Disorders of Known Causes: Occupational Lung Diseases/Pneumoconioses andEnvironmental Lung Disease

Restrictive lung diseases; low lung volumes

WE KNOW the causes

- Asbestosis
- Silicosis
- Coal Worker's pneumoconiosis
- Berylliosis
- Hypersensitivity Pneumonia

APPROVED

inhalation of dust

inhaled organic antigens

Asbestos is still used in the US, most other places have banned asbestos

Most expensive to take care of and most misery, along with the most legal ads on tv is asbestos

Asbestos-related pleuropulmonary disease

- Benign asbestos effusions
- Pleural plaques
- Rounded atelectasis
- Asbestosis

interstitial lung disease

- Asbestos-related malignancies- malignant mesothelioma, bronchogenic carcinoma

Asbestos:
1. Asbestos can cause the following:
a. Benign asbestos effusions
b. Pleural plaques
c. Rounded atelectasis
d. Asbestosis, mesothelioma, bronchogenic carcinoma
2. Microscopically see beaded or dumbbell shapes

Types of Asbestos

naturally occurring products

- **Serpentine**
  - **Chrysotile (white asbestos)**
- **Commercial Amphiboles**
  - **Amosite (brown asbestos)**
  - **Crocidolite (blue asbestos)**
- **Non-commercial Amphiboles**
  - **Tremolite, Actinolite, Anthophyllite**

Accounts for most of the asbestos used in industry

Amphiboles are less prevalent but more pathogenic than chrystolies, particularly with respect to induction of malignant pleural tumors (mesotheliomas)

Bad problems

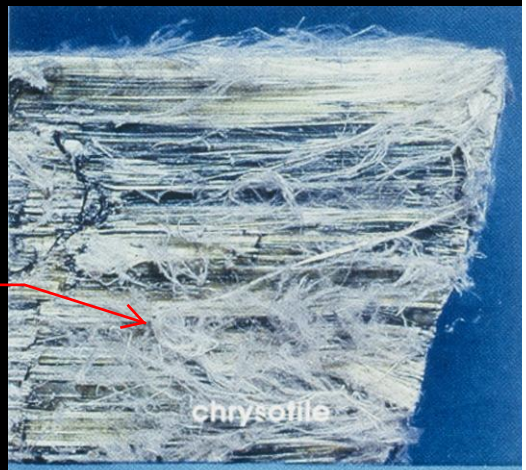
mostly comes from Montana

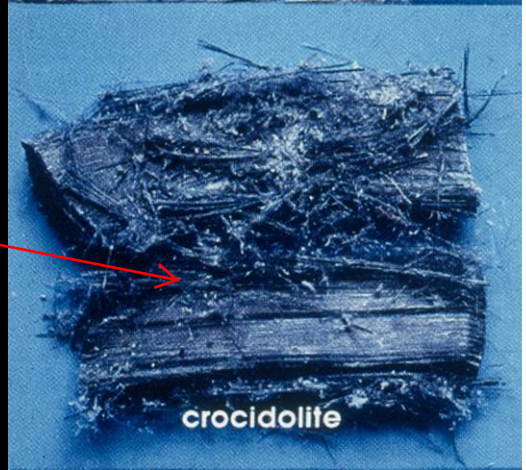
what absetos looks like

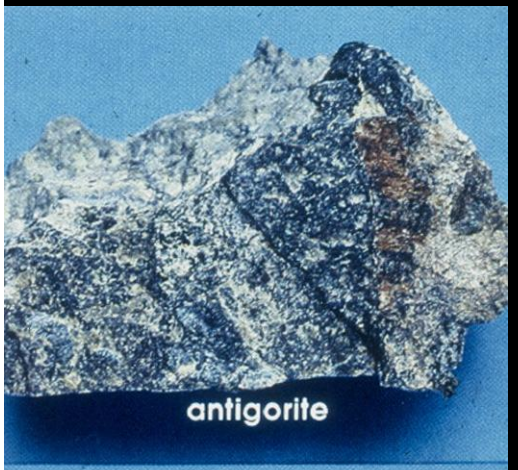
still used in US:

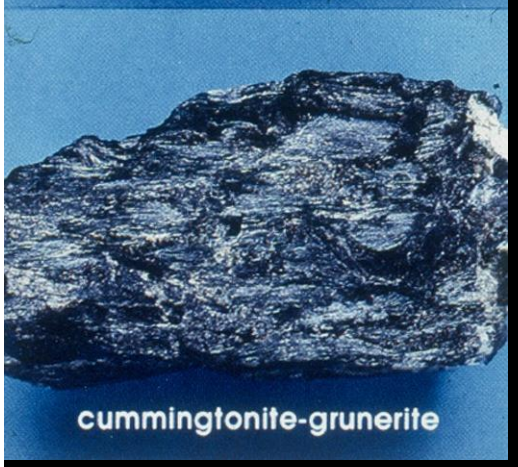
found in South Africa

Still used today:
chrysotile
crocidolite
amosite










Fiber core in the center; asbestos bodies generated by body to counteract the negative aspects of asbestos
ASBESTOS is EVERYWHERE!!!!
We all have it in us!
asbestos in the lung
We have all inhaled asbestos and we develop macrophages to counteract asbestos

Asbestos fibers can be seen in great abundance in those who worked on warships in the second great world war and with insulation materials

Asbestos bodies appear as golden brown or beaded rods with a translucent center and consist of asbestos fibers coated with an iron-containing proteinaceous material. They arise when macrophages attempt to phagocytose asbestos fibers; the iron is presumably derived from phagocyte ferritin.

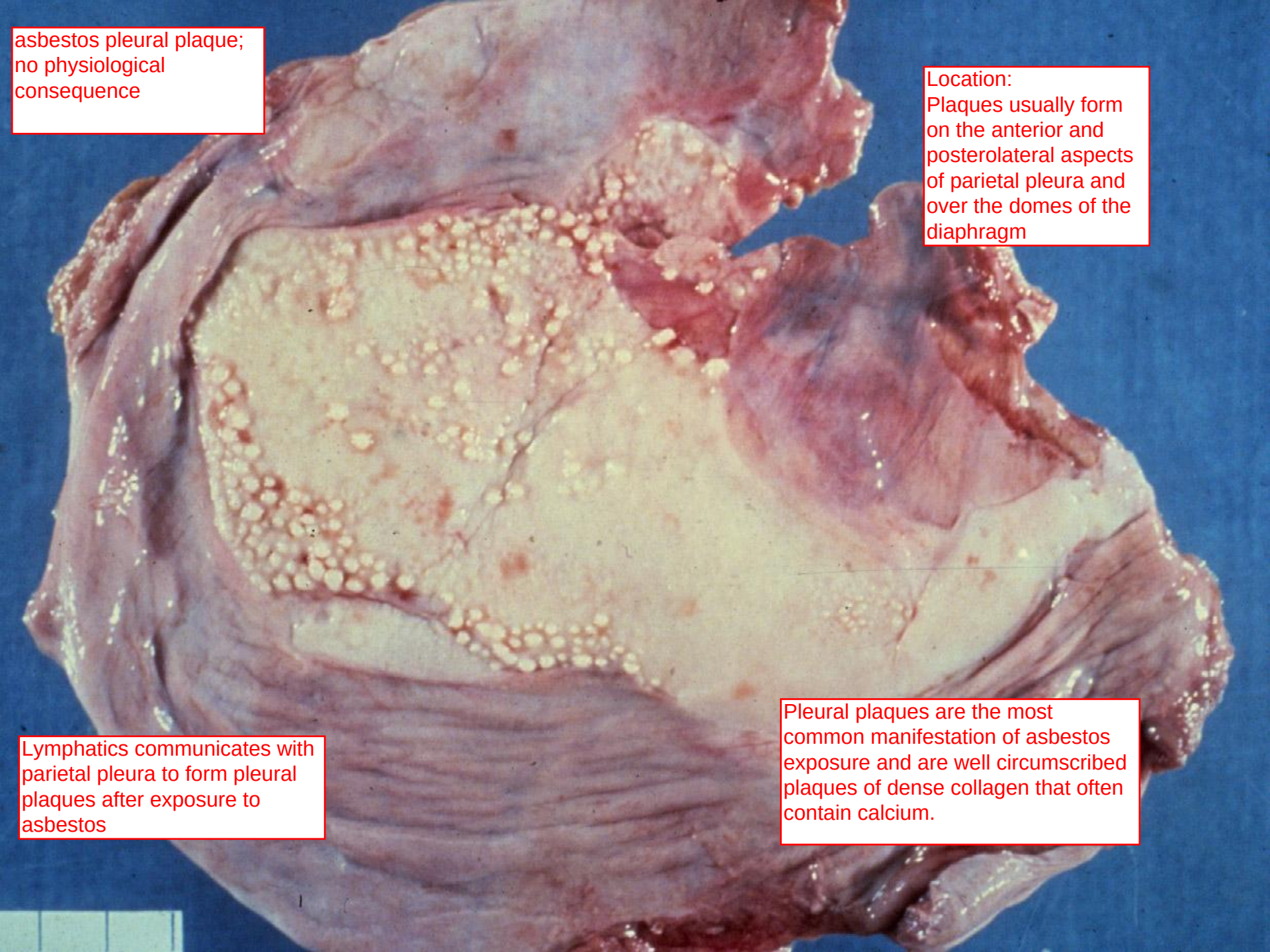
We will see patients with asbestos lung problems still today

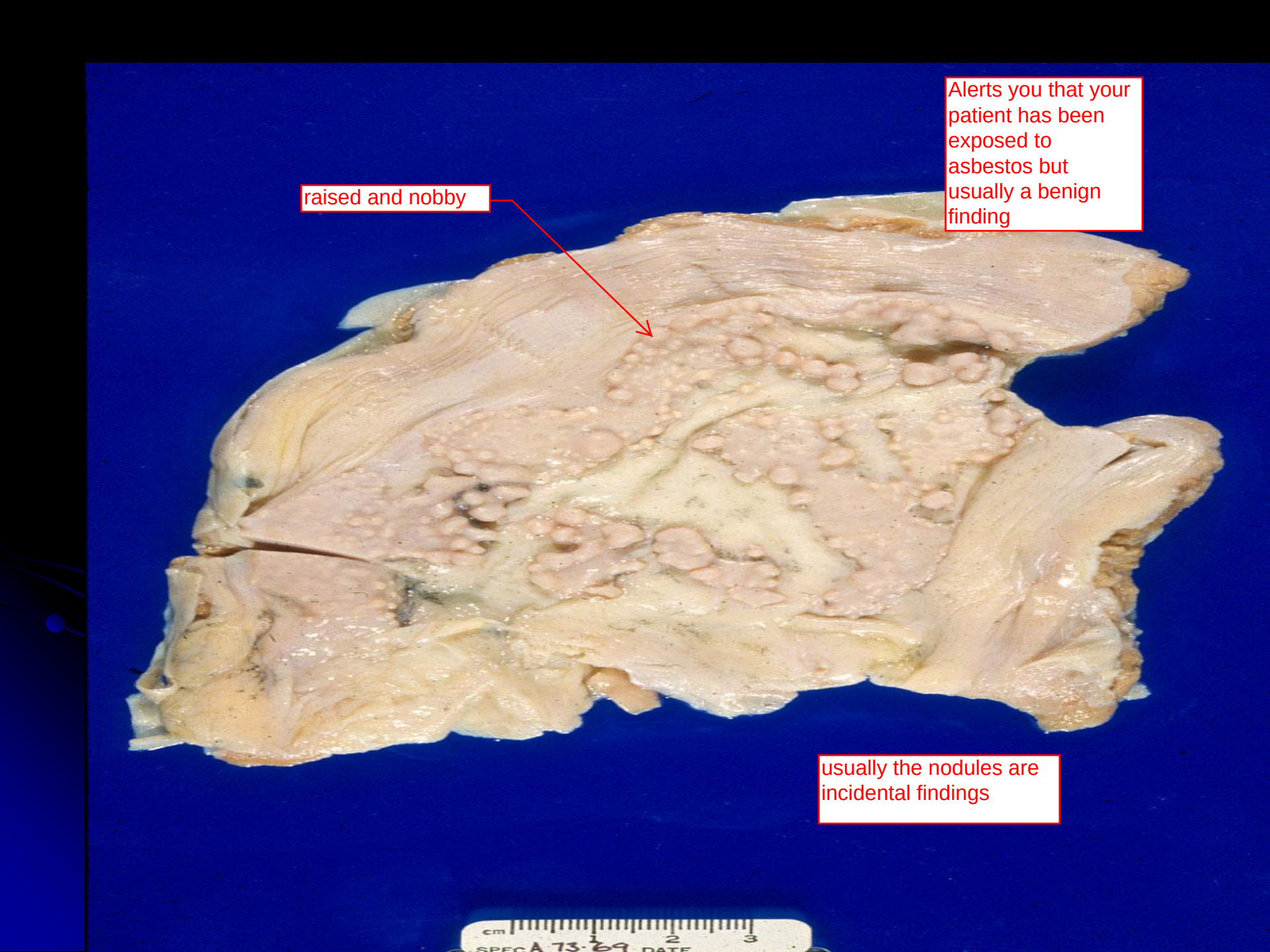

Can sample these fibers and determine their source
Takes more than a causal exposure to asbestos to cause significant harm
1 0 µm

