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There's no such thing as a 'pure' European—or anyone else

Most of us are a mishmash of many migrations over thousands of years

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Researchers are trying to extract DNA from skeletons buried in the ancient Philistine cemetery of Ashkelon, in what is now Israel. © TSAFRIR ABAYOV/LEON LEVY EXPEDITION

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When the first busloads of migrants from Syria and Iraq rolled into Germany 2 years ago, some small towns were overwhelmed. The village of Sumte, population 102, had to take in 750 asylum seekers. Most villagers swung into action, in keeping with Germany's strong *Willkommenskultur*, or "welcome culture." But one self-described neo-Nazi on the district council told *The New York Times* that by allowing the influx, the German people faced "the destruction of our genetic heritage" and risked becoming "a gray mishmash."

In fact, the German people have no unique genetic heritage to protect. They—and all other Europeans—are already a mishmash, the children of repeated ancient migrations, according to scientists who study ancient human origins. New studies show that almost all indigenous Europeans descend from at least three major migrations in the past 15,000 years, including two from the Middle East. Those migrants swept across Europe, mingled with previous immigrants, and then remixed to create the peoples of today.

Using revolutionary new methods to analyze DNA and the isotopes found in bones and teeth, scientists are exposing the tangled roots of peoples around the world, as varied as Germans, ancient Philistines, and Kashmiris. Few of us are actually the direct descendants of the ancient skeletons found in our backyards or historic homelands. Only a handful of groups today, such as Australian Aborigines, have deep bloodlines untainted by mixing with immigrants.

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"We can falsify this notion that anyone is pure," says population geneticist Lynn Jorde of the University of Utah in Salt Lake City. Instead, almost all modern humans "have this incredibly complex history of mixing and mating and migration."

Wind back the clock more than a thousand years—a trivial slice of time compared with the 200,000 years or so since our species emerged—and stories of exclusive heritage or territory crumble. "Basically, everybody's myth is wrong, even the indigenous groups," says population geneticist David Reich of Harvard University.

Tacitus, the Roman historian, reports that in 9 C.E. a member of the Germanic Cherusci tribe called Arminius led a rebellion against the Romans near the village of Kalkriese in northern Germany. Against all odds, the tribes slaughtered three Roman legions in what became known as the Battle of the Teutoburg Forest.

After Tacitus's account resurfaced in the 15th century, German nationalists resurrected the myth of Arminius, who is often depicted as a blond, muscular young chieftain and known as Hermann. Hailed as the first "German" hero, he was said to have united the Germanic tribes and driven the Romans from their territory. That was considered the start of a period when fearsome Germanic tribes such as the Vandals swept around Europe, wresting territory from Romans and others.

In the 20th century, the Nazis added their own dark spin to that origin story, citing Arminius as part of an ancient pedigree of a "master race" from Germany and northern Europe that they called Aryans. They used their view of prehistory and archaeology to justify claims to the tribes' ancient homelands in Poland and Austria.

Scholars agree that there was indeed a real battle that sent shock waves through the Roman Empire, which then stretched from the island of Britain to Egypt. But much of the rest of Arminius's story is myth: The Romans persisted deep in Germania until at least the third century C.E., as shown by the recent discovery of a third-century Roman battlefield in Harzhorn, Germany. And Arminius by no means united the more than 50 Germanic tribes of the time. He persuaded five tribes to join him in battle, but members of his own tribe soon killed him.

Moreover, Arminius and his kin were not pure "Aryan," if that term means a person whose ancestors lived solely in what is now Germany or Scandinavia. The Cherusci tribe, like all Europeans of their day and later, were themselves composites, built from serial migrations into the heart of Europe and then repeatedly remixed. "The whole concept of an ethnic German ... it's ludicrous when you look at the *longue durée* [long time] scale," says archaeologist Aren Maeir of Bar-Ilan University in Ramat Gan, Israel.

After World War II, many scholars recoiled from studying migrations, in reaction to the Nazi misuse of history and archaeology. The Nazis had invoked migrations of "foreign" groups to German territory to justify genocide. "The whole field of migration studies was ideologically tainted," says archaeologist Kristian Kristiansen of the University of Gothenburg in Sweden. Some researchers also resisted the idea that migration helped spread key innovations such as farming, partly because that might imply that certain groups were superior.

