This resource charts the many developments in polar clothing during the period covered by the Freeze Frame collection. It begins by outlining the polar climate and why this makes clothing so vital to the success of an expedition. It then moves on to what happens when polar clothing fails. A failure in polar clothing to meet the demands of the polar climate on the body can have serious consequences for the wearer.

The resource then moves on to consider the clothing worn in the three key eras covered by the project:

- **The Heroic Age** - here we see explorers struggling to meet with the demands of the polar climate. They knew the causes of these problems but were hampered by the lack of truly waterproof and windproof fabrics.

- **The inter-war period** - here we see many of the problems of the heroic age still affecting men nearly 50 years later. However, we start to see developments in polar clothing which make it much more suitable for the cold climate.

- **The post-war period** - it is here we see significant developments in polar clothing. With a range of new fabrics explorers were able to wear clothing which was waterproof, windproof and insulated. However, this was not always problem free and ways of wearing clothing from the heroic age are still used.

We conclude the resource by taking a brief look at what indigenous people of the north wear. For them clothing is not simply about utility but also about the cultural values ascribed to clothing.
The climate of the polar regions can be extremely harsh if an explorer is not adequately equipped for it. The Arctic and Antarctic make up the polar climatic zone, a region that is perpetually covered by snow and ice. In these high latitudes, the sun's rays are insufficiently powerful to melt much of the snow and so the cover remains year round.

The Antarctic continent covers an area that is about 14.2 million sq km and there is a range of temperatures across the region. At coastal stations winter temperatures range from -10°C to -30°C, in summer temperatures rise to around 0°C and occasionally above. Temperatures inland tend to be much lower, because of the land's increased elevation, higher latitude and greater distance from the warming effects of the ocean. Here temperatures in summer rarely get above -20°C and in winter monthly averages fall below -60°C. The lowest temperature on the earth's surface was recorded in the interior of Antarctica at Vostok Station, where a temperature of -89.2°C was recorded. Antarctica has very little precipitation and is the world's largest desert.

The Arctic is around 14 million sq km and has a range of temperatures as it covers land mass and frozen sea. Minimum temperatures are around -32°C and maximum around 2°C in Greenland and northern Siberia. Maximum temperatures on the ice sheet itself are between -5°C and 2°C but highs in the region of 30°C have been recorded on land. Explorers to these regions need to be well equipped to survive in such low temperatures. In the Arctic annual precipitation is usually between 500 and 1000mm, made up mainly of winter snowfall.

For both the Arctic and Antarctic we need to take into account the wind-chill factor, which will reduce how high the temperature feels. Both the Arctic and Antarctic have high winds and blizzards, with Antarctica being the windiest continent. Winds are not just problematic in themselves but also due to their effect on a person's body temperature. Wind chill is the cooling effect that wind has on temperature; it is expressed as a loss of body heat in watts per square metre of skin surface. Without wind there is no wind chill effect.

**Fundamental Elements of Polar Clothing**
The styles of clothing may have changed but the underlying principles of polar clothing have remained the same during the period covered by the Freeze Frame project.

The fundamental principles are:

- Maintain a warm layer of air next to the skin
- Avoid damp clothing next to the skin
- Keep out the wind

**Trapping Air**

Suitable cold weather clothing is not warm in itself - it is simply a good insulator and a poor conductor of heat. Heat is lost from the body through radiation and conduction. Air is an excellent insulator; therefore those clothes that trap air work well to keep the body warm. Several thin layers of clothing have the advantage of trapping multiple layers of air and so are more effective than one thick layer.

**Dampness**

When a person becomes too warm they sweat - this is the body's own way of cooling itself and regulating temperature. Sweating can be especially problematic in the polar regions where strenuous physical exertion may cause a person to become too hot in their polar clothing. The layers of clothing topped with a waterproof layer will slow down or prevent evaporation, resulting in clothes becoming damp. This will result in the stable insulating layer of air being replaced with
water and, as moisture is a much better conductor of heat than air, the insulating capacity of the clothes will be reduced. These clothes will now act to conduct heat away from the body and their wearer will become cold.

