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The Poetry of Genetics:
On the Pitfalls of Popularizing Science

Anita L. Allen

et neque utrum superavit eorum nec superatumst”

(“Neither conquering, neither conquered”)

–Lucretius¹

What role does genetic inheritance play in the way human beings look and behave? This is a question about the biology of human sexual reproduction, one that gene scientists connected with the Human Genome Project dashed to answer before the close of the 20th century. This is also a question about politics, and, it turns out poetry, because poetry is an ancient tool for the popularization of science. “Popularization” is a good word for successful efforts to communicate elite science to non-scientists in non-technical languages and media.

According to prominent sociobiologist E.O. Wilson, “sexual dominance is a human universal.”² He meant, of course that men dominate women. But is this assertion science or politics? Some would say that it is politics, and the politics of patriarchy at that.³ Like sociobiology, gene science is freighted with politics, including and especially, gender politics. Scientists are men and (to a lesser extent) women with gender biases and perspectives comparable to other classes of educated citizens. These biases and perspectives may color what scientists “see” in nature. Scientists accustomed to thinking that men naturally dominate women, might interpret genetic discoveries accordingly. Biologists have good, scientific reasons to fight the effects of bias. Imagine the disaster for genetics if Gregor Mendel had viewed his pea plants as male and female in the human, cultural sense, and allowed patriarchal bias to drive his observations. He might have been slow to see the equality of contribution from parent plants,

each contributing a share of the invisible “factors” we now call genes.

“[S]cientists are not detached observers of nature,” nor are the non-scientists who popularize science detached observers of nature and what scientists say about it.⁴ Gender biases and perspectives doubtless also color what these translators “see” in scientific research. We are properly cautioned by the politically-minded, including feminists, to be critical of how scientists and popularizers of science frame truth and theory. It seems to matter, still, who plays what role in genetic inheritance and making babies. One has the sense that it would be politically inconvenient if it turned out that either men’s or women’s biological roles could be plausibly interpreted as more important.

On the surface, the roles played by each sex are arguably comparable and complementary. They seem that way to me. In ordinary sexual reproduction, up to the point of impregnation, both sexes play similar, vital roles. Setting aside cloning for a moment, each must contribute a gamete. Off-spring are the products of a union of sperm and egg. Off-spring receive half of their DNA from a woman’s egg and half of their DNA from a man’s sperm. This tale of equality is not the full story for anyone pre-committed to the “battle of the sexes” version of genetic inheritance. In that version, men are encouraged to gloat because their sperm can carry either the X or the Y chromosome, whereas women carry only the X chromosome. The males of the species do the important work of determining who will be male and who female. Men score points in the battle of the sexes because color-blindness and number of more serious genetic disorders are X-linked. That is, they arise because of mutations on the X chromosomes inherited from mothers. But women score points from the observation that it is the double-dose of the Y chromosomes that some researchers used to believe played a role in criminal insanity

among men with the XYY chromosomal abnormality. Women may boast that they are the critical gestators of fertilized eggs. Women may take competitive pride in being less dependent on men than vice versa to achieve their reproductive goals. In the not-to-distance age of reproductive cloning, men become superfluous to women who want daughters. The unique source of human ova for denucleation, women can produce generations of female clones without any sperm at all.

The “battle of the sexes” has a doubtful place in serious science, and is morally repugnant in that context. Yet, in the on-going social negotiations over the allocation of power and responsibility between the sexes, one senses with regret that some tangible advantage might be had by the sex which experts say dominates reproduction or is most determinant of whatever we value most about human life and its perpetuation. Heaven forbid that research reveals that violence stems from men or intelligence from women! We are therefore cautioned by the politically-minded to trust no scientist and no popularizer of science too much. They have political biases affecting what they think they have found or found out.

