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Petroglyph Manufacture by Indirect Percussion: The Potential Occurrence of Tools and Debitage in Datable Context

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Petroglyph manufacture probably often involved indirect percussion, especially for carefully made lines and edges of larger figures. Experimental replication shows that during indirect percussion, debitage is produced from the chisel-stone that should be recoverable in archaeological context at rock art sites. Following experiments that demonstrated how the debitage is produced, this report describes its characteristic shape and provides suggestions as to what sorts of contexts might contain this evidence.

RECENT professional rock art literature has focused on traditional archaeological recovery methods and techniques at rock art sites to recover data that frequently have importance for placing rock art motifs in a chronological context or otherwise interpreting the images (Loendorf 1994). The results of such work have yielded important information for a variety of sites (Steinbring MS; Whitley et al. MS; Brink 1979; Loendorf 1990; Park 1990; Frison and Van Norman 1993). Certainly the most romanticized of these discoveries is the exposure of art images buried by dated sediments (Buchner MS; Cannon and Ricks 1986; Walker and Francis 1989), but a potentially more common and probably more useful result is the possibility of finding rock art manufacturing tools in datable context in association with rock art panels. Evidence of manufacturing activities in the form of tools and related items that have been recovered in the archaeological record include engraving implements, hammerstones, abraders (or possibly pigment applicators), and actual splatters of pigment (Brink 1979; Bahn and Vertut 1988: 57; Loendorf 1990; Bednarik 1998).

Unfortunately, only a handful of North American rock art site excavations have focused on the retrieval of archaeological materials associated with the production of rock art, and for those few that have, the effort of the investigator was often focused on searching for obvious manufacturing tools that might have worn out and been left behind. Obviously, finding such specimens requires at least three fortuitous occurrences: (1) the exhaustion of a tool at the site; (2) the discard of that tool in the immediate area of the art image; and (3) the archaeologist recognizing and recovering the tool. Even if a tool became worn past its point of functional utility, it may have been saved for

rework or tossed aside, thus effectively precluding its direct association with the rock art panel.

Although manufacturing evidence has been found in association with pictographs (e.g., Bahn and Vertut 1988; Loendorf 1990), several factors suggest that such evidence would probably be less common at pictographs than at petroglyphs. First, pigment containers would likely have been reused and thus removed from the sites. Second, applicators (if the artist used more than just fingers) would almost always be perishable materials (hide, hair, twigs, cancellous bone, feathers) which, even if left at the site, would rarely preserve. In this respect, Loendorf's (1990) recovery of two abraders at the Valley of the Shields pictographs may have been more a result of the artist's need for such a tool to smooth the surface in preparation for pigment application rather than a paint applicator. As Loendorf (1990:47) noted, the abraders were expedient tools casually acquired in the site area, used short-term, and immediately discarded.

Alternatively, petroglyphs were made with a variety of tools that would likely preserve in the archaeological record; for example, abraders, hammerstones, splinters of dense long bone, antler tines, stone flakes, and even sharp metal tools—all used to produce a variety of pecked, incised, scratched, and abraded petroglyphs throughout western North America (Turner 1963; Grant 1967; Keyser 1977; Loendorf 1984; Keyser and Klassen MS). Some of these were surely "tools of the moment" (like the abraders found at Valley of the Shields) and would more likely have been abandoned at the site. However, finding and identifying one of these tools still requires that the artist leave it in the immediate area of the engraved image, rather than tossing it even just a few feet away.

Some kinds of pecked petroglyphs, however, provide a much more favorable opportunity for locating manufacturing evidence. These are pecked images produced by indirect percussion, where a hammerstone is used to strike a smaller chisel-stone to produce carefully controlled line engravings. The experiments discussed below suggest that this method was most likely used to make small figures, to produce fine lines as parts of larger images, or to draw careful outlines for the edges of larger figures otherwise manufactured by direct percussion. Thus, the research herein focused on identifying and describing the tools and debitage used in indirect percussion of petroglyphs.

REPLICATING PECKED PETROGLYPHS

One purpose of this research was to learn what kinds of tools would most likely have been used to produce various types of petroglyphs, and to identify what remains might have been left behind during the course of petroglyph manufacture.[1] The intent was to focus on pecked petroglyphs, both because they are so common worldwide and because they are produced by the process most likely to leave behind evidence of their manufacture.

A petroglyph can be pecked either by direct or indirect percussion. Direct percussion produces an image by pounding a hammerstone directly against the surface of the rock "canvas," creating a small crushed area or "dint" which shows up as a lighter grey or white against the normally darker rock surface (Turner 1963).[2] This light-colored pecked image is most noticeable when the canvas is a dark basalt or sandstone, but it is also visible on lighter colored parent rocks such as granite and quartzite. Repeated blows on the small crushed area create a shallow pit that can then be expanded to make the design.

Unless the image is deeply pecked or abraded smooth after initial pecking, direct percussion typically shows a pattern of slightly unevenly distributed peck marks (Fig. 1) that produce large areas with a densely stippled appearance (e.g., Schaafsma 1980:29; Keyser 1992:70). Lines pecked by direct percussion show slight irregularities if they are narrow (e.g., antlers, feet, fingers). Slightly ragged edges characterize larger pecked areas or wide lines such as legs, arms, or "stick" bodies (e.g., Busby et al. 1978:104-105).

