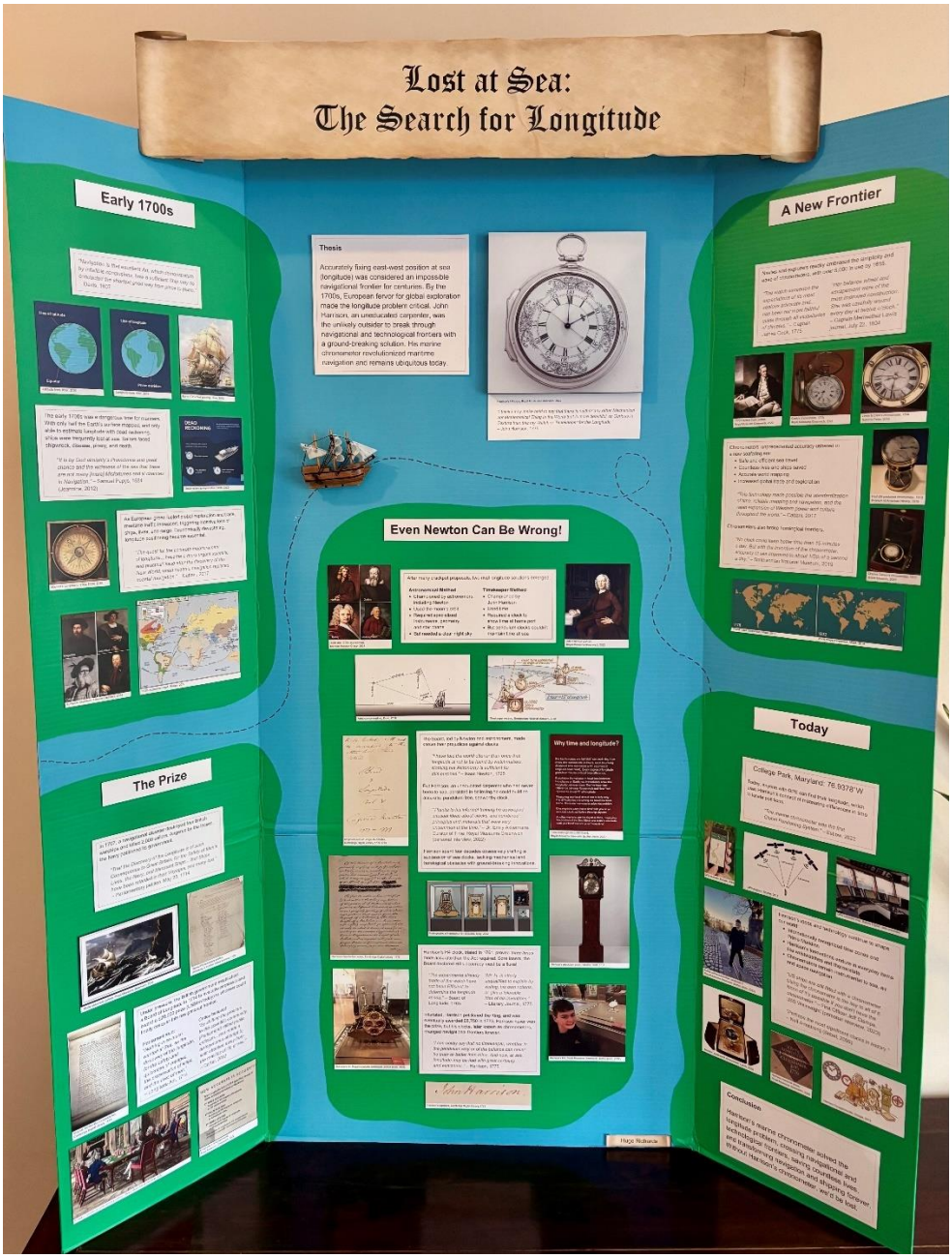
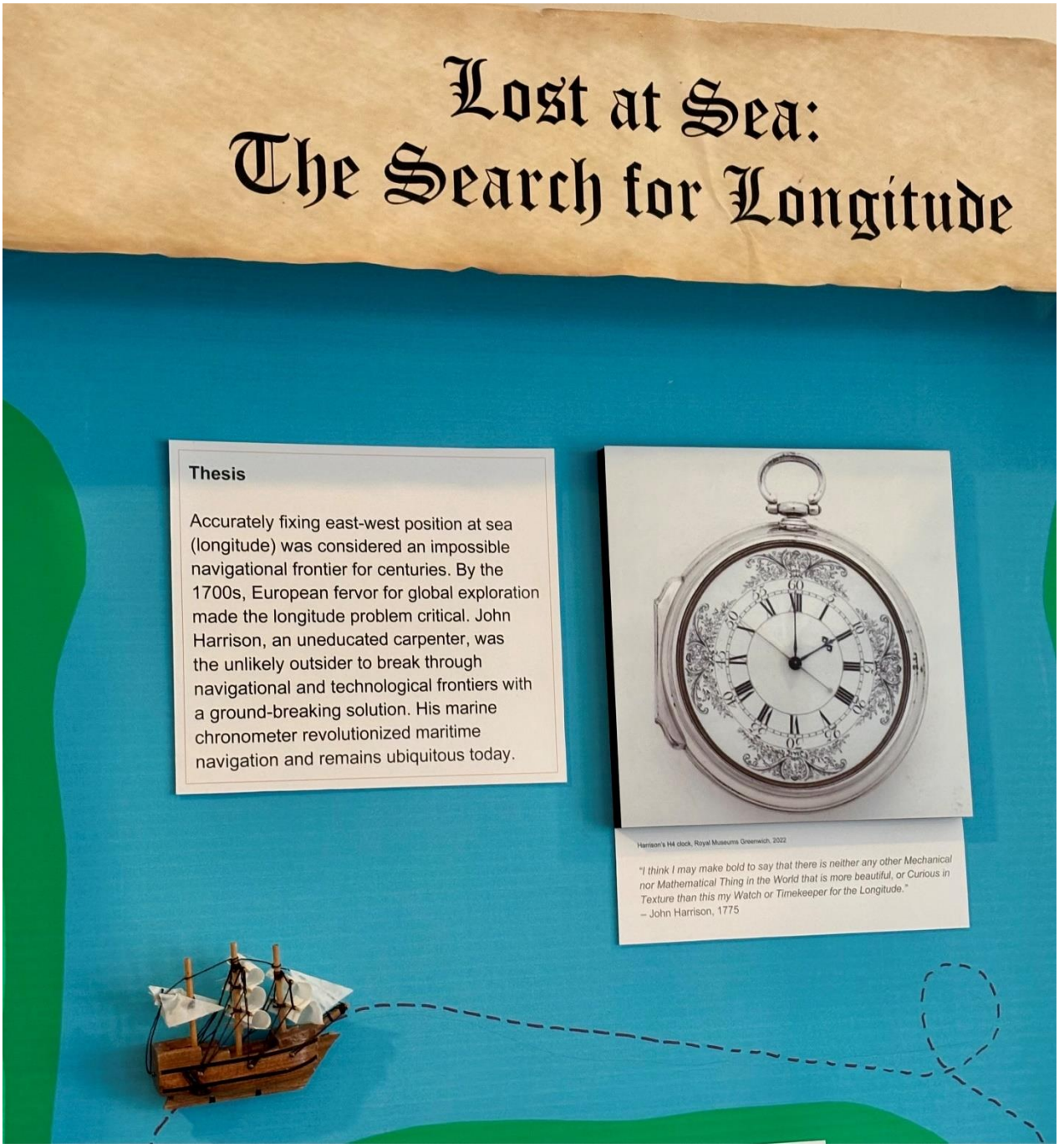
NOTE: This exhibit is a sample only, and may not be used as secondary or primary sources, or in the production of student work.



