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TECHNO-MORPHOLOGICAL AND USE-WEAR ANALYSES OF GUNFLINTS FROM TWO SPANISH COLONIAL SITES (PATAGONIA, ARGENTINA)*

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The aim of this paper is to present the results of the analysis of a gunflints sample from two Colonial archaeological sites located in Patagonia (Argentina). The questions that guided the investigation were related primarily to determination of their origin and the context of their use, as well as the possibility of recycling and reclamation after they were discarded. We perform techno-morphological, raw materials and use-wear analyses. The results indicate that, given their form, the raw materials, an important amount of edge scarring and evidence of contact with metal, all of the pieces were used as gunflints and are of European origin.

KEYWORDS: GUNFLINTS, PATAGONIA (ARGENTINA), 18TH CENTURY, TECHNO-MORPHOLOGICAL AND USE-WEAR ANALYSES

INTRODUCTION

The study of gunflints in order to understand gun-manufacturing technology still poses unanswered questions in research into historical archaeology in Argentina. Even though a number of so-called gunflints have already been found at some archaeological sites across the country, just a few local studies have thrown some light on their origin (i.e., European vs. Colonial and/or indigenous production), their manufacture, the context of their use (whether they were gunflints or some other kind of artefact designed to ignite fire) and the use and discard cycle (use-life, claim and recycling) of these lithic pieces (Schávelzon 1991, 1994; Bednarz 2008; Landa *et al.* 2010; Ciarlo 2011; Elkin *et al.* 2011; see below). On the whole, these aspects are still unclear; hence new results are needed to broaden the available background. This paper presents the characterization of a sample of fire flints recovered in two Spanish sites settled by the end of the 18th century in the Argentinean Patagonia: the settlement and fort known as La Nueva Colonia y Fuerte de Floridablanca (San Julián Bay, Santa Cruz province) and the San José Fort (Valdés Peninsula, Chubut province) (Fig. 1). Both enclaves, together with the Nuestra Señora del Carmen Fort and subsidiary settlements, were included in the Spanish royal plan to settle the Patagonian coast in order to protect its southern possessions, stimulate the economic development of the region and put into practice new ideas born in the Enlightment (see, e.g., Sarrailh 1992; Senatore 2007).

The questions guiding the analysis of these artefacts were mainly related to the identification of their origin and the context of their use, as well as to the possibility of identifying claim and

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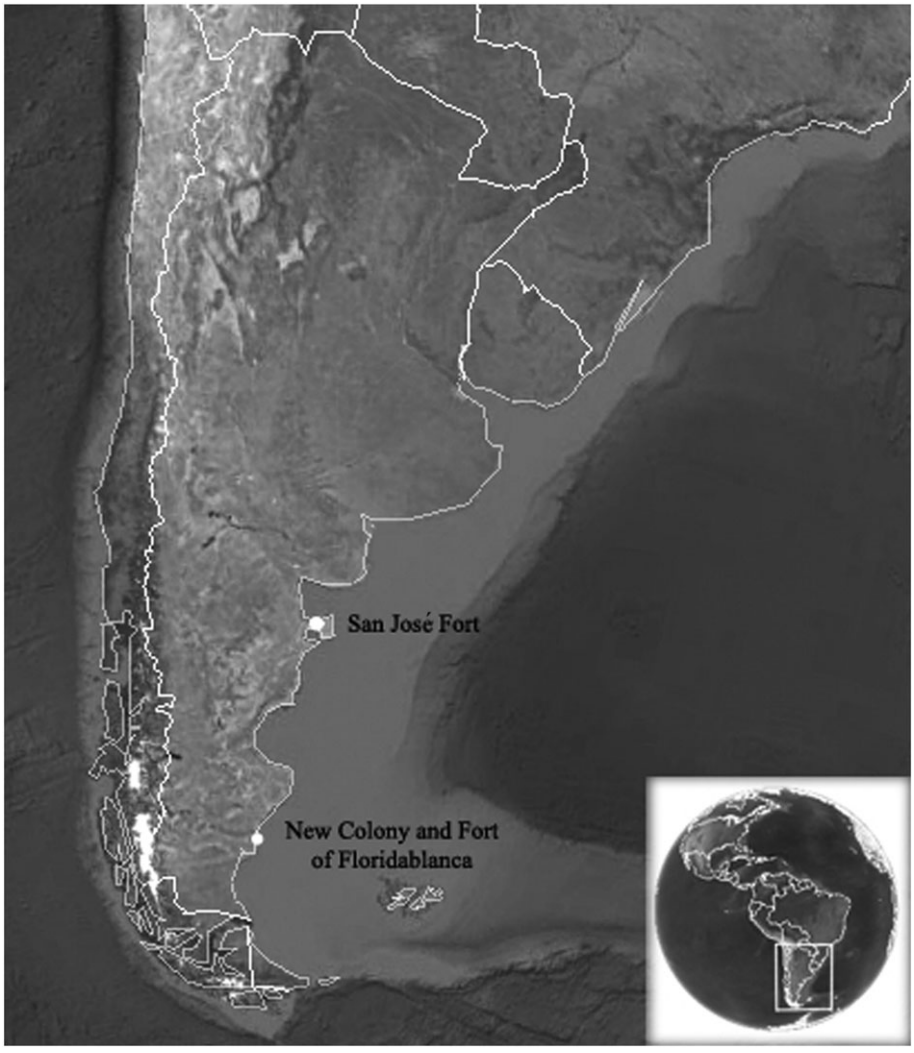

