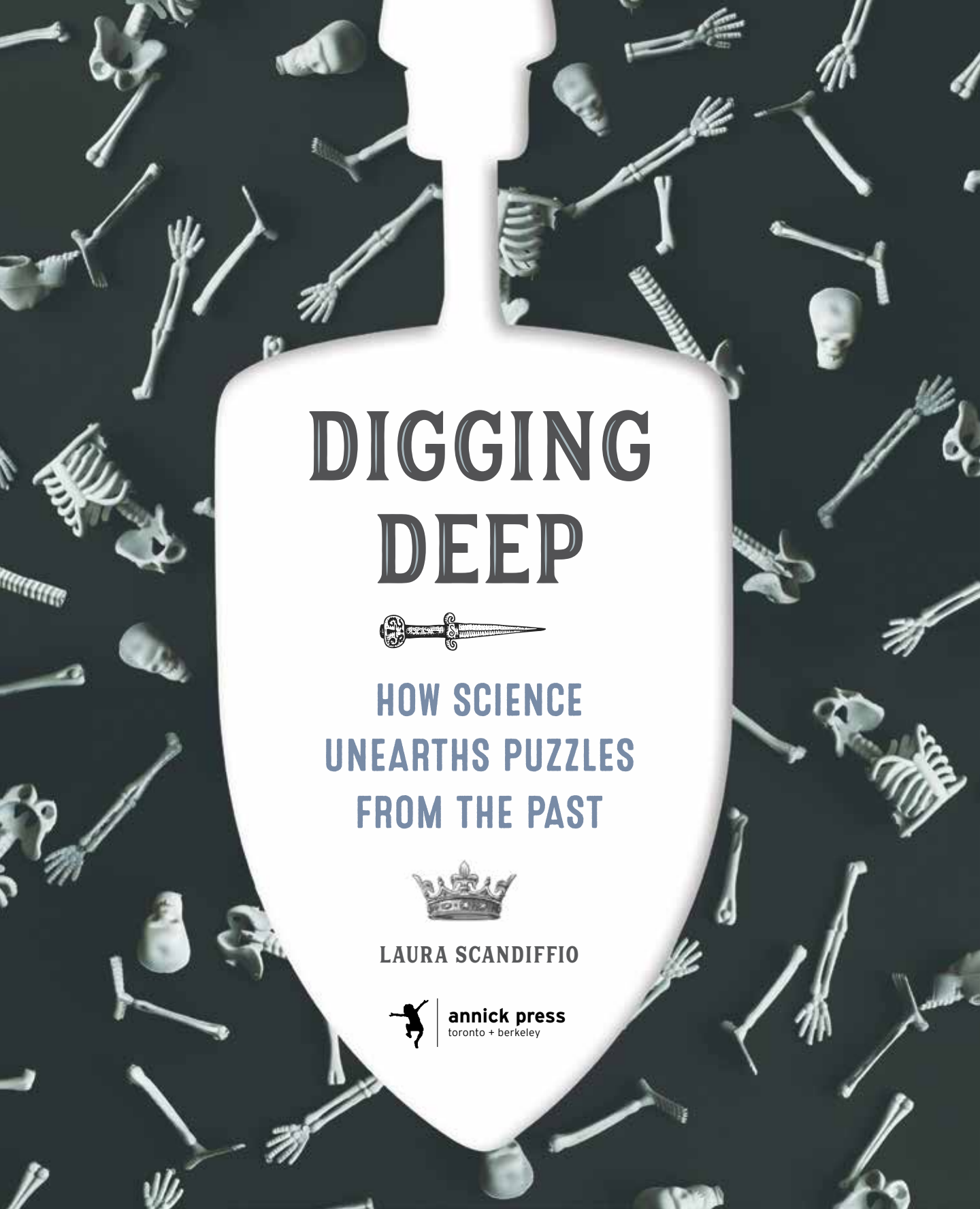

DIGGING DEEP

HOW SCIENCE UNEARTHS PUZZLES FROM THE PAST

LAURA SCANDIFFIO

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To Rob, with love—LS

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Detectives of the Past

EACH TIME AN ARCHAEOLOGIST brushes the dirt off a remnant of the past, whether it's a pottery shard or a human bone, it adds a little to our knowledge. But sometimes an archaeological discovery is so startling, so unexpected, that it dramatically changes our understanding of history. It shakes up assumptions, overturns theories, and forces us to change our minds about what we *thought* we knew. Sometimes the new evidence is like a missing puzzle piece that, once put in place, changes the whole picture.

