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Minors in the Mines: Archaeological Indicators of Child Labor in Prehistoric Mining Contexts in Europe

Nikita K. Werner
University of Wisconsin-Milwaukee

MINORS IN THE MINES: ARCHAEOLOGICAL INDICATORS OF CHILD LABOR IN PREHISTORIC MINING CONTEXTS IN EUROPE

by

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ABSTRACT

MINORS IN THE MINES: ARCHAEOLOGICAL INDICATORS OF CHILD LABOR IN PREHISTORIC MINING CONTEXTS IN EUROPE

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Nikita K. Werner

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Under the Supervision of Professor Bettina Arnold

Developing a theoretical and methodological framework for the study of children, childhood, and child labor in prehistory has two goals. The first is to reintegrate children into cultural narratives in light of the increased popularity of the topic among archaeologists; the second is to equip researchers with the tools to apply developing theories to prehistoric populations in which there is material and physical evidence of child labor. Using the prehistoric mining complex of Hallstatt in alpine Austria as a case study, this thesis highlights how a reevaluation of existing data can provide a more inclusive interpretation of childhood even in the distant past. By viewing the existing material and biological evidence through the theoretical lens of Grete Lillehammer's child's world, and incorporating additional lines of evidence through analogy, a child-centric analysis can be generated. Future directions for the study of children and childhood in prehistoric mining contexts are discussed in the course of demonstrating the unique opportunity these communities provide to discuss childhood in occupationally specialized societies.

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The writing process can feel like a lonely one, but it is more realistically the result of an individual relying on a network of people around them and the guidance and patience of those who have themselves been through the process. This thesis is the culmination of my own effort and that of so many others. I would first like to extend my deepest gratitude to my advisor, Dr. Bettina Arnold. Her investment in my success was made clear from the beginning of my time in graduate school and she has undoubtedly made me a better writer, a more critical reader, and a more engaged student of archaeology. Her confidence in my ability to finish this thesis is surely one of the reasons I eventually did. Dr. Arnold's thoughtful revisions and candid advice were always welcome and fueled my desire to give a voice to the voiceless in prehistory by studying children. I would also like to thank my committee members, Dr. Patricia Richards and Dr. Jason Sherman for agreeing to read my thesis and contribute their unique perspectives to my work.

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Chapter One: Introduction

Scholarship focusing on children in mining contexts in prehistoric Europe is gaining in popularity but remains relatively rare (Arboledas Martínez and Alarcón García 2015:105). Though occasionally referenced in passing (see Barber 2003:111; Kern 2010; Lewis 1994:36; Pany-Kucera et al. 2010; Shennan 1998:197; Stöllner et al. 2003:138), analyses of the potential contributions of child labor to proto-industrial mining activities are generally few in number. What we see instead is a lumping together of women and children as an integral, albeit poorly investigated, part of the post-extraction processing of raw material at mining sites (Barber 2003:113; Miller 2007:150). Moreover, the majority of these studies are based on analogies with modern and near historical examples of mining communities in sub-Saharan Africa and South America (Barber 2003:111; Herbert 1998; Johnston 2008; Shennan 1998:197), which is a problematic approach if improperly applied.

The inclusion of children in the discourse on social complexity in prehistoric mining communities has the potential to provide scholars with a means of exploring the transfer of expert knowledge of mining techniques from one generation to another (see Lewis 1994; O'Brien 2015). There is also an opportunity to further our understanding of the way children's interactions with their peers, their families, and their communities were changed by the shift from domestically focused agricultural societies to those exhibiting proto-industrial labor specialization. Children would have been part of the generational shift in societal rules and dynamics, so their activities and contributions should be an integral part of our understanding of changing social and power structures during the Bronze and Iron Ages in Europe. It is with these points in mind that this thesis sets out to test the hypothesis that children were not only present in prehistoric mining communities but engaged in labor activities in a deliberate and meaningful way. Our understanding of the cultural meaning of children's participation in preindustrial labor systems more generally is enhanced at the same time.

The question of whether archaeologists possess the requisite tools for identifying evidence for the presence of children in prehistory is one that has been largely avoided in the past but is gradually gaining more attention. Material evidence is only one component of a research methodology that has become more sensitive to the inclusion of children (Roveland 2001:50). It is the combined strength of multiple lines of evidence, including material culture, mortuary analysis, bioarchaeology, ethnographic and historical analogy, experimental replication, and consideration of other social science disciplines such as sociology and developmental psychology, that makes a holistic interpretation possible (Baxter 2005b:3-4, 2005c:81; Bednarik 2008; Bugarin 2005; Chamberlain 1997:250; Králík et al. 2008; Lillehammer 2008:101,108, 2010:16; Perry 2005; Roveland 2001:47,50). Drawing on independent lines of evidence using a combination of the above-mentioned research methods will ultimately change the way children and childhood are viewed in archaeology, serving as a *topic* of discourse in its own right rather than mainly as a *tool* for the study of adult activities and interactions. Applying this synthetic approach to European prehistoric mining communities has the potential to shift our view of the division of labor, the role of children in society, and the processes of socialization that drive cultural reproduction and culture change.

This thesis draws on evidence from the early Iron Age site of Hallstatt in Austria to outline possible strategies for accessing evidence for child labor in pre-industrial mining on the basis of the archaeological record. The salt mining complex of Hallstatt in the Salzkammergut region was in use as early as the mid-second millennium BC, ending in the fourth century BC after a presumed landslide brought operations to a halt (Harding 2013; Kern et al. 2009;

McIntosh 2006; Wells 1981). The site was chosen due to the quantity and variety of evidence for mining technology and changes in extraction strategies, the associated cemetery with mortuary, material, and biological remains, and the fact that this Late Bronze Age/Early Iron Age community was one of the first with a year-round permanent population of miners in Europe. Likewise, the cemetery at Hallstatt stands out as one of the few prehistoric sites in Europe containing a substantial number of juveniles, especially juveniles outfitted with grave goods. Of the excavated graves thought to contain juveniles at Hallstatt, the available data for a sample of 39 were compiled and analyzed to address the research questions below. The history of investigations at the Hallstatt cemetery and mines, and the types of evidence available from the excavations, are discussed in Chapters Two and Three.

Research Questions

The following research questions were designed to be applicable within a wider social context. The archaeology of childhood, like the archaeology of gender, should be treated as a call for the inclusion of a previously marginalized social category into archaeological discourse more generally. The research questions were intended to put the child's experience at the center of investigation. The primary questions are specific to the site of Hallstatt while addressing common issues in the study of prehistory. The secondary questions address prevailing attitudes in archaeology toward children in prehistory and suggest how a shift in focus could impact future investigations.

Primary Questions

- To what extent did prehistoric children participate in mining-related tasks at Hallstatt and what is the available evidence for such activity?

- Can divisions of labor be identified, and if so, can these divisions be categorized by developmental age, gender, or other factors?
- Are the roles of children and adults' perceptions of their contributions reflected in the mortuary and material evidence, and are they differentiated?

By employing the interdisciplinary framework proposed below, the hypotheses accompanying these research questions reflect a broader understanding of the experience of childhood in prehistoric mining communities in Europe. Combining biological, material, and mortuary lines of evidence demonstrates that children were present and active in mining activity to a far greater extent than previously thought. Their economic and domestic contributions were substantial and would have required gender and age-related divisions of labor. It is also argued below that if evidence exists for such labor activity, the divisions should be expressed materially through mortuary treatment and grave goods, reflecting the perceptions and emotions held by adults toward children in the community.

Secondary Questions

- To what extent would evidence of child participation in mining change archaeologists' perceptions of childhood in prehistoric Europe and in general?
- Would the prevailing view of mining and other industrial activities as predominantly masculine be affected by the inclusion of children as an integral source of labor?
- What are some of the future applications and ramifications of the proposed theoretical and methodological approaches to the study of childhood in archaeology?

These secondary questions are more generally concerned with how the study of children and childhood in archaeology can contribute to changes in the discourse on childhood and mining in prehistoric Europe. There is reason to believe that, much like the incorporation of women into social interpretations in archaeology, the inclusion of children and their experiences within societies will challenge preconceived notions of childhood and the masculine nature of laborious production and extraction activities. Future applications and the potential for shifts in how childhood is portrayed in archaeological interpretations are addressed in Chapter Four.

Literature Review

Children and Childhood in Archaeology

Understanding how scholars have handled the general neglect of children as active members of prehistoric societies provides a basis for the development of methods for identifying children as a labor source in the archaeological record. Roveland's (2001) review of *American Antiquity* articles between 1935 and 1999 makes the exclusion of children in archaeological scholarship painfully apparent. Of the journal's hundreds of articles, only two made mention of children as an important area of study within the field until the 1970s, after which the vast majority of articles approached children primarily as a tool for studying paleodemography (Roveland 2001:40). *American Antiquity* is not unique in its silence on childhood in prehistory. A growing number of scholars have criticized the field of archaeology for this glaring omission (Baxter 2005a, 2005b, 2005c; Chamberlain 1997; Lillehammer 2008; Roveland 2001; Sofaer Derevenski 1997).

Despite the demonstrated ability of researchers to utilize independent lines of evidence in order to develop interdisciplinary interpretations of children and childhood in the past, there are still few practical applications of the theoretical approaches. One example expanded on in Chapter Four is the creation of the *Lebensbild*, an illustrated snapshot-like quotidian vignette that incorporates available evidence for the particular context presented (Reschreiter et al. 2013).

Theoretically focused scholarship on the archaeology of children and childhood has provided a solid foundation for inquiry, as discussed below. Books such as Derricourt's (2018) *Unearthing Childhood* include broad discussions on topics related to children in a variety of contexts but fail to apply theory to supporting hypotheses on the meaning of these contexts. An approach that evaluates archaeological evidence with a theoretical framework will make reevaluating existing analyses and developing new interpretations of communities in prehistory possible.

Residual preconceptions of the usefulness of studying children and childhood can be seen in the way children were used to support old paradigms without being given any sort of agency (Sánchez Romero 2017:32). For example, children were used traditionally as a metaphor for "primitive" societies in the late-19th and early-20th centuries in anthropology and archaeology. Both children and less "developed" societies (ancient and contemporary) were viewed as lacking in cognitive ability, reason, and sophistication. Their accomplishments were seen as crude and only significant in that they demonstrated how the process of modernization (or "growing up") could be applied as universally as the concept of childhood itself. If all children were born to grow into adults, it stood to reason that all societies were born to advance in sophistication. The adult in this metaphor is the antiquated notion of the fully modernized, technologically and cognitively superior (white) nations of Western Europe and North America. This analogy had lasting negative effects on the perception of children in the social sciences that have been more pervasive than stereotypes regarding non-Western cultures of the past and present (Sánchez Romero 2017:33).

As Kamp (2001:2) points out, the contemporary rationale for the exclusion of children in archaeological interpretation sounds strikingly similar to the rationale provided for the absence of gender considerations that preceded it. Following the second wave of feminism and the emergence of gender archaeology in the 1980s, a new focus on the identification and interpretation of children in the archaeological record began to develop (Baxter 2005a; Lillehammer 2010a; Sofaer Derevenski 1997). The marginalization of children's potential contributions to social evolution was central to the emerging commentary. Scholars have offered two main reasons for the dismissal of children as significant social actors impacting the archaeological record. The most widely cited reason is the perceived elusiveness of material evidence for the participation of children in society (Baxter 2005a:2; Sofaer Derevenski 1997:193). The counterargument is that such evidence is elusive primarily because archaeologists have not paid attention to it until recently, or as Chamberlain (1997:249) summarizes it: "children contribute to the archaeological record *whether or not we are competent to recognize them"*. Archaeologists' failure to recognize the material culture of children is inherently linked to the second reason cited by critics for the absence of children in the archaeological record – namely, Western-biased notions of children and childhood as being inactive in work or community activities (Baxter 2005a:2; Chamberlain 1997:249; Lillehammer 2008:108; Sofaer Derevenski 1997:193).

Related to the more well-known biases inherent in the great majority of archaeological scholarship of the 19th and 20th centuries (i.e., gender and ethnicity), an adult-centric bias is also present. As Roveland's (2001) literature review suggests, a small number of scholars admitted the existence of this bias, but little discourse developed until after the acceptance of gender archaeology as a subfield. The Western bias manifests itself in the idea that children do not influence social processes, site formation, or material production (Baxter 2005a:1). Not unlike the dichotomous Western concepts of gender, age is viewed in contrasting terms such as child (or subadult) versus adult, with the category "child" viewed as archaeologically invisible or insignificant (Chamberlain 1997:249; Lillehammer 2008:108; Sofaer Derevenski 1997:193). The wide range of developmental processes that occur between birth and biological maturation are lumped into one socially recognized life stage called childhood. Age stages are differentiated within this time frame, which are generally marked by certain biological or social landmarks in development and culminate in the transition into an adult at a designated, arbitrarily and legally defined chronological, rather than social, age.

Childhood as a Social Construct

What has eluded archaeologists in the past is the fact that Western definitions of children and childhood cannot be applied universally. Childhood is a social construct exhibiting considerable cross-cultural variation in meaning and implication (Baxter 2005b:79; Kamp 2001:1; Lillehammer 2010a:22). Applying a culturally specific, contemporary definition of what it means to be a child to prehistoric social systems is inadequate at best and at worst an obstacle to the study of children in archaeological contexts. The inclination to project into the past our modern definition of childhood as a long, distinct period in the life-history of an individual that is characterized primarily by play, exploration, and learning cannot be ignored (Cunningham 1995:82; Halcrow and Tayles 2011:346; Kamp 2001; McIntosh 2000:15). The perspective that children are vulnerable, dependent, and incapable of making meaningful contributions until the age of 18, or even later, is a product of the Enlightenment, Romanticism, the Industrial Revolution, and the introduction of compulsory education (Cunningham 2014; McIntosh 2000:14). Where divisions in childhood once included the transition from being an economic liability to becoming an economic asset for the family and community (Cunningham 1995:87; Kamp 2001:14), contemporary Western notions of childhood have changed to view the worth of children not as practical or economic, but as perceptual and inherent (Kamp 2001:15).

Hugh Cunningham gave a lecture at Gresham College in London in 2014 in which he provided some important insights into the formation of preconceived notions of childhood in historical discourse. He focused on the duality in narratives about how the experience of childhood has changed throughout time. On the one hand, the narrative of progressive improvement, as popularized by Lloyd de Mause in the 1970s, argues that childhood has moved from a place of abandonment, abuse, ambivalence, and infanticide to become a more positive experience of nurturing supervision and intentional socialization. In this romantic narrative, the chronological lengthening of childhood in the Western world is presented as an improvement and a victory for those philanthropic, and later governmental, organizations of the late 19th and early 20th centuries that set out to save children and restore the innocence lost during the "terrors" of the Industrial Revolution. On the other hand, while in some ways still very evident in the study of childhood in historical contexts, a pessimistic counter-narrative developed that gathered popularity through sensationalized mass media, and the movement away from optimism regarding progress that began in the late 1970s and early 1980s (Cunningham 2014).

Cunningham (2014) deconstructs why narratives such as these are used in academia even though they do not accurately reflect reality. The above narratives idealize childhood as a distinct and finite time of development, with strictly defined rights and a laundry list of social ills to be guarded against. The narratives have underwritten frameworks that not only lengthened chronological childhood but shortened it in terms of social development. One example is the change in cash-flow between children and adults; where children once worked and contributed to the household, now children are financially reliant on their parents up to and sometimes well beyond becoming adults in chronological and/or legal terms. These two narratives have remained subliminal in the British and American study of childhood in the past. They have stalled the considerations of agency, participation, and socialization that characterize other archaeological narratives, such as those developed in Scandinavia by scholars like Grete Lillehammer. In Scandinavia, a historically culturally homogenous and progressive region, prevailing social attitudes resulted in an early adoption of gender archaeology, as well as the archaeology of children. Scandinavian researchers tend to approach children as a competent, trustworthy, capable, and integral subset of the general population resulting in the subfield gathering significant support nearly a decade before Britain and North American (Cunningham 2014).

Grete Lillehammer and the Child's World

Some scholars are currently working to counter historically exclusionary frameworks by emphasizing a discourse focused on children and childhood in the past. Sánchez Romero (2017:33) remarks in her recent review of scholarship on the archaeology of children that where a quarter century ago the questions centered on what childhood is and how it impacts our understanding of society, the focus has now expanded to include concepts of "agency, hybridization, liminality, otherness, transformation and change". Given the interdisciplinary nature of these new research topics, there has been a recent push to integrate various research methods into the corpus of interpretation. Grete Lillehammer, a Norwegian archaeologist and forerunner in the development of the study of children and childhood in the past, has argued that a methodological framework that draws on a variety of disciplines is essential if the study of children and childhood is going to be useful in furthering our understanding of ancient societies (see Lillehammer 1989, 2008, 2009, 2010a, 2010b, 2015). Twenty-five years after publishing her seminal article in 1989, Lillehammer released a deliberate follow-up article (Lillehammer 2015) that addressed how the field has changed since her pioneering publication and discussed plainly the points in her initial argument that have stood the test of time, and those that had not anticipated the future directions the field would take. The article ends with an appeal for the archaeology of childhood to remain its own separate subject within the field, as the importance of continuing integration efforts through cross-disciplinary analysis has not waned (Lillehammer 2015:84).

Lillehammer (2015:79) emphasizes the following arguments from her 1989 article that are still pertinent to the continued reevaluation of children and childhood in the past:

- The child's world contains biological and cultural categories and it has been neglected in archaeological investigation and analysis.
- "Discovery of archaeological evidence of the child's world requires knowledge of the adult world" (Lillehammer 2015:79), which is a limitation. The best starting point for previous research is exploring what we know about adult life. In the future, the inclusion of the child's world should begin with initial research on the entire population.
- Childhood is an experiential phenomenon that connects children and adults through memory.
- Child's play acts as a "mediator of cultural transmission between the child's world and the adult world" (Lillehammer 2015:79) and is a liminal space where children interpret and emulate what they understand to be adult behavior.
- Recognizing children in the material record requires an understanding of learning and play, and the use of toys.
- Technology is an integral part of the transmission of knowledge and culture from one generation to another and needs to be studied to incorporate its impact on the child's world.

- Lithic analysis and the study of patterns in manufacturing are promising avenues for studying the processes of learning and imitation in prehistoric material.

Advances have been made in both enduring and emerging analytical methods. Common themes include the study of “biological, cultural and social aspects” (Lillehammer 2015:80). These research foci use evidence from the burial record, the study of technological change, and the production methods of crafts and artwork, and have been driven by the introduction of methods such as hypothetical modelling, which focuses on transmission of knowledge by recording cognition and capacity at various life-stages (Lillehammer 2015:80). The lattermost focus lends itself to the study of experience in child labor and material production because limitations in physical ability and cognitive understanding of labor-related tasks can dictate the roles assigned to individuals at various life-stages and may help us understand how a child advances through the learning processes that ultimately culminate in labor specialization.

Among the limitations and challenges to research methods is the way archaeological analyses have changed in the last quarter century (Lillehammer 2015:82). Specialization in the field of archaeology has sometimes caused rifts in the focus of research by dividing it into natural versus cultural investigative approaches. The result is different epistemological and ontological frameworks (Lillehammer 2015:82). Creating a more comprehensive framework is essential in developing an approach from which specialized research methods can be applied to a common goal: understanding the complexity of the child’s world within a specific place and time in history and prehistory.

If identifying links between the past, present, and future is a focal point of archaeology, the study of children should be paramount, as they are important agents of change through time (Lillehammer 2015:84). To move the field forward, archaeologists need to consider whether the challenges and limitations of the study of children and childhood in the past are related to, or worsened by, the lack of commonality in frameworks (both theoretical and methodological), terminology, language, and use of material evidence in research. What are the opportunities that arise from recognizing and addressing these challenges and limitations? In her consideration of Lillehammer's critique on the current shortcomings and future work in the field, Sánchez Romero (2017:33) relates the ongoing challenges to vacuums in theory and methodology, with application of new frameworks being the main issue. There must be increased understanding of how the cross-cultural study of variation in the experiences between children and adults cross-cuts all research interests, including "similarity, difference and variation of spatial, historical, biological, social, economic, religious and political orders" (Lillehammer 2015:83).

To Lillehammer, the main challenges to an archaeology of childhood today are the same as they were 25 years ago: despite an increased awareness of children in the archaeological record, the subject is still overlooked in many investigations, both in excavation analysis and research conducted on previously excavated material (Lillehammer 1989, 2010a, 2010b, 2015). An adult-centric mentality continues to permeate the interpretations and reconstructions of ancient life. Limitations include issues related to reconnecting previously under-analyzed evidence, and a lack of appropriate case study sites, some of which have been investigated in ways that have destroyed or decreased the research value of the evidence available. Through a more effective use of analogy and available evidence, scholars may be able to include children in interpretations of previously excavated sites, providing guidelines for future excavations in the process.

Child Labor in Proto-Industrial Societies

Much of the literature on the archaeology of children thus far has been rooted in culturally constructed definitions (by archaeologists themselves) of childhood, motherhood, and the relatedness of women and children (Baxter 2005a:17). The presence of women and children in permanent mining settlements would have been accompanied by an inevitable shift in family structure gravitating toward specialized community activity. This shift is best modeled using historical analogy. In medieval Europe, most regions were predominantly occupied by farming communities. Children would have been considered dependent for a shorter period of time than they are now (Cunningham 1995:87; Kamp 2001:15; McIntosh 2000), viewed mainly as economic assets due to their compulsory contribution to operations on the farm. An ideal number of children would allow for adequate labor without expending too many resources. There is evidence from this period for the hiring out of "excess" children, primarily as servants to the upper class or in the form of fosterage, as is seen in early medieval Ireland (Cunningham 1995:84, 86; Ó Cróinín 1995:132).

Children in proto-industrial communities could be put to work earlier than in agricultural communities because not all the work required size or strength. Family size might increase if children became more of a labor asset at an earlier age (Cunningham 1995:87). Testing the validity of a comparison between prehistoric communities and peasant farming communities in the Middle Ages is dependent on comparable demographic information from burial sites associated with both agricultural and proto-industrial populations. Both the percentage of children present as well as the use of stable isotope analysis to determine whether children were local or not could reveal the extent of increases in child labor and mobility in these mining contexts. Investigating where children in mining communities were coming from could provide evidence for the sources of labor in prehistoric mines as well as links between regions that may have been politically and economically interconnected.

The material and skeletal evidence at the salt mining complex at Hallstatt clearly shows that women were not confined to domestic and child-rearing activities; children were also hard at work from early ages (Kern et al. 2009; Pany-Kucera et al. 2010; Reschreiter et al. 2013). This leads one to wonder what the child-rearing dynamic was in these early pre-industrial societies. Was putting children to work with simple tasks an effective way of keeping them within sight of adults, making community child-raising a sensible arrangement? Perhaps older adults (whose presence is attested to in the Iron Age cemeteries at Hallstatt) oversaw very small children after they could no longer participate in the more laborious tasks involved in mining. Alternative solutions might include rotations for childcare, and/or delegating of the domestic duties necessary to sustain such a large population, such as cooking and resource acquisition. Perhaps older children were responsible for cooking and carrying supplies such as wood and water before they were strong enough to work in the mines. The number of possible arrangements seems almost infinite, which complicates our ability to make confident assertions. Material evidence inside the salt mines at Hallstatt, including shoes, a baby hat, a child's leather cap, and small mine picks, clearly shows that children were present. One thing archaeologists know now is that the patriarchal notions of women and children as incapable or ill-suited for labor and industrious activity are not only antiquated and culturally biased, but they also run counter to the material and biological evidence found in the archaeological record.

Participation versus Exploitation

The way Western researchers approach childhood runs the risk of equating child labor in prehistory with child exploitation, and therefore erases the contributions of children in production labor (Arboledas Martínez and Alarcón García 2015:106). Though we may be able to draw an analogy between proto-industrial and industrial child labor in the context of mining operations (see McIntosh 2000), we would be remiss to assume that prehistoric children were being exploited as a labor source in the same way as during the Industrial Revolution, a time when child labor practices in Europe were often cruel and harmful, and neglected the best interests of children's health and well-being (Goose and Honeyman 2013). Cultural reproduction in the Bronze and Iron Ages would have included training children as early as possible to replicate and contribute to the activities of adults in the community. A child's contribution to agricultural and general household activities would have been integral to their education. Developmentally, children of seven years old can start helping with domestic tasks (Cunningham 1995:83). There is evidence that children as young as four years old can be productive in industrial production activities (Kamp 2001:18). There is so far no evidence suggesting that children are over-represented in prehistoric mining contexts, though consideration of this topic has not been systematically addressed in scholarly investigations. Of course, if we are to use analogies such as medieval child labor in mining contexts, the possibility that child labor was being exploited in the form of fosterage, servitude, or slavery in prehistory cannot be ruled out (Cunningham 1995:84-86; Ó Cróinín 1995:132).

Mining: Environmental and Human Ecology

Mining communities provide a unique arena for exploring the experiences of children as they are often isolated, their activities restricted in some ways, and the occupational specialization comes with a distinct set of lifestyle hazards that researchers can sometimes identify through the analysis of biological remains, such as the prevalence of chronic sinusitis in a sample of adults from the Hallstatt cemetery (Pany-Kucera et al. 2018). In addition to the occupational hazards associated with the physical nature of mining and resource processing activities, the dangers of working in inhospitable landscapes, and higher risk of accidental death in underground mining (discussed in Chapters Two and Three), the living conditions and hygiene issues associated with spending long periods of time underground should be considered.

Human excrement, preserved in Bronze Age and Iron Age salt mines, has provided invaluable insight into the nutritional habits of prehistoric miners, but also into the prevalence of intestinal parasites that would have made life rather unpleasant (Stöllner et al. 2003). This was likely not a feature unique to salt mining communities. While biological samples of this kind do not generally preserve in the shafts and galleries of metal-extraction mines, it would stand to reason that the amount of time spent underground or inhaling and ingesting toxic material would have produced similar conditions elsewhere. For example, Ötzi, the well-preserved Chalcolithic mummy found in the Tyrol, had several intestinal parasite eggs in the soft tissue of his abdomen (Cook 2015; Stone 2000). Fleas, genetic evidence of Lyme's disease, soot-blackened lungs, heavy musculoskeletal wear, and industrial levels of arsenic in Ötzi's hair all indicate that life in the prehistoric Alpine region would have been difficult (Cook 2015; Stone 2000). These ailments may also be indicative of a life lived in a mine or metal smelting area (see Table 1.1 below on toxicological effects of industrial levels of exposure to heavy metals).

