Friends in Deed

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Help for Ukrainian academics and students advances a larger goal: a Western-oriented system of higher education and research.

By Mark Matthews

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A s Russian forces bombarded and encircled Kyiv in the winter of 2022, overseas colleagues implored Tetiana Herasymova to join the millions fleeing Ukraine. "Tanya, what about you?" asked a research collaborator at the University of Utah. "You should go to Canada," urged a mentor at Regina University in Saskatchewan. But the entrepreneur-academic brushed these appeals aside. Sitting in an air-raid shelter, she decided to stay in Ukraine, near her family and boyfriend, and pursue a new career in data analytics. She wouldn't let the aggressor crush her dreams, she says. After completing an MITx online MicroMasters course, she joined a virtual research partnership in artificial intelligence between New York University (NYU) and Ukraine Catholic University (UCU).

Herasymova, 36, who holds a PhD in linear algebra, chuckles at the "non-linear direction of my life." "Non-linear" also describes her country's path toward becoming a Western-style knowledge economy.

Ukraine boasts a vibrant information technology sector and a rich science heritage, exemplified by Nobel laureates and leading figures in mathematics, nuclear physics, and engineering. American aeronautics engineers are doubtless familiar with Igor Sikorsky, the Ukrainian-born helicopter pioneer (1889–1972) whose name graces a polytechnic in Kyiv and generations of US military choppers.

That proud tradition can't be separated from the former Soviet Union's legacy of scientific achievement. Even after declaring independence in 1991, Ukraine found some vestiges of its Soviet past worth preserving, such as the strong foundation in math that underpins students' success in IT. But other practices, like Soviet-style management of higher education and research, held Ukraine back.

Vladimir Putin's brutal 2022 invasion spurred leading Ukrainian scientists to push for reform of structures they viewed as cumbersome and outdated. Intent on transforming the nation's universities and scientific institutions, they sought to spur efficiency and innovation while at the same time reversing a long decline in funding and research capacity. Their efforts have been embraced by national academies in the United States and Europe and in Western-backed planning for Ukraine's postwar reconstruction.

Meanwhile, as the war shrinks Ukraine's business sector, wrecks civilian infrastructure and buildings, and scatters educators and scientists, a host of public and private efforts have sprung up to assist Ukrainian academics and students. NYU and other leading US, European, and Canadian schools have offered scholarships and fellowships, online mentoring for graduate students, and advanced-research partnerships.

Clear Boundaries

The NYU–UCU partnership that Herasymova joined is the brainchild of Julia Stoyanovich, who directs the Center for Responsible AI at NYU's Tandon School of Engineering, and Yaroslav Prytula, UCU's dean of applied sciences. Stoyanovich, an associate professor in computer science and engineering as well as data science, emigrated from Russia as a child. She was appalled by the invasion of Ukraine. "This is one of the situations where it's very clear where the boundaries [are] between good and evil," she says. "I wanted to do something that would materially help the people there cope with the situation." In addition to offering NYU's online summer computer science courses for free to any Ukrainian student pursuing an IT degree, she and Prytula wanted to contribute to building Ukraine's research talent.

NYU has several Ukraine initiatives, developed in partnership with international support groups. Its Prague branch campus welcomed more than a dozen Ukrainian undergraduates last September with free housing, a living stipend, and health insurance. The Tandon School, in Brooklyn, encourages Ukrainian PhD and postdoctoral candidates to apply for grant-supported on-site positions in its Dynamical Systems Laboratory, a center for high-tech research on systems ranging from fish to fluid mechanics and human behavior. Applicants can access help with the visa process and accommodations, if needed.

Stoyanovich's program is perhaps the most inventive of the NYU–Ukraine partnerships. Six faculty members from five universities designed research projects around responsible AI. Eight graduate students—most of them seeking PhDs—signed up as mentors. Eighteen students from Ukraine were screened and chosen to participate, while receiving stipends. Over six weeks last summer, eight teams, each with one to three Ukrainian students and two mentors, tackled problems related to algorithmic fairness and transparency, privacy and data protection, and social media manipulation.

