



POISEUILLE  
(1797-1869)

# Contributed Articles

JEAN LEONARD MARIE POISEUILLE\*,<sup>1</sup>

MARCEL BRILLOUIN†

Poiseuille, born and died in Paris, appears to have passed his entire life as unattached (*libre*) professor of medical physics. He was the son of a carpenter. We know nothing of his primary studies nor of his preparation for the *École Polytechnique*.

At the age of eighteen years, at the reopening of the session of 1815, Poiseuille was admitted, the fiftieth among ninety-eight pupils; he remained there only about six months for reasons which I do not know, probably political, as a result of the restoration<sup>2</sup>—the entire *École Polytechnique* was disbanded on April 13, 1816; its organization was changed and when the doors were again opened to the students, Poiseuille did not appear there.

During his short residence, Poiseuille had Cauchy as professor in Mathematical Analysis, *i. e.*, Differential and Integral Calculus; Ampère in Mechanics; Hachette in Geometry; Arago in Astronomy; Alexis Petit<sup>3</sup> in Physics; Thénard in Chemistry.

His marks on quizzes or examinations, on a basis of 20, were in Analysis, 17, 13, 15, 14, 10, 15; in Descriptive Geometry, 12, 16, 13, 16, 17, 15; in Physics, 17; and in Chemistry, 10. These marks indicate a good training in mathematics and physics. Alexis Petit, who succeeded the mediocre Hassenfratz was, it appears, an admirable professor and, as one says now, exceptionally inspirational. The work done during his brief life (d. 1820), the greater part in collaboration with Dulong, who succeeded him at the *École Polytechnique*, is of a physicist endowed with a very rare sense of experimental precision. It is evidently from these studies that Poiseuille derived the very remarkable qualities which made his classic memoir an unassailable work.

It seems that after the disbanding of the *École Polytechnique*, Poiseuille undertook his studies in medicine; perhaps at the same time he gave lectures to some students for he was known some years later as “professeur *libre* de Physique expérimentale.” He was never official Professor of the Faculty of Medicine.<sup>4</sup>

It does not seem that he took part in the first convocation, which oc-

\* Born in Paris, April 23, 1797, died in Paris, December 26, 1869.

† Professor of Physics, Collège de France, Paris.

curred in 1831, for the appointment of the titular Professor of Medical Physics in the Faculty—at the time of the making over of the Faculty of Medicine—nor in that of 1844.

His study of medicine continued for a considerable time, for he did not submit his Thesis for the Doctorate until 1828, thirteen years after having left the *École Polytechnique*. It was indeed a fine piece of work and one which foretold the preoccupations of his entire scientific life. The subject is "Studies on the Force of the Aortic Heart,"<sup>5</sup> soon followed by "Studies on the Action of the Arteries in Arterial Circulation" (January, 1829) and by "Studies on the Causes of the Movement of the Blood in the veins" (September, 1830). The last paper was read at a meeting of the *Académie des Sciences*. They are the researches of a physicist as well as of a physiologist. After a "history" which demonstrated the incoherence of the current explanations, Poiseuille undertook the absolute measurements on a mercury manometer chiefly on the dog and horse; he found that one can secure the transmission of the pressure of the arteries to the manometer by the aid of water saturated with bicarbonate of soda without producing any coagulation of the blood in the connecting tubes. He found thus an average pressure of about 144 mm of mercury, with some oscillations at each beat of the heart. He followed the influence, for an additional reason, of the respiratory movements, noted the rôle of the elasticity of the arteries, followed with his microscope the movement of the red corpuscles in the capillaries, and studied minutely the existence of what he called "the layer adhering to the wall" (*la couche adhérente*), which he found void of corpuscles, and the thickness of this layer varied with the strangulations. No indication has been found as to the places and the resources by the aid of which the work was effected. Was it at his own home? Did he find some resources with Magendie who was then doctor at "*La Salpêtrière*" but not yet professor at the *Collège de France*? We do not know anything about it.

There were scarcely any "laboratories" for a century. It was in fact to meet this need that Berthollet, LaPlace, Humbolt, Gay-Lussac and some others founded in 1807 the celebrated *Société d'Arcueil*. It was in the kitchen of his apartment in the *Collège de France* that Biot made his beautiful experiments on the rotary forces.

However it may be, these researches drew sufficient attention to Poiseuille so that, at the time of the foundation of the *Académie de Médecine*, he was appointed by the government as a member of the Academy as were all the other members. Thus is explained why there are not, in the archives of this Academy, any papers of Candidature with a sketch and reports.

These researches and the following brought him prizes of the *Académie des Sciences*, and the titles of corresponding member of the Academy of

Medicine of Sweden, of Berlin, of Breslau, etc., member of the Société Philomatique of Paris; Chevalier, afterwards, Officier of the Légion d'Honneur. He also became, I do not know at what date, *Examiner of the Hôtel de Ville* of Paris.

