

Through the GOLDEN DOOR

B Y R A N D Y W E D I N

Nobel Prize season usually brings a wave of smugness about the superiority of “American science.” In reality, there is no such thing. Scientists and students with roots overseas have made huge and often unrecognized contributions to the advancement of domestic science.

Every October, the scientific world eagerly awaits news from Stockholm as the Nobel Prizes are announced. And year after year, the American news media pays homage as the ranks of Nobel laureates swell with more Americans.

The message to the American public is clear: Americans are the cream of the crop in science.

In chemistry, for example, the past 20 years have seen 42 laureates, and 26 of them practice their chemistry in the United States. No other single country can claim more than four Nobel Prizes during that period.

A closer inspection of the data, however, reveals a more complex picture. Many of these “American” scientists were not born in the United States at all, but immigrated during their childhoods, scientific training, or professional careers.

A 1997 National Research Council report (*The New Americans: Economic, Demographic, and Fiscal Effects of Immigration*, National Academy Press, 1997), found that a third of U.S. Nobel Prize winners from 1901 to 1995 (in chemistry, physics, medicine, economics, and literature) were born outside the United States. In chemistry, 26% of the American winners were non-U.S.-born. In recent years, the results are even more dramatic, with 42% of the “American” chemistry laureates since 1996 being born outside the United States.

Among “American” chemists who’ve made the December trip to Stockholm are Walter Kohn (born in Austria), Alan MacDiarmid (ACS ’55; New Zealand), Rudolph Marcus (ACS ’50; Canada), Mario Molina (ACS ’71; Mexico), George Olah (ACS ’56; Hungary), Yuan T. Lee (Taiwan), and Ahmed Zewail (ACS ’76; Egypt). Clearly, any definition of “American science” must include the many immigrant scientists who have come from all corners of the globe, bringing their talents, creativity, and energy to the United States.

Profile of the chemistry community

Does the entire chemistry community have demographics similar to this elite group?

Yes, most definitely.

National Science Foundation (NSF) data from *Science & Engineering Indicators 2000* show that in the physical sciences, at least 28% of the employees in industry and 23% in academe are non-U.S.-born. The international nature of American science becomes even clearer when the demographic focus zooms in on graduate and postdoctoral students. According to NSF, for chemistry, 34% of the graduate students (6,156 out of 18,188) were in the United States on temporary visas. At the postdoctoral level, the percentage of international students increased to 68% (2,415



CORNELL UNIVERSITY

“One of Hitler’s Gifts to America”

Roald Hoffmann, who won the 1981 Nobel Prize for Chemistry, was among the prominent scientists forced to flee Europe and other countries because of adverse political situations.

out of 3,574). The corresponding statistics for chemical engineering were 45% (graduate students) and 73% (postdocs).

The American scientific community is more global than the general population. The percentage of people born outside of the United States ranged from a high of 15% in 1910 to a low of 5% in 1970. By 1990, it stood at 8%.

Immigration of chemists, just like immigration in general, occurs in waves, driven by global and regional economics and politics. In the World War II era, for example, many chemists immigrated from Europe (see sidebar, p. 24). In recent years, China has been the leading country of origin. The annual *Open Doors* report of the Institute of International Education (www.iie.org) lists the top 10 countries of origin as India, China, Republic of Korea, Japan, Taiwan, Canada, Mexico, Turkey, Indonesia, and Thailand.

“Push” and “pull” of immigration

Every immigrant can tell a unique story about the decision to come to the United States (see sidebar, p. 24, for some of the more dramatic stories), but there are also

common themes. Both “push” (from the countries of origin) and “pull” (by the United States) play important roles in immigration.

“Push” means the strong desire to take advantage of the excellent system of education and research in the United States.

Although some scientists have been pushed out of their countries for political reasons, including World War II-era Jewish scientists in Europe, economics is a more common motivation for countries to send highly qualified students and scientists to the United States. Skills and experience gained here can drive economic growth and development when the scientists return home.

Roald Hoffmann (ACS ’63), the 1981 Nobel laureate who was born in Poland, illustrated the “push” from other countries with this jaw-dropping example in an essay published in *Science*:

“If Cornell admitted its entering class of chemistry Ph.D. students without regard to language ability, and only on academic merit (measured as imperfectly as that may be), I estimate that our class of 32 students would have 24 students from the People’s Republic of China (PRC), 3 Indians,

2 Russians, 1 Korean, 1 Taiwanese, and 1 American. In fact, in 1997 we enrolled a majority of U.S. citizens or permanent residents, 5 PRC students, 2 from India, and one each from Hungary, Israel, and Liberia.”

