

People's instinctive travels and the paths to science

Avery August

Department of Microbiology and Immunology, Cornell University, Ithaca, NY 14853

ABSTRACT To be the recipient of the E. E. Just Award for 2014 is one of my greatest honors, as this is a truly rarefied group. In this essay, I try to trace my path to becoming a scientist to illustrate that multiple paths can lead to science. I also highlight that I did not build my career alone. Rather, I had help from many and have tried to pay it forward. Finally, as the country marches toward a minority majority, I echo the comments of previous E. E. Just Award recipients on the state of underrepresented minorities in science.

IN THE BEGINNING

I did not have the same hurdles as the namesake of this award, E. E. Just. My path was different. I was born in Belize, in Central America, to a teenage mother, with the accompanying "destined to fail statistics" that came with my birth circumstances. I grew up practicing science without realizing it, spending summers performing experiments: mixing various chemicals to see what would happen, rediscovering that plants grow toward the sunlight, using tadpoles to study developmental biology. I credit my biology teacher, a Peace Corps volunteer, for encouraging these activities. It was not until much later that I found out one could actually make a living as a scientist. Whenever I was asked what I wanted to be, rather than saying a carpenter (my grandfather's occupation and what I secretly wanted to be), I



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said a doctor. That's what kids interested in biology did. But my mother changed the trajectory of my life. She decided that we could get better opportunities in the United States, and she migrated (initially illegally, and then legally), so that she (and her children) could do better. She got her high school GED in the United States, and my story is her story continued.

CALIFORNIA AND DREAMING

I moved to Los Angeles in the mid 1980s, just as the crack epidemic was getting underway. My friends were involved in "the trade." By the time I was leaving for graduate school, half had been shot, all had been to jail at least once, a few were dead. All were casualties of the war on drugs and the disparity in sentencing laws.¹ This is not in my curriculum vitae, but I was mugged on the campus of Los Angeles Southwest Community College, where I was trying to register for classes, had a gun

stuck in my stomach, and learned not to look a gang member directly in the eye. On arriving in Los Angeles, I was placed in the 11th grade at Los Angeles High School, although I dropped out at the end of the semester, deciding to take my chances with the GED. It's the diploma that I have had framed, because it was my ticket to

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Address correspondence to: Avery August (averyaugust@cornell.edu).

Abbreviations used: LACC, Los Angeles Community College; NIH, National Institutes of Health; NSF, National Science Foundation; TcR, T-cell receptor.

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¹Policies that disproportionately affected the African-American and Hispanic communities, with the proportion of drug arrests of African Americans increasing from 25% in 1980 to 37% in 1995, and these groups being more likely than non-Hispanic whites to be jailed for a drug offense. Disparities in sentencing for crack cocaine offenses passed by Congress in 1986 and 1988 also contributed to this imbalance. Congress also passed legislation in 1994 prohibiting convicts from receiving Pell Grants, effectively preventing a large proportion of African Americans and Hispanics from being able to get higher education. See Mauer, 1999.

being able to register at a community college. At the time, I knew no one who had gone to college in the United States and had no guidance on the process. I eventually registered at Los Angeles Community College (LACC).

After two years at LACC, I transferred to the California State University in Los Angeles, initially registering as a biology major but then, like many others, switching to medical technology, because I needed to get a job if medical school didn't pan out. I was working a full-time job to pay for college, and soon this started to take its toll. I started to reconsider going to medical school, because I was always more interested in the why and how. Fortunately, I took an organic chemistry course with Costello Brown at Cal State; he called me into his office after one exam and asked me my major. He then said: "Do you want to do urine analysis for the rest of your life?" He suggested I try to get some research experience in a lab and go to graduate school. This was the first time I had ever heard of this option. At around the same time, one of my friends in "the trade" said to me, "Why are you hanging out with us, you should be focusing on your studies" (sadly, Joe was later shot). I was eventually able to get into the laboratory of Phoebe Dea, who opened my eyes to the world of science and the idea that one can have a career in science. She even got me financial support from the National Institutes of Health (NIH)-funded Research Infrastructure for Minority Institutions program, so I could reduce my hours working. In her lab, I worked on investigating the catalytic synthesis of fatty acids and other lipids using homogenous catalysts. We eventually published my first paper on this topic (August *et al.*, 1993). Professor Dea encouraged me apply to graduate school. I was skeptical and started looking for jobs as I neared graduation, now burdened with student loans and seeing all my friends enjoying their lives with the accoutrements. I couldn't afford not to work for the yearlong internship it took to become certified as a medical technologist, and the closest I got to a job was as a part-time technician at the Doheny Eye Institute, harvesting eyes from accident victims (the interview consisting of an actual eye harvest!). So I applied to graduate schools, choosing immunology, because I really enjoyed taking this course, and was accepted to the Graduate School of Medical Sciences at Cornell University in New York City.

