




URINARY ANALYSIS

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URINE ANALYSIS PROCEDURE

For a routine urine analysis, a fresh (*<1 hr old*), clean-catch urine sample is acceptable. If the analysis cannot be performed immediately, refrigerate the sample. (When urine stands at room temperature for a long period, casts and red blood cells undergo lysis, and the urine becomes alkalinized with precipitation of salts)



Urine Analysis: appearance, dipstick, microscopic

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1. Pour 5–10 mL of well-mixed urine into a centrifuge tube.
 2. Check for appearance (color, turbidity, odor). If a urine sample looks grossly cloudy, it is sometimes advisable to examine an unspun sample. In general, for routine urine analysis, a spun sample is more desirable.
 4. While the sample is in the centrifuge, use the dipstick (Chemstrip, etc.) to perform the dipstick evaluation on the remaining sample. Read the results according to the color chart on the bottle. Allow the correct amount of time before reading the test (usually 1–2 min) to avoid false results.
- Chemstrip 10 provides 10 tests (specific gravity, pH, leukocytes, nitrite, protein, glucose, ketone, urobilinogen, bilirubin, and blood). Other strips may provide less. Agents that color the urine (eg, phenazopyridine [Pyridium]) may interfere with the reading. Dipstick specific gravity is also available on some assay strips.**

Normal Urine Analysis Values

Appearance: Yellow, clear, or straw-colored

Specific gravity: Neonate: 1.012 – Infant: 1.002–1.006

– Child and adult: 1.001–1.035 (with normal fluid intake 1.016–1.022)

pH: – Newborn/neonate: 5–7 – Child and adult: 4.6–8.0

Negative for bilirubin, blood, acetone, glucose, protein, nitrite, leukocyte esterase, reducing substances

Trace: Urobilinogen

RBC: The exact definition of microscopic hematuria is debated, but is generally defined as >3 RBC/HPF

.(x40)

WBC: 0–4/HPF

Epithelial cells: Occasional

Hyaline casts: Occasional

Bacteria: None

Crystals: Some limited crystals, based on urine pH

Case 1

**Diluted urine, request a voided urine in the morning
If persisting low SG, possible diabetes insipida
A microscopic may give negative results**

Glucose	Negative
Bilirubin	Negative
Ketones	Negative
S.G.	1.001
Blood	Negative
pH	5.5
Protein	Negative
Urobilinogen	0.2 mg/dL
Nitrite	Negative
L.E.	Negative

A 35-year old man undergoing routine pre employment drug screening.

**Physical characteristics: Clear.
Not performed. Microscopic:
None. Drugs Identified:**

Questions:

- What is your differential diagnosis?**
- What would you do next to confirm your suspicion?**
- Would you order a microscopic analysis on this sample?**

Case 2

**Possible gallbladder or hepatic disease.
No hemolytic anemia. Perform bilirubins in serum
Microscopic unlikely to provide additional info**

Glucose	Negative
Bilirubin	+++
Ketones	Negative
S.G.	1.020
Blood	Negative
pH	5.5
Protein	Negative
Urobilinogen	0.2 mg/dL
Nitrite	Negative
L.E.	Negative

A 42-year old woman presents with “dark urine”

**Physical characteristics: Red-brown.
Microscopic: Not performed.**

Questions:

- What is your differential diagnosis?
- Could this be a case of hemolytic anemia?
- How would you rule it out?
- What tests would you order next? Why?
- Would you order a microscopic analysis?

Case 3

Possible UTI, request culture and antibiotic sensitivity
Negative Nitrite test: Gram positive bacteria
Lower SG may show less number of cells and bacteria
Un-common diagnosis in this type of patient

Glucose	Negative
Bilirubin	Negative
Ketones	Negative
S.G.	1.030
Blood	+++
pH	6.5
Protein	Trace
Urobilinogen	1.0 mg/dL
Nitrite	Negative
L.E.	+++

A 42-year old man presents painful urination

Physical characteristics: dark red, turbid

Microscopic: leukocytes = 30 per HPF

RBCs = >100 per HPF

Bacteria = >100 per HPF











Questions:

- **What is your suspected diagnosis?**
- **What would you do next?**
- **What do you make of the nitrite test?**
- **How would the microscopic exam differ if the S.G. were 1.003?**
- **Is this a common diagnosis for this type of patient?**

Case 4

Diabetes

May be decompensated and with ketoacidosis
Ketones should become negative after treatment

Glucose		++
Bilirubin		Negative
Ketones		Trace
S.G.		1.015
Blood		Negative
pH		6.0
Protein		Negative
Urobilinogen		1.0 mg/dL
Nitrite		Negative
L.E.		Negative

A 27-year old woman presents with severe abdominal pain.

**Physical characteristics: clear-yellow.
Microscopic: Not performed.**

Questions:

- What is the most likely diagnosis?
- What do you make of the ketone result?
- What do you expect to happen to the ketone measurement when treatment begins?

Case 5

Glomerulonephritis
RBC casts reveals renal cortex involvement
RBC cast are not always present in GN

Glucose	Negative
Bilirubin	Negative
Ketones	Negative
S.G.	1.015
Blood	+++
pH	6.5
Protein	+
Urobilinogen	1.0 mg/dL
Nitrite	Negative
L.E.	Negative

8-year old boy presents with discolored urine

Physical characteristics: Red, turbid.
Microscopic: erythrocytes = >100 per HPF
(almost all dysmorphic)
Red cell casts present.

Questions:

- **What is the most likely diagnosis in this case?**
- **Does the presence of red cell casts help you in any way?**
- **If the erythrocytes were not dysmorphic would that change your diagnosis?**

Case 6

“Functional” proteinuria?
Microscopic may reveal a few leukocytes
Request protein concentration in 24 h urine

Glucose	Negative
Bilirubin	Negative
Ketones	Negative
S.G.	1.010
Blood	Negative
pH	5.0
Protein	+
Urobilinogen	0.2 mg/dL
Nitrite	Negative
L.E.	Negative

22-year old man presenting for a routine physical required for admission to medical school

Physical characteristics: Yellow
Microscopic: Not performed

Questions:

- What is your differential diagnosis?
- Would you order a microscopic analysis on this sample?
- What would you do next to confirm the diagnosis?

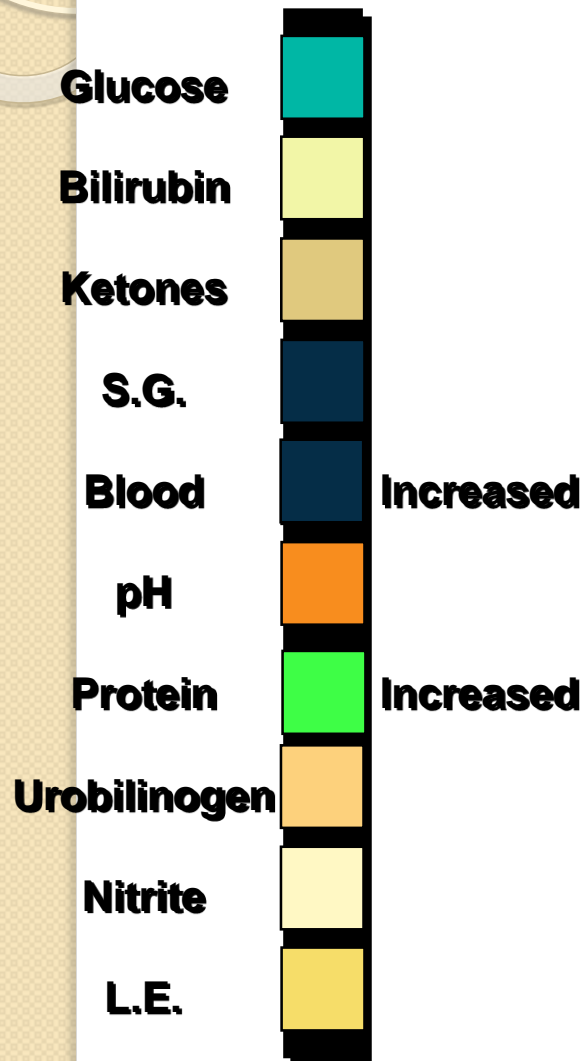
Common Findings in: Acute Tubular Necrosis

Glucose	
Bilirubin	
Ketones	
S.G.	Decreased
Blood	+ / -
pH	
Protein	+ / -
Urobilinogen	
Nitrite	
L.E.	

Microscopic:

- Renal tubular epithelial cells
- Pathological casts

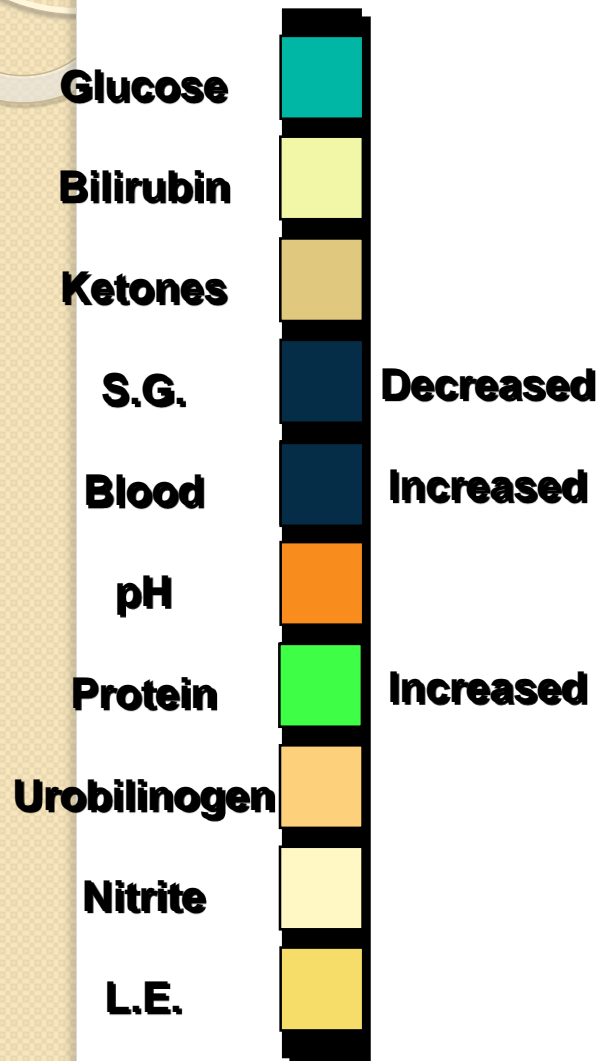
Common Findings in: Acute Glomerulonephritis



Microscopic:

- **Erythrocytes (dysmorphic)**
- **Erythrocyte casts**
- **Mixed cellular casts**

Common Findings in: Chronic Glomerulonephritis



Microscopic:

**Pathological casts •
(broad waxy casts, RBCs)**

Common Findings in: Acute Pyelonephritis

Glucose		
Bilirubin		
Ketones		
S.G.		
Blood		
pH		
Protein	Trace	
Urobilinogen		
Nitrite	Positive	
L.E.	Positive	

Microscopic:


- **Bacteria**
- **Leukocytes**
- **Leukocyte, granular, and waxy casts**
- **Renal tubular epithelial cell casts**

Common Findings in: Nephrotic Syndrome



Microscopic:

- Oval fat bodies •**
- Fatty casts •**
- Waxy casts •**

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3. Spin a capped sample at 3,000 rpm for 3–5 min
 5. **Decant and discard the supernatant.** **Mix the remaining sediment** by flicking it with your finger and **pouring or pipetting 1 or 2 drops onto a microscope slide.** Cover with a coverslip.
 6. **Examine 10 low-power fields (LPFs; 10× objective) for epithelial cells, casts, crystals, and mucus.** Casts are usually reported as number per low-power field and tend to collect around the periphery of the coverslip.
 7. **Examine several high-power fields (HPFs; 40× objective) for epithelial cells, crystals, RBCs, WBCs, bacteria, and parasites (trichomonads).** RBCs, WBCs, and bacteria are usually reported as number per high-power field.

Urine Sediment – Microscopic Analysis

Many labs no longer do microscopic examinations unless specifically requested or if the dipstick test shows evidence of an abnormal finding (such as positive leukocyte esterase):

Elements in microscopic analysis:


1- **Cells:** RBC, WBC, tubular epithelial cells, Squamous cells, Oval fat body, Transitional cells, others

2- **Casts:** A- Acellular: Hyaline, Granular, Waxy, Broad, fatty, microbe, pigmented

B- Cellular: RBC Cast, WBC Cast, Epithelial cell cast, Mixed

3- **Crystals:** Note that urine should be examined fresh and warm because clouding due to phosphate precipitation may be observed when urine cools:

- Abnormal: Cystine, sulfonamide, leucine, tyrosine, cholesterol
- Normal in acidic urine: Oxalate (small square crystals with a central cross), uric acid
- Normal in alkaline urine: Calcium carbonate, triple phosphate (resemble coffin lids)



RBCs: Trauma, pyelonephritis, genitourinary tuberculosis (TB), cystitis, prostatitis, stones, tumors (malignant and benign), coagulopathy, and any cause of blood on dipstick test (see above on hemoglobin)

WBCs: Infection anywhere in the urinary tract, TB, renal tumors, acute glomerulonephritis, radiation, interstitial nephritis (analgesic abuse)

Epithelial cells: Acute tubular necrosis (ATN), necrotizing papillitis (most epithelial cells are from an otherwise unremarkable urethra)



Parasites: *Trichomonas vaginalis*, *Schistosoma haematobium* infections

Yeast: *Candida albicans* infection (especially in diabetics, immunosuppressed patients, or if a vaginal yeast infection is present)

Spermatozoa: Normal in males immediately after intercourse or nocturnal emission

Contaminants: Cotton threads, hair, wood fibers, amorphous substances (all usually unimportant)

Mucus: Large amounts suggest urethral disease (normal from ileal conduit or other forms of urinary diversion).

