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Some Anthropological Aspects of the Prehistoric Tyrolean Ice Man

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The corpse of a Late Neolithic individual found in a glacier in Oetztal is unusual because of the intact nature of all body parts that resulted from the characteristics of its mummification process and its protected geographical position with regard to glacier flow. Anthropological data indicate that the man was 25 to 40 years old, was between 156 and 160 centimeters in stature, had a cranial capacity of between 1500 and 1560 cubic centimeters, and likely died of exhaustion.

In the autumn of 1991 a mummified corpse (known also as the "man from Hauslabjoch" or "the Similaun man") was found after having been released by glacier ice in the Tyrolean Oetztaler Alps. After a number of attempts by amateurs to remove the corpse it was recovered in a professional way by forensic experts from the University of Innsbruck, Austria. The original position of the corpse could therefore not be determined (*1*). Thereafter the corpse was stored and preserved in the Anatomy Department at the University of Innsbruck. The corpse is now under simulated glacial conditions at a relative humidity of 96 to 98% and a temperature of −6°C. Radiocarbon dating of the corpse conducted independently in Oxford and in Zurich have shown that the corpse is between 5200 and 5300 years old (*2*). In this report, we present anthropological results on the find that may be of general interest for further discussions and investigations. The morphometric and morphological investigations have required painstaking efforts in conservation. It is not possible to remove the mummy from its refrigerator for longer than 30 min because of the risk of deterioration that thawing would cause on structural features of the tissue. Considering the time necessary for preparation and maintenance, hardly 15 min remained for each examination. Our first examinations of morphological details therefore have been carried out only to a small degree on the corpse itself. For more extensive examinations (for example, analysis of metric data or the description of cranial sutures) three-dimensional reconstructions were made (*3*). For this we used two lines of approach: One was the measurement and examination of rotated computer tomography (CT) sectional pictures. The other involved plastic reconstruction of the skull (Fig. 1).

Because of their special interest for physical anthropologists, we have included a selection of some metric characters of the skull (Table 1). These measurements demonstrate that the morphological characteristics of the "man in ice" are well within the measurement ranges of Late Neolithic and Bronze Age populations as have been described in the literature (*4*, *5*). Note the hyperorthognate facial form expressed in the facial and alveolar angles of the profile. The estimation of cranial capacity according to different estimates of multiple analysis regressions was between 1500 and 1560 cm^3 (*6*, *7*) (Table 2).

The measured stature of the "man in ice" also ranges within the known variation of Neolithic populations as have been described from Italy and Switzerland (*8*). During one of the earlier attempts to recover the mummy, a pneumatic drill was used to partially extract the corpse out of ice. Severe damage occurred in the left pelvic region, and the caput femoris was set free. From the isolated caput femoris the physiologic length of the femur was measured and used for the estimation of the body stature. This measurement of the extremities and several sections of the rump of the corpse with a measuring tape showed that the bodily stature was between 156 and 160 cm. The estimates arrived at by regression (*9*) correspond to the stature that was arrived at by direct measurement (158 cm).

An estimation of the age at death is based on the degree of wear of the front teeth. The remarkably strong degree of abrasion indicates an age of between 35 and 40 years. Sometimes, however, an extreme-

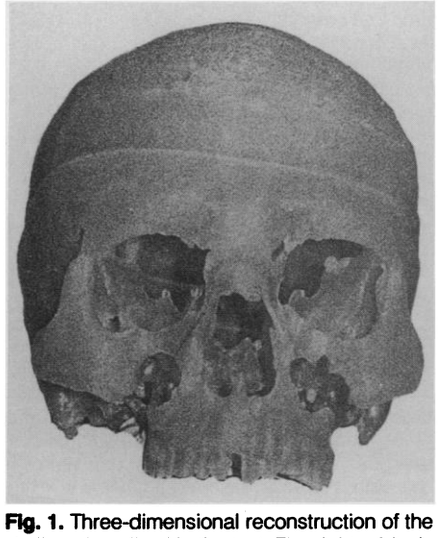

Fig. 1. Three-dimensional reconstruction of the skull as described in the text. The right orbita is slightly displaced; the medial trema is easily recognizable.

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ly high degree of tooth abrasion can be found in juvenile individuals from Late Neolithic and Bronze Age finds. The type of dental occlusion found is an edge-to-edge bite for the anterior teeth. This labiodontal form of biting necessarily causes a stronger degree of wear. The external surfaces of cranial sutures visible in the CT also allowed an age estimation: the sutures were closed but not obliterated. In the following sections there were no signs of obliteration: sutura coronaris: C1, C2, and C3; sutura sagittalis: S1, S2, and S4; and sections of the sutura lambdoidea. The sagittal region S3 was possibly obliterated. The degree of suture closure may therefore indicate an age of 25 to 30 years. But because of the uncertainty of the method, and taking age variation of the wear of the front teeth into account, we define the age at death conservatively as 25 to 40 years.

Table 1. Skull measurements; values in parentheses are estimates due to uncertainty of reference points.

