FROM CATENANES AND ROTAXANES TO MOLECULAR MACHINES

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The simplest catenane, a [2] catenane, consists of two interlocking rings. Rotaxanes consist of rings threaded by acyclic fragments (axes). Interlocking ring compounds have attracted much interest in the molecular sciences, first as pure synthetic challenges and, more recently, as components of functional materials. In particular, these compounds appear as perfect precursors to dynamic systems for which motions can be triggered and controlled in a precise manner. This property led to the use of catenanes and rotaxanes as *molecular machine prototypes*.

Subsequently, the research field of artificial molecular machines has experienced a spectacular development, in relation to molecular devices at the nanometric level or mimics of biological motors. In biology, motor proteins are of the utmost importance in a large variety of processes essential to life (ATPase, a rotary motor, or the myosin-actin complex of striated muscles behaving as a linear motor responsible for contraction or elongation). A few recent systems are based on simple or more complex rotaxanes or catenanes acting as switchable systems or molecular machines. Particularly significant examples include a "swinging catenane", "molecular shuttles" as well as multi-rotaxanes reminiscent of muscles or able to act as molecular compressors or switchable receptors. The molecules are set in motion using electrochemical, photonic or chemical signals. Examples will be given which cover the various approaches used for triggering the molecular motions implied in various synthetic molecular machine prototypes. The work of various groups using non interlocking compounds will also be briefly discussed. Potential applications of rotaxanes and molecular machines will also be mentioned.

References:
J.-P. SAUVAGE, "From Chemical Topology to Molecular Machines", Angew. Chem. Int. Ed., 2017, 56, 11080.