White blood cells/red blood cells in urine

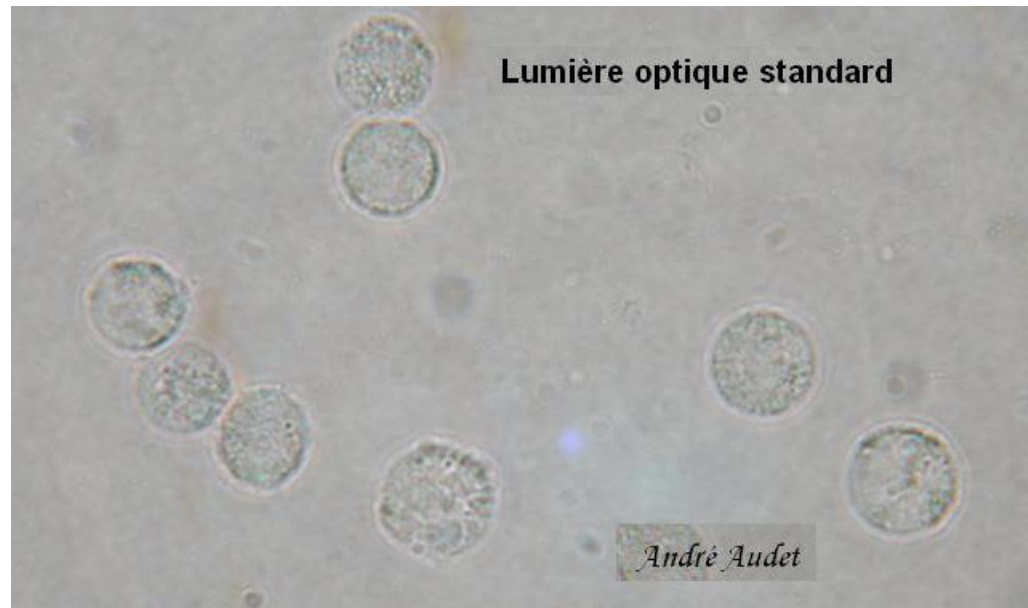


This is a photograph of urinary sediment under brightfield microscopy (250X magnification). The sediment contains two red blood cells (right) and one white blood cell (left). The white blood cell appears to have a lobulated nucleus.

WBC in Urine :

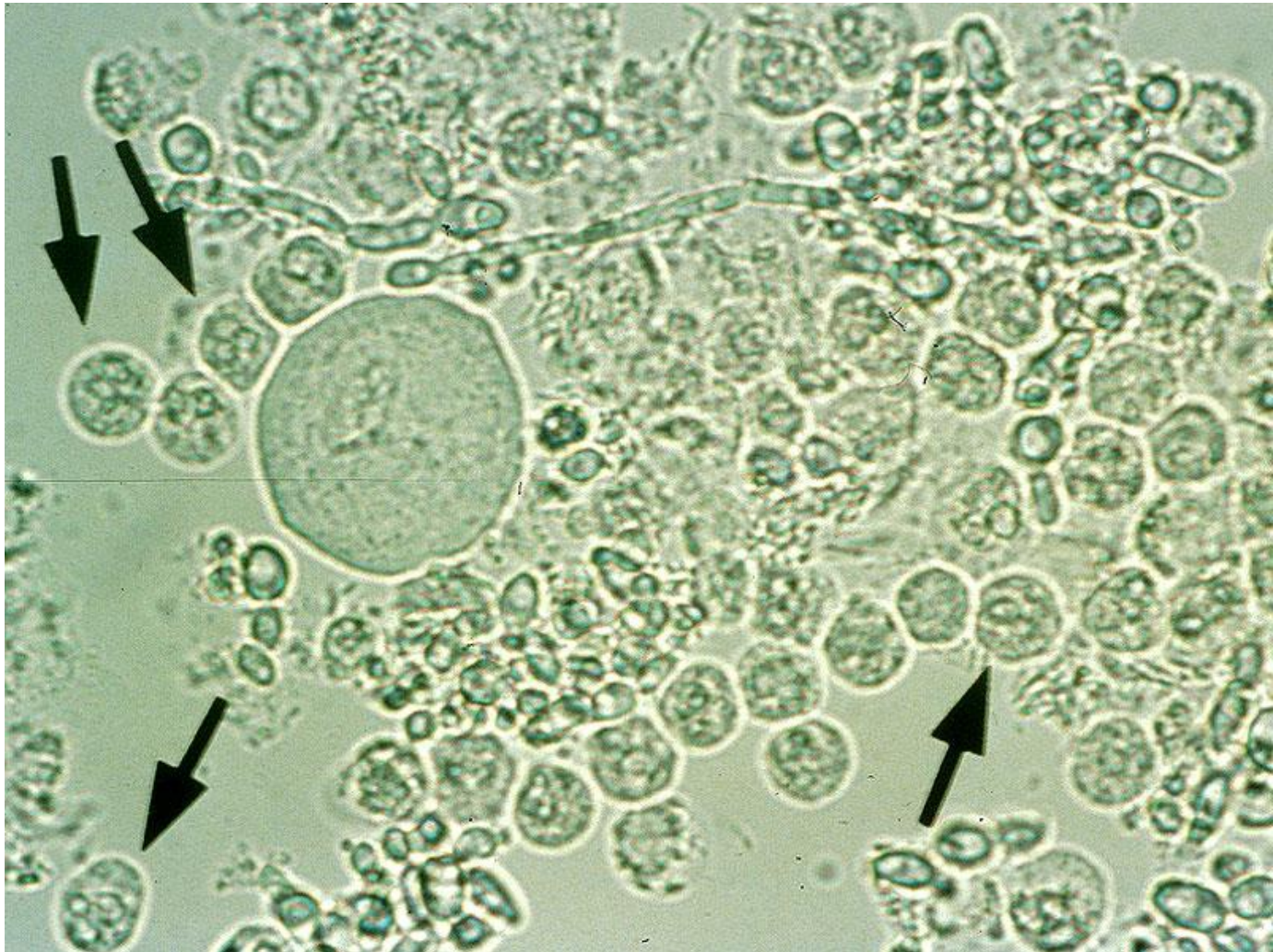


Microscopic Sediment – White Blood Cells



Microscopic Examination

WBCs



White blood cells and bacteria

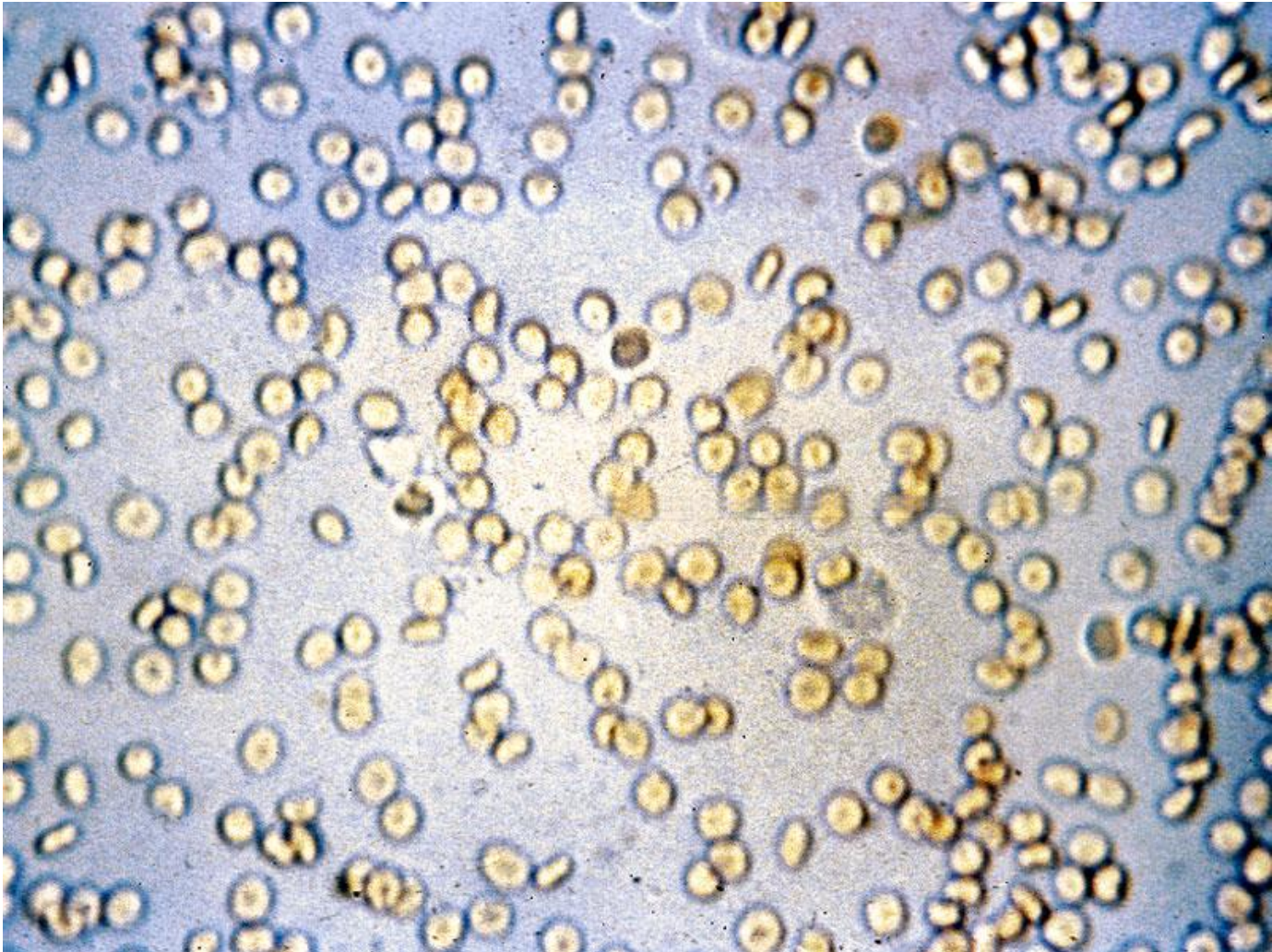


These are white blood cells and bacteria found in urinary sediment using interference-contrast microscopy. The cell in the center has a pseudopod extending from its cytoplasm indicating amoeboid motion.



