The Study of Finger Flutings

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Archaeologists have usually glossed over parietal finger flutings, especially non-figurative and non-symbolic lines. This article develops a nomenclature and defines four forms to provide a descriptive structure from which to build analyses. It then develops methods for such investigations, using experiments and studies of physiology to derive information about the fluters from the flutings. The methods are applied to each of the four forms of fluting, showing which approaches may be most useful for each form. Broader questions and applications are touched on, including approaches to meaning, figures, and other families of parietal markings such as hand stencils. This approach to flutings augments other approaches to prehistoric 'art' by seeking to know about the artists themselves, their gender, age, size, handedness, and the number of individuals involved in creating a panel.

Finger flutings are lines made with fingers drawn over a soft surface. Palaeolithic flutings occur in caves through southern Australia, New Guinea, and southwestern Europe, and presumably were made over a considerable time span including some or all of the Upper Palaeolithic (see Fig. 1). They can appear figurative (for instance, figures of mammoths in Rouffignac Cave, France), form patterns or motifs (tectiforms in Rouffignac, for instance), or present no recognizable symbol, picture, or pattern. Evidently, a significant proportion of prehistoric cave 'art' in France comprises non-figurative fluted lines. Lorblanchet (1992, 451) writes about the 120 m^2 of flutings in Pech Merle Cave, France: 'Almost all the clay walls that are accessible without too much difficulty bear these markings'. Plassard (1999, 62) mentions 500 m^2 of flutings ('meanders' as he calls them; also known as 'macaroni' and 'serpentines': Marshack 1977, 286) in Rouffignac Cave, whereas he isolates 254 figures of animals, humans, and other motifs in the cave; these cover far less surface area. Leroi-Gourhan (1958, 314) reports that 'incomplete outlines and bundles of lines … with very few exceptions … exist in every cave'.

Some investigators in the past speculated about the meaning of these lines (Breuil *et al*. 1915; Leroi-Gourhan 1958; 1972) but most nowadays merely mention their occurrence, if anything. Thus, regarding Chauvet Cave, France, Chauvet and his colleagues do not mention them, whereas Clottes and his colleagues do, at least a little (compare Chauvet *et al*. 1996, pls. 29–30, 32–3 with Clottes 2003, illus. 84, 87–8, 94). Aujoulat & Gély (2003, 91) write about a wall 'covered with bear claw marks' in the Hillaire Chamber of the cave, 'on which some long, sinuous vertical lines have been engraved' — actually, fluted — which they interpret as 'a reminder of the claw marks that probably inspired them'. Previous understandings of non-figurative flutings perhaps appear wanting and so scholars increasingly say less and less about them, and what they do say often is speculative. Write Clottes & Courtin (1996, 59):

> barely a quarter of the finger tracings in some seventy European Palaeolithic painted caves has been the subject of surveys and precise analyses. This clearly has to do with the indifferent aesthetic appeal of these depictions, with the technical difficulty their study presents, and with the uncertain and often insufficiently gratifying results that the researcher can expect at the conclusion of the task.

Despite their prevalence, little until now has been or could be written about flutings, especially the non-figurative examples. This article tries to change this by proposing a language and systematic methodology for their study based on theory, experiment, field research, and analysis (Sharpe & Van Gelder 2004; in

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Figure 1. *Finger flutings in Chamber A1, Rouffignac Cave, France.*

press a). From this, we endeavour to gather sufficient information for each site to replicate the markings as the original fluters made them and to describe their ages, genders, handedness and sizes, and number. Analyzing their flutings, what can we know about the people who used the cave? The core of the research is to glean as much information as possible from the lines in order to learn about the fluters and how they fluted. The methodology suggested is different from that normally used for prehistoric 'art' but it is still an archaeological search for finding out about the fluters.

The method developed here derives from the internal analysis that Marshack introduces, where he studies incised lines (for instance, Marshack 1972). For example, often using magnification, he examines the junctions and cross-sections of lines. Different cross-sections of incised lines may imply the use of a different tool, perhaps by different people, and perhaps at different times. Junctions may tell which lines overlie others and therefore the temporal sequence of their creation. Marshack's major contribution is to look at the lines themselves before launching into questions of meaning.

Internal analysis has been practised by others (for instance, Bednarik 1986; 1994; 1999; d'Errico 1992; 1994; d'Errico *et al.* 2001; Lorblanchet 1992; 1995; 1999). D'Errico focuses on engravings on portable artefacts, reproducing lines experimentally and subjecting them to statistical analysis when a large enough sample exists. Some work, especially by Bednarik, explores the effect of the medium on flutings. The history of flutings on a soft medium such as moonmilk or clay depends on, among other factors, the history of the medium: the growth of moonmilk, for instance, can distort the original flutings (moonmilk may, on the other hand, offer the opportunity, Bednarik thinks, to date the flutings). Lorblanchet (1995) further refines Marshack's recording techniques by developing photography with different filters and various light sources (including infrared and ultraviolet).

This investigation is part of a research programme that bases its methodology on the flutings themselves, including repeated examination of them (for instance, Sharpe 2004; Sharpe & Lacombe 1999; Sharpe *et al.* 1998; 2002; Sharpe & Van Gelder 2004; 2006; in press a–c; forthcoming). It does not first introduce ideas as to the meaning of the flutings (for instance, as depicting animals, humans, or symbols) and their significance, then looking at the lines through those ideas. Rather, it seeks to establish an objective and experimental approach to flutings, seeing what can be said about the marks themselves as they were made and, thereby, what the marks might say about their makers. It also involves experimentation to ascertain how the markings may have been made and limitations on them given their means of manufacture. Such investigations logically come before approaches that seek subjective interpretation, intention or meaning; they may help sort out the various suggestions as to meaning or lay a solid foundation for seeking them.

For flutings, internal analysis suggests a close examination of the points at which lines meet or overlie. Flutings can be looked at more extensively than this, however, to see what else they might reveal about their creators and their creation.

The following nomenclature provides a language to describe and understand the fluting phenomenon, and thus remove some of the confusion and near silence associated with it (Sharpe & Lacombe 1999).

- *Finger fluting*, or *fluting*, refers to a line drawn with a finger.
- *Graphical unit*, or *unit*, refers to flutings drawn with one sweep of one hand or with one finger (Marshack 1977).
- *Cluster* labels an isolatable group of units that exhibit a unity, for instance because they over-lie each other. A cluster of flutings may be isolated if it is possible to tell what flutings one person creates as a continuous act — while standing in one place, for instance, or while squatting or moving sideways.
- *Panel* refers to a collection of clusters that appears spatially or otherwise distant from other clusters or

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on a surface of reasonably uniform orientation.
- *Engraving* refers to lines made with a tool (*scratches* [animal claw marks], *incisions* [made with flint flakes or a piece of other rock], *scorings* [with a stick], and *bone marks*).

