

PRINCIPLES OF ARCHAEOLOGY

# UNDERSTANDING CHIPPED STONE TOOLS



BRIAN HAYDEN

UNDERSTANDING  
**CHIPPED**  
STONE TOOLS

# PRINCIPLES OF ARCHAEOLOGY

## ADVISORY EDITORS

**Robert L. Bettinger**, *University of California, Davis*

**Gary M. Feinman**, *The Field Museum, Chicago, Illinois*

---

## A PRIMER ON MODERN–WORLD ARCHAEOLOGY

Charles E. Orser, Jr.

## REGIONAL SETTLEMENT DEMOGRAPHY IN ARCHAEOLOGY

Robert D. Drennan, C. Adam Berrey, Christian E. Peterson

## APPLIED ZOOARCHAEOLOGY: Five Case Studies

Steve Wolverton, Lisa Nagaoka, Torben C. Rick

## THE ARCHAEOLOGY OF ANCIENT CITIES

Glenn R. Storey

## A PRIMER ON CHIEFS AND CHIEFDOMS

Timothy Earle

## UNDERSTANDING CHIPPED STONE TOOLS

Brian Hayden

# UNDERSTANDING CHIPPED STONE TOOLS

BRIAN HAYDEN

*Simon Fraser University (Burnaby) and  
University of British Columbia (Vancouver)  
British Columbia, Canada*



ELIOT WERNER PUBLICATIONS, INC.  
CLINTON CORNERS, NEW YORK

Library of Congress Cataloging-in-Publication Data

---

Names: Hayden, Brian, author.

Title: Understanding chipped stone tools / Brian Hayden.

Description: Clinton Corners, New York : Eliot Werner Publications, Inc., 2022. | Series: Principles of archaeology | Includes bibliographical references.

Identifiers: LCCN 2021046141 (print) | LCCN 2021046142 (ebook) | ISBN

9781734281866 (paperback) | ISBN 9781734281873 (epub) | ISBN 9781734281880 (pdf)

Subjects: LCSH: Stone implements. | Tools, Prehistoric.

Classification: LCC GN799.T6 H39 2022 (print) | LCC GN799.T6 (ebook) | DDC 930.1/2—dc23/eng/20220103

---

ISBN-10: 1-7342818-6-3

ISBN-13: 978-1-7342818-6-6

Copyright © 2022 Eliot Werner Publications, Inc.

PO Box 268, Clinton Corners, New York 12514

<http://www.eliotwerner.com>

All rights reserved

No part of this book may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, microfilming, recording, or otherwise, without written permission from the Publisher.

Printed in the United States of America

To the memory of my father, who first encouraged  
me to become an archaeologist



## PREFACE

This book distills insights from the better part of my career, which has been spent trying to understand the mysteries of stone tools: how they were made, what they were used for, what variations are meaningful, and how they fit into the cultures that generated them. In pursuing this quest, I went to the Australian deserts to work with Aboriginals who remembered making and using stone tools; I went to France to study with François Bordes; and I learned how to make stone tools and use them to work hides, chop wood, make spears and bone awls, and undertake many other projects. I have obtained a fairly good grasp of many of the fundamental aspects of stone tools, and I would like to pass along these aspects to readers keen to know about stone technology.

My goal in this book is to convey—in a basic and simple way—the perspective that I have found most useful for dealing with stone tools. The study of chipped stone tools is sometimes viewed as an arcane field that can only be understood by the most serious devotees, and is often dealt with superficially by the least informed. What I want to present is an engaging way of looking at stone tools, tools designed to solve basic problems. And to understand these problems and how stone tools were used to solve them, it is necessary to engage with the traditional world, to know first hand what it is like to make a spear using stone tools or an awl or a shell bead. Understanding stone technology is best done on an experiential basis, not simply from reading books. And this is what makes it engaging and fun. Learning by doing is far more effective than learning through reading. It makes connections to the real world and can be a lifelong source of satisfaction.

