Stone Knapping: The Necessary Preconditions for a Uniquely Hominin Behaviour

Valentine Roux and Blandine Bril (eds.)
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In this ambitious and timely volume, V. Roux and B. Bril compile 24 papers (including co-authored introductory and concluding chapters) that shed some much-needed light on the multiple dimensions of the hominin capacity to acquire, develop and master systematic stone knapping. While the volume's title may lead some to expect a preponderance of archaeological and experimental case studies, these turn out to be comparatively few. This is due to the book's unusual but very appropriate focus on the morphological, neural, cultural and manipulative conditions that underlie the capacity for knapping rather than on a more traditional concern with the byproducts of knapping activities.

In *Stone Knapping*, Roux and Bril seek to assemble a multidisciplinary consensus on what it is that differentiates hominin knapping from that of other primates, and they are to be congratulated for their tremendous job in assembling papers concerned with highlighting the wealth of apparently distinct features that go into making controlled stoneworking possible. To do so, they combine archaeological overviews (Pelegrin, Roche, Holder, and Steele and Uomini), experimental studies (Winton), primate ethology (Foucart et al., Byrne, Cummins-Sebree and Fragaszy, and Marchant and McGrew), ethnographic work (Bril et al., Biryukova et al., Roux and David), biomechanical and functional studies (Ivanova, Smitsman et al., Corbetta, Marzke, Maier et al., Stout, Jacobs et al., and Bushnell et al.), and theoretical syntheses that develop, among other things, the "perception-action perspective" in approaching the cognitive dimensions of lithic technology (Lockman, Stout). It is important to stress, however, that these loose headings do not really do justice to the fundamental plurality of perspectives and approaches used in the studies included in the volume. In fact, most of the contributions healthily transgress traditional disciplinary boundaries to provide a holistic view of stone knapping. As a result, the studies included in the volume help generate common languages to describe the various dimensions of knapping as a behavior in a way that will enable fruitful discourse across various fields of study. In my view, this is one of the main reasons why *Stone Knapping* is an absolute must-read for anyone with a genuine interest in lithic technology.

After an introductory chapter by the editors, Pelegrin discusses the properties of conchoidal stone fracture which characterizes the purposeful flaking of stone and distinguishes the knapping of hominins from the unintentional fracturing of sharp flake-like pieces by some primates. This distinction is a running theme throughout much of the rest of the volume, and appears to be poised to gain in importance in light of recent developments in the archaeology of the "Chimpanzee Stone Age" (Mercader et al. 2007). Roche follows with a chapter on the shift from the technological concept of *flaking* to that of *shaping* over the course of the Lower Paleolithic, which attests to a diachronic refinement of knapping skills. Together, these two chapters provide a very useful English-language introduction to the fundamental concepts of the *chaîne opératoire* approach.

The next section comprises three papers that report on actualistic studies of the production strategies of differentially-skilled stone bead makers in Khambhat (India). Because the craft of these artisans still depends on the mastery of the basic principles of conchoidal fracture, studying it provides useful insights into the biomechanical and behavioral dimensions of stone knapping. Bril et al. use video-image capture of knapper movement and hammer-mounted accelerometers in order to document how differences in skill are manifest in the motions of different knappers, and to differentiate between skilled and unskilled responses to changes in experimental controls (e.g., raw material). Biryukova et al. use information derived from sensors attached to the arms of the knappers in order to characterize how control of motion and "elementary movement kinematics" differ between skilled and unskilled knappers. Roux and David study the methods and courses of action used by different stone bead makers and conclude that these are 'tweaked' according to the ultimate goals of a given knapping task, with higher skill being associated with the capacity to more competently switch between steps and production "sub-goals." The three Khambhat studies shed some interesting new light on how knapping skill is acquired, conceptualized, and expressed in modern contexts, with direct implications for how archaeologists conceive of prehistoric lithic production. This is especially notable in questions such as how much planning depth is involved in knapping, whether know-how and practice are sufficient predictors of high-quality final products, how different stages of productions must be conceptualized as part of a goal-directed set of actions, and how the notion of "elementary movement" fits into reconstruction of lithic *chaînes opératoires*. Some of these questions are taken up in Winton's innovative experimental study of skilled and unskilled handaxe production, in which she concludes that control of shape and proportion can be used to monitor some dimensions of skill in Pleistocene archaeological assemblages.

