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# Summary report on the mummified glacier corpse found at Hauslabjoch in the Ötztal Alps

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*Key words:* Mummy, neolithic, Ötztal Alps, glacier, archaeology, radiocarbon dating, prehistoric equipment, man in the ice, palaeopathology

## ZUSAMMENFASSUNG

Die jungneolithische Mumie vom Hauslabjoch in den Ötztaler Alpen wurde am 19. September 1991 gegen 13.30 Uhr von Touristen entdeckt und vier Tage später in offiziellem Auftrag von dem Innsbrucker Gerichtsmediziner Prof. Dr. Rainer Henn geborgen. Archäologen wurden erst einen Tag später hinzugezogen. Die langwierigen Recherchen zur Fundgeschichte ermöglichen nun eine in sich stimmige Rekonstruktion des archäologischen Befundes.

Die Mumie lagert zur Zeit im Anatomischen Institut der Universität Innsbruck unter simulierten Gletscherbedingungen (–6 °C, 96–98% Luftfeuchtigkeit, steril, Abdunklung). Rund 40 internationale Teams unter Leitung des Innsbrucker Anatomen Prof. Dr. Werner Platzer sind an den Untersuchungen beteiligt. Erste Forschungsergebnisse liegen u. a. für folgende Fachgebiete vor: Paläopathologie, Anatomie, Parasitologie, Tätowierungen, Schädelrekonstruktion, Morphologie, Untersuchungen der DNA, Spurenelementanalysen, klassische Anthropologie, Pilzbefall, Photogrammetrie, Röntgenologie und Muskelfunktionen.

Die den Gletscherfund betreffenden archäologischen Untersuchungen werden von Prof. Dr. Konrad Spindler koordiniert. Die Beifunde befinden sich zur Zeit noch in der Restaurierung im Römisch-Germanischen Zentralmuseum in Mainz. Nach Abschluss dieser Arbeiten kommen sie nach Innsbruck zur wissenschaftlichen Untersuchung. Im einzelnen handelt es sich u. a. um folgende Gegenstände:

Kleidung	Gürtel mit Tasche, Schuhe, Leggings, Lendenschurz, Pelzmantel, Grasmantel, Mütze
Waffen	Bogen mit Bastsehne, Köcher mit Pfeilen, Beil mit Kupferklinge
Geräte	Knochenahle, Dolch mit Scheide, drei Feuersteinwerkzeuge, Schlagfeuerzeug, Hirschgeweihdorn
Behälter	Rückentragesack mit Gestell, zwei Birkenrindengefäße, davon eines als Gluttransporteur genutzt.
Ersatzmaterialien	Rohsehnen, Lederriemen, Hirschgeweihspäne
Schmuck	Troddel mit Marmorperle
Proviand	Steinbockfleisch (?), Schlehfrucht

Einzelne der vom Gletschermann mitgeführten Gegenstände befinden sich in unfertigem Zustand oder sind bereits in antiker Zeit erheblich beschädigt worden. Dies führt zur Theorie eines Desasters oder einer gewalttätigen Auseinandersetzung, die der Eismann kurz vor seinem Tod durchlitt. Er war 25–40 Jahre alt, männlich und 1,60 m hoch. Nach C<sup>14</sup>-Analysen ist er mit ~3200 Jahren v. Chr. datiert.

Archäologische Prospektionen (Leitung: Dr. Walter Leitner) im hinteren Ötztal führten zur Entdeckung einer steinzeitlichen Jäger- und/oder Hirtenstation, die die Anwesenheit des vorgeschichtlichen Menschen in der Region bestätigt.

Des weiteren gelang es im Rahmen systematischer Geländebegehungen (Leitung: Dipl. Geol. Alexander Binsteiner), das neolithische Feuersteinbergwerk, aus dem die Silexgeräte des Gletschermannes stammen, wieder aufzufinden.

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Fig. 1. The rock gully at Hauslabjoch where the Iceman was found during the archaeological follow-up on 10 August 1992 (Photo by W. Leitner).

