

ARCHAEOLOGICAL EXPLORATION
OF SARDIS

METALWORK FROM SARDIS

Jane C. Waldbaum

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ARCHAEOLOGICAL EXPLORATION
OF SARDIS

*Fogg Art Museum of Harvard University
Cornell University
The Corning Museum of Glass
Sponsored by the American Schools
of Oriental Research*

General Editors

George M. A. Hanfmann
Jane Ayer Scott

Monograph 8

METALWORK FROM SARDIS: THE FINDS THROUGH 1974

Jane C. Waldbaum

*with contributions by Reed Knox, Jr., Robert
Maddin, Pieter Meyers, James D. Muhly,
Andrew Oliver, Jr., John G. Pedley, George
Rapp, Jr. and Leon Stodulski*

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EDITORS' PREFACE

The Archaeological Exploration of Sardis began its work in 1958 as a joint effort of Harvard and Cornell Universities under the general sponsorship of the American Schools of Oriental Research; The Corning Museum of Glass joined in 1960. This is the eighth Monograph and tenth volume that presents the results achieved at Sardis since 1958 during the directorship of George M. A. Hanfmann. Jane C. Waldbaum presents a complete corpus of metal objects and evidence for metalworking ranging in date from the Early Bronze Age to the Ottoman period. In addition to the material excavated between 1958 and 1974 she includes those metal objects from Sardis that have been found by chance and those that were excavated by the Princeton Expedition under Howard Crosby Butler in 1910-1914 and 1921-1922. A chapter of testimonia provides historic and cultural context and the results of extensive analyses provide new information on the development of alloys and working techniques.

We take this opportunity to express our profound gratitude to the government of the Republic of Turkey for the privilege of working at Sardis. The Department of Antiquities and Museums, formerly under the Ministry of Culture, and the Directors General, their officers and representatives, have been unfailing in their help. We owe a special debt of thanks to the successive directors and staff of the Archaeological Museum in Manisa, especially to its present director, Kubilây Nayır. The pieces excavated by the Sardis Expedition are stored in the depots of the expedition camp unless the Manisa Museum accession number is given.

The Sardis Expedition is privileged to have a distinguished scholar and expert on the transition from the

Bronze to the Iron Age undertake this study.¹ Jane C. Waldbaum brings to her task thorough knowledge of the history of metallurgy and ancient Sardis. As author and editor of *Sardis* R1 (1975) she has gained close knowledge of the archaeological contexts of the finds. She worked at Sardis in 1969 and 1974 to prepare this study. A leading proponent of an interdisciplinary approach to archaeology, she has gathered collaborators in the sciences and humanities to complete the metallurgical picture. John G. Pedley expands the sources he presented in *Sardis* M2 (1972). Andrew Oliver, Jr. shares his wide knowledge of ancient jewelry. Reed Knox, Jr., Robert Maddin, Pieter Meyers, James D. Muhly, George Rapp, Jr. and Leon Stodulski have been extremely generous in providing laboratory and instrumentation time and in sharing results. Thanks are due to all and to the Loeb Classical Library Foundation for permission to publish several texts.

In 1968 Andrew Ramage discovered the first archaeological evidence for purifying the gold that made Sardis the seat of legendary wealth. The subject has been touched on here and will be presented *in extenso* in a forthcoming report by Ramage in collaboration with S. M. Goldstein.

The editors join the author in thanks to the many who have assisted in the field and at the Sardis research office at Harvard. That objects found over a sixteen year period could be located, photographed and drawn is due to the careful recording system implemented by Ilse

1. *From Bronze to Iron: The Transition from the Bronze Age to the Iron Age in the Eastern Mediterranean*, SIMA 54 (Göteborg 1978) is the published version of her Harvard dissertation.

Hanfmann. Field conservators, especially L. J. Majewski, A. P. Lins and S. M. Goldstein, have contributed to the examination and understanding of objects as well as to their preservation. Illustrations of the Expedition's finds are first the work of field photographers and draftspeople who have spent long, hot hours under difficult conditions. The majority of photographs were taken and printed for publication by Elizabeth Gombosi and Steve Shippis. The major share of the drawings is work of Elizabeth Wahle, Rosemary Jones and Kathryn Gleason. T. N. Howe prepared the regional map, Plan I. The final versions of the drawings and plans were prepared at Harvard by Kathryn Gleason, Caroline Hemans and T. N. Howe. Our gratitude also goes to the directors or curators who provided photographs of pieces in their care (as listed on p. 218) and to Robert Maddin and Reed Knox, Jr. for excellent photomicrographs.

The presentation of the visual material and final editing and text design is the work of Catharine von Klemperer. Without her care and concern the book could not have been produced. She prepared every aspect of the plates for the printer and edited and proofread the text with the assistance of Katherine Barrett, Elizabeth Dobell, and Conyers Thompson. Previous members of the research staff, notably Debra Hudak and Electra Yorsz, helped in the early stages.

Both the excavation and research programs have been made possible by grants and contributions extending over two decades from the Bollingen Foundation (1959-1965), the Old Dominion Foundation (1966-1968), the Loeb Classical Library Foundation (1965-1970), the Wenner-Gren Foundation for Anthropological Research (1967), the Charles E. Merrill Trust (1973), the Ford Foundation (1968-1972), and the Billy Rose Foundation (from 1970). Donations were received through the American Schools of Oriental Research, and Cornell University contributed university funds from 1957 through 1968. Much of the Harvard contribution came from the group of Supporters of Sardis, established in 1957, which includes both individuals and private foundations. We owe the continuity of our work to their enthusiasm and generosity, and particularly to the advice and support of James R. Cherry, Landon T. Clay, Catherine S. Detweiler, John B. Elliott, Mrs. George C. Keiser, Thomas B. Lemann, Nanette B. Rodney, Norbert Schimmel, Richard Sherwood, and Edwin Weisl, Jr.

The excavation of the sectors which yielded the coin finds was aided by a grant in Turkish currency made by the Department of State to the President and Fellows of Harvard College for the years 1962-1965.²

The National Endowment for the Humanities, through a series of research grants, largely on a matching basis, has played a key role in sustaining the Sardis program.³ This vital help is most gratefully acknowledged. Our special gratitude goes to the friends and foundations who enabled the project to receive the Endowment's support through their matching contributions. In accordance with a request of the Endowment, we state that the findings and conclusions here do not necessarily represent the views of the Endowment.

This is the second volume in the Sardis series to benefit by a grant from the Publication Program, Division of Research Programs, National Endowment for the Humanities.⁴ It is especially gratifying to have this assistance in responsibly presenting the results of an excavation which has been funded in part by the Endowment.

The NEH award was made possible by matching funds from the Billy Rose Foundation and by a contribution from the Foundation of Münzen und Medaillen AG Basel for the Promotion of Numismatic and Archaeological Research. Our deep appreciation for their interest and support goes to the trustees of those foundations, especially James Cherry and Herbert Cahn. The University of Wisconsin at Milwaukee provided funds for research, travel and photography.

Thorough archaeological publication in a time when all relevant costs are skyrocketing would not be possible without the generous support detailed above and the hard work of the authors and illustrators. Through this collaboration we are able to present a study of all the metal objects used and made by the inhabitants of Sardis over five millennia.

George M. A. Hanfmann
Jane Ayer Scott
Harvard University

2. No. SCC 29 543, under the Mutual Educational and Cultural Act, Public Law 87-256, and Agricultural Trade Development and Assistance Act, Public Law 480 as amended.

3. Division of research, grant nos. H67-0-56, H68-0-61, H69-0-23, RO-111-70-3966, RO-4999-71-171, RO-6435-72-264, RO-8359-73-217, RO-10405-74-319, RO-23511-76-541, RO-20047-81-0230.

4. Grant nos. RP-10050-80-0387, RP-20247-81-2162.

AUTHOR'S PREFACE

The metalwork of Sardis is a large and varied corpus of material. It comes from most of the excavated sectors of the site and represents all major phases of occupation from the Early Bronze Age through the Byzantine and Turkish periods. All of the metals and alloys known in antiquity were used: gold, silver, electrum, copper, bronze, brass, iron, steel and lead. Finds of metal objects were made both by the Princeton Expedition of 1910-1914 and 1922 and by the first phase of the Harvard-Cornell sponsored Archaeological Exploration of Sardis working from 1958-1974.

In addition, various aspects of the metal industry, from mining and processing of raw materials, to the striking of coins, to the manufacture of objects for utilitarian and luxurious purposes, are known from ancient sources to have been important in certain periods of Sardis' history. This is especially true of the famed gold of the Lydian era, but also extends to the working of iron in Late Roman times.

This book attempts to provide an account of what was found by the Harvard-Cornell Expedition and to place it in its historical and technological context. It contains first an introductory essay outlining the range of material discovered at Sardis and a history of the metal industry at Sardis. Following this is a chapter giving translations of ancient literary sources and inscriptions referring to the Sardis metal industry and its products. Commentary on these sources in light of present archaeological and technological knowledge is also provided. The central portion of the book is a catalogue of some 962 objects excavated by the Harvard-Cornell Expedition between 1958 and 1974. These objects are arranged by type according to function, and within type categories—so far as possible—by date.

Most objects are illustrated, and parallel material from other excavations and museums is included to help in dating the objects and in relating them to a larger stylistic and cultural framework. This catalogue is followed by a supplementary catalogue containing fifty-four objects found, or allegedly found, at or near Sardis by other researchers and now dispersed in museums in Turkey, Europe and the United States.

A very important part of the book is the final chapter which contains the results of scientific analyses—emission spectrography, neutron activation, atomic absorption and metallography—made on samples of objects of copper alloy, iron, gold and silver. This undertaking represents one of the most extensive series of such analyses done to date on excavated material from a single site. From it we have been able to shed new light on alloying and manufacturing techniques carried out at Sardis over a long period of time.

The cooperation of many colleagues, friends and institutions have contributed to numerous aspects of this book and are herewith gratefully acknowledged.

First and foremost, I owe special thanks to George M. A. Hanfmann, Director of the Archaeological Exploration of Sardis from 1954 to 1976, who first suggested this project to me and who encouraged its completion in every way possible.

Research on the metal objects at Sardis in 1974 was supported by grants from the College of Letters and Science and the Graduate School of the University of Wisconsin-Milwaukee and by the Sardis Expedition Fund, Harvard University. Further research and writing were financed by a National Endowment for the Humanities Summer Stipend in 1975 and by a University of Wisconsin-Milwaukee Graduate School Research

Grant in 1975-76. The University of Wisconsin-Milwaukee contributed to the cost of preparing the final illustrations.

A number of the translations in Chapter II are taken from John G. Pedley, *Sardis* Monograph 2 (1972) and Clive Foss, *Sardis* Monograph 4 (1976). In addition, John Pedley contributed many new translations of sources not included in his monograph. John H. Kroll kindly allowed me to quote his yet unpublished translations of the goldsmiths' inscriptions from the Synagogue, and Louis Robert graciously permitted me to include inscriptions that he will publish more fully in a forthcoming volume in this series. George M. A. Hanfmann called my attention to a number of relevant sources and supplied provisional translations.

Andrew Oliver, Jr. initially suggested a joint publication of the silver objects in the Istanbul Archaeological Museum found by the Princeton Expedition, and provided most of the impetus for their study and analysis. He also photographed the objects and wrote the first draft of the relevant catalogue entries.

A number of scientific colleagues generously gave of their time, expertise and laboratory facilities in order to undertake the analyses in Chapter V. For this, thanks are due to Reed Knox, Jr., Robert Maddin, Pieter Meyers, James D. Muhly, George Rapp, Jr. and Leon Stodulski. Sidney M. Goldstein kindly shared with me the results of neutron activation analysis of gold rubbings done by Adon Gordus for a study of the Lydian gold refinery.

Directors and curators of several museums graciously provided access to their collections, information, photographs and permission to publish objects from Sardis. I would like to thank especially Necati Dolunay and the late Nezih Firath of the Istanbul Archaeological Museum; Kemal Ziya Polatkan of the Manisa Archaeological Museum; Dietrich von Bothmer and Joan Mertens of the Metropolitan Museum of Fine Arts in New York; Timothy Kendall of the Museum of Fine Arts, Boston; Michael Vickers of the Ashmolean Museum, Oxford; Bert Kaeser and Ulrich Gehrig of the Staatliche Museen Preussischer Kulturbesitz, Antikensmuseum, West Berlin, and E. Klengel, Vorderasiatisches Museum, East Berlin. The Fogg Art Museum, Harvard

University granted permission to publish the small collection of the objects donated by Mrs. Frederick M. Godwin.

For information and advice on numerous matters concerning material in this book I am very grateful to John S. Crawford, Paul Craddock, Clive Foss, Crawford H. Greenewalt, Jr., Herbert Hoffmann, John F. X. McKeon, David G. Mitten, John P. Oleson, Andrew and Nancy Ramage, James Russell and Andrew R. Seager.

The staff and facilities of the Sardis Research Office at Harvard University under the supervision of Jane A. Scott, Executive Director, gave invaluable assistance at every stage of preparation of the manuscript and illustrations for publication. Ilse Hanfmann initiated me into the intricacies of the filing system and enlivened many long afternoons of compiling data in the office. Catharine Lee von Klemperer performed the lion's share of editorial work assisted by Leslie Beer, Katherine Barrett, Elizabeth Dobell and F. Conyers Thompson. Debra Hudak and William Mierse participated in earlier stages of work on the manuscript.

Drawings were produced by Elizabeth Wahle, Rosemary Jones, Kathryn L. Gleason, Caroline Hemans and Sandi Clothier. Elizabeth Gombosi and Steve Shippis took most of the photographs in the field. Andrei Lovinescu of the Department of Art History, University of Wisconsin-Milwaukee, rescued a crucial photograph from potential uselessness. John Cullinan, Christine Buth-Furness, Nan Blyth and Lawrence Hoey were patient proofreaders. To all of them I am most heartily thankful.

Finally, a special word of thanks is offered here to the members of the Sardis Expedition team of the summer of 1974, whose cheerful willingness to engage in a running game of "what-in-the-world" at teatime facilitated the identification of some of the more mysterious objects in the catalogue. Without their help the "miscellaneous" category would have been considerably larger.

Jane C. Waldbaum
Milwaukee, Wisconsin
December 1982

Chronological Terminology

Early Bronze Age	ca. 3000-2000? B.C.
Middle Bronze Age	ca. 2000-1400 B.C.
Late Bronze Age	ca. 1400-1100 B.C.
Lydian	ca. 1100?-547 B.C.
Persian	547-334 B.C.
Early Hellenistic	334-213 B.C.
Late Hellenistic	213 B.C.-A.D. 17
Early Imperial	A.D. 17-280
Late Roman	A.D. 280-395(400)
Early Byzantine	A.D. 395(400)-616
"Dark Ages"	A.D. 616-ca. 800
Middle Byzantine	A.D. ca. 800-1204
Late Byzantine	A.D. 1204-1453
Turkish	A.D. ca. 1300-present

An outline of the history of Sardis appears in *Sardis* R1 (1975) 6-7.

Technical Abbreviations

AA	atomic absorption	m.	meters
a.s.l.	above sea level	max.	maximum
C.	centigrade	mg.	milligram
C.	century	mm.	millimeters
ca.	circa	N	north
cm.	centimeters (unless otherwise noted all dimensions are in cm.)	NA	neutron activation
	depth	no.	number
D.	diameter	NoEx (preceding numeral)	not from the excavations
diam.	east	P (preceding numeral)	pottery
E	emission spectrography	P. diam.	preserved diameter
ES	especially	P.H.	preserved height
esp.	estimated	P.L.	preserved length
est.	exterior	Pl.	plate
ext.	figure	P.W.	preserved width
Fig.	gram	publ.	published
g.	gallon	r.	right
gal.	height	ref.	reference
H.	inscription	S	south
IN (preceding numeral)	inches	S (preceding numeral)	stone
in.	inscribed	T (preceding numeral)	terracotta
inscr.	interior	Th.	thickness
int.	jewelry	transl.	translated by
J (preceding numeral)	kilogram	unpubl.	unpublished
kg.	length	W	west
L.	left	W.	width
l.	liter	Wt.	weight
l.	pound	* (preceding numeral)	level (e.g. *98.00)
lb.	metal		
M (preceding numeral)			

MANISA followed by a number indicates the piece is in the Archaeological Museum, Manisa, Turkey. All other finds are stored at the excavation camp (as of 1982).

Sector Abbreviations

For more complete sector information and explanation of grid systems see *Sardis* R1 (1975) 9-16. For plan of Sardis and surrounding region see Plan I; for site plan see Plan II.

<i>Abbreviation</i>	<i>Sector</i>	<i>Number on Plan II</i>	<i>Abbreviation</i>	<i>Sector</i>	<i>Number on Plan II</i>
Ac	Acropolis	20	BS Colonnade	Colonnade S of BS	
AcN	N spur of Ac	20.2	BSH	S apsidal hall of central part of B	
AcS	S spur of Ac	20.3	BT	Bin Tepe Cemetery	
AcT	Top of Ac	20.1	BW	Western area of B	
AhT	Ahlath Tepecik		BWH	Central hall of BW	
AT	Artemis Temple	17	BW Lat	Latrines W of BW	
B	Bath-Gymnasium Complex	1	CG	Roman bath E of City Wall (formerly "City Gate")	28
BCH	Central hall of B		Church E	Church E at PN	11
BE	Eastern area of B		DU	Duman Tepe at BT	
BE-A, BE-B, BE-C,	Rooms S of BE-H and		EB	Eski Balikhane	
BE-D, BE-E	BE-S		ERd	East Road	60
BE-AA, BE-BB, BE-CC,	Rooms N of BE-H and		HoB	House of Bronzes and Lydian Trench area	4
BE-DD, BE-EE	BE-N		KG	Kâgırlık Tepe	19
BE-H	Hall with pool W of MC		L	Building L complex SW of AT (formerly "Lydian Building")	17
BE-N	Room N of MC		LA	Altar of Artemis W of AT	17
BE-S	Room S of MC		LNH	Long hall N of Pa at B	
BNH	N apsidal hall of central part of B		MC	Marble Court at B	
BS E1-19	Byzantine Shops, E shops from E1, S of BE-A, to E19, S of porch of Syn FC	3	MRd	Main Road or Avenue	
BS W1-13	Byzantine Shops, W shops from W1, at SW corner of BE-A, to W13, S of latrines	3	MTE	Middle Terrace E, trench S of HoB	5
			MTW	Middle Terrace W,	

Sector Abbreviations

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<i>Abbreviation</i>	<i>Sector</i>	<i>Number on Plan II</i>	<i>Abbreviation</i>	<i>Sector</i>	<i>Number on Plan II</i>
	trench S of HoB	5	RTW	W part of RT	
Pa	Palaestra E of MC at B		Şeytan Dere	Cemetery E of Pactolus	54
Pa-E, Pa-N, Pa-S, Pa-W	E, N, S, W corridors of Pa		SWG	Southwest Gate	8
PC	Pactolus Cliff	13	Syn	Synagogue	2
PC-LVC	Large Vaulted Chamber at PC		Syn FC	Forecourt of Syn	
PCA	Packed Columns Area E of BS		Syn MH	Main hall of Syn	
PN	Pactolus North	10	Syn P	Porch of Syn	
PyT	Pyramid Tomb	14	Syn 'd'	Corridor S of apse of Syn	
RT	Road Trench		Trench S	Trench S at AT	
RTE	E part of RT		UT	Upper Terrace at HoB	5
RT S Colonnade	Colonnade S of RT (Main Avenue)		West Bldg.	Building W of B	
			WRd	West Road	61

BIBLIOGRAPHY AND ABBREVIATIONS

The following list includes references which are cited more than once and therefore abbreviated in the text. Full references are given in the text for works cited only once.

Abbreviations of periodicals used throughout are those listed in the *American Journal of Archaeology* 82 (1978) 3-10. Abbreviations of classical authors generally follow those set forth in the *Oxford Classical Dictionary*, 2nd rev. ed., ed. N. G. L. Hammond and H. H. Scullard (Oxford 1970) ix-xxii.

The monographs and reports published by the Harvard-Cornell Expedition and referred to here are cited below under *Sardis*. The reports of the Princeton Expedition were published under the general series title of *Sardis*, Publications of the American Society for the Excavation of *Sardis*. Seventeen volumes were planned by H. C. Butler, Director of Excavations (*Sardis* I [1922] viii); of these, nine were actually published and those referred to in this volume are cited here under *Sardis*.

All publications preceding the Princeton Expedition will be found in the prospective *Bibliography of Sardis* (available in mimeographed form from the *Sardis* Expedition, Fogg Art Museum, Harvard University). A preliminary selection appears in G. M. A. Hanfmann, *Letters from Sardis* (Cambridge, Mass. 1972) 346-349. Reports of the current expedition have appeared regularly since 1959 in the *Bulletin of the American Schools of Oriental Research* (*BASOR*) and *Türk Arkeoloji Dergisi* (*Dergi*) of the Turkish Department of Antiquities.

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I INTRODUCTION

Sardis has been renowned as a center for the working of metal since the Lydians first panned gold from the Pactolus River, developed techniques for refining gold and invented the first bimetallic coinage.¹ The ancient sources from Herodotus on tell of her fabulous wealth and enumerate rich objects in gold, silver and bronze manufactured by her craftsmen and deposited in important sanctuaries in honor of the gods.² In later times her iron work was preferred for cutting tools; and the city was a center of an imperial arms factory, turning out weapons and armor for the troops of Rome.³

Earlier Expeditions and Finds

All expeditions to Sardis from the time of the early treasure hunters and explorers to the present generation of scientific archaeologists have hoped to discover some of the lost riches of the Lydian kings.

Looting in the royal tombs at Bin Tepe probably began in the Lydian era and continued through Roman and medieval times to the present, leaving little of value beyond the actual structures of the tombs themselves. Some material, however, remained in lesser tombs.

The Princeton Expedition, working from 1910-1914 under Howard Crosby Butler, and in 1922 under

T. Leslie Shear,⁴ recovered a number of fine vessels in copper alloy and silver, and quantities of gold and silver jewelry from the more than 1,100 Lydian graves opened. The graves and their contents, including metalwork, were published only in summary form;⁵ and most of the objects are not fully described or closely datable. The jewelry and seals, published in a monograph by C. Densmore Curtis,⁶ are more completely discussed and illustrated, although the published photographs lack the sharpness of definition necessary for close analysis of the pieces.

The collections of finds made by the Princeton team have been broken up, and much was lost or destroyed in the turbulent period of World War I and the early 1920s.⁷ Of the preserved metalwork, all of the jewelry, some bronzes and about half the silver objects from the tombs are in the Istanbul Archaeological Museum (963-971).⁸ Several objects are in the Metropolitan Museum of Art in New York, including one silver and several copper alloy vessels apparently from

4. *Sardis* R1 (1975) 2-3.

5. *Sardis* I (1922) 78-86 (season of 1911); 115-122 (1912); 140-144 (1913); 154-156 (1914). Most of the graves had been at least partially robbed and only some 70 of 1,104 graves contained any objects (*Sardis* R1 [1975] 2).

6. *Sardis* XIII (1925).

7. *Sardis* I (1922) ix, x; *Sardis* XIII (1925) 9. According to Butler (*Sardis* I [1922] x) a collection of bronze mirrors was lost in the wars. At least one decorated mirror is now in Istanbul (Oliver, "Bronze Mirror," 113-120) and another, plain one is in the Ashmolean (see 991).

8. See Chap. IV and Oliver, "Bronze Mirror," 113-120.

1. Hanfmann-Waldbaum, 310-315.

2. See Chap. II and *Sardis* M2 (1972) passim.

3. Broughton, 826 (iron cutting tools); *Sardis* M4 (1976) 7, 14-15, 106 (arms factory).

tombs; a number of copper alloy and iron arrowheads of various types and dates; and a fragment of a copper alloy statue (972-988). A few pieces are in the Ashmolean Museum, Oxford, including one of a set of four tiny gold lions (989) the rest of which are in Istanbul,⁹ and some small bronzes (990-992). A miscellaneous collection of small bronzes was given to the Fogg Art Museum of Harvard University by Mrs. Frederick M. Godwin, widow of a member of the Princeton team (1001-1016).

In addition to these excavated finds, a number of chance finds made prior to the Princeton Expedition and allegedly from Sardis or the Sardis region have turned up in scattered museums and collections. At least one object, a brass steelyard acquired in the late nineteenth century, is in the British Museum (993).¹⁰ Some gold jewelry in Achaemenid style is in Berlin (994-996).¹¹ The whereabouts of three small gold pendants allegedly found in a tomb near Sardis in 1899, and of a gold diadem purportedly found in a sarcophagus at Sardis and seen in the antiquities market in Smyrna in 1917 are not known,¹² and their Sardinian provenance remains open to question.¹³

The Harvard-Cornell Expedition

The metalwork recovered by the Princeton Expedition and earlier explorers came primarily from tombs and is rather limited in character and date. The recent excavations have been more extensive both in areas dug and in range of materials recovered.

In the course of excavations from 1958 to 1974 the Harvard-Cornell Expedition has turned up more than one thousand metal objects of iron, copper and its alloys bronze and brass, gold, silver and lead. This material covers all major periods of Sardis' occupation: Bronze Age, Lydian, Persian, Hellenistic, Roman, Byzantine and Turkish, with the bulk of it coming from Lydo-Persian and Late Roman-Early Byzantine phases. Many kinds of metal objects are represented. They include domestic utensils and agricultural implements; carpenters' and masons' tools, nails and clamps; weapons

and armor from the many battles in the history of Sardis; shopkeepers' weights and balances and their stock-in-trade—hardware, locks and keys, pots and pans; jewelry, mirrors and cosmetic implements from the boudoirs of the ladies of Sardis; liturgical equipment of the local Christian clerics, and odds and ends of assorted types from all periods. In addition, a number of finds in other materials such as stone molds and clay tuyères attest to the manufacture of metal objects in certain periods.

Chronological and Geographical Distribution of Finds

Sardis is not a compact or conveniently stratified site like a *tell*, and many sectors are disrupted by erosion and earthquake or are thickly covered by alluvium brought down by flooded *wadis* from the Tmolus and the Acropolis.¹⁴ Consequently, there is much disturbance in the sequence of finds. Distribution of object types and materials is also strongly affected by the nature of the sectors from which metal objects have been excavated. For example, excavation concentrating mostly on the freeing of major architectural monuments (B-Complex, Synagogue, Bath CG, Artemis Temple, etc.) yielded such objects as nails, clamps, tacks and other articles related to construction; while domestic or commercial sectors (House of Bronzes, Pactolus North, Byzantine Shops and to some extent the Acropolis), which were usually better stratified, generally produced objects exhibiting a wider range of functions.

Owing to these limitations and discrepancies in the nature of the evidence, any attempt at statistical analysis of materials or of object types by date would be misleading. Taken as a whole, however, the Sardis metalwork is highly diversified and provides an interesting overall picture of metalworking at Sardis throughout history.

Third millennium B.C. (Early Bronze Age) material comes primarily from graves at the sites of Ahlatlı Tepecik and Eski Balikhane on the Gygean Lake (Plan I),¹⁵ and provides evidence for the use at that time of copper, silver and gold, the latter probably from local sources (I-3, 717, 718, 881). Middle and Late Bronze Age metal finds are exceedingly rare, but some Early Iron Age implements of iron and copper alloy have been found in deep levels of the Lydian Trench at the HoB sector (118, 127, 172).¹⁶ Lydian and Lydo-Persian material comes from higher levels of the Lydian

9. Ashmolean 1928.323, *Sardis* XIII (1925) 34, pl. VIII no. 86; *Sardis* R1 (1975) 3.

10. Walters, *Bronzes*, 359 no. 2991.

11. Luschej, 760-772, esp. 770, fig. 5; Otto, 9-22, esp. 11, fig. 1.

12. Collignon, 188-191; Walter, "Antikenbericht," cols. 223-260, esp. col. 251 no. 9, fig. 140.

13. Oblique reference is made to a treasure of Early Hellenistic jewelry allegedly from Sardis and now in the Schmuck-museum, Pforzheim (Hoffmann-Davidson, 2, 64, 123, 162). The treasure, of 4th C. B.C. gold, is published in Segall, *passim*, but no provenance for the hoard is given in the text. According to Hoffmann (personal communication, 1979) information on the provenance came from the dealer and is therefore not totally reliable.

14. See *Sardis* R1 (1975) 25-26.

15. *BASOR* 191, 7-9; 199, 12-16; Mitten-Yüğürüm, "Ahlatlı Tepecik," 22-29; idem, "Gygean Lake," 191-195.

16. *BASOR* 186, 31-37; 170, 6-9; 162, 14-16; *Nestor* (Jan. 1, 1967) 473.

Trench as well as from stratified deposits at PN on the banks of the river. A few Lydian tombs in the Bin Tepe cemetery and elsewhere were explored by the present expedition, but all had been robbed and yielded only a few objects of interest.¹⁷

Because of the lack of detailed stratification for the Hellenistic and Roman Imperial eras, surprisingly few metal objects attributable to these periods have been found.¹⁸ Nevertheless, some objects of these dates have been identified on stylistic grounds. These come chiefly from mixed deposits in HoB, Middle and Upper Terraces, the Building B-Gymnasium area, Pactolus Cliff, and the Artemis Precinct including Trench S, Building L and the Kâgirlik Tepe Cemetery.¹⁹ A few Roman graves containing some metal objects have also been found near HoB.

The Late Roman-Early Byzantine period is well represented by the wealth of material coming primarily from the Byzantine Shops and the House of Bronzes proper—the house of a rich cleric, possibly the Bishop of Sardis.²⁰ The shops and the House of Bronzes were both destroyed in the Sassanian Persian attack of A.D. 616,²¹ and not reused, leaving many of their contents intact in well-dated contexts (Plans III and IV).

The shops contained an interesting combination of the merchants' own equipment and merchandise:²² steelyards, balances and weights for weighing goods; iron farm and carpentry tools and utensils; copper and copper alloy vessels of all descriptions; and large numbers of locks and keys. The shops and the House of Bronzes both contained quantities of Christian liturgical equipment: incense burners, lamp holders, crosses, an incense shovel and the like (577-609).

The Early through Late Byzantine phases at other sectors at Sardis are not so well-defined. Metal objects that can be dated stylistically to the Byzantine era are known from the Acropolis, Road Trench, PN, PC, the Artemis Precinct and Bath CG as well as from several Byzantine graves on the Acropolis and at PN.

17. E.g. *BASOR* 186, 38-52; 166, 27; Greenewalt, "Lydian Graves," 113-145.

18. See *Sardis* R1 (1975) 5.

19. See *ibid.*, 13-16 "Sector Index" for references to these areas, and Chaps. IV-VIII for excavations and soundings in the Artemis Temple and Precinct.

20. See *Sardis* M4 (1976) 43-44; Hansen, 173.

21. For date of destruction see *Sardis* M1 (1971) 1-2; *Sardis* M4 (1976) 53-55; Foss, "Fall of Sardis," 11-22; *idem.*, "The Persians in Asia Minor and the End of Antiquity," *EHR* 90 (1975) 721-747, esp. 736-738. For comment on the numismatic evidence see *Sardis* M7 (1981) 208-209.

22. See J. S. Crawford, forthcoming report on the BS.

Turkish objects, for the most part, are not well stratified, although they are found occasionally in the upper layers of fill in the major sectors, especially the Acropolis, Building B-Gymnasium Complex and HoB. An exception is PN where an area west of the destroyed apse of Church E at levels ca. *91.00-90.00 represents a Turkish village occupation of the Selçuk (fourteenth through sixteenth centuries) and Ottoman (seventeenth through nineteenth centuries) eras.²³ Here, a few stratified metal objects were associated with a possible workshop (162, 167).

THE SARDIS METAL INDUSTRY IN HISTORY

Mineral Resources and Mining

The major metals used in ancient Sardis were copper, iron, gold, silver, lead, tin and zinc—the latter two employed primarily as alloying constituents with copper. Some of these metals were available in the vicinity of Sardis; others must have been imported.

Gold

Gold was the most famous of Sardis' mineral resources in Lydian times. Ancient authors tell us that the chief source was the alluvial gold washed down from Mt. Tmolus by the Pactolus River that flowed through the city of Sardis.²⁴ Gold was also undoubtedly mined directly on Mt. Tmolus, as well as at other deposits within one or two days' journey of Sardis.

According to Strabo (13.1.23; 13.4.5), native gold had been exploited at least from the time of Gyges in the seventh century B.C. through the time of Croesus in the mid-sixth. But by Strabo's own time, towards the end of the first century B.C., the gold in the Pactolus had apparently been exhausted. Although the Sardinian gold industry in the Lydian era is thus documented, it is not known exactly how long the gold supply lasted.

It has been suggested that the Pactolus gold was worked as early as the third millennium B.C. and that its products were traded as far afield as southern Mesopotamia.²⁵ A few gold objects have indeed been found in

23. *Sardis* M4 (1976) 91-92, 97.

