

Biotech's pale shadow

Brady Huggett

Two years after the biotech industry was called out on gender imbalance, the lack of racial diversity in the workforce is largely being ignored.

The International BioGENEius challenge has become the Biotechnology Innovation Organization's (BIO) showcase for bright and aspiring talent that represents the future of the industry. The contest, run by the Biotechnology Institute, (Washington, DC) (<http://www.biotechinstitute.org/>), highlights high school and home-schooled students from global locations, who have worked on translational science projects, though finalists are often American. Attending the BioGENEius ceremony this June at BIO's annual conference in San Diego, the contrast between the students on the stage and the audience in the room was striking. More than half of the 15 finalists were female and overall the group was about 80% Asian and Indian, while the lunch crowd below looked radically different—for the most part white and male.

This year was no different from previous years. White males are always in short supply among the BioGENEius finalists, yet the BIO convention hall is filled with them. In fact, anyone attending industry meetings cannot

Brady Huggett is Business Editor at Nature Biotechnology. Photo at top of page is Ted Love, CEO of Global Blood Therapeutics.

help but notice the lack of diversity in biotech's workforce. This article—a result of ten months of interviewing and examination—reveals an industry aware of the lack of diversity but lacking a collective, concerted effort to address it, despite growing evidence for the benefits of diversity. Biotech is a science-driven endeavor, and its white majority is, for the most part, educated, enlightened and receptive, yet industry is not doing enough to dissect unconscious bias or to encourage greater participation of minorities. Indeed, when contacted by *Nature Biotechnology*, many public biotech companies refused to discuss this issue on the record. For most of the biotech sector, race remains not just off limits—it is radio-active.

Race report

The US census estimates the country's population in July 2016 at >323 million. Of that number, 61.3% identified themselves as white non-Hispanics, 17.8% as Hispanic or Latino, 13.3% as black or African American alone and 5.7% as Asian alone. Those identifying solely as American Indians and Alaska Natives were estimated at 1.3%, and Native Hawaiian and Other Pacific Islanders alone came in at 0.2% (Table 1). In a more balanced world, the ethnic

representation in the biotech workforce would loosely mirror these numbers for the general population.

Yet, that is that is not how things are. In collaboration with BIO (Washington, DC), we surveyed 54 biotech companies (Box 1) to assess the representation of ethnicities within their workforce. The results clearly show that non-Hispanic whites and Asians are over-represented in biotech compared with the general population, whereas blacks

Table 1 US census demographic estimates, 2016

Race	Percentage of US population as of July 2016
White, non-Hispanic or Latino	61.3
Hispanic or Latino	17.8
Black or African American alone	13.3
Asian alone	5.7
American Indian or Alaska Native alone	1.3
Native Hawaiian or Other Pacific Islander alone	0.2

Source: US Census Bureau

Box 1 Methodology

Springer Nature's in-house team for data collection constructed an online survey seeking details on biotech company demographics; BIO sent this survey to its broad US-based membership and encouraged participation. Fifty-four companies completed it, a mix of public and private firms, large and small, from more than 20 states, though more responses came from companies based in California and Massachusetts. The result is a small, but representative, sampling of US biotech (**Supplementary Data**).

and Latinos/Hispanics are underrepresented (**Fig. 1**). It is also clear that American Indians, Alaska Natives, Native Hawaiians and other Pacific Islanders are also underrepresented. This holds true for all the companies in our survey, irrespective of venture size, location and maturity.

These figures will not be much of a surprise to biotech veterans—simply walking into an industry conference visually confirms this data set—and the percentages are similar to the field of biomedical researchers, which has long struggled to find parity (**Fig. 2**). Which raises two questions: why is it this way and what can be done about it?

Overachieving

Our survey shows that Asians are a strong presence in this industry. They comprise nearly 20% of the overall biotech workforce, 16% of management and ~15% of boards (**Fig. 1**), despite making up only 5.7% of the broader US population. Asians receive a greater percentage of life science PhDs than Latinos/Hispanics or blacks (**Table 2**). But they are also wealthier than any other major demographic group in the United States, and their children are being raised the furthest from poverty (**Table 3**).

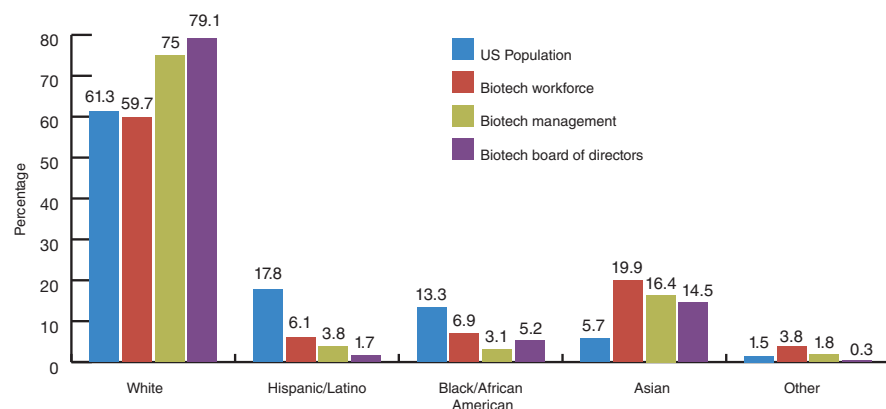


Figure 1 Survey of biotech company demographics. In collaboration with BIO, we sent a survey to the US-based biotechnology membership. We received 54 completed surveys. For the demographic definitions, Asian includes those from the Far East, Southeast Asian or Indian subcontinent origin. “Other” includes Native American, Alaska Natives, Hawaiian and other Pacific Islanders. See **Supplementary Data** for complete results.

This success has been a long time coming. When Asian immigrants—mainly from China—first came into America in the 1800s to work in gold mines, in factories or on the railroads, they were resented by the white American majority, who blamed cheap Asian labor for rising unemployment and low pay. As a result, the US government passed the Chinese Exclusion Act of 1882, barring the immigration of Chinese laborers and, later, similar xenophobic laws were passed to discriminate against other Asian groups.

The change in perception of Asian communities started in 1943, when the Chinese Exclusion Act was repealed and replaced with the Magnuson Act, which provided a quota for Chinese immigrants. Following World War II, the US government began to recast itself as a global leader in human rights. It liberalized its immigration policy and sought to improve its relationship with Asian Americans—a relationship that had recently been damaged by the internment of Japanese immigrants and citizens after the attack on Pearl Harbor. The federal government launched a publicity campaign highlighting the patriotic, law-abiding, family-centric Asian community. This campaign later expanded to promote Asians as anti-communist, and the overall effort was



Travis Huggett

Ken Horne, CEO of Symic Bio.

supported by groups such as the Japanese American Citizens League.

