

ABSTRACT Transitions of power are fragile, anxious moments for political systems. This paper explores how electoral machinery – the material and social technologies of casting, counting, and contesting votes – dynamically stabilizes democratic transitions. The paper analyzes the controversy surrounding the 2000 US Presidential election. For 36 days political stability in the USA hung on uncertainty over a seemingly simple matter of fact: which candidate won the most votes in the state of Florida. Interrogating the civic epistemology of US elections – the processes by which elections produce, validate, and put knowledge to use – the paper contends that electoral machinery functions to contain common uncertainties, contingencies, and conflicts that might otherwise destabilize democratic political order. The paper develops a model of electoral machinery as a loosely integrated network of sites including polling places, election administration, the courts, the media, and the American public. This network constructs credible knowledge in a distributed fashion and helps form an intermediate layer in US politics, integrating geography, state, and civil society. This network model of electoral machinery implicates both democratic theory and practical electoral reform.

Keywords civic epistemology, democracy, election, knowledge, stability

Interrogating the Civic Epistemology of American Democracy: Stability and Instability in the 2000 US Presidential Election

Clark A. Miller

Early evening, Election Night, 7 November 2000. News anchors for the major US television networks call the Presidential election in Florida for the Democratic candidate, Al Gore. An hour later, they take it back, replacing Florida in the category of undecided. Once again, around midnight, many call the race a second time for the Republican candidate, George W. Bush. And once again, shortly thereafter, they decide that Florida and its decisive 25 electoral votes remain too close to call.¹ There the race remains until 12 December 2000, when the US Supreme Court rules in a bitterly divisive 5–4 decision to award the state's votes in the Electoral College – and the Presidency – to Bush.

The 36 days between Election Day and the Supreme Court decision offer an unprecedented window into US politics, and especially into ways

in which political institutions in the USA are subject to and work to contain certain forms of instability. The transition of power is a fragile, anxious moment for almost all political systems, but perhaps less so for 'stable' democracies. The proper functioning of electoral processes is obviously central to how democratic institutions stabilize this transition. Yet, as many struggling democracies have discovered, and the Bush–Gore election reiterated for 'the world's oldest democracy', elections are subject to uncertainties, contingencies, and partisanship that can exacerbate rather than reduce conflict. How, then, do elections contain these instabilities, in normal practice, and in exceptional circumstances like those that haunted the US electoral machinery during November and December 2000?

To answer this question, I argue, requires an investigation into *civic epistemology*: the cultures and practices of knowledge production and validation that characterize public life and civic institutions in modern democratic societies (Jasanoff, 2004b). By opening the black box of elections, the Bush–Gore contest reveals the centrality of knowledge and knowledge-making practices to the political legitimacy of democratic governance. Elections are a hallmark and frequently a benchmark of democracy. Whether viewed as the cornerstone of democracy or merely indicative of deeper democratic values, elections are a key marker of legitimacy and arbiter of authority in Western politics.² Yet in the aftermath of the 2000 controversy, it is clear that elections are not merely political institutions; they also entail important epistemological elements. For 36 days, the peaceful and orderly transition of power in the USA hung on uncertainty about a seemingly simple question of fact: who received the most votes in Florida? For an election to serve as an effective arbiter of the will of the people and a legitimate practice for selecting representatives, the state's citizenry must accept the final vote tally as a credible and reliable measure of the electorate's choice. They must know, as a matter of objective fact, who won. Elections thus depend on elaborate and extensive arrangements for constructing factual knowledge and for rendering that construction publicly transparent and invisible (Carson, 2001).

To investigate the civic epistemology of US elections – processes and arrangements for arriving at credible factual claims regarding electoral outcomes – I adopt a co-productionist idiom, which takes seriously that knowledge and order are coupled products of human work, and that democracy entwines politics with epistemology and truth with power. Co-production highlights the dynamics of interwoven *knowledge-order complexes* – how they come into being, maintain stability, and undergo challenge – and, as such, the idiom is particularly apropos for the study of controversy, its accompanying contested and competing claims to knowledge, and the role of social processes and institutions in fomenting and settling epistemic conflict (Jasanoff, 2004a). I begin by refracting my analysis through the major scholarly debate on the 2000 election among legal and constitutional scholars. That debate has focused primarily on the US Supreme Court's intervention to halt the process in mid-December. Participants in this debate, and especially its two most ardent antagonists,

US Appeals Court judge Richard Posner and Harvard law professor Laurence Tribe, rest their arguments on competing constructions of the stability of American democracy, and, more specifically, the election knowledge–order complex. Yet, somewhat surprisingly, they offer little in-depth analysis of how elections contain instability and the degree to which those mechanisms functioned well, or not, in November and December 2000. I then analyze the knowledge–order complex of US elections in which the Bush–Gore debate took place. What were the sites of contestation? How was the management of credible testimony accomplished in each? How were these sites linked together to produce a final outcome?

In answering these questions, I argue that the knowledge–order complex of US elections involves an interlaced network of heterogeneous social spaces. This network forms an intermediate layer of social and institutional arrangements that connects voters and the volunteers who manage individual precincts to state election bureaucracies, the Electoral College, the Supreme Court, and the Presidency. This layer thus integrates geography, the state, and civil society, knitting the nation together in a thick web of formal and informal relationships (Evans et al., 1985; Putnam, 2000). Electoral knowledge production occurs in a distributed fashion within this layer. Strictly speaking, the voting system, as it is often called, is neither hierarchical nor bureaucratic.³ Its pieces are much more loosely tied together, consisting of elements of county, state, and federal governments, the courts, the media, and individual households. This network-like organization of the voting system was an essential factor, I argue, in helping to contain political instability in the 2000 election controversy.

Electoral Stability in the 2000 Election

Questions of stability and instability appeared front and center in the 2000 election controversy. In a nation that had only recently recovered from the political whiplash created when a Republican Congress had sought to impeach a sitting Democratic President, uncertainty over the outcome of a Presidential election was an unwelcome encore. The controversy quickly became public spectacle. Reporters and teams of legal experts descended on Florida, and the dueling press conferences began. Millions of people watched the drama unfolding on their television sets. Over the next 6 weeks, the nation was treated to its second thorough exposition of rarely used constitutional processes in as many years, as the two antagonists fought for public opinion, administrative decisions, and legal rulings that would uphold their claim to electoral victory. But were these events evidence of political instability?

For James Baker, the Bush team's lead spokesperson, the answer was unequivocally yes. On 11 November, Baker forcefully argued to the assembled national press the need to end the dispute, then only a few days old, to preserve the stability of American democracy. The immediate question at hand was the desirability of manual recounts requested by the Gore team in several of Florida's counties. Baker dramatized this prospect

as frightening, threatening to open up a potentially endless array of ‘human error, individual subjectivity, ... risks ... and mischief.’⁴ Even more frightening to Baker was the prospect of a protracted legal battle over the electoral contest, which might last months or even years. Precedent for protracted conflict certainly existed. In the 19th century, previous Presidential electoral disputes had lasted until March of the following year, while contemporary electoral disputes in other races had gone on even longer, sometimes taking more than a year to resolve fully. Could the nation survive such a contest? Baker didn’t want to find out. Defending the Bush team’s decision to ask a US Federal Court to halt the manual recount process, he recounted his own participation in a previous close election:

We regret that we were compelled to take this action. At some point, however, Florida’s voters and indeed all Americans are entitled to some finality in the election process. I keep remembering that day when I was with President Ford following another hard fought election that was decided by a razor thin margin. Many in the room advised President Ford to challenge the result with just one recount. President Ford said no. He spoke about the country’s interest. Now 24 years later, our opponents have lost a vote. They’ve even lost a recount of that vote. And sadly they’ve chosen another course. And so the country has been pushed in a very different direction. As I cautioned yesterday, *there is no reasonable end to this process if it slips away.*⁵

The emphasis on stability continued in the per curiam opinion in *Bush v. Gore*. Explaining its decision to halt the manual recount and award the Presidency to Bush, the Court highlighted the importance it placed in electoral legitimacy as a central component of democratic governance: ‘The contest provision, as it was mandated by the [Florida] State Supreme Court, is not well calculated to sustain the confidence that all citizens must have in the outcome of elections.’ Quoting *Burroughs v. United States* (1934), the Rehnquist, Scalia, and Thomas concurrence went further, insisting on the unique nature of the Presidential election as a focal point of stability in American democracy: ‘The President is vested with the executive power of the nation. The importance of his election and the vital character of its relationship to and effect upon the welfare and safety of the whole people cannot be too strongly stated.’⁶

After the conflict ended, the majority’s reasoning – and especially its commitment to finality and stability – became the subject of intense political and legal commentary. For a number of authors, particularly US Appeals Court judge Richard Posner, the fears of Baker and the Court majority were exactly right; moreover, the longer the dispute lasted, the more threatening it became to American democracy. Describing the contested process, Posner recounts ‘the *agony* of hand recounts protracted beyond the seven-day statutory limit’ (2001: 99, emphasis added) carried out by a ‘judgment-laden, subjective, imprecise process’ (p. 99). Had the Supreme Court not intervened, he contends, the result would have been a

'free-for-all' (p. 144), full of 'rancorous struggle' (p. 137), sullied by 'raw politics, with no tincture of justice ... unprecedented bitterness ... disorder and temporary paralysis' (p. 143), and would have put the next President 'behind the eight ball, with an irregular and disputed accession, an abbreviated term of office, and no transition' (p. 138) – regardless of who was elected. 'The longer the deadlock had persisted, the deeper and longer lasting the wounds would have been' (p. 145). The Supreme Court majority's pragmatic decision to step in and halt the process after a mere 5 weeks was, therefore, for Posner, a courageous commitment to the stability of American democracy, regardless of what one thinks about the legal principles and reasoning in which it was couched (Posner, 2002).

