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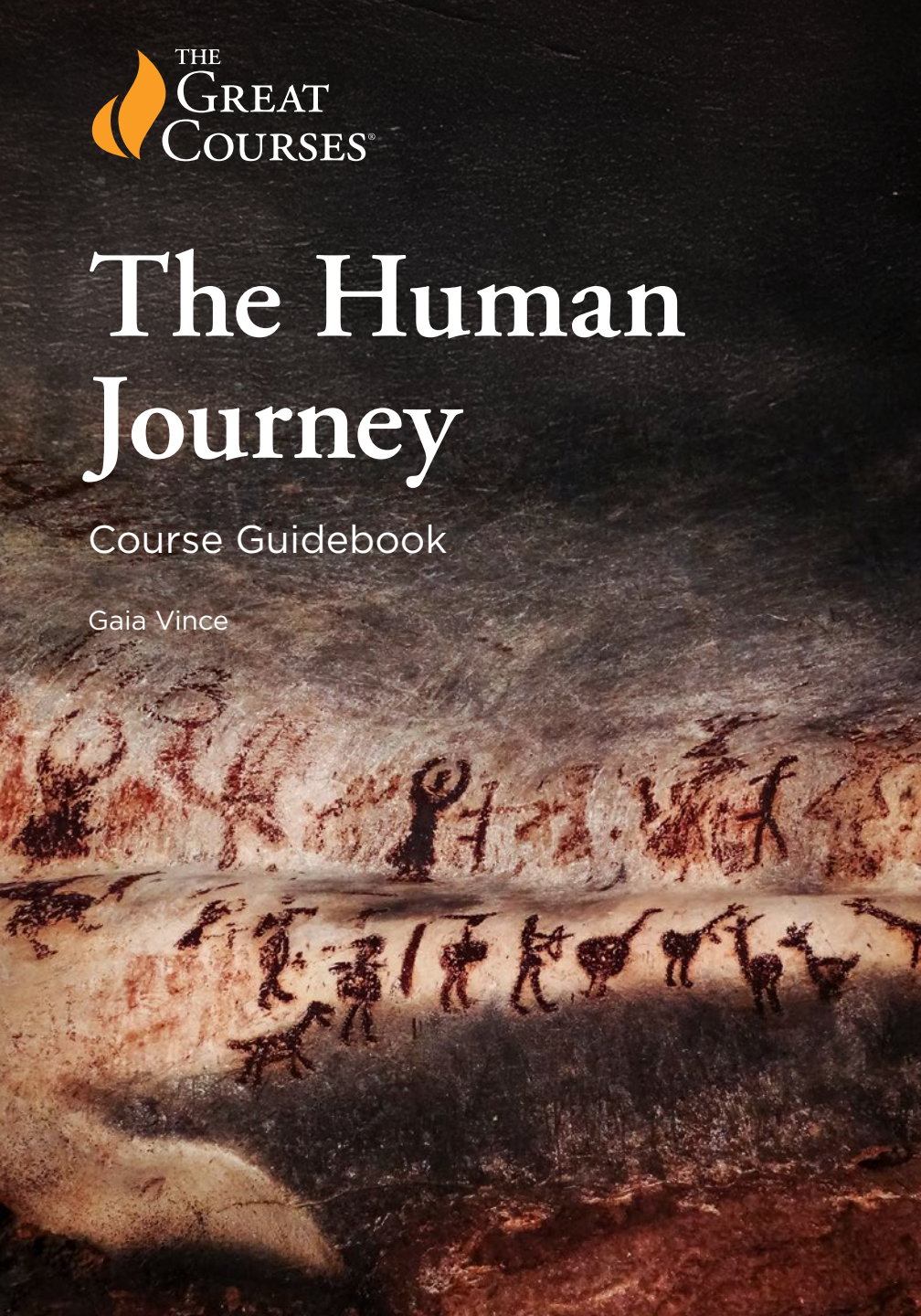
The Human Journey

Course Guidebook

Gaia Vince



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The Migrating Ape

THE HUMAN JOURNEY IS THE STORY OF A TROPICAL ape that evolved the ability to migrate. It used this ability to leave dangerous conditions, escape climate disasters, and find new fertile lands, reliable freshwater, and bountiful resources. Because of migration, that extraordinary primate has become the dominant species on Earth—with a current population of more than 8 billion. However, this success has also created the conditions for a looming climate breakdown, a biodiversity crisis, and a demographic crisis. In this course, you'll learn about migration as the tool that has allowed humans to thrive across different environments, grow their populations, and change the world. You'll also explore how a new mass migration spurred by climate change will reshape life, what it means for the planet, and how to prepare for it.

Migration as a Tool for Survival

One cannot understand human beings' place in the world or begin to grapple with today's environmental and social challenges without appreciating the fundamental role played by migration. Much of this understanding hinges on the dynamic interactions between human societies and their changing environments; however, the role of Earth's environment in human history has largely been overlooked. Climate change has guided where people live and where they move, and it has shaped the structure, power, and collapse of societies. It has sent people across continents and created concentrated explosions of settled populations.

Changes in temperature and the success and stability of states—as well as the expansion and collapse of empires—are strongly correlated. Whenever climates have become too dry, too cold, or too hot, large, settled populations have had to uproot. Throughout history, the availability of food and water and the ability to migrate people and possessions through geographically connected networks have been fundamental to the success of the human species. Where such networks have been strong and expansive, societies have been able to survive climate disasters by migrating away from danger or by transporting the resources they needed.

Migration is widely used as a survival strategy in nature. Many species have evolved an innate migratory response to seasonal or geographical variations in food and weather conditions. The bar-tailed godwit and the Atlantic salmon undertake long, arduous, and dangerous journeys because they are compelled to do so. When a caged American robin's biology triggers *Zugunruhe*—birds' migratory restlessness—it will launch itself northward again and again, hammering against glass walls even if it has no view of the outdoors. A western sandpiper's digestive organs atrophy to accommodate the demands of migration, and they obsessively stock up on specific foods and even naturally available types of performance-enhancing drugs.

Indeed, studies show that global dispersal is the most effective strategy for any species to prevent extinction. However, only a few species can adapt to multiple environments—most are exquisitely adapted to their particular niche. Among primates, only humans have spread across the globe without evolving into diverse species at different locations. This superpower has only

Birds migrating

been possible because of their highly adaptive brains and ability to cooperate with large numbers of unrelated people. By supporting each other through sharing resources, ideas, and knowledge, people have learned how to change the environment to suit their needs and to adapt themselves with skills and behaviors to suit various environments.

Building up webs of cooperative agents has allowed humans to spread the risk and energy involved in moving far from their original evolutionary niche. For instance, during the Pleistocene Epoch—which lasted from about 2 million years ago until around 11,000 years ago—hunter-gatherers populated the world whenever the climate was favorable. They were able to navigate a landscape of mile-thick ice sheets through flexibility and a deep reliance on group support—not through solo migrations.

Climate Change and the Mongol Empire

An example of how migration and climate are intertwined occurred at the end of the 1100s. At that time, the Eurasian Steppe was wracked by droughts, constant winds, and sparse foods. This vast area was home to continually

warring nomadic tribes who rode horseback over the Mongolian plains. These people spent much of their time raiding and fighting each other over scant resources and grazing grounds. To the south, east, and west lay the glittering cities of Persia, India, China, and Europe—where more sedentary populations had amassed great wealth and established legendary civilizations. Within decades, however, they all fell to the Mongols.

The Mongols created the largest land empire in history and ruled over modern Korea, China, Russia, eastern Europe, southeast Asia, Persia, India, and parts of the Middle East. So, how did relatively few nomadic warriors manage to conquer so many kingdoms in such a short period? Genghis Khan was undoubtedly a remarkable leader and formidable warrior who was able to unite the warring tribes and launch successful invasions. Nevertheless, scientists have discovered that he had help from the climate.

Genghis Khan

Decades of drought had made large settlements with cooperative water infrastructures—such as canals, irrigation channels, and reservoirs—the most efficient way to feed large populations. Cities relied on these communal projects for food and water, whereas nomadic tribes were unable to feed their herd animals or maintain healthy populations. These harsh conditions drove tribal division over scarce resources. Survival depended on raiding settlements and constant mobility in search of pastures.

Researchers studying millennia-old tree rings have found that the extraordinary rise of Genghis Khan and the

explosive expansion of the Mongol Empire coincided with unusually heavy rainfall and mild temperatures. At the turn of the 13th century, the climate warmed and became wetter. The grasslands of the Eurasian Steppe became green and verdant, feeding the Mongol herds and fueling the horses that were the backbone of the tribes' military. Genghis used this supply of horses to form the greatest cavalry force the world had yet seen. Thus, a good case can be made that climate change made the Mongol Empire possible.

By the middle of the 13th century, the Mongols had plundered, raided, or destroyed all the great cities of the region. Their capital, Karaqorum, and their many other conquered cities were bolstered by vast encampments comprising thousands of massive tents and wagons that could transport them between grazing grounds. In fact, the Mongols had a sort of internally migrating empire.

Climate Change as a Result of Migration

The rise of the Mongol Empire is an exemplar of how climate change ushers in the conditions that may in turn result in human-made climate change. This case is a microcosm of the continuous interplay between humanity and the environment.

Beyond the Mongols' tents roamed herds of millions of horses, sheep, goats, and other animals, which represented the traditional mainstay of their nomadic way of life. Expert workers—such as goldsmiths, weavers, and miners—were uprooted from their homes, transported for hundreds or even thousands of miles, and set to work wherever the Mongols felt they could be best employed. During the Mongol offensive into Hungary in 1241, a group of German miners was transported from Transylvania to work deep within the Mongol Empire to mine gold and forge weapons. This sort of disruption to settled populations dramatically accelerated the natural movements and mixing of human genes, ideas, cultures, and technologies across the entire region.

Depiction of Genghis Khan's hordes engaged in fearsome, violent invasions

In addition, Genghis and his warriors led a campaign of slaughter, cruelty, and destruction wherever they went. Indeed, the tales coming from invaded cities that had valiantly resisted were so horrific that many cities decided to submit rather than fight. The disruption to life, industry, and production caused by the invasions was immense. An estimated 40 million people were killed by Genghis's armies—approximately one-tenth of the global population of the time—which had a profound effect on the environment.

During this time, so many people were killed that large, cultivated swathes of land returned to forests, eliminating an estimated 770 million tons of carbon dioxide from the atmosphere. Thus, the bloodthirsty emperor Genghis is the only person in history to have carried out global cooling.

In 1323, a peace treaty with the Mamluks of Egypt forced the Mongols to abandon their ambitions of global conquest. Afterward, the Mongols in the Near East gradually converted to Islam, and the model of Mongol rule began to change, acquiring many of the norms and customs common to Muslim societies. In the following decades, the Mongols assimilated into the local cultures. In other words, the conquered peoples culturally conquered their conquerors.

Yet, these nomadic warriors had profoundly impacted millions of lives—whether through war, governance, trade, or the remaking and reorienting of their world. Technologies and ideas such as gunpowder and paper money were carried out of China and disseminated across the continent. Emissaries traveling to the Mongol courts returned home bearing tidings of strange and hitherto-unknown places and peoples, sparking the interest of many—including Marco Polo. Moreover, 1 in every 200 men worldwide—and 16 million in central Asia—are direct-line descendants of Genghis and carry his DNA. Hence, the Mongols dramatically changed the demography, society, resource dispersal, culture, climate, and genes of the entire continental mass.

Reading

Pederson, N., A. Hessl, N. Baatarbileg, K. Anchukaitis, and N. Di Cosmo. "Pluvials, Droughts, the Mongol Empire, and Modern Mongolia." *Proceedings of the National Academy of Sciences, USA* 111, no. 12 (2014): 4375–4379.

Vince, G. *Nomad Century: How Climate Migration Will Reshape Our World*. Flatiron Books, 2022.

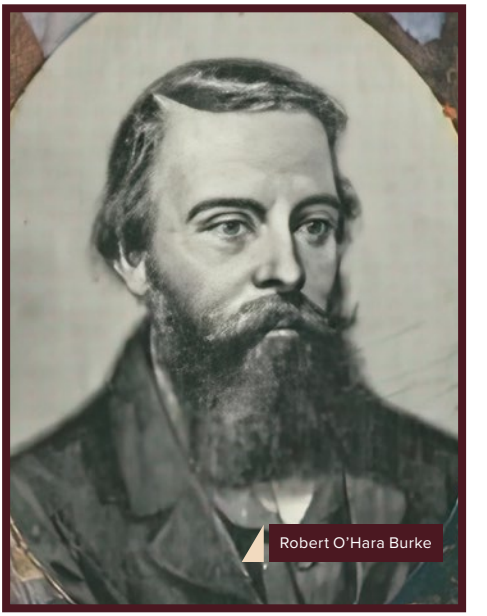
Vince, G. *Transcendence: How Humans Evolved through Fire, Language, Beauty, and Time*. Basic Books, 2020.

2

Why Cooperation Is the Key to Our Success

FOR HUMANS, MIGRATION IS DEEPLY INTERWOVEN with cooperation. Human beings' extensive collaborations have enabled them to migrate, and their migrations have forged today's global society. In other words, the survival and evolution of the human species depend on people's hypersociability and the cooperative networks they form. All people have this ability but sometimes choose not to use it—with devastating results. This lecture is about this key adaptation—the ability to rely on the cooperation of others—and how it has allowed the human species to dominate the planet and its climate.

The Burke and Wills Expedition


Robert O'Hara Burke

In 1860, an expedition of 19 men, 26 camels, 23 horses, and 6 wagons left Melbourne on the southern coast of Australia. They were headed north to discover the best route for an overland telegraph line through the uncharted interior of the continent—a distance of around 2000 miles. Ex-army officer and police superintendent Robert Burke and surveyor William John Wills led the expedition, which set off with great fanfare from the Royal Park in front of more than 15,000 spectators.

However, one of the wagons collapsed before they even made it out of the park. Within 3 days, another two wagons broke down. By the time the group reached Cooper Creek—the farthest limit explored by Europeans at the time—they had ditched the majority of their load. The group split, and only Burke, Wills, Charles Gray (a sailor), and John King (a soldier) set off for the northern coast with 3 months' supply of food in the height of summer.