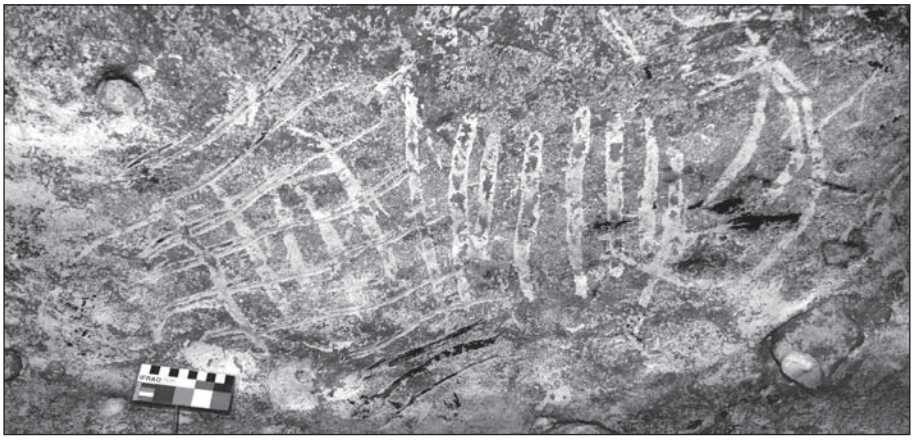


Figure 2. *Kirian flutings (the Goursolle Panel [Panel I] in Chamber E, Rouffignac Cave). Also apparent are horizontal scorings made with a charcoal stick and clay reapplications over some of the flutings.*



Figure 3. *Evelynian flutings (Gargas Cave).*

Forms of fluting

A definition of forms also helps to develop a language and a basic framework for studying flutings. With reference not to design or appearance but to manufacture, this definition aims at methodological questions for the study of each form of fluting. Two factors help to categorize flutings from what has been observed in caves, from experiments in fluting, and from methodological considerations that arise. They are, for each unit:

1. whether the fluter uses one or more than one finger of one hand to flute the unit; and;
2. whether the fluter stands in one place, hips still, or moves his or her lower body during the fluting of the unit.

'Stands still' means no lower body movement: the people who flute the walls or ceilings stand still, moving their upper bodies to mark with their fingers. The fluter may move between making units, but is stationary for each unit. 'Moves' means lower-body movement: the people fluting the walls or ceilings not only sometimes walk or otherwise move their legs (the lines may extend beyond the arm range of a stationary fluter) but move from their hips to create the flutings by, for instance, bending, twisting, or shifting their weight.

These two factors produce four forms of fluting (the names of the forms are coined from those of people we know but who have nothing to do with fluted sites or this field of study, and thus we hope to avoid possible interpretive inferences):

- *Kirian flutings*: the fluter stands still while fluting each unit, and each unit comprises only one line (Fig. 2).
- *Evelynian flutings*: the fluter moves while fluting each unit, and each unit comprises only one line (Fig. 3).
- *Rugolean flutings*: the fluter stands still while fluting each unit, and each unit comprises more than one line (Figs. 4 & 5).
- *Mirian flutings*: the fluter moves while fluting each unit, and each unit comprises more than one line (Fig. 6).

The two variables that form the basis of this differentiation lead to different sets of methodological

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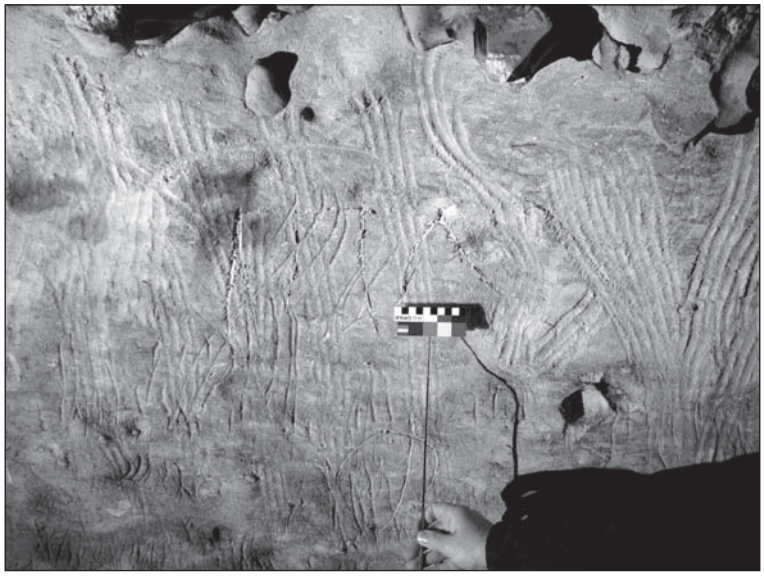


Figure 4. *Rugolean flutings of a vertical orientation (Chamber G, Rouffignac Cave).*