Other authors emphatically disagree. Berkeley political scientist Nelson Polsby admits 'enough irregularity in this to stimulate the adrenalin of onlookers, not to mention partisans', but he continues:

this does not add up to a crisis by world standards. Tanks did not rumble in the streets. There were no shootouts at polling places. Nobody stormed the television stations. The armed forces went about their usual business. Americans are accustomed to peaceful transitions of power, and the election of 2000 provided no exception. (Polsby, 2002: 266)

Harvard law professor and frequent participant in Supreme Court wrangles, Laurence Tribe (2002a: 106), concurs, asking why leading jurists such as Posner and the three most conservative members of the Supreme Court majority so strongly feared that allowing the contest to proceed might have resulted in 'a constitutional crisis that might have lasted beyond the next inauguration day or, worse still, imperiled our democracy.' Tribe observes: 'The Court's only justification for *ending* the recount rather than at least allowing the Florida court to *try* fashioning a remedy for the alleged defects in its December 8 order was the state's supposed interest in finality' (Tribe, 2002a: 136, emphasis in original). Allowing the process to continue might have been ugly, Tribe contends, both in the courts and in Congress, but it hardly justified the kind of heroic judicial intervention undertaken, wresting the decision from the hands of Congress to implement a judicial coronation of the President (Tribe, 2002b).

Indeed, Tribe and others, including Yale law professor Bruce Ackerman and Chicago constitutional scholar Cass Sunstein, lodge their critique of the Court's decision to intervene in what they perceive to be a longer-term, and potentially more destabilizing, series of decisions taken by the Rehnquist Court. Highlighting several decisions prior to *Bush v. Gore*, these scholars suggest that the Court has become dangerously unwilling to rely on democratic processes to resolve political conflicts. The Court, they argue, has become especially arrogant in asserting its own privilege to interpret the Constitution over that of Congress. Ackerman sees in this arrogance the potential for instability so great that he calls on the Senate to redress the growing power of the Court by selecting future

justices 'who will demonstrate greater appreciation of the virtues of political decision making' (Ackerman, 2002: xii; Sunstein, 2002).

In developing their competing accounts of the legitimacy and propriety of the Supreme Court's decision, both sets of scholars rely heavily on assumptions about the stability of democratic processes for resolving political conflict – and especially the stability of the post-election processes for reconciling disputes over election irregularities. Posner assumes great instability, based on observed contingencies, partisan maneuvering, and interpretive flexibility. As Tribe points out, however, electoral processes regularly adjudicate competing claims about misconduct and close elections, arriving at settled judgments about who won any given election. Would they have successfully done so here as well? Neither Tribe nor other critics of Posner's analysis provide in-depth answers to this question. They neither analyze how electoral processes contain the kind of instabilities described by Posner, which are well known to occur in a wide range of elections, nor whether those mechanisms did in fact operate in this case. The question is of sufficient import, in my view, to deserve a more thorough investigation of what happens inside the black box of US elections.⁷

Containing Instabilities in the Electoral Network

Transfers of power are, by their very nature, moments of potentially extreme political instability. Not infrequently, in many political systems, they engender small or great violence. When successful, elections serve to contain that instability. They both enable and discipline the production of novelty in political life. Whether to fill a political office, recall a sitting official, or decide a public referendum, elections allow for the possibility of peaceful political change, albeit in a highly controlled manner, but how? One of the central claims of this paper is that electoral stability is a dynamic social construction tied up with the credibility of publicly produced knowledge. Fundamentally, a democratic polity must consent to allow the winner of the election to take the reins of government. Epistemic as well as normative factors weigh heavily in this judgment. Electoral processes must ascertain knowledge of who is the winner. Underpinning the democratic act of voting, whether in a club meeting, a state legislature, or a Presidential election, is always the perceived ability to render an accurate and objective count of the votes. The transfer of power is adjudicated by measuring 'the will of the people', and elections are the instrument for accomplishing that measurement. Their determination of who wins, as a matter of *fact*, not conjecture, establishes who will hold power for the next interval or whether a change of law takes place.

As revealed spectacularly in this contest, however, not just in Florida but in other locations, efforts to count votes are frequently fraught with glitches, irregularities, partisan maneuvering, and even deliberate fraud. Americans in general may have been caught unprepared by the controversy, but students of electoral politics were unsurprised by revelations

about butterfly ballots, voter identification numbers, punch cards, absentee voting, and other apparent irregularities in the Bush–Gore controversy. Contingencies in the electoral process are commonplace and provide easy fodder for campaign strategists constantly on the lookout for any political advantage. The strategic efforts to mobilize and exclude blocs of votes that so destabilized the post-election process were natural extensions of pre-election strategies to do the same thing through campaigns to get out the vote and, more nefariously, prevent people from voting. The Bush and Gore campaigns each sought to undermine the credibility of the other's approach to counting ballots, deliberately highlighting uncertainties and imputing bias that threatened to make it impossible to develop an accurate count (Bowker & Star, 2001).⁸ The campaigns actively considered, and threatened, widening the controversy to other states.

Yet few elections, including Presidential elections, result in the kind of brawling political conflict manifest in this case. Why not? As I elaborate in considerably greater detail later, I believe that the answer lies in the dynamic social arrangements and institutions that enable the practical management of credible testimony about who won the election (Miller, 2001). To discipline the process of political change enabled by elections, elaborate rules and regulations determine who, or what, may be on the ballot as well as who may and may not vote in the election and how that vote is to be cast and counted. These rules are embedded in a set of social and institutional arrangements that interpret and apply the rules to specific circumstances during the conduct and review of an election. Together, these rules and regulations, social arrangements, and political institutions form a *heterogeneous, loosely networked electoral system*.

At the core of this system are polling places (and, to a lesser degree, an even more ad hoc and unmanaged suite of additional sites of voting, such as locations where absentee ballots are cast), the citizens who vote at these localities, the volunteers and administrators who work the polls, and the machines that collect (and, in some locations, at this stage in the process, count) votes. In addition, core elements also include the practices and technologies used to tally (and, when called for, re-tally) votes, at the level of precinct, county, state, and nation, as well as the audit trails generated at each stage that certify individual tallies. Backing these up are local, state, and federal courts, which are empowered to resolve contested elections. Fifty distinct state laws govern these elements, underpinned by the US Constitution. Finally, two other sets of social arrangements are involved: media coverage of elections and election disputes, and the public, who generally act as spectators, but occasionally, as in Florida, mobilize in smaller or larger numbers to try to influence the process. This network includes elements of social capital, in the engagement of citizens in the process, as voters, volunteers, protestors, parties to court filings, and spectators. It also includes bureaucratic and legal elements: election administrators and the courts. It thus ranges across civil society and the bureaucratic state, binding together a web of social and institutional relationships.

In the following sections, I explore the dynamic construction of stability and instability in several of these elements in the American electoral system, contrasting 'normal' operations and the 2000 election. At stake in the 2000 election controversy was the accuracy and objectivity of the vote tally in Florida: as a matter of fact, which candidate won the most votes? Did voting machines appropriately or inappropriately count various groups of ballots? Were some ballots illegally cast? Were some individuals deprived of their legal votes by illegal or otherwise problematic ballot designs? And, not inconsiderably, could the electoral system be said to have arrived at a final vote tally, or less ideally but perhaps acceptably, a final declaration of a winner that most Americans would accept as an objective and authoritative outcome? I focus in the following sections, therefore, on the role of various nodes in the electoral system network for stabilizing and destabilizing the network's ability to achieve a vote count that can be seen as objective and authoritative.

Polling and Its Machinery

A key element in the network of social processes and institutions involved in US elections are polling places, the registration and voting practices that occur there, and the voting machinery used to collect and tally votes. These sites (and representations of them) were on display throughout the election controversy. Ideally, these sites play an important role in helping to stabilize elections through their visual and ritualistic elements. Typically, a voter enters the polling place, presents his or her credentials (which often involves as little as giving one's name and address), receives a ballot, marks the ballot, and submits the ballot. If all goes well, the voter leaves with the impression that he or she has cast a ballot and that his or her votes will be (or have been) counted. Extensive rules cover such details as who can vote, distances party or issue advocates must remain from the polling place, the form of the ballot, the kinds of machines used, secrecy of ballots, and many more aspects of polling place layout and practice.

Much can go wrong in this ideal picture, however. The lengths to which parties will go to suppress voter turnout for the other side is well known. Parties have been known, for example, to undertake numerous kinds of illegal activities, such as trying to put machines out of order in particular precincts to make lines longer and thus reduce the number of people who are able to vote. Strategies to manipulate and challenge registration are also common. These problems are obviously important. The Caltech-MIT Voting Technology Project estimated that between 1 and 3 million voters went to the polls on 7 November 2000, but were turned away for problems with registration alone (Caltech-MIT Voting Technology Project, 2001). Because they affect who ends up being allowed to vote, rather than how those ballots actually cast get tallied, however, I plan to leave these issues aside in this paper – even though, if sufficiently widespread, they could certainly have an impact on the perceived legitimacy of the election.

