In February, before the invasion of Ukraine, Russian President Vladimir Putin (left) met with German Chancellor Olaf Scholz. Germany has led sanctions that isolate Russia.

PHOTO: AP PHOTO/MIKHAIL KLIMENTYEV/SPUTNIK/KREMLIN POOL PHOTO

SCIENCE DIPLOMACY

Science ties to Russia cut after Ukraine invasion

Institutions struggle to remain neutral as Western nations take hardline stances

By **Richard Stone**

In 2011, Russia signed a deal that would pay the Massachusetts Institute of Technology (MIT) $300 million to help found the Skolkovo Institute of Science and Technology (Skoltech), an English-language research university on the outskirts of Moscow. Dozens of researchers from around the world leaped at the chance for a foreign assignment, which they thought would help mend lingering rifts from the Soviet era, while boosting innovation in a place aspiring to be Russia's Silicon Valley. "It was a very exciting time," says Ed Seidel, a computer scientist and current president of the University of Wyoming, who was tasked with building up Skoltech's research capacity.

Citing "the Russian government's violent invasion of a peaceful neighbor," MIT on 25 February dissolved its partnership with Skoltech, 1 day after President Vladimir Putin began a bloody war with Ukraine. The decision had a personal echo for MIT President L. Rafael Reif, who in a statement says his parents fled the western Ukraine-Moldova region on the eve of World War II. MIT's withdrawal only affects a handful of faculty and students, but it will still be an enormous loss of prestige, says Skoltech Provost Keith Stevenson, an electrochemist who moved to Russia from the University of Texas, Austin, to establish a center for energy storage technology. "It's kind of like getting a divorce from someone you love," says Stevenson, who plans to stay in Russia. "We'll have to think creatively how we can maintain morale."

A rising chorus is calling on the West to cut other ties with Russian science. The European Commission suspended Russia's participation in its flagship research program, Horizon Europe, and the national research councils of several European nations, including France, Germany, Italy, and the Netherlands, froze collaborations with Russia. "While there is a war and people are fighting, the only decision is to stop everything," says Augusto Marcelli, a physicist at Italy's National Institute of Nuclear Physics and adviser to Italy's Ministry of Foreign Affairs.

Science diplomacy veterans who spent careers forging ties with Russia agree. "It's important to be consistent in our policy toward Russia, which is to isolate and punish them. If there were high-level scientists in a position to influence decision-making, I would be more comfortable in making an argument to keep ties open," says Cathleen Campbell, former president of CRDF Global, a nonprofit that specializes in nuclear and bioweapons nonproliferation work in the former Soviet Union. "Why should we treat scientific exchanges any differently than Champions League soccer matches, ballet performances, financial transactions, and investment projects—which have all been canceled in recent days?" asks Alfred Watkins, chairman of the Global Solutions Summit and a former World Bank official who led science capacity-building projects in Russia and Ukraine.

Other science organizations have resisted being drawn into what they see as a political minefield. Last week, for example, the International Astronomical Union rejected a petition from Ukrainian astronomers to ban Russian astronomers from IAU activities. "That would definitely be making a political statement, which the IAU cannot do," IAU President Debra Elmegreen wrote in a 1 March email to Yaroslav Yatskiv, president of the Ukrainian Astronomy Association. "The IAU was founded right after WWI [World War I] in order to bring

colleagues together, so we do not wish to drive them apart by deciding whom to support based on what their governments are doing." And the experimental ITER fusion reactor in France has no plans at present to expel Russia, which is a full member of one of the world's biggest science collaborations. "ITER is a child of the Cold War and is deliberately nonaligned," says ITER spokesperson Laban Coblentz.

Universities UK, which represents the nation's vice chancellors, advised its members to review collaborations with Russia on a case-by-case basis. "We do not support a blanket boycott," it said in a statement. Although Germany is taking a hardline stance, cutting off funding for supported researchers in Russia, Peter-André Alt, president of the German Rectors' Conference, encouraged scientists to keep informal channels open. He notes that many scientists in Russia have spoken out against the war—at least until last week, when Russia passed a law that threatens jail time for anyone departing from Russia's characterization of the assault on Ukraine as a "special military operation." "We want to support these colleagues," Alt says.

