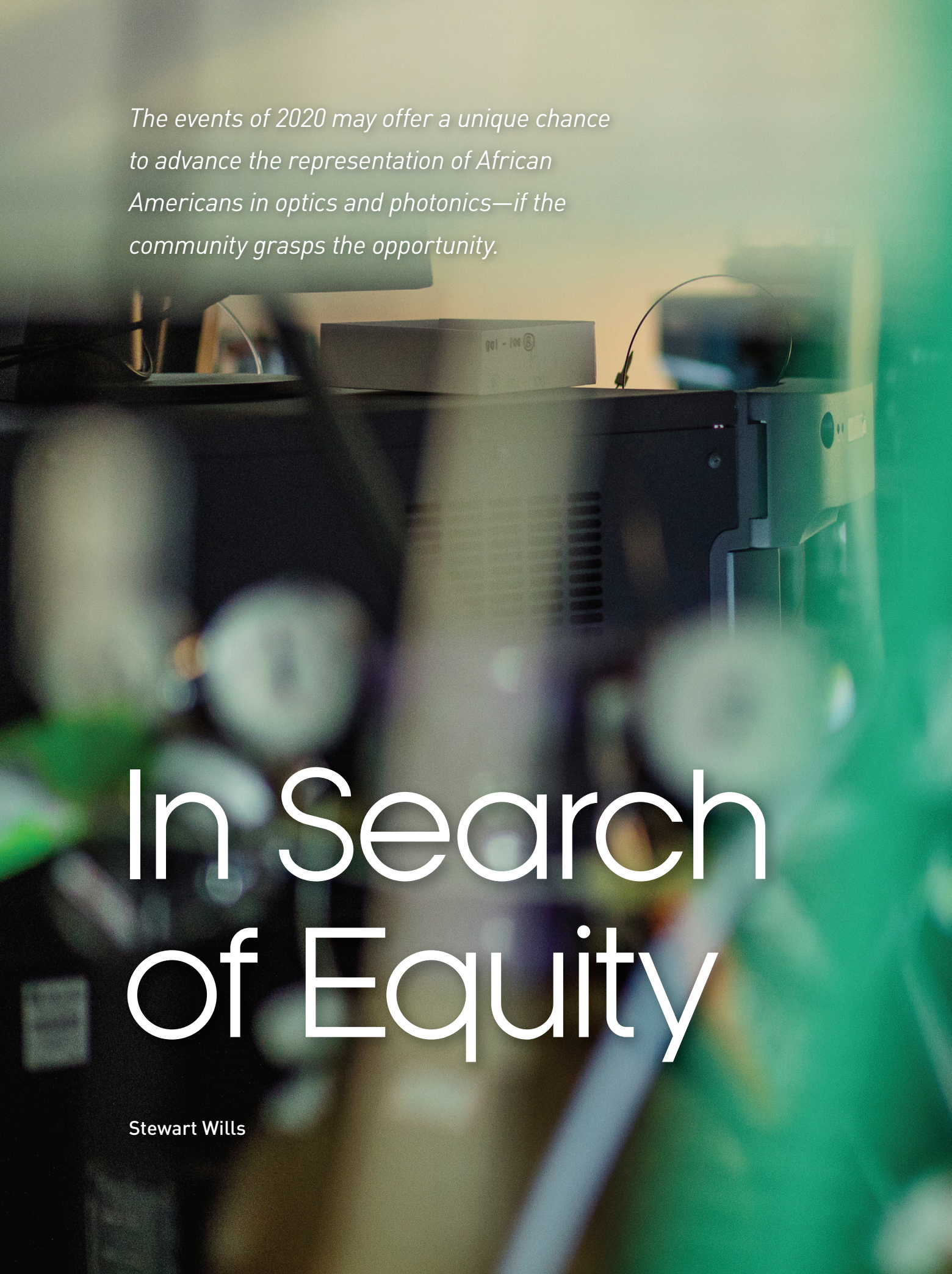


*The events of 2020 may offer a unique chance to advance the representation of African Americans in optics and photonics—if the community grasps the opportunity.*

# In Search of Equity

Stewart Wills


Getty Images

The killing of George Floyd, an unarmed Black man, by a white police officer in Minneapolis, MN, USA, provided an indelible image of racism in America, and sparked outrage and sustained protests both in the United States and worldwide as summer 2020 unfolded. It also has prompted considerable public soul-searching by U.S. companies and institutions regarding the inadequacy of their own efforts toward equity and inclusion.

