

The CW Way of Life

Why CW matters in an FT8 world

by

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We're going to examine:

- **The History of Technology - How we got here**
- **The Age of Discovery - The First Hams**
- **The Age of Invention - “The Victorian Internet”**
- **The Rise of the Users - The most important component in any telegraph system**
- **Why CW matters in an FT8 world...
“Androids do NOT dream of electric sheep.”**

...And on the first day,

The Lord said:



“Let there be **CW**.”

* Continuous Waves of electromagnetic energy

The CW Way of Life Began with a single “dit.”

The First Big Bang

STUFF

For 13 Billion years, stuff did what stuff does.

Matter occurred because of a self-ORGANIZING principle:

- **For every action, there is an opposite and equal reaction**
- **“Bang” implies destruction. The “Big Bang” was massive organization**
- **The self-organizing principle eventually results in...**

The Second Big Bang

LIFE

- The Self-REPLICATING principle
- Builds copies using resources from the environment
- All life exhibits intelligence
- Employs passive or active strategies to obtain resources

We're not the first creatures to think.

Intelligence solves problems related to survival



Passive survival strategies = "Run what ya brung"

- **Native capabilities are dictated by genetics.**
- **Adaptation via genetics**

Active survival strategy #1: “Tools Found”



Simple tools came first.

- Complements native (genetic) abilities
- Limited contemplation of past and future
- Compare with Alexa & Google Assistant – limited skillset & knowledge
- Short-term, goal-directed activity

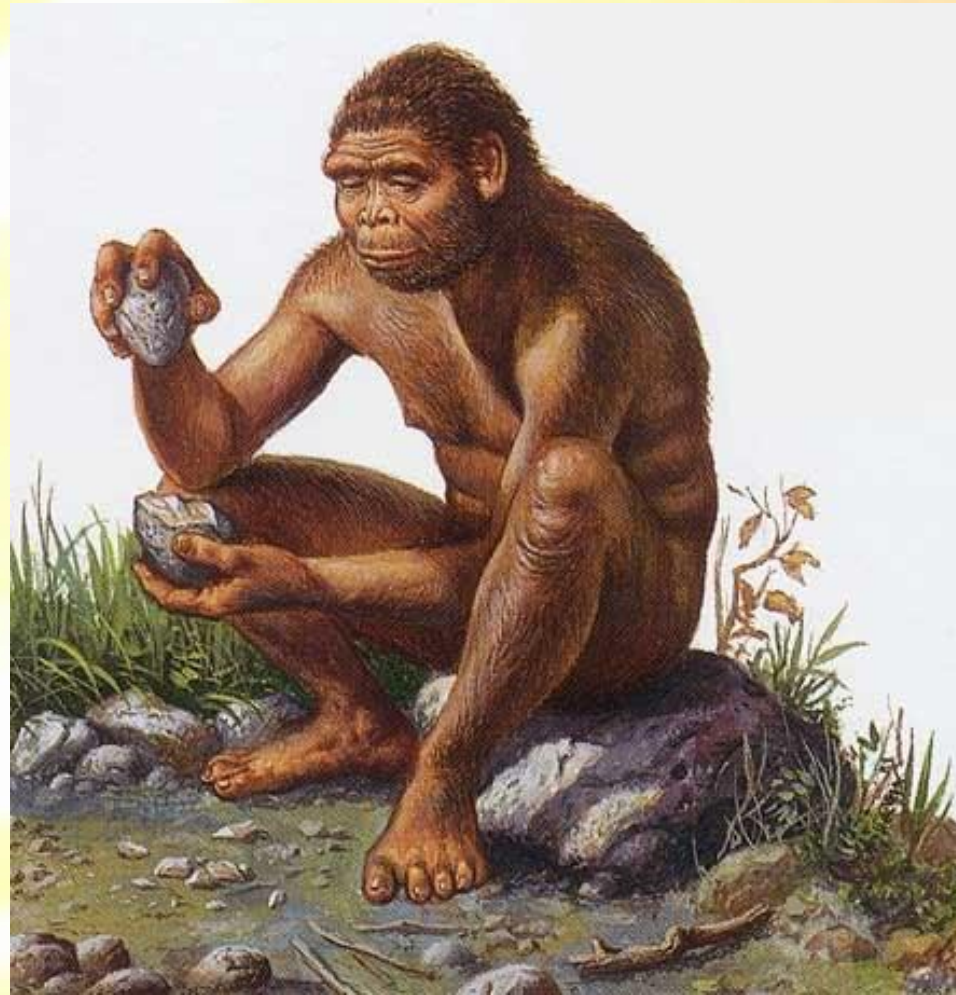
The Third Big Bang

TECHNOLOGY

*Life finds a way –
Technology makes a way*

- The Self-MODIFYING principle
- Creates or modifies needed resources
- Learns from past, plans future

Active survival strategy #2: *“Tools Made”*



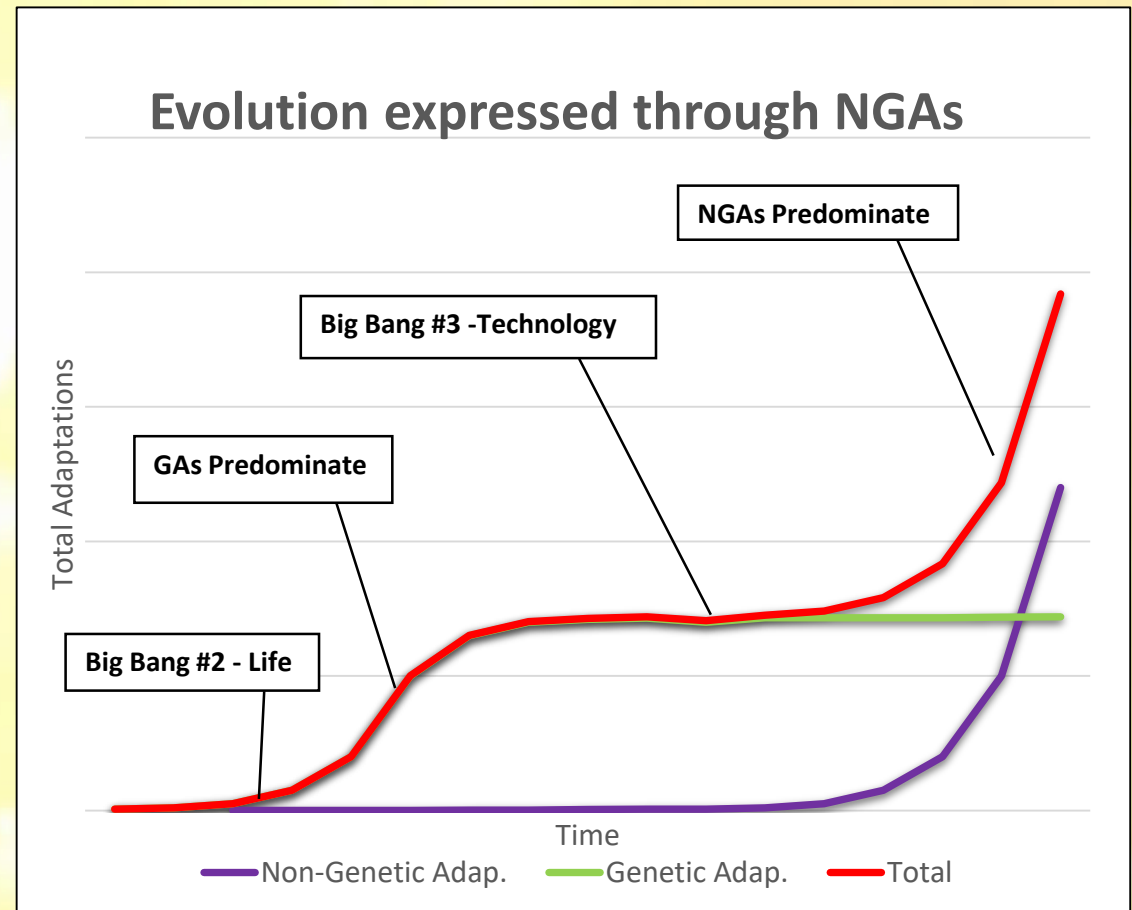
Survival strategy #2 = “If you can’t Find it, make it.”

- Tools = *Non-Genetic Adaptations* (NGAs)

(Don’t wait to grow taller, invent a ladder)

Graphing the Big Bangs

- NGAs now predominate
- Resources MADE not FOUND
- We participate in evolution
- Tools modify both the organism and the environment
- Modifying one modifies other
- Culture = organism + environment
- Cultures self-organize around tools

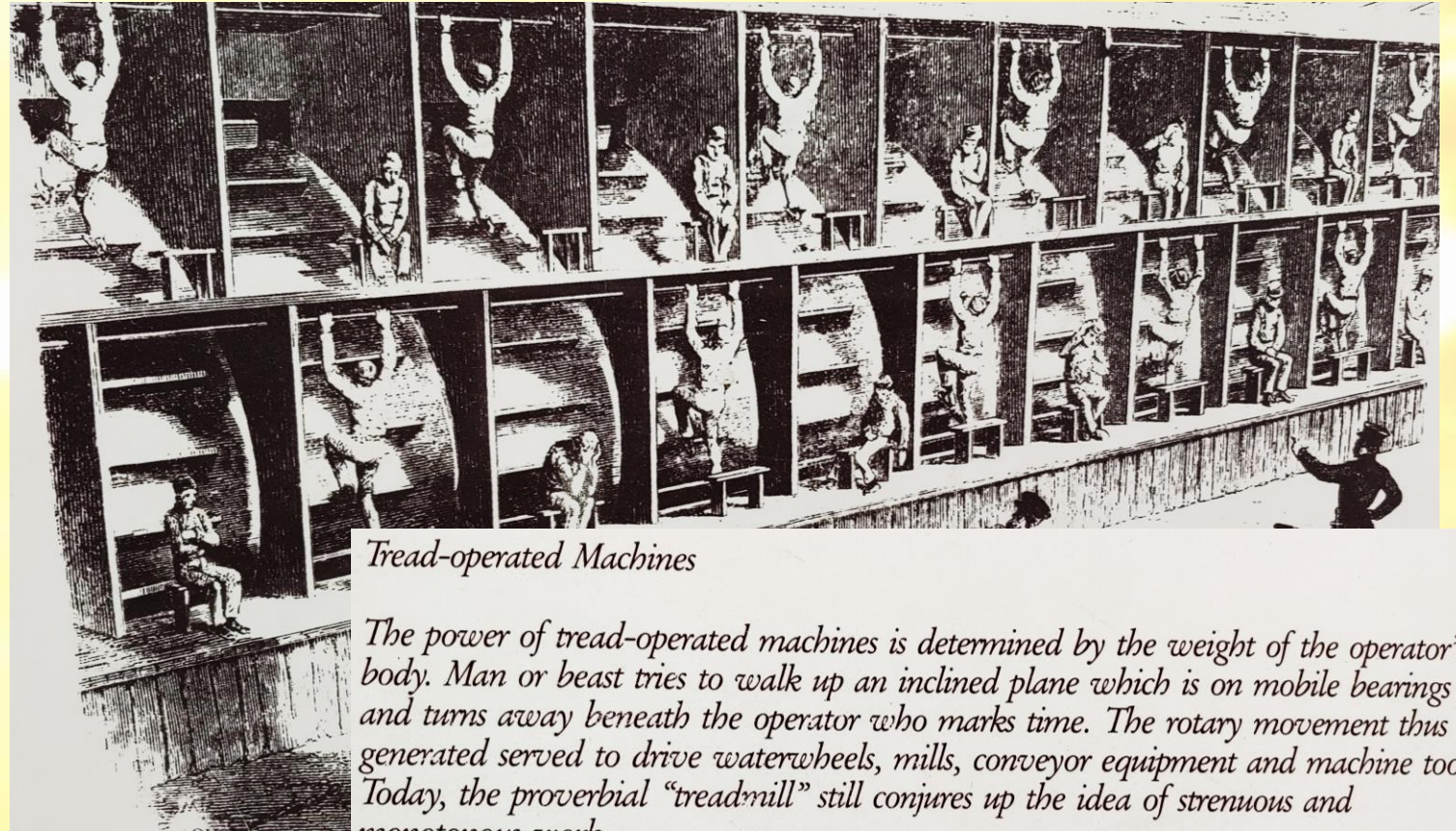


Tools Gone Wild...

