Lecture 23

Fundamentals of Physics

Phys 120, Fall 2015

Thanksgiving Special

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Overview

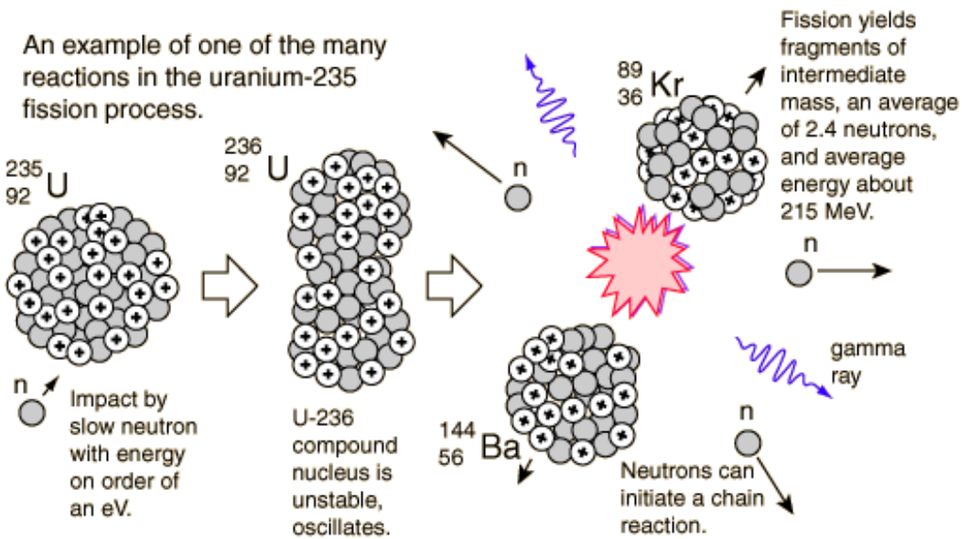
- Some students requested a special Thanksgiving lecture
- Nuclear power for Energy generation: power plants
- Special Pilgrim conspiracy theory
- Sailing to the new world
- Extra Credit special

Nuclear reactor

To extract a steady amount of energy from Uranium ^{235}U fission it is important to control the chain reaction. We saw that if there is too little ^{235}U and too much ^{238}U present, then the chain reaction fizzles out.

However, if there is too much ^{235}U the chain reaction leads to an exponential growth of the atoms undergoing fission at any one time, which leads to uncontrolled heating (also known as a reactor melt-down).

This means one needs to control the chain reaction judiciously inserting neutron absorbing materials to keep the chain reaction going at a steady rate.



Nuclear melt down

When things go wrong, they can go disastrously wrong. If the chain reaction goes out of control you can get a nuclear melt down which does not cause a nuclear explosion, but uncontrolled heating and complete failure of the plant.

