

**The Islamic University of Gaza- Environmental Engineering Department
Environmental Microbiology (EENV-2321)**

Lecture 1: Introduction to Environmental Microbiology

**Prepared by
Husam Al-Najar**

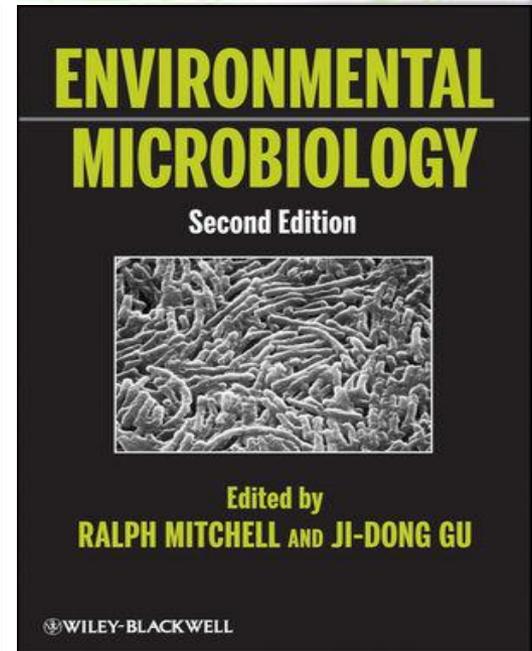