The late Professor Susan Okin Miller, a prominent feminist and political theorist, was one such voice of caution. In an unpublished paper presented in 2002 at Washington University, St Louis, at a conference devoted to assessing the Human Genome Project, Professor Okin regretted that popularizers of recent findings in genetics and evolutionary biology are following in what she characterized as Aristotle’s footsteps. Like Aristotle, contemporary popularizers (1) understand the universe in remarkably teleological terms; (2) tend to see in science what they expect to see, and (3) fall prey to “tenacious and pervasive sexism.”⁵

“Teleological” thinking in scientific understandings of human sexual reproduction is

especially disturbing. As Professor Okin has pointed out, teleology in this domain easily turns sexist. Women are nurturers and caretakers by design. Their natural *telos* or purpose is to serve men and aid men's more important purposes. Women are handmaidens, ancillaries. Aristotle assumed gender differences, female subservience and male super-importance. Aristotle deemed women's role in human reproduction to be that of a passive vessel of soil into which men plant the seed whence springs human life. The vital, active force, the seed, comes from man. Women provide the inert medium of creation. Women are important; but, less important.

In her 2002 remarks—I was privileged to hear them and indeed assigned to comment on her paper-- Okin illustrated her general claim that Aristotelianism is in the air through an analysis of Matt Ridley's best selling book, Genome (2000). Okin accused Ridley of sexism and feminist-baiting. In some respects, it is easy to see why. Ridley's discussion of sex in his chapter on chromosome 15 provided Okin with what she took to be a striking example of teleology stained by sexism. Ridley implied that, by reason of their biologies, each sex has unique traits, virtues and roles:

Boys and girls have systematically different interests from the very beginning of autonomous behavior. Boys are more competitive, more interested in machines, weapons, and deeds. Girls are more interested in people, clothes, and words... [M]en like maps and women like novels."⁶

In labeling this kind of writing "sexist," one need not deny that science has found differences between males and females, or that science could discover genuine, significant differences in the future. The point of the condemnatory label of "sexist" is that science is unlikely ever to show that the kinds of differences Ridley pointed to as "systematic" are biologically based. Besides, men also like novels and women also like maps. Now, to be charitable, one should perhaps assume that Mr. Ridley's quip about maps and novels was intended as humor. But for a science

writer writing to educate non expert voices, as well as to entertain, the risk is great that someone will take his entertainments literally and seriously. The humor (if I am correct that he intended humor) was misplaced.

Serious readers looking to Ridley for unbiased information, rightly condemn his lapse into sexist entertainment-journalism. But fairness to Ridley's book requires that his reader-critics take a broader look at his efforts. His efforts are largely effective and admirable. They are not largely sexist or unthinkingly "teleological," in Okin's sense, about the roles men and women play in the natural world. Professor Okin unpersuasively criticized Ridley for beginning Chapter 15, a chapter entitled "Sex", with a discussion of a pair of paintings of an obese girl, hanging in the Prado Museum in Madrid, Juan Carreno de Miranda's 'La Monstrua vestida' and La Monstrua desnuda'. But while "fat girl" jokes are popular forms of entertainment in American culture, Ridley does not abuse the image of these paintings as a sophisticated "fat girl" joke. Far from it. The five year old child portrayed suffers from Prader-Willi syndrome, a serious genetic syndrome that Ridley is warranted in profiling. He does so without resorting to "fat girl" jokes, and in fact, takes exception to the 17th century painter's use of the term "monster" to describe the morbidly obese youngster. Ridley uses the painting to illustrate that some genetic disorders are the result of gene mutations inherited from one parent only. The girl in the painting suffers from a mutation inherited through the male parent. Other genetic mutations, such as Angelman's syndrome, result from inheriting a defective gene from one's female parent.⁷

Professor Okin also unpersuasively criticized Ridley for his treatment of psychologist John Money's famous flawed twin-study. Ridley strongly condemned Dr. Money, the John Hopkins researcher who believed his work with sex-assigned patients proved that gender identity

is solely a matter of nurture not nature. But Ridley does not condemn Money for the purpose of belittling feminist nurture-theorists who once relied on Money's later discredited twin-study. It is real tragedy that Money's questionable clinical, research and publishing ethics contributed to a life of misery for a poorly educated Canadian couple and their twin sons, one of whom lost his penis in a botched circumcision, and both of whom committed suicide.⁸ It is not sexist or anti-feminist to point out that some of the very "best" elite research pointing to nurture over nature, turns out to have been weaker than it once seemed. Ridley's "men like maps, women like novels" quip, suggests, though, that his own bias is toward a nature theory of gender. Professor Okin may understandably have read his criticism of Dr. Money as a way of advancing his own "nature theory." Ridley's playful sex stereotyping in one place in the book, undermined his credibility in another.

