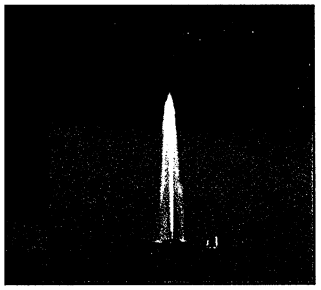
Gaston Kayser, speaking from Lake Nyos. "We are very happy with the results."

While applauding the effort, some experts remain cautious. "Everybody is in favor of any attempt to degas the lake. ... This is a great idea," says Sam Freeth of the Geological Hazards Research Unit at the University of Wales in Swansea, U.K. But he says there are "major risks involved" if the experiments are scaled up. Freeth worries that the movement of large quantities of cold, dense water resulting from the removal of the carbon dioxide could generate currents that would trigger another limnic eruption. Freeth urges the French-led team to publish its data so others can review them.



Water safety. Carbon dioxide is gushing from Lake Nyos thanks to equipment first tested in 1995.

The team intends to install four or five more pipes over the next year to degas the lake to acceptable levels. The team will return to France next week and continue to monitor the lake via satellite. Local authorities can turn off the apparatus, which will otherwise run indefinitely, at the first sign of a pending eruption.

–JOHN PICKRELL

POLYGRAPH SCREENING

Panel Seeks Truth in Lie Detector Debate

An expanded polygraph screening program at U.S. nuclear weapons labs begun in the wake of suspected espionage has heated up the perennial debate over the validity of lie detectors. And if testimony at the first meeting last week of a new National Academy of Sciences panel examining the thorny issue is any guide, the truth will be hard to come by. Researchers are, however, exploring alternative technologies, including the use of brain and thermal imaging, to identify what happens in the brain when people lie.

The academy study is funded by the Department of Energy and follows the flap over Wen Ho Lee, a computer scientist at Los Alamos National Laboratory in New Mexico who pled guilty to mishandling classified information after facing allegations of more sinister activities (*Science*, 15 September 2000, p. 1851). The $860,000 study is the first major government-sponsored polygraph study since a 1983 report by the Office of Technology Assessment (OTA) concluded that polygraphs are not an effective scientific method to check for security breaches. A 2-day meeting in Washington, D.C., made it clear why panelists expect the job to take no less than 21 months. "I heard a major disconnect between what different people were saying," says study director Paul Stern.

The panel, headed by statistician Stephen Fienberg of Carnegie Mellon University in Pittsburgh, was confronted immediately with seemingly irreconcilable testimony. Officials from the Energy and Defense departments touted the successes of their programs, while a Department of Energy physicist claimed that polygraph screening does more harm than good. What's more, the panelists heard testimony that experiments aimed at establishing the validity of the polygraph as a generalized screening instrument may be unreliable.

This month, for example, the Department of Defense (DOD) is starting a screening validation study involving 120 subjects—recruited through newspaper ads—some of whom have been trained to pretend they have committed espionage. But panelist Paul Ekman, a psychologist at the University of California, San Francisco, said in a written statement that such research won't yield solid results until the primed subjects are playing for "high stakes"—such as loss of a job.

Other participants questioned the reliability of polygraph use in personnel-screening (as opposed to criminal) cases, because the low base rate of miscreants results in an unacceptably high number of false positive readings. This situation, said Alan P. Zelicoff, a physicist at the Center for National Security and Arms Control at Sandia National Laboratories in Albuquerque, New Mexico, has led to "tremendous cynicism and doubt about the utility of the test in both management and technical staff." He predicts that almost all those who fail the current round of polygraph tests being given at the three national labs will later be found to have been truthful—but with lasting damage to already-low morale.

Even practitioners acknowledge that the validity of polygraph tests relies heavily on factors not related to the instrument, such as the training of polygraphers and the nature of the screened population. There is thus growing interest in alternative types of technology. Panel member Richard Davidson of the University of Wisconsin, Madison, says that new approaches now have abundant brain research to draw from—knowledge that didn't exist at the time of the OTA report.

First introduced in the 1920s, the polygraph machine measures four parameters—heart rate, blood pressure, respiration, and sweating. But that physiological quartet doesn't get at what Davidson says is presumably the emotion being measured, namely, "fear of detection." For that, he says, researchers must go straight to the brain: "And if there's one emotion that we have really learned a lot about in the last decade, it's fear."

Animal studies have shown that fear is particularly associated with a brain region called the amygdala. That finding is also borne out by human brain imaging studies using functional magnetic resonance imaging (fMRI) on subjects exposed to facial expressions of emotion. Fear elicits the strongest activation of the amygdala, he says, and it looks quite different from a more generalized anxiety response.

So far there have been no fMRI studies for lie detection. But the DOD is reviewing outside proposals received in response to a broad solicitation for new ways to study the subject. Andrew Ryan, chief of research at the DOD Polygraph Institute, says an fMRI study would ask subjects to lie about something so that researchers can examine patterns of brain activation. "Deception requires more cognitive effort than truth," Ryan points out, so you would expect not just fear but increased cognitive activity.

The DOD is also doing research on thermal imaging, in which the temperature changes caused by variations in facial blood flow during lying is detected with an infrared camera. Other technologies being explored include the use of lasers to pick up muscular, circulatory, and other bodily changes in a process called "laser Doppler vibrometry"; the use of a new voice stress analyzer known as the Vericator; and the monitoring of brain waves, similar to a "brain fingerprinting" system currently in use commercially. All are noninvasive technologies "not even available 10 years ago," says Ryan.

Out of line? Output from a polygraph may fail to detect real emotions behind lying.

Ryan and others hope that this research will usher in an era of new technologies far more adept at ferreting out the truth than what has been available for the past 80 years. "The future machine," he predicts, "will look very different."

–CONSTANCE HOLDEN

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