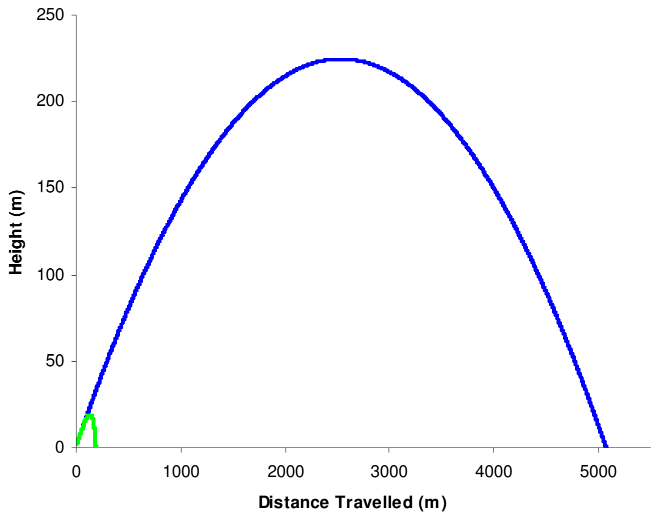
THE EFFECT OF WIND DRAG

To properly appreciate how great an effect wind drag has, we should probably first discuss how a projectile would move in the *absence* of aerodynamic resistance.

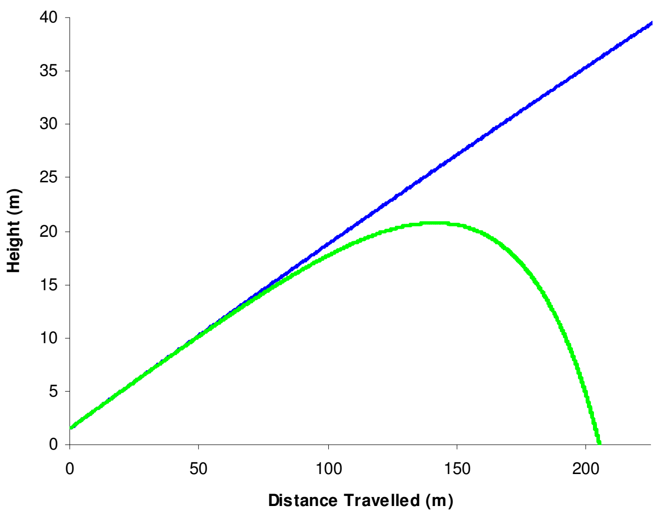
Theoretically, if you were to shoulder your shotgun at say 1.5m from the horizontal and shoot a shell which exited the muzzle at 1250 fps, your shot would travel five thousand and seventy (yes, 5070) metres!!! The path of the shot would be a perfect parabola (as discussed last issue) and, at the point of impact, the shot would *still* be traveling at 1250 fps. The shot would hit a height of 225m and would take 13.5 seconds to come back to earth.

As we all know, this is utter nonsense.

Now it's common knowledge that in reality the shot is pulled back dramatically by air resistance, but by how much? Well, the following graph shows the theoretical path our projectile, as discussed above, would follow...



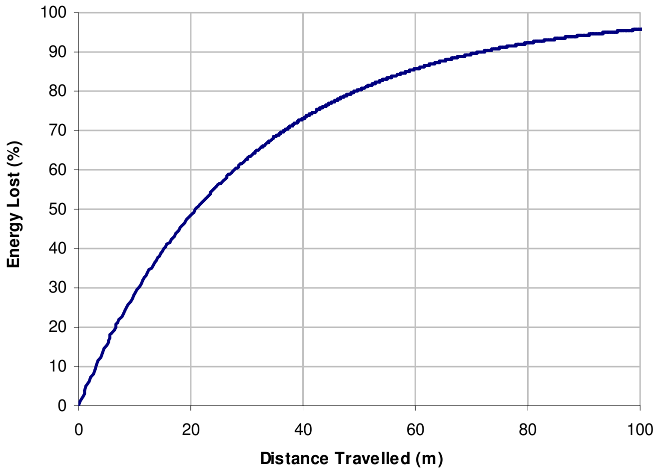
... but if you look very, very closely at the bottom left hand corner of the graph you'll see another little arc. This arc is the realistic path a piece of shot would take. Somewhat smaller, isn't it? Let's blow that section of the graph up and have a better look.



As you can see, the realistic path of flight doesn't quite travel 5.07km, nor does it reach a height of 225m. In fact, the effect of wind drag is so great that the range is now reduced to about 205m and only attains an altitude of 21m. For comparisons sake, the almost-straight line heading upwards is actually the path of our theoretical projectile!

You'll note that the path traveled by our realistic piece of shot isn't an exact parabola either; it's a bit squashed at the end. At this point, the shot has lost most of its energy and is now falling towards the earth pretty much due only to gravity.

Aerodynamic resistance doesn't only reduce range and height though; it also reduces hitting power (see graph below).



If you're like me and you enjoy shooting trap houses then you'll be disappointed to know that, by the time your shot has traveled the 15m from you to the trap house, it will have lost about 40% of its energy.

But it gets worse. Let's say you're a reasonably quick shooter and you manage to snot every bird about 15m in front of the trap house. To hit this bird your shot has had to travel 30m at which point it will have lost about 62% of its energy. If you're slow and get it about 30m from the trap house, the total 45m of flight your shot has undertaken will have cost it about 77% of its initial energy.

These figures worsen as you use smaller shot and conversely get better if you use larger shot. Bigger shot sizes tend to maintain their speeds better and we'll cover this in later issues.

Please note:
All of these calculations have been undertaken assuming a piece of lead shot with a diameter of 2.4mm. This is close to the 7 ½ shot we use for target shooting. Future issues of The Science of Shooting will deal with shot size, metal type and the associated ballistic consequences these variables have. Now don't go and takes these figures as sacrosanct as I've made lots of assumptions and simplifications along the way, such as ignoring the increased coefficient of aerodynamic drag due to the projectile exceeding Mach 1 (ie. the speed of sound) in its early flight. The physics behind this is horribly complicated and there are bound to be shortfalls in my calculations. But what I can claim to be correct are the trends and relationships, such as a projectile does lose and awful amount of hitting power very early in its flight.

© Colin Nelson, Mornington Clay Target Club Inc.