

# Technologists as Political Reformers: Lessons from the Early History of Voting Machines

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The files of the US Patent Office contain scattered patents for voting systems from as early as the late 1840s. There was little focus to these patents until the 1880s. In effect, many of the early patents resemble hammers searching for nails. The character of the voting patents filed in the 1880s and 1890's is radically different. Despite the rigid form imposed by the patent office, these patents include polemic text that makes it clear that the inventors thought of themselves as crusaders for good government.

Much of the modern debate about voting technology centers on questions of security. We ask, for each voting system and each potential attacker, what barriers does the system put in place to prevent that attacker from manipulating the results. It is interesting, looking back through the record of the 19th and early 20th centuries, to ask, when did voting system developers first recognize each of the threats we currently view as being significant.

In this regard, it is clear that, starting in the mid 1870s, a major motivation behind the development of voting technology was the defense against precinct-level vote fraud. Precinct-level fraud was a dominant factor in that era, and voting machines, whether mechanical or electronic, are fairly resistant to attack at the precinct. The developers clearly saw this potential, and both reformers and their opponents understood that voting machines would largely close off this avenue of attack on democracy.

In defending against precinct-level attack, voting machinery centralizes control of the election system in the hands of the technicians and administrators at the city or the county level. Some early voting system developers sought to incorporate defenses against insider attack, but these defenses were largely ignored in the marketplace. Through the mid 20th century, election reformers paid scant attention to the risks of centralized manipulation.

Meanwhile, as the new technology was actually put in place, those intent on manipulating elections shifted their focus toward new arenas, controlling access to the ballot, on the one hand, and somewhat more slowly, learning to manipulate the

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machines themselves. As a result, while voting machines may have reduced ballot box stuffing and vote buying, they did not end corruption.

There are interesting parallels between the transition that took place in 1880 and the transition that took place in 2000. Prior to 2000, the focus of technologists intent on developing new voting technology was to find ways to apply computers and electronics to voting. Again, the story was one of a hammer in search of a nail. After 2000, on the other hand, the technological community has been driven by an understanding of the weaknesses in our established election practices and the need to find new ways of conducting elections that address these problems. Today, much of the focus among technologists is on the threat posed by excessive centralization of control at the county level.

It is to be hoped that this look back at the transition from paper to mechanism will put modern developments in a useful perspective. Those of us who are developing new voting technologies should ask ourselves if we are too focused on a single risk at the expense of the big picture.

### **Voting Technology Outside of Polling Places**

#### US Patents

5,469,	Mar. 14, 1848,	R. E. Monaghan, Counting the Yeas and Nays.
7,521,	July 22, 1850,	A. N. Henderson, Aye and Nay Apparatus.
28,339,	May 22, 1860,	G. L. Bailey, Ballot Box.
90,646,	June 1, 1869,	T. A. Edison, Electric Vote Recorder.
185,950,	Jan. 2, 1877,	W. H. Nicolls, Registering Ballot-Box.
272,011,	Feb. 6, 1883,	H. Zimmer, Apparatus for Registering Votes.
458,805,	Sept. 1, 1891,	L. S. Gardner, Voting Machine.

The first patents for voting systems were not targeted at the polling place. Rather, inventors focused on votes in legislative chambers and fraternal organizations. These inventions are fascinating applications of the mechanical and electrical technology of their day, but they were not developed in response to any particular need, and they saw very little use.

Monaghan, Henderson and Edison developed mechanical punched card, electrochemical and electromechanical systems for counting roll-call votes in legislative chambers. All proposed equipping each legislator's desk with levers or keys that could be depressed by the legislator to record a vote on a paper record at the desk of the secretary of the legislature. Monaghan's scheme used levers, bell cranks and wires to punch a record of the vote in the roll-call page, while Henderson and then Edison used telegraph keys to control the electrochemical printing of the legislator's name on the roll-call list.

Bailey and Nicolls, as well as several others, developed machines to record yes-no votes in fraternal organizations. Bailey's machine was the first machine I found that included a mechanical counter to count the number of votes. Both Edison and Nicolls incorporated such counters into their machines.

The patents for these machines include only the briefest statements of rationale. Of the patents cited here, Edison's gave the longest and clearest statement of intent: "... to produce an apparatus which records and registers in an instant, and with great accuracy, the votes of legislative bodies, thus avoiding the loss of valuable time consumed in counting and registering the votes and names, as done in the usual manner."

As Zimmer's and Gardner's patents illustrate, lodge and legislative voting patents continued to be issued late into the 19<sup>th</sup> century. While these machines incorporate interesting mechanisms, their descriptions continue to offer no evidence of the kind of social engagement that would typify the bulk of early patents for machinery used in the polling place.