24. See Chap. II, Sources 3-16.

25. F. E. Whitmore and W. J. Young, "Application of the Laser Microprobe and Electron Microprobe in the Analysis of Platinumiridium Inclusions in Gold," in Boston Museum of Fine Arts Research Laboratory, *Application of Science in Examination of Works of Art, Proceedings of the Seminar: June 15-19, 1970* (Boston 1973) 88-95; W. J. Young, "The Fabulous Gold of the Pactolus Valley," *BMFA* 70 (1972) 5-13. Young, noting platinumiridium inclusions in Lydian gold

the Early Bronze Age graves on the Gygean Lake (717, 718)²⁶ but it has not yet been determined whether the gold used was local, although it seems most likely.²⁷ The question of trade in Pactolus gold at such an early date is highly complex and must remain unresolved for the present.

After the conquest by Cyrus in 547 B.C. Sardis became a tributary of the Persian Empire. A Persian source of the fifth century B.C. reports that Sardin gold was among the tribute brought to the capital at Susa where it was worked by Median and Egyptian craftsmen.²⁸ This tribute implies that Lydian gold sources were still productive at least through the end of the sixth century B.C. and possibly into the fifth—an inference supported by the story of Pythius, a wealthy Lydian who owned his own gold mines at the time of Xerxes in the

coins, an Achaemenid earring and in several gold objects from the Royal Cemetery at Ur, concluded that Pactolus gold was the most likely source for all objects examined. He based his judgment on the presumed rarity of such inclusions in natural gold ores, and on the fact that Lydian gold was imported in Achaemenid Persia (see Chap. II, Source 36). In 1975 S. M. Goldstein of the Sardis Expedition examined all the gold objects and gold industrial samples from Sardis for platinumiridium inclusions and found that none of the Lydian gold samples from the gold refining area contained these inclusions. On the other hand, a Lydian earring (see 719) did contain them. If, as seems likely, the industrial material derives from local Pactolus gold, it would seem that not all local gold contained platinumiridium inclusions (see *BASOR* 228, 54). K. R. Maxwell-Hyslop, "Sources of Sumerian Gold: The Ur Goldwork from the Brotherton Library, University of Leeds. A Preliminary Report," *Iraq* 39 (1977) 84-85, and J. D. Muhly, review of Branigan, *Aegean Metalwork*, in *Materials Science and Engineering* 19 (1975) 159, posit other occurrences of platinumiridium in gold deposits nearer to Sumer that might have been more likely sources for the Ur gold. Indeed, D. Meeks and M. S. Tite recently have shown that platinumiridium inclusions are not commonly found in ancient gold objects, including Lydian coins, although inclusions of related platinum group elements occur fairly frequently. They conclude that the presence of these inclusions shows only that the gold in question originated from placer deposits, and cannot be used to identify the exact source. See D. Meeks and M. S. Tite, "The Analysis of Platinum-group Element Inclusions in Gold Antiquities," *JAS* 7 (1980) 267-275. Pászthory, "Electrum Coins," 156 also failed to distinguish platinumiridium inclusions in the Lydian coins he investigated. (It should be noted also that the Achaemenids received gold from Bactria as well as Lydia; see Chap. II, Source 36.) The whole issue of the origin of the gold used at Ur in Achaemenid Persia seems quite a bit more complicated than Young and Whitmore allege.

26. See above, n. 15.

27. Neutron activation analyses show a silver content of ca. 6-15 percent in the Early Bronze Age earplugs (see 717-718 and Chap. V). The relatively high silver content is in keeping with findings for gold from later contexts at Sardis, though is not in itself conclusive (see Chap. V and Hanfmann-Waldbaum, 313-314). S. M. Goldstein, (personal communication, 1978) found no platinumiridium inclusions in the earplugs when he examined them under the binocular microscope in 1975.

28. See Chap. II, Source 36; Kent, 144 = *Sardis* M2 (1972) no. 303.

early fifth century B.C.²⁹ Hellenistic inscriptions from Sardis testify to rather lavish use of gold to ornament bronze portrait statues, a practice which G. M. A. Hanfmann suggests may indicate the continued local production of gold (see Chap. II, Source 54).

Modern exploration has proved the presence both of gold and of ancient mining activity near Sardis. M. Collignon reported a possible mine and ancient workings discovered near the Pactolus by the engineers Catalanos and Axiotakis of Smyrna. The find consisted of a vein of quartz with traces of a water conduit nearby, the latter interpreted as part of an installation for washing minerals.³⁰ The exact location and date of the installation are not stated in Collignon's report and have not been established by the present expedition. In a recent article, however, Clive Foss suggests that the workings found by Catalanos and Axiotakis should be equated with traces of mines discovered by Clarence Wendell in 1967 about 3 km. south-southwest of Sardis. These workings are on a ridge above a site identified by Foss as ancient Metallon ("The Mine") on the Pactolus.³¹

H. C. Butler, director of the Princeton team, claimed to have collected a number of small bits of gold in pits dug in the Pactolus bed, although he presented neither detailed description nor scientific evaluation of these findings.³² In a later article, T. L. Shear refers to Butler's report but implies that it lacks value as evidence for the continued presence of gold in the river.³³

In explorations conducted more recently under the auspices of the Maden Tetkik ve Arama Enstitüsü (MTAE), S. Birgi and M. Saydamer found traces of gold in the alluvia flowing into the Hermus valley between Turgutlu and Salihli.³⁴ Quantities of gold apparently do not warrant modern exploitation but they

29. See Chap. II, Sources 33 and 34; Herodotus 7.27-29; Plutarch, *Moralia* 262e-263a.

30. M. Collignon in "Séance du 6 Février, 1903," *CRAI* (1903) 73-74. Dominian, 584, also refers to ancient workings "on the slopes of Mount Tmolus" and on Mount Sipylus, although he does not locate them specifically.

31. Foss, "Explorations," 37-39. The name of Metallon as a place where the Pactolus yielded its riches is found in Nonnos, *Dionysiaka* 13.472, 5th C. A.D. (see Chap. II, Source 14). Reconnaissance in 1980 failed to find any surface trace of the remains described by Wendell.

32. *Sardis* I (1922) 16 n. 1.

33. See T. L. Shear, "The Gold Sands of the Pactolus," *CW* 17 (April 28, 1924) 188.

34. S. Birgi, "Occurrence of Gold in the Sardis (Salihli) Region," MTAE Report no. 1521 (Ankara 1944) and M. Saydamer, "Report on the Prospecting of Gold in the Alluvia Between Turgutlu and Salihli, with a Detailed Study of Gold in the Area Around Sart Çay," MTAE (Ankara 1963), both unpubl. and both in Turkish. See also Pamir-Erentöz, 98-99.

do confirm the numerous ancient references to the sources of Sardinian wealth.

Silver

The Lydians were noted for wealth in silver as well as gold, and indeed the Pactolus gold was actually a natural electrum (argentiferous gold) with silver content ranging from ca. 17 to 24 percent.³⁵ Silver could be extracted from the gold by the process of cementation or chlorination, some evidence for which has been found in the workshops on the Pactolus bank.³⁶ Silver is also to be found at the hot springs of Sart Çamur Hamamları just south of Sardis, and in the vicinity of Kemalpaşa and Kurudere, where possible ancient workings of the lead-silver ore galena have been noted.³⁷ Argentiferous lead is noted also in the Salihli district, and to the north at the Balya lead mine, which is said to have been operated since antiquity.³⁸

Iron

While major sources of iron are not found in the immediate neighborhood of Sardis, several rich deposits are within a few days' journey. Among the richest in ore potential today are the Çamdağ deposit in the Marmara region near Izmit; the Çavdar-Koslari deposits in Söke (magnetite and hematite); the Ayazmant deposits north of Izmir and 20-25 km. east of Ayvalık where magnetite ore is found in association with copper ores (chalcopyrite, covellite, malachite and azurite); the Sakarkaya deposit in Milas south of Aydın (magnetite, hematite, pyrite and pyrrhotite); the Hortuna deposit east of Izmit, 8 km. northwest of Torbalı (hematite and limonite); and the Egmir deposits 30 km. northeast of Edremit (hematite and limonite).³⁹ Ancient sources,

35. Hanfmann-Waldbaum, 314, and S. M. Goldstein, unpubl. report, 1969.

36. Hanfmann-Waldbaum, 311-313.

37. *Sardis* R1 (1975) 21; W. Gentner, et al. "Silver Sources of Archaic Greek Coinage," *Die Naturwissenschaften* 65 (1978) 276, fig. 4, Table 1 nos. TG 9, 10.

38. Pamir-Erentöz, 101; Ryan, 7, 66; Ravndal, 128, 149; de Jesus, "Metal Resources," 100 n. 12; idem, "The Metallurgy of Early Bronze Age Troy and its Relationship with Greater Anatolia," in *Troy: History and Contacts* Proceedings of the 4th International Colloquium on Aegean Prehistory, Sheffield, Eng. 1977, forthcoming.

39. Ravndal, 141, 142; A. Gümüş, "Iron Ore Deposits of Turkey," in *Symposium on Iron Ore Held in Ispahan, Iran Oct. 2-5, 1963*, (CENTO n.d.) 64, 66, 69-70, 72, 75-76 and maps; Ryan, 81-83, 86; Pamir-Erentöz, 100 and map; C. Nishiwaki, "Iron Ore Deposits of the Middle East, Asia and the Far East," in United Nations Panel of Experts on World Iron Ore Resources, *Survey of World Iron Ore Resources: Occurrence and Appraisal* (New York 1970) 104-108.

however, do not say whether the Lydians and their successors exploited any of these iron ore deposits.⁴⁰ The fame of the Sardinian iron industry in Roman times, and particularly of the imperial arms factory or *fabrica*, probably implies an abundant local source of iron.

Copper

Copper occurs in greatest abundance in eastern Turkey and Cyprus, where it has been extensively mined and exported since the Bronze Age. Sources of copper in the nearer vicinity of Sardis are not common, though some are reported in the Tmolus range,⁴¹ and Ryan notes "insignificant deposits" in Akşehir and Turgutlu counties near Manisa.⁴² Copper ores are also found in association with iron ores at some locations—specifically the Ayazmant deposits north of Izmir. Ravndal mentions deposits with evidence of ancient (undated) workings at Kilisse-Alan 45 km. southwest of Biga, and mines at Asarlı and Bulbul-Dereh in the Izmir (Smyrna) region.⁴³ As with iron, there is no specific documentary evidence for ancient exploitation of copper.⁴⁴

Tin, Lead, Zinc

To date, no reliable source of tin has been found in Turkey. Known ancient sources of tin include areas as

40. See Greenewalt, *Ritual Dimers*, 18 n. 21; and Lucian, *Charon* 11-12 (Chap. II, Source 58) who has Croesus say that Lydia is poor in iron. It has been suggested that magnetite iron ore was to be found at Magnesia ad Sypylum (modern Manisa) (C. Foss in *Sardis* R1 [1975] 21, 171 n. 19 citing *RE* s.v. "magnet"). The relevant passage is Pliny, *N.H.* 36.128: "Sotacus describes five kinds of magnet . . . a fifth from Magnesia in Asia Minor . . . the most worthless kind is that of Magnesia which is white, has no power of attracting iron and resembles pumice." D. E. Eichholz, editor and translator of Pliny *N.H.* in the Loeb Classical Library edition from which the above passage was taken, says "Possibly not all the five varieties were magnetite. The last stone . . . from Magnesia in Asia Minor, was probably the variety of talc which is called μαγνητικός λίθος by Theophrastus (*de Lap.* 41). However, magnetite is found today at Manisa, the ancient Magnesia, 25 miles E.N.E. of Smyrna." (Pliny, *N.H.* vol. X [1962] 103, n. 'd'). Eichholz does not document this source and it is not noted in recent geological literature; there is, in any case, no concrete evidence that iron ore was mined here in antiquity.

41. Alfred Philippon, *Reisen und Forschungen im westlichen Kleinasien II Ionien und das westliche Lydien* Dr. A. Petermanns Mitteilungen aus Justus Perthes' Geographischer Anstalt, Ergänzungsheft nr. 172 (Gotha 1911) 68. A copper deposit appears on the Izmir sheet of the Geological Map of Turkey in the mountains west of Ödemiş, but is not discussed in Pamir-Erentöz.

42. Ryan, 30.

43. Ravndal, 140-141, and see Ryan, 30.

44. See de Jesus, "Metal Resources," 97. de Jesus, noting general lack of chronological data, advises the necessity of caution in assuming ancient exploitation of most Anatolian mineral sources.

far afield as Spain, Cornwall, Bohemia, northern Italy and an unspecified region to the east of Mesopotamia, whence it had to be imported for the production of bronze.⁴⁵ Some deposits in Turkey are occasionally mentioned in the literature,⁴⁶ but the reports seem largely unsubstantiated.

Lead occurs in association with silver in the ore galena which is extracted along with zinc in the Balya mine in the Balıkesir region. This mine is said to have been worked since antiquity and to have continued in operation intermittently until 1938.⁴⁷ Several other locations, also containing silver and zinc, appear on Ravndal's map in the district from Balıkesir to the coast.⁴⁸ In addition, Ryan notes similar deposits in the Salihli and Alaşehir regions,⁴⁹ as well as near Lüb-bayayla in the Tmolus range south of Sardis (Plan I).⁵⁰

Ryan mentions zinc in association with lead in the Manisa district near Subeşir, Mentişe, Kobaklar and Türkali, as well as in several locations near İzmir.⁵¹

According to Strabo (13.1.56) a mineral called "mock-silver," usually believed to be zinc, was found in the Troad at Andeira, and on Mt. Tmolus. His description of the process used to extract "mock-silver" is problematic and has caused some modern scholars to doubt the identification with zinc.⁵²

Evidence for Metalworking at Sardis

Literary and archaeological evidence confirms that local metallurgical and manufacturing activities often took place at Sardis. Most of the major metals—gold, silver, copper, iron—were involved in these efforts, although at different times some materials were more important than others.

Gold and Silver

The production of gold and silver luxury objects and coins was, of course, a major industry in ancient Lydian Sardis.

Literary sources from Herodotus on speak of the wealth of dedications in gold and silver lavished upon the sanctuaries of Delphi, Ephesus, Boeotian Thebes and elsewhere by the Lydian kings Gyges, Alyattes and Croesus.⁵³ Among the items so dedicated was a statue of a lion resting on a base of 117 gold bricks. The lion and four of the bricks were of "refined" gold (δραφθος, literally "cooked"); the rest of the bricks were of electrum or "white" gold.⁵⁴ Also among the dedications were a life-size gold statue of a woman, a great variety of gold and silver vessels—some of immense size—and jewelry.⁵⁵ While it is assumed that most of these items were made in Sardis of local materials and by local Lydian craftsmen, some of the more spectacular objects were produced by foreigners, especially Eastern Greeks. A silver bowl on a welded iron stand, dedicated by Alyattes at Delphi, was the work of Glaukos of Chios; and a silver crater, dedicated by Croesus at Delphi, was reputedly made by Theodoros of Samos, one of the most famous metalworkers and sculptors of his time.⁵⁶

Little direct evidence for this richness has been found by the current Sardis Expedition, although the Princeton Expedition discovered a number of small silver vessels and a considerable quantity of gold and silver jewelry in Lydian tombs.⁵⁷ The successive plundering of the Lydian capital from the Persian sack in the late sixth century B.C. to the campaigns of Tamerlane in the early fifteenth century A.D. certainly explains the lack of precious metal outside of tombs.⁵⁸

Despite the dearth of luxurious objects, evidence for processing of gold and silver at Sardis is not lacking. A

54. *Sardis* R2 (1978) 14, 30. See Elderkin, 1-8 for suggested reconstruction of the gold lion monument. Healy, 201, makes a distinction between "white gold," which he views as a natural alloy of gold and silver, and "electrum," an artificial alloy.

55. P. Amandry, "Statue de taureau en argent," *BCH-Suppl. 4 Études delphiques* (1977) 291, has suggested that an archaic, nearly life-size sphryrelaton statue of a bull in silver, found at Delphi in 1939, was one of the gifts of Croesus in precious metal that somehow escaped both plundering and mention in the ancient literature. In the same hoard were remains of several chryselephantine statues, including two nearly life-size—a male and a female—with much of their decorative gold plating preserved. Because of the lavish use of gold and East Greek elements of style in these statues, it has been suggested that these too are Lydian offerings and that the figures may even represent Croesus himself and other members of his family, although Apollo and Artemis are more likely identifications for the two largest figures. See K. Koubetos, "The Gold and Ivory Treasure of Delphi," *Tachydromos* 26 (29 June 1978) 41 and 36-41 for illustrations.

56. *Sardis* M2 (1972) nos. 62, 99; *Sardis* R2 (1978) 29, 30. For other works in metal by Theodoros of Samos see Pausanias 8.14.8; 10.38.6; Pliny, *N.H.* 34.83.

57. See above ns. 5, 6.

58. *Sardis* M2 (1972) no. 140 (Persian sack, 547 B.C.); *Sardis* M4 (1976) 129 no. 36 and see App. 2, pp. 137-139 (Tamerlane).

45. See Muhly, Chaps. IV, V; J. C. Waldbaum, *From Bronze to Iron: The Transition from the Bronze Age to the Iron Age in the Eastern Mediterranean SIMA* 54 (Göteborg 1978) Chap. 5.

46. See e.g. Muhly, 257; Ryan, 62-63.

47. Pamir-Erentöz, 101; Ravndal, 149, 151; Ryan, 5.

48. Ravndal, fig. 8, map opposite p. 128 and text, p. 151; see also Ryan, 6.

49. Ryan, 7. See also above n. 37.

50. Ryan, 8, and see Foss, "Explorations," 39.

51. Ryan, 7-8.

52. Chap. II, Source 68. See also Forbes, VIII, 275-276; Michell, 21-22; Caley, 18-19; Eaton-McKerrell, 187-188; and below Chap. III, n. 4.

53. Chap. II, Sources 20-30; *Sardis* M2 (1972) nos. 41, 62, 97-100.

workshop area has been uncovered on the banks of the Pactolus at the PN sector, testifying to the existence of the Lydian gold industry.⁵⁹ According to the excavator, A. Ramage, the activities of the workshop area span more than half a century from ca. 620 B.C. to the time of Croesus, ca. 550 B.C. Scientific investigation suggests that at least two different operations were taking place: (1) the purification of electrum from its mineral impurities by means of cupellation and (2) the parting of gold and silver from the refined electrum by the process of cementation.

Associated with cupellation were two to three hundred small, hemispherical depressions or "cupels" in the ground. These were lined with clay, showed traces of burning and slag, and often contained pieces of oxidized lead and tiny gold globules and dribbles. Fragments of thin gold foil, some dark and some light in color, and several furnaces have been linked with the cementation process.⁶⁰

Further signs of metallurgical activity at PN included dump areas containing quantities of lead oxide (litharge), fragments of clay tuyères (bellows nozzles), an iron blow pipe and many sherds with gold globules and lead slag adhering to them.

Herodotus' reference to "refined" or "cooked" gold as distinct from "white" gold or gold-silver alloy in respect to the lion on its gold brick base at Delphi (Hdt. I.50) may well refer to gold that had been cemented, and the institution of the first bimetallic coinage under Croesus (Hdt. I.94) may also stem from the Lydians' ability to separate the two metals.⁶¹

59. BASOR 199, 18-25, 26-28; 228, 57, figs. 10, 11; Hanfmann-Waldbaum, 310-313. Complete study of the gold refinery operations and technology will be published in a forthcoming monograph by S. M. Goldstein.

60. Hanfmann-Waldbaum, 311-313; cupellation process: Tylecote, 79-80; Forbes, VIII, 172-173. For cupellation in ancient and modern Persia see Wulff, 13-14. Cementation or chlorination process: Tylecote, 3, 82; Forbes, VII, 175-176; Healy, 154-155; idem, "Greek Refining Techniques and the Composition of Gold-Silver Alloys," *RBN* 120 (1974) 25-28, and see Diodorus Siculus 3.14.1-4 for ancient description of the process.

61. Hanfmann-Waldbaum, 313, 315. See Sture Bolin, *State and Currency in the Roman Empire to 300 A.D.* (Stockholm 1958) 23-37, Table 2, p. 24 for possible dilution of pre-Croesian Lydian coins by deliberate addition of silver. In any case, the amount of silver shown in the coins in Bolin's table (ca. 45-69 percent) is considerably greater than that found in the natural Pactolus electrum (ca. 17-24 percent) implying some deliberate alloying. More recent analysis of coins from the time of Alyattes has also shown high silver contents, see Pászthory, "Electrum Coins," 151-156. Of three coins examined two were approximately 50 percent gold and 50 percent silver; the third was an ancient counterfeit having a silver core covered with a thin sheet of electrum. Pászthory, unlike Bolin, assumes the 50:50 electrum alloy is natural. The ancient counterfeit, however, shows that at least some

evidence for production of actual gold or silver objects was less dramatic, consisting primarily of a number of small stone jewelry molds and an intaglio die for raising decorative relief patterns in gold foil. The die (948) is made of copper alloy and comes from a sixth century B.C. context at HoB. The design on the surface can be closely paralleled on a small, gold foil, relief plaque from the archaic Artemision at Ephesus,⁶² perhaps a tiny remnant of the wealthy gifts once dedicated there by Croesus. One of the jewelry molds (949) comes from a Lydian level at PN and was apparently used to cast an assortment of small earrings and pins. Four similar molds from HoB (950-953) are possibly Lydian, although the contexts in which they were found are less clearly datable.

From much later come fragments of a crucible containing a slaggy crust with dribbles of gold on the interior (958). The crucible was found in the Byzantine Shops and was possibly used to obtain small amounts of gold for making jewelry or gilding small objects. A few copper alloy objects of various dates had been gilded on their surfaces, among them 916, a statuary horse's ear, perhaps Hellenistic or Roman in date, and 685, an Early Byzantine brooch. Gilded bronze statues of archaic date are known from literary sources, and the practice of gilding marble sculpture and architectural ornament was common for a long time.⁶³

Copper Alloys

Copper alloys containing varying amounts of tin, lead and zinc were produced in quantity in all periods at Sardis as the abundance of catalogued objects, probably in local style, will demonstrate. Some of the earliest pieces contain small amounts of arsenic, possibly as a deliberate addition.⁶⁴

Because copper alloys can be worked and cast into complex shapes, they were used for a wide variety of objects ranging from the most mundane and utilitarian

experiments in cheating were taking place in the royal mint. The beginning of the Sardinian refinery in the late 7th C. B.C. corresponds well with the date assigned to the coins in question. Bolin's suggestion (p. 32) that addition of silver goes back to the earliest coinage and that the state stood to gain about 30 percent in value on an exchange of state-minted coins for ingots of natural electrum raises the possibility that the incentive for the introduction of coinage arose from the institution of the refinery. It is interesting to note in this regard that Pollux, *Onomasticon* 7.98, refers to Gygean gold as ἀρεθός (refined). See Chap. II, Source 23.

62. Hogarth, *Ephesus*, 113, pl. X no. 4.

63. See Chap. II, Sources 44-46, 54, 57. See also *Sardis* R2 (1978) 9, 112 no. 128.

64. See 656, 657 and Chap. V, Table V.3 for analyses.

to fine liturgical utensils and jewelry. Copper alloys were also, presumably, the preferred metals for sculpture in most periods, although direct evidence for this is provided mainly by small figurines or objects with animal or human figurative decoration and not by the remains of monumental works of art in metal. An ancient source mentions gilded bronze statues of Apollo, Artemis and Herakles by Dipoinis and Skyllis which were taken by Ardashir (Cyrus). The original location of these statues is not known and the sculptors were Cretan Greeks rather than native Lydians.⁶⁵ A small bronze statue of a girl carrying water, made in Athens and dedicated there by Themistocles before 480 B.C., was carried off by the Persians in 480, and seen in the Sanctuary of the Mother at Sardis by Themistocles himself sometime between 468 and 465 B.C.⁶⁶ A bronze portrait statue of a Lydian named Adrastus belonged to the Early Hellenistic period.⁶⁷ Another was erected to Heliodoros, son of Diodoros; and a third with a gold wreath was made in honor of an unnamed ambassador to Zeuxis. In the Late Hellenistic period, before 50 B.C., a prominent citizen, Iollas, was honored with three gilded and four other bronze portrait statues. Under Augustus a bronze portrait statue of an official named Menogenes was decreed, and a base with the name of a bronze sculptor can be dated to the second century A.D.⁶⁸

While these sources testify to the presence of monumental bronze statuary at Sardis from at least the sixth century B.C. through the second century A.D., the only remains of this art are fragments of toes from a human foot found by the Princeton Expedition and now in the Metropolitan Museum of Art (972), and the gilded horse ear mentioned above (916). Manufacture of small scale figurative bronze work at Sardis is evidenced by an unfinished decorative relief plaque—probably a horse trapping—of an ibex with attachment loops at the back (87). The piece has affinities with Scythian and Persian style and probably belongs somewhere in the sixth century B.C.

An area of industrial debris east of Building C in a Hellenistic level of HoB may also relate to bronze production. According to an unpublished report by the

late G. F. Swift, Jr. (1970), the industrial deposits here extended over an area ca. 8-10 m. in diameter and were ca. 50 cm. thick. They contained fragments of the clay floor of a furnace, pieces of clay molds, earth discolored by heat, fragments of charcoal and corroded copper and/or bronze, slag pieces and quantities of animal bone (possibly to make bone ash for flux), all of which may suggest the presence of a bronze foundry. The full significance of this area and associated finds has not yet been studied, nor has the exact type of industrial activity carried on there been determined.⁶⁹

Objects of copper and copper alloy were undoubtedly manufactured in or near the Byzantine Shops in Late Roman and Early Byzantine times. A number of hammered vessels in various shapes and sizes (490-498, 515-520, 523-528, 531-533) were found both inside several of the shops and piled in the colonnade in front of the doors, much as they would be displayed today in the copper workers' district of a Middle Eastern bazaar. When analyzed, many of these vessels proved to be made of nearly pure copper with only trace impurities. Handles and other parts, however, were sometimes made of cast bronze or wrought iron (Chap. V).

Iron

Evidence for iron use at Sardis dates at least to the early first millennium B.C., as a few implements found in deep levels of the Lydian Trench at HoB demonstrate (118, 127, 172). Local production of iron utilitarian objects was probably fairly continuous from that time on, although on occasion a foreign specialist might be called in for a job requiring particular skill. This was apparently the case with the silver bowl on a welded iron stand made by Glaukos of Chios that Alyattes dedicated at Delphi. According to the sources, Glaukos was the only man of that age who knew how to weld (κολλάω) iron;⁷⁰ and his stand was still an item worthy of detailed description by Pausanias on his visit to Delphi in the second century A.D. (10.16.1-2).

Later on, specialized branches of the iron industry developed, and Sardis became one of several major centers of iron working in Asia Minor, each with its own distinctive products. In Roman times, for example, Sardian iron was valued for cutting tools—rasps, swords, razors and engraving tools—while the best iron for building purposes was believed to come from the

65. See Chap. II, Source 46; Moses of Khorene 2.12; Dipoinis and Skyllis: Pliny, *N.H.* 36.9; Pausanias 2.15.1; 2.22.5; Clement of Alexandria, *Protrepticus* 4.47.

66. See Chap. II, Source 47. *Sardis* M2 (1972) no. 274; *Sardis* R2 (1978) 19, 30-31.

67. See Chap. II, Source 48. *Sardis* M2 (1972) no. 270; *Sardis* R2 (1978) 31-32.

68. See Chap. II, Sources 52-56. *Sardis* VII.1 (1932) 19, 23, 50-51, 70, nos. 8.XI, 27, 56. See also Robert, 9-21; Pekáry, 730-731. I am grateful to G. M. A. Hanfmann for the last reference.

69. Large quantities of materials from the HoB industrial area have been stored in the laboratory at Sardis and would amply repay a scientific investigation.

70. See Chap. II, Sources 24, 59, 60; *Sardis* R2 (1978) 29; Pernice, 62-68.

Black Sea area.⁷¹ There was also a guild of nailsmiths at Hierapolis south of Sardis, and a guild of bedmakers at Tralles.⁷²

The peak of the Sardinian iron industry was in Late Roman times when Sardis was endowed with an imperial weapons and shield factory or *fabrica*.⁷³ Such factories, first established under Diocletian, were very large and employed big work forces. The state owned and operated them and supplied them with raw materials such as iron and charcoal. Workers were ranked as soldiers and tied to their occupations by heredity.⁷⁴ Such an institution would clearly have an important effect on the social, economic and political life of the surrounding community. Since the factory at Sardis was one of only three such establishments in Asia Minor, it must have represented a substantial undertaking.⁷⁵

The factory buildings at Sardis have not been located or excavated, and surprisingly few weapons attributable specifically to the Late Antique period have been found on the site. Foss suggests unexcavated Building A—a large third to fourth century A.D. building in the center of town—as a possible location for the factory,⁷⁶ but there is no evidence to support this identification. In fact, the central location of Building A among the public structures of Sardis (Plan II) argues more strongly against its housing a large, noisy and smelly industrial establishment. In 1979 a detailed surface survey located an area of industrial activity with heavy concentration of slags and Late Roman coarse pottery on the surface of the ground near the northeast edge of the Late Antique city wall (Plan II, 9.15). This area may have some relation to the *fabrica* which further exploration would reveal. A few objects tentatively identified as smith's tools have been catalogued (143-148), although none can be associated specifically with the *fabrica*. Three inscriptions, however, confirm the existence of the *fabrica*. The first (IN 64.3) is a gravestone from MTW made sometime between A.D. 300 and 600 reading "Tombstone belonging to (P)anion, worker

in the *fabrica* and *ducenarius*."⁷⁷ The second (IN 76.8) was painted in a fourth century A.D. tomb (Grave 76.1) dedicated to one "Flavios Chrysanthios *ducenarius* and worker in the *fabrica* . . ."⁷⁸ The third (IN 77.2), from the same tomb, notes that the tomb owner was both *ducenarius* and painter. The term *ducenarius* apparently denotes a high salaried official of equestrian rank who in this case may have been director of the arms factory.⁷⁹

Items for local consumption were manufactured on a smaller scale.⁸⁰ As with copper and copper alloys, iron products for household or commercial use were probably made in or near the Byzantine Shops where many of them were sold. One shop was dubbed the "Hardware Shop" (BS E9-11, Plan III) because of the quantities of tools and utensils found in it. It contained, among other things, nearly 150 bronze and iron locks (346-358, 365, 366), some of which were left unfinished when the shop was destroyed. An object described as a stone anvil with remains of iron on it was reportedly found in Room A (BE-A) behind the Synagogue,⁸¹ but was not seen by this writer and must remain unevaluated.

Middle and Late Byzantine workshops in a secondary occupation of Bath CG may also have been connected with a late phase of the Sardinian iron industry. Evidence was found inside the Main Hall (CGC) for an activity that involved considerable firing and produced a slag. A series of industrial hearths found at the north end of CGC contained large amounts of charcoal and ashes and was surrounded by dumps of industrial wastes; these included lumps of iron, slag, pieces of vitrified brick and tuyère fragments, all suggesting that iron ore was smelted in the vicinity.⁸²

Foreign or Imported Metalwork at Sardis

In addition to local metal production, both literary and archaeological evidence reveal the presence at Sardis of imported metalwork. This material came to Sardis not only through trade, but also through invasion and war.

71. See Chap. II, Source 63; Stephanus Byzantinus, s.v. "Lakedaimon"; Broughton, 826.

72. Broughton, 827.

73. See Chap. II, Source 64; *Notitia dignitatum* 11.18-39, ed. O. Seeck (Berlin 1876) 32, ca. A.D. 400; *Sardis* M4 (1976) 7-8, 14-15, 106 no. 1; Jones, II, 834.

74. *Sardis* M4 (1976) 14; Jones, II, 835; MacMullen, 29-33; idem, *Soldier and Civilian in the Later Roman Empire* (Cambridge, Mass. 1963) 24-26, 30; O. Seeck, *RE* VI.2 (Stuttgart 1909) 1925-1930 s.v. "fabricenses"; J.-P. Waltzing, *Étude historique sur les corporations professionnelles chez les Romains II* (Brussels 1896) 239-243.

75. *Sardis* M4 (1976) 7.

76. See Plan 2, no. 24; *Sardis* M4 (1976) 36-37, fig. 8; Foss, "Fall of Sardis," 17.

77. See Chap. II, Source 65; *Sardis* M4 (1976) 106 no. 2.

78. See Chap. II, Source 66; *BASOR* 229, 61-64; 233, 4-8; "Roman Tomb in Sardis," *Archaeology* 30 (1977) 56; Melink, "Archaeology," 309-310.

79. See Chap. II, Source 67; *BASOR* 233, 6, 29 n. 5 and Foss, "Fabricenses," 279-283.

80. See Broughton, 826, for local systems of manufacture.

81. Clive Foss, *Byzantine Cities of Western Asia Minor* (Ph.D. Dissertation, Harvard University 1972) 59.

82. *Sardis* R1 (1975) 140-141, 186 n. 48 and S. M. Goldstein, unpubl. laboratory report, July 5, 1969.

