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ASCB AWARD ESSAY

Diversifying the Biological Sciences: Past Efforts and Future Challenges

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I am honored to receive the E. E. Just Award for 2010. In my invited essay, I have opted to discuss the state of diversity in the biological sciences with some recommendations for moving forward toward a more positive and inclusive academy. The need to develop cohorts of minority scientists as support groups and to serve as role models within our institutions is stressed, along with the need to ensure that minority scientists are truly included in all aspects of the academy. It is imperative that we increase our efforts to prepare for the unique challenges that we will face as the United States approaches a "majority minority" population in the next 50 years.

I am honored to receive the E. E. Just award for 2010. Ernest Everett Just was a cell biologist most noted for his work on the role of the cell surface in development. Just was born in 1883 in South Carolina when schools were legally racially segregated. At age 16, he moved to New Hampshire for College Preparatory School because his mother feared that black schools in the segregated South were inferior. Afterward, Just attended Dartmouth College, where he graduated *magna cum laude*. He then taught biology at Howard University, a historically black college, before receiving his Ph.D. at the University of Chicago. Even with these credentials, it was not possible for Just, as an African American, to obtain a professorship in a white university in the United States. As a result, Just immigrated to Europe. Just was captured and imprisoned by the Nazis in France in 1940. He was rescued and returned to the United States, where he died in 1941.

There are many parallels between my life and Just's. Like Just, I am an African-American scientist born in South Carolina. Although I was born 84 years after Just, hospitals, schools, buses, and other services were still racially segregated when I was born in 1967. Schools were integrated by 1970, but my elementary school was still all African American. I was accepted into the "gifted" program for middle and high school, but because schools tracked students, I was never with more than three other African-American students in my honor's classes. After high school, I attended Harvard, so also like Just, I was graced with an Ivy League education. Three and a half years after earning my bachelor's degree, I completed my Ph.D. at the University of California, Berkeley. Now, I have the dubious distinction of being the only African-American biology professor at UC Berkeley, a distinction that I share in the sciences with one African American in the Chemistry department, one in Astronomy, and one in Psychology.

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To get to campus, I travel through Oakland, which is 36% African American, to teach biology classes that (at most) are 2% African American. In my 21 years in the Department of Integrative Biology, only three other African-American males have completed Ph.D.s. I recruited all three, and two of the three completed their degrees in my laboratory. Only 4% of the undergraduates and 3% of the graduate students at Berkeley are African American. In the United States, there are three times more African Americans living in prison than in college dormitories, and even if we correct for college-age (18–24) the ratio of African Americans in college to those in prison is 2.6 to 1, compared with 28 to 1 for Caucasians. So, how far have we come in nearly a century (94 years) since E. E. Just obtained his Ph.D.?

Unlike Just, I did not have to go to Europe to get a job. After completing my Ph.D., I obtained a professorship at Berkeley and was promoted to tenure and then full professor by age 35. The rapid ascent, however, was not without difficulties. As the only under-represented minority in my department, I filled the role of "diversity officer" and was the faculty sponsor for multiple diversity-oriented groups and scholarship programs. Serving these roles is an obliga-

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tion felt by most minorities. After all, we presumably understand the issues better, are identifiable as role models, and generally care deeply and are committed to these issues. The obvious cost, however, is that we end up overburdened with commitments that limit our ability to focus on other efforts.

While I served as diversity officer, my colleagues served on committees that assigned research space, determined prices for services, etc. In other words, my colleagues were making decisions that directly affected all of our research programs. Over ten years, my colleagues set a price structure that eventually left me paying 15 times more for my animal space than others and thus subsidizing everyone else's research programs. When I pointed out my disadvantages because of biased committee assignments to the administration, I was told "We must find how to put history behind us. Nelson Mandela was able to." Furthermore, recently, I was asked for the first time to serve as a peer reviewer for a colleague's promotion case. When I asked a more senior faculty member for advice on preparing the case, he was surprised that I had not conducted one before. "I do at least one per year," he said. Thus, while my colleagues have conducted peer-review for me over the last 17 years, this responsibility has not been reciprocal. While I don't think anyone had the intention of "keeping the black faculty member isolated," that is effectively what happened.

Without other African-American colleagues, I had no one to turn to when advice was needed. There was not a more senior African-American faculty member there 17 years ago to say, "don't over extend yourself on diversity committees" and "make sure you are requesting to be on other committees." In addition, as one administrator pointed out, in the absence of other African-American colleagues, "you don't know if any of this happens because you're black, because you are the only one." In response to this comment I wrote to Lovell Jones, an African-American colleague at the MD Anderson Cancer Center, University of Texas at Houston, explaining how isolated I felt at the university. His reply:

"I have had all of this happen to me at some point in my career. I can also point to many other persons of color who this has happened to. In some instances, I can also point to women as well. For the most part, we have not elected to 'go along to get along,' and that has placed us in the path of an institution that does not appreciate diversity, at least not in how they define diversity."

Dr. Jones circulated my story to other scientists of color. Among dozens of responses were:

"Over and over and over again, these types of things are happening to us, and because we are few and isolated across institutions, it takes years, if ever, for us to be heard. Take care and again, thanks for sharing. I needed this validation."

Another wrote: "I would rather come in and go home every day hoping that they will just not notice I am around."

