

Medicine in Stamps

Claude Bernard (1813-1878): father of experimental medicine

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If a comparison were required to express my idea of the science of life, I should say that it is a superb and dazzlingly lighted hall which may be reached only by passing through a long and ghastly kitchen. – Claude Bernard

In the nineteenth century, doctors based their theories on metaphysical ideology, and personal experience often dictated their clinical decisions. Science-based medicine was largely absent, so anecdotes and half-truths prevailed. This began to change towards the end of the century. By introducing the rigour of laboratory investigation and animal experimentation, French physiologist Claude Bernard takes the credit for medicine's scientific march into the twentieth century.

Surmounting Obstacles: Claude Bernard was born on June 12, 1813 in the south of France. Educational possibilities were scarce for this son of a bankrupt wine merchant. His early education was meagre, studying Latin with a local priest and later at a Jesuit school where no natural science was taught. At 18, he became an apprentice in an apothecary, where his days were spent in menial tasks, relieved by errands to a veterinary school. There, he had the opportunity to observe crude pharmacotherapy, including the preparation of the universal medicine called Theriak. This concoction, whose essential ingredient was opium, had been in use for more than two thousand years to treat almost every disease.

Claude's early passion was the theatre. As a fledgling playwright, he achieved initial success with his comedy play, *La Rose du Rhône*. However, his next play, a historical heroic drama in five acts, was a flop. Professor Gérardin, Professor of Literature at the Sorbonne and a leading drama critic, advised him to instead try medical school (*"You have done some pharmacy. Now, study medicine. You have not*

the temperament of a dramaticist.") Shortly thereafter, in 1834, he enrolled at the medical school of the University of Paris. Claude Bernard was a below-average student, and was thought by his teachers to be lazy. He finished near the bottom of his class, ranking twenty-sixth out of twenty-nine students. After completing medical school, he failed the examination that would have allowed him to teach in the hospital, so had to be contented with being an assistant doctor. In 1841, Magendie, the leading physiologist at the time, discovered Bernard's dissecting skills and took him on as his laboratory assistant. By the third year, Bernard had grown dissatisfied and was considering a position as a country physician when a friend attempted to save his research career by arranging for him to marry the daughter of a Parisian doctor. The marriage brought him a large dowry but it was destined to be unhappy.

Birth of Experimental Medicine:

It was not until Claude Bernard's 40th year of life that he began to make a series of landmark scientific discoveries, the most notable being the role of the pancreas in digestion, and the liver's ability to make sugar. While continuing his research that he had begun under Magendie, he discovered through meticulous dissections of animals that fats were largely undigested before reaching the pancreatic ducts. Crushed pancreatic tissue was capable of hydrolysing neutral fats into their component fatty acids and glycerin, and starch was changed into simpler sugar. He therefore concluded that pancreatic secretions played a major part in the digestion of foods, thereby demonstrating for the first time the role of internal glands in body function.

Bernard is probably best known for his studies on liver glycogen. A common theory in his day was that only plants synthesised sugar. In 1848, he set out to test this theory by determining where sugar was concentrated



among the various organs of the body. Although the methodology in those days did not allow for the differentiation of various carbohydrates and simple sugars, his studies drew attention to the liver, where he found that sugar was formed, irrespective of whether sweets or starches were ingested. He had stumbled on the substance glycogen and the discovery that the liver was a prime storehouse and manufacturer of sugar.

Through his research on the toxin curare, Claude Bernard made another significant discovery. Curare was used as a poison by hunters in South America. The toxin, concentrated in the tips of arrows, immobilised animals that had been struck. In his laboratory, he found that curare affected only the motor nerves at the neuromuscular junction, sparing sensory nerves as well as the muscle itself. This discovery explained why the substance would paralyse its victims but allowed them to remain aware of their surroundings until coma or death intervened. The specific action of curare on motor nerves opened the way to a better understanding of drug specificity and site of action. Yet another of Bernard's important discoveries was the presence and function of vasomotor nerves. Through carefully controlled experiments, he was able to identify two sets of nerves which either constricted or dilated blood vessels.

Le Milieu Intérieur: Together, these discoveries led to the brilliant idea of a milieu intérieur or inner environment. He postulated that living organisms possessed control sensors that regulated their internal environment, keeping it constant despite fluctuations and changes in the external environment. We now know this to refer to the fundamental physiological principle termed homeostasis. Proposing that "*the fixity of the internal environment is the condition for free life,*" Claude Bernard explained:

"The living body, though it has need of the surrounding environment, is nevertheless relatively independent of it. This independence which the organism has of its external environment, derives from the fact that in the living being, the tissues are in fact withdrawn from direct external influences and are protected by a veritable internal environment which is constituted, in particular, by the fluids circulating in the body."

Bernard wrote many papers, but the masterpiece was his book entitled *An Introduction to the Study of Experimental Medicine*, published in 1865. No less of a luminary, Louis Pasteur, who was a friend and contemporary, had this to say about the book: "*Never has anything clearer, more complete, more profound been written about the true principles of the difficult art of experiment. The book is as yet little known because it stands at a level which is so far attainable only by a few.*"

In his book, Bernard argued that progress in medicine could not be achieved without the application of experimental physiology. He outlined the essential steps of scientific inquiry, and emphasised the futility of reaching meaningful and reliable results without a hypothesis that is tested with a controlled experiment. In advocating for animal experimentation, he wrote "*Among the experiments that may be tried on man, those that can only harm are forbidden, those that are innocent are permissible, and those that may do good are obligatory ... If it is immoral, then, to make an experiment on man when it is dangerous to him, even though the result may be useful to others, it is essentially moral to make experiments on an animal, even though painful and dangerous to him, if they may be useful to man.*"

Death of a Genius: Claude Bernard's stand on animal experimentation earned him severe criticisms from anti-vivisectionists, among them his own wife who subsequently left him. He withdrew to his birthplace in Saint-Julien, and spent his final years on his father's old vineyards. By this time, he had won many accolades, including the Professorship of Physiology at the Collège de France, a prestigious post previously held by Magendie and Laennec. In 1868, French Emperor Napoleon III created a new Chair of General Physiology for him at the Museum of Natural History.

In the late 1860s, he was forced to quit laboratory research due to unidentified chronic painful enteritis. Ironically, it is believed that he had symptoms affecting the pancreas and the liver, topics of his own research. His friends, including Pasteur, blamed the damp and unsanitary conditions of the laboratory for his illness. Claude Bernard saw his health decline precipitously after he developed pyelonephritis in the autumn of 1877. Mostly confined to bed, he managed to deliver his last lecture just two months before his death. He was honoured with a state funeral, the first ever for a man of science.

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