It is vital that anyone living and working in the polar regions wear exactly the right amount of clothing, allowing them to remain warm without sweating. They will need to adjust what they wear so that less is worn in strenuous activity and more when being still. This is an added benefit of wearing layered clothing.

If clothes do become damp it is vital that they are allowed to dry fully before they are put back on, so that they are able to recover their insulating properties. This is especially true in the case of woollen clothing, which works very well as an insulator unless it is wet.

**Wind Factor**

Insulating layers are the best way to trap warm air, keeping the body warm. For the insulating properties of air to be effective they need to keep air next to the skin between 25 and 30°C. When the external temperature is very low, or a very strong wind is blowing, or clothes are damp, they will fail to maintain the temperature of this layer of air.

To reduce the effect of the wind chill factor and prevent any air circulation removing warm air, these layers need to be topped with a windproof and waterproof layer. This prevents strong winds blowing heat away from the body by encasing the layers.

**What Happens When Clothing Fails**

If people find themselves ill prepared to keep warm in a polar climate three outcomes are likely:

- Hypothermia
- Frostbite
- Snow blindness

Explorers who have not been well equipped have died due to a combination of the effects of hypothermia and frostbite and so adequate clothing is vital when travelling in the polar regions.

**Hypothermia**

The average body temperature is around 37°C. The body has a number of ways to keep itself at its vital temperature; falling even a couple of degrees below this can have very serious consequences, as many of the body’s chemical reactions central to survival can only occur within specific temperature ranges. When a body’s temperature is lower than 35°C it is in the early stages of hypothermia. At this stage a person will shiver to try and generate heat. The blood vessels will contract to prevent warm blood reaching the surface; it will also reduce blood flow to the extremities to prevent the loss of heat. As the body becomes colder it will try to release more energy to heat the body and to power the action of shivering, the metabolic rate will increase and food will be used up more quickly - obviously this is problematic if food is in short supply. Once these mechanisms of maintaining and increasing heat are overwhelmed and the loss of heat is greater than heat production, the body is suffering from hypothermia.

A person suffering from hypothermia is likely to have a slow breathing rate and low blood pressure. They are likely to feel tired and may become argumentative, but are unlikely to realise this is a warning sign of the onset of hypothermia. Blood will be cut off to the extremities making them numb, the sufferer will then have problems undertaking dexterous tasks such as fastening up clothing and so they may not bother which in turn will make the hypothermia worse. A victim of hypothermia is likely to be stumbling, very sleepy and suffering from confusion. People with hypothermia are often unable to make rational decisions, for example they may lie down in the snow for a rest when they really need to keep moving. This is obviously very problematic when out in the field.

As the hypothermia worsens the heartbeat will become irregular and the pupils will become dilated, giving the victim the appearance of being in a coma. Once a person is in such a situation they need to be warmed up. Severe exposure can
normally be treated only in hospital, which is difficult for a polar explorer. For milder cases of hypothermia an explorer can recover by being warmed up in a tent with hot drinks and blankets.

**Frostbite**

Frostbite can attack any part of the body, but it usually affects exposed areas such as the face, hands or feet. It can attack very suddenly with the sufferer feeling as though a wasp has stung them. It can be recognised by white patches appearing on the skin. Frostbite will initially present as a feeling of intense coldness, eventually replaced by numbness.

Frostbite occurs when the temperature of the skin falls below its freezing point, which allows ice crystals to form within the skin's cells, killing them. When the skin is re-warmed the skin will swell and blister and these purple and black blisters will harden. For superficial frostbite these areas can be removed to reveal a layer of new skin beneath.

A more serious frostbite will extend the damage below the layers of skin to the muscle and bone. This almost certainly results in permanent tissue damage. There is no cure for such damage and many explorers have had amputations, especially of fingers and toes but also parts of arms and legs.

Frostbitten skin needs to be warmed up to aid the recovery process. However, it should not be warmed up if there is a possibility it will re-freeze. A continual thawing and freezing of the skin will cause greater damage. Today, medical guidelines suggest a person should be taken straight to hospital where they can be warmed up. For explorers in the polar region this poses a particular problem. It can be difficult to thaw skin out quickly enough or prevent it refreezing.

