Clinical Pathology Brief Talk 1/29/07

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Crystals in Urine and Synovium

Urine Crystals

TABLE 5–2.—Normal Urinary Crystals

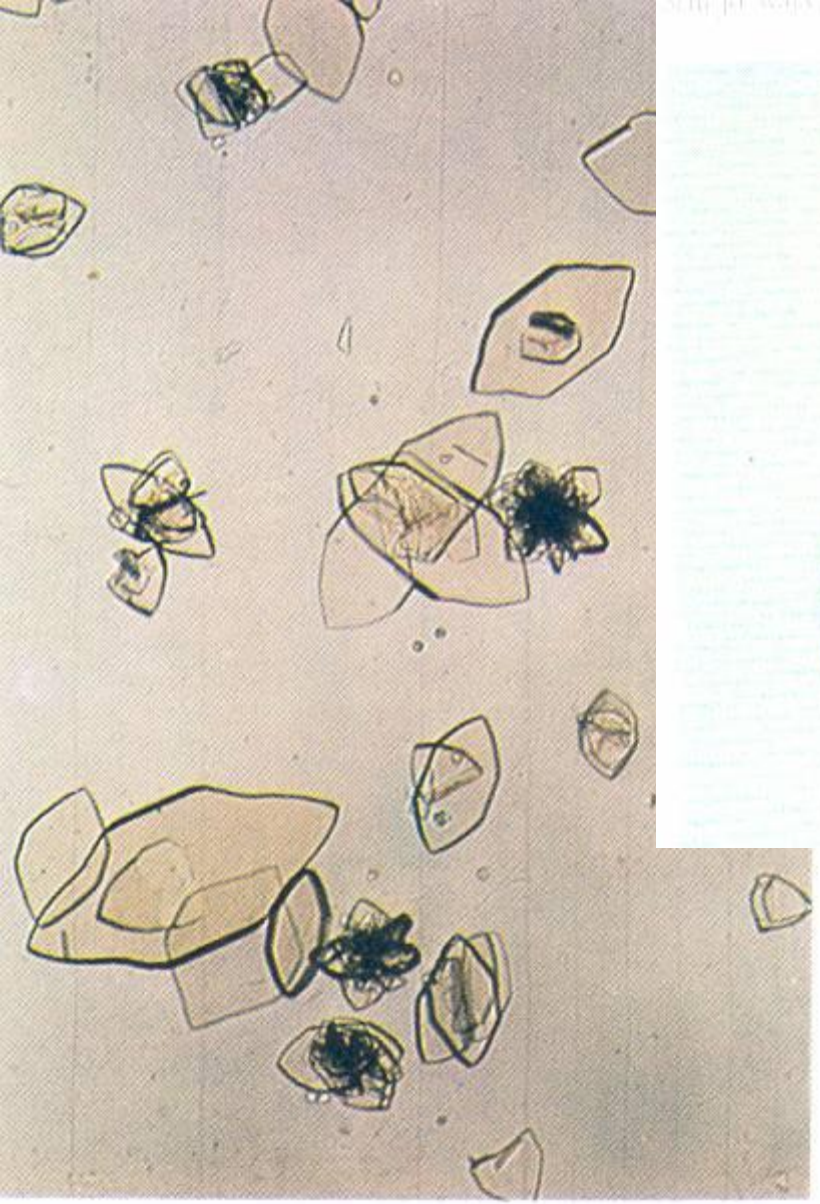
ACID URINE
Uric acid
Amorphous urates
Calcium oxalate
Hippuric acid
ALKALINE URINE
Amorphous phosphates
Triple phosphate
Calcium phosphate
Calcium carbonate
Ammonium urate

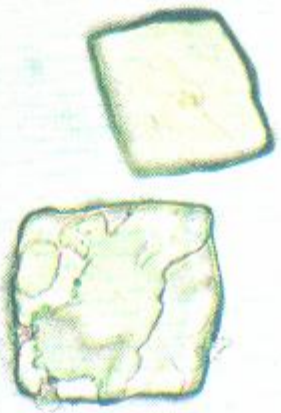
ABNORMAL CRYSTALS

Tyrosine	Colorless, yellow	Fine silky needles	Acid	NaOH, HCl, heat	CH_3COOH, alcohol, ether
Leucine	Yellowish brown	Spheroids with central striations	Acid	NaOH, hot CH_3COOH, heat	HCl, room temperature CH_3COOH, ether
Cystine	Colorless	Hexagonal plates	Acid	NaOH, HCl, NH_4OH	CH_3COOH, alcohol, ether, boiling H_2O
Cholesterol	Colorless	Flat plates with corners chipped out	Acid, neutral	$CHCl_3$, ether, hot alcohol	H_2O, dilute acids, dilute alkalis
Sulfa	Colorless, yellowish brown, greenish brown; colored complex formed by Lignin test	Amorphous, fan-shaped, shocks of wheat	Acid	Strong CH_3COOH, NaOH, acetone	Dilute CH_3COOH
Bilirubin	Bile-stained	Granules, needles	Acid	CH_3COOH, HCl, NaOH, $CHCl_3$, acetone, ether	
Starch	Colorless; purplish blue-black with iodine; does not stain with Sudan III	Irregularly round with dark striations to the center; asymmetric "Maltese cross" in polarized light; may be confused with leucine, fat bodies			

Uric Acid

- Most common crystals in urine
- Almost any urine specimen allowed to stand for over 48 hrs will demonstrate uric acid deposition
- Morphology: Very pleomorphic
  - Squares, six sided, stars, needles, barrels



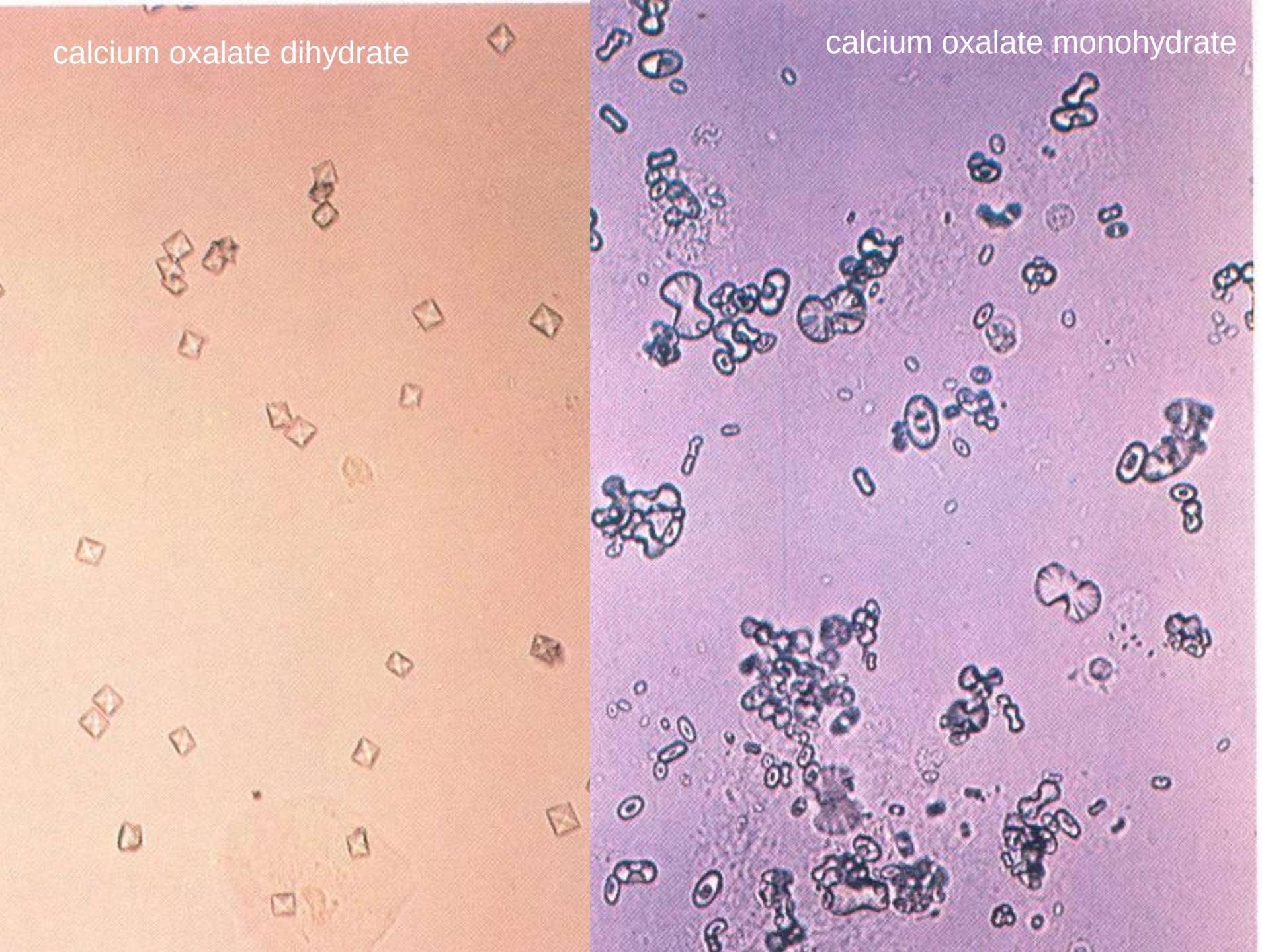


Uric Acid

- Clinical significance
  - Small numbers are common without specificity
  - Large numbers can be found in uric acid stone formers, leukemic patients.
  - Persistent excretion in uric acid over excretors, those with hypoxanthine guanine phosphoribosyl transferase deficiency

