and achievements reflect not only their potential, but also the opportunities they have had, their developmental trajectories, and known sources of error in standard metrics" (reference 2, page 12).

The key idea is that traditional measures used in admissions are incomplete and do not weigh characteristics for success as a physics or astronomy researcher as opposed to as a classroom student. Those characteristics include perseverance, creativity, conscientiousness, realistic self-appraisal, a focus on long-term goals, and leadership.

A powerful new study of various factors contributing to PhD completion looked at more than 2000 US students receiving physics PhDs from 27 programs over a 10-year period.[3] It found that the physics and verbal GRE tests showed no statistically significant relationship with PhD completion. The range of physics scores varied from the 10th percentile to the 90th, so the lack of correlation is not due to a restricted sampling range.

The GRE-Q (quantitative measure) showed a barely statistically significant correlation with PhD completion. Students scoring in the 90th percentile for the GRE-Q are only 9% more likely to receive their degree than those scoring in the 10th percentile, so even that test is a poor tool for predicting success in graduate school. The use of the GRE for PhD admissions becomes even more problematic when one considers that scores on all three GRE tests—physics, verbal, and quantitative—show strong correlations with gender and ethnicity in a way that greatly reduces diversity.[3,4]

So, without the GRE to guide you, how do you make admissions decisions? The AAS report suggests that "programs should reduce reliance on standardized tests, structure information gathered via recommendation letters, and incorporate assessment of socioemotional competencies (i.e., non-cognitive skills). Faculty reviewers should also approach prospective students as learners, not only as research or teaching assistants, and evaluate them for their potential to grow into great scientists, not only for their accomplishments to date. *Because opportunities to learn and conduct research vary considerably with forms of social privilege, it is critical that programs working to mitigate inequalities not simply admit the students with the most impressive credentials"* (reference 2, page 13; emphasis added).

In particular, the use of rubrics to evaluate candidates can ensure that reviewers consider the many characteristics of successful PhD students, including the socioemotional competencies mentioned above. Toolkits, some of which are included in the appendices of the AAS report, can guide admissions committees in assessing these skills as a complement to more traditional measures such as GPA, essays, and letters of recommendation.

The AAS report contains examples from PhD programs whose holistic admissions practices have begun to show success in boosting diversity without reducing student quality. In fact, evidence from some of the programs suggests that the attention to socioemotional skills has increased the quality of PhD students. Although implementing such practices may take more work than simply sorting by physics GRE score, that extra effort should vastly improve the resulting PhD pool.

The time is long past to make the physics and astronomy communities representative of the society we live in, and thereby utilize the full potential of society's scientific ability. Multiple factors have impeded progress in achieving that goal, but the largest is probably ignorance of the real characteristics that influence success in graduate school. Most physics and astronomy faculty members assume they know what a successful PhD student looks like, but such assumptions are largely untrue or untested. If physics and astronomy faculty seek out better information and implement the types of practices recommended in the AAS report, then we may yet succeed in our shared goal of improving diversity and inclusion in our fields.

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LETTERS

For love and physics

Toni Feder's photo story "Snapshots from the life of Cécile DeWitt-Morette" on the PHYSICS TODAY website (10 October 2017) brought back fond memories about my mother and more than a few smiles! I would like to correct one anecdote, though, which I gather came from my sister Chris when she provided background on our mother without knowing it was incorrect.

The error, I know, would have saddened Cécile had she read it. It had to do with her reason for not marrying Peng Huan-wu, her adviser at the Dublin Institute for Advanced Studies in 1947. The story says it was because he wasn't French, but that was not the case.

Cécile did indeed tell us she used the excuse that our father, Bryce DeWitt, was not French (or Catholic) for her initial reluctance to marry him, though they wed in 1951. But her reasons for not marrying Peng were quite different. She was very much in love with him and would have married him, but it was the late 1940s and he was returning to China, which was in the midst of a civil war. When he left, he offered her a one-way ticket to Hong Kong and told her that from there he could get her into China. In her words, recorded during a series of interviews I filmed with her in 2003, "I chickened out. Honestly, I thought I'd be a problem for him in a country in turmoil and not speaking the language. And I was scared by the possibility that I would never be able to go back to France."

So her fear of being a burden to him as a foreigner in China and the idea of not seeing her country again were what led her to turn him down.

