

Commentary

Asked to speak in a developing country? Say yes!

Picture this: You receive a formal email from a science- or education-related group in a developing country asking you to visit and give a talk. Because of teaching, exams, deadlines, family commitments, or a scheduling conflict with another conference, the timing is not good—it never is. The country's indigenous food might not be to your liking; the weather could be too hot, too cold, or too rainy; reports of a country's water or air quality might cause concern; a travel advisory could be in effect. So how should you reply to the invitation? With an emphatic yes! Permit me to convince you.

Naturally, I wouldn't recommend a course of action unless it's one that I would undertake, that benefits your hosts, and that is in your best interests. I'll elaborate on those three points in turn.

My own travels

During the past two decades, I have been a regular scientific visitor to the developing world. Those travels began for me in the 1990s, when, as a faculty member at Macquarie University in Australia, I encountered two wonderful opportunities.

First, I worked as a consultant to help develop a physics curriculum for a Maldives program on lower secondary teacher education. In that role, I initially met with Maldivian education students at Macquarie. I also made two visits to the capital city of Male, trips that had an amazing effect on me. The complexity of creating a scientific program in the Mal-

dives tantalized me. Irresistible goodwill, energy, and planning met immovable regulation, politics, and paucity. I learned that those irresistible forces and immovable objects are universal properties of the developing world and that the irresistible forces can triumph through persistence.

My second great opportunity took me to China as a visiting scientist supported by a joint initiative of the Australian Academy of Science and the Chinese Academy of Sciences (CAS). The purpose of the visit was to share scientific knowledge and explore collaboration potential. Like my initial visit to Male, my first trip to Beijing was enlightening, but in a different way. During a month-long visit, I encountered excellent hard-working graduate students and postdocs at the Institute of Physics of the CAS and at other institutes and universities. But most facilities were inadequate for world-class experiments, and many senior scientists had suffered a compromised education as a result of the Cultural Revolution and its aftereffects. Despite those challenges, the pertinacity of the youth and the solicitude of the senior scientists inspired me.

In the early 2000s, I made many subsequent trips to China to collaborate, lecture, and attend conferences. I was privileged to be a witness to history as the



THE AUTHOR (center, dark blue shirt) joined chapter members at the launch of the Optical Society of America student chapter in Durban, South Africa.

country rapidly transformed from scientific backwater to nascent scientific superpower. My involvement intensified to the point that, as part of China's Thousand Talents Plan, I received an appointment at the University of Science and Technology of China in 2013.

Since the 1990s I have co-organized conference series in Iran (see my piece "Science without borders," *PHYSICS TODAY*, May 2008, page 51) and Africa; been a regular visitor to India and Pakistan; and enjoyed trips to Bahrain, Saudi Arabia, Uzbekistan, Algeria, and many more. Those efforts consume time and energy, but the payoff is worth it.

The formative moments that led me to become a physicist invariably involved inspiration from listening in person to someone who exuded a passion for science and shared it with great insight and clarity. That elixir of scientific zeal would have been diluted had it been transmitted over radio, television, books, or the internet. Science is a pursuit that transcends the foibles of humanity, but scientists and scientists-to-

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be are human and need to be nurtured in a human way.

When I visit developing countries, I share insights, give tips, teach techniques, and suggest references. Along the way, I meet many bright, talented youth and heroic professors doing good science in challenging environments. I am reminded of the wish expressed by Neil Turok, director of the Perimeter Institute for Theoretical Physics in Canada and founder of the African Institute for Mathematical Sciences: to find the next Einstein in Africa. To do so, he has created the Next Einstein Initiative (www.nexteinstein.org).

Benefits to the hosts

Accepting an invitation to visit a developing country benefits the hosts in several ways. Sharing your knowledge, choices of research topic, and experimental methods with scientists and students helps them not only learn science but broaden their worldview in general.

Furthermore, you can be an inspiration. Some developing countries do not hold science in high regard; some cultures—even in developed countries—find it threatening or misleading. Your acceptance of the invitation, on the other hand, reinforces your hosts' commitment to the pursuit of science. Your visit can help impress upon politicians and industrial and business leaders that science has value, which may encourage them to give or advocate for funding to improve it. Opportunities to encourage support for science can be subtle; they can range from a clear, inspiring plenary talk to a candid conversation over dinner.