Science is no exception. Despite decades of tacitly recognizing its equity problems, the face of much of professional science in America—and of physics in particular—remains resolutely white and male. And while other underrepresented groups have at least begun to make measurable progress toward equity, the available data suggest that Black representation in physics has barely budged in two decades.

OPN talked with a number of scientists in the optics and photonics community and elsewhere who have lived this reality, to get their perspective on the current moment and its meaning for the future, particularly for Black representation in academic physics. The discussions highlighted the systemic nature of race inequity in science, and the huge task of addressing it. But they also embodied a sense of hope that the events of 2020 may offer a unique opportunity for change—if science chooses to grasp it.

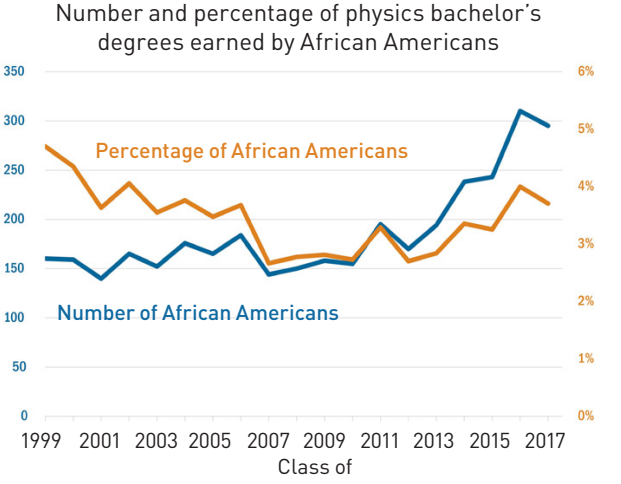
## Pervasive inequities

In the realm of academic physics, at least, all evidence suggests that racial inequity begins early, and that it carries through from undergrad to postdoc and beyond.

One recent effort to look at the undergraduate-education side has been the National Task Force to Elevate African American Representation in Undergraduate Physics & Astronomy (TEAM-UP), a project of the American Institute of Physics (AIP). (OSA is a member of AIP.) The January 2020 task force report (www.aip.org/teamup) noted that the Black share of bachelor's degrees in physics and astronomy remains "appallingly low," and indeed actually *dropped* from nearly 5% in the late 1990s to less than 4% in 2017. And the growth in the absolute number of physics bachelor's degrees earned by Black students appears to have lagged that for all other physical-science disciplines between 1995 and 2018.

The lack of Black progress is even more striking further up the academic career ladder. According to the National Center for Science and Engineering Statistics (NCSES) of the U.S. National Science Foundation (NSF), the number of Ph.D.s in physics and astronomy granted yearly to U.S. citizens and permanent residents expanded from 907 in 2008 to 1,300 in 2018, a 43.3% increase. Some historically underrepresented groups saw significant progress in that period; the number of doctorates granted to women, for example, grew some 69.1%, while Ph.D.s to Hispanic or Latino recipients more than doubled.

For Black recipients, however, the number of Ph.D.s awarded in physics and astronomy went exactly nowhere between 2008 and 2018, remaining stuck at just 15 recipients—a shockingly low 1.1% of the 2018 national total.




AIP/TEAM-UP report, January 2020


1047-6938/20/09/24/10-$15.00 ©OSA

## "Okay, there's three of us"

Similar quantitative data don't exist on the underrepresentation of Black scientists in optics and photonics. But the scientists OPN spoke with cited abundant anecdotal evidence of the sparse presence of black faces at meetings, professional committees and other contexts.

OSA Fellow Anthony Johnson, a professor of physics and electrical engineering at the University of Maryland, Baltimore County, who served as OSA President in 2002, has seen this dynamic play out over decades. "I joined OSA around 1980, when I was finishing up graduate school—it's been 40 years," he says. "And when I think about who attends the meetings, I see very little increase in [Black] participation after all of this time. It's just amazing to me that I haven't seen more Black colleagues at meetings."

