Institute for Microbiology, Medical Faculty of Masaryk University
and St. Anna Faculty Hospital in Brno

Agents of digestive system infections – I

Digestive system

- **Its both ends are the „buggiest“ parts of the body**

- **Normal colonic flora: 99 % anaerobes *(Bacteroides, Fusobacterium*, *Clostridium*, *Peptostreptococcus*), only 1 % enteric bacteria (mostly *E. coli*) & *enterococci***

Mouth cavity – I

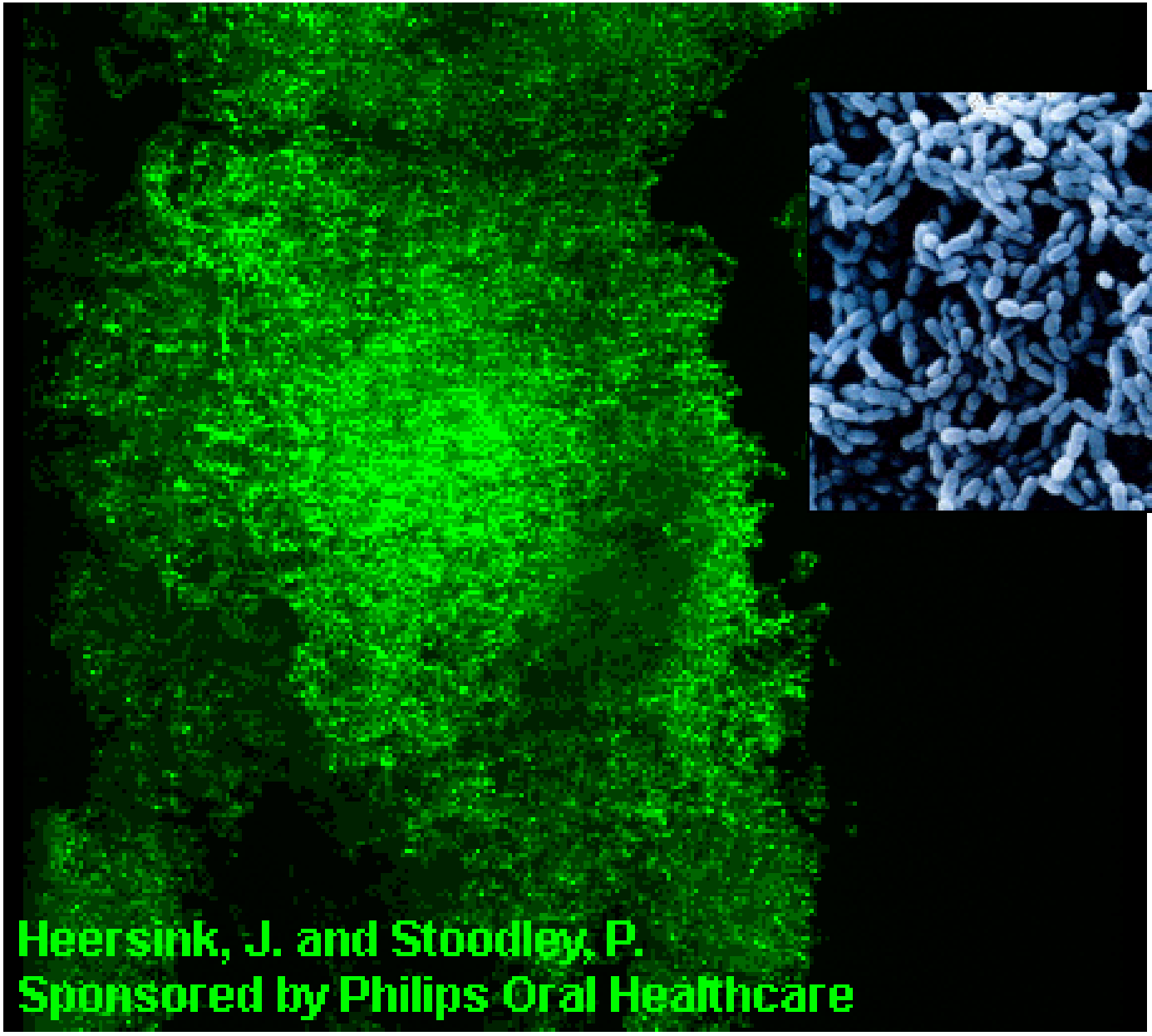
Normal flora:

- **viridans (= α-haemolytic) streptococci (e.g. *Streptococcus salivarius*)**
- **oral neisseriae (e.g. *Neisseria subflava*)**
- **haemophilli of low pathogenity (e.g. *Haemophilus parainfluenzae*)**

Dental plaque: adherent microbial layer made up from living and dead bacteria and their products together with components from the saliva

In essence, dental plaque is a biofilm

It cannot be washed off, only mechanically removed.


Heersink, J. and Stoodley, P.
Sponsored by Philips Oral Healthcare

Biofilm

- Bacteria regulas the quantity of their population by regulative compounds
- Process – quorum sensing
- More resistant to
  - desinfectants
  - antibiotics
  - immune rection
- The product of normal flora (which is positive) and pathogens as well

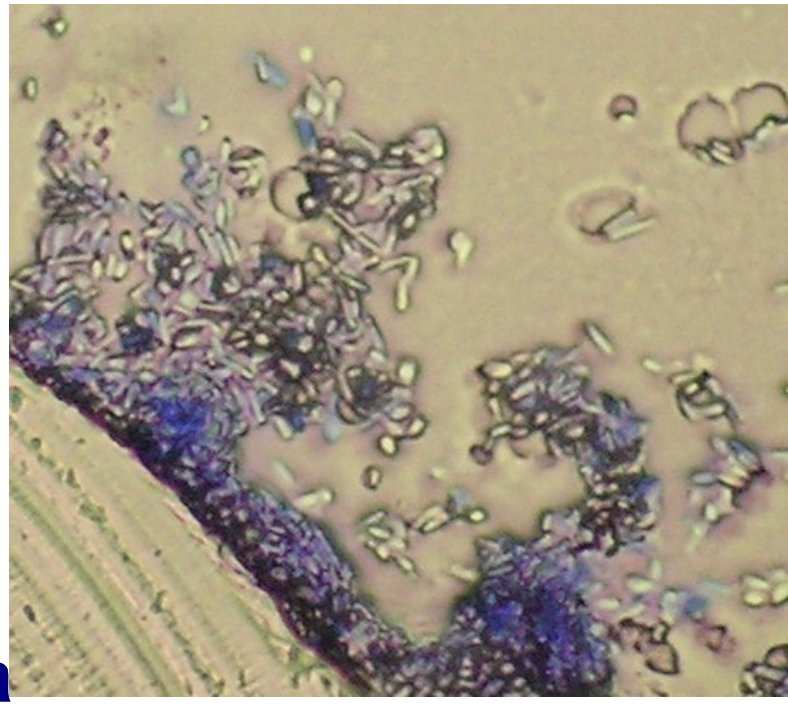


Foto: Veronika Holá

Mouth cavity – II

Dental caries: chronic infections caused by normal oral flora → localized destruction of tooth tissue