According to literary sources, foreign artists and craftsmen (primarily East Greeks) were employed to create some of the more luxurious objects associated with the wealthy Lydian kings. Some statues placed in the very sanctuaries of Sardis were made elsewhere and, in fact, represented plunder rather than peaceful imports. In addition, a number of the small metal objects found at Sardis by the Harvard-Cornell Expedition are unquestionably of foreign design.

Mention has already been made of the dedication at Delphi of silver vessels made by Glaukos of Chios and Theodoros of Samos, of the iron stand by Glaukos of Chios, and of the Attic bronze statue present at Sardis in the fifth century B.C. No remains of such monumental works of foreign manufacture have been identified to date. A number of smaller metal objects from several periods and contexts do, however, provide some information on various kinds of foreign contact throughout history. While not all were well stratified, several may be dated by parallels from other sites, thus helping to further our understanding of chronological development at Sardis.

The oldest such object is a bronze arrowhead (46) whose closest analogies appear to belong to the Hittite Imperial Age (ca. 1400-1200 B.C.).⁸³ Unfortunately, the context in which the arrowhead was found (a mixed fill in the south colonnade of the Road Trench) does not permit close dating, nor does it reveal anything significant about possible Hittite contacts with Sardis.

Two bridle ornaments of "Scythian" type have been identified (85, 86). Both belong to types with parallels in Eastern Anatolia (Lake Van region) and in southern Russia in the graves of Scythian nomads. The first was found on or slightly above the floor of a sixth century B.C. Lydian house in the PN sector.⁸⁴ The second appeared in the area of Hellenistic Building C in the HoB sector in a mixed fill containing material ranging from the Lydian to Roman eras. Both probably date somewhere between the mid-seventh and early sixth centuries B.C., and are to be attributed either to the Kimmerian invaders who swept through Western Anatolia in the early part of that era or to Scythian wanderers who infiltrated somewhat later. The nomadic presence at Sardis is still rather obscure, although it is attested to by literary sources. It is also suggested by destruction levels at HoB that have been associated with the Kimmerian invasion, and by a few more small finds in the barbarian "animal style."⁸⁵

Other contacts with the East in the archaic period may be found in a few probably Phrygian fibulae (671-675). The earliest (671) is dated stylistically to the eighth or early seventh century B.C., and, judging from many parallels from Gordion and other Phrygian sites, was almost certainly imported from Phrygia. The origins of the four other fibulae are more problematic. These belong to types that originated in Phrygia but apparently were copied later in the West, particularly at Old Smyrna where molds for fibulae resembling 672 and 673 have been found. All four were found in archaic contexts at HoB and PN with absolute dates ranging from the late seventh through early fifth centuries B.C.—a chronology that fits well with that of the known examples from Phrygia and Ionia. It is possible that at least some of the examples in this group were made in Ionia rather than Phrygia, or even that they are local Lydian products. At present, however, there are too few examples from Sardis to make a definitive statement as to foreign versus local manufacture.

The battle with the Persians in 547 B.C. that led to the defeat of Lydian Sardis and the downfall of King Croesus is amply attested to by the quantities of Persian arrowheads found on the Acropolis and in the HoB sector. Two main types of arrowhead can be distinguished: a leaf-shaped, ribbed and socketed point (18-36), and a three-edged socketed point (41-45). Both types are widely distributed in the Eastern Mediterranean and Near East, and numerous examples of each have been found at sites in Anatolia and Greece in contexts relating to the Persian wars of the sixth and fifth centuries B.C. Also probably Achaemenid are three examples (49-51)—one in copper alloy, two in iron; the former from the Road Trench, the latter two from the Acropolis; none is from a good context. Closest parallels can be found in the Treasury at Persepolis.

The outstanding import of the Hellenistic era is a small earring of gold and semi-precious stones found in the Roman terracing fill beneath the northwest corner of the Main Hall of the Synagogue (731).⁸⁶ The piece belongs to a class of elaborate Hellenistic jewelry apparently originating in Greece, and is a slim indication of contact with the West in this turbulent era.

The Roman Imperial Age is almost as deficient in definitely identifiable foreign finds. Three fibulae of common Roman types are the most securely identified as such (681-683). The first two, of the "aucissa" type, are from upper levels of fill in HoB; the third belongs to

83. Parallels for objects noted in this discussion are cited in the catalogue.

84. *BASOR* 199, 18, 21 fig. 11.

85. On Kimmerians and Scythians at Sardis see *BASOR* 211, 33-34 n. 28; Mitten, 44; *Sardis* R1 (1975) 6; *BASOR* 170, 6; 162, 12

n. 8. For small finds other than metal see forthcoming study by R. S. Thomas; for literary sources see *Sardis* M2 (1972) nos. 49-52, 59, 60, 65, 292, 293, 295.

86. *BASOR* 199, 51, fig. 42.

the "crossbow" type and was found in Grave 61.10 on the Acropolis, dated ca. A.D. 200-250.

The Late Roman-Early Byzantine era at Sardis was one of the richest, producing a variety of metallurgical material, some local, some imported. Several distinctive types of Early Byzantine buckles and brooches probably belong to the latter category. They have turned up in contexts ranging from the Byzantine Shops to the Synagogue to the Acropolis. The buckles include two examples of the widely distributed "Syrakus" type (689, 690), which is found all over Europe and western Asia and was probably manufactured in Constantinople. A fine large buckle with double-eagle heads at one end (698) was found in BS and is paralleled throughout eastern Europe and South Russia in "Migration Period" contexts. Both types, along with several examples of related varieties from the BS, HoB and elsewhere (691-697, 699-702), can be dated by their foreign counterparts to the sixth and seventh centuries A.D. They thus provide a synchronism that agrees closely with the date for the destruction of BS and HoB proper arrived at independently by numismatic and stratigraphic evidence.⁸⁷

Of the same general date and distribution are four circular cloisonné brooches made of a copper alloy matrix inlaid with colored glass and/or enamel (684-687). Two of these were found in BS, a third either in the Synagogue or BS, the fourth in HoB proper. The four brooches are closely related in appearance and decorative technique to a fragment of a buckle (699), which in turn belongs to the same general groupings of Early Byzantine buckles cited above.

The destruction of Early Byzantine Sardis by the Sassanian Persians in A.D. 616 is well documented by the numismatic evidence.⁸⁸ Additional remnants of the raid can probably be identified in numerous examples of a type of iron arrowhead found in scattered locations all over Sardis, but especially on the Acropolis and in and around Building B and BS (53-73). The type seems to have originated further to the east and to extend chronologically from Early to Late Byzantine times at other sites, raising the possibility that at least some of the Sardis examples should be assigned to the later limits of the range. In most cases contexts were not precise enough to be decisive.

As a great city, commercial center and object of constant attack, Sardis has a long history of foreign contact exemplified by some of the outstanding metal finds. The Hittite arrowhead, "Scythian" bridle ornaments, and Persian and "Sassanian" arrowheads would seem to owe their presence to less than friendly contacts. The Phrygian and Roman fibulae, Hellenistic earring and Early Byzantine buckles and brooches are slender evidence for what is known from literary documents to have been a long-standing two-way trade in luxury materials.

Much is still left to be learned about the nature of the Sardian metal industry and the extent and duration of the metals trade. It is hoped that this study of the metal objects from Sardis will provide the raw material for the assessment of both, and also present some preliminary scientific data towards the solution of technological problems.

87. See above n. 21.

88. See above n. 21.

II LITERARY AND EPIGRAPHIC SOURCES

with contributions by John G. Pedley

Most of the ancient sources and inscriptions quoted here have been or will be published in other volumes in the Sardis series. Since these sources are crucial to our understanding of the metal industry of Sardis, however, they are included here with brief commentary on their metallurgical significance.

Many of the literary sources relating to the Pre-historic through Roman eras at Sardis have been set forth by John G. Pedley in *Sardis* M2 (1972), and the later sources and epigraphic remains have been summarized by Clive Foss in *Sardis* M4 (1976), Chap. IV. A few passages on metal sculpture appear in George M. A. Hanfmann and Nancy H. Ramage, *Sardis* R2 (1978), Chaps. III and IX. Greek and Latin inscriptions found by the Harvard-Cornell Expedition will be published by Louis Robert in a forthcoming volume; those found by the Princeton Expedition are published in W. H. Buckler and D. M. Robinson, *Sardis* VII.1 (1932).¹

Most translations of ancient authors included here follow those in *Sardis* M2 and M4, where original Greek and Latin texts and commentary may also be found. John G. Pedley has graciously supplied many new translations of sources that were not included in previous volumes. In addition, John H. Kroll has allowed me to quote his translations of the relevant inscriptions from the Synagogue (Sources 40-43).

MYTHOLOGICAL REFLECTIONS ON LYDIAN METALS AND METALLURGY

The fame of the genuine mineral wealth of Lydia inspired a host of literary references. Most of these references reflect the historical situation—with varying degrees of accuracy. A few authors, such as Ovid, transcend the real world and enter the realm of mythological speculation about the sources of Lydian riches; others, such as Plato, reshape possible ancient legends to advance their own points of view.

1. Ovid, *Metamorphoses* 11.127-145

1st C. B.C.-1st C. A.D.

“Rich but wretched [Midas] longs to escape his wealth, and what was just now the object of his prayers, he hates. . . . Deservedly is he tortured by the gold he detests. . . . When he admitted the error of his ways, Bacchus restored him . . . and said, ‘Lest you remain enveloped in the gold you have so grievously wanted, go to the river close to great Sardis and make your way through the Lydian hills against the smooth flowing waters till you come to the river’s source; immerse your body and head in the bubbling spring where it bursts out most strongly, and cleanse your offence.’ The king obeyed and made his way to the spring; the gold’s power transferred itself to the water passing from his human frame into the torrent. Today the fields still receive the yield of the old vein, and become hard as the damp sods yellow with gold.”

1. For an early summary of the sources and their relation to the current geological literature see Dominian, 569-589, esp. 581-586.

Transl. J. G. Pedley. Mentioned: *Sardis* M2 (1972) no. 230.

Ovid gives a mythological account of the origin of Lydian gold, linking it with the disastrous "golden touch" of Midas, King of Phrygia, a kingdom neighboring Lydia.

2. Plato, *Republic* 2.359c-e 4th C. B.C.

"The kind of freedom which I mention would probably be realized if they had obtained the sort of power which they say the ancestor of [Gyges] the Lydian acquired. For it is said that he was a shepherd working for the king of Lydia at that time and that after a great storm and earthquake the earth was split and a chasm appeared in the place where he was. When he saw this he was astonished and descended into the chasm; and he saw other amazing things, so they say, and a hollow bronze horse with little doors through which he looked inside and saw a dead body within, larger than life-size apparently. There was nothing else, they say, but a gold ring on the corpse's hand which he took and went away."

Publ. *Sardis* M2 (1972) no. 36.

While certain elements of the story, especially the gold ring which later confers invisibility on Gyges, are folkloristic and probably apochryphal, G. M. A. Hanfmann argues that the bronze horse with the corpse inside is credible, and may be associated with local Anatolian rituals pertaining in particular to the Hittite god Pirva.² Archaeological evidence for a Hittite presence in the territory of Lydia is slim but not altogether lacking (see e.g. arrowhead 46). To my knowledge no such large-scale bronze sculpture such as a horse large enough to enclose a larger than life-size body has yet been attributed to the Hittites.

GOLD AND SILVER

Mineral Resources

Ancient literary references range from the fifth century B.C. to the twelfth century A.D. They cite two main sources of gold in Lydia: the Pactolus River alluvium and the gold mines in Mt. Tmolus above the Pactolus. The gold appears to have given out by no

later than the late first century B.C., since most texts from that time on speak of it in the past tense.

3. Sophocles, *Philoctetes*, 391-395 5th C. B.C.

"Oh Earth, you who dwell in the mountains and feed all men, mother of Zeus himself, you who supply great Pactolus rich in gold, to you, my mother and sovereign, I call."

Publ. *Sardis* M2 (1972) no. 253; *Sardis* R2 (1978) 31 no. 13.

4. Strabo 13.4.5 1st C. B.C.-1st C. A.D.

"From Tmolus flows the Pactolus stream which in antiquity carried down a great amount of gold dust, from which, they say, the famed wealth of Croesus and his ancestors derived; but now the gold dust has failed."

Publ. *Sardis* M2 (1972) no. 234.

5. Strabo 14.5.28

"The wealth of Gyges, Alyattes and Croesus came from the mines in Lydia, and from the area between Atarneus and Pergamon, where there is a desolate small town the territory of which has been mined to death."

Transl. J. G. Pedley.

6. Strabo 13.1.23

"Above the city of Abydos in the Troad is Astyra, a city in ruins which now belongs to Abydos though formerly it was independent and had gold mines. These are now exhausted like those on Tmolus near the river Pactolus."

Publ. *Sardis* M2 (1972) no. 264.

Strabo provides documentary evidence for Lydian gold derived both from panning the Pactolus alluvium and from mining at the source on Mt. Tmolus. He also suggests that the Lydian kings went farther afield "to the area between Atarneus and Pergamon" to obtain it. By Strabo's own time none of these sources of gold was still viable (see Chap. I).

7. Pliny, *N.H.* 33.66 1st C. A.D.

[Gold is found] "in the silt of rivers, as in the Tagus in Spain, the Hebrus in Thrace, the Pactolus in Asia, and the Ganges in India. No gold is more pure as this has been thoroughly polished by the rivers' flow and by friction."

Publ. *Sardis* M2 (1972) no. 248.

2. G. M. A. Hanfmann, "Lydiaka," *HSCP* 63 (1958) 76-79.

8. Silius Italicus, *Punica* 1.157-159 1st C. A.D.

"He would not have preferred the Maeonian stream nor the Lydian lakes for himself, nor the well-watered plain irrigated with gold, which becomes yellow with the sands of the Hermus carried upon it."

9. Silius Italicus, *Punica* 1.234-235

"From these parts, O Pactolus, the Durius and the Tagus vie with you, and the river which tumbles its shining sands over the Gravii."

Transl. J. G. Pedley.

10. Dio Chrysostom, *Orationes* 78.31
1st-2nd C. A.D.

"Just as, I think, they say that in days gone by the Pactolus flowed through the middle of Sardis and brought riches for the taking for Croesus—a greater income and tribute than the whole of Lydia and the Maeonians and the Mysians and all who hold the territory this side the Halys yielded him."

Publ. *Sardis* M2 (1972) no. 242.

11. Philostratus, *Life of Apollonius* 6.37
2nd-3rd C. A.D.

"There are two tales narrated in Sardis, one that the Pactolus at one time carried down gold dust to Croesus, and the other that the trees are older than the land. Apollonius said that the former story was trustworthy as being plausible enough, since at one time there had been golden sand on Tmolus and showers had carried it down into the Pactolus, sweeping it away. In time, however, as is customary in such matters, it was all washed away and the supply ceased."

Publ. *Sardis* M2 (1972) no. 247.

By the late second to early third centuries A.D. reports of the gold sands of the Pactolus had become remote legends.

12. Athenaeus, *Deipnosophistae* 5.203b-c
2nd-3rd C. A.D.

"What kingdom, comrade diners, has become so rich in gold? Not that which took over the riches of Persia and Babylon, nor any that worked mines, nor that which had the gold dust bearing Pactolus stream. For only the Nile truly is called streaming with gold."

Transl. J. G. Pedley.

13. Solinus 40.10 3rd C. A.D.

"The mountain of Lydia is Tmolus, abundant with saffron; the river is the Pactolus which, swirling rapidly with its floods of gold some call the Chrysorrhoas."

Publ. *Sardis* M2 (1972) no. 252 with refs. to similar quotations.

14. Nonnos, *Dionysiaka* 13.466-473 5th C. A.D.

"Those who inhabited fertile Sardis, nurse of riches, of equal age with the dawn itself; those that dwelt in the country of Bacchus rich in grapes, where vineclad Dionysos cup in hand first mixed it full of wine for Mother Rheaia, and called the city Kerassai; those that held the mountain peaks of Oanos, and the river Hermus and watery Metallon, where the yellow wealth of the spring sparkles, turning its back on the mud of the Pactolos."

Transl. J. G. Pedley.

The text seems to name several cities or towns in Lydia. Besides Sardis, Metallon—"The Mine"—was known as a center for the recovery of Pactolus gold. C. Foss has tentatively identified it with a site on the Pactolus ca. 3 km. south of Sardis on the ancient road from Sardis to Hypaepa and near traces of ancient mines.³

15. Joannes Laurentius Lydus, *De Magistratibus Populi Romani* 3.64 6th C. A.D.

"The Lydians of old were extremely rich with a plentiful supply of gold—as much as the Pactolus just by the Hermus used to supply—became keen even to weave gold into their garments. The evidence is supplied by Peisander who remarks 'goldrobed Lydians'."

Transl. J. G. Pedley.

Peisander is a Rhodian poet of the seventh or sixth century B.C. who wrote when Lydian prosperity was at its peak.

16. Tzetzes, *Historiarum variarum chiliades* 1.1, 1-5
12th C. A.D.

"Croesus . . . was ruler of the Lydians and possessed the metropolis, Sardis, as his home. Because the river Pactolus, which formerly was golden and received the dust from Mt. Tmolus during rain storms, flows through there, Croesus became richer in gold than any king."

Publ. *Sardis* M2 (1972) no. 83.

3. Foss, "Explorations," 38, and see Chap. I, n. 31.

As many of the above sources show, the gold of the Pactolus River was legendary, even after it had given out. For additional poetic and metaphorical references to golden Pactolus see *Sardis* M2 (1972) nos. 76, 81, 232, 244, 245, 250, 254, 255 and 260.

Lydian Coinage

The Lydians used their native gold resources to develop first an electrum and then a bimetallic coinage. Their ability to separate gold and silver from the natural electrum ore of the Pactolus and to adjust the proportions of gold and silver in the coins may be responsible for these developments.⁴

17. Herodotus 1.94 5th C. B.C.

"As far as I know, [the Lydians] were the first people to mint currency in gold and silver and put it into circulation."

Publ. *Sardis* M2 (1972) no. 132.

18. Pollux, *Onomasticon* 9.84 2nd C. A.D.

"In a list of terms, the staters of Croesus belong together with those of Philip and Darius."

Transl. J. G. Pedley.

19. Pollux, *Onomasticon* 9.83

"Whether Pheidon of Argos was the first to strike coins, or Demodike from Kyme who married Midas king of Phrygia—she was the daughter of Agamemnon, king of Kyme—or Erikhthonios the Athenian and Lykos, or the Lydians as Xenophanes says."

Transl. J. G. Pedley.

Pollux quotes Xenophanes of Colophon, a poet of the mid-sixth through early fifth centuries B.C., and suggests that the Lydians are only one of several peoples who might have invented coinage.

Wealth of the Lydian Kings

The wealth of Croesus and his predecessors is expressed in ancient literature by the enumeration of the gifts in precious metals that they dedicated at the major

Greek sanctuaries. Several amusing anecdotes on their lavish way of treating guests are also indicative of their splendid lifestyle. Finally, this period of wealth is contrasted with the defeat of Croesus and the decline of Lydian fortunes which followed. The descriptions of religious dedications are of particular value, since they record several elaborate types of Lydian metalwork of which all physical traces have vanished.

Gyges: ca. 680-645 B.C.

20. Herodotus 1.13-14 5th C. B.C.

"... and Gyges the king sent many gifts to Delphi. Most of his offerings there are of silver, but as well as the silver he dedicated a great quantity of gold among which six golden mixing bowls are most worthy of mention. These stand in the Treasury of the Corinthians and weigh thirty talents. . . . This gold and silver which Gyges gave is called by the Delphians Gygadas after the name of the dedicator."

Publ. *Sardis* M2 (1972) no. 41; *Sardis* R2 (1978) 29 no. 2.

The weight of one talent is between ca. 60 and 80 lb. (27.2136.29 kg.).⁵ If the figure of thirty talents represents the total weight of all six bowls, the amount of gold in question is between 1,800 and 2,400 lb. (816.46-1088.62 kg.).

21. Athenaeus, *Deipnosophistae* 6.231e-232a 2nd-3rd C. A.D.

"The silver and gold dedications in Delphi were set up first by Gyges, king of the Lydians. Before him the Pythian god was without silver, and gold for that matter as Phaenias of Eresus says and Theopompus in the fortieth book of his *Philippika*. These historians tell us that the Pythian sanctuary was adorned by Gyges and his successor Croesus. . . ."

Publ. *Sardis* M2 (1972) no. 97.

Athenaeus quotes Theopompos of Chios and Phainias of Eresos, historians of the late fourth century B.C.

22. Archilochos, Fragment (22 Diehl) Early 7th C. B.C.

"I do not care for the wealth of Gyges rich in gold. Envy has never taken hold of me. I am not vexed at the divine

4. Early Lydian coinage: Robinson, "Ephesian Artemision," 165-166; idem, "The Date of the Earliest Coins," *NC* 6th ser. vol. 16 (1956) 1-8, and see Chap. I, n. 61.

5. Talent: see N. G. L. Hammond and H. H. Scullard, eds. *Oxford Classical Dictionary*, 2nd ed. rev. (Oxford 1970) s.v. "weights"; Skinner, 14, 37, 57, 60.

order nor do I long for a tyrant's power. These things are far from my eyes."

Publ. *Sardis* M2 (1972) no. 40.

Archilochos writes as a contemporary of Gyges, and his lines show that the fame of Lydian gold was already great.

23. Pollux, *Onomasticon* 7.98 2nd C. B.C.

"Refined, perfect, pure, without alloy, sheer gold, Daric, Gygad and the like."

Transl. J. G. Pedley.

The implication of this is that Lydian gold was already being refined at the time of Gyges. For the Lydian gold refinery of somewhat later date see Chap. I. The word ἀπεφοῦς, "refined," is the same as that used by Herodotus to describe Croesus' lion monument in Source 25.

Alyattes: ca. late 7th C. B.C.-561 B.C.

24. Herodotus 1.25 5th C. B.C.

"When he recovered from his disease, [Alyattes] became the second member of his family to set up a dedication at Delphi—a great silver bowl on a welded iron stand. Of all the dedications at Delphi, this is most noteworthy, the work of Glaukos of Chios, who on his own discovered the welding of iron."

Transl. J. G. Pedley. See also Overbeck, no. 263. Mentioned: *Sardis* M2 (1972) no. 62; *Sardis* R2 (1978) 29 no. 3. See also Sources 59 and 60.

Croesus: 561-547 B.C.

25. Herodotus 1.50

"After this [Croesus] propitiated the god at Delphi with great offerings. He sacrificed three thousand animal victims; and piling up a great pyre he burnt thereon couches inlaid in gold and silver, golden bowls, purple garments and coats, hoping by these gifts to win over the god. Furthermore, he instructed all the Lydians to sacrifice whatever each man had to the god. After the sacrifice, he had the Lydians melt down an immense quantity of gold and make bricks of it; the length of each brick was six hands-breadths, the width three hands-breadths, and the height one, and there were one hundred seventeen bricks in all. Four of these were of refined gold, each weighing two and a half talents, but the rest were of white gold, each two talents in weight.

He also had made of refined gold a statue of a lion, ten talents in weight. When the temple at Delphi burned down, this lion fell from atop the bricks—for this was where it had been placed—and now lies in the Treasury of the Corinthians weighing only six talents and a half; for three and a half talents melted away in the fire."

Transl. J. G. Pedley. Publ. in part in *Sardis* M2 (1972) no. 99; *Sardis* R2 (1978) 30 no. 6. For a possible restoration of the lion on its base of gold bricks or ingots see Elderkin, 1-8, fig. 1. The temple at Delphi was burnt and the lion partially destroyed in 548 B.C.

The word Herodotus uses for "refined" is ἀπεφοῦς, literally "cooked." Gold with silver alloy he calls λευκός χρυσός, "white gold." On Lydian methods of refining gold from base metals and separating it from silver see Chap. I and Hanfmann-Waldbaum, 310-313; *BASOR* 199, 16-28; 228, 53-57.

According to our figures (see Source 20) the lion when whole would have weighed between 600 and 800 lb. (272.15-362.87 kg.); an ingot of refined gold ca. 150-200 lb. (68.04-90.72 kg.); an electrum ingot ca. 120-160 lb. (54.43-72.57 kg.). Using the lower figure of 60 lb. for a talent, the total weight of gold and electrum used was 246 talents or 14,760 lb. or 6,694.99 kg. The text implies that at least some of the metal was obtained from the gold- and silver-covered couches and golden goblets melted in Croesus' sacrificial pyre.

26. Herodotus 1.51

"When he had finished these, Croesus sent them to Delphi along with the following other offerings: two mixing-bowls of extraordinary size, one gold and one silver. Of these the gold one stood to the right of a person entering the temple, the silver to the left. At about the time that the temple burned down, these were moved; the gold one is to be found in the Treasury of the Klazomenians and weighs eight and a half talents and twelve minai, while the silver one is at the corner of the temple's forecourt and holds 600 amphoreis. This one is used as a mixing-bowl by the Delphians at the Theophania. The Delphians say that it is the work of Theodoros of Samos, and I agree; for it does not seem to me to be an ordinary object. Furthermore, he sent four silver wine-jars which stand in the Treasury of the Corinthians, and he set up two perirrhanteria, one gold and one silver. There is an inscription on the gold one to the effect that it is an offering of the Lacedaimonians who deceitfully claim it as theirs. It is in fact a gift from Croesus; but some Delphian, whose name, though I know it, I will not disclose, inscribed it wishing to ingratiate himself with the Lacedaimonians; but neither, I repeat, of the perirrhanteria is. Croesus sent many

other unremarkable things together with these, and some circular silver bowls and a statue in gold of a woman three cubits in height, which the Delphians say is a statue of Croesus' baker. In addition, Croesus dedicated his wife's necklaces and belts."

Transl. J. G. Pedley. Publ. in part in *Sardis* M2 (1972) no. 99; *Sardis* R2 (1978) 30 nos. 7, 8, 9; Overbeck, no. 284.

Figuring the talent at 60-80 lb. and the mina at one-sixtieth of a talent, the golden mixing bowl or crater weighed between 522 and 696 lb. (236.77-315.70 kg.). Figuring an amphoreus conservatively at ca. 9 gal. (34.06 l.), the silver vessel had a capacity of ca. 5,400 gal. (20,439 l.).⁶ The golden female statue was ca. 60 in. or 5 ft. tall or 1.52 m. (about life-size), if the cubit is estimated to be ca. 20 in. (50.80 cm.).⁷

The vast amount of gold and silver noted in these texts no doubt derived from Croesus' own mines. The workmanship on some of these objects, however, was not always Lydian—viz. the silver crater by Theodoros of Samos, one of the most famous artists of his time,⁸ and the earlier crater and stand by Glaukos of Chios (Source 24). Hanfmann posits figurative decoration on many of these vessels (*Sardis* R2 [1978] 29-30, nos. 2, 8). On the story of the baker and why she was worthy of a dedication at Delphi see Plutarch, *De Pythiae oraculis* 16 (*Sardis* M2 [1972] no. 68).

27. Plutarch, *Moralia* 556F-557A (= *De sera numinis vindicta* 12) 1st-2nd C. A.D.

"For example, it is said that Aesop came here with some gold from Croesus, with a view to making a magnificent sacrifice to the god and to giving four minai to each of the Delphians. When, however, some angry incident, as it seems, and difference of opinion occurred between him and those here, he made the sacrifice but sent the money back to Sardis. For he did not think the men worthy of help."

Transl. J. G. Pedley.

28. Herodotus 1.92 5th C. A.D.

6. On the capacity of the amphoreus see V. R. Grace in *Délos XXVII* (Paris 1970) 360; idem, "Samian Amphoras," *Hesperia* 40 (1971) 85-86; W. K. Pritchett, "The Attic Stelai," *Hesperia* 25 (1956) 195-196; *Sardis* R2 (1978) 30 no. 7 and n. 4.

7. Hultsch, 98 gives the Roman *cubitus* at 44.36 cm. or ca. 17.46 in. For Near Eastern and Greek cubits see Skinner, 4-5, 35, 39-41, 60-61.

8. For Theodoros of Samos see Chap. I, n. 56. Pausanias 8.14.8 credits Theodoros with the invention of bronze casting.

"Croesus made many other dedications in the Greek world besides those which I have mentioned. For in Boeotian Thebes there is a golden tripod which he set up to Ismenian Apollo, and at Ephesus the golden oxen and many of the columns, and in the temple of Pronoia at Delphi a great gold shield. These objects have survived until my time, but some of his gifts have been destroyed. It is my understanding that the dedications at Milesian Branchidae were equal in weight and appearance to those at Delphi. The gifts to Delphi and Amphiarus were his own from money inherited from his family, but the others were paid for out of the estate of an enemy who opposed him before he became king. . . ."

Publ. *Sardis* M2 (1972) no. 100; *Sardis* R2 (1978) 29 no. 5.

The enormous quantity of gold and silver gifts given at Delphi (Sources 25 and 26) was duplicated at Didyma but apparently had disappeared by Herodotus' time, ca. 100 years later. Parts of the columns given by Croesus at Ephesus have been found,⁹ and some of the small objects found at Ephesus have been identified as Lydian.¹⁰

29. Herodotus 1.52

"These were the things which [Croesus] sent to Delphi; but when he found out about the prowess and suffering of Amphiaras, he set up to him a shield, solid gold throughout, and a solid gold spear, shaft and spearhead alike being of gold. Both of these were to be found up to my time anyway at Thebes, in the temple of Ismenian Apollo of the Thebans."

Transl. J. G. Pedley. Mentioned, *Sardis* M2 (1972) no. 99.

30. Herodotus 6.125

"Hearing from the Lydians who frequented the oracle [at Delphi] that Alcmaeon was his benefactor, Croesus sent for him to Sardis and on his arrival rewarded him with a gift—as much gold as he could carry off at one time by himself. In the face of such a gift Alcmaeon made the following preparations. He put on a large chiton, leaving a deep fold in it, and the largest boots he could find. In this outfit he entered the treasury to which guides took him. He heaved headlong into a pile

9. F. N. Pryce, *Catalogue of Sculpture in the Department of Greek and Roman Antiquities of the British Museum* 1.1 *Prehellenic and Early Greek* (London 1928) 35-63. Some of the column capitals seem to have been gilded (e.g., no. B 50, p. 43).

10. See Barnett, "Ivories," 18; Hanfmann, 13; A. Greifenhagen, "Schmuck und Gerät eines lydischen Mädchens," *AntK* 8 (1965) 15.

of gold dust and first crammed alongside his legs as much gold as the boots could hold; he next filled all the fold of the chiton with gold and sprinkled dust on the hair of his head and pushed more of it into his mouth. Then he left the treasury, dragging his boots along with difficulty. Since his mouth was stuffed and his body all puffed out the last thing he resembled was a human. When Croesus saw him he burst into laughter and gave him all he was carrying and as much again at least on top. In that way his family became very rich. . . .”

Publ. *Sardis* M2 (1972) no. 77. See also Dio Chrysostom, *Orationes* 78.32 (*Sardis* M2 [1972] no. 75) for another version of this story.

31. Herodotus 1.69

“For the Spartans sent to Sardis to buy gold, wishing to use it for the statue of Apollo which now stands on Mt. Thornax in Laconia. But though they intended to purchase it, Croesus gave it to them as a gift.”

Publ. *Sardis* M2 (1972) no. 103.

In another version of this story (Athenaeus, *Deipnosophistae* 6.232a, quoting Theopompos, *Philippika* = *Sardis* M2 [1972] no. 97) the Spartans, having been advised to buy gold from Croesus, go to Sardis and do buy it.

32. Pausanias 3.10.6

2nd C. A.D.

“For the Spartans the cult of the Amyclean is the more illustrious so that they used the gold which Croesus the Lydian had sent for Apollo Pythaeus to decorate the statue in Amyclae.”

Publ. *Sardis* M2 (1972) no. 105.

Pythius: early 5th C. B.C.

Pythius was a wealthy Lydian who lived at the time of Xerxes. While not a king he did, nevertheless, seem to have ruling power over some (unnamed) city.

33. Herodotus 7.27-29

5th C. B.C.

“Pythius, son of Atys, a Lydian, waited for them in this town [Kelainai] and greeted the whole of the king’s army and Xerxes himself with extravagant hospitality. He also said that he wanted to provide money for the war. When Pythius offered money, Xerxes asked those of the Persians who were there who Pythius was and how rich he was that he made these offers. They replied, ‘O king, this is the man who gave your father

Darius the plane tree and the vine of gold; of people we know he is the richest man in the world after you.’ Bemused at the last of these remarks, Xerxes then personally enquired of Pythius how rich he was. And he said, ‘O king, I will not conceal nor feign ignorance of my estate; I both know it and will tell you truthfully. As soon as I knew that you were coming down to the Greek sea, and wishing to contribute money for the war, I made enquiry. Calculating things up I found that I had two thousand talents of silver, and in gold four million Daric staters less seven thousand. I offer you this, since there is living enough for me from my slaves and lands.’”

Transl. J. G. Pedley.