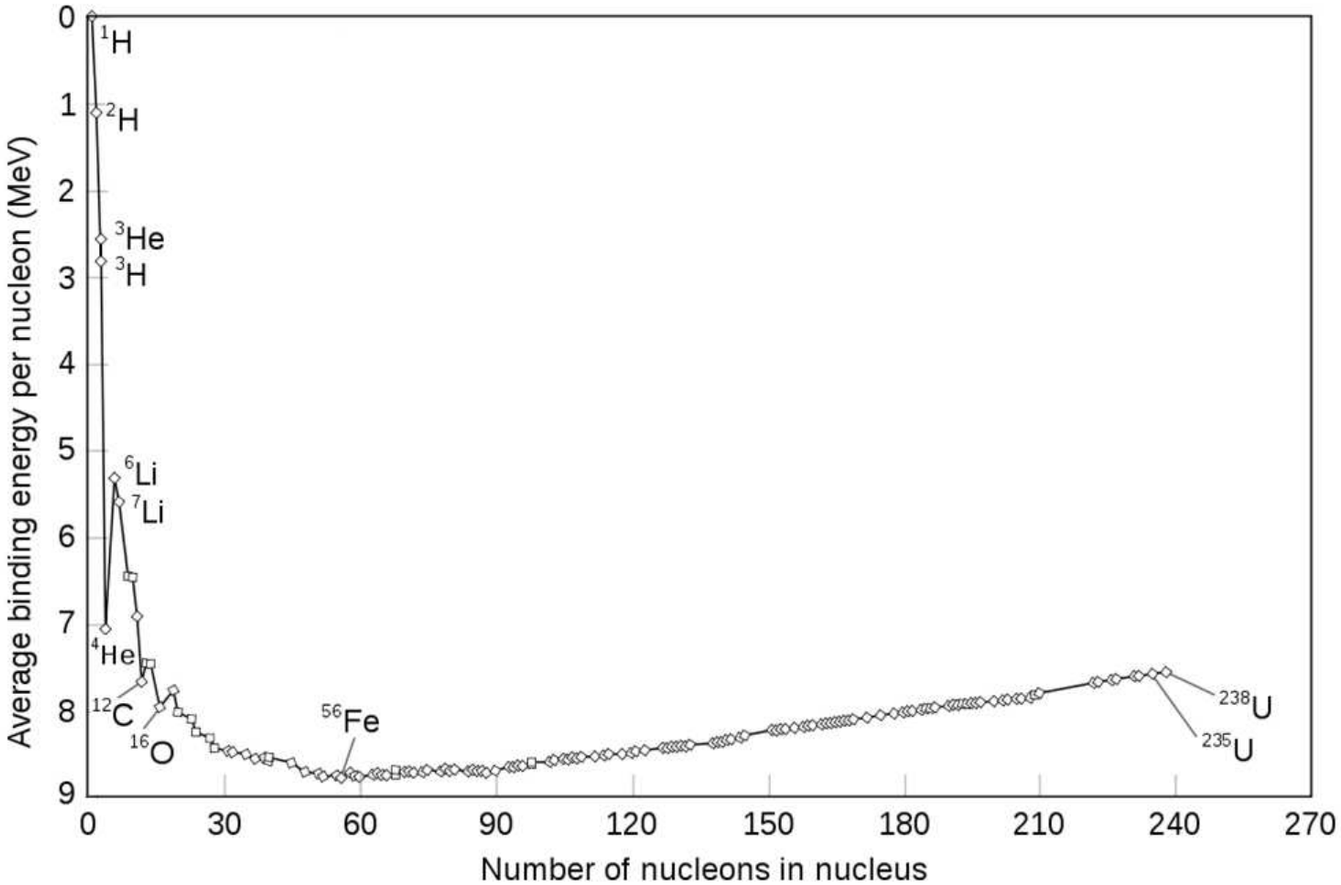
Availability of Uranium

There is a reasonably large abundance of Uranium on earth. It is about 10 times more abundant than silver.

This would allow current nuclear plants to run for at least 50 more years, but remember that only 0.7% of the Uranium is ^{235}U. The useless ^{238}U can be transformed into Plutonium by neutron capture. In the neutron rich environment of a nuclear reactor this process occurs naturally. To facilitate it the conditions (i.e. the speed of the neutrons) needs to be controlled, and in ideal conditions more fuel than is used can be generated in a breeder reactor.

The disadvantage is that breeder reactors generate large amounts of Plutonium that can be used in nuclear weapons.

