



**PAULY SYSTEM DOUBLE GUN BY EUGENE PICHEREAU,
PARIS, the early 1820's.**

In 1812, Samuel Pauly patented and started to produce

1. the first breechloading percussion firearms;
2. the first percussion enclosed action firearms;
3. and the first breechloaded, self-obturing, separate-primed, centerfire metallic cartridge.

His cartridge had a specialized base called the "roustie", and, though strikingly modern, followed in a centuries-long tradition of front-loaded, reloadable metallic cartridges placed into the breech of guns, rifles, and pistols. For a look at this type of cartridge from the 14th century through 1870, see the James Freeman gun's information binder.

Pichereau was the manager of Pauly's Paris business in the early 1820's. His "patent" was to modify the Pauly cartridge, and his gun, to use the new and more reliable copper caps.

2.
Feel free to open the gun, but with care. First cock it using the external cocking levers (be careful both cocking the breech or action cover (the "bascule") using the ring above the end of the wrist. On the floor of the action, you'll see the hammers, which are the ends of the tumblocks. The breech openings look like a modern shotgun; note the notches for extraction, for which a special tool was supplied which will be in line with the hammers when the action is closed. In the roof of the bascule there are two long firing pins. The only difference between the action of "Pichereau's Improvement" and pre-copper cap era Pauly guns is the placement of the firing pins, which leave room for a copper cap nipple on the base of the reloadable cartridge. Please carefully close the gun when you're finished.

Matthew Schneiderman

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SAMUEL PAULY AND I: AN IGNITION ODYSSEY

by Matthew Schneiderman

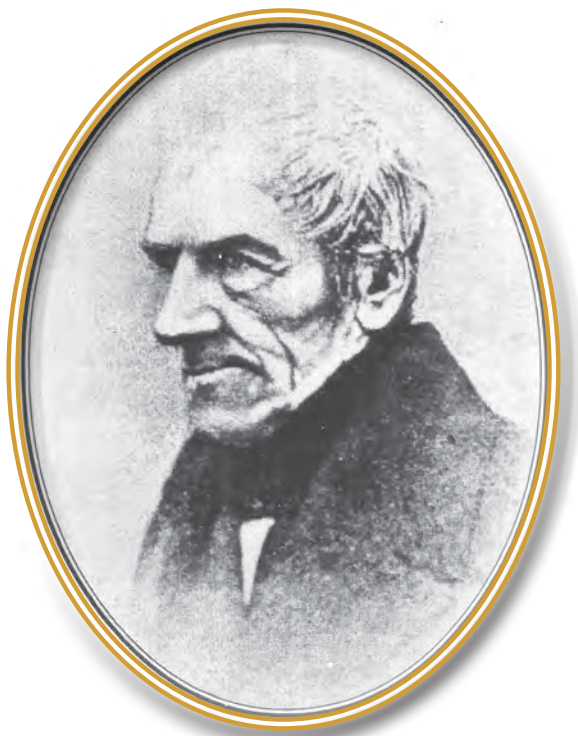


FIGURE 1: Alexander Forsyth.

Two men created the foundation for the function of almost all modern firearms. The first is Alexander Forsyth, whom we all know (Figure 1). In 1807, he patented the basic idea of using fulminates¹ to ignite firearms.² If this patent protection had lasted for 200 years instead of the usual 14, his descendants would be the richest people on earth. He is the father of modern ignition.

The second is Samuel Pauly, whom many people don't know (Figure 2). In 1812, he invented the first percussion breechloading firearms and (most important) the first center-fire cartridge. He is the father of modern ammunition. My primary goal for this talk is to introduce you to Samuel, his work, and his legacy.



FIGURE 2: Samuel Pauly.

My second goal is to share some stories and travel photos from a collecting and research trip that changed my thinking about the classification of firearms ignition. Here's the traditional outline:

Hand cannon.
Matchlock.
Wheellock.
Snaphaunce.
Miquelet.
Flintlock.
Percussion.
Cartridge.

In this view, each type of firearm is separate. Instead, I'll suggest that firearms centuries apart belong to families related in fundamental ways.



FIGURE 3: The Freeman gun. (Photo: Dan Retting)

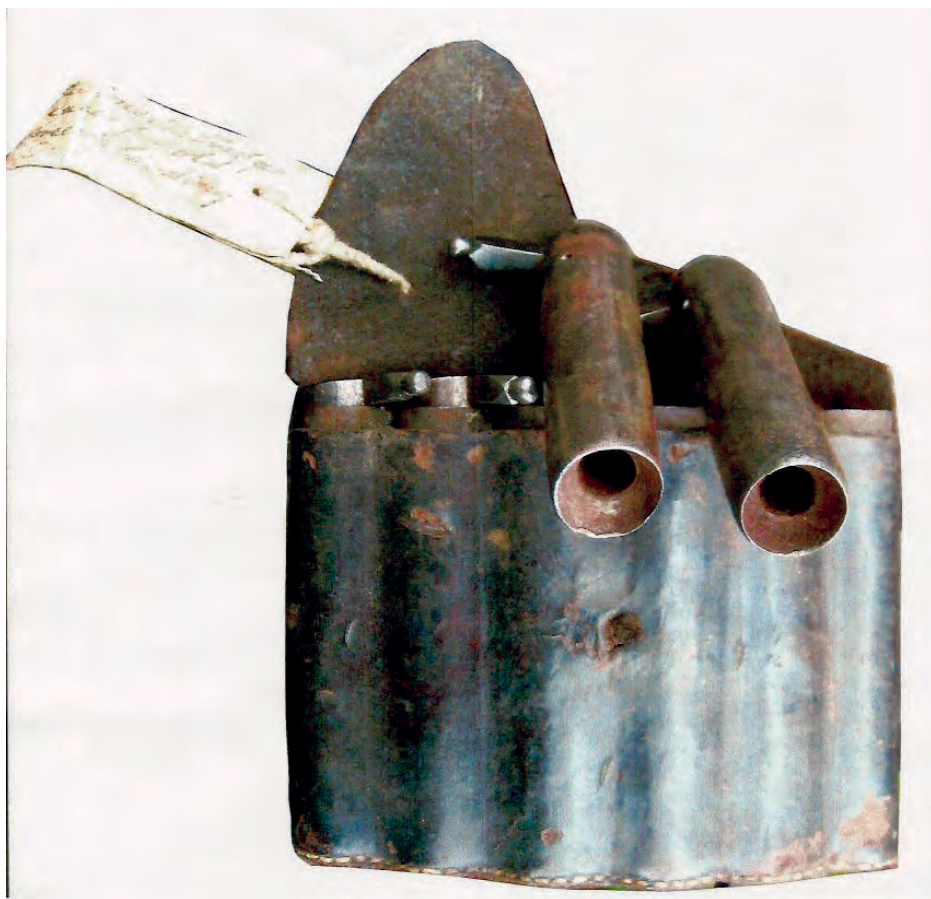


FIGURE 4: The Freeman gun's reloadable iron cartridge. The lug at the end allows alignment of the barrels and cartridge's touchholes. (Photo: Bolk Antiques)



FIGURE 5: The Freeman gun's 4 1/2" cartridge fully removed. Note the breech open, with a cutout for the alignment lug. (Photo: Dan Retting)

FIGURE 6: A small leather holster containing a group of reloadable cartridges (designed for a different gun, with a different alignment structure). Note the touchholes. (Photo: Craig Ross)



The Freeman Gun

In 2009, I bought the gun shown in Figure 3. It's an English breechloading flintlock gun from the 1720s by James Paul Freeman, who worked in London from 1716 to 1736. When the trigger guard is pulled back, the barrel can tilt up, disgorging a cartridge (Figure 4). It's iron, front-loaded (like a mini-muzzleloader), and lugged to line up its own touchhole with the touchhole of the barrel (Figure 5). Originally it came with pre-loaded siblings in a small leather holster (Figure 6), which allowed rapid fire. The Freeman cartridge surprised me, and it started this project.