This is the America Ken Horne, CEO of Symic Bio, grew up in. The son of a white father and Japanese mother, both professors, Horne was a “faculty brat” in Palo Alto, California—a liberal, diverse town without much racial tension. The first time he experienced racism was in college, when he was walking between campus parties with a collection of Asian friends and a group of whites called them “chinks.” It was a memorable moment. He’d spent his life with the ability to move from one side of his racial background to the other—the white, the Asian. But here a label had been affixed to him, a slur, and all choice seemed gone. “It opened my eyes,” he says, “about how to treat other people, and how to be aware of our own personal biases.”

He had an initial interest in medicine, but during his sophomore year at Stanford he required knee surgery, and when the doctor told him he’d done >3,000 such procedures, the enormity of the number stuck in his brain.

“That’s exactly the person you’d want to do your knee surgery,” Horne says, but he wanted to do something less monotonous, more innovative. He earned his bachelor and master of science degrees in mechanical engineering, and began to focus on business development. In 2009 he started the venture capital firm TauTona Group, and he joined Symic Bio as CEO in 2014.

His biracial makeup has given him a broad view on race, and he considers it an advantage. “I am able to take both sides of the ethnic coin,

so I'm more sensitive to [a person's ethnicity], but less affected by it," he says, and he has built Symic to mirror his beliefs that diversity is a strength. The management team includes three women and is about half people of color.

Our survey shows an Asian CEO is still somewhat rare in biotech, but it's becoming less so. This is happening in part because more Asians are founding their own companies, but meanwhile, the concept of the 'model minority' in post-war America has "absolutely" stretched to include those with ancestral ties to the Indian subcontinent, says Ellen Wu, director of the Asian American Studies Program at Indiana University, and the author of *The Color of Success: Asian Americans and the Origins of the Model Minority*¹.

"Though the concept of a model minority first started with the Chinese and Japanese, there were occasionally laudatory depictions of other groups, including Asian Indians," she says. And the focus greatly widened after the 1965 immigration reforms.

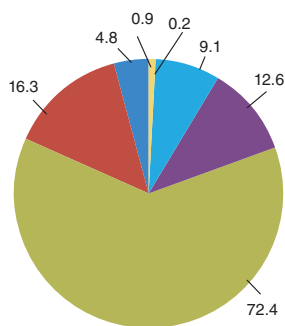
Anil Goyal, who works with biotech startup MimiVax, has been a beneficiary of this shift. His father was a military man in India, and as a boy Goyal's family moved to a new border town every couple of years before finally settling in what is today called Mumbai. At first Goyal imagined a military life for himself, too, but when he was a teenager his cousin moved in with Goyal's family to access the better Mumbai schools. This cousin was diagnosed with a neck tumor not long after; the cancer metastasized, and the boy died at 17.

"After that, I only wanted to look at the sciences," Goyal says.

He earned bachelor's and master's degrees in microbiology from the University of Mumbai, but applied for an F-1 visa to earn a PhD at Rutgers University, with its renowned microbiology program. When he arrived in New Brunswick, New Jersey, he was a stranger in a strange land. School was hard enough, but off campus it was even tougher. He wandered the grocery store, the streets, feeling out of place, like an outsider. "You're ashamed of it, a little bit," he says.

He completed a PhD in bioethanol in Douglas Eveleigh's laboratory, did post-doc work at Merck in Kenilworth, New Jersey, then left the pharma for a post-doc in bioremediation at Rutgers. When that was done, he applied for the EB-1 permanent visa as an outstanding researcher. He has now been living in America for nearly 30 years; he's married to a woman he met at Rutgers (an Indian immigrant, like him), and they have two children. He's had stints with Cambridge, Massachusetts-based

2010 census US population



2010 PIs on RPGs

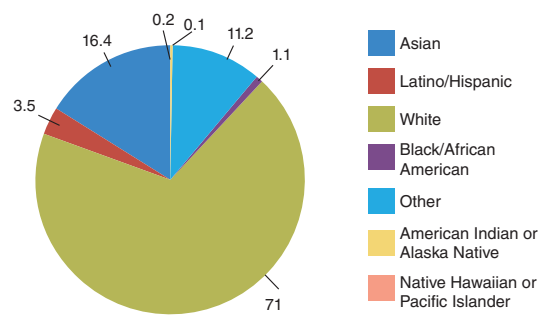


Figure 2 Race and ethnicity of 2010 US population and 2010 NIH principal investigators (PIs) of research project grants (RPGs). Among minority groups, Asians do proportionately better in receiving NIH funding, whereas Hispanics and blacks do proportionately worse than their demographic would indicate. "Other" includes unknown, not reported or more than one race. Total percentage is greater than 100 because those identified as Latino/Hispanic may also have identified as other races. PI information collected by NIH includes the option for an applicant to signify both race and ethnicity. Source: US Census Bureau and the National Institutes of Health's Draft Report of the Advisory Committee to the Director Working Group on Diversity in the Biomedical Research Workforce.

Millennium Pharmaceuticals and Durham, North Carolina-based Heat Biologics, and today is a consultant with Buffalo, New York, startup MimiVax, which develops cancer immunotherapies. He does not think bias has held him back in his career. "It would be hard for me to say that I had not been promoted because of race," he says, "and mostly I've been surrounded by multi-racial teams." But he cautioned that workforce diversity does not seem to be reaching company management.

Asian Americans and skilled Asian immigrants—who sometimes push their offspring to perform in the classroom, Goyal told me, because they know the difficulty of competing in a majority-white country—have

produced an educated, prepared cadre for the labor market. The result is that many Asians are excelling in biotech and elsewhere.

"I'd say that on any given [job] search, [Asians] are probably 25% to 50% of our candidates," says Robin Toft, who is president and CEO of Toft Group, an executive search firm for biotech based in San Diego. For years, she said, bright, accomplished immigrant Asian candidates were being held back by their inability to speak fluent English, or their poor fit with American business culture.

"But now, it's next gen," she says, "and these kids are being raised here." The language problem and the culture rift have closed. When you put these Asian applicants alongside others, "Asians will win."