Instead, I want to focus on instabilities that emerged around the use of vote casting and vote counting machines. Machines have come to dominate vote casting and vote counting over the past half century.⁹ Since the introduction of the first mechanical vote tabulating machines in the 1950s, counties in the USA have converted overwhelmingly from the old standard, hand-marked paper ballots, to a variety of new mechanical and electrical technologies.¹⁰ Punch-card systems became very common, with lever systems less so, but still prevalent. Recently, many counties have introduced optical scan technologies, in which the machine reads an ink mark made on a ballot as indicative of a vote. Especially in the wake of the Florida controversy and the Help America Vote Act, the current trend is toward electronic voting, typically on automated teller machine (ATM)-like machines that ask voters to select candidates on a touch-screen panel. Current estimates suggest that 30% of precincts will use these technologies in 2004 (only 10% did so in 2000).

The failures of voting machines in Florida have been widely discussed in the media and academic literature, so I will only briefly describe these instabilities. By midday on election day, several complaints had already begun to circulate, notably with regard to the use of a 'butterfly ballot' in Palm Beach County. On 8 November, reporters following the story of the election recount began airing stories about the butterfly ballot. Apparently, the ballot layout confused a number of individuals who voted for a minor-party candidate Pat Buchanan while intending to vote for Al Gore. Later counts suggest this number could have been as great as 6000 individuals. Stories also began to emerge about what election administrators refer to as 'undervotes' and 'overvotes', ballots for which the voting machine counted, respectively, either no vote or more than one vote for President, especially in counties using punch-card ballots. On the basis of a perception that voters in counties with strong Democratic turnouts might have had disproportionately high numbers of votes for Gore thrown out as undervotes or overvotes, the Gore campaign requested hand recounts in a small number of Florida counties.¹¹ In both cases, the dispute quickly focused on the voting machinery and whether it had failed either to allow people correctly to cast the vote they intended or to count a properly cast vote. Butterfly ballots and punch-card machines dominated the news, as the press honed in on the practices of hand recounts and the technical parameters of ballot design and machine function, giving rise to a whole new public vocabulary: chads, dimpled chads, pregnant chads, hanging chads, and so forth. Mechanical failure thus emerged as an important image of contingency in the electoral process, as Gore sought to overcome a statistically insignificant Bush lead in Florida.

A central element in the Bush campaign's approach to post-election strategy was to undercut this image of mechanical failure and to redeploy a metaphor of the machine as an unbiased, precision tool for counting ballots. In the same 11 November press conference cited earlier, 4 days into the controversy, James Baker, spokesperson for the Bush team, announced that they intended to file a lawsuit requesting the courts to stop

the manual recount in the counties in which Gore had requested them. In his remarks, Baker explicitly drew upon an ideological model of rationality that Theodore Porter has termed *mechanical objectivity*: the idea that machines and forms of rule-bound behavior that mimic machines offer politically neutral standards for making decisions and arbitrating disputes (Porter, 1995, 2000):

The manual vote count sought by the Gore campaign would not be more accurate than an automated count. Indeed, it would be less fair and less accurate. Human error, individual subjectivity, and decisions to . . . quote . . . determine the voter's intent . . . close quote . . . would replace precision machinery in tabulating millions of small marks and fragile hole punches. There would be countless opportunities for the ballots to be subject to a whole host of risks. The potential for mischief would exist to a far greater degree than in the automated count and recount that these very ballots have already been subjected to.¹²

Baker reminded his audience that humans make mistakes, too, by accident and design, and he argued that the propensity for human bias and error was the principal reason that the USA had moved to machine counting in the first place.

It is precisely, ladies and gentlemen, for these reasons, that our democracy over the years has moved increasingly from hand counting of votes to machine counting. Machines are neither Republicans nor Democrats and, therefore, can be neither consciously nor unconsciously biased. There are not even any procedures or standards to govern this third and selective vote count.¹³

At a later point in the contest, the Bush campaign articulated a second aspect of the metaphor of the machine, arguing that the task of voting was itself a mechanical task, subject to clear, explicit rules that could be easily followed and that, if not followed, constituted sufficient grounds to deny the legitimacy of a person's vote. This argument was later picked up and expanded on in the Supreme Court ruling in *Bush v. Gore*. In their interpretation of Florida election law, Justices Rehnquist, Scalia, and Thomas cast voters in the role of conforming or failing to conform with the necessary behavior to enable vote tabulation machines to work properly. Voters whose votes were not counted because they failed to cast their votes in a manner that could be successfully read by the machine could not count on the recourse of a manual recount.

Florida statutory law cannot reasonably be thought to require the counting of improperly marked ballots. Each Florida precinct before election day provides instructions on how properly to cast a vote, §101.46; each polling place on election day contains a working model of the voting machine it uses, §101.5611; and each voting booth contains a sample ballot, §101.46; In precincts using punch-card ballots, voters are instructed to punch out the ballot cleanly:

AFTER VOTING, CHECK YOUR BALLOT CARD TO BE SURE
YOUR VOTING SELECTIONS ARE CLEARLY AND CLEANLY

PUNCHED AND THERE ARE NO CHIPS LEFT HANGING ON
THE BACK OF THE CARD.

... No reasonable person would call it 'an error in the vote tabulation', Fla. Stat. §102.166(5), or a 'rejection of legal votes', Fla. Stat. §102.168(3)(c), when electronic or electromechanical equipment performs precisely in the manner designed, and fails to count those ballots that are not marked in the manner that these voting instructions explicitly and prominently specify.¹⁴

This model of proper human behavior conforms to assumptions incorporated into certain aspects of the practical administration of elections. Pre-election testing and certification of voting machines is typically carried out by running a sample of mechanically generated ballots through the machine and verifying that the final vote tally matches that of the sample. The process thus certifies that, within a certain margin of error (currently a voluntary, industry standard of less than one error per 250,000 votes), the machinery is 'capable of correctly counting votes'. Votes which are not counted can be considered under this logic as improperly cast votes and thus the failure to count them is neither 'an error in the vote tabulation' nor a 'rejection of legal votes'. Machines, in other words, arbitrate who does and who does not cast a legal vote. To assert otherwise, according to Rehnquist et al., is to insist on a logical contradiction: the construction of:

[a] scheme ... in which machines are *required* to be 'capable of correctly counting votes', §101.5606(4), but which nonetheless regularly produces elections in which legal votes are predictably *not* tabulated, so that in close elections manual recounts are regularly required. This is of course absurd. (emphasis in original)¹⁵

Others who have looked closely at the performance of election machinery disagree, however. Engineers and political scientists working for the Caltech-MIT Voting Technology Project suggest in their report, *Voting: What Is, What Could Be*, that between 4 and 6% of voters (4 million to 6 million individuals) who went to the polls intending to cast a vote for President failed to do so, because of registration problems, polling place operations such as long lines, locations, and hours, and ballots that failed to register a vote for president. This last category, which includes machine errors, unintentional undervotes (when the voter casts a vote but the machine does not register a vote for president), and overvotes (when the machine registers more than one vote for president), is estimated to account for approximately 1.5% of the total votes cast or 1.5 million votes (Caltech-MIT Voting Technology Project, 2001).

The authors of the Caltech-MIT report are careful to adopt politically neutral language in their report. The phrase 'lost votes' is clearly intended to be ambiguous as to whether or not these votes either were or should have been 'legal votes' or 'errors in vote tabulation' under Florida or any other state's election laws. Nonetheless, the authors clearly believe that these 'lost votes' do represent a failure of the voting system.¹⁶ Quite

frequently the report refers to 'lost votes' as the effective error rate of the voting system. According to *Democracy Held Hostage*, the *Miami Herald* report on the election in Florida, this error rate has been well known among election supervisors for decades and has come to be regarded as 'inevitable – and acceptable' (Merzer et al., 2001: 51).

Investigators for *The Miami Herald* also found numerous cases in both Palm Beach County and Miami-Dade County where voting machines failed pre-election certification tests and yet were used on election day to record votes. These machines recorded significantly higher rates of under-votes over the course of the day than other machines at the same polling stations (Merzer et al., 2001: 78–80). In a classic case of what Harry Collins has termed 'experimenter's regress', polling officials remarked that they had left the machines in service out of a belief that election workers had carried out the tests incorrectly, while election workers insisted that they believed they had carried out the tests correctly (Collins, 1985). In short, if the authors of the *Miami Herald* and Caltech-MIT studies are to be believed, a situation existed in Florida (and, indeed, throughout the nation) where intended votes were indeed predictably not being tabulated, and this conclusion is the basis for deep concerns about the future of American democracy expressed by the authors of both studies.¹⁷

Here again the metaphor of an US election as a machine (or technological system) looms large, although the authors offer a very different interpretation in the reports of how to understand 'improperly marked ballots'. 'Lost votes' result not from voter failure to follow the rules but rather from system failures that prevent voters from casting intended votes. Whether these ballots should be counted or not is not a particularly relevant question for the Caltech-MIT study. Rather, the authors stress that the voting system should be redesigned to eliminate these system failures so that everyone who intends to vote will successfully accomplish their intent. The stability of the electoral system still rests on an accurate, mechanical count, in their view, but the machines are to be adapted to the people – not the other way around.

Election Boards, Canvassing Boards, Counts, and Recounts

A second major element of the election network is what might be termed election administration: the election boards that oversee polling places and vote counting; the county canvassing boards that collect individual precinct tallies, compile countywide tallies, and report results upwards; and election officials working for the Florida Department of State and its counterparts in other states who compile, tally, and report statewide electoral results and, during the course of elections, interpret election procedures and laws. In Presidential elections, they also certify a state's electors to the Electoral College. The specific duties and titles of these officials and institutions vary by state, each of which has its own election laws. The system I describe here is that operated by the State of Florida. The final election administration node is, in Presidential elections, the Electoral College, which tallies

counts of state electors to arrive at a determination of who will serve as the next President.

