Recovery of Neandertal mtDNA: An Evaluation

MARVIN L. LUBENOW

ABSTRACT

The recovery of mtDNA from the original Neandertal fossil discovered in 1856 is a remarkable achievement. However, the interpretation placed upon it — that the Neandertals are not closely related to modern humans — is flawed. The Biblical, cultural and fossil evidence strongly suggests that the Neandertals were the ancestors of at least some modern humans. The biochemical analysis of the Neandertal mtDNA has statistical, methodological and philosophical problems associated with it. These challenge the interpretation that the Neandertals are not closely related to modern humans. A number of possible explanations for the differences between the Neandertal mtDNA and modern human mtDNA that would allow the Neandertals a place in modern human ancestry have not been fully considered.

The recovery of mitochondrial DNA (mtDNA) from the right arm bone (humerus) of the original Neandertal fossil discovered in 1856 in a cave in the Neander Valley, near Dusseldorf, Germany, has been hailed as a stunning feat of modern biochemistry. Christopher Stringer (Natural History Museum, London) said: *Tor human evolution, this is as exciting as the Mars landing'.* The achievement was announced in the July 11, 1997 issue of the journal, **Cell.**[1] There is no question that the accomplishment was both conceptually and experimentally brilliant. However, the brilliance of the methodology does not guarantee the accuracy of the interpretation which the authors of the **Cell** article have placed on the data.

Based upon the differences between the Neandertal mtDNA and modern human mtDNA, the evolutionary interpretation is that the Neandertal line diverged from the line leading to modern humans about 550,000 to 690,000 years ago, and that the Neandertals became extinct without contributing mtDNA to modern humans. The implications are that the Neandertals did not evolve into fully modern humans, that they were a different species from modern humans, and that they were just one of many proto-human types that were failed evolutionary experiments. We alone evolved to full humanity.

Two factors make humans unique. We are the only members of our genus, *Homo,* on the planet; **and we are interfertile worldwide.** Biologically, we humans are an oddity Almost all other organisms have many kindred species, some living and some extinct. Since evolutionists believe humans are just a part of nature and of the evolutionary process, they believe that there must have been a number of proto-human species at one time, even though we are now alone.

The fossil record is now being reinterpreted to bring human origins more in line with the rest of nature. Evolutionary trees are out. Evolutionary bushes are in. *Homo habilis* is being split into two separate species, *Homo habilis* and *Homo rudolfensis. Homo erectus* **is being split** into two separate species, *Homo erectus* and *Homo ergaster.* The Neandertals are just one of at least five twigs on the human evolutionary bush. Evolutionists do not know — and say that they may never know — from which of the twigs modern humans evolved. However, the Neandertals — through the interpretation of this mtDNA recovery — are now being eliminated from modern human ancestry. Since 1964 the Neandertals have been considered a sub-species of modern humans. They will now almost certainly be moved out of our species and back into a separate species, *Homo neanderthalensis.*

The extensive publicity associated with this remarkable biochemistry is certain to give the concept of human evolution added stature. However, there is solid evidence for believing that the Neandertals **were fully human,** and the ancestors of at least some modern humans. The evidence that the Neandertals were members of our species and were fully human falls into three general categories :-

(1) the Biblical and cultural evidence,
(2) the fossil evidence for gradations, and
(3) the flawed interpretation of the mtDNA evidence.

BIBLICAL AND CULTURAL EVIDENCE

No one has had a worse public image to overcome than have the Neandertals. Soon after that Neander Valley individual was discovered in a cave in Germany in 1856, the shape of his skull and the curves in the long bones of his body caused evolutionists to believe that the expected link between apes and humans had been found. Evolutionary preconceptions also guided the world-famous anatomist, Marcellin Boule, as he restored the Neandertal skeleton from La Chapelle-aux-Saints, France, to show the world what a Neandertal looked like — a stooped and stupid hunchback. This view of the Neandertal 'Cave Man' prevailed for 100 years.

In the 1960s Boule's glaring mistakes were corrected. It was realised that the Neandertal people, when healthy, stood straight and erect. The physical 'redemption' of the Neandertals was accomplished. However, the Neandertals were still considered to be culturally barren. Even the discovery at Shanidar Cave, Iraq, that the Neandertals buried their dead with flowers[2] did not improve their general image. Many evolutionists still talk about the Neandertal people as having been culturally stagnant. They say that about 40,000 years ago, 'The Great Leap Forward' took place. Anatomically modern humans invaded Europe bringing art, technology, and innovation.[3] The Neandertals, being outclassed, disappeared.

In recent years, however, we have witnessed a cultural 'redemption' of the Neandertals beginning to take place. The year 1996 saw the discovery of items of personal ornamentation used by Neandertals, five different types of musical instruments used by Neandertals, and the first example of Neandertal cave painting.[4-7] Archaeologist Randall White (New York University) says of the Neandertals: *'The more this kind of evidence accumulates, the more they look like us'*.[5] It can now be said that every type of evidence that we can reasonably expect from the fossil and archaeological records showing that the Neandertals were fully human has already been discovered.

One of the strongest evidences that the Neandertals were fully human relates to their reputation as 'Cave Men'. Since so many of their remains have been found in caves. it was assumed that they lived in caves because they had not evolved enough to invent more sophisticated dwellings. The public is unaware that Neandertal dwellings have been found. Nor is the public aware that thousands of people across the world live in caves today. When Ralph Solecki (Columbia University) excavated Shanidar Cave, Iraq, he discovered that about 80 Kurds had lived in that cave until 1970, during a time of political unrest.[8]

The book of Genesis sheds light on the activity of early humans regarding the use of caves. The first reference to caves is in Genesis 19:30, which states that Lot and his daughters lived in a cave after fleeing the destruction of Sodom. This is in keeping with the use of caves throughout human history as temporary or permanent shelters. However, all other references to caves in Genesis refer to a usage that is seldom considered today.

Genesis 23:17-20 (NIV) records a business transaction between Abraham and the Hittite, Ephron. Abraham wanted to purchase property in order to bury Sarah.