Individual scientists also experience an inner push to take advantage of the best scientific resources. John Pople (ACS '64), the 1998 Nobel laureate who was born in the United Kingdom, explained his mid-career decision to move to the United States:

“When we returned to England in June 1962 [from a one-year sabbatical at the Carnegie Institute of Technology in Pittsburgh], it was not clear where we might go, for there were opportunities both in the U.K. and the U.S.A. Eventually, after much debate, we decided to return to Pittsburgh in 1964. Leaving England was a painful decision, and we still have some regrets about it. However, at that time, the research environment for theoretical chemistry was clearly better in the United States.”

The “pull” of immigration originates in America’s need to import scientific talent from abroad. The number of U.S.-born citizens with the appropriate interests and skills doesn’t meet demand from academe and industry.

Adjusting to life in the United States

Students and scientists who arrive in the United States immediately face a huge adjustment process.

The biggest barrier for many, of course, is language. Not only must they master English grammar, vocabulary, and pronunciation, but they must also learn to contend with colloquial expressions, slang, and jargon.

“Arriving in the States, I had the feeling of being thrown into an ocean,” Egyptian-born Zewail, the 1999 Nobel laureate, recalled of his transition to the University of Pennsylvania.

“The ocean was full of knowledge, culture, and opportunities, and the choice was clear: I could either learn to swim or sink. The culture was foreign, the language was difficult, but my hopes were high. I did not speak or write English fluently, and I did not know much about western culture in general, or American culture in particular. I remember a ‘cultural incident’ that opened my eyes to the new traditions I was experiencing right after settling in Philadelphia.

“In Egypt, as boys, we used to kid each other by saying ‘I’ll kill you,’ and good friends often said such phrases jokingly. I became friends with a sympathetic American graduate student, and, at one point, jokingly said ‘I’ll kill you.’ I immediately noticed his reserve and coolness, perhaps worrying that a fellow from the Middle East might actually do it!”

Chemical Abstracts Service (CAS) in Columbus, OH, employs a very wide range of international scientists and has recently added a number of employees from China and Russia.

Ed King (ACS '82), a senior editor at CAS who emigrated from Taiwan in the 1960s, has been at CAS for 30 years. He encourages new immigrants to get involved in the community—everything from attending American Chemical Society (ACS) Local Section meetings to joining a birdwatching group or musical organization.

“I try to get them involved in activities outside their own circles. If new employees can learn how to communicate with their colleagues who come from a different ethnic background, they become better employees.”

An ACS online resource, *Graduate-Level Chemical Sciences Education in the USA: An Internet Guide for International Students and Scholars*, can help international students adjust to American life. It is available at chemistry.org/international.

The complexity of American culture is far from obvious. For a sense of how

challenging cultural adjustment is, check out *eduPass: The SmartStudent Guide to Studying in the USA* (www.edupass.org/culture), one website that helps orient students born outside of the United States:

- To wave goodbye or hello, wave it from side to side, not front to back. Wave the whole hand, not just the fingers. Waving the hand front to back or the fingers up and down means “no,” “stop,” or “go away.”
- Shaking your head from side to side means no. Shaking your head up and down means yes.
- Never show your fist with the middle finger extended. This is an insult. Shaking a closed fist at someone is also rude, especially if it is in their face, and is an expression of anger.

To stay or to return?

As difficult as it may be to adjust to life in the United States, a much more difficult challenge soon faces many international students and scholars: Should they stay in the United States or return to their home country?

Historical data from NSF show that about half the non-U.S. students who earned science and engineering doctoral degrees at U.S. universities planned to locate in the United States, and a smaller proportion, about 40%, had firm offers to do so.

In the 1990s, however, doctoral recipients from Asia, Europe, and North America increasingly planned to stay in the United States and received firm offers to do so. By 1997, 69% of foreign doctoral recipients planned to stay in the United States following the completion of their degrees, and 50% had accepted firm offers to do so.

The decision on whether to return home, like the decision to immigrate, is also highly dependent on factors such as economic conditions in the United States

Great escapes

Every immigrant chemist has a story, and some read like Hollywood scripts packed with drama, history, and personal sacrifice. Here are first-person highlights from three laureates, excerpted from their autobiographies on the Nobel Prize website (www.nobel.se).