Etiology: mouth microbes (mostly *Strept. mutans*) making acids from sucrose in food

Thrush (in Latin soor): *Candida albicans*
It occurs mostly in newborns

Herpetic stomatitis: primary infection with **HSV 1**

Ludwig s angina: polymicrobial **anaerobic** infection of sublingual and submandibular spaces (*Porphyromonas*, *Prevotella* etc.)

Herpetic stomatitis

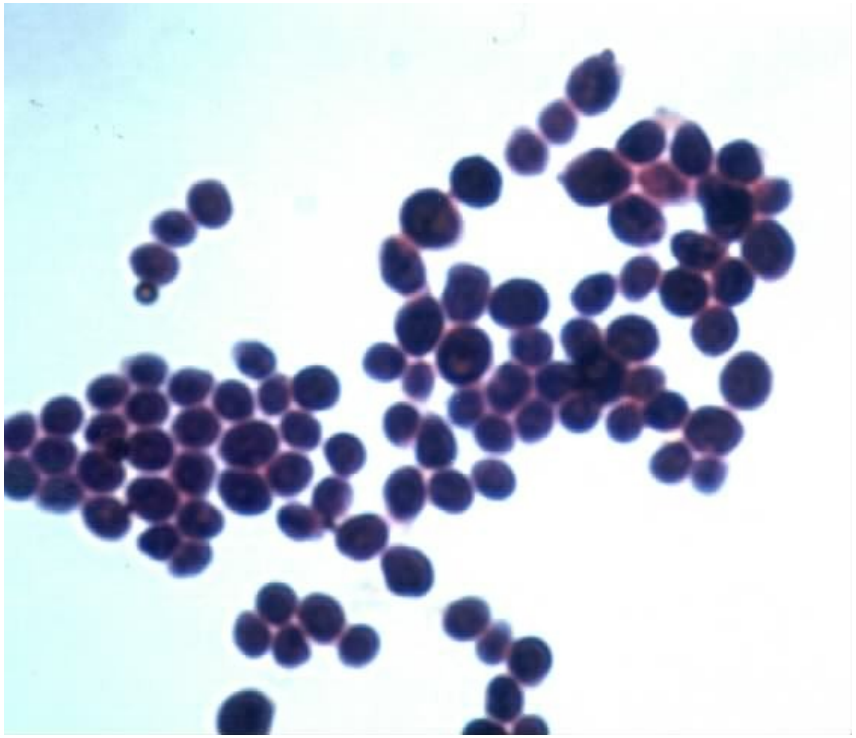
http://imaging.cmpmedica.com

Thrush

http://www.mydochub.com/images/oral_thrush.jpg

http://www.clarian.org/ADAM/doc/graphics/images/en/17284.jpg

C.albicans



www.medmicro.info

Oesophagus

Infections never in previously healthy individuals

Only in severely immunocompromised persons (AIDS):

