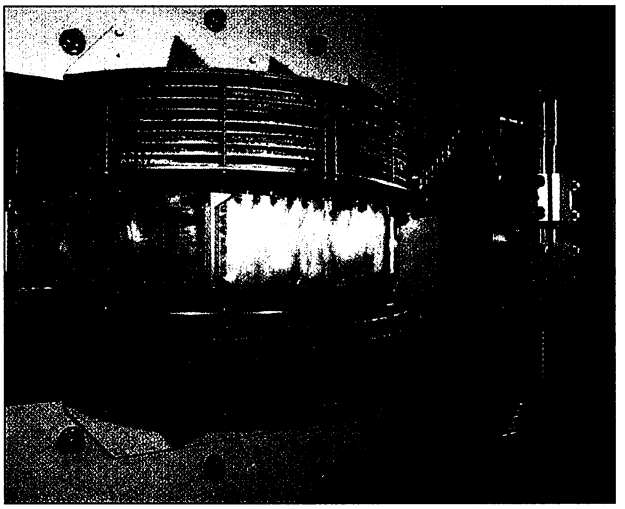
incomparably better than anything even new, democratic Yugoslavia can hope to offer for a long time," says Ivancevic. "My generation is really all over the world," says Sokcic-Kostic. She has a son in 10th grade in Germany and would only return to Yugoslavia after he graduates. Indeed, added Kurepa, "the scientific community in Belgrade has almost ceased to exist."

Ivković, who as *Science* went to press was expected to lose his post as Serbia's science minister, disputes those claims. "Despite the sanctions, we have managed to maintain a thriving scientific community," he said in an interview in August, pointing out that the number of Serbian scientists actually rose from 15,100 in 1990 to 15,910 in 1999, as researchers who emigrated were readily replaced. Ivković also pointed out that Serbia currently has a few dozen joint projects with Russia and China, two countries that didn't agree to U.N. sanctions.



Physics centerpiece. Cyclotron at the TESLA Scientific Center near Belgrade may finally be completed with international help.

Scientists say, however, that the sanctions had long-term effects. Coming back from trips abroad, says electrical engineer Srbijanca Turajlić, "I smuggled vacuum tubes and other spare parts in my suitcases." Sanctions hit hard even on a personal level. Kurepa, who did his Ph.D. in nuclear physics at the University of Liverpool in the early 1960s before returning to Belgrade, maintained contacts and friendships over the years—until after the sanctions, when he said his British colleagues suddenly fell silent. "They didn't even ask, 'Milan, do you need a pencil?' " The sanctions, Turajlić says, "were one of the biggest mistakes the West made. We were not able to *live* under sanctions, let alone do research."

The NATO bombing campaign in spring 1999 dealt a further blow, bringing research to a virtual standstill for months. "Is it possible to think seriously about science when one sees tens or hundreds of people injured daily?" asks one Belgrade scientist. Rumors even spread that Vinča was on the NATO target list.

Repairing the damage

Undoing a decade's worth of damage may take years and require grooming a new generation of scientists to take the place of colleagues who went abroad—and probably

Science Survives in Breakaway States

LJUBLJANA AND ZAGREB—As Serb scientists start rebuilding a research system devastated by wars and international ostracism (see main text), they might draw some lessons—and hopes—from colleagues in the nations that won their independence from Yugoslavia during the past decade.

Slovenia, a country the size of New Jersey with 2 million people, has emerged from the chaos of the Yugoslav breakup with the biggest head start in science. One reason is that it escaped unscathed from its 1-week war of independence in 1991. But Slovenia has also tried hard to keep talented young scientists at home, and Slovenian researchers were able to join the European Union's (E.U.'s) flagship research program last year. "Because of our determination to join the E.U. and to focus our priorities on European programs and initiatives, science in Slovenia has improved at a faster rate than in other nations of the former Yugoslavia," contends plant biologist Lojze Marinček, Slovenia's science minister. In the initial rounds of the E.U.'s Fifth Framework Programme, the ministry says, researchers in Slovenia landed a role in 46 projects, about half as many as did scientists in Poland—a country with a population nearly 20 times as large.

Good start. But biochemist Vito Turk says more resources are needed to maintain momentum in Slovenian science.

But Slovenian scientists, although proud of the quality of their research, are worried, because government science spending has eroded over the past few years, forcing institutes to channel a higher proportion of their budgets into salary payments. This month, Slovenia's Association of Research Institutes even resorted to newspaper ads to call attention to their plight. Vito Turk, a biochemist who heads Slovenia's biggest research center, the Jožef Stefan Institute, says, "Farsighted initiatives in the past helped Slovenia preserve the quality of its science. But we won't be able to keep up this momentum without more resources for research."

Slovenia has slowed down the brain drain with a fellowship program called "2000 Young Researchers," but leading scientists fear that if government and industry don't focus more on R&D, many young researchers will grow pessimistic about their prospects for productive careers in Slovenia. "Without the Young Researchers program, we would have been devastated," says physicist Robert Blinc. "But what do we do with all these talented young researchers?"

Shaky start

Like Slovenia, Croatia also has a proud scientific tradition and has for centuries felt closer to its Alpine and Adriatic neighbors than to the Balkan nations to the east. But Croatia paid a much higher price than Slovenia paid for its freedom: a bloody war for independence that took nearly 4 years to settle. Serb rockets killed students and hit university buildings in downtown Zagreb in 1995 and nearly destroyed the university in Osijek, recalls Branko Jeren, rector of the University of Zagreb. The war, and Croatia's involvement in the related Bosnian conflict, sapped the country's economic vitality. And Western European governments barred Croatia from E.U. research programs because of a virulent strain of nationalism nurtured by former President Franjo Tudjman's regime, which ended after Tudjman's death late last year.