Calcium oxalate

- Cacium oxalate dihydrate
  - Tetrahedra, envelope like
- Calcium oxalate monohydrate
  - Oval and dumbbell
  - Can mimic RBC casts


calcium oxalate dihydrate
calcium oxalate monohydrate

Calcium Oxalate

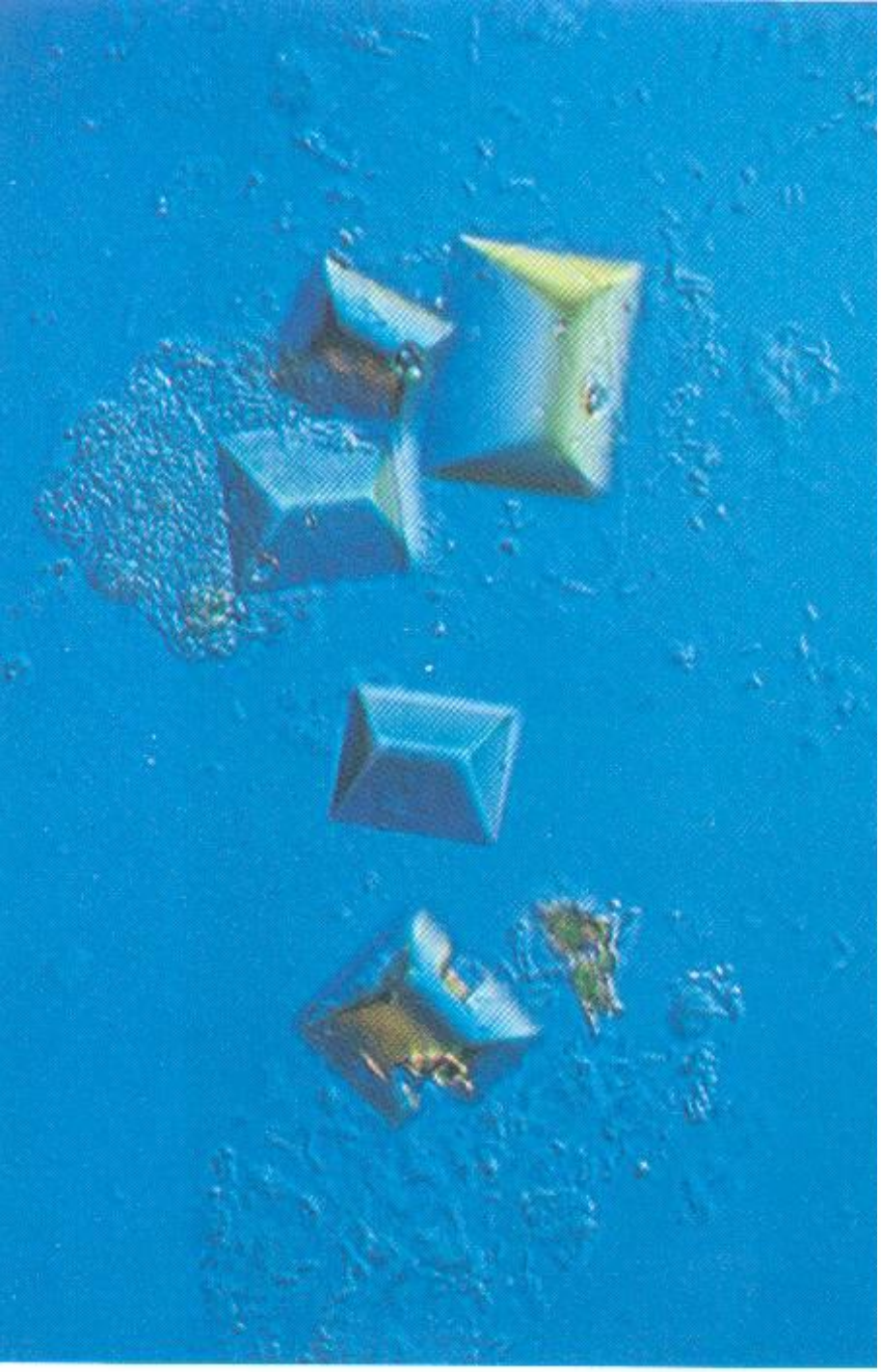
- Most of the time are of no clinical significance
- Diet rich in oxalic acid: tomatoes, apples, asparagus, oranges, carbonated drinks
- Calcium oxalate stone formers
- Ethylene glycol: calcium oxalate monohydrate