### Discovery

The Man in the Ice was discovered on 19 September 1991 just before 1.30 p.m. and was recovered four days later under dramatic circumstances. The corpse was found approximately 300 meters below Hauslabjoch and about 80 meters from the line of the main Alpine ridge in an unnamed rock gully that drains to the north into the river Inn (Fig. 1). A geodetic survey of the site performed on 1 October 1991 showed that it is located exactly 92,56 meters from the border between Italy and Austria on the territory of the Autonomous Province of Bolzano/South Tyrol. The authorities of the Italian province therefore have title to the finds. Scientific investigation of the discovery, on the other hand, is centered on the University of Innsbruck, which is also the regional university for South Tyrol. A contract has been signed between the university and the South Tyrolean provincial government to this effect.

As a consequence of the prevailing climatic conditions in recent years, the process of glacial retreat had reached a new peak in September 1991. The glacier, which had covered the rock gully where the find was made with meters of ice only a few decades before, had melted away leaving just a 60–80 cm thick ice core at the bottom of the gully. About three days prior to discovery, the ice melt had started to release the corpse (Fig. 2). Had it not then been discovered, it would have been concealed again six days later by the first fall of winter snow and would presumably have gone undetected for all time, as about seven meters of snow fell on Hauslabjoch during the following winter, and the snow cover did not melt completely in the summer of 1992.



Fig. 2. The head and shoulders of the human mummy emerging from the glacial ice as discovered towards 1.30 p.m. on 19 September 1991 (Photo by H. Simon).

The site of the find is located in the permafrost of the High Alps at an altitude of 3210 meters above sea-level. The ice trapped in the gully, which has an approximately east-west axis running perpendicular to the line of slope, had remained more or less motionless over the centuries so that the corpse was not carried along by the downhill flow of the glacier. That explains the outstanding state of preservation of the mummy. Otherwise the body would have been subjected to the shearing forces of the moving ice and possibly crushed and ground to particles as has been the case with other glacier corpses. Even the location in the hollow of the gully, however, was not completely unaffected by basal ice movement that occurred in the course of time as a result of ice flow over the top of the dip. This movement in the ice appears to have affected the position in which the Iceman was lying. Having died in what was presumably a natural left-sided sleeping position, his body was rotated by the movement of the ice through about 90 degrees into a prone position. This caused displacement of the soft tissues of the face and also pulled the upper body over and across the left arm, leading to the unnatural position of the left arm when discovered.

### **Preservation of the Man in the Ice**

There is evidence to suggest that the Iceman died during the first snowfalls of winter. One important indicator is a sloe he was carrying, a fruit that ripens at the end of September or beginning of October and needs to freeze in the first frost to be made more or less edible. The Iceman must have been covered by fresh snow the night he died. Otherwise his body would certainly have been discovered and attacked by carrion-eaters, particularly vultures, eagles and ravens, whereas insects can be ruled out at that time of year.