Nor did researchers have a reliable method to trace prehistoric migrations. "Most of the archaeological evidence for movement is based on artifacts, but artifacts can be stolen or copied, so they are not a real good proxy for actual human movement," says archaeologist Doug Price of the University of Wisconsin in Madison, who tracks ancient migration by analyzing isotopes. "When I started doing this in 1990, I thought people were very sedentary and didn't move around much."

Today, however, new methods yield more definitive evidence of migration, sparking an explosion of studies. The isotopes Price and others study are specific to local water and food and thus can reveal where people grew up and whether they later migrated. DNA from ancient skeletons and living people offers the "gold standard" in proving who was related to whom.

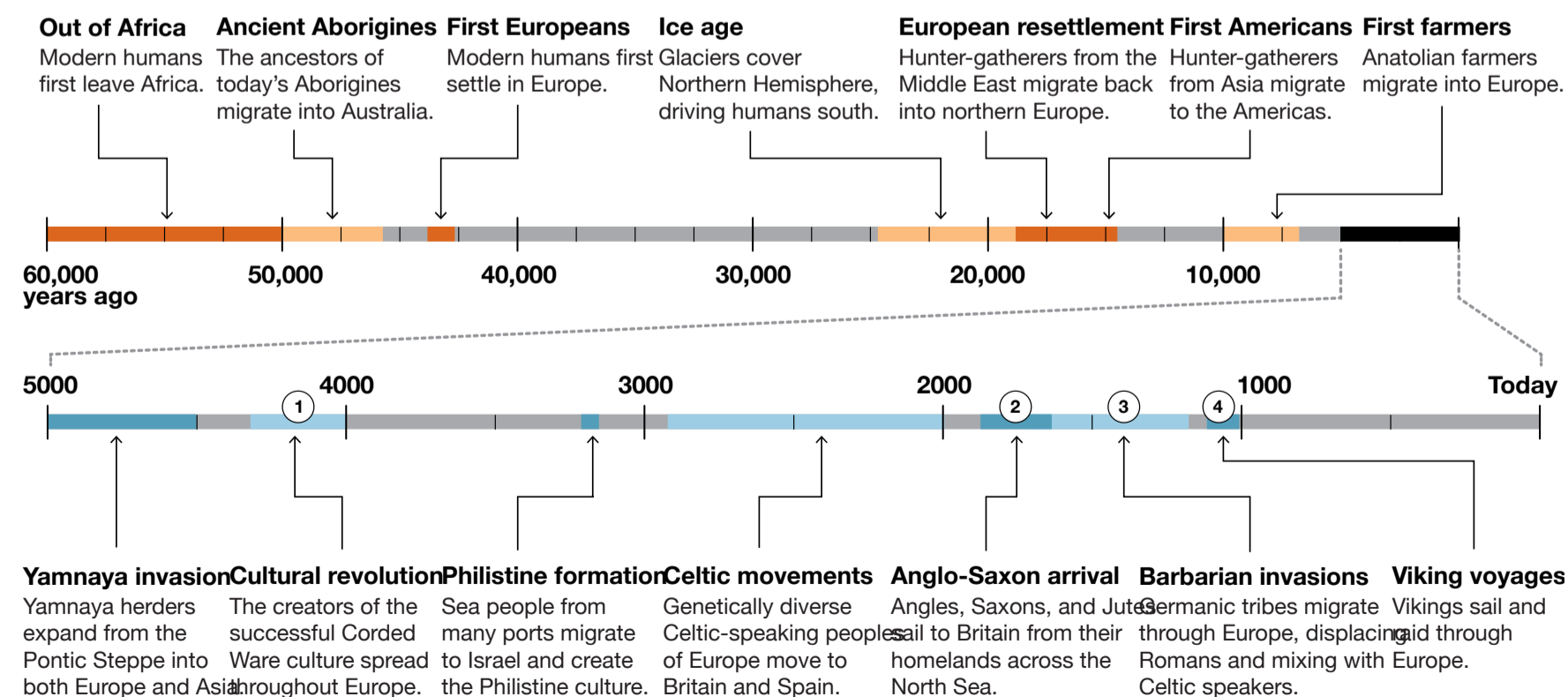
The new data confirm that humans have always had wanderlust, plus a yen to mix with all manner of strangers. After the first *Homo sapiens* arose in Africa, several bands walked out of the continent about 60,000 years ago and into the arms of Neandertals and other archaic humans. Today, almost all humans outside Africa carry traces of archaic DNA.