Fig. 1. Replicated petroglyph of a mountain sheep. Note the stippled appearance, relatively wide lines, and ragged edges, all indicative of direct percussion.

These irregularities of line and edge result from the inability of even an experienced petroglyph maker[3] to exactly align individual peck marks or make especially fine lines (less than five mm. wide) by direct percussion with a hammerstone large enough to produce a figure in any reasonable time.[4] Our experimental results agree with suggestions made by Turner (1963), von Werlhof (1965), and Loendorf (1984), and were designed to evaluate specific suggestions for comparing the two methods (see Busby et al. 1978:100).

Direct and Indirect Percussion

Our experiments indicate that hammerstones weighing between 350 and 700 g. are most efficient for pecking petroglyphs. Stones of lesser weight lack sufficient mass to produce petroglyphs in a reasonable time on the basalts that characterize the northern Great Basin and southern Columbia Plateau, which was the area of research. Heavier stones cause the carver's arm and hand to tire quickly and result in much less control for blows against the canvas. Even with optimally sized hammerstones, tiring of the arm decreases pinpoint accuracy of the blows before even a moderately sized petroglyph (25 by 25 cm. of pecked area) can be finished using direct freehand pecking. During direct pecking, a hammerstone may fracture and a spall may detach, but hours of experimentation show that these occurrences are not common. In more than 20 hours of petroglyph manufacture, only two of the five hammerstones used had small spalls detach. Hammerstones did exhibit characteristic wear patterns, including dulling and flattening of the points or edges that directly impacted the rock surface (Fig. 2).

Indirect percussion involves placing a smaller chisel-stone against the rock canvas and hitting the chisel-stone with a hammerstone. The mass of the larger hammerstone is transferred through the chisel-stone to produce the same crushed area which, through repeated blows, can be enlarged into a pit of the desired depth and ultimately into a design. The primary difference in these two methods is that by using a chisel-stone, the artist can place it exactly where desired to mark the canvas and thereby create carefully aligned peck marks that produce regular, thin-lined, even-edged designs. After many hours of experimentation, indirect percussion was found to be the only way to produce narrow, finely controlled pecked lines in a petroglyph during a reasonable time.

The results of these experiments showed that even the most carefully controlled direct freehand pecking (with hammerstones weighing from 100 to 600 g.) produced lines five to seven mm. wide with ragged edges and a few out-of-alignment

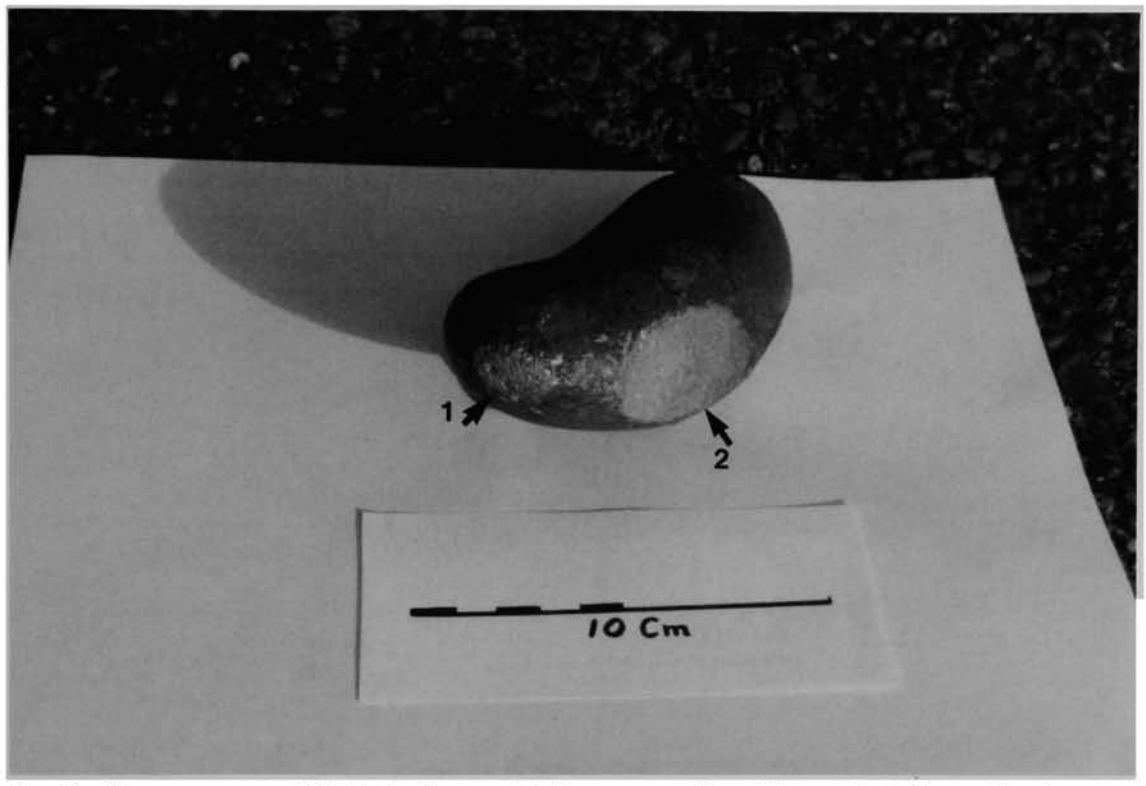

Fig. 2. Hammerstone used for both direct and indirect percussion. The crushed, flattened end nearest the camera (arrow 1) was used in direct percussion experiments (see mountain sheep in Fig. 1). The large, smoothed facet along the side of the tool (arrow 2) is the striking area for chisel-stones in indirect percussion experiments.