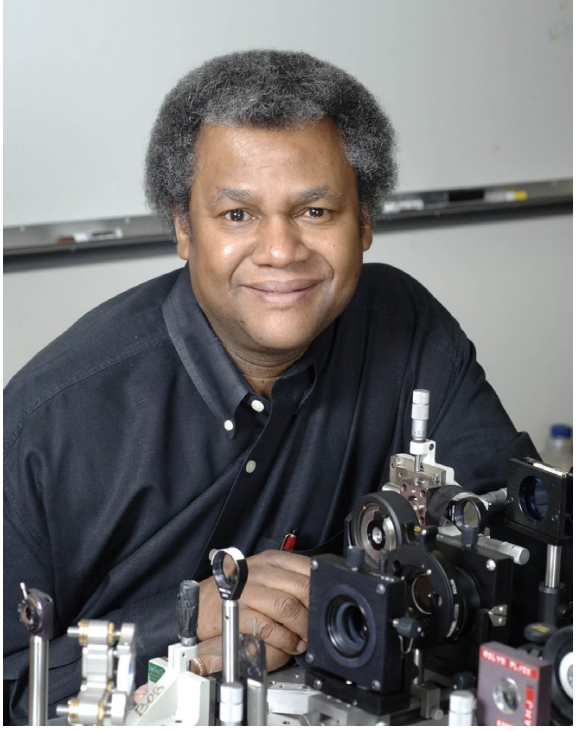
Thomas Searles, an associate professor of physics at Howard University, Washington, DC, vividly recalls an experience at the CLEO Conference in 2017, which attracted 4,000 attendees. Yet Searles found that only a handful of Black scientists were on site, including OSA Fellows Herbert Winful of the University of Michigan and Peter Delfyett of CREOL. "I had just started at Howard, in 2015," says Searles. "And Professor Winful, who I didn't even know, walked up to my poster, and he was like, 'Okay, there's three of us … You're the new guy.'"

## A system of problems

Why has it been so hard to move the needle on Black representation, both in optics and in academic physics more generally? While the lack of progress no doubt traces partly to structural racism in American society, the quantitative and anecdotal evidence suggests that it also stems from deep-rooted patterns and issues specific to the physics community itself.

"Physics is kind of its own world," says Shirley Malcom, a senior adviser at the American Association for the Advancement of Science (AAAS) and the director of STEMM Equity Achievement (SEA) Change, an AAAS program aimed at supporting academic institutions in the quest to build more equitable structures. And, she adds, that insular world has its own set of issues to address on race. "It's a system of problems. And the physics community has to *own* that system of problems."

The 2020 TEAM-UP report attempted to flesh out the elements of that system at the level of undergrad education—a critical point in filling the pipeline



UMBC

> "It's a lack of actually seeing folks that look like you progressing and doing well."
>
> *— 2002 OSA President and OSA Fellow Anthony Johnson*

toward an advanced degree and a physics career. The task force identified a variety of factors that can discourage Black students from pursuing physics degrees or, even more important, from staying in the game once they've started.

One significant factor is the huge financial burdens under which many students labor—"one of the greatest difficulties facing African American students," according to the report. Malcom, who wrote the foreword to the TEAM-UP report, says that many students "are basically working multiple jobs, and they can't spend time on their studies if they're putting in 20 or even 40 hours a week to pay for their education." And, she adds, "they're 'in competition' with students for whom the only thing they're being asked to do is study. At the end of the day, who would *you* bet on?"

These kinds of inequities, says Malcom, are "really starting to raise serious questions about opportunity."

## Matters of identity

In addition to financial inequities, the TEAM-UP report highlighted the hurdles that students of color face in developing a feeling of community, peer

AAAS/photo by Michael Colella

> “It’s a system of problems. And the physics community has to *own* that system of problems.”
>
> —*Shirley Malcom, American Association for the Advancement of Science*

solidarity and a “physics identity” within a milieu that remains overwhelmingly white.

“Physics is a bit of an elitist field … It’s really kind of the top of the ivory tower,” says Jami Valentine Miller, an examiner with the U.S. Patent and Trademark Office, and the first African American woman to graduate with a physics Ph.D. from Johns Hopkins University. “And so it can be a little off-putting if you don’t look like what someone thinks a physicist should look like.”

