

Asymptote[®] REVIEW

Ballots, Boxes & Machines: The Technology of Democracy

By W. Thad Adams, III

Well, Election 2000 is over. Some were very happy at the end. Some very angry. But democracy survived. Those interested in the post-election melee were not only treated to numerous trials, hearings, arguments, TV talking heads and the like, but also an enforced and largely unwelcome introduction to the technology behind the need to count millions of votes quickly and accurately. Never before has the technology of voting achieved anything like general public awareness. This is the stuff that state and county election boards argue over, right? Right. This time, though, the election was so evenly contested that paper-thin margins in numerous races made even a handful of "misvotes" critical to the outcome. Thus the nation was subjected to endless arguments about undervotes, overvotes, misvotes, hanging, swinging, pregnant and dimpled chads, butterfly ballots and similar arcane additions to our vocabulary.

As a result, state and county election boards are fleeing headlong from punch card ballot systems towards optical scanning devices or direct computer vote entry and tabulation equipment. No elected official wants to be in the sad

condition of the various Florida election officials who found themselves quite unexpectedly stared at by countless TV cameras as they eyeballed thousands of paper punch cards to read the mind and thus the intent of the voter.

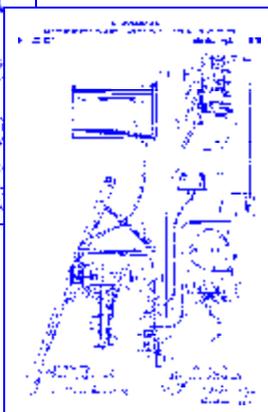
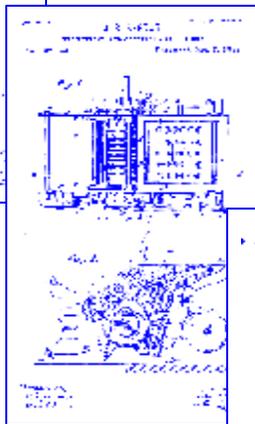
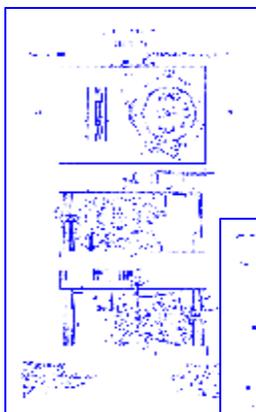
How did the idea of machine vote counting originate? Isn't any machine capable of malfunctioning or being rigged to skew the vote? Elections by popular vote themselves are a quite recent development. For millennia "voting" meant little more than choosing up sides and standing behind a chief, king, lord or other potentate,

and giving support in making war or defending against attack. Dissenting "voters" were generally cast out

balloting with shells.

In societies ruled from above, there was little need to know what those being ruled thought about the ruler. This, of course, was the almost invariable situation prior to the Reformation and Renaissance, when there first emerged writers and thinkers willing to publically propose the natural right of man to have a say in the ways and means of government. Even then, voting was generally restricted to those of noble birth or position who were relatively few in number. Votes were typically cast publically as a means of demonstrating loyalty. As one might

(See 'Ballots' on page 2)



Many patents for vote tallying have been filed over the years. See Inside

of the group or dispatched, usually by the most gruesome means imaginable.

The ancient Greeks voted by clashing spears on shields. Other societies voted by casting pebbles into urns, dividing into groups, or

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The Technology of Democracy

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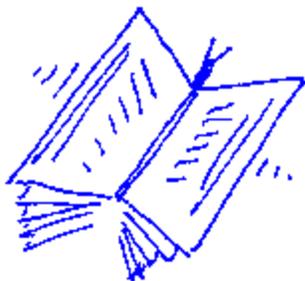
imagine, the outcome of many of these “elections” was preordained and quite unanimous.

As late as the 1700’s elections were conducted orally and in public. As democracy further evolved and voting populations increased, elections tended towards written ballots signed by the voters. Ultimately, however, this was also recognized as a means of punishing voters not voting for the winner, so secret paper ballots eventually became the norm.

