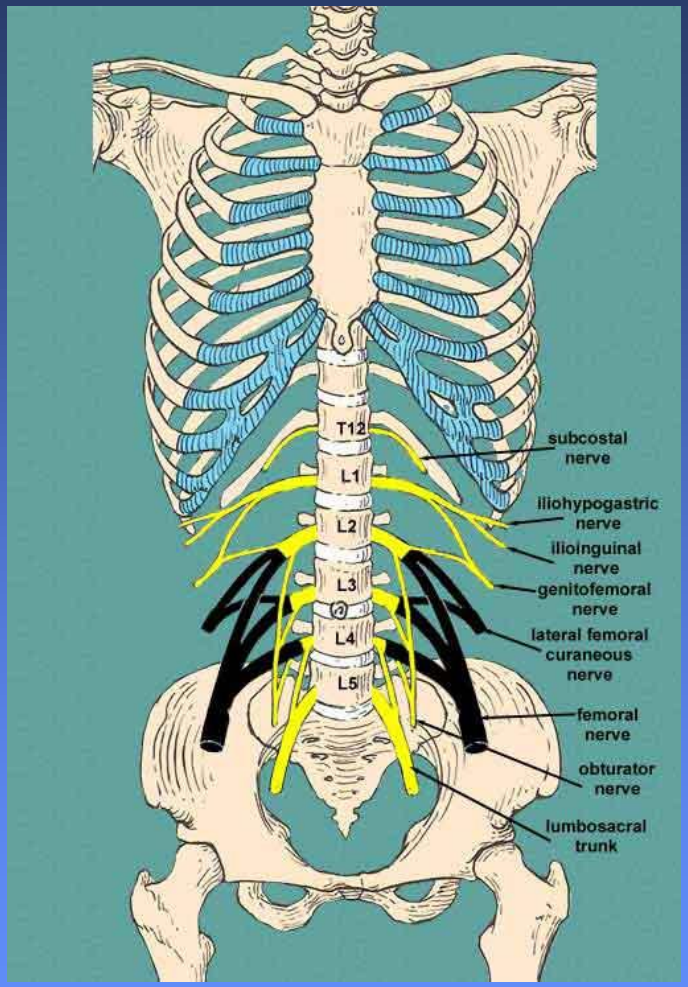

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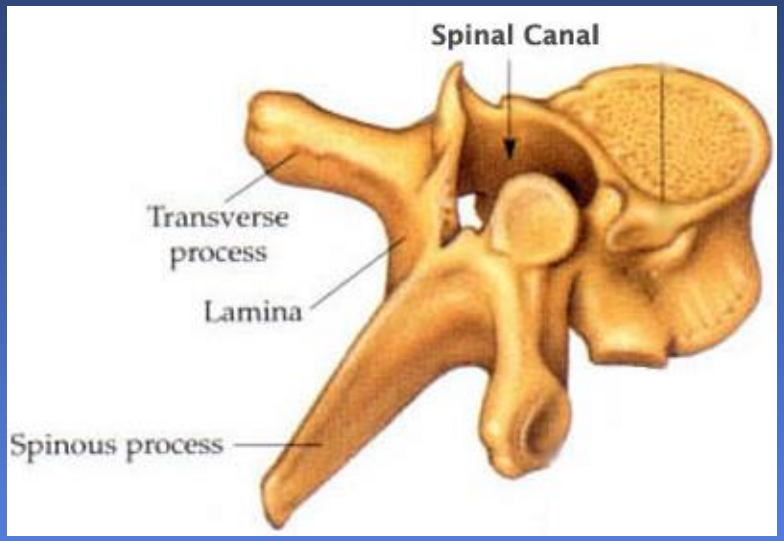
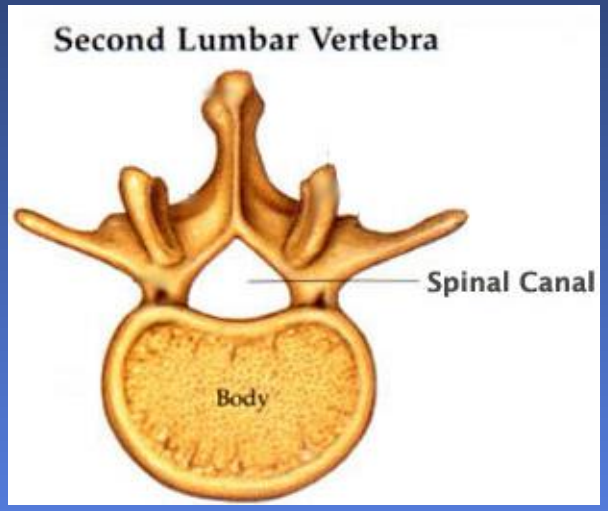


