

## JEAN LE ROND D'ALEMBERT (November 16, 1717 – October 29, 1783)

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A few days after the birth of her illegitimate son, CLAUDINE-ALEXANDRINE GUÉRIN DE TENCIN, a well-known French salon hostess and author, placed the infant on the steps of the *Church of Saint-Jean-Le-Rond* in Paris. As was the custom, the foundling was baptized with the name of the patron saint of the church and brought up in the church's orphanage. The child's father, LOUIS-CAMUS DESTOUCHES, a military officer, learned of his son's fate only after his return from abroad. He saw to it that the child was placed with foster parents. Mme. ROUSSEAU, the wife of a glazier, took care of the child as though she were his mother. The adopted child lived in her house into his forty-eighth year. D'ALEMBERT's biological father provided sufficient funds for the child's upbringing, and even after his death, there was money for the young man's schooling. When JEAN entered a *Jansenist college*, he took the name JEAN-BAPTISTE DAREMBERG, which later was transformed into JEAN D'ALEMBERT.



The Jansenists, whose most famous adherent was the philosopher and mathematician BLAISE PASCAL (1623–1662), had a strong belief in God's grace, with no room for human free will. A disagreement over this teaching led in 1713 to a schism with the Catholic Church in France. The Jansenists sought, therefore, in their conflict with the Jesuits, to produce among their pupils as many theologians as possible who would decide the doctrinal dispute in their favour. JEAN D'ALEMBERT was not among them. He was more interested in making use of the school's extensive library to teach himself mathematics.

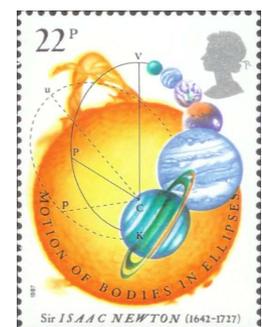
At the age of 17, he began studying jurisprudence at university, after three years taking the examination that qualified him as a lawyer. But then he began to pursue a medical degree until he realized that this second course of study gave him even less pleasure than theology.

D'ALEMBERT began his career as a mathematician in the year 1739 by presenting to the *Academy of Sciences* in Paris a list of errors that he had discovered in a standard mathematical work. In the following year, he produced a highly regarded article on fluid mechanics. Then in 1741, D'ALEMBERT was elected a member of the *Academy*.

In 1743, his most important work appeared, *Traité de dynamique* (Treatise on Dynamics), in which he further developed ISAAC NEWTON's mechanics. He showed how problems of systems in motion could be solved using what is today called D'ALEMBERT's principle:

- An accelerational force  $F$  acting on a body triggers an equal but opposite force  $F^*$  (called a D'ALEMBERT force).

For D'ALEMBERT, mechanics should be seen as a branch of mathematics; in contrast to NEWTON, he considered experimentation as an aid in the solution of physical problems to be superfluous, which can be seen in his work *Réflexions sur la cause générale des vents*. For this work he received in 1744 a prize from the *Prussian Academy of Sciences*. D'ALEMBERT claimed that the tides were the single cause of the emergence of winds; nonetheless, he was the first to describe physical processes in terms of partial differential equations (that is, equations of several variables in which partial derivatives in terms of these variables appear).



In 1747, he published an article on vibrating strings, whose motion he characterized in terms of a differential equation. This contribution is also original and brilliant from a mathematical point of view.

LEONHARD EULER recognized the possibilities offered by such ideas and methods, and he developed the theory much further. In the process, he criticized D'ALEMBERT's work for its imprecise formulations. D'ALEMBERT, who until this time had been on friendly terms with EULER, now came into conflict with him, even to the point of accusing him – as had other of his contemporaries – of having stolen his ideas.

D'ALEMBERT was quick to become vigorously embroiled in argument and had great difficulty in acknowledging his own errors. After repeated conflicts with members of the French *Academy of Sciences*, he determined no longer to submit his articles for publication in Paris, but turned instead to Berlin. However, in Berlin, the *Director of the Division of Mathematics* at the *Prussian Academy of Sciences*, the person responsible for receiving submissions for publication, was none other than EULER. The flames of conflict were further fanned when FREDERICK THE GREAT invited D'ALEMBERT to succeed PIERRE LOUIS MOREAU DE MAUPERTUIS as president of the *Prussian Academy of Sciences*, an appointment that was opposed by EULER.



