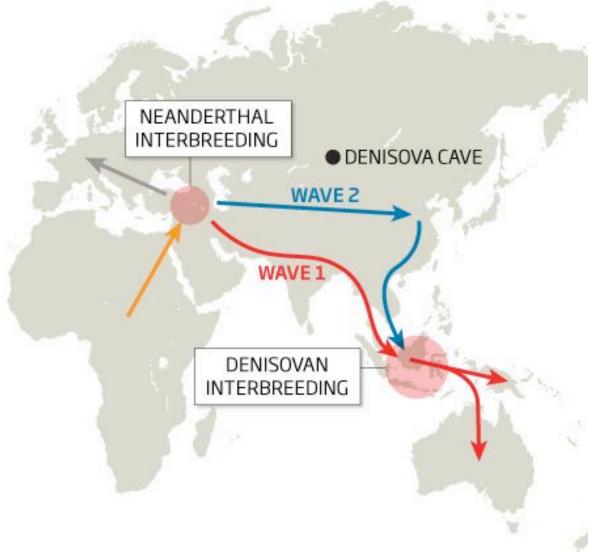
Humans colonised Asia in two waves

Into Asia, again

NewScie

Modern humans migrated across Asia in two waves



- 19:00 22 September 2011 by Michael Marshall
- For similar stories, visit the **Evolution** and **Human Evolution** Topic Guides If at first you don't succeed, have at least one more go. Early humans did, colonising Asia in two waves. The two migrations have left their mark in the genes of native people in south-east Asia, Polynesia and Australia.

Anthropologists have long debated whether there was more than one migration from Africa into Asia. Two studies published today aim to resolve the question.

A team of geneticists led by Eske Willerslev of the Natural History Museum of Denmark in Copenhagen has sequenced the genome of an Aboriginal Australian man, using a 100-year-old lock of hair.

They compared the genome with 1220 others from 79 populations around the world. It was

most similar to those of highland Papua New Guineans. The analysis suggested that the two groups had each been isolated from other humans for about 30,000 years, and that Australian Aboriginals are descended from the first colonists of Australia. Archaeology suggests humans have been there for 50,000 years, so the Aboriginal Australians may be one of the oldest continuous populations in the world.

Hardy hair

To find out how many migrations there were, Willerslev's team compared the Aboriginal Australian genome with Han Chinese, European and African genomes. They calculated that the Aboriginal Australians split from the other three between 75,000 and 62,000 years ago. The Chinese and European populations split much later, between 38,000 and 25,000 years ago. That suggests there were two migrations into east Asia.

It is remarkable that Willerslev was able to get so much information out of human hairs that had been stored for decades without any special conservation measures, says Chris Stringer of London's Natural History Museum.

But it is not clear where the first migration began, says Morten Rasmussen of the Natural History Museum of Denmark, who was also involved in the study. "We can't infer geographic origins from genetic data," he says. The genetics tells us when populations split, but not where.

One possibility is that the Aboriginal Australian migration left Africa before everyone else, but Stringer thinks that is unlikely. "If the ancestors of the Australian Aboriginals left Africa 70,000 years ago, where were they for 20,000 years before they made it to Australia and New Guinea?" he asks.

Going tropical

There's another explanation, says Mark Stoneking of the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany. Stoneking thinks there was only one migration out of Africa, which got as far as the Middle East. From there, two successive migrations headed east. The first colonised Australia and the neighbouring islands, while the second colonised mainland Asia (see diagram).

Stoneking and colleagues scoured genomes from 33 populations from mainland Asia, Indonesia, the Philippines and Polynesia, as well as Australia and New Guinea. They looked for signs that their ancestors interbred with the Denisovans, a recently discovered human group known only from the DNA in tooth and bone fragments found in Siberia. The Denisovan genome has already revealed that the ancestors of modern New Guineans interbred with them.

Stoneking found more Denisovan DNA in populations further south and east of Siberia, especially in east Indonesia, Australia, New Guinea, Fiji and Polynesia. People from mainland Asia and west Indonesia didn't have any, suggesting they descend from a separate migration that did not interbreed with the Denisovans.

Between them the two studies are strong evidence for multiple dispersals, Stoneking says. "But one thing I've learned from being in anthropology for a long time is that data alone are never enough to settle an argument."

Journal references: Willerslev and Rasmussen's paper: Science, DOI: 10.1126/science.

1211177; Stoneking's paper: *American Journal of Human Genetics*, DOI: 10.1016/j.ajhg. 2011.09.005

23 September 2011 Last updated at 00:23 GMT

Lock of hair pins down early migration of Aborigines

By Leila Battison Science reporter



A lock of hair is all that is needed to decode the history of an entire race

A lock of hair has helped scientists to piece together the genome of Australian Aborigines and rewrite the history of human dispersal around the world.

DNA from the hair demonstrates that indigenous Aboriginal Australians were the first to separate from other modern humans, around 70,000 years ago.

This challenges current theories of a single phase of dispersal from Africa.