As in so many other instances, Thomas Edison was an early inventor of voting machines. He is generally recognized as the inventor of the first voting machine, and, in fact, the very first patent issued to him was for a voting machine for recording and counting congressional votes by means of an electromechanical device.

For decades the common practice was to print a standard ballot which would be marked in private by a voter, who then placed it in a sealed ballot box for later tabulation. This system originated in the Australian state of Victoria in 1856 and thus became known as the “Australian ballot.” New York adopted the practice in 1889 and soon thereafter the practice was in widespread use throughout the United States and other parts of the world.

The BUTTERFLY BALLOT

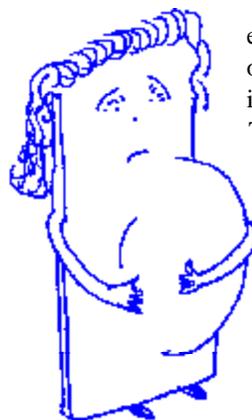


There go Al's chances

As might be expected, efforts to stuff ballot boxes with additional ballots closely followed the adoption of the Australian system and, in turn, prompted inventors to develop ways of preventing this corruption of the electoral process. As early as 1885 J.H. Laskey of Boston, Massachusetts, patented a ballot box which automatically printed, counted and registered the number of ballots deposited in the box. In the same year J.B. Benton, also from Boston, patented a box which used a hand crank by which the ballot was inserted into the box, and which automatically registered and canceled (i.e., marked so it could not be altered or reused) the ballots as they were placed in the box. In addition to a mechanism that prevented two ballots from being placed in the box at the same time, an alarm bell was provided which sounded every time a ballot was canceled, but did not sound if the hand crank was turned without a ballot being inserted.

Thereafter, an avalanche of patents were issued on various types of voting machines—clear evidence of a continuing problem both with vote fraud and the more basic problem of counting many votes accu-

rately in a very short period of time. Many of these patents disclosed various types of mechanical lever machines which punched or marked a paper tape when the lever was pulled.



The dilemma of the pregnant chad —
Was it Al or Dubya?

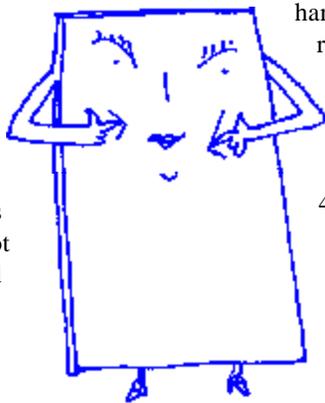
where punch cards were used as a means of sorting data and storing information.

Punch cards and computer tabulating machines to record votes were first used in primary elections in Fulton and DeKalb Counties, Georgia in 1964, and quickly became the dominant form of vote casting and tabulating throughout the United States.

The 2000 Presidential Election and its aftermath spelled the doom of punch card voting systems. An interesting reference to punch card voting machine patents occurred during the election contest hearing which took place before Judge Sauls in Tallahassee, Florida, on December 2 and 3, 2000. During this two-day hearing attorneys for George Bush called as a witness Mr. John Ahmann, an inventor of the Votomatic punch card voting machines used in Dade County, Florida. During his direct testimony he discounted the possibility that a mass of “chads” could build up under the plastic template on which the voter’s punch card was placed to be punched with a stylus, thus preventing the hole from being cleanly punched. Mr. Ahmann disputed that the various hanging, swinging, pregnant and dimpled chads could have resulted from either a defect or malfunction in the machine, but said that they were most likely the result of insufficient pressure with the stylus by the voter.

On cross-examination, Mr. Ahmann was shown the following language from his own United States Patent No. 4,297,566, directed to an improved punch card device:

When such a punch board or die is utilized, precautions must be taken to insure that all of the chips punched from the card are expelled from between the resilient die strips and that none of these chips will remain caught in the grip of the tightly spaced resilient strips after the punching tool is withdrawn. If chips are permitted to accumulate between the resilient strips, this can interfere with the punching



Ms. Chad Dimple —
A real cutie!