- ***Candida albicans***
- **Cytomegalovirus (CMV)**

Stomach

Stomach = sterile, killing by means of HCl most of swallowed microbes

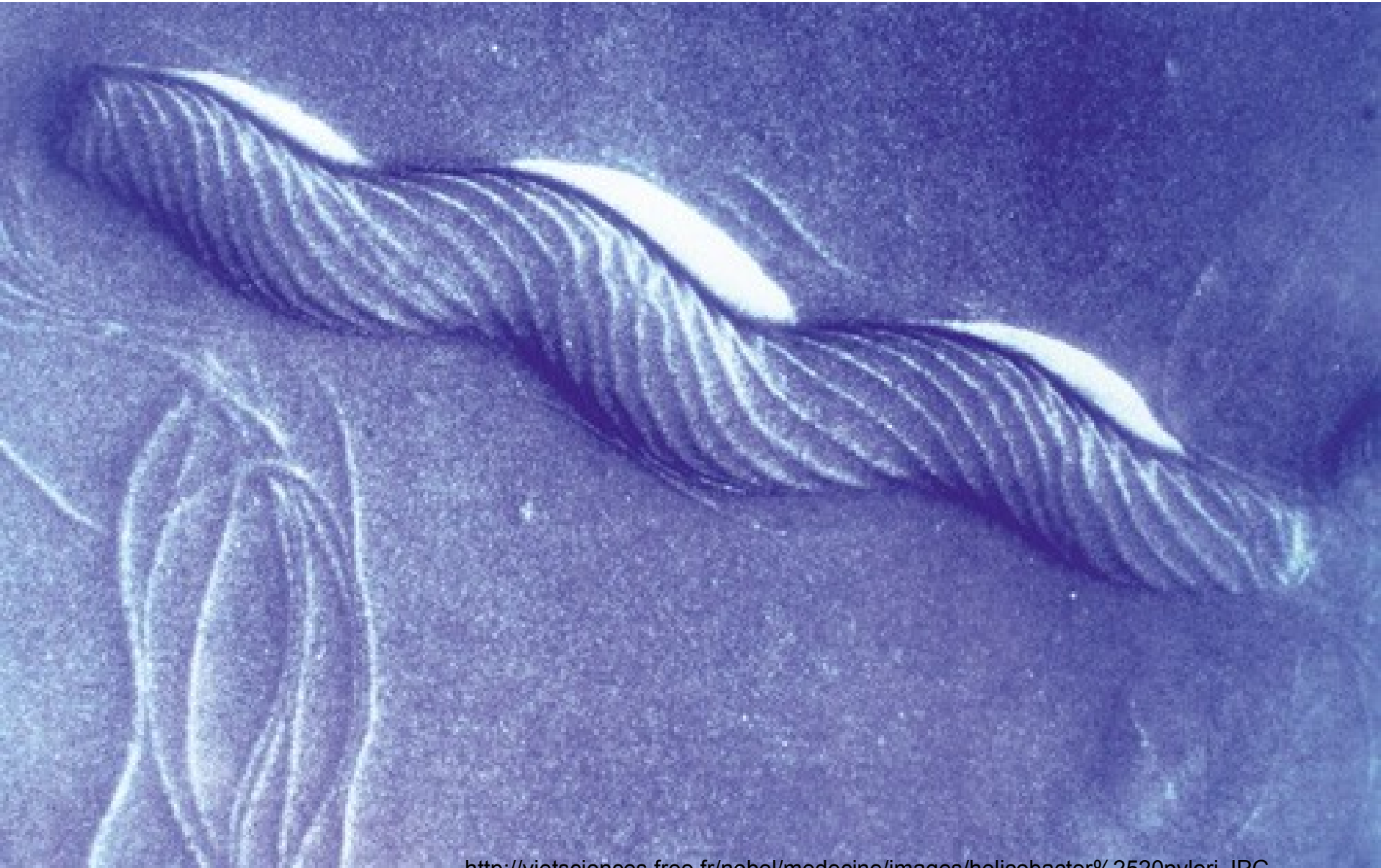
Helicobacter pylori

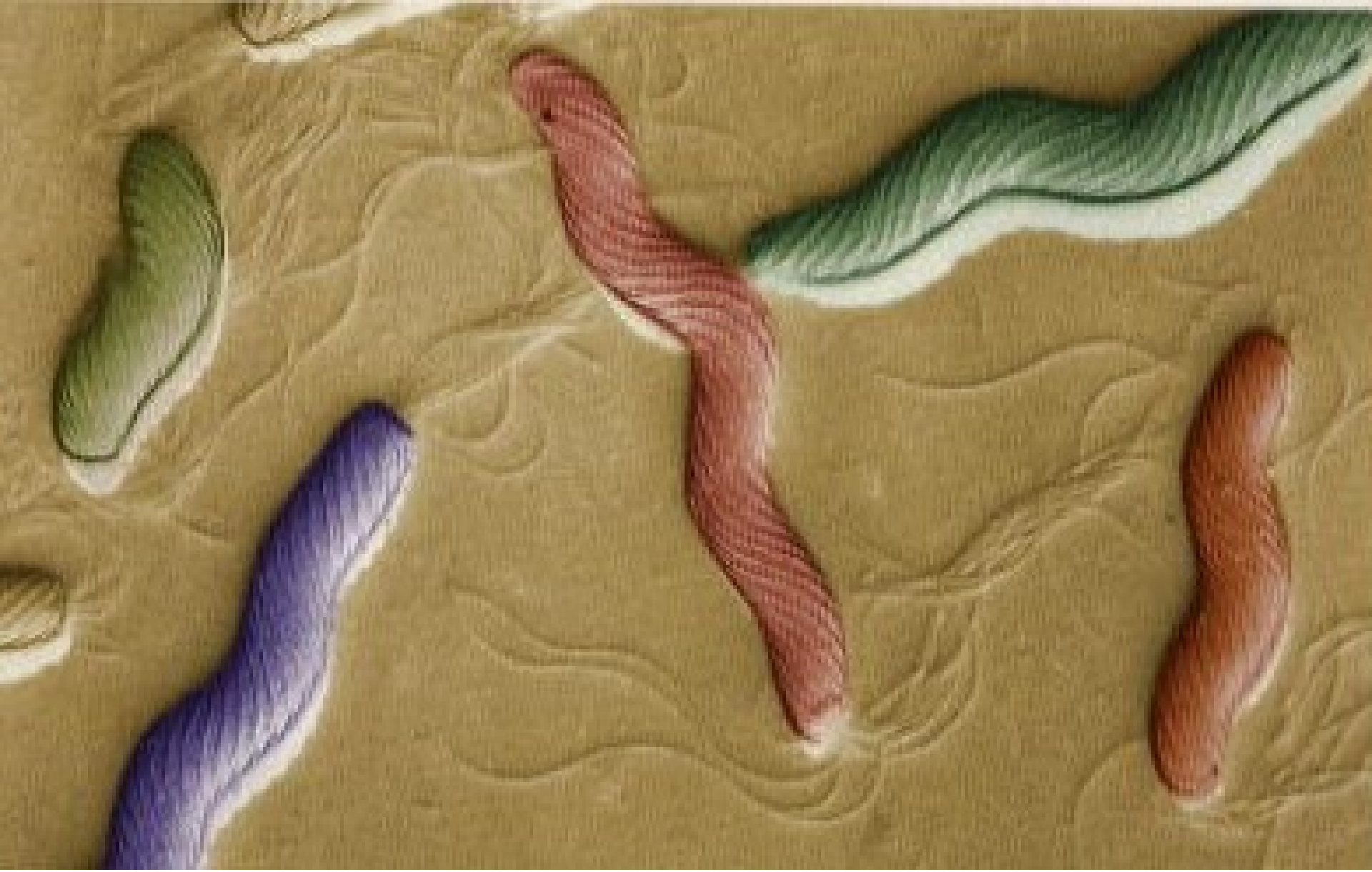
produces a potent urease and by splitting tissue urea it increases pH around itself (1 molecule of urea → 1 CO_2 + 2 NH_3)

***H. pylori* causes**

- **chronic gastritis**
- **peptic ulcers**

Helicobacter pylori





www.univie.ac.at/hygiene-aktuell/helicobacter.jpg

Biliary tree & the liver

Acute cholecystitis (colic, jaundice, fever): obstruction due to gallstones

Etiology: intestinal bacteria (*E. coli* etc.)

