

## Reply to Larry Moran's *RNCSE* review of *Evolution: A View from the 21<sup>st</sup> Century*

Before I saw Larry Moran's book review, I wrote the following: "It is a shame that NCSE chose Larry Moran to review my book. Not because of anything he said in the review but because he is hostile to new ideas and perspectives."

A year ago, Larry posted a blog entitled "Physicists and Biologists" on his *Sandwalk* web page (<http://sandwalk.blogspot.com/2011/08/physicists-and-biologists.html>). In this blog, he ridiculed the enthusiasm I expressed in the book for physicists coming into evolutionary studies and bringing new skills and new ideas.

Here's one of Larry's comments in his blog:

"Meanwhile, I welcome all those physicists who know nothing about evolution, protein structure, genetics, physiology, metabolism and ecology. That's just what we need in the biological sciences to go along with all the contributions made by equally ignorant creationists."

What a great way to make new friends for evolution science – equating physicists with creationists and calling them “equally ignorant”!

The scientific community is engaged in an important struggle to convince the public of the reality of evolution and the importance of evolution science. NCSE is the organization entrusted with representing us. The shame in NCSE choosing Larry is that he seeks to alienate everyone not educated in a certain way. Hardly the best choice to convince the public that evolutionists are open-minded and that evolution science is an active, exciting and forward-looking field.

Now that I have seen Larry's review, I have to conclude that my expectations were, sadly, fulfilled. Let me illustrate what I mean by summarizing what I tried to say and giving a few quotations from the review.

My argument is that molecular research over the past 60 years on DNA change processes has taught us that virtually all genetic variation results from the action of regulated cell biochemistry, including a wide array of cutting, splicing and polymerizing functions that I summarize under the term “natural genetic engineering.” I assert that this realization represents a fundamental shift from the conventional view that genetic change is a random, accidental process.

I discuss these molecular discoveries, which continue well into the 21<sup>st</sup> Century, in detail in Part II of my book, entitled “The genome as a read-write (RW) storage system.” I used this title because another way of stating the conceptual change I see is to say that we have to substitute a RW view of the genome for the conventional notion of a “read-only memory” (ROM), which changes only by copying errors. As far as I know, others had not made this argument before I started writing about it in primitive fashion almost 30 years ago (Shapiro, 1983). I suspect the idea of a RW genome is still new to most readers of these *Reports*.

In his review, Larry tells us “**I have to confess that I skipped most of this chapter** [i.e. Part II, emphasis added]. I know about genome rearrangements and so does everyone else who has read a textbook in the past forty years.” Frankly, I am

not aware of textbooks that have routinely covered mutator polymerases, diversity-generating retroelements, retrosplicing group II introns, CRISPRs, SINE elements and many other natural genetic engineering systems over the past 40 years. In fact, one of the reasons for writing the book was that people who had seen my journal articles would often ask, “Is there a book where I can read more about this?”

Larry goes on to write scornfully about the large amount of tabulated information I included, “A litany of examples is not only overkill, it smacks of an agenda.” I did have an agenda, to be sure. As I told the reader in my introduction,

“The goal of this book is to acquaint you with previously ‘inconceivable’ but currently well-documented aspects of cell biology and genomics to prepare you for the inevitable surprises in evolutionary science waiting for us as this new century runs its course.”

How else to do this but by laying out the facts exhaustively and organizing them in a way that lets them tell a coherent story by themselves? Larry, by acknowledging that he did read the most detailed part of the book, was not particularly interested in learning what the facts or my interpretation of them might be.

Ignorance of what I actually wrote in detailed support of my argument is not the only shortcoming of Larry’s review. He makes a number of erroneous statements that clearly seek to minimize the evolutionary importance of what I had to say in the book.

For example, I cited whole genome duplications deduced from sequencing as a key part of the DNA evidence for abrupt, multi-character changes in evolution. Such duplications have been fully documented in yeasts and other fungi, in protists, in an extremely wide range of flowering plants (Darwin’s “abominable mystery”), and at the origins of vertebrate evolution.

To counter my position, Larry writes,

“His main thesis seems to be that such mutations are not random as neo-Darwinism demands. Genome duplication is one example. There may have been two genome duplications in the vertebrate lineage. Both of them occurred in fish.”

This is wrong and misleading. There were indeed two genome duplications in the history of teleosts, at key points of phylogenetic diversification, but they were far from unique in vertebrate evolution. I was quite explicitly referring to the pair of duplications that, successively, coincided with the origins of all vertebrates and then of all jawed vertebrates (Nakatani et al. 2007). I think *RNCSE* readers will agree that these certainly constituted major events in animal evolution.

Larry continues to depict what I had to say about the evolutionary role of natural genetic engineering as exaggerated:

“Another example involves transposons. In the hominid lineage there may be evidence of a few transposon-related genome alterations that turned out to be

beneficial and subsequently became fixed in the population. That's a rate of approximately one every million years or so."

This downplaying of the role of transposons (a class of mobile genetic elements) is quite an ironic assertion. The rate with which "transposon-related genome alterations" are being discovered by parsing genome sequences is truly astonishing. At the end of last year, a group of bioinformaticians published a *Nature* paper examining the human genome as compared to 29 other aligned vertebrate genomes. They said:

"We report ... 280,000 non-coding elements exapted from mobile elements and more than 1,000 primate- and human-accelerated elements" (Lindblad-Toh et al. 2011).

Perhaps Larry would not have made his tendentious error about the rarity of "transposon-related genome alterations" if he had not have skipped so much of the core of my book.

Finally, since I spoke of cell sensory mechanisms and cognition, it was predictable that Larry would pull out the Intelligent Design card and make disparaging use of the fact that I published two peer-reviewed papers on the importance of repetitive DNA in 2005 with Rick von Sternberg (Shapiro & Sternberg, 2005; Sternberg & Shapiro, 2005). Rick turned out to become something of an ID cause célèbre the following year.

"Shapiro's views seem to be philosophically similar to those of Richard Sternberg (Richard von Sternberg)—the two of them published several articles together a few years ago."

What Rick's personal views have to do with these papers or the contents of my book, readers can judge for themselves. I am happy to stand by their scientific validity. The fact that Larry chose to use a "guilt-by-association" approach to criticize my book speaks volumes about the character of his review.

Let me reiterate in closing that it is a shame NCSE chose someone who wrote such a closed-minded and ill-informed review of my book as Larry Moran did. This review will only help the opponents of evolution science. Larry's review fits the Creationist cartoon of evolutionist views all too well: prejudiced, uninterested in facts, and unwilling to change positions in the face of new ideas and data.

The truth is that this happens to be one of the most exciting periods in evolution science because of all the revolutionary new molecular data. I invite RNCSE's readers to find some of it in my book or in the copious reference lists I have posted online at <http://shapiro.bsd.uchicago.edu/evolution21.shtml> .

## References

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