



A building at Kharkiv National University, damaged by shelling, Kharkiv, Ukraine.

REUTERS/O. Lapshyn

## SPECIAL REPORT

# Ukraine: Kharkiv Stories

Scientists with ties to a vital Ukrainian scientific and industrial center talked with OPN about what the war has meant thus far—and what the future might hold.

Stewart Wills

**S**oon after the Russian invasion of Ukraine began on 24 February 2022, the city of Kharkiv—Ukraine’s second-largest municipality, situated in its northeastern region a mere 40 km from the Russian border—emerged as a key strategic target. A significant industrial, commercial and cultural center, Kharkiv also is a hub of Ukrainian education and scientific research, with dozens of universities, technical and professional schools, and research institutions.

Kharkiv’s experience in the war’s wrenching early months thus offers a window into the conflict’s impact on members of Ukraine’s research community and on its

scientific prospects. To learn more, OPN talked in April and early May with several scientists with ties to the Kharkiv area—both persons in the country struggling with the war’s disruptions, and expatriate Ukrainian scientists anxiously tracking the conflict from outside.

## Before the invasion

For those in other countries looking at coverage of the current conflict, it is easy to forget that Ukraine and Russia have been at war for eight years. The war commenced in February 2014, in the wake of the Ukrainian Revolution of Dignity and the Russian annexation of

Crimea. According to a United Nations report, it had cost more than 14,000 lives by the end of 2021. But before the February 2022 Russian invasion, the conflict had been limited largely to Ukraine's Donetsk and Luhansk oblasts (administrative regions)—collectively known as the Donbas—in the country's extreme southeast. Day-to-day life elsewhere in Ukraine was largely unaffected.

That was true even in Kharkiv, a mere 150 km from the border with the Luhansk oblast. "When the war started in 2014, in Kharkiv, nothing changed," according to Nataliia Mysko-Krutik, an Optica Ambassador and a research scientist at the Verkin Institute for Low Temperature Physics and Engineering in the city. Indeed, she told OPN in April, "life before the [2022 invasion] in Kharkiv was amazing. Because Kharkiv is a 'student city' ... a very 'young' city," owing to its high concentration of the country's universities, medical and technical schools and research institutes.

Mysko-Krutik herself had wrapped up her Ph.D. study in 2020, and was working at the Verkin Institute, where she also serves as chair of the institute's chapter of the Ukraine Council of Young Scientists. "It was a typical life, a normal life," she said.

Mysko-Krutik acknowledged that some people discussed the possibility of renewed war as Russian Federation forces gathered along the Russia-Ukraine border in January 2022. But, she said, most didn't believe an invasion would come—or thought that if it did, it would remain limited to the Donbas. "We spoke about it sometimes," she said, "but we didn't believe" that Ukraine might soon see a wider war.

Gennadiy Khrypunov—a physicist, professor and vice rector at the National Technical University



“Life before the [2022 invasion] in Kharkiv was amazing. Because Kharkiv is a ‘student city’ ... a very ‘young’ city.”

—Nataliia Mysko-Krutik

“Kharkiv Polytechnic Institute” (KhPI), eastern Ukraine’s largest and oldest technical university—also recalled that, before 24 February, most Ukrainians, himself included, were skeptical regarding a potential invasion. “Of course, we knew about the concentration of Russian forces near our border,” he said, “but I was sure this was only political pressure on Ukraine.”

According to Khrypunov, one of the “few people” who believed that war was coming was his wife, who persuaded their son and daughter-in-law to abandon Kharkiv, leaving with them by car for western Ukraine only a few days before the Russian attack.

“For this,” he said, “I am very grateful to my wife.”

### The shelling begins

Khrypunov himself stayed behind in Kharkiv, and was at his university office when Russian shelling of the city began on the morning of 24 February. He remained at the school for nine days with several other university officials, sleeping in an educational building’s bomb shelter. “We did not go home,” he told OPN.

Early efforts focused on getting students out of Kharkiv. The KhPI rector, Evgeny Sokol, struck an agreement with schools in western Ukraine to admit KhPI students, and the staff organized their evacuation from student hostels. With public transit down and rail travel disorganized, students were told to board any train they could and to inform the faculty of where they were headed. The western Ukraine institutions were notified, and the students were met at their destinations and provided with room and board. Since then, Khrypunov said, they have continued their KhPI education online.



K. Andi / Getty Images

Aerial view of Kharkiv city center before the invasion.