Figure 1 *The locations of the Spanish settlements in Patagonia.*

recycling events after their disposal. By 'claim', we refer to the possibility of the reuse and possibly reshaping of the gunflints. In order to solve these questions, it was necessarily to thoroughly review the background information available about gunflint technology—both at the local/regional and at the international level—to characterize raw materials, and to perform techno-morphological studies and use-wear analysis by reflective light microscopy, which altogether may define the most probable origin and use of the artefacts.

GUN TECHNOLOGY AND GUNFLINT PRODUCTION

One of the most frequent uses of gunflints relates to gun firing. A gunflint may be defined as a piece of rock mounted on the touchhole of a gun barrel, which produces a spark when the trigger

is pulled: consequently, it strikes the steel of the gun frizzen (Kent 1983) (Fig. 2). This spark burns a small amount of gunpowder, leading to ignition of the gun and the subsequent explosion of the gunpowder located in the barrel to release the projectile (Kent 1983).

This kind of technology originated in Europe around the 1550s, when gunflints replaced the previous fuse-based sparking system. France and Britain were the main centres of production and supply, both for Europe and abroad (Merino 1965; Ballin 2012), whereas other countries only provided for their internal market (Ballin 2014). The first wedge-shaped (i.e., non-lenticular) French gunflints appeared around 1675, a morphology that prevailed until about 1750 (Schock and Dowell 1983). Between 1750 and 1775, Britain developed its own gunflints production centres, generalizing the prismatic-shaped gunflints (Schock and Dowell 1983). The raw material most commonly used to make gunflints was a siliceous rock that was free of imperfections, with excellent flaking quality. French gunflints used to be made of a honey-yellow or blond flint with white inclusions, whereas the British preferred translucent black to opaque grey flint (De Lotbiniere 1984; Kenmotsu 1991; Ballin 2013a). According to Kenmotsu (1991, 344), 'this chert has often been called chalcedony to distinguish it from the fine-grained English flint'. In both countries, quarry exploitation for gunflint production was intensified from 1790 with the Napoleonic wars, which triggered some changes in the manufacturing system and in the dominance of British gunflints.

The procurement and circulation of gunflints in Argentina in Colonial times

Considering that the contexts analysed in this paper were Spanish colonies, it is noteworthy that although Spain had its own gunflint industry, it was restricted to the domestic market (Roncal Los Arcos and Morgado Rodríguez, 1995–6; Roncal Los Arcos *et al.,* 1996). This is important with regard to supply to the American colonies in general, and to the Patagonian coast in particular. According to the available literature, most of the gunflints recovered in Spanish colonies in America have been either French or British, perhaps due to the fact that Spain had not yet reached the production levels needed to export gunflints (Merino 1965). Just a few sites have reported Spanish gunflints, probably brought individually by soldiers from the Peninsula

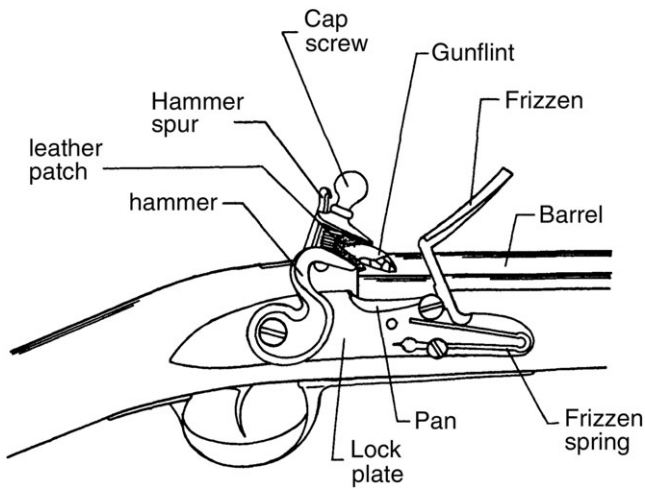

Figure 2 *A sketch of the firing mechanism of a flintlock musket (taken from Kenmotsu 1991, 343).*

(Kenmotsu 1991; Villalobos 2003; Silva 2006; Durst 2009; Austin 2011). In the case of the Patagonian colonies, the presence of French gunflints is expected at least until the end of the 18th century, a choice conditioned by the conflict between Spain and Britain. Lastly, it should be noted that no information regarding the development of gunflint production centres is known so far for the context of the Río de la Plata viceroyalty. As described in the historical sources, they were still being imported in the 19th century, with an increase in the number of countries producing them (De María 1972; Schávelzon 1991, 1994).