Anthony Johnson believes that this sense of not belonging is a fundamental cause underpinning low representation of Black people in physics. “It’s a lack of actually seeing folks that look like you progressing and doing well,” he says. He recalls the hunger of Black students for a sense of community when he was recruited from Bell Laboratories in 1995 to take his first academic position, as the physics department chair—and the first Black faculty member—at the New Jersey Institute of Technology. “Once I got there, students would start approaching me with the hope that I would have an environment that was welcoming—there was this common theme of wanting to feel welcome in the field.”

“Physics is a very tough discipline, and there are all kinds of cliques” and implicit and explicit competition, even at the student level, says Johnson. “It really does play out that way. And so you need a place where you feel comfortable, and that you can thrive in.”

## Beyond the “student deficit model”

Such a welcoming environment can be lacking in predominantly white academic institutions (PWIs) in the United States. Instead, students of color often encounter attitudes and false assumptions hardened by centuries of stereotyping. In the context of undergraduate training, the TEAM-UP report refers to this constellation of assumptions as “the student deficit model”—the notion that Black students, simply by virtue of their race, have “learning challenges making them less capable than others.”

Shirley Malcom says that such biases can influence faculty decisions about which students to support in their physics goals, and which to discourage. “A fundamental question, if you’re a faculty member and you’re looking out into the first-year, intro course that you teach,” she says, “is, Who do you see? And who do you think of as a potential major, as physics material?” And, she adds, it “isn’t just a matter of attracting people … to what extent are you retaining them?”

These dynamics can play out in a range of conversations and signals that operate to push minority students away from pursuing physics. “I can say to a student, ‘Your mathematics background is sufficiently weak that I think you should change majors,’” says Malcom. “Or I can say, ‘Your mathematics background needs bolstering. Maybe we can find some additional coursework or support to help you get them to where they need to be.’ Which message would you rather deal with?”

And the right message and assistance at the right time can be world-changing—as Malcom knows from her own experience. She recalls her early undergrad days in the chemistry lab at the University of Washington, for which she says her experience in the underfunded labs of segregated schools in Birmingham, Alabama, had ill prepared her. She struggled in early quizzes and lab work, but with the encouragement and help of a teaching assistant—the school’s only Black grad student in chemistry—she persevered, going on to earn her undergrad degree and, eventually, a doctorate in ecology from Penn State.

"If it had not been for that TA, I wouldn't be where I am today," she says.

## The HBCU role

Malcom says that to a certain extent, that kind of support is what Black students have found at the more than 100 historically Black colleges and universities (HBCUs) in the United States. These are institutions—many dating back to the Reconstruction period after the American Civil War, and located in the southeastern United States—that for most of their history enrolled primarily African American students.

These schools initially grew out of a segregated society in which opportunities for enrollment of Black students at PWIs were closed off. Malcom says that students in tough disciplines like physics have found at HBCUs "somebody who is going to help them problem-solve" issues of underpreparation, community and financial stress, rather than "just casting them aside to thin the herd."

Willie Rockward—an optical scientist who chairs the physics department at an HBCU, Morgan State University in Baltimore, MD, and who previously chaired the department at another, Morehouse College in Atlanta, GA—observes that even at an HBCU, Black students in physics may find that only a minority of the faculty teaching them is African American. "If you look at the makeup of the [physics] faculty," he says, "I promise you, you're going to be surprised."

While acknowledging that these departments draw from an international talent pool and that faculty members tend to be committed in their work supporting Black students, Rockward believes addressing this aspect of faculty distribution is important from the student perspective. "If I'm an African American student in physics," he says, "I would expect to see somebody who looks like me and may have had the same experience as I've had in America, in the physics department."

Nonetheless, the supportive environment offered by HBCUs has kept many Black students in the physics game. "I think HBCUs play a critical role," says Jami Valentine Miller,

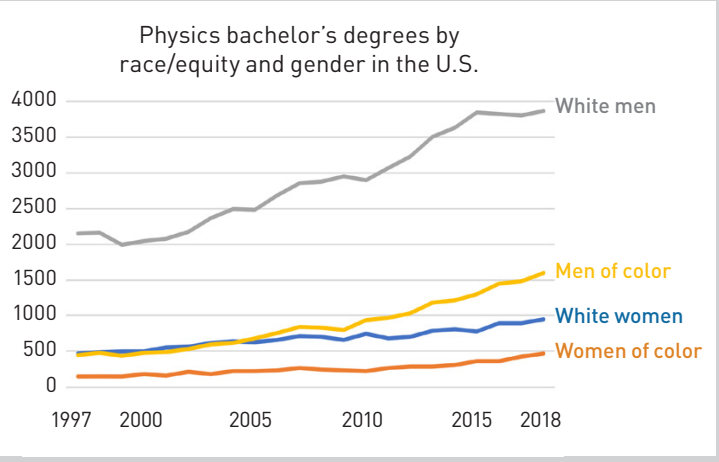
## Women of color: Double bind

The issues of equity, opportunity and stereotyping that have limited minority representation generally have proved particularly "horrendous" for women of color, says Shirley Malcom of AAAS, who herself has been studying and addressing these issues for more than four decades.

