

Chapter 8: The Genomic Origins of East Asians

The Failure of the Southern Route

Reich is concerned with two issues in this section: Did modern humans interbreed with archaic humans long resident in East Eurasia?, and if they did, Did it matter?; and Why is there no evidence of the use of Upper Paleolithic stone tools in East Eurasia? The narrative arcs of the two issues interweave throughout Reich's analysis.

Reich introduces the archaic humans: "East Asia has been home to the human family for at least around 1.7 million years, the date of the oldest known *Homo erectus* skeleton found in China... Archaic humans—whose skeletal form is not the same as that of humans whose anatomically modern features begin to appear in the African fossil record after around three hundred thousand years ago—have lived in East Asia continuously since those times."

He next offers the archaeological evidence for the interbreeding: "There has been intense debate about the extent to which the archaic humans of East Asia contributed genetically to people living today. Chinese and Western **geneticists** nearly all agree that present-day humans outside of Africa descend from a dispersal after around fifty thousand years ago, which largely displaced previously established human groups. Some Chinese **anthropologists and archaeologists**, on the other hand, have documented similarities in skeletal features and stone tool styles in people who lived in East Asia **before** and after this time, raising the question of whether there has been some degree of continuity."

"In the west, the grand narrative is that sometime after around fifty thousand years ago, modern humans began making sophisticated Upper Paleolithic stone tools, which are characterized by narrow stone blades struck in a new way from pre-prepared cores. The Near East is the earliest known site of Upper Paleolithic stone tools, and this technology spread rapidly to Europe and northern Eurasia." Given the superiority of these tools to existing ones, they should have also spread to East Eurasia.

But they didn't: "The archaeological pattern in the east does not conform to that in the west. Around forty thousand years ago and across a vast tract of land in China and east of India there is indeed archaeological evidence of great **behavioral change** associated with the arrival of modern humans, including the use of sophisticated bone tools, shell beads or perforated teeth for body decoration, and the world's earliest known cave art. In Australia, archaeological evidence of human campsites makes it clear that modern humans arrived there at least by about forty-seven thousand years ago, which is about as old as the earliest evidence for modern humans in Europe. So it is absolutely clear that modern humans arrived in East Asia and Australia around the same time as they came to Europe. But, puzzlingly, the first modern humans in central and southern East Asia, and those in Australia, **did not use Upper Paleolithic stone tools**. Instead, they used other technologies, some of which were more similar to those used by modern humans in Africa **tens of thousands of years earlier**."

This suggests that there may have been a migration out of Africa of a lineage before 50,000 YA. "... the first humans in Australia might derive from a migration of modern humans out of Africa and the Near East **prior** to the development of Upper Paleolithic technology in the west.

OLLI 497: Ancient DNA

According to this “**Southern Route**” hypothesis, the migrants left Africa well before fifty thousand years ago and skirted along the coast of the Indian Ocean, leaving descendants today among the indigenous people of Australia, New Guinea, the Philippines, Malaysia, and the Andaman Islands.”

“The Southern Route hypothesis was far more than a claim that there were modern humans outside of Africa well before fifty thousand years ago—a fact that every serious scholar now accepts. Evidence of early modern humans outside of Africa well before fifty thousand years ago includes the morphologically modern skeletons in Skhul and Qafzeh in present-day Israel that date to between around 130,000 to 100,000 years ago.” He next notes that there is “tentative genetic evidence” that this earlier lineage may have interbred with Neanderthals. “Although many geneticists, including me, are still on the fence about whether this finding of earlier interbreeding between modern humans and Neanderthals is compelling, the key point is that almost all scholars now agree that there were early dispersals of modern humans into Asia that preceded the widely accepted dispersals after fifty thousand years ago that contributed in a major way to all present-day non-Africans. The outstanding question raised by the Southern Route hypothesis is not whether such expansions occurred, but whether they had **an important long-term impact** on humans living today”

“In 2011, Eske Willerslev led a study that seemed to show that the early expansions indeed left an impact. He and his colleagues reported a Four Population Test showing that Europeans **share more** mutations with East Asians than with Aboriginal Australians, as would be expected from a Southern Route contribution to the lineage of Australians. Applying a Southern Route migration model to the genomic data, they estimated that Australian Aborigines harbor ancestry from a modern human population that split from present-day Europeans at twice the time depth that East Asian ancestors split from Europeans (seventy-five thousand to sixty-two thousand years ago versus thirty-eight thousand to twenty-five thousand years ago).”

