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Some Thoughts on 50 Years Experience In Biology

From the vantage point of 2007, in a new millennium, the status of biology in the early 1950's seems primitive and inactive. But biology, as well as many other areas of the physical and biological sciences was just beginning a period of radical revolution. New basic landmark discoveries in biochemistry were being made, the most spectacular of which was the divining of the structure of the DNA molecule by Crick and Watson. New scientific tools, such as radical improvements in electron microscopes generated new ultrastructure studies, were defining for the first time the structure of the cell. The theory of "one gene-one enzyme" came to dominate the basic genetic/physiological philosophy. In rapid order, the structure of nucleotides was determined, and the so-called genetic code was decyphered. The details of the relationships of RNA to DNA were worked out, and replication, transcription, and translation were understood, and this facilitated an explosion of new discoveries. The details of cellular respiration, the biochemical pathways concerning glycolysis and the Kreb's carboxylic acid cycle, and the hitherto mysteries of photosynthesis were worked out. None of this was known in 1952-1953, so in retrospect, biology was at best, a sluggish field.

Evolution is the unifying principle of biology. In the early 1950's, the basic taxonomic evolutionary relationships had been thoroughly worked out in a painfully slow, systematic fashion based on principles of what is now known as "classical biology," through the macro fields of comparative anatomy, comparative embryology, and in a more primitive way, comparative physiology. In the last 50 years, evolution has been reevaluated in light of every major discovery. Our greatest understanding has been in the details of evolution on a molecular level. The ultimate result has been that there were no surprises, no radical reorganization of the inter-relationships of the various plant and animal groups, though we understand the structure and function of bacteria and viruses for the first time.

The specialty of "molecular biology" began slowly around 1960, and biochemists began taking over the area that was pejoratively designated as "classical biology." I have observed the development of the biological sciences through the years for over half a century, and watched investigators become more interested in the biochemicals in organisms than in the

organisms themselves. Many "biologists" cannot recognize the species whose cytology and physiology they study. The organism lost its importance, and was only considered to be the convenient containers that carried DNA. *The chicken was the egg's way of producing another egg!* I am more impressed with the overwhelming evidence that a molecular approach has given to biology an understanding of the basic unity of all organisms on all levels of organization. All are composed of the same carbon-based chemicals, and carry nucleic acids with common sequences of nucleotides forming the genes. All of life on the planet share a common origin, and organisms were subjected to the same forces of evolution which has resulted in an incredible variety of forms.

So the biological paradigm in the early 1950's was a narrow one, but very basic. All that I can see that molecular "biology" has done to zoology is to verify the relationships between animal species that had already been worked out through "classical" studies. There have been no surprises. We still do not know about why one molecular pattern is superior over another one, or why one is selected for, and another is selected against, today than we did in the early 1950's. And the molecularists don't yet seem to recognize the possibility/probability of adaptive convergence on the molecular level. When they do that, it might be a humbling event. I am saddened by the observation that the organisms of our biosphere are not being considered holistically -- that entire animals and plants, bacteria, fungi, and prokaryotes are not being discussed much in the teaching of biology. When I retired from Transylvania college in 1996, many "biology" majors were graduating who thought that whales were fish! My plea is for students to be exposed to a balanced, holistic view of biology, on the molecular, cellular, organismic, and population levels. If I were a beginning student today in most undergraduate level biology courses, I don't think that I could become interested in the field, which has become too abstract and undemonstratable. I guess I am suspicious of experimental evidence that requires heroic application of complicated statistical formulas in order to "prove" that some change has taken place. If a change occurs in a test tube, I would still have to take the instructor's word explaining the reason why it did.

REALITY

In Plato's cave allegory, a man is chained in a cave, with a light source behind him, watching shadows on the wall in front of him, and considered them reality. I have witnessed a modern version of the cave experience. Nucleic acids, combinations of which make up DNA are determined by sequences of triplets of paired nucleotides. These structures are identified by electrophoresis, a process of separating nucleotdes according to their molecular weight and electrical charges. The result is a sheet of paper covered by blobs of shadowy darker areas that resemble the shadows on the walls of Plato's cave. Students today are being told that these shadowy images ARE reality. Alas, we are still chained in a cave, watching flickering shadows, confident that we know what reality is.

J. Hill Hamon, Frankfort, Kentucky
KyHamon@AOL.COM