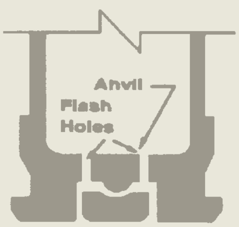
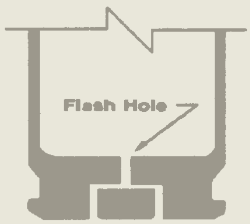
Gun Digest

GUIDE TO AMMUNITION





Cartridge Basics Explained

Cartridge Identification

BY Frank C. Barnes

Cartridge identification is important to anyone who works with cartridges, whatever the reason. It is of particular consequence to those involved in forensic firearms identification, military intelligence, or serious collecting. In addition to the information presented here, the collector of old, obsolete cartridges has special problems involving ignition systems and types not manufactured for 100 years or more. Much of this is beyond the scope of this book, but the basic procedures are still the same.

In teaching classes in firearms identification, I always tell my students that the easiest way to identify a cartridge is to look at the headstamp, if there is one, because in many instances that will tell you exactly what it is. Unfortunately, it isn't always that simple, since some cartridges don't have headstamps, or if it is a military or foreign round, the headstamp may not be readily decipherable. Additionally, the headstamp may be misleading. You might be dealing with a wildcat cartridge, something made by necking an original case up or down or otherwise changing the configuration. For example, the .30-06 case is used as the basis for a variety of wildcats using both military and commercial cases, so the headstamp would only indicate the original case, not the actual cartridge. Cartridge identification may range from a simple determination of caliber to the more complex ascertainment of the country of origin, date of origin, place of manufacture, and type of gun involved.

The various factors and problems involved in cartridge identification can be summarized as follows:

1. What is the caliber and/or other designation of the cartridge? For example, .38 Special, 9mm Luger, .250 Savage, 7.62x39mm (M43) Russian, .303 British, etc.
2. What type of cartridge is it, handgun, rifle, sporting, or military? Is it modern or obsolete?
3. What is the country of origin, who made it, and when was it made? The headstamp is usually the clue to these answers, but it may not do for all of them.
4. What is the functional character of the cartridge—ball, tracer, incendiary, explosive, sporting, match, etc.?
5. Is the cartridge functional? This usually requires actual testing and is important primarily to those in the forensic field. Obviously, one does not test-fire rare and valuable collectors cartridges.

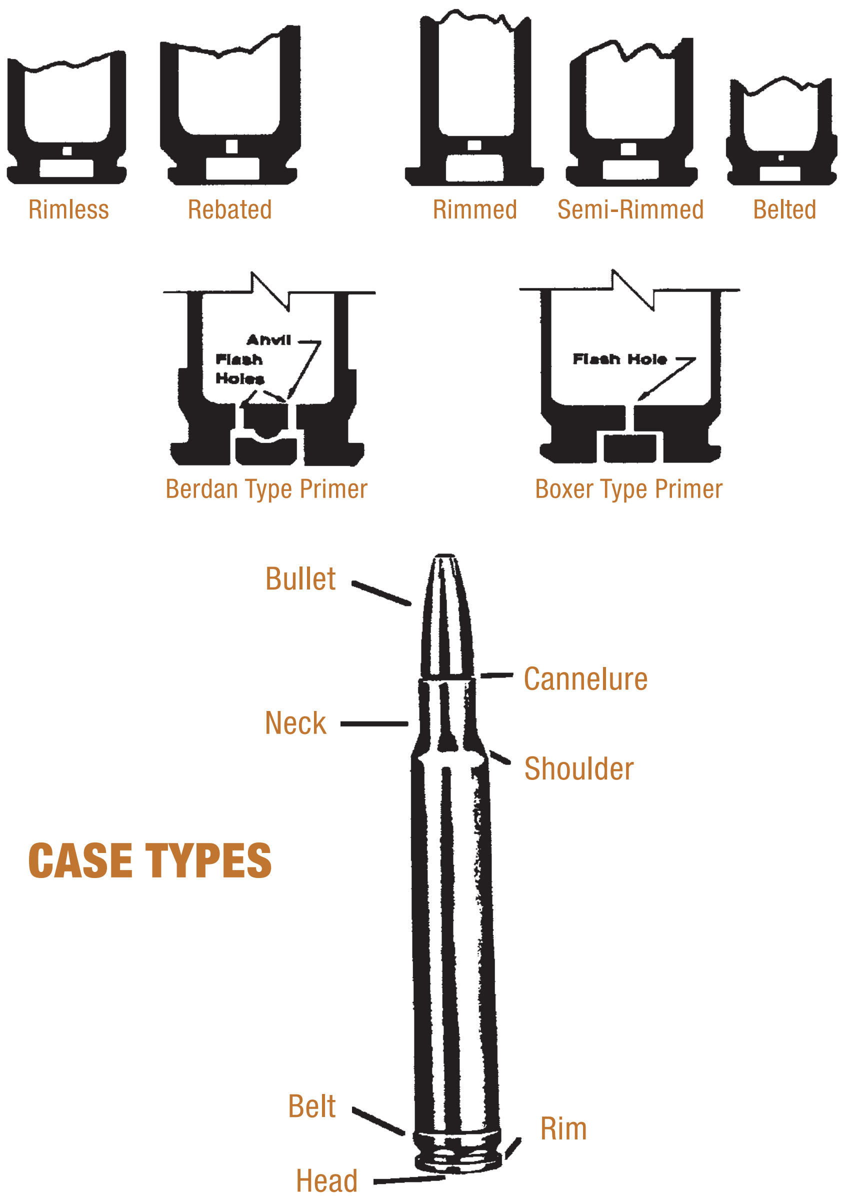
Cartridges are classified on the basis of ignition type, case shape, and rim type. Combustion of the propellant charge is initiated by the primer. If the priming compound is distributed around the rim of the cartridge, it is a rimfire. If the priming compound is contained in a separate cup in the center of the case head, it is a centerfire. Until the advent of Remington"s EtronX® ammunition and rifle system featuring electronic ignition in the year 2000, all small arms cartridges are percussion-fired, that is, the primer is detonated by the blow or impact of a hammer or firing pin. However, some military ammunition, usually of a size 20mm or greater, is electrically fired. There are two types of centerfire primers currently in general use, Boxer and Berdan. The Boxer primer is entirely self-contained with the anvil as a part of the primer. The Berdan type lacks the anvil that is produced as a small "teat" or protrusion in the primer pocket. Boxer-primed cases have a single flash hole in the center of the primer pocket, whereas Berdan-primed cases have two or more flash holes surrounding the anvil. The Boxer-type primer is used almost exclusively in the United States at the present time, although some Berdan-primed cartridges were manufactured here in the 1800s and early 1900s. The Berdan type is preferred by many European manufacturers and is usually an indication of such origin.

The cartridge base and rim type are important identifying features. These also serve an important functional purpose in feeding and extraction of the cartridge within the gun mechanism. There are five rim types: rimmed, semi-rimmed, rimless, belted and rebated.

Rimmed cartridges have a rim or extractor flange of larger diameter than the case base, often with a grooved or undercut area immediately ahead of the rim. Semi-rimmed cartridges have a rim that is only slightly larger in diameter than the base, and usually also a distinct undercut area between the rim and case base. It is sometimes difficult to recognize a semi-rimmed cartridge without actually measuring rim and base diameter, and these can easily be mistaken for a rimless case. Rimless cartridges have a rim and base of the same diameter although the rim may actually be .001- or .002-inch larger than the base. These are the most common type of military cartridges. Belted cartridges have a distinct belt or flange at the base, just forward of the rim, and an extractor groove between the rim and the belt. Rebated cartridges have a rim of significantly smaller diameter than the case body at the base, plus a definite extractor groove between rim and base or belt. Only a few rebated cartridges have been commercialized with success, and those are usually easy to identify. In several rebated rim designs, the rim is only very slightly smaller than the case head. The .404 Jeffery and its derivatives (chiefly the Imperial and Canadian Magnums) are the best examples. These can be difficult to identify without taking careful measurements. Also, note that naming a case design "semi-rimmed" versus "rimmed" is strictly a subjective call—there is no specified difference in base diameter and rim diameter that automatically separates these two styles. However, cases described as semi-rimmed are usually visually distinguishable from similar rimless cases.

The shape or configuration of the cartridge case is also an important identifying characteristic. Cartridges can be divided into the following 12 case types, with their corresponding letter designation used in the cartridge dimensional tables at the end of each chapter:

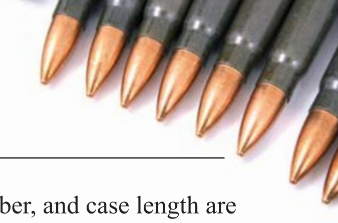
A. Rimmed bottleneck
B. Rimmed straight
C. Rimless bottleneck
D. Rimless straight
E. Belted bottleneck
F. Belted straight
G. Semi-rimmed bottleneck
H. Semi-rimmed straight
I. Rebated bottleneck
J. Rebated straight
K. Rebated belted bottleneck
L. Rebated belted straight



It will be important to note when referencing these letter designations that some cases described and lettered as straight are atually often tapered; case diameter can be considerably larger at the base, compared to the neck.

The bullet or projectile also provides a clue to the identity of a cartridge, its functional use, and the gun it is fired in. Based on the material or construction, bullets are divided into two major types, lead and jacketed. Lead bullets are used for low-velocity guns, such as handguns or black-powder arms. However, these may also be used for target practice in more powerful guns. Training cartridges may have wooden, fiber, composition or plastic bullets. The shape of the projectile is also important and can be round-nose, flat-nose, conical or spitzer (sharp pointed). Because of the Hague Convention, military bullets do not have lead exposed at the point and are restricted to full-metal-jacket types. Sporting ammunition or that intended for civilian use can have a variety of bullet tips with varying degrees of lead exposed, hollow-point, plastic tips and bronze or other metal tips, to control expansion in the target.

