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Nineteenth Century Gunflints from the Nepalese Armory

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Abstract
A sample from a stockpile of gunflints discarded by the Nepalese military in the early to middle 1800s shows that although Nepal obtained most of its munitions from Britain, the situation was complex. The Nepalese rapidly learned to manufacture their own guns, imitating or varying British patterns. However, gunflints were a necessary component of flintlock firearms that were obtained by most nations from a few European centers. Although most of the flints in the Nepalese armory are clearly of British origin, and some are French, a relatively small number of anomalous form and different material are probably of native manufacture, previously undocumented. Variation in quality also suggests multiple sources, some of which may have been black market or irregular. Different damage patterns represent wear and re-sharpening, fitting to guns, and use in flint-and-steel fire-starting. The flints reveal some patterns in the interaction of the British Empire with its colonial enterprises.

Keywords Gunflints · Nepal · East India Company · Firearms · Colonial trade

Introduction: Archaeology of Gunflints

The British Empire controlled a large part of the globe by the early nineteenth century. Relations with different fractions of this empire and the rest of the world varied from conquest and suppression, to largely commercial contacts. Some of the empire was effectively "outsourced" to commercial enterprises like the East India Company, which managed the full range of functions from trade to conquest and governance on the Indian subcontinent. But wherever the Empire operated, whether in trade or war, British muskets, familiar to us under the generalized colloquialism of "Brown Bess" were military necessities, symbols of power, and currency of exchange. A relatively

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numerous and well-organized military, armed with effective guns, created and maintained the empire. The muskets that blasted the British to imperial power resulted from Britain's leadership in the Industrial Revolution, but they relied for their ignition on gunflints produced by a technology descended from the Stone Age. As archaeological objects, gunflints provide information on military organization, provision and use of firearms, and relationships of exchange and even resistance within the British Empire.

Early archaeologists in Europe took notice of gunflints as remnants and analogs to prehistoric stone tools (e.g., Skertchly 1879), but current archaeological study of gunflints began in the United States with Hamilton (1964) and Witthoft's attempts (1966) to classify them by national origin for chronological purposes at historical sites in the United States. Witthoft's typology and ideas about gunflint origins were widely used but parts have been superseded by later knowledge. In general, the flints from the two major national industries, British and French, are consistent and identifiable, but there are overlaps, especially in the quality and color of the raw materials, so many assemblages include flints whose origins cannot be surely determined (Ballin 2012; Durst 2009; Watt and Horowitz 2017). At least the later stages of the British and French industries were very well documented, both by contemporary observers (e.g., Clarke 1935; de Mortillet 1908; Dolomieu 1797; Skertchly 1879; Smith 1960), and recent analyses (de Lotbiniere 1980, 1984; Emy 1978; White 1976; Whittaker 2001). Gunflints were also made in many other nations about whose industries we know much less (Ballin 2014a; Evans 1887; Roncal los Arcos et al. 1996; Woodall et al. 1997; Weiner 2016b), but most of these were not so widely traded, and are unlikely to be included in the assemblage under discussion.

Identification of the origin of gunflints has proven useful in archaeological discussions of chronology (Hamilton 1980; Hamilton and Emery 1988; Hamilton and Fry 1975), native and immigrant trade and access to imported goods (Watt and Horowitz 2017), and the history of weapon technology. In the case of a large assemblage from nineteenth-century Nepal, the gunflints give us insights into the history of Nepalese military technology and organization, and the flow of European armaments to the fringes of the British Empire.

History of Nepalese Arms

The gunflints discussed here came from a huge "cache" of disused Nepalese military stores bought for resale by International Military Antiques. Nepal was a small mountain kingdom on the edge of the developing British Empire in India. The British East India Company (EIC) began as a trading company chartered under Queen Elizabeth I. By the beginning of the 1800s, it had become a primary tool of the expanding British Empire, a quasi-governmental authority with large military forces that protected EIC trading interests, sometimes by outright conquest (Lawson 1993). When the Nepalese invaded into northern India, the British decided to suppress them. After suffering a series of defeats, EIC armies under Major General Sir David Ochterlony finally overcame the Nepalese in 1816. The treaty of Segauli allowed Nepal to remain independent under the supervision of a British "Resident" in Kathmandu. The EIC was given a trade monopoly in Nepal, and allowed to recruit Nepalese soldiers for the British and EIC armies, having been greatly impressed by the performance of the Ghurkha tribesmen against them (Cranmer 2004:10). For their part, the Nepalese under their first Prime

Minister, Bhimsen Thapa, began to acquire British firearms and established arms factories to produce their own copies. Cranmer (2004:37) suggests that many "Brown Bess" flintlock muskets were captured from the pre-treaty battles with the EIC, as the cache includes many musket locks with pre-1815 dates, "but Windus or India-Pattern locks were apparently acquired in quantity in England and smuggled into Nepal. There they were matched with native-made iron barrels and stocks of local wood."

In 1857, Nepal sided with the British in the "Indian Mutiny," sending as many as 15,000 soldiers, armed with their now obsolete flintlock muskets. The British rearmed them with percussion muskets, only a few of which apparently were taken back to Nepal, but the Nepalese acquired others from mutineers who fled to Nepal and were disarmed. Through the 1860s the Nepalese made versions of the British percussion rifle muskets to replace their flintlocks, and eventually the British began supplying Nepal with more modern arms as each in turn became obsolete in British armies. As weapons became obsolete in Nepal, they were warehoused in a dis-used palace. The cache eventually contained the standard "Brown Bess" flintlock muskets, the percussion muskets that followed, both smooth-bore and rifled, the first cartridge rifles, which were Sniders (1860s–70s) followed by Martini-Henrys (1870s–90s), Nepalese copies and variants of all of these, plus some non-military royal small arms, early machine guns and artillery, and finally Enfield bolt-action rifles starting in the 1890s and carrying on into the World War II forms (Cranmer 2004:40–42; Walter 2005). In 2000–03 Christian Cranmer bought the entire contents of the palace for around $5 million, when costs of moving it are included. Over the course of several months, some 430 tons of armaments, including about 55,000 longarms, were packed and shipped to the US, where Cranmer's International Military Antiques (IMA) continues to market them in a variety of ways. It is unfortunate that the whole palace was not treated as an archaeological site and national collection. To his credit, Cranmer (2004) documented the find in a personal way, publishing a short illustrated book, and producing a video (Pelzer 2007). Both are fairly cursory, but provide basic contextual information. Another short book discussing the firearms themselves in more detail (Walter 2005) was also sold by the enterprise.

The period of flintlock musket use in Nepal stretched from the beginning of the 1800s to the 1850s or 1860s, as their weaponry lagged behind European modes, although the Nepalese became adept at producing good quality local copies of imported guns, and some innovative variations. Unfortunately, the discarded flintlocks, the oldest arms in the cache, did not fare well. Many were stripped of brass butt plates and other parts that could be melted down for the valuable metal, and the wooden stocks often deteriorated. Cranmer's International Military Antiques sold most of the muskets as sets of original parts fitted to new stocks, or as loose locks, with relatively few more or less complete muskets. Stone however, is the most durable part of both prehistoric tools and muskets, and among the finds in the palace storage was a roomful of gunflints.

"In one basement area, we found a large pile of stones taking up a recessed area about equal to the size of a single-car garage. Walking on these stones, in places up to four feet deep, was accompanied by a noise that sounded almost like walking on coins. In the dim candlelight, we discovered that these 'stones' were, in fact, original British musket flints from the time of the Napoleonic wars. They had been acquired by the Nepalese after the treaty of Segauli, together with many other munitions." (Cranmer 2004:18).