Burke was highly suspicious of the Indigenous people they met and shot over the heads of natives who offered them fish to eat. Weak, short of food, and with swamps blocking their way, the group decided to turn back 58 days later. Gray soon died of dysentery, while the remaining trio eventually made their way back to Cooper's Creek. Disaster continued to befall them until they met a local Aboriginal tribe—the Yandruwandha—who looked after them with fish, beans, and their staple bread made from a seed called ngardu.

Nevertheless, Burke remained antagonistic toward the Yandruwandha and eventually drove them away by shooting at one of them. The explorers sought out more ngardu seeds from a semi-aquatic fern and ground them into a flour. For a month, they ate 5 to 6 pounds of ngardu bread a day but mysteriously grew weaker. Before long, Wills and Burke died. The remaining member, King, managed to survive because the Yandruwandha took him in. Some 3 months later, a relief party from Melbourne found King and brought him back to the city.

Like so many European explorers, Burke and Wills fell afoul of the cultural knowledge trap. Had they used the accumulated wisdom of the Yandruwandha, they would have learned how to prepare the ngardu to be nourishing rather than deadly. Ngardu must be collected once it has aged—not while it is young and green. It must be ground for digestibility and then sluiced thoroughly with water. This leaches the flour of thiaminase—an enzyme that destroys the body's stores of vitamin B1 if ingested. The trio would also have learned to expose the ngardu flour directly to the ash during baking, which further breaks down the enzyme. Without such cultural knowledge, the explorers unwittingly poisoned themselves.

The Human Brain, Culture, and Cooperation

Humans gave up adaptation to an ancestral habitat in return for the cultural advantage to survive in any environment. However, liberation from their ecological niche came with a cost to self-reliance. Unable to biologically adapt to every environment, they have to rely on others for survival know-how. Therefore, local knowledge is indispensable because of this evolutionary trade-off.

Cultural knowledge is accumulated over generations and allows communities to glean information, read landscapes, and find food and shelter easily. For instance, the Yandruwandha were able to see the food around them that was invisible to the Europeans, just as a European dropped into a city would easily locate food stores and cafés. All people are adept at navigating their environments because they learn to do so from infancy. Their cultural

Contemporary migrants helping one another during migration

developing bath—the behaviors, technologies, and other cultural practices of their societies—shapes their behavior, cognition, perception, personality, intelligence, and physical abilities.

The human brain is literally shaped by culture. One recent study looked at the cerebral cortices of human and chimpanzee brains and noted that the folds—called gyri and sulci—grow and change differently in the two species. The shape and location of chimps' brain folds are largely determined by genes, whereas environmental and social factors play a larger role in shaping humans' brains. Humans' brain growth mostly occurs postnatally—where the outside world has a greater effect.

This plasticity of the human brain means having to learn almost everything to survive from others. The demands of cultural learning require an exceptionally large brain, a long childhood, a period of adolescence in which to learn, and a strong social group. These characteristics evolved together as a successful strategy. A baby's first teacher is their mother, and as they grow older, other family members, peers, and older, trusted group members become their teachers.

Indeed, expanding and strengthening social bonds beyond the immediate mother-child and pair-bond relationships to wider kin and community was an important cultural step for the human species. Its origins are likely in the

social dependency of mothers, the pooling of childcare, and the maternal pursuit and maintenance of cooperative networks. This enhanced cooperative behavior benefitted humans' survival by increasing resilience in times of trouble. Within a few million years, human ancestors became smart, sociable, big-brained people capable of forging strong, supportive coalitions.

Humans operate in networks that go beyond their immediate families or even their groups or tribes. Unlike other social animals—such as bees or ants—which cooperate with their genetic clones or siblings, people cooperate with complete strangers and are a globally networked species. Social networks provide practical assistance as people move across geographical distances—and also through time. The way social groups hold, store, and share cultural knowledge acts as a database of information for people navigating different environments.

The Power of Stories

In the case of the ancestors of the Yandruwandha, stories provided a useful technology for learning, recalling, and teaching their cultural knowledge. As one Aboriginal elder explains:

> We have no books, our history is in the land. We learned from our grandmothers and grandfathers as they showed us these sacred sites, told us the stories, sang and danced with us the Tjukurpa (the Dreaming Law). We remember it all in our minds, our bodies and feet as we dance the stories. We continually recreate the Tjukurpa.

These cultural techniques passed down through the generations in "songlines" led to flourishing human populations across Australia. These oral maps of stories, land, people, and culture allowed Aboriginal groups to differentiate from each other, but they also functioned as a unifying factor.

Songlines also probably saved the Aboriginal people from extinction. Around 20,000 years ago, a trenchant ice age devastated Australia's environment. Droughts became severe, and conditions became impossible for many

mammals. Australia's giant marsupials all died out during this time, and the human population crashed by 60%. The groups that managed to hang on were geographically isolated across the vast continent, and the situation persisted for thousands of years.

Australia's giant marsupials

However, what should have been an evolutionary dead end did not result in local extinction. Songlines helped the Aboriginal Australians to survive when many other large animals died out. Facing harsh environmental challenges, people had to rely on specialized knowledge to find the resources they needed and to navigate different environments. Multistep, complex techniques had to be stored in the collective memory bank and passed on. Even when such information was useless at the time, they could be recalled as a lifesaver generations later.

Australian Aboriginals from 6500 years ago hunting

Furthermore, songlines helped ensure the survival of a healthy population to host this cultural information. Songlines kept the cultural avenues and gene pools healthy and enabled ice age Aboriginal culture to find a balance between being separated and connected. Throughout the terrible ice age, songlines and the rituals they described helped tribes cope with isolation, and isolation helped the stories and rituals survive. As the climate warmed and the continent became more habitable, Aboriginal populations flourished.

Stories such as the Aboriginal groups' songlines are oral archives of cultural knowledge that bind their collaborators together through shared cultural reference. They work as collective memory banks and subtly redefine the parameters of family or society. Stories do more than hold information, though. They also bind people together in shared belief systems and create patterns of behavior that allow them to identify each other as supportive, cooperative members of the group.

Storytelling is an inherently social enterprise: It relies on sharing a mental commons and agreeing together to suspend reality and explore a virtual space-time. Stories are a powerful survival adaptation because they allow people not only to travel back in time with their memories but also to mentally explore different future scenarios without expending time and energy. Stories act as

virtual world thought experiments to test risky or difficult permutations and store the outcomes. Through stories, the human species has been able to adapt to different environments.

Reading

Henrich, J. *The Secret of Our Success*. Princeton University Press, 2018.

Vince, G. *Transcendence: How Humans Evolved through Fire, Language, Beauty, and Time*. Basic Books, 2020. See esp. chaps. 2–4.

3

Moving Ourselves and Our Tools

HUMAN MIGRATION RELIES NOT ONLY ON EXCELLENT social skills but also on technological brilliance. As human ancestors migrated beyond their tropical niche, they needed to be innovative adapters to survive new environments and make them hospitable. In other words, they needed super social and technological abilities far beyond those of any other primate. This lecture presents the cultural innovations that led to evolutionary adaptations in human biology. Mastery of fire, the production of tools, and the invention of containers afforded humans unique opportunities and changed them physically and geographically. In a relatively short period, different abilities and anatomical and behavioral traits emerged to create a creature whose descendants would one day take over the world.

The Discovery and Use of Fire

Millions of years ago, wildfires consumed forested areas. They expunged habitats and food sources, opened up areas to new plant growth, and recalibrated the hierarchy of survival for other plants and animals. Large herbivores became more numerous in open savannahs, and so did the carnivores that hunted them. The power of fire to change the food density of a landscape would not have gone unnoticed by early forest-dwelling hominids, and they began to exploit it. They observed that the fires exposed creatures that were easy pickings, and their taste for meat eventually grew.

However, chewing and digesting raw meat was tough, whereas scavenging cooked carcasses (and plants) was a tastier, more hygienic, and more efficient way of getting calories. Early humans who ate cooked meals became healthier and were more likely to survive long enough to pass on their genes and food-sourcing habits to others. Cooking their food also changed their anatomy, brain size, and capabilities.

In time, humans learned to capture wild flames to produce their own fires and then carry the embers from camp to camp. Good, dependable social networks would have been essential to maintain these legacy fires over time and across different locations. Thus, as people became ever more reliant on fire, they also became more reliant on each other.

Stone Age people using fire

Whereas the earliest human ancestors had bedded down in tree nests for safety, fire protected their descendants from predators and the cold and allowed them to sleep in open savannahs. They became fully bipedal, losing climbing feet in favor of feet that were better adapted for running. This adaptation would only have been feasible if night-time safety was assured by fire protection. In other words, fire culture allowed the human species to change its habitat and increase its chances of survival. Fire gave people the ability to alter the environmental selection pressures acting on their genes.

Next came fire making. The act of making stone tools—chipping one with another—would have produced sparks from time to time. From there, imagining hominins kindling a fire is not a huge leap. Fire making can be as simple as rubbing a stick into a groove on another piece of wood, but this simplicity is deceptive. For a start, the choice of stick and hearth woods and where to find them are important yet unobvious. Therefore, whichever method a group used was passed from one generation to another. This information was as precious as the materials used.

Different methods to create fire demonstrate a key difference between how hominins and all other animals operate. While primate cultural practices are simple and easy enough for an intelligent individual to innovate, fire making is multistep and complex. By the time of *Homo erectus* more than 1 million years ago, the collective cultural tool kit contained so many different and complex skills—from fire making to tool production—that an individual would not have been able to come up with them all in a single lifetime. Instead, humans learned from each other. They practiced and remembered details in such a way that their cultural knowledge became cumulative.

Fire Making and Human Evolution

One of the consequences of humans' fire-powered landscaping and migration to the savannahs was that hunting bigger animals became easier. This important cultural development changed humans' anatomy and behavior. Hominids had been primarily vegetarian foragers for millions of years, but their bodies adapted as their culture and environment changed to support a meatier diet. They evolved into endurance hunters that ran on flexible,

high-arched feet. They developed narrow hips and pelvises, muscled buttocks, and S-shaped spines to carry their flat-faced heads. Their torsos and arms lengthened to counterbalance their stride and provide stability.

Furthermore, humans developed a novel ability to throw projectiles—such as stones and spears—with speed and accuracy. They shed their body hair and dramatically increased their number of sweat glands, which enabled them to maintain a safe body temperature while running in the heat of the tropical sun. A gene for dark skin appeared, which protected them from ultraviolet sunlight. Their genes also responded to cultural behaviors, enabling them to run beyond the endurance of any animal on the savannah or chase it until it was in range for stones and spears.

Perhaps most importantly, cooked food changed the human brain. It turned human ancestors into creatures clever enough to plan to leave their comfortable tropical niche and set off into unknown lands. Because cooked food was easier to chew, the large jaw, strong teeth, and facial musculature required to tear apart and break down meat and plant material were no longer required. As a result, humans evolved bulbous, globular skulls and flatter faces with the jaw and mouth anatomy for speech.

Cooked food was also more nutritious because heat chemically broke down food so that more calories, protein, and other nutrients could be absorbed by the body. Eventually, smaller guts that required fewer calories were selected, and the size of the human brain's cortex dramatically increased. Raw food would not have provided enough protein and calories to support a brain of such size. Thus, humans' barbecuing ancestors became more intelligent, more social, better able to hunt, and better able to get high-quality cooked food. All of these benefits allowed for further development in the brain's structure and capabilities.

This suite of anatomical changes was highly adaptive; in other words, they were evolutionary changes that improved humans' survival in the environment. Although humans—with their puny bodies and lack of sharp teeth and claws—did not look like other savannah hunters, their cultural and anatomical changes made them the deadliest creatures alive.

Hunting and Secondary Migrations

Even 2 million years ago, humans' hunting tools and weapons were more varied than the sticks used by chimps or the sponges wielded by dolphins to flush out their respective prey—and they were deliberately manufactured. Unlike other animals, human ancestors fashioned a selection of tools and used them to process their kills afterward. Using a specific tool for a particular job was more efficient than maintaining vast biological reserves of less specialized muscle energy. Thus, hunting became a learned cultural adaptation whose multistep practices evolved over thousands of generations.

Hunting fundamentally changed society by introducing divisions of labor between hunters and gatherers and allowing for longer settlement periods. At the same time, dependence on the campfire became mutual: The fire became another hungry member of the group, needing constant attention and refueling. More frequent, increasingly longer, and more costly journeys in search of firewood became necessary at a time when people lived a hand-to-mouth existence. To accommodate these extra labor costs and make hunting more efficient, human societies responded by forming larger, multigenerational bands.

Indigenous people hunting an elephant

Therefore, hunting made humans more socially and technologically adept. A hunt could require a group of people working in concert, and each person had to be able to anticipate the actions of the other hunters—as well as any other predators—by imagining the thoughts and perspectives of other minds. They learned persistence, skill, careful observation, and strategy. They came to recognize and follow animal tracks and understand animals' behaviors. They could also mentally conjure a future scene and communicate this idea with the group.

These abilities gave humans another key tool: secondary migrations. Human migration differed from that of other species because people moved not only themselves but also their stuff. Carrying technology—such as bags, sacks, and baskets—enabled them to bring weapons, water, food, and tools with them. Being able to carry an infant in a sling, firewood in a basket, and water in a bladder was transformational. People were no longer limited to locations with constant freshwater availability. They did not need to remain in places with the resources to make hunting tools from scratch, and they were able to make longer excursions into unknown lands.

For instance, archaeological sites at Blombos Cave in South Africa and Qafzeh Cave in Israel reveal the use of shells for holding red ochre around 120,000 years ago. A small piece of cord made from bark fibers was found

at a Neanderthal site and dated to between 41,000 and 52,000 years old; it suggested the creation of bags and the weaving of baskets. At other sites, indicators of baskets, nets, and pots date back to about 30,000 years ago. Containers made of wood and stalagmites made some 50,000 years ago have been discovered. In 1991, a 5300-year-old frozen man was found in the Ötztal Alps in Tyrol, Italy. Named Ötzi, he carried dozens of tools in his quiver and baskets—including an ax, a bow and arrows, a dagger, medicinal fungi, and a fire-making kit. A pouch sewn to his belt contained a drill, an awl, and a scraper.

When living in locations and times of plenty, tools carried in containers made it possible to store and plan for locations and times of need. Carrying such tools indicated that people were increasingly thinking ahead and recognizing their future utility. This ability may be right at the heart of what it means to innovate, as the appearance of mobile containers in the archaeological record can indicate a key cognitive shift. Foresight began to drive tool innovation—including new types of containers—and the evolution of ever-more-sophisticated material cultures.