Bullets for military use can also be classified in terms of special functional design, such as ball; tracer (T); armor-piercing (AP); incendiary (I); high explosive (HE); and observation/ranging, or spotter-tracer types. There can also be two or more of these combined in the same bullet, such as APT, API-T, HEI, or HE-T. Not all types are made in every cartridge, since their function is developed to fulfill a specific military requirement. In addition, makeup depends, to



some extent, on the gun for which each is loaded. In general, ball or full metal jacket (FMJ) bullets are intended for use against personnel or unarmored vehicles. These usually have a lead core covered by a cupro-nickel jacket, or a mild steel jacket plated with some copper alloy. These can be easily identified with a magnet. At one time, the French 8mm Lebel military bullet was made of solid bronze. Tracer bullets are used for fire correction or target designation. These cannot be distinguished from ball, unless some identifying marking, such as a colored tip (usually, but not always, red), is included. Armor-piercing bullets are also similar to ball except they have a hardened steel or tungsten alloy core. They may or may not have a colored tip. Incendiary bullets contain an incendiary mixture that ignites on impact; visual identification depends on the color-coding system used. High-explosive bullets are uncommon, but do exist. These are made to explode on impact and can only be recognized by the color-coding. Observation and ranging bullets are intended to produce a flash and/or a puff of smoke to mark the point of impact. Again, these are recognizable only when color-coded. One should handle any ammunition with a colored bullet tip with great care, as appropriate.

The headstamp is the stamped markings on the head of the cartridge. Information that can be obtained from the headstamp is extremely varied and depends on the intended purpose or use of the cartridge and who manufactured it.

Headstamps consist of one or more parts or information elements. Cartridges intended for sporting or civilian use usually have two elements. One identifies the specific chambering, the other identifies the manufacturer. Military cartridges can have from one to five elements, including cartridge, date and place of manufacture, plus other identifying markings. Some headstamps are segmented, that is, these have one or more segment lines that divide the head into two to four equal parts. This usually indicates an older cartridge, since most countries discontinued segment lines shortly after World War I. The location of the elements is most conveniently indicated by its clock-face orientation, with 12 o'clock at the top, three o'clock at the right, six o'clock at the bottom, and nine o'clock at the left. The basic U.S. military headstamp prior to World War II had two elements, with the factory code at 12 o'clock and the date at six o'clock. Rapid expansion of ammunition manufacturing facilities as the result of the war introduced many new designs without any effort at standardization. Some used three elements spaced equidistant from each other while others adopted a four-element system located at 12, three, six, and nine o'clock. Also, the location of the factory code was changed, in some instances, to six o'clock or another location.

Worldwide, there are more than 800 military headstamps in existence plus some 400 or more commercial headstamps that have existed at various times. Obviously, this is a complex and highly specialized field. Several volumes have been published on headstamps, including at least three by various U.S. governmental agencies. In addition, some books for cartridge collectors include headstamp data on obsolete cartridges. Since it would require another whole book to adequately cover the subject, it is quite impossible to include more than a few basics here. However, we have listed several sources for such data to assist those readers who find a need for it.

The procedure for identifying a cartridge, using the tables in *Cartridges of the World*, are as follows:

1. First look at the headstamp and see what, if any, information is provided there.
2. Look at the cartridge and determine what type it is: straight, necked, rimmed, rimless, etc.
3. Measure the dimensions of the cartridge and make up a table as follows:
   - Type (A, B, C, D, etc., as shown in the tables)
   - Bullet Diameter
   - Neck Diameter
   - Shoulder Diameter (if there is one)
   - Base Diameter
   - Rim Diameter
   - Case Length
   - Cartridge Length

Now go to the cartridge measurement tables in Chapter 13 or at the end of each group chapter and compare your data with the dimensional data. Check bullet diameters under the proper type, then compare case length and, finally, other dimensions with your measurements. The type of cartridge case, caliber, and case length are the key elements to start with. For practice, two examples are shown below. See if you can identify the cartridges.

Example #1

Type: C

Bullet Diameter:	.308"
Neck Diameter:	.340"
Shoulder Diameter:	.441"
Base Diameter:	.470"
Rim Diameter:	.473"
Case Length:	2.490"
Cartridge Length:	3.340"

Example #2

Type: B

Bullet Diameter:	.410"
Neck Diameter:	.432"
Shoulder Diameter:	n/a
Base Diameter:	.433"
Rim Diameter:	.488"
Case Length:	1.280"
Cartridge Length:	1.580"

Bear in mind that there is a certain amount of manufacturing tolerance to be allowed for and your measurements may vary .001- to .002-inch plus or minus from some dimensions in the table. The cartridge in Example 1 will be found in the chapter on modern rifle cartridges; Example 2 is in the chapter on handgun cartridges. Not every known cartridge is listed in *Cartridges of the World,* particularly the more obscure blackpowder types. However, practically all modern sporting and military are included, so most readers will not have any difficulty. The idea here is to help you to determine what the cartridge is rather than where it originated or when.

In trying to identify cartridges, there are a couple things the reader should know. For one thing, the major ammunition manufacturers have, from time to time, made up batches of ammunition on special order with the purchaser's headstamp. Anyone can do this if your order is large enough and you have the money. Then there is the matter of commercial reloading firms that turn out ammunition for police departments and others using recycled cases of varying make and loaded with powder and bullets never used by the original company. Last, but not least, you have the individual handloader whose imagination is unbounded and who may turn out a few wondrous and non-standard products.

Cartridge Identification

Headstamp Markings of the Principal American Ammunition Manufacturers

Federal Cartridge Co.
Rimfire, AL EP, G or G, HP, F, XL, XR and WM Centerfire, FC

General Electric Co.
GE plus date (military)

Newton Arms Co.
NA plus caliber (Made by Rem.)

Peters Cartridge Co.
Rimfire, P or PETERSHV Centerfire, P, PC, P.C., PCCO,

PETERS E. Remington & Sons
E REMINGTON & SONS (1870-1890)

Remington Arms Co.
U, UMC, REM, REM*, UMC, R-P, RAH

Robin Hood Ammunition Co.
R, RHA, R.H.A. Co.

Savage Arms Co.
S.A. Co. (made by U.S. Cartridge Co.)

Savage Repeating Arms Co.
S.A. Co., S.R.A.C.O.

Richard Speer Manufacturing Co.
SPEER WEATHERBY

Union Metallic Cartridge Co.
U, UMC or R B (Purchased by Remington in 1911)

United States Cartridge Co.
US, U.S., *U.S CARTRIDGE CO*,U.S.C. CO. or RL (1869 to 1936)

Western Cartridge Co.
SUPER X, SUPER-X, W, WCC, W.C. Co. WESTERN

Winchester
W, H, SUPER SPEED, W.C. Co.

Winchester-Western
W-W, super speed

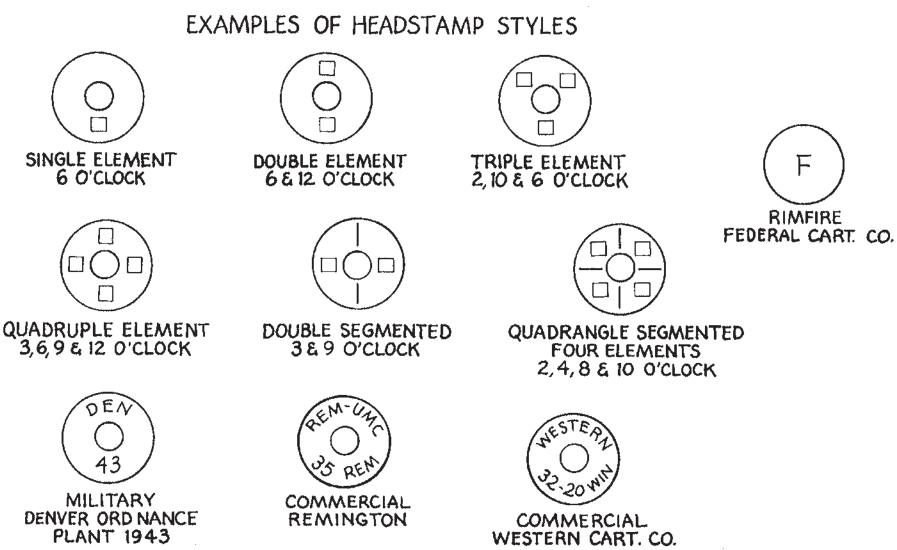
There were about 15 other companies that manufactured ammunition at various times, particularly during the 1860-1900 period. Also a number of private firms manufactured military ammunition during World War I and II.

United States Arsenal Headstamp Markings

Alleghany Ordnance Plant	KS plus date
Denver Ordnance Plant	DEN plus date
Des Moines Ordnance Plant	DM plus date
Eau Claire Ordnance Plant	EW plus date
Evansville Ordnance Plant	ECS plus date
Frankford Arsenal	CF plus date (45-70) F plus date FA plus date
Lake City Arsenal	LC plus date
Lowell Ordnance Plant	LM plus date
Milwaukee Ordnance Plant	M plus date
Saint Louis Ordnance Plant	SL plus date
Twin Cities Ordnance Plant	TW plus date
Utah Ordnance Plant	U plus date UT plus date

U.S. Small Arms Ammunition Color Codes

Bullet Tip Marking	**Functional Type**
Black	Armor piercing (AP)
Red	Tracer
White	Tracer, aircraft type
Blue	Incendiary



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Cartridge Nomenclature

It is difficult or impossible for the novice to follow the action without some knowledge of cartridge caliber designation. Even the individual experienced with standard American ammunition may be ignorant of British, European, or even obsolete American cartridge nomenclature. The subject, regrettably, is full of inconsistencies and confusion.