dints. Directly struck individual peck marks were two to four mm. wide using several different hammerstones. Clearly, with marks being a minimum of two mm. in width, there is almost no possibility that direct percussion could align such marks perfectly. In contrast, indirect percussion was used to produce even-edged lines that were two, three, and four mm. wide. Dints made by indirect percussion were also two mm. wide, but by careful placement of the chisel-stone they could be perfectly aligned and even slightly overlapped to avoid any raggedness along the line edge.

In actual petroglyphs, fine, even lines were often used to make entire figures, but more frequently they were used to carve legs, feet, fingers, toes (see Fig. 3), ears, horns or antlers, or interior body decoration on figures otherwise produced by direct percussion. Indirect pecked lines are readily recognizable by the careful alignment of peck marks along a line or at the edge of a figure, or by the narrowness of a completely pecked line that shows no extraneous, "out-of-alignment" peck marks alongside it (Fig. 4). In some instances, a large, directly pecked area was first outlined with indirect pecking that shows up as an especially even border on an otherwise roughly pecked area. Our experiments showed that even a novice carver can produce the finest lines and most carefully controlled alignments using indirect percussion.

Tool Breakage

In contrast to hammerstones that seldom break or spall, chisel-stones show patterns of wear and breakage, producing characteristic debitage and

Fig. 3. Replicated petroglyph. Note the thin, even-edged lines forming cat claws produced by indirect percussion.

worn-out tools that would thus seem likely to have been abandoned in the immediate area of the image being pecked.

In our indirect percussion experiments, a variety of chisel-stones and two different shapes of hammerstones were used. Selected hammerstones (Figs. 2, 5) were larger river-rolled basalt cobbles as they are the most common fist-sized (and larger) rocks in the area where most of the petroglyphs occur. Selected chisel-stones were river gravel pebbles measuring from three to five cm. in maximum dimension and weighing 20 to 60 g. Experiments showed that significantly smaller stones could not be readily held with one hand and struck with the hammerstone, and significantly larger chisel-stones absorbed too much of the hammerstone's energy. Using a larger hammerstone with a larger chisel-stone quickly tired the petroglyph carver.

Hammerstones included specimens with a generally spherical shape and others with a more cylindrical shape. In the many hours of experimenting with indirect percussion conducted by one of us (JDK), the more cylindrically shaped hammerstone, held like a short, thick rod, seemed to offer the best opportunity for finer hand-eye coordination and was less tiring to the user's hand.[5] This seems to be due to less transfer of the shock from repeated blows into the muscles and bones of the hand when the hammerstone is held loosely at one end while the side of the opposite end strikes the chisel. This position allows the hammer itself to rebound slightly (thereby absorbing energy) and much of the remaining energy can be absorbed by the wrist joint. Using a more spherical hammerstone, which must be grasped like a ball, significantly more shock was transferred into the user's hand,

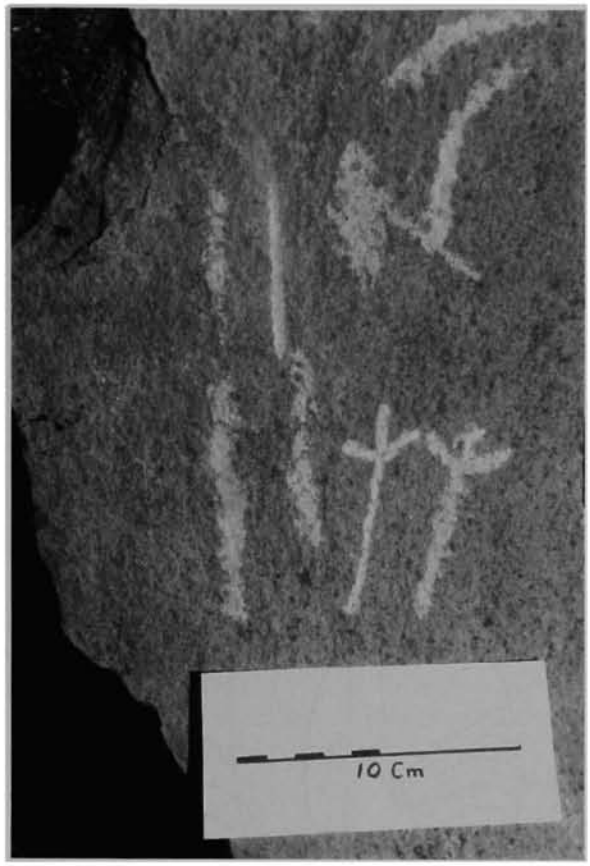

Fig. 4. Replicated petroglyphs showing differences in lines due to the type of percussion. The thin lines in the top row (second from left, diagonal at right) and bottom row (second from right) were produced by three different chisel-stones. Wider, more ragged edged lines were produced by three different direct percussors.

since it was more difficult to grasp loosely and had less freedom to rebound. A loose grasp was crucial to allow the shock to dissipate with either type of hammer. Although several novice petroglyph makers expressed no preference for either spherical or cylindrical hammerstones, the 30 hours of experimentation conducted by one of us (GR) convincingly demonstrated that for him, too, cylindrical hammerstones were easier to use and less tiring. The hammerstones that the authors found easiest to use measured 11 and 15 cm. in length and weighed 455 and 640 g., respectively.

