1.1C: Pasteur and Spontaneous Generation

LEARNING OBJECTIVES

- Explain the concept of spontaneous generation

Spontaneous generation is an obsolete body of thought on the ordinary formation of living organisms without descent from similar organisms. Typically, the idea was that certain forms such as fleas could arise from inanimate matter such as dust or that maggots could arise from dead flesh. A variant idea was that of equivocal generation, in which species such as tapeworms arose from unrelated living organisms, now understood to be their hosts.

Doctrines held that these processes were commonplace and regular. Such ideas were in contradiction to that of univocal generation: effectively exclusive reproduction from genetically related parent(s), generally of the same species. The doctrine of spontaneous generation was coherently synthesized by Aristotle, who compiled and expanded the work of prior natural philosophers and the various ancient explanations of the appearance of organisms; it held sway for two millennia.

Today spontaneous generation is generally accepted to have been decisively dispelled during the 19th century by the experiments of Louis Pasteur. He expanded upon the investigations of predecessors, such as Francesco Redi who, in the 17th century, had performed experiments based on the same principles.

Louis Pasteur’s 1859 experiment is widely seen as having settled the question. In summary, Pasteur boiled a meat broth in a flask that had a long neck that curved downward, like a goose. The idea was that the bend in the neck prevented falling particles from reaching the broth, while still allowing the free flow of air. The flask remained free of growth for an extended period. When the flask was turned so that particles could fall down the bends, the broth quickly became clouded. In detail, Pasteur exposed boiled broths to air in vessels that contained a filter to prevent all particles from passing through to the growth medium, and even in vessels with no filter at all, with air being admitted via a long
tortuous tube that would not allow dust particles to pass. Nothing grew in the broths unless the flasks were broken open, showing that the living organisms that grew in such broths came from outside, as spores on dust, rather than spontaneously generated within the broth. This was one of the last and most important experiments disproving the theory of spontaneous generation.

Figure: Pasteur’s test of spontaneous generation: By sterilizing a food source and keeping it isolated from the outside, Pasteur observed no putrefaction of the food source (top panel). Upon exposure to the outside environment, Pasteur observed the putrefaction of the food source (bottom panel). This strongly suggested that the components needed to create life do not spontaneously arise. Louis Pasteur’s pasteurization experiment illustrates the fact that the spoilage of liquid was caused by particles in the air rather than the air itself. These experiments were important pieces of evidence supporting the idea of germ theory of disease. (CC BY-SA 4.0; Kgerow16).

Despite his experiment, objections from persons holding the traditional views persisted. Many of these residual objections were routed by the work of John Tyndall, succeeding the work of Pasteur. Ultimately, the ideas of spontaneous generation were displaced by advances in germ theory and cell theory. Disproof of the traditional ideas of spontaneous generation is no longer controversial among professional biologists. Objections and doubts have been dispelled by studies and documentation of the life cycles of various life forms. However, the principles of the very different matter of the original abiogenesis on this planet — of living from nonliving material — are still under investigation

Key Points

- Before the discovery of microbes, it was widely thought that life, as in the case of rotting food, arose from nothing. This idea was referred to as spontaneous generation.
- By sterilizing cultures and keeping them isolated from the open air, Pasteur found that contamination of the media
only occurred upon exposure to the outside environment, showing that some element was needed to give rise to life. In other words, life does not arise spontaneously.

- Despite Pasteur’s work and the work of others, it still took a better understanding of germ theory and cell theory to finally displace the concept of spontaneous generation.

**Key Terms**

- **abiogenesis**: The origination of living organisms from lifeless matter; such genesis as does not involve the action of living parents; spontaneous generation.

- **germ theory**: The germ theory of disease, also called the pathogenic theory of medicine, is a theory that proposes that microorganisms are the cause of many diseases. Although highly controversial when first proposed, germ theory was validated in the late 19th century and is now a fundamental part of modern medicine and clinical microbiology, leading to such important innovations as antibiotics and hygienic practices.