It is quite common for frostbite and hypothermia to occur in conjunction. If a person is suffering from hypothermia, this should take precedence in treatment as saving the victim's life is more important than saving a frostbitten area.

**Snow Blindness**
Snow blindness is a painful eye condition caused by overexposure to ultraviolet rays (UV). These are strong in intensity at the poles due to their high elevation. Light is also highly reflected as snow and ice have a high albedo (reflectivity property).

Snow blindness can be considered sunburn of the cornea of the eye; like sunburnt skin it can take a few hours to realise what is happening. Eyes suffering from snow blindness tend to be bloodshot and teary, sufferers will complain of feeling grit in their eyes and their eyes may swell shut. Moving the eyes or blinking can become extremely painful. Often snow blindness will result in temporary blindness, but at its most severe this can be permanent.

To treat snow blindness the eyes should be bandaged or covered with cloth, this prevents further irritation from light or the movement of eyelids. The eyes need to rest to allow the healing process. Today drops are used to speed up the healing process. In years gone by ophthalmic cocaine (of a different chemical composition to recreational cocaine) would be dropped into the eye to assist healing. Polar explorers often do not have the liberty to rest for a few days and so have been known to man-haul their sledges blindfolded with their companions directing them.

To prevent snow blindness, the indigenous people of the north would wear goggles. These consisted of an eye mask with a long thin slit to allow in a limited amount of light. Polar explorers in the heroic age would develop many types of snow goggles. Initially using goggles modelled on Inuit design, Scott and his crew on *Discovery* also experimented with types containing coloured glass, often green, to reduce the brightness of glare from the snow. In addition, tents were often made out of a green fabric to give the eyes a rest from the whiteness. Today, explorers, scientists, visitors and indigenous people wear sunglasses suitable for the polar climate; these are very similar to the glasses worn by skiers.

**Changing Styles and Methods**
Whilst the fundamental principles of polar clothing have remained the same over the years, many different types of fabric have been tried. The main development in polar clothing has been a shift from the use of natural fibres to synthetic fibres.

**Heroic Age**

Explorers in this period relied heavily on natural fibres such as wool and cotton to form the basis of their polar clothing. Whilst indigenous peoples in the north wore furs and skins, there was a reticence by some explorers to use furs as they considered indigenous people and their methods uncivilised. As man-hauling was a typical way of moving across the ice during this period it is possible the men would get too hot when hauling a sledge if they had worn furs. Indigenous peoples themselves tended to rely on dog sledges, for which fur clothing is ideal as it protects against the cold when the wearer is seated on a sledge, should the wearer become too warm the outer garment (parka) is designed to be loosened to allow cold air in.
Clothing was layered so that air could be trapped between the layers. However, in the early period it was difficult to find totally windproof or waterproof fabrics to make clothing.

There are many accounts of explorers from this time suffering from frostbite, hypothermia, and snow blindness. Unfortunately, some died from hypothermia or lost limbs due to the action of frostbite.

**British Antarctic Expedition 1898-1900**

The men on the British Antarctic Expedition 1898-1900 found that keeping feet warm was essential and Carsten Borchgrevink, having taken advice from his Finnish crew, reported,
"I found the Lapps method of never using socks in their Finn boots answered well. Socks are never used in Finnmarken in winter time, but ?senne grass' which they, of course, had a special method of arranging in the ?komager' (Finn boots) ... if you get wet feet while wearing the grass in the ?komager' you will be warmer than ever, as the fresh grass will, by the moisture and the heat of your feet, in a way start to burn or produce its own heat by spontaneous combustion. The great thing seems to be to arrange the grass properly in the boots, and although we all tried to imitate the Finns in their skill at this work, none of us felt as warm on our feet as when they had helped us.”

