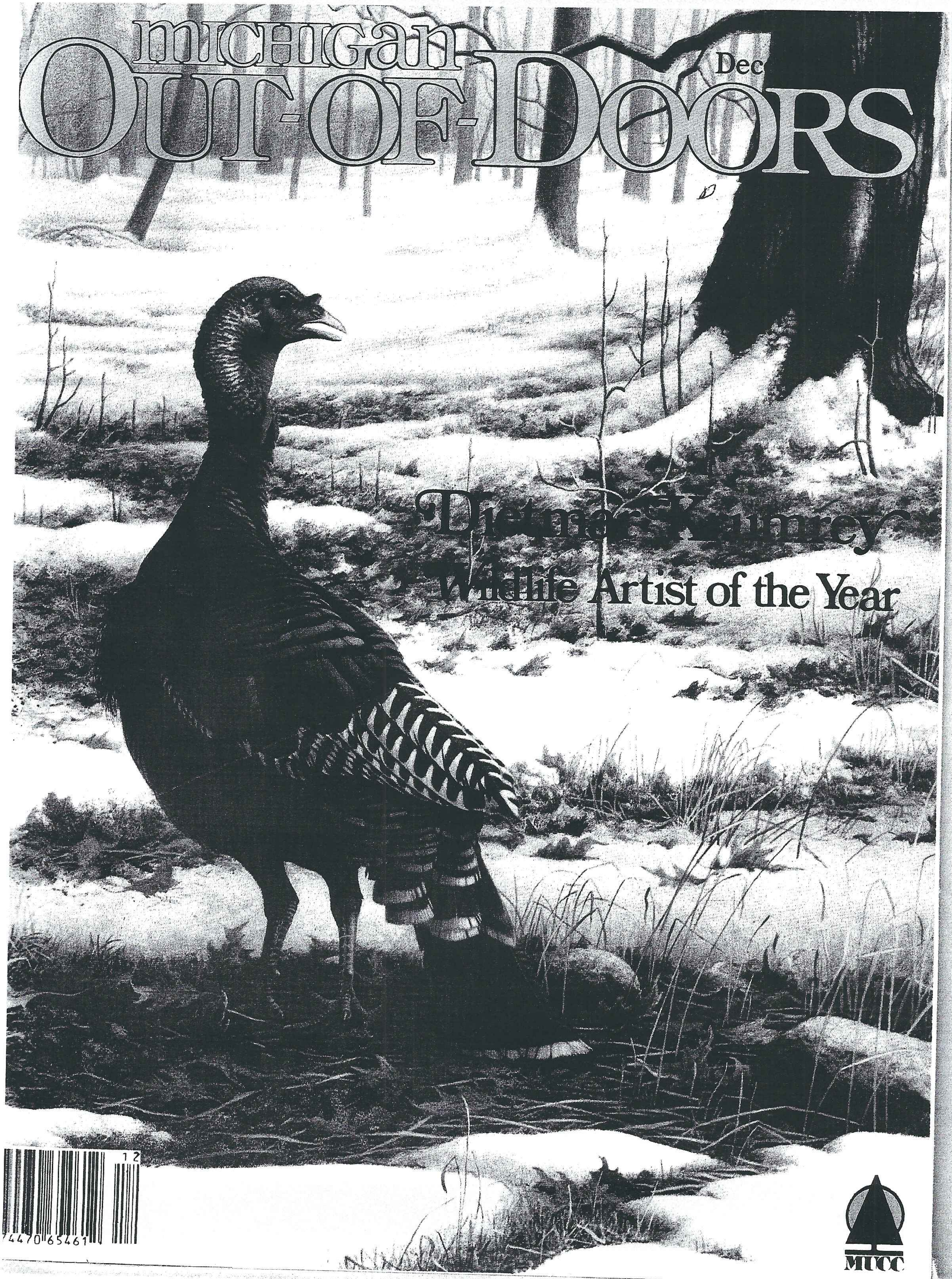
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Gunsmoke

By Tom Smith

Hilly Hunting

In terms of accuracy, shooting a weapon on a horizontal plane is quite unlike shooting a weapon up a hill or down a hill. One need only query experienced hunters, law enforcement personnel, or soldiers to appreciate the merit of this frustrating fact. This quite diverse group may tell stories, usually cloaked in anger and bewilderment, of how they missed their prey which was standing idle on a 45° slope at 100 yards when they took great pains to perfectly zero in their weapons at the same distance on level ground.

