English title

Science, sport and landscape: The development of high-altitude training methods after 1945.

Titre Francaise

Science, Sport et Environnement: le développement des techniques d’entraînement en altitude depuis 1945.

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Abstract

Today, most elite endurance athletes use high-altitude training to some extent. For at least the last 40 years, it has been linked to increased performance. But how was high-altitude training established as a means of improving performance? And how did the scientific approach to altitude differ from the traditional, natural valuation of mountains as a site for training? In this essay, these questions are addressed.
High-altitude training was introduced in sports in the post-war period. During the 1960s, it became a highly contested method, with controversies between scientists, athletes, doctors, sport organizations and coaches. What ideas about altitude and performance were important in this process? What type of scientific hypotheses led scientists and sport practitioners towards increasing high-altitude training? Interestingly, those within sports who rejected the scientific, ‘machine-like’ training methods also often valued the mountains. Famous Swedish coach Gösta Olander is one example. He was the most influential protagonist of the natural training method in Sweden, and his base was in Vålådalen (in Jämtland, near Östersund and Åre). Both Swedish (e.g. Sixten Jernberg, Gunder Hägg) and international athletes (e.g. Michel Jazy and Michel Bernard) came to Vålådalen. The fresh mountain air and scenic surroundings were important as a place for training camps, but scientists later demystified the mountains via scientific explanations about increased oxygen uptake and increasing hemoglobin levels in the blood. Vålådalen became a center not only for natural training, but also for scientific monitoring, testing and evaluation.

And the setting of international standards regarding high-altitude training had a political aspect, as the issue was addressed when white runners from low altitude were threatened by the results of mainly runners from high altitude countries like Kenya and Ethiopia.

Focusing on the Swedish case, we will analyze the scientific interest in high-altitude training for sports. Especially, we will study the links between science, military and sports.

Introduction: Mountains and Humans

Attitudes to mountains have shifted from fear and awe to appreciation of perceived beauty or the sublime. While Dante still thought of mountains as, in John Ruskin’s words, “always causes of rudeness or cruelty”, Petrarch is commonly cited as the first to experience true ‘mountain glory’ on his ascent of Mt Ventoux in 1335.¹ The aesthetic qualities of the mountain landscape have remained important, but during the 20th century other properties of mountains became ever more. One of those was the high altitude they offered and its impact on human physiology and psychology. ‘Thin air’ was clearly affecting human performance in war, sports and other activities. At high altitude, the air pressure (and therefore the oxygen

pressure) is lower than at sea level, causing hypoxia. Oxygen uptake is reduced, but acclimatization to high altitude can counter this reduction. This is done when the body produces more red blood cells and thus raises the hemoglobin level of the blood, increasing the ability to transport oxygen. The general thesis behind high-altitude training is that acclimatization allows for better performance at high altitude, and that when returning to sea level, the improved oxygen transport capacity will improve performance, especially in endurance sports.

A look at Google Ngram shows that high-altitude training was rarely mentioned up until the start of World War II, when the interest exploded. After the war, it dropped back to near nothing, but started a slow and steady climb in the 1950s that would go on until the issue of high-altitude reached new heights in the early 1990s. Of course, this kind of search is a blunt instrument, but it does say something about when a phenomenon has been mentioned in books and articles. For high-altitude training, it is clear that it was during World War II and then again in the 1990s, with a small peak also around the 1968 Olympic Games in Mexico City.

Why at these times? In this chapter we will argue that high-altitude training has been developed by two major interests: military and sports. Physiologists have been important for both, but at least in sports, they were challenged by another way of looking at training and mountains – the romantic, naturalistic perspective, unknowingly launched by Petrarch. An important question has been whether high-altitude training is only about the physiological effects of altitude, or if there are other dimensions as well?

This study draws to a significant extent on material from the Royal Central Institute of Gymnastics (GCI) in Stockholm and from the Harvard Fatigue Lab in Boston. Both these research environments have been crucial for the developments in high-altitude training. They were also similar in their attempts to quantify human physical and mental performance and in their service role vis à vis societal institutions, notably the military. We will also compare the scientific approach with naturalist and aesthetic ideas about mountains and training, exemplified by coaches and athletes.

