COUNT 'EM AGAIN, SAM:
A Report for the Center for Voting and Democracy
on the Cambridge PR Election Recount of 2001

Cambridge, Massachusetts, being one of the few jurisdictions anywhere to use proportional representation to elect its municipal officers, and the only one using computers to tally the votes, refined and added to its distinctiveness this year by conducting a recount -- and doing so by hand. Though the process was exhausting, expensive and time-consuming, the experience taught two things: first, that the computerized vote-tallying systems works very well; and second, that the recount philosophy and mechanics could be improved upon.

I. Public Vindication of Computerized Vote-Tallying

The big news about the recount was that there was no news. First, as is the case in many recounts, the results did not change. And second, while that bottom line may have been important for the candidates, their supporters, and the school department (it was the school committee election that was recounted), for election administrators, the big news was that the vote tallying system worked well. Not only did it work well, but the public got the chance to see that it worked well.

Unlike the presidential recount of 2000 in Florida, where the recount process triggered nationwide demands for replacement of voting equipment, both the candidates and the press had little quarrel with the way the voting equipment in Cambridge worked. The main deficiency with the system was that it "misread" ballots that voters had mismarked, but which human readers could interpret without much difficulty. For example, a voter might mark his first preference (fill in oval 1) for candidate A, then change his mind and cross out his oval 1 for A, mark oval 1 for candidate B, and mark oval 2 for A. Since optical scanning equipment reads a cross-out the same way it reads a correct mark, it would read an overvote on such a ballot.

Although there were enough ballots resuscitated by human reading to have made a difference in the outcome of this election,[1] no systematic error was observed and the principal beneficiaries of the changes turned out to be candidates whose election was not in dispute. Thus, while humans accepted 11 more ballots as valid in the first round than the scanners had, it was largely the 1st, 2nd, and 3rd place finishers who picked up votes from invalids and mis-credits (a total of 41) and it was only 6th place finisher Richard Harding, of the three contesting candidates, who netted any votes (7).

[1] The Cambridge School Committee has six elected positions. At the end of the decisive 8th round in the original count, the last 3 finishers, each of whom petitioned for a recount, had 2220 (Walser), 2219 (Harding), and 2213 (Segat), out of 17,649 ballots cast. On the recount, the 8th round had those same finishers at 2237, 2230, and 2221. (The fact that all 3 candidates increased their vote totals in the 8th round can be attributed, in part, to the ability of human readers to interpret fewer ballots as "exhausted" than the computer. An "exhausted" ballot is one that shows no choice for an available candidate. Thus there were 486 exhausted ballots at the end of the 8th round originally, but only 472 exhausted at the same point in the recount.)

Two factors played a role in making the misreading of ballots a non-issue in this recount: first, there was neither an empirical nor a theoretical basis for believing that the mismarking had any systematic source, and second, the contesting candidates were all from the same political camp, muting antagonisms that may have arisen in a more partisan context. If any imperative emerged from the misreading, it was that the election administrators should re-teach the electorate how to mark ballots, and more specifically, what a "spoiled ballot" is.

Apart from the misreading, the candidates and the press seemed satisfied that the system -- from the optical scanners to the vote tabulation software -- worked correctly. Indeed, given the time needed to complete the recount and a few human errors that occurred, most participants were thankful that a computer did all the work in the first place.

II. Problems with the Recount Laws

On the other hand, no one was particularly happy with the legal requirements for the recount. Cambridge's municipal elections are governed by the old, indeed, repealed, chapter 54A of the Massachusetts General Laws, which, because it actually functions as part of the city charter for Cambridge, is protected from the legislature's general repeal by the Massachusetts Home Rule Amendment. In combination with the general laws for recounts of computer-tallied elections, the recount of a computerized PR election is a major undertaking.

Three elements combine to create the burden:

First, any candidate who qualifies for a recount of a computerized election is entitled to demand that the recount be done *by hand*. G. L. c. 54, §135B.

Second, in a proportional representation recount, "every ballot shall be made to take the same course that it took in the original count unless the correction of an error requires its taking a different course." G. L. c. 54A, §9(o) (repealed).

Third, Cambridge, as authorized by G. L. c. 54A, §16(b) (repealed), uses a method of distributing "surplus" (a winning candidate's first choice ballots in excess of the threshold) referred to as the "Cincinnati method." This method requires the re-distribution of sufficient ballots to second choice candidates from the winning candidate's *entire set* of first choice ballots, *chosen at a fixed interval*, so that the winning candidate is left with a number of ballots equal to quota, and no more.

