Chirality
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http://geomsymm.cnsm.csulb.edu/courses/303/reading/whyteChirality.pdf
Notes:

"The scientific mind looks for symmetry, so it is scarcely surprising that it was not until the 19^{th} and 20th centuries that quantitative science came to grips with the chiral aspects of nature, which we now know to be of great importance. On six occasions from 1810 to 1957, chiral phenomena were unexpectedly discovered that involved a revision of previous theoretical assumptions."

Crystal optics. Arago (1810) discovered the rotation of plane-polarized light (optical activity) by quartz crystals and Fresnel (1827) correctly ascribed this to a helical arrangement in the structure of the crystal. No bias was present in this work, as L and R rotations were produced by different specimens.

Crystal mechanics. During the 1950's nonsymmetric tensors, representing screw stresses and strains, were discovered in crystals containing helical molecular arrangements. No bias; both forms of crystal exist.

The other four cases are more interesting, as they revealed a bias in nature calling for explanation.

Electromagnetic interaction. Oersted (1820) discovered the anomalous R-handed screw action of an electric current on a magnet. (Mach's 'shock'). This bias was incorporated into classical Electromagnetic Theory but was modified and believed to be substantially explained in Electron Theory and Quantum Mechanics (Weyl, 1952).

Living systems and chiral molecules. In 1815, Biot discovered that many materials from organisms (sugar, tartaric acid, oil of turpentine, etc.) in the liquid state or in solution displayed optical activity and conjectured that this might be due to some structural asymmetry of the individual molecules.

Pasteur followed this up and, in 1848, separated-by manually sorting out from a mixture the small crystals of the two mirror-image forms, a procedure seldom applicable-two optically active (R and L) forms of tartaric acid. He interpreted this as due to the existence of two mirror image.

It was established, from 1920 onwards, that the organic realm is distinguished, as Pasteur had suggested, by the presence of chiral molecules of one sense only in any particular biochemical process. 'In living organisms all syntheses and degradations of dissymetrical molecules involve one enantiomorph alone' [lo]. This must be carefully interpreted; it does not mean one universal bias. While more than 99%, of natural amino acids are L, and sugars are R. Moreover, at different levels opposite chiralities may be present; for example, the L amino-acids form R macro helices in proteins.

In spite of these complexities, one principle at present appears absolute: where two opposite forms of a molecule are possible, these are never used simultaneously. Mixed enantiomers are never found in cellular organisms. This suggests that the presence of structures of one chirality only in any situation is-at least at the molecular and conformational levels-an indispensable condition of organic stability and coordination.

Particles and Antiparticles. In 1931 Dirac, using a relativistic wave equation th at he had previously proposed for the (negatively charged) electron, predicted the existence of a positively charged anti-particle to the electron and this new antiparticle, called the positron, was discovered in 1932-3.

the positron can be regarded as the mirror image of the electron and the general laws show in this respect no chiral bias, both particles corresponding to permissible solutions of the Dirac equation….

But: electrons are present in myriads everywhere, while positrons are very rare and vanish in a flash.

Weak particle interaction. Between 1956 and 1958 it was established that all weak interactions (e.g. in y-ray radioactive decay) display a marked bias ('failure of parity conservation'). This anomaly in the fundamental constitution of matter, as shown in the processes of atomic nuclei, constitutes a major challenge. What possible reason can there be for a left or right bias in the structure of atomic nuclei ? It could be that this nuclear bias and the electron-positron lack of symmetry are two expressions of one underlying factor, not yet identified, that has to do with the structure of electricity in atoms and nuclei.

There appears to exist more asymmetry in the physical universe than is yet understood and it would not be surprising if this required a further revision of fundamental concepts. It has been known since 1956/7 (Time-Charge-Parity T.C.P. Theorem) that reflection symmetry must be regarded as a member of a closely linked triplet of invariances: under (i) reversal of the direction of motion, (ii) reversal of sign of electric charge and (iii) reflection. Any major advance of physical theory beyond this Theorem may be expected to throw light on three basic issues: the reversibility or not of the fundamental physical processes, the nature of electricity and the role of left- and righthandedness in the physical universe.