Mountains have a long history of relating to issues of health, struggle, and outstanding human performance, and implications of high altitude have fascinated scientists of various disciplines for at least 200 years. Mountain sickness had struck mountaineers and balloonists during the late 19th and early 20th century, and attempts to explain this phenomenon scientifically were

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made by physiologists. French physiologist and zoologist Paul Bert (1833-1886) is often given credit as the father of modern high-altitude physiology, firmly based on scientific ground as opposed to earlier, more speculative accounts of mountain sickness and dramatic collapses during balloon flights. But despite this rather long history of high-altitude physiology, the interest did not really rise until the mid-20th century with the military as a major contributor and benefactor of the new knowledge.

**Militarization and scientification of mountains**

During the Second World War, science was mobilized in many countries as an asset that could improve military efficiency. Leading research centers of physiology, physics, and medicine were asked to contribute to their nations military. This process, that only gained more momentum when the war was over, has been described as a militarization of science and a scientization of the military. The science was used for both civil, welfare-related issues as well as for military reasons. Similar processes can be found in the relationship between sports and science, for example, the science of physiologists in Sweden were used both for the broader masses (in industry, domestic work etc.) and for elite athletes.

In the early stages of high-altitude research, the Harvard Fatigue Laboratory was among the few institutes active in the field. It was founded in 1927 by Lawrence J. Henderson and David Bruce Dill and soon became the perhaps most prestigious, boosting one of the first experimental high-altitude chambers in the U.S. as early as 1943. High-altitude issues were important from the very beginning of the lab’s existence. Dill, together with colleagues like Ancel Keys and Edgar Folk, conducted experiments in the lab and on extensive field trips. A number of extravagant expeditions took place during the 1930s.

For the physiologists at Harvard Fatigue Laboratory, the landscape had little significance in itself. It was mainly valued for its climatological aspects, and since these could be reproduced in the laboratory, the landscape was basically a larger version of the lab. Many research

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3 West, High Life, p. 54-73.
5 Svensson, ‘How Much Sport is there in Sport Physiology?’, p. 896-899.
6 Folk and Thrift, ‘The Harvard Fatigue Laboratory: contributions to World War II’, p. 119
7 Tracy, ‘The Physiology of Extremes’, p. 644.
projects in physiology, as well as anthropology, were funded by the U.S. military. A look at the reprints of Harvard Fatigue Laboratory and David Bruce Dill shows a number of studies relating to the issue of high altitude in some way, including topics like blood chemistry, mental effects, perspiration, mountain sickness, and acclimatization. There are also records in the laboratory’s archives of studies on oxygen in relation to hemoglobin values, physical fitness of soldiers training at high altitude in the Rocky Mountains, and comparisons between athletes and non-athletes. These studies indicate a clear interest in high altitude and its effects on the body at work. Studies were conducted with the scientists themselves as the main study objects, but in the HFL Andes expedition in 1935, which made tests at four elevations ranging from 2800 to 6 200 meters, tests were also conducted on local mining workers. However, we have found no signs of this research in any way affecting the athletic community at the time. The main benefactor was the American military, another was military and civic aviation especially when supersonic aircraft were rapidly developing after WWII.

Another center for this kind of research was Peru, where Carlos Monge and others studied high-altitude adaption in Andean residents. Italian scientists began work on physiological effects of high altitude in the Alps already in the 1890s, and French colleagues also started out in the late 19th century.

In Sweden, the scientific approach to high altitude came from The Royal Central Institute of Gymnastics (GCI). The physiology department there was activated in 1941, when Eric Hohwü-Christensen was appointed the first professor of physiology. Influenced by his Danish mentors, physiologists August Krogh, Nobel Laureate in 1920, and Johannes Lindhard, both at the University of Copenhagen. Christensen wanted to study the limits of human performance, and if and how these limits could be moved. He was interested in high altitude

