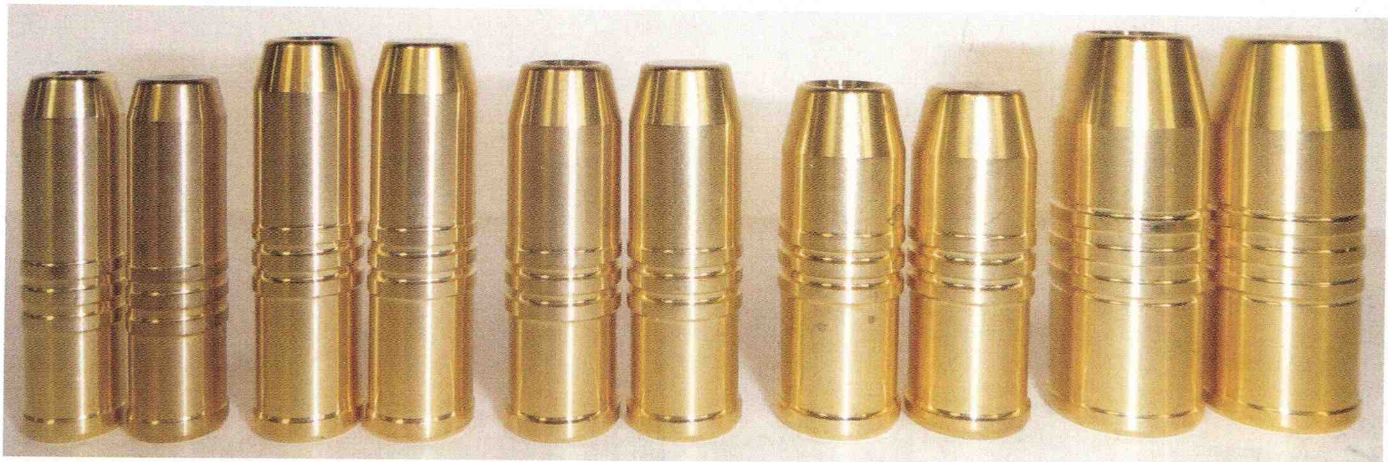
Bullet performance

- the shape of things to come

by Daryl Lenkic



A selection of paired BBW #13 Hollow Points and Solids. Apart from the hollow-point projectiles' hexagonal cavity, which makes them slightly lighter, all other dimensions are the same, for virtually the same point of impact.

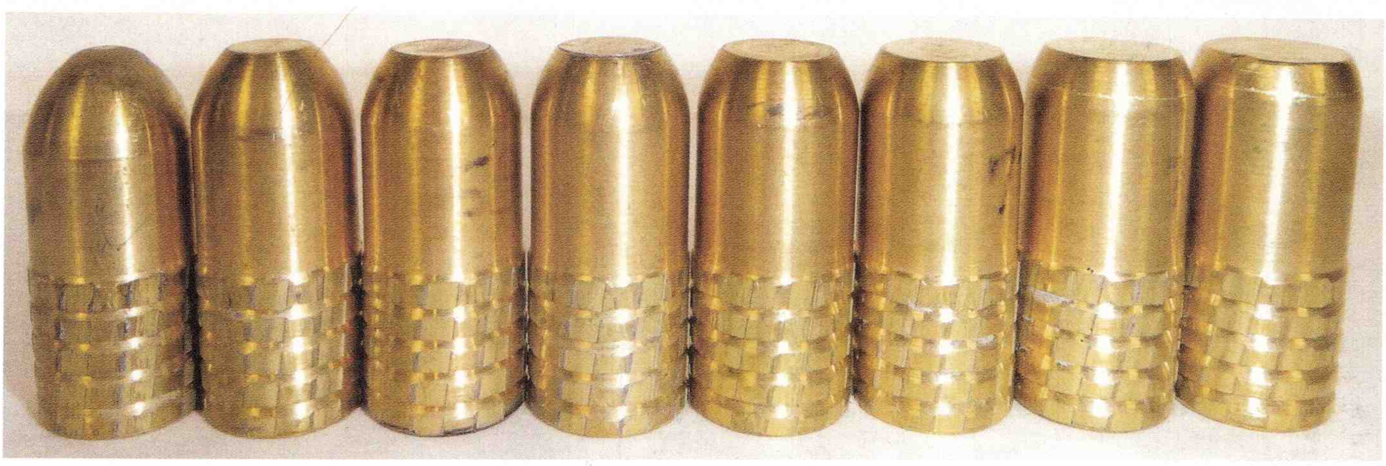
For hunters, conventional wisdom concerning bullet performance suggests that soft-nose bullets should ideally expand in game to double their original diameter and retain as close to 100 per cent of their original weight. That sounds right, doesn't it? However, new bullets are emerging that now fly in the face of that paradigm. Not only that, but they perform better terminally than conventional bullets. To understand how these bullets developed, we must first look at their heritage, the non-expanding bullet and one man's search for the perfect solid bullet.