34. Plutarch, *Moralia* 262e-263a (= *Mulierum virtutes* 27)
1st-2nd C. A.D.

“Pythes himself, so it seems, was lucky enough to find some gold mines, and he loved the wealth from these, not sensibly, but greedily and inordinately. He himself was accustomed to spend all his time at these mines, and making the citizens go down there he forced them all without exception to dig or carry or clean the gold. They did nothing else at all and engaged in no other activity. When many died and all were collapsing, the women went to the house of Pythes’ wife, as suppliants. She told them to be of good cheer and to go away; but she called those of the goldsmiths she specially trusted, locked them in, and ordered them to make golden loaves of bread, and all kinds of cakes and fruit and whatever kinds of delicacies and foods she knew that Pythes liked best, all of gold. After these were made, Pythes came home from a journey, for he chanced to have been abroad. When he ordered supper, his wife set before him a golden table which had nothing eatable on it, but everything was gold. . . . This shook Pythes, and he stopped almost all of his own involvement with the mines; furthermore, he ordered just one fifth of the citizens to mine the gold in turn, and turned the rest to farming and the trades.”

Transl. J. G. Pedley. See Polyaeus, *Strategemata* 8.42 for a similar account.

Pythius, living in the early fifth century B.C., at the time of Persian domination, had a vast amount of wealth in gold and silver. In Herodotus’ account, its source is not stated, but Plutarch recounts that he found some gold mines and had the power to enslave his fellow citizens and compel them to work them. Plutarch does not mention the city that Pythius rules over. Herodotus

says he is a Lydian but that he met Xerxes in a Phrygian town.

Plutarch's description of mining operations implies working of the gold sources in the Tmolus rather than alluvial panning. Presumably these mines were enough out of the way so that the Persian authorities were not aware of Pythius' activities and did not exact tribute from him. (Although he makes the gesture of offering his wealth to Xerxes, he tells him that it comes from slaves and farms.) Pythius' wealth goes back to the time of Darius to whom he gave a golden plane tree and vine (Hdt. 7.27), perhaps another of the clever golden imitations made by his goldsmiths for a different purpose in Plutarch's account.

Destruction and Disappearance of Lydian Wealth

The dispersal of Lydian gold and silver treasure began soon after the time of Croesus. Gifts donated at the various Greek sanctuaries were stolen or melted down in the vicissitudes that these centers suffered so many times throughout history. Croesus' own fortune was broken up in the Persian sack of 547 B.C., and gold subsequently mined from the Pactolus was sent to Persia as tribute.

35. Diodorus Siculus 9.33.4 late 1st C. B.C.

"When Croesus had been taken prisoner and the pyre had been put out, and he saw that the city was being ravaged and much silver and gold as well as other things were being removed, he asked Cyrus what the soldiers were doing. With a laugh he replied that they were plundering Croesus' wealth. 'By Zeus, no,' said Croesus, 'it is yours they pillage, for Croesus no longer possesses a thing.' Cyrus was impressed by this argument and immediately changed his plans, checking the plundering of his soldiers and taking the belongings of the Sardians for the Imperial Treasury."

Publ. *Sardis* M2 (1972) no. 140.

36. Darius, *Susa F* 35-55 5th C. B.C.

"The gold was brought from Sardis and from Bactria, which here was wrought. . . . The goldsmiths who wrought the gold were Medes and Egyptians."

Publ. *Sardis* M2 (1972) no. 303; Kent, 144.

After the Persian conquest, Lydian gold was sent as tribute to the Persian kings. The Pactolus and Tmolus sources had apparently not yet given out, since the gold appears to have been sent in an unworked state and to

have been worked at Susa by Median and Egyptian craftsmen.

37. Diodorus Siculus 16.56.6 late 1st C. B.C.

"For he coined for money one hundred twenty gold bricks dedicated by Croesus the king of the Lydians, each weighing two talents, and three hundred sixty gold goblets weighing two minae each, and a golden lion and a woman weighing in all thirty talents of gold. The total of gold coined to money, referred to the standard of silver, is found to be four thousand talents. The generals had also expended six thousand talents derived from the silver dedications of Croesus and all the others, and when the gold offerings are added to these the sum exceeded ten thousand talents."

Publ. *Sardis* M2 (1972) no. 98.

This conversion took place at the pillaging of Delphi by the Phocians 347/6 B.C. and accounts for the final disappearance of the lion monument, the golden statue of the baker and many of the smaller gold vessels (Sources 25 and 26). See also Diodorus Siculus 9.10.6: "The golden ingots of Croesus and other handiwork like them have vanished. . . ."

38. Pausanias 10.8.7 2nd C. A.D.

"The Delphians said that Philomelos stole the golden shield given by Croesus the Lydian to Athena Pronaia."

Transl. J. G. Pedley.

See Source 28 for this dedication, which was seen by Herodotus.

Goldsmiths at Sardis

Regardless of how long the local supply of gold lasted, the continuation of the goldworking craft at Sardis into later periods is attested to by a few inscriptions from the Hellenistic and Roman eras.

39. Archaeological Museum, Selçuk-Ephesus, Inv. 1631, Lines 7-12, 34-35 ca. 325-300 B.C.
Inscription found at Ephesus in 1961

"When the ambassadors arrived at Sardis and at the temple of Artemis founded by the Ephesians, (the accused) desecrated the offerings, and insulted the envoys. The penalty of the law is death. The following have been condemned. . . . Strombos, son of Herakleides, the goldsmith."

Transl. J. G. Pedley. Publ. Dieter Knibbe in Anton Bammer, Robert Fleischer and Dieter Knibbe, *Führer durch das archäologische Museum in Selçuk-Ephesos* (Vienna 1974) 95-97. See also G. M. A. Hanfmann and J. C. Waldbaum, "Kybebe and Artemis: Two Anatolian Goddesses at Sardis," *Archaeology* 22 (1969) 265.

Strombos the goldsmith was one of forty-five Sardians sentenced to death for attacking a sacred embassy going from the Sanctuary of Artemis at Ephesus to the Sanctuary of Artemis at Sardis. The text, very important for the history of the cult of Artemis, gives some slight evidence for the working of gold at Sardis in the Early Hellenistic period.

40. IN62.50 + 53 + 55 + 56 ca. A.D. 350-600
Donor's Inscription from the Synagogue

"Pegasios, Councillor, goldsmith, with my wife I fulfilled a vow."

To be publ. by John H. Kroll in the report volume on the Synagogue. See also Robert, 54-55 and pl. VII, no. 13. I am grateful to J. H. Kroll for his kindness in permitting me to include this and the other Synagogue-goldsmith inscriptions and for providing me with the translations and information about them.

41. IN62.134 + 135 + 69 ca. A.D. 350-600
Donor's Inscription from the Synagogue

"... goldsmith, I fulfilled a vow."

To be publ. by John H. Kroll in the report volume on the Synagogue.

42. IN62.61 + 62 ca. A.D. 350-600
Donor's Inscription from the Synagogue

"Aurelios Hermogenes, citizen of Sardis, Councillor, goldsmith, I fulfilled a vow."

To be publ. by John H. Kroll in the report volume on the Synagogue. See also Robert, 55 and pl. VII, no. 14.

43. IN63.48 + 49 ca. A.D. 350-600
Donor's Inscription from the Synagogue

"Aurelios Hermogenes, citizen of Sardis, pious, from the gifts of Providence, I made the seven-branched candlestick."

To be publ. by John H. Kroll in the report volume on the Synagogue. See also *BASOR* 174, 27; 187, 27.

This inscription probably refers to the same man that Source 42 does, even though his occupation is not

specifically mentioned here. Since he is a goldsmith, Kroll suggests the assertion that he "made" a seven-branched candlestick or menorah may be taken literally and perhaps refers to a metal menorah like the bronze fragment 610 which may once have been gilded.

These inscriptions show that goldworking was practiced in the Late Roman era by members of the Jewish community and that they were prosperous enough to afford to donate decorations to the Synagogue. At least two of these goldsmiths were also members of the City Council (Pegasios and Aurelios Hermogenes) showing that they "belong to the highest social and economic rank of Sardis and are likely to be owners of goldsmithing establishments, not mere artisans" (Kroll, personal communication, 1979). The source of gold used for their work is, of course, unknown, as is the exact nature of their work.

Gilded Architectural Ornament

Gold was used at Sardis not only for making objects and coins, but also for gilding other materials. A few rather late inscriptions testify to the gilding of architectural decoration in such large public buildings as the Marble Court of the Gymnasium. It is doubtful, however, that by this time the gold used was extracted locally.

44. Dedication of the Marble Court of the Gymnasium
A.D. 211
(Pavilion VI, lower register, fragments 3, 14, 12; Pavilion VII, fragments 13, 4, 25)

"And the entire structure (*ergon*) was gilded by the city and Antonia Sabeina, Consular Woman, and Flavia Pollitte, Consular Woman."

Translation of these fragments kindly supplied by G. M. A. Hanfmann. Forthcoming publication of entire inscription by L. Robert. Mentioned: *BASOR* 177, 23, 25; Hanfmann, 52; *Sardis* R2 (1978) 9.

45. IN61.1- 4th-6th C. A.D.
"Bench" inscription found in MC in many fragments

"Wonder seizes me, whence the work . . . earth/ Of the immense, high-roofed, gold-gleaming chamber . . . old age . . .

. . . nonius, son of the country . . .
As he saw how he had decorated . . . he immediately created

An ever-living decoration which envy never . . .
He granted a wide foundation, unfolding . . .
Always gaze . . .

The golden-roofed . . . was restored . . . of the city, . . . in the eighth indication, in the month of July; thus the revetment . . . laying the floor . . . apart from the mosaic and the other . . .

Publ. *Sardis* M4 (1976) 40, 114 no. 16. Forthcoming publication by L. Robert.

The inscription suggests the donation or restoration of a room or building with gilded ceiling.

COPPER AND BRONZE

Bronze Sculpture

Sardis, like most other ancient cities, was adorned with bronze statuary—both dedicatory and honorific. Except for small fragments, however, no monumental bronze sculpture from any period has survived at Sardis, and only a few literary references and inscriptions testify to its former existence.

46. Moses of Khorene 2.12 5th C. A.D.

"Then Artashēs . . . marched to the west and took as prisoner Croesus (Croesus), king of Lydia.

"Finding in Asia images of Artemis, Heracles, and Apollo that were cast in bronze and gilded, he had them brought to our country to be set up in Armavir. The chief priests . . . took those of Apollo and Artemis and set them up in Armavir; but the statue of Heracles, which had been made by Scyllas and Dipenes of Crete, they supposed to be Vahagn their ancestor and so set it up in Tarawn in their own village of Ashtishat after the death of Artashēs."

Publ. and transl. by Robert W. Thomson, *Moses Khorenats'i, History of the Armenians* (Cambridge, Mass. and London 1978) 148. See also *Sardis* R2 (1978) 32 no. 19; E. Sellers in Jex-Blake and Sellers, 184-185; Overbeck, no. 326.

Scyllas and Dipenes are Skyllis and Dipoinis, Cretan sculptors of the early sixth century B.C. Pliny, *N.H.* 36.9 gives their floruit as the fiftieth Olympiad (572-568 B.C.), which is early for monumental bronze statuary, and says their fame was as marble sculptors. G. M. A. Hanfmann, *Sardis* R2 (1978) 32, notes that the pieces mentioned by Moses of Khorene may not actually have stood in Sardis but may have come from elsewhere in Lydia or even farther away. The only extant evidence for gilded bronze statuary at Sardis is the ear of an equid broken off a larger statue and probably dating much later (916).

47. Plutarch, *Themistocles* 31 1st-2nd C. A.D.

"When [Themistocles] had arrived in Sardis and in his leisurely way was inspecting the arrangement of the sanctuaries and the quantity of the dedications, he saw in the Temple of the Mother the statue called the Water Carrier, a girl in bronze and two cubits high. When he had been the water commissioner in Athens he himself had had this made and had dedicated it from the fines he extracted when he caught individuals stealing and draining off the water. Whether he was now irritated at the capture of the statue or whether he wished to show the Athenians how much respect and influence he had in the king's affairs, he spoke to the satrap of Lydia asking him to send the statue back to Athens. . . . The barbarian got angry and threatened that he would write to the king."

Publ. *Sardis* M2 (1972) no. 274; *Sardis* R2 (1978) 30-31 no. 11. For date and probable style of the statue see *Sardis* R2 (1978) 30-31 no. 11.

The piece had been carried off from Athens in the Persian attack of 480 B.C. and installed in Sardis by the Persian conquerors. The late archaic, bronze, underlifesized (ca. 40 in. high) statue is paralleled in material and date by the Piraeus Kouros.¹¹ This is yet another example of the presence in Sardis of works of art by foreign artists (See Sources 24 and 26).

48. Pausanias 7.6.6. 2nd C. A.D.

"But the Lydians set up a bronze statue of Adrastus in front of the sanctuary of Persian Artemis, and they wrote an epigram saying that Adrastus died fighting for the Greeks against Leonnatos."

Publ. *Sardis* M2 (1972) no. 270; *Sardis* R2 (1978) 31-32 no. 18. On the date of Adrastus see *Sardis* R2 (1978) 31-32 no. 18.

The work probably would have been a bronze portrait statue in Early Hellenistic style.

49. Pausanias 6.15.2 2nd C. A.D.

"Next to him is the statue of Ageles the Chian who had been the winner in the boys' boxing. It is the work of Theomnestos of Sardis."

11. For the Piraeus Kouros see G. M. A. Richter, *Kouros: Archaic Greek Youths* 3rd ed. rev. (New York 1970) no. 159 bis. This work is 1.92 m. high, nearly twice the presumed size of the water carrier. The bronze "Apollo of Piombino" is closer in size (H. 1.16 m.) but the archaic date is controversial, with recent opinion favoring the 1st C. B.C. for its creation. See B. S. Ridgway, "The Bronze Apollo from Piombino in the Louvre," *AntP* VII.2 (Berlin 1967) 43-75.

Transl. J. G. Pedley. See also Overbeck, no. 2046.

Theomnestos' statue stood at Olympia among the victors' dedications. There is no specific evidence either on his date or on the date of Ageles of Chios whose image he made.

50. Pliny, *N.H.* 34.91 1st C. A.D.

"The following, however, have made statues of athletes, warriors, hunters and men making sacrifices . . . Theomnestos. . ."

Transl. J. G. Pedley. See also Overbeck, no. 2047.

Pliny includes the sculptor (without ethnic) in his list of "also ran" bronze sculptors. Jex-Blake and Sellers, 77, cross reference to a painter named Theomnestos, (Pliny, *N.H.* 35.107 = Overbeck, no. 1979). According to G. M. A. Hanfmann, the identity of this Theomnestos with the Sardinian sculptor is not certain nor even likely (personal communication, 1979).

51. Inscribed statue base from Chios

"Theomnestos son of Theotimos and Dionysios son of Asteas (Astios?) made [it]."

CIG II, 2241 (Muratori II, p. 1014, 11); Overbeck, no. 2048; Emanuel Loewy, *Inscripfen griechischer Bildhauer* (Leipzig 1885) 199-200 no. 286. Cited also in Ch. Picard, *Manuel d'archéologie grecque: La sculpture 3.1 Periode classique—Ive siècle* (Paris 1948) 194, who places Theomnestos tentatively in the fourth century B.C. See also G. Lippold, s.v. "Theomnestus," in *RE VA:2* (Stuttgart 1934) 2036 no. 14; M. Bieber, s.v. "Theomnestus," in Thieme-Becker, *Künstler-Lexikon* 33 (Leipzig 1939) 1.

Of the three references to Theomnestos (Pliny, Pausanias and the Chios inscription), only one (Source 49) specifically identifies the sculptor as a Sardinian. Both his name and his father's—Theotimos—are Greek. All three references, however, would seem to refer to the same individual. The subject of his Olympia statue (Source 49) is a native of Chios, where the signed statue base (Source 51) was found; and the Theomnestos mentioned by Pliny (Source 50) is a sculptor of athletes, which is consistent with the Olympia commission (Source 49).

52. IN63.119, lines 12-14 late 3rd C. B.C.
Decree of the Council and the People of Sardis

"It was decided by the council and the people to crown him with a golden wreath and to inscribe on the bronze image this decree and that the *strategoí* are to take care of these matters."

Provisional translation kindly supplied by G. M. A. Hanfmann. Complete decree to be published by L. Robert who dates it between March and August, 213 B.C. Mentioned: *BASOR* 174, 34.

The decree bestows honors, including a golden wreath and a bronze statue, on one Heliodoros, son of Diodoros.

53. IN60.1, lines 5-8 209-193 B.C.
Decree honoring an (unnamed) ambassador to Zeuxis, viceroy of hither Asia

"(It has been decided) . . . to erect a statue of him in bronze, to crown it with a crown of gold of ten staters in the assembly of the people. . ."

Publ. Robert, 9-21 no. 1.

The inscription honors the dignitary with a bronze portrait statue crowned with a wreath of ten gold staters. According to G. M. A. Hanfmann (personal communication, August 1979), the specification of the ten gold staters for the crown probably refers to the weight in gold. He suggests that this represents a lavish use of gold, which may imply that the Sardinians were still obtaining gold from a local source (see Chaps. I and II). Robert, 15-16, on the other hand, notes that the ten staters of gold would be the equivalent of 200 drachmas and was not a particularly large amount.

54. Statue Base of Iollas ca. 75-70 B.C.

"The people honored Iollas, son of Iollas with two gilded wreaths, prizes fully deserved; and with a gilded portrait, with a gilded *kolossike* (overlife-size?) statue, with a gilded equestrian statue, four other bronze statues, three marble statues, and four inscribed statues."

Transl. J. G. Pedley. Publ. *Sardis* VII.1 (1932) 50-51, pl. IX no. 27; W. H. Buckler and D. M. Robinson, "Greek Inscriptions from Sardes II," *AJA* 17 (1913) 29-47. Also mentioned in Pekáry, 730-731; G. Roux, "Qu'est-ce qu'un *κολοσσός*?" *Revue des études anciennes* 62 (1960) 37-39. The base was found in the Artemis Precinct near Altar LA 2 (see *Sardis* R1 [1975] 43).

The translations of both *κολοσσική* "colossal" and *χρυσή* "gilded" have been questioned. Roux, 37-38, suggests that the term *κολοσσική* was used to refer to a herm-statue, not necessarily of monumental scale; G. M. A. Hanfmann (personal communication, 1979) suggests it refers to a cuirass statue. Pekáry, 730, and Roux, 38, take the term *χρυσή* literally to mean "golden" rather than "gilded," which might make sense if these were not large-scale statues.

Buckler and Robinson, *AJA* 17 (1913) 31, also opt for

"golden." They point out, however, (pp. 32-33) that such lavish honors were usually decreed by the state but paid for by the one honored or by his family. Since a person might not choose to indulge in such expense, he might legitimately erect only one statue and simply list the other authorized awards on the accompanying inscription. This would account for the lack of sufficient bases to correspond to the number of statues decreed. In favor of translating χρυσή as "gilded" is the well-established practice of gilding bronze statues. On the other hand, Oddy, et al., "Gilding," 182, suggest that life-size gilded bronze sculpture is uncommon until well into the Roman Imperial era.

55. Decree of the Council of Sardis 1 B.C.

"Whereas Menogenes, son of Isidoros son of Menogenes, advocate of Asia for a third term, a good and noble man, strove for excellence from his first appearance in public life and has become a perfect man; whereas being entrusted with the most honorable magistracies by his native land he conducted himself in all of them with reserve, attentiveness and honesty, and having served with success as ambassador to Augustus and to other influential men he has brought honor to his city as a result of their excellent judgments in advantage matters; whereas being preeminent among the Greeks for wisdom, he was thought fit to exercise the same magistracy three times on account of his probity, good qualities and manly spirit, for all of which the council praised him and determined to honor him in that he properly fulfilled the office of the priesthood of the Pergamenes; therefore be it resolved that he be honored with a bronze statue to be set up in the agora and properly inscribed. . . ."

Transl. J. G. Pedley. Publ. *Sardis* VII.1 (1932) 19, 23 no. 8.XI, pl. IV; W. H. Buckler and D. M. Robinson, "Greek Inscriptions from Sardes V," *AJA* 18 (1914) 322-362 and see Pekáry, 730.

The stele was found in the Artemis Precinct 10 m. east of the northeast corner column of the temple. Menogenes, a Sardinian official and ambassador to Augustus, was honored a number of times by the people of Sardis and Asia (see *Sardis* VII.1 [1932] 16-17). The bronze portrait statue decreed here is the most elaborate of the honors he received.

56. Statue base of a tribune ca. A.D. 125-150

"(The ---- tribe honored ----) tribune of the third legion Cyrenaica. . . . Those who took care that the work was done were Theophilos son of Alexandros, the bronze sculptor, and Klaros son of Papias, the phylarch."

Transl. J. G. Pedley. Publ. *Sardis* VII.1 (1932) 70, fig. 47 no. 56 lines 9-11. Found in a ravine on the south side of the Acropolis. The base belonged to a (lost) bronze portrait statue of a tribune of the Third Cyrenaican legion.

According to G. M. A. Hanfmann (personal communication, 1979) the bronze portrait statue must have been executed by Theophilos, even though the word τοπευτήρ, used here to refer to him, is normally translated as "sculptor in relief." If this interpretation is correct, then Theophilos and the apparently much earlier Theomnestos (Sources 49-51) are the only Sardinian bronze sculptors whose names are known to us.

I am grateful to G. M. A. Hanfmann for bringing this source to my attention.

57. IN72.26 4th-6th C. A.D.

"These are the snakes which were once seen by everyone passing by, above the fountain in the middle of the public road. Basiliskos, who held the office of judge there, set them up, wound round with brazen scales, reddened with gold from their necks to their heads, sending up the streams of the fountain from below to their mouth."

Publ. *BASOR* 211, 21 fig. 4, 22; *Sardis* R1 (1975) 27; *Sardis* M4 (1976) 21, 40-41, 114-115 no. 17; *Sardis* R2 (1978) 83-84, 85, 179 no. 278, fig. 471. Forthcoming publication by L. Robert.

The inscription describes an elaborate fountain ornament in the form of snakes with bronze scales and gilded heads and necks, presumably used as spouts. The original location of the fountain is unknown, but apparently it was somewhere in the main road. The pedestal, on which the reused serpents were presumably mounted, was found in front of a niche in the west wall of Room BE-H of the Gymnasium (E3.00/N48.00 *96.50). For other inscriptions referring to fountains see *Sardis* VII.1 (1932) 37-40 no. 17.

IRON

As the finds show, iron was probably produced at Sardis from the beginning of the "Iron Age" and continuously thereafter. The sources tell us that Lydian iron was prized; an early dedication by Alyattes at Delphi included a noteworthy iron stand made by a Greek master craftsman. In Roman times Lydian iron was valued for special purposes, and eventually Sardis became the seat of an imperial arms factory specializing in iron weapons.

Mineral Resources

58. Lucian, *Charon* 11-12 2nd C. A.D.

“Charon: But who are these men who Croesus is sending off, and what do they have on their shoulders?”

Hermes: He is dedicating golden bricks to Pythian Apollo as payment for the oracles by which a little later he will be destroyed.

Solon: Come now, Croesus, do you think that Pythian Apollo has the slightest need for these bricks?

Croesus: Yes, of course; for there is no comparable dedication to him at all in Delphi.

Solon: Then you believe the god will be happy if along with his other possessions he also acquires some golden bricks?

Croesus: Why not?

Solon: You are suggesting, Croesus, that there is much poverty in the heavens if the gods are obliged to send for gold from Lydia if ever they have the urge for it.

Croesus: Where would so much gold be found as among us?

Solon: Tell me, is iron to be found in Lydia?

Croesus: Not much.

Solon: After all then you are lacking in the better resource.”

Transl. J. G. Pedley.

Lucian, in his imaginary dialogue between Solon and Croesus has Croesus admit that Lydia is poor in iron. This would seem to be borne out by the geological evidence, although iron is available in adjacent areas (Chap. I).

Iron Working

59. Pausanias 10.16.1-2 2nd C. A.D.

“Nothing survived of the dedications which the Lydian kings sent with the single exception of the iron stand for the bowl of Alyattes. This is the work of Glaukos of Chios, the inventor of welding. All the metal plates of the stand are attached to one another not by pins or pegs but by the welding, which alone holds together and is the binding agent for the iron. The form of the stand is like a tower, which rises from a broader base to a narrow top. No side of the stand is completely closed, but each side has rungs of iron placed sideways like steps on a ladder. At the top the vertical plates of iron have been bent outwards so as to shape a base for the bowl.”

Transl. J. G. Pedley. See also Overbeck, no. 269.

60. Athenaeus, *Deipnosophistae* 5.210b-c
2nd-3rd C. A.D.

“Hegesander the Delphian in a memorandum registered as *On Statues and Dedications* comments that the stand of Glaukos of Chios in Delphi is comparable to an iron chest and is an offering of Alyattes. Herodotus calls it to mind describing it as a support for a mixing bowl. This is what Hegesander reports. I too have seen it there in Delphi, and it really is worth a good look because of the representations of small animals, creatures and plants worked upon it; mixing bowls and other equipment can be set on top of it.”

Transl. J. G. Pedley. See also Overbeck, no. 270.

The iron stand, perhaps because of its non-precious material, remained on view at Delphi long after the other, richer dedications had been looted or melted down. Although Herodotus (Source 24) calls it “most notable among all the offerings at Delphi,” Pausanias’ description of the stand is reminiscent of the common types of Late Bronze Age Cypriot tripods and stands with openwork frames and circular strips at the top for support of the vessel.¹² However, most of these, as well as their Geometric successors, are of bronze, not iron, and are joined by methods other than welding.¹³ The

12. Catling, 190-207, pls. 28-34.

13. Catling believes the Late Cypriot bronze stands were joined by hard soldering (brazing), or possibly by casting on, though this is less likely. “They certainly cannot have been welded together” (Catling, 190). For techniques of soldering and riveting see Coghlan, *Copper and Bronze*, 116-120; Lechtman-Steinberg, 9-14; Tylecote, 152-156; Steinberg in Mitten-Doeringer, 11-12. Decorated Geometric and Orientalizing tripods and stands are mostly of bronze and of the “tripod-cauldron” type with cast legs soldered and riveted to the bowls. See Willemsen, *OlForsch* III, pls. 3, 5, 12, 13, 20, 21 (legs with rivets or rivet holes); Bernhard Schweitzer, *Greek Geometric Art*, transl. P. and C. Usborne (London 1971) 168; Perdrizet, *Delphes* V, 59-68. For iron tripods with no decoration see Furtwängler, *Olympia* IV, 75-76 no. 548, and S. Benton, “The Evolution of the Tripod-Lebes,” *BSA* 35 (1934-1935) 80. A fragmentary tripod stand with bronze feet and iron legs, arched struts and support ring at the top, and the bronze feet of three similar stands have been found at Delphi (Perdrizet, *Delphes* V, 68-69 nos. 248-251, figs. 222-225). The feet are cast in the shape of bulls’ hooves or lions’ paws; the iron struts are riveted together, and there is no apparent relief decoration. The workmanship overall is much simpler than that of the bronze tripod-cauldrons cited above. For similar examples from other sites see Savignoni, 312-314, fig. 9 (Praeneste); 314-315, fig. 10 (La Garenne, Burgundy); 320, fig. 14 (Caere, Regolini-Galassi Tomb); 320-321, fig. 16 (Falieri); Charles Waldstein, *The Argive Heraeum* II (Boston and New York 1905) 296 nos. 2231-2234; Furtwängler, *Olympia* IV, 126-129 nos. 811-814; P. J. Riis, “Rod-Tripods,” *Acta* 10 (1939) 1-30. Very simple, plain iron

technique of welding in iron for this sort of object could not have become common, since Pausanias, writing centuries later, still finds the method of construction worthy of detailed description. Athenaeus adds the interesting detail that the stand was decorated with figures of animals, insects and plants in relief—a very rare occurrence for iron of this date, although bronze Geometric and early archaic stands frequently have such relief ornament.¹⁴

E. Pernice¹⁵ suggests that Glaukos' bowl and stand were already antiques by the time Alyattes dedicated them, basing this judgment on the date of the twenty-second Olympiad—684-681 B.C.—given for Glaukos by Eusebius as opposed to the late seventh century B.C. date traditional for Alyattes' dedications.¹⁶ Pernice also summarizes the arguments made by some scholars that the word *κολλάω* meant "solder" not "weld"; in the end, however, he opts for the technique of welding as Glaukos' chief contribution.¹⁷ A more recent opinion in

tripods were found in tumuli at Gordion. See G. and A. Körte, *Gordion: Ergebnisse der Ausgrabung im Jahre 1900* JdI-EH 5 (Berlin 1904) 68 no. 49, fig. 44; 80-81 nos. 99-102, fig. 70b. Körte asserts that the legs of no. 99 are welded to the ring. See also R. S. Young, "The Gordion Campaign of 1957," *AJA* 62 (1958) 150, pl. 25 fig. 15 (late 8th C. B.C.).

14. For relief ornament on Geometric and Orientalizing bronze tripod legs and stands see Herrmann, *OlForsch* VI, 162-174, pls. 65-76; Willemssen, *OlForsch* III, pls. 44-52 (abstract and animal ornament); 63 (human figures); 92 (mythological creatures); 93 (plants). A number of archaic bronze rod-tripods have elaborate figural ornament; see Savignino, 289-291, pl. IX.2, 3 (Vulci); 296, fig. 2 (Rome); 299, fig. 3 (Leningrad, from Italy); 305-306, pl. VIII (Metapontum), but these appear to be of 6th C. B.C. date—much later than the time assigned to Glaukos (see below n. 16). A similar, 6th C. B.C. Etruscan tripod in iron with simple stylized floral ornament in relief is in the Metropolitan Museum of Art in New York (no. 03.23.53).

A propos of figural work in iron there are some ancient references to iron statues (e.g. Pliny, *N.H.* 34.141, statue of Herakles at Rhodes; *N.H.* 34.148, statue in Temple of Arsinoe at Alexandria; Pausanias 4.31.10, statue of Epaminondas in Sanctuary of Asclepius at Messenia; idem, 10.18.6, statue group of Herakles and the Hydra by Tisagoras at Delphi; heads of a lion and bear dedicated to Dionysus at Pergamon). The date, size and method of manufacture of these statues are not given, although some would seem from context to have been Hellenistic. Pausanias, 10.18.6, comments that "to make images of iron is a very difficult task, involving great labor." For further discussion of iron sculpture see R. Halleux, *Le problème des métaux dans la science antique* Bibliothèque de la Faculté de Philosophie et Lettres de l'Université de Liège, fasc. 209 (Paris 1974) 192.

15. Pernice, 62.

16. *Sardis* R1 (1975) 6 (Alyattes); H. von Brunn, "Zur Chronologie der ältesten griechischen Künstler," Akademie der Wissenschaften zu München. Philosophisch-philologischen und historischen Classe. *Sitzungsberichte* I (1871) 542 n. 1. von Brunn dismisses the early date for Glaukos' stand as "possible but not probable."

17. For the technique of welding various metals see Coghlan, *Copper and Bronze*, 120-121; Lechtman-Steinberg, 14-32; Tylecotte, 152; Steinberg in Mitten-Doering, 12.

favor of hard soldering or brazing has been expressed by H. Maryon.¹⁸ It would be very difficult to detect the difference between a brazed and a welded joint by ordinary observation.

61. Herodotus 1.34

5th C. B.C.

"The dream revealed to Croesus that Atys [his son] should be struck by an iron spear and perish. When he awoke and thought the dream over, Croesus was very afraid, arranged a marriage for Atys, and no longer sent javelins and spears and all the weapons men use in war from their rooms and heaped them up in the women's quarters lest any of them suspended above Atys should fall on him."

Publ. *Sardis* M2 (1972) no. 89.

The story implies that the Lydian army was armed with iron weapons, specifically javelins and spears. Most of the weapons actually found at Sardis and assigned to this date are bronze arrowheads, although many of these may be Persian and not Lydian (18-37, 40-45, 49-52, of which 36, 50-52 are iron). Other exceptions are an iron spearbutt from a Lydian grave (16) and one or two possible spearheads from mixed contents (9, 10).

62. Persepolis Fortification Tablets PF 873

late 6th-early 5th C. B.C.

"121 ½ [BAR of] flour, supplied by Ištimanka, Sardinian men, blacksmiths, subsisting on rations (at) Kurra, whose apportionments are set by Iršena, received as rations. . ."

Transl. Richard T. Hallock, *Persepolis Fortification Tablets* OIP XCII (Chicago 1969) 252. Publ. *Sardis* M2 (1972) no. 297.

The text records regular monthly rations paid by the Persepolis treasury for work done near Persepolis. The possible presence of Lydian or Sardinian blacksmiths is intriguing, but Pedley, *Sardis* M2 (1972) 83, suggests that the translation of "blacksmiths" is rather free. The logogram **AN.BAR** (iron) does appear in the text with a verb meaning "strike."

63. Stephanus of Byzantium, s.v. "Lakedaimon"

6th C. A.D.

"Sinopic and Chalybidian [steel] is for construction, while Lakonian is for files, iron augers, engraving and masons' work. Lydian too is for rasps, daggers, razors

18. H. Maryon, "Metal Working in the Ancient World," *AJA* 53 (1949) 111-112.

and engraving instruments, as Daimakhos says in his treatise on siegecraft."