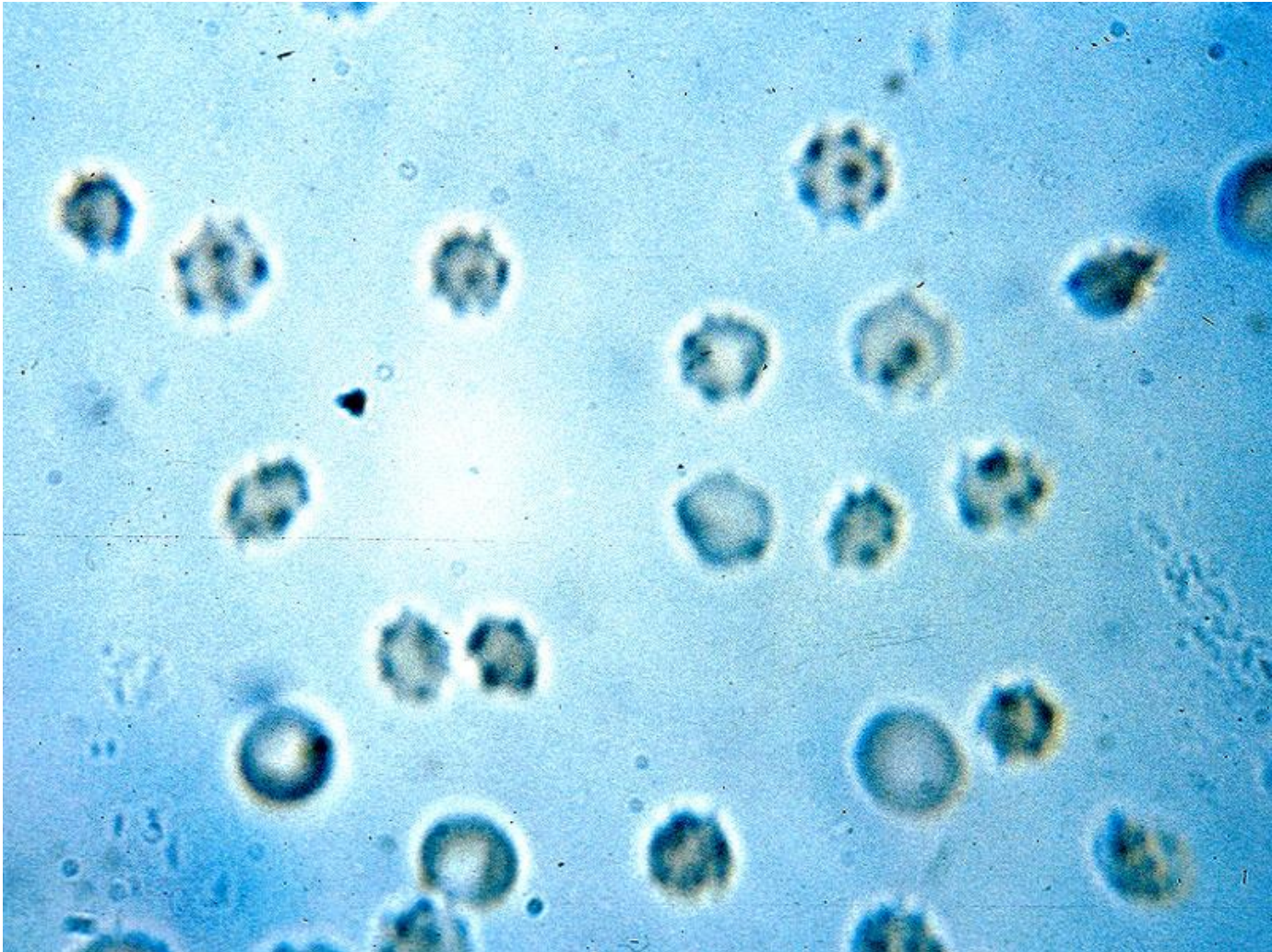
Microscopic Examination

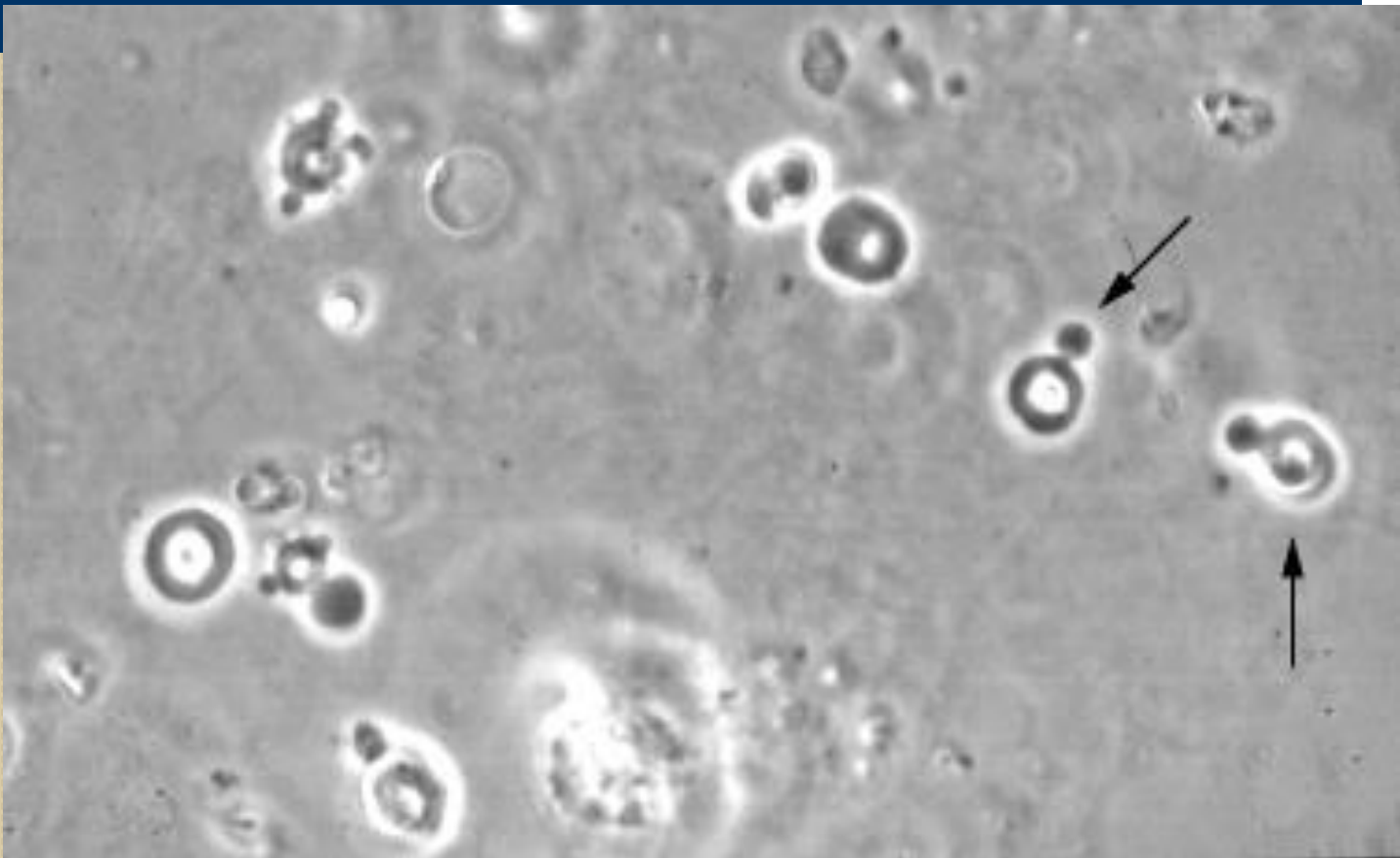
RBCs



Microscopic Examination

RBCs

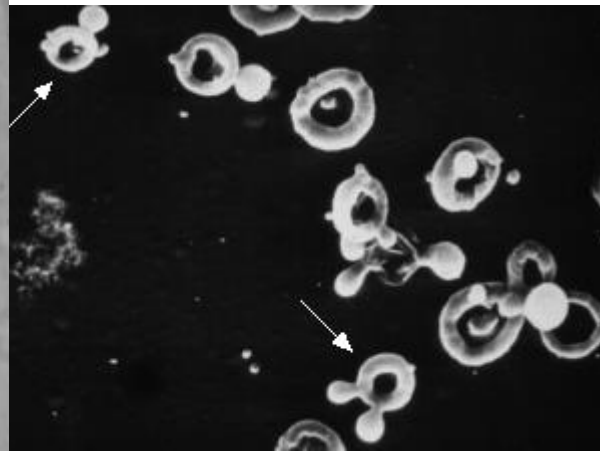
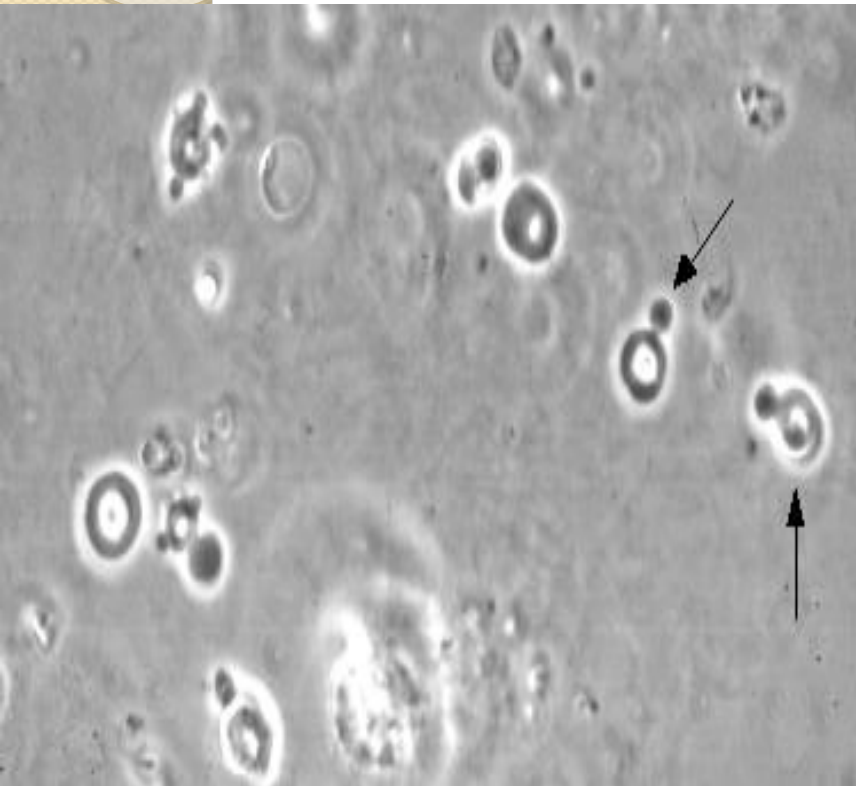




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Dysmorphic erythrocytes (of glomerular origine) are typical finding in proliferative GN

