

ONTARIO
SUPERIOR COURT OF JUSTICE

B E T W E E N

HERBERT GOLDIE

Applicant

- and -

**THE CORPORATION OF THE TOWNSHIP OF BROCK, TERRY CLAYTON,
LARRY O'CONNOR**

Respondents

AFFIDAVIT OF DOUGLAS W. JONES

1. I, Douglas W. Jones, of Iowa City, Iowa, MAKE OATH AND SAY AS FOLLOWS:
2. I am a citizen and resident of Iowa City, Iowa in the United States of America, residing at 816 West Park Road.

My Qualifications

3. I am an Associate Professor at the University of Iowa, Department of Computer Science, where I have taught since 1980. I received my Ph.D. and MS degrees in Computer Science from the University of Illinois at Urbana Champaign, in 1980 and 1976, respectively, and a BS degree in Physics from Carnegie-Mellon University in 1973.
4. My expertise in voting technology is described below, and as such, I have knowledge of the matters to which I hereinafter depose:
5. I served on the Iowa Board of Examiners for Voting Machines and Electronic Voting Systems from 1994 to 2004, and chaired the board for 3 years. This board examines all voting systems offered for sale in the state of Iowa to determine if they meet the requirements of Iowa law.
6. I was invited to testify before the United States Commission on Civil Rights on evaluating voting technology for their January 11, 2001 hearings in Tallahassee Florida. I was invited to testify before the House Science Committee on problems with voting systems and the applicable standards for their May 22, 2001 hearings. I was invited to testify at an April 17, 2002 hearing of the U.S. Federal Election Commission. At that hearing, I recommended changes to the draft voting system standards that were subsequently adopted as the 2002 FEC Voluntary Voting System Standards.

7. I wrote Chapter 1 of *Secure Electronic Voting*, edited by Dimitris Gritzalis and published by Kluwer Academic Publishers in 2002. I wrote “On Optical Mark-Sense Scanning”, a chapter in *Towards Trustworthy Elections*, edited by David Chaum, Ronald Rivest, et al, and published by SpringerLink in 2010, a copy of which is attached as Exhibit “A” to this my Affidavit.
8. In the summer of 2004, I consulted with Miami-Dade County to assess problems with their ES&S iVotronic touch-screen electronic voting system and to assess their pre-election testing of their touch screen systems and the ES&S 650 optical scan voting system they use for postal absentee ballots.
9. My paper, *Auditing Elections*, was published in October, 2004 in the Communications of the Association for Computing Machinery.
10. I am one of the ten principal investigators in A Center for Correct, Usable, Reliable, Auditable, and Transparent Elections (ACCURATE), a multi-institutional center awarded a 6-year research grant by the U.S. National Science Foundation starting in October 2005. Some of the research I report here was funded by this grant, the Iowa portion of which is NSF grant number CNS-052431.
11. In 2005 and 2007, I was invited to Kazakhstan, and in 2006, I was invited to Holland, in all cases by the Office for Democratic Institutions and Human Rights of the Organization for Security and Cooperation in Europe to help assess the electronic voting systems in use in those countries.
12. My work in Kazakhstan led to my writing “Kazakhstan: The Sailau E-Voting System”, a chapter in *Direct Democracy, Progress and Pitfalls of Election Technology*, edited by Michael Yard and published by the International Foundation for Electoral Systems in 2010.
13. In December 2005, I was invited by the Arizona Senate Government Accountability and Reform Committee to investigate the Optech 4C central-count optical mark-sense vote tabulators used by Maricopa County for postal absentee ballots.
14. I offered expert testimony in *Conroy v. Dennis*, a case heard by the District Court of the City and County of Denver Colorado in September, 2006. I testified in the matter of [the] primary election ballot dispute [in] 2008, before the Supreme Judicial Court of Maine in July, 2008, and I testified in *NAACP v. Cortes* before the U.S. District Court for Eastern Pennsylvania in October, 2008. I am currently involved in *Banfield v. Cortes* in the Commonwealth Court of Pennsylvania. All of these cases involve voting technology.
15. In October 2009, I was appointed to the Technical Guidelines Development Committee of the US Election Assistance Commission. This committee advises the commission on the system of

voluntary voting system guidelines that govern the construction of voting systems used in the United States.

