8.0

THE MODERN REVOLUTION

0:00–0:38

THE MODERN REVOLUTION

Hi, I'm John Green. Welcome to Crash Course Big History. Today we're going to look at the modern revolution.

Mr. Green, Mr. Green! But what does modern even mean? I mean, I know that fax machines and Super Nintendo are modern, but, like, people used to think that toilets that flushed were modern.

That's actually a pretty perceptive question, me from the past. So, if we're going to talk about modernity, we should probably define modernity. But first, I have great news. There is a future me from the past where video games are so much better than Super Nintendo. In fact, this machine plays 24,000 games and it's in the office of future you.

0:38–1:37

DEFINING MODERNITY

What were we talking about? Oh, right, modernity. So, some historians date the beginning of the modern era with the beginnings of the Industrial Revolution in the 19th century. Some date it to the French Revolution in 1789. Some push it further back to 16th and 17th century European colonialism. And some date modernity with the European Renaissance and call anything past the year 1500 "early modern."

But through a Big History lens, all of these are just signs of acceleration in human collective learning, which was already underway and took its first tiny steps in East Africa 250,000 years ago. Then again, it would be silly to call the first human foragers "early-early-early modern." So for the purposes of today, let's say: early modern period began around 1500, and the modern modern period around 1750. With an acknowledgment that it's all a little bit arbitrary. And I know what you're wondering, but no, 1750 was several decades before the first flushing toilets.

1:37–2:12

COLLECTIVE LEARNING

So last week, we looked at how collective learning — which relies on population numbers and connectivity to produce new ideas — grew by leaps and bounds with the introduction of agriculture. By the year 1400, the human population had advanced magnificently, but the world was still divided into four isolated world zones: the Americas, Australasia, the Pacific, and Afro-Eurasia.

From a Big History perspective, what makes the European explorations worthy of a place in an episode called "Modern Revolution" is that they eventually united all four-world zones into a global system. An increasingly connected network of potential innovators was great for collective learning.

2:12–2:52

EXPANSION

But why did the Europeans feel so motivated to expand? Well, a lot of reasons.

One, Ottoman dominance of overland trade routes with Asia, particularly after the conquest of Constantinople in 1453, made Europeans seek alternative routes to the populace and rich lands of the East.

Two, European states were fairly small compared to some of the vast empires of Asia and needed to compete for more resources to fuel their almost-constant wars.

And three, the fruits of exploration undoubtedly had positive effects, whether it be the many advanced inventions and consumer goods imported from China or the spices of India and Indonesia, or crops from the Americas.

That last one should not be underestimated. Crops like the potato — which earned the nickname "ready-made bread" because it was easy to prepare — combined with maize and squashes and tomatoes and various yams allowed farms in Europe to support more people. This was also good for Asia, where those crops were introduced in the 17th century.

2:52–3:19

CROPS AND SILVER

And let us not forget about the vast amounts of silver that the Spanish "acquired" from the Americas or the many cotton, tobacco, and sugar farms that Europeans bolstered their economies with.

3:19–3:49

SLAVERY

The unification of the world zones also had many, many negative effects. For instance, it was terrible for people who worked on those cotton and tobacco and sugar farms. Europeans increasingly relied on African slaves, the first of whom were granted to the Portuguese by African rulers, and then, you know, several centuries of horror ensued with an incomprehensible number of African slaves dying in the appalling conditions of the Atlantic crossing. Life was also pretty miserable for the slaves that survived the journey and generations of their descendants.

3:49–4:38

DISEASES

Also, because Afro-Eurasia was a modestly connected thriving cesspool of disease, Europeans had developed many immunities. When they started arriving in the previously isolated Americas in the late 1400s and 1500s, the indigenous inhabitants had no immunity to those diseases. This resulted in one of the most horrific events in human history. A cocktail of various European diseases, most notably smallpox, killed off an estimated 50 million people in the Americas in little over a century. A similar tragedy played itself out in Australia when Europeans started arriving there in the 18th century.

Now, along with all this horrific stuff, the unification of the world zones was, nevertheless, a good thing for collective learning, which would eventually prove our salvation in many ways. Which is why people can now look at this on their smart phone.

