

Bacterial Classification and Disease

Purpose

- **To provide an overview of how physicians think when confronted with a bacterial infection**
- **To alert you to the importance of bacterial classification in treatment**
- **The importance of knowing the etiology of organ system based infection and the Gram stain**

Purpose

- **Some microbiology courses teach infectious diseases in a "bug parade" - Here are all of the gram-positive cocci, and here's what they do. Here are their random virulence factors, ...**
- **That is not our philosophy (see Schaechter).**
- **This lecture provides that framework for students who want the bug parade organization.**

Purpose

- **The detail in this lecture is NOT to be memorized for exams.**
- **The principles ARE testable.**

Bacterial Classification

- **Based on several major properties**
 - **Gram stain (and other stains)**
 - **Morphology**
 - **Metabolic behavior (e.g., oxygen)**
 - **Infection patterns (e.g., zoonoses)**
 - **Obligate intracellular**
 - **Antigenic composition**
 - **DNA sequence**

Metabolic properties

- **May influence the type of disease caused, but not necessarily**
 - **Anaerobes have a greater propensity to cause abscesses**
 - ***Mycobacterium tuberculosis* is an obligate aerobe – affects tissue tropism**
 - **Acid fast organisms grow slowly - chronic infections**
 - ***Vibrio vulnificus* grows fast - rapid progression**

Bacterial classification

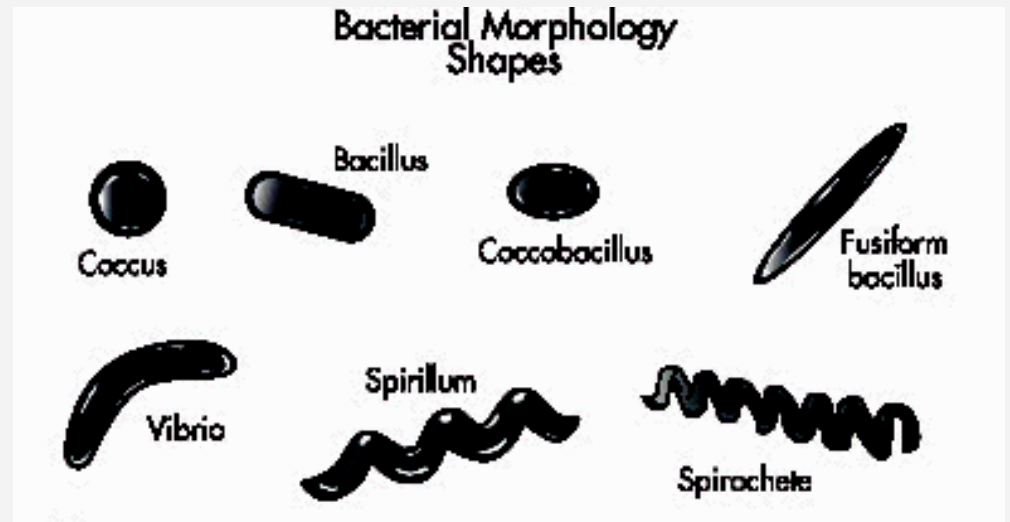
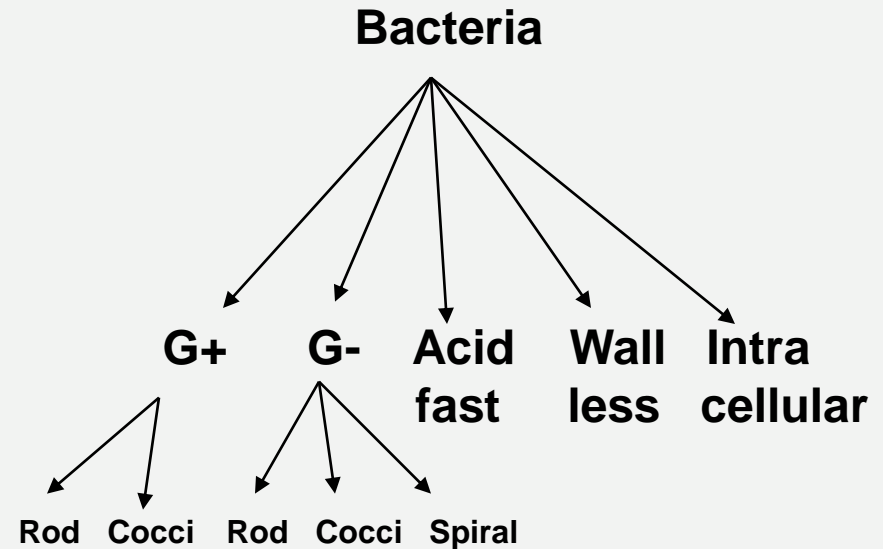
- Cell morphology