16. In connection with my research support from the National Science Foundation, and in connection with my seat on the Technical Guidelines Development Committee, I am obligated to state that the opinions expressed here are my own and do not represent any position or policy taken by either of these government agencies.
17. I have declined the offer of compensation for my work on this affidavit.

Summary of Opinions

18. For the reasons discussed below, it is my opinion that when a central count mark-sense tabulator is used to count postal ballots, all ballots that scan as overvotes or scan as blank should be examined by people on the first count. In the event that this is not done, if the margin of victory of the winning candidate is under the number of overvotes plus undervotes, there is a question as to whether the declared result truly reflects the will of the voters. If overvotes and ballots that scan as blank are hand processed, then a hand recount may still be justified if the margin of victory of the winning candidates is under one half of a percent.
19. Therefore, in my opinion, the will of the voters would best be ascertained by a hand recount of all of the ballots cast in the Brock Township, Ontario mayoral election of October 25, 2010, and if such a recount is not performed, then by a hand recount of all ballots that are reported as overvotes or undervotes by the tabulating machines used in that election.

Factual Background

20. I have reviewed the Affidavit of Herbert Goldie, sworn November 26, 2010, and the exhibits attached to that document (the "Goldie Affidavit").
21. As I understand it, the Township of Brock, Ontario, held a municipal election on October 25, 2010. Ballots were cast by post and counted using optical mark-sense scanning technology.
22. In the election for Mayor, held as part of the Township of Brock municipal election, Larry O'Connor was declared the winner over Terry Clayton by a vote of 2339 to 2326, based on Forms EL08 and EL32, Exhibits D and E of the Goldie Affidavit. This implies a margin of 13 votes out of 4665 votes counted, or about 0.27 percent of the votes counted.
23. A total of 4757 ballots were counted in the mayoral election, of which 3 were discounted because they contained overvotes and 89 were discounted because they contained undervotes, based on the information from Exhibit F of the Goldie Affidavit. These 92 discounted ballots represent about 1.9 percent of the total votes cast, which is about seven times as many ballots as

- the margin of victory in the election.
24. I have also reviewed the Affidavit of Thomas G. Gettinby, sworn December 2, 2010 (the “Gettinby Affidavit”) and understand from paragraph 27 that Dominion Voting Systems provided the ballot tabulators used in this election. I further understand from the Goldie Affidavit that the model used was the Dominion CF520. I have not personally examined the Dominion system, although I am broadly familiar with it. Sequoia Voting Systems sells Dominion equipment in many jurisdictions in the United States.
 25. The Dominion CF520 was configured to count all marks made by voters in a designated voting target as votes that exceeded a specified threshold, and to ignore marks below that threshold. This behavior is documented in paragraph 13.3 on page 16 of Exhibit B of the Goldie Affidavit.
 26. This threshold was set to 12 percent, as stated in the Goldie Affidavit and discussed in more detail in paragraph 26 of the Gettinby Affidavit.
 27. Some technical characteristics of the Dominion Democracy Suite, including the CF520 vote tabulator, are documented in an academic paper “Election Workflow Automation – Canadian Experiences” by Goran Obradovic, James Hooper, Nick Ikonomakis, and John Poulos, all from Dominion Voting Systems Corporation of Toronto, published in the *Proceedings of the 2nd International Workshop on Electronic Voting*, Robert Krimmer, Ed., *Lecture Notes in Informatics P86*, Gesellschaft für Informatik, 2006 (the “Dominion Paper”). Pages 137 and 138 are of primary interest. A copy of the Dominion Paper is attached as Exhibit “B” to this my Affidavit.
 28. According to the Dominion Paper, the CF520/40, a member of the CF500 series of scanners, processes up to 2500 ballots per hour (about 41 ballots per minute or one ballot every 1.44 seconds). The CF/500 series scanners all store a scanned image of each ballot which is then delivered to image processing software for analysis.
 29. The Dominion Paper says that the images processed by the Democracy Suite are binary – that is, black and white with no shades of grey. This implies that the scanners interpret each pixel, that is, each spot on the image, as either black or white prior to searching the ballot for the voting targets, called “ballot marking fields” or “answer areas” in the Dominion Paper, and called “spaces designated for the marking of the ballots” in the Municipal Elections Act, 1996, S.O. 1996. Chapter 32, Schedule (the “Act”).
 30. The Dominion Paper says that the Dominion software computes a bounding box for each voting target using sophisticated pattern analysis to determine which pixels are in the box. Nonetheless, the processing still boils down to examining the pixels within this box to determine if a vote has been cast in a particular race.