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12 The archives of the Harvard Fatigue Laboratory is rich of evidence of this and it is no exaggeration claim that the military was by far the single most important benefactor of the HFL research. So closely related was the HFL to the US war effort that it had to close operations when peace returned, the official shutdown was in 1947. See also the general history of HFL, Horvath and Horvath, The Harvard Fatigue Laboratory: Its History and Contributions.
13 Peru was a stopover as the HFL high-altitude research expedition to Chile returned home to the US in July and August 1935. Keys and Hall, ‘Preliminary Report’.
and air medicine, and brought to GCI a low-pressure chamber when he arrived from Denmark.\textsuperscript{15} Christensen had first-hand experience of high altitude research in the field. He had been a member of the 1935 Andes expedition, where he was responsible for respiration and exercise studies, and also spent time at the HFL in preparing for the expedition during 1934 and 1935 thanks to a grant from the Rockefeller Foundation. Some of the equipment for the expedition had been developed at the Zoophysiological Laboratory at the University of Copenhagen and was shipped from there to Boston.\textsuperscript{16} Christensen’s institute at GCI would become a major contributor in relating high-altitude training and sports. During the 1960s, GCI physiologists published at least eleven articles specifically relating to physical performance at high altitude, some of which received external funding from sports organizations or the military (or both).\textsuperscript{17} They also worked close to industry, military and the sport community to further scientific knowledge in these areas.\textsuperscript{18} Clearly, the topic was scientifically and commercially interesting.

An interesting aspect of these connections between science, military and sport is the element of secrecy in military science. Secrecy in a way goes against the foundation of science – to further knowledge through opening dissemination of and competence between ideas. But of course, to spread possible military advancements funded by a national army across the globe would render this research pointless, from the funder’s point of view. There is a similar problem with research that has bearing on elite sports. If funded by a national sports federation (like part of the physiology research about high-altitude training), then this research is expected to pay off in medals. These mixed loyalties may be problematic for the scientists.\textsuperscript{19} Secrecy can also limit the scope of science, affecting the very knowledge that is being produced, and not only the access to it.\textsuperscript{20}

\textsuperscript{15} Svensson, ‘How Much Sport is there in Sport Physiology?’.
\textsuperscript{16} Keys and Hall, ‘Preliminary Report’.
\textsuperscript{18} Svensson, ‘How Much Sport is there in Sport Physiology?’. See also: Schantz, 'Om Lindhardskolan och dess betydelse i ett svenskt perspektiv'.
\textsuperscript{19} Dennis, ‘Secrecy and science revisited’, p. 180-181.
\textsuperscript{20} Dennis, ‘Secrecy and science revisited’, p. 180.
Sportification of mountains

High-altitude issues have an almost intrinsic connection to sport, in the sense that it deals with establishing and pushing limits of human performance. The step from “how high can you jump?” to “how high can you ascend and still function?” is not that big. Mountaineering, polar expeditions and other ventures into extreme landscapes have long since resembled the logic of modern sport – the imperative is to be the first, fastest or most enduring. For example, Norwegian skiing expeditions to Greenland have shown a pattern of sportification during the 20th century, in a way that now makes these endeavors quite similar to other sports (albeit more extreme). The same can be said of many mountaineering expeditions, both current and historical.

There had been a scientific interest in heavy physical exercise at high altitude since at least the 1940s. For example, GCI physiologists like Christensen, who could use his Andes experiences from the previous decade, and Wilhelm von Döbeln had done work relating to heavy work at high altitude. In 1954, GCI physiologist Per-Olof Åstrand wrote a paper on respiratory activity during hypoxia. The experiments were conducted in the lab at GCI, on a simulated altitude of 3 000 to 4 000 meters. It contained no references to sport or military, but Åstrand referred to an article by D.B. Dill of Harvard Fatigue Laboratory. High altitude research had not yet developed into something applicable in sports. It was still a clear focus on the dangers, not the potential benefits, of altitude.

Scientific interest in high-altitude issues has a long history, but high-altitude training was not being broadly investigated until the 1960s. The interest from the sport community in high-altitude issues accelerated when the Olympic Games were held in Squaw Valley 1960 (at an altitude of approximately 1800 m), and in Innsbruck and, especially, Mexico City 1968, the latter at an altitude of approximately 2300 m. The physiological effects of staying at high altitude were already a known fact, but now more efforts were put into understanding how the body was affected when exercising at high altitude. In 1959, Åstrand accompanied a group of Swedish athletes to Squaw Valley, to take part in the pre-Olympic competitions. Åstrand was

21 Goksöyr, ‘Taking Ski Tracks to the North’, p. 569. Sportification is the development process that many modern sports undergo, where they become more organized, bureaucratized, rationalized etcetera. These processes have been studied by Guttmann, From Ritual to Record and Yttergren, Täflan är livet, among others. For sportification of landscapes and landscape use, see Sandell, ‘Naturkontakt och utveckling’ and Fredman, Stenseke and Sandell (eds.), Friluftsliv i förändring: studier från svenska upplevelselandskap.

