



# Establishing Adam: Recent Evidences for a Late-Date Adam (AMH@100,000 BP)

David L. Wilcox

**T**he appearance of modern humans continues to be a major controversy in paleoanthropology. The issues include genetic, anatomical, and cultural matters. For the Christian, there are also important theological issues, leading to various estimations of the timing of “Eden” ranging from two million years ago to six thousand years ago.<sup>1</sup> Several interesting papers related to this issue were published last year. This communication notes several of these and suggests a biological mechanism possibly involved in the process by which God created humanity.

The controversy centers on the idea that the modern human skeletal form first appeared around 100,000 to 160,000 years ago in northeast Africa. Does this represent a unique cusp of history, or is it just a standard spot on the long path from ape to human? (Or, since human and chimpanzee share at least 95% of their genes—from proto-chimp to professor.)<sup>2</sup> The primary evidence is genetic.

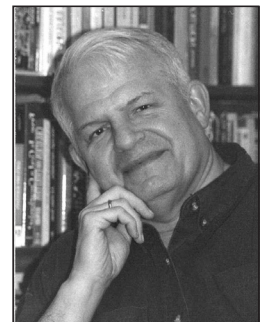
Genetic trees depend on mutation and drift, processes that are highly sensitive to the effective population size (Ne). It is instructive to compare the Ne’s of modern hominoids. Estimates for the long term (Pleistocene) effective population size of *Homo sapiens* are in the range of eight to ten thousand individuals.<sup>3</sup> In contrast, high gene diversity in the five extant ape species indicates they all have Ne’s that are four to nine times greater.<sup>4</sup> Apparently the common ancestor of humans and chimps also had a larger Ne.<sup>5</sup> In fact, gene diversity within the two chimp species (*Pan*) is almost as great as the genetic distance between them.<sup>6</sup> Since the two chimp species diverged around 1.8 million years ago, populations with Ne’s of around

40,000/80,000 (like the chimps) retain one to two million years of mutational (gene sequence) diversity.<sup>7</sup>

One and one-half million years ago saw *Homo erectus* (or *ergaster*) scattered from Kenya, to Dmanisi in Georgia, and on to Indonesia.<sup>8</sup> Thus, genus *Homo* has been spread over a much wider area than genus *Pan* for the last two million years. Subdivided populations have much larger Ne’s, retaining far more genetic diversity.<sup>9</sup> Also, the human species (and its Ne) obviously is currently much larger than that of any ape species. If we were descended from all of those ancient scattered populations of archaic hominids, we should have retained most of their ancient genetic diversity—and added all of the new mutations of the last two million years. Thus we should be far more genetically diverse than genus *Pan*, not less.

Is it possible that humans are unusual, demographically speaking? Did we move around so much that we “pruned” our worldwide genetic tree to the point that our Ne looks much smaller than it really is? Recent reports of relic African tribes (the Hadzabe, the Sandawe, and the !Kung) indicate otherwise.<sup>10</sup> These ancient tribes have almost as much genetic diversity in one valley as the rest of the entire human race, i.e., they have retained most of the diversity generated since the time of their founding. So, ancient isolated human populations can and do maintain high levels of genetic diversity.

**David Wilcox** is professor of biology at Eastern University, where he has taught since 1976. David was stimulated by a conference on Christian graduate work to study evolutionary mechanisms, leading to a Ph.D. in population genetics from Penn State. He has contributed through several publications on theoretical aspects of Christianity and evolution. David is a fellow of the ASA and served on the Executive Council, 1993–1997. He can be reached at: [dwilcox@eastern.edu](mailto:dwilcox@eastern.edu)



David Wilcox

*The controversy [of the appearance of modern humans] centers on the idea that the modern human skeletal form first appeared around 100,000 to 160,000 years ago in northeast Africa.*



*All primate species but us have two chromosomes that are homologous to the two arms of our second chromosome. Human chromosome two clearly was created by fusing two ancestral sub-metacentric chromosomes. ... That fusion chromosome, at first existing in only a single organism, has become the established human karyotype.*

## Communication

*Establishing Adam: Recent Evidences for a Late-Date Adam (AMH@100,000 BP)*

The relatively low overall human genetic diversity must mean that we grew numerous recently (and relatively rapidly) from some single small population (termed “founder effect”).<sup>11</sup>

Having a smaller  $N_e$  than *Pan* is particularly remarkable, since apparently the chimp species also went through a sharp reduction in numbers—an AIDS epidemic about two million years ago.<sup>12</sup> The human lineage therefore must have experienced an even sharper reduction in population size than that caused by an uncontrolled AIDS epidemic.

