

The Living Genome

Tina Munjal, '12

The genome is indeed a curious creature. You may find it strange for a set of assorted strings of nucleotides to be referred to as a “creature,” because the implication would be that this collection of macromolecules is somehow alive and capable of self-preservation. Indeed, this is precisely the portrait that author Matt Ridley paints in his novel entitled *Genome: The Autobiography of a Species in 23 Chapters*.

Evidence for the idea of genomic autonomy can be found in the very origins of life. Ridley ponders these beginnings when he says, “It now seems probable that the first gene, the ‘ur-gene,’ was a combined replicator-catalyst, a word that consumed the chemicals around it to duplicate itself.” Thus, this gene served no higher purpose than to ensure its own survival and propagation. The ur-gene was not a subservient sequence.

If the initial purpose of genes was to attend to themselves, how is it that DNA has, over time, become an instrument of the organisms in which it resides? Or has it? As Ridley explains, it may be quite possible that the genome remains the omniscient executive, and the organism is but its compliant agent. The end goal of the genome-organism system is the proliferation of the genetic material itself, not of the “essence” of the organism in any platonic sense.

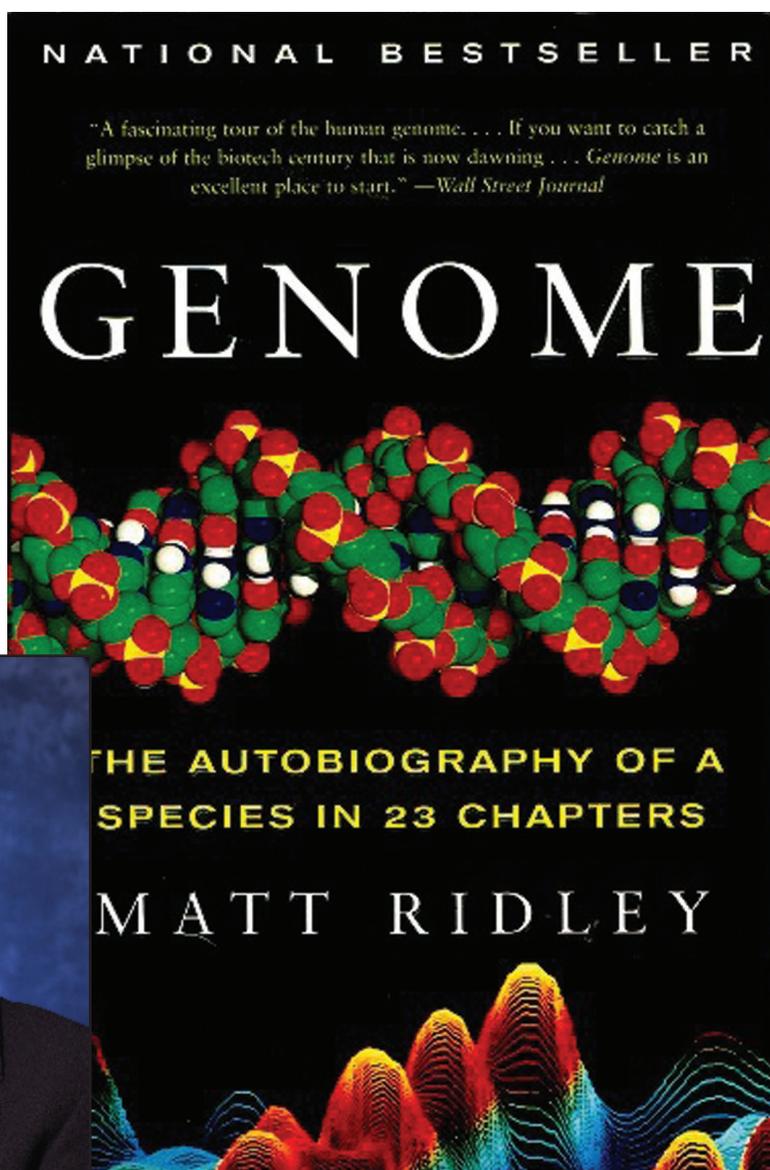
The most fundamental display of this phenomenon occurs during bacterial conjugation, in which each bacterium is a “temporary chariot” for the genes it carries. The transfer of genetic material can then be compared to the formation of “transient alliances” between the involved parties. Ridley proposes that, over time, genes “found a way to delegate their ambitions, by building bodies capable not just of survival, but of intelligent behavior as well. Now,

if a gene found itself in an animal threatened by winter storms, it could rely on its body to do something clever like migrate south or build itself a shelter.” The author’s choice of words leaves no doubt that the genes, although relatively flexible masters, do indeed hold the reins over the actions of the organism to ensure that they are in agreement with—not in opposition to—the survival of the genetic message.

Extending this notion of genes as active doers rather than passive

coders, Ridley offers a plausible explanation for the presence of so-called “junk DNA” in the genome. He likens these seemingly useless sequences, such as retrotransposons, to parasites that, at some point in the distant past, invaded the endogenous DNA. Just as there is war among nations to exert and expand influence, there is “competition between genes using individuals and occasionally societies as their temporary vehicles.” DNA is therefore much like a battle zone in constant evolutionary flux.