Hermann the German was mythologized as a hero who stood up to the Roman Empire. AKG-IMAGES/NEWSCOM

Migrations through the ages

Modern humans have been on the move ever since a small band of people migrated out of Africa more than 50,000 years ago. New studies of genes and isotopes are helping reveal how major migrations shaped who we are today. (See slideshow below for artifacts that trace some of these ancient journeys.)



G. GRULLÓN/SCIENCE



1 Corded Ware culture: Early farmers and Yamnaya immigrants help give birth to a new culture that spreads through Europe. ROBERTO FORTUNA KIRA URSEM/THE NATIONAL MUSEUM OF DENMARK



That was just one of many episodes of migration and mixing. The first Europeans came from Africa via the Middle East and settled there about 43,000 years ago. But some of those pioneers, such as a 40,000-year-old individual from Romania, have little connection to today's Europeans, Reich says.

His team studied DNA from 51 Europeans and Asians who lived 7000 to 45,000 years ago. They found that most of the DNA in living Europeans originated in three major migrations, starting with hunter-gatherers who came from the Middle East as the glaciers retreated 19,000 to 14,000 years ago. In a second migration about 9000 years ago, farmers from northwestern Anatolia, in what is now Greece and Turkey, moved in.

That massive wave of farmers washed across the continent. Ancient DNA records their arrival in Germany, where they are linked with the Linear Pottery culture, 6900 to 7500 years ago. A 7000-year-old woman from Stuttgart, Germany, for example, has the farmers' genetic signatures, setting her apart from eight hunter-gatherers who lived just 1000 years earlier in Luxembourg and Sweden. Among people living today, Sardinians retain the most DNA from those early farmers, whose genes suggest that they had brown eyes and dark hair.

The farmers moved in family groups and stuck to themselves awhile before mixing with local hunter-gatherers, according to a study in 2015 that used ancient DNA to calculate the ratio of men to women in the farming groups. That's a stark contrast to the third major migration, which began about 5000 years ago when herders swept in from the steppe north of the Black Sea in what is now Russia. [Those Yamnaya pastoralists herded cattle and sheep, and some rode newly domesticated horses](#), says archaeologist David Anthony of Hartwick College in Oneonta, New York.

In the journal *Antiquity* last month, Kristiansen and paleogeneticist Eske Willerslev at the University of Copenhagen reported that the sex ratios of the earliest Yamnaya burials in central Europe suggest that the new arrivals were mostly men. Arriving with few women, those tall strangers were apparently eager to woo or abduct the local farmers' daughters. Not long after the Yamnaya invasion, their skeletons were buried with those of women who had lived on farms as children, according to the strontium and nitrogen isotopes in their bones, says Price, who analyzed them.

The unions between the Yamnaya and the descendants of Anatolian farmers catalyzed the creation of the famous Corded Ware culture, known for its distinctive pottery impressed with cordlike patterns, Kristiansen says. According to DNA analysis, those people may have inherited Yamnaya genes that made them taller; they may also have had a then-rare mutation that enabled them to digest lactose in milk, which quickly spread.

It was a winning combination. The Corded Ware people had many offspring who spread rapidly across Europe. They were among the ancestors of the Bell Beaker culture of central Europe, known by the vessels they used to drink wine, according to a study by Kristiansen and Reich published this month. "This big wave of Yamnaya migration washed all the way to the shores of Ireland," says population geneticist Dan Bradley of Trinity College in Dublin. Bell Beaker pots and DNA appeared about 4000 years ago in burials on Rathlin Island, off the coast of Northern Ireland, his group reported this year.

This new picture means that the Hermann of lore was himself a composite of post-ice age hunter-gatherers, Anatolian farmers, and Yamnaya herders. So are most other Europeans—including the ancient Romans whose empire Arminius fought.

