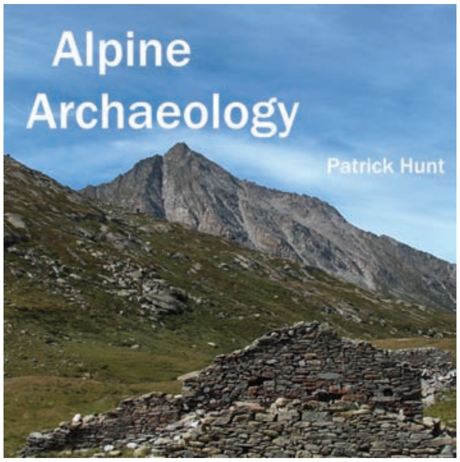

Alpine Archaeology

By Patrick Hunt

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ALPINE ARCHAEOLOGY

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NEW YORK

Patrick Hunt is on the Classics and Archaeology faculty at Stanford University, where he has been Director of the Stanford Alpine Archaeology Project since 1994.

His Hannibal research is sponsored by the National Geographic Society, with a grant from their Expedition Council for 2007-2008. He is also an elected Fellow of the Royal Geographic Society (London) for montane exploration and has served as President of the Stanford Society of the Archaeological Institute of America (since 1995).

His archaeology research has also been featured on the HISTORY CHANNEL broadcasts on various topics and in ARCHAEOLOGY Magazine (Jan/Feb 2007). Author of many global archaeology journal articles, his archaeology books include TEN DISCOVERIES THAT REWROTE HISTORY (Fall 2007) from Penguin/Plume and other monographs.

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Published 2007
11 10 09 08 07   1 2 3 4 5
Printed in the United States of America
ISBN: 1-934-26900-X (paper)
978-1-9342690-0-8 (paper)

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ACKNOWLEDGMENTS

This book is the fruit of more than a decade of labor, not that it took so long to write but rather that its observations were made over time in numerous field seasons and gradually built up over years of research in the Alps. This book is not intended to be comprehensive, but rather is a small picture of our work to date. Its archaeological relevance (as a work in progress) to other Alpine contexts is more to be inferred from common elements than expressly stated here. The first part of the book is derived from our fieldwork, mostly in the Grand-St-Bernard region, and the second part derives from our ongoing research attempting to trace Hannibal's route across the Alps.

Many students assisted in the patient collection of data and nearly all those students between 1994-2006 hiked and climbed over Alpine mountains and down into Alpine valleys searching for often elusive archaeological remains or tracking Hannibal across the mountains. Sometimes we marveled together peering down at the courage of the tiniest brilliant flowers growing in sheltered cracks in rocks, sometimes on our hands and knees we exulted over the finds of thumbprints of potters pressed into potsherds still surviving after thousands of years or over glass, or while holding up just-excavated bronze and even silver coins minted by Romans and then buried for millennia far from their points of origin. Sometimes on our backs we were awed by meteor showers in night skies filled with stars. It was worth it when with tired hands and feet we finished a day's research and then found a season's satisfaction under craggy peaks that were there long before we came and will still be there long after we are gone. So this is those students' book as well. This book is dedicated to at least a generation of wonderful students for whom the Alps will always evoke shared memories of spectacular vistas and camaraderie.

There is also one individual to whom this book is dedicated. Robert Tousey, whose vision and big heart are unforgettable, worked for years on my photographs and gradually brought my teaching via archaic slide projectors to digital and computer projection and into the 21st century. Bob was in many ways my mentor and teacher in matters archaeological and pedagogical.

Generous sponsors have encouraged and underwritten our Stanford Alpine Archaeology Project by providing the resources to dream and study all these years in the Alps. These benefactors include Peter and Helen Bing, Herant and Stina Katchadourian and Cordell and Susan Hull, to all of whom I owe a great debt. Gratitude is also expressed to the Classics Department at Stanford University and to its Chairman, Professor Richard Martin, who has always encouraged scholarship by his own example. Friends and encouragers who have followed this research from the outset include Fritz and Beverly Maytag. Last but not least, I am grateful for the sponsorship of the National Geographic Society through a major grant from the Expedition Council for our Hannibal research in 2007-2008.

