Biographical Encyclopedia of Astronomers

Cauchy, Augustin-Louis

Born Paris, France, 21 August 1789

Died Sceaux near Paris, France, 23 May 1857

Augustin-Louis Cauchy was one of the outstanding mathematicians of the 19th century. His contributions to astronomy are recognized even today through contemporary problems bearing his name, such as the Cauchy problem in general relativity and Cauchy horizons for black holes

Augustin-Louis was the eldest of six children (four boys, two girls), born just one month after the storming of the Bastille, to Louis-François Cauchy (1760–1848) and Marie-Madeline Desestre (1767–1839). The Revolution interrupted the middle-class lifestyle of Louis-François, principal commis to the *Lieutenant-Général de Police* of Paris. Fearing what he perceived as a dangerous situation for himself and his family, Louis-François fled to his country estate at Arcueil with his wife and his two sons, Augustin-Louis and Alexandre-Laurent, in 1794. Ever solicitous of his children's education, he began teaching them at Arcueil and continued that task for several years after the political situation stabilized

On the advice of Joseph Lagrange, a friend of the Cauchy family, Augustin-Louis was enrolled in the École Centrale du Panthéon, Paris, in the fall of 1802. Three years later he entered the École Polytechnique and in 1807 was admitted to the École des ponts et chaussées, where the major portion of his instructional time was spent on fieldwork involving highways and bridges. After completing his studies there, Cauchy was assigned to Cherbourg in 1810 to work on the construction of the Port Napoléon. Two of the four books he took with him to Cherbourg were Pierre de Laplace's Mécanique céleste and Lagrange's *Théorie des fonctions analytiques*

Because of ill health, Cauchy left Cherbourg and returned to Paris in 1812. During his sick leave, he continued working on mathematical research begun at Cherbourg. Although he returned to work as an engineer in Paris, Cauchy had academic ambitions, and the years 1812–1815 saw him establish his mathematical reputation. After failing to be appointed to a position several times, due to Despite political infighting in academia, Cauchy finally received an appointment to the École Polytechnique in 1815. Besides this position, Cauchy's academic experience included positions at the Collège de France and the Faculté des sciences. His most notable nonacademic position was at the Bureau des longitudes.

With his appointment to the École Polytechnique, Cauchy had a somewhat secure place in life, so his father decided it was time for him to marry, choosing for him Aloïse de Bure, daughter of bookseller Marie-Jacques de Bure. They married at the Church of Saint-Suplice in Paris on 4 April 1818. The couple had two daughters, Marie-Françoise-Alicia, born in 1819, and Marie-Mathilde, born in 1823

What was ostensibly a trip to restore his physical and emotional health after the July Revolution of 1830 developed into a self-imposed exile for Cauchy. This was partly due to his refusal to swear allegiance to the new regime, which resulted in the loss of his academic positions in France. During this exile, Cauchy spent some time in Turin and in 1832 was appointed to a chair in mathematical physics at the University of Turin by King Carlo Alberto. The following year, Cauchy moved to Prague to tutor Charles X's grandson, the Duke of Bordeaux. Cauchy returned to France in 1838

For 10 years following his return, Cauchy's intransigence was the cause of many lost appointments. For example, in 1839, he was appointed to the Bureau des longitudes, but his refusal to swear an oath of allegiance to the new government made this appointment short-lived. Finally, in 1848, with the establishment of the Second Republic, the act requiring the oath of allegiance was repealed. In October 1848, Urbain le Verrier, who held the chair in mathematical astronomy at the University of Paris—a chair that had been specifically created for him—transferred it to a chair in physical astronomy. Indications are that he did this to create a position for Cauchy, and indeed, Cauchy was appointed to the chair in mathematical astronomy in March 1849

In April and May of 1857, Cauchy presented papers to the Académie des sciences concerning a new method for determining star positions based on the use of coefficient regulators, an artifice he developed from analysis resulting in greater accuracy for calculating coefficients of series expansions. After these presentations, on the advice of his physician, Cauchy left Paris for his country home in Sceaux, suffering from what he called "great rheumatism." For the first few days he seemed to improve, but his condition worsened, and Cauchy died

The preeminence of Cauchy's work was recognized through various awards, although some were politically motivated. These include appointment to the Académie des sciences (1816), the *Légion d'Honneur* (1819), foreign membership in the Royal Society of London (1832), and the bestowed title of Baron by Charles X (1837). Cauchy was also granted membership in the Academy of Sciences of Berlin, the Academy of Saint Petersburg, and the Royal Society of Prague, among others. In addition, several lunar features are named for Cauchy: Crater Cauchy, Rima Cauchy, and Rupes Cauchy

Cauchy, along with Carl Gauss, was one of the last universal mathematicians in the sense that his research permeated all the then extant branches of mathematics. Cauchy's two most significant contributions to mathematics were his seminal work in the theory of functions of a complex variable and providing calculus with a rigorous, firm, theoretical foundation. Although less well-known, the fundamental results he obtained in celestial mechanics were also significant.

The origin of Cauchy's research in celestial mechanics can be traced back to a paper presented to the Turin Academy of Sciences on 11 October 1831. In the introduction to this paper, Cauchy pointed out the need for strengthening the mathematical underpinnings of astronomy. The "bible" for astronomers during this period was Laplace's *Méchanique céleste*. Laplace based his calculation methods on series expansions but did not address any questions about convergence that were fundamental to Cauchy's approach to series

Cauchy published over 40 papers on celestial mechanics from 1831 until 1857. In general, these works placed astronomy on a rigorous analytic foundation, similar to his efforts in mathematics. In particular, Cauchy was successful in developing methods that simplified the tedious computations involved in celestial mechanics, especially simplifying the computation of error estimates and the series expansion for the perturbation function.

Perhaps Cauchy's most noteworthy contribution to astronomy was an 1845 report on Le Verrier's study of the motion of the minor planet (2) Pallas. This study involved interpolation formulas that required lengthy calculations. The simplifications produced by Cauchy encouraged Le Verrier to investigate the unexplained perturbations of Uranus. Ultimately, this led to Le Verrier's discovery of the planet Neptune, first by calculation and then by observation in September 1846

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