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A PERSONAL JOURNEY THROUGH GENETICS AND CIVIL RIGHTS

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The most powerful force shaping society today is science applied by industry, medicine, and the military. New scientific ideas and techniques pervade every aspect of our lives, changing the way we do things and how we perceive the world, thus altering our aspirations and notions of who we are, why we are here, and where we are going. Yet, with rare exceptions, scientists are virtually invisible in the popular media and in debates and reports on economic, social, and even environmental issues. As a geneticist and a journalist, I am constantly reflecting on the nature of the relationship between science and society. Here I recount the path that I have followed as a means to convey my experiences around, and opinions on, this complex relationship.*

My grandparents emigrated to Canada early in this century, driven from their homeland by terrible poverty. Both of my parents were born in Vancouver, British Columbia, as was I in 1936. Insulated from widespread racism and the ravages of the Great Depression by my parents and childish innocence, my earliest memories are of a happy childhood. On 7 December 1941, when Japan attacked Pearl Harbor, my life was changed forever. The racism that had festered in British Columbia ever since Japanese and Chinese began coming to the province in the late 1800s could now be vented openly under the guise of self-defense and patriotism. My family and I felt completely Canadian because we had never been to Japan, and at home English was our spoken language. In the months following Pearl Harbor, the Canadian government moved to control the feared treachery of its Japanese population by invoking the War Measures Act against all people of Japanese descent.

The War Measures Act was a heinous piece of legislation that failed to recognize that while it is easy to guarantee civil rights and freedoms when times are good, those guarantees only matter when times are difficult. Twenty-two thousand Japanese, most Canadian citizens by birth, were rounded up and sent to internment camps in abandoned mining settlements deep in the Rocky Mountains. My father was separated from our family and shipped to a different camp for 1 year before being reunited with us. We were impoverished by the loss of our savings, our home, and almost all of our possessions (each person was allowed to take 70 pounds of luggage to the camps). When the war drew to a close, we were expelled from British Columbia and my family ended up working as farmhands in southern Ontario. As a child I learned that hard work and a good education were the only means to extricate myself from this poverty. Pearl Harbor, incarceration, and expulsion from British Columbia shaped my psychic demons—a knee-jerk aversion to any perceived discrimination or bigotry—and I developed a compulsive need to excel at whatever I did to prove my worth as a human being.

I did well in high school and received a scholarship to Amherst College, where I majored in biology. In embryology and genetics courses, I was enthralled by the exquisite beauty and elegance of development and heredity. After graduating in 1958, I enrolled in the doctoral program in zoology at the University of Chicago. The launch of Sputnik by the Soviet Union electrified the world and stimulated a frantic rush to bolster science, mathematics, and engineering in North America. It was a golden period of enthusiasm and expansion in all of the natural sciences, including genetics. As a graduate student during this exuberant time, I acquired the belief that science could eliminate superstition and ignorance by providing us with an understanding of the underlying mechanisms of all the cosmic forces impinging on our lives. In genetics, I believed that through a better understanding of mutation, recombination, and gene activity, we would eventually be able to manage, and possibly even eliminate, the hereditary problems that afflict humankind.

In the early 1960s there were numerous job opportunities in the United States as universities expanded their science departments. Nevertheless, I chose to return to Canada. Even though Canada had incarcerated my family during the war and expelled us from British Columbia, it was still my home and I wanted to contribute and work to make it a nation that could live up to its boast of being a place where all of its citizens were treated equally. I returned in 1962 as an assistant professor in the Department of Genetics at the University of Alberta in Edmonton.

As the most junior member of the department, I was assigned to teach genetics to students majoring in agriculture. They constantly pushed me to explain the agricultural implications of genetics with questions about the green revolution, about ways to improve milk output or weight gain by gene engineering, and about the possibility of the perpetuation and amplification of highly productive animals by cloning. As a snobby scientist who

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*D. T. Suzuki, *Metamorphosis: Stages in a Life* (Stoddart, Toronto, 1986). †K. M. Ludmerer, *Genetics and American Society* (Johns Hopkins Univ. Press, Baltimore, 1972). ‡E. M. East and D. F. Jones, *Inbreeding and Outbreeding* (Lippincott, Philadelphia, 1919), pp. 235–254. §B. Müller-Hill, *Murderous Science* (Oxford Univ. Press, Oxford, 1988); R. Proctor, *Racial Hygiene: Medicine Under the Nazis* (Harvard Univ. Press, Cambridge, MA, 1988). ‖W. B. Provine, *Science* **182**, 790 (1973). ¶K. Adachi, *The Enemy that Never Was: A History of the Japanese-Canadians* (McClelland and Stewart, Toronto, 1976). #*ibid.*

reveled in basic research, I had not paid attention to the practical consequences of genetics research and was now forced by students to read more widely on this topic, whereupon I discovered a vast and interesting literature.