Reading

Dominguez-Rodrigo, M., T. Pickering, F. Diez-Martin, et al. "Earliest Porotic Hyperostosis on a 1.5-Million-Year-Old Hominin, Olduvai Gorge, Tanzania." *PLOS ONE* 7 (2012): e46414.

Fessler, D. "A Burning Desire: Steps toward an Evolutionary Psychology of Fire Learning." *Journal of Cognition and Culture* 6 (2006): 429–451.

Henrich, J. *The Secret of Our Success*. Princeton University Press, 2018.

Perkins, S. "Baseball Players Reveal How Humans Evolved to Throw So Well." *Nature* (June 26, 2013). https://doi.org/10.1038/nature.2013.13281.

Vince, G. *Transcendence: How Humans Evolved through Fire, Language, Beauty, and Time*. Basic Books, 2020. See esp. chaps. 3 and 4.

4

How We Invented Valuables to Exchange

AT FIRST, HUMANS LIKELY MIGRATED TO ACQUIRE the resources they needed for survival. At some point, however, a surplus of these essential resources began to be exchanged across social networks. A vigorous exchange in nonessential resources also developed, and migrations driven in pursuit of these goods eventually became so important that they changed the world. Such exchanges increased groups' resources and shared the energy costs of acquiring everything an individual needed. They allowed people to specialize and built groups' resilience for difficult times or environments. In this lecture, you'll look at the origins of trade and how it oiled the wheels of human migration.

The Role of Beauty in Conquest and Trade

In October 1492, Christopher Columbus landed in the New World and ended the roughly 10,000-year isolation of the American people. His voyage supercharged the process of globalization and transformed the world. The Columbian Exchange brought silver, gold, minerals, foods, tobacco, and turkeys to Europe, Asia, and Africa. To America, it brought diseases, slavery, extinctions, Christianity, livestock, and guns. The impact was rapid and extreme. Advanced American civilizations were devastated within decades, as more than 90% of the Indigenous population was extinguished by measles, smallpox, and flu.

Christopher Columbus

For the Europeans, trade in resources and enslaved American and African labor reduced the energy costs of innovation and funded a cultural explosion of creative ideas, technologies, architecture, and arts. The new wealth pouring from the Americas into the European elite restructured and strengthened institutional hierarchies. It enabled Christianity to push Islam out of Europe and ramped up exploration, colonization, and private enterprise across the known world. Wars were fought, lands were colonized, and fortunes were made.

The flourishing of industry and creative expansion in the advancing Western economies

occurred at the expense of the stifled economies in the Global South, whose resources were stripped and whose impoverished cultures were crushed. As tribes were split and relocated or were no longer allowed to practice their social rituals, much of the cultural knowledge acquired over generations was lost. In some cases, new migrations swamped Indigenous populations, and new cultures and languages took over. In others, populations died as a result of disease, conflict, or famine.

The Dutch and English especially profited from the control of the spice trade in the East Indies—particularly the Spice Islands, which were the only source of nutmeg and cloves. Before Columbus's voyage, spices' high prices, limited supply, and mysterious Eastern origins fueled a lucrative European market. However, the Ottoman Empire controlled all roads to the East, and the spice trade became increasingly dangerous and costly. Therefore, a sea route was sought.

Nevertheless, spices had an entirely arbitrary and invented value. The word *spice* derives from the Latin *spec*—the noun referring to appearance. Spices were desired for their beauty. Colorful, exotic, aromatic, and flavorsome, they were essentially useless as a nutritional resource. Any alleged preservative benefit was outweighed by the fact that fresh meat was cheaper and easier to obtain than spices. In other words, pepper, cloves, cinnamon, and nutmeg were desirable because of the cultural value people ascribed to them. Once this value was accepted by society, spices became objects of conspicuous consumption, a mark of elite status, and the first globally traded plants. The spice trade was a phenomenally important global activity because the human quest for beauty was—and is—so powerful.

Long before the Columbian Exchange, human ancestors harnessed this innate desire for beauty to lower the costs of trade, building networks that boosted cultural complexity and improved survival. Trade was the cultural lever that enabled the human species to compete through cooperation, but beauty was the facilitating mechanism. Beauty has always played a key role in human culture: People use it to ascribe meaning and social value to things irrespective of their survival benefit—such as rare flavors, difficult-to-make colors, and all manner of shiny materials. Indeed, humans delight in the very uselessness of ornament.

Specialization and Barter

The earliest human societies traded with each other through barter relationships. Although each group drew strength from its own patriotism and prejudice against outsiders, they operated in a web of dependence. Tribes cooperated over resources, collaborated against other tribes, and traded in skills and materials. Indeed, trade was so important that some anthropologists believe it may have driven the emergence of language. Without language, even straightforward exchanges would have been difficult.

Just as individuals' specialization within a tribe made sense, specialization as a tribe also made economic sense, as the 19th-century economist David Ricardo showed. Ricardo's scenario presents two countries: One is good at producing food and very good at producing clothing, while the other is bad at producing food and very bad at producing clothing. One may think that the first country should make both food and clothing because it is better at both tasks, and the second country should just be ignored. However, for each country to specialize in what it is best at and trade with the other is more efficient, since comparative advantage is more important than absolute advantage.

While early humans could improve their skills more quickly through specialization, they also had to trust each other. However, trust was more challenging between groups. For example, if one group had no whale meat but made spearheads, they could trade with a hunting group that needed this tool. But what if the hunters had no meat to trade and needed the spearhead to get it? This sort of delayed reciprocity required trust, since it involved one party handing over a commodity in the hope that they would eventually be compensated.

Thus, barter relied on a coincidence of supply, skills, preferences, and time. However, barter could not scale well. As societies grew bigger and networks became more complex, keeping track of goods and services in multiple exchanges relying on trust between strangers became difficult and costly. Relying on reputation and social norms to safeguard delayed delivery became risky. Reputational beliefs could suffer from errors about which person did

what, and people could disagree over the evaluation of goods and services. Over time, the mental load of calculating transaction costs and risks started to hinder trade and could potentially lead to conflict.

Beauty—in the form of desirable items—solved this problem. Humans are acquisitive and have a collecting instinct. From childhood, they collect things that they desire simply for their beauty. In humans' cultural evolution, the transfer and exchange of valued collectibles replaced reputation as the enforcer of reciprocation between tribes. Once this happened, trade boomed.

Take the 75,000-year-old shell necklace discovered in Blombos Cave on the southern tip of Africa—part of what makes it so special is that it is collectible. Finding the shells and making the necklace must have taken a great deal of skill and time when humans lived on the brink of survival. A compelling theory is that aside from their social purpose in strengthening tribal identity, such beautiful trinkets were collectibles that could be exchanged. Like modern money, the perforated shell beads at Blombos were small and portable and could be stored without decaying.

Similar shell beads have been found at sites ranging from Algeria in North Africa to the southern Cape and across to Israel, dating back 120,000 years. Several of these locations are so far inland that the shells must have been brought there—revealing active, continent-wide trade networks between migrating coastal and inland peoples. These ancient, organized networks enhanced genetic and cultural exchange and accelerated humans' technological evolution toward greater complexity.

Migration and the Trade of Collectibles

For most of history, humans lived as nomadic hunter-gatherers or herders owning the bare minimum of stuff that could be packed up and carried. The few personal items they owned—usually jewelry or perhaps a decorative rug—tended to be valuable and collectible. Trade in these goods provided some measure of economic certainty in an unpredictable life. Objects valued as collectibles acted as insurance policies because they were economically

Depiction of a hunter-gatherer tribe

significant—thus spurring the development of decorative material culture. As humans migrated, their reliance on the trade of collectibles grew, and this socio-material culture helped them survive in difficult environmental conditions.

For instance, the Blombos shell beads were pieces of raw material that had been made valuable through beautification rather than because they fulfilled a biological need. The society that made them valued creative skills and could devote the time and human resources to learning and practicing them. Similarly, the decorative objects and evocative paintings left by the first Europeans on cave walls tell the story of a creative, resourceful people who survived and thrived in some of the harshest conditions in human history. They used strong trade networks to exchange culturally learned ideas, technologies, resources, and genes.

The main way the human population increased the land's carrying capacity may well have been through wealth transfers that were made more effective—or even possible—through collectibles. Human ancestors collected and traded raw materials over great distances as they migrated. Using these materials, they made musical instruments, figurines, jewelry, and other decorative items

of added value—which they traded. Trade allowed them to build greater social networks, increase their group size and cultural institutions, and improve their resilience to the harsh environment. It enabled them to occupy land across continents.

Trade helped ancient groups to migrate because it spread environmental risks. For example, if the water holes dried in one tribe's territory, causing a dearth of game, they could acquire food in an exchange with another tribe. Trade also provided security by allowing for safe passage through another tribe's territory and by enabling territories to be shared or bought. Humans discovered the benefits of doing business with their neighbors and consequently developed social strategies for intergroup interaction. These social norms helped boost the diversity and complexity of culture and changed the environment and human genes.

Reading

Cook, J. "The Lion Man: An Ice Age Masterpiece." The British Museum Blog, October 10, 2017. https://www.britishmuseum.org/blog/lion-man-ice-age-masterpiece.

Henrich, J. *The Secret of Our Success*. Princeton University Press, 2018.

Jacobsen, T. "Beauty and the Brain: Culture, History and Individual Differences in Aesthetic Appreciation." *Journal of Anatomy* 216 (2010): 184–191.

Vince, G. Transcendence: *How Humans Evolved through Fire, Language, Beauty, and Time*. Basic Books, 2020. See esp. chaps. 9 and 10.

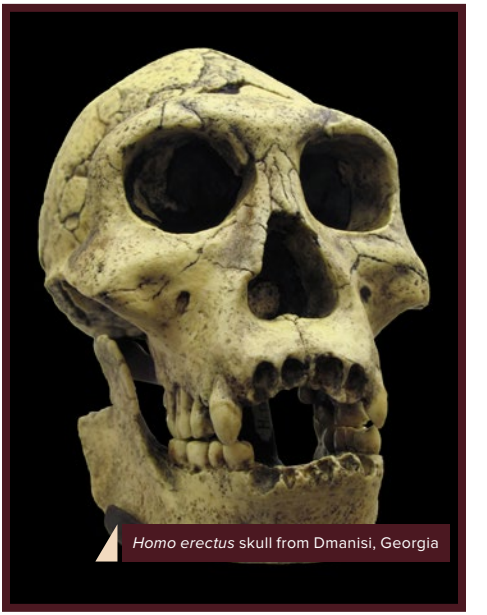
5

Moving Out of Africa and across the Globe

TODAY'S CITIES, CULTURES, AND ECONOMIES WERE forged on the movements of ancient human populations. Their networking skills enabled them to respond better to environmental change, to be resilient, and to adaptively migrate. By the end of the ice age, humans' migrations had allowed them to spread to every continent except Antarctica. This lecture is about those original trailblazers: the intrepid hunter-gatherer populations who migrated out from the cradle of Africa, the earliest people to populate Asia and reach Australia, the original Europeans, and the first courageous people to venture across an ancient land bridge to the Americas.

The Emergence of *Homo sapiens*

Emerging around 1.9 million years ago, *Homo erectus* pioneered the human diaspora across the globe. The first human species to leave Africa, they reached the frozen Arctic in the north, the vast plains of Central and Eastern Asia, and the tropical forests in the south. The earliest evidence of *Homo erectus* outside Africa comes from fossils discovered in places such as Dmanisi, Georgia, at the edge of the Caucasus region linking Europe and Asia. Fossils and artifacts dated to around 1.8 million years ago show that *Homo erectus* was highly resourceful and created tools to suit different environments.



Homo erectus skull from Dmanisi, Georgia

In the environments that *Homo erectus* inhabited, the human lineage diversified and evolved over hundreds of thousands of years and gave rise to a variety of different species—including *Homo sapiens*, Neanderthals, and Denisovans. *Homo sapiens* came on the scene in Africa some 300,000 years ago, when Earth was in the Pleistocene Epoch. So much of the world's water was locked up in ice that sea levels were far lower than they are now, and arid zones covered much of the planet's continents. Because of the scarcity of water and food, even the most resourceful human species were limited in how far they could explore.

However, occasional climate changes during this period produced rare wet spells that transformed and greened the Sahara. This unusual lushness attracted herds of herbivores to the formerly inhospitable northeastern reaches of the African continent. Human hunters followed them, eventually venturing

into the Middle East. Archaeological sites such as Ubeidiya in Israel, which dates to about 1.4 million years ago, contain stone tools associated with the earlier migrations of *Homo erectus* and the later arrivals of *Homo sapiens*. On the western side of Mount Carmel in Israel, Skhul Cave contains skeletons and sophisticated stone tools dating from 120,000 to 80,000 years ago. Such evidence reveals that *Homo sapiens* were thriving, adapting, and interacting with their environment in novel ways.

Homo sapiens migrated in waves, with the earliest sortie around 120,000 years ago and a subsequent, larger one around 80,000 years ago. These migrations were influenced by climate change, the development of new technologies, and the need for resources. Hunter-gatherers traveled on foot and used their networks to gain information about resource availability, obtain security and shelter, and trade and exchange essentials. The physical remains and artifacts these pioneering populations left behind reveal a remarkable people with rich inner lives.

For instance, a 51,200-year-old painting depicting a wild pig and three human-like figures was discovered in 2017 in Leang Karampuang on the Indonesian island of Sulawesi. It predates the famous cave paintings of Europe—the oldest of which was found at El Castillo in Spain and was created around 40,800 years ago. Such artworks provide a glimpse into humankind's prehistoric past and are transforming knowledge about early human explorers. Once considered a primitive protohuman species, ice age people clearly held very human motivations—including spiritual, artistic, and creative expression.

The vast geographical and cultural divides between cave art sites in Europe and Southeast Asia suggest that human ancestors developed the same types of abstract thinking and artistic skills independently at the different places they migrated to. Nonetheless, a more likely explanation is that the seeds of such artistic expression were planted in Africa and had been part of the tool kit people carried with them on migrations to other parts of the world.

Neanderthals and Denisovans

Fifty thousand years ago, humans had already spread from the frozen far north of Eurasia to the southern land mass of Australia and from western Africa to the eastern reaches of today's China. Sometimes, *Homo sapiens* were the first humans there; other times, the land was already occupied by their cousin species—such as Neanderthals and Denisovans. The DNA of Neanderthals, Denisovans, and *Homo sapiens* is very distinct, so the migrations of these different types of humans could not have led to widespread social assimilation. However, some modern European and Asian populations carry 1% to 2% Neanderthal DNA, and Melanesian people have 4% to 6% Denisovan DNA—indicating interbreeding to some degree.