> 'So Ephron's field in Machpelah near Mamre — both the field and the cave in it, and all the trees within the borders of the field — was deeded to Abraham as his property in the presence of all the Hittites who had come to the gate of the city. Afterward Abraham buried his wife Sarah in the cave in the field of Machpelah near Mamre (which is at Hebron) in the land of Canaan. So the field and the cave in it were deeded to Abraham by the Hittites **as a burial site'.**

Upon his death (Genesis 25:7-11), Abraham was buried in that same cave. In Genesis 49:29-32, Jacob instructs his sons that he, too, is to be buried in that cave where Abraham and Sarah were buried. We then learn that Jacob buried his wife Leah there, and that Isaac and Rebekah were buried there also. Abraham and Sarah, Isaac and Rebekah, and Jacob and Leah were all buried in the cave in the field of Machpelah which Genesis 23:20 states Abraham purchased 'as a burial site'. Only Sarah died in the geographic area of the cave. All of the others had to be transported some distance to be buried there, and Jacob's body had to be brought up from Egypt. It was important then, as it is today, to be buried with family and loved ones.

The Neandertal fossil evidence shows that the Neandertal practice is in complete accord with the Genesis record. At least 345 Neandertal fossil individuals have been discovered so far at 83 sites in Europe, the Near East, and western Asia. Of these 345 Neandertal individuals, 183 of them (53 per cent) represent burials — **all of them burials in caves or rock shelters.** Further, it is obvious that caves were used as family burial grounds or cemeteries, as the following sites show:

Krapina Rock Shelter, Croatia
— 75 (minimum) Neandertals buried.
Arcy-sur-Cure caves, France
— 26 Neandertals buried.
Kebara Cave. Mount Carmel, Israel
— 21 Neandertals buried.
Tabun Cave. Mount Carmel, Israel
— 12 Neandertals buried.
La Ferrassie Rock Shelter, France
— 8 Neandertals buried.
Shanidar Cave, Iraq
— 7 Neandertals buried.
Amud Cave, Galilee, Israel
— 7 Neandertals buried.
Guattare Cave, Monte Circeo, Italy
— 4 Neandertals buried.
Ksar 'Akil Rock Shelter, Lebanon
— 3 Neandertals buried.

It is understandable why burial in caves was common

in ancient times. Graves in open areas must be marked so that future generations can return to pay homage to their ancestors. However, grave markers or reference points can be changed, destroyed, or moved. Directions to the grave site can become confusing over time. Landscapes can change, and memories of certain features can become clouded. Just as Abraham did not always live in one place, so the Neandertals may have moved seasonally following herds of game. Since caves are usually permanent, it would have been easy to locate the family burial site if it were in a cave. One could be sure that he was at the very spot where his ancestors were buried.

Most anthropologists recognise burial as a very human. and a very religious, act. But the strongest evidence that Neandertals were fully human and of our species is that **at four sites Neandertals and modern humans were buried together.** In all of life, few desires are stronger than the desire to be buried with one's own people. Jacob lived in Egypt, but wanted to be buried in the family cemetery in the cave of Machpelah. Joseph achieved fame in Egypt, but wanted his bones to be taken back to Israel (Genesis 50:25; Exodus 13:19; Joshua 24:32). Until recently it was the custom to have a cemetery next to the church so that the church family could be buried together. For centuries, many cities had separate cemeteries for Protestants, Roman Catholics and Jews so that people could be buried with their own cultural/religious kind.

Skhul Cave, Mount Carmel, Israel, is considered to be a burial site of anatomically modern *Homo sapiens* individuals. Yet, Skhul IV and Skhul IX fossil skulls are closer to the Neandertal configuration than they are to modern humans.[9] Jebel-Qafzeh, Galilee, Israel, is also considered to be an anatomically modern burial site. However, Qafzeh skull 6 is clearly Neandertal in its morphology.[10] Tabun Cave, Mount Carmel, Israel, is one of the classic Neandertal burial sites. But the Tabun C2 mandible is more closely aligned with modern mandibles found elsewhere.[11] The Krapina Rock Shelter, Croatia, is one of the most studied Neandertal burial sites. At least 75 individuals were buried there. However, the remains are fragmentary, making diagnosis difficult. The addition of several newly identified fragments to the Krapina A skull (also known as Krapina 1) reveals it to be much more modern than was previously thought, indicating that it is closer in shape to modern humans than it is to the Neandertals.[12]

That Neandertals and anatomically modern humans were buried together constitutes strong evidence that they lived together, worked together, intermarried, and were accepted as members of the same family, clan, and community. The false distinction made by evolutionists today was not made by the ancients. To call the Neandertals 'Cave Men' is to give a false picture of who they were and why caves were significant in their lives. If genuine mtDNA was recovered from that fossil from the Neander Valley, the results have been misinterpreted.

> 'From one man he (God) made every nation of men, that they should inhabit the whole earth… '(Acts 17:26 NIV).

In comparing the Neandertal burial practice with Genesis, I do not wish to imply that Abraham and his descendants were Neandertals. What the relationship was — if any — between the people of Genesis and the Neandertals we do not know. Young-Earth creationists tend to believe that the Neandertals were a post-Flood people. Evolutionists date the Neandertals from about 300,000 to about 33,000 years ago. What is striking is that the burial practice of the Neandertals seems to be identical with that of the post-Flood people of Genesis.

FOSSIL EVIDENCE FOR GRADATIONS

What is it that makes a Neandertal a Neandertal in contrast to an anatomically modern *Homo sapiens?* G. A. Clark (Arizona State University) states a problem:-

> *'That researchers cannot distinguish a "Neandertal" from a "modern human " might seem surprising to some, but there is little consensus on what these terms mean'.*[13]

Although anthropologists have yet to agree on a formal definition of the Neandertals, there is a set of physical characteristics that are used in referring to a classic Neandertal morphology. The most significant are:-

(1) The skull is lower, broader, and elongated in contrast to the higher doming of a modern skull.
(2) The average brain size (cranial capacity) is larger than the average modern human by almost 200 cubic centimetres.
(3) The forehead is low, with heavy brow ridges curving over each eye.
(4) There is a slight projection at the rear of the skull (occipital bun).
(5) The cranial wall is thick compared to modern humans.
(6) The facial architecture is heavy, with the mid-face and the upper jaw projecting forward (prognathism).
(7) The nose is prominent and broad.
(8) The frontal sinuses are expanded.
(9) The lower jaw is large and lacks a definite chin.
(10) The body bones are heavy and thick and the long bones somewhat curved.