31. It is fair to conclude that the bounding box computed by the scanner is largely coincident with the rectangular voting target printed on the ballot, but it may not be identical to the target. I have encountered ballot tabulators that are sensitive to marks outside the printed voting target, notably the Election Systems and Software model 650 central-count tabulator and model 100 precinct-count tabulator, both of which will count a circle made by the voter closely around the voting target.
32. I infer that the 12 percent threshold discussed above refers to the number of black pixels that must be found in this bounding box to determine whether the box is considered to have been marked or not. This conforms paragraph 26 of the Gettinby Affidavit which states that the threshold refers to the area of the “ballot box” that is darkened.
33. I found no documentation of how the CF520 determines whether a pixel should be reported as black or white. This could be based on a second fixed threshold, or on a more complex algorithm that attempts to preserve some information about intermediate levels of grey in the final black and white image.
34. The documented procedures for using the scanners require a test prior to the election to make sure that the scanner will correctly tabulate ballots marked with a “valid mark”, see paragraph 13.4 on page 16 of Exhibit B of the Goldie Affidavit.
35. The term “valid mark” is not defined, but the term “valid vote” is apparently defined as being a mark exceeding a certain darkness threshold, if I interpret paragraph 13.3 of Exhibit B of the Goldie Affidavit as a definition of validity. The same material can alternatively be interpreted as a specification of the threshold in terms of some externally defined notion of validity.
36. The pre-election testing required in the procedures tests the accuracy of the tabulation of votes, overvotes and undervotes, but no testing of the marking threshold is required. This is documented in paragraph 13.6 on pages 16 and 17 of Exhibit B of the Goldie Affidavit.
37. The voter instruction sheet included in the voting kit sent to voters says “complete the ballot” but gives no additional marking instructions. Images of the complete voting kit were attached as Exhibit A of the Gettinby Affidavit.
38. The instructions on the ballot itself read “To vote, fill in the square next to your choice(s), like USE BLACK PEN OR MARKER, DO NOT USE PENCIL” (above equivalent French text). The ballot is part of the complete voting kit cited above. Voting targets are rectangles to the right of candidate names, approximately as illustrated in the instructions (where exact squares were used).

39. I examined the Act, which makes it clear that, regardless of any alternative ballot tabulation technology being used, many voters will be familiar with the instruction to “make a cross” in the designated space to the right of the candidate's name for which they intend to vote, as documented in the Voting Procedure given in Section 52, Paragraph 3 item a. Thus, I expect that some voters will mark ballots with crosses, regardless of the specific instructions that may be printed on the ballot.

Ballot Marking

40. I have been examining optical mark-sense ballot scanners for almost fifteen years. In the course of this work, I have had occasion to test numerous ballot scanners, observe the conduct of elections using such ballots, and study how voters have marked such ballots.
41. There are three interrelated considerations that go into the evaluation of an optical mark-sense voting system: The actual mark sensing mechanism used by the tabulating equipment, the instructions provided to voters, and the reaction of voters to those instructions. One cannot evaluate the marking instructions out of the context of how voters respond to them or out of the context of how the machine evaluates marks. One cannot evaluate the mark-sensing mechanism out of the context of the instructions and how voters respond to them.
42. My students and I have conducted a preliminary study of how voters in Humboldt County, California, marked their ballots in the November 2008 general election. The Humboldt County Ballot Transparency Project made color scans of every ballot cast in that election. We examined all 118,756 ballot images collected by that effort.
43. Voters in Humboldt County were instructed to completely fill in the oval next to the name of the candidate of their choice. Nonetheless, we observed that 0.27 percent of the ballots contained X marks, 0.08 percent contained checkmarks, and 1.14 percent contained corrections. There were also ballots containing hesitation marks, small dots in the voting target.
44. Humboldt County switched from hand-counted paper ballots to Votomatic punched-card ballots in 1966 and then to their current system of optical mark-sense tabulators in 1996, according to Ed Arnold's *History of Voting Systems in California*, California Secretary of State, 1999. Thus, it has been over a generation since Humboldt County voters have routinely been instructed to vote by making X marks on a ballot.
45. Note that Humboldt County explicitly provided for correction in their marking instructions for postal absentee ballots, asking the voter to cross out the incorrect marking, make a new marking, and write “yes” next to the new mark. I would expect the frequency of corrections to decline in the absence of such instructions, but I would not expect the frequency to decline to zero.

