

**Unexpected Histories:**

**Spotting Patterns and  
Making Connections  
That Others Miss**

**Edward Barnard**

# Unexpected Histories: Spotting Patterns and Making Connections That Others Miss

The HPC Tradecraft Master Practitioner, Volume 2

Edward W. Barnard

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# Part I: The Day the Internet Died

How do large systems innovate, and how do they fail? Big Tech often presents itself as something unprecedented and unstoppable. This book calmly and firmly takes a different view.

**Part I** examines three moments when technology and infrastructure systems reshaped society, drew institutional response, or collapsed under their own scale.

**The Day the Internet Died** revisits the 1988 Morris Worm, a graduate-student experiment that revealed how fragile the early internet really was. The most damaging phase was not the attack itself, but the period of uncertainty. Observers did not yet understand what they were observing. Then, once they understood, those operators “killed the internet” by taking the backbones offline from each other. The author was present during those early days, watching the response unfold.

**Silicon Valley Takedown** looks at modern antitrust scrutiny through a historical lens. The coming reckoning for Big Tech is not primarily a technology story, but a replay of earlier infrastructure battles. This chapter centers on *Northern Pacific Railway v. United States* (1958) while avoiding legal trivia. The U.S. Department of Justice cites that Supreme Court case as precedent for Big Tech antitrust enforcement. Government enforcement moves slowly. But when it moves, it reshapes entire landscapes.

**Transcontinental Railroad** traces how ocean trade gave way to railroads, and how infrastructure consolidation shaped the origins of American antitrust law. From clipper ships to checkerboard land grants, this chapter demonstrates that antitrust enforcement follows infrastructure, not innovation. Dominant systems are displaced not by morality, but by larger systems. Unfortunately, infrastructure expansion has always involved coercion as well as growth.

Together, these three chapters form a work of historical nonfiction examining moments when large technological and infrastructure systems failed,

consolidated, or provoked institutional response. Part I does not advance a unified argument or policy position, but invites you to view modern platforms through the lens of earlier systems: become, as the Department of Justice suggests, a student of history.

# Chapter 1. The Day the Internet Died

The more things change, the more they remain the same. It's been more than 37 years since the Morris Worm took down the Internet. We'll find that the same attacks and defenses remain in use today. It behooves us all, as modern software developers, to understand our history.

2025 marked the 37-year anniversary of the Morris Worm. It launched November 2, 1988, and internet providers took themselves down for several days. There was no internet for the better part of a week!

Only VAXen (DEC VAX computers) and newer Suns (Sun-3 computer systems) were vulnerable. The problem was, as long as they remained connected to the internet, they could get re-infected. So the internet backbone operators partitioned the internet, disconnecting from each other until everyone was worm-free.

You might wonder how they knew when it was safe to put the internet back together again, given that they couldn't send messages to each other. They picked up the telephone and talked to each other!

If you google *Morris Worm* you'll find various articles including:

- [“How a grad student trying to build the first botnet brought the internet to its knees”](#)—the *Washington Post* looking back after 25 years, with good information
- [“The Morris Worm”](#)—focused on the criminal prosecution and forming of the Computer Emergency Response Team which in turn created the idea of protecting critical infrastructure
- [Morris worm](#)—Wikipedia has a photo of the floppy diskette containing the worm source code, and not much else

YouTube also has several presentations focusing on what went wrong.

The various retrospectives tell us the Morris Worm fundamentally changed the internet, and specifically our thinking about the internet. **I disagree.**

I want to remind you that “the more things change, the more they remain the same.” The Morris Worm exploited several internet vulnerabilities. We’ll see details later. First, do any of these sound familiar? Similar types of vulnerabilities remain today:

- Email server misconfiguration (sendmail had powerful debug commands enabled by default)
- A known operating system vulnerability (buffer overflow in fingerd, a utility commonly used at the time)
- Remote login and remote command execution via remote login
- Successfully guessing weak passwords
- Denial of service

Before the Morris Worm, people left the doors unlocked—almost nobody worried about internet security; we were all friends. The world changed. But, 37 years later, those same types of weaknesses remain. Humans remain human. Please remember that!

This is why in-depth security is essential. Whatever you’re working on, consider the security implications. Could input be unfiltered? Could something be misconfigured? Be sure you know the [OWASP Top Ten](#).

## What Actually Happened?

I was not involved in fighting the Morris Worm. But over the next year, I was involved in telling the story to those who had fought the worm or had been directly affected by the attack.

Robert Morris accidentally released the worm into the wild Wednesday evening, November 2, 1988. As we’ll see in the chronology below, teams of system administrators worked overnight and throughout the day Thursday figuring out what was happening. Some of their top software developers happened to be in the class I was teaching in Minnesota: Cray Research Operating System Internals.

We had no cell phones back then, and email was partly down due to the internet collapsing. Some of my students were in and out of class to consult on the disaster in progress. None of us knew—yet—how big a deal this was.

The next time I taught the operating system internals class, I had a new handout: [A Tour of the Worm](#) by Donn Seeley of the University of Utah. This was a hugely popular handout for the next few months.

We're not going to dive into details of how the worm worked. The bottom of the Wikipedia article links to the source code, analyses, and walk-throughs for those interested.

## Timeline

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### Wednesday, 11/2

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### Thursday, 11/3

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### Friday, 11/4

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### Tuesday, 11/8

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### Friday, 11/11

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## **Attack**

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## **Summary**

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## Chapter 2. Silicon Valley Takedown

On November 18, 2019, U.S. Deputy Attorney General Jeffrey A. Rosen laid out a game plan dealing with the fact that tech giants such as Amazon, Apple, Facebook, and Google are actively killing competition and forming monopolies. Congress has discussed the possibility of needing new laws to deal with advancing technology. Rosen's speech, by contrast, showed us that our current laws have already proven themselves up to the task of returning high tech to being fair and competitive. Should "big tech" change in a significant fundamental way, that affects all of us.

The various tech giants so pervasively affect our daily lives that any significant outcome will affect each of us in fundamental, perhaps unexpected, ways. You might recall the *Microsoft antitrust case* decided in 2001. Microsoft had built Internet Explorer into its Windows operating system, effectively blocking both users and developers from other products such as Netscape or Java.

Now, almost 20 years later, we see the tech giants stifling competition on a much grander scale. Much of today's retail economy comes through Amazon sales. Advertising revenue likewise flows through these tech giants. During a pandemic, Amazon's distribution and logistics come to the fore. It's very much a "pay to play" economy in that sense. In fact these characteristics closely match the Prohibition-era distribution and money-laundering networks.

The U.S. Department of Justice has officially noticed. I'll start by walking through the speech, letting Rosen explain what bad behavior is in fact illegal. Rosen then explains what the government can do about it, and what the U.S. Government has done about similar situations in the past. Finally, Rosen explains that all of this can be accomplished without requiring new laws.

The speech's net effect, for me, is to picture a steamroller coming against "big tech," flattening everything in its path. But here in Minnesota we have something far more fearsome—the conga line.

## Conga Line

Have you ever seen a conga line of snow plows ([Figure 2.1, “Snow plow conga line”](#))? Here they are plowing six wide, six dump trucks with blades. The Minnesota “conga line” takes its name from the dance pattern where dancers follow each other in a line, following the leader through various twists and turns. The Minnesota plows spread out to cover the highway side to side in a diagonal formation. The snow flows from one plow blade off to the side to be caught by the next plow and so on down the line. It’s like a bucket brigade handing buckets of water down the line, but in this case it’s the snow being handed from plow to plow, clearing the entire highway off to one side.

As we walk through the stated game plan, I picture the Department of Justice as a six-wide plow line. It’s frustratingly slow, only 40 miles an hour, but maaaaan you don’t want to be the one standing in the way.



**Figure 2.1. Snow plow conga line**

Or, if you prefer, visualize a platoon of steam rollers (Figure 2.2, “Steam roller”). They are extremely slow, but things are awfully flat once they’ve passed by. That, I suspect, is basically the DOJ game plan.



Figure 2.2. Steam roller

The U.S. Department of Justice has strongly hinted at how they intend to deal with the giants of Silicon Valley. Here's the speech on the official DOJ web site, "[Deputy Attorney General Jeffrey A. Rosen Delivers Remarks on the Review of Market-Leading Online Platforms at the American Bar Association's 2019 Antitrust Fall Forum](#)".

## A View to a Kill

James Bond movie fans will recall that arch villain Max Zorin, in *A View to a Kill* (1985), tried to take over Silicon Valley 35 years ago. That didn't work. The irony is that it's now the opposite situation. It's Silicon Valley itself that is—allegedly—trying to take over by stifling all competition. The announced DOJ plan contains neither literal explosives nor Bond himself, but makes an interesting reference to our checkered past. Or, more precisely, to our “checkerboard” past.

Here's the plan as Jeffrey Rosen laid it out for the American Bar Association's

2019 Antitrust Fall Forum on November 18, 2019. I'm going to excerpt from the speech showing my perspective on the game plan. Am I twisting the words? Goodness gracious, please do read the one-page speech and judge for yourself!

Rosen is here “to share how the Department of Justice is thinking about the intersection of antitrust, data, and digital markets as we conduct our ongoing review of market leading platforms.”

Now, if I were heavily invested in Amazon, say, this might be where I'd sit up straight and take careful notice. But Amazon's in Seattle, not Silicon Valley, so I'm safe. Right? Unless Rosen starts talking about Microsoft (which is in Seattle), we're good. Or so I'd be thinking.