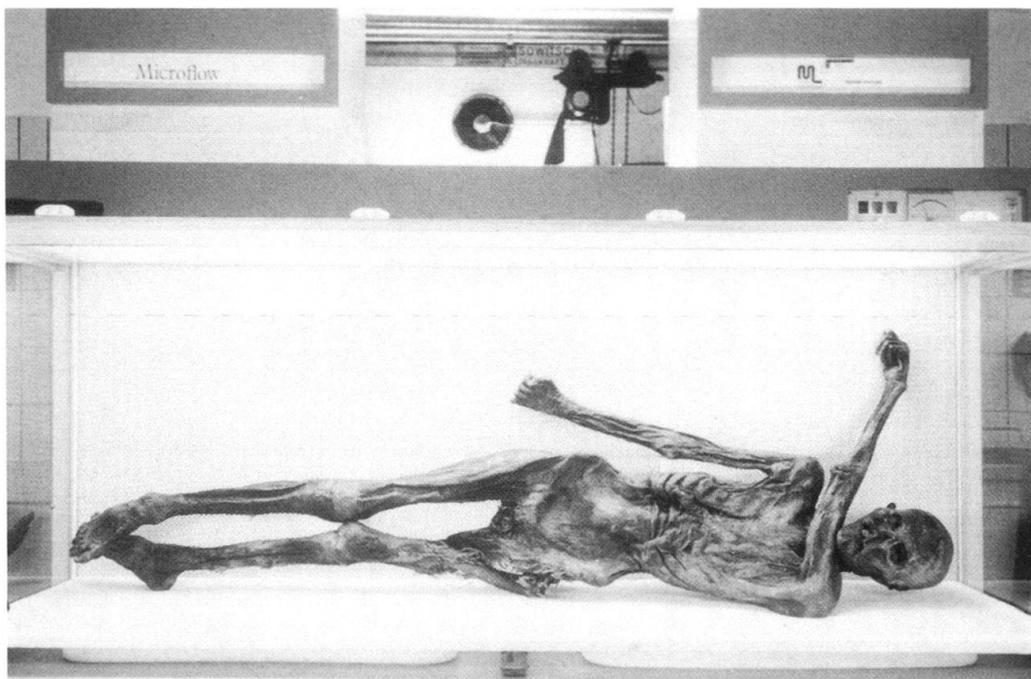


Fig. 3. Anterior view of the Iceman in a micro-flow box at Innsbruck University's Department of Anatomy (Photo by H. Maurer).

Dry cold snow remains permeable to air for about 10 to 15 years, during which a kind of freeze-drying process must have led to mummification of the body. The resulting dehydration of the soft tissues reduced the Iceman's body weight to 13.03 kilograms, and today the appearance of the mummy resembles a tube of skin pulled tight over the skeleton. (Fig. 3).

At the present time the causal chain leading to death can only be surmised. It is reasonable to assume death by freezing in a state of total exhaustion and hunger. No intravital or perimortal traces of violence can be detected.

The lesion to the soft tissues at the back of the head – the highest point of the body as it lay in the ice – is thought to be the result of recent decay caused by the hot weather conditions prevailing in September 1991 when the ice melt released the corpse.

The severe injuries inflicted in the area of the left hip and the left leg and extending to below the knee were caused by the use of a pneumatic drill in an attempt to recover the body on the day after discovery.

Minor epidermal decay that occurred during the process of mummification presumably caused the Iceman's hair and nails to fall out. Three nails and numerous human hairs have been identified from among the finds. It has been concluded that the Man in the Ice had dark-brown to blackish, slightly wavy and approximately shoulder-length hair and presumably a beard.

When alive the Iceman was about 160.5 cm tall. He was between 25 and 40 years old, probably closer to 40 than to 25. Anatomical examination of the genitals of the corpse identified the penis and scrotum, and thus provided definitive proof of the sex of the

body. Minor lesions, apparently caused during recovery, were observed in the lower portion of the scrotal skin.

The Iceman has a number of skin markings in various places. Two parallel lines around the left wrist must have been caused by the pressure on the skin exerted by cords wrapped round the wrist. All the other markings are tattoos, probably made with powdered charcoal as the pigment. The tattoos are in the form of sets of stripes or crosses on both sides of the lumbar spine, the right knee, the calves and ankles. The location of the tattoos matches the X-ray findings of discrete to medium arthrotic changes in the corresponding joints. It therefore seems reasonable to assume that the markings were applied for a therapeutic reason.

Further X-ray examination and CT scans produced the following findings.

- The fracture of the left humerus must be a recent lesion. That interpretation is supported by the report from the undertaker's responsible for transporting the corpse to Innsbruck, according to which a clear cracking sound was heard when an attempt was made to bend the protruding arm to fit the body into the coffin.
- Similarly the fractures of the (frozen) brain are thought to be the result of unsuccessful recovery procedures.
- A number of fissures, fractures and deformation of the skull can be attributed to basal ice movement at the bottom of the rock gully and the pressure of the ice mass. The presence of a facial depression extending medially makes it impossible to produce a reliable reconstruction of the Iceman's original appearance at the present time. A serious attempt to achieve such a result will only be feasible on the basis of computer calculations needed to compensate for the deformations, and even then it will be difficult.
- The vascular network at the base of the brain shows a slight hardening of the arteries.
- An old fracture of the nasal bone had healed during the Iceman's lifetime leaving the bone dislocated medially by almost ninety degrees.
- The sixth and seventh right ribs are fractured. There is no callus formation. The trauma was therefore sustained shortly before death and did not have time to heal.
- On the left side, on the other hand, serial rib fractures can be seen which had healed well. The Iceman therefore had some experience with broken ribs.
- The twelfth ribs are absent on both sides. That is a rare variant of the human thorax, but it in no way hindered the Iceman and would not have been noticed.
- The Iceman was suffering from arthrosis of the right hip of medium severity.
- Osteolysis of the little toe is indicative of frostbite. The absence of bony reactions suggest that the Man in the Ice had suffered frostbite in the last winter before his death at the most.