Complication: **ascending cholangitis**

Chronic cholecystitis: the most important is *Salmonella* Typhi (carriers of typhoid fever)

Granulomatous hepatitis: Q fever, tbc, brucellosis

Parasitic infections of the liver: **amoebiasis** (*Entamoeba histolytica*: liver abscess), **malaria** (the very first, clinically silent part of the life cycle of plasmodia), **leishmaniasis** (*Leishmania donovani*: kala-azar, *L. infantum*), **schistosomiasis** (eggs of *Schistosoma japonicum*)

Systemic infections which start in the digestive tract

Enteric fever (typhoid fever and paratyphoid fever): *Salmonella* Typhi, *Salmonella* Paratyphi A, B and C

Listeriosis: *Listeria monocytogenes*

Peritonitis: colonic flora

Viral hepatitis: HAV, HBV, HCV, HDV, HEV

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Agents of digestive system infections – II

Diarrhoea

Infectious:

- Bacterial (most frequent)
- Viral
- Parasitic
- Mycotic

Non-infectious:

- Food poisoning

Bacterial agents of diarrhea – I

Escherichia coli

Most *E. coli* strains are component (approx. 1 %) of normal intestinal flora

- important
- essential
- beneficial
- non-pathogenic in the intestine

Only some *E. coli* strains are pathogenic - even in the intestine

Escherichia coli

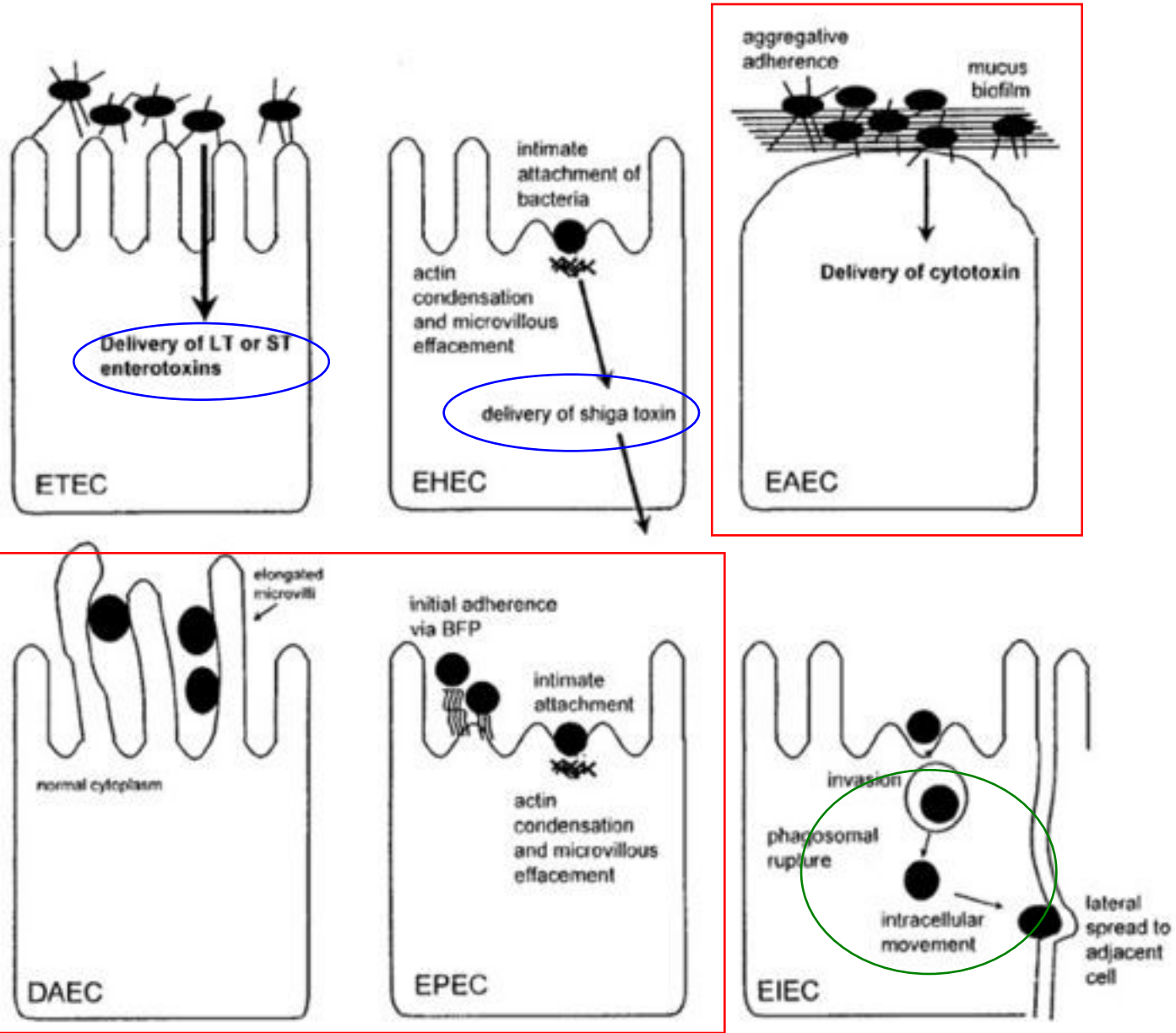
www2.mf.uni-lj.si/~mil/bakt2/bakt2.htm

Bacterial agents of diarrhea – II

Escherichia coli **strains causing diarrheal disease:**

- **ETEC (enterotoxic *E. coli*): children in developing countries, traveller s diarrhea; 2 enterotoxins (heat-labile and heat-stable)**
- **EPEC (enteropathogenic *E. coli*): O55, O111; small infants; disruption of microvillus structure**
- **EIEC (enteroinvasive *E. coli*): similar to *Shigella*; invasion of colonic cells**
- **EHEC (enterohaemorrhagic *E. coli*): O157:H7; 2 cytotoxic Shigatoxins, destruction of microvilli; hemorrhagic colitis & hemolytic-uremic syndrome**