ILLUSTRATIONS

Chapter One

WHY ALPINE ARCHAEOLOGY?

Introduction

Why should alpine archaeology deserve a separate category? One does not usually hear or read about desert archaeology or tropical archaeology as separate sub-disciplines within the larger study of general archaeology, yet each unique environment presents different problems, advantages and disadvantages. The study of alpine archaeology as a separate sub-discipline presents unique contextual and climatic circumstances that play a large role in both the location and preservation of artifactual material.

That there should be some focus within archaeology specifically oriented to mountains and the Alps in particular is not surprising when the global picture is examined. Virtually 11% of the Earth's land surface is higher than 2,000 meters (6400 ft) or above a mile in elevation.[1] This altitude, while modifying human interaction, has hardly prohibited human occupation or even long-term presence.

The working definition of alpine archaeology relevant to this text is of that specific montane or high altitude archaeology pertaining to the European cultures or material remains and types across the convex mountain arc of the Alps in France, Switzerland, Austria, Germany and what was Yugoslavia but is now Slovenia. [2] This text does not generally consider or report on archaeology from other global high montane elevations on different continents, even though many of the same considerations are applicable, for example, in the Rocky Mountains in continental North America or the Caucasus mountains in Asia, etc.

The primary archaeology considered in this text concentrates on contexts in montane elevations above 800 meters (approximately 2700 ft. altitude) or the alpine valleys between these mountains where the general prevailing climate is dictated by the mountains above.

The upper elevation limits for alpine archaeology could go as high as the Alps themselves – including Mont Blanc at 4807 meters (15,771 ft.) – but significant human presence has traditionally been clustered below the fluctuating yet near-permanent historical snowline around 3600 meters (11,520 ft.) in summer.

The chronology involved is generally different and often later than in other locales, generally beginning from the Stone Age, generally Mesolithic, circa 12,000 - 9,000 years BP (10,000-7,000 BCE), Neolithic circa 9,000 - 6,000 years BP (7,000-4,000 BCE), Copper Age circa 6,000 – 4,000 BP (4,000 – 2,000 BCE),[3] Bronze Age circa 4,000 – 2800 BP (2,000 – 800 BCE), Iron Age circa 2,800 – 2,200 BP (800 – 200 BCE) from Hallstatt to La Tène cultures, Roman and Gallo-Roman circa 2,200 - 1,500 BP (200 BCE – 500 CE), Medieval circa 1500- 500 BP (500 – 1500 CE).

Mesolithic archaeology in the Alps is usually a reliable *terminus post quem* (Latin for "point after which…") because heavy glaciation in the Alps prior to this period appears to have obliterated anything earlier as the underlying glacial moraine acted like a huge blotter grinding away the earth's surface as glaciers wiped it clean like a slow-moving blotter of ice and rock.

Thus, Paleolithic archaeological material is almost nonexistent in this glacially dominated alpine landscape prior to 10,000 BCE, looking then much like the topography around the Schreckhorn at 4078 meters or around 13,000 ft. (Figure 1) above Grindelwald with adjacent glaciers in the Bernese Oberland.

1. ALPINE SCHRECKHORN

This researcher has spent the past several decades concentrating on montane or alpine archaeology in the Alps themselves but also in other montane zones where certain contextual circumstances may overlap. The Andes mountains of South America, the Apennine range of Italy, the Lebanon – Mt. Hermon massif of the Levant, the Tuxtlas and Sierra Madre ranges of Central America (Mexico), the Sierra Nevada and Pacific Coast ranges of the U.S. among others, are some of the contexts where this researcher has spent time in archaeological study from which some principles are drawn for this text.