Of course, if I were a Silicon Valley tech bro, I'd know the rules don't apply to me anyway. The industry has been disrupted. Everything is interconnected. That's what tech does. “Ain't” no way to untangle that. We're good.

But if not... we just move on to found another startup with VC (Venture Capital) funding. VC funds are a bro club, so no worries. There's an exit plan.

For example, [Axios reports](#):

Figure, a San Francisco-based consumer lending platform, raised \$103 million in Series C funding led by Morgan Creek Digital at a \$1.2 billion valuation. Figure is led by Mike Cagney, who resigned as CEO of SoFi after reports of company-wide sexual harassment problems—including Cagney's multiple relationships with female employees and at least one instance of sending unwanted texts (an incident which resulted in a financial settlement). Figure backers contacted by Axios are singing a consistent tune: We're confident Cagney has learned from his mistakes and his new company is “doing things better.”

In a world where tech bros have an exit plan and ethics have little practical impact, we likely need government intervention. This fact is why I started out with the “snow plow conga line” analogy. Some situations (such as a Minnesota snow event) simply require government intervention. Our Minnesota transportation system requires maintenance in the form of our fleet of 30-ton snow plows.

Rosen continued:

I applaud the antitrust section for hosting today's discussion about digital markets, machine learning, intellectual property, data, and

digital platforms. The human impact of these technologies cannot be overstated. Ordinary Americans rely on them in their day-to-day lives.

## Picking Rocks

Come spring, over here in Minnesota, we plow the fields. That's when the rocks float to the top, rising out of the field being plowed. The [Jones Family Farm](#) blog laments:

Then again, maybe you've never even heard of "picking rocks." Picking rocks is one of the basic truths of farm life. Every farmer has done it in their lifetime, almost regardless of where they farm in these United States. Some areas are much worse, of course, and some fields have a constant problem. But, why in the world do farmers pick rocks???

Why do I mention this? I think of lawyer speeches in the same way. It's a word salad that I don't see as terribly useful. Like the corn field next to my house in the spring, it's an expanse of well-manured dirt.

But some interesting rocks arise from Rosen's speech to be picked up. Interesting phrases pop out. "... As law enforcers ... important to all of us who are charged with upholding the law..." Oh, oh! There's a steam roller on the horizon.

Rosen announces the steam roller's impending arrival:

Antitrust is often a forward-looking exercise... but antitrust can also be a retrospective exercise. So we should try to be students of history. I often find intriguing, and sometimes instructive, how markets have behaved over time—and how competition and antitrust enforcement have affected them.

That's quite a statement. I want to bring out the implications there.

Do you remember how we laughed at the incompetent Congressional hearings when Mark Zuckerberg, co-founder of Facebook, and the other Silicon

Valley bros were brought to town? Our congresspeople obviously didn't have a clue about the technology involved, "high tech."

But we were looking at this from the wrong perspective. This wasn't about technology. They were building a case. With that in mind, take another look at any of the articles from around July 16-18, 2019. Here's one from the New York Times, [Tech Hearings: Congress Unites to Take Aim at Amazon, Apple, Facebook and Google](#).

We all know that with tech hearings, Congress just doesn't get it. Most can barely use a Blackberry. But look at the slug in the web link. It's "big-tech-antitrust-hearing". That's the key to the whole thing. It was never about "tech." It was about antitrust.

Here in Minnesota, we've been hammered by climate change (and the so-called trade war). Road technology has changed over the years, and our roads are far more interconnected than they used to be.

But, uff da, when it snows we know what to do. Out comes the conga line of 30-ton snow plows, and it's a *government* function. For sure, ya you betcha, we have countless private plows—everything from a pickup truck with hydraulic blade attachment down to a blade on the lawn mower ([Figure 2.3, "Lawn mower with plow blade"](#))—but we still expect the conga line.



**Figure 2.3. Lawn mower with plow blade**

Rosen notes that “antitrust is often a forward-looking exercise” but then turns to drawing from historical precedent. It will become clear that it’s *history* that provides the game plan.

## Historic Game Plan

In other words, per Rosen, we won’t bother trying to create new laws to deal with Big Tech. We’ll see that we already have well-equipped steam rollers (so to speak) in place.

Rosen explained:

Looking back, it has been suggested that industries involving technology and information exchange have displayed a common pattern: they often start out as open and fragmented, with a wide range of participants, but over time they become dominated by just a few.

Radio broadcasting in the early 20th Century is one example. When radio was a nascent medium at the start of the 20th Century, amateur radio stations popped up all over the country. None were aimed at meaningful mass communication.

Starting in the 1920s, however, the transformative potential of mass communication became clearer, leading a handful of businesses to acquire and expand radio networks by the end of that decade. The most famous of these are still familiar today: the National Broadcasting Company, or NBC, and the Columbia Broadcasting System, or CBS, and the American Broadcasting Corporation, or ABC. Throughout the 1930s and 40s, these major broadcast radio networks expanded their programming and commanded steadily greater audiences.

Also in the early and middle 20th Century, economic power similarly consolidated in the film industry. This was at the expense of many smaller production companies that had, in earlier years, produced a diverse array of films.

This consolidation had some rational business explanations. Larger film companies were able to produce increasingly expensive movies more efficiently, to survive flops, and to distribute hits to a broader audience.

But some suggested more problematic explanations for this consolidation... major film and production companies engaged in a pattern of anticompetitive acts aimed at excluding competition and expanding their market power, including in adjacent markets.

Today, in the 21st Century, we marvel at the World Wide Web and mobile technology, but we once again face questions about the consolidation of power by some companies that provide platforms for information exchange and related technologies.

Some of today's leading platforms were in their infancy, or did not even exist, just two decades ago. In a relatively short amount of time, they have disrupted industries, amassed substantial economic power, and developed business models that monetize potentially sensitive consumer information that they control.

Didn't someone (me) point out that these government idiots don't have a clue about high tech? On the contrary, Rosen nailed it. He's carefully *not* naming any side issues. He's limiting himself to laying out the antitrust case.

Rosen continues:

So, as with past technologies like radio and film, things today look quite different than they did in the early days of the internet revolution. Accordingly, in the face of those changes and the issues that have been raised, we are once again bound to ask whether any dominance is the result of competition on the merits and, if not, how antitrust law can cure any competitive deficiencies.

[We] rightly observe that it is possible for dominant firms to ward off—or at least delay—industrial change through practices cementing their dominance at the expense of innovative competitors. Moreover, many see the structural features of today's major technology industries—which are characterized by network effects and “tipping”—as facilitating perpetual dominance.

We have not reached any ultimate conclusions yet. I want to underscore that. We will follow the evidence and, if it is warranted, we will enforce the law and seek appropriate remedies, just as the Department's Antitrust Division has done with respect to titans of industry during more than 120 years of Sherman Act enforcement.

That *could* sound ominous. But if you're an entitled tech bro, probably not. Laws don't actually apply to you. Rosen's describing the ending of the Gilded Age of tycoons and robber barons. The robber barons came back with the Roaring Twenties, so this just might be a "nothing burger."

## Remembering Microsoft

Rosen's not done yet:

With regard to technological markets in particular, we are now almost twenty years past the famous Microsoft case, where...

Oh, oh. Microsoft? That's Seattle, not Silicon Valley away south in California. Since Boeing decamped, and Microsoft got squished a bit, Seattle is now the land of cruise ships and Amazon. Perhaps our Amazon bros may encounter a twinge of concern? No, probably not.

Rosen explains about Microsoft:

...and private companies pursued antitrust damages [against Microsoft] for the violations. Those cases focused on Microsoft's integration of its web browser into the Windows operating system.

Microsoft recognized that a web browser could become an alternative platform for developers, which could threaten its monopoly in operating systems. It therefore took a variety of steps to thwart that innovation, which the D.C. Circuit found to be anticompetitive.

Today, almost two decades after the D.C. Circuit's opinion in Microsoft, another technological cycle has undoubtedly occurred. Innovations in browsers, search, social media, and mobile technology have introduced new platforms—and new allegations that the platform operators are preventing disruption and preserving dominance.

It is therefore unsurprising that concerns about the leading online platforms have been widely expressed, including by industry participants who have direct insight into the competitive dynamics of technology platforms.

This is getting tedious, but bear with me once more. We've all been assuming—or at least I have, silly me—that we're going to need new laws to deal with Big Tech. Let's hear Rosen explain, Nope, and jump straight to the point.

The goal of the Department's review is to assess the competitive conditions in the online marketplace in an objective and fair-minded manner and to ensure Americans have access to free markets in which companies compete on the merits to provide services that users want.

Others, particularly in Congress, have raised concerns whether laws apart from the antitrust statutes may have produced unwanted results or otherwise need changing, and we are open to engaging on legislative proposals as well. But, for more than a century, antitrust law has proven itself powerful and flexible enough to address this country's most daunting monopolies, including in technological markets.

I'm reminded of the exchange in *Back to the Future* (1985):

Marty McFly: Hey, Doc. You'd better back up, we don't have enough road to get up to 88.

Dr. Emmett Brown: Roads? Where we're going we don't need roads.

## Getting Serious

Finally! Here we are. We've arrived at the transcontinental railroad that just might bring down bro tech—hard. Rosen explains:

Sixty years ago, as most in this room probably know, Justice Black explained in *Northern Pacific Railway v. United States* that:

“The Sherman Act was designed to be a comprehensive charter of economic liberty aimed at preserving free and unfettered competition as the rule of trade. It rests on the premise that the unrestrained interaction of competitive forces will yield the best allocation of our economic resources, the lowest prices, the highest quality, and the

greatest material progress, while at the same time providing an environment conducive to the preservation of our democratic political and social institutions. But even were that premise open to question, the policy unequivocally laid down by the Act is competition.”