E. coli types



http://microbewiki.kenyon.edu/index.php/Escherichia

Salmonella - MAL agar

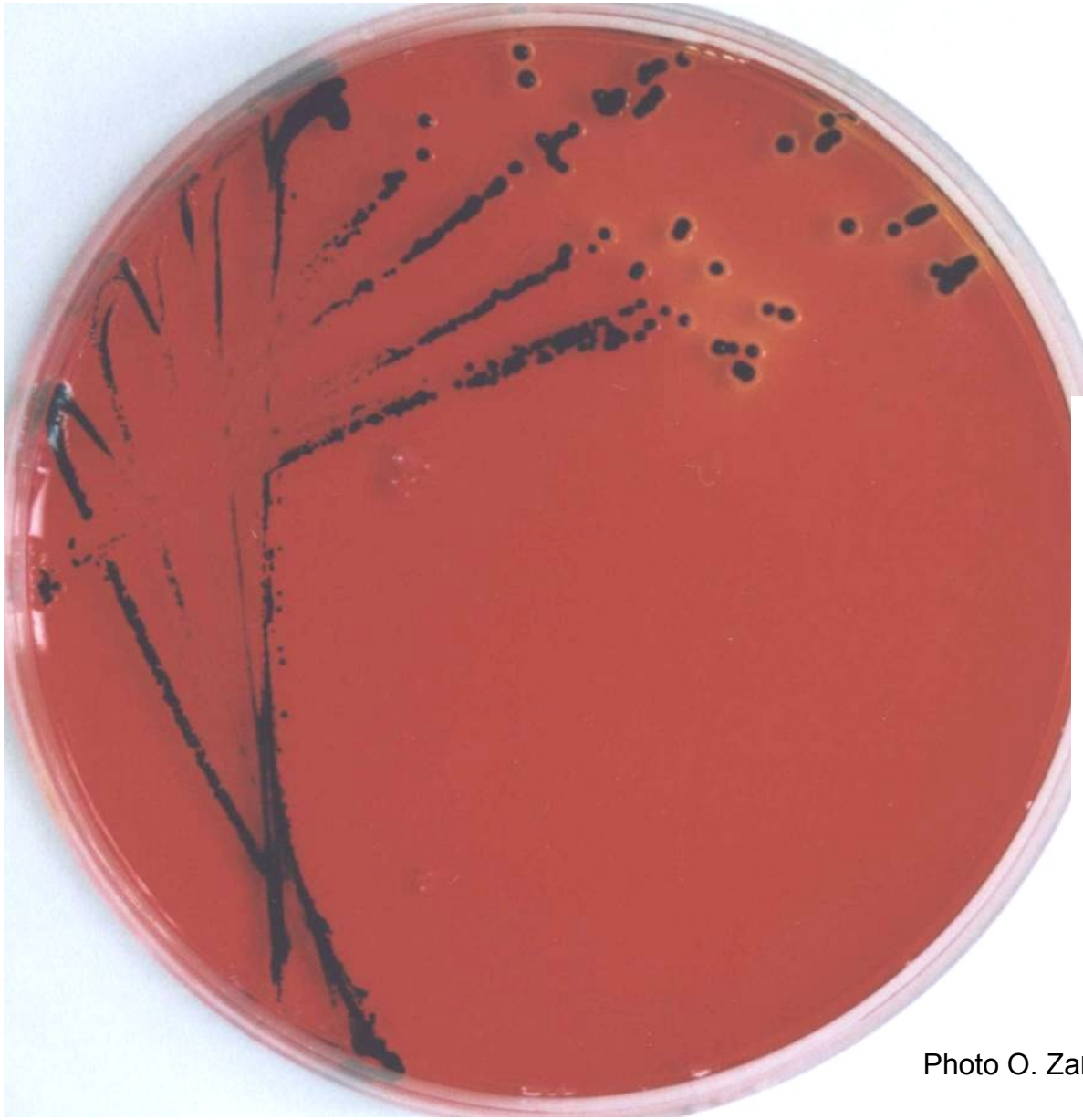


Photo O. Zahradníček.

Bacterial agents of diarrhea – III

A) Salmonella systemic infections (enteric fever): *S.* Typhi, *S.* Paratyphi A – C (reservoir: human beings only)

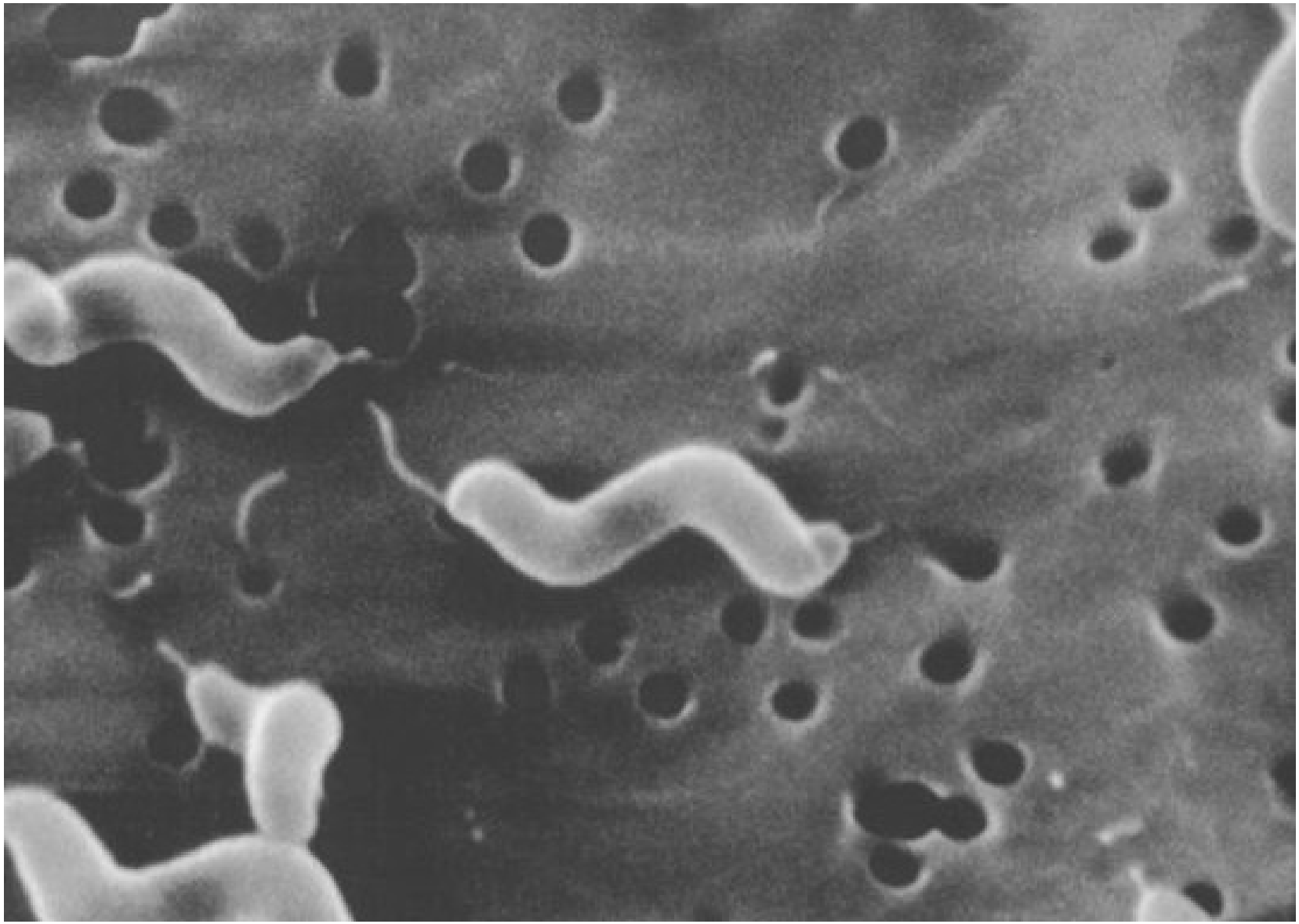
..... gut invasion continues and infection becomes generalized → no diarrhea, pronounced fever & other general symptoms; detection of salmonella in blood, urine and stool, in susp. carriers in duodenal fluid.
Treatment: antibiotics