- Shapes

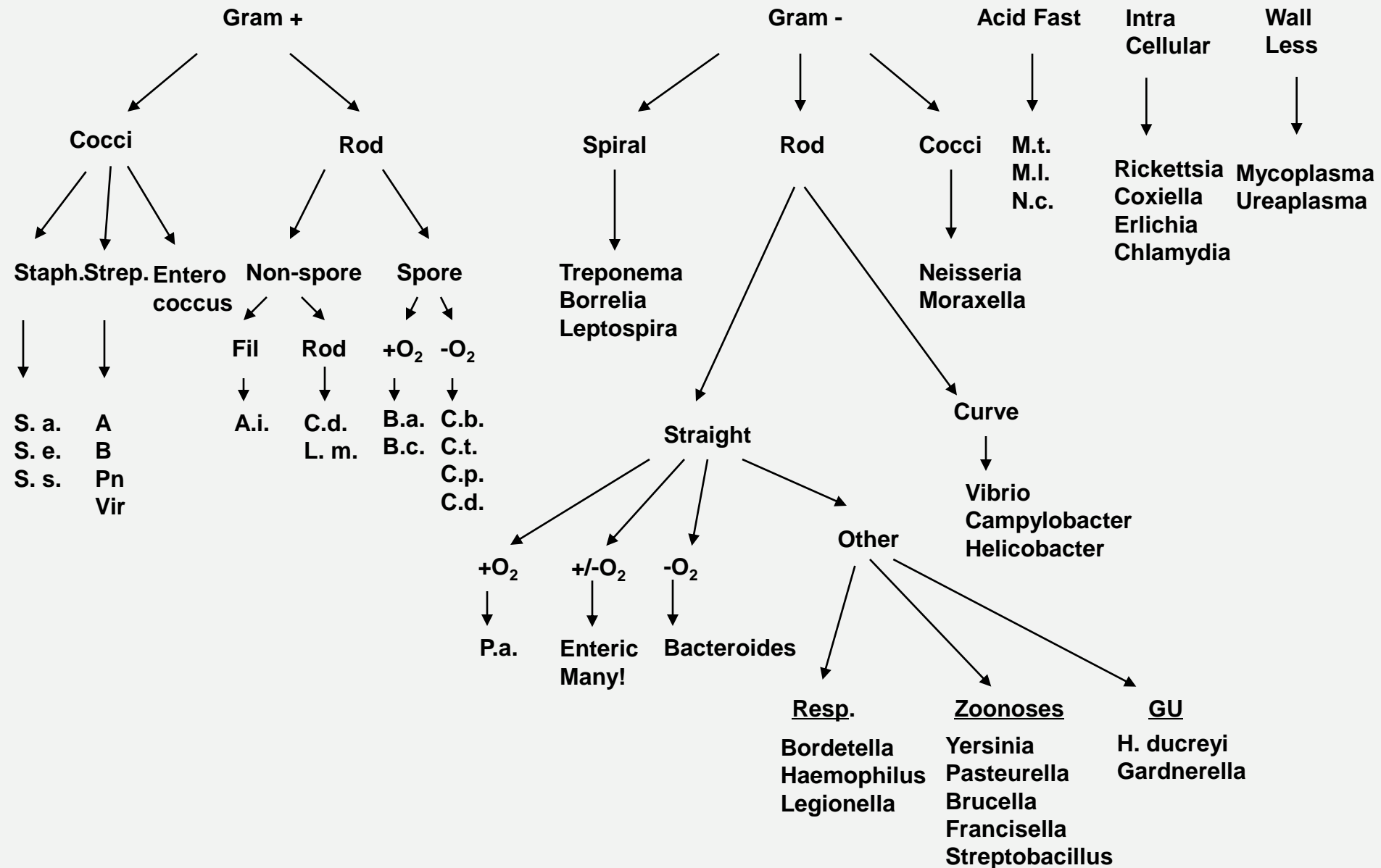
- Rod
- Cocci
- Spiral
- Filamentous

- Associations

- Individual
- Diplo-
- Staphylo-
- Strepto-
- Filaments



Bacteria



Classification and Disease

- **Gram-positive cocci - pyogenic**
 - *Streptococcus pyogenes*
 - *Staphylococcus aureus*
- **Gram-negative cocci - pyogenic**
 - *Neisseria gonorrhoeae*
 - *Neisseria meningitidis*
- **Spirals - chronic infections**
 - *Treponema pallidum*
 - *Borrelia burgdorferi*
 - *Leptospira*

How a physician approaches bacterial diseases

- **Organ system approach**
 - Which bacteria cause disease in a certain location
 - The "usual suspects"
- **Gram stain approach**
 - The Gram stain is used to treat empirically before cultures are completed
 - Requires that one is able to get a Gram stain directly from a patient sample, which is not always the case (e.g., stool, sinus, endocarditis)
- **The combination of these is ideal**

Upper Respiratory Tract

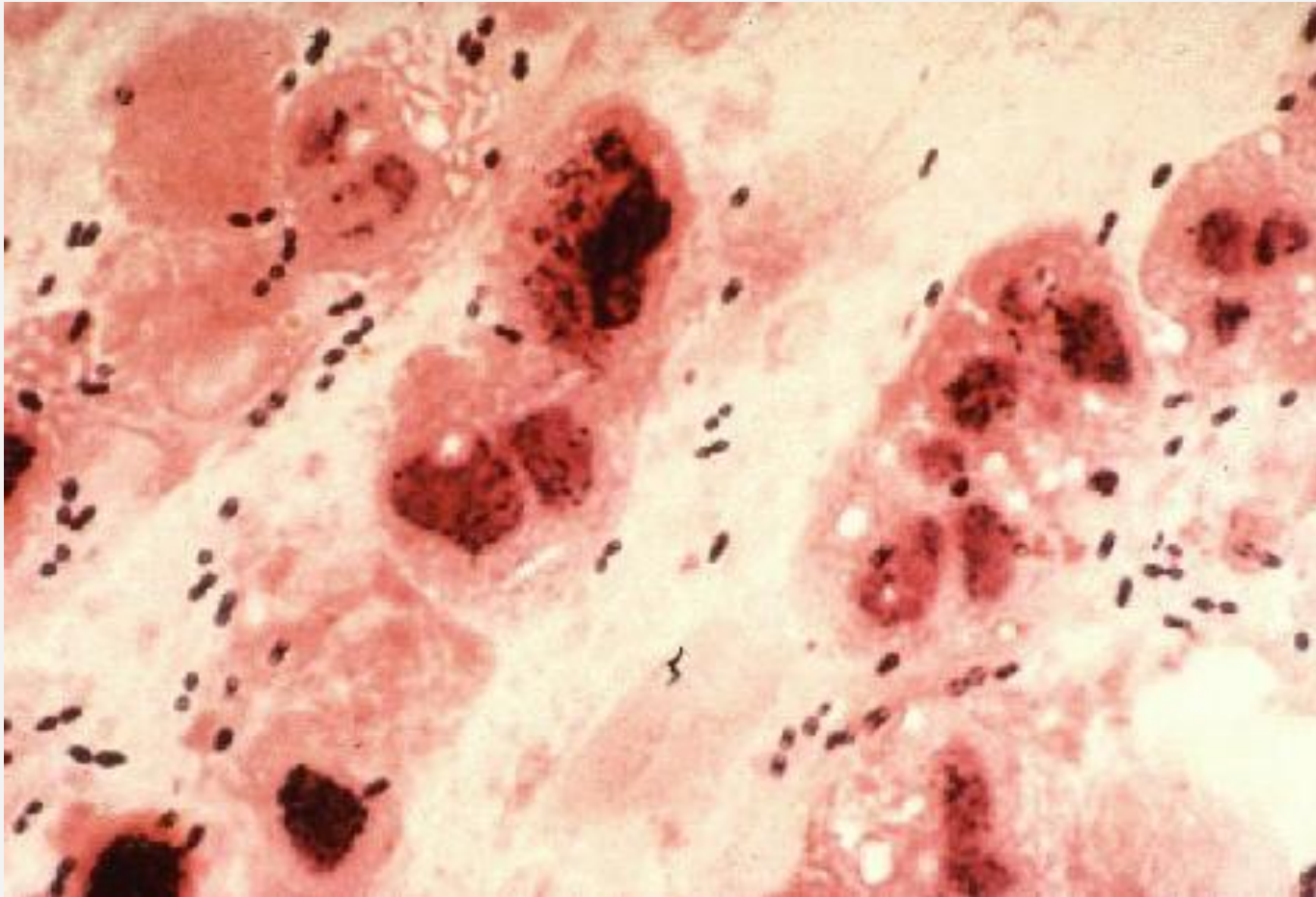
- **Pharyngitis**
 - mostly viral
 - lots of normal flora (Gram stain little value)
 - rapid test (e.g., Phadebact), culture
 - If *Streptococcus pyogenes* (Group A strep) must treat - why?
- **Other causes - young adult**
 - Mononucleosis
 - Gonorrhoea
 - Diphtheria (not likely - why?)