Mining activity is a major contributor to anthropogenic landscape changes in prehistory. The lasting effects on the environmental health of areas once used for prehistoric mining and processing metals has been a recent topic for scholars interested in the long-term consequences of pollution on human ecology and the environment. Digging of mine shafts and galleries, increased deforestation for wood to make charcoal and build infrastructure, and increased plowing of land for agricultural use in the surrounding areas would have all permanently

Table 1.1 Known health effects of industrial levels of heavy metal exposure and potential sources of exposure for prehistoric and early historic mining community members (Bolt 2012; Grattan, et al. 2002; Hughes 2015; Lessler 1988; Nordberg et al. 2007; Pyatt and Grattan 2001; Waldron 1973).

Metal	**Documented Health Effects of Toxic Concentrations in Humans**	**Vectors**
Arsenic (As)	Skin lesions that can lead to skin cancer and Bowen's disease, nervous system disturbances, heart abnormalities, vascular disturbances resulting in gangrene and loss of limb, anemia, organ cancers such as lung, bladder, kidney, and liver, perforation of nasal septum. Nausea, vomiting, headache, trouble breathing, and blood in urine are all common in industrial exposure to arsine gas.	• Ingestion through contaminated food • Inhalation of particulates in the air • Inhalation of industrial fumes caused by combustion of arsenic-rich material • Skin absorption
Copper (Cu)	Metal fume fever (influenza-like syndrome), gastrointestinal disturbance, liver and kidney damage, and hemolysis.	• Ingestion, primarily through water • Inhalation of particles and industrial fumes (much less is known about the effects of copper inhalation than ingestion)
Iron (Fe)	Slowly progressing organ failure including heart, liver, and pancreas in cases of chronic overload. Acute iron poisoning can be lethal and includes gastrointestinal toxicity, circulatory shock, hepatotoxicity, and gastrointestinal scarring. Benign siderosis (arc welder's lung) can occur in industrial levels of inhalation.	• Ingestion of inappropriately iron-rich foods (possible, but not well documented) • Inhalation of particles in an industrial setting • Most modern iron overload occurs as a result of frequent blood transfusions and hereditary diseases
Lead (Pb)	Central and peripheral nervous system damage, kidney, cardiovascular, endocrine, immune, gastrointestinal, and reproductive tissue and function damage. Reproductive effects can include transference of lead in the skeleton from mother to fetus or weaning infant. Fetuses are at risk of damage to the nervous system and mental development can be delayed.	• Ingestion through contaminated food and water. • Inhalation in areas of industrial processing. • Absorption through skin.
Silver (Ag)	Argyria, a blue-gray pigmentation of the skin and visceral organs, can occur in cases of continued exposure. Possible impairment of vision, chronic bronchitis, and abdominal discomfort are also possible in cases of industrial overload.	• Ingestion through food and water (silver salts) • Inhalation of particles (colloidal silver)
Tin (Sn)	Abdominal pain, vomiting, diarrhea anemia, nerve damage, ischemic heart disease, changes in metabolism of cholesterol, and stannosis (a benign pneumoconiosis without dysfunction) can be effects of high exposure levels of tin compounds. Tin is converted into more toxic compounds through chemical reactions in the environment, some of which can lead to extensive cell damage and neurotoxicity. Skin and eye irritation, and occasional allergic skin reactions in cases of physical contact with tin salts.	• Ingestion of soluble tin compounds in food and water • Inhalation of particles (tin oxide) • Absorption through skin (tin salts, either acidic or alkaline)

changed the landscape. Apart from the usual changes associated with building structures, farming fields, and increased deforestation due to use of wood in pyrotechnic activities such as metal smelting and firing ceramics, the consequences of metal contamination in soil, air, and water can still be seen in areas near ancient mining and smelting activity sites (see Breitenlechner et al. [2014] for the Mitterberg, Austria; Grattan et al. [2002] for Wadi Faynan, Jordan; Mighall and Chambers [1993] for Copa Hill, Cwmystwyth, Wales; and Oakberg et al. [2000] for Shiqmim, Israel). Some of this contamination resulted from atmospheric pollution due to high-volume smelting activity, which is subsequently reintroduced through rain water at a great distance from the center of operations. Metal particulates also leach into soil and water supplies through slag piles and spoil tips, which would have been bountiful near large-scale mining operations.

Evidence of environmental contamination has been examined by a number of scholars and has demonstrated the prolonged environmental effects of metal mining, even in prehistory. Some scientists have focused their research on the effects on landscapes (Hong et al. 1996; Mighall et al. 2002; Pyatt 2001; Pyatt et al. 2002) in the form of bioaccumulation of metals in flora and fauna, as well as identifying methods of tracing prehistoric contamination in the environment and in biological remains (Hong et al. 1996; Oakberg et al. 2000). Others have discussed more in-depth contemporary public health issues (Hughes 2015; Lessler 1988; Pyatt and Grattan 2001; Waldron 1973; Wright et al. 1998). Comparatively few scholars have extended their research to make conjectures about the life histories of ancient mine workers in connection with the high-degree of metal contamination in the environment (Bolt 2012; Grattan et al. 2002; Pyatt et al. 2000; Waldron 1973). Most recently, there have been investigations into the relationships between prehistoric miners and their environments at copper mining sites such as Wadi Faynan in Jordan led by John Grattan and David Pyatt, who explore multiple methods of analysis to study both the lasting effects of copper contamination and the conditions under which mining was carried out in the Bronze Age Levant (Grattan et al. 2002; Pyatt et al. 2000; Pyatt et al. 2002; Pyatt and Grattan 2001).

Many copper mining sites were worked in sedimentary rock that contained multiple types of metal veins including lead, arsenic, and other less toxic minerals. While direct exposure to heavy metals can cause various ailments (see Table 1.1), it was the compounded accumulation through ingestion and inhalation both inside and outside the mines that would have made metal poisoning an ongoing community health threat. Early copper mining and bronze production involved mostly copper, lead, and arsenic, at least until the introduction of tin as a new metal for making alloys (Bolt 2012; Nordberg et al. 2007). Children exposed to these pollutants at an early age would have likely accumulated toxic loads at a developmentally sensitive time in their lives and this may be documented in their physical remains. Additionally, it would have affected the age at death profiles for mining communities compared to contemporary non-mining groups.

Infants and children are particularly susceptible to the effects of poor hygiene, environmental contamination, and malnutrition (Nordberg et al. 2007), as the ongoing crisis of lead poisoning in children in the United States exemplifies. Growing up in and around mines would have posed a unique set of problems for children, including issues with physical development. For example, one study found a strong correlation between malformation in infants with mothers who worked in copper smelting areas during pregnancy in one area of Sweden. The observed difference in occurrence was five times that of other mothers in the same region (Nordberg et al. 2007:391). To draw conclusions about exposure to heavy metals and the frequency of birth defects and malformation in infants and children in prehistory, more focused skeletal analysis is needed. Even then, some defects manifest mainly in soft-tissue, visceral or cognitive complications and would not be reflected in physical remains even where they are available for analysis.

Incorporating the study of landscape alteration, environmental contamination, and human health into the discourse on the life-history of mining communities in prehistory offers a rich supplement to the study of material culture and mortuary analysis, providing a better overall understanding of society in proto-industrial settlements, including age and gender differentiation. Prehistoric European mining areas offer ideal cases for exploring the ecological effects of mining on the environment and human health and their impact on the interpretation of social constructs and the experiences of children and childhood.

Theoretical Approach

A Phenomenological Approach

To counteract the preconceived notions inherent in Western archaeology regarding the value and abilities of children in the past, a lexicon must be used that clarifies the research focus of the archaeology of children and childhood. The concept of the child's world, as introduced by Lillehammer (1989, 2008, 2010), has been adopted by several scholars to describe the relationships of children with their peers, adults, and their environment (Baxter 2005a, 2005b; Bugarin 2005). This theoretical approach clearly differentiates between the consideration of children as social agents and the notion of children as a variable in the study of adult interactions and experiences (Bugarin 2005; Lillehammer 2008; Sofaer Derevenski 1997). The concept of the child's world also maintains a focus on the integration of children into the community and deemphasizes the study of children in isolation (Baxter 2005a:1; Lillehammer 2008).

The perspective Lillehammer (2010a) adopted in more recent work is phenomenology, arguing that the best way of approaching the subject of children in prehistory is to study their experiences. She does this by studying children from the viewpoint of their relationships and interactions with the world around them. Given that childhood is a social construct applied by adults to describe what they see or remember regarding the experience of being a child, Lillehammer's use of the child's world framework attempts to mitigate the problems associated with relative definitions of childhood by inserting a child-centric focus into archaeological discourse. The child's world provides a spatial dimension as it relates to children's activities and allows for a discussion of agency in how children occupy themselves (Lillehammer 2010a:28).

The phenomenological theoretical approach, in which gender and age are concurrent areas of study in archaeology, grew naturally out of the preceding feminist critique of archaeological. It was also influenced by new ways of thinking about the interplay between nature and culture (Lillehammer 2010a:17,19), which Lillehammer applied to the category of interpretive archaeology. She argues that one of the benefits of a phenomenological approach is that it minimizes bias in interpretation by allowing researchers to detach themselves from their subject (Lillehammer 2010a:23). This is particularly important when the subject is one every researcher has experienced in their own way. She stresses that combining standard language, theory, and methodology with an analysis that is child-centric and phenomenological in focus will aid in fostering subjectivity (Lillehammer 2010a:23). Throughout her 2010(a) article, Lillehammer reviews the main challenges in the study of children in archaeology and emphasizes the need for a multi-disciplinary methodology. She draws heavily on the perspective of socialization and the relationship between children's experiences and adult perceptions of those experiences.

Socialization and the Experience of Childhood

To understand childhood as a lived experience, effective theories of socialization must view the process as one that "implies adaptation, interiorization, appropriation, reinvention and reproduction on the part of children" (Sánchez Romero 2017:25), all of which relate directly to how children maneuver through their own world and reconcile their experiences with what they observe around them. The theoretical framework suggested here is best applied to the experience of children in internalizing and perceiving the process of socialization in contrast to an approach that focuses on how it is transmitted by adults, as the former has been argued to be more in line with practices across subsistence types in small-scale societies (Lancy 2015:210). To do so will reinforce the fact that children are active agents in this process.

There are several limitations to traditional interpretations of socialization in the past. One example is the dependence on historical documents (where present), which rarely mention children, having been written by adults (Cahan et al. 1993). Save for more recent historical accounts using children as informants, most notably those produced about the state of child labor in the Industrial Age in the UK and North America, there are few historical documents that include the child's perspective on their own experiences, some of which are mentioned below.

Jane Baxter's book *The Archaeology of Childhood: Children, Gender, and Material Culture* (2005a) relies heavily on the concept of the child's world to explore the way scholars can better incorporate children into archaeology. Baxter (2005a:24) was also one of the first scholars to suggest an alternative definition of socialization in lieu of constructing a new theoretical mechanism for the study of childhood experiences. She argues throughout the book that other models and traditional uses of the term socialization include several limitations, particularly in the area of researcher bias. By reconceptualizing socialization, Baxter attempts to make it more inclusive of the diverse cultures to which the concept can be applied. She takes its basic tenets from subjects such as sociology and developmental psychology and addresses the inherent biases that limit its application to contemporary Western cultures. In her words, socialization is "a process that simultaneously promotes continuity between generations and acts as an arena where changes in social norms, beliefs, and behaviors may occur" (Baxter 2005a:34).

The child's world can only be explored through the mechanism of socialization if children are acknowledged as active participants in the process. By expanding the definition of socialization beyond the unilinear transmission of cultural knowledge from adult to child, we begin to see that the process of socialization includes many factors, all of which involve not only transmission, but interpretation and renegotiation on the part of the child (Baxter 2005a). Cahan et al. (1993:195-202) organize the elements of this definition of socialization into four categories:

- The physical environment
- The social environment
- The imperial practices of adults
- The native practices of children

In the above division, the first and second elements act as supplementary, albeit integral, factors, while the third and fourth encompass the basic means of socialization. The third category covers the transmission of knowledge through observation and expands beyond parents and other caretakers to include any other individual whose behavior children may witness. It also includes the direct transmission of knowledge we generally associate with socialization – that is, direct and indirect instruction including verbal lecturing, controlling experiences and exposure, controlling what toys and activities are appropriate for a child (related to age, gender, class, ethnicity, or other identities), and modifying behaviors by way of reward and punishment. Lancy (2015:210) argues that "autonomous learning" is dominant in small-scale societies, a model with far less regard for formal teaching than what is standard in post-industrial society. Waldorf schools around the world embrace the autonomous learner model, a system developed by Rudolf Steiner in the early 20th century, in which young children are "given over to their physical surroundings" and encouraged to learn through active exploration, observation, and imitation (Barnes 1991:52).

In reviewing the methods and means associated with the transmission of knowledge, skills, and culture, Sánchez Romero (2017:21) states that learning takes place through socialization, imitation, and play (manipulation of that which is observed or instructed). Tacit knowledge through observation is combined with correction of inappropriate behavior, and differential instruction given based on gender and developmental stage. Social worldviews are reproduced through these landscapes of learning. Learning what it means to *be* an accepted member of a group is the *hexis*, while the tacit or unconscious development of skills and logic makes up the *habitus* (Sánchez Romero 2017:25). There should be a contrast between the processes of learning in these two frameworks. The two components of learning also involve biological and psycho-social development as they are related to changes in motor and cognitive/intellectual development respectively (Sánchez Romero 2017:21). The interplay between the two will be discussed further in Chapter Four. Socialization drives cultural continuity in the face of changing technology and landscapes (Derricourt 2018:148; Stöllner 2010:307). Some aspects of socialization are subtle, while others are rigid, supported through rites of passage and preparation for other benchmarks of maturity (both physical and symbolic)

(Baxter 2005:83). Psycho-social socialization therefore sustains social, cultural, religious, and political order.

Play

Play constitutes a substantial means of preparation for adult life (Sánchez Romero 2017:22). Imitation of adult activities, rituals, work, and behavior are examples of this process. While technical skills are often taught through direct instruction (Sánchez Romero 2017:22) or observation of adult behavior (Lancy 2015:205), play and games allow children to negotiate what they have learned, testing out their skills and knowledge in a safe space through interactions with peers. Games can be divided into those developed and/or supervised by adults, and those conceived of and regulated by children themselves (Sánchez Romero 2017:23). Unfortunately, games are not artifacts in the way toys are (Derricourt 2018:162) and often leave little evidence in the material record. What does remain can only be identified as involved in play based on the objects' continued use in history or the present, as well as inferences made through mortuary contexts (Derricourt 2018:162). In some cases, material related to play exists but is difficult for researchers to accept as having the primary function of a toy, as with the miniature shields and cauldrons found at the Iron Age site of Salisbury (Derricourt 2018:163). To appreciate material as related to play, new methods and sources of information are needed and are currently being applied to some analyses of the use of space (Baxter 2005a).

Occasionally, areas of the landscape can be identified as primary areas of play based on concentrations of materials that could be construed as toys (Baxter 2005). Beyond public spaces, children frequently appropriate other interesting landscapes; spaces can include remains of uninhabited settlements or ruined structures (Sánchez Romero 2017:24) such as the World War II ruins in Poland where the use of space for play has been observed (Sidorenko 2014). Even today children are drawn to a variety of structures and landscapes for play (abandoned houses, caves, bridges, wooded areas), which establish more interesting backdrops for play and usually involve areas of less adult supervision. Limitations would have existed; adults are not inclined to allow children to play unsupervised in areas they know to be dangerous such as cliffs, fast moving rivers, and areas with dangerous wildlife (Lancy 2015:243-244). Children may also have been barred from playing in sacred areas, both natural or built. Physical spaces used for playing may be particularly difficult to find if play was heavily restricted or discouraged in some places such as among the Yucatec Maya, where preference is given to spending long periods of time doing chores (Lancy 2015:244).

Socialization and Movement of People

Instruction and guided play are ways for adults to reinforce not only social norms based on gender (and later, social class), but continuity in ritual and religious practices as well (Sánchez Romero 2017:23). “Children are considered fundamental and instrumental in adapting the social organization of the new settlements and acting as mediators in cultural interaction and assimilation through mechanisms such as religious conversion” (Sánchez Romero 2017:31). This pertains especially to shifts in populations, either through migration or conquest, and is imperative in understanding the hybridization or creolization of different groups. One example is the movement of children from imperial Britain to colonies around the world, sometimes unaccompanied by an adult family or community member (Sánchez Romero 2017:31). We see earlier examples of such movement in the form of fosterage in Ireland and other parts of the UK from the early Middle Ages onward (Ó Cróinín 1995).

Children can also be the unfortunate victims of warfare. Even if they survive the initial fighting, they may become displaced persons, moving with their families, or alone, to war camps or used as slave labor. Populations can experience drastic shifts in the size of various age groups depending on the requirements for going into battle. A large increase in the number of young children versus adults would have also altered the experience of childhood and relationships with adults (Sánchez Romero 2017:31). In some cases where juvenile skeletal and dental evidence is present, the use of isotope analysis could improve the understanding of the movement of people in prehistory, their motivations, and the processes of adaptation. Evidence of such realities and their effects on socialization exist in the presence of miniature weapons throughout European prehistory. Examples include battle axes found at sites in Wales and Scotland, and a small bow found in a pit at Isleham in England (Derricourt 2018:191). At Early Bronze Age Titris Höyük in Turkey, a massacre that resulted in the site's abandonment left evidence of at least three child casualties in a mass grave also containing 16 adults (Derricourt 2018:186). An understanding of the risks of violence and warfare would likely have been a regular part of learning and negotiation for children in prehistory.

Whether as a result of warfare, being uprooted to labor away from their families, or due to increased demand for child labor, as in the Industrial Revolution, drastic changes in the experiences of children took place during times of massive social and political change resulting from civil unrest, conquest, natural disaster, or technological innovation (Sánchez Romero 2017:31). During such times, it would have been impossible for children to experience the same strategies of socialization and learning as the generations before them (Sánchez Romero 2017:31). Strategies would have been constantly altered, and the experiences of children during times of transition would have been quite different than for adults.

Going Forward

Employing Lillehammer's phenomenological approach and the concepts of socialization as defined by Baxter creates a theoretical lens through which the material and biological data from the Hallstatt site and cemetery may be viewed, allowing us to construct a model of how children were conceptualized in the working world of Iron Age Europe. By maintaining a child-centric focus on the experiences of children in this mining community, the evidence can be extended beyond traditional topics of paleodemography and differential burial practice. Viewing participation in labor activities as an essential experience within the child's world is the first step in developing a narrative that tells the story of childhood in a prehistoric mining community. Possible labor activities, divisions of labor, and the reflection of the child's role in the mortuary and material evidence will be considered in terms of how they might relate to other aspects of the child's world. Child labor in this context was not simply an industrial necessity but a process of socialization that would have included elements of direct and indirect learning, play, health and safety, and interactions with the surrounding environment.

To extend this multi-pronged approach to the interpretation of the child's world in prehistoric mining contexts, published primary data available for the site of Hallstatt were reorganized and interpreted. The limitations of relying on data reported by other researchers are discussed in subsequent chapters. The analysis of these data in this thesis serves as an example of how existing research can be revisited and reevaluated in the face of changing theoretical and scientific methods in archaeology. Expanding the discourse to include models of childhood in prehistory is one goal of this endeavor. Likewise, the need for access to additional data for case studies and comparable collections is reflected throughout.

In Chapter Two, an archaeological context is provided for the data presented later in this thesis. To make the interpretations more meaningful, the social milieu and themes from the Bronze and Iron Ages in Europe will be discussed as well as evidence for changes in industrial methods and technologies in mining throughout prehistoric Europe. Though the case study site was a salt mining complex, it is important to discuss prehistoric mining of other resources, such as metal and flint, to demonstrate the similarities and differences that will need to be considered in comparative analyses of future data. Chapter Two also provides an overview of the site of Hallstatt and briefly details its history of excavation. This leads into a discussion of the types of evidence available at the site in Chapter Three. The parameters, definitions, and limitations of the data compiled and presented are also addressed. Chapter Three concludes with a discussion of how the theoretical approach outlined above can be applied to the data in preparation for the analysis in Chapter Four. Chapter Five discusses the secondary research questions presented above and considers how the results of the analysis can be used to address them. It also provides suggestions for future research on children and childhood in prehistory.

Chapter Two: Prehistoric Mining in Europe

Archaeological Context

Exploring children and childhood in prehistoric mining communities requires an understanding of the way technology and labor methods changed throughout time and the impact they had on social structure and how children fit into their cultural surroundings. Prehistoric Europe provides a good point of departure because there is an extensive corpus of scholarship about mines and mining technology from across the continent. Technical aspects of mining operations are a necessary element of studying mining communities. The choice to employ or not employ certain methods, tools, or technologies is deeply embedded in identity, politics, economics, religion, culture, and community in occupationally specialized communities (O'Brien 2015). When individuals make choices regarding technical operations, the technology, tools, and methods themselves become imbued with meaning and thus serve as intersections between the social and the material. Likewise, when new technical methods of operation are first introduced to a group, there are social connections and ramifications associated with the change (O'Brien 2015).

Bryan Pfaffenberger argues for the use of the *chaîne operatoire* model of studying mining communities. He sees technology as "not so much a matter of *things,* but of *activities"* (Pfaffenberger 1998:294). Employing this lens in the study of individuals in mining communities puts personal interactions between members at the center of the operation. Including children in the interpretation of mining communities helps conceptualize this approach. When employing theoretical frameworks involving socialization and phenomenology as described in Chapter One, we are ultimately concerned with how children experience the formal and informal transmission and negotiation of technical and social skills and knowledge. The *chaîne operatoire* represents a learned sequence of technical activities (Pfaffenberger 1998:294) and is therefore a useful way to approach socialization. This chapter on the technical elements of mining in European prehistory provides an industrial context for the study of children and childhood as an integral element of mining communities (Arboledas Martínez and Alarcón García 2015:105).

Mining in Prehistoric Europe

The introduction of mining marked the beginning of major changes in social structure in the Chalcolithic and Early Bronze Ages in Europe (Arboledas Martínez and Alarcón García 2015:105; O'Brien 2015:250). The extraction of new raw materials, copper and tin, and the circulation of the finished bronze metal goods, resulted in noticeable changes in social differentiation as well as the expansion and reconfiguration of interregional trade both north of the Alps and in the societies of the Mediterranean (Cunliffe 2008:155-156). Likewise, mining and trading salt became sources of great wealth for communities with access to these deposits (Kern et al. 2009). As the demand for raw materials such as metal and salt grew from the late Neolithic into the early Bronze Age in Europe, communities involved in extraction activities became increasingly specialized in their techniques and organization. What began as a rural industry, perhaps employing only a small number of miners on a seasonal basis, developed into proto-industrial operations that included every member of the community (Shennan 1998). Table 2.1 summarizes the timeline of prehistoric stages based on changes in technology between 2500 BC and AD 100.

The identification of mining sites and the investigation of the logistics of mining methods both require an understanding of geology and new techniques in site modeling (Kowarik et

Table 2.1. A general chronology of European prehistory dating back to 2500 BC. For more comprehensive chronological tables including further breakdown of the included regions see Cunliffe (2008), Fokkens and Harding's (2013) edited volume, and Price (2013). The highlighted area denotes the general timeframe for the present case study.

DATE	Iberia	Central Europe		Scandinavia	British Isles	DATE
2500 BC	Chalcolithic	Neolithic		Neolithic	Neolithic	2500 BC
2400 BC					Chalcolithic	2400 BC
2300 BC						2300 BC
2200 BC	Early BA					2200 BC
2100 BC		Early BA	Bz A1			2100 BC
2000 BC					Early BA	2000 BC
1900 BC			Bz A2			1900 BC
1800 BC	Middle BA					1800 BC
1700 BC				BA: Phase I		1700 BC
1600 BC						1600 BC
1500 BC	Late BA	Middle BA	Bz B	BA: Phase II	Middle BA	1500 BC
1400 BC			Bz C1			1400 BC
1300 BC			Bz C2	BA: Phase III		1300 BC
1200 BC			Bz D			1200 BC
1100 BC	Final BA	Late BA	Ha A1	BA: Phase IV	Late BA	1100 BC
1000 BC			Ha A2			1000 BC
900 BC			Ha B1	BA: Phase V		900 BC
800 BC	Iberian IA	Early IA (Hallstatt Period)	Ha C1a/b			800 BC
700 BC			Ha C1b/C2	BA: Phase VI	Early IA	700 BC
600 BC			Ha C2/D1			600 BC
500 BC		Late IA (La Tène Period)	Ha D2/3, LT A	Pre-Roman IA		500 BC
400 BC			LT A/B			400 BC
300 BC			LT C1		Late IA	300 BC
200 BC	Carthaginian/Roman Period		LT C2/D1			200 BC
100 BC			LT D1/D2			100 BC
BC/AD		Roman Period		Roman IA	Roman Period	BC/AD
100 AD						100 AD

al. 2012; Lewis 1994; O'Brien 2015). In the case of non-coastal salt extraction, identifying areas rich in salt water springs, such as the alpine slopes near the sites of Hallstatt and the Dürrnberg, can help identify areas of possible mining activity. To locate early prehistoric lithic or ore mining sites, identifying landscapes where outcrops of metal or stone would have been visible to the occupants of that area is a critical first step (Lewis 1994:32).

In some areas, such as the Grimes Graves flint mining complex in Britain, evidence is easier to find due to the lack of tree-cover and the pocked appearance of the turf that covers ancient mine shafts (Figure 2.1). Along with the mines themselves, evidence of beneficiation, the post-extraction processing of metal ore, may indicate a high degree of community involvement (Miller 2007:150). Evidence of smelting ore also relies on landscape analysis. Not all mining sites would have had ready access to the requisite fuel sources needed to smelt ore into ingots on-site. This was the case at Great Orme, a copper mining area on the northern coast of Wales that has been dated to as early as 1400 BC (Lewis 1994:31). Evidence for manufacturing activities at Great Orme is scant as very little remains of the furnaces used to smelt the ore (Lewis 2004:36). The absence of timber and charcoal sources in the vicinity meant that the extracted ore was probably transferred to areas further south for smelting (Lewis 2004:36), potentially implying the

Figure 2.1 Aerial photograph of Grimes Graves, a former prehistoric flint mining complex in Britain. (Photo credit: Alan Denney 2017, https://www.flickr.com/photos/alandenney/35092898686) Commons.

existence of other types of specialized community operations, including metal manufacturing and material transportation.