With the majority of American, British, or European (metric) cartridges, the caliber (indicating bore land diameter in 1/100-inch) is the first figure given. However, there are exceptions that will be pointed out later. Caliber may be given in terms of bullet or bore diameter (land or groove), and is neither accurate nor consistent. For example, we have the .307 Winchester cartridge, which uses the same .308-inch diameter bullet as the .308 Winchester. Then there is the .458 Winchester Magnum and the .460 Weatherby Magnum, both of which are loaded with the same .458-inch diameter bullet. Similar examples abound. In the latter example, the Weatherby people didn't want anyone to get their round mixed up with the Winchester design, so they changed the figures a little. That is one reason some cartridges do not follow in normal caliber designation in the dimensional tables. There are others.

The second figure, if there is one, is usually some distinguishing feature such as case length or powder charge. Cartridges of European origin are, almost without exception, designated in metric units by caliber and case length. Obsolete American cartridges, or any that have a blackpowder origin, are designated by caliber and powder charge weight, or caliber-powder/charge-bullet weight (the last two in grain weight). Smokeless powder charges vary so widely with the powder type and grain structure that this system is no longer used. However, there are again such exceptions as the .30-30 Winchester and .30-40 Krag. Here, the second figure represents the original smokeless powder charge, although it no longer has anything to do with it. With blackpowder cartridges the designation .45-70 Springfield means a .45-caliber bullet with 70 grains of blackpowder; or .45-70-405 spells out the same cartridge, with a 405-grain bullet to distinguish it from such other bullet loadings as the .45-70-500. But then there was the .45-56-405 carbine load in the same case!

The truth of the matter is the American "system" of cartridge nomenclature really hasn't any system to it, and what there is can only be learned through reading and experience. Otherwise, you simply never know what is meant. For example, take the .30-06, a very popular military and sporting round. Here, the first figure shows the caliber, while the last two numbers are the date of origin. In other words, a .30-caliber cartridge—model of 1906. Or, again, the .250-3000 Savage (.25-3000 simply lacked that special "ring" the advertising folks wanted). This translates out as a .25-caliber cartridge firing a bullet at 3,000 fps muzzle velocity. The bullet diameter is actually .257-inch and muzzle velocity varies with bullet weight from 2,800 to over 3,000 fps. Some of the older blackpowder cartridges included the case length and type; thus the .44-90 Sharps 2⅝-inch necked, or .45-120 Sharps 3¼-inch straight. As you can see, cartridge nomenclature isn't a system at all—it's a code.

The British, to a large extent, follow the same "system" as we do. However, they add to the general confusion with such cartridges as the .577/450 or .500/465. Here, the second figure gives the approximate bullet diameter in 1/1000-inch, and what is meant is that the .577 case is necked to .450-caliber, while the .500 case is necked to .465-caliber. The Britih may also add the case length. At this point, it is necessary to point out that some American wildcat (noncommercial) cartridges dreamed up by individual experimenters are designated by a similar though opposite system. Here, we have such cartridges as the 8mm-06, .30-338, and .25-06. These work out as an 8mm based on the .30-06 case, a .30-caliber based on the .338 Winchester case, and a .25-caliber based on the .30-06 case. Confusing indeed!

The Europeans have evolved the only real system of cartridge designation that is consistent and somewhat meaningful. Dimensions are in millimeters, including bore land diameter, case length, and type. The 7x57mm Mauser is a cartridge, for example, for use with a 7mm bore land size (7.21mm groove size), with a 57mm rimless case. The 9.3x74Rmm is a 9.3mm caliber with a 74mm rimmed case. The "R" denotes the rimmed type, while its absence indicates a rimless case. The name of the originator or manufacturer may follow. This is a relatively simple and straightforward system, but, unfortunately, it isn't perfect, either. The Germans used two rim types in some of their older cartridges, and this resulted in duplicate designations of cartridges that differ only in the rim (9.05x36.4R, 10.85x24.9R, etc.), and there must be at least three 9.3x72mm cartridges that differ only in case configuration. This is all something of a mess and probably too late to change. Mister Barnes, in an effort to straighten things out (or perhaps add to the confusion), developed two wildcat cartridges that he designated as the .308x1½-inch and .458x2-inch.

To further elucidate, the reader needs to know that there are two major classifications of cartridges—centerfire and rimfire. The former is fired by a primer located in the center of the case head, the latter by the priming compound distributed around the entire inside of the rim's outer diameter. The modern centerfire cartridge primer is removable and replaceable, so that the case can be reloaded after it is fired. It is possible, but not practical, to reload rimfire cases after they have been fired. Centerfire cartridges are subdivided into two types based on the primer, Berdan and Boxer. The Berdan-primed case has the anvil as a separate protrusion, or teat, in the bottom of the primer pocket. The Boxer primer is completely self-contained, and its anvil is a part of the primer. All American-made ammunition is normally Boxer-primed, whereas much British and European ammunition is Berdan-primed. Most foreign-made ammunition manufactured for the American market has the Boxer-type primer.

Rim Types

There are four common types of centerfire cartridge cases based on rim type. These are rimmed, rimless, semi-rimmed, and belted. The British equivalents are flanged, rimless, semi-flanged, and belted. There is a fifth type, not widely used, which is the rebated rimless, in which the rim is of smaller diameter than the base of the case. Examples would be the .284 Wincehster and .30 Remington AR. The .41 Action Express pistol cartridge is also rebated. The purpose of the rebated rim is to allow the use of a standard diameter bolt with a larger diameter cartridge. In the past, there have been a few rimless cases without the usual extractor groove.

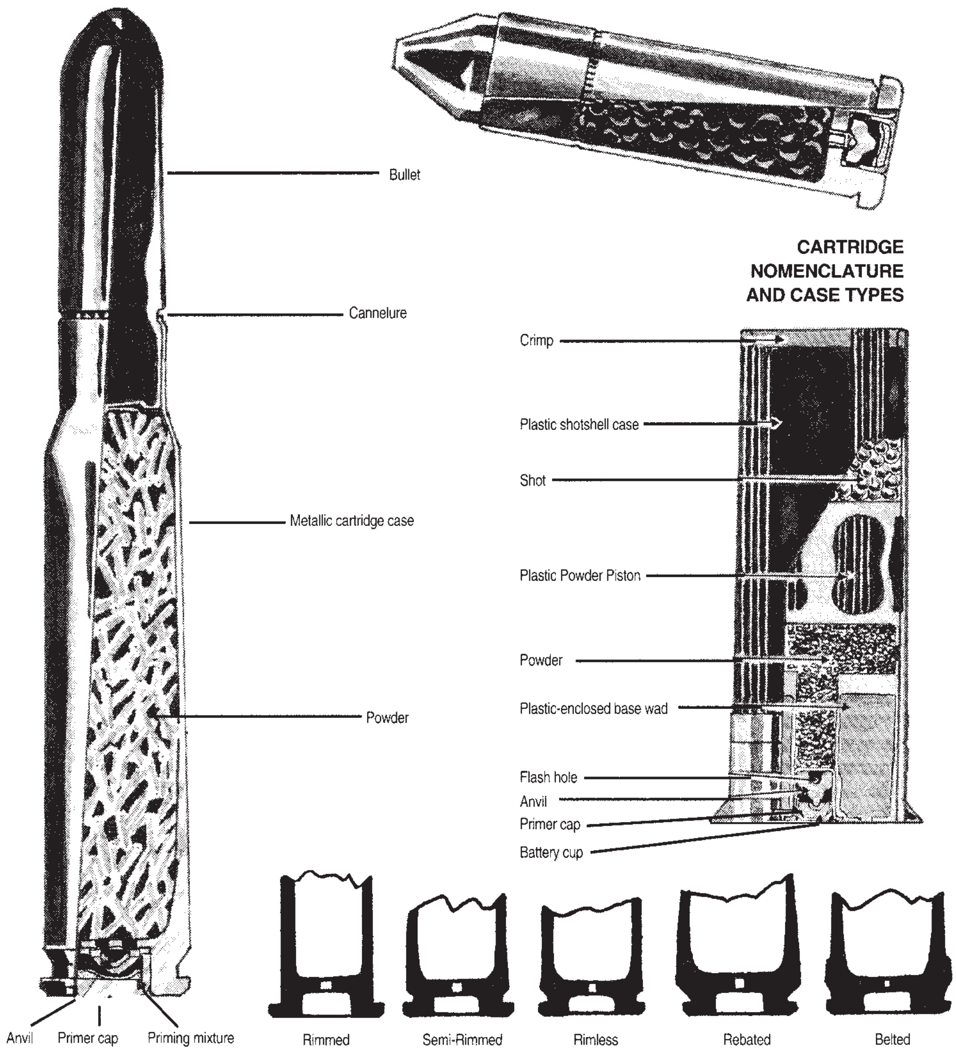
Both centerfire and rimfire cartridges may be of straight or necked type. Contrary to popular opinion, the necked case was *not* designed to provide greater velocity for smokeless powder cartridges. It evolved back in blackpowder days as a means of getting the same powder charge in a shorter case, thus allowing the repeating actions of the day to handle cartridges of the same power as the single-shots with their long, straight cartridges. Some of the very early rimfire cartridges were of the necked type.

The latest fad in cartridges is the caseless, or combustible type, an idea not really all that very new, as it acutally dates back to the early 1800s or before. The original design used a nitrated paper or cloth container for the powder charge, and sometimes, also, the bullet. The entire package was loaded into the gun, and the powder and its container were consumed in firing. During World War II, the Germans began an intense research and development program to perfect caseless ammunition and design weapons to shoot it. The principal motivating factor at the time was the severe shortage of brass and other metal for cartridge cases. The Germans are known to have had at least partial success with caseless cartridges, and some insist complete success. United States military ordnance facilities, as well as private industry, have been working on the problem of caseless ammunition for the past 50 years or more. There has been considerable success in developing caseless and partially caseless artillery rounds, but there are still many problems in the small arms field. Obturation is a big problem, as is ejecting a misfired round from the chamber of a repeating action. Modern caseless ammunition usually consists of compressed powder grains fastened to the base of the bullet, or the powder may be encased in a plastic case made of the same material as the propellant. Ignition may be percussion or electrical, and there is, in some types, a booster charge extending through the center of the powder charge.