Sources of Nepalese Gunflints

The large standing armies of Europe from the seventeenth century onward consumed literally billions of gunflints. England and France were the major producers, and have by far the best-studied industries. British and French gunflints dominated the markets and were sold all over the world, but many other countries in Europe and the Ottoman Empire also produced flints that did not travel quite so universally. The French and British industries were vastly expanded during the Napoleonic wars from 1793 to 1815, which involved much of Europe in what was essentially a first "world war," although the Napoleonic conflicts in turn could be considered an extension of the previous 50 or so years of intermittent conflicts among the powers of Europe, especially France and England. Colonial empires in the New World and Asia depended on ammunition and flints from the home countries as well. In India, the East India Company maintained an army as large as that officially under the Queen. David Harding (1997a, 1997b, 1999a, b) has produced an extraordinary documentation of the EIC smallarms in the eighteenth and nineteenth centuries, and this is relevant to understanding the Nepal flints. Starting in the late 1600s, the EIC began to import flints from England, eventually recording imports of millions per year into the 1820s (Harding 1999a:191–192). After that, the gunflint industry began to decline as percussion firearms supplanted flintlocks. Although the EIC did not apparently supply Nepal with arms directly, some of their flints, like some of their guns, must have reached Nepal through official and other trade, capture, and smuggling. Disposal of obsolete and damaged gear was a problem for the EIC, and some of these munitions certainly "leaked" (Harding 1999b:71–75, 590). As gunflints were munitions that were widely traded throughout the world, although the EIC may have claimed an official monopoly on trade in Nepal, the Nepalese could have sourced their flints through many routes, as the number of French flints in the assemblage suggests. Harding (Harding 1999a:193; also see Cumming 2003) suggests that some of the flints reaching the EIC in India were old stock after the Napoleonic wars, or substandard flints that may have been intended for sale rather than use by the company armies.

Assemblage, Methods and Attributes

When the IMA's collection of Nepalese arms was processed, Cranmer and company began by selling small lots of nice flints. Eventually flints started appearing in much larger lots on ebay, and I (JW) decided that they were interesting enough that some should be salvaged for archaeological analysis, so in 2010 I bought one batch from IMA, and two lots on ebay from an independent seller who had bought them from IMA. Any analysis must consider how representative the sample is of the whole cache. I wrote to the Cranmers explaining my interest and received this reply:

> The flints were unlisted in the Army disposal and were found in the basement of the old palace just piled in a corner. We had them dug out, sieved, and packed into 44 Kilogram Sacks.
> In total we ended up with 371 Sacks and each contained approx 3,500 flints. Our conclusion was that we got in terms of 1.3 Million units. Upon marketing them in

> the U.S. we just put 5 in a bag and heat sealed offering in lots of 5 or 20 flints. We have made a few wholesale sales and those are the ones you see offered in bulk on the internet. We made no attempt to sort by color, size or any other criteria.

My two purchases of flints from the ebay seller came packaged as two bags of black flints, one of gray, and one of gray flints with some blond ones in it. I asked the seller if they had sorted the flints and the seller replied that "The flints come in sacks of literally thousands and thousands. We just pour them out a little at a time and wash each one and sort them by color. We very rarely pick out ones we 'like.' The only time we sort is when we are sorting for an auction." After a further inquiry I was assured that the flints were not sorted by size.

As one reviewer pointed out, although we recorded a large number of flints, they represent only a very small fraction of the estimated 1.3 million. We agree that we cannot be sure that the proportions of flint types and sizes in our sample are necessarily those in the deposit, but there is also no reason to believe that the sample is systematically biased either. For instance, the flints we believe might be of Nepalese manufacture are distinctive to us, but probably do not stand out enough to be selected for or against by those sorting the cache for modern sale. Our analyses below suggest that we have a fair representation of the overall picture, and that those flints for which we recorded details are also representative of the whole. In total, we examined 1194 flints (Tables 1 and 2). Of these, 435 were measured and recorded in detail. These (Riv1) were the contents of two bags from the ebay seller, which had apparently been sorted into a bag of mostly black flints and another of mostly grey and blond flints, so the measured sample was not selected randomly, but comparison with the overall type breakdowns in Tables 1 and 2 suggests that they are not a greatly biased sample of what we obtained.

We were also able to obtain XRF compositional analysis on a subset of 79 of the flints, plus some other relevant stone material.

Gunflint Terminology

Flintlock guns are mechanized flint-and-steel fire-starters (Fig. 1). The cock holds a piece of flint, and when the trigger is pulled, it is propelled forward by a spring, and strikes the frizzen, a sloping piece of steel, from which super-heated shavings are scraped to produce the sparks. This frizzen, called the hammer in eighteenth and nineteenth century terminology, is struck forward, uncovering the pan, which holds a small amount of gunpowder, ignited by the sparks. This flash in turn is communicated through the touchhole to explode the main charge in the barrel of the musket, propelling the ball.

Gunflints are manufactured by "knapping," a controlled fracture process taking advantage of the consistent concoidal fracture of homogeneous silica stones (Whittaker 1994). The developed forms under discussion here have a sharp leading edge which strikes the frizzen, and often a steeper, duller "heel" opposed, although some gunflints were double-edged and could be used with either edge forward (Fig. 2). The sides are generally trimmed to shape, and the faces roughly flat and parallel so that they can be firmly held between the jaws of the cock. Flaked flint is conducive to these

Table 1 Distribution of major attribute categories in our sample. Riv1 and Riv2 are from ebay, IMA from International Military Antiques. Detailed analysis was performed on the Riv1 sample

	Riv1	%	Riv2	%	IMA	%	Total	Total%
British	285	65.5	469	87.8	171	76	925	77.5
Other	43	9.9	16	3	9	4	68	5.7
French	107	24.6	49	9.2	45	20	201	16.8
Total	435		534		225		1194	
Black	93	21.4	196	36.7	63	28	352	29.5
Grey	192	44.1	273	51.1	108	48	573	48
Other	43	9.9	16	3	9	4	68	5.7
Blonde	107	24.6	49	9.2	45	20	201	16.8
Total	435		534		225		1194	
Blade	335	77	421	78.8	192	85.3	948	79.4
Spall	57	13.1	97	18.2	24	10.7	178	15
Other	43	9.9	16	3	9	4	68	5.7
Total	435		534		225		1194	
Pistol	58	13.3	57	10.7	16	7.1	131	11
Carbine	161	37	184	34.5	72	32	417	35
Musket	210	48.3	292	54.7	137	60.9	639	53.5
Wallpiece	6	1.4	1	0.2	0	0	7	0.6
	435		534		225		1194	100.1

features. Gunflints are made by striking flakes off a core and shaping them to the desired size. Although gunflint manufacture was always a cottage industry in both France and Britain, it was definitely industrial mass-production. Skertchly (1879: 33) tells us that one knapper and his apprentice, with another man and boy working nights, produced 44,800 finished gunflints in a week. From an archaeological point of view, one of the fascinating things about gunflints is that humankind's most ancient documented technology, flaked stone, survived into the industrial age because it was the most efficient way to manufacture the tools necessary for making fire, and especially because the gunflint, the most efficient way to fire a gun for over two centuries, was a military necessity.