The timing of this bottleneck is indicated by many studies (for example, the recent FOXP2 study) that suggest such genetic diversities stem from 100,000 to 200,000 years ago.<sup>13</sup> But is such an event biologically reasonable? There is indeed a smoking gun, clear evidence pointing to a necessary bottleneck. All primate species but us have two chromosomes that are homologous to the two arms of our second chromosome. Human chromosome two clearly was created by fusing two ancestral sub-metacentric chromosomes.<sup>14</sup> The fusion happened between the telomeres of the short arms (each about 30 map units in length), producing a fusion chromosome with two centromeres 60 map units apart. Relic telomeric and centromeric sequences still exist in the corresponding sites of the human chromosome. That fusion chromosome, at first existing in only a single organism, has become the established human karyotype.

Hominids with the fusion chromosome would have had a profound reduction in fertility due to the formation of abnormal karyotypes during meiosis (caused by non-disjunction and chromosome breakage). When one of the centromeres became deactivated, fertility would have improved, but would still have been below normal in “cross-breeds.” Nondisjunction would reduce gamete production, and crossovers with the short arm of an ancestral-type chromosome could reactivate the relic centromere. Only about one third of the gametes formed by such “cross-breeds” would produce viable offspring.

In a large population, natural selection would quickly get rid of such a fusion chromosome. It could only replace the original karyotype in a small isolated population

where genetic drift instead might weed out the ancestral form within a very few generations. When a new karyotype becomes established in such an isolated population, it will have full fertility, but only as long as breeding stays within the group. Any mating that takes place with individuals having the ancestral karyotype (in this case, all other living hominids on the planet) would have sharply reduced fertility. This must have happened to the human lineage. (This is not the only evidence, of course. Such an abrupt bottleneck might also be implicated by the excess of 313 SNP’s that seem to be derived sequences in the human [different than the chimp sequence], and yet show no signal of positive selection.)<sup>15</sup>

In most mammals, this strong fertility barrier will drive the quick establishment of pre-reproductive isolating mechanisms—i.e., recognizable identification signals such as changes in physical appearance and behavior. Apply this process to hominids.<sup>16</sup> A recent report identifies two unique and non-overlapping features of the modern skull vis à vis the archaic skull—facial retraction and neurocranial globularity.<sup>17</sup> (“Modern” includes the early modern skulls of Skhul and Qafzeh in Israel). Add in the modern pointed chin. All three change the shape of the face, the primary recognition site for primate communication. Facial change would not be driven by brain evolution—the archaic hominids of the period already had large brains—nor was it a product of a lifestyle. Analyses of growth in Neanderthal neonates indicate that such unique differences in skulls were apparent from birth.<sup>18</sup> The biological explanation for facial change is species recognition. Think of the striking differences between the faces of many monkey species.

Where would this happen? Biologically speaking, most new species seem to form as isolated populations on the edge of a “parental” species (peripatric speciation). Such an isolate would be necessary to allow fixation of the fusion chromosome and the various genetic shifts involved in the making of modern humans. As an alternative model, Eller has suggested a large widespread subdivided population, with continuous extinction and recolonization, thus keeping the effective population size small.<sup>19</sup> However, though such a “winner-takes-all”

evolutionary lottery might reduce population size by catastrophes, or by attacks on neighboring populations, it simply would have the effect of isolating a single population. The usual model seems more reasonable.

---

*Biologically speaking, most new species seem to form as isolated populations on the edge of a "parental" species ... Such an isolate would be necessary to allow fixation of the fusion chromosome and the various genetic shifts involved in the making of modern humans.*

---

Where was the location of the "parental" population? The oldest evidence of modern humans points to Ethiopia. A modern specimen found at the Omo River is dated at 130,000 years ago, and three modern skulls dated at 160,000 years ago have been found in the Middle Awash area.<sup>20</sup> However, since peripatric speciation requires significant isolation, the middle of the African savannah seems unlikely. A peripheral isolate plausibly could have been established somewhere on the Arabian peninsula, on the northeastern border of the African savannah—perhaps even in the fertile valley which existed where the Persian Gulf presently flows. The incipient human species could easily return to northeast Africa, spinning off bands of ancient wanderers, working their way down the endless savannas of East Africa to leave their bones at the Klaises River mouth in South Africa.<sup>21</sup>

Species also are distinguished from each other by behavior. No species has ever had as much behavioral flexibility as the human, of course. But when and why did that flexibility begin? Perhaps this too reflects the need to generate species recognition signals. Humans can obtain a change in appearance a lot faster by applying ocher than through changes in melanin density! And early moderns used it.<sup>22</sup> (So do late moderns, but our palette has grown.)