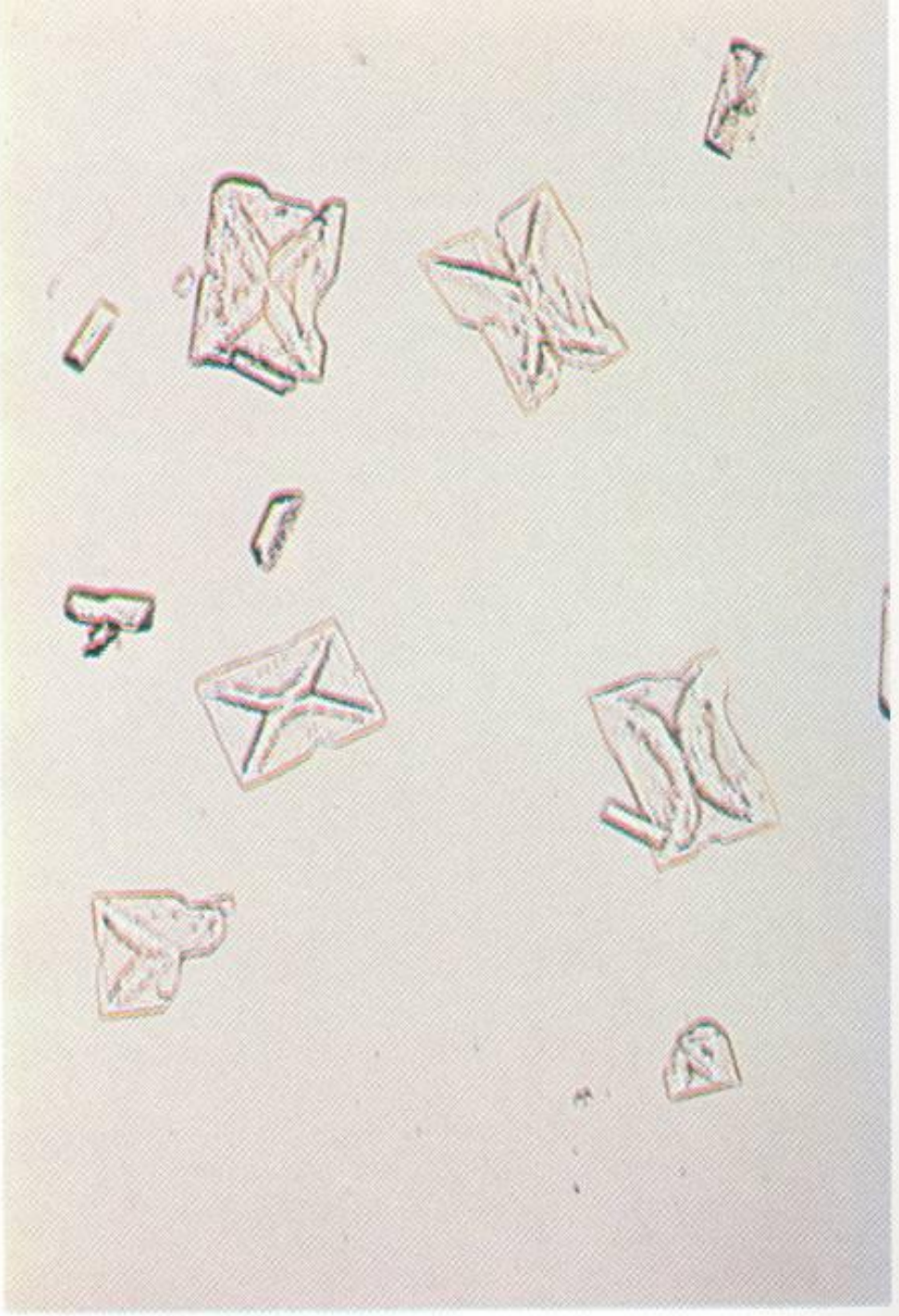
Hippurinic Acid

- Fruits and vegetables
- Stones in hepatic failure

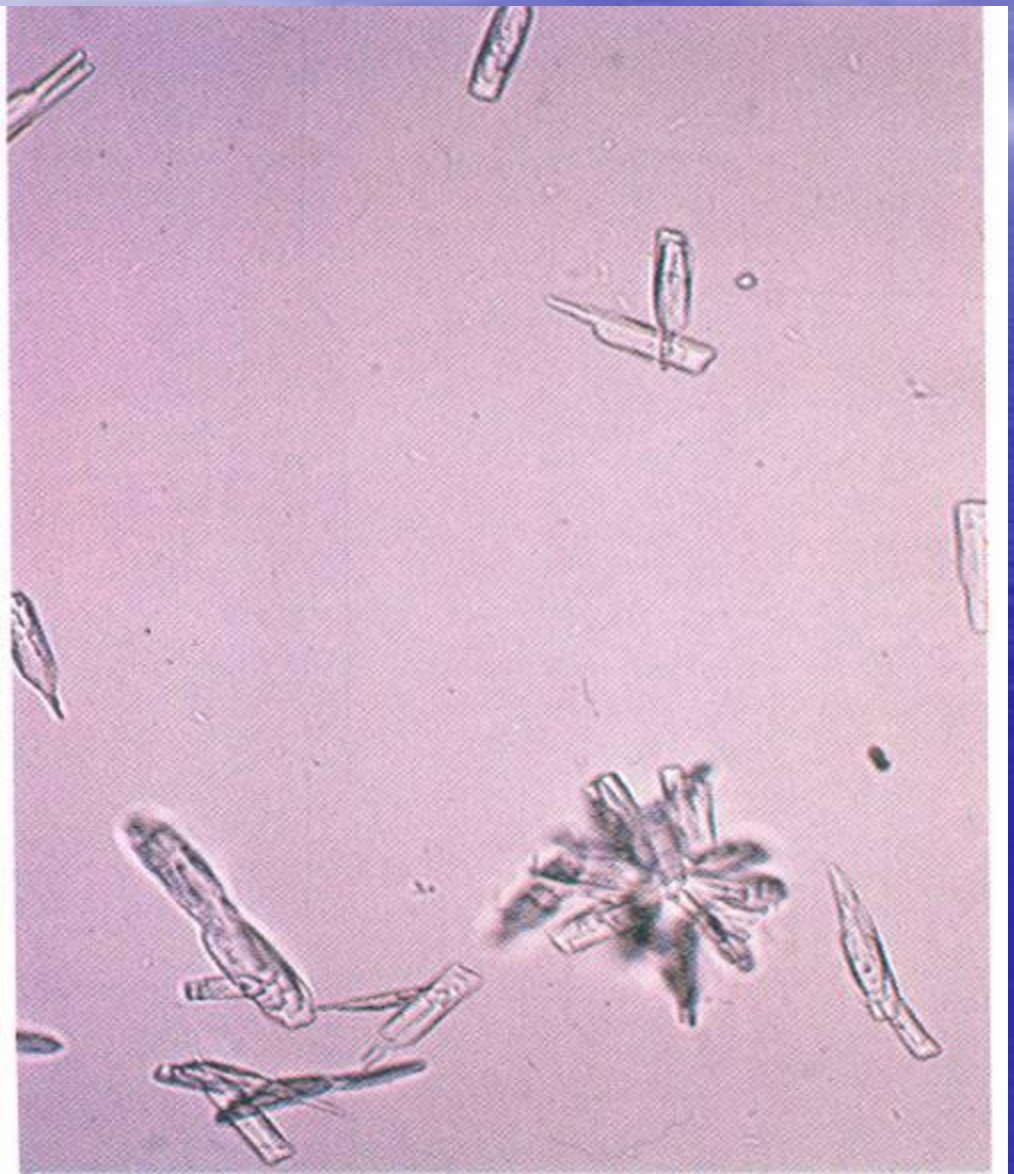
Triple Phosphate

- Ammonium magnesium phosphate
- Prism, coffin lid shape
- Not clinically significant
  - Unless large numbers found in fresh urine
    - Urea splitting microorganisms
    - Struvite stones



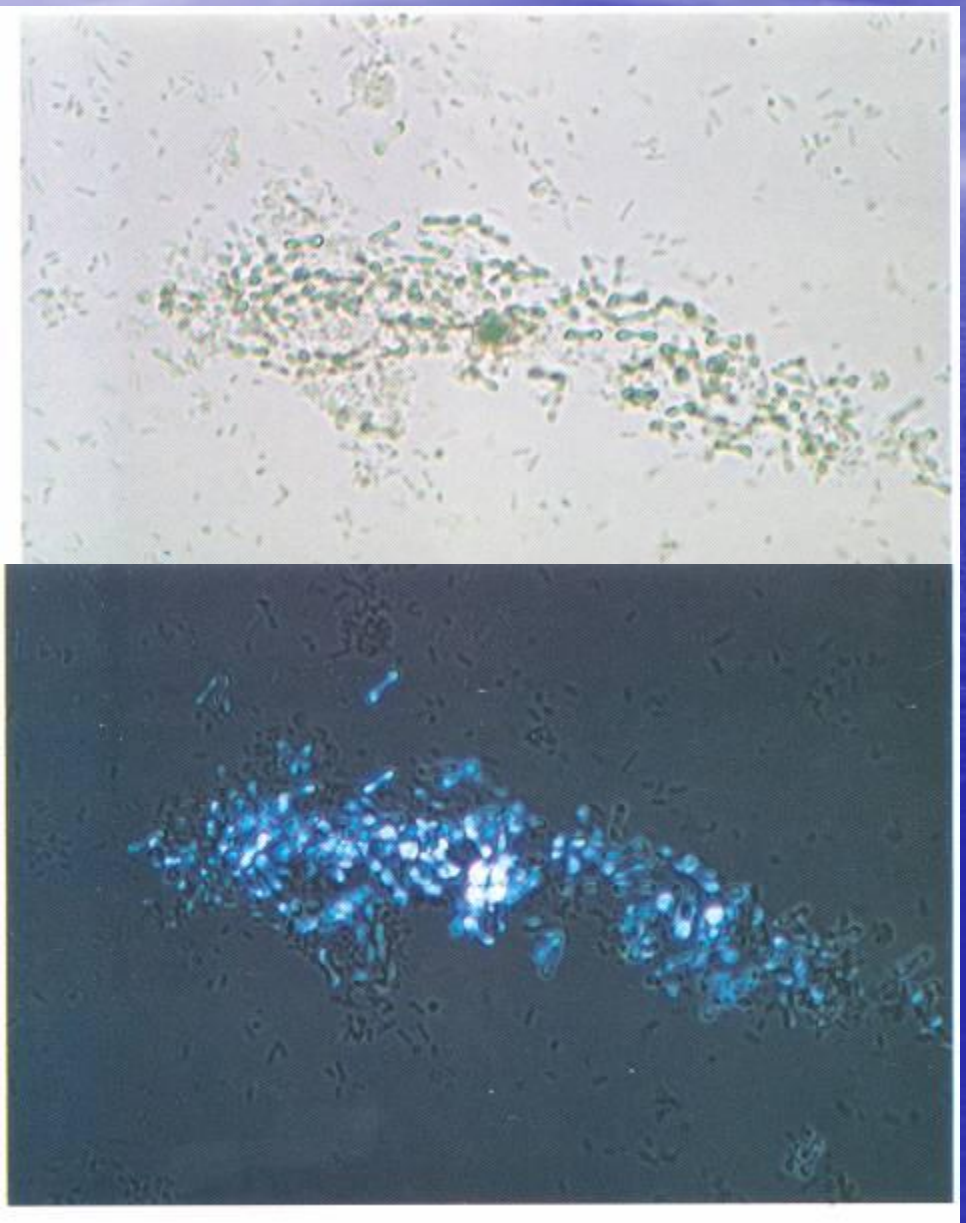


Calcium Phosphate



- Flat, irregular, sheet of ice look
- Increased in patients with urine retention.
- Tend to irritate the urinary tract, causing cystitis-like symptoms.

Calcium Carbonate



- Vegetable ingestion
- Confused for microbacterial organisms
- No clinical significance

Ammonium Urate

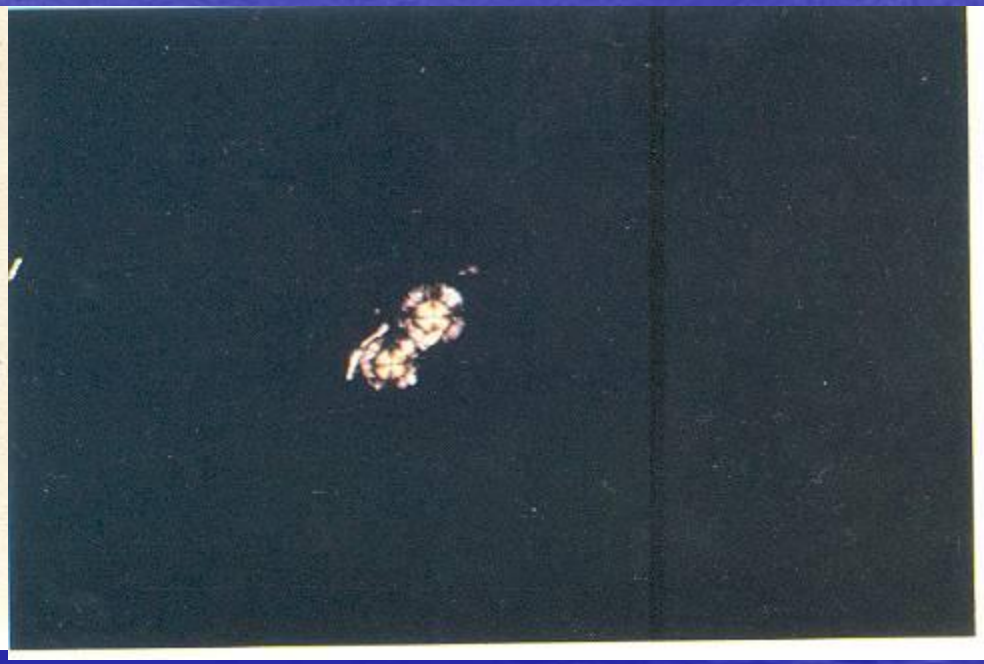
- Thorn Apple
- Ammonium producing bacteria

Tyrosine and Leucine

- Products of protein metabolims
- Seen in patients with tissue degeneration/ necrosis
  - Acute hepatitis, liver cirrhosis, leukemia
- Tyrosine – Needles
- Leucine – Spheres with pseudo Maltese Cross