Biogeography and geomorphology are themselves important for all archaeologists who wish to draw greater inferences from their fieldwork about the larger questions that human prehistory and history have followed without necessarily having any conscious attention for having done so. If, as this author has stated for years, geomorphology shapes history and humans live by the adaptive constraints of biogeography [4] (note how most human population for millennia have been concentrated in the mid latitude temperate climate zone and fairly close to large water masses and coastal areas or river outlets at low altitude), then human occupation in the Alps is somewhat anomalous.

Types of Global Climatic Environments

As mentioned, the types of environments in which archaeological and cultural materials are found include *tropical, desert, temperate, alpine* or *montane, and Arctic* (or *Antarctic*). Some of these environments are dependent on latitude, others on prevailing winds and geomorphology, among other factors. That human prehistory and history have been much influenced by climate needs no elaborate proof, yet because Alpine prehistory and history have been so strongly determined by paleoclimates [5] for the past ±10,000 years, [6] it is important to differentiate some major climatic zones. To best understand alpine climate in context, it is also necessary to briefly discuss other climates.

Tropical

Tropical is further defined by the quantity of liquid moisture, either by high precipitation in this wettest of biomes (minimum 60 inches but may exceed 160 inches, in any case usually above 1000 mm per year) [7] or high relative humidity (above 50%) along with a higher year-round median temperature (above 25 ° C / 75 ° F (usually between 68-82 º F) and a near absence of seasons (although there may be both wet/dry seasons without much transition). The total number of species in tropics may be up to

35-40 per hectare and this biome may produce 0.2-0.7 lbs per square foot of biomass per year.[8] Of these climatic zones, tropical is generally found within 30 ° north or south latitude from the equator, and Arctic and Antarctic zones generally found above 60 ° north or south latitude from the equator. Therefore, tropics are generally fixed climatic zones.

Desert

On the other hand, although often contiguous with temperate and even subtropical or even tropical latitudes, desert – defined mostly by high aridity (under 15-35 mm or 4-10 inches of precipitation), very low relative humidity (under 18%) and often fairly high daily temperature (median above 30 ° C / 85 ° F) can be found anywhere moisture from prevailing winds is either blocked by mountains or already been released in those mountains where little rain shadow exists. For example, the deserts of Egypt can be well within the tropical latitudes north, as can some of the Peruvian coastal desert around 13 ° latitude south, but in both cases moisture from large evaporitic bodies of water like oceans has already long been lost. When wind-driven moisture from a body of water hits mountain ranges, the air is forced up and upon cooling reaches dew point and releases its water rather than carry it across a plain. This is called *orographic* (montane-determined) precipitation. With a prevailing westerly wind (form the west), because the Sierra Nevada range on the U.S. Pacific coast blocks and drains this moisture from reaching points eastward, the eastern Nevada side of this high plain is desertified. The same phenomenon works in reverse in South America where the easterly winds (from the east) are blocked by the very high Andes mountains even in the tropics, thus resulting in the huge water-rich Amazon basin on the tropical eastern side and the deserts on the western side of the Andes, even though tropical in latitude. At the other extreme to tropics, biomass productivity in deserts is very limited, usually under 0.06 lbs per square foot per year. [9]

Temperate

The other climatic zone, primary and most important to archaeology in terms of concentration of artifacts buried, is actually the temperate climate areas between 30 ° – 60 ° latitudes north and south. Not surprisingly, this temperate zone is where most of the world's population has been historically concentrated. This temperate climate zone has been relatively stable in the past with precipitation, temperature and humidity within the high and low extremes of tropics and deserts but with distinct seasons. Temperate climate biomass of 6 lbs per square foot has a productivity range around 0.1-0.5 lbs per year.[10] Unfortunately, the actual preservation of artifactual material in the temperate climate zone is generally not as good as might be found in both desert and arctic climatic zones, for reasons explained shortly.

Temperate climates always have the highest density of human modification in terms of artifacts *buried*, as mentioned, due to prehistoric and historic demographics of where people have usually lived, but they do not retain the highest density of artifacts *preserved*. Variations occur between the cold and wet state versus the warm and dry state fluctuations so prevalent in temperate climates. Wet states increase solubility of materials, since water is the universal solvent, accelerating the loss of structural integrity. Dry states also contribute to the problem with the evacuation of water – carrying away matter through leaching - via the process of slaking. This is also a function of lost structural integrity due to the differential of thermal contraction and expansion.

