f16 So what is evolving? < proteomics, retrogenes, homeobox, evo-devo >

> And indeed one suspects that in fact the vast majority of features of biological organisms do not correspond to anything close to optimal solutions: rather, they represent solutions that were fairly easy to find, but are good enough not to cause fatal problems for the organism
> —Stephen Wolfram, *A New Kind of Science,* 2002.[1]

Changes in DNA can result in new proteins and determine where and when they are synthesized.[2]

In the 1920-30s, data from embryonic development study was marginalized as too sparse to contribute much to the *neo-Darwinian Synthesis* that eschews Lamarckian inheritance of acquired characters and finds for a back-and-forth link between an organism's genetic makeup (genotype) and its form and function (phenotype). How proteins are modified, when and where they are expressed, how they are involved in metabolic pathways, and how they interact with one another, is the new study of *proteomics* (derived, by Marc Wilkins, from the term *proteome* that he coined in 1994 for "proteins that are encoded and expressed by a genome").[3] Neo-Darwinian evolution is the reduction of genetic variation as a population becomes adapted to its environment as desirable genes for this spread throughout the population. Neo-Darwinian population genetics is weismannian in that the germ cell is protected by an impregnable barrier to what may affect the parent. However, "the nature of the organism" (intrinsic factors) and "nature of the conditions" (extrinsic factors), can have Lamarckian consequences though the agency of retrogenes. Edward J. Steele writes:[4]

In 1970 [Howard] Temin [[5]] and [David] Baltimore [[6]] first reported on reverse transcription in viruses that could cause tumours in chickens and mice. These C-type RNA tumour viruses were then renamed retroviruses (of which HIV is a family member).[[7]] But within a decade it was apparent that reverse transcription was not restricted to a special class of viruses at all. Indeed retrogenes and retrosequences began cropping up all over the genome from bacteria through to man. It is now conservatively estimated that perhaps a third or more of the genomic DNA has been made first into RNA and then copied back into DNA. There are probably hundreds of thousands of copies of these retrotransposons. How many of these are functioning genes given that we detect them because they are non-functioning pseudogenes? The suspicion arises that maybe the DNA of the entire genome has been processed through RNA before copying back into DNA (the tell-tale features of many of these retro DNA sequences is that they no longer have introns and possess "tails" as typically seen in mature RNA messages)[[8]].

In 1983 was the discovery of homeobox genes, which are cassettes of genes that play important roles in the development of all multicellular organisms. Study of homeobox genes has begun to reveal general mechanisms that underlie, in common, the development of morphologically diverse organisms. Peter W. H. Holland's "new Synthesis": 1) Evolutionary developmental biology (nicknamed "evo-devo"):[9] Morphological differences between species can be due to mutations in developmental control genes that cause large phenotypic shifts. However, numerous mutations of very small phenotypic effect can result from subtle differences in the regulation genes.[10] 2) Populations can harbor extensive genetic variation with the potential to cause morphological change. Particular conditions reveal these.

Evolutionary "choices" made during development can thereafter constrain evolution. Themes recur when cassettes of regulatory genes switch on and off developmental features again and again in the course of evolution. (Example: Tunicate larvae are found by Billie Swalla from their genes-reconstructed evolution, to have repeatedly gained and lost their tails.) Hox genes are conserved because any change "might mess up the whole body," says **Sean B. Carroll**. But stretches of DNA that homeotic proteins (the Hox genes' product) bind to, and so control, are not conserved as genetic accidents that duplicate segments make spares that evolve freely while the other segments continue their original function.

Evo Devo layers-over population thinking with typological schemas.[11] "Evo Devo reveals that macroevolution is the product of microevolution writ large." —Carroll, 2005.[12] ❑