As with polling places, the ideal operation of these institutions is intended to convey confidence in the process of vote tallying. What Yaron Ezrahi has labeled attestive visual practices pervade these spaces in the USA, as do audit trails.¹⁸ Although machines have taken over much of the work of counting ballots, machine counts are only a small part of the overall process. Florida statute, for example, requires that counts take place in front of witnesses, including an election board, other election officials, and any members of the public who wish to watch the count. The members of the board and other election officials then create a record of the final count and attest to its accuracy by signing and delivering to appropriate locations three copies of that record. Results are posted at the polls, 'for the benefit of the public'. Inspectors also seal the official copy of the certified tally and seal and transmit election records, including all ballots.

A similar process then takes place whereby a canvassing board established for each county publicly reviews the recorded tallies for each precinct in the county, counts any absentee or other special ballots, and attests to and delivers to the Florida Department of State the final vote tallies for the county as a whole. A statewide Elections Canvassing Commission then tallies the totals for statewide elections from county returns and certifies the winner of the election. The members of the various election and canvassing boards are drawn from appropriate public officials. Although the details of these practices differ from state to state, most state elections operate under comparable schemes. Thus in each precinct, county, and state across the country, a public space is created on Election Day in which the counting of votes creates a collectively witnessed and attested fact among the members of these groups.¹⁹

Up to this point, during the election controversy, election administration was subject to relatively little contestation. One case was filed in Seminole County, protesting the actions of an election official who had allowed a Republican Party official to fill out voter information on absentee ballots after those ballots had been filed. Otherwise, neither party ultimately chose to challenge the actions of election officials during the initial vote tally and machine recounts (although not the subsequent recounts, as discussed below). This is a relatively important fact, especially since, outside Florida, it meant that the vote counts were tallied and recorded without question in thousands of precincts nationwide. Election laws typically also provide for recounts, however, and here the process was subjected to considerably greater instability. In Florida, for example, elections where candidates are separated by less than one-half of one percent automatically generate machine recounts. Election and canvassing boards reconvene and repeat the counting process carried out on Election Day. Candidates may also request manual or hand recounts, as Gore did in several counties, which also entail collective witnessing procedures. These counts 'shall be open to the public' and shall involve 'counting teams of at least two electors' who are, 'when possible, members of at least two

political parties'. 'If a counting team is unable to determine a voter's intent in casting a ballot, the ballot shall be presented to the county canvassing board for it to determine the voter's intent.'²⁰

Here again, we acquire a sense of the attestive, visual epistemology built into electoral practice. Counting teams visually inspect each ballot. If they agree on how to interpret the ballot, it is counted as an objective vote for one candidate or the other. If they cannot agree, the ballot is turned over to the County Canvassing Board, who likewise visually inspect the ballot and seek consensus on what they see. Florida statute recognizes the potential for corruption in this process and guards against the possibility that a politically motivated individual might bias the system by deliberately mis-reading how a ballot is marked. Counting teams 'must have, when possible, members of at least two political parties.' The process is open to the public, journalists, and members of the competing candidates' campaigns, who can watch the proceedings, should they so choose. Here we see clear evidence of a socio-political process deployed to shore up epistemic credibility. The ideal goal is to establish a transparent process that will create public confidence in the final vote tally. Ideally, such confidence should enroll voters as well as the winning *and* losing candidates. As happened in Florida, however, visual evidence can also be exploited to reduce the credibility of the count when candidates wish to exploit the contingencies and irregularities that crop up in actual electoral practice. These procedures thus made possible the spectacle of the election controversy. Party representatives participated in and observed the counting process, collecting evidence for later court trials. The public gazed attentively (and at times noisily) over their shoulders, in person and through live television coverage, as was their right under Florida statute.

What the Bush legal and visual strategy successfully accomplished was to temporarily destabilize the notion that visual evidence would unproblematically generate social consensus.²¹ They did this by highlighting actual and potential discrepancies in the reading of individual ballots by different teams of observers and, especially, in the rules used by different teams in different counties. As many science studies authors have noted, undisciplined observers do not all necessarily arrive at identical interpretations of the same visual evidence (for example, Law & Lynch, 1990). Thus a 'dimpled chad' might appear to some as an intention to vote and to others as an indication that the person had started to vote for that candidate but changed his or her mind. Even if a counting team were to agree on how to treat such ballots, other teams might adopt different standards. For the Bush team, the uniformity of the machine ideal – reading each ballot identically, from ballot to ballot and county to county – became the standard for equal protection under the law.

This position ultimately became the basis for the Supreme Court majority's ruling that consistency of ballot interpretation was required, although the majority also ruled that insufficient time remained for Florida to develop and apply a standard approach. Interestingly, this position went

unchallenged by the dissenting minority, who contested the lack of sufficient time but not the idea that counts needed greater uniformity. The Florida election controversy also involved other elements of election administration dealing with recounts. When Florida Secretary of State Katherine Harris interpreted state law as allowing her to reject tallies from hand recounts that came in after the statutory date for official certification of the election (7 days after the election date itself), Gore sued to disallow her interpretation and continue the hand recounts. This suit, which foreshadowed subsequent legal wrangling, was denied, and the Gore team was forced to move on to a further stage for contesting the election.

Despite their short-term success in destabilizing the hand recounts carried out in several counties and preventing several of them from being incorporated into the officially certified final tally, however, the Bush team's arguments have not overly dissuaded American civic epistemology from reliance on the basic principle of 'seeing is believing'. In the wake of the 2000 Presidential election, the Florida legislature moved to clarify the procedures for a manual recount through reforms of its election law. Although Rehnquist, Scalia, and Thomas had argued that the Florida legislature could not have intended to create an electoral scheme whereby undervotes or overvotes could count as legal ballots, the Florida legislature reaffirmed in 2001 its intention to allow for that very possibility, guaranteeing a manual recount of overvotes and undervotes in all close elections (defined as less than one-quarter of one percent difference in vote tallies). They thus upheld, *pace* Posner, that undervotes and overvotes are errors in vote tabulation that need to be rectified.²² To shore up the uniformity of this system, the Florida Department of State is to set standards for interpreting ballots, but the social infrastructure of manual recounts remains as before: teams of counters that include representatives from each party must collectively agree upon and attest to the intent of each voter. If they cannot agree, the ballot is turned over to the County Canvassing Board who then make a determination, with a vote of the Board (which has three members) as a final recourse. The entire procedure remains public. Indeed, one might take the actions of the Florida legislature to be at least an implicit repudiation of the Bush team's more strident claims that machine counts were to be preferred over manual recounts regardless of the circumstances.

Court Redress

Elections may also be contested under Florida law. Contests are filed in court. In such cases, additional social spaces become available to participants in the network, as an array of different courtrooms become sites of contestation. Plaintiffs and defendants are given an opportunity to present their case, under normal judicial procedures. In turn, according to the 2000 Florida Code, 'The circuit judge to whom the contest is presented may fashion such orders as he or she deems necessary to ensure that each allegation in the complaint is investigated, examined, or checked, to

prevent or correct any alleged wrong, and to provide any relief appropriate under such circumstances.' In practice, in 2000, the courts in Florida and the US Supreme Court became crucial sites in which numerous questions of fact and law were raised and resolved concerning the manner in which votes were cast and counted.²³ Both the Bush and Gore campaigns, as well as several other interested parties, took advantage of the contest provision and requested court action either to modify the behavior and interpretations of election officials or to provide recourse for alleged complaints.

The laws governing elections are obviously normative in content. They require that elections be 'free and fair': election practices cannot prohibit anyone with a legal right to participate in an election from doing so, whether as a candidate or a voter. Elections may not be biased so as to make the result a foregone conclusion. However, the rules also manage which votes are counted, and the manner of counting and recounting, in order to shore up the objectivity of the outcome. They determine who (or what) is allowed to count votes, following what procedures, and how the result must be reported. They also empower the courts to investigate and remedy faults in the electoral process, although legal traditions also limit the scope of these arrangements, which can act as sources of instability rather than stability, if taken too far. Thus, legal precedents often encourage courts to eschew investigations into election irregularities unless enough votes are in doubt to call into question the final outcome – effectively trading off accuracy of the vote count against the potential for further investigations to undermine the factual objectivity of the result. The role of the courts is thus to ensure that contested claims about the management and tallying of a particular election are resolved in accordance with widely accepted notions of justice and the law.²⁴

Several comments are worth making about the behavior of courts and of parties to legal cases during the 2000 Presidential election, as they relate to concerns about stability and instability. During the first few days after the election, it appeared that recourse to the courts might be avoided altogether, as the campaigns seemed to view them as too great a source of potential instability. Neither side seemed inclined to appear as if it was widening the dispute by being the first to involve the courts. There was a fear that doing so might appear destabilizing to the public and therefore reduce support for the candidate in question. However, other parties were not so reluctant, and several court cases were filed, especially the one in Seminole County noted briefly earlier. This set the stage for rapid escalation in court actions. Among the two campaigns, the Bush team moved first, on 11 November, requesting that the US District Court for the Southern District of Florida step in to stop the hand recounts then proceeding in several Florida counties. Soon thereafter, in the wake of the 9 November Harris ruling that hand recounts completed after the 7-day statutory limit would not be included, the Gore campaign filed suit in Leon County Circuit Court to force her to allow these additional votes to be counted. Gore then subsequently filed to contest the election. The legal

battle was on and, at this point, much of the focus of the controversy shifted into the courtroom.

