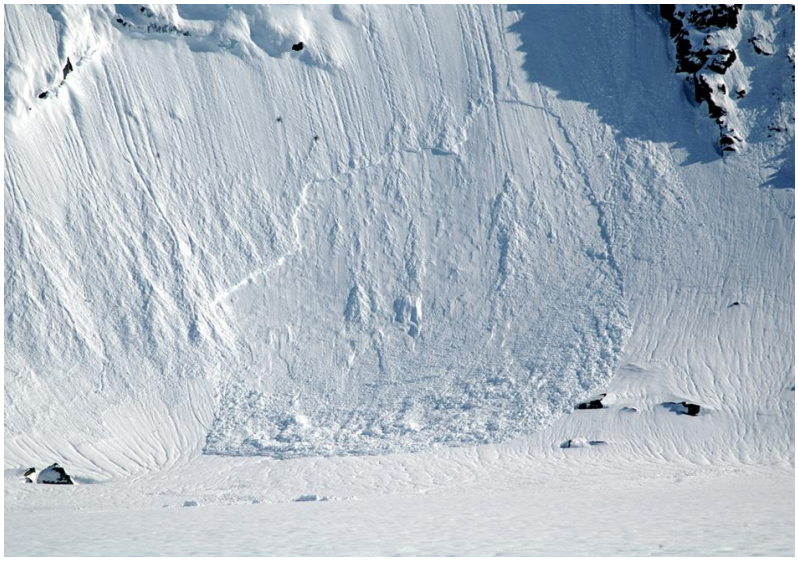
Avalanches and how to avoid them!

Avalanches can occur whenever snow lies on a slope above 25 degrees. Understanding how snow forms and subsequently changes on the ground plays a big part in keeping experienced winter mountaineers safe.

As the earth's tilt presents less of the northern hemisphere to the sun, the barrier between warm moist air to the south and cold arctic air to the north (the 'Polar Front') moves southwards. The battle between these two air masses produces the winter storms that brings snow and ice to Ireland and the UK and turns the mountains into a white playground.

Snow



Snow is created when the temperature of a cloud falls below 0ºC and water vapour turns into ice crystals. With varying temperature, moisture and wind a plethora of crystals are created, from the classic snowflake to columns and needles or soft rounded particles called graupel. When snow accumulates on the ground it undergoes cycles of change that either weaken or strengthen the snowpack. Each time snow falls, or is blown by the wind, it creates a new layer, when the differences in consistency between layers is large enough one layer can slide on another. When the snow melts and repeatedly refreezes the layers can become an amorphous solid mass, but unfortunately that is not always the case.

The main factor that affects the structure and stability of the snowpack is the movement of water vapour both at the crystal level and by rising through the layers of snow. Water vapour moving from the ends of the crystals to the centre making them round which breaks down the snow crystals and helps to stabilise the snowpack. When the temperature of the snow in the upper layers is higher water vapour moves from crystals in the lower layers to crystals in the layers above. When this water vapour can't escape, the crystals may start to develop into cup-shaped crystals called depth hoar. These crystals don't bond well to each other creating weak layers. According to the book

‘Avalanche Accidents in Canada’ surface hoar are the weak layers in the failure plane in 78 per cent of fatal accidents.

Three factors that create avalanche conditions

1. **Wind -** Even on a clear day, wind blowing over a ridge or the top of a mountain, can deposit old snow onto the the sheltered side forming a dangerous layer known as ‘wind slab’.
2. **Heavy snowfall -** 80 per cent of all avalanches occur during or shortly after a storm. A build-up of more than two cm/hr of new snow can produce unstable conditions and more than 30 cm continuous snow is very hazardous. Snow falling at a rate of 2-3 cm per hour, or more, increases avalanche danger rapidly.This is due to the extra weight of fresh snow and the difference in consistency between the new snow and the layer below.

3. **Rain -** In the short term this can cause instability through additional loading and possible lubrication of lower layers, but when the snow pack refreezes it can also help to stabilise it.