Nataliia Mysko-Krutik, meanwhile, was away from Kharkiv when the initial attack came, and in Irpin, a suburb of Ukraine's capital, Kyiv. "My niece called me [from Kharkiv]" reporting the initial bombardment, and subsequently spent three days with other Kharkiv residents taking shelter in an underground metro station. "But in Irpin there was nothing." The morning seemed fine, and as usual, Mysko-Krutik went out to walk her dogs.

Within hours, however, Irpin itself was under attack, and the apartment building where she and her husband lived on the 18<sup>th</sup> floor began to shake. Her husband persuaded her, with some difficulty, that it was time to go. "I was crying," Mysko-Krutik told OPN. "My husband took me, and put me in a car and said, keep calm—and it didn't work." Eventually, after a harrowing journey that took her through temporary quarters in western Ukraine, Moldavia, Romania, Hungary, Slovakia and Poland, she was able to find a six-month position in the lab of a fellow Optica Ambassador, Clara Saraceno, at Ruhr-Universität Bochum in Germany.

**“When I called my mom, I heard these awful sounds of bombing. I can't even describe this feeling ... something unbelievable.”**

—*Mariia Pashchenko*

Mysko-Krutik put much of her energy into helping other women scientists, whom she knew from her leadership position in the Council of Young Scientists, to get out of Ukraine. "I asked all of them to get out, and now all of them are in Europe," she said, with positions in countries such as the Czech Republic, France and Poland. When OPN spoke with her, she was continuing efforts to find ways to bring Ukrainian students temporarily to the university where she works.

But women students only—at present, men between the ages of 18 and 60 cannot legally leave Ukraine, as they are subject to possible

mobilization in the war effort. As a result, Mysko-Krutik's husband did not accompany her to Germany, but was, at the time OPN spoke with her, staying with her 59-year-old father (and her dogs) in her hometown in the country's Dnipropetrovsk region. "He's sitting and waiting" for an opportunity to help, she said. "It is a big problem ... Men cannot get a salary and they cannot go to work. So they sit and wait."

"They are not taken to fight," said Mysko-Krutik. "They do not want just to sit, but to go and defend their country."

## Outside looking in

Anxiety about relatives and loved ones is an inevitable and devastating aspect of any war. Gennadiy Khrypunov said that, after the invasion's onset, he lost contact for 45 days with his mother-in-law, who lived in the city of Izium, around 120 km southeast of Kharkiv. Izium had begun to experience Russian rocket fire in early March and came under Russian occupation in April—with many living for weeks without heat, electricity or running water. When Khrypunov spoke with OPN, he had only recently learned that his mother-in-law was still alive.

While their experiences can't be compared with those actually in the country, Ukrainian scientists who have lived and worked for years in other countries have dealt with similar fears for those left behind. Optica Senior Member Svetlana Boriskina grew up in Kharkiv when it was still part of the Soviet Union and took her Ph.D. at Karazin Kharkiv National University in 1999; she now works as a principal research scientist at the Massachusetts Institute of Technology, USA. She told OPN that her parents, in Kharkiv, were

“under constant bombardment” during the war’s first two weeks.

“It was just terrifying,” Boriskina said. “I would be on the phone with them, and you can hear rockets—*zzz, boom; zzz, boom*. And you don’t know which one is going to hit their building.” Luckily, they were eventually able to evacuate and go to stay with Boriskina’s brother in France. She says her father and his colleagues from the Kharkiv Institute of Physics and Technology continue their research remotely despite being “scattered all over Ukraine, Europe and the USA.”

Optica Ambassador Mariia Pashchenko, who was born, raised and educated in the Kharkiv region and worked for 10 years at the Verkin Institute, left to pursue an opportunity in the Czech Republic more than five years ago. She told OPN she first heard from her husband, early on the morning of 24 February, that all of Ukraine was under attack. “I was really shocked and shaken,” she said. “When I called my mom, I heard these awful sounds of bombing. I can’t even describe this feeling ... something unbelievable.”

To assuage a frustrating sense of helplessness, Pashchenko—who, like Mysko-Krutik, was involved with the Council of Young Scientists in Ukraine—concentrated on working to find places at her institute in the Czech Republic for scientists fleeing the war. “It was my chance to do at least something to change the situation,” she said. “If scientific workers, at any level, stop doing their work, it will be difficult, after the war stops, to come back.”