46. We observed votes cast on Humboldt County ballots with felt-tip marker, blue ball-point pen, pencil, and green pen. Postal absentee ballots were marked with the widest range of ballot marking devices, while most voters who voted in polling places used the markers provided by the county.
47. I note that the fraction of unusual markings we observed in ballots from Humboldt County is greater than the margin by which the winner was declared in the Township of Brock mayoral election.
48. Whether or not this matters to the outcome of the Brock election depends on what standard is applied for which marks constitute votes. The pivotal question is, whether an election is about the ability of voters to follow instructions, or whether it is about determining the will of the electorate.

Calibration, Testing and the Question of What is a Vote

49. The written documentation I examined contains no meaningful specification of what marks constitute votes in the election in question. One definition is circular, the other is imprecise:
50. The circular definition rests on a testing requirement: The machine must be tested to see that it accurately counts "valid marks" (Section 13.4 of Exhibit B of the Goldie Affidavit), where "valid votes" are defined in terms of "an appropriate threshold" (Section 13.3 of Exhibit B of the Goldie Affidavit). The documents I have seen provide no rule for determining whether a mark is valid, for the purpose of testing, aside from running it through a scanner. As such, testing can find failures in the vote tabulation function, but it cannot check the ability of the scanner to distinguish marks that are marginally acceptable from marks that are marginally unacceptable.
51. The other definition given rests on the 12 percent threshold as identified in paragraph 26 of the Gettinby Affidavit. Since there is no specification of how the scanner decides to classify a pixel as black or white, on the basis of a particular shade of colored mark made by a voter, this specification is incomplete.
52. Both of these definitions appear to conform to what was called the "machine model" in the court cases following the Bush versus Gore election in the United States in 2000.
53. The machine model assumes that the vote tabulating machine is an impartial objective judge of what marks constitute votes, without recognizing that the machine itself was constructed by humans, that it is potentially fallible, or that ultimately, the machine must be judged by its ability to interpret marks made by real voters as those marks were intended.
54. The ballot instructions themselves provide no guide. The illustration on the ballot shows only a

perfectly blank voting target and a perfectly blackened target. Real voters, when marking a target, will generally only approximate a fully blackened target, either leaving some of the space in the target unmarked, making markings somewhat outside the border, or quite frequently, both in some combination.

55. The ballot marking instructions do not and should not give the detailed legal standard for what marks are acceptable and what are not. If the marking instructions were taken as the legal standard, any voter who left a small unmarked spot inside the box could be disqualified.
56. Rather, the purpose of the marking instructions is to encourage voters to make marks that are unambiguous under whatever standard is used for evaluating them.
57. I do not doubt that the Dominion CF520, used with a 12 percent threshold might well classify well over 90 percent of all marks correctly. The problem in the Township of Brock mayoral election is that the outcome could be changed by a different classification of a small fraction of one percent of all votes cast.
58. I suspect that the Dominion CF520 with a 12 percent threshold will count X and checkmarks made with a felt-tip pen. I am not sure it would count the same mark made with a black fine-tip ballpoint pen.
59. Whenever I test optical mark-sense scanning systems, I always mark test ballots with a wide range of marking devices. I understand from paragraph 28 of the Gettinby Affidavit that test ballots were marked with black and blue pens, but beyond that, I do not know if the scanners used in the Brock Mayoral Election were tested with any broader variety of markers or markings.
60. In the test I performed in Maricopa County, Arizona, I found that the Optech IV-C scanners used there were extraordinarily sensitive to pencil marks, counting even marks that were barely visible to the naked eye. They were very sensitive to black felt-tip markers and gel-ink ballpoint pens, and surprisingly insensitive to conventional black ballpoint pens. Voters using such pens with that scanner would need to make an extra effort to blacken their marks.
61. When I tested the Global (later Premier, then Diebold, now Dominion) AccuVote 2000 scanner for the state of Iowa, I found that the scanner was surprisingly insensitive to pencil, moderately sensitive to ballpoint pen, and very sensitive to black felt-tip marker.
62. As demonstrated by the comparison of the Optech IV-C and the AccuVote 2000, the sensitivity of different scanners to different ballot marking tools varies. Voters cannot guess, from looking at the ballot, what markers will make easily detected marks and what will not.