I then discovered that similar pistols and guns were made as far back as the 16th century, both in England and on the Continent. This is the oldest and longest-serving of the many early breechloading systems. There are matchlocks and wheellocks with such cartridges.³ In the flintlock era, some were made like the Freeman, using a simple tube with a touchhole. Others were made with an integral frizzen and pan (Figure 7). Breechloading percussion firearms using similar reloadable metallic cartridges continued in the 19th century (Figures 8, 9), the cartridges often residing now in cases, as late as the 1870s (Figures 10, 11). Intrigued by a "cartridge era" that I now realized started in the 1500s, I kept reading, and learned much more than I'd previously known about Samuel Pauly.⁴



FIGURE 7: A reloadable cartridge with integral pan and frizzen. (Vienna, circa 1650.) (Photo: Dan Retting)



FIGURE 8: A reloadable cartridge with copper-cap nipple, constructed for an external hammer.



FIGURE 9: Another cartridge with copper-cap nipple, constructed in-line for an internal striker. Note the unusual design choice, placing a rear sight on each cartridge. (Photo: Peter Bower)

The Pauly System

Pauly was born in Berne, Switzerland, in 1766, and as a young man served in the Swiss artillery, rising from Sergeant-Major to Colonel.⁵ For most historical figures in the gun world, we find only facts. For Pauly, we also find some personality. He was an adventurer, a balloonist. He was not a gunmaker, but instead, in his patents, called himself an "engineer," in the 19th century a word meaning inventor, designer, and creator of machines. Legal records show his unpleasant side.

He moved to Paris in 1808, and entered the firearms industry, working with the gunmaker Prelat, at the highly unusual age of 42. In 1812 he opened his own business to make and market the guns and pistols he patented⁶ (Figure 12). You'll see how incredibly modern they were for that time. All these firearms are breechloaders, with the pistols and very rare rifled carbines breaking open and their barrels tilting down (Figures 13, 14). The double guns have a rising breech or action cover, which he called



FIGURE 10: Cased Sylvester H. Roper revolving shotgun, U.S. patent from 1866, produced through 1876. It uses separate-primed, reloadable steel cartridges, seen muzzle-down and on their sides at the left. (Photo: Rock Island Auction)



FIGURE 11: A group of Roper revolving shotgun and rifle cartridges. Lower left: earlier, with copper-cap-primed nipple. Top: later, using assorted primers pressed into the base. Bottom right: the open muzzle end, for loading. (Photos: Pete deCoux)

the “bascule.” (Figures 15, 16). All have external cocking levers and either internal strikers (the pistols) or hammers (the guns).⁸ They are the earliest percussion enclosed action firearms. Note that in the double guns, the tumbler also serves as the hammer (Figure 17), hitting a long firing pin that then strikes the base of the cartridge (Figure 18).¹⁰

This cartridge was Pauly’s major advance. Some of the double guns use a paper cartridge attached to a special brass base (Figure 19). Other double guns, and all the pistols and carbines, are in the same breechloading family as the Freeman gun, using a front-loaded brass cartridge with the same base, the “rosette,” the key to his design. In the center of the rosette, there’s a small indentation or cup (the “bassinet”) with a hole (the ignition channel) in the middle. Into this cup went the fulminate, ready for the striker or firing pin. Rosettes used with paper cartridges

are made with a screw to hold a felt base and anchor the paper; the ignition channel transverses the center of the screw (Figure 20). Each owner of a paper-cartridge gun would use a special tool set to construct the cartridges (Figure 21).¹² In the brass cartridges, the rosettes are part of the construction and don’t require the screw.

Neither the articles nor the collectors I’ve consulted know what a Pauly system primer looked like. The English gunmaker John Deane, in 1858,¹³ called the Pauly primer “fulminate of mercury in powder.” He was almost certainly wrong about the mercury. “Forsyth’s Percussive Powder,” from 1807, used potassium chlorate (potash), sulfur, and charcoal, in the same proportions as gunpowder (75%-12.5%-12.5%), with gunpowder’s potassium nitrate (salt-peter) being replaced.¹⁴ Other literature agrees with the early use of potassium chlorate rather than mercury, and it’s very likely Pauly used the same formula.

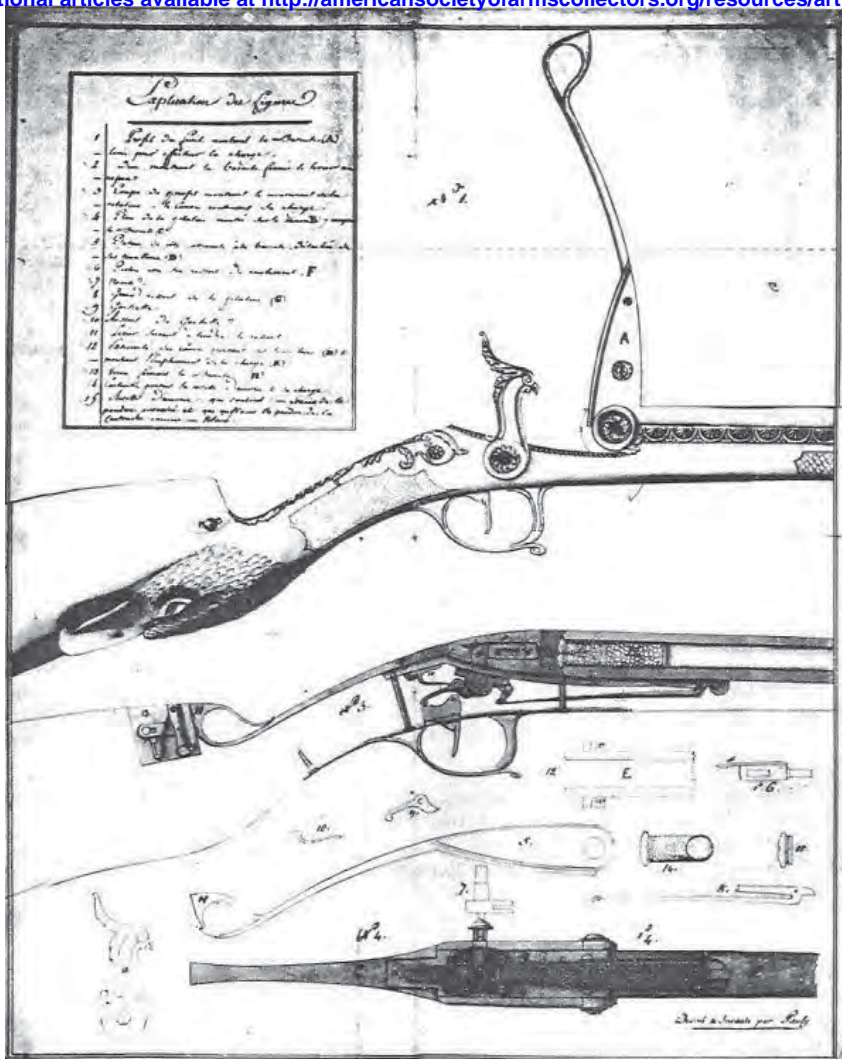


FIGURE 12:
Pauly's French patent. ⁷



FIGURE 13: A Pauly pistol, closed.
Note the external cocking lever. ⁵ Winant, p. 26.

