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The U of M's Theoretical Physics Institute is light-years from their homeland. But then these world-class Russian scientists are accustomed to operating in a universe of their own.

Worlds Apart

BY JELENA PETROVIC
PHOTOGRAPHY BY JOHN LINN

On a balmy Saturday afternoon Boris Shklovskii, director of the Theoretical Physics Institute at the University of Minnesota, stands before the blackboard in his neon-lit office, drawing diagrams resembling beaded necklaces and talking urgently in a blend of scientific jargon and everyday metaphor.

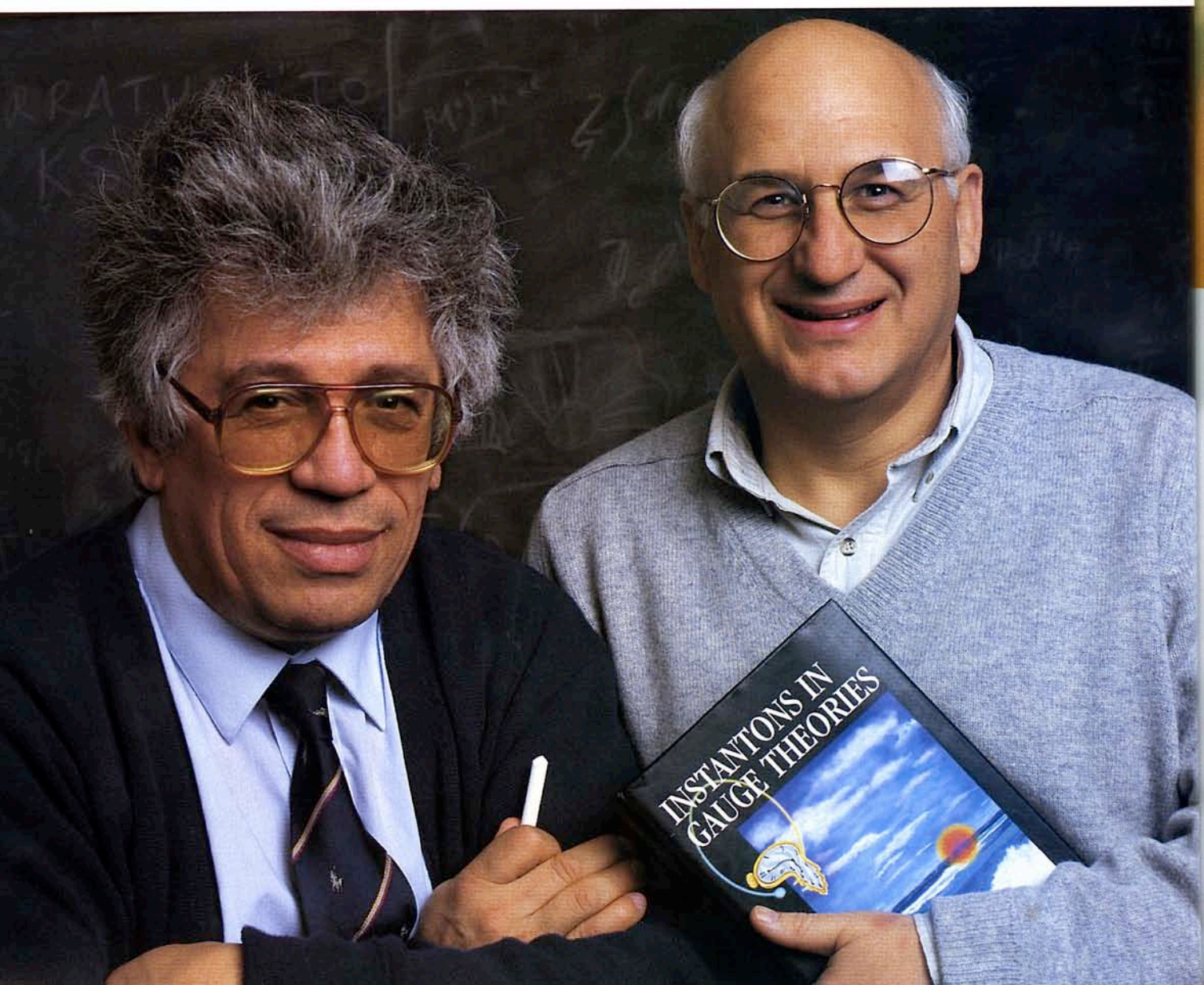
"Now we should add to this salad quite a bit of quantum mechanics," he says with a grin that suggests