Throughout the Bronze and Iron Ages, communities that were permanently settled in mining activity areas increased in size (Shennan 1998:203; Stöllner et al. 2003:149). A stable political system and effective management of mining and processing activities were essential in maintaining these communities, especially those relying on outside resources for subsistence (Miller 2007:149; Stöllner et al. 2003:128). The prehistoric salt mines of the Austrian Alps area are a good example of this. The sites of Hallstatt in the Early Iron Age and the Dürrnberg after 600 BC are both mining sites with associated cemeteries and in the case of the Dürrnberg, a settlement area as well. Both sites needed to be supplied with food, at least in part, from outlying areas, likely facilitated by trading raw materials extracted from the mines (O'Brien 2015:247; Stöllner et al. 2003). Regardless of where the subsistence materials came from, members of the mining community would still have been responsible for preparation and logistical activities. The complex trading requirements necessary for sustaining large permanent populations would have required a stable and efficient organizational system with leaders who were well-versed in both domestic and long-distance trade.

The phenomenon of symbiotic intercommunity trade that sustained permanent salt mining populations also extended to metal ore mining sites. Examples of potentially large-scale enterprises include the Great Orme in northwest Wales (1800-600 BC), Peñalosa in Spain (2000-1600 BC), and the Mitterberg in the Austrian Alps (1700-1000 BC) (Arboledas Martínez and Alarcón García 2015; Barber 2003; Johnston 2008; O'Brien 2015; Price 2013). These specialized proto-industrial communities required a great deal of logistical support from agricultural communities capable of producing excess food. In addition to their dependence on neighboring communities for sustenance, burials at Hallstatt and the Dürrnberg show evidence of a great deal of wealth imported from outside the region (Kern et al. 2009; Stöllner et al. 2003), indicating the existence of long-range trading networks.

Understanding the way mines were worked illustrates the organization and specialized knowledge required in the industry (see Table 2.2). General knowledge of the layout of the

Table 2.2. A list of metal production activities (adaptable for salt mining), some of which could have been carried out by children (Miller 2007:146; O'Brien 2015:29, 237; Schibler et al. 2011).

Stages of Metal Production at Bronze Age Mining Sites	Associated Activities
Raw Material Procurement and Preparation	• Prospecting for sources of ore • Gathering of water • Gathering and/or production of fuel – wood and charcoal • Tool making • Carpentry and construction and maintenance of physical infrastructure
Metal Ore Extraction	• Fire-setting • Hammering mine faces • Collecting ore • Hauling ore, rock and equipment (pushing/pulling/lifting) • Logistical support (drainage, lighting, ventilation)
Material Preparation	• Ore beneficiation (crushing, pulverizing, hand/water sorting) • Fuel and flux preparation • Manufacturing of crucibles, cores, models, and/or molds • Building of smelting furnaces • Transporting slag-sand away from the smelting furnace
Community Supporting Activities	• Food and material procurement from surrounding areas • Food preparation • Animal care (when animals were kept for either food, milk, or as labor animals) • Transportation • Repair of tools and shelters • Mining and production related rituals • Childcare

mines and the use of very narrow passages have been the primary lines of evidence used to suggest the participation of children in underground mining activities in recent literature (Kowarik et al. 2012; O'Brien 2015). For example, at the Great Orme mine, either adult miners were being chosen for specific tasks based on their stature, or children were being put to work underground (Barber 2003:111). The use of children in processing activities, attested ethnographically and historically, is more difficult to identify based on archaeological evidence alone.

Early subsurface mining activities did not require sophisticated tools (Miller 2007:148), but the specialized knowledge of how to build the infrastructure to support and maintain stable passageways, work mine faces effectively, and process raw materials efficiently would have been something adults imparted to the next generation of miners within their communities. Just as important as productive use of time and resources was a general knowledge of the inherent dangers of mining, including flooding or collapsing of mine shafts and the dangers of noxious fumes (Miller 2007:148). As with agricultural and domestic activities learned at a young age, the activities associated with mining for children in these communities would have been an integral part of social reproduction and intergenerational continuity in techno-cultural practice.

Resource Extraction in Prehistoric Europe

Flint

Underground mining technology in Europe predates the exploitation of salt and metal ore. Flint mines show evidence for the early use of pit-mines, mine shafts, infrastructure, and other elements that are found in later mining activity (Kern et al. 2009:46). During the Neolithic period flint mines were mostly seasonal operations, perhaps only locally utilized (McIntosh 2006:206-207). While the surface gathering and shallow extraction of stone to make tools dates back tens of thousands of years, mining activities accelerated with increasing levels of technological sophistication in Europe following the adoption of agriculture around 7000 BC (O'Brien 2014:1). The earliest known Neolithic mining site in Europe is Casa Montero in central Spain. Though over 3,500 vertical shafts have been identified, it is estimated that the site was only worked for a few centuries. Radiocarbon dating of wood charcoal and ceramic analysis suggests the mines were in use between 5400 and 5000 BC (Diaz-del-Rio et al. 2006:2). The majority of the shafts were shallow, averaging one meter deep, while the deepest shaft measured seven meters (Diaz-del-Rio et al. 2006:3). The four flint layers embedded in clay stone would have been relatively easy to quarry with rudimentary bone and antler tools. Evidence of back-filled shafts suggests chert nodules were selected and preliminarily processed on-site, likely to reduce the amount of material necessary to transport (Diaz-del-Rio et al. 2006:3). Despite the shallow depth of the shafts at Casa Montero, social cooperation would have been necessary to quarry, mine, process, and transport the material (Diaz-del-Rio et al. 2006:5).

Quarries and open pits were mined between 4400 and 2000 BC at the site of Spiennes in Belgium, the largest concentration of ancient flint mines in Europe with an estimated 20,000-30,000 pits and shafts (Price 2013:166-167). The output from the mines would have far exceeded the needs of local populations and may signify a community occupation supported through trade and labor specialization. A nearby fortified Late Neolithic settlement could have been the permanent home of miners and craftsmen. Evidence of the manufacture of long flint blades and polished axes suggests that the settlement was a self-contained workforce and potential trade center (Price 2013:168).

Spiennes also provides an example of how dangerous flint mining operations could be. The top layers of earth quarried to make shafts were soft and needed to be wide with sloped walls (Price 2013:167). The risk of collapse was high and skeletal evidence found in collapsed shafts is a reminder that these endeavors were not always successful. Shafts tended to narrow as the sediment into which they were quarried became more stable, but the building and maintenance of solid scaffolding would have been an ongoing activity. One difference between the mines at Spiennes and other contemporaneous mines is the lack of horizontal galleries connecting the shafts. This would have limited ventilation and, consequently, the depth at which the shaft could be worked. Ceramics and faunal remains inside the mine shafts indicate that miners were eating and drinking while working (Price 2013:168). Evidence exists for votives being left in unproductive or collapsed mine shafts as early as the Neolithic, where at Grimes Graves a collection of ritual materials was found together in one gallery (McIntosh 2006:207). Ethnographically, where data are available from various metal mining sites in Africa, evidence for the ritual activity increases with deeper shaft mining (Herbert 1998:149). There also seems to be a higher degree of ritual involved in communities with strong divisions of labor based on gender, or where pyrotechnic manufacturing was taking place near the mines (Herbert 1998:149).

In his comparative analysis of working models for the flint mining sites of Ryckholt-St. Geertruid in the Netherlands and Grimes Graves in England, Felder (1981) explored how the depth and shape of mine shafts, and the number of galleries, allow the number of individuals necessary to carry out the operation and the likely daily output to be estimated. Both sites contained over 1,000 vertical shaft mines at least two meters deep. Ryckholt-St. Geertruid, in use between 3150 and 3050 BC, showed changes in working methods depending on the depth of the shaft (Felder 1981:59-60). In general, the methods focused on maximizing daily output of material instead of minimizing the length of time extraction took place. In contrast, miners at Grimes Graves, in use between 2200 and 1800 BC, employed working methods that minimized the time spent mining instead of maximizing daily output. This is illustrated by the shape and depth of the mine shafts. Mines at Grimes Graves had a conical shape, with more galleries, making hoisting materials with ropes nearly impossible and suggesting the use of ladders for transport out of the shafts (Felder 1981:57-58). Despite the labor involved, the method at Grimes

Graves would have resulted in faster quarrying and allowed for more time being spent extracting flint. More individuals would have been needed to move the increased amount of material in the shafts to reach the deep flint layers (Felder 1981:58), which could have implications for the presence of children in the labor force.

Differences in working methods also could be weather-related, as the mining season would have been shorter in Britain (Felder 1981:62). Felder's comparative study demonstrates that despite the differences in working methods, evidence from both Ryckholt-St. Geertruid and Grimes Graves indicates that Neolithic flint mining was a well-organized operation with specific objectives and a host of unique variables. Although Felder suggests at the end of his analysis that investigation into the social implications of these working models would be a worthwhile endeavor, he considers the discussion outside the scope of his work. Neolithic flint mining may have been an activity only undertaken by adults due to its seasonal nature, although entire families could have been involved in a more transient way. Mining activity may have been seasonally dependent on the agricultural cycle, or it could have been undertaken mainly by individuals with specialized knowledge of mining and flint knapping as a trade.

The lack of cemetery and settlement evidence from most prehistoric flint mining areas makes it difficult to know if child participation in mining activity was uniquely developed in areas of year-round resource extraction. One exception is Mauer-Antonshöhe in the St. Veit Klippenbelt region of Austria where evidence exists for the presence of children at the mining site (Trnka 2011:288). Seven individuals were discovered buried within the mine shafts. One was buried in back-fill, the other six in unfilled shafts. The individuals included a child (9-10 years old) and a neonatal infant in addition to two adult males and three adult females, all aged between 25 and 35 years old. The child and the infant were discovered in the same grave (Grave

1) along with a fragmented ceramic vessel. The other five burials were all individual graves, one being composed of scattered skeletal remains only, the remaining four all accompanied by ceramic grave goods (Trnka 2011:288).

Stylistic ceramic analysis and radiocarbon dating of the skeletal material dates the Mauer-Antonshöhe mines to the second half of the fifth century BC (Trnka 2011:288). This suggests the burials are contemporaneous with the mining activity and while we cannot say children were involved with mining at this site, they were clearly present and could have been active participants. Additional non-mortuary related artifacts recovered from the mine shafts include picks and antler fragments, stone axes, hammer stones, debitage and chert flakes of various geographic origins (Trnka 2011:288-289).

While a handful of other European mining sites have produced skeletal material, preservation and poor recovery techniques have prevented meaningful analysis (Trnka 2011). At Mauer-Antonshöhe the primary disposition of the burials was not recorded but was recreated based on photographs after discovery by mine workers (Trnka 2011:287). Despite potential problems with the integrity of the reconstructions, the presence of juvenile and adult burials within the mine shafts is intriguing for several reasons. Unlike skeletal remains found in collapsed mine shafts at sites like Spiennes in Belgium, the burials at Mauer-Antonshöhe were deliberate inhumations. Their presence in the mine shafts versus a more traditional cemetery site may signify a special connection between the individuals and the mines or may have had some spiritual significance for those individuals. In this example, the presence of an infant makes it unlikely that the burials were related exclusively to labor activity. What is discernible is that entire communities were aware of and had access to the flint mines and that the mines played an integral role in the lives of those individuals on a spiritual and cultural level.

Metal

The Chalcolithic period in Europe is the time between the Late Neolithic and the Early Bronze Age when native copper was starting to be used to create ornaments. Early copper mines from this period are known at sites as far apart as Aibunar in Bulgaria and Mount Gabriel in Ireland (McIntosh 2006; O'Brien 2015).

During the Chalcolithic we see evidence of metal working (particularly copper and gold) being accompanied by Bellbeaker and Cordedware pottery, ground stone battle axes, and the introduction of the single-grave culture (Heyd 2013:63). The wide distribution of these objects and traditions is likely due to increased migration of individuals and whole families, as well as diffusion and trade. Recent analysis of DNA from 683 prehistoric individuals ranging from the Neolithic to the Bronze Age provides new insights into the movement of people during this time period. While the Neolithic populations of Britain shared much of its DNA with its Iberian counterparts, the Bell Beaker phenomenon was characterized by the migration of central Europeans into Britain that almost entirely replaced the original population's genetic signature. Equally surprising, the Bell Beaker culture in Iberia does not have a genetic relationship with that of Britain (Krakowka 2018). This movement of people happened on a large scale beginning in the mid-third century BC and was intimately connected with technology transfer associated with metallurgy. Evidence of contemporary migrations has been supported by strontium and oxygen isotope analysis in southern England (Evans et al. 2006), with evidence of groups consisting of local children and nonlocal adults.

As mining operations and trade routes improved, the use of arsenic and tin bronze increased and ushered in the European Bronze Age (Figure 2.2). Mastering the technology involved in ore extraction, beneficiation, and the manufacturing of metal implements had major implications for societies around the world. Metal implements increased efficiency in agricultural activities, intensifying production and freeing up labor for other activities. With an increase in productivity, larger populations could be supported, making possible the transition from small-scale farming communities to occupationally specialized communities and later semi-urban centers built on trade wealth (Cunliffe 2008:181-183).

Figure 2.2 Map displaying Bronze Age European locations of raw material resources (McIntosh 2006:64).

Metal objects, both functional and ornamental, carried ritual and spiritual significance. There is evidence of offerings being intentionally placed in areas such as kilns, mine shafts, galleries, and dwellings, indicating the supernatural connotations of the transformative nature of metal and metal working (Brück and Fokkens 2013:91; O'Brien

2015:255-260). The single-grave burials are significant as they represent a move away from communal burials to a more individualistic mortuary tradition in the Bronze Age (Kähler Holst et al. 2013). There is extensive evidence of metal jewelry being used as an indicator of status and wealth, as well as to differentiate individuals based on age or gender in the burial record throughout the Bronze and Iron Ages in Europe (O'Brien 2015:260-262). Hodson's (1990) material analysis of the grave goods found at the Hallstatt cemetery noted patterns of burial assemblages that denoted status and gender differentiation. Objects such as bracelets and fibulae, along with the presence of weapons in burials, informed his interpretations. Hodson's analysis and his contributions to the development of the case study dataset used for this thesis below will be discussed in Chapter Three. Given the functional value of resources being extracted and new material goods being traded, it is not surprising that richly outfitted burials began to appear in the Bronze and Iron Ages. In cases such as Hallstatt, this included the graves of children accompanied by items of value such as amber and glass beads, pendants, and bronze rings. The topic of children's burial goods at Hallstatt will be discussed at length in Chapter Four.

From the late Chalcolithic through the ninth and eighth centuries BC, bronze was the strongest metal available in Europe, eventually replaced by iron for tools and weapons. It is thought that the production of bronze initially developed by accident as arsenic-rich copper ore was processed and subsequently created an alloy that was stronger than copper and could be recycled many times without losing its structural integrity (O'Brien 2015). Tin later replaced arsenic as the main element used in bronze alloys because of its added strength, though arsenical bronze remained in use. While it may be impossible to know for sure, the replacement of arsenic with tin may at least in part have been due to the adverse health effects of working extensively with arsenical copper (see Table 1.2 for a summary of toxicological effects of arsenic on human health).

After the eighth century BC, iron was mined and forged more regularly (McIntosh 2006:224). Large-scale iron mining sites are rare as most iron ore could be gathered on the surface or in shallow pits, though some iron mine shafts exist in the Eastern Alps and other areas of Europe (McIntosh 2006:224; Price 2013:296). Though the ore was easier to obtain and far more readily available, the energetic cost of processing and manufacturing iron was more complicated. Iron is stronger when heated in the presence of carbon (Price 2013:296) and could not be recycled in the same way as bronze because Iron Age craft workers could not achieve the extremely high temperatures required to cast it. Bronze therefore continued to be used widely throughout Europe in the Iron Age for implements and adornments that required casting, such as socketed axes, horse and wagon gear, and ornate jewelry.

Mining and post-extraction processing of metal both require specialized training to maximize output and minimize the risk of injury. With this new specialization came changes in the composition of social groups and the way labor was organized. Opportunities for individuals to specialize in other areas would have resulted from the increased demand and rapid output of material. Some of the possible occupational specialties would have included timber felling, charcoal burning, construction, smelting, and the transportation and trade of raw and finished materials. Hoards of metal items have been found throughout Europe, often along trade routes (Shennan 1998:201), perhaps signifying the way individuals conducting trade kept their wares safe while making the long journey between settlements. Because many trade routes fall along major waterways there was also a need for more advanced water transportation and specialized manufacture of boats, rafts, and tools for portaging or moving between land and water.

Labor specialization was frequently a family affair in later periods, as evidenced by surnames that developed to differentiate families based on their collective occupation. A few English examples include Cooper, Smith, Carpenter, Faulkner, Fisher, Glover, Mason, and Wright. In German, names like Kohler, meaning someone who burns charcoal, and Bergman, which translates to miner, both have mining and metal-working connections. Prior to urbanization and the development of more modern types of apprenticeship, children would likely have been trained in a family trade, whether that was toiling in mine shafts, smelting and forging weapons, designing intricate metal ornaments for the elites, or any number of trades and crafts that developed throughout prehistory. It is worth noting, however, that we know very little of how technology transfer operated, whether it was through formal apprenticeship or a more informal, kin-based system of training, though Lancy's (2015:210) model of "autonomous learning" would suggest the latter was more likely for small-scale mining communities. There is also an argument to be made for maintaining familial specialization based on the technically complex skillset necessary to safely and efficiently maintain a mining operation. While tasks such as hauling mineral ore or slag from the mine galleries would not have required any advanced skills, there are specific dangers in working underground, and being able to recognize these and avoid catastrophe would have taken a fair amount of training (O'Brien 2015).

Mining involves a number of tasks that children could have carried out that would have allowed them to watch adults work, thereby learning both directly and indirectly about the intricacies of working underground. One example is the task of keeping tapers lit (Pany-Kucera et al. 2010:56; Reschreiter et al. 2013:31-32). The light inside underground galleries at Hallstatt was provided at least in part by wood tapers that were lit one after the other. There is limited evidence of dental impressions on the ends of some of these tapers, the remnants of which are bountiful inside historically and archaeologically documented mines (Barth 1988:44). While individuals working the mine faces might have held their own lit tapers in their teeth, it was more likely that it was another person's job to hold and light the tapers. A child could have easily performed this task, and simultaneously watched the process of resource extraction first-hand without being in the way of the operation. Similarly, those children large enough to carry a leather sack (Kern et al. 2009:60; O'Brien 2013) may have joined in line with adults carrying slag or salt from inside the mines to the processing area, the children gradually building strength and endurance. These are only two examples of tasks that may have been delegated to children. Whether the children performed only the same activities as their parents, or whether they had free will to choose their occupational position is currently undiscernible.

What we know from historical and ethnographic data is that mining has long been considered a community specialization (Knapp 1998). In many parts of the world mining communities have been built on this occupational identity (Douglass 1998:107) with the expectation that as long as resources existed, children would take over for their parents in extracting it. When archaeological narratives shift from portraying mining as simply an industry or occupation to discussing it as a socially defining community activity, it becomes clear that children would have been integral to the future of this unique, and often very isolated or marginal, way of life.

Salt

Mining, processing, and trading of salt was similar in many ways to metal extraction during the Bronze and Iron Ages in Europe. Salt, an essential food preservative and flavoring, was a much sought-after commodity in many parts of the prehistoric world. The preservative nature of salt was understood long before underground mining was used to extract it (Kern et al.

2009; Stöllner et al. 2003). Prior to mining (Figure 2.3), salt was extracted from water, either from sea-water in coastal regions or from salt-water springs in regions such as those near Hallstatt in the Alps. Early salt extraction techniques included briquetage, a system of heating salt water in single-use ceramic vessels over a furnace until the water had evaporated and the salt crystals formed a cake that could be collected via breaking the vessel (Kern et al. 2009:46). There are other evaporative techniques that do not require the use of ceramics, including a system of soaking large-pored vegetation in salt water, then burning the stems to release the salt

Figure 2.3 *Lebensbild* depicting Bronze Age mining at Hallstatt. (Copyright Dominic Gröbner and Hans Reschreiter, Natural History Museum Vienna, 2008) Commons.

crystals, as observed in areas of New Guinea (Kern et al. 2009:47). These evaporative extraction techniques leave less archaeological evidence behind but are well documented ethnographically and historically in regions such as Romania, Malta, Mexico, and Papua New Guinea (see Harding [2013] for review of ethnoarchaeological evidence).

Underground salt mining developed in areas where salt water springs were likely already being exploited. While no direct evidence currently exists, deep-shaft salt mining could have been practiced as early as the Late Neolithic, given what we know about the technological knowledge available at flint mining areas in the Alpine regions of Bavaria and Austria (Kern et al. 2009:46; Trnka 2011). Large-scale underground salt extraction was very labor intensive and would have required specialized tools and techniques for efficient and safe removal and transport. In the Middle Bronze Age, evidence shows that salt was chipped off gallery faces onto the gallery floor where it was collected in leather bags or carrysacks and hauled to the surface (Figure 2.4) (Kern et al. 2009:60; O'Brien 2013).

Figure 2.4 Leather transport carrysack from the site of Hallstatt. There is evidence that these sacks were developed to fit the individual wearing them and included a stick along the side that could be pulled to dump the contents quickly (Kern et al. 2009). (Photo credit: *7000 Years of History at Hallstatt* exhibition 2013) Commons.

As picking techniques improved, so did the method of extraction. In the Late Bronze and Early Iron Ages there was a shift to using bronze and iron picks to carve deep grooves in the gallery face. Once the grooves were connected the salt within the groove would be chipped off as a solid plaque (Figure 2.5) then carried up flights of stairs or hoisted using a system of ropes for deep shafts. The salt plaques were quite large and there is evidence that they were tied to long sticks with rope and carried over one shoulder (Kern et al. 2009:54-55). Leather palm and finger protectors as well as thick ropes and wool fabric have been found on the floors of the Hallstatt mine galleries, indicating a well-structured chain of operation (Kern et al. 2009:56-61).

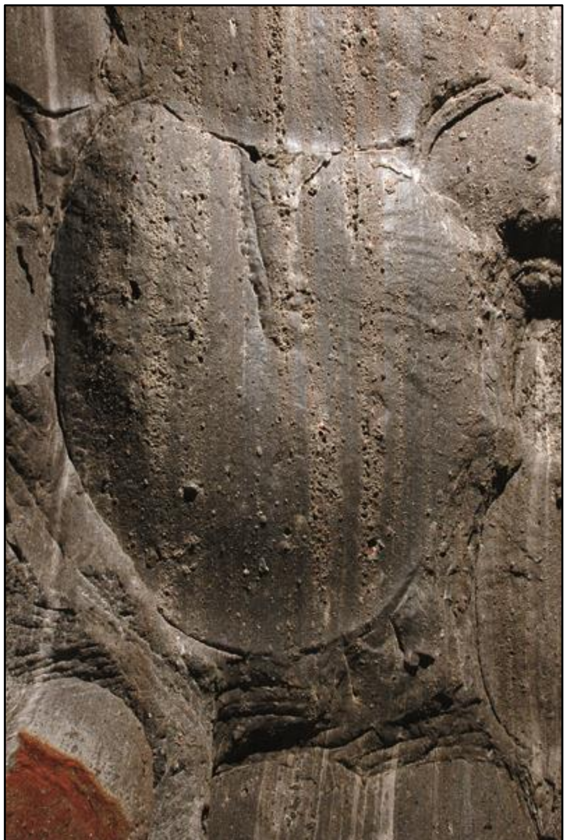

Figure 2.5 A heart-shaped salt plaque impression from the Early Iron Age mines at Hallstatt. (Copyright Andreas W. Rausch, Department of Prehistory, Natural History Museum Vienna 2008) Commons.

Summary

Research on life in the Bronze and Iron Ages in Europe draws on many archaeological subdisciplines. Extensive collections of biological and material artifacts from across the continent provide evidence for societal transformations including the emergence of elite classes, long distance trade, and divisions of labor. By synthesizing prehistoric evidence and historical and contemporary experiences of children in the context of labor and economic participation, we can make new connections about the treatment of children, their standing as individuals in their communities, methods of socialization in occupationally specialized societies, and the nature of age-specific divisions of labor. Though the focus of this thesis is prehistoric Europe, the framework presented is adaptable to other social, temporal, and geographic contexts.

In Chapter Three a working dataset is presented that was compiled from published research on the prehistoric cemetery at Hallstatt. The excavation timeline at Hallstatt demonstrates changes in recording and analysis at the site. How these changes contribute to the available data for children in the cemetery will be outlined, followed by a brief description of the methods of analysis used by previous researchers demonstrating the utility of such a data compilation.

To date, there is no comprehensive, publicly available dataset addressing children specifically and holistically at the site of Hallstatt. This thesis proposes that the data available represent an important starting point for understanding the social contexts of prehistoric mining communities. Application of the child's world theoretical framework to the social and technical contexts outlined above, tested against the data from the Hallstatt cemetery, serves as the basis for the analysis presented in Chapter Four. Finally, the relevance of this analysis to the study of mining communities as special microcosms, melding occupation with group identity for which there is global historical and ethnographic evidence, is discussed.

Chapter Three: Methodology

The Late Bronze Age/Early Iron Age salt mining site of Hallstatt in Austria was chosen as the case study for integrating the theoretical framework of the child's world in prehistoric mining contexts. A major component of the analysis is based on the data available for children buried in the Hallstatt cemetery (Table 3.5). This dataset combines information drawn from both antiquarian and modern excavations and illustrates the level of confidence with which inferences might be made about the childhood experience at Hallstatt. The variables include all information available for each burial in current and historical publications, including skeletal and material evidence. A standardized age-group designation system was employed to reconcile the individual designation strategies of each source. The goal in compiling a single comprehensive list of the available data was to organize the information in a way that addresses the following questions:

- At what age do physical indicators of labor appear?
- What areas of the body are most likely to be affected by wear and trauma?
- Are patterns of wear and trauma identifiable over time?
- Can we differentiate between potential activities at various age ranges?
- Is there evidence to suggest that some activity was based on body size?
- Are child labor activities linked to specific burial treatments?

If the skeletal evidence can provide insight into the above questions, the next step is to test it against the material evidence accompanying children in mortuary contexts. Patterns linking the biological and material evidence enable a larger narrative that incorporates theory and analogy to better understand the child's world in prehistoric mining communities. The first section of this chapter introduces the case study site, after which the dataset is introduced, and data parameters are discussed. The chapter concludes with a discussion of how the dataset helps to inform the research questions posed in Chapter One.