Courtesy of Dr. Francis Green



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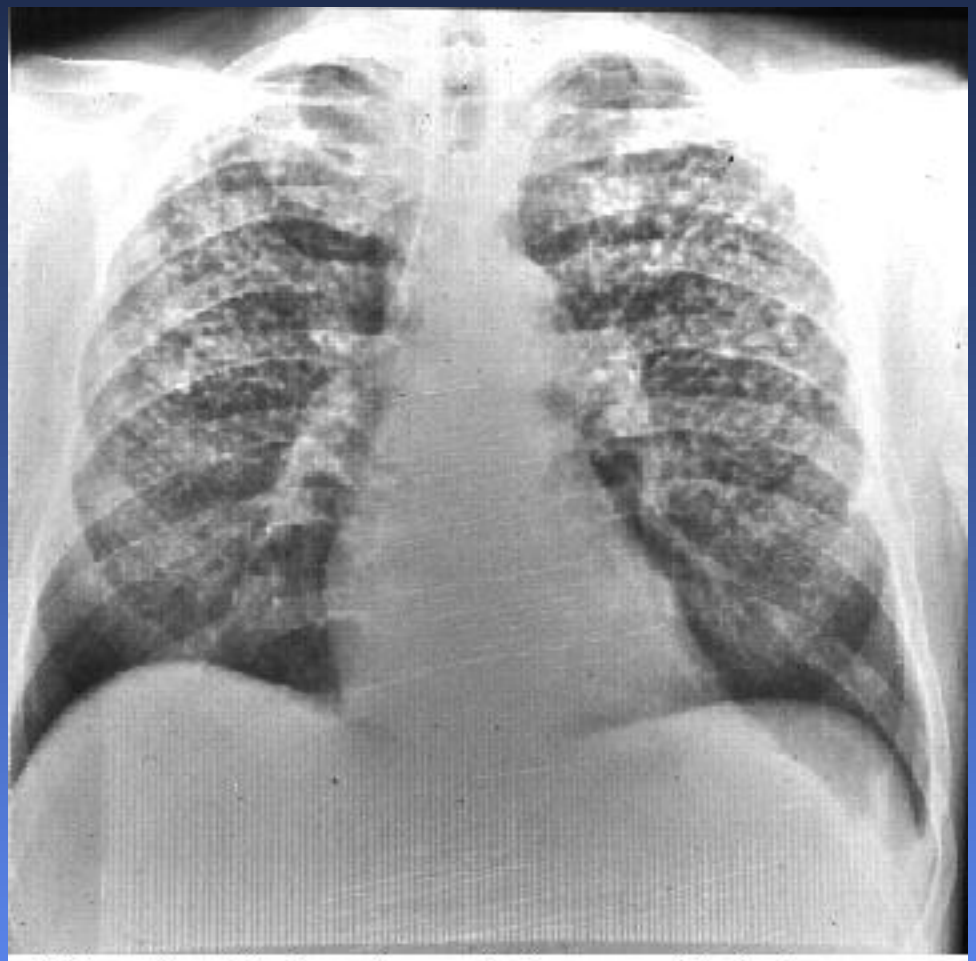

Silicosis Chest radiograph shows multiple larger nodules, 3-5 mm in diameter, with a bias for the upper lobes. Note calcification in some of the pulmonary nodules and the hilar lymph nodes. Courtesy of Paul Stark, MD.

Courtesy of Dr. Francis Green

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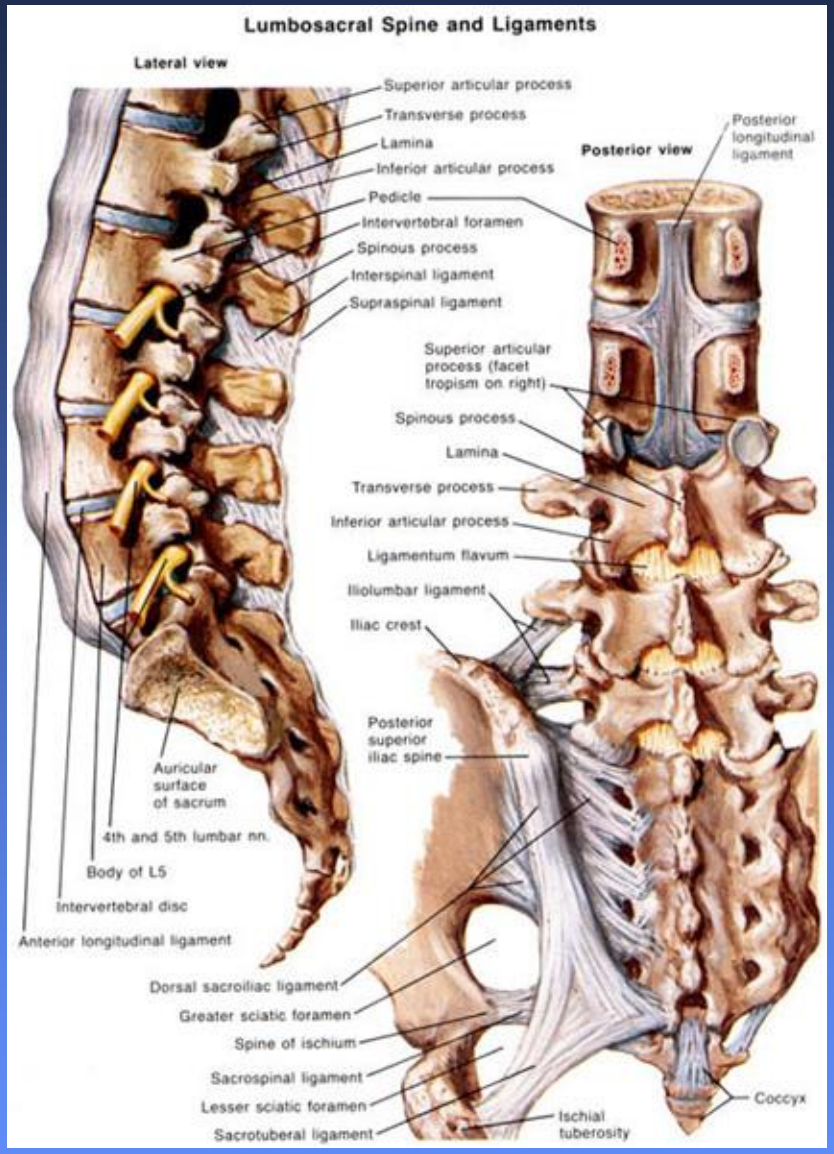