British National Antarctic Expedition 1901-04

The men on the British National Antarctic Expedition 1901-04 found that layering was the essential principle to follow during this expedition; wool was considered the ideal material for polar clothing, Wilson went as far as to say:

"It is a golden rule to avoid anything but wool as far as possible. All furs are far too impervious, and, instead of allowing the free evaporation of moisture from the body, collect and absorb it all, and become heavy and wet when frozen."

Whilst Wilson thought fur an inappropriate material for polar clothing, indigenous people, who relied on fur clothing, worked with its absorption properties to produce clothing which was suitable for cold and damp conditions.

One of the problems with the layered clothing worn by the men of the British National Antarctic Expedition 1901-04 was that it was too tight fitting. Whilst man-hauling their sledges they would sweat, which would make their woollen clothes damp. Once their clothing became wet it acted to conduct heat away from the body rather than to insulate it and so the men became cold and clammy.

During the furthest south march Scott, Shackleton, and Wilson all suffered frostbite. One of the reasons for this was their lack of a fixed hood. The men wore a Burberry cloth topcoat, which was the most windproof available at the time. However, this did not have a fixed hood and was too close fitting. This meant the body was not entirely covered and parts of the neck could be exposed as the unfixed hood moved. In addition, this allowed the warm air to escape, reducing the warming action of the layers. Wilson went onto remark in his medical report that windproof clothing is key, as any mild breeze will make a person working in these conditions feel especially cold.

As well as the effects of cold on the body, the men also had to deal with the effects of cold on the clothing they wore. Wilson remarked that their finnesko boots (made out of reindeer hair) would be frozen to their socks; when they removed their boots their socks would come off too, requiring them to tear the socks out the following morning. To keep their feet warm the men used sennegrass, a sedge (Carex vesicaria) from the Arctic areas of Europe. This would be arranged in their finneskos filling the spaces between the toes and the boot and so acted as a good insulator. In addition, sennegrass has absorptive properties and so will absorb any sweat, keeping the feet dry and warm.

British Antarctic Expedition 1907-09

Whilst many explorers by this time had adopted the Inuit style parka, Shackleton on the British Antarctic Expedition (1907-09) had not learnt lessons from the clothing on the British National Antarctic Expedition 1901-04 and still carried on with the same design of jacket which did not have a fixed hood. Instead, to keep the head and ears warm, a muffler was wrapped twice around the chin and head, giving protection to the ears - which are one of the first parts of the body to experience frost bite. The muffler was then wrapped around the neck and topped with a fleecy travelling cap. If there was a blizzard the muffler was discarded and a helmet put on with the Burberry helmet on top. This had a stiff flap which could be buttoned into a funnel shape. However, the problem with this was it could let in cold air around the neck, exposing the skin and reducing the effect of the insulating layers.

So that a helmet could be temporarily removed without being lost, it was tied around the neck along with the mittens. On their hands the men wore woollen gloves topped with fur mitts. Whilst mittens will keep heat in better than gloves, they
also reduce dexterity and so inner gloves would be worn alone for short periods of time to undertake tasks requiring especially dextrous hands. On their feet they wore several pairs of woollen socks and then finnesko (boots made entirely from reindeer fur). These were lined with sennegrass, an Arctic sedge traditionally used in polar footwear due to its insulating and absorbent properties.

Whilst Shackleton did use fur for clothing on the feet and hands he did not believe fur necessary for coats, in contrast to the indigenous people of the north. Instead of fur clothing the men wore winter suits consisting of a double-breasted jacket, vest, and trousers made from heavy pilot cloth, lined with Jaeger fleece. This was then topped with a Burberry gabardine, which was the most windproof available at the time.

They took with them a small repair kit containing spare pieces of Burberry cloth, so that they could patch their wind battered clothes. However, they still had problems with thin and threadbare clothes on their furthest south journey. Shackleton tore his Burberry trousers on a piece of sharp ice; this exposed the skin and resulted in a frostbitten knee which developed into an open wound, in which the wool from the layer below came stuck. Shackleton had to work this out with a knife so that the wound could heal.

In addition, their finnesko boots became old and tattered. Shackleton would find his heels soaked in blood at the end of day’s march. As Shackleton himself said:

?*Our troubles with frostbite were no doubt due in a measure to the lightness of our clothing*’ (The Heart of the Antarctic page 377).