Considering the firearms using gunflints that were available in the Spanish colonies of South America, the specific literature indicates the use of Spanish miquelets well into the 19th century, when they were definitively replaced by French weapons (De María 1972; Moore 2001). This is an important hint, as this kind of gun left a peculiar trace on the gunflints, producing greater damage on the edges as the flint was stroked by the steel frizzen (Kenmotsu 1991; Dadiego 2014). For the Río de la Plata viceroyalty (1776–1810), the range of firearms was limited; hence, the most common types in the army were the bolt-action rifle, the carbine, the pistol and, to a lesser extent, the musket. In the case of the Patagonian colonies considered here, it was possible to identify several stock records related to the demand and provisioning of different kinds of gunflints according to their use in either rifles or pistols (AGN, Sala IX, Legajo 16-4-1; Sala XIII, Legajo 26-5-4).

A further aspect to be considered implied the manufacture and use of gunflints as well as the introduction of guns to American Aboriginal peoples. North America offered several examples of this situation from the early Colonial era, when the Americans used local raw materials and imitated the design of imported artefacts (see, e.g., Kenmotsu 1991; Elliott and Elliott 1997; Gary 2007; Stelle 2008). Broadly speaking, gunflints manufactured by American Aboriginals can be identified by their bifacial knapping technique, unlike European ones, which were made through unifacial reduction (see, e.g., Kent 1983; Kenmotsu 1991; Quinn 2004). The record for these artefacts was more frequent and conspicuous from 1650, whereas gunflints of European origin were incorporated by the end of the 18th century.

During the Colonial period in Patagonia, the use of firearms was not generalized among indigenous populations, who continued using their traditional weapons well into the 19th century (Martinic 1987, 1995). Even though, during the period considered, the provision of firearms to indigenous people was punishable by death (De María 1972), their circulation among them by alternative acquisition and exchange mechanisms and circuits should not be dismissed. Thus, for the context and period under study, there were a few documentary records that reported the ownership of guns by indigenous people in Patagonia, but no reference was made to their use (AGN, Sala X, 2-3-15; González 1965 [1798]). Unfortunately, in Argentina, no research on the manufacture and use of gunflints among indigenous peoples from an archaeological perspective has been undertaken so far; hence it is a pending issue in the understanding of the materiality of these populations after European contact.

THE ARCHAEOLOGICAL RECORD OF GUNFLINTS IN ARGENTINA

In terms of background knowledge about gunflints from archaeological contexts in Argentina, the literature on the topic was not only limited but also unbalanced with regard to the topic considered. Some of the articles reviewed are summarized here, and they exemplify the small number of samples generally analysed.

The first references date to the 1990s, and mainly describe the former Buenos Aires Fort (16th–19th centuries), where the headquarters of the national government are currently based. In this case, only 15 artefacts were preserved, as most materials were illegally acquired by private

collectors. From the total assemblage of gunflints recovered, six were identified as French, being quadrangular in shape (32 mm long) and used for rifles. Two other pieces, regarded as British, were manufactured from a dark grey siliceous rock and measured 25 and 30 mm respectively. Two of the artefacts presented use-wear, but no information is available for the remaining ones in the sample (Schávelzon 1994). Some more gunflints were recovered later in different urban and rural archaeological contexts in Buenos Aires province, although further details of these are not provided (Schávelzon 1991, 1994).

Within the framework of research into military enclaves, the Fortín Miñana (1860–3) and Otamendi Fort (1858–69), both located in Buenos Aires province, also are examples of gunflint usage. Although the historical documents refer to the provision of gunflints to the former, the archaeological analysis of lithic remains does not indicate their presence (Ramos and Gómez Romero 1997). Hence, Otamendi Fort must be considered the first study at the local level where the gunflints recovered have been thoroughly analysed in terms of their techno-morphological features and microscopic use-wear. The sample considered by Landa *et al.* (2010) included eight artefacts manufactured using a siliceous rock that was not available in the vicinity of the fort. Two of the pieces were light brown, two were grey and one was dark grey–black; information on the other three elements is lacking. Microwear analysis allowed the identification of at least three kinds of effects on the edges and surfaces of the materials studied: (1) those produced by transportation and/or friction with other lithic artefacts; (2) those produced by taphonomic agents and/or use as a result of contact between the flint and the hammer; and/or (3) use traces, which consisted of notches in the edge striking the flashpan. The morphology of these gunflints, with more abrupt edges, supported the idea that they must have had only one edge that acted as a 'leading edge' (Landa *et al.* 2010). Considering the chronology of the context analysed, this case study represented an example of continuity in the use of gunflints well into the second half of the 19th century in Argentina.