Pneumonia

- **Sputum Gram stain (and other stains) very helpful (why?)**
- **Coupled with chest X-ray**
- **Other signs, symptoms, history**

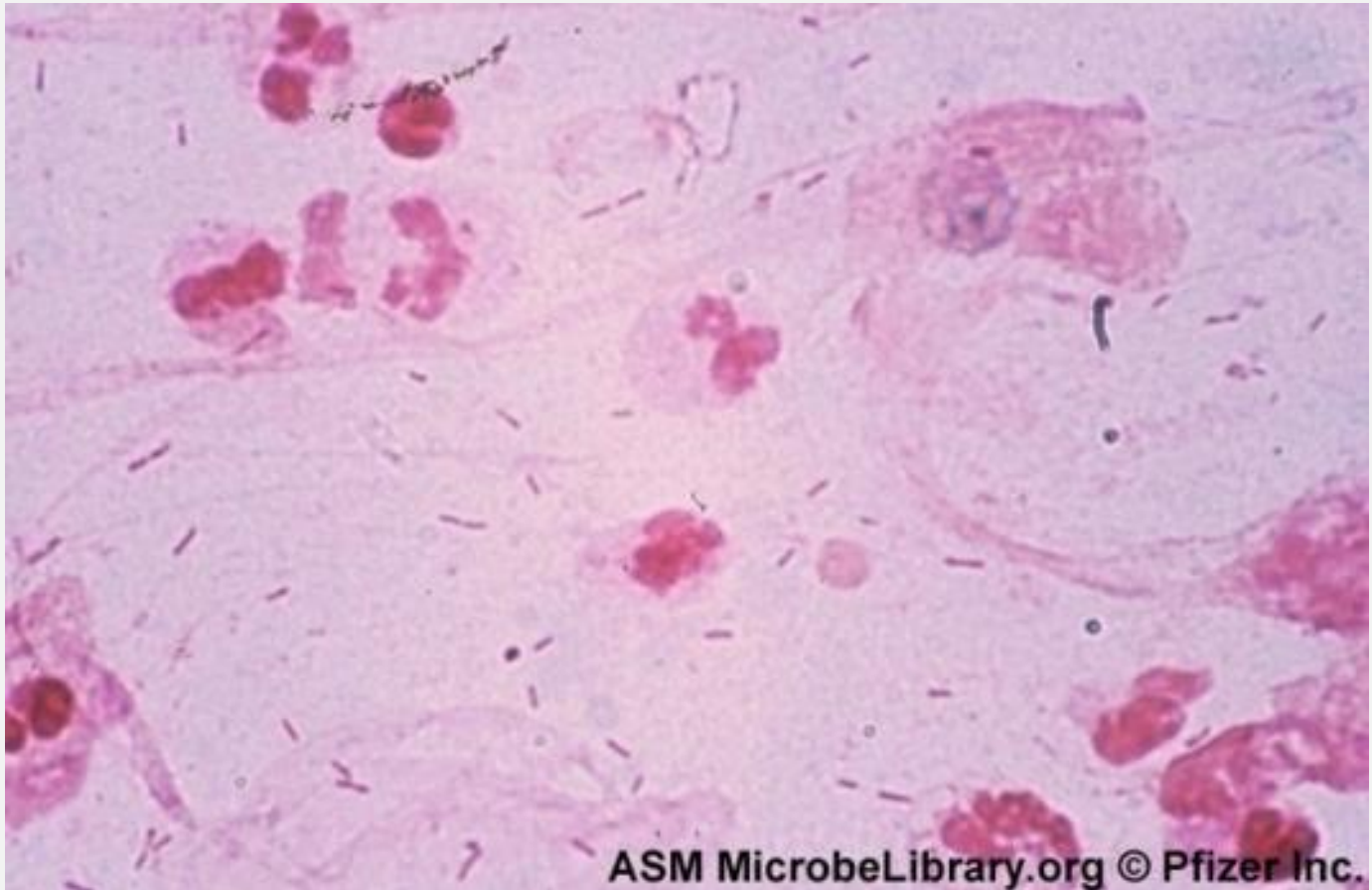
Gram stain

What is this?