Although Ridley is not fairly criticized as having written a significantly "sexist" book, he admittedly did capitalize on "battle of sexes" thinking, which sometimes has sexist, "teleological" undertones. Ridley sought to make gene science more popular by highlighting the competitive, antagonistic, and in those senses, political nature of sexual biology:

"The idea of genes in conflict with one another, the notion of the genome as a sort of battlefield between parental genes and childhood genes, or between male genes and female genes, is a little known story outside a small group of evolutionary biologists. Yet it has profoundly shaken the philosophical foundations of biology"

What is good for parents may not be good for children, Ridley reported. Of greater interest here, what is good for females of the species is often deleterious for males.

One of Ridley's chapters, denominated "X and Y," was largely about conflict between the sexes. Half-way through the chapter on conflict Ridley advised readers that the "violence and

conflict” promised at the beginning of the chapter was forthcoming; and that what might thus far have looked like mere molecular evolution was linked to “real human conflict.”⁹ He explored the fascinating theory that the placenta, so vital to human reproduction, is actually a kind of male parasite boring its way into the resistant female womb to provide a haven for the embryos that are (hu)man’s path to genetic immortality. He wrote of “sexually antagonistic genes.” There is an “antagonistic” relationship between the genes responsible for sex characteristics. As Ridley told the story, DAX (the gene on the X chromosome that makes women and even some genetic males develop into normal females) and SRY (the gene on the Y chromosome that “makes men into men”) battle for dominance.¹⁰

That said, Ridley was not the problematically sexist, teleological science writer Professor Okin seeks to condemn. Indeed, Ridley shares many of Okin’s concerns about bias in science. In a number of places he comments on the detrimental effects of seeing what you expect to see and on modes of purposive thinking. In connection with the scientists who continued to “see” 24 chromosomes when the photographic images plainly displayed only 23, because they expected to see 24, Ridley quotes the saying that “There are none so blind as do not wish to see.”¹¹ Overall, Ridley seemed to appreciate the problem of seeing purpose, divine or otherwise, where accident could explain. And he was emphatic about evolution not being purposive or inherently progressive: He wrote:

Evolution has no pinnacle and there is no such thing as evolutionary progress. Natural selection is simply the process by which life forms change to suit the myriad opportunities afforded by the physical environment by other life forms¹²

Ridley thus escaped most of Okin’s categorical criticisms, and was to a remarkable degree a

fellow traveler.

II.

Teleological, biased and sexist thinking are easy to dismiss as “old think.” But they were not essential to science or its popularization in the ancient world, and are not essential to its popularization today. Not all pre-modern, pre-feminist accounts of human reproduction placed women in an inferior, ancillary position. Aristotle's did, some others did not. Consider the lovely, egalitarian account of sex and inheritance of traits found in the work of the Epicurean poet, Lucretius (c. 98- c. 55 BC)

Lucretius used the poetic form to popularize the materialist scientific teachings of the philosopher Epicurus (341-270 BC). The six books of the Lucretius' masterpiece, De Rerum Natura, are dedicated to Epicurus, "...whose genius surpassed all humankind, extinguished the light of others, as the stars are dimmed by the rising sun."¹³ Much of what is known about the tenets of Epicureanism comes from Lucretius. Epicurus and his followers are believed to have been more egalitarian than other ancient Greek philosophic communities, welcoming women and servants into their midst. Although there should be no doubt that Lucretius wrote De Rerum Natura from a male perspective -- his ambivalent accounts of love and sex seem to be aimed at male readers -- the poem's biology is surprisingly egalitarian. Of special interest here, Lucretius set about to disabuse his readers of a number of preconceived notions about women's sexuality and human reproduction. Myth-busting is precisely Epicurean. As quoted by Diogenes Laertes, Epicurus wrote that: "Error and false judgments always depend upon the supposition that a preconceived idea will be confirmed, or ... not be overturned, by evidence."¹⁴