The question of skill is also broached in Ivanova's study of "complex coordinated strokes" which she approaches by reference to a study of stroke control in tennis players of

different levels. She emphasizes that suites of actions that involve multiple segments of the body are biomechanically complex, and that any break in the operational sequence linking these actions will lead to the failure of the stroke. The flexibility in linking gestures is the main difference between humans and other primates. This flexibility is a central element of Smitsman et al.'s contribution in which they argue that this flexibility can only be acquired in a social context where it is possible for a novice to observe the verbal and non-verbal cues of more expert knappers during lithic production. They conclude that intention, communication, and the ability to link observed behavior to conceptual goals are some of the most fundamental characteristics of human knapping.

Primatological studies offer a productive way of testing some of these differences. Foucart et al.'s study of chimpanzee nut cracking, Cummins-Sebree and Fragaszy's study of capuchin "knapping," and Byrne's review of great ape stone-use show that non-human primates are able to use stones in complex tasks that require social transmission and prolonged periods of practice to master. However, it seems clear from all three papers that these abilities differ in kind much more than in degree from knapping by humans, leaving unresolved the question of whether non-human primates (and even great apes) are capable of that skill, and if not, why not? Is it mainly the result of cognitive or manipulatory differences (or both), compounded by the fact that use for knapped stone is not necessary for most tasks undertaken by non-human primates, or are other causes to be sought out? Later in the book, Marchant and McGrew use their study of baobab fruit smashing among chimpanzees from Mt Assirik to suggest that knapping finds its ultimate roots in hard-shell fruit smashing, first in forests then in more open environments where stones and anvils were more readily available. For them, occasional inadvertent flaking in such contexts would eventually lead to purposeful stone-on-stone action aimed at intentionally producing sharp pieces of rocks. While this is a plausible scenario, it remains to be documented by future paleoanthropological research.

In her study of patterns of the acquisition of fine-manipulation by human toddlers, Corbetta argues that bipedal posture is one of the most important features that distinguishes humans from other primates, especially in terms of how it enables the development of tool-use. This shift in habitual posture and the resulting stability in upright movement would have created the requisite "bio-behavioral conditions" for the development of brain lateralization and fine manipulation that seem to be intrinsic features of human tool-use and tool-making. In the next chapter, Holder uses a "cost:benefit:milieu" approach to minimize the influence of unwarranted assumptions and anthropocentrism, and to better contextualize tool-use. This allows her to argue that manual specialization is necessary for knapping but that handedness—as measured only by its direction (rather than its strength)—is an insufficient criterion to identify its presence in other primates, living or extinct. In their far-ranging review of the fossil and archaeological record to establish the antiquity of human handedness, Steele and Uomini suggest that the ca. 9:1 ratio of right-to-left hand preference manifest in modern humans may stretch back to other, earlier species of *Homo*. After detailing the morphological correlates of habitual tool-use and tool-making in humans as revealed by an integrated behavioral-functional-morphological approach, Marzke reviews the early hominin fossil record and concludes that metacarpals from Swartkrans and Sterkfontein display features only known in the modern human hand, but that hand bones from Olduvai do not.