Once again, Reich shows Willerslev to be wrong: “There was a problem, though, which is that the analysis did not account for the 3 to 6 percent of ancestry that Australians inherited from **archaic Denisovans**. Because Denisovans were so divergent from modern humans, mixture from them could cause Europeans to share more mutations with Chinese than with Australian Aborigines. Indeed, this explained the findings. My laboratory showed that after accounting for Denisovan mixture, Europeans **do not share more** mutations with Chinese than with Australians, and so Chinese and Australians derive **almost all** their ancestry from a homogeneous population whose ancestors separated earlier from the ancestors of Europeans. This revealed that a series of **major population splits** in the history of non-Africans occurred in an exceptionally short time span—beginning with the separation of the lineages leading to West Eurasians and East Eurasians, and ending with the split of the ancestors of Australian Aborigines from the ancestors of many mainland East Eurasians. These population splits all occurred after the time when Neanderthals interbred with the ancestors of non-Africans fifty-four to forty-nine thousand years ago, and before the time when Denisovans and the ancestors of Australians mixed, genetically estimated to be 12 percent more recent than the Neanderthal/modern human admixture, that is, forty-nine to forty-four thousand years ago.”

So even if modern humans interbred with the indigenous archaic human populations they encountered, there was no lasting effect: “The rapid succession of lineage separations during the relatively short interval between Neanderthal and Denisovan interbreeding with modern humans suggests that throughout Eurasia, modern humans were moving into new environments where their technology or lifestyle allowed them to expand, **displacing the previously resident groups**. The spread was so fast that it is hard to imagine that archaic humans who had already been resident there for close to two million years, and who we know were also there when modern humans expanded based on the evidence of interbreeding with

OLLI 497: Ancient DNA

Denisovans, put up much resistance. Even if early modern humans expanded into East Asia via a Southern Route, they were likely also **replaced by later waves** of human migrants and **can be ruled out** as having contributed more than a very small percentage of the ancestry of present-day people. In East Asia as in West Eurasia, the expansion of modern humans out of Africa and the Near East had an effect akin to the erasing of a blackboard, creating a blank slate for the new people. The old populations of Eurasia collapsed, and in their place came new groups that swiftly inhabited the landscape. There is **no genetic evidence of any substantial ancestry** from these earlier populations in present East Asians.”

Reich now circles back to the question of the absence of the Upper Paleolithic tools: “... if essentially all modern human ancestry in East Asia and Australia today derives from the same group that contributed to West Eurasians, what explains how Southeast Asians and Australians missed out on the Upper Paleolithic technology that is so tightly linked with the spread of modern human populations into the Near East and Europe?”

He speculates that the lineage split could have occurred earlier than the development of the tools: “... the main split of West Eurasian and East Asian ancestors could have occurred before the development of Upper Paleolithic technology, and the geographic distribution of this technology could just reflect the spread of the population that invented it.”

After citing corroborating evidence, Reich concludes: “Both the distributions of stone tool technology and of genetic ancestry are as expected if Upper Paleolithic technology came into full flower in a population that lived prior to the separation of the lineages leading to Ancient North Eurasians and West Eurasians, but after the separation of the lineage leading to East Asians.”

The Beginnings of Modern East Asia

“The first genomic survey of modern East Asian populations was published in 2009, and reported data on nearly two thousand individuals from almost seventy-five populations. The authors focused on their finding that human diversity is greater in Southeast Asia than in Northeast Asia.” They proposed a model in which a single population moved into Southeast Asia and radiated from south to north. Reich says this is wrong: “... we now know that this model is likely to be of limited use. In Europe there have been multiple **population replacements** and **deep mixtures**, and we now know from ancient DNA that present-day patterns of diversity in West Eurasia provide a distorted picture of the first modern human migrations into the region. The model of a south-to-north migration, losing diversity along the way, is profoundly wrong for East Asia.”

In 2015, Reich gained access to genome-wide data on 400 present-day Chinese from diverse populations. He combined this data with other published data on East Asians, and his own ancient DNA from Russian caves. “By using a principal component analysis, we found that the ancestry of the great majority of East Asians living today can be described by three clusters.”

“The first cluster is centered on people currently living in the Amur River basin on the boundary between northeastern China and Russia. It includes ancient DNA data that my laboratory and others had obtained from the Amur River basin. So, this region has been inhabited by genetically similar populations for more than eight thousand years.”

