The Columbian Exchange: Crash Course History of Science #16

Crash Course: History of Science
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Over the last four episodes, we've examined some of the stories that make up the idea of a "revolution" in knowledge-making in Europe.

But we can't understand this idea fully, without unpacking another one—the so called Age of Exploration. This encompasses a lot of events that happened from 1400 through the 1600s and were driven in part by new ideas about knowledge-making.

And the span of history that we've been taught as the "Age of Exploration" might be better described as an exchange—the greatest exchange of people, plants, animals, diseases, and ideas that the world has ever seen. [Intro Music Plays] Why did European explorers seek out the New World after 1400? And why didn't they do it earlier? Well for one thing, medieval European states had been too small and poor to support large navies.

For another, they didn't have the technologies that other Eurasian cultures had. By 1400, the compass and gunpowder had both made it from China to Europe, changing armies and navies across the continent. In time, political power became more centralized, and states started to compete for things like land and precious metals, and for valuable trade routes to the rich empires of China and India.

By the late 1400s, two European states in particular began to use their massive naval might to search out trade advantages. In 1488, Portuguese explorers became the first Europeans to sail along the coast of sub-Saharan Africa. And in 1497, Portuguese explorer Vasco da Gama sailed to the Indian Ocean from Europe by way of Africa's Cape of Good Hope.

Interesting thing is, Portuguese ships were smaller than Chinese ships at the time. Chinese explorer Zheng He, for example, explored parts of Asia and Africa from 1405 to 1433, with huge, four-tiered ships carrying hundreds of sailors. But there was also a philosophical difference in exploration between the two states: most people living around the Indian Ocean respected overlapping political boundaries.

But European states didn't recognize other states' claims to their own territories. So it's not that the Europeans had the best ships; the difference was in how they used them. The most famous European explorer, of course, set sail on behalf of Spain in—you know the year—1492, changing the world forever.

In fact, historians call the widespread movement of people, plants, animals, germs, ideas, and technologies between the Americas and Eurasia after 1492 "the Columbian Exchange." You can learn more about Christopher Columbus in a lot of other places. For us, what matters is how knowledge moved due to the Columbian Exchange. Now, what role did scientific thought play in these voyages?

Not much. Gunpowder and the compass were not new in 1400. Centralized states were not new.

These were just relatively new to Europe. It seems that, in this case, technology and politics spurred science. The discipline of geography, for example, became important when it came to settling political disputes about who had claimed what already-inhabited land.

The Portuguese crown spent tons of resources on making maps of lands that were new to them. And the Spanish government in Seville sponsored the House of Trade in 1503 to make master-maps. In Spain, Philip II founded the Academy of Mathematics in Madrid in 1582, where young nobles could learn cosmography, navigation, military engineering, and what were called "the occult sciences": kinda like "The Citadel" from Game of Thrones crossed with Hogwarts from Harry Potter.

And, in the 1570s, Philip II sent out a scientific expedition to the Americas under Francisco Hernández to collect geographical, botanical, and medical information. The later colonial powers—the English, Dutch, and French—followed the Portuguese and Spanish pattern of state support for science, focused on geography and botany. Science became a tool of empire.

But let's be real: the "voyages of discovery" weren't full of scientists boldly creating knowledge. These weren't nerds like Galileo and Copernicus obsessing over truth. These voyages were about exploitation.

European powers -used knowledge creation as another tool to fight proxy wars between each other. By 1800, Europeans controlled 35% of land and resources on earth. It was as though not one but five Roman Empires had set off on a quest for world domination.

So, what kinds of things were exchanged as Europeans sailed farther? For one, European explorers looked for new plant specimens that might have agricultural and medical uses. They were also interested in animals, but plants were more important.

Few animal species in the Americas had been domesticated. Americans did carefully manage things like ducks and vultures. But Europeans were amazed that Americans got anything done without cows and horses.

On the flip side, edible plant diversity in the Americas matched, if not blew away, that of Eurasia. It was wondrous. Take us there, Thought Bubble.

Can you imagine a world without corn, potatoes, tomatoes, bell peppers, chili peppers, beans, tobacco, pumpkins, chocolate, avocados, vanilla, peanuts, pecans, cashews…? I can go on. But really, no hot sauce!?

No chocolate? No tacos? No tomato sauce?

What did Eurasians eat before the Columbian Exchange? It doesn't even matter. In fact, there was so much knowledge about plants coming back to European capitals that old ideas about living things quickly started to look… old.

A few keen observers started to compare different plants, part by part. The name to remember is Swedish natural philosopher Carl Linnaeus, who came up with a rational system for classifying plants based on their sex parts. We'll come back to him.

How did plant specimens travel from the New World to Europe? At first, the English, French, and Dutch relied on the Spanish and Portuguese for access. They quickly realized that it would be more economical to set up their own exploratory operations, and then their own colonies, including slave-powered mines and plantations.

For example, a Puritan "company of adventurers" called the Providence Island Company left England in 1633 for the eastern coast of what is now Honduras and Nicaragua. They went with a specific plan to find useful plants that they could sell or turn into new products. The Puritans traded with the local people, the Miskitu, who helped them identify the local flora.