In other words, these different species of humans who emerged in different ecological niches in diverse parts of the world are both *Homo sapiens*' cousins and ancestors. Human evolution is often pictured as a hierarchical parade of human species evolving one after the other to reach the pinnacle of human development: modern humans. Sometimes, it is pictured as a tree, with the trunk as a common ancestor and the branches representing distinct species.

However, human evolution looks much more like a braided river course. Different types of humans emerged and evolved in separate locations, migrated around, formed networks, and interbred with each other. *Homo sapiens* is now thought to have emerged from several closely related, interbreeding African humans. As they migrated out of Africa and across Eurasia, human ancestors met and mated with varied people everywhere they went—including different species of humans.

Scientific knowledge about these other species is relatively new. Since Neanderthal remains were discovered in Germany in the 19th century, many more of their bones, skulls, and artifacts have been found. These objects provide evidence of their skilled toolmaking and build a picture of how they lived. In 2008, a finger bone was discovered in Siberia's Denisova Cave, which belonged to another cousin species living between 48,000 and 32,000 years ago. Archaeologists later identified a few other fragments of Denisovan people, including a jawbone, a rib, and evidence of their skilled tool use.

Siberia's Denisova Cave

Homo sapiens migrated far more extensively than other human species, and their genes reflect this. They shared broadly the same area with Neanderthals for at least 30,000 years, but they seemed to have had little direct interaction with Neanderthals until they spread more extensively across Europe during one very cold period. *Homo sapiens*' presence likely discouraged Neanderthals from returning to areas they once favored, thus reducing their range and hastening their demise. Just a few thousand years after *Homo sapiens* moved into Europe, Neanderthal numbers dwindled to the point of extinction. All traces of this ancient cousin species had disappeared by about 40,000 years ago.

By contrast, *Homo sapiens* thrived, with greater numbers and prodigious cultural explosions. Furthermore, they went on an incredible journey southward from Asia over open ocean to Australia some 60,000 years ago. They may well have been drawn there by wildfires that would have been visible across the straits that separate today's Indonesia and the northern tip of Australia. The journey must have involved the building of rafts or other ocean-worthy craft to enable a population substantial enough to survive on the new continent.

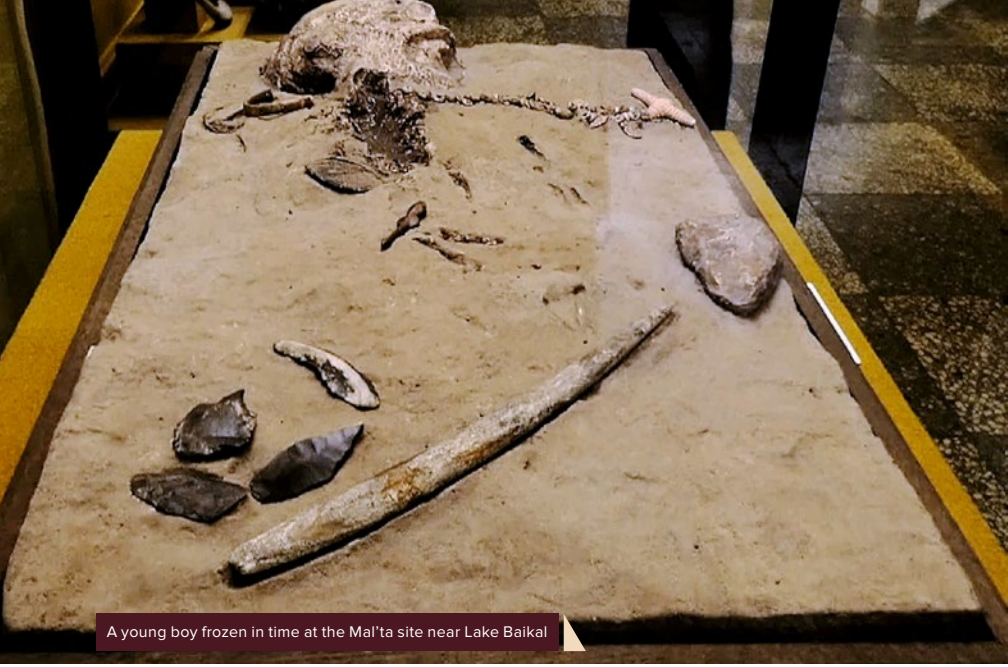
The First Americans

The first humans arrived in North America during the last glacial maximum between about 26,500 and 19,000 years ago. Ice sheets covering much of Alaska, Canada, and the northern United States locked up so much of Earth's water that Pacific Ocean levels in the north fell by as much as 410 feet below today's levels. These harsh climatic conditions gave rise to a 1000-mile-wide landmass called Beringia, which connected Alaska and the Russian Far East. The journey would have been walkable between 30,000 and 12,000 years ago.

In the 1920s, archaeologists discovered sharp-edged, leaf-shaped stone spear points near Clovis in New Mexico. The people who made them—now known as the Clovis people—lived in North America between 13,000 and 12,700 years ago. The Clovis were thought to be the first group to travel across Beringia, exiting through an ice-free corridor between the continental ice sheets in Alaska and Canada. From there, they spread quickly throughout the Americas and hunted megafauna—such as mammoths and bison—with their signature spear points.

However, in 2021, scientists announced that human occupation occurred far earlier than 13,000 years ago. They discovered fossilized human footprints in New Mexico's White Sands National Park, which was once a lakeshore occupied by people and wildlife for more than 2000 years. Using traces of organic matter pressed into the mud by ancient feet, archaeologists were able to carbon-date the footprints to 21,000 to 23,000 years ago. They concluded that humans arrived in North America long before any ice-free corridor through North America had opened. They must have traveled south along the Pacific coast on foot, by watercraft, or both.

Genetic studies suggest that the first people to arrive in the Americas descended from an ancestral group of Ancient North Siberians and East Asians that mingled around 20,000 to 23,000 years ago in Siberia. The DNA of a young boy frozen in time at the Mal'ta site near Lake Baikal 24,000 years ago reveals that the Siberian contingent of these ancient Arctic dwellers were a Eurasian tribe whose ancestors had mixed with Denisovan people. Native Americans today can trace 14% to 38% of their genomes to this boy's tribe, with the rest from an ancient East Asian group—likely from China.



A young boy frozen in time at the Mal'ta site near Lake Baikal

DNA evidence also indicates that at the end of the last ice age, the first Americans took only a few hundred years to migrate widely across the northern continent and reach Patagonia. Still later, migrations from Beringian populations peopled the Arctic. Before the end of the last ice age, all humans were migrating around the world. People were moving through the landscape, settling for no longer than a season, and meeting up in regular gatherings—but they soon dispersed into more sustainable population densities. These migrations brought the exchanges necessary for healthy genetic and cultural diversity.

Reading

Henrich, J. *The Secret of Our Success*. Princeton University Press, 2018.

Vince, G. *Transcendence: How Humans Evolved through Fire, Language, Beauty, and Time*. Basic Books, 2020. See esp. chap. 9.

6

From Hunting and Gathering to Growing Food

FOR ALMOST ALL OF HUMAN HISTORY, PEOPLE moved continually as hunters and foragers. Then, they began settling and relying on agriculture to feed themselves. Sedentism and agriculture evolved out of their success as a migratory species—when they were able to increase their populations to levels that impeded constant movement. Today, the majority of humans are settled and rely on the migrations of their food, resources, energy, and globally distributed human workers to provide them with what they need from faraway lands. In this lecture, you'll see how the migrating hunter-gatherer populations began to settle, built the first permanent homes, and sustained themselves using a revolutionary new culture of farming.

The First Human Settlements

Although hunter-gatherers tend to be thought of as nomadic and continually migrating, most tribes had semipermanent settlements that could have been in the same place for generations. Such camps could have lasted for months as the regular focus of feasting, religious rituals, festivals, and trade. Evidence of ancient semipermanent, open-air camps are now being discovered in increasing numbers in Western Europe. They appear to be summertime halts occupied by small groups of hunters, who joined up with larger groups to live in the shelter of caves during winter.

The idea of building a home goes back hundreds of thousands of years. Neanderthal constructions dating from 176,000 years ago have been discovered in southwestern France. Made from broken bits of stalagmite pieced together, several low circular walls deep inside Bruniquel Cave are among the earliest deliberate architecture known. In creating their homes, humans modified natural architecture by decorating caves and rock shelters. They also made structures using wood, cave-lion skins, and other available resources.

Permanent structures, such as caves, were occupied for tens of thousands of years. They reveal the rich semi-settled lives of human ancestors. Astonishingly detailed artworks beautify these earliest homes—including Neanderthal paintings and stencils dating back 65,000 years and figurative work made by humans in Sulawesi more than 35,000 years ago. In making a habitat a home, humans increasingly transformed their environment by logging forests, hunting megafauna, and eventually creating entirely artificial landscapes.

In 1965, an excavation site near the confluence of two rivers in the village of Mezhyrich, Ukraine, revealed around 150 mammoth bones in strategic, interlocked clusters. The bones had once formed the frames of four extraordinary houses built some 20,000 years ago—when wood was scarce and the shelter of caves unavailable. They were built by a hardy society braving some of the toughest conditions humans have endured—including forbidding ice sheets, blizzards, and violent storms. The hunter-gatherers who survived this frigid landscape had managed to create grand, lasting structures of great beauty—the earliest evidence of monumental architecture.

Each house required an entire herd of mammoth bones to construct. Organization and cooperation were necessary to drag enormous skulls weighing at least 220 pounds each. The primary purpose of these dwellings was presumably as shelter from extreme cold and high winds, and some of them could fit as many as 100 people inside. They were a cultural adaptation of migration that enabled a tropically evolved ape to survive an arctic environment.

Similarly, a hunter-gatherer society made what may be the world's first megalithic building at Göbekli Tepe in southeastern Turkey. Massive carved stones—some 16 feet high and topped with a vast horizontal oblong of stone—stand in circles on a hilltop. These 7-ton pillars were carved, erected, and covered 12,000 years ago by people who cooperated on an unprecedented scale over decades or even centuries. The immensity of this undertaking required hundreds of people who all needed to be fed and housed by the collective community. Settlements would have been required to sustain a growing population of worshippers, traders, and migrants seeking new opportunities in this area.

The Invention of Agriculture

The first permanent settlements appeared more than 10,000 years ago. They affected how humans interacted as a society and changed the dynamics of their interactions with the rest of the ecosystem. Such settlements put extra

pressure on the local resources. People exhausted the easiest foods and had to rely on eating less desirable options that needed greater preparation and were more costly to acquire. These new villagers began corralling wild sheep and goats and planting gardens of wild grains and fruits while weeding out unproductive, unappetizing plants.

This transformation of nomadic hunter-gatherers into farmers was only possible because of global climate change. The Earth's atmosphere during the last ice age contained so little carbon dioxide—around 180 parts per million—that photosynthesis was very inefficient. Consequently, the planet's total vegetation was just half of what it is currently. Nomadic tribes living 20,000 years ago could not permanently settle because the wild grasslands that managed to grow at that time could not support permanent herds—let alone farmers.

However, atmospheric carbon dioxide rose to 260 parts per million 8000 years ago. A phenomenal rise in plant productivity helped invigorate the soil and store nitrogen and water. The vast increase in wild grains, fruits, and other useful plants meant that hunter-gatherers did not need to travel so far for supplies, herds could settle for longer periods, and people had enough stability in their resources to invest in infrastructure—including irrigation channels and protective silos for grain.

Humans gathered and used the seeds from wild grasses for thousands of years, gradually shifting their evolution until they produced new species of domesticates. The idea of storing grains led to greater experimentation. People began selectively planting varieties with the fattest, easiest-to-husk seeds. These new crops with their big protein-rich seeds could be beaten and baked in the fire to make bread.

Within the Fertile Crescent area of the Middle East, the idea of farming was traded between populations—along with tools and other valuables. Small populations of these farmers migrated from Anatolia. One group made it north into Europe around 9000 to 7000 years ago and brought their Linear Pottery, new seed-collecting and sowing technology, brewing expertise, and animal husbandry to colder climes and less-conducive seasons. Another group from the Levant likely traveled west into East Africa; in fact, as much as one-third of Somali DNA can be traced to the Levant population. These skilled,

experimental farmers created glorious monuments, such as the Stonehenge complex in England, which took an army of builders fed on the first farmed produce and supplemented by wild food.

Permanent settlements soon became reliant on farming, which increased an area's capacity to support humans. Few as they were, the first Neolithic people outpopulated the hunter-gatherers everywhere they settled. Farming was such a useful technology that it was independently invented several times across the globe and widely transmitted elsewhere. The built world depended on it.

The Evolution of Sedentism

Once humans made the cultural shift to agriculture and a settled lifestyle, they started domesticating wild animals to make new livestock species and wild plants to make new crop species. This environmental and cultural evolution led to changes in human genes—with selections for adaptations to help metabolize cereals and resist the diseases of dense populations. Moreover, a sedentary lifestyle resulted in women having babies as frequently as every year, and this increase in population meant that more land was required.

Agriculture also fundamentally changed human migration patterns. Once humans invested in a field of sown crops, they needed to be around to reap the benefits. But although they became tied to the land, they tended to move on when they depleted the landscape. Demographers have modeled the evolution of sedentism and concluded that it only occurred where a population reached a level that impeded constant movement and the resource depletion rate was low.

Furthermore, agriculture enabled civilizations and allowed them to flourish. But at the same time, egalitarian societies became more socially unequal through settlement. For instance in today's Turkey, Çatalhöyük—a city of hundreds of mud-brick homes 8000 years ago—was a remarkably egalitarian society. However, it changed 6500 years ago, with inequality among households and violent punishment for wayward members of society—as evidenced by skulls with deliberate attack marks that had healed.

Çatalhöyük site in modern Turkey

Settled farming had other enormous social repercussions. For a start, it relied on greater cooperation on bigger public collaborations—such as protective battlements—since people needed to protect their crops and property from other tribes. Agriculture on the scale needed to support larger villages and cities also required massive earthworks, such as the digging of irrigation channels and protective dykes. Such projects needed planning, organizing, and managing and the establishment of hierarchical structures and institutions. This altered social networks, people's positions in them, and thus their life chances.