Measurement	Value (mm)
Maximum cranial length	187
Maximum cranial breadth (parietal)	141
Facial height	115
Minimum frontal breadth	99
Foraminal length	40
Nasal height	46
Orbital height (left)	31
Bigonial breadth	95
Maximum horizontal perimeter	533
Median sagittal arc	384
Frontal arc	132
Parietal chord	(119)
Alveolar profile angle	97
Basi-bregmatic height	143
Maximum cranial breadth (ossa temporalia)	145
Upper facial height	64
Bizygomatic breadth	132
Foraminal breadth	33
Nasal breadth	24
Orbital breadth (left)	43
Mastoidal width	105
Transverse perimeter	321
Median-sagittal-parietal arc	(133)
Frontal chord	114
Occipital chord	99
Face profile angle	97

As previously mentioned, the exact position of the mummy could not be reconstructed. This information would have been very helpful in determining the particular cause of death. Nevertheless, the circumstances of the find indicate that the man ascended the Oetztaler Alps up to 3200 m and froze to death with subsequent mummification in a relatively unprotected, small shallow trench approximately 20 m long and 6 m wide. Mummification (dehydration) must have taken place before the man became enclosed in ice. The reason for this is that normal glacier corpses that have been salvaged out of crevasses display typical transformation of the body tissues into white grave wax (adipocere). A hypothesis for the cause of death is possible when one considers the morphology of the ears (Figs. 2 and 3). The left folding line is strikingly straight and shows no signs of subsequent deformations or damages. The fold would have been possible only if one assumes that the individual lay on his left side, with his head resting on a somewhat raised, rough, hard support. A further indication for this position is the numerous small impressions in the skin tissue around the left frontal temporal region that are not present on the right side. In the CT picture the left tabula externa does not show any changes that indicate damage due to injury. Bearing this in mind and allowing for the necessary caution with regard to broad assumptions, we proposed that the Similaun man was in a state of exhaustion perhaps as a consequence of adverse weather conditions. He therefore may have laid down in a small depression, fallen asleep, and froze to death. In this state of complete exhaustion the folding of an auricle would have not been consciously experienced. We assume that he froze to death in the following position: lying on the left side with the left arm, muscles relaxed and elbow almost straightened, extended across the rump pointing slightly downward. The right arm also lay stretched out longitudinally close to the body and the legs were slightly spread.

The relatively slight deformations of the soft tissues of the body indicate that the "man in ice" was enclosed by ice for a long time in the exact position of death. These secondary deformations on the corpse are the result of the slight ice pressure due to the glacier flow in the valley. The following overall changes on the corpse resulted from this pressure. The left arm was moved upward to the right above the neck and the right shoulder, slowly and without massive tension. The upper lip was deformed upward to the right and shows a distinct trema

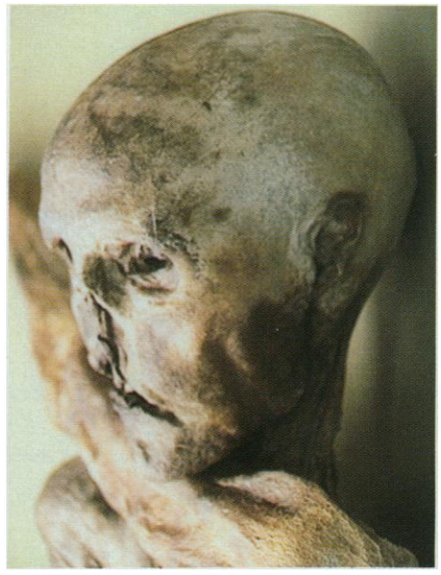

Fig. 2. Left profile. The left temporal region shows numerous small impressions in the skin tissue.

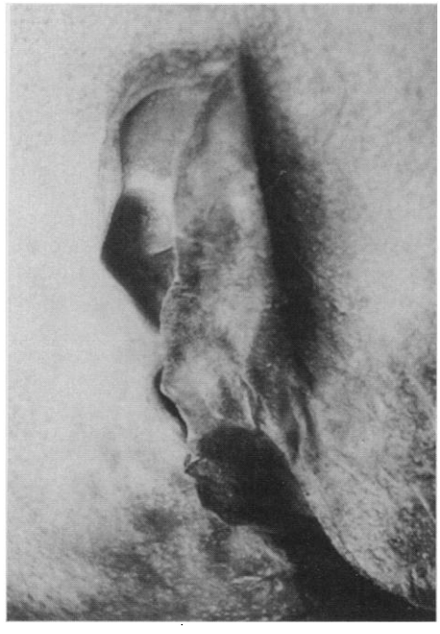

Fig. 3. Flexion of the left shell of the ear. The robust processus mastoideus is quite pronounced.

Table 2. Cranium capacities according to different calculations; Ref., reference.