"Lost at Sea: The Search for Longitude"

By Hugo Richards

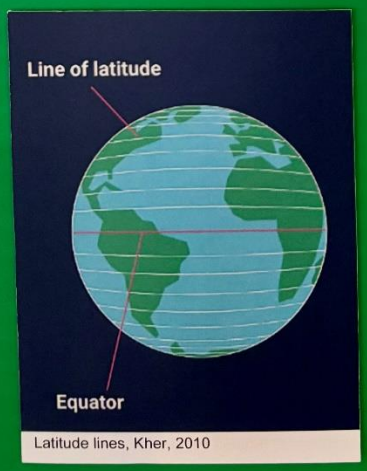
Junior Individual Exhibit



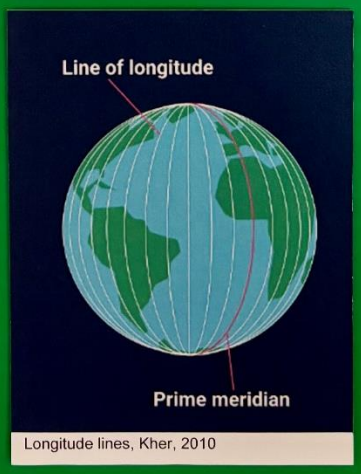
Title & Thesis

Early 1700s

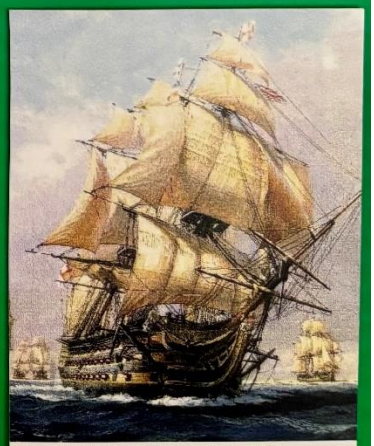
"Navigation is that excellent Art, which demonstrateth by infallible conclusions, how a sufficient Ship may be conducted the shortest good way from place to place."
– Davis, 1607



Latitude lines, Kher, 2010



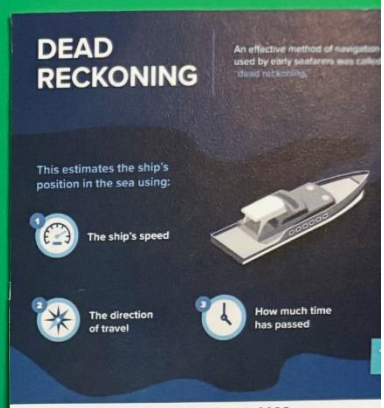
Longitude lines, Kher, 2010


Early 1700s fleet painting, Hare, 2010

Section 1

The early 1700s was a dangerous time for mariners. With only half the Earth's surface mapped, and only able to *estimate* longitude with dead reckoning, ships were frequently lost at sea. Sailors faced shipwreck, disease, piracy, and death.

> "*It is by God almighty's Providence and great chance and the wideness of the sea that there are not many [more] Misfortunes and ill chances in Navigation.*" – Samuel Pepys, 1684 (Jeannine, 2012)



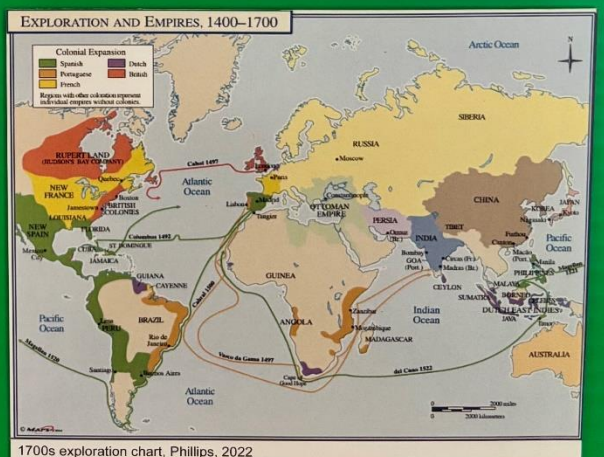
Dead reckoning explanation, Orzel, 2022


Mariner's compass c.1700s, Dunn, 2016

As European greed fueled global exploration and trade, maritime traffic increased, triggering massive loss of ships, lives, and cargo. Economically devastating, longitude positioning became essential.

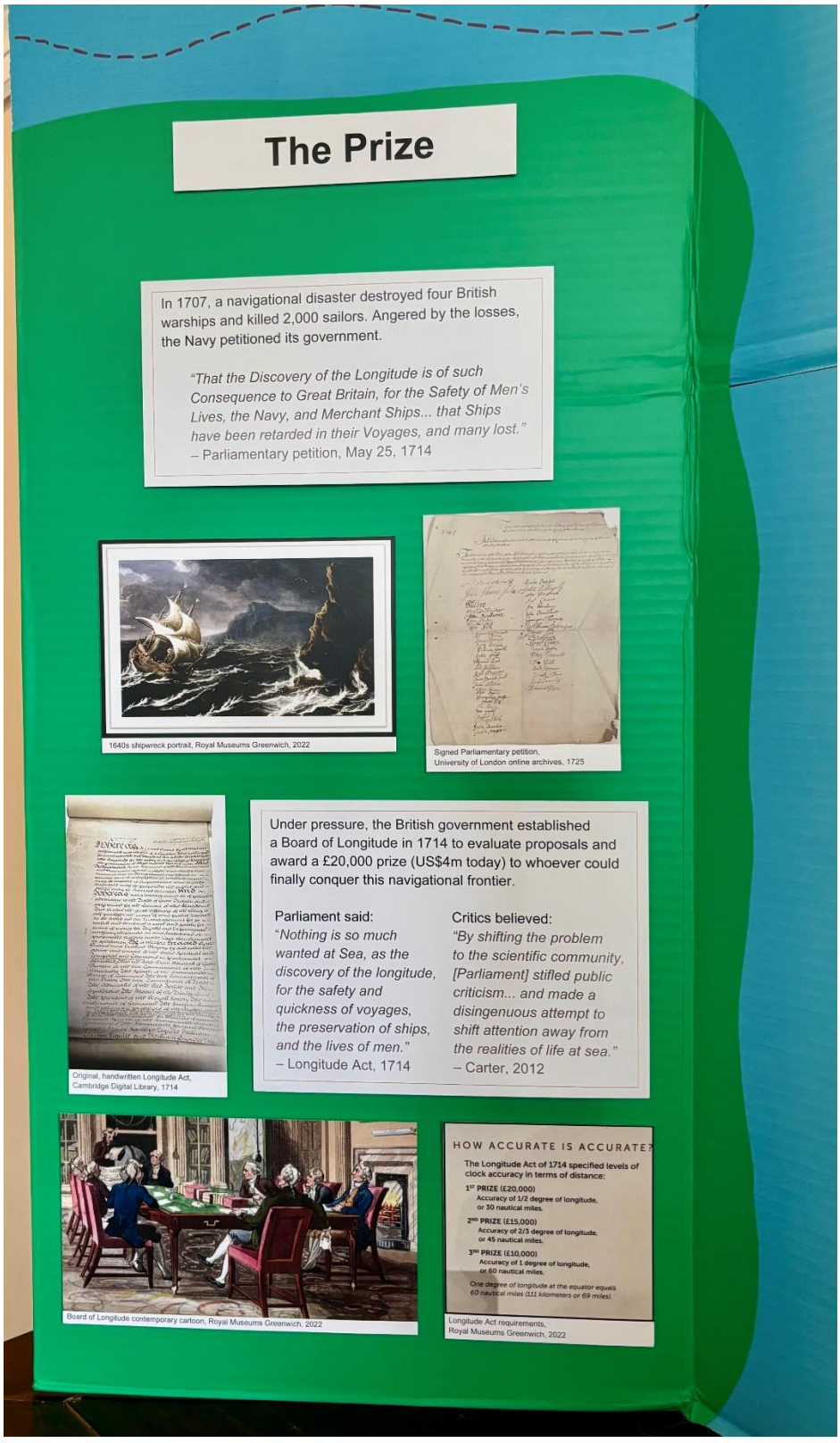
> *"The quest for the accurate measurement of longitude... became a more urgent scientific and practical issue after the discovery of the New World, when oceanic navigation replaced coastal navigation."* – Cattani, 2017