Table 2 Ethnic breakdown of life science^a doctorates received from 1995 to 2015

Race	1995	2000	2005	2010	2015
	Number of doctorates (percentage of total)	Number of doctorates (percentage of total)	Number of doctorates (percentage of total)	Number of doctorates (percentage of total)	Number of doctorates (percentage of total)
White, not Hispanic or Latino	4,545 (75)	4,762 (80.2)	4,761 (78.9)	5,689 (76.9)	6,045 (74.9)
Hispanic or Latino	183 (3)	242 (4)	293 (4.9)	449 (6.0)	632 (7.8)
Black or African American	190 (3.1)	221 (3.7)	289 (4.8)	392 (5.3)	452 (5.6)
Asian ^b	1,111 (18.3)	680 (11.4)	671 (11.1)	843 (11.4)	922 (11.4)
American Indian or Alaska Native	27 (0.4)	27 (0.4)	19 (0.3)	22 (0.3)	22 (0.3)
Total	6,056	5,932	6,033	7,395	8,073

^aIncludes agricultural sciences and natural resources, biological and biomedical sciences, and health sciences. ^bIncludes Indian Asians, Native Hawaiians or other Pacific Islanders who are not Hispanic through 2000, but excludes them since 2001. Source: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Earned Doctorates.

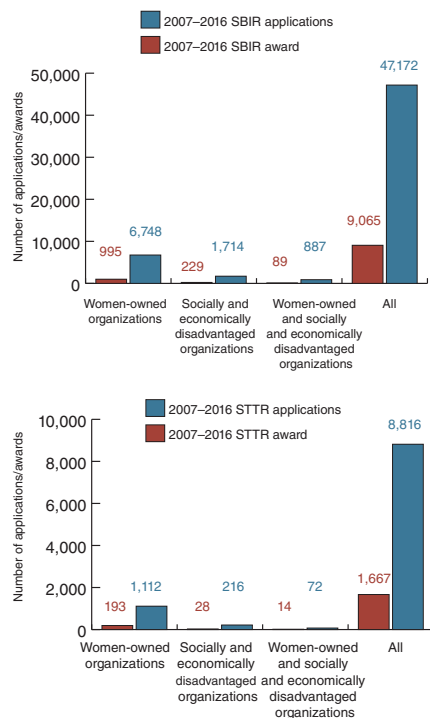


Figure 3 Access of women and disadvantaged minorities to startup funding from NIH. SBIR, Small Business Innovation Research; STTR, Small Business Technology Transfer. Source: NIH

Underrepresented and underpromoted

If the Asian workforce is succeeding in biotech, the story is different for African Americans/blacks. According to our survey, far fewer blacks work in the biotech industry than their percentage in the wider US population. More than 13% of Americans are black, yet they represent just under 7% of biotech company workforces, a mere 3% of management teams, and around 5% of boards in our survey (Fig. 1).

Part of the explanation for this underrepresentation is that the biotech industry requires a highly educated workforce, and education and training in the United States to the doctorate level comes with a steep price tag. The US non-profit College Board estimates that a ‘moderate’ college budget for an in-state public college for the 2016–2017 academic year averaged \$24,610; a moderate budget at a private college was even more, averaging \$49,320. Black communities in the United States earn less overall than other racial groups, have a larger proportion of its members below the poverty line, and the highest percentage of children raised in poverty (Table 3). Economic hardship makes a university education more difficult to attain, which may be part of the reason why blacks earn PhDs in the life sciences at a lower percentage than whites or Asians (Table 2).

The relative lack of accumulated wealth for blacks is partly the product of federal and local governments in the United States passing laws that put the black minority at a disadvantage. Although slavery was abolished in 1865, black Americans continued to be subjected to official, systematic discrimination via Jim Crow state and local laws, which enforced segregation in all publicly run facilities and services. Racial segregation was not limited to the South; it was re-initiated in federal workplaces by US President Woodrow Wilson in 1913. Passage of the federal Civil Rights Act and Voting Rights Act overruled Jim Crow laws in the mid-1960s, but discrimination and racism continued; indeed, it continues to be part of the daily life of black Americans, as was acknowledged by President Barack Obama in unscheduled remarks in 2013 (ref. 2).

Racial inequity in America also looms over science. Many black Americans view the scientific establishment with distrust following scandals involving ethical breaches in

research. Examples include the infamous US government-sponsored “Tuskegee Study of Untreated Syphilis in the Negro Male,” which failed to offer treatment to black men with syphilis and disregarded the need for informed consent of study participants, and the case of Henrietta Lacks, whose cervical cancer cells were immortalized as HeLa cells and distributed throughout the scientific community without informing her or her family, which has been perceived as racially discriminatory.

“It’s an uneasy relationship,” says Susan Windham-Bannister, CEO of Biomedical Growth Strategies and the founding president and CEO of the Massachusetts Life Sciences Center, the investing agency charged with implementing a \$1-billion initiative to support life sciences in Massachusetts. “There are not a lot of [science] role models for people of color, and parents of color have not been as encouraging of their children toward the life sciences.” And while it has benefited the life sciences to forge strong ties with researchers at “the usual suspects”—the University of California system, Harvard, the University of Pennsylvania, for example—the biotech industry has not done so with colleges and universities where the student body is predominantly black, Windham-Bannister points out (Table 4). Which school you go to is deemed important; biotech and venture capitalists both love educational pedigree and Ivy League schools, and so swaths of PhD minorities can be dismissed out of hand simply because they choose to go to a school more heavily attended by their own ethnicity. (For more on Susan Windham-Bannister’s life, career and thoughts on race, go here for her First Rounders podcast: <http://www.nature.com/nbt/podcast/index.html>.)

Ted Love, the CEO of Global Blood Therapeutics, is black and grew up against this backdrop—raised on a farm in Huntsville,

Table 3 Income, poverty rate, under-18 poverty rate by race in the United States from 1995 to 2015

Ethnic group	1995			2000			2005			2010			2015		
	Real median household income (\$)	Poverty rate (%)	Under 18, below poverty (%)	Real median household income (\$)	Poverty rate (%)	Under 18, below poverty (%)	Real median household income (\$)	Poverty rate (%)	Under 18, below poverty (%)	Real median household income (\$)	Poverty rate (%)	Under 18, below poverty (%)	Real median household income (\$)	Poverty rate (%)	Under 18, below poverty (%)
Asian alone ^a , including Pacific Islander	62,769	14.6	19.5	76,737	9.9 ^b	12.7	74,148	11.1	11.1	69,856	12.2	14.4	77,166	11.4	12.3
White/white alone ^a	55,276	11.2	16.2	60,441	9.5	13.1	58,928	10.6	14.4	56,213	13	18.5	60,109	11.6	17.2
Latino/Hispanic, any race ^c	35,330	30.3	40	45,649	21.5	28.4	43,652	21.8	28.3	40,909	26.5	34.9	45,148	21.4	28.9
Black/black alone ^a	34,608	29.3	41.9	40,830	22.5	31.2	37,451	24.9	34.5	34,922	27.4	39	36,898	24.1	32.9

^a“Alone” denotes individuals identifying as single race; some individuals who identify as Asian, white, black, etc., are of mixed race. ^bEnds inclusion of Pacific Islander. Source: US Census Bureau. ^cFederal policy defines “Hispanic” as an ethnicity; Hispanics can be of any race. Source: US Census Bureau



Susan Windham-Bannister, founding president and CEO of Massachusetts Life Sciences Center.

