Discussion on Petal Variegation, Its Relevance as an Artistic and Evolutionary Indicator

Variegation is a term used to describe a pattern of two or more colors existing in a distinct alternating pattern.

The ornamental plant, Camellia japonica, is a flower species which has been highly bred for variegation patterning and color breaks. Variegation occurs in camellias for two reasons: The first is due to a virus being present or introduced into the plant. It is thought that there are between two to six different viruses which affect camellias. A virus induced variegation is revealed in flowers that show small spotting, large white blotches or a white rippled pattern called moire. The second type of variegation is due to inheritance through genetic factors. Cultivars in this category can have streaks, dashes, or picotee (white patterning) around the edges of the petals. This can occur because of different cells in one tissue expressing different color genes. This type of variegation can also be caused by a mutation in the meristem that results in a chimera, or the existence of two different cell lines growing within one plant.

On a genetic level, specific genes are involved in pigment synthesis. There are two type of genes which affect color patterning in flower petals. Structural enzyme genes, flavonoids such as anthocyanins, are ones that code for any RNA or protein products. Regulatory genes influence the type, intensity, and pattern of flavonoid accumulation, but do not themselves encode the flavonoid enzymes. Positional signals that regulate gene expression can also determine variegation pattern. Precise spatio-temporal effects during petal development influence pattern development.

One way variegation can be generated is by manipulating transposons. A transposon is a DNA sequence that can change its position within a genome. The insertion of a transposon can result in white sectors on a colored background. Excision of transposons results in colored sectors on a white background. The size of the sector that is changed depends on the timing the of the manipulation during petal development. Sometimes called a jumping gene, a transposon can randomly move about the chromosome creating a genetic mosaic which is expressed through color variegation.

Variegation is the over expression, or the silencing, of structural gene expression in the flavonoid biosynthetic pathway. A process called RNAi, or RNA interference, is a type of cellular silencing mechanism that uses the gene's own DNA sequence to turn the gene off. This process was discovered when researchers (Jorgensen, 1990) were trying to create darker purple petunias by injecting a transgene encoding chalcone synthase, which is responsible for purple coloring, into the genome. Instead of a darker flower, they developed a variegated purple flower, in which part of the DNA was silenced, and part was unaffected. This was called co-suppression of gene expression.

Camellias are a naturally genetically unstable plant. All camellia species can and will mutate. When a camellia bud shows variegation, even if its only a single small streak of color, it serves as an indicator. It indicates that the plant, at some time in the future, will form a "sport", or mutation. When genetically induced, it indicates the turning on and/or silencing of a specific color gene; or, it may indicate the presence of a chimera, two differentiated cell lines growing side by side. When virally induced, it indicates the presence of a pathogen. Variegation evidences biological change, and/or evolutionary mutation-a recombination of DNA.

A major desire of evolutionary developmental biology is to understand, or bring to light, the genetic changes that result in the evolution of novel characteristics. This is a parallel process to that of artistic creation, which perhaps has more emphasis on the "to bring to light" novel ways of seeing, or manifesting novel outcomes as "artworks".

The idea of an artist as an evolutionary agent of biological matter, is a predictable conjoining of the theory and methods the two disciplines. The element of aesthetic desire, of determining a function or non-function, of simultaneously utilizing scientific and artistic processes of creation, of bringing into being something which has not yet existed, all transpire and interact within an ethical, theological, and ecological realm. Artistic research of this sort raises questions that perhaps would not be asked in quite the same way in any other single discipline. The questions that emerge out of this research pathway lead the way to a new artistic discourse, or critical theory, about the nature, limits and purposes of biological invention/intervention.