European explorers, Famous Explorers, 2023



1700s exploration chart, Phillips, 2022

Section 1 cont.


The Prize
In 1707, a navigational disaster destroyed four British warships and killed 2,000 sailors. Angered by the losses, the Navy petitioned its government.
"That the Discovery of the Longitude is of such Consequence to Great Britain, for the Safety of Men's Lives, the Navy, and Merchant Ships... that Ships have been retarded in their Voyages, and many lost."
– Parliamentary petition, May 25, 1714
1640s shipwreck portrait, Royal Museums Greenwich, 2022
Signed Parliamentary petition, University of London online archives, 1725
Original, handwritten Longitude Act, Cambridge Digital Library, 1714
Under pressure, the British government established a Board of Longitude in 1714 to evaluate proposals and award a £20,000 prize (US$4m today) to whoever could finally conquer this navigational frontier.
Parliament said:
"Nothing is so much wanted at Sea, as the discovery of the longitude, for the safety and quickness of voyages, the preservation of ships, and the lives of men."
– Longitude Act, 1714
Critics believed:
"By shifting the problem to the scientific community, [Parliament] stifled public criticism... and made a disingenuous attempt to shift attention away from the realities of life at sea."
– Carter, 2012
Board of Longitude contemporary cartoon, Royal Museums Greenwich, 2022
HOW ACCURATE IS ACCURATE?
The Longitude Act of 1714 specified levels of clock accuracy in terms of distance:
1ST PRIZE (£20,000)
Accuracy of 1/2 degree of longitude, or 30 nautical miles.
2ND PRIZE (£15,000)
Accuracy of 2/3 degree of longitude, or 45 nautical miles.
3RD PRIZE (£10,000)
Accuracy of 1 degree of longitude, or 60 nautical miles.
One degree of longitude at the equator equals 60 nautical miles (111 kilometers or 69 miles).
Longitude Act requirements, Royal Museums Greenwich, 2022

Section 2

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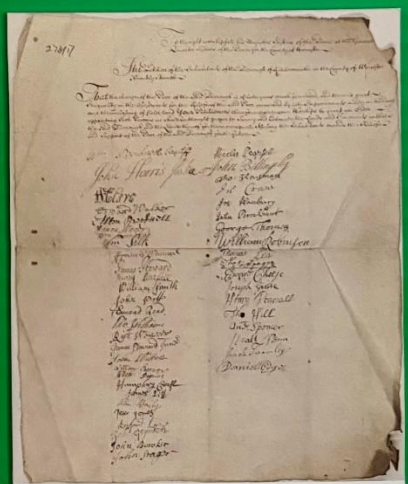
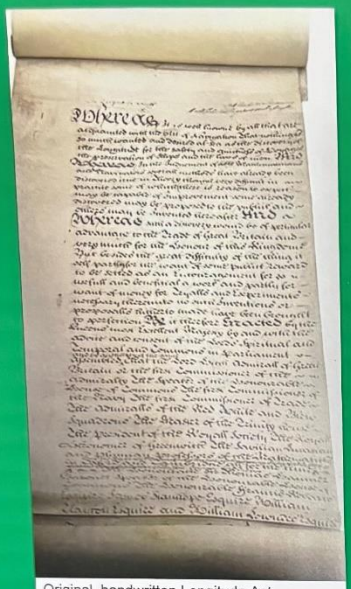
1640s shipwreck portrait, Royal Museums Greenwich, 2022



Signed Parliamentary petition,
University of London online archives, 1725

Section 2 close up

University of London online archives, 1725



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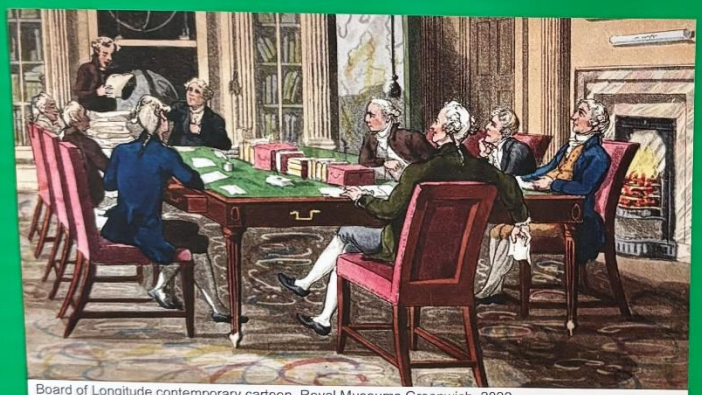