A whole new economy—one that included taxes—supported more public building and the social infrastructure to increase the population in a mutually reinforcing cycle. Grains could easily be taxed because the crops were harvested at a predictable time and could be stored, traded, and used as currency. A taxable populace allowed new social structures to form—with an elite that exerted power and used crop surpluses and taxes to fund infrastructure, armies, and city walls.

Agriculture was very labor intensive, and labor became an important resource. Elites strived to maintain large workforces at a time when life expectancy was falling due to disease and malnutrition. They did so primarily by

enslaving tribes through warfare and by controlling peasants in some form of bonded labor. The first civilizations all used slavery—including Sumer in Mesopotamia, which dates back 5500 years.

Still, settlement had clear advantages at the societal level. It allowed for larger populations that could develop more complex cultures. Everywhere agriculture was invented or imported, farmers colonized land formerly roamed by nomadic peoples. In addition, they became reliant on the migrations of people and resources from elsewhere to bring them the foods and other necessities that their own harvests could not supply. These secondary migrations of stuff eventually gained more importance than the primary migrations of humans.

Reading

Çatalhöyük Research Project. www.catalhoyuk.com.

Vince, G. *Transcendence: How Humans Evolved through Fire, Language, Beauty, and Time*. Basic Books, 2020. See esp. chap. 11.

7

How Migration Changed Our Genes and Cultures

MODERN EUROPEANS DERIVE AROUND 12.5% OF their DNA from hunter-gatherers who entered the continent more than 45,000 years ago and about 36% from Neolithic farmers who migrated from the Middle East about 9000 years ago. The remaining European DNA comes from a third migration of nomadic pastoralists from the Eurasian Steppe some 5000 years ago. These great migrations have shaped the human species—genetically and culturally. Today's populations are the result of such large-scale movements from faraway regions, and only a few people share ancestry with those who lived in the same region thousands of years earlier. As you'll see in this lecture, everyone is descended from migrants.

The Yamnaya Culture

Around 6000 years ago, Europe was largely peopled by Neolithic crop farmers, with some hunter-gatherers living on the hard-to-sow fringes. These ancient Europeans were dark-skinned, generally stocky, and shorter on average. Today's Europeans owe their pale skin, languages, and much else to the remarkable people who established the world's first transcontinental trading network. Called the Yamnaya, they journeyed north 5500 years ago from their territories along the banks of the Black and Caspian Seas.

The Yamnaya's own transformation began with the domestication of wild horses, which gave them both a beast of burden and a war vehicle. Then, they invented the wheel, allowing them to travel farther and faster while transporting goods. When drought hit their grasslands, they sought greener pastures and new trading opportunities. Some hitched their wagons and headed for central and northern Europe, while others ventured east into Asia.

By any standards, the Yamnaya migration was a violent invasion. Bands of male warriors riding on horseback and wielding sophisticated weaponry—including battle axes and bows and arrows—overwhelmed, slaughtered, or evicted the local men. The women were raped or chose to partner with the tall, healthy, exotic foreigners—who had fair skin and dark eyes and who spoke an Indo-European language. These people had advanced metalworking skills and made decorative jewels and intricately patterned, bell-shaped earthenware known as Beaker pottery—which they traded widely.

Furthermore, the Yamnaya were successful animal herders and breeders who transformed wild cattle, goats, and sheep into new domesticated varieties to provide food, hides, blood, and milk products. These people are thought to be the first to milk their herds, and they likely made yogurts, curds, and cheeses. They also experimented with unprocessed milk and developed the so-called lactase persistence gene—enabling them to benefit from the sugar, protein, fat, and other nutrients in milk.

Within just a couple of centuries of their invasion, the Yamnaya revolutionized European society, culture, and genes. They drove Stone Age farmers rapidly into the Bronze Age. The result of this cultural and genetic fusion was a predominantly fair-skinned, lactose-tolerant people who spoke

Depiction of Yamnaya-like people

a new Proto-Germanic language. They practiced crop, livestock, and dairy farming and invented a new pottery style known as Corded Ware. The Yamnaya's web of mobile societies formed an intercontinental communication system with horses and wagons. They pioneered globalization by exchanging food, knowledge, metalworking technology, and cultural skills across vast stretches of Europe and Asia.

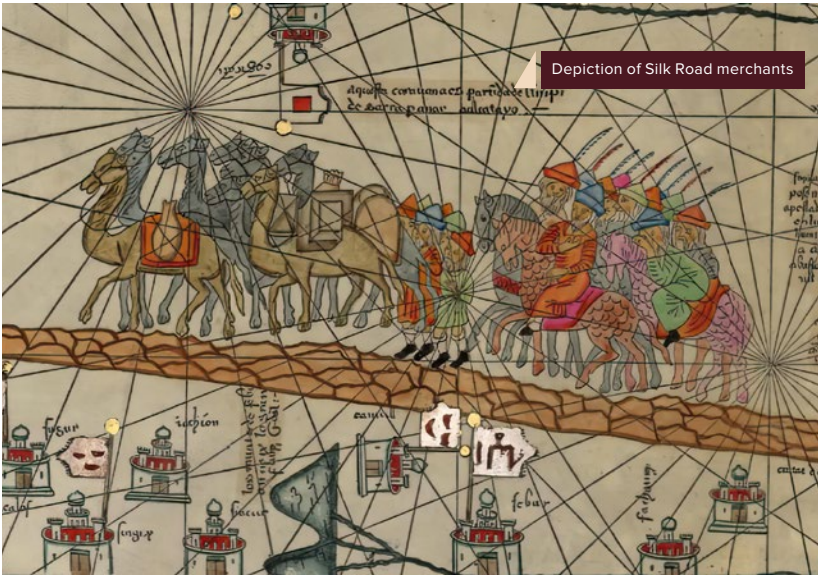
The trade routes created by the Yamnaya and their neighbors were important exchange networks for valuable collectibles—including amber, silk, and spices. These networks eventually became part of the Silk Road several millennia later. At a time when the global population was only about 5 million, the Yamnaya-were genetic and cultural revolutionaries. The world's population had grown to 360 million by the height of the Silk Road, which meant greater cultural and genetic diversity. Trade routes became complex networks that exported and imported cultures and whose interactions propagated new ideas, technologies, and beliefs.

The Silk Road

Arguably, the Silk Road began well before the Yamnaya figured out how to capture and domesticate wild horses. Some 7500 years ago in China, artisans began taming *Bombyx mori*—the silkworm moth. Over several centuries of breeding, they domesticated it to grow larger, breed faster, lay more eggs,

and produce tenfold more silk. The silk that the worm produced to cocoon itself during metamorphosis could be spun into a lustrous, strong, and fine material. This decorative thread was China's most valuable commodity, and it changed the world.

From Egypt to Rome, people lusted after silk cloth and even sent spies to try to decipher the secret of its production. By the 2nd century, the Yamnaya's ancient trade routes had been broadened into a 4000-mile network between the Pacific and the Mediterranean. This important economic and intellectual link between cultures persisted for centuries and connected previously isolated populations. Everything from ideas—such as Buddhism and Islam—to spices, precious stones, metals, and ceramics migrated along the Silk Road.



However, diseases such as the bubonic plague also found a way to travel. Flea-infested marmots and gerbils carried the deadly *Yersinia pestis* bacterium from Central Asia, and by 1345, the plague reached Black Sea ports. From there, it spread to Constantinople, the Middle East, Egypt, and the Mediterranean. In Europe, nearly two-thirds of the population died, and formerly prosperous cities were deserted. The societal restructuring that followed the Black Death

facilitated the rise of the Ottoman Empire, which made the Silk Road an expensive, dangerous passage for European traders. This disruption prompted the discovery of the Americas by Columbus.

Depiction of Black Death's impact on Europe

The secret of silk production eventually got out, and the Chinese lost their monopoly. Nevertheless, silk had catalyzed a cultural and genetic exchange of tribes who used to be separated by mountains and rivers and thousands of miles. The benefits of trade forced people to cooperate with other tribes with different social norms, genes, and technologies. Thus, trade boosted cultural innovation because technologies and behaviors that had been nurtured and selected in some tribes were brought under new types of selection pressure by other populations.

In some cases, new ideas and technologies, resources, and collectibles were exchanged. In other cases, the people themselves were part of the exchange through migration or other means—and their culture replaced an earlier one.

The great mixture of genes, people, cultures, and technologies that exists today owes much of its variety and complexity to settled peoples' interactions with migrants from faraway lands.

Nomadism and Expansionism

Nomadism allows people to adapt to danger by migrating to safety, so the steppes people were better able to cope with climate disasters than settled farmers. For instance, climate chaos triggered a 300-year period of drought in the Near East around 3200 years ago. Cities from the Levant to the Euphrates fell, and dynasties that had ruled for centuries across the Mediterranean and Mesopotamia collapsed. Waves of mass migrations over land and sea and warfare with invaders overwhelmed the Egyptians and Sumerians, and the beneficiaries were the migratory people.

In the following millennia, nomadic steppes warriors plundered agricultural settlements and cities. However, they were continually forced to retreat to where they could feed their horses. Alternatively, they settled and gave rise to the civilizations such as the ancient Greeks and the Ottoman Turks. These agile warriors—including Genghis Khan and the Mongols—brought down entire empires and left their mark on the gene pool.

The oceans also hosted migratory raiders. The Philistines repeatedly attacked Egypt and Canaan, and the Vikings raided coastal populations. However, nowhere were humans' expansionist tendencies more impressive than in Austronesia. Starting in Taiwan about 5000 years ago, human ancestors cast off overcrowded islands on boats filled with their children, animals, and seeds. With no guarantee when they would glimpse the next piece of land, these Polynesians expertly navigated across open ocean using the stars and their knowledge of ocean currents. They were able to occupy remote islands from Hawaii to Indonesia.

By contrast, European navigators discovering New Worlds (and new parts of Old Worlds) often found them already populated. These navigators invariably stole resources, lands, and people and migrated them to new regions. They asserted their own culture over the native one in the belief that it was inherently better, seeding the racist idea that some people were "primitive."

Although these journeys globalized humanity and advanced knowledge of the world, they also brought death and disease, devastated established cultures, and dramatically altered the environment.

Migration drove the industrialized world, and a part of it was in pursuit of forced human labor to transform the environment and the wealth of nations. Africa had previously been excluded from the large-scale intermixing of Eurasia, but some 12 million Africans were shipped to the Americas during the transatlantic slave trade. Such a dramatic movement of principally young men from one society to another has had lasting effects on genes, culture, society, and demography. Much of the genetic and cultural diversity in the Americas and beyond has a brutal, shameful history achieved through great suffering.

The genetic difference between the peoples of Europe and West Asia has more than halved within the past 10 millennia, and the ties that bind societies to particular lands—their national identities—are cultural and based on arbitrary moments in time. As the branches of the human family tree become ever more entwined, populations will increasingly feature a mixed heritage. Describing differences between people based on the fallacy of biological "race" will no longer be credible, as all human beings will be the products of familial migrations that occur within a few generations.

Reading

Krause, J., and T. Trappe. *A Short History of Humanity: How Migration Made Us Who We Are*. W. H. Allen, 2021.

Long, T., M. Wagner, D. Demske, C. Leipe, and P. Tarasov. "Cannabis in Eurasia: Origin of Human Use and Bronze Age Trans-Continental Connections." *Vegetation History and Archaeobotany* 26 (2016): 245–258.

Vince, G. *Transcendence: How Humans Evolved through Fire, Language, Beauty, and Time*. Basic Books, 2020. See esp. chaps. 10 and 11.

8

How We Invented Civilization

MIGRATIONS GLOBALIZED THE WORLD AND ENABLED the human population to grow. Eventually, a new kind of settlement emerged: the city. Cities are built on immigration, and they catalyze a diversity of migration—from people to food to ideas. They are rich melting pots of the human endeavor and play a significant role in shaping who people are today. The city is humanity's ultimate monument: an entirely artificial landscape designed and built with the intention to symbolize the culture and aspirations of its people. This lecture discusses how migration creates and shapes cities and the importance of cities in the development of the modern, networked world.

Melting Pots of Culture, Innovation, and Genetics

The story of human migration is one of human genes, culture, and landscape as they have changed over millennia. It is the story of nomadism and shifting agriculture, the endless tussle between people and the soil, the empires that expanded and vanished, the explorers that reached the furthest corners of the planet, and the people that followed in their footsteps. It is the story of belonging and its opposite—the displaced, the homeless, and the stateless. It is also the story of the most triumphant creation of a human niche—the city—and the migrants it attracts.

Humans spread across the world through the networks they maintain. Where such networks are dense and well connected, movement is easy, and societies thrive. However, where networks are disrupted, movement is restricted, and societies and cultures decline. People are dependent on the migration of other people and resources for the modern world to function. The exchange of people and goods from other places, the words they speak, the foods they eat, and the music they listen to all rely on the mobilized human world.

In making cities an important habitat, people have accelerated their cultural progress, complexity, and evolution. Just as the Silk Road and the Atlantic Ocean were vital networks for the exchange of ideas, technologies, and genes, cities have become focal points for cross-cultural trade. They are cultural factories that attract migrants from diverse populations into a dense environment that increases the opportunities for them to interact. As trade networks grow and technologies evolve, cities become ever denser—increasing the rate of innovation in a positive feedback loop.

Because of citizens' relative anonymity, which weakens social pressure to follow societal norms, they are freer to explore ideas and more able to invent new norms—from political philosophies to gender differences to musical genres. City dwellers have different social networks and ties to the land from villagers, as well as a different sense of identity. They are likelier than villagers to know a diverse range of people, and the expansion of their networks increases the potential for fruitful interactions and drives innovation.

Furthermore, cities are the ultimate genetic melting pots. Differences between populations are fading. The reason is not because people have stopped evolving genetically but because they are intermixing more. Much of the tribal isolation of the past has been ended by increased migration and trade. This blending has been accelerated by the domestication of the horse and the invention of wheeled transport by the Yamnaya, as well as the sale of 4 million bicycles that enabled pre–First World War Europeans in geographically distant populations to meet and marry.

