

VIEWPOINT

Immigration in science

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The advance of science is dependent upon collaboration, which does not have a visa attached to it. Indeed, over 40% of all American-based Nobel Prize winners are immigrants, and data from the National Science Foundation show that 49% of postdocs and 29% of science and engineering faculty in the US are foreign-born. However, restrictive new immigration policies in the US have left many scientists deeply concerned about their future and many American-based laboratories worried about attracting the best talent. At JEM, we're celebrating immigration by sharing the experiences of immigrant and nonimmigrant scientists on our editorial board. Alexander Rudensky and Jean-Laurent Casanova give their firsthand perspective on immigrating to the US, while Jedd Wolchok, Carl Nathan, David Holtzman, Susan Kaech, Lewis Lanier, and David Tuveson reflect on how immigration has affected their laboratories.

Alexander Rudensky

I came to the US 30 yr ago to join Charlie Janeway's laboratory at Yale as a postdoctoral fellow with a firm plan to go back to Moscow in 2–3 yr, thinking naively that the Soviet Union would transition to a stable democracy. The open, intense, and diverse research community in the US and the exciting science exceeded my highest expectations. The incredible mix of people from all over the world, with equally diverse ideas and approaches to science, and the pace of research have all been intoxicating, and they still are 30 yr later. I felt most fortunate and lucky to experience a sense of acceptance and camaraderie from my early days in and outside the laboratory. There were inevitable difficulties of integration, including cultural and language barriers; strains on family life and differences in ways of raising children and their schooling; increasing loss of friendships in, and a strange combination of growing nostalgia for, the country I have come from; and estrangement from the culture and language. Despite the dark times we currently live in, I believe that there is no better place for biomedical research anywhere in the world, and that reason and science will prevail.

Jean-Laurent Casanova

I arrived in the US in September 2008. I decided to cross the Atlantic because of the exceptional history of the Rockefeller University, where many of my scientific heroes had worked. Also, because America has become, after World War II, "the" scientific country. No other country on the planet values, fosters, sponsors, and rewards science the way it does here. None. The most challenging issue I have faced since moving here has been the English language. Speaking a broken scientific English is one thing; understanding a play by Shakespeare is another. I would need another life to speak English the way I speak French. I actually surrendered and happily admit to still reading Pascal, Chateaubriand, and Proust. I still don't even understand most jokes of my American colleagues; I often smile and laugh by politeness and mimicry. The only advice I can give to a scientist tempted by the American experience is to make sure that science matters more to him or to her than anything else. Working abroad for more than a few years is only worth it if your life is centered on work. Otherwise, there is little doubt to me that it is more enjoyable to stay in a

familiar environment, with the relatives, houses, museums, mountains, streets, bistros, and books of your youth.

Jedd Wolchok

The scientific research environment in the US, and certainly the work in my laboratory, benefits enormously from the participation of scientists from all over the world. Immigrants bring not only creativity, intellect, and dedication to our group, but also diverse opinions and opportunities to share their rich culture. The hard data support that at many of this country's most prestigious research institutions, immigrant scientists represent a major subset, and in some cases the clear majority, of the scientific talent. The engine of innovation that is US science is powered by the energy of immigrants who have strived their entire lives to seek the freedom of expression and exploration that US society was known for. On a global scale, immigrant scientists trained in the US have established new laboratories here or in their original countries to extend the reach of their accomplishments.

Challenges in immigration may certainly impact the ability of scientists to collaborate in a hands-on way.

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Carl Nathan

Brilliant, creative minds are as widely distributed as the diseases we seek to understand, prevent, and treat. My laboratory's research, like most, has benefited enormously from outstanding scientists from around the world. Some have gone on to lead productive scientific careers in their countries of origin. Others have given this country the gift of making it their home. They have enriched each other and the resident Americans scientifically and culturally.

Shared endeavors for the common good can redefine community, dissolving prejudices. Recently, as my laboratory has immersed itself in workshops on racism, the experiences of immigrant scientists with forms of discrimination in their own societies have provided an invaluable perspective.

America cannot become a land without immigrants without also becoming a land without scientific leadership, democracy, liberty, tolerance, and respect for truth, because only a country that rejects all of the latter would choose to close itself to immigrants.