22 For example: Hohwü-Christensen, ‘Bodily activity at high altitudes’, and von Döbeln, Asmussen and Nielsen, ‘Blood lactate and oxygen debt after exhaustive work at different oxygen tensions’, 1948; both Asmussen and Marius Nielsen had, like Christensen, been visiting scientists at the HFL.

engaged by the Swedish Ski Federation. The athletes were rigorously monitored and tested on bicycle ergometer, which showed a clear increase of work pulse at high altitude. The tests were conducted both in Squaw Valley and at GCI (in the low-pressure chamber). Åstrand and his colleagues concluded that in order for the athletes to perform at their maximum level in Squaw Valley, an acclimatization period of significant length (at least two weeks) would be necessary. This hypothesis was increasingly embraced in the scientific community, as well as among athletes at the time. However, long acclimatization periods were both expensive and unpractical, and in the end the Swedish athletes arrived in Squaw Valley only ten days before the games. Members of the Swedish team experienced major problems acclimatizing to the high altitude, and Janne Stefansson, one of the best skiers in the world at the time, suffered a dramatic collapse in the relay race. The effects of high altitude on sport performance and the possibilities of acclimatization were thoroughly discussed in the 1960s, but there were still no suggestions of using high altitude as a training method to improve performance at sea level. Altitude was still mainly seen as a particular challenge that perhaps could be managed by acclimatization.

This was tried before the Olympic Games of 1960, 1964 and 1968. Karl-Åke Asph, a Swedish cross-country skier who were part Sweden’s gold-winning team in men’s relay in Innsbruck 1964, recently stated that the effects of high altitude were discussed in the national team back then, and that the need for acclimatization was obvious, due to the information received by physiologists working close to the national team.

In the build-up towards Mexico 1968, several research teams in different countries pursued studies concerning the physiological effects of heavy exercise at high altitude. For example, in 1968, Bengt Saltin, also at GCI in Stockholm, and a number of international colleagues did a study about maximal oxygen uptake and cardiac output after two weeks at high altitude. Their work was financed by the U.S. Airforce and the U.S. Public Health Service and the U.S. Army Research Contract. Saltin et al. were still ambivalent about the possible usefulness of high-altitude training, but suggested that it might increase maximal oxygen uptake upon return to sea level, because of the raised hemoglobin levels. This beneficial effect, though

24 Åstrand, ’Physiological aspects on cross country skiing at the high altitudes’, p.24.
26 Karl-Åke Asph, interviewed in Orsa, June 9th 2013.
27 Holmberg and Lundby, ‘Effects of high-altitude training – myth or reality?’, p. 43.
28 Saltin et al., ’Maximal oxygen uptake and cardiac output after 2 weeks at 4,300 m’, p. 407-408.
still somewhat disputed, now motivates elite skiers and other athletes to spend several weeks at high altitude each season.

Saltin’s text has no references to the landscape – altitude is described as something scientific, and as something very problematic. There are several reasons for this, but the most important is the logic and ideology of sports. The uncertainty and equality of the sporting competition is fundamental. And high-altitude training was perceived as a threat to those ideals, not least because of the perceived unfair advantage of African runners in Mexico City 1968. In the build-up towards Mexico City 1968, it was clear that something had to be done in order to ensure equality and uncertainty in the endurance events. But there were serious political implications in the process. Athletes living at high altitude (mainly Mexicans, Ethiopians and Kenyans) had an advantage, but could not be banned based on where they lived. There were also fears that wealthy nations or individual athletes could afford long periods of acclimatization, which would threaten both the equality and the amateur ideal. The racial and colonial discourse of altitude acclimatization was something that had to be avoided, and thus science was the chosen way to legitimize restrictions in high-altitude training. During the 1950s and 1960s, increasing international competition in sport led to increasing scientific effort being invested in sports. The altitude problem, as discussed during the 1960s, was yet another sign of this. After years of scientific debate, the International Olympic Committee (IOC) agreed on allowing an acclimatization period of four to six weeks.