Whilst their clothing may have been effective for shorter journeys, it was not designed to withstand harsh conditions for such long periods.

To combat the effects of snow blindness, the expedition wore snow goggles all the time when out in the field. These were made with green and red lenses so that everything had a yellow tint. Their only relief was to get into their tents made out of green fabric, inside which everything looked very subdued.

**British Antarctic Expedition 1910-13**

The **British Antarctic Expedition (1910-13)** like others of the period, experienced similar clothing problems. Wilson noted
that their clothing was susceptible to freezing in the cold temperatures:

"With all this clothing wet and all frozen stiff it becomes difficult to move with one’s customary agility and any climbing up ropes or climbing out of crevasses becomes exceedingly difficult for anyone but an acrobat" (Edward Wilson July 4th 1911, trip to Cape Crozier).

When dragging a sledge over difficult terrain and sleeping in cramped tents agility was a key requirement, a lack of agility would delay them further and reduce their chances of success. Due to its absorbent properties, wool freezes easily and in cold conditions it is difficult to thaw out. Scott began to question if they would have been better not to be so over reliant on wool and cotton:

"One continues to wonder as to the possibilities of fur clothing as made by the Esquimaux, with a sneaking feeling that it may outclass our civilised garb. For us this can only be a matter of speculation, as it would have been quite impossible to have obtained such articles" (Scott’s diary p.289).

This marks a shift in recognising that the knowledge of those who live in similar conditions in the north is important for polar explorers, who might learn from their techniques and knowledge.

Perhaps the most well known death from frostbite and hypothermia is that of Captain Oates. In Scott's diary he remarks that, before they have even reached the pole, their finnesko are bald and that Oates is feeling the cold more than the others. During their return journey, Scott's diaries are littered with comments concerning the poor state of Oates' feet. However, Oates was hiding how poor the condition of his feet was from the rest of the men. He knew a lame man would be a burden to the rest of the group and so kept going; however, he got slower and slower. On 2 March Oates disclosed the full extent of the problem and by 6 March was unable to march and was pulled on a sledge by the other men.

From here each of Scott's diary entries became more and more concerned with the fate of Oates, as it became apparent there was no way he could continue. The rest of the group urged him to keep going, but also knew this was unrealistic and Scott ordered Wilson (the group's doctor) to give out the opium tablets, so that the men, if they wanted, could decide to end their lives.

On 17 March Oates left the group and walked out of the tent to his death in the hope that the rest of the men would be able to move faster without him. Scott recorded in his diary that Oates slept through the night hoping not to wake, but he
woke to find a blizzard blowing. As he left the tent he said to the rest of the party, *I am just going outside and may be some time.* His body was never found.

This demonstrates the stark reality of the failure of polar clothing. Their boots were too thin to last such a long journey and whilst Oates had the most extreme case of frostbite the others suffered too, as Scott remarked:

*‘Amputation is the least I can hope for now, but will the trouble spread?’* (Scott’s diary p.463).

**Interwar**

Expeditions in this period were able to learn from the mistakes made during the heroic age and build on principles which worked well. The layering of clothes had proved successful and in the 1930s Norwegian army officer Henrik Brun built on this to develop the Brynje system of mesh underwear. This was a vest made from open weave cotton strands with a woollen vest immediately outside, resulting in the all-important stable layer of air. Clothes worn over this would open at the neck so that a vent could be made in case of sweating; allowing a release of moisture as well as cooling the wearer down. Once dry the wearer could close the neck shut, trapping a layer of air in between the vests and so restabilising their warming capacity.

Learning from the mistakes of the heroic age, it was typical in this period for explorers to have a hood attached to their outer windproof layer. This would be edged with fur to protect the face from frostbite.

Protecting the hands and feet was considered very important. Mittens continued to be used as they contained more warmth than gloves, and if the wearer needed to be able to do something quickly in bare hands mittens are very quick to remove. They also learnt from the heroic age with regards to the thinness of boots, and innersoles were added to increase the insulation at the bottom of the boot. In
addition, in extremely cold weather an over-boot of canvas and leather was worn on top of the boots to further protect the feet.

