

## Lecture 23: A Bacterial Survey

### I. Anaerobic chemoheterotrophs

#### A. Fermentation

##### The Genus

*Phylum: Firmicutes, Class: Clostridia*

*Bergey's Manual Volume 3 (Low G+C Gram-positives)*

1) Generate ATP by fermenting a wide variety of \_\_\_\_\_ as well as \_\_\_\_\_ and ethanol.

2) \_\_\_\_\_ Many species are pathogenic: *C. botulinum*, \_\_\_\_\_, and *C. perfringens*.

3) Commonly found in anaerobic microenvironments within the \_\_\_\_\_  
Some species are normal flora of the \_\_\_\_\_

## B. Anaerobic respiration

*Phylum: Proteobacteria, Orders: Desulfovibrionales, Desulfobacterales and Desulfuromonadales  
Volume 2 of Bergey's Manual*

1. Generate ATP when \_\_\_\_\_ are used as the \_\_\_\_\_ in the electron transport chain. This reduction produces (H<sub>2</sub>S).
2. Found in \_\_\_\_\_ or marine sediment, sediments of polluted lakes and streams, sewage lagoons and digesters. These locations are rich in organic material and oxidized sulfur compounds.
3. There are \_\_\_\_\_ including \_\_\_\_\_ and *Desulfuromonas*.

## II. Anoxygenic phototrophs

Generally inhabit rare ecological niches that are but have little  
or no light

### A. The

bacteria that are due to the light  
absorbing pigments (e.g. bacteriochlorophyll).

#### 1. Purple sulfur bacteria

*Phylum: Proteobacteria, Class:  $\gamma$ -proteobacteria*

a. Generally photolithoautotrophic, and use

b. ( $> 5 \mu\text{m}$ ), motile cells that commonly contain  
enabling them to move to the desired water depth. Most also have  
internal that may eventually be  
oxidized further. Representative genera include

c. Found in such as sulfur springs.  
Fig 20.20 and 20.21 (8th ed.) or 22.21 and 22.22 (9th ed.)

## 2. Purple Nonsulfur Bacteria

*Phylum: Proteobacteria, Class:  $\alpha$ -proteobacteria*

*Bergey's Manual: Volume 2*

- a. Generally use  $\text{Fe}^{2+}$ , rather than  $\text{H}_2\text{S}$  as a source of electrons. They are very  $\text{H}_2$  sensitive and although growth is generally anoxygenic and phototrophic, most can grow using chemotrophic metabolism.
- b. Cells contain polyphosphate and sulfur storage granules.
- c. Most are Gram-negative.
- d. Morphology varies: *Rhodospirillum rubrum* (rods), and *Rhodocyclus ruber* (half circles or circles)
- e. Found in a variety of aquatic environments such as sulfidic sediments and moist soils.

## B. The Green Bacteria

Gram-negative bacteria that are green or brown in color.

### 1. Green sulfur bacteria

*Phylum: Chlorobi*

*Bergey's Manual: Volume 1*

a. Generally use  $\text{H}_2\text{S}$  and are strictly anaerobic.

b. Diverse morphologically: rods, cocci or vibrios

c. Cells  $\text{H}_2\text{S}$  but they  $\text{CO}_2$  and sulfur granules form Representative genera include

*Chlorobium* and *Pelodictyon*.

d. Like purple sulfur bacteria, they generally live in

Fig. 19.5 (8th ed.) or 21.9 (9th ed.)

## 2. Green nonsulfur bacteria

a. Like purple nonsulfur bacteria, use  $H_2$  as a source of electrons. Also like purple nonsulfur bacteria, they are anaerobic and can use chemotrophic metabolism.

