The developing genome? More than just packaging, the genome affects the way our genes change and develop

February 13 2012

Since Charles Darwin first put forth the theory of evolution, scientists have been trying to unlock the mysteries of genetics. But research on the genome — the organism's entire hereditary package encoded in DNA and RNA — has been less extensive. There is a tendency to think of the genome as a static and passive container of information, says Dr. Ehud Lamm of Tel Aviv University's Cohn Institute for the History and Philosophy of Science and Ideas.

In the *Proceedings of the 23rd Annual Workshop on the History and Philosophy of Science*, Dr. Lamm has introduced a critical new paradigm that redefines the genome as a dynamic structure that can impact genes themselves. "When you try to explain human society by reducing it to individuals, you neglect the fact that people are also shaped by their social environment. The picture is bidirectional," he says, explaining that the relationship between genes and genomes is comparable. "Genomes have a physiology — and genes are a manifestation of this."

His reconception of the genome could change both biological discourse and research. Focusing on notions such as genomic response to stress factors, his theoretical work has the potential to provide deeper insight into how organisms develop and evolve.

Changing genetic research

Historically, genetic research has relegated understanding of the genome to the background, says Dr. Lamm. Past theories that regarded the capacity of the genome to respond to its environment were largely dismissed. But the concept of the genome as a mere collection of genes is a hindrance to research, he says. Based on current empirical knowledge from the fields of genetics, epigenetics, and genomics as well as "thought experiments," a tool used by scientists and philosophers to analyze situations and experimental conditions, Dr. Lamm is bringing to light the consequences of a new perspective on the genome.

From its embryonic development and continuing throughout our lives, the three-dimensional structure of the genome is changing constantly. The subtle relationship between genes and genomes impacts properties such as recessivity and dominance — a result of the developmental system rather than an intrinsic genetic property — and the process of how genes are inherited.

Lamm calls mechanisms that are involved in genomic changes "genomic epigenetic mechanisms" (GEMs) and highlights their importance for understanding the evolution of both genomes and organisms. Some GEMs are activated under conditions of ecological or genomic stress and can lead to changes that are subsequently inherited, contributing to the evolutionary process.

Although research into genomic structure and dynamics is ongoing, existing information can be used to reassess central notions in evolutionary biology. Ultimately, the mechanisms of the genome impact how, when, and in what way genetic material acts, as well as the physiology of cells themselves.

Building a new conceptual framework

So far, no useful theoretical framework exists to help scientists

conceptualize the genome and the genes as a developmental system. Dr. Lamm hopes to provide it.

"The time is ripe to start thinking about how the genome and genes work as a system. With a gene-centric point of view, central concepts in genetics are problematic, most critically the gene concept itself. Considering the genome in addition to the gene might fill the gaps," concludes Dr. Lamm. With better conceptual tools, scientists can become more adept at thinking about these crucial biological systems.

Provided by Tel Aviv University