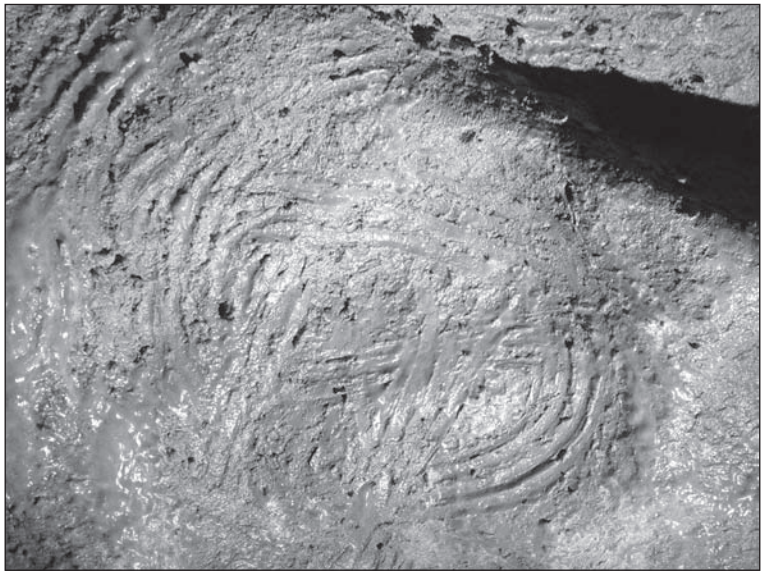


Figure 5. *Semicircular Rugolean flutings (Gargas Cave).*

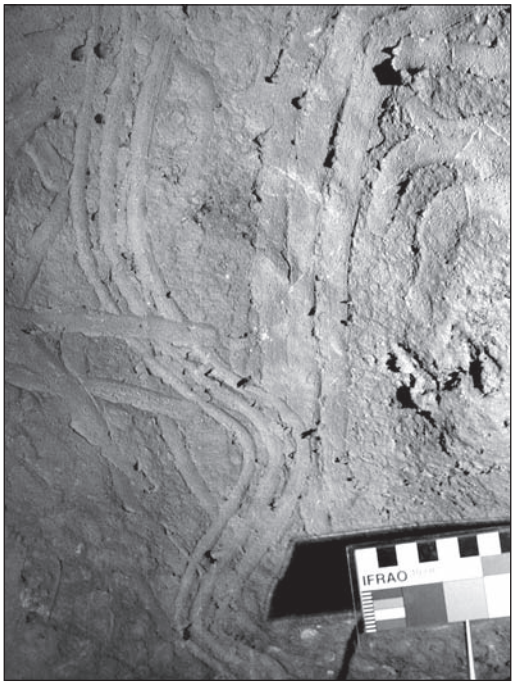


Figure 6. *Mirian flutings made by different people (Gargas Cave).*

Mirian form along one side of a central crevice run over onto the other side of the crevice to become Rugolean (Sharpe & Van Gelder forthcoming). In Rouffignac Cave, some figures are drawn using several means: Barrière's 'lion' in Chamber G is made with stick scorings, stone incisions, and finger flutings (see Fig. 7; Barrière 1982; Sharpe *et al.* 2002). Also at Rouffignac, the markings on the ceiling around Cupola or Kolk A in Chamber E include flutings of the Kirian form, plus (interspersed and over the top of each other) single scored lines (sometimes leaving charcoal) and application of clay on some of the flutings (see Fig. 2; Sharpe & Van Gelder in press a). While the form differentiation is designed to provide a method for studying the Kirian flutings, other techniques may help in the study of the scorings and clay application, and yet other techniques may help in understanding the cluster as a whole.

questions. For instance, more than one finger in a unit may lead to the possibility of determining the ages, the genders, and the number of fluters, matters not so easily amenable to these techniques when the units comprise only one finger. Lower body movement allows the possibility of drawing different shapes than when stationary. It can also lead to the investigation of the paths the fluters take while fluting.

Markings of different means of manufacture and different forms of fluting can co-exist in the same panel or cluster, hence 'multi-media' panels or clusters. In Gargas Cave, for instance, narrow fingers fluted in the

There are variations from place to place within each form. For instance, Kirian flutings appear in the Goursolle Panel in Chamber E of Rouffignac Cave (Fig. 8; Sharpe & Van Gelder in press a) and in the Heather Cluster in Gargas Cave (Fig. 9; Sharpe & Van Gelder forthcoming). Flutings in both are made with one finger by a stationary fluter. The Kirian lines in the Goursolle Panel are separated in sets of 7 or 14; the

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Kirian lines in the Heather Cluster overlap, are very narrow, vertical, and in sets of large numbers. Units of Mirian flutings in the Desbordes Panel in Chamber A1 of Rouffignac Cave (Fig. 10) are about 30 cm to 2 m long, cover the ceiling, and sometimes occur as 2+2 units (see below for details; Sharpe & Van Gelder in press a,c). Units of Mirian flutings in the Ferrer Panel in the Crevices Area of Gargas Cave can extend for 9 to 12 m and are often in single units (Fig. 11; Sharpe & Van Gelder forthcoming). Both of these Mirian units are made by a moving fluter using more than one finger.

Thus, the basis for distinguishing variations within each form to some extent uses significant physical differences between clusters. Whether or not different methodological questions arise for different variations, the importance of recognizing variations is to allow for cultural and personal differences from place to place and period to period.

Experiments

Nomenclature and discrimination of forms provide tools with which to start in-depth and systematic study of flutings. Flutings were looked at *in situ* and replicated in the laboratory in different media. Lines were drawn to see what is possible and how they look, and how they compare with the flutings found in caves. The experiments replicated flutings in Bara Bahau, Cougnac, Gargas, Goutran, Pech Merle, and Rouffignac caves, France. The flutings were replicated in or on five media (though not in the moonmilk of caves).

As a medium, plaster of Paris in aluminium trays (Sharpe *et al.* 1998) is restricting. The plaster can only be worked on when it is within a particular range of drying, thus limiting how much can be made up and poured into trays, in turn limiting the surface area that can be worked on. Further, it is difficult to use plaster for exploring the relationship of the body of the fluter to the cave wall owing to the restrictions imposed by the size of the pans and the action of gravity on soft plaster.

Clay is better than plaster of Paris because it keeps the lines and maintains its

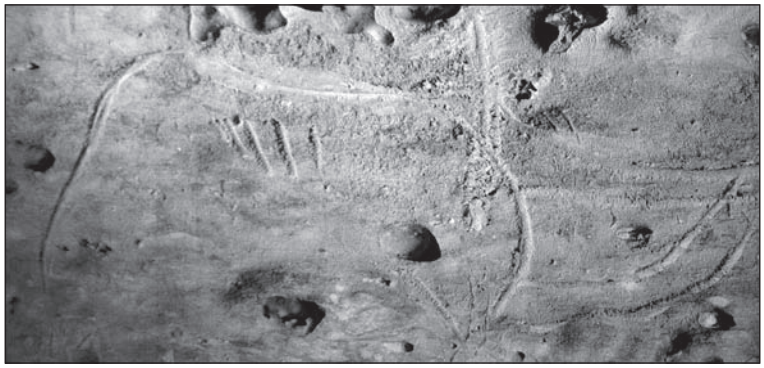


Figure 7. *Barrière's 'lion' figure, Chamber G, Rouffignac Cave.*

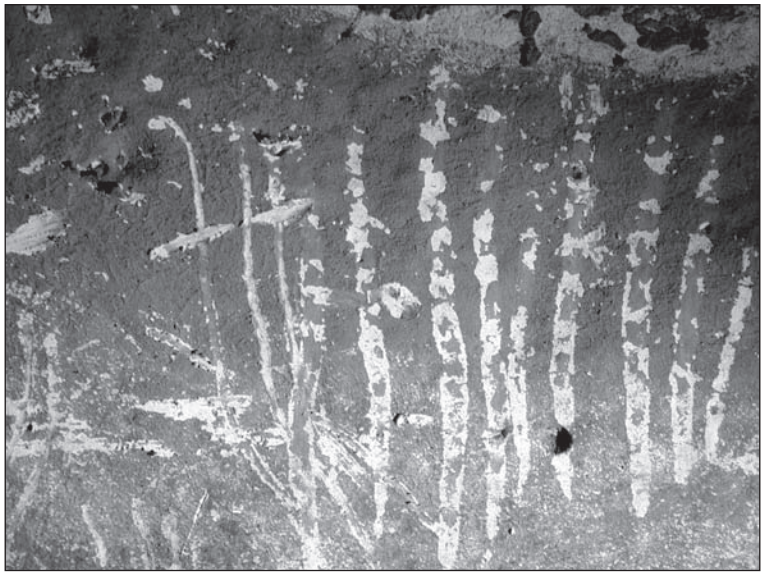


Figure 8. *Kirian flutings (the vertical fatter lines) in the Goursolle Panel in Chamber E, Rouffignac Cave.*