Arctic / Antarctic

Arctic and Antarctic climatic zones above 60 ° latitude north and south can be excellent for material preservation because of annual average low temperature (under 2 ° C or around 35 ° F) and a natural almost permanent frozen state except in some tundra contexts. Yet, Arctic and Antarctic can actually be similar to "desert" conditions if the water is thereby inaccessible for solubility in its frozen state rather than liquid state.

Because of low temperature and short growing season, biomass productivity in tundra (polar desert) is low, ranging between 0.02-0.08 lbs per square foot per year. [11]

2. ALPINE MAP

Alpine

By the above definition applicable here, the alpine zone usually lies within the temperate zone in terms of latitude - completely so in the European Alps (see Alpine Map, Figure 2) – but at higher elevation where the climate can mimic Arctic or Antarctic conditions for at least half the year. The old geographer's adage that "altitude mirrors or parallels latitude" in terms of climatic expectations is certainly true in the Alps. Above 3000 m (10,000 ft.) elevation the general climatic zone is closest to arctic or above 60 ° latitude. Below 3000 m elevation but above 2000 m, the climatic zones gradations often approximate the same conditions found normally between 50 – 60 ° latitude, and can result in a frozen state of snow and ice for nine months per year. Yet, alpine summers at 2400 m (8000 ft.) elevation can be relatively mild and even warmish with temperatures up to 19 ° C (around 66 ° F) after spring snowmelt, although alpine summers at this elevation are generally so variable that it can snow almost any day of summer in the right cold temperature conditions. After spring thaw, the resulting short but intense period of vegetative growth and the higher likelihood of rain rather than snow makes the alpine climate excellent for material preservation except during the summer months. This will be elaborated shortly.

Another working definition of Alpine climate – not necessarily applicable here because it is not specifically about climates of the Alps but mountain climates in general – explains it differently. A term called dry adiabatic lapse rate suggests that the rate of change results in a decrease of 10°C per each kilometer of increased altitude. This results in that if one walks 100 meters (roughly 320 ft.) up a mountain, the difference is about equal to walking 80 kilometers (45' or 0.75° of latitude) towards the North Pole ("altitude mirrors latitude"). The best theorists about cold climate relevant to this discussion are most likely Koppen and Nordenskiold. [12]

Some interesting climatic variations exist in places, for example, like the high Andes Mountains in South America or other specific mountain peaks within the tropical latitudes like Mt. Kilimanjaro (5892 meters or 19,331 ft) in Africa. The tree line in the Alps averages around 6,550 ft whereas in the Himalayas it is closer to 11,150 feet, mostly due to the higher latitude of the Alps.[13] In tropical montane contexts, the snowline is much higher and prevailing climate may mimic temperate zones at lower latitudes but here at much higher altitudes. Where in higher latitudes boreal taiga coniferous forest may cover thousands of hectares or square miles across a continent above 50-55 ° latitude even at low altitude, in the Andes and in Africa such coniferous forests are not only rare but are instead replaced by hardwoods at 3000 meters (9,600 ft.) and scrub forest thriving even at 4000 meters (12,800 ft.) and the snowline may instead be above 5000 meters (16,000 ft). In such unique contexts, the “latitude parallels altitude” assumption does not apply and other biological anomalies exist such as hummingbirds with wingspreads of almost 20 cm and avocado fruit growing to be almost as large as soccer balls at 10,000 ft. because the altitude is mitigated by tropical latitude.

Naturally, there are many other global locations where the climatic zoning is transitional or anomalies apply that may hybridize or alter the normal climatic patterns or expectations. The Alps also have internal climatic variations depending, for example, on whether the prevailing influence is from the cooler northern European plain, since most northern alpine weather is determined by the westerly winds that can also cool from the north in their Coriolis effect driven gyres, just as most southern alpine weather can be influenced by the warmer Mediterranean to the south. Even those contexts on the European continental divide can exhibit fluctuations where both climatic influences can alternate.