In the end, the setting of international standards on high-altitude training was a way to ensure the uncertainty of sporting events, but also to avoid controversies between athletes living at low or high altitude. Access to mountain landscapes could have become a serious conflict area, but this was partly solved by setting standards based on state of the art-science. Still, the debate about high altitude has not ceased. In 2007, FIFA banned football matches at altitudes of 2.750 m. or higher, arguing that such games could jeopardize the players’ health and give unfair advantages to teams acclimatized to such altitudes. The ban affected Bolivia, who suddenly could not play their home games in their capital, La Paz. Bolivia and a couple of other Andean nations waged a campaign to lift the ban, and this was done in 2008. The debate was highly political, with Bolivian president Evo Morales calling the ban “football

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29 Guttmann, From Ritual to Record, p. 54-55.
31 Heggie, ‘Only the British Appear to be Making a Fuss’, p. 217.
It is no longer an issue of whether the athletes can afford to acclimatize – they are all professionals. But as such, their schedules are so full that it is practically impossible for them to get away for the necessary two-three weeks. The problem of freeing sufficient time for acclimatization has not been solved.

Among those who took part in the scientific debate, both Åstrand and Saltin were at times very reluctant about high altitude endurance sports competitions. In the official organ for Fédération Internationale de Ski (FIS), Åstrand in 1962 published a short text where he heavily critiqued skiing competitions at high altitude. This was only two years after Swedish skiers had faced serious problems in Squaw Valley. Saltin was equally critical and raised his concerns before the 1968 Mexico City games. He argued, without success, that the endurance events should be moved to lower altitude.

A decade earlier, the legendary Swedish coach Gösta Olander (1893-1972), manager of the Vålådalen alpine station in the mountains west of Östersund, had described mountain training camps in a very different tone. Olander made a name for himself as the host of several world class endurance sports athletes. He held a naturalistic view on training and propagated a holistic method that built on practical experience rather than science. He was also inspired by the movements of the Sami and of mountain wildlife. Using the natural variations of the mountain landscape was also important. Olander recommended running in moors and slopes during the summer, and running in deep snow or pursuing cross country skiing during the winter. The landscape itself was important to Olander who had colleagues who already in the 1930s advocated training in mountain landscapes. Olander’s ideas place him in a tradition that is far from the scientific, physiological approach developed by scientists like Åstrand and Saltin, and coaches like Gössé Holmér and Frantz Stampfl. Olander rejected the use of stopwatches, measuring tapes etcetera, and his holistic method is more comparable to that of Percy Cerutty, the legendary Australian who coached runners like John Landy and Herb Elliott. Both coaches believed that the actual place, the natural environment of the

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34 Åstrand, ‘Physiological aspects on cross country skiing at the high altitudes’, p.24. In Squaw Valley, Per-Erik Larsson underperformed in the 15 km race and Janne Stefansson dramatically collapsed during the men’s relay race.


36 For more details about Olander and his training ideology, and the battle between natural and scientific training in Sweden, see: Svensson, ‘Changing tracks? The battle between natural and scientific training in Swedish cross-country skiing, 1948-1972’.

37 Olander, *Träningsråd för skidåkare*, p. 4-8.

training mattered, while science-influenced coaches relied more on the reproducibility of running tracks, stopwatches, ergometers etcetera.\textsuperscript{39} For Olander, the mountains carried meaning in themselves, and he would not have approved of simulated high-altitude in tents or in a laboratory. His methods were followed by many who came to Vålådalen, including runners like Gunder Hägg (Sweden) and Michel Jazy and Michel Bernard (France).\textsuperscript{40}

As a consequence of the resistance from official organizations of sport, it was not until the 1980s that high-altitude training, as a means to improve performance at sea level, really became widespread in the athletic community. Taking Norwegian international rowers as example, their high-altitude training camps increased drastically in the 1980s and continued to increase during the 1990s.\textsuperscript{41} A similar pattern can be seen in cross-country skiing, long distance running and other endurance sports. But even though scientifically based high-altitude training is a rather late invention, many athletes had already in practice trained according to roughly the same principles. Swedish skiers, for example, had training camps in Vålådalen, situated at an altitude of 600 m, at least twice a year during the 1950s and 1960s. The surrounding nature reserve has mountains that reach altitudes of above 1200 meters.\textsuperscript{42}

**Landscape vs. Labscape – what is the value of mountains and high-altitude training?**

In the Swedish context, there has been two quite different approaches to the concept of high-altitude training – one scientific and one more traditional, based in ideas about the landscape and its effects.