Cartridge Collectors

Though this book is not a collectors' manual, it nonetheless includes considerable material of use and interest to collectors or any serious student of cartridges and related weapons. The tables of dimensions are organized to facilitate cartridge identification. The key to reading these tables lies in the bullet diameter and case type. The reader must understand that, in measuring cartridge dimensions, certain manufacturing tolerances must be allowed, and these can affect the last, or even the second, decimal figure. Dimensional tolerances can be rather considerable with old blackpowder cartridges and the modern bottlenecked numbers. Also, the true diameter of the obsolete paper-patched bullet should include the patch, not just the lead slug protruding from it. Minor variations in dimensions should not be mistaken for errors or the existence of an unknown caliber.

The dimensional tables can also be used to identify the caliber of a gun if the chamber dimensions are known. This can best be determined by a chamber casting. The means of doing this is explained in Chapter 3. If you own an obsolete or foreign gun for which ammunition is not available, the tables of dimensions will assist in determining whether ammunition can be made by reforming some similar existing case.



Metallic Cartridge Development

The self-contained metallic cartridge is a fairly modern development, one perfected only about 1850. The use of blackpowder as a propellant in guns in the Western world goes back something like 650 years, and the knowledge of gunpowder more than 700 years. The Chinese knew about gunpowder 500 or 600 years before it was introduced to Europeans, although they used it as fireworks and not as a propellant any earlier than the Europeans. The centerfire cartridge, a necessary prerequisite to our modern ammunition, evolved during the 1860s and '70s. Smokeless powder and high-velocity cartridges date back only to the 1890s. Improvements since the turn of the century have been more in the area of improved ignition, powder chemistry, and bullet construction, rather than cartridge design. Charles Newton designed cartridges back around 1910 that, had modern powders been available, would have equaled the performance of present-day high-velocity developments of similar caliber and type. Smokeless powder military cartridges designed between 1888 and 1915 were so good that improvement was possible only after more advanced powders became available, and many of these cartridges were still in use through World War II. As the result of this situation, many modern innovations in the gun and cartridge field turn out, after a little investigation, to be a reintroduction of something really quite old.

A few examples of the not-really-very-new among modern cartridges are worth pointing out. The .244 Remington (6mm) makes a good case to start with. Introduced in 1955, it is based on the .257 Roberts case necked down, which in turn is the 7x57mm Mauser slightly modified. Back in 1895, or thereabout, the Germans had a 6x57mm, made by necking down the 7x57mm Mauser. With the exception of a slight (insignificant) difference in the shoulder angle, the .244 Remington is a carbon copy of this much older cartridge.

The 7mm Remington Magnum is another brilliant "design" that is really just a modification of a much older cartridge. It is very similar to the .275 Holland & Holland Magnum introduced around 1912 or 1913. However, the H&H round didn't have a good American smokeless powder of later development to bring out its full potential. On the other hand, there are a number of wildcat 7mm short-belted magnums practically identical to the 7mm Remington Magnum that pre-date it by quite a few years and are identical in performance.

Yet another Remington innovation is the .280 Remington, a rimless cartridge based on the .30-06 case necked down. This is a dead ringer for the 7x64mm Brenneke, introduced in 1917. It is also practically identical to the wildcat 7mm-06 developed around 1928, so there is nothing very original here. However, none of these cartridges are interchangeable.

The commercial manufacturers are not alone in their design duplication. Many individuals have inadvertently done the same thing. One of the most popular wildcat cartridges anyone has thought up is the .35 Whelen, introduced about 1922 and adopted as a commercial standard by Remington, in 1987. This is simply the .30-06 case necked-up to .35-caliber and was originated by the late Col. Townsend Whelen. It is a very close copy of the German 9x63mm, which dates back to about 1905. As a matter of fact, a number of wildcat cartridges are nothing more than a duplication of some much older British or European designs. In fairness, it must be stated that the originator of the wildcat version probably was completely unaware of the existence of a parallel cartridge at the time.

Some companies and wildcatters go to considerable trouble to complete the circle, often coming up with something that duplicates a long-forgotten cartridge. If they were more familiar with the history of cartridge development, they could save a lot of time. The .444 Marlin, introduced during 1964, is a good case in point. To begin with, it is a poorly disguised copy of the wildcat .44 Van Houten Super that pre-dates it by at least three years. According to Parker Ackley, in his *Handbook for Shooters and Reloaders*, the .44 VHS is made by necking up the .30-40 Krag case, trimming it to two inches, and turning down the rim. When this is done, we end up with a near carbon copy of the 10.3x65Rmm Swiss cartridge (DWM 237A) that originated around 1900 or earlier. The only difference is in the fact that the 10.3mm case is .3-inch longer than the .44 VHS or .2-inch longer than the .444 Marlin. However, that's not all there is to the story, because the 10.3x65Rmm cartridge is based on the brass .410 shotgun shell loaded with a conical bullet and fired in a rifled barrel. It is possible to make the .444 Marlin from brass .410 cases, and the new originators could have done the same thing in the beginning.

Cartridges don't just happen—they evolve in response to some need or use requirement. Our Western frontier dictated American cartridge development for 50 years or more. Its influence is still an important factor in directing the imagination of the modern hunter. British rifle cartridges, in the main, were designed for conditions existing in other parts of the world, such as Africa and India, rather than the home island. European cartridges were developed on one hand because of hunting conditions and available game on the European continent, and on the other to compete with American and British innovations. Since the end of World War II, there has been considerable blending and standardization of the various worldwide cartridge designs. More British and European rifles and cartridges are used by American gun buffs than ever before, and they, in turn, have adopted many of our ideas.

Modern Ammunition

The most important factor influencing the ammunition available at any given time is economics. The ammunition manufacturers are willing to produce anything that will sell, but, obviously, are most reluctant to tool up and turn out something for which there is little or no demand. Military developments, as illustrated by the .30 Carbine, .30-06, 7.62mm NATO (.308 Winchester), 5.56mm (.223 Remington), .45 ACP, and that old standby, the .45-70, have almost always provided a good long-term sales record, when introduced in sporting version. For this reason, the ammunition companies have usually been quick to adopt these. They have not been quite so enthusiastic in their attitude toward cartridges developed by individuals or wildcatters. However, Remington has been the leader in introducing commercial versions of what were originally wildcat cartridges. They initiated the trend with the .257 Roberts back in 1934 and, since 1945, have added a number of others including the .17 Remington, .22-250 Remington, 6mm Remington, .25-06 Remington, 7mm-08, 7mm Remington Magnum, and the 8mm Remington Magnum, to name most of them. Actually, we must recognize that Winchester adopted the .22 Hornet (an original wildcat development), in 1930. Also, the .300 Winchester Magnum and possibly the .358 Winchester were around in wildcat versions before the company decided to develop something similar. The .444 Marlin is another cartridge based on an original wildcat innovation. Since most of these have had good sales records, it would not be surprising to see some of the other more popular wildcats introduced in commercial version as time goes on. This is a healthy trend, and we hope it will continue.

Nostalgia is another factor that is now exerting considerable influence on ammunition and firearms trends. Shooting muzzleloading and blackpowder cartridge guns of all types is a solidly established facet of the shooting game. Although there have always been a few muzzleloading clubs and a small core of blackpowder devotees, the current popularity of this sport has given birth to a whole new industry specializing in the manufacture of replica arms. Muzzleloading clubs with several hundred members are now common, and most states have special muzzleloading big-game hunting seasons. As an example of the magnitude of this development, Colt's once again sold its cap-and-ball revolvers, Harrington & Richardson offered replicas of the U.S. 1873 Trapdoor cavalry carbine, Shiloh Rifle Mfg. will sell you 1874 Sharps carbines and rifles, and one can buy any number of Hawken-type muzzleloading replicas. What is mentioned here is only a very small portion of what is available to blackpowder shooters. If you are interested in the full extent of the offerings in this field, I suggest you buy the latest edition of *Gun Digest* (from the same publishers that produce this book) and look in the manufacturer's web directory in the back of the book.

How does all this affect modern cartridges? The nostalgia syndrome is responsible for the reappearance of a number of long-obsolete cartridges, or at least new reloadable cases, although, admittedly, this is as yet on a rather limited or custom basis for most of the old-timers. Dixie Gun Works, for example, is offering new, reloadable cases in the old .50-70 Government caliber and has recently brought in the .41 Rimfire. The development of modern cartridges is a dynamic, rather than a static, process, although it does move in starts and stops, depending on the fads and trends of any given time. These, then, are the factors that shape our modern ammunition, and this includes some very exciting innovations (some old and some new) since the first edition of *Cartridges of the World*.

Cartridge Loading Data

Basic loading data has been furnished as part of the general information on each cartridge when available and if test rifles or cartridges were obtainable. Insofar as possible, the loads listed are for those powders that provide the most efficient velocity and energy for the caliber and bullet weight involved. With old blackpowder cartridges or obsolete smokeless powder numbers, the objective has been to supply data that more or less duplicates the original factory performance figures. The cartridge loading data has been gathered from various published sources and the extensive experience of the author and various editors. The data selected for inclusion in *COTW* provides a good starting point for the handloader, but there are many more good powders available for loading each cartridge than can possibly be presented here. It is therefore recommended that the serious reloader obtain one or more of the very fine reloading manuals published by Krause Publications, Lyman, Speer, Hornady, Hodgdon, Sierra, Nosler, P.O. Ackley, and others. Loading data listed here does not necessarily agree with that published elsewhere, regarding the velocity obtainable with a given charge of powder, because the test conditions and equipment are not the same. There is no such thing as absolute loading data, and all published loads reflect the conditions of test firing, which includes a number of important variables such as barrel length, chamber configuration, temperature, components used, test equipment, etc.