Changes in Human Biology

Cities are built environments that separate humans from the natural environments where they have evolved. These new environments have dramatically affected human biology—such as in the case of urban air pollution, which causes cardiovascular and respiratory problems and is responsible for about 9 million deaths a year. Urban infrastructure has also added to the problem by literally piping in disease and toxins. For instance, lead plumbing poisoned citizens in ancient Rome, and the Roman Empire's technological advances—as great as they were—were pretty disastrous for the health of their subjects. Indeed, archaeologists can now track the spread of the Roman Empire by tracing the spread of intestinal worms.

Sanitation has always been an issue for citizens. Until very recently, the death rate of city populations was so high that they were only maintained through the regular immigration of countryfolk. Once humans started living in dense, large populations, regular epidemics of diseases that were contracted through close contact with other people or animals spread easily. The people who survived tended to pass their resistant genes on. Plagues sweeping through Europe and Asia changed the course of history, bringing down empires and ushering in new waves of people and cultures—such as the Yamnaya and the Mongols.

One chilling consequence of Europe's lengthy exposure to infection was the rapid conquest of Australia and the Americas, where the Indigenous populations succumbed to smallpox, measles, and flu. Meanwhile, Europeans trying to conquer African and Asian rainforest territory in search of gold, diamonds, and ivory were beaten by malaria. The Indigenous resistance in

those areas was coupled with a high incidence of hereditary sickle-cell anemia, which offers malaria protection. For example, African populations with a history of yam cultivation—a perfect mosquito-breeding environment—have a higher incidence of sickle-cell anemia but a lower mortality from malaria. As people change their environments, they also change their genes.

For a long time in Europe, people believed that keeping clean was best achieved by wearing a linen shirt that could be washed. Washing the body was thought to increase the risk of plague and other deadly consequences. With the notion of germ theory and the public investment in sanitation that followed cholera epidemics and events such as the Great Stink of London in 1858, keeping clean became easier and more desirable. Social norms quickly changed, and attractiveness became linked to how clean people and their clothes were. Cleanliness became an important and achievable goal, leading to the proliferation of bathhouses, toilets, sewerage, and the perfume industry.

Nevertheless, humans are still biologically evolving to live in urban environments, which they can find stressful. This strain is linked to a rise in conditions such as schizophrenia and asthma. But despite their health risks, cities remain hugely seductive. They represent the enlargement of the human tribe, with the associated benefits of monetary and cultural wealth.

Spitalfields, a district in east London

Urban Migration and Transition

All of the world's major cities were created by migration, often by refugees. In the next 80 years, the equivalent of a million-person city will be built every 10 days as humans undergo their biggest mass migration in history. Most urbanization in the coming decades will consist of poor people in Africa and Asia migrating from rural areas for paid work. Almost all of them will live in slums at densities as great as 2500 people per 2.5 acres.

Today, roughly one-third of humanity is on the move. Ideally, this urban growth will be matched by improvements in well-being. However, urban transition in areas such as Africa is happening at greater levels of poverty. For example, the city infrastructure of Lagos, Nigeria, is not developing at the pace needed to manage new migrants. Its vast, sprawling slums are bisected with narrow thoroughfares, poor sewerage, frequent power cuts, and other problems. The story is more or less similar across the world: Urban migration tends to be unplanned and iterative.

Cities that experience rapid urban migration generally expand through rural migrants building clusters of shacks on the outskirts of the established city. As they grow in number, they start to envelop rural villages, which become the new suburbs of the city. Governments regularly neglect these areas because the housing is often illegal, so the residents do not receive sanitation, water, health services, and other essentials. They also live in constant fear of eviction or returning from work to find their homes bulldozed—usually without compensation. Still, these informal, affordable housing projects are usually vibrant, commercial markets and can be an essential social mobility path out of poverty.

Eventually, these slums, shanty towns, favelas, and urban villages become legitimized as part of the city proper, and their structures are made permanent. The irony is that the diversity of culture and entrepreneurship that characterizes these areas often makes them some of the most desirable parts of the city. The result is housing prices rising to the extent that the original community can no longer afford to live there once it has been gentrified. The poor get pushed out to high-rise housing without the established social network or opportunity for entrepreneurship that gives a slum city its economically empowering dynamic.

These days, cities have considerable agency over issues such as migration and climate action. City governments decide on housing and employment for its occupants—whether they were born there, entered legally, or came as undocumented migrants. Many cities have already started issuing "urban visas." By 2050, some megacities—defined as cities with more than 10 million inhabitants—are expected to merge into dozens of megaregions. An example is Hong Kong–Shenzhen–Guangzhou in China, where more than 100 million people will live in a seemingly endless city. Such megaregions will probably become more influential than some nation-states.

Depiction of London slums called Seven Dials

Reading

Saunders, D. *Arrival City*. Vintage, 2012.

Vince, G. *Transcendence: How Humans Evolved through Fire, Language, Beauty, and Time*. Basic Books, 2020. See esp. chaps. 11 and 12.

9

Migration in the 21st Century

THIS LECTURE IS ABOUT TODAY'S MIGRATIONS and the coming decades' human movements. A great upheaval is coming, and it will change humans and the planet. The biggest migration in history is underway because of urbanization, conflict, and climate change. Conflicts are generating displacements around the globe, and climate change is a contributing factor in many of these conflicts. However, disasters now cause more people to migrate than conflicts—and this is only going to increase. Humans are currently facing a species emergency, and surviving it requires a planned and deliberate migration of a kind humanity has never undertaken before. In other words, people will have to move to survive.

Climate Change and Extreme Conditions

According to a 2020 study, the optimum climate for human productivity consists of an average temperature of 52°F to 59°F. This global niche is where human populations have concentrated for millennia, and so crops, livestock, and other economic practices are ideally adapted to these conditions. However, hotter temperatures combined with more intense humidity are set to make large swathes of the globe lethal for hundreds of millions of people. Fleeing the tropics, the coasts, and formerly arable lands, huge populations will need to seek new homes. This climate-driven movement has already begun, and it is adding to a massive migration already underway to the world's cities.

For large portions of the world, local conditions are becoming too extreme, and people have no way to adapt. The world already sees twice as many days where temperatures exceed 120°F than in the 1980s. This level of heat is deadly for humans and problematic for buildings, roads, and power stations. Consequently, large populations will need to migrate—not simply to the nearest city but across continents. In addition, those living in regions with more tolerable conditions will need to accommodate millions of migrants into increasingly crowded cities while adapting to the demands of climate change themselves.

Take the case of Bangladesh, a country where nearly one-third of the population lives along a sinking, low-lying coast. More than 13 million Bangladeshis are expected to leave the country by 2050. In India, more than 80% of the population lives in districts already highly vulnerable to extreme weather events. Also by 2050, half a billion people will need to move within China, and millions more across Latin America and Africa. Southern Europe's Mediterranean climate has already shifted north, leaving regular desert-like conditions from Spain to Turkey. Parts of the Middle East have been made intolerable by increasing heat, lack of water, and poor soil, and desert nations such as Sudan are becoming unlivable.

Unlivable conditions in low-lying areas of Bangladesh

In the coming decades, wealthy nations will be severely affected too. Hot, drought-afflicted Australia will suffer, as will parts of the US. Millions will be forced to move from cities such as Miami and New Orleans to cooler states like Oregon and Montana. Not only will the world's poorest have to flee deadly heatwaves and failed crops, but the educated, the middle class, and people who can no longer live where they planned will also need to migrate.

In 2024, all US states were afflicted by drought, and more than 78% of the population was affected. At the other extreme, by 2050, half a million existing US homes will be on land that floods at least once a year. Residents of important cities, such as the 350,000-plus inhabitants of New Orleans, will be affected. Louisiana's Isle de Jean Charles has been allocated $48 million of federal tax money to move the entire community to escape coastal erosion and rising sea levels. In Wales, the villagers of Fairbourne have been told their entire village is to be "decommissioned" in 2045 because of the encroaching sea. Larger coastal cities are at risk too: The Welsh capital, Cardiff, is projected to be two-thirds underwater by 2050.

For some populations, the upheaval may happen suddenly in the wake of catastrophes; for others, it may happen slowly. The number of people who will be forced to move within the 21st century is not set and depends on many factors that can be controlled. People can decarbonize faster to limit global temperature rise, and they can help affected communities adapt their homes, infrastructure, and agriculture to withstand extreme conditions. Nevertheless, people are not doing any of these things on a significant scale today.

Carbon Emissions and Global Warming

The amount of carbon dioxide in the atmosphere is currently higher than it has been for the past 3 million years. It is heating the planet beyond anything humans have experienced during their entire evolutionary history. Only the instantaneous Cretaceous–Paleogene meteorite impact 66 million years ago—which famously killed off the dinosaurs—caused more rapid global climate change than this human-induced global heating. People know that the present level of carbon emissions is dangerous and that the production of greenhouse gases must be stopped at a much faster rate. However, the vast, complex human economic, cultural, and technological system is slow to shift.

The major reason is that global energy use is increasing and will continue to do so for many decades. Most of this energy is generated by adding carbon dioxide to the atmosphere because it comes from burning fossil fuels. Therefore, the obvious options are to produce much less energy, to capture the resultant carbon dioxide before it enters the atmosphere, or to produce energy without emitting carbon dioxide. This problem is the most complex that human society has faced. In addition, vested interests in the rich world have made it much harder for the rest of the world—particularly the poorest in the Global South, who are also the most vulnerable to climate change.

Still, signs that the world is starting to act are encouraging. To begin with, acceptance is now widespread that the global warming crisis is caused by humans. In 2015, governments met in Paris and pledged to keep the temperature rise below 35.6°F and pursue efforts to limit the temperature increase to 34.7°F by 2100. People have taken key steps toward this commitment with the phenomenal rise in renewable electricity production. Installing a new solar or wind power plant is now cheaper than continuing to produce electricity at an existing coal plant. The plunge in the cost of renewables has also coincided with accelerated improvement in their capabilities.

However, this progress represents a mere fraction of what is needed to stabilize emissions—let alone reduce them. In 2024, the world's average temperature exceeded 34.7°F of heating for the first full year. Current carbon dioxide

Carbon emissions from factories

levels are more than 50% higher than the preindustrial average. Many scientists think that staying below a heating of 35.6°F by the end of the century is highly unlikely. Most countries are not making anywhere near enough progress to meet their pledged emissions reductions. Even if they fulfilled them, the national targets are so inadequate that they would be far short of what is needed.

Climate models predict that the heating will be somewhere between 37.4°F and 39.2°C by 2100—which actually refers to global average temperatures. Subtract the seas from those calculations, and the increase at the poles and over the lands where people live may be double that. In other words, some communities may experience an increase of as much as 50°F by 2100. If that seems a long time away, consider how many people alive today will still be around then.

A Picture of Earth in the Future

The world has reached a 39.2°F hotter temperature before—well before humans appeared. During the Miocene epoch 15 million years ago, intense volcanic eruptions in western North America emitted vast quantities of ash and carbon dioxide. Sea levels rose about 130 feet higher than today. The Amazon River ran backward, and California's Central Valley was an open ocean. A seaway stretched from western Europe to Kazakhstan and spilled into the Indian Ocean, while lush forests grew in Antarctica and the Arctic.

However, that global heating took place over many thousands of years, giving animals and plants time to adapt to the new conditions. Crucially, the world's ecosystems had not been degraded by humans yet.

Things look bleak for the world in 2100, with plenty of extinctions as species struggle to migrate and adapt. The oceans will have vast dead zones as pollutants combine with warmer waters to produce an explosion in algae that will starve marine life of oxygen. On top of that, ocean acidity from dissolved carbon dioxide will cause a mass die-off of shellfish, plankton, and coral. Coral reefs will be lost, and without them, fish populations will also plummet globally.

Coral reefs are among those affected by global warming.

As for humans, a wide equatorial belt of high humidity will cause intolerable heat stress across most of tropical Asia, Africa, Australia, and the Americas. Vast areas will be rendered uninhabitable for much of the year. To the south and north of this humid zone, bands of expanding desert will also rule out agriculture and human habitation. Some models predict that desert

conditions will stretch from the Sahara right up through south and central Europe, drying out rivers such as the Danube and the Rhine. In South America, the weakening of the easterly trade winds over the Atlantic would dry the Amazon, increase fires, and turn the rainforest into grassland. By 2050, tropical rainforests may well be pumping out more carbon dioxide than they absorb.

Humans are leaving the sanctuary of an unusually stable climatic era in Earth's history—one that has allowed crops to grow and civilizations to flourish. People are heading toward a world of increasingly frequent and intense droughts, as well as deadly storms and floods. The expanding human population must deal with an ever-shrinking zone of habitability within the restrictive cage of social and geopolitical boundaries.

Although the scale and extent of the current situation are unique, humans have experienced other crises over the past hundreds of thousands of years. They have survived them by migrating. Migration is the solution and always has been.

Reading

Boers, N., and M. Rypdal. "Critical Slowing Down Suggests That the Western Greenland Ice Sheet Is Close to a Tipping Point." *Proceedings of the National Academy of Sciences, USA* 118, no. 21 (2021): e2024192118.

Burls, N., and A. Fedorov. "Wetter Subtropics in a Warmer World: Contrasting Past and Future Hydrological Cycles." *Proceedings of the National Academy of Sciences, USA* 114, no. 49 (2017): 12888–12893.

Vince, G. *Nomad Century: How Climate Migration Will Reshape Our World*. Flatiron Books, 2022. See esp. chaps. 1 and 2.

10

How We Made Migration Hard

WHEN ENVIRONMENTAL CATASTROPHES, overcrowding, and poverty occurred in the past, relocation was the solution. This capability can also solve many of these problems today—and not just for the migrants. Host nations and the migrants' origin nations can also win in multiple ways. Yet, countries are currently sealing their borders, building walls, and demonizing migrants. People who need to relocate are facing enormous difficulties, as they risk not being included in the life-giving social networks of their destinations. In this lecture, you'll learn how humans have deliberately hobbled their extraordinary capability to migrate across their shared planet.

The Origins of Prejudice

The main barrier to relocation today is the system of restrictions on movement imposed by either someone's own state or the states they wish to enter. Most of the arguments against immigration rest on the idea of a true and pure national identity—meaning that some people "belong" while others do not. Dubious identifiers—such as religion or skin color—are employed to decide ancestral claims to land. This prejudice has long evolutionary roots.

Humans can be easily suspicious and mistrustful of outsiders, and they are easily persuaded that people from elsewhere are not as worthy or deserving of their resources. Being able to rely on each other in their social group is so important to survival that humans have evolved many ways to prove that they belong to their tribe and deserve its security and other benefits. From birth onward, people consciously and subconsciously learn their tribe's social norms. Doing so allows other tribe members to predict their behavior and trust them to act in everyone's interests.