Lucretius argued that the pleasures of sex are, for better or for worse, mutual. They are a product of recurring patterns of caring, sharing, and of daring to be vulnerable, observable in nature in the natural world. First, Lucretius took on the assumption that beautiful women are superior to ordinary ones in the things that matter for love and sexual attraction: “The truth” he writes, “is that she [the beauty] does all the same things as the ugly woman does.” Second, he took on the assumption that women do not experience sexual pleasure:

Nor does a woman always feign the passion which makes her sigh, when she embraces her mate joining body to body, and holds his lips in a long kiss, moistening them with her own. For she often does it from the heart, and seeking mutual joys rouses him to run the full course in the lists of love.¹⁵

Lucretius does suggest in one place that married women wishing to have children should remain motionless during copulation. However, his point is not to demand passivity of women, but to suggest that, due to what we now call gravity, erotic and pleasurable movement may result in the man’s seed (sperm) failing to reach the woman’s seed (egg). Movement may result in the sperm missing its mark.– inadvertent *coitus interruptus*.¹⁶ Third, he rejected the idea that women are to be blamed for infertility. Lucretius did not blame infertility on the woman or the man, but on an incompatibility that can often be cured in many cases by a simple change of partners. Finally, and importantly for our purposes, he rejected the woman-as-vessel/man-as-seed perspective. He argued that both men and women have “seed” and that both have an equal chance of determining what physical characteristics will be passed along to off-spring. By modern standards of science, Lucretius’ account is neither entirely accurate nor complete. However, the poetic spirit of equality will appeal to many modern readers:

And in the mingling of seed, when by any chance the woman suddenly overcomes the man’s force by hers and has gained the upper hand, then by means of the mother’s seed children are born like the mother, as they are born like the father by reason of the father’s seed. But those whom you see with the shape of each,

mingling the marks of their parents's countenances together, grow from the father's body and the mother's blood both, when the seeds stirred up through the frame by the goads of Venus have been thrust together by the passion of two breathing as one, neither conquering, neither conquered. ¹⁷

How do children come to resemble grandparents? Lucretius offered an explanation for generation skipping resemblances: "...[T]he parents often conceal in their bodies many first-beginnings mingled in many ways, which fathers hand on to fathers received from their stock." And do male children require a dominate male seed from the father? That is, are men responsible for males, women for females? The answer of Lucretius was negative: "Female children also spring from their father's seed, and male children appear made from their mother's substance; for the birth always is made out of both seeds, and whichever parent the offspring resembles, of that parent it has more than half; which you may discern, whether the child be male or female."

III.

Rather than by his teleology or his gender politics, one should be most troubled by as aspect of what we might call Ridley's poetry. His pervasive use of the human genome-as-book discourse is a strategy of popularization that potentially contributes to public misunderstanding of genetics. And perhaps one has to be at least a little puzzled by Ridley's implicit metaphysics, to the extent that his poetry implies the existence of a mysterious Creator otherwise absent from his evolutionary tale.

The genome, Ridley writes, is "a sort of autobiography"¹⁸ and "a record. . . of all the vicissitudes and invention that have characterized the history of our species."¹⁹ And, "The idea of the genome as a book is not, strictly speaking, even a metaphor. It is literally true."²⁰ A bit later he writes that: "The genome is a very clever book..."²¹ In a final place he writes that: "The human genome is a book."²² I maintain that to call the human genome a 'book' is poetry. And

confusing poetry at that.

It is possible to describe the human genome to a general audience without resort to book-related metaphors and analogies. For example:

A genome is all the DNA in an organism, including its genes. Genes carry information for making all the proteins required by all organisms. These proteins determine, among other things, how the organism looks, how well its body metabolizes food or fights infection, and sometimes even how it behaves. DNA is made up of four similar chemicals (called bases and abbreviated A, T, C, and G) that are repeated millions or billions of times throughout a genome. The human genome, for example, has 3 billion pairs of bases. The particular order of As, Ts, Cs, and Gs is extremely important. The order underlies all of life's diversity, even dictating whether an organism is human or another species such as yeast, rice, or fruit fly, all of which have their own genomes and are themselves the focus of genome projects. Because all organisms are related through similarities in DNA sequences, insights gained from nonhuman genomes often lead to new knowledge about human biology.²³

The genome is not literally a book, as Ridley claims, at least not in any of the plain senses of the term 'book' that the ordinary reader would bring to his text.

