THE FIRST AMERICANS, like the dinosaurs, the origin of life, and human evolution, is a subject that fascinates both scientists and the general public.

The peopling of the Americas is extraordinarily rich in areas of interest—humans coping with changes in their environment at the end of the Ice Age; the remarkable courage and perseverance of human colonizers undaunted by unfamiliar terrain and wildlife; the enviable versatility and ingenuity of toolmakers, who learned to make implements of stone for every purpose, from everyday chores to killing game the size of giant ground sloths, mammoths, and mastodons.

As we enlarge our knowledge, our fascination with the First Americans grows ever more intense. That is why the editors are pleased to present this special issue of ***Current Research in the Pleistocene,*** which illuminates the earliest existence of humans on the continent of South America. Here 98 Latin American scientists, from México to Argentina, apply their scholarship in Quaternary science, archaeology, and anthropology to answer—at least in part—such seminal questions about this complex feat of colonizing as, Who were the first inhabitants of the southern continent? When did they arrive? Which routes did they follow from their places of origin? How long did it take to complete this task?

After a century of research, our fascination is more acute than ever. We are encouraged to pursue our search for knowledge by this thought of Florentino Ameghino, the scientist whose discovery of fossils on the Argentine Pampas at the turn of the century rivals the accomplishments of his North American coevals:

> *"Por nuestra parte, no vamos a hacer más que descorrer una punta del tupido velo que encubre la pasada existencia del hombre Americano. Descorrerlo por completo está reservado al esfuerzo de muchos."*
>
> [*From our side, we will not do more than pull back an extreme of the veil that covers the history of American man's existence. Uncovered it is reserved entirely to the efforts of many of us.*]

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SOUTHBOUND
Late Pleistocene Peopling of Latin America

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Broken Stone Tools from Cerro El Sombrero Cima (Tandilia Range, Argentina)

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➤**Keywords:** Accidental breakage; intentional breakage; Pampean region

Cerro El Sombrero Cima (Pdo. Lobería, Buenos Aires Province), located on a hill atop a quartzite outcrop (Flegenheimer 1994, 2003), is an open-air site that dates to the Pleistocene/Holocene transition. It has been interpreted as a place where early inhabitants refurbished weapons, replaced projectile points, and performed final stages of tool manufacture. Its location on a promontory means that the site would also have been used as a lookout (Flegenheimer 1994, 2003). Because of its prominence and the activities performed there, the site must have been an outstanding feature of the landscape that had special meaning for early people (Flegenheimer and Mazzia 2008; Mazzia 2010–11). Several unique characteristics distinguish Cerro El Sombrero Cima from other places visited by groups of hunter-gatherers (Mazzia 2010–11). This paper focuses on one of these traits: a high incidence of breakage, which affects 90% of the stone tools.

The lithic assemblage recovered from excavations and surficial finds consists of 1501 tools, with Fishtail projectile points the most diagnostic item (Flegenheimer 2003). Most of the tools were made of Sierras Bayas Group orthoquartzite (SBGO) quarried from a locality about 50 km west of the site (Flegenheimer 2004). In this paper we analyze a sample of 62 Fishtail points and 462 broken tools recovered from an area of 25 m^2 (67.6% of the total excavated area).

The high percentage of broken tools motivated a research project to characterize different types of tool fracture and to relate these types to their origin. We conducted several experiments on tool breakage including trampling (Flegenheimer and Weitzel 2007), knapping errors (Weitzel 2010; Weitzel and Colombo 2006), use of projectile points and other tools (Flegenheimer et. al 2010; Weitzel 2010), and intentional breakage (Weitzel 2010; Weitzel and Colombo 2006). Experimental tools were manufactured on SBGO.

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Experimental fractures were compared and contrasted with descriptions published by several researchers (see Table 1 for references and types of fractures considered). We then merged our results with descriptive attributes used in Argentinean lithic analysis (Aschero 1975) to obtain a detailed description of each type of fracture associated with its probable origin (Weitzel 2010, 2011).

Table 1. Fracture types considered among the Fishtail points and other lithic artifacts recovered from Cerro El Sombrero Cima.

Fracture type	Cause	References
Perverse fracture	Knapping error	Crabtree 1972; Frison and Bradley 1980; Johnson 1979; Miller 2006
Lateral snap	Knapping error	Rondeau 1981
Snap fracture	Intentional	Deller and Ellis 2001
Radial fracture	Intentional	Deller and Ellis 2001; Frison and Bradley 1980; Root et al. 1999
Complete cone fracture	Intentional	Deller and Ellis 2001
Bending fracture	Knapping error; trampling; use; impact	Fisher et al. 1984; Whittaker 1995
Bending initiating step terminating fracture	Impact on projectile points	Fisher et al. 1984; Odell and Cowan 1986
"Spin-off" fracture	Impact on projectile points, trampling, knapping error	Fisher et al. 1984
Impact flute	Impact on projectile points	Bradley 1982; Odell and Cowan 1986; Titmus and Woods 1986
Impact burin	Impact on projectile points	Bradley 1982; Odell and Cowan 1986; Titmus and Woods 1986

Analyzing Breakage Patterns

Most of the tool fractures were of accidental origin; intentional breakage accounts for only a small percentage of fractures (Weitzel 2010). Only 5% of fractures were caused by trampling; these are not considered here.