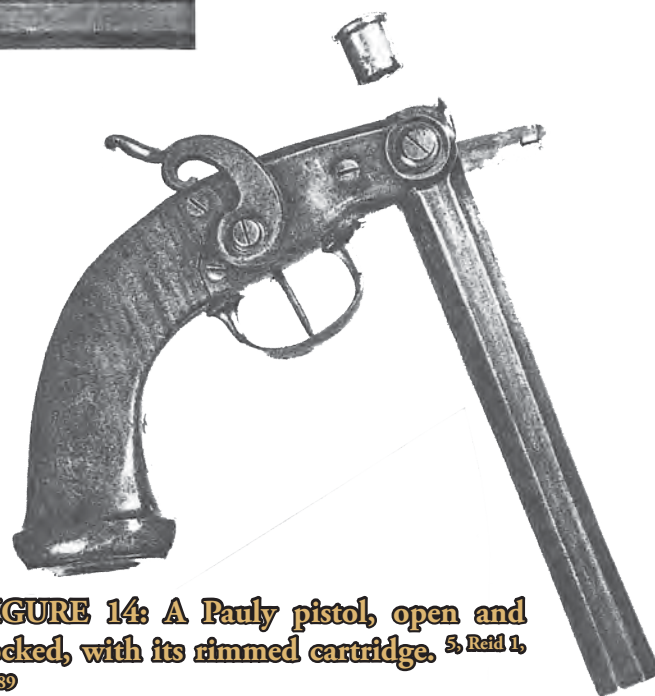


FIGURE 14: A Pauly pistol, open and
cocked, with its rimmed cartridge. ⁵ Reid 1,
p.189



FIGURE 15: A Pauly system double gun, breech cover ("bascule") closed. Note the ring above the end of the wrist, for opening the action. (Photo: Dan Retting)



FIGURE 16: The "bascule" partly open. (Photo: Dan Retting)



FIGURE 17: Inside the double gun action. **RIGHT:** Hammers (the protruding ends of the tumblers) cocked. **MIDDLE:** Breech openings for rimmed cartridges. **LEFT:** The bascule fully raised, with the spring-controlled firing pins. With the action closed, the firing pins will be within reach of the hammers. (Photo: Dan Retting)

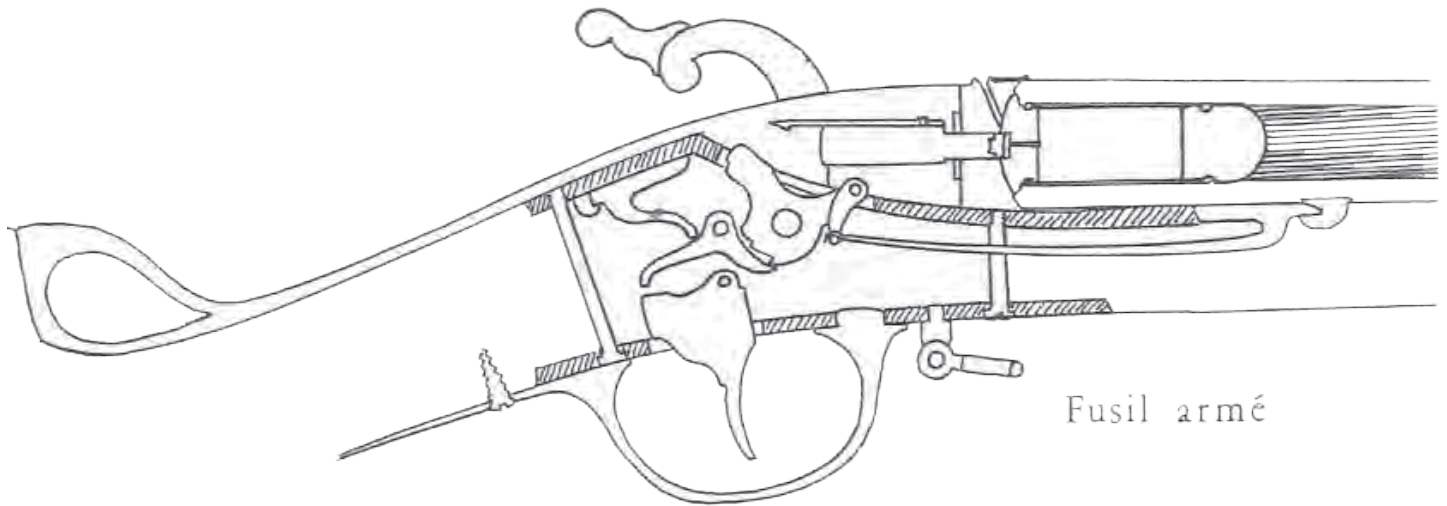


FIGURE 18: A schematic view of the closed Pauly action cocked, showing how the end of the tumbler, acting as the hammer, will strike the firing pin. (In the drawing, between the end of the firing pin and the cartridge is the ignition channel, not a small pin.)⁹



FIGURE 19: A Pauly gun paper cartridge, with the brass base ("rosette") seen from the side. (Photo: Jim Gooding)