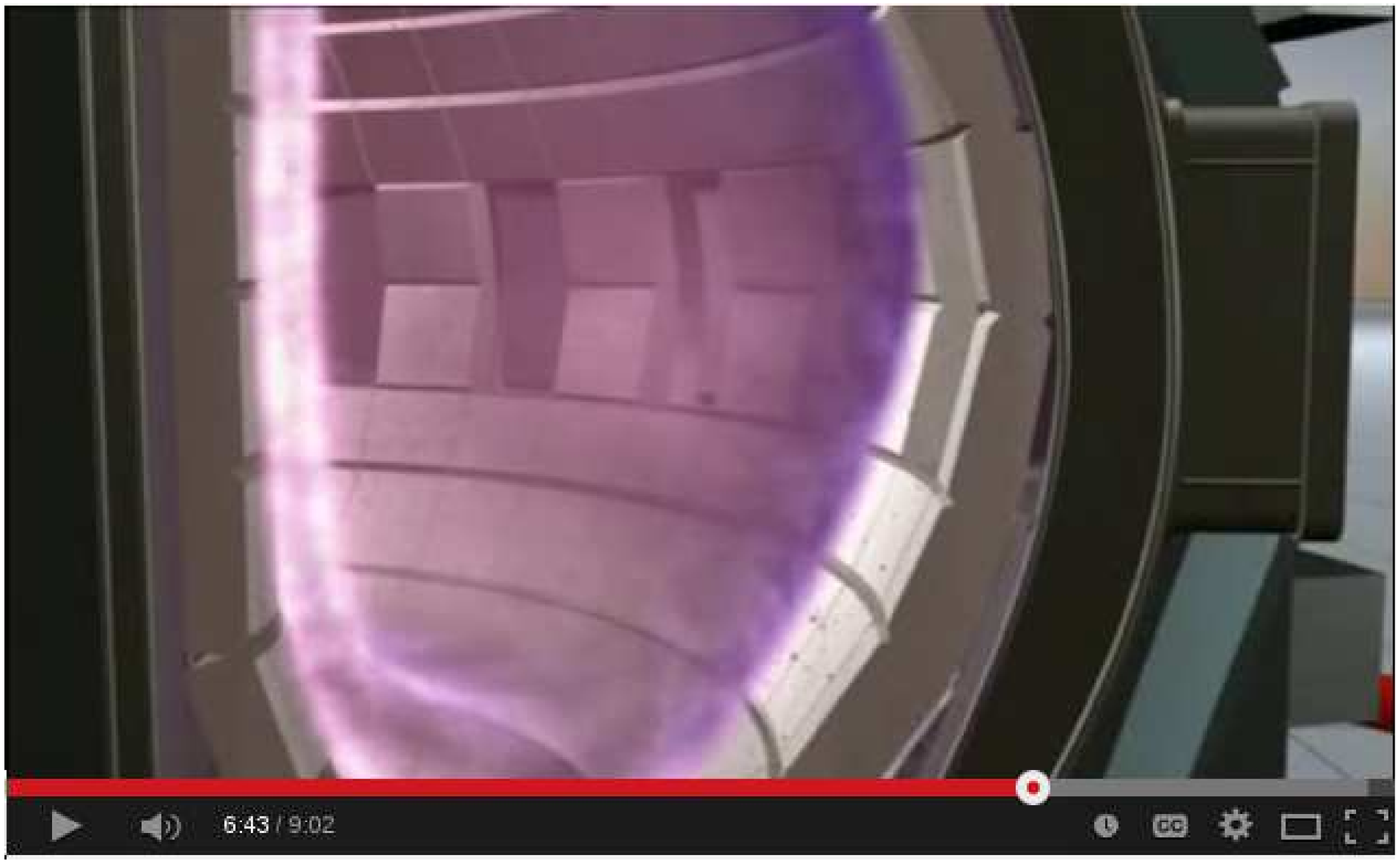
The nuclear energy curve

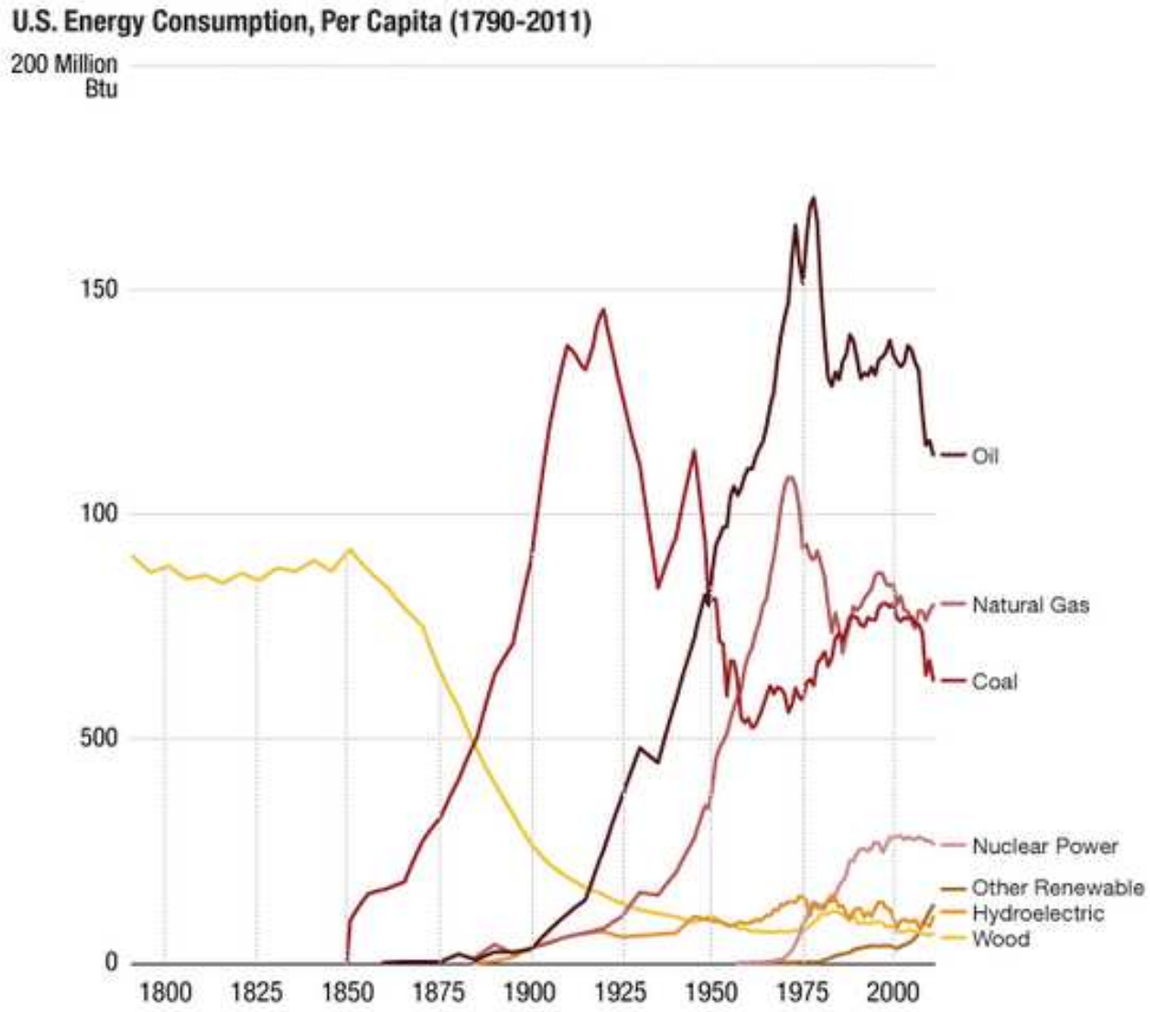


Fusion Power

Even more efficient should be the generation of fusion power. However, there are significant difficulties since the atoms have to be kept a very high temperature and a high density.

Fusion Power





Source: U.S. Energy Information Administration, Census Bureau

Credit: Lam Thuy Vo / NPR

The energy challenge

We receive the largest part of our energy from fossil fuels. These generate CO_2, which is a green house gas. Global warming will lead to great difficulties, including increasing sea levels and other extreme events, which will be costly.

Nuclear energy has been suggested as an alternative, but there are other risks involved like exposure to radioactive materials and nuclear proliferation.

Alternative energies are becoming more cost effective.

Science and politics

We hear a lot about scientific arguments for policy decisions. You will often find that politicians use scientific reports to motivate their policy decisions.

