

Clapeyron, Benoit-Pierre-Ém | Encyclopedia.com

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(b. Paris, France, 26 February 1799; d. Paris, 28 January 1864),

[civil engineering](#).

Clapeyron graduated from the *École Polytechnique* in 1818 and then attended the *École des Mines*. In 1820 he and his friend and classmate Gabriel Lamé went to Russia, where they taught pure and applied science at the *École des Travaux Publics* in [St. Petersburg](#) and did construction work (1). While in Russia they published a number of papers in the *Journal des voies de communication de Saint-Petersbourg*, the *Journal du génie civil*, and the *Bulletin Ferussac*, as well as various works that came out in France (2). They left, following the [July Revolution](#) of 1830, when their position became somewhat difficult because of their well-known liberal tendencies.

Upon returning to France, Clapeyron engaged in railroad engineering (3), specializing in the design and construction of steam locomotives. In 1836 he traveled to England to order some locomotives that would negotiate a particularly long continuous grad along the St.-Germain line. When the illustrious [Robert Stephenson](#) declined to undertake the commission because of its difficulty, the machines were built in the shops of Sharp and Roberts, according to Clapeyron's designs (4). He extended his activities to include the design of metal bridges, making notable contributions in this area (5).

Clapeyron was elected to the Academy of Sciences in 1848, replacing Cauchy, and served on numerous committees of the Academy including that which awarded the prize in mechanics and those which investigated the project for piercing the Isthmus of Suez and the application of steam to naval uses.

Clapeyron had a continuing interest in steam-engine design and theory throughout his career. His most important research paper (6) dealt with regulation of the valves in a [steam engine](#). From 1844 Clapeyron was a professor at the *École des Ponts et Chaussées*, where he taught the course on the [steam engine](#).

Clapeyron is best known today for the relationship, which bears his name, between the temperature coefficient of the equilibrium [vapor pressure](#) over a liquid or solid and the heat of vaporization. This was an application of [Sadi Carnot's](#) principle, as developed by Carnot in his memoir *Réflexions sur la puissance motrice du feu* (1824). Carnot's work found hardly an echo among his contemporaries until 1834, when Clapeyron published a paper (7) that is a detailed exposition of the *Réflexions*. In it he transformed Carnot's verbal analysis into the symbolism of the calculus and represented the Carnot cycle graphically by means of the Watt indicator diagram, familiar to engineers. The paper also appeared in translation in England and Germany, so that despite the rarity of the original, Carnot's work was generally available and associated with the name of Clapeyron. However, not only was Clapeyron's original paper ignored by the other engineers, but he himself made only one passing reference to it until the work of Kelvin and Clausius made its true significance generally known as the basis for the second law of thermodynamics (8).

NOTES AND BIBLIOGRAPHY

1. Toward the end of 1809 Emperor [Alexander I](#) created a corps of engineers that was to deal with highways and bridges as well as [military engineering](#). He requested some engineers from the French government to provide a nucleus for this corps and to engage in instruction. This program was reinstated after the Restoration. See article on Clapeyron in A. Fourcy, *Histoire de l'École polytechnique* (Paris, 1828).

2. G. Lamé and B. P. E. Clapeyron, *Mémoire sur la stabilité des voûtes avec un rapport de M. de Prony sur ce Mémoire* (Paris, 1823); *Mémoire sur les chemins de fer considérés sous le point de vue de la défense des territoires* (Paris, 1832); and *Vues politiques et pratiques sur les travaux publics* (Paris, 1832), written with E. Flachet.

3. Clapeyron and Lamé entered the railroad business at an early stage. The period 1823–1833 saw several concessions to private companies; but except for some short lines radiating from St-Étienne, these were failures. In 1833, under pressure from a group of brilliant young followers of Saint-Simon, 500,000 francs were authorized for an engineering study of the problem, including the sending of engineers to England and the [United States](#) for study and observation. The engineering talent for this and the earlier assistance to the "concessionaires" was provided by the Corps des Mines and included Clapeyron and Lamé. Clapeyron conceived the idea of a railroad from Paris to St.-Germain; but while waiting for financing he went to St.-Étienne as professor at the *École des Mineurs*, where he taught the course in construction. In 1835, upon authorization of a line from Paris

to St.-Germain, Clapeyron and Lamé were charged with direction of the work. Lamé left shortly thereafter to accept the chair of physics at the École Polytechnique.

4. B. P. E. Clapeyron, “Expériences faites sur le chemin de fer de Saint-Germain avec une nouvelle locomotive,” in *Bulletin de la Société d’encouragement de l’industrie nationale*, **45** (1846), 413–414, and “Note sur une expérience faite le 17 Juin, 1846 au [chemin de fer](#) de Saint-Germain,” in *Comptes rendus de l’Académie des sciences*, **22** (1846), 1058–1061.

5. B. P. E. Clapeyron, “Calcul d’une poutre élastique reposant librement sur des appuis inégalement espacés,” in *Comptes rendus de l’Académie des sciences*, **45** (1857), 1076–1080, and “Mémoire sur le travail des forces élastiques dans un corps solide déformé par l’action de forces extérieures,” *ibid.*, **46** (1858), 208–212.

6. “Mémoire sur le réglage des tiroirs dans les machines à vapeur,” in *Comptes rendus de l’Académie des sciences*, **14** (1842), 632–633.

7. B. P. E. Clapeyron, “Mémoire sur la puissance motrice de la chaleur,” in *Journal de l’École polytechnique*, **14** (1834), 153–190. The English trans. is by Richard Taylor, in *Scientific Memoirs, Selected From the Transactions of Foreign Academies of Science and Learned Societies and From Foreign Journals* **1** (1837), 347–376. The German trans. by Poggendorff appeared in *Annalen der Physik and Chemie*, **59** 446–451.

M. Kerker, “[Sadi Carnot](#) and the Steam Engine Engineers,” in *Isis*, **51** (1960), 257–270.

Milton Kerker