### **Technologists Emerge as Activists**

#### US Patents

158,652,	Jan. 12, 1875,	H. W. Spratt, Voting Apparatus.
211,056,	Dec. 17, 1878,	A. B. Roney, Registering Ballot-Box.
248,130,	Oct. 11, 1881,	A. C. Beranek, Voting Apparatus.
320,218,	Apr. 20, 1886,	W. M. Kinnard, Combined Tally Sheet and Poll Book.
412,761,	Oct. 15, 1889,	L. Kutscher, Apparatus for use in Secret Voting.
415,549,	Nov. 19, 1889,	J. H. Myers, Voting Machine.
424,332,	Mar. 25, 1890,	J. H. Myers, Voting Machine.

Spratt's voting booth and voting machine represents two significant shifts, first, a shift of attention to the polling place, and second, a shift in tone. Spratt's patent, filed less than five years after Edison's and less than five years before Roney's, contains a statement of purpose that is quite different from the statements in those patents. It is politely worded, but it implies strong criticism of the status quo:

My invention consists in an improved voting-chamber, and mechanism therefor, which mechanism can also be applied to an existing building, or inclosed in a portable chamber for voting, and which is suitable and available for every description of voting, and for securing purity and secrecy of election, with the following advantages: First, balloting (that is, voting secretly) without the aid of balls, tickets, passes, letters, figures, official stamps, or ballot boxes; second, absolute secrecy, it being impossible to discover for whom the voter has voted; third, while secrecy is obtained, all parties, pro and con, can be satisfied that the voter has voted; fourth, at the close of the poll the result of the voting can be instantly made known; fifth, a complete check as to the numbers voted, preventing any tampering with the apparatus; sixth, economy, great savings of time, trouble, and expense at elections, and also with government officials, and office routine afterward.

Spratt was British, and his voting machine was designed to collect only a single vote in a race for a single office, as is typically the case in elections in parliamentary democracies.

Roney's registering ballot box is the first patent I found that addresses the problems of a general election in the United States. His drawings show a ballot box configured to handle 4 parties (Republican, Democratic, Temperance and National) competing for 3 offices (Mayor, Controller and Treasurer). As with Spratt, his rationale implies strong criticism of the status quo:

The object of this invention is to avoid the trouble and waste of time caused by counting the votes, to prevent intimidation, to guard against fraud, to save the cost of elections, and to guarantee satisfaction to the candidates and preserve the purity of the franchise.

Beranek's machine was the first voting machine that strongly resembled the machines that would dominate voting in the 20<sup>th</sup> century. The machine had rows and columns of push buttons, with a row for each office (President, Vice-Pres', Secreta' and Treas) and a column for each party (Republ', Democ', Greenb' and Prohib'), the party-column ballot format. The machine incorporated an interlock mechanism to prevent overvotes, and like Spratt's machine, opening the voting booth door caused vote recording as it reset the machine for the next vote. Bareneck's statement of rationale is interesting:

The object of this invention is to provide a voting apparatus for registering the number of votes cast for any particular candidate or candidates, and which will dispense entirely with the use of printed ballots.

While Beranek implies that there was something undesirable about printed ballots, Kinnard sets out to fix the problems with viva-vocce voting. There is no technology here, but rather, an improved organization of the paperwork traditionally used for voice votes:

My invention ... has for its object the production of a single compact binding of a combined tally-sheet and poll-book for the use of the officers of elections, wherein is contained in a readily accessible, accurate, and compact form the names of all of the voters, the names of the candidates of all parties, and the number of votes cast for each candidate, and so arranged and displayed as that the total number of votes cast for each candidate may be accurately read off at a glance, and whereby, after the polls have been closed and the proper certificates have been made in said books by the clerks and judges of the election, the whole may be transmitted to the proper officers in a precise and compact and not readily-alterable form.

Here, we see an implicit comment on existing practice with regard to viva-vocce voting. The objects Kinnard seeks are only relevant if some elections are not being accurately counted, or if records of some elections have been altered during transmission from the polling place.

Kutscher takes a more radical position, providing a voting booth and tools for management of paper ballots. In the process, he gives a stinging critique of the status quo:

It is well understood by those who have given the subject study that the system of open balloting now in use in most of the United States is open to serious objection through liability that the will of the people may be defeated by fraud and bribery. So serious has the evil become and so great the danger of corruption of the ballot as to lead to much discussion of the subject and a universal demand for the passage of laws to insure the purity of the ballot. The most prominent sources of corruption are, first, intimidation of voters; second, bribery of voters, and third, fraudulent casting of votes, or, as it is commonly called, "ballot box stuffing." It is universally conceded that in order to insure purity of the ballot all ballots or tickets should be made of uniform size, color, type, and quality of paper and free from other marks. The ballots cast by a voter should be inclosed in an envelope to be sealed by the voter, the envelopes to bear no marks except the official stamp, and to be illegal if otherwise marked, and lastly, that secret compartments be provided having a shelf and a door, so that each voter can prepare his ballot or ballots wholly unseen by any other person.