Figure 9. *Very narrow Kirian flutings in the Heather Cluster, Gargas Cave.*

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Figure 10. *Mirian flutings, including some sometimes called 'serpentines', in the Desbordes Panel in Chamber A1, Rouffignac Cave.*

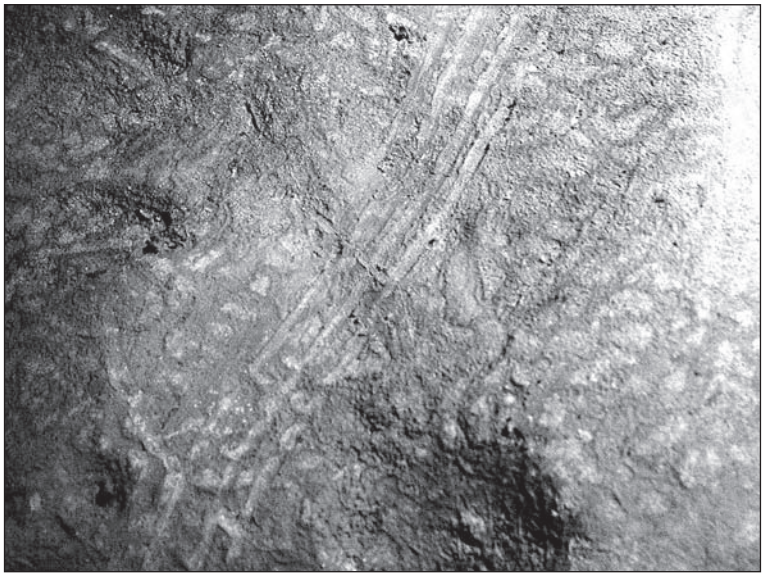


Figure 11. *Mirian flutings, which can extend for several metres, in the Ferrer Panel in the Crevices Area, Gargas Cave.*

softness and it is even sometimes the original medium. But it remains soft and therefore is easily damaged. It meets the problems of gravity, so that only a small horizontal area can be used.

Finger paint can be applied to sheets of paper taped together or onto sheets of plastic. Paint is more flexible than plaster of Paris and clay, and is easier to use over a wider area and on a vertical surface. Flutings can thus be replicated on an area similar in size and inclination to the caves, allowing the extension of arms into positions the earlier fluters might have used. The flexibility of the finger paint also allows use of the surface several times over to try for different effects. While finger paint helps the experimenting, it has limitations: the paper wrinkles, for instance, and impedes application of paint; and, on plastic, the individual flutings do not stand out well.

A blank wall allows the stretching of arms in various directions and distances to see if flutings can be made. A wall covered in condensation is better, as it can be seen where the fingers mark; but the same space cannot be marked again. Condensation also runs and evaporates.

Markings feasible

Anatomy and comfort limit possible flutings and the positions from which they can be made. Based on an absence of scratches, we assume that fingernails were not used for the markings, that the fluting was done with the soft pad of the finger. What shapes, then, do the investigations described above suggest it is possible and impossible to flute? For a person using the right hand — mirror results apply for the left — standing in front of and facing the wall, the following seems to hold ('Le chain graphique' [Leroi-Gourhan 1958]: what one person can do without moving).

Drawing vertically downward, the fingertips press into the surface when the hand is above the shoulders; a little below the shoulders, the fingernails start to scrape the lines, unless the hand is slanted more vertically. It is comfortable to reach over the head right of the body and flute vertically downward and to a short distance past the shoulder but above the waist. These marks start approximately 60 cm beyond the right shoulder. It is less comfortable to continue fluting at the waist and below. Drawing vertically upward, the fingertips press into the surface when the hand is below the chest; above the chest, the fingernails scrape lines. It is comfortable to flute vertically upward to about hip height.

It is possible to flute horizontally, moving right, from the far left to about 15 cm right of the left shoulder. It is possible to flute horizontally, moving left, from the far right to the left shoulder. It is more

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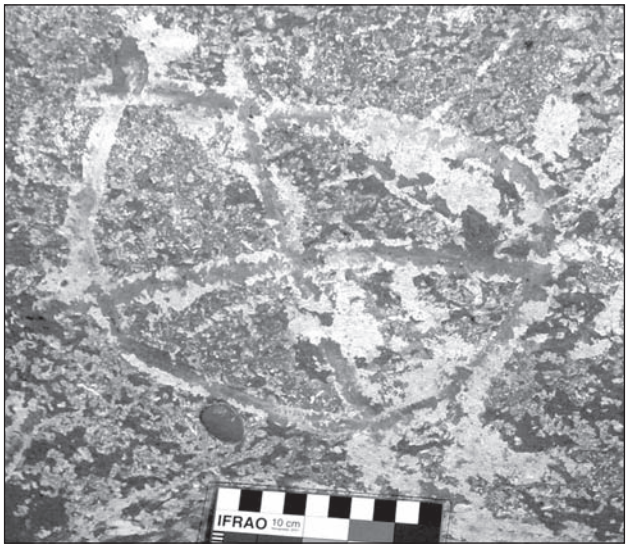


Figure 12. *A fluted circle in Chamber E, Rouffignac Cave. It must have been made from underneath.*

comfortable to flute horizontally from right to left than from left to right.

It is more comfortable at the corner of a curved line to twist the hand with the arm stretched out than to twist the wrist if the surface is less than 30 cm from the body.

The form of the hand lends itself to curves, circles, and intricate pictures when only one or two fingers are used (Fig. 12). The index finger or the index and middle fingers give more flexibility; curves are easier to make and can be quite sharp, making drawings of animals or designs easier. The fewer the number of fingers used, the greater is the control and manoeuvrability, and the more complex the fluted cluster can be. Greatest dexterity is achieved by fluting with only one finger.