The Industrial Revolution

We built pyramids and nations harnessing mechanical energy sources

- Human
- Animal
- Gravity (the wheel, water, architecture)
- Fire (metallurgy)
- Portable power - steam



Tread-operated Machines

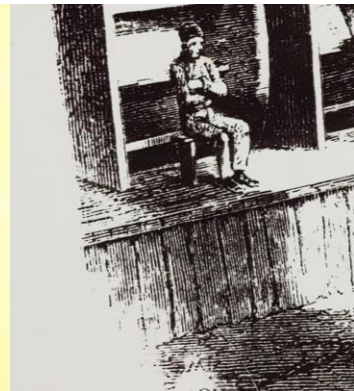
The power of tread-operated machines is determined by the weight of the operator's body. Man or beast tries to walk up an inclined plane which is on mobile bearings and turns away beneath the operator who marks time. The rotary movement thus generated served to drive waterwheels, mills, conveyor equipment and machine tools. Today, the proverbial "treadmill" still conjures up the idea of strenuous and monotonous work.

Tools Gone Wild...

The Industrial Revolution

We built pyramids and nations harnessing mechanical energy sources

- **H** **Missing just one thing...**
- Animal
- Gravity (the wheel, water, architecture)
- Fire (metallurgy)
- Portable power - steam



Tread-operated Machines

The power of tread-operated machines is determined by the weight of the operator's body. Man or beast tries to walk up an inclined plane which is on mobile bearings and turns away beneath the operator who marks time. The rotary movement thus generated served to drive waterwheels, mills, conveyor equipment and machine tools. Today, the proverbial "treadmill" still conjures up the idea of strenuous and monotonous work.

Electricity



**Since the dawn of time,
lightning had been the stuff of heaven,
the wrath of Gods.
That was all about to change.**

**The Telegraph was the first
practical application of Electricity.**

Electricity



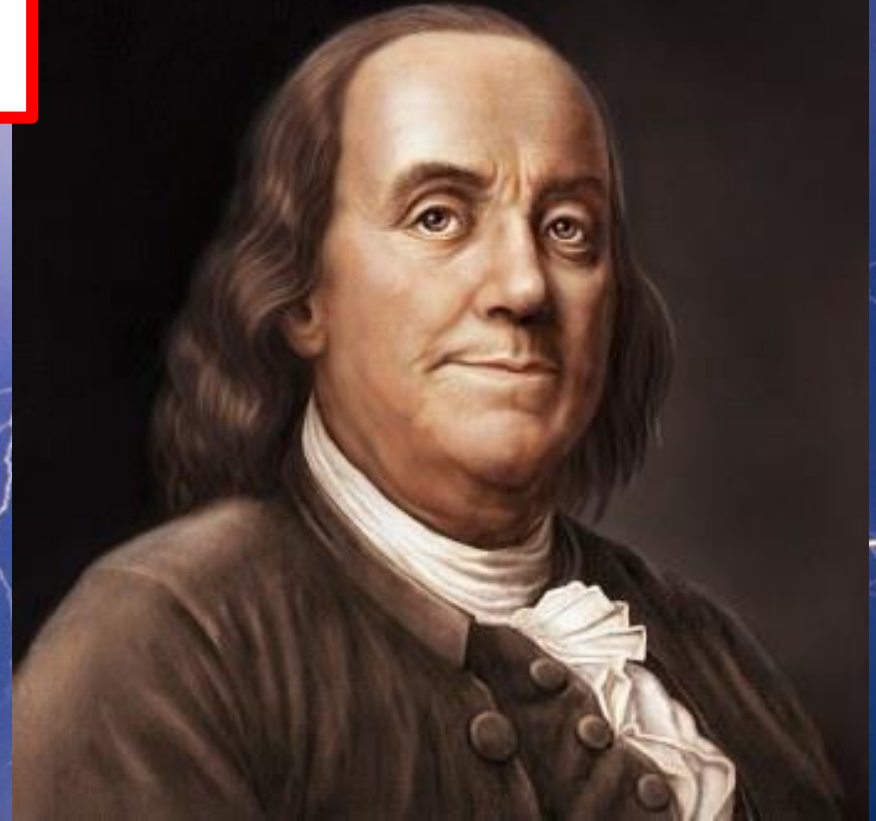
It's hard to imagine a world without electricity

Since the dawn of time, lightning had been the stuff of heaven, the wrath of Gods. That was all about to change.

The Telegraph was the first practical application of Electricity.

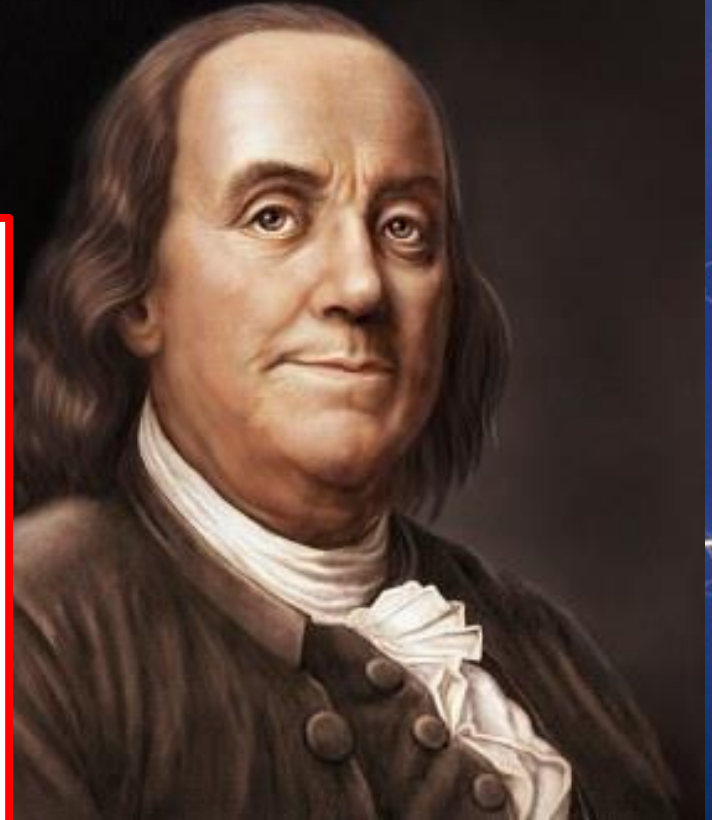
Say hi to Ben Franklin

- **Founding Father,**
- **Political Theorist,**
- **Scientist,**
- **Inventor,**
- **Humorist,**
- **Statesman,**
- **and...**



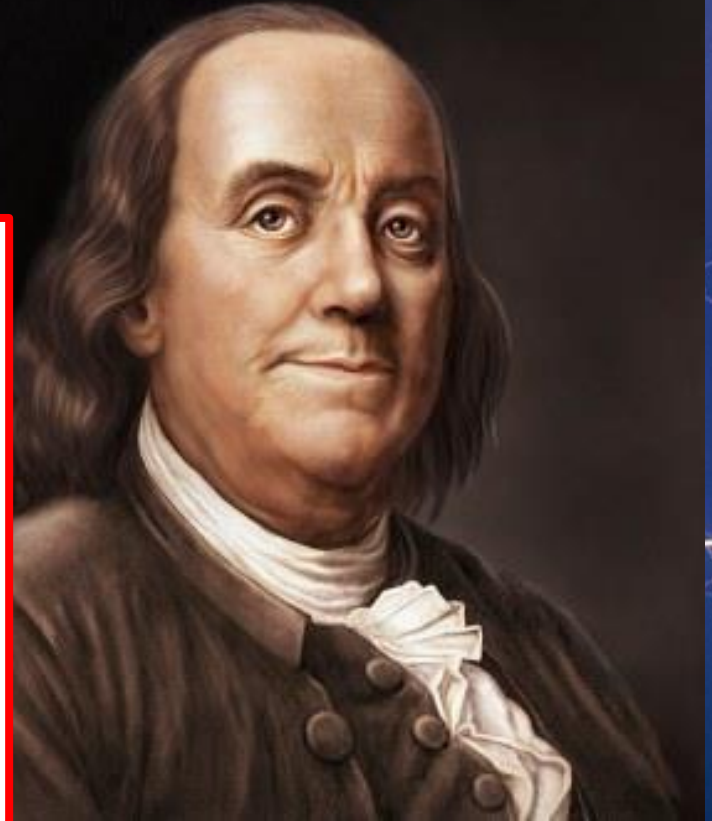
The First Ham.

- Civic spirited, curious, resourceful, social
- Thrifty (Poor Richards Almanac)
- Invented post office, library, fire dept
- Proved lightning = electricity (1752)
- Named “positive” and “negative”
- Invented lightning rod



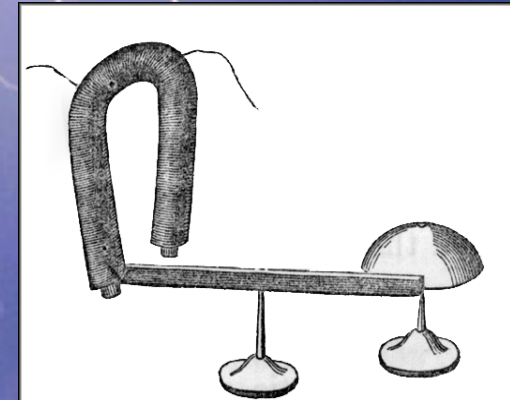
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- Named “positive” and “negative”
- Invented lightning rod
- Neighbors & wife thought he was nuts



Franklin sparked Big Discoveries: cool things happen when you run electricity through a wire...

- **WIRE** from jewelers, armorers, hoop makers
- **Galvani** – Electricity/Nerve flow 1790s
- **Volta** – the battery 1799
- **Oersted** – electromagnetism 20 April, 1821
- **Sturgeon** – electromagnet 1824
- **Ohm's Law** ($E=IR$) 1827
- **Joseph Henry** – Bell Telegraph (1831)



Sketch of "telegraph" Joseph Henry showed his classes at the Albany Academy. From Smithsonian annual report for 1857, p. 105



Meanwhile, the First Industrial Revolution filled the world with stuff.

Commerce and travel underwent massive expansion of scale

- Growth of cities = growth of consumption
- Food, textiles, portable power (steam)
- World markets and commerce
- Capitalism
- Railroads (1821-25), steamboats (1803)

All in a world where information traveled no faster than a horse, or a boat.

That is, the raw ingredients for the telegraph were ready.

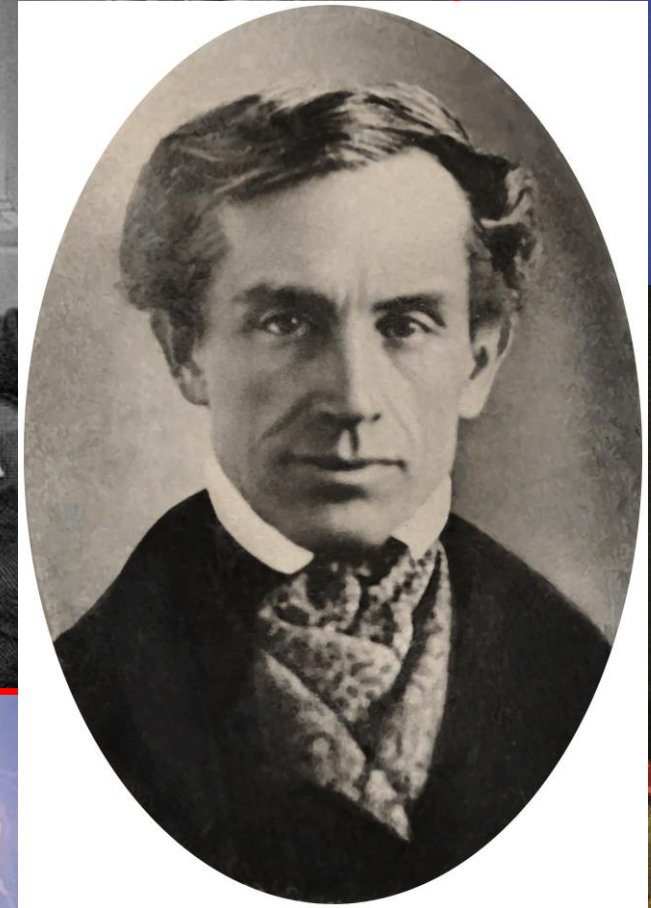
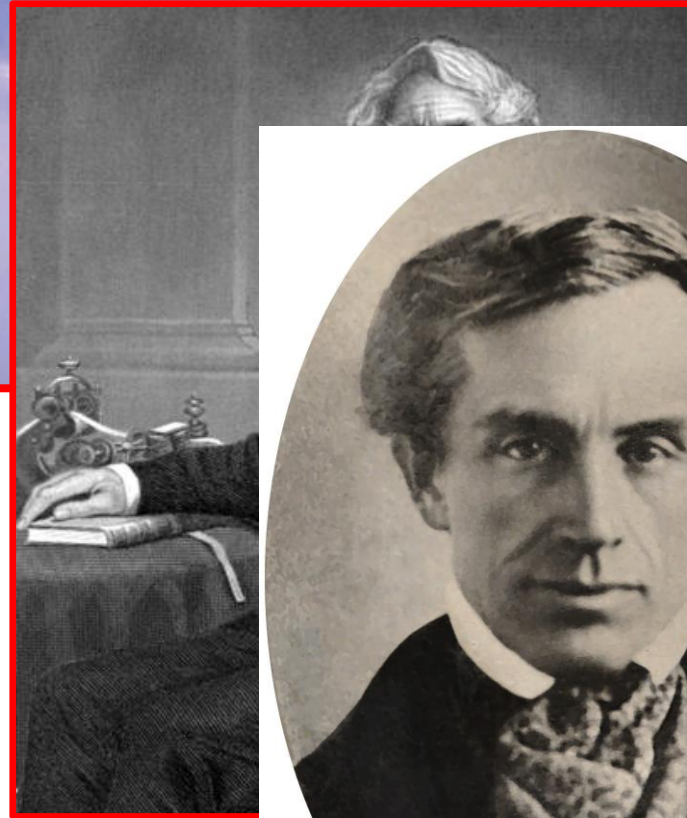
- **Human activities across greater and greater distances introduced unacceptable time delays into decision making**
- **These activities and needs crossed government, commercial, and personal spheres**
- **The technologies existed (battery, wire, electromagnets, codes)**