**East Greenland Expedition (Pan Am) 1932**

On the East Greenland Expedition (Pan Am) 1932 we see a greater use of fur in clothing of polar explorers, marking a shift in British exploration clothing. The layers of clothing consisted of camelhair underclothes, flannel shirt and two sweaters, corduroy trousers, a light windproof coat, woollen inner mitts and a pair of sealskin outer mitts with an edging of dog-fur. This was topped with a sealskin anorak with fox fur edging to the hood, which they found very useful in preventing frostbitten faces. As they were on sledges pulled by dogs, rather than man-hauling, they tended to wear the anorak when riding along on the sledge as they would not generate heat through movement and so would need extra layers.

This was one of the first expeditions to test out the zip fastener, which they found very useful as it allowed them to easily adjust their layers.

**Post-war**

It is in this period that we see a great shift in clothing techniques and a development in new materials and methods which revolutionised polar clothing. For example, Ventile is a high-quality woven cotton fabric first developed during the Second World War for use in pilot's immersion suits and remains popular today. The greatest shift was a move from natural to manufactured fibres to provide a basis for clothing. This is not to suggest clothing in the heroic age or inter-war years was naive or poorly constructed, but these pioneering explorers discovered what worked and what did not. This meant that with the development of new materials these could be applied to aspects of clothing that explorers already knew were problematic.
The Norwegian-British-Swedish Antarctic Expedition (1949-52) was one of the last expeditions to rely on natural fibres as the basis of its clothing. The men wore Wolsey pure wool vests and matching long pants next to the skin (the same type worn by Scott and Shackleton.) On top of this was a thick lumberjack shirt, heavy blanket-cloth trousers, over which was worn a lightweight hand-knitted Shetland wool jumper and/or a heavyweight Norwegian sweater. When outside, these were topped with dog-skin trousers, reindeer-skin leggings, and a thick reindeer parka. In addition they had a sheepskin cap held in place by elastic ski goggles. This followed the traditional principle of layering clothes for warmth, and interestingly this international effort included a lot of fur clothing with which to do this.

Being an international expedition, there were sometimes disagreements about the correct way to do things. One area was the best choice of polar footwear. The leader Jonh Giaever brought almost every known variety, so the men could choose which they preferred, but an agreement about which were best was never reached. For skiing, Charles Swithinbank (whose photographs form part of the Freeze Frame collection) used Norwegian ski boots copied from the ones worn by Roald Amundsen on his South Pole journey in 1911. These were made from alternate layers of leather and felt which were soft, flexible and warm but firm enough to control skis.

Others on the expedition thought the ordinary ski boots were too cold for the Antarctic and wore mukluks, a soft boot made from seal and bear skin. Inside their boots the men would wear wool socks, with bootees from blanket cloth, dog skin or sheepskin. Special bindings would be used to hold the mukluks in place on the skis. Another choice for outdoor wear was finnesko; the wearing of these reindeer-skin boots had been the first choice for many polar explorers. As in the heroic age, sennegrass would be placed in the boot to insulate the feet and to keep them dry.

Although exposed skin is susceptible to frostbite, for much of the time the men did not wear anything on their faces. They
discovered that whilst a face mask will protect the face, it quickly becomes icebound due to frozen condensation from breathing and sweating. This would make the mask uncomfortable and prevent it from doing its job.

What this expedition highlights is that techniques or materials used had changed little in nearly fifty years of polar exploration. Explorers benefited from the results of trial and error by previous explorers, but what was suitable clothing was still being tested. The first major change in technique is shown in the US Navy Expedition Deep Freeze.

United States Navy Antarctic Expedition (Deep Freeze)

Before the United States Navy Antarctic Expedition (Deep Freeze) departed, a lot of research was conducted into what clothing would be suitable for polar conditions. They practiced putting up their prefabricated huts in giant freezers at their base in the United States, which allowed them to see which clothing would work. They decided to make two outfits that could be worn individually or combined in very cold weather.