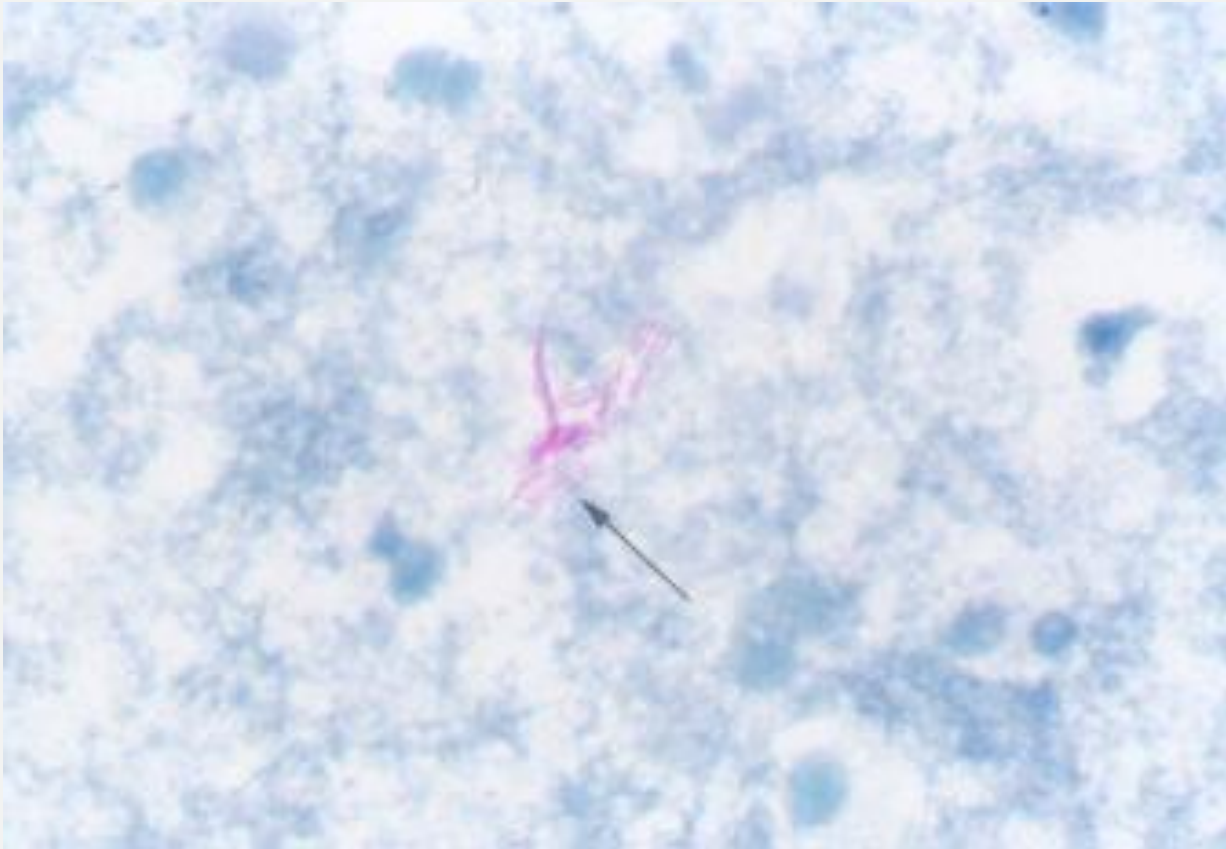
Gram stain

What is this?



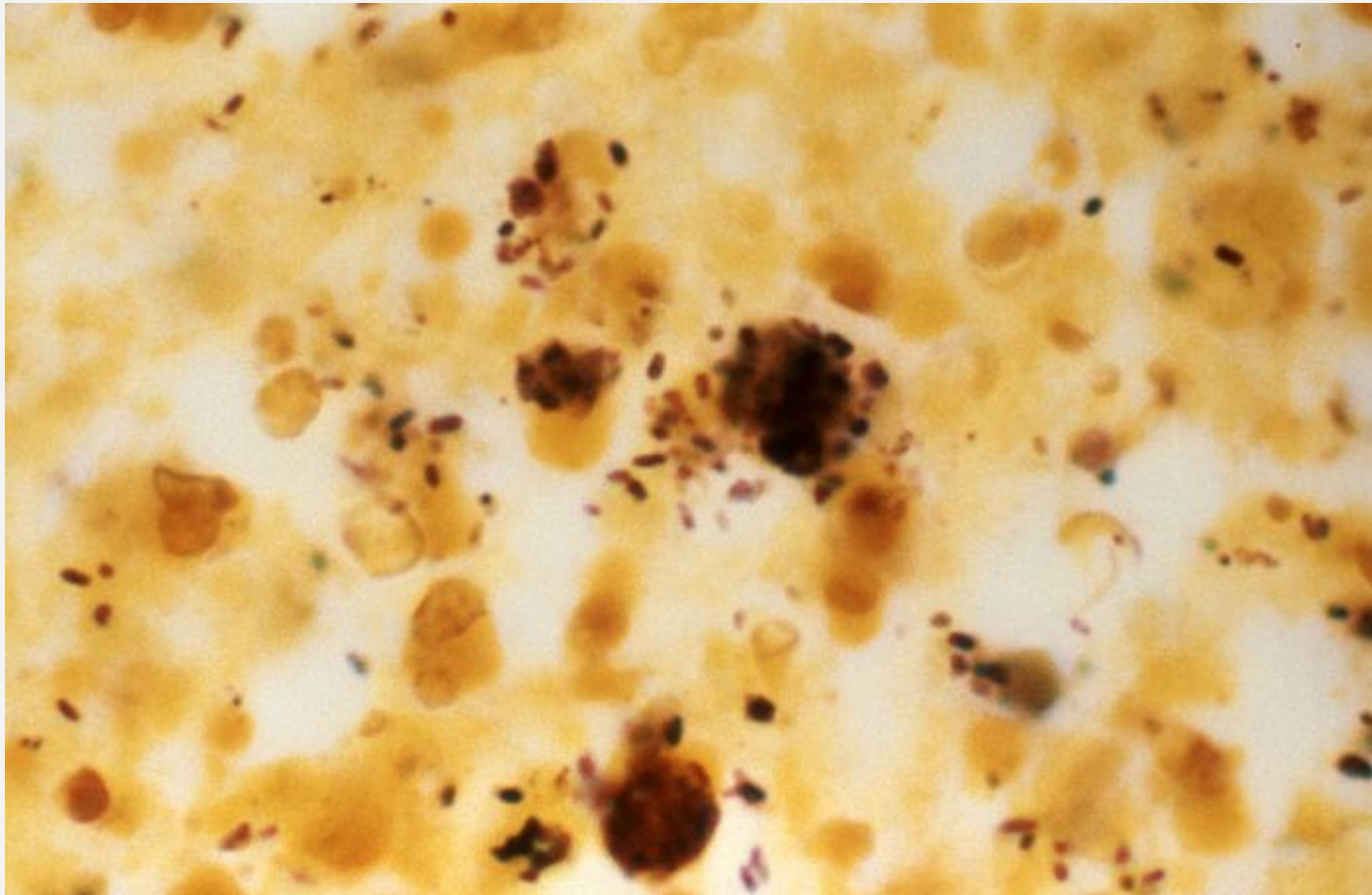
Acid fast stain

What is this?



Silver stain

What is this?



