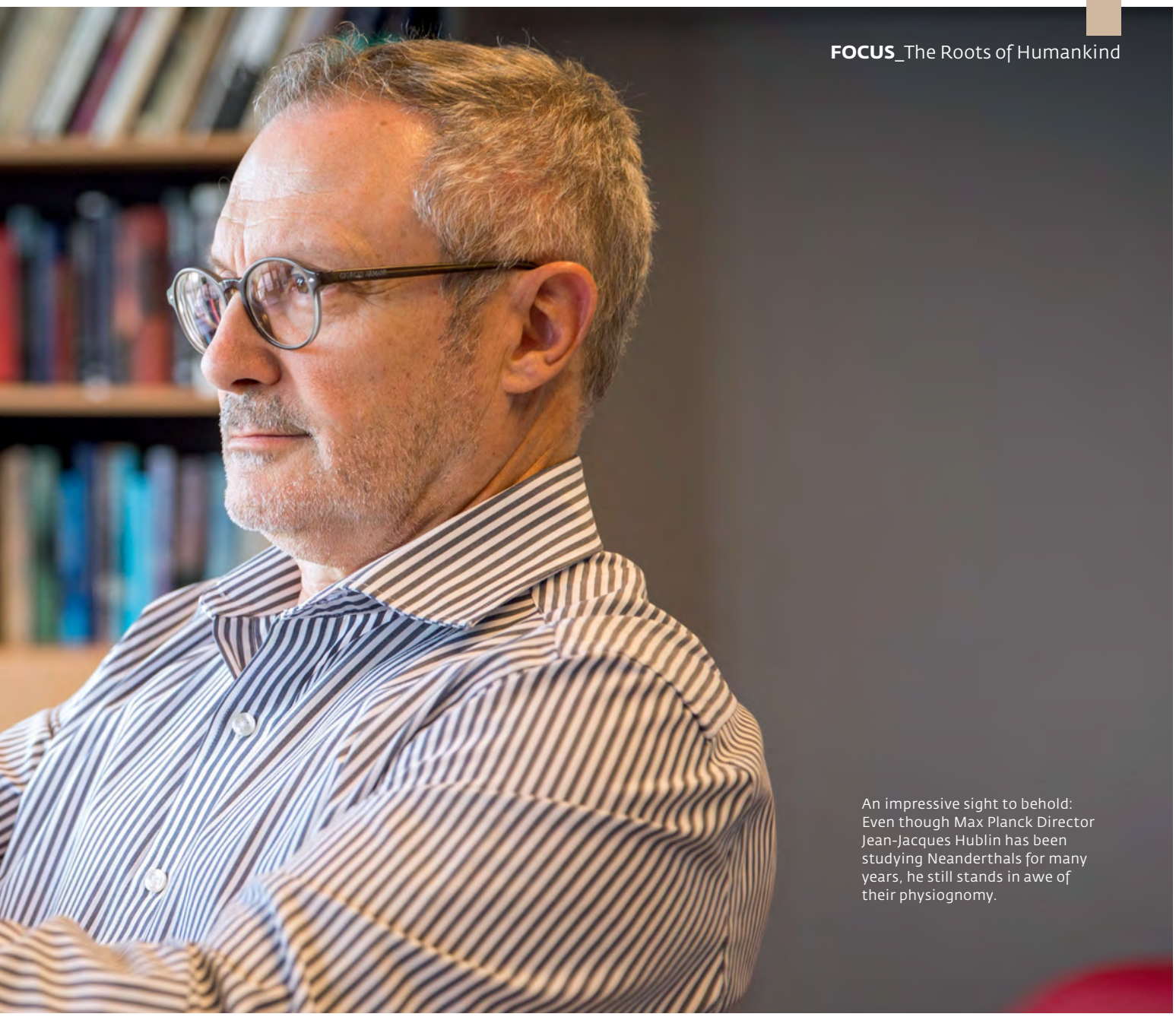
Face to Face **with Neanderthals**

Neanderthals and modern humans must have coexisted in Europe for several thousand years. What happened when they encountered each other and how they influenced one another are riveting questions. **Jean-Jacques Hublin** and his team at the **Max Planck Institute for Evolutionary Anthropology** in Leipzig are searching for the answers. In the process, they have found clues as to what the Neanderthals learned from *Homo sapiens* – and what they didn't.



An impressive sight to behold: Even though Max Planck Director Jean-Jacques Hublin has been studying Neanderthals for many years, he still stands in awe of their physiognomy.