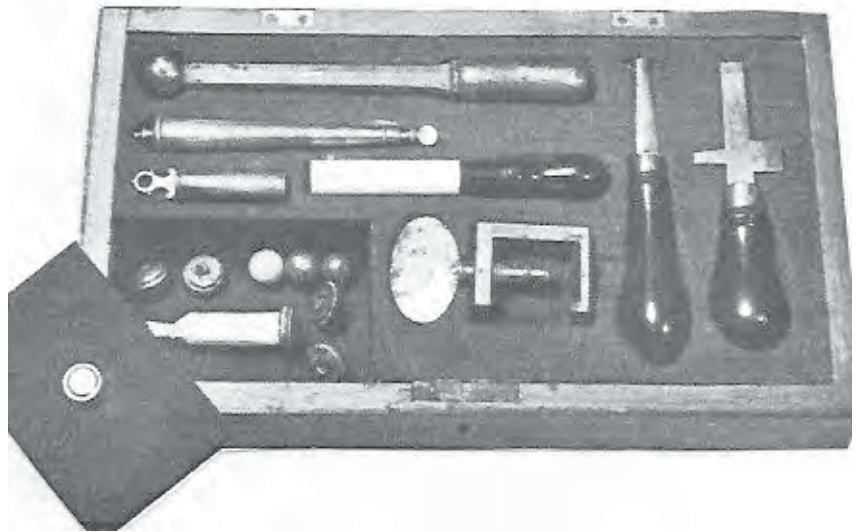
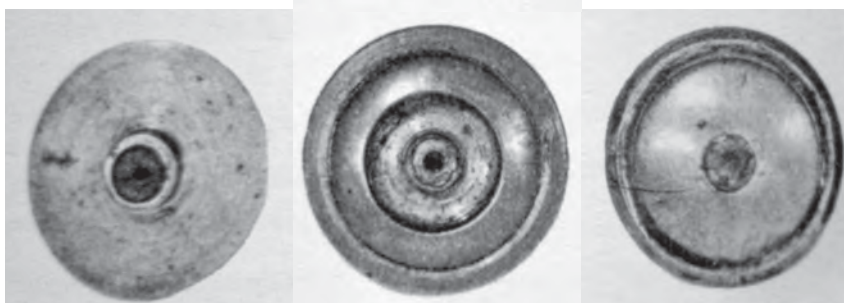


FIGURE 21: The tool kit for making the paper cartridge for some Pauly double guns.¹²



FIGURE 20: Top: the inside of a paper cartridge rosette. The screw helps attach the rosette and cartridge. The ignition channel passes through the center of the screw.



Bottom: three rosettes, each with a different form of bassinet (the central depression where the fulminate is placed). (Photo: Craig Ross¹¹)

Also, Deane can't be correct about the form of the primer: powder wouldn't stay in the rosette. Others say "wafer," "pellet," "capsule," or "fulminating paper cap" (each too vague). The most entertaining suggestion I've read is "blob." The most likely to be correct is "fulminate primer enclosed in wax".¹⁵ I believe the system used a sticky pill.

Pauly also understood and attempted to design expansion of the brass case to minimize gas leak, and he added a rim to aid gas seal, extraction, and positioning. He had created the first breechloaded, self-obturator, separate-primed, centerfire, metallic cartridge.

Pauly firearms worked, and the guns are said to have been fairly popular with sportsmen. They were accurate, and fired rapidly. Pauly tried hard to interest the military, but was rejected: the guns were too complex. The fulminate tended to fall out of the rosette, was prone to accidental ignition, and probably wasn't the easiest thing to handle.

Pauly moved to London in 1814. There are English-marked Pauly firearms, but things didn't go so well there. Much of his energy went into a spectacularly failed attempt to design and fly a balloon ("The Dolphin") in partnership with the gunmaker Durs Egg (Figure 22). This was followed by a 3-year, nasty lawsuit,¹⁶ obscurity, and death (date unknown, but sometime in the early 1820s).

However, back in Paris, the business continued, run by a succession of managers, selling guns marked "Systeme..." or "Invention Pauly." First was Henri Roux, for the remainder of the 1810s. Next was Eugene Pichereau, in the first half of the 1820s. Pichereau's "patent" improvement (Figure 23) was to replace the rosette and its unstable sticky "blob" of fulminate with a copper cap nipple

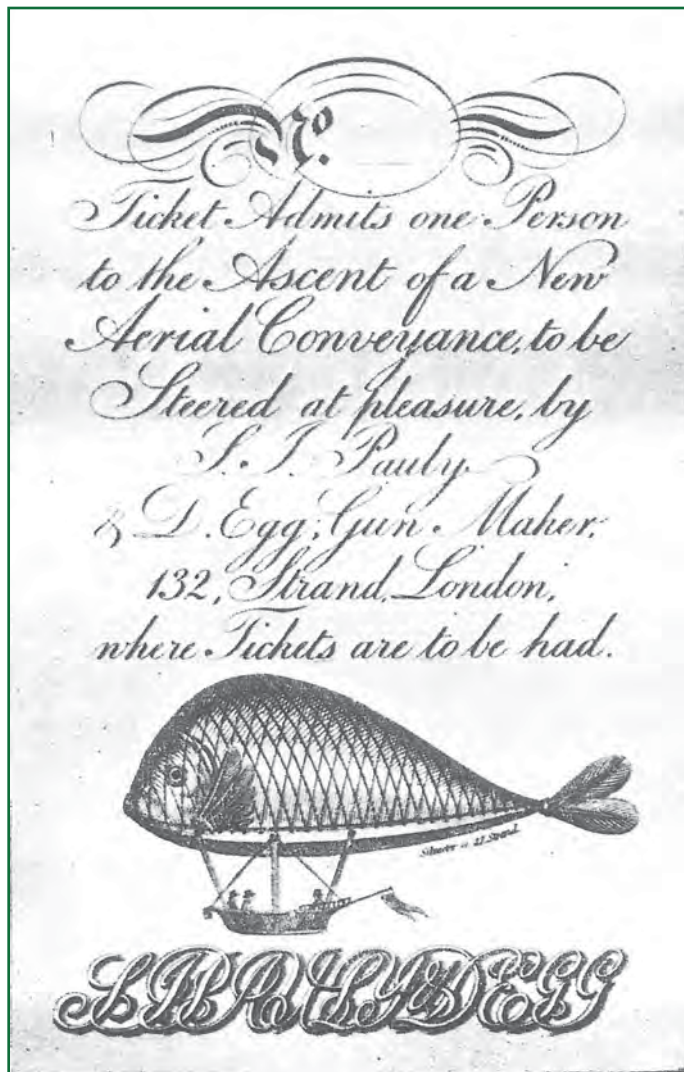


FIGURE 22: Admission ticket for the flight of the Dolphin, which never took place. ^{5, Reid 1, p. 195.}

on the base of the copper cartridge, which he did very soon after the appearance of copper caps (about 1819 or 1820). (Figures 24, 25). His guns are often marked "Invention Pauly Perfectionne,"¹⁷ in dual homage to both

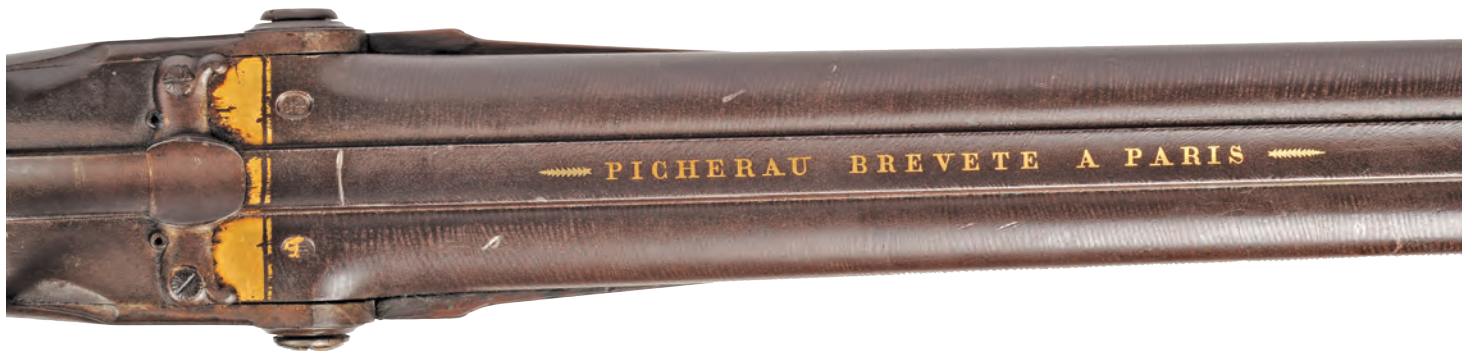


FIGURE 23: Pichereau Pauly-system double gun. ("Brevete" means patent.)
(Photo: Dan Retting)

