Claude Bernard: a founder of experimental medicine

Claude Bernard is rightly regarded as one of the founders of modern experimental studies in medicine. This year marks the 200th anniversary of his birth, on 12 July 1813 in St. Julien, France, just south of the Swiss border, opposite Geneva. His father was an unsuccessful wine grower. When his business finally failed, he became a school teacher and when he died, Claude's mother, of peasant background, did her best to give young Claude a decent education. He first studied Latin with a local priest, then entered a Jesuit-conducted school in Villefranche.

Leaving school at 17 years of age, Bernard became an apprentice to an apothecary in Lyons. Here he wrote a couple of plays, which were not a success. In 1834 he showed the manuscript of his five-act historical drama to the theatre critic, Saint-Marc Girardin, who gave young Claude excellent advice – give up playwriting and study medicine. Bernard and Girardin met again many years later as members of the French Academy.

Bernard enrolled in the winter term of that year at the School of Medicine in Paris. After passing his examination for internship, Bernard's skill at dissection came to the attention of François Magendie, physician at the Hôtel Dieu, who appointed him as his research assistant at the Collège de France in 1841. Magendie himself had made considerable advances in experimental neurology. In 1822 he had confirmed the studies of Sir Charles Bell, of the Middlesex Hospital, London that the anterior spinal nerve roots were motor and the posterior roots were sensory (the Magendie–Bell law).

Bernard's first researches were involved with Magendie's spinal nerve studies, while his medical dissertation in 1843 looked at the functions of gastric juice.

In 1847, Bernard was promoted to deputy professor under Magendie and, in 1855, succeeded him as full professor, as well as being appointed Professor of Physiology at the Sorbonne, a post that was created specially for him.

In 1868 Bernard's work achieved the accolade of his election to the French Academy, then an unusual honour for a physician.

Using extensive animal experiments, Bernard made numerous contributions to our knowledge of physiological processes. Among them can be listed:

1. The sympathetic control of cutaneous blood vessels; cervical sympathectomy resulted in increased skin temperature and vasodilatation, as well as Horner's syndrome. He also demonstrated the parasympathetic action of the chorda tympani branch of cranial nerve VII, the facial nerve, stimulation of which produced salivary secretion and vasodilatation in the submaxillary salivary gland in the dog.

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2. Before Bernard, it was considered that only plants could synthesize complex substances. He showed in 1855 that dogs fed on meat had no sugar in the portal vein, although this was present in the hepatic vein, and 2 years later he discovered glycogen in the liver, where it is synthesized.
3. The demonstration of the secretion of digestive enzymes by the pancreas. This involved a long series of experiments, starting with the observation in rabbits induced to eat meat that the lacteals in the mesentery of the small intestine only contained white fluid after the point of entry of the pancreatic duct into the intestine. Incubation of crushed pancreatic tissue with neutral fat splits the fat into fatty acids and glycerol. Pancreatic juice also converts starch into sugar. However, Bernard was doubtful whether pancreatic juice affected proteins. This error was because trypsin in pure pancreatic juice is present in its inactive form, trypsinogen, which requires the presence of enterokinase from the succus entericus to activate it. Since the pancreatic juice in his studies came directly from the cannulated pancreatic duct, the change to trypsin had not taken place in his samples.
4. The demonstration that curare causes motor but not sensory nerve paralysis, thus making it a useful tool in experimental studies.

In 1865, Bernard published his important textbook *Introduction to the Study of Experimental Medicine*. He stressed that observable facts are the only authority for the medical scientist. Science is only carried forward by experimental studies, not by slavishly accepting the prevailing views if these are not supported by facts. He wrote: 'When we meet a fact which contradicts a prevailing theory, we must accept the fact and abandon the theory, even when the theory is supported by great names and generally accepted'; words as true today as when penned by Claude Bernard.

I suppose Bernard is best remembered today by the expression he used 'le milieu interior', i.e. the internal environment. The body's physiological processes maintain the body in a stable state in health independently of external changes.

Interestingly, Bernard was sceptical about the application of statistics to his physiological results. This fault in a great scientist can be excused by the primitive methods of analysis at his time, with conclusions often based on totally inadequate samples.

Sadly, Bernard's domestic life was not a happy one. In 1845, in financial difficulties, he married the daughter of a wealthy physician. Both his wife and their daughter were violently opposed to his practice of animal experimentation and in 1869 the couple separated. His wife went on to become an active anti-vivisectionist. In 1877, Bernard's health deteriorated and he died on 10 February the following year. He was accorded a state funeral, the first ever granted to a scientist in France. BJHM

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