

INSULATIONS & HOW TO STAY WARM

Until now I have given an accounting of my education in the textile industry with the major emphasis on insulation materials and how they differ. Now for my observation of how best to stay comfortably warm in cold conditions. Controlling heat loss is primary to staying comfortable. But first what exactly is insulation? Dead air is what insulates!

If you place polyester fiberfill or down between two materials the air that is trapped within the fiberfill or down does not move because air sticks to any surface for a distance of 1/8th of an inch. If you break up the air within the 1/8th inch to smaller increments it is still harder to move it so it stagnates. Stagnant air like stagnant water will retain the heat that it receives and insulates, not the actual material. The material is the catalyst and the difference between the polyester and the down is that the polyester does not absorb the moisture that it is exposed too while the down does.

There are 4 primary actions that take place and two of them are in my opinion not very important so I will mention each of them first. But before that an explanation of what constitutes warming the earth needs to be explained.

The sunlight that hits the earth warms the earth. It is this solar radiation that the earth receives that is absorbed by the clouds, oceans and landmasses. All of these objects then heat the air. The air is not heated by the radiant heat directly. The air around us is heated by the objects that absorbed the sun's rays. When the earth is exposed, it is dark; i.e. soil and dark objects absorb heat, it will absorb the sun's rays and heat up and the heat that the earth has absorbed will rise and heat the air it is coming in contact with. That is how the air is heated, not by the sun directly. All dark objects that are exposed to the sun's rays absorb the heat in that manner and then heat the air that is in contact with the objects.

People of the desert always wear white clothing because the sun's rays are reflected away from the white surface. During the summer months in Antarctica the snow and ice do not melt in the interior of the continent because the sun's rays which hit the surface of the continent for 24 hours a day do not melt the snow, the rays basically bounce off of the white surface, snow, and are reflected back into space. What does melt is the ice and snow around the perimeter of the continent because the water is absorbing the sun's rays, heating and that heated water is heating the ice and causing it to melt. Also note that the melting takes place under the ice, not on top, because the white surface is reflecting the sun's rays back into space.

When we have large snowfalls on the ground you can see that the snow begins to melt along the edges where it is next to uncovered ground. As soon as an opening appears in the snow and the ground is exposed the opening gets bigger also from under the snow because the dark ground is absorbing the sun's rays and warming so that warmth is causing the snow to melt. Since dark colors absorb heat that is the reason all of the cold weather bags I make are black and the rest are made with dark colored fabrics. Did you ever put your hand on the exterior of a black car in summer? It is hot because the dark surface has absorbed the radiant heat from

the sun. Do the same to a white car and it is cool to the touch. Generally people who live in warm climates like the southern part of the USA will buy white cars for this very reason.

RADIANT HEAT

Radiant heat loss is for all intents not a factor of any consequence. Radiant heat which the human body produces just like the sun is always absorbed by the first solid object that it hits, just like the objects that the sun's rays hit. If you are active and the temperature is 80 degrees F your core temperature is 98.6 degrees. As your core temperature increases due to your activity your internal body temperature increases and automatically sends the excess heat to your skin surface. Along with the heat coming off of your skin surface—which is radiant heat—there is moist vapor coming out of your pores, which is also warm. This vapor will condense, coating the surface of your skin, which absorbs the heat on the skin's surface and cools your body; this is because the moisture is absorbing that heat. The heat coming off of your skin's surface is radiant heat, which is being released into the air. Now if you are dressed and the air temperature is 40° F your body is still giving off radiant heat, only now it is being absorbed by the fabric; i.e. the object covering your body. It does not travel any further away from you. If you are dressed for temperatures as low as -40° F again you are giving off radiant heat but the loss getting outside the layers of clothing is again non-existent, therefore radiant heat loss is not to be considered.

CONVECTIVE HEAT

Convective heat loss or heat loss via convection is the second action of no consequence. Convective air movement occurs when air is heated and it rises. Some examples are the heat coming off of a candle, heat rising off of a radiator or the reason glider pilots like to fly over black top parking lots especially in Arizona during the summer; the sun's rays heat the black top; the air contacting the black top is warmed; the warm air rises and cooler air that is sinking moves in to take the rising air's place and as it warms from the black top surface it rises, and this cycle continues until the earth's surface, black top cools. This convective air movement is so aggressive glider pilots can hit altitudes of 40,000 to 50,000 feet. Do you think the human body can generate that type of heat? Of course not! Therefore, it is not necessary to consider convective heat loss as a detrimental action either with respect to the human body losing the heat it is producing.