Tyrosine

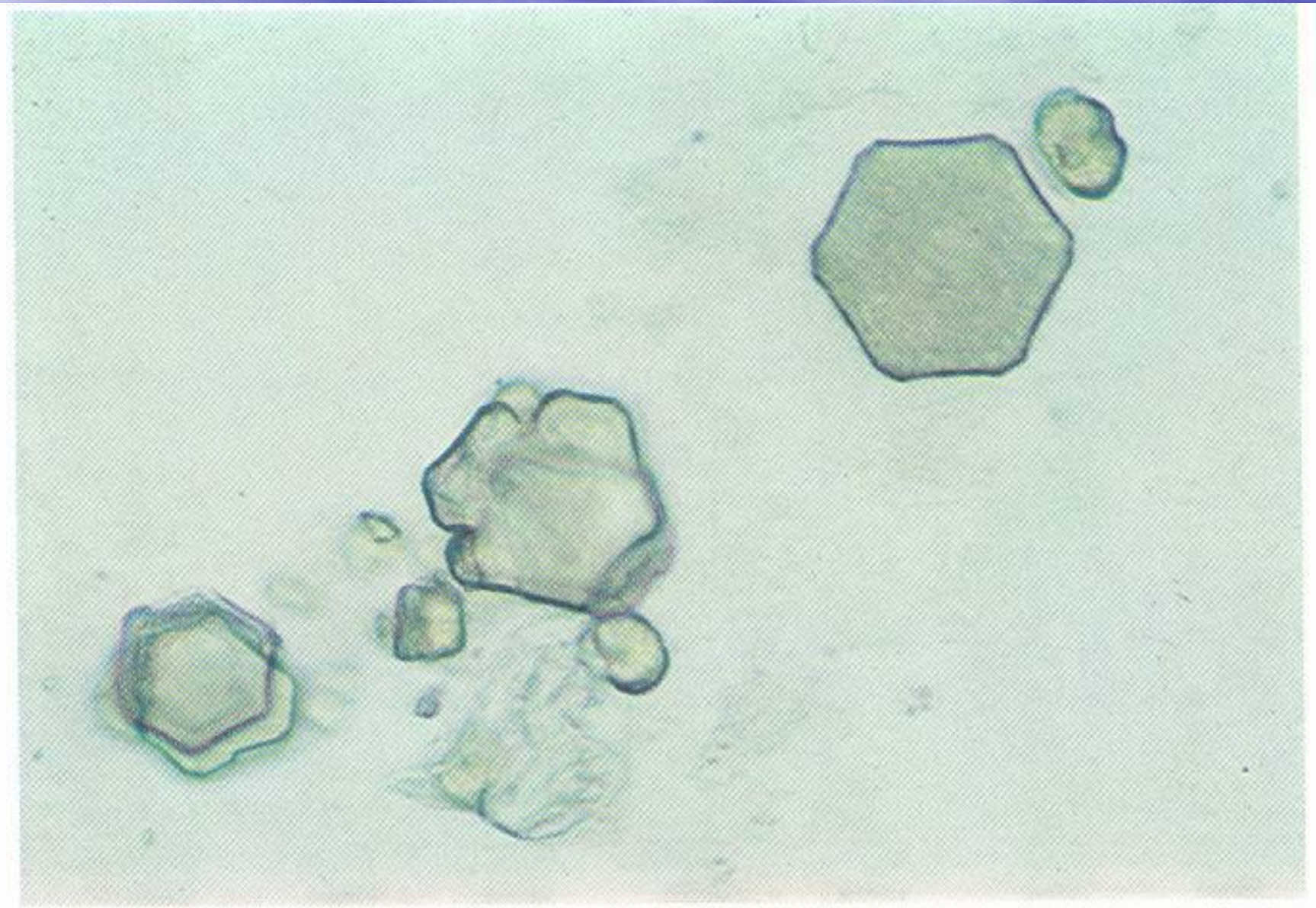
Leucine



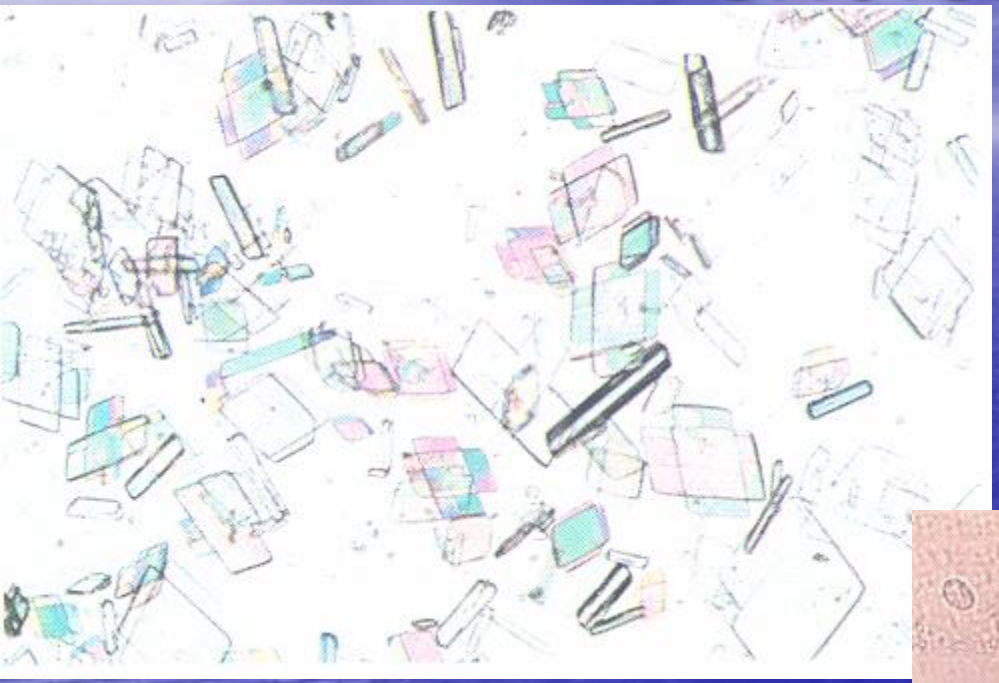
Cystine

- Flat, symmetrical hexagonal crystals
- Cystinuria: AR, ch 2p16.3
  - Cystine, lysine, arginine, ornithine
- Cystine stones are only phenotypic manifestation