Drawing curves with three or four fingers, the lower place of the little and ring fingers can result in overlapping and overlays or obliteration of marks. The marks made by the other fingers may also overlap each other. For undulations, it is easier not to twist the fingers at the corners, which also causes overlap if the surface is within 30 cm of the body. It is easier to twist the hand if the arm is outstretched. Four-fingered curves and undulations may be made with two fingers of each hand held touching each other ('2+2' flutings)



Figure 13. *Parallel flutings made with two hands. Rouffignac Cave.*

to remove the overlap that can occur with the use of four fingers of one hand (see Fig. 13).

Anatomically, it is only possible to flute a one-movement circle overhead, as opposed to a circle fluted with two or more sweeps of the hand. When fluting a one-movement circle overhead, the torso, legs, and perhaps the feet need to twist to bring the fingers around the 360°. The hand and fingers are not flexible enough to create a one-movement circle to the

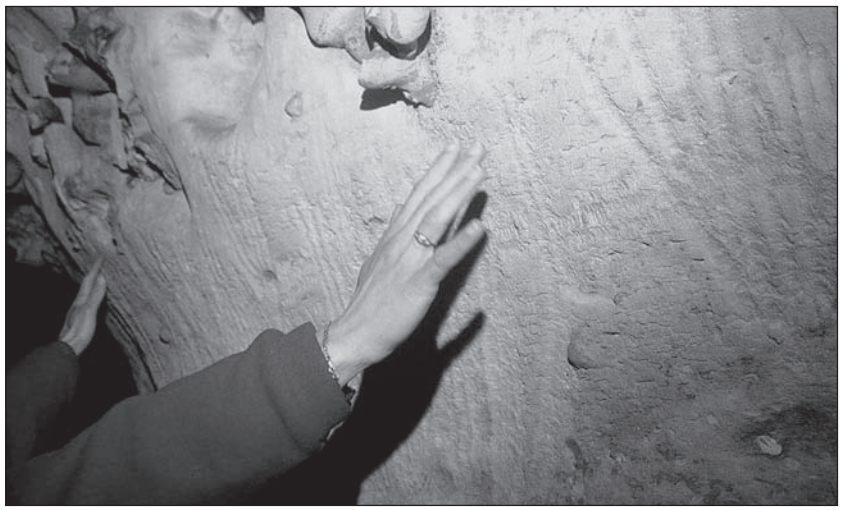


Figure 14. *Fluting with an outstretched arm produces arcs. Chamber G, Rouffignac Cave.*

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side. When fluting with an outstretched arm, the unit tends to arc with the arm as the radius (Fig. 14).

We have derived some general principles about discomfort:

- It is uncomfortable to place the hand directly in front of the body, finger pads on the wall.
- It is comfortable to flute in any direction toward and in front of the body, and it is more comfortable to flute at 45° to the vertical than horizontally.
- It is uncomfortable to flute left of the centre of the body. It is more comfortable to flute above the head to shoulder level to the left of the body than below the shoulder. Swivelling the hand to the left can make it more comfortable.
- It is more comfortable and practical to flute at a distance of between 30 and 45 cm from the centre of the body to the wall directly in front rather than to stretch the arm excessively in any direction.
- It is more comfortable to flute with the three middle fingers than with them plus either or both the thumb and little finger — the distance from the wall is an important factor. It is more comfortable to flute with the index or middle finger than with the third finger, the thumb, or little finger.
- It is more comfortable to flute on wetter surfaces with more than 2 cm between the fingers than with the fingers closer together. It is more comfortable to flute on drier surfaces with less than 1.5 cm between the fingers than with the fingers further apart. More pressure is required to make a mark on drier surfaces, so the lower parts of the fingers (the proximal phalanges) provide support.

Fluting can continue below waist height by squatting or kneeling. However, it is more comfortable to flute by moving up from the floor with the hand inverted than to move the hand downwards. The flutings made when squatting or kneeling tend to sweep toward the body.

With the body turned at right angles to the wall, it is more comfortable to flute with the hand further from the wall than with the hand nearer the wall. (It is possible to face different directions to create different parts of a panel.)

If the fluters' comfort determines where they mark the wall, the set of flutings made by an individual standing without moving the feet would encompass a maximum area of approximately 60–90 cm long and 90 cm wide. If the fluter continues fluting while or after moving down into a squatting position, this lengthens the marked area; if the fluter finds a way to rise above the floor, this also lengthens the area; if the fluter steps sideways, this widens it. Flutings do appear in some sites at floor level (Snowflake Cave in Victoria, Australia, for example) and above an easily reached level on ceilings and walls; in Cosquer Cave, France, for example, the lines are visible over 3 m from the floor (Clottes & Courtin 1996). These observations assume that the floors of these sites are at the same level as when the flutings were made.

How relevant, though, are findings based on comfort? Discomfort could offer a constraint but fluters may not have worried too much about discomforts or they may have been in a state where they did not notice them. The constraints imposed by the cave itself — height, width, darkness, hard *versus* soft surfaces, and uneven floors, for instance — may have been more pertinent. Further, if flutings needed to be made, for whatever reason, the restrictions imposed by the cave, personal discomfort, and other such factors may have been largely irrelevant until fluting became physically impossible (for instance, downward fluting below the waist). Given that many cave settings are difficult, it could be assumed that fluters would accept minor discomforts; but how much discomfort would fluters accept?

The experimental findings help to inform whatever else is thought about and investigated regarding flutings. They form a foundation for all other work.

Significant observables

Research into engraved lines through internal analysis requires observation of line overlap and tool cross sections. In a sense, the engraved lines hold data. Similarly, flutings hold data beyond merely visible shapes. What follows starts this line of thought by turning, in part, to physiological considerations (forensics). Besides the most obvious observables like the number of fingers in a unit, the lengths, depths, widths, and courses the lines take, the following can be looked for. Each observable listed may apply to some forms and not to others. Yet others, not listed here, can be observed: the list will increase, it is expected, as research proceeds.

Different fingers sometimes produce different flutings. The little finger may not make as deep a fluting — if any fluting at all — as do the three central fingers and its line is thus usually fainter than theirs. Further, in a unit, it starts lower down than they do (Fig. 15). When the hand is relatively straight, the lateral position of the thumb means that it drags over the medium nearly at right angles to the orientation of the other fingers. The fingernail is, therefore, sometimes pressed into the surface to produce a sharp nail line or wide gouge. If it flutes a line, it is usually fainter than the lines from the central three fingers. It also starts lower down than those of the other four fingers and may appear at a greater distance from the flutings

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Figure 15. *The little finger (on the right) may not make as deep a fluting as the three central fingers, and it starts lower down. Rouffignac Cave.*



Figure 16. *The flutings from the different fingers at the beginning of a unit usually show different relative height but curling when stretching may render the tips straight. Rouffignac Cave.*

made by them when compared with their inter-digital spacings — which could incorrectly suggest that the thumb fluting is unconnected to the others. While build-up can appear on both the left and right sides of the fingers, it only appears on the nail-side of the thumb (it is fluted perpendicular to the other fingers, on its side as it were).

