

Scientific Studies

Here are some findings from recent scientific studies conducted on the Iceman:



Study reveals two attacks and a clear chronology of Ötzi's hand and back wounds (1/28/2009)

A recent study by researchers at Ludwig Maximilians University in Munich and published in [Intensive Care Medicine](#) concludes that Ötzi was attacked at least twice during his final few days of life. He had an "older" wound (on his hand where there was a deep and severe gash) and two "newer" wounds (both on his back: the site where the arrow struck him and a bruised area nearby where he was struck by a blunt object).

According to the researchers who analyzed previous studies and conducted their own, the condition of the hand wound "clearly indicated that the laceration must have been survived for at least several days." A few days later, he died after he was shot with an arrow. The researchers write that the two back wounds "suggest a wound age of the back lesions of less than few hours survival time."

What the researchers don't mention is the head wound, for reasons that are not clear.

The lead researcher, Andreas Nerlich, said: "It is now clear that Ötzi endured at least two injuring events in his last days, which may imply two separate attacks. Although the ice mummy has already been studied at great length, there are still new results to be gleaned. The crime surrounding Ötzi is as thrilling as ever!"

New DNA study suggests that the Iceman apparently has no living relatives (10/30/2008)

A study in [Current Biology](#) has found that the Iceman's mitochondrial DNA (mtDNA), one of the best ways of determining genealogy, is apparently not related to anyone living today.

Researchers discovered that "Ötzi's mtDNA belonged to a broad genetic category called K1, which is still common in Europe today.... However, modern Europeans today belong to three sub-lineages of K1, whereas ... Ötzi belonged to a previously unidentified lineage of K1 that has not been seen to date in modern European populations." According to Martin Richards, a professor of biology at the University of Leeds in northern England, "Our research suggests that Ötzi's lineage may indeed have become extinct."

This finding contradicts an earlier 1994 study (based on a very small section of the gene sequence) which suggested that Ötzi might have living descendants.

Researchers are careful to point out that, if a larger number of Europeans are tested, especially in the alpine areas where the Iceman roamed, it is still possible a genetic link might be found between the Iceman and people today.

Study suggests that Ötzi was a herdsman (8/21/08)

Research published in *Rapid Communications in Mass Spectrometry* (using the mass spectrometer) provides evidence that the Iceman might well have been a herdsman. Scientists analyzed hair samples taken from his coat, leggings and shoes (apparently just the uppers) for proteins (or more specifically, the "patterns of peptides of fermented proteins") using MALDI-TOF mass spectrometry. Then they compared them to hair samples from various present day animals. According to an article in [sciencedaily.com](#), "They found that Ötzi's coat and leggings were made from sheep's fur, while his moccasins were of cattle origin" [that is, cowhide]. According to [nationalgeographic.com](#) summary of the study

moccasins were not made of bearskin, as previously believed. Instead they were ancient cattle skin from the kinds of seasonally migrating animals cared for by herdsmen in the region of the Alps where he was discovered."

The lead researcher, Klaus Hollemeyer of Germany's Saarland University, told reporters that MALDI-TOF mass spectrometry "was faster and more reliable than methods based on DNA analysis." It has modern day applications, too. Hollemeyer explained that "This method could...be used in checking the purity of products made from animal hair, such as Cashmere wool." It can also be used to determine if clothing uses banned animal products (such as dog or cat fur).

By the way, MALDI-TOF is short for "Matrix-assisted laser desorption/ionization time-of-flight."

Ötzi's mitochondrial DNA may trace descendents ancestors (4/30/08)

A new DNA study is underway, conducted by Dr. Gianluca De Bellis of the CNR Institute of Biomedical Technology and Professor Franco Rollo of the University of Camerino, according to a press release issued by Roche Diagnostics.

Original DNA studies suggested that "Oetzi's mitochondrial DNA does not resemble any sub-type found in any present existing ethnic group." However, a new process, called Genome Sequencer FLX from Roche Diagnostics, can purportedly "shed more light on the subject of Oetzi's descendents, and establish his place in the genetic scenario of the present European race. Furthermore, 454 Sequencing data will enable researchers to trace Oetzi's ancestors; and reconstruct an accurate phylogenetic family tree, obtaining an authentic global view of human evolution." Results are expected by summer 2008.

