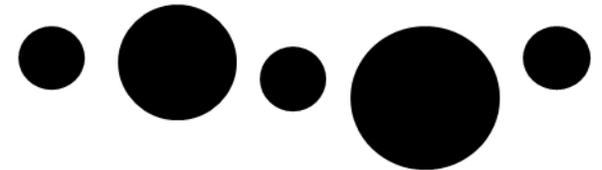
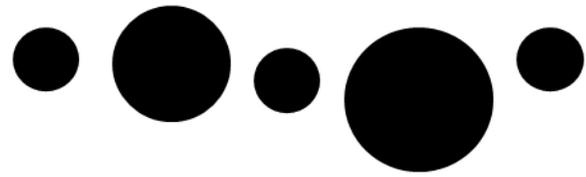




# Welcome to **Online Office Hours!**

We'll get started at 2PM ET





# Library of Congress **Online Office Hours**

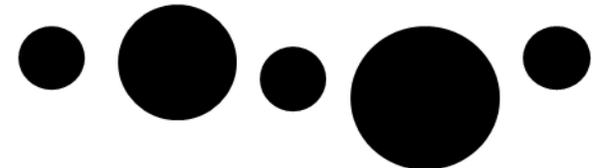
Welcome! We're glad you're here! Use the chat box to introduce yourselves. Let us know:

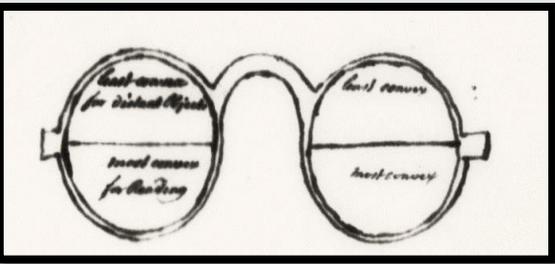
- **Your first name**
- **Where you're joining us from**
- **Grade level(s) and subject(s) you teach**



**Thank you!**

**Questions? Post them in the chat box!**





Two persons A and B depart at the same time one from Boston the other from Hartford the distance being about 100 miles after 7 hours they meet on the road when it appeared that A had  $1\frac{1}{2}$  miles faster than B

1 1797 1798 1796

Use bird's wings on apparatus.



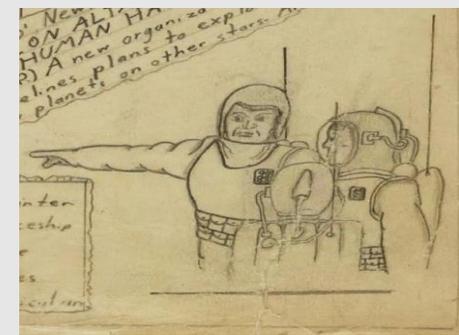
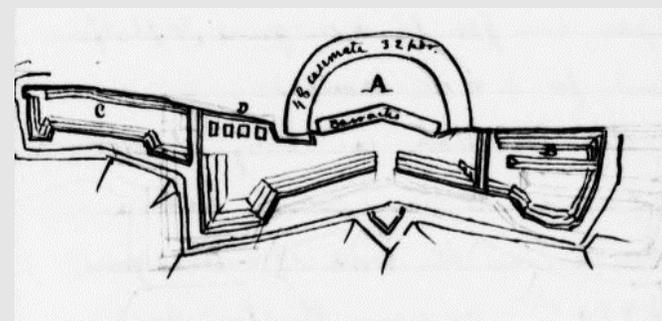
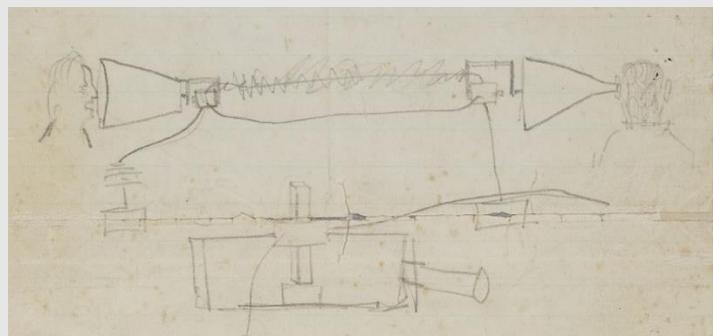
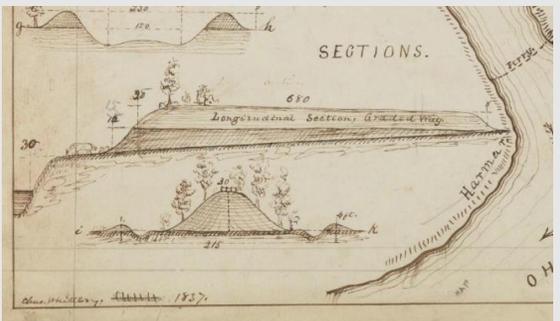
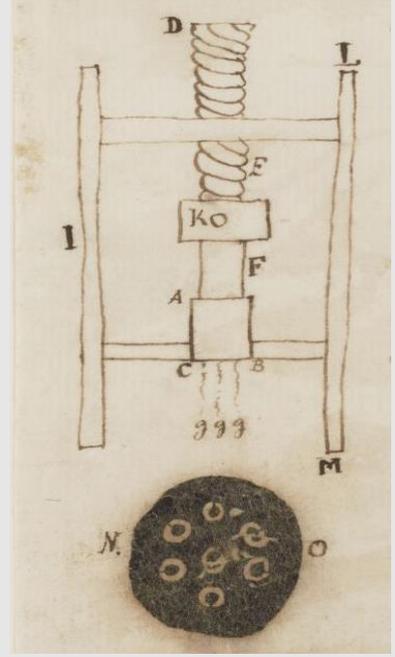
We have killed a turkey today - use turkey wings



# STEM Primary Sources in the Manuscript Division

*(Expect the Unexpected)*

Michelle Krowl and Josh Levy, historical specialists  
Manuscript Division



**Edward O. Wilson,**  
*biologist*

**Charles Townes,**  
*physicist, astrophysicist*

**Margaret Mead,**  
*anthropologist*

**Thomas Eisner,**  
*biologist*

**Jack S. Kilby**  
*engineer, inventor*

**Vera C. Rubin,**  
*astronomer*

**Glenn Seaborg,**  
*nuclear chemist*

There are many Manuscript  
Division collections in which  
you would expect to find  
STEM-related primary sources

**Alexander Graham Bell,**  
*inventor*

**Orville and Wilbur Wright,**  
*aviation pioneers*

**Herman Hollerith,**  
*inventor, computer pioneer*

**Benjamin Franklin,**  
*scientist*

**Samuel F. B. Morse,**  
*inventor*

**Montgomery C. Meigs,**  
*engineer, architect*

**Carl Sagan,**  
*astronomer*

**Maxine Singer,**  
*biochemist*

**Luther Burbank,**  
*botanist, horticulturist*

**Frances Oldham Kelsey**  
*pharmacologist*

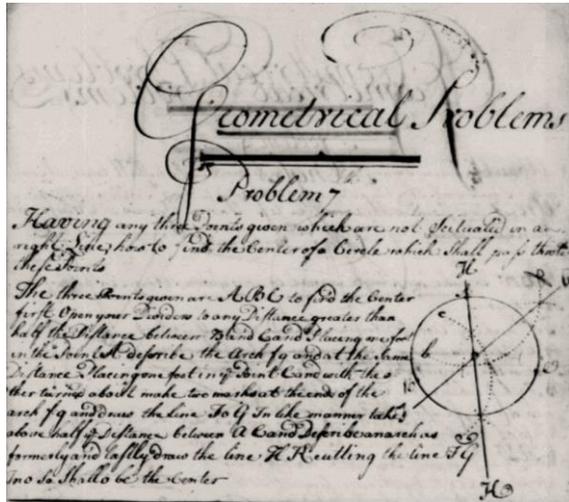
**Barry Commoner,**  
*biologist, ecologist*

**Gloria Hollister Anable,**  
*zoologist*

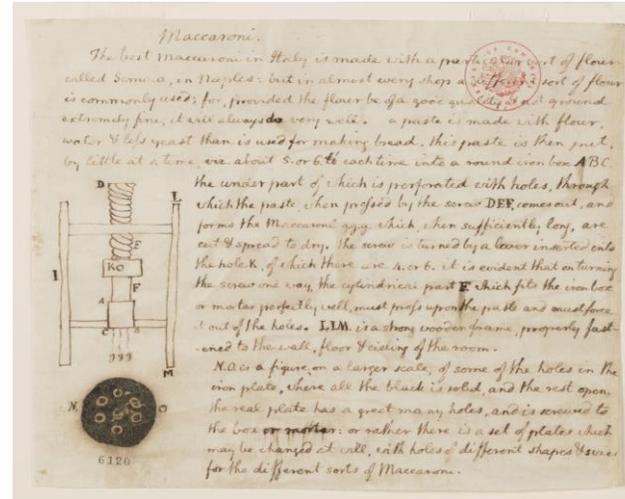
**J. Robert Oppenheimer,**  
*physicist*

# But had you also considered the papers of ...?

George Washington



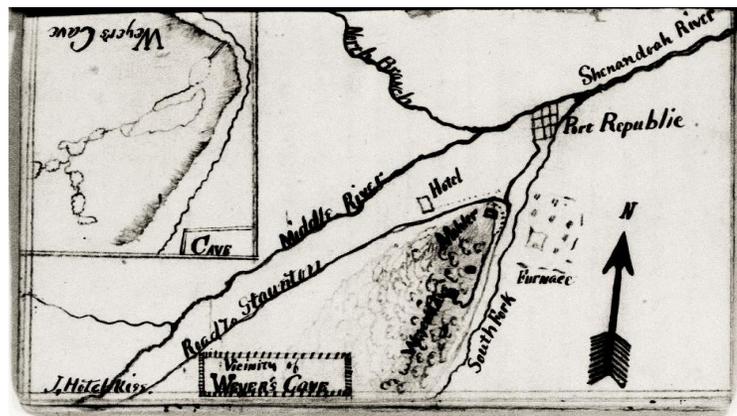
Thomas Jefferson



The American Colony in Jerusalem



Civil War mapmaker Jedediah Hotchkiss

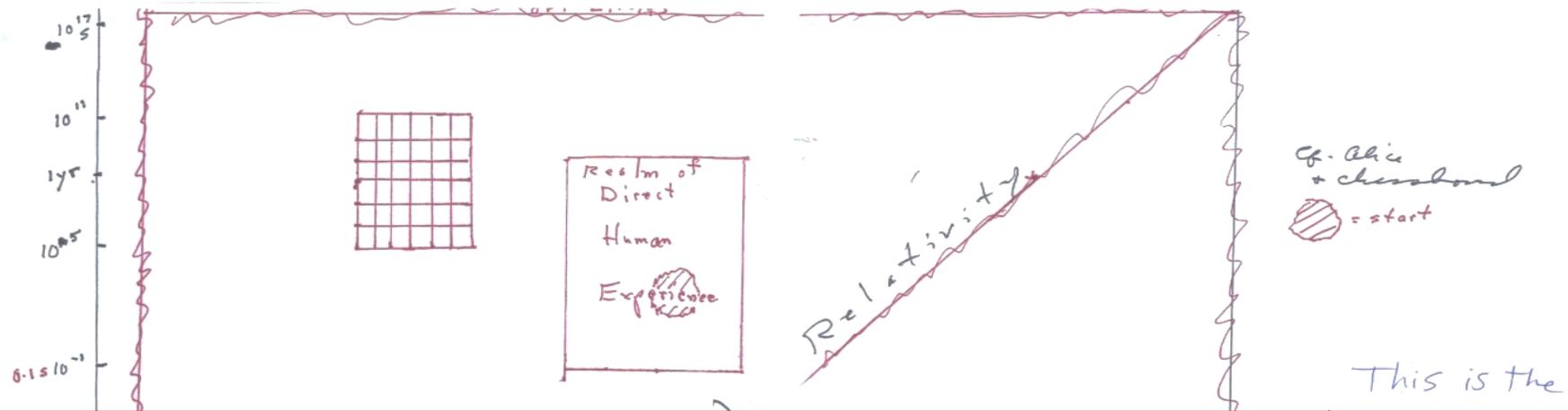


*Apotekens*

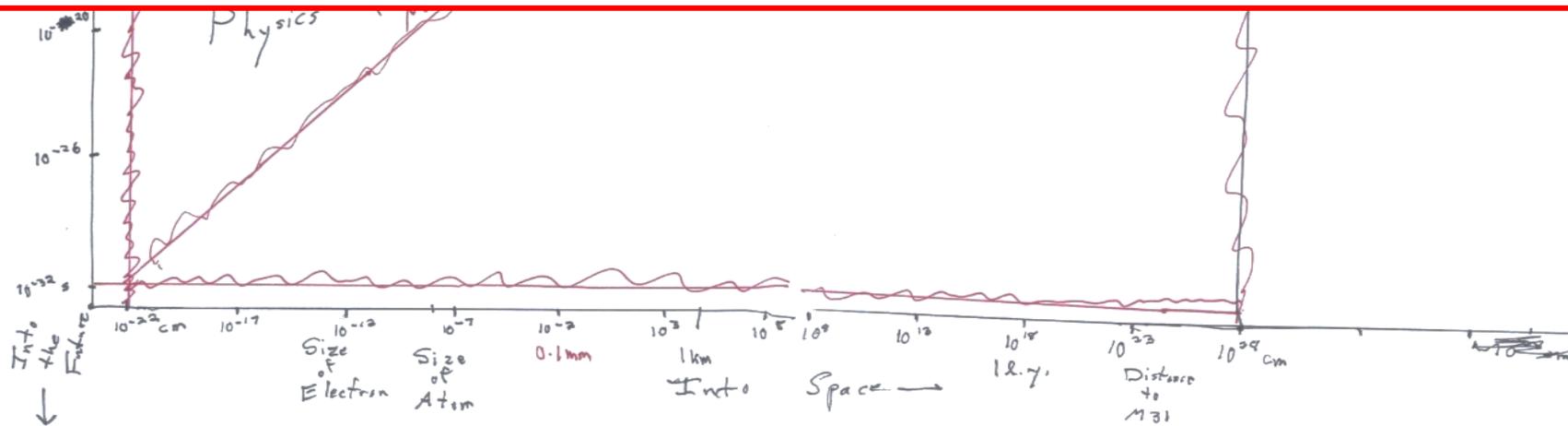
*Chart IX*  
*of the collection*

1200-02	<i>Aristolochia</i>	3	(7)
1203	<i>Sassafras</i>	1	(15)
1204-8	<i>Lindera</i>	3	(9)
1207-11	<i>Lophoc. . .</i>	4	(8)
1212	<i>Liriod.</i>	1	(9)
1213-15	<i>Stephanandra</i>	4	(2)
1217	1217-26	<i>Ulmus</i>	10. 1 (C) 9 (D)
1217		<i>Hippophae</i>	1 (8)
1217-37		<i>Ulmus</i>	10. (A) 1208-12 (B)
1253-6	<i>Platanus</i>	2	(8)
1254-8	<i>Lith.</i>	4	(C)
1259-61	<i>Prunus</i>	6	(18)
1265	<i>Bombycilia</i>	1	(C)
1266	<i>Malva</i>	1	(9)
1267	<i>Viburnum</i>	1	(5)

