

CAREERS

EQUALITY Lack of female academic leaders misrepresents faculty and students **p.473**

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VANDERBILT PHOTO/DANIEL DUBOIS



Vanderbilt University, Tennessee, is the leading US producer of minority graduates with PhDs in astronomy, physics and materials science.

HIGHER EDUCATION

On the lookout for true grit

With the right mix of persistence and support structures, scholars from minority groups can thrive as they pursue their PhDs.

BY KENDALL POWELL

Jedidah Isler had always dreamed of attending an Ivy League graduate school. She had a stellar record as an undergraduate at Norfolk State University in Virginia, one of many US universities that traditionally enrol mostly African American students. She earned her bachelor's degree in physics there in 2003. But a two-year break after college, taken for personal reasons, left her shaky and unsure. "In physics, there are so many things you have to have at the top of your head, like formulae, and I was feeling out of the loop," she says.

However, an e-mail from the American Physical Society encouraging people from minority

groups to study physics showed her an avenue back to graduate school. In a follow-up e-mail exchange, she learned about a joint programme starting in Nashville, Tennessee, called the Fisk–Vanderbilt Masters-to-PhD Bridge Program. Six weeks later, Isler threw her possessions into a rental car and drove to Nashville to start a master's degree at Fisk University, an historically black institution less than 2 kilometres from Vanderbilt University, the programme's partner.

Isler was part of the second cohort of students in the Fisk–Vanderbilt programme, which helps students from minority groups that are under-represented in the sciences to pursue doctorates in astronomy, biology, chemistry, physics and materials science. After launching

in 2004 with just four students, it has emerged as one of the most successful initiatives aimed at minority scientists in the United States. Fisk University is now the United States' biggest producer of black students with master's degrees in physics, and Vanderbilt is the biggest producer of minority scholars receiving doctorates in astronomy, physics and materials science. Where other programmes have tried and failed, this one seems to have a winning formula.

Boosting the number of minority-scholars science PhDs has been a major challenge in the United States, despite university programmes and government incentives. In 2010, African Americans were awarded just 3% of all science and engineering doctorates; Hispanics ►

► received 3.6% and Native Americans 0.3%.

Leaders of the Fisk–Vanderbilt programme see it as a problem at the entry level. Programmes such as the US National Institutes of Health Minority Access to Research Careers graduate fellowships and other minority-specific funding schemes help only minority students who have already succeeded in getting into a graduate programme. “Our goal is fundamentally different,” says Keivan Stassun, the co-director of the Fisk–Vanderbilt programme. “If we are going to move the needle at a national level, we have to engage individuals from a larger pool.” This unorthodox approach — which includes intensive mentoring and eliminating standardized test scores as a criterion for admission — is already boosting minority numbers in some of the least diverse fields, such as astronomy and physics.

The Fisk–Vanderbilt programme’s success is clear. Since 2004, it has admitted 67 students. It awarded its first PhD in 2009, and will see its eighth PhD granted by the end of this year. That number includes mostly Vanderbilt graduates and a few students who choose to pursue a PhD at another university. Stassun expects that about five doctorates will be awarded each year in future. He notes that an average US PhD-granting programme in the sciences awards a doctorate to a minority scholar about once every 5–10 years.

BUILDING RELATIONSHIPS

From his very first associations with Vanderbilt, Stassun had been clear about his passion for boosting minority scholarship. In his 2003 job interview for a tenure-track astronomy position, he presented his vision for a programme that would address the low numbers. Himself a minority scientist, he saw the potential for synergy in connecting Fisk, an institution that was already producing smart, capable, master’s-level scientists, with the research resources of the PhD-granting departments at Vanderbilt.

During his job-offer negotiations, he asked for extra financing for the programme and found that he had ample support from his department and Vanderbilt administrators. Faculty members including physicist Arnold Burger, Stassun’s co-director and counterpart at Fisk, were equally invested in the idea.

The programme is designed for students who are dedicated to pursuing graduate studies in science but who may need additional coursework, training or research experience before beginning a doctorate. Students benefit from individualized mentoring, a seminar series on professional development and a seamless transition between master’s and PhD research. By the time students formally apply to a Vanderbilt PhD programme, they have already taken classes at Vanderbilt, worked on a research collaboration between a Fisk and a Vanderbilt laboratory for two years and established relationships with the faculty members who will become their thesis advisers. To

Stassun, science undergraduate degree-holders are at the ideal academic level from which to recruit. “These students have already stood up and said: ‘I want to be a physicist,’” he says.

So far, 81% of the 67 students admitted to the programme have advanced to doctoral studies. That flips another statistic on its head: typically,



“You climb as high as you can, and then you guide the next person, who may go higher.”