Otitis media and Sinusitis

- **Gram stain and culture not practical**
 - Otitis media - tympanostomy
 - Sinusitis - must access sinus
- **Usual suspect list (same)**
 - *Streptococcus pneumoniae*
 - *Haemophilus influenzae*
 - *Moraxella catarrhalis*
- **Empiric therapy**

Meningitis

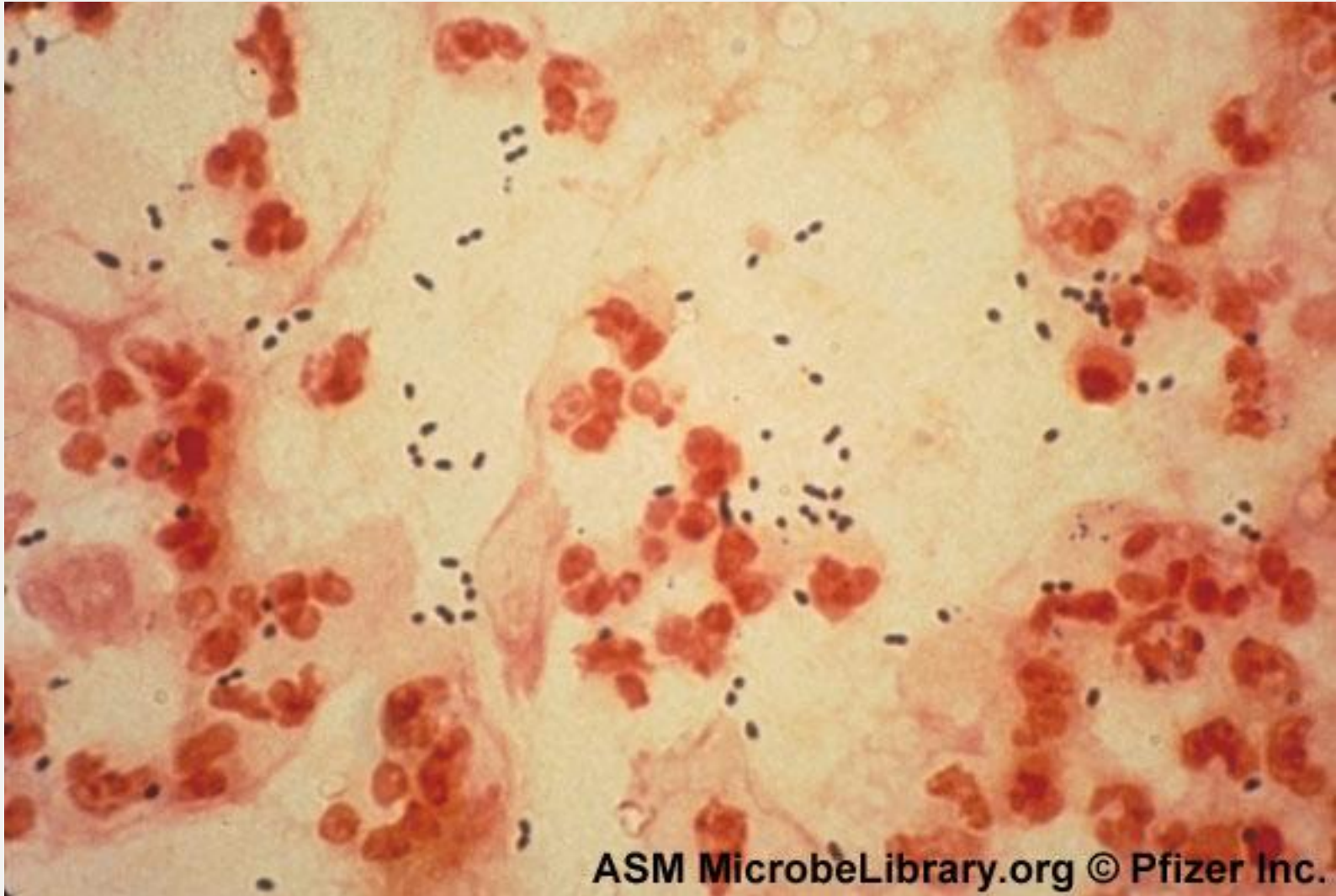
- **Gram stain practical and extremely important**
 - **CSF sterile, few host cells**
 - **Note bacteria and host cells**
- **Couple with age**
 - **Neonate**
 - **Child**
 - **Adult**

Meningitis

- **Neonate**
 - *E. coli* K1
 - **Group B streptococcus (*S. agalactiae*)**
 - *Listeria monocytogenes*

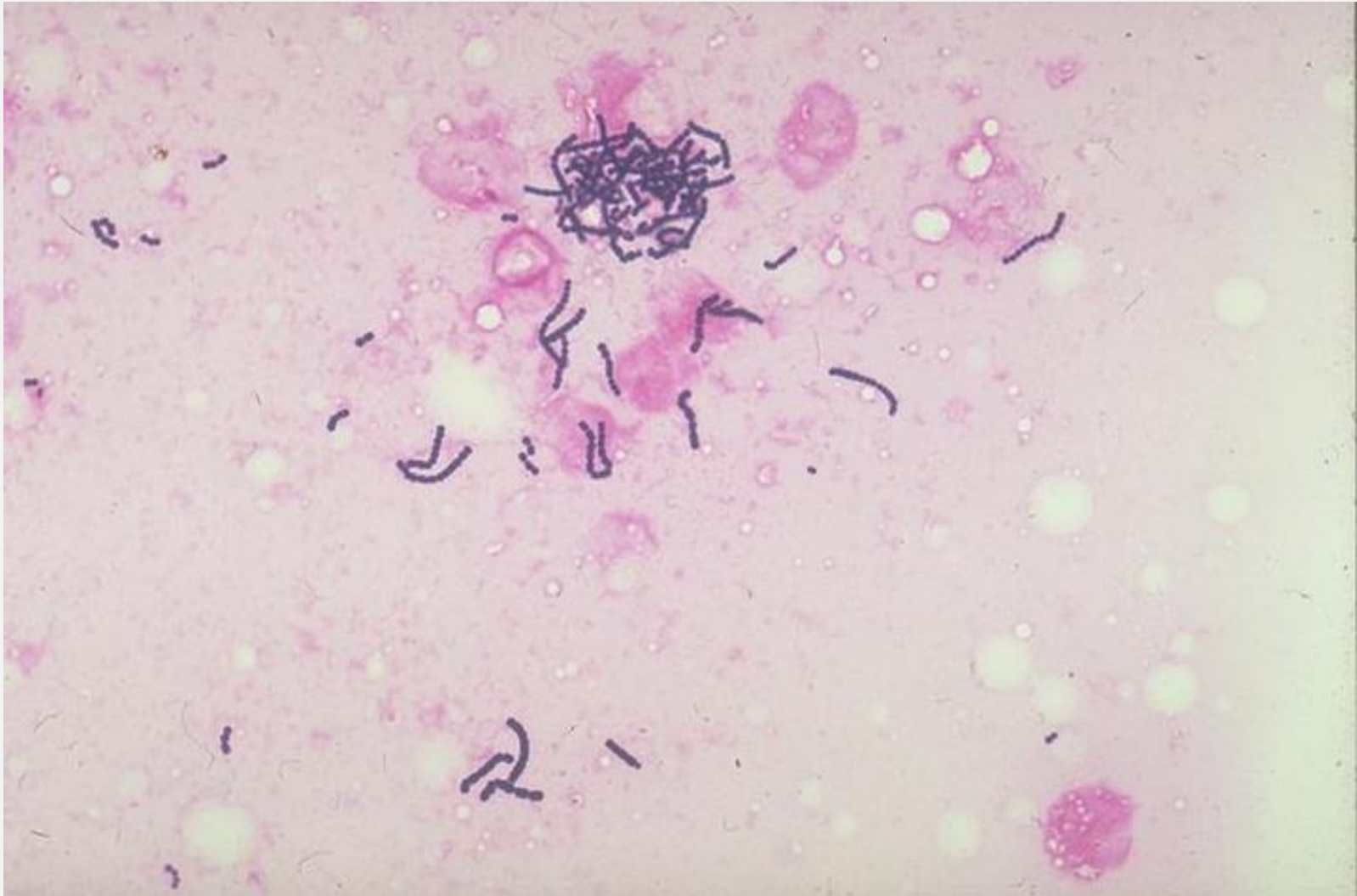
- **Children and adults**
 - *Streptococcus pneumoniae*
 - *Neisseria meningitidis*

