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More than Just Any Rock: On the Manufacture of Gunflints

"…the hunters in this country … commonly have miserable flint guns which snap continually and afford an excuse for not killing…" Journal of Nathaniel Wyeth, August 18, 1833[1].

Contrary to Wyeth's opinion, the flintlock proved to be a remarkably reliable technology for firearms ignition in use for well over two centuries. The earliest firearms, developed by at least the early 14th Century, did not use gunflints but were essentially crude hand cannons touched off with a match. These primitive firearms evolved into the matchlock ignition system. Although the matchlock proved to be a functional ignition system, keeping the match (a hemp cord) in readiness, often for long periods of time, proved both cumbersome and unreliable. An alternative system, the wheel-lock was devised in the early 1500's. With this system a piece of pyrite (actually marcasite), clamped in a spring-loaded vise, was held against a spinning steel wheel. Although the pyrite could throw a good shower of sparks, pyrite is relatively soft and abrades quickly, thus requiring frequent replacement. Due to its complexity, wheel-lock mechanisms were both expensive to fabricate, and were fragile and delicate. Thus this mechanism never found widespread use except amongst the wealthy. By the mid to late-1500's two primitive forms of the flintlock, the

Gunflint Terminology

Gunflint terminology used in the literature is often conflicting and the use of overlapping terms can be confusing. For the purposes of this paper, the following terms will be used as defined below:

Flint-any siliceous microcrystalline lithic material

Gunflint-any flint shaped such that it can be fitted in a gunlock.

Wedge-shaped gunflint-used in preference to the term gun-spall.

"D"-shaped gunflint-gunflints produced using flint blade techniques with secondary flaking around the sides and heel

Prismatic gunflints-rectangular gunflints produced using flint blade techniques with little secondary flaking on the sides or heel

snaphaunce and the miquelet locks, had been developed. Continued improvement of these ignition systems lead to fully evolved flintlocks by the mid-1600's, which then remained largely unchanged for the next two centuries.[2]

Any siliceous lithic material can be used for striking sparks from hardened steel. However, flint (which may variously be known as chalcedony, jasper, novaculite, chert, agate, etc. depending on color, occurrence and locality) possesses a number of properties which make it a superior material for striking sparks. Flint is composed of interlocking, microcrystalline, grains of silica, a form of quartz. Quartz has a hardness exceeding most hardened steels, so that when struck against hardened steel a minute amount of metal is scraped off and friction heated to incandescence.[3] Interlocking microcrystalline grains impart to flint great resistance to shattering, fracturing or spalling relative to other quartz bearing or quartzose materials. Even amongst those lithic materials described as flint, all do not perform equally well for striking sparks. Chemical and lithic impurities, the size and shape of microscopic void spaces, fracturing of the source material, as well as the nature of the microcrystalline grain boundaries within the flint influence the ultimate suitability of the material for use in gunlocks.

European flints occur in nature as both nodules and tabular bodies parallel to depositional beds in the Cretaceous age Chalk Group. The Chalk Group was deposited throughout parts of the British Isles, France, Germany, Belgium, Sweden, Denmark, across the southern Mediterranean countries and into Russia.[4] These flint deposits provided the raw material for gunflint production throughout Europe.

The early morphology of gunflints were quite primitive but developed as it became recognized that the quality of the lithic material and shape were significant factors in achieving reliable ignition. Many of the early flints used in the snaphaunce and miquelets were not subject to any systematic manufacturing process and likely took numerous shapes as long as they could be fit in the lock vise. Even as late as 1703 the French soldier, though provided with firearms, was responsible for obtaining his own flints through whatever means available.[5] Terminology specific to the shape and parts of a prismatic type of gunflint are shown below on Figure 1.

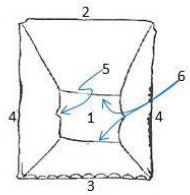

Figure 1. Parts of a Gunflint

1-Back; 2-Edge; 3-Heel; 4-Sides, 5-Bulbs or Knots, 6-Ribs. (Modified from Skertchly)

Gunflints were produced throughout Europe including Italy and Sicily[6], Germany, Belgium, Spain, France, England, [7] Albania and Turkey.[8] Prior to 1675, the earliest regularly manufactured flints are Nordic in origin. These primitive gunflints are bi-facially flaked and square to rectangular in shape. The edge is bilaterally symmetrical rather than beveled to one face. From about 1650 to 1700 the Nordic gunflints were made obsolete and replaced by wedge-shaped gunflints[9].