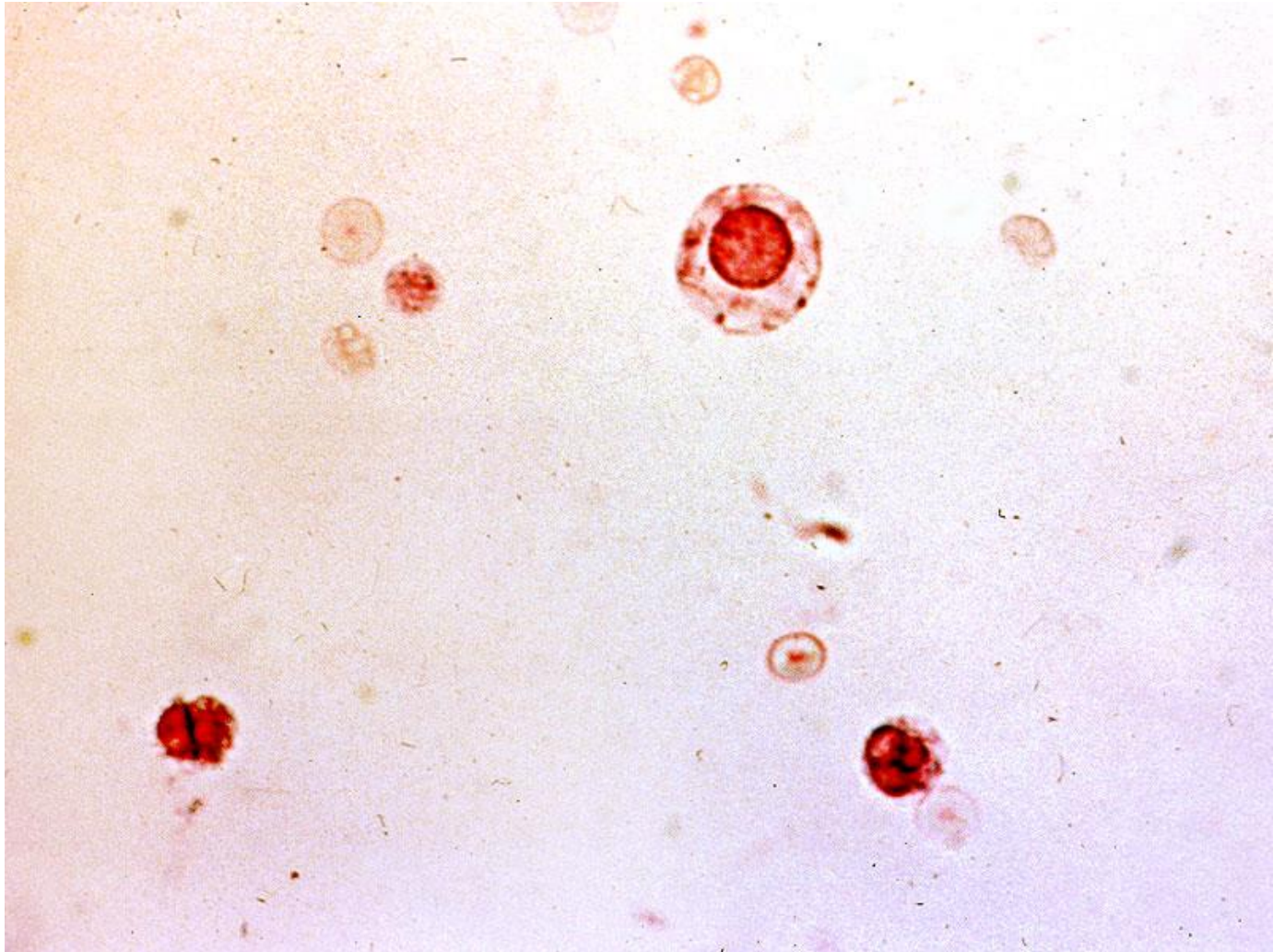


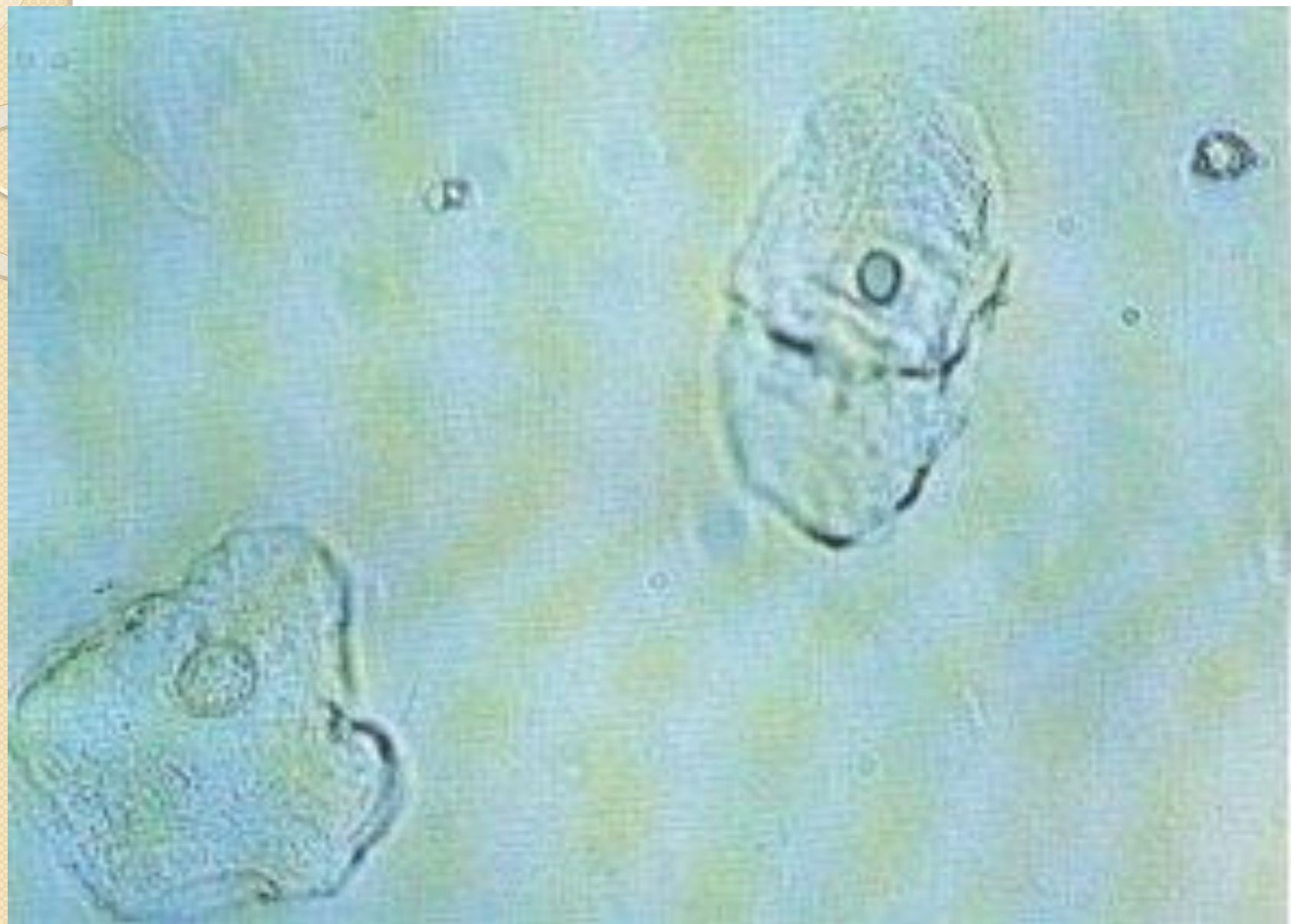
Urine sediment in phase contrast

Electroscanning microscopy

Microscopic Examination

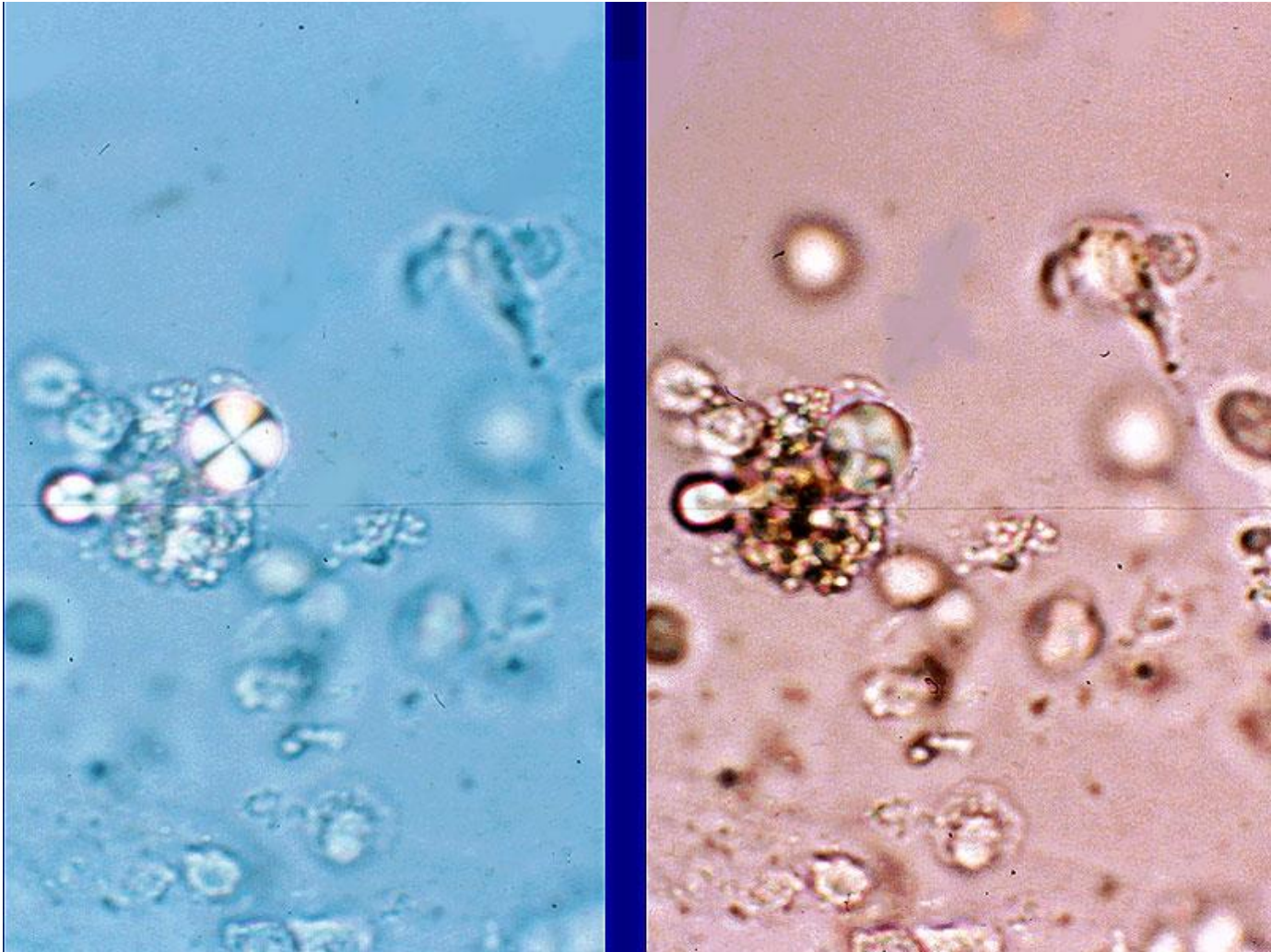
Tubular Epithelial Cells





Microscopic Examination

Oval Fat Body



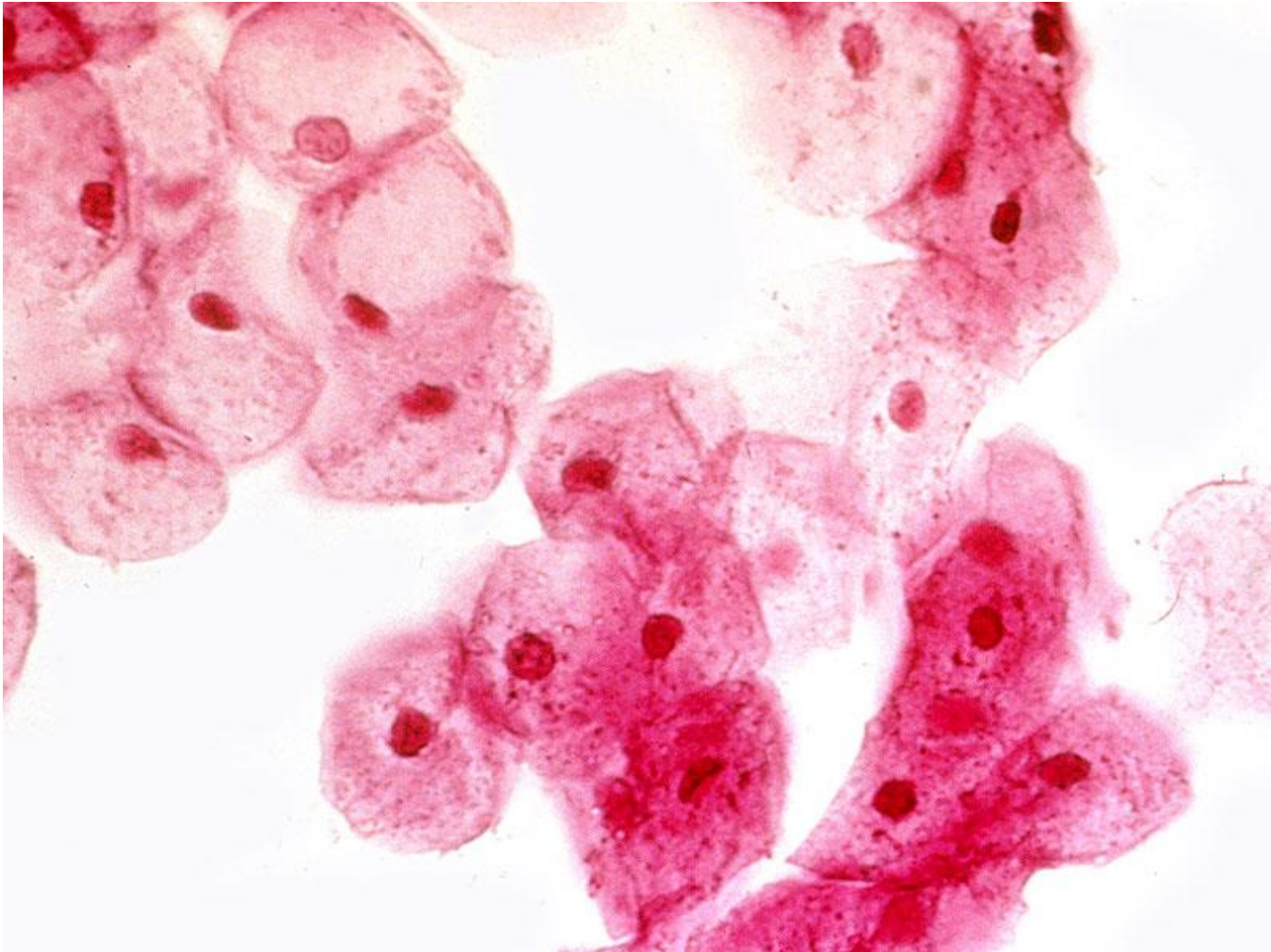
Starch in urine



A derivative of cornstarch is used as a dusting powder for surgical gloves. It can enter the urine during catheterization. The starch granules are usually identifiable by their size, shape and high refractive index. (Brightfield microscopy, 100X magnification.)