EVAPORATIVE HEAT

Evaporative heat loss, however, is a concern. Moist heat leaving the human body can be a very serious problem when it is trapped next to the skin surface. The human body is constantly giving off moisture through the pores. This moisture has a very specific purpose, to cool the body as internally it heats up. When the air temperature is 80 degrees F and you are active the sweat glands produce lots of moisture. That moisture then acts as a conductor, removing the heat from the skin surface cooling your body and it is then conducted to the air. If you are active when the air temperature is 0 degrees F and you are dressed for the condition and

you are sweating and the moisture has no place to go outside of your clothing, once you stop the activity the moisture cools down quickly and cools your body quickly as well. You now experience a chill.

The cooling action of the moisture, demonstrates how efficient water is at absorbing heat. Actually water is the most efficient absorber of heat on the planet. The word insulation comes directly from the Latin word "insular" pertaining to island. Islands are generally warmer than the main land because they are surrounded by water. The water is absorbing the sun's rays keeping the island warm or insulating the island.

CONDUCTIVE HEAT

The final method of heat loss is via conduction. Conductive heat movement is when an object is heated such as a cast iron skillet. The heat from the skillet travels to the handle and consequently you need some form of protection when you grab the handle. When it comes to clothing that is insulated, the purpose of the insulation is to trap the heat that the human body gives off. As the heat travels away from the body, which is the source of the heat, it heats the first layer of clothing it comes in contact with which in turn heats the second layer which in turn heats a third layer. The heat is being conducted away from you and if the insulation is not efficient at stopping or reducing the rate of conduction the heat movement is not slowed. Therefore, the insulation that you use to surround your body should not be a good conductor of heat.

The combination of evaporative heat loss and conductive heat loss is what we are dealing with. I have mentioned that water in any of its three forms is the greatest absorber of heat on the planet and it moves the heat via conduction. Water in any of its forms; liquid, solid, or vapor is a conductor of heat. From the study of physics we know that heat moves to cold. If you are in a humid cold environment the moisture in the air even though you do not see it is conducting the heat from your body away from you. Having grown up in New York City (NYC) I know firsthand how cold it can get because of the humidity factor. Now living in Colorado I can be dressed in less clothing for the same temperatures since the humidity factor is 10 percent versus 80 percent in NYC. Over the years as I was learning about insulations and how they perform I read all of the explanations and theories from a scientific perspective. What I did not read was from a practical application. The science references the thickness of insulation for a given temperature condition. That is not necessarily accurate once you begin to learn the differences between the different insulating materials and how they are formed into a useable state.

Gerry Cunningham the founder of Gerry Products that was established in 1946 in my opinion was the original authority in the outdoor industry on "How to Keep Warm" which was the name of a booklet he wrote and published in 1971. The basic information was very valuable to my understanding of what it took to be warm. Generally speaking his booklet discusses in detail all of the methods by which we lose heat, how we produce heat, metabolism, insulations (i.e. types) and a very important topic titled "Ventilation" which I believe to be extremely important. In that subject he talks about fishnet underwear, which he refers to as "ventilating underwear." To follow is the whole subject as he wrote it:

VENTILATION: Starting with the skin and the need to prevent body moisture from entering the clothing, the requirement is for an air space around the body so the moisture can evaporate and the vapor laden air can then move freely out the neck opening. It will not force itself through the clothing if it is free to leave by an easier method. The many brands of ventilating net underwear are the answer to the problem. They even make an ordinary suit of clothes feel better in winter. The proper type is distinguished by a 3/8th square mesh or larger, about 1/8th in thickness and completely open. Smaller holes and "waffle weave" underwear simply do not allow the necessary evaporation to take place. So-called "insulated underwear" should not be worn next to the skin except for short periods. It can be used as an effective insulation when worn over ventilating underwear...if great thickness is required. Start out right by keeping body moisture out of your clothing. Wear ventilating net underwear.

By ventilating evaporative heat loss and conductive heat loss are reduced dramatically.