### **Age of the mummy**

The combination of thickening of the arteries, attrition of the joints, the healed fractures and frostbite lesions illustrate the hard life to be endured by the Man from Hauslabjoch and by Late Stone Age man in general.

Radiocarbon dating performed at five different laboratories and producing nine date sets (Oxford GB, Uppsala S, Paris F, Zurich CH, Cambridge USA) yielded highly consistent results for the various finds in the form of three closely bunched time periods:

3352–3300 BC cal with a probability of 31%

3235–3175 BC cal with a probability of 36%

3166–3108 BC cal with a probability of 33%

The Man in the Ice can accordingly be assigned to the Late Neolithic culture. For the region to the north of the main Alpine chain the C<sup>14</sup>- dating corresponds to the transition from the Altheim to the Cham culture and for the south of the Alps to an early phase of the upper Italian Remedello culture. In addition to the usual Late Stone Age phenomena, all three cultural groups had access to a highly developed copper technology. Archaeological analysis of the finds from Hauslabjoch, however, indicate closer affinities with the south. The area of Val Venosta in South Tyrol as the Iceman's «base» would therefore be the hypothesis of choice.

### **Clothing and equipment**

The Iceman's possessions comprised clothing, weapons, utensils, tools, containers, replacement materials, ornaments and provisions. A number of the artefacts are multifunctional, like the axe, which served as both a tool and a weapon.

The Iceman's clothing was of good workmanship and highly functional and in general represents a most impressive find. The individual items of dress were mostly made of small to medium size pieces of fur and leather sewn together in a patchwork style. As the first ever find of Neolithic garments that are either complete or at least permit reconstruction of the originals, it has extended our knowledge of European costume history back into the past by more than 1500 years. This is not to say, however, that we are now familiar with Neolithic dress in general. It may be that the Iceman's garments were specially made for a certain purpose and to cope with specific conditions. The fine threads used to sew the clothes were mainly twisted from animal sinew, while threads produced from animal hair (wool?) and grass were employed for repair work. Whipstitching was used as the principle sewing technique.

- The Iceman had a narrow belt made of calf leather which was worn wrapped twice around the waist. A pouch (with contents) was sewn onto the front of the belt.
- The belt was also used to attach the straps holding up leggings made of goatskin. Sewn onto the bottom of each legging is a tongue of deerskin that was inserted into the neck of the shoes and tied in.
- The soles of the shoes are made of bearskin and the uppers of deerskin. The low shafts had grass cords wrapped round them. Inside each shoe is a net knotted from grass cords, which served to prevent the grass insulation layer from slipping (Fig. 4).
- The belt also supported a loincloth made of goat leather.
- The upper garment was a knee-length cape made of goatskin. A certain patterned effect was achieved by sewing vertical strips of light and dark fur together.
- The final outer garment was a second cape made of plaited grass with a loose-hanging fringe around the bottom.
- The hemispherical cap is made of bearskin. The chin strap has an old tear. (Fig. 5).

The Iceman's equipment includes an unfinished bow-stave made of yew. The superbly worked and fully functional axe has a knee-handle shaft, which is also made of yew, and a flanged copper blade lashed in place with strips of leather or hide. The Iceman carried a (poorly preserved) backpack. The frame comprises a hazel rod bent into a U-shape with two larchwood boards for the base. The pieces were lashed together with thick cords made of grass. The actual rucksack was made of fur.