Olmsted Associates, landscape architects



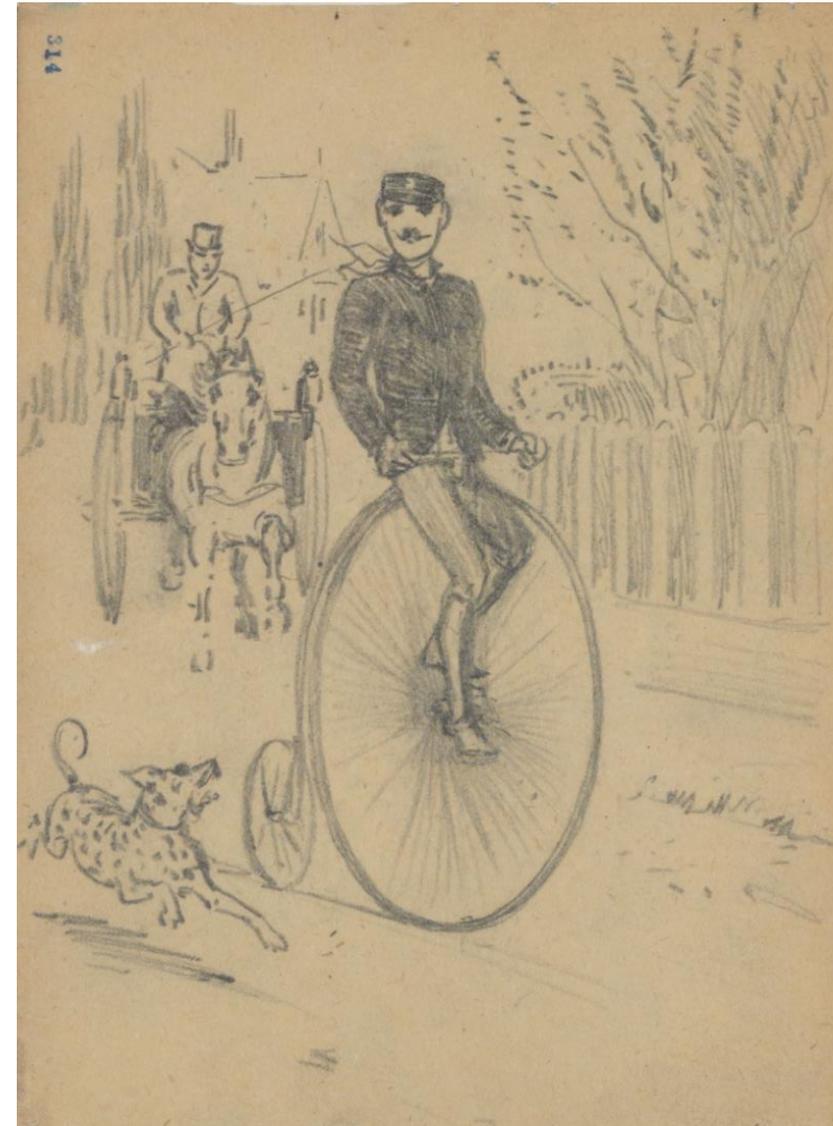
Let's take a closer look at three documents in the Manuscript Division that might be incorporated into a STEM lesson in unexpected ways...



Penny-farthing bicycles in Charles Wellington Reed Papers:  
*How can these be STEM resources?*

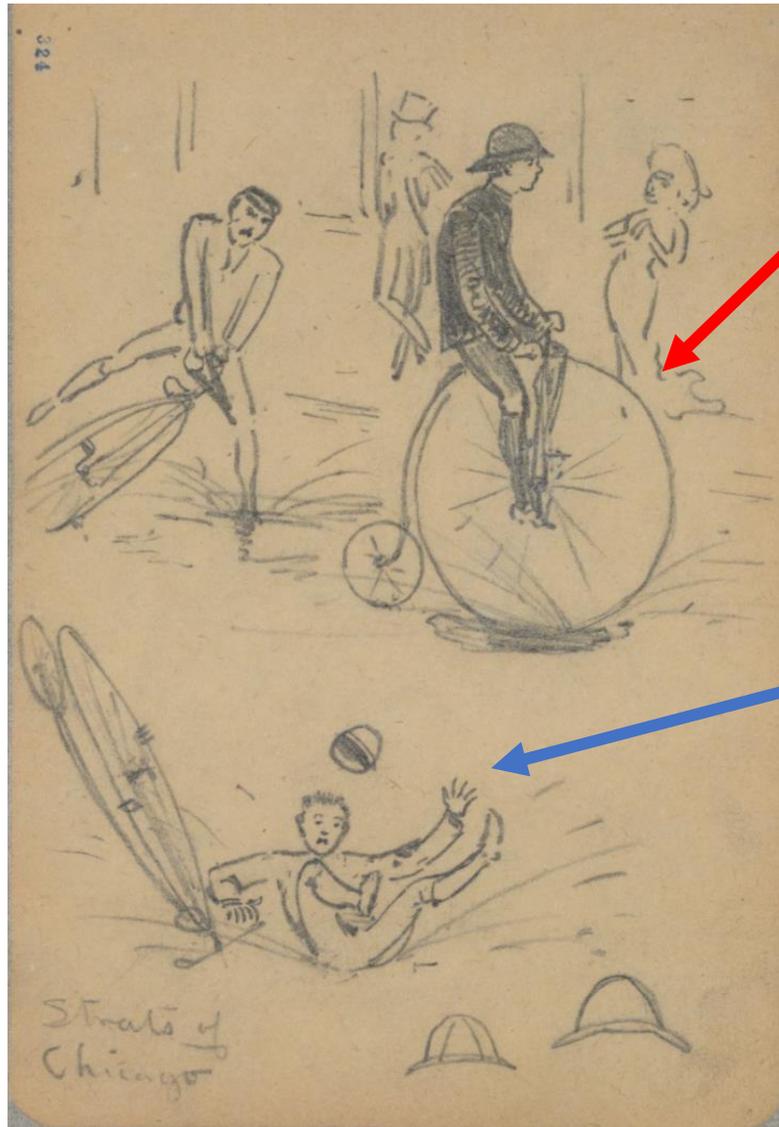


<https://www.loc.gov/resource/mss37457.0301/?sp=380>



<https://www.loc.gov/resource/mss37457.0301/?sp=366>

## Depends on the questions you ask!



- What are the physics involved with such a bicycle?
- What is the advantage to having a large wheel in the front and a small one in the back?
- How does the rider get on the bicycle?
- What challenges might someone encounter in riding it?
- How fast might it go?
- How does the rider stop it?
- Was it prone to crashing, as this sketch suggests, and if so, why?
- Could a woman in a long skirt ride a penny-farthing? Were fashion and engineering compatible in bicycle design? (See LibGuide on this subject: <https://guides.loc.gov/chronicling-america-early-bicycle-fashion>)
- In what way is the technology of bicycles today different than those of the “penny-farthings,” and when did that shift start to occur?

Can pair with images from Prints & Photographs Division and Chronicling America to add to the lesson



Precarious mounting of a penny-farthing style bicycle  
Prints & Photographs Division  
<https://www.loc.gov/pictures/item/2016827929/resource/>

---

## Columbia Light Roadster Safety.



Tangent Spokes, Cold-Drawn Seamless-Steel Hollow Fellos, Columbia Tubular steel Frame with anti-vibrating Spring Fork Ball-Bearings all around, Ball-Bearing Socket Steering-Head, One-Piece Hollow Handle-Bar, Improved Ewart Chain.

Readily adjustable in every essential particular, to meet the requirements of any rider, within reasonable limits.

The anti vibrating fork affords ample elasticity of frame without affecting the positive steering, in which respect this machine has no equal; the improved Ewart chain is quiet, strong and every link is detachable; its equipment is unsurpassed, and its lines and finish admirable in every detail. We have put more money into its construction than any other bicycle ever built.

*Just the machine for business and professional men.* A sound, safe, easy roadster. It costs less than a good horse and eats no oats. Catalogue sent free upon application to

### C. D. KNOX, Agent, Lime Rock, Conn.

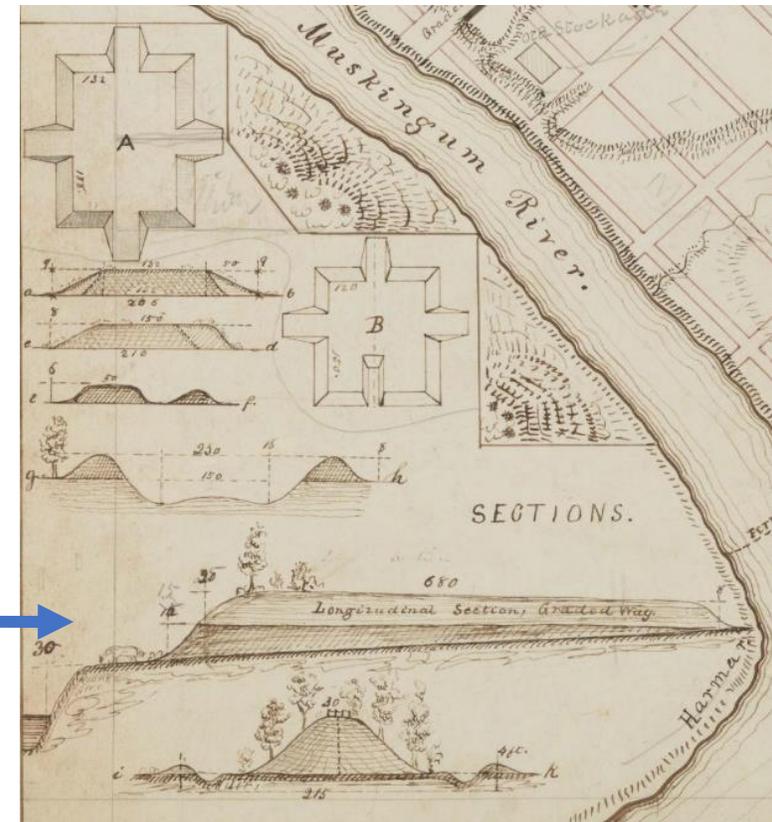
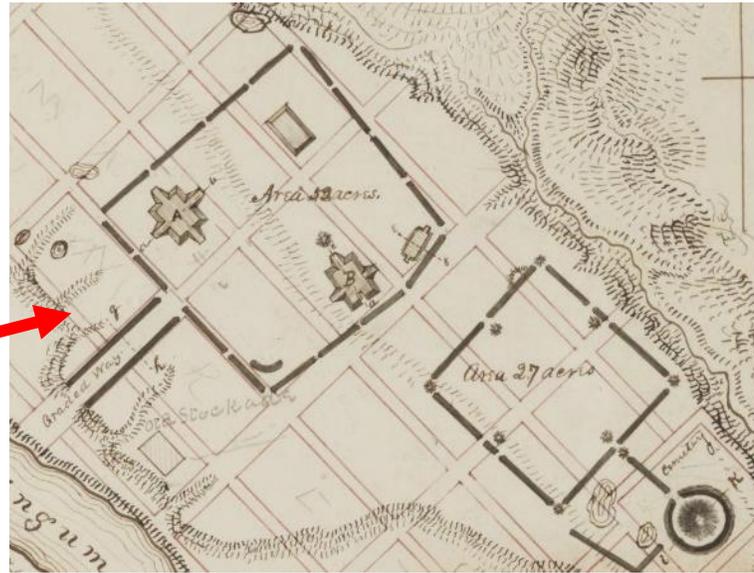
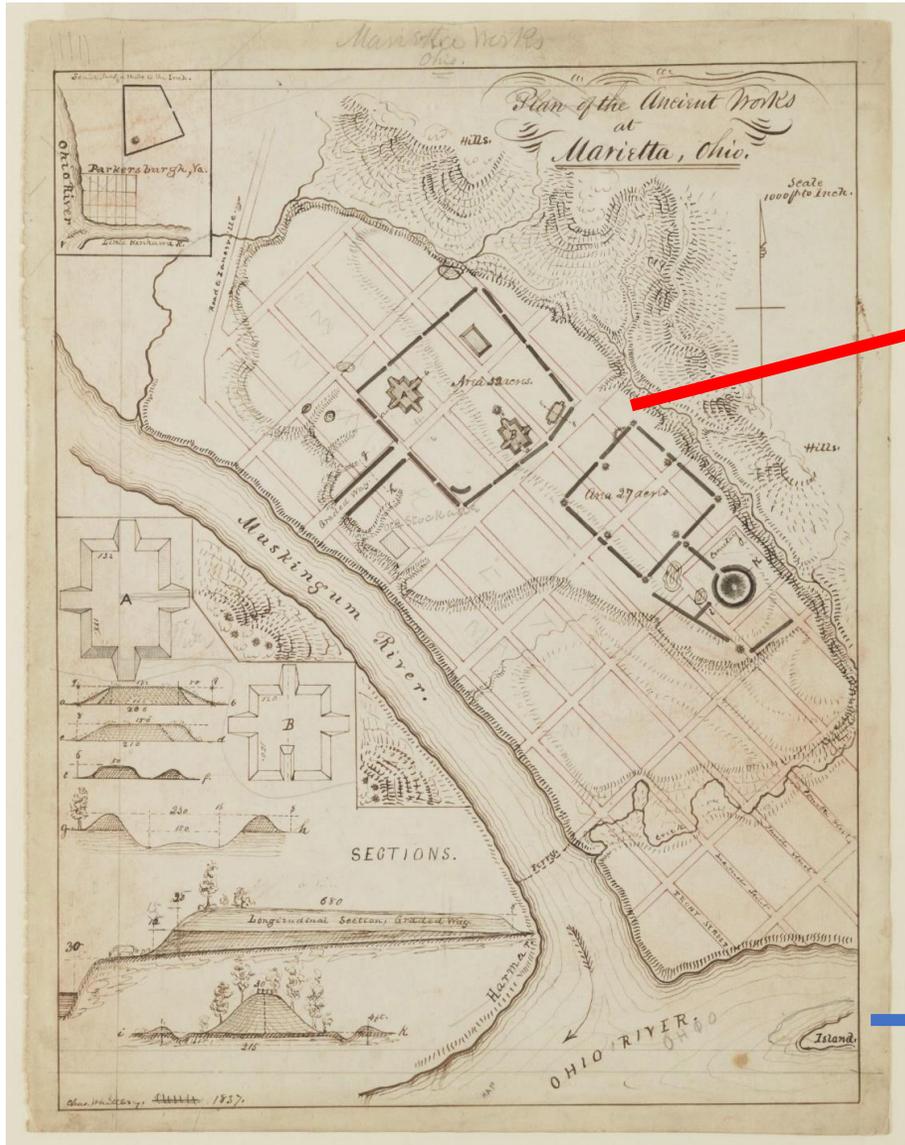
My terms for selling on monthly installments will interest you. It is easy to get a wheel without stretching your pocket book out of shape if you only know how. I can and will give you the information for the asking.