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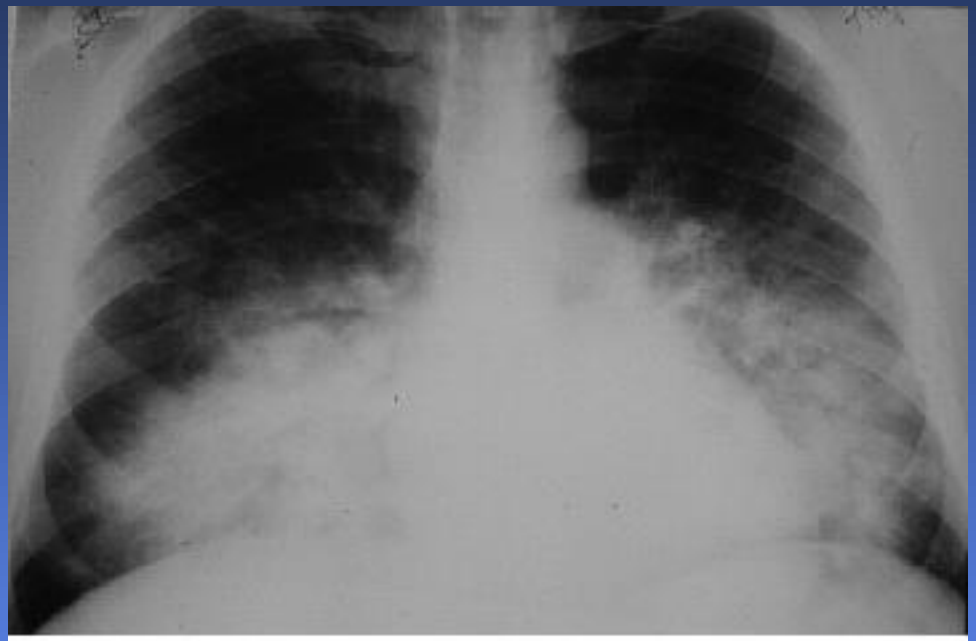
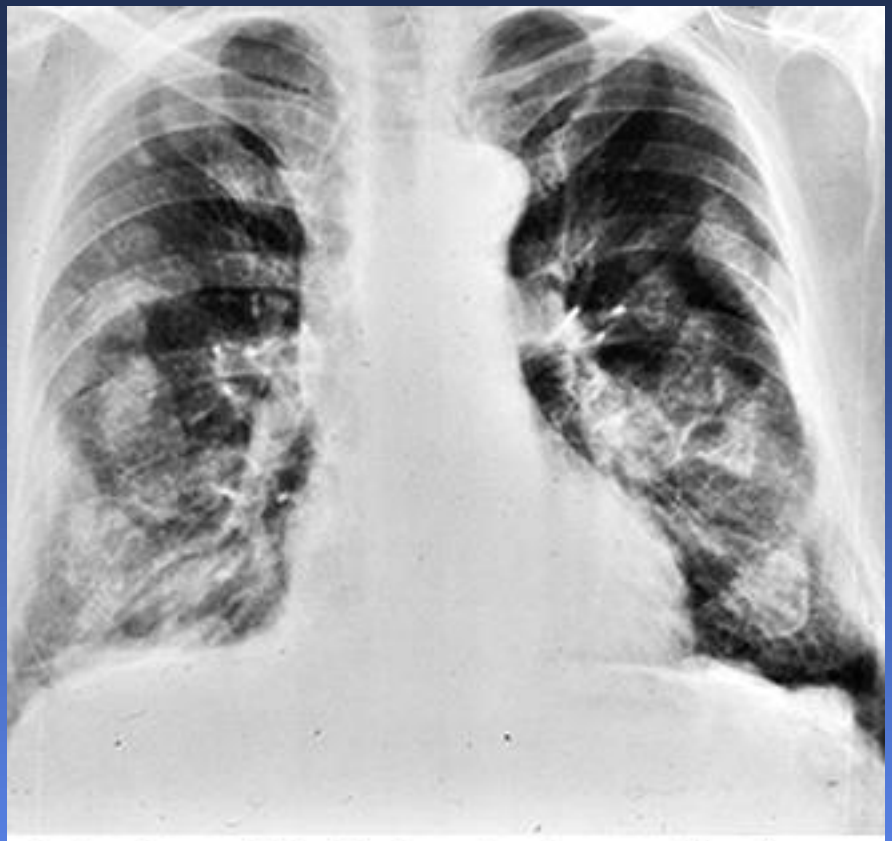


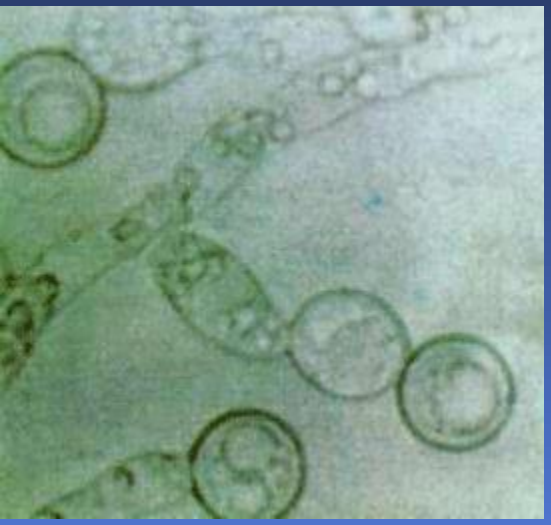
Pulmonary alveolar proteinosis Chest radiograph shows large perihilar and lower lobe opacities with normal cardiac silhouette. Courtesy of Paul Stark, MD.

Courtesy of Dr. Francis Green



Asbestos-related pleural plaques Chest radiograph shows multiple pleural plaques in a shipyard worker exposed to asbestos. These lesions can be mistaken for multiple pulmonary nodules. (Courtesy of Paul Stark, MD).