In the past century, stunning discoveries such as the tomb of the Egyptian pharaoh Tutankhamun and the Dead Sea Scrolls captured the imagination of the world. In more recent years, advances in science and technology have transformed archaeology, taking its detective work to a whole new level.

Thanks to radiocarbon dating, science can at last answer a question archaeologists have always wanted to solve—exactly how old an artifact is. Advances in extracting ancient DNA from bones means we can now reconstruct the genetic codes of people who lived hundreds or thousands of years ago—and know everything from their eye colors to their diseases. Now DNA can even link an ancient skeleton to a living descendant. With remote sensing—from radar and sonar to airborne lasers and satellites—it's now possible to "see" through a jungle canopy, reveal a shipwreck at the bottom of the ocean, or map an entire ancient city from space.

And forensic science—all the technology available to crime solving—can be applied today to an archaeological site. The same science that detects the residue left from a smoking gun or determines the cause of a suspicious death is being used to reconstruct what happened hundreds or thousands of years in the past.

> “WE ARE THE DETECTIVES OF THE PAST. AND WE HAVE TO FIGURE OUT WHAT HAPPENED. THAT IS WHAT IS FASCINATING ABOUT ARCHAEOLOGY.”
>
> —Luis Jaime Castillo, archaeologist

The true stories in this book are about recent discoveries that transformed our understanding of that past, whether two centuries or 40,000 years ago. And scientific breakthroughs made them possible.

A hidden cave in France proved that our Ice Age ancestors were more like us than we imagined—already powerful artists producing masterpieces. A skeleton found under a parking lot told a startling new story about a medieval king. A mysterious man, perfectly preserved in a glacier for thousands of years, became a unique time capsule of our prehistoric past. Ancient cities long lost under a jungle were brought into view, and the story of an empire's rise and fall was rewritten.

Today, archaeological finds are also playing a role in our planet's future—with discoveries that bear directly on climate change and a sustainable relationship between humans and our environment.

The stories of these dramatic finds are reminders that, despite our scientific advances, we still don't know it all (even when we might think we do!). There is still so much to learn about our world and our human story. Tomorrow, someone else might make a discovery that will make us question everything we believe today. It's what keeps archaeologists filled with a sense of wonder and anticipation!