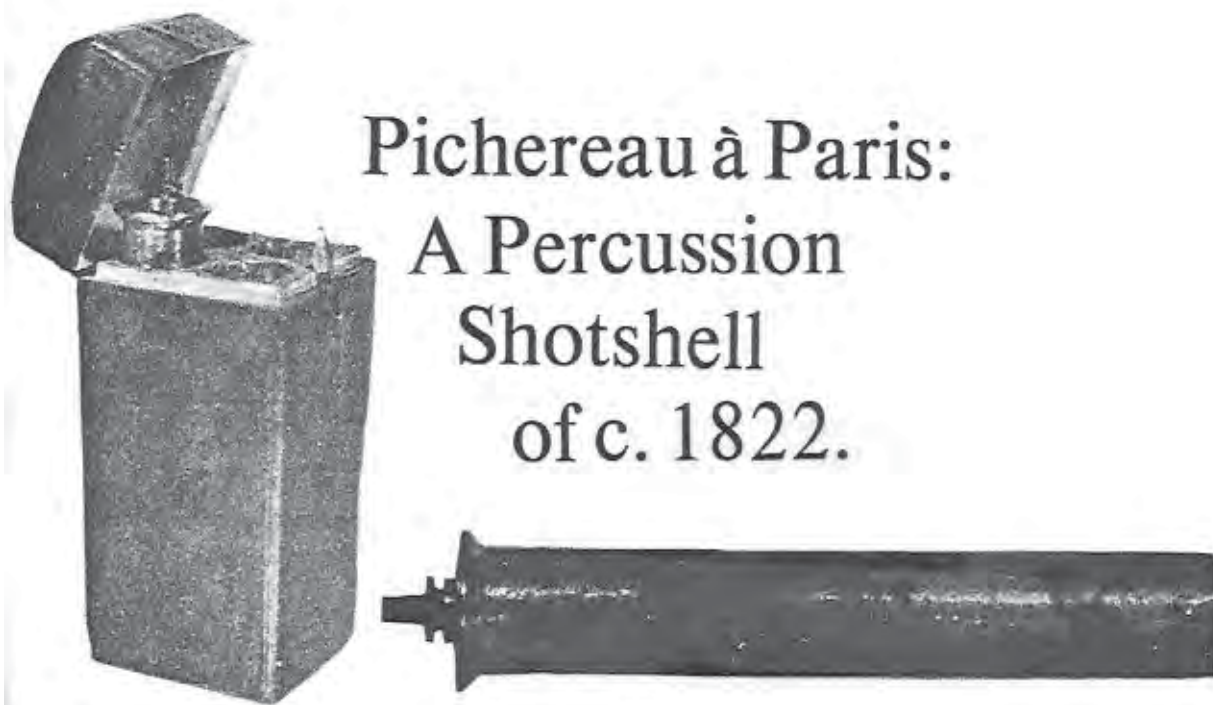


FIGURE 24: Pichereau copper-cap metallic cartridge, with case, used in 1820s Pauly system guns redesigned to accommodate the long nipple. (It would not fit the earlier guns shown in Figures 20 and 21 because their firing pins sit too close to the cartridge.) ^{17, p. 81.}

Pauly and himself. Finally, in 1826, there was Casimir Le-faucheaux, who'd worked in the business for years before running it. Another familiar name worked for Pauly as a lockmaker, before returning to his native Germany (and fame) in 1814: Johann Nikolas von Dreyse. These men, employed by Pauly and exposed to his ideas, invented two of the major steps between the Pauly system and modern inside-primed metallic cartridge ammunition: the pin-fire system, and needlefire. Pauly was ahead of his time, and a genius, but not the isolated, forgotten genius he's sometimes called. Pauly founded an active, direct line of ammunition research and invention, with results we continue to use today.

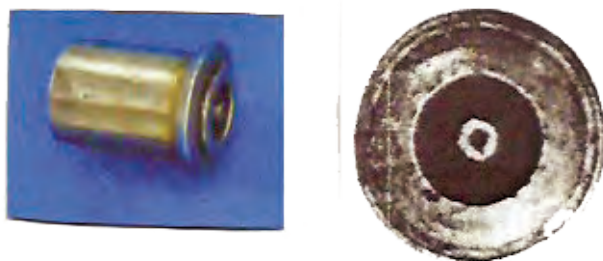
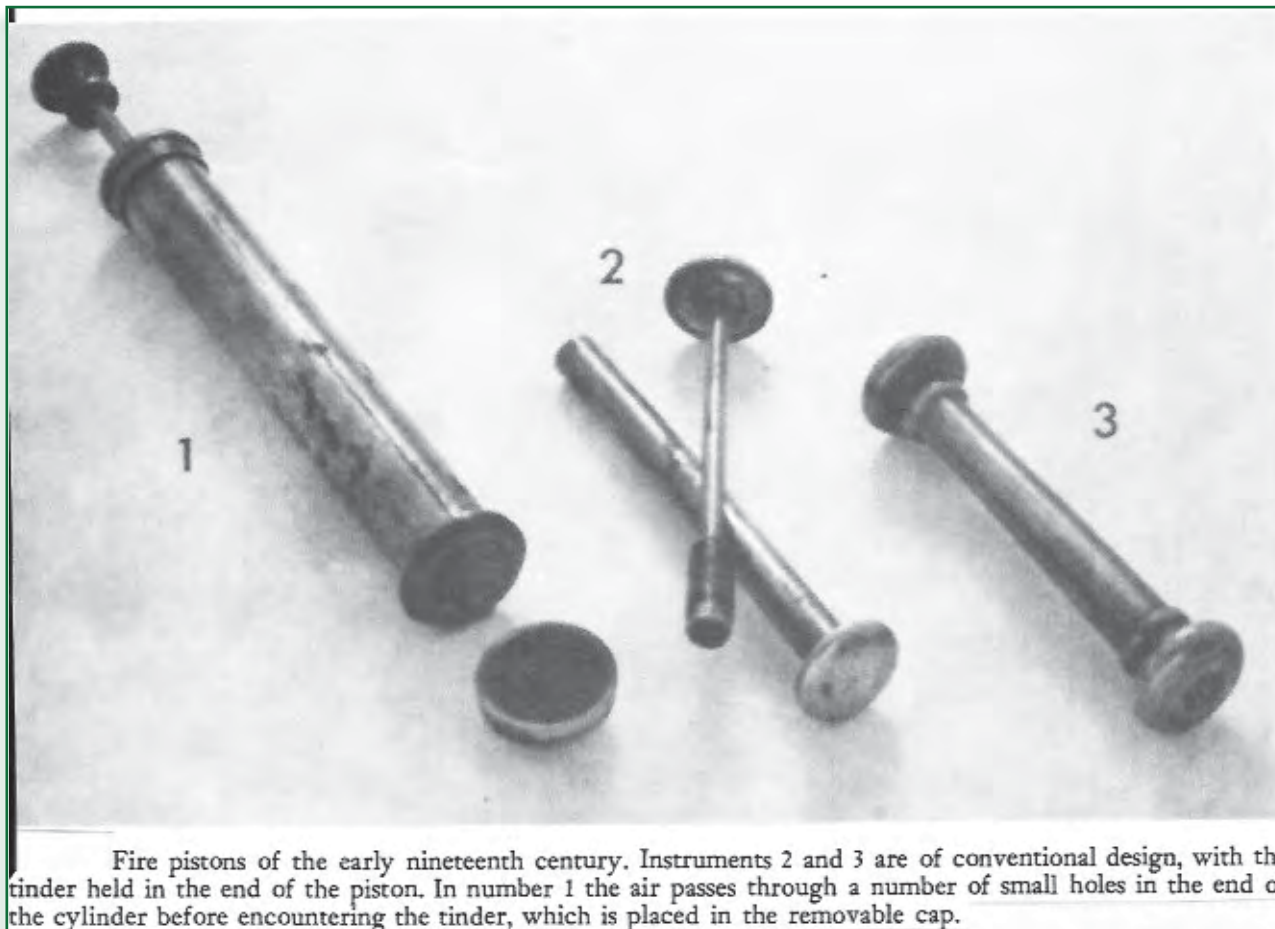