Alabama, to parents who had finished the fourth (~age 9) and sixth grades (age 11), respectively. Yet, he had “an enormous appetite for learning,” he says, and he excelled in school, especially in math and the sciences. When he began to think about his future, he noted that the local doctor, a black male like him, was well-respected, well-liked and financially better off, and Love decided that would be his career.

It nearly was. He went to Haverford College, in Pennsylvania, a top-tier liberal arts school, for his bachelor of arts in molecular biology, thinking about being a doctor. He was a long way from Alabama, and among a sea of white students, an unease crept in. “I found that if you don’t have insecurities, you’re not normal,” he says. “It’s part of our DNA and has probably helped keep us alive. I had a fair amount of racial insecurity when I went to Haverford, but it was almost all obliterated. When I left, I felt I could compete with anyone.”

His achievements, however, were not enough to fully dispel the notion among his peers that he was somehow lesser. His senior year, while climbing a stairwell on his way to lab, he overheard his own name. He paused, unseen, and listened as a handful of classmates asked a professor, why of all the students in their 25-person group was Ted, the lone African American, the only one to get into Yale? Why was he the only one Harvard had shown interest in?

It stung. What made it worse was that the professor did not quash the conversation, did not point out to them Love’s sterling academic record.

“But I can tell you it did nothing but make me feel I’d go to Yale and kick ass,” Love says. “They were entitled to their opinion, and I was entitled to mine. So I went and proved that Yale taking me was a very good thing.”

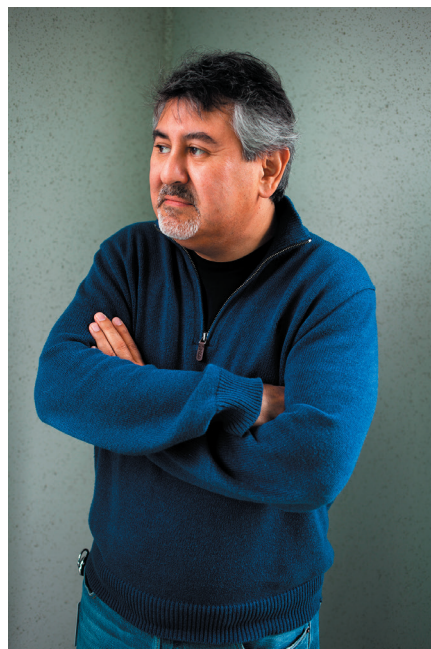
Love moved from Yale to Harvard and finally to S. San Francisco, California-based Genentech in 1992. Since then, he’s been senior vice president, development, at Theravance and had an R&D position at Onyx before joining Global Blood Therapeutics. The company is focused on sickle cell anemia, a disease that predominantly affects blacks. He considers the company’s mission social justice.

“Look,” he says, “there are 29 drugs for kids with HIV. We have zero drugs for kids with sickle cell disease. That’s a startling observation. Scientifically, which is harder to cure? I’d say HIV.”

The whiteness of biotech, Love thinks, is more about a lack of effort than bias. “I know people aren’t building these homogenous environments because of prohibitions,” he told me. “It’s because it’s easier to hire within who you know. But that’s not good enough if you want to bring the best to the table. You can’t do the lazy thing, which is to hire your buddy, which you can get away with more easily if you are white.”

Fast growing, but still lagging

Another minority that biotech is failing is Latinos/Hispanics. Our survey shows that although this group comprised nearly 18% of the US population in 2016, they represent only ~6% of the workforce, fewer than 4% of management teams, and fewer than 2% of board



Lino Gonzalez, senior scientist at 23andMe.

members (Fig. 1). Though Hispanics are slowly increasing their share of life science PhDs received annually, the total remains a fraction of their overall US demographic. And though Latinos/Hispanics have leapfrogged black Americans in terms of poverty rate since 2005, Latinos/Hispanics still live in poverty more than both non-Hispanic whites and Asians and earn less per household (Table 3). And though the gap has closed significantly in recent years, Hispanics still have a higher rate of high school drop outs—9.2% in 2015, compared with 6.5% for blacks and 4.6% for whites³.

The place of Hispanics and Latinos in American culture has been shaped by both geography—the Mexican Cession of 1848, which shifted land from Mexico to the United States that today makes up Utah, Nevada, California, parts of Arizona, New Mexico, Colorado and Wyoming—and immigration. During World War II, when the United States suffered a labor shortage, Mexican guest workers were invited into the country through the Braceros program. This ran from 1942 to 1964, and about 4.5 million Mexicans applied (some repeatedly) to work in agriculture in the United States, with as many as 450,000 entering per year. When the program ended, many simply stayed and started families. This helped establish a pattern of Mexicans traveling to the United States for labor work and higher wages, which has broadened to other Latin American communities and continues to this day, both documented and undocumented.

In the decade leading up to 2015, Mexicans were easily the most numerous of new documented immigrants into the United States at 1.5 million—about twice as many as the second-largest group, the Chinese. Yet Mexicans are generally emigrating as relatives of current residents, rather than as skilled workers (Table 5); indeed, only ~6% were granted legal status in the United States based on employment-based preferences. Contrast that with the Chinese, with 22% of their ~770,000 immigrants over that same decade awarded status for employment-based preferences, and Indians, with more than 44%. Biotech requires highly skilled candidates, which means that many Mexican immigrants, in contrast to Chinese or Indian immigrants, must study for higher educational credentials in the United States before they have the kind of qualifications industry seeks.

Latinos/Hispanics are the largest ethnic minority in the United States, one still working to increase their presence in higher education. Lino Gonzalez, a senior scientist in the therapeutics division at Mountain View, California-based 23andMe can testify to this. A Mexican American, he grew up in Hollister,

Table 4 Top 20 universities for NIH funding in 2015, and top 20 schools from which minorities received science and engineering degrees, 2011–2014

	Asian	Black or African American	American Indian or Alaska Native	Latino/Hispanic	Native Hawaiian or Pacific Islander
Johns Hopkins University	•	•			
University of California, San Francisco					
University of Michigan	•	•		•	
University of Pennsylvania	•				
Stanford University	•			•	
University of Pittsburgh at Pittsburgh					
University of Washington	•		•		
University of California, San Diego	•		•	•	•
University of North Carolina at Chapel Hill					•
University of California, Los Angeles	•			•	•
Columbia University Health Services	•				
Yale University					
Duke University	•		•		•
Washington University					
Vanderbilt University		•			
Emory University					
University of Wisconsin-Madison			•		
University of Minnesota			•		
Icahn School of Medicine at Mount Sinai					
Northwestern University at Chicago					

Top schools for NIH funding suggest universities conducting innovative research. Dots indicate which top NIH-funded universities were also top schools for producing science and engineering doctorates for each ethnic minority. Top schools for Asians are more often a top school for NIH funding when compared to other ethnic minorities. Source: NIH, National Science Foundation

The smaller populations of established US minorities, such as American Indians, Alaska Natives, native Hawaiians and other Pacific islanders, are barely found in the higher reaches of biotech. Collectively, this group made up just 1.5% of the total US population in 2016, according to US census estimates, but in our survey they totaled just 0.2% of board members, though that increased to 1.8% of management and 3.8% of the overall biotech workforce (Fig. 1). This subsection of America's demographics is small, as is the sample size in our survey, but this collective group is also not participating at levels biotech needs if it is to harness the power of diversity for innovation.