All loading data, wherever published, should be used with caution and common sense. If you are not sure or don't know what you are doing, *don't do it!* Since neither the author, editors, nor publisher has any control over the components, assembly of the ammunition, arms it is to be fired in, the degree of knowledge involved or how the resulting ammunition might be used, no responsibility, either implied or expressed, is assumed for the use of any of the cartridge loading data in this edition of *COTW*.

Cartridge Dimensional Data

The reader should understand that the cartridge schematics and the table of cartridge dimensional data at the end of this book are based either on actual cartridge measurements, SAAMI specs, or other drawings. In some instances, data is based on measurement of a single specimen. In others, it may be an average taken from several cartridges of different manufacture. The table is intended primarily to assist the reader in identifying cartridges, and its use for the purpose of chambering rifles is *not* recommended unless checked carefully against manufacturers' chamber dimensions. The reason? There are far greater differences in cartridge dimensions between makes and production lots than most people realize. There are differences in the third decimal place even within most 20-round boxes, in fact.

This brings up another point. From time to time the editors will receive letters from readers complaining that their measurement of some cartridge dimension does not agree with ours and, therefore, we must be wrong. We have, for example, two letters before us—one claiming a certain figure is too high, the other stating that the very same figure is too low. The differences are all in the third decimal place. This is not a matter of anyone being wrong, but rather variances in manufacturing tolerance.

As a more specific example of the tolerance factor, I acquired a box of 10mm pistol ammunition for the Bren 10 and other semi-autos and, in measuring several rounds, found some discrepancy in the rim diameters. Just to see what the minimum and maximum figures were, I measured the entire 20-round box. It turned out that the minimum rim diameter was .419-inch and the maximum was .426-inch, or a difference of .007-inch. Is that a sufficient range to cause the pistol to malfunction? I hardly think so.

All of this is just to get the subject of cartridge dimensions into proper perspective. In any event, if your measurements don't match someone else's by a few thousandths of an inch, don't get excited and don't get the idea you may have discovered a new and heretofore unknown cartridge. You may be dealing with maximum and the other guy with minimum dimensions.—*Frank C. Barnes*

Shotgun Shells

(Current & Obsolete – Blackpowder and Smokeless)

Shotguns, or "fowling pieces," as these guns were originally called, were among the earliest firearms to achieve sporting status. Of course, the use of a number of small pellets of varying sizes for military and hunting purposes predates what we would consider true sporting firearms made primarily for that pursuit. Originally, all guns were smoothbored, because rifling was unknown, until around 1500. American colonists used shot in their flintlock muskets, because it was easier to hit small moving targets, such as birds or rabbits. Single-barrel and side-by-side double-barrel flintlock shotguns reached a high state of development in the late eighteenth and early nineteenth centuries.

In England, Joseph Manton and others turned out high-quality flintlock shotguns that were the equal of any made today. When percussion replaced the flintlock, fine shotguns of this type were also manufactured. As a matter of fact, single- and double-barrel muzzleloading percussion shotguns were still popular until the early twentieth century. This wasn't due to reluctance by hunters to accept the new breechloaders, but, rather, because muzzleloaders were cheaper and didn't require expensive shotgun shells. For a largely rural population, it was simple economics.

The first breechloading shotguns appeared in the late 1840s, although some experimental types go back much earlier. The Lefaucheaux pinfire shotshell was patented in France, in 1836. In 1852, Charles Lancaster marketed an improved breechloading shotgun, which was followed by others and gradually led to our modern break-open type. The 1864 Schuyler, Hartley, and Graham catalog illustrated several breechloading shotguns.

The general acceptance of the breechloading shotgun depended on the development of a gun that was affordable to middle-class hunters, rather than only the wealthy. One disadvantage of the flintlock, percussion lock, and the pinfire designs is that these guns all require external hammers. As soon as breechloaders firing self-contained centerfire ammunition became available, a number of internal-lock shotguns began to appear, starting in the 1870s. The first modern hammerless, breechloading double-barrel gun was the Anson and Deeley, introduced in England, in 1875. This shotgun incorporated the self-cocking principle, which operated when the breech was opened, and is the design typical of all present-day doubles.

The pump-action shotgun was mostly developed in the United States in the late 1800s (though the first and not terribly functional design was actually created in England), and is, today, the most popular type in this country; this is also a matter of economics, because one usually can purchase a good pump-action shotgun for less than half the price of a double. The principal of choke-boring was long recognized by 1871, but wasn't widely known or used prior to that time. In that year, it was further developed and publicized by the American Fred Kimble. Shortly thereafter, choke-boring became standard on practically all shotguns. Walter Roper, also an American, was issued the first patent for choke-boring, in 1866. However, his screw-on device was for single-barrel guns only and did not become popular. By 1990, screw-in chokes had become the practice on nearly all shotguns.

The type of shotgun used is largely a matter of personal preference, and one has no great advantage over another as a practical matter. As to gauge, the 12- will cover the widest variety of game and hunting conditions, and, for the man on a limited budget, the repeating 12-gauge with an adjustable or interchangeable choke system is the way to go. The 16-gauge is almost as good, but very few guns are still made in this gauge. Actually, the best shotgun is the one in which you have the most confidence and can shoot the best. There is nothing wrong with the 20- or 28-gauge, or even the .410-bore, except that these relatively small bore sizes impose limits on what game and ranges you can hunt effectively. At one time, smaller-gauge shells were less expensive, but today those shells cost the same or even more than the larger gauges, so economy is no reason to pick one over the other, unless you are a handloader.

Bore and Gauge Defined

The gauge or bore diameter of a shotgun is designated differently from that of a rifle or pistol. The system used goes back to earliest muzzleloading days. It was the custom, then, to give the "gauge" of muskets in terms of how many lead balls of the bore diameter weighed one pound. A 12-gauge, thus, had a bore of such diameter that a round lead ball weighing 1⁄12-pound would just enter the barrel. Sometimes gauge was given as a "12th-pounder" or "20th of a pounder" (20-gauge). In England, modern terminology often uses 12-"bore" or 20-"bore," rather than "gauge," although the two mean the same thing.

The gauge system has persisted to the present. However, there are exceptions, such as with the .410-bore, which is always referred to as .410-bore, and never .410-gauge. This shell is actually a 68-gauge or .410-inch (.41-caliber). Then there's the 9mm rimfire shotshell, which is also a bore-size designation, rather than a gauge. At one time, shotguns were made in every gauge from about 1-gauge down to 32-gauge. Shotguns above 4-gauge were usually punt guns mounted on some type of support or swivel and used in boats for the market hunting of waterfowl. In addition, "gauge designations" larger than 10-gauge were often misrepresented, e.g., the bore of a 4-gauge gun would not accept a ¼-pound pure lead sphere. American manufacturers no longer load shotshells larger than 10-gauge for sporting use, but some European companies still turn out 8-gauge shells.

Shotgunning Myths

There are all sorts of odd ideas regarding shotguns. It is at least worth some effort to stamp out a few of these. For example, there is the idea that some shotguns shoot "harder" than others of the same gauge. The idea may arise in part from the fact that some shotguns have stocks poorly fitted to the user. Since apparent recoil is more severe than with other guns, the owner decides he has a harder-shooting gun. On the other hand, a shooter who has a gun that fits and handles exceptionally well may conclude he has a "hard shooter" because he does such good work with it.

Another outdated belief is that the longer the barrel, the longer the effective range. Modern smokeless powder shotshells develop maximum velocity in about 20 to 22 inches of barrel. Anything

over that is just for balance and looks. If the barrel is too long, it will actually reduce velocity slightly through friction or drag. A shotgun with a 26-inch barrel will kill just as far away as one with a 40-inch barrel. In addition, the short barrel will be much faster in getting on target. In deference to those who refuse to accept this, some shotgun manufacturers provide at least one model available with extra-long tubes! If it takes a 36-inch barrel to make you happy or build your confidence, by all means, use one. However, beyond placing the muzzle 10 inches closer to the target, it does not give you any ballistic advantage over the fellow using a much shorter barrel.

The effective range of shotguns is another matter usually subject to much argument and misunderstanding. Some people believe the larger the gauge, the higher the velocity. Others believe that the smaller the gauge, the higher the velocity. Obviously, there is room for all sorts of confusion here, but both claims are wrong. The average muzzle velocity of a similar 10-, 12-, 16-, or 20-gauge load is nearly the same. Why, then, does a larger gauge have a greater effective range? It is a matter of pattern density. For example, if you fire a .410-bore at a dove flying 40 or 50 yards away, the chances are he will fly right through the pattern without being touched. If he is hit, the pellet or pellets will do as much damage as if fired from a 12-gauge. On the other hand, if you fired at this same bird with a 20-gauge, your chances of bringing him down would be greater, because you have thrown more pellets in his path. With a 12-gauge at this same range, the pattern density is great enough that the chances of the bird slipping through are even more reduced. We are, of course, assuming here the same degree of choke for all guns, because choke controls pattern size and density at a given range. There isn't much difference in the actual diameter of the pattern thrown by different gauges at the same range, if all other factors are equal. However, pattern *density* (the number of pellets in the pattern) will absolutely vary according to gauge, with the advantage going to the larger bore. This is also contrary to common belief, so, if you disagree, go out and pattern a number of guns of different gauges but similar choke (and be sure you use the same size shot and type of load in all guns.