The Lightning Man

Samuel F. B. Morse

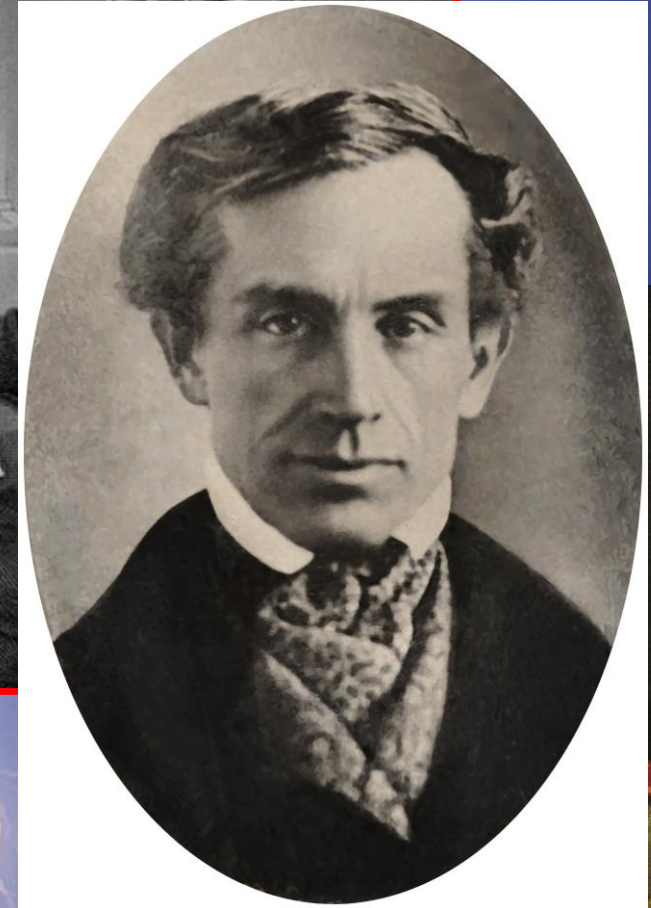
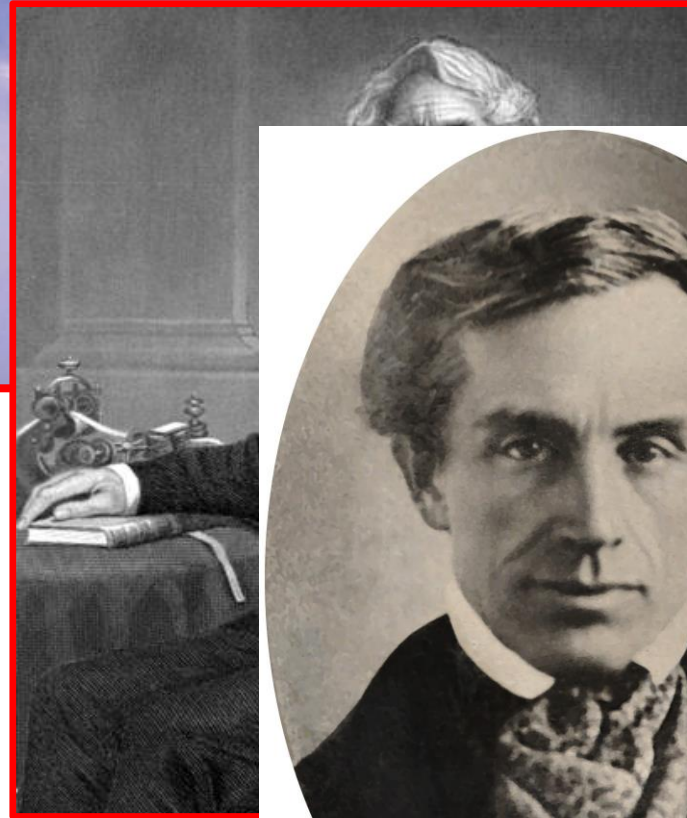
- Son of “The Geographer” – access to power
- Showed early talent as artist – and as entrepreneur
- Fond of the good life (“seegars...”)
- Trained to become “Historical Artist” in EU
- Invents telegraph while returning (1832)
- Other inventions and patents fail (fire water pump, marble carving machine)
- Portrait artist – has access to power
- 1837 - First Professor of Art at NYU (unpaid)



The Lightning Man

Samuel F. B. Morse

- **TIPPING POINT:** early 1837 RFP for a telegraph for USA – so it's now or never...
- Morse starts building model
- Enlists help of NYU chemistry professor, Leonard Gale, as first partner (batteries and electromagnets)
- Prototype works over 1/3 mile loop of wire in his NYU quarters/studio
- Morse shows it to a young NYU divinity student he'd met...



Morse's Telegraph – 1837-1838

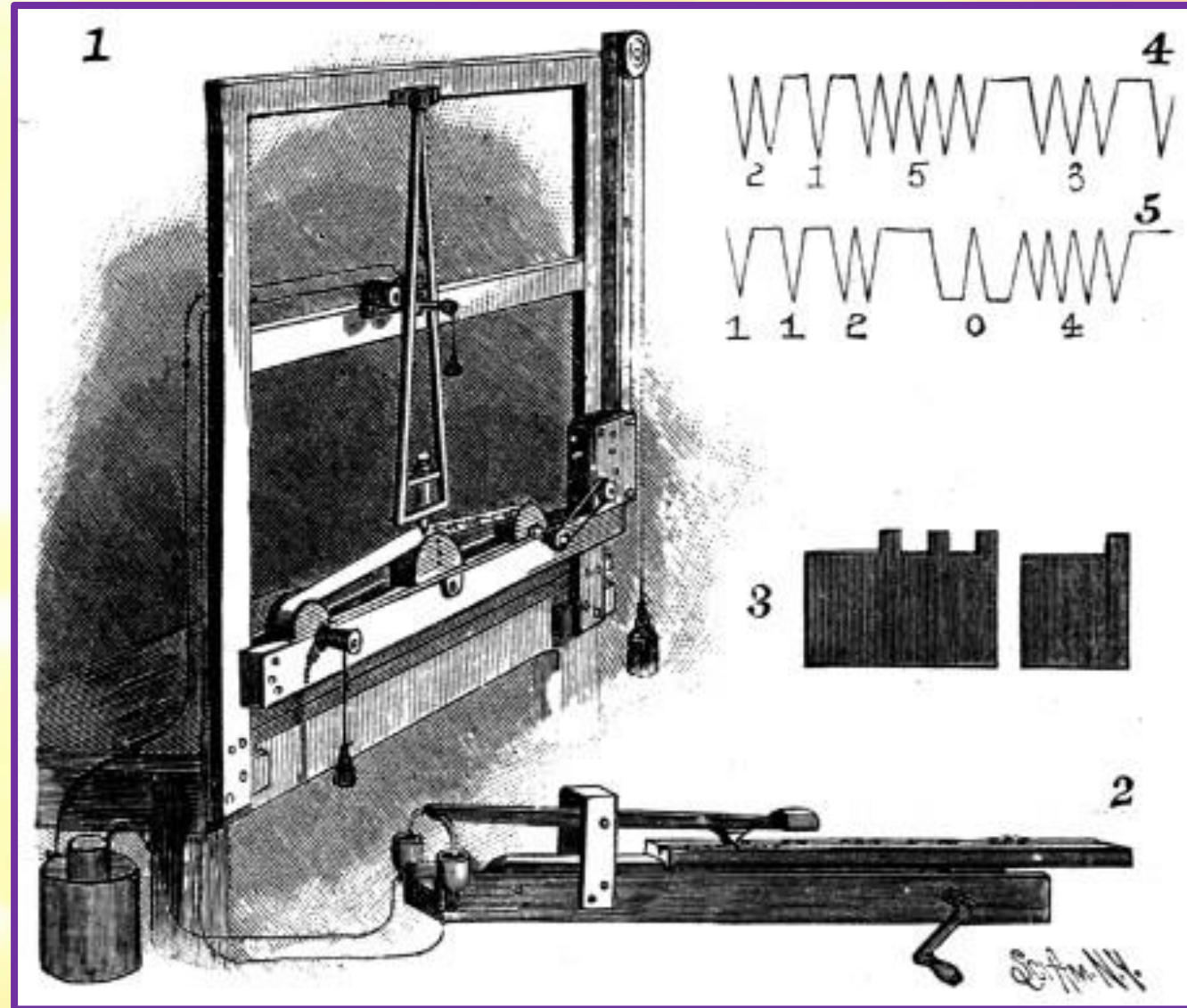
Sending End

- Compositor converts words to numbers, arranges number ingots (3) on “port rule,” (2) then turns crank to send

Receiving end

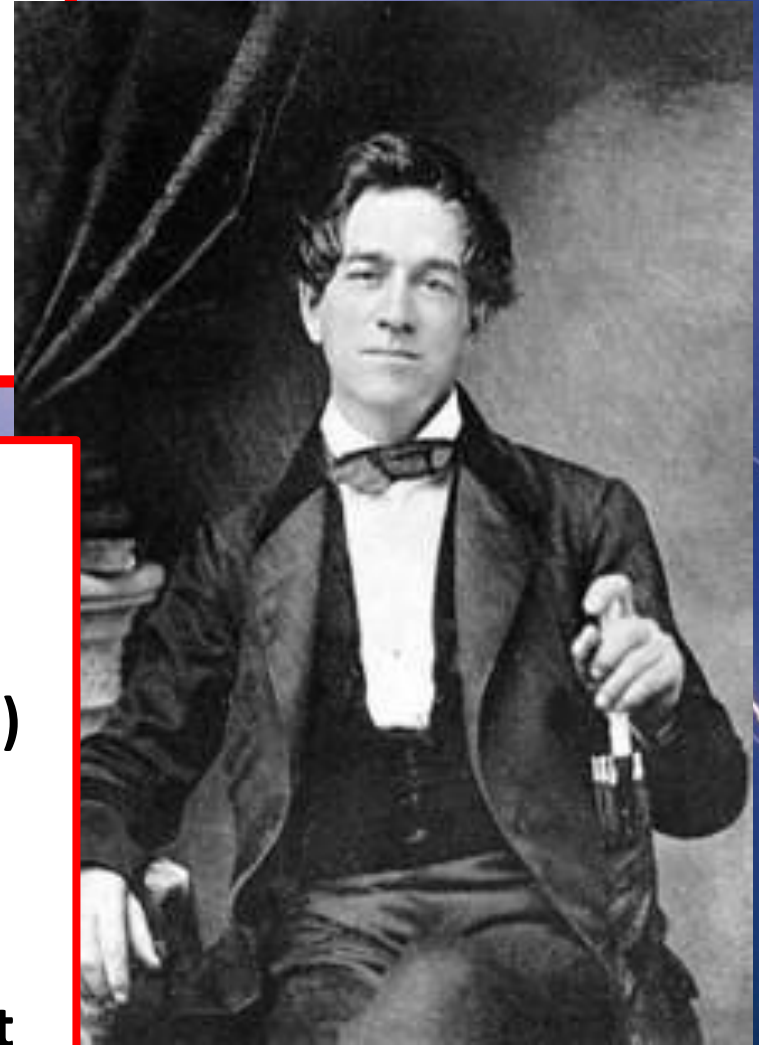
- Register (1) “writes” squiggly line on paper tape (4,5)
- Transcriber counts “points,” writes number on tape, looks up number in word dictionary

May require two persons at each end



***Morse conceived a telegraph system.
Alfred Vail made it work.***

- Son of uneducated self-made businessman (made prop shaft for first steamship)
- Gifted draftsman/machinist/engineer
- Had financial resources (family - during recession)
- Recognized potential of world-wide telegraph system immediately
- Within weeks (Sept 1837) signs contract with Morse to make workable telegraph machines, get patents, pay for everything, and sign all rights to Morse in Morse's name for $<1/4$ interest.