Case Site: Hallstatt, Austria

The Late Bronze Age-Early Iron Age salt mining community of Hallstatt is the type site for the Early Iron Age Hallstatt cultural period in central Europe (Figure 3.1). The site was occupied year-round and mined for salt between 1000 and 600 BC, after which evidence shows the mining settlement was abandoned, and major salt mining operations reemerged in the Dürrnberg area (Hodson 1990; Malin-Boyce 2004:144). One reason cited for the decline of mining activity at Hallstatt is the rise of the Dürrnberg as a salt mining site better positioned for

Figure 3.1 Area of the Early Iron Age Hallstatt culture with modern political borders. Copyright K. Grömer, Department of Prehistory, Natural History Museum Vienna (Hartl et al. 2015:572) Reproduced with permission.

communications along trade routes (McIntosh 2006), although flooding of the mine shafts caused by a combination of climate change and over-exploitation seems more likely (Kern et al. 2009:157). An Early Iron Age community cemetery of up to possibly 5,000 burials, both cremations and inhumations, make this site an ideal case study for an investigation of prehistoric mining communities.

The cemetery evidence indicates a demographically normal population including individuals of all ages and roughly equal numbers of women and men (Hodson 1990; Kern et al. 2009; Pany 2003). Burials often included grave goods, some quite lavish, including imported items indicative of extensive trade connections (Hodson 1990). A population of between 200 and 400 people at any one time indicates that an advanced management system must have existed to ensure safe and efficient mining operations and to maintain social order. Though social stratification increased during this period, well-equipped burials belonged not only to elites but to those who worked in the mines as well (Pany 2003; Kern et al. 2009). Labor induced markers on the skeletal remains in well-outfitted graves contradict the original theory that mine workers belonged to a lower or slave class, as discussed below.

The Upper Austrian Salzkammergut region near the present-day city of Salzburg is home to the modern village of Hallstatt (Figure 3.2), situated on the shores of a lake with the same name, at the foot of the Dachstein mountain (Figure 3.3). The entire region is dotted with lakes and there are alpine ranges with natural saltwater springs present in the valleys throughout the area. The High Valley above the present-day village is where the archaeological site of Hallstatt is located. Stone axe and deer antler tools indicate that the High Valley was occupied continuously from the beginning of the Neolithic period 7000 years ago until the site was

Figure 3.2 The present-day village of Hallstatt at the foot of the Dachstein mountain (Copyright Csakany 2007). Commons.

Figure 3.3 Hallstatt. Copywrite Luftbildarchiv [Aerial Archive], Institute of Prehistoric and Historical Archaeology, University of Vienna (Hartl et al. 2015:570). Reproduced with permission.

abandoned in 600 BC (Kern et al. 2009:14). While there is no direct evidence of underground salt mining prior to the Middle Bronze Age, antler picks (Figure 3.4) that could have been used for extraction have been found that are similar to those used in regions of Bavaria in extensive Neolithic flint mining operations (Kern et al. 2009:47). Until underground mining became commonplace, the people of the Hallstatt region likely used other extraction techniques such as briquetage to separate salt from the spring water (Kern et al. 2009:46). The mining complex, its associated cemetery, meat processing area, and later settlement evidence at the Dammwiese make Hallstatt an important site for studying changes in prehistoric European culture and technology.

Salt Mines and Preservation

One of the most extraordinary things about Hallstatt as an archaeological site is the degree of artifact preservation. The same salt extracted from the mines to preserve and season food also preserved organic material left inside the mine galleries. Materials that would otherwise have deteriorated such as clothing, shoes (including some examples that could have belonged to children), leather bags, wooden pick shafts, tapers for lighting torches and fires, food, excrement, rope, and ladders persist along with the more commonly found bone, metal, and stone artifacts (see Barth 1992; Boenke 2005; Kern et al. 2009; Reschreiter et al. 2013; Stöllner et al. 2003). Like the salt mines at the Dürrnberg in Austria and the Iranian Cher Abad salt mine, human bodies mummified in salt have also been recovered from the mines at Hallstatt (Kern et al. 2009:40-41). Unfortunately, having been discovered prior to the development of modern archaeological methods, the salt mummies at Hallstatt, including the famous “Man in the Salt” discovered in 1734, were reburied by the local

Figure 3.4 Antler pick from Hallstatt region, radiocarbon dated to approximately 5000 BC. (Copyright Andreas W. Rausch, Department of Prehistory, Natural History Museum Vienna) Commons.

church in a Christian cemetery near the modern village (Kern et al. 2009:40). There is, however, a very good chance that more individuals yet to be recovered have also been preserved in the mines, likely victims of gallery collapses or landslides.

Types of Evidence at Hallstatt

The degree of material preservation at Hallstatt means an unusual diversity of evidence has been discovered throughout the complex. The abundance of material provides clues of the kinds of activities that were carried out in the mines. Table 3.1 highlights the various categories of archaeological material and provides examples of each. What is interesting to note is that in the literature on the site, there was little discussion of children until very recently (Kern 2010; Kern et al. 2010; Pany-Kucera et al. 2010; Reschreiter et al. 2013). Table 3.1 therefore includes a column noting whether any connections between evidence found at the site and children have been made explicitly to date. How the available evidence can be approached is discussed in Chapter Four.

Sources of Evidence

Excavation History

Much of the information available from the prehistoric site of Hallstatt comes from two distinct datasets. The first consists of the early excavations conducted between 1824 and 1907, and secondary interpretation by later scholars including Kromer (1959) and later Hodson (1990) (Table 3.2). The second set of data comes from more recent excavations conducted using modern archaeological methods, which includes many of the biological remains and artifacts necessary for systematic analysis of activity. Unfortunately, the lack of properly curated skeletal material from the 19th century excavations makes it nearly impossible to substantiate or refute some of the estimations of age and sex of individuals found at that time. This is not an uncommon

Table 3.1 Categories of archaeological evidence available at Hallstatt.		
Evidence Type	**Examples available from Hallstatt**	**Evidence related to children in prehistory [and sources]**
Biological (in burials as well as mine shafts and galleries)	Skeletal evidence Excrement Food residue	Skeletal pathology of juveniles at Hallstatt (Pany-Kucera et al. 2010; Reschreiter et al. 2013)
Material (in mine shafts and galleries)	Leather • Shoes • Hats • carry-sacks • palm protectors Rope Lighting tapers Bronze picks Antler picks Textiles	Leather shoes of children identified at Hallstatt and in the Dürrnberg salt mines (Barth 1992; Reschreiter et al. 2013; Stöllner 2003; Watson 2018) Child's leather cap from the Hallstatt mines (Watson 2018) Lighting tapers and dental impressions (Barth 1988; Reschreiter et al. 2013) Child-sized mining picks (Watson 2018)
Mortuary (in burials)	Weapons • swords • daggers • spears • arrows Amber beads Metal vessels Metal ornaments/jewelry Ceramics furnishings	Grave goods in juvenile burials (Hodson 1990; Kern 2010, Kromer 1959)
Other (in mine shafts and galleries or near the mines)	Structural elements • meat processing structure • scaffolding • ladders • stairs	None explicitly linked to children or their activities

predicament, as many prehistoric mines were discovered by developers and mining engineers who sometimes conducted their own avocational excavations. Most of the later analyses carried out using the data collected by Ramsauer and others (see below) focused on whether the material and mortuary data reflect differentiation based on gender, status, and sometimes age (Hodson 1977, 1990; Pauli 1978; Wells 1994). Despite improvements in the recovery and handling of prehistoric skeletal material by excavators that have increased the research value of excavations in the 20th and 21st centuries, it is difficult to integrate the earlier and later data sets in studies such as this one.

Residents of the Hallstatt region have been aware of prehistoric activity in the High Valley throughout history, with written references to the occasional discovery of ancient burials recorded as early as the Middle Ages (Kern et al. 2009). It was not until a general focus on antiquities developed in Europe that the 19th century salt mine supervisors at Hallstatt (*Bergmeisters*) and their crews became actively interested in unearthing burials in the ancient cemetery. Early explorations were periodic, opportunistic, and lacked discipline in recording and collecting practices (see Table 3.2 for a timeline of major excavations undertaken at the Hallstatt cemetery). In the latter half of the 19th century, excavations became more systematic and scientific with respect to recording techniques and attention

Table 3.2 Major excavations at the prehistoric Hallstatt cemetery from the 19th century onward (Kern et al. 2009:116-120, 150-155).

Excavator(s) and Institutions	**Years**
Karl Pollhammer	Between 1824 and 1831
Johann Georg Ramsauer (1795-1874)	Between 1846 and 1863
Gustav Schubert and Eduard v. Sacken	1864
Bartholomäus Hutter	Between 1868 and 1874
Isidor Franz Engl (1832-1918)	Between 1871 and 1907
Gustav Schubert and Josef Stapf	From 1871 to 1876
Josef Stapf and Ferdinand von Hochstetter	1877 to 1878
Franz von Hauer, Josef Szombathy and Bartholomäus Hutter	1886
The Hallstatt Museum Association	1884 to 1899
The Duchess of Mecklenburg (1856-1929)	1907
Josef Bayer	1928
Friedrich Morton (1890-1969)	Between 1937 and 1939
Kern & collaborators (at the Natural History Museum Vienna)	1993 to present

paid to context (Figure 3.5). Eventually, museums and other institutions took over the task of excavation management from mining professionals, and documentation continued to improve. Kern (2009:116-120, 150-155) provides a summary of research techniques, historical context, and known locations of the collections in *7000 Years of Hallstatt.*

Figure 3.5 Illustration of various inhumations from the Ramsauer excavation records for the Hallstatt cemetery, by I. Engl (Kern et al. 2008:128, public domain).

An important consideration in the history of research at Hallstatt is that the material collected and curated by excavators varied and oftentimes documentation was unsystematic, resulting in skewed data in the demographic profile of the cemetery. It is likely that some burials were not well recorded because their assemblages were not seen as significant. This may have been the case with a number of children's burials, which Hodson (1990:91) noted were often less well equipped with grave goods than their adult counterparts. This may have led to an underrepresentation of children in the Hallstatt cemetery and therefore in the available datasets as well. While unfortunate, there is at least some record of children's burials from the 19th and early 20th century excavations, even if some of the material has lost its provenience or was not curated.

To what extent the neglect of children's graves has contributed to the low numbers of juveniles represented in the Hallstatt cemetery is not easily determined. Until more representative samples are recovered systematically, as in the ongoing investigations led by Anton Kern and his colleagues at the National History Museum Vienna, we will not have accurate demographic data for child mortality rates or other factors that might change what is currently known about the presence and role of children in this early mining community. The effect of a potential underrepresentation of children in the Hallstatt cemetery does not substantially affect the arguments made in this thesis as the sample is not comprehensive and no assertions related to demographic patterns are made.

Recent Analyses

In his attempts to subject the descriptive information available for the early Hallstatt cemetery excavations to a quantitative data analysis, Hodson (1977, 1990) employed Ramsauer's 19th century *Hallstatt Protokoll* (unpub. 1846-1863) and Kromer's (1959) catalog compilation and organization of the data therein. Hodson (1977:411) recognized that the burial record indicated a demographically normal population. For the 1990 analysis, Hodson selected only those burials that were accompanied by illustrations in the *Protokoll* to make his sample size more manageable. These illustrations allowed him to include information about the relative position of objects in the graves, among other details. This subset of burials was then categorized according to burial treatment, grave quality, grave location, and material classification. In his analysis, Hodson proposed a hierarchy for status objects based on his method of subdividing both stylistic and functional material classifications. He concluded that the graves in the Hallstatt cemetery could be divided into two distinct groups: one characterized by weapons, tools, and dress pins, the other by bracelets, spectacle fibulae, beads, belt fittings, and hairpins. Hodson (1990:81,83) suggested that the former assemblage is associated with males and the latter with females. Hodson’s 1990 analysis provides a useful English-language synthesis of Ramsauer’s notes, but does not go into great interpretive detail about any potential social aspects other than the gendered nature of the object types and their indication of status.

While children’s burials are present in Hodson’s catalog, there is little mention of their significance beyond noting that their grave assemblages were generally less impressive than adult burials, although a few of the burials could be considered high status based on their material classifications (Hodson 1990:90). References to children’s burials in the analysis are not accompanied by age-group definitions beyond what is reported by Ramsauer in the *Protokoll*. Ramsauer used his own children’s heights as verification of age in his records (Kern et al. 2009:73). He also relied on visiting physicians for definitions of age, predominately based on dental development (Kromer 1959). For much of the early investigation into the cemetery at Hallstatt, the size of the individual buried, the size of a cremation, and the size of the grave goods (such as bracelets) were used to assign ages to individual burials (Kern 2010:70).

Hodson (1990:90) references a few juvenile burials that were described as containing weapons. There is reason to be skeptical about this. There is little to no prehistoric precedent for weapons in children’s burial assemblages in the central European Iron Age in (see Arnold [2016:847] for discussion of material from the Heuneburg). Likewise, the context for each of the burials in question is debatable. The four burials cited are:

- G204 – A multiple burial in which a spear point was discovered at shoulder height between the skeletons of a child and an adult. Additionally, two daggers with bronze handles and iron blades were found to the left of the adult (Kromer 1959:69), which is also an unusual find. In this case, the weapons in the grave most likely belonged to the adult individual.
- G313 – A young person judging from the teeth, Ramsauer recorded the individual as being four feet tall and found with four small ringlets and one iron spear point (Hodson 1990:145). However, the *Protokoll* entry provided by Kromer (1959:87) does not mention the grave as belonging to a juvenile despite the size matching the translation in Hodson. The grave goods are not currently in the collection. Additionally, Hodson (1990:90) reports the burial as being "disturbed". Though the skeleton seems to be rather small, this individual could be an adult. The use of the term "young person" in the *Protokolle* is vague and makes it difficult to discern if the individual was a child or a young adult.
- G657 – Ramsauer wrote in the *Protokoll* that the skeleton was four feet tall but was mostly destroyed. Judging from the teeth, Ramsauer claimed the individual was likely a young person, but he did not offer an estimated age. There was an iron spear point recorded as being next to the individual, but as Kromer (1959:140) reports, the grave goods are not in the collection today. Hodson (1990:90) reports the burial as being "greatly disturbed," which may indicate a secondary addition of material, or an intermingling of grave goods with another grave.
- G902 – Again, Ramsauer reports an individual three feet tall found with a broken bronze needle on the chest and an iron spearhead next to the head (Kromer 1959:173). The grave

goods are not currently in the collection. This could be one example of how skeletal size may be unreliable as an age indicator depending on whether the height estimate recorded was accurate, or only measured from the chest down, as in the example below.

If the above burials were indeed juveniles associated with weaponry, it would be particularly important to be able to make an age estimation. At this point it is uncertain if any of the skeletal material has been preserved and curated for the above individuals and if so, whether more recent efforts have been made to analyze them for more definitive age designation. Unfortunately, when trying to identify patterns in age ranges assigned to the Ramsauer graves and skeleton size, there was little continuity. Aside from many of the ages being estimated based on tooth development, there were few burials with associated skeletal size. Likewise, skeletal size was recorded for some burials but not given an age designation. Juveniles recorded as three feet tall ranged in assigned age from six to 10 years old, while one 10 to 11-year-old individual was recorded as being five feet tall. In one burial, the skeletal size was recorded, but only from the chest down (four feet) and had an estimated range of 10 to 12 years old. The small sample size and inconsistency with correlating age with skeleton size make positively identifying the above individuals as juveniles highly speculative. It is also important to consider, as discussed below, that while skeletal or dental morphology may be used to identify a chronological age-range, they do not necessarily reflect the individual’s social age.

Doris Pany-Kucera’s thesis research at the University of Vienna (Pany 2003) involved a subset (n = 99) of skeletons from the 215 individuals available at the time from the Hallstatt cemetery (Table 3.3; Figure 3.6). Her aim was to analyze musculoskeletal stress markers (MSM)

Table 3.3 Distribution of age and sex in the sample of 215 well-preserved skeletons recovered from the Hallstatt cemetery (Pany 2003:56, modified). Legend: Infant I: 0-6 years, Infant II: 7-14 years, Juvenile: 14-19 years, Adult: 20-39 years, Mature: 40-59, Elderly: > 60 years. Indet.: indeterminable

Age Class	n Males	n Females	n Indet.	n Total	%
Infant I	-	-	8	8	3.7
Infant II	-	-	21	21	9.8
Juvenile	-	1	10	11	5.1
Adult	26	25	19	70	32.6
Mature	35	11	39	85	39.5
Elderly	9	6	5	20	9.3
Total	70	43	102	215	100
% Total	32.6	20	47.4	100	100

using the system developed by Hawkey and Merbs (1995) to determine whether the individuals buried in the well-outfitted graves in the Hallstatt cemetery were also those working in the mines. Her analysis also compared MSM data for males and females to identify possible activities undertaken and to determine whether mining activities were gender-specific. To strengthen her argument, she compared her sample to four different Austrian cemetery sites ranging from the Bronze Age to the Iron Age, located in the High- and Low Valleys, where it is presumed that the communities were chiefly agricultural. In her initial investigation, only individuals identified as adults were included in the dataset. While 47% of the total sample was of indeterminate sex, Pany-Kucera's interpretation of the results was that mining-related

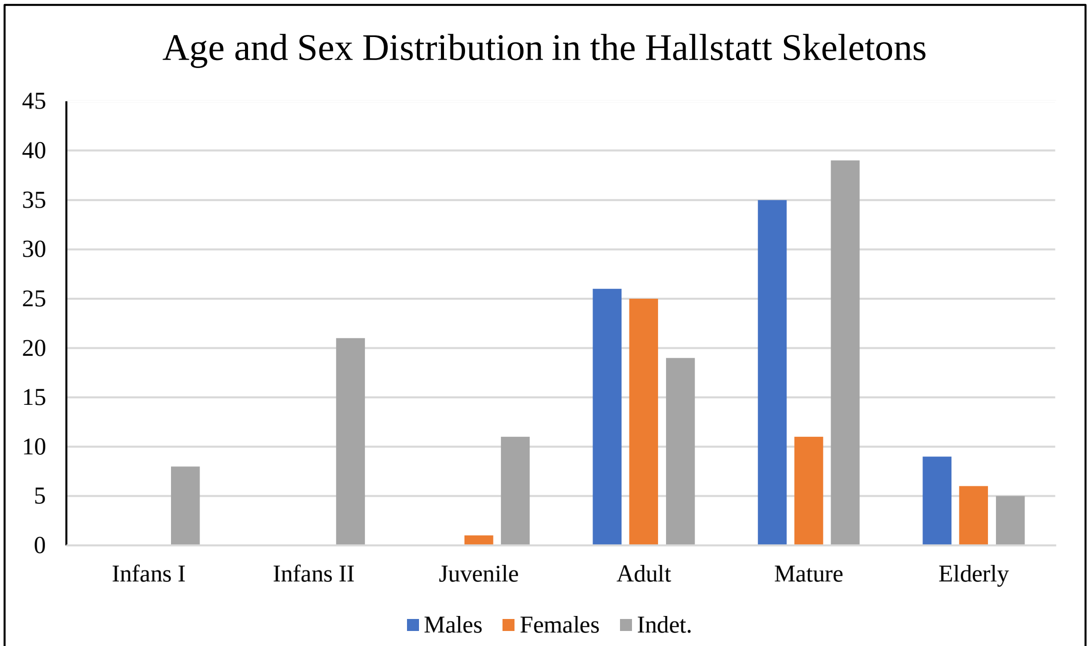

Figure 3.6 Age and sex distribution of the 215 well-preserved skeletons at Hallstatt as reported by Pany (2003:56-57).

activities were gendered, with patterns of markers that indicated specific repetitive body movements that could be associated with a range of activities (Pany 2003:60).

It is unclear why the "Juvenile" category (aged 14 to 19 years old), totaling 10 (or 11) individuals ranging in age from 14 to 19 years old, was omitted from the original analysis. While not always physically mature at that stage, it would stand to reason that individuals in their mid- to late- teens would have been capable of engaging in the full range of mining and related activities and that by that time they would likely have been fully associated with a specific gender group. This again could have been due to the preservation status of the individuals, or it was more likely a conscious decision to examine only individuals where the odds of accurate sex determination were high. In more recent research, Pany-Kucera, Kern, and Reschreiter (2010) extended the analysis of labor-induced MSM to the juvenile skeletons in the sample. Results of this analysis are detailed below.

Kern (2010) provides an analysis of the presence and participation of children in labor activities at the Hallstatt salt mines by reviewing and compiling data recorded during the Ramsauer excavations by way of the *Protokoll* and the watercolor illustrations by Isidor Engl. In his analysis, which includes data gathered from later excavations as well, Kern (2010:83) identified 160 subadults (aged 15 years old and younger) in the Hallstatt cemetery. These included inhumations and cremations from the most recent excavations as well. The Ramsauer excavations, limited to descriptions in the *Protokoll* and the accompanying illustrations, do not provide enough information about cremations, including the size of ash piles or bone fragments, to determine whether these burials were adults or subadults (Kern 2010:83). An important aspect of Kern's analysis for this thesis is the 15-year-old cap he places on the subadult category. In an effort to avoid confusion going forward, a standard lexicon for the present dataset will be presented and justified below.

Compilation of Child Burial Data

Data and Research Parameters

To make the available data more explanatory and to better illustrate the utility of such a small sample size, a simplified table is presented below (Table 3.5). This working dataset, as it is referred to throughout the thesis, serves as the jumping off point for a discussion of the experience of childhood at Hallstatt from the theoretical perspective of the child's world. The working dataset consists of a sample of 39 individuals out of a total of 181 graves containing the remains of juveniles as defined by the excavators. Kern (2010:70) outlines the criteria used to identify a burial at Hallstatt as belonging to a child as follows:

- Skeleton size or indication of the individual's height
- Size and development of bones and teeth

- Size of the grave
- Costume and grave good assemblages
- Differing funerary rites
- Differing burial locations

The data for the 181 graves were compiled from the following sources:

- Kromer's (1959) catalog based on the Ramsauer *Protokolle* and information available from the excavations of the late 19^{th} and early 20^{th} centuries
- Hodson's (1990) English-language analysis of burial assemblages at Hallstatt and their use in assigning gender to co-occurrences of different material categories
- Kern's (2010) analysis of bracelet size as an indicator of child burials at Hallstatt
- Pany-Kucera et al.'s (2010) bioarchaeological analysis of child skeletal morphology from the Hallstatt cemetery

While additional catalog information no doubt exists, the working dataset presented here was based solely on published information. Catalog inventories were available for 150 of the graves, of which 31 have been identified as multiple burials. Eighty burials include an assigned age-range provided by primary or secondary analysis and based on one or more of the criteria mentioned above. Grave good assemblages for the multiple burials contain outliers attributed to adults in the same graves that would skew qualitative discussion of the child specific data. Therefore, individuals in multiple burials were not included in the working dataset and will be discussed separately in Chapter Four.

Of the single child burials with an attributed age range, 44 also have associated catalog information including an inventory of associated grave goods. Children aged from neonatal up to four years old (five total) were omitted from the working dataset to include only children of developmental stages capable of at least rudimentary labor activities based on Piaget's (1965) developmental stage designations discussed below. These very young children will also be discussed separately. This leaves 39 individuals between four and 16 years old at the time of death that make up the sample considered in the thesis. The sample is too small for statistical inferences to be drawn but serves as a point of departure in discussing age-related burial treatment and the child experience in prehistoric Hallstatt.

Definitions

In the working dataset, the burials are organized by estimated mean age. Discrepancies exist between age ranges reported by primary investigations and those undertaken by Pany (2003) in her reanalysis of the skeletal remains from Hallstatt. Given that subsequent research on the remains makes use of the new age ranges, these values were used in the present data compilation. There are also discrepancies between how age-groups were categorized by different researchers. Pany-Kucera et al. (2010:46) categorize their sample of juvenile skeletons as: *Neonatus-Infans* Ia (0-23 months); *Infans Ib* (2-6 years); *Infans II* (7-13 years); *Juvenis* (14-19 years). The researchers go on to include a *Juvenis-frühadult* category (17-25 years) containing two individuals whose age-range overlaps between the *Juvenis* and *Frühadult* (young adult) categories. In the same volume, Kern (2010) (who was also a contributing author in the previous article) breaks down the age-groups of the 20th and 21st century sample further into:

- *Neonatus-Infans Ia* (1-6 years)
- *Infans Ia-Ib*
- *Infans Ib-Infans II*
- *Infans Ia*
- *Infans Ib*

- *Infans II* (7-14 years)
- *Infans II-Juvenis*
- *Juvenis* (15-20 years)
- *Juvenis-adult* (21-40 years)

The result is a somewhat confusing mix of designations, used differently when discussing bioarchaeological data and material/mortuary data. More troubling than this, the data presented by Hodson (1990:89-90) do not include an age-group distinction at all but designates individual graves by their reported age range. In order to mitigate these inconsistencies, and to allow for the multidisciplinary examination of the sample presented here, the designations presented below were chosen based on developmental categories. It must be stressed, however, that these developmental categories are based on 20th century child development theory and do not necessarily reflect the social age stages assigned to the individuals in their time.

To complement the child-centric approach, the developmental stage designations used by Piaget (1965) were employed to define the age-groups used in the working dataset (Table 3.4). The stage system is part of a larger cognitive developmental theory that functions on the assumption of universal application. Despite the inherent risks of reducing childhood to a single developmental system, the stages allow for a comparative analysis on the basis of *average* cognitive function in different chronological age-ranges to be applied. In Table 3.4 the four developmental stages are outlined along with their defining characteristics, and the corresponding terminology used in the working dataset is provided.

Table 3.8 Developmental stages, age ranges, and defining characteristics (Piaget 1965).		
Developmental Stage	Age range	Characteristics of Stage
Sensorimotor [Infancy]	Birth to 2 years	Knowledge is limited to what is perceived through the senses and behaviors are simple, generally in response to physical stimulus.
Preoperational [Early Childhood]	2 to 6 years	Language skills emerge, and basic comprehension of abstract ideas and symbolism develop through the use of play and pretending. The individual still cannot manipulate information and has limited logic skills, using an egocentric lens in understanding new experiences.
Concrete operational [Middle Childhood]	7 to 11 years	Math and logic skills emerge as well as empathy and there is increased manipulation of information.
Formal operational [Adolescence]	12 years to adult	Moral reasoning and comprehension of abstract concepts develop. Deductive reasoning and planning skills emerge.