---

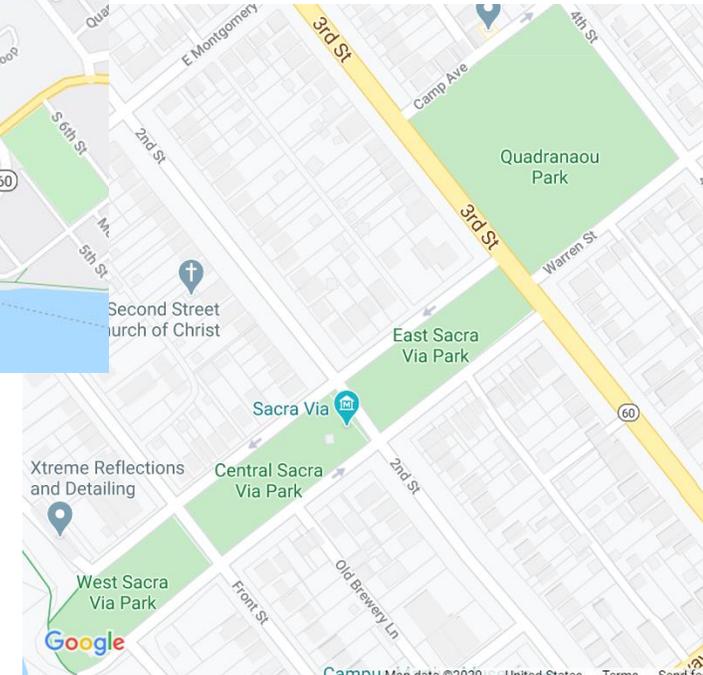
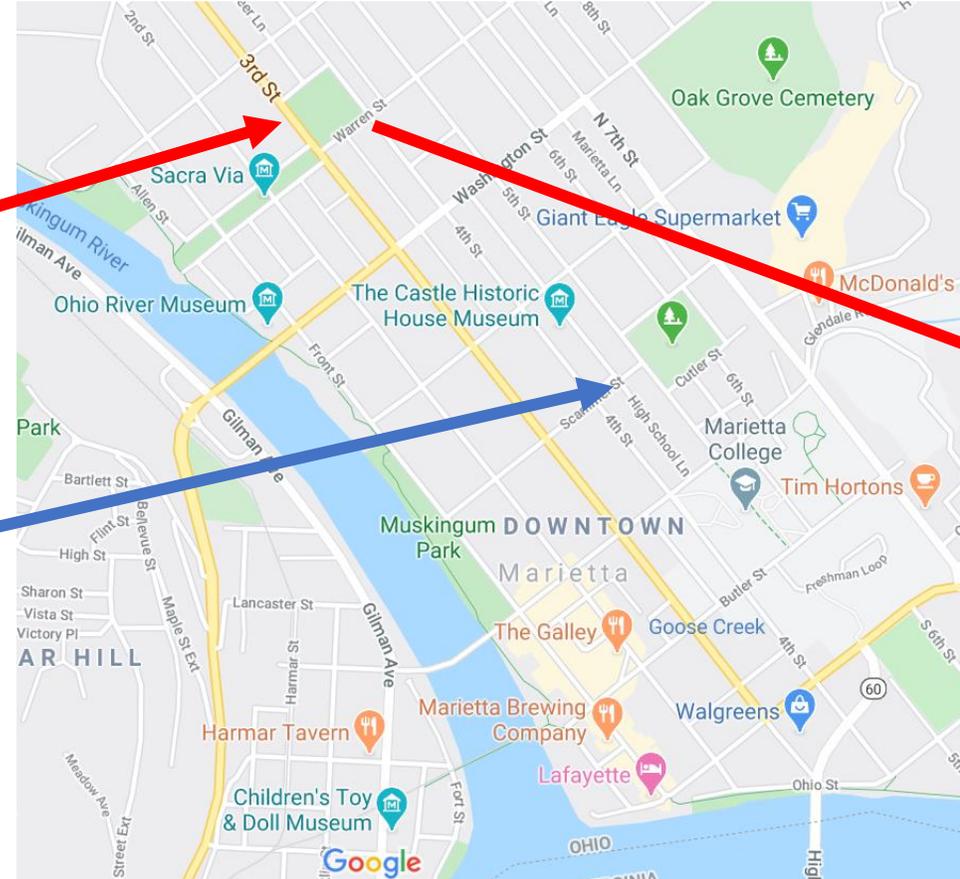
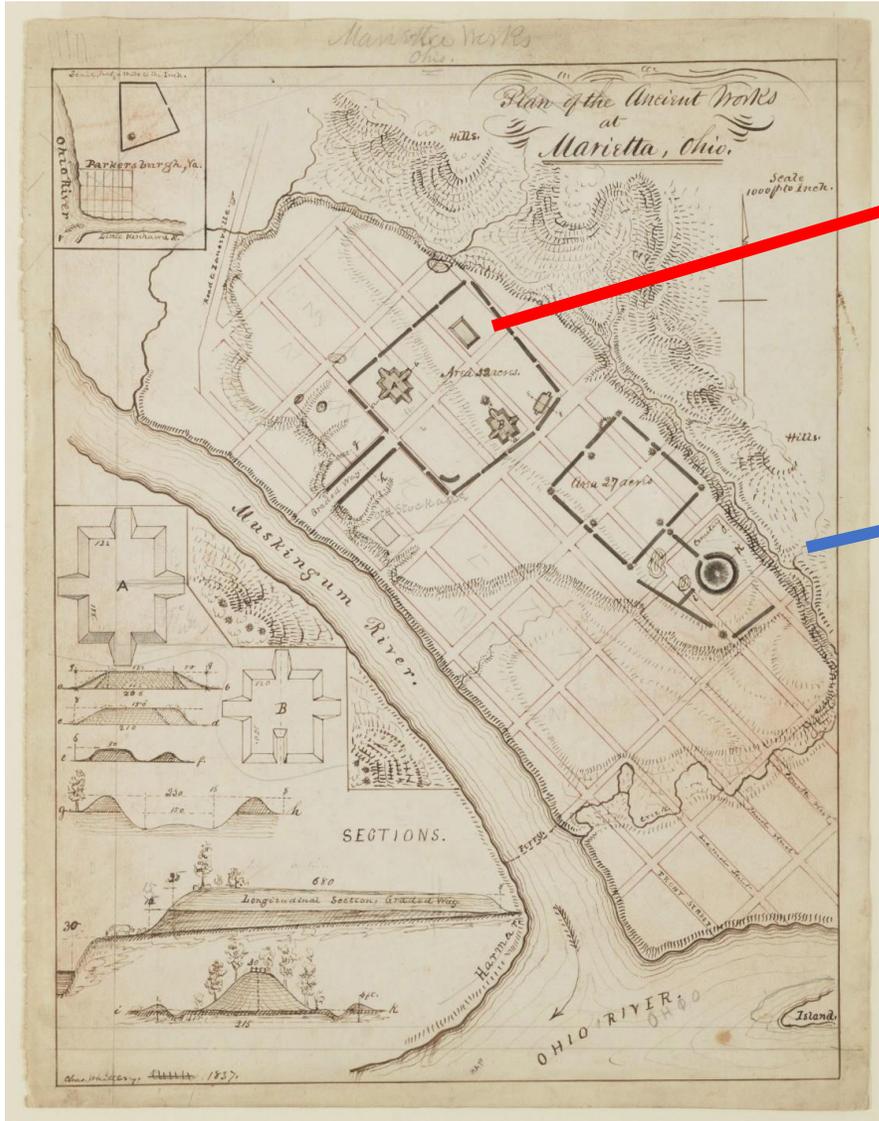
Example of a new “safety” bicycle similar to modern models

Connecticut Western News (Salisbury, Conn.),  
September 25, 1889. *Chronicling America*  
<https://chroniclingamerica.loc.gov/lccn/sn84027718/1889-09-25/ed-1/seq-3/>

Maps helps us orient ourselves to the world around us, but what else do they reveal?  
This 1837 map of Marietta, Ohio was produced amid a heightened interest in Hopewell mound builders.



**Will comparison with more familiar maps help us find out what questions to ask?  
Here we can see more clearly how Marietta's mounds were/are included within its downtown street grid.**



<https://www.loc.gov/item/mcc.048/>

**Pair with images from Prints & Photographs Division to add to the lesson**

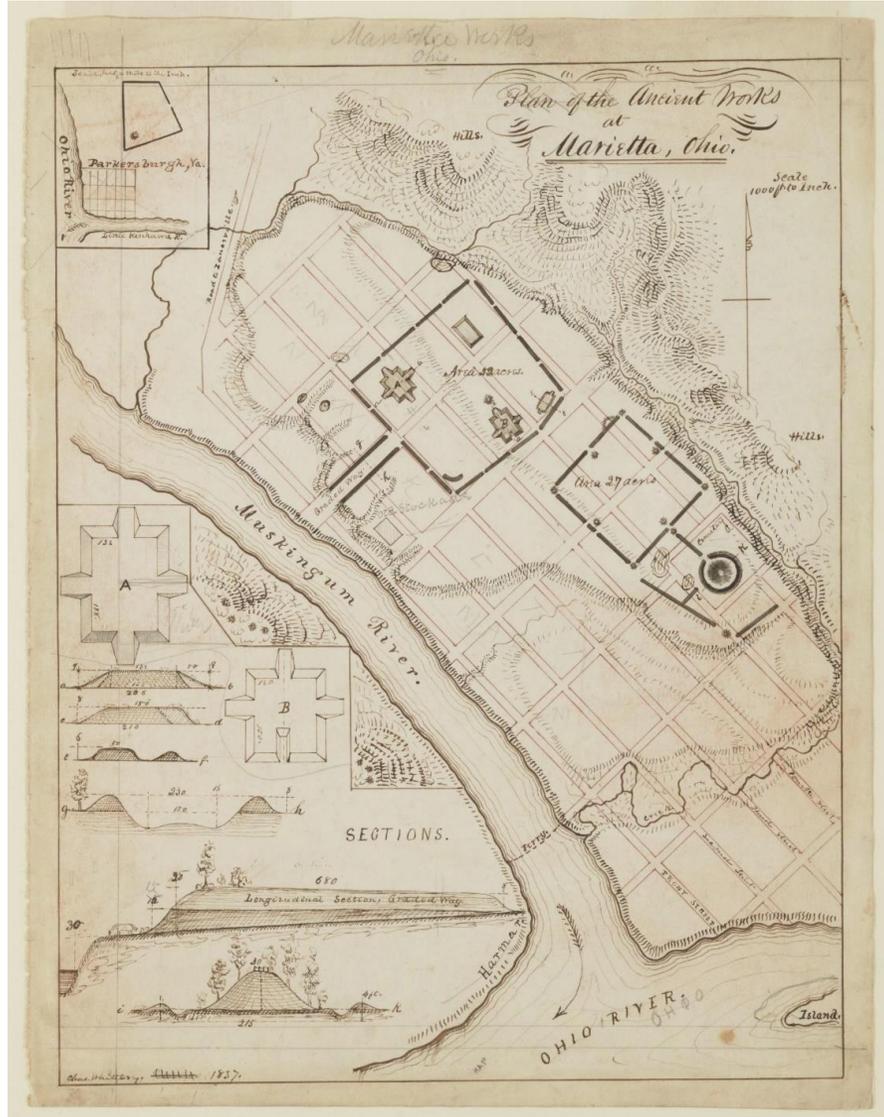


**Great Mound at Marietta, Ohio, 1848**  
*Lithograph illustration in Squire, Ancient  
Monuments of the Mississippi Valley  
Prints & Photographs Division  
<https://www.loc.gov/pictures/item/2003675053>*



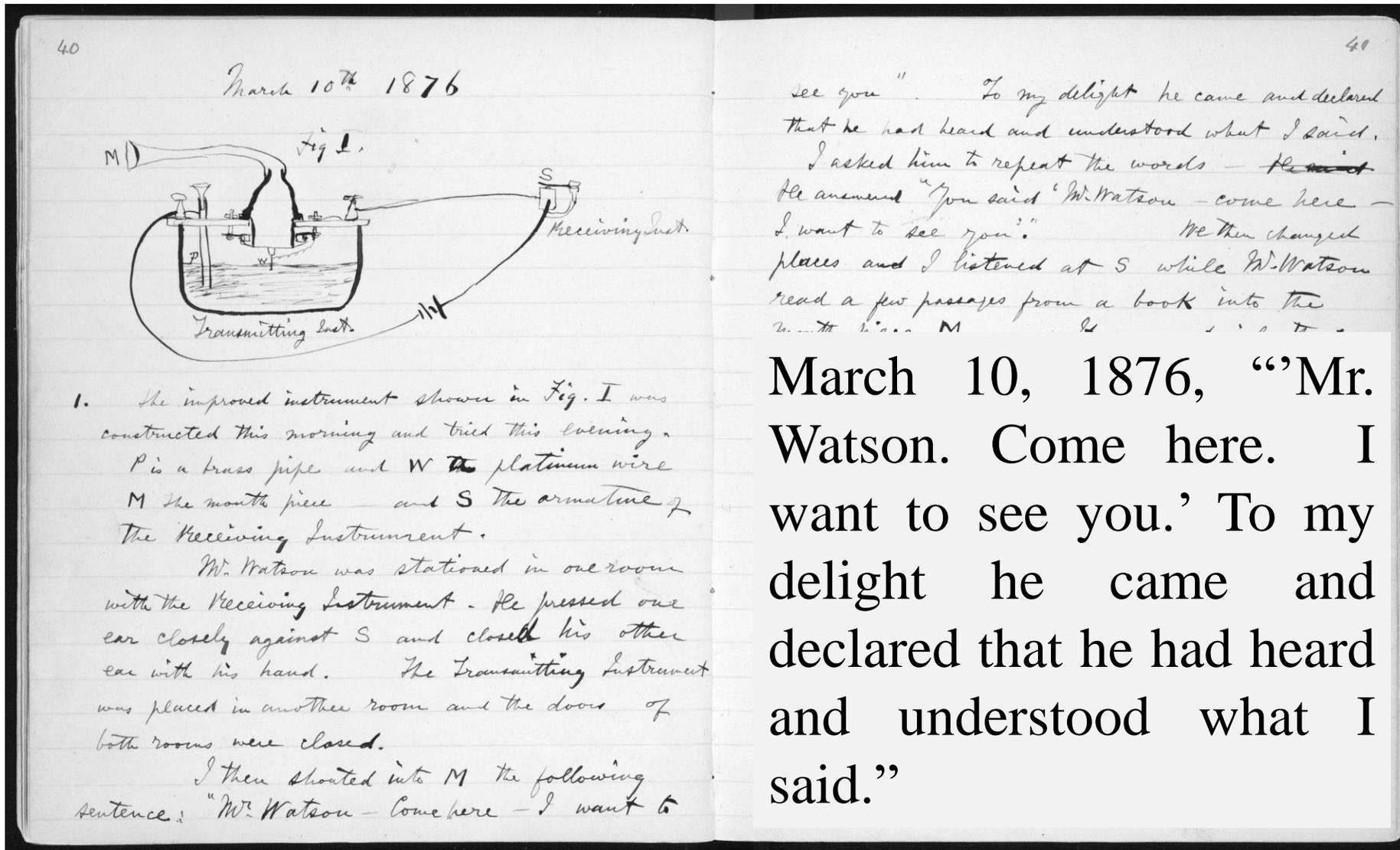
**Mound Cemetery, Marietta, c. 1920-1950**  
*Prints & Photographs Division  
<https://www.loc.gov/pictures/item/98512163>*

## So what questions could these maps help us answer?



- What technologies did Hopewell people use to build these mounds, and to incorporate items from places as distant as Minnesota in their burials?
- Record the height and calculate the circumference of Marietta's cone-shaped mound. Then measure a building near your home or campus. How do the structures compare?
- Calculate the volume of each of Marietta's mounds in 1837, then go online and find the volume of the mounds that remain today. What percentage of the 1837 soil has been lost to development and erosion?
- The plan for Marietta was first laid out in 1788. How have land surveying instruments changed since then?
- Why did the Ohio Company give Marietta's mounds Latin names? (*Sacra Via*, *Quadranaou*, *Capitolium*, *Conus*) (Hint: Roman ruins)
- Why did early settlers take so much interest in Ohio's mounds, even as the U.S. was engaged in a series of Indian Wars? What did the mounds tell them about what it meant to be an American, shortly after 1776? Or an Ohioan, as the new state's population grew?