Board of Longitude contemporary cartoon, Royal Museums Greenwich, 2022

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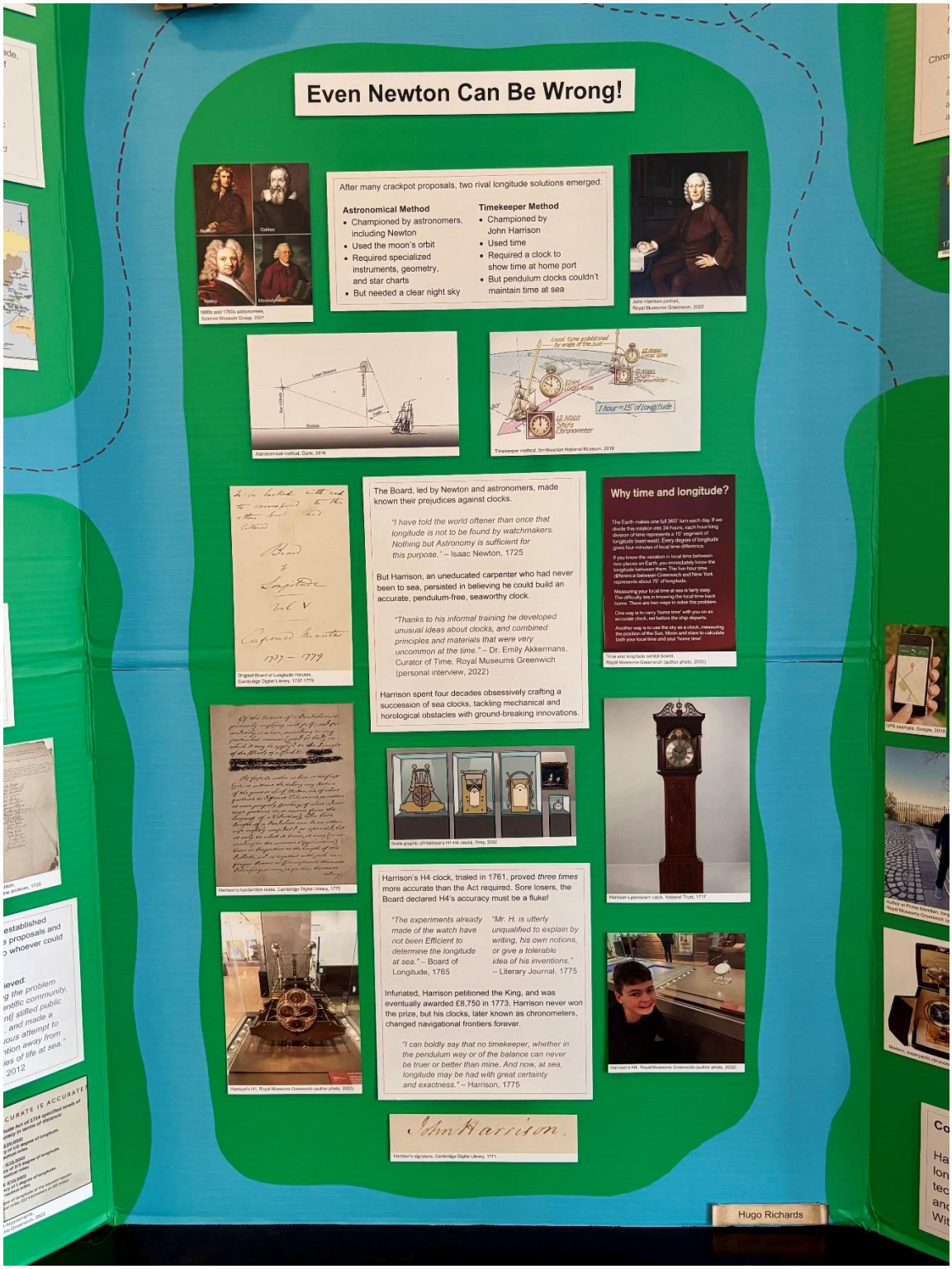
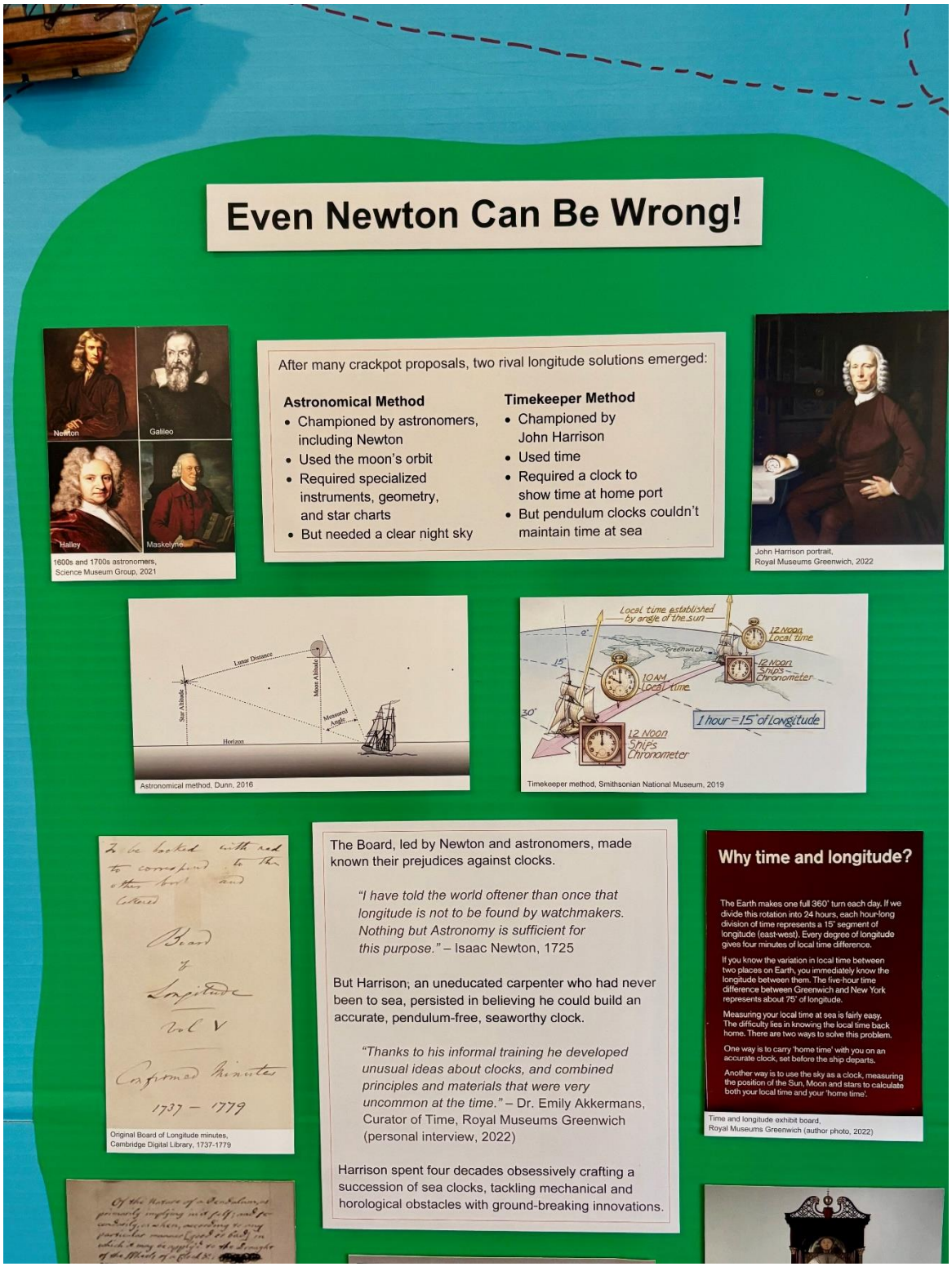
Longitude Act requirements, Royal Museums Greenwich, 2022