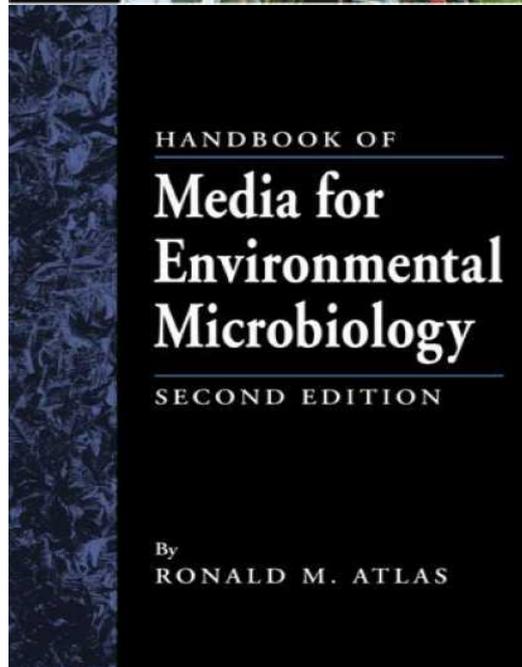
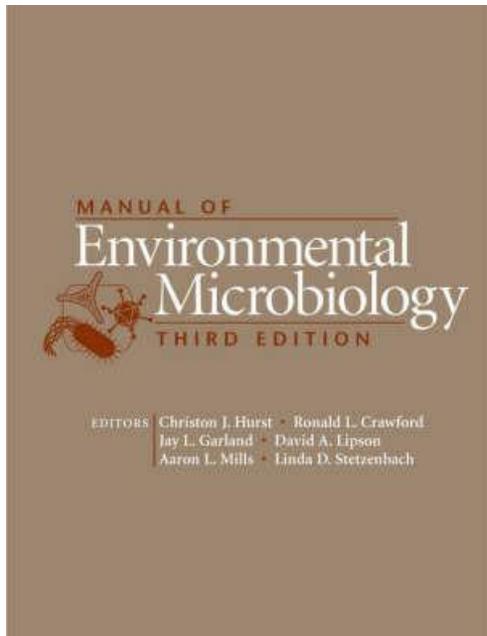
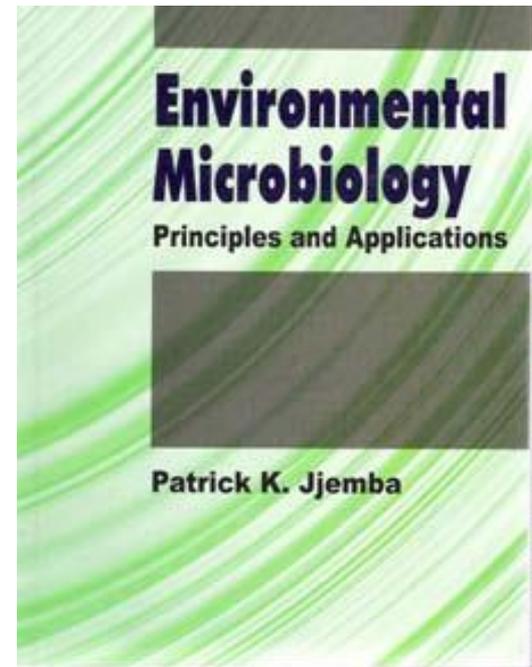
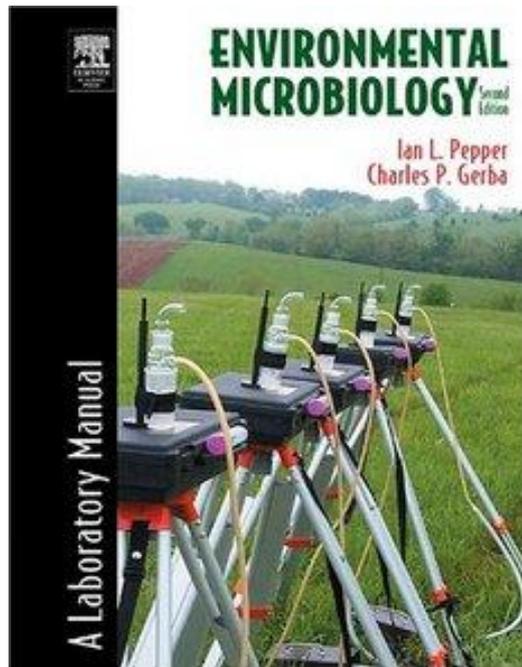
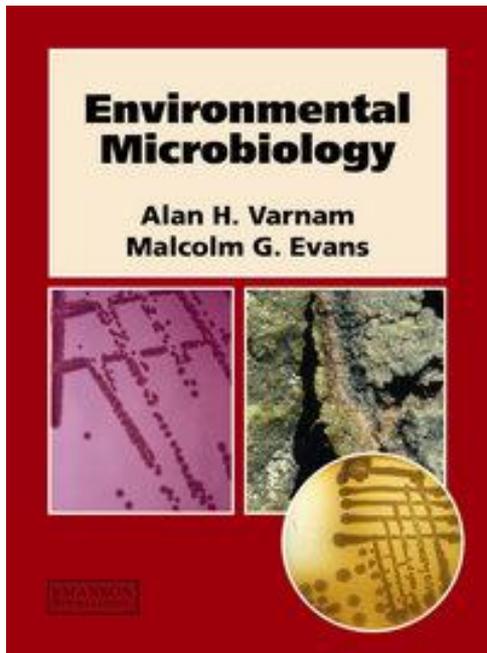
Objectives of the course:

The course commences with a basic introduction to cell microbiology and microorganisms, their role in degradation of the pollutants in the environment, and explores their role in shaping the geochemistry of the earth.

A survey of modern microorganisms and their activities of environmental and geochemical importance is an important foundation for the course. Indicator microorganisms and how to disinfect pathogenic microorganisms is essential part of the course.

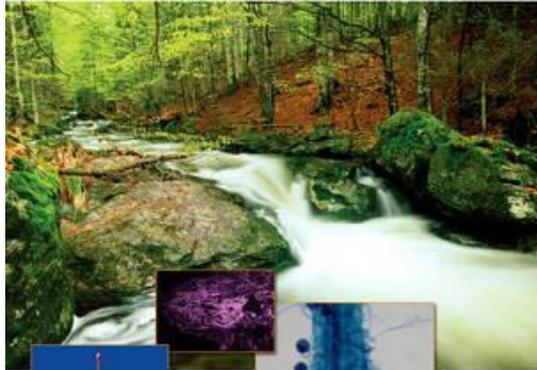
Text Book:

Environmental Microbiology. Second edition. Raina M. Maier, Lan Pepper and Charles P. Gerba. Academic press and Elsevier 2009. ISBN: 978-0-12-370519-8.



Environmental MICROBIOLOGY

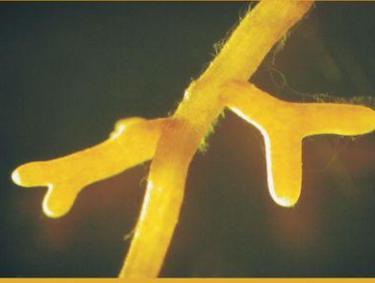
Second Edition



Raisa M. Maier - Ian L. Pepper - Charles P. Gerba



Textbook of Environmental Microbiology



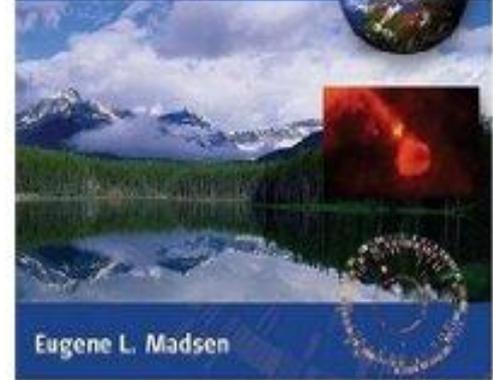
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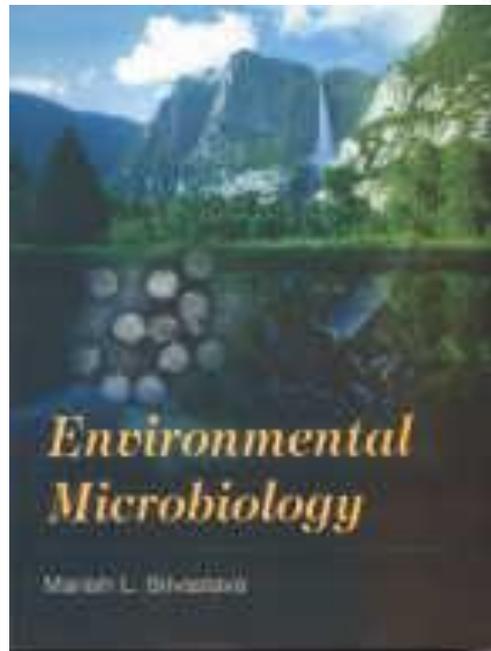
Environmental Microbiology

From genomes to
biogeochemistry

Microsoft
Publishing



Eugene L. Madsen



Environmental Microbiology

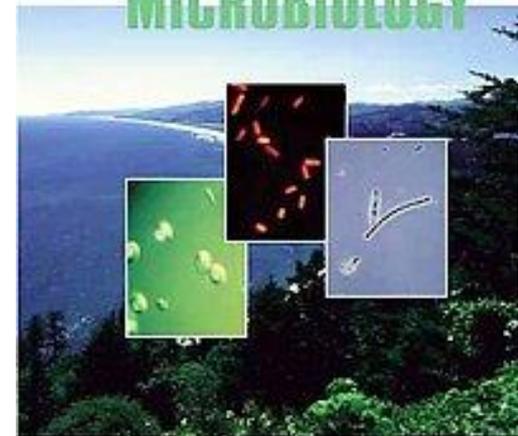
Marion L. Birkhead

ENVIRONMENTAL MICROBIOLOGY

SEJANA TELIC



Environmental MICROBIOLOGY



Raisa M. Maier - Ian L. Pepper - Charles P. Gerba

The recommended Textbook:

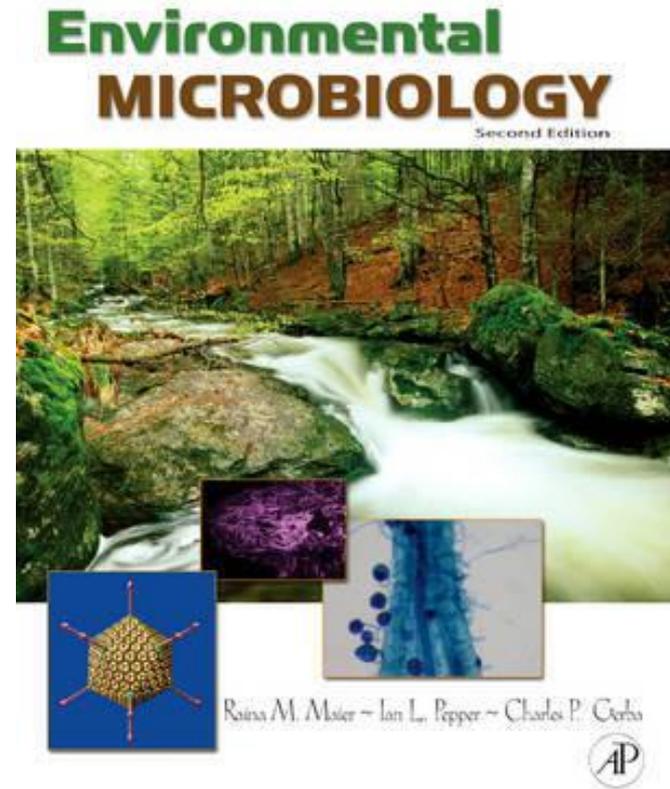
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Course Outline

