When we arrived in Paris, Bryce was so sick he went to a hotel. I thought with the baby, I better go to my family. So I got in a taxi. After a few minutes, I said, "Where is the baby?" The taxi driver had put it on top of the car in the luggage rack!

PT: Where did your career take you next?

DEWITT: We spent 15 years at the University of North Carolina in Chapel Hill. I didn't have a position there. Then Bryce got an offer from the University of Texas at Austin. The astronomy department hired me, and eventually I got a job in the physics department. I'm now the Jane and Roland Blumberg Centennial Professor, Emerita.

PT: What have been your main research areas?

DEWITT: My contributions are very often related to functional integration, both developing the mathematics and applying it to physics questions. If you move from classical physics to quantum physics, basically you have moved from finite dimensional spaces to infinite dimensional spaces. Integration then becomes functional integration.

Feynman integrals, sometimes called path integrals, are a special type in the whole domain of functional integration. At the end of his Nobel speech, [Feynman] said—I will misquote, but it's close—"You may ask me what happened to the beautiful young lady of my youth. Like all young women, she has become an old woman. She has very little attraction left in her. She has given me some good children"—meaning the Lamb shift.

The "young lady" was definitely the path integral. I was not going to let that go by. I had worked on it and proved she is not just an old woman who has nothing left in her. Here was something very interesting that had a lot of potential. So I sent him some of my work, and I wrote in the margin, "She's beautiful in her own right." He wrote back, "You only dressed her up."

PT: Did you and Bryce overlap?

DEWITT: Yes, unfortunately, because that was an area for fights. The only thing we really fought about was physics.

PT: You don't need to be married to fight about physics.

DEWITT: No, but it was touching me more. A judgment from him to me, and a judgment from me to him. It's not good to be both a colleague and a spouse.

PT: What are you working on these days?

DEWITT: I am going to do a book called "The Pursuit of Quantum Gravity: Memoirs of Bryce DeWitt from 1946 to 2004." [Bryce DeWitt died in 2004.] I will have editorial privileges, so for several issues, I can put a little note saying "the editor thinks he would have gone further if . . . ." But I'm not going behind his back, because he knew it. We've done enough fighting about it.

Another big project is "Physics at work in neuroscience, neuroscience at work in mental health." I can put people together, make an overall plan. There are no committees; it's just me. I want solutions to mental health problems, and I am interested in what physics can contribute, for example, with functional magnetic resonance imaging.

Another one that is not physics but takes a lot of time and effort on my part is a manual I've written called "IT for Intelligent Grandmothers." I want it to be a bestseller because I am going to give all the royalties to PLAN [Planned Living Assistance Network] of Central Texas, the mental health organization that I started.

PT: Is it okay to mention that your interest in mental health stems from your daughter's health problems?

DEWITT: Absolutely. She feels the more it's spoken about clearly and openly, the more it gives a better picture of mental illness—that they're not all violent or homeless. It can happen to anybody.

Anyway, of all the changes in modern life that I have seen since I was born, I could adjust very happily. But not computers. I bought all the manuals and hated them. The only way I could survive was to write my own. It doesn't say "push this button," because that changes depending whether you have a Mac or a PC. Instead, it gives the principle. It's for *intelligent* grandmothers. You don't see a child giving his grandmother a manual for "dummies."

Then there is the resurfacing of the book I wrote in 1945, in the weeks following Hiroshima. Everybody was asking, What is it? What happened? Basically, the book is a solid but quick course in nuclear physics. It's a primer, and it presented nuclear energy as neither good nor bad. It was the first book on the subject in France for the public. It begins with reactors before going to the bomb. I think that my book was just a little bit of help in the word "nuclear" not having a negative impact in France.

One of my daughters found the primer. I tried to get in touch with the publisher, but they don't exist anymore. It's an orphan publication. [The primer, *L'Energie Atomique*, will be available electronically this fall via the University of Texas Digital Repository, according to the UT physics librarian.]

