The Evolution of the Shotshell

James McLauglin

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Dr. McDaniel

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The first shotgun cartridges were simple paper packages of shot, wads and powder used to expedite the loading of muzzleloading shotguns. These cartridges were primarily used by the military. (Butler, p.171)

When the early breech loading percussion shotguns, such as the Sharps, became popular in the 1850's, paper cartridges were used more widely. These guns could be fired using loose powder and shot, but the efficiency of these easy to make paper shells made it expedient for the shooter to spend a couple of hours at night rolling up cartridges to be used the next day. The Sharp's cartridges consisted of a twisted paper shot tube which contained the shot, the wadding and a separate folded paper tube of black powder which was pasted in the rear of the shot tube. When the cartridge was loaded in the gun, a bit of the powder tube would protrude from the rear of the chamber. When the breech block closed, this back end of the powder tube was cut off, exposing the powder to the flash hole. (Butler, p.172) All that remained to finish loading was to place a fresh cap on the nipple.

These early breechloaders, using loose powder and shot or paper cartridges, were important steps in the evolution of the shotshell. However, their archaeological significance is small as far as dating is concerned because the paper cartridges decomposed quickly, and the paraphernalia associated with their loading was much the same as that used with earlier muzzleloading percussion arms.

The shotshells which most concern the archaeologist are those which were made of durable material which could survive in the soil for many decades. Beginning in the 1830's, the first reusable, durable, true cartridges, the forerunners of today's shotshell, were being developed. There are several definite criteria for a successful breechloading cartridge.
First, the cartridge must be durable, easily handled, and somewhat weatherproof. Second, it must be flexible enough to expand with its own gas pressure at the instant of firing. This expansion of the case forms a gas-tight lining of the chamber, sealing the breech and preventing the escape of hot gasses which can endanger the shooter, a paramount problem with the earlier breechloaders. Expansion at the case mouth is especially important, to prevent fouling of the chamber at each shot. (Butler, p.42). And third, the case must be resilient enough to return approximately to its original dimensions after firing so that it may be extracted from the chamber.

The materials which were found to have these essential properties are copper, brass and paper which has been coated with glue and wrapped around a cylinder to form a tube. This many-layered paper construction proved to be the most economical and easiest to manufacture. The basic construction generally accepted for the shotgun cartridge was a rolled, tapered paper tube with a brass head retaining a fiber base wad (Butler, p.42).

The development of this elastic, resilient cartridge case for breech-loading firearms was no small achievement. As W.W. Greener writes, "Probably no invention connected with firearms has wrought such changes in the principle of gun construction as the invention of the expansive cartridge case." (Greener, p.133)

The first truly successful expansive shotgun shell was the pinfire cartridge, designed by two French experimenters, Robert and Lefacheux, in the early 1830's (Butler, p.42). The basic paper tube—fiber base wad—crimped brass head construction was used, with an interesting system of ignition. A hole was drilled through the side of the brass head, through the tube and the side of the base wad to the inside of the cartridge. A percussion cap was placed under the hole from the case mouth, and a brass pin,
the actual firing pin, was fitted through the hole and into the open end of the cap, holding it in place.

After priming was completed, a charge of black powder was dropped in the case and tightly fitting fiber wads were positioned over the powder. The shot charge followed, with an over shot wad used to keep it in the case. The first pinfire cartridges were rimless, or nearly so, and were extracted by pulling on the pin. The brass head was very shallow, with barely room for the pinhole.

The pin-fire was patented in England in 1840, and pin-fire shotguns were still being produced in Belgium and France as late as 1910 (Greener, p.134). However, the centerfire guns and cartridges had made the pin-fire obsolete by the 1880's. The pinfire cartridge was an ingenious design, but had several flaws and drawbacks. The most obvious disadvantage to this design is the inherent danger. A pin-fire, if dropped on the pin, could easily detonate, and in a black powder cartridge this could be a serious accident. Another disadvantage was the tendency of the cartridge to permit gases to escape around the firing pin, especially after a few reloadings. And of course the guns and ammunition were too expensive for the average American shooter, at least at first (Butler, p.46).