(Continued on page 3)

The Technology of Democracy

(Continued from page 2)

between the resilient strips, this can interfere with the punching operations, and occasionally it has been observed that a partially punched chip has been left clinging to a card after the punch was withdrawn, because the card-supporting surface of the punch board had become so clogged with chips as to prevent a clean punching operation. Incompletely punched cards can cause serious errors to occur in data processing operations utilizing such cards.

Mr. Ahmann's own statement in his patent substantially discredited histestimony, although, of course, this had no effect on the outcome of the election contest or the election.

As a result of what happened in 2000, most states are investing either in optical scanning or direct recording electronic systems. The optical scanning system uses a preprinted ballot card on which the voter marks a choice, which is then read by an optical reader using "dark marking logic." The reader selects the darkest mark within a given set of choices as the correct vote. These machines have been in widespread use for many years for lotteries, for standardized testing, and statistical and market surveying.

The direct recording electronic system is simply an electronic version of the old mechanical lever machines used for so long. The voter enters his choices into temporary electronic storage with a touch screen, keyboard, or other device. When voting is complete, pressing a key or area of the screen registers the vote and stores it on a memory cartridge, diskette or other storage device for later combination with votes from other machines or systems.

This is currently the state of the art. Of course, such systems are also capable of being misused, and it will be interesting to see what the future holds. Will vote fraud occur by fiddling with the software of the computer system so that some or all votes cast for one candidate are recorded for another? We'll see.

There is one voting system developed long ago which appears not to have caught on, but which might work about as well as some of the others. See the back page for details.

J. H. LASKEY.
BALLOT BOX.
No. 320,803. Patented June 23, 1885.

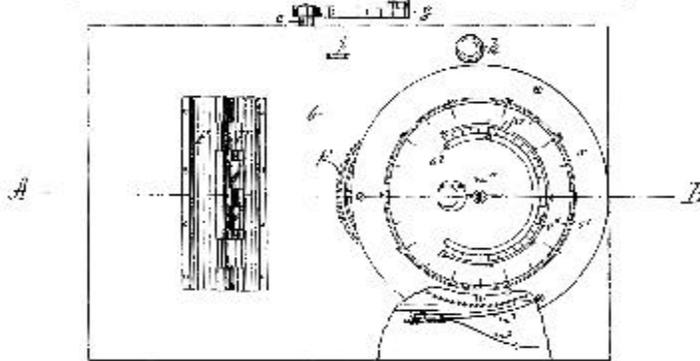
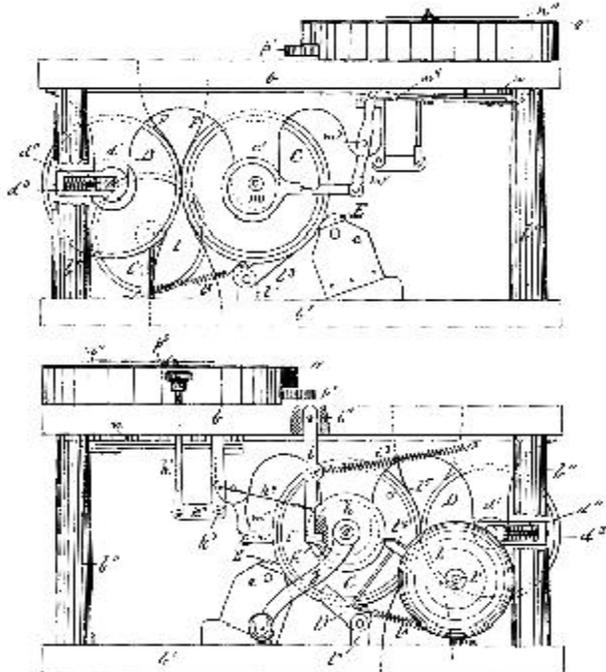


Figure 1



Witnesses:
Henry Charlbon
George Southern

Inventor:
John H. Laskey
Abraham Anderson

As early as 1885 J.H. Laskey of Boston, Massachusetts, patented a ballot box which automatically printed, counted and registered the number of ballots deposited in the box.

