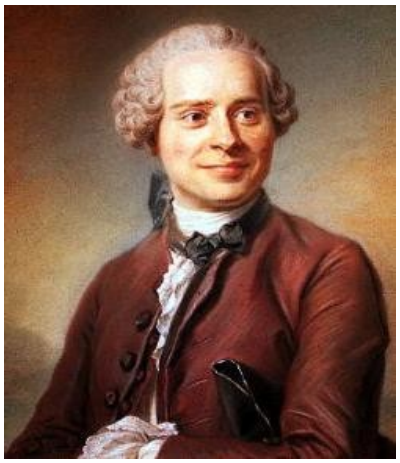
Jean Le Rond d'Alembert



French philosopher and mathematician **Jean Le Rond d′Alembert** **(**November 17, 1717 – October 29, 1783) was among a group of intellectuals, known as Encyclopaedists, who edited the famous *Encyclopédie, ou Dictionnaire raisonée des sciences, des arts et des métiers.* He was the illegitimate son of Mme. de Tencin, a former nun and hostess of one Paris' most fashionable salons. His father was Chevalier Louis-Camus Destouches; one of de Tencin's many short-time lovers. Fearing she might be returned to the convent, Tencin abandoned the infant on the steps of the St. Jean le Rond, a church nestled under the great porch of Notre-Dame de Paris. The foundling was baptized and given the name of the church before being placed in the home of a glazier and his wife. D'Alembert regarded this woman as his real mother and lived in her home until he was 47 years old. As a young man, he adopted the surname d′Alembert, for reasons not known. When he became a famous mathematician, he spurned the overtures of his birth mother to establish a relationship. Destouches provided sufficient funds to guarantee that d′Alembert received a good education, but never acknowledged him as his son. When he died, he left the nine-year old boy an annuity that gave him a modest lifetime income of 1200 livres a year, providing him with some security and independence.

D′Alembert attended the Jansenist school, the Collége de Quatre-Nations, where he studied the classics, rhetoric, and a fair amount of mathematics. The aim of his teachers was to produce theological experts who would defend the Jansenist case against the Jesuits. But they were unable to interest d′Alembert in a religious career and after graduating, he spent a few years studying law and medicine. Before long he found he had less interest in these areas than he did in theology and turned his full attention to his true

passion, mathematics. As his knowledge of mathematics was mainly due to self-study, he often found that others had already established his mathematical discoveries by more elegant and more direct means. In 1739 d'Alembert submitted his first paper to the French Académie Royale des Sciences, in which he described the errors found in the standard textbook, *Analyse démontrée*, written by Charles Reyneau.

At the age of 26 d'Alembert published his most important work *Traité de dynamique* (*Treatise on Dynamics*), in which he developed the mathematical theory of Newtonian dynamics, including the principle later named for him. It states that the "internal forces of inertia" (forces that resist acceleration) must be equal and opposite to the forces that produce the acceleration. To put it another way d′Alembert's principle means that Newton's Third Law of Motion holds not only for fixed bodies but also for those free to move. The application of the principle made it possible to obtain the differential equations of motion in any rigid system. In 1744 d'Alembert expanded on his previous results with the publication of his *Traité de l'equilibre et du mouvement des fluides (Treatise on the equilibrium and motions of fluids*).

Two other important books by d′Alembert are *Réflexions sur la cause générale des vents* (1747) and *Recherches sur la precession des equinoxes et sur la nutation de la terre* (1749). In the former, d ′Alembert developed the theory of partial differential equations and solved such systems as a vibrating string and the general wave equation. The second work dealt with the precession of the equinoxes, that is, the slow, gradual western motion of the equinoxes due to the moment of the Earth's axis. In his paper of 1768, "Réflexions sur les suites et sur les racines imaginaires," he became one of the first mathematicians to study the convergence of series. During the 1740s d'Alembert became a fixture in the intellectual and social salons of Paris, much appreciated for his wit. He was one of the leading thinkers of the Enlightenment, a philosophical movement that rejected traditional religious and political

ideas while championing human reason. Like the other *philosophes*, d′Alembert, who never married, worked during the days, and spent the evenings in the salons, particularly those of Mme du Deffand and Mlle Julie de Lespinasse, the latter with whom he shared a close relationship for many years.