Transl. J. G. Pedley. I owe this reference to Clive Foss.

Imperial Fabrica or Arms Factory at Sardis

64. *Notitia dignitatum orientalis* 11.18-39

ca. A.D. 400

"Under the administration of the illustrious master of the offices, the following factories . . . one in Asia: shield works and weapons factory, Sardis in Lydia."

Publ. *Sardis* M4 (1976) 106 no. 1.

65. IN64.3

4th-6th C. A.D.

"Tombstone belonging to (P)anion, worker in the *fabrica* and *ducenarius*."

Publ. *Sardis* M4 (1976) 106 no. 2; Foss, "Fabricenses," 279. Forthcoming publication by L. Robert. Found in MTW, apparently not *in situ*.

66. IN76.8

ca. 4th C. A.D.

Dipinto on south wall of Grave 76.1

"God help them
Flavios Chrysanthios
ducenarius fabrikesios
and his house
they prepared the tomb with
his wife and children."

Transl. by C. Foss. Forthcoming publication by L. Robert. See Foss, "Fabricenses," 279; *BASOR* 229, 61-64; Mellink, "Archaeology," 309-310; "Roman Tomb in Sardis," *Archaeology* 30 (1977) 56.

67. IN77.2

ca. 4th C. A.D.

Dipinto on west wall of Grave 76.1

"Flavios Chrysanthios
ducenarius, painter,
worker in the arms factory decorated
the tomb."

Transl. by C. Foss. Forthcoming publication by L. Robert. See *BASOR* 233, 406.

The above three inscriptions are interesting in two regards: (1) they testify to the existence of the arms factory and to two men who worked in it, perhaps in some official capacity, and (2) the second, Flavios Chrysanthios, was apparently proud of his abilities as a

painter.¹⁹ According to C. Foss,²⁰ the word *ducenarius* by which both (P)anion and Flavios Chrysanthios are designated, may mean either a noncommissioned officer rank in the army or an equestrian ranked official making a salary of 200,000 denarii. Foss also points out that workers in the imperial *fabricae* were organized in military ranks.²¹ Seeck notes, however, that by the time of Diocletian the office of *ducenarius* was no longer defined by salary but signified either a military or civilian rank.²² Foss also suggests that Fl. Chrysanthios may have been director of the arms factory or at least a high ranking and prosperous member of it, although he translates the same word (*fabrikesios*) simply as "worker in the arms factory" in the case of the (P)anion inscription.²³

ZINC

Only one, rather controversial, source refers to the possible availability of zinc ("mock-silver") in the Tmolus region of Lydia.

68. Strabo 13.1.56

1st C. B.C.-1st C. A.D.

"Around about Andeira a kind of stone can be found which when subjected to burning becomes iron. Then when it has been heated in a furnace with a special kind of earth, it yields mock-silver drop by drop; and this with the addition of copper becomes what is called an alloy, which some name Oreichalkos (yellow copper ore). Mock-silver may also be found near Tmolus."

Transl. J. G. Pedley.

The passage is quoted from Theopompos' *Philippika* of the fourth century B.C.²⁴ The exact meaning of *pseudargyros* or "mock-silver" is controversial. It is usually taken to mean zinc, and the mixture of copper and mock-silver to be brass; however, it is generally believed

19. G. M. A. Hanfmann suggests that he was actually a professional painter of shields rather than an enthusiastic amateur. See Hanfmann, "Painter," 87-88.

20. Foss, personal communication, Oct. 1976, and see idem, "Fabricenses," 279-283.

21. Foss, "Fabricenses," 279-280, and see Jones, II, 835.

22. O. Seeck, *RE* V.2 (Stuttgart 1905) 1752-1754 s.v. "Ducenarius."

23. For ranks in the *fabricae* see MacMullen, 31-32; Jones, II, 835. Foss, "Fabricenses," 280, points out that the fabricenses were employees of varying status who might (or might not) achieve relatively high rank.

24. Leaf, 287.

that the ancients were not able to reduce zinc ore directly to metallic zinc as implied in this passage.²⁵ Craddock, however, notes at least a few examples of metallic zinc found in archaeological contexts.²⁶ The translation of ἀποστράζει is also problematic. Leaf and Michell render it as “distils,” Eaton and McKerrell as “drips down” (which they say is impossible for producing metallic zinc),²⁷ Craddock as “yields droplets” of *pseudargyros*.

25. E.g. Michell, 21-22; Forbes, VIII, 276.

26. Craddock, “Composition 3,” 7 and see discussion Chap. V.

27. Eaton-McKerrell, 188.

Craddock also points out that it is possible, though inefficient, to produce small amounts of zinc by a kind of distillation process.

The location of the source of *pseudargyros* in the Tmolus is still uncertain. The closest known modern sources of zinc are near Subeşir, Mentişe, Kobaklar, and Türkah in the Manisa district.²⁸ That zinc was used at Sardis for making brass in the Roman and Early Byzantine eras we now know from analyses (see Chap. V).

28. See Chap. I, n. 52.

III CATALOGUE OF FINDS

USE OF THE CATALOGUE

In the following catalogue, objects are grouped according to major typological classifications—e.g. weapons and armor, tools, vessels, etc.—and within each class by types—swords, daggers, spears, etc.—and finally, where possible, according to individual variations or subtypes. Where sufficient stratigraphic information is available there has been some attempt to group subtypes of objects chronologically; in general, however, typological and stylistic considerations are primary for the grouping of objects. A brief introduction is included for most major classes of objects and for some important types where more extensive discussion than could be included in individual entries seemed warranted.

Criteria for Inclusion

In an effort to be as comprehensive as possible, the catalogue includes most metal objects found by the Sardis Expedition, with the exception of unintelligible fragments and certain objects that are being treated elsewhere. Some objects published here also appear in other Sardis publications. A number of objects have been mentioned in the preliminary publications on Sardis that have appeared in *BASOR*, *Dergi* and elsewhere. In addition, objects important for the stratigraphy and interpretation of the sectors in which they were found will be or have been included in the

final volume on that sector (see e.g. *Sardis* R1). A few objects made of metal have been omitted from this volume and catalogued elsewhere. These include metal lamps (except the lion lamp 618), which will be treated in the monograph on lamps by Jane A. Scott, and seals, which are in the monograph on small objects by Ruth S. Thomas.

Financial considerations have precluded illustration of every object listed here. Therefore, where several examples of the same type of object are available only the most legible or best preserved are illustrated. In addition, the following kinds of objects are illustrated: at least one object which is representative of each particular class, type or subtype of any given chronological phase (if this can be determined); all objects believed to be of foreign manufacture, and all unique objects. Duplicates and less well preserved objects are listed briefly with dimensions, sector and findspot, to give at least some idea of frequency of occurrence and size range for each object type and of distribution on the site. Photographs of most objects are available in the Sardis Research Office at Harvard University.

Individual catalogue entries include the original inventory number if catalogued previously by the Expedition (number preceded by M); material, dimensions in cm., sector and findspot; and a brief description. Prior publication or reference to the object in other publications is also given, followed by comparative material if appropriate. Where several objects of the same type are listed only the first will contain reference to comparative data.

In general, references to comparative material include only works helpful in establishing chronological, geographical and typological affinities of objects. Comparisons found only in museums or collections with no accompanying information on date, distribution, manufacture or style have generally been omitted unless no others could be located.

Condition of the object, if complete, and its present location will not appear in every entry. As of 1981 most of the objects were still kept in the expedition depots at Sardis. A few objects, however, chiefly those of precious metals, have been transferred to the regional museum in Manisa and given inventory numbers, and these are noted in the catalogue. Eventually, all objects found by the Expedition will be sent to the Manisa Museum for permanent storage and display.

A Note on the Findspots

Most findspots used here are recorded on the B-grid and level system, first applied to the Building B-Gymnasium Complex and later extended to most other sectors. At CG and the Acropolis, however, local grid systems were imposed and kept. Since a number of different and potentially confusing grid systems were used at different times for Acropolis soundings, an attempt has been made here to convert the local systems to the B-grid system. In many cases, this conversion was only possible within a rather broad range of accuracy (2-5 meters); in others, it was not possible to make the conversion at all. In these cases, and for all the objects from CG, the designation "local grid" is included with the findspot information in the catalogue. Similarly, local level or datum systems exist in several sectors. There is one for the Artemis Temple that has also been applied to the Artemis Precinct as well as to PN and PC; CG has another. All Acropolis material has been calculated in meters above sea level (a.s.l.). In addition, many inconsistencies and inaccuracies exist in the determination and recording of findspots for individual objects such that most findspots given should only be considered approximations and not precise indications of location.¹

A Note on Materials

Objects listed in the catalogue are made of gold, silver, iron, lead and a variety of copper alloys. Many

1. For explanations of the various grid and level systems used see *Sardis R1* (1975) 9-11; *Sardis M1* (1971) 15-16. For discussion of inconsistencies in the recording of some findspots see Greenwalt, *Ritual Dinners*, 5.

of the copper-based objects have been analyzed to determine their chief alloying constituents (Chap. V); these range from nearly pure copper to copper with small amounts of arsenic, to copper with varying combinations and proportions of tin, lead and zinc. Since there is no way of knowing the composition of the unanalyzed objects it has been thought safer to avoid the designation "bronze" as misleading and to refer to all copper-based objects in the catalogue as "copper alloy," unless the specific composition of a particular object has been determined by analysis.

For those items which have been analyzed, the terminology suggested by E. R. Caley for Roman *aes* coinage² has been applied as follows: "impure copper," when proportions of zinc, tin and lead in a copper alloy amount to ca. 1 percent; "tin bronze," when the proportion of tin is much higher than proportions of zinc and lead and the proportion of zinc is under 5 percent; "leaded tin bronze," when proportions of tin and lead are much higher than the proportion of zinc, and the proportion of zinc is under 5 percent; "zinc bronze," when the alloy contains 5 percent or more of zinc, and the proportion of tin or lead or both together exceeds the proportion of zinc.

In addition to the above alloys Caley lists another which he calls "orichalcum." He defines this as an alloy with proportion of zinc over 5 percent and in greater proportion than either tin or lead or both together. He prefers the term "orichalcum" to "brass" since modern brasses usually contain far more zinc than the ancient alloy (30-40 percent as opposed to under 20 percent for most ancient alloys).³ Since the exact ancient meaning of orichalcum is still somewhat controversial⁴ it has been thought preferable to use the term "low zinc brass" when referring to alloys of the above description.

WEAPONS AND ARMOR

Among the weapon types found at Sardis are daggers and swords, spear-, javelin-, and arrowheads, and one object interpreted as a spearbutt. In addition

2. Caley, 69, 70.

3. Caley, 1; Tylecote, 53. Tylecote calls the low zinc ancient alloy the equivalent of a modern "gilding metal."

4. Michell, 21-22; M. Robertson, "Ibycus: Polycrates, Troilus, Polyxena," *BICS* 17 (1970) 11-12 (oreichalkos only less precious than gold); A. Schramm, *RE* XVIII.1 (Stuttgart 1939) 938-941 s.v. "ὀρείχαλκος"; Forbes, VIII, 276; Craddock, "Composition 3," 6-8. Eaton-McKerrell, 186-188 suggest that Greek *oreichalkos* referred to arsenical copper while Latin *orichalcum* meant brass. There is little or no evidence, however, for continued deliberate use of arsenical copper after the Middle Bronze Age (see Chap. V).

there are a few fragments of what were apparently two dagger sheaths and a single possible armor scale. Distinction between swords and daggers is made according to size, based on the definitions of D. H. Gordon, with daggers under 35.56 cm. in length and swords above 50.80 cm.⁵

Dates range from Early Bronze Age for three daggers (1-3) to Late Byzantine or Turkish for some of the arrowheads.

Daggers and Swords

Of four daggers found at Sardis, three come from Early Bronze Age contexts at sites near the Gygean Lake (1-3). All three are quite small and extremely simple in shape. One of these (3) was analyzed spectrographically and found to be of almost pure copper; the other two are probably similar in composition. The fourth dagger (4) comes from Shop E5 in BS, as does a sword (5), while a second sword (6) comes from Shop E14. All three of the weapons from the shops are of iron and date to the late sixth-early seventh century A.D. Another iron sword is noted as coming from the floor of Unit 13 in HoB, also dating to the destruction level of the early seventh century;⁶ this sword was not catalogued and was not seen by the present writer.

Daggers

1 *Pls. 1, 45.* M69.5:7972. MANISA 4340. Early Bronze II, ca. 2500-2000 B.C.

Copper or copper alloy. Edges chipped; heavily corroded with some bronze disease.

L. 10.30; max. W. 1.85; Th. 0.20.

EB Pithos Grave 69.3; laid flat beside femur in pithos. Found with earplugs (717, 718) and pendant (881).

Lozenge-shaped blade with rounded, perforated butt end and sharply tapered point. Widest part of blade nearest butt. Flattened lozenge-shaped section.

Publ. *BASOR* 199, 15, 16, fig. 4; Mitten-Yügrüm, "Gygean Lake," 193, figs. 4, 5. According to Stronach, "Metal Types," 89, the dagger is one of the oldest Anatolian metal types. This dagger seems to belong to Stronach's Type 3, a predominantly Western Anatolian type common in the second half of the third millennium B.C., and specifically to Type 3a,

dated after ca. 2200 B.C. See Stronach, "Metal Types," 96-98, fig. 2.11, 12 (Soli, Cilicia; without rivet hole).

2 *Pl. 1.* M67.22:7426. Early Bronze II, ca. 2500-2000 B.C.

Copper or copper alloy. Point broken off; edges chipped.

Max. P.L. 15.50; max. W. 2.10; Th. 0.20.

AhT Pithos Grave 67.10; under bones in pithos.

Similar to preceding but with longer, more slender blade, sharply tapered butt end, and no rivet hole.

Publ. *BASOR* 191, 6, 8, fig. 4. See Stronach, "Metal Types," 96-98, fig. 2.11, 12 (after ca. 2200 B.C.).

3 *Pl. 1.* M68.24:7894. Early Bronze Age, ca. 2500-2000 B.C.?

Nearly pure copper. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3. Haft broken through rivet hole.

Max. P.L. 10.70; max. W. 1.50.

AhT Trench A E45.00-50.00/S40.00-45.00 ca. *75.00-74.75 in fill surrounding pithos burial AT 68.8 with silver finial 430 and two others.

Flat, tapering blade with sloping shoulders. Rectangular haft with remains of a single rivet hole. The type differs from 1 and 2 in having clearly set off shoulders.

Publ. *Dergi* 17.1 (1968) 126; Mitten-Yügrüm, "Ahlatlı Tepecik," 26. This appears to be the same object as one mentioned in *BASOR* 199, 14-15 as having been found in pithos burial AT 68.8. Closest parallels seem to be the simpler varieties of Stronach's Type 2, "Metal Types," 92-94, fig. 1.1, 2, which are found in the Yortan cemeteries of Bayındırköy and are possibly somewhat earlier in date than Sardis 1 and 2 ranging from "possibly before 2500 B.C. to after 2200 B.C."

4 *Pl. 1.* Early Byzantine, late 6th-early 7th C. A.D.

Iron. Haft broken; heavily corroded.

Max. P.L. 16.00; W. at shoulders 2.50; W. tang 1.30. BS E5 E36.50-38.50/S0.00-2.50 *97.30-96.50.

Flat tapering blade with sloping shoulders. Apparently rectangular haft with flat section.

Swords

5 *Pl. 1.* M68.23:7889. Early Byzantine, late 6th-early 7th C. A.D.

Iron. Broken in six joining pieces and heavily corroded. Traces of charred wood adhere to surface.

Max. P.L. 76.50; W. at shoulder 5.40; W. haft 2.10. BS E5 E38.30/S3.50 *96.75.

5. Col. D. H. Gordon, "Swords, Rapiers and Horse-riders," *Antiquity* 27 (1953) 67, and Catling, 110.

6. *BASOR* 157, 24.

Long, narrow blade with parallel edges and flat section tapering near point. Slightly sloping shoulders and narrow haft with flat section at other end.

6 *Pl. 1.* Early Byzantine, late 6th-early 7th C. A.D.

Iron. Broken in six joining pieces and heavily corroded. Point and haft broken off and missing.
Max. P.L. 53.80; W. shoulders 5.50; W. tang 2.50.
BS E14 E87.00/S2.00 *96.70.

Long, straight, flat blade unusual in having only a single edge. Edge parallel to slightly thickened back. Straight shoulders and narrow tang with rectangular section.

Dagger Sheaths?

7 *Pl. 1.* Lydian, 7th C. B.C.

Iron. Broken in three joining pieces and heavily corroded. Only one side preserved.
Max. P.L. 11.70; max. W. 5.90; H. flanges 1.30.
HoB Building G W34.00/S114.00 *98.50 in bowl on floor.

Flat piece, slightly tapered to rounded end; sides turned up to form flanges. Two rivets—one near tip, one 5.50 cm. above it.

8 *Pl. 1.* M61.74:3782. Byzantine?

Copper alloy. Separated in two pieces—front and back; half of back missing.
Max. L. front 24.90; W. at top 8.30; W. at bottom 3.50; Th. 0.20; max. P.L. back 15.00; max. P.W. 6.60.
MRd *96.75 "above Early Byzantine road."

Front piece tapers to rounded end; edges flanged to fit back. Incised dotted pattern all around edges; dotted inscription near top: "hygienōn rou ch." Back piece has deep vertical ridges or creases.

Spearheads

Several examples of spearheads were found. A couple are probably Lydian (9, 10), the rest Roman or later (11-15). All are of iron, but aside from material most differ considerably from each other and no major groupings could be established.

9 *Pl. 2.* M61.99:4098. Lydian?

Iron. Tip and tang broken; heavily corroded and encrusted.
Max. P.L. 14.00; L. blade 8.50; W. blade 1.60; W. tang 0.70.

acT in NE pit local grid W18.00-16.00/N21.00-25.00 *402.20-401.90 a.s.l. Found with arrowhead 52.

Slender leaf-shaped blade with midrib. Short socket or boss at base of blade from which narrow tang projects.

10 Lydian or later.

Iron. Broken in three pieces; tang missing; heavily corroded.
Max. P.L. 9.00; max. W. 1.50; Th. edge 0.10; Th. rib 0.50.
PN W296.00-300.00/S325.00-331.00 *86.20-86.00 near Roman water pipes.

Apparently similar to preceding but shape obscured by corrosion.

11 *Pl. 2.* Roman?

Iron. One edge of blade and part of socket missing; corroded.
Max. P.L. 16.00; max. W. blade 2.50; diam. socket 1.00.
HoB E10.00/S85.00 *102.00-101.50 mixed fill.

Elongated leaf-shaped blade with faint midrib tapers to narrow point; rounded shoulders. Socket formed by hammering metal around a core.

See Jacobi, *Saalburg* I, 491; II, pl. 38.5; Curle, *Roman Frontier Post*, 188, pl. 36.1, 7 (Roman).

12 *Pl. 2.* Roman or later?

Iron. Tip of point, one edge and end of socket missing; heavily corroded.
Max. P.L. 11.80; max. W. blade 2.00; diam. socket 1.00.
Pa-E E105.25/N91.50 *97.80.

Flat blade, sides tapering to point, straight shoulders opposite. Socket formed by hammering around a core.

13 *Pl. 2.* M63.50:5731. Middle Byzantine?

Iron.
Max. L. 9.50; max. W. blade 1.50; diam. socket 0.70.
Syn MH E70.00-75.00/N4.00-4.50 *97.00-96.50 over level of A.D. 660 occupation.

Lozenge-shaped blade with faint midrib tapering to rounded tip. Widest part of blade below center; shoulders taper to socket. Socket formed by hammering around a core; nail hole near end for securing to shaft.

14 *Pl. 2.* M60.35:2463. Late Byzantine?

Wrought iron. For metallographic and atomic absorption analyses see Chap. V, Table V.5. Tang broken off.

Max. P.L. 15.00; max. W. blade 5.20; Th. tang 0.80.
AcT E1003.00-1006.00/S1074.00-1076.00 *403.90 a.s.l.
Level Ia, mixed context.

Flat, triangular blade with slightly convex edges tapering to sharp point; concave sloping shoulders, stump of narrow tang.

15 Pl. 2. M62.35:4296. Late Byzantine?

Iron. Heavily corroded.

Max. L. 24.00; L. blade 11.00; max. diam. socket 2.70.
AcT E-W wall of Unit 2, Level Ia local grid W0.00/
N22.00 *404.20-403.90 a.s.l.

Triangular blade with sharp point, lentoid section, widest at base. Long hollow socket with nail hole near end farthest from blade. Three rings around socket at base of blade and at end of socket. The socket is apparently not seamed and may therefore be cast.

Spearbutt

16 Pl. 2. M62.73:4718. Lydian, 6th C. B.C.

Iron. Heavily corroded.

L. 7.70; max. diam. 1.50.

BT Mound 62.4 E5.00/N2.00 *97.15 on floor of antechamber in NE corner.

Conical point formed by hammering sheet metal around a core leaving vertical seam on one side.

Publ. *BASOR* 170, 58 (called a spearhead). See Ghirshman, *Village Perse* 32, 100, pl. 43 G.S. 808 (bronze, 7th-6th C. B.C.); Petrie, 33, pl. 39.190, 191 (Cyprus, LB), 201 (La Tene).

Javelinhead

17 Pl. 2. Roman-Early Byzantine?

Iron. Part of socket missing; corroded.

Max. P.L. 7.40; L. head 1.00; L. socket 6.40; max. W. head 0.65; max. diam. socket 1.10.

AcS contents of Hall 3 ca. 0.90 m. below surface.

Small pyramidal head with long, conical socket. The piece belongs to a fairly common type of Roman throwing spear or javelin occasionally also identified as a spear- or javelin-butt.

See Conze, *Pergamon* I.2, 327-328, Beiblatt 70 second row, first on r. (Byzantine); Boehmer, *Boğazköy* VII, 154, pl. 54 no. 1613 (unstratified); Petrie, 35, pl. 41.158 (Adelsberg, "probably a Roman casting spear").

Arrowheads

The most common type of weapon found at Sardis is the arrowhead. It appears in both copper alloy and

iron and ranges in date from the Lydo-Persian through Byzantine eras. Two major types are socketed and tanged; within each of these are several subtypes classified by size and form of blade.

Socketed

Type 1a: The blade is leaf-shaped with beveled edges and has a midrib with lozenge-shaped section. This type, together with Type 1b, is the most common early type of arrowhead found at Sardis. All examples are of copper alloy. Five (18-22) were analyzed and proved to be of leaded tin bronze. All are of fairly uniform size, ranging from ca. 3.15-4.00 cm. in length. Most are from the Acropolis, though only one was found in a fairly good context there. Two (24, 25) were found at HoB-24 in a Lydian context.

The type has a wide geographical and chronological distribution in the Eastern Mediterranean and Near East. It ranges in time from about the eighth to the fourth centuries B.C. Although most of the contexts in which it appears at Sardis are not stratigraphically revealing, numerous examples from other sites in Anatolia and Greece can be convincingly related to the Persian conquests of the sixth and fifth centuries B.C. This helps to support the Lydo-Persian attribution of the type and suggests its probable use at the capture of Sardis in 547 B.C.

18 Pl. 3. M60.46:2602. Persian, mid-6th-5th C. B.C.

Leaded tin bronze. Analyzed by neutron activation and atomic absorption. See Chap. V, Tables V.1, 4a, b. A few chips and some disease as of 1974.

L. 3.20; max. W. blade 1.00; diam. socket 0.55.

AcT local grid D/5 *402.50 a.s.l. Level II found with 27.

The high, hollow midrib is extended to form a short projecting socket with round section.

Publ. Hanfmann-Detweiler, 4, 6 fig. 4. For recent discussion of this and other socketed types see Snodgrass, 148-154, Type 3, esp. 151, 152, fig. 10.1 Type 3A1. For distribution of the type see R. S. Young, "Gordion 1956: Preliminary Report," *AJA* 61 (1957) 324; idem, "History at Gordion," 164-165, 166 fig. 10 (Gordion, ca. 550 B.C.); Haspels, *Phrygie* III, 97, 151, pl. 42a.1-3, 5 (Midas City); O. Broneer, "Excavations on the North Slope of the Acropolis in Athens, 1931-1932," *Hesperia* 2 (1933) 341 fig. 13c, f, 342; idem, "Excavations on the North Slope of the Acropolis in Athens, 1933-1934," *Hesperia* 4 (1935) 113-117, fig. 4 (Athens, North Slope of Acropolis, probably 480 B.C.); E. P. Blegen, "News Items from Athens," *AJA* 43 (1939) 698 fig. 3,700 (Thermopylae, probably 480 B.C.); Walters, *Bronzes*, 346-347 Type B, nos. 2803 (Kalymnos), 2804 (Sardinia), 2806 (Marathon), 2807 (Kamiros), 2812 (Ephesus), 2813 (Hierapolis); Robinson, *Olynthos* X, 380-382, Type B, 1901-1906 (before 348 B.C.).

The following are all similar to 18:

19 M60.76:2846. 6th-5th C. B.C.

Leaded tin bronze. Analyzed by neutron activation and atomic absorption. See Chap. V, Tables V.1, 4a, b. Edges of blade and socket chipped.

Max. P.L. 3.80; max. W. blade 1.00; diam. socket 0.60. AcT Trench E E1050.00-1051.00/S1071.00-1073.00 *0.40 a.s.l. with Lydian and Attic sherds.

Nail hole on midrib near base of blade to secure head to shaft.

20 M60.88:2991. 6th-5th C. B.C.

Leaded tin bronze. Analyzed by emission spectrography, neutron activation and atomic absorption. See Chap. V, Tables V.1, 3, 4a, b. Socket chipped; corroded.

Max. L. 3.80; max. W. blade 1.00; diam. socket 0.60. AcT Trench E E1049.00-1050.00/S1077.00-1079.00 *398.50 a.s.l. mixed context. Found with arrowhead 36.

21 M61.96:4065. 6th-5th C. B.C.

Leaded tin bronze. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3. Most of socket missing; corroded.

Max. P.L. 2.80; max. W. blade 0.90; diam. socket 0.60. AcT W of N-S stretch of "Lydian-Persian" wall *401.40-400.55 a.s.l. mixed context.

22 M60.79:2924. 6th-5th C. B.C.

Leaded tin bronze. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3. Socket chipped.

Max. P.L. 3.30; max. W. blade 1.00; diam. socket 0.60. AcS in mixed surface fill.

23 6th-5th C. B.C.

Copper alloy. Diseased. Socket and tip broken.

Max. P.L. 3.20; max. W. blade 0.95; diam. socket 0.60. AcT local grid W22.00-25.00/N5.00-10.00 ca. *401.00 a.s.l. "Lydian Wall."

24 6th C. B.C.

Copper alloy. Corroded and chipped.

Dimensions unavailable.

HoB W36.00/S123.00-126.00 to *99.20 with Early Lydian sherds.

25 M61.20:3230. 6th-5th C. B.C.?

Copper alloy. Diseased.

L. 3.40; W. blade 0.90; diam. socket 0.60.

HoB W10.00/S100.00 *100.50 in mixed fill.

Small nail hole on rib near base of blade.

Type 1b: This type is very similar to Type 1a except that the midrib has a round instead of lozenge-shaped section. It is a variant of 1a and has a similar history and distribution. At Sardis it appears on the Acropolis and at HoB with possible stray examples from PN and KG. Most are from mixed contexts but are probably to be dated in the same way as the 1a examples. Three were analyzed; one (29) is tin bronze, a second (30) is leaded copper and the third (34) leaded tin bronze.

26 Pl. 3. M62.50:4441. 6th-5th C. B.C.

Copper alloy.

Max. L. 3.60; max. W. blade 0.90; diam. socket 0.60. AcT local grid E16.50/S13.00 *401.40 a.s.l. mixed context.

The following are all similar to 26:

27 Pl. 3. M60.46:2602. 6th-5th C. B.C.

Copper alloy.

L. 3.50; max. W. blade 0.90; diam. socket 0.60.

AcT local grid D/5 *402.60 a.s.l. Level II. Found with 18.

28 M62.49:4440. 6th-5th C. B.C.

Copper alloy. Heavily corroded.

Max. L. 4.00; max. W. blade 0.90; diam. socket 0.70.

AcT local grid W27.00/S7.00 *401.90 a.s.l. mixed context.

29 M60.87:2990. 6th-5th C. B.C.

Tin bronze. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3. Socket chipped; diseased.

Max. P.L. 3.50; max. W. blade 1.30; diam. socket 0.60.

AcT Trench A E1009.00-1013.00/S1067.00-1071.00 to ca. *398.80 a.s.l. mixed fill.

30 M61.32:3401. 6th-5th C. B.C.?

Leaded copper. Analyzed by neutron activation and atomic absorption. See Chap. V, Tables V.1, 4a, b. Chipped.

Max. P.L. 3.15; max. W. blade 1.00; diam. socket 0.70.

HoB W5.00/S90.00-95.00 *100.20-100.10 mixed fill.

31 6th-5th C. B.C.?

Copper alloy.

Max. P.L. 4.00; max. W. blade 0.80.

HoB W20.00/S105.00 to *99.60.

32 6th-5th C. B.C.?

Copper alloy.

L. 3.60; max. W. blade 0.85.

HoB E0.00-W5.00/S105.00-115.00 *99.60.

33 6th-5th C. B.C.?

Copper alloy.

L. 3.60; max. P.W. blade 0.80.

HoB W36.00/S123.00-126.00 to *99.20.

34 Pl. 3. M67.11:7347. 6th-5th C. B.C.?

Leaded tin bronze. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3. Point and edges chipped. Max. P.L. 2.30; max. W. blade 1.00; diam. socket 0.65. PN W267.50/S339.50 *88.00.

35 Pl. 3. M58.32:419. 6th-5th C. B.C.?

Copper alloy. Most of socket broken; corroded.

Max. P.L. 3.50; max. W. blade 1.10; max. P. diam. socket 0.40.

KG not found in grave but in fill ca. 25 cm. below surface of ground.

Rectangular hole in rib near base of blade.

For KG cemetery see *Sardis* RI (1975) 125-128.

A single example of an iron arrowhead that probably belongs to Type 1a or 1b was found on the Acropolis but was so corroded it was impossible to be sure of its details.

36 Pl. 3. M60.89:2992. 6th-5th C. B.C.?

Iron. For atomic absorption analysis see Chap. V, Table V.5. Heavily corroded and encrusted.

Max. P.L. 4.90; max. W. blade 1.50; diam. "socket" 0.90.

AcT Trench E E1049.00-1050.00/S1077.00-1079.00 *398.50 a.s.l. mixed fill. Found with bronze arrowhead 20.

Oval blade with midrib; short tang or socket (not possible to determine if it was once hollow).

See O. Broneer, "Excavations on the North Slope of the Acropolis in Athens, 1933-1934," *Hesperia* 4 (1935) 115, 116 fig. 5 (Athens, North Slope of Acropolis, probably 480 B.C.).

Type 1c: This type is similar to the preceding but the blade is widest at the base, forming straight shoulders to the socket. Only one example was found.

37 Pl. 3. M61.31:3400. 6th-5th C. B.C.?

Copper alloy. One side of blade chipped away.

L. 3.70; max. W. blade 1.10; diam. socket 0.50.

HoB W10.00/S90.00 *100.30 in pit fill containing Lydian, Hellenistic and Roman sherds.

Type 1d: Objects of this type differ from those of Types 1a-c in being somewhat larger and in having proportionately broader blades and narrower midribs. Two examples were found, both at PN, fairly close together but in mixed contexts; parallels at other sites, however, suggest dates from the fourth century B.C. to the Roman period. **38** and **39** were analyzed and proved to be leaded tin bronze.

38 Pl. 3. M64.19:6035. 4th C. B.C.-Roman?

Leaded tin bronze. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3. Point, one edge and socket chipped.

Max. P.L. 5.00; max. W. blade 1.40; diam. socket 0.50. PN W259.00-261.00/S336.00-338.00 *88.40-88.25, mixed context.

See Robinson, *Olynthus* X, 380-382, pl. 120 Type B, nos. 1896-1900 (before 348 B.C.); Conze, *Pergamon* I.2, 253, 252 fig. 8b.

39 M64.16:6014. Hellenistic or Roman?

Leaded tin bronze. Analyzed by neutron activation and atomic absorption. See Chap. V, Tables V.1, 4a, b. Small crack in socket.

L. 4.70; max. W. blade 1.65; Th. 0.10; diam. socket 0.70.

PN W264.00/S336.00 *88.25.

Type 2: Lozenge-shaped and ribbed with spur on socket. A single example of this type was found (**40**) in a PN Lydian context. Although the type is rare at Sardis it was among the most common found in the Lydian siege debris at Old Smyrna (ca. 600 B.C.) where it was apparently the favorite type used by the Ionians against their Lydian attackers. Nicholls points out, however, that it is also a common Anatolian type, and seems to have been the main type used by the Persians in the attack on Gordion.⁷

7. Nicholls, 131.

40 Pl. 3. M64.24:6210. Late 6th C. B.C.

Copper alloy. Heavily corroded; spur broken off.
L. 3.60; max. W. blade 1.00; diam. socket 0.60.
PN W276.00-279.00/S344.00-346.00 *86.60-86.40 clear
Lydian context.

