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Essay Review

The French Evolution: A review of *Of Flies, Mice, and Men* by François Jacob (trans. G. Weiss). (1998) Cambridge, MA: Harvard University Press, 158 pp., paper.

By

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Mosaic models are now very much with us. They are found not only in *Of Flies, Mice, and Men* but also Gould (2002), Carroll et al., (2001), and even Raff (1996). Most recently, Svante Pääbo (2003, p. 409) uses mosaic images to illustrate the many exchanges between the genomes of gorillas, chimps, and humans: "Although the majority of regions in our genome are most close related to chimpanzees and bonobos, a non-trivial fraction is more closely related to gorillas." Jacob, therefore, gives the rest of us an introduction to evo-devo but in a non-technical, erudite, charming manner.

François Jacob and Jacques Monod shared the Nobel Prize for Medicine in 1965 for their work on the regulator sequences in genes. Jacob argues here that modules, each consisting of 20-30 genes, are an Erector Set for the combinatorial mosaics that characterize each of us. Small changes in regulatory genes make large changes in organisms, perhaps by shifting entire blocks of genes on and off or by changing activation sequences. But, whether flea, fly, or Celine Dion, the materials are the same.

The book's cover is a deceptive white, beige, and Williamsburg Blue. It suggests both refinement and tradition but Jacob the geneticist gives very few nods to environment. I really like his viewpoint and his richly embroidered prose and will refer to him often. He may, however, upset other people but as Jacob reminds us, if you are going to have science, you have to take all of it and not just the parts that you like.

Jacob's text, a collection of seven lectures, is itself a combinatorial mosaic and models the very processes that he describes. He anchors his structure with genetic engineering but polishes and decorates it with classical myths, anecdotes about politicians and biologists, and observations about human good and even the arts. He also has architectural modules for the parts of his building that we see and that hold his decorations together:

1) Today's scientific concepts and tools continue to evolve and refine each other, thus, we cannot predict what basic research will teach us tomorrow or what we might say about it. Likewise for most emergent products: we can explain a snowflake but cannot predict the pattern for any one of them. We explain some aspects of a cell in language that must be consistent with what we know about water but our knowing water would not lead us to predict cells. (A

similar theme is presented in Solé & Goodwin, 2000).

2) There is a unity in life's organization. D'Arcy Thompson attempted to infer organizational principles in the structure of organisms but without help from genetic engineering. Geoffroy Saint-Hilaire also recognized a unity in the structural organization of mice and men and flies. More than a century later, we found that *Hom* genes in flies are strongly similar to *Hox* genes in mammals. Swap a *Hox* gene from a mouse into a fly and get a normal fly rather than a gifted one. The "same" gene produces eyes in flies and in mice but it produces a compound eye in the former and a familiar round brown one in the latter. Our sharing our *Hox* genes with nearly every plant and animal testifies to the continuity of life and persuades us of evolution's truth more eloquently than any shelf of skulls. (See Eldridge, 2000, on the persuasive impact that displays of fossilized human and prehuman skulls have had on fundamentalist doubters.)

3) Jacob argues that molecular biology changed the rest of biology in the '90s. Molecular biology allows us to understand our dog with greater precision than was possible 10 years ago when we might have described Rover as a mass of colloids --- instead, he is the outcome of combinatorial processes. Jacob's view implies that traditional biologists must retool their thinking; these newer ideas also give some of us outside of biology a chance to get in the door.

4) The building blocks of life are constant but their combinatorial mosaics have endless surprises. Not a new idea! Saint-Hilaire commented in the early 19th century that "Nature constantly uses the same materials and her only ingenuity is in varying the forms" (cited by Jacob, 1973, p. 107). Given the strong probability that combinations of genes are arranged or rearranged as units, then saltatory effects and spandrels become possible. Gradualism is out for many structures. That is, a mutation and a structure appear, the organism discovers how to make it work. Rover's form becomes somewhat independent of environment.

5) Genes occur and then Rover seeks or shapes environments. (It is as if Galatea comes to life and starts to shape Pygmalion.) Genes have an immediate effect on environment whereas environment modifies genes across generations. Each "instructs" the other and each sometimes does so through selection. "... the ambient system could not modify an organism without the organism exerting a corresponding influence. The organism cannot be dissociated from its environment. It is the whole system that is modified and transformed" (Comte, *Cours de philosophie positive; Oeuvres.* 1838, Vol. III, p. 235; cited by Jacob, 1973, p. 155). Lewontin (1998/2000) is only the most recent advocate for this concept; Leibniz and Comte spun it past Locke and Darwin to Popper, Turner, Jacob, Lewontin, and others of us. (See especially Turner, 2000, on environments as products of selection by organisms.)

Selection's arrow sometimes reverses.

Anecdotes

Jacob's anecdotes are wonderful and so are his examples from Greek mythology & French literature. For example, a scorpion once asked a frog for a ride across the river. Halfway across, the scorpion stung the frog. The frog gasped, "Why?" The scorpion apologized, "It's my nature." Daedelus represents science without conscience, one that allows politicians and tyrants to act on their hubris until they over-reach their resources or neglect to maintain what they have already made. Tiresius has his biographies woven into the text as do Prometheus and Pandora. Other gods, a.k.a. politicians and scientists, also have their tiles in Jacob's mosaic: Charles de Gaulle (led the French government's first investing in molecular biology), Pompidou (who once held up funds --- "politicians have the memory of an elephant and the spitefulness of a rhinoceros"!), Thomas Hunt Morgan, Ernst Hadorn, Louis Pasteur, Francis Galton, and, of course, Jacques Monod who worked with Jacob (great research is done by pairs of scientists

who communicate with each other in their own jargon, excluding third parties and in a manner similar to that of identical twins). There are also villains such as Lysenko: "The style of Lysenko's declarations ... bring to mind the ramblings of self-published autodidacts convinced they have found the secret of life or a cure for cancer and furious because 'official science' is ignoring them. (p. 29)" Welcome to the Internet!