Jedidah Isler

80% of minorities who complete US science, technology, engineering or maths (STEM) bachelor’s degrees do not continue on to graduate school. One-fifth continue to master’s programmes and about 2% continue on to a doctorate.

In meetings with faculty members from minority-serving undergraduate institutions, Stassun heard one potentially unsettling reason why many of these students might fall out of the academic science pipeline: advisers at minority-serving undergraduate institutions sometimes actively discourage students from pursuing graduate degrees. Instead, they steer students towards scientific and technical industry careers that already have better minority mentoring and support networks in place. One report suggests additional barriers: greater financial needs and being more location-bound owing to finances or family obligations (K. G. Stassun *Bull. Am. Astr. Soc.* 35, 1448–52; 2003).

In building their programme, Burger and Stassun considered the problem of the leaky pipeline. They knew from statistics that nearly 40% of white or Asian students proceed to a PhD straight from a bachelor’s degree, compared to about 27% of minority students. They knew what they needed to do — provide a stepping-stone to the PhD. “The data were there. Students who were successful did it slowly. Now we are giving them that vehicle,” says Burger.

The approach resonated with Erica Tross, now in her second year of a biology master’s degree at Fisk. Like many bachelor’s biology-degree holders, she did not know whether she wanted to pursue a career in medicine or research when she graduated from what she calls the “itty-bitty” Oakwood University in Huntsville, Alabama. “I had research experience, but not that much. This would be a perfect transition; in two years you have your master’s and I could decide then to go to medical school or go on to Vanderbilt,” she says.

The master’s portion also gives students time to fill holes in their undergraduate education. “I was afraid of graduate school,” says Fabienne Bastien, a fifth-year astronomy PhD candidate in the programme. “I thought I had

to be much more prepared.” Bastien, a first-generation American, unfavourably compared herself with undergraduate peers who had their own telescopes, had taken high-school science classes that were more difficult and had an astronomy vocabulary that, to her ear, sounded “like a completely different language”.

GRITTY REALITY

The programme also had to confront another trend in the data from minority STEM graduates — an elephant in the room that was far more worrisome and controversial. Students applying to graduate school must take the Graduate Record Examination (GRE), and median maths GRE scores for Hispanic, Native American, black and female students are consistently lower than those for Asian, white and male students. Many graduate departments use a cut-off score to narrow applicant pools, which automatically limits minority numbers. “If someone wanted to intentionally shut the door to minority students, the GRE is the filter they would use,” says Burger. So the Fisk–Vanderbilt programme uses an entirely different measure of persistence in the face of adversity — what Burger and Stassun call ‘fire in the belly’ or ‘grit’.

Grit is, in fact, a metric in the social sciences, based largely on work by Angela Duckworth, a psychology researcher at the University of Pennsylvania in Philadelphia. She defines it as a predisposition for pursuing long-term, challenging goals with passion and perseverance. To measure grit, the Fisk–Vanderbilt programme developed an interview during which applicants describe what intrigues them about science, a challenging experience or obstacle, their fears, how they pulled through and the resources or relationships on which they relied. At least two faculty members score interviewees’ answers on a grit scale, and the programme uses that number and the professors’ qualitative assessment of the student’s interview for selection.

In Bastien’s interview, her self-awareness and determination to become an astronomer were clear. Stassun describes her GRE



Arnold Burger measures applicants on their ‘grit’.

STEPHEN SARTORI/SYRACUSE UNIV.

FISK UNIV.

scores as “reflective of what’s typical of her ethnicity and gender”, but her grit score as off the charts. “That’s a person who will start graduate school way ahead of the game, with all the resources and skills that go beyond smarts: self-discipline, organization, follow-through,” says Stassun. “Far too often, graduate programmes ignore that.” Bastien’s grit has paid off: this year she appeared as the first author of a *Nature* paper defining a new, relatively easy and more precise way to calculate a star’s evolutionary age (F. A. Bastien *et al. Nature* **500**, 427–430; 2013).

Duckworth cautions that assessing grit in such high-stakes settings as graduate admissions is tricky. “The grittiest people are often the least willing to say they are gritty,” she says. Moreover, she adds, the higher the stakes, the greater the incentive the interviewee has to provide phony or insincere answers. “You can interview for social intelligence on the spot,” Duckworth says. “But I don’t know that you can assess whether [the candidate] will be awake at 6 a.m. the next morning — or if after their first major screw-up, they are going to give up.” She still thinks that screening for grit might be worthwhile, but how best to measure it remains uncertain.

Regardless, the Fisk–Vanderbilt students exemplify the grit quality, and they say that the programme’s focus on character building sets it apart from other minority initiatives. Tross is currently struggling in a Vanderbilt class on advanced molecular genetics. She is relying on her grit to get her through. “I’ve cried my tears. I’ve weighed whether I’m going to pass or not. But I’ll keep doing the work,” she says.