Flat blade with beveled edges tapers to a sharp point. Widest part of blade below midpoint. Shoulders slope to projecting socket. High midrib with lozenge-shaped section widens to socket with round section (see Type 1a). Originally a single spur or barb on socket.

See Nicholls, Type b, 130-131 n. 122 with refs., pl. 6d; Young, "History at Gordion," 164-165, 166 fig. 10. A similar type but without the spur was found at Susa. See Ghirshman, *Village Perse*, 100, pl. 44 G.S. 1258c, 2104 (level III, 5/4 C. B.C.).

Type 3a: Three-edged blade with internal socket.

This type is so far less common at Sardis than Types 1a and 1b, but has a similar geographical and chronological distribution in the Near East and Greece, and can probably also be attributed to the Persian presence at Sardis. According to Nicholls, this type is neither of Greek nor of Anatolian origin but ultimately derives from seventh century B.C. Scythian varieties whence it spread to Persia and the West.⁸ Up to 3,600 examples of this and its variant, our Type 3b, were found mixed together in Treasury Hall 41 at Persepolis—by far the most common Achaemenid type of arrowhead at the site. They are also very common in Persian War contexts in Greece where they are usually found together with the leaf-shaped type.

41 Pl. 3. M65.11:6909. 6th-4th C. B.C.

Copper alloy.
L. 3.30; max. W. blade 1.00; diam. socket 0.70.
Syn MH in Roman terracing fill below floor level of Syn at level of Hellenistic steps, E90.00-91.00/N1.50-2.00 *93.90.

Lozenge-shaped, three-edged blade with short, round internal socket. Rectangular hole in one side of socket near base.

Discussion: Nicholls, Type a, 129-130 n. 120 with refs. (Old Smyrna, ca. 600 B.C.); Snodgrass, 151-153, 152 fig. 10 3B3, 3B1. Distribution: see 18, to which add: Ghirshman, *Village Perse*, 32, 100 pls. 18.1; 43; 44 (levels I-III, 7-4th C. B.C.); Schmidt, *Persepolis*, II, 99, pl. 76.7, 8 (in Treasury 41, ca. 500-330 B.C.); Moorey, "Iranian Troops," 110 fig. 1.5, 6 (Deve

Hüyük, Persian Garrison, ca. 500-475 B.C.); H. H. von der Osten, *The Alishar Hüyük Seasons of 1930-32* part II, OIP XXIX, Researches in Anatolia VIII (Chicago 1937) 441, 443 fig. 496, d 1392, e 1001, e 1033 ("post-Hittite-Phrygian level," ca. 9th-7th C. B.C.); C. N. Johns, "Excavations at 'Atlit (1930-1): The South-Eastern Cemetery," *QDAP* 2 (1933) 55, 56 fig. 14c, pl. 20c ('Atlit, Palestine, Persian period); Einar Gjerstad, et al. *Swedish Cyprus Expedition III Finds and Results of the Excavations in Cyprus 1927-1931* (Stockholm 1937) 99, 102, 105, pl. 45.11, 12 Type 3a, b (Vouni, ca. 500-450 B.C.); Blinkenberg, *Lindos* 1, 196, pl. 23, no. 608 (61 specimens, probably 6th C. B.C.); Petrie, 35, pl. 42.218-227 (Defenneh); 239-247 (Memphis, Persian period); Davidson, *Corinth* XII, 200, pl. 91, nos. 1517-1519 (5th or 4th C. B.C.); Robinson, *Olynthus* X, 397-405, Type F, nos. 2027-2096, pls. 125-126 (before 348 B.C.); C. Dugas, "Le sanctuaire d'Aléa Athène à Tégée avant le IV^e siècle," *BCH* 45 (1921) 378, fig. 40 no. 179, p. 389 (Tegea, "before the 4th C. B.C.").

42 M62.58:4478. 6th-4th C. B.C.

Copper alloy. Socket broken and corroded.
Max. P.L. 3.00; max. W. blade 1.00.
HoB W25.00/S98.00 *100.20 mixed fill.

Type 3b: Similar to 3a but with projecting instead of internal socket. Similar in date and distribution to 3a.

43 Pl. 3. M61.72:3778. 6th-4th C. B.C.?

Copper alloy. Edge chipped.
L. 3.30; max. W. blade 0.90.
AcT E section Room 4 local grid N0.00-6.00, under floor at *403.20 a.s.l. with Byzantine sherds.

See Snodgrass, 151-153, 152 fig. 10 Type 3B1; Stronach, *Pasargadae*, 180-181, fig. 94.1-17, pl. 165a, b (Achaemenid to 3rd C. B.C.).

44 M61.42:3549. 6th-4th C. B.C.?

Copper alloy. Edge of socket chipped.
Max. P.L. 2.40; max. W. blade 0.80; diam. socket 0.60.
MRd E5.30/S16.50 *96.48 in collapsed fill.

45 6th-4th C. B.C.

Copper alloy.
L. 3.30; max. W. blade 0.80; diam. socket 0.70.
HoB E0.00/S115.00 in well to *93.00 with Lydian and Attic Black Glaze sherds.

Tanged

Type 4a: Barbed-and-tanged. Only one example.

8. *Ibid.*, 129-130.

46 *Pl. 4.* M62.64:4557. Hittite Imperial Age, ca. 1400-1200 B.C.

Copper alloy.

Max. L. 10.00; L. blade 7.50; max. W. blade 2.10; Th. rib 0.25; Th. tang 0.30.

RTE E35.00/S27.00 *96.30 in fill N of S Colonnade foundation.

Triangular blade with rounded tip; sharply pointed barbs at base of blade. Flat midrib on either side; short tapered tang with rectangular section. Although the type has a long development in the Aegean from the Late Bronze Age to the classical period in Greece this particular example appears to have its closest analogies in arrowheads of the Hittite Imperial Age. Unfortunately, lack of a stratified context for the arrowhead precludes discussion of a possible Hittite contact with Sardis. There are, however, some indications of a Bronze Age Anatolian presence in the finds from the Deep Trench at HoB (see *BASOR* 162, 14; 170, 7-9).

For shape see Koşay-Akok, 196, pl. 131 nos. 2, 6; K. Bittel, *Boğazköy: die Kleinfunde der Grabungen 1906-1912 1 Funde hethitischer Zeit* (Leipzig 1937) 20, pl. 13 no. 18; Boehmer, *Boğazköy VII*, 105, 107, 108, pls. 26 nos. 817, 818 (15th C. B.C.); 29 nos. 865, 866 (unstratified); and see Hayat Erkanal, *Die Äxte und Beile des 2. Jahrtausends in Zentralanatolien* Prähistorische Bronzefunde IX.8 (Munich 1977) 53 and pl. 18 nos. 69-80 (Boğazköy and Alaca Hüyük). According to Erkanal, this type is found mostly in 13th C. B.C. contexts in Anatolia.

Type 4b: Boss-and-barb. Two examples found at Sardis. The type has a long history and may be a descendant of 4a, but is especially common in Hellenistic and Roman contexts at other sites.

47 *Pl. 4.* M67.3:7278. Hellenistic or Roman?

Leaded tin bronze. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3.

Max. L. 8.80; L. blade with barbs 4.00; L. tang 5.40; max. W. blade 1.60; Th. tang 0.25.

PN W267.80/S333.50 *88.30.

Triangular blade with blunt, possibly broken, tip and narrow vertical ridge down center; two long barbs extending from base of blade; boss or swelling at junction of blade and tang. Tang quite long in relation to blade.

Discussion of type: Snodgrass, 146-148, 145 fig. 9, Type Ic; Robinson, *Olynthus X*, Type D1, 387-391, nos. 1940-1971 (5th-4th C. B.C.). See also Davidson, *Corinth XII*, 199, pl. 91 nos. 1512-1514 (4th C. B.C.); Deonna, *Délos XVIII*, 208-209, figs. 239, 240, pl. 69.556 (most common type at Delos); Goldman, *Tarsus I*, 389, pl. 264.3 (Hellenistic-Roman Unit);

Chavane, *Salamine VI*, 107-108 and n. 3, pl. 31 nos. 329, 330 (Hellenistic); Furtwängler, *Aegina*, 423, pl. 117.45 (early Hellenistic); Crowfoot, et al., *Samaria-Sebaste III*, 451 fig. 110, 453 nos. 15-19 (some Hellenistic, others unstratified).

48 M64.20:6062. Hellenistic-Roman?

Copper alloy. Blade bent, tang and barbs broken; heavily corroded.

Max. P.L. 4.30; max. W. blade 1.40.

MC E33.50-35.00/N57.00-60.00 *91.27 in vaulted chamber among building's substructures.

Sharp midrib; tang has lozenge-shaped section.

Type 5: Rather flat, elongated, lozenge-shaped blade widest near tip; long tang. Three examples were found at Sardis, one of copper alloy, two of iron. Although contexts are not revealing the type is most likely another Achaemenid variety contemporary with Types 1a, b, 2 and 3. In the Treasury at Persepolis twenty-two examples similar to this were found in bronze, 192 in iron.

49 *Pl. 4.* M61.49:3570. 6th-4th C. B.C.?

Copper alloy.

Max. L. 6.50; max. W. blade 1.30; Th. tang 0.25.

Mrd E10.00-15.00/S25.00-33.00 *98.25-97.50 upper fill.

Flat, lozenge-shaped blade, widest above center. Slight raised ridge on one side of blade; blade slightly thickened at base. Tapered, slender tang slightly curved at end.

See Schmidt, *Persepolis II*, 99, pl. 76.6; Robinson, *Olynthus X*, 380, pl. 120 no. 1895.

50 *Pl. 4.* M60.39:2527. 6th-4th C. B.C.?

Iron. Heavily corroded.

Max. P.L. 6.90; max. W. blade 1.80; Th. blade 0.15; Th. tang 0.30.

AcN local grid E3.00-5.00/S23.00-25.00 *395.50 a.s.l. in mixed fill.

See Schmidt, *Persepolis II*, 99, pl. 76.5 (iron); Haspels, *Phrygie III*, 99, 151 pl. 42c 11 (no date).

51 M60.86:2987. 6th-4th C. B.C.?

Iron. Heavily corroded.

Max. L. 6.10; max. W. blade 1.50; Th. blade 0.25; Th. tang 0.40.

AcT Trench E E1051.00-1052.00/S1084.00-1086.00 *397.30 a.s.l. in mixed fill.

Type 6: Lozenge-shaped blade with widest point below center. Pronounced midrib. Short socket at base

into which a tang is fitted. Only one example was found.

52 Pl. 4. M61.99:4098. Lydian?

Iron. Badly corroded; part of tang broken off.
Max. P.L. 6.30; L. blade 4.50; W. blade 1.10.
AcT in NE pit local grid W18.00-16.00/N21.00-25.00 *402.20-401.90 a.s.l. Found with spearhead 9, and similar to it in shape.

Type 7a: Flat, lozenge-shaped blade with widest point at center; swelling or short socket at base of blade into which a tang is fitted. Several examples of this and its variant Type 7b were found at Sardis, all of iron. Dating appears to range from the late sixth/early seventh century A.D. through the Late Byzantine era. Most examples of this variant were found on the Acropolis, but 7b was more widely distributed on the site, found in most of the major sectors containing later material: the Acropolis, BS, Building B. Earliest examples of the type may be remnants of the Sassanian raid that devastated Sardis in A.D. 616.

53 Pl. 4. M62.21:4218. Byzantine.

Iron.
Max. L. 8.70; L. blade 4.30; max. W. blade 2.40; Th. tang 0.30.
AcT local grid E19.00/N24.00-29.00 *403.80 a.s.l. top of E wall of cistern.

See Conze, *Pergamon* I.2, 327, Beiblatt 69 first row, first on r. (Byzantine); Ploug-Oldenburg, *Hama* IV.3, 55, figs. 18.10, 21.2 no. 8A496 level A3-4 (A.D. 636-1260); Petrie, 35, pl. 42.193, 194 (Egypt but "not native to Egypt; probably left behind by a Sarmatian soldier"); Chantre, *Recherches dans le Caucase* III, 112, pl. 12.2 (Kammunta necropolis, "Scytho-Byzantine" epoch); Haspels, *Phrygie* III, 99, 151, pl. 42c8-10 (no date); Boehmer, *Boğazköy* VII, 151, 154, pl. 53 nos. 1603-1605 (unstratified).

The following are all similar to 53:

54 M60.40:2531. Byzantine?

Iron.
Max. L. 8.80; max. W. blade 2.00; Th. blade 0.30; Th. tang 0.40.
AcN local grid E2.00-6.00/S14.00-15.00 top fill.
Tang has round section.

55 M61.12:3193. Late Byzantine?

Iron.
Max. L. 5.80; W. blade 1.10; diam. socket 0.60; Th. tang 0.15.

AcT local grid DD/FF a-b/1-2 E of Room 3 *403.20 a.s.l.

56 Pl. 4. M71.1:8160. Byzantine or later.

Iron. Heavily corroded.
Max. L. 4.70; max. W. blade 1.40; diam. socket 0.90; L. tang 2.20; Th. tang 0.30.
AcT local grid E20.00-22.00/N0.00-2.00 *400.40-400.00 a.s.l. just below surface; found with Islamic coin C71.20.

57 Byzantine?

Iron.
Max. L. 8.10; L. blade 5.30; max. W. blade 3.10; Th. tang 0.50.
Pa E97.50/N32.60 *96.05.

Type 7b: This type is similar to Type 7a but the blade is widest below center. Dating and distribution are similar.

58 Pl. 4. M60.77:2854. Middle-Late Byzantine?

Iron.
Max. L. 8.50; max. W. blade 1.70; Th. tang 0.35.
AcT Trench E E1050.00-1054.00/S1067.00-1070.00 in fill.

Tang has round section.

See Davidson, *Corinth* XII, 200, pl. 91 nos. 1529-1530 (Byzantine).

The following are all similar to 58:

59 M60.19:2348. Byzantine?

Iron.
Max. L. 5.20; max. W. blade 1.50; Th. blade 0.15; Th. tang 0.30.
AcT Trench A mixed fill around wall E1009.00-1011.00/S1071.00-1073.00.

60 M61.8:3174. Byzantine?

Iron. Corroded.
Max. L. 7.60; max. L. blade 4.80; max. W. blade 1.60; Th. 0.30.
AcT Trench E.
Tang has square section.

61 M60.27:2407. Byzantine?

Iron. Tang broken. Heavily corroded.
Max. P.L. 10.00; L. blade 7.00; max. W. blade 2.70; Th. tang 0.30.

AcT Trench A E1007.00-1010.00/S1070.00-1076.00
*404.74 a.s.l. Found with nail heading tool 145.

62 M62.39:4344. Byzantine?

Iron. Point missing.
Max. P.L. 5.80; max. W. blade 1.70.
AcT local grid E14.00/N29.00 *401.60 a.s.l. near
bottom of cistern.

63 M60.18:2325. Byzantine?

Iron. Tang broken.
Max P.L. 4.00; max. W. blade 2.00.
AcS Trench A E1123.00-1134.00/S1106.00-1120.00
surface.

64 M60.13:2261. Byzantine?

Iron. Corroded; edges chipped.
Max. P.L. 8.30; L. blade 6.00; max. W. blade 2.70;
Th. blade 0.20; Th. tang 0.40.
BE-DD E1.20/N98.75 *100.00
Tang has round section.

65 M60.34:2456. Byzantine?

Wrought iron. For metallographic and atomic absorption
analyses see Chap. V, Table V.5. Heavily corroded;
tip broken off.
Max. P.L. 8.50; P.L. blade 3.20; max. W. blade 1.30;
Th. tang 0.40.
BE "fill N of S wall, main entrance," *100.00-99.90.

66 M60.1:2227. Byzantine?

Iron.
Max. L. 9.00; L. blade 4.50; max. W. blade 1.90; Th.
blade 0.20; Th. tang 0.30.
BE-A E13.50/N7.50 along W face of arch, *100.25-
100.00.
Socket has square section, tang has round section.

67 Byzantine?

Iron. Tang broken.
Max. P.L. 5.50; max. W. blade 1.50; Th. blade 0.30.
BE-H E4.00-10.00/N53.00-57.00 *99.30-99.00.

68 Byzantine?

Iron. Heavily corroded.
Max. L. 8.80; max. W. blade 1.90; Th. tang 0.30.
BE-H E10.00-12.70/N75.00-80.00 *98.00.

69 Byzantine?

Iron.
Max. L. 7.50; max. W. blade 2.20; Th. tang 0.60.
BCH W9.00-15.00/N62.00 *102.00-101.00.

70 Pl. 4. Byzantine?

Iron. Complete?
Max. L. 8.00; max. W. blade 2.40; Th. tang 0.50.
Pa-W E43.10/N94.20 *97.58.

Slightly convex edges, concave shoulders.

71 M73.2:8226. Early Byzantine?

Iron.
Max. L. 6.20; max. W. blade 1.90; Th. tang 0.50.
BS Colonnade E26.90/S12.20 *97.35.

72 Byzantine?

Iron.
Max. L. 8.50; max. W. blade 2.00; Th. tang 0.70.
RT E20.00-25.00/S20.00-25.00 *98.50 surface.

73 Byzantine?

Iron.
Max. L. 8.50; max. W. blade 2.15; Th. tang 0.50.
RT E24.00/S18.00 *98.00 in upper fill.

Type 7c: Similar to 7a and b but blade widest
above center. Only one example was found.

74 Pl. 4. M60.58:2658. Middle to Late Byzantine?

Iron. Tip and tang broken.
Max. P.L. 5.40; max. W. blade 1.60; Th. blade 0.20;
Th. tang 0.45.
AcT Trench C E1079.00-1095.00/S1066.00-1076.00
*400.65-400.50 a.s.l. in mixed fill.
Tang has square section.

Most of the last nine arrowheads seem to belong
to different subtypes, although since there are only one
or two examples of each it is difficult to establish this
with certainty. Most also lack clear-cut contexts and
only a few are distinctive enough in form to date with
any confidence by parallels from other sites.

75 Pl. 5. M62.43:4351. Late Byzantine?

Iron. Part of tang broken; corroded.
Max. P.L. 7.70; L. blade 6.00; max. W. blade 2.00; Th.
tang 0.60.

AcT local grid E17.00/N20.00 *402.37 a.s.l. at base of wall fragment Unit 7, Level Ia.

Triangular blade, widest at base. Tang round in section.

76 Late Byzantine?

Iron.

Max. P.L. 6.30; max. W. blade 2.00; Th. tang 0.80.
BE-H E5.60-7.00/N52.70-53.70 *101.00 in Test Pit.

Similar to 75.

77 Pl. 5. M62.48:4421. Late Byzantine?

Iron. Tip broken; corroded.

Max. P.L. 6.10; max. W. blade 0.90.

AcT local grid W25.00-31.00/S6.00-9.00 *402.50-402.00 a.s.l. along fortification wall in mixed fill.

Slender, triangular blade with slight midrib; short socket at base fitted with slender tang.

78 M60.51:2613. Byzantine?

Iron. Heavily corroded.

Max. P.L. 7.20; max. W. blade 1.30; Th. tang 0.30.
AcT E998.00-1000.00/S1072.00-1073.00 *402.50 a.s.l. Level II.

Similar to 77.

79 Pl. 5. M61.5:3150. Byzantine?

Iron.

Max. L. 11.00; L. blade 5.20; max. W. blade 1.40; Th. blade 0.30; Th. tang 0.50-0.10.

MC E25.00-35.00/N70.00-80.00 *100.50-98.50 in rubble.

Flat, leaf-shaped blade with rounded tip. Boss or short socket at base fitted with long tapered tang with square section.

See Robinson, *Olynthus* X, 379, pl. 120 no. 1893, for a similar example in bronze. Robinson suggests an oriental origin for the type.

80 Pl. 5. M58.62:828. Roman-Byzantine?

Iron. Heavily corroded.

Max. P.L. 7.50; L. head 2.10.

L NW side of trench, *98.00-97.50 in mixed context.

Blunt rounded head with short collar or boss at base; long tapering tang. A bolt?

81 Pl. 5. Roman-Byzantine?

Iron. Corroded.

Max. L. 4.25; L. head 1.20; max. W. head 0.95; Th. tang 0.15.

RT E23.50/S19.40 *96.45 mixed context.

Similar to 80 but with smaller conical head.

82 Pl. 5. M61.76:3784. Middle-Late Byzantine.

Iron. Tang broken off at end.

Max. P.L. 6.80; max. W. blade 0.60; Th. tang 0.30.

BE-H E3.00-4.00/N51.00-52.00 *99.50-99.00.

Slender four-sided tapering blade with short socket at base into which a tang is inserted.

See Ploug-Oldenburg, *Hama* IV.3, 55, fig. 18.11 5E743, Level A1? (A.D. 1302-1401); Chantre, *Recherches dans le Caucase* III, 112, pl. 12.5 (Kammunta nekropolis, "Scytho-Byzantine," very common type in Kourgans nekropoli in this period); B. Dean, "The Exploration of a Crusaders' Fortress (Monfort) in Palestine", *BMM* 22 (1927) Sept. suppl., 37 fig. 53 N, P, 38 (beginning of 13th C. A.D.); Haspels, *Phrygie* III, 99, 151, pl. 42c2-6 (no date); Boehmer, *Boğazköy* VII, 153, pl. 52 nos. 1573-1578 (unstratified).

83 Pl. 5. M61.16:3207. Byzantine.

Iron.

Max. L. 14.50; max. W. blade 3.90; L. tang 7.40; Th. tang 0.40; Th. blade 0.30.

MC E33.00-35.00/N79.00 *99.00 above floor in fill.

Blade has two flat tapered prongs with triangular section meeting at base of V. Below is a short socket fitted with a long, narrow tang. Prongs are quite sharp along inner edges. The type seems to be a fairly widespread medieval hunting weapon, perhaps originating in the Caucasus and then spreading westward.

See Petrie, 35, pl. 41.167 (Caucasus); Chantre, *Recherches dans le Caucase* III, 112, pl. 12.3 (Kammunta nekropolis, "Scytho-Byzantine"). Hampel II, 882; III, pl. 527 fig. 16.2. An example from Blenheim is in the Ashmolean Museum, no. 1879.248. According to the label, it is medieval and "used in hunting for hamstringing deer." The type is alluded to also in Shakespeare, *As You Like It*, II, 1: "Come, shall we go and kill us venison?/ And yet it irks me the poor dappled fools,/ . . . / Should in their own confines with forked heads/ Have their round haunches gored."

Armor

Finds of armor or parts of armor are virtually non-existent at Sardis. In fact, only a single piece can be identified as an armor scale.

84 *Pl. 5. 6th C. B.C.?*

Iron. Corroded; broken in two joining pieces; edges worn and chipped.

Max. P.L. 8.00; max. W. 1.90; Th. at ridge 0.50.
HoB W15.00-16.00/S103.00-104.00 to ca. *99.60-98.80.

Oblong scale with narrow vertical ridge. Holes for attachment in upper r. and lower l.

Scale armor was used by the Roman army but was also used by peoples to the east. See e.g. Petrie, 38, pl. 42.115-117 (Khorsabad, 8th C. B.C.); Schmidt, *Persepolis* II, 100, pl. 77.6-8 for Persian iron armor scales from the Treasury; Stronach, *Pasargadae*, 181, fig. 96.1-5 (Achaemenid). Ammianus Marcellinus 24.4.15 says the Parthians used armor fashioned of tongues of iron connected like feathers, while Herodotus 7.61 says that the Persian army "wore . . . on their bodies sleeved tunics of divers colors, with scales of iron like in appearance to the scales of fish . . ." (Loeb Classical Library transl. by A. D. Godley).

HORSETRAPPINGS

A small, but interesting group of metal objects consists of horsetrappings and related equipment. Comprising only six objects—four bridle ornaments, a side piece of a bit, and a stirrup—this group can hardly supply a history of horsemanship at Sardis; nevertheless, some of the pieces are foreign, and the rest so distinctive that they provide a considerable amount of historical information.

In addition, some of the bells and miscellaneous "attachments" (91-103) may have served as decoration on horse harnesses; since there is no way to determine this from context, however, it was felt safest to treat them separately.

Bridle or Harness Ornaments

Of the four objects in this category, the two smaller ones (85, 86) appear to be of Scythian manufacture, while the other two (87, 88) are probably Lydian, but also show possible Scythian and Near Eastern influence. Both Scythian examples are of types that can be dated externally to the late seventh to early sixth century B.C., although one was found in a somewhat later sixth century B.C. context and the other came from a mixed context.

87 and 88 are quite different from 85 and 86 in style and in the way they were attached to other materials. The two pairs were clearly made by different hands and were probably intended to be placed in

different positions on the harness. Neither 87 nor 88 was found in a clear context, but closest parallels suggest a sixth century B.C. date for both.

85 *Pl. 6. M68.1:7597. Scythian, ca. 600 B.C.*

Copper alloy; hollow interior filled with lead.
H. 2.20; W. beak to back of head 2.50; ext. diam. base 1.80; diam. lateral holes 0.40.
PN Unit XXVIII W260.70/S344.50 *86.80.

Stylized hawk's or eagle's head with solid curved beak and hollow neck forming base. The round eyes are in relief; pupil and beak defined by incision. The neck is pierced laterally by four circular openings; a fifth perforation is at the base. The once hollow neck was filled with lead secondarily, perhaps to convert it into a weight.

Two very similar attachments are in the Museum of Fine Arts, Boston, 1970.511, 512; H. 2.50; W. at beak 2.50 (*Pl. 6*). This type of bridle attachment is closely paralleled at sites in South Russia and eastern Turkey, whence the Scythians and other nomads came on their way to the west in the late seventh to early sixth century B.C.

Publ. *BASOR* 199, 18, 21 fig. 11; *Dergi* 17.1 (1968) 112. See B. B. Piotrovskij, *Karmir Blur* I (Yerevan 1950) 92-93, figs. 61, 62; idem, *Karmir Blur* II (Yerevan 1952) 37, fig. 19; idem, *Il regno di Van Urartu* (Rome 1966) 349 fig. 82; H. Hauptmann, "Die Grabungen auf dem Norşun-Tepe, 1970," in Middle East Technical University, *Keban Project Publications* Series 1 no. 3 Keban Project 1970 Activities (Ankara 1972) 105-107, pl. 69.1 (in Scythian horse burial); Artamonov, 12, 14, 23, figs. 7, 13 (Kelermes Barrows, 1, 2; 6th C. B.C.); Borovka, 64, 99, pl. 32 F-H (carved bone bridle ornaments from the Kuban district, 7th-6th C. B.C.). For other Scythian objects at Sardis see *BASOR* 211, 33-34 n. 28; 182, 13-14; Mitten, 45; and forthcoming study by R. S. Thomas. I want to thank John F. X. McKeon for bringing many of these parallels, including those in the Boston Museum, to my attention.

86 *Pl. 6. M62.8:4183. Scythian, ca. 600 B.C.*

Copper alloy. Some corrosion along ridges in beak.
Max. H. 3.80; W. 4.20; diam. base opening 1.00; diam. lateral openings 1.00; 0.80; 0.60; 0.90.
HoB Building C W20.00-25.00/S90.00 to ca. *99.80, mixed context.

Stylized bird's head with solid, high curving exaggerated beak. Narrow "flutes" or ridges parallel curve of beak. Base is a hollow cube with four circular lateral openings at right angles to each other and a fifth opening on bottom.

The general distribution of the type is similar to that of **85**. This type was also apparently adapted by the Achaemenid Persians and can be seen in sculptural representations of their horses on the Apadana at Persepolis. Actual examples in various materials were also found in the Treasury at Persepolis.

See Schmidt, *Persepolis II*, 100, pl. 79.3-5 (limestone, chalk and carnelian examples); Pope, IV, pls. 94A, B; 99B, 110B (Apadana reliefs). In addition to parallels cited for **85** see R. D. Barnett and W. Watson, "Russian Excavations in Armenia," *Iraq* 14 (1952) 143, 146 fig. 22 (Karmir Blur, ca. 625 B.C.). For flutings in beak see Borovka, 64; Artamonov, figs. 7, 15, 26, pl. 58.

87 Pl. 6. M62.57:4476. Lydian, early 6th C. B.C.

Tin bronze. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3. Complete but unfinished. Solid casting; edges untrimmed; surface detail not worked out. Surface cleaned.

Max. H. 4.20; Max. L. head to rump 5.30; Th. 0.90; W. attachment loops 1.80; H. loops 1.50; diam. loops 0.80.

HoB W20.00/S95.00 *99.88.

A recumbent ibex in relief rests on folded legs with head turned backward facing r., beard draped over the hindquarters. A long, tapered, segmented horn curves upward from the forehead, then down and inward to meet the base of the neck. The nearly circular depression between the horn and neck is filled with solid metal and into this area the ear projects, its slant paralleling the upward curve of the horn. Shallow, indented lines separate the neck from back, legs from underbelly and tail from rump. The details of the head and horn are not clearly formed but one can make out a relief eye and nostril, a line for the mouth and four relief ridges marking off the segments of the horn. The back is flat with two vertical attachment loops which, according to R. Maddin, were apparently cast in one piece with the plaque.⁹ Running across the back between and under the loops is a flat, shallow horizontal depression.

This piece is one of a small group of such plaques which seems to center in western Turkey, but it is the only one so far known to derive from a legitimate excavation. The fact that it is unfinished probably indicates that it was manufactured in Sardis, although, unfortunately, the context in which it was found yielded

no information on the workshop or process by which it was made. It is tempting to speculate that it belongs to a local school of Lydian decorative metalwork. In favor of a Lydian attribution is the distinctly orientalingizing flavor of the motif which would seem to be characteristic of some aspects of archaic Lydian art as noted by G. M. A. Hanfmann in *Sardis R2* (1978) 14, 16.

Hanfmann, when the ibex was first excavated, suggested a date of late fifth/early fourth century B.C. on the basis of associated finds (*BASOR* 170, 11) although the context does not preclude an earlier date. At present, on the basis of comparisons with dated material from Ephesus, and general stylistic considerations, a date in the early sixth century B.C. seems best for this piece.

Publ. *BASOR* 170, 11, 16, fig. 9; G. M. A. Hanfmann and A. H. Detweiler, "Sardis: A Season of Varied Discoveries—Some Splendid Mosaics and a Third Century A.D. Synagogue," *ILN* (March 9, 1963) 344 fig. 26; Amandry, 153 no. 1.12; Greenewalt, "Lydian Elements," 41, pl. 18.11-13; Waldbaum (full discussion of chronology and style). For parallels see H. Otto, "Achämenidische Kleinkunst in Anatolien," *Die Antike* 17 (1941) 81-88, figs. 1, 2; H. Th. Bossert, *Altanatolien: Kunst und Handwerk in Kleinasien von den Anfängen bis zum Völligen ausgehen in der griechischen Kultur* (Berlin 1942) 94, pl. 320 fig. 1217 (bronze ibex, allegedly from Izmit); R. D. Barnett, "A Review of Acquisitions 1955-62 of Western Asiatic Antiquities (I)," *BMQ* 26 (1963) 99, pl. 50a (bronze ibex in British Museum, no. 132120); W. K. Simpson, *The Museum Year: 1972-73 The Ninety-Seventh Annual Report of the Museum of Fine Arts, Boston*, 51 (bronze ibex, Museum of Fine Arts no. 1972.924); Hogarth, *Ephesus*, pls. 21.5, 23.2 (ivory ibex, now in Istanbul Archaeological Museum). For early Near Eastern history of the motif of the reclining caprid with folded legs and head turned back see Amandry, 149-160.

88 Pl. 7. M60.24:2367. Lydian 6th C. B.C.

Copper alloy. Complete. Light green patina.

Max. L. 9.50; H. 4.50; int. diam. loops 0.70; 0.60.

AcN local grid W1.00/S8.00 *391.50 a.s.l. in Late Byzantine debris.

A recumbent boar in relief facing r., snout resting on forehoof, tail curled up, then laid horizontally across rump. The bristles stand up in a continuous diminishing line from ear to tail with deliberate gap in center. Ear, eye, tusk, rump, genitals are in relief; bristles are shown as incised vertical lines. Incision is used to pick out details of head, tail, legs; a deep indentation at neck separates head from body.

The back is hollow with a narrow rim around the edge. There are two vertical attachment loops with projecting tabs at the top; according to R. Maddin, the loops may have been made separately from the plaque and cast

9. I owe this information to David G. Mitten who was present when Robert Maddin saw the piece at Sardis.

on.¹⁰ Thus it apparently differs from **87** in technique of manufacture, as it does also in size.

Hansen, writing before the discovery of the Sardis ibex (**87**), compared the boar to the "Izmit" ibex because of its loop attachments, as well as stylistically to the ivory ibex and boar from Ephesus and bronze boar and ibex in the British Museum (*BASOR* 168, 28-29, 31). He concluded on stylistic grounds that the Sardis boar and related Ephesus and British Museum pieces should be dated in the first half of the sixth century B.C. Although Hansen seems to lean towards a Lydian attribution for the Sardis boar, he cautiously relegates it to a larger "Ionian" or "East Greek" stylistic framework (*ibid.*, 36). Given the similarity to the bronze ibex (**87**) it is tempting to see both of these as nearly contemporary examples of local Lydian craftsmanship.