Herasymova and Ukrainian teammate Nazarii Drushchak, a master's student at UCU, tackled widespread concerns that artificial-intelligence and machine-learning systems—such as those used in lending, healthcare, and education—treat members of marginalized groups and other individuals unfairly. They explored whether it was possible to weed out bias across multiple criteria without sacrificing an algorithm's accuracy. Challenging notions of an inevitable

trade-off between fairness and predictive certainty, the researchers concluded that results could be achieved with a few tweaks that didn't significantly alter an algorithm's performance. Herasymova and Drushchak used five real-world datasets to demonstrate. One cluster, for instance, contained detailed student records from two high schools, including grades, absences, time spent studying, and "sensitive attributes like the student's sex, their parents' education levels, and whether the students live in an urban or rural location." Using these data, they gauged what they considered a realistic risk that a given student would fail and needed special help.

Tech Talent

Originally planned for six weeks, the NYU–UCU project continued through the fall of 2022 and into this year and will recruit a new class of students and mentors in the summer. The extension allowed Herasymova and Drushchak to keep working with mentor Andrew Bell, a PhD candidate. From what he's seen so far, Bell says, "there's no shortage of talent when it comes to computer science in Ukraine right now, and coming out of Ukrainian universities."

Caltech's Rana Adhikari found Ukrainian researcher Rami Kamalieddin similarly impressive. The pair spent a week together last summer in the Laser Interferometer Gravitational-Wave Observatory (LIGO), looking for ways to delete interference from streams of instrument data. Kamalieddin's visit was arranged after the LIGO Lab, run jointly by Caltech and MIT, announced in March 2022 that it would give special consideration to scientists from Ukraine. An experimental physicist, Adhikari shared the 2019 New Horizons in Physics Prize for his work on gravitational wave detection. Kamalieddin's PhD in high-energy physics, from the University of Nebraska, drew on his work at the European Organization for Nuclear Research, or CERN, developing machine-learning tools to gain insights into the Higgs boson—the "God particle."

Kamalieddin was already living in New York at the time, so he didn't strictly fit LIGO's criterion of scientists newly displaced by the war. But he offered special skills. It wasn't just Kamalieddin's comfort with large-scale, complex machinery and particle physics that appealed to Adhikari; Kamalieddin also had been working since 2019 in New York's finance industry. Not only was he good with data and mathematical modeling, Adhikari says, but Kamalieddin was, "most importantly, using modern machine-learning methods to do data cleaning"—filtering out errors and irrelevant information.

"When you think about it, who's got to have the best of those algorithms? It's people who are working in finance, because for them, it really, really matters," says Adhikari. "If you have a 1 percent better software algorithm, that's a lot of money." The pair stays in touch. One problem Kamalieddin would like to tackle during a lengthier future visit is LIGO's loss of large amounts of data, due to the altered states of its mirrors when the machine is idle. Adhikari adds, "I do hope that we can work together in the future."

'Exciting' Science

Like Kamalieddin, Maxym Dudka may help advance US research. A senior scientist at the Institute for Condensed Matter Physics, part of Ukraine's National Academy of Science, he has partnered remotely with Raymond Orbach, who holds joint appointments in mechanical engineering, physics, and geosciences at the University of Texas–Austin. They have "a couple of really very exciting scientific ideas that

we intend to pursue," Orbach tells *Prism*. "I think science in general will benefit from these interactions."

Orbach, a former undersecretary, chief scientist, and director of the Office of Science at the Department of Energy, conducts research at the intersection of physics and materials science. Dudka's research and his came "as close as you could ever expect," Orbach says. "What I work on is a class of systems which are disordered and non-linear," he explains. "Now, that may sound exotic, but frankly, window glass is a perfect example of a system that is disordered and its dynamics are very complex. We still don't really understand glassy dynamics, even though it's the oldest artificial material known to mankind; it still has its own mysteries of behavior." Orbach and Dudka intend to employ "simulation methods using very large-scale computers as well as experiments and theoretical analysis to see what those dynamics are." Practical applications are hard to predict, but Orbach sees the possibility of glass solar cells and glass windows with adjustable brightness and transparency.

