METAL OBJECTS FROM GOURNIA

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The Cretan Collection in the University of Pennsylvania Museum

Volume III

METAL OBJECTS FROM GOURNIA

By

Philip P. Betancourt, Susan C. Ferrence, and
Alessandra Giumlia-Mair

With contributions by

Noël H. Gale†, Lynn Grant, Moritz Jansen, Caitlyn Mahony, and Zofia Anna Stos-Gale

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Preface

This book is the third installment on the Cretan Collection of the University of Pennsylvania Museum of Archaeology and Anthropology in Philadelphia, Pennsylvania. Like volumes I and II (Betancourt 1983; Betancourt and Silverman 1991), it presents catalog entries, drawings, and photographs of objects that were given as a gift to the people of Philadelphia by the government of the independent state of Crete before it joined with Greece in 1913.

The objects were chosen in Crete as a representative sample of those found in the Minoan town of Gournia during the excavations directed by Harriet Boyd (later Harriet Boyd Hawes). They provide primary evidence for the early history of metalworking in southeastern Europe during the second millennium B.C. The collection from Gournia is the largest group of Minoan metal artifacts in the United States.

Studying these objects for publication has been a pleasant experience because of the surprises and the new discoveries that have appeared, especially with the microscopic examination and the compositional analyses of the artifacts. The collection is important in several respects. It includes four fragments of copper oxhide ingots, one bar ingot made of lead, and the largest known group of cut strips and cast blank bars that were the preliminary stages for the manufacture of small tools in Minoan Crete. This is the largest collection of workshop material surviving from the site from the middle of the second millennium B.C., and its information is crucial for understanding the metalworking practices that were used at Gournia during this period.

The other objects represent a sample of the metal artifacts excavated by Harriet Boyd and her team at the beginning of the 20th century. Like the workshop materials, they had never been seriously studied before this project. The study has resulted in several new discoveries. For the first time, it has been possible to identify specific metal chisels that were used as masonry tools to work stone, thanks to the study of microscopic wear patterns on the tools. The collection has two examples of the rare cast-on process used for mending

and adding metal to previously cast objects, which has not previously been documented for Minoan Crete. Several daggers have silver-plated rivet heads whose plating was achieved with eutectic bonding, a process with relatively few documented examples from Bronze Age Crete. The presence of this practice on objects in the collection in Philadelphia was not recognized before this study. The museum also houses numerous examples of the very ordinary metal objects that would have been common in a Bronze Age Cretan town. One of the surprises emerging from the study of this large assemblage of ordinary objects is that bronze played much less of a role in the metal objects from Gournia than was expected. Although copper tools were already well integrated into the Bronze Age society of Crete by the middle of the second millennium B.C., tin to manufacture the bronze was still not very plentiful in this small palatial community away from the great centers of Minoan Crete.

The assemblage is remarkable not for any artistic contribution, but for the light its objects shed on the history of technology. When examined as a whole, it provides a good picture of the metalworking expertise available in a Minoan town in East Crete, well away from the largest Minoan center at Knossos, ranging from very simple techniques to unexpectedly sophisticated accomplishments like eutectic bonding.

The catalog of the Gournia metals collection is presented in several parts. After an introduction to the work of Harriet Boyd Hawes, the archaeologist who directed the excavation that discovered the metal artifacts in Philadelphia, the volume presents the scientific analysis data that was used to augment the visual investigation. The artifacts are then presented by classes, with the individual catalog entries followed by their discussion sections, some of which are complete chapters by specific scholars. Comments and discussions follow after the general presentation.

Several preliminary reports have been presented on this collection (Betancourt et al. 1978; Gale 2011; Betancourt 2014a; Ferrence and Giumlia-Mair 2014; Giumlia-Mair, Ferrence, and Betancourt 2015).

Philip Betancourt
2021

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Before this study was undertaken, the objects examined for this volume required special conservation to stabilize the metals, remove some corrosion, and prepare the artifacts for long-term storage. We thank the Institute for Aegean Prehistory (INSTAP), which awarded the authors a grant to support the cleaning and stabilization of these artifacts. This important work stopped the deterioration of the objects of copper alloy and stabilized their surfaces.

The authors wish to thank the members of the Scientific Testing Committee of the Penn Museum for their approval. The analysis by XRF was conducted by Alessandra Giumlia-Mair, head of the Research Laboratory of the Institute of Archaeology in the Russian Academy of Sciences, Moscow, and director of AGM Archeoanalisi Laboratory in Merano, Italy. The analysis by ESEM-EDS was conducted at the Singh Center for Nanotechnology of the University of Pennsylvania, and we are grateful to Jamie Ford for the operation of the scanning electron microscope to conduct these analyses.

The three principal authors have worked together in Crete for several years at the INSTAP Study Center for East Crete in Pacheia Ammos and at the Archaeological Museum in Herakleion. The preparation of this catalog has profited greatly from our work with Minoan metal artifacts in Crete, and we are thankful to our many colleagues at these two institutions where we have gained experience with the fascinating world of Minoan metals.

Help with preparation of drawings, charts, and other illustrative material was given by Sydney Sarasin, Diane Evitts, Sarah Peterson, Hilary Sperling, and Leanna Kolonauski.

List of Abbreviations

AAS	atomic absorption spectroscopy
Ag	silver
Al	aluminum
As	arsenic
Au	gold
Ba	barium
Bi	bismuth
BTA	benzotriazole
ca.	circa
Cd	cadmium
cm	centimeter(s)
Co	cobalt
Cr	chromium
Cu	copper
d.	diameter
dim(s).	dimension(s)
EB	Early Bronze
EC	Early Cycladic
EM	Early Minoan
ESEM-EDS	environmental scanning electron microscopy with semiquantitative energy dispersive spectroscopy
est.	estimated
Fe	iron
fig.	figure
h.	height
HM	Herakleion Archaeological Museum
In	indium
Ir	iridium
kg	kilogram
km	kilometer
LC	Late Cypriot
LH	Late Helladic
LIA	lead isotope analysis
LIBS	laser-induced breakdown spectroscopy
LM	Late Minoan
max.	maximum
MB	Middle Bronze
Mg	magnesium
MM	Middle Minoan
mm	millimeter(s)
Mn	manganese
Mo	molybdenum

MS	accession number, Mediterranean Section, Penn Museum
µm	micrometer(s)
NAA	neutron activation analysis
Ni	nickel
OES	optical emission spectroscopy
Pb	lead
Penn Museum	University of Pennsylvania Museum of Archaeology and Anthropology, Philadelphia
PIXE	particle induced X-ray emission spectroscopy
pl.	plate
ppm	parts per million
pres.	preserved
Sb	antimony
Sc	scandium
Se	selenium
SEM	scanning electron microscopy
SEM-EDS	scanning electron microscopy and energy dispersive spectroscopy
Sn	tin
Te	tellurium
th.	thickness
TIMS	thermal ionisation mass spectrometry
Tr.	trace
w.	width
wt.	weight
XRF	X-ray fluorescence spectroscopy
Zn	zinc