FISHNET LONG UNDERWEAR

Today Wiggy's is the only manufacturer of ventilating (i.e. fishnet underwear) in the USA. It is coincidence that the fishnet fabric I use is knitted with nylon yarns that are about 1/8th inch thick and the holes are 3/8th inch in a circular shape rather than square. Gerry also suggested various thicknesses of insulation that should be worn at different temperatures and during different activities. He was also a firm believer in the use of down as the optimum insulating medium. When I spoke with him about using the information in his booklet when I started Wiggy's he was delighted that I was going to make his knowledge available to one and all. At that time, in 1987, he was still very active and he had a sailboat moored in San Carlos, Mexico, which is a town on the Sea of Cortez. He wrote a book about cruising there that he sent a copy to me and I gave him a couple of my Nautilus bags in exchange. We had sailing in common as well as our business activity, when he told me about the boat I told him about my trip and how the Nautilus bag came to be. It is my belief that if he were active in the outdoor business during the time I have been making Lamilite he would have been a customer for Lamilite. I do not in any way minimize the knowledge that I have acquired from his writings. However the proper use of silicone coated continuous filament fiber trade named Climashield manufactured by Harvest Consumer Insulations located in Clinton, TN, is, when it is laminated which is the primary component of Lamilite and it does make down obsolete as well as every other insulating medium currently available, and it is my belief that it will not be improved upon.

DOWN

Let us look at "down". It has been around for less than 100 years as an insulator used in sleeping bags and jackets. Eddie Bauer pioneered its use starting in the 1930's I believe. Unfortunately it was not publicized widely or at all that the down back then had the same problems it has today, loses all insulating capability when it gets wet. Some interesting facts that I came across while researching down: According to the America/European and International Down Associations whenever you buy a down filled product, whether it is a jacket, sleeping bag, comforter, or pillow that is marked 100 percent down, it actually is at most 75 percent down and the balance is feathers. The literature they publish has the following

statement; "Down is never all down clusters; some feathers are mixed in. The Federal Trade Commission formerly required that if you call it down it must consist of at least 70% down clusters, but this has been rescinded. In Canada, products labeled as containing "down" must contain at least 75% down clusters." They then go on to bring to light the difficulty in assuring the mixture is accurate. They state the following; "The problem with this ratio as a figure of merit is that there is no easy way of measuring it: a sample of the down must be laboriously picked apart, cluster by cluster, sorted into piles and the piles weighed. Was the sample representative of the batch as a whole? Then there is a legitimate question of whether each particular piece constitutes down or feather. As a result, you may not want to make a purchasing decision on the basis of a small difference in this ration." I find it interesting that these down associations warn against purchasing a product that incorporates the product they promote.

That said down has demonstrated over the years when used in ideal dry conditions for a few days at best it does not on an ounce for ounce basis retain heat as well as Lamelite. Over the years I have read on many web sites about down bags not performing as the manufacturers label states. That was not a surprise to me, as over the years that I have been a sleeping bag manufacturer I have noted that the down product sellers (I say sellers because there are no manufacturers anymore, all bags and clothing are made in China or some other Asian country) have attempted to sway the public with down that supposedly (I have never believed the numbers) is 600,700, 800, and as much as 900 fill power. Big deal. Down still absorbs moisture and if the down fill power were what they claim it is, it would collapse sooner than the 400-fill power down. Some companies that process down are now bathing the down and feather blends with water repellent chemicals to ward off the absorption of moisture, doesn't actually work very well or for very long. Water repellent treatments are known to break down or wash away. The end result is bags that have never performed as advertised.

All of the Lamelite insulated sleeping bags that I have produced have never failed to perform for all of the temperatures which I have rated them.

What follows is a newsletter I published after getting more information about down that I did not know when I originally wrote the section about down.

March 2014

"We are taught to admire the second-hander who dispenses gifts he has not produced above the man who made the gifts possible. we praise an act of charity. we shrug at an act of achievement." —Ayn Rand

MORE ABOUT THE MYTH OF DOWN

For all of the years (now 52) that I have worked in the outdoor industry — first selling fiberfill insulation to the manufacturers and then becoming a manufacturer — I have been told, as has the general market place, that down (the under plumage of ducks and geese) is the best insulation in the world. In recent years I have come to disagree with that statement. Now I have more information about down. Recently a German company that processes down e-mailed me information about their company and its history. As a result I have increased my knowledge of down.

The salesman that contacted me giving me prices for the various qualities eventually surprised me with the statement that they had 1000 cubic inch down. I was skeptical and he chose to send to me a pillow of approximately 3 ounces or a value of \$44.00 plus his overnight air cost from Germany. What that tells me he is really looking for business since I am not, nor have I ever been (or will be), a user of down. I did notice that there are feathers mixed in the sample.