The Sherman Act remains such a charter today. But to be clear, we do not view antitrust law as a panacea for every problem in the digital world. Indeed, we will not ignore any harms caused by online platforms that partially or completely fall outside the antitrust laws. We are keeping in mind other tools in areas such as privacy, consumer protection, and public safety as part of a broader review of online platforms, to whatever extent warranted.

So, Rosen makes it clear, we intend to deploy far more than one little ole fleet of steam rollers crushing everything in its path.

Rosen only cited one specific case—the Northern Pacific Railway case decided by the U.S. Supreme Court in 1958. He also said, “So we should be students of history.” That Northern Pacific Railway case is the key to our “checkerboard” past. We’ll be exploring that past.

Remember, Rosen was speaking to an audience of lawyers at an antitrust conference. He wasn’t there to teach antitrust law, provide a “feel good” speech, provide context, or fill in a speaking slot on behalf of the DOJ. It looks to me like he was providing these antitrust lawyers a preview of the upcoming biggest undertaking of their lives. He was providing direction, vision, and laying out the game plan.

We’ll next have some fun as students of history. I’m placing our history in chronological order. I’ll begin with the early 1800s, then look at the late 1800s, then the 1930s, along with the more recent six years (2014-2019, pre-Covid).

But first, let’s continue Justice Black’s opinion continuing from Rosen’s quote above. Don’t the following characteristics describe “big tech” and, for that matter, the price-gouging aspects of “big pharma”?

However, there are certain agreements or practices which because of their pernicious effect on competition and lack of any redeeming virtue are conclusively presumed to be unreasonable and therefore illegal without elaborate inquiry as to the precise harm they have caused or the business excuse for their use.

Among the practices which the courts have heretofore deemed to be unlawful in and of themselves are price fixing; division of markets; group boycotts; and tying arrangements. For our purposes a tying arrangement may be defined as an agreement by a party to sell one product but only on the condition that the buyer also purchases a different (or tied) product, or at least agrees that he will not purchase that product from any other supplier.

## Summary

I believe Rosen has provided us a road map for bringing down what I call “bro tech” because of anti-competitive practices. I’m not a lawyer, as I may have mentioned. My focus has been on preparing to share the surrounding history.

When I recently deleted my Facebook account, I noticed it was easy to export my history such as photos I had posted over the years. It’s possible that Facebook is intentionally making it easier to migrate away from Facebook as a way of showing that they are not anti-competitive. Yo, Facebook, good luck with that.

# Chapter 3. Transcontinental Railroad

We're looking at the background behind the U.S. Department of Justice plan to consider antitrust action against the giants of high tech. We'll see how ocean transportation gave way to transcontinental transportation. That's the background we'll need for seeing how transcontinental transportation became the antitrust action that's setting a precedent for big tech.

This all sounds ridiculously boring, but don't worry. Like many things, it all starts with a remarkable flame war. We continue with the transcontinental railroad, which took their case of excessive greed to the Supreme Court—and lost. That loss becomes the centerpiece of antitrust investigations of high tech.

## Railroading

Deputy Attorney General Jeffrey Rosen shared the U.S. Department of Justice [plan to investigate big tech over antitrust concerns](#). Rosen cited one and only one specific court case, *Northern Pacific Railway v. United States*, decided by the U.S. Supreme Court in 1958. Rosen also explained, in that context, that “we should be students of history.”

That court case involved our westward expansion in the USA during the early 1800s, the transcontinental railroads, and specifically the “checkerboard” land grants made to those railroads.

Congress gave the transcontinental railroads (which only existed on paper at that point) vast tracts of land, which the railroads could sell. This was how the railroad company raised funds to pay for building the railroad. The Northern Pacific Railway tried to lock in their customer base by adding a condition to the land sales. The purchaser—while paying good money for the land—could only use the Northern Pacific Railway to transport anything produced on that land.

It's much like Oracle, Apple, Microsoft, or IBM trying to lock you in to using their product—with a hefty enterprise license. The Supreme Court called the

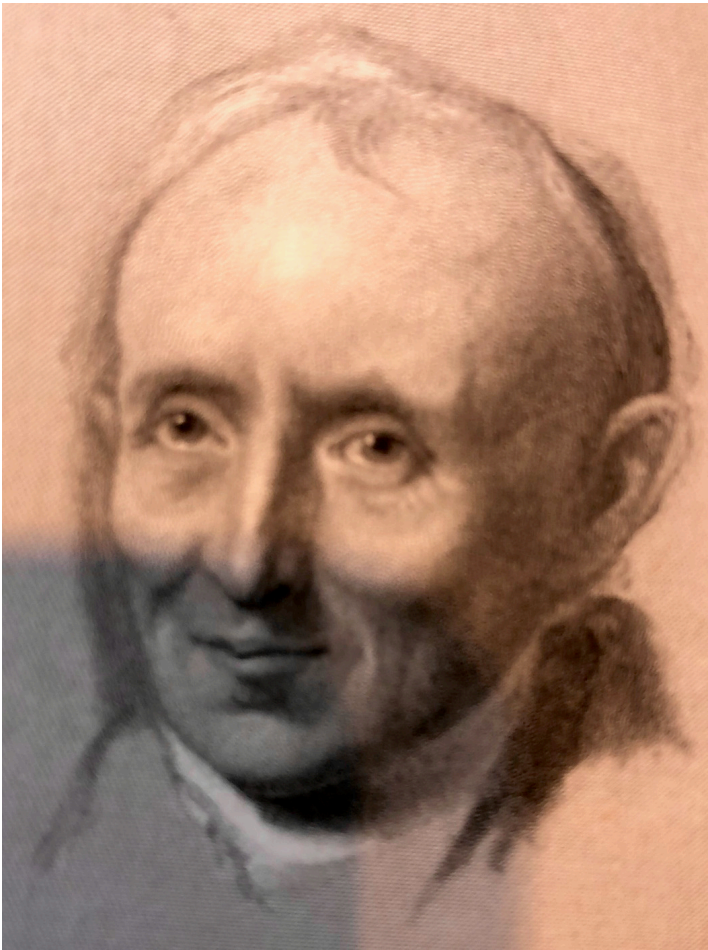
Northern Pacific's conditions of sale an anticompetitive practice. Rosen's using that court decision as a centerpiece of DOJ antitrust investigations.

As we watch the antitrust action unfold (assuming it does), bear in mind the delightful Merriam-Webster pair of definitions for “to railroad” something or someone (as a transitive verb):

1. (a) To convict with undue haste and by means of false charges or insufficient evidence; (b) to push through hastily or without due consideration.
2. To transport by railroad.

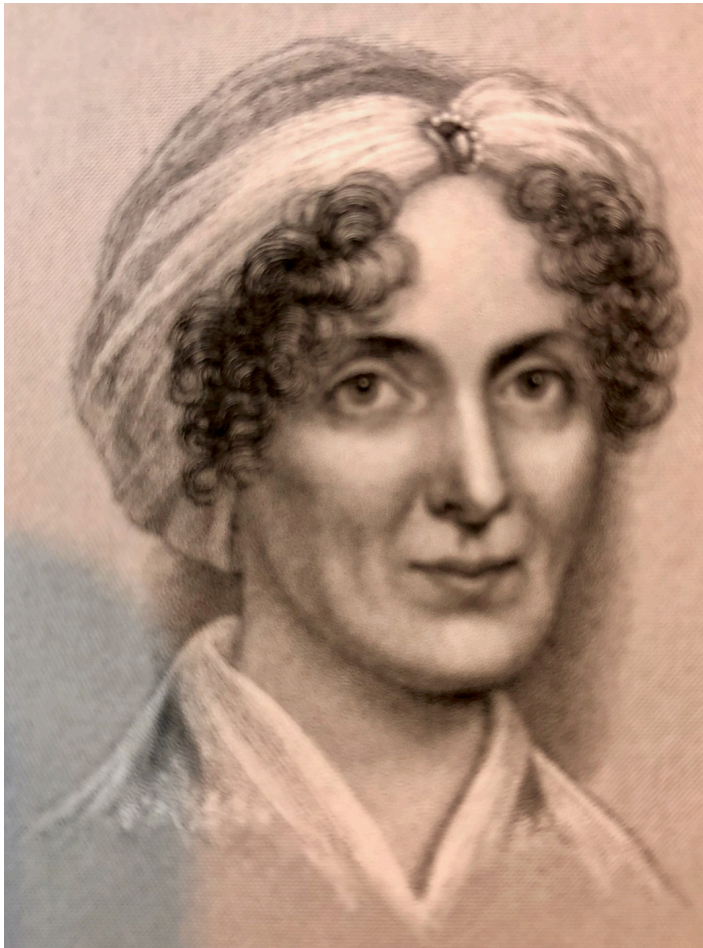
When the tech bros start screaming about being railroaded (definition one), we can all answer, “Yup!” (definition two).

## **Nat and Mary Bowditch**



**Figure 3.1. Nathaniel Bowditch**

Dr. Nathaniel Bowditch is a “Generation X” person, born in '73, albeit 1773. See [Figure 3.1, “Nathaniel Bowditch”](#).