Why is this? Well, the answer is simple, but the reasons are a bit more complex. The answer is that the same bullet that was precisely zeroed in at a level 100 yards will consistently shoot *above* the point of aim when shooting *either* uphill or downhill. Of course, the exact distance that the bullet will be above the point of aim is a function of a number of variables—absolute distance, the slope of the hill, and, finally, the velocity and weight of the projectile.

This account, however, is not intended to give specific answers to many combinations of scenarios based on caliber, velocity, and slope angles. It has as its sole intent to articulate a general scientific maxim and its theoretical underpinnings. The maxim can be stated without a lot of effort: "The prospective hunter will hit higher than intended when shooting either uphill or downhill, if the firearm was sighted in on flat terrain over the same distance."

In contrast, finding the reasons for this quite baffling phenomenon was a little more difficult, so as a result their presentation will, regretfully, have to be somewhat more long-winded.

For a simple approach to explaining this mystery, a couple of things have to be stated up front. One must first understand that a bullet drops, however slightly, the moment that it leaves the barrel of a firearm. And secondly, one has to envision three vectors that are always involved when one shoots a weapon of any kind: (1) the line of sight, (2) the line of the barrel, and (3) the trajectory (path) of the projectile itself.

If we take as a given that a bullet drops as soon as it leaves the muzzle of a firearm, it becomes quite obvious that even over a moderate distance (100 yards), the line of sight cannot be the same vector as the line of the barrel. As you can probably imagine, if this were the case, the bullet would drop below the line of sight at 100 yards and would, of course, not hit the designated spot. It is a plain fact that when firearms are sighted in, the line of sight is a straight vector that extends from your eye to the target itself.

The line of the barrel, however, is not the same, or even parallel, to the line of sight; it is pointing upward to compensate for the pull of gravity over distance and time. It really has no correlation to the line of sight. But, the path of the projectile, in contrast, correlates with both the line of sight and the line of the barrel—but at exactly different time spectrums. Once the projectile is fired, it initially follows the line of the barrel, but over time and distance it veers away from this vector, and bends toward earth and the line of sight. What actually happens when the bullet leaves the barrel is that it immediately drops, but it is traveling on a vector that is above the line of sight and will converge with the line of sight at the point of aim. The trajectory of the bullet takes on the shape of a hyperbolic curve with its hopeful destination, the target.

When a weapon is being fired up or down a hill, the bullet trajectory flattens out and becomes more in line with the line of the barrel pointing upwards and above the line of sight. The bullet path flattens out because of the effects of gravity over distance and time. Simply imagine a fly rod that is held straight up and then gradually lowered until it becomes horizontal with the ground. When it points straight up, curvature of the rod is nonexistent. But when the rod is being lowered, the curvature of the rod itself is increasing to its maximum point of curvature—when the rod is horizontal. Likewise, when I now take that horizontal rod and lower it until it is pointing straight down, curvature is decreasing until it becomes perfectly straight when it is pointing down. As you can see, there is no distinction to be made with downward or upward angling slopes. The rod is perfectly void of curvature when pointing either straight up or straight down.

The fly rod in this simple analogy is the flight path of the projectile. So as the angle of the firearm approaches straight up or straight down, the projectile's path will not fall victim to the effects of gravity (just as the fly rod doesn't) as it would if the firearm was leveled on a horizontal plane. What is happening is that the projectile's path has straightened out and is not adhering more to the vector from which it started—the line of the barrel. Remember again, the line of the barrel is never the same as the line of sight; it is pointing above it. So being that the projectile's path is now more straight (and less curved), it will hit where the barrel is pointing at; not where the firearm was sighted in at. The projectile will not curve back toward earth and the point of aim; it is blindly following the vector on which it was launched—the line of the barrel.

Thus, on planes either above or below horizontal, the projectile will hit above the point of aim every time. As was stated above, the distance that it will hit high is based on many factors. But this does not negate the fact that hunters must take this theory into consideration and aim *lower* on targets that reside on slopes either higher or lower than a horizontal plane—if, indeed, she/he intends to hit the target.