Eugenics and Responsibility

Verschuer & Mengele get special attention but Jacob further remarks, (pp. 119-120) "What matters here is not the role of the physician who performed what he called 'experiments' in the camps. It is that of the scientist who inspired the theory." Scientists have responsibility for what might be done with their discoveries.

This is an old problem but Jacob doesn't resolve it. He first denies the possibility of making predictions in science, especially from basic research (in Chapter 1). In Chapter 6, Jacob puts great faith in some antiseptic consequences: give full information ("the whole truth and nothing but the truth") to the public and get informed consent. Jacob, however, does not address the problems of conflicting sectors within any public or that of prima donna feuds between scientists. (Ed Wilson and Dick Lewontin likely each told their respective publics their respective versions of the whole truth.) Jacob also praises Pasteur for his military mind and "swaggering," "irresistible" style, for being a "little Napoleonic,"(in Chapter 7) and for inoculating dairy herds against anthrax despite strident objections from French farmers (in "Conclusion"). So much for informed consent. (Some of these inconsistencies may be attributable to each chapter's originating as a separate talk over the past several years.)

Jacob's position also resembles that of Thomas Huxley and his philosophical great grandchildren who advocate that we ignore our genes and transcend our nature. Humbug. These positions are smoke from elder mutualists and young Puritans who rarely imagine that kindness and cooperation might be our sensed awareness of our genetic heritage. Their very argument is apt to be a physico-genetic emergent, one just as adaptive as copulating or killing (Haig, 1999; Hamilton, 1995, pp. 134-135). (See Ridley, 2000, pp. 286-300, for another interpretation of eugenics and the Holocaust.)

Recognizing Individuality

Darwinian gradualism (although Darwin himself saw the possibility of changes "per saltum") and a growing emphasis on large populations accounted for the origins of species. Neo-Darwinism sought order and tried to build science but ignored individual variations while doing so. It also ignores the variations that run in families of closely related individuals.

Clinical and educational work, however, demands we recognize those variations. As Jacob comments on p. 100, "Until now, confronted with a patient, medicine established a diagnosis from which it drew a prognosis. Now it evaluates the genetic profile right away, from which it predicts the medical destiny of the person. We no longer interrogate the gods to learn about a person's future life or that of his descendants. We interrogate the genes." Thus, clinical applications come from molecular genetics rather than from Darwinian models that idolize uniformity.

An Empirical God?

Jacob has faith in an unlimited exploratory human nature. I am less optimistic. Other cultures have remained in stasis for centuries while humans reasoned about truth instead of measuring it with their fingertips. Further, he does not mention the fundamental role of technology in shaping our beliefs. Pasteur was not possible without a microscope, genetic engineering depends heavily on polymerase chain reactions and other methods unknown a dozen years ago. However, once a tool is available, it interacts with human nature to refine our understandings. We follow our fingertips and receptors when we use science to reshape nature and to build our personal Edens. As Jacob wisely notes, we each find the God that we want.

Audiences

Intermediate and advanced students in biology, psychology and philosophy. Also, some of us gray heads with nostalgic memories about the biological and behavioral sciences in the last part of the 20th century. Jacob's style reminds me of Loren Eiseley, *The Immense Journey*. You might compare: *All the Strange Hours* (Eiseley's autobiography) and *The Statue Within* (Jacob's), *Darwin's Century* (Eiseley) & *The Logic of Life: A History of Heredity* (Jacob). *Of Flies, Mice, and Men* complements *Genome* (Matt Ridley), *Heredity: the Logic of Life* (Jacob), *Triple Helix* (Richard Lewontin), *Signs of Life* (Ricard Solé & Brian Goodwin), and *Consilience* (Ed Wilson).

References

Carroll, Sean, Grenier, J., & Weatherbee, S. (2001) *From DNA to Diversity: Molecular Genetics and the Evolution of Animal Design.* Malden, MA: Blackwell.

Eldredge, N. (2000) *The Triumph of Evolution and the Failure of Creationism*. NY: Freeman.

Gould, S. (2002) *The Structure of Evolutionary Theory*. Cambridge, MA: Harvard Belknap.

Haig, D. (1999) Genetic conflicts and the divided self. A talk given at Hunter School of Social Work, May 6, 1999. See also: (1997) The Social Gene. In J. R. Krebs & N. Davies (Eds) *Behavioral Ecology: An Evolutionary Approach*, pp. 284-306. London: Blackwell Science.

Hamilton, W. (1996) *Narrow Roads of Geneland: The Collected Papers of W. D. Hamilton, Vol 1, Evolution of Social Behavior*. NY: Freeman

Jacob, F. (1973) *Logic of Life: A History of Heredity*. NY: Pantheon.

Lewontin, R. (1998/2000) *Triple Helix*. Cambridge, MA: Harvard.

Pääbo, Svante (2003) The mosaic that is our genome. *Nature.* 421: 409-412.

Solé, R., & Goodwin, B. (2000) *Signs of Life: How Complexity Pervades Biology*. NY: Basic.

Raff, Rudolf (1996) *The Shape of Life*. Chicago, IL: University of Chicago Press.

Ridley, Matt (2000) *Genome: The Autobiography of a Species in 23 Chapters*. NY: Harper Collins.

Turner, J. S. (2000) *The Extended Organism: The physiology of animal-built structures*. Cambridge, MA: Harvard University Press.