The talent pipeline

The lack of fuller ethnic representation in biotech is often chalked up to a pipeline problem. That is to say, more people of color (and more women, too) would hold positions in the biotech ecosystem if only there were more available.

This is true, and it isn't.

Over the 20-year period leading to 2015, there has been a steady increase in the number of doctorates received in the life sciences, up ~57% to 12,520 in 2015, including foreign students⁴. When looking only at doctorates received by US citizens or permanent residents, the growth is more subdued, but still up 38% to 8,484.

Of that number of life science doctorates among US citizens and permanent residents, 71.3% of recipients were non-Hispanic whites in 2015, 10.9% were Asian, 7% were Latinos/Hispanics, 5% blacks or African Americans, and fewer than 1% for American Indians or Alaska Natives. These figures confirm a paucity of underrepresented minorities with the necessary education to begin a career in, or toward, the biotech industry. There are a host of issues that must be addressed to bring more underrepresented minorities into higher education and ensure their success (see Careers article, doi:10.1038/nbt.4025), but at first blush these figures do back up the claim that the pipeline is thin.

Yet, partly it's thin because the already difficult task of chasing science to a PhD level is more difficult when one is a minority. In Claude Steele's book, *Whistling Vivaldi: How Stereotypes Affect Us and What We Can Do*⁵, the author presents the concept of 'stereotype threat', in which people of all colors, backgrounds and sexes will perform down to expectations when placed in positions in which they can be negatively stereotyped. Examples of unfounded negative stereotypes cited by Steele in the book include women being bad at math, whites lacking athletic

California, a small agricultural town about 50 miles south of San Jose. His mother worked in a tomato cannery, his father in the grape fields. The family lived in low-income housing and they were "pretty poor," he told me. By his own account, through middle school his grades were not good, and he wasn't considering college as part of his future.

But he got lucky—he had engaging, bright teachers in his public high school, particularly a young biology instructor who brought in copies of *Science* and *Nature*, tossed them down onto student desks and said, this is how science happens. And he remembers his physics teacher bringing in a completed dissertation and showing it to the class, saying, this is the creation of new knowledge.

That triggered something in Gonzalez. "I didn't have those kinds of role models in my family or community," he says, and he began to make up ground, taking summer courses and earning excellent grades. A guidance counselor pushed him toward the University of California at Santa Barbara (UCSB), instead

of a community college, and he took her advice.

He signed up for a general organic chemistry class his freshman year, but it bored him. He thought, I'm just following directions here, and he transferred into the organic chemistry class in UCSB's College of Creative Studies. His classmates there were sharper, more driven, and like before, he rose to compete with them. He went to the University of California at Berkeley for his PhD in molecular and cell biology, and then did post-docs at Yale and Stanford before entering the biotech field, spending 14 years at Genentech, and then leaving for 23andMe. He is a past president of SACNAS, the Society for the Advancement of Chicanos/Hispanic & Native Americans in Science.

Gonzalez's story is proof that students in poorer communities with lackluster schools, or those without mentors and role models in the sciences, can succeed "if you can change their mindset" and give them the opportunity, he says. The difficult part has been providing the opportunity.

pro prowess and blacks having low IQ. The author, who is black, devotes large portions of his book to the experience of students of color in majority-white, higher education institutions, where their status as a minority increases stress and sends them endless cues that they do not belong, such as being the only African American in a class, or getting instruction from a long line of white professors.

This was a factor for David Burgess, who is an American Indian and a professor of biology at Boston College. He has advised on underrepresented minorities to the US National Institutes of Health (NIH), the US National Science Foundation (NSF), the President's Council of Advisors on Science and Technology and the American Association for the Advancement of Science (Washington, DC).

"The first time I ever met another American Indian who was a scientist, I was a senior graduate student," he says. "And so, like with many underrepresented minorities, there is a question as to whether you fit in. All those feelings of belonging are raised."

Fighting against this, on top of a heavy academic load, is exhausting and "can be hurtful, even to the strong," says Anthony DePass, an African American professor of biology at Long Island University, founder of DePass Academic Consulting and a leader in encouraging minorities in research careers. These cues partially explain the increasingly loud call for more diversity on college campuses. *The New York Times* conducted an analysis of protests over race relations in 2015 at 51 US college campuses. They found that the number 1 demand across schools was for greater diversity among college professors⁶.

The pipeline to biotech is also made thinner by bias, unconscious or otherwise. A study by Donna Ginther *et al.*⁷ on race, ethnicity and NIH type 1 R01 research awards examined >40,000 unique investigators and found that Asians were 4% less likely to receive grant funding, and blacks 13% less likely, than white counterparts. Though the study found that race and ethnicity did not affect grant applications with high scores, in general, the results were clear: for NIH grants, "black PhDs are the most disadvantaged," Ginther says.

Minorities also have a harder time securing money to launch and keep startups afloat. Much as there is no comprehensive look at the demographics of biotech, little is known about the racial makeup of the industry's startups. Yet the NIH collects demographic data on company ownership for its Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) grants, which are often the prime funding for

academic spinouts. These stats present a familiar picture.

Over the ten-year period to 2017, just 3.6% of SBIR applications were submitted by organizations owned by the socially and economically disadvantaged (generally considered ethnic minorities⁸) and only 2.5% of awards went to this group. The percentages are slightly lower for the STTR program (Fig. 3). Not only are the number of applicants and awards smaller for the disadvantaged, but their chances of winning the award are lower, too: in the same ten-year period, organizations owned by white men had about a 20% chance of having their SBIR or STTR application granted. That percentage fell to ~15% for organizations owned by women, 13.3% for those owned by the socially and economically disadvantaged and to 10% for those owned by a socially or economically disadvantaged female (Fig. 3). It isn't clear whether the blame lies with inferior applications or an unseen bias, but either way, minorities are not sufficiently accessing this funding source.