After this study is completed, "De Bellis plans to study Oetzi's eating habits. Tissue samples that have been extracted from the mummy's colon will enable an analysis of his intestinal flora. The reason for this investigation will be to compare the genes between the embryonic digestive tube bacteria of Neolithic man with those of the present day modern man...."

Study proves how Ötzi died (6/6/07)

Swiss researchers have used a multi-slice CT-scan at the University of Zurich to piece together views of the iceman's shoulder and determine exactly how he died. They established that the point of the arrow tore

established that the point of the arrow tore a hole in an artery beneath his left collarbone, leading to a massive loss of blood. That, in turn, caused Ötzi to go into shock and suffer a heart attack, according to the article published online in the *Journal of Archaeological Science*. Even today, the chances of surviving such an injury long enough to receive hospital treatment are only 40 percent...."

Chief researcher Frank Rühli said that the Ct images show "a large hematoma, which means he must have had huge bleeding into the thorax cavity." His death, the scientists stated, would have been rather quick under these circumstances.

These results can be found in the current issue of the *Journal of Archaeological Science* and will be published in the U.S. and German editions of *National Geographic*.

Study provides evidence that Ötzi was probably killed by multiple assailants near findspot (9/14/06):

For a long time, scientists believed that the Iceman was a hunter who was killed by another hunter's arrow in a mountain valley and managed to climb up the mountain where he died. The primary evidence for this theory was the type of plant material found in his stomach which suggested that he had been in a specific mountain valley. However, a recent CAT-scan revealed that his arrow wound involved a major artery. According to Bolzano Hospital pathologist [Eduard Egarter Vigl](#) (who has studied the Iceman over the years), this indicates that he pretty much died very near to where he was attacked and wounded, since he would not have been able to take even one step before the enormous loss of blood from such a wound killed him. (News story at [ansa.it.](#))

Study suggests that Ötzi was a shepherd (9/5/06):

From the time of his discovery in 1991, scientists and others have speculated that the Iceman was a hunter. But a recent study published in the *Journal of Human Evolution* ("Body size, body proportions, and mobility in the Tyrolean ' Iceman,' "volume 51, issue 1, July 2006) suggests that he may have been a shepherd instead.

By studying Ötzi's leg bones, primarily his [tibia](#), or shin bone, and comparing it to the shin bones of 139 other prehistoric men who lived from the Mesolithic Stone Age) and from the [Neolithic age](#) (12

Stone Age) and from the [Neolithic age](#) (Late Stone Age), scientists led by [Christopher Ruff](#) from John Hopkins University hoped to answer the question: how did the Iceman's measure up?

The answer: "In many respects, his tibia more closely resembles those of European Mesolithic rather than Neolithic males, which may reflect a more mobile lifestyle than was characteristic of most Neolithic males, perhaps related to a pastoral subsistence strategy" (that is, work as a shepherd). According to Dr. Ruff, The Iceman "evidently went for long walks over extremely hilly terrain" and "was much more active than his contemporaries" as reflected by the look of his tibia. Ruff continued, "He was more like the people who came before" (that is the people from the Mesolithic Age) and suggests that his occupation was "probably that of a high-altitude shepherd." (News story at [ansa.it.](#))

DNA Tests Suggest: Ötzi Died After Violent Fight But Not Alone (8/10/03):

Results of recent DNA tests conducted by an Australian researcher have led to all sorts of new speculation about Ötzi's final days. Like crime scene investigators, molecular biologist Thomas Loy and his team (from the University of Queensland's Institute of Molecular Bioscience in Brisbane) looked for blood traces on the Iceman, his tools, and weapons. During their investigation, they saw further signs of trauma to Ötzi's body, including bruises (and cuts) on his abdomen (especially on his rib area), which (they concluded) indicates that he may have been beaten. They found DNA from four different people other than the Iceman, and they carried out each test twice to be certain of their findings.