Accidental breakage Observed on 60% of the specimens, this type consists generally of bending fractures. The specific origin of accidental breakage was only identified in 18% of the cases. Most of these (14.6%) were the result of knapping errors: perverse fractures (9.6%), lateral snap (0.8%), and a single overshot fracture. Bending fractures were only considered to be the result of knapping errors on thick (>9 mm) tools (3.5%).

Perverse and lateral fractures were observed on Fishtail point preforms (Figure 1A) and on finished points with abraded stem margins (Figure 1B); knapping errors were, however, mainly associated with bifacial thinning on other tools, and they were also found on unifaces (Figure 1C). Diagnostic impact fractures were observed on 23% of finished Fishtail points; these include impact flutes, spin-off fractures, and bending-step terminating fractures (Figure 1D). Most of the Fishtail points are stem fragments broken when bent transversely where the stem widens to the shoulder. Bending fractures are difficult

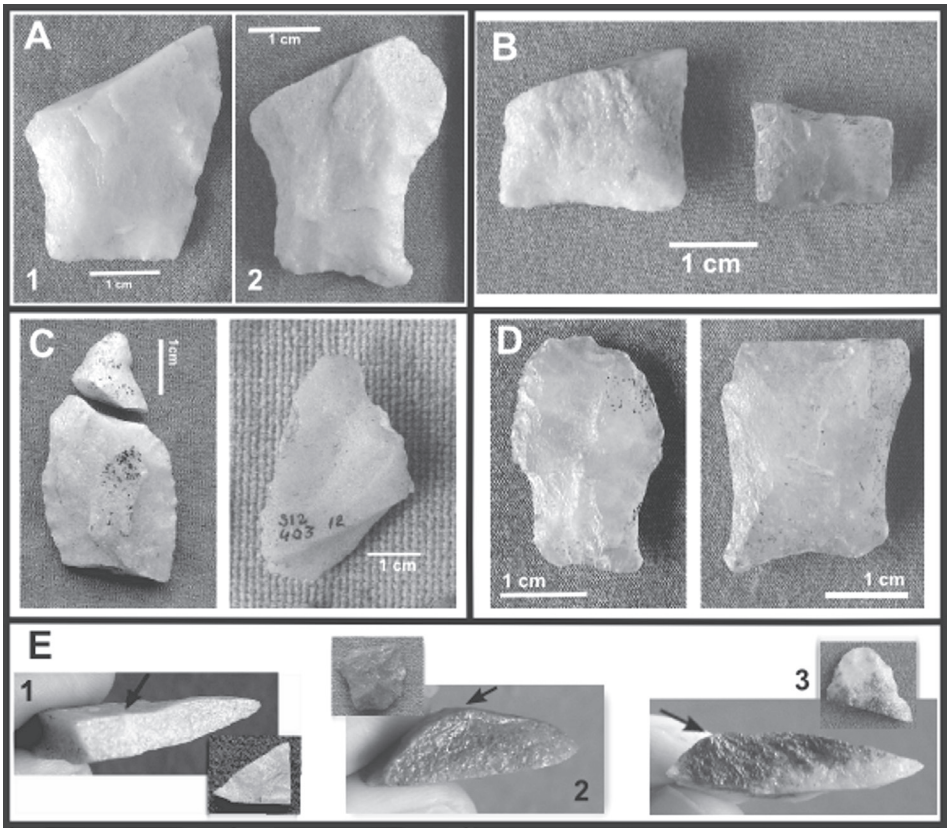

Figure 1. Fractured artifacts from Cerro El Sombrero Cima. **A1,** Fishtail point preform with perverse fracture; **A2,** fishtail point preform with lateral snap; **B,** finished Fishtail points with perverse fractures; **C,** biface *(left)* and uniface *(right)* with perverse fractures; **D,** Fishtail points with impact flute *(left)* and spin-off fracture *(right);* **E,** intentionally broken tool fragments with radial fracture **(1),** snap fracture **(2),** and undetermined intentional fracture **(3).** 21

to trace to a specific origin; experiments, however, showed that bending fractures in this specific location on Fishtail points frequently resulted from impact (Flegenheimer et. al 2010; Weitzel 2010).

Intentional Breakage Radial, snap, and undetermined intentional fractures were found on 8% of the sample. Intentional breakage is confined to tools with specific attributes: All are thin (5–10 mm thick), with triangular and plano-convex cross sections (Figure 1E). The thinness and cross-section profiles are recurring traits common to radial and snap fractures on SBGO tools (Weitzel 2010). 12

Discussion and Conclusions 13

These results were useful for confirming inferences about the tasks carried out at Cerro El Sombrero Cima—the final stages of manufacturing Fishtail points and other tools, and 14

maintaining and replacing projectile points. Our results are also relevant when considering people's choices in using and discarding stone tools.

Occasionally some tools were deliberately broken, presumably as an expedient technique
15 to obtain obtuse angled edges and points, as has been observed in Folsom sites (Frison and Bradley 1980; Wilmsen and Roberts 1978; Root et. al 1999).

The unusually high incidence of breakage with a preponderance of accidental fractures, and the absence of tools refitted (Weitzel 2010) and deposited in a highly significant place
16 (Flegenheimer 1994; Flegenheimer and Mazzia 2008; Mazzia 2010/2011), together lead us to propose as a working hypothesis that Cerro El Sombrero Cima was also chosen as a place to deliberately deposit certain objects, frequently once they were broken.

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