**Figure 3.2. Mary Bowditch**

Nathaniel and Mary (Ingersoll) Bowditch (Figure 3.2, “Mary Bowditch”) had children—and those children published (Figure 3.3, “Nathaniel Bowditch Memoir”). That will be part of our story. For example, their son Nathaniel Ingersoll Bowditch (1805-1861) was a well-known lawyer and the author of several articles and publications, primarily concerning genealogy and real estate law. Their second son Jonathan Ingersoll Bowditch (1806-1889) took over editorial responsibility for *The New American Practical Navigator* upon Bowditch’s death in 1838.

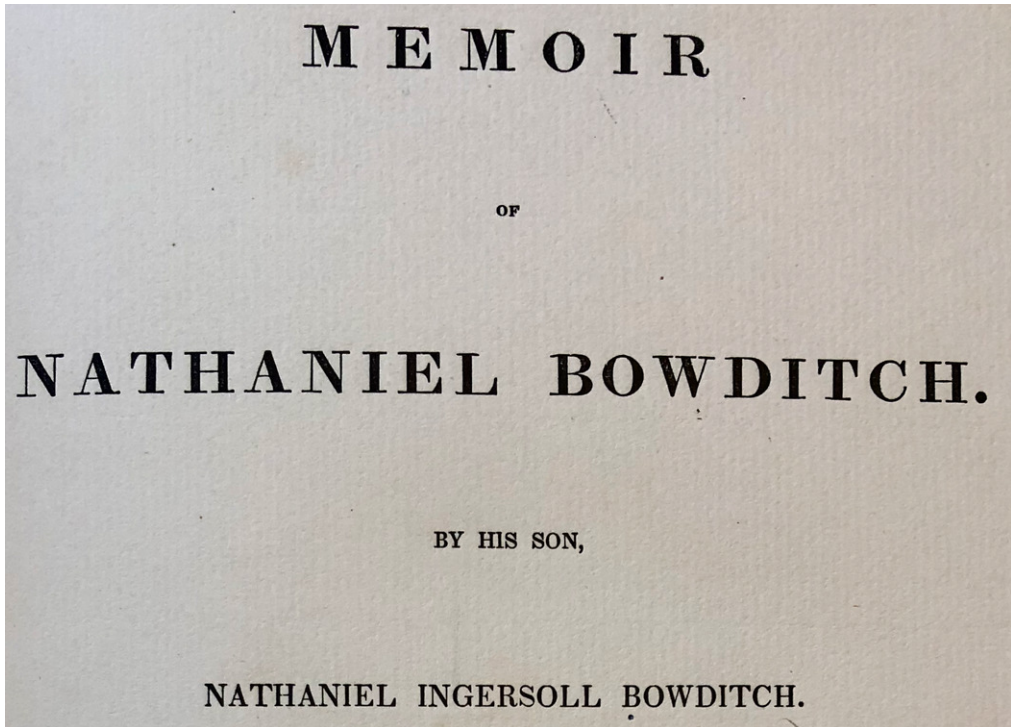


Figure 3.3. Nathaniel Bowditch Memoir

Without Dr. Bowditch, we couldn't have modern capitalism as we know it today. When you think about it, you'll realize that modern capitalism and antitrust concerns are likely connected.

*Popular Astronomy*, May 1895, in [The Services of Nathaniel Bowditch to American Astronomy](#) reports his encouragement by Harvard (page 388):

In his early years Dr. Bowditch was given much encouragement to pursue his scientific career by Harvard University; in July, 1802, to his great surprise, he was given the honorary degree of Master of Arts... Dr. Bowditch was admitted to the American Academy of Arts and Sciences in 1799... In 1829 he was elected President of the Academy, in succession to the illustrious John Quincy Adams, ex-President of the United States—a high honor which he continued to hold until his death.

Pages 392-393 continue:

He was equally honored in his own country, by being chosen to

membership in all the learned societies of the time, and in 1816 at the annual Commencement of Harvard College he received the honorary degree of Doctor of Laws. In 1806 Dr. Bowditch was elected Hollis Professor of Mathematics at Harvard University, but this position was declined owing to an unwillingness to break up his long connection with Salem... in 1823 Dr. Bowditch accepted the position of Actuary to a Life Insurance Company in Boston.

Harvard College was in trouble. Tamara Plakins Thornton, in *Harvard Magazine*, continues our story in [Nathaniel Bowditch: Brief life of a mathematician and businessman: 1773-1839](#):

He assumed a far more significant role in 1826, when he was named to the Corporation, appointed this time for business, not mathematical, expertise. The College was a financial mess and Bowditch, who had taken charge of a Boston trust and investment company, had a reputation for making it operate like a miniature solar system, a “great machine” running “with the regularity and harmony of clock-work.” Had Harvard’s powers-that-be known what he would do, they might have thought twice about their decision... College monies were mixed in with personal accounts... President John T. Kirkland distributed scholarships without the Corporation’s knowledge or consent, awarded honorary diplomas against its explicit orders, regularly skipped chapel duty to dine with patrician friends in Boston—and then sought reimbursement for the bridge tolls.

The Harvard (college) trust fund was going bankrupt. It had unconscionably lackadaisical management. Dr. Bowditch set things straight—and ruffled feathers in the process. That’s where it gets fun!

Today we have Twitter feuds. Back in the days of Usenet, we had flame wars. They are the same thing. Bowditch was in a flame war. But the people on both sides of the flame war, at the outbreak of flame war, were *dead*. How cool is that?

On the one side was Bowditch, who was brought in to set the Harvard endowment on a sound footing. On the other side was the previous guy in charge. He picked up his toys and went home. But the flame war erupted after *both* were dead.

Bowditch died first, 1838. The other guy, a past president of Harvard, died two years later.

The other guy, Dr. Kirkland, was eulogized at his funeral, naturally, which was at Harvard. The eulogy basically said that he had been wronged by Bowditch without actually naming Bowditch. Dr. Bowditch's children were still alive—and listening (Figure 3.4, “Bowditch response”).

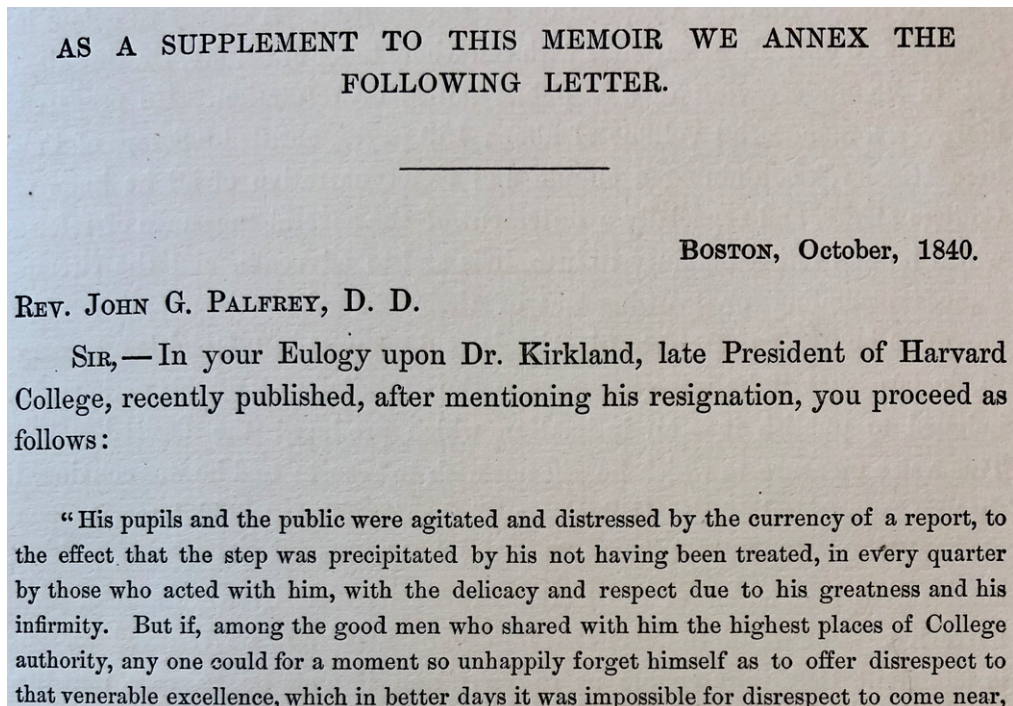


Figure 3.4. Bowditch response

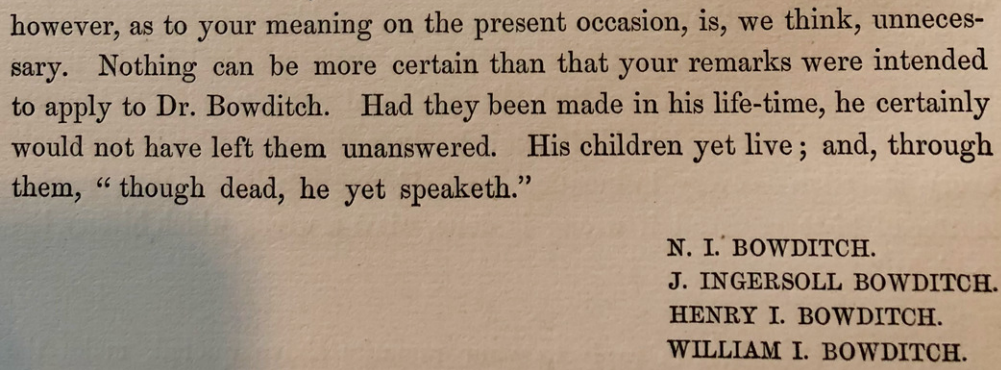
Bowditch's children were willing to let the eulogy pass. It was just words. But Harvard chose to publish the eulogy. At that point, the Bowditch family found it necessary to say something. In writing. Harvard had just “tugged on Superman's cape.”