Thus, my experience is quite common. Most who responded even asked for anonymity for fear of retaliation at their institutions. Our institutions need to make real efforts to achieve diversity at all academic levels. That effort has to be more than simply adding one or two minorities to a department, and we have to really strive to include our scientists of color in all aspects of the academy. Without a cohort of adequate numbers, the support needed to be successful, confident colleagues will not exist. The consequences of not making these efforts are several.

Role models are needed. African-American students from my class tell me that, in addition to being a role model, I "legitimize" them. They report that until they take my class, they are excluded from successful study groups and often even accused of cheating in classes where they do well. Thus, having an African-American professor not only provides a role model but also improves their performance in other ways.

Equally important, diversifying science will impact what science is done. Although the basics of how to do science will not vary with race, ethnicity, or culture, what we choose to study does. In my years of experience, minority and first generation college students, in particular, tend to choose science as a major, because of a childhood experience (a parent who died of a disease or witnessing habitat loss in their community, etc.). What's more, minority students more often express a strong desire to "give back."

Consider that African-American men are twice as likely to develop prostate cancer and 2.4 times more likely to die from it (American Cancer Society, 2010). African-American women are 50% to two times more likely to die from breast cancer (American Cancer Society, 2010), and yet no African-American cancer cell lines are well characterized and used in cancer research. African Americans are also more likely to develop and die from diabetes, heart disease, and hypercholestemia. Although African Americans represent only 13% of the U.S. population, 50% of those infected with HIV/AIDS are African American (ten times the rate in Caucasian Americans) (Centers for Disease Control and Prevention 2010). African American are more likely to die violent deaths, become teen parents, and to be single parents. Sixty percent of all African Americans age 18 or younger live below the poverty level. People who live in poverty are less likely to live in school districts that will prepare them for college, less likely to be educated about health concerns, less likely to have access to proper health care, and more likely to work in jobs and live in areas that expose them to environmental hazards that contribute to adverse health outcomes. Thus, given that we are more likely to commit to studying issues with which we are familiar and given the paucity of African-American students in science and the paucity of African-American professors to teach them, we are not likely to nurture the students who are likely to study these issues.

In fact, this relationship is reflected in my work with atrazine (Fan *et al*., 2007; Hayes *et al*., 2002a, 2002b, 2006, 2010). Atrazine demasculinizes and feminizes vertebrate animals primarily by inducing aromatase (Fan *et al*., 2007a,b; Sanderson *et al*., 2000, 2001, 2002), which results in a higher estrogen:androgen ratio. In rodents (Eldridge *et al*., 1994; Pintér *et al*., 1980; Rosenberg *et al*., 2008), human cell lines (Fan *et al*., 2007a,b; Sanderson *et al*., 2000, 2001, 2002; Suzawa *et al*., 2008), and epidemiological studies (Swan *et al*., 2003; Maclennan *et al*., 2002; Kettles *et al*., 1997), this effect of atrazine likely plays a role in breast and prostate cancer. In addition to the fascinating science, I am driven by a "need to give back" and am concerned about minority communities that suffer health care disparities and the roles that chemicals, like atrazine, play. In particular, I am concerned that Mexican Americans (who suffer health disparities similar to those of African Americans) represent a disproportionate fraction of agricultural workers (90% in California) and thus are more likely exposed to pesticides. African Americans are similarly more likely to live in areas and work in occupations where they are exposed to such hazards. For example, Sygenta's atrazine production facility in St. Gabriel, Louisiana's "cancer alley," which boasts a prostate cancer rate 8.4 times higher in factory workers exposed to atrazine, is in a community that is 80% African American. In addition to my laboratory research, I make every effort to inform the public about the emerging science on this issue.

In the next 50 years, the United States will become "majority minority" with African Americans and Hispanic Americans becoming the majority. If the trends in health and education described above continue, we will be in dire straits. Imagine a country where the majority of people are in prison rather than college; where the majority of its people are more likely to die from HIV/AIDS, diabetes, breast cancer, and prostate cancer, and where 60% of the majority live below poverty. Imagine the health care, welfare, and prison costs to the United States.

In conclusion, I thought long and hard about the topic of my essay. People interested in my science can come to my lecture. Those who do not make it to my lecture can read my papers. But this is probably the only place many will learn how difficult it is being a team player when you're not really part of the team. Pioneers like Just have made my path possible, and reflecting on his and my life has made me realize how much further we still have to go. Minority scientists should not avoid those obligations and commitments to serving as role models, reaching out to underserved communities, and taking on scientific questions that will improve the quality of life for all citizens. However, academic institutions must recognize these added burdens and give true credit to those individuals that take on these responsibilities. Real efforts to train, recruit, and nurture people of color in the sciences must be made at all levels (grade school, undergraduate, graduate, postgraduate, and faculty levels). The efforts must not stop simply because a department has one or two representatives, but critical mass must be built so that single isolated individuals are not overburdened. Further, recruiting critical mass at all levels will ensure that role models are available to support and nurture the careers of people of color. Everyone must take some responsibility for these efforts and not simply assume that the few minorities in their department will automatically take on these roles. Finally, we must lobby for more funding for research to address health disparities and incorporate this information into our courses to attract students of color and demonstrate the many ways that students can "give back" by entering careers in science. This must truly be a team effort. I hope that in the next 100 years we come a lot further than we find ourselves now. It is imperative.

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