Any one of these characteristics, several of them, or even perhaps all of them could be found in some humans living today There is nothing profoundly distinct about them. In fact, when the first Neandertal was discovered in 1856, even 'Darwin's bulldog', Thomas Huxley, recognised that it was fully human and not an evolutionary ancestor. Donald Johanson, in his book, **Lucy's Child,** writes:-

> *'From a collection of modern human skulls Huxley was able to select a series with features leading "by insensible gradations " from an average modern specimen to the Neandertal skull. In other words, it wasn't qualitatively different from present-day* Homo

sapiens'.[14]

What Huxley was able to do with his collection of skulls more than a century ago, any anthropologist with a respectable collection of modern skulls could do in his laboratory today — show that the Neandertals were not qualitatively different from present-day *Homo sapiens.*

This same gradation from Neandertals to modern humans can also be seen in the fossil record. We are not referring to an evolutionary transition from earlier Neandertals to later modern humans. We are referring to morphological gradations between Neandertals and modern humans both having the same dates and living at the same time as contemporaries representing a single human population. Whereas evolutionists have chosen to divide these humans into two categories — Neandertals and anatomically modern *Homo sapiens* — individual fossils are not always that easy to categorise. There is a wide range of variation among modern humans, and there is variation within the Neandertal category as well. A number of fossils in each group are very close to that subjective line, and could be categorised either way. These fossils constitute a gradation between Neandertals and modern humans, demonstrating that the distinction made by evolutionists is an artificial one.

Among fossils usually classified as Neandertal are at least 25 individuals from five different sites who are clearly close to that subjective line which divides Neandertals from anatomically modern *Homo sapiens.* These fossils constitute part of that continuum or gradation from Neandertals to modern humans found in the fossil record. Evolutionists recognise these fossils as departing from the classic Neandertal morphology and describe them as 'progressive' or 'advanced' Neandertals. Their shape is sometimes explained as the result of gene flow (hybridisation) with more modern populations. This would refute the interpretation of the mtDNA evidence that the Neandertals and modern humans are not the same species — since reproduction is on the species level. Those sites having 'advanced' Neandertals are:-

Vindija Cave remains, Croatia
— twelve individuals.[15]

Hahnofersand frontal bone, Germany
— one individual.[1617]

Starosel'e remains, Ukraine, CIS
— two individuals.[18]

Stetten 3 humerus, cave deposits, Germany
— one individual.[19]

Ehringsdorf (Weimar) remains, Germany
— nine individuals.[20]

Completing that continuum or gradation from Neandertals to modern humans are at least 107 individuals from five sites who are usually grouped with fossils of anatomically modern humans. However, since they are close to the line which divides them from the Neandertals, they are often described as 'archaic moderns' or stated to have 'Neandertal affinities' or 'Neandertal features'. These five sites are:-

Oberkassel remains, Germany
— two individuals.[21]

Mladec (Lautsch) cave remains, Czech Republic
— minimum of 98 individuals.[22,24]

Velika Pecina Cave skull fragments, Croatia
— one individual.[25,26]

Bacho Kiro Cave mandibles, Bulgaria
— two individuals.[27]

Pontnewydd Cave remains, Wales
— four individuals.[28]

G. A. Clark summarises the evidence that the Neandertals are the ancestors of at least some modern humans:-

> *'Those who would argue that Neandertals became extinct without issue should show how it could have occurred without leaving traces of disjunction in the archaeological record and in the fossils themselves'.*[13]

THE mtDNA EVIDENCE

Details of Ancient DNA Recovery

DNA is the incredibly complex molecule involved in the genetics of life. Deprived of the repair mechanisms found in the living cell, there is substantial breakdown of DNA within a few hours after the death of the organism. Causes of DNA degradation include water, oxygen, heat, pressure, time, exposure to transition metals (such as zinc), microbe attack, and radiation. This degrading involves the breakage of the cross-linking of the DNA molecules, modification of sugars, alteration of bases, and the breakage of long strands into strands that eventually become so short that no information can be retrieved from them.

It is uncertain how long retrievable DNA will last. It is thought that it might last a few thousand years. To last longer, DNA must be removed from degrading factors soon after biological death and preserved. Under the most favorable conditions, evolutionists estimate that DNA might last 'tens of thousands of years'.[29,30] However, even under ideal conditions, background radiation will eventually erase all genetic information. Sensational reports about the recovery of DNA millions of years old are now discounted because researchers have not been able to repeat the results. Even amber is not the fool-proof preservative it was once thought to be.[31]

In the past, there was a scarcity of genetic material for experimentation. It was largely inaccessible because it was always embedded in a living system. Kary B. Mullis writes: *'. . . it is difficult to get a well-defined molecule of natural DNA from any organism except extremely simple viruses'.*[32] One of the most remarkable breakthroughs in modern biotechnology was the development in the 1980s of the polymerase chain reaction (PCR). Kary Mullis shared the 1993 Nobel Prize in chemistry for his 'invention'. The PCR technique can make unlimited copies of a specific DNA sequence independent of the organism from which it

came.

'With PCR, tiny bits of embedded, often hidden, genetic information can be amplified into large quantities of accessible, identifiable, and analyzable material'.[33]

In dealing with the Neandertal specimen, the scientific team, led by Svante Pääbo (University of Munich), decided to search for mitochondrial DNA rather than nuclear DNA. Whereas there are only two copies of DNA in the nucleus of each cell, there are 500 to 1,000 copies of mtDNA in each cell. Hence, the possibility was far greater that some of the ancient mtDNA might be preserved. Unlike nuclear DNA, it is thought that mtDNA is passed unchanged from a mother to her offspring. The father's mtDNA ends up 'on the cutting room floor'. Since changes in mtDNA are from mutations rather than from genetic mixing, evolutionists believe that mtDNA is a more accurate reflection of evolutionary history. Further, because it has no repair enzymes, mtDNA accumulates mutations at about ten times the rate of nuclear DNA, making it, evolutionists believe, a higher resolution index of time.