that the highly abstract concoction he is explaining might be truly delectable. Then he erases the board and switches to bedtime-story spookiness. "OK, so these guys and their little brothers attract each other from a large distance. It's a little bit like me telling you that my head is in Chicago while I am here talking to you." Shklovskii emits a high-pitched giggle. Physics ought to be fun, he seems to be saying, even—perhaps *especially*—when discussing the fractional quantum Hall effect with outsiders.

The occasion is a one-day conference titled "The Need to Understand," and it features speakers from the University of Chicago, Columbia University, and other eminent institutions addressing such strangely poetic topics as "Flavor Symmetry and Heavy Meson Decay" and "Speculations about Cosmic Gamma-ray Bursts." The offices of Minnesota's TPI are in fact teeming with theoretical physicists who chat over coffee and cookies before heading to one of the day's dozen lectures. The mood is far less serious than the subjects under scrutiny. At one of the nation's top physics think tanks, it seems that rarefied scholarship and a good-humored, quirky brotherhood peacefully coexist.

Think theoretical physicist and you may picture a nearsighted fellow with several pens in a pocket protector and only a tenuous relationship with the rest of the world—a quintessential nerd who operates in a heady realm of formulas and diagrams, offers no "product," and seems indifferent to society's day-to-day concerns. The truth, of course, is more complicated. At TPI, which is home to eight world-class theoretical physicists, the universe is indeed perceived in terms of waves, particles, and fields, yet the kind of research conducted here is of immeasurable importance to the rest of us. The next time you're browsing the Web or having your groceries scanned at a supermarket checkout, keep in mind that both technologies derive from theoretical-physics research. In 1948, when the transistor was invented by three Bell Laboratories physicists, few imagined that the device would become a basic building block of the computer age. Discover-

Defining their fields: Mikhail Shifman (left) and Arkady Vainshtein, like their TPI colleagues, are winners of major international physics prizes.



Theoretically speaking: Leonid Glazman, TPI's youngest Russian theorist, appreciates local rules of debate: "You don't interrupt, you don't insult. . . . "

ies made through physics research are so much a part of our everyday lives that we simply take them for granted.

In the world of fundamental-science research institutes, TPI is, for its part, something of an oddity. While most such organizations are large, National Science Foundation–funded enterprises, Minnesota's TPI was created in large part out of the generosity of a single private donor, and it is dedicated to the research efforts of its members. Though it's part of the university, it operates independently of administrative mandates, meaning that its physicists have the freedom to explore the frontiers of science in whichever direction they please. Perhaps most intriguing of all, TPI is an oasis of Russian culture in the American heartland: Six of its eight physicists have come from the former Soviet Union.

Actually, "oasis" describes TPI in more ways than one. Ensconced on the top floor of the U of M's Physics and Astronomy Building on the Minneapolis campus, the institute has the feel of a safe haven. It is a plushly carpeted, pleasantly lit string of offices and common spaces free of the usual undergraduate traffic and, most of the time, resonantly peaceful. Muted English and Russian conversation and the *clik-clik* of chalk dancing across a blackboard reach a visitor through partially open doors. Occasionally, a high-volume dispute erupts, usually followed by peals of hearty laughter.