Both grant and job seekers also face a 'university bias' of sorts. Race is not reported on NIH R01 grant applications, but school affiliation is, as is author name and publication history. Part of the NIH's job is to decide if work suggested for a grant or award is financially viable. This can favor schools with larger endowments, such as Yale University (New Haven, CT, USA) or Stanford University, and leave out historically black universities and colleges, or exclude the schools where a majority of Latinos/Hispanics teach and do research (Table 4). This is not to suggest that the NIH is consciously withholding grants from blacks or Hispanics and Latinos, says Anthony DePass, but the NIH "does have strong feelings on pedigree."

As do venture capitalists, and human resource departments and CEOs.

Other unconscious biases are harder to root out. A *PLoS One* paper published last year by Andrei Cimpian (now an associate professor at New York University but at the time the paper was published, in the department of psychology at the University of Illinois at Urbana-Champaign), and colleagues examined the frequency of the terms "brilliant" and "genius" being applied to university professors in 14 million online reviews on *Ratemyprofessors.com*. Their findings showed that in the fields where students used those words frequently in their evaluations, the fields contained fewer women and blacks, suggesting an unconscious bias toward white men as the sole owners of mental brilliance⁹. The effect is stronger in fields that are perceived to require innate intelligence, such as biotech, and while

the study did not extend to Latinos/Hispanics or American Indians, the author suspects the issue occurs there as well.

"People in [biotech] companies come from an academic background where brilliance and genius are traits that are valued," Cimpian says. "They will look to add those traits to their company." If Latinos or Hispanics, blacks, women and other underrepresented minorities are not seen as inherently brilliant, that's strike one in the hiring process for academic jobs and industry positions alike.

All these biases have the effect of thinning the pipeline further. But the poor numbers for minorities in our survey of the biotech workforce also suggest that these groups are insufficiently represented in the networks used for hiring, or companies are failing to put in the extra effort required to find qualified minority applicants.

"There are a bunch of scientists who are great and happen to be minorities," Burgess told me. "None of us recall getting a call from a biotech company, asking us for advice, for recommendations, or for help identifying individuals that might provide different insights to their company and their products. There has been no outreach to myself or to anyone I know."

What can be done?

There have been study after study showing that diverse corporations outperform others. A 2015 report by McKinsey & Co., *Diversity Matters*, examined 366 public companies in the United States, Canada, Latin America and the United Kingdom, and showed that companies in the top quartile for ethnic diversity are 35% more likely to have financial returns above their national industry medians. Companies in the top quartile for gender diversity are 15% more likely to have financial returns above respective national industry medians¹⁰.

There is some research showing that small, young companies might do better with homogeneous management, as those with similar backgrounds can find it easier to pull in the same direction at launch, but that benefit dissolves when these companies begin to face obstacles: failed clinical trials, manufacturing issues, black swans. Problems are better solved with a mosaic of minds, and in essence the diversity issue is no longer up for debate.

So then, how to remedy it?

The first, and most obvious, way to increase biotech's racial inequality is to diversify the biomedical researcher pipeline that feeds it. Broader ethnic representation in academic research has been a goal for the NIH, the NSF and the US government for some time, yet progress has been slow (Table 2). Still, increasing the number of minority instructors

Table 5 Visa preferences according to origin of immigrant, top three groups, 2006–2015

Country of origin	Total visas issued over ten years	Number of visas with family-sponsored preferences	Percentage of visas with family-sponsored preferences	Number of visas with employment-based preferences	Percentage of visas with employment preferences	Number of visa applicants who are immediate relatives of US citizens	Percentage of visas where applicant had US relative
Mexico	1,533,973	462,804	30.2%	88,533	5.8%	919,792	60.0%
China	770,617	152,302	19.8%	170,942	22.2%	261,038	33.9%
India	662,469	140,468	21.2%	294,040	44.4%	203,631	30.7%

Source: US Department of Homeland Security

at universities would soften stereotype threat for students and provide mentors who better understand what underrepresented minorities experience as they move through their programs. But some data here, too, suggest a bias. A paper by Kenneth Gibbs points out that underrepresented minorities earn about 10% of the life science PhDs overall but are only 2% of medical school basic science tenure or tenure track professors¹¹, and his paper in 2016 showed that between 1980 and 2013, the number of underrepresented minority PhD graduates increased by a factor of 9.3, but the increase in assistant professorships was just 2.6-fold. There was no such drop-off for whites or Asians—those groups increased PhD graduates 2.2-fold over the same period, with a 1.7-fold increase in assistant professorships¹².

Certainly white professors can also help underrepresented minority students succeed by being conscious of their position and inviting students of all backgrounds into the circle. The same goes for the heads of laboratories and principal investigators. “You don’t always need a role model that has the same ethnic or cultural background,” Gonzalez says. “You need folks who are willing to mentor anyone, from any background, without implicit biases.”

Ted Love, for example, found a mentor in his white chemistry professor at Haverford.

“He was very aware that Haverford had not produced very many African Americans in science, and also aware, on balance, the performance of African Americans in science classes had not been above average,” Love says. “He told all of us if we didn’t understand something, we could come to his house. I went to his house many times. So much so that I got to know his wife and kids.”

Breaking down diversity

A second way to help: biotech should stop making ‘diversity’ one big issue. Diversity is a national buzzword these days, as biotech is well aware. Yet, so far, the industry’s response has mainly focused on increasing the number of white females in power positions, in part because that is the easier fix.

“The cultural gap between white men and minorities is greater than it is with white

females,” says DePass. “And we will chew on what is available to us, which is why you see [biotech] chewing on gender.”

Robin Toft agrees. She has spent 20 years in biotech, most notably with Roche (Basel, Switzerland), before leaving and eventually founding Toft Group. The difficulty with biotech’s current push for diversity is that companies can “lump it all together and get their numbers with women,” she says.

“I think we have to take the gender issue out,” she told me. “This industry has realized that gender diverse companies perform better, but we still need racial diversity in these companies.”

And diversity can’t be all about importing international biotech talent, either. After the election of Donald Trump, and his administration’s attempts to ban immigrants from seven Muslim countries, members of the biotech community spoke, strongly and at length, about the importance of a global biotech workforce¹³. This is undeniably true. But the indus-

try has not yet mustered that same fervor over its homegrown racial imbalance.

“The immigration issue and racial diversity are blurring together,” says Windham-Bannister. “Immigrants add diversity, yes. But we need inclusion for those individuals who are in our country now and who have been living here. We need to make sure they’re being trained and given access into the workforce.”

