Episode Book

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Punched Cards: The 200-Year Reign of Cardboard Computing

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SYNOPSIS

Long before magnetic disks and SSDs, the world ran on holes punched in cardboard. This episode traces the full arc: Joseph Marie Jacquard's 1801 loom cards, Herman Hollerith's census machines, the rise of IBM as a punched card company, and the 1928 business decision that created computing's first proprietary format. We dig into the actual encoding — the 80-column card, zone punches, the six-bit BCD codes that became EBCDIC — and the keypunch tradeoffs that made the fastest data entry machine also the one you couldn't verify. Then the surprising afterlives: paper tape running CNC machines into the nineties, NSA cryptographic key tapes produced until 2019, and punched card ballots deciding a presidential election. Finally, the question that started it all: is there anything today that preserves the same principle — data on a medium you can hold, read, and trust for a very long time? Microsoft's Project Silica says maybe.

TRANSCRIPT



Corn

Everybody frames the punched card as the Stone Age of computing. Cardboard with holes. Caveman data storage.



Corn

Daniel doesn't buy it, and neither do I. His question is basically this. Take the whole arc seriously, from Jacquard's looms through Hollerith to the early digital machines. How did the thing actually work, the encoding, the writing, the reading. Why did it hold the world for the better part of a century. Where did punched cards and punched tape survive after the mainstream walked away. And the sharp end of it: is there anything now that preserves the same principle, data on a medium you can hold, read, and trust for a very long time. Or is the punched card extinct and we just say so.



Herman

Which is the right way to ask it, because the card was not primitive. It was extremely well engineered, and we should probably start where it starts. Not with data. With silk.



Corn

Because a French weaver wanted prettier fabric.



Herman

Joseph Marie Jacquard, Lyon, 1801. His loom let unskilled workers weave complex silk patterns, and the pattern lived in a chain of cards strung together on cords. Each card punched with holes, and the holes decided which warp cords got raised for each pass of the shuttle. The heavy cardstock wasn't a style choice. The loom's reader was entirely mechanical, needles feeling for holes, so the card had to survive being pushed against. Modern high-volume Jacquard looms use metal cards for the same reason.



Corn

Before Jacquard there was Basile Bouchon in 1725, perforated paper tape controlling a loom. So the concept is even older.



Herman

Bouchon's tape is the first recorded use of perforated paper to control a machine. And then the part that actually matters for the legal history. Charles Babbage borrowed the idea for the Analytical Engine in 1837. He planned to drive it with punched cards, and that decision, decades later, is why Hollerith's company and its successors could never claim a patent on the idea of storing data on cards at all. Babbage had published it. The precedent killed the patent.



Corn

So the most valuable thing Babbage ever produced was prior art.



Herman

That's cold, but it's roughly accurate.



Corn

I'll take it. Now Hollerith. The census.



Herman

1880 census, counted by hand, and it was a disaster of slowness. Herman Hollerith, 1860 to 1929, watched train conductors punch holes in different positions on tickets to record what a traveler looked like. Positions of holes as a description. He called it the punch photograph. He tried paper tape first, then went to cards, and his first punches were round because he was using a conductor's punch.



Corn

His cards went out before the census, though, didn't they.



Herman

Vital statistics tabulation, New York City Board of Health and a few states, before the 1890 census ever touched them. Then 1890 itself, and it finished months ahead of schedule and under budget.



Corn

A government project. Under budget. Put that on the card.



Herman

Hollerith's real contribution, and this is Douglas Jones's argument, wasn't punching holes. It was building the machinery to process the punched data, and building a system around that machinery. The card was the easy half.



Corn

Which is the whole lesson, and I'd rather sit here than move past it. The physical medium is never the invention. The machinery that reads it without a person in the loop is the invention. Fifteenth century Europe had paper and ink and it still took a printing press.



Herman

Then the corporate chain, because it explains what comes next. Hollerith founds the Tabulating Machine Company in 1896. Charles Flint merges it with three others in 1911 into the Computing-Tabulating-Recording Company. And in 1924 Thomas Watson renames that International Business Machines.



Corn

So IBM is a punched card company that later discovered computers.



Herman

IBM is a punched card company. Full stop, for a long time.



Corn

Now the encoding, because this is where people wave their hands. What is actually on the card.