In Patagonia, two more cases were recorded for the Colonial period. One of them comprised the British gunflints recovered from the wreck of the British frigate *HMS Swift*, which sank at Puerto Deseado (Santa Cruz province) in 1770. The sample included three gunflints, two of a similar shape and size, and the third one of a rather different morphology, with less regular edges. In all cases, the percussion bulb, as well as three worked edges and one—either the frontal or the striking edge—slightly convex natural edge, were identified. One of the pieces was interpreted as a musket gunflint (Ciarlo 2011, 197–8; Elkin *et al.* 2011, 177–8).

The last finding also included three lithic artefacts that were recovered from the area operated by the Real Compañía Marítima, a Spanish enterprise created for the exploitation of sea resources between 1789 and 1806 (Puerto Deseado, Santa Cruz province). The aforementioned pieces, interpreted as potential gunflints, were identified as medial parts of fractured blades, with no further details being provided (Bednarz 2008).

THE TECHNO-MORPHOLOGICAL CHARACTERIZATION OF GUNFLINTS AND FIRE FLINTS

This section introduces the main features considered for gunflint identification, as they represent one of the variants of the so-called fire flints.

Following Kenmotsu (1991), the main problem for the identification of gunflints is the ambiguity in the terminology used to define them. She argued that, 'Gunspalls are wedge-shaped, non-lenticular gunflints [Hamilton 1960, 73–9] ancestral to the prismatic gunflint in France and England. The term gunflint is employed to refer to the prismatic gunflints manufactured in Europe through a blade technology. It is also employed to refer to the entire artifact class

regardless of when, where, how, or by whom manufactured' (Kenmotsu 1991, 346). In this paper, we replace the term 'gunspall' by the expression 'flake-based gunflints', in order to refer to wedge-shaped gunflints manufactured on flakes, with the heel on the ventral surface—which tended to be slightly convex and usually presented the percussion bulb—whereas the dorsal surface was typically relatively flat or slightly concave (Hamilton 1960; De Lotbiniere 1984; Kenmotsu 1991; Austin 2011; Ballin 2012, 2013b). Gunflints manufactured on blades were characterized by their lenticular, rectangular or prismatic shape—the latter dominating the British sample by the end of the 18th century (Christianson 1982; De Lotbiniere 1984; Ballin 2012)—and the presence of a bevel along the dorsal surface.

As Ballin points out, gunflint production was standardized from early times (Ballin 2012). Gunflint size generally ranged between 50×30 and 10×10 mm. As gun production was not standardized, the place available in the gun cock may differ from one artefact to the other, depending on the kind and calibre of the weapon (Kenmotsu 1991). Nevertheless, Schock and Dowell (1983, 61) indicated that, 'it is very difficult and frequently impossible to determine whether a particular gunflint was used with a rifle or a pistol. This is further complicated by the fact that a large pistol might use a larger flint than a small, light rifle.'

Ballin (2012, 2013a, 2013b pointed out that British gunflints (produced after 1800) were as a rule blade-based, exceptionally standardized, elongated and rectangular in shape, and generally slightly thicker than the French pieces, which were standardized from the mid 1700s. De Lotbiniere (1984) identified four main types among British gunflints: (1) D-shaped flake gunflints (formerly 'Dutch' gunflints); (2) square flake gunflints; (3) square blade gunflints with two dorsal ridges; and (4) square blade gunflints with a single dorsal ridge (De Lotbiniere 1984, in Ballin 2013b). French gunflints (produced during the 18th and 19th centuries) were also blade-based, but were broad and rectangular, and somewhat trapezoidal in shape, with rounded heel edges (also see Ballin 2012). Finally, Spanish gunflints were often characterized by small invasively retouched pieces, similar to the Ottoman and Native American ones (Ballin 2013a, 9; Ballin 2013b).

Considering manufacture, Merino (1965) and Kenmotsu (1991) indicated that gunflints were knapped from a siliceous core using a disc-shaped metal hammer and a steel anvil, thus originating a concave short retouch, which is easily distinguished from prehistoric knapping. As a rule, they were made from flakes, although their replacement by blades brought about more standardized pieces and less waste of raw materials. A typical feature resulting from this manufacture was the presence on the edges of 'demicones', small percussion bulbs that originated when the blades were stroked by the hammer to be segmented, an attribute found on both British and French gunflints after the second half of the 18th century (Ballin 2013b).

Traces related to use and wear

The study of archaeological, modern and experimental samples has led many scholars to discuss the different kinds of damage and wear generated in the use of gunflints. A summary of the most diagnostic attributes is discussed on the basis of the published references. However, it is fundamental to point out that some of the analyses performed were cautious about the variability expected in use and wear patterns for gunflints, which depended heavily on, amongst other things, the raw material used, the manufacturing technique, the kind of weapon, the size and orientation of the gunflint in the frizzen, or its use-life—limited to 20 rounds before reactivation of the old edge or the use of a new one became imperative (Kenmotsu 1991; Ballin 2012).

