

Chapter 6: The Nineteenth Century: Major Advances in Biology

Introduction

The **19th century** was a turning point in the history of biology. With the improvement of the **microscope** and the development of new **experimental methods**, scientists formulated fundamental theories that became the basis of **modern biology**. These advances included the **cell theory**, the birth of **embryology**, the emergence of **molecular biology**, and the foundation of **genetics**.

1. Cell Theory and Microscopy

- Improvements in **microscopy** allowed the detailed observation of tissues and cells.
- **Matthias Schleiden (1838)** (botanist) and **Theodor Schwann (1839)** (zoologist) formulated the **cell theory**, stating that:
 1. All living organisms are made of **cells**.
 2. The **cell is the basic unit of structure and function** in living beings.
- **Rudolf Virchow (1855)** expanded the theory with his famous principle:

"Omnis cellula e cellula" → Every cell arises from a pre-existing cell.

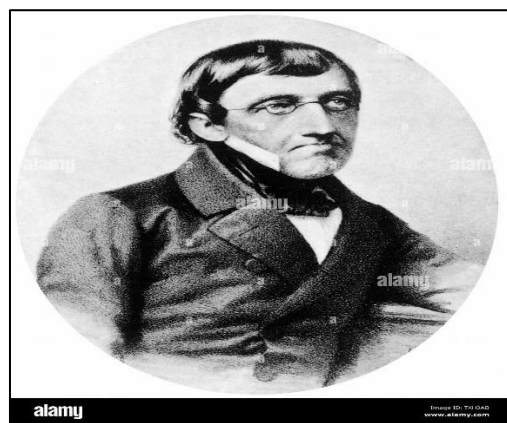
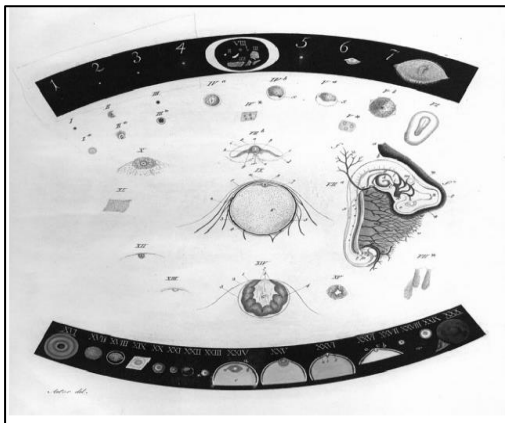
- This theory laid the foundation for **cytology** and modern **cell biology**.



2. Sexual Embryology

- The 19th century marked the beginning of **scientific embryology**.

- **Karl Ernst von Baer (1827)** discovered the **mammalian egg** and described the stages of **embryonic development**.
- He formulated **Baer's Laws of Embryology**, including:
 - Development proceeds from the **general to the specific**.
 - Embryos of related species share **common stages** in early development.
- This work helped establish the role of **gametes (egg and sperm)** in reproduction and the continuity of **sexual generation**.



3. Molecular Biology (Early Foundations)

- Although the term “molecular biology” came later (20th c.), the **19th century** provided its foundations.
- **Friedrich Miescher (1869)** discovered a substance he called “**nuclein**” (later identified as **DNA**) in the nuclei of white blood cells.
- This discovery marked the beginning of the study of **nucleic acids**.
- Advances in **biochemistry** during this century began to explain the **chemical nature of life processes**.

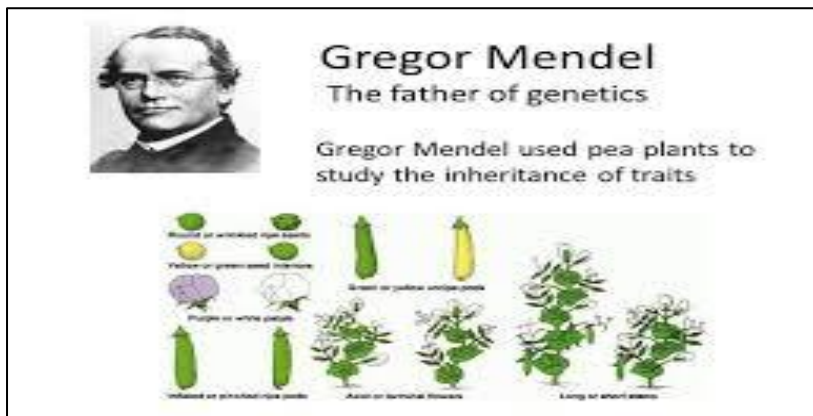


- **4. Genetics and DNA Foundations**

- **Gregor Mendel (1866)**, through experiments on **pea plants**, established the **laws of inheritance**:

1. **Law of Segregation** → Each trait is determined by pairs of factors (genes), which segregate during gamete formation.
2. **Law of Independent Assortment** → Traits are inherited independently of one another (when on different chromosomes).

- Mendel's work went largely unnoticed until it was **rediscovered in 1900**.
- Meanwhile, cytologists identified the **chromosomes** and linked them to heredity, preparing the way for **chromosomal theory of inheritance** in the early 20th century.



Summary

The **19th century** transformed biology into a modern science:

- **Cell Theory** → All living organisms are composed of cells (Schleiden, Schwann, Virchow).
- **Sexual Embryology** → Discovery of the **egg**, stages of embryonic development, and laws of embryology (von Baer).
- **Molecular Biology Foundations** → Discovery of **DNA (nuclein)** by Miescher.
- **Genetics** → **Mendel's laws** of inheritance laid the groundwork for classical genetics.

Together, these discoveries established the **cell, the gene, and the embryo** as the three central pillars of **modern biology**.