

Mungo Man's DNA Shakes the *Homo* Family Tree

Guy NOLCH reports that DNA extracted from Australia's oldest skeleton has weakened the Out of Africa Model of human evolution.

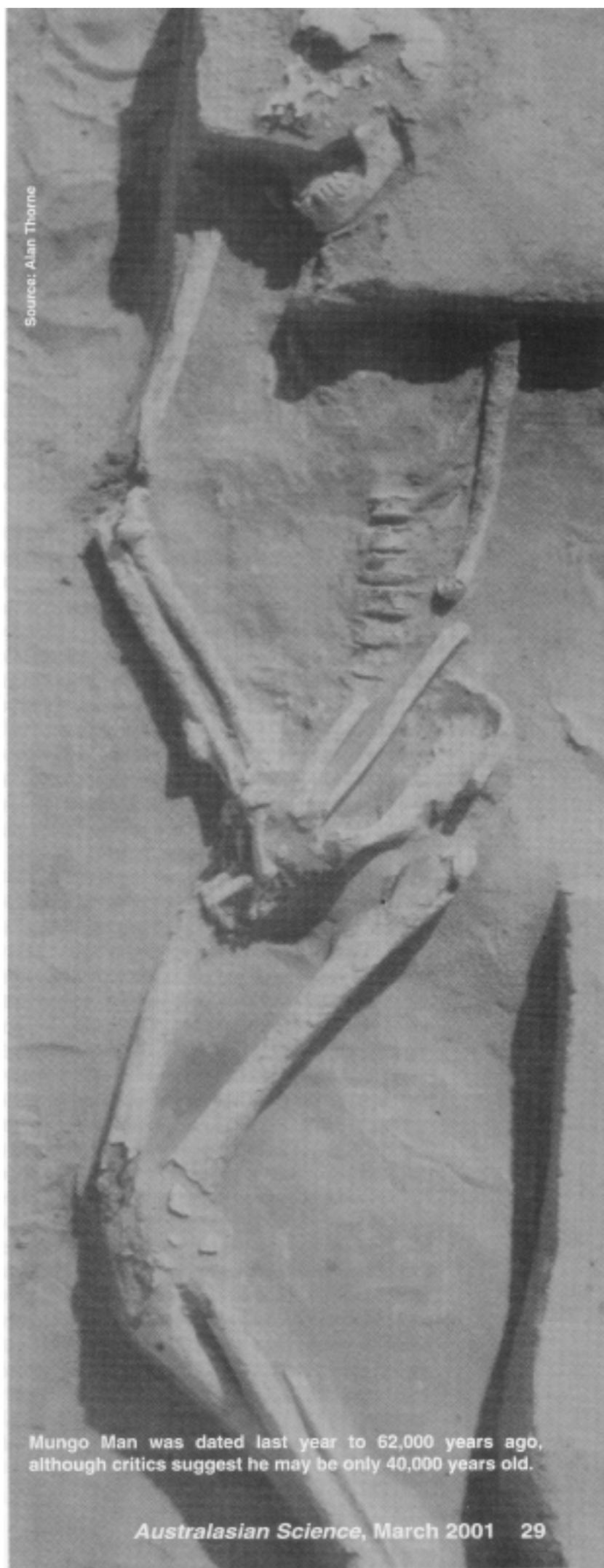
Analysis of DNA extracted from Australia's oldest human skeleton has reopened the debate over the origins of the human species. The Lake Mungo 3 (LM3) skeleton was controversially dated last year to approximately 62,000 years, which would make it the oldest skeleton in the world from which mitochondrial DNA (mtDNA) has been extracted.

Dr Greg Adcock from the Australian National University's (ANU) Research School of Pacific and Asian Studies compared the mtDNA of LM3 and nine other ancient Australian skeletons with Aboriginal people from the Willandra Lakes region of western NSW. Reporting his findings in the *Proceedings of the National Academy of Sciences* in January, Dr Adcock found that LM3's mtDNA no longer existed in modern humans, and therefore LM3's lineage "diverged before the most recent common ancestor of contemporary human mitochondrial genomes". Dr Adcock says that this "implies that the most divergent known mtDNA lineage from an 'anatomically modern' human is from an Australian individual". However, "this finding does not imply that all living people originated in Australia".

The genetic data has implications for our understanding of the origin of the human species. Adcock explains that there are two competing models for the evolution of modern humans. The Recent Out of Africa Model contends that "*Homo sapiens* emerged in Africa approximately 100,000 years (ka) before present and spread globally, replacing other species of *Homo* that it encountered during its expansion".

An alternative model is the Multiregional Model, which "postulates that ever since humans began to migrate out of Africa, more than 1.5 million years ago, there has been a single evolving species, *Homo sapiens*, distributed throughout the Old World, with all regional populations connected, as they are today, by gene flow. Some skeletal features developed and persisted for varying periods in the different regions so that recognisable regional morphologies have developed in Africa, Europe and Asia."