The argument has frequently been made that archaic hominids showed behaviors that indicate they were fully human. For instance, the presence of ancient tools on the island of Flores is taken to mean they built boats.<sup>23</sup> But, a recent report of an Indian "tool factory" of one million years ago indicates those stone tools were simply made,

used, and tossed away—hardly a modern pattern of thoughtful provision.<sup>24</sup> Since the channels of the Sunda shelf at Glacial maximum would have been at most only a few miles wide, it seems more likely that the transportation was rafts of flood vegetation—or even swimming. That is a far cry from the ninety kilometers of open ocean to be crossed to reach the Sahel shelf of greater Australia.

Were Neanderthals fully human? Certainly they had brains as big as modern people, but we do not know exactly how they used them. Did they behave in ways we would recognize, or are we only seeing them in a foggy mirror? Are we really looking for ourselves rather than at their reality? The difficulty of human preconceptions in evaluating ambiguous evidence is illustrated in a recent paper on Neanderthal adaptations for cold climate.<sup>25</sup> The authors propose as possible adaptations—brown adipose, heat shock proteins, growth factors, altered calcium metabolism, and typical physiological shifts, though they think subcutaneous fat (blubber) too difficult and too expensive to maintain. However, it does not seem to occur to them that a primate with a 500,000-year history of glacial adaptation would be likely to have the energetically cheap adaptation to cold of the Japanese macaque—a built in fur coat. In any other mammal lineage, it would be a foregone conclusion. The obvious conclusion should be that modern arctic zone humans have bare skins only because they arrived in the Arctic already able to borrow coats from the reindeer.

Of course, hairy or not, this is not to say that the Neanderthals were necessarily without wisdom and beauty. In theory, they could have been our cultural equals.<sup>26</sup> Perhaps they were the first choral singers and superb birch bark artists. But they left no indisputable signs that they had such capacities. It is true that they sometimes cared for their disabled and possibly buried some of their dead. But elephants seem to mourn their dead. And caring for the disabled is typical behavior for pack predators such as wolves. In fact, evidence of healed disabling wounds is used to argue for such pack behavior in saber-tooth cats and tyrannosaurs.

However, it is the genetic evidence that is compelling. Four Neanderthal mtDNA sequences cluster neatly together at a common distance from modern human sequences, corresponding to a common root of 500,000 years ago.<sup>27</sup> Cro-Magnon mtDNA groups with modern Europeans, not Neanderthals.<sup>28</sup> There have been some critiques,<sup>29</sup> but so far the results still seem convincing. Further, ongoing evaluation of what seemed to be a hybrid child (Spain) points away from that conclusion.<sup>30</sup> Skeletal evidence of jaw structure indicates that Neanderthals were a specialized species which is not ancestral to ours.<sup>31</sup> And even if it were demonstrated that Neanderthal genomes group with those of modern humans, it would not change the genetic comparison with the various ape species.<sup>32</sup> Humans are still genetic paupers.



## Communication

### *Establishing Adam: Recent Evidences for a Late-Date Adam (AMH@100,000 BP)*

Not that ancient DNA has all of the answers. The complexities and pitfalls of such analyses are illustrated by a report that the human nuclear genome has more than one thousand sequences (including later duplications) homologous to sections of mtDNA.<sup>33</sup> This report is particularly significant, because the uniquely distant mtDNA sequence reportedly extracted from a Lake Mungo skeleton in Australia is close to some of these insertions.<sup>34</sup> This suggests that it is likely to be a bit of modern nuclear DNA picked out for the PCR by mtDNA primers rather than a sign of ancient admixture.<sup>35</sup>

Can genetic studies shed light on what happened as we became human? How significant is the 95% sequence similarity between human and chimp genomes? A broad survey of gene expression in various human tissues (for transcriptomes and protein expression patterns) shows pronounced changes in the gene expression pattern only in the brain.<sup>36</sup> We can conclude that these are not new genes, but new patterns of expression, new genetic blueprints made from the old clay. And too, there is evidence that endogenous retroviruses may be implicated in sudden genomic reorganizations in the human lineage producing “punctuation” events, such as the appearance of modern traits.<sup>37</sup>