David Holtzman

Immigrant scientists have had a big impact in my laboratory over the last 25 yr. Of the 68 graduate students and postdocs who have trained or are training in my laboratory, 29 of them are immigrant scientists. These immigrant scientists not only have made major scientific contributions to the field but have expanded the culture and experiences of every US citizen in the laboratory, creating a much stronger environment that makes everyone more attuned to many important societal issues. The immigrant scientists who have come to my laboratory have made some of the most important scientific discoveries in the field of neurodegeneration. The breadth of our discoveries, I am convinced, would not have been as strong or as broad without them, and these findings have benefited the entire world community working on neurodegeneration and Alzheimer's disease. Current changes in immigration will affect collaboration because the presence of immigrant scientists leads to more collaborations from laboratories from the locations where they were previously or where they go back to.

Lewis Lanier

Science has greatly benefited from the international collaborations resulting from our ability to recruit the best and brightest young scientists from around the globe. I first appreciated this when I was at the DNAX Research Institute in the 1990s, where more than half of our faculty and fellows were from Europe, South America, Japan, and Australia—forging friendships and scientific exchanges that have lasted more than three decades. I've had the opportunity to train students and fellows from 19 countries, who have gone on to successful careers in academia, biotech, and pharma here and abroad. Discouraging or preventing this international exchange by restrictive immigration policies does not benefit scientific advancement or the US.

Susan Kaech

One of the best things about science is the inherent randomness of fate and discovery... and I mean this both on a scientific and personal level. Not only does our journey in science bring us to new discoveries that we could not really have predicted at the onset, but our journey also introduces us to different people all over the globe who share common interests who we never could have planned to meet. And it is this international diversity in ideas, creativity, and cultural upbringing—which allows us to tackle problems based on different experiences using different approaches—that gives rise to innovation and new discoveries. I feel so fortunate to have the opportunity to work with people all over the world and to generate new insights in biology, as well as to develop friendships that last a lifetime. Being an American, I also feel privileged to share many of the great opportunities that our country offers young international scientists who choose to come to the US to train in our laboratories—fantastic PhD and postdoc training programs, cutting edge technology, and a collaborative spirit for sharing information. And as these international scientists move forward in their careers, they often make the US their home and become highly engaged and valuable members of our communities and schools. Their children become your children's best friends! But even if they choose to leave the US and re-root in another country, they tend to maintain strong ties to the US and

the scientists they interacted with here, which strengthens the scientific web we have been weaving across the globe that provides for improved health, education, technological innovation, and prosperity. Even if you look at this issue squarely based on economics, nearly half of the Fortune 500 companies today were founded by immigrants or their children. Thus, our country greatly benefits from immigrant scientists and researchers in so many ways, and our political leaders should be recruiting, not obstructing, the best and brightest minds from all over the world to come to the US for their education and scientific training. It's a no-brainer!

David Tuveson

The advances we see in the US in healthcare, engineering, education, music, literature, cuisine, and entertainment have largely been driven by waves of immigrants who sought freedom from oppression. My grandparents and great-grandparents were immigrants from Sweden and Croatia, and they brought their cultures and hopes for a better life to our country. I am the fortunate offspring of my family's immigrants and try to be welcoming of anyone who expresses interests in visiting the US for training or employment. I have also had the great experience of living and working overseas for 6 yr in Cambridge, UK, and so I see this issue from both perspectives. Science is a universal language, and science itself can only thrive if we maintain universal open borders to scientists and ideas. After all, the job of science is to discover new aspects about our existence so we are more informed about life, and to fix problems through our work so that illness can be avoided or ameliorated. My laboratory has benefited from migrant scientists, as over half of my trainees have been from overseas; they have always brought a fresh intellectual and cultural perspective to our laboratory to help us explore pancreatic cancer. We have terrific collaborators in Europe, Australasia, and Africa. It is critical that we hold open borders to the training of scientists, lest we embrace a stagnant existence that will be less productive and counter-productive to the reasons that society supports science in the first place. I believe that the first editor of *JEM* was Dr. William Welch, a famous pathologist and one of the four founding physicians of

Johns Hopkins Hospital who was trained first in Germany, where he learned about new histochemical stains; then in England, where he realized that cholera was transmitted by sewage water leaking into drinking wells to stimulate the field of public health; and finally, back in New

York, where he trained legions of young medical residents how to perform autopsies. Dr. Welch was an example of reverse migration, in which Americans travel the world to learn the skills necessary to build our own biomedical research institutions. Today, the US remains the place where

young trainees from overseas, eager for a chance to learn from the best, want to migrate to learn from the protégés of Dr. Welch so they can then go back to their own countries (or stay in the US and enrich our country). Let's not make a huge mistake and undo what Dr. Welch started.