How to predict avalanches

Experienced winter mountaineers seem to have a ‘feel’ for avalanche conditions, but its not magic, they are simply combining the previous day’s weather and the information from the avalanche report, with the conditions they meet during the walk in and ascent. This level of expertise is only achieved by experiencing winter in all its guises, but here are some things that will short circuit the learning process.

Watch the weather from home

The previous day’s weather can tell you the amount of snow that may have fallen, where the wind may have redistributed it and whether it has been thawing. Look at the avalanche report, but remember it is a prediction from the previous days. The actual weather on the mountain may have been very different and any predictions should be adapted according to the conditions found on the mountain.

The Sportscotland Avalanche Information Service
www.sais.gov.uk

SAIS publishes the daily forecasts of the avalanche, snow, and climbing conditions at five climbing areas of Scotland during the season. The website also offers information and advice regarding avalanches. If you see an avalanche please help the SAIS by 'Reporting an Avalanche'

From the valley

As soon as you leave your car, start questioning the predictions made at home. Is there any avalanche activity, especially on slopes with the same aspect as the slopes on your journey? Where has the wind been blowing from? Can you see the current wind

direction from snow being blown from the ridges? Where is the snow accumulating? Are slopes loaded with fresh (bright) or drifted snow (dull)? How much has it snowed?

During the walk/climb

Continue to look for signs of where the wind has been blowing - is it a local wind created by the mountain and different to the weather forecast? Look for sastrugi or parallel etching where the steep edge faces the direction from where the wind was blowing and rime, which builds in the direction of the wind. Feel for changes in the consistency of the snow under foot. Is cracking of the surface an indication of slab? Settling of the snowpack is due to the presence of slab – the harder the slab the more it will settle. The surface of hard slab has a velvety texture and a dull matt colour. Are small slabs releasing easily as you cross small safe slopes? How far are your feet sinking into the snow? If 30 cm of snow has fallen and you always sink 20 cm, little settlement of the snowpack has occurred and the conditions are still dangerous. Look for cornice build-up. Is there a sudden temperature rise? Is the sun just catching the top of the crag? Carry a thermometer on your rucksack to spot temperature inversions.

Do you feel unsafe: the gut instinct of the experienced mountaineer should not be underestimated; it usually means the subconscious has spotted something.

Avoidence is the safest way

The majority of avalanches are triggered by the people that get caught in them, or by someone in their group. It is possible to travel safely in the mountains by choosing a route that keeps to gentle slopes or defined ridges and avoids lee slopes, plateau rims and open slopes. Consider the following:

- **What is the angle of the slope?** Most large slab avalanches occur on slopes between 30° and 45°,
- **What surface is the snow resting on?** Smooth ground is more likely to result in full-depth avalanches whereas rough ground, or large boulders, will tend to anchor the base layers in position. However, once the boulders are covered, surface avalanche can continue unhindered. Substantial trees and rocks that stick up through the snowpack can help to hold it in place.

- **What is the shape of the slope?** Convex slopes are more hazardous because the point of maximum convexity is a frequent site of tension fracture.
- **What is the orientation of the slope to the sun?** The majority of avalanche accidents occur on north and east facing slopes because this is where you find the best snow and people will trigger more avalanches. They also exhibit more persistent weak layers. The opposite is true when it is warm, and south and west facing slopes will produce more wet avalanches. During cloudy conditions there will be very little difference between sunny and shady slopes.
- **What is the orientation of the slope to the wind?** Lee slopes, including the sheltered side of ridges and plateau rims, become loaded with snow after a storm or heavy drifting.