The above definitions of developmental stages lend themselves to a discussion of what production-related tasks might have been possible for children of a given age. For example, looking at the relative number of subadults unearthed at the Hallstatt cemetery, we see the largest percentage is in the middle childhood category. Given that during this developmental stage children are beginning to develop and hone skills in logic, deductive reasoning, and the negotiation of new information in the framework of what they already know, it would stand to reason that this would also be a time when they begin to understand industrial processes, the basic concepts of teamwork and time management, and the importance of safety and compliance. This concept will be explored further in relation to the skeletal pathology data presented in Chapter Four.

There are serious limitations to the use of a four-stage system in exploring the labor capacities of children in prehistoric mining contexts. One such limitation is the early childhood category, which spans the period between two and six years old. This is a time period when a remarkable amount of cognitive and motor development is taking place. As mentioned above, the working dataset using the designation of early childhood to mean juveniles in the four to six year age range. This is not to say that children under the age of four were entirely unable to contribute. The distinction in the dataset is based on the evidence available from historical sources indicating children as young as four were able to partake in industrial-level tasks (Kamp 2001:18). Children between the ages and two and three would typically not be able to participate with the same amount of autonomy as the older children in the early childhood category.

Working Dataset

The dataset below (Table 3.5) includes basic information for the 39 individuals with an associated age-range and catalog information including grave good inventories. The individuals are identified using the grave numbers assigned by excavators. The reported age-range is provided in the second column, followed by the mean age and corresponding age-group designation. A summary of skeletal analysis is provided where applicable. The "category total #" column includes the total number of material types present in the catalog information. This information proved useful for identifying patterns and comparing assemblages by way of a ranking system developed and discussed in the analysis chapter. The organization of the material types will also be discussed in greater detail below.

Table 3.5 Working dataset for the juvenile burials at the cemetery at Hallstatt. N = 39

Grave/ID number	Age Range (yrs)	Mean Age (yrs)	Age Designation	Bioarchaeological Analysis	category total #	Material types
854	4	4	Early Ch.		3	Amber ring (1); bracelet (1); other fibula (1)
170	4-5	4.5	Early Ch.		1	Other fibula (1)
315	5-6	5.5	Early Ch.		1	Bracelet (1)

Table 3.5 (continued) Working dataset for the juvenile burials at the cemetery at Hallstatt. N = 39

429	5-6	5.5	Early Ch.		1	Bracelet (1)
807	5-6	5.5	Early Ch.		2	Bronze ring (1); dress pin (1)
19/1996	5-6	5.5	Early Ch.		3	Animal bones; bracelet (1); ceramics
MO 14/1938	5-7	6	Early Ch.		1	Other fibula (1)
800	6	6	Early Ch.		2	Bracelets (2); ceramics
39	6-7	6.5	Early Ch.		4	Amber beads; amber rings (2); bronze rings (2); other fibula (1)
MO 8/1939	6-8	7	Middle Ch.	Displays signs of osteoarthritis in the right trochlear notch	4	Bracelet (1); bronze ring (1); ceramics; neck ring (1)
282	6-8	7	Middle Ch.		1	Ceramics
66	6-8	7	Middle Ch.		1	Bronze rings (2)
103	7	7	Middle Ch.		2	Bracelet (1); needle (1)
412	6-8	7	Middle Ch.		2	Bracelets (2)
804	6-8	7	Middle Ch.		2	Amulet/pendant (2); bracelet (2)
416	6-8	7	Middle Ch.		3	Ceramics; rusty iron; miscellaneous
601	7-8	7.5	Middle Ch.		1	Bracelets (2)
182	7-8	7.5	Middle Ch.		1	Needle (1)
76	7-8	7.5	Middle Ch.		2	Spectacle fibula (1); miscellaneous (2)
424	7-8	7.5	Middle Ch.		3	Animal bones; bracelet (1); ceramics
102	8	8	Middle Ch.		1	Neck ring (1)
779	8	8	Middle Ch.		1	Bracelet (2)
867	8	8	Middle Ch.		4	Amber beads; bracelets (2); bronze ring (1); glass beads
MO 1/1938	7-10	8.5	Middle Ch.		2	Other fibula (1); rivets/buttons
305	8-10	9	Middle Ch.		1	Bronze rings (3)
638	8-10	9	Middle Ch.		4	Ceramics; neck ring (1); other fibula (1)

Table 3.5 (continued) Working dataset for the juvenile burials at the cemetery at Hallstatt. N = 39						
95	8-10	9	Middle Ch.		3	Amber beads; amulet/pendant (2); bracelets (5)
302	8-10	9	Middle Ch.		11	Amber beads; amber rings (3); amulet/pendant (1); animal bones; bracelets (2); bronze rings (6); ceramics; glass beads; jangle pendant (1); other fibulae (4); miscellaneous
MO 11/1938	9-10	9.5	Middle Ch.	Exhibits an underdevelopment or hypoplasia of the dens	1	Other fibula (1)
334	10	10	Middle Ch.		1	Bronze rings (2)
8	10-11	10.5	Middle Ch.		3	Amulet/pendant (1); bronze ring (3); handle (1)
172	10-12	11	Middle Ch.		1	Bracelet (1)
225	10-12	11	Middle Ch.		2	Bracelet (1); miscellaneous
33/1997	11-14	12.5	Adolescent	Displays indicators of osteoarthrosis in right and left trochlear notch, left medial femoral condyle, and right lateral femoral condyle (with signs of new bone growth); exhibits a hypoplasia or partial absence of the dens; skull fracture (healed): left frontal bone, approx. 0.4 x 0.4 cm. depressed, circular, superficial	8	Amber beads; bracelet (2); bronze rings (2); ceramics; neck ring (1); rivets/buttons; spindle whorl (1); small knife
Grab 1006	11-14	12.5	Adolescent	Skull fracture (healed): left frontal bone, approx. 0.4x0.4 cm. depressed, circular, superficial	2	Ceramics; other fibulae (2)
MO 20/1938	12-14	13	Adolescent	Evidence of a circular, superficial, depressed cranial fracture (right parietal bone), healed. Approx. 0.4 x 0.4 cm	2	Ceramics; other fibulae (1)
MO 25/1938	12-15	13.5	Adolescent	Displays indicators of osteoarthrosis on right and left medial femoral condyles, right and left lateral femoral condyles, and right and left proximal talus	2	Ceramics; heavy bronze ring (1)
Grab VII/II	12-16	14	Adolescent	Displays indicators of osteoarthrosis on left lateral femoral condyle	3	Anklet (2); bracelet (1); neck ring (1)

Table 3.5 (continued) Working dataset for the juvenile burials at the cemetery at Hallstatt. N = 39						
MO 2/1937	14-18	16	Adolescent	Exhibits evidence of osteochondritis dissecans with a lesion of approx. 0.7 x 0.4 cm on the latero-frontal part of left talus joint	3	Anklet (2); needle (1); other fibulae (2)

Bioarchaeological Evidence

Pany-Kucera, Kern, and Reschreiter (2010) examined a sample of juvenile individuals from the Hallstatt cemetery displaying signs of osteoarthritis in the elbow, knee, and/or ankle joints. To be considered for the analysis, individual skeletons had to exhibit at least two signs of arthritis at a given joint and the total joint surface had to be at least two-thirds complete. The researchers' nonmetric data are listed in the abbreviated Table 3.6 below. To better visualize the

Table 3.6 Individuals exhibiting at least two signs of osteoarthritis at the respective joints (Pany-Kucera et al. 2010:47). For each individual, the joint area had to meet the criteria of being at least 2/3 complete.

	Joint	Trochlear notch (elbow)		Medial femoral condyle (knee)		Lateral femoral condyle (knee)		Proximal talus (ankle)	
Grave No.	Age (yrs)	Right	Left	Right	Left	Right	Left	Right	Left
KE 33	11-14	x	x		x	x			
MO 8/1939	6-7	x							
MO 25/1939	14-15			x	x	x	x	x	x
MH 1/I/1938	10-14					x			x
SA 2/B/1938	9-12							x	
26905/10	11-14		x						
Inv.A. 913/II./1878	12-14						x		
n. affected/N		2/9	2/5	1/3	2/5	3/4	2/4	2/7	2/5
% affected		22.2	40	33.3	40	75	50	28.6	40

affected areas and the prevalence of osteoarthritis in the sample, the non-metric data are summarized in Figure 3.7.

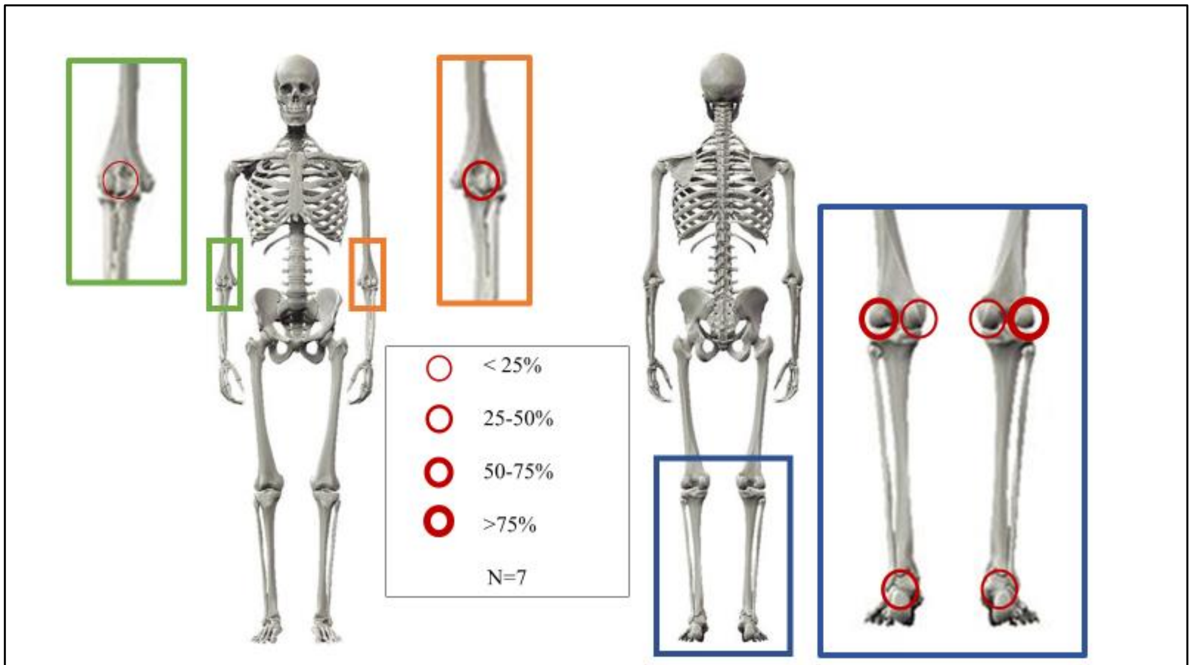

Figure 3.7 Percentage of individuals displaying at least two indicators of osteoarthritis (values from Pany-Kucera et al. 2010) N = 7.

Given that this thesis used only previously published data, the analysis that follows operated under the assumptions developed by the researchers who initially analyzed the sample. In this case, Pany-Kucera et al. (2010) report the presence of arthritis in the joints as osteoarthritis and attribute it to labor stress. It should be noted that labor stress is not the only possible explanation for evidence of arthritis in juvenile skeletal remains. In the first volume of the research findings from the U.S. General Services Administration's African Burial Ground project, the chapter on "Subadult Growth and Development" (Goode-Null et al. 2009:227-253) goes into detail on the way combinations of skeletal indicators can reflect different causes of arthritis in juveniles. While the researchers do attribute evidence of biomechanical stressors in children as young as four to labor stress, they agree that disorders such as rheumatoid arthritis and lupus can also cause arthritis to manifest in the juvenile skeleton (Goode-Null et al. 2009:245). Adding additional variables to the analysis of children at Hallstatt, such as abnormal long-bone morphology, could strengthen the findings.

While a sample size this small precludes statistical analysis, it is a starting point in the development of comparative analysis for juvenile skeletal remains. For instance, it is possible to use these data and the accompanying interpretations to compare patterns of wear in the juveniles and adults that might reflect different habitual activities. The analysis can be incorporated into the presently proposed framework as an independent line of evidence to be weighed against mortuary and material evidence from the accompanying graves and those outlined by Kromer (1959) and Hodson (1990) from the earlier excavations.

Table 3.7 Indicators of skeletal pathology present in children at the Hallstatt cemetery (Pany-Kucera et al. 2010). OA = Osteoarthritis; (*) indicates the individual is included in the working dataset.

Grave #	OA	Injury	Other pathology
*MO 8/1939	X		
*MO 11/1938			X
Grab 1/I	X		
MO 2/1938		X	
2/B/1948	X		
26.905/10	X		
*33/1997	X	X	X
*Grab 1006		X	
*MO 20/1938		X	
*MO 25/1938	X		
*Grab VII/II	X		
MO 21-23/C/1939		X	
*MO 2/1937		X	

Skeletal analysis of 13 juveniles from the Hallstatt cemetery revealed signs of either traumatic cranial injury or post-cranial musculoskeletal markers and evidence of osteoarthrosis (Pany-Kucera et al. 2010) (Table 3.7). Details of each individual's morphological evidence are included in Chapter Four (Table 4.2) followed by an analytical discussion of the implications of these data. Individual MO 21-23/C/1939 is included in the juvenile skeletal analysis by the researchers, though the age range suggests that the individual would better fit in the adult category. Nonetheless, the healed cranial fracture could have been the result of a childhood trauma and is worth noting. Of the 13 individuals listed in Table 3.7, eight are included in the working dataset (denoted with an *), having met the additional criteria of being an individual burial with an attributed age range and catalog information including grave goods.

Material Evidence

The material types used in the working dataset were adapted from Hodson (1990) who used a similar list of what he referred to as "functional material types" to examine gender- and status-based differences as reflected in the burial record. Material categories not present in any juvenile graves at Hallstatt were omitted to condense the data. While categories present in the juvenile graves but not explicitly discussed by Hodson were added. Table 3.8 provides a summary of material type frequency in the burials identified as juvenile. Again, burial assemblages belonging to multiple individuals have been omitted. All values reflect the number of burials that include the material type. For each data entry the total number of material categories present is included along with a list of the material types. All values in parentheses indicate the total number of objects of that type except the following, which are recorded as either present (1) or absent:

- Ceramics
- Amber beads
- Glass beads
- Animal bones
- Iron object
- Shell (present in juvenile burials, but not included in the working dataset)

Table 3.8 Frequency of material types in the juvenile burials present in the working dataset. Material types with an asterisk (*) not originally in Hodson's (1990) analysis.		
MATERIAL TYPE:	Burials w/o age; n=57	Burials with age; n=44
Bracelet	40	22
Ceramics*	23	15
Other fib	3	12
Bronze ring	17	10
Amber beads*	7	7
Miscellaneous	7	5
Amulet/pendant*	1	4
Glass beads*	3	4
Neck ring	0	4
Needle	6	4
Amber ring	1	3
Animal bones*	4	3
Anklet	0	2
Belt fittings	4	2
Rivets/buttons*	3	2
Spindle whorl	0	2
Bear tooth pen.	2	1
Clay coffin	2	1
Handle*	1	1
Jangle pendants*	1	1
Lignite rings	0	1
Roll-head pin	1	1
Rusty iron	2	1
Spectacle fib	11	1
Small knife	3	1
Heavy bz ring	0	1

A breakdown of material types based on age will be discussed below.

Mortuary Evidence

The data compilation for single child burials from the prehistoric cemetery at Hallstatt was central to understanding children and material in the analysis presented in this thesis. The cemetery site at Hallstatt is unique in a number of ways in the context of prehistoric Europe. One reason is the presence of children intermingled with adults. The Bronze and Iron Ages in Europe increasing social differentiation over time that is reflected in the burial record. Many societies begin differentiating status by burying high status individuals in mounds instead of flat cemeteries. Children are rarely present in the elite burials; often being buried in domestic settings, in middens, or in separate, undifferentiated graves (Arnold 2012). Mound burials have not been found at Hallstatt. Regardless of how wealthy a burial assemblage was, it seems that all individuals in the Hallstatt community were buried in the same flat cemetery. The main differentiation in burials at Hallstatt seems to be how well-outfitted the graves were. As mentioned earlier, it is unclear whether there is an underrepresentation of children in the cemetery due to excavation techniques. The presence not only of single-child burials at Hallstatt, but burials containing large numbers of local and imported grave goods is unusual for this time period. Therefore, it can be argued that in the case of Hallstatt, there is likely a correlation between the burial assemblages in juvenile graves and the social status of the individual. The significance of the grave goods associated with the burials included in the working dataset will be discussed further in Chapter Four.

The working dataset compiled for this thesis included single juvenile burials with grave inventories and assigned age-ranges. Table 3.9 provides a complete list of these individuals and their corresponding burial inventories. Using this table, age-group specific patterns and outliers can be discussed. Burials not included in the working dataset, but with associated age-ranges and material inventories include infants, young children up to four years old, and children in multiple burials; these groups will be discussed in Chapter Four. The mortuary record of children physically developed enough to participate in labor activities is discussed first.

In trying to determine if age-related categories are reflected in the mortuary record, a ranking system was developed based on the number of objects found in each burial and the number of individual material categories they represent. These are two different values because while a grave may contain hundreds of amber beads but no other object categories, a grave with seven material categories totaling only ten objects is significant in another way. Some items, such as ceramics, animal bones, beads, and pieces of unidentified iron were not counted for their total quantity, only their presence. This is in part because the total number of these items was not always provided in the catalog entries and would likely skew the comparative analysis. After summarizing the material data below, the ranking system will be discussed and applied to the dataset.

Single Child Burials at Hallstatt

Organized by mean age, the working dataset provides an opportunity to explore age-related patterns in material expression in single child burials. While the working dataset is small (n = 39), it may enhance what we currently know about the life of children at Hallstatt beyond the material evidence preserved in the mines themselves. A simple frequency graph showing the number of burials by material category (Figure 3.8) is helpful for seeing what materials are or are not present for each age group when considered as a group.

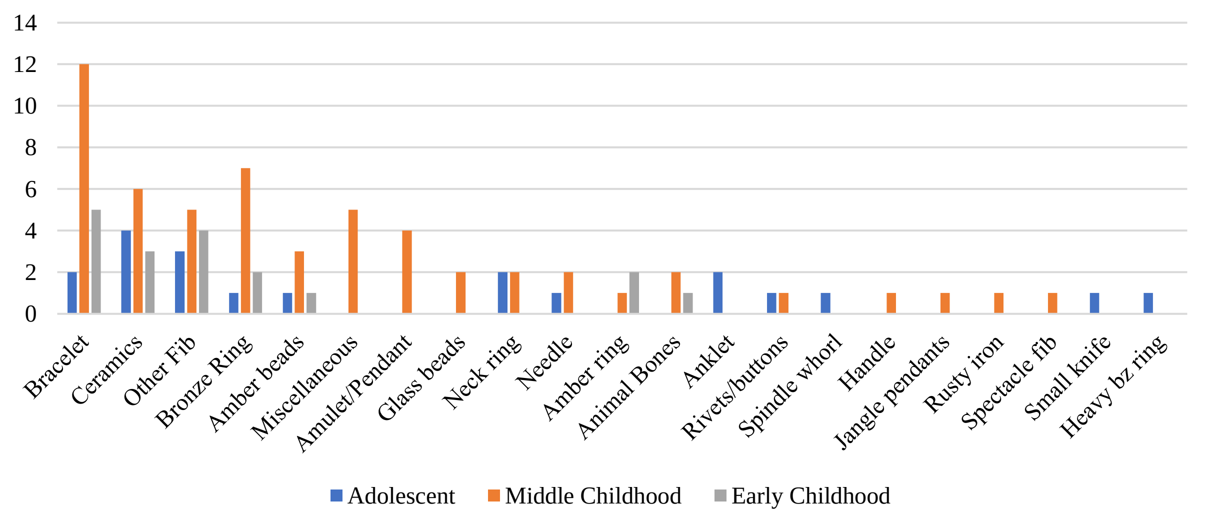

Figure 3.8 Material category frequency for child burials (n = 39) by age-group: Adolescent group = 6 burials; Middle Childhood = 24 burials; Early Childhood = 9 burials. Table excludes material types not found in any of the above age groups.

The representation of how common specific grave goods are for the different age categories in the above graph is skewed by the number of burials in each age group. Figure 4.6 presents the same data as a percentage of burials in each age-group category containing each material type to better assess frequency of each type. For example, only two of the adolescent burials contained bracelets (as reflected in Figure 3.8) but given that the adolescent group contains only six burials total, the two graves with bracelets make up 33% of the total graves for that age-group (as reflected in Figure 3.9). By comparison, the early childhood group has a total of five burials containing bracelets which equates to 55% of the total number of early childhood burials. In these figures it is interesting to note which material types are not present in any burials for a certain age group. Adolescent burials contained material from 12 categories but did not include items in the miscellaneous category, amulets or pendants, glass beads, amber rings,

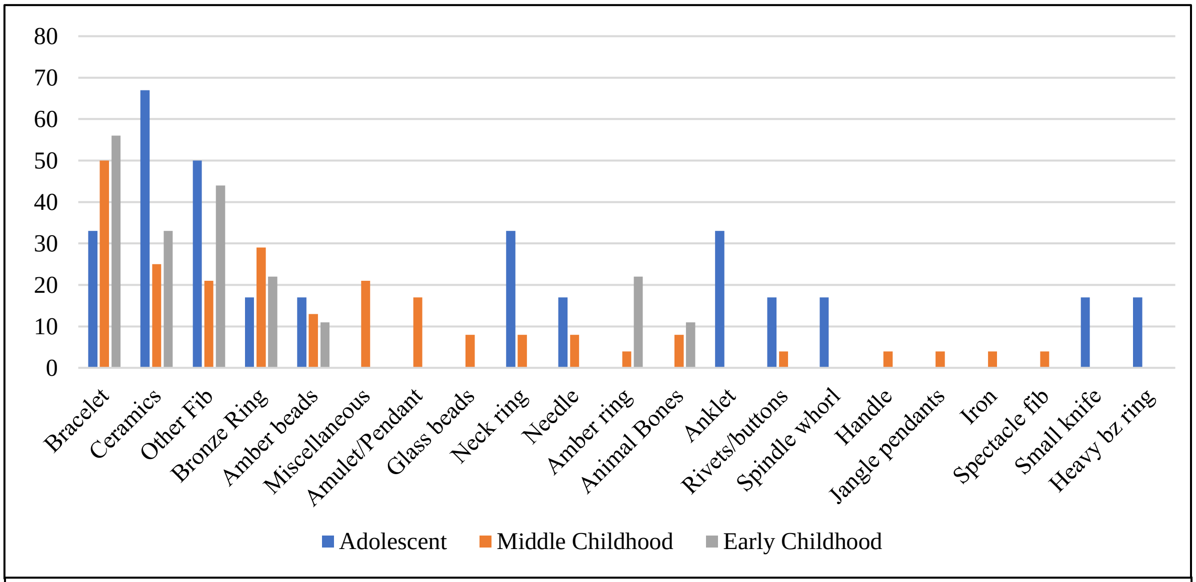

Figure 3.9 Percentage of child burials (n = 39) by age-group containing each material type. Adolescent group = 6 burials; Middle Childhood = 24 burials; Early Childhood = 9 burials. Table excludes material types not found in any of the above age groups.

animal bones, handles, jangle pendants, rusty iron, or spectacle fibulae. Burials in the middle childhood group contained the highest number of material categories (17), but no anklets, spindle whorls, small knives, or heavy bronze rings. The early childhood burials contained the smallest number of categories (seven) and were missing all but bracelets, ceramics, other fibulae, bronze rings, amber beads, amber rings, and animal bones. Table 4.4 summarizes the material categories present for each age group in the working dataset.

To identify patterns in the occurrence of individual materials in the graves in the working dataset, the values of both the grave goods included and the number of material types included are summarized in Table 3.9. Using these divisions, we can see that the majority of the juvenile

Table 3.9 Summary table for the working dataset. Left: summary of the frequency and percentage of graves given the number of associated material categories. Right: summary of the frequency and percentage of graves given the total number of grave goods in the burial assemblage.

Number of grave goods	Number of graves	Percent of total graves (n=39)	Number of material categories	Number of graves	Percent of total graves (n=39)
1	9	23	1	14	36
2	11	28	2	11	28
3	9	23	3	8	21
4	3	8	4	4	10
5	3	8	5	0	0
6	1	2.5	6	0	0
7	0	0	7	0	0
8	1	2.5	8	1	2.5
9	0	0	9	0	0
10	1	2.5	10	0	0
11	0	0	11	1	2.5
22	1	2.5			

graves have between one and three grave goods, and one or two material categories. Three and four material categories are not uncommon, but the outliers, one with eight categories and one with eleven categories, are significant. Likewise, the outliers for total number of grave goods is anything above five grave goods. These values are for the combined age groups included in the dataset. To explore the differences between age groups, a ranking system was developed for individual graves. The system was developed as follows:

- Graves with one or two material categories = A
- Graves with three or four material categories = B
- Graves with five or more material categories = C
- Graves containing one to three objects = 1
- Graves containing four or five objects = 2
- Graves containing six or more objects = 3

The above breakdown allows us to combine frequencies to show how the graves are outfitted. In Table 3.10, the rankings are broken down by age-group. In the working dataset there seems to be little change between the early- and middle childhood groups. The majority of the graves in each group are in the A1 category, meaning there are only one or two material categories with between one and three burial objects. By Hodson's (1990) standards these burials would be poorly outfitted. Bracelets, fibulae, and the presence of ceramics are the most abundant categories in the A1 category across the early- and middle childhood groups. The ubiquitous presence of ceramics in the juvenile burials is less noteworthy as they seem to be standard for most burials and were likely under-reported in the earlier excavations (Hodson 1990:5). Likewise, animal bones were probably a common inclusion in burial assemblages but were less likely to be recorded (Hodson 1990:5).

Table 3.10 Number of burials (and percent) in the working dataset of each rank by age-group.