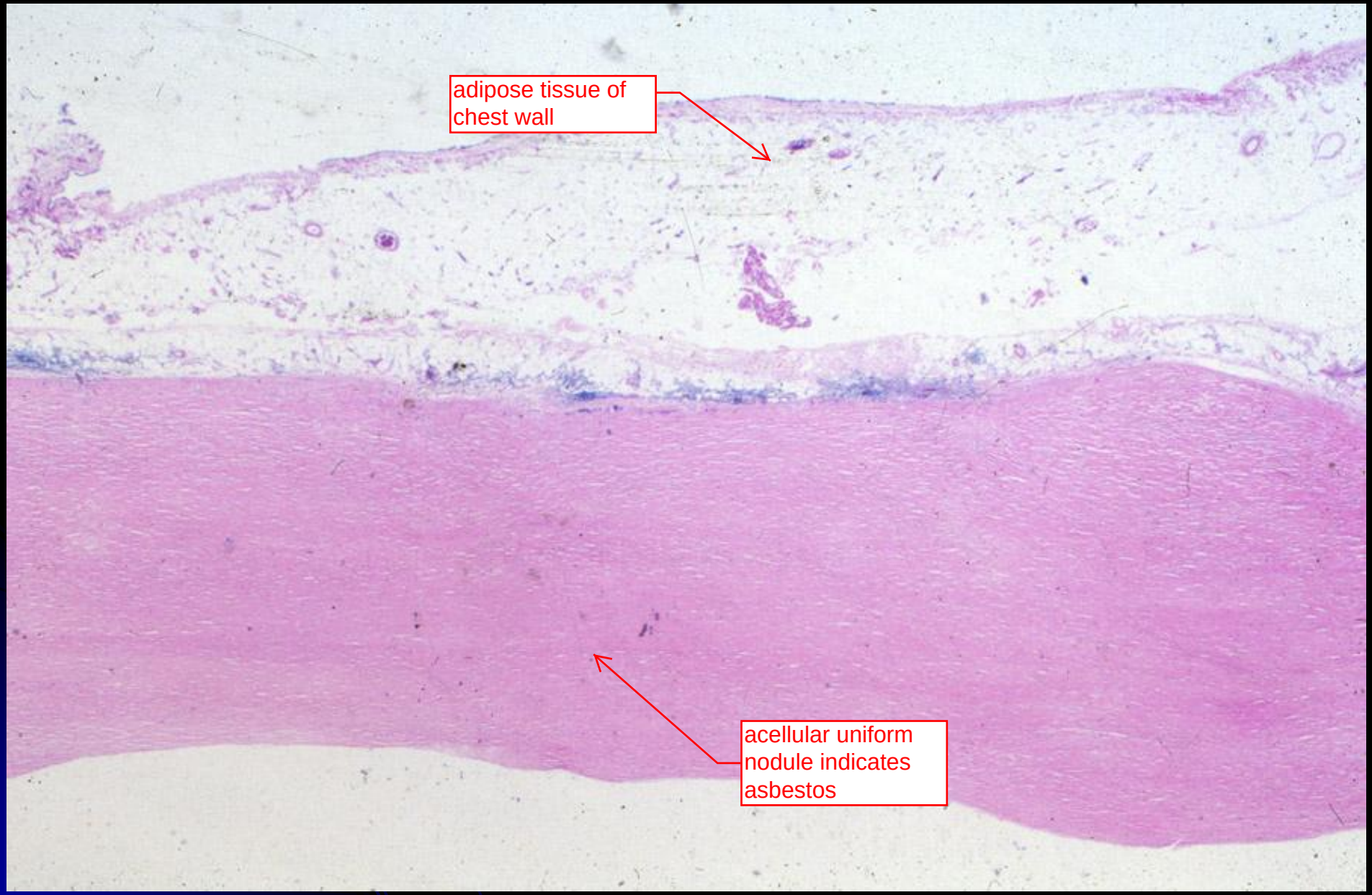
Pleural Plaques

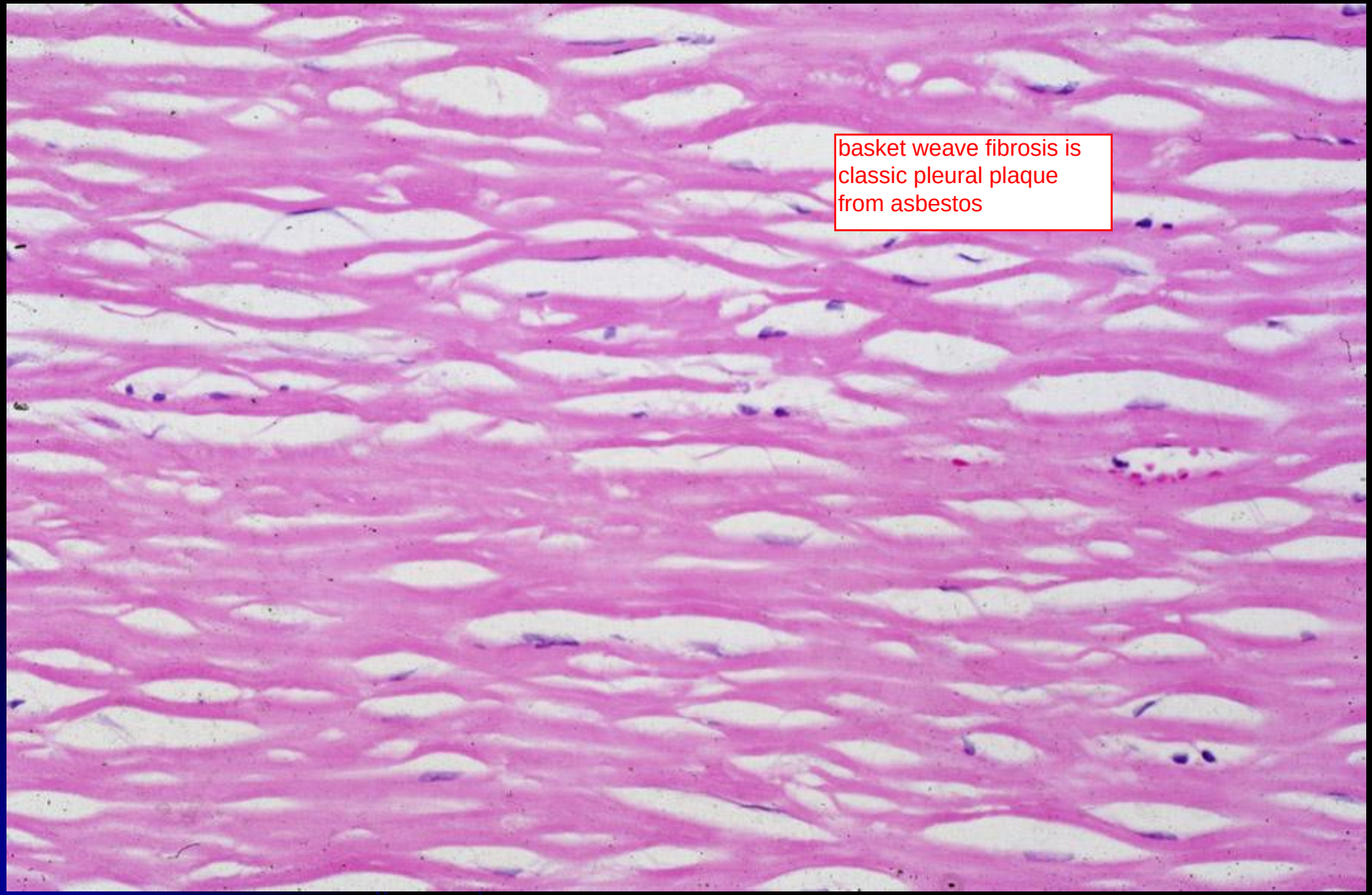
Pleural plaques:
a. Not much clinical significance (just indicates exposure to asbestos)
b. Very **common**, white rocks seen on parietal pleura
c. Uniform **acellular collagen proliferation**
d. Plaques appear on parietal pleura

Damage of asbestos depends on the level of exposure.
Most people have between 1-20 asbestos bodies. A higher exposure leads to pleural plaques

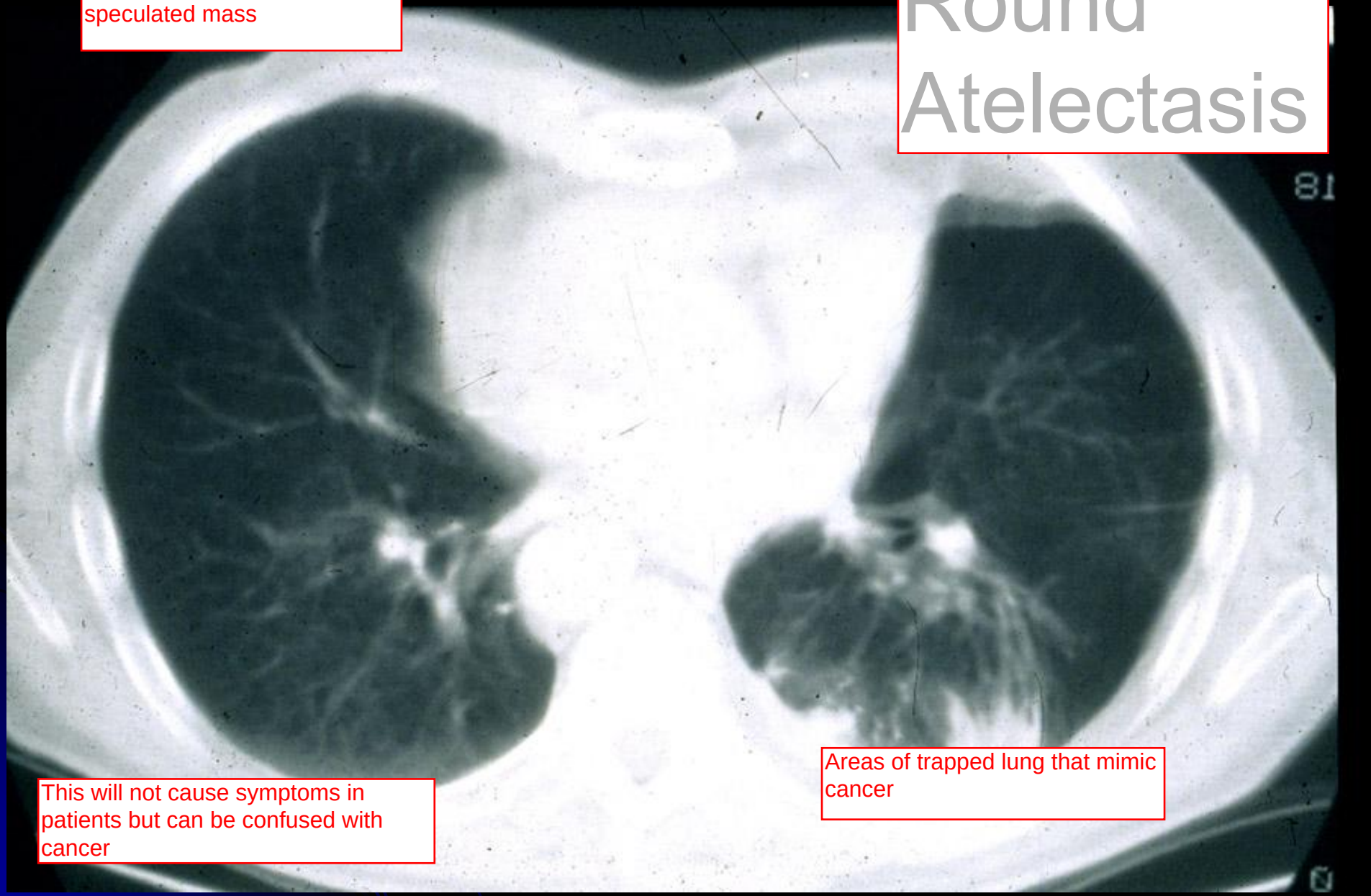

asbestos pleural plaque; no physiological consequence
Location:
Plaques usually form on the anterior and posterolateral aspects of parietal pleura and over the domes of the diaphragm
Lymphatics communicates with parietal pleura to form pleural plaques after exposure to asbestos
Pleural plaques are the most common manifestation of asbestos exposure and are well circumscribed plaques of dense collagen that often contain calcium.


raised and nobby
Alerts you that your patient has been exposed to asbestos but usually a benign finding
usually the nodules are incidental findings


adipose tissue of chest wall
acellular uniform nodule indicates asbestos


basket weave fibrosis is classic pleural plaque from asbestos

Round Atelectasis



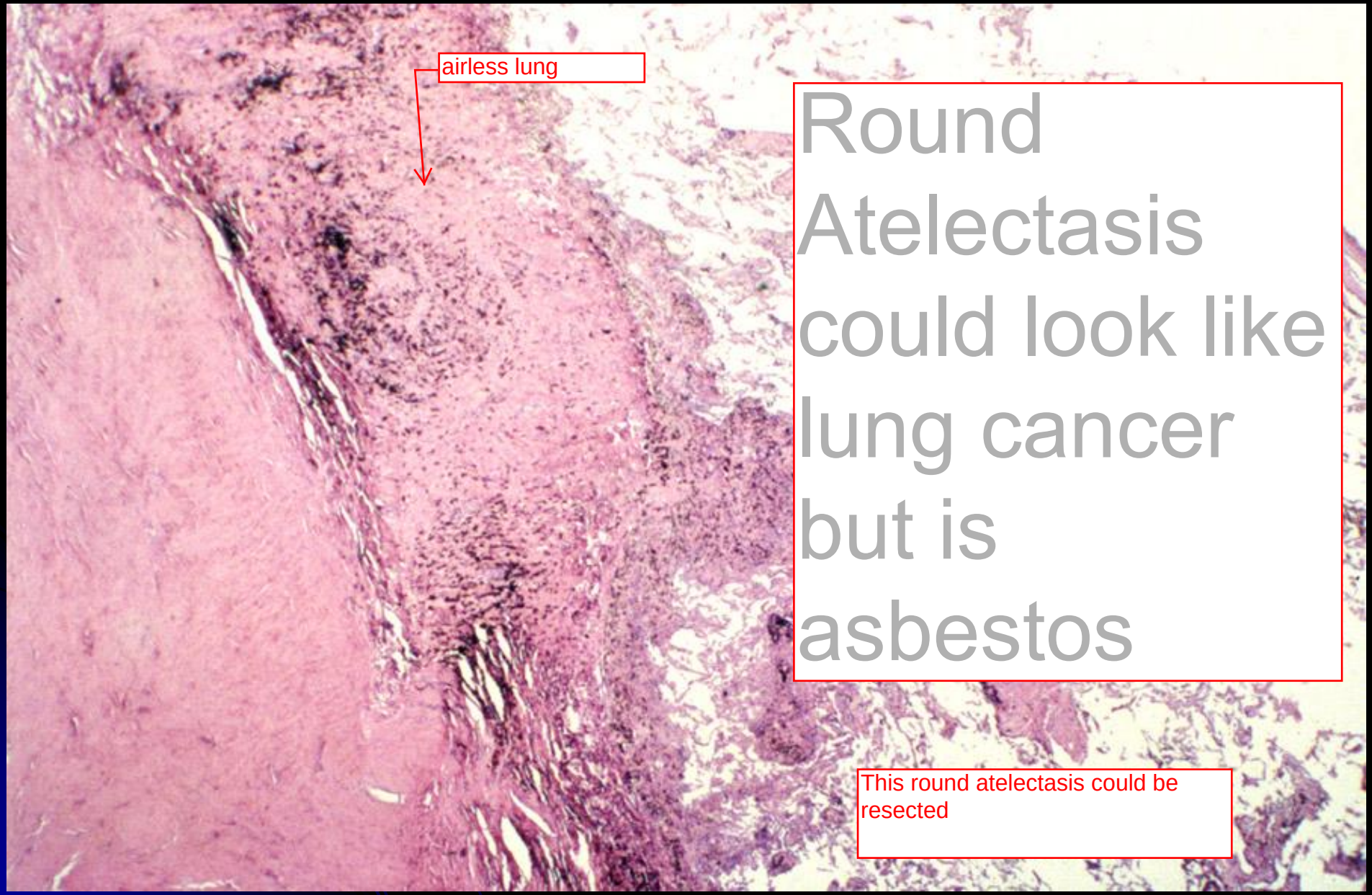
CT scan
speculated mass

This will not cause symptoms in patients but can be confused with cancer

Areas of trapped lung that mimic cancer

Visceral pleural fibrosis and Round Atelectasis

Round atelectasis:
a. Mimics malignancy in peripheral lung
b. Is benign without clinical significance


airless lung
Round Atelectasis could look like lung cancer but is asbestos
This round atelectasis could be resected

used to be a huge problem for individuals working in shipyards

Asbestosis

seeing less and less as we improve hygiene

- Associated with prolonged/heavy oocupational exposure to commercial forms
- Linear interstitial and bronchiolocentric fibrosis, most sever in lower lobes, periphery
- Histologic sine qua non is the asbestos body
- Increased risk for lung cancer

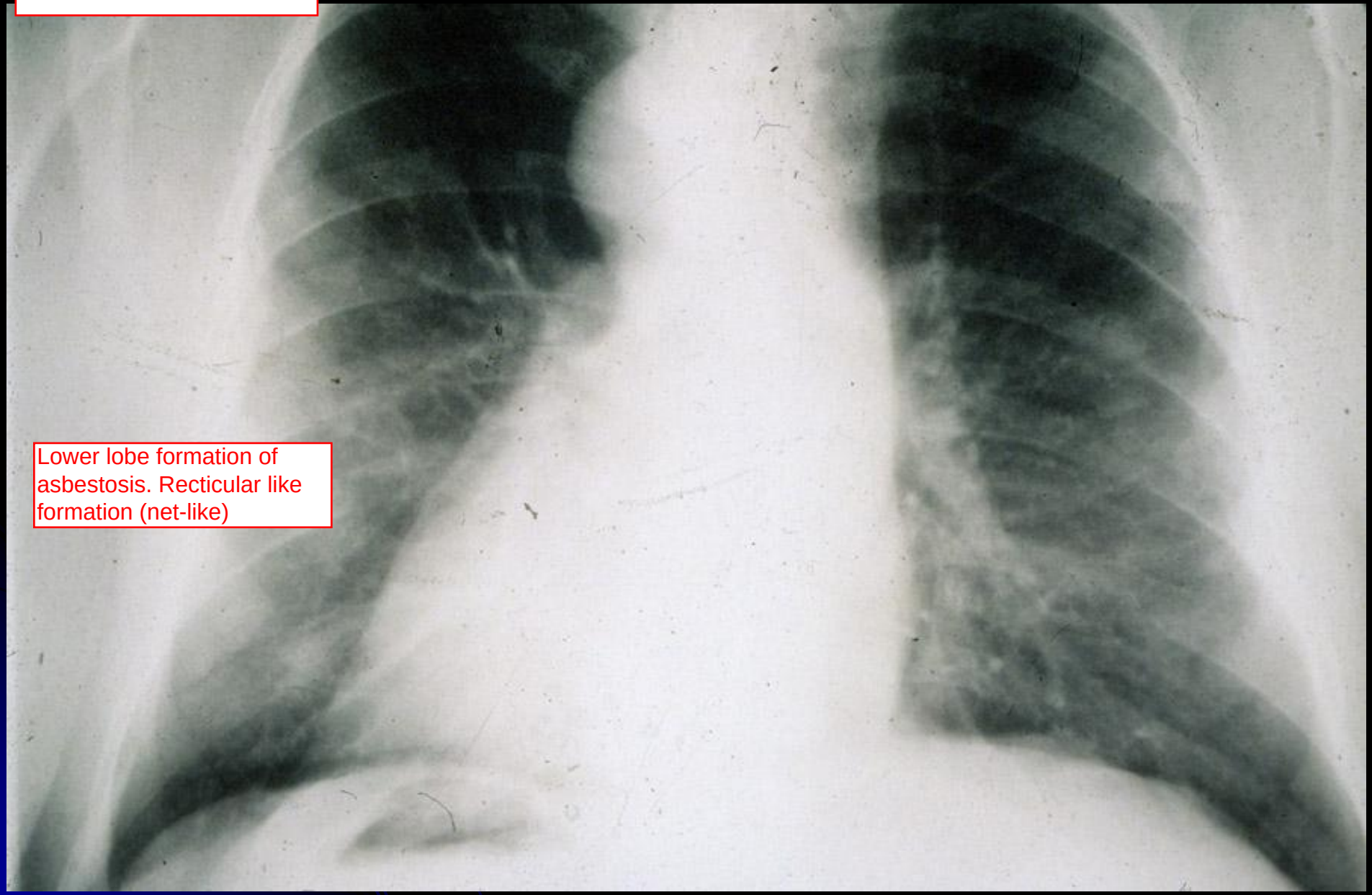
lower lobes is where the asbestos seem to settle out