Modern Shotshells

Shotgun shells were originally made from wound paper or drawn brass, although some have also been made from drawn aluminum, cast zinc, and molded or drawn plastic, the latter two of which are currently the most popular design. Paper shotshells (Federal Cartridge Company still makes paper-hulled shotshells), consisted of a laminated paper tube made by winding glue-impregnated paper sheets around a mandrel. The tube was then coated with paraffin wax to make it moisture-resistant, cut to proper length, and one end plugged with a tightly rolled paper or composition base wad. The final step was to add a crimped-on brass (or other metal) head, which incorporated the rim and primer pocket. Inside the shell, the height of the internal base wad determined the volumetric capacity of the hull and, therefore, loading density. Cases were divided into high-brass and low-brass types, depending upon intended loading.

In general, the low brass wad was used with blackpowder or bulk smokeless powder, because these powders required more volume to function correctly. The high brass wad was used with dense smokeless powders that required less volume. So, you can see, this dispells another myth, i.e., the terms "high-brass" or low-brass do not refer to the heights of the brass head. Over the years, shells with a high-brass head have become associated with high-velocity or magnum loads, and shotshells with low metal heads with target or light field loads.

Almost all modern shotgun shells are made from some variety of polyethylene plastic. Such shells were first introduced by Remington, in 1958. Most plastic shells have metal heads of brass, brass-plated steel, or anodized aluminum. A few makers have marketed all-plastic shells without metal heads

Smokeless powder has completely replaced blackpowder for loading shotshells. Early smokeless powders were termed "bulk" powders, because these could be loaded bulk-for-bulk with blackpowder. However, these powders didn't all weigh the same, even though ballistics were similar with equal volume, and, so, a system of nomenclature evolved to accommodate this. Regardless the powder type, the charge is given in "drams equivalent." Thus, a shotshell marked "3¼-1¼" means the ballistics are the same as 3¼ drams of blackpowder and 1¼ ounces of lead shot.

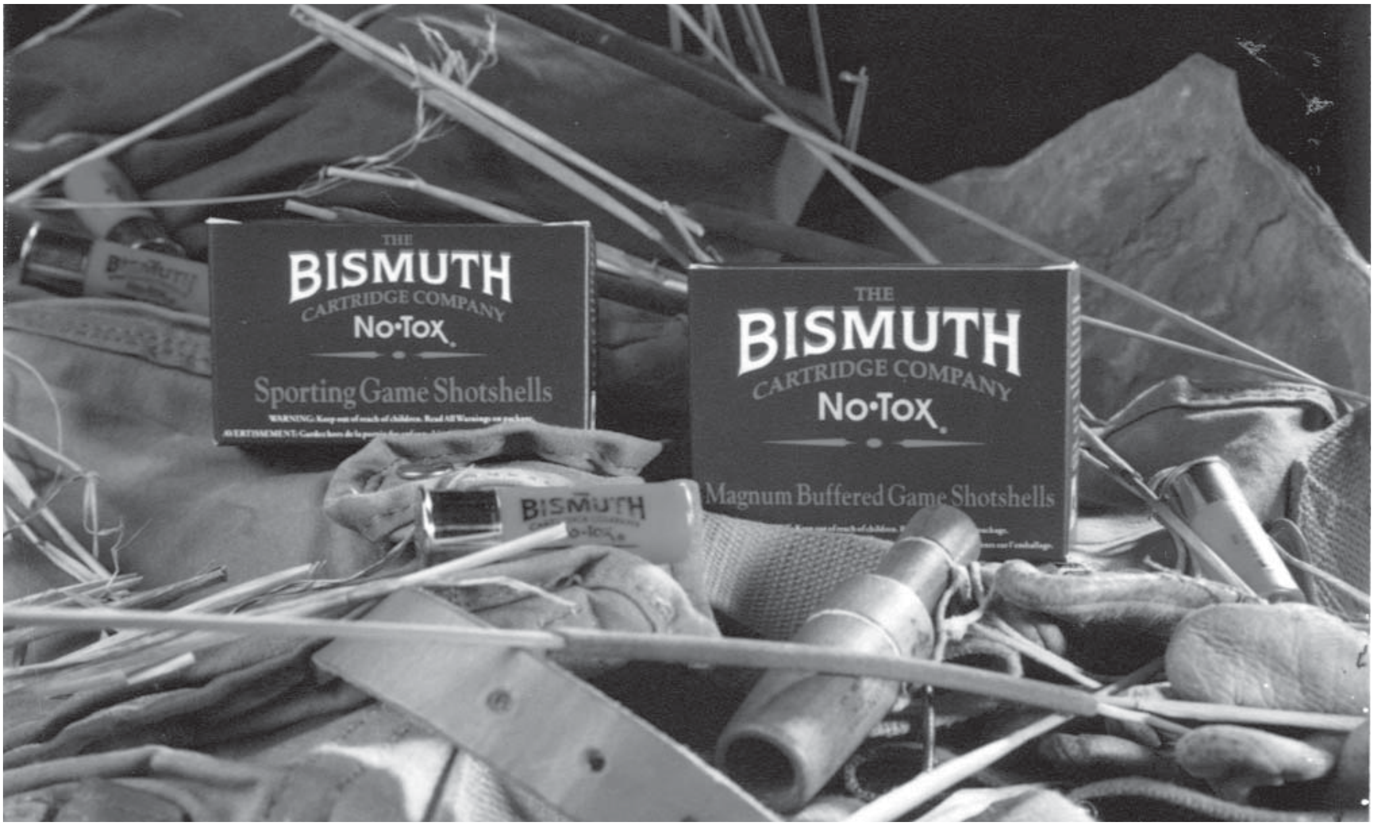
Shotgun shell primers differ from rifle primers in size and type. The three- or four-piece No. 209 battery-cup primer is used in most modern shells. Until recently, some European shotshells used Gevelot-type primers, and all-brass shotshells usually take Large Rifle primers. Brass shells are shorter, but have the same volume as those of paper or plastic. These cases require larger wad diameters, as well.

There has been more meaningful development of high-performance shotshells in the past couple decades than there has been previously in the history of arms. Shotshells now shoot payloads farther, hit game harder, and are manufactured more precisely than ever. But it has come at a price: It's not uncommon to pay $1, $2, or even more per round.

Considering what one gets in the deal, the new high-performance shotshells are well worth their prices. Yet, there is a dichotomy. Concurrently, low-tech "shootin' shells" are comparatively cheaper than ever in the history of shotshells. That's because of the global "dumping" of low-grade ammo from countries where their manufacture is subsidized. That's right, some shells sell for less in the U.S. than they can be manufactured for, even in their countries of origin. Global economy—most interesting.

The Lead Toxicity Issue

It has been recognized, since the late 1800s, that the ingestion of lead shot pellets by bottom-feeding waterfowl can cause a toxic reaction and lead to the death of the bird. In 1959, a wildlife biologist named Frank Bellrose completed a 15-year study on the possible affects of lead shot ingestion and the resultant lead poisoning (called "plumbism"), on North American waterfowl.



The results of this study were released in a bulletin known as the *Bellrose Report*. One of the conclusions in this report was that between two and three percent of the population in each waterfowl species in North America was lost each year through lead poisoning.

Truthfully, this was actually only a very rough estimate and one based upon incomplete data. The Bellrose study was based on the examination of bird gizzards furnished by hunters who had removed these from formerly live, healthy birds they had shot. In other words, *none of the wildfowl in the study were suffering from or had died from lead poisoning*.

The Bellrose Report wasn't intended to be a final conclusion on the subject, but rather an effort to point out a potential problem in a limited area and, at that, one possibly requiring further study. Unfortunately, this report was seized on by the U.S. Fish and Wildlife Service and the National Wildlife Federation as a *cause célèbre*, something that would demonstrate their deep concern for wildfowl and the ecology. The original study had encompassed a relatively small area in the Midwest, but this didn't stop the extrapolation of the data to cover all of North America, although there was no valid basis for such a conclusion. Whatever the merits of the argument, the fact is that Federal law now bans lead shot for virtually all waterfowl hunting (the one exception tends to be in some late-season snow goose hunting regulations, which have been instituted for some much-needed population control over the last decade or so). Furthermore, the outlook for the future has leaned towards an extension of the lead shot ban to encompass other kinds of hunting, as well, such as can now be seen on some public hunting lands frequently used for upland bird and small-game hunting.

Waterfowl Loads

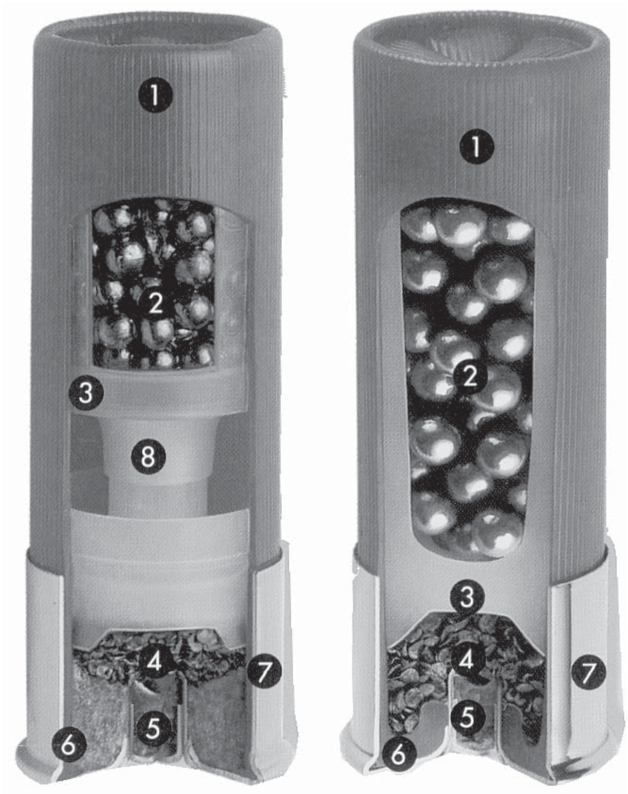
To be classified as a "waterfowl" load these days, ammo must contain non-toxic shot. This means that, rather than the traditional lead, waterfowl cartridges now contain other metals such as bismuth, iron/steel, tungsten, the brands of non-toxic shot pellets known as Hevi-Shot/Hevi-Metal and NICE SHOT, and the new proprietary steel shot from Federal Cartridge Company known as FLITESTOPPER. Steel shot was the first widely used substitute for lead shot in shotshells intended for waterfowl hunting, but, as it turns out, steel shot has (or at least had, given the super-high-performance loadings available at the 2012 SHOT show), a lot of bad features, not the least of which is the ability to ruin the bores of older shotguns. It is as hard as the barrel steel of many high-grade shotguns and can dig grooves in the bores if allowed unprotected contact. Also, steel shot won't compress the way lead shot does as it passes through the choke and, so, will eventually bulge the choke area.