Special Problems Posed by Postal Ballots

63. Postal ballots pose special problems. First and foremost, regardless of any instructions printed on the ballot and regardless of whether a pen or pencil is provided with the ballot mailed to the voter, voters will vote with whatever pens or pencils are conveniently available.
64. The instructions on the Township of Brock ballot in question, to use black and not to use pencil, will bias voters away from, for example, blue or red pens, and it will bias them away from using pencils, but it will not prevent their use.
65. Some voters, in marking ballots, casually rest their pen or pencil on a voting target, leaving a spot that is generally known as a hesitation mark. When ballots are scanned, some of these hesitation marks are dark enough to be counted as votes.
66. In some cases, hesitation marks that are counted as votes by the scanner may not be visible to the voter. This is a particular problem for voters with moderate vision problems. Furthermore, voters with moderate vision problems are particularly likely to use their pen or pencil as a pointer to help keep their place in the ballot while they read candidate names and issues, thus making them more likely to make hesitation marks than a voter with good eyesight.
67. When scanning is at the local polling place, dark hesitation marks lead to ballots being returned to the voter as overvoted, after which the voter can request a replacement ballot in exchange for the overvoted ballot under the rules for spoiled ballots.
68. Postal voters have no equivalent protection. Thus, unless the central count tabulation procedures account for the possibility of hesitation marks and corrections, postal voters will be at a significant disadvantage compared to voters in a conventional election.
69. Postal ballots are generally folded for mailing, and as the post office handles the mail, the folded ballots are frequently both compressed and subject to vibration. This causes some pencil marks, in particular, to print as smudges on the paper they come into contact with.
70. Fred Berghoefer, in his September 20, 2004 testimony before the Technical Guidelines Development Committee of the United States Election Assistance Commission commented on the problem of pencil marks causing smudges. I have personally observed the same problem in Johnson County, Iowa while observing postal absentee ballot processing for the election of November 2, 2010. In both cases, some smudges were printed onto voting targets in other races, converting votes to overvotes and converting abstentions to votes. A copy of his testimony is attached as Exhibit "C" to this my affidavit.
71. The image of the ballot used in the Township of Brock election does not show enough detail for

me to understand how it was to be folded, but I strongly recommend that election procedures be adopted that can deal with such problems. Merely telling voters not to use pencil is not enough.

72. Occasionally, mail is damaged by the post office. When the election office receives a damaged postal ballot, it must have some procedure for processing that ballot. The procedures I found in section 12.6, 12.7, 12.10, and 12.13 through 12.17, on pages 13-15 of Exhibit B of the Goldie Affidavit, appear adequate for this purpose and are typical of procedures I have encountered in Iowa, California, Florida and Arizona.
73. Fred Berghoefer's recommendation to the Technical Guidelines Development Committee, contained in the testimony cited above, is that all ballots that scan as overvoted or blank be subject to the same processing as damaged ballots.
74. In my observation of the election procedures in Humboldt County, California, Miami-Dade County, Florida, and Maricopa County, Arizona, I saw the same procedure being used. All postal ballots that scanned as overvoted were set aside for examination by humans to determine if the overvote was deliberate.
75. As used in both Humboldt County and Miami-Dade County, the ballot instructions for absentee voters explicitly instruct voters to cross out mistakes. This instruction is only effective because of the fact that all overvotes on postal absentee ballots are examined by human eyes.
76. I saw an alternative procedure used in Johnson County, Iowa. There, the scanners have two distinct thresholds. Voting targets lighter than one threshold are declared to be certainly blank, targets darker than a second threshold are declared to be certainly voted, and targets that are intermediate between the two thresholds are declared to be ambiguous, requiring human interpretation. This model does not allow for correction of absentee ballots but it deals effectively with all but the darkest of smudges and hesitation marks.

Conclusions

77. I strongly recommend that jurisdictions that use central-count ballot scanning equipment adopt procedures to test their ballot tabulators using a variety of marking implements representative of the types of pens and pencils real voters are likely to use.
78. I strongly recommend that such jurisdictions adopt procedures to test their ballot tabulators using a variety of marks typical of those made by real voters. Not just marks made by scrupulously following the voting instructions (as most voters do make) but also a wide range of marks of the sort made by careless or poorly informed voters. Testing should also include the scanner's ability to ignore lightly smudged voting targets and voting targets containing small hesitation marks and

