

## Camille Jordan and the *Cours d'Analyse*.



Camille Jordan (1838-1922)

On January 5, 1838, French mathematician **Marie Ennemond Camille Jordan** was born. Jordan is known both for his foundational work in group theory and for his influential *Cours d'analyse*.

*“[I was advised] to read Jordan’s ‘Cours d’analyse’; and I shall never forget the astonishment with which I read that remarkable work, the first inspiration for so many mathematicians of my generation, and learnt for the first time as I read it what mathematics really meant.”*

— G. H. Hardy, in *A Mathematician’s Apology* (1940)

## Camille Jordan – Early Years

Camille Jordan was born in Lyon, France, to Esprit-Alexandre Jordan, an engineer who had been educated at the École Polytechnique, and, Joséphine Puvis de Chavannes. Jordan studied at the Lycée de Lyon and at the Collège d’Oullins. He entered the École Polytechnique to study mathematics in 1855 to become an engineer. Augustin-Louis Cauchy,[6] the pioneer of analysis, in particular had been one to take this route and, like Cauchy, Jordan was able to work as an engineer and still devote considerable time to mathematical research.[1]

Jordan’s doctoral thesis was in two parts, one in algebra and the other on integrals, which he passed successfully on January 14, 1861. After the examination he continued to work as an engineer, first at Privas, then at Chalon-sur-Saône, and finally in Paris. From 1873 he was an examiner at the École Polytechnique where he became professor of analysis in 1876. In 1883, he was appointed also a professor at the Collège de France. It is significant, however, that he found more time to undertake research when he was an engineer. Most of his original research dates from this period.[1]

## Geometry and Analysis

Jordan was a mathematician who worked in a wide variety of different areas essentially contributing to every mathematical topic which was studied at that time. His early research was in geometry. His *Traité des substitutions et des équations algébriques* (1870; “*Treatise on Substitutions and Algebraic Equations*”), which brought him the Poncelet Prize of the French Academy of Sciences, both gave a comprehensive account of Galois’s theory of substitution groups and applied these groups to algebraic equations and to the study of the symmetries of certain geometric figures. Jordan published his lectures and researches on analysis in *Cours d’analyse de l’École Polytechnique, 3 vol.* (1882). In the third edition (1909–15) of this notable work, which contained a good deal more of Jordan’s own work than did the first, he treated the theory of functions from the modern viewpoint, dealing with functions of bounded variation.[2]

## The Group Concept in Geometry

Jordan’s use of the group concept in geometry in 1869 was motivated by studies of crystal structure. He considered the classification of groups of Euclidean motions. His work had gained him a wide international reputation and both Sophus Lie and Felix Klein visited him in Paris in 1870 to study with him [4,5]. Jordan’s interest in groups of Euclidean transformations in three dimensional space influenced Lie and Klein in their own theories of continuous and discontinuous groups.[1]

In his lecture on group theory mathematician Felix Klein used to tell the following story to his audience:

*“At the memorable Congress of Mathematicians in Paris in 1900, a simple ceremony was held to commemorate all the important mathematicians who had blessed time in the last ten years. Among others, the group theoretician Camille Jordan, born in 1838, died on November 7, 1898, was named. In the last rows, a haggard figure rose up to announce to the assembly that the date of his death, at least the year could not be correct because he was still alive “.*

## Finite Groups

Jordan was particularly interested in the theory of finite groups. He was the first to embark on a systematic development of the theory of finite groups and of its applications in the directions opened by Galois.[\[7\]](#) Chief among his first results were the concept of composition series and the first part of the famous Jordan-Hölder theorem, proving the invariance of the system of indexes of consecutive groups in any composition series (up to their ordering).[\[3\]](#)

Furthermore, Jordan is remembered now by name in a number of foundational results:

- The Jordan curve theorem, a topological result required in complex analysis
- The Jordan normal form and the Jordan matrix in linear algebra
- In mathematical analysis, Jordan measure (or Jordan content) is an area measure that predates measure theory
- In group theory the Jordan–Hölder theorem on composition series is a basic result.
- Jordan's theorem on finite linear groups

## Later Years

In 1912 Jordan retired from his positions. Among the honours given to Jordan was his election to the Académie des Sciences on 4 April 1881. On 12 July 1890 he became an officer of the Légion d'Honneur. He was the Honorary President of the International Congress of Mathematicians at Strasbourg in September 1920. Camille Jordan died on 22 January 1922 in Paris, France, aged 84.

## References and Further Reading:

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- [3] “[Jordan, Camille](#).” Complete Dictionary of Scientific Biography. . Encyclopedia.com.
- [4] [Sophus Lie and the Lie Theory](#), SciHi Blog, December 17, 2017.
- [5] [Felix Klein and the Klein-Bottle](#), SciHi Blog, April 25, 2016.
- [6] [Augustin-Louis Cauchy and the Rigor of Analysis](#), SciHi Blog
- [7] [Only the Good Die Young – the Very Short Life of Évariste Galois](#), SciHi Blog
- [8] [Camille Jordan at Wikidata](#)
- [9] [Camille Jordan at zbMATH](#)
- [10] [Camille Jordan at Mathematics Genealogy Project](#)
- [11] Michael Penn, [Representations of Finite Groups | Definitions and simple examples](#), [Michael Penn @ youtube](#)

- [13] *Jordan, Camille (1881). “Sur la série de Fourier” [On the Fourier series]. [Comptes rendus hebdomadaires des séances de l'Académie des Sciences](#). Paris: Gauthier-Villars, Académie des Sciences.* **92**: 228–230.
- [14] *Jordan, Camille (1870), [Traité des substitutions et des équations algébriques](#), Paris: Gauthier-Villars.*
- [15] [Timeline for Camille Jordan](#), via Wikidata