I have more. I have been in touch with King Abdullah University of Science and Technology [see PHYSICS TODAY, August 2007, page 33]. I am really attracted by [Saudi Arabia's] opening of their society. KAUST also resonated with me because the newspaper article I read mentioned it would be not too far from a little fishing village on the Red Sea. They have the means to do whatever they want. Their main problem is to attract first-rate faculty and first-rate students. I know a lot of people. I think I could help because when I created Les Houches, France was similarly scientifically isolated. What I would offer KAUST is to organize three consecutive summer schools, a bit on the pattern of Les Houches. It would attract people and create a current.

Toni Feder

Iranian and US scientists keep channels of communication open

Visiting physicists and engineers are welcomed in Tehran and carry conciliatory messages from Iranian leaders back to the US.

Burton Richter told the sponsors of his recent eight-day visit to Iran that he wasn't going to go there just to talk about particle physics. The retired director of SLAC insisted that the topics to be discussed include energy, specifically nuclear energy.

But the Nobel laureate had no inkling that he would spend an hour with Gholam-Reza Aqazadeh, one of Iran's vice presidents and its top atomic energy official. The Iranian official, Richter said, "clearly was sending a message" for him to pass along to the US authorities: Iran will consider suspending its uranium enrichment program, but only as part of negotiations covering other issues of "mutual interest," including resolving the Israeli-Palestinian conflict, stabilizing Iraq and other strife-torn Middle East nations, and countering illegal drug exports from Afghanistan.

"My interpretation is that they think that we want some things from them, but they want some things from us," said Richter, "and in negotiating a package deal, they would have more negotiating

power than if they were just to go to the nuclear thing and do a deal with us." He added, "[Aqazadeh] said the US attitude toward nuclear matters is one where we are ready to tolerate anything from members of our club but not willing to tolerate a peaceful program from someone not in our club." Examples, Aqazadeh told Richter, include nuclear weapons in Israel, the US nuclear agreement with India, and US weapons sales to Pakistan.

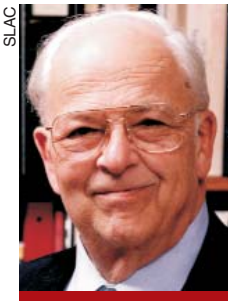
Richter's visit was one of a dozen or so exchanges between US and Iranian scientists and engineers that have been brokered and partly financed by the National Academies over the past 10 years. Glenn Schweitzer, who manages the program at the academies, said the visits are meant to encourage Iran to participate in the international science and technology arena. Each visit requires months, and sometimes years, of advance work, Schweitzer said. Depending on the particular focus of the visit, approval may need to be obtained from the State, Commerce, or Treasury departments if goods, services, technology, or funding is transferred. In Richter's case, no permission was required.

Diplomacy not a goal

Schweitzer insisted that diplomacy is not among the program's goals, although the enrichment issue has arisen on several occasions in recent years during visits sponsored by the National Academies. Delegations are not required to file reports of their trips with the State Department, but the academies regularly discuss the Iranian program with appropriate officials at State, he said.

Richter said an official at State told him that his visit marked the first time that a negotiating signal had been sent from the vice presidential level and also the first time that the Afghan drug trade was included on Iran's list of mutual concerns. The State official, an adviser to the acting undersecretary for arms control and international security, didn't return calls for comment. The US hasn't responded directly to such overtures from Iranian officials but continues to insist publicly that Iran must suspend uranium enrichment as a prerequisite to talks on other issues. The ultimatum "is an absolute nonstarter" for the Iranians, said William Wulf, former president of the National Academy of Engineering, who led a delegation of scientists and engineers to Iran last October. Wulf said that every government official he spoke with, including former president Mohammad Khatami, insisted that Iran isn't interested in nuclear weapons. One source said that Iranian leaders are very interested in presumed Democratic presidential nominee Barack Obama, who has said he would be open to bilateral talks without preconditions.

Having no diplomatic relations with Iran, the US has been channeling its communications with the country through the so-called five-plus-one nations—the five permanent United Nations (UN) Security Council member nations plus Germany. In June, after Richter had returned home, the six nations presented a package of incentives to Tehran, hoping to coax the suspension of uranium enrichment. At press time there were conflicting reports on the Iranian response to the incentives, but tensions were further heightened by Iran's test-launching of missiles capable of reaching Israel and bellicose statements issued from the two nations.