In the mid-1970s, Malcom was one of a group of scholars who focused on the "double bind" of exclusion owing to bias related to both race or ethnicity and gender. In more recent years, this bind has commonly been schematized under the rubric of intersectionality, which, AIP's TEAM-UP report notes, arises from "discrimination that occurs as the result of overlapping systems of oppression."

Whatever label is applied, the phenomenon is real, and can crush nascent physics careers, Malcom says. She cites numerous experiences recounted by women of color about being dissuaded from applying to undergraduate physics programs at all; being told they should "think about changing their major"; or, in the case of one woman with a near-4.0 GPA who had set her sights on Harvard University, being told she was "reaching too high."

"If somebody looks at us, we don't look like what they are used to seeing," Malcom says. "And that's not on us; that's on them—that's their problem. But it becomes our problem when they use it as a criterion for determining opportunity." Malcom believes that boosting women's representation in physics generally will hinge on addressing these intersectionality issues. "It's going to be hard to push the overall women's numbers up when the women of color are so far down."




People of color include Asian, Black/African American, Hispanic/Latino, and people of other nonwhite race/ethnicity. International students are excluded.

Data courtesy of S. Malcom, from analysis of U.S. government sources by L. Malcom-Piqueux, Caltech.

Courtesy of J. Valentine Miller

> “People are trying to hold companies, departments and others accountable.”
>
> *—Jami Valentine Miller*
> *Founder/CEO, AAWIP Inc.*

who received her undergrad degree from the HBCU Florida A&M University, “because they don’t just teach the physics that you need; they teach life skills, and how to navigate once you leave the campus … There’s something that’s taught about persistence and dealing with challenges, and that carries on to help students to be successful in graduate school.”

These aspects of HBCUs could, in the opinion of many, have much to teach PWIs. Valentine Miller recalls one year, during her undergraduate education, when a professor from the University of Delaware visited Florida A&M for a year on sabbatical to teach there. “She learned as much from that experience as we learned from her,” Valentine Miller says.

## Outsized contribution

The educational strategies and nurturing of talent at HBCU physics departments have historically allowed them to excel at producing physics graduates—such that, until 2006, HBCUs produced a majority of the physics bachelor’s degrees granted to African Americans, according to the TEAM-UP report. “I don’t think that we really appreciated the extent to which the HBCUs were actually contributing to the physics numbers,” says Shirley Malcom—adding that these schools also have an outsized role in producing Black undergraduates who go on to pursue graduate degrees.

Since the mid-2000s, however, the number of physics grads from HBCUs has declined, even as the number of Black students obtaining physics bachelor’s degrees from PWIs has grown. Part of the reason is financial: between 2003 and 2015, the TEAM-UP group notes, federal funding for HBCUs per full-time student collapsed 42%. In light of that decline, “the very institutions that are most effective in graduating African American students can least afford to do so,” the report concludes, “and the students themselves have the least capacity of any racial and ethnic group to absorb the costs.”

Thomas Searles, who himself teaches in the physics department of an HBCU, also notes that the general trend of a decline in the percentage of physics bachelor’s degrees received by Black students happened at the same time that a number of HBCUs closed or merged their physics departments. “It tracks exactly the same,” Searles says.

## Driving away talent

The risk to physics is that the many hurdles and discouragements will push talented Black students out of the study of physics and into other, more welcoming areas. “Students today have so many more technical options,” than in the past, notes Jami Valentine Miller. “If you were talented in math or science 30 years ago, you had to choose physics, chemistry, math or one of five engineering fields. Now there’s 20 engineering disciplines; there’s all kinds of interdisciplinary options that may not be as stodgy and off-putting. They may be more welcoming.”