Courtesy of Dr. Francis Green



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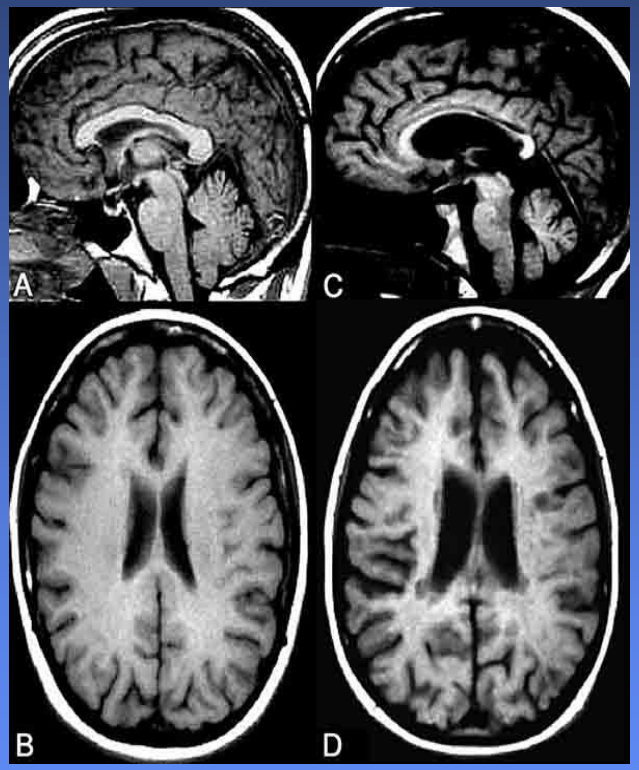

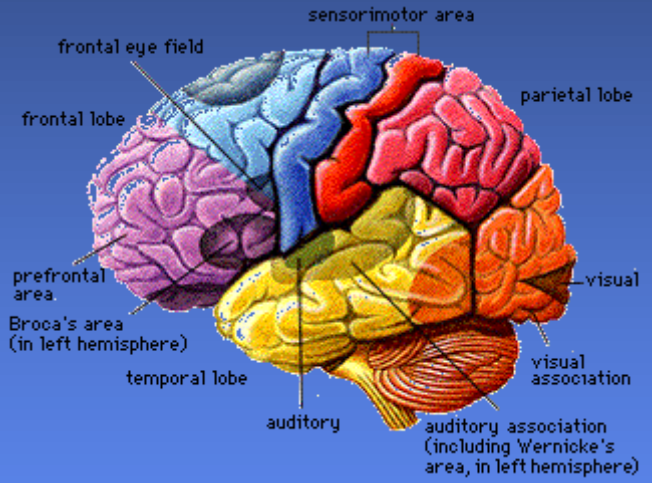

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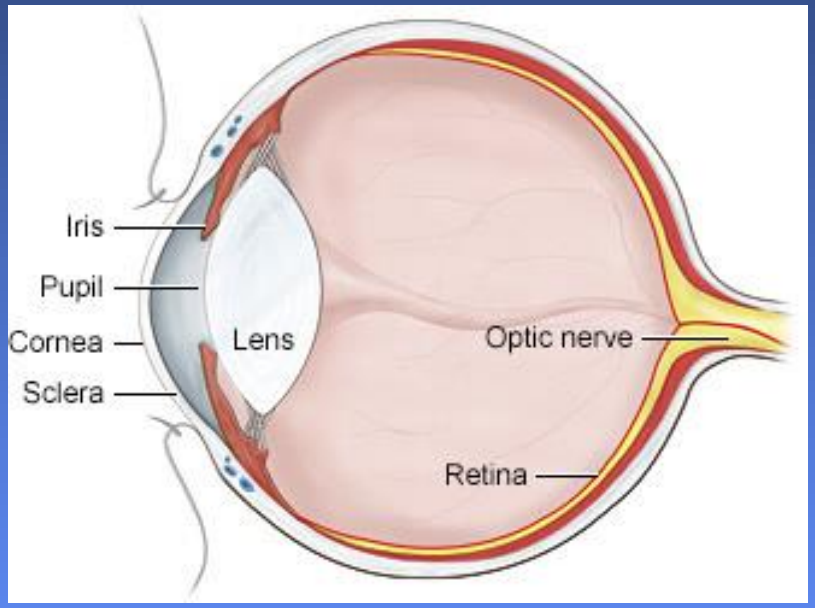

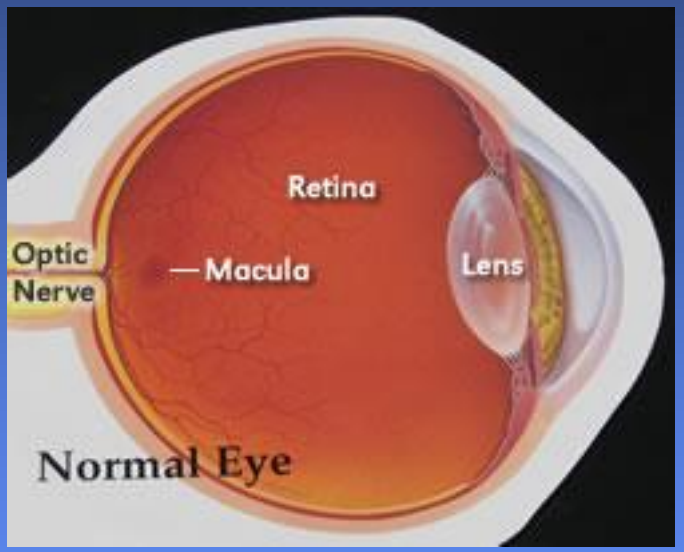

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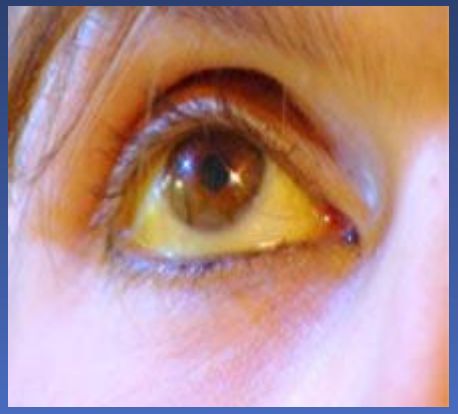