Over time, however, the courts emerged as a relatively stabilizing force in the election contest. During the controversy, the legitimacy of the courts to rule on electoral questions went largely unchallenged. Although rhetoric surrounding the initial move to the courts suggested that this might be viewed as illegitimate, once the dispute shifted into the courts such rhetoric quickly subsided. The Bush campaign initially sought to limit the scope of the courts' actions by insisting on the metaphor of playing by the rules set prior to Election Day. However, the Bush team was the first to file court action, and Florida law appeared to grant the courts wide discretion in fashioning remedies for disputed elections. In the end, none of the judicial rulings chose to adopt the Bush campaign's suggestions in arguing for a limited role for the courts. The closest parallel was the argument of the Rehnquist et al. concurrence that the Florida courts should be especially deferential to the legislative scheme as a result of the language of Article 2 of the Constitution. The three judges were unable to persuade their colleagues of this logic, however, and the force of their argument was reduced by the fact that the three admitted that the Supreme Court was itself stepping into legal disputes over electoral law in which it would itself normally be extremely deferential (and, in effect, insisting upon changes in state election law).

Perhaps the most important moment of deference to the legitimacy of the courts came when Gore finally conceded the election, choosing not to contest the US Supreme Court ruling in favor of Bush. Moreover, as the various trials and hearings proceeded, recourse to the courts seemed to shore up an image of order in the post-election process. Unlike the images of the first few days, which had included street demonstrations, dueling press conferences, and so forth, images of the dispute now shifted to lawyers presenting testimony and judges making rulings, all in the atmosphere of a courtroom familiar to generations of Americans who have watched such programs as *Night Court*, *L.A. Law*, and *Judge Judy*, if somewhat more prosaic than these television dramatizations.

Crucially, the courts proved able to resolve a host of electoral disputes about how to count ballots. Authors such as Posner and Tribe have largely missed this role, by focusing narrowly on the back and forth debates between the US Supreme Court and the Florida Supreme Court. However, the question before the two Supreme Courts regarding whether and how to count overvotes and undervotes was only one of dozens of disputes that emerged in the early days of the election dispute. A large number of these disputes appeared, given the extremely narrow margin of the election, to have the potential to overturn the result and, therefore, to turn out to be central to the contest. Yet only one of these disputes was still in play by 12 December, thanks to lower court rulings. Consider the butterfly ballot dispute in Palm Beach County. In a consolidated hearing of several lawsuits filed over butterfly ballots, the Florida Supreme Court determined on 1 December 2000, that the ballots were legally cast and that the handful

of citizens involved had insufficient grounds to justify a new election that would damage the rights of the vast majority who had properly cast their votes. Nor, given the secrecy of ballots, was there the possibility to change individual votes, since there was no way to determine as a matter of fact that a person who said they had voted for Buchanan had in fact done so or that, if they said they had desired to vote for Gore, they had in fact so intended.²⁵ And what about the case in Seminole County of a Republican party official who had added voter identification information after several thousand absentee votes had been cast? Had this information remained absent when the votes were tallied, they would have been invalidated. Were they legal? Again, a court ruling determined that, consistent with legal precedent in Florida, the sanctity of voting as an act of citizenship required a standard in which technical inconsistency with the law was not sufficient to invalidate otherwise legally cast votes. The votes counted.²⁶

As a result of these and several other court rulings, numerous questions about the election were resolved long before the dispute arrived at the doors of the Florida or US Supreme Court.²⁷ As contested as the issue of hand recounts had become, it was significantly less complex than trying to deal with the whole range of issues that had arisen during the previous 36 days. In particular, the prior resolution of the many other issues left whole the officially certified vote tally filed on 14 November by Katherine Harris, barring the legality of hand recounts under a subsequent election contest proceeding. This considerably simplified the task of those members of the US Supreme Court who wanted to bring finality to the controversy, since they could simply vacate the Florida Supreme Court ruling and leave the 14 November count as final.

Media Coverage

The final element of the electoral network I want to explore briefly is media coverage. After casting their votes, a large majority of US voters engaged with the 2000 election solely through proceedings on television. An even larger number of US citizens engaged with the controversy over the election only through television (and, to a smaller extent, through radio or newspaper accounts). The visual medium was thus tremendously important, as it is for most US Presidential elections, in public constructions of electoral stability.

One aspect of the media's role in electoral closure involves the production of Election Night television coverage, which creates a visual space in which citizens witness the election count. Over the course of typical Election Night coverage, reporters and newscasters identify the winner of each state after its polls close and tally that state's Electoral College votes for the winning candidate. These winners are not initially determined according to machine tallies of votes, but rather according to projections and forecasts based on exit polls: surveys of voters outside of polling places after they have cast their votes. Often the winner of the Presidential race is announced long before the vast majority of vote tallies are complete and

sometimes even before polls close in some states. The losing candidate then concedes, usually days before election officials certify state-by-state election results and more than a month before the Electoral College meets to formally ratify electoral victory. In short, Americans almost always know who the next President will be well before the machinery of the voting system has worked its way to a final conclusion. At least, that's how it's supposed to work.²⁸

Election coverage is ritually connected to historical traditions in the public production of factual knowledge regarding the outcome of elections. In the 19th century, US elections were held in public spaces and the community would gather to cast and count ballots in full view of one another. Today, Americans often congregate at parties and in public spaces to watch television coverage of electoral proceedings. They want to see for themselves who wins and who loses. Public concession and acceptance speeches covered by television news testify to and acknowledge winners and losers. When it goes smoothly, at the end of the night, those who have watched know, as a matter of fact, who their next President will be, because they have witnessed the ritual tallying of the votes and the anointing of the elect. Moreover, the knowledge is collective. All viewers receive the same information at essentially the same point in time. Of course, the process is heavily scripted, by the ritual expectations of the candidates and the television viewers and also by careful standardization of coverage by the various networks. To avoid conflicting visual messages stemming from multiple forecasting technologies (and to reduce the costs of supporting multiple exit polls), the networks recently formed a coalition called the Voter News Service (VNS) to forecast each state's winner.²⁹ VNS operates an elaborate system of exit polling, carried out by surveys conducted in carefully selected precincts around the country, combined with computer models that extrapolate from survey data to project electoral outcomes.

The power of this ritual to provide closure to the election is clear. Premature announcement of a winner in the Presidential race is well known to produce significant drop-offs in voter turnout in places where polls are still open. What was shown in 2000, however, was the power of this ritual to prevent closure in the Presidential race. In the early evening, the VNS erred in projecting that Gore would win Florida, and the networks immediately followed suit. Many Democrats who heard this news cheered the prospect of a Gore victory. The VNS error was the result of faulty data entered into the computer model that projected electoral results from exit polling. Later, when the data were corrected, VNS retracted its projection and put Florida back in the undecided column, and the networks again followed suit. Then, as early vote counts (actual, not projected) began to come in from rural counties in Florida, showing larger than expected Bush victories, VNS again projected a Florida victory, but this time for Bush, and again the networks followed suit. Finally, early in the morning of 8 November, as heavily Democratic urban counties in Florida began to go overwhelmingly for Gore (again, in actual vote counts), the networks once

again backed off and asserted that Florida was still undecided. This last switch occurred just as Gore was getting ready to concede to Bush and prompted Gore to renounce his concession. The post-election contest was on.

Just as it has proved able to do on Election Night, television coverage also both exacerbated instabilities and helped resolve them during the subsequent electoral dispute. During the first days after the election, television news coverage was disjointed and showed disjointed events. Reporters focused in on hanging chads, public protests, voter questions, and dueling press conferences. Neither voting machines nor hand recounts fared well under the scrutiny. Caught unprepared, networks scrambled to find anyone who could and would comment on the events viewers were watching. Still, they framed the dispute as spectacle and helped viewers feel that they were seeing what was happening, perhaps providing some degree of reassurance. As the dispute progressed, commentators became more knowledgeable and coverage shifted to legal proceedings. The process acquired a greater sense of order. The candidates were seen playing football with their families. Television coverage of the spectacle waned until it was only seen on the evening news and cable channels. A sense of normalcy in American life returned. The Supreme Court heard arguments and made its decision. Gore conceded – on television.

Network Performance and Stability

The picture of the voting system as a heterogeneous network that I have presented offers a number of useful advantages both for our understanding of the stability of US democracy, and for more pragmatic concerns, such as election reform. If one thinks of the voting system in binary terms, as either broken or working, then one is left with a democratic system either threatened with imminent collapse (as Posner argues) or fully robust (as Tribe suggests). Understood as a network of heterogeneous, interconnected social spaces, however, the question of stability acquires more nuance and gradation. Networks are often capable of functioning, at least partially, even when a large number of their nodes fail (consider the Internet, for example, or a neural network). At least initially, network operations degrade with a falloff in capabilities, rather than in a precipitous crash. If one node fails (as in the case, for example, that the counts produced by a particular precinct or county are disputed), other nodes (such as canvassing boards or courts) offer additional opportunities to arrive at publicly attestable facts about vote tallies and election outcomes. Localized instabilities or irregularities regularly occur, but only become problematic when they threaten to overwhelm many nodes simultaneously.