Herman

Standard card is seven and three eighths inches wide, three and a quarter high, seven thousandths of an inch thick. And the dimensions are not arbitrary. Hollerith apparently sized it to fit boxes already being made for the Treasury Department, because it matched the dimensions of US banknotes of the era.



Corn

The format of computing's first storage medium was set by the size of a currency box.



Herman

Set by a government supply catalogue. The eighty column card is eighty columns numbered one to eighty left to right. Each column holds one character. Twelve rows per column. Two zone rows at the top, row twelve and row eleven, then rows zero through nine. A digit is a single punch in rows zero through nine. A letter is a zone punch plus a numeric punch in the same column. Punches get written in hyphenated notation, so a comma is zero, eight, three. Three punches in one column.



Corn

And that is a code. Not an image.



Herman

It's a code with sixty four combinations in the common six bit BCD scheme. And EBCDIC, the character set built for the System/360, is a direct descendant of those six bit BCD codes.



Corn

The alphabet of the mainframe was drawn on cardboard first.



Herman

Early cards were different. Eighteen ninety census used twenty two columns by eight punch positions. Nineteen hundred, twenty four by ten. Nineteen ten, twenty seven by twelve. Late twenties, forty five columns of round holes by twelve. The rectangular hole eighty column format arrives in 1928.



Corn

And 1928 is not a technical milestone. It's a business decision.



Herman

A secret competition between IBM teams. James Bryce picked Clair Lake's rectangular hole design, and he picked it for two reasons. It could be implemented quickly, and it was compatible only with IBM's own machines. Deliberate lock-in, 1928.



Corn

So every time we complain about a proprietary format, we should know the first one was holes in cardboard.



Herman

The dimensions eventually got standardized, EIA RS-292 media one, the hole patterns by ANSI X3.21, the Hollerith code itself by ANSI X3.26 in 1980. Once it was everyone's format, nobody could leave.



Corn

Writing. The keypunch.



Herman

IBM model 026, July 1949. The workhorse. It printed the character along the top of the card so you could read your own work. The 024 was the same machine without the printer.



Corn

And the printer made it slower.



Herman

Brutally slower. The 026 topped out at eighteen columns per second because the dot matrix printer couldn't keep up. The 024, no printer, eighty columns per second.



Corn

So the fastest data entry in the world was a machine that gave you no way to check it.



Herman

That's the tradeoff, yes. Then the 029, around 1964, the standard keypunch of the late sixties and early seventies, full sixty four printing characters. And reading was card readers feeding tabulators or computers. One card is about eighty bytes.



Corn

Eighty bytes. One line of code.



Herman

One line of code per card, which is why you carried a deck, and why dropping a deck was a catastrophe. And the cards were almost always preprinted with field labels so a human could look at one and know what each section meant. Which is where the warning comes from. Do not fold, spindle, or mutilate.



Corn

Now here's the part I actually want on air, because it proves the whole system was readable. John Graham-Cumming found two punched cards from a computer school in Lisbon in the seventies. Instituto de Estudos Mecanográficos. And he decoded them.



Herman

Employee number in columns two through seven. Name in columns eight through thirty two. Hourly salary in columns forty two through forty six. One card reads one five zero zero zero zero one nine zero. That's João A. Fernandes earning fifteen thousand escudos an hour with a one hundred and ninety escudo weekly deduction.



Corn

Fifteen thousand escudos an hour, Herman.



Herman

Inflation, Corn.



Corn

The second card reads one zero zero one seven zero four seven six. Week of the tenth of January, 1970, and forty seven point six hours worked.



Herman

And note what he needed to do it. No machine. His eyes, the published field layout, and the code. That is the property every storage medium since has given up. You cannot decode a hard drive by looking at it.



Corn

Which raises the question Daniel actually cares about. Why did this hold for so long. And I have a theory and I want you to tell me if it's wrong.



Herman

Go.



Corn

It wasn't that the card was good. It was that everything was the card. Every tabulator, every sorter, every reader, every form, every clerk in every office. The switching cost was the whole economy.



Herman

You're half right, and the numbers back the other half. By 1937 IBM had thirty two presses in Endicott, New York, printing, cutting and stacking between five and ten million punched cards every day.