Meningitis

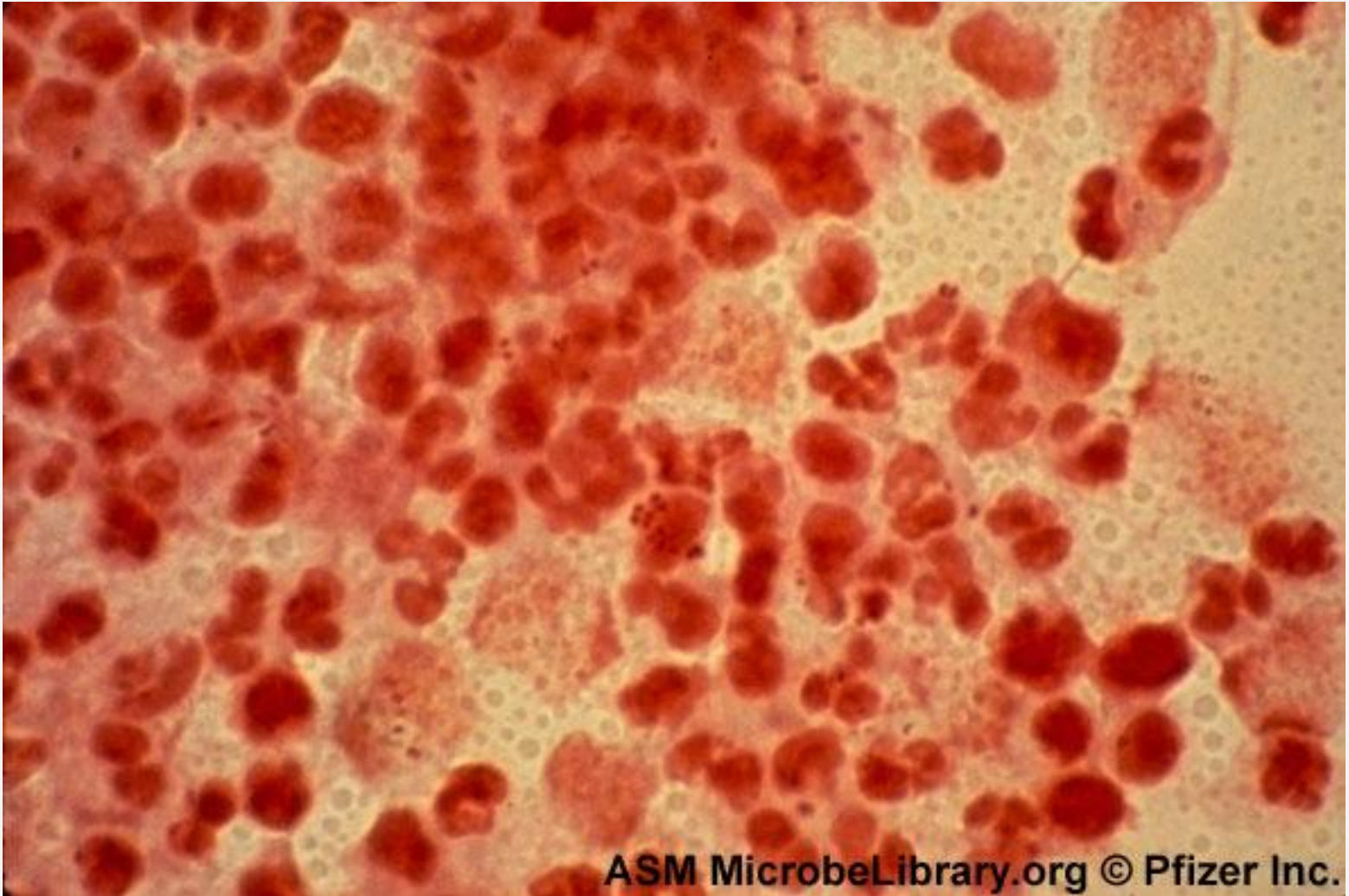


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Meningitis



Meningitis



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Endocarditis

- **Gram stain not practical**
 - **Can't access infection site!**
 - **Bacteremia too low**
 - **Usual suspects**
- **Oral streptococci**
- **Enterococci**
- **Staphylococci**

Enteric infections

- **Gram stain not practical**
 - **Can't access infection site**
 - **Too much stuff in stool**
 - **Mostly viral**
- **Blood and pus indicators of disease**