CERN, the world's largest particle physics laboratory, in Switzerland, has long prided itself as an East-West crossroads. "One of CERN's mottos is 'science for peace,'" says John Ellis, a theoretical physicist from King's College London who works at CERN and was on the lab's staff for more than 40 years. He notes that CERN did not expel Russian scientists when the Soviet Union invaded Czechoslovakia in 1968 or Afghanistan in 1979. "My personal attitude is that we should really strive to maintain that collaboration, if it's all politically possible."

The governing CERN Council appears to be walking a fine line. In a special session on 8 March, representatives from the lab's 23 member states voted to suspend Russia's "observer" status and barred its representatives from auditing the council's deliberations. But it did not expel the more than 1000 Russian scientists who make up roughly 8% of CERN's international users. In a statement, the council says it will continue to monitor the situation and "is ready to take further measures as appropriate."

Many Ukrainian scientists excoriate Western colleagues for attempting to remain neutral. Civilian deaths are mounting after Russia shifted its strategy and amped up indiscriminate shelling of civilian targets. "We need help in the isolation of Russia and Russian people from the world," says Sergiy Ryabchenko of Ukraine's Institute of Physics. "And we need more weapons."

"We are calling on the world scientific community to immediately stop the bloodshed and barbaric destruction of a civilized European country," says Anatoly Zagorodny, president of the National Academy of Sciences of Ukraine. "Do not leave us alone facing the brutal aggressor." Western institutions must take a stand, says global security expert Gerson Sher, who led early efforts to engage Russian scientists after the Soviet breakup in 1991. "It's a moral issue, and silence is not an option."

Conditions in Kyiv and other besieged cities are rapidly deteriorating. Last week, missile fragments damaged a pipeline that provides heat and hot water to central Kyiv where Sergei Mosyakin, director of the Institute of Botany, resides. "I do not care much because I'm rather cold-resistant," he says. Rather, he worries how it will affect the elderly and young children.

Mosyakin says many of his colleagues have taken up arms to defend their homes. Others have sought refuge abroad. Irina Belskaya, an expert on asteroids and comets at V.N. Karazin Kharkiv National University, reached Poland, she says, thanks to help from colleagues at the Poznań Observatory. Some are seeking sanctuary for their scientific prizes: Entomologist Valery Korneyev of the I.I. Schmalhausen Institute of Zoology in Kyiv was trying to get to Berlin with two plastic duffels stuffed with type specimens. "Keeping my fingers crossed," he says.

Other Ukrainian scientists have yet to escape the war zone. "I have no strength to stand for hours and hours at the train station," says Irina Yehorchenko, a mathematical physicist at the Institute of Mathematics who has spent her days shuttling between a bomb shelter and her Kyiv apartment. She hopes to join a humanitarian convoy bound for Lviv, in western Ukraine.

Labs in Europe, the United States, and elsewhere are throwing open their doors. Taras Oleksyk, a Ukrainian evolutionary biologist at Oakland University in Michigan, and colleagues have compiled a list of more than 1000 labs willing to host refugee scientists. The Polish Young Academy, part of the Polish Academy of Sciences (PAN), has already found accommodations and jobs for dozens of Ukrainian researchers, says Jacek Kolanowski of PAN's Institute of Bioorganic Chemistry. "I think in the upcoming weeks we will have a logarithmic rise in requests," he says.

On 5 March, Ukrainians fleeing Kyiv crowd under a destroyed bridge over the Irpin River.

PHOTO: AP PHOTO/EMILIO MORENATTI

Russian scientists will be among the refugees. Rumors are swirling that Putin will declare martial law and close borders. Some Russian scientists who oppose the war are fleeing before a new Iron Curtain traps them. "They leave in fear of what is coming," says Igor Krichever, a Russian American mathematician at Columbia University who has spent several months each year in Moscow as the head of Skoltech's Center for Advanced Studies and is one of more than 500 Russian mathematicians who signed an open letter denouncing the invasion.

But room for dissent is disappearing in Russia. Last week, it expunged the last ves-

tiges of its free press. And the leaders of nearly 200 Russian universities have come out staunchly in support of the war. In a signed statement posted to the website of the Russian Union of Rectors on 4 March, the leaders commended Putin's decision to "achieve the demilitarization and denazification of Ukraine." The nation's premier nuclear research center, the Kurchatov Institute, which helped Ukraine deal with the aftermath of the Chernobyl disaster, posted a similarly prowar statement to its website on 7 March.

The U.S. government was among the leaders in enacting financial sanctions on Russia and slapping new limits on technology transfers. Still, a governmentwide policy on cooperation with Russia on R&D has yet to be publicly issued.