Photo: Anna Schroll

TEXT **KLAUS WILHELM**

Nobody knows what the baby died of. An infection? The attack of a wild animal? A congenital disease? Perhaps. In any case, the parents left the child behind in a cave in central France, which prehistorians today call the Grotte du Renne. It's even possible that the parents buried their baby in mourning.

Time travel: At the Max Planck Institute for Evolutionary Anthropology in Leipzig, the Human Evolution Department headed by Jean-Jacques Hublin conducts research into human prehistory, or paleoanthropology. Postdoc Frido Welker prepares bone fragments, some of them splinters, from the Grotte du Renne. All the experts had previously considered such fragments to be useless – or more accurately, paleoanthropologists such as Welker had no procedures for extracting insights from such damaged witnesses of prehistory.

Thanks to a method known as paleoproteomics, this has now changed. This method can detect even the minutest traces of proteins in ancient bone material and reveal information about the identity of the living being from which it stems – a "fairly revolutionary method," says Jean-Jacques Hublin. Proteins survive ten times longer than DNA in ancient bone material. Examination of the genome was previously regarded as the standard method of assigning a bone to a certain animal. Paleoproteomics could take over this mantle from DNA analysis. "The proteins of Stone Age bones contain valuable information on the evolutionary relationships and lifestyles of these people," Welker explains.

It was thus determined that the baby from the Grotte du Renne was a

Underestimated artists: Neanderthals were long thought to have lacked the ability to make jewelry. Scientists at the Max Planck Institute for Evolutionary Anthropology have been able to establish beyond doubt that these items of jewelry made from teeth, ivory and fossil shells were used by Neanderthals.

little Neanderthal, not even weaned, perhaps six months to two years old on the day it died 44,000 to 40,000 years ago. Its meager remains shed more light than ever before on a decades-long dispute among paleoanthropological experts. This genre of research is marked by sometimes heated debate. On the question, for example, of how Neanderthals and "modern man" – meaning you and me – encountered each other in Europe roughly 45,000 years ago. Following the latest high-tech analyses carried out by his team, Jean-Jacques Hublin is convinced that "there was a cultural transfer between the two hominins. It was only when *Homo sapiens* arrived that the Neanderthals suddenly began to do things they had never done before."

The Leipzig-based scientist assumes that this exchange "didn't require any particularly intensive contact." Let alone any love affair between *Homo sapiens* and *Homo neanderthalensis*, as was widely circulated in recent years. "Too many stories are being invented," says the Frenchman quite profanely. "It's highly likely that the truth was anything but romantic."

The witnesses to this past dating back tens of millennia – bones, teeth and cultural objects such as tools and jewelry – are limited and often lead to acrimonious discussions. "Of course that bothers me," says Hublin. "We would be well advised to distinguish between fact and fiction."

THERE WERE ALMOST NO HUMANS IN THE STONE AGE

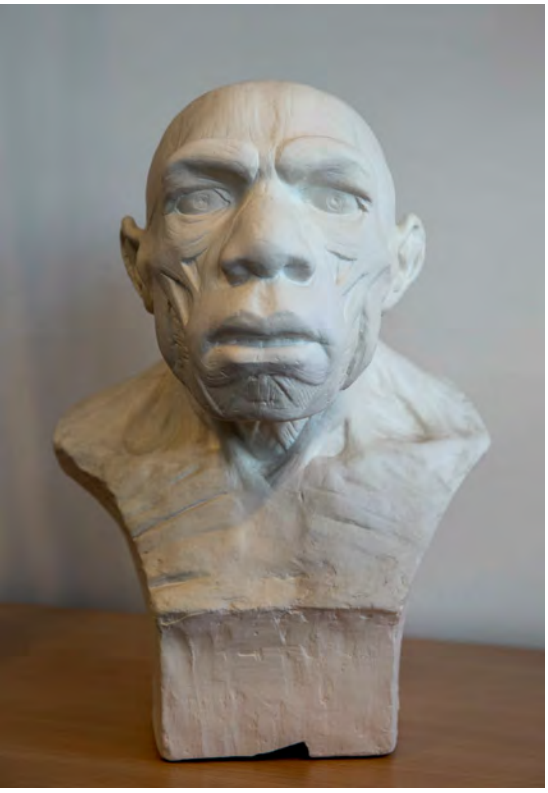
So let's take a look at the sapiens-Neanderthals case – one of the Max Planck scientist's specialist areas – in this light. Ever since the first bones of this hominin were discovered in the Neander Valley near Düsseldorf in 1856, legends have been woven around his existence – primarily because he looks so different from modern man.