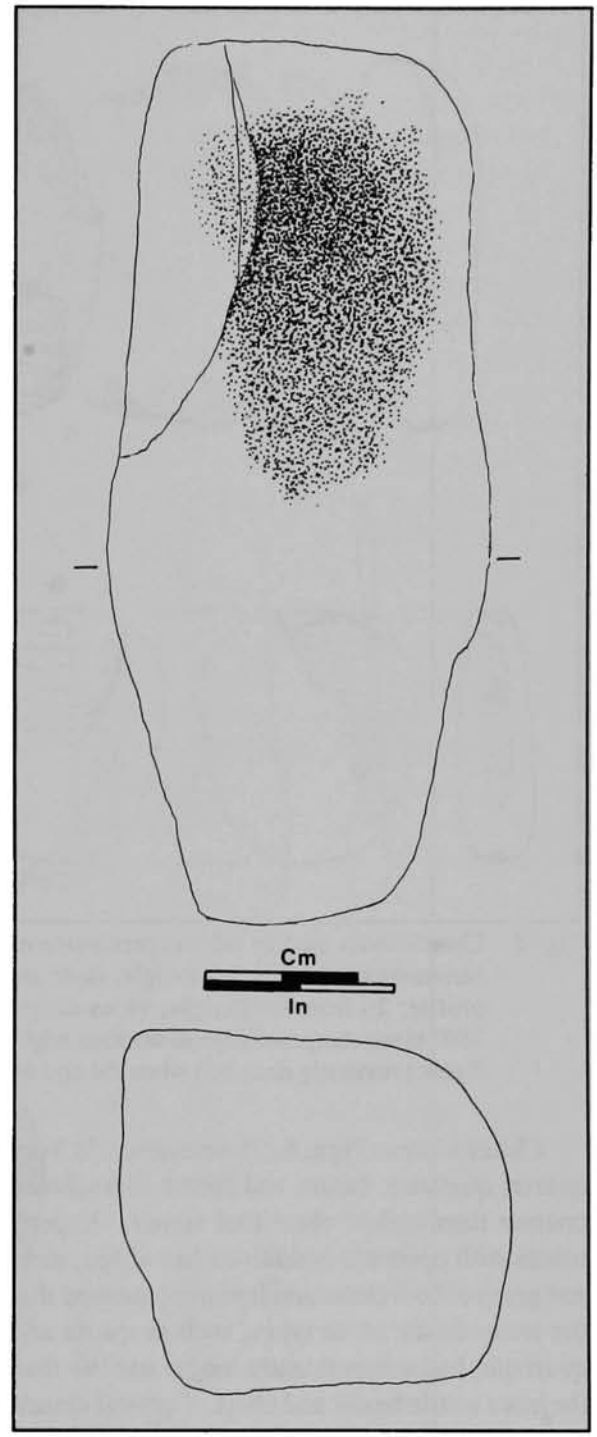

Fig. 5. Cylindrical hammerstone used extensively in indirect percussion. Note that two spalls have detached from the upper left corner of the tool, but it remained functional for continued use. Bottom is cross section at tick marks.