The Cincinnati method, and indeed, all methods of distributing surplus that are authorized under §16(b) (as far as known), gives PR the unfortunate characteristic that the outcome of an election not unique. That is, the same ballots, counted in a different order, can theoretically give a different set of winners. Since the "fixed interval" requirement essentially requires a random draw of ballots through the entire set of a winner's ballots, a different ordering of the ballots can give a different draw and a

different set of ballots to transfer to continuing candidates. This different set of ballots could elect different candidates. This is the reason for the requirement in §9(o) that the original order of the count be maintained. Nonetheless, the random element that exists gives a defeated candidate an incentive to "roll the dice" to get a better outcome.

Obeying this stricture in the 2001 recount was quite onerous, and took seven working days. It was implemented by creating from the computer's database of the 17,649 ballot images "ballot replicas," i. e., 8 1/2" x 11" pieces of paper containing the ward and precinct from which the ballot came, the computer-generated identifying number attached to it (its sequence number), the scanner-read preferences shown on the ballot, displayed in the same format as the ballot itself (i. e., following the rotated format of the ballot) as well as in preference order, and a chronicle of the ballot's transfers during the count, if any. See the attached for an example. These ballot replicas were then matched one-for-one with their counterparts, the actual paper ballots stored since the original tally. Once the ballots were matched with their replicas, the replicas would show the sequence in which the ballots were originally counted and hence to be recounted.

Matching ballots to replicas and then putting the ballots in sequence had never been done before, even though Cambridge had re-sorted ballots from manual counts in the past. Thus whether the technique used in this case was the optimal one is hard to tell. It was easy to tell, however, that the time spent in this phase of the process put a strain on the resources of the candidates and on the stamina of election officials.

III. Lessons from 2001

For jurisdictions that are considering the adoption of PR, Cambridge's 2001 recount experience offers several lessons:

First, they should be assured that the vote-tallying system of optical scanners and computer software used by Cambridge correctly tallies the results, not merely to the satisfaction of election administrators but to the satisfaction of the candidates, the press and the public.

Second, the electorate must be educated in marking optically-scanned ballots. In particular, it must know when a ballot is spoiled and to ask for a replacement. Alternatively, or, better, in conjunction with voter education, the precinct-based optical scanners could be programmed to reject ballots that appear to the machine to be incorrect or ambiguous so the voter might be given a chance to correct his or her error on the spot.

Third, they should avoid the combination of factors that leads to the necessity of re-constructing the order of counting. The best way of doing this is adopting a "mathematical method" of re-distributing surplus. This method counts *all* the second preferences in a winning candidate's ballots, then applies a discount factor to each sum. The discount factor is the winning candidate's surplus divided by his or her total. The discounted sum of the ballots is then distributed to each of the continuing candidates and the total distributed deducted from the winner. This leaves the winning candidate with

exactly the threshold and adds to continuing candidates' totals (usually including fractional votes). The virtue of this technique is that it makes the result independent of order, since all ballots are included in the surplus distribution, not a random sample that could change. (Its drawback is that it makes PR even more difficult to explain and will surely create a dissonance with the familiar slogan, "One person, one vote.") A similar technique should be used to avoid order-dependency in subsequent rounds.[2] If they must replicate Cambridge's system, then there are techniques, such as pre-numbering ballots with a bar code unreadable by humans, or post-numbering them, e. g., imprinting them as they are read into the scanner, that would make the reconstruction of order easier.

It would be easy to conclude, after watching the two weeks of Cambridge's recount, that PR is too difficult a system to administer because of it. I suggest the opposite conclusion: Cambridge has successfully harnessed computers to the preferable way of voting for representative bodies, creating a system that has passed the test of official and public confidence. *All* recounts are tedious, but usually they confirm the mechanisms used and the results they reach. Florida's 2000 presidential recount is a good negative example: people did not have confidence that the mechanics were precise enough to give an indisputable result (even after a hand recount) and still debate whether the result actually reflected the will of the voters.

Florida, of course, suggests other lessons as well: preference voting is better for determining who legitimately has a "majority" for winning a single prize such as all the electoral votes of a state. It is also better for dividing electors in proportion to voting strength, which is perhaps an even better way to elect a president.

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Attachment: Sample ballot replica

The writer served as the Cambridge Election Commission's auditor for the 2001 election and for the recount, and gratefully acknowledges input from Steve Owades, who served as the Commission's computer consultant for the count and recount, and from CVD member Robert Winters, in writing this report. The opinions and conclusions, however, are the author's own.

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[2] Order dependency occurs in subsequent rounds, not involving distribution of surplus, if a candidate reaches the threshold in the middle of a round. Cambridge's rules dictate that no further ballots be credited to that candidate, so choices for him or her on subsequent ballots go down to the next lower preference. Obviously, if the ballots were counted in a different order, the ballots occurring after threshold was reached would be different, resulting in different candidates getting different totals.