OLLI 497: Ancient DNA

“The second cluster is located on the Tibetan Plateau, a vast area north of the Himalayas, much of which is at a higher altitude than the tallest of the European Alps.”

“The third cluster is centered in Southeast Asia, and is most strongly represented by individuals from indigenous populations living on the islands of Hainan and Taiwan off the coast of mainland China.”

“We used Four Population Test statistics to evaluate models of the possible relationships among present-day populations representing these clusters and Native Americans, Andaman islanders, and New Guineans.” The latter three served as proxies for ancient DNA.

“Our analysis supported a model of population history in which the modern human ancestry of the great majority of mainland East Asians living today derives largely from **mixtures**—in different proportions—**of two lineages that separated very anciently**. Members of these two lineages spread in all directions, and their mixture with each other and with some of the populations they encountered transformed the human landscape of East Asia.”

The Ghost Populations of the Yangtze and Yellow Rivers

Reich attempts to identify the two ancient lineages. He begins: “Archaeological evidence shows that starting around nine thousand years ago, farmers started tilling the windblown sediments near the Yellow River in northern China, growing millet and other crops. Around the same time, in the south near the Yangtze River, a different group of farmers began growing other crops, including rice.”

Reich notes the difficulties he faced in his genetic analysis and the absence of ancient DNA from China, but persisted using present-day genetic data. “We found that in Southeast Asia and Taiwan, there are many populations that derive most or all of their ancestry from a **homogeneous ancestral population**. Since the locations of these populations strongly overlap with the regions where rice farming expanded from the Yangtze River valley, it is tempting to hypothesize that they descend from the people who developed rice agriculture. We do not yet have ancient DNA from the first farmers of the Yangtze River valley, but my guess is that they will match this reconstructed “**Yangtze River Ghost Population**,” the name that we have given the population that contributed the overwhelming majority of ancestry to present-day Southeast Asians.”

However, “... we found that the **Han Chinese**—the world’s largest group with a census size of more than 1.2 billion—is not consistent with descending directly from the Yangtze River Ghost population. Instead, the Han also have a large proportion of ancestry from **another deeply divergent East Asian lineage**.”

“What could the other ancestry type be?” Reich notes that the Han emerged from tribes in the Yellow River Valley, one of the regions where farming originated, and that this farming technique spread into eastern Tibet.

He found that “... the Han and Tibetans both harbored large proportions of their ancestry from a population that no longer exists in unmixed form and that we could exclude as having contributed ancestry to many Southeast Asian populations. Because of the combined evidence of archaeology, language, and genetics, we called this the “**Yellow River Ghost Population**,” hypothesizing that it developed agriculture in the north while spreading Sino-Tibetan languages.”

OLLI 497: Ancient DNA

The Great Admixtures at the East Asian Periphery

Reich now gives us a grand tour of the population migrations and mixtures that have led to present-day East Eurasian populations outside of China. “Once the core agricultural populations of the Chinese plain—the Yangtze and Yellow River ghost populations—formed, they expanded in all directions, mixing with groups that had arrived in earlier millennia.”

First up: “The peoples of the Tibetan Plateau ... harbor a mixture of about two-thirds of their ancestry from the same **Yellow River** ghost population that contributed to the Han... [and] about one-third of their ancestry from an early branch of East Asians that plausibly corresponds to Tibet’s indigenous hunter-gatherers.”

Next the Japanese. “The genetic data confirm that the spread of farming to the islands was mediated by migration. Modeling present-day Japanese as **a mixture of two anciently divergent populations of entirely East Asian origin**—one related to present-day Koreans and one related to the Ainu who today are restricted to the northernmost Japanese island and whose DNA is similar to that of pre-farming hunter-gatherers... present-day Japanese have about 80 percent farmer and 20 percent hunter-gatherer ancestry. Relying on the sizes of segments of farmer-related ancestry in present-day Japanese, we... estimated the average date of mixture to be around sixteen hundred years ago.”

Then Southeast Asia: “In 2017, my laboratory extracted DNA from ancient humans at the almost four-thousand-year-old site of Man Bac in Vietnam, where people with skeletons similar in shape to those of **Yangtze River** agriculturalists and East Asians today were buried side by side with individuals with skeletons more similar to those of the previously resident hunter-gatherers.” Reich’s lab “... showed that in ancient Vietnam, all the samples we analyzed were a mixture of an early splitting lineage of East Eurasians and the Yangtze River Ghost Population.”