The most serious problem in analysing ancient DNA is the possibility of contamination from modern DNA. This contamination could come from anyone who has ever handled the fossil since its discovery, from laboratory personnel, from laboratory equipment, and even from the heating and cooling system in the laboratory. Even a single cell of modern human contamination would have its DNA amplified blindly and preferentially by the PCR because of its superior state of preservation over the older material. The PCR technique is 'notoriously contamination-sensitive'.[34] The problem is so serious that some contamination from modern DNA is unavoidable. Ann Gibbons and Patricia Kahn express the problem :-

'Worst, it's tough to distinguish DNA intrinsic to an ancient sample from the modern DNA that unavoidably contaminates it — the source of many false claims in the past. Ancient human samples are especially tricky, because their sequences might not differ much from that of contaminating modern human DNA, so it's hard to get a believable result'.[35]

Since repeatability is at the heart of experimental science, many have suggested that what is needed is to retrieve DNA from a second Neandertal specimen in order to confirm the results of Svante Pääbo and his team. In fact, several other teams have tried unsuccessfully to retrieve Neandertal DNA. One attempt dealt with a Neandertal bone fragment from Shanidar, Iraq.[36] Pääbo reports that he and his team have also attempted to retrieve DNA from Neandertal fossils from Zafarraya (Spain), Krapina (Croatia), and La Chaise (France), as well as from a Cro-Magnon fossil from Nerja (Spain), all without success. He suggests that the climate in these areas was too warm for DNA preservation. In contrast, the Neander Valley, Germany, is one of the northernmost Neandertal sites. It is just south of the limit of maximum glaciation during the late Pleistocene (Ice Age). Hence, that fossil was likely to have experienced cold conditions during most of its history. Pääbo states:

'Therefore, preserved Neandertal DNA is likely to be rare, and the DNA in the type specimen [the 1856 Neander Valley Neandertal fossil] *may result from its unique preservation conditions. . . . Most Neandertal specimens are therefore unlikely to contain amplifiable DNA . . . .'*[37]

Whether or not genuine Neandertal mtDNA has been retrieved is impossible for an outside observer to say at this time. Knowing the unstable nature of the DNA molecule, if DNA was retrieved from that Neandertal fossil, it is strong evidence that the fossil is not nearly as old as evolutionists claim — 30,000 to 100,000 years. From a scientific point of view, the fact that the recovery may never be duplicated on another specimen could add a degree of contingency to the results.

As far as the recovery, itself, is concerned, it is possible that the mtDNA is genuine. However, the evolutionary interpretation of those mtDNA sequences — that the Neandertals are a separate species and are not closely related to modern humans — is not scientifically justified.

In the Cell article, Svante Pääbo and his associates explain their findings and their interpretation:

'The Neandertal sequence was compared to 994 contemporary human mitochondrial lineages, i.e., distinct sequences occurring in one or more individuals, found in 478 Africans, 510 Europeans, 494 Asians, 167 Native Americans and 20 individuals from Australia and Oceania. Whereas these modern human sequences differ among themselves by an average of 8.0 ± 3.1 (range 1-24) substitutions, the difference between the humans and the Neandertal sequence is 27.2 ± 2.2 (range 22-36) substitutions. Thus, the largest difference observed between any two human sequences was two substitutions larger than the smallest difference between a human and the Neandertal. . . .

'When the comparison was extended to 16 common chimpanzee lineages, the number of positions in common among the human and chimpanzee sequences was reduced to 333. This reduced the number of human lineages to 986. The average number of differences among humans is 8.0 ± 3.0 (range 1-24), that between humans and the Neandertal, 25.6 ± 2.2 (range 20-34), and that between humans and chimpanzees, 55.0 ± 3.0 (range 46-67). Thus, the average number of mtDNA sequence differences between modern humans and the Neandertal is about three times that among humans, but about half of that between modern humans and modern chimpanzees. . . .

'To estimate the time when the most recent ancestral sequence common to the Neandertal and modern human mtDNA sequences existed, we used an estimated divergence date between humans and chimpanzees of 4-5 million years ago and corrected the observed

sequence differences for multiple substitutions at the same nucleotide site. This yielded a date of 550,000 to 690,000 years before present for the divergence of the Neandertal mtDNA and contemporary human mtDNAs. When the age of the modern human mtDNA ancestor is estimated using the same procedure, a date of 120,000 to 150,000 years is obtained, in agreement with previous estimates. Although these dates rely on the calibration point of the chimpanzee-human divergence and have errors of unknown magnitude associated with them, they indicate that the age of the common ancestor of the Neandertal sequence and modern human sequences is about four times greater than that of the common ancestor of modern human mtDNAs.'[38]

Flaws in the Neandertal mtDNA Interpretation

(1) The Problem of Statistical 'Averages'

The **Cell** article points out that the mtDNA sequence differences among modern humans range from one to 24 substitutions, with the average being eight substitutions. The mtDNA sequence differences between modern humans and the Neandertal fossil range from 22 to 36 substitutions, with the average being 27. Thus, the few modern humans who have the largest number of substitutions (24) have two more substitutions in their mtDNA than the smallest number (22) between modern humans and the Neandertal individual. However, by comparing the 'average' of eight substitution differences among modern humans and the 'average' of 27 substitution differences between modern humans and the Neandertal individual, the false impression is given that the number of mtDNA sequence differences between modern humans and the Neandertal is three times as great as that among modern humans. Using averages allows Kahn and Gibbons to write in **Science:-** *'These data put the Neandertal sequence outside the* ***statistical*** *range of modern human variation. . .'.*[39] (Emphasis added.) Statistics has been used to cloud the relationship between Neandertals and modern humans. It is improper to use statistical 'averages' in situations where many entities are being compared with only one entity. In this case, 994 sequences from 1669 modern humans are compared with one sequence from one Neandertal. Thus, there is no Neandertal 'average', and the comparison is not valid. Although it may not be the intention, the result of such a comparison could not help but be deceptive.

This inappropriate use of averages and the resulting confusion has carried over into the scientific and popular press. Almost every journal reporting on the **Cell** article has made errors in describing the relationship of modern humans to the Neandertal. Science writer Robert Kunzig, describing the Neandertal mtDNA results in the January 1998 issue of **Discover,** first states that the Neandertal individual *'. . . differed at 27 positions, on average, from the modern human sequences . . . .'* He then goes on to say:

Among themselves the modern sequences differed by an average of only eight places. Picture a crowd of modern humans huddled around a camp fire, with nobody more than eight yards from the center; then the Neanderthal is 27 yards away, well outside the circle, in the shadows at the edge of the woods '.[40]

Kunzig's illustration is inaccurate. Since we are dealing with modern human 'averages', only some of the modern humans would be exactly eight yards (eight sequences) from the centre. Many of them would be less than eight yards from the centre, with a few of them just one yard (one sequence) from the fire. Instead of *'nobody more than eight yards from the center',* the rest of them **would** be more than eight yards from the centre, with a few of them 24 yards (24 sequences) from the centre. The one Neandertal individual, Kunzig says, would be 27 yards from the centre. But there would not be the large gap between modern humans and the Neandertal that Kunzig was trying to illustrate.