Certain specific genes, however, do seem to have been modified. For instance, the membrane protein sialic acid is not made in humans, a deactivation event due to an ALU shift thought to have occurred around two million years ago.<sup>38</sup> Genes such as apoE are turned on—or modified significantly.<sup>39</sup> The most interesting is the FOXP2 gene, a transcription factor involved with the face and jaw movements necessary for speech. This highly conserved gene shows three sequence changes between mouse and humans. Two of these changes are between chimp and humans, only one change is between mouse and chimp. The FOXP2 gene shows a selective sweep—the value of Tajima’s D statistic for FOXP2 has the most significant value of any human gene (save one). The probability is 95% that divergence in this gene within the human species took place in under 120,000 years. Further, the differences between the human and all other forms of the gene are functional differences—the human protein is phosphorylated.<sup>40</sup> Such changes

alter the activities of entire genetic networks. So speech too probably began with a bang—or perhaps with a click. (Click languages are still spoken by the most ancient tribes—the Hadzabe and !Kung.)<sup>41</sup>

If genetic and skeletal evidences point to a common era, how about culture in that era? The early (100,000 years ago) modern forms at Skhul and Qafzeh caves on Mount Carmel apparently used artifacts which were much like those of the Neanderthals who used the neighboring Tabun cave. However, there is some new evidence about them. The hand bones of early moderns have articular surfaces indicating that their owners were engaged in modern manipulative behaviors.<sup>42</sup> This conclusion is reinforced by several reports from central Africa indicating the use of ocher and the manufacture of incised stones, beads, micro-liths (compound tools) and carved bone harpoons dating to 90,000 years ago.<sup>43</sup> This evidence is consistent with the appearance of folks who thought like us at around 150,000 years. Around those early dates we see modern morphology, glimmers of complex thought, genetic roots, etc. Shall we place Adam there? That is probably a theological decision rather than a scientific one.

It is true that the culture implied in the Genesis narrative (Gen 4: 2–4, 19–22) did not exist 160,000 years ago. It, in fact, did not exist anywhere until about 11,000 years ago.<sup>44</sup> Further, in much of the world (Australia, for instance) culture has never reached that level. Even where it did arrive, it was preceded by vast stretches of time in which the hunting and gathering ancestors of the farmers used only wood, bone, and stone. Does Genesis describe Adam’s culture, or the author’s understanding of culture?

Does proposing a mechanism of creation imply that Nature rather than God created us? Only if God is an absentee landlord. Would he use such methods? If he governs nature (as in Psalm 104), obviously he uses nature every day. Unless God made Adam with the appearance of very specific “pseudo-ancestors,” hominid descent was involved in his creation. This leaves the theological problem, of course. Is Adam unique? Do we have souls? Surely God’s governing of nature does not preclude his placing a soul within a creature that he had

*... the FOXP2 gene, a transcription factor involved with the face and jaw movements necessary for speech ... shows ... two [sequence changes] between chimp and humans ... The probability is 95% that divergence in this gene within the human species took place in under 120,000 years.*

prepared for it by using natural forces. At some point was Adam the only human?<sup>45</sup> The mechanism of human origins is not "business as usual" in the New Species shop. There is evidence of a sharp bottleneck. All humans must be descended from that hominid with the chromosomal (#2) fusion. But there are still difficulties in fitting Adam to all of the data. At this point, it does not look possible to make the immunological evidence fit a single human pair. We have too many alleles in the HLA immune system.<sup>46</sup> Rather, it looks like we all descended from a small contemporary group of that hominid's "clan." Could Adam have been placed in the garden to sin or swim as a representative of his "clan"? Perhaps.

Since all truth is one and all truth is God's truth, all the puzzle pieces can fit together. Somehow. I have done my best. Dump the box for yourself, but don't lose any of the pieces!