Abdomen

- **Organisms come from the GI tract**
- **Gram-negative rods**
 - **Facultative anaerobes (Enterobacteriaceae)**
 - **Obligate anaerobes (*Bacteroides*, *Fusobacterium*)**
- **Sometimes gram positive cocci**
 - **Aerobic (*Enterococcus* and *Streptococcus*)**
 - **Anaerobic (*Peptostreptococcus*)**
- **Obligate anaerobic gram positive rods (*Clostridium*)**

Skin Infections

- **Skin flora - gram-positive cocci**
 - *Staphylococcus aureus*
 - *Streptococcus pyogenes*
- **Complex skin infections**
 - **Skin flora plus enteric flora and environmental flora**

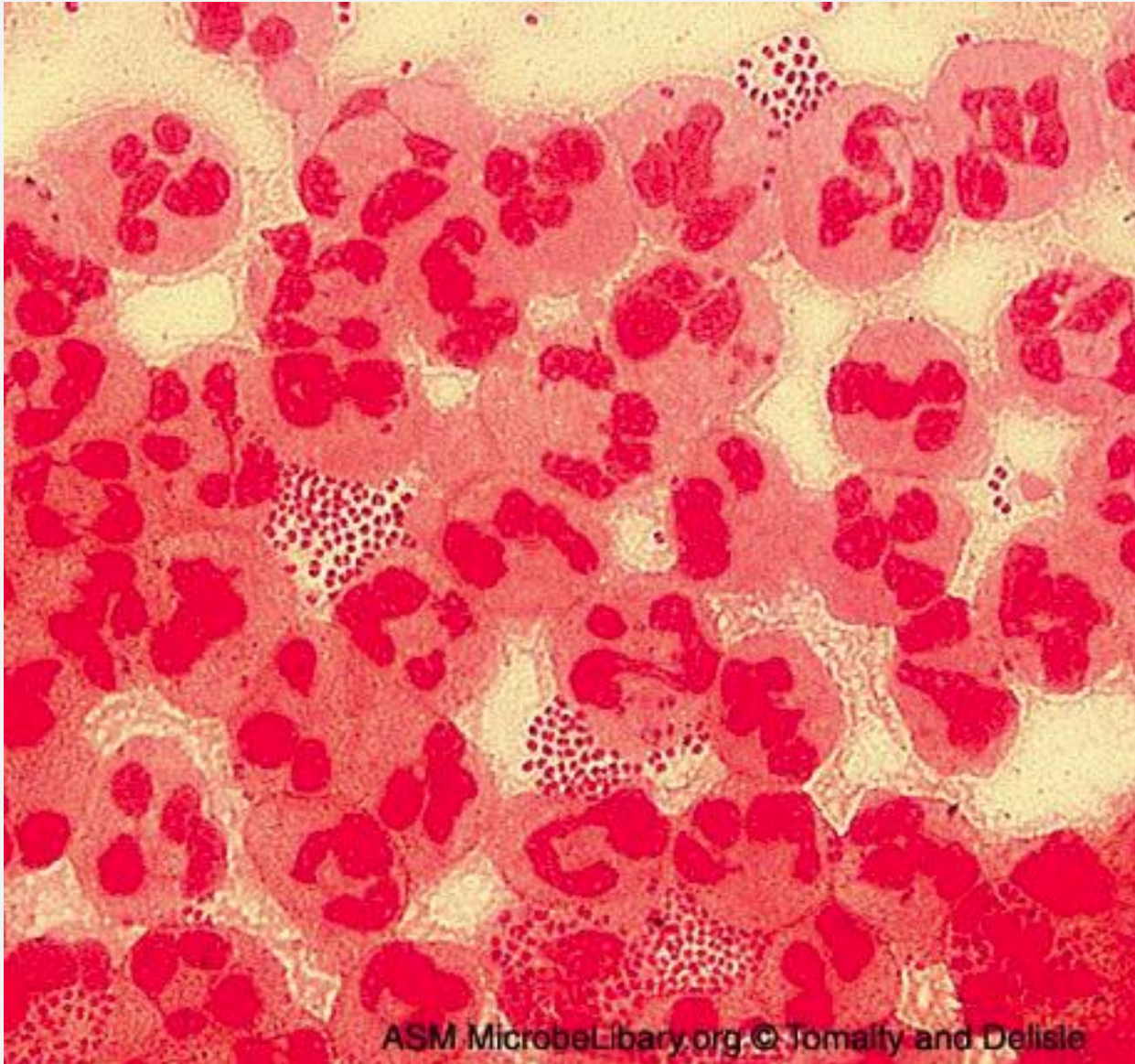
Urinary tract infection

- **Because of proximity to GI tract enteric flora are the prime suspects**
 - **Facultative aerobic enteric gram-negative rods predominate (*E. coli*)**
 - **Unusual to find staphylococci and streptococci or anaerobes**