Asbestos fibers have been linked to increased free radical production. The link between smoking and asbestos and lung cancer could be related to the ability of the asbestos fibers to absorb the carcinogens produced by smoking. If they are absorbed rather than metabolized they stay in the body for a longer period of time; 35 fold increase for lung cancer when individuals is exposed to smoking and asbestos

Asbestosis:
a. Clinical history of exposure
b. Seen mainly in **lower** lung lobes
c. Grossly see cobble-stone appearance
d. Increases risk of bronchogenic carcinoma in smokers

Have to see asbestos bodies to make a diagnosis of asbestosis, because can be confused for other diseases. No treatment for asbestosis

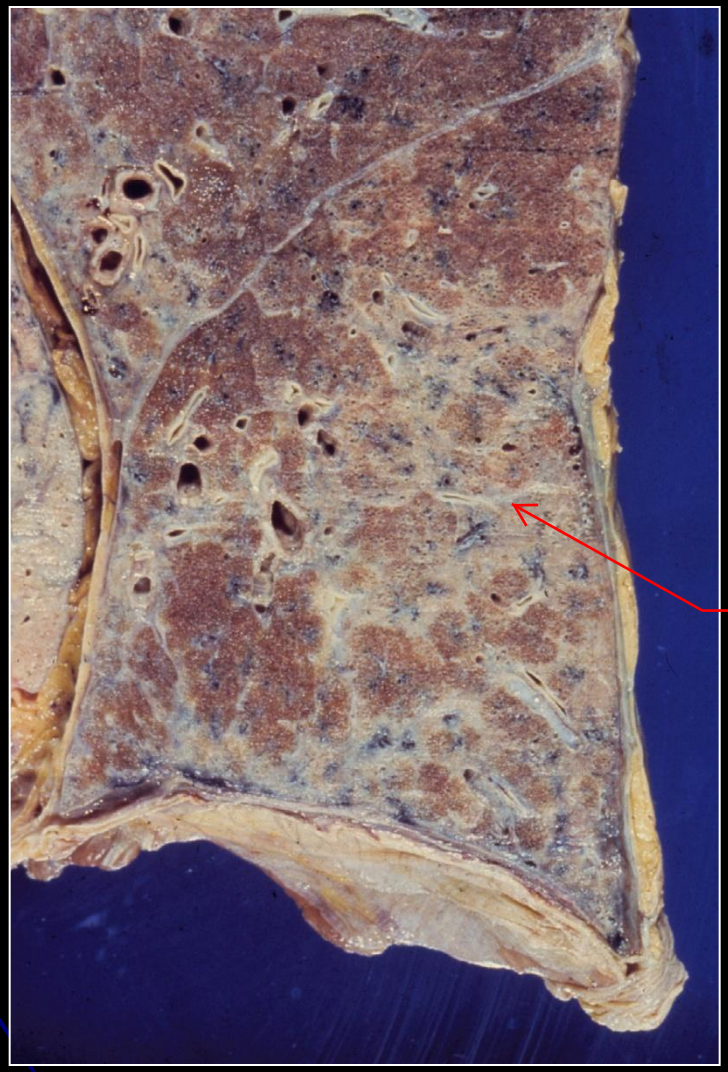
This radiograph is backwards



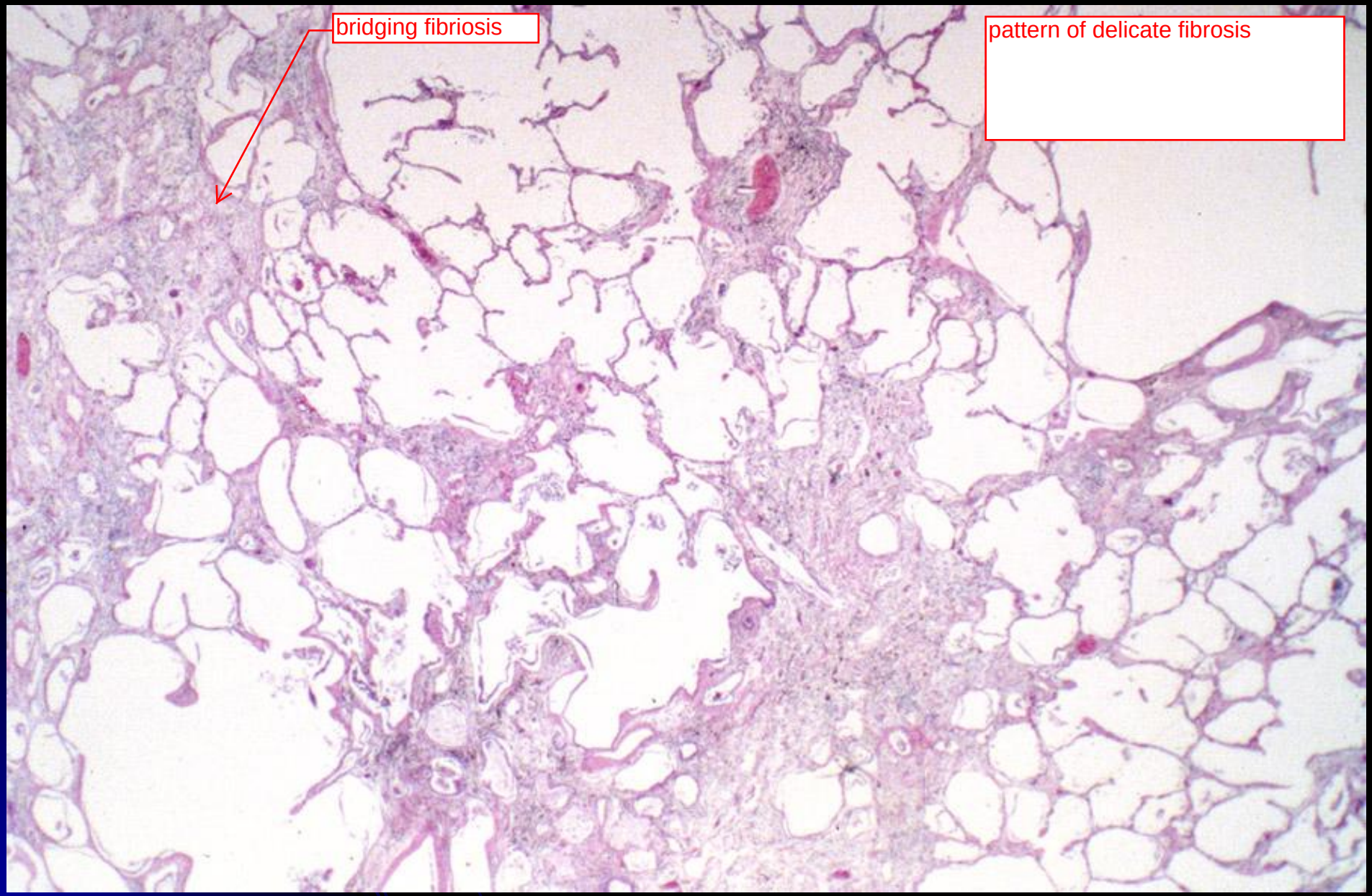
Lower lobe formation of asbestosis. Recticular like formation (net-like)

Favors lower lungs like UIP but does not appear honeycomb shape, more bridging like

asbestosis
Bridging fibrosis



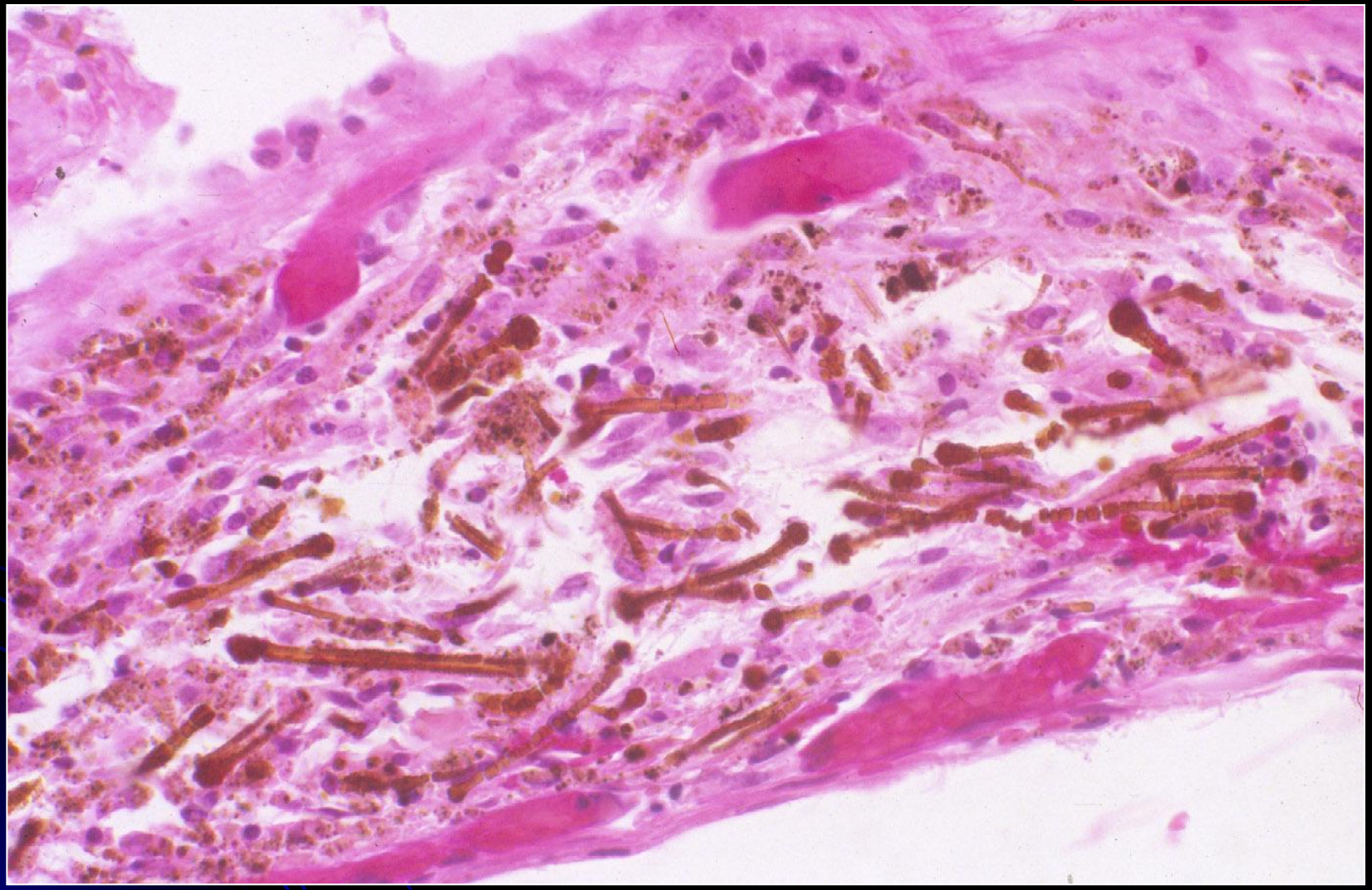
lacy and reticular


bridging fibriosis
pattern of delicate fibrosis


pearl-iron stain to bring out asbestos
Asbestos bodies
The likelihood of finding asbestos bodies in normal individuals is uncommon unless the levels are high.

Thickened septum and numerous asbestos bodies

asbestosis



Patients with asbestosis more likely to get lung cancer. Asbestos Initiator and promoter of cancer. Exposure to asbestos and smoking raises the chances of lung cancer almost 35 fold

Silicosis

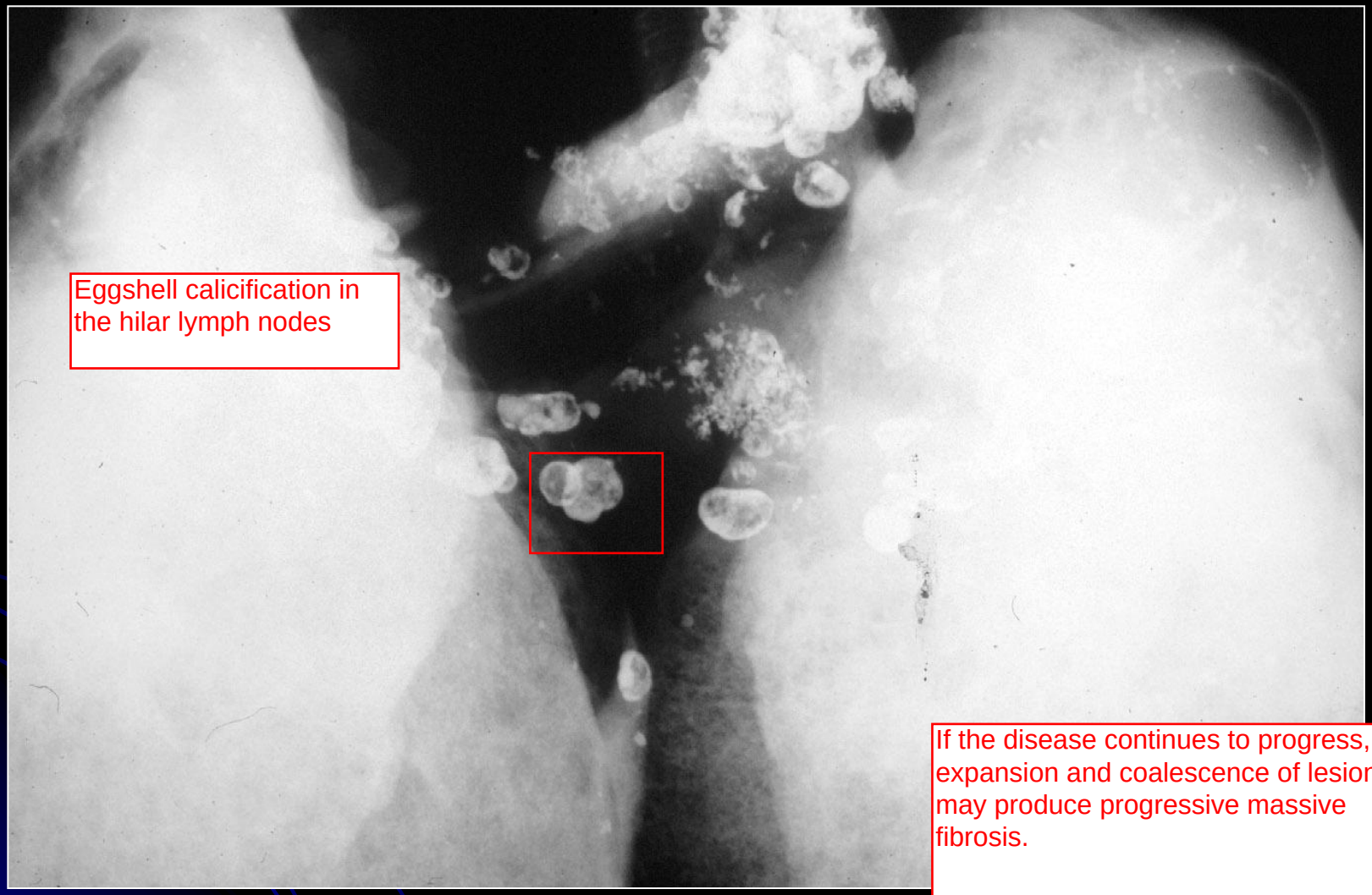
Silicates very common on planet; most prevalent chronic occupational disease in the world

