A Journey in Chirality

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Abstract: Using practical examples from the everyday life, we raise the question of the right vs left recognition problem. The purpose is to ensure a thorough understanding that only chiral systems can recognize chirality. HPLC chiral stationary phase and NMR chiral shift reagents illustrate this concept in molecular chemistry. This gives us the opportunity to define the diastereoisomeric interaction and the enantiomeric excess. Prochirality and racemization notions are used to clarify the principles of asymmetric synthesis.

Finally, we arrive to the idea that ultimately, all materials and asymmetric methods that synthetic chemists currently employ to access enantio-enriched synthetic products all rely on the chiral information originally imparted from biology. This finding allows us to define the chiral pool and to ask the still unanswered question of the origin of the biological homochirality.

Among the possible chiral references that could have tilted the balance towards a given handedness are (i) the extended high circular polarization in the Orion massive star forming region and (ii) the parity violating energy difference. These two hypothesis are considered with the aid of examples such as circular dichroism and beta radioactivity.

Once admitted the concept of chiral bias, the ways by which an initial tiny enantiomeric excess can be amplified can be explored. For that purpose, two experimental examples of spontaneous deracemizations are described, namely the Soai reaction and the Viedma deracemization. These two examples are explained with the help of comprehensive kinetic networks.

We conclude highlighting the importance of chirality by showing the possible links between racemization and several degenerative diseases.