In 2006, Michael McCourry from South Carolina in the United States wanted to find the very best big-game bullet that he could use in his established B&M line of cartridges in compact rifles. Michael had undertaken many dangerous game hunts in Africa and other parts of the world and wanted a bullet with terminal performance that was reliable every time. He needed deep, straight-line penetration that could reach the vitals of the toughest game animals from any angle.

Having done extensive terminal testing on all the commercial premium bullet brands available to him from around the world, as well as some custom offerings, he began a long series of tests to determine the factors that determined straight-line penetration and penetration depth. The results would shape the bullet design that he eventually settled on, with some interesting discoveries along the way.

The test medium utilised for almost all terminal testing comprises a mix of around 90 per cent newsprint and 10 per cent glossy paper, soaked with water overnight and again prior to firing, in order to

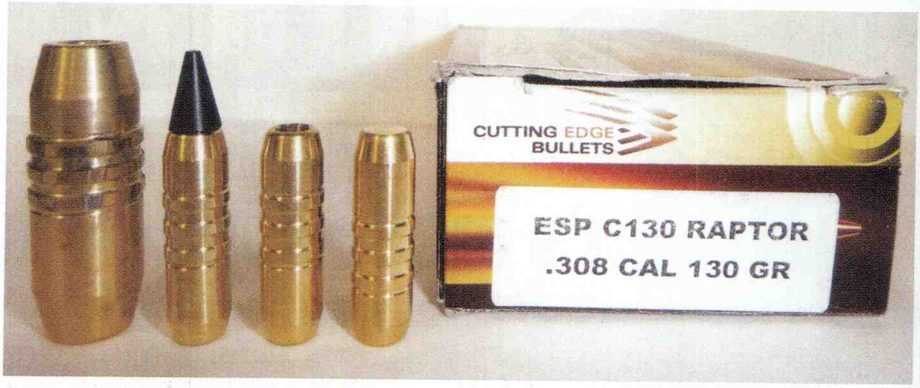
The flat meplat designs tested included round nose, left, meplats 50, 55, 60, 65, 70, 75 and 80%. The 65 and 70% meplats gave equal best performance.



maintain a consistently dense aqueous medium. This is contained by a wooden bullet box, the width of the newsprint and 5ft in length. There are, of course, detractors who will say that this does not accurately replicate animal tissue. While this is true, what is does provide is a test medium that is uniform and repeatable, such that all projectiles fired into it are confronted with the same baseline, and their performance can be directly compared. At any rate, it is certainly a truer representation of animal tissue than the less dense ballistic gelatin.

Another point worth considering is that no two shots on an animal will necessarily encounter the same resistance anyway. One may enter the soft tissue in the lungs, while another may pass through denser muscle and strike bone. Even if large-scale lab testing on animal carcasses was viable, differing results would make it much harder to interpret the data in a meaningful way.