Dr Adcock says the DNA data "present a serious challenge" to interpretations of Neandertal mtDNA that have been used to support the Recent Out of Africa Model of human evolution. He says that LM3's separate mtDNA lineage and modern anatomy



Source: Alan Thorne

Mungo Man was dated last year to 62,000 years ago, although critics suggest he may be only 40,000 years old.

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implies that “anatomically modern humans were among those that were replaced and that part of the replacement occurred in Australia”.

Speaking with *Australasian Science* from Paris, where he is now examining anthropomorphic effects on populations of barn swallows at Universite Pierre et Marie Curie, Adcock says he “downplays” the notion that his finding “disproves everything about the Out of Africa Model because it doesn’t. What I think it has engendered is a healthy debate that also has raised questions and made people think about the simplistic model that Out of Africa is based on. The LM3 data do not reject the Out of Africa hypothesis but suggest that they need to incorporate complexity into their model of human evolution.”

Dr Adcock’s analysis of ancient mtDNA required him to extract as little as 0.1pg of mitochondrial DNA (mtDNA) from bone fragments taken from LM3 - referred to by the local Aboriginal people as Mungo Man - and three other “gracile” skeletons discovered in the Willandra Lakes region, as well as six morphologically distinct “robust” skeletons from Kow Swamp in northern Victoria.

Dr Simon Easteal and colleagues at the John Curtin School of Medical Research were instrumental in the interpretation of the ancient DNA sequences, which were compared with mtDNA collected from 45 Aborigines, 3400 people from around the world, two Neandertal skeletons, a pygmy chimpanzee and a common chimpanzee. Adcock’s DNA was also analysed to ensure that he had not contaminated the experimental samples.

Mitochondrial DNA (mtDNA) is contained in every cell in the body. It lies outside each cell’s nucleus and is inherited solely from the mother’s ovum.

Therefore it should not be surprising that Dr Adcock found that LM3’s mtDNA is not found in human mtDNA today. If Mungo Man had no sisters who lived to produce daughters, granddaughters and so on, his specific mtDNA will have been wiped from genetic history.

Professor Colin Groves from the Australian National University’s School of Archaeology and Anthropology says that mtDNA evolves much faster than nuclear DNA, and the changes through different lineages are easy to track.”in the 1980s it was found that all living people seem to have mtDNA that descend from a single woman who lived between 150,000 and 250,000 years ago, Prof. Groves told *Australasian Science*. “She has been called ‘Mitochondrial Eve’, although she was obviously not the only woman alive at that time - think about it, every time a woman has only sons her mtDNA becomes extinct even though her other DNA survives and flourishes, and some lines expand at the others’ expense. So of course the mtDNA of all living people will go back to one source, but this source is not ‘the origin of Homo sapiens’ or anything like that.”

Prof. Groves has been at loggerheads with Adcock’s supervisor at ANU, Dr Alan Thorne, over interpretations made from Mungo Man about Australia’s colonisation. The media were quick to pit Groves and Thorne against one another when Adcock’s paper was published.

Prof. Groves told *Australasian Science* that he was sceptical of the conclusion that Mungo Man belongs to a lineage that diverged before Eve. “The spin that has been put on this discovery - that there were two different sources for the original peopling of Australia, and that the common belief that *Homo sapiens* originated in Africa is somehow wrong - is quite unjustified. Because of the way it is inherited, the older the specimen from which you get mtDNA the more likely it is that you will come across a lineage that has since died out...The LM3 mtDNA was very likely a variant within a *Homo sapiens* population.”

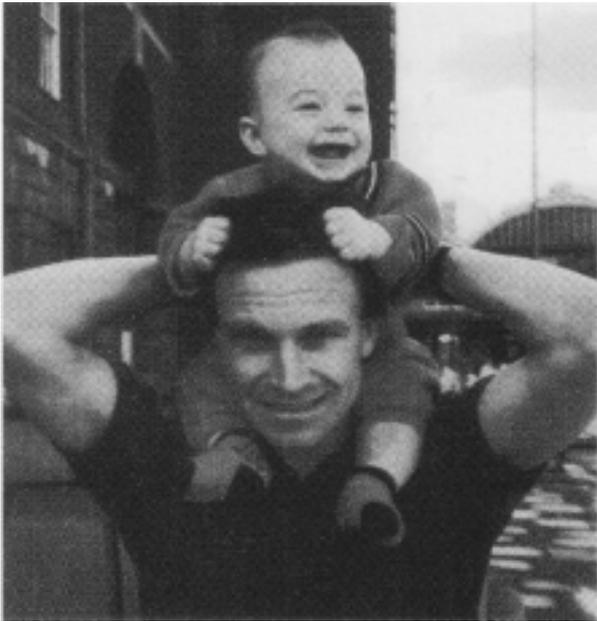
But Dr Adcock says that there is no mention of the debate about Australia’s colonisation in his ancient DNA paper. “I contend that our data does not provide a test of hypotheses concerning the number of migrations that contributed to the present day genetic make-up of Aboriginal people.”