### Notes

- 1J. A. McIntyre, "The Historical Adam," *Perspectives on Science and Christian Faith* 54, no. 3 (Sept. 2002): 150-7; and G. R. Morton, "Language at the Dawn of Humanity," *Perspectives on Science and Christian Faith* 54, no. 3 (Sept. 2002): 193-4.
- 2R. J. Britten, "Divergence Between Samples of Chimpanzee and Human DNA Sequences Is 5%, Counting Indels," *Proceedings of the National Academy of Sciences USA* 99, no. 21 (Oct 15, 2002): 13633-5; and E. Eller, "Population Extinction and Recolonization in Human Demographic History," *Mathematical Bioscience* 177-8 (May-Jun 2002): 1-10.
- 3F. C. Chen, E. J. Vallender, H. Wang, C. S. Tzeng and W. H. Li, "Genomic Divergence Between Human and Chimpanzee Estimated from Large-Scale Alignments of Genomic Sequences," *Journal of Heredity* 92, no. 6 (Nov-Dec 2001): 481-9; and E. Zietkiewicz, V. Yotova, M. Jarnik, M. Korab-Laskowska, K. K. Kidd, D. Modiano, R. Scozzari, M. Stoneking, S. Tishkoff, M. Batzer and D. Labuda, "Genetic Structure of the Ancestral Population of Modern Humans," *Journal of Molecular Evolution* 47, no. 2 (Aug 1998): 146-55.
- 4I. Ebersberger, D. Metzler, C. Schwarz and S. Paabo, "Genomewide Comparison of DNA Sequences Between Humans and Chimpanzees," *American Journal of Human Genetics* 70, no. 6 (Jun 2002): 1490-7; P. Gagneux, C. Wills, U. Gerloff, D. Tautz, P. A. Morin, C. Boesch, B. Fruth, G. Hohmann, O. A. Ryder and S. Woodruff, "Mitochondrial Sequences Show Diverse Evolutionary Histories of African Hominoids," *Proceedings of the National Academy of Sciences USA* 96, no. 9 (Apr 27 1999): 5077-82; and A. C. Stone, R. C. Griffiths, S. L. Zegura and M. F. Hammer, "High Levels of Y-chromosome Nucleotide Diversity in the Genus *Pan*," *Proceedings of the National Academy of Sciences USA* 99, no. 1 (Jan 8 2002): 43-8.
- 5M. I. Jensen-Seaman, A. S. Deinard and K. K. Kidd, "Modern African Ape Populations As Genetic and Demographic Models of the Last Common Ancestor of Humans, Chimpanzees, and Gorillas," *Journal of Heredity* 92, no. 6 (Nov-Dec 2001): 475-80; and E. Zietkiewicz, et al., "Genetic Structure of the Ancestral Population of Modern Humans."
- 6A. C. Stone, et al., "High Levels of Y-Chromosome Nucleotide Diversity in the Genus *Pan*."
- 7N. G. de Groot, N. Otting, G. G. Doxiadis, S. S. Balla-Jhagjhoorsingh, J. L. Heeney, J. J. van Rood, P. Gagneux and R. E. Bontrop, "Evidence for an Ancient Selective Sweep in the MHC Class I Gene Repertoire of Chimpanzees," *Proceedings of the National Academy of Sciences USA* 99, no. 18 (Sep 3 2002): 11748-53; and A. C. Stone, et al., "High Levels of Y-Chromosome Nucleotide Diversity in the Genus *Pan*."
- 8A. Vekua, D. Lordkipanidze, G. P. Rightmire, J. Agusti, R. Ferring, G. Maisuradze, A. Mouskhelishvili, M. Nioradze, M. P. De Leon, M. Tappen, M. Tvalchrelidze and C. Zollikofer, "A New Skull of Early Homo from Dmanisi, Georgia," *Science* 297, no. 5578 (Jul 5 2002): 85-9.
- 9V. Laporte and B. Charlesworth, "Effective Population Size and Population Subdivision in Demographically Structured Populations," *Genetics* 162, no. 1 (Sep 2002): 501-19.
- 10M. K. Gonder, H. Mortensen, J. B. Hirbo, J. Mountain and S. A. Tishkoff, "Demographic History of Khoisan Speakers of Tanzania Inferred from mtDNA Control Region Sequences," *The American Society of Human Genetics* (2002); [www.ashg.org/genetics/ashg/ashg02search.html](http://www.ashg.org/genetics/ashg/ashg02search.html); and A. Knight, P. A. Underhill, H. M. Mortensen, L. A. Zhivotovsky, A. A. Lin, B. M. Henn, D. Louis, M. Ruhlen and J. L. Mountain, "African Y Chromosome and mtDNA Divergence Provides Insight into the History of Click Languages," *Current Biology* 13, no. 8 (Apr 15 2003): 705.