Maier et al. investigate patterns of neurological activation cause by upper-limb use in cats, squirrel monkeys, macaques, and humans, and establish that a strong corticomotoneuronal system is positively correlated with high dexterity in upper-limb movements. While this relationship is necessary for manual dexterity, it does not constitute convincing independent evidence of use or manufacture of tools. Stout investigates the brain activity resulting from Oldowan knapping through Positron Emission Tomography, and concludes that Oldowan knapping is a conceptually easy task, but that it is associated with a high degree of perceptual-motor brain activity, with clear implications for the neural organization of early hominins. A study by Jacobs et al. reveals that apraxic and brain-damaged individuals have comparable difficulty capitalizing on a tool's mechanical properties to maximize action efficiency, suggesting that the left parietal cortex of modern humans may play a critical role in fully functional and contextualized tool-use.

The book closes with three papers on the socio-cultural context of knapping and innovation in tool-use and tool-making. Bushnell et al. present the result of experiments on knowledge acquisition and on the transfer of means-ends behaviors across contexts in infants. They conclude that the capacity for such transfers—even detached from an understanding of full causal mechanisms—may be what underlies the human capacity for behavioral innovation. They speculate that the emergence of behavioral transfers might provide the link between accidental rock-breaking during nut-cracking activities and subsequent intentional rock-on-rock percussion. Lockman's contribution summarizes the findings of his project on infant manipulation and capacity for tool-use. While infants appear capable of independently developing some tool-using behavior, Lockman indicates that interacting with caregivers helps infants better develop their tool-using abilities due to the stimulating social environment in which behavioral acquisition becomes situated. Likewise, in his second contribution, Stout uses his ethnographic work among contemporary Lagda adze-makers to show that the social context in which knowledge is acquired plays a critical role in knapping skill acquisition and development. This fundamental observation suggests that knapping must have always been a socially-mediated activity, one perhaps characterized by structures resembling master-apprentice relationships. Given the emerging awareness of the place of children in prehistoric societies as reflected in the lithic record (e.g., Shea 2006), these three pa-

pers provide interesting insights into some of the features one might expect the archaeological record of apprenticeship to display.

While the diverse and high-quality contents of the volume make for extremely stimulating and rewarding reading for anyone with an interest in lithic technology, there are a number of typographical errors that make reading sections of the book difficult. For instance, on many pages the letter cluster 'fi' is systematically replaced by the symbol 'Ì' while 'fl' is replaced by 'Ó', to give two examples of the six or seven comparable substitutions. Under other circumstances, this might not have been so bothersome, but considering the frequency at which words such as 'finger' and 'flake' come up in many of the papers, it can make for cumbersome reading. Given their ubiquity and semi-systematic distributions throughout the volume, these substitutions are an undeniable annoyance. Otherwise, however, the overall production value of the volume is very high, with very few typographical errors and crisply-rendered graphs and charts which greatly facilitate the understanding of some of the highly detailed arguments presented by the various contributors. The high standard of the English translations is also a testament to the editors' commitment to disseminating the results of a number of projects dealing with the issue of knapping as a research focus—notably those based in French laboratories and research centers—to a wide international audience.

Given the multifaceted nature and uniqueness of lithic production, reading through the papers contained in *Stone Knapping* cannot be expected provide a single, definite answer to the question of why no non-human primates currently practice it. The experience does, however, underscore the critical importance of adopting a multidisciplinary perspective in order to effectively tackle this thorny issue and to clarify the nature of this truly unique adaptation that laid the groundwork for all subsequent hominin cultural evolution. By transcending traditional ways of approaching stone knapping, by aptly characterizing it as a behavior dependent on morphological, cultural, and neural specificities, and by bringing together the diverse approaches employed by the various contributors, Roux and Bril have done a great service in helping advance our understanding of how stone knapping helped define humanity on many different levels.

REFERENCES

Mercader, Julio, Huw Barton, Jason Gillespie, Jack Harris, Steven Kuhn, Robert Tyler, and Christophe Boesch. 2007. 4,300-Year-old chimpanzee sites and the origins of percussive stone technology. *Proceedings of the National Academy of Sciences* 104(9): 3043–3048.

Shea, John J. 2006. Child's play: Reflections on the invisibility of children in the Paleolithic record. *Evolutionary Anthropology* 15: 212–216.