This book is mainly for students and others who are just setting out to explore what stone tools are all about—people who want to see if studying stone tools is what they want to pursue. It is meant to engage your interest rather than provide all the details you need to know about lithic technology. Detailed studies can come later and there are many other books that explain in much more detail the mechanics of flaking stone, typologies of tools, ways of measuring stone tools, the characteristics of debitage and core reduction, determining geological types of stone used, use-wear traces, residue analysis, and many other facets. This book is different. It is a conceptual approach focused on the user's

decisions in the design of tools and what stone tools were used for. I hope you get some enjoyment out of a number of the exercises, and I hope you obtain a good grounding in understanding how stone tools were made, why certain techniques were used for flaking, and how stone could be modified to solve specific problems.

I will forever be in the debt of everyone who has taught me about lithics, and consider myself to have been very lucky for the good mentoring and productive interactions I have had with gifted individuals—whether in academia or in native settlements. These individuals are far too numerous to list but François Bordes, Errett Callahan, Don Crabtree, Jeffrey Flenniken, Johan Kamminga, Maxine Kleindienst, and Jim Riggs stand out.

I am very grateful to Eliot Werner for this opportunity to present my views on lithic analysis and pull together a number of disparate pieces of research that I have carried out over the years. I also wish to thank the students and colleagues who collaborated on the research mentioned in this book. Finally, except where noted the photographs in the book were taken by me.

# CONTENTS

|                                                        |           |
|--------------------------------------------------------|-----------|
| <b>1 • Perspectives on Lithics</b>                     | <b>1</b>  |
| Perspectives: Old, New, and From the Bottom Up         | 1         |
| What Do You Want To Find Out?                          | 2         |
| Experiential and Experimental Archaeology              | 3         |
| My Background                                          | 4         |
| Organization of This Book                              | 6         |
| Exercise                                               | 7         |
| Additional Readings                                    | 7         |
| <br>                                                   |           |
| <b>2 • Design Theory</b>                               | <b>11</b> |
| Steps in Design Analysis                               | 11        |
| Design Theory in Practice                              | 13        |
| Constraints                                            | 13        |
| The Importance of Quantity                             | 15        |
| Prestige Technologies                                  | 18        |
| Exercise                                               | 19        |
| Additional Readings                                    | 19        |
| <br>                                                   |           |
| <b>3 • Design Theory as Applied to Lithic Analysis</b> | <b>21</b> |
| End Scrapers: A Specially Designed Tool Type           | 21        |
| The Problem                                            | 23        |
| Step 1: Dehairing and Removing the Epidermis           | 24        |
| Step 2: Defleshing                                     | 24        |
| Step 3: Removing the Inner Membrane                    | 25        |
| Step 4: Stretching and Working the Hide                | 25        |
| Step 5: Abrading the Hide                              | 26        |
| Design Lessons from Making Buckskin                    | 26        |
| Deconstructing End Scrapers: The Design Factors        | 27        |
| Material Constraints                                   | 28        |
| Task Constraints                                       | 29        |
| Size and Kinematic Constraints                         | 29        |

|                                                                     |           |
|---------------------------------------------------------------------|-----------|
| Skill Constraints                                                   | 30        |
| Technological Constraints                                           | 30        |
| Quantity                                                            | 30        |
| Size Matters                                                        | 30        |
| Designing Hide-Scraping Tools                                       | 31        |
| Blades and Reduction Strategies                                     | 32        |
| Discussion                                                          | 34        |
| Exercise                                                            | 34        |
| Additional Readings                                                 | 34        |
| <b>4 • Tier 1: Analyzing Stone Tools</b>                            | <b>39</b> |
| Expedient, Extemporaneous, and Opportunistic Tool Use               | 39        |
| The Nuts and Bolts of Analyzing Stone Tools:                        |           |
| Tools and Debitage                                                  | 41        |
| An Artifact or Not an Artifact?                                     | 41        |
| Flake Tools: The Six Sides of a Flake                               | 45        |
| Types of Edge Modification                                          | 46        |
| Other Sources of Edge Modification                                  | 59        |
| Unmodified Tools                                                    | 61        |
| Summary                                                             | 62        |
| Exercise                                                            | 63        |
| Additional Readings                                                 | 63        |
| <b>5 • Tier 2: Basic Reduction Strategies and Specialized Types</b> | <b>65</b> |
| Specialized Tools: Projectile Points                                | 65        |
| Spears or Arrows?                                                   | 68        |
| Consequences                                                        | 70        |
| Reduction Strategies                                                | 70        |
| Hard Hammer Block Core Reduction                                    | 71        |
| Blade Reduction                                                     | 72        |
| Bipolar Reduction                                                   | 76        |
| Bifacial Reduction                                                  | 78        |
| Levallois Reduction                                                 | 87        |
| Pressure Reduction                                                  | 89        |
| Summary                                                             | 91        |
| Exercise                                                            | 93        |
| Additional Readings                                                 | 94        |
| <b>6 • Tier 3: Design Considerations</b>                            | <b>99</b> |
| Reliability                                                         | 99        |
| Maintainability                                                     | 100       |
| Versatility and Multifunctionality                                  | 101       |