The electoral network was neither completely stable nor wholly unstable during the 2000 Presidential election. The objectivity and authority of the final electoral outcome were neither polarized nor static; rather, it must be understood in terms of the dynamics of social and institutional

practice. Commentators like Posner highlighted contingencies and uncertainties that haunt the detailed practices of many elections. These elements of the election dispute were serious. They did, in fact, lead to a complex, contested, highly partisan dispute that significantly damaged the legitimacy of the Bush Presidency. They might very well have led to extended political debates through even more arcane constitutional procedures, had the Supreme Court opted not to step into the fray, or had Gore failed to concede following the Supreme Court decision. But the result did not ultimately imperil US democracy, and the fact that it did not can be laid squarely on the activities of the electoral network.

In the case of the 2000 Presidential election, the vast majority of nodes in the network generated settled matters of fact concerning the electoral tally for a given precinct, county, or state. Consistent with other findings in science and technology, the objectivity of these factual claims received strong support from social and institutional practices that helped to reinforce uncertain epistemological claims. Baker's threat, that the process would slip away, generating a cascade of new election contests, outside Florida as well as in, and leaving Americans without a legitimate President, did not bear out.³⁰ Election administrators counted ballots, certified vote tallies, and resolved local uncertainties and inconsistencies as usual, at the level of precincts, counties, and states. Within days of the election, Americans knew with some degree of objectivity what the vote total was, officially, everywhere except Florida, and they knew, even in Florida, where the official vote tally stood – although, obviously, its objectivity remained in question.

Deliberate threats to widen the controversy were not enough to destabilize other nodes. The decentralized character of the process enabled contests to be contained. Most other states in the country did not face the near tie that Florida did, thus removing them from easy contestability. Neither campaign saw enough benefit to outweigh the potential costs of opening up another contest.³¹ Florida was enough for Gore to win, and no other close state would have gotten him enough votes in the Electoral College to overcome the Bush lead. Bush, on the other hand, relied heavily on the moral authority and rhetoric of opposing more recounts, a position he would have been denied had he opted to contest elections in other states. The propensity of the courts to avoid detailed investigations of electoral practice, unless enough votes are in question to alter the outcome, also helped ensure that only a very small number of other states might have been potential candidates for election contests in court.³² As mentioned earlier, in Florida numerous local disputes about vote counts, ballot designs, and so forth, were resolved in county court decisions that were upheld on appeal. Thus the legal question in front of the Florida Supreme Court and the US Supreme Court was narrowed considerably from the vast scope of election abuses cited in Florida and elsewhere. In the end, the two Supreme Courts were faced solely with the question of whether Al Gore was entitled to a manual recount of the undervotes and overvotes in the election of Florida's electors.

The media played a more ambiguous role. Election Night television coverage can enhance or detract from the perceived objectivity of electoral outcomes. In Florida, television coverage helped exacerbate suspicions that the day's voting and tallying had not arrived at an objective outcome, by contributing to uncertainty about who had won Florida. So, too, did coverage of the first days of the controversy, which highlighted irregularities and contested proceedings. Later, however, television coverage of court proceedings helped reinforce views of a more ordered process for sorting out the various contested claims and, ultimately, the finality of the election, with Gore's concession. Throughout, media accounts also gave viewers a sense that they were able to see events transpire, contributing to a sense of transparency and spectacle that some have speculated was also important in contributing to public calm during the controversy (Dennis, 2001). Lacking an overwhelming incentive to abandon their Constitutional institutions, the American public deferred to the authority of the Supreme Court, even if many people raised their eyebrows regarding the objectivity of the Court's decision. They were left with a partial settlement, one that effectively closed the controversy but did so in a manner that left room for doubt.

The sources of this doubt are consistent with a co-productionist idiom. First, the political/legal judgment of the Court did not decisively resolve the objectivity of the final vote count or even the final electoral outcome. The official Florida tally stood, but the status of the contested overvotes and undervotes remained in question. The Court ruled on the basis of 'finality', explicitly acknowledging that it had chosen not to pursue a more accurate vote count. The discrepancy between the Electoral College and the popular vote totals, which favored Gore by nearly a half million votes, certainly did not reinforce the message that the candidate who had won the most votes nationwide was accorded the electoral victory. Neither did the prolonged campaign in the months after the election by *The Miami Herald* to produce what they considered to be an accurate count of the disputed ballots. Second, the Court's behavior contravened notions of the proper role of the legal system in American society. Americans living today may be accustomed to courts resolving all kinds of disputes, including electoral disputes, but they are not accustomed to the Supreme Court deciding who will be the next President. That said, however, it seems unlikely, under the circumstances, that any process could have been fashioned to successfully construct an objective vote count in the period between 12 December, when the Court ruled, and the vote of the Electoral College on 18 December – or even the counting of the Electoral College votes in Congress on 6 January.³³ Neither 6 nor 25 days allow much time to try to fashion an appropriate solution. In this regard, Presidential elections may place an inherent constraint on the ability of a deep social network to redress instabilities in extremely close elections, a constraint that does not exist for the vast majority of other elections.³⁴

For many, the Supreme Court's divisive decision in *Bush v. Gore* offered further testimony to the declining stability of US democracy. In

recent years, a broad debate has emerged over whether the US public remains a sufficiently cohesive community to continue to successfully hold together in the face of globalization and other challenges. Robert Putnam, for example, has probed the depth of the America's social capital, suggesting that it is declining (Putnam, 2000). Others, most notably Joseph Nye, have pointed to what appears to be a declining trust in large-scale institutions as scandals have riven the White House, Enron, Arthur Andersen, and the Catholic Church (Nye et al., 1997). This view is too simple, however, given a careful analysis of the voting system. To be sure, recent scandals seem to have undermined the ability of elections to authorize power in the American as securely as they might once have. Nixon's resignation, Clinton's impeachment hearing, the 2000 controversy, and the recall of Gray Davis all suggest new limits on the power of elections to authorize transitions of power in the USA. Yet discussions of a decline in trust in government institutions have not given much attention to the array of intermediate, hybrid institutions that span the USA, integrating across scales from the local to the national and across society from civic groups to the state. Nor have political scientists given much attention to the questions of knowledge and epistemology that play a key role in determining public trust in governing institutions. I hope I have shown, viewed as a network of social spaces and institutions with important epistemological dimensions, the voting system offers a model for how to think about the ways in which the activities of individual Americans are linked, in wider circles of interaction, to form a nation as a whole, in part through the distributed production of collective matters of fact. Moreover, if the events documented here are any indication, these intermediate networks continue to function in important ways to stabilize US democracy. As we pursue election reforms in the wake of the 2000 controversy, therefore, we must be careful not to degrade their ability to continue to do so.

Conclusion: Questions of Reform

Throughout the 20th century, Florida courts (and most others across the country) have consistently ruled that ballots cannot be excluded merely because technical irregularities occurred in the way they were cast or subsequently handled, as long as the vote otherwise was legally cast. The principle is simple. Participation in elections is one of the fundamental acts (and signs) of citizenship in a democracy, and to disenfranchise a voter is seen as too great a penalty for mere failure to follow the rules in a precise and exact manner. From a pragmatic standpoint, the rule is equally sensible. By ruling that all ballots cast in substantially correct ways are to be counted, the courts avoid becoming embroiled in debates about every minor infraction of the rules, which, as became apparent in Florida, can be ubiquitous in actual electoral practice.

Justices Rehnquist, Scalia, and Thomas ruled in their concurrence in *Bush v. Gore* that voters who fail to follow the rules, so that machines cannot read their ballots, negate their right to have their votes counted.

The debate here is over how to interpret somewhat imprecise norms. Broad agreement seems to exist on the need for all ballots cast in a substantially correct manner to be counted using a consistent set of counting rules. However, the three conservative justices' definition of what counts as a substantially correct manner of voting was far narrower than Florida precedent allowed and was, in fact, narrower than the majority of the Supreme Court accepted or the Florida legislature subsequently adopted in its post-election reforms. The five-justice majority was only able to agree on the position that there was insufficient time to implement an acceptable standard for the manual recounts; this presumed the potential validity of votes that the machines did not count.

The notion that people can be reliable participants in elections took quite a beating from image-makers who sought to cast voters as incompetent to operate machines and county vote counters as political hacks looking to steal votes. Support for this position clearly exists in public discourse about machines and technology; discourse that disparages people who cannot adapt to machines: technophobes who shy away from computers or who fear to fly or drive automobiles. Yet, we also know that there are times when machines do not work as expected. Under such circumstances, we demand human backups who can sort through the machines' errors and repair them.³⁵ Fewer people would use an ATM if they did not trust that their bank would rectify any errors made by the machine. Fewer people are willing to fly on airplanes now that they distrust the human security measures at airports.

We need to work to foster, and where necessary rebuild, public trust in the human networks that maintain confidence in electoral machinery. Good social institutions can and regularly do repair a wide range of mechanical and human faults in the conduct of elections. Without such institutions, however, even the best machines are unlikely to satisfy very many people for very long. This is one of the reasons that creating democratic elections in places where they have not flourished before is so challenging. Without public trust in the people who back up the machines, the legitimacy of elections is likely to suffer. Building such trust, however, especially in violence-riven societies, is enormously difficult.

Suggestions for reform offered by groups like the Caltech-MIT Project and those adopted in Florida acknowledge the importance of building and maintaining strong social institutions – and not just buying 'high-tech' vote-counting machines – to the generation of objective vote counts. Florida moved to mandate manual recounts of undervotes and overvotes in elections where those votes might make a difference. The Caltech-MIT Project has recommended numerous technological changes, many of which focus on making it easier for the people who conduct elections to fix errors throughout the voting system so that every eligible citizen is given an opportunity to cast a vote and to have that vote accurately included in the electoral tally. Examples include on-line registries that can be checked by poll workers to fix mistakes or omissions in paper lists of registered voters; permanent records of votes that can be used to carry out recounts and

audits and that track which machines cast and counted the vote, so that errors can be identified and fixed; and verification printouts so that voters can ascertain for themselves that the machine recorded the vote they actually cast.