4:38–5:08

THE INDUSTRIAL REVOLUTION

Anyway, the unification of the world zones did not in itself lead to a breakthrough in the way humans harvested matter and energy. The last major shift happened with the arrival of agriculture 10,000 years prior. The colonizing European societies of the 16th, 17th, and 18th centuries remained agrarian.

But the explorations did allow for a network of exchange that eventually did lead to a major breakthrough in how humans harnessed more energy and produced more and more cultural complexity: The Industrial Revolution.

5:08–5:49

INDUSTRY IN BRITAIN

The Industrial Revolution began in Great Britain, as they'll be happy to tell you, in the 18th century. But it was a global revolution involving collective learning shared across the global system. But a number of innovations that kick started industry originated in Britain, like the more intensified use of steam engines or the use of coke to refine metal. Not that Coke — yeah, that coke.

Also, they invented many textile machines and Britain had lots of coal and it was relatively easy to mine. Thank you, trees that died hundreds of millions of years ago. We're going to turn you into industry. And smog.

But all those British breakthroughs wouldn't have been possible without a huge global network of trade that supplied raw materials like cotton and that opened new markets where Britain could sell its goods.

5:49–6:19

INTERNATIONAL INFLUENCES

And it wouldn't have been possible to expand that network of trade in the first place without gunpowder and the compass, which both came from China.

The methods of porcelain manufacture that were important to the Industrial Revolution in Britain also came from China via Germany.

And the improved methods of farming, which freed up many British farm workers for industrial wage labor in the cities, came from Flanders in the Netherlands.

Early designs for steam engines came from 18th century France, and much of the designs for these machines depended on mathematics preserved and transmitted by Islamic and Hindu civilizations.

6:19–6:53

AN ENERGY REVOLUTION

So up until the end of the 18th century, virtually all production in human history was propelled by human or animal muscle power, or else by wind and waterpower. But it turned out the coal and oil had stored energy from the Sun that had built up over hundreds of millions of years.

And using those resources dramatically increased the energy that humans could harness. Huge numbers of goods could be produced by factories at relatively low prices, which meant that over many decades, goods that had previously been seen as luxuries by common people were suddenly viewed as necessities.

6:19–6:53

AN ENERGY REVOLUTION

By the 1900s, most Europeans enjoyed a standard of living higher than the kings of the Middle Ages. Coal and oil also allowed mechanization of agriculture, which raised the carrying capacity, increasing the population.

And new modes of connectivity beginning with the telegraph, and then later, the telephone, increasingly bound the human species together, allowing for swift and rapid exchange of ideas. For 250,000 years, if I wanted to tell someone who lived 100 miles away from me something, it took me days to do so. For the last 100 years, it's taken me seconds.

7:24–7:57

RAPID CHANGE

Because a slight tweak in modes of production in the 18th century and the adoption of fossil fuels lead to an explosion of productivity and invention in the 1800s and 1900s, people often compare the Industrial Revolution to the Cambrian explosion about 540 million years ago. Remember: when a new skill or trait opens up new ways or 'niches' to extract energy from the environment, evolutionary change can proceed very quickly. In the Cambrian explosion, that evolutionary change was biological. In the Industrial Revolution, that increased pace of change was cultural.

7:57–8:42

BICYCLES AND ELECTRONICS

Consider bike design. In the 1800s, there were many, many different designs for bikes, some of which look amazingly, terrifyingly unsafe. In the beginning of innovations for bicycles, a huge number of designs filled all of the available niches. Eventually, those designs started competing with each other and a few forms won out. You've got the road bike and the mountain bike and the BMX bike. Just a little bit different variations of the same thing.

Another example is the adaptive radiation of electronics. Take a look at all the stuff you needed in the 1980s to do what your average cell phone can do today. And that was only a few decades ago. Many new ideas sparked an increase in the human standard of living and the complexity of societies in tons of different ways. The explosion of cultural evolution that started 200 years ago has yet to cease.

8:42–9:04

RISE OF COMPLEXITY

The Cambrian explosion went on for millions of years. The Agricultural Revolution proceeded for thousands of years. We're still right in the middle of the modern revolution — maybe only at the beginning.