What has been demonstrated repeatedly is that bullets that performed well in the test medium, performed well in game, while those that performed poorly had the same tendency to deliver inadequate performance in the field. Impact velocity is important for comparing bullets, and a chronograph immediately forward of the bullet box is employed to measure this value on all terminal testing. Any given projectile is tested at a range of impact velocities in order to compare its performance at difference muzzle velocities.



ESP Raptors included an original fired .500-calibre prototype with round cavity, left, production .308 130-grain Raptor with Talon Tip fitted in hollow-point end, the same .308 projectile with a hexagonal hollow-point up, and the same .308 projectile with the solid end up. Note band placement to optimise performance.

Original test bullets were of copper construction. Brass was then substituted, as, being harder than copper, it was less prone to deformation - an important factor for solid bullets. Initial concerns that the brass would increase chamber pressures proved unfounded, as the higher lubricity of brass was a compensating factor. Although around 5 per cent lighter than copper, brass also had superior machining qualities.

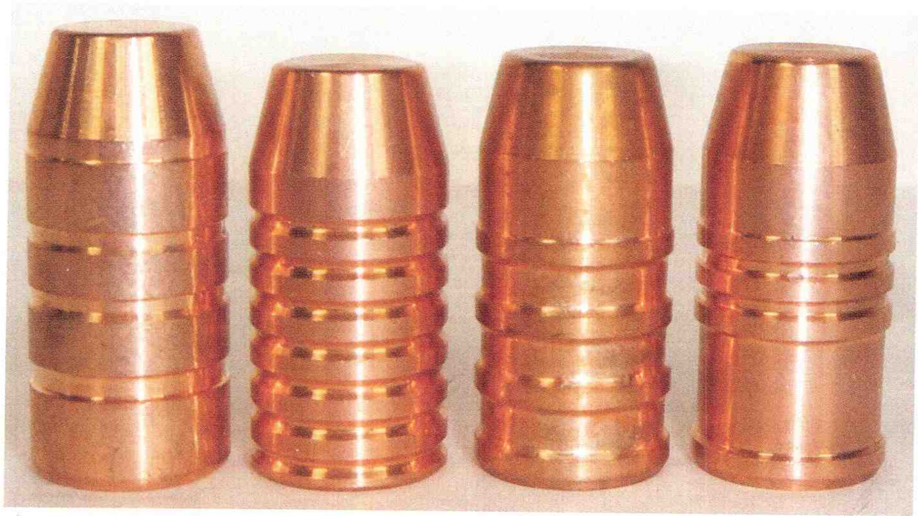
Michael's testing of existing designs indicated that flat-nose solid designs such as those from Speer, Barnes and GS Custom remained stable throughout their path and did not tend to tumble or veer off-course the way round-nose solids often did. He also knew that bullets made from a homogenous material such as copper or brass were less prone to deformation (which could produce erratic behaviour) than those with a lead core, even if surrounded by a heavy jacket.

Along with friend and prototype maker

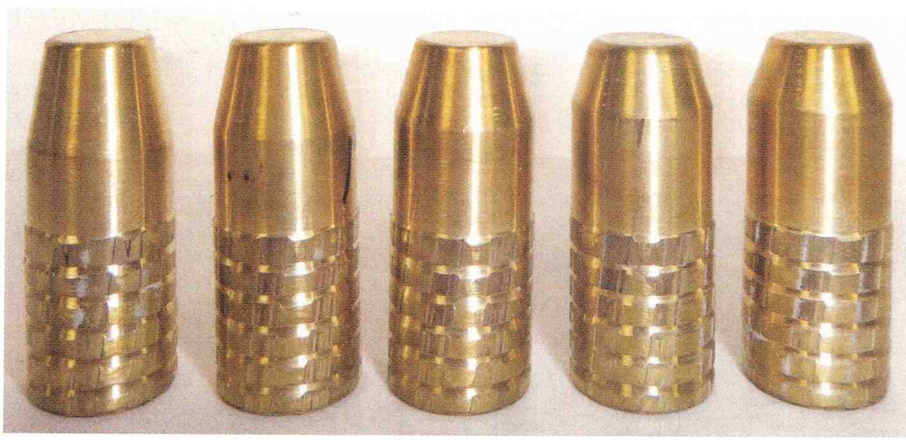
Sam Rose, Michael began by testing solid copper bullets with flat meplats of varying widths, expressed as percentages of bullet diameter. Bullets with meplats of 50 to 80 per cent of bullet diameter were made in 5 per cent increments and tested in the media. The bullets with meplats of between 65 and 70 per cent provided the deepest penetration (penetrating to double the depth of the 50 per cent meplat bullets). To optimise feeding in bolt-action rifles, a 67 per cent meplat was selected.