Climate variation within the Alps from north to south and west to east is due to a complex set of interrelated and multivariate factors – including the great temperature fluctuations and water cycle (including snow pack and snow release) within the year from winter to summer (unlike the Arctic) - that greatly affect vegetation and overall phytomass.[14] Partly dependent on this interannual climatic variation within a yearly cycle, also understanding the microclimates in deep alpine valleys between high massifs must factor into the equation the geomorphological and climatic differences between mostly east-west Alps regions such as the Bernese Oberland and Pennine Alps vs. the north-south Alps regions, e.g. the Cottian, Tarentaise, Alpes Maritimes, and yet others such as the Mont Blanc massif that have combined features of both north-south and west-east. These variables help to make Alpine climatology a very complex subject, one where climatic generalizations – and even visible changes like tree lines at one location and elevation – are often suspect and difficult topics, especially where sheer rock may otherwise bar vegetation from a natural biome.

Global warming poses another problem for making long-term Alpine climate assumptions, with expected glacial regression to lose more than 50% of its cover since 1850 by 2025 at present rates of loss.[15] Such loss of huge, solar reflective and cooling ice cover may result in enormous temperature and vegetation changes in the Alps, such that all previous assumptions about Alpine climate since prehistory may no longer apply. Mesoscale Alpine Climate that uses a prior century of meteorological data as a benchmark from which to quantify predictable weather patterning is currently engaged in a systematic re-evaluation of Alpine climate, having also to consider prior data no longer valid. [16] Factoring in the fast-changing range of twentieth century data against more stable varve and dendrochronology dating of Alpine contexts since 1600 suggest that current calibration models for understanding Alpine climate make the quantification of Alpine meteorology less stable than is desired.[17] The well-recorded twentieth century alone is inadequate to read as a template for past Alpine climate. [18] All this new questioning makes it difficult to estimate the long-term climatic stability of the Alps in the future as a reliable gauge relative to the assumptions about Alpine climate since prehistory as recorded in varves, glacial ice and tree rings.

The Agents Working Against Material Preservation: Water, Heat, Light

Survival of archaeological materials is usually dependent on several factors, perhaps the most important being the exposure to *water, heat* and *light*, all three of which will contribute to or accelerate the destruction of artifacts – especially organic material – in sufficient concentration. Too much water (“the universal solvent”) causes hydrolysis or solubility, which breaks down material, too much light causes photolysis which bleaches out pigments, and too much heat increases electron mobility.

Deserts, being arid, lack water and can therefore assist the material preservation of some materials, although too much light and heat can cause problems for certain artifacts, causing them to become brittle when they lose all moisture. On the other hand, the deserts of ancient Egypt in places like Oxyrhynchus have preserved the trash-piles of discarded papyrus, textiles and even leather sandals.

Arctic or extreme cold temperature environments create a near-cryogenic state where organic artifacts are sometimes almost perfectly preserved in a frozen refrigerated state where the same water content in liquid form could eventually dissolve the same tissues ice preserves. Ice crystals, however, can cause tissue swelling and rupturing since water in the solid state expands.

Temperate regions suffer from seasonal fluctuations in the abundance of all water, light and heat in both good and bad circumstances (spring and fall as seasons are not good for artifacts in a rainy climate because artifacts decompose at a faster rate; summer and winter are better if dryness and coldness contribute to artifact survival).

Tropics generally create the worst of all possible circumstances for artifact survival – especially organic – because there is most often a simultaneous abundance of all three agents of change (water, heat, light). High rainfall of a higher temperature such as warm rain wreaks havoc with materials. Excessive light in relatively high humidity also accelerates decomposition unless a vegetation canopy protects vulnerable artifacts. Even certain stone artifacts of a higher solubility rate (such as limestone) can be significantly impacted in tropical climates. Maya carved reliefs of soft limestone such as in an interior courtyard of the so-called “Governor’s Palace” at Palenque, for example, are eroding quickly as jungle canopy is removed.[19] Then these reliefs bear the brunt of wet / dry slaking states with the coefficient of thermal expansion and contraction at its most polarizing effects.