Vail was the first Telegrapher.

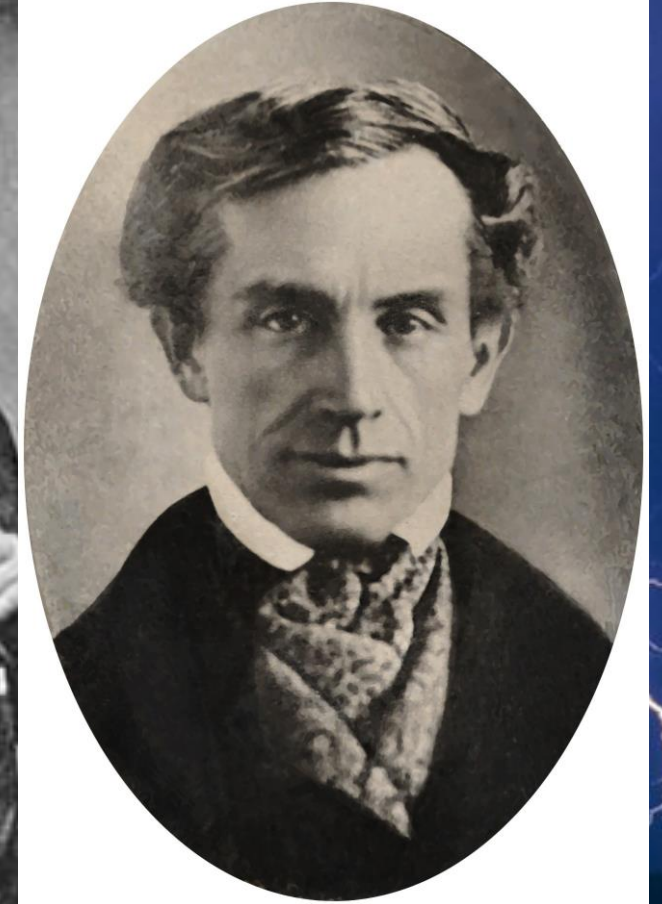
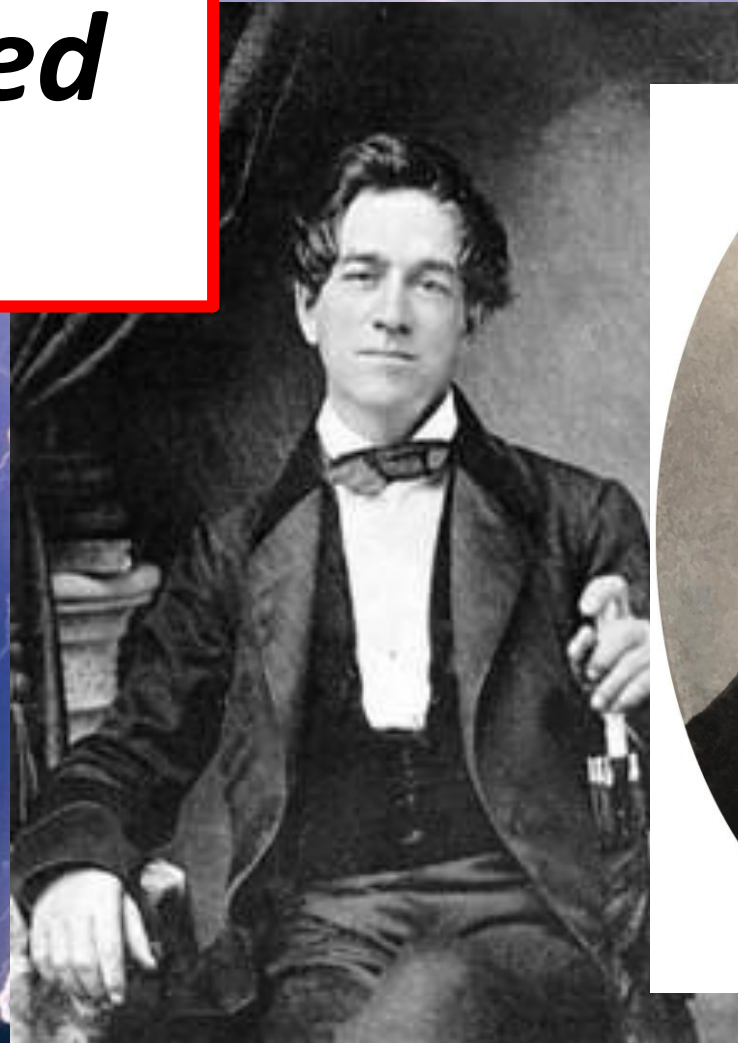
Inventions:

- **The straight key**
- **The up/down printing register**
- **The original dot-dash code**
- **The “Alpha” Code (American Morse)**
- **Compose by hand, Copy by ear**
- **Many technical details**



Like Jobs and Woz, Sam and Alf needed each other

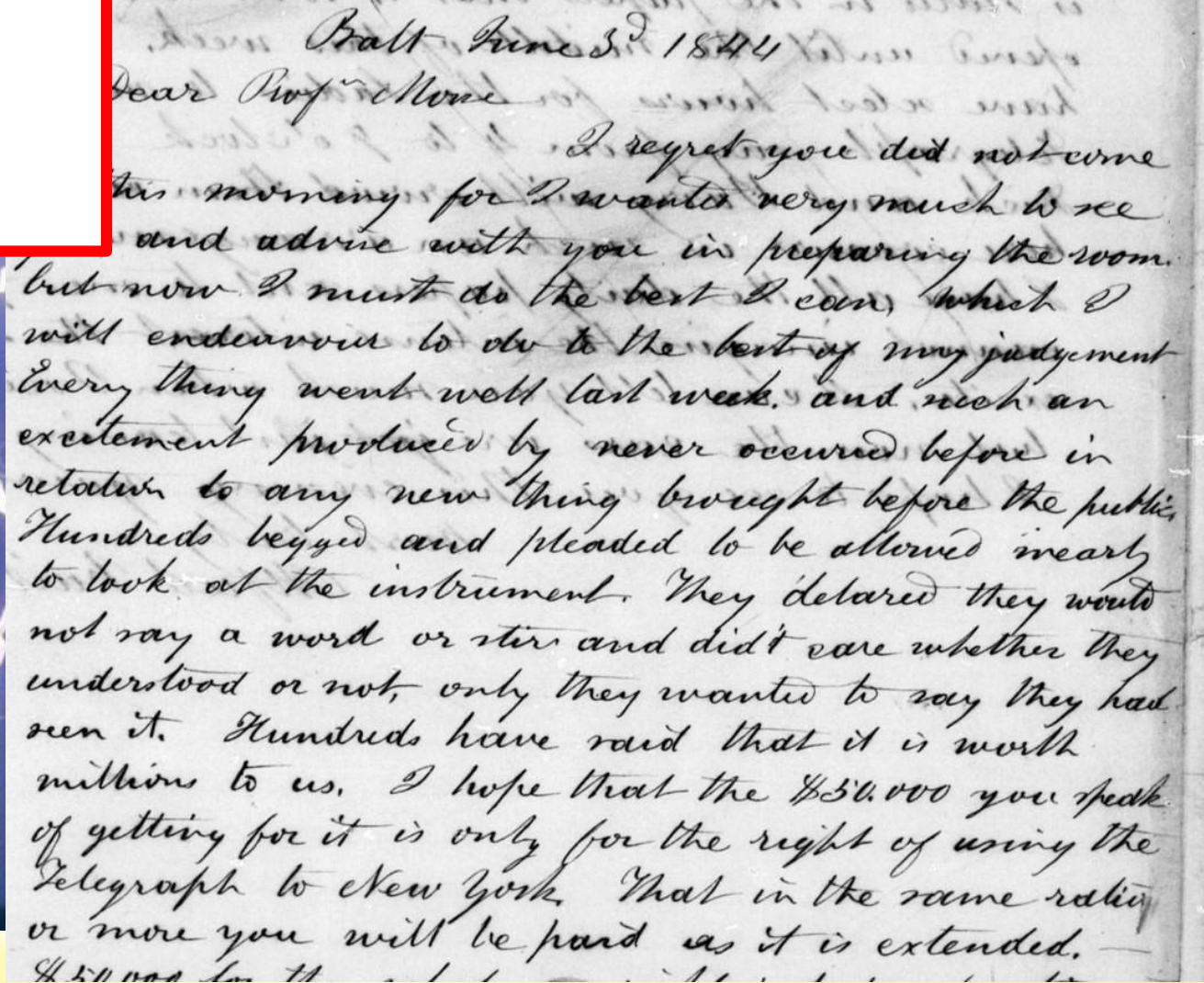
- **Without Vail, we would remember Morse only as an early American artist. Morse's window of opportunity was finite.**
- **Without Morse, we would never have heard of Vail.**



But together, what results they had!

“Everything went well last week and such an excitement (has) never occurred before in relation to any new thing brought before the public. Hundreds begged and pleaded to be allowed merely to look at the instrument. They declared they would not say a word or stir and didn't care whether they understood or not, only they wanted to say they had seen it.”

Albert Vail, June 3, 1844



Balt June 3^d 1844
Dear Prof. Morse
I regret you did not come this morning for I wanted very much to see and advise with you in preparing the room. but now I must do the best I can, which I will endeavour to do to the best of my judgement. Every thing went well last week, and such an excitement produced by never occurred before in relation to any new thing brought before the public. Hundreds begged and pleaded to be allowed merely to look at the instrument. They declared they would not say a word or stir and didn't care whether they understood or not, only they wanted to say they had seen it. Hundreds have said that it is worth millions to us. I hope that the \$50,000 you speak of getting for it is only for the right of using the Telegraph to New York. That in the same ratio or more you will be paid as it is extended.
\$50,000 for the right of using the Telegraph to New York.

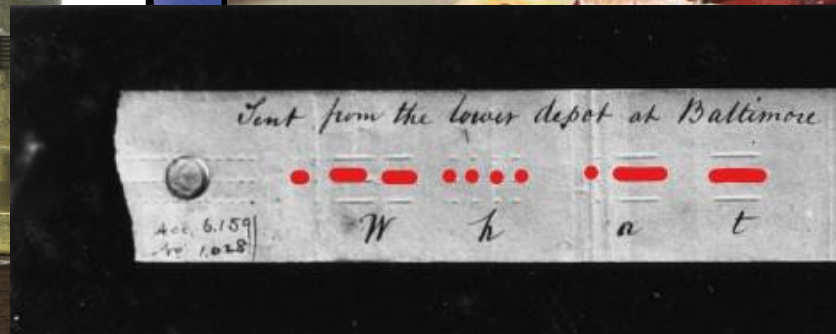
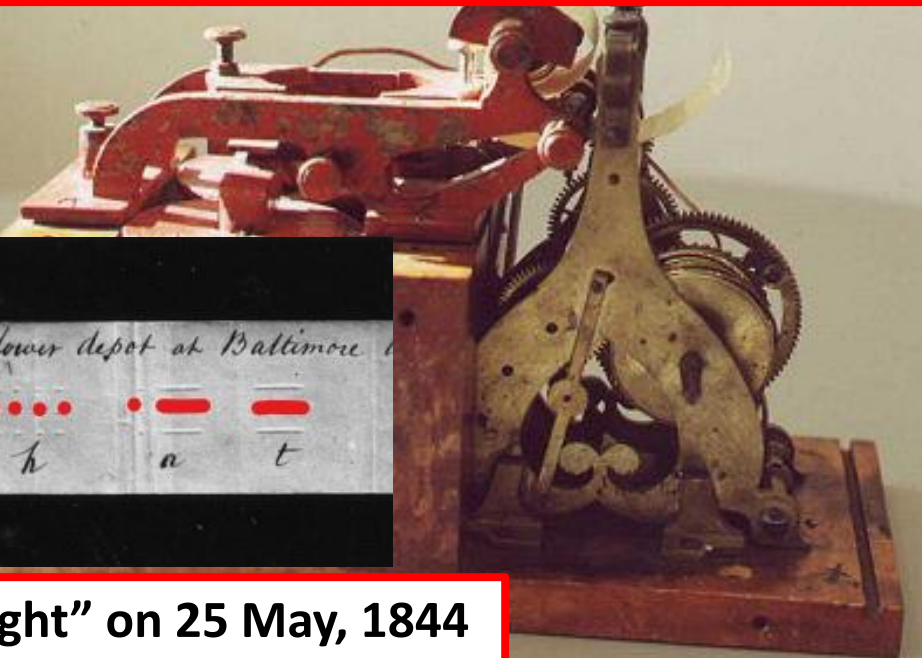
Vail's Telegraph – 1844

