Can This Be Justified?
Stirring the Throbbing Ground of Life: Claude Bernard and Vivisection
Galen and Anatomy of the Hand

Barbary Ape
(Macacus inuus)

Human
The Revolution in Anatomy: From the Scholastic Middle Ages to Vesalius
The Revolution in Anatomy: From the Scholastic Middle Ages to Vesalius
“We shall reach really fruitful and luminous generalizations about vital phenomena only in so far as we ourselves experiment and, in hospitals, amphitheatres, or laboratories, stir the fetid or throbbing ground of life.”
In sciences of observation, man observes and reasons experimentally, but he does not experiment; and in this sense we might say that a science of observation is a passive science. In sciences of observation, man observes but in addition he acts on matter, analyzes its properties and to his own advantage brings about the appearance of phenomena which doubtless always occur according to natural laws, but in conditions which nature often has not yet achieved. With the help of these active experimental sciences, man becomes an inventor of phenomena, a real foreman of creation.

—An Introduction to Experimental Medicine, p18
Biological Experimentation:
William Harvey Discovers the Circulation of Blood in the 17th Century
“To the honor of French science, it must be stated that it had the glory of decisively inaugurating the experimental method in the science of vital phenomena. Towards the end of the last century the renewal of chemistry strongly influenced the advance of physiological science, and the work of Lavoisier and Laplace on breathing cleared a fertile path for analytical physico-chemical experimentation on the phenomena of life.”

--An Introduction to the Study of Experimental Medicine
Lavoisier’s experiments on respiration
Cells obey the laws of chemistry

however, the answer was immensely exciting. The structure appeared to be two intertwined strands of complementary structures, suggesting that one strand serves as the specific surface (template) upon which the other strand is made. If this hypothesis were true (which it is now known to be!), then the fundamental problem of gene replication, about which the geneticists had puzzled for so many years, was, in fact, solved.

There were thus initiated over the past 12 years a variety of experiments designed to study, at a molecular level, how DNA molecules control what a cell is like. These studies have brought many discoveries, unforeseen in 1953, about how the genetic material functions. Because these answers are, for the first time, consistently at the molecular level, it is convenient to refer to the subject matter at this level as molecular genetics.

**THE GOAL OF MOLECULAR BIOLOGY**

Until recently, heredity has always seemed the most mysterious of life's characteristics. The current realization that the structure of DNA already allows us to understand practically all its fundamental features at the molecular level is thus most significant. We see not only that the laws of chemistry are sufficient for understanding protein structure, but also that they are consistent with all known hereditary phenomena. Complete certainty now exists among essentially all biochemists that the other characteristics of living organisms (for example, selective permeability across cell membranes, muscle contraction, nerve conduction, and the hearing and memory processes) will all be completely understood in terms of the coordinative interactions of small and large molecules. Much is already known about the less complex features, enough to give us confidence that further research of the intensity recently given to genetics will eventually provide man with the ability to describe with completeness the essential features that constitute life.
“A lot of people don’t want the world to be changed, but we shouldn’t be too upset. We just have to go on with our business. We want to make the world better. There are people [who] say, well, we’re playing god. And, you know, I have a straightforward answer: if we don’t play god, who will?”
Napoleon: “I see no mention of God in this work.”

Laplace: “Sir, I have no need of that hypothesis.”
The Ice Calorimeter

Antoine Laurent de Lavoisier (1743-94)

Pierre Simon Laplace (1749-1827)
Antoine Laurent de Lavoisier: Guillotined 8 May 1794
François Magendie
(1783-1853)
François Magendie’s experiment proving that the blood carried strychnine to the spinal cord
The Sorbonne, where Bernard held the Chair of Physiology

Claude Bernard
(1813-1878)
“When I saw the rabbits’ acid urine, I instinctively asked myself what could be its cause. ... The inductive reasoning which I implicitly went through was the following syllogism: the urine of carnivora is acid; now the rabbits before me have acid urine, therefore they are carnivora, i.e., fasting. This remained to be established by experiment.”

“I thus reached this general proposition[:] ... when fasting, all animals are nourished by meat, so that herbivores then have urine like that of carnivores.”

Bernard’s Experimental Physiological Investigation
Bernard’s Manual for the Experimental Investigation of Physiology

Lessons in Operative Physiology, 1879
Vivisection Table

Claude Bernard, *Leçons de physiologie opératoire*, fig. 10
Vivisection Table

Claude Bernard, *Leçons de physiologie opératoire*, figs. 12 and 13
Vivisection Table
Claude Bernard, *Leçons de physiologie opératoire*, figs. 17 and 18
Folding Cradle

Claude Bernard, *Leçons de physiologie opératoire*, figs. 20(a) and 22
Dog in Double-Rod Transverse

Claude Bernard, Leçons de physiologie opératoire, fig. 24
Thermo-electrical experiment

Claude Bernard, Leçons de physiologie opératoire, fig. 100
Experiments on death by heat

Claude Bernard, *Leçons dur la chaleur animale*, pp 347 and 363
<table>
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**Table on death by heat**

Claude Bernard, *Leçons dur la chaleur animale*, pp358-9
To stop the cries of the animal without hindering respiration, the windpipe is first dissected out and then a hole made into it. It is then raised up and a large nail is passed in across it behind, so as to prevent the blood from running into the respiratory tract.

Many other physiologists have tried, like De Graaf, to stifle the cries of the animals in order to avoid the complaints of persons living in the neighborhood of the laboratories.
Anesthetizing animals

Claude Bernard, *Leçons de physiologie opératoire*, figs. 33, 35 and 36
Asphyxiation experiment

Claude Bernard, *Leçons sur les anesthésiques et sur l’asphyxie*, fig. 5
“Have we the right to make experiments on animals and vivisect them? As for me, I think we have this right, wholly and absolutely. It would be strange indeed if we recognized man’s right to make use of animals in every walk of life, for domestic service, for food, and then forbade him to make use of them for his own instruction in one of the sciences most useful to humanity. No hesitation is possible; the science of life can be established only through experiment, and we can save living beings from death only after sacrificing others.”

—Claude Bernard, An Introduction to the Study of Experimental Medicine, p102