Between the era of the pin-fire shotgun, and the time when centerfire became truly successful, there were several cartridge designs which were the relatively unsuccessful forerunners of centerfire-primed shotshells. An example of this type of ammunition is the Lancaster cartridge. Introduced in England in 1852, this design incorporated a tubular body sealed at the base with a copper disc (there was no base wad). This disc had four holes punched through it around its center where a priming compound was
smeared on its outer side. This assembly was held together by a capsule of thin copper. When the gun's firing pin struck the head, the priming would be crushed between the copper head and the copper plate, igniting and flashing through the four holes to the powder charge.

The main problem with the Lancaster system was the difficulty in achieving the perfect priming charge. If the charge were too heavy, the thin copper capsule could expand and rupture, and if it were too light, the flame would quench before it could flash through the four holes (Butler, p.174). These shells were also expensive, and could not be easily reloaded.

The first successful shotgun cartridges with centerfire primers were developed in France in the 1850's. In 1862 there was only one exhibition of centerfire shotguns and ammunition in the English International Exhibition of that year. A few years later the original British patent was broken and centerfire shotguns and ammunition became popular throughout Europe.

The situation in America was very different than that in Europe. The European shooters were, as a rule, wealthy sportsmen who could afford factory-loaded ammunition and looked upon handloading with disdain (Pollard, p.70). On the other hand, American shooters were a mixed lot, with a high percentage of the populace using guns, and needing to shoot them as economically as possible. As Butler puts it, "What Americans wanted was rugged reliable cartridge cases that could easily be reloaded during the evenings in preparation for the next day's shooting" (Butler, p.174). Metallic shotshells which could be reloaded indefinitely were the answer to the needs of the American shooters. One of the first successful American
shotshells was developed by a New York dentist named Edward Maynard. His first effort was merely a drawn brass cup with a soldered brass disc for a head. A regular percussion cup on a nipple was used for ignition, and the flame was directed through passages to a small hole punched in the center of the brass disc, igniting the powder.

Maynard's second shotshell, developed in 1873, was more sophisticated. A self-primed cartridge, it utilized a drawn brass cup soldered to a heavy turned brass head. A hollow anvil was riveted into the head, and the cartridge used Berdan-type primers (Primers without integral anvils). The spent primers could be pried out with a pointed tool and there are two cuts in the head to enable the shooter to do this. These shells were obviously designed to be reloaded, and they are quite heavy and durable. These brass shotshells could be used indefinitely if they were cleaned well after each shooting, for the low pressures of black powder didn't tend to wear down these cases.

Another early brass shotshell was the Draper shotshell patented in 1864. This complex shell consisted of three different machined, threaded parts. The brass tube was machined from a solid bar, and the thickness of its walls tapered from the base to the mouth, providing a good gas seal there. The nipple was hardened steel and threaded into the brass case. A regular pistol percussion cap was placed on this nipple to prime the case. Over the nipple, a machined brass head screwed into the case, completing the assembly. This cartridge must have been extremely expensive, but the heavy machined brass and steel would have made for an exceptionally durable case.

In the 1870's, cartridge manufacturers began producing brass shotshells in which the tube and the head were formed in one piece on sophisticated
drawing machinery. A Remington cartridge of this type was introduced in the 1870's and remained in production for the rest of the 1800's (Butler, p.177). These drawn-brass cases were superior to the older two-piece designs in strength, and were lighter. The priming was much the same in the first drawn-brass cases as in the earlier cases, using a hollow anvil riveted in the primer pocket with Berdan-type primers.

In the late 1870's an improvement was made on the one-piece shells in that the riveted steel anvil was discarded, and primers which contained their own anvils were used. Winchester began marketing these shells in 1877, and Remington had them by the 1880's (Butler, p.179). Another slight improvement which came out in the 1880's was serration of the case mouth. After the powder, wadding, shot, and over shot wad had been placed in the case, the brass fingers could be bent inward to retain the top wad. These cases had a shorter life than regular cases, because after extensive working of the brass, the points at the mouth would break off. Of course it would seem that the cases could be used as regular cases even after the tips broke, the mouth being crimped by simply rolling the edge slightly inwards over the top wad.

One must bear in mind, while considering the evolution of the shot-shell, that cartridges of many different types were being manufactured simultaneously. For example, the older drawn-brass cases with the riveted anvil were marketed alongside the one-piece shells for years, improvement notwithstanding; the shooter was given a choice.