With the rise of a more democratic government in Croatia this spring, the nation's scientists are once again eligible to apply with partners for E.U. research programs. And, even though research spend-

CREDITS: (TOP TO BOTTOM) ALAN CHIN; R. KOENIG

aren't coming back. "You can definitely forget about the wave of scientists returning to their homeland," predicts Arseni Markoff, a molecular biologist at the University of Münster in Germany, who sees parallels between the nearly bloodless transition to democracy in Serbia and what happened in Bulgaria, his native land, 10 years ago. Serbian scientists agree. "We do not expect the return of a significant number of scientists to our country," says Ivancevic. "But we expect that they will continue to help us by sending us information and establishing contacts."

Inflation factor. Banknotes (featuring Nikola Tesla) tell the story of rampant inflation, which has crippled the Yugoslav economy.

Cultural changes are necessary too. "In an increasingly impoverished country, money-making, whichever way possible, has become the only goal," says Ivancevic. "I fear that it will take a long time for this attitude to change." Indeed, predicts Gligor Tashkovich, executive vice president of AMBO LLC's Trans-Balkan Oil Pipeline project, which will be the largest private infrastructure project in the region when construction starts in 2003, "as the economy gets restructured, scientists will be disproportionately squeezed out of jobs. Things will get worse for scientists before they get better, and the only ameliorating condition will be if [the U.S. National Science Foundation] and its counterparts across Europe take a leadership role at this early stage."

Like the rest of the Yugoslavian scientific community, Vinča and its 400-strong researchers are undertaking the seemingly paradoxical endeavors of rebuilding old ties and burying the past. It's hoping to start afresh with erstwhile collaborators like Oak Ridge National Laboratory in Tennessee and CERN, the European particle physics laboratory in Geneva, which helped set up TESLA's advisory committee before severing ties with Vinča after sanctions were imposed. Renewed cooperation "might attract some of our scientists who have left the country," says Nebojsa Neskovic, Vinča's associate director for science. Once the cyclotron is finished—Neskovic estimates that the center can be up and running within 30 months after construction resumes—the first project will hook up the hydrogen ion source to produce a beam of 30–million electron volt protons for use in manufacturing radioisotopes and for radiation research. So far, 15 institutes in eight countries, from Italy to Macedonia, have become members of the center.

The future is less certain for the resumption of close scientific ties between the nations of former Yugoslavia. "If democratization in Yugoslavia results in real—not

ing has been low for years, science minister Hrvoje Kraljević told *Science* that the new government "is committed to increasing support for research." He is trying to convince Parliament to set aside for R&D a small percentage of the income from the state lottery and from privatization of state-owned companies. That income, he says, could go to setting up something that Croatia doesn't have at the moment: a competitive granting agency. The government now spends only 0.4% of its gross domestic product on science, and "almost nothing comes from the private sector now," says Kraljević.

Although researchers at Croatia's institutes and universities are hurting because of the budget crunch, many are optimistic that—with more government support and eligibility for E.U. research programs—they will be able to improve the quality of science. "Croatian scientists have had to cope with aging buildings, old equipment, and a lack of innovative technology," says Krešimir Pavelić, who directs the Ruđer Bošković Institute's molecular medicine division. "But there is great potential here because of the young talent." Pavelić has tapped that potential by aggressively expanding his research division in recent years, and he has even attracted some scientists from abroad.

Nikola Zovko, a physicist who directs the Bošković Institute—Croatia's largest—also sees great potential for growth in Croatian science, but he says scientists have to find more international sources of funding. One possibility is to cash in on one of Croatia's assets: its natural beauty, a long Adriatic coast dotted by historic cities such as Dubrovnik and Split. Croatia now holds about 20 international scientific conferences a year. Such events, says Zovko, "show that good science is taking place in Croatia."

There are concerns, however, about whether Croatia can hold onto another of its national assets: its youth. At a recent biophysics summer school sponsored by the Bošković Institute, many Croatian undergrads told *Science* that they hoped to go westward for graduate study. "You want to get your Ph.D. where there is high-quality science," says Anita Krisko, a University of Zagreb undergrad. And, with the scarcity of jobs, it is tough to lure well-trained young students back to Croatia. "About half of the young scientists in my college class left Croatia, and I would say only about 10% have returned," says Nenad Ban, who graduated from the University of Zagreb in 1990. He later did a postdoc at Yale and recently landed a post at Switzerland's prestigious ETH Polytechnic. "The problem is that a scientist has to have something to return to."

Meager budgets. But Science minister Hrvoje Kraljević says Croatian government is committed to increasing research funds.

The problems of Croatian researchers pale in comparison to those in neighboring Bosnia-Herzegovina, governed by a fragile coalition of Muslim, Croat, and Serb ethnic groups. Top scientists fled Bosnia during the war, and few have returned. Some left because of bloodshed, others because their workplaces were destroyed. Energoinvest, once the former Yugoslavia's largest exporter, in its heyday had 11 R&D centers throughout the country. Ten were mostly obliterated during the war, driving three-quarters of the company's Ph.D. researchers abroad, says Bozidar Matic, president of the Bosnia-Herzegovina Academy of Sciences, which itself is estranged from a separatist Bosnian Serb academy. The astronomy observatory outside Sarajevo was also damaged beyond repair by the constant shelling of the war years, and other institutes—such as the Center for Balkan Research, a Sarajevo-based archaeological institute—are wasting away. The center wasn't bombed during the war. Rather, its best scientists simply died or left. Says Matic: "There was a process of 'negative selection' in science: The best researchers left."

—ROBERT KOENIG

CREDIT: R. KOENIG