

of US 12th graders, 38% of 4th graders, and 34% of 8th graders were proficient in science. The 4th-grade and 8th-grade proficiencies were up 4% from their 2009 levels.

Education secretary John King Jr says that 12th graders in the 2015 test cohort had already finished their elementary and middle school years by the time Obama's new programs to improve STEM teaching took hold. He says 12th-grade improvement should be evident in the next round of tests. Adds Holdren: "We've known for a long time that it's very important to reach kids early when they're most impressionable, when they're really deciding what they're interested in. What we're seeing is success in reaching kids in the earlier grades in a

way that is making science more exciting." Many of the Obama initiatives are only partially implemented, he says, and a new White House effort to bring computer science classes into all K–12 classrooms just kicked off in January.

But Alberts, who helped to develop STEM learning standards in the 1990s, says the Obama administration's "top-down, command-and-control" enforcement of federally mandated standards is harming science teaching. Teachers are forced to devote an inordinate amount of time preparing students for multiple-choice tests that aren't meaningful, he says, even though schools and school district performance are measured by the results. "It's been incredibly destructive of teacher initiative and teacher esprit de

corps and the empowerment of teachers that we really need," he says.

Alberts also questions whether all the new STEM teachers are receiving quality training and wonders how many will remain in the profession given the "oppressive atmosphere" created by the emphasis on standards.

King replies that while adherence to state standards is important, "we of course want teachers to be creative and ensure that their classes are engaging and rigorous, not narrowly focused on assessments." He says the Department of Education has just issued new regulations to "ensure greater transparency around the level of preparation of teachers" to meet state standards.

David Kramer

Turmoil in Turkey hits science

In a time of funding gaps, suspicion, and uncertainty, international interactions are key to keeping up morale and scientific output.

Sometimes I am amazed that my life and that of many of my colleagues remains as undisturbed on an everyday basis as it does. But there are no guarantees that it remains unimpacted," says Cihan Sağlıoğlu, a theoretical particle physicist at Sabancı University near Istanbul. "My university is like a haven."

Turkey is suffering from wars in neighboring Iraq and Syria, an influx of Syrian refugees, and attacks by Islamic State adherents and Kurdish PKK terrorists. On top of that, Turkish science faces chronic problems of low-level investment in large-scale scientific infrastructure and eroding autonomy of universities, says Ercan Alp, a physicist at Argonne National Laboratory who maintains close ties with his native Turkey.

The 15 July failed coup, he says, "added salt to the wound."

The Turkish government admits that it has ousted around 100 000 state employees in the last year or so. That includes a thinning out of the police and armed forces and firings of nearly 28 000 people in K–12 education. In a series of purges, some 2500 academics have been sacked and 15 universities have been

shuttered. A mood of uncertainty, suspicion, and fear pervades campuses.

Purges

The purges and university closures are aimed at supporters of Fethullah Gülen, a former imam who lives in self-imposed exile in Pennsylvania. Until they fell out in recent years, President Recep Tayyip Erdoğan and Gülen were close allies; Erdoğan blames Gülen for the coup. The Gülen movement is known to have penetrated deeply into Turkish education, business, government agencies, army, and police. Among government officials and secularists, the movement's far-

reaching international network of schools and universities are seen as nurseries for growing a workforce loyal to Gülen and a threat to democracy in Turkey.

But the purges "also resulted in some unfair accusations," says Haluk Ünal, a professor of finance at the University of Maryland and president of the Turkish American Scientists and Scholars Association (TASSA). Academics come under suspicion for voicing criticism of the current regime or for seeming to support the PKK. The clampdown on academic freedom threatens national and international collaboration and could have a negative impact on R&D, Ünal says. And

MIDDLE EAST TECHNICAL UNIVERSITY

THE MIDDLE EAST TECHNICAL UNIVERSITY in Ankara, among the best engineering schools in the region, is an oasis for faculty and students during tough times in Turkey. The pedestrian boulevard running through its campus is more than 2 km long.



the intense scrutiny “under the magnifying glass” that many scientists endure when they return to Turkey after studying or working abroad can have “dire consequences” for science. Ünal emphasizes that he speaks for himself, not for TASSA.

“There is quite a bit of arbitrariness to what is going on in general in Turkey,” says Zehra Sayers, a biophysicist at Sabancı. “When the information you have is incomplete, a lot of things seem bizarre.”

Above the fray

Why have Sabancı and some other universities hovered above the fray? “The government probably has its own screening methods,” says Saçlıoğlu. Many academics credit their university rectors with protecting them. Sayers and Saçlıoğlu also note that Sabancı is “apolitical” and has been “well governed.” Avni Aksoy, deputy director of the Institute of Accelerator Technologies at Ankara University, posits that the established universities have existed under different governments and “therefore had balanced relations with all the previous government groups.” For the most

part, it’s the older, more elite institutions that feel the heat less.

Despite the uncertainties, there are notable bright spots for Turkish science: Last year the country joined CERN as an associate member, with annual dues of about \$4 million. And Turkey is a founding member of SESAME, the regional synchrotron light source soon to open in Jordan (see the story on page 32). “Both projects help to integrate Turkish physicists and scientists with Europe and the Middle East, consistent with Turkey’s broader traditional role,” says Alp.