I am not expert at this, but this appears to be a relatively new trend. A major shift came through the Manhatten project, where a group of theoretical Physicists convinced lawmakers to invest significant amounts of money into a secret government project to use an unproven technology for converting nuclear energy into a powerful explosive.

The success of this project had a longlasting effect that changed the relation between science and policy.

When scientific evidence collides with other interests

Whenever there are strong policy interests that have a scientific component, science now plays a role. And as funding for science becomes more dependent on political goals, the independence of some scientific endeavors can sometimes be put to question.

So how do you know whether or not to trust "science" in a specific case?

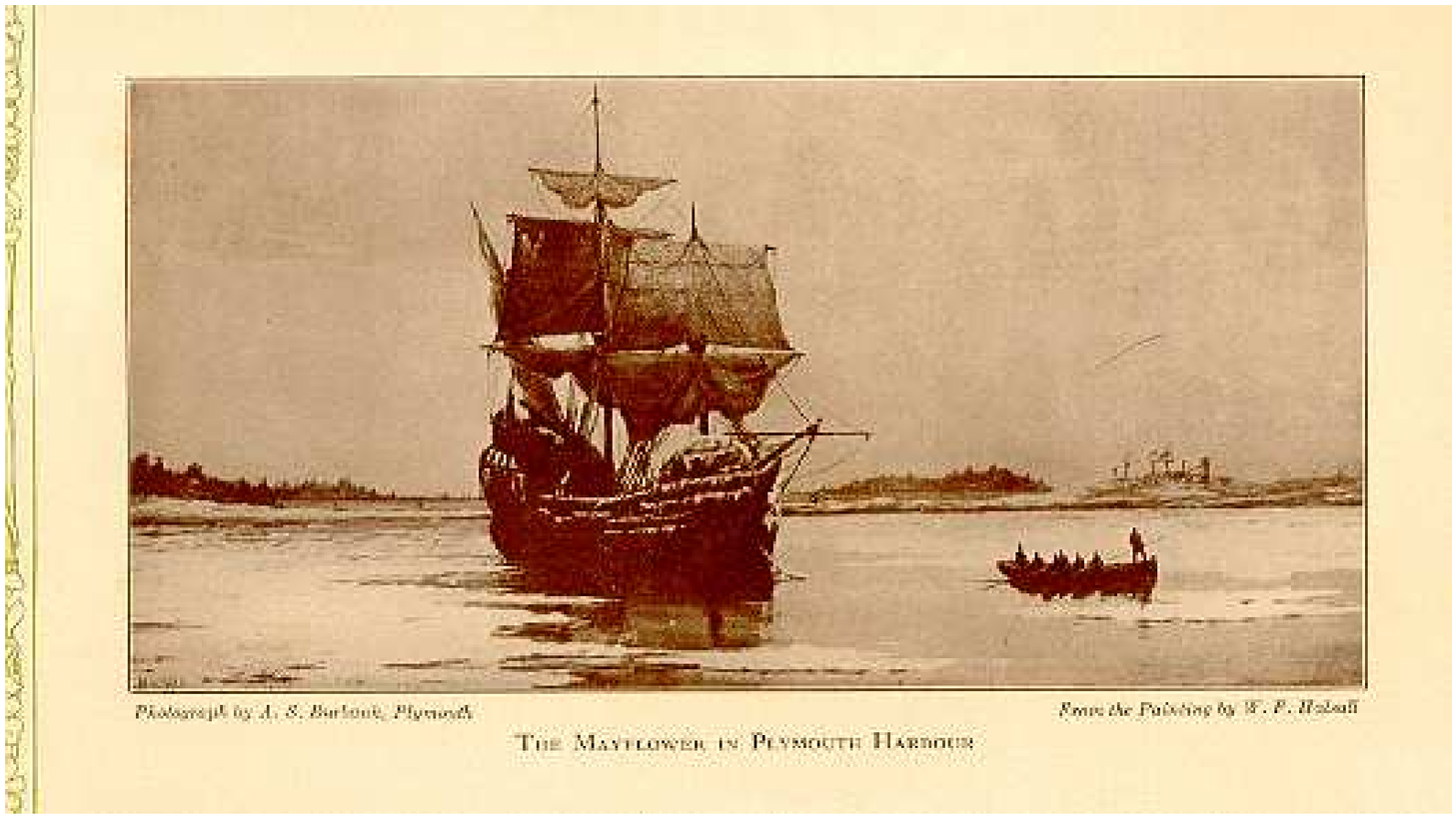
And if someone raises doubt on the veracity of science, how do you figure out whether to trust the "deniers"?

