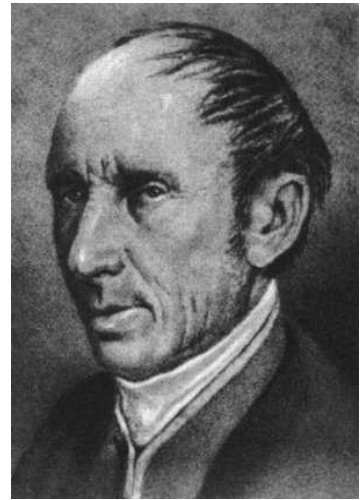


Augustin Louis Cauchy

Augustin Louis Cauchy (August 21, 1789 – May 23, 1857) was one of the greatest mathematicians of the 19th century and a leading representative of the French school of analysis. His most notable research was in the theory of residues, the question of convergence, differential equations, the theory of functions, the legitimate use of imaginary numbers, operations with determinants, the theory of equations, the theory of probability, and the applications of mathematics to physics. His writings introduced new standards of rigor in calculus from which grew the modern field of analysis. In *Cours d'analyse de l'École Polytechnique* (1821), by developing the concepts of limits and continuity, he provided the foundation for calculus essentially as it is today. He introduced the “epsilon-delta definition for limits (epsilon for “error” and delta for “difference”), with which calculus students are familiar but often find frustrating to understand. He transformed the theory of complex functions by discovering integral theorems and introducing the calculus of residues. Besides the , his other major treatises were *Résumé des Leçons sur le calcul infinitésimal* (1823) and *Leçons sur les applications de calcul infinitésimal à la géométrie* (1826 – 1828).



Cauchy founded the modern theory of elasticity by applying the notion of pressure on a plane, and assuming that this pressure was no longer perpendicular to the plane upon which it acts in an elastic body. In this way, he introduced the concept of *stress* into the theory of elasticity. He also examined the possible deformations of an elastic body and introduced the notion of *strain*. One of the most prolific mathematicians of all time, he produced 789 mathematics papers, including 500 after the age of fifty. He had sixteen concepts and theorems named for him, including the Cauchy integral theorem, the Cauchy-Schwartz inequality, Cauchy sequence and Cauchy-Riemann equations. In addition to his own

research, he wrote many reports on the memoirs submitted by others to the Academy of Sciences.

When the Academy established a weekly journal, *Comptes rendus*, Cauchy, who often presented two full-length papers in the same week, filled up most of the periodical. As a result the Academy imposed a limit of four pages for papers appearing in its journal and restricted the number of memoirs that a single author could publish in one issue.

The eldest of six children, Cauchy was born in Paris a month after the storming of the Bastille. His father, Louis- François, was a parliamentary lawyer, classical scholar, lieutenant of police, a staunch royalist and a pious but bigoted Catholic. Cauchy's mother, Marie-Madeleine Desestre, was no less narrow-minded. Depending upon one's point of view, many regarded Augustin Cauchy as a bigoted, perhaps even a hypocritical Catholic. Others praise him as a loyal and obedient son of the Church, who found his greatest pleasures in his numerous acts of charity and his proselytizing. Whether it can be laid to his pompous personality or his zealous piety, Cauchy annoyed a great number of people who still acknowledged his tremendous mathematical talent. His father seemed a likely candidate for the guillotine, so he moved his family from Paris to their country place in the village of Arcueil. There they lived a destitute existence, surviving on small amounts of bread, hard crackers and rice, while sitting out the reign of terror.

All the schools were closed after the Revolution, so during the eleven-year period in which the family lived from hand-to-mouth, Louis-François undertook the education of his children, writing his own textbooks, several in fluent verse, and taught them to revere the monarchy. His mother provided her sons with a strict Catholic religious training. While in the country, frail and undernourished young Cauchy came to the attention of Pierre-Simon de Laplace, who was impressed by the boy's remarkable mathematical talent. In 1800, after the political situation stabilized, the family returned to Paris where Louis-François was elected Secretary of the Senate. Through this post the family became acquainted

with Joseph-Louis Lagrange who predicted that one-day Augustin would surpass both him and Laplace as mathematicians.