Science writer Kate Wong, in the January 1998 **Scientific American,** states that the mtDNA variation between the Neandertal and modern humans was, on average, **four** times greater than that found between any two modern humans.[41] The **Cell** authors said it was, on average, **three** times greater. Wong mistook a time difference, given in the **Cell** article, for a genetic distance. Thus in the two most popular science magazines in the United States, mistakes were made in describing the interpretation of the Neandertal mtDNA. In both cases, the mistakes portrayed the genetic distance between modern humans and the Neandertal as being even greater than was originally reported in **Cell.** However, both mistakes were probably the result of the misleading and improper use of 'averages' by the **Cell** authors.

(2) The Problem of Species Distance

Based upon an improper use of statistical averages, the authors of the mtDNA Neandertal study arrive at a fallacious interpretation of the nature of the Neandertals by using mtDNA sequence differences as a measure of species differences. They write:-

'The Neandertal mtDNA sequence thus supports a scenario in which modern humans arose recently in Africa as a distinct species and replaced Neandertals with little or no interbreeding'.[42]

The Neandertal individual has a minimum of 22 mtDNA substitution differences from modern humans. That implies that 22 mtDNA substitution differences delineates a new or different species, and that the Neandertals should be so classified. However, mtDNA substitution differences among modern humans range from 1 to 24. That means that there are a few modern humans who differ by 24 substitutions from a few other modern humans — two substitutions more than the Neandertal individual. Would not logic demand that those few modern humans living

today should also be placed in a separate species? To state the question is to reveal the absurdity of using such differences as a measure of species distinctions. Maryellen Ruvolo (Harvard University) points out that the genetic variation between the modern and Neandertal sequences is within the range of other single species of primates. She goes on to say: *'. . . there isn't a yardstick for genetic difference upon which you can define a species'.*[39]

(3) The Problem of Evolutionary Time and Distance

Based upon their improper use of statistical averages, the authors of the mtDNA Neandertal study arrive at another fallacious conclusion from their experiment. They use mtDNA sequence differences as a measure of evolutionary time and distance. This is a universal practice in evolutionary studies. Hence, the Neandertals are less evolved than are modern humans and are more closely related to chimpanzees. However, as we saw above, there are a few modern humans living today who have more mtDNA substitutions than the minimum number between modern humans and the Neandertal. Would not logic also demand that these few humans living today be considered as less evolved than were the Neandertals, and as more closely related to chimpanzees than were the Neandertals?

Biochemist John P. Marcus makes a significant observation about a graph in the **Cell** article. He writes:-

'This graph might lead one to think that Neandertal sequences are somewhere between modern human and chimp sequences. This could then give the impression that Neandertal is a link between chimps and humans. On closer examination, however, this is not the case. As labelled, the graph shows the number of differences between human-human, human-Neandertal, and human-chimp pairs. Significantly, the authors do not show the distribution of Neandertal-chimp differences. The reason they do not show this last of four possible comparisons between the populations is not clear to me. What is clear, however, from the DNA distance comparisons that I performed, ***is that the Neandertal sequence is actually further away from either of the two chimpanzee sequences than the modern human sequences are. My calculations show that every one of the human isolates that I used was "closer" to chimp than was the Neandertal.*** *The fact that Neandertal and modern human sequences are approximately equidistant from the chimpanzee outgroup seems to be a good indication that Neandertal and modern humans comprise one species. Clearly, the Neandertal is no more related to chimps than any of the humans. If anything, Neandertal is* ***less*** *related to chimps'.*[43] (Emphasis added.)

(4) The Problem of the Molecular 'Clock'

The basis of the interpretation that modern humans and the Neandertals are separate species is the acceptance, by evolutionists, of the concept of the molecular 'clock'. Yet the authors of the mtDNA Neandertal study admit (in the lengthy quotation cited above) that

'. . . these dates rely on the calibration point of the chimpanzee-human divergence and have errors of unknown magnitude associated with them'.

Their interpretation assumes the legitimacy of the molecular 'clock' as a means of determining the relationship of modern humans to chimpanzees and to Neandertals. G. A. Clark writes:

'Molecular clock models are full of problematic assumptions. Leaving aside differences of opinion about the rate of base pair substitutions, how to calibrate a molecular clock, and whether or not mtDNA mutations are neutral, the fact that the Neandertal sequence. . . differs from those of modern humans does not resolve the question of whether or not "moderns" and "Neandertals" were different species'.[13]

Karl J. Niklas (Cornell University) refers to using mutation rate calibration to determine species relationships as: *'. . . a research area that is at present characterized by too much speculation chasing too few data'.*[44]

The most amazing development regarding the molecular 'clock' is the possibility that mtDNA may mutate much faster than has been estimated. A recent article in **Science** states that the 'clock' may be in error by as much as twenty-fold. Neil Howard (University of Texas Medical Branch, Galveston) says: *We've been treating this like a stop-watch, and I'm concerned that it's as precise as a sun dial'.*[45] If the new rates hold up after further research, the results for evolutionary time estimates, such as for 'mitochondrial Eve', could be startling. *'Using the new clock, she would be a mere 6000 years old'.*[46]

(5) The Problem of Using mtDNA to Determine Relationships

Evolutionists themselves are questioning the use of mtDNA as a proper method of determining relationships. Geneticist L. Luca Cavalli-Sforza (Stanford University) and his associates write:

'. . . the mitochondrial genome represents only a small fraction of an individual's genetic material and may not be representative of the whole'.[41]

After testing the assumptions involved in the use of mtDNA to determine primate relationships, D. Melnick and G. Hoelzer (Columbia University) state:

'Our results suggest serious problems with use of mtDNA to estimate "true "population genetic structure, to date cladogenic events, and in some cases, to construct phytogenies'.[48]

Jonathan Marks (Yale University) emphasises the subjectivity involved in using mtDNA to determine relationships. He comments:

'Most analyses of mitochondrial DNA are so equivocal as to render a clear solution impossible, the preferred phytogeny relying critically on the choice of outgroup

and clustering technique'.[49]

(6) The Possibility of PCR Copying Errors

PCR copying errors on oxygen-damaged residues in the Neandertal mtDNA could result in the Neandertal mtDNA appearing to be more distant from that of modern humans than it actually is. John Marcus sees evidence of this in his own study of the **Cell** report. He observes possible PCR-induced systematic errors due to a uniform oxidation of particular residues in particular sequence contexts. He explains:-

*'When the nature of the differences between the modern human reference sequence and the Neandertal sequence was compared, it was noted that there were 27 differences. Twenty-four of these were transitions (G to A, and C to T) changes. Apparently it is easier for DNA polymerase to make this kind of substitution as it copies the template DNA. Since PCR also makes use of DNA polymerase to amplify the original template DNA, it is possible that the differences seen with the mtDNA from the Neandertal is actually a result of PCR-induced errors. Some phenomena in the ancient DNA could actually cause a consistent mis amplification of the DNA template present in the Neandertal bone. A possible example of this in the **Cell** paper can be seen in Figure 4 of the paper. At positions 107 and 108 as well as 111 and 112 there were a number of consistent variations that could be the result of bad copying by the DNA polymerase used. Tomas Lindahl, who writes a mini-review at the beginning of the **Cell** volume, comments on this. Is it not then possible that a somewhat uniform oxidative process might damage the DNA in such a way that the original information present in the Neandertal mtDNA would be reproducibly "copied" wrongly?'*[43]

(7) The Problem of Philosophical Biases

Little attempt was made by Pääbo and his associates to hide their philosophical biases. These are:-

(a) A bias toward molecules over fossils; and

(b) A bias toward the more politically correct 'Out of Africa' model of modern human origins, which demands a separation of the Neandertals from anatomically modern humans.

(a) The bias toward molecules over fossils. Ever since the advent of molecular taxonomy, palaeontologists have been divided over which method is the better interpreter of evolutionary history. Molecules seem so neat and tidy, so precise and objective. Their use is based upon the unproven assumption that every organism's evolutionary history is encoded in their genes. Fossils, on the other hand, seem so dirty and messy. Their interpretation is anything but objective. Palaeontologists have felt the sting of the charge that their discipline is *'non-experimental'* and *'resistant to falsification '.*[50] The newer fossil discoveries have not fulfilled their promise to clarify the picture of human origins. Instead, they have brought more confusion. Christopher B. Stringer explains the problem with the fossils:-

'The study of human origins seems to be afield in which each discovery raises the debate to a more sophisticated level of uncertainty. Such appears to be the effect of the Kenyan, Tanzanian, and Ethiopian [fossil] *finds'.*[51]

However, the search for objectivity is an elusive one. Although the molecular data appear to be very objective and precise, John Marcus states that the interpretation of the molecular data is just as subjective as is the interpretation of the fossils. Not only is the molecular evidence unfalsifiable, but

'. . . the scientist must always choose which piece(s) of DNA he is going to use to do his comparisons. Very often a particular piece of DNA will not give the "right" answer and so it is dismissed as a poor indicator of the evolutionary process'.[43]

Kenneth A.R. Kennedy (Cornell University) comments:-

*'This practice of forcing the paleontological **and** archaeological data to conform to the evolutionary **and** genetic models continues in reinterpretations of dates based upon the molecular clock of mitochondrial DNA as well as radiometric samples . . . .'*[52]

The misinterpretation of the mtDNA data is seen in the work of Pääbo and his associates. We have earlier shown that the Neandertal fossil evidence contradicts their interpretation of the mtDNA evidence.

(b) The bias toward the more politically correct 'Out of Africa' model of modern human origins. The popularity of the 'Out of Africa' model is due, in part, to its being so politically correct:-

(i) Modern humans are said to have originated in Africa, a source of satisfaction to non-Western people who may feel that they have been exploited by Westerners;

(ii) The model emphasises the unity of all humans despite differences in external appearance;

(iii) For many people it is satisfying to have the Neandertals removed from their ancestry. After all, who wants to be related to a Neandertal as usually depicted?

(iv) A woman, mitochondrial Eve, is the hero of the plot. We all owe our existence to her; and

(v) The sudden replacement of the Neandertals by modern humans favours the newer and more popular punctuated equilibrium evolution model.

We seem to be witnessing a classic struggle in paleoanthropology between the molecules and the fossils. Some palaeoanthropologists are bewildered at how rapidly their fellows have forsaken the fossils for the molecules. It is all the more surprising because the human fossil evidence clearly contradicts the 'Out of Africa' model. The European fossil evidence is against it, as we have shown in this paper. The Chinese fossil evidence is strongly against it, as Xinzhi Wu and Frank E. Poirier demonstrate.[53] The Javanese and Australian fossils also witness against it.[54] With the African fossils, the jury is still out. The reason is

that the 'Out of Africa' model demands that the fossils fall within a certain time-frame. However, many of the fossils upon which the 'Out of Africa' model is based, such as the Border Cave fossils and the Klasies River Mouth Caves fossils, are very difficult to date.

OTHER POSSIBLE INTERPRETATIONS OF THE DATA

The fossil record clearly supports a close relationship between the Neandertals and modern humans. However, the mtDNA data, if accurate, shows some differences between the two groups. These differences have been over-interpreted by Pääbo and his associates who claim that the Neandertals were a separate species from modern humans. Geneticist Simon Easteal (Australian National University), noting that chimpanzees, gorillas and other primates have much more within-species mtDNA diversity than modern humans do, states: *'The amount of diversity between Neanderthals and living humans is not exceptional'*.[41]

Regarding these differences, there are a number of legitimate interpretations of the mtDNA Neandertal data that have not been fully considered by Paabo and his associates. In keeping with the fossil evidence, these interpretations would allow the Neandertals a place in modern human ancestry. Some of these interpretations may be more likely than others, but all are possibilities:

(1) That this particular Neandertal individual was from a small, isolated group. The Neander Valley of Germany is one of the northernmost Neandertal sites, close to the ice-age glaciers. Of the 345 Neandertal individuals discovered to date, only 14 are from Germany, and 12 of them were far to the south of this individual.