In 1963 I moved to the University of British Columbia. Most students in my classes hoped to go to medical school, so they would quiz me about medical genetics, human heredity, and the possibility of genetically altering people. I gave a talk about genetic engineering to students at a campus dorm in which I discussed the techniques of DNA transfer by transformation and transduction, the possibility of cloning, and the implications for people. At the end of my talk a student demanded to know why, if such terrible possibilities come from new ideas and techniques, was I still doing research in genetics. I glibly answered that I was doing basic research into mechanisms of cell division and chromosome behavior in fruit flies, not applied work. The student rejected my answer. Knowledge, he pointed out, was like a huge pool of information. Like water added to a lake, any scientific result becomes diffused throughout the pool of information. So when someone comes up with a practical application, there is no way to identify the specific studies that made it possible. Ideas are built on the collective base of accumulated knowledge, thereby blurring any distinction between practical and basic science. The student had a point, and I was spurred to read more about applied genetics.

To my shock, I discovered that eugenics, the attempt to apply hereditary principles to improve the human genetic condition, was not some weird aberration, but had been created and supported by leading geneticists.† Eugenics was considered a legitimate scientific discipline. Eugenicists made pronouncements about the supposed hereditary nature of tuberculosis, syphilis, indolence, sloth, drunkenness, criminality, and deceit. Indeed, Edward East, a distinguished Harvard professor and president of the Genetics Society of America, once wrote: "In reality, the negro is inferior to the white. This is not hypothesis or supposition; it is a crude statement of actual fact."‡

As geneticists discovered principles governing heredity and showed that most were universal, there was an understandable sense of excitement. Geneticists believed that they had their hands on the levers of life and were on the verge of elucidating principles that could be applied to eliminate hereditary disease and abnormalities while increasing the level of intelligence and ability. Extrapolating readily from studies on inheritance of physical traits like flower color in plants or wing shape in flies, geneticists jumped to conclusions about the i nheritance of intelligence and behavior, often confusing their beliefs and values with scientifically meaningful categories. By invoking the word "inferior"—like the words "better" or "worse"—East, too, was treating a value judgment as if it was not something that could be measured scientifically.

To my horror, I found that Josef Mengele, the infamous "angel of death" at Auschwitz, was a human geneticist who held peer-reviewed research grants to carry out studies on twins at the death camp.§ Race purification, an element of Nazi policy, was in part justified by the climate of optimism surrounding genetics as a means to improve the human condition. By the end of the war, when the horrors of the Holocaust were revealed, the accepted wisdom was that human behavior and intelligence were primarily an expression of environmental factors.‖ Even though I had received an outstanding liberal arts education and a thorough training in genetics, I had not been taught this aspect of the history of my discipline.

To add to my discomfort, I began to understand that genetics had been the underlying rationale that had justified the incarceration of Japanese-Canadians. Parliamentary transcripts indicate that a British Columbian member of Parliament, A. W. Neill, stated in 1937: "To cross an individual of the white race with an individual of a yellow race, is to produce in nine cases out of ten a mongrel wastrel with the worst qualities of both races."¶ While not quite a mendelian ratio, it was, nevertheless, an apparently quantified claim. In February 1941, Neill told the Prime Minister: "We in British Columbia are firmly convinced that once a Jap, always a Jap."# Implicit in Neill's statement was a belief in the hereditary nature of perceived racial traits, such as perfidy and deceit. Thus, bigotry was cloaked by the legitimizing claims of scientists. At the very least, this lesson from recent history can warn us about the hazards of extending the boundaries of scientific claims beyond immediate experiments.

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This grotesque intersection of two great passions in my life—genetics and civil rights—was an agonizing confrontation with the intersection of science and society. I concluded that, above all, scientists are fallible human beings with all of the foibles, idiosyncracies, talents, and shortcomings of any other group. Our perspective is shaped by professional self-interest, training, and ambition, and it is easy to become so enthralled with our work that, without reflection, we make grand claims about the potential of our discoveries and ideas. Moreover, in the flush of research and its exciting results, it is easy to forget that science progresses by conjecture and supposition, and that hypotheses will be evidentially modified, corroborated, or discarded. The ideas about gene and chromosome structure and regulation that excited me when I graduated in 1961 seem laughably far from what we believe today, and most of today's cutting-edge notions will be just as far off the mark 20 or 30 years from now. So what is the hurry to apply our notions so quickly? Often we make discoveries simply because our knowledge base is so tiny that we are bound to learn new things. This means that our ignorance is so great that we have virtually no capacity for prescription, that is, little capacity to recommend ways to correct problems that we encounter.

Scientists need to learn more about the social ramifications of their activity as revealed by history. We need to understand more intimately the nature of scientific knowledge, its strengths, weaknesses, limits, and how it differs from other ways of knowing. Above all, we must encourage public discourse about the interface between science and society and support those among our students and colleagues who enter this arena.

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