Publ. D. Hansen, "An Archaic Bronze Boar from Sardis," *BASOR* 168 (1962) 27-36 with refs.; *BASOR* 162, 39, 41 fig. 24; Hanfmann-Detweiler, 6 fig. 7; *idem*, "From the Trojan War to the Time of Tamerlane: Discoveries on the Citadel and in the Ancient City of Sardis," *ILN* (April 1, 1961) 538 fig. 14; Mitten, 55-56, fig. 13; Amandry, 153 no. II.8, 154; Greenewalt, "Lydian Elements," 41, pl. 18.14; Waldbaum.

Horse-Gear

Only two examples of horse-gear other than bridle ornaments were found, both evidently later in date than the preceding.

89 Pl. 7. M62.38:4343. Late Roman-Early Byzantine?

Copper alloy. Excellent state of preservation.

L. 14.20; W. 0.80-0.50; W. loop 2.70; H. loop 1.60. PN W240.00/S365.00 *90.50.

Side piece of a bit. Slender, tapered rod with octagonal section, the narrower end bent up. At each end is a conical finial, the larger one decorated with incised radiating lines. A double loop is riveted to the center of the rod for attaching to harness.

See Emery, *Ballana and Qustul* I, 253 fig. 92, 254 Type 3, 256; II, pl. 60A, Tomb B73-2 no. 336 (5th-6th C. A.D.). For discussion of types of bits and origins see Robinson, *Olynthus* X, 487-495 esp. 494, pl. 162 no. 2555 (before 348 B.C.).

90 Pl. 7. M62.25:4222. Byzantine?

Iron. Corroded.

H. 14.00; max. W. 13.50; diam. footrest 5.30.

AcT local grid E20.00-25.00/N25.00-29.00 *403.60-403.50 a.s.l. upper fill.

Stirrup. Curved band with flat section widened at bottom for footrest. At top is a horizontal, oblong slot for leathers; at sides are circular grips.

According to J. K. Anderson, *Ancient Greek Horsemanship* (Berkeley and Los Angeles 1961) *passim*, and E. Saurel, *Histoire de l'équitation des origines à nos jours* (Paris 1971) 102-103, 180-181, the stirrup was not used in Greek or Roman Imperial times; hence our example is unlikely to have been made before the Byzantine era. For similar example from a Migration period context see J. A. H. Potratz, *Die Pferdetransport des alten Orient* *AnaO* 41 (Rome 1966) pl. 39.88b. Potratz (p. 60) notes that metal stirrups first appear in South German graves of the Migration period not much before the 7th C. A.D. For possible origin of the stirrup among the Scythians to the east see W. W. Arendt, "Sur l'apparition de l'étrier chez les Scythes," *ESA* 9 (1934) 206-208; A. D. H. Bivar, "The Stirrup and its Origins," *Oriental Art* n.s. 1 (1955) 61-65. C. Chenevix Trench, *A History of Horsemanship* (New York 1970) 64 ascribes the invention of the stirrup to the Huns, perhaps in the 4th C. A.D.

BELLS

Of the thirteen bells found at Sardis, most are quite small, ranging in height from ca. 1.60-6.10 cm. Most also have loops at the top for suspension.

The variety of functions that such bells might serve is discussed by Chavane, *Salamine* VI, 147-148 and René Cagnat and Victor Chapot, *Manuel d'archéologie romaine* II *Decoration des monuments* (Paris 1920) 194-195. Emery, *Ballana and Qustul* I, 262-265, fig. 94 and II, pls. 55-56 shows how bells served as decorative horsetrappings. Some of the Sardis examples may have been used in clusters as horsetrappings; most seem too small, however, to have been hung singly around the necks of such animals as sheep and goats.

All but one, **103**, are of copper alloy, though **91** and **92** have traces of iron clappers. The iron bell, **103**, is by far the largest (H. ca. 21.00) and was perhaps used to bell a large animal like an ox or camel.

Contexts of most were mixed, though some (**93**, **94**, **100**, **102**, **103**) came from HoB proper and BS and so could be dated with some certainty to the Early Byzantine period.

91 Pl. 8. M67.12:7370. Lydian?

Copper alloy with iron clapper corroded to one wall. Suspension loop missing.

H. 1.60; diam. base 1.10.

PN W277.00/S323.60 *87.00.

10. See above n. 9.

Conical bell with faint incised parallel lines around circumference.

See Goldman, *Tarsus* I, 393, fig. 266 no. 98 (Grave 3, 3-4 C. A.D.).

92 *Pl. 8. M64.35:6429. Hellenistic-Roman?*

Copper alloy. One side dented. Corroded; traces of iron clapper inside.

Max. H. with loop 2.40; diam. base 2.00; diam. loop 0.90.

MTE E49.00-54.00/S125.00-131.00 *101.10.

Small conical bell cast in one piece with proportionally large suspension loop.

93 *Pl. 8. M59.32A:1593. Early Byzantine, late 6th-early 7th C. A.D.*

Copper alloy. Dented; clapper missing.

H. with loop 6.10; H. without loop 3.90; diam. base 5.40; Th. 0.20.

HoB Area 13 E30.00/S80.00 *97.82 on floor.

Nearly hemispherical bell cast in one piece with somewhat irregular suspension loop. Two incised lines around circumference; inside edge beveled.

See Chavane, *Salamine* VI, 148 no. 422, pl. 43 (Roman Imperial, 1st-3rd C. A.D.); Colt, *Nessana* I, 54, pl. 22.37 (7th C. A.D. or later); Ploug-Oldenburg, *Hama* IV.3, 88 no. 5E810, fig. 32.8, level A3 (A.D. 1170-1260); Russell, no. 46 (Aeneas, Early Byzantine).

94 and **95** are similar to **93**:

94 Early Byzantine.

Copper alloy. Clapper and part of suspension loop missing.

Max. P.H. 3.90; diam. base 3.30.

BS E9-10 E61.00/S2.20 *96.89.

95 M59.81:2220. Early-Middle Byzantine?

Copper alloy. Clapper, part of rim and loop broken.

Max. P.H. 5.20; diam. base 5.50.

BW Lat W51.00-53.00/N8.00 *98.00-97.00.

96 *Pl. 8. M61.55:3676. Byzantine?*

Copper alloy. Clapper missing.

Max. H. 5.70; diam. base 4.30; diam. loop 1.20.

AcT local grid W21.00-23.00/N0.00-3.00 *401.40-401.30 a.s.l.

Conical bell decorated with pairs of parallel incised lines around circumference. Four holes in lower edge,

two pairs opposite each other. Suspension loop made separately and pinned into top of bell.

97 Late Roman-Byzantine?

Copper alloy. Clapper missing.

Max. H. 2.30; diam. base 2.00; diam. loop 0.90.

Syn P E116.00/N13.00 *96.70.

Conical bell with pentagonal suspension loop.

See Greifenhagen, *Schmuckarbeiten* II, 115-116, pl. 79 nos. 2-6d (Late Roman-Early Byzantine).

98 *Pl. 8. M62.12:4189. Byzantine?*

Copper alloy. Clapper missing.

Max. H. 3.80; diam. base 3.00.

AcT local grid E21.00-22.00/N21.00-22.00 *403.50-403.45 a.s.l.

Domed bell cast in one piece with pentagonal suspension loop. Surface decorated with irregularly grouped incised lines.

99 *Pl. 8. M60.80:2947.*

Copper alloy. Clapper missing.

Max. H. 5.70; diam. top 2.50; diam. base 4.00; Th. 0.10.

BE "North Corridor" E33.00-35.00/N115.00-125.00 *97.00-95.00.

Truncated conical bell cast in one piece with suspension loop.

100 *Pl. 8. M62.16:4207. Early Byzantine, late 6th-early 7th C. A.D.*

Copper alloy. Clapper and part of edge of base missing.

Max. H. 2.70; diam. base 1.60.

BS E14 E83.00-84.00/S0.00-1.00 *96.55-96.30.

Conical bell cast in one piece with suspension loop. Surface decorated with three pairs of parallel incised lines: one set at base, one around middle, one under loop.

101 *Pl. 8. M61.53:3674. Turkish?*

Copper alloy. Clapper and part of one side missing.

Max. H. 5.00; diam. 4.30.

MRd E15.00/S23.00-50.00 *98.00 surface fill of Ottoman Road.

Spherical bell with flat suspension loop. Lower half crudely cut into curved segments. Around the middle are two crudely incised parallel lines.

102 *Pl. 8. M62.60:4480.* Early Byzantine, late 6th-early 7th C. A.D.

Copper alloy. Heavily corroded; clapper, several fragments of rim and top missing.

Max. P.H. 6.90; diam. base 6.00.

BS E14 E81.00/S2.00 *96.80 just above floor.

Conical bell with spreading base. Around the outer surface are finely incised parallel lines.

103 *Pl. 8. M63.39:5553.* Early Byzantine, late 6th-early 7th C. A.D.

Iron. Heavily corroded; clapper missing. Bronze corrosion adhering to top, possibly from part of chain or clapper.

Max. H. ca. 21.00; max. diam. 12.00.

BS E16 E95.90/S1.40 *96.00.

High domed bell, narrowing at base. At top is a depression, possibly for suspension loop or clapper.

TOOLS

The Sardis excavation is fortunate in having uncovered a large quantity and variety of iron tools, many well enough preserved for their original shape and function to be clear. There are several kinds of farming tools including ploughshares, hoes, spades, sickles and billhooks, and a fair number of carpentry, masonry and possibly smithy implements such as axes, adzes and their variants, hammers, chisels, punches, a saw and a wood plane. Some of the carpentry tools, of course, have agricultural functions as well. There are also domestic tools: knives, needles, shears, spindle hooks and the like.

The tools range in date and provenance from the deep Iron Age levels of the Lydian Trench in HoB to archaic Lydian at HoB and PN, Roman-Byzantine at HoB proper, the BS and elsewhere, and through the Turkish periods at PN, though of course not all types are represented in all periods or contexts.

The best and most representative sampling of implements comes from the BS, especially Shop E10-11—the “Hardware Shop”—in which many agricultural and carpentry tools were found, together with nearly 200 bronze and iron locks and other objects.¹¹ The tools

and locks of this shop formed part of the shopkeeper's stock-in-trade which also included spades (114-116), a billhook (122), hammer-adzes (136, 137), pick-axes (140, 141), a sledgehammer (144), a smiths' set (146) and a chisel (153) among other items. Some of the tools may have served as the shopkeeper's own working tools, since he seemed to manufacture certain items such as the locks in his shop. The contents of this shop, along with implements from the other shops and from contemporary HoB (e.g. a spade or fire shovel, 113, trowel, 110, and a chisel, 157) provide a valuable body of utilitarian material firmly datable in the period from the late sixth to early seventh century.

Agricultural Implements

Ploughs

Parts of two ploughs of the “beam-ard” type have been found, one (104) in the S Colonnade of the RT, the other (105) on the Acropolis. The type is described by K. D. White as a “breaking” plough, symmetrical in design, with “a curved plough-beam pierced by a spear-like body (Lat. *dentale*), with which is incorporated the stilt.”¹² In both Sardis examples only the *dentale* is preserved, but its resemblance to White's illustration of a bronze votive model from Cologne (pl. 10b) is so close as to make identification certain. According to White, the beam-ard is still used in western Turkey and other parts of the Near East, raising the possibility that one or both of the Sardis pieces are more recent than Roman antiquity.

104 *Pl. 9. M69.10:8020.* Late Roman-Early Byzantine?

Iron. Only sole-beam or *dentale* preserved but condition is excellent.

Max. L. 37.00; L. blade 11.50; max. W. blade 6.50; L. hook 3.80; max. W. shaft 3.70; Th. shaft 2.30.

RT S Colonnade E27.00-33.00/S29.00-32.00 *97.00-96.25.

Shaft with rectangular section is flattened at one end to form a triangular blade with sharp point. At other end the shaft narrows and curves downward to form a pointed hook. In either side of the widest part of the blade is a small hole.

See White, 127, 189.99, pl. 10b.

12. White, 127, 189.99, pl. 10b. See also R. Aitken, “Virgil's Plough,” *JRS* 46 (1956) 97-106; Haberey, 99-100, fig. 4; W. H. Manning, “The Plough in Roman Britain,” *JRS* 54 (1964) pl. 8.1.

11. See *BASOR* 191, 22; J. S. Crawford, forthcoming study of the Byzantine Shops.

105 *Pl. 9.*

Iron. Only sole-beam or *dentale* preserved. Corroded. Max. L. 45.50; max. W. blade 10.00; W. shaft 4.90-3.00; Th. shaft 2.30; diam. ring 9.00; W. ring 3.40. AcT Trench C E1079.00-1083.00/S1070.00-1073.00 ca. *400.55 a.s.l.

Similar to **104** but somewhat larger. Found with large flat iron ring. The ring was not attached and may or may not belong to the plough.

Hoes

Three hoes (**106-108**) were recovered. Unfortunately the least well preserved (**108**) came from the best context—BS E16 of Early Byzantine date. **106** and **107** appear to be of roughly the same type, White's *sarculum*,¹³ which has a fairly broad blade and a long, hammered socket, curved near the blade, then straightening and rising at right angles to the blade. The socket of **108** is broken off but it may have been similarly treated.

Two items, tentatively called trowels (**109, 110**), may also have served as some form of hoe or mattock, depending on how they were hafted. Each has a flat, triangular blade with a fairly short hammered socket at right angles to it. Contexts in BS E6 and HoB proper date each to the Early Byzantine period.

106 *Pl. 9.* Roman or later?

Iron. Badly corroded and flaked; end of socket missing. Max. P.W. blade 18.00; max. P.L. blade 13.00; Max. P.H. with handle 17.50. HoB W2.00-12.00/S117.00-122.00 *100.20-99.80.

Nearly rectangular blade set at right angles to S-shaped curving handle, ending in hammered open socket.

For general discussion of hoes and mattocks see White, 36-43; pl. 2.

The following are similar to **106**:

107 *Pl. 9.* M67.34:7547. Early Byzantine.

Iron. Heavily corroded and fragmentary. Max. P.H. 21.50; max. W. blade 13.50; max. L. blade 9.00; diam. socket 5.50-3.50. BS E13 drain E75.00-78.00/S0.00-2.00 *95.36.

108 M63.51:5732. Early Byzantine.

Iron. Corroded and fragmentary. Max. P.H. 16.00; max. W. blade 24.00; max. L. blade 14.00. BS E16 E91.50-95.00/S0.00-3.50 *97.00-96.40 in fill above the floor.

*Trowels***109** *Pl. 9.* Early Byzantine.

Iron. Heavily corroded; blade and handle broken. Max. P.L. blade 13.00; max. W. blade 6.50; W. handle 3.50. BS E6 E41.00/S3.80 *96.84 found in a putlog hole.

Triangular flat blade set at right angles to curved handle. No socket preserved.

See Jacobi, *Saalburg* I, 218, fig. 32 nos. 12-17; II, pl. 35.6-9 (Roman).

110 M59.13:1366. Early Byzantine.

Iron. Heavily corroded and fragmentary. L. blade 15.50; max. P.H. 2.50. HoB Room 5 E30.00/S70.00 *97.64 Level I floor. Similar to **109**. Open, hammered socket preserved. Found with shovel **113**, and chisel **157**.

Spades and Shovels

Seven spades were found. Five came from BS or HoB proper and can therefore be dated to the Early Byzantine period (**113-117**). Two (**115, 116**) were found together just outside the Hardware Shop.

Types vary: three (**114-116**) are socketed, one internally; two (**111, 112**) are tanged; one (**113**) has a long iron handle and turned up edges, and perhaps served as a fire shovel (it was found in a domestic context in HoB).¹⁴

111 *Pl. 10.* M60.55:2628.

Iron. For metallographic analysis see Chap. V. Corroded; edge of blade and end of tang missing. Max. P.L. 14.30; max. W. blade 12.60; Th. blade 0.30; max. P.L. tang 6.40; W. tang 1.70; Th. tang 0.80.

14. For general discussion of spades and shovels and their functions see White, 17-35; see also Gailey-Fenton.

13. White, 43-47, figs. 22-26.

acT Trench C E1079.00-1080.00/S1074.00-? *401.15
a.s.l. in fill.

Rectangular flat blade in same plane as narrow tapered tang.

112 *Pl. 10.* M63.26:5350. Early Byzantine?

Iron. In several joining pieces with parts of blade and end of tang missing.

Max. P.L. 26.00; blade 11.00 × 12.00; max. P.L. tang 13.00; W. tang 3.00; diam. tang. 0.95.

Syn P "Restaurant" E122.00-125.00/N5.00-6.00 *97.50-97.00.

Flat, rectangular blade with slightly sloping shoulders in same plane as tapered tang with round section.

113 *Pl. 10.* M59.30:1591. Early Byzantine.

Iron. Blade broken from handle; end of handle not preserved.

Max. P.L. 50.00; blade 14.50 × 10.80.

HoB Room 5 E30.00/S70.00 *97.64 on floor found with trowel **110**, and chisel **157**.

Fire shovel? Rectangular blade with sides turned up to form a low rim. Shoulders slope to long, narrow handle.

114 *Pl. 10.* M72.7:8198. Early Byzantine.

Iron. Heavily corroded; one corner of blade, top and back of socket missing.

Max. P.L. 39.70; max. W. blade 20.20; max. L. blade 21.40; max. P.L. socket 9.10; W. socket 7.40.

BS E10-11 E64.90-67.00/S4.50-6.10 *96.90.

Nearly rectangular blade with rounded corners, slight taper to edge. Shoulders slope to large open hammered socket in same plane as blade.

115 Early Byzantine.

Iron. Corroded and broken.

Max. P.L. 14.00; max. W. 19.00; socket 3.20 × 3.10. Colonnade outside BS E11 E60.00-66.00/S4.00-6.00 *98.00-96.70.

Wide flat blade with internal socket. Socket square in section at edge of blade. Found with **116**.

See Jacobi, *Saalburg* I, 444, fig. 69.2 (Roman).

116 Early Byzantine.

Iron. Corroded and broken. Most of edge missing.

Max. P.L. 13.00; max. P.W. 18.00.

Colonnade outside BS E11 E60.00-66.00/S4.00-6.00

*98.00-96.70.

Curved blade with wide open hammered socket. Found with **115**.

117 M58.112:505. Early Byzantine.

Iron. Only blade with one corner missing preserved.

Max. P.L. 24.00; max. W. 19.50.

BS W3 *97.10.

Flat, oblong blade.

Sickles and Pruning Hooks

Sickles have a long history at Sardis. The earliest (**118**) comes from deep levels in the Lydian Trench at HoB, possibly dating as early as the eleventh or tenth century B.C., certainly no later than the eighth. Another (**119**) from somewhat higher up, is probably archaic Lydian in date, as is **120** from PN. All three are heavily corroded and encrusted, but show a characteristic strongly curved blade.

From Roman or later times come three billhooks or pruning knives—related to sickles but with a more pronounced curve and elongated tang or socket at right angles to the blade.¹⁵ The best preserved example (**121**) comes from CG and is not well stratified; but one (**122**) comes from the Hardware Shop in BS and can be dated to the Early Byzantine era; the third (**124**) from the S Colonnade of RT is less well dated. A fourth, poorly preserved blade (**125**), which may belong to the same class of instrument, was found in BS E5.

118 *Pl. 10.* Early Iron Age.

Iron. For metallographic and atomic absorption analyses see Chap. V, Table V.5. Corroded and encrusted. In several joining fragments but probably not complete.

Max. P.L. 20.00; max. W. 2.60.

HoB Lydian Trench W4.00-6.00/S89.00-92.00 *95.30-94.75.

Slender curved blade with concave edge and pointed tip. Apparently uniform width except at tip. No sign of rivets.

For finds in the lower levels of the Lydian Trench see *BASOR* 186, 31-37, esp. 36 where the sickle is referred to as a knife blade.

119 *Pl. 10.* Lydian, 6th C. B.C.

Iron. Three joining pieces; heavily corroded.

Max. P.L. 15.00; W. haft 2.40; L. rivet 2.60.

15. See White, 85-103 and figs. 59, 62, and 183-184 *falx arboraria* for discussion; see also Gaitszch, 65 fig. 39; 77.

HoB Lydian Trench W31.00-35.00/S125.00-128.00 *99.20-99.00.

Curved blade with concave edge, apparently tapering somewhat to point. At other end is a straight haft with a single large iron rivet preserved.

See Boehmer, *Boğazköy* VII, 158, pl. 55 no. 1653 (Phrygian).

120 *Pl. 10.* M68.9:7701. Lydian, 6th C. B.C.

Iron. In two pieces; heavily corroded.

Max. P.L. 16.00; W. 2.80.

PN W271.00-273.00/S330.00-332.00 *85.40-85.20.

Elongated, narrow blade with roughly parallel sides. One end (the haft?) is curved downward and ends or is broken off straight across. The other end is somewhat tapered and apparently rounded.

121 *Pl. 10.* Roman or later.

Iron. Apparently complete.

Max. L. ca. 50.00; max. W. blade 2.60; W. tang 1.00. CG local grid W22.00-23.00/N4.00 within arch TW *99.50-99.00.

Tall cutting blade curved over to form a sharp point at right angles to tang ed shaft. Shaft tapers from blade to midpoint, then flares to widest point at base. One shoulder angles in from base of shaft to tang which has a "rat-tail" curve at end.

The type corresponds to White's *falx arboraria* or billhook, used for pruning trees. See White, 86-88, figs. 60 (West Germany), 62 (Boscocoreale), 183-184. For CG see *Sardis* R1 (1975) Chap. IX.

122, 123 *Pl. 10.* Early Byzantine.

Iron. **122** nearly complete but in four fragments; **123** only a small fragment of blade.

122: Max. P.L. 34.40; W. blade 3.00; diam. socket 3.50

123: Max. P.L. 16.00; max. P.W. 4.00.

BS E11 E67.94-71.11/S2.50-3.00 *96.20

122 has high, arched blade tapering to point at one end. Blade curves into straight shaft which ends in hammered open socket. **123** is only a section of curved blade.

See Wiegand-Schrader, *Priene*, 389 fig. 504; Petrie, 47-48, pl. 57.52 (Roman, from Egypt); White, 86, fig. 59 (Pompeii), 183 (discussion).

124 Byzantine or later.

Iron. Point and most of forepart of blade gone; heavily corroded.

Max. P.L. 27.00; diam. socket 2.00.

RT S Colonnade E27.00-33.00/S29.00-32.00 *97.00-96.25.

Similar to preceding but shaft becomes open socket filled with the top of an iron pole.

See White, 87 fig. 62 (Boscocoreale), 184.

125 *Pl. 10.* M69.2:7918. Early Byzantine.

Iron. Inner edge, point and handle broken; corroded. Max. P.L. 25.50; max. W. 4.00; Th. back 0.60; Th. edge 0.11.

BS E5 E37.73/S3.60 *96.56.

Curved tapering blade. One end apparently straightens to form tang or socket.

See Petrie, 48, pl. 57.48 (Boscocoreale).

Fork

126 *Pl. 10.* Early Byzantine.

Iron. Handle broken; heavily corroded.

Max. P.L. 12.50; W. handle 2.10; Th. handle 1.15; Th. prong 0.90.

BS E11 E70.00-71.00/S2.50-3.00 *96.20.

Two-pronged fork with curved prongs bent at right angles and coming together to form a flat handle with rectangular section. From size and design it would seem to belong to the class of light two-pronged fork identified by White as a *ferrea* or *pastinum*, used for cultivating vineyards, orchards and gardens.

Publ. *BASOR* 191, 22. See White, 108 (Boscocoreale); discussion: 107-113, figs. 87, 88 (Pompeii), 187; Petrie, 55, pl. 67.44, 45 (Pompeii). The Pompeii and Boscocoreale examples are both much earlier than the Sardis piece but are fairly close to it in form.

Carpentry, Masonry and Smithing Tools

A variety of tools that could be used by carpenter, stone mason or smith have been found. They include axes, adzes and their variants; sledge hammers; chisels of all kinds; boring tools; pounders; a saw; a plane and a compass. In some cases there is an obvious overlapping of function. Axes and adzes can be used in farming as well as carpentry, and a chisel can be used by carpenter, mason or smith, depending on size and weight. With this in mind it has been thought best to group these tools by form, suggesting only where it

seems obvious which of the crafts might have employed a particular object.¹⁶

Adzes and Axes

Adzes, axes and their variants (axe-adzes, hammer-adzes, etc.) serve a number of different functions in both agriculture and carpentry. Axes or hatchets are used for splitting or chopping and have their cutting edge parallel to the line of the socket or haft. Adzes are used for whittling or chipping and have their cutting edge at an angle to the socket or haft.¹⁷

The earliest tool of this class is an adze (127) found in the deepest sounding of the Lydian Trench at HoB and possibly dating as early as the eleventh or tenth century B.C. The only other simple adze (128) comes from a sounding on the Acropolis and is probably much later than the first.

The earliest axe (129) comes from an archaic Lydian level at HoB, while two more (130, 131) are both from BS and much later in date.

Several tools of this general type were designed to serve double functions and therefore have two working edges. There are four axe-adzes (132-135) with edges at right angles to each other on either side of the socket—all from mixed contexts but presumably of Roman or later date. All are variants of the *dolabra* as defined by White.¹⁸ Three hammer-adzes (136-138) have heavy, blunted heads opposite adze blades. All three came from BS, two (136, 137) from the Hardware Shop. A hammer-axe (139), however, was found in a less reliable context and may be modern. Two pick-axes (140, 141) both came from BS E10, part of the Hardware Shop complex, and have elongated points opposite the axe blades. This is another form of the *dolabra*. A miniature version of the pick-axe (142) may have served as either a jeweler's hammer or a votive implement.

Adzes

127 Pl. II. Early Iron Age.

Iron. For metallographic analysis see Chap. V. Heavily corroded on surface but quite a bit of metal preserved in the core.

Max. P.L. 21.90; max. W. 6.30.

HoB Lydian Trench Deep Sounding E10.00-15.00/
S100.00-105.00 *94.80.

Broad, flat blade, roughly rectangular in shape. Working edge flattened and slightly splayed, other end narrows somewhat and is constricted for hafting—presumably by lashing to haft with rope or leather.

128 Pl. II. M60.52:2617. Byzantine?

Iron. Heavily corroded; one end broken off.
Max. P.L. 21.00; max. W. 4.20; Th. 0.60; int. diam. socket 2.00.

AcT E1005.00-1007.00/S1070.00-1071.00 *402.70 a.s.l.

Preserved part of blade has parallel sides with rounded edge perpendicular to socket. Other end is thickened, blunt and rectangular in section. Round socket nearest thickened end.

Axes

129 Pl. II. Lydian, 7th C. B.C.

Iron. Corroded; part of one edge missing.
Max. P.L. 24.50; W. at center 8.00; W. edge 9.00; diam. pole 1.90.

HoB Lydian Trench W29.00/S99.00 *98.00 on floor,
Lydian level 2, near corner of Bldg. K.

Double-edged axe with flattened and splayed edges parallel to socket. Part of an iron pole corroded into socket.

Publ. *BASOR* 203, 9.

130 Pl. II. M68.22:7843. Early Byzantine.

Iron. Broken through socket and about half missing.
Max. P.L. 11.90; W. edge 8.40; W. at socket 2.80.
BS E5 E33.80-35.80/S0.00-5.00 *96.44-96.20.

Flat blade with wide, splayed edge parallel to remains of socket.

131 M63.45:5642. Early Byzantine.

Iron. Broken in half and heavily encrusted.
Max. P.L. 9.80; W. 7.00; Th. "neck" 2.50.
BS E12 in cupboard in N wall E72.00-73.10/N0.00-
0.75 *98.00-97.50, with 716.

Trapezoidal blade, thinned at cutting edge. Other end constricted for hafting.

Axe-Adzes

132 Pl. II. M62.47:4416. Roman or later.

Iron. Surface encrusted.
L. 17.00; max. W. axe blade 4.70; max. W. adze blade

16. For general discussion of carpentry tools and their development see Goodman, *passim*, Mercer, *passim* and Gaitzsch, 22-23.

17. White, 59. For comprehensive history of both types see Goodman, 12-38.

18. White, 61-64, figs. 36, 38.

3.00; ext. diam. socket 3.50; int. diam. socket 2.00.
MC E19.00/N42.00 *97.50-97.25.

Double-edged instrument with edges flattened and played. Axe edge parallel to socket; adze blade sloped down from socket, edge perpendicular to it. Round socket with traces of wood preserved in it.

See White, 61-64, figs. 36 (Pompeii), 38 (Boscoreale), 181; Petrie, 15, pl. 14.53 (Boscoreale); Wiegand-Schrader, *Priene*, 388 fig. 494.2-4. Similar implements have also been identified as mattocks, see W. H. Manning in Gailey-Fenton, 18 fig. 1. b, c, e, j, k. 19.

133 *Pl. II*. M62.52:4443. Late Roman?

Iron. Heavily corroded.

L. 24.00; max. W. axe blade 6.80; max. W. adze blade 2.50; int. diam. socket 1.80; H. at socket 5.20.
PN Street of Drain Pipes *89.00 mixed context.

Similar to **132** but socket is more distinct from blades on ext.

The following are similar to **132**:

134 Roman or later.

Iron. Heavily corroded; socket damaged.
Max. P.L. 20.10; W. axe blade 6.00; W. adze blade 2.60; int. diam. socket 2.30; H. at socket 2.70.
HoB W10.00/S100.00 *100.20-99.20.

135 Roman-Byzantine.

Iron. Corroded and broken.
Max. P.L. 23.00; W. axe blade 6.50; W. adze blade 4.00; int. diam. socket 2.40.
BS E14 in drain under shop E82.00/S1.00 *95.50.

Hammer-Adzes

136 *Pl. II*. Early Byzantine.

Iron. Heavily corroded.
Max. P.L. 23.00; W. adze blade 4.90; diam. hammer head 3.90; W. at socket 3.70; int. diam. socket 2.40.
BS E11 E67.94-71.11/S0.00-3.00 *96.20.

Seen in profile the implement has a high curvature. At one end is a thin, curved adze blade sloping down from a fairly wide socket. At the other end is a rounded pounding head. Found with **137**.

Publ. *BASOR* 191, 22. See Petrie, 18, pl. 18.136 (Roman); Gaitzsch-Matthäus, "Schreinerwerkzeuge," 163-166, pl. 24; Gaitzsch, 54, fig. 26, 75.

137 *Pl. II*. Early Byzantine.

Iron. Edge broken; heavily corroded.
Max. P.L. 23.30; W. adze blade 3.60; diam. hammer head 3.60; int. diam. socket 2.20; W. at socket 5.50.
BS E11 E67.94-71.11/S0.00-3.00 *96.20.

Nearly flat in profile. The adze edge is straight, the hammer end is square to rectangular in section. Narrow socket. Found with **136**.

138 Early Byzantine.

Iron. Edges and part of socket broken. Heavily corroded.
Max. P.L. 21.00; W. adze blade 3.50; diam. hammer head 2.80; int. diam. socket 2.50; H. at socket 3.50.
BS E6 E43.71/S1.60 *96.86.

High curvature in profile similar to **136**. Adze blade slopes down from socket and is thinned and played at edge. Hammer end apparently round in section. Fairly large socket.

Hammer-Axe

139 *Pl. II*. M72.8:8201. Roman or later.

Iron.
Max. L. 16.50; max. L. axe blade 9.10; max. W. axe blade 6.00; L. hammer head 2.30; diam. hammer head 2.30; Th. at socket 3.80; diam. socket 2.40.
BE-H E7.00-7.50/N52.70-53.00 *99.80-99.60.

Axe blade wide, flattened and played. At other end is a blunt hammer head. On either side of the base of the socket is a pointed lug.

See Petrie, 12, pl. 11.95-98 (Sweden); Römisch-Germanisches Zentralmuseum Mainz, *Ausstellungskataloge I, Grossmähren Slawenreich zwischen Byzantinern und Franken* (Mainz 1966) 202 no. 699, fig. 76 (seven iron axes, two with pointed sockets on both sides, from Nejdeč, 9th C. A.D.).

Pick-Axes

140 *Pl. II*. M72.5:8196. Early Byzantine.

Iron. Tip of pick, edge of blade missing; heavily corroded.
Max. P.L. 22.90; L. axe blade 9.60; max. W. axe blade 6.80; P.L. pick point 10.00; max. W. pick 2.60; H. at socket 5.00.
BS E10 E65.40-65.65/S4.50-4.80 *96.99.

Flat axe blade played at edge. Other end is a tapering point; socket in center with pointed lugs above and below it.

For discussion of type see White, 61-64, figs. 36, 38. See also Petrie, 15, pl. 14.60 (Mainz); Curle, *Roman Frontier Post*, 278, pl. 57.

