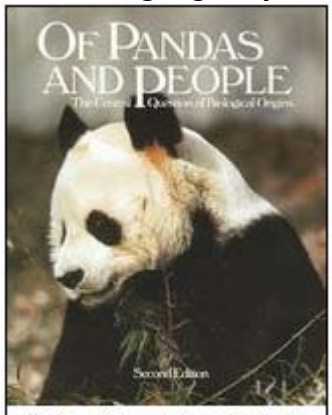
Complexity too allows changes

The environment is found to be capable of driving nature to select the improbable, says S.Ananthanarayanan.

A team of biologists at the University of Michigan and Taiwan's National Health Research Institutes has found evidence to counter one of the main arguments against the theory of evolution of the species. This school of thought argues that the incredible complexity of living things is simply not explicable by a theory that depends on random events bringing about the changes. The Michigan and Taiwan team finds that it is in moderate complexity, as opposed to simple systems, that evolutionary changes occur most readily.

Darwin controversy

Darwin's conclusion, based on observation and data, about the evolution of species went against the Biblical view of creation and drew flak from many quarters. The process of ***natural selection*** was viewed as ***undirected*** and in its place, it was held that the wonders of nature were unthinkable without an agency of ***intelligent design***. The concept grew in importance when the state of Louisiana in USA passed a law that schools should teach the theory of creation, as described in the ***Book of Genesis*** in addition to the theory of ***evolution***. The law was struck down by the US Supreme Court as against the Constitution as the law had the effect of advancing a particular religion. The movement had become so strong that a school text book, ***Pandas and People***, presenting arguments against the theory of evolution, was published with the description, '***The Design of Life: Discovering Signs of Intelligence in Biological Systems'***.



School text book that promoted creation in preference to evolution

The idea of intelligent design however has had other champions, and the work of ***Ronald Fisher***, noted English statistician and evolutionary biologist has been used to promote the idea that evolution by natural selection is unlikely in the presence of complexity. Ronald Fisher was a pillar of modern statistical and information theory and is counted among the greats in every field he touched. But one of his conclusions was that the more complex an

organism, the more difficult it would find it to adapt to changing conditions. This seems intuitively appealing, as a more complex organism would clearly need to carry out more complex changes to adapt and there is less chance of these changes coming about through the random process of mutation and evolution. Fisher had suggested that random mutations, which get selected to drive evolution, are more likely to benefit simple organisms than complex ones.

Ronald Fisher, statistician, biologist, eugenicist, geneticist

Think of a hammer and a microscope," says one of the Michigan university researchers, "One is complex, one is simple. If you change the length of an arbitrary component of the system by an inch, for example, you're more likely to break the microscope than the hammer."

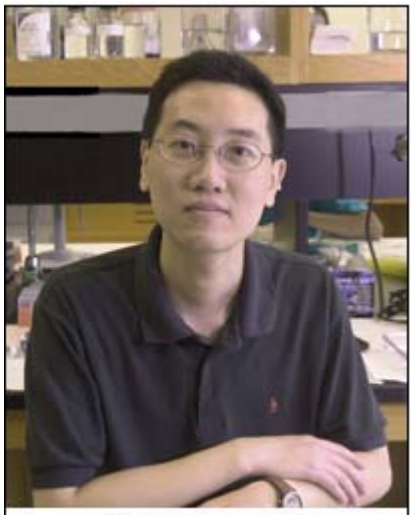
In a paper published in 2000, evolutionary geneticist H. Allen Orr of Rochester proposed another reason for the cost of complexity. According to his model, even if a mutation benefits a complex organism, it would lack a simple mechanism to spread throughout the population and become "fixed." And in the case when it is able to do that, the advantage of the mutation is likely to be small.

For all the evidence of fossil records and current day understanding of the genetic bases of evolution, the difficulty of random events bringing about evolution in complex organisms has thus been a problem.

Facts re-examined

Professor Zianzhi “George” Zhang and colleagues, at Michigan and in Taiwan, took a fresh look at this mathematically evolved idea of the ‘***high cost of complexity***’. Their study examined a genetic phenomenon called ***pleiotropy***, where a single gene affects more than one trait. There are many instances of such genes, including some which are involved with the features of development and aging. In early years, these genes promote cell division and growth. But keeping this action going in later years, to maintain tissue

health, would also shut down the contrary tendency to inhibit cell division and growth of cancers.



Zianzhi Zhang PhD

Although it is difficult to measure Pleiotropy or to follow its general patterns, there have been mathematical models, based on a number of assumptions, of how pleitropy could affect evolution. The work of Zhang and coworkers was to test the assumptions against real-life observations by analyzing several large databases that catalog the effects of specific genetic mutations on traits in model organisms (yeast, roundworms and mice). Each data set included hundreds to thousands of genes and tens to hundreds of traits.

For simplicity, the mathematical models have assumed that all genes affect all traits. A first finding was that this assumption is not true – most genes affect only a small number of traits and only a few genes affect large numbers of traits. The other findings were that there are groups of genes, which affect groups of traits and again, that the more traits a gene affects, the stronger its effect on each trait.

These discoveries profoundly affect the assumptions from which the difficulty of evolution in complex systems is derived. Mutations in a few genes that affect a large number of traits could then bring about major changes. While it is true that complexity does bring its own baggage, it is in the very simple organisms that greater numbers of simultaneous genetic changes may be need for adaptation. The analysis, in fact, shows that the ability of organisms to adapt is highest at intermediate levels of complexity. "This means a simple organism is not best, and a very complex organism is not best; some intermediate level of complexity is best in terms of the adaptation rate," says Zhang.

The work of Zhang and Co strengthens evolutionary biology against the criticisms of intelligent design proponents. Zhang says, "The evolution of complexity is one thing that (proponents of intelligent design) often target. Admittedly, there were some theoretical difficulties in explaining the evolution of complexity because of the notion of the cost of complexity, but with our findings these difficulties are now removed."

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