- 11E. Zietkiewicz, et al., "Genetic Structure of the Ancestral Population of Modern Humans."
- 12de Groot, et al., "Evidence for an Ancient Selective Sweep in the MHC Class I Gene Repertoire of Chimpanzees."
- 13W. Enard, M. Przeworski, S. E. Fisher, C. S. Lai, V. Wiebe, T. Kitano, A. P. Monaco and S. Paabo, "Molecular Evolution of FOXP2, A Gene Involved in Speech and Language," *Nature* 418, no. 6900 (2002 Aug 22): 869-72; and B. Sykes, *The Seven Daughters of Eve* (New York: W.W. Norton Co, 2001).
- 14G. Finlay, "Homo divinus: The Ape that Bears God's Image," *Science and Christian Belief* 15, no. 1 (2003): 17-40; J. W. Ido, A. Baldini, R. A. Wells, D. C. Ward and S. T. Reeders, "FRA2B Is Distinct from Inverted Telomere Repeat Arrays at 2q13," *Genomics* 12, no. 4 (1992 Apr): 833-5; and J. W. Ido, A. Baldini, D. C. Ward, S. T. Reeders and R. A. Wells, "Origin of Human Chromosome 2: An Ancestral Telomere-Telomere Fusion," *Proceedings of the National Academy of Sciences USA* 88, no. 20 (1991 Oct 15): 9051-5.
- 15J. A. Schneider, A. E. Anastasio, Y. Morozov, T. S. Kalbfleisch, C. D. Brain, J. L. Vanden-Eng, M. S. Pungliya, R. Jiang, C. Xu, R. S. Judson and J. C. Stephens, "Non-neutral Evolution Revealed by Comparison of Gene-Based DNA Sequence Diversity in Humans and Chimpanzees," *The American Society of Human Genetics* (2002); [www.ashg.org/genetics/ashg/ashg02search.html](http://www.ashg.org/genetics/ashg/ashg02search.html)
- 16C. J. Jolly, "A Proper Study for Mankind: Analogies from the Papionin Monkeys and Their Implications for Human Evolution," *American Journal of Physical Anthropology* Suppl 33 (2001): 177-204.
- 17D. E. Lieberman, B. M. McBratney and G. Krovitz "The Evolution and Development of Cranial Form in *Homo sapiens*," *Proceedings of the National Academy of Sciences USA* 99, no. 3 (2002 Feb 5): 1134-9.
- 18B. Maureille, "Anthropology: A Lost Neanderthal Neonate Found," *Nature* 419, no. 6902 (2002 Sep 5): 33-4; M. S. Ponce de Leon and C. P. Zollikofer, "Neanderthal Cranial Ontogeny and Its Implications for Late Hominid Diversity," *Nature* 412, no. 6846 (2001 Aug 2): 534-8; and R. Rogers-Ackermann and G. E. Krovitz, "Common Patterns of Facial Ontogeny in the Hominid Lineage," *Anatomical Record* 269, no. 3 (2002 Jun 15): 142-7.
- 19E. Eller, "Population Extinction and Recolonization in Human Demographic History," *Mathematical Bioscience* 177-178 (2002 May-Jun): 1-10.
- 20J. D. Clark, Y. Beyene, G. WoldeGabriel, W. K. Hart, P. R. Renne, H. Gilbert, A. Defleur, G. Suwa, S. Katoh, K. R. Ludwig, J. R. Boissier, B. Asfaw, and T. D. White, "Stratigraphic, Chronological and Behavioural Contexts of Pleistocene *Homo sapiens* from Middle Awash, Ethiopia," *Nature* 423 (2003 June 12): 747-52; and T. D. White, B. Asfaw, D. DeGusta, H. Gilbert, G. D. Richards, G. Suwa, and F. C. Howell, "Pleistocene *Homo sapiens* from Middle Awash, Ethiopia," *Nature* 423 (2003 June 12): 742-7.
- 21C. S. Henshilwood, F. d'Errico, R. Yates, Z. Jacobs, C. Tribolo, G. A. Duller, N. Mercier, J. C. Sealy, H. Valladas, I. Watts and A. G. Wintle, "Emergence of Modern Human Behavior: Middle Stone Age Engravings from South Africa," *Science* 295, no. 5558 (2002 Feb 15): 1278-80; and C. S. Henshilwood, F. d'Errico, C. W. Marean, R. G. Milo and R. Yates, "An early Bone Tool Industry from the