The TPI theorists themselves will probably not be confused with car salesmen or interior decorators, but they may not be what you expected either. They dress casually in sweaters and slacks, sport somewhat unruly hairdos, and seem only slightly less interested in pedestrian details than your next-door neighbor. They may also be friendlier and more down-to-earth than you'd expect of internationally renowned scholars engaged in deciphering the fundamental truths of the universe. Their affability does not disguise the fact, however, that they are passionate about their calling in a manner that suggests artistic devotion. Boris Shklovskii, a leader in the field of disordered systems (the study of solids whose constituent particles are arranged randomly rather than in a regular, repeating lattice structure), is a bespectacled man in his mid-fifties with intense blue eyes and bushy eyebrows. "Without emotions you can't do anything creative," he insists. "You can only do mechanical work. With age you learn how to control your emotions and how to use them, but without them you can't do anything."

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Not surprisingly, Shklovskii says he decided to become a physicist at about the age of twelve, when he would "get excited at the thought of solving a problem."

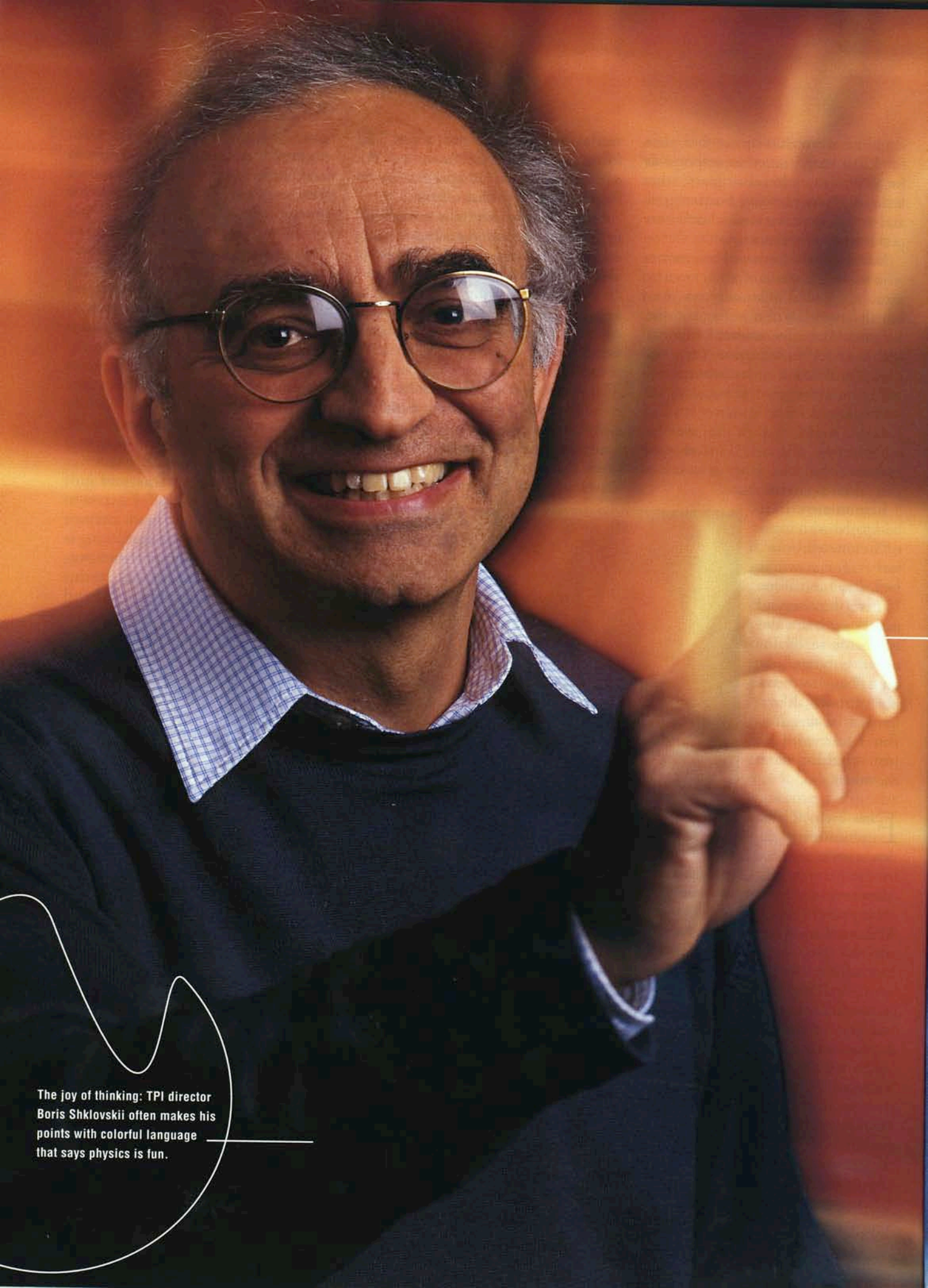
It's midquarter at the University of Minnesota. By three o'clock on a weekday afternoon the large common space in front of TPI secretary Jennifer Curtis's desk is crowded with physicists, graduate students, and foreign visitors. Someone needs help interpreting directions on the laser printer, someone is animatedly debating something in Russian with a friend. Someone else needs a Russian text translated into English. Shklovskii, en route to a weekly departmental seminar, grabs a cup of coffee and exchanges a word or two with a colleague. As is the case with the rest of the TPI scholars, Shklovskii's time is spread thin between research, teaching, lecturing, writing papers, and travel—all of that in addition to his institute director's duties.