In 1745 publisher André Le Breton asked Denis Diderot to assist in translating the English *Cyclopedia* of Ephraim Chambers into French. Diderot changed the nature of the assignment by expanding its scope. He decided to produce an *Encyclopédie* that would give the present state of knowledge of the sciences, arts, and crafts. Each subject was assigned to the person or persons most suited to writing it. Diderot chose d′Alembert to be the mathematics and science editor. It turned out that Diderot and d'Alembert wrote most of the 71,818 articles. Other contributors included Jean Jacques Rousseau, Voltaire, Charles Louis de Secondat, Baron de la Bréde et de Montesquieu, Baron Paul d'Holbach, Georges-Louis Leclerc, and Comte de Buffon. D'Alembert not only wrote the famous epistemological preface, the *Discours préliminaires*, he contributed some 1,500 articles, including most of those on mathematics and science. His writing style has been called brilliant, but not polished. He used his position in society to obtain financial and moral support for the project from the leading salons and the participation of the greatest scholars and writers. The first edition consisted of 17 volumes of text and 11 volumes of plates with one or two new volumes produced each year between 1751 and 1772. It was the most ambitious publishing enterprise of the century. Church leaders viewed the *Encyclopédie* as a threat to their authority and that of the king. The first seven volumes were printed under a royal privilege, which was withdrawn in 1759. Diderot was forced to continue the work clandestinely. The last ten volumes of the first edition were printed in Paris, issued under a false imprint.

In the *Encyclopédie,* d′Alembert replaced Newton's notion of "prime and ultimate ratio" for his concept of "fluxion" with the notion of limit. D′Alembert asserted that one quantity is the limit of another when the second approaches the first nearer than by any given quantity. He wrote, "The differentiation of

equations consists simply in finding the limits of the ratio of finite differences of two variables included in the equation." This marked an important improvement in the calculus but his contemporaries were not convinced of its importance. Nor did they recognize the wisdom of d'Alembert claim that the secant connecting two points on a curve becomes the tangent where the two points become one.

Described as bold, honest and frank, d′Alembert seemed constantly surrounded by controversy, arguing with everyone around him, and entering into extended quarrels with men he regarded his rivals, including Alexis Claude Clairaut, Daniel Bernoulli, and Leonhard Euler. Bernoulli and d′Alembert carried on extensive arguments about a problem in applied probability. It was known that inoculating a person with a fluid taken from a person with smallpox usually resulted in a mild case of smallpox, followed by immunity from the disease. But occasionally an inoculated person developed a more serious case of the disease and died. The question then was: is a person more likely to live longer with or without the inoculation? There were many variables in the problem; the age of the person inoculated, life expectancies, etc. D′Alembert argued that the laws of probability would offer small comfort to a parent who had his child inoculated and lost the gamble. He felt this human consideration was as relevant to the problem as were probabilities.

D'Alembert believed that Euler was stealing his ideas and not giving him due credit. The truth is that Euler took the sloppy work of d′Alembert much further than he could ever have imagined, but only after rediscovering the results for himself. When d'Alembert had a falling out with his colleagues at the Paris Academy he took to sending his papers to the Berlin Academy. But having them published in Berlin meant getting Euler's approval, so he ceased publishing his mathematical articles through academies. Instead he collected them together and published them as *Opuscules mathématiques* in eight volumes between 1761 and 1780. In 1764 he spent three months at the court of Frederick the Great,

who asked his guest to move to Potsdam and become president of the Prussian Academy. D′Alembert declined and also turned down a generous offer of 100,000 livres a year from Catherine the Great of Russia to tutor her son. He considered his intellectual freedom more valuable than huge salaries provided by royalty, which always came with restrictive strings. In 1765 d′Alembert became gravely ill and moved into the home of Mlle de Lespinasse, who nursed him back to health. He lived with her until her death in 1776. When he found evidence of her many love affairs among her effects, his loss was doubly bitter. Old and lonely, he sadly complained that his illness had robbed him of the ability to concentrate on mathematics. He suffered from poor health for several years and died from a bladder problem. Because of his well-known atheistic views he was buried in an unmarked common grave.

Quotation of the Day: “Geometrical truths are in a way asymptotes to physical truths; that is to say, the latter approach the former indefinitely near without ever reaching them exactly.” – Jean Le Rond d′Alembert