Sending

- Operator sends message with Vail's "correspondent" key

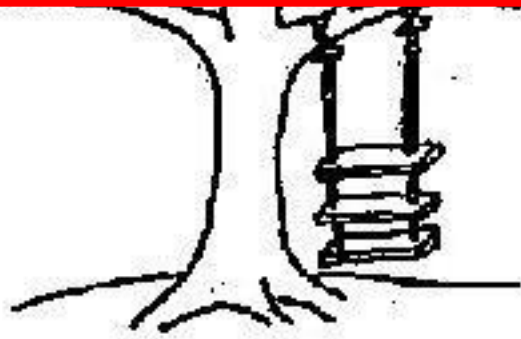
Receiving

- Dots and dashes on paper tape can be translated to letters on the tape - or in the head

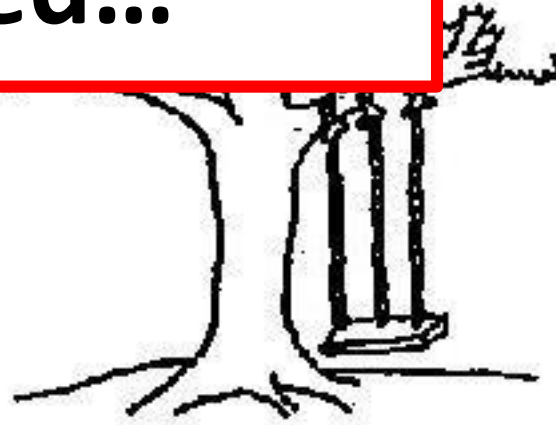


These were used to send "What Hath God Wrought" on 25 May, 1844

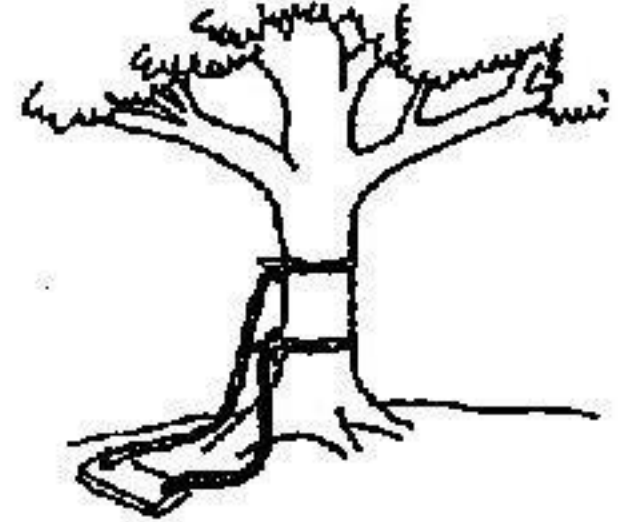
What the user wanted...



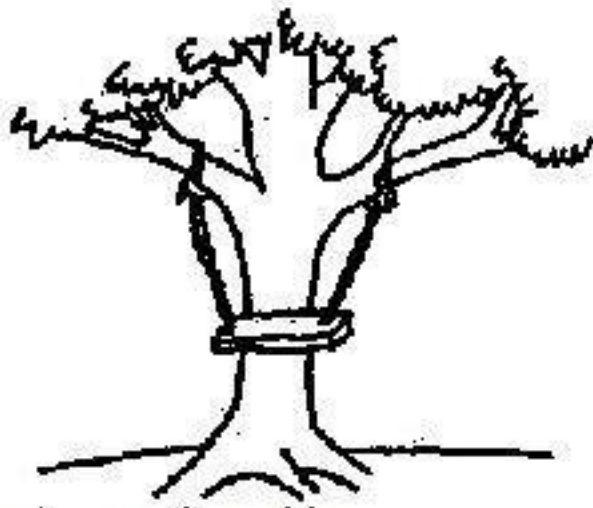
As proposed by the project sponsor.



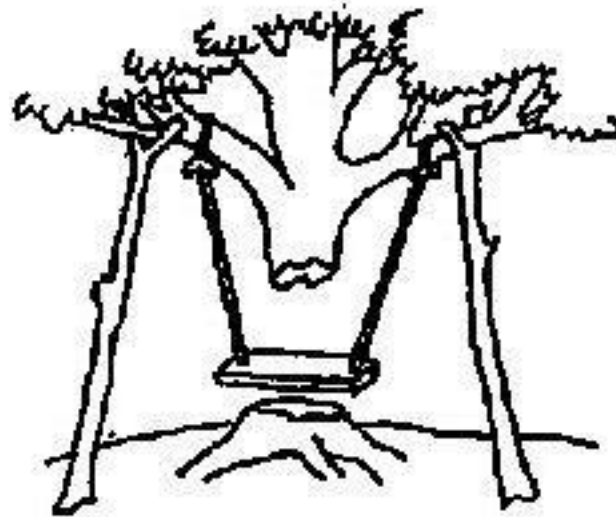
As specified in the project request.



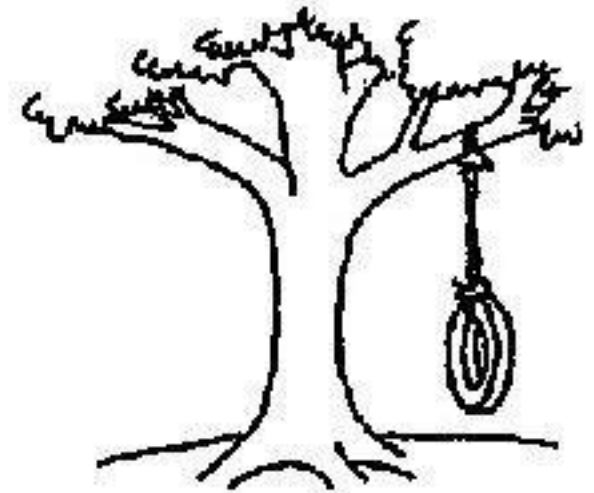
As designed by the senior analyst.



As produced by the programmers.



As installed at the user's site.



What the user wanted.

Vail's Telegraph – 1843

Sending

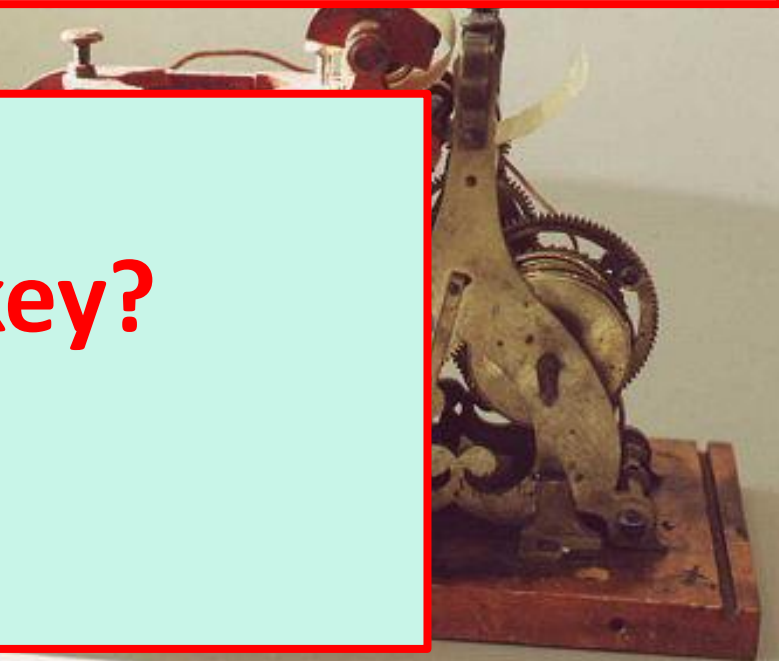
- Operator sends message with Vail's "correspondent" key

Receiving

- Dots and dashes on paper tape can be translated to letters on the tape - or in the head

Questions:

Why did Vail invent an improved key?