SLAC

Richter

A delegation of seven American earthquake experts did not meet with government officials during a June trip to Iran. The six-day visit included a workshop, hosted by Tehran's Sharif University of Technology, that focused on upgrading the earthquake resistance of Iran's largely adobe and unreinforced masonry building stock. Especially urgent, according to William Anderson, a National Academies official who led the trip, are the tens of thousands of schools in Iran that need structural upgrades, a fact tragically underscored by the catastrophic quake in China's Sichuan Province just weeks before. With a population of 12 million, Tehran is among the most earthquake-vulnerable big cities in the world. Anderson said that although the national government has committed $4 billion to retrofitting buildings, progress has been slow, and the Iranians are hoping for technical assistance to accelerate the process. The US delegation also visited the city of Bam, site of a 2003 earthquake that killed approximately 30 000 people.

Iranians visit US

Last fall a group of 20 Iranian scientists traveled to the US to discuss with American colleagues the topic of foodborne diseases. Although the trip was organized by the National Academies, the State Department took care of the domestic travel and accommodation arrangements for the visitors. Following a three-day workshop in Washington, the Iranian scientists were shuttled to several laboratories and research centers around the country. One participant, Habib Bagheri, a chemistry professor at Sharif, said by e-mail that the program was "first-class" and "very fruitful for me." It wasn't the first US visit for Bagheri, who spent a sabbatical year at Purdue University, where his research resulted in two publications. "I believe scientific relationships could be very important for the two nations and hope that they will be continued," he said.

Maryam Sanaei, a researcher at the Shaheed Beheshti University of Medical Sciences in Tehran, said that although she was disappointed the workshop didn't touch on her particular research topic, she was impressed by the prosperity of the country and its research institutions, and added, "I wish I were in your land again; thank God and your government for this opportunity." Hosein Dabiri, also of Shaheed Beheshti, said he and his colleagues have been trying to establish ongoing collaborations with US scientists, but they have been unable so far to get a response. He lamented that even educated Americans view Iran "more badly than it is."

Wulf went to Tehran last fall with a goal of broadening bilateral scientific collaborations. He said such cooperative arrangements have been encouraged by the State Department as a "backdoor channel of communication" between the two governments. The American delegation, which included Nobel physicist Joseph Taylor of Princeton University, was asked by Iran's vice president for science Sadegh Vaez-Zadeh to cooperate with Iranian colleagues in monitoring and deterring harmful applications of science. In response, a bilateral effort to be initiated next year will look for misuses of nanotechnology, cybertechnology, biological research, and other scientific applications. Separately, the National Academies and Sharif will initiate an exchange of science policy experts later this year or early next year, Schweitzer said.

Warm reception

Despite escalating US–Iranian political tensions, Richter, Wulf, and others all reported warm receptions from faculty, students, and the general population. Wulf, who first visited Tehran in 2000, said he was curious to see if Iranian attitudes toward Americans had turned negative after seven years. He found

they hadn't: "We were welcomed then, and we are welcomed now." Taylor was "treated like a rock star," he said, with 1400 students packing into a room with only 400 seats to hear his lecture.

"Scientists and engineers share a set of values that is independent of culture," Wulf remarked. That is particularly true at Sharif, he added, where 80% of faculty members were educated in the US.

Richter saw no evidence of the military or of an overbearing religious presence in either of the two cities he visited. He added that the country appeared to be prospering despite economic sanctions, although there was some evidence that the most recent round of UN-imposed sanctions might be beginning to pinch. Anderson said that he and his fellow travelers had steeled themselves for a possible hostile reaction from Iranians, but their hosts "couldn't have been more cooperative and friendly."