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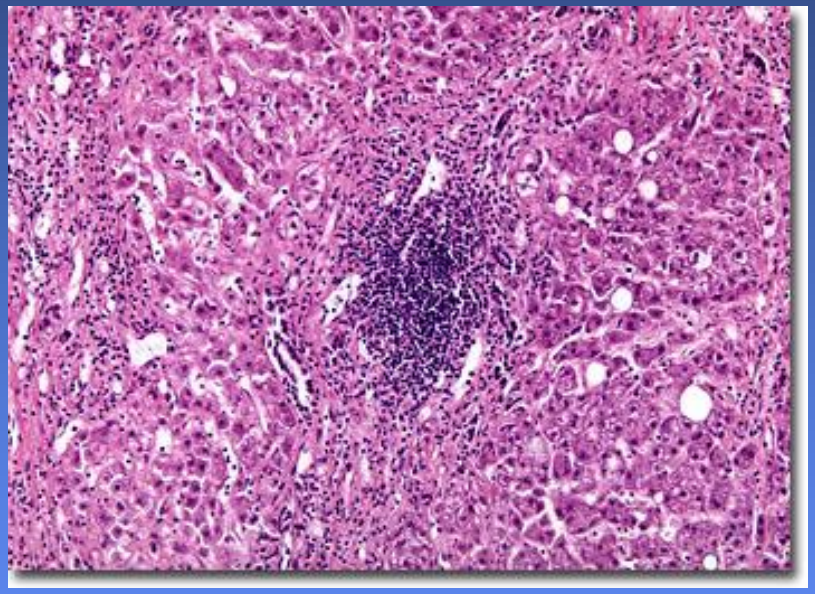

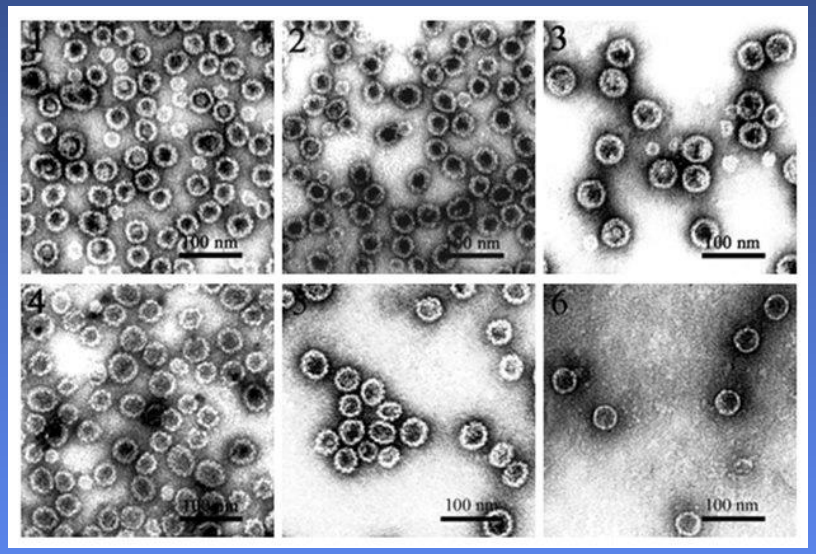

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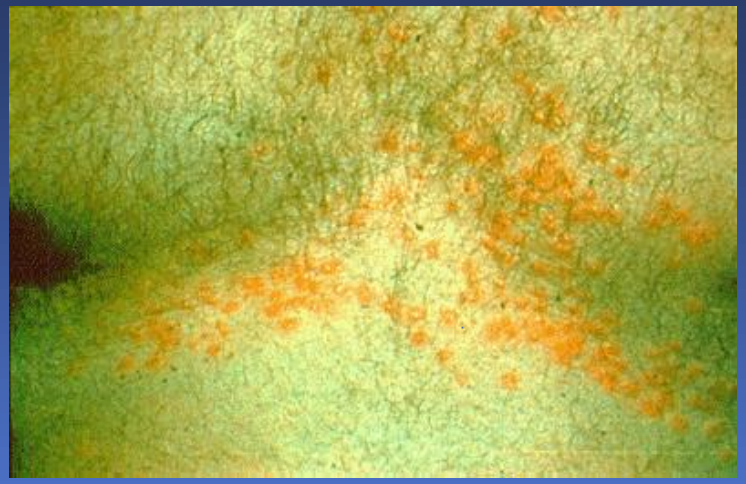

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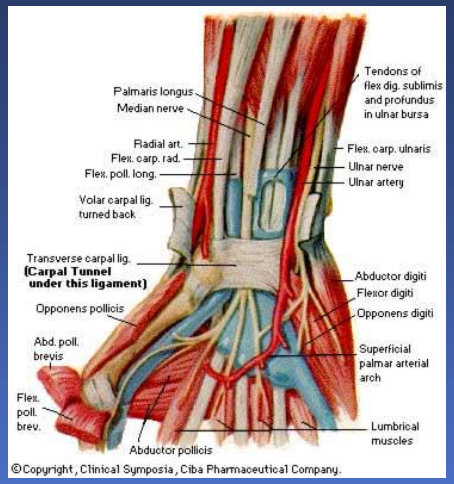