- Associated with occupational exposure to alpha-quartz: sand blasters, miners, masons, quarry workers
- Nodular fibrosis, most severe in upper lobes, "eggshell" calcification of hilar nodes
- Defining histologic feature is the Si nodule
- Increased risk for TB due to macrophage toxicity

upper lobe where ventilation is better is where silicosis is usually located

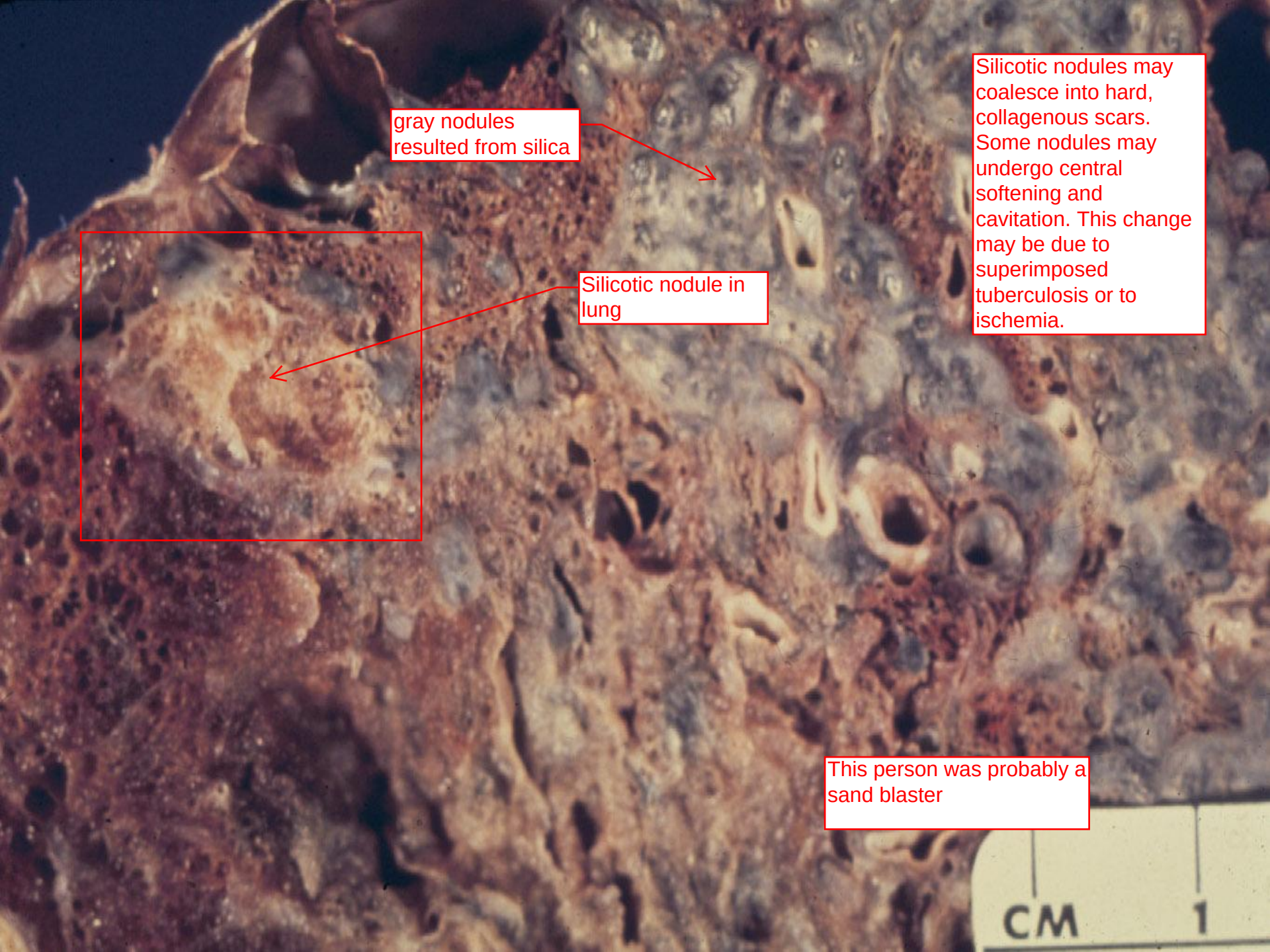
Macrophages provide a key line of defense for silicosis. When macrophages take in silica it causes the activation of mediators like IL-1, TNF, fibronectin, lipid mediators, oxygen free radicals and fibrogenic cytokines

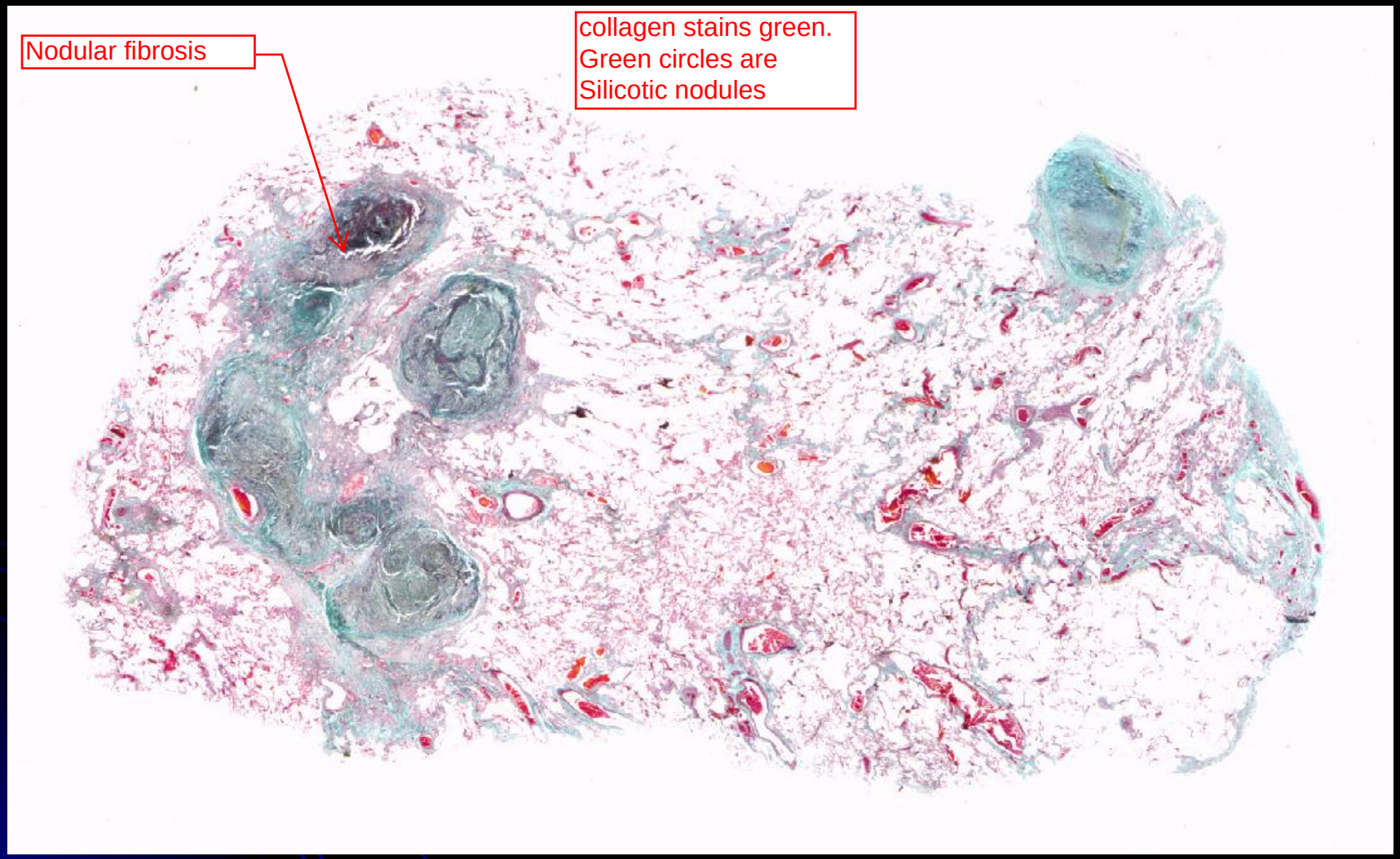
Si is a chick that produced eggshells for easter!



Eggshell calicification in the hilar lymph nodes

If the disease continues to progress, expansion and coalescence of lesions may produce progressive massive fibrosis.

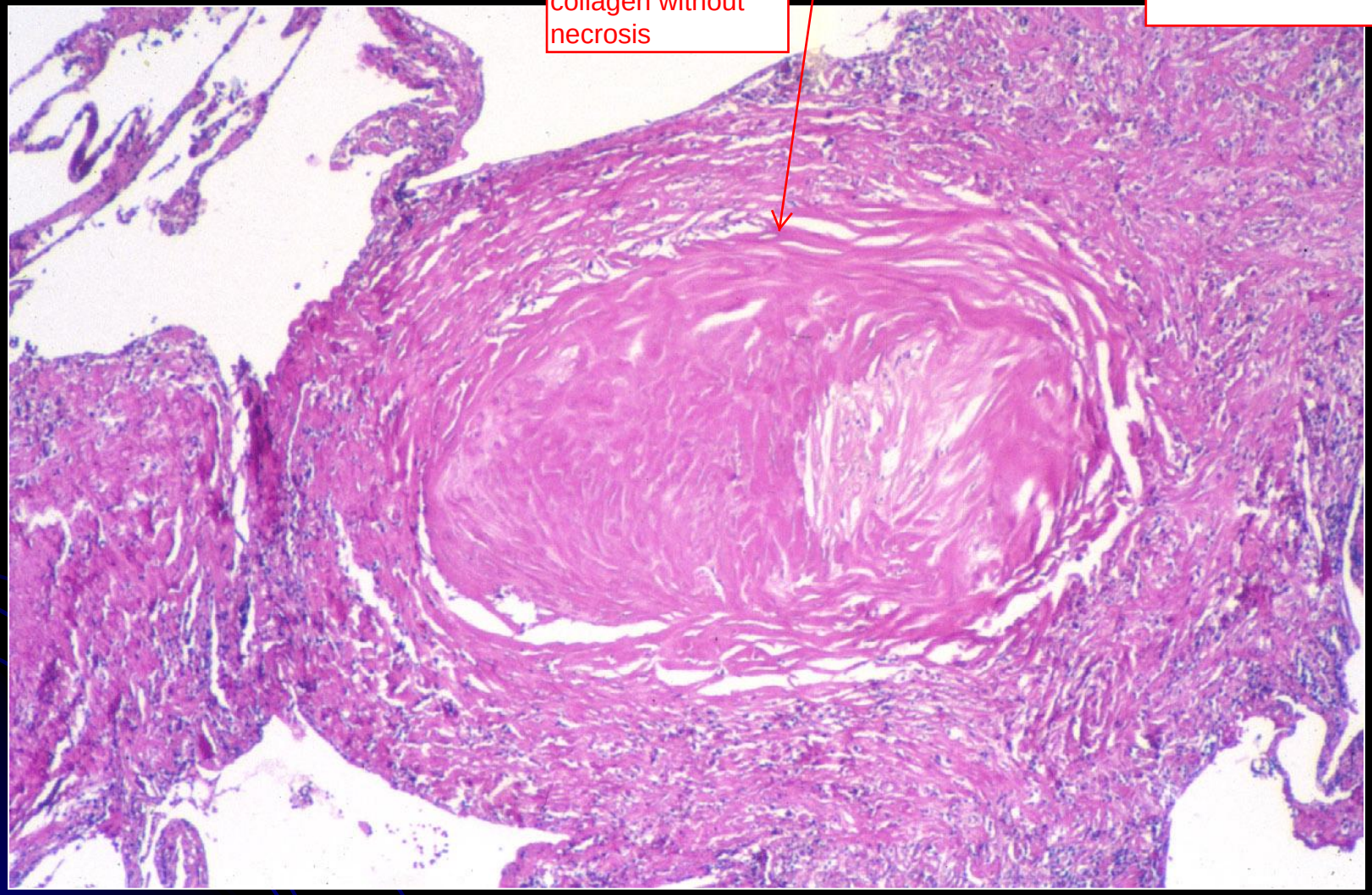

gray nodules resulted from silica
Silicotic nodules may coalesce into hard, collagenous scars. Some nodules may undergo central softening and cavitation. This change may be due to superimposed tuberculosis or to ischemia.
Silicotic nodule in lung
This person was probably a sand blaster
CM
1

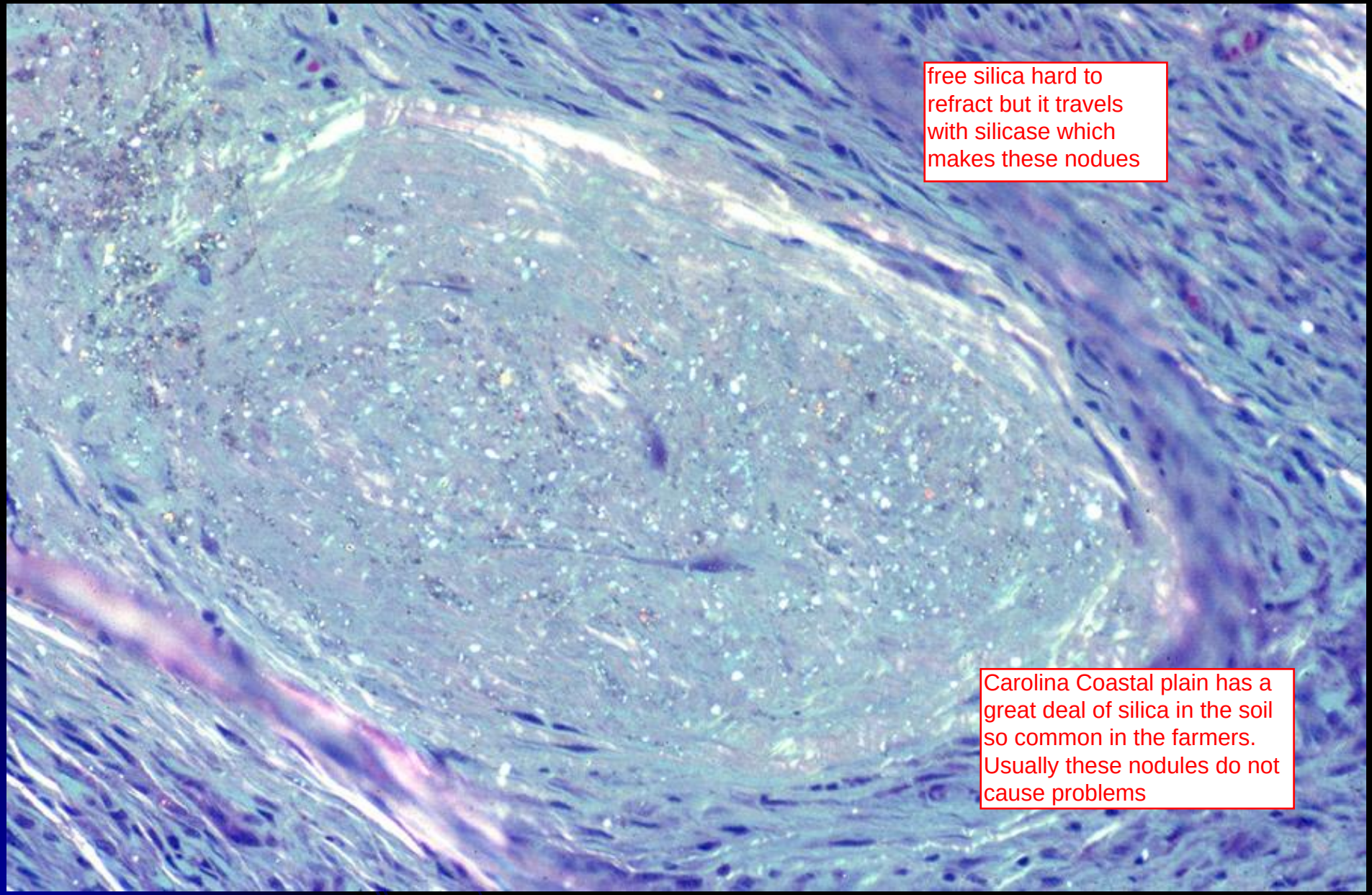

Nodular fibrosis
collagen stains green.
Green circles are
Silicotic nodules

H/E stain

Silicotic nodule

acellular dense collagen without necrosis




free silica hard to refract but it travels with silicase which makes these nodues
Carolina Coastal plain has a great deal of silica in the soil so common in the farmers. Usually these nodules do not cause problems

Silicosis:

1. See "**eggshell**" **calcification of hilar nodes**:
2. Defining characteristic is the **silica** nodule
3. Polarized light can see silica more clearly

Coal Worker's Pneumoconiosis

Not a true medical term

- "Black lung disease" entire spectrum of disease and complaints associated with occupational exposure to coal dust-
- black pigmentation of lung may be associated with silicotic nodules, or progressive massive fibrosis- may result in cor pumonale
- Sine qua non of CWP is the coal dust macule: Simple and complicaed forms

Cor Pumonale:right sided heart side due to lung failure. No forward flow from heart to lungs due to parenchymal lung disease

Cor pulmonale: pulmonary heart disease is enlargement of the right ventricle of the heart as a response to increased resistance or high blood pressure in the lungs.
Chronic cor pulmonale usually results in right ventricular hypertrophy (RVH), whereas acute cor pulmonale usually results in dilation.
Hypertrophy is an adaptive response to a long-term increase in pressure. Individual muscle cells grow larger(hypertrophy) in order to generate the increased contractile force required to move the blood against greater resistance.