There is, besides, a monograph on physiology, finished in 1835, which appeared in Volume VII of the *Mémoires des Savants Etrangers* printed in 1841 only. This memoir of 71 pages in quarto, accompanied by plates, brought to its author the *Prize of Experimental Physiology* for the year 1835 of the Académie des Sciences of Paris. This paper, "On the Causes of the Movement of the Blood in the Capillaries" is even today extremely interesting, as much for the variety of the experiments and the care taken in the technique<sup>6</sup> as for the detail of the observations on salamanders and frogs, the bladders of young rats, etc.

It is only after this long series of researches *in vivo* that Poiseuille recognized the necessity of studying the more simple phenomenon of the flow through some inert and undeformable capillary tubes, and undertook the work, truly admirable for precision and method, entitled, "Experimental Studies on the Movement of Liquids in Tubes of Very Small Diameter," which every rheologist ought to have studied before inventing any apparatus—too often condemned by this very work of Poiseuille.

This long monograph accompanied by one plate, finished in 1842, occupies pages 435–544 of Vol. IX of the *Mémoires des Savants Etrangers* not printed until 1846. One may find an extended résumé and an interesting discussion of it in the long report<sup>7</sup> presented to the Académie des Sciences by Victor Regnault in the name of the Commission (Arago, Babinet, Piobert) to decide upon its insertion in the *Mémoires des Savants Etrangers*.

I have analyzed it, with all the detail which it merits, in Chapter 1 of Book II of my "Lessons on the Viscosity of Liquids and Gases" (Paris, Gauthier-Villaire, 1907).<sup>8</sup> All the laws are established for distilled water, studied at different temperatures, from 0–45° and in a short final work, for mixtures of alcohol and water.

One finds there, p. 523, an indication of the interest which he had in studying tubes of greater and greater diameter, in order to find at what diameters the laws of the small diameters cease to be exact (researches of Reynolds) with the hope of utilizing for this purpose the hydraulic installation of Savart at the Collège de France. It does not seem that this project was realized.

Poiseuille then studied the solutions of various salts in water and diverse organic liquids. The results of these have been published in the short notes in the *Comptes Rendus de l'Académie des Sciences* of the following years.

Note also researches on the ventilation of ships and on various questions of physiological chemistry and of medicine.

The scientific activity of Poiseuille seems to have been lessened during the last years of his life.

His daughter married a Mr. Denis, Professor of Rhetoric of the Lycée St. Louis.

Of his last years we know nothing, except that he was attacked with an acute pleurisy near Christmas, 1869, with cerebral complications which carried him off about the fifth day.

Translated by EDITH S. BINGHAM

<sup>1</sup> From the February 10, 1870, number of the *Journal des Connaissances Médicales et Pharmaceutiques*, pp. 62-64. These two pages of necrological notice contain the only information published in regard to the life of Poiseuille. The director of studies of the École Polytechnique has furnished me some precise information in regard to the brief course of Poiseuille at that school. The Faculty of Medicine has nothing about him. The life secretary and librarian of the Academy of Medicine were kind enough to permit me to make a copy of the only photograph of Poiseuille which has been preserved.

<sup>2</sup> The École Polytechnique depended at that time upon the Minister of the Interior as did, moreover, all of the public instruction.

<sup>3</sup> Alexis Petit (1791-1820) whose name is attached to the celebrated law of specific heat (Dulong & Petit). Extremely precocious, he was received first at the École Polytechnique at age of sixteen, Docteur of Science at the age of twenty, already gifted with remarkable talent as professor; Adjunct Professor of Physics at the École Polytechnique at age of twenty-three, titular at age of twenty-four (1815). Absolute expansion of mercury (1818); of the solid (1819). Specific heat of solids and liquids (1819). Law of cooling in the air and in a vacuum, \* \* \* See the fine note that Biot devoted to him (*Annales de Chimie et de Physique*, 16, 327-35 (1821)).

<sup>4</sup> The titular professors of Medical Physics of the Faculty of Medicine have been successively: Pierre Pelletan (1823-43), Gavarret (1844-85), Gariel (1886-98), Broca (1898), all former pupils of the École Polytechnique.

<sup>5</sup> *Journal de Physiologie by Magendie*, 8, July, 274-305 (1828); 9, January (1829); 10, September (1830).

<sup>6</sup> In describing an ingenious pneumatic device for demonstrating that the constant external pressure is without action upon the circulation.

<sup>7</sup> *Comptes rendus Acad. des Sciences*, 15, 1167-86, December (1842).

<sup>8</sup> The preparation of the present paper has caused me to discover some inexact information in paragraph 102: Line 2. Delete "à la Faculté de Médecine de Paris." Line 4. Replace "commença" by "finit." Line 6. Delete "préliminaire." Line 11. Replace "Regnault" by "Petit." This is the most serious error, because it constituted a great anachronism: Regnault born in 1810 was considerably younger than Poiseuille; he was educated at the École Polytechnique fifteen years later (1830-1832) and he received there instruction from Dulong, the collaborator of Petit and of Arago. Regnault himself had scarcely begun his researches in 1842 upon the compressibility of a gas; it is as *Chemist* that he had just been elected (1840) at the Académie des Sciences.