The Iceman also carried two containers made of birch bark. One was used as an ember carrier, with fresh leaves of Norway maple for insulation. A wide-meshed net made of thin grass strings was possibly used for catching birds. The Iceman had a small dagger (Fig. 6) with a flint blade and a handle made of ash. The tip of the blade broke off during use but was not retouched. The dagger was in a finely plaited bast scabbard. The Iceman's utensils also included a retoucheur, which is made of a piece of lime-tree branch with a thin splinter of stag's antler with a rounded head driven firmly into the medullary canal. Among other things the pouch contained a number of tools, namely a bone awl and three flint implements: a scraper, a drill, and a thin razor-sharp blade. Traces of down found on the blade show that it was also used for shaping the feathers for the arrows. The contents of the pouch also included a large piece of true tinder fungus to which fine pyrites crystals from the firelighter adhered. Two pieces cut from the fruiting-body tissue of the birch fungus, with a hole drilled in the middle for threading on strips of fur, probably served medicinal purposes and can be interpreted as a kind of first-aid-kit. They may have been carried on a cord wrapped round the left wrist and this would explain the pressure marks to be seen there.

The quiver is a long narrow bag made of fur and reinforced along the side seam with a hazel rod (Fig. 7). It was seriously damaged during the Iceman's lifetime. The quiver

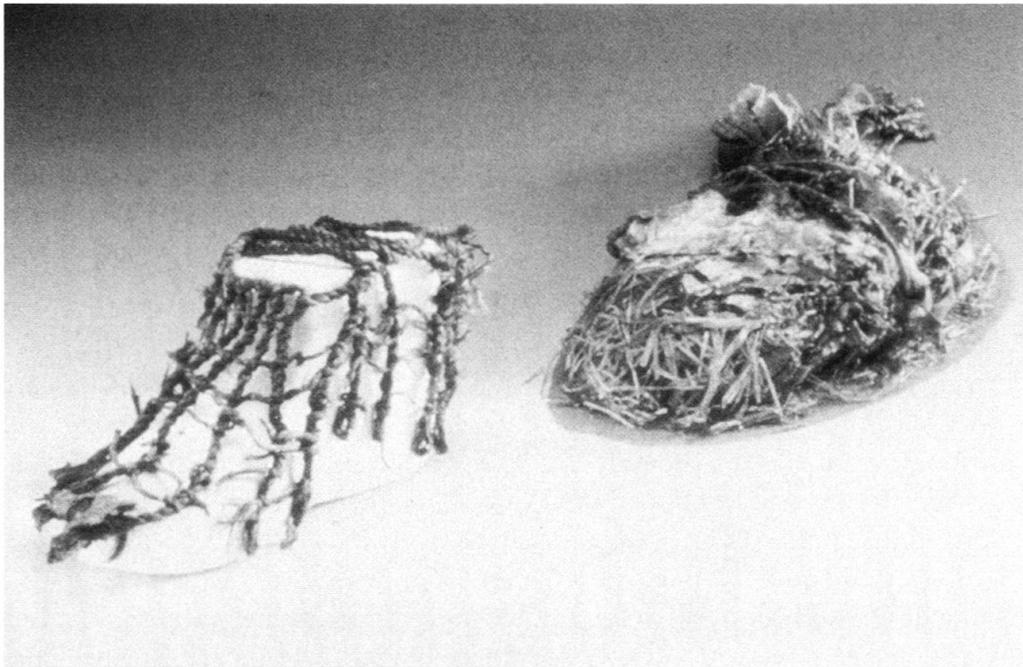


Fig. 4. Right shoe and inner netting of the left shoe following restoration (Photo by Römisch-Germanisches Zentralmuseum Mainz).



Fig. 5. Cap made of bearskin with chin strap (Photo by Römisch-Germanisches Zentralmuseum Mainz).

contained two primed arrows with flint points. Both arrows had been broken in several places. The triple radial flechting glued in place with birch tar comprises trimmed pieces of feather wrapped around with extremely fine threads for additional stability. The quiver also contained twelve unfinished arrow shafts, which had been stripped of bark and notched at one end to take the arrow heads. All the arrow shafts are made from shoots of the wayfaring tree except for the foreshaft of one of the two primed arrows (a composite arrow), which was made of wood from the cornel tree.