# Communication

## Establishing Adam: Recent Evidences for a Late-Date Adam (AMH@100,000 BP)

Middle Stone Age at Blombos Cave, South Africa: Implications for the Origins of Modern Human Behaviour, Symbolism and Language," *Journal of Human Evolution* 41, no. 6 (2001 Dec): 631-78.

<sup>22</sup>Henshilwood, et al., "Emergence of Modern Human Behavior."

<sup>23</sup>Morton, "Language at the Dawn of Humanity."

<sup>24</sup>H. Briggs, "Human Ancestors 'Dogy at DIY,'" Report, British Association Science Festival, Leicester, *BBC NEWS* (2002 Sept 12).

<sup>25</sup>A. T. Steegmann Jr., F. J. Cerny and T. W. Holliday, "Neanderthal Cold Adaptation: Physiological and Energetic Factors," *American Journal of Human Biology* 14, no. 5 (2002 Sep-Oct): 566-83.

<sup>26</sup>Morton, "Language at the Dawn of Humanity"; M. A. Schillaci and J. W. Froehlich, "Nonhuman Primate Hybridization and the Taxonomic Status of Neanderthals," *American Journal of Physical Anthropology* 115, no. 2 (2001 Jun): 157-66; and R. W. Schmitz, D. Serre, G. Bonani, S. Feine, F. Hillgruber, H. Krainitzki, S. Paabo and F. H. Smith, "The Neanderthal Type Site Revisited: Interdisciplinary Investigations of Skeletal Remains from the Neander Valley, Germany." *Proceedings of the National Academy of Sciences USA* 99, no. 20 (2002 Oct 1): 13342-7.

<sup>27</sup>Ponce de Leon and Zollikofer, "Neanderthal Cranial Ontogeny and Its Implications for Late Hominid Diversity."

<sup>28</sup>D. Caramelli, C. Lalueza-Fox, C. Vernesi, M. Lari, A. Casoli, F. Mallegni, B. Chiarelli, I. Dupanloup, J. Bertranpetit, G. Barbujani, and G. Bertorelle, "Evidence for a Genetic Discontinuity Between Neanderthals and 24,000-year-old Anatomically Modern Europeans," *Proceedings of the National Academy of Sciences USA* 100, no. 11 (2003 May 27): 6593-7.

<sup>29</sup>G. Gutierrez, D. Sanchez and A. Marin, "A Re-analysis of the Ancient Mitochondrial DNA Sequences Recovered from Neanderthal Bones," *Molecular and Biological Evolution* 19, no. 8 (2002 Aug): 1359-66.

<sup>30</sup>J. Arsuaga, V. Villaverde, R. Quam, A. Gracia, C. Lorenzo, I. Martinez and J. Carretero, "The Gravettian Occipital Bone from the Site of Malladetes (Barx, Valencia, Spain)," *Journal of Human Evolution* 43, no. 3 (2002 Sep): 381.

<sup>31</sup>Ponce de Leon and Zollikofer, "Neanderthal Cranial Ontogeny and Its Implications for Late Hominid Diversity"; Y. Rak, A. Ginzburg and E. Geffen, "Does Homo Neanderthalensis Play a Role in Modern Human Ancestry? The Mandibular Evidence," *American Journal of Physical Anthropology* 119, no. 3 (2002 Nov): 199-204; and Rogers-Ackermann and Krovitz, "Common Patterns of Facial Ontogeny in the Hominid Lineage."

<sup>32</sup>Jolly, "A Proper Study for Mankind."

<sup>33</sup>Y. Tourmen, O. Baris, P. Dessen, C. Jacques, Y. Malhiery and P. Reynier, "Structure and Chromosomal Distribution of Human Mitochondrial Pseudogenes," *Genomics* 80, no. 1 (2002 Jul): 71-7.

<sup>34</sup>G. J. Adcock, E. S. Dennis, S. Eastal, G. A. Huttley, L. S. Jermin, W. J. Peacock, and A. Thorne, "Mitochondrial DNA Sequences in Ancient Australians: Implications for Modern Human Origins," *Proceedings of the National Academy of Sciences USA* 98, no. 2 (2001 Jan 16): 537-42.

<sup>35</sup>A. Cooper, A. Rambaut, V. Macaulay, E. Willerslev, A. J. Hansen and C. Stringer, "Human Origins and Ancient Human DNA," *Science* 292, no. 5522 (2001 Jun 1): 1655-6.