B) Salmonella gastroenteritis (salmonellosis, reservoir: poultry & animals): >4.000 serotypes – e.g. S. Enteritidis

.... infection is localized to ileocaecal region → diarrhea, nausea & vomiting, abdominal pain, temperature may be elevated, examination of stool only

Treatment: symptomatic only, no antibiotics

Campylobacter jejuni



www.cdc.gov/ncidod/eid/vol5no1/altekruseG.htm.

Bacterial agents of diarrhea – IV

Campylobacter jejuni

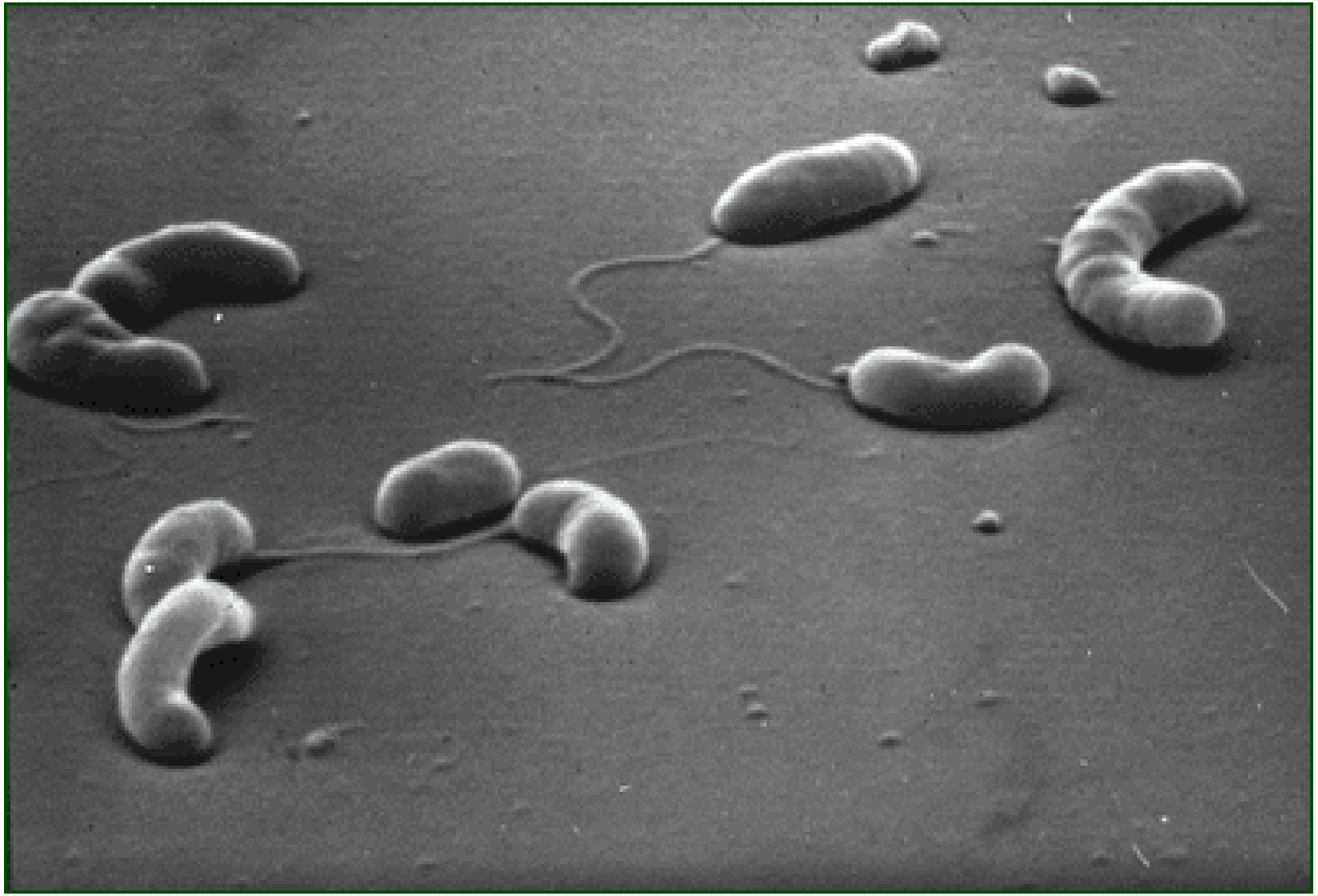
As common as salmonella (or even more); invades jejunal epithelium ; reservoir: poultry

Cultured on a special medium, in reduced oxygen, at 42 C

Shigella sonnei, S.flexneri, S.boydii, S.dysenteriae

- very low infectious dose → epidemic outbreaks
- transmitted only among human beings
- invasion of cells of colon and rectum
- the disease - bacterial dysentery

Vibrio cholerae



http://www.cs.dartmouth.edu/brd/Research/Bio/water-borne-bioterrorism.htm

Bacterial agents of diarrhea – V

Yersinia enterocolitica

- gastroenteritis, in children also mesenterial lymphadenitis (mimicking acute appendicitis)
- vector: contaminated food, multiplies at 4 C