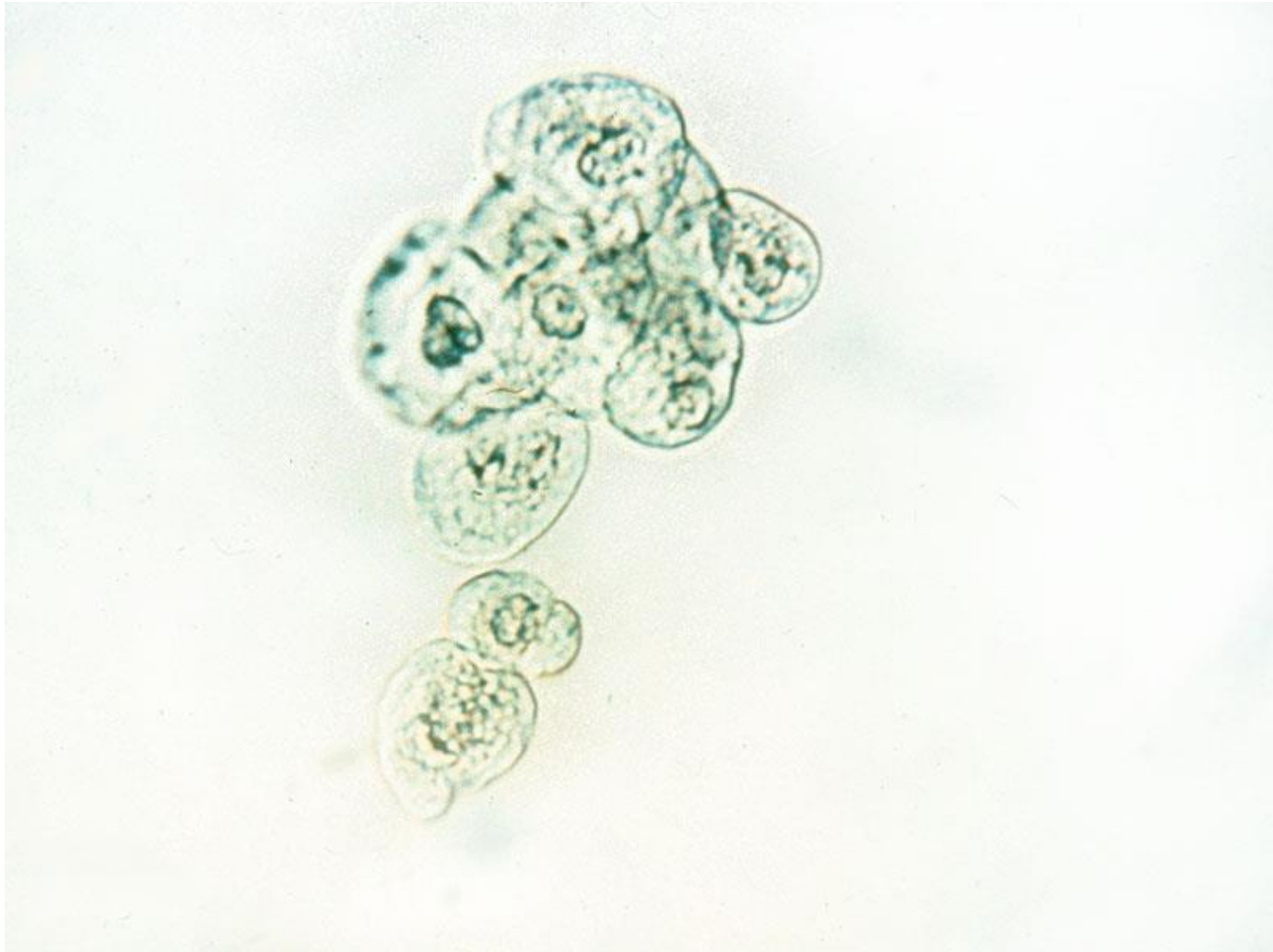
Microscopic Examination

Squamous Cells



Microscopic Examination

Transitional Cells

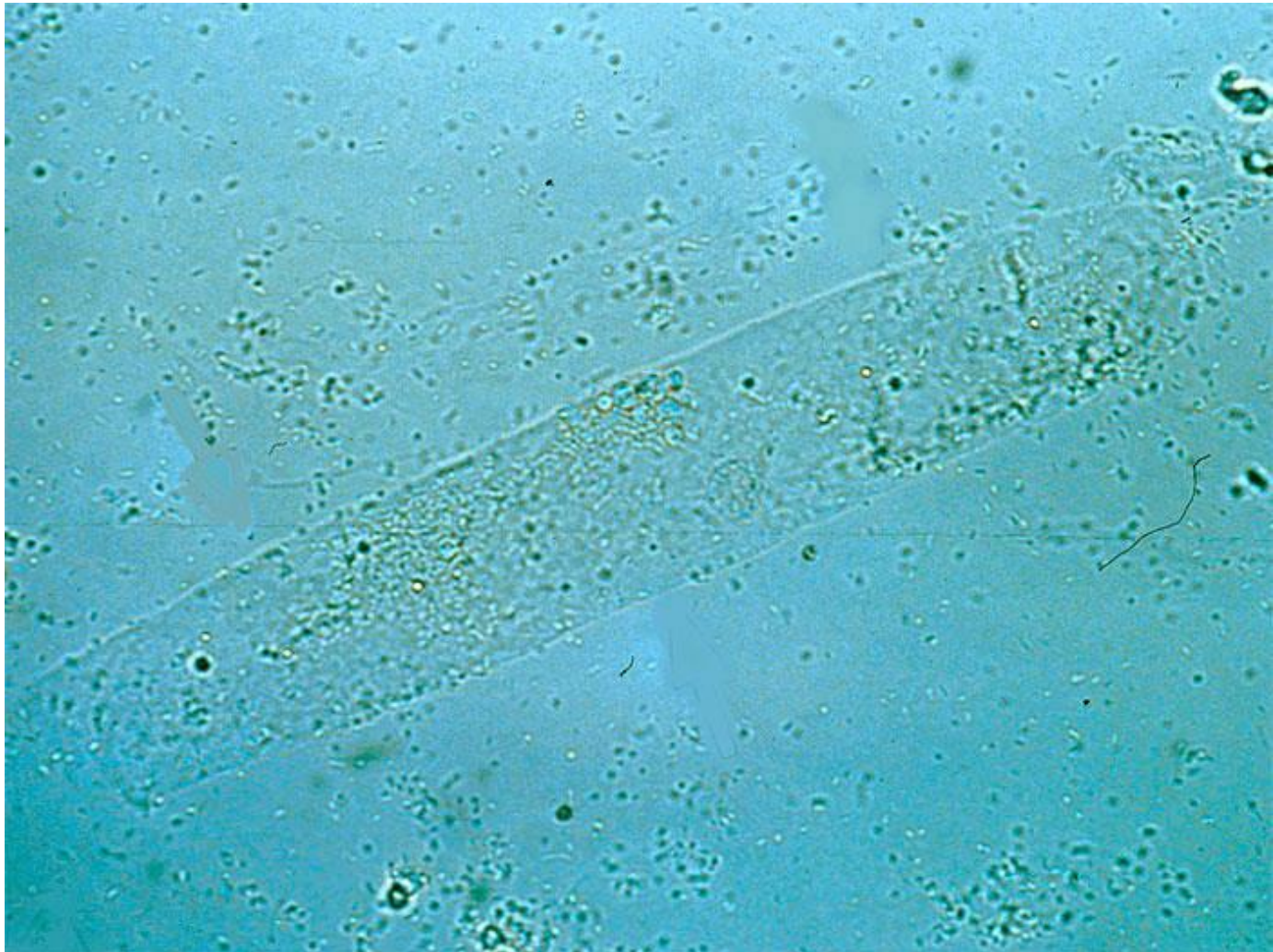


Hyaline



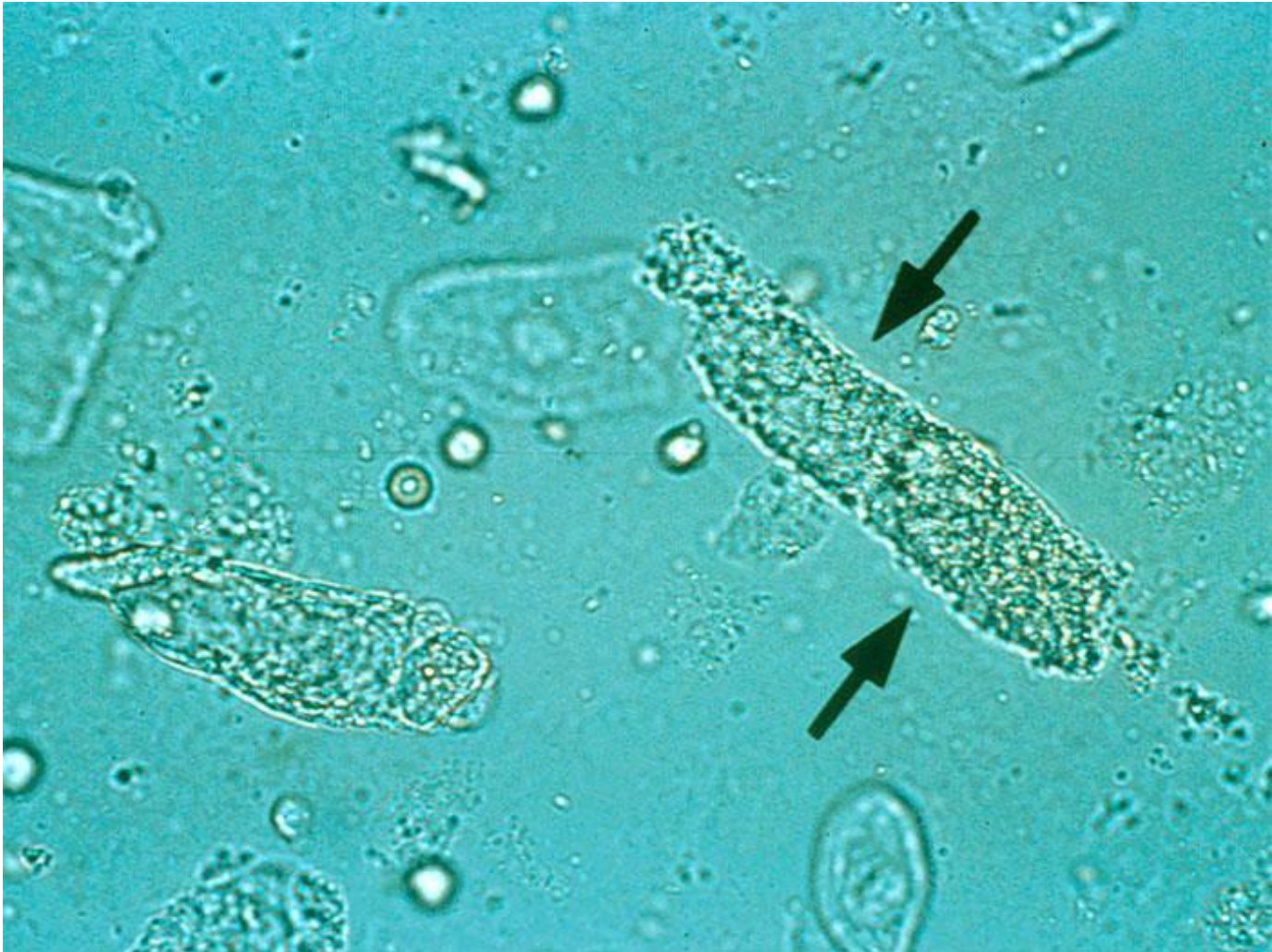
Microscopic Examination

Hyaline Cast



Microscopic Examination

Granular Cast



Waxy



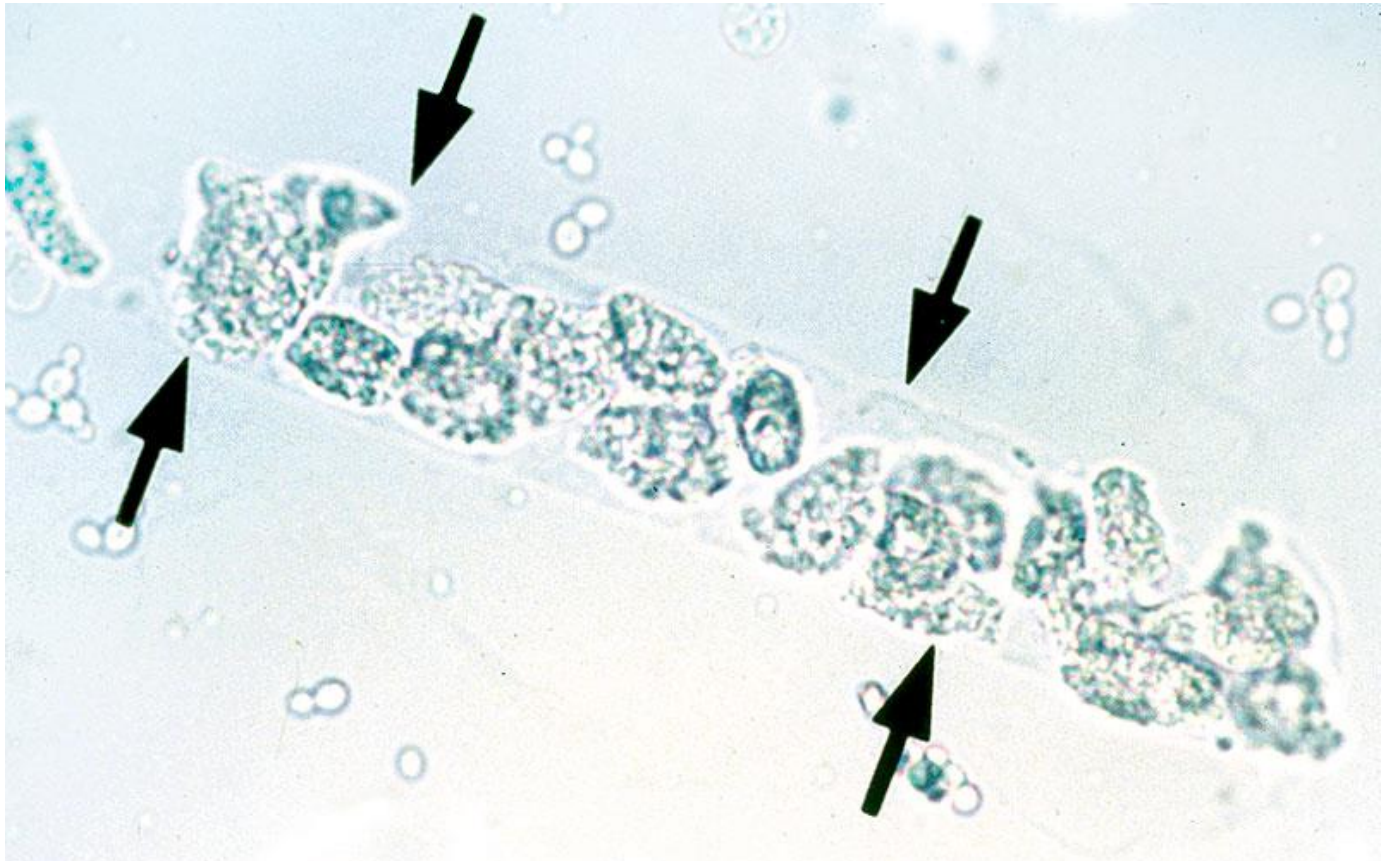
Microscopic Examination

Waxy Cast