Gunflint Typology

The simplistic assumption of many archaeological studies of gunflints, in North America at least, has been that French flints are usually made of a blonde or honey-colored flint, produced by segmenting blades, and either rounding the heel, or keeping a relatively long segment with two straight striking edges. British flints in contrast are usually made of black or grey flint, either by striking a flake with a strong bulb of percussion and then shaping it into a rectangle, or by segmenting longer blades into squares. In either case, the gunflint is finished with a steep square heel. As a good many analysts have pointed out, these expectations oversimplify the situation (e.g., Ballin 2012; Watt and Horowitz

Table 2 Distribution of our basic types in the sample

	Riv 1		Riv 2		IMA	
Type	N	%	N	%	N	%
BrBlkBldPist	9	2.1	23	4.3	4	1.8
BrBlkBldCarb	29	6.6	48	9	12	5.3
BrBlkBldMusk	44	10.1	106	19.8	40	17.8
BriBlkBldInd	0	0	1	0.2	0	0
BriBlkSplPist	1	0.2	3	0.6	0	0
BriBlkSplCarb	1	0.2	5	0.9	0	0
BriBlkSplMusk	9	2.1	10	1.9	7	3.1
BriGryBldPist	14	3.2	18	3.6	8	3.6
BriGryBldCarb	50	11.5	67	12.5	26	11.6
BriGryBldMusk	83	19.1	111	20.8	57	25.3
BriGrySplPist	9	2.1	12	2.2	1	0.4
BriGrySplCarb	16	3.7	30	5.6	5	2.2
BriGrySplMusk	20	4.6	35	6.5	11	4.9
OtherPist	4	0.9	1	0.2	0	0
OtherCarb	17	3.9	7	1.3	4	1.8
OtherMusk	22	5.1	8	1.5	5	2.2
FreBlnBldPist	21	4.8	0	0	3	1.3
FreBlnBldCarb	47	10.8	26	4.9	25	11.1
FreBlnBldMusk	32	7.4	20	3.7	17	7.6
FreBlnBldWall	6	1.4	1	0.2	0	0
FreBlnSplPist	0	0	0	0	0	0
FreBlnSplCarb	1	0.2	1	0.2	0	0
FreBlnSplMusk	0	0	1	0.2	0	0
Total	435	100	534	100.1	225	100

2017), but the attributes mentioned are useful for our analysis of the Nepalese flints, which conform to patterns pretty consistent with the expectations.

Technology

Gunflint technology has been usefully reviewed by Ballin (2012) and others (Emy 1978; de Lotbiniere 1980, 1984; Hamilton 1980; Hamilton and Emery 1988); we present only a brief summary here. For almost 300 years, flint and steel was the most effective way to fire a gun, and the techniques used to produce the "stone-age" component of this early industrial technology evolved through time for greater efficiency, as the demand for firearms expanded (Whittaker 2001, 2019). The terms used, the precision of definitions in available documents, and the measured standards applied by various governmental authorities varied through time. A whole menagerie of idiosyncratic and badly applied terms have been added by archaeologists. All too often, because these were historic archaeologists with little experience of stone tools, gunflint terms clash with well-established usages in lithic technology. We will settle for defining some common terms here and attempt to be consistent.

From the invention of early types of flintlock in the 1500s, to the development of the “true” flintlock with the steel or frizzen forming one piece with the cover of the pan in the early 1600s, and still into the early 1700s, military firearms were generally unstandardized, and supply chains, markets, and ordnance bureaucracies were slowly developing. Gunflints likewise were unstandardized, and sometimes the soldier was expected to make his own, occasionally from raw flint provided by the authorities (Luedtke 1998).

More systematically produced and shaped flakes form the next stage, as the military authorities in Britain and France began to standardize their expectations, and industries sprang up to supply them. By the late 1600s and early 1700s, gunflint makers are documented around London and elsewhere in Britain (de Lotbiniere 1980), and in central France (Emy 1978; White 1976). These early industries should have been producing the shaped flake forms that we will reluctantly call “spall” gunflints (see Fig. 2). “Spall” is an outdated term for “flake” that seems to have stabilized in gunflint literature in preference to flake.” This form of gunflint is also referred to as “wedge.” They generally have a strong bulb of percussion, and are trimmed, or retouched, toward this ventral or interior flake face, rather than toward the dorsal face as on most of the later blade-based gunflints. It has been suggested (Hamilton and Emery 1988:10) that this is a simple and sometimes expedient technique, using poor or small material (de Lotbiniere 1984), but this is only partly true. Cores from both French (Weiner 2016a) and British (Chandler 1917; Clay 1925) sites show that sometimes knappers systematically produced large flakes that were used as cores from which

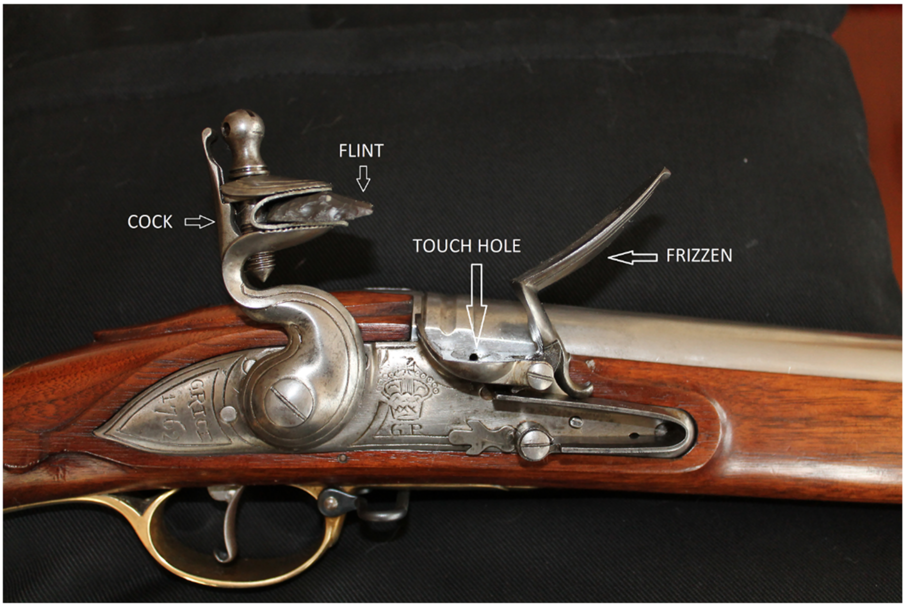

Fig. 1 Flintlock mechanism and terminology

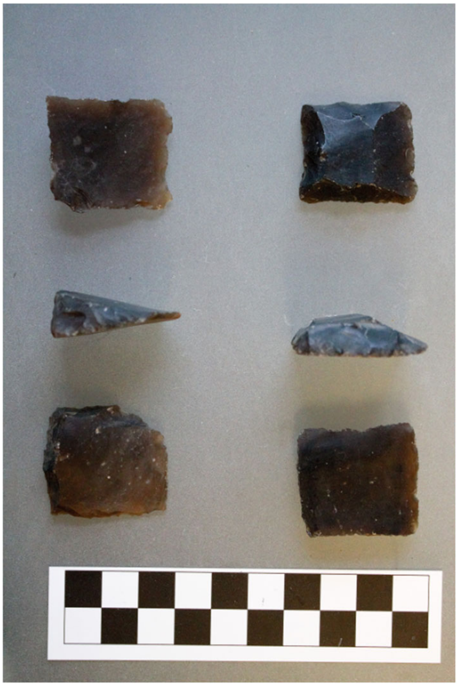

Fig. 2 Spall (left) and blade (right) gunflints. Both oriented with edge to right, retouched heel to left and edge retouch up at bottom. This, the ventral face of the flake (which usually includes the bulb on a spall gunflint), is usually the face placed downward in the cock. The edge view shows why flake-based spall flints are sometimes called "wedge" and blade-based flints "platform" flints. The points of percussion or "demi-cones" left by trimming on an iron stake are visible on the edge and top (dorsal face) of the blade flint, but less visible on the spall

several "spall" gunflint blanks could be removed. It requires a good deal of knapping skill to produce these efficiently and to consistent sizes, and sites with large quantities of such cores and debris also show an industrial scale of manufacture. The later British spall gunflints were finished by shaping on a stake like the blade gunflints, and some from the Nepal collection and elsewhere are of the best quality stone.

