
Complex and time-consuming to produce, iron-ore mirrors stand out among pre-Hispanic artifacts for their aesthetic beauty, their symbolic implications, and the complexity and skill of their assembly. Manufactured Light presents the latest archaeological research on these items, focusing on the intersection of their significance and use and on the technological aspects of the manufacturing processes that created them.

The volume covers the production, meaning, and utilization of iron-ore mirrors in various Mesoamerican communities. Chapters focus on topics such as experimental archaeology projects and discussions of workshops in archaeological contexts in the Maya, Central Mexico, and northwest Mexico regions. Other chapters concentrate on the employment and ideological associations of these mirrors in pre-Hispanic times, especially as both sacred and luxury items. The final chapters address continuities in the use of mirrors from pre-Hispanic to modern times, especially in contemporary indigenous communities, with an emphasis on examining the relationship between ethnohistoric and archaeological interpretations.

While the symbolic role of these artifacts and the intricacy of their construction have long been recognized in archaeological discussion, Manufactured Light is the first synthesis of this important yet understudied class of material culture.
EMILIANO GALLAGA M. is a Mexican archaeologist interested in northwest Mexico and experimental and historical archaeology. He is the director of the Escuela de Antropología e Historia del Norte de México (EAHNM), INAH, Chihuahua.

MARC G. BLAINEY is a research fellow at the Trent University Archaeological Research Centre (TUARC). He received a PhD in anthropology from Carleton University and served as a SSHRC postdoctoral fellow in the Department for the Study of Religion at the University of Toronto. His research and publications bridge the anthropology of religions, medical anthropology, cognitive archaeology, and consciousness studies.

"This book fills a theoretical and analytical gap in our understanding of Mesoamerican lifeways and world views and is necessary for any Mesoamerican archaeologist who wishes to consider the entirety of the archaeological record."

~ ZACHARY KOODY, NORTHERN KENTUCKY UNIVERSITY

CONTRIBUTORS

Thomas Calligaro
Carrie L. Dennett
Julie Gazzola
Sergio Gómez-Chavez
Olivia Kindl
Brigitte Kovacevich
Achim Lelgemann

Jose J. Lunazzi
John J. McGraw
Emiliano Melgar
Joseph B. Mountjoy
Reyna Salas
Karl Taube

Green photograph: Mexico from pre-Columbian National Museum of the American Indian, Smithsonian Institution (12/98); photo by Smithsonian Institution.
Contents

List of Figures, vii
List of Tables xiii

Chapter 1: Introduction
   Emiliano Gallaga M. 3

Chapter 2: How to Make a Pyrite Mirror: An Experimental Archaeology Project
   Emiliano Gallaga M. 25

Chapter 3: Manufacturing Techniques of Pyrite Inlays in Mesoamerica
   Emiliano Melgar, Emiliano Gallaga M., and Reyna Solis 51

Chapter 4: Domestic Production of Pyrite Mirrors at Cancuén, Guatemala
   Brigitte Kovacevich 73

Chapter 5: Identification and Use of Pyrite and Hematite at Teotihuacan
   Julie Gazzola, Sergio Gómez Chávez, and Thomas Calligaro 107

Chapter 6: On How Mirrors Would Have Been Employed in the Ancient Americas
   José J. Lunazzi 125
Chapter 7: Iron Pyrite Ornaments from Middle Formative Contexts in the Mascota Valley of Jalisco, Mexico: Description, Mesoamerican Relationships, and Probable Symbolic Significance

*Joseph B. Mountjoy* 143

Chapter 8: Pre-Hispanic Iron-Ore Mirrors and Mosaics from Zacatecas

*Achim Lege mann* 161

Chapter 9: Techniques of Luminosity: Iron-Ore Mirrors and Entheogenic Shamanism among the Ancient Maya

*Marc G. Blainey* 179

Chapter 10: Stones of Light: The Use of Crystals in Maya Divination

*John J. McGraw* 207

Chapter 11: Reflecting on Exchange: Ancient Maya Mirrors beyond the Southeast Periphery

*Carrie L. Dennett and Marc G. Blainey* 229

Chapter 12: Ritual Uses of Mirrors by the Wixaritari (Huichol Indians): Instruments of Reflexivity in Creative Processes

*Olivia Kindl* 255

Chapter 13: Through a Glass, Brightly: Recent Investigations Concerning Mirrors and Scrying in Ancient and Contemporary Mesoamerica