My plant manager for the past 28 years was with Marmot when I moved to Colorado and I hired him away. Kok is one of the brightest people I have ever met in the sewing business and am very grateful to have him as my plant manager. Kok was in charge of many areas of work at Marmot to include quality control of the down they received. So I showed him this sample and told him it is represented as 1000 cubic inch down. He took out a couple of clusters and said it wasn't even 800 cubic inch down and explained to me why. I have never discussed down with him before because I had no reason too. He said in order to get 1000 cubic inch down the birds would need to be on steroids. He further told me that he never believed that Marmot received 800 cubic inch down or did he think there was any better than 650 cubic inch down was available. He then told me of a trick to show how down can be shown to increase its filling power. Marmot had a cylinder about 15 inches in diameter and they would put approximately one pound of down in the cylinder, then with a fiberglass rod spin the down and it would create static which would cause the clusters to increase in height, hence showing a greater volume than actually existed. Of course once it settled there went the cubic inch shown. I am sure that the companies that sell down products are very aware of this so they advise the customers to vigorously shake the product, but the down ultimately settles anyway.

I have a very good friend on many years since 1966 actually who was head of production for a company long gone from the industry named Holubar. In their heyday they were considered the best producer of down parkas, pants and sleeping bags in the country. They made baffled parkas and bibs that no other company made. I called Terry to find out about down and he told me at Holubar they only used 100 percent 550 cubic inch down back then and it was 100 percent down, versus now-a-days a blend of 75 percent down and 25 percent feathers is considered 100 percent down. The problem here is that you cannot ever know if the feather part is only 25 percent, and when I looked at the 3 ounces sent to me I found that all of the down varies from clusters about as big as a dime to about 2 inches long. According to Kok the cluster would have to be at least 4 inches long to reach 1000 cubic inch territory, and that is not about to happen.

It is my opinion that the many companies that have been touting down for all these years probably knew about the lofting qualities of down and the settling properties as well. Just like in the 1950's when the auto makers would advertise their cars with 250 horse power engines and then 300 and 400 horse power, the down garment and sleeping bag makers came up with 600 plus fill power products as fast as they could, and then 700, 800, and 900. You would think the birds were growing down clusters like crazy to keep up with the need for larger and larger clusters. I always thought their claims bogus. Even back then the down processors couldn't eliminate all of the feathers so the industry, I believe, through government directive which was desired by the manufacturer, had the blend put in place because they knew they couldn't get a 100 percent product.

So we know that down does not perform at the temperatures assigned to the bags, doesn't perform at all when it gets wet. The wetness needn't come from the outside because when you are in a down

bag the wetness in the down comes from the person in the bag. I know this to be fact because of the number of mountaineers I have spoken with who have told me in no uncertain terms that after about a week in cold dry conditions their bags start showing signs of ice buildup. This also happens with very densely packed polyester bags as was experienced by Will Steger when he used Sierra Designs made 15 pound Quallofil insulated bags on his expedition to the North Pole in 1985. They the bags according to Will gained 35 pounds of ice. He thought this would happen with down which is the reason he took them instead of down bags which he knew would ice up. I believe we now know that the fill power numbers that are published for down are in my opinion not only not accurate but cannot be proven.

Hence the myth of down.

After carefully examining the down that was sent to me some aspects of this down became obvious. It is not 1000 cubic inch down; the clusters are quite small. Again when Kok looked at the down clusters he said he still had bags that he acquired from Marmot that contain down that has much larger clusters. Those bags were made over 28 years ago; I know that since Kok has been with me 28 years. Twenty-eight years ago the thought of 1000 cubic inch down did not exist. The clusters in the sample I received are also of very different sizes, mostly small. There is no continuity with regard to size.

I have been thinking about the various sizes that the companies have been promoting for years like 550, 600, 650, 700, 750, 800, 850 cubic inch lofting capability and how that relates to retaining heat. If these cubic inch numbers were true, I do not think so, but for the sake of discussion they are true, why the 850 fill power would be more efficient than the 550 fill power down, it isn't. If the space allotted for the down in a sleeping bag baffle is, and here I have to suppose the size of the baffle that would apply to a zero degree rated bag with down fill. I will make the baffle 8 inches wide (what is visible on the outside of the bag) and 5 inches deep (what is between the shell and the lining). Suppose that the space is filled with 550 cubic inch down about 3 ounces worth. Now we fill the same space with 850 cubic inch down. But the fill capacity of the 850 cubic inch down suggest that we only need 2 ounces of down, due to the larger size down cluster if only it were true. As I see it while we have reduced the total weight of the bag by as much as 10 to 12 ounces due to less down per baffle we have also reduced the density of insulation in the bag and that tells me the bag with the 850 fill down is less efficient as an insulator for the following reasons. We have to take into consideration the simple fact that down does absorb the moisture from the body of the occupant of the bag. With the 550 fill down there is a greater amount of material in the fact that there is one ounce more of the down clusters to absorb the moisture than exists in the bag with 850 fill down. Therefore, the 850 fill down will collapse more quickly than the 550 fill down bag will because there is less down to absorb the moisture. The end result is a bag with less efficiency.