(2) That the Neandertals did contribute to the modern gene pool, but that their sequences disappeared through random genetic loss, selection, or both. John Marcus suggests that the human race could have had much greater mtDNA sequence variation in the past. Being genetically stronger, ancient humans were able to cope with greater genetic variation. Today, because of many more mutations, we are a weaker race. Perhaps greater mtDNA variation in this area was deleterious to health and selective pressure has reduced the variation.[43]

(3) That this particular Neandertal from whom sequences were derived was at one extreme end of a diverse spectrum in Neandertals that includes other more modern-like sequences. The recovery of mtDNA from other Neandertal individuals, if possible, may confirm whether or not this is true.

(4) That while Neandertal mothers did not contribute mtDNA to the modern gene pool, according to Paabo and his associates, Neandertal fathers may have contributed nuclear genes to the modern gene pool. Throughout history, warfare, conducted by men, has been characterised by the victimising of conquered women. Hence, Neandertal men may have made 'unsolicited contributions' to the modern human gene pool. Further, since most migrations in history have initially involved men, Neandertal men migrating into a new area might have victimised the modern human women of that area.

(5) That our ancestors underwent a population bottleneck that wiped out a great deal of the original genetic variation. Kahn and Gibbons write :-

'Living humans are strangely homogeneous genetically, presumably because . . . their ancestors underwent a population bottleneck that wiped out many variations'.[55]

Iceland illustrates an isolated population whose genetic homogeneity increased when it experienced two bottlenecks, one caused by bubonic plague and the other by famine.[56]

FUTURE NEANDERTAL mtDNA RECOVERY

What is most needed is an independent test of ancient DNA authenticity. Researchers, including Paabo, believe they might have devised such a technique, based upon the ratio of amino acid racemization to DNA depurination, to determine if a particular ancient specimen might still contain retrievable DNA. In testing this new method for DNA in ancient specimens, they write:

'. . . we excluded human remains because of the inherent difficulty of recognizing contamination from contemporary humans'.[51]

In other words, it is much easier to recognise modern human DNA contamination in ancient non-human specimens than in ancient human specimens. It is obvious that much of the contaminating DNA would come from modern humans because modern humans are doing the research and handling the ancient DNA. The closer ancient human DNA sequences are to modern ones, the harder it is to tell if they are truly ancient or if they are just the result of modern human contamination.

The fossil evidence shows that the Neandertals were closely related to anatomically modern humans. Since the mtDNA evidence is being used to challenge that relationship, almost all observers recognise the need to obtain mtDNA from other Neandertal specimens. Robert DeSalle (American Museum of Natural History) states:

'But it's possible that you could see something quite different if you looked at DNA from another Neanderthal sample'.[58]

It is at this point that biochemist John P. Marcus sees a problem. He states:

'Knowing the bias of evolutionists, it would not be surprising if, in the future, true Neandertal mtDNA sequences were rejected on account of their being too close to modern human ones and therefore suspected of arising from modern human mtDNA contamination'.[43]

Such concerns are justified, since most evolutionists

involved in mtDNA recovery favour the 'Out of Africa' model of human evolution which demands a separation of the Neandertals from anatomically modern humans. Hence, any future mtDNA evidence showing a close relationship of Neandertals to modern humans could be dismissed as contamination from modern human mtDNA and the results not reported. This would perpetuate the false idea that Neandertals and modern humans were not closely related.

CONCLUSION

The words of anthropologist Robert Foley (University of Cambridge) written about a book by geneticist Luigi Luca Cavalli-Sforza (Stanford University) could aptly be applied to the work of Svante Pääbo and his team, which in spite of brilliant biochemistry,

> '. . . *shows plainly the futility of trying to interpret genes without knowing so much more — about selection and drift, about processes of cultural transmission, about history and geography, about fossils, about anthropology, about statistics*'.[59]

After 140 years, the Neandertals are again having to fight for their reputation. If genuine mtDNA has been recovered from the fossil from the Neander Valley, the results have been misinterpreted — both in a statistical and cultural sense. However, within the context of the Biblical record of human history, this individual is likely to post-date the dispersion from Babel (Genesis 11:8,9). This being the case, we can conclude that he, like all human kind, was a direct descendant of one of the sons of Noah (Genesis 9:19, 10:32).

ACKNOWLEDGEMENT

I would like to thank the reviewers of this paper, in particular John P. Marcus, for their invaluable comments and suggestions which served to improve the text and strengthen the case presented.