Kenmotsu (1991) described and tested several guidelines regarding the damage and wear patterns expected from the use of gunflints, which were useful for the analysis of the sample presented here. According to this author, unifacial step flaking may be considered a typical pattern of use, produced by the steel parts that were in contact with the gunflint. Moreover, as the contact with the steel frizzen was confined to the edge, scars should be concentrated in that section. These patterns were often associated with smoothing of the working edges and some flat flaking on the lower surface of these edges. This retouch was rough, matte, invasive, pitted and rounded, with blunt edges, a feature that differentiated them from scrapers (Merino 1965). Specifically, Kenmotsu indicated that, 'It should be noted that the terms "upper" and "lower" surfaces of a gunflint cannot be equated to the terms "face" or "back"... Gunflints are used today with the bevel up or down, and are frequently turned over. Historic accounts also document variation in gunflint position, especially with regard to whether the bevel is up or down' (Kenmotsu 1991, 354; see also Ballin 2014).

Blunting, though not as common, may also be present. Occasionally, working surfaces also exhibited crushing. Finally, rejuvenation of the gunflint can be recognized by multiple working surfaces and retouch. According to Kenmotsu, rejuvenation may result from rotating the gunflint to use a different surface, turning the flint over, or retouching the surface using a wooden billet or another instrument such as antler, bone or lithic tools, or even copper ones (Kenmotsu 1991, 354).

Together with the use intensity and wear patterns identified by Kenmotsu (1991), it should be noted that experimental studies developed by Quinn indicated a wide variety of alterations as well as obliteration by edge rejuvenation, which made it difficult to define the gunflint use-life or the number of use events (Quinn 2004). This author also indicated that, 'other factors, such as differences in individual gunflint shape and size and orientation in relation to the frizzen, appear to account for the lack of a uniform use-wear pattern that increases systematically through use' (Quinn 2004, 66).

One factor to be considered is the probable reuse of gunflints as stones to ignite fire ('fire flints') by using steel strike-a-lights (Ballin 2005). Many authors have remarked that this use produced a distinctive wear pattern, defined by the removal of relatively large flakes from the edge of the piece, giving it a crescent-shaped appearance (Christianson 1982). Consequently, particles and striations with metal traces were evident on the surfaces (Schock and Dowell 1983). The absence of references to these kinds of artefacts in Argentina should be noted, including their use among indigenous populations.

Three different kinds of residue would be potentially expected on the working surfaces and edges of gunflints. Following Kenmotsu (1991), they could be: (1) metal residues from manufacture and/or contact with the frizzen (see also Quinn 2004)—additionally, Landa *et al.* (2010) suggested that the metal traces on gunflints were generally found on the most acute angle(s), which may be either all the edges or just some of them; (2) organic residue from the leather used to fix the gunflint to the cock, and (3) evidence of thermal alteration as a consequence of the ignition with gunpowder (micro-crackled and vitrified surfaces, *sensu* Ballin 2014). Nevertheless, some of these residues may be absent regardless of use, the presence of a specific residue did not always indicate use (Quinn 2004) or the remains may be masked by taphonomic processes, demanding a strict control of the original context of the sample.

MATERIALS AND METHODS

The sample of possible gunflints and fire flints analysed in this paper included five artefacts recovered from two Spanish Colonial sites on the eastern Patagonian coast in Argentina. In both

cases, contact with indigenous Tehuelche populations has been confirmed from a historical and archaeological perspective (Buscaglia 2011, 2012, 2015). The first of these sites was known as San José Fort, settled next to the Puesto de la Fuente in the Valdés Peninsula (Chubut province). Created in 1779, both settlements fulfilled military and productive functions until 1810, when they were destroyed by an indigenous attack that killed most of the settlers. The fire flint (see below) analysed in this paper was recovered in the sector called San José 1 (Fig. 3 (a)), interpreted as the area where most people had their temporary dwellings—that is, leather tents—in the 31 years during which the site was occupied (Buscaglia *et al.* 2012; Buscaglia and Bianchi Villelli 2016).

The second archaeological context involved the Nueva Colonia y Fuerte de Floridablanca (San Julián Bay, Santa Cruz province), a short-lived agricultural enclave that was active between 1780 and 1784, when it was burnt down and abandoned following an official Orden Real (Senatore 2007; Senatore *et al.* 2008). Four artefacts were recovered from this site, which were interpreted as possible gunflints. All of them were found inside the fort of the settlement, two inside the structure—in the facilities for the farmers, which were reused as a storehouse (Northeast Sector, Fig. 3 (b)) and the Superintendent's chamber (Western Sector, Fig. 3 (c))—and the last two from the ditch surrounding the structure, which could have been used as a disposal area (Northeast Sector, Fig. 3 (d)) (Buscaglia and Nuviala 2007; Buscaglia 2012).