Similar thinking has spawned a number of independent efforts to find temporary employment for displaced Ukrainian scientists. One is Science for Ukraine ([scienceforukraine.eu](http://scienceforukraine.eu)), an online effort that began as a Twitter hashtag and grew into a clearing



Getty Images

“As a result of the war, many teachers in our university will lose their jobs ... [I]t will take a long time to restore such a scientific school.”

—Gennadiy Khrypunov

house for jobs for scientists across a variety of disciplines.

Closer to the world of optics is WaveJobs ([wavejobs.eu/ukraine](http://wavejobs.eu/ukraine)), a European photonics job board that, in partnership with the Candela Foundation and the Polish Technological Platform on Photonics, has set aside a special section highlighting opportunities for displaced Ukrainian scientists. (Providing financial support for the WaveJobs portal is one of a number of actions Optica has undertaken in response to the Ukrainian crisis; more information is available at [optica.org/statement\\_on\\_ukraine](http://optica.org/statement_on_ukraine).)

### Blow to Ukrainian science

Commendable as these efforts are for bridging this tumultuous period, Nataliia Mysko-Krutik

stressed that are only temporary. “Because we all want to come back,” she told OPN. “We want to come back, and build our country.” Yet the war has left physical, economic and psychological scars that will profoundly complicate that task.

One obvious challenge will be the sheer damage to scientific infrastructure. The Kharkiv region has been one of the country’s hardest-hit areas; as of the end of April, the Kyiv School of Economics estimated that 18.7% of all physical infrastructure in Kharkiv oblast had been damaged or destroyed.

Within the academic sector, Karazin Kharkiv National University—the source of three Nobel laureates—is “badly destroyed,” according to Gennadiy Khrypunov, who added that the National Aerospace University in the city has also sustained significant damage. In his own institute, the physical toll has included scores of broken windows, structural damage, destruction of heating and water systems for the student hostel, and more. And both Nataliia Mysko-Krutik and Mariia Pashchenko have heard from contacts at the Verkin Institute about similar ravages and damage to equipment there.

Pashchenko suggested that in one sense, rebuilding from the war’s destruction could afford an opportunity to modernize Ukrainian scientific infrastructure—much of which, she believes, was old and of low quality. “It’s a huge opportunity to start, not from the zero point, but ... science, and maybe industry, can start from a much higher level.”

That view, she acknowledged, stems partly from the unprecedented international support that Ukraine has experienced during the war, which she hoped might continue after its end, to science’s benefit. But

O. Marques / Getty Images



Children who fled the war in Ukraine and Polish students take part in a chemistry lesson during a family picnic organized by the City Hall in Krakow, Poland, in March 2022.

the claims of science will be only one item on the war's billing sheet. Some estimates have placed the cost to rebuild Ukraine at US\$600 billion or more—and that number, of course, climbs each day the war continues. It remains to be seen whether the world's interest and aid can be sustained at such levels after the bombing stops.

Meanwhile, scientists in Ukraine have done their best to keep their work going amid the war's destruction. "Life continues," said Khrypunov, noting that, with experimental science effectively off the table for now, researchers "write articles, carry out theoretical research, create computer programs." But, he added, "such a form of scientific research cannot continue a long time. Computer simulation cannot replace a real experiment."

## Human factors

Beyond rebuilding infrastructure, there's another unknown: Will the current, war-induced diaspora of young researchers eventually return

**“Punishing individuals who are already against the war is not going to make the world better.”**

—Alexandra Boltasseva

to Ukraine? Optica Fellow Alexandra Boltasseva, a professor at Purdue University, USA—who grew up in a mixed Russian-Ukrainian family before leaving Russia shortly before the start of Putin's regime, and who still has relatives living in both countries—believes it will. "Ukrainians are wonderful people," she told OPN. "Even if many of them manage to leave now, many of them will be happy to come back to rebuild the scientific community."

Given the challenges of that rebuilding, though, Khrypunov is not so sure. "I think young people will remain abroad, and maybe

obtain positions in other European universities," he said, a possibility with serious implications for his institution and perhaps others in Ukraine. Indeed, when he spoke with OPN, Khrypunov noted that the disappearance of students was already creating significant problems.

That's because revenues from foreign students in particular have been "a powerful source of financial support for our university," he said. The decrease of those student numbers, coupled with significant declines in tuition-paying Ukrainian students and consequent further decreases in state funding, are hobbling the school's financial viability. "As a result of the war, many teachers in our university will lose their jobs," he predicted. And "it will take a long time to restore such a scientific school."