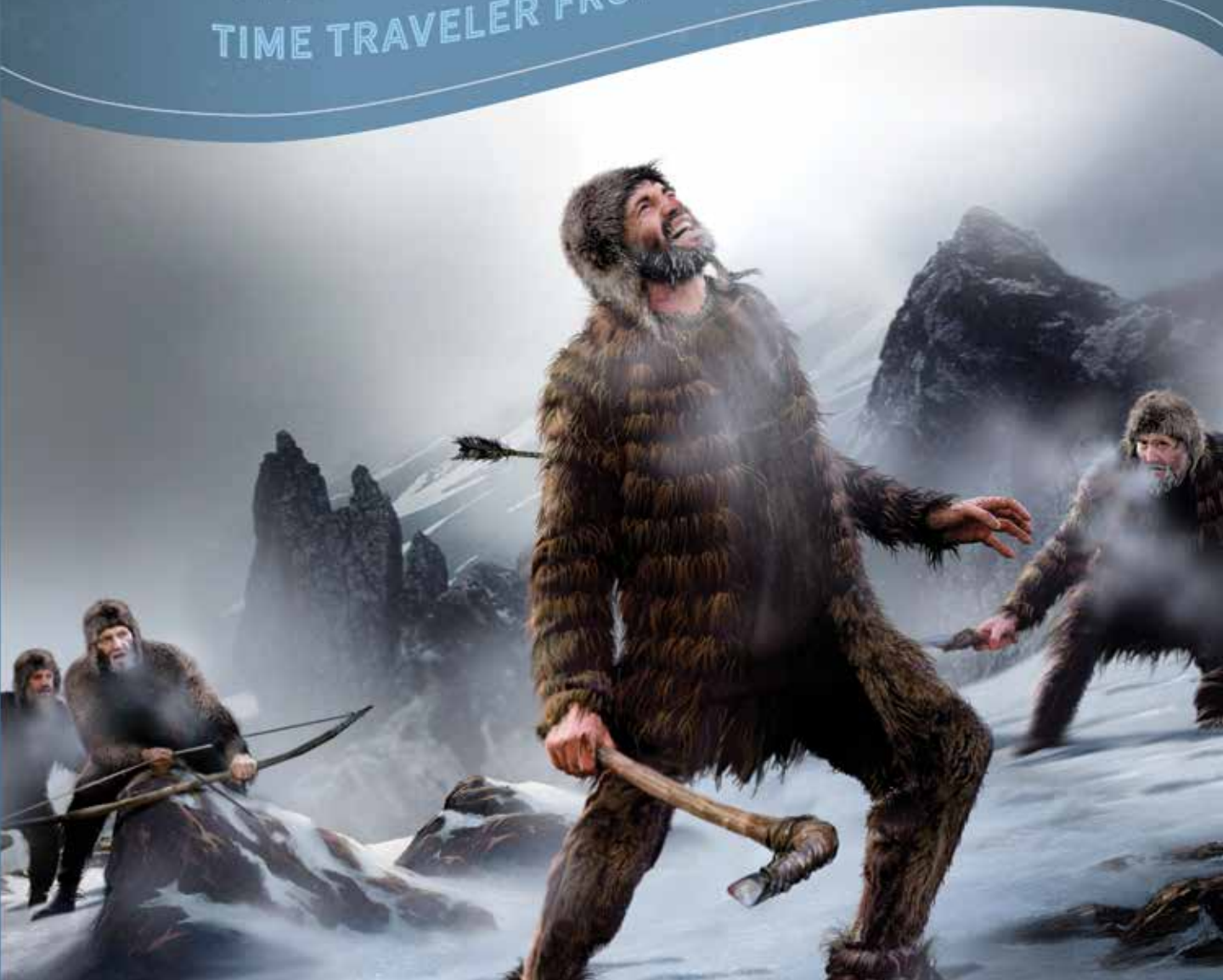
An archaeologist delicately removes earth from ancient human remains and artifacts.


GERMANY
AUSTRIA
SLOVENIA
SWITZERLAND
ÖTZI'S BODY FOUND
CROATIA
FRANCE
Adriatic Sea
ITALY
CORSICA
Rome
N
W
E
S
SARDINIA
Tyrrhenian Sea

Chapter One

ÖTZI THE ICEMAN

TIME TRAVELER FROM THE STONE AGE



HIGH ABOVE THE VALLEY, a man moves with strong strides up the mountainside. He is carrying everything he needs—food, fuel, weapons—in his backpack or wrapped in a leather pouch on his belt.

He advances steadily through the pines toward a mountain pass on the icy summit. His breath is steaming in the frosty air, but his animal-hide clothing keeps him warm. A couple of slain birds dangle from his belt.

It's clear he is in a hurry, retracing his steps downhill and then up again. What is he seeking so high up in the mountains—or fleeing from?

He will never get out of the mountain pass. The man's journey was made long before Stonehenge was built or the ancient Egyptians constructed their pyramids. And the answers to the questions of who he was and where he was going will lie preserved under the snow and ice for thousands of years—the world's oldest unsolved homicide case. When his secrets do come to light—thanks in part to advances in studying ancient DNA—they will also shatter assumptions about our early tools and technologies, the distances we traveled, and the diseases that plagued us even then.

The mountains and glaciers of the Ötztal Alps

A GRISLY DISCOVERY

On a sunny September day in 1991, Erika and Helmut Simon, a German couple on holiday, were hiking high in the Ötztal Alps near the Austrian-Italian border. The scenery was spectacular, but the thin mountain air made their climb challenging. Veering off the marked trail, they glimpsed a brown object sticking out of the ice, which had partially melted in the sun. Coming closer, they stopped in their tracks. It was unmistakably the head and back of a person, dead and lying facedown. They thought it must be a mountain climber, recently killed in some tragic accident.