Both sites were located in an arid environment, with sand to silt–sand substrates, exposed to intense wind action and the activity of different taphonomic agents, including anthropic

Figure 3 *Excavations at San José 1, Sector SJ1 (a) and Floridablanca fort: the farmers' rooms reused as warehouses (b); the Superintendent's room (c); and the ditch surrounding the structure (d).*

destruction by looting. The following paragraphs explain the results of the techno-morphological and use-wear by reflective light microscopic analysis of the five pieces recovered.

Based on previous literature, the analysis of the sample was intended to identify the origin of the possible gunflints—that is, European or indigenous—their function and any evidence related to manufacture, use, claim and recycling during and after disposal. All these issues were considered in the techno-morphological analysis of the gunflints, following the criteria described by Kenmotsu (1991) and Merino (1965). The identification of raw materials was based on Alberti and Fernández (2015). Additionally, in order to determine the presence of traces that may indicate whether these pieces were actually used as gunflints, use-wear microscopic analysis was proposed. It included the identification of macro- and microwear, as well as technological and post-depositional alterations by observing them with an Olympus BHMS metallographic reflective light microscope (Semenov 1964; Keeley 1980) supplemented by 50× to 500× lenses.

RESULTS

Techno-morphological analysis

The results of the techno-morphological analysis of the gunflints are presented in Table 1. The measurements of these pieces range from 13 to 25 mm in length, 16 to 29 mm in width and 6 to 10 mm in thickness.

According to these results, four out of the five gunflints analysed in this paper were manufactured on a honey-coloured translucid flint with white inclusions (Fig. 4, B–E), while the fifth one was made on a grey siliceous rock (Fig. 4, A). None of them presented cortex.

Based on the attributes identified (flake negatives from different directions, the absence of a regular bevel on the dorsal surface and the presence of percussion bulb), the five pieces seemed to have been knapped on flakes. This blank was expected for the chronology when the two archaeological sites were inhabited (1779–1810), as blade technology was not generalized until 1790. This issue was particularly relevant for the materials from the Floridablanca site, occupied between 1780 and 1784. According to their morphology, four of the pieces may be classified as flake-based gunflints (Fig. 4, A–C and E) and the last one was a non-determinate piece due to its fragmentation (Fig. 4, D). In all cases, unifacial knapping was confirmed as the manufacturing technique, and both their measurements and the trapezoidal transversal sections conformed to those expected for this kind of artefacts.

In all the artefacts, the number of flake scars on the dorsal surface was higher than on the ventral side. They could have been made either by use or in the course of manufacture. These pieces, however, yielded other traces that may correspond to their use in guns, as follows:

Piece A: microwear was only identified on two opposing edges. One presented a projecting point, although not too pronounced, typical of use.

Piece B: it was not possible to clearly estimate the number of negatives on the surfaces, as they were obliterated by later retouch. Jagged and exhausted edges.

Piece C: flaking and micro-retouch on the whole perimeter. It showed the typical projecting point that indicated exhaustion of the edge for striking.

Piece D: flaking and micro-retouch in the whole perimeter. It showed the typical projecting point that indicated the exhaustion of that edge for striking. Evidence of exhaustion on all edges. Flaking indicative of use on the ventral surface.

Piece E: notched and exhausted edges. One of them had the projecting point typical of use, not too pronounced. It may have been discarded due to breakage.

Table 1 *The technological characteristics of the gunflints analysed in this paper*

Piece	*Raw material*	*Colour*	*Shape*	*Condition*	*Number of flake scars on dorsal face*	*Number of flake scars on ventral face*	*Length (mm)*	*Width (mm)*	*Thickness (mm)*	*Angles (degrees)*
A	Flint	Grey	Quadrangular (wedge)	Unbroken	8	3	25	24	6	55/70/60/55
B	Flint	Translucent honey		Broken	3	3	18	29	10	85/60/75
C	Flint	Translucent honey	Flake-based	Unbroken	11	9	20	20	9	80/78/80/75
D	Flint	Translucent honey	Flake-based/pyramidical truncated	Unbroken	10	1	23	21	7	70/90/75/70
E	Flint	Translucent honey	Flake-based	Broken	4	3	13	16	7	75/90/75