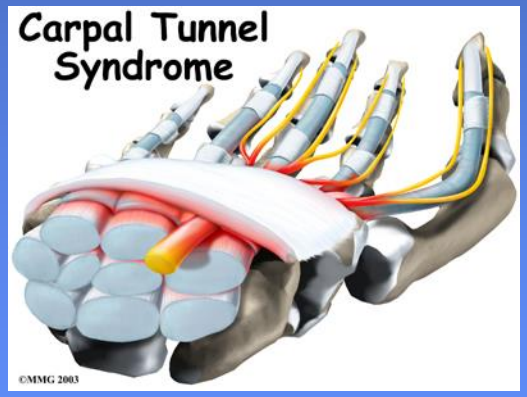

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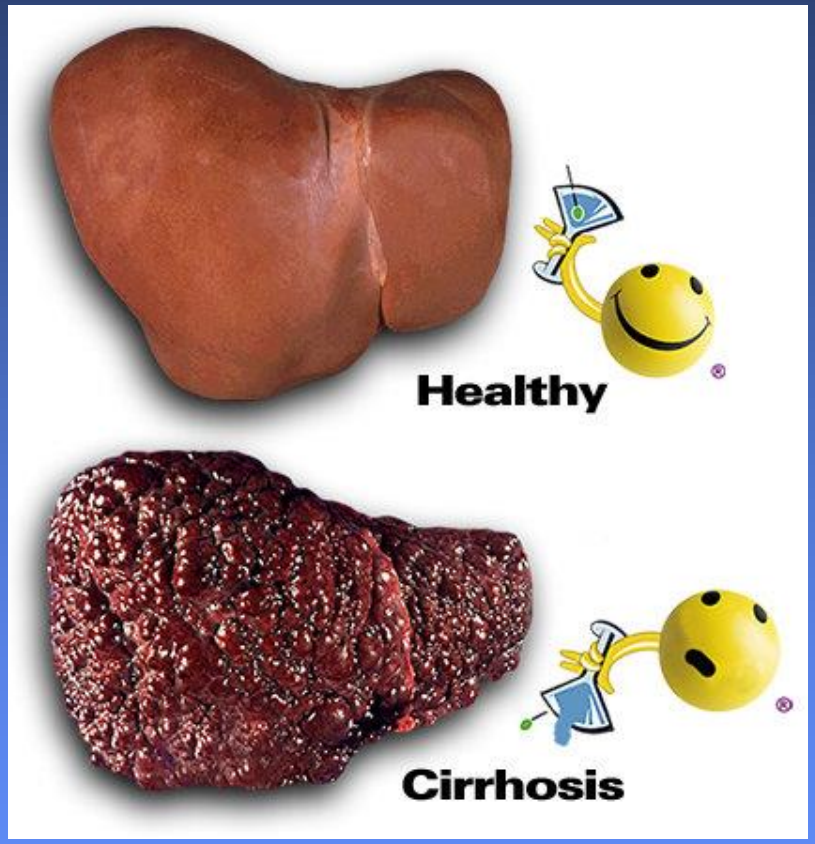