The Simons hurried down to the nearest mountain refuge—an hour-long trek—and told the landlord. The next day, police officers and volunteers returned to the scene and struggled to free the corpse from the ice, but they could not budge him. He was stretched over a boulder, in a peculiar position: his left arm under his torso sticking out to the right, his right hand stuck under a rock. They spotted strange items scattered around him, frozen in the ice—leather fragments, handmade rope. Not the usual gear of a mountaineer—who was this man? The skin looked oddly freeze-dried. The most striking object near the body was a long handmade ax with what looked like a copper blade.

Two mountaineers examine the mysterious corpse in the ice.

CARBON-14 DATING (RADIOCARBON DATING)

Carbon-14 is a variation of the element carbon that is present in all living organisms; it is steadily replenished as the organism consumes food or air. Once an organism dies, the carbon-14 in its tissues decays at a constant rate. So, by measuring how much carbon-14 is left in a dead organism, scientists can estimate how long ago it died. Thanks to this scientific breakthrough, archaeologists can date fossils and other remains that are as much as 50,000 years old.

Four days after it was discovered, the mysterious corpse was finally freed with ice picks. Without closer analysis, it was impossible to tell the age of the body, but one forensic scientist thought it could be as much as a hundred years old. Someone else thought it might be the body of a World War I soldier who became lost in a storm and froze to death. The corpse was placed in a body bag and flown out by helicopter, then taken in a hearse to the Institute of Forensic Medicine in Innsbruck, Austria.

A forensic examination of the body was carried out to identify the dead man and determine if the cause of death was suspicious. Early on in the exam, it became clear that the body might actually be hundreds of years old. The public prosecutor decided it was time to call in historical experts. Konrad Spindler, an archaeologist and historian, looked at the corpse and said it might even be 1,000 years old.

During the short time it had been out of the ice, the body had begun to deteriorate, so it was put in an icy cell. Samples of body tissue, gear, and plant remains found on the corpse were sent to three different laboratories for radiocarbon dating. All the results confirmed the same stunning revelation: this was the eerily intact body of a man who had lived 5,300 years ago!

The Simons had stumbled upon the oldest naturally preserved human body ever discovered.

The Iceman as he was found, lying facedown

A HUMAN TIME CAPSULE

Archaeologists and other scientists soon began to realize just how marvelous and rare a find this was. Ötzi the Iceman (as a journalist nicknamed him, after the mountain range where he was found) was so intact that he provided a unique window into the ancient world. Very few artifacts from Ötzi's era had been discovered in that region. No one knew for sure what our Neolithic ancestors were really like. Did they look like us? How did they spend their days? What did they eat and wear? Where did they travel, and why?

Nothing like Ötzi had ever been found before. His body and gear, perfectly preserved by glacial ice, were a time capsule of life in the New Stone Age—a turning point in human history.

How *did* Ötzi stay intact for over 5,300 years? He died at a high altitude, and over time his body was mummified by the ice, dehydrating his tissues and preserving them. Whereas Egyptian mummies were treated with special substances to prevent decay, this process happened naturally to Ötzi. A deep layer of snow and ice covered and protected this "wet mummy."

Archaeologists had to wait until the summer of 1992 to fully excavate the site. After removing snow and ice with steam blowers, they found even more clothing and equipment. They also turned up remnants of plants on Ötzi's body—pollen, seeds, moss, and fungus. All these held valuable clues about his diet, home, and travel.

Ötzi's arrows

LIFE IN THE NEW STONE AGE

The Neolithic Period, or New Stone Age, is named for the stone tools people used, made by polishing or grinding. This age began at different times in different places but started around 10,000 BCE and ended with the rise of the Bronze Age, between 3000 and 2000 BCE.

Our ancient ancestors once lived as nomadic hunters and gatherers, but in the Neolithic Period, people began to settle down in villages. They grew wheat and barley and raised goats and sheep. Population was on the rise, and people began to travel to trade with one another.