Now Indonesia: “The genetic impact of the population spread that also dispersed Austroasiatic languages went beyond places where these languages are spoken today.” His lab “... showed that in western Indonesia where Austronesian languages are predominant, a substantial share of the ancestry comes from a population that derives from the same lineages as some Austroasiatic speakers on the mainland.” This suggests “... that Austroasiatic speakers may have come first to western Indonesia, followed by Austronesian speakers with very different ancestry.” Alternatively, the “... findings could be explained if Austronesian-speaking farmers took a detour through the mainland, mixing with local Austroasiatic-speaking populations there before spreading farther to western Indonesia.”

“The most impressive example of the movements of farmers from the East Asian heartland to the periphery is the **Austronesian expansion**. Today, Austronesian languages are spread across a vast region including hundreds of remote Pacific islands. Archaeological, linguistic, and genetic data taken together have suggested that around five thousand years ago, mainland East Asian farming spread to **Taiwan**, where the deepest branches of the Austronesian language family are found. These farmers spread southward to the Philippines about four thousand years ago, and farther south around the large island of New Guinea and into the smaller islands to its east. At about the time they spread from Taiwan they probably invented outrigger canoes, boats with logs propped on the side that increase their stability in rough waters, making it possible to navigate the open seas. After thirty-three hundred years ago, ancient peoples making pottery in a style called Lapita appeared just to the east of New

OLLI 497: Ancient DNA

Guinea and soon afterward started expanding farther into the Pacific, quickly reaching Vanuatu three thousand kilometers from New Guinea. It took only a few hundred more years for them to spread through the western Polynesian islands including Tonga and Samoa, and then, after a long pause lasting until around twelve hundred years ago, they spread to the last habitable Pacific islands of New Zealand, Hawaii, and Easter Island by eight hundred years ago. The Austronesian expansion to the west was equally impressive, reaching **Madagascar** off the coast of Africa nine thousand kilometers to the west of the Philippines at least thirteen hundred years ago, and explaining why almost all Indonesians today as well as people from Madagascar speak Austronesian languages.”

Reich’s lab identified a marker for the Austronesian expansion, “... a type of ancestry that is nearly always present in peoples who today speak Austronesian languages. ...nearly all people who speak these languages harbor at least part of their ancestry from a population that is more closely related to **aboriginal Taiwanese** than it is to any mainland East Asian population. This supports the theory of an expansion from the region of Taiwan.”

Reich notes that some geneticists “... balked at the suggestion that the first humans who peopled the remote islands of the Southwest Pacific during the Lapita dispersal were unmixed descendants of farmers from Taiwan.” The issue is the lack of mixture with the New Guineans. The scenario that the Austronesians didn’t mix is implausible given that “... today, all Pacific islanders east of Papua New Guinea have at least 25 percent Papuan ancestry and up to around 90 percent. How could this fit with the prevailing hypothesis that the Lapita archaeological culture was forged during a period of intense exchange between people ultimately originating in the farming center of China (via Taiwan) and New Guineans?”

“We succeeded at getting DNA from ancient people associated with the Lapita pottery culture in the Pacific islands of Vanuatu and Tonga who lived from around three thousand to twenty-five hundred years ago. Far from having substantial proportions of Papuan ancestry, we found that in fact they had little or none. This showed that there must have been a later major migration from the New Guinea region into the remote Pacific. The late migration must have begun by at least twenty-four hundred years ago, as all the Vanuatu samples we have analyzed from that time and afterward had at least 90 percent Papuan ancestry. How this later wave could have so comprehensively replaced the descendants of the original people who made Lapita pottery and yet retained the languages these people probably spoke remains a mystery. But the genetic data show that this is what happened.”

Reich concludes: “Thus there must have been not one, not two, but at least three major migrations into the open Pacific, with the first migration bringing East Asian ancestry and the Lapita pottery culture, and the later migrations bringing at least two different types of Papuan ancestry.”

Reich recognizes the impact of the lack of ancient DNA from East Asia is having: “... right now our understanding of what happened in mainland East Asia remains murky and limited. The extraordinary expansion of the Han over the last two thousand years has added one more level of massive mixing to the already complex population structure that must have been established after thousands of years of agriculture in the region, and after the rise and fall of various Stone Age, Copper Age, Bronze Age, and Iron Age groups. This means that any attempt to reconstruct the deep population history of East Asia based on patterns of variation in present-day people must be viewed with great caution.” But he remains hopeful!