(Figures 2-3 on pages 4-5)

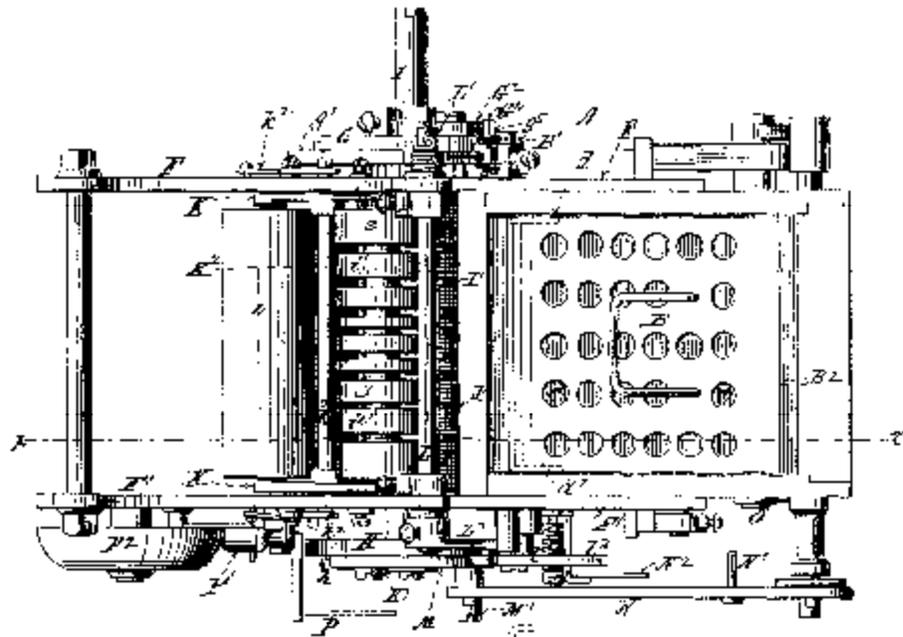
J. B. BENTON.

REGISTERING AND CANCELING BALLOT BOX.

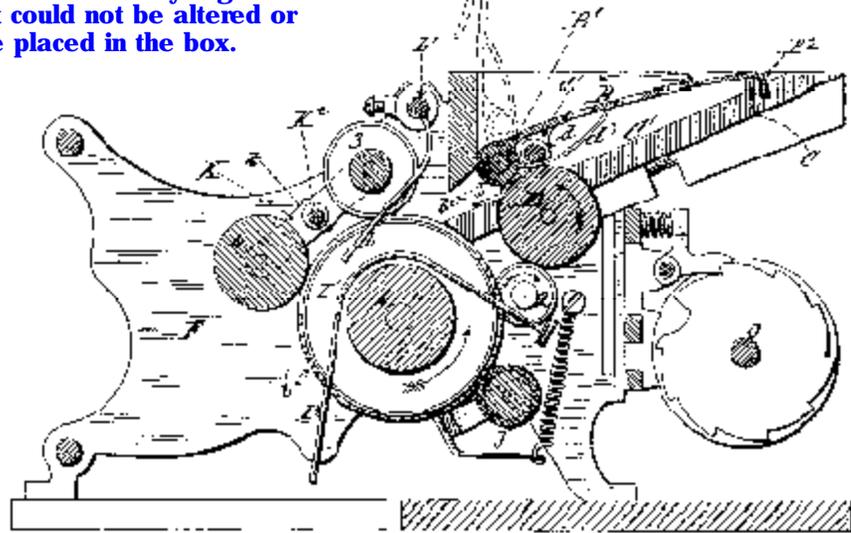
No. 327,644.

Patented Oct. 6, 1885.

Figure 2



Later in 1885, J.B. Benton, also from Boston, patented a box which used a hand crank by which the ballot was inserted into the box, and which automatically registered and canceled (i.e., marked so it could not be altered or reused) the ballots as they were placed in the box.