Orbach sought out Dudka after the Office of Science encouraged its grantees, including Orbach, to apply for supplemental funds enabling them to host or collaborate with Ukrainian students and scientists affected by the war. US researchers seeking to work with Ukrainians can also tap several National Science Foundation mechanisms, the agency says: international supplements to existing awards, RAPIDs (Rapid Response Research Proposals), and EAGERs (Early-Concept Grants for Exploratory Research).

The Simons Foundation is funding Ukrainians as well—a lot of them. The New York–based private foundation, cofounded in 1994 by hedge fund billionaire James Simons and his wife, Marilyn, to support basic research in science and mathematics, says it will spend $1.2 million to provide monthly stipends for a year to 405 Ukrainian mathematicians, biologists, physicists, and chemists who remain in Ukraine. Each PhD researcher will get $200 a month; PhD students, $100. "There is a lot of activity supporting Ukrainian scientists who escaped the war and left the country, but not a lot of thought was given to the scientists who remained there," says Gregory Gabadadze, an associate director, in a foundation statement.

Campus Crusaders

Globally, numerous institutions—many with funding from their national governments—have offered opportunities to Ukrainian academics and students. Overseas support "gives some comfort, to know that people care about you," says Georgiy Shevchenko, a mathematics professor and academic director of undergraduate education at the Kyiv School of Economics (KSE). Ukrainian-Americans, including Iryna Zenyuk, have propelled assistance on US campuses. Zenyuk, an associate professor of chemical and biomolecular engineering at the University of California–Irvine (UCI), arrived in the United States at 15. Soon after Russia's February 2022 invasion of her homeland, Zenyuk spearheaded a fund drive, working with the university's chapter of Scholars at Risk, and collected $250,000 to bring a half-dozen Ukrainian researchers and students to UCI for up to two years. Among them is a nuclear scientist from the bombed-out Kharkiv Institute of Physics and Technology, Anatoliy Turkin, now in Europe, who will join a UCI chemistry lab. A master's student in comparative literature arrived with her two-year-old daughter and parents-in-law. And more are expected.

West Virginia University neuroscientists Valeriya Gritsenko and Sergiy Yakovenko, both originally from Ukraine, arranged for students in Ukraine to perform research remotely with WVU graduate students, making use of the university's neural engineering lab. "One of the projects was basically signal processing, analysis of motion capture data from humans," says Gritsenko, who, like Yakovenko, is a medical school faculty member with an adjunct appointment in WVU's engineering school. "Another project was using AI, machine learning, to help understand how the brain makes a model of the external world and use it for controlling our limbs." One of WVU's remote students was caught "behind enemy lines, essentially," after visiting his parents in Russian-occupied Donetsk over winter break. When the war broke out, he couldn't leave, Gritsenko relates. "And moreover, he was hiding, I don't know where, because the Russian soldiers were gathering young men to send to war." He finally got out from Russian-controlled territory in midsummer. Gritsenko hopes to resume work with these or other Ukrainian students in summer 2023.

KSI's Shevchenko, a specialist in probability theory, says that after war broke out, "I got invitations from some universities in Germany, Luxembourg, France, the UK, Canada, and China," plus an offer to spend a semester at Stanford. Prevented from leaving the country, like most Ukrainian men, he accepted a non-resident fellowship at the University of California–Berkeley.

Europe's Open Door

Expecting "100,000 Ukrainian students and researchers" needing support, the German Academic Exchange Service (DAAD) last April launched a website, National Academic Contact Point Ukraine, with a regularly updated and extensive list of scholarships and research opportunities. By October, much of its information was in Ukrainian. The European Union, meanwhile, opened up its continent-wide research funding apparatus to Ukraine. For example, the EU sponsors several "4Ukraine" grant programs, including one created by its flagship doctoral education and postdoctoral training program, Marie Skłodowska-Curie Actions.