EXPANDING HORIZONS

Other universities are taking note of the Fisk–Vanderbilt success. Abigail Stewart, who has been involved in setting up the programmes at the University of Michigan in Ann Arbor, says that all science-graduate admissions committees could learn from the Fisk–Vanderbilt model. “In general, we are eager to use simple tests or cut-offs to limit applications to a manageable number, and that means that, too often, we rely on indicators that are not actually indicators of what we care about,” she says.

Although the University of Michigan is not particularly close to any minority-serving institutions, four campus departments have started master’s programmes, based on

the Fisk–Vanderbilt model, in ecology and environmental biology, molecular, cellular and developmental biology, applied mathematics and applied physics. In addition, the American Physical Society now funds similar bridge-to-PhD programmes at Ohio State University in Columbus and the University of South Florida in Tampa.

Edmund Bertschinger, institute community and equity officer at the Massachusetts Institute of Technology in Cambridge, which has its own physics bridge programme, says that the Fisk–Vanderbilt programme has amazingly dedicated faculty members and staff that watch out for and support one another. “They don’t let students slip through the cracks.”

Bertschinger and Stewart say that all graduate programmes could boost the pipeline persistence of alumni by taking a closer look at the ‘grit factor’ and other personality measurements when deciding which students to admit. After all, persistence in the face of adversity describes most successful academic science endeavours. For all types of STEM graduate students entering US PhD programmes, only 50–65% (depending on ethnicity, gender and discipline) complete their doctorates — a miserably low return on investment for the time and money spent training students.

Participation in the bridge programme does not provide automatic admission to Vanderbilt — students must apply formally and meet all of the requirements. Isler decided to apply to other PhD programmes as well and was admitted to the astronomy programme at Yale University in New Haven, Connecticut. Stassun gently but firmly encouraged her to leave the bridge programme and follow her Ivy League dream. “That was the most generous thing anyone has ever done for me,” she says.

On her first day at Yale, she felt out of place as the sole black woman, and also for her acute lack of pedigree. No one in her class knew what a historically black institution was, and no one had heard of Norfolk State or Fisk. “At a different time in my life, that would have crushed me,” she says. But her time in the Fisk–Vanderbilt programme had given her the confidence to keep going. And her bridge family was never more than a phone call away.

In October, Isler defended her thesis work on blazars — hyperactive supermassive black holes that spew out accelerated particles. She became the first black woman to graduate from Yale with a PhD in astronomy and has already begun a Chancellor’s Faculty Fellowship at Syracuse University in New York, a post that provides a transition to a tenure-track faculty position. “You climb as high as you can,” she says, “and then you guide the next person, who may go higher.” ■

Kendall Powell is a science writer based in Lafayette, Colorado.



“I was afraid of graduate school. I thought I had to be much more prepared.”

Fabienne Bastien

EQUALITY

Lack of female leaders

Women chair just 12% of all UK higher-education governing bodies and lead 17% of UK institutions as vice-chancellors, says a study. *Leaders in Higher Education 2013*, released by the non-profit group WomenCount in Cardiff, says that the low numbers of women in leadership roles at institutions do not accurately reflect the proportion of female faculty members and students. Unconscious bias might be partly to blame for the numbers because people often appoint and promote others who are like themselves, the report suggests. Author Norma Jarboe, director of WomenCount, says that women must seek sponsors who will help them to get promotions, and pursue a position on the board of a company or charity. “Cross-sector knowledge and powerful contacts can be door openers,” she says.

RECESSION

Focus on outcomes

The global recession has led government-funded academic science to focus increasingly on ‘targeted outcomes’ with a clear societal or economic impact, finds a report. *The State of Higher Education 2013*, released on 1 December by the Organisation for Economic Co-operation and Development in Paris, polled presidents and rectors at 34 higher-education institutions across 29 nations. Researchers are also spending a lot of time on public outreach, it finds. “If taxpayers understand the value of the research, they’re more likely to agree to fund it,” says report co-author Ellen Hazelkorn, vice-president of research and enterprise at the Dublin Institute of Technology. She suggests that early-career researchers polish their communication skills and focus on interdisciplinary work.

COMMUNICATION

Internet freedom

US faculty members are entitled to discuss issues relevant to the public on social media, argues a draft report. *Academic Freedom and Electronic Communications*, released on 3 December by the American Association of University Professors in Washington DC, notes that faculty members in some states have been suspended or dismissed for writing on Facebook or Twitter about controversial issues such as religion and gun control. Academics should be involved in creating social-media policies, the report says.