Thus, tribal allegiance is predicated on being an insider who must protect the tribe's resources from outsiders. This outgroup prejudice is learned in early childhood and is a deeply held cognitive pattern. People empathize with other members of their group, but if they are told that another person is a member of an outgroup, they can stop empathizing. By identifying an outgroup, a person can clarify the parameters of the ingroup and make their position more secure within it.

The more similar people look and the more similar their cultural background, the more important identifying tokens and social norms become. Humans tend to accentuate any small differences—such as rituals, religions, and foods—and craft a group identity through stories that cast themselves as the righteous side in competition with other groups. These compelling narratives can even be an effective way of getting socially alike individuals to kill each other on the basis of belonging to opposed groups.

When a group feels threatened, it binds itself most strongly in defense of its collective tribal interests. These group dynamics offer politicians a cynical way to strengthen national institutions and keep politically diverse societies cohesive by creating competition and conflict with other groups. However,

the threat in most nations today is not external. Rather, the threat is from internal social divisions and inequalities—between rich and poor, old and young, rural and urban, university educated and not.

The Growth of Social Networks

The great paradox of human culture is that while people are primed for tribalism, they rely on networks of cooperation between tribes to exchange ideas, resources, and genes. Humans are skilled at welcoming strangers and use well-honed social strategies to enable cooperation between groups, as well as within them. For instance, more than half the people on Earth are bilingual or multilingual, and many share families between multiple groups. All of humanity has an entangled ancestry within a few generations, even if it is not immediately revealed in someone's skin tone.

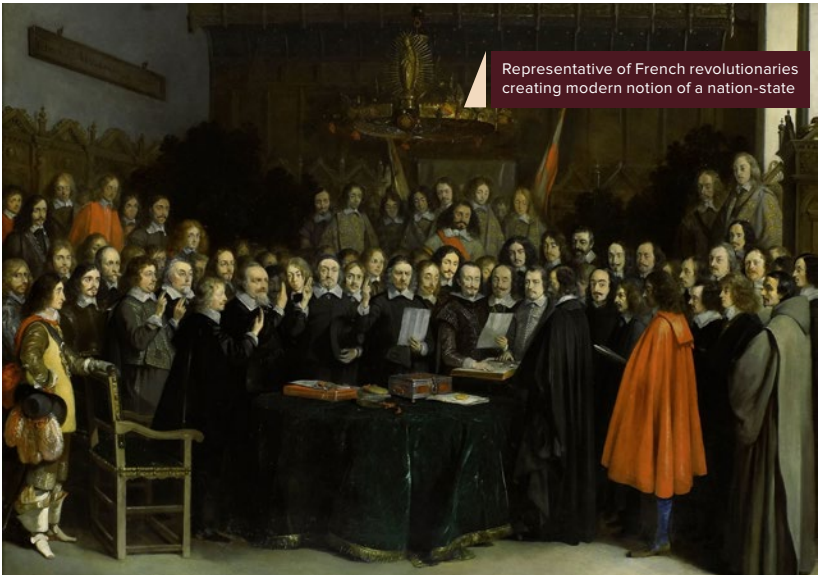
Human societal structures evolved in complexity as populations grew from bands of hunter-gatherers to larger settled villages that were loosely networked. These alliances helped people to survive hardship and feed and defend themselves. Societies grew through the mechanism of hierarchies: Several villages banded together under one chief, several chiefdoms were then banded together under a still higher chief, and so on. To grow, more villages could be added—and so could further layers of hierarchy.

This social complexity enabled greater collective action. Villages became organized around market towns grouped for tax purposes to supply armies or labor for harvesting or building infrastructure. People were largely self-organizing, and leaders did little actual governing. Leaders were mainly involved in the business of war—either to acquire more territory or to keep those territories they had.

People defined themselves "vertically" by who their rulers were. The land they lived on became the property of whichever ruler had acquired it through conquest, inheritance, or marriage. Alliances and territories were vague and changeable and often came under different jurisdictions for various purposes. The seeds of change occurred in 1648, when peace treaties were signed in northern Germany to end centuries of war. Existing kingdoms, empires, and

other political entities were declared "sovereign": None was to interfere in the domestic affairs of the others. However, these sovereign states were defined by their leaders' family trees and not by their people's national identities.

Revolutions created the first nation-states defined by their citizens' national identities rather than their rulers' bloodlines. In 1776, the 13 colonies of the United States of America declared independence from Britain. In Latin America, the revolutions were pioneered by the Creoles—descendants of European colonizers—who wanted independence from Spanish control. Before the French revolutionaries created their nation-state, almost nobody in France thought of themselves as French, and only about 10% could even speak the language—but by 1900, they all did.



Representative of French revolutionaries creating modern notion of a nation-state

The Rise of Nationalism

After the First World War, state borders were redrawn along linguistic and cultural lines, and the nation-state became the norm. Much of this was pragmatic: With the move from agricultural economies to industrialization,

micro-states became less viable because they did not always contain the necessary resources. Nation building required the creation of an ideology of nationalism, and national identity was deliberately fostered with mass education and mass media. Newspapers and other literature standardized vernaculars and established a linguistic community of people who read and cared about the same things. Once people's nationality became important, identity papers and the modern state emerged.

Greater government intervention in people's lives and a broad systemic bureaucracy were needed to run a complex industrial society and forge a national identity in its citizens. As governments exerted greater control, people got more state benefits from their taxes. They also acquired more rights—such as voting—which engendered a feeling of ownership over the state. It became their nation.

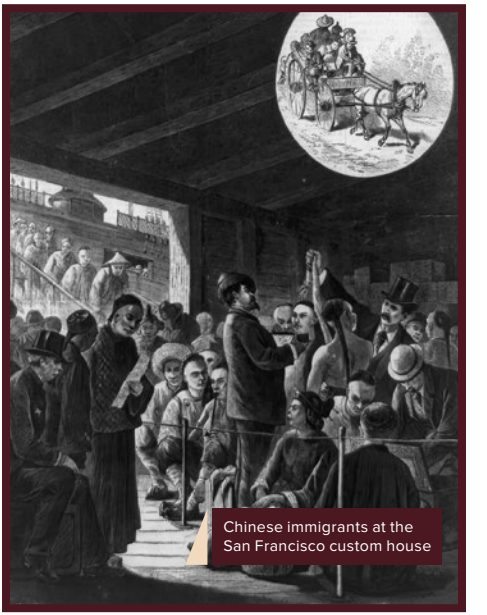
Therefore, the nation-state is an artificial social structure that emerged out of the complexity of the industrial revolution. It is predicated on the mythology that the world is made of distinct, homogeneous groups that occupy separate portions of the globe, and it lays claim to most people's primary allegiance. However, the reality is far messier: People always have a sense of belonging to numerous groups. The idea that a person's identity and well-being are primarily tied to that of some invented national group is a stretch.

Unsurprisingly, the nation-state model often fails, and such failures are often used to support the idea that nations should be forged from single homogeneous tribes instead of collating multiple groups within arbitrarily created boundaries. Nevertheless, the problem is not diversity but rather insufficient official inclusiveness. An insecure government allied to a specific group that it favors over others breeds discontent. The result is people falling back on trusted alliances based on kinship with other groups.

By contrast, a government with a mandate of official inclusiveness is generally more stable. Bringing diverse groups together into a functional system needs a complex bureaucracy to work, but the diversity of the nation's people must be equally included by officialdom. This inclusion by the bureaucracy is a starting point for building national identity in all citizens—particularly with a large influx of migrants.

The Demonization of Migrants

When the nation-state model spread, so did passports. Nonetheless, the explosive activity of the industrial revolution required the free movement of labor, trade, and money for production, so many passport requirements were relaxed. For example, Britain had a proud history of granting asylum to people. Between 1823 and the Aliens Act of 1905, not a single foreign citizen was refused entry or expelled from the country. However, nationalism propelled Europe toward war, radically shifting attitudes toward suspicion of foreigners and stoking fears about whether they were spies.



Chinese immigrants at the San Francisco custom house

Borders are "othering" structures, and nations have been quick to use them to maintain their ingroup/outgroup hierarchies. Border policies have included the United States' Chinese Exclusion Act (1882), the White Australia policy (which lasted until 1973), and Britain's Commonwealth Immigrants Act (1962)—which effectively reduced citizenship rights for darker-skinned people born outside the UK. Within the past few decades, borders have become more restrictive, and the rhetoric around immigration has grown hostile—particularly to refugees. Some states are even paying others to imprison would-be migrants within their borders.

Migrants have been portrayed as a security threat, and pledging stronger borders is a vote-winner across the world. People are told that immigrants will steal their jobs, drive down wages, and freeload on social services—from hospital care to government benefits. Politicians have allowed the rhetoric

around human movement to become truly toxic. People are banned from crossing invented lines of geography not because of what they have done but because of where they were born.

While immigration controls are regarded as essential, huge efforts go into enabling the cross-border migration of goods, services, and money. Yet, humans—who are a key part of all this economic activity—are unable to move freely. Industrialized nations with demographic challenges and labor shortages are blocked from legally employing migrants who are desperate for jobs. By 2050, up to 1.5 billion people will have to leave their homes for safety or new opportunities. They will either add to economic growth, or their talents will be wasted.

Humanity now numbers more than 8.2 billion people locked into geographical positions on this planet by chance of birth. Passports and privileges are bestowed or inherited unequally, enabling some people to explore the planet unhindered, while others are trapped. Wall-building and the demonization of migrants can result in death, slavery, and hate crimes—but they do little to prevent migration. People will continue to move, and many have no choice but to do so.

Reading

Gaskell, A. "The Economic Case for Open Borders." *Forbes*, January 21, 2021.

Loarie, S., P. Duffy, H. Hamilton, G. Asner, C. Field, and D. Ackerly. "The Velocity of Climate Change." *Nature* 462 (2009): 1052–1055.

Vince, G. *Nomad Century: How Climate Migration Will Reshape Our World*. Flatiron Books, 2022. See esp. chaps. 3 and 4.

11

The Economics of Migration

MIGRANTS CONTRIBUTE AROUND 10% OR $6.7 trillion of global gross domestic product (GDP). This amount is $3 trillion more than they would have produced in their origin countries. Several economists calculate that if borders were removed, global GDP might increase by at least $90 trillion a year. However, nation-states' recently invented national border controls and attitudes toward national identity and migrants are causing unnecessary trouble. People are trapped in terrible circumstances when they could be using their talents to improve their lives and help the societies and economies of safer locations. This lecture discusses the importance of migration to the wealth of nations and challenges some beliefs about migrants.

The Myths Surrounding Immigration

Decades of anti-migration rhetoric and misinformation have resulted in a massive misconception about migration. People also tend to believe racist and prejudicial tropes about migrants—particularly when they are repeated by prominent politicians. For example, many believe that migrants tend to be Muslim and male when, in fact, half of all migrants worldwide are Christians. The idea that immigrants move to rich countries just to use their benefits also fails to stand up to scrutiny. The vast majority of migrants tend to go where the jobs are—not where the most generous benefits can be found. In fact, migration controls prevent them from even applying for benefits.

Fears around crime and violence are similarly unfounded. Studies show no increase in crime linked to migratory patterns—except in a handful of cases where petty crimes rose slightly. Moreover, immigrants are far less likely to commit crimes than native-born citizens. For instance, a 2020 study based on Texas Department of Public Safety data found that immigrants of all legal statuses were arrested at less than half the rate of US-born citizens for violent and drug crimes and at one-quarter of the rate for property crimes.

One of the biggest fears surrounding mass immigration is the idea that immigrants take jobs from the native-born and drive down wages. However, migrants bring a greater diversity of skills to the workforce, which tends to improve the efficiency of the overall economy and leads to more jobs. Migrants also increase the size of the economy: They need to eat, shop, get their hair cut, and so on. By spending their wages and paying taxes, migrants support new jobs and businesses.

Evidence shows that even large waves of low-skilled migrants have no negative impact on the native population's wages or employment prospects and often have a positive impact. To illustrate, immigration to the US between 1990 and 2007 boosted the average yearly wage by $5100—a quarter of the total wage increase within that period. Furthermore, low-skilled migration slows down the adoption of mechanization and automation, which require huge capital and training investments. A ready supply of affordable workers—especially for farm and factory work—makes labor-saving technologies less attractive to industry bosses. In other words, the jobs available to all workers would be reduced significantly without immigrants.

Low-skill migrants working crop fields in the US

Immigration also triggers the reorganization of the labor market, which is almost always beneficial to natives. Generally, low-skilled immigrants get manual jobs, and native workers with local language skills and more experience are upgraded to nonmanual jobs with higher wages. Thus, an increase in migration means that workers can be more efficiently matched to demand and skillset, boosting productivity across the broader economy. Increased labor brings an increase in profits that can be invested in more production.

Importantly, most jobs available to immigrants are the jobs natives do not want to do. If immigrants are paid to do work such as childcare, looking after the sick and elderly, cleaning, and cooking, that enables natives—who may have been doing these as unpaid labor—to join or rejoin the workforce. On top of that, enterprising migrants also start businesses that employ more migrants and natives. Some of these businesses help generate greater social, economic, and cultural productivity—driving a whole new economy.

A Model for Migrant Workers

The truth is that a diversity of skills and talents is needed for productive economies and vibrant societies. By boosting economies, innovation, and wealth, migrants contribute far more than they take out of communities. They also tend to improve livelihoods, housing, education, and opportunities in the countries they physically leave behind because they remain

economically linked to them. Migrants' networks facilitate the transfer of technology, trade, and investment. They also help the institutions and norms that foster economic growth.

The Philippines, for example, has developed a formidable reputation for its expertly trained specialist nurses. The global demand for such nurses outstrips the supply. Aging populations in Western nations have a shortage of dementia-care nurses, and emigration offers Filipinos the chance to escape poverty. Highly trained people often struggle to find employment in poor countries, and so they benefit from migrating to where they are needed. Additionally, having the option to migrate can spur enrollment in high school and further education. One study found that an increase in migration caused a 3.5% increase in secondary school enrollment in migrants' home communities in the Philippines, as well as a general rise in income.

At the same time, origin countries such as the Philippines can suffer from an exodus of highly skilled people. Over the long term, this brain drain is the exception rather than the rule. Consequently, destination and origin countries should work together to tailor skills to benefit both. Doing so in the Philippines means ensuring that host countries invest in the training of nurses in the different specializations required by both host and origin nations.