Microscopic Examination

WBCs Cast





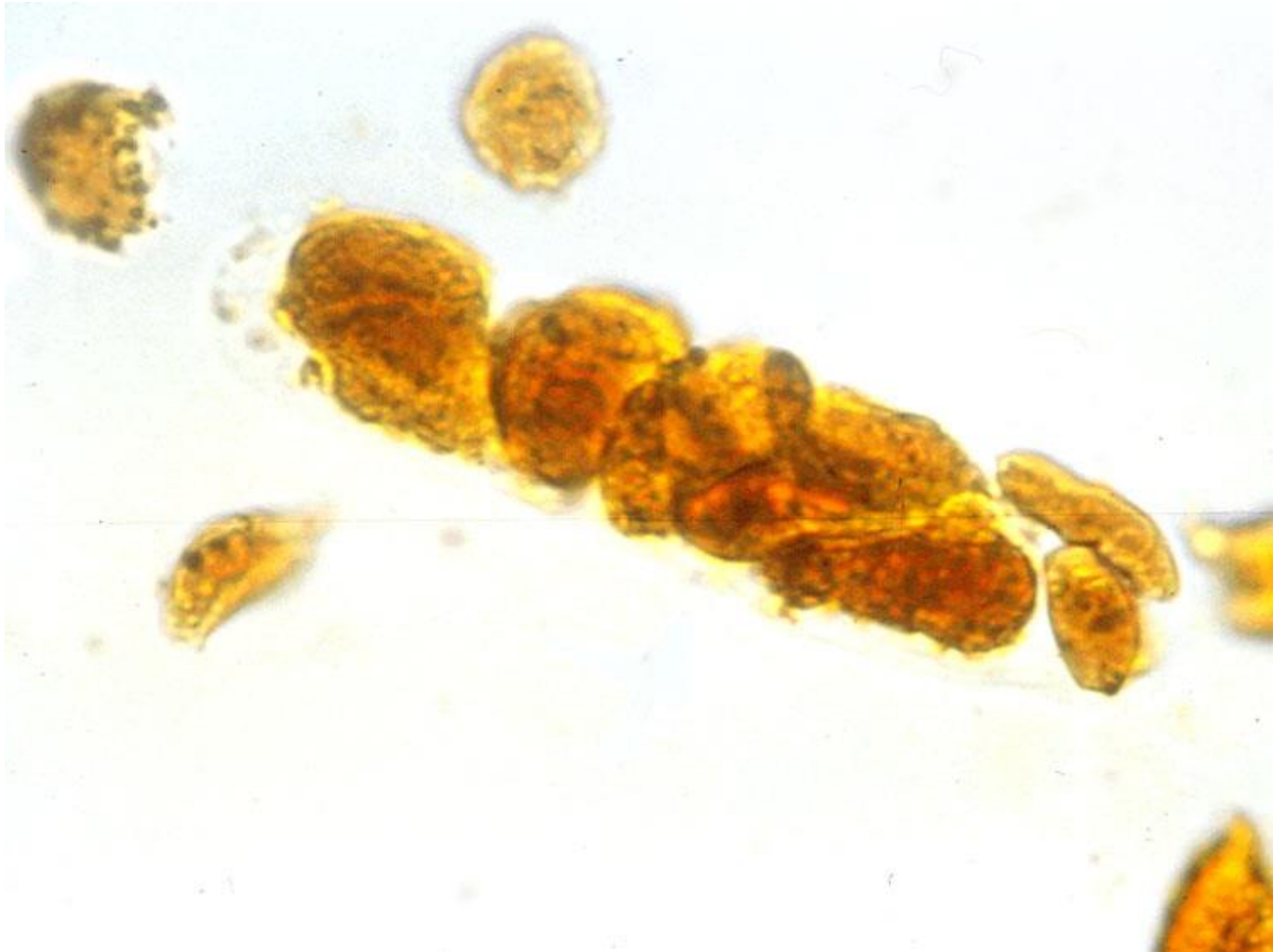
Microscopic Examination

Tubular Epith. Cast



Microscopic Examination

Tubular Epith. Cast



RBC Cast



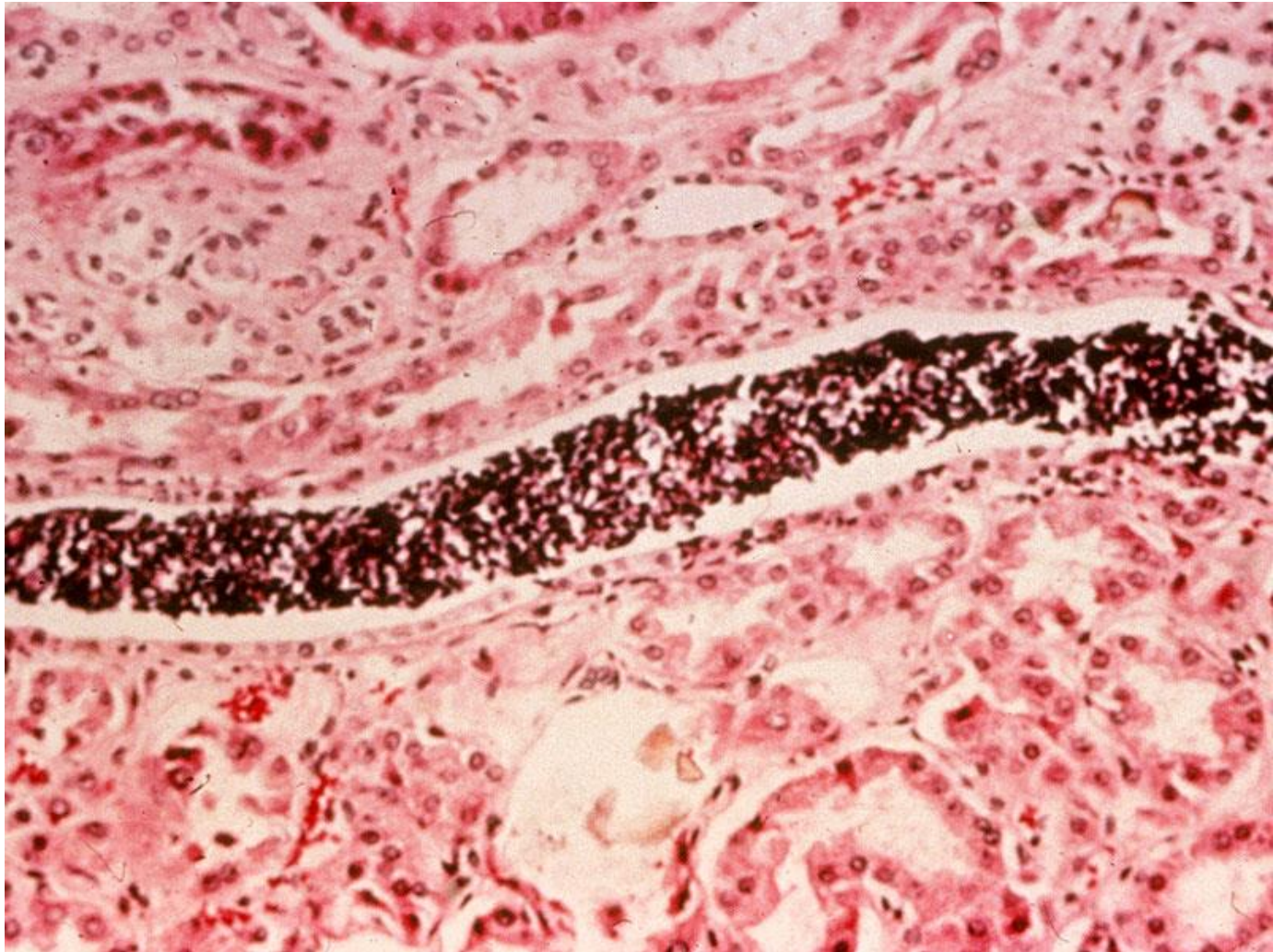
Red blood cell cast



This slide shows a red blood cell cast with red blood cells concentrated at one end.(Bright field microscopy, 160X magnification)