|                                        |            |
|----------------------------------------|------------|
| Flexibility                            | 102        |
| Diversity                              | 103        |
| Other Design Considerations            | 104        |
| Commentary                             | 105        |
| Identifying Tasks and Strategies       | 105        |
| Types                                  | 106        |
| Traditional Typologies                 | 107        |
| Contemporary Typologies                | 108        |
| Exercise                               | 108        |
| Additional Readings                    | 108        |
| <b>7 • Changes</b>                     | <b>111</b> |
| Raw Materials                          | 111        |
| Geological Nomenclature versus         |            |
| Prehistoric Choices                    | 112        |
| Resharpener Strategies Over Time       | 113        |
| The Oldawan                            | 114        |
| Acheulian Handaxes and Mousterian      |            |
| Levallois Flakes                       | 115        |
| Upper Paleolithic Blades and Bifaces   | 116        |
| Mesolithic Microliths                  | 117        |
| Ground Stone Axes                      | 117        |
| Additional Readings                    | 119        |
| <b>8 • Total Assemblages</b>           | <b>121</b> |
| Profile of the Keatley Creek Site      | 121        |
| The Lithic Assemblage at Keatley Creek | 122        |
| The Block Core Strategy                | 124        |
| Bifacial Reduction                     | 125        |
| Bipolar Reduction                      | 128        |
| Pressure Reduction                     | 130        |
| Grinding Reduction                     | 130        |
| Other Strategies and Comparisons       | 134        |
| Additional Readings                    | 134        |
| <b>9 • Precepts and Prospects</b>      | <b>137</b> |
| Getting Oriented                       | 137        |
| Prospects                              | 138        |
| Research Constraints                   | 139        |
| Additional Reading                     | 140        |
| <b>Sources for Images</b>              | <b>141</b> |
| <b>Glossary</b>                        | <b>143</b> |



# CHAPTER 1



## PERSPECTIVES ON LITHICS

Stone tools are perplexing when you first look at them—a jumbled collection of sharp-edged chunks of stone with no rhyme or reason to their existence except for the occasional arrowhead or spearhead. Which pieces were the equivalent of industrial waste and which were useful? What can we learn from analyzing lithics? A lot more than you might initially suspect.

Stone tools are the Stone Age equivalent of modern plastics: they don't decay and they litter the landscape wherever there were people. There is even "microdebitage" in the landscape from producing stone tools. People just threw away stone tools and stone waste when they were done with them, no matter where they were. They have lasted for thousands, hundreds of thousands, and even millions of years. The Egyptians called stone the material of eternity. As one bumper sticker proclaimed at a conference in England, "Love is fleeting but stone tools are forever."

### **PERSPECTIVES: OLD, NEW, AND FROM THE BOTTOM UP**

When first encountered by people plowing their fields, stone artifacts were mysterious things thought to have been produced by lightning strikes shattering rocks. "Thunder stones," they called them. Since the time of Christian Thomson, who identified the Stone Age as a technological stage of cultural evolution in 1820 and who employed the concept of evolution a half-century before Darwin, archaeologists have used experimentation, use-wear analysis, ethnographic observations, replication, tool designs, and residue examination to gradually develop an understanding of how stone tools were made and what many types of stone tools were used for.