Removing the blinders

When the press began to harp on diversity in the tech industry—something biotech has been lucky to avoid as yet—Google stepped forward in 2014 and released all its demographic data. It showed what many already suspected: a company controlled by white and Asian male employees. Current data show Google internationally is 69% male. In the United States, it is 56% white, and 35% Asian. Google’s CEO is Indian American, but overall, international leadership is 75% male, and in America, it is 68% white; blacks

Box 2 BIO’s diversity principles

Released by BIO in the summer of 2017, the principles below set forth the organization’s position on workforce development, diversity and development.

1. BIO believes that our members’ products and services should be intended to address the needs of a diverse population.
2. BIO believes that diversity in all aspects of business operations will optimize the continued growth and success of the biotechnology industry.
3. BIO will champion workforce development, diversity and inclusion as a way to attract, develop and retain the employee talent pool within the globally competitive biotechnology industry.
4. BIO will lead by example and be outward-facing in our diversity efforts, and will incorporate diversity and inclusion into all aspects of BIO operations: in communications and membership engagement, at BIO events through programming and education, and in the composition of the board of directors and its committees.
5. BIO will engage with external partners to broaden the reach and incorporation of diversity throughout the biotechnology ecosystem.
6. Definitions. For purposes of the Principles, the following terms shall have the meanings set forth below:
 - a. Diversity is defined as the wide-range of similarities and differences among persons and perspectives, and follows guidelines established by the US Equal Employment Opportunity Commission.
 - b. Inclusion is defined as the process of creating a business culture and environment that recognizes and effectively leverages the talents, skills and perspectives of diverse employees.



Jackie Grant, senior associate at SV Health Investors.

Travis Huggett

to-college students both attend and succeed in college, and also Bunker Hill Learn and Earn program, which helps recruit underrepresented minorities to Vertex's college intern program. It built a 3,000 square-foot learning lab inside its Boston headquarters, and hired a black woman as its full-time instructor to run it—about 1,000 Boston public school kids come through the lab annually. The company gives two undergraduate scholarships to Boston-area high school students to pursue a career in STEM each year, and it has agreed to give \$50 million over ten years to benefit underserved students and young women in science, technology, engineering, arts and math (STEAM).

Vertex is also making changes at the top: its nine-person board includes three women and two people of color. Damian Wilmot, senior vice president, chief risk and compliance officer at Vertex, and also black, says Vertex is aware diversity efforts take persistence. “This is not an easy space, and there is no magic pill you can take,” he says. “But this is who we are. We’ve attracted some diverse talent to our company, and we’ve done a good job of keeping it.”

Vertex is considering releasing the demographics of its entire company, if it can ensure that type of transparency will translate into results. If it does, it would be a big step forward for biotech.

Industry-wide self-reporting

An article in *The Scientist* more than 20 years ago explored the same topic as this one—the lack of underrepresented minorities in biotech¹⁵. That article also pointed to the thin pipeline, and BIO president and CEO at the time, Carl Feldbaum, told me BIO soon began contacting human resource departments, gathering anecdotal evidence on the industry's racial makeup. He “never caught a hint” of overt bias, he says, but admits that problems in the talent pipeline “can be traced to a couple of centuries of racism.”

There is some sentiment that the current version of BIO is late to the racial diversity party. “I know Jim [Greenwood], I’ve had good conversations with Jim,” says Chad Womack, national director, STEM Initiatives and the Fund II Foundation United Negro College Fund Stem Scholars Program. “I like him. I just don’t know where this fits on his priority list, and I don’t think it’s very high. I don’t know the extent that [BIO] values diversity and inclusion and how value is created in this field and industry.”

BIO in some ways is a product of the companies it represents. The lobby group's biotech members nominate their representation for

BIO's board, who are then approved by BIO's various committees. For small and mid-size companies, the representation must be either CEO or chairman, though larger companies can nominate members of executive management teams. With biotech as white as it is at the top, BIO's board and committees are going to look similar. Regardless, Greenwood bristled at the notion that his organization does not care.

“I’ve been here 13 years, and we’ve been conscious the entire time I’ve been here of trying to attract women and ethnic minorities to our board,” he says. “The challenge is the same challenge of our industry and the country as a whole. But we are not oblivious to this issue, and we’ve not been discriminatory.”

Indeed, BIO has committed to expanding and repeating the biotech demographic survey it conducted in partnership with *Nature Biotechnology*, and was instrumental in disseminating this first one. Every employee at BIO currently undergoes diversity training, and unconscious bias training is planned to be included next year. At June's annual meeting in San Diego, the trade organization announced its diversity principles, putting forth all the things it pledged to do to promote inclusion (Box 2). Greenwood points out that BIO has done all these things organically, without outside prodding.

“What no one should conclude is that we have chosen not to include board members or committee members that are racial minorities,” he says. “We barely have any, but that's not for lack of trying.”

It starts with companies

The most direct way to make biotech more diverse would be installing quotas, fanning management, the board and employees over the ethnic spectrum. Yet I was told repeatedly—by venture capitalists, CEOs, whites and minorities—that this idea would not work, that it would likely lead to “token” hires and slow down the process of company formation and growth. For smaller firms, getting the best person for the job quickly is imperative, and hiring can't be hindered by the need to meet demographic guidelines, especially with the relative rarity of underrepresented minorities in the pipeline.

The goal instead is increasing the visibility of diverse applicants, so they are hired because they have the right skillset, which includes bringing a diverse way of thinking to the company, its management or board.

Building companies with this mindset is easiest when the concept is present at inception, as it was with Ken Horne's team at Symic. Yet Jackie Grant, a biracial senior associate at SV Health Investors (her mother is white

and Latinos/Hispanics are just 2% of US leadership, respectively, with fewer than 1% for American Indians, and <1% for Pacific Islanders, too¹⁴.

These are dreary numbers for underrepresented minorities, but Google can at least be credited with transparency, and that, in turn has forced the sector to be more accountable. Amazon and Facebook have also begun releasing their demographics.

Thus far, biotech has not done this. None of the US industry's top five market cap biotechs has disclosed the diversity of their workforce. When contacted by *Nature Biotechnology*, Amgen (Thousand Oaks, CA, USA), Gilead (Foster City, CA, USA), Celgene (Summit, NJ, USA) and Regeneron (Tarrytown, NY, USA) all declined to be interviewed for this article. Biogen (Cambridge, MA, USA) did not respond to multiple inquiries.

Trailblazing at Vertex

That isn't to say company accountability can't happen. Boston-based Vertex, a mature, profitable biotech company with a ~\$37-billion market cap, began to systematically consider diversity and inclusion four or five years ago. Today, its internal efforts include IWILL (Inspiring Women In Leadership and Learning), VIBE (Vertex Includes Boundless Ethnicities) and Vertex Pride, a group focused on its LGBT community. Externally, Vertex partners with Bottom Line, a non-profit organization dedicated to helping low-income and first-generation-

European, her father African American) says that “early-stage science is high risk, and there are many things at the seed-funding stage needed to get the science up and running,” which means diversity and inclusion can be overlooked “unless the CEO is making that part of the business plan.”