In a radio interview about his book, Ray Suarez suggests that Ridley's book metaphor aids non-scientists and serves the goal of popularization:

RAY SUAREZ: It helps the non-scientists really understand these articles that have been bubbling up on the news pages lately. There's a nice passage close to the beginning of the book that starts, "Imagine the genome is a book." Take it from there.

MATT RIDLEY: Well, I think, in a funny way, the genome is a book. I mean, that's one of the great discoveries, is that there is an instruction manual-- a recipe, if you like-- written inside ourselves. It's 800 times as long as the Bible, but it's very small, because we've got 100 trillion copies of it. And it's broken up into 23 chapters-- 23 individual pairs of chromosomes, we call them. And so that's what I did with my book, was split it into 23 chapters and try to tell one story from each chromosome. The stories are the genes, if you like. There's 80,000 of them on these various chapters.²⁴

Yet, for all its simplicity, I wonder just how much real additional understanding of genetics the book metaphor really advances. A row of chemical bases, whose scientific names can be abbreviated with four different letters of the alphabet, is not a literal book. A literal book is a stack of papers, printed with the words of one or more human writers, bound with glue or thread between paper or cloth or leather covers, and sold in Barnes and Nobles or on amazon.com. Or, a book is a text someone keys or scans into a computer to create an electronic file that can be read with the aid of a computer. It is curious that Ridley and others who employ genome-as-book-of-life metaphor neglect the central feature of books, namely authorship. By identifying the genome with a literal book, Ridley implies that our individual or collective humanity is a text designed by someone wishing to record or communicate meanings. He implies that our humanity, like the books we read, has an author, an intelligent designer. One cannot buy into the book metaphor, without asking oneself the obvious question: who wrote the book? Maybe Ridley wanted his readers to ask this obvious question, but on their own time, so to speak. Ridley the science writer, a student of zoology enthralled by evolutionary biology, selected a metaphor that is congenial to Judeo-Christian religion because it hints at an Unknown Author of life, but that is not overtly committed to religion. Ridley remains “scientific,” but creates a domain for his readers’ theology. Perhaps he did this hoping to avoid the troublesome creationists versus evolutionists debates.

He does not avoid trouble, though, from readers like me who find his ‘book’ metaphor obfuscatory. Human genetics and the human genome projects’ discoveries can surely be explained and popularized without misleading implying divine biographers or chemical autobiographers. Aristotle gave us an Unmoved Mover. Popularizers of the gene science offer the equally mysterious Unauthored Author. It may disturb confused readers to think that

'someone' wrote a book that determined that they have breast tumors and a proclivity to migraines. More importantly, while the book metaphor may be to some degree comforting or entertaining, it fails to convey the straightforward information the public needs about proteins and bio-chemical processes in order to assess practical applications of genetic science to agriculture, reproduction and health care. I believe a public full of biography, autobiography and similar book metaphors for the genome, is needlessly confused about and biased against manipulating genomes and the exploitation of "genetic engineering," cloning, and stem cell research. Who are we to rewrite the great Book of Life or someone else's life story?

An essay by Tim Beardsley in Understanding Genome, a slim volume from the editors of Scientific American magazine sold as "science made accessible," is entitled "Where Science and Religion Meet: Francis S. Collins." The essay is a personality profile of the University of Michigan Professor appointed to head the National Institutes of Health Human Genome Research Institute in the 1990s. Beardsley calls attention to the fact that Collins, a practicing scientist, is also a practicing Christian, a man of religion. Beardsley reported with seeming approval that Collins scrupulously attempted to separate his personal religious views, which went against the grain of trends in evolutionary biology and medical genetics testing, from his responsibilities as government science administrator. One of the many interesting challenges for popularizing genetic science and investing it with popular appeal remains the challenge of reconciling the gene story with the God story embraced by so many Americans. One way to bridge the gap, exemplified by Beardsley and Scientific American is simply to point out that some gene scientists are ethically sensitive, even religious, people who do not necessarily agree with turning embryos into research subjects or aborting mildly imperfect fetuses. Another way, exemplified by Ridley, is to describe scientific discoveries that may contradict the tenets of

traditional Judeo-Christian religion and philosophic ethics with both a poetry that preserves Mystery and with an enthusiasm that makes us glad for new knowledge.