You don't tug on superman's cape. You don't spit into the wind. You don't pull the mask off that old lone ranger. And you don't mess around with Jim.

—*You Don't Mess Around with Jim* (1972) by Jim Croce

The children published an explanation. Around 1840 they had published *A Memoir* documenting the life of their father, Nathaniel Bowditch, and family. I

found this explanation, signed by the Bowditch sons (Figure 3.5, “The feud”), in the very back of the third edition, printed in 1884.



however, as to your meaning on the present occasion, is, we think, unnecessary. Nothing can be more certain than that your remarks were intended to apply to Dr. Bowditch. Had they been made in his life-time, he certainly would not have left them unanswered. His children yet live; and, through them, “though dead, he yet speaketh.”

N. I. BOWDITCH.  
J. INGERSOLL BOWDITCH.  
HENRY I. BOWDITCH.  
WILLIAM I. BOWDITCH.

Figure 3.5. The feud

The University of Minnesota Duluth has a copy. The book is falling apart, but they lent it to me anyway. How cool is that? This is where I found traces of the posthumous flame war. What was the problem?

That response in the back of the *Memoir* explains that, during his lifetime, Nathaniel Bowditch kept receipts. There had been murmuring and complaints during Dr. Bowditch’s lifetime. He’d been heavy-handed in setting the Harvard Endowment straight.

Let me be clear here. This is not a small thing. The Harvard Endowment is a very big deal; in 2018, it was [forty billion dollars](#).

Why is the Harvard Endowment so outrageously large? Dr. Bowditch. He set the nearly-bankrupt endowment on that course. Meanwhile, there was unhappiness amongst those who had been trampled in the process. Thornton explains (linked above):

“Order, method, punctuality, and exactness were, in his esteem, cardinal virtues; the want of which, in men of official station, he regarded not so much a fault as a crime,” Josiah Quincy reflected in his *History of Harvard University*, and when Bowditch detected such wrongdoing, he “would descend on the object of his animadversion with the quickness and scorching severity of lightning.” ... Out went the College treasurer, the steward, and finally Kirkland himself. Proper Boston was appalled, not so much by what Bowditch revealed,

or even by the results of his actions, but by the roughshod way in which he had conducted affairs.

The *Memoir* reports, during Dr. Bowditch's lifetime, when the bleating got too loud, he called a quiet meeting with the bleaters. He had notes, memos, receipts, names, dates, places, conversations.

Bear in mind Harvard is in, and this flame war takes place in Boston. Dr. Bowditch grew up in and famously sailed from rival seaport Salem. Bowditch's children state:

When the late President of the University resigned his seat... it was currently reported that Dr. Bowditch had treated him, when enfeebled by disease, with a respect upon which he durst not otherwise have ventured.

He was therefore denounced through the public press as "a Salem sailor," and called upon by name to retire from the Corporation of the College. A charge so odious in itself... Dr. Bowditch felt to be undeserving of any public notice or refutation.

He prepared, however, a manuscript volume of about 150 pages, entitled "Scraps of College History," containing a simple and exact narrative of all he knew of College affairs, and especially a statement of the several measures of reform which he had felt it his duty to introduce and to advocate, and the circumstances attending or growing out of their discussion and adoption.

Now we come to the point.

His narrative he freely showed to his friends, and even, at last, found it necessary that if he were any longer assailed, he might, perhaps, be induced to publish it—an intimation which produced the desired effect.

Clearly, Dr. Bowditch's children were in possession of *Scraps of College History*—and had the ability to publish. We are, after all, reading this story in a published book. Let the posthumous flame war begin:

Dr. Bowditch died in the belief that he had lived down this calumny. Little could he have anticipated that so soon after his death, upon

a most solemn and public occasion, an individual, recently at the head of one of the departments of the College, and who, though not an officer of the institution at the period alluded to had yet the means of knowing the truth, should nevertheless have seen fit, under the disguise, indeed, of gentle insinuations, and the show of much forbearance, distinctly to allude to this charge in a manner which none of his hearers could misunderstand.

The mere insertion of this paragraph in the discourse when delivered, we should not have noticed. But a PRINTED eulogy... of one of its most universally popular presidents... may exist to be referred to by the future historian of the College. (Emphasis in original.)

Had [the remarks] been made in his life-time, he certainly would not have left them unanswered. His children yet live; and, through them, "though dead, he yet speaketh."

I'm quite impressed with this flame war—since both principals were already dead when it started. Take note of the hallmark of modern flame wars, namely the seemingly-endless rant, which "states the facts." The published rant covers four large 11-inch by 9-inch pages.

Was this a trivial matter? No. This was over the \$40,000,000,000 Harvard Endowment. As the Harvard Endowment hits the news from time to time, remember where it began. Beloved Harvard president Dr. Kirkland fluffed it; self-taught Dr. Bowditch saved it.

Did you catch the lesson for us today? Keep a journal. Only in retrospect will you know what parts were important. A contemporaneous log carries high credibility. It's a good habit to form.

When some tech bro comes at you like he's just invented the Twitter feud... Nope. Refer him to the back pages of *The Memoir of Nathaniel Bowditch, Third Edition* (1884). Note that they feuded when the principals were stone-cold dead, and suggest he might be inspired to take a similar approach.

Meanwhile, Dr. Bowditch did stuff after setting Harvard's endowment straight. He arguably set us on the path to modern capitalism. He was the first professional fund manager—and, as the *Memoir* explains, he refused to lend to any woman, ever. His reasoning was that, in the case of default, he could not possibly consider going after a woman to collect on the default. (I but report the facts.)

## Clipper Ships

Bowditch had much to do with the wealthy people—the shipowners—staying wealthy. Tamara Plakins Thornton wrote the award-winning book *Nathaniel Bowditch and the Power of Numbers: How a Nineteenth-Century Man of Business, Science, and the Sea Changed American Life* in 2016. Her book is “at once a lively biography, a window into the birth of bureaucracy, and a portrait of patrician life, giving us a broader, more nuanced understanding of how powerful capitalists operated during this era and how the emerging quantitative sciences shaped the modern experience.” It’s amazing how one relatively-unknown person set forces in motion that we experience today.

Much of the USA’s economic power, in the 19th Century, came from the ships, especially the Yankee Clippers with their split topsails. Bowditch made it possible for them to reach their destinations months sooner thanks to his writing *The New American Practical Navigator*.



Figure 3.6. Portrait of an American clipper ship

Figure 3.6, “Portrait of an American clipper ship,” is by Lai Fong, a Chinese artist working in the final quarter of the 19th Century, primarily from his studio in the Indian port of Calcutta, born circa 1869. This painting was owned by the family of Captain Thomas Belch Perkins (1816-1875) of Salem. The flag flown on the ship is a “house flag,” possibly that of I.F. Chapman of Bath, Maine.

Compare the clipper ship to Figure 3.7, “USS Constitution,” the earliest known depiction (ca. 1803-1804) of the USS Constitution, “Old Ironsides.” Count the number of sails on the main (center) mast. From bottom to top, the Constitution’s sails are the mainsail or “course,” the topsail, the topgallant, and royal. The “royal” is so-called because it sits above everything else.



Figure 3.7. USS Constitution

There’s something odd about this painting of USS Constitution. Which way is the wind blowing? The ship is pointed to the right. The direction of the ship, and the shape of the sails, tell me that the wind is blowing from left to right in the painting. Yet the flags indicate the wind flowing from right to left. Perhaps the cannon smoke near the bow gives us the answer. Perhaps the

wind is flowing from the observer towards the ship. That would explain why the smoke appears to be blowing back, across the ship.

Remember, ships of this era were entirely wind-powered. Wind and weather are everything. So, in this case, we're looking downwind to the ship, and that's why the flag seems to show the wind flowing one direction while the sails are billowing in the other. I mention this oddness because it's a lesson for software development today. When symptoms or circumstances don't quite seem to align, it's a sign you do not yet understand the situation correctly. Keep digging or searching for that understanding!

A half-century later (mid 19th century), merchant vessels, including the clipper ships, split the sails ([Figure 3.8, "Split sail plan"](#)). Merchant ships had far fewer sailors to handle the sails as compared to military vessels such as *Constitution*. It was far easier to handle the topsail as separate upper and lower topsail. The topgallant was likewise split into gallant and topgallant.