Benefits to you, the traveler

Now here's the hard part. What do you get out of saying yes? There's the obvious: If you are convinced by what I have said so far, then you accept that you will be making the world a better place, and you are gratified by knowing you did something good. But, of course, you have other ways to make the world better and other ways to derive gratification, so let's explore various tangible, nonaltruistic benefits.

The most direct benefit is meeting talent face-to-face and recruiting superb budding scientists into your group as students or postdocs. Recruitment was not my intention when I became in-

involved with science in developing countries, but it has been a significant outcome. Much student recruitment is from the developing world, and school admissions committees have only transcripts, references, and exam scores on which to base their decisions.

By going to developing countries, you establish your own network of trusted contacts who alert you to student "gems," and you get to meet those gems yourself. Opportunities increasingly exist, in fact, for doctoral students to jointly attend

your and their home institutions: That so-called cotutelle program is becoming popular among international students as a way of expanding and diversifying their experiences in education.

Another benefit of going to developing countries is your audience's eagerness to learn about your work. Scientists and students in the developing world are often isolated, with very limited access to journals and books; even internet access is a challenge. In some countries, graduate students are not even aware of the arXiv

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preprint server and its freely available articles. A lack of fluency in the English language can also be an obstacle.

Consequently, the thirst for knowledge can be satisfied by your presentation and your patience in explaining your investigations and showing your methods. Graduate students in developing countries are often grateful for guidance and will work wholeheartedly on topics you suggest. Both you and the students will benefit from that symbiosis. They have problems to work on and a mentor for advice, and you have a broader audience and a larger collaborative team engaged in studying the topics that interest you.

In addition to the benefits of recruitment, collaboration, and dissemination of your research, you get to see the world in relative safety, in the hands of locals. My experience, without exception, has been that my hosts showed me great respect and took care of me far beyond my expectations. From the moment I arrived to the moment I departed, they made sure I was safe and well nourished and that I had a full experience of their coun-

try and culture. Because your local hosts profoundly understand the risks in their home countries and how to mitigate them, you can be sure that you're in good hands: They will not invite you if you will be in danger, and you will be told immediately if risk becomes a concern.

Our understanding of much of the developing world is caricatured by news stories and documentaries that emphasize sensationalism and neglect the cultural soul. The benefits to you of being there and seeing the countries and environments for yourself are enormous. So when that opportunity arises to visit a developing country, seize it. Say yes. Share your research interests and your passion for science with people who lack your resources and connections, and let them spoil you with a visit that you will always remember.

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comes crucial, and the partial analogy to the oil drops fails. In other words, the analogy does not extend to what most people consider the most interesting aspects of quantum mechanics.

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I was recently perusing my copy of the August 2015 issue of *PHYSICS TODAY*, looking in particular at the feature articles. To my surprise, I read the following as the opening of "The new wave of pilot-wave theory" by John Bush:

"If particle physics is the dazzling crown prince of science, fluid mechanics is the cantankerous queen mother: While her loyal subjects flatter her as being rich, mature, and insightful, many consider her to be démodé, uninteresting, and difficult. In her youth, she was more attractive."

I trust that Bush was intending to be charismatic and appeal to his male readers. However, I was disappointed that he did not think through the sexist stereotypes that this writing reinforces. Invoking a metaphor that casts women as the "cantankerous queens" of science does not help us to be treated with respect in the workplace.

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► **Bush replies:** I appreciate Jeffery Winkler's opinion, but it has yet to be proven that dynamic nonlocality of the form exhibited by the walking droplets cannot give rise to a feature analogous to quantum nonlocality, that memory cannot account for entanglement. A proof, rather than an assertion, on this matter would be most welcome.

I feel obliged to point out to Leslie Kerby that in my opening paragraph, I was appealing not to my male readership but rather to the careful reader. The cantankerous queen mother was a metaphor for the field of fluid mechanics, not women in science. She was, moreover, cast as the heroine.

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LETTERS

Walking droplets, pilot waves, and word choices

After reading John Bush's article "The new wave of pilot-wave theory" (*PHYSICS TODAY*, August 2015, page 47), I want to remind readers of the limitations of the analogy. The oil-drop experiments provide a tangible partial analogue of the pilot-wave picture, but one that is restricted to single-particle phenomena. Such experiments cannot reproduce the types of phenomena that depend on entanglement; only in the case of a single particle does the wavefunction have the same mathematical form—a scalar function over space—as the waves in the oil.

Once two particles are involved, the fact that the wavefunction is defined over the configuration space of the system rather than over physical space be-

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