Unfortunately, most of the updates to the electoral system in the wake of election 2000 have gone in precisely the opposite direction. The major change has involved the shift from punch cards to direct recorded electronic voting (essentially, an ATM machine that records votes).³⁶ These systems, which today are found in 30% of US counties, have been charged with being insecure and vulnerable to a wide range of hardware and software failures, as well as deliberate fraud;³⁷ yet they prevent the election network from functioning to back them up. Complaints have been made that the most prevalent model of these machines offers no 'voter verified audit trail', preventing voters from determining for themselves if the machine counted their vote, and providing no record for an election board or court to verify the original vote. Reconstructing the result in a fraudulent or error-laden election would also prove impossible. The result is likely to be more frequent outcomes, in many elections, that cannot achieve the kind of closure around accurate vote counts necessary for the public to accord full trust in their knowledge that their elected officials were indeed elected.³⁸

A second, equally important question that remains unanswered – and largely unasked – in the literature on the 2000 election is whether there is enough time available in Presidential elections for the electoral network to bring controversies to closure. Plenty of evidence in this case suggests not. The date up to which states could obtain 'safe harbor', 12 December, was only a little more than 1 month after Election Night and less than 1 month after the official certification of the Florida election on 14 November. The Electoral College met on 18 December, its votes were counted 6 January, and Inauguration Day was 20 January. Resolving protracted hand recounts, court filings, and appeals in the time allotted poses a challenge to the closure process to appear legitimate and fair. Fortunately, Presidential elections as tight as the one in 2000 have been rare (although closer Presidential elections had occurred in recent decades, they lacked the protracted drama). Just how the recount and contest process might be altered to allow for a longer period of time is not clear. Advancing Election Night or delaying Inauguration Day only broadens the 'lame duck' period in the case of a win by a challenger. Eliminating the Electoral College might at first appear to help, since a close election in the actual popular vote seems plausibly more unlikely than a close vote in a single state large enough to throw the Electoral College (the 2000 election, for example, wouldn't have been contested). On the other hand, relying solely on the popular vote would, in the case of an extremely close election, arguably result in Florida-like disputes being waged in every state in the nation, as candidates searched for any vote they could find, anywhere. Such a situation would strike many, I suspect, as potentially unstable and certainly more in danger of slipping away than the election contest in 2000. The

decentralization of operating 50 distinct state systems would become a liability instead of an asset.

What we have learned from this election, then, is that the US election system, while well designed to resolve election irregularities, is at its weakest when dealing with irregularities in its most important election. This is surely not a good position to be in – especially if, as some have suggested, the growing use of electronic voting machines further reduces the system's ability to repair contested counts. Yet, it is not clear where to go. Are Americans, as Tribe suggests, tolerant of archaic and infrequently used constitutional processes for resolving such fundamental questions as who will next hold the office of President of the United States? Or would Americans prefer the finality of candidates eschewing election contests, as Baker suggested, even when they appear legitimate, or of the courts pragmatically anointing a President, as Posner argues? One point to consider is that we simply don't know. There has been little discussion of these matters since the early 19th century. Perhaps the time has come for the world's oldest democracy to hold a debate about some of its foundational legal and constitutional procedures. At least then, the next time a contest like this comes up, there would be a better chance of knowing what those procedures are, and the nation's political institutions might have some guidance on how to proceed.

Notes

I would like to thank Stephen Turner and three anonymous reviewers for extremely valuable contributions. Participants in the brown bag series at the Robert and Jean Holtz Center for Science and Technology Studies at the University of Wisconsin-Madison also offered a number of very useful suggestions on an earlier version of this paper. Any errors remain my own. The material for this paper is based on work supported by the National Science Foundation under grant no. SES0296211.

1. The night would ultimately end with the Florida Division of Elections reporting (unofficially) that Bush held a 1784 vote margin.
2. Thus the joke, common during the controversy, that recipients of American lectures on how to run a democracy – like Cuba and Serbia – should send election observers to Florida. For an illustrative example, see the cartoon published in Testi (2001: 416).
3. The mode of civic epistemology described in this paper for the voting system differs in many aspects from other modes that exist, including state-centric, statistical quantification and classification (see, for example, Porter, 1995; Bowker & Star, 2001), and formal expert advisory institutions (Jasanoff, 1990).
4. James Baker, Press Conference, Tallahassee, Florida, 11 November 2000. Full quote given later in the text (p. 1).
5. *Ibid.*, emphasis added.
6. *Bush v. Gore*, 000 U.S. 00-949 (2000). Concurrence by Rehnquist, Scalia, and Thomas. Printed in Dionne & Kristol (2001: 107, 109).
7. The role of the stabilizing arrangements for post hoc election management is not the only system of interest, of course. Suggesting that the close election can be modeled as a coin flip, Jasanoff (2001) argues that attention be paid to the selection of Presidential Candidates and why Americans saw little difference between the two in this election.
8. Other papers in the same issue by Agre, Collins, Finn and Sutton, Dennis, Hilgartner, Lewenstein, Lucier, Lynch, Miller, Turner, and Jasanoff also provide relevant accounts of the difficulties involved in the counting ballots during the election (Lynch, 2001b).

For an extensive account of the Bush team's strategies, tactics, and maneuvers during the election contest, see Zelnick (2001).

9. An account of the history of punch-card voting machines, their introduction into elections, and their repeated problems with undervotes and overvotes can be found in Merzer et al. (2001: 51–63).
10. In the USA before 2000, counties were the jurisdiction most frequently empowered by state election laws to select the manner by which voters would cast their votes. The percentage of counties using paper ballots fell from 40.4 in 1980 to 12.5 in 2000. The percentage of the total voting population using paper ballots fell from 9.8 in 1980 to 1.3 in 2000 (Caltech-MIT Voting Technology Project, 2001: 88).
11. Gore strategically requested recounts in Volusia, Palm Beach, Broward, and Miami-Dade Counties, counties with large democratic populations and substantial numbers of punch-card voting machines. The Florida Supreme Court later insisted on a full statewide recount of undervotes and overvotes, but this count was halted by the US Supreme Court. As a reviewer pointed out, one of the little ironies of the election is that, using certain not unreasonable counting standards, Gore would not have won had only the undervotes and overvotes of the four counties he requested been completed, but he would have won in a full statewide recount.
12. Baker, *op cit.*, note 4.
13. *Ibid.* The other principal reason for the introduction of machines, the much greater speed with which the could count votes, was left unsaid.
14. *Bush v. Gore*, 000 U.S. 00-949 (2000) Concurrence by Rehnquist, Scalia, and Thomas. Printed in Dionne & Kristol (2001: 114). This passage is also discussed in Lynch (2001a).
15. *Ibid.*, p. 114.
16. Punch-card systems were not the only technology that 'lost votes' in the 2000 election. According to the Caltech-MIT Voting Technology Project, which assessed the state of voting technologies in the USA after the election, every other kind of technology in use also created circumstances in which individuals entered the polling place intending to vote for one of the two candidates and left thinking they had done so, but did not have their vote actually counted. The accepted standard among election officials for 'lost votes' is apparently 2% – more than enough to tip the balance of not just this election but a surprisingly large number of Presidential elections in history.
17. I note later that the Florida legislature, in enacting electoral reforms after the 2000 controversy, deliberately signaled its commitment to just the logic Rehnquist, Thomas, and Scalia rejected, formally ratifying a candidate's right to a manual recount of under votes and over votes.
18. For a discussion of attestive visual practices of democratic accountability, see Ezrahi (1990). For an illustrative study of audit trails as tools in forging credibility chains for knowledge claims, see Jordan & Lynch (1998).
19. Florida Code, 2000, Title IX, 102.061 Duties of election board; counting; closing polls.
20. Florida Code, 2000, Title IX, 102.166 Protest of election returns; procedure.
21. Compare with Shapin & Schaffer (1985), especially chapter 2, 'Seeing and Believing'.
22. Posner (2001: 97) argues: 'To classify a "failure" that is built into the design of the tabulating machinery as an error or defect in the tabulation of the vote would make hand recounts mandatory throughout most of the state in all close elections – something the election statute cannot reasonably be read to contemplate.' Perhaps so, which may be why the (Republican) state legislature in Florida moved after the controversy to introduce a new provision that did, in fact, mandate hand recounts of overvotes and undervotes in all close elections. Florida Code 102.166 (1) now reads: 'If the second set of unofficial returns pursuant to s. 102.141 indicates that a candidate for any office was defeated or eliminated by one-quarter of a percent or less of the votes cast for such office, that a candidate for retention to a judicial office was retained or not retained by one-quarter of a percent or less of the votes cast on the question of retention, or that a measure appearing on the ballot was approved or rejected by one-

