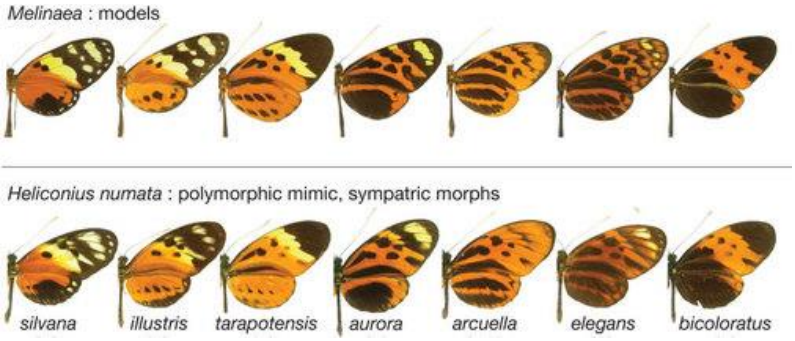
ScienceWatch – Lookalike Butterflies

"These butterflies are the 'transformers' of the insect world." – M. Joron

Mimicry, in which one organism copies the salient features of another, is widespread in nature. For example, certain plants, especially orchids that depend on a single insect species for pollination, produce flower parts resembling the female insect. This attracts amorous males, who try to mate with the flowers, thereby pollinating them. Many innocuous animal species mimic the bright, contrasting colors of toxic species in order to hide from predators under the mantle of a warning signal. The harmless milk snake (*Lampropeltis triangulum*) closely resembles the red, black and yellow banding pattern of the poisonous coral snake (*Micrurus fulvius*). This impersonation, known as "Batesian"* mimicry, is common among insects. Many harmless fly species mimic the warning coloration of stinging bee or wasp species, even copying the hovering flight and body shape of the model to broadcast a false danger signal.

"Müllerian"* mimicry is another form of imitation, except here the mimic and the model share the same toxic attribute along with the warning signal. This double whammy adds greater protection because each species reinforces the shared signal, losing fewer members than it would without its toxic partner. The close resemblance between the monarch (*Danaus pleixppus*) and the viceroy (*Limenitis archippus*) butterflies are well-known examples of Müllerian mimicry.



An extreme example of Müllerian mimicry is exhibited by the Amazonian butterfly *Heliconius numata*, which has seven specific wing patterns. Each pattern mimics a different local butterfly species of the genus *Melinaea*. How *H. numata* maintains seven distinct patterns with no gradations has long puzzled geneticists. It's as if people only grew to 5, 6 or 7 feet tall with nothing in between.

Now a team of 23 biologists, headed by Mathieu Joron, National Museum of Natural History, Paris, has discovered that the *Heliconius* mimic employs an unusual genetic trick to conserve the seven patterns. The research is described in the August 14, 2011 issue of the journal, *Nature*.

Joron *et al*. sequenced the DNA of the chromosomal region responsible for the wing patterns. That DNA segment, containing 18 genes, forms a "supergene" cluster. The 18 genes cannot recombine with genes from a different cluster, but are locked together and inherited as a single unit. Each supergene falls into a hierarchy of genetic dominance; when the parents have different wing pattern supergenes, the offspring will inherit both versions, but will exhibit the pattern of whichever version of the supergene is more dominant.

Individuals generally inherit two sets of genes, one from each parent. During gamete formation (meiosis) DNA strands line up in pairs so that maternal and paternal genes controlling the same traits lay side-by-side in close proximity. The pairing is based upon the similarity of their DNA sequences. This is when maternal and paternal genes can normally recombine to form new varieties. But the DNA of supergenes does not recombine and the team has learned why.

By sequencing three versions of the seven possible supergenes, they found that in each version a different segment of DNA is reversed. Since the DNA strands of different supergenes contain large segments that don't match up, alignment during meiosis is blocked, effectively preventing recombination within the supergene and maintaining the seven distinct wing patterns.

"We were blown away by what we found," said Dr. Joron. "These butterflies are the transformers of the insect world. But instead of being able to turn from a car into a robot with the flick of a switch, a single genetic switch [supergene] allows these insects to morph into several mimetic forms—it is amazing and the stuff of science fiction. Now we are starting to understand how this switch can have such a pervasive effect."

Saul Scheinbach

*Each form of mimicry is named after the naturalist who described it, Henry Walter Bates and Fritz Müller.