Moving the fingers horizontally places the fingers in a particular relative position. For example, when moving from right to left with the right hand above the shoulder, the thumb will usually not flute because the twisting of the hand can place it too far off the surface. This may not happen with the right hand moving from left to right.

The thumb and little finger can be used for support when the medium is wet, and the fingers are held at a steep angle of approximately 45° to the surface. This produces a five-finger unit. On the other hand, when the medium is barely wet, the mark made by the little finger may not be as strong, perhaps to the point of being indistinct.

Various pressures on fingers can alter the width of a fluting, causing the flutings in a unit to spread out or close in. When the fluter is stretching, for example, the fingers tend to splay. Thus, the spacing between the flutings in units of lines that one person makes may not be the same. They may be more or less the same, however, if the fingers are held close together. Measurements were made of the three-fingered flutings in the same medium (clay) from two fluter subjects (one male, one female), fingers close together, and with various pressures applied. For each person, the widths ranged 0.5 mm from the mean, within the error associated with the measuring process. That is, the size of the hand or fingers can be determined when fingers are together in fluting a unit (Fig. 15). Further experiments might be conducted to ascertain what happens to fluting width when the flesh of the fingers is softened by working in water or hardened by physical activity, or when fluting in a variety of media of differing firmness.

If there are fewer than five lines in a unit, there is ambiguity as to which fingers were used. One line could be from the index or middle finger, for example, and two may be the index and middle, or the middle and ring fingers. To remove the ambiguity, therefore, the three central fingers close together are used to study the width of the hand — though probably a still sufficiently accurate study may be made using two fingers because, for comfort, people are most likely to make a two-fingered fluting with the index and middle fingers.

Variations in the breadth of a fluting could in theory result from different pressures being applied or from different densities or firmness of the media. But, apart from a very light or a very heavy touch — and these are obvious — fluting widths are much the same for one person's fingers held together on the same medium.

The medium can build up at the end of a fluting, the remnant of the finger's gouging action as the finger

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Figure 17. *Junctions may show which lines overlie others. Rouffignac Cave.*

moves and then stops. The start of a fluting does not have this build up and may be smooth. However, by pressing the finger instead of dragging it, no medium may amass at the end. Note also that flutings made without removing the medium adhering to the fingers cannot be distinguished from those made with clean fingers.

The flutings from the different fingers at the beginning of a unit usually show different relative heights, whereas they usually conclude a unit at the same level. Note that the curling of the fingers — for instance, to provide enough pressure to go into the surface, or when stretching up — renders the tops straighter. If a unit is fluted with the hand at an angle away from the body and the unit is made downward but slightly toward the body, the fingers may appear to start at the same level (see Fig. 16). When making a long fluting with an outstretched arm, the unit tends to arc with the arm as the radius (Fig. 14).

An examination of line junctions may tell which lines overlie others (Fig. 17). At line crossings and intersections, one can look for build up — a fluting that cuts another one can leave build-up at the beginning of the intersection — cutting of the walls of a unit, and marking by one unit inside the other. These indicate which line overlies the other.

Re-enactment of a fluted unit in front of it without touching the original medium — using both the left and right hands if the original handedness is not clear, or the original hand if known — produces data relating to the levels of discomfort and practicability of making the fluting.

Inferences

Besides the obvious inferences that can be drawn, such as the distinction between units, clusters, and panel, the following information may also be obtained about the fluters and their activities from the above data. Handedness, age and sex can be inferred, amongst other things.

The side of the unit that shows evidence of a thumb or a little finger suggests the fluting hand, whether the unit was made with the left hand or with the right: the thumb on the left or the little finger on the right suggests the right hand, thumb on the right or little finger on the left suggests the left. Not only might the fluting hand suggest the fluter's handedness, but re-enactment to gauge practicability can sometimes tell the probable handedness by the efforts required in the various local circumstances.

The size of the hand relates to the fluter's age; the widths of young children's are the most distinctive. Adult size is often reached before the teenage years (Sharpe & Van Gelder 2004; in press b). The width of a unit may, therefore, indicate the age of the fluter. Because it cannot be determined on the basis of digital separation if the same person made different units, the use of fingers close together is taken to measure the hand width. Another reason for using the fingers close together is that, while a small hand can flute lines spaced apart at various distances, a large hand cannot flute a unit of lines close together at less distance across than the width of the fingers. Thus, the size of the hand or fingers can be determined when three fingers are close together in fluting a unit, and this in turn indicates an age range for the fluters.

The direction in which a unit was fluted may be told from the beginnings and ends of flutings. Build-up — if it exists — lies at the end of a unit and not at the beginning, and the existence of relative finger heights — if it exists — shows at the beginning of a unit and not at the end.

It may be possible to distinguish fluters' sex. The fluting of the middle finger is the furthest out at the start of a unit of flutings made with more than one finger. Consider the relative heights of the three central fingers. Peters's research into the ratio of the extent of the index or second finger (2F), relative to the middle

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finger (3F), to the extent of the ring or fourth finger (4F) offers a tool that may help distinguish male from female fluters. In the ratio of the index finger to the ring finger, a smaller value indicates further finger height; thus, a figure of <1 means the index finger does not extend as far as the ring finger and a figure of >1 means the converse. Averaged across 1455 subjects in five countries, Peters *et al.* (2002a, 179b) write, 'the ratio for the male left hand was .84 and, for the right hand, it was .84 as well. For the women, the ratio for the left hand was 1.08 and for the right hand 1.00' (see also Peters *et al.* 2002b). 'The dimorphism is present from at least age 2 years,' write Manning *et al*. (1998, 3000), and the ratio 'is probably established *in utero*'. Thus, 2F/4F <1 suggests a male and 2F/4F ≥1 suggests a female.

It is recommended that the following two observables be used to distinguish between fluters and hence determine the number of fluters of a panel or a site: the width of three fingers held together, and the relative heights of the three central fingers for the left or right hand in a vertical non-stretching position. The relative heights of the three central fingers were unique to each of the experimenters mentioned above — as with the gender issue, the 'uniqueness' of the relative finger heights requires further elaboration. This information might help to unscramble many mazes of lines and help to relate lines that do not intersect.