The best-known type of gunflint is the blade flint (also called "platform" flint – another confusing misuse of standard lithic terminology). These are produced by striking a blade from a prepared core, and segmenting the blade by resting it on a metal stake and striking with a specialized iron hammer. The French preferred a disk-shaped hammer; the British knappers used one made from a file, but the results were similar – characteristic bulbs of percussion were often produced on the dorsal face of the gunflint where it rested on the stake as the blade was segmented and retouched. These late industries and their techniques have been well documented (Skertchly 1879; Gould 1981). The French are credited with developing the blade technique between 1670 and 1740 (Emy 1978:30–31). Faulkner's (1986:83) dates from Fort Pentagoet suggest a transition in some French production sites from spall to blade between 1650 and 1670, although spall types continue to dominate later at Fort Michilimackinac. As blade-making was much more efficient than the spall technique, the French considered it a military secret, but it spread to Britain in the late 1700s. Sealed finds like the wreck of the Abergavenny, which sank in 1805, show that both spall and blade forms from Britain were current at that time (Cumming 2003; Harding 1999a).

A final gunflint form, not really relevant to Nepal, is the bifacial "pillow" shape. Although some of the less known European industries such as that in Albania (Evans 1887) may have produced rectangular bifacial gunflints, these are mostly known in North America, where native knappers applied their traditional arrowhead-making techniques to a new use, often with local materials (Kent 1983; Kenmotsu 1990).

In some parts of the world, these basic technological sequences are confused by the possible or likely presence of industries that have not yet been well documented, and which made gunflints by any or all the techniques above, with materials that may not be visually distinctive. Nevertheless, England and France probably supplied the majority of gunflints used all over the world. The only likely competitor in Europe might be the Ottoman Empire, whose extensive firearm industries must have had supporting knapping industries. In any case, it is unlikely that such flints reached Nepal, although we will consider the likelihood of some native-made Nepalese flints.

Raw Material and Basic Forms in the Nepalese Assemblage

Tables 1 and 2 show the distribution of our basic types and categories in the sample, and Table 3 shows heel form, which, in conjunction with flint material, we considered diagnostic. In general, French flints (Fig. 3) are supposed to be recognized by their rounded heels and blond, brownish, or honey colored flint, but the situation is more complicated than that. The rounded heel form was supposed to be the military standard, and rectangular flints, mostly double-edged flints of various sizes, were made for civilian use and export. In France, as in England, there were a number of centers of manufacture, mostly in the Cher-et-Loire district of central France. The flint sources varied, so as well as the blond flint, there are browns, grays, and even black (Emy 1978; White 1976).

The British industries use the flint common in southern England, generally derived from chalk formations. Grays and blacks dominate (Fig. 4). The best and most famous flint was the exceptionally hard and fine-grained black "floorstone" from the deeper levels of mines in the Brandon district. Other British flint, especially that in surface deposits, is likely to be dark to light gray, sometimes with mottling or fossil remnants. These have been a source of confusion for early workers (e.g., Witthoft) because such grey colors are also typical of flint from Scandinavia. We believe that the gray gunflints in the Nepal collection are all British. There is no reason to expect Scandinavian material, and the gray specimens are mostly of the British squared form, whether "spall" type, or blade type. As Table 3 shows, there are a few gray flints with rounded heels that may be French.

The material we described as Grainy Gray and Grainy Black is quite distinctive. It appears to be a metamorphic rock rather than a sedimentary cryptocrystalline flint. Sometimes there are remaining areas of thin brownish cortex on the dorsal face. The gunflints made of this material are all of a form and technique that does not conform to either French or British norms, or to any other European source with which we are familiar. Gunflints of this form and material, referred to throughout as "Other," are fairly uniform in size, roughly square with two corners rounded to make a steeply retouched heel. They are all made on irregular flat flakes, and the bulb may be oriented

Table 3 Gunflint material classes (rows) and heel forms (columns)

	Heel form						
Material	Missing	None	Rounded	Round chalk	Square	Square chalk	All
Black flint	1	2	2	0	83	6	94
Blonde	0	9	54	7	3	1	74
Blonde mottled	0	4	12	0	0	0	16
Dk gry	0	1	4	0	46	1	52
Dk gry mottled	2	1	5	2	41	1	52
Grainy Black	0	1	17	0	1	0	19
Grainy gry	0	0	10	1	0	0	11
Gray blonde	0	2	14	0	0	0	16
Lt gry	1	3	7	0	27	1	39
Lt gry fossiliferous	0	0	1	0	1	0	2
Lt gry mottled	0	4	8	1	46	1	60
All	4	27	134	11	248	11	435

in any direction, quite unlike the norm in European gunflints. Where the edge is thick, it is usually steeply retouched, and many of the striking edges are also steeply retouched, much more coarsely than the British or French gunflints. Retouch is usually from the

Fig. 3 Representative French blade gunflints, heel up, edge down, dorsal face. Left rows are "musket" size with one "wall piece" at top left. Bottom two are double edged. Right row is "carbine" size

bulbar surface to the dorsal surface, and some of the gunflints are partly bifacial with the bulbar surface thinned by a few percussion flakes. We believe these gunflints are of Nepalese manufacture, although we cannot demonstrate it. Figure 5 shows representative specimens.

Chemical characterization of flaked stone artifacts to match them to stone sources works well with volcanic materials like obsidian, but has had only limited success with sedimentary flints and cherts (Luedtke 1992; Ray 2007:46; Mehta et al. 2017; Newlander and Lin 2017). Studies using atomic absorption spectrometry (Stevenson et al. 2007) and inductively coupled plasma-mass spectrometry (Durst 2009) have had some success sorting gunflints of probable European origins. As we had the opportunity to try XRF (X-Ray Florescence) on our specimens, we thought it a useful experiment, although we have no parent sources in Nepal with which to compare. Through the kindness of Jeffrey Ferguson of the University of Missouri Research Reactor Center, my student Daniel Lee analyzed 105 specimens (Table 4). As expected, the European flints did not separate very well, but there are indeed visible trends. Most importantly, the "Other" gunflint specimens were much higher in iron (FE), zinc (ZN), and zirconium (ZR) than either British or French gunflints or source specimens (Fig. 6), and showed high rubidium (RB) content, an element lacking from the other specimens. They are plainly from a very different source than any of the European materials.

Although we cannot be sure that the "Other" gunflints were made in Nepal by the Nepalese, it is the most likely alternative. They do not resemble the products of any other known gunflint industries. They are not merely unskilled or inferior products,

Fig. 4 Representative British flints. Top row Black Blade Musket. Second row Gray Blade Musket. Third row Black Spall Musket. Fourth row Black Blade Carbine. Fifth row Gray Blade Carbine and one Pistol

they are worked with a different technique and made on a unique material. They are a small but consistent presence in our sample, and in other batches advertised online, so they are unlikely to be the only evidence of a lost European industry. They are unlikely to be the product of British soldiers knapping in India. The technique is wrong, and it seems unlikely that the EIC would have developed a trade in the sparse products of unskilled soldiers. Harding (1999a, b) hints that the EIC did attempt to find flint sources in India for gunflint making by locals or Europeans, but this apparently came to naught. We need further information from Nepal to go any further with this problem.

Gun Sizes

From the time military guns were standardized in the early 1700s in both Britain and France, to the end of the muzzle-loading era in the 1860s, European armies tended to distinguish several consistent classes of arms. The musket, the largest caliber and longest firearm, was the standard for most troops. Light infantry, cavalry, and some officers might carry a shorter and sometimes smaller caliber carbine or musketoon, and specialized rifle corps developed in the late 1700s, using slower-loading but more accurate rifled longarms. Pistols were mostly for the use of cavalry and officers, and might use musket caliber balls, but were more often carbine or rifle caliber, or even smaller. Gunflint sizes reflected these classes, although in both the guns and the flints there were many variant labels and overlapping sizes that changed somewhat through time. There was also a civilian market with somewhat different demands that we will not consider here. Moreover, the numbers of types and quality grades used by the gunflint producers themselves declined through time as flintlocks were supplanted by more modern guns and the gunflint industry faded (Whittaker 2001). We use gross gun size designations that reasonably reflect contemporary usages, but have not tried to apply more refined original distinctions.