FIGURE 25: 1820s Pauly cartridges for copper caps. The recessed nipples allow use in and "conversion" of standard, early Pauly firearms from before 1820. (Photos: Bolk Antiques ²⁵)

A Second Pauly System: The Fire Piston

Following Samuel's trail in London, I discovered his strange British patents.¹⁸ Described as using an "Apparatus for Discharging Fire-Arms by Means of Compressed Air," the few known pistols covered by these patents are not air guns, but firearms ignited by a fire piston (Figure 26). Fire pistons are fire-starters, and have been used for centuries in various forms.¹⁹ At the start of the 19th century, they were an active topic of scientific research and popular discussion.²⁰ It's no surprise that Pauly knew about this idea. A fire piston is made of air; a tube that's closed, or has only a tiny hole at the bottom; and a close-fitting piston. Having drawn up the piston to the top, you then vigorously push it downward into the tube. The air column can't escape and is rapidly compressed. The muscle energy you use to plunge the piston can't just disappear (that's NOT ALLOWED by the first law of thermodynamics).²¹ Instead, it heats the air that's been compressed, raising its temperature A LOT — by about 100 °F ²⁰ or more (400+ °F per Wikipedia). In a fire starter, this very hot air ignites tinder placed at the tip. In the Pauly fire-piston pistol, the hot air stream exits a tiny hole in the center of the breech end of the action (Figure 27). What happens next? The literature says that a primer is still required in the bassinet (the cup in the center of the rosette), between the hot air stream and the main charge in the cartridge, but dis-



Fire pistons of the early nineteenth century. Instruments 2 and 3 are of conventional design, with the tinder held in the end of the piston. In number 1 the air passes through a number of small holes in the end of the cylinder before encountering the tinder, which is placed in the removable cap.

FIGURE 26: Photo: 20, plate 1

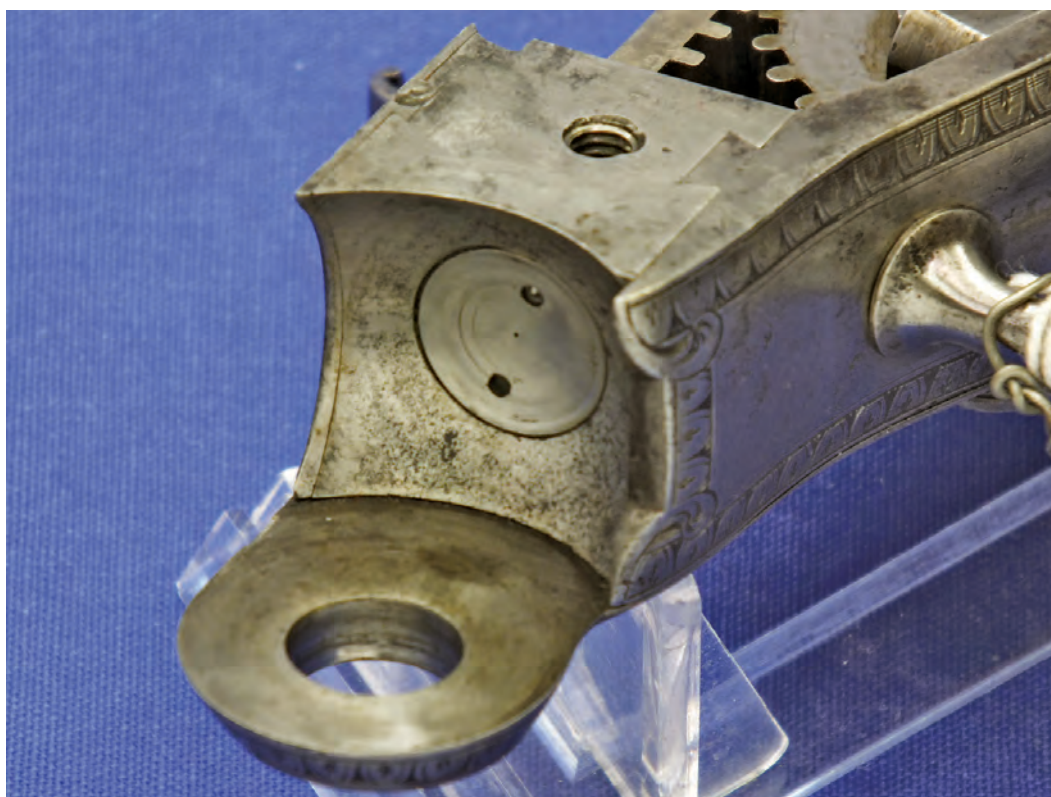


FIGURE 27: The breech end of the fire piston action, showing the tiny central hole for the hot air stream. (The two larger holes are for screws.) (Photo: Bolk Antiques)