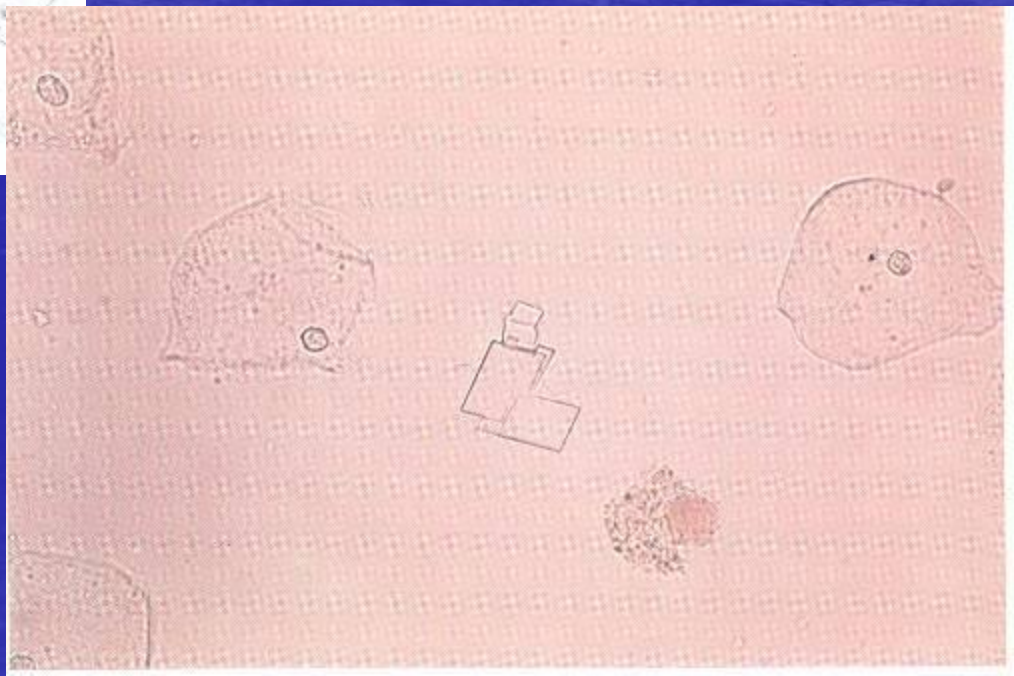
Cystine



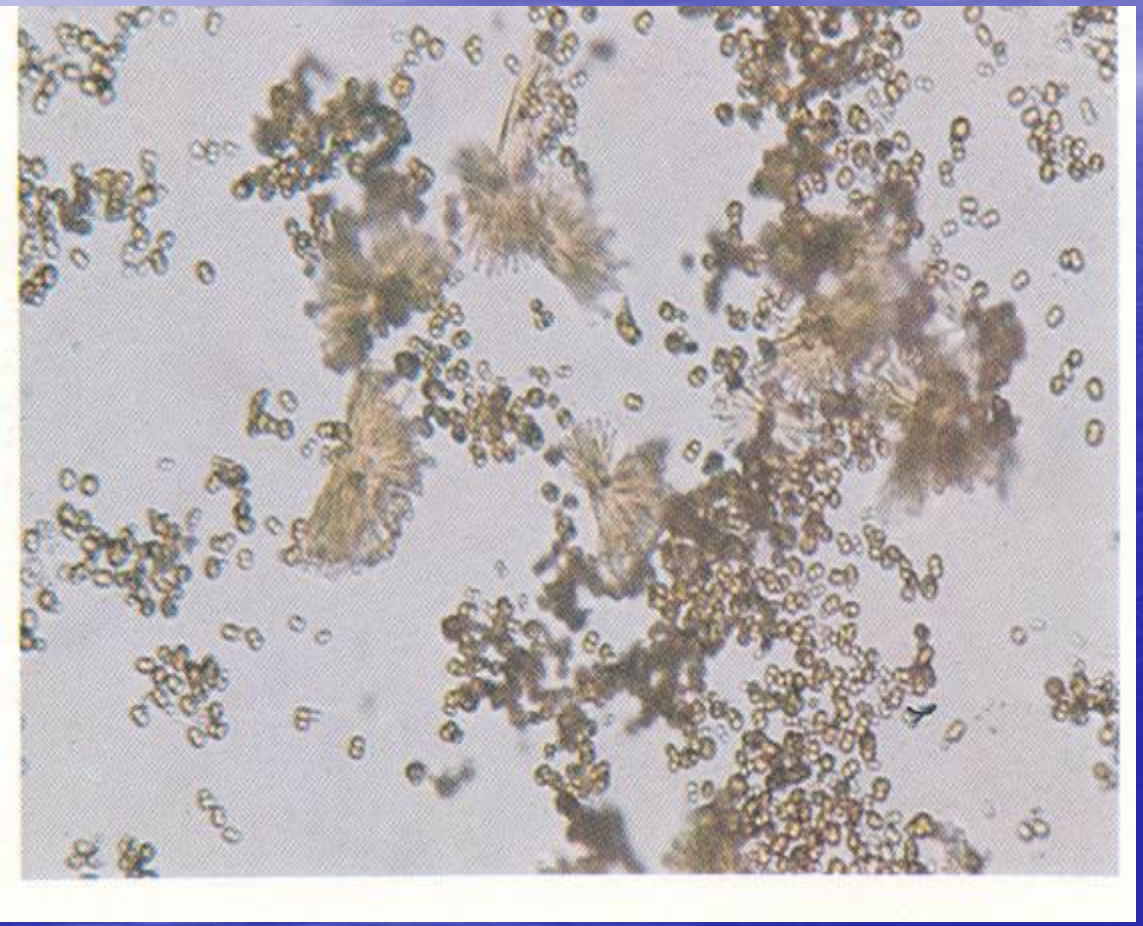
Cholesterol



- Stairstep crystal
- Nephrotic syndrome



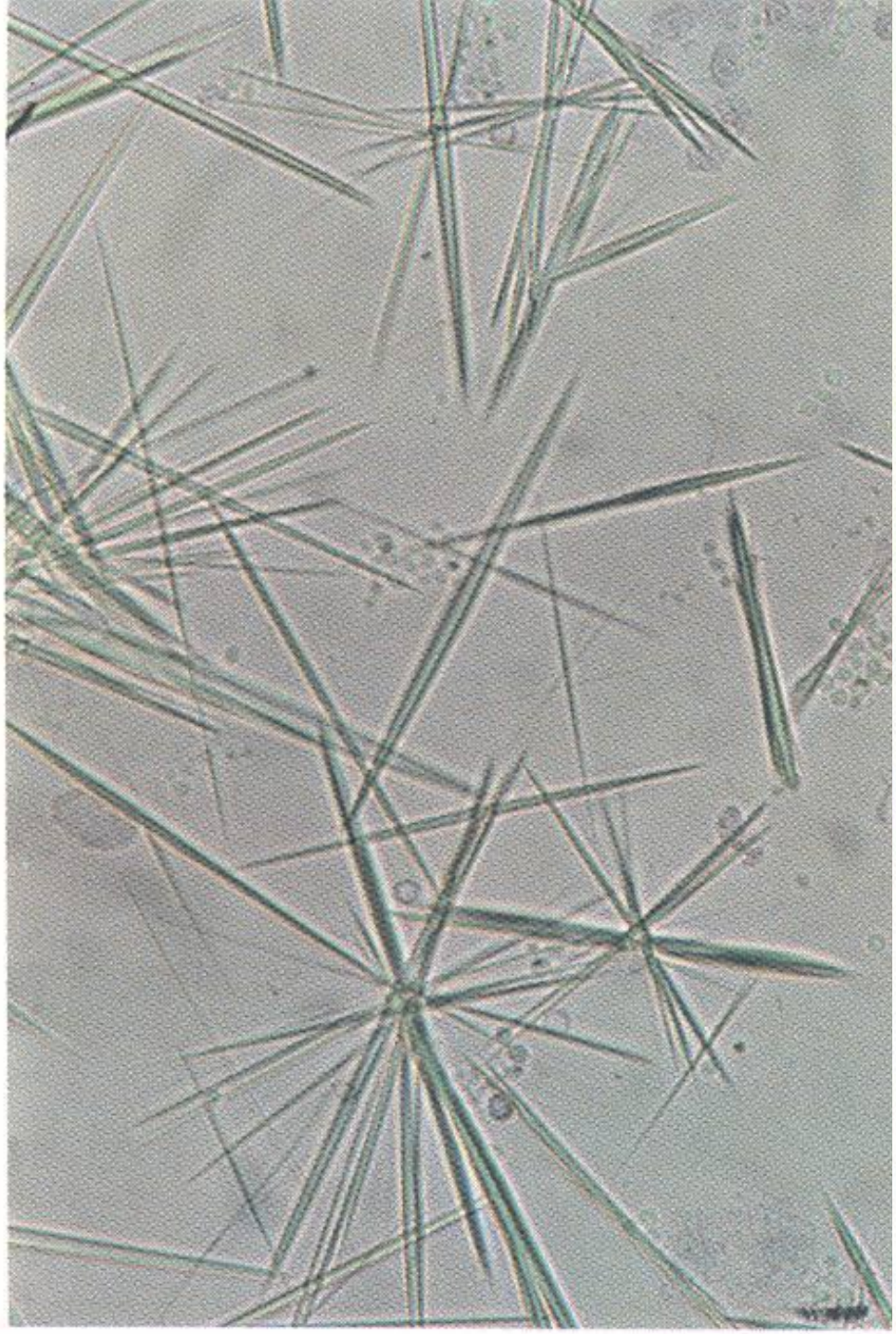
Bilirubin



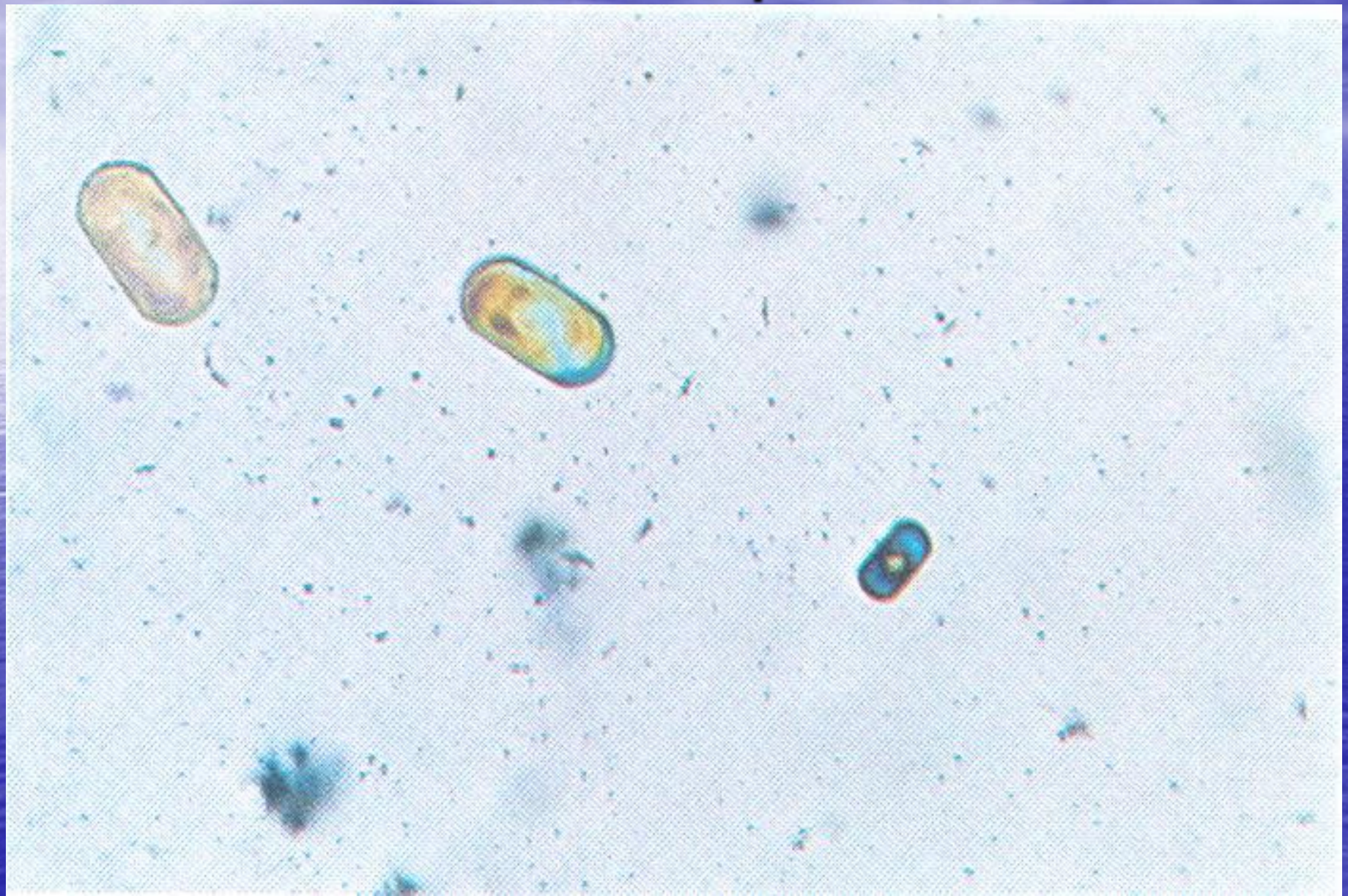
- Pigmented clustes of granules and needles
- Clinical Jaundice
  - Hepatobiliary
  - Hematologic

Sufonamide Crystals

- Fan shapes, needles
- Lignin Test
  - Urine, 10% HCL, yellow-orange color
- Can form stones, damage to renal tubules, suboptimal hydration.