A straight nose angle was selected over a radiused ogive and testing began to determine the optimum angle. The test angles initially ranged between 10 and 20 degrees in increments of 2.5 degrees. The 12.5-degree angle provided the best results and after further testing, a 13-degree angle was selected.

To reduce friction, and hence chamber pressures, various shank designs were examined. Banded bullets with full-calibre bands and sub-calibre shanks were already on the market (such as Barnes). An eight-band design was tested, followed by a four-band, which increasingly reduced pressures, allowing more powder and higher velocities to be achieved. To improve neck tension, a '3+1' design was selected, with three bands forward and the last band at the base of the projectile.



Band configuration evolutions included four wide bands, left, eight narrow bands, four narrow bands and the '3+1' band configuration.



Nose angles initially tested included 10, left, 12.5, 15, 17.5 and 20 degrees. After fine-tuning, the 13-degree nose angle was selected as optimal.

An additional design improvement to the flat-nose profile that increased penetration was the addition of a slight radius on the edge of the flat meplat. Another significant but accidental discovery was that for the lighter bullets the penetration increased with a longer nose projection (the distance from the nose to the leading full-calibre band). Compressing the '3+1' band design to provide a longer nose projection noticeably increased penetration performance.

The final solid design, labelled the 'BBW #13', was reached (BBW was from

Michael's quip on Sam's prototypes, which he dubbed as being from 'Bastard-file Bullet Works'). This design outperformed every commercial solid that Michael could test. Having perfected the solid, Michael began looking for an expanding bullet that could partner it.

Enter Cutting Edge Bullets (CEB), a company specialising in making premium lathe-turned mono-metal bullets. Michael required a greater number of bullets than Sam could make and some advanced machining capabilities. CEB was quickly able to manufacture the many design evolutions needed for testing and producing extremely uniform and consistent projectiles. CEB was also able to machine hexagonal profile cavities. Michael signed an agreement with CEB's president Dan Schmichko and a fruitful partnership was formed.

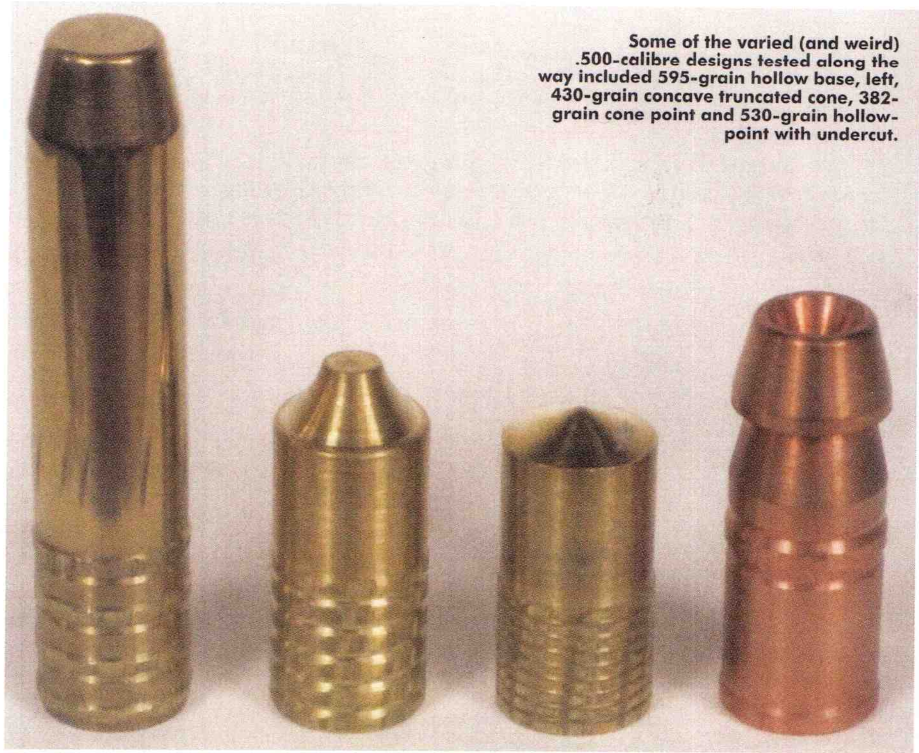
Accepted practice with most thick-skinned big game is to fire the initial shot using an expanding bullet to maximise trauma, usually when the animal is stationary and presenting a clear shot at the vitals. Any required subsequent shot may well be at less than optimal angles and require deep penetration to reach the vitals, such as when an animal is angled away. Additionally, with dangerous game, bullets need to be sturdy enough to break heavy bone, should the animal charge. As such, follow-up bullets are generally all solids.