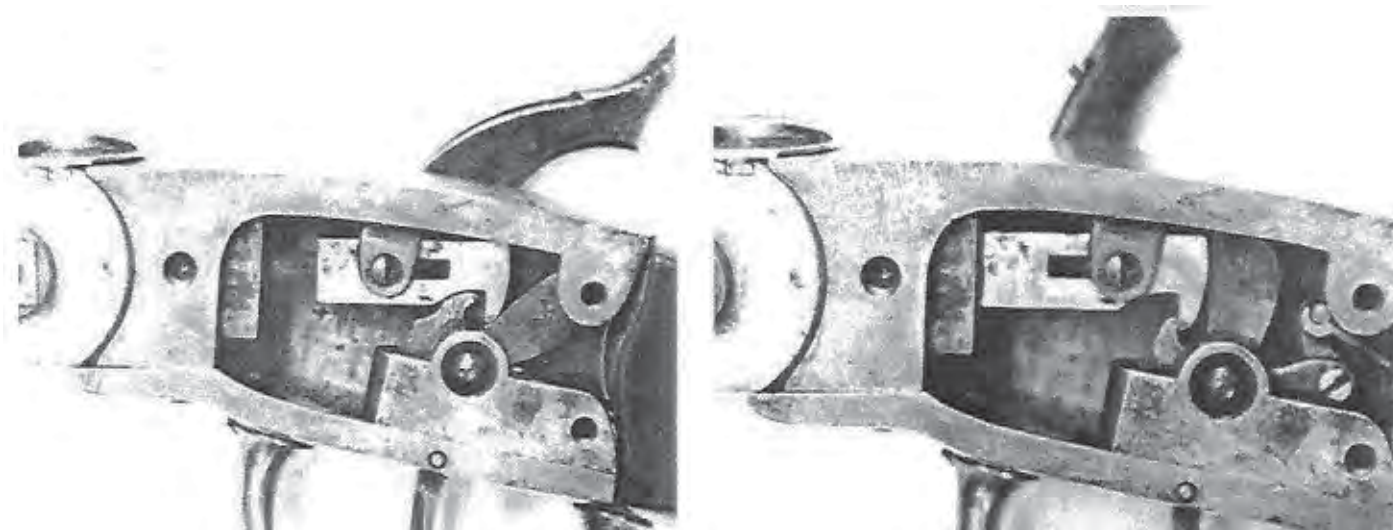


FIGURE 28: Standard Pauly pistol mechanical action, cocked (left) and fired (right). 25, p. 89.



FIGURE 29: Pauly fire-piston pistol action, cocked. Note the piston plunger, and gearing. (Photo: Bolk Antiques)

agrees about its nature. Choices include fulminate (which makes no sense, fulminate igniting when struck not heated), a vague “explosive composition,”²² or “gunpowder covered by paper”²³ However, I believe that Pauly wanted to avoid sticking anything in the rosette, this being his original system’s weakness. I say the hot air steam ignites the gunpowder directly, through the hole in the center of the rosette.²⁴

On a table, both types of Pauly pistols look similar. When searching for the very rare fire piston pistol, remove the action cover (with permission). Standard Pauly pistols have a spring-driven striker. (Figure 28). The fire-piston pistols have spring-driven gears, and the piston is visible at full cock (Figure 29). Also, as we saw in Figure 27, you can open the breech and look for a fire piston exit hole instead of a striker. There are no known fire-piston longarms.

The Fire Piston, Continued

When I discussed this Pauly “discovery” with my friend Jas van Driel, he said, “That’s like the Daisy V/L!” Daisy marketed the V/L in 1968 and 1969.²⁶ It’s a .22 caliber single shot rifle (Figure 30), using caseless ammunition (Figure 31), with solid propellant attached to the back of the bullet. That propellant is ignited by a fire piston. Daisy was not licensed to sell firearms, but claimed that the V/L was an air rifle. The BATF correctly pointed out that in air rifles compressed air is the propellant, but in the V/L air provides ignition, which causes an explosion, so it’s clearly a FIRE-arm. The V/L quickly transitioned from product to collectable. When I asked friends the good question of where fire piston firearms fit in the classification of ignition systems, the answer was “miscellaneous.”



FIGURE 30: The Daisy V/L.
(Photo: internet, via Jas van Driel)



FIGURE 31: Daisy V/L ammunition, solid propellant attached to projectile.
(Photo: internet, via Jas van Driel)

The Electric Cannon

Finally, I found an issue of the journal *Arms Collecting* with Figure 32 on the cover.²⁷ In the 18th century, scientists were fascinated by the new idea of electricity, and made progress in understanding, creating, and using it. This electric cannon uses a brass tube filled with hydrogen, a projectile, and an electric sparking system. It was invented by Alessandro Volta in 1777; he also made pistols using the same design. The results are impressive.²⁸

In our century, there are some “electric trigger” firearms in which the hammer is released by an electric impulse (activated by a button) rather than the usual mechanical trigger mechanism. These continue to use fulminate ignition. There are also “electric ignition” firearms in which the heat of an electrified wire ignites an intermediate priming charge, which then explodes the main charge. (This is also how blasting caps work.) There is no fulminate. How do we classify guns like these?



FIGURE 32: Alessandro Volta's electric cannon. ²⁷p.46

A Revised Classification of Firearms Ignition

As a conclusion, I want to suggest a somewhat different way of describing firearms ignition and its history. Although I thought this up all by myself, I'm not the first to do so. The 1954 drawing in Figure 33 is by Herschel Logan, best known as the author of "*Underhammer Firearms*." ²⁹ Logan understands that "hand cannon" and matchlocks are in the same family, and I'll add that fire piston and electric ignition guns are their younger siblings. That family's surname is "Fire." He understands that wheellock and flint-lock firearms are fundamentally the same, and belong together. And he understands that the key feature of modern firearms, beginning in the 19th century, is fulminate ignition. What he doesn't make clear, and what my Freeman gun and its three centuries of relatives taught me, is that there is no "cartridge era." Cartridges have played a part in all stages of firearms development.

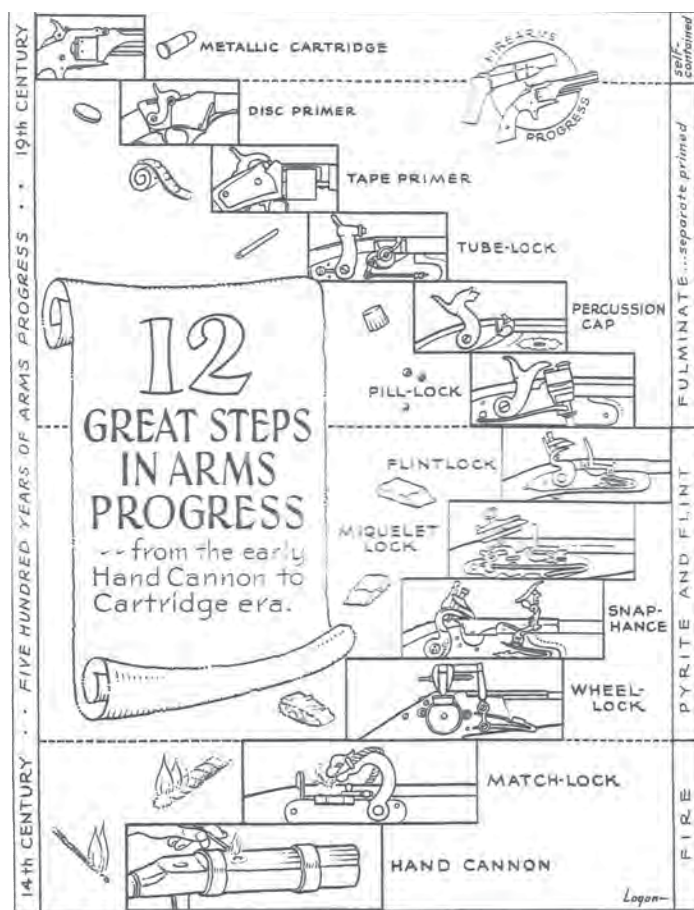


FIGURE 33: Herschel Logan's take on the history of firearms ignition.