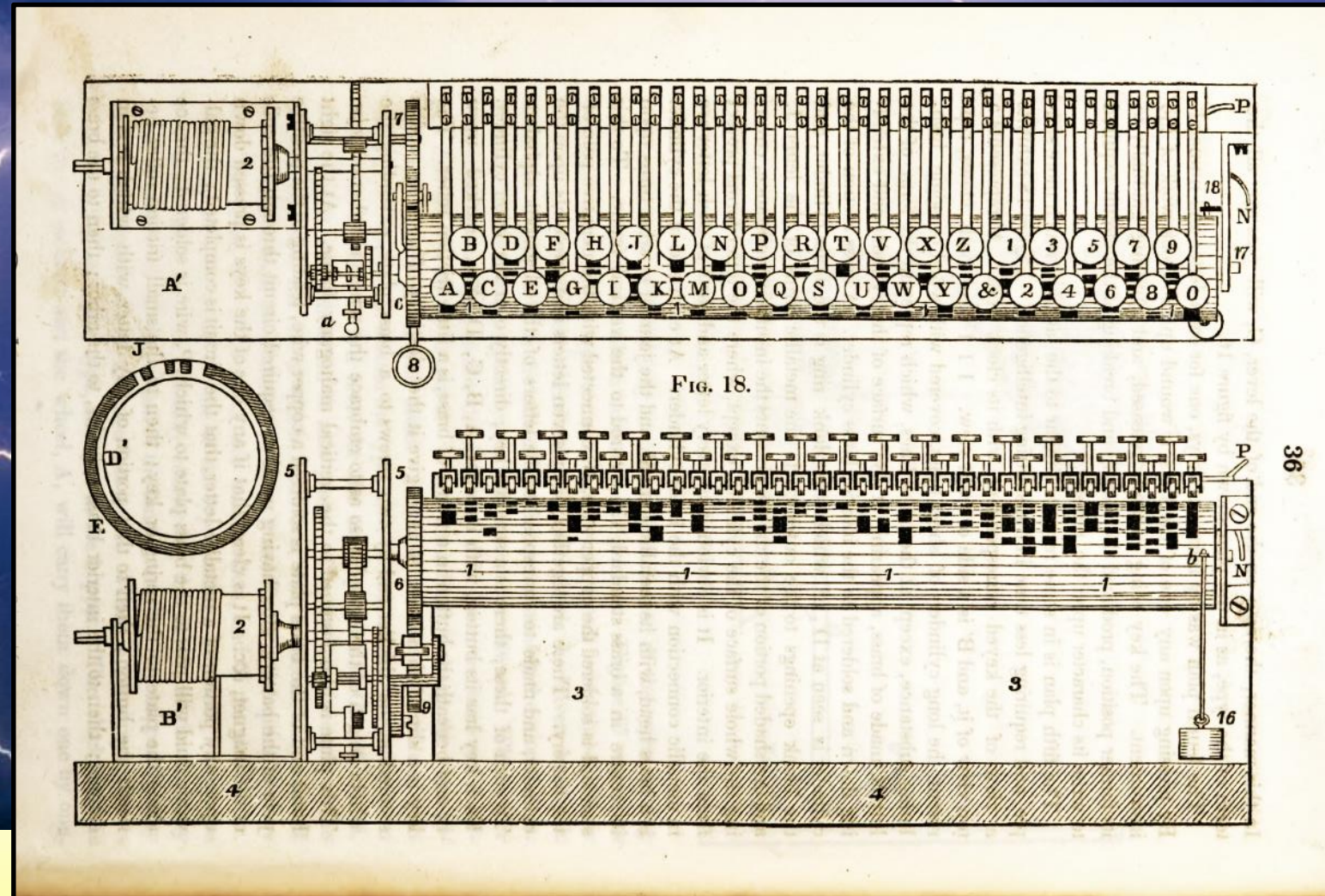
The Evolution of Keys – 1837 to 1843

Morse's "Port Rule" 1832



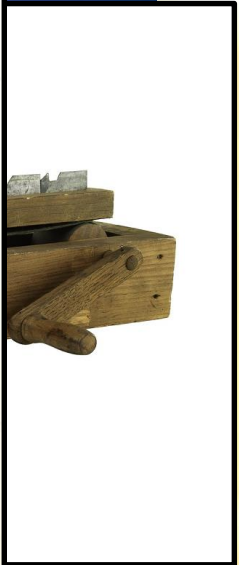
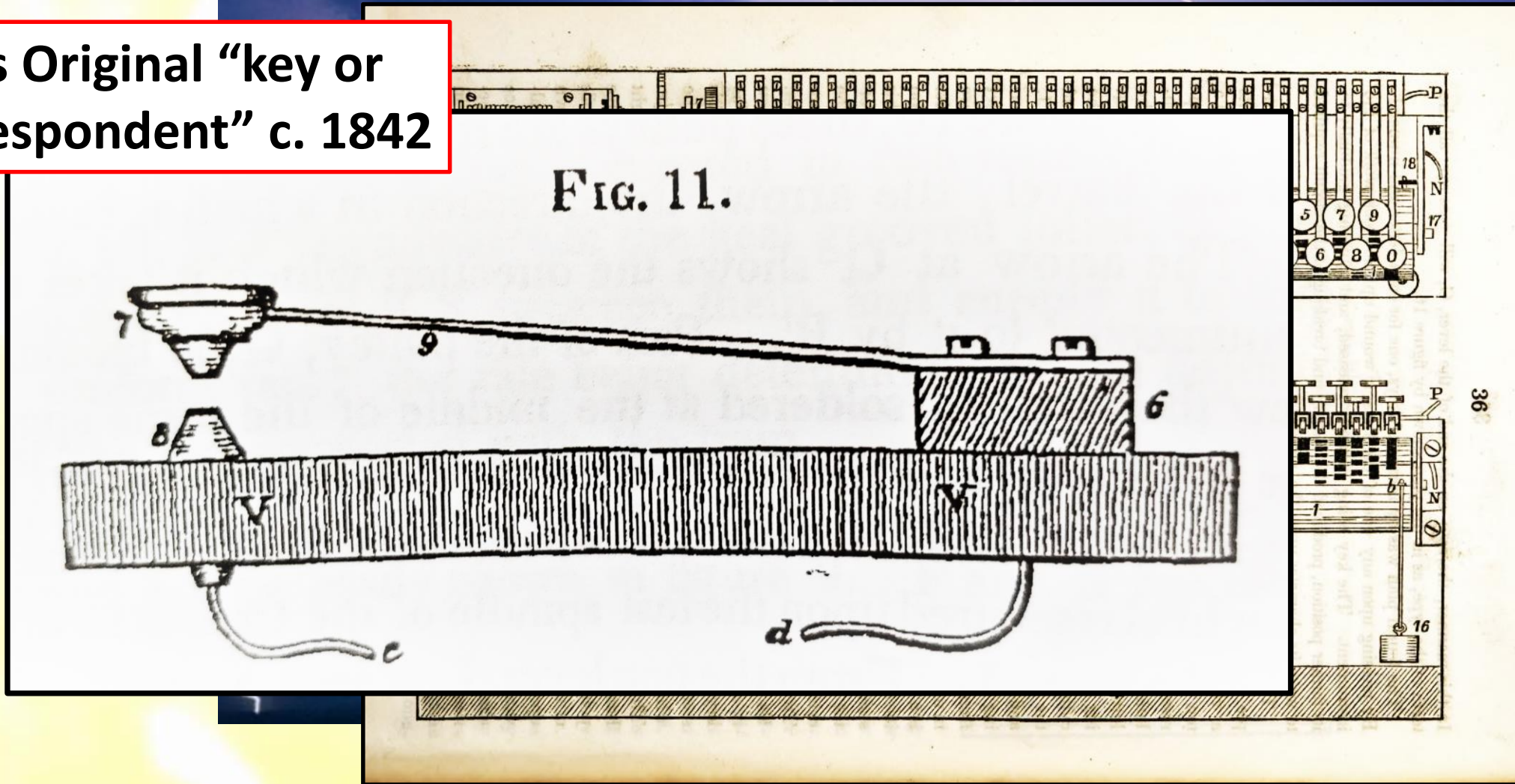
The Evolution of Keys – 1837 to 1843

Vail – 1838-1840



The Evolution of Keys – 1837 to 1843

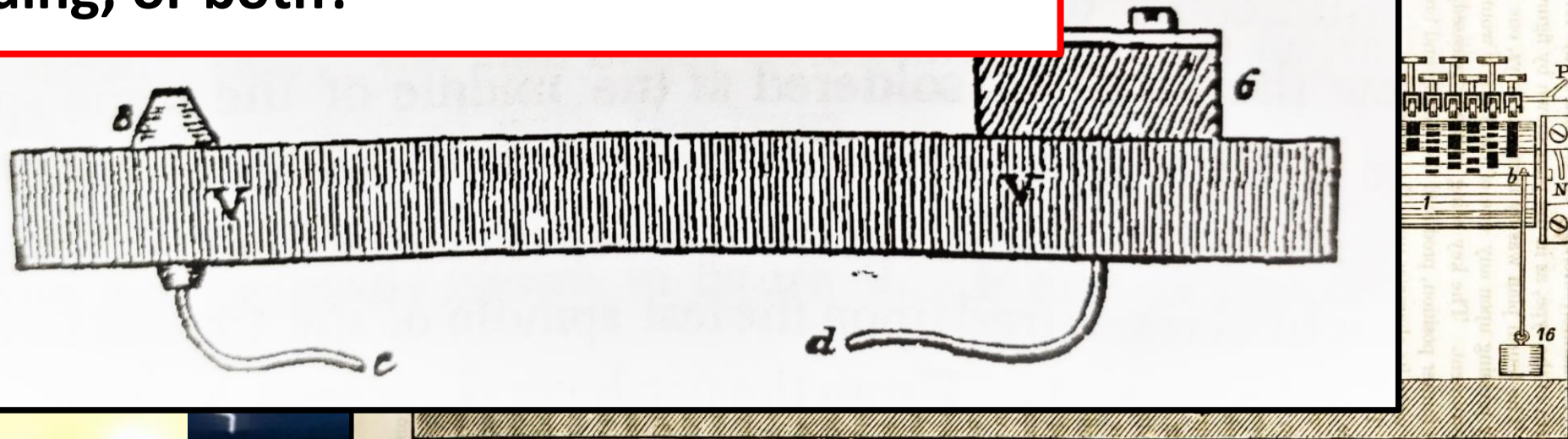
Vail's Original "key or correspondent" c. 1842



The Evolution of Keys – 1837 to 1843

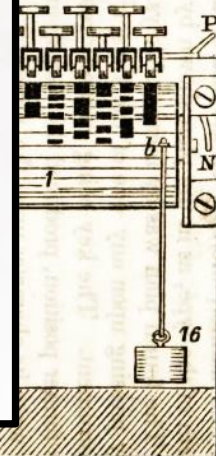
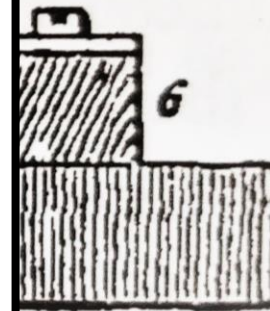
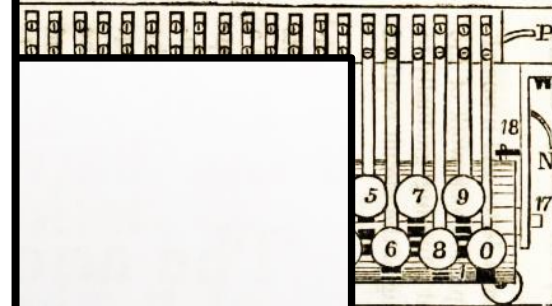
Vail's Original "key or correspondent" c. 1840

First hand key - Created for register tests, sending, or both?



The Evolution of Keys – 1837 to 1843

Vail's "Lever Key" 1843

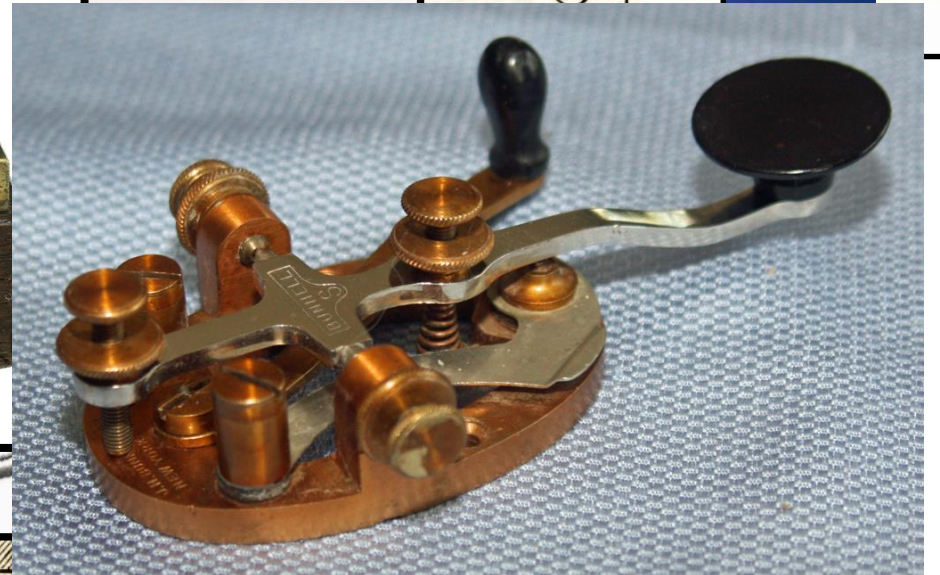
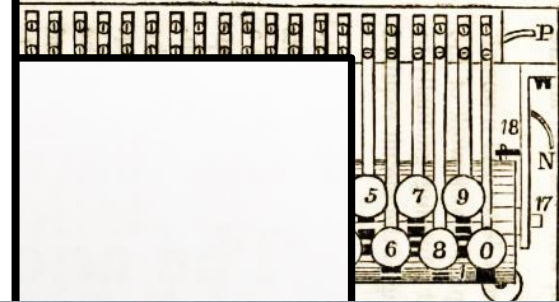


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The Evolution of Keys – 1837 to 1843

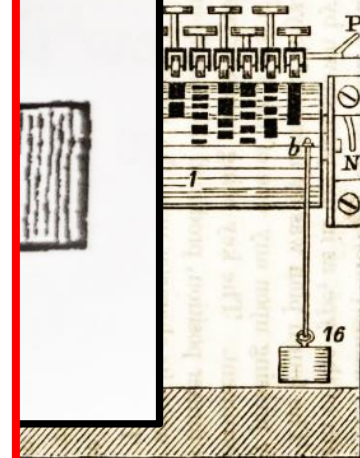
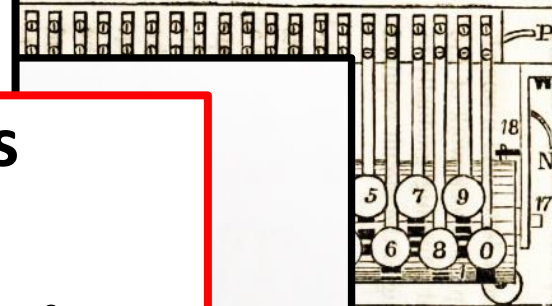
Vail's "Lever Key" 1843



The Evolution of Keys – 1837 to 1843

Vail's "Lever Key" 1843

- "Lever key" clearly for faster sending – thus faster was a motivation
- Vail said "this form of writing (sending) requires that the operator should be perfectly familiar with the alphabet..." and sends info "faster than it can be written down..."
- Which came first: code or key?



Evolution of the Code 1832-1843

- **1832 - Morse invented code to send numbers; numbers sent correlate to words in a dictionary. Selecting numeric-code implied rejecting LETTER CODE**
- **Nov-Dec 1837 - Vail developed a dot-dash code while Morse worked on dictionary (Per Baxter)**
- **But number code was used for first ever demos, Jan 1838. Why?**
- **1837 patent application specified number code/dictionary. COULD NOT SHOW THINGS NOT IN PATENT.**
- **1840 revised patent includes letter code**
- **1843 – Vail revamps his 1837 code into more efficient “Alpha” code (American Morse). Creates “Lever key” at same time.**
- **Coincidence?**

Vail's Telegraph – 1843

Sending

- Operator sends message with Vail's "correspondent" key

Receiving

- Dots and dashes on paper tape can be translated to letters on the tape - or in the head

Questions:

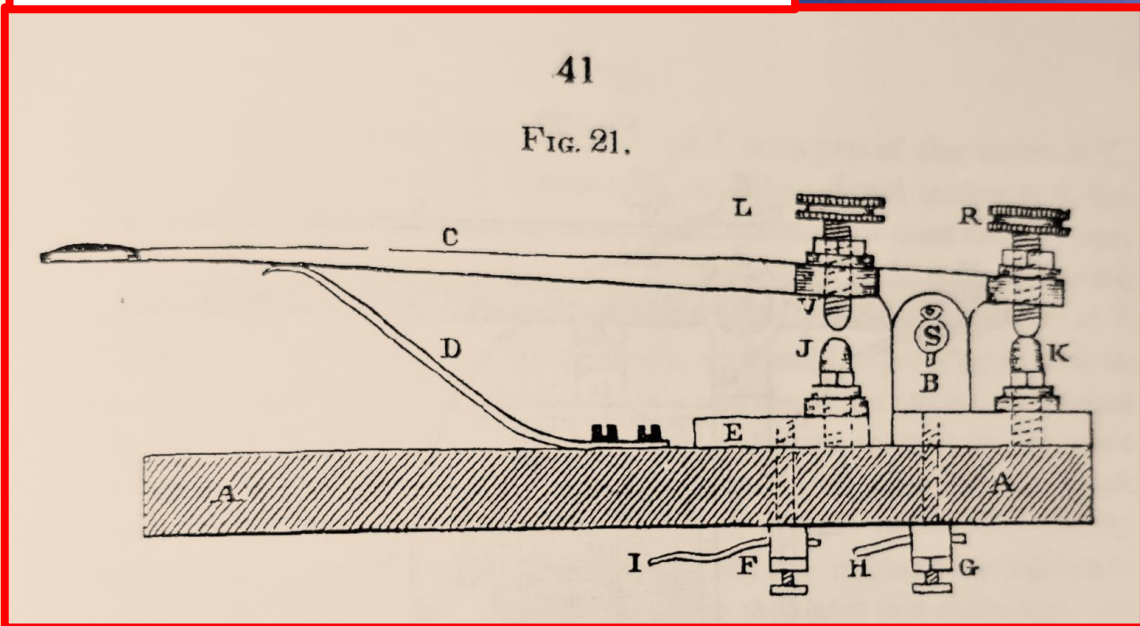
Why did Vail invent an improved key?