The first outfit was made from a rubberised nylon material to make it waterproof and windproof, the inside of the trousers was also lined with a lighter weight rubberised material. This substantially increased the waterproof and windproof properties of the clothing beyond that of the traditional wool and heavy cotton. They continued with the same principles of layering as previous expeditions, but used new technology to take this further. Between the outer lining of the clothing and the fabric a fleecy material was inserted, this acted to trap air and as this insulating layer was trapped between two waterproof layers it would remain dry.

In addition their clothing allowed for adjustment in case they got too hot. The jacket had a removable liner, which allowed the regulation of the insulating properties of the jacket. In addition this jacket had interchangeable hoods, which could be zipped on or off, depending on the weather.

The second outfit was lighter, made from a lightweight, wind resistant fabric lined with a quick drying nylon fleece. This was intended for use in dry cold weather, but could be combined with the waterproof outfit if in need of extra warmth.

Mitts were still worn, as these had the greatest insulating power, and gloves were worn under these - to be worn alone only when undertaking tasks which required dexterity. A combination of mittens and gloves was not new, but here the gloves were made of a quick drying nylon fleece to prevent them remaining damp if they got wet.

To prevent the feet getting wet, waterproof boots were worn. As with the first outfit, fleecy material was sealed in between the inner and outer rubber linings of the boot. This fleecy material worked so well at insulation that the wearer only needed to wear one pair of socks.

Further building on principles of layering, the men's underwear was made of a newly developed cotton waffle knit cloth which created multiple air pockets on both sides of the fabric, enabling the fabric to entrap warm air whilst reducing surface contact. A secondary benefit of this new fabric was that it was not itchy like woollen underwear.

The clothing made for this trip was made in many colours, providing a change of colour amongst the whiteness of Antarctic and aiding identification of the wearer against the white snow.

From this expedition is clear that the fundamental requirements of polar clothing remained the same. However, this is the first expedition illustrated in the Freeze Frame collection that used new technologies to meet those requirements.

Transglobe 1979-82
photographs form part of the Freeze Frame project. New methods and technologies are developing all the time and so the clothing worn on the Transglobe expedition differs drastically from clothing worn today. It is interesting to compare clothing from the Transglobe expedition with that of earlier expeditions to see how things have developed throughout the era that the Freeze Frame project covers.

What the Transglobe expedition highlights is that the requirements of polar clothing have not changed since the heroic age of exploration, and whilst some of the ways these requirements are met have changed, others have remained the same.

Layering again was a fundamental principle in the clothing. Whilst on Antarctica, the men wore five layers of clothing to trap heat, two of the men topped this with a wolf skin parka, made in the indigenous fashion. What these men had learnt was that the indigenous peoples of the north have knowledge about what to wear in extremely cold weather. Without such knowledge, these people would not have survived. In addition to this, Fiennes and his companions wore three layers of footwear, with mitts, caps, goggles and facemasks, but as Fiennes remarked:

"the coldness cuts through as though we were naked. Fingers are soon numb but still alive enough to hurt, which is good. Toes and nose likewise" (Fiennes 1983:112).

Once at the poles they used a mixture of man-hauling and skidoo to make their way across. They found their clothing suitable for travelling on skidoo but not for man-hauling, which was a greater exertion on the body. When man-hauling they found themselves sweating, this sweat would then turn to ice between the layers of clothing. As a result, whilst man-hauling in Antarctica they chose to wear winter gear instead of polar gear, as they found the windproof polar clothes did not breathe and prevented the sweat from evaporating. This shows that new developments in clothing may not always represent an improvement until tested in the field.

In addition to suffering from the effects of sweating, the men also suffered from the effects of the cold. The found that the windproof extensions to their jackets would move when skiing, which would allow wind to enter the jacket top, reducing the insulation effects of the layers. Fiennes developed frostbite at the base of his neck from the movement of the extension.