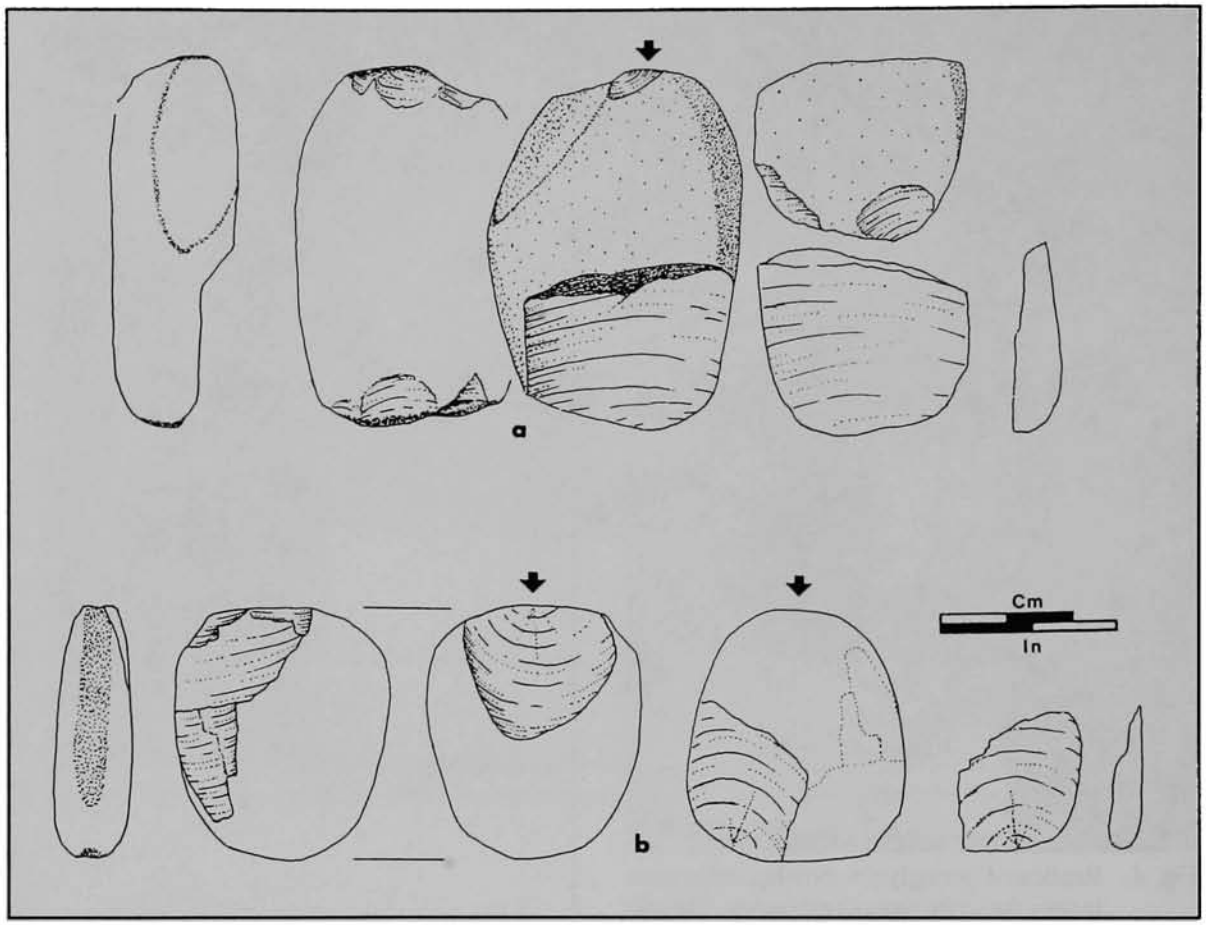

Fig. 6. Chisel-stones used in indirect percussion experiments. Arrows indicate the striking platform for the hammerstone: (a) from left to right, views are profile, reverse, obverse, flake front and back, and flake profile; (b) from left to right, views are profile (note worn facet), reverse, obverse, reverse (turned 180° to use sharpened edge as working edge), flake, and flake profile. The dotted lines show scars of flakes previously detached when the end was the striking platform for the hammerstone.

Chisel-stones (Figs. 6, 7) were selected from quartz, quartzite, basalt, and coarse chert (much coarser than typical chert tool stone). Experiments with optimum conditions (for shape, size, and grasp of both chisel and hammer) showed that the more elastic stone types, such as quartz and quartzite, had a significantly longer use life than the more brittle basalt and chert. Optimal chisel-stones could survive more than 200 blows before spalling and as many as twice that number before multiple spalls wore them out. Chisel-stones of sedimentary rock types were either too soft or quickly broke or split along bedding planes.

Both cylindrical hammerstones and chisel-stones spalled during indirect percussion. One hammerstone (Fig. 5) initially spalled along the side of the working end at a flaw in the stone that was not originally visible to the naked eye. Despite the break, this hammerstone was still functional and additional heavy use caused a second (much smaller) flake to detach from the initial fractured edge. Neither spall precluded further use of the tool, but both of them would likely have fallen to the ground at the base of a panel on which the petroglyph was being pecked, and might have ended up incorporated into the archaeological de-