Kutscher does not use the term Australian ballot, but there is no doubt that he is aware of the Australian system that he describes in his text.

Myers voting machine, the direct ancestor of the commercial voting machines that would dominate the 20'th century, strongly resembled Beranek's machine, supporting multiple parties (Democratic, Republican, Prohibition and Labor) and multiple offices (Governor, Leut. Governor, Sec'y of State, Congressman). From a functional point of view, his major contribution was the straight-party lever that could be used to vote an entire slate with a single operation. The inventive in Myers 1889 patent is not as extensive as Kutschers, but it is, nonetheless, an indictment of the status quo.

My present invention ... has for its objects to provide one by the employment of which an honest vote can be had and counted without liability of voters being intimidated, the balloting being secret, or of their voting more than once for the same candidate or different candidates for the same office, and as the votes are counted as fast as the voter indicates his preference the total number cast for each candidate can be ascertained rapidly and accurately at the close of the polls.

Myers repeats essentially the same language in his 1890 patent.

### **Australian Voting (mechanized or not) becomes Routine**

#### US Patents

440,545,	Nov. 11, 1890,	K. Dougan, Ballot Holder.
438,624,	Oct. 21, 1890,	O. H. Hasselman, Election Booth.
475,013,	May 17, 1892,	J. Hanley, Folding Election Booth.
480,925,	Aug. 16, 1892,	A. A. Hinkley, Voter's Compartment and Shelf.
481,571,	Aug. 30, 1892,	J. Jones, Election Booth.
494,588,	Apr. 4, 1893,	J. H. Myers, Voting Machine.
590,942,	Sept. 28, 1897.	J. Boma, Booth for Voting Machine

Even before the secret ballot came into widespread use, some patents for precinct-based election mechanisms returned to the routine form, merely presenting mechanism with no significant social commentary. Dougan's patent is the first in this category. This machine is genuinely innovative, recording votes on blank ballot forms that are punched through a holder on which the candidate names are marked, very much like the Votomatic punched-card voting system that was the subject of so much controversy in the election of 2000. Dougan's punched-ballot reader is also innovative in the way it eliminates all human interpretation of the punches in a ballot.

The patents for Hasselman's voting booth provides an interesting contrast to Kutscher's patent. Kutscher's booth was patented only a year before Hasselman's, yet Hasselman offered no invective, simply taking the need for voting booths for granted. He did note that his booth is designed "for the use of voters in elections under what is known as the 'Australian system'," but he makes no comment about why the Australian system is desirable.

Hinkley's 1892 patent offers no justification at all, but Hanley and Jones explain themselves in terms of satisfying existing law. Jones does so in the clearest detail:

In several of the States, the law requires that a suitable shelf and space shall be provided, properly screened from public observation, at and in which a voter may prepare his ballot for voting unobserved by any other person.

By April of 1890, when Hinkley's patent application was filed, inventors in this domain were responding to legislative mandates. As such, practical considerations such as weight, portability and price were driving factors in their work, not the need to reform a corrupt system that was so evident in the patents of the previous decades.

Myers 1893 patent, filed in 1892, is a typical patent for an improvement on an existing family of devices. The statement of rationale assumes that the reader is interested in mechanical voting machines, and therefore makes no effort to justify their use.

Boma's 1897 patent illustrates how the development of voting machines led others to develop accessories. In this case, the patent covers a voting booth that has a passing resemblance to Spratt's voting booth, but without any invective in its description. Rather, it takes for granted that you want to use voting machines, and simply presents a reasonable way to present such machinery to the voter.