With a height of no more than 1.70 meters, he wasn't particularly tall, but his physique was strong and powerful, with a very wide chest, the males weighing up to 90 kilos. "Very impressive," says Jean-Jacques Hublin as he gazes at the sculpture of a Neanderthal head in his office. It was fashioned at the beginning of the 20th century, but is still essentially in line with current knowledge. This means that the face is long and projected forward, with striking ridges over the eyebrows, while the nose is voluminous, the jaw massive and the chin area receding. "If you were to meet a Neanderthal in the train," the paleoanthropologist explains, "you'd change compartments."

Even 45,000 years ago, it must have been a highly unusual event when representatives of modern man, *Homo sapiens*, first came across members of *Homo neanderthalensis* in the forests and prairies of Europe. "For both sides," Hublin says with a laugh. According to the results of recent studies, the Neanderthals could already look back on at least 400,000 years on the continent – in an area ranging from Spain to the Russian Altai Mountains and up to the latitudes of northern Germany.

As hunters and gatherers, they most likely wandered across stretches of land measuring many thousands of square kilometers in groups number-

Photo: M. Hardy/MPI for Evolutionary Anthropology



Early settlers: Neanderthals – here an absolutely realistic bust from the 1910s – are estimated to have lived in Europe for 400,000 years before modern man arrived around 45,000 years ago. Both used the Grotte du Renne (right).

Photo: Anna Schroll (left), MPI for Evolutionary Anthropology (right)

ing no more than 50 to 60 men and women. They were able to kill even large animals such as bison and horses with great efficiency. They also consumed plants and vegetables to a much greater extent than previously believed. And Neanderthals probably lived at a faster pace. Hublin's team determined the age of a Neanderthal child from wafer-thin layers of enamel on its teeth. This showed that the children of this hominin matured one to two years earlier than the offspring of modern humans.

Their winters were brutal and long. It's likely that many of their small groups simply died out in long starvation phases and were replaced by new members. Even in times of their widest distribution, there were probably no more than an estimated 10,000 "Neanderthal Europeans." "The Stone Age was an empty world," Hublin says. According to the latest studies, Neanderthals faced this lonely existence with mental faculties that were almost as sophisticated as those of their cousins and (future) competitors. "They were more complex than we had long assumed," the researcher concedes. He then adds: "Both hominins were almost identical at this time in terms of their cognitive powers, definitely not apelike, but also not like us."

HOMO SAPIENS BROUGHT WITH THEM A SUPERIOR MIND

From a technical standpoint, Neanderthals were definitely skilled, as evidenced by the intricate spears they made in their earliest days. They even developed a tool culture roughly 120,000 years ago – or "industry" as paleoanthropologists say – which characterized a period: the Mousterian. During this time, they produced tools such as arrow points, scrapers, scratchers and blades that were hewn from stones in a characteristic fashion. Explorers have found artifacts from this culture in many archaeological sites – for instance in the aforementioned Grotte du Renne in Burgundy.

The Neanderthals thus coped with the adverse conditions in Europe quite well. They would doubtless have survived for further tens of thousands of years if another species hadn't suddenly created a stir in Europe 45,000 years ago: modern man. The new arrivals were much more delicately built than the established species. More importantly, they brought with them a mind that was ultimately superior. *Homo sapiens* not only worked stones, but also made fishhooks from fish bones, fashioned jewelry from bones, snails and eggshells, and formed points for arrows and harpoons. No sooner had they arrived in Europe than they created their own industry – this period is referred to as the Aurignacian. It is typified by projectile points, made from ivory and bones, that at the time were the finest in hunting technology.

The oldest bones bearing testimony to modern man are found in northern Italy, and soon they were scouring areas east of the Rhine in Baden-Württ-

Dental growth: Tooth enamel – here seen in a digital 3-D model – can be used to show how quickly Neanderthal children developed. According to this evidence, they matured one to two years earlier than children of modern humans.

temberg, not far from the Grotte du Renne. Around 20,000 years ago, the roof of this cave collapsed, burying everything beneath it – a stroke of luck for archaeologists, who have been uncovering rich finds from the various layers of the buried cave for decades. The cave was clearly a popular place of refuge during the Stone Age. People were continually stopping by. Besides the Mousterian artifacts in the deeper, older excavation layers, archaeologists also discovered remains of the Aurignacian industry in the upper, more recent layers.