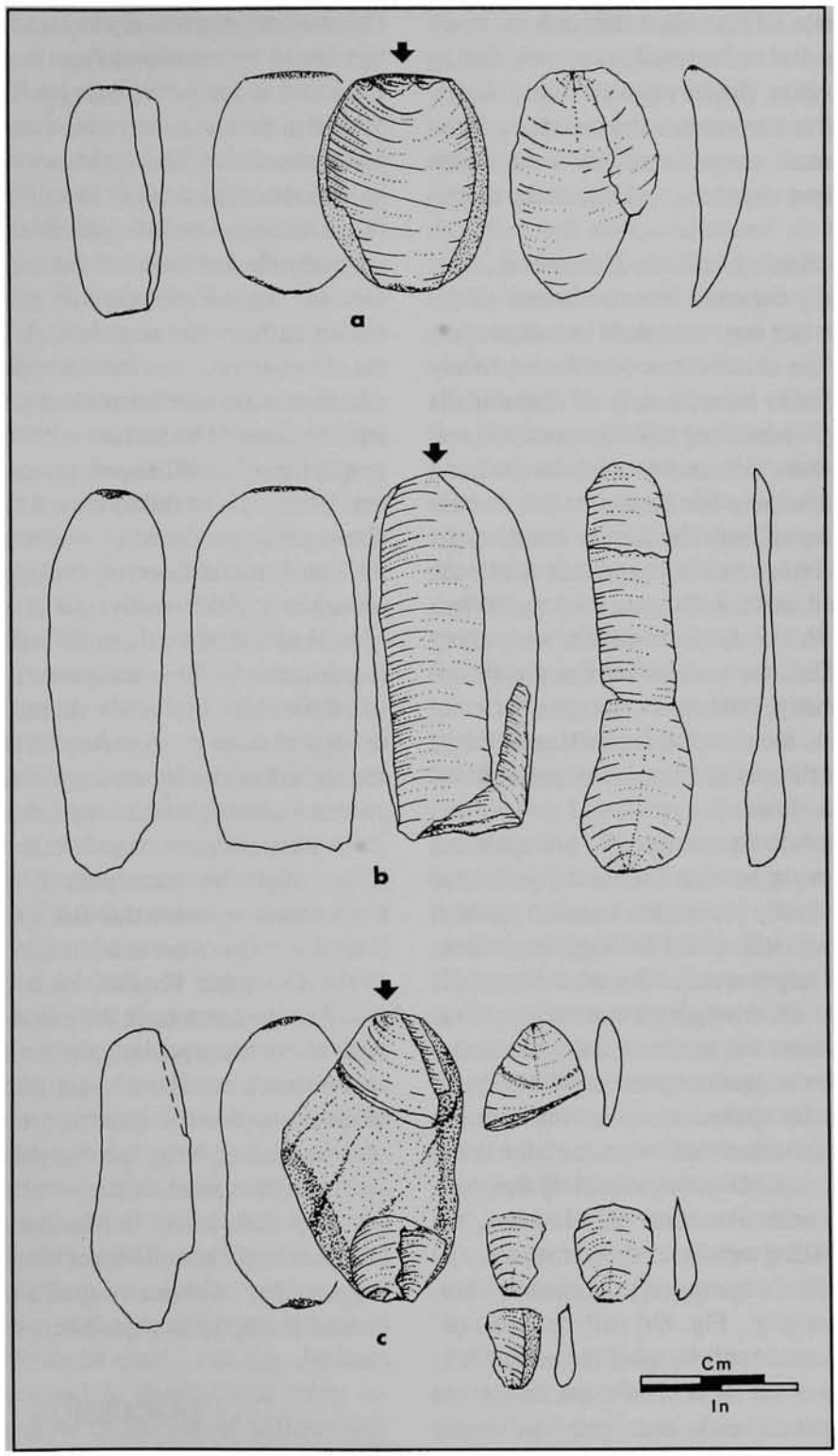

Fig. 7. Chisel-stones used in indirect percussion experiments. Views in all are profile, reverse, obverse, flake (front and back for lowest flake in Figure 7c), and flake profile. Note flakes detached from both ends of Figure 7c.

posit at the site. Other than this one hammerstone, none spalled or fractured in any way during indirect percussion, despite repeated heavy blows. All cylindrical hammerstones showed characteristic wear patterns characterized by worn facets along their edges where the tool struck the chisel-stone.

The experiments indicated, however, that spalls regularly detached from both ends of the chisel-stones when they were used in indirect percussion. If the chisel-stone was seated firmly against the canvas stone, nearly all of the spalls (see Figs. 6b, 7a) detached from the proximal end of the chisel-stone (the end struck with the hammer). If the chisel was less firmly seated, or held just slightly away from the canvas stone, spalls often detached from the distal end that struck the canvas as well as from the proximal end (Figs. 7b-c). Spalls on loosely seated chisels were about evenly split between both ends when the chisel-stone was finally exhausted. In cases of catastrophic failure, the chisel-stone itself split longitudinally. For those with flaws, this occurred after only a few blows.

In two cases, chisel-stones did not spall and ultimately wore out because their heavily crushed working ends finally became too broad to produce fine lines (they still could be used in indirect percussion of larger areas). But other than these two cases, all chisel-stones eventually spalled. Even most of those that survived heavy use (more than 200 blows to produce parts or all of several glyphs) ultimately spalled at one or both ends because the chisel-stone itself was actually being subjected to continuous (albeit relatively light) bipolar percussion.[6] For some chisel-stones, the initiation of spalling rapidly rendered the tool useless as the broken edge quickly crushed and collapsed. Others (e.g., Fig. 6b) suffered spall detachment and could still be used for more pecking—on some of the most elastic specimens, the spalled (sharpened) ends even provided better edges for finer pecking.[7]

The debitage spalls produced from these worn chisel-stones seem likely to be a key artifact type that could be recovered from a petroglyph site. Produced at the petroglyph itself, and likely deposited in the immediate area, these small, bipolar percussion flakes have a characteristic morphology that should be readily identifiable. The spalls (Figs. 6, 7) tend to be broad, thick, cortex flakes, relatively flat and "tabular" in both cross and long section. Terminations are hinged, indicating insufficient force to carry through the long axis of the chisel-stone. This indicates that the blows on the chisel-stone were intentionally struck with less force than would be the case with a knapper trying to split the pebble (J. Fagan, personal communication 1998). These flakes have a markedly curved dorsal profile produced by a relatively wide, very thick platform (and correspondingly thick bulb of percussion). Additionally, platforms are so heavily crushed and battered that they should be readily recognizable in lithic analyses. In Fagan's opinion, these flakes uniformly showed all the characteristics of those produced by bipolar percussion, and should be readily distinguishable from flakes produced during bifacial reduction.

Our experiments suggest that such percussion flakes might be manufactured most frequently from quartzite, since this stone type worked the best of any that were used in this study. In most of the Columbia Plateau, such quartzite flakes would not be common at the predominantly basalt cliffs where many petroglyphs are pecked, and recent research has shown a significant association of quartz grains (or quartzite) embedded in the rock varnish covering petroglyphs pecked in basalt throughout much of the western United States (Whitley et al. MS). In this case, a convergence of experimental and site-specific evidence strongly suggests that evidence of quartz and quartzite at pecked petroglyphs should be expected to be recovered.