- quarter of one percent or less of the votes cast on such measure, the board responsible for certifying the results of the vote on such race or measure *shall order a manual recount of the overvotes and undervotes* cast in the entire geographic jurisdiction of such office or ballot measure' (emphasis added).
23. A more extensive discussion of the role of the courts in the election controversy is given in Gillman (2001). Dionne & Kristol (2001) reproduce the judicial decisions taken in several of the key court cases. The courts' role in helping shore up the objectivity of elections is also discussed in Miller (2001). For a detailed examination of the visual practices of epistemology in the US courts, see Jasanoff (1998).
 24. For a broad discussion of law and precedent in Florida election contests, see *Boardman v. Esteve*, 323 So.2d 259 (1975).
 25. *Fladell v. Palm Beach County Canv. Bd.* and *Katz v. Florida Elections Canvassing Commission* 772 So.2d 1240 (2000).
 26. *Jacobs v. Seminole County Canv. Bd.* 773 So.2d 519 (2000).
 27. An extensive array of documentation of the more than 30 court cases filed in the election controversy can be found on the Findlaw website at <<http://news.findlaw.com/legalnews/us/election/election2000.html?index>>.
 28. One reviewer noted that, given the importance of attestive visual practices to the authority of elections, both in Election Night coverage and vote tallying procedures, it is striking that the US government does not require or even encourage the public to show up and watch the proceedings – nor is there a strong social norm to that effect. Aside from noting the importance of voluntarism in US elections, I can only suggest that Americans place their faith as much in the potential for processes to be seen as they do in the seeing itself – or perhaps in a belief that others are watching.
 29. This helps to avoid a situation in which the networks compete to call the election and, therefore, it reduces the incentive for networks to call the election prior to the close of precincts in late-voting states.
 30. To be sure, Baker himself may not have expected fundamental instability but sought to use the threat strategically, in the hopes of making a difference at the margin.
 31. In line with arguments that Latour (1987) has made for black-boxes more generally, candidates' decisions to acknowledge or refuse to acknowledge defeat, and to formally or informally contest elections, make a tremendous difference to the perceived objectivity and stability of electoral outcomes and vote counts. Stability thus emerges, in part, as a result of the cost of continuing the contest. As I hope I have demonstrated here, however, this kind of individual agent model is only partially persuasive. Social and institutional resources for closing controversies are also important.
 32. For a more complete discussion of this propensity of the courts, see especially Miller (2001: 455–56).
 33. Tribe's argument that Congress would provide a more legitimate settlement than the Court, should the Electoral College be unable to arrive at a winner, seems unlikely in this regard.
 34. It should be noted that the election network and its contest provisions were designed and honed around other, less weighty elections than that of President. Only once before in the past 150 years, in 1876, was there a delay in certifying the result of a US Presidential election.
 35. Collins (1990) has argued that human activities to repair machines are endemic and essential to the function of all technologies.
 36. Stewart, Charles, III (2004) 'Voting Technology: Current Assessment and Future Prospects', Presentation to the American Association for the Advancement of Science Annual Meeting, Seattle, WA, USA, 15 February 2004.
 37. A wide range of software and hardware problems, as well as security failures, have been reported for electronic voting machines. For a list, see Peter G. Neumann, 'Illustrative Risks to the Public in the Use of Computer Systems and Related Technology: Section 1.21 Election Problems', available online at <<http://www.csl.sri.com/users/neumann/illustrative.html>>.

38. Stanford computer scientist David Dill has launched an Internet campaign to promote the use of voter-verifiable audit trails in all elections. See <<http://www.verifiedvoting.org>>.

References

- Ackerman, Bruce (2002) 'Introduction: The Question of Legitimacy', in Bruce Ackerman (ed.), *Bush v. Gore* (New Haven, CT: Yale University Press): vii–xiii.
- Bowker, Geoffrey & Susan Leigh Star (2001) 'Pure, Real, and Rational Numbers: The American Imaginary of Countability', *Social Studies of Science* 31(3): 422–25.
- Caltech-MIT Voting Technology Project (2001) *Voting, What Is, What Could Be: Report of the Caltech-MIT Voting Technology Project* (Pasadena, CA, & Cambridge, MA: California Institute of Technology and Massachusetts Institute of Technology).
- Carson, John (2001) 'Opening the Democracy Box', *Social Studies of Science* 31(3): 425–28.
- Collins, H.M. (1985) *Changing Order: Replication and Induction in Scientific Practice* (London: SAGE Publications).
- Collins, H.M. (1990) *Artificial Experts: Social Knowledge and Intelligent Machines* (Cambridge, MA: MIT Press).
- Dennis, Michael Aaron (2001) 'Count Me Out!', *Social Studies of Science* 31(3): 436–39.
- Dionne, E.J., Jr & William Kristol (eds) (2001) *Bush v. Gore: The Court Cases and the Commentary* (Washington, DC: Brookings Institution Press).
- Evans, Peter, Dietrich Rueschemeyer & Theda Skocpol (eds) (1985) *Bringing the State Back In* (Cambridge: Cambridge University Press).
- Ezrahi, Yaron (1990) *The Descent of Icarus: Science and the Transformation of Contemporary Democracy* (Cambridge, MA: Harvard University Press).
- Gillman, Howard (2001) *The Votes that Counted: How the Court Decided the 2000 Presidential Election* (Chicago, IL: University of Chicago Press).
- Jasanoff, Sheila (1990) *The Fifth Branch: Science Advisers as Policymakers* (Cambridge, MA: Harvard University Press).
- Jasanoff, Sheila (1998) 'The Eye of Everyman: Witnessing DNA in the Simpson Trial', *Social Studies of Science* 28(4/5): 713–40.
- Jasanoff, Sheila (2001) 'Election 2000: Mechanical Error or System Failure?', *Social Studies of Science* 31(3): 461–67.
- Jasanoff, Sheila (ed.) (2004a) *States of Knowledge: The Co-Production of Science and Social Order* (New York, NY: Routledge).
- Jasanoff, Sheila (2004b) *Designs on Nature* (Princeton, NJ: Princeton) (In the Press).
- Jordan, Kathleen & Michael Lynch (1998) 'The Dissemination, Standardization, and Routinization of a Molecular Biological Technique', *Social Studies of Science* 28(5/6): 773–800.
- Latour, Bruno (1987) *Science in Action* (Cambridge, MA: Harvard University Press).
- Law, John & Michael Lynch (1990) 'Lists, Field Guides, and the Descriptive Organization of Seeing: Birdwatching as an Exemplary Observational Activity', in Michael Lynch & Steve Woolgar (eds), *Representation in Scientific Practice* (Cambridge, MA: MIT Press): 276–99.
- Lynch, Michael (2001a) 'Noise and Politics', *Social Studies of Science* 31(3): 446–54.
- Lynch, Michael (ed.) (2001b) 'Pandora's Ballot Box: Comments on the 2000 US Presidential Election', *Social Studies of Science* 31(3): 417–19.
- Merzer, Martin, and the staff of *The Miami Herald* (2001) *Democracy Held Hostage: The Miami Herald Report* (Miami, FL: The Miami Herald).
- Miller, Clark A. (2001) 'Making Democracy Count', *Social Studies of Science* 31(3): 454–458.
- Nye, Joseph, Philip Zelikow & David King (eds) (1997) *Why People Don't Trust Government* (Cambridge, MA: Harvard University Press).
- Polsby, Nelson (2002) 'Holy Cow! Preliminary Reflections on the 2000 Election', in Ronald Dworkin (ed.), *A Badly Flawed Election: Debating Bush v. Gore, the Supreme Court, and American Democracy* (New York: The New Press): 265–83.

- Porter, Theodore (1995) *Trust in Numbers: The Search for Objectivity in Public Life* (Princeton, NJ: Princeton University Press).
- Porter, Theodore (2000) 'It's Not in the Numbers', *Washington Post*, 26 November: B01.
- Posner, Richard (2001) *Breaking the Deadlock* (Princeton, NJ: Princeton University Press).
- Posner, Richard A. (2002) 'Bush v. Gore as Pragmatic Adjudication', in Ronald Dworkin (ed.), *A Badly Flawed Election: Debating Bush v. Gore, the Supreme Court, and American Democracy* (New York: The New Press): 187–213.
- Putnam, Robert (2000) *Bowling Alone: The Collapse and Revival of American Community* (New York: Simon and Schuster).
- Shapin, Steven & Simon Schaffer (1985) *Leviathan and the Air Pump: Hobbes, Boyle, and the Experimental Life* (Princeton, NJ: Princeton University Press).
- Sunstein, Cass R. (2002) 'Lawless Order and Hot Cases', in Ronald Dworkin (ed.), *A Badly Flawed Election: Debating Bush v. Gore, the Supreme Court, and American Democracy* (New York: The New Press): 75–104.
- Testi, Arnaldo (2001) 'Tribulations of an Old Democracy', *Journal of American History* 88(2): 415–23.
- Tribe, Laurence (2002a) 'Freeing eroG v. hsuB from its Hall of Mirrors', in Ronald Dworkin (ed.), *A Badly Flawed Election: Debating Bush v. Gore, the Supreme Court, and American Democracy* (New York: The New Press): 105–54.
- Tribe, Laurence (2002b) 'eroG v. hsuB: Through the Looking Glass', in Bruce Ackerman (ed.), *Bush v. Gore* (New Haven, CT: Yale University Press): 39–66.
- Zelnick, Robert (2001) *Winning Florida: How the Bush Team Fought the Battle* (Stanford, CA: Hoover Institution).

Clark A. Miller is assistant professor in the Robert M. La Follette School of Public Affairs and the Robert and Jean Holtz Center for Science and Technology Studies at the University of Wisconsin-Madison. His work explores the constitutional role of knowledge in political systems, with an emphasis on US democracy and global governance. He is the editor, with Paul Edwards, of *Changing the Atmosphere: Expert Knowledge and Environmental Governance* (MIT Press, 2001).

Address: Robert M. La Follette School of Public Affairs, University of Wisconsin-Madison, 1225 Observatory Drive, Madison, WI 53706, USA; fax: +1 608 265 3233; email: miller@lafollette.wisc.edu