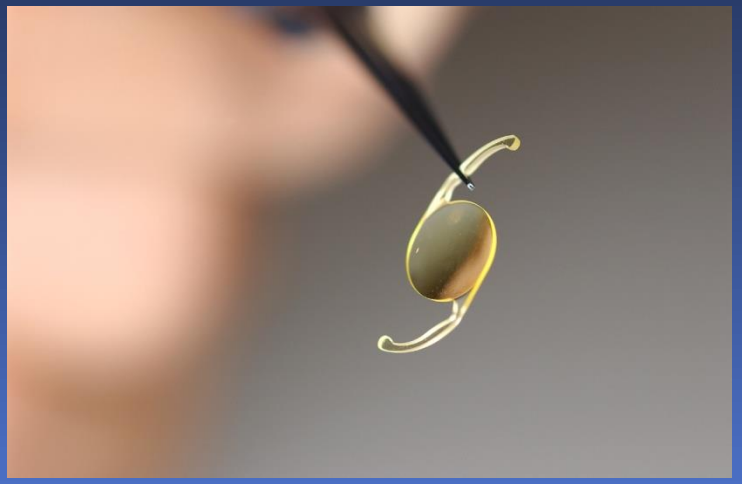

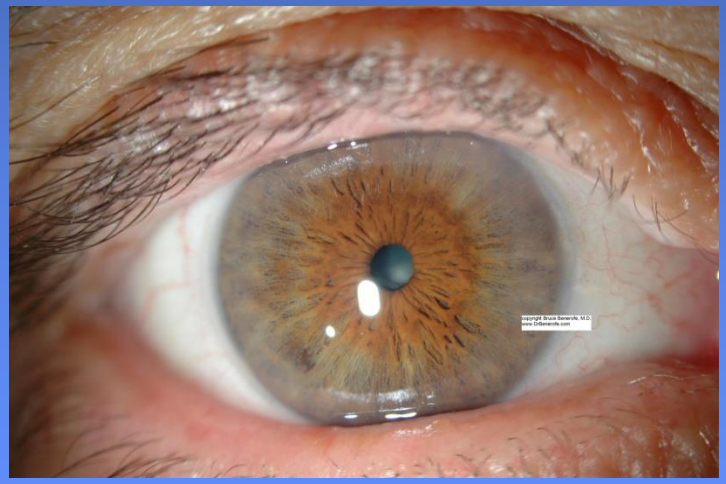

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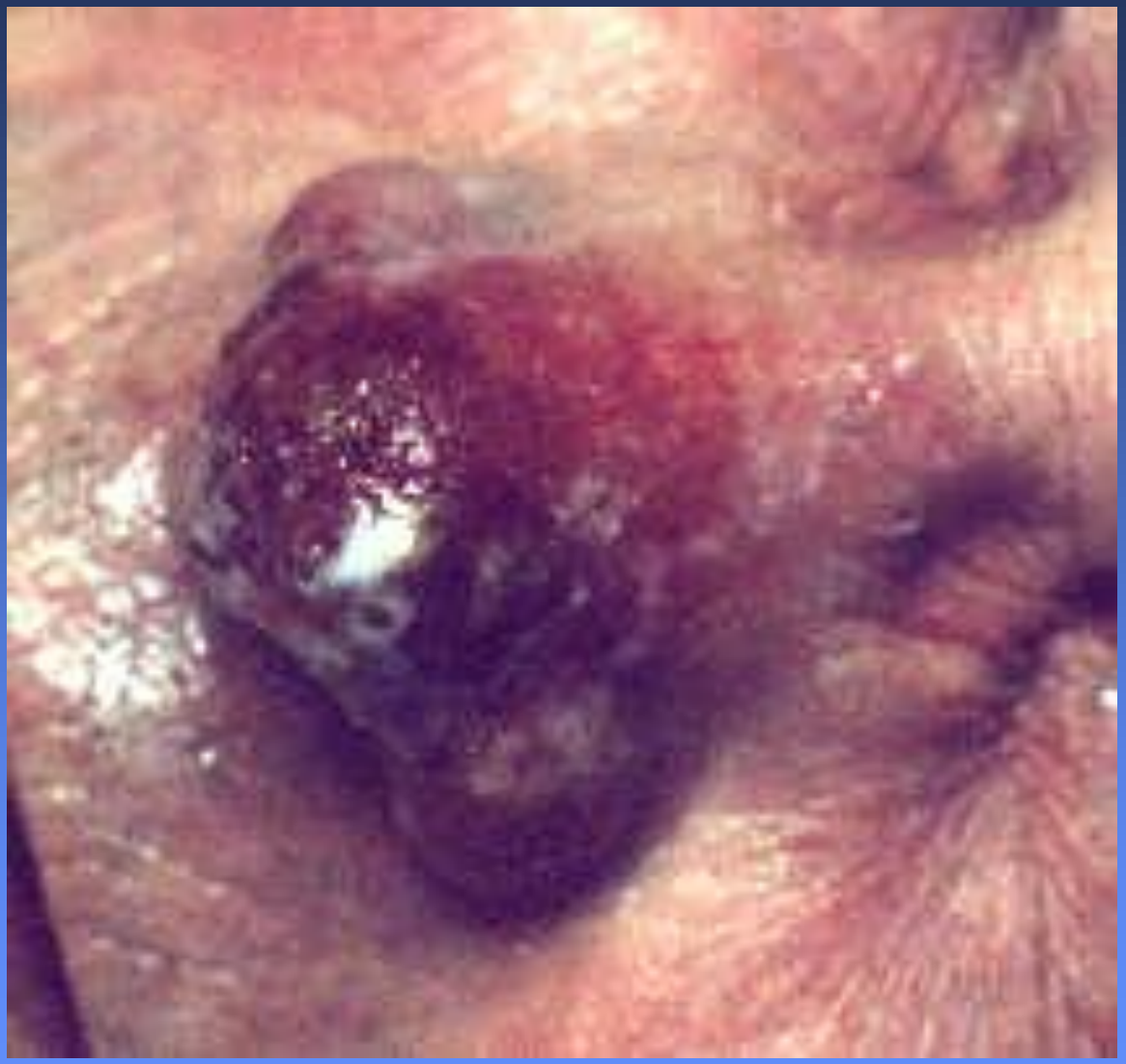

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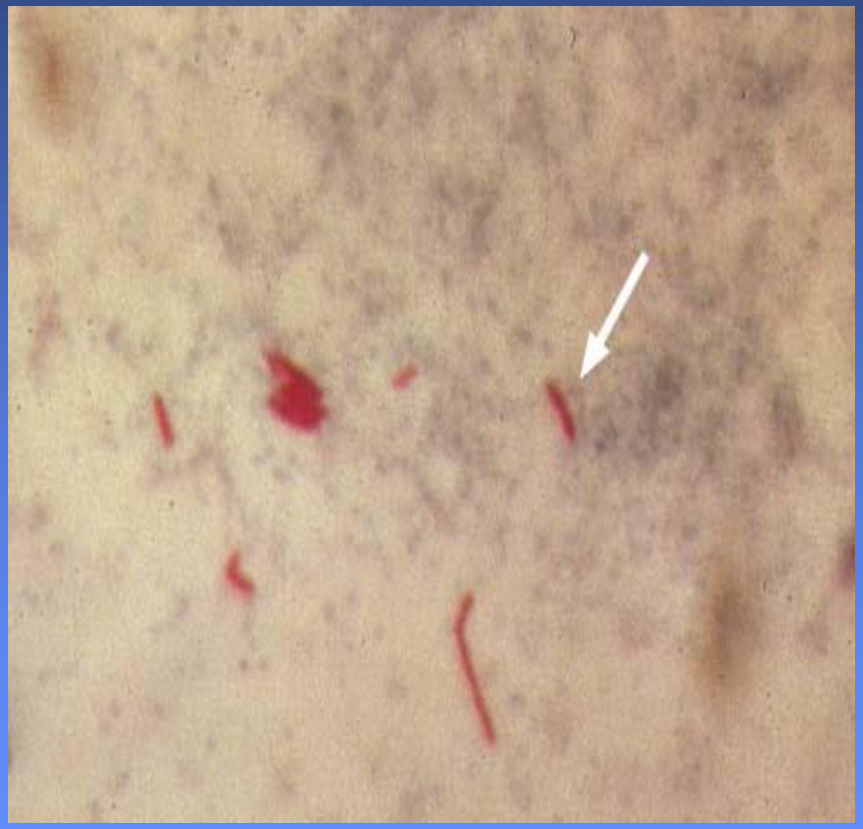

