Dear Colleagues

**Shooting in convection wind conditions**

**The Problem:**air overlying the length of a rifle range is warmed by the Sun and rises. At longer ranges shooters can find that a group within the bullseye may for no apparent reason be accompanied by magpies and outers. That is, if an unwary shooter with a V-bull or X-ring group, then scores a magpie and ignores it, another may appear right alongside. Such wide shots may also connect corner shots with a V-bull group. They may even form diagonals of shots across the target.

Convection wind conditions at 900x and1000x occur at Belmont (Qld) for several weekends each year. The conditions are well known at Kalgoorlie, Darwin, Broken Hill and Alice Springs. To the present day the effect has not been known at Malabar (Sydney), Bendigo, rifle ranges in New Zealand, Scotland or Canada. The effect was also unknown at Pontville (Tasmania), Swanbourne (WA), the Dean Range (SA) and Williamstown (Victoria).

Interestingly, convection of light and its effect upon shooting are well known at 1000x at Stickledown, Bisley (UK). The phenomenon commonly leads to shots at 8, 10, 2 and 4 o’clock, i.e. above and below the mid-level horizon across a target. The most frustrating experience for a shooter occurs upon successfully correcting for a change in wind velocity, only to find that the shot appears just above or below the bullseye. As a result, many long-range Bisley shooters can be seen correcting for wind and elevation at the same time.

This article describes the effect of light convection and its correction in long-range shooting.

**Discussion and Observations:** the mass of air overlying the length of a rifle range inevitably absorbs heat from the Sun, rises and allows cooler air to flow in and replace it. A shooter aiming at a target watches the flags as they indicate the inrush of cooler air. The flags show the direction of flow and its velocity as it enters the range. Shooters sometimes comment when flags indicate the arrival of air from each side of the range. Cooler air usually flows toward a rifle range from a sea-breeze, adjacent land or a prevailing stream of inland air.

Shooters are aware that as air lying over a rifle range is warmed, it expands, becomes less dense, changing the velocity and direction of light passing through it. Light also changes to a downward or upward direction until it meets another mass of air and acquires a different density, changing direction once again. Upon light ceasing to travel in a straight line from the target, a shooter is only able to aim at its new position, i.e. where the target now appears to exist. This is very often directly above where it was previously. However, the shooter is usually unaware of the apparent change in elevation of the target, because not only the target but the mantlet, stop-butt and target numbers also appear to move upward. That is, shooters are unaware that this is happening.

Although shooters do not see the targets rising as warm air is replaced the length of a range, a shooter is able to measure how far the image of a target actually rises. It is usual to shoot a string of bullseyes and upon the image of the target rising, a high magpie is scored. If the shooter on the Kalgoorlie rifle range is a visitor from Perth, the locals will quietly smile and watch the shooter ignore the magpie, only to put the next shot right beside it! A local shooter would instantly recognise the light effect, bring the rear-sight down and score a further bullseye. At Belmont (Brisbane), shooting in convection conditions does not occur often enough for shooters to form a practised strategy and continue to shoot bullseyes. Brisbane shooters tend to think of this as a day when conditions are difficult.

In the Northern Territory, shooters have learned the well-practised sequence which enables them to know which way a shot will go: up or down. These shooters then wind the rear-sight or scope sight, correcting for both change of wind and elevation due to light convection.

Before Darwin shooters come onto the mound at long-range, they watch shooters to see if they score wide shots in the corners of their targets. This immediately indicates to them that convection conditions are occurring and it is necessary to apply the well-practised technique. On taking a position on the firing point and about to release the first sighter, the shooter watches for a wind change about to occur. The first sighter is fired when the flags show that the wind is blowing at a particular velocity, then the second is released when the wind is at a different velocity. The shooter is then able to conclude that light convection leads to a higher or lower shot when wind velocity is greater. Hence, throughout the shoot, each time the wind is seen from the flags to be faster, a correction is made to bring the shot into line with the bullseye. That is, the shooter winds the elevation up or down for the shot to hit the bullseye.

Throughout a shoot, observers are clearly able to see the shooter winding on shots for increased wind velocity and at the same time, winding the elevation either up or down.

**Practical:** at Darwin or Belmont, the required elevation change can be as much as 2 or 3 MOA for a 3 MOA wind change. Whereas, at the lower air temperatures at Stickledown in the UK, the changes are typically 0.5 or 1 MOA elevation for a 2 or 3 MOA change in wind velocity. This technique avoids shots appearing in the corner of a target.

Nevertheless, the well-known high magpie scored at Kalgoorlie, can even appear at 500x in the middle of a shoot. This is due to the velocity of air rushing in to take the place of rising warmed air. Experienced Kalgoorlie shooters recognise what happens and immediately bring the sight down to score a bullseye. A visiting shooter who does not recognise when light convection occurs, may decide to ignore a high magpie, only to score another one.

**Conclusion:**shooters should place convection of light at the head of a list of principles which must be followed:

* observe preceding shooters to determine whether they are experiencing wide shots due to the convection of light in changing wind conditions, noting whether shots appear higher or lower on the target when flags indicate that the velocity of wind has increased
* there is a natural point of aim associated with a shooter’s body position, which must be confirmed prior to every shot and when necessary, corrected by moving a cm or so, or the group will split and produce two or more groups across the aiming mark [a shooter can be unaware of movements which change the natural point of aim]
* correcting the natural point of aim involves sideways movement of the left foot as little as a cm, with forward or rearward movement of the navel by as little as a cm
* a rifle may only be supported dead still if arm muscle tissues are not utilised or if the skeletal structure is held still by a sling or rifle rest
* a rifle supported dead still with the aid of a sling, must not involve the use of muscle tissues to pull the weight of the rifle sideways toward the fulcrum; hence, the elbow must be positioned directly under the rifle
* achieving the natural point of aim at the outset when setting up the prone position, will govern the angle of the body relative to the target and height of the rifle above the mound
* in order to adjust the natural point of aim with minimal movement, both of the shooter’s legs need to be straight, so that only one meeds to be moved sideways instead of each buttock, one at a time (when a leg is bent)
* the rifle must be allowed to travel backward under recoil, without energy absorbed by: a thumb at the pistol grip, the forward hand at the front sling swivel (or hand-stop), a thumb behind the action, or by the thumb bearing within a thumb-hole, so that the maximum amount of recoil is absorbed by the shoulder (TR) or rifle-rest under friction (F Class)
* the rifle should not be subject to varying sideways tension from a cheek-piece or the hand on the pistol grip (i.e. tension varying from shot to shot)
* the smallest group relies upon the trigger-release technique, i.e. release of the imagined second pressure of the trigger, with the aiming mark remaining motionless and dead centre, without wandering from the centre of the foresight ring or scope element
* the group achievable with a target rifle is smaller than 1.0 MOA, i.e. the V-bull
* the group achievable with an F Class rifle is smaller than 0.5 MOA, i.e. the X-ring.

Best regards

Geoff