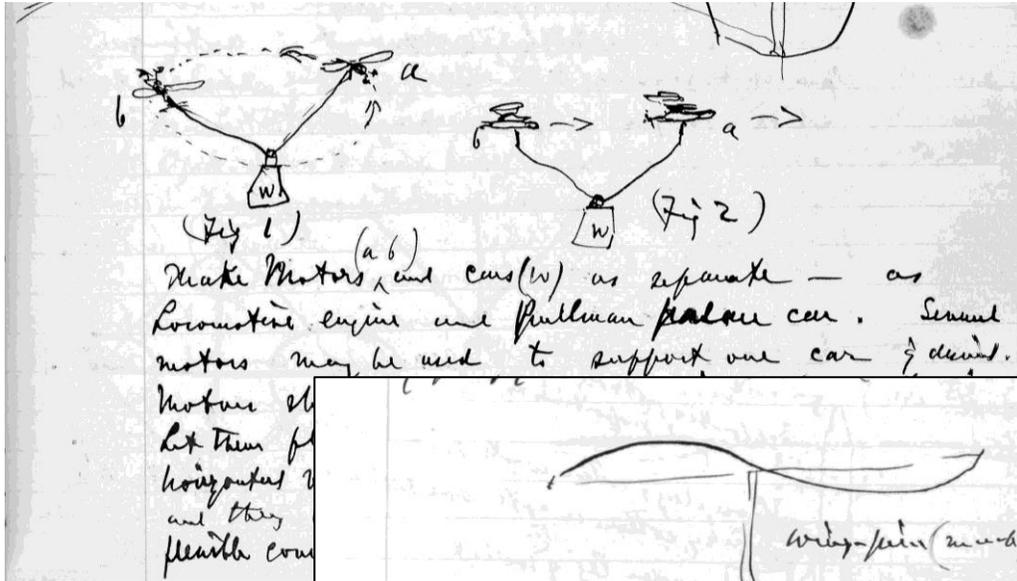
It would be logical to look in the Alexander Graham Bell Papers for documentation of Bell's experiments with the telephone, such as his 1875-1876 scientific notebook in the Subject File series



# But did you know that Bell's notebooks available online also document his extensive experiments with propulsion and flight?

The December 29, 1891 to June 5, 1893 laboratory notebook is particularly rich with experimentation and data

See <https://www.loc.gov/item/magbell.36500101/>



Wings pair (made Jan. 4th p. 29)

Boiler (diameter foot p. 77)

Fia-bra [used in Expt. - Jan. 5/92 p. 40]

Expt. fia-bra = 123 grammes  
alcohol = 48 grammes (extra from supply)

Our store of alcohol is exhausted. No more trying experiment - as 48 grammes is little more than what is required to moisten the wicks.

Propulsion

Paper line

W. Ellis & I will touch off each loop by means of iron rods. Each rod dipped into sulphuric acid. Let figure will simultaneously touch off chl. of pot. mixture with sulphuric acid - and fly

1, 2, 3

And another

Now we will try it - and work out to.

1871 Dec. 31 — Monday — at 1871

Thought  
C. G. B.

Use bird's wings on apparatus.



Thought

We have killed a turkey today — use turkey wings.

Thought  
C. G. B.

It will require two right wings — or two left — for our purpose — ~~the~~

Notes

One of the turkey's wings ~~weighs~~ weighs 188 grammes.

~~The other~~ Left wing weighs 188 grammes

Right wing weighs 189 grammes (this wing & cut)

~~Right wing~~  
Left wing



~~ac = 18 inches~~

ab = 18 inches

ac = 17

ad = 17 1/2 inches

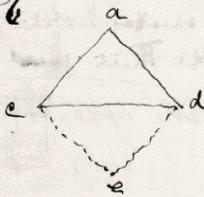
cd = 21 1/2 inches

Angle at a = 180°.

Area of triangle acd = 1/2 area  
of ~~triangle~~ parallelogram aced

Area of aced = 18 x 18 (sq in)  
= 162 square inches.

Will weigh bird at house to see what weight



On this page, Bell looks to nature to solve the mysteries of flight by examining bird wings. Questions that might be asked of this and subsequent pages:

- How did the natural world influence Bell in his pursuit of flight?
- What type of data did Bell record based on his observations?
- Were other early aviators similarly inspired by nature?
- Does nature continue to inspire invention? Can you provide examples?
- Why do you think Bell initialed and dated many of the entries in this notebook? (Hint for one reason: patents)

Not all of Alexander Graham Bell's scientific and laboratory notebooks are currently available online, and they are not all in one place in the collection.

But if you keyword search for "notebook" in the "This Collection" search bar, you'll have several options from which to choose to explore!

**LIBRARY** LIBRARY OF CONGRESS

This Collection notebook

Library of Congress » Digital Collections » Alexander Graham Bell Family Papers at the Library of Congress » Search

Share

COLLECTION  
**Alexander Graham Bell Family Papers at the Library of Congress**

About this Collection Collection Items Articles and Essays

Results: 1-25 of 31 | Refined by: Part of: Alexander Graham Bell Family Pap... Available Online

Refine your results

- Available Online 31
- All Items 31

**Original Format**

- Manuscript/Mixed Material 27
- Web Page 4

**Online Format**

- Image 29
- PDF 10
- Online Text 10
- Web Page 4

**Date**

- 1000 to 1000 11

## Collection Items

View List Go Sort By Relevance Go

**MANUSCRIPT/MIXED MATERIAL**  
**Notebook by Alexander Graham Bell, undated**  
Contributor: Bell, Alexander Graham  
Resource:  
[View 97 Images](#)

**MANUSCRIPT/MIXED MATERIAL**  
**Notebook by Alexander Graham Bell?, undated**  
Contributor: Bell, Alexander Graham

# How do I find STEM materials in the Manuscript Division?

- Manuscript Division collections are usually not described at the level of individual items, as photographs or maps often are, so you may have to do a little searching and use your intuition.
- Search the online catalog (<https://catalog.loc.gov/>) for relevant names and subjects. Sorting the results by “Date (oldest to newest)” will often bring Manuscript material to the top. Look for the “Manuscript or Mixed Format” icon. The catalog record will provide links to any online presentation and the collection finding aid, and includes a collection summary which may help determine relevance to your project.
- Look at the list of online Manuscript Division finding aids for names/organizations that look promising; see <https://www.loc.gov/rr/mss/f-aids/>. *(Please note that only a small percentage of our collections are currently available online.)*
- Browse options “Digital Collections” (<https://www.loc.gov/collections/>) by clicking on “Manuscript Division” facet in “Part of” section of left navigation bar.

# How do I find STEM materials in the Manuscript Division?

- Browse “Words and Deeds in American History” grouping for individual STEM-related documents.

<https://www.loc.gov/search/?fa=partof%3Awords+and+deeds+in+american+history%3A+selected+documents+celebrating+the+manuscript+division%27s+first+100+years&sb=date&st=gallery&c=160> (apologies for the currently very long URL!)

- Look at current and past exhibits represented online; see <https://www.loc.gov/exhibits/> Manuscript Division material may be included in an exhibit, and those items/images may not be available online elsewhere. (The full list of exhibitions is at <https://www.loc.gov/exhibits/all/>)
- And sometimes a little serendipity is involved in coming across STEM materials in Manuscript collections!

# And you can always ask us for help!

Josh Levy: [jlevy@loc.gov](mailto:jlevy@loc.gov)

Science specialist, Manuscript Division

Michelle Krowl: [mkrowl@loc.gov](mailto:mkrowl@loc.gov)

Civil War and Reconstruction specialist, Manuscript Division

Manuscript Division, general email address: [mss@loc.gov](mailto:mss@loc.gov)

Manuscript Division homepage: <https://www.loc.gov/rr/mss/>

*Includes helpful links to additional information, guides, etc.*

Ask a Manuscript Librarian: <https://www.loc.gov/rr/askalib/ask-mss.html>

# **Math, Science and Technology**

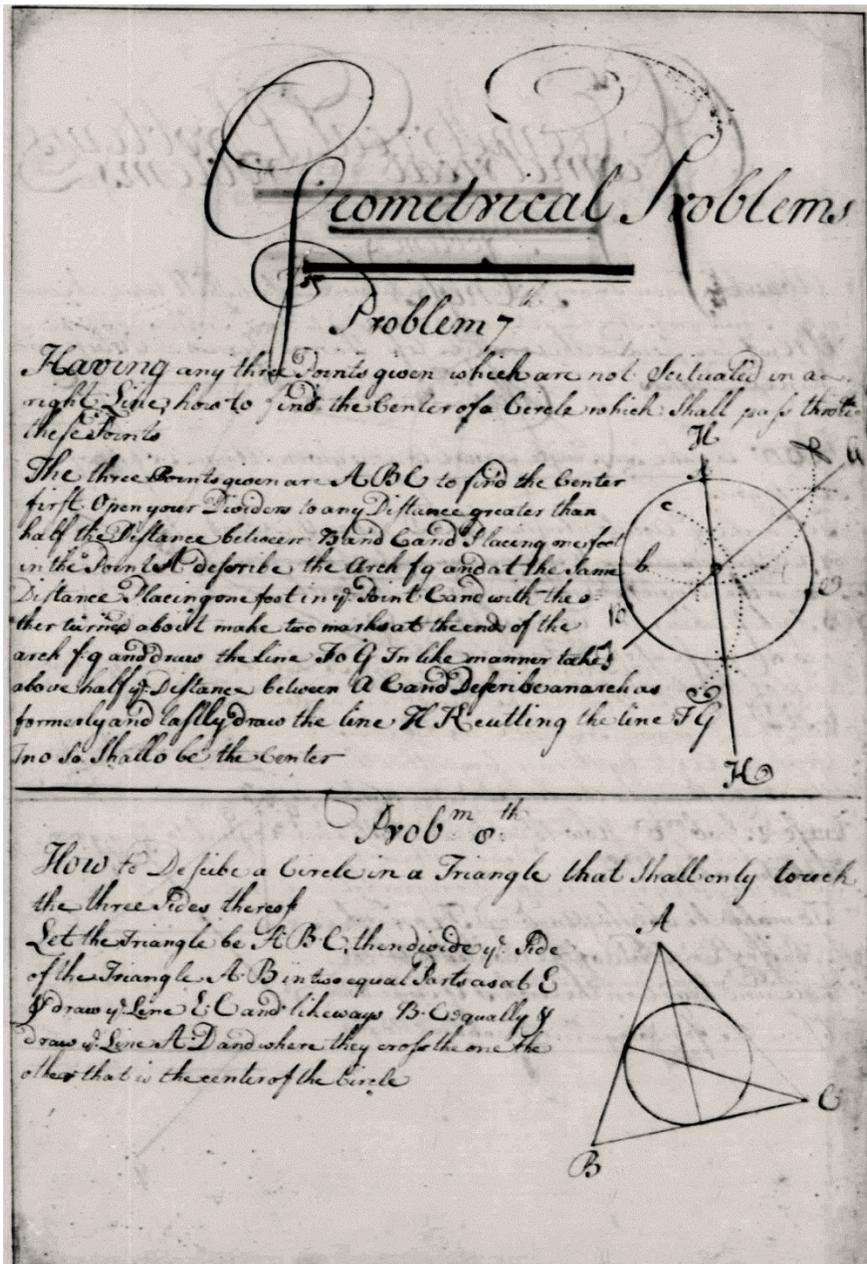
**in the Manuscript Division  
of the Library of Congress**

**Selected facsimile documents from the  
collections with possible questions for  
engagement with primary sources**

**(presented in roughly chronological order)**

**[mss@loc.gov](mailto:mss@loc.gov)**

**<http://www.loc.gov/rr/mss/>**



School Copy Book, Volume 1, 1745, Subseries 1A, Exercise Books 1745-1747, Series 1, Exercise Books, Diaries, and Surveys 1745-99, George Washington Papers, Manuscript Division.

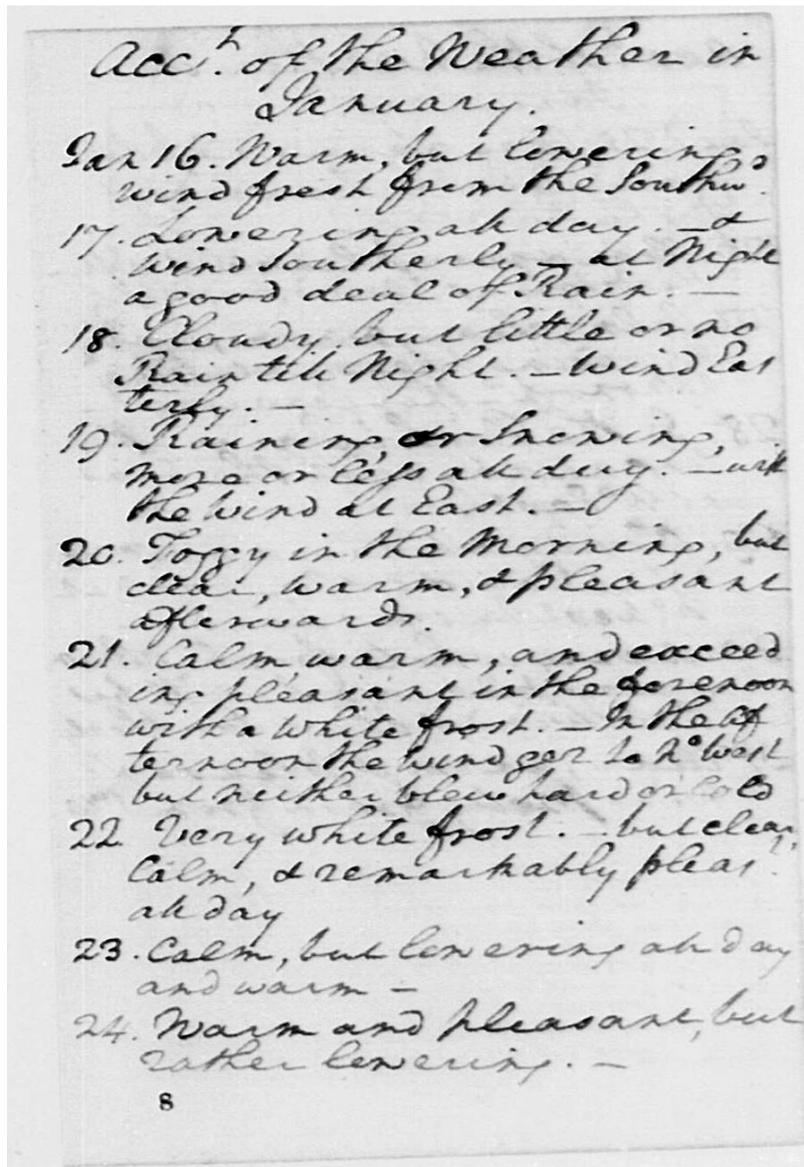
<https://www.loc.gov/resource/mgw1a.002/?sp=9>

The George Washington Papers are available online;  
see <https://www.loc.gov/collections/george-washington-papers/about-this-collection/>

George Washington studied geometry, as shown in his 1745 school copy book.