The three-part European mixture varies across the continent, with different ratios of each migration and trace amounts of other lineages. But those quirks rarely match the tales people tell about their ancestry. For example, the Basques of northern Spain, who have a distinct language, have long thought themselves a people apart. But last year, population geneticist Mattias Jakobsson of Uppsala University in Sweden reported that the DNA of modern Basques is most like that of the ancient farmers who populated northern Spain before the Yamnaya migration. In other words, Basques are part of the usual European mix, although they carry less Yamnaya DNA than other Europeans.

Farther north, the Irish *Book of Invasions*, written by an anonymous author in the 11th century, recounts that the "Sons of Míl Espáine ... after many wanderings in Scythia and Egypt" eventually reached Spain and Ireland, creating a modern Irish people distinct from the British—and linked to the Spanish. That telling resonates with a later yarn about ships from the Spanish Armada, wrecked on the shores of Ireland and the Scottish Orkney Islands in 1588, Bradley says: "Good-looking, dark-haired Spaniards washed ashore" and had children with Gaelic and Orkney Islands women, creating a strain of Black Irish with dark hair, eyes, and skin.

Although it's a great story, Bradley says, it "just didn't happen." In two studies, researchers have found only "a very small ancient Spanish contribution" to British and Irish DNA, says human geneticist Walter Bodmer of the University of Oxford in the United Kingdom, co-leader of a landmark 2015 study of British genetics.

The Irish also cherish another origin story, of the Celtic roots they are said to share with the Scots and Welsh. In the Celtic Revival of the 19th and 20th centuries, writers such as William Butler Yeats drew from stories in the *Book of Invasions* and medieval texts. Those writings described a migration of Gaels, or groups of Celts from the mainland who clung to their identity in the face of later waves of Roman, Germanic, and Nordic peoples.

But try as they might, researchers so far haven't found anyone, living or dead, with a distinct Celtic genome. The ancient Celts got their name from Greeks who used "Celt" as a label for barbarian outsiders—the diverse Celtic-speaking tribes who, starting in the late Bronze Age, occupied territory from Portugal to Turkey. "It's a hard question who the Celts are," says population geneticist Stephan Schiffels of the Max Planck Institute for the Science

of Human History in Jena, Germany.

Bodmer's team traced the ancestry of 2039 people whose families have lived in the same parts of Scotland, Northern Ireland, and Wales since the 19th century. These people form at least nine genetic and geographic clusters, showing that after their ancestors arrived in those regions, they put down roots and married their neighbors. But the clusters themselves are of diverse origin, with close ties to people now in Germany, Belgium, and France. "Celtic' is a cultural definition," Bodmer says. "It has nothing to do with hordes of people coming from somewhere else and replacing people."

English myths fare no better. The *Anglo-Saxon Chronicle* recounts that in 449 C.E., two Germanic tribespeople, Hengist and Horsa, sailed from what is now the Netherlands to southeast England, starting a fierce conflict. As more Angles, Saxons, and Jutes arrived, violence broke out with the local Britons and ended in "rivers of blood," according to accounts by medieval monks. Scholars have debated just how bloody that invasion was, and whether it was a mass migration or a small delegation of elite kings and their warriors.

An answer came in 2016 from a study of the ancient DNA of Anglo-Saxons and indigenous Britons, who were buried side by side in the fifth and sixth centuries in a cemetery near Cambridge, U.K. They lived and died together and even interbred, as shown by one person who had a mix of DNA from both Britons and Anglo-Saxons, and a genetic Briton who was buried with a large cruciform Anglo-Saxon brooch. Although the stories stress violence, the groups "were mixing very quickly," says Duncan Sayer, an archaeologist at the University of Central Lancashire in Preston, U.K., who co-wrote the study.

The team went on to show that 25% to 40% of the ancestry of modern Britons is Anglo-Saxon. Even people in Wales and Scotland—thought to be Celtic strongholds—get about 30% of their DNA from Anglo-Saxons, says co-author Chris Tyler-Smith of the Wellcome Trust's Sanger Institute in Hinxton, U.K.

The boom in studies of migration is centered on Europe, where access to ancient remains is relatively easy and cold climates can help preserve DNA. But geneticists are beginning to probe the makeup of ancient people elsewhere. For example, findings from recent excavations in Israel are close to solving a long-standing mystery from the Bible: the identity of the ancient Philistines.

