

Claude Bernard: bicentenary of birth and his main contributions to neurology

Claude Bernard: bicentenário do nascimento e suas principais contribuições à neurologia

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ABSTRACT

Claude Bernard (1813-1878) followed two main research paths: the chemical and physiological study of digestion and liver function, along with experimental section of nerves and studies on sympathetic nerves. Curare studies were, for example, of longstanding interest. His profound mental creativity and hand skillfulness, besides methodology quality, directed his experiments and findings, mainly at the *Collège de France*. His broader and epistemological concerns were carried out at the Sorbonne and later at the *Muséum national d'Histoire naturelle*. His insight gave clues to define the “*milieu intérieur*”, later known as “homeostasis”, and grasp the brain complexity. Bernard followed and surpassed his master François Magendie who also fought against dogmas and laid the foundations of experimental medicine, and its main heinous tool – vivisection. Bernard created the methodological bases of experimental medicine, and collected honors as a renowned researcher.

Keywords: Claude Bernard, sympathetic nerves, homeostasis, epistemology, history of neurosciences.

RESUMO

Em suas pesquisas, Claude Bernard (1813-1878) seguiu dois caminhos principais: o estudo fisiológico e químico da digestão e da função hepática; a seção experimental de nervos e os estudos sobre nervos simpáticos. Estudos sobre curare, por exemplo, foram de interesse duradouro. Suas profundas criatividade mental e habilidade manual, além da qualidade metodológica, conduziram às suas experiências e descobertas, principalmente no *Collège de France*. Seus interesses sobre temas epistemológicos mais amplos foram conduzidos na Sorbonne e, posteriormente, no *Muséum national d'Histoire naturelle*. Seu discernimento deu subsídios para definir o “*milieu intérieur*”, mais tarde conhecido como “homeostase”, e para ajudar a compreender a complexidade do cérebro. Bernard seguiu e superou seu mestre François Magendie. Este também lutou contra dogmas e lançou os fundamentos da medicina experimental, utilizando sua principal ferramenta hedionda – a vivisecção. Bernard ampliou estes estudos e criou as bases metodológicas da medicina experimental, tendo colecionado honrarias como renomado pesquisador.

Palavras-chave: Claude Bernard, nervos simpáticos, homeostasia, epistemologia, história das neurociências.

Claude Bernard (1813-1878) was the founder of modern physiology, pharmacology and experimental medicine, and his findings and insights on nervous functions are here succinctly presented.

BERNARD'S EARLY LIFE, SOCIAL REMARKS, AND ACADEMIC CAREER

Bernard was born in the village of Saint-Julien, near Villefranche-sur-Saône and Lyon¹. He was the son of a modest proprietor of vineyards and wine merchant. He received

his early education in the Jesuit school of Villefranche (1821-1831), and then proceeded to the college, where he soon left to become an apprentice in a pharmacy, and periodic visitor to a nearby veterinary school in Lyon¹. From there, he went to Paris to consult a famous theater critic who did not valorize his inclination to write theater plays, but recommend him instead to exploit his pharmacy experience and enter medicine². He enrolled at the Faculty of Medicine of Paris (1834), and was approved for *externship* (1836), and the internship (1839), under the sponsorship of François Magendie (1783-1855), in the *Hotel Dieu*^{1,2}. As usual, even in the medicine course, he did not excel in his formal

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Conflict of interest: There is no conflict of interest to declare.

Received 11 September 2013; Received in final form 24 September 2013; Accepted 01 October 2013.