Corn

A day.



Herman

The 1935 Social Security Administration contract required millions of cards and tabulating machines just to process the data and print the checks. And in the mid-fifties, punched card sales were roughly twenty percent of IBM's revenue and thirty percent of its profit.



Corn

Thirty percent of the profit on cardboard.



Herman

The eighty column card had become a de facto standard, and standards don't die on merit. They die when the ecosystem around them dies, and the ecosystem was enormous.



Corn

Then the computers arrived and the card became the computer's mouth.



Herman

Primary input medium for early digital machines. Round hole cards survived into the early nineties in limited use. The last use Douglas Jones knows of is toll tickets on some eastern turnpikes.



Corn

Toll tickets. Which is exactly right. A medium that survives because it's a thing you hand to a person.



Herman

Now, punched tape. Separate lineage, longer afterlife. Bouchon's 1725 tape, then teleprinters, then computer input through the fifties and sixties, then minicomputers, then machine tools. In the seventies, computer aided manufacturing ran on paper tape, because a tape reader was smaller and cheaper than a card reader or a magnetic tape drive, and reasonably reliable on a factory floor.



Corn

And it outlived the card in that world.



Herman

A G-code instructor remembers his apprenticeship company still using punch tape to store their CNC programs in 1991. Paper tape was also used to move binary data for mask programmable ROM and EPROM chips through the seventies and early eighties. And some modern CNC systems still measure program size in feet or metres, which is the length of tape the program would need. The tape is gone and the unit of measure stayed.



Corn

The unit of measure is the ghost.



Herman

Then the strangest one. The NSA used punched paper tape to distribute cryptographic keys well into the twenty first century. Read by fill devices, the handheld KOI-18 among them. Production of those paper keys ended on the second of October, 2019.



Corn

The American intelligence community was punching holes in paper for key material after the iPhone existed.



Herman

Because a paper key tape is not connected to anything. No network, no radio, no firmware to corrupt. You feed it into a device and it's gone.



Corn

And punched card ballots. Voteomatic, 1965, became the most widely used computer based election technology in the country. By 2000, roughly a third of American polling places were still using them.



Herman

Which gives you the hanging chad. The card as a political artifact. A storage medium deciding a presidential election.



Corn

A storage medium, a butterfly ballot, and a county clerk's hole punch. Now Project Silica, because this is the payoff for Daniel's last question.



Herman

Microsoft stores data in glass. Quartz initially, femtosecond lasers writing the data, polarization sensitive microscopy reading it. Write once, read many. Immune to electromagnetic fields. Lifetimes in the tens to hundreds of thousands of years. Raw capacity around seven terabytes in a platter the size of a DVD.



Corn

And the 2026 advance, which is the interesting part.



Herman

It works in ordinary borosilicate glass now. Kitchen cookware glass, not exotic fused silica. The writing uses phase voxels that need only a single laser pulse, and the reader simplified from three or four cameras down to one. Microsoft presented the research phase as complete at the Library of Congress this March.



Corn

And their stated reason for doing any of this is our topic.



Herman

Magnetic media degrades. Hard drives need migration roughly every five years, tape every ten, plus regular scrubbing, which means reading and rewriting everything to catch bit rot. Microsoft's pitch is glass that needs none of it. Resistant to water, heat and dust.



Corn

So the argument for glass in 2026 is the argument for cardboard in 1890. Read it without a machine in the loop, keep it away from magnets, and it survives you.



Herman

There's a parallel thread too. DNA storage, Microsoft and the University of Washington demonstrated the first fully automated DNA data storage in 2019. Different physics, same ambition. Encode the data in a molecule that is stable for a very long time and readable with the right equipment.



Corn

And the last legacy, which I think is the best one. Sixty four columns. Eighty columns, I mean.



Herman

The eighty column convention. Terminal widths, coding style guides, the line length programmers still argue about, all of it traces back to the width of a Hollerith card. There's an essay that calls it the tyranny of the eighty column Hollerith punched card.



Corn

We are still formatting source code to fit a card nobody has touched since the seventies.



Herman

And the format was chosen in 1928 for a machine that no longer exists, made by a company that chose it so you couldn't buy anyone else's.



Corn

The card is gone. The column is not.