But they never made a lot of money, so the Puritans turned from botany to… piracy. They even got local Miskitu excited about piracy! They ended up stealing a bunch of enslaved Africans from their Spanish rivals and then executing Spanish soldiers who surrendered after a failed attack.

So the Spanish sent an armada of eleven ships and took over the Providence Island Company's operation. You know, typical science

problems! Thanks Thoughtbubble.

In the end, empire turned out to be very uneconomical for the states themselves. European corporations—some of which are still around—made a lot of money, but only because the states paid major costs to set up colonies. These costs included both the capital for ships, supplies, and sailors, as well as the costs of fighting battles with other states and subduing native populations.

One consequence of discovering whole continents full of new plants and animals was a new sense in Europe of, well, newness—novelty, curiosity, wonder. As more people learned about the New World, they wanted to make more sense of it. So exploration led to the development of museums and the practice of scientific collecting.

Early museums were not like the ones we have today. They were special rooms curated by nobles called wunderkammern or "cabinets of curiosity." The ideal cabinet of curiosity had one of everything. There was a divided focus between cataloging the natural, the human, and the "abominations" of nature such as dragons and mermaids.

Wunderkammern brought order to an explosion of new knowledge. But the order they imposed was highly individual. For example, you could often find a rhino horn next to the horn of a supposed "unicorn," or narwhal.

And every gentleman worth his salt had a crocodile mounted on his ceiling! But other results of the Columbian Exchange were not at all fun or wondrous. In addition to the intentional violence perpetrated against native populations, disease played a major role in changing who lived there.

Human immune systems are adaptive: they learn over time how to better respond to threats from dangerous microbes. Which is amazing! But the populations of Eurasia and Africa had been mostly separated from those of the Americas and Australia for thousands of years.

By a stroke of extremely bad luck, this meant that the populations of the Americas had no natural protection against smallpox. As more Americans came in contact with more Eurasians, smallpox ran rampant, killing one out of every two people who caught it. This led to social breakdowns and meant that native groups were less able to fight off European invaders.

In some regions, populations fell by 75%. And smallpox was only the most deadly among a number of diseases. Eurasians had developed some immunity to the plague, measles, typhus, and tuberculosis.

Africans had some immunity to malaria and yellow fever. But the Americans had no immunity to these diseases. One notable disease that may have crossed the other way—we aren't sure—is syphilis, which first appeared in Europe three years after the beginning of the Columbian Exchange.

The exchange of diseases also led to the exchange of medical practices. In Boston, in the early 1700s, the influential Puritan minister Cotton Mather learned the practice of variolation from his slave Onesimus, who later bought his freedom. Variolation is a way of protecting someone against smallpox by deliberately infecting them with material from another person who had survived the disease.

This is different from vaccination, which uses a similar but milder virus to trick the body into fighting smallpox. Cotton Mather found the variolation worked, and he actually tried to implement a variolation campaign in Boston that was inspired by his former slave, but most of Bostonites were not simply having it. In addition to the fact that intentionally injecting someone with powdered scabs was counterintuitive, most white people at the time wouldn't trust the medical knowledge of an African.

Now, alongside trade wars, genocide, and disease, another specter haunts the story of the Columbian Exchange. In fact, the economic metaphor of "exchange" sounds ridiculous when you consider that the European "explorers" colonized populations they encountered in the Americas by force and enslaved Africans and brought them to the Americas to labor. There's a lot to say about colonization and the slave trade.

In terms of knowledge production, these practices embodied Francis Bacon's philosophy of instrumentalizing, or exploiting, "nature": the new world and its peoples were resources to be used for the betterment of humankind, in this case, meaning Christian humankind. Colonization and slavery also produced a series of questions that natural philosophers would obsess over for centuries: were native Americans more "natural" than other peoples because they didn't have the same technologies? Did they provide a simplified and therefore useful model of how societies function in general?

These questions sprung from a deep misreading of indigenous cultures, but at least they inspired a few philosophers to question the naturalness of European ways of living. Questions also arose for the life sciences: were the Americans, Africans, and Eurasians descended from the same ancestor, or had there been multiple acts of genesis? Was the bible literally true?

It didn't say anything about a new world! And questions about the Columbian exchange still haunt historians of science. How did people in the "New World" understand the arrival of Eurasians?

What kinds of knowledge did they make? What counts as science? Only recently have some historians started to recognize the skills and technical knowledge of indigenous and enslaved peoples.

This is an active area of research today, and one we'll return to. Alongside the "new science" created by the thinkers of the Scientific Revolution, the Age of Exploration created a new sense of the new in Europe. It revealed a new world to explore, to map, to find tomatoes and chocolate in, as well as to conquer and to enslave.

No document captures this shift better than the Nova Reperta, or New Discoveries of 1600. This series of engravings, based on designs by the Flemish painter Jan van der Straet, showed symbols of the Americas and the voyages of exploration alongside stuff that was simply new—or stuff that actually had been around in Europe for a while but suddenly felt new, such as the compass, the mechanical clock, and gunpowder. Next time—we'll meet a humble farmer named Ike who reimagined physics.

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