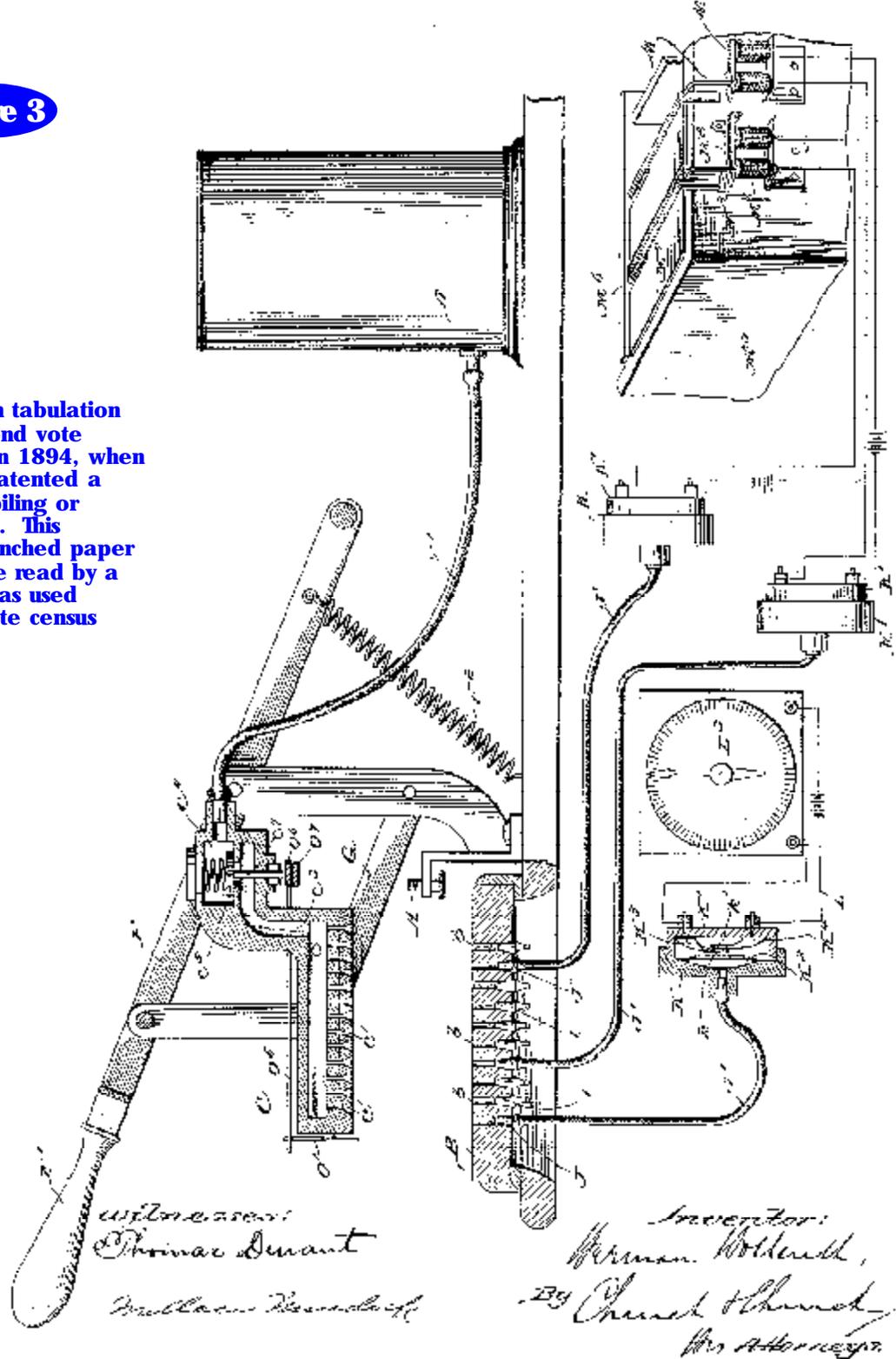
Witnesses:
 R. C. Howes
 M. L. Adams.

Inventor:
 John B. Benton.
 Per Geo. E. Quincy,
 Atty.