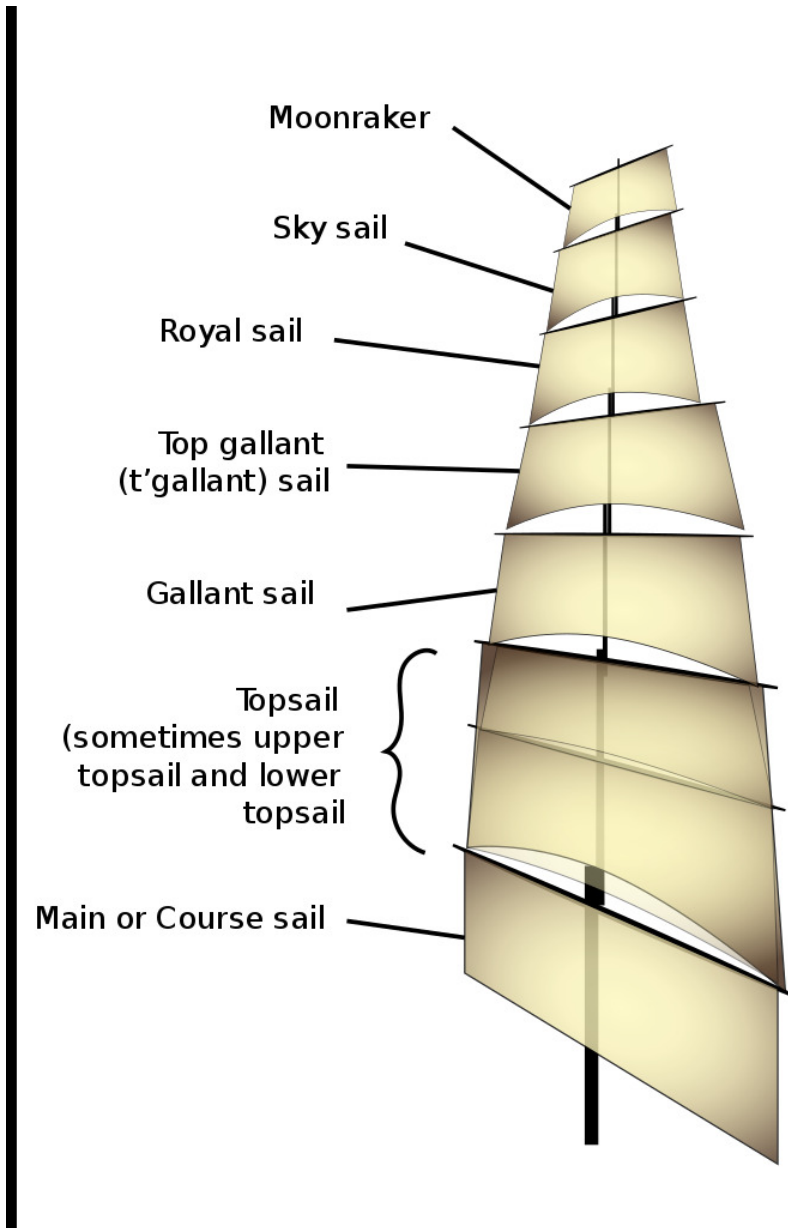


Figure 3.8. Split sail plan

[National Geographic Magazine](#) explains that “Clipper ships’ owners made millions... Shipping barons like Warren Delano and Robert Forbes got rich from the opium trade in China. Many of the great clipper ship fortunes funded... universities such as Harvard, Princeton, and Yale.”

Do you recognize either of those names? “Forbes” is probably familiar. You

might know of Delano's grandson, Franklin Delano Roosevelt (FDR). He made the *Day of Infamy* speech, bringing the United States into World War II. (The linked article describes how FDR crafted his "call to arms" in a remarkably short time frame.)

Have I wandered off course with this talk of sail plans and so on? No. There's a general principle I follow in software development. We just saw this principle at work with the painting of the *USS Constitution*. When something doesn't quite add up, or the known facts don't all fit the explanation of what happened, it's important to check further.



Figure 3.9. Pride of Baltimore

The *National Geographic* article linked above, titled “Clipper Ship Owners Made Millions. Others Paid the Price,” opens with “Clipper ships traveled at blistering speeds but conditions on board were brutal, and opium was their most profitable cargo.”

So far, so good. The article’s dramatic title got me to click. But the photo is of the *Pride of Baltimore*, “a reproduction 1812 Baltimore clipper” (Figure 3.9, “[Pride of Baltimore](#)”). It doesn’t look anything like Figure 3.6, “[Portrait of an American clipper ship](#),” which we know to also be a “clipper ship.” Do you see that the sail plan is quite different?

It turns out that there were two different things, both called clipper ships. Sheesh! Daniel Brown explains in “[The Need for Speed: Baltimore Clippers and the Origin of the First American Ship Type](#)” that American shipbuilders created something called the Baltimore Clipper—the perfect pirate ship (privateer) to prey on British shipping during the War of 1812.

The later clipper ships from 1850 onwards (Figure 3.6, “[Portrait of an American clipper ship](#)”) were entirely different. In one regard, this is due to Bowditch’s voyages. Shipowners, during the Baltimore Clipper era (which was the era of Bowditch’s five voyages), didn’t dare use larger ships; the risk of ruinous loss was too great. Once Bowditch demonstrated reliable navigation, shipowners were willing to take advantage of much larger (and therefore much-faster and capable of carrying more cargo) ships to circle the globe.

So, that minor mystery is solved. There was a “Baltimore clipper” in the late 18th and early 19th Centuries, but there were also the better-known “clipper ships” of the late 19th Century. Technology always evolves, and the pace of evolution evolves rapidly. It took a century for clipper ships to change; we measure changes in programming languages and frameworks in months (or days when we joke). Now we can move on!

## Great Northern Railway

The clipper ships disappeared. Why? Railroads. First, we had a railroad across Panama. No longer did ships need to double the Cape of Good Hope or Cape Horn. The NASA Earth Observatory explains [Cape Horn: A Mariner’s Nightmare](#):

Before the opening of the Panama Canal in 1914, Cape Horn (Figure 3.10, “[Cape Horn](#)”; image from this article) was a place that gave

mariners nightmares. The waters off this rocky point, at the southern tip of Chile's Tierra del Fuego peninsula, pose a perfect storm of hazards.

Southwest of Cape Horn, the ocean floor rises sharply from 4,020 meters (13,200 feet) to 100 meters (330 feet) within a few kilometers. This sharp difference, combined with the potent westerly winds that swirl around the Furious Fifties, pushes up massive waves with frightening regularity. Add in frigid water temperatures, rocky coastal shoals, and stray icebergs—which drift north from Antarctica across the Drake Passage—and it is easy to see why the area is known as a graveyard for ships.

On July 12, 2014, the Operational Land Imager on Landsat 8 satellite captured this image of Cape Horn and the Wallaston and Hermite Islands.

Hundreds of ships have gone down near Cape Horn since Dutchman Willem Schouten, a navigator for the Dutch East India Company, first charted a course around the Horn in 1616. One vessel that narrowly escaped that fate was the HMS *Beagle*, with naturalist Charles Darwin [for whom the modern Darwin Awards are named] aboard. In *The Voyage of the Beagle*, Darwin described the harrowing journey as the explorers tried to round the horn just before Christmas 1832.

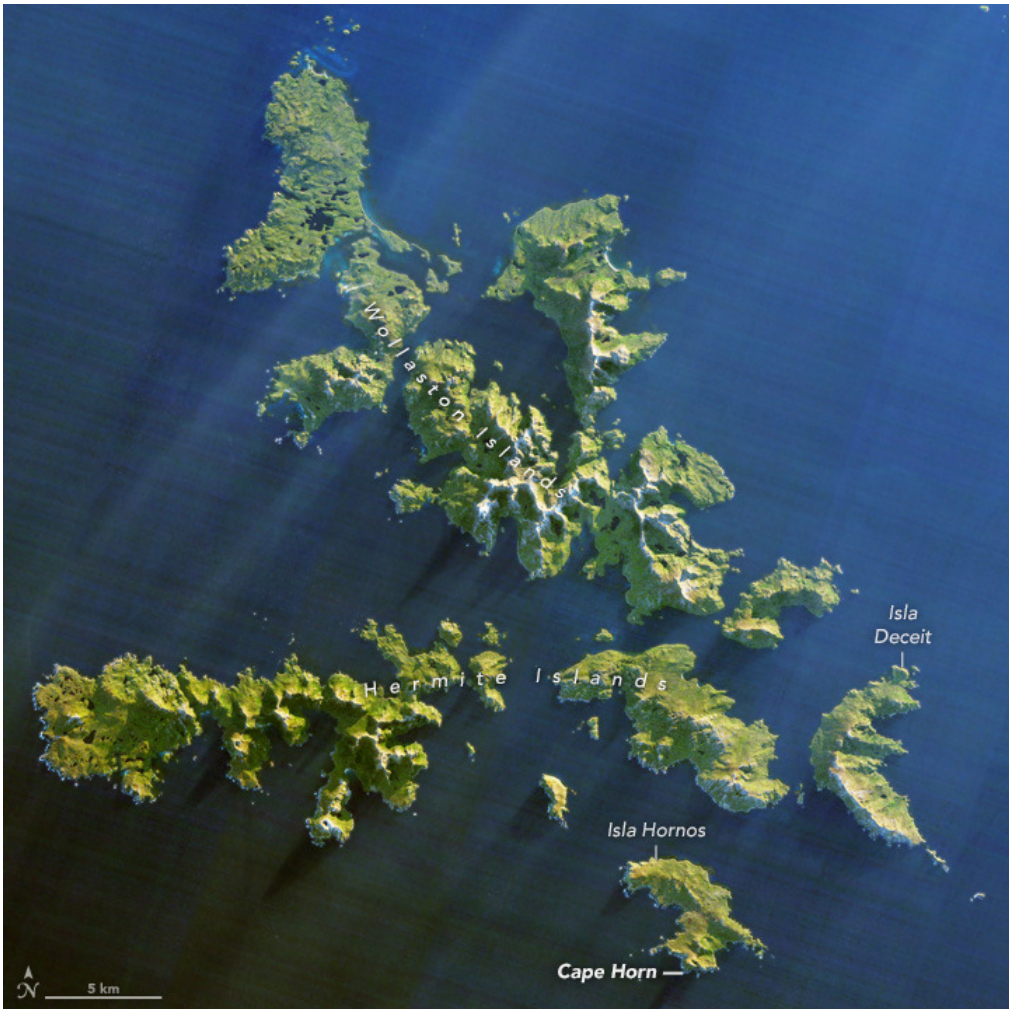


Figure 3.10. Cape Horn

In [Chapter X—Tierra del Fuego](#) Darwin writes:

December 21st.—The Beagle got under way: and on the succeeding day, favoured to an uncommon degree by a fine easterly breeze, we closed in with the Barnevelts, and running past Cape Deceit with its stony peaks, about three o'clock doubled the weather-beaten Cape Horn. The evening was calm and bright, and we enjoyed a fine view of the surrounding isles.