Coal is a fossil fuel that is combustable, however the silica in the coal is what drives the fibrosis

This is normal lung tissue; normal amount of pigment---slight black tint

Simple CWP: characterized by coal macules (1 to 2mm in diameter) and the somewhat larger coal nodules. The coal macules consists of carbon-laden macrophages.

Coal Worker's Pneumoconiosis:

1. In mines the mineral dust causes fibrosis (not the organic coal)
2. This can fall under the category "**black lung**"

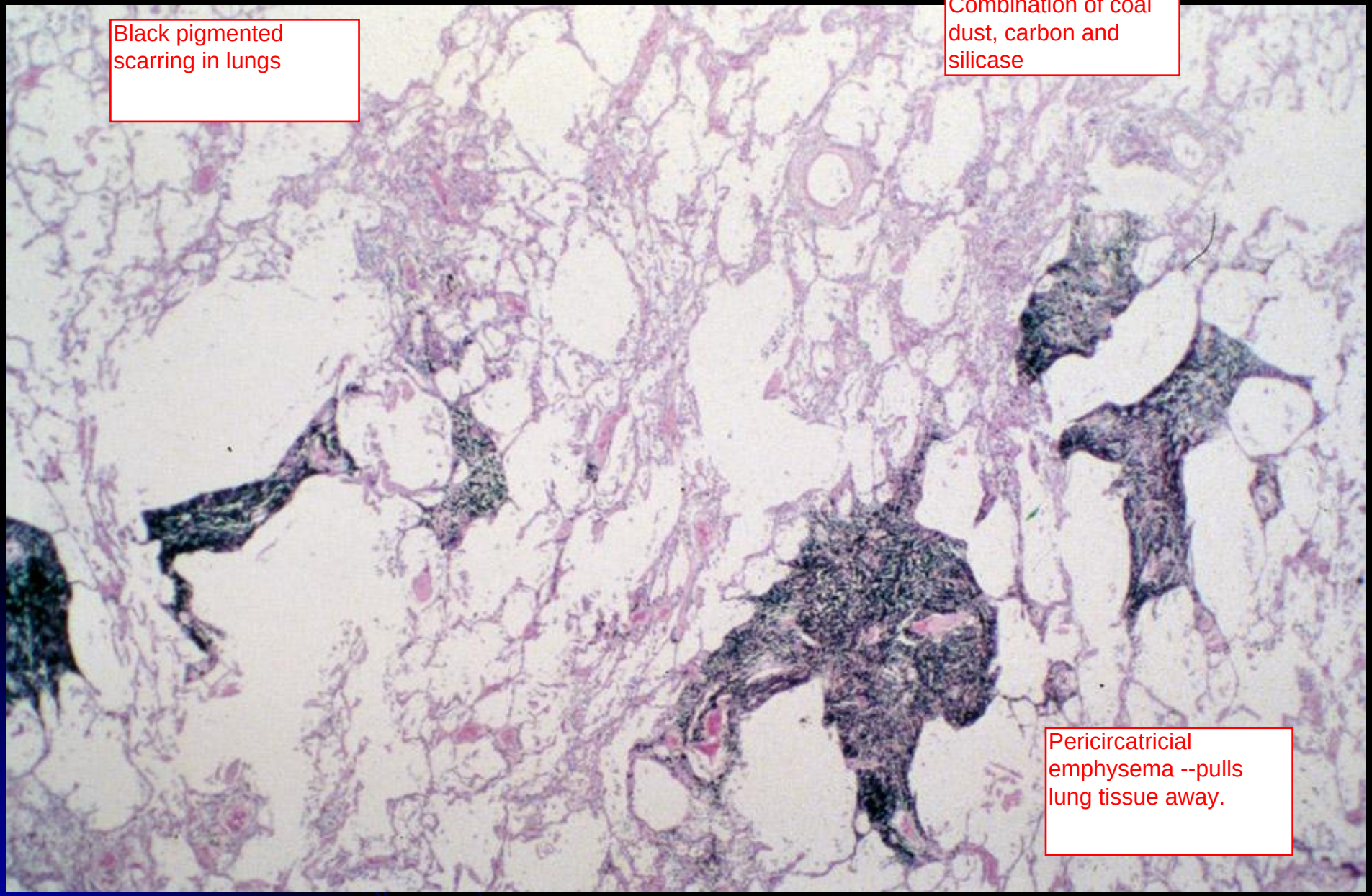
usually the upper lobes and the upper zones of the lower lobes are more heavily involved. Usually lesions start adjacent to respiratory bronchioles, the site of initial dust accumulation.

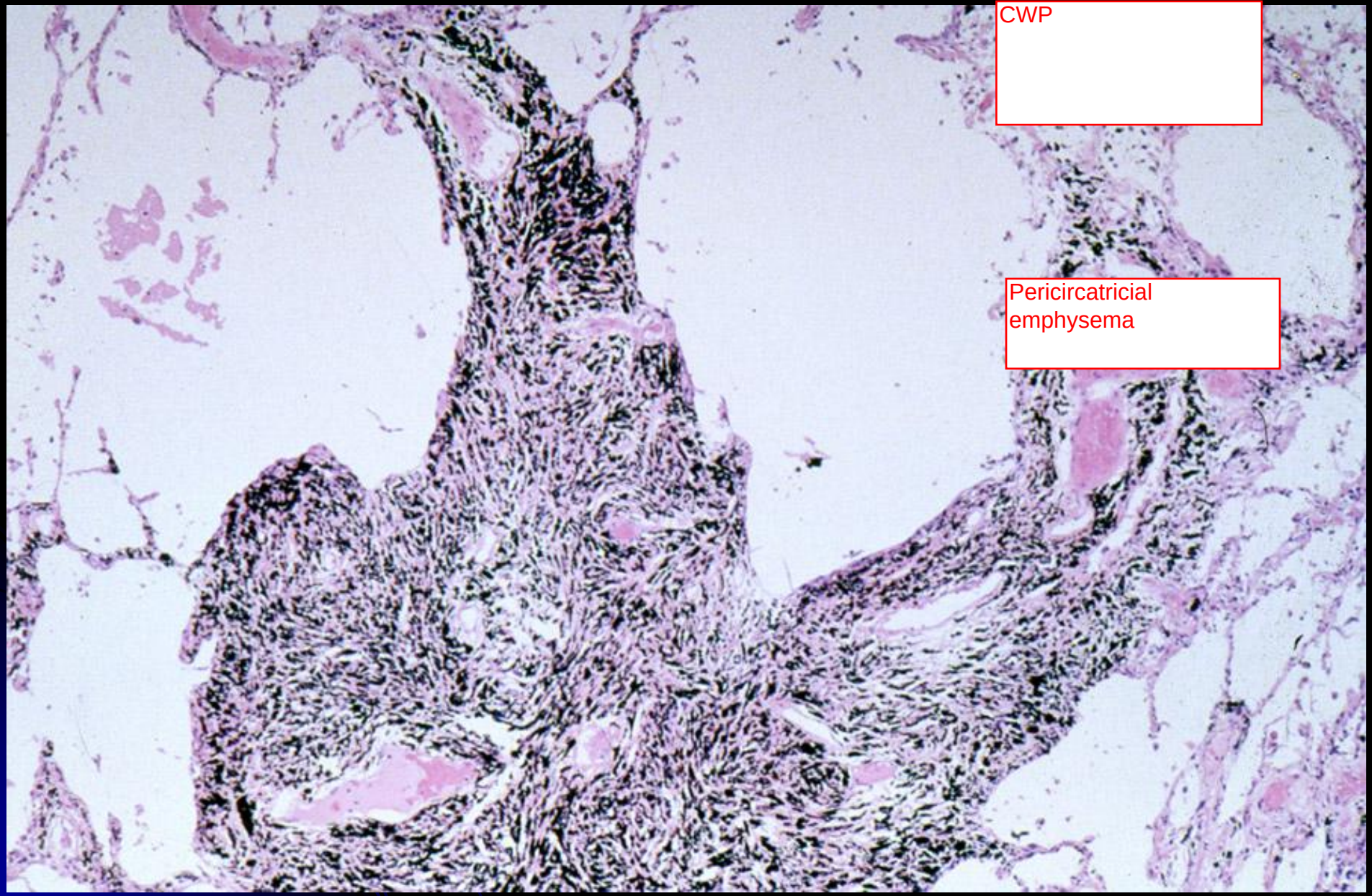
PMF--will cause respiratory problems. Will cause black India ink like secretions

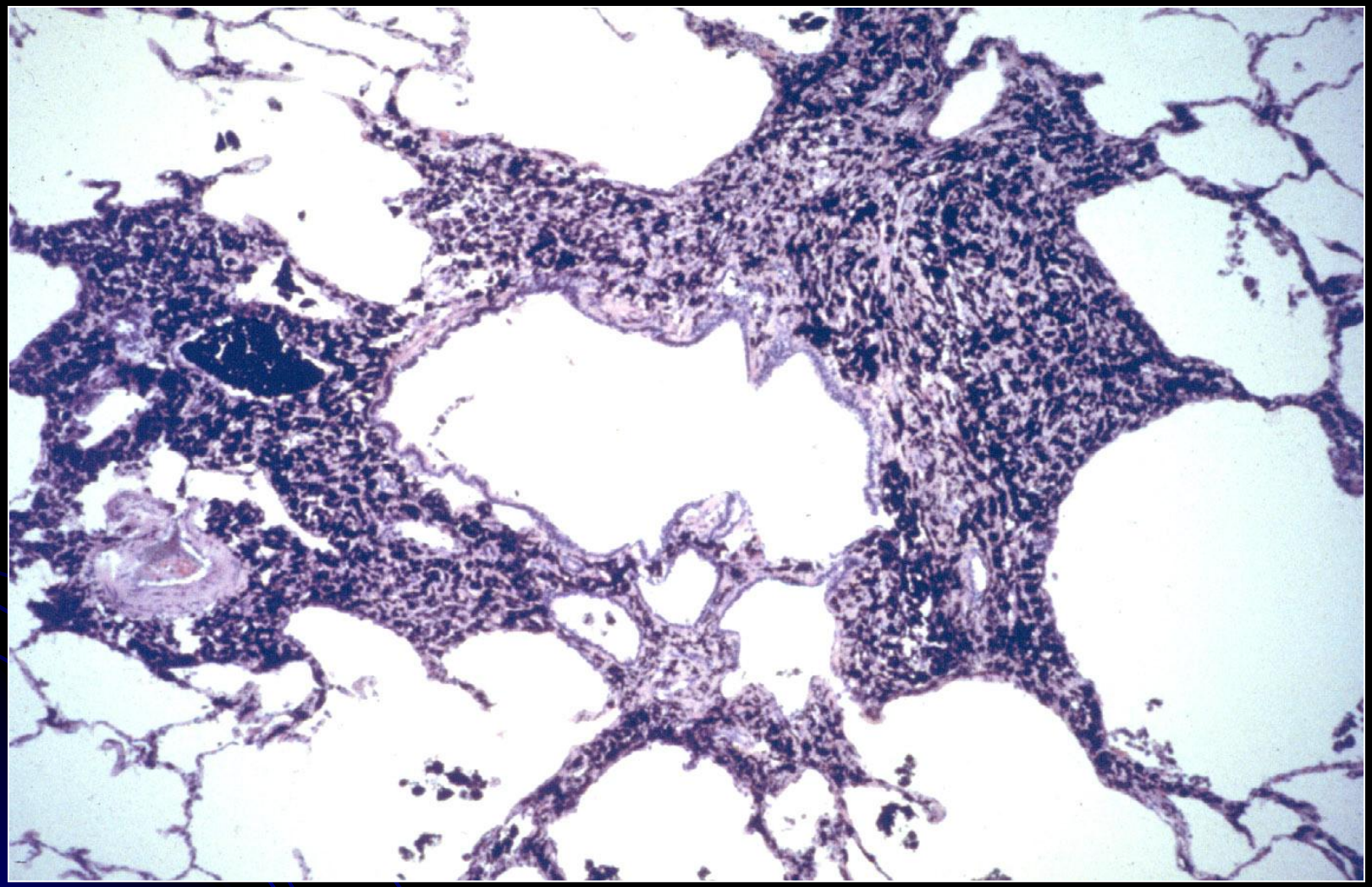
Complicated CWP:progressive massive fibrosis (PMF)