Steel shot also has (or again, had) poor ballistic properties, compared to lead shot of the same diameter. Lead shot of equal size is 44-percent denser. This means that steel shot doesn't carry over distance as well as lead shot, and it loses velocity and energy at a faster rate.

In descending order of actual use, today's shot payloads typically contain steel, tungsten and iron, or tungsten and polymer (in a matrix), bismuth, Hevi-Shot, or the other proprietary materials just mentioned above.

There has been relatively little, if any, actual development of late on the bismuth front. And there is good reason. Bismuth works great just as it is. It offers two major advantages. First, it acts almost exactly like traditional lead. This means it works great, since lead was/is the single finest material for shot (not withstanding the controversy over toxicity). Also, bismuth lends itself superbly to use in the older, finer shotguns that cannot handle steel or hard tungsten loads. Thanks for this product availability goes to Bob Petersen, the former publisher and general gun guru. (Incidentally, Bob's affinity for the .410-bore also has resulted in the availability of these diminutive cartridges in the Bismuth line for the waterfowler.)

Tungsten is a very heavy (heavier than lead) and extremely hard metal. This means that, to match a lead load, tungsten must be "watered down" with something else. This dilution is usually accomplished by mixing the tungsten with iron, steel, or some kind of plastic (polymer). In the tungsten/polymer shot, powdered tungsten is suspended in a plastic matrix and then formed into round pellets.



LEAD SHOT **STEEL SHOT**

1. TUBE
2. SHOT
3. WAD
4. POWDER
5. PRIMER
6. BASE WAD
7. HEAD
8. CUSHION (lead only)

Although the Brits generally are credited with brainstorming tungsten/polymer shot, there have been a couple North American companies that have offered such ammunition to the general trade. One was Federal, but the sales numbers and sales velocity of Federal's tungsten/polymer loading were not enough to keep that superb offering in the line. Without question, Federal's tungsten/polymer load was a great performer, and while it's not as popular as it was when it was initially introduced, the company conitnues to be an innovator in waterfowl loads, with high-performance choices like those in its Black Cloud lineup. Meanwhile, Kent Cartridge Co., headquartered in Canada, continues to offer tungsten/polymer ammunition, which work great, but this company has also recently made improvements to its steel shot loadings, with the relatively new line of super-high-velocity rounds known as SilverSteeel.

As you can see by even just the mention of the loads from Federal and Kent, most recent developments in non-toxic waterfowling ammunition has been with regular steel shot and with tungsten/other-metal combinations. The metal combo-shot used by the various companies comes in a variety of proprietary names such as Hevi-Shot (formerly a Remington product, but one now marketed independently), and the smaller company known as NICE SHOT, which offers its non-toxic pellets for handloaders. The trend for the metal combo loads has been for companies to offer payloads per volume that are heavier than lead, which, in theory, means they are ballistically superior. This trend is so evident with the heavier metal combos that, in addition to waterfowl loads, companies now are offering this kind of shot in high-density turkey hunting ammunition and upland bird loads (though this last is mostly to satisfy recent laws restricting the use of lead shot on certain public lands altogether, waterfowl habitat or not). On the steel front, most development has been a form of fine-tuning, in which velocities are increased while pattern uniformity is improved. Without question, velocity is the prime determinant in the success of steel shot load, and it doesn't hurt with the combo metal loads, either.

There are several reasons why velocity is so crucial for loads that contain super-hard payloads. With respect to steel, the higher velocity stretches the effective distance a bit. But, with all super-hard pellets, it is the way they take game that makes velocity so crucial. Because the pellets are so hard, they do not deform as lead does (even plated, hardened lead deforms a bit). This means that each individual pellet acts similarly to a full metal jacket rifle bullet; it puts a small hole in its wake, but does little other damage on the way. This was the characteristic that caused many birds hit with steel shot in the early days of steel introduction to be hit hard, yet limp off through the air, only to fall dead a mile or so away after they had bled out. Higher velocity helps preclude this kind of problem.

Years ago, really high velocities (over 1300 fps) were achieved with non-toxic loads only when the payload was relatively light for the bore diameter. In 12-gauge, this generally meant one-ounce payloads. Since then, companies have offered many heavier payloads at the higher velocities, thus removing one more negative variable from the equation. To make things even better, changes in wads and manufacturing techniques have taken waterfowling loads to new highs in every respect. And not insignificantly, virtually all commercial non-toxic waterfowling ammunition these days is as close to being waterproof as is possible.

Turkey Loads

Developments in wild turkey hunting loads have continually focused on ways to deliver the densest patterns at ever increasing distances. This means developing ammunition that patterns superbly at high velocity. In the long ago, muzzle velocities of 1200 to 1300 fps were typical for shotshells. Now it's common to find loads, some even with quite heavy payloads, that send the shot out of the barrel at 1400 fps or faster.

Most turkey loads continue to keep muzzle velocities in the 1300 to 1400 fps range, but now deliver that speed with heavier shot charges. And what shot charges they are! Although Federal and Mossberg originally developed the 3½-inch 12-gauge shell as a way to put more of the lighter steel shot into waterfowl ammunition, the 3½-inch 12-gauge shell has found a welcome home among many turkey hunters who don't mind the recoil of a gun that shoots 2½ ounces or more of shot out of the barrel at high velocity.

Federal Cartridge Co. upped the ante a bit, in recent times, with the development of what it calls the FLITECONTROL wad. By its very design, this wad keeps the shot swarm together longer, which extends the density of the pattern downrange. This wad is used in both turkey loads and those for waterfowl.

Major breakthroughs in ammunition seem to be happening with regularity these days, and Federal's new Mag-Shok turkey hunting load, with its all-new wad design, takes patterning for big toms to a whole new level. Initial tests resulted in roughly twice as many pellets in the head/neck kill zone as was common with more traditional ammunition from the same gun/choke combination. At the heart of Federal's new turkey ammunition is an ingenious wad that keeps the pellet swarm tighter. The new wad is thick and made of a plastic that is about the same hardness as that used for steel shot loads for waterfowling. However, that's about where any similarity to most wads ends. A cross-section of the wad itself would remind one of the Nosler Partition bullet's jacket design, with the front partition area being about twice the length of the back divider. The front partition holds the buffered shot, while the rear encapsulates the top of the powder charge. Truly, it is quite different from the typical wad.

The front section of the wad, literally, is a cup that holds the shot all the way out the barrel and then some. There are no petals, slices, or slots in the front part of the wad, as is normal in most modern wad designs. Yet, at the bottom of the front part of the wad, there are three partial cutouts that, upon firing, merely relieve the bottom area of the front, shot-containing cup. These cutouts flare out, though almost not at all, during the firing process. It looks like they are there more to relieve some kind of pressure effect on the wad itself than anything else.

Most intriguing is the base, or skirt, of the long, orangish, one-piece wad. The skirt has six major petals that, upon exiting the barrel, flare out, causing major wind drag that, in turn, pulls the wad away from the shot that then continues on at normal velocity. This means the shot doesn't leave the wad until it is long gone from the barrel, and that means the pattern begins to open up much later, making it much tighter at any distance. Couple that wad with hard, copper-plated shot, and the world of turkey hunting just got a lot easier.

Upland Game Loads

There hasn't been a dramatic development in upland game loads that there has been in other arenas. About the biggest news in the past few years is that where 1300 fps was common for upland loads a decade or longer ago, 1400 fps, or even a little more, is now in vogue with the latest offerings.

Although the higher speeds work well, their primary advantage, if any, is that they mitigate, at least a bit, the amount of lead ahead of a moving target necessary to effect a hit. This probably translates into a few more pattern-edge hits for those whose timing is a little rusty. Other than that, there is an increase in felt recoil that naturally goes with the higher velocity.

Also recently, there has been a slight level of advancement in upland game loads for the smaller gauges. One must consider that, in the general shotgunning world, there are the 12- and 20-gauge, and then there's everything else, in which everything else doesn't add up to the volume of either of the top two. Nonetheless, there still is "everything else." Generally speaking, companies are now offering comparatively heavy shot charges for the 28-gauge and .410-bore guns. For example, there are 28-gauge loads with one ounce of shot (the classic shot charge weight of the 16-gauge), and Winchester, at least, now offers a three-inch .410-bore with ¾-ounce of shot (classically the shot charge weight of the 28-gauge). Although the heavier 28-gauge loading maintains velocity at slightly above 1200 fps, which is classic, the heavier .410-bore load does not. For example, the classic ½-ounce target loading for the .410-bore has a muzzle velocity of 1200 fps. The traditional three-inch .410-bore loading with 11/16-ounce of shot has a muzzle velocity of around 1135 fps, and the ¾-ounce loading goes out at 1100 fps. This data suggests that hitting relatively tough targets at relatively close ranges is where the heavier payloads shine.

