

Right Now

The expanding Harvard universe

BOLLIXED BALLOTS

Voting into Vapor

FULLY ELECTRONIC SYSTEMS will record about one-third of the votes cast this November. But “Until and unless everyone understands NP-completeness and cryptographic theory,” computer-security expert Rebecca Mercuri is “adamantly opposed to the use of any fully electronic or Internet-based systems for use in anonymous balloting and vote tabulation applications.” The Radcliffe Institute fellow, a computer scientist who has studied electronic voting since 1989, believes that it is “incumbent upon all concerned with elections to *refrain* from procuring *any* system that does not provide an indisputable paper ballot which can be checked by the voter visually before deposit and used by the election board in case of a recount.”

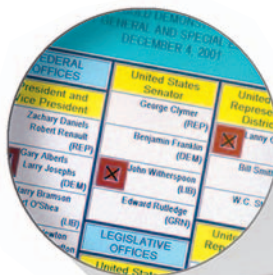
In a 2002 article in *IEEE [Institute of Electrical and Electronics Engineers] Spectrum* and many more recent publications, Mercuri argues that electronic voting is problematic in three ways: computer security, auditability, and transparency. All of these, she says, may pose insoluble difficulties.

The computer-security issues stem from a class of conundrums known to logicians and computer scientists as “NP-complete.” (“NP” stands for “nondeterministic polynomial-time.”) NP-complete problems are part of complexity theory, an aspect of computer science that

deals with the resources needed to solve problems, if solving them is indeed feasible at all. Computers cannot solve NP-complete problems, except, theoretically, over an infinitely long time. Take, for example, the problem of optimizing a stock portfolio. “If computers could solve this problem, we’d all be very

wealthy!” says Mercuri, with a laugh. “But computers can only approximate an answer. The problem with voting is that we need a non-approximate answer.”

In an electronic election, an NP-complete problem arises when one asks if the computer software has been properly constructed to register and tabulate votes. “Can we *prove* that?” asks Mercuri. “If we could prove that computers had no viruses, then the machines could test themselves. But the fact is that computer scientists have not figured out a way to



For Rebecca Mercuri, optically scanned paper ballots are the best voting option. But if electronic balloting is required by law, she suggests the mode illustrated here. A voter in a booth uses a touch-screen display (inset, upper left) to prepare a paper ballot. She inspects and verifies the paper ballot (upper right) and deposits it into a ballot box (lower right).



ILLUSTRATION BY BRYAN CHRISTIE

prove that the software is perfect: doing only what we want and nothing else. We *could* do it if we had infinite time and every possible input and output, but the permutations quickly become astronomical. And if you change one line of code in the software, you have to run the test again.”

Voting by secret ballot also conflicts with the need for auditability. “The way we audit something like banking or healthcare precludes anonymity, since we have to track each individual transaction, end-to-end,” Mercuri explains. “But anonymous voting requires privacy, so we shut off this kind of tracking during the most critical part of the process: the balloting. With this [fully electronic] equipment, you cannot perform an independent recount. It’s like asking Enron to give you a printout of their accounting data.” (Only one state, Nevada, requires electronic polls to be accessible to audit via voter-verified paper ballots. “Ironic, but it makes sense,” Mercuri explains.

“They have to audit all these casino gaming machines, so they know how to audit computers.”)

Third, says Mercuri, electronic voting “is still not sufficiently transparent for citizens of a democracy to have confidence in the system.” Since computer voting involves advanced technology and complex software, “it provides an opportunity for an intellectual elite to control the system. Do you want cryptographers in control of the electoral process?”

Even so, electronic balloting is going ahead. The 2002 Help America Vote Act authorized \$3.8 billion in spending through 2006; \$3 billion of that is going to voting-systems vendors. Non-auditable, fully electronic voting technology will record 30 percent of 2004 presidential votes. Optically scanned paper ballots will tally another 50 percent, and mixed systems like lever machines and punch cards will record the remaining 20 percent. The balloting business is so con-

centrated, reports Mercuri, that two companies founded by two brothers will ultimately tabulate 80 percent of all votes cast.