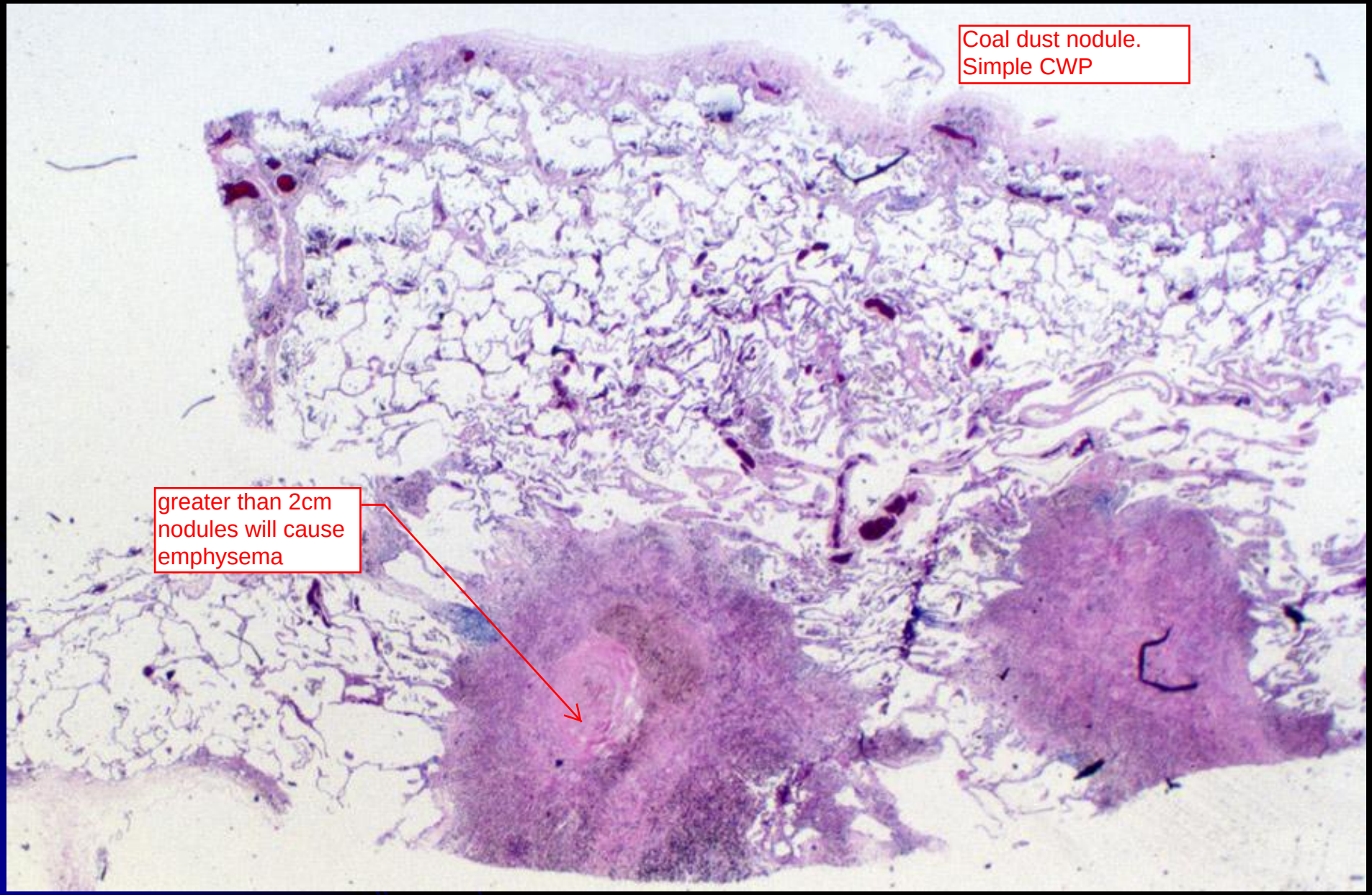
Intense black scarring usually larger than 2cm, sometimes 10cm in diameter. The center of the lesion is often necrotic, most likely due to local ischemia


Entire upper lobe replaced by PMF lesion
apex of lung destroyed due to coal intake

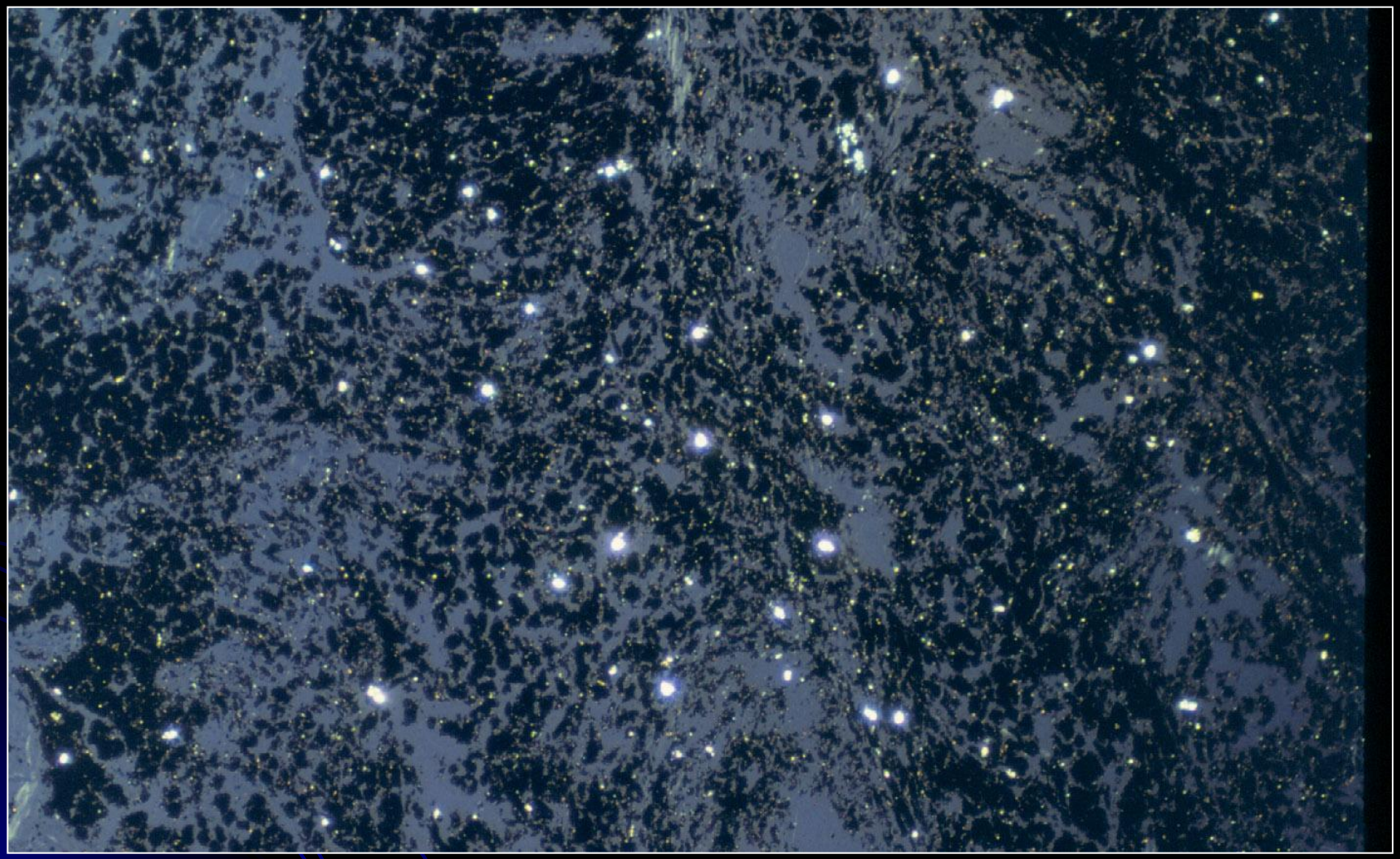

Black pigmented scarring in lungs
Simple lesions Combination of coal dust, carbon and silicase
Pericircatricial emphysema --pulls lung tissue away.


CWP
Pericircatricial emphysema




Coal dust nodule.
Simple CWP
greater than 2cm nodules will cause emphysema

silicase and silica crystals



Berylliosis

Beryllium- useful but toxic substance

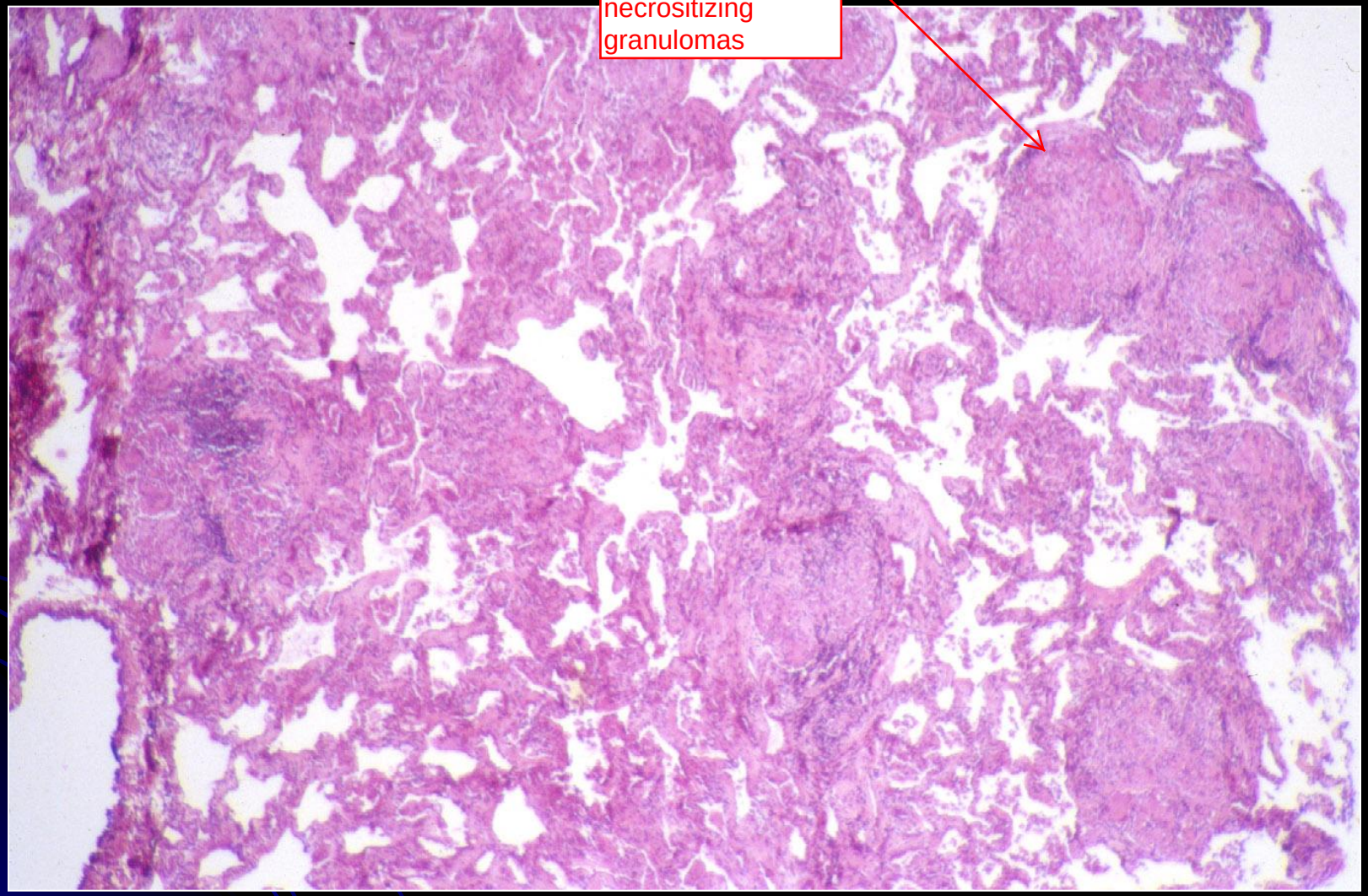
- Hypersensitivity/immune-mediated response occurring in small proportion of individuals exposed to Be
- At risk population: workers in aerospace, computer and electronic industries
- Clinical and histologic mimic of sarcoidosis

many commercial applications

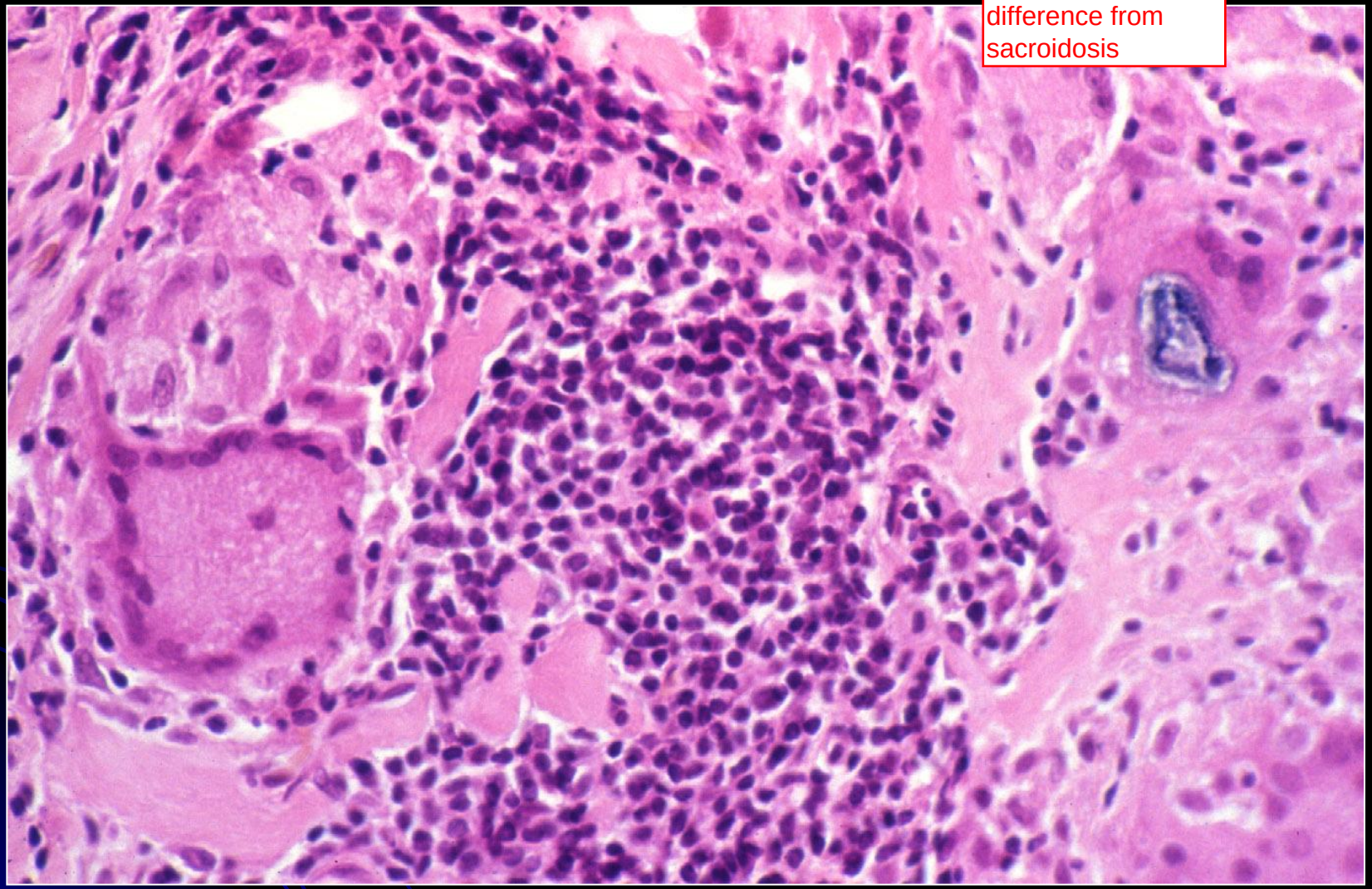
Berylliosis:
1. Hypersensitivity reaction for only some people exposed to beryllium
2. Risk group is aerospace, computer, and electrical tech people
3. **Can't tell this apart from sarcoidosis**
4. See multi-nucleated giant cells with Schaman body inclusions just like sarcoid
5. Diagnosis requires lab studies for berylliosis

Tends to be a genetic predisposition to berylliosis

Berylliosis looks like sacroidosis



Beryllium
Need history of patient to try to tell difference from sacroidosis



If you find out a person has berylliosis they should change their job which is different from if they have sicilosis

Berylliosis

Hypersensitivity reaction; not caused simply by dust

- Diagnosis studies include peripheral and bronchoalveolar lymphocyte proliferation studies following in vitro exposure to Be
- Electron microscopy/EDXA

HYPERSENSITIVITY PNEUMONITIS

Other reactions we have talked about were related to INorganic compunds, but this is caused by ORANGIC compunds

inflammation due to inhaled organic antigens

- Occupational
- Pets/hobbies
- Environmental

- Farmer's lung- thermophilic actinomycetes in moldy hay
- Maple bark strippers disease
- Bird fancier's lung