Using two different projectiles, the same or similar point of impact is needed. With this in mind, Michael decided that it made sense to begin his expanding bullet search with a projectile that externally matched the BBW #13 design.

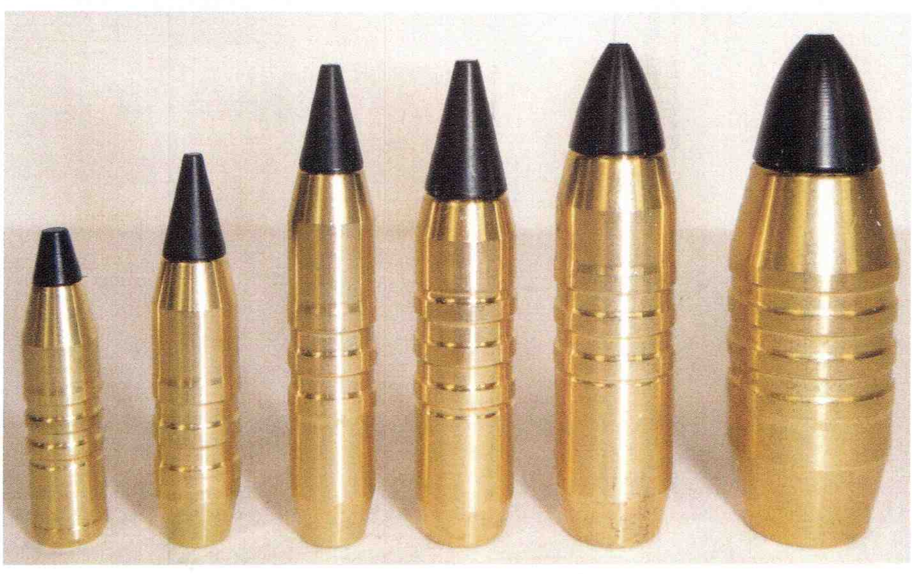
With the parent solid's mono-metal construction, the obvious choice was to make a hollow-point (HP) bullet with a deep cavity. Initially, the cavity width was narrow, but testing showed that a much wider cavity was required. As the projectile moved through the test medium, the segments around the cavity would expand and peel back, increasing frontal diameter and trauma. If the impact velocity was high enough, the segments would eventually peel back so far that they would break off. When they did break off, they would often radiate outward, creating secondary wound channels. The rear section of the bullet would not deform and would act like a solid, continuing to penetrate deep and straight. Deeper in fact than any of the other expanding bullets Michael had ever tested. However, sometimes the segments would break off unevenly - an undesirable trait that could cause uneven resistance and hence deviation from the straight line.