ScienceForUkraine (#ScienceForUkraine), an international group of volunteers that sprang into action soon after the war began, recorded "well over 2,600" listings of institutions offering help by the end of May 2022. NYU's Dynamical Systems Laboratory is one. The highest numbers were from Germany, France, and Poland, but offers also came from two institutions in China and one in India. Neither China's nor India's government has condemned Russia's invasion.

The #ScienceForUkraine initiative doesn't explicitly track the number of Ukrainians it has served, but "we've likely placed hundreds of students worldwide," says organizer Brokoslaw Laschowski, a coordinator for Canada. An assistant professor of mechanical and industrial engineering at the University of Toronto, Laschowski has tapped Ukraine's "incredible" computer science community for research collaborators in robotics and artificial intelligence. Drawing financial help from government, university, and industry sources, he and his colleagues arranged for dozens of Ukrainian computer science students to spend last summer in Canada—some in Toronto and others at the University of Waterloo. The Toronto team is planning to offer their summer research program in computer science again this year.

While Europe accounts for the largest number of its listed opportunities, #ScienceForUkraine has expanded its reach among US institutions, says the country's lead coordinator, Megi Maci, a first-year medical student at Loyola University Chicago. Her United States network "has grown significantly" since early in the war, she says. The group publicizes Universities for Ukraine's non-residential fellowships with help from the Association for Slavic, Eastern European, and Eurasian Studies and Harvard's Ukrainian Research Institute. It also partners with the National Research Foundation of Ukraine and the US-based Ad Hoc Working Group on Science in Ukraine to foster US–Ukraine scientific collaborations.

Word is spreading among university faculty. For instance, the University of Southern California's Ukraine Assistance Hub claims that over 350 USC-based faculty have expressed interest in supporting Ukrainian students and academics.

Practical Headaches

All this goodwill hasn't come without challenges. Placing Ukrainian students at US and European universities poses "a huge logistical issue," says Dmytro Iarovyi, who connects Ukrainian students with schools abroad on behalf of Ukraine Global University (UGU) while completing his second doctorate at Vytautas Magnus University in Lithuania. UGU, a project of Kyiv School of Economics, Ukraine Global Scholars, and other partners, has handled applications from thousands of Ukrainian students and helped identify the cohort now at NYU–Prague. While many Western universities offer non-degree programs, online courses, and library access, Ukrainian students want full degrees, Iarovyi says. "They want Ivy League and other top universities," believing that these schools offer "the best education, skills, and networks." If he can't dispel students' unrealistic expectations, Iarovyi is trying to make the application process more efficient by changing the approach. This year, "instead of selecting people for the general pool of finalists and then sending their profiles to numerous universities, we will be asking them to apply specifically for the program and university they prefer."

Ukrainians seeking a US education have a local option, though one constrained by war: American University Kyiv (AUK), a partnership with Arizona State University and Cintana Education, which manages ASU's overseas ventures. The industry-backed private school opened online with 152 students last fall, offering bachelor's and master's programs in global management and software engineering and a bachelor's in business administration. But AUK has been forced by Russian attacks on civilian infrastructure to postpone in-person learning at its campus in the newly renovated River Port Building on the Dnipro River. The war has also made student recruitment a challenge, says founding rector Roman Sheremeta, a Ukrainian-born experimental economist on leave from Case Western Reserve University. But discussions with business contacts leave him encouraged about the long term: "There is a huge demand for Ukrainian IT and engineers, so obviously we are in the right sphere," he says, adding that "if anything, our partners and investors are even more committed now than before" the war.