In Britain, three basic sizes, Musket, Carbine/Rifle, and Pistol, were common from 1750 to 1850, which saw the height both of the Company's power, and of the gunflint

Fig. 5 Representative "Other" flints showing typical material and heel form, irregular dorsal faces, and some thinning of ventral bulbar face

Table 4 Gunflints analyzed by XRF

Type	Key in Fig. 6	Count
British black from Nepal	Bpnep	10
Brandon debitage specimens	Brandon	11
British spalls from Nepal	Bsnep	19
French gray from Nepal	Fg	6
French modern flints	Fmod	15
French blonde from Nepal	Fnep	20
Other (gritty grey)	Other	24
N=		105

industry in England, before it declined with the arrival of percussion firearms in the 1840s. A few extra-large flints were used for cannons or smaller "wall pieces."

As in Britain, the French military demanded standard sizes, but the standard sizes took a while to be carefully defined beyond the labels of three main sizes (*fusil*/musket; *mousqeton*/carbine, *pistolet*/pistol). Apparently, after 1745, more types were designated but not sized: *rempart* (wall-piece), *fusil*, *mousqeton*, *pistolet d'arçon* and *demi-arçon* (two sizes of horse pistol), and *pistolet de gendarmerie*. Emy (1978:166–169) lists military size standards for musket and some pistol flints from 1740 to 1844, at which point flintlocks had been superseded by percussion guns. In that span of 100 years, the sizes given for musket and pistol flints varied slightly, and the tolerable variance also fluctuated. In general the practice seems to have been to make musket, carbine, and pistol flints to size, with gauges issued at least in 1816, while choosing larger and smaller flints for such things as wall-pieces, cannons, and smaller pistols, but with less

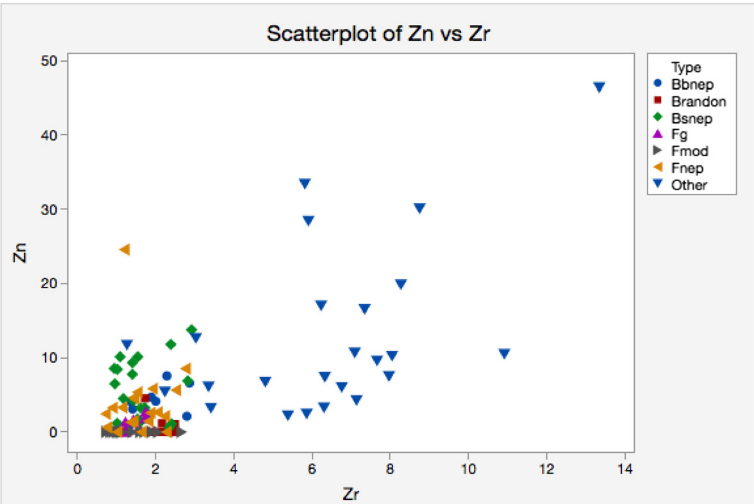

Fig. 6 Gunflints analyzed by pXRF; Zn (Zinc) plotted against Zr (Zirconium). The "Other" category of flints stands out from all the rest

standardized measures. Merchants seem to have preferred double-edged flints as opposed to the heeled military forms, and had long lists of named types, mostly poorly defined and without measured standards. As in Britain, these reflected various grades of quality as well as size, but these standards are so variably defined that it is probably not possible to reliably classify archaeological gunflints from either country using the ethnohistoric categories (White 1976:99).

For our purposes we classified the recognizably French flints into three size grades following the 1827 standards for military flints given by White (1976: Fig. 26; Emy 1978:171), plus extra-large "wall-piece" flints. As Table 5 shows, these sizes are not the same as the British ones from Skertchly (1879), but close enough to be comparable.

Figure 7 shows the distribution of gun size categories of each major type/source of gunflints. The British flints which make up most of the assemblage are largely musket size, while the French flints are more likely to be smaller. The distribution is even more striking when we remember that while British and French musket flints were similar in size, the French definition of carbine flints required them to be smaller than British carbine flints. Perhaps the French flints were from stocks intended for a civilian market, while the British flints were procured through the EIC or other channels from supplies intended for military use. The French specimens however, include more extra-large "wall piece" or cannon-size flints. In the measured sample of 435 flints, 20 of the 107 French flints (19%) are double-edged, while almost none of the British flints are. Among the 204 British flints in the sample, 30 have two or more used edges, but only nine appear to have been made double-edged, without a trimmed heel. This too suggests that the French flints may have come from non-military sources.

The size standards were poorly adhered to. Figures 8 and 9 plot length and width for British and French flints. It is plain that the acceptable variability is high, and relatively few flints fall close to the nominal standard. As Table 6 shows, considered as groups with considerable variability, British flints tended to be longer and thicker, while French flints, shaped differently, tended to be wider, i.e. to have wider striking edges.

Damage and Re-Use

As Tables 7 and 8 show, some of the flints were heavily used (Fig. 10). Most flints showed dulling and rounding of the small projections on the leading edge, which we interpret as normal use (Table 7). British, French, and "Other" flints alike frequently showed uneven wear on edges that were no longer straight (Table 5). Three of the larger French musket flints were strongly notched by use against a frizzen that was not as

Table 5 Size standards for French flints from White (1976) and for British flints (Skertchly 1879)

French:	British:
Musket 33 × 30 mm	Musket 33 × 28 mm
Carbine/rifle 25 × 24 mm	Carbine/rifle 30 × 25 mm
Horse pistol 20 × 20 mm (square after 1797)	Horse pistol 28 × 23 mm
	Wall-piece 51 × 38 mm

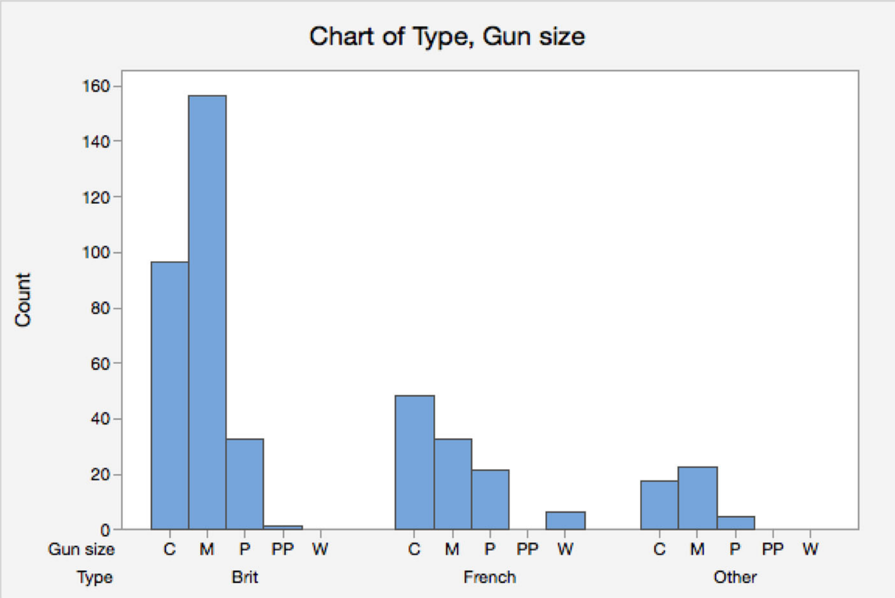

Fig. 7 Distribution of gun size categories by origin of gunflint

wide as the gunflint edge. The British flints especially showed signs of re-sharpening. Most were originally made with a slight bevel of small flakes raked off from the dorsal face to the ventral along the striking edge (Skertchly 1879:32). This is supposed to produce a steeper, stronger, more even edge at a better angle to the frizzen surface. As this beveled edge was dulled by use, it could be rejuvenated by removing more flakes to make a coarser, steeper bevel. Gunflints were not expected to last forever. British and United States armies issued them at rates of one flint per 20 cartridges (Busk 1860; Hamilton and Emery 1988; Harding 1999a), although good flints last longer. The high rate of re-sharpening may reflect an order for frugality from the authorities. Re-sharpened edges usually showed the normal dulling and rounding wear of use. Three of the British flints showed oddly polished edges that may reflect some sort of use as a cutting or scraping tool.