DISCUSSION

Similar to the argument made herein, Bednarik (1998:23, 25, 31-32) pointed out that recover-

ing manufacturing tools at petroglyph sites will provide increased opportunities for dating the images, and he urged archaeologists to begin looking for these tools in their excavations at rock art sites. He also provided a summary of previous replication work in Australia and Russia, lamenting the fact that more replication experiments have not been conducted. Further, he noted some similarities of morphology, use, and wear patterns for his hammerstones that mimic those described above.

However, Bednarik's (1998) research results differ from ours in two substantive findings: the size of the hammerstones and the use of indirect percussion. Both from experiments and actual artifacts recovered from rock art sites, Bednarik (1998:28) found that hammerstones most frequently ranged from 100 to 150 g., and were "very rarely over 250 gm." While this significant size difference cannot readily be explained, it may be due to many variables that could make it more or less difficult to peck a petroglyph on different types of rock canvases (see Bednarik 1998:24). In the experiments discussed above, hammerstones of different weights were used, and heavier ones seemed to work better.

Bednarik's (1998:24) conclusion that there is "no evidence that the indirect percussion method was ever used, in Australia or in any other continent, in any significant frequency—if at all" is significantly at variance with our proposals that the method appears likely to have been used at many sites in the northern Great Basin and the southern Columbia Plateau and that, if so, the by-products of this method could provide information to archaeologists. Unfortunately, it appears that Bednarik's (1998) conclusion is based both on a very different perception of the use of indirect percussion and on a misinterpretation of some of the evidence he cited. Initially, Bednarik (1998:24) seemed to suggest that other researchers' assertions of the use of indirect percussion relate to nearly all pecked petroglyphs, and he maintained that this cannot be true for many thousands of petroglyph sites. He supported his conclusion by contending that if indirect percussion was so widely used, there should be large numbers of worn-out chisel-stones at such sites. While we agree that many petroglyphs were made by direct percussion (and therefore left no chisel-stones or bipolar debitage), Bednarik's (1998) argument says nothing about the occurrence at archaeological sites of such tools and their debitage that actually were made by indirect percussion.

Although he denied the use of indirect percussion, Bednarik (1998) cited data that seem to support the probable occurrence of such a technique, at least at some sites. For instance, he cited an unpublished experiment by Clegg that did produce both direct percussion and indirect percussion images, but concluded that direct percussion was more "effective" (Bednarik 1998:24). Unfortunately, "effective" is not defined, and appears only to reflect an ability to make a large pecked area. Clegg's experiment also apparently failed to explore the possibility that indirect percussion may have been a specialized technique to make special figures or parts of figures (like the carefully controlled, fine line figures described in this report).

Bednarik (1998:27, 30) also cited Russian archaeological research that proposed indirect percussion of some petroglyphs but found only hammerstones used in direct percussion, as well as Russian experiments that replicated a petroglyph using the direct percussion method. However, he did not demonstrate that the Russian researchers even searched for bipolar debitage at this rock art site, and he noted that the Russian replicator had trouble producing "a precise edge; he attributes this to his lack of experience" (Bednarik 1998: 30).

That is precisely the point made herein—we do not lack experience, and we, too, had difficulty pecking a precise edge unless we used indirect percussion. Elsewhere, Bednarik (1998:24) also noted that the precision issue is important, but he

seemed to confuse it with depth of pecking, rather than the careful alignment of dints. Finally, he noted that "rock art scientists have . . . collected large numbers of [direct percussion implements] in every continent" (Bednarik 1998:24-25). We know the rock art literature of North America reasonably well, and we know of no such "large numbers" reported on this continent.

CONCLUSIONS

The authors have examined thousands of petroglyphs throughout western North America (in the Columbia Plateau, on the Northwestern Plains, and in the Great Basin), as well as in China and Italy. While we agree with Bednarik (1998) that many thousands of petroglyphs were made by direct percussion, some carvings (or parts of carvings) in all of these areas were very likely accomplished by indirect percussion. Many of these petroglyphs are located in settings where chisel-stone debitage (and even worn-out chisel-stones and used hammerstones) could easily have become incorporated into sediments at the bases of vertical panels or adjacent to more horizontal ones. Certainly, the Great Basin and Columbia Plateau regions, with their extensive panels of petroglyphs pecked on very hard and often heavily varnished basalt cliffs and boulders, offer an optimum opportunity for recovering debitage and broken tools from petroglyph production. The softer sandstones of the Plains, Colorado Plateau, and Southwest might be less prone to produce such bipolar debitage from chisel-stones, but Loendorf's (1984) experiments show that similar chisel-stone wear does occur when pecking petroglyphs on sandstone. Loendorf (1984:107-124) also reported quartzite flakes in a dated cultural level below a petroglyph panel at Petroglyph Canyon in Montana, but the possibility of these being spalls from chisel-stones was not recognized and the morphology of these flakes was not reported.