NEW STONE AGE PACKING LIST

Ötzi had been warmly dressed for the mountain wilderness. His clothes were made of leather, animal hide, and braided grass, stitched with animal sinews, grass, or tree fibers. He wore:

- a long coat made of goat hide, with the fur on the outside
- leggings made of goat and sheep hide
- a calfskin belt and pouch
- shoes made of deer hide sewn to a bearskin sole with the fur on the inside
- a bearskin cap
- a backpack, with a wooden frame and hide sack

Ötzi's gear showed an ingenious use of plants and animal parts to make everything he needed:

- two cylinder-shaped birch-bark containers, lightweight and tough
- a fire-starting kit—maple leaves wrapped around what would have been charcoal embers
- tools for scraping and boring and a piece of flint
- birch tree fungus, an antibiotic that could also be used to stop bleeding

The Iceman was armed for encounters with wild animals, such as wolves, or other humans with weapons such as:

- a longbow made of yew wood, still unfinished—the string had not yet been added. In an experiment, a replica of the bow hit targets 30 to 50 m (100 to 165 feet) away with fatal accuracy.
- a quiver made from deer hide, containing twelve arrow shafts but only two finished arrows with flint arrowheads and feather fletching.
- a dagger with a flint blade and ash-wood handle. The blade had been forced into the handle and wrapped tight with animal sinew.
- a copper-blade ax with a yew-wood handle. The blade was fixed with birch tar and bound with leather straps.

Recreations of shoes from Ötzi's era, made of leather and fur. String netting held in grass to keep feet warm.

The Iceman's unique copper axe

New Stone Age weapons were often made from wood, flint, and tree fibers.

The unfinished bow and arrows were baffling—what was Ötzi doing in the mountains with weapons that weren't ready? But the copper ax was the biggest surprise for the experts. It was the only one of its kind found in the world, and it was extremely advanced for Ötzi's era. Experts had long thought that the technology to mine and smelt metal had appeared in Europe much later. Now they were forced to completely revise the time line of technology in the New Stone Age. Clearly, the people of Ötzi's time had already been moving beyond stone tools.

What's more, the copper in the blade was from hundreds of kilometers south. That meant people had been traveling and trading over a much wider area than anyone had thought. And the ax offered an intriguing clue to the Iceman's identity. In Ötzi's time, only men of high status would have had such an enviable weapon, one so prized it was often buried with them. Ötzi may have been an important man.

PIECING TOGETHER ÖTZI'S STORY

Scientists in Austria examined the body using X-rays and a CT (computed tomography) scan. They also made a few incisions to conduct a limited internal exam. Ötzi was then moved to his permanent home at the South Tyrol Museum of Archaeology in Bolzano, Italy. Glacier-like conditions of -6 degrees Celsius (21 degrees Fahrenheit) and 99 percent humidity were maintained at all times where the body was stored to keep it from decomposing.

Learning about Ötzi at the Italian museum dedicated to the Iceman

THE NEW STONE AGE IN EUROPE

TIMELINE

c. 7000 BCE

Farming begins in Greece and spreads slowly northward:

- Crops of wheat and barley are planted; animals are domesticated.
- Stone is still used for tools, but now pottery is made.
- People begin to live in settled communities.

c. 5500 BCE

Farming comes to central Europe:

- Farmers are in contact with hunter-gatherers, who still dominate northern Europe.

c. 5300 BCE

Death of Ötzi.