Alpine regions of Europe – defined mostly by altitude here – can provide optimum environments for artifact survival between half to three quarters of a year when ice and snow cover the artifacts or where cold soil prevails. Because alpine temperature is rarely hot, and because cold inhibits diffusion and the resulting oxidation of materials, alpine contexts are mildly benign relative to tropical contexts. The spectacular "Ötzi" the Ice Man find in 1991, from around 5,300 years old in the alpine Neolithic age, was well preserved in a near glacier until glacial regression and massive snowmelt and ice loss over time (assumed to be the second half of the 20th century) exposed his body at around 3,300 meters elevation (a little below 11,000 ft.).[20] Artifacts associated with the Ice Man included stone tools but also preserved textiles (skins and leathers) in clothes and quivers and even preserved wood handles of weapons and tools. Inorganic artifacts also are often better preserved as well in Alpine contexts. Oxides of certain metals (iron, copper, silver, tin, lead, etc,) or their alloys are often reduced in Alpine contexts, so that corrosion products can be limited in the amount of rust, patina or other oxide accumulating from material degradation.

Shared Features with other Archaeological Environments

Like other types of archaeological inquiry in almost any conceivable global context (including nautical) involving field excavation, Alpine archaeology also requires a sequence of processes and common applications including survey and laying out a grid based on benchmarks, data points, an understanding of stratigraphy, some form of sieving and finds processing as well as recording with sample tags and some type of imaging (computer, digital, video or other photographic instruments). These are just a few of the more obvious shared features in fieldwork methods.

Other shared features with all archaeology include separation and careful study of artifactual materials (including provenance and conservation research) and the utilization of specialists in a diverse range of sub-disciplines, including but not limited to ceramic technology, archaeometallurgy, numismatics, bioarchaeology, soil chemistry, architecture, geology and geomorphology and many more facets of archaeological research.

Unique Features of Alpine Archaeology

Alpine field archaeology is also somewhat different than many types of field archaeology in that its locus is generally at a higher elevation. This may create breathing difficulties and it is usually much colder, which together can tax the energy of the individuals of a team more than usual at lower elevations. Inclement weather can also be much less predictable in that weather patterns can shift very quickly.

At elevations above 2400 meters (8000 ft.), it can snow any day of the year including high summer and nocturnal temperatures can easily drop below freezing. With these and other challenges of higher elevation than normal (if people usually live closer to sea level), it is often best not to extend field time in Alpine archaeology contexts for more than about three weeks at a time. After three weeks, our experience has been that the body’s resistance begins to be challenged and that many of the team can become sick.

In addition to this fieldwork obstacle, other problems in applying normal methodology require some different practices, such as in sieving. Because the ground moisture in the Alps is generally higher due to regular intermittent rainfall (usually at least once a week) and because the drainage is also different because there is usually a much thinner layer of soil above bedrock, the soil can be fairly saturated with moisture, especially if there is insufficient sunlight with necessary ambient heat to evaporate it.

Thus, it is not expected that dry sieving will be the most successful, but rather that wet sieving will be more practical. On the other hand, an added challenge is that wet sieving must preserve the soil, which must be replaced on backfilling at the end of excavation and turf replaced because it can grow so slowly in short summer seasons. Just as tropics can be reduced to two seasons, wet and dry, so Alpine climate can result in only two seasons: spring (relative to lower elevations and temperate climates) and winter.