Ridley’s novel discussion about the relationship between genome and organism is at once fascinating and humbling. However, it would be insufficient to state that all of the actions

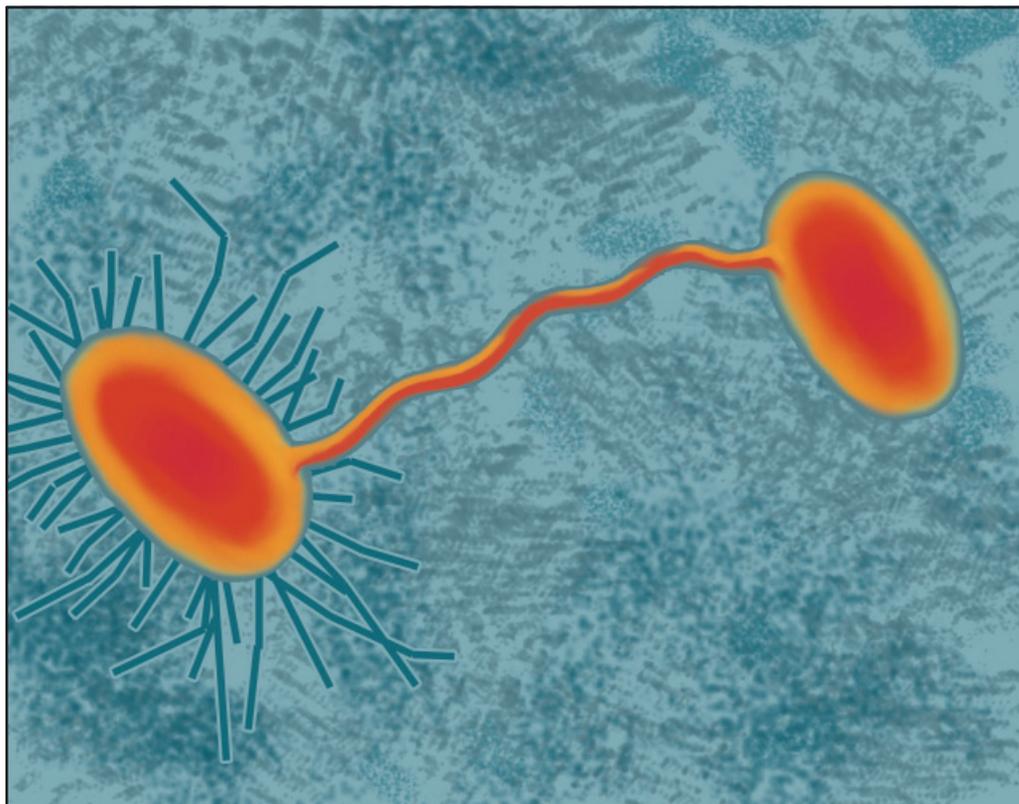


Above: Book cover of *Genome: The Autobiography of a Species in 23 Chapters*. Left: Photo of Matt Ridley, the book’s author. (Both images are courtesy of Eunice Ridley)

of an organism, especially a human, lead so imposingly and inevitably, to nothing more than the proliferation of a collection of genetic material. Further, the image of the genome as the driver of some insentient chariot is not enough to describe the intricate exchanges that occur between genes, mind, body, and environment. Ridley does recognize this fact and even likens the fragile interaction to the workings of a free market. Just as there is no centralized authority in command of making the economy's decisions, "You are not a brain running a body by switching on hormones. Nor are you a body running a genome by switching on hormone receptors. Nor are you a genome running a brain by switching on genes that switch on hormones. You are all of these at once." The organism, then, possesses a variety of hierarchical systems that work simultaneously to form a functional whole.

This idea of shared authority smoothly propels Ridley's discussion into the concluding philosophical treatise on determinism versus free will. On the one hand, there are those who would argue that genes are not what foster the development of behavior and personality—this view would be entirely too deterministic. Instead, proponents of the alternative hypothesis believe that the environment, not an intrinsic genetic factor, shapes individuals. However, as Ridley asks, is this not even more deterministic? He cites the example of Aldous Huxley's frightening novel, *Brave New World*, in which "alphas and epsilons are not bred, but are produced by chemical adjustment in artificial wombs followed by Pavlovian conditioning and brainwashing..." In this world, genes factor very little into the equation, and the hellish, deterministic society is created entirely by environmental manipulations. So the essential question remains: do we have conscious control over our fates? The dilemma is not a new one. As Ridley points out, the philosopher David Hume summarized the problem through Hume's fork, which states, "Either our actions are determined, in which case we are not responsible for them, or they are random, in which case we are not responsible for them."

Perhaps the best answer comes from chaos theory, which states that a general course of events can be predicted with some



In Matt Ridley's terms, the transfer of genetic material through bacterial conjugation can be thought of as the formation of an alliance in which the bacteria themselves act as chariots for the DNA they contain. (Image re-created by Katelyn Gray)

certainty, while the finer details of this course remain unknown. As Ridley explains, due to various reasons, an individual chooses whether to eat a particular meal and the time at which the meal is taken. It can be said with confidence, however, that the

individual will eventually eat at some point in the day. Eloquently, Ridley begins to close, "This interaction of genetic and external influences makes my behaviour unpredictable, but not undetermined. In the gap between those words lies freedom." There is indeed flexibility within determinism, and consciousness alongside instinct.

For all of its impossible questions and imaginative answers, Matt Ridley's book on the self-replicating, autobiographical, living, changing genome is worth its place on any

genome-holder's bookshelf.

Tina Munjal is a freshman double-majoring in Biochemistry & Cell Biology and Cognitive Sciences at Wiess College.

Reference

1. Ridley, Matt. *Genome: The Autobiography of a Species in 23 Chapters*; Harper Perennial: New York, 1999.