The crests of mountain ridges are usually protected from avalanches, however, even small slides of snow can take you off your feet and down a cliff. Travel on the windward side of ridges to avoid wind blown snow and cornices. Gullies are natural accumulation zones and should be avoided when the avalanche risk is high. Look above you because it is often the slopes above that are triggered which then swoop down onto the slope you are on. Beware of blind faith - tracks on the slope do not mean it is safe and just because you crossed it earlier in the day does not mean it is still safe. Beware of cornices, climbing below them should be avoided during a heavy thaw or sudden temperature rise, and 24-48 hrs after snowstorms or heavy drifting. Also take care walking above them

Assessing a suspect slope

Suspect slopes can be partially evaluated by digging a snow pit on smaller, safe slopes of similar orientation and altitude to the main one. You will then need to extrapolate for situations higher up, e.g. below cornices, where surface slab layers may be much thicker. Relying on snow pits alone can however give a false impression of safety and danger, it is not an exact science and even experts get it wrong. The main reason for digging is to explore the snowpack for weak layers and to verify what you have already noticed as you walk in.

Dig a pit one metre wide and down to the first thick layer of old refrozen snow, but no more than 1.5 m deep. Smooth the vertical back wall, feeling for any changes and then probe with a finger or fist all the way down to assess the hardness of the layers. Look for the weakest layer and try to estimate how well it is bonded to adjacent layers. If you find any of the below it may be a dangerous weakness in the snowpack:

- Adjacent layers of differing hardness
- Very soft layers

Hardness of the snow
1 is hard, 5 is soft

5 - Gloved fist penetrates
4 - Four gloved fingers penetrate
3 - One gloved finger penetrates
2 - Pick of an ice axe penetrates
1 - Knife penetrates

- Water drops squeezed out of a snowball made from any layer
- Layers of ice
- Layers of graupel - these act like a layer of ball bearings
- Feathery or faceted crystals
- Layers of loose, un-cohesive grains
- Air space.

You also need to make a judgement about bonding within the layer. Is it going to break up easily? Is the whole layer bonded and the whole slope will slide?

What to do if you must cross a dangerous slope

Every slope is a potential avalanche slope, so consider the following:

- What will happen should the slope avalanche?
- Belay someone on a rope to check it out.
- What is the depth of any layer?
- Is it likely to be a slab or loose snow avalanche?
- What is the terrain like - are you going to be swept over a cliff or will it pile up at the bottom?
- Cross one at a time and in the same track.
- Zip up, wrap a scarf round your mouth and nose and wear a hat.
- Undo rucksack waist belts and take your hands out of any leashes on poles and ice axes
- Direct descent or ascent of a potential avalanche slope is safer than traversing.

What to do if a slope avalanches

Fight for your life! If you are not close to the surface and you have not created an air space your chances of survival are slim.

- Delay being taken by the avalanche by plunging your axe into the snow, running to the side, or jumping up-slope above the fracture.
- Shout.
- Get rid of poles and skis, but recent evidence suggests that having a rucsack on keeps you higher in the avalanche.
- Try to roll like a log, off the debris.
- Swimming motions are rumoured to help.
- As the avalanche slows, make a desperate effort to get to the surface, or at least get a hand through.
- Push the snow away from your face and try to maintain an air space.
- Take and hold a deep breath at the last moment to maintain space for chest expansion.
- Try to conserve your energy. Your companions will be searching for you.

Rescuing an avalanche victim

Mountain walkers and climbers rarely wear avalanche transceivers, nor do they carry a shovel and probe, yet digging with a ice axe is slow and strenuous. A buried victim has an 80 per cent chance of survival if located within 15 minutes and not buried under more than 2 m of snow. Survival chances decline to 40 per cent after one hour and 20 per cent the hour after that.

- Check for further avalanche danger and post a lookout.
- Mark the point of entry and the point where the victim was last seen.
- Make a quick search looking for poles or clothing and sounds.
- Probe the most likely burial spots - pay particular attention to shallow depressions in the slope and around rocks and trees.
- Make a systematic search, probing the debris with axes or poles.
- Only send for help after you have searched for at least 15 minutes
- Do not give up - the longest someone has survived is 22 hours.

The next article examines the skills and techniques for climbing a grade 1 or 2 gully.