However, Adcock says the mtDNA data weaken Groves’ view of an African cradle for humanity. “According to the Out of Africa Model, all mitochondrial types around the world should be derived from an African source. Groves is saying that, for some reason, African mtDNA types related to LM3 disappeared but the types related to humans living today survived. He is also implying that much more diverse mitochondrial types existed in human populations not so long ago. Since the age of Eve is determined by the amount of diversity present in *Homo sapiens*, by his own logic Groves is suggesting an earlier origin of Eve - in other words, an origin closer to that predicted by the multiregional hypothesis.”

Groves, however, still contends that the mtDNA does not weaken the Out of Africa Model of human evolution. “When discussing modern human origins, the genetic evidence - at least the mitochondrial evidence - is equivocal; the African Origin model stands or falls by the fossil evidence and, in my opinion, it stands.”

Interpretations of Mungo Man’s age and anatomy have been the subject of bitter dispute among Australian scientists. Last year in *Australasian Science* Dr Peter Brown, an Associate Professor in Palaeoanthropology at the University of New England, challenged claims by Dr Thorne that Mungo Man was approximately 62,000 years old, arguing this was “at least 20,000 years older” than the sediments in which the skeleton was found (AS, May 2000, pp. 28-31). Dr Thorne countered that mourners at Mungo Man’s burial have sprinkled these younger sediments over the grave. Alternatively Mungo Man may have ingested antbed and clay as a remedy for abdominal pains. “He

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Greg Adcock continues *Homo's* evolution with son Magnus.

died of something after all," Dr Thorne says, "and his skeleton shows no signs of violence or anything that might have killed him".

Another area of dispute has been the morphological characterisation of LM3. Thorne says that LM3 "is very delicately constructed for a man - small, relatively thin-walled, with weakly developed features". He says that the appearance of a robust morphology 20,000 years ago – or 40,000 years after LM3 - indicates separate migrations into Australia. "A global trend over the past 200,000 years has seen the human skeletal form undergo significant gracilisation towards the present," he wrote in *Australasian Science* last June. "The Australian evidence appears to reverse this process as gracile people appear well before robust people."

Dr Thorne believes that "this is good evidence for migrations of physically distinct peoples to Australia over at least 70,000 years... These physical differences reflect the evolution, migrations and mixture of various peoples in South-East Asia as well as in Australia."

However, Brown challenges Thorne's assertion that the LM3 skeleton is gracile, saying it is "robustly built" like the Kow Swamp population. "Nothing about the skeleton warrants it being placed in a distinctive gracile population and it certainly does not provide support for the notion of two separate migrations to Pleistocene Australia from different parts of Australia," he wrote in *Australasian Science* last year.

Prof. Groves finds support for this conclusion from Dr Adcock's mtDNA analysis. "The Kow Swamp population...

has sometimes been said to be 'outside' the anatomical range of modern Aboriginal Australians," he said. "Although close analysis shows that this is wrong, it is interesting that Dr Adcock's findings indicate that their mtDNA fits within the modern range."

Similarly, Adcock told *Australasian Science* that his "sympathies don't necessarily lie with Thorne's point of view" of separate migrations of robust and gracile people into Australia. "The molecular data we have doesn't differentiate between robust and modern people but the earlier gracile LM3 is different. If the robust people were a different group that came in later then you might expect their DNA to be somewhat different to the original people. However, we have analysed too few ancient individuals to address the issue of separate migrations."

More controversy has centred on the ability to extract DNA from such an old skeleton. "Whether LM3 really is over 60,000 years old is still controversial," says Prof. Groves, "but it is probably the oldest fossil to have had DNA successfully extracted from it. Dr Adcock has achieved a remarkable feat sequencing DNA from a fossil as old as Lake Mungo 3."

But according to Dr Brown, "The biggest surprise to European fossil DNA researchers is that mtDNA is preserved at a claimed age of 60 ka and in the hot, but variable, climate of Lake Mungo. In Europe, DNA older than about 10 ka has only been recovered from very cold and dry environments... Contamination from other organic material or some other human DNA has to be a concern."

While contamination of minute samples of ancient DNA is problematic, Adcock was careful. He prepared bone samples and extracted DNA in two separate laboratories 2 km apart, and human DNA had never been isolated or analysed in either laboratory. Working in sterile conditions Dr Adcock was the only researcher to move between the two laboratories, yet to avoid contamination he never travelled between the two on the same day. The precautions paid dividends: sequences of mtDNA taken from Adcock were distinctly different from the ancient mtDNA sequences he was studying.

Will the dispute ever be resolved? Unfortunately a consensus on LM3's age may never be reached as the sediments in which it was buried have eroded away. "The only way the debate over Australia's first colonists will ever be solved is through the discovery of late Pleistocene human and cultural materials in Asia," Dr Brown said. "Unfortunately the time period in which people first floated to Australia 60,000 to 40,000 years ago remains something of an archaeological blank page in Asia."

Ditto for DNA studies, it seems. Nuclear DNA is difficult to find in such ancient remains, and Adcock says it is "very unlikely" that Mungo Man will yield his deepest secrets.