Wedge-shaped gunflints were derived from flakes of approximately the proper size and shape struck individually off a flint core. Each flake was relatively irregular in shape and some secondary percussion and pressure flaking would then be used to improve the form. These often have a convex bulge on one surface where the percussive blow of the flaker's hammer struck the core.[10] This method was an improvement over bi-facially flaked gunflints in that waste was reduced and productivity was increased. The manufacture of wedge-shaped gunflints was dominated by the Dutch and Belgium. Although both the English and French utilized this method in gunflint manufacture, they never attained the dominance reached by the Dutch gunflints.[11]

Figure 2. New and heavily worn French wedge-shaped gunflints (author's collection)

The French were first to rediscover the technique of striking long thin blades from a flint core. These flint blades were subsequently snapped into multiple gunflints. This method is more sophisticated than that used in production of wedge-shaped gunflints because it could produce gunflints of a more uniform size and shape, and also produced greater numbers of gunflints with less time and effort and with less waste material. Figure 3 shows flint blades as struck off a core.

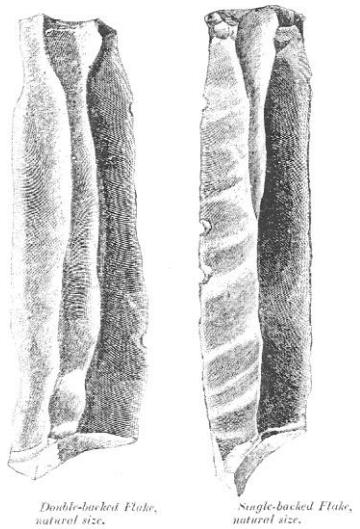

Figure 3. Flint blades struck from a core. Modified from Skertchly.

After individual sections were snapped off the flint blade, the French would use secondary pressure flaking applied to the heel and sides to produce the characteristic "D" shape of the French gunflints.[12] French gunflints manufactured using flint blade techniques start to appear by 1663 though the method may not have been perfected until the 1740's.[13] By means of this method a French worker was capable of knapping 500 or more gunflints a day.[14] The method was so advanced relative to production methods for wedge-shaped gunflints that French gunflints came to dominate in both Europe and North America until the end of the 18th Century. Archeological studies of British and American Revolutionary War military camps reveal that up to 95% of gunflints recovered from these sites were of French origin.[15] The production of gunflints by this method was considered a state secret.[16] The advantages in production by this method were so great that numerous attempts were made by other nations to obtain the method through industrial spying. One such attempt sponsored by the King of Prussia in the mid 1700's successfully stole the techniques and examples of the tools, though on applying the method, the local Prussian flints proved to be inadequate, shattering upon use in gunlocks.[17] The French method was published by Dolomieu in 1796[18] .

French centers of gunflint manufacturing and flint mining were located in the Seine and Marne River valleys in and around the villages of Couffy, Lye, Meusnes, La Roche-Guyon, Loir et Cher, and Noyers areas. In the Loir et Cher-Couffy-Lye-Meusnes area the flint beds were mined at depths of forty to fifty feet below the surface.[19] According to Dolomeiu, of the flint beds in the minable portion of the Chalk Group found in France, no more than one and seldom two beds in twenty contain flint acceptable for the manufacture of gunflints. [20] Figure 4 shows the principle flint mining and knapping districts of France and England.

French gunflints are generally composed of a honey-yellow or blond flint with color variations ranging to dark brown or grey (Figure 2). French flints often have white inclusions and or a chalky rind on one side. In France flint materials were referred to as silex. [21]

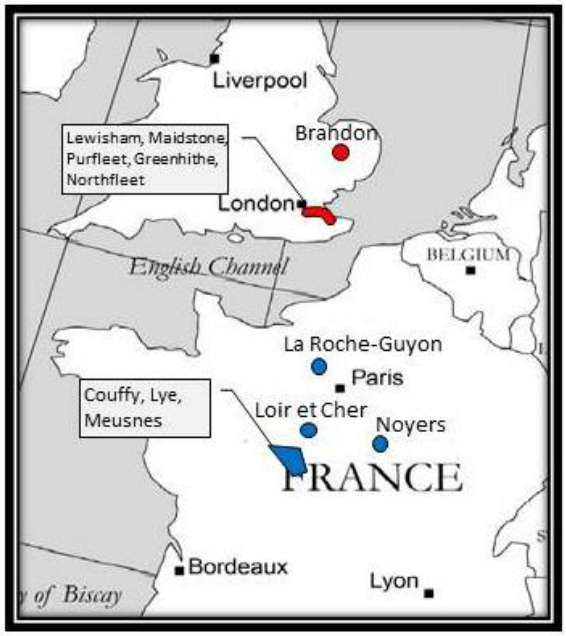

Figure 4 Principle flint mining and knapping centers of France and England.

