SYMmetry

in a cultural context

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SYMMEtRY
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(EXTENDED ABSTRACTS)

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by
Dénes Nagy

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1.3 NATURAL SCIENCES

SYMMETRY IN CHEMISTRY AND INDIAN RELIGION

Krishnan Balasubramanian
Department of Chemistry
Arizona State University

ABSTRACT

Symmetry plays an important role in many chemical problems. The symmetry of a molecule is characterized by the set of rotation axes and mirror planes which form a group called the point group of the molecule. The algebra of the associated set of operations (group theory) is quite important in chemical analysis since many useful results can be obtained from the symmetry group of the molecule. The character tables of the point groups of molecules are also quite useful in chemistry.

Group theory (algebra of symmetry) plays a key role in quantum chemistry, a subarea of theoretical chemistry which deals with methods of obtaining molecular energies and wavefunctions. The symmetry of a molecule can be exploited in solving the quantum mechanical equations which yield the energies of the molecule. The symmetry of the molecule is also reflected in the quantum mechanical wavefunctions which yield probability densities.

The symmetry of a molecule governs its interaction with light (spectroscopy). Thus symmetry enters into spectroscopy in determining the selection rules for transitions among various energy levels. The fundamental theorem to obtain selection rules for spectroscopic transitions is the Wigner-Eckart theorem which is basically an expression symmetry in the integrals of molecular wavefunctions.

The symmetry group of a molecule determines if a molecular vibration would couple to electromagnetic radiation. Group theory is extensively used
in finding if a given vibration would be active in the infrared or Raman spectrum.

The selection rules in chemical reactions (Woodward-Hoffmann rules) as well as selection rules in molecular collisions and scattering processes are derived from the symmetries of the associated system. Further, the stereochemistry of molecules, the spectral patterns and the chiral nature of molecules are related to symmetry.

Another topic which would be considered is related to symmetry in Indian religion and culture. Symmetric patterns are considered auspicious in the east-Indian culture. In the southern part of India, symmetric patterns called "Kolas" are displayed at the entrance of the home in the mornings as well as evenings. There are "Kolas" for various occasions. "Kolas" are used on religious occasions and matrimonial ceremonies. Many types of "Kolas" and their religious and cultural significance would be discussed in this talk.

References
