

# Menabrea, Luigi Federico | Encyclopedia.com

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(*b.* Chambéry, Savoy, 4 September 1809; *d.* St. Cassin [near Chambéry], France, 24 May 1896)

*structural and [military engineering](#), mathematics.*

Menabrea is known to scientists as one of the most important men in the development of energy methods in the theory of elasticity and structures, and to others as a distinguished general and statesman, each group being generally little aware of Menabrea's accomplishments in the other fields. Indeed, it is remarkable that he was able to make significant contributions in both types of activities.

Menabrea first studied engineering and then mathematics at the University of Turin. Upon graduation he entered the army corps of engineers. When [Charles Albert](#) acceded to the throne in 1831, Cavour resigned his army commission, and Menabrea replaced Cavour at the Alpine fortress of Bardonecchia. Menabrea soon left to become professor of mechanics and construction at the Military Academy of the Kingdom of Sardinia at Turin and at the University of Turin. To this early period belongs his exposition and extension of Babbage's invention of a mechanical calculator to be published in 1842.

His political career started at this time. Between the years 1848 and 1859 King [Charles Albert](#) entrusted Menabrea with diplomatic missions to Modena and Parma. Menabrea then entered Parliament (where he championed proposals for Alpine tunneling) and was attached successively to the ministries of war and foreign affairs. At the same time he attained the rank of major general and was commander in chief of the army engineers in the Lombard campaigns of 1859. He directed siege and fortification works and also the artificial flooding of the plains between the Dora Baltea and the Sesia rivers to obstruct the Austrian advance.

During this time (1857–1858) Menabrea's early scientific papers were published, in which he gave the first precise formulation of the methods of structural analysis based on the "virtual work principle" earlier examined by A. Dorna. He studied an elastic truss in these papers and enunciated his "principle of elasticity," calling it also "principle of least work." He stated that when an elastic system attains equilibrium under external forces, the work done by the tensions and compressions in the internal members of the system is a minimum.

Menabrea's political and military advance continued. In 1860 he became lieutenant-general, conducted sieges at Ancona, Capua, and Gaeta, was appointed senator, and was granted the title of count. He was minister of the navy under Ricasoli from June 1861 to May 1862 and from January to April 1863 and minister of public works from December 1862 to September 1864 (under Farini and Minghetti). He was named Italian plenipotentiary for the peace negotiations with Austria in 1866. In October 1867 he succeeded Rattazzi as premier, holding simultaneously the portfolio of foreign minister, and remained in these posts in three cabinets until December 1869. During this turbulent period he was faced with the difficult situation created by Garibaldi's invasion of the [Papal States](#). Menabrea issued the famous proclamation of 27 October 1868, in which he disavowed Garibaldi, against whom he instituted judicial proceedings. He protested against the pope's temporal power, insisted on the Italian prerogative of interference in Rome, and contended against infringement of Italian rights in repeated negotiations with [Napoleon III](#) and the pope.

In 1868 Menabrea published a new demonstration of his principle of least work, which, although superior to the preceding one, still failed to note the independence of the variations of the internal forces and of the elongations of the members of the structure. This oversight was criticized by Sabbia, Genocchi, and Castiglione, giving rise to a controversy lasting until 1875, which is described in the article on Castiglione. In 1870 Menabrea published jointly with the French mathematician J. L. F. Bertrand (1822–1900) a note that advanced the first valid proof of his principle.

In order to deprive Menabrea of influence as aide-de-camp to King [Victor Emmanuel II](#), and to get him out of the country, Giovanni Lanza, his successor as premier, appointed him ambassador to London, and in 1882 to Paris. In 1875 he was made marquis of Valdora; he retired from public life in 1892.

Menabrea's place in the history of Italy is assured; his role in the introduction of concepts of work and energy into analytical mechanics and engineering has been overshadowed by the greater fame of Castiglione. In the [United States](#), for example, Menabrea is hardly mentioned, although in Continental and particularly Italian textbooks the correct distinction between Menabrea's and Castiglione's theorems is generally made. Menabrea's methods placed these concepts for the first time very clearly before the engineering profession and thus started the essential work of education which was completed by Castiglione.

# BIBLIOGRAPHY

I. Original Works. Menabrea's principal scientific works consist of seven papers, as follows: "Notions sur la machine analytique de [Charles Babbage](#)," in *Bibliothèque Universelle de Genève*, n.s. **41** (1842), 352–376; "Principio generale per determinare le tensioni e le pressioni in un sistema elastico," a seminar presented to the Reale Accademia delle Scienze di Torino in 1857, which was then printed as "Nouveau principe sur la distribution des tensions dans les systémes élastiques," in *Comptes rendus hebdomadaires des séances de l'Académie des sciences*, **46** (1858), 1056. Then followed "tude de Statique Physique—Principe général pour déterminer les pressions et les tensions dans un système élastique," in *Memorie della Reale Accademia delle scienze di Torino*, 2nd ser., **25** (1868), 141. An abstract of Bertrand's letter to General Menabrea was published jointly by Menabrea and Bertrand in *Atti della Reale Accademia delle scienze*, **5** (1 May 1870), 702.

The last two contributions are the reply to criticism in "Un'ultima lettera sulle peripezie della serie di Lagrange in risposta al Prof. Angelo Genocchi per L. F. Menabrea, A. D. B. Boncompagni," in *Bullettino di bibliografia e di storia delle scienze matematiche e fisiche*, **6** (October 1873), 435, and the memoir which raised the dispute with Castigliano, i.e., "Sulla determinazione delle tensioni e delle pressioni ne sistemi elastici," in *Atti della Reale Accademia dei Lincei*, 2nd ser., **2** (1875), 201.

II. Secondary Literature. The reader is referred to the article on Alberto Castigliano for a listing of pertinent works, and to Menabrea's autobiography, covering the years up to 1871, published as *Memorie*, L. Briguglio and L. Bulferetti, eds. (Florence, 1971).

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