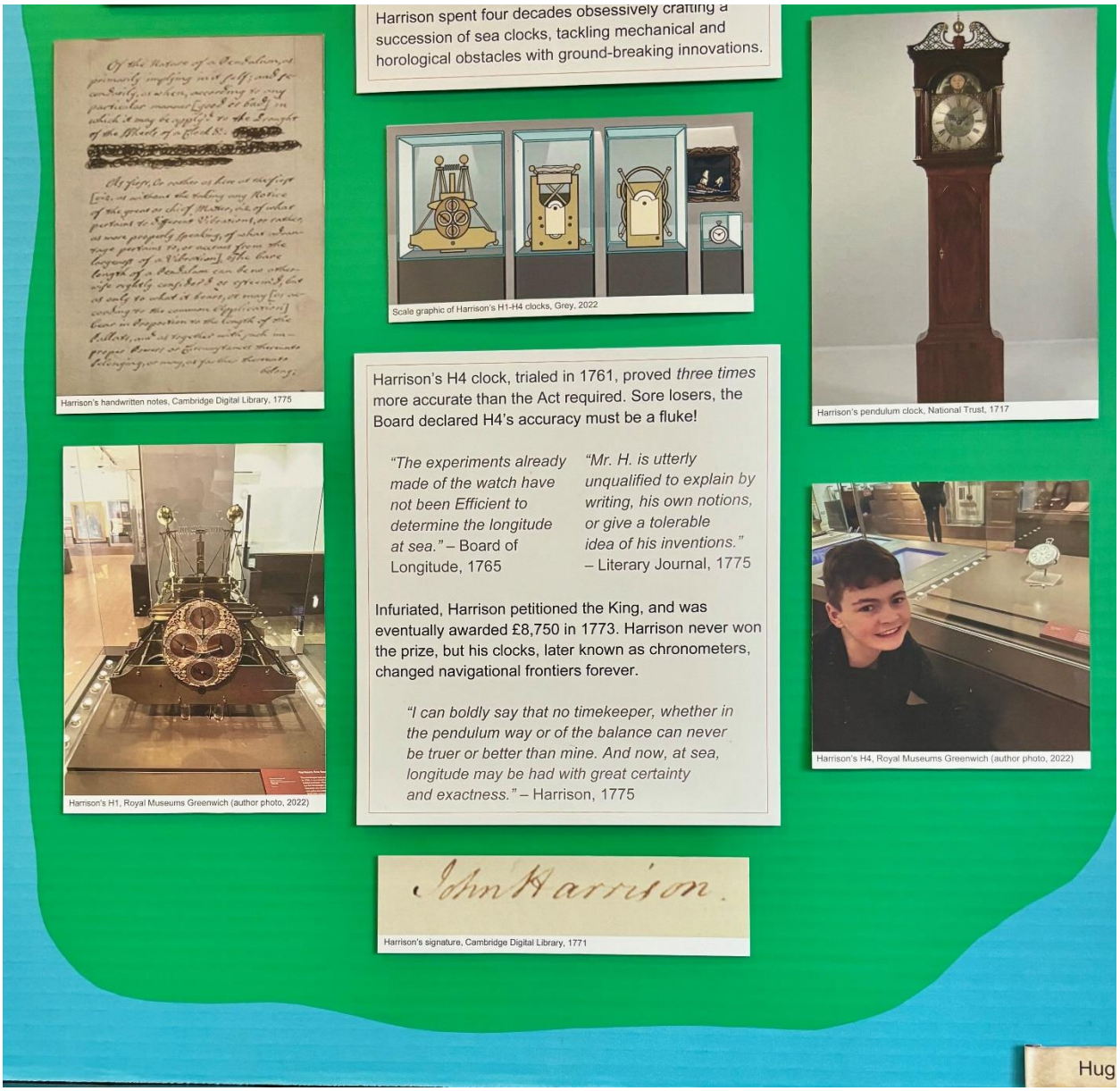
Section 2 close up


Even Newton Can Be Wrong!
After many crackpot proposals, two rival longitude solutions emerged:
Astronomical Method
Championed by astronomers, including Newton
Used the moon's orbit
Required specialized instruments, geometry, and star charts
But needed a clear night sky
Timekeeper Method
Championed by John Harrison
Used time
Required a clock to show time at home port
But pendulum clocks couldn't maintain time at sea
1680s and 1780s astronomers, Science Museum Group, 2021
John Harrison portrait, Royal Museums Greenwich, 2022
Astronomical method, Dunk, 2018
Timekeeper method, Smithsonian National Museum, 2018
The Board, led by Newton and astronomers, made known their prejudices against clocks.
"I have told the world oftener than once that longitude is not to be found by watchmakers. Nothing but Astronomy is sufficient for this purpose." – Isaac Newton, 1725
But Harrison, an uneducated carpenter who had never been to sea, persisted in believing he could build an accurate, pendulum-free, seaworthy clock.
"Thanks to his informal training he developed unusual ideas about clocks, and combined principles and materials that were very uncommon at the time." – Dr. Emily Akkermans, Curator of Time, Royal Museums Greenwich (personal interview, 2022)
Harrison spent four decades obsessively crafting a succession of sea clocks, tackling mechanical and horological obstacles with ground-breaking innovations.
Original Board of Longitude minutes, Cambridge Digital Library, 1737-1773
Why time and longitude?
Time and longitude exhibit board, Royal Museums Greenwich (author photo, 2022)
Harrison's handwritten notes, Cambridge Digital Library, 1775
Scale graphic of Harrison's H1-H4 clocks, Grey, 2022
Harrison's pendulum clock, National Trust, 1717
Harrison's H4 clock, trialed in 1761, proved three times more accurate than the Act required. Sore losers, the Board declared H4's accuracy must be a fluke!
"The experiments already made of the watch have not been Efficient to determine the longitude at sea." – Board of Longitude, 1765
"Mr. H. is utterly unqualified to explain by writing, his own notions, or give a tolerable idea of his inventions." – Literary Journal, 1775
Infuriated, Harrison petitioned the King, and was eventually awarded £8,750 in 1773. Harrison never won the prize, but his clocks, later known as chronometers, changed navigational frontiers forever.
"I can boldly say that no timekeeper, whether in the pendulum way or of the balance can never be truer or better than mine. And now, at sea, longitude may be had with great certainty and exactness." – Harrison, 1775
Harrison's H1, Royal Museums Greenwich (author photo, 2022)
Harrison's H4, Royal Museums Greenwich (author photo, 2022)
John Harrison.
Harrison's signature, Cambridge Digital Library, 1771
Hugo Richards