*Karl Taube* 285

*List of Contributors* 315

*Index* 317
1.1. Reflection from the Bonampak pyrite mirror  5
1.2. Mirror components and hole types  12
1.3. Pyrite plaques or tesserae from a mirror, tomb 10 of building 21, Tenam Puente, Chiapas, Late Classic period  15
1.4. Proposed registration sheet for pyrite mirrors  20
2.1. Known pre-Hispanic pyrite sources and mirror-craft production sites  33
2.2. Materials and tools used in the manufacture of the base of the mirror  34
2.3. Manual manufacturing process of the stone base  35
2.4. Photographic record, manufacturing process of sandstone base and tile of pyrite  37
2.5. Images of scanning electron microscopy, surface details and cut details  39
2.6. Experimental cutting of a pyrite with obsidian blades: 60 hours of work  45
3.1. Experimental archaeology in lapidary objects: abrading, cutting, polishing, and brightening  55
3.2. The analyzed objects from the Great Temple of Tenochtitlan  56
3.3. Analyses of surfaces (10x)  58
3.4. Analyses of surfaces (100x)  59
3.5. Analyses of edges (10x)  60
I made efforts to envisage how low-reflectivity (20%) polished-stone artifacts (i.e., “mirrors”) made in Central and South America would have been employed in ancient times, and performed some experiments to prove the suggested possibilities. For example, I describe how it would be possible to make images of objects with an intense light source (mainly by direct sunlight), with the mirror located in its shadow, and how curvature affects the luminous intensity and the capability of making images of large objects. I also consider the possible use of mirrors for communicating at long distances through reflections. Some examples are given to consider the sharpness of the image as of good quality. The mirrors’ ability to concentrate the sun to make fire is also discussed, making some experimental simulations. Some possibilities of mountings to hide the object to give a phantom impression are also considered.

As the chapters in this volume indicate, reflective optical elements are a proof of a sophisticated culture in action. Such objects are mentioned as being employed in several ancient cultures (Andersens 2007; Enoch 2006). The Egyptians used reflective optical elements to illuminate the inside of tombs, or to give the impression of mystery and supernatural power (Enoch 1999). In ancient Greece, Archimedes suggested burning enemy ships by concentrating the reflection of mirrors (Simms 1977). Mirrors are also mentioned as a product of ancient China (Xiu 1996).
image quality is not a fundamental concern (Taube 2004: 142). Even reflectivity power is not important, because just as sunlight is reflected by the lateral glass of a car’s window (what corresponds to less than 5% reflectivity), light was also noticed at our observation base at 1.2 km distance from the car. It is clear that the communication distance can be further increased if we consider pyrite mirrors like the archaeological examples reported as belonging to the ancient Maya, because they have 60% reflectivity. Future experiments can shed light on the capacities of ancient Maya mirror specimens.

CONCLUSIONS

To situate the importance of the analysis for an archaeological audience, this chapter could work as a sort of exploratory or experimental think-piece. Experiments were made and necessary parameters analyzed to help in evaluating six possibilities for the ancient use of low-reflectivity stone mirrors already considered previously. Self-observation of one’s face was reported, suggesting the need of sunlight. Observation of symmetrical images, although natural for plane mirrors, was applied to situations where the sky and its elements are important, and symmetry of the image was considered not only as a transversal property but longitudinal too, because depth is a very important element always present for the recognition of images (the reason for our binocular vision). Floating images, although evident when holding a concave mirror, were not specifically mentioned by other authors and are now proposed as a subject for future consideration. A physical explanation was given for why some mirrors were made with two curvatures. A possible way of making fire by using a mirror to manipulate sunlight was also detailed. And finally, a possibility of optical communication, not previously known to the author, was tested and analyzed. It is my hope that this work may help archaeologists in their evaluation of the fascinating civilizations of the ancient Americas, pre-Columbian cultures about which much remains to be revealed.

ACKNOWLEDGMENTS

The Pro-Reitoria de Extensão e Assuntos Comunitários-PREAC of State University of Campinas is acknowledged for funding that allowed for the purchase of some material. The Pro-Reitoria de Pesquisa of State University of Campinas is acknowledged for the “PIC Jr” fellowship given to students Cássia Sanches Delanhese, Caio Leonardo Duarte Bargas, and Rafael Pedro da Silva, who helped in performing and measuring the reflectivity adaptation.
same common mirrors. The Pro-Reitoria de Graduação of State University of Campinas is acknowledged for the SAE fellowship to student Alex Rafael de Costa and Henrique Guilherme Ferreira, who helped in performing the experiments under the sun. Teroslau R. Perallis is acknowledged for help in finding the proper elements for smoke deposition. The Museum of Archaeology of Mexico City, Mexico, the Museum Lareo, Lima, Peru and Museo del Oro, Lima, Peru are acknowledged for allowing me to take and reproduce pictures of museum pieces. Paul S. Baldi is acknowledged for grammar revision and Silvia L. Baldi for digital formatting of the photographs. The agreement between the Ministry of Education division CAPES and many universities allowed me to rapidly obtain important references. The open access information on the Internet was a great source of help for finding other references, mainly the Google Books service.

BIBLIOGRAPHY