At age 13 Cauchy entered the École Centrale du Panthéon, where he won a series of prizes - firsts in Greek, Latin, Latin verse and even the national prize in humanities. In 1805 he demonstrated his mathematical potential by giving a simple solution of Apollonius' problem, that is, to describe a circle touching three given circles. He studied engineering with some of the country's greatest mathematicians at the École Polytechnique, including Sylvestre François Lacroix, Jean Nicolas Pierre Hachette, Gaspard de Prony, and André Marie Ampère, and at 18 enrolled at the École des Ponts et Chaussées. Three years later he graduated with a degree in civil engineering and spent the next three years as an engineer with Napoleon's army at Cherbourg, working on port facilities for the French fleet in preparation for an invasion of England. While his military workload was extremely demanding he still found time to produce several significant mathematical papers in geometry, number theory and determinants. Due to poor health he was forced to resign his position and return to Paris.

In 1816 Cauchy won the Grand Prix of the French Academy of Sciences for his paper, "Theory of the propagation of waves on the surface of a heavy fluid on indefinite depth." Of far greater significance, he proved a conjecture of Pierre de Fermat on polygonal numbers that had stumped many great mathematicians before him. From 1815 on Cauchy lectured on analysis at the Polytechnic and by age 27, he was recognized as one of the greatest living mathematicians. He simultaneously was appointed to professorships at the Polytechnic, at the Collège de France, and at the Sorbonne. In 1816 he was elected to the Academy of Sciences, an honor bestowed only on the country's greatest scientists, usually those of a more mature age. Cauchy certainly was worthy of the honor but it might not have happened at the time it did had not Napoleon been overthrown. The Bourbon king, Charles X, removed all friends of the former emperor from the Academy, including one of France's greatest mathematicians

Gaspard Monge. Cauchy's case was helped because he was known as a fanatically staunch royalist.

Cauchy's appointment did not sit well with many scientists, earning him numerous enemies.

As evidence that Cauchy was not merely feathering his nest in doing the king's bidding, his loyalty to Charles cost him dearly when Charles was overthrown, and the eldest son of the duc d'Orléans, Louis-Philippe was crowned king. Members of the Academy were required to swear an oath of allegiance to the new monarch known as the *Citizen King*. Having sworn an oath of allegiance to Charles, Cauchy refused and was removed from his positions. He went into self-exile and became professor of mathematical physics at the University of Turin. Two years later he answered Charles's summons and moved to Vienna to supervise the education of the exiled king's heir. As a reward, Charles gave Cauchy the impressive but meaningless title of baron. Cauchy returned to Paris in 1838 when the Academy proposed him for a vacant chair at the Collège de France, but he was denied the position because of his stubborn refusal to take the oath of allegiance to the king.

In 1843 Cauchy published a defense of academic freedom of thought, which was instrumental in the abolition of the oath of allegiance after the Revolution of 1848 and the overthrow of Louis-Philippe. Cauchy was reappointed to a professorship at the Sorbonne, where he remained until 1852. Upon the establishment of the Second Empire, the oath was reinstated but Napoleon III made an exception in the case of Cauchy. Cauchy spent the last year of his life at Sceaux, outside of Paris, devoting himself to his mathematical researches. He calmly died on May 23, 1857 after contracting a fever on a trip to the country to help ease his bronchial condition. His last reported words were, "Men die but their works endure." Cauchy was survived by his wife Aloïse de Bure, whom he married in 1818, and their two daughters. His collected works *Oeuvres complètes d'Augustin Cauchy*, have been published in 27 volumes.

Quotation of the Day: “Cauchy is mad and there is nothing that can be done about him, although, right now, he is the only one who knows how mathematics should be done.” – Niels Abel