An international team of researchers published their findings in the journal Science.

While the Aboriginal populations were trailblazing across Asia and into Australia, the remaining humans stayed around North Africa and the Middle East until 24,000 years ago.

Only then did they spread out and colonise Europe and Asia, but the indigenous Aborigines had been established in Australia for 25,000 years.

Australian Aborigines therefore have a longer claim to the land in which they now live than any other population known.

The research also highlights the exciting future possibilities of comparing the genomes of multiple individuals to track migration of small indigenous groups.

Tiny genetic differences

Archaeological remains are known from Australia from around 50,000 years ago, putting a maximum age of the Aborigines' settlement there.

But the history of their journey and their relationship with the indigenous people of Asia and Europe had not been solved.

"They could walk almost the entire way because the sea level was much lower" Dr Francois Balloux Imperial College London

It was previously thought that modern humans dispersed in one pulse out of Africa and the Middle East, and because of the distances involved, the modern Europeans would have separated from the Asians and Australians first.

Genetic information from a lock of Aboriginal hair has been used to show that the Australians set off a lot earlier.

By looking at the tiny (fraction of a percent) differences between the DNA of Aborigines and other ancient humans, the scientists show that the indigenous Australians were first isolated 70,000 years ago.

Dr Francois Balloux, of Imperial College London described how a "population expanded along the coastline because of the rich resources available there. They could walk almost the entire way because the sea level was much lower". Just one small sea crossing would be required to reach Australia.

Any potential archaeological remains of this journey, which lasted 25,000 years, would be lost to the deep sea under rising sea levels.

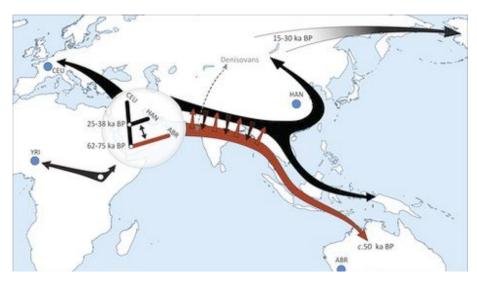
The remaining populations in the Middle East moved out to colonise Europe and Asia 24,000 years ago, and the aboriginal genome records some interbreeding between Asian populations and aboriginal ancestors at this time.

Discovering the history of human migration with DNA has been made possible by improvements in the techniques used to study the genome.

Traditionally, genetic divergence dates were arrived at by combining the number of unique mutations in the DNA with an assumed rate of acquiring those mutations.

Now, computationally powerful models can simulate lots of different scenarios for migration timings and directions, and researchers can compare and choose the situation that most closely matches what is seen in the genome.

By comparing the Aboriginal genome with the DNA of African, European and Han Chinese individuals it was possible to highlight the later interbreeding after initial colonisation.



Australia was the first place to be colonised; Eurasians remained in the Middle East until 24,000 years ago.

Comparison with Eurasian populations show that the Australian Aborigines have a similar percentage of Neanderthal genes within their DNA as their Eurasian counterparts, suggesting that any interbreeding occurred before the Aborigines embarked on their colonising journey.

The findings of these researchers are supported by an independent study, published this week in the American Journal of Human Genetics, which looks at the characteristic DNA from an extinct, archaic form of human, the Denisovans.

Denisovans lived over 30,000 years ago, and contributed genes mostly to present-day New Guineans.

This independent study identifies a pattern of Denisovan DNA in Asian individuals that can only be explained by two separate waves of human migration: the first of Aboriginals colonising Australia, and the second involving the occupation of Asia itself.

'Jurassic Park science'

The Aboriginal research was carried out on a single lock of hair, which was donated by a young Aboriginal man to the British anthropologist Dr A C Haddon in 1923.

"At this time, it was fashionable to take human samples," said Dr Balloux. The collection of hair was one of the more innocuous efforts of anthropologists at the time.

The researchers chose to examine the hair, as opposed to any other type of remains, for legal reasons. Hair is not classified as a human tissue.

"More important to us was that the research would be acceptable from a social and moral point of view" said Dr Balloux. To the surprise of the scientists, the people they consulted were very supportive of the study and its results. Dr Balloux explained that in the past, indigenous people have been "extremely sensitive of the motivations of western scientists".

The research has been published with "strong endorsement" from the Goldfields Land and Sea Council, the organisation that represents the Aboriginal traditional owners of parts of Western Australia, he said.

Genomics techniques like those used in this study have the potential to be used more extensively in the study of human migrations and the evolution of health and disease.

The international team next plans to look in more detail at the dispersal of modern humans out of Africa, as well as solving how and when the Americas were colonised.

Dr Balloux said he was excited about the unexpected potential of the techniques, describing it as "borderline Jurassic Park science".

Published online 22 September 2011 | Nature | doi:10.1038/news.2011.551

News

First Aboriginal genome sequenced

1920s hair sample reveals Aboriginal Australians' explorer origins.