### **Emerging Provisions for Audit and Voter Verification**

#### US Patents

415,548,	Nov. 19, 1889,	J. H. Myers, Voting Machine
500,001,	June 20, 1893,	U. G. Iles, Ballot Registering Device
526,668,	Sept. 25, 1894,	S. E. Davis, Voting Machine
620,767,	Mar. 7, 1899,	J. A. Gray, Voting Machine
622,191,	Mar. 28, 1899,	J. H. Dean, Voting Machine

Jacob Myers filed two voting machine patents that were both granted on the same day. His second patent is the one we remember today, for a paperless mechanical voting machine. His first patent shared many details with the second, except in the way voters entered their votes into the mechanism. In the second machine, voters pushed buttons to record votes, while in the first, they inserted metal tokens into slots. While Myers may have done this in response to legal requirements that votes be recorded by ballot – such tokens being an ancient form of ballot – his rationale statement explains why this might be desirable:

My present invention ... has for its objects to provide one by the employment of which an honest vote can be had and counted without liability of voters being intimidated, the balloting being secret, or of their voting more than once for the same candidate or different candidates for the same office, and as the votes are counted as they are cast the total number can be ascertained rapidly and accurately at the close of the polls without the necessity of counting by hand the separate ballots, although this may be done as a check or verification should it be necessary or desirable. [Emphasis added]

The first part of the rationale statement is the same in both patents, while the ending emphasized above is new. This clearly recognizes the possibility of recounting the individual physical ballots as a way to check or verify the correctness of the mechanical counters in the voting machine.

Urban G. Iles ballot registering device was a precinct-count punched-card voting system that differed in two significant ways from Dougan's earlier punched-paper ballots and from the later Votomatic. First, the ballot tabulating machine was designed to be used at the precinct immediately after the polls closed, and second, the ballots were designed to be voter verifiable. The statement of rationale for the patent does not mention voter verification, saying merely:

... the object of my invention is to produce a mechanical system of voting which will insure absolutely fair elections, and by which any vote may be taken with great accuracy and rapidity, and which also may be operated by any voter of ordinary intelligence.

A further object of my invention is to construct the apparatus in such a way that it may be easily manipulated and will not get out of order, to produce a ticket which is especially adapted to the system, to provide means for mutilating the ticket in such a way that it may be mechanically counted, and to provide a register which will accurately register the votes and exhibit the number of ballots cast so that the vote may be ascertained at any time.

Voter verification is not explicitly discussed in the statement of rationale, but it is implicit in the discussion on page 3, lines 40-44 of the patent text:

It will be understood that the marks 58 [a reference to the printing on the

face of the ballot] may be dispensed with, but they are preferably used. If they are not used, however, the holes would be made in the proper places when the keys [on the vote recording punch] are depressed.

Clearly, if the printing is not there for the sake of any mechanical requirement, the inventor's preference for having such printing must be in terms of some human requirement, specifically, in order to allow people to read and interpret a punched ballot. The most obvious reasons to allow this are to permit hand recounts and voter verification.

Sylvanus E. Davis, in his 1894 patent, assumes the desirability of mechanical voting, but at the same time, offers strong wording that implies critical weaknesses of his competitors' machines.

The object of my invention is the production of a voting machine ... which shall be beyond the possibility of failure from mechanical causes ... and so that no movement of the counting mechanism is possible, except that imparted to it by the voter.

My invention also involves the absolute prevention of fraudulent voting, ...

Here, reading between the lines, we find an allegation that previous voting machines allowed manipulation of the counting mechanism in order to produce fraudulent results. One of Davis's primary contributions is a sealed counter mechanism, so that technicians, in the normal course of maintaining the innards of a voting machine, would not have an opportunity to tinker with any vote counts.

Gray's voting machine was, in many regards, unremarkable, but for one feature: It incorporated what we would now call a voter-verifiable paper trail. Here is how Gray described it:

My invention ... is especially designed to enable the voter to indicate the candidate or candidates for whom he desires to vote upon a ticket having the names of the candidates printed thereon and at the same time to register his vote or votes by means of an apparatus designed for the purpose.

... This enables the voter ... to punch a hole in the margin opposite the name of the person for whom he desires to vote, the plan being the same as that of the "Australian Ballot," so called, ... In this case, the hole being punched through, it is impossible to erase or otherwise destroy the record of the vote.

... In this manner we have a mechanical check for the tickets, while the ticket is also a check on the register.

We can describe a classical mechanical voting machine as a direct-recording mechanical voting machine, making the analogy with modern direct-recording electronic voting machines quite obvious. In this regard, Gray's machine is analogous to the voter-

verifiable paper trail add-ons that manufacturers of direct-recording electronic voting machines have recently begun to offer for sale.

Of course, Myers' very first voting machine patent also offered something akin to this, since the tokens that voters deposited in the slots on the machine also offered the possibility of a recount, but tokens were relatively anonymous and could not be authenticated, whereas the paper ballots used on Gray's machine could be protected by the myriad of different schemes that have been invented to protect other versions of the Australian ballot from various forms of fraud.