Roald Hoffman: One of "Hitler's gifts to America"

Part of my family survived the Nazi occupation and the abiding anti-Semitism around us. The United States eventually received us, the true stateless refugees that we were. It did not receive us all that graciously—Do you remember the racist immigration quotas of 1921 to 1965, which delayed our immigration by a few years and completely discouraged so many others? But once we came, the world was open to me, as it was to the rest of "Hitler's gifts to America."

On July 18, 1937, I was born to Clara (née Rosen) and Hillel Safran in Zloczow, Poland. Our part of Poland was under Russian occupation from 1939 to 1941. Then in 1941, darkness descended, and the annihilation of Polish Jewry began. We went to a ghetto, then a labor camp. My father smuggled my mother and me out of the camp in early 1943, and for the remainder of the war, we were

hidden by a good Ukrainian in the attic of a schoolhouse in a nearby village. My father remained behind in the camp. He organized a breakout attempt that was discovered. Hillel Safran was killed by the Nazis and their helpers in

June 1943. Most of the rest of my family suffered a similar fate. My mother and I, and a handful of relatives, survived. We were freed by the Red Army in June 1944. At the end of 1944, we moved to Przemysl and then to Krakow, where I finally went to school. My mother remarried, and Paul Hoffmann was a kind and gentle father to me.

In 1946, we left Poland for Czechoslovakia. From there, we moved to a displaced persons' camp, Bindermichl, near Linz, in Austria. In 1947, we went on to another camp in Wasseraalpingen bei Aalen in Germany, then to München. On Washington's birthday 1949, we came to the United States.

I learned English, my sixth language at this point, quite quickly. After P.S. 93 and P.S. 16, Brooklyn, I went on to the great Stuyvesant High School, one of New York's selective science schools.



Roald Hoffman

George Olah flees Soviet oppression

In October 1956, Hungary revolted against the Soviet rule, but the uprising was soon put down by drastic measures and much loss of life. Budapest was again devastated, and the future looked rather dim. In November–



George Olah

December 1956, some 200,000 Hungarians, mostly of the younger generation, fled their country. With my family and much of my research group, we also decided to follow this path and look for a new life in the West. After we fled Hungary in early December 1956, we reached London late in December, where my wife had relatives. We subsequently moved on in the spring of 1957 to Canada, where my mother-in-law lived in Montreal after the war. During our stay in London, for the first time I was able to establish personal contact with some of the organic chemists, whose work I knew and admired from the literature. I found them most gracious and helpful. In particular, Christopher Ingold and Alexander Todd extended efforts on behalf of a young, practically unknown Hungarian refugee chemist in a way which I never forget and for which I am always grateful.

Dow Chemical, with its home base at Midland, MI, was establishing at the time a small exploratory research laboratory 100 miles across the border in Sarnia, Ontario. I was offered a position to join this new laboratory, and they also hired two of my original Hungarian collaborators. We moved to Sarnia in late May of 1957. As our moving expenses were paid, we checked in two cardboard boxes containing all of our worldly possessions onto the train from Montreal and started our new life. In the spring of '64 I transferred to Dow's Eastern Research Laboratories in Framingham, MA. In the summer of 1965, I was invited to join Western Reserve University in Cleveland, OH, and returned to academic life as professor with the added responsibility of becoming department chairman.

Alan MacDiarmid escapes poverty

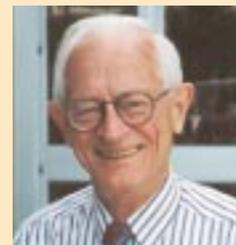
I was born a Kiwi (a New Zealander) in Masterton, New Zealand, on April 14, 1927, and still am a Kiwi by New Zealand law, although I became a naturalized United States citizen many years ago in order to have the right to vote in U.S. elections and, hence, voice my political opinions in a meaningful way. My father, an engineer, was unemployed for four years during the Great Depression which hit New Zealand rather severely in the early 1930s. Since jobs were believed to be more plentiful in the vicinity of Wellington, the capital city of New Zealand, located at the bottom of the North Island, we moved to Lower Hutt, a few miles from Wellington.

Although we did not have too much food, my mother was always inviting other, less fortunate people to meals. On such occasions, my older brothers and sister would frequently remind me and my younger sister at meals not to ask for more food by saying to us out loud at the table, "FHB," which meant, "Family Hold Back," i.e., don't eat too much! We had no phone or refrigerator. For most of my time at primary school, I went to school barefoot, like most of the other kids. The soles of our feet literally became leather!