Like other expeditions before them, they also had problems with face protection. Fiennes had been wearing two face masks when on the skidoo and continued to use these when man-hauling. However, he soon had problems as he breathed harder when man-hauling and so the small mouth hole quickly became encrusted with ice. At one point a face mask froze to his face, pulling off the skin from his chin when removed.

The party also suffered from the effects of hypothermia. Whilst in Antarctica, the medic Oliver Shepherd got off his skidoo and lurched over to the others unroped. They found that his speech was slurred - a key sign of the onset of hypothermia. It was vital he was quickly warmed up before the condition could worsen. As it would take them two hours to make camp, they decided against this and using one of their skidoos secured tarpaulin around it to provide a windproof shelter. This
shows how problems such as hypothermia and frostbite were not just problematic for explorers during the heroic age of exploration but continue to be so in modern times, despite adequate preparation.

Traditional Clothing in the Arctic

Traditional Inuit and Greenlandic clothing has practical, spiritual, decorative and political elements to it. Those early polar explorers who adopted indigenous clothing techniques suffered less from frostbite and hypothermia than those who tried to adapt western clothing for the polar climate. However, at the time many indigenous groups were viewed by the west as inferior or uncivilised, so their clothing techniques were rarely adopted. In some instances, particularly where forced settlement occurred, indigenous people were made to wear the less appropriate western clothes.

For indigenous people, this loss of their traditional clothing made them anonymous, as clothing was used to mark gender, age, status, locality and family groups (Buijs 1997:2).

The central materials of indigenous clothing were fur and animal skin; these are very good at insulation. Fur is made up of two layers, an outer layer of longer coarse hairs and an inner layer of short soft hair. These hairs are hollow in the centre and this space is filled by air. The arctic clothing system works on the principle of layering to trap warm air next to the body. Europeans followed this system, but would wear close fitting garments made from wool, linen, cotton or silk. Wool was often found to be too warm and would cause perspiration; it would then absorb the perspiration making it heavy, and would take a long time to dry and would often freeze before it dried out. A fur garment will also get wet and heavy making it uncomfortable. However, a fur can be left outside to freeze as, unlike wool, the water does not cling to the fibres but forms a layer on top of them. The Inuit will often hang fur clothing out in the cold, allowing the moisture to freeze so that this layer can then be removed. This will then return the insulating properties of the fur and it can be comfortably worn again.
are extremely waterproof and were used to make coats, anoraks, parkas and boots. These can be combined with fur to keep the wearer warm and dry. Certain stitches also work well to keep garments waterproof - seams are made without piercing all layers of the material so that water cannot penetrate. Sinew is used for sewing and will swell when wet, closing any holes in the seams.

Indigenous clothing is not purely about utility, it is also an expression of identity. Clothes are commonly patterned to reflect age, gender and status. For example in Greenland women would traditionally use glass beads traded from the whalers to decorate their anoraks with elaborate patterns. Cultural factors have at times resulted in a design of clothing which is not always best suited for the polar climate. For example women in East Greenland would wear short trousers with long boots exposing their thighs to the elements. It would be reasonably common to see women with blackened thighs suggesting the onset of frostbite.

There can be no doubt that those explorers in the heroic age who took on or adapted indigenous clothing styles were more comfortable than their counterparts who wore European style clothing.

Today indigenous clothing is a mix of traditional and western styles. Many indigenous people will live in heated homes where they no longer need the thick furs. However, if they are going out hunting or on an especially long journey, traditional clothing may be worn. Traditional and western clothing styles can be mixed, they are not mutually exclusive.

Further Information


Hall, Judy; Oakes, Jillian E. and Webster, Sally Qimmiu'nnaaq. 1994 *Sanatujut: pride in women's work - Copper and Caribou Inuit clothing traditions*. Hull, Quebec: Canadian Museum of Civilization.


Kasturiya, Nishkam; Subbulakshmi, M.S.; Gupta, S.C. and Raj, Hans. 1999 *System design of cold weather protective clothing*

The published diaries and accounts of various expeditions will give you an overview of each expedition's experience of polar clothing and their personal opinion of what they used. A list of accounts written by expedition members can be found in the further reading section.