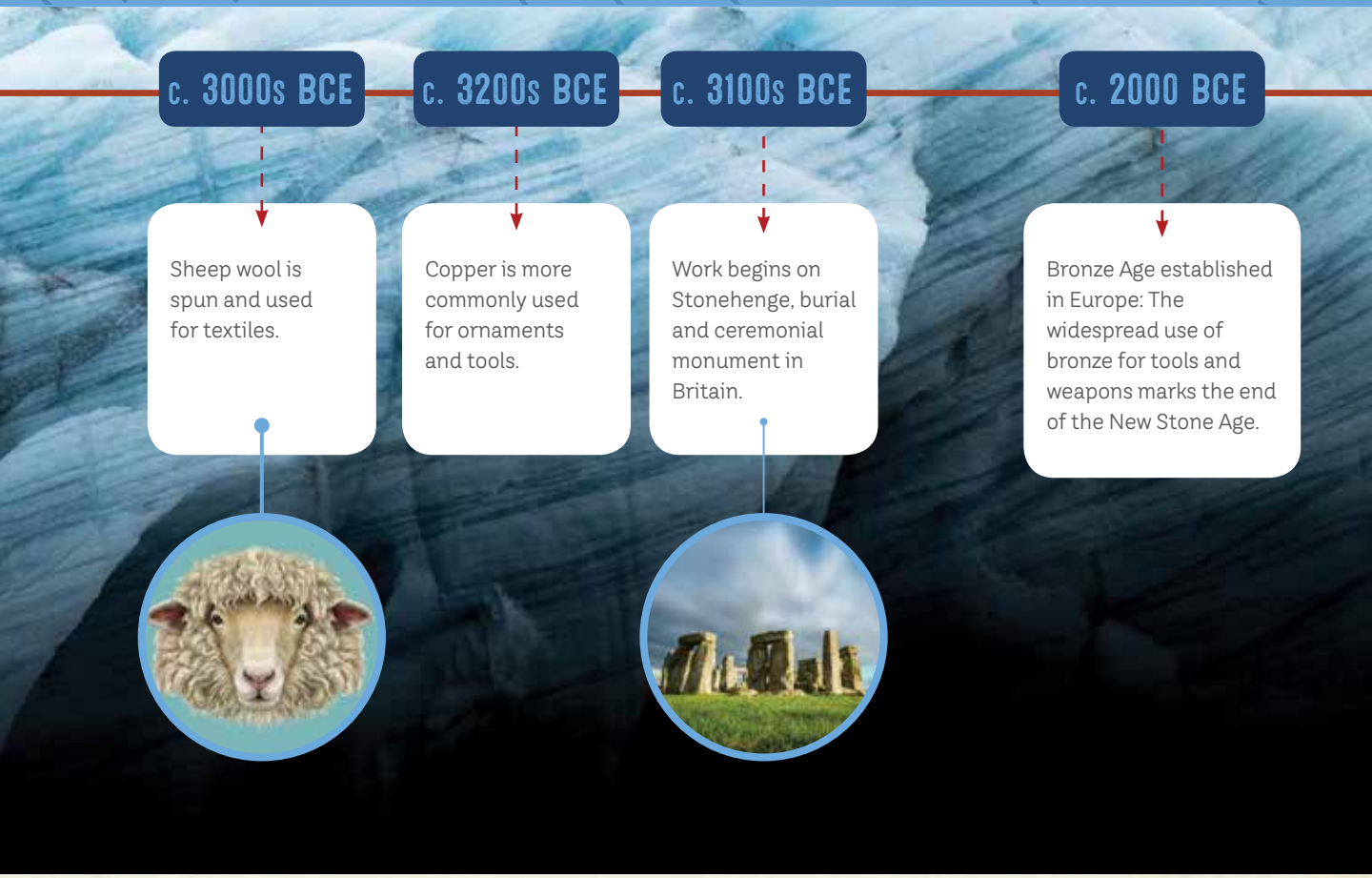
c. 4000 BCE

Farming comes to northern Europe and southern Scandinavia.

CT SCANS

Computed tomography (CT) scans work like a 3-D X-ray. A ring of X-ray detectors rotates around the subject, and a huge volume of data is processed by a computer that assembles the information into cross-sectional images (like slices in a loaf of bread). The result is a detailed, multidimensional view of the body's interior. In hospitals, CT scans help to identify internal injuries, tumors, and disease.

Slowly, scientists and archaeologists gathered evidence to piece together a theory about where Ötzi was from and where he was going. Chemical traces in his bones and teeth suggested he grew up in northeast Italy, perhaps in a valley not far south of the Ötztal Alps, and spent his adulthood in another valley southwest of where he was found.



There was pollen in his intestine from two kinds of trees—one that grows at low elevations and the other high on the mountainside. This suggested he was on the move, up from the valleys to the mountains, in the time immediately before his death.

At first, researchers supposed he might have been a shepherd who took his flock to graze on the hillsides and got lost in a snowstorm. But there was no sign of wool or any other evidence to back up this theory.