Why no sounder, if they could copy by ear?



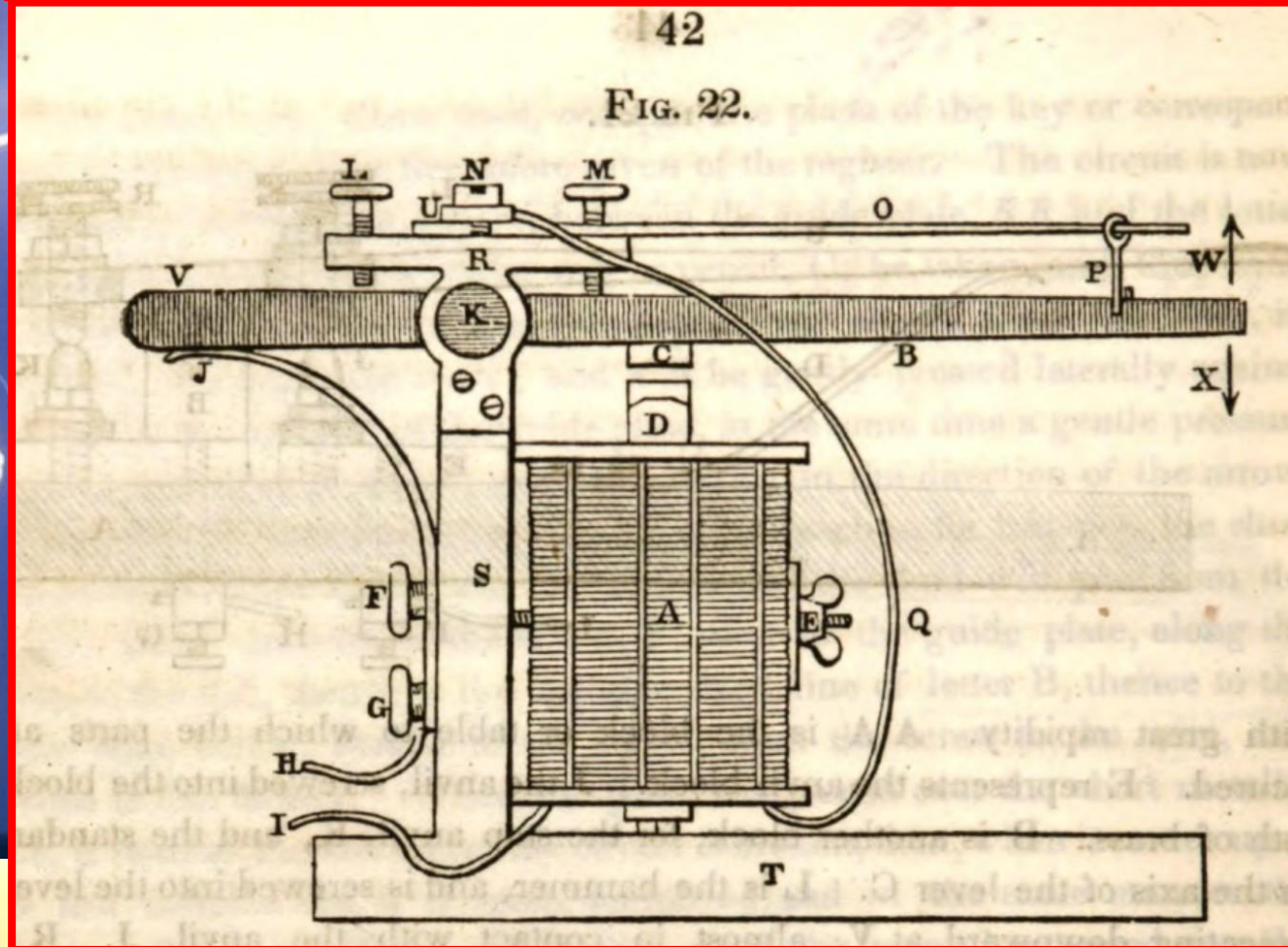
There was a sounder - Vail's "Hummer"

Vail's Lever Key is on Pg. 41.



Source: *The American Electro Magnetic Telegraph: With the Reports of Congress, and a Description of all Telegraphs Known, Employing Electricity or Galvanism*; Alfred Vail, 1845

Vail's "Hummer" is on Pg. 42



But wait, there's more... Vail's "Hummer"

Vail's Lever Key is on Pg. 41.

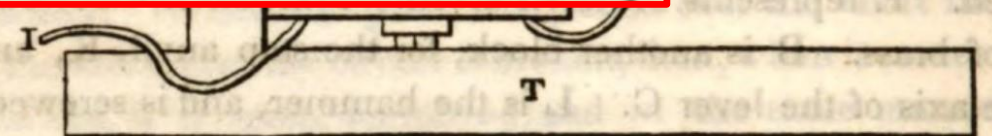
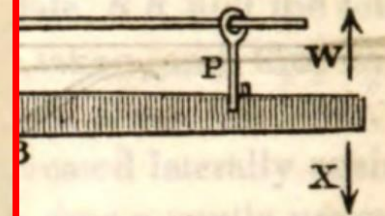
Vail's "Hummer" is on Pg. 42

And on Pg. 43

and unmade. When its parts are well adjusted, its vibrations are so quick that no part of the lever is distinctly seen. It appears bounded in size by the limits of its movement up and down, and the motion is so rapid as to produce a humming noise, sometimes varying the notes to a sharp key. In this way it will continue to operate so long as the battery is applied. We infer from this, the almost inconceivable rapidity, with which it is possible to manipulate at the key of the register in sending intelligence, far surpassing that of the most expert operator. This arrangement of the electrome, was devised by Mr. Vail in the summer of 1843.*

42

FIG. 22.



But wait, there's more... Vail's "Hummer"

Vail's Lever Key is on Pg. 41.

Vail's "Hummer" is on Pg. 42

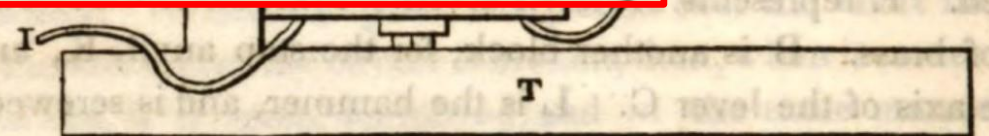
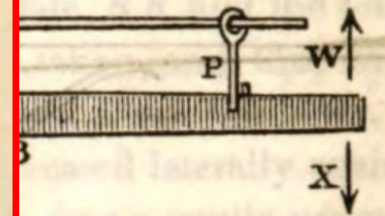
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"the motion is so rapid as to produce a humming noise, sometimes varying the notes to a sharp key."

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FIG. 22.



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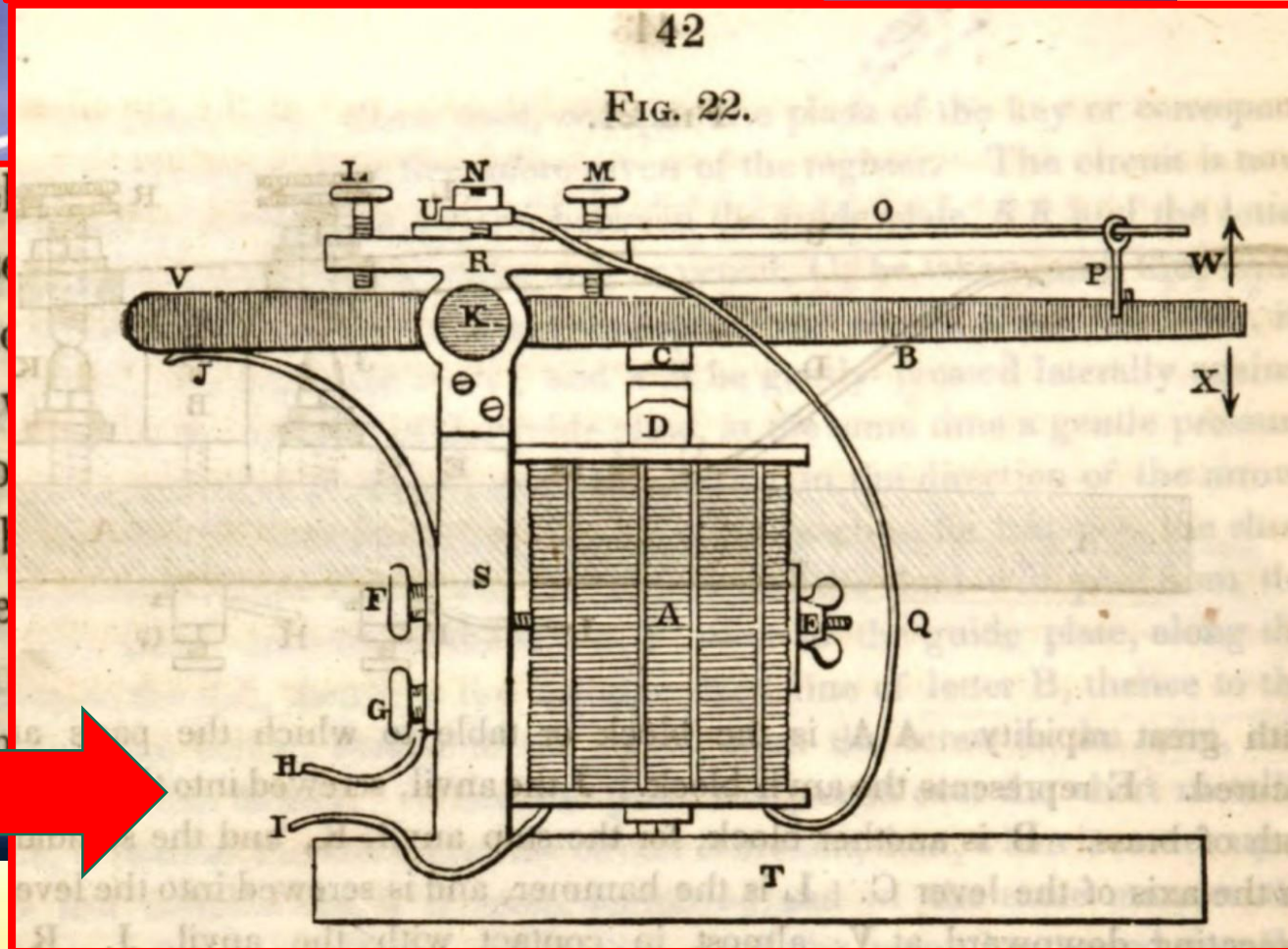
Vail's Lever Key is on Pg. 41.

Vail's "Hummer" is on Pg. 42

And on Pg. 43

"the motion is so rapid as to produce a humming noise, sometimes varying the notes to a sharp key."