NEW YORK STATE OF MIND²

I wanted to attend Cornell, because it was in New York City, a place where I didn't have to drive, thus losing the privilege of lying handcuffed on the sidewalk whenever the Los Angeles Police Department pulled me over for a simple traffic ticket.³ At Cornell, I wasn't being mugged or shot at or harassed by the police. However, I was initially very scared to start there, because my classmates were from all over the world, including Ivy League institutions; I was afraid that my preparation at Cal State would fall short. However, I soon found out that I could hold my own. After working for a short time in David Posnett's lab on interactions between the T-cell receptor (TcR) and superantigens (Posnett *et al.*, 1990), I ended up in the laboratory of Bo Dupont. I am eternally grateful to Professor Dupont, as he gave me wide latitude in working on projects in his lab. I investigated the signaling pathways downstream of the TcR and the costimulatory receptor CD28 and showed for the first time that CD28 recruited and activated the lipid kinase PI3K and that the Tec kinase ITK lay downstream of the TcR and CD28 (August and Dupont, 1994a,b,

1995, 1996; August *et al.*, 1994, 1997; Gibson *et al.*, 1996a,b; Teng *et al.*, 1996; King *et al.*, 1997). I continue to work in these areas in some form or another today (August and Ragin, 2012).

Following graduate school, I decided to stay in New York City and approached Hidesaburo Hanafusa at the Rockefeller University, who accepted me into his lab. Rockefeller is an awe-inspiring place, although the guards at the gate could never get used to my presence. In the Hanafusa lab, I worked in various areas, one of my discoveries being that the Tec kinase ITK (from my graduate work) lay downstream of Src kinases (August *et al.*, 1997; originally discovered by Hanafusa and others [Takeya and Hanafusa, 1983; Wang *et al.*, 1978]). I am grateful for the support of the National Science Foundation (NSF) for a minority postdoctoral fellowship.⁴ After about two-and-a-half years, I decided to probe the job market, applying for both industrial and academic positions. Surprisingly, I received several industrial and academic interviews and accepted a position at the Johnson & Johnson Pharmaceutical Research Institute.

TRAVELS ALONG THE WAY

I was quite happy at J&J, with great colleagues and a healthy respect for industrial work, but I missed the academic environment and really wanted to work with students. So, after a year at the company, I decided to leave and reenter the job market and landed a position at Penn State. I had great colleagues and great students at Penn State, but I very quickly realized how few minority scientists there were. And so I spent a lot of time working with underrepresented undergraduate and graduate students, acting as an unofficial mentor to our few minority students and being a Sloan faculty mentor to the minority students supported by the Sloan Foundation. I also decided to develop, and was able to get NIH funding for, a Bridges to the Doctorate program with Alcorn State (a historically black university) in Mississippi (August *et al.*, 2008). My students helped me build my publications and get funding, allowing me to rise to the title of Distinguished Professor. In 2010, I was recruited to my current position.

PUSHING IT ALONG

Along the way, I have had great mentors, advisors, and colleagues, and I have always felt that I stand on the shoulders and backs of slaves and civil rights workers, who have fought for people like me to be able to get to this point. I have had great support from my family and help from unknown supporters. I have tried to pass it along, with service on study panels and mentoring groups, always being willing to answer questions and provide support and advice for all students, but particularly for underrepresented students; We have a long way to go. I won't cite the statistics (they are cited elsewhere, e.g., Hayes, 2010), but I suggest you look around your labs and your campus or research institute to get a sense of the paucity of underrepresented minorities in science. While the NIH and a number of agencies, private and public, including the ASCB, have to be applauded for providing significant resources in training and supporting scientists from underrepresented groups, as well as supporting research into the health disparities of minority citizens,⁵ we have had very slow progress. I am reminded of an idea from the columnist Ezra Klein (Klein, 2014), commenting on Ta-Nehisi Coates'

²The title of a track from the 1994 album *Illmatic* by Nas.

³For example, in the late 1980s, in Volusia County, Florida, more than 70% of the drivers stopped for traffic stops by local police were either African American or Hispanic, and they were also stopped for longer times, with 80% of their cars being searched. See Harris, 1997.

⁴Where I overlapped with fellow NSF Fellow and 2010 E. E. Just Award recipient Tyrone Hayes.