What else is consistent about a person's flutings and that might differentiate one person's markings from another's? Differences in pressure and variability between media can cause differences in the depth of the lines. Therefore, it cannot be determined, on the basis of a fluting's depth, if the same person made different units of flutings or if units made by a woman or girl are shallower than those made by a man or boy. The consistency would thus have to span different pressures, speeds, lengths, number of fingers used, and so on.

The height of a person is approximately the horizontal stretch of the arms. It is possible to use left and right arced units to gauge stretch, and therefore the fluter's height. It is also sometimes possible to determine approximately the location of the person fluting a cluster. People have limited reach and mobility of hands and fingers.

Sequence and shape

Marshack's internal analysis suggests working out the lines' overlays and underlays and hence the temporal sequence of their compilation. Overlays tell the temporal sequence in which units in a cluster were fluted, which then tell, if applicable, the direction in which the cluster was composed — for instance, left to right (Fig. 18).

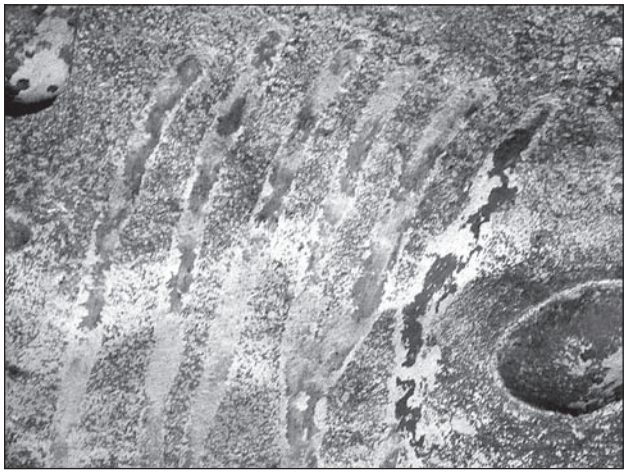


Figure 18. *The fluting with top second from right crosses over its left neighbour, suggesting that the cluster was fluted left to right. Chamber E, Rouffignac Cave.*

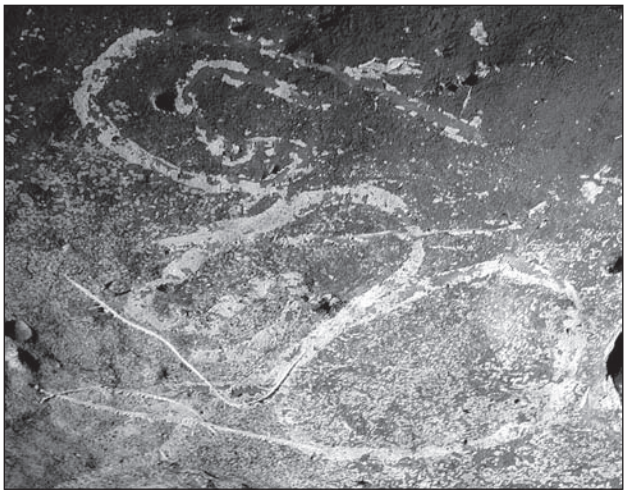


Figure 19. *Shapes recognizable as such may appear in a cluster. Whether these loops appear in other sites is unknown. Chamber E, Rouffignac Cave.*

Shapes modern people can recognize as such, especially repeated shapes, may appear in a cluster (Fig. 19). Part of this investigation could include the identification of 2+2 units versus units fluted with the four fingers of one hand.

Reconstruction of a cluster by the above means does not suggest that the fluter intended the composition of the cluster, though this is a possible subject for investigation that will probably call upon the above inferences and observations. In fact, the goal of this process for many investigators may be to provide data

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Table 1. *Inferences that can be drawn about each form of fluting.*

Inference	*Kirian* 1 finger Still	*Evelynian* 1 finger Moving	*Rugolean* 2+ fingers Still	*Mirian* 2+ fingers Moving
Fluting hand			✓	✓
Fluter handedness	✓	✓	✓	✓
Fluter age			✓	✓
Fluting direction	✓	✓	✓	✓
Fluter gender			✓	✓
Fluter numbers			✓	✓
Fluter position	✓	✓	✓	✓
Fluter height	✓		✓	
Temporal sequence	✓	✓	✓	✓
Cluster direction	✓	✓	✓	✓
Shapes	✓	✓	✓	✓

from which they might suggest intelligently what the intention or meaning of the fluters was.

Assessment

Several inferences can be drawn about each form of fluting (see Table 1). Each may have its own set of questions and ways to answer them.

Study of the lines ties with other investigations, including: study of lines other than flutings; dating of flutings; height of flutings above the original floor; layout of units in a cluster, clusters in a panel, and panels in a cave site; exploration, description, and archaeological analysis of sites (for instance, Aslin *et al.* 1985); distinguishing between animal scratches, taphonomic marks, other non-human marks, and human engravings (see, for instance, Bednarik 1994; Sharpe 2004); and the geomorphology of the marked surfaces and how they have changed (see, for instance, Bednarik 1999). For example, an earlier paper developed and provisionally applied our methodology to the Mirian flutings in the Desbordes Panel in Chamber A1 of Rouffignac Cave, asking what can be known from the flutings about the people who made them (Sharpe & Van Gelder 2004; in press b,c). The results suggest that many of the flutings were made by young children held aloft to touch the ceiling and draw their hands along it. Those holding the children were at times not only walking but also rotating from the hips, perhaps dancing. This may be the first clearly demonstrable case of Palaeolithic cave 'art' made by children aged 2 to 5.

The analytic technique and analysis is still being developed. It faces problems yet to be resolved. Lines in a unit may not be close enough to measure the three finger width. Errors of measurement may arise because of difficulties in reading the ruler, the vague edges of flutings, and so on. The relative heights of the fingers at the beginning of a unit may not be apparent because of the way the fluter held his or her hand. Overlays may not always be ascertained with certainty. Some sets of lines may contain none that overlap or meet, so the method may miss the lines' relative chronology. The rock may now have a quite granular surface so that this analysis can only be carried out to a certain size dimension; at some point, the rock surface may swallow up the lines and render them indistinguishable from background marks. This happens especially with weathered lines. Calcite may cover the markings and prevent closer examination.

These and other factors lead to a degree of subjectivity and error in the analysis of the lines. The significance of other limitations and constraints may become apparent with further studies. It is hoped that the current consistency in results indicates the accuracy of the conclusions despite the observational errors and other limitations (Sharpe & Van Gelder 2004; in press b,c; forthcoming).