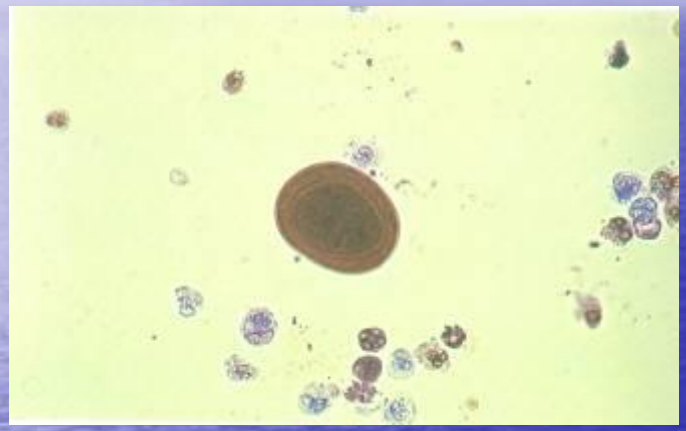


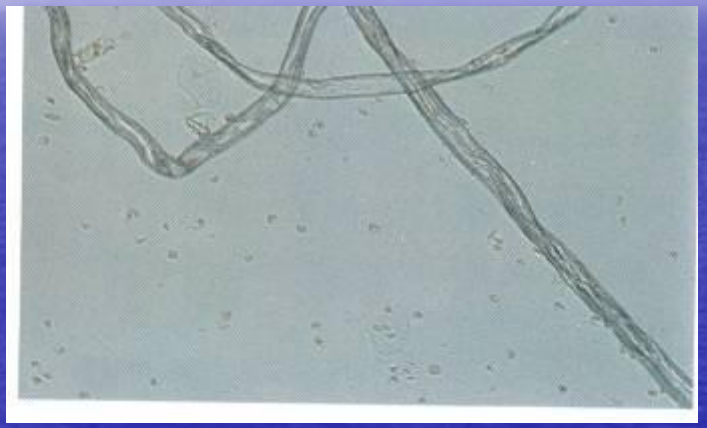
Acetaminophen



Starch

Miscelaneous

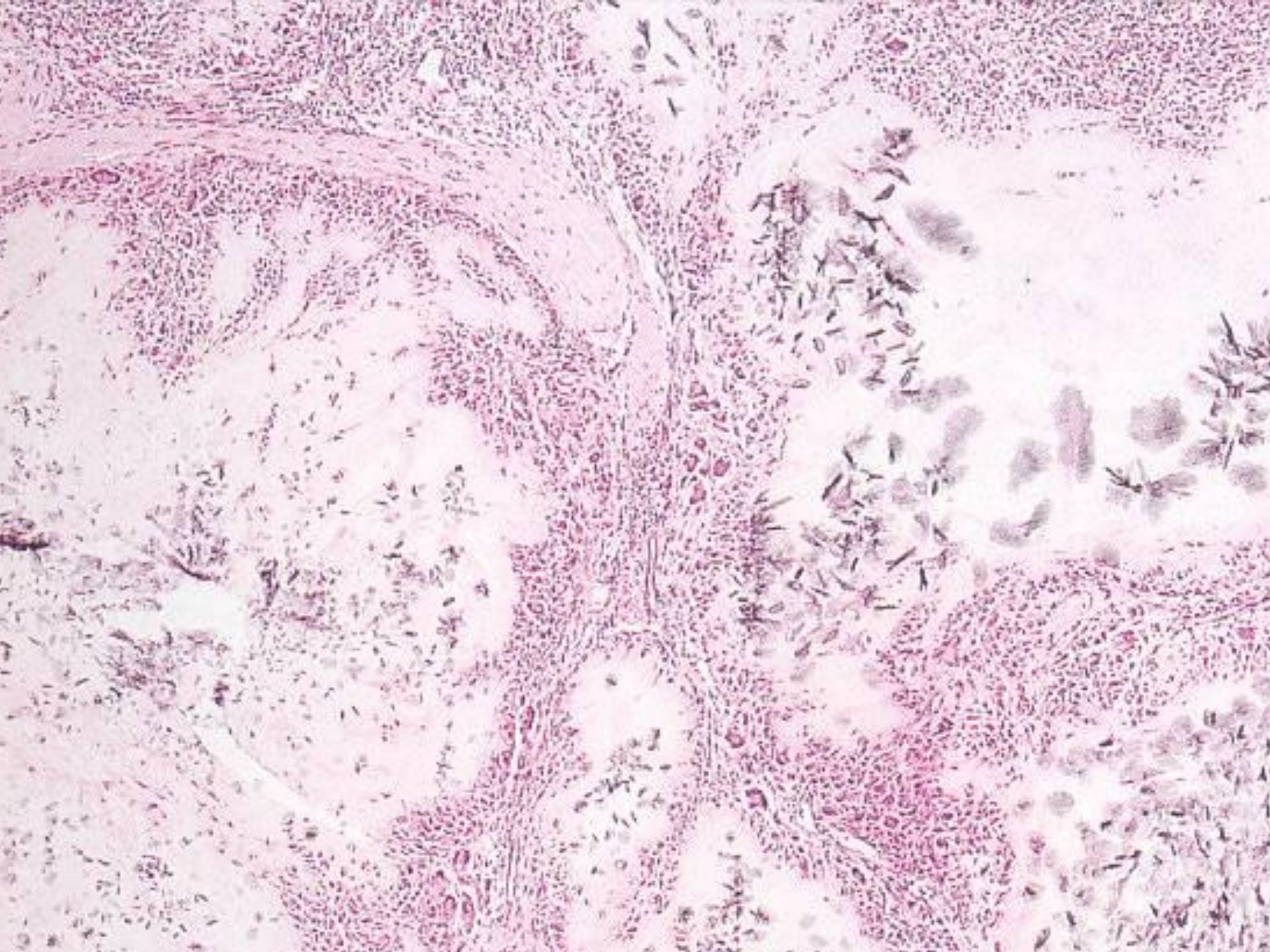




Synovial Fluid Crystals

Crystal	Clinical Disorder
Monosodium urate monohydrate	Urate gout
Calcium pyrophosphate dihydrate (CPPD)	CPPD deposition disease; Pseudogout; Pyrophosphate gout; Chondrocalcinosis
Basic calcium phosphates: hydroxyapatite, octacalcium phosphate, tricalcium phosphate (Whitlockite); Dicalcium phosphate (Brushite)	Apatite gout
Calcium oxalate monohydrate (Whewellite); Calcium oxalate dihydrate (Weddelite)	Oxalate gout (renal dialysis patients)
Cholesterol esters	Cholesterol gout (Chronic effusions, rheumatoid arthritis)