Soil differences

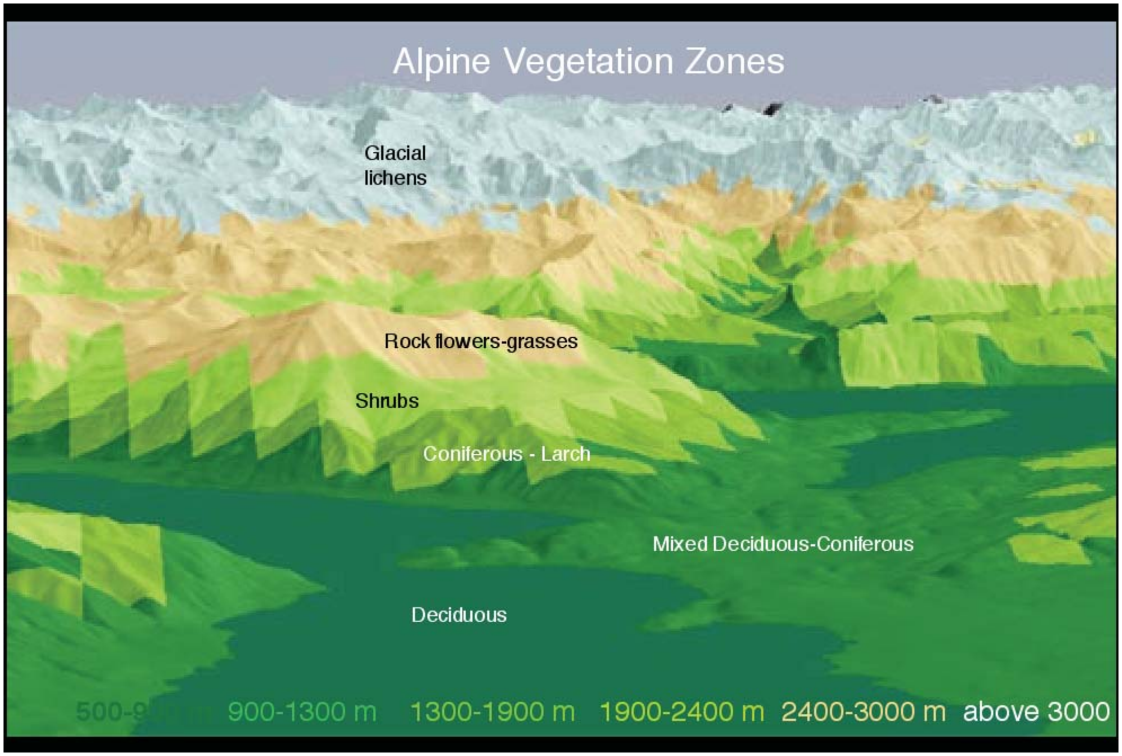
Another interesting feature of Alpine archaeology derives from soil types (pedology being the analytical science of soils). As stated, because there is more erosional stone (geological) than decaying vegetative material (biological) in high montane contexts, and because the thin alpine soils overlay bedrock, it behooves Alpine archaeologists to understand geological processes as well as oxidation processes. When montane soil is actually mostly glacial moraine, this can predetermine what vegetation can grow and thrive in it.

By contrast, alluvial soils in river plains are often deep and also rich in organic components from vegetative decay, so there can be a fairly rich biological component in alluvial soil. Depending on how deep a soil sample derives, a more even mix of organic (biological) to inorganic (geological) soil can be found.

A simple suggestion is that usually the more shallower one is looking on the soil column in any one place, the more organic the sources, and the deeper one is looking on the same soil column, the more inorganic the sources.

Deeper alluvial soils are often more complex than thin montane rock-derived soils, although even thin soil derived from glacial moraine can also be complexly heterogeneous. Alpine soil made up of quartz-rich eroded rock usually has a more acidic pH (below 7.0)), conversely montane soil made up of carbonate-rich eroded rock usually has a more alkali pH (above 7.0). Again, soil pH is as often determined by vegetation, for example where accumulated conifer needles create their own environment, as determining vegetation, for example when vegetation can only thrive in a certain pH range from the underlying geological stratum.

In addition, lower alpine soils under conifer forest cover are often podzolic with increased acidity from the conifer needles. Soil pH is covered in detail in Chapter Three.