That will significantly harm physics in the future, says Willie Rockward, as “we need everybody … We can’t afford to lose Black students; we can’t afford to lose white students; we can’t afford to lose Hispanic students; we can’t afford to lose women. We need everybody, because there are so many problems for us to solve.”

And it’s not just a question of raw numbers. In a revealing study published in April 2020 in PNAS, “The diversity-innovation paradox,” Stanford University researchers found that demographically underrepresented students in Ph.D. science programs tend to innovate at higher rates than majority students. Yet it also found that, owing to deeply entrenched biases, minority students’ contributions tend to be

discounted and devalued in these same settings, preventing them from gaining scientific traction.

"We forget that by someone bringing a different thought to the table … it interacts and triggers other thoughts," says Rockward. "We need different trains of thoughts and different ideas at the table from everybody."

## Searching for solutions

The positive arguments for equity and diversity in optics and photonics aren't new. Yet Black underrepresentation persists. Where will solutions come from?

Shirley Malcom believes a key focus area should be undergraduate physics departments, where promising careers in the science often are squelched for a lack of support. "There's a lot of exploration that individual departments need to do," Malcom says. "There are all these physics departments out there … if they aren't having African American students coming in as majors, have they ever questioned why? I don't know that they're even asking themselves these questions."

Getting departments to engage in that kind of self-examination lies at the heart of the SEA Change initiative that Malcom currently heads. Modeled on the successful Athena SWAN program in Great Britain, SEA Change centers around a self-assessment process for institutions regarding their own barriers to a truly diverse and equitable system. "I have found new optimism through SEA Change," Malcom says. "Fifteen years of history for Athena SWAN has shown that it's possible to move forward if you take a structured, systems approach, and get institutions to be really honest about themselves."

The very systemic nature of the problems of Black underrepresentation in physics, however, means that "the challenges are too difficult to be solved by individuals or departments alone," according to the TEAM-UP group. Instead, it will take concerted effort—including "both will and money"—from the entire physics community. TEAM-UP calls for a broad, system-wide combination of faculty training, departmental review and advocacy, and significant financial support, with the aim at least doubling the number of bachelor's degrees in physics and astronomy awarded to African Americans by 2030.

In that effort, the report sees a significant role for professional societies, such as OSA, in raising funds, fostering shared leadership, building networks and providing incentives and rewards for efforts to increase diversity. Thomas Searles, who is working with OSA on a number of the society's initiatives to build Black representation in optics and photonics, senses a big opportunity for professional societies to join forces to highlight the work of, and prospects for, Black physicists.

Morgan State University

> "We need different trains of thoughts and different ideas at the table from everybody."
>
> *—Willie Rockward*
> *Morgan State University*

Of particular importance to Searles has been the National Society of Black Physicists (NSBP), an organization founded in 1977 to "promote the professional well-being of African American physicists and physics students," both within the international scientific community and the broader society. "The NSBP meeting has always been kind of special for myself and my students," Searles says. "Every single important thing that's happened in my career happened at that meeting." It's a chance, says Searles, to show "that Black physicists *do* exist—500 or 600 Ph.D.s since 1973. We meet every year at NSBP."

## Taking it online

One element today that has been absent from some previous equity struggles, of course, is the internet

## OSA's effort

The Optical Society has a long-standing commitment to diversity, equity and inclusion (DEI) in optical science and engineering, and has strongly supported programs to boost participation and recognition of women and other historically underrepresented groups. As with many scientific organizations, however, the society has found in the events of 2020 a call to action to do much more to ensure equity for Black scientists and help dismantle systemic racism in the field.

OSA has responded to the call, assembling a rapid action committee (RAC) that will drive step-function changes in OSA's DEI effort going forward. The RAC, with members drawn from academia and industry, will look at the engagement of Black scientists and engineers in OSA and the optics and photonics community; will recommend sustainable actions with real impact to amplify and support Black scientists and engineers, and determine what's needed to move those actions forward; and will develop metrics and tools to track progress. The RAC's final recommendations will be delivered in April 2021.

For more on the DEI RAC, please visit **www.osa.org/DEI_RAC**. Follow other OSA efforts at **www.osa.org/CommitToChange**.

and, in particular, the constellation of social-media and other tools for building community online. Jami Valentine Miller—who herself started one such online community, African American Women in Physics (http://aawip.com), as a counterweight to the isolation she felt at being the only African American woman in her graduate department—says social-media channels have created a new vehicle for sharing direct experiences of racism in academia.