Shklovskii came to TPI ten years ago, leaving his post as principal researcher at the Ioffe Institute in Leningrad (now St. Petersburg). His contract with the U of M was originally for three years only, but after the Soviet Union disintegrated in the summer of 1991, he decided to stay in Minnesota and eventually became an American citizen. His wife, Marina, and sons Dimitri, thirty, and Leo, sixteen, joined him here and also became U.S. citizens. Though he was a distinguished scientist in his homeland, Shklovskii had not traveled to the West until 1988, when Gorbachev's liberalizing perestroika policies made foreign trips easier. "I am Jewish and I wasn't a member of the [Communist] party," he explains. "Therefore, I could never get permission to travel. The [party] didn't want me, because I'm Jewish, but I had no interest in joining either."

To American ears, it may sound strange that an eminent scientist's career would depend on the caprice of bureaucrats. Yet the reality of life in the former Soviet Union, even after perestroika, was often a harrowing experience. Joining the Communist party usually made life easier, helping secure passports and reducing the wait for apartments, cars, jobs, bank loans, and food. Party membership was tempting to many, but Shklovskii never considered it. His choice of profession, after all, had a lot to do with his belief in intellectual freedom. "There weren't many options in Russia," he says. "If you wanted to have a free mind, you could be a scientist or a musician. I chose to be a physicist."

Other Russians at TPI echo Shklovskii's tale. Leonid Glazman, a highly respected researcher in the field of mesoscopic structures (the study of the electrical properties of very small metal structures) and also a Jew, had similar experiences working at the Solid State Physics Institute outside Moscow. "For Jews, getting into reasonable institutions was a problem—a *big* problem," Glazman tells a visitor. "The level of anti-Semitism varied, but there were some particularly rough times. After 1968 and the Prague Spring, things got worse in Russia. People weren't dying in camps, but, if you were Jewish, jobs were hard to get. Getting into a good university was even harder for a Jew. When I was a Ph.D. student and looking for a job, it was plainly stated to me, 'We are able to employ only one Jew.' The head of the physics department told me that, and he personally liked me."

A boyish forty-one, Glazman is the youngest theorist on the TPI staff. Despite his great size—he stands six-foot-six—there is an aura of gentle innocence about him that you imagine would draw children to his enormous arms. He now lives in Hopkins. His mother, stepfather, and eight-year-old son live in the area (he is divorced). He's an agile and articulate talker, even in his adopted English. He arrived in Minnesota in 1990, and while he'd had the chance to travel outside Russia, he'd done so only the year before to Sweden, to the Chalmers University of Technology. "You know, Sweden is a socialist country, but the trip was an eye-opener for me," Glazman says. "In some sense, the Swedes got what we Soviets were



The joy of thinking: TPI director Boris Shklovskii often makes his points with colorful language that says physics is fun.

year, *two* years, and publish a short paper. Some of these papers are classics now."

TPI's founding, more than twelve years ago, was largely the work of a U of M physics professor and a Twin Cities real-estate developer.