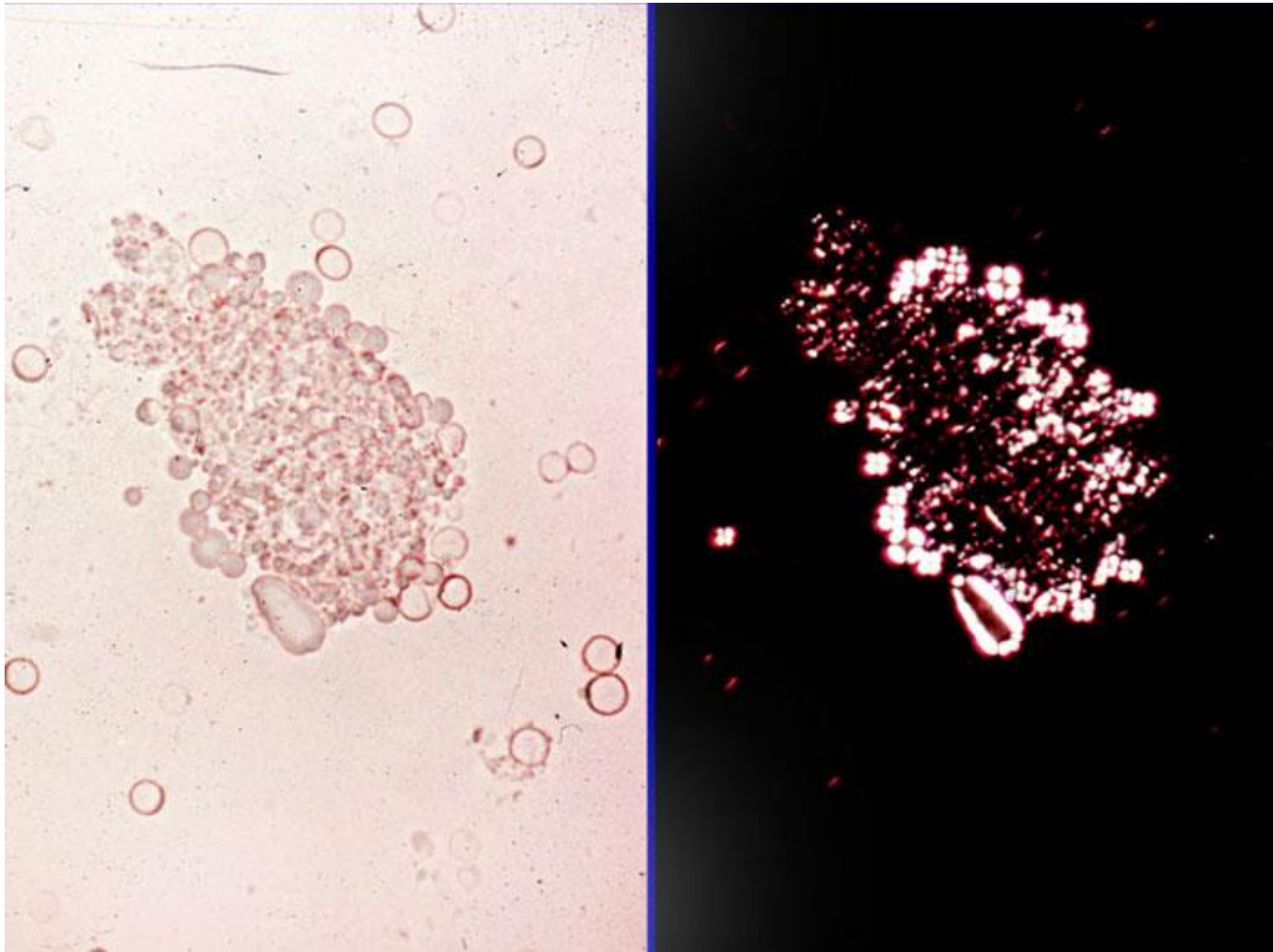
Microscopic Examination

RBCs Cast - Histology



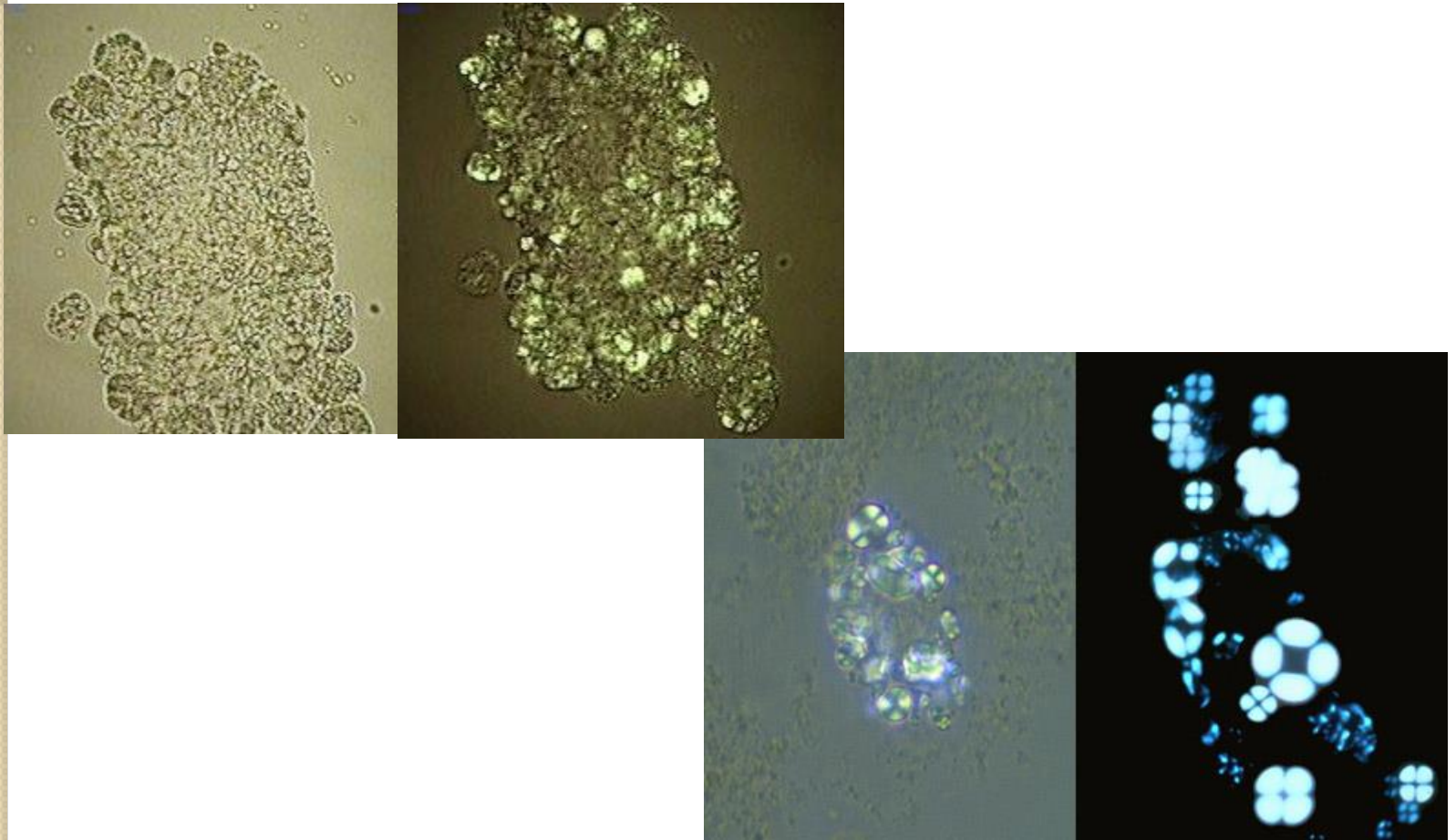
Microscopic Examination

Fatty Cast



Microscopic Sediment – Miscellaneous

Polarized oval fat bodies (maltese cross) •



Ca Oxalate





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Uric Acid crystals

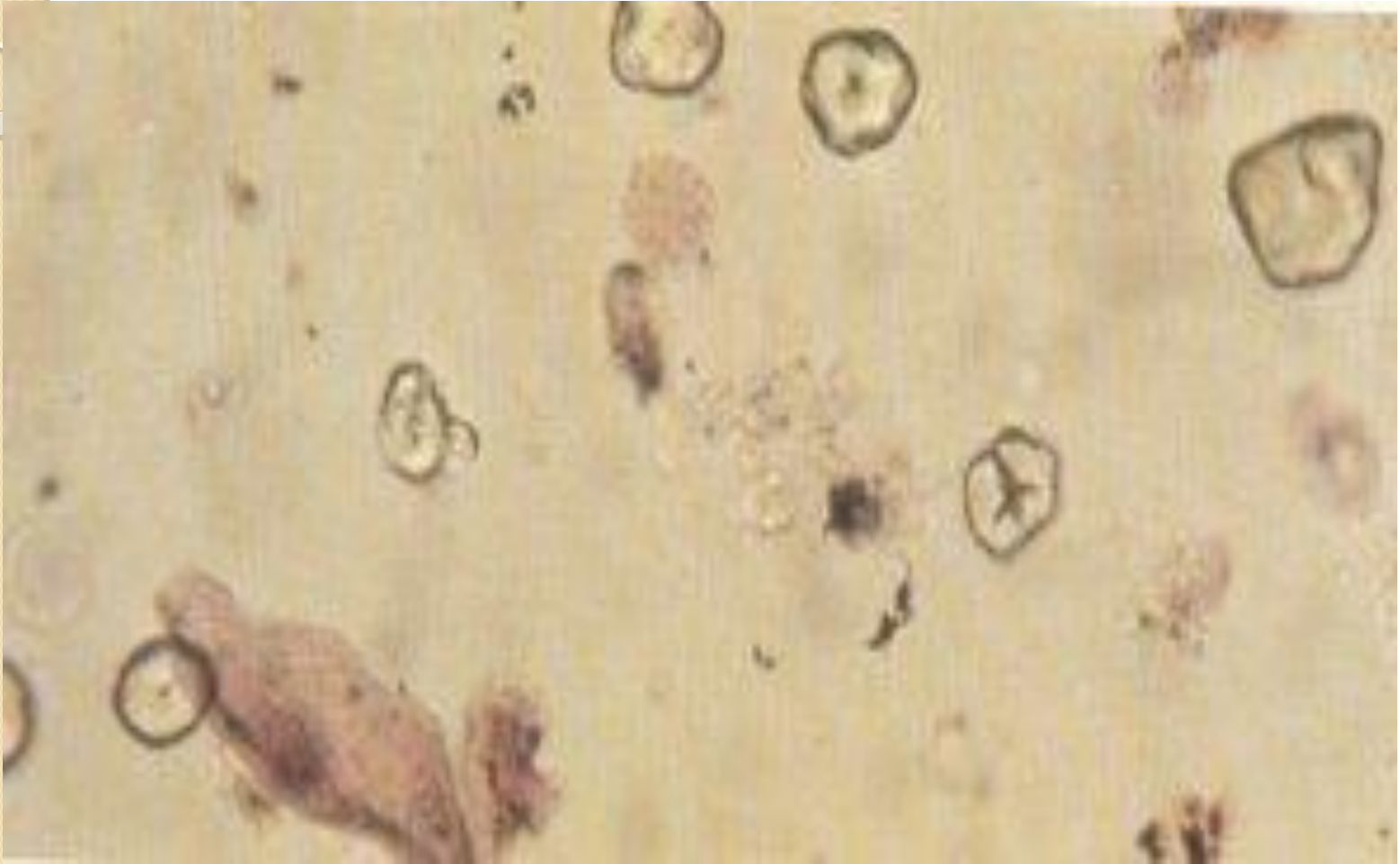


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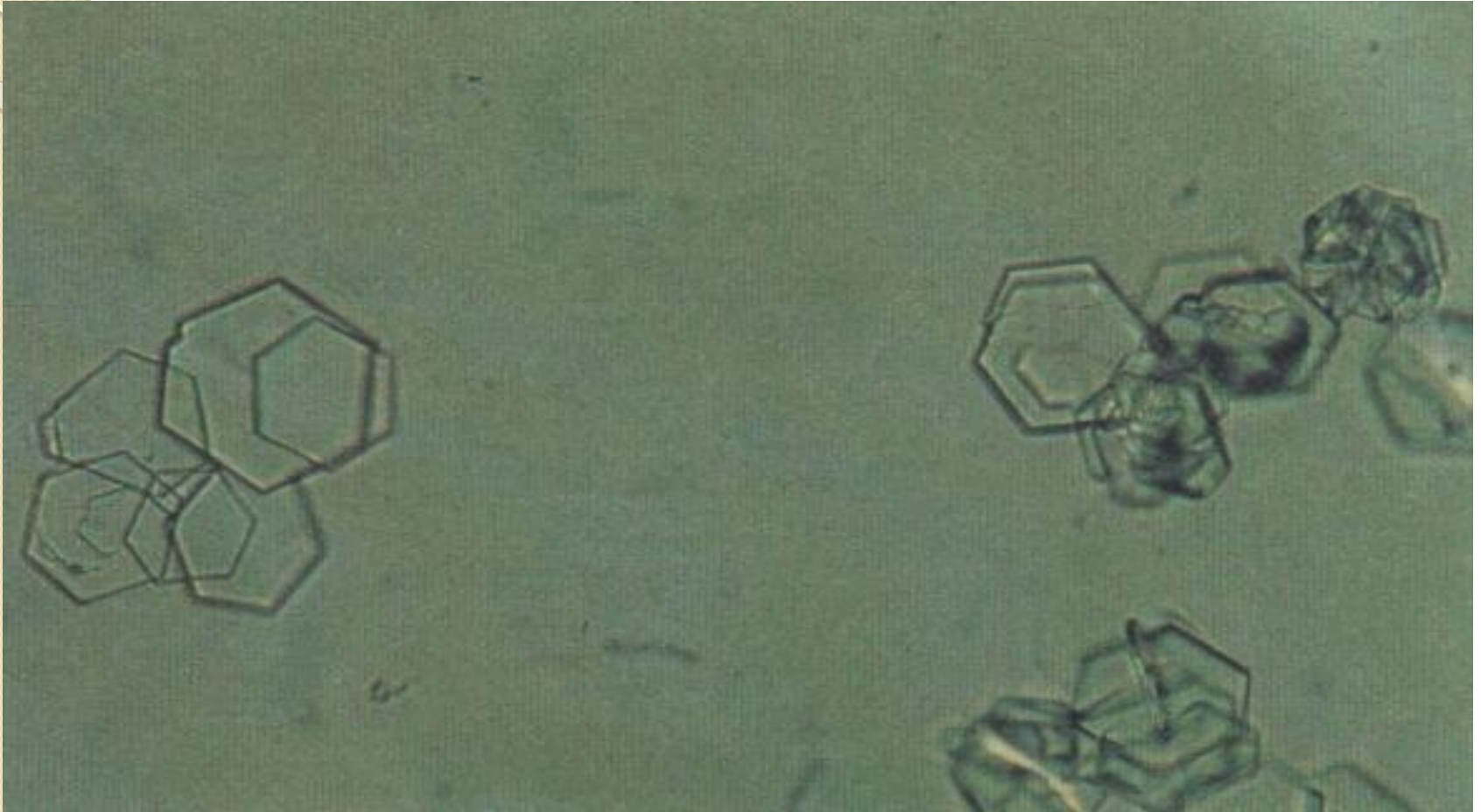
Triple phosphate crystal (coffin like