Skiing has a long history of being an important part in national identities of the North (and certainly the Nordic countries). Vasaloppet is one example, where the landscape has become something of a skiing heritage site. To underline this, the Vasaloppet Arena was declared a nature reserve in 1994. It is 90 kilometers long but only 10 meters wide.\textsuperscript{43} It is located in the province of Dalecarlia, which has a long tradition as a Swedish ‘ideal’, stereotyped as a county with proud and autonomous farmers maintaining a rich heritage of folklore, costume,

\textsuperscript{39} Howe, ‘Habitus, Barriers and the [Ab]use of the Science of Interval Training in the 1950s’, p. 325-327.  
\textsuperscript{40} Krüger, ‘Training Theory and Why Roger Bannister was the First Four-Minute Miler’, p. 322.  

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songs, and handicrafts. Vålådalen, the mountainous valley where Swedish skiers and later also international athletes from France, U.S.A. and other countries came to train, has a similar status. It is also a nature reserve, but the cultural elements are important as well. Even if it is questionable whether cross-country skiing can be considered a ‘national sport’ in Sweden, its ties to certain ‘national landscapes’ (of mountains and snow) are still there. These landscapes – that we may wish, with a reference to John Bale, to call sportscapes - and their relations to sport contribute to the meaning of the nation.

The landscape of sport is a poorly developed area of research, with a few exceptions. One is about the reproducibility of sportscapes. Sporting landscapes have a tendency to be reproducible, in the sense that they can be built in the same manner in many different geographical areas. In fact, the ability to reproduce a landscape of sport is often the very foundation of the game (like it is in football, baseball, ice hockey and many other sports) and a key element in the general sportification of societies. In endurance events, like cross-country skiing or long-distance running, the reproduction of the landscape is less regulated but still important. In Sweden, for example, the introduction of flood-lit jogging tracks in the 1950s was proposed by Per-Olof Åstrand, as a way of making rational training available to large parts of the population. This landscape has been described as something “portable”, since it was reproducible in nearly any geographic location in Sweden. The jogging tracks were often used for skiing tracks in the winter. We argue that the same process of de-localizing landscapes have been at play regarding mountains. The scientific and later athletic use of low-pressure chambers, high-altitude tents etcetera has the same ambition – to make a certain landscape available for more people, thus removing the perceived inequalities between people living in different landscapes. This is the spirit of equal and uncertain sports, transferred into

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45 The concept has no clear definition and is used in a pragmatic fashion, but it still seems to have some purchase. For example cross-country skiing is the undisputed national sport in Norway since many decades. In Sweden it is less obvious if there is any national sport at all, although skiing was probably a strong candidate in the past and football is now.

46 Bale, Landscapes of Modern Sport. See also: Vertinsky and Bale (eds), Sites of Sport: Space, Place, Experience, and Bale, Sports Geography.


48 Qviström, ‘Landscapes with a heartbeat’.
the landscape. And scientists have, when venturing into the landscape, often brought the lab with them, turning the landscape into a lab in itself.49

A potential problem with this labscape is that it pre-supposes a landscape that is solely based on scientifically determined qualities. And few people are that “rational” in their relation to landscape. Landscape is not just about geography – it is about history, memory and heritage as well. There might also be reason to fear that a portable and reproducible landscape is, in some way, also replaceable. To underline the uniqueness and nature experience of the mountain landscape as an arena for training, might help to preserve these landscapes. In that way, it is noteworthy that two of Sweden’s most iconized sporting landscapes, Olander’s Vålådalen and the tracks of Vasaloppet, have been declared nature reserves. These landscapes are also gendered. Skiing was for a long time primarily a male sport, rooted in rural manual work such as lumber. Gustavus Vasa was a Swedish king, proverbially hunted by the Danes on the path is now the 85 kilometer skiing track. Bale’s sportscapes are also gendered and occasional observations of gendered skiing landscapes have also been made in Canada and Norway.50

Science has still not settled on the issue of altitude. Current research on high-altitude training and acclimatization problematizes earlier findings. It is now said that acclimatization takes at least two weeks, and if this is not achievable, it is better to arrive as close to the competition as possible.51 So, a ten day acclimatization period, like the Swedish skiers had in Squaw Valley, was highly problematic. Effects of different types of high-altitude training are now being contested, and leading physiologists are uncertain about the exact results of several popular variations of high-altitude training.52 In spite of this, high-altitude training remains a vital ingredient in the training of elite athletes across the world. And the access to mountain landscape is still important, despite various scientific ways to simulate high altitude.