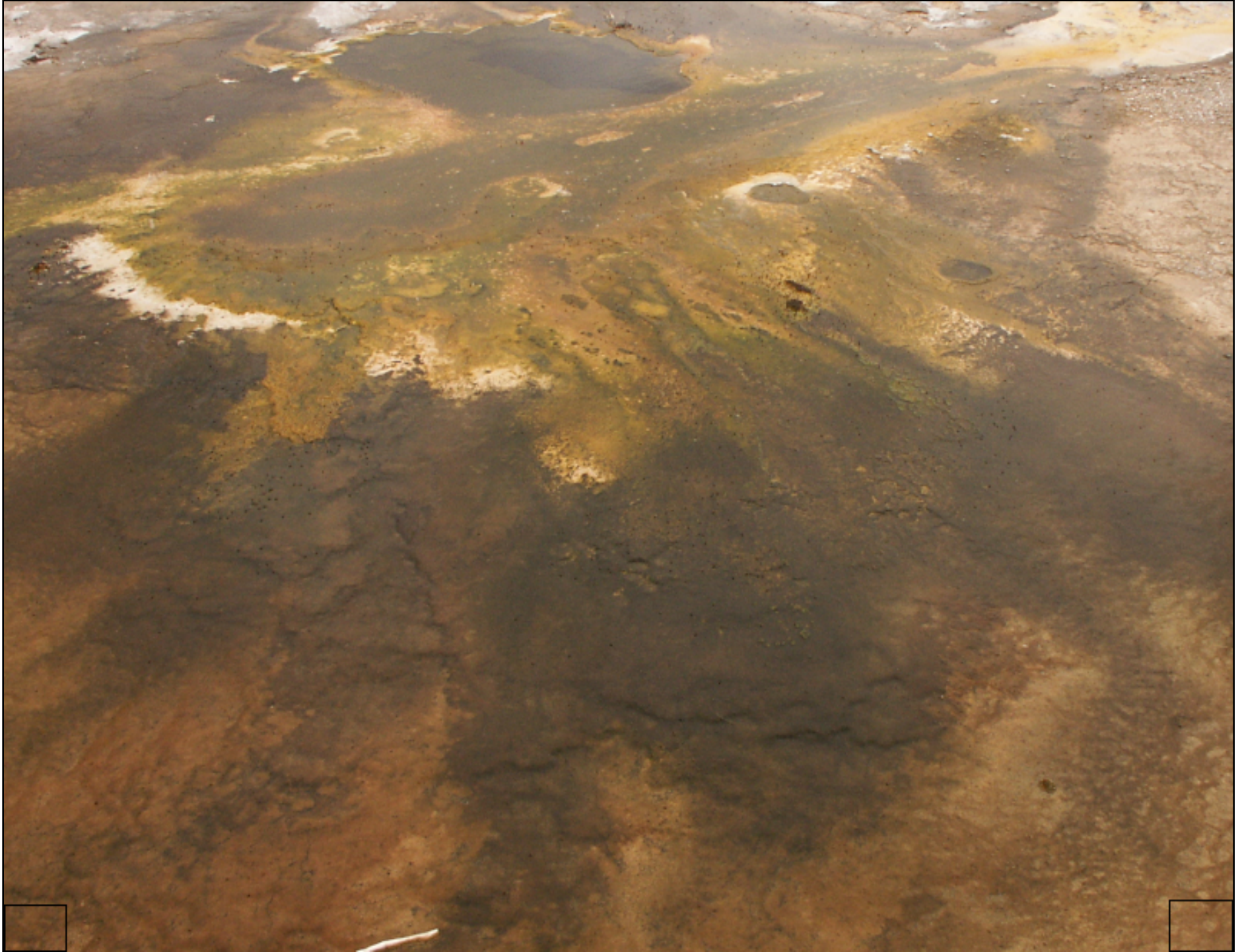
b. Growth is anaerobic and cells often use gliding motility.

c. *Chloroflexus* is the main representative. It is thermophilic, and lives in hydrothermal vents where it grows into orange-reddish mats along with cyanobacteria.







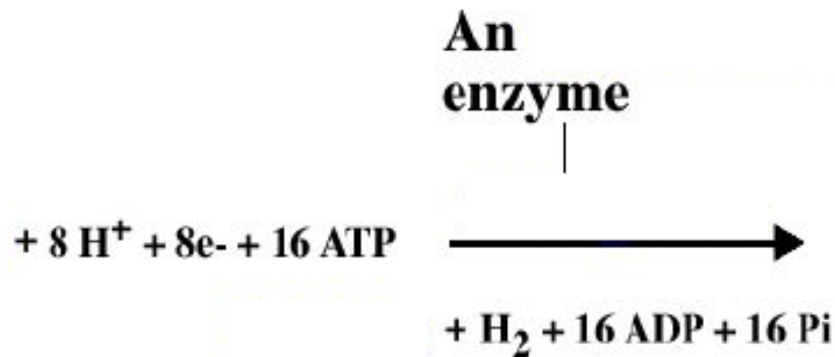


### III. Oxygenic phototrophs

(Phylum: Cyanobacteria, Bergey's Manual: Volume 1)

#### A. Metabolism

1. Obtain their energy from
2. Nitrogen fixation



Cyanobacteria from oxygen in a variety of ways. For instance, *Synechococcus* fixes nitrogen when photosynthesis is not taking place. *Nostoc* only fixes nitrogen in specialized cells called that are fairly impermeable to oxygen and lack photosystem II so do not themselves produce oxygen! In microbial mats (pictured previously) only the cells in an anoxic environment fix nitrogen.

## B. Characteristics

1. There are 62 species and 24 genera of cyanobacteria. Some are typical prokaryotic shapes: cocci, bacilli, and spirilla. Some form filaments that may be enclosed in a sheath. Some trichomes have heterocysts!
2. Often have flagella and can move by gliding.
3. Use a variety of mechanisms of reproduction: binary fission, budding, fragmentation and asexual reproduction (cell enlarges and divides several times).
4. Some can develop endospores which are dormant, resting structures that are resistant to desiccation.

2. Excessive growth causes \_\_\_\_\_ to form and in summer these cells will die and decay leading to a smelly scum called \_\_\_\_\_ .



Photo taken by Rachel (summer 2010)

## C. Environmental niche

Generally inhabit \_\_\_\_\_ and marine habitats, soils and \_\_\_\_\_.

### Microbiotic crust



Taken by Rachel in Utah in May of 2004





Frame 607