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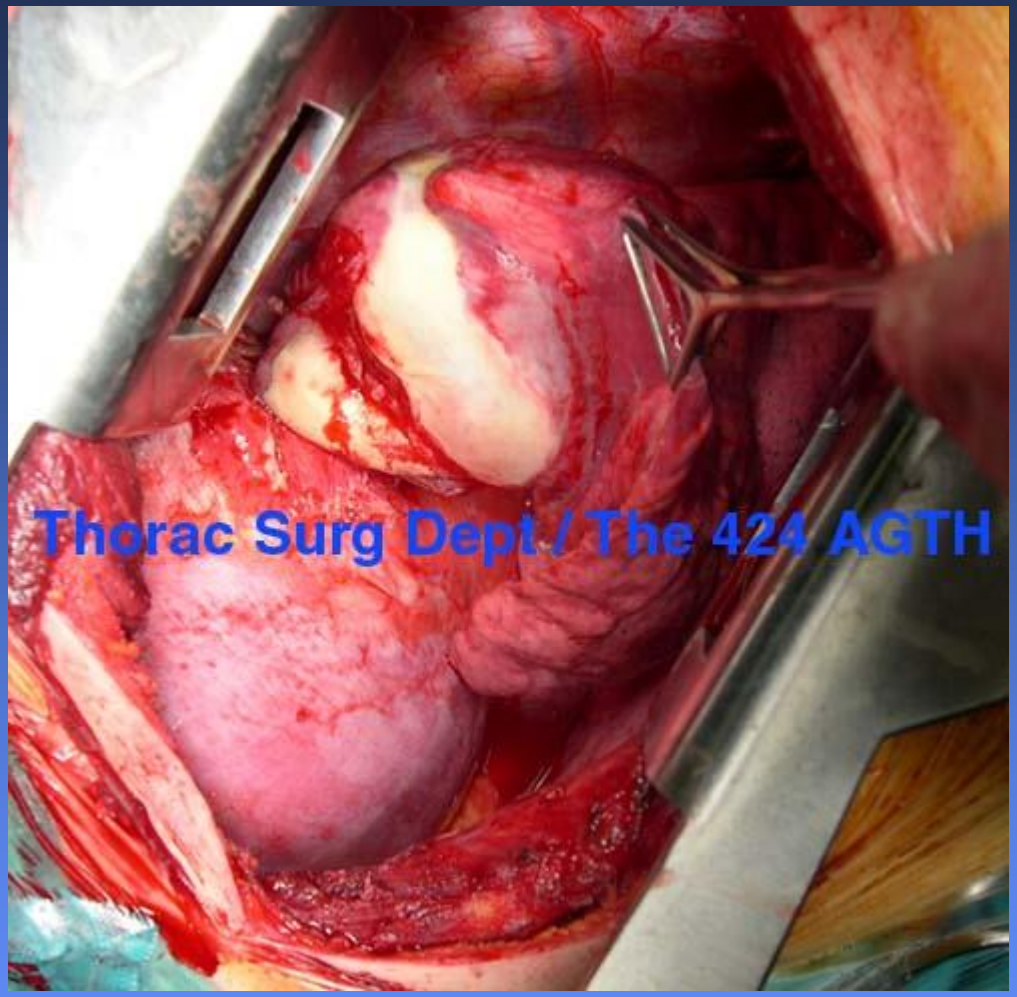

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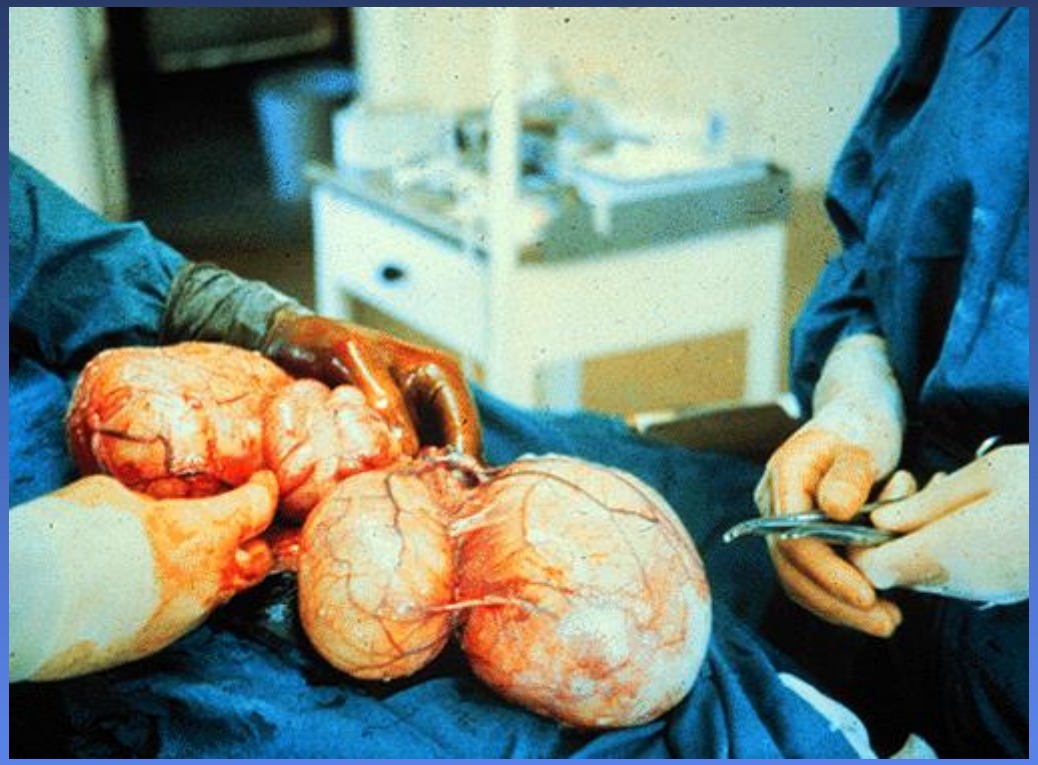

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