Cape Horn, however, demanded his tribute, and before night sent us a gale of wind directly in our teeth. We stood out to sea, and on the second day again made the land, when we saw on our weather-bow

this notorious promontory in its proper form—veiled in a mist, and its dim outline surrounded by a storm of wind and water.

Great black clouds were rolling across the heavens, and squalls of rain, with hail, swept by us with such extreme violence, that the Captain determined to run into Wigwam Cove. This is a snug little harbour, not far from Cape Horn; and here, at Christmas-eve, we anchored in smooth water. The only thing which reminded us of the gale outside, was every now and then a puff from the mountains, which made the ship surge at her anchors.

The early 19th Century American economy, to a large extent, depended on global trade, which in turn often meant doubling Cape Horn. This was an extremely dangerous proposition. The transcontinental railroads (which did not yet exist) provided an attractive alternative.

The railroads become the next stop in our story—the part that the Department of Justice mentioned in Rosen’s Silicon Valley Takedown speech.

James J. Hill was one of the railroad tycoons—in this case, the Great Northern Railway that extended from St. Paul to Seattle. So in the tycoon sense, the transcontinental railroads were a big deal. The Minnesota Historical Society [explains the antitrust connection](#):

The Great Northern was known for its Empire Builder passenger train, which operated service to the west coast by way of Glacier National Park. Despite antitrust proceedings that forced Hill to divest from his other railroad interests, the Great Northern weathered economic downturns and proved to be a profitable railroad for most of the 20th Century.

Ironically, the same railroads that Hill was forced to give up merged with the Great Northern in 1970 to form the Burlington Northern. This network merged with another historic railroad, and a considerable portion of the Great Northern now operates as the BNSF Railway. Amtrak continues to offer service on the Empire Builder passenger train.

To give you an idea of just how rich and powerful these transcontinental-railroad tycoons were, the City of Saint Paul produced a three-minute video about the [James J. Hill House](#). “Completed in 1891, railroad magnate James

Jerome Hill's 36,000 square foot mansion was the largest and most expensive house in Minnesota." The transcontinental railroads—and their presidents—were among the very most powerful institutions in the USA. We can now say the same with our tech giants of Seattle and Silicon Valley. That's why we're delving into the railroads. Breaking the railroads may well be our blueprint for bringing "big tech" to heel.

## Daniel Boone

Congress, throughout the 19th Century, passed various laws assisting the development of the railroads. We're focusing specifically on the transcontinental railroads intending to reach from the Mississippi River to the Pacific Ocean.

Congress "owned" lots and lots of land ([Figure 3.11, "U.S. territorial expansion"](#)). The westward expansion was highly political. The program was genocidal with respect to the Native Americans already living throughout the land. President Andrew Jackson's [Indian Removal Act](#) of 1830 and the resulting Trail of Tears is one example; to the north was the Black Hawk War of 1832. Both promulgated U.S. policies of removing Native Americans in favor of white settlement, planting, and ranching.

Its possession was also the result of wars with, or purchase from, the European powers who also claimed ownership. Once in U.S. possession, tycoons and robber barons coveted the natural resources (which remains true today).

Local and federal government played games to obtain settlers and homesteaders, as did local business interests. Settlers meant money and increased commerce, to be sure, but "proving" land (creating a productive farm or ranch) was also part of the process of taking the land from its prior occupants.



Figure 3.11. U.S. territorial expansion

The Daniel Boone Home is near St. Louis, Missouri. Why is that? Do you associate Daniel Boone with Missouri? Do you recall the TV series [theme song](#)?

Daniel Boone was a man. Yes a big man. With an eye like an eagle and as tall as a mountain was he.

But the TV series took place in Kentucky, not Missouri. What's the story?

As the Daniel Boone Home tour guide explained to me years ago, the Spanish invited Boone (age 65) and family to move into Missouri in 1799, in anticipation of the Louisiana Purchase. This situation was quite literally a celebrity endorsement for homesteading in Missouri (called Upper Louisiana at the time).

The State Historical Society of Missouri [explains](#),

In 1804, Boone lost his land claims after Spain had transferred the territory to France, which in turn sold it to the United States.

The page linked above has the petition of Daniel Boone, submitted in 1810 and finally considered in 1813, to the U.S. Congress for land in the Louisiana

Territory “together with the resolutions of the legislature of the State of Kentucky relative to said petition.” Even celebrities can get burned when doing a country a favor, but it certainly helps to be a celebrity when trying to get it back.

In a similar fashion, “Little House on the Prairie” in Minnesota was a result of various homesteading acts inviting people to take up land in the west. Never mind that this was closely related to the US-Dakota War of 1862 that resulted in the largest mass execution in U.S. history.

The Minnesota Historical Society (MNHS) describes [the Fort Snelling concentration camp](#):

The Dakota non-combatants arrived at Fort Snelling on November 13, 1862, and encamped on the bluff of the Minnesota River about a mile west of the fort. Shortly after, Marshall and his soldiers moved the Dakota to the river bottom directly below the fort. In December soldiers built a concentration camp ([Figure 3.12, “Sioux concentration camp”](#)), a wooden stockade more than 12 feet high enclosing an area of two or three acres, on the river bottom. More than 1,600 Dakota people were moved inside. A warehouse just outside the camp was used as a hospital and mission station. Throughout the camp’s existence, soldiers of the Sixth, Seventh, and Tenth Minnesota Volunteer Infantry Regiments guarded the stockade, controlling movement in and out. It is estimated that between 130 and 300 Dakota people died over the winter of 1862-63, mainly due to measles, other diseases, and harsh conditions.

The concentration camp at Fort Snelling was not a death camp, and Dakota people were not systematically exterminated there. The camp was, however, a part of the genocidal policies pursued against Indigenous people throughout the US. Colonists and soldiers hunted down and killed Dakota people, abused them physically and mentally, imprisoned them, and subjected them to a campaign calculated to make them stop being Dakota.



**Figure 3.12. Sioux concentration camp**

We learned about global transportation systems, both clipper ships and transcontinental railroads. But what does this have to do with antitrust actions concerning the giants of high tech?

That comes next. The Northern Pacific Railway took its case all the way to the U.S. Supreme court—and lost. They struck out.

The outlook wasn't brilliant for the Mudville nine that day: The score stood four to two, with but one inning more to play, and then when Cooney died at first, and Barrows did the same, a pall-like silence fell upon the patrons of the game. They thought, "If only Casey could but get a whack at that—we'd put up even money now, with Casey at the bat."

The sneer is gone from Casey's lip, his teeth are clenched in hate, he pounds with cruel violence his bat upon the plate; and now the pitcher holds the ball, and now he lets it go, and now the air is shattered by the force of Casey's blow.

Oh, somewhere in this favored land the sun is shining bright, the band is playing, and somewhere hearts are light; and somewhere men are laughing, and somewhere children shout, but there is no joy in Mudville—mighty Casey has struck out.

—*Casey at the Bat* (1888) by Ernest Lawrence Thayer (1863-1940)

## Summary

We have now laid the groundwork for Rosen's reference to the Northern Pacific Railway. Dr. Nathaniel Bowditch placed the fabulously rich Harvard Endowment on a solid footing. Thanks to being difficult with a president of Harvard in the process, those two engaged in a flame war—after both were stone cold dead.

The clipper ships gave way to the transcontinental railroads. We'll find out in **Part II** what a tangled mess this became.

# Part II: The First Silicon Valley Unicorn Startup

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## Chapter 4. The Bigger They Come

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### Modern Hiking Trails

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### Trolling the Bar Association

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# Chapter 5. The First Silicon Valley Unicorn Startup

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## Six Flags

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## Gold

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## Boston

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## Chapter 6. “Incipient” Battles

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### What Does History Tell Us?

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# Part III: The Secret in Arlington

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# Chapter 7. The Secret in Arlington

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## The Photograph

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## Arlington

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## Hiding in Plain Sight

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## Coast Guard Unit 387

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# Chapter 8. Return With Honor

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## Alternative Approach

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## Pandemic

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## Korea

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## Code of Conduct

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## Tap Code

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## Disinformation and Deflection

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## Vietnam Experience

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## Victory Garden

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## Final Checkpoint

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## Concrete Implementation

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## Chapter 9. The Salem Trials

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# Part IV: Safe Havens Then and Now

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## Chapter 10. First Rate

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### Sunken Treasure

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### Age of Sail

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### Ninth Rate

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# Chapter 11. Safe Havens Then and Now

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## St. Paul's Layover Agreement

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## The Bot Concession

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## Twitter Takes a Look

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## Impact

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## Summary

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# Chapter 12. Where Computers Come From

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## Fascination

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## Herbert O. Yardley

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## Sensitive Disclosures

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## NSA-Related Reading

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# Part V: Top Secret Ultra

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## Chapter 13. Top Secret Ultra

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### Ultra

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### Lorenz Machine

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### Colossus

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### D-Day

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### Declassification and Recognition

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## Colossus Rebuild Project

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## See Saw

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## Glider Factory

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## ATLAS

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## NSA Acknowledgement

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# Chapter 14. Bill Norris and Seymour Cray

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## From Code Breakers to Supercomputers

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## Engineering Research Associates

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## University of Minnesota

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## Drum and Demon

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## Task 13

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## **ENIAC**

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## **Honeywell v Sperry**

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## **ERA 1101**

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## **Remington-Rand**

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# Chapter 15. Control Data Corporation

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## CDC

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## Little Character

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## Transformer

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## CDC 6600

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## Supercomputing

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## Chippewa Falls

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# Road Map

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# Appendix A. HPC Tradecraft Road Map

What is “HPC tradecraft” as I know it? This is high-performance computing (HPC) arising from signals intelligence (code breaking) needs. My particular lineage begins with the “Tunny” code breaking project at Bletchley Park during World War II. That produced such an odd-looking contraption that the “Wrens” operating it named it the Heath Robinson. W. Heath Robinson was a cartoonist known for portraying fantastically complex machines designed to accomplish simple tasks.