1. Introduction to Environmental Microbiology
2. Microorganisms
3. Bacterial Growth
4. Principals of Biological Wastewater Treatment

Midterm Exam

5. Earth Environment
6. Aeromicrobiology
7. Aquatic Environment
8. Biogeochemical Cycling
9. Indicator Organisms
10. Disinfection

Final Exam

Course Evaluation

Homework & Quiz	05%
Mid term Exam	35%
Final Exam	60%

Definitions:

The roots of environmental microbiology are most closely to the microbial ecology, which comprises the study of the interaction of microorganism within the environment (air, water or soil).

Microbial ecology :

Is the relationship of microorganisms with one another and with their environment .

It concerns the three major domains of life - Eukaryota, Archaea, and Bacteria - as well as viruses .

Microorganisms, by their omnipresence , بانتشار impact the entire biosphere .

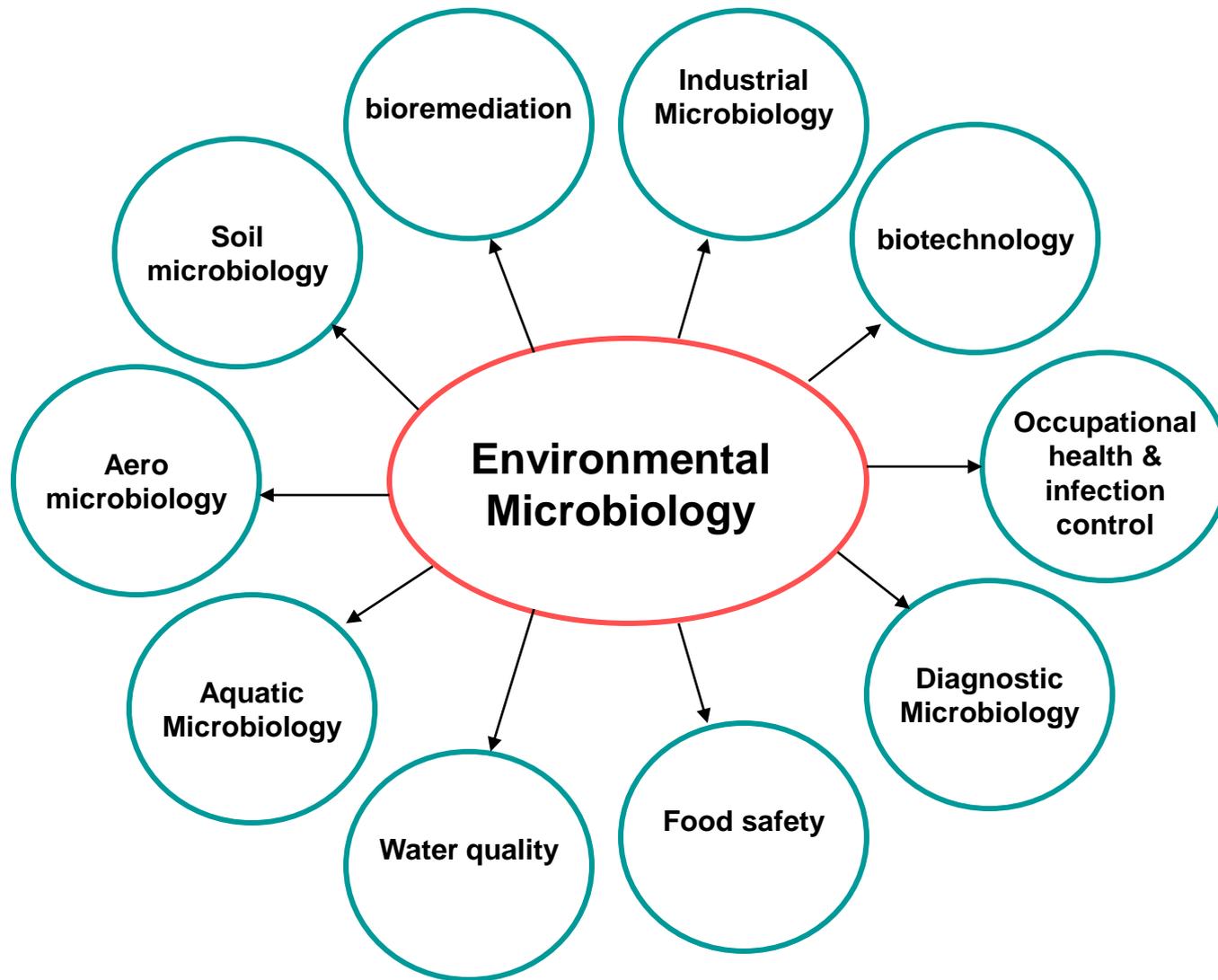
They are present in virtually all of our planet's environments, including some of the most extreme, from acidic lakes to the deepest ocean, and from frozen environments to hydrothermal vents. (المخارج الهيدروحرارية).