Function	Capacity (cm^3)	Ref.
Maximum cranial length × 7.425 + maximum cranial breadth × 12.664 + 5.3 × basi-bregmatic height − 2410.4	1522	(*5*)
Transverse arc × 4.8 + maximum cranial length × 4.85 × foraminal breadth × 8.94 − nasal breadth × 8.9 × median-sagittal-parietal arc × 2.82 + mastoidal width × 3.59 + occipital chord × 3.22 − 2035.51	1564	(*6*)
Transverse arc × 6.09 − nasal breadth × 9.85 + maximum cranial length × 8.83 − 1847.02	1528	(*6*)
Transverse arc × 6.29 × maximum cranial length × 7.34 − 1888.72	1503	(*6*)

Fig. 4. Right profile. The upper lip and the soft part of the nose are deformed upwards as a result of slight ice pressures. In addition one can see the depression in the right ear.

(diastema) between the two central, maxillary incisors. Tremata of various forms are frequently found in prehistoric populations (*5*). Lastly, the nose was strongly pressed upward to the right. The ossa nasalia remained undamaged. All of these observations indicate the effects of relatively slight but nevertheless continuous ice pressure in one direction. The right os zygomaticum moved nearly 2 mm in the sutura frontozygomatica toward the occipit; the right orbit was slightly displaced (Fig. 1).

One remarkable peculiarity was found on the right earlobe. It is a pit-like, sharp-edged rectangular depression covered by skin that cannot have developed post-mortem (Fig. 4). The edges are remarkably straight. Inflammatory processes, whatever their etiology might have been, would have left other forms of scars. This find may have resulted from body ornamentation. In graves dating from the Bronze Age, rings have been found that could be considered as earrings. This was shown by an archeological analysis of contents of graves (*10*). The form of the pit-like depression on the right earlobe could therefore be taken as indicating that the man wore an ornamental stone that was fitted into the earlobe a long time before his death. The CT images revealed that the distal humerus shaft of the left arm was fractured slightly above the trochlea. The possibility that the fracture happened during an initial recovery attempt cannot yet be excluded.

A word of warning is necessary in line with the importance of these data. From a scientific standpoint all efforts to describe the morphology and dimensions of the soft tissues and skeletal parts of the mummy must be viewed under the aspect of the singularity of the "man in ice." We have no knowledge about the variability of the population from which he descended. Especially the examination of small, sometimes locally closely neighboring Late Neolithic populations shows that there are remarkable differences of types (*4*). Very probably such differences depend on a strong endogamy, although additional barriers due to sociocultural reasons could have enhanced them. Although media coverage resulted in worldwide notoriety, it is important to relegate the individuality of this find into the form of a valuable piece of information about the development of human culture and history.

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1. In eyewitness reports the corpse was dressed with "leather wrapped" trousers and shoes before the official recovery. After the official recovery the corpse was undressed with the exception of the right shoe [G. Zissernig, *Bericht Über das Erste Internationale Symposium "Der Mann im Eis—Ein Fund aus der Steinzeit Tirols,"* Innsbruck, Austria, 3 to 5 June 1992, K. Spindler, Ed. (Veröffentlichungen der Universität Innsbruck, vol. 187, 1992)]. During the earlier recovery attempts the corpse was lifted out of the glacier ice in such a way that the trousers were torn. The corpse lacked the outer genitals, penis, and testes. The scrotum was in a good enough condition to determine the sex in context with the form of the angulus subpubicus. Currently the most probable hypothesis for this finding is that the prominent genitals, which were frozen to the clothing, were detached during the earlier manipulations.
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Slowing of Mortality Rates at Older Ages in Large Medfly Cohorts

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It is generally assumed for most species that mortality rates increase monotonically at advanced ages. Mortality rates were found to level off and decrease at older ages in a population of 1.2 million medflies maintained in cages of 7,200 and in a group of approximately 48,000 adults maintained in solitary confinement. Thus, life expectancy in older individuals increased rather than decreased with age. These results cast doubt on several central concepts in gerontology and the biology of aging: (i) that senescence can be characterized by an increase in age-specific mortality, (ii) that the basic pattern of mortality in nearly all species follows the same unitary pattern at older ages, and (iii) that species have absolute life-span limits.

Age-specific mortality rates (*1*) are used by gerontologists, demographers, and biologists in a number of interrelated ways including quantifying senescence in populations (*2*), comparing species (*3*), and inferring species-specific life-span limits (*4*). Surprisingly, the pattern of age-specific mortality is well known only for *Homo sapiens*, and even for humans data are sparse after age 85. For 48 species scattered across various phyla, Finch estimated the level of mortality at the age of sexual maturity and the increase in the mortality rate with age, but he warned that the estimates "should be considered first approximations within a twofold range" (*5*). The estimates depend on the untested assumption that mortality increases at the same rate from sexual maturity to advanced old age; as Finch noted, "there is no a priori reason why mortality rates should conform to functions" of this type (*6*). The number of observations of age at death for any nonhuman species is small. In a typical study of mortality, the life-spans of some 20 to 50 individuals are observed in laboratory or field settings (*7*); only rarely has mortality in several thousand individuals been monitored (*8*). When only a few hundred individuals are observed, the pattern of age-specific mortality at older ages,

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