Vibrio cholerae

Cholera toxin activates adenylate cyclase → hypersecretion of water & electrolytes → death by dehydration/electrolyte abnormalities

V. cholerae flourishes in water & causes epidemics

Vibrio parahaemolyticus: from raw fish & shell-fish

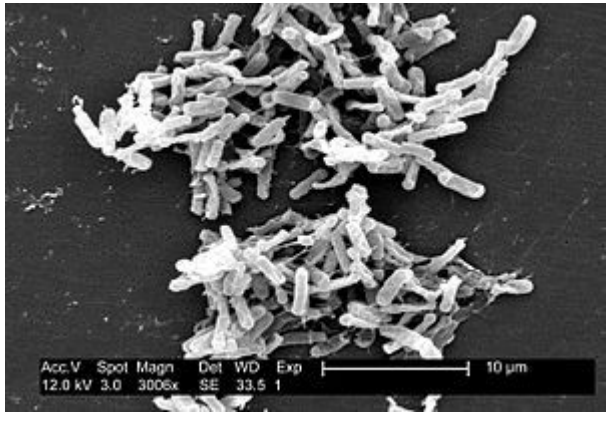
Diarrhoea during antibiotic therapy

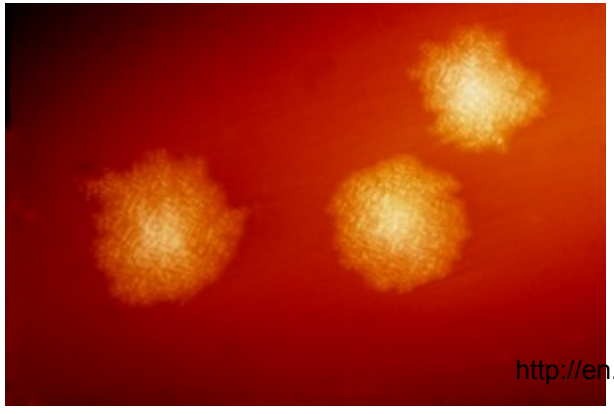
Clostridium difficile:

pseudomembranous colitis frequently after clindamycin, cephalosporines (virtually after every ATB), hypervirulent serotype O27

Patients contaminate the hospital environment with resistant spores.

Colitis is treated by metronidazol or vancomycin.



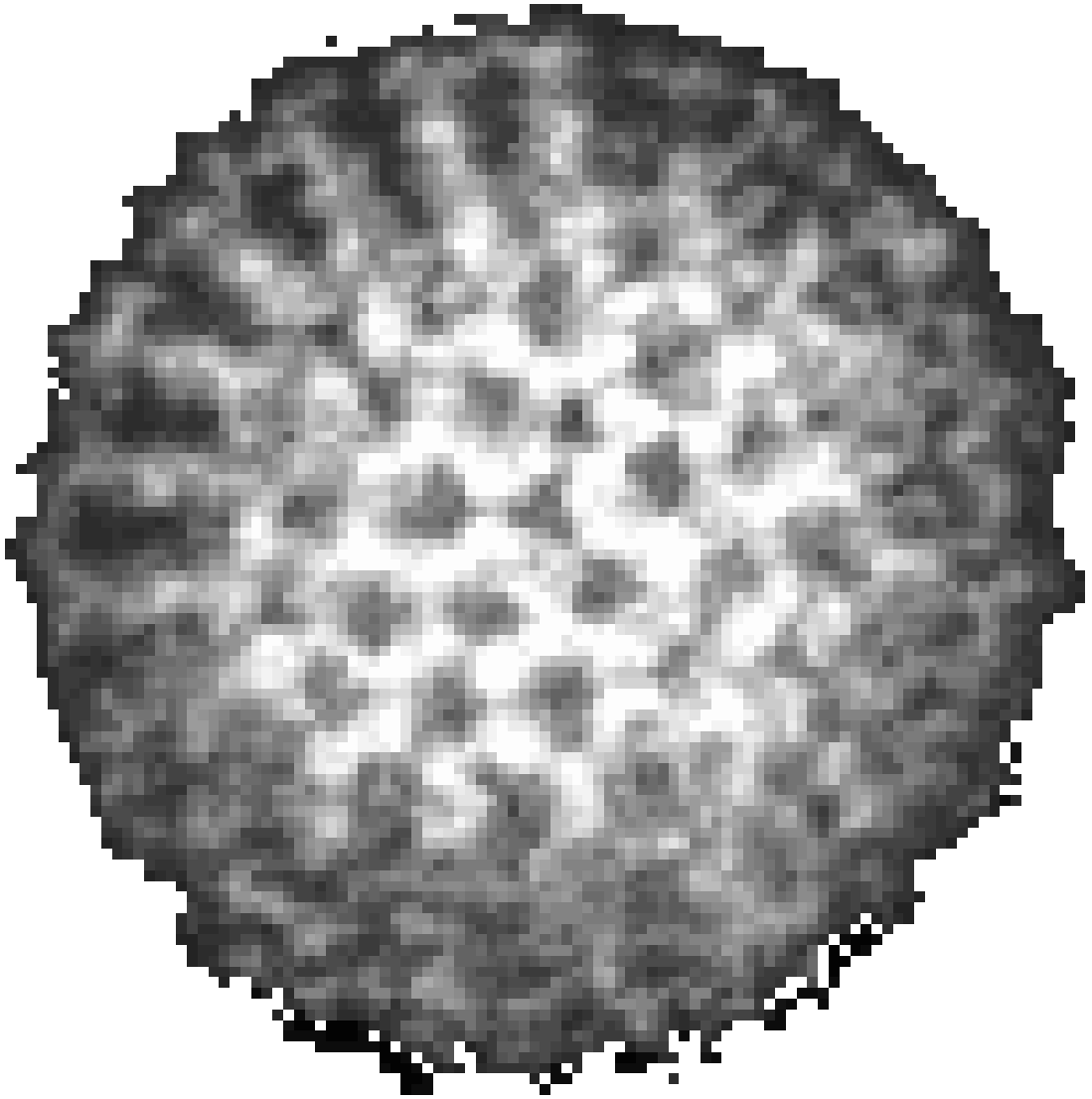


http://en.wikipedia.org/wiki/Clostridium_difficile

Direct proof of the toxins as antigen is essential because *C. difficile* can be found in healthy people