The Thanksgiving Conspiracy

In the next few slides I will alert you to a previously unreported conspiracy regarding the tradition of the American Thanksgiving holiday. I will prove to you that you have been bamboozled by Anglosaxon upstarts into believing in a English origin of the settlement of North America.

The Myth

You may have heard the claim that in 1620 a group of 102 pilgrims sailed in a sailing ship called the Mayflower to the new world and established a settlement at Plymouth, which is now in Massachusetts.



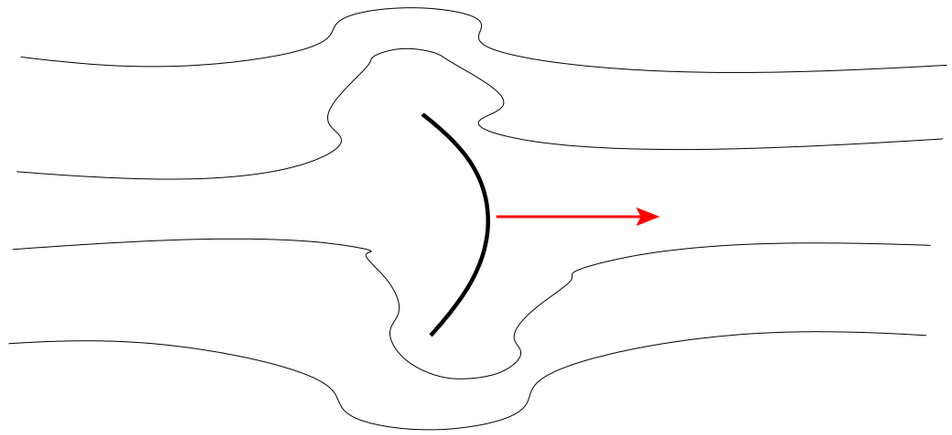
Photograph by A. S. Burbank, Plymouth *From the Painting by W. F. Halsall*

THE MAYFLOWER IN PLYMOUTH HARBOUR

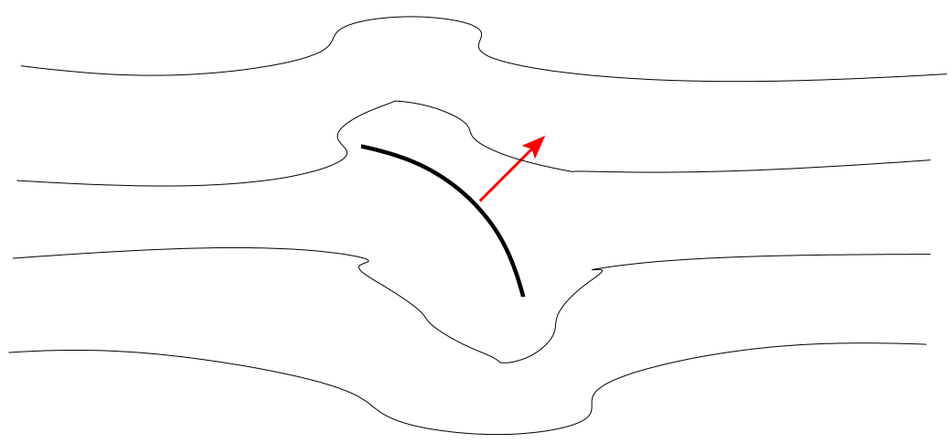
We will see in the following that this claim is demonstrably false, and I will enlighten you to the reasons for this conspiracy.