Can you solve the problems on this page?

How might Washington have used this geometrical training in his early career as a surveyor?



Diary, January 1 - June 19, 1775, Series 1, Exercise Books, Diaries, and Surveys 1745-99, Subseries 1B, Diaries 1748-1799, George Washington Papers, Manuscript Division.

<https://www.loc.gov/resource/mgw1b.751/?sp=16>

The George Washington Papers are available online;  
see <https://www.loc.gov/collections/george-washington-papers/about-this-collection/>

*Look at one of George Washington's diaries.*

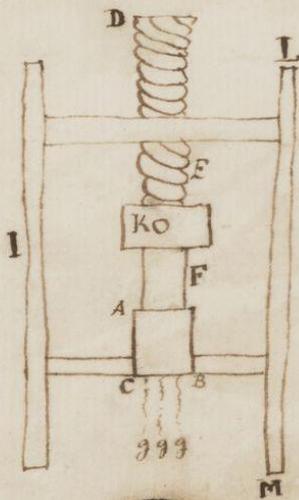
*How often does he mention the weather?*

*Why might Washington be so interested in the weather?*

*How does the weather in Washington's time and location compare with the weather in that location now?*

## Macaroni.

The best macaroni in Italy is made with a particular sort of flour called Semola, in Naples: but in almost every shop a different sort of flour is commonly used; for, provided the flour be of a good quality, & not ground extremely fine, it will always do very well. a paste is made with flour, water & less yeast than is used for making bread. this paste is then put, by little at a time, viz. about 5. or 6. lb each time into a round iron box ABC.



6120

the under part of which is perforated with holes, through which the paste, when pressed by the screw DEF, comes out, and forms the Macaroni g.g.g. which, when sufficiently long, are cut & spread to dry. The screw is turned by a lever inserted into the hole K, of which there are 4. or 6. it is evident that on turning the screw one way, the cylindrical part E which fits the iron box or mortar perfectly well, must press upon the paste and must force it out of the holes. ILM. is a strong wooden frame, properly fastened to the wall, floor & ceiling of the room.

N.O. is a figure, on a larger scale, of some of the holes in the iron plate, where all the black is solid, and the rest open. the real plate has a great many holes, and is screwed to the box or mortar: or rather there is a set of plates which may be changed at will, with holes of different shapes & sizes for the different sorts of Macaroni.

Thomas Jefferson's drawing of a macaroni machine and instructions for making pasta, ca. 1787, Thomas Jefferson Papers, Manuscript Division. <https://www.loc.gov/resource/mcc.027/>

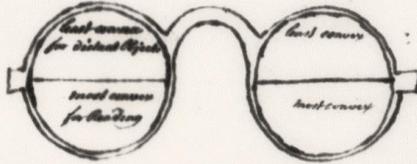
The Thomas Jefferson Papers are available online; see <https://www.loc.gov/collections/thomas-jefferson-papers/about-this-collection/>

*What do Thomas Jefferson's notes on macaroni tell you about his relationship with technology?*

*How does the macaroni Jefferson described compare with what is available today?*

*Can you find other examples in his papers of his scientific interests?*

Reading, is not the best for greater Distances. I therefore had formerly two Pair of Spectacles, which I shifted accordingly, as in travelling sometimes read and often wanted to regard the Prospects. Finding this Change troublesome and not always conveniently ready, I had the Glasses cut, and half of each lens separated in the same Circle, thus



By this means, as I wear my Spectacles constantly, I have only to move my Eyes up or down as I want to see distinctly for or near, the proper Glasses being always ready. Thus I find more particularly convenient when in France, the Glasses that serve me best at Table to see what I eat not being the best to see the Faces of those on the other Side of the Table who speak to me, and when one's Ears are not well accustomed to the Sounds of a Language, a Sight of the Movements in the Features of him that speaks helps to explain, so that I understand French better by the help of my Spectacles.

My intended Translator of your Oeuvre, the only one I know who understands the Subject as well as the two Languages, which a Translator ought to do or he cannot make so good a Translation, is at present occupied in an Affair that prevents his undertaking it, but that will soon be over. — I thank you for the Notice, and I should be glad to have another of the printed Pamphlets.

We shall always be ready to take your Children if you send them to us. I only wonder, that since London draws in and confines such Numbers of your Country People, that your Country should not, want and willingly receive the Children you have a Disposal of. That Circumstance, together with the great Demand as Men, to serve for a time as Laquays, or for Life as such, in consideration of small Wages, seems to me a Proof that your Country is over-peopled. — And yet it is afraid of Emigrations!

Adieu, my dear Friend, and believe me ever,

Yours very affectionately

Benjamin Franklin's illustration of bifocal eyeglasses, Benjamin Franklin Papers, Manuscript Division.

[https://www.loc.gov/resource/mss21451.mss21451-008\\_00005\\_00333/?sp=328](https://www.loc.gov/resource/mss21451.mss21451-008_00005_00333/?sp=328)

The Benjamin Franklin Papers are available online;

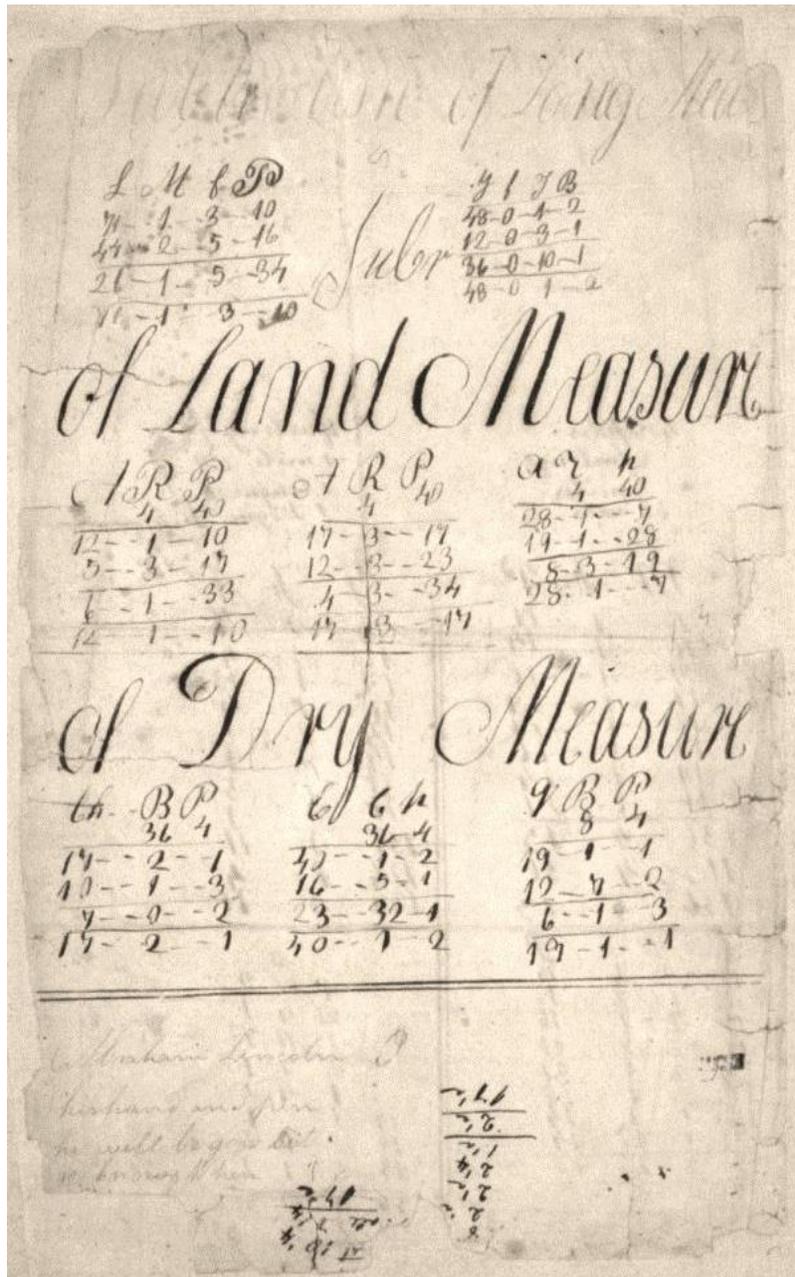
see <https://www.loc.gov/collections/benjamin-franklin-papers/about-this-collection/>

*What are bifocal eyeglasses and how do they work?*

*How are they different than other eyeglasses?*

*What conditions in the eye make them useful for some people?*



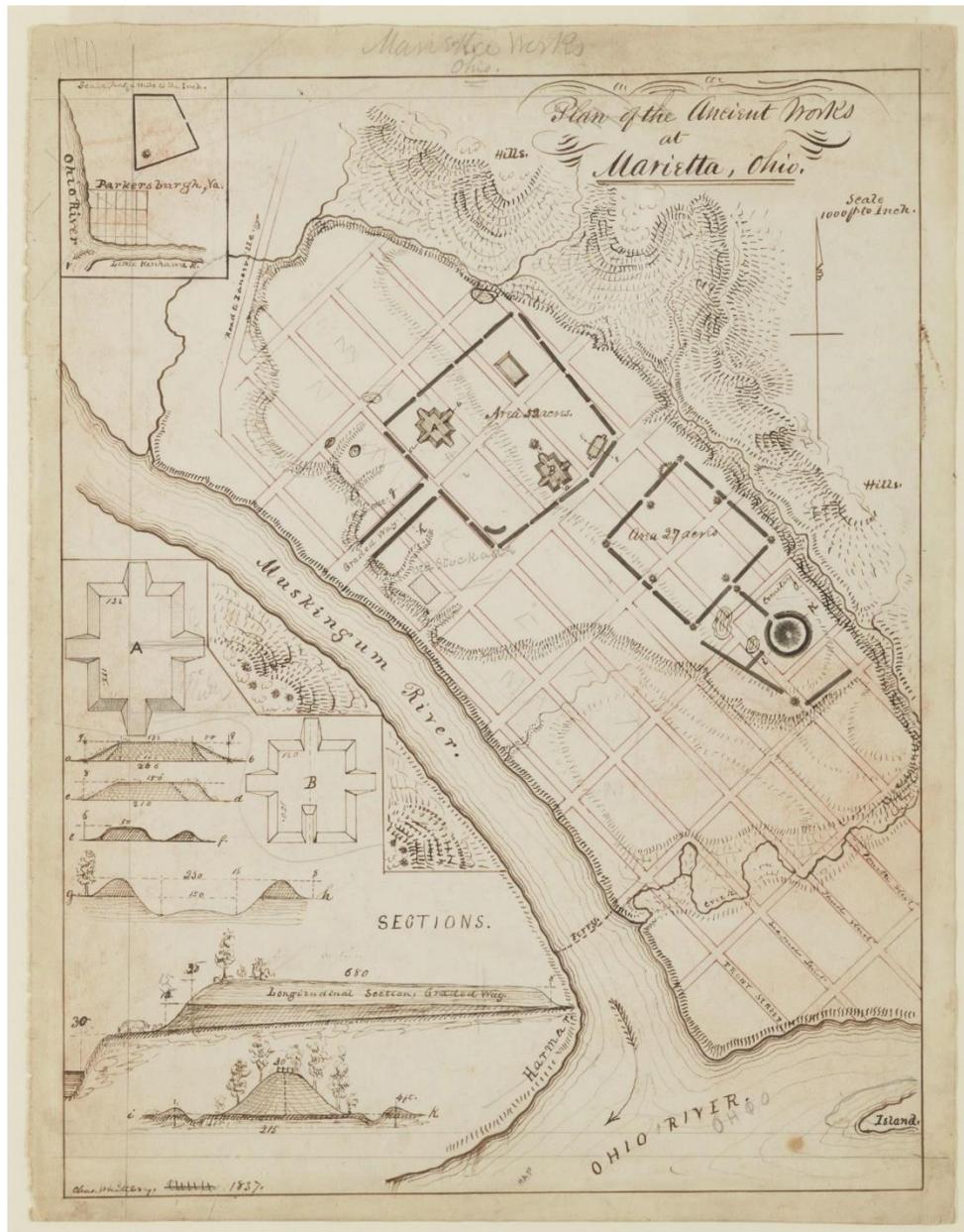


Page of Abraham Lincoln's student sum or cyphering book, ca. 1824-26, Herndon-Weik Collection of Lincolniana, Manuscript Division. <https://www.loc.gov/item/mcc.022/>

*What sort of figures was the young Abraham Lincoln calculating on this page?*

*Why might Lincoln have studied land measures?*

Read more about the context of Lincoln's cyphering book: McKenzie A. Clements, and Nerida F. Ellerton. "Abraham Lincoln's Cyphering Book and the Abbaco Tradition." *Journal of the Abraham Lincoln Association* 36, no. 1 (Winter 2015): 1-17. Available online at <http://hdl.handle.net/2027/spo.2629860.0036.103>



