

Louis Pasteur and the Discovery of Molecular Chirality

Louis Pasteur was born on December 27, 1822, in Dole, in the Jura district of the Franche-Comté region in eastern France. His father, Jean-Joseph Pasteur, was a tanner; his mother was Jeanne-Etiennette Pasteur, née Roqui. He had three sisters; a brother died before Pasteur was born. In 1830 the family settled in the nearby town of Arbois, where Pasteur spent the rest of his childhood. The young Pasteur showed remarkable artistic talent and produced many fine pastel portraits of family members, friends, and town personalities. He even contemplated a career in the arts, but upon completing his secondary education he dropped the idea and in 1843 enrolled in physical sciences at the Ecole normale supérieure in Paris. In 1847 he earned a doctorate with theses in chemistry and physics in the laboratory of Professor A.-J. Balard.

Pasteur then undertook a crystallographic study of tartaric acid (TA). He found that the crystals of natural (+)-TA and its salts were chiral (he used the term dissymmetric) due to hemihedrism, i.e., presence of small (right-leaning) facets at alternate corners. However, a then-new and mysteriously optically inactive version of TA gave crystals that were neither hemihedral nor dissymmetric, as did its salts. But Pasteur found an exception: the crystals of the sodium ammonium salt of the optically inactive acid were hemihedral and dissymmetric. Moreover, he found this salt to be a mixture of two chiral crystal forms with right- or left-leaning hemihedral facets, respectively, and related as object and its mirror image. He manually separated the two forms, finding that in solution the two salts had opposite rotations, as did the liberated acids. Thus, Pasteur identified, for the first time, the two enantiomers of a chiral substance, and recognized the existence of molecular chirality. In May 1848, at age 25, he presented his findings to the Académie des Sciences. Later he suggested, correctly, that molecular dissymmetry may arise from a tetrahedral or a helical arrangement of the atoms.

In 1849 Pasteur was appointed acting professor of chemistry at the University of Strasbourg, then full professor (1852), professor of chemistry and Dean of Sciences at Lille (1854), Scientific Director, Ecole normale supérieure (1857), and professor of chemistry, Sorbonne (1867). In the mid-1850s he turned to biology, and his revolutionary work, culminating in the rabies vaccine (1885), established scientific microbiology and proved of immense benefit to mankind. He was celebrated worldwide and received high honors, e.g., memberships in the Académie des Sciences (1862), the Académie de Médecine (1873), and the Académie française (1882); the Rumford Medal (1856); the Copley Medal (1874), the Leeuwenhoek Medal (1895); the Pasteur Institute (1887), etc. Despite the recognition and honors, however, Pasteur had to battle intense and irrational attacks on his work throughout his career. Modern-day detractors include Geison, who has questioned Pasteur's account of his discovery of molecular chirality. However, a reading of Geison's critique reveals a serious misunderstanding of Pasteur's work and the science involved.

In 1849 Pasteur married Marie Laurent (1826-1910); they had five children, three of whom died in infancy. Pasteur was deeply devoted to his family, intensely patriotic, compassionate, with bourgeois values and human imperfections, "without modesty but without pride", as one biographer wrote. He died at Villeneuve l'Etang, near Paris, on September 28, 1895. Louis and Marie Pasteur's final resting place is an imposing tomb at the Pasteur Institute in Paris.