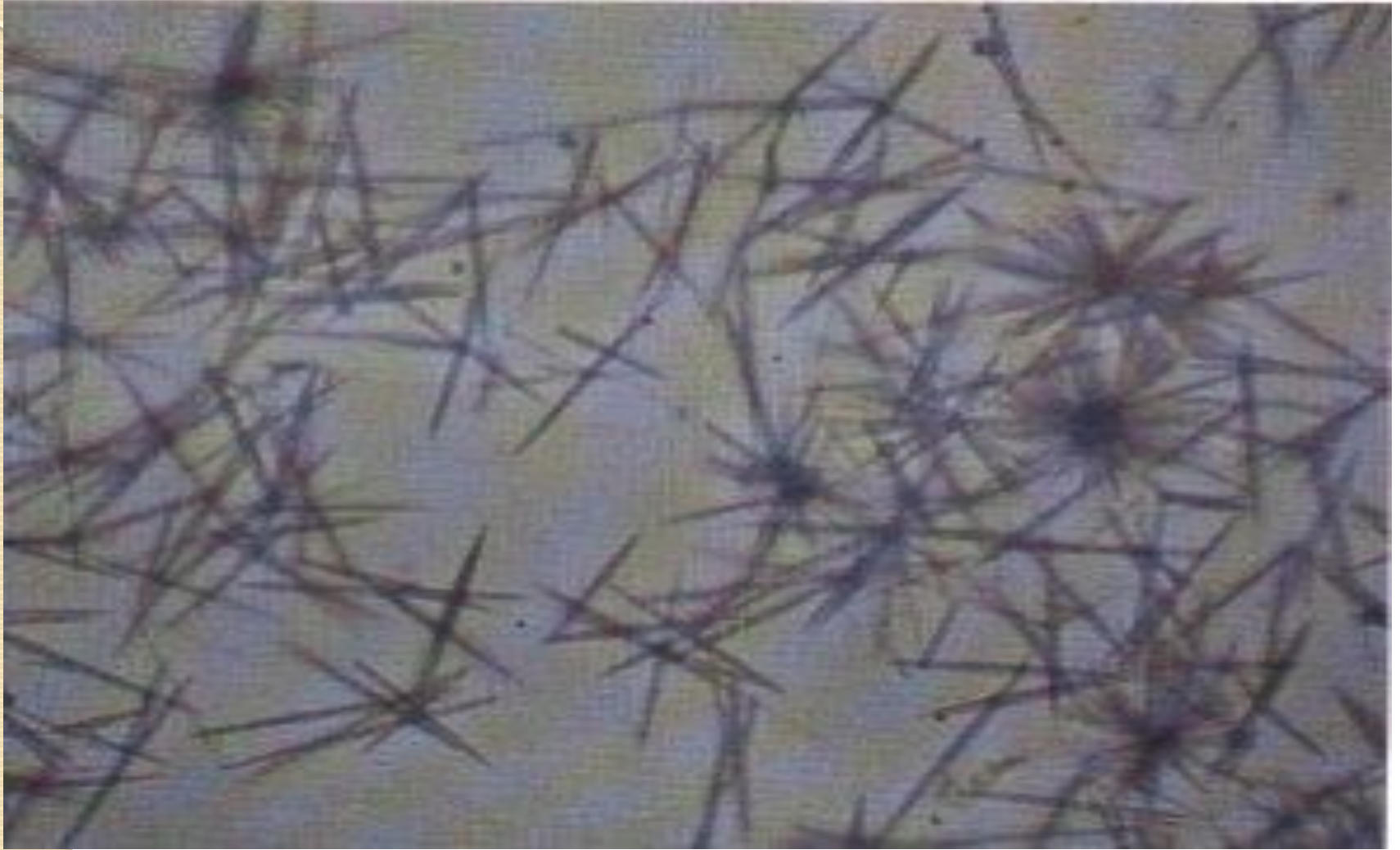
Starch granule

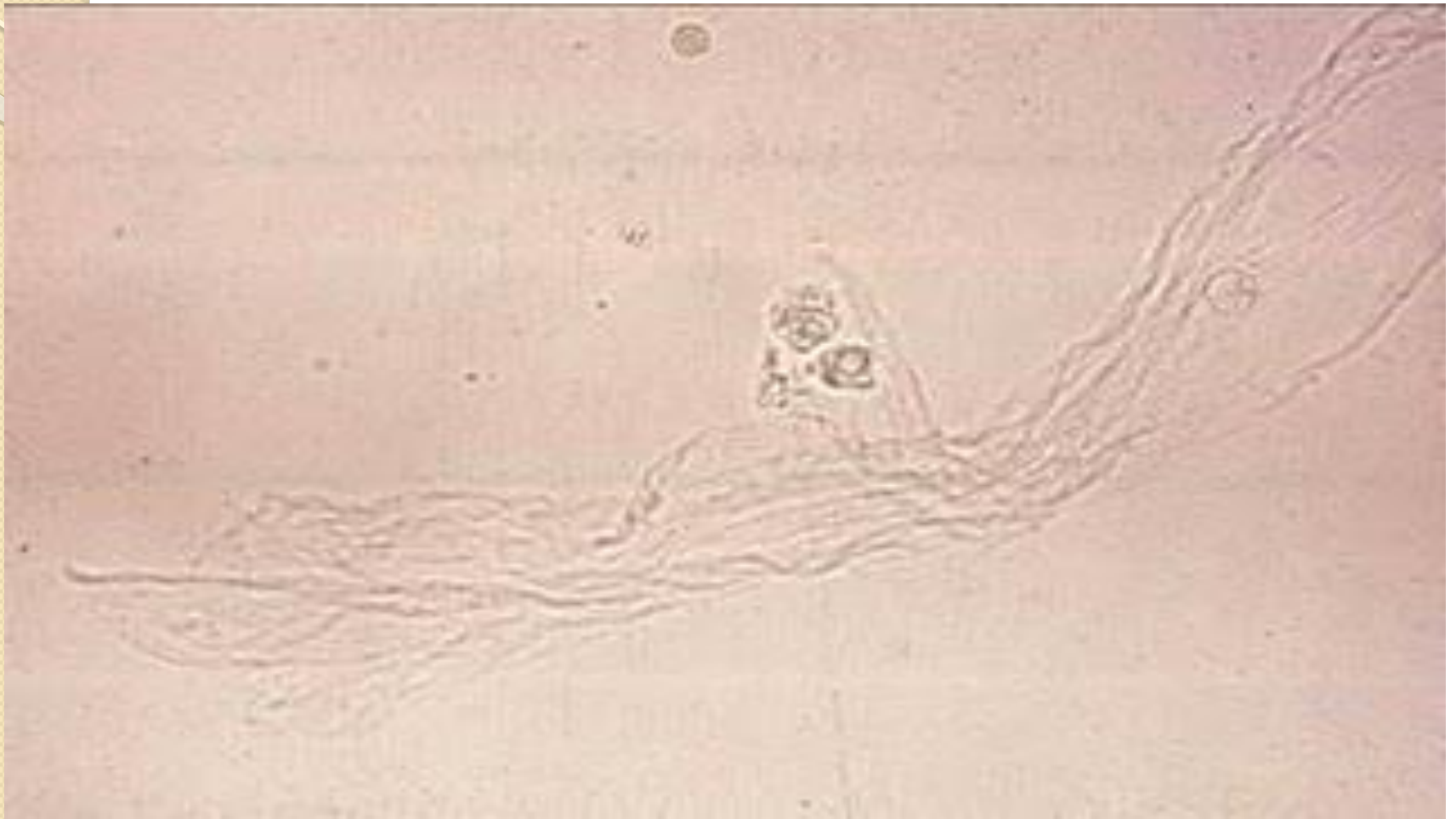


Cystine



Tyrosine



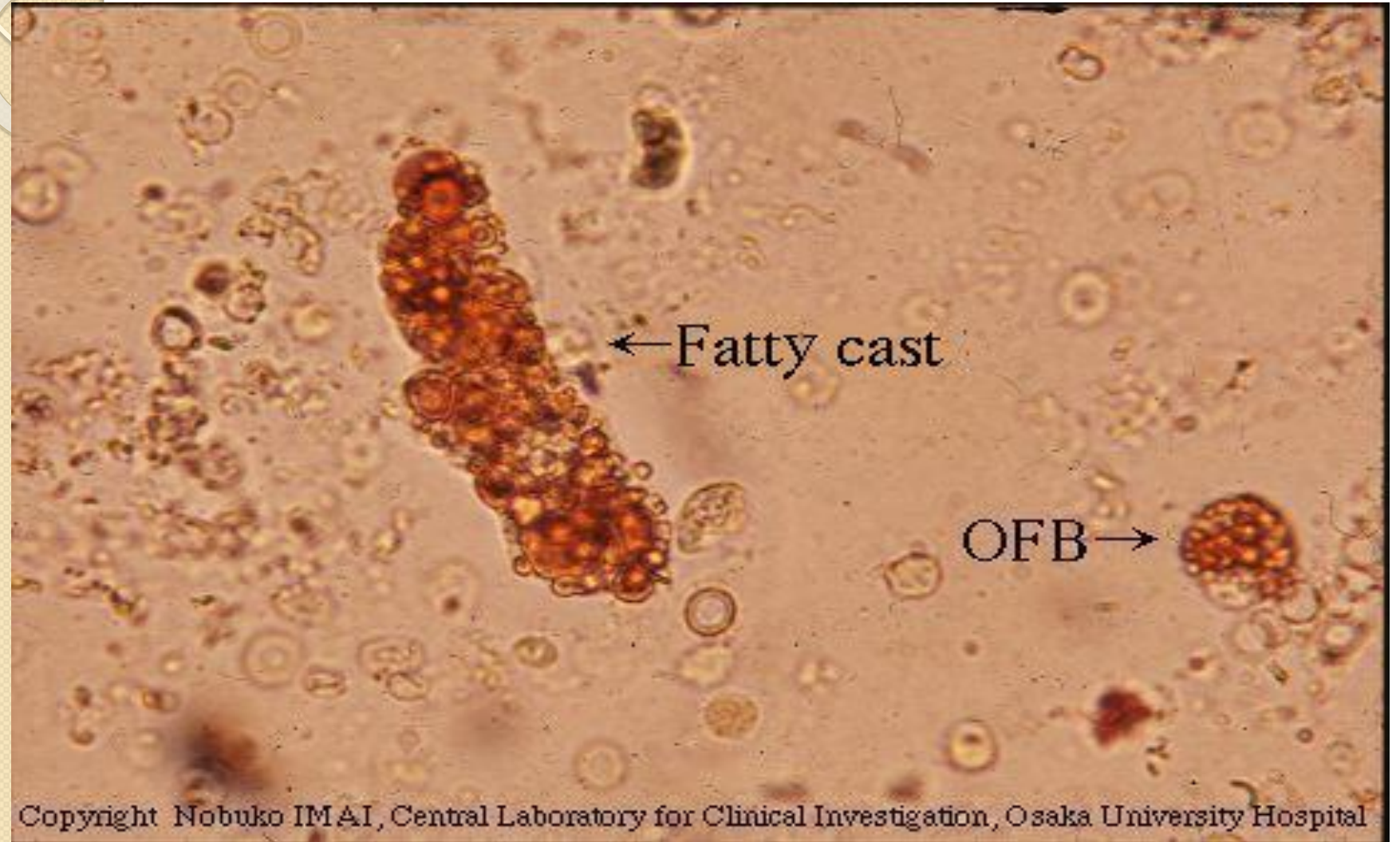


Budding yeast



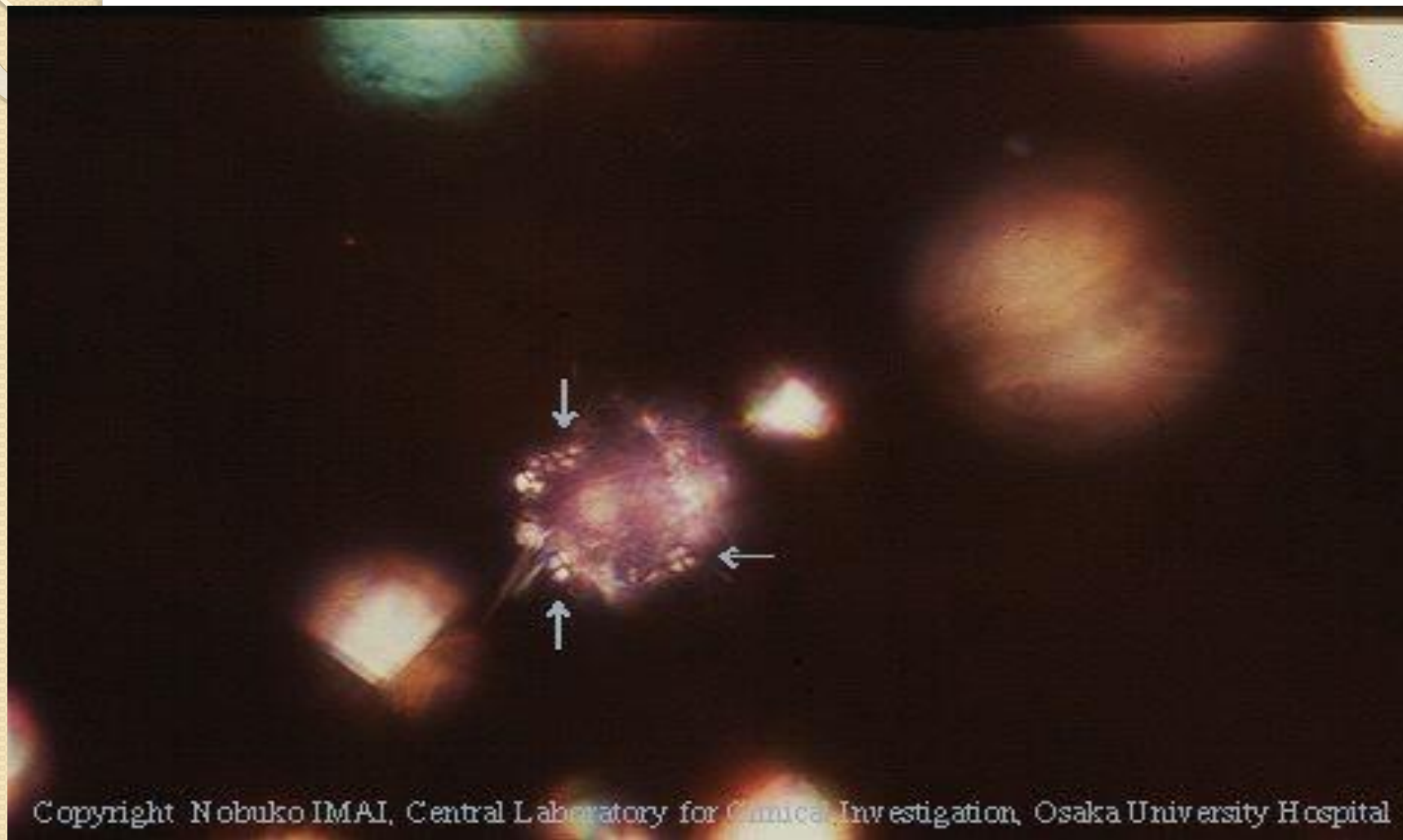
Triple phosphate



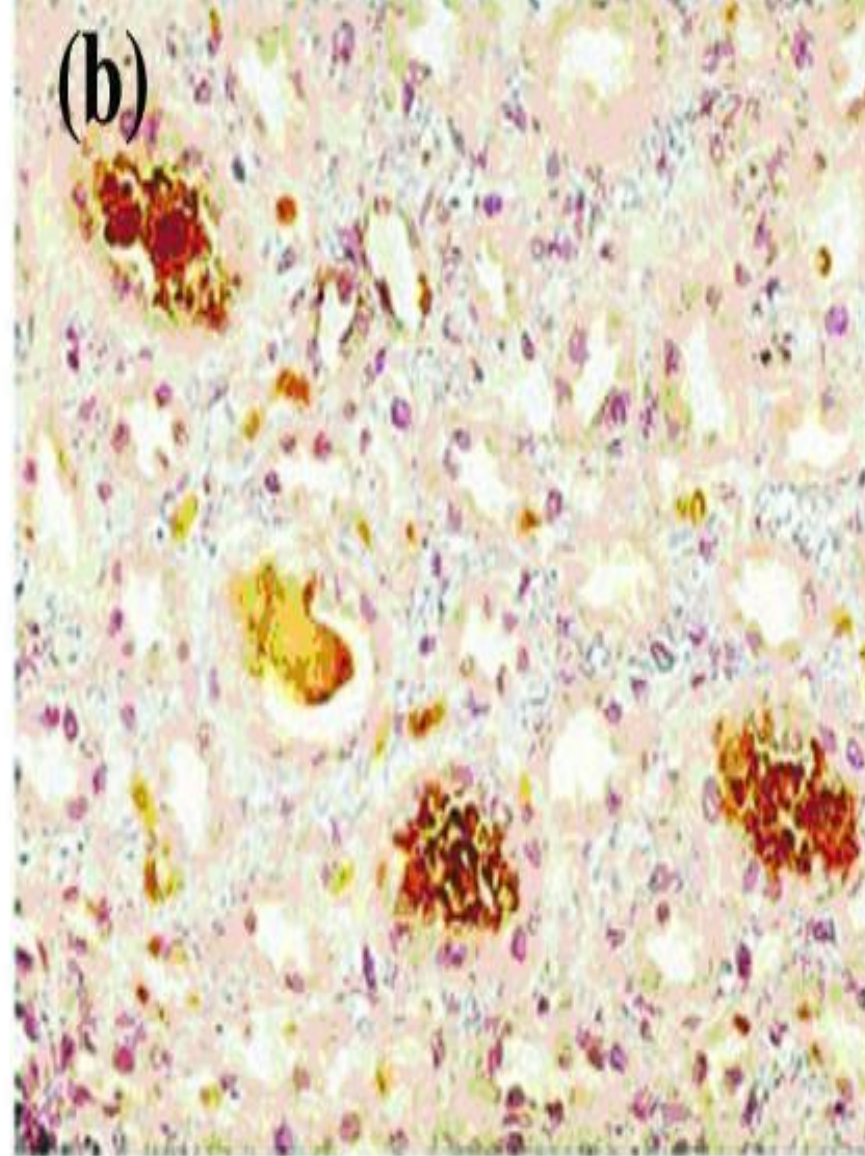


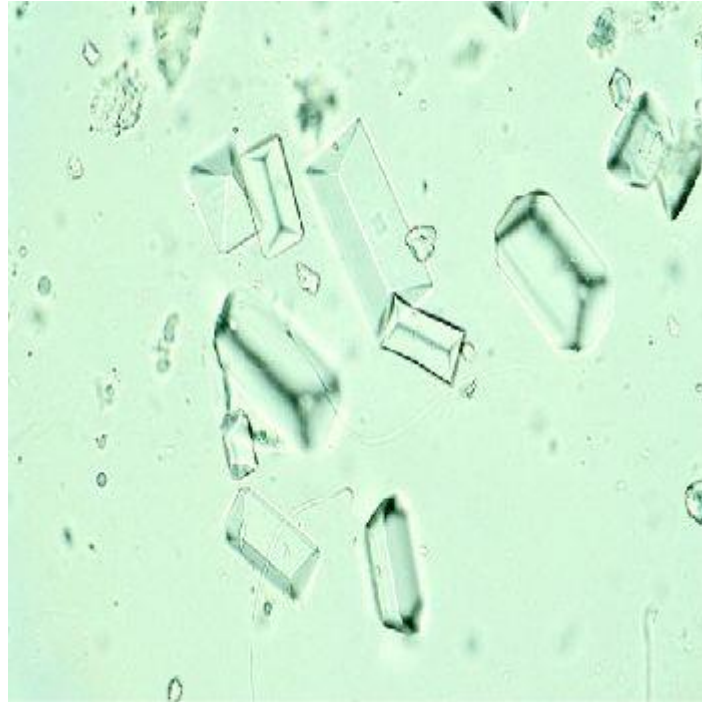
← Fatty cast

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Microscopic Examination

Yeasts



Microscopic Examination

Yeasts