The English acquired and improved on the French method starting in the 1790's. Prior to adoption of the French blade method, the English were produced the more primitive wedge-shaped gunflints. In his memoir on gunflint manufacturing Skertchly describes these as "Old English Gun-Flints."[22]

English manufacture of gunflints was centered on southeast England, specifically at Lewisham, Maidstone, Purfleet, Greenhithe, Northfleet[23] (Figure 4). After 1790 the manufacturers at Brandon dominated British production. The most favorable flint horizons mined by the English were present at depths of about thirty feet. The Brandon flints are typically black to dark grey in color, though colors range to greys and browns.

Due to high quality flint resources and superior manufacturing methods both English and French gunflints came to dominate the world gunflint trade. At its zenith the gunflint industry supported several hundred flint miners, flakers and knappers in southern Britain[24] and 800 workers in France[25] and was capable of producing millions of gunflints each year. In 1804 the British Board of Ordinance alone had contracts with seven suppliers to provide nearly 400,000 gunflints monthly.[26] With the adoption of the percussion ignition system in the 1820's and 1830's the industry went into decline with only five remaining gunflint knappers in Britain after World War II.[27]

As with all specialized forms of endeavor, gunflint production developed its own specialized vocabulary to distinguish the types and quality of the products. Sydney Skertchly, in 1879, described seven unique types of prismatic gunflints based on size and 32 subtypes based type of flint and product quality.[28] The unique types include: Swan, Musket, Carbine, Horse Pistol, Single, Double and Pocket Pistol.

According to Skertchly, the prismatic English gunflints come in three grades, being best, second and common. Best and second are gradational into each other and both of these are superior to common quality gunflints. Best and second quality gunflints have two ribs and a back as opposed to flints of common quality which have only a single rib and are lacking a back. Gunflints having a back were superior because they could be gripped more securely in the vise of the gunlock. Some English prismatic gunflints were produced with double edges and lacked the heel, thus could be reversed when the first edge became worn.[29]

Figure 5. Comparison of the plan and profile views of a best and common quality gunflint (Modified from Skertchly)

Gunflints manufactured from quality flint materials were capable of lasting for many successive firings. Skertchly tested a new Brandon gunflint and found that it functioned as reliably at the end of a test of 100 firings as at the beginning.[30] The1842 U.S. Army Ordnance Manual specified that gunflints should remain functional for 50 firings.[31]

Subsequent to the 1790's, English gunflints generally came to dominate in North America for several reasons. With adoption and improvement of the French Blade Method, the English gunflint manufacturers gained a production advantage over their French peers. Then a series of wars between Britain and France between the years 1782 and 1815 greatly limited the ability of the French manufactures to export their product due to British blockades of French seaports, as well as a ban imposed on the export of this critical war material by Napoleon.[32] It should be noted that at some North American sites, French gunflints still dominate or represent a major portion of the gunflints found, even at sites dated to the middle 1800's. This conundrum can be explained for some sites such as Fort Brooke, which received supplies of French gunflints from U.S. military stockpiles[33] and at other sites such as at the Grignon and Porlier's Trading Post (Lake Butte Des Morts, Wisconsin) by the liquidation of stockpiles of French gunflints as obsolete surplus after the widespread adaption of percussion weapons throughout Europe.[34] Also, there continued to be a perception that French flint was superior to English flint for manufacture of gunflints. Blades of French flint were exported to England where it was then worked into English shaped gunflints by Brandon knappers.[35]

Figure 6. New condition English prismatic and French D-shaped gunflints. (author's collection)

Skertchly provides a detailed description of the process of manufacturing prismatic gunflints at Brandon during the 1870's[36]. Raw flint was mined locally using hand methods. Explosives and other mechanized methods were not used because gunflint production was conducted as a low-capital, cottage-type industry. Also, the use of explosives would have produced undesirable fracturing in the brittle flint materials.

There were three primary steps in working the raw flint to produce gunflints, quartering or cracking, flaking and knapping. In the quartering process, large masses of flint were broken down to a convenient size and proper shape to be used as a core for striking off blades.

Flaking was the most important step in the process, and required the most skill to do properly. In the flaking process, the core is struck with a steel hammer such that long narrow blades of flint with relatively uniform width and thickness are produced. Figure 7 shows a core with the

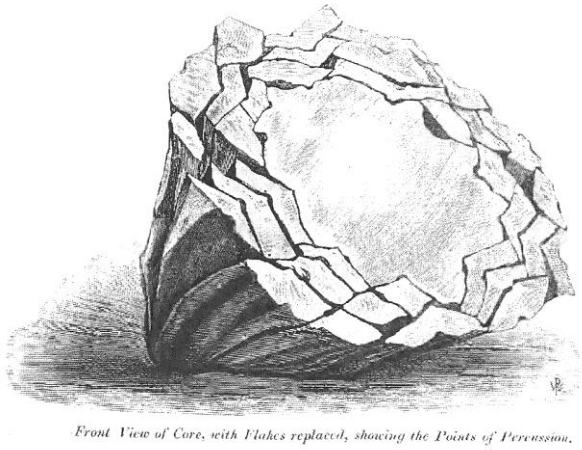

Figure 7. Flint Core showing how flakes might be struck off. Modified from Skertchly.

