Benchmarking Functionality of Historical Cold Weather Clothing: Robert F. Scott, Roald Amundsen, George Mallory

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Abstract: Replica clothing as worn by Robert F. Scott and Roald Amundsen in their race to be the first on the South Pole and by George Mallory in his ascent of Everest was tested for thermal insulative properties. These were benchmarked against modern day explorer clothing. Results are discussed in terms of insulation, insulation per weight, and wind protection. Further the effects of clothing on energy consumption were considered as well as the effect of altitude on insulation and energy consumption. The biggest advantage of modern clothing seems to be its lower weight. Scott's clothing resulted in extra energy usage for the wearers and provided less insulation than Amundsen's, though sufficient while active. The Mallory clothing had a low energy requirement due to the incorporation of 'slippery' silk layers. Its insulation would have been sufficient down to -30℃ in low wind. If wind were to increase, the clothing would however not have provided the required insulation.

Keywords: Clothing insulation, altitude, Antarctic, cold, explorer.

1. Introduction

Clothing for extreme environments has seen a dramatic development over the last decades. The introduction of man made materials, new technologies and new design and wear philosophies has led to high tech clothing that has been used and tested in a multitude of environments. To get a better feel for the advances made, this paper will look at the performance benchmarks for three historical clothing ensembles: Those worn by Robert Falcon Scott and by Roald Amundsen and their teammates in their attempt to be the first to reach the south pole in 1911 and 1912, and the clothing as worn by George Mallory, who vanished in an attempt to climb Everest in 1924. Though the original clothing was not available, as part of two different projects replicas of the original clothing were produced based on historical information sources and remnants of the clothing. Next these replicas were tested for their insulative properties on thermal manikins (Havenith et al. 2008), and benchmarked against a modern day explorer/high altitude climber outfit. These results were then interpreted in the light of the special circumstances they were exposed to.

1.1 Scott and Amundsen

In 1910, Robert Falcon Scott and Roald Amundsen left the UK and Norway respectively for Antarctica, both with the goal to be the first person on the South Pole. Amundsen started the actual trip to the South Pole on October 20, 1910 from the Bay of Whales (Ross Ice Shelf), with five men and 52 dogs. On Friday December 14, 1911, the team reached their destination. They arrived with 17 dogs and three sleds. After three days on the pole, taking measurements to ensure their position, and travelling 10 miles in each direction to ensure they had a safe margin in case an error in the calculation was made, they started their return. They had returned to the Bay of Whales on January 26th, 1912.

Scott left for the pole in November 1911, using ponies, which proved useless and were shot on December 9. Manhauling their sleds, they arrived on the South Pole on January 17, 1912, just over a month after Amundsen. On their way back they encountered unusually extreme weather conditions [8], and finally perished in a blizzard that forced them to shelter in their tent for 8 days on March 29, 1912.

Many books have been written about their trips and many theories were brought forward for Scott's demise. In 2006, Keo films produced a documentary for British Television in which this race was re-enacted in Greenland (due to a dog restriction in Antarctica). They brought together two teams, one Norwegian, one English to represent Amundsen and Scott's teams. As far as possible, clothing and equipment of the original trips was reconstructed based on archive knowledge. As part of the preparations, the replica clothing (Table 1) was brought to Loughborough University and tested on the thermal manikin 'Newton' (MTNW, Seattle,

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USA) [5]. In these tests the clothing insulation of the ensembles with the highest insulation were tested, and the effect of wind on this insulation investigated. At the same time, the clothing to be worn by the camera crew, i.e. modern exploration clothing, was tested too.

For this purpose the clothing (Figure 1) was put on the manikin (Figure 2) and this was then placed in a climatic chamber, exposed to wind of 10 m/s. The measured insulation values will be expressed in clo (1 clo=0.155 m2 ℃/W).

Table 1 Clothing available to Scott and Amundsen teams in the re-enactment of the race to the Pole, as well as details on clothing worn by Mallory (Source: [7])

Clothing for Amundsen team	Clothing for the Scott team	The Mallory Layering System		
Under garments	Under garments	Upper Body		
1 x pair of Wolsey woollen long johns and thermal long sleeved vest	1 x pair of Wolsey woollen long johns and thermal long sleeved vest	Silk wool vest	140 g	
1 x Devold Basic long sleeved thermal top + Devold Basic long johns	1 x Devold Basic long sleeved thermal top + Devold Basic long johns	Silk shirt (beige)		342 g
1 x Aquaduct long sleeved thermal top + Aquaduct thermal long johns	1 x Aquaduct long sleeved thermal top + Aquaduct thermal long johns	Shetland pullover		314 g
Inner layer top	Inner layer top	Silk shirt (green)	248 g	
Cotton/wool shirt x 1 or 2 supplied by team members themselves	Cotton/wool shirt x 1 or 2 supplied by team members themselves	Flannel (wool) shirt		595 g
1 x Devold woollen Nordsjosweater with turtle neck	1 x Devold woollen Nordsjosweater with turtle neck	Burberry jacket	824 g	
1 x Devold woollen Nansen sweater with crew neck	1 x Devold woollen Nansen sweater with crew neck	Sub total	2675 g	
Inner layer bottom	1 x woollen waistcoat	Lower body		
1 x Pair of corduroy trousers (tbc possibly not necessary)	1 x pyjama jacket/alternative thinner jumper tbc	Cotton long-johns		275 g
		Green Shetland long-johns		320 g
Outerwear	Inner layer bottom	Brown Shetland long-johns		450 g
1 x Reindeerskin anorak with hood	1 x corduroy trousers tbc	Burberry breeches		440 g
1 x sealskin anorak with hood	1 x woollen trousers tbc	Sub Total	1485 g	
1 x seal skin trousers	Outerwear	Total	4160 g	
1 x Burberry style windproof trousers	1 x Burberry style windproof trousers			
1 x Burberry style windproof jacket with hood	1 x Burberry style windproof jacket without collar	Footwear		
1 x pair of puttees (to wrap round bottom of trousers)	1 x pair of puttees (to wrap round bottom of trousers)	Blue socks	108 g	
Head and neck gear	Head and neck gear	Mixed Shetland socks		82 g
1 x woollen balaclava (designed and made especially)	1 x woollen balaclava (designed and made especially)	Argyle socks	82 g	
1 x woollen hat from Devold	1 x woollen hat from Devold	Puttees	106 g	
1 x woollen scarf	1 x woollen scarf	Sub Total	356 g	
Footwear	Footwear	TOTAL		WEIGHT
4 x pairs of Devold thick Nansen socks	4 x pairs of Devold thick Nansen socks	excluding boots	4516 g	
2 x pairs of Devold Active thinner socks	2 x pairs of Devold Active thinner socks			
2 x pairs of Wolsey woollen half length sock	2 x pairs of Wolsey woollen half length sock			
4 x pairs of Wolsey full length hose sock (variety of sizes for each man for layering)	4 x pairs of Wolsey full length hose sock (variety of sizes for each man for layering)			
1 x Finnesko boot	1 x Finnesko boot			
Hands	Hands			
1 x pair of large reindeer mits	1 x pair of large reindeer mits			
2/3 x pairs of ordinary woollen gloves from Ulvang	1 x pair of long to elbow fingerless gloves with mitten covering			
1 x pair of large woollen mittens from Ulvang	2/3 x pairs of ordinary woollen gloves			
	1 x pair of large woollen mittens			