While at Sharif, Richter participated with top Iranian officials from the energy and environmental fields in a public roundtable discussion on those topics. He observed that from an economic perspective, it makes sense for Iran to adopt nuclear energy for its domestic electricity needs and to sell its abundant oil to the world market. Richter also was interested to learn that Iran had witnessed a 1 °C rise in its minimum annual temperature since 1950. With a climate similar to California's, the nation has counted on the winter snowpack from the mountains to meet its water needs during the warm months. Aware of the change looming if snow turns to rain, Iran is now planning to erect more dams, he said.

As for physics, Richter found a strong theory program in particle physics, particularly in string theory. (See the Opinion piece on physics in Iran, PHYSICS TODAY, May 2008, page 51.) Experimentally, Iranians are participating in the Compact Muon Solenoid collaboration at CERN's Large Hadron Collider and have a cosmic-ray program. A 3-meter telescope is also under construction.

David Kramer

Low-drag suit propels swimmers

Competition in the pool at this month's Beijing Olympics will be not only among world-class swimmers but also their swimsuits. Since its debut in February, the low-drag hydrophobic Fastskin LZR Racer swimsuit from Speedo International Ltd has had more than 44 world records broken in it; critics allege that the $600 "space-age" suit, in part developed by NASA scientists, gives its wearers an unfair boost in buoyancy and amounts to "technological doping." The company claims a 5% decrease in drag over the previous model but no buoyancy increase, and the suit, along with competing models, has been approved for Olympic competition by FINA, the international swimming federation.

The LZR Racer is a descendant of the full-body swimsuit Speedo introduced in 2000 to mimic the viscous-drag-reducing denticles on a shark's skin. The shark suit proved that surface-engineered synthetic materials can be made to have lower drag than a swimmer's shaved skin. The next move for Speedo's internal R&D unit was to form a team of external partners led by Barry Bixler, the late Honeywell Corp engineer and computational fluid dynamics (CFD) expert, to further cut the passive drag. (See the figure on page 33 and Back Scatter on page 84.)

NASA aerospace engineer Stephen Wilkinson joined the team in 2005 after Bixler suggested that NASA's aerodynamic testing of materials would provide valuable data for CFD simulations used to model the fluid flow profile around the swimmer–swimsuit system. Wilkinson measured the skin-friction coefficient of more than 60 fabrics in a low-speed wind tunnel with a cross section of 18 × 28 cm at the Langley Research Center's flow physics and control branch. The results led Speedo to go with lightweight woven elastane-nylon as the base fabric of the LZR Racer.

With the new suit, Speedo abandoned denticles and turned its focus to minimizing form drag, which is due to body shape. "There is still debate as to what the primary source of drag is for a shark, but for a swimmer, it is primarily form drag," says Amy Lang, an experimental fluid dynamicist at the University of Alabama. From CFD simulations and studies in a swimming flume, the researchers determined that total drag is reduced when low-drag polyurethane panels are inserted to compress the chest, upper thighs, and other areas of the swimmer's body where form drag is most pronounced. "We spent a lot of time [on the previous model] drag testing anatomically accurate mannequins" in the flume, says David Pease, a biomechanist at the University of Otago in New Zealand. "This time around involved quite a bit more actual athlete testing in order to test differences in compression and support provided by the new suit."

The Olympic-ready design of the swimsuit is based on three-dimensional volumetric body scans of some 400 elite swimmers and the results of tests with prototypes at the Australian Institute of Sport. Instead of being stitched together, the various segments of the swimsuit are bonded by ultrasonic acoustic vibrations—a first for swimwear. "It's a complicated process to produce a fast swimsuit and that's why it took [nearly] four years to produce the LZR Racer," says Jason Rance, Speedo's head of innovation.

Speedo's external CFD expert, University of Nottingham fluid mechanist Hervé Morvan, says that the company's R&D collaboration is already looking to reduce active drag in preparation for the 2012 London Olympics. FINA will no doubt face mounting pressure to address advances in swimwear innovation. Some competitive swimming enthusiasts wonder whether the sport is becoming more like drag racing or golf, in which equipment is often as important as human skill, while skeptics say drag-reducing technologies offer at best

NASA LANGLEY/SEAN SMITH

A wind tunnel is used by NASA engineer Stephen Wilkinson to test skin-friction properties of fabrics for swimsuits.