3. ALPINE VEGETATION ZONES

Vegetation Zones

Vegetation zones encountered in the Alps are usually as follows: deciduous trees are found up to 700 meters elevation, then mixed deciduous and coniferous from about 700-1300 meters (around 2400-4000 ft.) elevation, mostly coniferous from 1300-1900 meters (around 4000-6000 ft.) elevation with a conifer tree line often around 1900 meters (around 6000 ft.) depending on which side of the Alps (Mediterranean side is warmer with a slightly higher tree line), shrub and scrub plants from 1900-2400 meters (around

7000-8000 ft.), alpine meadow flowers from 2400-3000 meters (roughly 8000-10,000 ft.) and mostly rockbound lichens above 3000 meters (roughly 10,000 ft.).

For archaeological purposes, lichenology itself can be useful in the Alps in positing generalized lichen growth rates relative to anthropogenic change of rock surfaces by human modification, such as carving routes through bedrock in steep, narrow places for greater ease of passages, but first the rate of growth of specific lichen colonies must be determined, since there is not necessarily a uniform rate over a region due to microcontext / microclimates, as we have noted in the Grand-St-Bernard where overall harsh weather dominates yearround, but a windswept area can be significantly different than a protected area a few meters away in terms of lichen growth. Other dating information about climatic change and the human record in the Alps can be inferred from dendrochronology (tree ring dating), particularly when wood like oak is used in human contexts and then preserved by the cold climate. While glacial varves (annual sediment deposits) are also useful for dating high altitude still lake climatic fluctuations, they are generally not as applicable to anthropogenic change unless they also contain human-derived carbonized wood ash and/or other aeolian particles or even ancient and modern pollutants.

The possibility of anthropogenic change and such realities as ancient deforestation must be considered, as it is likely that the ancient Alpine tree line in the Gallo-Roman period (200 BCE - 500 CE) might have been considerably higher given the normative logging and farming in almost continual practice since that time. On the other hand, tree line – not an exact altitude-derived Alpine phenomenon anyway - is much more difficult to predict, being based on many factors and is also dependent in paleoclimatic terms on whether the annual temperatures were higher or lower in antiquity, since a colder temperature could result in a lower tree line where trees would not have an optimum environment just as a warmer annual temperature could result in a higher tree line, although this is also on the type of timber in question with regard to its habitat. Reconstruction of alpine vegetation over a long historical period can be a very complicated matter. Anthropogenic change has also been a considerable factor in the Alpine tree line in the historic period since the Bronze Age (post-2000 BCE). A schematicized version of a“typical” Alpine vegetation zoning is shown here (Figure 3), where the zigzags between 1300-1900 meters are quite often human-induced.

Conclusion

All these factors discussed here (climate, latitude, geological or biological soil sources, soil pH, soil depth, air temperature, humidity, amount and state of water in liquid (highly solvent) versus frozen (low diffusion and therefore not solvent) form, soil temperature, soil vegetation cover, altitude, etc.) each have a bearing on the complex equation as variables for preservation of archaeological artifacts in alpine contexts.

Alpine archaeology is therefore a sub-discipline of general archaeology, where it is important to understand and apply both common as well as unique features of field research to excavation and conservation of artifacts found in alpine contexts at higher elevations.

Patrick Hunt

Patrick Hunt is on the Classics and Archaeology faculty at Stanford University.

As the Director of the Stanford Alpine Archaeology Project since 1994, he has conducted high altitude research in the Great St. Bernard pass between Switzerland and Italy.

Another of Professor Hunt's research interests has been to track Hannibal, who crossed the Alps in 218 BCE with an army accompanied by elephants. He has led annual teams—including multiple Stanford teams between 1996 and 2006—across at least ten Alpine passes in search of topographic clues matching the texts of Polybius and Livy, who wrote about Hannibal nearly two millennia ago.

While teaching for more than 12 years at Stanford, Patrick has also pursued several of his life-long dreams: being a writer, a composer, a poet, and an art historian. Some of the courses he has taught at Stanford accommodate his breadth of interests in the humanities, the arts, ancient history and ancient technology as well as archaeological science.