This book does not cover details about flintknapping techniques, mineralogy of stones, ground stone tools, or fracture mechanics. These are specialized topics best dealt with in separate works. Rather, it represents a somewhat different approach to analyzing chipped stone assemblages than traditional books. Most books on lithic analysis begin with describing types of stone, the mechanics of stone fracture, and the various types of stone reduction. They include an examination of some tool types, discussions of use-wear, and sometimes expositions about mobility effects or a few other factors that affect assemblages. They represent a top-down analytical perspective typical of geological or paleontological approaches to natural phenomena that emphasize mineral components and structure and treat artifacts like fossils to be described, measured, and placed in appropriate categories or understood in terms of their environments.

What I propose is to employ the viewpoints of the makers and users to approach chipped stone tools from a more holistic, bottom-up framework—an agent-based approach if you like, and one that I have used elsewhere to understand feasting and ritual behavior. Perhaps the most distinctive cognitive feature in human evolution has been the amazing ability of humans to solve problems in innovative and effective ways by employing highly developed conceptual skills in logic, causality, memory, foresight, and imagination. To undertake lithic analysis from this perspective, I have found the conceptual framework provided by design theory to be uniquely suited to the goal of understanding stone tools.

The next chapter describes exactly what this entails. The result of using this approach is that a broad range of constraints need to be identified that affect stone tool decisions and solutions. These include not only mobility constraints but also time constraints, procurement costs, effectiveness and efficiency of alternate solutions, quantities being processed, and transport aids—as well as social and other constraints. Design theory integrates them all.

## **WHAT DO YOU WANT TO FIND OUT?**

What do you want to know about stone tools? This question is of fundamental importance in undertaking any analysis, whether of stone tools or anything else. Merely recording observations is a limitless and meaningless task. Analysis needs to be structured by things that you—or whoever is directing a project—want to know. What preoccupies me is what people were doing with stone tools, how stone artifacts got where they were found, and how they relate to social aspects in the past. But other people have different priorities. They may want to know what

cultures or time periods stone tools represent, what interactions and exchanges took place with other groups, how mobile groups were, or how stone tools could be used to impress others. And indeed none of these topics are mutually exclusive. Sometimes analysis includes recording observations that can be used to deal with a number of different questions like cultural groupings, the age of artifacts, past exchanges, and the use of tools. But to engage in good analysis you should be aware of which observations are useful for dealing with specific kinds of questions (see Chapter 7).

If you are doing analysis for a consulting company, their “rote” kinds of inquiry are usually dictated by bureaucratic or client terms of reference. The problem that government agencies want to solve is how to standardize reports so that they are useful for managing cultural resources. This is an administrative problem usually involving lithic remains from different time periods and different cultural groups. To standardize recording the required typology of these agencies usually reflects time and culturally sensitive artifact types, as well as general assemblage descriptions that incorporate obvious use categories like “projectile points” and “grinding stones.”

The objectives of these standardized typologies haven’t changed much from the typologies developed in the first century of archaeological research—that is, to identify how old assemblages are and what cultural groups produced them. Indeed, for many archaeologists the term “typology” implies these purposes in the analysis of stone tools. In Europe this approach was borrowed from historical geologists (paleontologists) who tried to determine the kind of animals that existed in the past and the age of geological layers from the different types of bones occurring in the sediments. Stone tools were just another kind of physical remain, or fossil, to be used in the same way. In the last fifty years, archaeology and paleontology have expanded the range of issues being addressed—from sociopolitical organizations to rituals, social identities, domestication, dynamics of change, agency, and much more. We need different kinds of analyses to address these different kinds of questions.

## **EXPERIENTIAL AND EXPERIMENTAL ARCHAEOLOGY**

In order to understand the strategies employed in the past, it is above all important to indulge in what I refer to as experimental and experiential archaeology. This consists of learning how to knap flint or stone and how to use a variety of stone tools to accomplish basic tasks like making spears or baskets. I am convinced that understanding how to make *and use* stone tools is pivotal to understanding how to analyze stone tools. This approach was pioneered by archaeologists like Errett Calla-