Vail invented the
Code Practice Oscillator



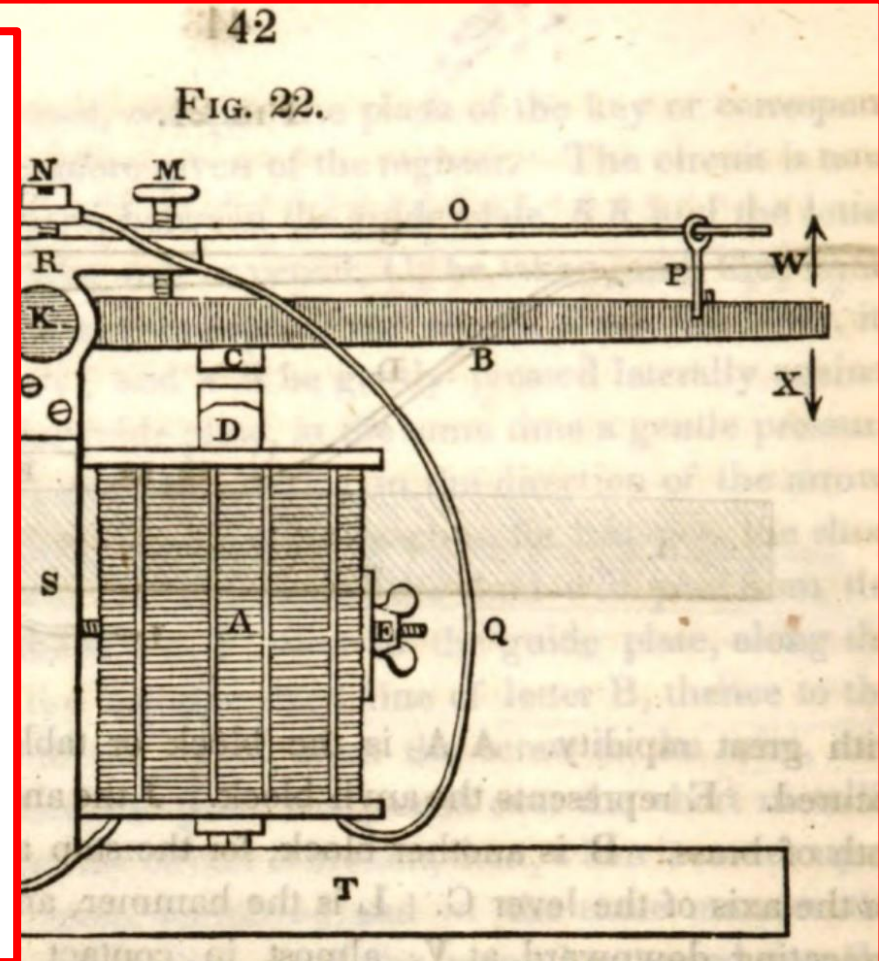
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Vail's Lever Key is on Pg. 41.

Vail's "Hummer" is on Pg. 42

Why don't we know about it?

- Morse actively opposed copy by ear. Practice spread on its own in late 1840s. Morse included it in revised & expanded patent.
- Vail could not pursue ideas on his own – everything belonged to Morse.
- The "Hummer" is one of the very few things Vail explicitly attributes to himself.
- 1852 - Sounder invented – Very similar to hummer design. i.e. register magnet with tape removed.



Vail's Telegraph – 1843

Sending

- Operator sends message with Vail's "correspondent" key

Receiving

- Dots and dashes on paper tape can be translated to letters on the tape - or in the head

Questions:

Why did Vail invent an improved key?

Why no sounder, if they could copy by ear?

Why did Morse's telegraph succeed?



There was lots of competition

Before Morse (1832), the options were

**Visual (Chape Semaphore system in France; 1795)
– 1832)**

Bells (Joseph Henry 1831)

Needles (Wheatstone and Clark- England (1832)

**Until patent wars resolved in 1850s, the options
were:**

Morse's Telegraph

**Alternatives that tried to get around Morse's
patents.**



Arguments went like this:

Morse's Telegraph required a skilled Operator

- Operators had to send, receive, and translate code
- Without operator system ceases operating, instantly.
- Operators were expensive
- Operators were a security risk
- Systems without operators were more secure

Alternatives saved on operators but were:

- More complex (mechanically)
- Less reliable (more dependent on line conditions)
- Thus slower
- More costly in real world



Arguments went like this:

Morse's Telegraph required a skilled Operator

- Operators had to send, receive, and translate code
- Without operator system ceases operating, instantly.
- Operators were expensive

Why did Morse's system survive 100+ years?

But was more cost effective in real world. Competitors were

- More complex (mechanically)
- Less reliable (more dependent on line conditions)
- Thus slower.
- Lower productivity in operation



Morse's telegraph was smart.

The others were not.

Morse's Telegraph leveraged the USER as a component.

The skilled operator, what some thought a weakness, turned out to be its greatest strength (see Third Big Bang - Technology).

Leveraged user's brain for Layers 2 thru 7 of the OSI model

- Filters
- Translates
- Stores, Forwards, and Routes
- Operator can read through noise, bad sending, better than best computers (particularly copying poorly sent code) even today.

Leads to most basic datum in Human Factors:



**The most important
component in any
system is the user.**

The 4th Big Bang

Direct Mind-Technology

Connections



The 4th Big Bang

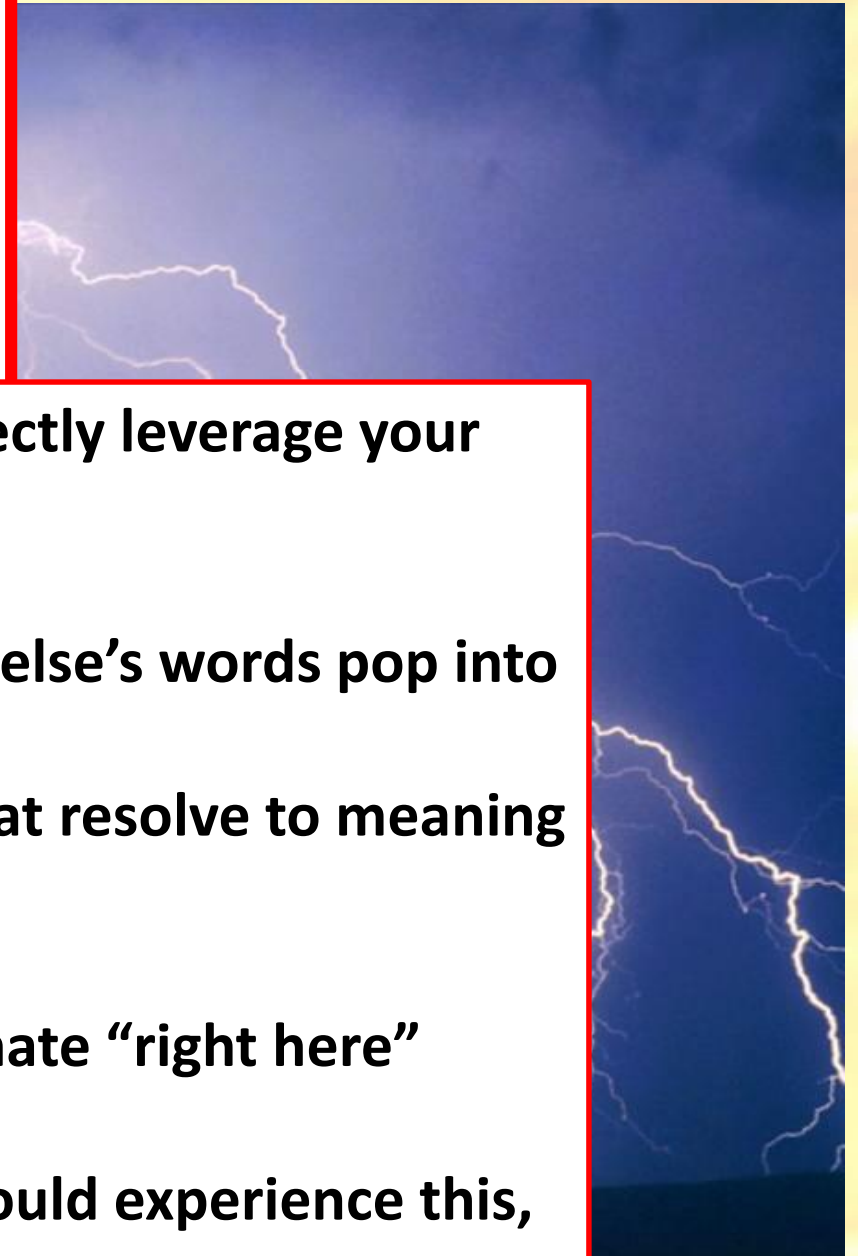
Direct Mind-Technology

Connections

CW was the first and (so far) only technology to directly leverage your processing power as part of the digital system.

- Digital symbols are directly converted: Someone else's words pop into focus as thoughts**
- Like Kanji – Morse characters are little puzzles that resolve to meaning**
- Solutions flash into your head**
- Different from other modes**
- Thoughts don't originate "over there" they originate "right here"**

Every engineer (every stakeholder in our future) should experience this, by learning CW.



The 4th Big Bang

Direct Mind-Technology

Connections

Big events on the mind-machine horizon:

- **Data display via Augmented Reality and/or implants**
- **Point and select interface by eye**
- **Manipulation by thought**

Big Problem: can't make the interface unidirectional

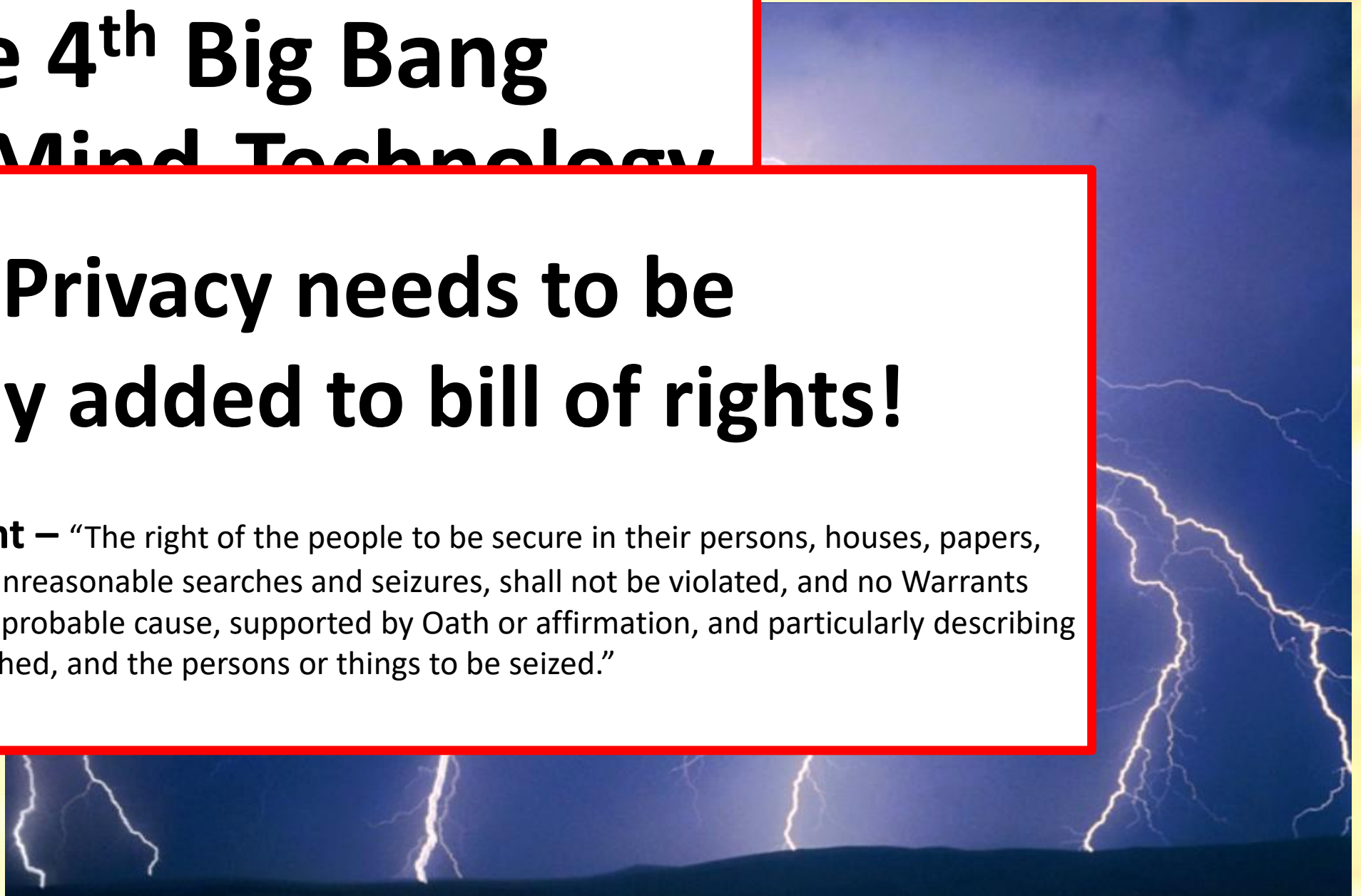


The 4th Big Bang

Direct Mind Technology

Mental Privacy needs to be explicitly added to bill of rights!

“4th Amendment – “The right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated, and no Warrants shall issue, but upon probable cause, supported by Oath or affirmation, and particularly describing the place to be searched, and the persons or things to be seized.”



The most important component is YOU

- **Technology is nothing without you**
- **If AI seems alive - it's just reflecting your life back at you**
- **Androids do not dream of electric sheep**
- **Dreaming is what you do when you're not busy "Solving problems related to survival."**
- **Dreaming is what your mind does with downtime.**
- **No AI would ever sail to Bouvet "just because its there." Of course neither would anyone else... just hams.**

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