Burial Ranking	Early Childhood (n=9)	Middle Childhood (n=24)	Adolescent (n=6)
A1	6 (66%)	15 (62%)	3 (50%)
A2	-	1 (4%)	-
A3	-	-	-
B1	2 (22%)	3 (13%)	-
B2	-	3 (13%)	2 (33%)
B3	1 (11%)	1 (4%)	-
C2	-	-	-
C3	-	1 (4%)	1 (17%)

The outliers in the working dataset are substantial. The highest number of material categories for early childhood is much lower than that of the other two age groups (early childhood = 4; middle childhood = 11; adolescent = 8). While the number of categories is generally similar for the early- and middle childhood groups, the number of categories begins to increase, though the categories themselves do not change substantially. In the adolescent group, there is a marked difference in burial contents. Bracelets become less ubiquitous, and there is a lack of beads (except in Burial 33/1997 discussed below) and pendants. This age-group is the only one to include anklets as well, a pattern also discussed below.

It is difficult to present concrete evidence for different burial treatment for age groups at Hallstatt. Children of all ages are found in the cemetery alongside adults, but at a lower frequency. What is discernable is that there are a few burials that have an abundance of grave goods compared to their peers. Hodson refers to these as "high status burials" in his analysis but is skeptical of the social significance of the data (1990:90). As the "high status burials" mentioned by Hodson come exclusively from the Ramsauer excavations, skeletal analysis is not available, and categorization is therefore based solely on the grave goods present.

Limitations

Catalog information was not always consistent between sources. What was reported in the 19th century *Protokolle,* for example, is not necessarily reflected in the material collections. This is due in part to issues with artifact recording, the propensity for some artifacts to be given as gifts to dignitaries or kept by excavators, and movement of collections over the last 150 years. Kromer's catalog compilation offers a standardized translation of Ramsauer's sometimes confusing terminology and gives a list of both the artifacts recovered, as reported by the excavator, and the artifacts available in museum collections that have been associated with that particular burial. While the artifacts available for research provide the most direct line of material evidence, the validity of the reported finds should not be questioned simply because the material has been lost or misplaced. Therefore, when possible, I have included all of the material reported in the primary reports taking into consideration the terminological clarifications provided by Kromer (1959). Similarly, I have attempted to provide accurate translations of catalog information when this is provided only in German. The antiquated lexicon used in the mid- to late- 19th century sometimes necessitated a modern German equivalent before being translated into English. Any misinterpretations or inaccurate translations are therefore my own.

In addition to the obvious limitations posed by a small dataset, there are issues with how much information is included for each individual. When more metadata from the Hallstatt cemetery become available, more of the original 181 individuals identified as juveniles can be included in a working dataset that uses the same criteria as those presented here. Information sharing will ultimately strengthen collective analysis incorporating various theoretical perspectives. In keeping with the trend of digitization in museum and repository collections, open use of catalog information in the future is more likely, particularly as new and innovative analytical techniques become available.

Applying the Theoretical Framework to the Dataset

To use the working dataset to help answer the research questions presented in Chapter One, it is paramount to incorporate interpretations of the data into a larger system of evidence that draws on analogy and theory to support them. Chapter Four discusses how the quantitative answers we seek can be suggested by the dataset and how these contribute to the overall narrative of the childhood experience for individuals growing up in mining communities in prehistory. Using this approach will allow researchers to view children as active agents in the community, and their experiences as a culturally specific series of developmental achievements, negotiations, interactions, adaptation, and integration.

Chapter Four presents the evidence for the possible range of tasks performed by children at mining sites including Hallstatt, and suggests alternatives to traditionally held hypotheses on divisions of labor in prehistoric mining. These technical and physiological considerations will inform the reassessment of the primary research questions presented in Chapter One. The incorporation of those interpretations into the theoretical framework will help address the secondary research questions in Chapter Five, which concern the broader implications of an inclusive approach to studying mining communities in prehistoric Europe.

Chapter Four: Analysis

A case was built in the previous three chapters for the use of the child's world framework in researching children and childhood in prehistoric mining contexts in Europe. In this chapter the research questions posed in Chapter One are reviewed in light of the data from the case study. Areas where additional research would provide supporting evidence for testing the presented hypotheses will also be considered. The research questions and preliminary hypotheses provided a guide for working within the child's world framework to establish a protocol for future researchers. A shift toward more inclusive investigation of prehistoric societies will require not only a focus on the activities of children in archaeological interpretation and narratives; it will require a renegotiation of what childhood is presumed to be. We must also ask how the experience of childhood is integrated into the formation and continuation of culture. Archaeologists will need to consider how children, as agents in their own development, come to understand the world around them. This shift in mindset might also lead to unforeseen reevaluations of other social constructs including gender, divisions of labor, social stratification, and socialization. This chapter presents ethnographic, historical, and prehistoric examples in support of the hypotheses presented in Chapter One. The working dataset presented in Chapter Three will be revisited to explore the significance of patterns that emerged in the case study, including specific areas that would benefit from new and emerging methods of archaeological analysis.

While not unique to the study of children and childhood in the past, it is useful to consider the inherent dangers in relying on analogy to support hypotheses that aim to describe social constructs or expressions of identity in a prehistoric society. The experience of childhood can vary dramatically, even between contemporary groups with similar subsistence and material production strategies. For example, in the Hadza and !Kung San Bush cultures, both extant African foraging societies, childhood experiences are vastly different. In the Hadza culture, children are made to contribute to food gathering and domestic chores as soon as they are physically able, being assigned tasks appropriate for their size and ability level. Little emphasis is placed on playing and learning, and children are likely to be severely reprimanded for not complying with their instructions. Conversely, children in the !Kung culture are rarely made to participate in food gathering or preparation and are left to play and spend ample time with their peers. The !Kung children are rarely reprimanded and are allowed a great deal of freedom (Bugarin 2005:17-19; Wileman 2005:55-66). Relying on only one of these examples to test a hypothesis of childhood experience in prehistory would be ill advised. Instead of assuming all children in prehistory were deeply embedded in the domestic and manufacturing labor activities of their respective societies, it is more fruitful to consider what each model would look like and how it would be reflected in the archaeological record. Using ethnographic and historical examples of how childhood may be expressed expands the possibilities of what it meant to be a child in prehistory, but it cannot be used to prove anything definitively.

Indicators of Child Labor at Hallstatt

Possible Activity Spectrum

The first research question posed in Chapter One asked to what extent prehistoric children were participating in mining-related tasks at Hallstatt and what the available evidence is for labor activities. Identifying tasks that could have been assigned to children in a labor context first requires evidence for the child's presence in the labor activity area. At Hallstatt, the material evidence found inside the mines includes shoes described as child-sized, a baby's hat, a child-sized leather cap, and a collection of very small mining picks (Kern 2010; Pany-Kucera et al.

2010; Watson 2018), all of which indicate that children were indeed present at the mines. The material evidence complements the bioarchaeological evidence of skeletal pathology found on a small sample of children excavated from the Hallstatt cemetery, detailed in Table 4.3. This allows us to move beyond presence, which may simply reflect accompanied minors, to positing active involvement by children in the work itself.

Beyond the indicators of osteoarthritis in the appendicular skeletal remains of the Hallstatt children, the presence of vertebral wear and traumatic skull injury in this population suggests labor activities that included children carrying heavy loads on or using their heads (Pany-Kucera et al. 2010:59). Skull fractures and healed cranial dents in a small sample of children are similar to those sustained by children carrying bricks on their heads in areas of India and Pakistan, for example (Reschreiter et al. 2013:29). While children could have been carrying materials such as wood, salt plaques, water, or baskets of other goods in this way, some of these injuries could be the result of working in poorly lit mine shafts, and of living in a rugged, mountainous landscape. What makes the cranial trauma so convincing as being related to labor is the symmetrical nature of the wear on the cervical vertebrae, which is highly indicative of evenly distributed load bearing (Pany-Kucera et al. 2010:49).

What is unknown is whether these loads were being balanced on top of the head or if they were assisted by a head strap similar to the Native American tumpline, also known as a burden strap (or *mecapal* in Mesoamerica) (Figures 4.1 and 4.2). The tumpline is still used today to carry heavy loads, distributing the weight down the spine instead of across the shoulders (Tiesler 2013:63). Habitual use of a tumpline has been associated with changes in spinal curvature and shortening of the vertebra as well as forehead flattening in one recent study from Guatemala

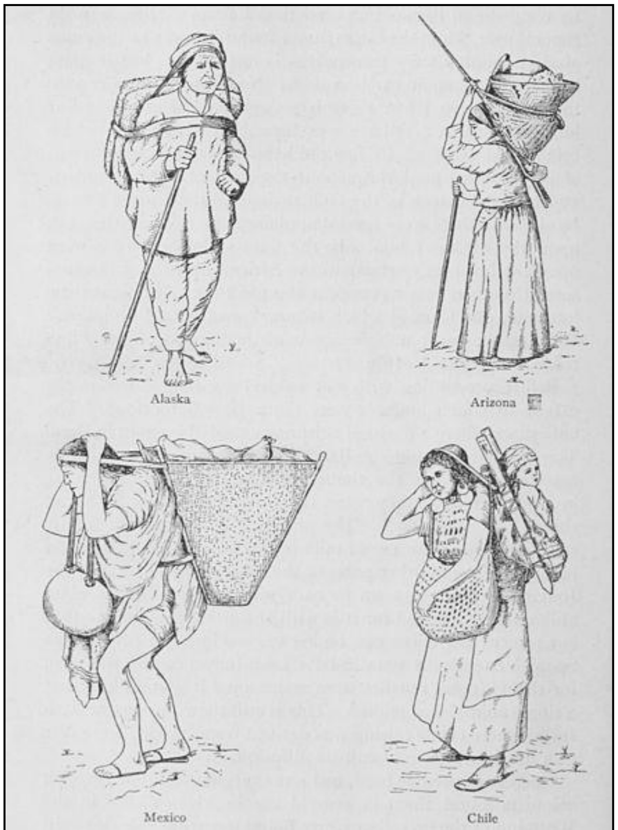

Figure 4.1 Various methods of using the tumpline (Wissler 1917:Fig 12). Public domain.

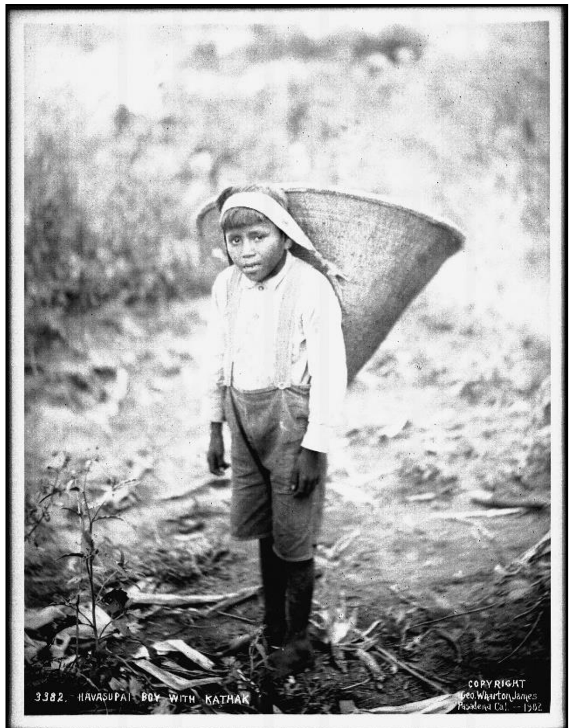

Figure 4.2 Havasupai boy carrying a *Kathak* on his back with the assistance of a burden strap. (Credit: George Wharton James, ca. 1900. California Historical Society Collection 1860-1960). Public domain.

(Gervais 2001). The carry-sacks found in the mines at Hallstatt may have been too large or heavy for a child to use, making a head strap one possible solution for children carrying heavier loads.

Evidence excavated from inside the mines at Hallstatt includes organic materials such as leather shoes, carry-sacks, palm protectors, rope, lighting tapers, wooden pick handles, antler picks, and textiles, as well as structural elements including remnants of ladders, scaffolding, and stairs. Based on the bioarchaeological evidence available from Hallstatt and the material evidence found inside the mines, Table 4.1 lists tasks children may have participated in as a

Table 4.1 List of possible labor-related tasks undertaken by children at prehistoric Hallstatt. Developmental stages based on Piaget (1932, 1965); motor skills based on Morin (2014).

Developmental Stage	Expected Motor Skills	Possible Labor-related Tasks
Infancy [birth to two years old]	Develops rudimentary skills culminating in being able to: Walk or run Use utensils for eating Hold an object Climb Throw May be able to use stairs	Little if any participation in labor. The child may be able to assist older children or adults in picking up easy to grasp objects. This age group would need help navigating uneven terrain and stairs.
Early Childhood [two to six years old]	Alternate feet going up or down stairs Jump, hop, skip, run Kick, throw and catch a ball Manipulate simple objects such as door handles Master use of eating utensils Recreate basic shapes	In the later part of early childhood an individual could carry objects up and down stairs or a ladder, hold and light a taper, crawl into small spaces, crush or process salt, and perform basic cleaning tasks.
Middle Childhood [seven to 12 years old]	Balance while spinning in place Perform multi-step tasks such as making a bed Tying knots and fastening buttons Use increasingly complicated tools Coordinated movements (sports)	In middle childhood, individuals are rapidly gaining strength and coordination. Children would be able to haul increasingly heavy loads over uneven terrain, start fires, cook, clean, watch over younger children, fetch supplies from farther distances, and use size-appropriate tools for digging, scraping, picking, and shoveling.
Adolescence [12 years old to physical maturation]	Coordinate movements for more complex activities Concerted effort to develop strength and endurance Growth spurts may cause clumsiness during puberty Development culminates in: More agility Improved spatial coordination Improved ability to judge distance Quicker reaction time	At the adolescent stage, children would have the coordination to perform most labor-related tasks with increasing agility, balance, and speed. In addition to the above-listed tasks, adolescents would be able to hammer or pick mine faces, assist in building and repairing infrastructure (including tools and structures), simple tool-making, transportation of equipment, animal care, and likely some labor-related rituals.

regular part of their labor activities. These tasks have been broken down by developmental age group, determined by generally expected motor skills development at different developmental stages (Morin 2014).

An important note on the juvenile skeletal pathology in the Hallstatt sample is that in all instances of fractures (cranial and post-cranial), the fractures had healed. In one case of osteoarthritis, there was new bone growth developing at the time of death (Pany-Kucera et al. 2010:47). Frequent childhood injury resulting from falls in and around the mines would be expected given the low light conditions, ever-changing obstacles, and risk of collapse inside the shafts. The pattern of skull fracture and signs of early onset osteoarthritis may be linked instead to habitual labor activity beginning at a very young age. Given that evidence of musculoskeletal markers (MSM) on adult individuals from Hallstatt differ from those found in the few children sampled, comparing the two may reflect the way labor was carried out at different age stages (Pany-Kucera et al. 2010). Pany (2003) found that females had a higher instance of MSM in areas of the shoulder girdle associated with carrying heavy loads over one shoulder, either using a rope or a long stick propped on the shoulder. The MSM for males skewed toward joint morphology associated with a repetitive swinging motion (Pany 2005). While some MSM was similar for children and adults, the vertebral morphology is different (Pany-Kucera et al. 2010) and may indicate that at a certain stage, children ceased their hauling and crawling duties and took on tasks relying more heavily on different joints.

If we consider the range of activities involved in the resource extraction process (Table 2.2), the motor skills developed by children in certain age-ranges (Table 4.1), what we know about child labor from historical and ethnographic sources, the material evidence placing children inside the mines (Table 3.1), and the bioarchaeological evidence of cranial injury and post-cranial labor-induced stress markers (Figure 3.7 and Table 4.2), we begin to develop a picture of the lives of children as they participated in labor activities at Hallstatt. Children may have been selected to work in small and hard to reach shafts and galleries, requiring them to navigate difficult subterranean environments while crawling and crouching for extended periods of time. The activity occurred with a frequency that eventually led to joint problems for some

Table 4.2 Individuals from the Hallstatt cemetery identified as juvenile and previously analyzed for skeletal pathology (Pany-Kucera et al. [2010] for bioarchaeological analysis, translated from German by author). (*) indicates the individual is included in the working dataset.					
Grave/ID number	**Age Range (yrs)**	**Mean Age (yrs)**	**Age Designation**	**Bioarchaeological Analysis**	**Possible Associated Activity**
*MO 8/1939	6-8	7	Middle Ch.	Displays signs of osteoarthrosis in the right trochlear notch.	Carrying heavy loads, hammering, shoveling
*MO 11/1938	9-10	9.5	Middle Ch.	Exhibits an underdevelopment or hypoplasia of the dens.	Carrying heavy loads on the head; acute neck injury; genetic defect
Grab 1/I	7-14	10.5	Middle Ch.	Displays indicators of osteoarthrosis in right lateral femoral condyle and left proximal talus.	Crawling, kneeling, carrying heavy loads while crouching or crawling
MO 2/1938	9-10	10.5	Middle Ch.	Evidence of avulsion fracture in the left distal tibial epiphysis (malleolus), healed.	Acute injury of the ankle, likely resulting from a twisting motion with significant force
2/B/1948	9-12	10.5	Middle Ch.	Displays indicators of osteoarthrosis in right proximal talus.	Crawling, walking in a crouching position, habitual dorsiflexion when kneeling, exacerbated when bearing weight
26.905/10	11-13	12	Middle Ch.	Displays indicators of osteoarthrosis in left trochlear notch.	Carrying heavy loads, hammering, shoveling
*33/1997	11-14	12.5	Adolescent	(1) Displays indicators of osteoarthrosis in right and left trochlear notch, (2) left medial femoral condyle, and right lateral femoral condyle (with signs of new bone growth); (3) exhibits a hypoplasia or partial absence of the dens; (4) skull fracture (healed): left frontal bone, approx. 0.4 x 0.4 cm. depressed, circular, superficial.	(1) Carrying heavy loads, hammering, shoveling (2) Crawling, kneeling, carrying heavy loads while crouching or crawling (3) Carrying heavy loads on the head; acute neck injury; genetic defect (4) Acute cranial fracture from accidental blow to the head or carrying too much weight using a tumpline or a basket
*Grab 1006	11-14	12.5	Adolescent	Skull fracture (healed): left frontal bone, approx. 0.4x0.4 cm. depressed, circular, superficial.	Acute cranial fracture from accidental blow to the head or carrying too much weight using a tumpline or a basket
*MO 20/1938	12-14	13	Adolescent	Evidence of a circular, superficial, depressed cranial fracture (right parietal bone), healed. Approx. 0.4 x 0.4 cm.	Acute cranial fracture from accidental blow to the head or carrying too much weight using a tumpline or a basket

Table 4.2 (Continued) Individuals from the Hallstatt cemetery identified as juvenile and previously analyzed for skeletal pathology (Pany-Kucera et al. [2010] for bioarchaeological analysis, translated from German by author). (*) indicates the individual is included in the working dataset.					
*MO 25/1938	12-15	13.5	Adolescent	(1) Displays indicators of osteoarthrosis on right and left medial femoral condyles, right and left lateral femoral condyles, and (2) right and left proximal talus.	(1) Crawling, kneeling, carrying heavy loads while crouching or crawling (2) Crawling, walking in a crouching position, habitual dorsiflexion when kneeling, exacerbated when bearing weight
*Grab VII/II	12-16	14	Adolescent	Displays indicators of osteoarthrosis on left lateral femoral condyle.	Crawling, kneeling, carrying heavy loads while crouching or crawling
MO 21-23/C/1939	17-20	18.5	Adolescent [Adult]	Evidence of an elongated, oval shaped, superficial depressed cranial fracture (left frontal bone), healed. Approx. 0.5 x 1 cm.	Acute cranial fracture from accidental blow to the head or carrying too much weight using a tumpline or a basket
*MO 2/1937	14-18	16	Adolescent	Exhibits evidence of osteochondritis dissecans with a lesion of approx. 0.7 x 0.4 cm on the latero-frontal part of left talus joint.	Repetitive heavy strain or high-impact actions such as pushing up from a crouched position while carrying heavy loads, jumping, or multiple accidental strains without sufficient healing time between

children. For example, shoveling might be a task designated to a child such as MO 8/1939 who at the age of seven already showed signs of osteoarthritis in their right elbow. Perhaps the same sort of pathology in 26.905/10, a 12-year-old child with evidence of osteoarthritis in the left elbow, was more indicative of hammering or picking of the mine faces based on the child’s age-range and presumed motor skills.

The children laboring above ground may have been involved in beneficiation activities that required carrying heavy loads some distance or kneeling or squatting for long periods of time while sorting material. Perhaps the loads were being carried with the help of a tumpline, occasionally overloaded with weight, causing superficial fractures of the frontal bone as seen in individuals 1006, 33/1997, and MO 21-23/C/1939. Injury involved in this heavy labor was likely a regular occurrence. If the heavy loads and contorting postures required did not cause physical trauma, a fall could leave a child with any number of fractures such as 10-year-old individual MO 2/1938's avulsion fracture, likely the result of a sudden, forceful twisting motion of the ankle. Given the possibilities and evidence available at the site of Hallstatt, I argue that children were not only present in the mines but were regularly engaged in labor-intensive tasks from the time they were physically able, increasing in complexity with changes in the equipment used as the child developed in strength, size, dexterity, and coordination.

Most of the labor-related tasks mentioned in this section could be intense and life-threatening at times. While children have some agency in their development, they may not have had the autonomy to choose whether to partake in these dangerous activities. The choice made by adults to risk the lives of children in dangerous conditions would have been very deliberate. There is little doubt that a permanent population of miners would be aware of the risks involved in their vocation and subjecting their future work-force, ultimately their children, to those conditions would not have been a decision taken lightly. In a secluded and highly occupationally specialized community such as Hallstatt, the socialization and technical education of children would have been paramount to the survival of the community and the continuation of the economic basis of their society. Therefore, it would stand to reason that children were not just valued for their potential as laborers, but for their active participation in labor *as children* and their role in cultural reproduction. This may be one explanation for the inclusion of children in the cemetery and their apparent share of the wealth accumulated by the community.

It would have been important for adults to mitigate the risk of injury or death of children as much as possible while maximizing their productivity in the mining activity at Hallstatt. There has yet to be a larger discussion about the various zones of activity that may have existed inside and outside the mines. Like Baxter's (2005a) zones of play activity, zones of labor activity for children may be identifiable if sufficient evidence for their presence could be mapped. This may prove exceptionally difficult in an underground mine setting, but the possibility may still exist.

An interesting introduction to developing a community-based understanding of mining in prehistory comes from the *Lebensbild* presented by Pany-Kucera, Reschreiter, and Gröbner, first in 2006 (in Pany-Kucera et al. 2010:41, Abb. 1) and later revised in 2013 to showcase what might be a more representative picture of the community composition in the labor area (Reschreiter et al. 2013:27, Abb. 1). The *Lebensbild* is a condensed snapshot of community life, developed by modern researchers and informed by available lines of evidence. While the activities depicted are all taking place at the same time in a single gallery, it is more likely that the variety of activities depicted would have been going on both above and below ground. Areas closer to shaft openings may have been used for domestic tasks such as cooking or fixing broken tools when the weather was bad, while these activities could have taken place above ground

Figure 4.3 *Lebensbild* representing the prehistoric mining community at Hallstatt in a salt mining gallery. Images from D. Gröbner and H. Reschreiter, 2006 (left) and D. Gröbner, H. Reschreiter, and D. Pany-Kucera 2013 (right) (National History Museum Vienna).

when weather permitted. It should not be assumed that the mining community at Hallstatt was living entirely underground, but it might have been possible that people were staying there temporarily if the permanent settlement area was far enough from the areas of operation to make travel to and from the mine inefficient.

The real strength of the *Lebensbild* may be that it can be easily updated and amended based on new findings and alternative interpretations of the data. Likewise, a series of these snapshots provide a chronicle of changes in interpretive styles. Two versions of the same *Lebensbild* from the Hallstatt salt mine have been produced. In Figure 4.3, the first image developed by researchers in 2006 is presented to the left and the 2013 version to the right. What we see in the newer *Lebensbild* is a livelier scene. The mine faces are being worked more openly and closer to areas of other activity, including cooking. There are more children present in the new image as well. They are seen here performing tasks such as stacking tapers, dumping basket-loads of material onto piles, and lighting tapers. There are also children congregating around one of the fires, without the direct supervision of an adult. At another fire, a child is crouched, watching two adults and one older child cooking. The scene also shows a general increase in activity, with more fires burning, more people moving around and an increase in tasks being performed. As a nod to research suggesting the chronic presence of intestinal parasites in the human coprolites found inside the mines, the researchers also included one person clutching their stomach while another sits in repose further back. The presence of human excrement in the mines (Reschreiter et al. 2013:34) makes this an unpleasant, but accurate, inclusion in the *Lebensbild*.

Divisions of Labor at Hallstatt

Divisions by Age

The second primary research question posed in Chapter One was whether a division of labor at the Hallstatt mining complex could be identified and, if so, whether the divisions could be assigned to specific ages and genders. There are a few different ways that labor can be divided within a community, but likely it would have been a combination of task differentiation that would have made up the intricate mining operations for maximum efficiency and safety. However, the most common divisions of labor are those along age and gender lines, which are both considered below. The division of labor might also be based on an individual's stature, strength, and/or ability, independent of either chronological age or gender. Non-material elements of skill development are often difficult to identify in the archaeological record, so many investigations have focused on crafts such as flint knapping and ceramic production to present evidence for the learning process (Derricourt 2018:136, 143). New evidence of small-sized mining picks at Hallstatt (Watson 2018) gives researchers direct evidence that children were learning the process of mining deliberately by practicing with child-sized implements.

According to Bugarin (2005:22), "The division of labor according to age-sets is an integral part of the success of all types of communities and thus must be included in the interpretations of any archaeological research". At the Hallstatt salt mines in late prehistory, children were present and contributing to operations. What is not immediately clear is whether the same tasks were performed in different ways depending on age groups. Whether the child-sized picks at Hallstatt are indicative of an apprentice-like learning process or represent a cooperative peer group remains unknown. Examples exist of cultures where children and adults, while engaged in the same labor activity, develop distinct and identifiable methods of completing the task. On the Meriam Islands, for example, all members of the community collected shellfish for sustenance (Wileman 2005:58). Children not only collected smaller, easier to reach shellfish, they often did so in peer groups as a form of play, without adult supervision. The smaller shellfish were also easier to clean, and children typically performed this task in groups. Middens of different sized shells are therefore evidence of activity zones based on age. If children's activity zones, as defined by Baxter (2005a), can be identified in labor contexts, material analysis can be extended to consider the modes of interaction involved in developing labor-related activities. Researchers may also begin looking for evidence of apprenticeship like that available for flint knapping (Wileman 2005:59). Debitage analyses at sites in France have shown that not all apprentices were children (as evidenced by the size of the cores and flakes being practiced on), but all were beginning with much lower ability levels than the "teacher" (Wileman 2005:59). Debitage analysis may not demonstrate a purely juvenile activity zone, but it could reveal zones of learning and cultural transmission, where interaction between learners of all ages would create space for negotiation of varying levels of knowledge and skill.

