

Part 3

Why Gene Duplication?

Chapter X

Duplication for the Sake of Producing More of the Same

The discussions presented in Part 2 revealed the true character of natural selection. It is not so much an advocator or mediator of heritable changes, but rather it is an extremely efficient policeman which conserves the vital base sequence of each gene contained in the genome. As long as one vital function is assigned to a single gene locus within the genome, natural selection effectively forbids the perpetuation of mutations affecting the *active* sites of a molecule. In the case of the enzyme locus, *tolerable* mutations might change the kinetic property such as pH optimum and Michaelis constant of the enzyme, but never the basic character. Therefore, the dihydro-orotase locus would forever remain the dihydro-orotase locus, and the β -galactosidase locus would remain the β -galactosidase locus.

It becomes quite clear that while allelic changes at already existing gene loci suffice for racial differentiation within species as well as for adaptive radiation from an immediate ancestor, they cannot account for large changes in evolution, because large changes are made possible by the acquisition of new gene loci with previously non-existent functions. Only by the accumulation of *forbidden* mutations at the *active* sites can the gene locus change its basic character and become a new gene locus. An escape from the ruthless pressure of natural selection is provided by the mechanism of gene duplication. By duplication, a redundant copy of a locus is created. Natural selection often ignores such a redundant copy, and, while being ignored, it accumulates formerly *forbidden* mutations and is reborn as a new gene locus with a hitherto non-existent function. Thus, gene duplication emerges as the major force of evolution.

Even before the advent of molecular biology, a number of geneticists with foresight, such as HALDANE (1932), realized the important role gene duplication played in evolution. However, full appreciation of the magnitude of importance was not possible until the elucidation of the coding mechanism enabled us to interpret evolutionary changes reflected in the direct gene products.

Although the creation of new gene loci by supplying redundancy is the most important role, there are other benefits the mechanism of gene duplication confers to organisms. When the metabolic requirement of an organism dictates the presence of