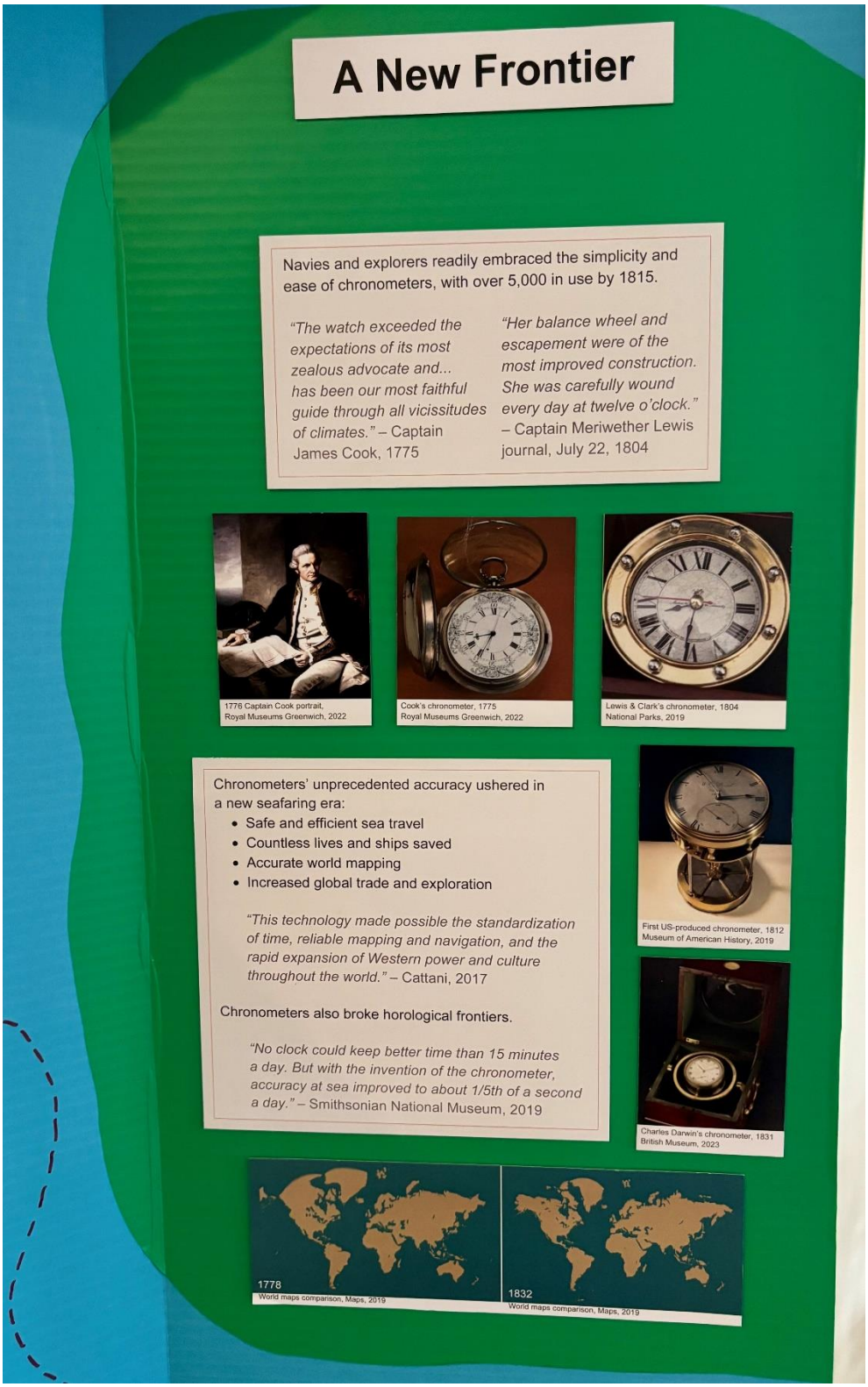
Section 3



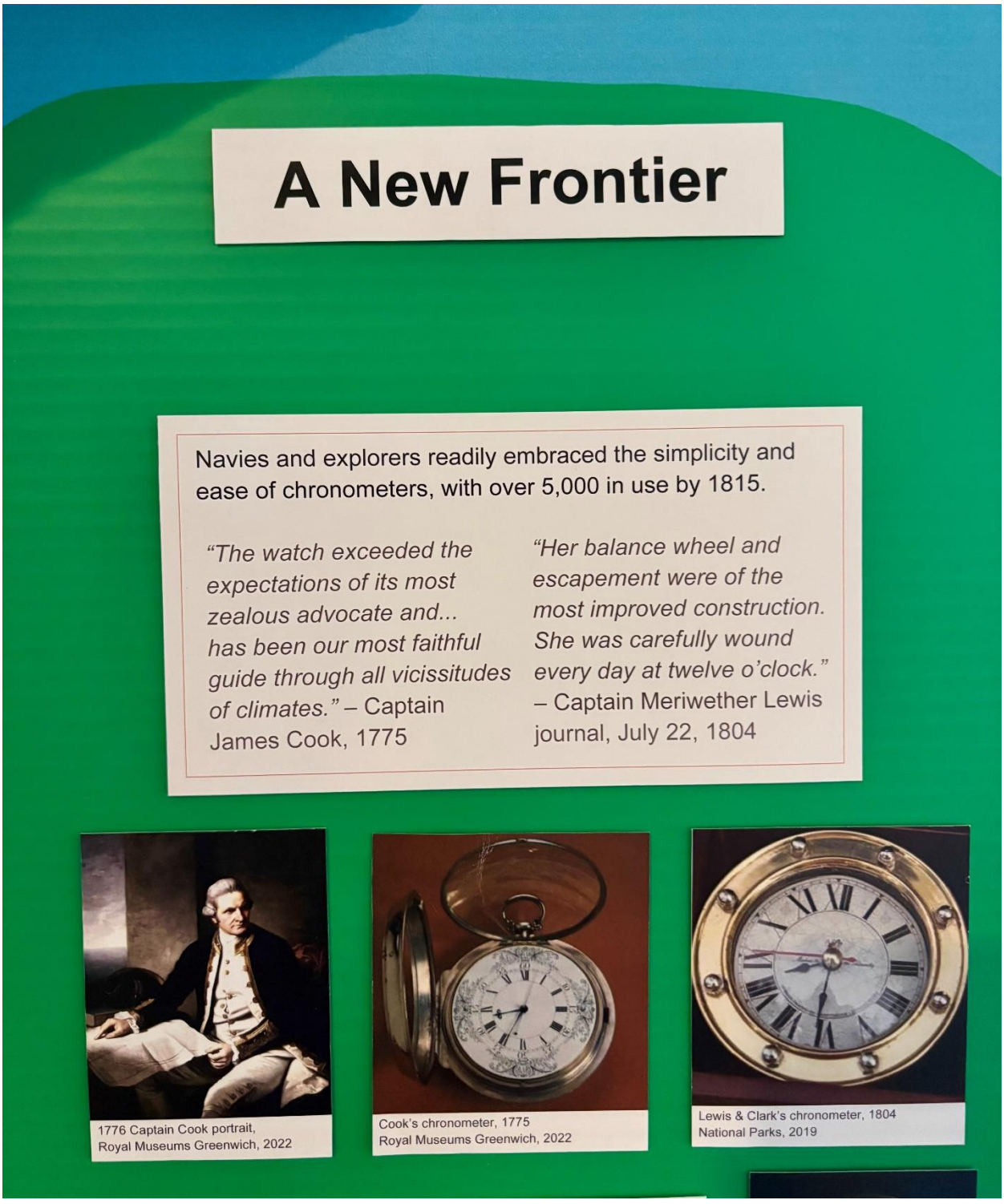
Section 3 close up



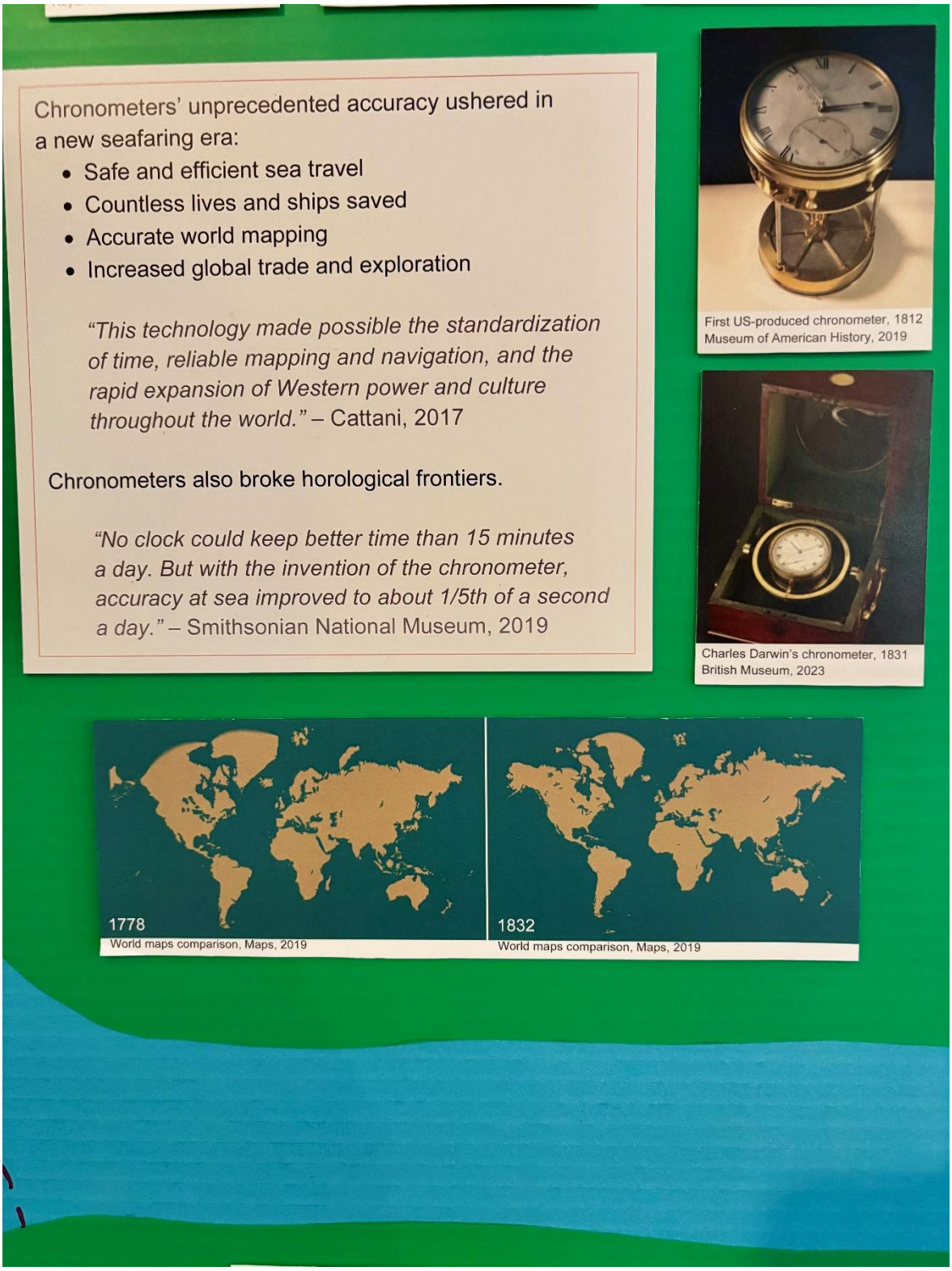
Section 3 close up


A New Frontier
Navies and explorers readily embraced the simplicity and ease of chronometers, with over 5,000 in use by 1815.
"The watch exceeded the expectations of its most zealous advocate and... has been our most faithful guide through all vicissitudes of climates." – Captain James Cook, 1775
"Her balance wheel and escapement were of the most improved construction. She was carefully wound every day at twelve o'clock." – Captain Meriwether Lewis journal, July 22, 1804
1776 Captain Cook portrait, Royal Museums Greenwich, 2022
Cook's chronometer, 1775 Royal Museums Greenwich, 2022
Lewis & Clark's chronometer, 1804 National Parks, 2019
Chronometers' unprecedented accuracy ushered in a new seafaring era:
Safe and efficient sea travel
Countless lives and ships saved
Accurate world mapping
Increased global trade and exploration
"This technology made possible the standardization of time, reliable mapping and navigation, and the rapid expansion of Western power and culture throughout the world." – Cattani, 2017
Chronometers also broke horological frontiers.
"No clock could keep better time than 15 minutes a day. But with the invention of the chronometer, accuracy at sea improved to about 1/5th of a second a day." – Smithsonian National Museum, 2019
First US-produced chronometer, 1812 Museum of American History, 2019
Charles Darwin's chronometer, 1831 British Museum, 2023
1778
World maps comparison, Maps, 2019
1832
World maps comparison, Maps, 2019