Flints also served a critical function among soldiers and civilians alike as components of flint-and-steel fire starting kits. We do not know what the usual source of fire-striking flints was in Nepal, but at least some of the gunflints in the "cache" show use with a steel striker. This "battering" (Table 8) usually takes the form of a concave worn area, heavily dulled, or similar dulling and crushing on many edges without producing a concave edge (Ballin 2005; Fig. 10). This wear usually obliterated other traces of use and resharpening. We considered 30% of the British gunflints to show strike-a-light use, labeled "battering" in Table 8. Only a few of the French flints showed similar wear. We suspect that the higher rates of both resharpening for gunflint use, and battering for fire-starting on British flints is partly because they tend to be thicker than the French flints.

The famous kukri short sword or fighting knife traditionally carried by the Ghurka soldier (Fig. 11) is worn in a sheath with additional pockets for other small tools, and

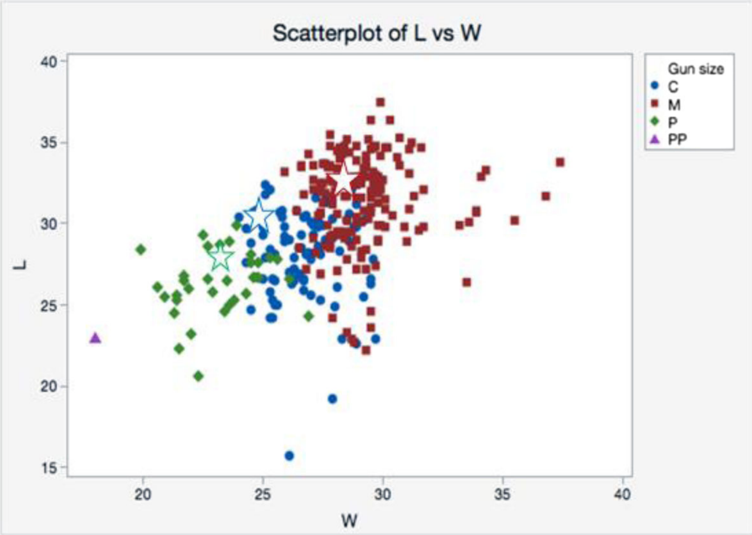

Fig. 8 Dimensional distribution (length and width) for British flints. Stars indicate the approximate size standards for Pistol, Carbine, and Musket flints. The dispersions around these standards are wide, and the separation between what we called carbine size and musket size flints is poor. Probably most of these flints were for use in the standard musket

sometimes a pouch for flint and tinder (Powell 2003). Most kukris are accompanied by at least a *karda*, a small utility knife shaped like a miniature kukri, and a *chakmak*, which looks similar but is dull, and now said to be used as a steel for sharpening the kukri (Sprague 2013). More importantly, the *chakmak* was the steel for striking fire, and the name is the word used in Turkey and elsewhere for fire strikers. Turner (1931:163) considers *chakmak* a loan word through Hindi from Turkish.

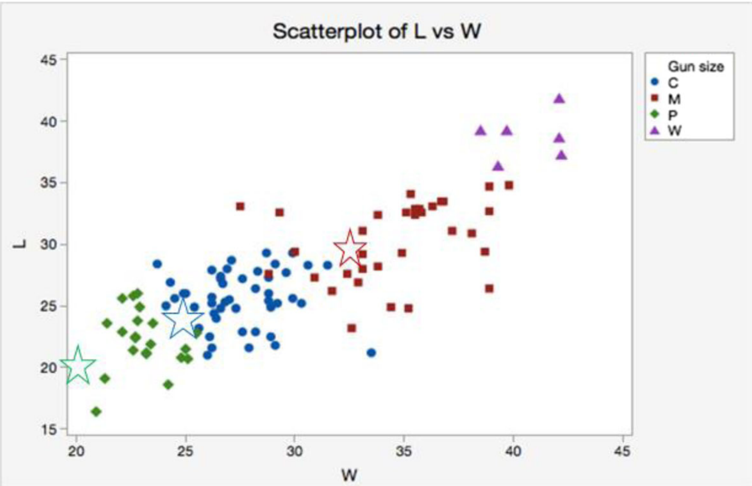

Fig. 9 Dimensional distribution (length and width) for French flints. Stars indicate nominal standards for Pistol-, Carbine-, and Musket-sized flints. The 1827 military pistol standard we used is small compared to some other French "pistol" flint dimensions at the same time. Alternatively, some small flints we called pistol could be considered carbine flints

Table 6 British and French gunflint size distributions compared

	Type	N	Mean	Standard Dev.	T	Degrees Freedom	P
Length	British	283	29.7	3.36	5.093	146.6	<.0005
	French	107	27.1	4.82			
Width	British	283	27.7	2.7	−3.394	125.8	0.001
	French	107	29.5	5.49			
Thickness	British	284	8.9	1.69	6.62	169.4	<.0005
	French	107	7.4	1.96			

Manufacture of gunflints using iron tools, and use against steel frizzens and *chakmaks* might be expected to leave traces of metal on the stone. In Whittaker's experiments making gunflints and threshing sledge blades with metal hammers, metal streaks are quite prominent on flake platforms near the point of percussion. Trimming flints on the metal knapping stake also leaves metal marks along the edges and at other points of contact. Metal marks are visible on flints in Whittaker's (1996) collections from knappers in Cyprus and Turkey, and from Fred Avery, the last of the traditional British knappers. They survive at least for a while on flints found in the field in Cyprus and at Brandon, which must date back at least a few decades, and still retain grey or rusty traces. Nevertheless, we were unable to find the expected metal traces on the Nepalese gunflints.

We were also unable to identify what Ballin (2014b) calls "powder-burn." Ballin found that heavily used specimens from a sample of Nepal cache flints like ours showed micro-crazing and vitrification on some corners that he interprets as heat damage from the flash of powder in the pan and touchhole of a firearm. We expect that he is right, and looked for this, but could not find it.

One other form of damage that occurred on a minority (about 7%) of our British and French flints, but not on the "Other" flints, was notching and crushing at the center of the heel, attributable to contact with, or fitting to, the screw that clamped the flint between the jaws of the cock. Especially on large flints, a notch is sometimes necessary to set the flint firmly in the jaws or to keep the striking edge from protruding too far.