“The equipment is extraordinarily expensive—small counties are paying as much as \$25 million for electronic voting machines—and frankly, unnecessary,” she asserts. “These machines are only used a couple of times a year, and the rest of the time have to sit in dark, air-conditioned warehouses. Their batteries run down and need replacement. Furthermore, people are now buying obsolete machines, since the money from the Help America Vote Act wasn’t tied together with technical standards. I don’t see that you’ll be getting much bang for your buck.”

The difficulties of electronic voting reappear even more clearly in on-line Internet voting, a novelty in which France, Germany, Australia, and Estonia have announced initiatives. On-line voting poses severe problems of voter identification, as

A most original luxury hotel.

ONE BENNETT ST, CAMBRIDGE / 617.864.1200 / 1.800.882.1818 / WWW.CHARLESHOTEL.COM

HARVARD SQUARE

Right Now

well as offering vast potential for disruption by spoofing and denial-of-service attacks. "A secure Internet voting system is theoretically possible," wrote cryptographer Bruce Schneier, founder of Counterpane Internet Security, "but it would be the first secure networked application ever created in the history of computers."

Mercuri worries, too, about the

expanded scale of potential abuses.

"Whereas earlier technologies required that election fraud be perpetrated at one polling place or machine at a time," she wrote in her *IEEE Spectrum* piece, "the proliferation of similarly programmed e-voting systems invites opportunities for large-scale manipulation of elections."

She closed with a comment from an un-

named observer of voting technology: "If you think technology can solve our voting problems," he said, "then you don't understand the problems and you don't understand the technology."

~CRAIG LAMBERT

REBECCA MERCURI WEBSITE:

www.notablessoftware.com/evote.html

JOIN AND DIVIDE

Anti-social Societies

IN THE MID 1800S, Alexis de Tocqueville remarked on and celebrated the multitude of social organizations that dotted the American landscape.

By the end of that century, the Masons, Knights of Labor, Knights of Columbus, Lions Club, Orangemen, and dozens of similar "secret societies" formed the civic backbone of many an American community. What exactly that legacy means is still an open question.

In his seminal 2000 book, *Bowling Alone: The Collapse and Revival of American Community*, Malkin professor of public policy Robert Putnam argued that the steady decline of such groups and the dwindling membership in clubs such as bowling leagues represented a dangerous fragmentation of American society that threatened to undermine our civic consciousness. Now, in a new book, Loeb associate professor of the social sciences Jason Kaufman argues that neo-

Tocquevillians like Putnam have it almost exactly backwards: the golden age of fraternity is, in fact, responsible for lingering societal problems and divisions, and the decline of such groups heralds a more equal society today.

Kaufman's book, *For the Common Good? American Civic Life and the Golden Age of Fraternity* (Oxford), attempts to refute the upbeat portrayal of such civic groups by delving deeper to study *what* organizations people joined, not just *whether* they did so. By combing through city directories covering the decades before and after 1900 for 53 major American cities, the sociologist has found data suggesting that the "nation of joiners" was originally built from our differences. "This period in American history was unique not because Americans suddenly turned to one another for faith and succor," he writes, "but because faith and succor were suddenly turned into matters

of organizational self-segregation."

"It's not just that everyone was a Mason," Kaufman explains. "There's a thousand different flavors. And many of them made explicit reference to religion, ethnicity, or racial characteristics." For example, the 1900 Boston city directory listed among its 56 different fraternal and sororal organizations six *different* branches of the Odd Fellows—two for blacks (one integrated, one not), two for women, and two specifically for white men. Thus, although the Odd Fellows overall may have attracted a wide range of people, the specific chapters were segregated by gender and race. Kaufman says such divisions undermined efforts to bridge differences and hindered the advancement of racial minorities and women by excluding them from social networks and initiatives.

Furthermore, the groups' recruiting practices tended to attract new members who shared the preferences, backgrounds, and social networks of existing members. "[Belonging to such organizations] was very helpful—but only if you could get into them," Kaufman says.



Shrine officials convene in New York at midnight on July 1, 1951.