

Ötzi the Iceman's Stomach Bacteria Offers Clues on Human Migration

By Nicholas Wade

An insight into the peopling of Europe has emerged from an unlikely source -- the stomach contents of a 5,300-year-old body pulled from a thawing glacier in the eastern Italian Alps.

Since his discovery in 1991, Ötzi the **Iceman**, as he was named, has provided a trove of information about the life of Europeans at that time. His long-frozen tissues have now yielded another surprise: Scientists have been able to recover from his stomach samples of *Helicobacter pylori*, a bacterium that infects about half the human population and can occasionally cause stomach ulcers.

The bacterium is transmitted only through intimate contact, and its distribution around the world matches almost perfectly the distribution of human populations. The bacterium's genetic variations are therefore used by researchers as a supplement to human genetics in tracking ancient human migrations.

Researchers led by Frank Maixner and Albert Zink of the Institute for Mummies and the **Iceman**, at the European Research Academy in Bolzano, Italy, reported on Thursday in *Science* that they had been able to reconstruct the entire DNA sequence of the ulcer bacterium from samples taken from the iceman's stomach.

Modern-day Europeans carry a type of *H. pylori* that is a hybrid of two ancient strains, one of which originated somewhere in Eurasia and the other in Africa, after modern humans first left that continent about 50,000 years ago.

One theory is that this hybridization occurred in the Middle East before or during the Last Glacial Maximum, a catastrophically cold period during the last ice age when glaciers swept south and made much of Europe uninhabitable.



Remains of Ötzi the Iceman

Related handout file photo of "Ötzi", Italy's prehistoric Iceman. Ötzi's 5,300-year-old body was found frozen in the eastern Italian Alps in 1991. (Credit: AP/Wide World Photos/Handout/Files) Photo credit by ProQuest Staff

After the glaciers began to retreat, about 20,000 years ago, people from the Middle East and other southern refuges moved north to recolonize Europe. It could have been these migrants who brought the hybridized ulcer bacterium to Europe.

Yet the ulcer bacterium from Ötzi is related only to the Eurasian strain, the researchers found, implying that hybridization with the African strain must have occurred much later, within the last 5,000 years.

The finding suggests that it may have been the first farmers, who brought the agricultural revolution to Europe from the Middle East starting about 8,000 years ago, who were the carriers of the African strain, said Yoshan Moodley of the University of Venda in South Africa, a co-author of the new report.

Reconstructing the history of human pathogens, a new science made possible by the ability to decode DNA molecules many thousands of years old, can yield deep insights into both medicine and history. Last October a team led by Eske Willerslev of the University of Copenhagen extracted *Yersinia pestis*, the plague bacterium, from human teeth up to 5,000 years old.

The plague bacterium, spread by fleas and rats, caused three devastating pandemics - the Justinian plague of the sixth century, the Black Death in 14th-century Europe and the global pandemic that erupted in the 1890s.

Mark Achtman, a leading expert on ancient pathogens at the University of Warwick in England, said that the authors of the Ötzi paper had done well to extract the ulcer bacterium from the **iceman**, but that it was difficult to infer from a single sample anything about the bacterium's distribution in Europe 5,000 years ago.

Besides looking at the DNA of the ulcer bacterium, the authors also found proteins in the iceman's stomach that are involved in inflammation, but the stomach is too poorly preserved to confirm that he suffered from gastric disease.

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THE ICE MAN

Tales of the Ancients

by Don Lessem

Grab a Cup of Cocoa, Wrap Yourself in a Blanket, and Read a Winter's Tale About a Lone Hunter Who Died in a Frozen Grave More Than 5,000 Years Ago and Became One of the World's Most Well-Preserved Bodies.

On a fall day more than 5,000 years ago, a frightening blizzard rages over the mountains of central Europe (in what is now the area between Austria and Italy). A lone hunter is headed over a mountain pass. The fierce winds and blinding snow cause him to fall and break his arm on the freezing, rocky ground. Shivering beneath his cape made of grass he falls asleep. Soon frozen, he never wakes up.

The story of this ancient hunter might never have been told. But on a very warm fall day in those same mountains in 1991, ice that had formed thousands of years ago melted away. And suddenly the frozen hunter could be seen near a mountain trail.

Hikers Erika and Helmut Simon thought the small, smooth body might be that of another hiker. Perhaps it was even a doll. The Simons called police, who began to pull the body from the ice with a jackhammer, axes, and ski poles. They also used a stick found near the body. At the time, the diggers had no idea they were using the Ice Man's own bow to unearth him.

Austrian scientist Rainir Henn was called in to examine the body. When Henn saw the waxy skin, he realized he was looking at a corpse preserved in the ice for many lifetimes. This Ice Man, Henn thought, might be older and better-preserved than any ancient body ever found in Europe.