Monosodium urate monohydrate

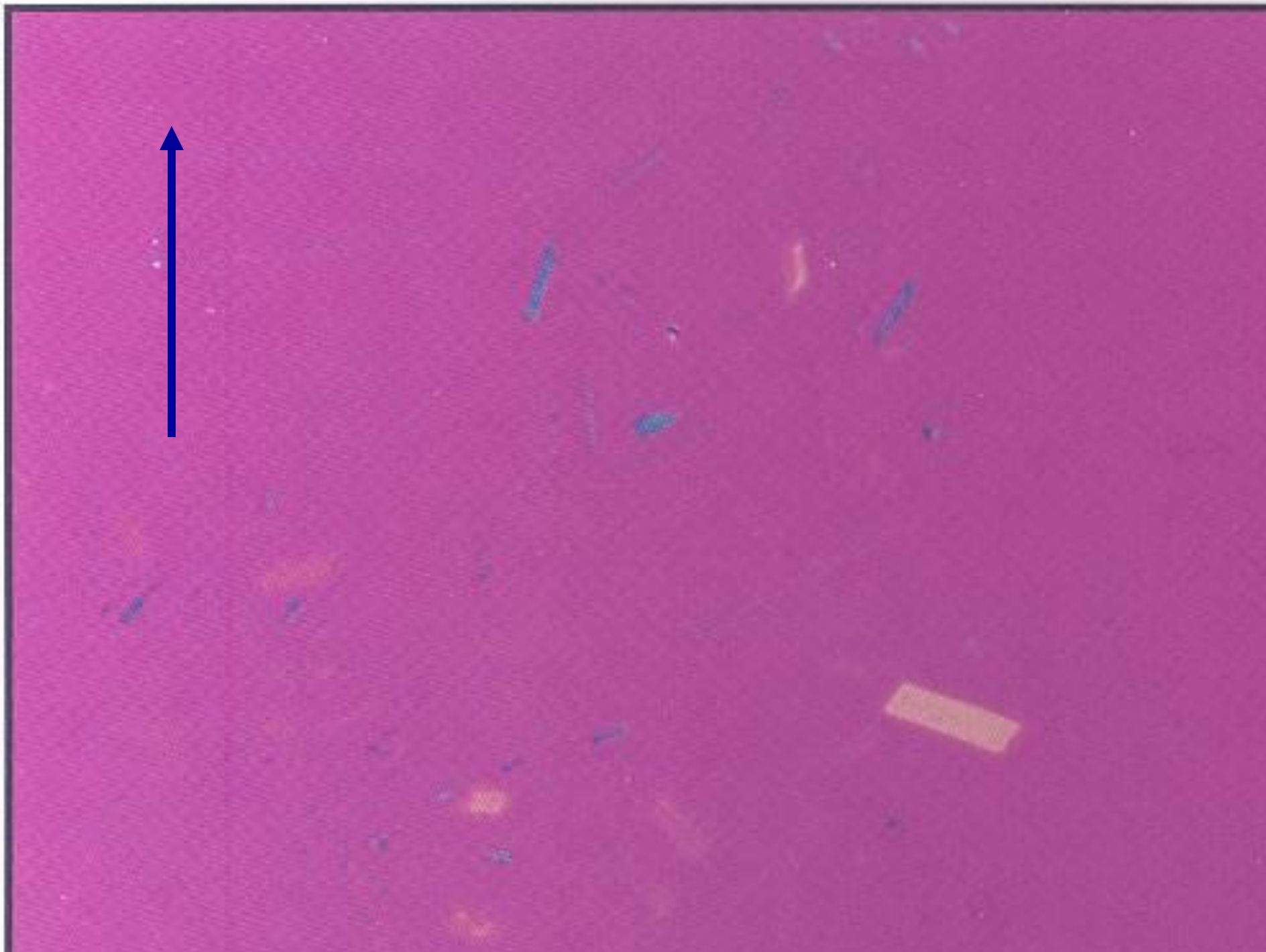


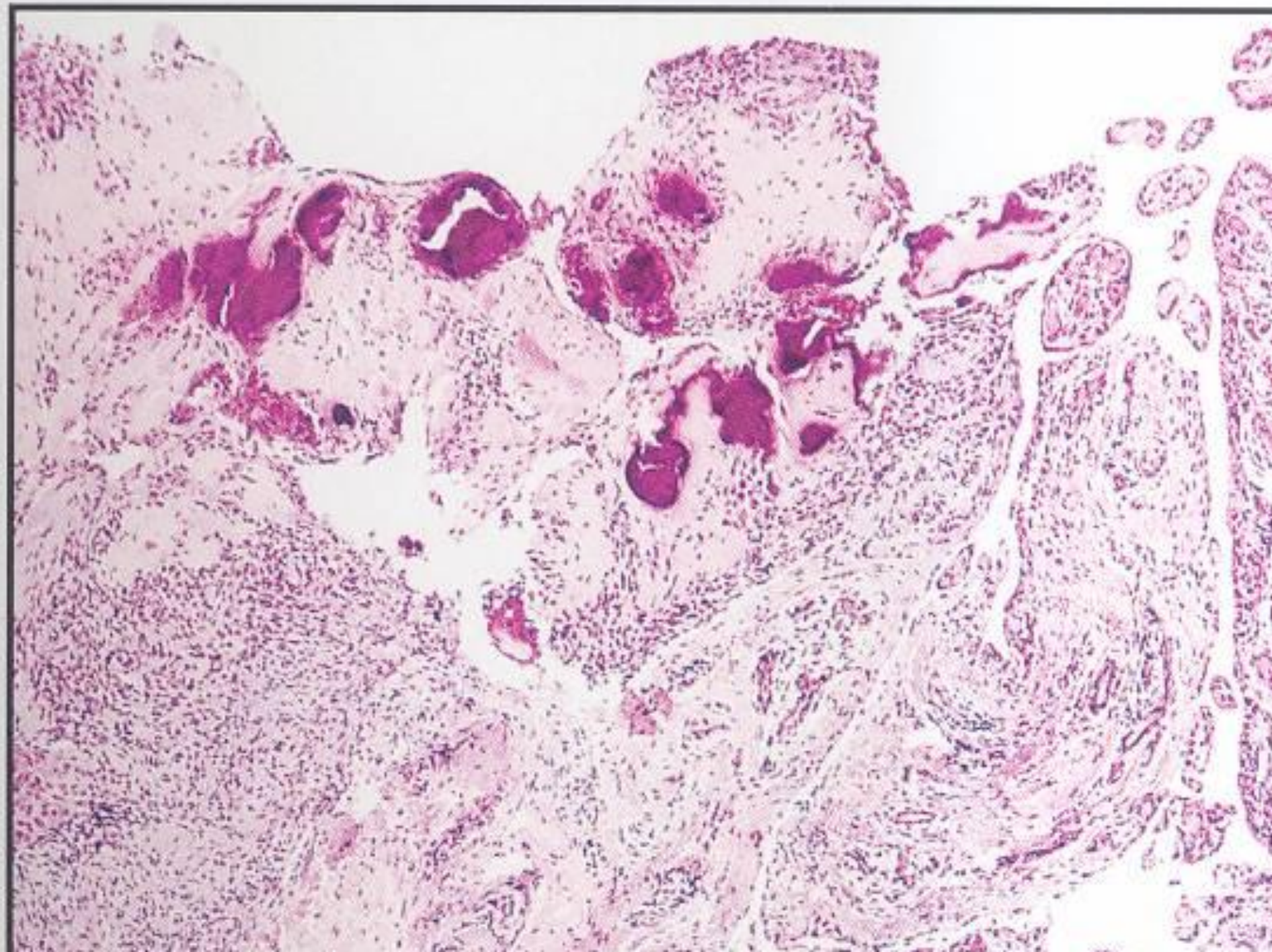
Calcium Pyrophosphate Dihydreate (CPPD)

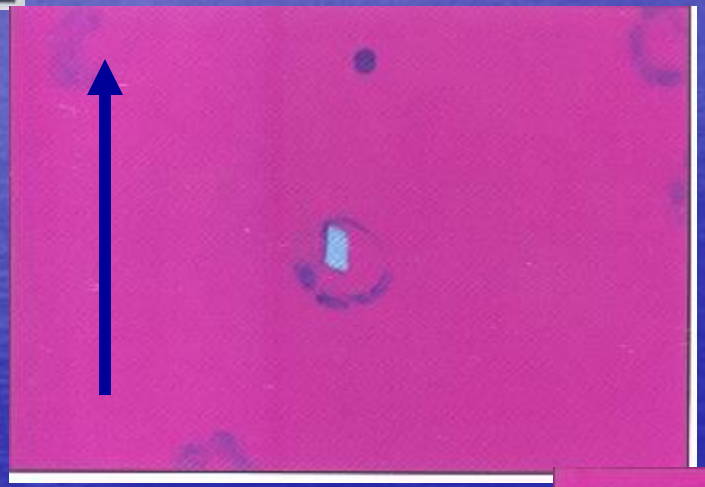
- Commonly associated with various metabolic disorders:
  - Hypothyroidism
  - Hyperparathyroidism
  - Hemochromatosis
  - Hypophosphatemia
  - Hpomagnesemia

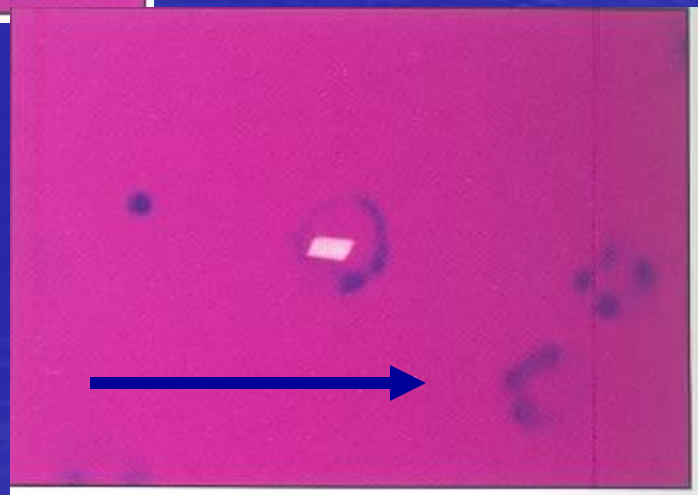
CPPD

- Symptoms
  - Progressive joint degeneration: knees, wrists, hips, shoulders, elbows, ankles.
  - Recurrent attacks of arthritis that attack one joint.