D'ALEMBERT turned down the offer, and stopped submitting articles for publication altogether, preferring to collect and publish them later in eight volumes under the title *Opuscules mathématiques* (mathematical booklets). These volumes contain extraordinary works on such topics as complex-valued functions, approaches to making precise the notion of limit, and the *quotient criterion* for infinite series (later developed further by CAUCHY).

In connection with the integration of rational functions (*Recherches sur le calcul intégral*), D'ALEMBERT discovered the method of *partial fraction decomposition*. He realized that every real polynomial of even degree can be decomposed as a product of quadratic factors with real coefficients, with complex roots always appearing as complex-conjugate pairs. Even today, the so-called *fundamental theorem of algebra*, which states that a polynomial of degree  $n$  always has  $n$  roots (counted with multiplicity) in the complex plane, is known in France as *le théorème de D'ALEMBERT*, although D'ALEMBERT's proof was deficient, with the first acceptable proof given only in 1799 by CARL FRIEDRICH GAUSS as part of his doctoral dissertation, which also contained a critique of d'Alembert's proof.

d'Alembert also worked on problems in the theory of probability, in which he also made numerous errors. For example, he stubbornly held to the opinion that the probability of (at least) one heads appearing in two tosses of a fair coin was precisely two-thirds, since there are precisely three possible outcomes, namely *heads*, *tails-heads*, and *tails-tails* (if *heads* appears at the first toss, then one need not proceed further; if the first toss brings up *tails*, then a second toss follows, yielding either *heads* or *tails*). He was also convinced that the probability for *heads* increases as the length of a sequence of successive *tails* increases.

He also incorrectly believed that there exist betting strategies in *roulette* that guarantee a net win. According to his method of “*progression*,” the player should place his bets on equal odds (*red or black, odd or even, low or high*), increasing the amount wagered by one coin if he loses, and decreasing it by one if he wins (and to continue until he has achieved a net win).



By the end of the 1840s, D’ALEMBERT was one of the most esteemed personalities in the scientific world. It is no wonder, then, that the publisher ANDRÉ LE BRETON invited him, along with DENIS DIDEROT, to put together an *Encyclopédie, ou dictionnaire raisonné des sciences, des arts et des métiers* (Encyclopaedia or a Systematic Dictionary of the Sciences, Arts, and Crafts). Between 1751 and 1772, there appeared twenty-eight volumes of this “manifesto of the Enlightenment,” including contributions from VOLTAIRE, MONTESQUIEU, and ROUSSEAU. D’ALEMBERT wrote the explanatory foreword (*Discours préliminaire*) of the first volume as well as more than 1500 articles on mathematical, scientific, and philosophical subjects. A number of articles gave the censors cause to intervene. The Jesuits and Jansenists joined forces, and the work was placed on the Catholic *Index Librorum Prohibitorum*. Under pressure from the Church and *Parlement*, the royal license to publish was withdrawn. Nevertheless, no action was taken against the sale of the volumes after D’ALEMBERT threatened to accept an offer from FREDERICK THE GREAT to publish the *Encyclopaedia* in Prussia. On another front, the Calvinist clergy in the city of Geneva felt themselves insulted by D’ALEMBERT’s article on “Genève”.

Tired of controversy, D’ALEMBERT withdrew in 1757 from participation in the project.

For his great service in the creation of the *Encyclopaedia* and in furtherance of the French language, D’ALEMBERT was elected in 1754 to the *Académie française*, and in 1772, he was appointed to the Academy’s most influential position, that of permanent secretary.



In his last years, he became more interested in philosophical questions. Even if he could not counter the argument that human intelligence cannot arise out of “matter” alone, he did not believe in the existence of God. He asked that as an avowed “unbeliever”, he be buried in an unmarked grave.

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