However, in an intermediate layer in the Grotte du Renne – and at further sites with deposits – relics of the Châtelperronian (CP) culture were found. Many rings, pendants and clasps of ivory, antlers and other materials were found in the 1950s. Earrings; decorative pendants made from perforated, grooved teeth; fossils; and so on. Points or knives with a rounded, blunted back are also very typical. These elaborately worked utensils are occasionally strongly reminiscent of the subsequent Aurignacian industry of *Homo sapiens*. And not of the Neanderthals.

Drilling for samples: Proteins in bone fragments can be used to determine which creatures the remains stem from. To do this, small quantities of bone material are first extracted from the find.

At the same time, however, easily identifiable remains of bones and teeth were found in the CP layer of the Grotte du Renne – from Neanderthals, as a study from the 1990s suggested. But this sparked renewed debate. In 2010, British researchers believed they had proved that there were age differences between the various finds from the Châtelperronian layer. According to their interpretation, the jewelry had been made by modern man and only subsequently mixed up with the Neanderthal relics when the lower layers were dug up.

Jean-Jacques Hublin was disinclined to believe this, and together with international partners he embarked on a series of year-long tests. First, his team selected 40 well-preserved bone samples from the Grotte du Renne – mostly from areas containing CP jewelry or Neanderthal remains, and less frequently from Mousterian or Aurignacian layers. In addition, the researchers examined the shinbone of a Neanderthal from a different, well-known French excavation site in Saint-Césaire.

The scientists extracted collagen from the bone samples, an organic component of the connective tissue that consists of protein chains. Then came the hour of modern analytical equipment. “I’m obsessed with technology,” Hublin says, smiling. Half a dozen of the latest mass spectrometers can be found in his department – both high-tech scales that measure the mass of atoms and molecules, and accelerator mass spectrometers that can deter-

Photos: MPI for Evolutionary Anthropology (top), Anna Schroll (bottom)

mine the exact age of bones, for instance, by using the decay of radioactive carbon isotopes in molecules.

NEANDERTHALS ADOPTED MANY INNOVATIONS

The extensive analyses showed that the samples from the Châtelperronian layers are between 41,000 and 35,500 years old and therefore must indeed be assigned to this culture. In addition, the ages of the Châtelperronian finds didn't overlap with the finds from other layers, thus ruling out any mixing of the sediments. With an age of 41,500 years, the Neanderthal skeleton from Saint-Césaire also fits into the picture perfectly.

Neanderthals could thus also have created the CP industries in France. Could have! But there was still a lack of unambiguous evidence that the bones from the CP layer in the Grotte du Renne once belonged to Neanderthals – and not to modern humans.

The team working with Hublin therefore applied relatively new methods within paleoanthropology in its study: peptide mass fingerprinting and shotgun proteomics, methods borrowed from the field of proteomics. They demonstrated for the first time that their methods can be used to determine whether proteins in a bone

Photo: Anna Schroll

The bone material can be analyzed using mass spectrometry to determine its origins. Frido Welker prepares the samples in the laboratory for this purpose.

come from a Neanderthal or from a modern human. Tiny bone samples suffice for the test, and this is the aspect that is crucial and new. It is also the precise reason why the scientists were able, for the first time, to conduct a molecular analysis of 28 bone fragments from a layer of sediment attributed to the Châtelperronian period.

"They come from Neanderthals," says Frido Welker. By combining the paleoproteomic analysis with paleogenetics, it was ultimately clear that the bone fragments were those of an infant from the Châtelperronian period. "Our study shows that with paleoproteomics alone, it is possible to differentiate between different Early Stone Age groups within our Homo genus," says Welker.

The big question overshadowing the studies is: How did *Homo sapiens* get along with *Homo neanderthalensis*? The new finds can be interpreted in different ways. One could take them to mean that Neanderthals independently made an unexpected leap forward in their development just as *Homo sapiens* spread across Europe. "But that would border on a miracle," says Jean-Jacques Hublin. For him, it is far more likely "that the two hominins came into contact and the Neanderthals adopted some of the innovations of modern man."

The Neanderthals could have conceivably found tools and jewelry made by *Homo sapiens* – and then copied and, in time, introduced them to neighboring groups. They were likely intelligent enough to do so. Perhaps a well-meaning, modern human showed them how to make these wonderful articles. There were conceivably barter transactions between the groups. Who knows? Now we are back in the realm of ever-popular legends. And Jean-Jacques Hublin again urges caution.