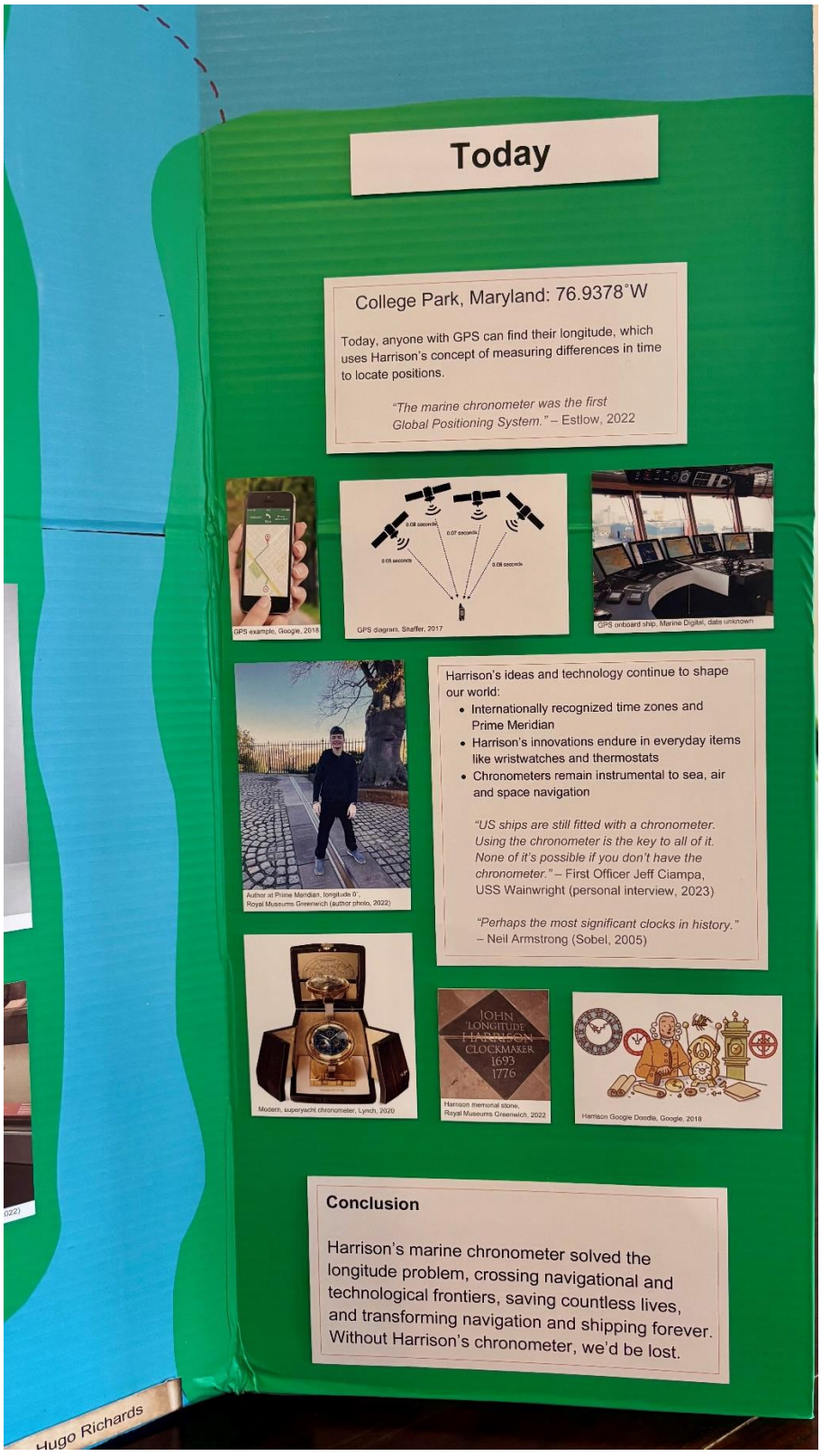
Section 4



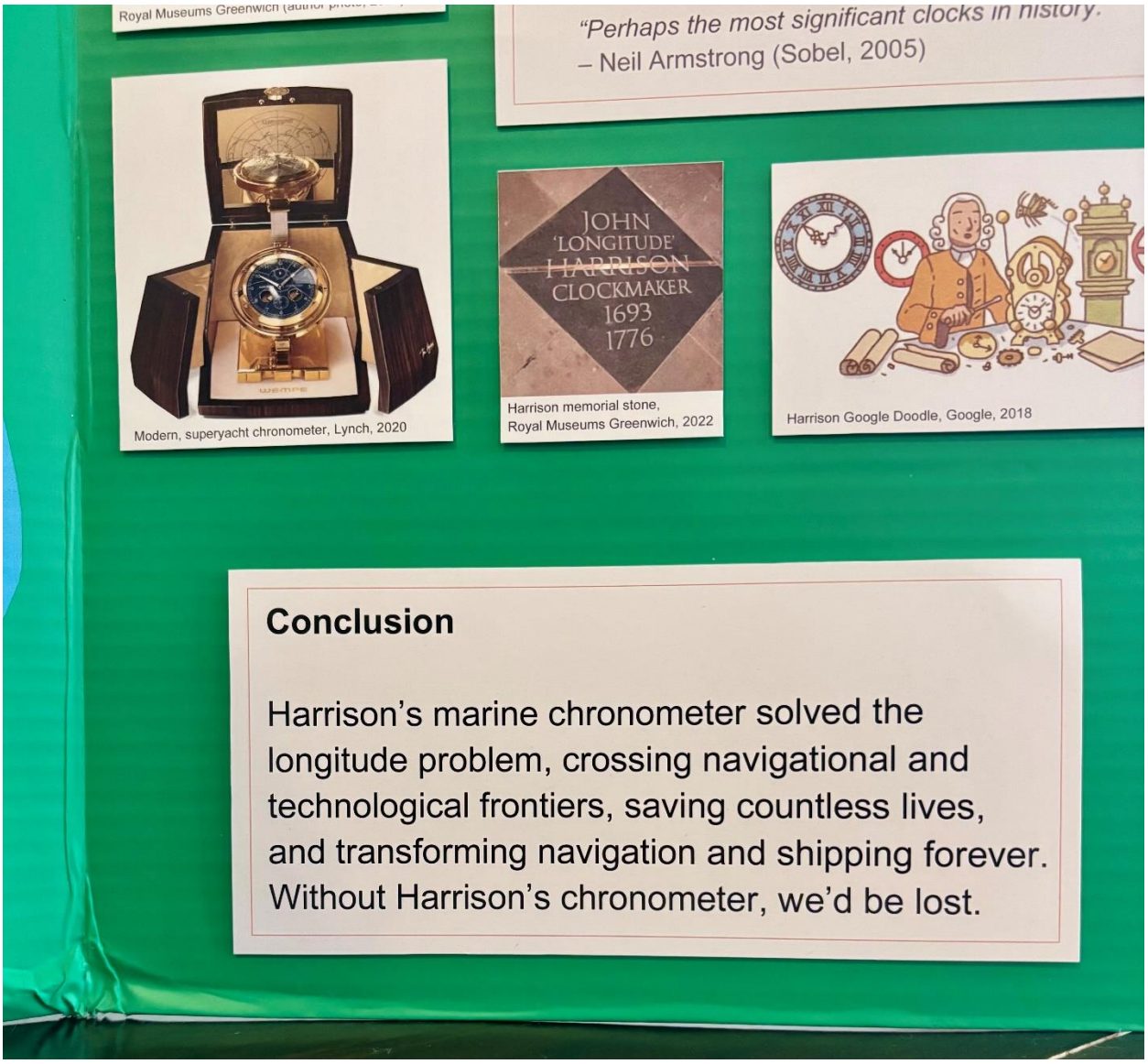
Section 4 close up



Section 4 close up


Today
College Park, Maryland: 76.9378°W
Today, anyone with GPS can find their longitude, which uses Harrison's concept of measuring differences in time to locate positions.
"The marine chronometer was the first Global Positioning System." – Estlow, 2022
GPS example, Google, 2018
0.08 seconds
0.07 seconds
0.05 seconds
0.08 seconds
GPS diagram, Shaffer, 2017
GPS onboard ship, Marine Digital, date unknown
Author at Prime Meridian, longitude 0°, Royal Museums Greenwich (author photo, 2022)
Harrison's ideas and technology continue to shape our world:
• Internationally recognized time zones and Prime Meridian
• Harrison's innovations endure in everyday items like wristwatches and thermostats
• Chronometers remain instrumental to sea, air and space navigation
"US ships are still fitted with a chronometer. Using the chronometer is the key to all of it. None of it's possible if you don't have the chronometer." – First Officer Jeff Ciampa, USS Wainwright (personal interview, 2023)
"Perhaps the most significant clocks in history." – Neil Armstrong (Sobel, 2005)
Modern, superyacht chronometer, Lynch, 2020
JOHN 'LONGITUDE' HARRISON CLOCKMAKER 1693 1776
Harrison memorial stone, Royal Museums Greenwich, 2022
Harrison Google Doodle, Google, 2018
Conclusion
Harrison's marine chronometer solved the longitude problem, crossing navigational and technological frontiers, saving countless lives, and transforming navigation and shipping forever. Without Harrison's chronometer, we'd be lost.
Hugo Richards

Section 5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