Recovery of bipolar debitage or exhausted chisel-stones in archaeological deposits, and radiocarbon dating of sediments from which these artifacts are recovered, would aid greatly in placing the rock art in a chronological context. Given recent advances in the recovery and recognition of microscopic remnants of pecking tools in petroglyph varnish studies (e.g., Whitley et al. MS), it might even be possible to relate specific tools to specific images on a panel containing several petroglyphs. In any case, recovery of such artifacts in dated context would provide a minimum age for the petroglyphs that were produced. We hope that future research is directed toward the discovery of such specimens.

NOTES

1. Following more than two decades of studying and observing petroglyphs on three continents, the senior author began an experimental project in 1994 to replicate various types of glyphs in order to understand both the method of manufacture and the evidence that such work might leave behind. Greer Rabiega became associated with the project in 1997 as a member of the Oregon Museum of Science and Industry (OMSI) Young Scholars Archaeology/Rock Art Program, during which time he elected to study the wear and breakage of petroglyph pecking implements as his Young Scholars research project (Rabiega MS). OMSI sponsored these Young Scholars archaeology programs in 1994, 1995, and 1997 with funding from OMSI, the National Science Foundation (Grant ESI-9452688), the USDA Forest Service, and the Bureau of Land Management. Jeffry Gottfried of OMSI served as Project Director, James Keyser as Principal Investigator, and Daniel Leen as Field Supervisor.

2. When fresh, the light color of the dint is due both to crushed rock "powder" (the geologist's "streak") and the exposure of the lighter colored, unweathered interior of the stone. The "streak" is what makes very lightly scratched petroglyphs so obvious when fresh, and its removal by weathering (wind and rain) is the major reason why scratched glyphs are so difficult to see after a few months or years (and why so many scratched petroglyphs are superimposed by others). For a pecked petroglyph, however, the image goes deep enough to expose the lighter interior stone, and it also frequently offers enough relief that it can be seen even after weathering and varnish accumulation have returned the pecked surface back to a color that is the same or similar to the unpecked surface.

3. One of us (JDK) has pecked more than 25 petroglyphs and supervised the production of more than

15 others by various novice carvers, including the second author (GR).

4. For several reasons, our research was not designed to document the actual time necessary to produce a measured area of pecked figure. First, the amount of petroglyph area produced varies significantly based on the hardness of both the hammerstone (or chisel-stone) and the rock canvas. Second (and somewhat obviously), more pecked area can be produced in a given time on a large, broad, fully-pecked figure than on an intricate line design or one with many separate parts (e.g., appendages, interior body decorations). For the purposes of our research, we felt that a "reasonable time" was between 30 minutes and two hours to produce a pecked petroglyph figure using a fist-sized hammerstone. We recognize that it might be possible to produce a fine-line pecked image that would mimic one produced by indirect percussion by using a much smaller and lighter hammerstone and correspondingly far more freehand blows. We simply felt that taking many hours to produce individual images was unlikely for most rock art, given the fact that indirect percussion can produce them in such a shorter time.

5. For direct percussion, the hammerstone could be held tightly in the palm and fingers of the hand, but we found it both easier and less tiring to loosely hold the hammerstone near the ends of the fingers so that it could rebound slightly and so that the rebound of fingers and wrist could absorb much of the remaining energy.

6. During discussion with expert flintknapper, John Fagan, he indicated that bipolar percussion intended to split small chert or obsidian tool stone pebbles involved significantly harder blows to the pebble. Pecking a petroglyph involves sharp, hard blows, although the carver attempts not to damage the chisel-stone. The spalling that results splits the pebble less frequently than does bipolar percussion (except for those chisel-stone pebbles with flaws), but the spalls are eventually produced due to repeated blows of approximately equal force directed at the same platforms (one on each end). The result is heavily battered and crushed platforms—even more than on tool stone flakes produced by bipolar percussion.

7. An anonymous reviewer noted that his/her research showed that hammerstones used to make metates and pestles from sandstone and andesite were similarly intentionally flaked to produce "sharpened, chisel-like" working edges.

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Reflections on the United States National Museum-Gates Expeditions to the American Southwest, 1901 and 1905

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American archaeology has reached a level of intellectual maturity which allows the study and analysis of its development. While most studies have stressed the growth of the discipline, few have emphasized the sociohistorical context or the motivations of the individuals involved. The United States National Museum-Gates Southwest expeditions serve as a focus of these historical variables, and this report discusses community lifestyle, expedition participants, and financial agreements to clarify the organization and success of the endeavors.

TURN of the century American archaeology witnessed a shift in regional studies from the "Moundbuilder" controversy of the Eastern Woodlands to the American Southwest (Willey and Sabloff 1980). The Southwest offered the study of sedentary, pottery-producing Pueblo societies as part of a historical continuum in a spectacular natural setting. Early archaeologists tended to view the archaeological record as a mirror of contemporary Pueblo culture (Gumerman 1991: 102), thereby establishing a focused direction to areal studies. This period (ca. 1875 to 1920) "played an important role in the professionalization of anthropology" (Parezo 1987:4) and in the large archaeological and ethnographic museum collections established throughout the country. While the United States National Museum-Gates (hereinafter referred to as USNM-Gates) expeditions were a part of this practice, little is known of the background of this effort. As Hinsley (1986: 231) observed:

> Curiously, we know very little of those who paid for so much American archaeology: their motivations, expectations, or influences on its devel-