The huge shift in human activity and a rise in complexity may continue long after our grandchildren's lifetimes. That is, so long as we don't do something stupid, which, you know, with *Homo sapiens*, is always a distinct possibility.

9:04–9:51

A VERY COMPLEX SYSTEM

And let's not forget about the rise in complexity that's been happening since the beginning of the Universe 13.8 billion years ago. A star is essentially a pile of hydrogen and helium. It's extremely simple. By comparison, a brain that arose via biological evolution is an intricate network of billions of connections and building blocks. Industrial society is an immense whirring global network of millions upon millions of brains more closely connected than ever before. The products of this society raised complexity even further.

Bottom line is this, if the first part of this series, which looked at the vastness of the Universe, made you feel insignificant, just remember that now at the tremendous heights of technological progress, humanity is, in terms of networks and building blocks, the most complex system that we know of in the Universe. And there's currently no end to the potential for rising complexity in sight.

9:51–10:27

WHY BRITAIN?

This brings us to a long-standing historical question: why did the Industrial Revolution happen in Britain? Great Britain was certainly uncommonly well positioned. That said, so was China.

So why didn't the Industrial Revolution happen in, say, Song Dynasty China between the 10th and 13th centuries? So, we know the two main drivers of collective learning are population numbers and connectivity. And China has had both for a long time. The medieval Chinese had much more advanced agricultural methods than Europe. They paid attention to weeding and growing crops in rows and frequently used tools like the seed drill. And they were doing it all centuries before that stuff was even heard of in Europe.

10:27–11:04

CHINA

In the 900s, the spread of wet rice farming in southern China raised the carrying capacity even further because rice fields simply produce more food. They are more efficient. Also, rice is easier to prepare than the laborious European process of turning wheat into bread.

So during the 10th and 11th centuries, the Chinese population increased from about 50 or 60 million to about 120 million. That's a lot of new innovators.

So many, in fact, that Song China came close to having a modern revolution of its own. I mean, coal was used to manufacture iron. Production increased from 19,000 metric tons per year around 900 CE to 113,000 metric tons by 1200 CE.

11:04–11:28

THE SONG DYNASTY

The Song Dynasty was the first to invent and harness the power of gunpowder, and then later in the 15th century, Zheng He conducted overseas explorations decades before Columbus. Textile production showed the first ever signs of mechanization in ways similar to the European spinning jenny.

But China had dry coal while the British needed to pump water out of their coalmines in order to mine coal, which led the British to build steam engines.

11:28–12:10

THE RIGHT COMBINATION

So why didn't the modern revolution start in China around 1000 CE? Well, it might have been the cultural and political climate and the shift away from innovation and commerce at the end of Song China in 1279. Possibly because they hadn't united the world zones in a network of trade and unified collective learning. And possibly because the right combination of cultural innovations required to launch a Cambrian-style explosion of growth just didn't happen.

The point is that collective learning is such a powerful force that, from the explosion of the world population from only six million people 10,000 years ago to the 954 million by the end of the Agrarian Era, the right combination of ideas that lead to the industrial explosion might have happened almost anywhere.

12:10–12:51

POTENTIAL INNOVATORS

So long as there are brains to think and exchange ideas, so long as there are energy flows on the Earth, humanity has a tremendous potential for rising complexity.

The modern revolution was accompanied by explosive growth in human population. It took 250,000 years for humanity to achieve its first billion people. By 1900, the world's population was 1.6 billion. Today there are over 7 billion potential innovators who are now connected by the lightning speed of the Internet, and collective learning is more powerful than ever.

Humans now have unprecedented control and power over the Earth's biosphere, which has prompted some scientists and scholars to claim that the Holocene is over and we now stand on the threshold of a new era, the Anthropocene.

12:51–13:26

THE ANTHROPOCENE

During this age, we may continue to raise complexity in our little pocket of the Universe to wondrous new levels, hopefully to the growing benefit of all humans rather than just a privileged few. Thanks to collective learning, our potential is awesome. Unless, that is, we hit a wall, like agrarian societies did every few centuries when their population growth outstripped their rates of agricultural innovation.

We are now in an era of immense danger where the modern global system of humanity might exhaust the resources of the Earth in the same way that agricultural societies often exhausted the resources of the field.

More on that next time.