Deer Hunting Loads

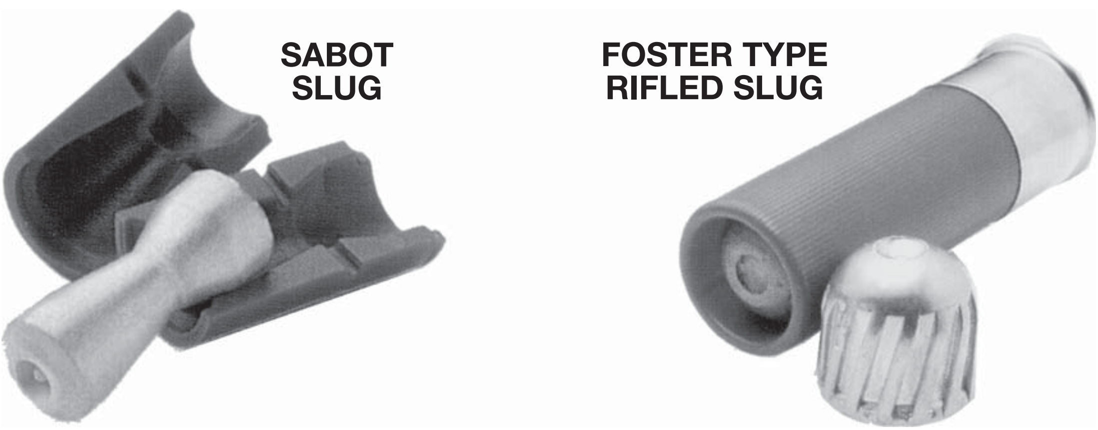
It was common practice with muzzleloading shotguns to load a solid roundball for big-game hunting. This worked fine, if the range was short, but accuracy beyond 40 yards was poor. It could be improved upon by using a patched ball, but the lack of proper sights limited what can be accomplished with a smooth-bored gun. When self-contained shotshells arrived, those were furnished in all gauges with a roundball loading. However, when choke-boring became common, it was necessary to use an undersized ball to prevent possible choke damage and, so, it became common practice to load a ball sized one or two gauges smaller than the bore. Thus, a 13-gauge ball was loaded in 12-gauge shells, a 17- or 18-gauge ball in the 16-gauge, and so on. These undersized lead balls usually were deformed when passing through the choke, so were even less accurate than bore-sized balls. Roundball loads in 12- and 16-gauge were useful in heavy cover, where they offered good short-range power on deer-size animals. In addition, 4-, 8-, and 10-gauge balls were used on dangerous game in Africa and India. Roundball loads were discontinued, in 1941.

The rifled slug has an accuracy potential that will allow one to hit deer at ranges of 100 yards (and now more), provided your shotgun is equipped with a set of rifle sights or a scope and is properly sighted in. Rifled slugs were introduced by RWS in Germany, in 1898. This slug, known as the Brenneke, is still available under the Rottweil label. The American, or Foster-type, slug, was introduced by Winchester, in 1936. The two differ in that the Brenneke is solid lead with a series of felt and card wads screwed to the base, whereas the Foster type has a deep, hollow base similar to the old Minié ball projectile used during the Civil War. Both have a series of angular grooves swaged into the outer circumference, and both work on the same principal as the badminton shuttlecock, in that most of the weight is forward of the center of air pressure, which causes these projectiles to fly point forward.

The newest slug design is a saboted copper solid designed to work in rifled shotgun bores, which have become common in specialized shotguns intended only for use with slugs. When fired from these rifled barrels, these slugs (made by Remington and others), can provide rifle-like accuracy and terminal performance.

Without question, effective range for shotgun ammunition in the deer/big-game hunting world took a giant step forward with the use of rifled barrels in conjunction with saboted slugs. Briefly, this move alone doubled (even more in some instances), the effective range of the shotgun slug. Where credible distance for the more traditional shotgun slugs was somewhere around 50 yards, now 100 yards or more are common distances for successful shots.

Rifling the barrels of shotguns spins the projectile, allowing it to fly more truly to the target—as is the case with bullets in



rifles and handguns. But, with modern shotgun ammunition, the maximum in accuracy and velocity for shotgun slugs has been achieved by using a sub-bore-diameter slug (bullet) cradled in a sabot (French for "shoe"). The plastic sabot engages the rifling, transferring the spin to the slug. After exiting the barrel, the sabot, due to air resistance, falls away from the slug, and the slug continues at high velocity to the target.

Advances in plastics and manufacturing techniques have allowed ammo makers to offer loads that are extremely accurate for shotguns and up the velocity several notches in the process. Some modern slug loads deliver a projectile weight and velocity similar, if not, in some cases, superior, to the blackpowder express rifle cartridges used against dangerous game in Africa and India at the end of the nineteenth century.

Depending upon the gun/ammo combination, it is relatively easy to achieve groups of four inches or less at 100 yards with a projectile that delivers above the traditional minimum of 1000 ft-lbs of energy for deer-killing performance. In some combinations, groups of two inches or less at 100 yards are achievable. This was considered to be good delivered *rifle* accuracy several decades ago. This means that today's deer hunter in the woods now can use a shotgun as effectively as their ancestor did the venerable Winchester Model 1894 rifle in .30 WCF.

Fortunately, development hasn't been limited only to the saboted slug loads for rifled barrels (saboted slug loads typically do not work very well in smoothbores). There also has been some advancement in ammunition for shotgun slug hunters who continue to use smoothbore guns. Nothing smaller than the 12-gauge slug can be considered adequate for any North American big game, and the .410-bore slug is useless for anything but small game at short range. The 12-gauge Brenneke slugs have proven effective on thin-skinned African game, including some dangerous species, such as lion and leopard. Shotgun slugs can be compared to the old large-bore blackpowder cartridges such as the big .45- and .50-caliber numbers. If you could only own one gun, consider a 12-gauge shotgun with an extra slug barrel. It will cover a greater range of game and hunting conditions than any other single gun.

Gauge Rifles

What we call the "gauge rifles" are from 12- to 4-bores, though a few 2-bores have appeared (see the 2010 edition of *Gun Digest*). These are rifles of full weight and power, rifled through and through, and originally were blackpowder cartridge guns intended for use against large and dangerous game. Bore- or gauge-designated cartridges larger than 8-gauge are seldom of true implied bore size. We include the gauge rifles here so that the reader may better differentiate them from shotguns with the same bore or gauge designations.

4-Bore: The bore designation indicates the number of bore-size lead balls to the pound, hence the 4-bore would nominally accept a round ball that weighed ¼-pound, or 1,750 grains. In actuality, the brass-cased 4-bore was loaded with a round ball of about 1,250 grains, or with a blunt or conical bullet that weighed about 1,880 grains. The usual propellant charge was 12 to 14 drams (325 to 380 grains) of blackpowder. Muzzle velocity was from 1300 to 1500 fps. Some 4-bore cartridges were loaded with up to 70 grains of cordite.

The 4-bore saw some use in Africa before the turn of the century, and in India for tiger shooting as recently as 1920. Typical 4-bore rifles weigh from 20 to 25 pounds. There is still quite a bit of interest in these, and at least one outfit is making new double-barrel and single-shot 4-bore rifles today. Variances in cases length were from about 3½ inches up to a 4¼-inch version.

8-Bore: The 8-bore was more popular than the 4-bore, because rifles for it could be built lighter. Typical 8-bores weighed about 15 to 16 pounds, hence were much handier and easier to use. Performance was not far behind that of the 4-bore, either. Typical loads are a 1,250-grain conical bullet at about 1500 fps, or a spherical ball of 860 grains at 1650 fps. Case length is from three to 3½ inches. Powder charge was about 10 to 12 drams (270 to 325 grains) of blackpowder.

A Paradox-type 8-bore cartridge with lighter loadings was also common. The Paradox was a Holland & Holland invention, which featured rifling in the choke area of its otherwise smoothbore barrels. These were also sometimes known as "ball-and-shot" guns, though some makers also used that name for smoothbores that had no rifling in the chokes. Numerous makers turned out variations on this theme and gave their creations highly individual names. Paradoxe 8-bores were a bit lighter than fully rifled guns and were, thus, handier still. The 8-bore Paradox was more of a big-game gun, while the 10- and 12-bore Paradoxes were more like heavily loaded shotguns, used only occasionally for big game.

10-Bore: Ten-bore rifles were also used against dangerous game and were, like the bigger bores, also loaded with detonating shells and/or lead-covered steel bullets for maximum penetration and performance. Here again, the Paradoxes were popular and efficient, and a common load used a 700-grain ball in front of a five-dram charge for 1300 fps. The full rifle load would give more than 1600 fps to the same round ball, or about 1500 fps to a somewhat heavier conical ball.

12-Bore: The 12-bore rifle saw lots of service against big game, but this size cartridge was probably most commonly seen as a Paradox load, either round ball or conical ball. In this guise, it was quite popular. The 12-bore Paradox worked well on medium-size game and was useful with shot loads for filling the pot with birds and small game. Most 12-bore Paradox-types weighed from seven to eight pounds. In a fully rifled arm, the weight would be more than 10 pounds and the load significantly more powerful. Case length for fully rifled arms varies from 18/10-inch up to 2¾ inches.

Gauge rifles were either single-shot or double-barrels. These evolved from muzzleloading firearms of similar bore size and, while the rapid-fire capability of these early breechloaders must have been a boon to the early explorers and hunters, it was no panacea.

The usual lead bullet's performance was such that it wasn't a good idea to take head shots on elephant. The skull of that beast consists of honeycombed cellular bone, and a lead ball could not be counted on to penetrate that, much less stay on course and find the brain. Shots to the head that missed the brain had little or no immediate effect on the animal, so the usual and much surer target was the body. A 4-bore ball through the heart would kill the elephant, but apparently not very quickly, as may be determined from the writings of many early African hunters.

The gauge rifles have a fascination matched by few other British or other sporting firearms. The cartridges are interesting and greatly varied, well worthy of study, collecting, or, if we are lucky enough to find a suitable rifle, shooting.

—F.C.B., with additional text by Steve Comus and Jennifer L.S. Pearsall