Black mold in NC is a huge problem that can cause hypersensitivity pneumonitis

Fairly common in people who keep birds especially parrots, cockatiels

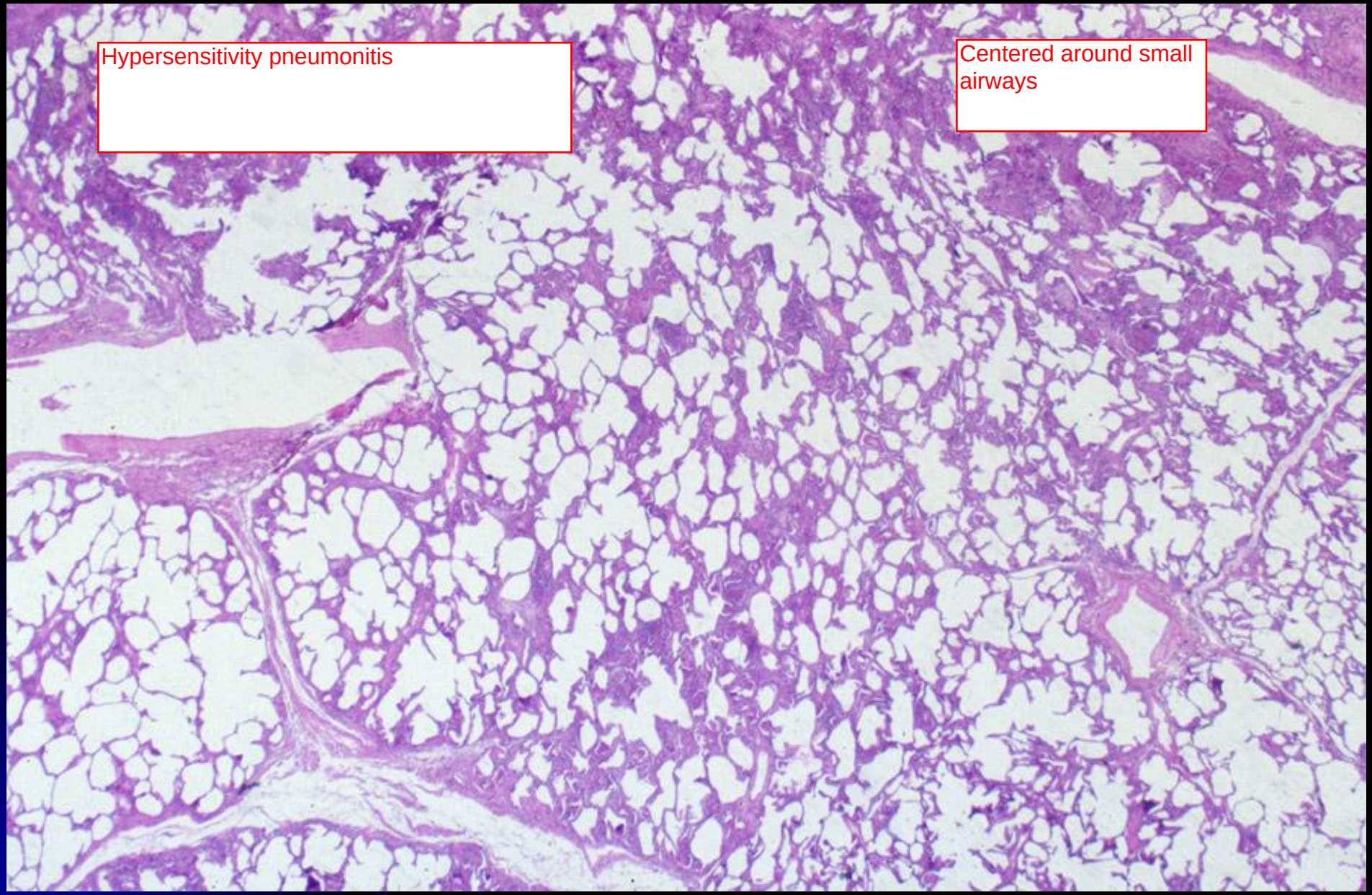
antigen in birds skin and can cause hypersensitivty pneumonitis in the owner

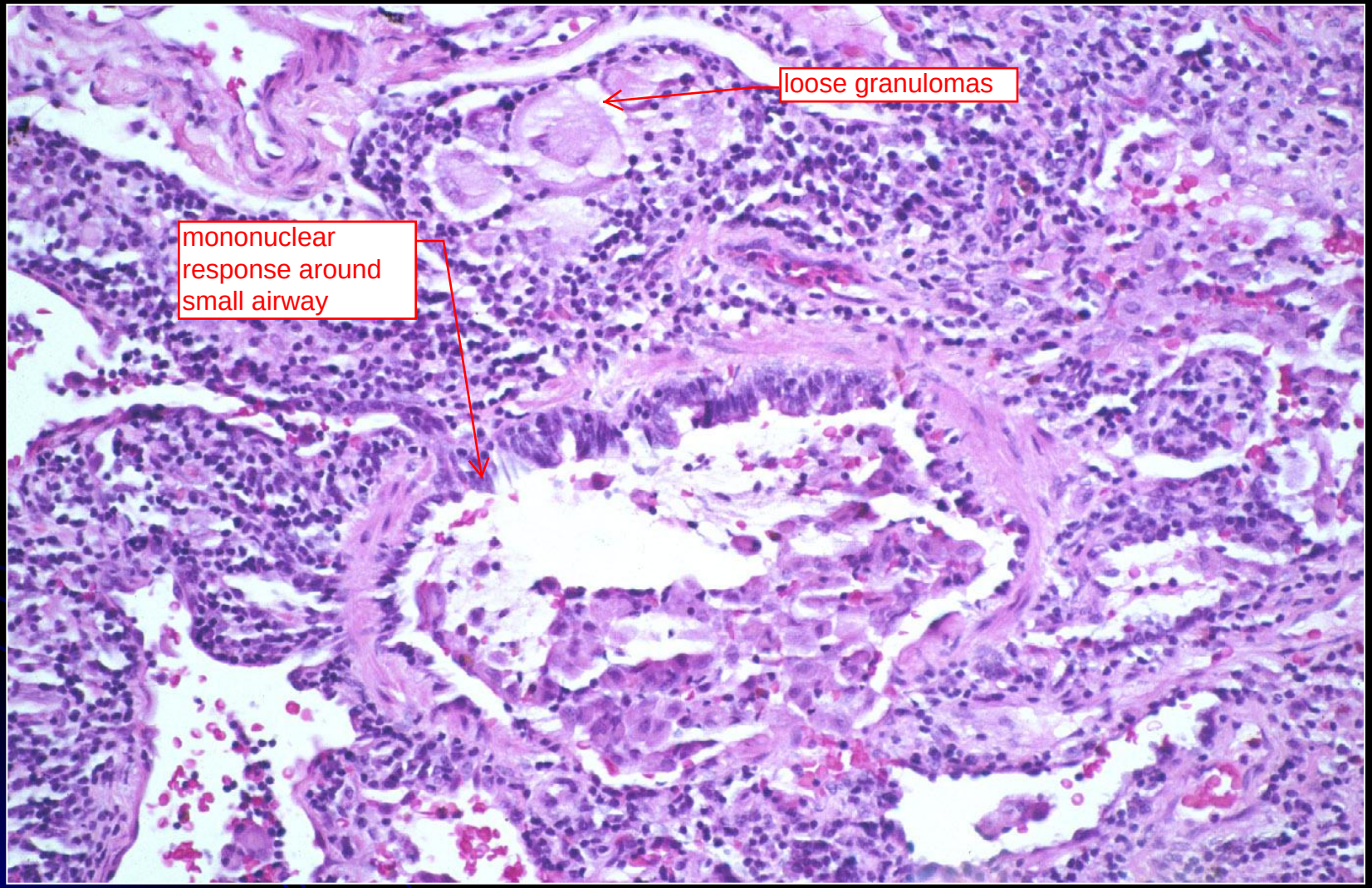
Hypersensivity pneumonia

- Temporally uniform pattern of airway centered chronic interstitial pneumonia
- Loose granulomata, occasional giant cells
- May progress to diffuse interstitial fibrosis, usually responds to removal of antigen, steroids

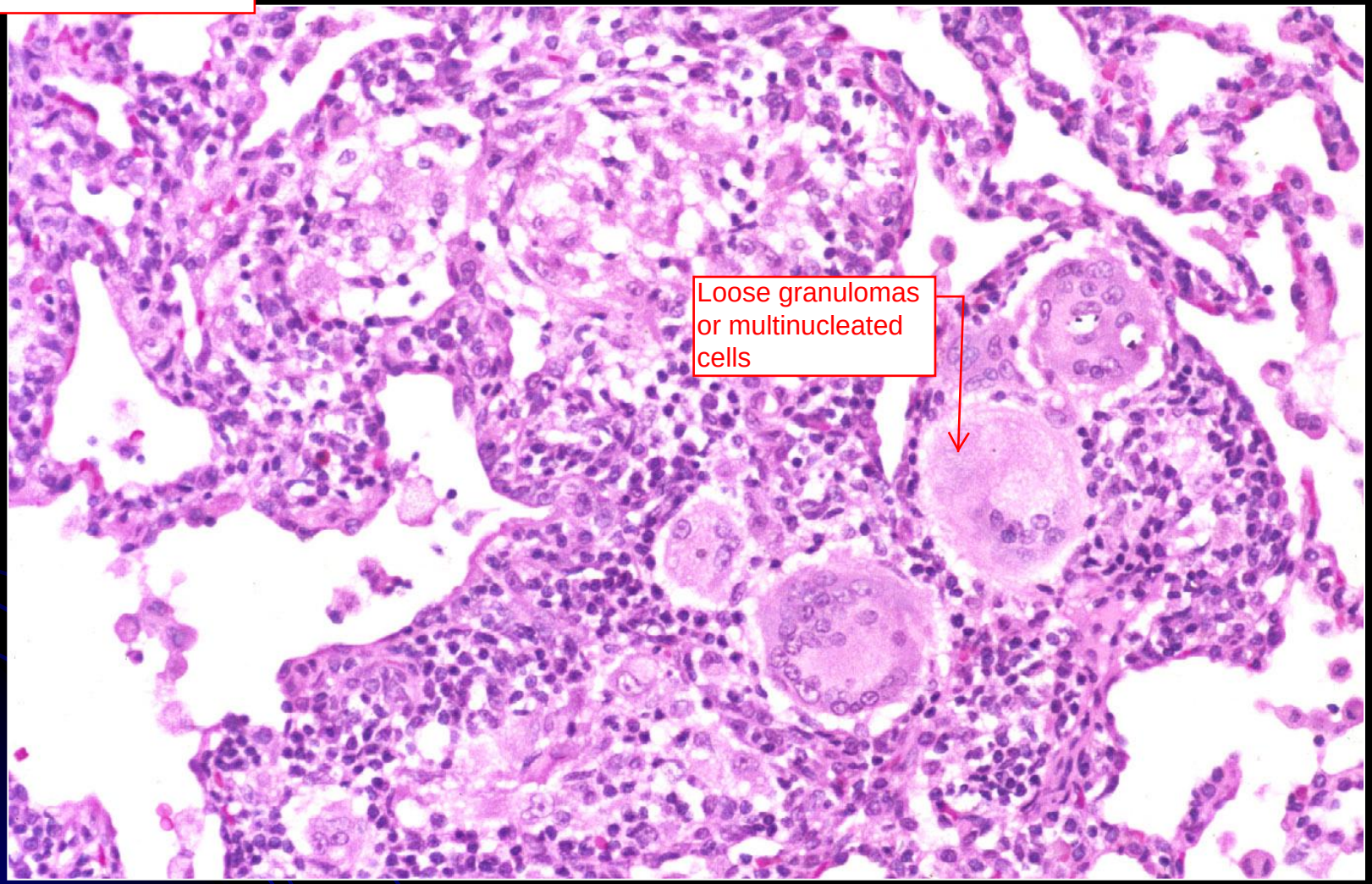
Hypersensitivity Pneumonitis:
1. These are allergic responses to many things (birds, farmer's lung)
2. Have temporally uniform pattern of interstitial pneumonia, centered on airways and chronic
3. Might contain loose granulomata or giant cells, but not compact

usually can make this diagnosis clinically from a patients history


Hypersensitivity pneumonitis
Centered around small airways


loose granulomas
mononuclear response around small airway

Granulomas not as robust or well formed as sacroidosis



physicians cause many lung disorders

IATROGENIC LUNG DISORDERS

Lance Armstrong was not given bleomycin because they didnt want to ruin the athletes lungs

Bleomycin linked to pneumonitis and fibrosis. Causes damage by direct toxicity of the drug and by stimulating the influx of inflammatory cells into the alveoli

- Cytotoxic drug injury-esp. antineoplastics, e.g. bleomycin
- Radiation pneumonitis-acute and chronic

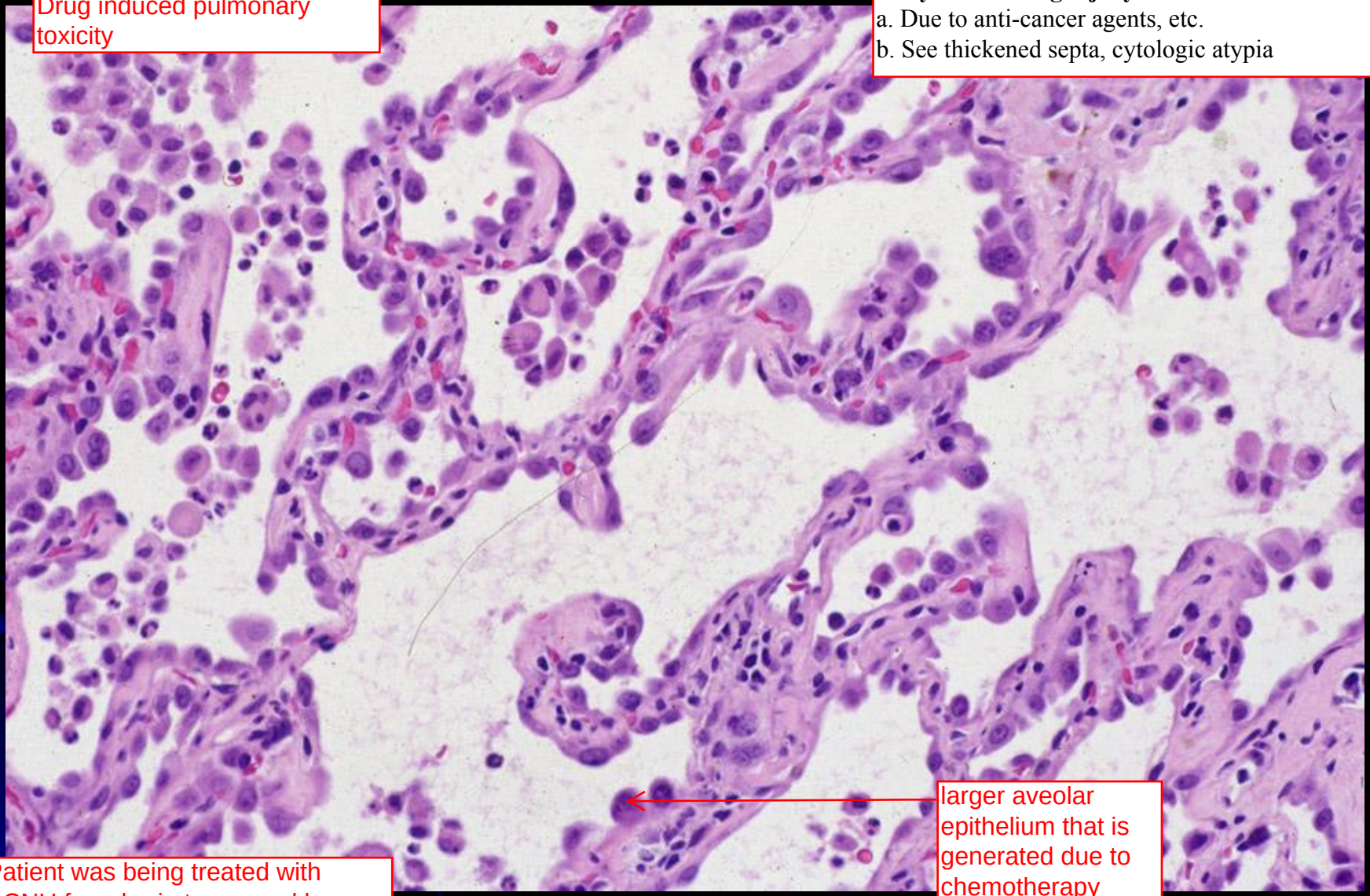
most often involves the lung within the radiation port but occasionally may extend to other areas of the same lung or even contralateral lung.