In addition to the arrows, the quiver contained the following items: a string, a spike, four stag antler fragments and two animal sinews. The string is a 1.9 to 2.1 meters length of bast cord in a bundle. It can be assumed to have been the Iceman's bowstring, which he had stowed in the quiver while he made himself a new bow. The spike is made from a piece of stag antler and was used among other things for skinning animals. The bundle of four stag antler fragments presumably served to make arrow heads. In the Late Stone Age flint was normally used for that purpose, but bone or stag antler were sometimes used as an alternative material when flint was not available. The two sinews are the

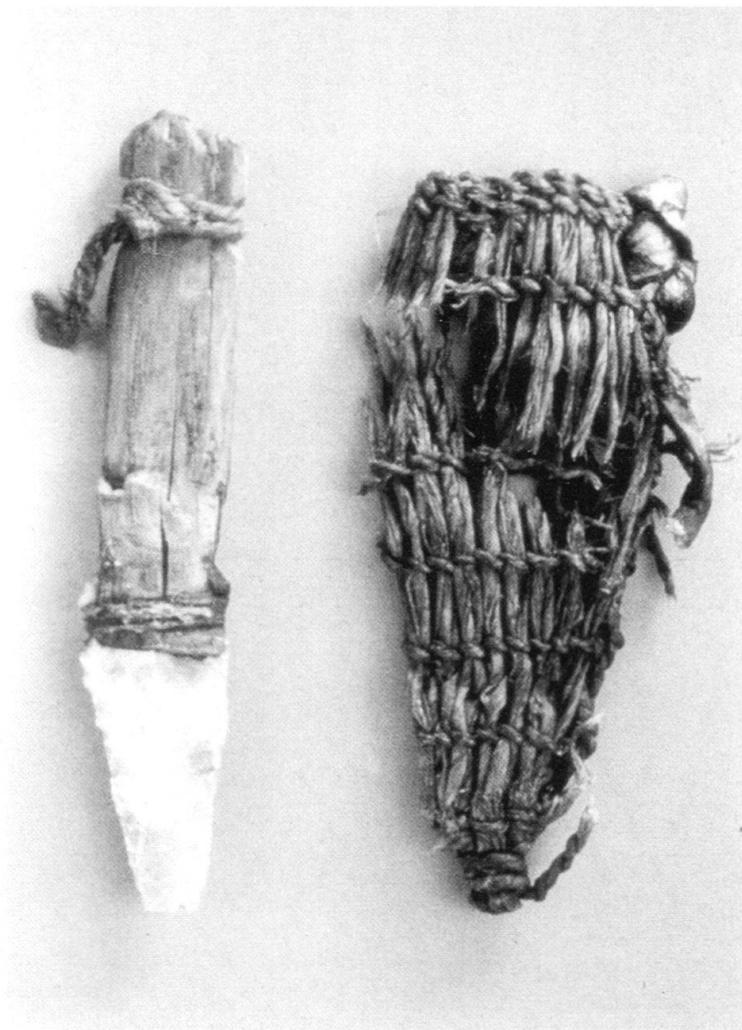


Fig. 6. Dagger and scabbard (Photo by Römisch-Germanisches Zentralmuseum Mainz).

Achilles tendons of an animal the size of a stag or cow. They were used for making threads that were the equal of modern nylon in terms of breaking strength.

The only ornament found is a white marble bead to which a tassel of twisted fur or leather tapes is tied. The bead must have been an amulet or had some similar apotropaic or magical function. The leather thongs could also be used for repair purposes.

In terms of clothing and equipment, the Iceman was prepared for life in the high mountain region. His weapons, tools and stock of replacement materials would permit him to survive away from his home village without regular supplies. Finds of threshing and winnowing fragments on the Iceman's clothing and in the ember carrier prove that, shortly before his death, he spent some time in a human settlement in which the grain crop had been harvested and threshed.