That concept, or problem, is partly why Third Rock Ventures, a Boston-based venture firm, is rethinking both its brand and how it builds companies. The venture capital firm is maybe best known for tight control and big investments, and it typically creates biotechs by first identifying an asset and then founding a company around it. Thus, it carries an oversized influence on how the company’s culture is formed. “We invest around a principle of group genius,” says Sarah Larson, partner at Third Rock. “That principle is, innovation can’t happen insularly. It has to happen by collaboration. And the more diversity you have, the better your chances are at innovation in that group.”

Our survey showed that nearly 75% of company respondents had no diversity or inclusion program. Certainly, these are more difficult to put in place at small companies, and Larson agrees that it’s harder for a five-person biotech to have a full-blown inclusion program, to have in-house groups dedicated to underrepresented minorities and women and support for the LGBT community. At the early stage, the science must come first. But companies can be built with an inclusion mindset from the start, and as the company grows it will be shaped by that initial belief. Third Rock is hoping to instill that mindset in every company it builds.

Larson is the chief human resources officer at Third Rock, with previous experience at Foundation Medicine and CombinatoRx. Third Rock not only made her a partner, but also put her on the board, alongside Abbie Celniker, another white female, as a nod toward the importance of diversity in human capital. Still, Larson admits Third Rock has distance to cover.

“We’ve been talking a lot about how people are attracted to things that look like them. We need to work on our African American population, and our Asian population, and our Hispanics. But until we have that [look ourselves], it’s hard to attract.”

That means diversifying its board beyond adding females. I asked Larson if she thought, even as a woman, biotech is focused too much on gender for its diversity imbalance.

“I do,” she told me. “Diversity is not a gender discussion. It’s a group genius discussion. It has to include race.”

Ask what you can do

There’s a final way biotech can help tackle this issue, and it begins not with the company,

but the individual. Julie Grant, who is white, is a partner at venture capital firm Canaan Partners and thinks it really might be as simple as that.

“Listen,” she says, “I think about women’s issues, because I’m a woman. That’s easy for me. So my network is biased toward women in executive positions in science, and when I hear people say ‘why aren’t there more women on boards?’ I literally want to rip my hair out. Because if you call me, I’ll give you plenty of names. So what I need to do is call, we all need to call, people who are black and who are Latino in our industry and say, where are your friends?”

“It’s all about action,” she says. “Have you actually advocated for someone who doesn’t look like you? Have you asked that person to coffee? Have you proposed someone for a job? Have you introduced that person to a power player? That’s what has to happen. Being cordial is not sufficient.”

A Gallup poll in March showed that 42% of Americans worried a “great deal” about race relations¹⁶. That figure is a sizeable jump from 17% in 2014, and the highest level since the poll began in 2001. It’s no wonder given the present climate—2017 has, at times, recalled the tensions of the 1960s and the Civil Rights Movement, most alarmingly during the deadly white nationalist/supremacist rally in Charlottesville, Virginia. All this brought to mind a story Ted Love told me, about the mindset of a majority, and the way in which it will begrudgingly give ground. When he was a freshman at Haverford, the Supreme Court was hearing arguments on the *Regents of the University of California v. Bakke*, which debated affirmative action and the use of race as a factor in college admission. The court eventually upheld the practice, but Love and his classmates had been following the case all along, and one day, while gathered in a Barclay Hall lounge, they began debating the issue themselves.

“Of course everyone was white in there,” he told me. “And one of my classmates stood up and walked over toward me and said, ‘I’ve listened to these arguments for months, I think the winning arguments are being made by Ted.’”

There was some murmuring among the others but then a student said, “Well, that’s fine now, but how will you feel when Ted takes your position in medical school?”

It was a moment of clarity for Love. These were his friends, his classmates, people he played sports with. He liked them, and they liked him. But in their eyes, medical school slots belonged to them, and the only way he’d get accepted was by displacing someone white.

Love looked at the white faces around him. “These slots are not for you,” he said. “They are for the best, and the brightest, and I am intending to show up with the view that I am equally entitled to them. Not entitled to them, but equally entitled.”

Change

Advocacy is often spurred when a person looks around and realizes they are the only one of their ‘group’ in a room. This is what Julie Grant feels when she walks into a boardroom and is the only female. It’s what David Burgess felt as he spent years in higher education before ever meeting another American Indian. It’s what Chad Womack felt when he went into advanced placement classes in high school and was the only African American for his grade. The response to this is to begin advocating for more people like you—in essence, advocating for your group—through organizations like Women in BIO, SACNAS and the UNCF Fellowship Program at Merck.

All these things will affect change, and have. Over the ten-year period to 2014, the number of African Americans receiving doctorate degrees has increased by two-thirds, to 4,780. Latinos/Hispanics have increased nearly 70%. American Indians have remained flat and this clearly needs attention, but overall the line of progress for underrepresented minorities in research has been positive.

Yet, change will arrive faster when biotech’s members also begin to advocate for each other, as Julie Grant suggests, across race and gender. At the BIO annual convention in San Diego this year, when the International BioGENEius Challenge finalists were on stage, there was not a white male among them. The winner was announced—a white female from Kansas named Erin Smith—and the students filed off. The next scheduled speaker remarked on the finalists’ diversity, calling it “a panoply” and the crowd gave up earnest applause for the quick minds it had just witnessed, and for the ‘diverse’ future of biotech.

Yet it was hard to ignore that every speaker during that lunch session was a white male, and afterward, I went looking for the students. I found a group of them in the Sails Pavilion, clustered by their posters. I asked them what they made of being held up as a model of diversity.

They went silent for a second. Race is an uncomfortable topic, and we aren’t great at talking about it. But then Lillian Tushman, a white female from Illinois, spoke up.

“I didn’t buy it,” she said, and when I asked her why not, she answered, “We’re not that diverse. Where are the African American

students? Where are the Latino students?” Her fellow finalists began to nod their heads in agreement.

That, in essence, is advocating for someone else, and to hear it from people so young can feel a lot like hope.

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Note: Any Supplementary Information and Source Data files are available in the online version of the paper.

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Erratum: Biotech's pale shadow

Brady Huggett

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In the version of this article initially published, on p.3, third column, Robin Toft's name was misspelled as "Toth"; on p.5, Ted Love's title at Theravance was given as "CEO," rather than "senior vice president, development"; on p.9, Vertex's headquarters were said to be in Cambridge, instead of Boston, and Damian Wilmot's title was given as "vice president of litigation and interim head of compliance" instead of "senior vice president, chief risk and compliance officer." The errors have been corrected for the print, PDF and HTML versions of this article.