In biblical texts, those "uncircumcised" people are known as the bitter enemies of the Israelites; the name "Philistine" is still a slur in English. They're said to have lived in Canaan, between present-day Tel Aviv and Gaza in Israel. They ate pork, battled Samson's armies, and stole the Ark of the Covenant. Goliath, whom David slew with a sling, was a Philistine. But after Old Testament times, the group disappears from both scripture and historical accounts.

To find the Philistines' origins, researchers have studied artifacts and remains from ancient Philistine cities in Israel. The evidence, including isotopic analysis, shows that the Philistines were a motley crew of immigrants, possibly pirates, who hailed from many ports, bringing pigs from Europe and donkeys in caravans from Egypt. "The Philistines are an entangled culture from western Anatolia, Cyprus, Greece, the Balkans, you name it," says Maeir, who has directed excavations at the Philistine city of Gath for 2 decades.

Maeir says he thinks that the Philistines soon intermarried with people already living in Canaan instead of going extinct. If so, the loathsome Philistines are part of the ancestral stock for both Palestinian Muslims and Israeli Jews. Those groups, so full of enmity today, are genetically closely related, according to a study in 2000 of the paternally inherited Y chromosomes of 119 Ashkenazi and Sephardic Jews and 143 Israeli and Palestinian Arabs. Seventy percent of the Jewish men and half of the Arab men inherited their Y chromosomes from the same set of paternal ancestors who lived in the Middle East within the last few thousand years.

As techniques for probing ethnic origins spread, nearly every week brings a new paper testing and often falsifying lore about one ancient culture or another. The Kashmiri of northern India do not seem to be related to Alexander the Great or the lost tribes of Israel. Parsis in Iran and India are not solely of ancient Iranian heritage, having mixed with local Indian women, although Parsi priests do descend chiefly from just two men.

"Ethnic groups in the past and present create an 'imagined past' of the longtime and 'pure' origins of their group," Maeir says. But that created past often has "little true relation to the historical processes" that actually created the group, he says.

So far, the origin stories that appear to hew most closely to reality belong to indigenous peoples around the world. For example, the Tlingit and Tsimshian tribes of British Columbia in Canada and Alaska claim to have lived along the west coast of North America from "time immemorial." Living tribespeople do descend in part from three ancient Native Americans who lived in the region 2500 to 6000 years ago, according to DNA analyses published last month. Even so, most modern Native Americans are not directly related to the ancient people who lived in the same areas because their offspring moved, were displaced, or went extinct over the millennia, Reich says.

In Australia, aboriginal stories recall even longer connections to their lands, even seeming to refer to times when sea levels rose and fell more than 15,000 years ago. Those claims are among the few that genome studies support. [DNA evidence puts aboriginal ancestors on the continent 40,000 to 60,000 years ago](#). Once the first Australians arrived, they settled in three regions and remained in those discrete homelands for tens of thousands of years, a DNA study published in March suggests.

But the Aborigines are rare among the peoples of Earth, where migrations have been the norm. Almost always, Reich says, "the idea that the ancestors of any one population have lived in the same place for tens of thousands of years with no substantial immigration is wrong."



Celtic speakers made the Battersea shield, found in the Thames River, more than 2000 years ago. © THE TRUSTEES OF THE BRITISH MUSEUM

Back in Sumte in the fall of 2015, the 750 refugees from Syria arrived on schedule. The adults mostly kept to themselves, learning German and taking occasional construction jobs. But their children sang "O Tannenbaum" in a local church at Christmas and their teens ventured out often, seeking cellphone signals in the quiet town.

In the following months, almost all the refugees dispersed to larger towns throughout Germany. In time, some of the young immigrants will contribute their DNA to the next generation of Germans, re-enacting on a small scale the process of migration and assimilation that once played out repeatedly on this same land—and far beyond.

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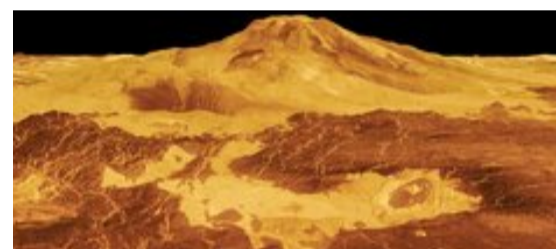
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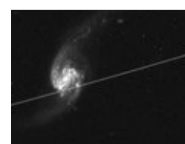
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