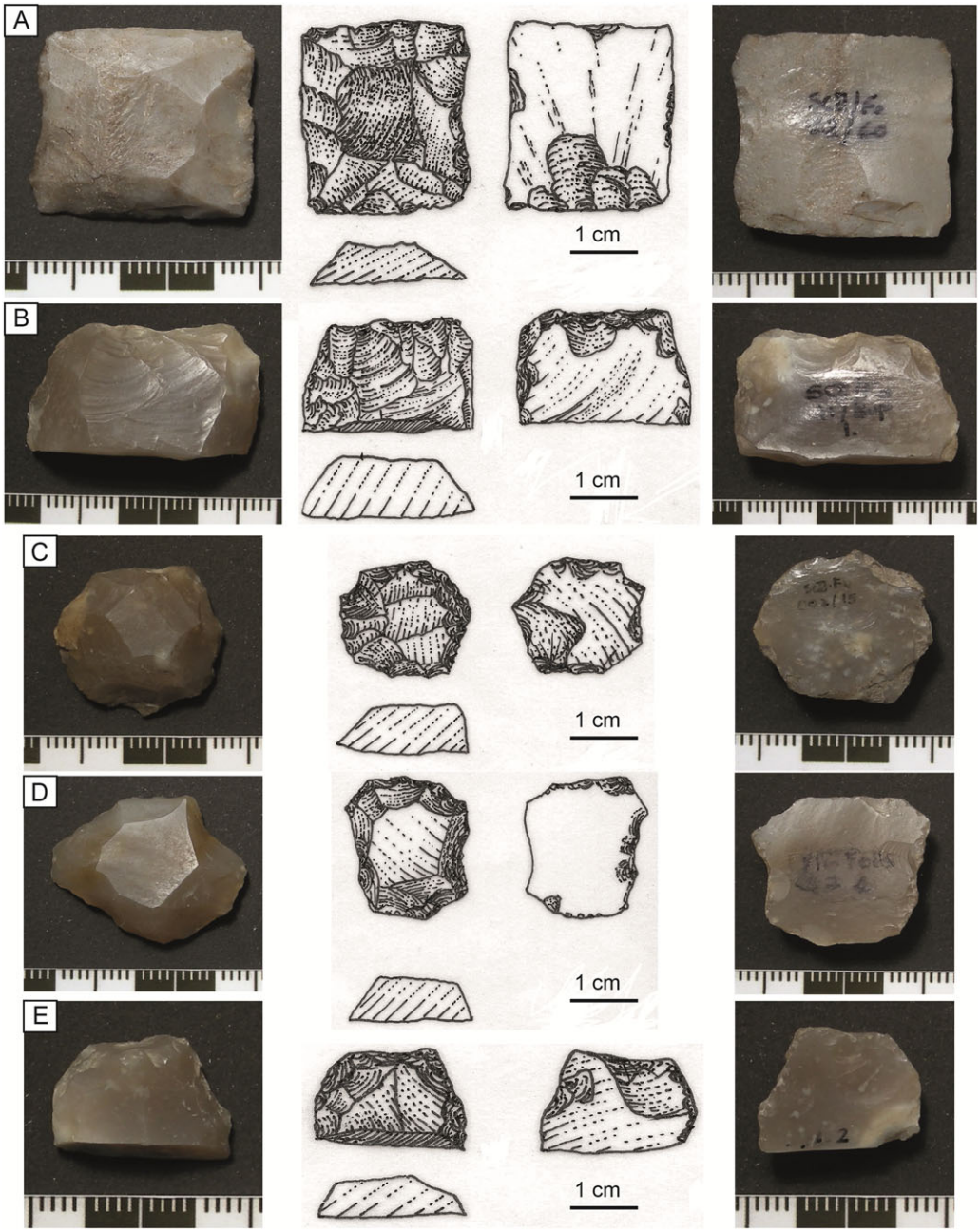

Figure 4 *Gunflints recovered at Floridablanca (A–D) and San José (E).*

Gunflint D (see Fig. 4) was rather peculiar. According to its morphology, it may have been struck by a steel strike-a-light. As suggested by one of the referees, pieces B, C and E may also have been used secondarily as fire flints, given the loss of their original form and the thin line of metal residue. The pieces applied to this function presented continuous and relatively large

flaking on the edge, giving the fire flint a crescent-shaped appearence with a projecting point, similar to that found on gunflint D and depicted in Figure 4 (Christianson 1982, 38, fig. 3; Austin 2011).

Functional analysis

Microscopic use-wear analysis identified significant post-depositional processes covering the complete surface of all the pieces considered. The main damage observed was soil sheen, defined as a kind of patina that looked like a colourless and glossy surface originated by the dissolution and later filling of cavities and depressions of the siliceous component of the rocks knapped to manufacture the artefacts (Fig. 5, E). In this case, it affected both the high and low parts of the microtopography of the piece, occasionally obliterating technological traces. The composition of the sedimentary matrix, wind action and the properties of the raw materials (fine-grained rocks) played a fundamental role in developing this kind of damage.

The presence of microscars on the retouched edges was evident on both surfaces across the complete sample, although they were dominant on the flat side. They mainly consisted of semicircular scars, together with some isolated notches (Fig. 5, D and E). Although this trace could have been originated by different actions, such as compression of sediments or trampling of the artefacts (among other agents), it is highly probable that the fractures observed in the samples were related to the percussion of the pieces when firing the gun, as the soil sheen invades the concave part of the scarring, indicating that they were not fresh or relatively recent fractures but, rather, produced before disposal; that is, during the use-life of the artefacts.