In 1983, Stephen Gasiorowicz, now professor emeritus, met the developer, William Fine, at a friend's party and was impressed by Fine's knowledge of current trends in physics. The two men met again some months later, at the funeral of another friend they had in common. Fine, a self-described physics fanatic, said he was interested in contributing money to the science and asked Gasiorowicz for advice. "I talked to some people and we came up with the idea of starting a theoretical-physics institute," Gasiorowicz recalls. "Bill got very excited about that."

It was a fresh and exciting idea, but one that would prove difficult to realize. The university's administration was hesitant to approve a large initiative in the pure sciences. The tepid response and bureaucratic runaround that followed so frustrated Fine that he considered taking his money elsewhere. "I went to a lecture at Harvard by the Nobel laureate Sheldon Glashow and I told him of my interest," says Fine, managing partner of Fine Associates in Minneapolis. "I got a letter from [Glashow] saying, 'Why don't you do it at Harvard?' I showed copies of our correspondence to Steve and several other people. They got the impression that I was serious and that I had reasons to be serious."

By 1986, prospects for a local TPI had begun to improve. With encouragement from Charles Campbell, who was then the outgoing head of the U of M's School of Physics and Astronomy, and Campbell's successor, Marvin Marshak, then university president Ken Keller accepted the merits of the idea. Though the output of a theoretical research institute is rarely measurable in terms of direct economic impact, Keller acknowledged with his approval that providing a workplace for great minds is an integral part of the job of a major university. Accordingly, the university agreed to match Fine's $2 million gift and to contribute ongoing funds for the institute. (Today, using state and Department of Energy monies, earnings on the endowment created by Fine's gift, and new dollars brought in by TPI members via the National Science Foundation, TPI's annual budget is about $1 million.)

With Gasiorowicz as acting director, TPI officially opened in January 1987. Two years later and in unusually short order, five exceptional physicists were recruited from the Soviet Union. Gasiorowicz attributes the Russians' availability to perestroika and the breakdown of the USSR's historic isolation. Larry McLerran—TPI's first permanent director and currently one of its five elementary-particle theorists—"had been traveling to Russia at least once a year and had worked with people from there," Gasiorowicz explains. "He personally knew the people who finally came. Within a rather short time we had recruited six members. One was American, five were Russian, and they were all absolutely first-class scientists." TPI currently has two American members—McLerran and Keith Olive, a newly appointed astrophysicist. Besides Shklovskii, Glazman, and Shifman, the Russian members are Arkady Vainshtein, Anatoly Larkin, and Mikhail Voloshin. The group's all-male roster reflects the general condition worldwide: The overwhelming majority of physicists are men.

The status of TPI's theorists is reflected in their honors and prizes. Glazman, Shklovskii, and Shifman all were elected fellows of the American Physical Society in the past year. Shklovskii has received the prestigious Landau Prize, named after Nobel laureate Lev Landau, one of the century's most famous theoretical physicists. This year, Vainshtein and Shifman were awarded the J. J. Sakurai Prize, presented by the American Physical Society and one of the highest honors a physicist can receive. Larkin is a winner of the London Medal for Low Temperature Physics and "an amazing, internationally famous theorist," according to Allen Goldman, current head of Minnesota's School of Physics

and Astronomy. "Vainshtein and Shklovskii are not that far behind in their level of distinction and fame, and Glazman is a leader in mesoscopic structures.

"These people are truly leaders in their fields," Goldman says. "In some cases, they *define* their fields."

It's five p.m., and TPI's support staff have left for the day. In their separate offices, Glazman, Shifman, and Shklovskii sit at their desks, quietly working beneath the glow of fluorescent lights.

