Part 3: The Evolution of the First Genes

Hemoglobin is the protein that caries oxygen in the blood of many animals.

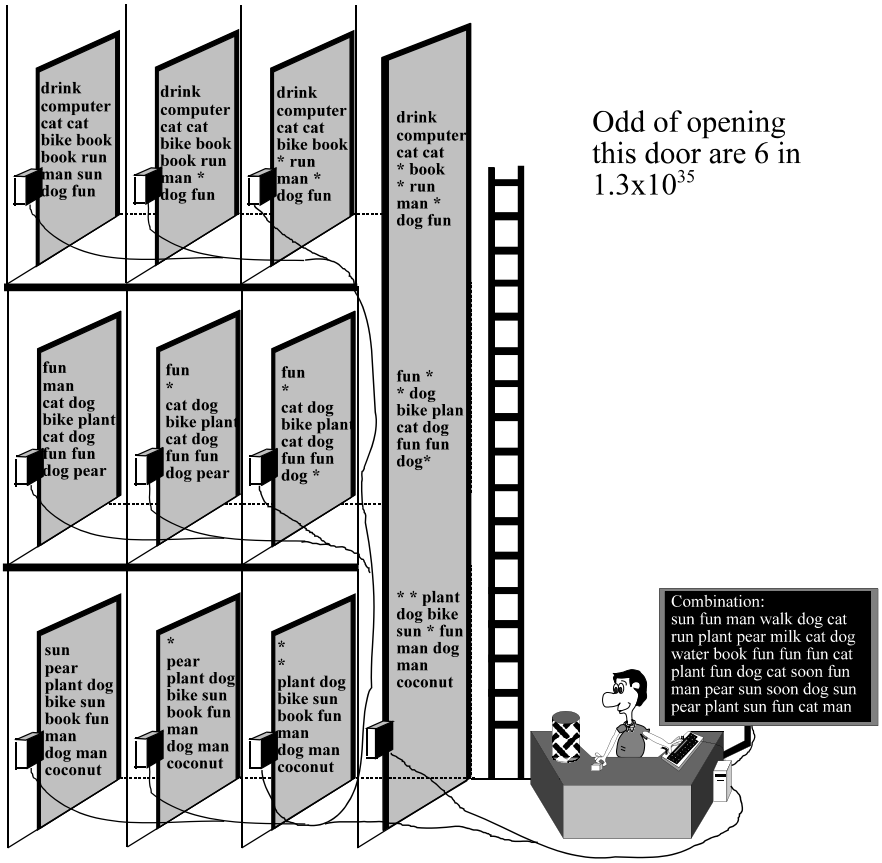
Chapter 12: Irreducible Complexity

Irreducible complexity was coined by Michael Behe in his book Darwin's Black Box. The idea is that many biological systems require several parts to function properly. Without all of the parts, the system does not provide any selective advantage, and natural selection cannot preserve or optimize it. Behe used a mousetrap to illustrate this concept in his book. The mousetrap does not function properly if any of the pieces are missing. The drawback with the mousetrap analogy is that it does not lend itself to a mathematical analysis.

The trapped scientist example will now be used to show how and why irreducible complexity makes evolution very difficult. Unlike previous examples, the scientist is in a three story building. There are three doors on each floor. But to get to these three doors, the scientist has to open one door that is three stories high (figure 12.1). This door has a very long combination, but once it is open, the combinations for the small doors are easy to find.

Figure 12.1 represents any system that requires three components to function. No selective advantage is realized unless all three components exist. Thus, the first door's combination represents three infons (instead of one). When the first door is opened, all three components exist, and the system conveys a selective advantage. If the scientist ever opens the door, then the knowledge is preserved by the computer. The computer will lock the 27 words needed to open the door, and the scientist will only be able to change 9 words. As he continues, the other doors will be opened very quickly as the steps are small (one word). These small doors optimize the three new genes and their associated proteins.

Figure 12.1: An Irreducibly Complex System



The odds for opening the first door are found as follows: this door requires 27 letters to be correct, and each letter has a 1 in 20 chance of arising by chance. So the odds of finding the combinations are 1 in 20^{27} tries. The odds are actually slightly better. The 27 required letters on this first door can be divided into 3 groups, and if the group associated with the bottom floor is switched with the one on the top, then the door should still open because all 3 infons still exist.

These three groups can be arranged into 6 different combinations because each series of doors can be moved to another story. For example, the doors on the first story can be moved to the second, and those on the second are moved to the first. Thus, a total of 6 outcomes will open the first door with 20^{27} attempts. This corresponds to 6 times in 1.3×10^{35} tries or a 1 in 2.2×10^{34} chance.

This example can be extended to cover more complex systems by imagining a scientist in a taller building. Perhaps, the first door is 10 stories high instead of three. In any case, the odds of the scientist opening the first door are vanishingly small.

Examples of irreducible complexity exist everywhere in life. The best examples are the metabolic pathways that synthesize complex chemicals. Metabolic pathways are a series of chemical reactions regulated by enzymes. These chemical reactions may create biological molecules like adenine, cytosine, uracil, thymine, glucose or ribose. The next chapter will consider one such pathway. It is the pathway that all living things with the exception of few parasitic organisms use to make adenine.

Reference:

Behe, Darwin's Black Box: the Biochemical challenge to Evolution, Touchstone, 1996.