Dr. Loy told a reporter from [USA Today](#), "We have been working round the clock for the last three weeks to get these results. It was very exciting when the blood samples came back positive for human DNA from four separate individuals."

Specifically, they took samples from the Iceman's antler-skinner tool, his stone-tipped knife, two of his arrows (one broken), his axe handle, and his goatskin coat. Using techniques devised especially for ancient DNA, the team found four different DNA sequences: one on the knife blade, two different sequences on one arrow, and a fourth on Ötzi's goatskin coat. (They also found a small tear in the coat which may have been the entry point of the arrowhead that was found embedded in his shoulder.)

They have interpreted these findings in this way:

1. The two different blood samples on

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may indicate that Ötzi killed two of his assailants and retrieved the arrow to use again.

2. The blood on his coat may indicate that Ötzi carried a wounded friend on his shoulder for some distance.

Dr. Loy told news.com.au: "On the basis of all my examinations, [Ötzi's] specialty was hunting the high alpine passes for ibex and possibly chamois which would have taken him into boundary conditions where other people would have disputed the territory. His gear was stacked up neatly. He didn't keel over, although he was probably tired, exhausted and hurt like hell."

The Iceman's Wounded Hand (2/2003):

The February 2003 issue of the [Smithsonian](http://www.smithsonianmag.com) contains an article by Bob Cullen summarizing what has been discovered about the Iceman. It is worth reading as a general summary of the findings, but most important is the information it contains about a dagger found near Ötzi.

A filmmaker working on a documentary for the Discovery Channel interviewed one of the men who helped recover the Iceman's body and learned that Ötzi may have been holding a dagger in his hand when he was discovered. Dr. Egarter Vigl re-examined the Iceman's right hand in June 2002 and "found a small cut running from the palm of the right hand, just below the index finger, over to the top side of the hand" ([Smithsonian](http://www.smithsonianmag.com)). About 1.5 inches long and 6 mm. deep, the cut was discolored along the edges, indicating that the injury happened when the Iceman was alive. Dr. Egarter told author Cullen, "I think that the wound was very painful. Two fingers are nearly immobilized." X-rays also revealed two cuts on the underlying bones (of the palm and the wrist).

Additional study of the Iceman's body would help clarify questions surrounding the cause of death: If the officials at the South Tyrol Museum would grant permission, the arrowhead could be removed and an endoscopy performed to determine if any nerves or blood vessels were severed.

Ötzi's Last Meal (9/17/02):

Scientists at the University of Camerino in Italy have published the results of their DNA analysis of the contents of Ötzi's intestines:

1. Ötzi first ate the meat of an ibex (wild goat) along with some grains (and pollen).

2. The pollen found in his intestines is

2. The pollen found in his intestines indicates that he hiked through "a coniferous forest at mid-elevation." This is most likely the site where he ate his ibex meal.

3. At a higher altitude he ate another meal: red deer and more grain. (For information about the final route that Ötzi took, [follow this link](#).)

Results of the study were published in [The Proceedings of the National Academy of Sciences](#).

Results of Ötzi's Colon Study (10/23/01):

Researchers at the University of Glasgow have released results of their study of the Iceman's colon: they found whipworm parasite eggs. This means that Ötzi had a fairly severe intestinal disorder which would have caused diarrhea or possibly dysentery. Barley, meat, and a cereal grain known as einkorn were also found; these would have comprised his last meal or meals.

Perhaps the most important finding was pollen, ingested when he drank water from local streams. These pollens indicate that he may well have died in late spring or even early summer, not in the fall (as some researchers had suspected).

SOURCES: [Reuters](#), [BBC News Online](#), 9/25/00; [Ananova.com](#), (10/23/01); [New York Times](#) (9/17/02); [Smithsonian](#), (2/2003); [News.com.au](#) (8/11/03); [ansa.it](#) (9/5/06; 9/14/06); [sciencedaily.com](#) (8/21/08); [nationalgeographic.com](#) (8/21/08)