Continuing development

Other techniques might penetrate the surface or bring out aspects of the lines not regularly seen under normal light. Different visible lighting sources could be used, x-ray, ultraviolet light, laser (Perkins 2004; Wasklewicz *et al*. 2004), as well as sonar or ultrasound, computer manipulation of the images, and so on. Digital imaging of finger prints — such as seen both inside and hanging from various flutings in Gargas Cave — may help to distinguish various fluters. One could explore factors that still fluters do not have to worry about but that moving ones must: the paths taken, steps danced, distances moved, obstacles stepped over, the different drawn shapes possible, and so on. Sideways or vertical movement of the body while fluting may in some way disrupt the flow of the resulting flutings. Other questions are not yet formalized. Video of Mirian and Evelynian lines may help to document flutings in ways that still photographs do not, leading to further questions.

Further experimentation is needed. For instance, we need to explore the relationship between different media and fluting width and to explore the effects of finger position — whether all fingers are affected if they are curled or what happens if only some are curled. How could this be ascertained? Other factors also need to be explored. For instance, how might the growth of moonmilk influence the flutings?

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Three types of fluting have been examined in the caves: non-figurative lines, images that modern people recognize as figures, and line images ('patterns', 'shapes' or structural repetitions) that moderns recognize as symbols. These types sometimes occur together. It is assumed at this point that there is no difference between the three in terms of the method for fluting, hence the inferences as outlined above that may be drawn for them; the same questions are studied for all three. This assumption may have to be rejected as the study progresses.

Several types of parietal markings besides flutings exist, including stick scorings, stone incisions, clay application, dots, hand prints, and stencils. The intention of our nomenclature is methodological: how to study flutings and, more generally, how to study each of the different types of markings. For instance, the forensic studies of hands help with study of the flutings and may also help with hand stencils. The techniques already developed by d'Errico, Lorblanchet and Marshack assist with the study of engravings with flint, combs, bones, and so on. Each family of markings raises its own set of methodological questions. The investigator needs to seek out the relevant techniques and develop them for the particular phenomenon investigated. Some techniques may apply to more than one type of line marking — both engravings and flutings display over-lays — and some may apply only to one type.

Is there a relationship between the different methods of marking? Perhaps lines engraved with sticks, stones, bones, or other tools are of the same, a similar, or a parallel tradition to flutings. The chief difference between them may arise from the softness of the media, flutings requiring a softer surface to mark. Further research may elucidate this for particular sites.

A complementary investigation

Nougier & Robert (1958, 60–61) wrote of flutings on the ceiling of Chamber A1 in Rouffignac Cave:

> On Oct. 11 and 13, 1956, we found four anthropomorphs at Rouffignac, two of them … in the great red dome of the white uniters [flutings]. All four obeyed the rules of the species, that is, of the anthropomorphic series, that is — no rule at all. They were true 'grotesques'; with big noses and big mouths … The anthropomorph on the red ceiling of the uniters has a blunt chin, a receding forehead, a jutting nose, and a lively eye. From the point of the chin to the top of the head he measures 45 cm ... A companion on another part of the roof, near-by is more mysterious. Drawn also with a finger, the head is excellent: forehead, nose, mouth, chin — then, going downwards, everything melts away in a shapeless mass. One of us tried to pick out the beginning of a leg and a pretty breast.

There probably are no drawings of anthropomorphs on the ceiling, just as there probably are no drawings of snakes there, despite what Nougier & Robert and Barrière (1982) firmly declare (Sharpe & Van Gelder in press c).

Nevertheless, Nougier & Robert observed the fluted ceiling through the eyes of a paradigm that now can be augmented. They believed that the key to understanding the activities lies in recognizing shapes in the maze of lines, and, in their case, they saw snakes and anthropomorphs. This Breuil approach, which includes the Lewis-Williams shamanism hypothesis (Lewis-Williams 2002), emphasizes appearance in a recognizable form because it primarily and dominantly aims at meaning, rather than asking about the act of manufacture and about information on the fluter. At least with respect to flutings, the Breuil approach can now be enhanced by forensic investigations.

The methodology suggested in this article is an archaeological search for objective information about the people who made the flutings, but the question of meaning has to be suspended. Most people immediately search for meaning when confronted by flutings. Once substantially more is known about the fluters from the flutings themselves, questions of meaning can be addressed and sifted with the information obtained about the fluters. Flutings may actually tell as much or more about their makers as does the painting of an aurochs or horse.

Summary and questions

This article develops a way to study finger flutings. It first suggests nomenclature, including words for engravings according to their means of manufacture. It then suggests a division of flutings into four forms and a recognition of local variations, for example, Kirian flutings in the Goursolle Panel, Chamber E, Rouffignac Cave, and Kirian flutings in the Heather Cluster, Gargas Cave. The key to differentiating the forms is recognition of two significant factors: whether the fluter uses one or more than one finger of one hand to flute the unit; and whether the fluter stands in one place, hips still, or moves his or her lower body in fluting. These two factors together produce the four forms.

The method derives from experiments with fluting in different media to provide an idea as to markings that are possible and what is required to

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produce specific features in the flutings. These experiments were correlated with flutings observed in various cave sites. From this work, a list was compiled of some significant observables: the different fingers of the hand used, the width of fingers, build-up at the end of a fluting, the relative heights of fingers, the presence of arced units, unit overlays, and practicability of execution. From these, some inferences may be drawn: the fluting hand, handedness, the direction of the fluting, the age and sex of the fluter, the number of fluters, the position of the fluter, the height of the fluter, the sequence of flutings, the direction of the cluster, and the shapes drawn. We discussed how the process of observation and inference may be applied, its limitations, and future work on the methodology. The methodology may also be extended into the study of other artefacts such as finger paintings and hand stencils.

Initial and sometimes detailed examination of the markings in the various caves mentioned above suggests the potential of the techniques this article develops. Many factors in the construction and structure of flutings can be ascertained: in principle, one can tell, for instance, the beginnings and ends of lines, the order of their creation, the position they were made from. Perhaps as much about the manufacture of the lines can be discerned as is necessary to reproduce them exactly. From this, inferences can be drawn about the fluters: for example, whether the units were fluted by different individuals, by left or right hands, the handedness of the fluter, the fingers used, and the age and gender of the fluters. In principle, one might be able to number and identify the individuals who fluted in a particular cave: for each of them, their gender, age group, handedness, height, even something about their personality from the way they flute, plus what lines they made. An initial application of some of the techniques has shown that young children aged 2 to 5 fluted the 150 m^2 of marked ceiling in Chamber A1 of Rouffignac Cave in France.

The search for the meaning or intention behind the flutings must conform to the data the above method isolates, and the meanings proffered ought to suggest researchable hypotheses that the method might adjudicate.

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