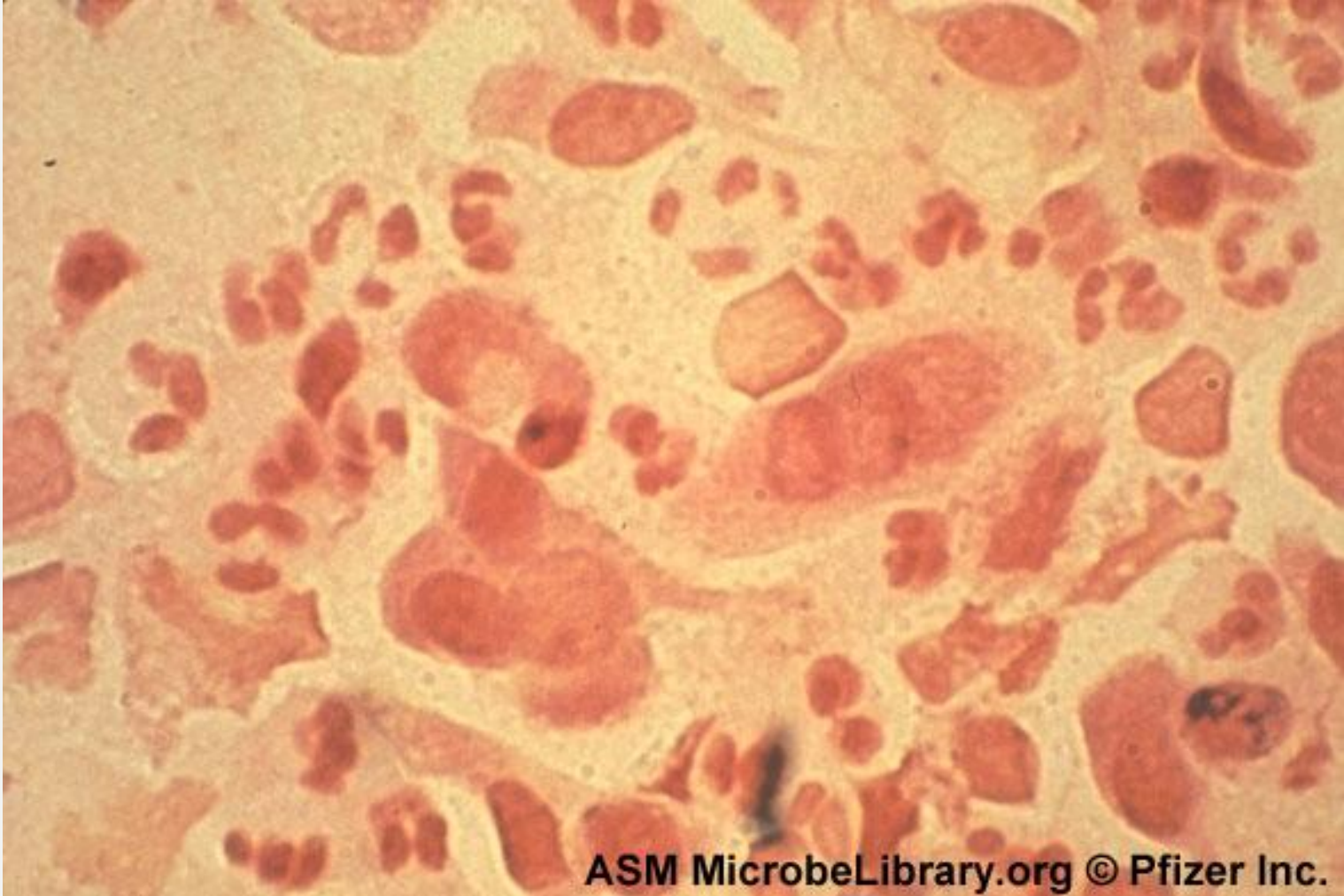
Sexually Transmitted

- **Only a few bacteria**
 - *Neisseria gonorrhoeae*
 - *Chlamydia trachomatis*
 - *Treponema pallidum*

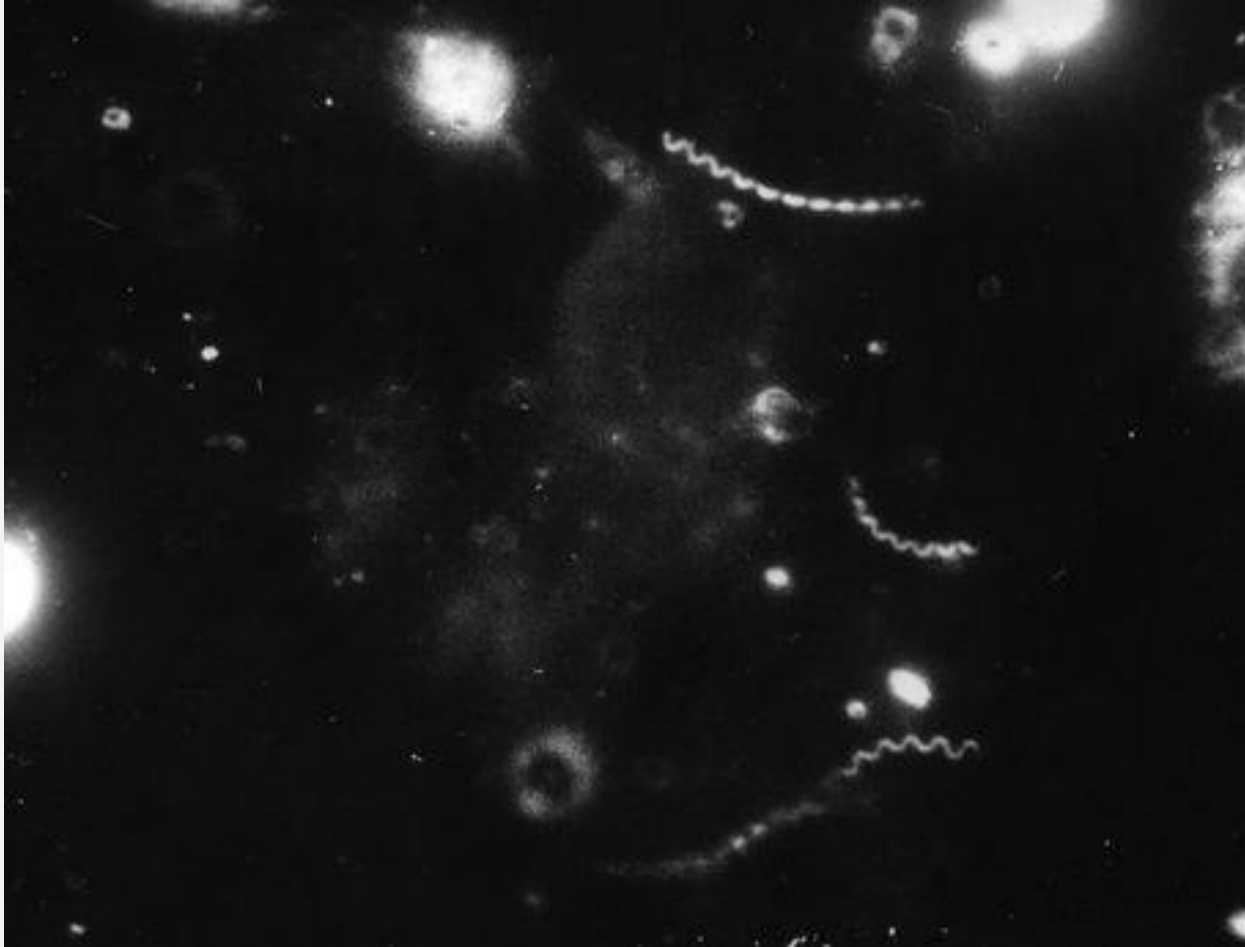
Sexually Transmitted



Sexually Transmitted



Sexually Transmitted Dark field



Take home messages

- **Classification is boring but important for initial therapy.**
- **Know what organisms are common at the various sites of infection as you go through the course.**
- **Know the Gram stain and metabolic properties of the common bacteria found at each organ system infection.**
- **Don't memorize it for this lecture. It will be taught in the lectures that follow.**