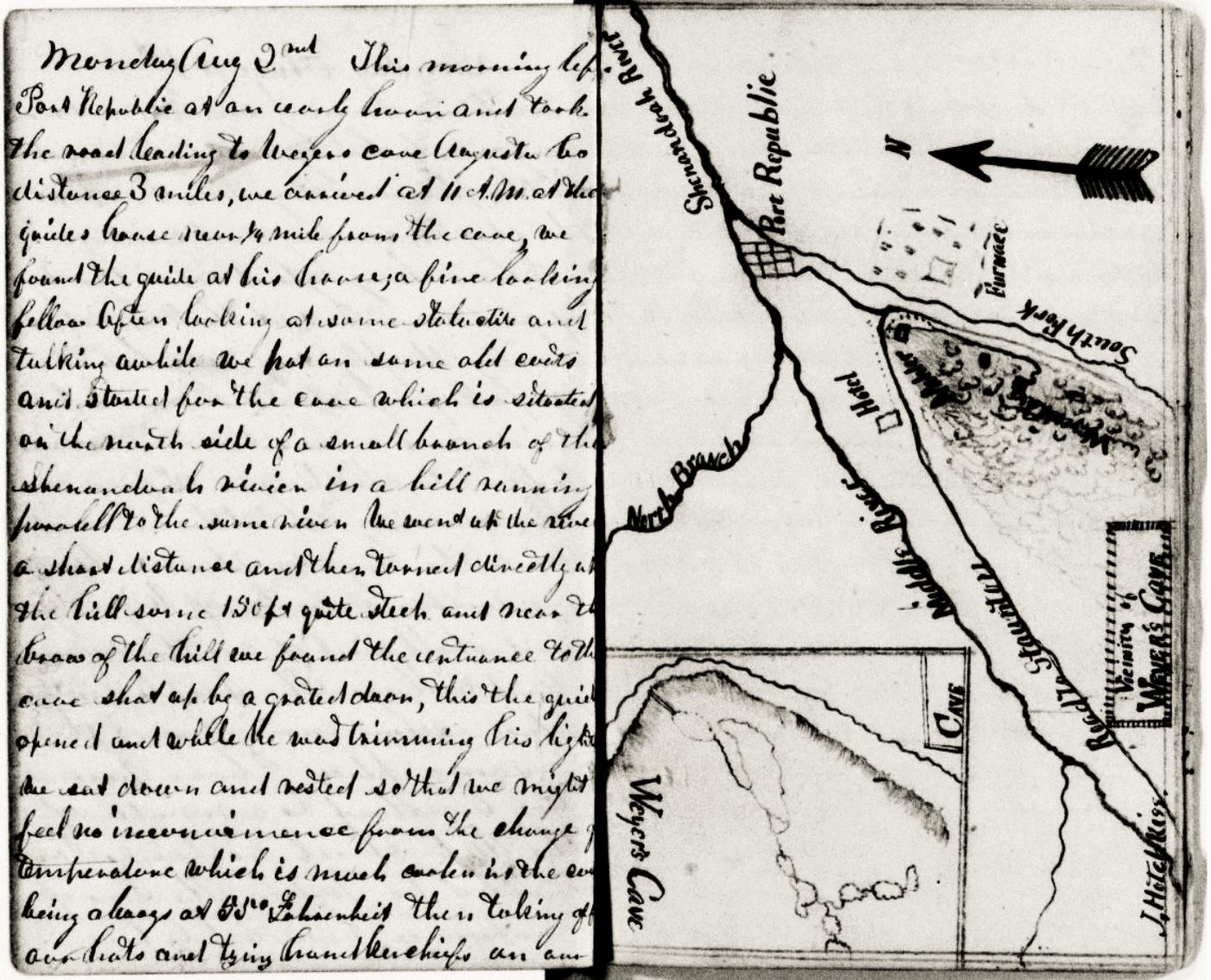
"Plan of the Ancient Works at Marietta, Ohio," by Charles Whittlesey, 1837, E. G. Squier Papers, Manuscript Division. <https://www.loc.gov/item/mcc.048/>

*Study the map of Marietta, Ohio.*

*What information does the map convey about the area?*

*In what ways could this information be useful?*

*What skills did the mapmaker need to create all the elements of the map?*



Aug. 2, 1847 diary entry with map, Diaries, 1845-1899, Jedediah Hotchkiss Papers, Manuscript Division.  
[https://www.loc.gov/resource/mss26526.001\\_0046\\_0116/?sp=64](https://www.loc.gov/resource/mss26526.001_0046_0116/?sp=64)

The Jedediah Hotchkiss Papers are available online;  
 see <https://www.loc.gov/collections/jedediah-hotchkiss-papers/about-this-collection/>

*What skills did Jedediah Hotchkiss employ to produce what looks like a simple map of Port Republic, Virginia?*

*Does his diary entry provide any clues to the information he assembled?*

*How would you map an area near you? What information would you collect?*

The interior of this work is occupied by two large magazines for the Army. The quarters (casemates) for Officers & men are well finished, but damp. Basements all plastered.

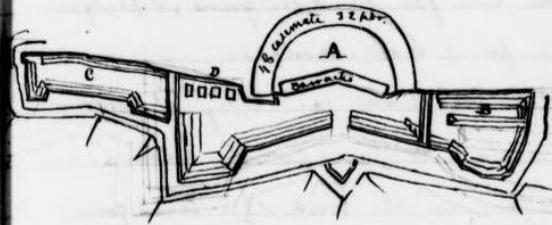
The barbette guns have cast iron carriages; in the casemates the upper carriage of iron, chassis of wood with front trussom of iron (cast).

This work is in the water, connected with the land by a star bridge.

Parapet of the barbette battery of earth; exterior slope of masonry.

Near this fort, on the shore a little to the W, is a very small redoubt - for some 3 or 4 guns.

### Fort Inverguille -



A is a circular range of 48 casemates, of one tier, armed with 32 pdrs. - no barbette battery on top of it; it is closed at the gorge by defensible bomb-proof barracks, without arrangements for guns. The place of arms (B) separated from the main work by a ditch, is armed with a battery of 12 8" guns & one 13" mortar. D is a hospital with bomb-proof barracks behind it.

In the place of arms (C), also separated from the main work by a ditch, is a battery

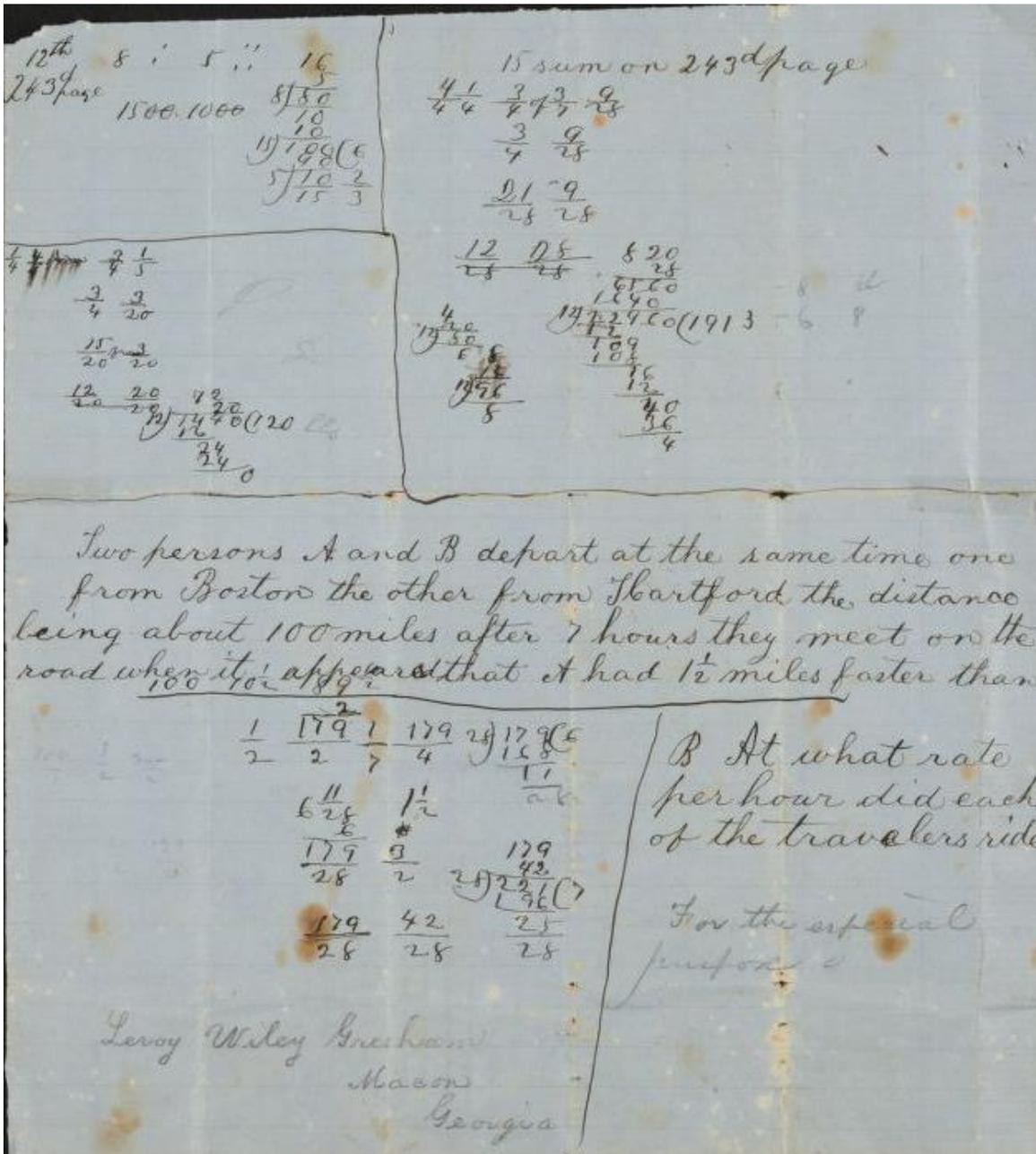
Notebook kept by George B. McClellan while studying European military systems during his service on a U.S. military commission in Europe, 1855-1856, Notebooks, 1842-1885, George Brinton McClellan Papers, Manuscript Division. [https://www.loc.gov/resource/mss31898.mss31898-076\\_0162\\_0376/?sp=64](https://www.loc.gov/resource/mss31898.mss31898-076_0162_0376/?sp=64)

The George Brinton McClellan Papers are available online; see <https://www.loc.gov/collections/george-brinton-mcclellan-papers/about-this-collection/>

What kind of structure has George B. McClellan sketched in his notebook?

Why do you think Captain McClellan was so interested in it?

What types of math and technological considerations are represented in this structure? Would topography also influence the design and construction?



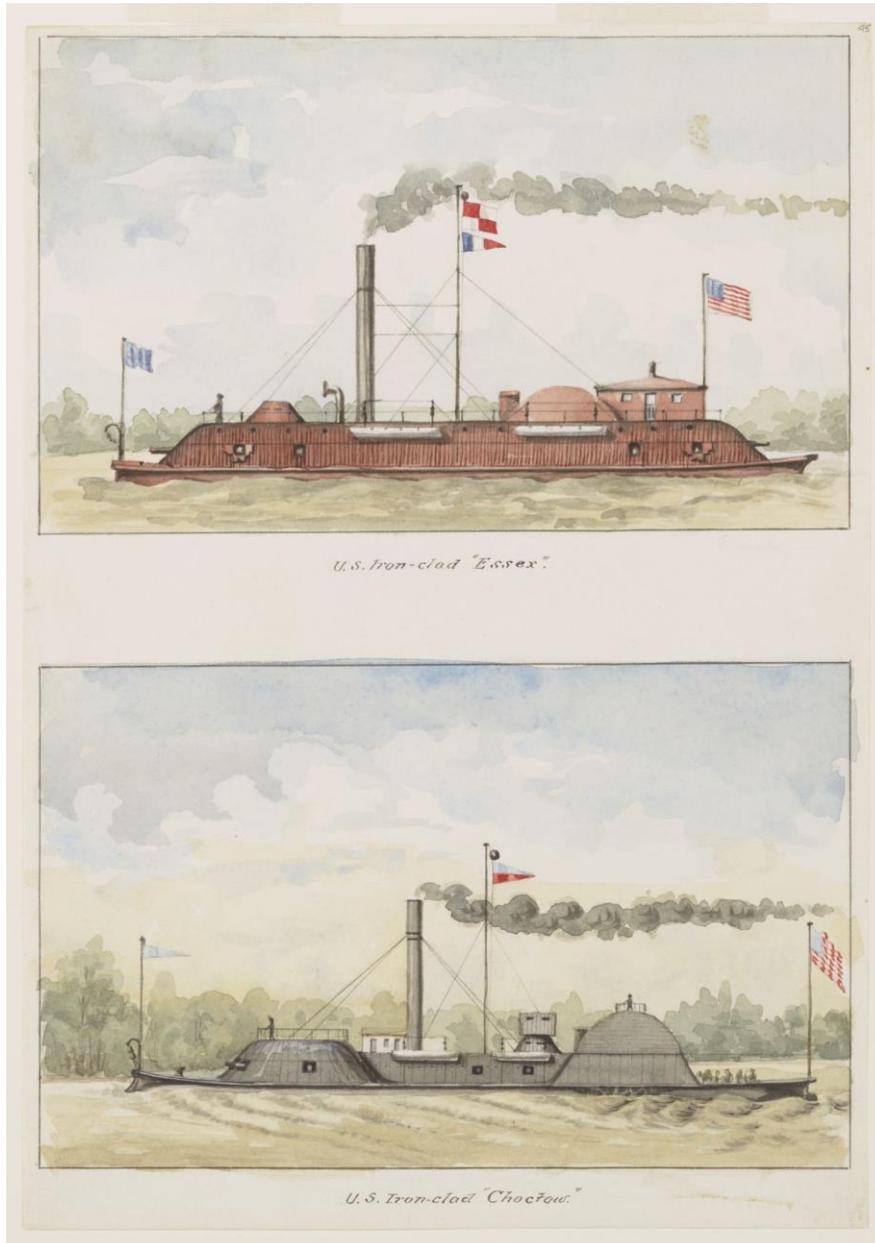
LeRoy W. Gresham, mathematical homework, September 20, 1863, Family Correspondence, 1862-1863, Lewis H. Machen Family Papers, Manuscript Division. <https://www.loc.gov/resource/mss86777.3203/?sp=74>

*Teenaged LeRoy Gresham worked on this word problem in 1863.*

*How would this word problem be written today?*

*What type of transportation would be used?*

*Would the figures included in the word problem change with the type of transportation?*