Henn was concerned that curious tourists might dig away this rare discovery, so his recovery team hurried to remove the Ice Man. There was no time to find the proper digging tools, map the site or record the condition of the finds as archaeologists usually do at excavation sites.

In the rush to free the Ice Man from his frozen gravesite, some of his remarkable belongings were probably lost. But just minutes before the Ice Man's frozen body was loaded onto a helicopter, the team found some clothes, his tiny wooden-handled stone knife, a copper ax, and a long wooden bow.

The description of a man who lived thousands of years ago was pieced together through many months of careful study of his body in a climate-controlled laboratory. The Ice Man's body provided many clues to his life and his death. Judging by the strength of his bones

and teeth, scientists determined that he was an adult, between 25 and 40 years old, and was about 5 feet 2 inches tall. Blue tattoo lines on his lower back may have been marks of a celebration ceremony held when he reached adulthood. The even length of the Ice Man's curly brown hair indicated he might have had a haircut shortly before he took his last hike. To keep up his strength, the Ice Man kept a dried-mushroom snack on a leather string and a bag full of herb medicines.

HOW THE ICE MAN LIVED

Scientists have investigated every aspect of the Ice Man, his belongings, and the remains of the area's prehistoric European villages. They have guessed at what the Ice Man's life might have been like before he died.

The Ice Man could have been on his way to trade his tool-sharpening flints for food in a valley village, where wood and mud houses stood on stilts beside muddy lakes. The villagers probably plowed their land to grow crops and moved belongings on wooden-wheeled carts. They also might have fished, raised domestic animals, and made their own linen clothes, which they might have traded for the Ice Man's fur cap.

After welcoming the Ice Man with a meal of herb tea and buttered bread, the villagers might have also traded for meat from the wild animals the Ice Man killed. The Ice Man was an expert hunter. He had probably hunted since he was a boy; he would have hunted deer and wild pigs, and used his bow and arrow for protection from wolves and bears. He knew how to feather his arrows at an angle so they would fly straight, and how to wield his copper ax to make new arrows and bows as he needed.

Tools such as these were known to exist more than 2,000 years ago. But just how old was the Ice Man? His ax provided the best clue. Its four-inch-long metal blade was wrapped in cow leather, glued with birch-tree gum, and was wedged into an L-shaped carved wooden handle. At first glance, the metal was thought to be bronze. Bronze metal blades were common 4,000 years ago. But soon, researchers realized the shiny metal was copper, not bronze. So the Ice Man belonged to an even more-ancient metalworking culture--Copper Age hunters. The Ice Man and his copper blade were more than 5,000 years old!

Five thousand years after his grim death, the Ice Man became a famous and unique scientific subject. The residents of the area named the popular body **Otzi**, after the name of the valley where he was found. He became a major tourist attraction in the Alps of southern Austria and northern Italy. Since **Otzi** was found near the border of these two countries, his remains were fought over in court. It was decided he had been found a few feet inside Italy. There the Ice Man is displayed in a specially cooled chamber within a new museum where, hopefully, his mummy will live forever.

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FROZEN FIND: **Otzi** the Ice Man was found in a glacier (a river of ice) on a mountain near the border of Italy and Austria. His 5,300-year-old naked body looked like it was trying to get out of a swimming pool, and his face was pressed down in the snow.

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RECONSTRUCTING THE ICE MAN

After 5,000 years, the Ice Man had a face only a mummy could love. Colorado artist John Gurche did a remarkable job re-creating the look of the Ice Man. Gurche, who is famous for his realistic dinosaur paintings, took measurements of the Ice Man's skull and compared them to the faces of modern Europeans with similar head dimensions. To build up the skin and muscles, Gurche used soft plastic. He added reddish tones to the chemical flesh to give the Ice Man's skin the ruddy, windburned look of a northern European mountain man.

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PRESERVING THE ICE MAN

Otzi was naturally preserved in the ice of a glacier for thousands of years. But within hours of being exposed to warm air, he began to decay.

To keep the Ice Man protected, scientists sprayed the body with mold-killing chemicals. The Ice Man soon went back on ice, in a laboratory room cooled to 21 degrees Fahrenheit, well below freezing temperature (which is 32 degrees). The air was kept at high humidity, just like the ice in which the Ice Man had been frozen. Scientists were not permitted to remove the Ice Man from his ice room for more than 20 minutes a day.

Now, the Ice Man lies in a new museum in northern Italy. He is placed on a green cloth atop electronic scales that reveal even the slightest changes of weight that might indicate decay. The temperature is kept at a relatively warm 43 degrees with high humidity. Computers keep watch over **Otzi** and the weather in his cell to make sure the Ice Man stays cool and undisturbed.