In ancient Greece, children are depicted engaged in tasks generally performed by slaves. It is not thought that the children in these images are themselves slaves, but that they begin their working lives learning to do the activities adults preferred not to do (Wileman 2005:61). This work may have been considered valuable and honorable if performed by children (Wileman 2005:61), as is mentioned by scholars like Aristotle. Egyptian tombs include images of children performing domestic tasks including tending to younger children. Agricultural work and apprenticeship are also reflected in the paintings and carvings (Wileman 2005:64). In smaller-scale societies, however, the differentiation of tasks based on social status would have been less important as most, if not all, members of the community would need to be versed in multiple functions (Lancy 2015:256).

At the Bronze Age Great Orme copper mining site, over four miles of prehistoric mine shafts have been investigated dating to around 1500 BC (O'Brien 2014). Many of the tunnels were found to be so small that it would be nearly impossible for an average sized adult to navigate them (Wileman 2005:61). In the Roman era Spanish mines of Riotinto, two potentially child-sized skulls were found adjacent to a smaller, lighter weight mining pick than others used at the site (Arboledas Martínez and Alarcón García 2015:108). It has been presumed by researchers that a correlation between the material and biological evidence, while speculative, is worth noting (Arboledas Martínez and Alarcón García 2015:109). While the evidence is indirect, it is compelling. Working in such tight tunnels would have been extremely dangerous with a great risk of bad ventilation, metal toxicity, and tunnel collapse (Wileman 2005:61). The work done by these children would have been highly valued as they would have contributed to the accumulation of wealth that sustained the entire community. While bioarchaeological data are not available for this site, it can be hypothesized that indicators of MSM related to tasks such as crawling and carrying heavy loads, as seen at Hallstatt, would be present in children at the Great Orme mining site as well.

While the labor activities of children at Hallstatt included work done underground in the mines, it is highly likely that they also participated in domestic duties and resource processing above ground. Preparing salt for transport, and other tasks that may have been performed in a kneeling position, particularly those that included kneeling or crawling while carrying heavy loads, could have been a contributing factor in the skeletal pathology present in children in the cemetery (see McMillan and Nichols 2005 for effects of habitual kneeling and crawling on joint morphology). In a review of modern small-scale hunter-gatherer and garden horticulture societies, carrying firewood was a ubiquitous task for children between three and five years old, with children in the six to 10 year old range participating in the care of younger children and grandparents (Derricourt 2018:132), all of which would have been possible for children at Hallstatt as well.

One age group rarely mentioned in most of the scholarship, and certainly in need of more investigation, is the geriatric population. If the compulsory bending, kneeling, and crawling associated with working mine faces, especially narrow corridors, resulted in irreparable joint damage, otherwise healthy adults may not have had a very long life as mine face-workers. Once osteoarthritis had reached a certain intensity it could have been debilitating, forcing miners to take on roles in other areas of community operation that were not as labor intensive. The institutional knowledge of older generations of miners would have made them well suited for domestic or managerial tasks, including deciding where to establish new mine shafts, engineering structural elements inside the mines, and possibly caring for and educating children. Transportation and trade negotiations might also have been responsibilities well suited for individuals of advanced age and knowledge in mining, as well as participation in food procurement, production, and provisioning. The archaeology of geriatrics is outside the scope of this thesis but is an area not well explored in the field and presents another opportunity to contribute to our understanding of occupationally specialized communities.

Divisions by Gender

Differential child-rearing practices and the distribution of cultural knowledge may also play a role in divisions of labor (Keith 2005:27). When groups are mostly egalitarian, divisions within the group are largely based on age and result in a difference in cultural knowledge (Keith 2005:27). We do not have much direct evidence for a gender-based hierarchy at Hallstatt, though nearly all members of the community clearly were contributing to labor activity. It may be that while a social hierarchy existed, a heterarchical system dependent on non-gender-related elements was possibly employed (Stöllner 2010:301). At Hallstatt, some amount of child-care would have taken place underground or near mine entrances and gendered divisions of labor, where they existed, would have likely been shaped from an early age. Pany's (2003,2005) MSM analysis of adult skeletal evidence from Hallstatt concluded that divisions of labor were largely determined based on gender. While a large portion of her sample was of indeterminant sex, the positively identified male and female individuals were interpreted as exhibiting different patterns of wear on joints, suggesting different ranges of tasks. The comparative material, all from prehistoric agricultural communities, showed that different patterns also existed for men and women in the mining communities. This analysis put to rest the argument that women were not actively involved in mining, but it opened up more questions regarding the types of work done by women and at what age they began to undertake gender specific activities.

Women and children have often been cited as being primarily or sometimes exclusively involved in above-ground resource processing activities in mining contexts (Herbert 1998; Shennan 1998:197). This is in part due to the biases discussed throughout this thesis, but there also are some historical and ethnographic precedents for this assertion. Different cultures have different ways of incorporating women into mining (Knapp 1998:17-18). In precolonial Africa women were integral to the iron ore preparation work but were not allowed into the mines and could not perform metallurgical tasks because they "lacked access to supernatural assistance" (Knapp 1998:17-18). Bioarchaeological evidence on individuals identified as female indicate that women were engaged in mining-related activity (Pany 2003). Anticipated research on hormones in the human excrement found in the mines may help solidify the assertion that women and children were working underground alongside adult men.

At the El Argar site of Peñalosa, paleodemographic studies indicate differences in the location of arthritis in men and women (Jiménez et al. 2014:137). Little anthropological interpretation has been integrated into the bioarchaeological investigations of the prehistoric population at Peñalosa, but one fascinating potential area of research is the difference in diet found between women and men at the site (Jiménez et al. 2014:143). Extending that analysis to include children and looking for connections between tasks and diet may illuminate more about the gendered divisions of labor and why such an organizational structure existed in this prehistoric copper mining community.

In the Aztec Codex Mendoza, children are depicted as being taught gender related tasks from an early age. In Aztec culture, gender differentiation increased in the course of a series of rites of passage (Ardren 2006:8) The stages of childhood were roughly four years apart starting at birth (Wileman 2005:168). During the ceremonies initiating these transitions, children were marked, either physically by piercings or by donning new clothing or hair styles (Wileman 2005:168). Gendered differences intensified after four years of age and are reflected in the Codex in images of children learning their labor tasks from a parent of the same gender.

Divisions by Ability and Stature

While gender differentiation and age-based tasks likely existed in some combination at Hallstatt, we might also consider a division based on physical ability. Mining by its nature is an extremely dangerous undertaking. Beyond the risks of large-scale disasters such as shaft collapse, landslides or shaft flooding, there was the constant threat of individual level accidents (McMillan and Nichols 2005). Miners were exposed to falling rocks and other debris while working mine faces. Low-light environments, uneven gallery floors, steep or unsteady passageways, and ventilation problems all could have resulted in increased risk of injury or death as well.

It is likely that mine workers were often in a state of recuperation after sustaining an acute injury or while suffering from a chronic labor-related condition such as osteoarthritis. With such an increase in the risk of injury, it may not have been possible to designate mining tasks strictly by gender or age. If there was a need for more miners to hammer and pick the mine faces, it may have been necessary for women or young people to step into these roles, at which point the less laborious tasks could have been picked up increasingly by younger children or others who were no longer able-bodied enough. If this hypothesis holds up against bioarchaeological evidence, we may adopt Lancy's (2015:256) "contrast between competence and productivity" and conclude that all members of the mining community were at least competent enough to perform various mining tasks as called upon. The example of boys being competent in foraging (typically a female task in small-scale hunter-gatherer societies) is used to demonstrate that while they are not as productive as their sisters in foraging, they could step up as a "reserve labor force" if circumstances dictated (Lancy 2015:256). In analyses such as those undertaken by Pany (2003; 2005), positive sex determination of individuals for the entire sample will be imperative to make inferences about the extent to which gender was related to the division of labor at Hallstatt. Improved methods of DNA analysis for prehistoric skeletal material have begun to open a gateway for reexamining previous hypotheses regarding non-gender and non-age-related labor organization structures.

As mentioned above, the role of children in navigating narrow passageways (O'Brien 2015) and in opening new mine shafts (Arboledas Martínez and Alarcón García 2015) would have required both a competence in the task and the physical stature required to complete the task. Small adults could have also been given tasks such as these. One recent example is the Rising Star paleoanthropology project in South Africa. When it became evident to researchers that the cave housing thousands of hominid fossils was inaccessible to most, a call went out looking specifically for excavators with some caving experience, and most importantly, who could physically access the Dinaledi chamber, which required crawling through the 10-inch high "Superman's Crawl" and the eight-inch wide "Dragon's Back." The result was an all-female team of six scientists with the necessary knowledge and physique for the job (Howley 2013).

Arboledas Martínez and Alarcón García (2005:110-112) provide an alternative example of labor divisions based on size and strength drawn from textual accounts of Agatharchides of Cnidus and Diodorus Siculus, both of whom describe the slave labor production chain at Ptolemy VIII's royal gold mines in Nubia. Both accounts describe specialized, as well as nonspecialized laborers involved in the extraction process. Pre-pubescent boys collected the minerals from the mines and brought them up through narrow passages where they were initially crushed by grown men, then taken by women, older adults, and anyone else not physically able to carry or pulverize the larger pieces, who milled the minerals to a fine powder (Arboledas Martínez and Alarcón García 2005:110-112). In these written accounts, we see a glimpse of the *chaîne operatoire* as it relates to different categories of people. While various age groups and genders are mentioned, the primary organizing principles behind these labor categories seems to be based on body size and physical strength.

Changing Labor Needs and Child Labor in Prehistoric Europe

In the Middle Ages in Europe, the emergence of rural industry (or protoindustry) was only viable in areas where the cost of production was low enough and the profit from production was higher than in agriculture. When these criteria were met, demographic shifts resulting in a lower age of marriage and a higher birth rate began to appear (Cunningham 2005:87). The few areas of Europe that developed protoindustrial communities in prehistory would have likely seen the same demographic shifts. As demand for resources such as salt and metal grew throughout the Bronze and Iron Ages, the need for skilled miners and better, more reliable organization also increased. What may have started as periodic child participation in below-ground activities in the Middle Bronze Age at Hallstatt may have turned into a more integral part of the increased output of salt extraction. While only a small percentage of the Bronze Age mines at Hallstatt have been excavated (Reschreiter et al. 2013:35), those shafts and galleries do not contain the same high amount of food remains or human excrement as their Iron Age counterparts. This could indicate that more time was being spent below ground in the early Iron Age. A demand for continual resource output would have resulted in everything from cooking, eating, and child-rearing taking place both below and above ground.

From the Early Iron Age at Hallstatt to the Late Iron Age salt mines at the Dürrnberg, there is evidence for a potential increase in less-skilled labor activity inside the mines that may have included children. At the Dürrnberg, extraction of salt was happening on a much larger scale than at Hallstatt. However, evidence in the mine galleries indicates that the methods being used were less efficient and mine faces reflect less skillful use of salt picking techniques than in previous centuries (Stöllner et al. 2003:138). The output needs of the late Iron Age could have been met either by an increase in child labor or through labor brought in from outside the community. Stöllner points to the presence of child-sized leather shoes in larger quantities at the Dürrnberg than at Hallstatt, possible evidence of an increase in child labor (Stöllner et al. 2003:138). DNA and strontium isotope analyses being carried out at the two sites may establish whether migratory patterns are evident in the workforce. Similar to the ongoing research at Hallstatt, hormone analysis of human coprolites at the Dürrnberg may yield insights into underground labor demographics.

Increasing child labor or lowering the age at which different tasks were learned may have had larger social implications beyond the increasing presence of children being more present in labor activity zones. In some cultures, such as the Kwoma and Koori, work-related tasks are tied to rank, making children's participation strictly limited up to a certain developmental age (Lancy 2015:258). If gendered tasks at Hallstatt were similarly rigid, one might expect to see a higher value put on male work, as is the case in societies where girls are generally confined to domestic tasks (Lancy 2015:258). The presence of small-sized mining implements mentioned above would contradict the idea of purely gendered activity, however, and may indicate a developmental structure based on labor achievement and ability rather than chronological age or sexual maturity.

An increase in child labor in Europe from the Middle Ages through the Industrial Revolution is easier to substantiate. By the time industrialization developed in urban and rural areas, people were used to seeing children at work, not just domestically or as craft apprentices, but doing manual labor in resource extraction and manufacturing. It was not a big leap for the use of child labor during the Industrial Revolution, when poverty and overpopulation were increasingly problematic in urban areas and child labor was a viable solution (Cunningham 2005:88-89). The 1851 census data on child labor in Britain indicate that 120,000 (28.4% of) boys up to the age of 15, and 12,000 (7.2% of) girls, were employed (Wileman 2005:65-66). While these numbers have fallen dramatically in post-industrial areas of the world, they persist at alarming rates in dangerous industrial activities such as those carried out in gold and tin mining in Asia and South America (Henne and Moseley 2005; Lancy 2015:61-63), and artisanal mining in Africa (Herbert 1998).

A better understanding of the prehistoric precedent for the use of child labor may shed light on the cultural milieu where such exploitation persists. The deeper held beliefs regarding the virtues of assigning children to work helps researchers better understand the underlying social structures that encourage its persistence. In places like Bolivia for example, prior to legislation legalizing child labor for children as young as 10 years old, children's labor unions formed that were mainly concerned with safer working conditions (Coster 2010). What is most interesting here is that the children themselves do not believe there is anything wrong with working while still a child. In fact, having a job is seen as virtuous and child laborers are collectively averse to the idea of humanitarian groups attempting to abolish their ability to work since without such work, many of them would not be able to feed themselves or contribute much needed resources to their families. In cases such as this it is important to consider the child's perspective, how their participation in labor is perceived, how it is connected to their identity, and how it shapes their reality outside of adult intention or perception. It is also important to consider these aspects as part of the underlying social problems that make child labor a necessary way of life in developing countries.

Childhood in the Mortuary Context

The analytical exercise developed in this thesis was centered around data accessibility and building datasets exclusively focused on children, without reference to dualistic comparisons between biological adults and subadults. Studying children in relation to their peers, or presumed peers, allows developmental and socialization experiences to come into greater focus. The small working dataset presented here provides a model for identifying developmental age categories in the absence of comparisons with the adult population. However, skeletal and chronological age are still important and should be considered when available, particularly in instances where burial goods are not extensive or show little sign of status differentiation. Bioarchaeological evidence is necessary to make inferences regarding social organization. In the above discussion of signs of labor-induced wear on juvenile skeletal material, having a biological age range is important in discerning when children may have started to work and what the long-term consequences of those labor activities were. The third primary research question in this thesis related to the mortuary evidence at the site of Hallstatt and the extent to which it reflects the roles of children, or their perceived roles, in the community. Without informants, written texts, or iconography, archaeologists have little scope for exploring the perception of childhood in the past. Mortuary analysis is one way of accessing this in a limited fashion (see Figure 4.4 for an illustration from Kromer's [1959] catalog).

Figure 4.4 Grave 305 at Hallstatt. The eight to 10-year-old is buried in a supine position, arms bent up at the elbow with large bronze rings around the upper- and forearms (Kromer 1959:86).

Typically, the mortuary context reflects adults' perception of childhood as burials are the product of survivors' representation of the deceased person. For children, burial assemblages reflect both the social and the symbolic construction of childhood (Baxter 2005a:107). To use mortuary evidence in researching the experience of childhood in a prehistoric community, evidence of the social construct should be available in the non-mortuary context as well (Baxter 2005a:107). As part of identifying these indicators of socially-defined childhood, we need to take what we know from the juvenile-specific datasets and compare them to those of the whole population, approaching the concept of age groups from a non-binary perspective. When adults are no longer assumed to be the normative category in mortuary contexts, it is possible to consider all age-based categories as social actors in the formation of the constructs researchers are trying to understand (Baxter 2005a:96-97).

While community-wide beliefs and traditions play a large role in burial assemblages, they are clearly not the only factor. The variation in assemblages, particularly for children in the same age group, or exhibiting similar skeletal pathologies, indicates that a set menu of burial rites was not applied to all children. Perhaps more immediate family members, including siblings, were free to design the burial of a child based on their means and kin-based traditions. Hodson points out that goods found attached, or in very close proximity, to an individual are typically considered to have belonged to that individual in life (1990:23-24). Items such as bracelets, anklets, torcs, fibulae, hair pins, and other costume items buried with a person are usually considered to be part of their personal costume. Ceramics and animal bones are more likely to be culturally prescribed communal additions to the burial.

Infants at Hallstatt

Of the single child burials at Hallstatt with an assigned age-range, only 11 were recorded as being in the infant group (comprised of children aged birth to four years old). Six of those burials were recorded as having no grave goods accompanying them. Of the five recorded as having grave goods, one was in the six to 12-month-old range and the other four were recorded as between two and three years old (Kromer 1959). Burial MO 1/1939, the youngest infant, included a bracelet, ceramics, and an iron object (Figure 4.5). Iron is not prominent in the burials of other children at Hallstatt, appearing in only three of the 101 children recorded with burial

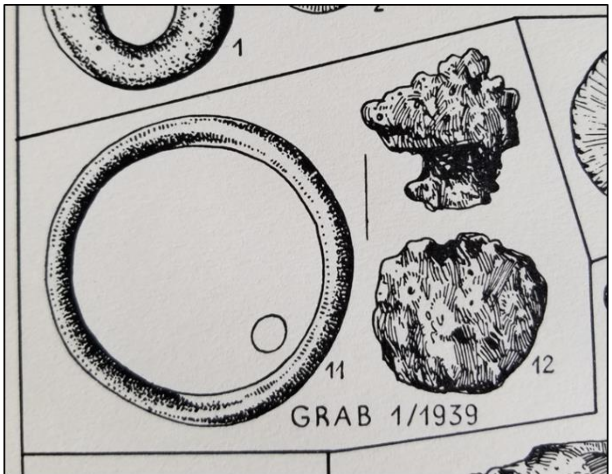

Figure 4.5 Grave goods associated with Burial MO 1/1939 include one bracelet (11) and a piece of rusted iron (12) (Kromer 1959:Taf 208).

goods, with or without age determinations. While unidentifiable pieces of iron are found in adult graves at Hallstatt with some regularity, Hodson attributes them to predominantly male burials (1990:74), making their presence in infant graves even more unusual and potentially amuletic in nature. Two of the older infants each contained only one grave good (a needle in one and a bracelet in the other). The remaining two would both rank as C3, including six material categories and seven objects each (see Table 3.10). The low number of young children overall in the dataset, and the richness of the burials that are present, are clear indicators of ascribed status. This is relevant because it suggests that children were valued and seen as inheriting the role or position of the family to which they belonged.

The scarcity of infants and young children in the Hallstatt cemetery may be at least partially attributed to differential burial practices. It was not uncommon in the Bronze and Iron Ages for infants to be buried in more domestic settings instead of in cemeteries, for example at the Ramsautal site in Austria where infants were found buried inside and near the outer walls of dwellings (Derricourt 2018:246). The practice of domestic child burials dates back even as far as the Mesolithic, with evidence of young children found within central hearths or beneath floorboards (Cunliffe 2008:82-83). The pattern of burying infants in “boundary locations” in Iron Age Europe and earlier may indicate a connection between infants and liminal spaces, including that between life and death (Cunliffe 2008:82-83). Different burial treatment beyond location may also play a role in the number of young children in the Hallstatt cemetery. Infants at the site of Vagnari in Italy were buried differently depending on their age, with wooden coffin burials reserved for children over the age of 12 months (Carroll 2012). At the site of the Heuneburg in southwest Germany, infants were disposed of most frequently in informal settlement contexts, including ditches and middens (Arnold 2012:93). These locations too may signify boundaries within the community. Evidence also exists for the transport of young children to infant-specific cemeteries. The archaic to early classical infant cemetery on the Greek island of Astypalaea contains at least 2,000 infants buried in amphorae from areas throughout the Aegean Sea (Clement et al. 2009; Hillson 2009). A contemporary cemetery near the infant cemetery includes a demographically normal population for the small island, indicating the spiritual or ritual significance of the infant burial site throughout the region (Clement et al. 2009; Hillson 2009). As there has yet to be a settlement discovered at the site of Hallstatt in which infant remains might be found, the above rationale is only speculative, however.

The older infants, or toddlers as we would call them in Western societies, are a group that would have required almost constant supervision, unable to navigate the mines themselves and only just beginning to express themselves verbally. The presence of C3 burial assemblages in this group is indicative again of an ascribed status not dependent on developmental age (see Table 3.10). The inclusion of amber, a bear's tooth pendant, and a clay whorl (found in the collection, but not mentioned in the *Protokoll* [Kromer 1959:122]) is similar to the well-outfitted burials in the older age-ranges, meaning these individuals were likely included in the same social category and may have been considered peers based on status rather than being buried like other children their own age.

One of the well-outfitted infant burials, Grave 428, was that of a two-year-old child, accompanied by a pair of bronze bracelets, an anklet on the left foot, glass beads, and a pierced bear tooth (Figure 4.6). This indeed signifies a socially significant individual. The only other instances of anklets being found in the juvenile burials are those found in the oldest of the adolescent age group, which are probably part of the adult category, as discussed below. When mentioning this burial, Hodson includes it in the female category based on the presence of the anklet despite an age estimated at just two years old (1990). A single anklet is somewhat of an anomaly, as ring jewelry is almost exclusively found in symmetrical pairs in Iron Age female burials (Arnold 2016:847). Assigning gender to juvenile burials, especially those of young children, based solely on grave goods is problematic given the historical precedent for young children being associated with female costume patterns irrespective of biological sex in some central European Iron Age contexts (Arnold 2016:847-848). As sexing juvenile remains with new methods such as peptide analysis of dental enamel becomes more commonplace, researchers will be able to determine at what age young children begin to reflect gender differentiation in the mortuary record, and whether they should be

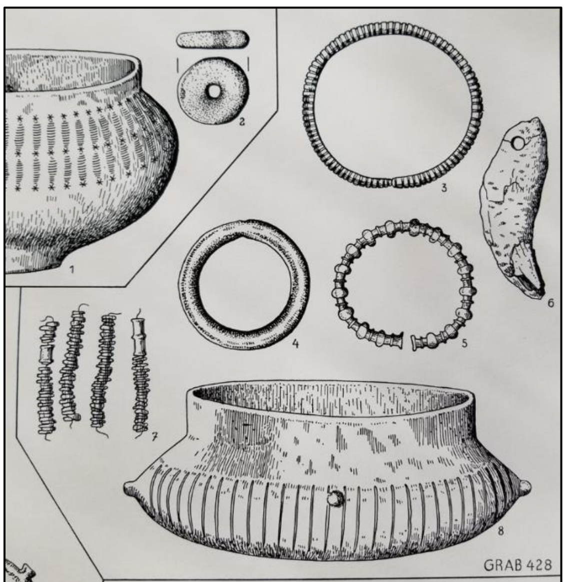

Figure 4.6 Grave goods associated with Grave 428. This unusual burial includes a single ring around the left foot (3). If this is an anklet of the sort buried with adult women, this would be indicative of a high-status individual. Other grave goods include a bronze bracelet on each arm (4 and 5), a bear's tooth pendant on the chest (6), blue glass beads around the neck (7), and a ceramic vessel near the head (8) (Kromer 1959:Taf 70).

placed in a separate social category entirely until then.

Multiple Burials

Thirty-one of the 101 juvenile burials that include catalog information are listed as multiple burials. While multiple-person burials in European prehistory appear regularly in mortuary contexts, archaeologists often struggle with interpretation given the frequent lack of consistency in burial rites, body position, grave goods present, and location of the grave (Arnold 2004:151, 2017; Kovářová 2004:26). Grave 957, a juvenile inhumation, is one example of the convoluted issues associated with interpreting material ownership in multiple graves at Hallstatt. In Ramsauer's *Protokoll* from 1862 (translated from Kromer 1959:179), the original entry recorded the burial as containing the mostly decomposed skeleton of a child with a crushed skull. The skeleton was found along with a spectacle fibula and a small bronze bracelet. Kromer notes that an additional *Protokoll* of Linz, Peduzzi, and St. Germain claims the grave also included a cremation on which the grave goods were placed, and the inhumation was said to have had no grave goods of its own (Kromer 1959:179). As this burial configuration becomes relatively common in the later Hallstatt period, Kromer chose to follow the multiple burial interpretation of the grave assemblage and the child's burial is thus recorded as being without any grave goods. Grave 955 is very similar: a juvenile inhumation and a cremation in the same grave, with the accompanying grave goods (one bracelet and one spectacle fibula) assigned to the cremation. In this instance, however, the cremation was recorded by Ramsauer (Kromer 1959).

Multiple inhumation burials have also been described with a wide variety of skeletal formations (Kromer 1959). Burial 4-5/1938 includes the skeletons of two individuals, with intermingled elements. The individuals have been identified as a woman and a young child with no age range given. Grave 896 is similar, but gender is not mentioned. The adult and child were laid side by side in a supine position. All burial goods are attributed to the adult. Burials 9-10/1939 included two skeletons laid on top of one another, oriented in opposite directions. The ages have been estimated as an adolescent and an adult, both believed to be male. The grave goods are not attributed to a single individual but lay between the skeletons and include a bronze ring, the needle of a fibula, and an iron ring.

In the case of multiple burials in which the majority of grave goods positively associated with a child are in direct contact with the individual, this mostly includes beaded necklaces, bracelets, and other costume elements. Other objects are assigned to adults, especially in the event that weapons are included. Burial 434 is an example in which the skeleton of a child estimated at eight years old was accompanied by costume elements in direct contact and a cremation at their feet, next to which were remains of a spearhead and an iron axe. The cremation is supposed to be a male and has been linked to the spearhead, axe, and nearby ceramic vessels (Hodson 1990). Exploring the mortuary context of multiple burials at the Hallstatt cemetery would no doubt enhance our understanding of familial relationships of children at the site. It would be a lengthy but worthwhile exercise to compare the assemblages and layouts of these burials and try to identify patterns in the treatment of members of all age ranges, but that is outside the scope of this thesis.