Some new scientific facilities are relative oases. For example, the \$60 million Turkish Accelerator and Radiation Laboratory in Ankara, with an IR free-electron laser (FEL) as the centerpiece, is set to begin operations in 2019 and will be open to scientists from anywhere. If the laboratory is successful, it would pave the way for additional facilities—a synchrotron light source, x-ray FEL, positron-electron collider, and proton source—to create a geographically distributed Turkish accelerator center.

The biggest challenge for research centers, says Aksoy, is that they are not autonomous. Despite recent legislation,

for example, he cannot hire people because of a labyrinthine bureaucracy and unclear authorization paths. “That’s our weakness,” he says, “and because of it, we have brain drain.”

No immunity

Even places that have not seen firings or mass investigations of faculty have not been immune to the country’s turmoil. Immediately following the July coup attempt, for example, many academics who were abroad were called back to Turkey by the government. As public employees, they had little choice; the penalty for noncompliance is unknown, but Turkish scientists assume it could consist of losing passports, facing legal action, and being fired. Unfortunately, says Sayers, “our times are such that we are becoming paranoid about every word we use and also worried about jeopardizing our institutions.”

After the failed coup, the Scientific and Technological Research Council of Turkey (TÜBİTAK), the country’s main research funding agency—which itself was purged of many employees with suspected connections to Gülen—suspended grants and delayed until next year a call



Best-in-Class Performance

Single-Photon Counters



New Ultra-low noise ID230 Infrared Series

- Free-running at 900-1700nm
- 25Hz dark count rate @ 10% quantum efficiency
- 100Hz dark count rate @ 20% quantum efficiency
- 100ps timing resolution
- Adjustable temperature from -50°C to -100°C



www.idquantique.com
visible and infrared single-photon counters

for new proposals. For a few months, until TÜBİTAK announced in October that it would resume paying graduate stipends, some faculty members paid graduate students and staff out of their own pockets. For now, the researchers who are faring best are those who are in collaborations funded by the European Union.

Although R&D spending has been growing in Turkey, in the past few years it has stalled shy of 1% as a percentage of GDP. In 2005 the government announced a goal of investing 3% of GDP by 2013, but by 2010 the target had slid to 2023 (as the Turkish Republic's centenary, a symbolic date); in 2015 the R&D investment goal was revised down to 2%. But even that target seems elusive, says Alp. "The institutional mechanisms and a road map for implementing ambitious scientific and technological projects are lacking." Despite the fact that TÜBİTAK has increased money for research, the evaluation and distribution of funding has become biased and arbitrary "and finally paralyzed" by the attempted coup, says Sabancı astrophysicist Ali Alpar.

In 2011, when the government decided that members of the Turkish Academy of Sciences would be appointed rather than elected on their merits, a majority of members quit, including Alpar. The defectors founded the independent Science Academy, which is funded by member fees and private donors. The new academy's success has been a surprise, says Saçlıoğlu: "Each year we award some 40 young scientists with two-year research grants. That is one thing of which we are proud."

On 29 October, the government decreed that all university rectors will be appointed by Erdoğan. The Science Academy board responded with a statement saying the measure "is tantamount to the eradication of university autonomy."

Before the coup attempt, "Turkey was experiencing brain gain," says Ünal. In one program, TÜBİTAK promised \$3000 a month for a year to returning early-career academics. Ünal warns that "after the attempted coup, Turkey again may see brain drain; many academicians are looking for positions in universities abroad."

"The most capable, the most easily employable, they are the ranks that will be depleted first," says Saçlıoğlu. Two



STUDENTS MEET OUTSIDE between classes at the Middle East Technical University in Ankara.

decades ago he would tell his students, "Sure, you can do better science abroad, but you can do good things here too." Now he is more reluctant to encourage them to stay in the country, he says, although "I am not at the point where I would say, 'You are crazy to stay here.'"

Staying connected

Over the past year or so, international conferences and workshops in Turkey have been canceled, mainly because speakers and participants are scared off by political events and terrorist attacks. "People who already know us, they come," says Aksoy, adding that he would say Turkey is not more dangerous than France or Germany. Serkan Çetin, a particle physicist at Istanbul Bilgi University, was the national organizer for a CERN accelerator school that was supposed to be held in Istanbul in September; the school was delayed and

moved to Hungary. According to Çetin, such cancellations have a big impact on scientific life. "Scientists feel their relations to the world are at a lower level, that they are no longer in the loop. People have lost motivation. It's like a pause button has been pushed. The uncertainty is a shock."

"I am aware of people who were under investigation, and who were cleared 100%, but were not given back their positions," Çetin continues. "I have collaborators from other cities who had such cases. They cannot travel abroad. Their passports are deactivated. Even if they start their jobs again tomorrow, the psychological healing will be hard."

And worst of all, says Çetin, "is what I see in young people, those who recently finished their PhDs. They want to see a future. I see the hope getting lost in their eyes."

Toni Feder

Middle East synchrotron light source is set to start up

SESAME is intended to nurture good science and good relations.

Twenty years in the making, SESAME (Synchrotron-light for Experimental Science and Applications in the Middle East) finally began debugging in November. If all stays on track, the light source, located in Allan, Jordan,

will open for experiments next year.

"Our fluffy dreams are becoming reality," says Eliezer Rabinovici, a theoretical particle physicist at Hebrew University in Jerusalem. "When I touched the magnets, it was unbelievable."