REFERENCES

1. Krings, M., Stone, A., Schmitz, R. W., Krainitzki, H., Stoneking, M. and Pääbo, S., 1997. Neandertal DNA sequences and the origin of modern humans. **Cell,** 90:19-30.
2. Solecki, R. S., 1971. **Shanidar: The** First Flower People, Alfred A. Knopf, New York.
3. Diamond, J., 1989. The great leap forward. Discover, 10(5):50-60.
4. Hublin, J.-J., Spoor, F., Braun, M., Zonneveld, F. and Condemi, S., 1996. A late Neanderthal associated with Upper Palaeolithic artifacts. Nature, 381:224-226.
5. Folger, T. and Menon, S., 1997. ... Or much like us? Discover, 18(1):33.
6. Anonymous, 1997. Human origins. **Discover, 18(4):** 19.
7. Anonymous, 1996. Neandertal noisemaker. Science News, 150(21):328.
8. Solecki, Ref. 2, p. 69.
9. Corruccini, R. S., 1992. Metrical reconsideration of the Skhul IV and IX and Border Cave 1 crania in the context of modern human origins. **American Journal of Physical Anthropology, 87(4)** :43 3-445.
10. Corruccini, Ref. 9, pp. 440-442.
11. Quam, R. M. and Smith, F. H., 1996. Reconsideration of the Tabun C2 'Neandertal'. **American Journal of Physical Anthropology, Supplement** 22, p. 192.
12. Minugh-Purvis, N. and Radovcic, J., 1991. Krapina A: Neandertal or not? **American Journal of Physical Anthropology, Supplement 12,** p. 132.
13. Clark, G. A., 1997. Neandertal genetics. Science, 277:1024.
14. Johanson, D. and Shreeve, J., 1989. **Lucy's Child,** William Morrow and Company, New York, p. 49.
15. Ahern, J. C. and Smith, F. H., 1993. The transitional nature of the late Neandertal mandibles from Vindija Cave, Croatia. **American Journal** of **Physical Anthropology, Supplement 16,** p. 47.
16. Tattersall, I., Delson, E. and Van Couvering, J. (eds), 1988. **Encyclopedia of Human Evolution and Prehistory,** Garland Publishing, New York, p. 241.
17. Stringer, C. and Gamble, C, 1993. **In Search of the Neanderthals,** Thames and Hudson, Inc., New York, pp. 179-180.
18. Tattersall *et al.*, Ref. 16, p. 56.
19. Oakley, K. P., Campbell, B. G. and Molleson, T. I. (eds), 1971. **Catalogue of Fossil Hominids,** Trustees of the British Museum — Natural History, London, Part II, p. 209.
20. Wolpoff, M. and Caspari, R., 1997. **Race and Human Evolution,** Simon and Schuster, New York, pp. 177, 182.
21. Boule, M. and Vallois, H. V, 1957. **Fossil Men,** The Dryden Press, New York, p. 281.
22. Smith, F. H., Falsetti, A. B. and Liston, M. A., 1989. Morphometric analysis of the Mladec postcranial remains. **American Journal of** Physical Anthropology, 78(2):305.
23. Wolpoff, M. H. and Jelinek, J., 1987. New discoveries and reconstructions of Upper Pleistocene hominids from the Mladec cave, Moravia, CCSR. **American Journal of Physical Anthropology,** 72(2):270-271.
24. Minugh, N. S., 1983. The Mladac 3 child: aspects of cranial ontogeny in early anatomically modern Europeans. **American Journal of Physical Anthropology,** 60(2):228.
25. Smith, F. H., 1976. A fossil hominid frontal from Velika Pecina (Croatia) and a consideration of Upper Pleistocene hominids from Yugoslavia. American Journal of Physical Anthropology, 44:130-131.
26. Oakley *et al.*, Ref. 19, Part II, p. 342.
27. Tattersall *et al.*, Ref. 16, pp. 56, 87.
28. Klein, R. G., 1989. The Human Career: **Human Biological and** Cultural Origins, The University of Chicago Press, Chicago, pp.236-237.
29. Lindahl, T., 1993. Instability and decay of the primary structure of DNA. Nature, 362:713.
30. Pääbo, S., 1993. Ancient DNA. **Scientific American, 269(5):**60-66 (US edition, p. 92).
31. Gibbons, A., 1998. Ancient history. **Discover, 19(1)** :47.
32. Mullis, K. B., 1990. The unusual origin of the polymerase chain reaction. Scientific American, 262(4):36 (US edition, p. 56).
33. Koshland, D., Jr. and Guyer, R. L., 1989. Perspective. Science, 246:1543. Cited by:
Rabinow, P., 1996. Making PCR, The University of Chicago Press, Chicago, pp. 5-6.
34. Lindahl, T, 1993. Recovery of antediluvian DNA. **Nature,** 365:700.
35. Kahn, P. and Gibbons, A., 1997. DNA from an extinct human. **Science,** 277:176-177.
36. Ross, P. E., 1992. Eloquent remains. Scientific American, 266(5): 72-81 (US edition, p. 116).
37. Pääbo, S., Cooper, A., Poinar, H. N., Radovcic, J., Debenath, A., Caparros, M., Barroso-Ruiz, C, Bertranpetit, J., Nielsen-Marsh, C, Hedges, R. E. M. and Sykes, B., 1997. Neandertal genetics. Science, 277:1021-1023.
38. Krings *et al.*, Ref. 1, pp. 24-25.
39. Kahn and Gibbons, Ref. 35, p. 177.
40. Kunzig, R., 1998. Not our mom. **Discover,** 19(1):33.
41. Wong, K., 1998. Ancestral quandary. Scientific American, 278(1):32 (US edition, p. 32).
42. Krings *et al.* Ref. 1,p. 27.

43. Personal communication.
44. Niklas, K. J., 1990. Turning over an old leaf. **Nature,** 344:587.
45. Gibbons, A., 1998. Calibrating the mitochondrial clock. Science, 279:28.
46. Gibbons, Ref. 45, p. 29.
47. Mountain, J. L., Lin, A. A., Bowcock, A. M. and Cavalli-Sforza, L. L., 1993. Evolution of modern humans: evidence from nuclear DNA polymorphisms. *In:* **The Origin of Modern Humans** and the Impact of **Chronometric Dating,** M. J. Aitken, C. B. Stringer and P. A. Mellars (eds), Princeton University Press, Princeton, p. 69.
48. Melnick, D. and Hoelzer, G., 1992. What in the study of primate evolution is mtDNA good for? American Journal of Physical **Anthropology, Supplement 14,** p. 122.
49. Marks, J., 1992. Chromosomal evolution in primates. *In:* The **Cambridge Encyclopedia of Human** Evolution, S. Jones, R. Martin and D. Pilbeam (eds), Cambridge University Press, Cambridge, p. 302.
50. Niklas, Ref. 44, p. 588.
51. Stringer, C. B., 1993. The legacy of *Homo sapiens.* **Scientific American,** 268(5):88 (US edition, p. 138).
52. Kennedy, K. A. R., 1992. Continuity of replacement: controversies in *Homo sapiens* evolution. **American Journal of Physical Anthropology,** 89(2):271, 272.
53. Wu, X. and Poirier, F. E., 1995. **Human Evolution in China,** Oxford University Press, New York, p. 113.
54. Lubenow, M. L., 1992. **Bones of Contention: A Creationist Assessment of the Human Fossils,** Baker Book House, Grand Rapids, Michigan, pp. 131-133.
55. Kahn and Gibbons, Ref. 35, p. 178.
56. Marshall, E., 1997. Tapping Iceland's DNA. **Science,** 278(5338):566.
57. Poinar, H. N., Hoss, M., Bada, J. L. and Pääbo, S., 1996. Amino acid racemization and the preservation of ancient DNA. **Science,** 272:864.
58. Rocky Mountain News, Denver, July 11, 1997.
59. Foley, R., 1995. Talking genes. **Nature,** 377:493-494.

Marvin L. **Lubenow** has a B. A. from Bob Jones University, a M.Th. from Dallas Theological Seminary and a M.S. in anthropology and palaeontology from Eastern Michigan University. Author of **Bones of Contention,** the product of more than 25 years of research in paleoanthropology, he is a Professor Emeritus at Christian Heritage College, San Diego, where he also received an honorary doctorate.