Forces on a sailing boat

When you catch wind in a sail you can use the sail to drag yourself with the wind. However, you have a limited steering capability of turning the sail to one side and deflecting the wind. By deflecting the wind you can obtain a sideways component to the force on the sail.
But which direction does that allow you to go? You can only have a force that is in the direction of the wind, and somewhat sideways. But you will **never** be able to have a force that will point into the wind.



Force with the wind.



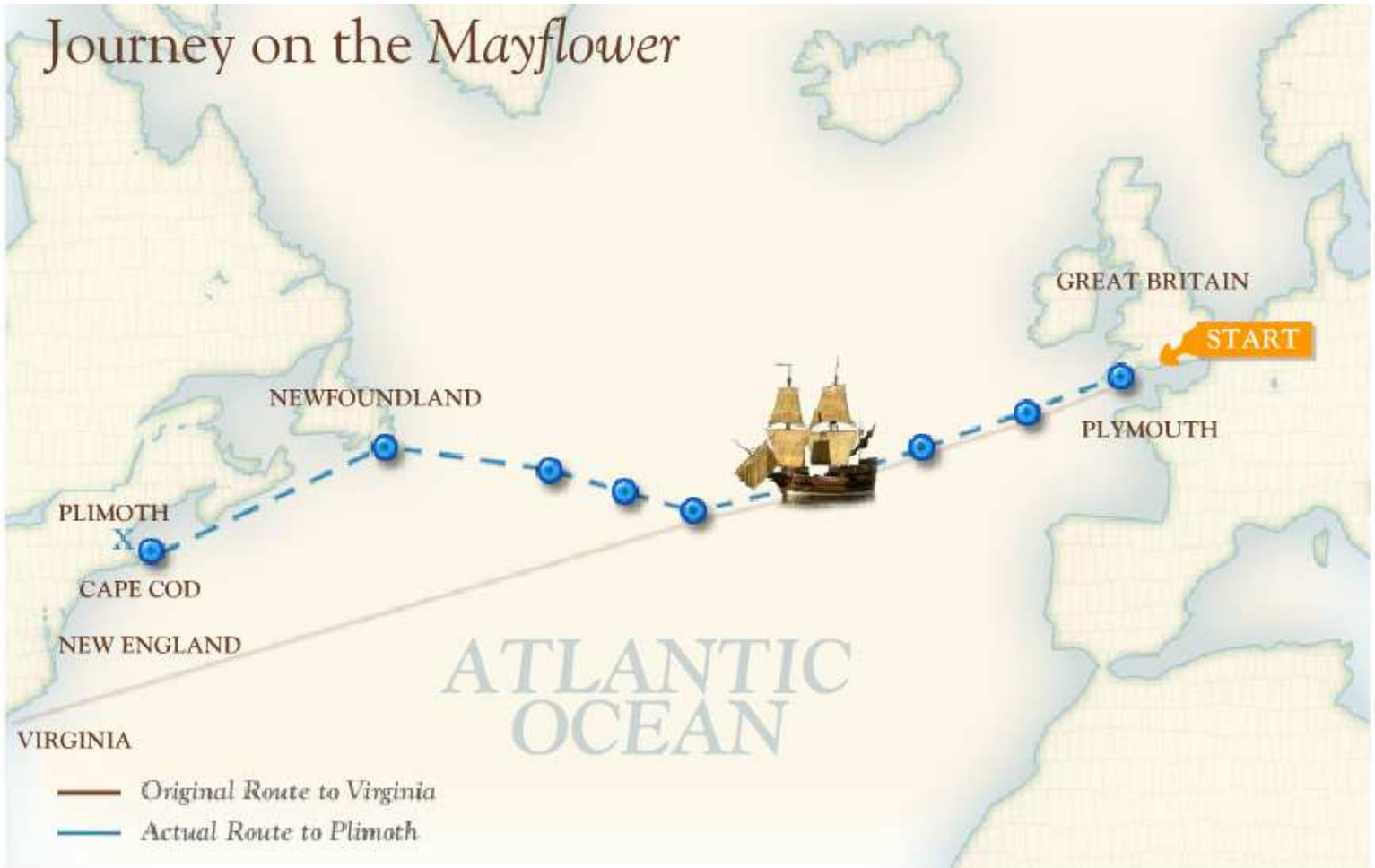
Sideways force by deflecting the wind.