H. HOLLERITH
MACHINE FOR COMPILING OR TABULATING STATISTICS
No. 526,129 Patented Sept. 18, 1894.

Figure 3

A major advance in tabulation extending far beyond vote counting occurred in 1894, when Herman Hollerith patented a "Machine for Compiling or Tabulating Statistics. This machine used a punched paper card which could be read by a card reader, and was used originally to tabulate census data.



A Suppositional History of the Chad

By W. Thad Adams, III

Geography and *Trivial Pursuit* buffs know that Chad, with a capital 'C', is a country in Africa. It is also a relatively common Christian name. Prior to the 2000 Presidential Election only a relative few knew the term as describing small punched pieces of paper. I first learned of chads when I invested in a Telex machine in 1980. Prior to the fax machine and e-mail, Telex was about the only way of communicating in print over long distances, particularly overseas. My Telex machine was a greenish gray box the size of a small refrigerator which weighed about 300 pounds and included a primitive keyboard, a rotary dial telephone and a tape reader. I could either type "live" to the receiving machine or could, particularly for long messages, type the message off-line on a long yellow paper tape by means of a hole puncher which punched holes corresponding to the letters and numbers of the message in the tape. The number of the receiving machine was dialed and the tape was then fed back through the reader at about sixty characters a minute (yes, that's minute, not second). The tape



reader and the print head that prepared the paper copy of the message sounded like a small duck and a handful of gravel in a Waring blender. Under the tape reader was a clear plastic "chad box" which held the accumulation of tiny circles of yellow paper created as the message was punched into the tape. These small dots of paper seemed to have magnetic qualities by which they clung to carpet and resisted the most extreme influences of the office vacuum cleaner.

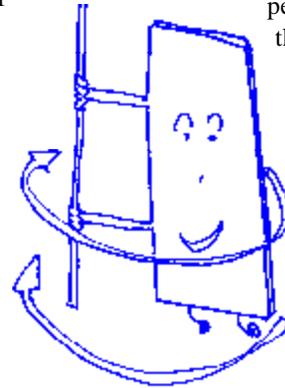
We bought our first fax machine in about 1986, quickly dispensed with the Telex machine, and I suspect its only use thereafter was as a boat anchor or some similar dead weight. I never thought of chads again until last November, when the whole election snafu gave to our popular vocabulary such terms as "hanging", "swinging", "pregnant" and "dimpled" chads. These terms are graphically illustrated throughout this issue.

There is considerable disagreement about the origin of this term. The American Heritage Dictionary of the English Language: Fourth Edition, 2000, defines a chad as "scraps or bits of paper, such as the perforated edges of paper for tractor feed printers or the tiny rectangles punched out from data cards," but indicates no known etymology. Some have suggested that the term is an acronym for "Card Hole

Aggregate Debris." Clever, but there is no etymologic support for this assertion.

Others have suggested that it is a shorthand version of a man with the last name "Chadless", an inventor of an early keypunch machine. Supposedly, people didn't realize that "Chadless" was a

person's name and assumed that the keypunch was dubbed "chadless" because it didn't produce chad – therefore the little pieces of paper must be "chad." No support for this one, either. No patents or other documentation can be found for this suggestion. The name "Chadless" also does not appear in the Latter Day Saint's family name database.



