

Book Review

Making Genes, Making Waves: A Social Activist in Science Jon Beckwith

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Review by Myron S. Simon, Ph.D.

What does a scientist owe to society? At what point does the science that one does raise questions which require a break with the “etiquette” of the scientific establishment to which one belongs? And, should a scientist become a “whistle blower” whenever he or she believes that science is being used improperly to influence social issues?

These questions form the basis of this fascinating short autobiography by Professor Beckwith, the American Cancer Society Research Professor of Microbiology and Molecular Genetics at Harvard Medical School. In it he describes and defends his career of two strands. Making Genes refers to his brilliant work in devising the first method for cloning genes, the first method for isolating and purifying a gene, as well as the fundamental studies in understanding the mechanisms for activating or repressing genes, and the understanding of how proteins are transferred through bacterial membranes. Making Waves refers to the second strand, the life he led as an activist, leaping into public prominence throughout his life in calling attention to real and potential misuses of science which affect society. The period of the 1960's was a time of tremendous unrest in academia, culminating in 1970, in the murders of students at Kent State College and the resulting strikes and sit-ins on many college campuses. While Beckwith doesn't refer directly to this, it is easy to see what an influence this climate had on his development.

Beckwith took his undergraduate and graduate degrees at Harvard, the latter in the Chemistry Department. His graduate work was in biochemistry and his thesis was on how fungi incorporate chloride into the organic compounds they manufacture. A course in molecular biology with James Watson led him to the work of François Jacob and his group in Paris which was using bacterial (*Escherichia coli*) genetics to study fundamental problems in biology. The style of research the Paris group used, “daring leaps of logic, simple experiments that seemed to yield profound insights”, and the lively literary style in which the papers were written caught Beckwith's imagination. After receiving the Ph.D. degree in 1960, pursuit of a postdoctoral appointment in Jacob's laboratory in the Pasteur Institute became an obsession.

Postdoctoral fellowships with Arthur Pardee at Berkeley and Princeton and with William Hayes at Hammersmith Hospital, Microbial Genetics Research Unit, in London gave

Beckwith the opportunity to learn the techniques of bacterial genetics. As had the French scientists, Beckwith has made the cells of the bacterium *E. coli* his research quarry. Work begun with Pardee, and later work in England demonstrated his abilities and by 1964, when an opening allowed him to join the Paris group, it came after he had published a paper correcting the site of the operator in the Jacob study, had achieved recognition, and had received an appointment at Harvard Medical School..

During a productive year in Paris he pioneered a method to move genes from large (chromosomal) to smaller (viral) DNA fragments to study them more easily. This was the first method for cloning. In 1965 he returned to Harvard Medical School and continued his *E. coli* experiments, devising mutant genes which allowed him to study how the promoter site of the gene works. But the most exciting results came a few years later as a byproduct of cloning experiments. Edwin Land used to say that breakthroughs in understanding were not flashes of genius but rather cessations of stupidity. Either way, Beckwith had one or the other and came up with the first ever method to isolate and purify genes.

The Harvard College of the '50s, Beckwith felt, was not particularly interested in political change, although he was aware that there were fellow undergraduates questioning the values of society. I find this strange, because ten years earlier, when I was there, I can recall the battles among the Republican Club, the Liberal Union, and a group that my room mates were wont to call the Communists, which were nothing if not political. Perhaps pressures from the greater stage, the McCarthy attacks in the Eisenhower era, had their damping effect on that "Little Red Schoolhouse on the Charles." At any rate, Beckwith did not become aware of the progressive currents until his first postgraduate post at Berkeley. Politicization of his thinking went rapidly, and by the time he was at Princeton he was walking in a protest demonstration against the threat of war with Cuba during the missile crisis. In Paris at the Institut Pasteur he found congenial the left-wing attitudes prevailing among his fellow scientists, and his interest in jazz and friendships with black expatriates led to an understanding of racism as an evil, and the war in Viet Nam as a disgrace. Returning to the med school in 1965, he was a confirmed liberal political activist.

In 1969, with the ability to isolate individual genes, the Beckwith team realized that their forthcoming publication would also be highly visible to the nonscientific world. They recognized that their work had opened the possibility of human experimentation, of genetic engineering with unknown, but potentially damaging consequences to the human race. Put badly, the gene was out of the bottle. Beckwith called a press conference. At this juncture the two strands in his life, science and social activism joined.

In the press conference the first isolation of a gene from a chromosome was announced, and statements were made that the work might lead to future dangers for mankind. Widespread reports stressed the latter, and Beckwith was castigated by many in the scientific community who felt that he was suggesting potential problems fifty years away, and had exaggerated the dangers and even the importance of the work. But while the work directly involved only bacterial systems, within five years development of recombinant DNA techniques permitted the isolation of genes from any organism. (By 1973 a moratorium on recombinant DNA existed.)

Beckwith's action had put him in the role of spokesman for the young, concerned scientists who had become politicized and cynical largely by the actions of their government in Viet Nam. Another incident sealed his reputation as a far left agitator. In 1970 the Eli Lilly Award in Microbiology and Immunology was offered him by the American Society of Microbiology. After consideration he accepted the honor, but when the ceremony took place he announced that he would turn over the \$1000 prize money to the Black Panther clinic and defense fund. Further, he excoriated the practices of big pharma in his acceptance speech.

While Beckwith was attempting to teach the social responsibilities of science and scientists, he continued to study major problems in biology using mutant genes in *E. coli*. Using this bacterium, he probed what causes a gene to turn on and generate its protein and learned what stops this activity. He wondered how proteins are capable of passing through cellular membranes and showed the necessary groups the protein must contain. He found that formation of the disulfide bridges in proteins require an enzyme catalyst. The clarity with which Beckwith writes about his research makes his book a primer for understanding much about molecular biology, and can be recommended on that score alone.

The main value of the book, however, is his preaching the need for scientists to be aware of how their science can be misused, promoting disastrous consequences for society. As a geneticist he became aware fairly late of what he calls genetic's "atomic bomb." Little known these days is the eugenic movement's push to improve the gene pool of this country. He describes how geneticists supported eugenics in the United States, in the early part of the last century. The movement claimed that "bad" genes were responsible for criminal behavior, low intelligence, and other "abnormalities." The effects on society were huge. Laws in many states were passed, under which tens of thousands were sterilized, and the federal government passed the Immigration Restriction Act of 1924 to keep out the undesirable genes of the so-called "inferior" cultures of eastern and southern Europe. Although eugenics began to fade after 1924, Hitler and the Nazi government in later years used the work of German geneticists, who had fallen back on earlier research

by American geneticists, to justify their racial policy of sterilizations and murdering of millions.

Later chapters describe Beckwith's exposing the "Myth of the Criminal Chromosome", the battle against E.O. Wilson's Sociobiology, and other cases where genetic studies were misused. In 1989 at the inception of the Human Genome Project, James Watson, the original director, set aside 3-5% of the budget to study the ethical, legal, and social implications (ELSI) of the project. The study would examine any "potential adverse social consequences of the project and to suggest means of preventing these consequences." Beckwith became a member of the ELSI Working Group. The mixed success and disappointments of this group of scientists and nonscientists working to solve potential problems (with pressures from considerations of insurance dollars, mass screening of populations, genetic testing running wild) is reflected in Beckwith's flight to C.P. Snow's Two Cultures. Still, all was not in vain.

"An environment now exists in which concern for the social and ethical consequences of science is at least not a taboo subject." — Jon Beckwith