TWO PERCENT OF OUR DNA COMES FROM THE NEANDERTHALS

The transfer of cultural innovations didn't require constant contact, much less close friendship. Modern man, too, had to master the harsh life of the hunters and gatherers, and competed with his contemporaries in the other species for territory and food. Even if there were only dozens or a few hundred groups that seldom encountered each other in the empty world of the Stone Age, most meetings of these contemporaries are more likely to have been unfriendly if not even hostile, aggressive and violent.

Admittedly, there is no concrete proof that this was the case. Nevertheless, we know that encounters between competing tribes seldom went smoothly in human history. It is therefore

Although the inner ear and middle ear ossicle of the Neanderthals are built differently than ours, both work in a similar way. This points to similarities in the sense of balance and the use of sound for communication.

Photo: Anna Schroll (top), MPI for Evolutionary Anthropology (bottom)

Left Focus on the facts in futuristic surroundings: Jean-Jacques Hublin takes a critical view when research and fiction are combined – for instance in the claim that there were love relationships between modern man and Neanderthals. Hublin suspects that encounters between the two were more likely to have been unfriendly.

highly likely that things would have been no different when *Homo sapiens* and Neanderthals met.

It's also possible that the females of the competing group were stolen in the process. So it may not have been fiery romances that led to sex between the parties, but acts of violence. They have left demonstrable traces to this day, as researchers have known for years. Around 2 percent of the DNA in our genome today stems from the Neanderthals – a limited but long-lasting legacy of this long-extinct hominin.

The earth has revealed evidence of the last Neanderthals in layers that are 40,000 or perhaps 38,000 years old. At some point during this period, the last of their species disappeared. "Because of us," says Jean-Jacques Hublin laconically. From a purely molecular standpoint, the differences between modern humans and Neanderthals are small: a mere 87 proteins separate the two species. Many of them, however, are important for brain function and development.

Something in modern man was different. It's possible he took a more aggressive approach than his related competitors; he probably cooperated more effectively in larger teams and in multiple groups, also showing more empathy and consideration for fellow members.

Experts have found some indications that this was the case. First, modern humans apparently bartered even in the early stages of their time in Europe. For example, shells from the Mediterranean have been found in Germany. "That suggests networks operating over large areas," says Hublin. "People knew that fellow humans were living on the other side of the mountains." And that they wear jewelry and decorate their bodies as a sign of their allegiance to a larger community consisting of hundreds or perhaps thousands. People who act in solidarity even if they don't see each other every day. There's nothing like this in the world of the Neanderthals.

HOMO SAPIENS PAINTED IMAGES FROM THEIR IMAGINATION

Second, Homo sapiens painted on cave walls in the early stages of their early European existence, also representing objects that didn't exist in reality, but only in their imagination. Men with lion heads, for instance. This means that, behind the objects, modern man recognized stories, mythical elements and faith. "This is a very strong factor that the Neanderthals apparently had no sense of," Hublin says.

Things of this nature are "difficult to investigate," even with the battery of equipment on hand at the Max Planck Institute in Leipzig. Just how much this frustrates the tech fan is noticeable. But who knows? Forty years ago, when he began his career as a young student, Hublin believed that all the essential elements of human history had already been researched, and that methodology wouldn't make any further significant progress: "I couldn't have been more mistaken." ◀

TO THE POINT

- **Neanderthals had similar cognitive abilities to *Homo sapiens* in the Stone Age.**
- **For example, they adopted the tool-making techniques of newly arrived modern man.**
- **The superiority of *Homo sapiens* probably consisted in their ability to form networks over large distances and to use artistic and mythical elements to reinforce the group.**

GLOSSARY

Paleoproteomics: Identification of prehistoric finds by means of protein analyses, for example in bone fragments.

(Tool) industries: Stone Age cultures characterized by certain tools – in some cases also jewelry and works of art – and the production techniques used.

Mousterian: The Neanderthal tool culture, marked by arrow points, scrapers and blades hewn from stone in a characteristic fashion.

Aurignacian: A culture that coincides with the appearance of modern man in Europe. Typified by projectile points of bone and ivory, long, narrow flint blades, and the first miniature works of art.

Châtelperronian: The last culture with which the Neanderthals are associated. It overlaps in time with the older Aurignacian and is characterized by bone, antler and ivory tools as well as jewelry.