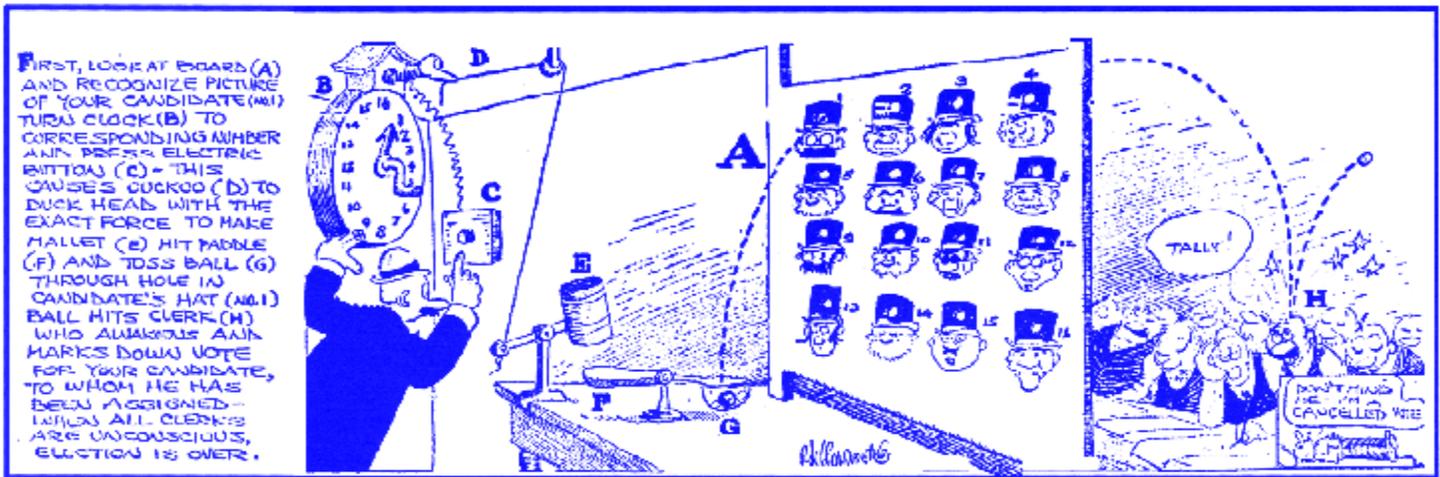
Let's Swing!

Still others claim that it is merely a variation of "chaff", with the sharp edges of the punched-out pieces accounting for the dental instead of fricative ending. This may be true, although there is no direct connection between the two terms supporting this suggestion.

My own favorite is that the term is a direct "borrow" from the Scottish language term "chad", meaning gravel. Both *The Concise Scots Dictionary*, edited by Mairi Robinson (Aberdeen Univ. Press, 1985), and *The Scots Thesaurus* give this definition. Its use dates from at least the 1800's and is still in use in NE Scotland. It is only a short distance and a little imaginative analogy to go from "chad" for small rocks to "chad" for small bits of paper. Admittedly, I don't have any direct etymology supporting this view either, but at least it doesn't seem to be as cute or obviously conjured up after-the-fact as some of the others. I am supported in my view by Iain Campbell of the UK patent firm of Swindell & Pearson, whose Scots upbringing lends credence to his view.

We would be grateful for any other suggestions our readers may have. You may e-mail or fax them to us – just don't send them via the Telex.

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Political cartoonist 'solved' problem years ago

Reuben Lucius Goldberg was one of the most clever cartoonists ever. Not only a skilled artist, he had a wit which could puncture the most overblown ego. His name has entered the lexicon in the form of a "Rube Goldberg Device", a comically involved contrivance, or a very complicated invention, machine, scheme, etc. laboriously contrived to perform a seemingly simple operation. As is shown in the cartoon above, Rube had the problem of hanging chads and butterfly ballots solved long ago. Too bad his very efficient and simple design was ignored in favor of the horribly complicated punch card ballot machine.

Many of Rube Goldberg's best cartoons are compiled in *Rube Goldberg Inventions*, by Maynard Frank Wolfe, Simon & Schuster, text copyright 2000 by Maynard Frank Wolfe; Illustrations and captions copyright 2000 Rube Goldberg Incorporated. Used by permission. Book is available for purchase through bookstores or at www.sciencenewsbooks.org.

Want to Know More?

For further information on the history of voting and voting machines, go to:

- <http://inventors.about.com>
- <http://sequoiavote.com>

For further information about the 2000 Presidential election, including a vast archive of PDF formatted transcripts, go to:

- <http://election2000.stanford.edu>.
- United States Patent No. 4,297,566 is available on-line at www.uspto.gov.

For more about chads, go to

- www.snopes2.com/business/names/chad.htm
- www.thecrimson.harvard.edu/fm/article11Q.shtml

For more about Rube Goldberg see:

- www.rube-goldberg.com
- The Adams, Schwartz & Evans website at www.adamspat.com.

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