In spite of the turmoil of events surrounding the recovery of the corpse, it is clear that significant items of the Iceman's equipment were either in an extremely poor state or were missing, and that he was trying desperately to replace the most important of them, i.e. bow and arrows, as quickly as possible. It is likely that he was fleeing and that he was at-

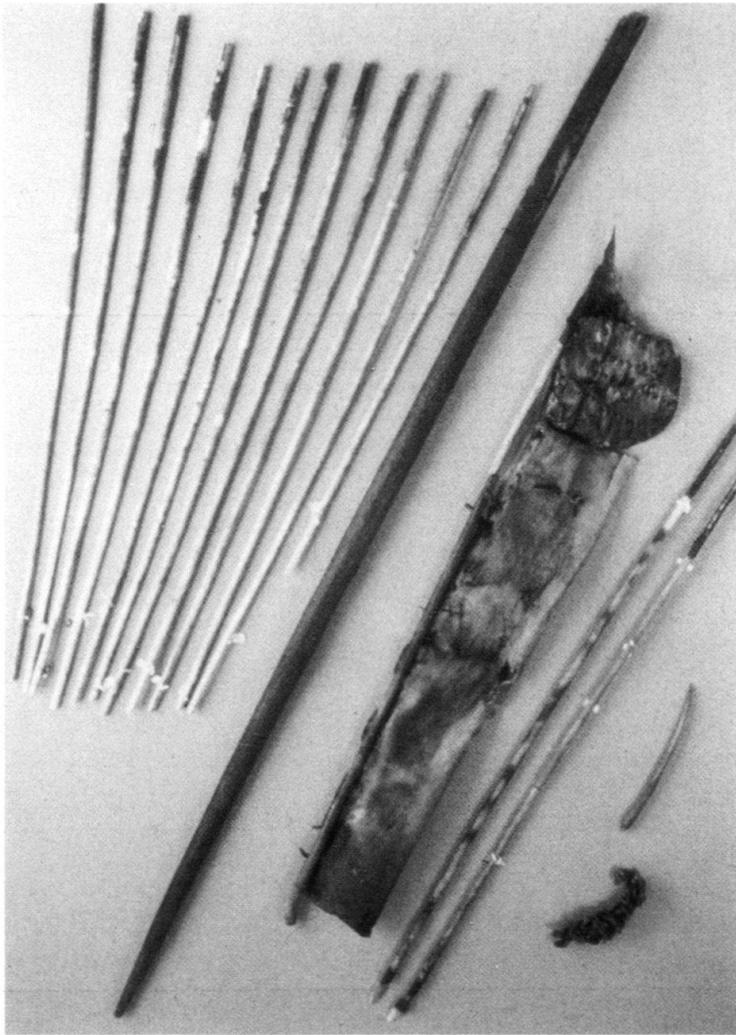


Fig. 7. The Iceman's bow, arrows and quiver (Photo by Römisch-Germanisches Zentralmuseum Mainz).

tempting to elude his pursuers by taking a route over the main Alpine chain. But why did he choose such a hostile high mountain region shortly before the onset of winter, handicapped as he was with unhealed fractures of the ribs?

Botanical investigations have shown that the alpine vegetation zones above the tree line (1900 to 2300 meters above sea-level) were used for pasturage by Late Stone Age man starting around 4000 BC. This form of migratory pasture farming or transhumance continues in the region to the present day, and the migratory movements involved have always originated in the Val Venosta and taken a route up the Val di Senales and over the main Alpine ridge to the extensive grazing lands of the upper Ötz Valley, where South Tyrolean farmers have grazing rights to this day.

As the Iceman was equipped with the weapons, utensils and replacement materials needed to survive away from his home base for a long period of time, it is reasonable to assume that he played a role in summer transhumance as a shepherd. The direction he selected for his flight would have taken him to an area with which he was familiar and where he hoped to escape his pursuers.

Archaeological fieldwork in the upper Ötz Valley conducted by members of our department has in fact led to the discovery of a Stone Age camp site at a height of over 2000 meters above sea level only 10 kilometers from Hauslabjoch, which is thought to have been a hunting camp and/or shepherds' mountain refuge. Perhaps such a refuge was the Iceman's goal when he was caught by an early snow storm and had to seek makeshift shelter on Hauslabjoch. The fact that he did not survive the onslaught of the forces of nature is not surprising in view of the fact that in 1993 – in spite of today's mountain rescue systems and modern equipment – 139 people paid with their lives the price of underestimating the risks of the high mountains in the Tyrol alone.

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