- Oxygen toxicity-may be additive to underlying insult

oxygen can cause scar tissue in the lung

Not normal lung disease
Drug induced pulmonary toxicity

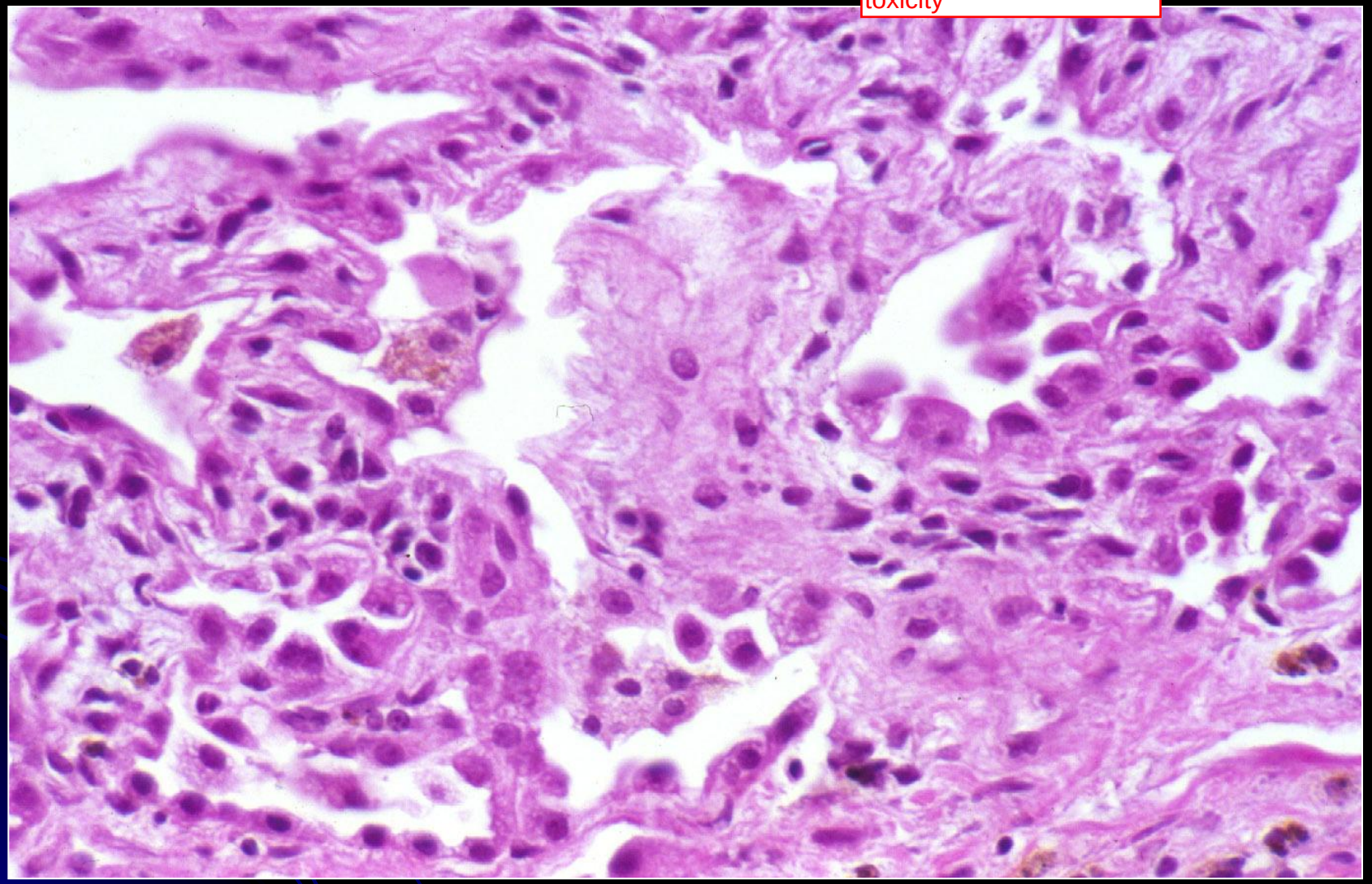
1. Cytotoxic drug injury:
a. Due to anti-cancer agents, etc.
b. See thickened septa, cytologic atypia



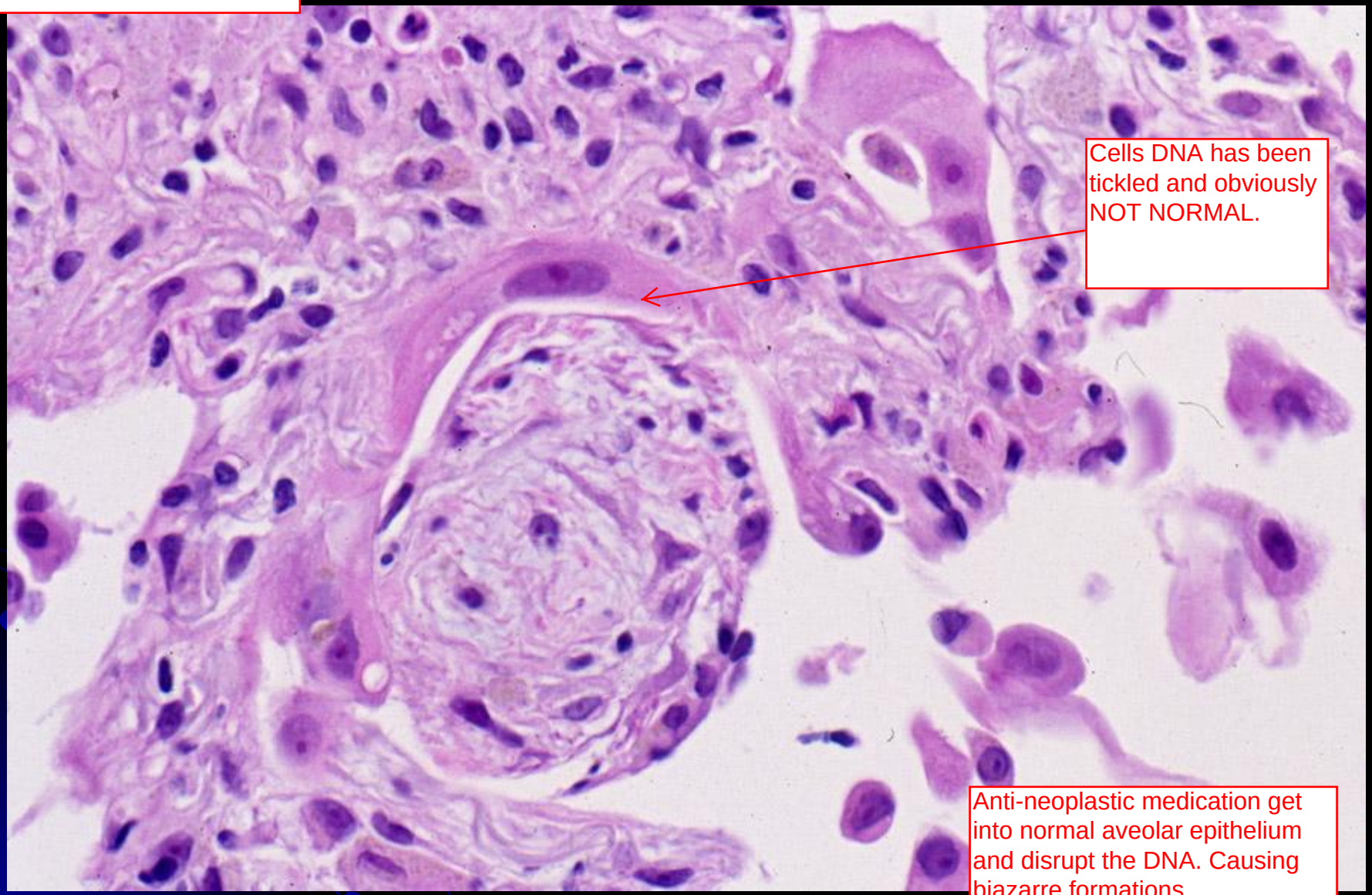
larger aveolar epithelium that is generated due to chemotherapy

Patient was being treated with BCNU for a brain tumor and has drug toxicity

Too many aveolar epithelium and they are very large. Think drug toxicity



Bizarre formations



Radiation pneumonitis/fibrosis

1. Radiation pneumonitis/fibrosis:
a. Chronic and acute, see fibrosis (chronic) and inflammatory cells (acute)

radiation fibrosis is usually most severe at apex of lung

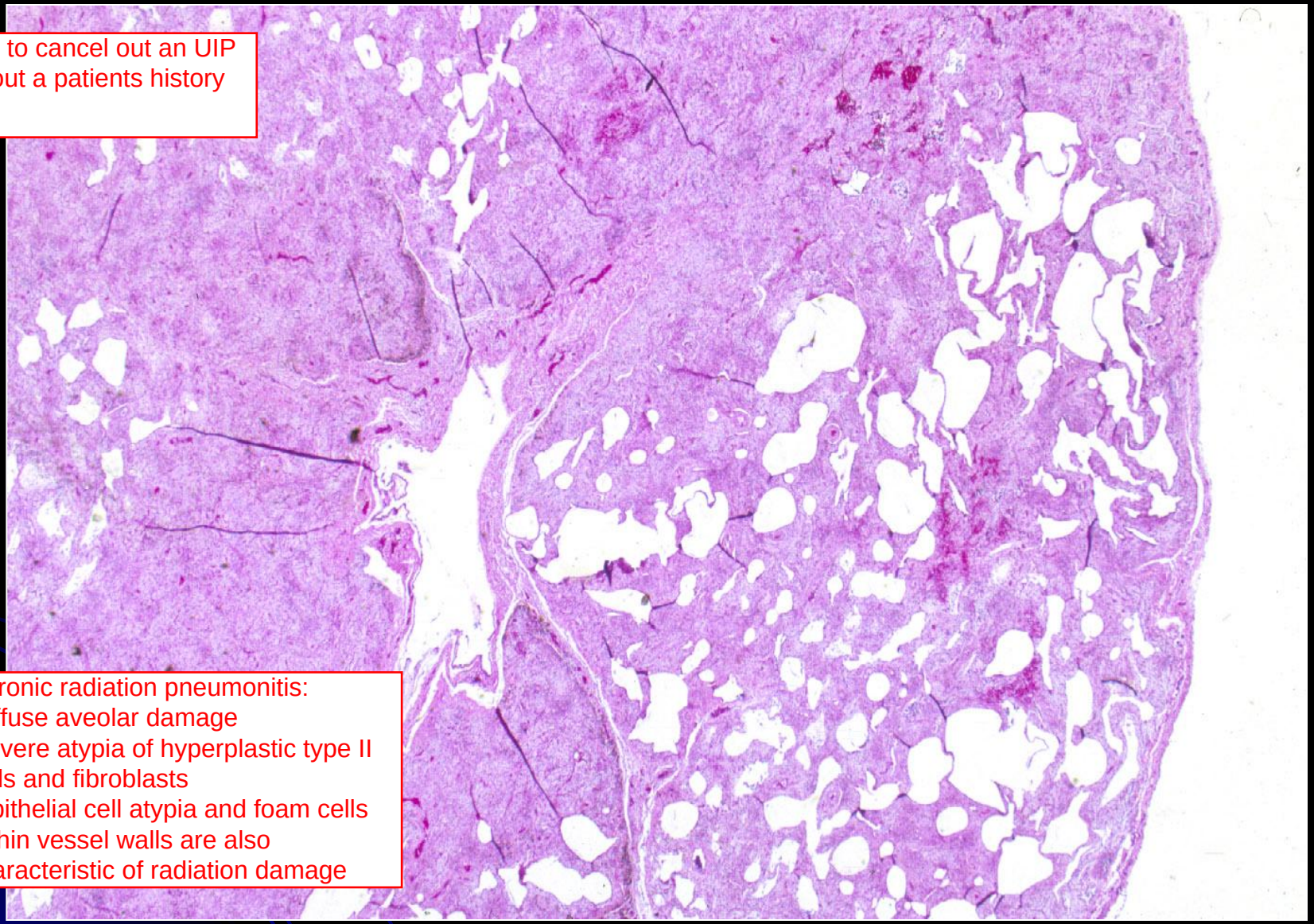
Lung has multiple small cysts
Honeycomb formation
Mediastinal radiation for Hodgkin's disease

Huge strides have been made to reduce the amount of radiation needed to treat the cancer to reduce toxicity.

Chronic radiation

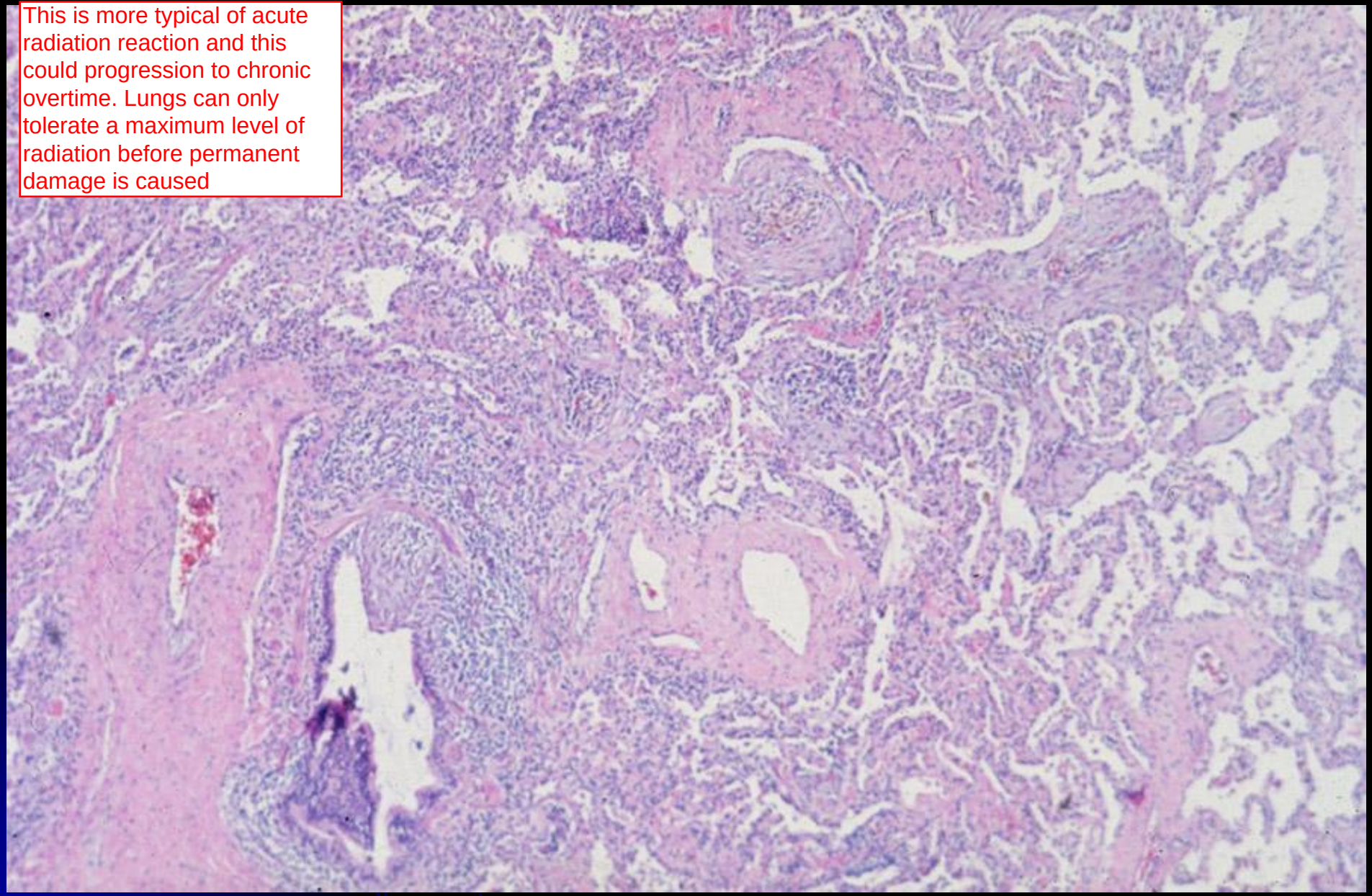
dense fibrous due to radiation for lung cancer

Hard to cancel out an UIP without a patients history



Chronic radiation pneumonitis:
-diffuse aveolar damage
-severe atypia of hyperplastic type II cells and fibroblasts
-Epithelial cell atypia and foam cells within vessel walls are also characteristic of radiation damage

A lot of elastin


This is more typical of acute radiation reaction and this could progression to chronic overtime. Lungs can only tolerate a maximum level of radiation before permanent damage is caused