When U.S. Navy veterans built something similar for a similar purpose, they named it GOLDBERG in honor of cartoonist Rube Goldberg’s fantastically complex machines, explicitly acknowledging the Heath Robinson tradecraft origins. One of the founders of Engineering Research Associates (ERA) was Bill Norris. ERA built GOLDBERG, and also hired Seymour Cray. Norris later founded Control Data Corporation (CDC) and Cray soon followed as their youngest employee. Cray later founded Cray Research, which I joined early 1980.

Thus the high-performance tradecraft I learned within Cray Research already had a 40-year history. Perhaps because so much was classified Top Secret, we never wrote down *how* we did things. Institutional knowledge was passed from person to person as mentorship, collaboration, and informal apprenticeship.

## The 1995 Barrier

Circa 1995, something shifted. We hid the messy details behind abstractions, allowing for far more complex software development. We no longer needed to think of systems as a whole, and how things performed on bare metal.

For high-performance computing, this presents a problem. HPC tradecraft remains constraint-based design, but we can no longer see the constraints informing the design. This became a niche topic rarely covered in school (or the workplace).

Meanwhile, the pre-1995 tacit knowledge is retiring out of the workforce. My role as Custodian (the Russian term is more specific, хранитель) is to share this knowledge with you as a living practice.

## Two Series

I created two book series to teach HPC tradecraft.

- “HPC Tradecraft Apprenticeship”, three books, is the institutional tradecraft as I learned and practiced, and still practice. Tradecraft is useless unless replicable. The first book teaches my replication method; the second teaches *how* we accomplished what we did; the third teaches systems thinking, with close observation and characterization of HPC systems under load, using modern AI as the example. The three books are transmission protocol; HPC design; HPC operations.
- “The HPC Tradecraft Master Practitioner”, three books, is the author letting loose and having fun, expressing his mastery of HPC tradecraft. High-Stakes Ethics prepares for the insurmountable power imbalance of a new graduate in the amoral corporate environment. Unexpected Histories demonstrates debugging skills applied outside computer science, showing their value and timeless nature. Constraint-Based Design demonstrates 1986 tradecraft directly applies to modern AI transformer design and usage.

## Book 1. HPC Tradecraft for Computer Scientists: What We Stopped Teaching

I iteratively created book 1 as I circled what I actually have to share, why it is important, and how to make it accessible to the right persons.

- Show my teaching method of formation text that performs what it teaches, which I frame as the manner of replication.
- Act as filter and qualification, so that readers have the necessary information before buying/committing to the two large flagship books.
- State *Nobody but Us* as prerequisite to *Wizard’s Lens*, which readers might perceive as problematic if they came for AI.

The sequence itself is formation. This was the teaching order within Cray Research.

## **Book 2. Nobody but Us: A History of Cray Research and the Building of the World's Fastest Supercomputer**

This book is by far the largest and highest writing quality. However, persona walk-throughs consistently report the quality as uneven. This is because the book attempts to overcome the Edwin Abbott Flatland paradox. “Look here” in the midst of formation text appears to be uneven quality requiring an editor, and a human might see it the same way, but “look here” is pointing to something most readers do not have the vocabulary to see on their own.

The book serves a crucial purpose of credentialing the author (via demonstration not assertion). Why? Because the next book makes apparently-outrageous claims which are not proven until reading through to the final chapter. The claims are based in “Nobody but Us” tradecraft.

What Cray Research accomplished is well documented. This book teaches *how* we did it. But there is another aspect, which is the next book.

## **Book 3. The Wizard's Lens: Learn to Think Like AI**

Think Jay Forrester and Donella Meadows and Eli Goldratt and Robert Gagné and Anders Ericsson, all of whom are referenced in the book. This is the craft of closely observing and characterizing HPC systems, using AI as the working example. This is the Cray Research attitude of treating barriers as opportunities. Barriers point to the point of maximum leverage. Meadows lists points of leverage. For my purposes, I collapse her list to Liebig's Law of the Minimum (plant growth is bounded by the relatively scarcest nutrient). This principle matches Goldratt's *The Goal*.

Rather than the skills in the prior book, this teaches shifting perspective, systems as a whole, interactions between systems at the boundary, and the attitude of not being distracted by the fact that it has never been done before.

This ends the primary series, the HPC Tradecraft Apprenticeship.

## **Book 4. High-Stakes Ethics**

The book is a work in progress. My premise is that we do not give computer scientists, particularly recent college graduates, the skills to survive the corporate power imbalance. I wrote two essays regarding that power imbalance. They are the raw material from which I plan to write the book, but the essays themselves have urgent importance, thus publishing as a work in progress.

## **Book 5. Unexpected Histories: Spotting Patterns and Making Connections That Others Miss**

This book consists of 15 essays/chapters, 49,000 words, demonstrating tradecraft in primary source analysis and constructing interesting narratives by “connecting the dots” that others miss. While nothing in here is technically difficult, some seem to have this aptitude and some do not. Book 2 has a chapter on what William Friedman has to say about developing intuition. This book is practice in developing that premise.

Tradecraft demonstrated across the centuries and outside computing demonstrates invariants, skills non-specific to a given technology, while demonstrating Piotr Galperin’s final stage of formation.

## **Book 6. Constraint-Based Design: A Gateway to AI**

In 1986, I wrote a bare metal device driver inside the Cray I/O Subsystem as a joke and to demonstrate the author’s capability. It is a text adventure game, Swiss Adventure, inspired by Colossal Cave Adventure. What is useful is its characteristics.

The game itself forces the user (adventurer) into an operational apprenticeship, working with incomplete information in an unfamiliar context. I created a PHP/Laravel/React.js version that is live on my website, stateless, requiring no login or registration or data collection. The live version is the game itself presented as typing at the operator console, with side displays (essentially event traces) showing flow through the assembly language overlays, and flow through the LLM attention mechanism patterns.

Thus it is an executable companion to the book. The 1986 source code and the PHP engine are in a public GitHub repository, with the most recent timestamp in the repository as May 2019, which is well before GPT and Claude became well known publicly.

- The live website is here: [Swiss Adventure](#)
- The assembler and PHP source code are here: [SwissAdventure](#)

There are several aspects of interest.

## UPDATE

The source code is in UPDATE format. Secondary sources (wikipedia) indicate CDC UPDATE is one of the earliest known source code management systems, from late 1950s or early 1960s, punch card based. I know from personal (as primary source) knowledge that the first Cray Research software person was hired directly from CDC. I know from internal statements that CDC's UPDATE was ported to Cray Research. While onsite at Boeing Computer Services 1980-1982, the front end systems were CDC Kronos. I used CDC UPDATE and Cray Research Update side by side. Thus I am clear on the provenance.

Relatively few extant examples of live code in UPDATE format exist. This one is publicly available on GitHub.

## APML

When the CRAY-1/S was announced with a new I/O Subsystem (IOS) in addition to the mainframe CPU, the IOS had been developed as the "A" Processor. Extant documentation as of 1980 called it that. The cpu assembler was CAL, Cray Assembly Language. The IOS assembler was called APML, "A" Processor Macro Language.

The 1986 source code is a live, complete, package, and likely the only substantial example of IOS programming written by an actual Cray Research IOS programmer. It was written (as a student) during a class *teaching* IOS programming, but I was later part of the IOS group for 10 years, so can act as primary source asserting it is authentic and representative.

"Live" might be misleading in that no system still exists to run it. But the precise port to PHP is live and online.

## **Adventurer Experience**

The adventurer experience has characteristics similar to many realms of operational training. I intentionally wrote it inspired by Colossal Cave Adventure and Zork. It might be worth noting that the authors of those two programs worked in operational environments. Thus I was not inventing the formation aspect. That was already a characteristic of text adventure games.

## **Constraint-Based Design**

The source code has many levels and aspects of constraint-based design, and it is possible to teach the design without dwelling on assembler syntax. I implemented the training data (all navigation and text content) as a domain-specific language using the assembler macro and micro facility. I had a deep enough understanding (including making mods to the CAL assembler source) to do this. Adding game features did not require executable code changes.

Here is the odd part: The source code architecture is isomorphic to 2017 “attention is all you need” architecture function. Similar constraints shape similar solutions (Genrich Altshuller’s TRIZ principle). My operating environment was quite similar to a hot LLM token context under load. Attention heads, weighting, pulling from external source then deallocating... quite a few features are present.

A working bare-metal example of constraint-based design can be useful. But a 1980s demonstration that HPC methods are relevant to modern AI has interesting implications, which is why I decided to include this as a book.