As I see it IF there were actually down clusters that were consistently of the various sizes that the companies making down bags advertise, and while I do believe there is a variation in the cluster sizes that can be graded like one grades eggs, I do not believe it is significant as judged by the theoretical 1000 fill power down sample I received from Germany. This tells me that there are different prices and not different sizes of clusters of consequence. I remember years ago when the Sunoco gas company had different blends of gas you could dial on the gas pump. The joke was one quality gas but six different prices. I think the same fits here.

As far as I know all of the down bags sold are made in China. I am aware of the fact that there are two or three companies in the US that make down bags. But they get their down from either China or Europe, but they also are subject to getting whatever their supplier chooses to send them and I do not believe it is much different than what is sent to the US in finished bags or outerwear garments.

Buyer beware!!!!!!!!!!!!!!

POLYESTER

In 1960 polyester fiber for fiberfill purposes entered the market place as a replacement for "shoddy" in quilted garments. Shoddy was the excess fabric that was left over when garments were cut in factories. Companies known as garnetters would be paid to take this fabric waste and then they would chop it up and make a batting out of it. This batting was sold to quilters who in turn sold it to outerwear manufacturers. It did not take very long for polyester to replace the shoddy even though it was more expensive. It was clean light in weight, launder-able and much more efficient as a form of insulation. It was also the original alternative to down. Since I started in the business in 1961 polyester fiberfill existed and it was 40 years later while in conversation with the fiberfill marketing director for DuPont that I learned when polyester fiberfill was first used, about 1960.

The polyester fiberfill that was being made, chopped staple fiber had to go through a quilting process in order for it to be used in manufacturing. Also, the quilting was necessary to hold the fiberfill together when it was laundered. However, with use, wearing a jacket, or sleeping in a sleeping bag and stuffing and un-stuffing it, as well as laundering them, they would lose their loft; i.e. insulating capabilities. Quilted insulations have an inherent problem in the fact that every stitch line is a cold spot. To keep the fiberfill stabilized the quilting is necessary but that is its downfall. This problem has existed with each and every chopped staple fiberfill used for insulating purposes to this day and will be the same into the future. This also applies to down insulated products, since they must be quilted as well.

In 2013 the company known as Primaloft also the producer of the product of the same name presented to the market place two new insulations one trade named Thermoball which called upon the technology developed in the 1960's or 70's where they tried to make a down cluster from polyester, they dropped the development. Apparently Primaloft is making it or rather probably having a company in Asia make it for them and they are also blending down with their branded fiber. I find that interesting since they entered the market place with "a synthetic alternative to down". Maybe they think the poor results they have had with their polyester product they will enhance it with polyester.

Then the 3M Company in 2014 is offering to the market place a new polyester fiberfill product that also is a down cluster look alike. This product is doomed to also fail. The problem that all of these products have is always the same: they must be quilted, which means a substantial number of cold spots.

When continuous filament fiberfill entered the market place I was once again present at its beginnings. The year was 1968 and I had been working on laminating fiberfills at that time to

eliminate the cold spots that existed due to the quilting process and was unsuccessful because the chopped staple fiberfills available were not suited for the end products I wanted to make. When I experimented with the continuous filament fiber I knew I had found the answer to a product that would revolutionize the manufacture of outerwear as well as sleeping bags. A direct result of eliminating the quilting is an increase in the insulating capability of the product made. By eliminating the quilting the continuous filament fiberfill was allowed to have a uniform loft. The end result of my development work is Lamilite. At the time I was selling insulations to the outerwear industry, which included companies that also made sleeping bags. You name the company that existed in the 1960's and beyond and I showed them what I had developed and explained why my lamination process made the insulation work better and every one of them rejected what I created believing that the general public had no interest in buying sleeping bags that looked like mine, completely un-quilted. They continued to quilt the continuous filament fiberfill that was at the time trademarked Polar Guard. No quilt stitching so there are no cold spots, a more efficient sleeping bag or garment. The people in charge then just didn't get it and even today those who have replaced them don't get it either.