Environmental microbiology :

Is the study of the composition and physiology of microbial communities in the environment .

The environment in this case means the soil, water, air and sediments covering the planet and can also include the animals and plants that inhabit these areas .

Environmental microbiology also includes the study of microorganisms that exist in artificial environments such as bioreactors.



The need to understand environmental microbiology:

1. The emergence of a series of new waterborne and food-borne pathogens that posed a threat to human and animal health.
2. The past waste disposal practices contaminate the surface and groundwater with organic and inorganic chemicals.
3. The discovery of the structural DNA engaged the development of new technologies (Polymerase Chain Reaction PCR) for measuring and analyzing microbes.

These together caused the scientists to question the notion مفهوم that our food and water supplies are safe and also allowed the development of tools to increase the ability to detect كشف and identify تحديد microbes and their activities in the environment.

تفشي Large scale food recalls تذكر وتنبيه due to food-borne outbreaks

Food recall	Year	Organism	No. of people involved	Location
Cheese	1998	<i>Salmonella enteritidis</i>	700	Canada
Turkey and chicken products	2002	<i>Listeria</i>	120	USA
Green onion	2003	<i>Hepatitis A</i>	600	USA
Spinach	2006	<i>E.Coli</i>	200	USA
Canned meat products	2007	<i>Clostridium botulinum</i>	4	USA

Common contaminants found in the environment

Chemical class	Example
Petroleum hydrocarbons (fuel)	Benzene, toluene, xylene, polycyclic aromatics
Coal tar and creosols	Aromatics and polycyclic aromatics قطران الفحم
Chlorinated solvents	Trichloroethene (TCE), tetrachloroethene (PCE), trichloroethane,
Munitions الذخائر	Trinitrotoluene (TNT), hexanitrobenzene (HNB), 2,4,6-trinitrophenol.
Pesticides المبيدات	Organochlorines (DDT), organophosphates.....etc.
Polychlorinated biphenyls (PCB)	Arochlor, Clophen, phenoclor, Fenchlor, Kanechlor.
Pharmaceuticals food additives & cosmetics	Endocrine disruptors, antibiotics, surfactants, dyes.
Fluorocarbons	Chlorofluorocarbons (CFCs), Hydrochlorofluorocarbons (HCFCs)
Fertilizers المحصبات	Urea, superphosphate.
Metals	Lead, Cadmium, mercury, arsenic, chromium, nickel, Zinc.
Radioactive contaminants	Uranium, Strontium, cobalt, plutonium.

Estimates of Morbidity And Mortality of Some Water-Related Diseases

Disease	Morbidity (episodes/yr.) (or as stated)	Mortality (deaths/yr.)	Relationship of Disease to Water Supply and Sanitation
Diarrheal diseases الإسهال	1,000,000,000	3,300,000	Strongly related to unsanitary excreta disposal, poor personal and domestic hygiene, unsafe drinking water
Infection with intestinal helminthes	1,500,000,000	100,000	Strongly related to unsanitary excreta disposal, poor personal and domestic hygiene.
Schistosomiasis البلهارسيا	200,000,000	200,000	Strongly related to unsanitary excreta disposal and absence of nearby sources of safe water
Malaria المالاريا	400,000,000	1,500,000	Related to poor water management, water storage, operation of water points and drainage
Poliomyelitis شلل الأطفال	114,000	-	Related to unsanitary excreta disposal, poor personal and domestic hygiene, unsafe drinking water
Trachoma الرمم	150,000,000	-	Strongly related to lack of face washing, often due to absence of nearby sources of safe water
Dengue Fever حمى الضنك	1,750,000	20,000	Related to poor solid wastes management, water storage, operation of water points and drainage