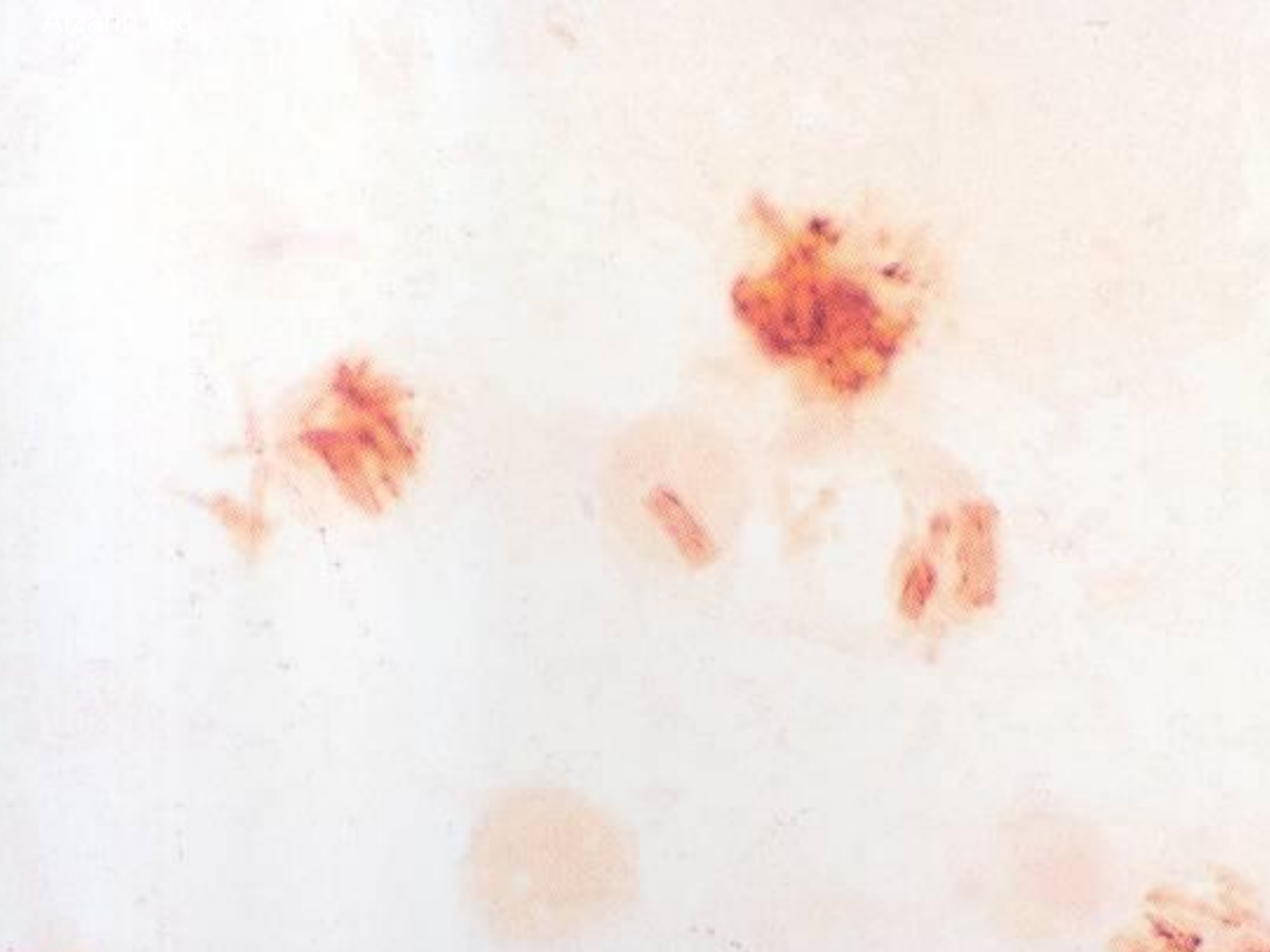






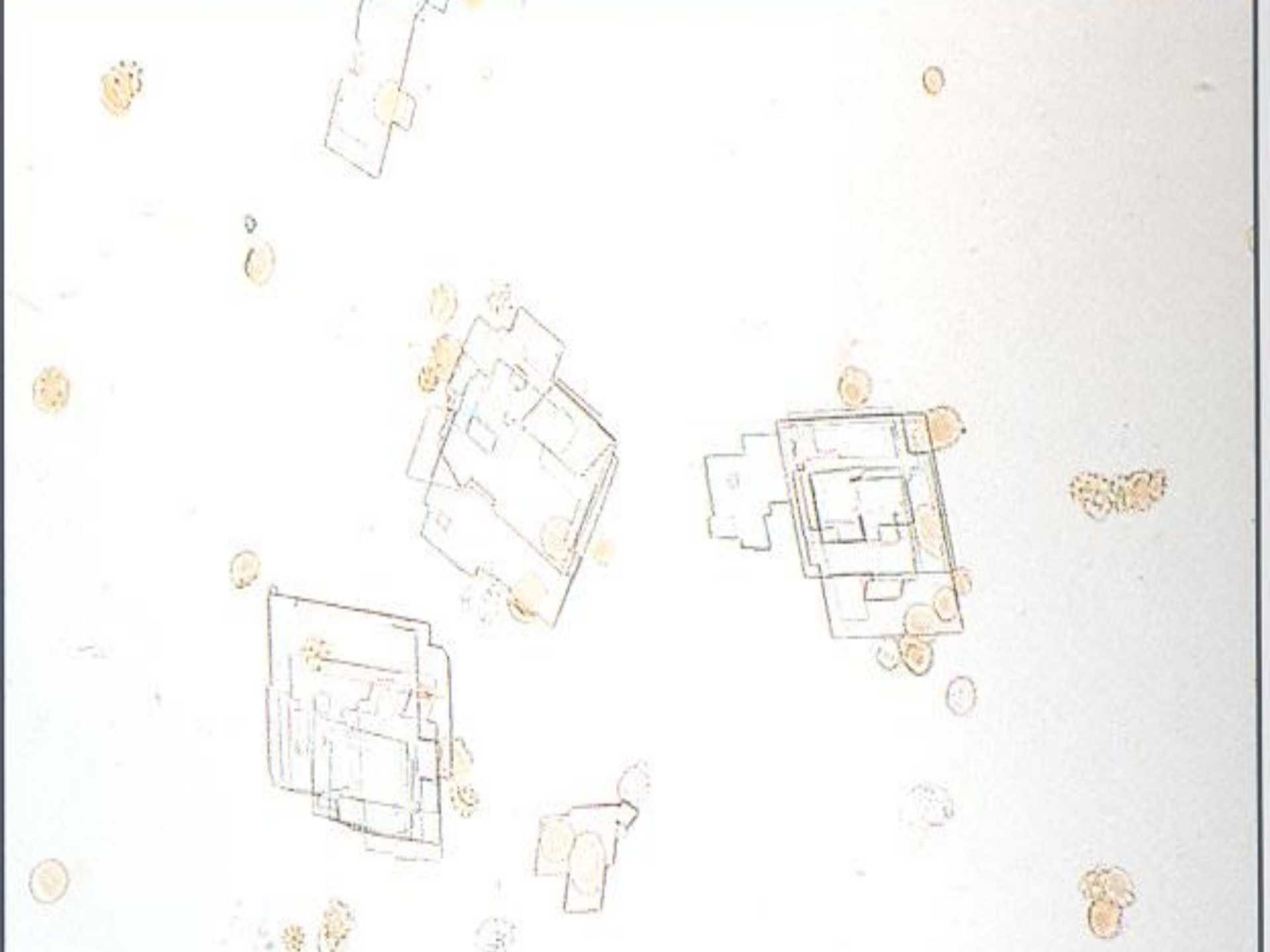
Basic calcium phosphate crystals

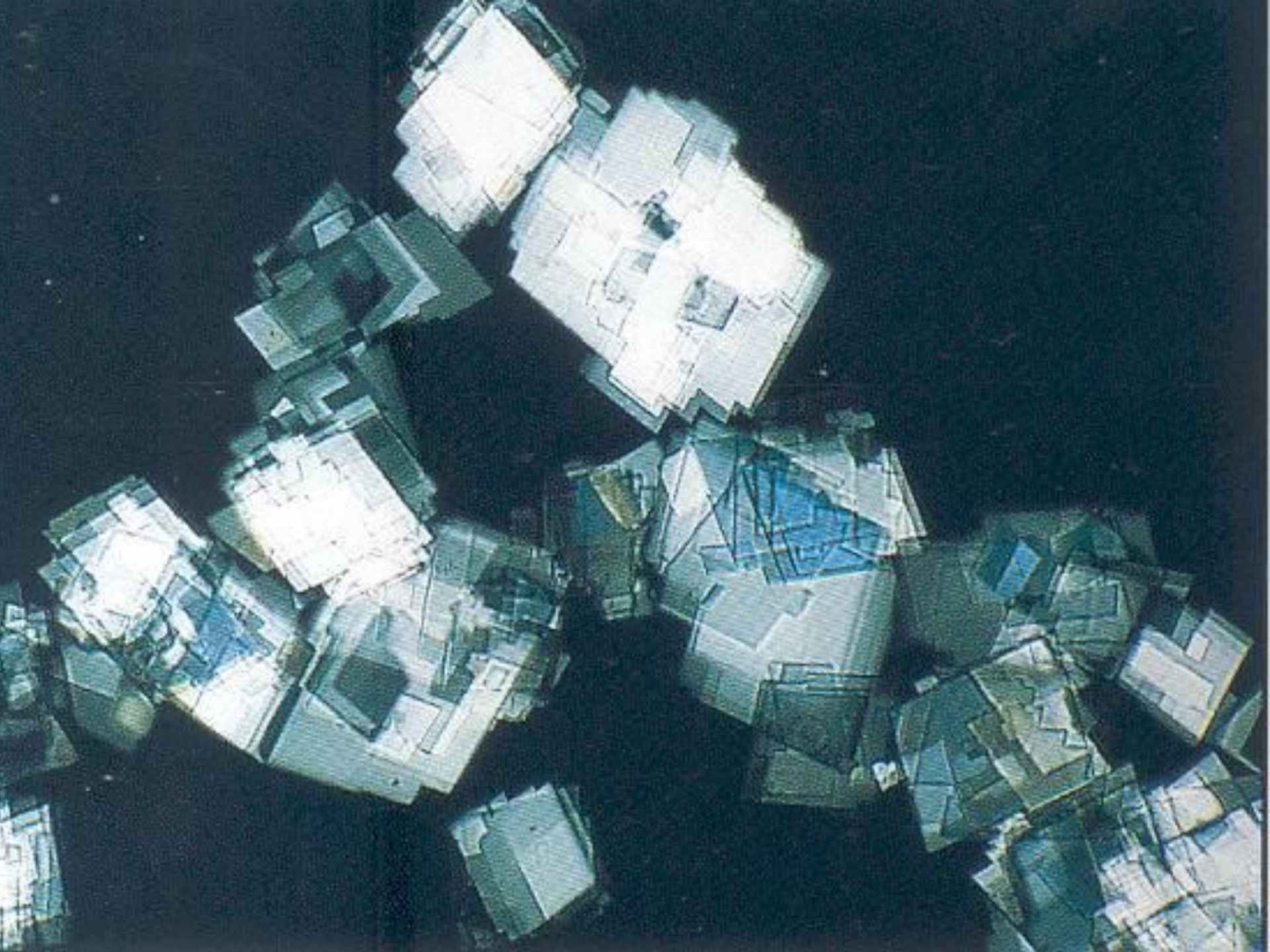
- Too small and too weekly birefringent to identify by conventional microscopy.
- Alizarin red dye may be used, but it is not very specific.
- Seen in osteoarthritis, and rheumatoid arthritis, but not required for dx.


Alizarin red

Cholesterol Crystals

- Rare finding in synovial fluid
  - Mostly seen with rheumatoid arthritis
  - Long stanting osteoarthritis, ankylosing spondylitis
- Formation involves cell membranes of degenerating cells





Microcrystalline Corticosteroid Esters