EXPERIENCES

Over the years that I have used the Lamilite for all forms of insulated products; sleeping bags, outerwear, footwear, hand-wear, headwear, dog coats to name a few, however incorporating the Lamilite improves the performance of any insulated product. Lamilite has shown some very interesting capabilities that I did not know of when I first started using it, such as its ability to maintain its heat trapping capability even though it was wet. I then noted from a multitude of customers whose bag were wet that a person's body heat was sufficient to actually drive the moisture out of a sleeping bag over an 8-hour time frame; while they were sleeping, and cause the bag to dry. This action is the most important performance characteristic a sleeping bag can have. One of my customers wrote to me that he put his wet down bag inside of his Wiggy's over bag and in the morning his down bag was basically dry. Until his account if I were asked about using a down bag inside of a Wiggy bag I would never have said sure and it will keep the down bag dry. To say I was surprised by this is an understatement. The end result is if you are in a survival situation even if the Wiggy bag gets wet it will save your life.

I personally had an experience that demonstrated to me how efficient the Lamilite is when it gets wet. I hunted for a few years in the Fossil Ridge Wilderness, which is located basically between Gunnison and Crested Butte, Colorado at an elevation of 12500 feet. One year, due to a lack of snow, it caused the animals to move. We went out really looking for them. As a result I was in somewhat unfamiliar territory and got lost. I was out for three days during which a big snowstorm showed up. The mountains make their own weather. I wandered for almost all three days until my guide and friend Rudy Rudibaugh found me. In my wandering I had to cross a number of streams. That was good because I would drink as much water as possible. Now to cross the streams represented a problem as I could not jump them and I did not want to wander looking for a narrower section so I walked right through them. I was wearing the Joe Redington Muk Luks. The snow I was trudging through was as much as 3 to 4 feet deep and the air temperature below zero not taking into consideration wind chill. When Rudy found me we



were at about 11000 feet and had to climb to 12500 feet before descending to base camp at 12000 feet. We had one horse, Rudy's and I was on his back while Rudy led the way. During the climb the temperatures must have gotten down to -30 with wind chill. We had to get into the trees at least six times to get out of the wind. After seven hours we finally arrived at base camp. We finally were met by the cook with a second horse. When I

finally got off of the horse and went into the cook's tent I took off my parka, the first Fossil Ridge Parka I made and my Muk Luks. As you can see in the photo my parka is covered with frost and I was bone dry because I was wearing my fishnet long underwear. All of the moisture my body was generating migrated through all of the materials that were covering my body. Inside of the Muk Luks was water in a liquid state, not ice! I really did not know what to expect. My boots were saturated with water. I thought now that I am safe and alive that I had an incredible experience and an incredible way to find out how well the products I make work. Even though my boots, which were foam lined, were soaked and my socks were wet, my feet were not cold!

Another benefit of having warm feet was a warm head. You have heard the expression wear a hat to keep your feet warm. Wearing a hat will keep your head warm and not your feet if you do not have warm footwear on your feet. During my venture I lost my hood. My head was never cold in spite of frozen hair and I attribute that to two factors: 1) heat coming out of my neckline and 2) the fact that my feet were never cold during the entire venture. The blood flow to the head is about 15 percent of the blood in the human body. My research showed that at any given time that is the percentage of blood in the brain. Our thigh muscles are the largest muscles in our body and therefore require the largest flow of blood. From the thighs the blood flow is to our feet. If our legs are well insulated as mine were, I was wearing my leg jackets, the blood heated by our thigh muscles is 98.6 degrees and that is what reaches our feet. If our feet are well insulated the blood flowing back to our heart will not have cooled down very much if at all. The end result is that the blood flow to our head is very constant with that of the rest of our body. It takes approximately one minute for the blood to make one circulation in the body in a rested state. Also when we are active the flow of blood through our body is more rapid than when we are at rest so it gets very little chance to cool if we are well insulated, as I was. The leg

jackets that I was wearing gave me the added leg protection. The same would be true if you are wearing mittens versus gloves, keeping your hands warm again means the blood flow returning to the heart will be much warmer. The steps that you take to keep your extremities warm means that the rest of your body stays warmer and your body works less to keep itself warm.