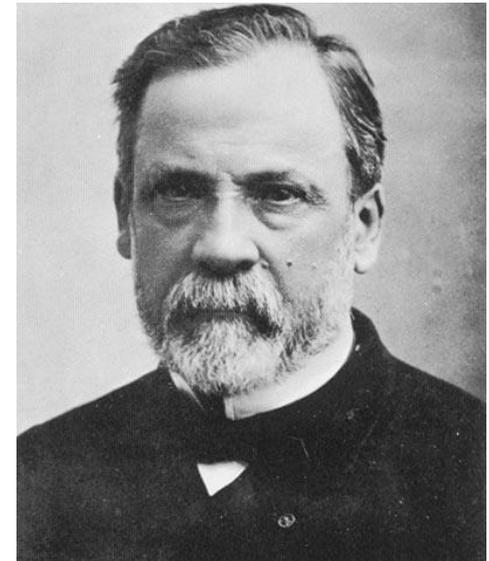
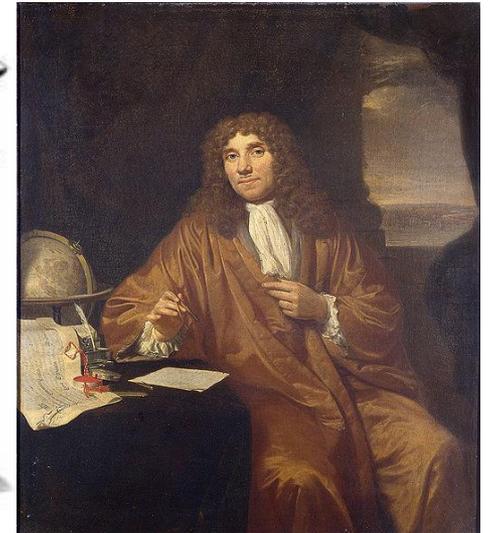
History of Microbiology:

The development of microbiology science in three periods:

1. Observation
2. Pure Culture
3. Molecular Ecology

Observation:

- 1664 → Robert Hooke → mold; “cell”
- 1680 → Antonie van Leeuwenhoek → 1st microscope
- Mid 18th century → Natural generation argue
- 19th century → Louis Pasteur (sterilization)
food spoilage → appearance of bacteria
→ cause or product?



Pure Culture

نظرية الأمراض الجرثومية

- Robert Koch → germ theory of disease

↳ Propagation of bacteria on solid media

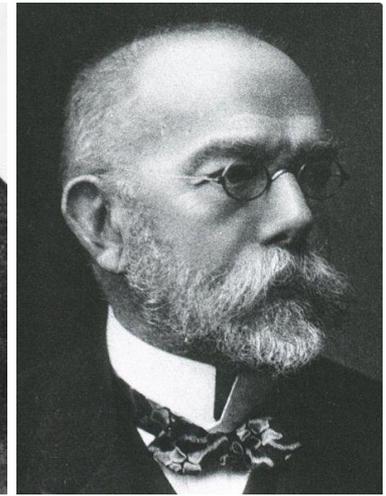
1st Environmental observations:

- chemical processes

↳ heat kills samples { H₂ oxidation in soils
ammonia oxidation in sewage

Development of enrichment cultures

↳ Martinus Beijerinck → provided “selected conditions” in media
↳ growth of organisms that exploit conditions



Molecular Microbial Ecology

~ last 15 years

“gene diversity” → track organisms that haven’t been cultured yet.

The mission of Environmental microbiologist:

To pursue the goal of environmental sustainability, which defined as “ the utilization of environmental resources for the benefit of human health and welfare without deterioration of the physical environment or the biological communities contained therein”.

Critical components of these biological communities are the microbial communities housed within the environment.

The challenge for the environmental microbiologists is to enhance the understanding of these communities in order to achieve environmental sustainability.