Concept Check

Which are possible directions for the force on a sail during a west wind (i.e. a wind going from west to east)?

a) a force to the east
b) a force to the north east
c) a force to the north
e) a force to the north west
f) a force to the west
g) a force to the south west
e) a force to the south
f) a force to the south east

The journey of the Mayflower



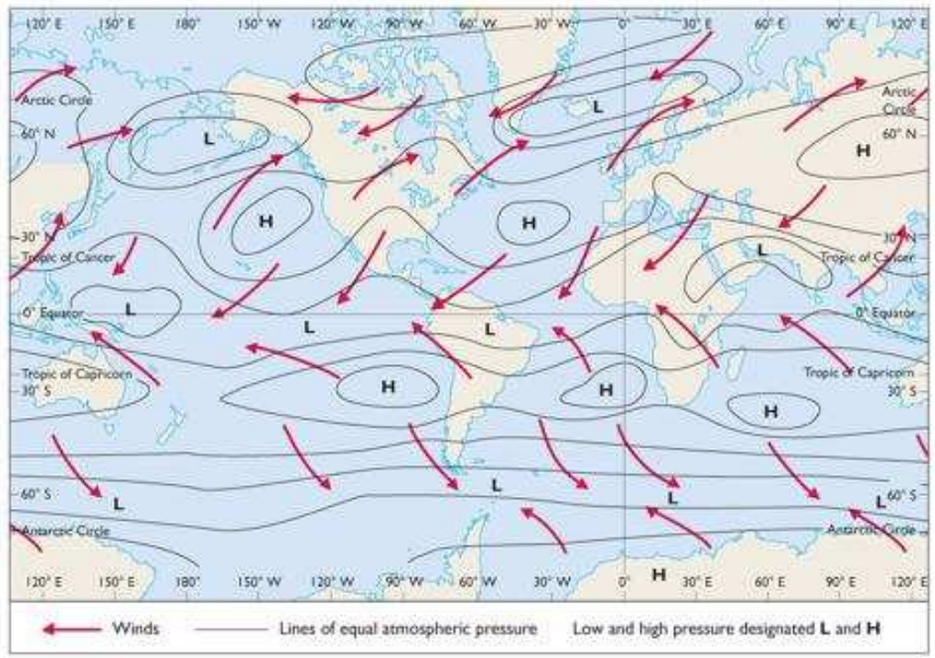
This is the alleged path of the Mayflower, a sailboat without any other mode of propulsion.

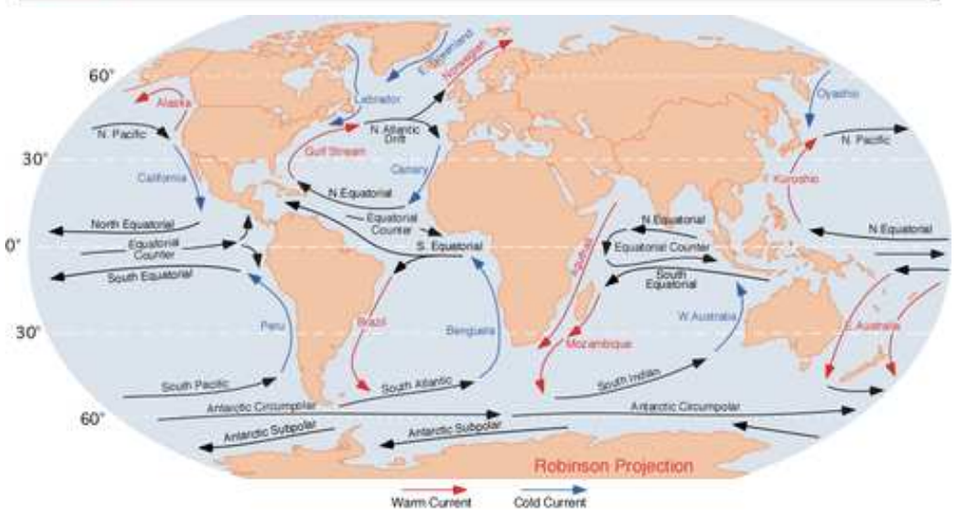
How we know that the pilgrim story is a lie

The weather patterns on the North Atlantic show strong prevailing winds from the west to the east. These winds are caused by the weather patters that have not significantly changed since the 1600s.

If you compare this to the alleged path of the Mayflower, you see that the boat would have sailed **into** the wind. That clearly flies into the face of reason.

The ocean currents are also moving from North America towards Europe, so there is no chance that the Mayflower could have been carried by the force of an ocean current.