"A lot of young scientists are posting about their experiences under the hashtag #BlackInTheIvory," says Valentine Miller, adding that these are stories that academic departments should follow and take seriously. "People are trying to hold companies, departments and others accountable," she observes. Academic departments, she adds, should "look at these experiences that people are finally talking about in public, and ask themselves: Is this something that could happen in our department? And what can we do to make sure it doesn't?"

One remarkable instance of social-media-driven advocacy occurred on 10 June, in the aftermath of the killing of George Floyd, when a group of physicists and other academic scientists, under the hashtags #ShutDownSTEM and #ShutDownAcademia, called for a one-day strike by the research community to call attention to systemic racism in academic departments. The effort billed itself as "an initiative from a multi-identity, intersectional coalition of STEM professionals and academics taking action for Black lives." And it called on members of the research community to use the strike day to educate themselves on structural racism, develop actionable plans to fight it and assist in the healing of those affected by it.

According to Erin-Kate Escobar, assistant director of the Center for Diversity at the California Institute of Technology, the success of the effort—the idea for which was raised only 10 days before the actual strike—came as a surprise. "We had no idea on the 31st, when the idea was hatched," where it would go, Escobar says. "It went viral in an incredible way," spawning tens of thousands of tweets and interactions on social media, and the high-profile participation in the strike of major scientific institutions and organizations.

OSA was one of the professional organizations that joined in the #ShutDownSTEM strike. Elizabeth Rogan, the society's CEO, notes that on 10 June the organization shut down all of its regular operations,

"so our staff had time to participate in activities and access resources as suggested by #ShutDownSTEM organizers, as we make a priority of addressing racism within our community."

## Finding hope

Such open discussion is crucial, since structural racism in academic physics, as in society more generally, is built on the silence and tacit acceptance of individuals who could do more. In a hard-hitting open letter to their department at UMBC, Anthony Johnson and a colleague, Belay B. Demoz—the only two Black faculty members in the department—noted that the lack of minority faculty has long been treated as "a taboo subject to discuss," and that silence in the face of racism can result in "complicity with the very atrocities we abhor."

"If you're in an organization where you don't see much progress, then perhaps it's comfortable just to be silent," Johnson told OPN. "But clearly that's not the right approach to the problem." Efforts such as #ShutDownSTEM, he says, give him hope, as they are "the kind of thing that's needed to change some of the mindsets and the environment … It's unfortunate that it took such a hideous event [as the murder of George Floyd], but it hit everybody's heart that something is wrong here and we need to change it."

While Willie Rockward acknowledges the possibility that the current moment will result in "the same old smoke screen being pulled over the public's eyes" as in the past—with no real change in policy—he also believes that it offers "a good shot at making major change." One powerful force, says Rockward, is the strong involvement of a cross-section of young people, who create the prospect of "starting anew" and providing "a better shot at getting to a more equitable world and society."

Shirley Malcom believes another unique—and counterintuitive—factor could be a cause for optimism: the COVID-19 pandemic. "It's the very disruption we're experiencing right now that's giving me the greatest hope," she says. "Our institutions are not going to be the same when we return to them. And whatever we return to, there's an opportunity to reimagine them, to reinvent them in ways that support diversity, equity and inclusion."

For Thomas Searles—who is from Albany, Georgia, a key locus of civil- and voting-rights activity in the early 1960s, and who says that the civil-rights movement was "something that was always talked about" when he was growing up—the current moment offers hope for "substantial change, not just professionally in physics and optics, but really across the board" in the status of Black people in the United States. "I feel that a lot of the struggles that my grandparents and parents had, they're just now able to get the word out," says Searles.

Howard University

> "We've been studying optics since we were free in this country. It's something we've always been doing."
>
> —*Thomas Searles*
> *Howard University*

And if the optics and photonics community follows through with its own efforts toward equity, it will vindicate history in another way.

"I always make the point that the first Black person with a Ph.D. in this country—Edward Bouchet, in 1876—studied the index of refraction of minerals," says Searles. "We've been studying optics since we were free in this country. It's something we've always been doing." OPN

Stewart Wills is the senior editor of *Optics & Photonics News*.

For references and resources, go online: **www.osa-opn.org/link/in-search-of-equity**.