Ensuring the return of the many students and academics who fled or sought opportunities outside Ukraine will be just one of many challenges in a postwar reconstruction phase. From her perch last year at Stanford, where she won a 2021–2022 fellowship as an emerging Ukrainian leader, Yulia Bezvershenko looked ahead to that moment. A theoretical physicist, she had played a key role in Ukrainian efforts to modernize the research and development (R&D) sector as director general for science and innovation at the Ministry of Education and Science. But she believed more was needed. "I think we are in the middle of this transformation," she told *Prism* last October. In December, she joined prominent Ukrainian physicist Oleksiy Kolezhuk in publishing a blueprint calling for merit-based stipends to keep Ukrainian researchers in academe; development of networks and partnerships involving Ukrainian and foreign researchers, businesses, and local governments; integration of Ukrainian and European research; and "closing the gap between education and research."

Compared with peer nations, "Ukraine's scientific resources have declined significantly over the last 20 years," Bezvershenko and Kolezhuk found. Economists note that among neighboring countries, Ukraine has grown the least since 1989, when the Soviet Union started to collapse. The R&D sector, the authors write, "is plagued by the Soviet legacy of weak links between research, education, and business; mistrust among principal stakeholders; insufficient state capacity; and a lack of coherent strategy. Before the war, Ukraine had been neglecting R&D, focusing instead on its strong but aged and carbon-intensive industry." While the number of researchers in Ukraine dropped between 2006 and 2020 in relation to its population, numbers in Poland and Bulgaria almost doubled.

Kolezhuk, who heads the Scientific Committee of the Ukrainian National Council on Science and Technology, says that if the higher education and research system is rebuilt to perform "in the same inefficient way" as before the invasion, "we'll finally see the demise of science in Ukraine" and have to settle for a mostly agricultural economy. He adds: "That's why everybody is talking now about not rebuilding but reforming and rebuilding, because everybody perceives that this is our last chance to make those reforms."

The list of inefficiencies in both higher education and research institutions is long. It includes a proliferation of universities—more per capita than Poland, Germany, and Hungary; inadequate state funding; low faculty and researcher salaries; outdated laboratories requiring maintenance; ministries that control research institutions yet assign a low priority to R&D; and poor-quality data. Last October, Kolezhuk joined an expert meeting in Berlin that urged integration of Ukrainians in international research networks and doctoral-level institutions, and stronger ties between research and business.

A postwar Ukraine would likely make good use of the skills of people like Rami Kamalieddin. At the time he spoke with *Prism,* he was helping his mother, a refugee, settle in the United States and obtain legal residency. "I love my country and I guess I would like to be in a position to contribute," he says—either from the US or back in Ukraine.

Tetiana Herasymova is contributing, even as the war caused her to move seven times and added more curves to her non-linear life track. Having decamped from Kyiv to Lviv, she's now an assistant professor at UCU, helping to coordinate the NYU–UCU Responsible AI project while teaching coding to 100 undergraduates. She and research teammate Nazarii Drushchak recently completed a paper on their algorithm-fairness project, co-authored by NYU's Andrew Bell, Lucius Bynum, Lucas Rosenblatt, and Julia Stoyanovich.

Herasymova believes that her current work "could help my country a lot." But it's hard for anyone to think about a future Ukraine, with a reformed science and higher education establishment, amid the present horrors of war. By leaving Kyiv, Herasymova escaped Russian barrages that struck, among other places, her alma mater, the prestigious Taras Shevchenko National University of Kyiv. That was where Georgiy Shevchenko spent New Year's Day, helping to clear shattered glass after missile attacks the day before. (He shares the surname of Ukraine's iconic 19th-century poet but is not a descendant.) At the Faculty of Mathematics, where Shevchenko had worked for 20 years before joining KSE, "maybe 90 percent" of the windows were broken and had to be replaced with boards. "And these were not just usual windows; these are enormous windows, like whole glass walls," he recalls. Shevchenko was startled by the sheer weight of the glass. Also surprising was his reaction when a missile struck a target some 300 meters from his apartment. "I was not scared at all," he says. "I guess this is kind of a protective reaction of my brain."

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