Vålådalen, the emblematic training site of Swedish skiers during much of the 20th century, was not just favored by skiers and other athletes. It was a refuge for parts of the Swedish cultural elite as well. Places like Aspen in the U.S., the Engadin Valley in Switzerland or Chamonix in France has played similar roles. Mountains have long since attracted people

49 This is notable among Harvard Fatigue Laboratory and GCI, see Johnson, Human Performance, p. 92-93 et passim, and Svensson, ‘How Much Sport is there in Sport Physiology?’.
50 See for example Stoddart, ‘Constructing masculinized sportscapes: Skiing, gender and nature in British Columbia, Canada’, and Sörlin, Kropps geni, which identifies Norwegian forest-agrarian landscapes with masculinity.
51 Holmberg and Lundby, ‘Effects of high-altitude training – myth or reality?’, p. 47.
52 Holmberg and Lundby, ‘Effects of high-altitude training – myth or reality?’, p. 47.
weary of cities and civilization, in search of something simpler, purer and better than city life. There is a vast literature covering this.\textsuperscript{53} Sweden is of course no exception. Vålådalen, established as a tourist station during the 1930s, has attained a status of a national landscape. The process of nationalizing landscapes was particularly strong during the first half of the 20\textsuperscript{th} century.\textsuperscript{54} The mountains of the area have been nationalized in a way that resembles how the Italian Alps have been framed in the Italian discourse, though not as militaristic.\textsuperscript{55} Swedish mountains have not been a site of war for hundreds of year – but they have been nationalized nonetheless, through tourism, outdoor life and training.\textsuperscript{56} Training sites like the glaciers and high-altitude valleys of the Alps or the remote valleys of Scandinavian mountain range are not easily reproduced in a lab. They might be reproducible in the sense that you could create a similar environment to train in, that would give the same physiological results. But the other aspects of Vålådalen, Davos or whichever landscape of training that you exemplify with – its status as a national sanctuary, the romantic and historic appeal of the mountain landscape – cannot as easily be replicated.\textsuperscript{57} So even if the altitude of the place can be simulated, the magnitude cannot. And there we have a major difference between the scientific and the naturalistic approach to high-altitude training. While scientists have stressed altitude, practitioners of skiing have more often talked about mountains.

\textbf{References}


\textsuperscript{53} The classic is Hope Nicolson, \textit{Mountain Gloom} (1959). Other notable examples: Shama, \textit{Landscape and memory}. Armiero, \textit{A Rugged Nation} on Italy

\textsuperscript{54} Hettne, Sörlin and Östergård, \textit{Den globala nationalismen}, p. 326-339 et passim.

\textsuperscript{55} Armiero, ‘Nationalizing the Mountains’, p. 244-245.

\textsuperscript{56} Sörlin, ‘Monument and Memory’, p. 271-272.

\textsuperscript{57} Kirk, \textit{Snow} (1998) is a good example.


Heggie, Vanessa (2008), ‘‘Only the British Appear to be Making a Fuss’: The Science of Success and the Myth of Amateurism at the Mexico Olympiad, 1968’ in *Sport in History*, vol. 28, nr. 2, pp. 213-235.


Hohwü-Christensen, Erik (1945), ‘Bodily activity at high altitudes’ (Swedish original title: ‘Kroppslig aktivitet på stora höjder’) in *Nordisk medicin* vol. 27.


Vertinsky, Patricia Anne and Bale, John (eds., 2004), Sites of Sport: Space, Place, Experience. London: Routledge.

West, John B. (1998), High life: a history of high-altitude physiology and medicine. New York: Published for the American Physiological Society by Oxford University Press.


Åstrand, Per-Olof (1962), ’Physiological aspects on cross country skiing at the high altitudes’ in *FIS Bulletin*, vol. 8, nr. 1, p. 24.

**Websites**

Google Ngram Viewer, 2013-06-25, search phrase ‘high altitude training’.  


Vasaloppet, official website (2013-06-20), ”Vasalopps Arena”  

**Interviews** (by Daniel Svensson)
Janne Stefansson, interviewed in Transtrand, June 8th 2013.

Karl-Åke Asph, interviewed in Orsa, June 9th 2013.

**Archives**

Harvard Fatigue Laboratory. Harvard Medical Library, Francis A. Countway Library of Medicine, Boston, MA.