Hilbert

So the man had it right below the fire door, and that's the part none of you have said yet.



Herman

What's that, Hilbert.



Hilbert

Nineteen seventy four. I was at a small insurance office on the second floor, and they were still running policy records on cards, long after everyone else had moved on. I didn't work the machine. I worked the vault.



Corn

The vault.



Hilbert

Fire safe, forty two inches deep, and the policy card decks lived in it because the state said they had to. The office manager was a man named Ray Przybylski. Ray had a rule about the readers. You never carried a deck across the room in your hands. You put it in a tray every time. If you dropped a hundred and twenty policy cards, you did not find out what you'd scrambled until the tabulator stopped on the wrong field, and then you spent the rest of the day sorting by hand.



Herman

Which is why the cards were almost always preprinted with the field layout.



Hilbert

You could sort them by hand. That's the whole reason Ray kept them. New system came in, magnetic tape, and Ray ran both for four years because if the tape went, the cards were the record. Then the flood, and the fire in the print room, and a fellow who left in a hurry and took a drawer of cards with him for reasons nobody ever got out of him. Ray had the decks dried out, and every card tabulated. Not one had to be repunched.



Corn

The deck outlived the machines that read it.



Hilbert

The machines went in a skip. The cards went to the vault. And I kept the manual, the maintenance manual for the 407 tabulator, and the wiring diagram, because nobody else wanted them. The tabulator went years ago. The paper is still in a box at my sister's house.



Herman

Does the 407 wiring diagram help you with anything, Hilbert.



Hilbert

It helps me with the 407.



Herman

Of course it does.



Hilbert

My aunt, on my mother's side, was a keypunch operator at an insurance firm in Hartford. Fastest in her department. Eighty columns, eight seconds, and they timed it with a stopwatch because the supervisor liked a contest. She got a plaque. And I'll tell you the thing that lasted longer than the machines. Ray never let anyone carry a deck loose, and I've never carried one loose since, and I have not touched a card in fifty years. The habit's still there.



Corn

And you still read them.



Hilbert

You read them from the top down, column by column, and you say the name of the punch. Row twelve plus row one. That's an A. It's not a trick. Anybody who did the job could do it.



Hilbert

Anyway, I'd say the man's right. The card was good enough that the only thing that killed it was somebody making something faster. Faster. There's a difference, and it shows up again about thirty years later.



Corn

Mark the difference. Something can be outrun without being beaten.



Herman

And it's the exact argument Microsoft is making. Glass isn't faster than a hard drive. It's slower. It's just still going to exist when the drive isn't.



Corn

Which closes Daniel's loop. The card is extinct as a format. The principle is in a research lab in Cambridge with a laser. And the eighty column layout is on your screen right now.



Herman

The cutting-room detail I can't get out of my head, since it doesn't fit anywhere else. Colossus, the wartime codebreaking machine at Bletchley, read punched tape at five thousand characters per second, using Arnold Lynch's optical reader. In 1943.



Corn

Five thousand characters a second, optically, in 1943.



Herman

And the tape ran at thirty miles an hour. They added a guide that threw the tape off the machine rather than let it snarl, because at that speed a bad splice shredded the reader. People assume optical sensing is modern. It's eighty years old and it was reading holes in paper.



Corn

The most sophisticated reading technology of the war was eyes made of lenses looking at punches in a tape.



Herman

Then Regnecentralen's RC 2000 in 1963, two thousand characters per second, later twenty five hundred. Slower than Colossus. Wartime urgency beat the commercial decade.



Corn

One thing to carry out of this. We are generating more data than any medium in history can hold or preserve, and we are preserving less of it than a sloth could read by eye in an afternoon. Microsoft isn't building glass because glass is fast. They're building it because everything we store on now has a migration schedule and a person attached to it. The paper card beat that arrangement for sixty years with no electricity at all. If you're betting on what lasts, bet on the thing that doesn't need to be maintained.



Herman

And the column width is the proof. The card died. The eighty columns never did. Whoever's running the archival business in fifty years is running something the card already taught us.



Corn

Credit where it's due, Hilbert Flumingtop keeps this show on the rails and occasionally reads a punch card from memory at us. If you enjoyed this one, rate and review the show on whatever platform you listen on, it helps other people find us. We'll be back soon.

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