Some decisions couldn't wait for a directive. The U.S. National Oceanic and Atmospheric Administration (NOAA) intervened in an ongoing expedition with Canada and Russia to better understand salmon ecology in the North Pacific Ocean, where salmon congregate before spawning in rivers in all three countries. A U.S. scientist was supposed to travel on the Russian vessel *Tinro*, but on 24 February, NOAA forbade the scientist from boarding the ship. And last week, Eric Regehr, a University of Washington, Seattle, biologist, abandoned plans to join Russian researchers on remote Wrangel Island in an annual campaign, supported by the U.S. Fish and Wildlife Service, to study polar bear migrations from Alaska to Siberia. "There's no way," Regehr says. "The idea of it being legal and safe and practical to go over there is zero."

Skoltech has survived previous rough patches. In 2014, Russia annexed Crimea, and later that year, Russian-backed separatists shot down a Malaysia Airlines flight over eastern Ukraine. The Dutch director of Skoltech's stem cell research center knew someone who died in the crash and resigned. Skoltech "persevered," Seidel says. But he fears this time it's different. He's already shelved an idea for a partnership he was exploring with a Skoltech colleague.

Skoltech hopes an infusion of young Russian talent will help overcome its impending isolation: Last week, it invited transfer applications from overseas Russian graduate students facing blowback from the war overseas. But so long as Russia remains a pariah, Skoltech will be crippled, Seidel says. "It leaves me heartbroken. I don't know how they'll recover from this." ■

With reporting from Edwin Cartlidge, Adrian Cho, Daniel Clery, Warren Cornwall, Andrew Curry, and Jeffrey Mervis.

Rocks at the foot of Hiawatha Glacier contained shocked zircon crystals that revealed the impact's age.

EARTH SCIENCE

Impact crater under Greenland's ice is surprisingly ancient

New date of 58 million years undercuts idea that strike triggered recent Younger Dryas climate cooling

By **Paul Voosen**

In 2018, an international team of scientists announced a startling discovery: Buried beneath the thick ice of the Hiawatha Glacier in northwest Greenland is an impact crater 31 kilometers wide—not as big as the crater from the dinosaur-killing impact 66 million years ago, but perhaps still big enough to mess with the climate. Scientists were especially excited by hints in the crater and the surrounding ice that the Hiawatha strike was recent—perhaps within the past 100,000 years, when humans might have been around to witness it.

But now, using dates gleaned from tiny mineral crystals in rocks shocked by the impact, the same team says the strike is much, much older. The researchers say it occurred 58 million years ago, a warm time when vast forests covered Greenland—and humanity was not yet even a glimmer in evolution's eye. Kurt Kjær, a geologist at the Natural History Museum of Denmark and a co-author of the new study, says the new date is at odds with the team's initial impression, gleaned from ice-penetrating radar. "But this is the way science works and should work," he says.

The date is a blow to a group of scientists that for more than a decade has advanced a controversial hypothesis that the Younger Dryas, a drastic, 1000-year cooling about 12,800 years ago, was triggered when a comet struck Earth. They had seized on the first Hiawatha paper as a smoking gun: The crater seemed about the right age, and it was in the right place—near a region of the North Atlantic Ocean that heavily influences Northern Hemisphere climate. Now, says Brandon Johnson, a co-author and impact modeler at Purdue University, West Lafayette, "It's probably safe to put the Younger Dryas impact hypothesis back to rest for a while."

James Kennett, a marine geologist at the University of California, Santa Barbara, and a leading Younger Dryas impact advocate, says the older date for the crater is a surprise, but Kjær's team "makes a very compelling case ... I don't think it's related to the Younger Dryas now." That leaves his group where it was before the discovery of Hiawatha: arguing the Younger Dryas trigger was an airburst rather than a body slamming into the ground. Kennett says the team will continue to advance its case with evidence from more than 40 sites worldwide that contain glassy spherules or platinum-rich sediments, which the group believes are indicative of an impact. "It's all alive and well and very active."

Kjær's team originally thought dating the impact would be impossible without drilling through 1 kilometer or so of ice to sample rocks in the center of the crater. The radar data, however, yielded clues to what seemed to be a young age: reflections indicating ice layers older than 11,700 years are deformed, hinting at an impact around that time.

But in 2019, the team got a chance to date

PHOTO: PIERRE BECK