Proof of the toxin A in *C. difficile. Photo: MÚ archive*

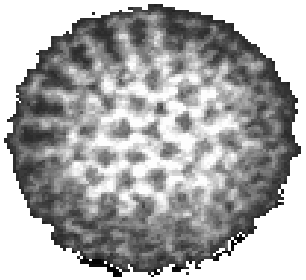
Rotavirus



http://web.uct.ac.za/depts/mmi/stannard/emimages.html

Viral agents of diarrhea

Generally: small, acid- and bile-resistant non-enveloped viruses



Rotaviruses (*Reoviridae* family)

serious diarrhea of young children, epidemics in winter, vaccination

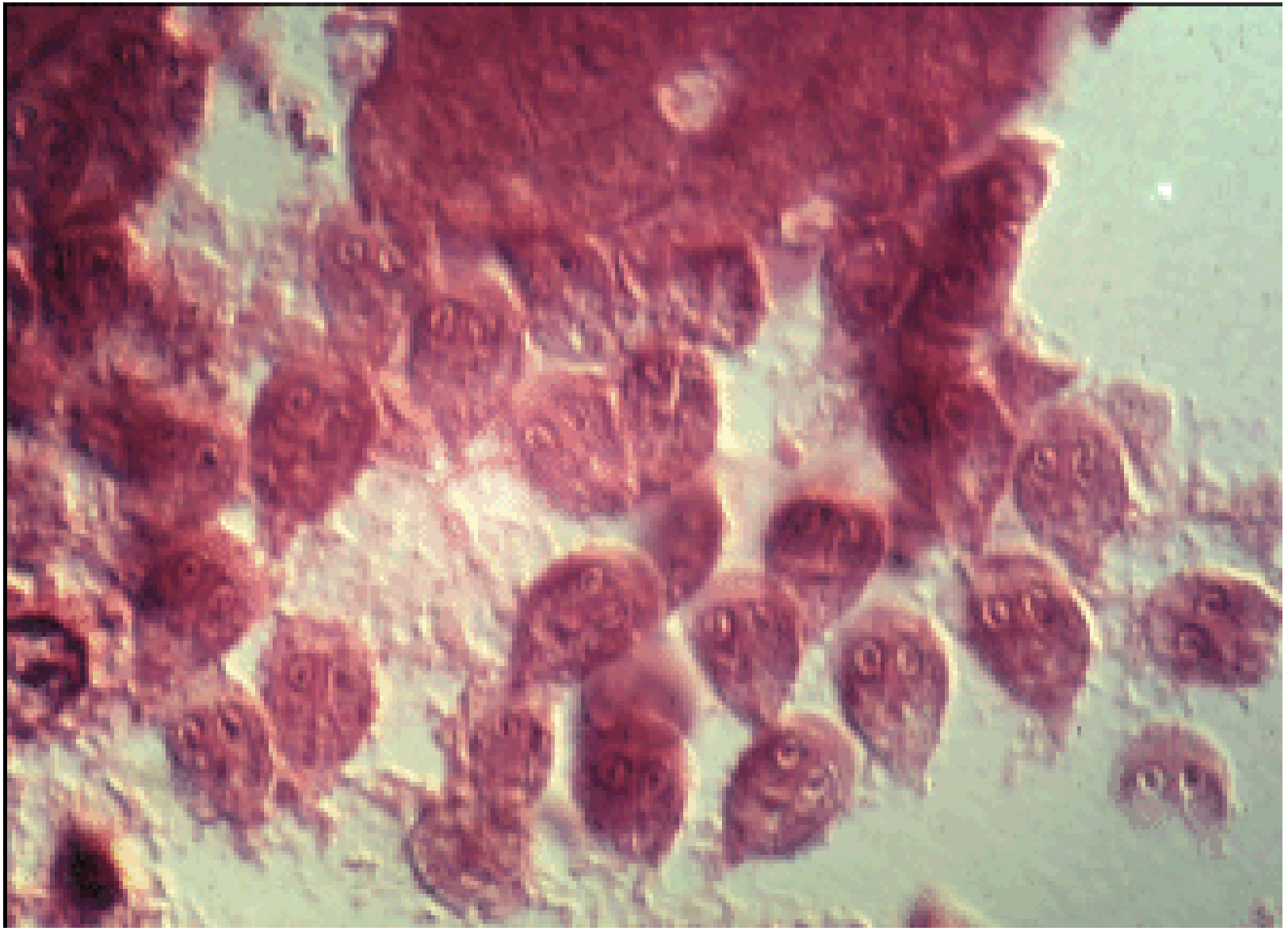
Noroviruses and sapoviruses (formerly agents Norwalk and Sapporo, *Caliciviridae* family)

epidemics in children and adults, in hospitals

Astroviruses (star-shaped virions)

Adenoviruses type 40 and 41

Lamblia



CD-ROM „Parasite-Tutor“ – Department of Laboratory Medicine, University of Washington, Seatle, WA

Ascaris lumbricoides egg

Fertile egg (wet mount 400X)

Parasitic agents of diarrhea

Protozoa:

- *Entamoeba histolytica*: amoebic dysentery
- *Giardia lamblia*: giardiasis
- *Cryptosporidium parvum*: cryptosporidiosis

Helminths in the small intestine:

Ascaris lumbricoides (human roundworm)

Strongyloides stercoralis (threadworm)

Taenia saginata (beef tapeworm), *T.solium* (pork tapeworm)

Hymenolepis nana (dwarf tapeworm)

Diphyllobothrium latum (fish tapeworm)

.....in the large intestine:

Enterobius vermicularis (pinworm)

Trichuris trichiura (whipworm)

Food poisoning

Intoxication due to a toxin preformed in the food

- ***Staphylococcus aureus*: heat-stable enterotoxin**
- ***Clostridium perfringens*: heat-labile enterotoxin**
- ***Bacillus cereus*: heat-stable enterotoxin and vomiting toxin (mostly in rice)**
- ***Clostridium botulinum*: heat-labile neurotoxin**

Harmenszoon Rembrandt van Rijn (1606-1669)
Anatomy Lecture of Doctor Tulp (1632)