⁵Starting with the Office of Minority programs established in 1990 by then secretary of the U.S. Department of Health and Human Services, Louis Sullivan, and culminating with the establishment of the National Institute on Minority Health and Health Disparities in 2010.

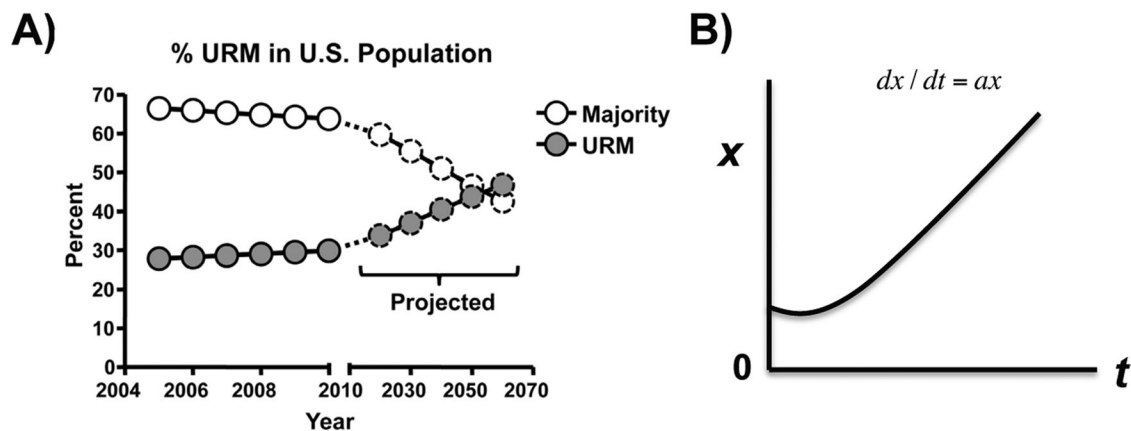


FIGURE 1: A changing minority majority. (A) Projection of the minority population in the United States (derived from data in National Science Foundation, 2004). (B) Plot representing the hope that we can exponentially increase representation of underrepresented minorities in science to match the population projections.

article “The Case for Reparations” (Coates, 2014). Klein writes that the plight of African Americans in the United States is like a compound interest problem. Applied to the situation in science, it’s the equivalent of getting \$10,000 a year for 42 years for minority programs,⁶ while the majority has gotten the equivalent of a penny a year for 67 years,⁷ and that penny has been doubling in value every year. The difference? \$420,000 for minority programs versus \$1,475,739,525,896,764,129.27. That’s a lot of resources to make up. We also know, due to the pioneering work of Ginther, Kington, and colleagues published in 2011, that African-American scientists in particular are significantly less likely to be funded by the NIH, for reasons that remain unclear (Ginther *et al.*, 2011, 2012; Tabak and Collins, 2011). Given the changing face of the nation (Figure 1A), many suggestions have been proposed to address the paucity of minority scientists (Pasick *et al.*, 2003; Carter *et al.*, 2009; Hayes, 2010; Byars-Winston *et al.*, 2011; National Academy of Sciences, National Academy of Engineering, and Institute of Medicine, 2011; Maton *et al.*, 2012; Valla and Williams, 2012). The good thing about any successful approach is that what works for our minority students can also work for our majority students. What I can say we do need is more dedicated mentors from the highest ranks of science, whose careers are dependent on the success of minority students (perhaps tied to their funding). We need to train those mentors on how to mentor minority students and use broader measures to judge minority applicants to graduate schools (e.g., see Posselt, 2014). Those of us from underrepresented groups who have made it here have a duty to be part of this process. We also need to challenge our communities and schools to support bright, smart kids as much as they support talented athletes. We need to find out what worked for those successful minority scientists and replicate it. And we need to keep moving forward to build on past successes with hope (Figure 1B). I am in awe of the company in which I have been placed as a E. E. Just Award recipient,⁸ and it gives me impetus to follow the words of Rick Ross: “Everyday I’m hustlin’, everyday I’m hustlin’.”⁹

⁶Let’s start with the initiation of the Maximizing Access to Research Careers program at NIH in 1972.

⁷Let’s start with the first NIH grants program in 1944, which very likely supported very few minorities, given the state of civil rights in the country at that time.

⁸E. E. Just Award recipients: www.ascb.org/component/content/article/122-about-ascb/committees/membership-committee/awards/144-keith-e-e-just-award.

⁹Lyrics from the song “Hustlin’” from the 2006 album *Port of Miami* by Rick Ross.

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