

# Biographical Encyclopedia of Astronomers

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Clairaut, Alexis-Claude

Born Paris, France, 7 May 1713

Died Paris, France, 17 May 1765

Alexis Clairaut was an outstanding mathematician and a prominent French Newtonian. Clairaut was the only one of his parents' twenty children to reach adulthood. His father, Jean-Baptiste Clairaut, taught mathematics in Paris and educated his son at home to an extremely high standard. Alexis used Euclid's *Elements* while learning to read, and by the age of nine had mastered N. Guisnée's classical mathematics textbook on algebra, differential calculus, and analytical geometry

In 1726, at the age of 13, Clairaut read his first paper, "Quatre problèmes sur de nouvelles courbes," to the Paris Academy of Sciences. After completing a work on double curvature curves, he was proposed for membership in the academy on 4 September 1729, but he was so young that his election was not confirmed by the king until 1731. Then, at the age of 18, Clairaut became the youngest person ever elected to the academy. He joined a small group of remarkable people who supported the natural philosophy of Isaac Newton: Pierre de Maupertuis, Voltaire, and the Marquise du Châtelet, who translated Newton's *Principia* into French in 1756 with many additions of Clairaut's own theories

Clairaut was responsible for major advances in mathematics. After studying with Johann Bernoulli in Basel, he published works on the calculus of variations and on the geodesics of quadrics.

In 1734, he studied the family of ordinary differential equations that are named after him. In his textbook *Éléments d'algèbre*, published in 1749, Clairaut successfully demonstrated why the introduction of algebraic notation was necessary. His book was used for teaching in French schools for many years and went through six editions. *Éléments de géométrie* was published in the year of his death

Clairaut's first work in astronomy was his participation in the expedition to Lapland (1736–1737) led by Maupertuis, to measure a degree of longitude. The expedition was organized by the Academy in order to resolve the controversy between Giovanni Cassini and Newton about the shape of the Earth. In 1743, Clairaut published *Théorie de la figure de la Terre*, confirming Newton's calculation that the Earth is an oblate spheroid, i.e., flattened at the poles. The book provided theoretical support for the experimental data from the Lapland expedition and also laid the foundations for hydrostatics

Clairaut then turned to the three-body problem, in particular the problem of the Moon's orbit. His first conclusions were that Newton's theory of gravity was incorrect. With Euler's support, Clairaut announced to the academy on 15 November 1747 that the inverse square law did not hold. However, a few months later, he realized that the difference between the observed motion of the Moon and the one predicted by the Newtonian theory was due to errors coming from the approximations being made in dealing with the three-body problem, rather than from the inverse square law of gravitational attraction itself. Thus, Clairaut announced to the academy on 17 May 1749 that his theory was now in agreement with the inverse square law.

In 1752, Clairaut published *Théorie de la lune*, where he made use of potential theory. This work was completed two years later with the publication of his lunar tables. He next applied his knowledge of the three-body problem to compute the orbit of Halley's Comet (IP/Halley) and predicted the exact date of its return. This required much more accurate approximations than the problem of the Moon. Calculations taking into account gravitational perturbations by Jupiter and Saturn were indeed monumental, requiring six full months of hard work for three gifted individuals. Clairaut enlisted the help of Nicole Lepaute, a mathematician working at the Paris Observatory, and the young astronomer Joseph de Lalande. On November 14, 1758, he was able to announce their result to the Academy—that the perihelion would occur on April 15, 1759. The actual date of perihelion turned out to be March 13. When the comet appeared, only one month before the predicted date, Clairaut received great public acclaim.

Clairaut also made important contributions to the problem of light aberration. He suggested an improved telescopic design using lenses made up of two different types of glass. Clairaut wrote several memoirs on the topic, but died at the age of 52 after a brief illness, leaving the work unfinished. By that time he had been honored by being elected to the Royal Society of London and the academies of Berlin, Saint Petersburg, Bologna, and Uppsala.

*Jean-Pierre Luminet*

### **Selected References**

Brunet, Pierre. "La vie et l'oeuvre de Clairaut." *Revue d'histoire des sciences et de leurs applications* 4 (1951): 13-40, 109-153; 5 (1952): 334-349; 6 (1953): 1-17

Itard, Jean (1971). "Clairaut, Alexis-Claude." In *Dictionary of Scientific Biography*, edited by Charles Coulston Gillispie. Vol. 3, pp. 281–286. New York: Charles Scribner's Sons.

Taton, René (1976). "Inventaire chronologique de l'oeuvre d'Alexis-Claude Clairaut (1713-1765)." *Revue d'histoire des sciences et de leurs applications* 29: 97-122.

——— (1978). "Sur la diffusion des théories newtoniennes en France: Clairaut et le problème de la figure de la terre." *Vistas in Astronomy* 22: 485-509.

——— (1986). "Clairaut et le retour de la comète de Halley en 1759." *L'Astronomie* 100: 397-408

Wilson, Curtis (1993). "Clairaut's Calculation of the Eighteenth-century Return of Halley's Comet." *Journal for the History of Astronomy* 24: 1-15