## Lasting scars

Perhaps the most lasting change for the Ukrainian scientists we spoke with, though, may lie in their views of Russia, its citizens and its scientific establishment. "Before the war I was apolitical—I loved all of the world; I loved all nationalities," said Nataliia Mysko-Krutik. Now, she bitterly observed, Russia is excluded. "This country broke my house," she said. "This country broke everything in my life."

Since the war, the scientific community and scientific organizations outside of Russia and Ukraine have struggled with how far actions against Russia, as exemplified by international economic sanctions, should extend to individual Russian scientists. Some have argued that all Russian scientists—irrespective of their expressed personal position on the war—should be blocked from publication in international scientific journals, from international



collaborations and from other forms of participation. Under this view, scientists in Russia are essentially agents of Putin's state, and any support of them indirectly assists his war effort.

Perhaps not surprisingly, the scientists in Ukraine that OPN spoke with tended to favor this firm line. "For me, it is not a difficult question," said Gennadiy Khrypunov. The scientific community should "completely stop the participation of Russian scientists in any form of international cooperation ... in any form—publication, scholarships, projects, anything." The prohibition, he added, should apply to areas, such as physics, chemistry, biology, engineering and computer science, that could "support creation of military technology."

Others, however, believe that giving Russian or Belarusian scientists who oppose the war the same treatment meted out to those who support it would be a mistake. Alexandra Boltasseva—who has been outspoken in her criticism of the war, and who expressed disappointment at the lack of protest against it inside Russia, which she notes could be explained by the new Russian law punishing citizens for any criticism of the army—feels that official business with institutions tied to the Russian government should be terminated. But "punishing individuals who are already against the war is not going to make the world better," she said.

"We have a Russian-speaking association of scientists here in US," Boltasseva observed. "And it was never about being Russian or Belarusian or Ukrainian. It was rather about people who understand each other, work together and support each other. I really hope that it will stay this way." She added that the Western

scientific community "should help those who are against the war so that they would be able to find their place in the West if needed." (As a global scientific society, Optica continues to support both Ukrainian and Russian members, while strongly condemning the Russian government's actions in the invasion.)

## Epilogue

As this story was going to press in early June, much had changed in Kharkiv. A counteroffensive by Ukrainian forces in May rolled back the Russian forces north of the city, in some places pushing them to near the Russia-Ukraine border. Russia announced a change in its war aims, to focus henceforward less on the areas of Kyiv and Kharkiv and more on the Donbas region. And some aspects of normal life have returned in Kharkiv, with the restoration of public transportation and with displaced persons starting to come back to the city.

Yet Russian units, while driven back, have regrouped and dug in, and remain within artillery range of parts of Kharkiv—periodically reminding residents of that fact by renewed shelling of the city from a distance. That seems sure to complicate the process of rebuilding not only Kharkiv's scientific infrastructure and workforce, but those of the city as a whole. Whatever the ultimate outcome of the "Battle of Kharkiv" as a strategic engagement in the war, the battle to restore Kharkiv to something like its former self will surely continue for years to come. **OPN**

*OPN deeply thanks the persons quoted here, as well as Alexander Kildishev, Purdue University, USA, for sharing their stories and for their help with this article.*

Stewart Wills is OPN's senior editor.



Getty Images

## Russian "brain drain"?

Optica Ambassador and Kharkiv native Mariia Pashchenko generally considers cooperation with scientific institutions or scientists in Russia "unacceptable" in light of the current conflict. She does, however, think dialogue with individual Russian scientists might make sense in one narrow area—to persuade them to leave the country and assist them in finding scientific homes elsewhere, thereby depriving the Putin regime of their talent.

Interestingly, such a "brain drain" appears already to be underway in Russia. Putin's re-election in 2012, and an increasingly authoritarian turn in Russian politics, had caused many young, educated persons to migrate abroad from the country even before this year. That pattern increased with the invasion of Ukraine, which has reportedly spurred an exodus of hundreds of thousands of technical and scientific workers from Russia (partly as a result of the departure of foreign employers doing business there).

The Biden administration in the US is said to be seeking ways to further poach high-skill workers from Russia by relaxing certain visa requirements. Such measures, adding to the already high outflow of Russian talent, could, in the view of some, damage Russia's science and economy not only during the war, but for years to come thereafter.