If the ranking system data are accepted as a representative sample of single child burials at Hallstatt, the results imply that children in the community were well integrated in the general population, that their identities and status were reflected in the burial record, and that they ultimately shared in the wealth resulting from salt extraction and trade. The presence of amber, an import from the Baltic region with supernatural connotations, in some of the children's graves is evidence that children were included in ritual and spiritual practices, and that their standing as community members warranted burial goods of this kind. Likewise, the inclusion of grave goods not directly related to regular costume, such as spindle whorls, iron fragments, and knives, may indicate that children held discernable roles within the workforce, or alternatively that their status was inherited and reflected in the burial record. Even in the graves with an A1 ranking, the presence of objects such as bracelets and fibulae indicate the children were being given a similar burial treatment as adults in the majority of single burial graves.

Having explored some of the possibilities of the childhood experience at Hallstatt, we can turn our attention to the impact of this reevaluation of existing data regarding children in prehistoric labor contexts. Chapter Five will discuss the secondary research questions including the potential for changing perspectives on childhood in the past. The variety of future applications and additional research opportunities for the study of children and childhood in archaeology, both in European prehistory and in general, are also considered.

Chapter Five: Discussion and Future Research

The Child's World

When Western archaeologists research Western cultures, either historic or prehistoric, it is easy to forget that other models of childhood exist beyond those that exist now or have existed in the recent past. Vastly different experiences of childhood change definitions of who a child is and how they relate to the world around them. In southern India, hunter-gatherer groups described themselves as being *makalo,* or children of the forest. They also consider themselves to be children of all the people who lived in the area before them, who are referred to as the "big parents" or "grandparents" (Montgomery 2009:55). Nurit Bird-David (2005) reports that in these hunter-gatherer groups there was no delineation between children and adults in terms of separate cultures or categories of personhood. The only child-like status that existed was related to the forest and the ancestors (Nurit Bird-David 2005).

In the Navajo tradition, development continues from infancy through adulthood in a series of stages that do not have direct counterparts in Western models. Developmental stages are organized around attained knowledge and social competence and not chronological age. Social maturation is more important than physical maturation, and typically does not occur until an individual is beyond 30 years old (Montgomery 2009:54-55). In both the Navajo and the South Indian examples, the experience of childhood varies greatly simply based on the definition of who is considered a child and until when. Interactions with peer groups in Western societies is usually seen as play and learning for groups of children in the same age-range or category (toddlers, young children, older children, adolescents), but in other cultural models, peer groups of children may include much larger age gaps or may be based on a different categorization than the Western dualistic "child" and "adult" model.

A Child-Centric View of the Past

When considering the experience of childhood in the prehistoric Hallstatt mining community, expanding possible models of childhood and personhood is an important exercise. The model may differ, as well as the definition of which individuals are considered children, but as we focus on the child's world, we aim to use the interactions of children with their peers, with adults, and with their environment as the basis for understanding. In an example from the present dataset, the individual in Grave 33/1997 provides a glimpse of the experience of childhood based on both the biological and material evidence. This juvenile is in the adolescent category, with a mean age of 12.5 (range reported 11-14 years old). This range corresponds to the average age range for sexual maturity by today's standards (which may need to be adjusted for differences in nutrition and hormone exposure in the past). The individual is noteworthy within the dataset as having the highest number of burial material categories (8), as well as the most extensive evidence of skeletal pathology in their age group. These values could be coincidental, or a product of improved excavation and recording methods in the late-20th century as compared to the other adolescent samples, which were excavated in the 1930s. However, they are consistent with the idea that children and adolescents were integral to the economic success of the community and benefitted from their labor.

The individual in Grave 33/1997 exhibits evidence of the early stages of osteoarthritis in both elbows and both knees, and the left femoral condyle shows signs of new bone growth. This adolescent also displays a rare hypoplasia of the dens, i.e. the process of the C2 vertebra is partially missing. This would have resulted in neck instability and pain. A healed circular, superficial skull fracture left a depression on the left frontal bone which could have been associated with an incident that also injured the dens (Pany-Kucera et al. 2010:50). Conversely, the hypoplasia could be the result of a rare genetic condition (an interesting case study, as one other child in the dataset also shows an underdevelopment of the dens) (Pany-Kucera et al. 2010:50). While a skull fracture can be the result of a simple fall, the combination of osteoarthritis and a hypoplasia of the dens indicate that this individual was involved in labor-intensive activity.

The burial assemblage for Grave 33/1997 included amber, a small knife, and a spindle whorl as well as two bronze rings, ceramics, a neck ring, and rivets, possibly signifying high ascribed social status, or the acquisition of a rich burial assemblage through achieved merit as a laborer, or both. It is worth noting that while amber is frequently found in the graves of younger children, it is also sometimes found in large quantities in burials of individuals with physical deformities or evidence of chronic disease in other prehistoric societies (Effros 2003:112), due to its supernatural and healing properties (Murillo-Barroso and Martinón-Torres 2012:187). In the example above, the community may have recognized the suffering endured by individual 33/1997 and included amber in the burial assemblage to assist the child in healing in the afterlife. In the small dataset compiled in this thesis, there are no other material constants that show up in all graves exhibiting skeletal pathology, so the inclusion of amber in the 33/1997 burial is an outlier in this sample.

This child would likely have exhibited mobility issues, changing their relationship with their environment and the rest of the community. The presence of a spindle whorl in the grave might indicate an activity that the child took up when they could no longer participate in mining activities. Even after being removed from their peer (age) group, they might have had increased interaction with older adults, changing their social experience and, depending on the age at which they had to cease mining activities, this might have separated them from the normal playing, learning, and bonding experiences of other children. Evidence exists for situations where a child's disability or deformity was accommodated by an entire family or community, as was the case for the Andean peasants whose work activities were scheduled around the needs of a child with endemic cretinism (Cook et al. 2014:17). Despite the importance of mining activity to the livelihood of the Hallstatt community, accommodations may have been made for children such as 33/1997. The data available do not allow us to prove this was the case, but this burial suggests alternative ways of presenting the *Lebensbild* for individuals who found themselves excluded from their peer group due to disability. If the amber in the child's grave was the result of extra care given to protect or heal them in life and death, this suggests a system of belief that might be explored further – that is, how the community cared for its vulnerable members.

Two other adolescents in the sample (Graves VII/II and MO 2/1937), with the highest mean ages in the dataset (14 and 16 respectively), both show signs of osteoarthritis in at least two joint surfaces, and both include a set of ankle rings, something not found in any of the other child burials analyzed in the dataset, and all but one (see above) in the list of juvenile burials with catalog information. At the time of their deaths, these two children may not have been considered children at all. It could be argued that they had already reached a level of maturation that put them firmly into the "adult" category. This is an example of chronological age based on physical development being used as the measure of social age. While archaeologists need to be able to categorize individuals for demographic analysis, it is important to consider elements beyond stature or dental development in assigning them to a social category.

Changing Perceptions of Childhood in Prehistory

Mining as Masculine versus the Family Affair

Men have traditionally been seen as “gender-neutral” in archaeological discourse on mining, to the point that separating androcentricism from mining becomes difficult (Knapp 1998:17). Much of what has been studied about mining includes the technological evolution of the industry, with the underlying notion that men were at the center of the labor (Arboledas Martínez and Alarcón García 2015:105; Knapp 1998:17). In Chapter One a secondary research question was raised regarding whether the prevailing view of mining and other industrial activities as predominantly masculine would be affected by the inclusion of children as an integral source of labor in occupationally specialized communities. Much like gender archaeology and the inclusion of women in critical archaeological narratives, the addition of children pushes back against the antiquated model of “Man the Hunter” (or Farmer, Warrior, Miner, etc.). By considering the participation of children in labor activities, we can explore how mining communities create and preserve their occupation-related collective identity. The focus on the study of mining communities (prehistoric, historic, and ethnographic) can begin moving away from an image populated by ephemeral, heterogenous, adult male-dominated groups of seasonal and opportunistic laborers and managers and begin to incorporate other possible demographic configurations. Temporary mining communities and their unique dynamics in often remote regions is a fascinating subject, but it does not touch on the dynamics of permanent mining communities that have a different type of working structure. If divisions of labor can be identified based on strength and stature and not just gender or chronological age, we may see a different type of temporary labor model come to life as well.

In his review of the Ramsauer excavations, Kromer (1959) argued that the social structure at Hallstatt was built around a highly specialized male workforce, in which occupants belonged to one of three groups: manual laborers (miners); those involved in commercial and technical activities; and those dedicated to community security (Kern 2010:71). While he could not deny that women and some children were present, Kromer minimized their contributions and suggested their presence was purely domestic. McMillan and Nichols' (2005) review of the effects of habitual kneeling and crawling activities on joint surfaces in miners contained no studies involving children or women. Even the more recent research tends to focus on males as the main labor force. Some of this has historical precedent, as most of the studies were based on demographic and epidemiological investigations conducted in the 20th century when labor activities were even more gendered than they likely were in prehistory.

Reflecting on the *Lebensbild* presented above, it is obvious that current research at Hallstatt has moved away from Kromer's model and has embraced the possibility of a community in which most members were active in mining activies. Extending this concept to other archaeological mining sites strengthens the argument that protoindustrial undertakings required a demographically normal workforce, with men, women, and children of all ages participating in labor, and being actively involved in the socialization of subsequent generations of miners.

Children in the Context of the Prehistoric Mining Community and Beyond

The next research question explores the extent to which evidence of child participation in mining could change the existing perceptions of childhood in prehistoric Europe and in other comparable contexts. The *Lebensbild* approach enables an exploration of how women and children were an integral part of the extraction of resources, either directly or through supporting activities, and the Hallstatt mining community is a good example of how other prehistoric European mining sites may have operated. Understanding childhood as it was experienced by the children themselves offers opportunities for more comparative analysis, creating a richer understanding of prehistoric mining as an occupation and a social identity. Archaeologists do not have the luxury of working directly with child informants, but with a more complete understanding of occupationally specialized communities, we can create a more comprehensive context for children in the labor force.

The inclusion of children in mining activities counters the Western bias toward children as consumers of resources rather than economic assets to their communities (Wileman 2005:55). The general disapproval of child labor in the West permeates and impacts our view of the past because the most recent historical examples involve child exploitation. By letting go of the notions that children are blissfully unaware of the harsh realities of life and therefore need to be sheltered, protected, and kept pure, the possibility that life in European prehistory did not reflect the moral values of today can be accepted and archaeologists can move forward with greater objectivity. As evidence of children in prehistoric labor contexts is more actively investigated, an array of different childhood experiences will be illuminated.

Perhaps surprisingly, children working in agricultural contexts and their perspective on childhood, labor, and value have not been part of the corpus of ethnographic analogy consulted in connection with prehistoric child labor in Europe. Agricultural work has long been seen as a family affair. According to the United States Department of Labor, most states allow children as young as 12 to be employed on family farms. A few states have exempted farm work from most or all of their child labor laws, including maximum number of hours worked or minimum age for children to work during school hours. This contrasts with the minimum age limits for labor in other industries, generally between 14 and 16 years old, depending on state laws. Farm work can be just as grueling as industrial labor and yet it is a generally accepted part of rural life. Children who grow up on farms are expected to learn farm-related activities as soon as possible, their contributions central to the family's economic success. This context poses an opportunity to explore the experiences of children as a labor source using living informants who can provide a picture of child labor activities that is not biased by the moral fall-out of the Industrial Revolution.

Future Research

Opportunities in New Analytical Techniques

We turn our attention now to future applications and ramifications of the presented framework. Recently, a child's leather cap and a number of very small mining picks have been found at Hallstatt dated to 1000-1300 BC (Watson 2018). This discovery marks the oldest evidence of children in the mines and is at least 200 years older than any previous organic evidence. The rising popularity of the study of children in archaeology means that continued reevaluation of existing evidence will prove fruitful and will continue to weave children's narratives into the tapestry of their communities. Improving methods of analysis will need to go beyond the rethinking of the material and biological information as it is currently available. New scientific techniques that will greatly expand the research value of collections hidden deep in repositories around the world include the following:

- Peptide analysis of dental enamel (amyl-x and amyl-y) for sexing subadults. This recent advance in sex determination involves minimally destructive enamel surface acid etching to identify isoforms of amelogenin that are strictly sex-chromosome linked (Stewart et al. 2017). The new method will be groundbreaking as more collections of juvenile biological material can be analyzed, providing reliable sex determination. Likewise, analysis of adults will become more reliable and previous data can be compared and reanalyzed.

- Hormonal analysis of coprolites preserved in salt. Researchers at the Natural History Museum in Vienna are planning to undertake analysis using the coprolites found inside the mines at Hallstatt (Watson 2018). Reschreiter and his colleagues are in search of an absence of certain hormones in the excrement that would indicate children were present. This technology could be extended to determining the biological sex of workers engaged in underground activities.
- Strontium and oxygen isotope analysis for determining the area of origin of children in the community. Where molars are present for individuals at the cemetery, isotope data from tooth enamel can indicate whether the labor sources were local or migratory (Evans et al. 2006:311-312). As labor needs increased through time, one might expect to see more people joining mining communities from farther away. A comparative analysis of the Hallstatt burials and other prehistoric European mining sites could identify a trend toward more heterogenous populations over time, and whether whole families or just children were migrating to these areas for work.

Applying these new techniques to the Hallstatt skeletal population will provide important demographic information that, when combined with other lines of evidence, has the potential to greatly enhance our understanding of when gender divisions first emerged in salt mining at Hallstatt, the extent of gendered divisions of labor, and the degree of genetic isolation of the Hallstatt mining community.

Several other methods of analysis could be applied to the Hallstatt data to generate a more holistic understanding of children within their communities. A few interesting possibilities include:

- Analyzing dental impressions on light taper chips found inside the mines to determine if the size of the occlusal surface could have been from deciduous teeth of children.
- Reexamining the location of finds made inside the mine shafts to better mark zones of activities. Accompanying biological evidence might be used to assign areas to specific gender or age groups.
- Genome mapping and aDNA analysis of individuals in the Hallstatt cemetery. Genome banks have started accumulating thousands of aDNA samples from across Europe and other parts of the world that will allow researchers to trace the large-scale movement of people, changes in genetic makeup by region, and uncover previously unknown connections between groups of people (Krakowka 2018).
- Skeletal examination for evidence of chronic sinusitis in children. While the researchers at the Natural History Museum Vienna were limited in their research to adult skeletons with a good degree of preservation (Pany-Kucera et al. 2018:987), the method of identifying signs of chronic sinus problems in children could indicate their continued presence in underground mining environments.

More generally, comparative studies can be carried out on adult and child skeletal remains from analogous sites to augment the small sample size from Hallstatt (Pany et al. 2010). Currently, the hypothesis is that the Hallstatt community was largely genetically isolated. More DNA analysis is needed to determine whether this is true or if newcomers to the community (adults and/or children) came to participate in the mining and share in the wealth. The geographical remoteness of the mining area, the demographic self-containment of the workforce, and the seemingly steady population size would indicate a thriving homogeneous group, but this idea needs to be tested.

Contributing to the recent collection of aDNA samples may lead to interesting, potentially unexpected information about the inhabitants of the Salzkammergut, the larger region where Hallstatt is located. As the research on the Bell Beaker population movement into Britain suggests, the more samples are added to the data bank, the more information on the movement of mining technology and the miners themselves will become available (Krakowka 2018).

Additional methods exist for studying children in prehistory that are not well suited for the Hallstatt population, but are promising for research on children in metal mining contexts. Toxicological analysis of bone metal quantities can be illuminating for studying industrial exposure to heavy metals such as those found in metal mining and processing environments. What is particularly useful about this sort of analysis is the ability to use historical and ethnographic analogy to a greater extent, as examples of children involved in metal mining in parts of South America, Africa, and Asia are available for comparison. Additionally, understanding metal toxicology and the public health risks of industrial exposure will contribute to the work of advocates attempting to mitigate the health threats represented by labor for children in countries where this is still a common practice.

Environmental toxicology provides evidence of prehistoric metal mining and smelting activities and enriches the discussion of community health. Little research exists using toxicology to explore the prolonged effects of prehistoric mining on present day landscapes, but what is available promises to inform us about both extinct and extant populations around the globe. One such study, in the *Journal of Public Health Medicine*, highlighted the effects of metal pollution in the Jordanian region of Wadi Faynan caused by mining activities that took place nearly 2000 years ago (Pyatt and Grattan 2001). Bioaccumulation of copper and lead particles in the soil were transferred to food sources in the area of Wadi Faynan, affecting the health of current populations (Pyatt and Grattan 2001:235). By analyzing bioaccumulation of heavy metal pollution originating in prehistory, researchers may have a better idea of the magnitude of resource extraction and the health risks involved for prehistoric miners or those living near the mines.

Opportunities to Extend the Methodology

With advancements in archaeological science, a shift in focus to the interactions of children in the form of the child's world, and the increased availability of metadata for previously excavated and investigated collections, the archaeology of childhood will transcend its mostly theoretical and epistemological state to become a practical and functional subfield. In this thesis, the microcosm of children in prehistoric salt mining contexts in central Europe offers a brief glimpse into what the expansion of the subfield might contribute to existing archaeological knowledge. The case study of the prehistoric salt mining community at Hallstatt is just one example of the variety of mining populations available for research. The approach presented here could be explored in contexts such as the copper mines of the Mitterberg in Austria, Peñalosa in Spain, Great Orme in Wales, and other Iron Age salt mining complexes such as the Dürrnberg in Austria.

Continuing the study of young children in the Hallstatt cemetery will shed more light on status and the treatment of infants in prehistoric Hallstatt. The pattern of infants being excluded from adult and child burial grounds in Iron Age Europe (Arnold 2012:93; Derricourt 2018:246) makes the few, but well-outfitted infant burials at Hallstatt an important topic in addressing social status at the site. As mentioned above, if infants are able to be sexed using new forms of chemical analysis of dental enamel, the variable of gender could be discussed more definitely in regard to very young children as well. A *Lebensbild* specifically focused on the experience of infants at Hallstatt would provide an interesting perspective on personhood in prehistoric mining communities, particularly if infant burials are found outside the confines of the cemetery. As in Roman occupied Britain, burial practices associated with infants can change with the introduction of other cultures into the community (Derricourt 2018:248). Infants were rarely buried with adults and older children in Iron Age Britain until the Romans introduced new burial practices that incorporated all ages into the same cemetery. After the Romans had withdrawn, the pattern returned to the pre-Roman practice of burying very young children away from the rest of the community (Derricourt 2018:248). Knowing more about the timeline of the Hallstatt cemetery where the infants were found would allow a determination of whether burial practices for infants changed over time.

As Baxter (2005a) has summarized, the way evidence is considered is just as important as the evidence itself. A farmstead provides an entire world in which a child learns, grows, plays, develops, and negotiates interactions. Identifying children in these contexts without direct mortuary evidence requires careful consideration of the potential zones of activity, the placement of seemingly unrelated and misplaced objects, and the process of socialization in learning technical skills needed to work on a farm. Once potential areas of children's activity can be identified, those activities begin to come to life. Perhaps a few broken ceramics and a small figurine are found a few meters into a wooded area beyond the main areas of activity that acted as a stage for child's play. This could have been a child-specific space, free from supervision, but not outside the acceptable proximity to home assigned by adults. Miniatures and other tokens found together in remote or unexpected places are often attributed to ritual and superstition, however in some instances they could represent veritable toy-chests full of the prized possessions of prehistoric children (Derricourt 2018:171).

Identifying children's activity zones, considering their relationships with their peers, with adults, and with their environments within these zones, and looking for evidence of socialization techniques in the way of material culture and bioarchaeological data can, as a package, be applied to nearly any type of settlement investigation. When available, texts, iconography, and photographic evidence can also be used to build stronger analogies for the study of children and childhood in prehistory.

Conclusion

The choice to reevaluate existing evidence for children at the site of Hallstatt was made in hopes of addressing some of the major shortcomings of archaeological interpretation regarding the experiences of children in prehistoric Europe. Early critiques lamented that children were missing in general, that their contributions were unnoticed, and that without children, there could be no cultural reproduction. Diving deeper into the rationale for the omission of children in archaeology, themes became increasingly clear that aligned with the top three assumptions Baxter (2005a:20) cites as preventing an archaeology of childhood from being mainstream in the field:

1. that childhood is universally based on chronological age and biological maturity;
2. that children cannot, or should not, participate in meaningful economic activities, whether because they are lacking the requisite sophistication, or because it would jeopardize their ascribed innocence;

3. that evidence of children in the archaeological record is elusive and often undetectable, and therefore children are impossible to study from an archaeological perspective.

Finding an appropriate archaeological case study to explore, and ultimately refute, the above assumptions was the starting point for this analysis. Children had been historically marginalized in archaeological interpretations until gendered interpretations of the past were adopted (Baxter 2005a, 2005b; Chamberlain 1997; Lillehammer 2008; Roveland 2001; Sofaer Derevenski 1997; and others). While such studies are gaining momentum, there is still room to explore how well theories about childhood work when applied to data about children, particularly in the newest publications such as Derricourt's (2018) encyclopedic-style volume, *Unearthing Childhood: Young Lives in Prehistory*, which offers a wealth of evidence surrounding a series of themes such as learning, play, fighting and death, but provides little theoretical perspective tying the cases together. The child's world as developed by Lillehammer was chosen as a theoretical framework for this thesis mainly due to its interdisciplinary nature. The child's world is the sum of a child's interactions with peers, with adults, and with their surrounding environment, and therefore involves biological, material, and cultural components that should be considered holistically (Lillehammer 2015:79).

Hallstatt proved to be an appropriate case study for a number of reasons. Primarily, the available evidence from the site aligns with what Lillehammer (2015:79) believes to be some of the basic tenets of the child's world theory:

1. The child's world contains biological and cultural categories. Hallstatt provides evidence for both categories of evidence.
2. To find evidence of the child's world in prehistory, something must be known of the adult's world. As one of the most well-studied sites in prehistoric Europe, extensive

analyses and interpretations are available regarding the biological and cultural data at Hallstatt.

3. Technology is an integral part of the transmission of knowledge and culture from one generation to another and has a direct impact on the child's world. Having some idea of the occupational activities at Hallstatt, and its isolated, seemingly self-contained workforce, make the mining community an ideal location to explore how children learn and experience being part of their society, and how those strategies may transform over time as a result of shifts in socio-political organization or changing economic factors.

The analysis included reorganizing the data on children at Hallstatt by recording material, mortuary, and bioarchaeological evidence, identifying shortcomings, and looking at areas where studying the age-groups of childhood, or the potential for them, might yield insights into the process of growing up in a mining community. Finally, the incorporation of *comparanda* and modern theories on child development assisted in creating a broader picture of the experience of children working in prehistoric mining contexts more generally.

Evaluation of the evidence supported the hypothesis that children were participating in mining activity (Kern 2010; Pany-Kucera et al. 2010; Reschreiter et al. 2013). Labor activities likely began at a very young age, which may have had a connection to defining personhood as represented by burial treatment of infants and young children. While evidence is limited, it suggests that social status (either related to gender or wealth/role) begins to present in adolescence (i.e., anklets) with not much difference between the early and middle childhood age-groups. There is historical and ethnographic precedent for divisions of labor by age and given the potential for a heterarchical social organization at Hallstatt (Stöllner 2010), this may have been more important than gender differentiation. Likewise, divisions based on strength and stature may have been employed given the nature of various mining activities. Regardless of how many divisions were possible, it was more likely that a combination of social and biological factors dictated the work being done by individuals at Hallstatt. This contrasts with traditionally held perceptions that mining is a male-normative activity (Kromer 1959) and extends the list of mining-related activities beyond extraction, protection, and management to include the intricate system of supporting activities, including domestic duties, post-extraction processing, and trade negotiation. By default, this widening of focus puts equal emphasis on the contributions of all community members and embeds socialization into the *chaîne operatoire (*Arboledas Martínez and Alarcón García 2015:105).

Future research opportunities for the study of childhood in prehistoric mining communities are increasing with the development of new and improving scientific methods of archaeological analysis (including methods of sexing, hormone analysis, isotope analysis, toxicology, and many others). This thesis demonstrates how disparate data, source material, theoretical perspectives, and analogous material can be integrated to reevaluate children in an archaeological context from a specific time and place. Currently the dataset presented here is the only example of inquiry into the role of children at Hallstatt available in English. This will hopefully prove useful for future English-language research being conducted on the topic of children in occupationally specialized communities, as issues with the accessibility of academic research data are an ongoing obstacle to innovative interpretations. For the dataset presented, for example, the antiquated German terminology used by excavators had to be translated into a more modern idiom before it could be translated into English and finally into the archaeological lexicon. It is likely that more comprehensive catalogs exist but are not currently shared publicly and are almost certainly only available in German.

One of the most useful discoveries resulting from this thesis project was the utility of the *Lebensbild* in compiling and interpreting the available evidence in a way similar to a museum diorama, but infinitely more transmittable. The researchers at the Natural History Museum Vienna have employed a series of these illustrations for everything from educating the public to planning new research directions (Reschreiter et al. 2013:34-35). While there are limitations to using such illustrated interpretations, the *Lebensbild* employed by researchers in Austria is a great step toward more inclusive assessment of whether all the available evidence is represented in the picture, and if not, why.

Figure 5.1 *Lebensbild* of the Hallstatt community inside an Early Iron Age salt mine. (Copyright Dominic Gröbner, Natural History Museum Vienna, 2013) Commons.

If you look closely at the *Lebensbild* in Figure 5.1, you will see a young child bleeding from the forehead and being attended to by slightly older children (one of whom has an infant strapped to his back), a boy scratching his back because lice was a prevalent health issue, children can be seen lighting tapers, preparing food, hauling small baskets of broken tools, and heavy loads of salt with the assistance of a burden strap, and in the distance, helping with picking the mine faces. The children depicted in the *Lebensbild* cannot be considered from a purely economic perspective and discussed as though their status as asset or liability is what dictated their own lived experience. By illustrating the available evidence, one can appreciate that these children were an integral part of a community and played multiple social and industry-related roles. They participated in the economic production and accumulation of wealth, and subsequently benefitted from it in the same way adults did. Their experience of childhood at Hallstatt would have been dictated by a mosaic of social categories including age, gender, and social rank, and would have been directly impacted by who and what they interacted with on a daily basis. The nature of mining activity, and the importance of steady resource output for an occupationally specialized community, might have meant that children spent less time playing and more time congregating with their peers in labor-related environments or participating in labor activities that provided informal learning of a variety of tasks. With the collection of analytical and theoretical tools available to archaeologists today, any of the vignettes highlighted in the *Lebensbild* could be extracted and the child's world explored in more detail.

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