SO, consider three basic families:

1. IGNITION BY DIRECT APPLICATION OF FIRE.

HANDGONNE (Formerly "hand cannon").³⁰

MATCHLOCK.

ARTILLERY into the 19th century.

FIRE PISTON IGNITION,

19th and 20th centuries.

ELECTRIC IGNITION GUNS,

both ancient and modern.

2. IGNITION BY STONE AND STEEL.³¹

WHEELLOCK:

Stone (pyrite) on rotating iron.

FLINT-LOCK :³² Falling stone (flint) on iron.

Snaphaunce.

Miquelet.

English lock.

Flintlock.

3. IGNITION BY FULMINATE.

(A.K.A. Ignition by Percussion.)

We live in and will remain firmly entrenched in the world of Ignition by Fulminate, Forsyth's patent, and Pauly's cartridge design, until the firearm itself is replaced by the Ray Gun and the Phaser.

I hope this talk has given you the pleasure of seeing some unusual firearms, and new recognition and appreciation of Samuel Pauly. I also hope you'll enjoy thinking about and perhaps discussing my reclassification of firearms ignition.

Acknowledgments

Thanks for research assistance, discussion, and photos to Will Adye-White, Ton and Richard Bolk, Peter Bower, Ted Bradstreet, John Burgoyne, Mike Carrick, Pete de-Coux, Geza Kerekffy, Martin Miller Jr., Dan Retting, Craig Ross, Joe Salter, and Jas van Driel. As always, I welcome questions and comments at mms615@yahoo.com

References and Notes

1. Fulminates are chemicals which explode when struck.
2. British patent # 3032, July 4, 1807. This patent still applies to almost all modern firearms. See Matthew Schneiderman, "The Forsyth Patent: An Anniversary Appreciation." *The Gun Report*, volume 53 (#2), July 2007, pp. 40-53.
3. For examples, see Howard L. Blackmore, *GUNS AND RIFLES OF THE WORLD*. Viking, New York, 1965, illustrations 349-357.
4. Pauly was a man of many names. He was born Samuel Johannes Pauly. In France, this became Samuel Jean. In his British patents, he's Jean Samuel. In one of his ballooning announcements, he's S.J.
5. The core articles on Pauly are by W. Reid, in the *Journal of the Arms & Armour Society*, volume II (1958): "Pauly, Gun-Designer", from # 9 (March), pp. 181-210; and "Pauly, A Postscript", from # 11 (September), pp. 254-258. In addition, chapter 2 in Lewis Winant's *EARLY PERCUSSION FIREARMS* (Bonanza books, New York, 1959) is worth a look: "Pauly Breech-loading Detonators", pp. 18-31.
6. French patent # 843, September 29, 1812. Pauly's Paris address was 4 Rue des Trois Freres.
7. J. R. Clergeau, "Le Fusil de Chasse de Pauly". *Les Arquebusiers de France*, Bulletin #4, July/August 1964, page 16.
8. A striker moves in a straight line, either horizontally or vertically, and a hammer moves through an arc. Either may be internal or external.
9. G. Demaison, "Le Fusil Pauly en 1812." *Les Arquebusiers de France*, Bulletin # 2, March/April 1964, p. 8.
10. Pauly's design was the second use of a firing pin. Forsyth's was first: in his original roller-primer design, the hammer hits the primer's short firing pin, which detonates the fulminate powder.
11. A.N.Kennard, *FRENCH PISTOLS AND SPORTING GUNS*. Country Life Books, London, 1972, page 58.
12. Warren Moore, *GUNS: THE DEVELOPMENT OF FIREARMS, AIRGUNS AND CARTRIDGES*. Grosset & Dunlap, New York, 1963, page 56.
13. John Deane, *DEANES' MANUAL OF THE HISTORY AND SCIENCE OF FIREARMS*. London, 1858, page 168.
14. D.H.L. Back, *GREAT BRITISH GUNMAKERS FORSYTH & Co. PATENT GUNMAKERS 1806-1852*. Historical Firearms, U.K., 1995, p.140.
15. Jean Martin, *ARMES A FEU DE L'ARMEE FRANCAIS 1860 a 1940*. Editions Crepin- Leblond, Paris, 1974, page 108. "...l'amorce fulminante enrobee de cire..."
16. Claude Blair, "Egg v Pauly." *Journal of the Arms & Armour Society* Volume VI #1 (March 1968), pp. 9-27.
17. "Pauly's Invention Perfected." See John Belton, "Pichereau a Paris: A Percussion Shotshell of c. 1822." *Canadian Journal Arms Collecting* Volume 15 #3 (August 1977), pp. 81-83.
18. British patents # 3833, August 4, 1814, and # 4026, May 14, 1816.
19. For a short video showing the explosive use of a large fire piston, see www.thenakedscientists.com/html/content/kitchenscience/exp/fire-piston-1/
20. Robert Fox, "The Fire Piston and Its Origins in Europe." *Technology and Culture*, volume 10, #3 (July 1969), pp. 355-370.
21. Energy can be neither created nor destroyed, but can change forms.
22. W. Keith Neal and D.H.L. Back, *THE MANTONS: GUNMAKERS*. Herbert Jenkins, London, 1967, page 269.
23. Howard L. Blackmore, *GUNS AND RIFLES OF THE WORLD*. Viking, New York, 1965, p. 67.
24. The patent is also quite clear on this, stating that the air stream ignites the powder directly.
25. Herbert G. Houze, "A Cased Pair of Pauly Percussion Pistols." *Arms Gazette*, June 1977, pages 38-39.
26. The product name "V/L" was chosen in honor of the inventor, Jules Van Langenhorn.
27. Howard L. Blackmore, "English Instrument Makers: Airguns and Electric Guns." *Arms Collecting*, volume 31 (#2), pages 39-47.
28. For an entertaining video of the loading and firing of an electric cannon, see www.youtube.com/watch?v=Xm9oir5jyZo
29. *42 YEARS' SCRAPBOOK OF RARE ANCIENT FIREARMS*, compiled by F. Theodore Dexter. Warren F. Lewis, Publisher, Los Angeles, California, 1954. Frontispiece.
30. See Sean McLachlan's *MEDIEVAL HANDGONNES, THE FIRST BLACK POWDER INFANTRY WEAPONS*. Osprey Publishing Co., 2010.
31. True steel was hardly used at all in firearms until the 19th century. In spite of this, please allow me the pleasure of alliteration.
32. For the distinction between the flint-lock (the overall name for the several types of locks using flint and "steel") and the flintlock (one of such locks, invented in the second quarter of the 17th century and lasting into the 19th), see S. James Gooding's last published article, "A Note on Flint-locks, and the Flintlock." *Bulletin of the American Society of Arms Collectors*, # 105 (June 2012), pp. 29-41.