<sup>36</sup>W. Enard, P. Khaitovich, J. Klose, S. Zollner, F. Heissig, P. Giavalisco, K. Nieselt-Struwe, E. Muchmore, A. Varki, R. Ravid, G. M. Doxiadis, R. E. Bontrop and S. Paabo, "Intra- and Interspecific Variation in Primate Gene Expression Patterns," *Science* 296, no. 5566 (2002 Apr 12): 340-3.

<sup>37</sup>I. Ovchinnikov, A. Rubin and G. D. Swergold, "Tracing the Lines of Human Evolution," *Proceedings of the National Academy of Sciences USA* 99, no. 16 (2002 Aug 6): 10522-7.

<sup>38</sup>H. H. Chou, T. Hayakawa, S. Diaz, M. Krings, E. Indriati, M. Leakey, S. Paabo, Y. Satta, N. Takahata and A. Varki, "Inactivation of CMP-N-acetylneuraminic Acid Hydroxylase Occurred Prior to Brain Expansion During Human Evolution," *Proceedings of the National Academy of Sciences USA* 99, no. 18 (2002 Sep 3): 11736-41.

<sup>39</sup>H. S. Kaplan and A. J. Robson, "The Emergence of Humans: The Coevolution of Intelligence and Longevity with Intergenerational

Transfers," *Proceedings of the National Academy of Sciences USA* 99, no. 15 (2002 Jul 23): 10221-6.

<sup>40</sup>M. Balter, "Language Evolution: 'Speech Gene' Tied to Modern Humans," *Science* 297, no. 5584 (2002 Aug 16): 1105; H. A. Bruce and R. L. Margolis, "FOXP2: Novel Exons, Splice Variants, and CAG Repeat Length Stability," *Human Genetics* 111, no. 2 (2002 Aug): 136-44; W. Enard, M. Przeworski, S. E. Fisher, C. S. Lai, V. Wiebe, T. Kitano, A. P. Monaco and S. Paabo, "Molecular Evolution of FOXP2, A Gene Involved in Speech and Language," *Nature* 418, no. 6900 (2002 Aug 22): 869-72; and C. S. Lai, S. E. Fisher, J. A. Hurst, F. Vargha-Khadem and A. P. Monaco, "A Forkhead-Domain Gene Is Mutated in a Severe Speech and Language Disorder," *Nature* 413, no. 6855 (2001 Oct 4): 519-23.

<sup>41</sup>A. Knight, P. A. Underhill, H. M. Mortensen, L. A. Zhivotovsky, A. A. Lin, B. M. Henn, D. Louis, M. Ruhlen and J. L. Mountain, "African Y Chromosome and mtDNA Divergence Provides Insight into the History of Click Languages," *Current Biology* 13, no. 8 (2003 Apr 15): 705.

<sup>42</sup>W. A. Niewoehner, "Behavioral Inferences from the Skhul/Qafzeh Early Modern Human Hand Remains," *Proceedings of the National Academy of Sciences USA* 98, no. 6 (2001 Mar 13): 2979-84.

<sup>43</sup>Henshilwood, et al., "Emergence of Modern Human Behavior"; and Henshilwood, et al., "An Early Bone Tool Industry from the Middle Stone Age at Blombos Cave, South Africa."

<sup>44</sup>J. Diamond and P. Bellwood, "Farmers and Their Languages: The First Expansions," *Science* 300 (2003 Apr 25): 597-603.

<sup>45</sup>J. A. McIntyre, "The Historical Adam."

<sup>46</sup>de Groot, et al., "Evidence for an Ancient Selective Sweep in the MHC Class I Gene Repertoire of Chimpanzees."

### Position Opening Taylor University Center for Research and Innovation

#### Seeking Applications and Nominations of Distinguished Research Candidates to be Director

PhD required, preferably in the life sciences, but possibly in fields of physical science, engineering, or business. Preference given to applicants with experience as principal investigators on national-level research projects with proven records of research and publications. Duties include exercising visionary leadership to foster research programs and securing research contracts.

Must be strongly committed to the educational mission and evangelical Christian orientation of the university. Members of minority groups are encouraged to apply. Inquiries, credentials, and supporting materials should be addressed to: **Dr. William R. Klinger, Interim Vice President for Academic Affairs, 236 W. Reade Avenue, Upland, IN 46989-1001; fax 765-998-4910; email [wklinger@tayloru.edu](mailto:wklinger@tayloru.edu).** Taylor University complies with federal and state guidelines for nondiscrimination in employment. See [www.taylor.edu/provost/cri.htm](http://www.taylor.edu/provost/cri.htm)