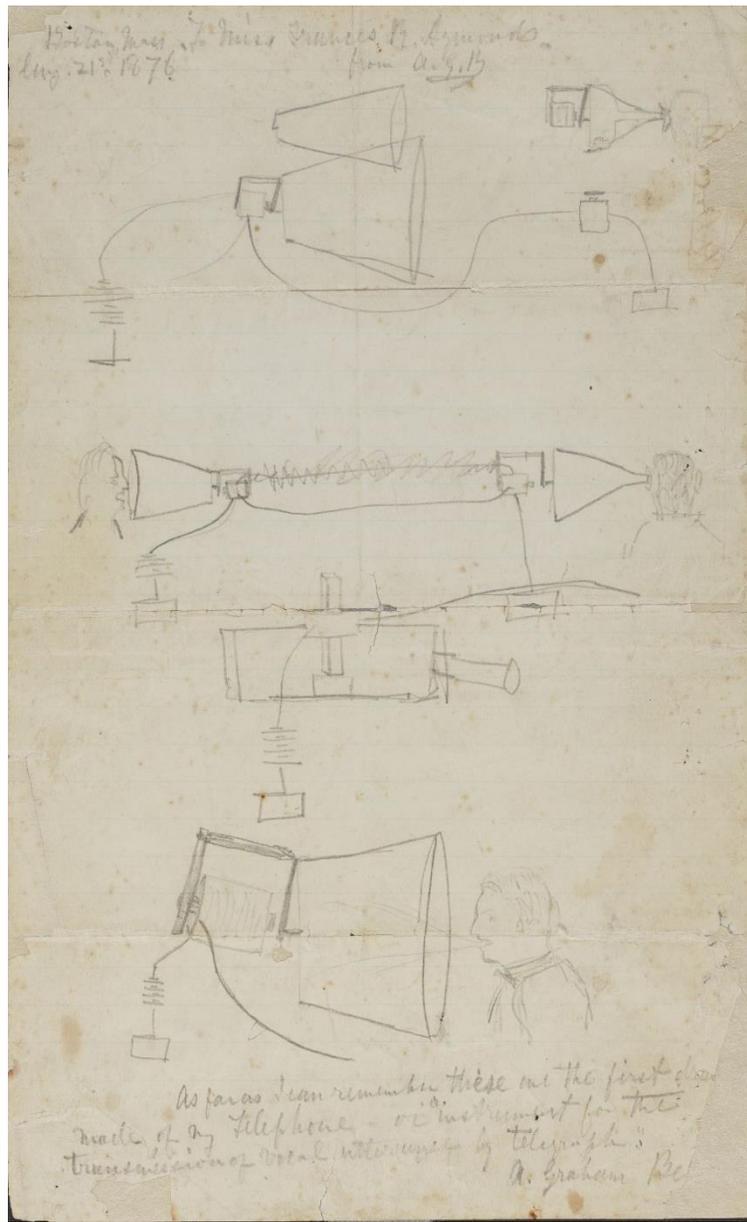
Watercolors of Civil War ironclads by Ens. D. M. N. Stouffer, ca. 1864-65, David Dixon Porter Papers, Manuscript Division. <https://www.loc.gov/item/mcc.042/>

*The American Civil War saw the introduction of iron-clad vessels.*

*How were they made?*

*How did they change naval technology?*

*Did a heavier building material change the draft, propulsion, and navigation of these ships?*



Alexander Graham Bell's design sketch of the telephone, ca. 1876, Alexander Graham Bell Family Papers, Manuscript Division. <https://www.loc.gov/item/mcc.004/>

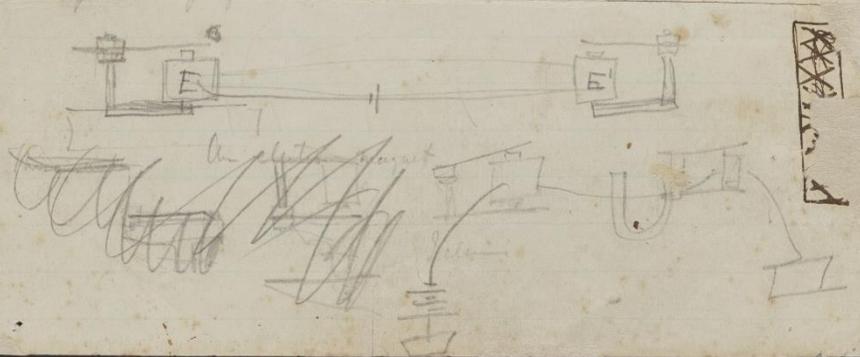
Selections from the Alexander Graham Bell Family Papers are available online; see <https://www.loc.gov/collections/alexander-graham-bell-papers/about-this-collection/>

*Examine this sketch and the back of the same page, which is the first sketch Alexander Graham Bell made of his telephone in 1876. How did Bell's telephone work? What technology was involved?*

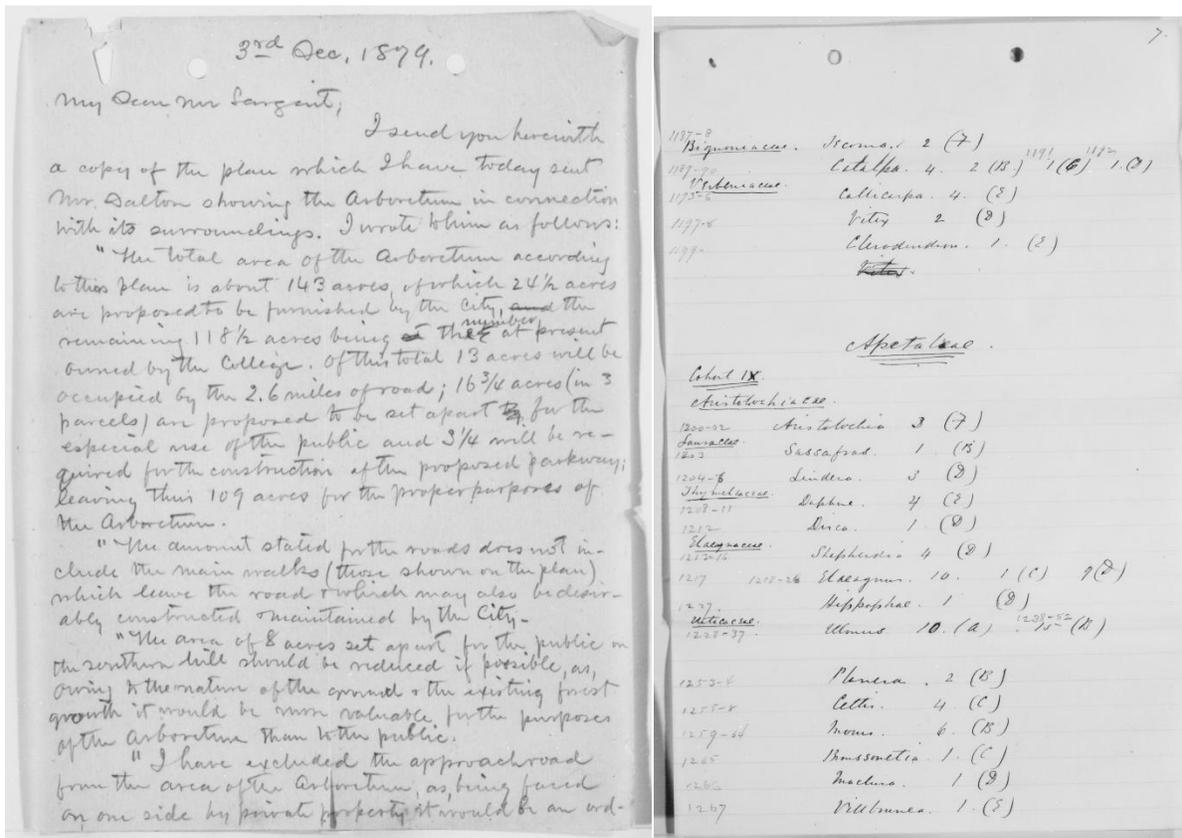
*Then look at Bell's [notebook for 1876](#). How much experimentation did Bell do in developing the telephone? Did the technology change over time?*

*If so, how did Bell document his advances, and/or failures?*

I have written application for letters patent I have described a  
 method of apparatus for transmitting...  
 In illustration of that method I have  
 shown in the upper apparatus as one form of apparatus  
 A steel spring is kept  
 under a certain amount of strain in a local circuit  
 which is a local circuit...  
 which opening in circuit  
 makes & breaks the main circuit a definite number of times  
 in second producing an intermittent current upon the  
 main line. This produces the sound.  
 My present invention consists of a method of aid apparatus  
 for producing vibrations or oscillations of a proper  
 frequency in a continuous current of electricity, thereby  
 transmitting telegraphic messages or signals in blank  
 along a single wire by the employment of transmitters  
 instruments each of which can produce <sup>these</sup> vibrations or undulations  
 of definite number per second in a continuous current of electricity  
 and of this instrument to each end to a point at which  
 it will be put in vibration to produce its fundamental  
 tone by one end of the transmitting instruments.



Verso of Alexander Graham Bell sketch of the telephone  
<https://www.loc.gov/resource/mcc.004/?sp=2>



[John Charles Olmsted to C. S. Sargent, December 3, 1879](#), (left), and [list of plants](#) (right), Arnold Arboretum; Boston, Mass., 1877-1966, Job Files, Olmsted Associates Records, Manuscript Division.  
<https://www.loc.gov/item/mss5257100828>

Selections from the Olmsted Associates Records are available online;  
 see <https://www.loc.gov/collections/olmsted-associates-records/about-this-collection/>

*Consult the Arnold Arboretum job file in the Olmsted Associates Records. Given the information presented about the property, how would you determine the available acreage for the landscape design project? How much space must be devoted to infrastructure (roads, pathways). How much space can be used for gardens/woods, taking into account public areas, property boundaries, and topography?*

*What kind of plants did the Olmsted Associates record for the project? How do the plants accord with the ecosystem in Boston? Are they native plants or meant to look natural? How might the list may reflect the needs/interests of the client (an arboretum)?*

*How would you answer similar questions about the gardens and public spaces in your area?*

1891 Dec. 31 — Monday — at 1845h

Thought  
Left  
27

Use bird's wings on apparatus.



We have killed a turkey today — use  
turkey wings.

It will require two right wings — or  
two left — for our purpose & ~~the~~

Only the turkey's wings <sup>right</sup> weigh 188 grams.  
~~The left~~ left wing weighs 188 grams  
 Right wing weighs 189 grams (with wing & cut)

~~Right wing~~

Left wing

~~ac = 18 inches~~

ab = 18 inches

ac = 17

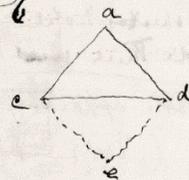
ad = 17 1/2 inches

cd = 21 1/2 inches

Angle at a = 180°.

Area of triangle acd = 1/2 area  
of ~~rectangle~~ parallelogram acedArea aced = 18 x 18 (204)  
= 162 square inches.

Will weigh bird at house to see what weight



Notebook by Alexander Graham Bell, from December 29, 1891 to June 5, 1893, Laboratory Notes, Volume 31, 1891-1893, Alexander Graham Bell Family Papers, Manuscript Division.

<https://www.loc.gov/resource/magbell.36500101/?sp=19>

Selections from the Alexander Graham Bell Family Papers are available online;  
see <https://www.loc.gov/collections/alexander-graham-bell-papers/about-this-collection/>

Look at Alexander Graham Bell's laboratory notebook on aviation experiments.

How did the natural world influence him?

Were other early aviators similarly inspired?

Does nature continue to inspire invention?

150

1892 Sept. 14 - Wed - at VSB. Lab.

Exp. 1

Old ~~brass~~ vacuum jacket made in England for me - many years ago - and recovered by W. McClellan from Prof. Geo. at King's College - London - has been put in order for trial. Brass pipe attached seemed to have two small channels - so it has been removed and larger tube substituted -  $1\frac{1}{2}$  inch diam.



John McKillop submitted to experiment - seemed to succeed perfectly. W. Ellis worked bellows. John McKillop stated that he made no effort to breathe - yet a piece of paper was moved to and fro when held in front of

Alexander Graham Bell, laboratory notebook drawing of a vacuum jacket, included in drawings by Alexander Graham Bell, from December 29, 1891 to September 13, 1894, Alexander Graham Bell Family Papers, Manuscript Division, Library of Congress

<https://www.loc.gov/resource/magbell.20500102/?sp=9>

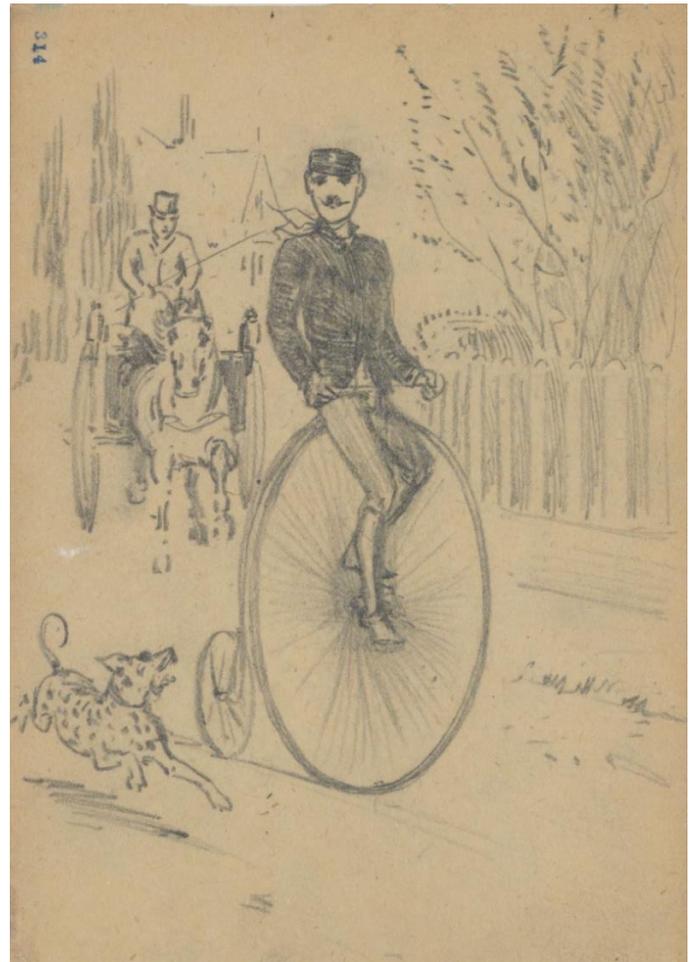
Selections from the Alexander Graham Bell Family Papers are available online; see <https://www.loc.gov/collections/alexander-graham-bell-papers/about-this-collection/>

Alexander Graham Bell responded to two tragedies in 1881 by experimenting with inventions. He worked on an "induction balance machine" or metal detector to try to find the bullet in President James A. Garfield after he was shot by an assassin in 1881. The same summer Bell's infant son died because his lungs were not developed enough to breath on his own, and Bell long experimented with a "vacuum jacket" (seen above) to provide artificial respiration.

*Can you think of other inventions that were created to address a practical problem?*

*Have you ever made something because you had a problem to solve?*

*What problems do you wish could be solved by a new invention?*



Sketches of penny-farthing bicycles, Charles Wellington Reed Papers, Manuscript Division.  
<https://www.loc.gov/resource/mss37457.0301/?sp=380> and <https://www.loc.gov/resource/mss37457.0301/?sp=366>

The Charles Wellington Reed Papers are available online;  
see <https://www.loc.gov/collections/charles-reed/about-this-collection/>

*Consider the physics of the penny-farthing style of bicycle represented above.*

*How does the rider get on the bicycle?*

*What are the challenges to riding it?*

*Would it have been prone to crashing?*

*What is technologically different about the bicycles of today?*



Instructions for Herman Hollerith's Electric Sorting and Tabulating Machine, ca. 1895, Herman Hollerith Papers, Manuscript Division. (See also next page) <https://www.loc.gov/item/mcc.023/>

Herman Hollerith saw train conductors punch train tickets to record transportation information, and later applied the punch card technology to compiling federal census data and other computing tasks.