Winchester introduced paper shotgun shells in 1877 which were sold unloaded (Butler, p.181). These shotshells consisted of a layered paper tube with a much shorter (.450") reinforcing tube inside, containing the paper
base wad. The thin, low brass head was swaged onto the paper assembly such that the primer pocket was formed in the brass. A regular centerfire rifle primer with anvil was used for ignition. By the 1880's, slight improvements had been made. The inner reinforcing tube had been extended to 3/4", and the primer was slightly more sophisticated, with a layer of foil covering the priming charge. These shells were mostly sold in 10 gauge during the 1870's and 1880's, but by the last part of the century, the smaller gauges gained popularity. Also in the 1880's, it became profitable for Winchester to offer loaded cartridges, which it did beginning in 1886, under the "Rival" trademark (Butler, p.181).

With the development of smokeless powder by the French chemists in the 1880's came great changes in the nature of firearms and ammunition. Because of the metallurgic weakness of 19th century shotguns, the first smokeless shotshell powders were deliberately degraded to be approximately equal in performance to black powder. These early smokeless shotshell powders were called "bulk smokeless." The Winchester "Leader" shotshell was developed to be used with the bulk smokeless powder. Ten, 12 and 16 gauge loadings were offered in the 1880's, with 8 and 20 gauge being marketed by 1900. These were very strong shells, with the inner paper tube extending far up the main layered paper tube, and the brass base was over an inch high, covering almost the entire powder charge. In the brass head were inscribed three shallow circumferential grooves which served to strengthen the head's attachment to the paper tube.

Ignition was a problem with early smokeless powders. The Leader shotshell used a rifle style primer which fit into the brass-lined primer pocket.
Handloaders were often forced to use a small amount of black powder over the primer to assist in igniting the smokeless powder.

An interesting transition in the ammunition business took place around the turn of the century. With smokeless powder gaining popularity, it became practical for most shooters to buy factory-loaded shotshells. This was due to the greater sophistication of modern shotshells, and the difficulty in loading reliable smokeless cartridges at home.

In the 1900's, there were many small loading companies which purchased components from the large manufacturers and put together high quality, reliable loads for the shooter. One of these which increased their manufacturing capabilities until they became a self-sufficient ammunition company was the Western Cartridge Company. The shells manufactured by Western in the early 1900's were fairly sophisticated. The paper tube contained a thick base wad, swaged to a fairly low brass base. There was no primer pocket lined with brass, however. A small battery-cup primer, which provided better ignition than the earlier rifle-style primers, fit in the primer cavity and projected into the inside of the shell. Flake smokeless powder was placed against the primer to aid in igniting the granular powder which made up the bulk of the propellant. A groove was inscribed in the head to lock it to the tube more securely. Western also utilized a triple wad column, with a cork wad between two fiber wads. Western was so successful in the ammunition business that it bought Winchester in the early 1930's, forming the Olin corporation Winchester-Western.

Probably the height of early 20th century shotshell technology was manifested in the Nitro Club steel-lined shotshell patented in 1912 by Remington. Brass-lined shells had been marketed by Winchester and Remington
since 1894, but Remington Nitro Club incorporated several advanced improvements. Besides the steel liner, which extended almost 1¾" up the inside of the paper tube and virtually eliminated gas blowouts, a large battery cup primer was used to ignite the small charge of dense smokeless powder. The base wad of wound paper was very thick and a groove was rolled into the high (over 1") base to lock the assembly together. These were the finest shotshells of the early decades in this century.

After 1920, the trend towards dense smokeless powders continued, as both primers and powders were improved. The first major development after that time was the development of non-corrosive priming, which was introduced by Remington under the "Kleanbore" name in the late 1920's. Cup wads, which provided superior gas sealing, were introduced in the 1930's. Remington developed the first successful polyethylene plastic shotshells in the late 1950's, and the first one-piece plastic "power-piston" wads a little later. Recent developments include premium shells loaded with copper-plated, buffered shot, and improvements in shotshell reloading equipment.

Thus has the shotshell grown up. By tracing its development, and establishing dates for each specific improvement, the archaeologist can establish the dates of occupation in a High Hollows site to within a few years, using the shotgun shells and cartridge cases he finds.
Remington drawn-brass case w/ riveted anvil

drawn brass case

One-piece drawn brass shell

serrated brass case mouth

early style paper case with brass-lined primer cap

later paper case with brass-lined primer

brass case
Lefaucheux pin-fire

Lancaster shot-shell

Maynard shot-shell

Later Maynard Shot-shell
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