resultant flakes replaced. After each flake is struck off the core, some subsequent shaping may be required before the blade is ready to be knapped for gunflints. A skillful flaker was capable of generating flakes which produced a maximum number of gunflints of a specified size, for example if he is filling an order for carbine flints. A skillful flaker was also able to maximize the number of flakes with double-ribs, for producing flints of best and second quality. Figure 3 shows flint blades with double and single ribs ready for snapping into individual gunflints. An average flaker was capable of producing 7,000 to 8,000 flakes in a twelve-hour day, and a good flaker 10,000.

Knapping is the final step in gunflint manufacturing. Four to five gunflints could be obtained from each properly shaped blade with a minimum of secondary flaking. The knapping process required an iron stake set in a large block of wood. The flint blade is held against the stake and struck lightly with an iron hammer. By controlling the angle at which the blade is held against the stake and the offset of the hammer relative to the stake, the knapper could determine the width and angle at which individual gunflints are struck off the blade. Figure 6 shows how gunflints might be struck off a flint blade.

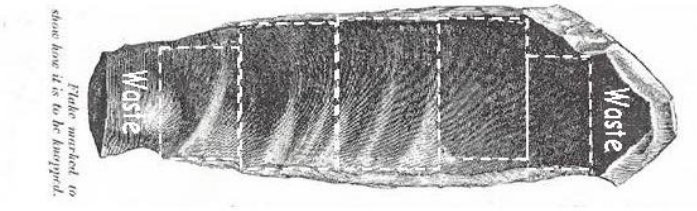

Figure 6. Possible layout of gunflints to be struck from a flint blade. Modified from Skertchly.

An expert knapper could produce gunflints at a rate of eleven to thirteen a minute for short periods. Over the course of a day (twelve hours), an average workman was capable of knapping 3,000 gunflints and an expert 4,000 or more.

During the Napoleonic Wars, a period when demand for gunflints was extraordinarily high, best musket gunflints had sold for as high as two guineas (~$9.70) per thousand. In 1837, a time when demand for gunflints was in decline due to widespread adoption of the percussion ignition system, Mitchell reports that best musket flints were selling for between 7 and 8 shillings per thousand flints ($1.70 to $1.95).[37] Prices received by the manufacturers per 1,000 gunflints in 1879, a time of greatly diminished demand, are shown on Table 1. These prices expressed in equivalent U.S. dollars range from 31¢ to 85¢ per thousand. (Conversion of British pounds to U.S. dollars based on a nearly constant 19th Century rate of $4.87.[38])

Table 1: Prices received by gunflint manufacturers (1879).

Type of gunflint	Price/1,000		
	Shilling	Pence	$ Equivalent
Second Muskets	3	6	0.85
Common Muskets	2	9	0.67
Spotted Muskets	2	6	0.61
Solid Grey Muskets	2	0	0.49
Second Carbine	3	4	0.81
Second Horse Pistol	2	9	0.67
Common Horse Pistol	1	8	0.41
Second Single	2	6	0.61
Second Double	1	6	0.31

When finished, gunflints were counted and then packaged in sacks or kegs containing from 5,000 to 20,000 flints.[39] If transported by ship, kegs or sacks of gunflints were frequently used in place of other forms of ballast.[40]

The end user of course paid much higher prices for gunflints. William Ashley contracted with Smith Jackson and Sublette to provide gunflints at rendezvous for 50¢/dozen (4.2 cents each).[41] Bent's Fort ledgers record gunflint costs given in both dollars and in pounds sterling. In 1838 1,000 were purchased for $4.50 whereas in 1841 several different lots were purchased with prices of $3.25, $3.75 and ~$6.22 per thousand[42].

Conclusions: Only flint of a high quality was suitable for producing gunflints which were reliable for firearms ignition. Gunflint morphology changed as flaking/knapping techniques were developed or reaquired, starting with bi-facially flaked gunflints, proceeding to wedge-shaped gunflints, D-shaped, blade-knapped gunflints, and ending with prismatic blade-knapped gunflints. Each change in shape and methodology was accompanied by improvements in production efficiency and reduced waste of raw material. With the change in knapping techniques came changes in regional production centers that dominated the industry. With the introduction of percussion ignition systems gunflint manufacturing went into decline and the art was nearly lost after World War II. Gunflints of the English prismatic form are still produced

today using both French and Brandon flints by English knappers for living history enthusiasts and reproduction arms aficionados.

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