Dean's voting machine patent of 1899 recognizes a problem that has continued to plague voters since the advent of mechanized voting. His statement of objectives is very long, but it addresses a new issue:

... particular objects of the invention are to avoid the use of the bewildering number of keys found in the present voting machines ...

Aside from mechanical improvements, Dean's other general objectives are restatements of requirements met to one or another extent by other voting machines. Dean is quite correct in stating that existing voting machines faced the voter with a dismayingly complex user interface. This complexity continues to plague voting systems to this day.

## **Perspectives**

The list of 19<sup>th</sup> century voting patents cited here is by no means exhaustive, and as an examination of the dates of the cited patents makes clear, the division lines between the different classes of patents are far from sharp. Nonetheless, two dates do a good job of bracketing the period during which patent applications were so full of reformist rhetoric.

The 1876 presidential election, in which Rutheford B. Hayes won a majority of the electoral vote while his opponent Samuel Tilden won the popular vote certainly focused the attention of both the public and inventors on the weaknesses of our system of elections.

The 1870s were full of news of corrupt election practices. Boss Tweed's testimony before the Special Committee of the Board of Aldermen was published in 1878.<sup>1</sup> The extent of election fraud in the late 19<sup>th</sup> century is difficult to exaggerate. Consider, for example, the reports from Harrison County that well over a third of all ballots counted in some races were fraudulent.<sup>2</sup> This makes it amply clear that election fraud was in no way confined to the big city machines of the northeast.

It took time for the Australian system of secret ballots to be widely understood in the United States. The Electoral Act of 1856 in Victoria, Australia was not instantly understood elsewhere. It appears that all of the inventors of voting booths and voting

1 Morris. R. Werner, Tammany Hall, Doubleday, Doran and Company, 1928, page 130, quoting Tweed Ring Investigations – Report of the Special Committee of the Board of Aldermen, Jan. 4, 1878, document 8, pp. 133-137, 225. Werner's book is available as a Greenwood reprint.

2 Worth Robert Miller, Harrison County Methods: Election Fraud in Late Nineteenth Century Texas. Locus: Regional and Local History 7, no. 2 (Spring 1995): 111-28.

machinery cited here had some degree of acquaintance with the Australian system, although not all cited it by name.

There had been earlier reports of election fraud.<sup>3</sup> These led to interesting patents for transparent ballot boxes, for example, Alan Cummings patent 20,256 and Samuel Jollie's patent 21,684. I have not had time to investigate these closely.

The end of the period of activism is as ill defined as the start, but the election of 1892 is an important landmark. This was the first election in which lever voting machines and the Australian ballot saw widespread use in the United States, although both were used on a smaller scale in 1888.<sup>4</sup>

I believe that it is reasonable to ask, why was the one family of paperless mechanical voting machines descended from Meyers' patents so successful, while so many of the alternatives, such as voter verified paper trails and precinct-count voter-verifiable punched-card machines became dead-ends that were forgotten. Was it just a matter of patent trusts and monopolists? Was it a matter of economics? Was it the luck of the marketplace or were crooked politicians aware of what we would later know about how to corrupt mechanical lever voting machines?

I suggest that, at least initially, and possibly all the way into the early 1930s when Joseph Harris wrote his book on election fraud, most of the crooked politicians did not fully understand the vulnerability of mechanical lever voting machines. Resistance to the installation of these machines continued into the 1950s in some of America's more corrupt locales. Chicago resisted until 1960.<sup>5</sup> Louisiana resisted almost as long.<sup>6</sup>

Furthermore, it is clear that, as the Australian ballot and the mechanical lever voting machine came into widespread use, the focus of those intent on election fraud shifted from the ballot box and voting booth to voter registration, literacy tests and similar mechanisms. The popularity of such measures is evident when one considers that even ardent political reformers eagerly embraced such measures.<sup>7</sup>

So, it seems that the technologist-reformers won an important battle in the late 1800s, forcing the front in the war over elections to shift into new territory for many decades. Unfortunately, they did not win the war, and over the century that followed, until the election of 2000, developments in the field of elections were mostly driven by "normal engineering considerations" and not the reformist drive of the 1880s.

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3 Stuffer's Ballot Box, reported in Frank Leslie's Illustrated Newspaper, July 19, 1856.

4 Joseph P. Harris, Election Administration in the United States, The Brookings Institution, 1934.

5 Edmund F. Kallina, Jr., Courthouse over White House -- Chicago and the Presidential Election of 1960, University Presses of Florida, 1988.

6 Abbot. J. Liebling, The Earl of Louisiana, Simon and Shuster, 1961, pages 136-7.

7 Carrie Chapman Catt, Speech Favoring Education Tests For Suffrage, The Woman's Journal, February 20, 1904.