They continued to communicate even after he returned to China, until early 1950. His letters, which Chris recently uncovered, reveal a generous, wise man who continued to love her and to hope she would accept his offer but who knew it would be too difficult for her. That she kept his letters reveals the depth of her feelings toward him. She told me that she visited the newly opened China in 1982 as part of a US scientific delegation, and even then, when she saw him again for

the first time since Dublin, there was still something "special" between them. When the officials told the delegation some cars were waiting to take them somewhere, Peng told them, "No, this one walks with me." She recalled that as the two of them walked, he simply told her, "I'm so glad that you're still wearing sensible shoes."

I took Cécile with me on a business trip to China in 2004, and I had the privilege of accompanying her as she met up once more with Peng, who by then was in his nineties. When we were in his apartment, she opened up her old photo album of Dublin, and I saw his demeanor completely transform: He switched suddenly from communicating formally with her through an interpreter to speaking perfect English, and the two of them disappeared into another world, another time, two old dear friends kidding each other and reminiscing. Later that day, Cécile gave a talk at Peking University, with Peng in attendance. What surprised me the most was that the Chinese lecture attendees all seemed aware of the special relationship between the two of them.

Thank you for writing so nicely about Cécile and for the opportunity to reminisce about this old love story.

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Wanting funds to "look everywhere"

David Stevenson's Commentary on the habitable zone as a guide for the search for life in the universe is, as always, trenchant (PHYSICS TODAY, November 2018, page 10). Certainly, we should not focus all of our astrobiology efforts into searches for Earth-like life, lest we miss the variety of life and habitats that may exist elsewhere.

Many proponents of the habitable zone concept never argued otherwise. Rather, they find its value to be not in how it can help us exclude "unhabitable" planets from search efforts but in how it can help us chase the only lead we have in the hunt. Ideally, we would explore all potential habitats for life. But in a funding-constrained environment, it makes sense to allocate resources according to our best guess for where life can be found, with nonzero but smaller efforts spent on unlikely habitats and larger efforts on planets with "naked oceans."

Until "look everywhere" is a funded strategy, spending most of our time in the habitable zone will have to do.

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The Heisenbergs and the Goudsmits

Like my father, Werner Heisenberg, I have been the recipient of many questions regarding his role during World War II. After recently rereading Mark Walker's review (PHYSICS TODAY, March 2018, page 55) of David Cassidy's book *Farm Hall and the German Atomic Project of World War II: A Dramatic History*, I would like to reiterate what I personally know about Sam Goudsmit.

He approached me at an American Physical Society meeting around 1978, shortly before his death, and expressed to me how sorry he was about his immediate and strong rebuke of my father at war's end. He felt that our whole family must have been harmed by it. That friendly outreach at the time caught me unaware about the detailed circumstances he referred to. My father's letter on Goudsmit's behalf is a most welcome addition to the factual record. I thank Walker for highlighting it and sharing it with the larger physics community. There was actually such slim hope for Goudsmit's parents, once they were in the horrendous machinery of the Nazi genocide.

My father was an unassuming man with a mind schooled in antiquity (his father was a professor of classics), and he carried the tragedy of the Third Reich within him. He probably accepted that he had tried his best, against great odds, to save Goudsmit's parents. By the same token, he also believed he had done his utmost to prevent Adolf Hitler from having access to a weapon of mass destruction.

The Farm Hall tapes, secretly recorded conversations among 10 captured German scientists including my father, essentially reflect the dense moment of a truth that was irreversible in its consequences for mankind. Great minds are observed as they stumble through that complexity, each from a unique vantage point. No wonder the events at Farm Hall remain a subject of deep inquiry.

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Correction

May 2019, page 46—In "Microswimmers with no moving parts" by Jeffry Moran and Jonathan Posner, the affiliation of Walter Paxton, Ayusman Sen, Thomas Mallouk, and colleagues should be the Pennsylvania State University. PT

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Letters and commentaries are encouraged and should be sent by email to **ptletters@aip.org** (using your surname as the Subject line), or by standard mail to Letters, PHYSICS TODAY, American Center for Physics, One Physics Ellipse, College Park, MD 20740-3842. Please include your name, work affiliation, mailing address, email address, and daytime phone number on your letter and attachments. You can also reach us at **http://contact.physicstoday.org**. We reserve the right to edit submissions.