In an attempt to rectify this, brass was substituted as the construction material, as its lower malleability was thought to solve the issue. It did, but with surprising results. Rather than peeling back, the six brass segments would rapidly blow off within the first few inches of penetration and radiate forwards and outward in a surprisingly even and consistent pattern. The trauma observed in the test medium was greater than any of the premium soft-point/expanding bullets that Michael had ever tested, and he had tested them all. The sharp segments would slice their way through the medium like small cutting blades. CEB's hexagonal cavity provided consistent fracture points that provided six even-sized blades each time.

It was observed that with higher impact velocity, greater trauma and deeper penetration resulted. This was a new phenomenon, as with conventional expanding bullets, penetration depth would reduce as velocity (and hence frontal expansion) increased. The harder Michael tried to find



Some of the varied (and weird) .500-calibre designs tested along the way included 595-grain hollow base, left, 430-grain concave truncated cone, 382-grain cone point and 530-grain hollow-point with undercut.



A selection of CEB projectiles with Talon Tips installed, including a .224 50-grain BBW #13 HP, left, and Raptors in .257-, .264-, .308-, .366- and .500-calibre. Note the short tips on .366- and .500-calibre projectiles.

the upper limit of penetration, the more he was surprised. He found that in big-bores, he could not push a bullet fast enough to see a reduction in penetration. This in itself is an extraordinary characteristic of the design. Unsurprisingly, the final design was simply called the 'BBW #13 Hollow-Point'.

One of the followers of Michael's work suggested a bullet that was double-ended, with a solid design on one end and a hollow-point design on the other. While Michael initially thought this to be a 'kooky' idea, he decided to try it out. Amazingly, the design proved to be not only viable, but also highly effective. In one set of tests, bullets were fired solid end first into the media, recovered and reloaded, then fired the hollow-point end into the media. The bullets performed flawlessly, as though they were being fired for the first time. (Safety note: the average handloader should never reload recovered bullets and fire them a second time.)

The light-for-calibre double-ended design was named the 'ESP (Enhanced System Projectile) Raptor'. While it may seem gimmicky at first glance, this revolutionary projectile is amazingly efficient and performs out of all proportion to its bullet weight. CEB then developed polymer tips that could be added to the hollow-point end by the handloader, which increases the ballistic coefficient of the projectile and hence improves downrange impact velocities. These became known as 'Talon Tips'. The Raptor design was perfected with the appropriate placement of the full-calibre bands to allow appropriate nose projection for the solid end and room for the tip in the hollow-point end, allowing them to fit in standard magazine lengths.

While Michael did the bulk of his testing in his much-loved .500-calibre, the design elements translate equally well to all other calibres. CEB makes a full range of BBW #13 projectiles and ESP Raptors in calibres ranging from .224 to .620, with varying bullet weight options at each calibre. Michael has done the test work on all these, even though he jokingly describes calibres below .358 to be 'rat-calibres'.

Along the way, Michael's test data and observations suggested that the list of the factors affecting depth and straightness of bullet penetration were quite different than the accepted thinking, and he listed them in order of importance:

1. Nose profile
2. Meplat percentage of calibre
3. Radius edge on meplat
4. Barrel twist rate (for terminal stability, as opposed to in-flight stability)
5. Impact velocity
6. Construction and material
7. Nose projection length
8. Sectional density.

It is highly interesting that sectional density is last on the list, as it is always touted to be crucial for good penetration. Yet, it has been demonstrated that when all other factors are present, even bullets of low sectional density can penetrate deeply and straight. Sectional density then is perhaps a compensator in the absence of other more important factors.

The CEB BBW #13 Solids and HPs and the ESP Raptor may need time to overcome the scepticism of traditional thinkers, but this is starting to occur in the US. However, without doubt, they are the best performing hunting bullets available today, with reports from the field in Africa and North America confirming this every week.

In time, other manufacturers are sure to copy design elements they contain. Michael McCourry's insatiable desire to find the best possible bullet, and the years of hard work by himself and Sam Rose, coupled with the vision of CEB, have led to the creation of not only a great new product, but also a revolution in the paradigm of the factors affecting terminal performance. ●