Nursing students in Manila

Dementia cases are set to triple globally by 2050, so investing in training in the Philippines would enable the nation to become a center of expertise for its own needs too.

Moreover, bilateral agreements between countries can ensure that skill and technology investments by labor-poor host countries into labor-rich origin countries meet both nations' needs—as well as the migrants themselves. An example is an investment to train 50% of nurses in a college on the pledge that 20% would be offered employment in the host nation. Such agreements can also include other social and infrastructure investments in origin countries.

One example is the Global Skill Partnerships model, which was included in the Global Compact for Migration signed by 163 nations in 2018. In this model, the country of origin agrees to train people in skills specifically and immediately needed in both the country of origin and the destination. Some of these trainees choose to stay and increase human capital in the country of origin, while others migrate to the country of destination. The country of destination provides technology and finance for the training. In return, it receives migrants with the skills to contribute to the maximum extent and integrate quickly.

Representative of Global Compact for Migration in 2018

Benefits for Both Sides

By putting up barriers to immigration, governments in rich countries are forcibly preventing the world's poorest people from helping themselves. Additionally, they are hampering their own national productivity. An overwhelming wealth of research shows that a strategy of accommodating migrants is far better than attempting to keep them out. According to the McKinsey Global Institute, "better economic and social integration of migrants could lay the groundwork for economic gains of up to $1 trillion globally."

Of course, migration also benefits the migrants. On average, someone moving from a poor to a rich country can earn three to six times what they could at home, according to the World Bank. Rich countries often have superior institutions, better and less corrupt governance, more efficient markets, and well-run global companies. They also tend to be safer. This environment means that workers doing the same job are more productive in a rich country than in a poor one. Scientists can be more productive because they have better equipment, more stable funding, a wider selection of expertise to draw from, and more opportunities to collaborate. Construction workers can build better buildings because they have access to better tools and higher-quality materials, reliable supplies of electricity and water, and more stringent regulations governing safety and quality.

Another important reason why many countries need immigrants is the depopulation crisis. China's fertility rate has slipped to 1.3 children per woman. India is at a replacement rate of 2.1 and falling, and Brazil has a fertility rate of 1.8. In the US, the fertility rate is at 1.6, and more than 20% of its citizens will be older than 65 by 2050. Russia's depopulation crisis has emptied rural towns of their young, and entire villages across Europe have been put up for sale or touted for free in the hope that someone will revive them.

The crash in birthrates is a significant crisis affecting many of the world's nations. Society cannot function without the productivity of young workers and their taxes to support increasing numbers of long-lived elders, children, and those who cannot work because of sickness or disability. Demographic shrinkage alone means the US will need at least 35 million more workers by

2030. By 2050, the EU will need 80 million extra workers, and Japan will need another 17 million to be able to maintain existing living standards and social support systems.

Meanwhile, populations are continuing to grow in some parts of the poor world. Africa is heading for a triple whammy of exploding numbers of young people living in rural poverty at the mercy of climate change. Nearly one-quarter of the global population lives in South Asia, and it will soon have the highest prevalence of food insecurity in the world. For the people in these areas, allowing migration is by far the best and most efficient way to help them. The amount of money most developing countries receive in remittances outstrips what they receive in aid from rich nations by 2.5 times on average. Looking at global productivity purely from an economic perspective, labor is the most important commodity humans have.

Not only is migration an important adaptation for those who migrate, but it is also needed by those who receive migrants. If migration is well managed for everyone's benefit, it can be a multifaceted solution to many global issues. Migration is inevitable in the coming decades, but although being forced to leave home will be a personal tragedy for some, it does not have to be a calamity for all.

Reading

Banerjee, A., and E. Duflo. *Good Economics for Hard Times*. Allen Lane, 2019.

Caplan, B., Z. Weiner, and M. Cagle. *Open Borders: The Science and Ethics of Immigration*. St. Martin's Press, 2019.

Gibson, J., and D. McKenzie. "Eight Questions about Brain Drain." *Journal of Economic Perspectives* 25, no. 3 (2011): 107–128.

Vince, G. Nomad Century: How Climate Migration Will Reshape Our World. Flatiron Books, 2022. See esp. chaps. 5 and 6.

12

The Next Phase of Our Human Journey

THE HUMAN JOURNEY HAS BEEN AN INCREDIBLE one thus far, taking a puny ape from a corner of Africa to global domination. Along the way, humans faced daunting challenges, but they prevailed by using the strength of their networks to migrate away from danger and into new lands of opportunity. Migration is the tool that saved people in the past, and they will need to rely on it again in the uncertain decades ahead. If migration is managed well, people can create new cities of hope and opportunity, whose citizens can flourish as they restore the planet's livability. In this final lecture, you'll explore ways to plan and manage the coming large-scale human migration so that it benefits societies and allows economies to flourish.

New Ways to Manage Global Mobility

Nations will need to move on from the idea of controlling migration to managing migration. People need new mechanisms for lawful economic labor migration and mobility and far better protections when fleeing danger. Ideally, those who are at risk should be moved before their lives are at stake, but most people do not want to leave their supportive social networks, familiar environments, and cultural ties. Across the globe, though, people between their late teens and mid-thirties are leaving their family homes for study and work—or simply for love, curiosity, and independence. They easily form new networks, learn new languages, and integrate into existing structures. These natural migrants can create a network to assist the harder-to-move older demographic to migrate if necessary.

Migrants of working age should be matched with job vacancies before leaving home, but many will be forced to move more urgently by extreme events. A way to address this problem is to establish a global United Nations (UN) Migration Organization with real powers to compel governments to accept refugees. The organization would also be charged with getting governments to agree to a sensible plan for the redistribution of people and to manage the immediate and long-term strategy of relocation, remuneration, funding, and potential returns. This body would need to be set up with intergovernmental backing, be run by an international consortium of civil servants advised by experts, and be fully funded by an international system contributed to by all nations.

Citizens of low-lying islands face the prospect of being stateless after their nations cease to exist later in the 21st century. Some ways to manage this eventuality include regional agreements to give people dual citizenship with a safer nation and setting up a "digital territory" with citizenship. Alternatively, everyone could be offered UN citizenship to give them access to international recognition and assistance. For example, nearly half a million Nansen passports—named after Fridtjof Nansen, the first High Commissioner for Refugees—were issued after the First World War, mostly to Armenian and Russian refugees. They provided refugees with a new form of international protection before they acquired new citizenship. A UN-citizen scheme would be similar.

Furthermore, migrants should be involved in building new cities or expanding existing ones. Visas may include a requirement that the bearer commits to a certain number of hours a week for 2 to 5 years of community service, which may include working in construction, caring jobs, litter and waste management, or wildlife restoration. These migrants would receive training and be paid, and they could be given ownership options on the resulting homes and business spaces. The cultural and social transition of new citizens would be eased, especially if native-born people were also committed to such programs.

This scenario will enable host cities to better integrate much larger populations while meeting the labor needs to make the social and infrastructure improvements required in the coming decades. Immigration can put a lot of pressure on host communities when local housing, schools, health care, and other services become strained. To ease tensions in an enlarged population, careful planning and adequate investments by governments are required.

The Move to the North

Preparing for climate migrations involves the phased abandonment of major cities, the relocation of others, and the building of entirely new cities in foreign lands. Nowhere will escape the negative impacts of climate change,

and nations will need to have hard conversations about which places to abandon and which to shore up. As a general rule, people will need to move away from the equator and coastlines. They will also need to leave shrinking small islands and arid or desert regions. Rainforests and woodlands are also places to avoid because of fire risk.

Around the globe, land is mainly distributed in the north. Less than a third of Earth's land is in the southern hemisphere, and most of that is either in the tropics or Antarctica. Therefore, the main areas of opportunity for migrants are in the north. Happily, the northern latitudes are home to wealthy nations that generally have strong institutions and stable governments. They are among the best placed to build social and technological resilience to face the coming challenges. But problematically, many of them have also struggled politically with immigration.

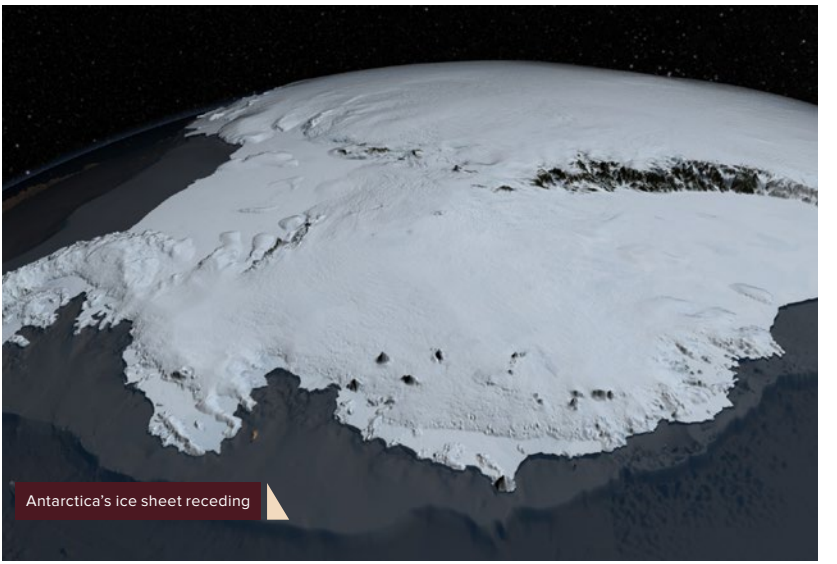
North of the 45th parallel will be the 21st century's booming haven. Home to a small fraction of the world's people, it represents 15% of the planet's total area but holds 29% of its ice-free land. It is also entering that optimum climate for human productivity, with mean average temperatures of around 55°F. Inland lake systems, such as the Great Lakes region of the US and Canada, will see a huge influx of migrants because these vast bodies of water should keep the region fairly temperate. On Lake Superior, Duluth in Minnesota bills itself as the most climate-proof city in the US. Other upper Midwest cities around the lakes—including Minneapolis and Madison—are also likely to be desirable destinations.

Preparation and adaptation may enable some coastal cities to survive. One example is Boston, which is far enough north to escape much of the projected extreme heat. Planners have developed a detailed strategy that includes elevating roads, building up coastal defenses, and introducing marshes to absorb flood waters. New York City, which faces extreme threats but might be too important to fail, is also planning extensive defenses.

Alaska seems to be the best place to live in the US, and cities will need to be built to accommodate millions of migrants heading for the Arctic. In 2017, the US Environmental Protection Agency released a Climate Resilience Screening Index, which ranked Kodiak Island in Alaska as being at the lowest risk of climate events in the country. By 2050, Alaska may experience average monthly temperatures similar to Florida today—but as with everywhere,

location is key. Currently, the residents of Newtok in Alaska are relocating because melting permafrost and increasing erosion have caused portions of their village to wash away.

Indeed, the retreat of ice sheets and the melting of tundras are already irrevocably altering Indigenous communities' way of life. The terrible loss faced by both humans and native wildlife—not to mention other dangers, including unknown pathogens waiting to be exposed—will be countered by vast opportunities for development. Many tropical migrants will create homes in the new north while humanity battles to restore a livable globe. Whether self-governed Indigenous communities will welcome this influx of southern migrants or reject them remains to be seen.



Humanity and the New World

The far north will be transformed by new agriculture and a bustling North Sea Passage shipping route. The melting of Greenland's ice sheet—the largest on Earth after Antarctica—will expose new areas for people to live, farm, and mine minerals. Buried beneath the Arctic ice of Greenland, Russia, the US,

and Canada are useful agricultural soil and land to build upon. Greenland's farmers are already harvesting new crops, and the retreating ice is exposing mining opportunities and offshore oil exploration. According to projections, Greenland will even have forests by 2100 and may become one of the best places to live.

Other places that will see new or expanded cities include Scotland, Ireland, Estonia, and elevated sites with plenty of water. The Nordic nations will also benefit from global heating, as they score comparatively low on climate change vulnerability and high on adaptive readiness. Growing seasons will significantly expand, and new species of plants and animals will thrive. In Europe, the use of electricity is projected to fall as warming winters reduce the demand for heating.

Canada will be a key destination for migrants, and its government is betting on it. Aiming to triple its population from 37 to 100 million by 2100, the nation is currently adding 400,000 new immigrants a year—mostly from climate-threatened nations in Asia. Global heating may raise the average income in Canada by 250% because of greatly expanded growing seasons, reduced infrastructure costs, and increased maritime shipping. With a stable, non-corrupt democracy, one-fifth of the world's freshwater reserves, and as much as 1 billion acres of newly arable farmland, Canada may become the world's new breadbasket.

Russia will be another net winner. Its 2020 national action plan describes ways to "use the advantages" of climate change. According to a detailed modeling study, more than half of Siberia's permafrost will thaw by 2080, and the most inhospitable third of this massive Eurasian nation will switch from "absolute extreme" to "fairly favorable" for civilization.

In the south, Patagonia, Tasmania, New Zealand, and perhaps the newly ice-free parts of the western Antarctic coast offer potential for new cities. Elsewhere, people will move to higher elevations, such as the Rocky Mountains in North America and the Alps in Europe. Switzerland has lakes and altitude, and Boulder and Denver in the US—both above 5000 feet—are already attracting migrants. Ljubljana in Slovenia is another alpine location with rich underground aquifer systems and lush agriculture.

Migrant labor force in US harvesting crops

Every aspect of human activity will undergo an upheaval in the coming decades. Food production will shift from the tropics to northern latitudes, and novel foods will supplement agriculture. Energy systems will undergo a revolution to renewables. New cities will be built sustainably and be adapted to withstand extreme conditions. Buildings will generate their own power and recycle their water, waste, and heat. Such cities will be dense, thriving, and diverse. They will be home to people from all over the world, the majority of which will be recent migrants.

Reading

Fischetti, M. "Sea Level Could Rise 5 Feet in New York City by 2100." *Scientific American*, June 1, 2013.

Fratzke, S., and B. Salant. *Moving beyond "Root Causes": The Complicated Relationship between Development and Migration*. Migration Policy Institute Policy Brief, January 2018.

Smith, L. *The New North: The World in 2050*. Dutton Books, 2010.

Vince, G. *Nomad Century: How Climate Migration Will Reshape Our World*. Flatiron Books, 2022. See esp. chaps. 8–12.

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