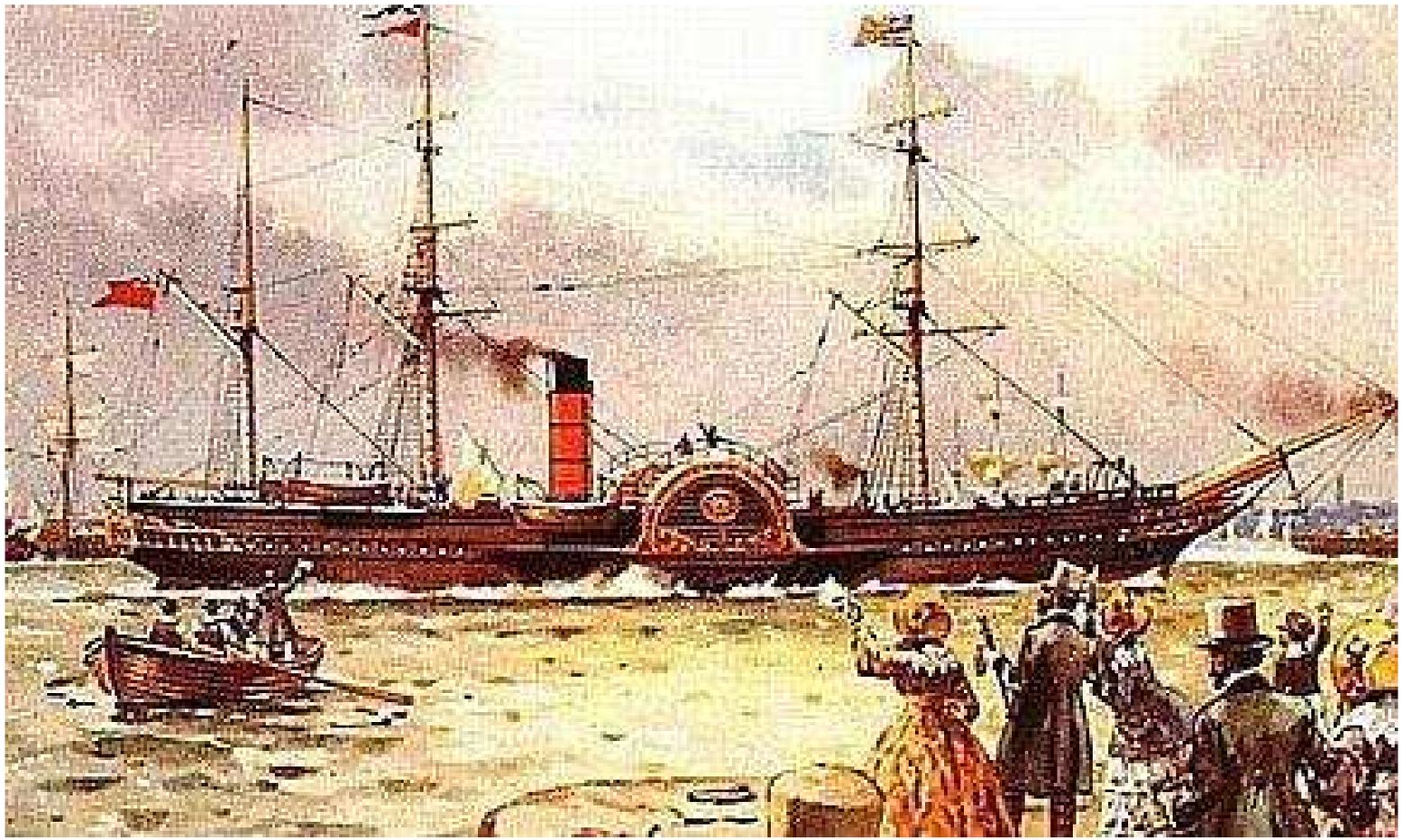


But where did the Europeans come from?

Ships that are capable of moving freely over the ocean are ships that are not dependent on the wind, like the famous Viking longboats. Leif Erickson was the first of the Viking explorers and this shows that the true heritage and settlement of north america was performed by the Vikings.

There were other nations capable of building such ships (like the Greeks and Romans), but there is no evidence that they made it over the Atlantic. An example is the Roman trireme on the left. The only person from the ancient world reported to have traveled to the new world was Jesus of Nazareth, but the book or Mormon does not suggest that he used a trireme.

How did the Anglosaxons get here?



By steamship!

Conclusion about the Pilgrim's story

Since the sailing ship could not have traveled along the route claimed by the proponents of the Anglosaxon Pilgrims hypothesis, we have now conclusively shown that North America was settled by Viking explorers instead. Later Anglosaxon immigrants arriving by steamship rewrote history to give themselves a more important role in the glorious history of North America. They were so successful that instead of Swedish or Norwegian we are now all speaking English.

Extra credit

Those of you who find extra time during the Thanksgiving holiday have to opportunity to write a careful rebuttal of my Viking supremacy theory. Make sure to disprove my physical reasoning in any submission. (i.e. don't just use historical documents etc., or counter examples. Really show me where my reasoning is wrong, not just inconsistent with the record).

Happy Thanksgiving everyone!