When my father retired (on a very small pension) and moved away from Wellington, it was necessary for me to leave Hutt Valley High School after only three years at the age of 16 and take a low-paying, part-time job as "lab boy"/janitor in the chemistry department at Victoria University

College, as it was then known. I boarded with friends of my parents and, as a part-time student, took only two courses—one in chemistry and one in mathematics. I

remained a part-time student throughout my B.Sc. and M.Sc. studies at Victoria University College. After completing my B.Sc. degree, I graduated to the position of demonstrator. Since the age of 17, I have supported myself financially, assisted later only by scholarships and fellowships for which I am most grateful. In 1950, I had the good fortune to receive a Fulbright fellowship from the U.S. State Department to do a Ph.D. at the University of Wisconsin.



Alan MacDiarmid

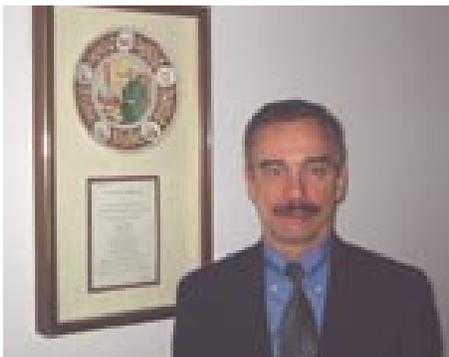
and the home country, politics, scientific opportunities, and cultural traditions.

U.S. immigration policies play a big role, and the issue is politically charged. Some policy makers argue that immigration is the cornerstone of American society and needs to be encouraged. Others argue that non-U.S. scientists should return home to aid in the development of their countries. There are a wide range of views within the chemistry community, according to John Malin (ACS '65), ACS's assistant director for international activities.

"It's contentious," Malin said. "Some folks feel very strongly that the United States should be a haven for the best brains in the world. Others would say that we have to protect American workers."

Immigration policy has gotten even more confused and complicated in the post-September 11 world. An emerging set of new policies, homeland security issues now are affecting immigration and scientific exchange. The September 11 terrorist attacks spurred the Immigration and Naturalization Service to implement an online system for monitoring non-U.S. students and exchange visitors in the United States. Called the Student and Exchange Visitor Information System (SEVIS), the new system places additional reporting requirements on institutions. In the past, schools provided a student's name, address, academic status, course load, and field of study. Now, schools also must report other information, including disciplinary action taken because of a criminal conviction, failure to appear for class once school begins, and changes to part-time enrollment status.

Brad Miller, an international specialist at ACS, has worked in foreign student affairs and international program development at several universities. Like others who follow these issues, Miller believes SEVIS may place extra burdens on institutions. "Just to try to keep track of all these students is an



John Malin

ACS's assistant director for international activities cited differing opinions on whether immigrant scientists should remain in the United States permanently.



Bradley D. Miller

Miller, ACS's lead international specialist, has experience in the academic world, and expressed concern that SEVIS's requirements will place extra burdens on colleges and universities.

incredible challenge," he said. "The University of Southern California, for example, has an international student enrollment of 5,950."

The Interagency Panel on Advanced Science and Security (IPASS) also is having an impact. It will help consular officials identify areas of science that might pose a national security risk and review suspicious visa applications.

As SEVIS and IPASS are implemented, the international science and education community—including organizations such as NAFSA: Association of International Educators (www.nafsa.org)—is monitoring potential glitches and long-term impacts.

Looking ahead

With the new scrutiny coming from the U.S. Department of Homeland Security and the continuing ups-and-downs of national economies, it's difficult to make solid predictions about the exact numbers and countries of origin of immigrant scientists who will arrive on American shores in the coming decade. However, it's a safe bet that American science will continue to grow more and more global.

Next month, when you hear the news from Stockholm ("American Chemist Wins Nobel Prize"), be sure to read the biographical information closely. There is a good chance that the chemist will be another immigrant who has come through the Golden Door to enrich the chemistry community here in the United States. ●

Randy Wedin, president of Wedin Communications in Wayzata, MN, uses his chemistry Ph.D. in science writing and consulting. Wedin worked for years on ACS's headquarters staff. His writing awards include the ACS Grady-Stack Award for Interpreting Chemistry for the Public.