Table 7 Damage categories

	Fracture	Missing	None	Notch	Polished	Resharp	Uneven wear	All
British N	17	1	113	0	3	83	67	284
%	5.99	0.35	39.79	0	1.06	29.23	23.59	100
French N	3	0	63	3	0	8	30	107
%	2.8	0	58.88	2.8	0	7.48	28.04	100
Other N	2	0	32	0	0	0	8	42
%	4.76	0	76.19	0	0	0	19.05	100
All N	22	1	208	3	3	91	105	433
%	5.08	0.23	48.04	0.69	0.69	21.02	24.25	100

Table 8 Wear (rounding/dulling) and strike-a-light damage (battering)

	Battering	Dulling/Rounding	Fracture	None	Polished	All
British N	84	186	3	9	3	285
%	29.47	65.26	1.05	3.16	1.05	100
French N	7	98	0	2	0	107
%	6.54	91.59	0	1.87	0	100
Other N	0	43	0	0	0	43
%	0	100	0	0	0	100
All N	91	327	3	11	3	435
%	20.92	75.17	0.69	2.53	0.69	100

Interpretations

The Nepalese arms cache, represented here by a sample of gunflints, opens a small window on the firearms technology that helped to spread the British Empire across a large part of the globe. Armed with flintlock muskets, the British military and "non-governmental" organizations like the East India Company subdued native peoples and bested European opponents. Firearms, and the materiel needed to use

Fig. 10 Damage and poor quality: Left: poor quality flints with excessive thickness, irregular form and ridges, chalk heels, multiple knapping strike marks. Top specimen is French. Middle, top two show notched heel and extensive resharpening, others show battering from strike-a-light use. Bottom R has a polished and rounded striking edge, shown facing up. Others shown striking edge down

Fig. 11 Kukri and accompanying *karda* (knife) and *chakmak* (firesteel) from the Nepal armory. One of the *chakmak* examples is plainly made from an old hand-made file

and maintain them, became a mainstay of British imperial policy, supporting client states and allies. The firearms industry in Britain employed thousands, and brought enormous profits to the arms merchants of London, Birmingham, and other English centers.

The size of the gunflint deposit, estimated at 1.3 million flints by Cranmer, seems surprising for a small kingdom, especially considering that equal numbers were likely lost or destroyed in use. But an organized and active army must have used numbers of flints that are hard to calculate. The quantity of gunflints exported from England must have been truly staggering. We know for instance that hundreds of thousands of cheap muskets were shipped *yearly* from Britain alone from the late 1600s to the late 1800s, to enter the West African trade in slaves and ivory (Inikori 1977; Richards 1980; White 1971). Tons of gunpowder are also documented, and along with these munitions must have been millions of less-often reported gunflints. Harding (1999a) says that between 1680 and 1850, most of the flints used by the EIC in India were bought in England as finished flints, ultimately in enormous numbers, for example a 1791 order for 4 million flints. As the guns provided by the EIC to native troops and sold in trade varied in quality from outdated military models to poorly made trade guns, some composed of parts rejected by the British ordnance authorities (George 1947), we should expect that the accompanying flints and powder were also unlikely to have been top-drawer. EIC documents discussed by Harding (1999a) show frequent complaints about the quality of flints, inspections that rejected the majority of supplies, and trials to test their efficacy, although many of the trials end by blaming the soldiers' lack of skill in fixing flints in their muskets.

We are probably seeing some of these problems in the Nepalese collection, where many of the flints would probably have been rejected by military standards, but were good enough to pass off in foreign trade. We did not try sorting our sample into subjective quality grades, but did note many that were poorly made with curved surfaces, a single dorsal ridge rather than a flat surface between two ridges, large bulbs, chalk heels (see Table 2; Fig. 10), and fossil or other inclusions. These are all things that Skertchly (1879) regards as marks of lower quality. High rates of resharpening may also partly reflect attempts to improve poor flints, or poor positioning in the cock, as well as a degree of frugality with an imported munition.

From the point of view of the Nepalese authorities, obtaining munitions required a number of strategies. The British authorities were often reluctant to supply client or subjugated states with the best or most up-to-date weapons, fearing with some reason that they might sooner or later be turned against them. At various times and places, they tried to control also the trade in firearms, and "leakage" of surplus or substandard military weapons and discarded parts (Harding 1999b, 71–75). A sophisticated and wealthy state, Nepal circumvented some of these controls in several ways. Apparently they sent buyers to Europe; the rulers at least obtained some of the finest available firearms (Cranmer 2004; Walter 2005). For their military needs, they rapidly applied ancient metal-working skills evident in their kukris, swords, and armor to the production of modern firearms. At first they imitated British muskets, but eventually they invented their own variants of the Martini-Henry and a rapid fire Bira "machine gun." Usable gunpowder was certainly within their capabilities, and surely they would have tried to find a native source of gunflints to reduce their dependence on imports of uncertain quality and cost. We suspect that our "Other" category of gunflints represent these efforts. If so, they appear to have been only somewhat successful, probably because the material is inferior, and neither the material nor local knapping skills were amenable to efficient production of quality gunflints. Archaeological work in the workshops and armories of Nepal might improve our understanding.

And finally, a room full of gunflints provides insight into the mind of military bureaucrats everywhere. A flint was issued, a flint should be returned to stock when used up. If it was turned in on a discarded musket, it should be removed and stored. These flints were probably even more worthless than the outdated guns which were abandoned in the palace, but some officious bean-counter felt it necessary to collect them. It is possible that there are Nepalese records that might illuminate the sources and disposal of their gunflints, but these are beyond the current authors' reach or ability to read.

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References

Ballin, T. B. (2005). Lithic artefacts from Townparks, Antrim town, Northern Ireland – prehistoric lithic artefacts, gunflints, and fire-flints. *Ulster Archaeological Journal* **64**: 12–25.

Ballin, T. B. (2012). "State of the art" of British gunflint research, with special focus on the early gunflint workshop at Dun Eistean, Lewis. *Post-Medieval Archaeology* **46**(1): 116–142.

Ballin, T. B. (2014a). East European gunflints - a case study: Gunflints from the Modlin Fortress, near Warsaw, Poland. *Gunflints – Beyond the British and French Empires N.S.* **3**: 3–11.

Ballin, T. B. (2014b). Identification of "powder-burn" and the interpretational value of this feature. *Gunflints – Beyond the British and French Empires N.S.* **1**: 4–13.

Busk, H. (1860). *Handbook for Hythe: A Familiar Explanation of the Laws of Projectiles and an Introduction to the System of Musketry Now Adopted by All Military Powers*. Routledge, Warne, and Routledge, London.

Chandler, R. H. (1917). Some supposed gun flint sites. *Proceedings of the Prehistoric Society of East Anglia* **2**: 360–365.

Clarke, R. (1935). The flint-knapping industry at Brandon. *Antiquity* **9**: 38–56.

Clay, R. C. C. (1925). A gun-flint factory site in south wilts. *Antiquaries Journal* **5**: 423–426.

Cranmer, C. (2004). *Treasure is Where You Find It: The Thirty-year Quest to Save the Royal Armory of Nepal*. Tharston, Godstone, Surrey.

Cumming, E., ed. (2003). The earl of Abergavenny, historical record and wreck excavation, version 3.3. CD, MIBEC Enterprises.

de Lotbiniere, S. (1980). English gunflint making in the seventeenth and eighteenth centuries. In Hamilton, T. M., ed., *Colonial Frontier Guns*. Fur Press, Chadron, NE. Reprinted 1987, Pioneer Press, Union City, pp. 154–159.

de Lotbiniere, S. (1984). Gunflint recognition. *The International Journal of Nautical Archaeology and Underwater Exploration* **13**(3): 206–209.

de Mortillet, A. (1908). Les pierres à fusil: leur fabrication en Loir-et-Cher. *Revue de l'École d'Anthropologie* **18**: 262–266.

Dolomieu, D. (1797). Mémoire sur l'art de tailler les pierres à fusil (silex pyromaque). *Journal des Mines* **6**(33): 693–712 Paris.

Durst, J. J. (2009). Sourcing gunflints to their country of manufacture. *Historical Archaeology* **43**(2): 18–29.

Emy, J. (1978). *Histoire de la Pierre à Fusil*. Société de l'Exploitation de l'Imprimerie Alleaume, Blois.

Evans, A. J. (1887). On the flint-knapper's art in Albania. *Journal of the Anthropological Institute of Great Britain and Ireland* **16**: 65–68.