*How does a punch card work to collect data?*

*How did punch card tabulation lead to modern computing?*

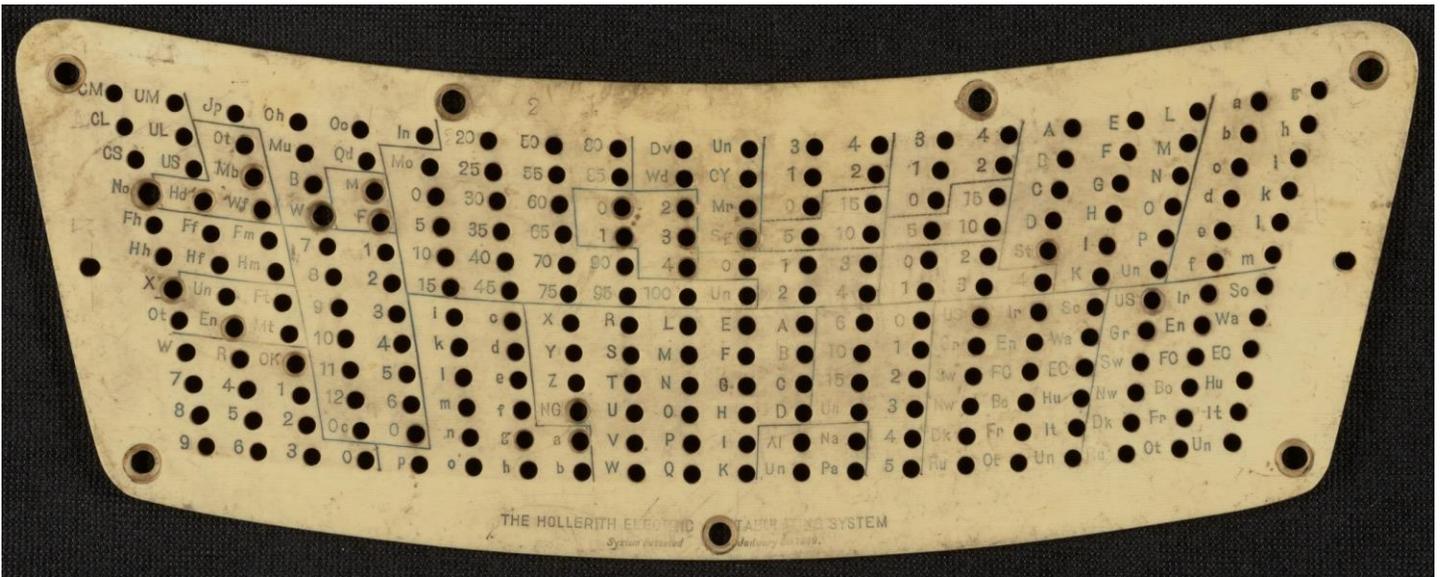


Plate for Herman Hollerith's Electric Sorting and Tabulating Machine, ca. 1895, Herman Hollerith Papers, Manuscript Division. <https://www.loc.gov/resource/mcc.023/?sp=9>

	1	2	3	4	5	6	7	8	9	0	On	S	A	C	E	a	c	e	g	EB	SB	Ch	Sy	U	Sh	Hk	Br	Rm	
1	1	3	0	2	4	10																							
2	2	4	1	3	E	15	Off	IS	B	D	F	b	d	f	h					SY	X	Fp	Cn	R	X	Al	Cg	Kg	
3	0	0	0	0	W	20			0	0	0	0	0	0	0	0	0	0	0	●	0	0	0	0	0	0	0	0	0
A	1	1	1	1	0	25	A	1	1	1	1	1	1	1	1	1	1	1	1	1	●	1	1	1	1	1	1	1	1
B	2	2	2	2	5	30	B	2	2	●	2	2	2	2	2	2	2	2	2	2	2	●	2	2	2	2	2	2	2
C	3	3	3	3	0	3	C	3	3	3	●	3	3	3	3	3	3	3	3	3	3	3	●	3	3	3	3	3	3
D	4	4	4	4	1	4	D	4	4	4	4	●	4	4	4	4	4	4	4	4	4	4	4	●	4	4	4	4	4
E	5	5	5	5	2	C	E	5	5	5	5	5	●	5	5	5	5	5	5	5	5	5	5	5	●	5	5	5	5
F	6	6	6	6	A	D	F	6	6	6	6	6	6	●	6	6	6	6	6	6	6	6	6	6	6	●	6	6	6
Q	7	7	7	7	B	E	Q	7	7	7	7	7	7	7	●	7	7	7	7	7	7	7	7	7	7	7	●	7	7
H	8	8	8	8	a	F	H	8	8	8	8	8	8	8	8	●	8	8	8	8	8	8	8	8	8	8	8	●	8
I	9	9	9	9	b	c	I	9	9	9	9	9	9	9	9	9	●	9	9	9	9	9	9	9	9	9	9	9	9

Punch card for Herman Hollerith's Electric Sorting and Tabulating Machine, ca. 1895, Herman Hollerith Papers, Manuscript Division. <https://www.loc.gov/resource/mcc.023/?sp=8>

My ribs will all get old warty - that is, they will  
look like oak molas in time - my wales colors  
will fade - but I aim to endure in bronze -  
even rust does not touch. - I am modeling -  
I find I do well - I am doing a cow boy  
on a bucking bronco and I aim quay to rattle  
down through all the ages, unless some anarchist  
unwinds the old mansion and knocks it off the shelf.

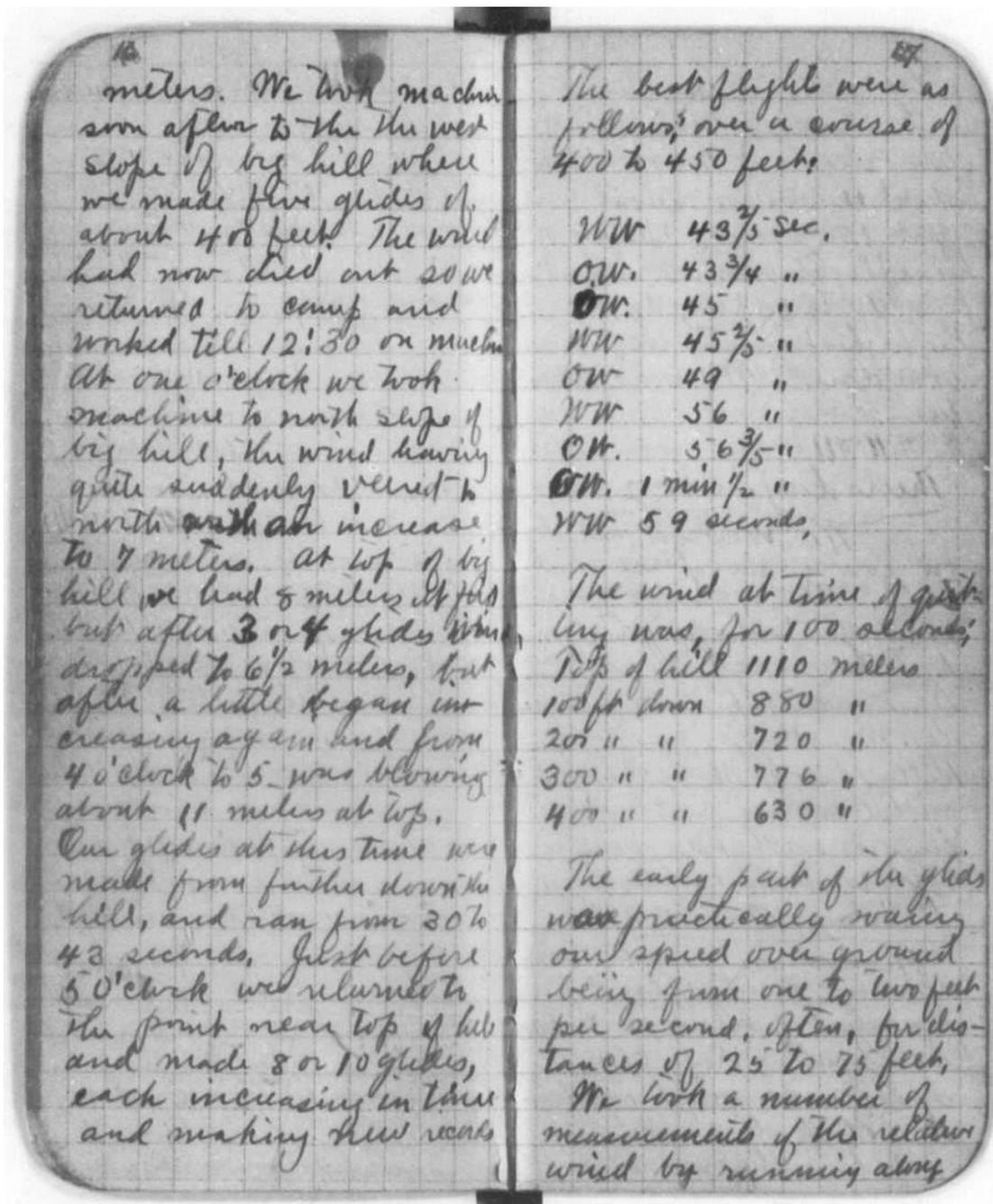


Illustrated letter, Frederic Remington to Owen Wister containing a sketch of Remington's bronze Bronco Buster, ca. January 1895, Owen Wister Papers, Manuscript Division. <https://www.loc.gov/item/mcc.058/>

*Although the central focus of this document is artistic, art involves science and technology as well.*

*What metal would you use to make this sculpture and why?*

*What are the physics involved in keeping the horse balanced securely on its hind legs?*



Entry for October 27, 1903, Orville Wright notebook, Wilbur Wright and Orville Wright Papers, Manuscript Division. <https://www.loc.gov/resource/mwright.01007/?sp=10>

Selections from the Wilbur Wright and Orville Wright Papers are available online; see <https://www.loc.gov/collections/wilbur-and-orville-wright-papers/about-this-collection/>

*Consult the diaries and notebooks of Orville and Wilbur Wright as they worked out the logistics of flight.*

*What data did they collect with each experiment?*

*How did they use this information to adapt their airplanes?*



Before and after photographs of a tree depicted in a photograph album of the Locust Plague of 1915, [American Colony in Jerusalem Collection](#), Manuscript Division.

Read more about the Locust Plague of 1915 at:

<https://www.loc.gov/collections/american-colony-in-jerusalem/articles-and-essays/the-locust-plague-of-1915-photograph-album/>

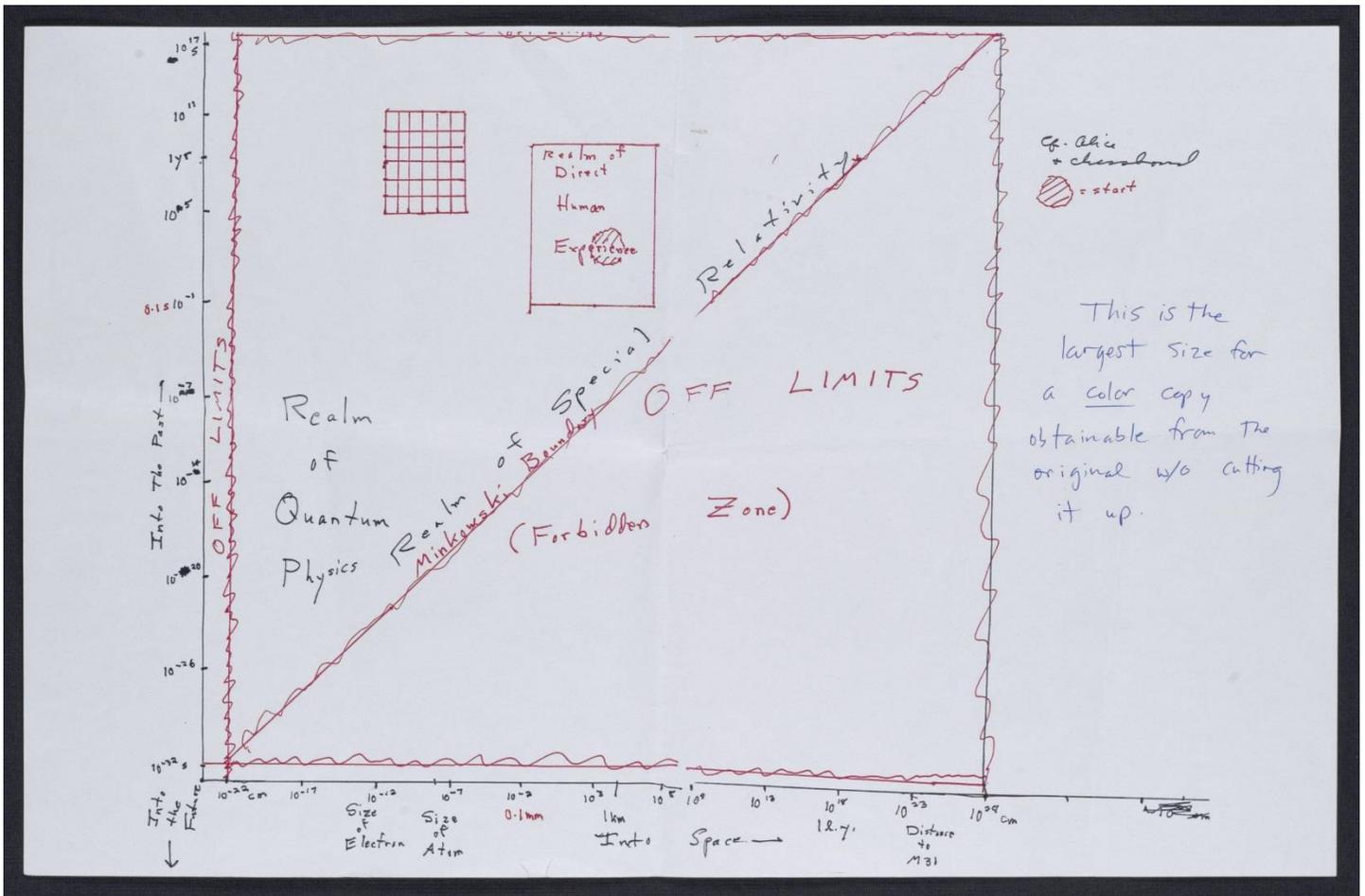
*Describe the effect of the locusts on the tree pictured above.*

*How did the locusts do this damage?*

*What might be the effect of plagues of locusts and other insects on agriculture?*

*Can you find other examples of similar insect “plagues”?*

*How might farmers deal with insect swarms?*



Carl Sagan, diagram of all space and time, The Seth MacFarlane Collection of the Carl Sagan and Ann Druyan Archive, Manuscript Division, Library of Congress. <https://www.loc.gov/resource/mss85590.084/>

This hand-drawn diagram by astronomer Carl Sagan represents all of space and time. The X axis represents time, going into the future and into the past and the Y axis represents scale, from the size of the electron to the distances between galaxies. It marks the relatively small “realm of direct human experience” and the much larger “realm of quantum physics” and “realm of special relativity.”

*How would you diagram all of space and time?*