Ewen Callaway



Descendent of the first humans to leave

Africa.Mark Kolbe / Getty Images

A 90-year-old tuft of hair has yielded the first complete genome of an Aboriginal Australian, a young man who lived in southwest Australia.

He, and perhaps all Aboriginal Australians, the genome indicates, descend from the first humans to venture far beyond Africa more than 60,000 years ago, and thousands of years before the ancestors of most modern Asians trekked east in a second migration out of Africa.

"Aboriginal Australians are descendents of the first human explorers. These are the guys who expanded to unknown territory into an unknown world, eventually reaching Australia," says Eske Willerslev, a palaeogeneticist at the University of Copenhagen, Denmark, who led the study. It appears online today in Science1.

Hanging on a hair

The oldest human remains in Australia date to around 50,000 years ago2, and yet older stone tools found in India and elsewhere hint at an early southern migration of anatomically modern humans out of Africa and through India and Southeast Asia.

However, genetic studies of contemporary Asians and Oceanians haven't always told the same story. The most comprehensive genetic analysis carried out so far pointed to a single migration that spawned all Asian populations, including Aboriginal Australians3. But estimated times of the separation of European and Asian ancestors in this population does not chime well with the archaeological evidence for the continuous settlement of Australia from much earlier times.

"These papers make an overwhelming case for multiple waves of migration." David Reich Harvard Medical School

A complete genome from an Aboriginal Australian would settle this debate, Willerslev says. Many contemporary Aboriginal Australians also descend from Europeans because of recent interbreeding between Aboriginals and Australian colonists. To get a better picture of the ancient history of Aboriginals, Willerslev wanted to sequence the genome of someone who did

not descend from Europeans.

About a year ago, his team obtained a hair sample originally collected by the British ethnologist Alfred Cort Haddon. Historical records suggest that Haddon got the hair from a young Aboriginal man in the early 1920s while on a train journey from Sydney to Perth.

Willerslev believes that the man offered his hair to Haddon willingly, and a Danish bioethics review board saw no problem with sequencing his genome. Willerslev later received the blessing of a committee that represents Aboriginal people in the region where the man probably lived.

An analysis of his genome indicates that his ancestors started their journey more than 60,000 years ago, branching off from humans who left Africa. The ancestors of contemporary Europeans and most other Asians probably went their separate ways less than 40,000 years ago, according to Willerslev's team.

Ancient relations

Like other populations outside Africa, the Australian Aboriginal man owes small chunks of his genome to Neanderthals4. More surprisingly, though, his ancestors also interbred with another archaic human population known as the Denisovans. This group was identified from 30,000–50,000-year-old DNA recovered from a finger bone found in a Siberian cave5. Until now, Papua New Guineans were the only modern human population whose ancestors were known to have interbred with Denisovans.

A second study incorporating genomic surveys from different Aboriginal Australians paints an even clearer picture of their ancestors' exploits with the Denisovans. Researchers led by Mark Stoneking at the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany, calculated the portion of Denisovan ancestry found in the genomes of 243 people representing 33 Asian and Oceanian populations. Patterns of Denisovan interbreeding in human populations could reveal human migration routes through Asia, reasoned the team. The paper is published today in the American Journal of Human Genetics6.

This comparison revealed a patchwork in which some populations, including Australian Aboriginals, bore varying levels of Denisovan DNA, while many of their neighbours, like the residents of mainland Southeast Asia, contained none.

Stoneking says that this pattern hints at at least two waves of human migration into Asia: an early trek that included the ancestors of contemporary Aboriginal Australians, New Guineans and some other Oceanians, followed by a second wave that gave rise to the present residents of mainland Asia. Some members of the first wave (though not all of them) interbred with Denisovans. However, the Denisovans may have vanished by the time the second Asian migrants arrived. This also suggests that the Denisovan's range, so far linked only to a cave in southern Siberia, once extended to Southeast Asia and perhaps Oceania.

"Put together, these two papers make an overwhelming case for multiple waves of migration," says David Reich, a population geneticist at Harvard Medical School in Boston, an author on the second study.

Alan Redd, a biological anthropologist at the University of Kansas in Lawrence, says that the peopling of Australia may have been more complicated than either paper suggests. Dingoes, for

instance, were brought to the island continent by humans who arrived in the last 5,000 years. "It's certainly possible that people were trickling in at different times," he says.

References

- 1. Rasmussen, M. et al. Science http://10.1126/science.1211177 (2011).
- 2. Bowler, J. *et al.* Nature 421, 837-840 (2003). | Article | PubMed | ISI | ChemPort |
- 3. HUGO Pan-Asian SNP Consortium Science 326, 1541-1545 (2009). | Article | PubMed | ISI | ChemPort |
- 4. Green, R. E. *et al.* Science 328, 710-722 (2010). | Article | PubMed | ISI | ChemPort |
- 5. Reich, D. et al. Nature 468, 1053-1060 (2010).
- 6. Reich, D. et al. Am. J. Hum. Genet. 89, 1-13 (2011). | Article |