studies³. In 1841, Magendie discovered Bernard's dissecting skills and took him on as his laboratory assistant^{2,3}. In 1843, Bernard became physician, and in 1845 he married a Parisian wealthy doctor's daughter, but the unhappy couple was officially separated in 1870¹. However, much of his work was carried out between 1843-1858 in a little moist basement, with limited funding³. In 1847, he was appointed Magendie's substitute at the *Collège de France*, and in 1855 he took the Chair of Physiology, held previously by Magendie and Laennec, and later occupied by Charles Edouard Brown-Séquard (1878)². Bernard took over also the chair of experimental physiology created for him at the Sorbonne University (1854), but in 1868 this chair was transferred from the Sorbonne to the *Muséum national d'Histoire naturelle*. He was also elected to the Academy of Sciences, the Academy of Medicine, and Imperial Senate – a nomination made by the emperor Napoleon III. In conclusion, he was extensively admired, including by the Brazilian emperor, Dom Pedro II^{1,2}. However, some authors argue that he trivialized the significance of clinical and epidemiological studies, but Morabia⁴ gave Bernard's mainstream thought: "He was realistic about statistics and comparative therapeutic trials and virulent against irrational medicine." Much of his work was based on animal vivisection (Figure 1), and many people opposed to this shocking disrespect regarding the well-being of the experimental animal, including his wife and daughters^{1,3}. However, considering his precious contributions, Bernard had the first French funeral settled to a scientist. This happened after a declining health (1859-1878), with chronic painful enteritis, rheumatism, unrelenting migraines, and abrupt health deterioration after kidney infection^{1,2}.



Figure 1. Bernard's laboratory and associates (The Lesson of Claude Bernard or Session at the Vivisection Laboratory -1889 by Leon Augustin Lhermitte - 1844-1925, Académie de Médecine, Paris, France)³. http://fr.wikipedia.org/wiki/Claude_Bernard

BERNARD'S MAIN SCIENTIFIC ACHIEVEMENTS IN NEUROPHYSIOLOGY

Bernard shed light on the role of the pancreas in digestion, and the liver in creating glucose, for instance. Additionally, he undertook research on neurophysiology by assisting Magendie on spinal nerves studies. His first communication (1843) was on *Recherches anatomiques et physiologiques sur la corde du tympan, pour servir à l'histoire de l'hémiplegie faciale*. This was the beginning of a long series of investigations on the relations of nerves to secretion, temperature and vasomotricity^{2,5} (Figure 2). One important landmark in his^{6,7} career was the discovery of the sympathetic nervous system control of heat regulation and blood flow, through vasodilator and vasoconstrictor functions, as initially identified by Brown-Séquard, and acknowledged by Bernard many years later (Figure 3). In 1851, he reported an increase in temperature in the corresponding side of the face (including the ears) as an effect of sectioning the cervical branch of the great sympathetic in rabbits, he attributed to "calorification" (an increase of temperature) due to a more active circulation⁶. In 1852, Bernard reported that the galvanization of the peripheral extremity of the cut sympathetic nerve produced exactly opposite effects, reverting the temperature rise, accompanied by paleness of the ear. He also describe in detail the effects of such section-galvanization experiments on the pupil, eyelid, and ocular globe, the basis of a syndrome named after him⁶. Moreover (1858), he showed that chorda tympani excitation dilates the vessels of the submandibular gland, while secretory activity enters². In this way, he discovered that the sympathetic nerve was the constrictor of the blood vessels and the chorda tympani a dilator. Consequently, he established the concept of the physiological equilibrium of the two antagonistic innervations. Bernard (1858), in his lessons on the nervous system, traced the modern distinctions between neuronal and muscle paralysis causes through the use of curare, a topic of extreme interest to him since 1844. He was the first to reveal that curare blocked the nerve stimulation of muscles, but he suggested that the blocked muscle contractions was due to a direct action on the nerve. He did not distinguished a specific junction between nerve and muscle. However, his pupil Alfred Vulpian (1826-1887) suggested that curare acted on the motor endplate⁸. These studies led Bernard to study asphyxia and anesthetics, besides, the receptor concept started with the curare studies (1856), providing the basis of the synapse and neuron theory⁷. Bernard demonstrated also that simple reflex movements were due to the influence of sensory roots exerted on the motor roots. He discovered moreover the production of diabetes by puncture of the floor of the fourth ventricle (1849), interpreted by many as being the result of excessive stimulation of the liver by secretory nerves. Furthermore, he postulated that living organisms

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