Lucretius, whose aim was to translate Greek science for lay Roman audiences, was so effective at the science/religion bridge-gapping required of science popularizers, that he deserves to be the patron saint, if you will, of science writers. His thoroughly materialist scientific vision is embodied in a poem that pays homage to myth and Mystery. De Rerum Natura begins with an invocation to God, or rather to one of the gods, the goddess Venus, mother of the Roman people, “darling of men and gods” who “alone govern[s] the nature of things.”²⁵ “Without you,” wrote Lucretius before embarking on a tale of a universe governed by the movement of atoms, “nothing comes forth into the shining borders of light, nothing joyous or lovely is made.”²⁶ “Thus, “you I crave as a partner in writing...on the Nature of Things.”²⁷

¹. See Lucretius, *On the Nature of Things*, translated by W.H.D. Rouse, revised by Martin F. Smith (Cambridge, Mass: Harvard University of Press, 1997), Book 4, Line 1217, pages 370-71. Titus Lucretius Carus (c. 99-c55 BC) is best known for his book-length poem, De Rerum Natura (On the Nature of Things). The Rouse translation for the Loeb Classical library was published in 1924; revised versions by Smith appeared in 1975, 1982 and 1992. I have relied on the 1997 reprint edition of Smith's 1992 revised translation.

². Wilson, E.O. (1975) *Sociobiology: The New Synthesis*. Cambridge, Massachusetts: Harvard University Press.

³. Science and Nature (Lewontin, 1991, p. 62)

⁴. Lori Andrews, Maxwell J. Mehlman and Mark Rothstein, Genetics: Ethics, Law and Policy (St. Paul: West Group, 2002) p. 12)

⁵. Okin's Conference paper.

⁶. Matt Ridley, Genome: The Autobiography of a Species in 23 Chapters (New York: Harper Collins 2000), pp. 217, 218.

⁷. Matt Ridley, pp. 206-208.

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- ⁸. John Colapinto, As Nature Made Him: The Boy Who Was Raised as a Girl (New York: Harper Collins, 2002).
- ⁹. Matt Ridley, p. 112-113.
- ¹⁰. Matt Ridley, p. 110.
- ¹¹. Matt Ridley, page 24.
- ¹². Matt Ridley, p. 24
- ¹³. Lucretius, *De Rerum Natura*, III, 1045
- ¹⁴. Diogenes Laërtius, *The Lives and Opinions of Eminent Philosophers*, Book X, The Life of Epicurus (written circa 230 A.D), translation by C.D. Yonge (1812 - 1891), quoting Epicurus' Letter to Herotodus. Available on line at <http://www.atomic-swerve.net/tpg/Lives.html#XVIII>
- ¹⁵. Lucretius, Book 4, Lines 1192ff.
- ¹⁶. Lucretius, Lines 1263
- ¹⁷. Lucretius, Lines 1209ff
- ¹⁸. Matt Ridley, p. 5.
- ¹⁹. Matt Ridley, p. 5.
- ²⁰. Matt Ridley, p. 7.
- ²¹. Matt Ridley, p. 8.
- ²². Matt Ridley, p. 219.
- ²³. See, "The Human Genome Project," Official Website of the U.S. Department of Energy Office of Biological and Environmental Research, Human Genome Program, <http://www.nih.gov>
- ²⁴. http://www.pbs.org/newshour/bb/science/jan-june00/genome_2-29.html
- ²⁵. Lucretius, Book I, lines 1-2.
- ²⁶. Lucretius, Book I, lines 21-24, p. 5.
- ²⁷. Ibid.