Shklovskii has been struggling with a perplexing problem in disordered systems, and he returns to it this evening with the hope of making some headway. The problem has been a personal obsession for the past ten years, and some days that hope is hard to muster. "I have a hunch that this phenomenon exists," he says, referring to his suspicion that localized electrons in superconductors have a way of conducting energy, even though they can't conduct current. "But I always see difficulties I cannot work out." Next door, his hands pressed tightly against his ears and his torso hunched over his desk, Shifman works on the speech he will give when accepting the Sakurai Prize. There is a large window facing the grassy quad in front of him, and he looks up periodically, contemplating his eventful career and trying to convert it to describable terms. Across the hall, Glazman rises (his head nearly reaching the ceiling), stands in front of his blackboard, and ponders a mathematical calculation for a problem he's working on with a former student. He prefers performing such calculations in the company of a colleague, but the after-hour silence today sharpens his focus and he persists by himself. In a few hours, the three men will head home to their families. For the time being, however, they are each absorbed in a world of quarks, conductivity, and other concerns unknown—perhaps unknowable—to most of the rest of the world.

Having spent the past several years in the United States, the three men (and their Russian colleagues) live somewhere on the border between their native culture and their adopted one. Their English is fluid and rich, their wardrobes are casually up-to-date, and they seem at ease with the American work culture. Nonetheless, with their accents and their preference for classical music and hiking over Garth Brooks and the Minnesota Twins, they remain unmistakably Russian—or at least foreign. They are aware of the dichotomy and reflect on it with a mixture of curiosity, frustration, and acceptance.

Shifman, for instance, acknowledges that doing research in the United States is remarkably easy, yet he says the American system puts too much pressure on "production." "Life is very smooth in the U.S.," he says. "It's probably the best place for an outsider to settle in terms of conditions for working. Whatever I need done, it's done immediately. If I need a new computer, I get a new computer. If I need to travel, I can travel. But here there is more pressure to produce papers and more pressure to work on hot topics. The fashion of the day plays a much more significant role in science here. And because of this pressure, people sometimes choose easy topics instead of the difficult, interesting ones."

Shklovskii notes a significant difference in the way physicists interact with one another in America. "In Russia, our seminars lasted for many hours," he says. "They continued at night until we found the truth. We would fight to death. Here, there are no arguments. People don't like [to argue]. It's very polite." And, true enough, it's hard to imagine Shklovskii or Shifman leaping at a colleague over the accuracy of a mathematical calculation; yet they have been known to raise their voices in seminars and discussions among themselves. Jennifer Curtis attributes such outbursts to the Russian temperament. "From talking to non-Russian scientists who have visited TPI, I gather that the style of debate is totally Russian here," Curtis says. "You have to be aware when you come here that at the end of your talk there might be a shouting match and you'll have to explain all kinds of contradictions. Somebody plays the dev-

il's advocate at every seminar.

"It's not something Americans are used to," she adds. "They are also not used to the emotional involvement—the fact that voices will be raised. Americans don't yell at each other unless they're angry, especially not in the Midwest."

For some of the physicists themselves, however, the so-called "Russian temperament" is something of a stereotype and can be an excuse for argumentative excess. "Culture changes from country to country," says Glazman, "but it changes very strongly from person to person. There are differences between individuals here as well as in Russia. As everywhere, all types exist—good scientists, jerks, et cetera." Glazman, for his part, credits his adopted country with a more sensible approach to disagreement and values the fact that "in this society, people are taught at an early age the culture of argument—you don't interrupt, you wait your turn, you don't insult people."

A balance between such different cultures may seem a difficult one to strike, particularly when most of your time is spent in an ivory tower. Nevertheless, Glazman, Shklovskii, and Shifman all say they have found an equilibrium that works for them, having realized perhaps that there's no single model for bicultural happiness. All three speak excellent English, but choose to communicate with each other in Russian. They travel all over the world ("I am compensating for the first forty years of my life," Shifman says), but spend most of their time with each other, their families, and a tight circle of mostly Russian friends. They are not big consumers of popular entertainment and spend what little leisure time they have enjoying jazz records, old movies, and the northern Minnesota wilderness.

They are Russian born and bred. But they are also American by choice and law. Above all, however, they are scientists whose field, they will tell you, knows no bounds. ■

Jelena Petrovic is a Minneapolis freelance writer and choreographer who wrote about the dancer's life in last November's MPLS.ST.PAUL Magazine.