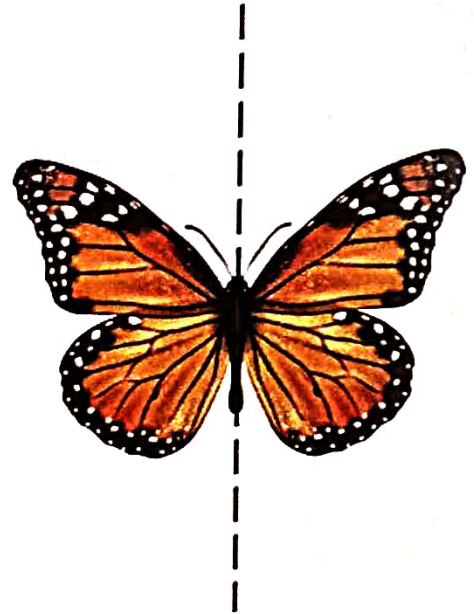
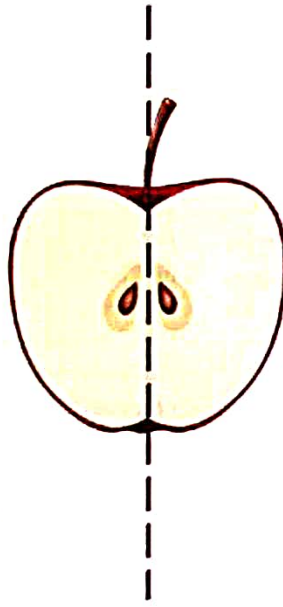


SYMMETRY

AN INTRICATE CONCEPT

PK Mukherjee



SYMMETRY commonly means harmony or balance. It also signifies beauty (regularity) and unity. That has been the notion of symmetry right from the outset; nature loves symmetry. If we observe objects of nature like flowers, butterflies, etc., we shall always notice a kind of symmetry in them. From an engineering and architectural point of view, symmetry can also be seen in the design of buildings. It manifests in myriad man-made art, drawings and patterns.

It is easy to understand what visual or geometrical symmetry is. Think of a circle, a square, a triangle or a rectangle. Now, if you hold any of these forms down the centre, if each side is equal in size and shape to the opposite side, refer to it as bilateral symmetry. A candle or a pencil held vertically with its tip down is symmetric about a vertical axis because it rotates about that axis without changing in appearance or any other feature; it is also symmetric to reflection in a mirror, referring to as reflection symmetry. You can even find symmetry in circular designs. When an object rotates around a circle in equidistant increments, it leads to radial symmetry. In other words, when something rotates around a circle to form a symmetrical design, it possesses radial symmetry. The face and the rest of the human body are (usually) symmetrical. If you have a line drawn in the middle

of a typical human face, you will find that if you fold that image, the eyes will line up well as the ears, both halves of the man and the mouth.

Physicists and mathematicians, however, define symmetry more precisely, that symmetry of a particular kind exists when a certain operation leaves something unchanged. Something is symmetrical if one or more aspects are indifferent to a change under certain operations. In other words, scientists view symmetries as changes that don't really change anything, differences that don't make a difference, and variations that leave deep relationships invariant. For example, a rubber ball can be turned freely, and its appearance won't be altered. A physicist, therefore, might say the ball is "symmetrical with respect to rotation".

From a physicist's point of view, space and time have certain symmetries. Space, for example, has a kind of symmetry, according to which the space is exactly the same no matter where you are. The laws of physics are the same whether you are in India, Germany, the moon or the bottom of the ocean. Time also has a kind of symmetry, according to which no particular instant in time is inherently different from any other. Physics is the same whether it is yesterday or tomorrow, a thousand years ago or a few weeks later. As symmetry signifies something which is