Carvalhaes (2011) proposed a grading scale to define intensity of use based on the microfractures present on the edges. According to this scale, the materials analysed exhibited a medium to high development of use-wear, in accordance with the techno-morphological analysis (Carvalhaes 2011, 24–5): clear scarring, but preservation of the general form of the artefact. Only the pieces identified as B and E were fractured (Fig. 5).

Traces or residues typical of contact with metals were observed on virtually all the artefacts (see Fig. 5, A–C), except for piece D. In this case, the probable rejuvenation of the edges may have destroyed previous traces. This conclusion, however, contradicted the expectations regarding the presence of metal residues on this kind of artefact. In some cases, they were distributed along all of the retouched edges; in others, they were just focused on one. Their development was also quite dissimilar: some of them yielded highly focalized contacts, whereas in two cases—gunflints A and B, in Figures 4, 5—micropolish covered the pieces invasively from the edge to the core, developing scars that ran perpendicular to the gunflint edge. These

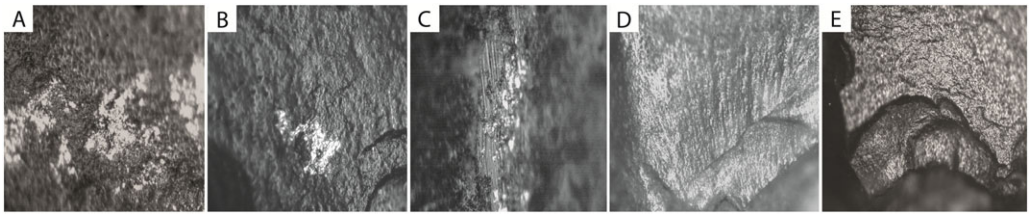

Figure 5 *Micrographs by use-wear method: A, B, traces of metal; C, D, micropolishing and striae due to metal contact; E, snap fractures and glossy patina.*

traces, and their characteristics and distribution, were similar to those produced by knapping and retouching tools during manufacture and rejuvenation activities, identified as spalling from the edge. In other words, they drew a thin line that extended to the core of the piece, associated with deep striations on a lustre surface (Fig. 5, C and D).

DISCUSSION AND CONCLUSIONS

From both the techno-morphological and use-wear analyses, it may be concluded that the five archaeological artefacts recovered were used as gunflints. Taking into account the context, raw material and morphology, four of them seemed to have been imported from France (Fig. 4, B–D). The morphology and manufacturing technique of piece A (Fig. 4, A) could indicate its Spanish origin (see Ballin 2013a, 2013b), without evidence of having been used as fire flint. The attributes recorded in all the cases, particularly the fact that they were manufactured on flakes and, in most cases, had a French origin, dated them to before 1790, contemporaneous with the period during which the Spanish settlements and forts studied were occupied. Thus, the pieces analysed coincided with the attributes expected for European gunflints—both in terms of manufacturing techniques and raw materials—rather than having a creole or Aboriginal origin.

In all cases, intensive use of the artefacts was noted, evidenced in the use and wear traces on the edges, particularly the presence of the projecting point produced by the exhaustion of the edge that operated as a leading edge. Use intensity is an interesting variable to be considered in future work in order to evaluate the conditions under which these kinds of artefacts were supplied to the Patagonia colonies in particular, and the Río de la Plata viceroyalty in general. In only one case (Fig. 4, D) was clear evidence of possible recycling and/or claim detected, so that it could be reused as a fire flint, struck by a steel strike-a-light. In the other three cases, major analyses need to be carried on in order to prove or disprove reuse of the pieces.

The results of the functional analysis were in line with both the experimental results and the use-wear analyses performed by different authors: the presence of striations and evidence of metal residues (e.g., Barandiarán, 1974; Kenmotsu 1991; Quinn 2004, 2010; Carvalhaes 2011). On the other hand, no evidence for gunpowder residues or organic material—such as the leather used to hold the piece in place—was detected. Contrary to our expectations, metal traces were relatively frequent. Only the pieces identified as A and B (Figs 4, 5) yielded clear indications of percussion on a metal material. This may be due to the notorious post-depositional alterations of the whole assemblage. Spalling, however, was present in all of the pieces. Despite the multiple possible origins implied in this kind of trace, it was highly probable, as previously mentioned, that it was a result of the use of the artefacts rather than a later modification.

The observation of these materials raised the question of the origin of the metal traces detected. Were they a consequence of use or of manufacture? Considering that they dated to historical times, their manufacture may have implied the use of metal tools (see, e.g., Barandiarán, 1974; White 1975). The limited development of these traces noted in many of the gunflints did not confirm this issue, although their location contradicted the idea of blank extraction.

Finally, it is expected that the recovery of more gunflints in our as well as other research will throw more light on the technological and historical aspects of this element of the lithic assemblage. Although gunflints are still a challenge for specialists on the Colonial and Republican periods in the Southern Hemisphere, further samples would encourage the discussion of their peculiarities, distribution and use in the different contexts worldwide.

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