Faulkner, A. (1986). Maintenance and fabrication at Fort Pentagoet 1635-1654: Products of an Acadian armorer's workshop. *Historical Archaeology* **20**(1): 63–94.

George, J. N. (1947). *English Guns and Rifles: Being an Account of the Development, Design and Usage of English Sporting Rifles and Shotguns – From their Introduction during the Fifteenth Century until the Advent of Metallic Cartridges in the Nineteenth Century – Together with Notes on Muskets, Service Rifles, Blunderbusses, and Other Arms*. Small-Arms Technical Publishing, Plantersville, SC.

Gould, R. A. (1981). Brandon Revisited: A New Look at an Old Technology. In Gould, R. A. and Schiffer, M. eds., *Modern Material Culture: The Archaeology of Us*. Academic, New York, pp. 269–282.

Hamilton, T. M. (1964). Recent developments in the use of gunflints for dating and identification. In Holmquist, J. D. and Wheeler, A. H. (eds.), *Diving Into the Past: Theories, Techniques, and Applications of Underwater Archaeology*. Minnesota Historical Society and the Council of Underwater Archaeology, St Paul, pp. 52–57.

Hamilton, T. M. (1980). The gunflint in North America. In Hamilton, T.M. ed., *Colonial Frontier Guns*. Fur Press, Chadron, NE. Reprinted 1987. Pioneer Press, Union City, pp. 138–147.

Hamilton, T. M. and Emery, K. O. (1988). *Eighteenth-Century Gunflints from Fort Michilimackinac and other Colonial Sites*. Mackinac Island State Park Commission, Mackinac Island, MI.

Hamilton, T. M. and Fry, B. W. (1975). A survey of Louisbourg gunflints. *Canadian Historic Sites Occasional Papers in Archaeology and History* **12**: 101–128.

Harding, D. F. (1997a). *Smallarms of the East India Company 1600–1856, Volume I: Procurement and Design*. Foresight, London.

Harding, D. F. (1997b). *Smallarms of the East India Company 1600–1856, Volume II: Catalogue of Patterns*. Foresight, London.

Harding, D. F. (1999a). *Smallarms of the East India Company 1600–1856, Volume III: Ammunition and Performance*. Foresight, London.

Harding, D. F. (1999b). *Smallarms of the East India Company 1600–1856, Volume IV: The Users and their Smallarms*. Foresight, London.

Inikori, J. E. (1977). The import of firearms into West Africa 1750-1807: A quantitative analysis. *Journal of African History* **18**(3): 339–368.

Kenmotsu, N. (1990). Gunflints: a study. *Historical Archaeology* **24**: 92–124.

Kent, B. C. (1983). More on gunflints. *Historical Archaeology* **17**(2): 27–40.
Lawson, P. (1993). *The East India Company: A History*. Longman, London.
Luedtke, B. (1992). *An Archaeologist's Guide to Chert and Flint*. University of California, Los Angeles.
Luedtke, B. E. (1998). Worked ballast flint at Aptucxet. *Northeast Historical Archaeology* **27**: 33–50.
Mehta, J. M., McCall, G., Marks, T., and Enloe, J. (2017). Geochemical source evaluation of archaeological chert from the Carson mounds site in northwestern Mississippi using portable X-ray fluorescence (pXRF). *Journal of Archaeological Science: Reports* **11**: 381–389.
Newlander, K. and Lin, Y. (2017). Integrating visual and chemical data to source chert artifacts in the north American Great Basin. *Journal of Archaeological Science: Reports* **11**: 578–591.
Pelzer, C. (2007). *Treasure is Where You Find It: The Thirty Year Quest to Save the Royal Arsenal of Nepal*. DVD, International Military Antiques, Gillette, NJ.
Powell, J. (2003). The Kukri. Electronic documents, URL: https://web.archive.org/web/20040805025304/http://www.himalayan-imports.com:80/Powell/kukri/kukri-02.html, accessed March 19, 2018.
Ray, J. H. (2007). *Ozarks Chipped Stone Resources: A Guide to the Identification, Distribution, and Prehistoric Use of Cherts and Other Siliceous Raw Materials*. Missouri Archaeological, Springfield.
Richards, W. A. (1980). The import of firearms into West Africa in the eighteenth century. *Journal of African Prehistory* **21**(1): 43–59.
Roncal los Arcos, M. E., Martinez Fernandez, G., and Morgado Rodriguez, A. (1996). Las piedras de chispa: una producción litica olvidada en España. *Munibe Antropologia-Arkeologia* **48**: 105–123.
Skertchly, S. B. J. (1879) *On the Manufacture of Gun-Fints, the Methods of Excavating for Flint, the Age of Palaeolithic Man, and the Connexion Between Neolithic Art and the Gun-Flint Trade*. Memoirs of the Geological Society of England and Wales. London. Reprinted 1984, Museum Restoration Service, Bloomfield, ON.
Smith, C. S. (1960) Two 18th Century Reports on the Manufacture of Gunflints in France. *Missouri Archaeologist* **22**: 40–70.
Sprague, M. (2013). *Kukris and Gurkhas: Nepalese Combat Knives and the Men Who Wield Them*. www.modernfighter.com.
Stevenson, C. M., Bikowski, E., Neff, H., Orliac, M., and Pendleton, C. (2007). Investigations into the European provenance of historic gunflints from fort Christanna, Virginia, through trace element chemistry. *Archaeology of Eastern North America* **35**: 49–62.
Turner, R. L. (1931). *A Comparative and Etymological Dictionary of the Nepali Language*. London: K. Paul, Trench, Trubner. Online, Digital Dictionaries of South Asian Languages, University of Chicago, URL: http://dsal.uchicago.edu/dictionaries/turner/, accessed March 19, 2018.
Walter, J. (2005). *Guns of the Gurkhas: The Lost Arsenal: Pistols, Rifles, and Machine-guns of the Royal Nepalese Army, 1816–1945*. Tharston, Godstone, Surrey.
Watt, D. J. and Horowitz, R. A. (2017). An analysis of a Natchez gunflint assemblage from the lower Mississippi valley and its implications for eighteenth-century colonial economic interactions. *Southeastern Archaeology*. https://doi.org/10.1080/0734578X.2017.1336606
Weiner, J. (2016a). Die kaum bekannte, frühe Flintensteinmanufaktur bei Veaux-Malaucène (Dépt. Vaucluse, Provence, Frankreich) und ihre Einordnung in den internationalen Forschungsstand. *Archäologische Informationen* **40**: 1–22.
Weiner, J. (2016b). On gunflint manufacture in Germany. *Archäologische Informationen* **39**: 247–264.
White, G. (1971). Firearms in Africa: an introduction. *Journal of African History* **12**(2): 173–184.
White, S. W. (1976). *The French Gunflint Industries*. Master's thesis, University of Calgary, Alberta.
Whittaker, J. C. (1994). *Flintknapping: Making and Understanding Stone Tools*. University of Texas Press, Austin.
Whittaker, J. C. (1996). Athkiajas: a Cypriot flintknapper and the threshing sledge industry. *Lithic Technology* **21**(2): 108–119.
Whittaker, J. C. (2001). "The oldest British industry:" continuity and obsolescence in a flintknapper's sample set. *Antiquity* **75**(288): 382–390.
Whittaker, J. C. (2019). Stone Age Economics: Efficiency, Blades, Specialization, and Obsolescence. In Horowitz, R. A. and McCall, G. S. eds., *Lithics in Sedentary Societies: Themes, Methods, and Directions*. University of Colorado Press, Boulder.
Witthoft, J. (1966). A history of gunflints. *Pennsylvania Archaeologist* **36**(1–2): 12–49.
Woodall, J. N., Trage, S. T., and Kirchen, R. W. (1997). Gunflint production in the Monti Lessini, Italy. *Historical Archaeology* **31**(4): 15–27.