141 Pl. 11. M72.6:8197. Early Byzantine.

Iron. Pick point broken.

Max. P.L. 32.00; L. axe blade 10.90; max. W. axe blade 9.50; max. P.L. pick point 17.30.

BS E10 E63.82/S4.50-4.80 *97.08.

Similar to **140** but without pointed lugs on socket.

Miniature or Votive Pick

142 Pl. 12. M60.5:2246. Late Roman-Byzantine?

Iron shaft with lead head.

Max. L. head 5.20; L. shaft 6.70.

HoB E20.00/S105.00 ca. *101.20 in mixed fill.

Head pointed at one end, blunt at the other; pierced through center with socket. Iron shaft with square section remains in socket. Perhaps functioned as a jeweler's hammer for beating gold foil into a die. Such a small tool could also have had a votive or funerary function. A whole assemblage of miniature tools was found in a late fourth century A.D. German grave near Cologne and included several axes, picks, gardening and agricultural tools.

For the Cologne hoard see Haberey, 94-104, esp. 100-101, fig. 2 nos. 9-12, 18. See also Davidson, *Corinth* XII, 195, pl. 89 nos. 1474-1475 (bronze "miniature axes," one Byzantine, one uncertain); Höckmann, 45, pl. 29 no. 130 (Roman "votive hammer").

Sledgehammers

Two large, socketed sledge heads were recovered (**143**, **144**), the first from a Lydian level at HoB, the other from BS E10. These could serve both mason and smith for a variety of functions such as breaking stone and striking heavy chisels or sets (see **146**).

143 Pl. 12. M61.82:3864. Lydian, 6th C. B.C.?

Wrought iron or low carbon steel. For metallographic and atomic absorption analyses see Chap. V, Table V.5. One end gone; heavily corroded.

Max. P.L. 20.00; max. W. 6.00; Th. 3.30; int. diam. socket ca. 2.20.

HoB W19.00/S95.00 *99.60.

Preserved end blunted. Socket at presumed original center. Head apparently swells at socket.

144 Pl. 12. Early Byzantine.

Iron. Both ends broken.

Max. P.L. 21.00; W. at socket 5.30; diam. head 3.40; diam. socket 1.50.

BS E10 E64.90-67.00 *97.60-96.00.

Socketed head with square section at each end.

See Jacobi, *Saalburg* I, 218 fig. 32.5-9, 219 (Roman, to 3rd C. A.D.); Petrie, 40, pl. 45.104 (Pompeii); Curle, *Roman Frontier Post*, 285, pl. 63.11; Gaitzsch, 16-17, 32-33, figs. 3.4, 72 (Weyer, Remagen).

Nailheader

145 Pl. 12. M60.28:2414. Byzantine?

Iron. Badly corroded; one end broken.

Max. P.L. 23.50; W. bar 1.60; diam. head 4.00; Th. bar 0.70.

AcT Trench A E1007.00-1010.00/S1070.00-1076.00 *404.74 a.s.l. Found with arrowhead **61**.

Straight bar with flat, rectangular section connecting two round heads each with a hole through the center. Corrosion obscures the shape of the holes.

Nailheaders in various sizes are part of a smith's normal equipment. To use, the hot nail shaft is inserted point first through the hole in the heading tool set on an anvil, and the head is formed by hammering the protruding end of the shaft.

The context in which this example was found does not allow a precise date to be assigned.

For function and use see Bealer, 96-97, 207-208; A. A. Watson, *The Village Blacksmith* (New York 1968) 12-13. For nails, see **295-325**. For other ancient examples of nailheaders see W. H. Manning, "Blacksmithing," in Strong-Brown, 151-152, fig. 259 (Silchester, Roman).

Smiths' Sets

Smiths' sets are heavy chisels used for cutting hot or cold metal. This is accomplished by striking the head with a sledge hammer.¹⁹ Two were found at Sardis, one in BS E11, the other in the vicinity of BE.

146 Pl. 12. Early Byzantine.

Iron. Heavily corroded; edge broken.

Max. P.L. 20.00; W. edge 3.40; Th. head 2.40.

BS E11 E67.94-71.11/S2.50-3.00 *96.20.

19. See Bealer, 89; Frere, *Verulamium* I, 163 for function.

Heavy implement with round section; top flattened where pounded. The other end is narrowed to a slightly splayed edge.

See Frere, *Verulamium I*, 163, fig. 60 nos. 2, 3 (Roman, 2nd and 3rd C. A.D.).

147 *Pl. 12.* M60.85:2977. Roman or later?

Iron.

Max. L. 21.50; max. W. 5.40; diam. head 5.40; Th. edge 1.00.

BE N of LNH E43.50/N124.00 *95.75.

Heavy implement with round section, flattened head. Lower end thinned to edge. In sides are narrow grooves.

See Jacobi, *Saalburg I*, 218 fig. 32.10, 11; 219 (Roman, to 3rd C. A.D.).

Smiths' or Carpenters' Punches

The punch is used by the smith to punch holes in hot metal or by the carpenter to drive nail heads below the surface of wood. Since smiths' punches are usually fairly long to keep the smith's hand away from the hot metal being worked on, the two rather short examples from Sardis are probably carpenters' tools.²⁰

148 *Pl. 12.* M68.7:7657. Early Byzantine.

Iron. Point broken; heavily corroded with bits of charred wood adhering to surface.

Max. P.L. 9.00; diam. top 2.00; P. diam. point 0.70. BS E2 E14.00-16.00/S2.00-4.00 *97.00.

Tapered rod with flat top and round section.

See Frere, *Verulamium I*, 163-164, fig. 60 nos. 4, 5.

149 *Pl. 12.* Roman or later?

Iron.

L. 11.40; W. top 1.50; W. point 0.30; Th. 0.80. HoB E49.00-62.00/S101.00-109.00 to ca. *100.00.

Tapered rod with rectangular section, flattened at one end, pointed at the other. According to Jack Silva, metalsmith, this implement could have functioned as an engraving tool or tracer.

Chisels

Fourteen chisels of widely varying sizes and shapes were recovered (150-163). Four (152, 153, 155, 159) are certainly Early Byzantine, since three of them are from BS, and one is from HoB proper (157). Two from upper levels of PN are probably Turkish (162-163). The rest are not securely dated but probably range from the Late Roman through Byzantine periods.

150 *Pl. 12.* Roman-Byzantine?

Iron. Top broken.

Max. P.L. 23.10; diam. top 1.55; W. at juncture to point 2.10; Th. point 0.60.

Pa E98.80/N66.00 *95.90

Straight shaft with flat (broken) top and round section becoming square near point. Lower end tapers to sharp point. Probably a mason's chisel or punch.

See Petrie, 20, pl. 21.42 (Pompeii); D. Strong and A. Claridge, "Marble Sculpture," in Strong-Brown, 196 fig. 318 (Aphrodisias).

151 *Pl. 12.* Roman or later?

Iron. Edge broken; heavily corroded.

Max. P.L. 30.00; diam. shaft 2.00.

RT E80.00-83.00/S7.00-11.00 *95.50-94.75 under sidewalk.

Heptagonal shaft with slightly domed top tapers to large blade, thinned towards the edge.

152 Early Byzantine.

Iron. Corroded; edge apparently broken.

Max. P.L. 34.80; W. blade 2.40; diam. top 1.40; Th. edge (?) 0.60.

BS E13-14 E80.00-85.00/S1.00-4.00 *97.32-96.80.

Long shaft with round section becoming rectangular near edge.

153 *Pl. 12.* M59.18:1396. Early Byzantine.

Iron. For atomic absorption analysis see Chap. V, Table V.5. Edge chipped.

Max. P.L. 12.30; max. W. edge 1.40.

BS W9-10 W31.35-36.85/S3.40-4.40 *98.80-97.80.

Shaft with rectangular section is thickened towards the middle. One end is hammered to a flat slightly splayed edge, the other is pointed, probably for insertion into a handle.

20. Bealer, 87-88; Frere, *Verulamium I*, 163.

154 Pl. 12. M64.39:6526. Late Roman or later.

Iron. Heavily corroded.

L. 17.80; W. edge 1.30.

ERd E128.00-130.00/N4.00-6.00 *96.90.

Long narrow shaft with rectangular section flattened and slightly splayed at edge. According to metalsmith Jack Silva, this tool could have been used for carving detail work on stone or as a chasing or engraving tool for copper.

155 Pl. 12. M63.62:5878. Early Byzantine?

Iron. Heavily corroded; end of shaft broken.

Max. P.L. 23.50; W. edge 5.00; W. end 1.50.

Syn P "Restaurant" E121.00-121.60/N0.50-1.10 *97.00-96.75.

Shaft with round section tapered at one end, possibly for insertion into handle. Other end flattened and widely splayed.

This general type of chisel with widely splayed blade belongs to a type known as the paring chisel and is meant to be guided by hand pressure rather than struck by a mallet. **156-162** also belong to this general type.

See Frere, *Verulamium* I, 164, fig. 60. no. 10 for function.

156 Pl. 12. Byzantine or later.

Iron. End of shaft and edge broken.

Max. P.L. 18.00; W. shaft 2.50; max. W. blade 4.60;

Th. shaft 1.45; Th. blade 0.10-0.20.

BS Colonnade W56.00/S7.70 *96.40.

Shaft with rectangular section, slightly tapered towards blade then flattened and splayed to edge.

157 M59.30:1591. Early Byzantine.

Iron. End of shaft broken.

Max. P.L. 16.00; W. edge 3.00; W. shaft 1.50.

HoB Room 5 E30.00/S70.00 *97.64 on floor. Found with **110** and **113**.

Shaft with square section; splayed triangular blade.

See Gaitzch, 46 fig 16.1, 73 (Kastell Niederbieber).

158 Roman or later.

Iron.

L. 24.10; W. edge 4.85; W. end 1.50; Th. edge 0.20; Th. shaft 0.90.

AcT floor around hearth in buildings S of Unit 6 local grid E10.00/N13.00 *402.00-401.40 a.s.l.

Similar to **157**. Top of shaft flattened.

159 Pl. 12. Early Byzantine.

Iron.

Max. P.L. 10.00; W. blade 5.30; L. blade 3.80; W. shaft at base 1.00.

BS E11 E67.94-71.11/S2.50-3.00 *96.20. (One of three in this context; other two not seen by writer).

Short, straight shaft pointed at end; broad, flat triangular blade.

Find publ. *BASOR* 191, 22. See Jacobi, *Saalburg* I, 208, 218 fig. 32.19; II, pl. 34.24 (Roman); Petrie, 21, pl. 21.108 (Pompeii); Frere, *Verulamium* I, 164-165, fig. 61.11; D. Strong and A. Claridge, "Marble Sculpture," in Strong-Brown, 198 fig. 324r.

160 Pl. 13. Lydian, 7th C. B.C.?

Iron. Heavily corroded; end broken.

Max. P.L. 10.00; W. edge 2.50.

HoB W9.00-11.00/S110.00-114.00 to *98.90-98.70.

Shaft with round section broadened to rectangular blade with straight edge.

161 Pl. 13. M60.48:2608.

Steel. For metallographic analysis see Chap. V. Heavily corroded.

Max. L. 12.50; max. W. 4.80; W. shaft 1.00; Th. 0.60.

AcT E1005.00-1009.00/S1074.00-1075.00 *402.60 a.s.l. in fill.

Square blade with straight edge and shoulders; thickening at transition to shaft. Rectangular shaft slightly tapered to blunt end.

162 Pl. 13. M62.44:4364. Turkish, 14th C. A.D.

Iron. Edge corroded and chipped.

Max. P.L. 23.70; W. blade 5.40; W. shaft 0.55; Th. 0.40.

PN Workshop W of Church E W225.00/S380.00 *90.70-90.50. Found with plane **167** and bowl **519**.

Long, slender shaft slightly flattened at one end, flattened and splayed to triangular blade at other.

Publ. *Sardis* M4 (1976) 92; *BASOR* 170, 15.

163 Pl. 13. M62.26:4223. Middle Byzantine-Turkish.

Iron.

L. 24.00; W. edge 2.00; Th. shaft 1.00; diam. head 2.50.

PN W233.00/S370.00 *91.00.

Long shaft with square section and flat round head at one end. Other end flattened to slightly splayed edge.

See Jacobi, *Saalburg* I, 209 fig. 28.7; 230 fig. 34.10, 15; II, pl. 34.32 (Roman to 3rd C. A.D.).

Boring Tools

Only two boring tools, an awl (164) and an auger (165), could be identified. The awl could be used by carpenter or leather worker for making small holes, the auger for making larger holes in wood.

Awl

164 Pl. 13. M61.34:3497. Late Roman or later.

Iron with bone handle. Metal corroded but complete. Max. L. 16.80; L. point 11.00; diam. point 0.40; diam. handle 1.00.

MRd in fill along N edge of S Colonnade foundation E5.00/S29.50 *96.50.

Long, tapering point fitted into a bone handle and held in place by an iron band around the base of the handle. The turned handle has a knob at the top set on a short "neck" or constriction below which are two rings.

Auger

165 Pl. 13. M63.2:4966. Turkish.

Iron. L. 33.50; max. W. handle end 2.00; max. W. blade 2.70; W. shaft 1.00.

PN W245.00/S355.00 *90.00 "Islamic floor no. 2."

Long shaft with square section flattened at upper end to fit into a wooden handle set perpendicular to blade. The lower end is concave and spatulate with rounded edge forming a kind of scoop. As handle is turned edges of blade would form a hole in wood.

See Goodman, 165-166, fig. 166 no. 7 (10th-13th C. A.D. Russian "spoon auger") and p. 123 fig. 128 (Viking, ca. A.D. 950-1000). For Roman examples of similar size see W. H. Manning, "A Hoard of Romano-British Ironwork from Brampton, Cumberland," *Transactions of the Cumberland and Westmorland Antiquarian and Archaeological Society* 66 (1966) 15-16 nos. 11, 12; Jacobi, *Saalburg* I, 209 fig. 28.17; II, pl. 34.7.

Hand Saw

166 Pl. 13. M59.21:1411. Early Byzantine.

Iron. In five fragments, partly restored. Max. P.L. 37.00; W. blade 5.30; diam. ring 2.70; Th. tang 0.30; Th. blade 0.40. BS W7 W20.00-23.50 *97.60-97.00.

Straight back slopes down to pointed tip. Straight serrated edge with small teeth. At back is a flat rectangular tang surrounded by an iron ring held in place by rivets.

See Boehmer, *Boğazköy* VII, 159, pl. 57 no. 1678 (Hellenistic); Goodman, 123, fig. 128 top (Viking, ca. A.D. 950-1000).

Wood Plane

167 Pl. 13. M62.45:4365. Turkish, 14th C. A.D.

Iron. Badly corroded and now in several pieces.

L. 18.50; H. 9.50; W. 8.00.

PN Workshop W of Church E W225.00/S380.00 *90.70-90.50. Found with chisel 162 and bowl 519.

Flat sole with semicircular mouth set closer to toe. Diagonally supported chisel-like blade protrudes through mouth and is supported by a backward curving extension of the sole. The blade is held against the curve by a forked support resting at the bottom against two corners of the toe and coming together at the top to form the hand grip.

Publ. *Sardis* M4 (1976) 92; *BASOR* 170, 15. For iron planes from Hellenistic times to the 19th century see J. M. Greber, *Die Geschichte des Hobels von der Steinzeit bis zum Entstehen der Holzwerkzeugfabriken im frühen 19 Jahrhundert* (Zurich 1956). Gaitzsch-Matthäus, "Schreinerwerkzeuge," 166-169; Goodman, 39-109; F. H. Wildung, *Woodworking Tools at Shelburne Museum* Museum Pamphlet Series no. 3 (Shelburne, Vt. 1957) 14-31, 34-35; and Mercer, 99-133, also have useful information. There are no direct parallels in any of these sources, however.

Compass

168 Pl. 13. M63.11:5088. Roman or later.

Copper alloy. One leg broken off.

L. 15.00; W. near loop 0.60.

Syn FC E110.00/N3.00 *97.30-97.00 in fill over the floor N of S door. Found near balance 459.

Preserved leg is a flat, tapered bar marked with groups of two and three horizontal bars at regular intervals. At wider end is a loop with a hole through which passes a pin with a round head holding two disks, one of which is the top of the second leg. Behind the disks a slim wedge passes through a slot in the pin serving to tighten and loosen the position of the legs.

See British Museum, *Greek and Roman Life*², 185, fig. 204; Tarbell, 141, pl. 112.268-270, esp. 270 with wedge tightener (before A.D. 79); Petrie, 60, pl. 72.213-215 (Roman); Jacobi,

Saalburg I, 210, fig. 29.18-19; II, pl. 34.3 (Roman); Gaitzsch, 50 fig. 20 (right), 74 (Cambodunum).

Pounders

A curious set of tools appear to be tanged pounders (169-171). All come from BS. They have fairly heavy working ends with flat lower faces, narrowing to a tang at the top, presumably for insertion into a wooden handle. This apparent use of a wooden handle and the rather fragile tang seem to preclude their being used as smiths' flatters, which they otherwise resemble.²¹ Possibly these served a more domestic function such as the pounding or tenderizing of meat.

169 *Pl. 13.* M69.1:7917. Early Byzantine.

Iron.

Max. P.L. 18.80; max. W. 4.50; max. Th. 2.00; W. tang 0.90.

BS E5 E37.73/S3.60 *96.56.

Wide head with flat underside narrows to tapering tang with rectangular section.

170 *Pl. 13.* Early Byzantine.

Iron. Heavily corroded.

Max. P.L. 22.00; W. head 4.90; Th. head 3.30; W. shoulders 4.20.

BS E5 E33.60-37.00/S0.00-5.00 *98.00-97.00.

Trapezoidal head with sloping shoulders; long tapered tang with rectangular section.

171 Early Byzantine.

Iron. Heavily corroded.

Max. P.L. 20.80; W. base 4.70; W. shoulders 2.90; L. head 11.00; Th. head 1.80; Th. tang 2.60.

BS 8 or 9 E55.20-58.00/S0.00-2.50 *96.40-96.20.

Similar to 170.

Domestic Tools

Metal household implements include those used in the kitchen—knives, choppers, scrapers, ladles and spoons—and those used for sewing and spinning—needles, spindle hooks, shears and a thimble. The largest

category is knives which were found in all contexts and at all dates at Sardis.

Knives

Knives are defined as one-edged cutting instruments and may serve many functions. They are used as domestic and agricultural cutting tools and may also be used as weapons. Since it is not always possible to identify the primary function of such instruments, particularly in the corroded state of most of the knives included here, it was thought best to treat them all together, even though some may have served other or multiple functions.

Iron knives found at Sardis range in date from as early as the tenth century B.C. to the latest periods of occupation. The earliest knife (172) is interesting chiefly for its age; it was found in the same deep stratum of the Lydian Trench at HoB as the adze (127) and sickle (118). All three of these testify to the use of iron tools beginning around the tenth century B.C. at Sardis. Two more (173, 174) come from the eighth to seventh century B.C. levels in HoB, while eleven (175-185) were included among the curious sacrificial "pothoards" found in Lydian levels at HoB and PN.²² These hoards, now dated ca. 575-525 B.C. by C. H. Greenewalt, Jr.,²³ typically consisted of four clay vessels—a skyphos, a round-mouthed jug, a trefoil-mouthed oinochoe, a plate—and an iron knife. Inside a number of the jugs were the bones of newborn puppies. These puppy burials or pothoards have been interpreted as the remains of a ritual meal honoring Hermes the "Dog Throtler," a Lydian god whose earlier name was Kandaules.²⁴ Most of the knives in these pothoards are in very poor condition, but do not appear to be all of the same type.²⁵

Other closely datable knives at Sardis are scarce. A number of knives of different types (187-189, 191-194) came from the BS and are therefore Early Byzantine in date. Several others (190, 195, 196) came from the vicinity of the shops and the Main Road and may be Late Roman to Early Byzantine in date. The rest come from scattered mixed contexts (several from the Acropolis).

22. *BASOR* 166, 8-9; 170, 10-11, 24; 177, 4, 6; 203, 8.

23. See Greenewalt, *Ritual Dinners*, 30 for information on the dating of the pothoards.

24. *BASOR* 170, 10; J. G. Pedley, "Carrians in Sardis," *JHS* 94 (1974) 97-99; Greenewalt, *Ritual Dinners*, 40-55.

25. Greenewalt, *Ritual Dinners*, 17-18. The remains of at least sixteen knives have been reported from these deposits; several knives have apparently completely corroded away.

21. Bealer, 91-92; H. R. B. Smith, *Blacksmiths' and Farriers' Tools at Shelbourne Museum: A History of their Development from Forge to Factory*, Museum Pamphlet Series, no. 7 (Shelbourne, Vt. 1966) 110-112.

172 Pl. 14. Early Iron Age.

Iron. Heavily corroded; shape somewhat obscured.

Max. P.L. 10.00; max. W. 2.60.

HoB Lydian Trench W0.00-3.00/S100.00-106.00 *95.50-94.80.

Back apparently convex and edge concave sloping up to tip at one end. Other end narrows to form tang.

173 Pl. 14. Lydian, 8th C. B.C.

Iron. Heavily corroded; shape obscured.

Max. P.L. 7.00.

HoB Lydian Trench E5.00/S90.00 to *97.30.

Broad blade with apparently blunt tip at one end. Back convex, tang curved.

174 Pl. 14. Lydian, 7th C. B.C.

Iron. Heavily corroded.

Max. P.L. 17.00; W. butt 1.25.

HoB Lydian Trench E1.00-5.00/S90.00-95.00 *98.10 on floor.

Narrow blade with convex back and concave edge sloped up at one end to form a pointed tip. Other end forms a straight butt with two rivets set one above the other.

For stratigraphy see *BASOR* 170, 4-6. For shape, see Boehmer, *Boğazköy* VII, 147, pl. 46 nos. 1300, 1302-1304 (early first millennium B.C.).

175 Pl. 14. M70.1:8073. Lydian, ca. 575-525 B.C.

Iron. Heavily corroded but complete.

Max. P.L. 22.80; max. W. blade 2.70; max. W. tang 1.30.

PN W248.00/S371.00 *86.60-86.40 in pothoard.

Slender blade with gently convex back, sloping down at one end to pointed tip, at other end to tang. Edge slightly concave with shoulder sloping up to tang. Tang tapered with rectangular section and remains of wood on the surface.

This is the best preserved example of this type of knife found among the puppy burials or pothoards.

Discovery publ. *BASOR* 203, 8; Greenewalt, *Ritual Dinners*, 76 no. cd 26.5, pl. 33.

176-178 are similar to **175**:

176 M63.23:5316. Lydian, ca. 575-525 B.C.

Iron. Heavily corroded and in two joining fragments. Traces of burnt wood on blade.

Max. L. 14.50; max. W. 3.00; W. tang 0.50.

HoB Lydian Trench W12.00/S102.00 *99.60 in pothoard.

Publ. *BASOR* 174, 8; Greenewalt, *Ritual Dinners*, 70 no. cd 19.5, pl. 33.

177 M63.31:5396. Lydian, ca. 575-525 B.C.

Iron. Heavily corroded.

Max. P.L. 10.00; max. W. 1.70.

HoB Lydian Trench W13.00/S103.00 *99.50 in pothoard.

Tang has round section.

Publ. *BASOR* 174, 8; Greenewalt, *Ritual Dinners*, 71 no. cd 20.6, pl. 33.

178 Lydian, ca. 575-525 B.C.

Iron. Heavily corroded; in two joining pieces; tip missing.

Max. P.L. 13.80; max. W. 2.10.

HoB Lydian Trench W15.00/S110.00 *99.50 in pothoard.

Publ. *BASOR* 174, 8; Greenewalt, *Ritual Dinners*, 72 no. cd 21.5, pl. 33.

179 M64.15:5996. Lydian, ca. 575-525 B.C.

Iron. Heavily corroded; tang or haft missing.

Max. P.L. 8.50; Max. W. 1.40.

HoB Lydian Trench W12.00/S118.00 *99.50 in pothoard.

Possibly similar to **175**.

Publ. Greenewalt, *Ritual Dinners*, 72 no. cd 22.5, pl. 33.

180 Pl. 14. M63.16:5183. Lydian, ca. 575-525 B.C.

Wrought iron. For metallographic and atomic absorption analyses see Chap. V, Table V.5. Heavily corroded; tip missing.

Max. P.L. 12.10; max. W. 2.20.

HoB Lydian Trench E0.00/S112.00 *99.64 in pothoard.

Straight back sloping down to tip at one end. Other end forms a straight butt with two rivets and traces of wood preserved on surface. Edge is slightly concave. This seems to be a second type of pothoard knife, differing from the first (**175-179**) chiefly in the lack of curvature in the back and the lack of a tang.

Discovery publ. *BASOR* 174, 8; Greenewalt, *Ritual Dinners*, 69 no. cd 18.5, pl. 33.

181 M62.65:4575. Lydian, ca. 575-525 B.C.

Iron. Corroded and fragmentary; tang and tip missing. Max. P.L. 10.00; max. W. 1.80.
HoB Lydian Trench W22.00/S96.00 *99.20 in pothoard.

Back apparently straight. Possibly similar to **180**.

Publ. Greenewalt, *Ritual Dinners*, 66 no. cd 15.5, pl. 33.

182 Pl. 14. M61.75:3783. Lydian, ca. 575-525 B.C.

Iron. Heavily corroded; tip missing. Max. P.L. 13.00; max. W. 3.10; Th. 1.00.
HoB Lydian Trench E13.00/S98.00 *99.55 in pothoard.

Wide blade with straight back and edge. Edge slopes up and back to short tapered tang. This is apparently a third type of pothoard knife.

Publ. Greenewalt, *Ritual Dinners*, 58 no. cd 4.5, pl. 33.

The following is apparently similar to **182**:

183 M64.38:6505. Lydian, ca. 575-525 B.C.

Iron. Heavily corroded; tang and tip broken. Max. P.L. 9.50; max. W. 2.30.
PN W241.00/S352.00 *87.05 in pothoard.

Publ. Greenewalt, *Ritual Dinners*, 74 no. cd 24.5, pl. 33.

184 Pl. 14. M62.67:4668. Lydian, ca. 575-525 B.C.

Iron. Heavily corroded; tip missing. Max. P.L. 13.00; max. W. 3.00; W. tang 1.00.
PN "Persian East" *87.30 on floor under heavy destruction level at ca. *87.70 and in pothoard.

Broad blade with convex back and slightly concave edge. Tapered tang with round section. This is a fourth type of pothoard knife.

Discovery publ. *BASOR* 170, 24; Greenewalt, *Ritual Dinners*, 68 no. cd 17.5, pl. 33. n.b.: The drawing published by Greenewalt does not correspond to the photograph of this object shown here.

185 M61.81:3853. Lydian, ca. 575-525 B.C.

Iron. Corroded, fragmentary and virtually amorphous. Max. P.L. 9.90; max. W. 2.30.
HoB W11.00/S89.00 *99.10 in pothoard.

Publ. Greenewalt, *Ritual Dinners*, 62 no. cd 10.5. For additional, more fragmentary knives from pothoards see Greenewalt, *ibid.* pp. 57 no. cd 1-2.10, 64 no. cd 13.5, 65 no. cd 14.5, 66 no. cd 16.4, 73 no. cd 23.4, 75 no. cd 25.6.

186 Pl. 14. Roman or later.

Iron. Corroded; tip and haft missing. Max. P.L. 9.50; max. W. 1.80.
HoB E49.00-62.00/S101.00-109.00 to *100.20.

Back and edge apparently straight and parallel most of length, then both curve up in long tip.

Closest parallels belong to a type called "crook-backed knives" in Petrie, 25-26, pl. 27 (various dates). See also Curle, *Roman Frontier Post*, 281, pl. 60.6 (Roman).

187 Pl. 14. M58.83:692a. Early Byzantine.

Iron. Corroded. Max. P.L. 11.00; max. W. 2.20; W. tang 0.40.
BS W1 W1.00-E2.00/S2.00 *97.80-96.40.

Straight back and edge narrowing to sharp point. At other end are two short straight shoulders, a short collar, and a narrow tang with a square section.

188 M58.71:581. Early Byzantine.

Iron. Corroded; tip and end of tang gone. Max. P.L. 7.90; max. W. 1.60; W. tang 0.60.
BS W2 W5.00/S4.50 fill at *97.30-96.60.

Similar to **187**.

189 Pl. 14. M64.23:6188. Early Byzantine.

Iron. Corroded and swollen. Max. P.L. 9.70; max. W. 1.70; W. tang 1.10.
BS E12 E73.00-74.00/S1.00-2.50 *97.50-96.50.

Straight back and edge. Edge slopes up to tip. At other end is a tang with a rectangular section set off from edge by a narrow shoulder.

190 Pl. 14. Byzantine or later.

Iron. Corroded; tang broken. Max. P.L. 11.60; max. W. blade 1.70; W. tang 0.90.
BS Colonnade W69.60/S6.80 *97.10 in mixed context with late material.

Similar to **189**. Ring around tang.

191 Early Byzantine.

Iron. Corroded and fragmentary. Max. P.L. 19.80; max. W. 2.30.
BS E6 E42.00/S3.03 *96.58.

Similar to **189** but with long triangular tang.

192 Pl. 14. Early Byzantine.

Iron. Corroded.

Max. P.L. 33.20; max. W. blade 5.50; W. tang 3.50.
BS E12 E71.00-74.00/S0.00-2.50 *97.25-96.40.

Straight back continuing into haft. Edge is convex and slopes up to point. At other end is one shoulder sloping up to haft. Haft has rectangular section.

193 *Pl. 15.* M63.28:5352. Early Byzantine.

Iron. Corroded. Tip missing.

Max. P.L. 21.00; max. W. blade 3.40; diam. loop 2.80.
BS E17 E98.00-100.00/S2.00 *97.25-96.75.

Slightly concave back; convex edge sloped up slightly to narrow tang bent under to form a loop.

194 *Pl. 15.* M58.118:498. Early Byzantine?

Iron. Completely corroded.

Max. P.L. 16.00; max. W. blade 4.20; W. tang 1.40.
BS W2? "2.00-2.50 below surface."

Broad chopping blade with slightly convex back continuing into tang. Edge is convex and slopes up to point at one end; at other end is a steep shoulder. Tang is rectangular.

See Jacobi, *Saalburg* I, 437 fig. 68.8-10; II, pl. 37.10, 14 (Roman to 3rd C. A.D.).

195 *Pl. 15.* M63.48:5729. Early Byzantine?

Iron. Corroded.

Max. P.L. 21.80; max. W. blade 7.10; W. tang 2.10.
BS outside E16 E95.00-97.00/S4.00-6.00 *97.00-96.50
"on mosaic floor."

Triangular chopping blade with straight back continuing into tang; straight slanted edge; steep shoulder and long rectangular tang.

See Curle, *Roman Frontier Post*, 282, pl. 60.8 (surface find).

196 *Pl. 15.* M65.9:6785. Late Roman-Byzantine?

Iron. Handle broken.

Max. P.L. 16.00; max. W. 3.00; diam. bone handle 2.00.

ERd E126.00/N12.00-16.00 *97.50-97.00.

Straight back slopes down to point. Edge is straight but slopes up at butt. At upper end of butt is a suspension loop. A bone handle, now split in two halves, is riveted to the blade and pivots to fold over the edge of the blade as a form of clasp knife. The back of the blade would not have been covered when the knife was closed.

See Yadin, *Cave of Letters*, 88, fig. 31, pl. 24, no. 29-61.2.4; Jacobi, *Saalburg* I, 437, fig. 68.16.

197 *Pl. 15.* M59.44:1679. Roman or later?

Copper alloy. Back end of blade missing.

Max. L. 9.20; max. W. blade 1.50; diam. loop 0.85; diam. ring 0.90.

B *99.50-98.00 in int. fill.

Back slightly curved up near tip, convex near other end. Edge curved out and up near tip, slightly concave near other end. Back flattened into a loop at right angles to blade through which passes a thin ring.

198 *Pl. 15.* M59.80:2207. Roman or later?

Iron. Corroded; tip missing.

Max. P.L. 7.90; max. W. blade 1.00; W. haft 0.90; max. P.L. rivet 0.70.

BWLat W54.00-51.00/N13.00-17.00 *98.00.

Edge and back straight and parallel most of length; edge curves up at tip; back continues into haft at other end. A single rivet passes through center of haft.

199 *Pl. 15.* M62.76:4796.

Iron. Corroded.

Max. P.L. 7.40; max. W. blade 1.40; W. tang 0.40.
Syn FC E93.00-98.00/N10.00-13.00 *96.80-96.60 over floor.

Back concave, edge convex, sloping up sharply to tip. Back and edge taper to narrow tang.

200 *Pl. 15.* M59.25:1485. Early Byzantine or later.

Iron. Heavily corroded; socket broken off.

Max. P.L. 26.50; max. W. blade 3.50; diam. socket 2.20.

HoB Room 5 E30.00/S70.00 *97.70 fill over floor.

Back straight, edge convex, sloping up gradually to point. At other end is an open socket formed by hammering metal around a stake. Traces of burned wood remain in socket.

See Hampel, *Ungarn* I, 96 fig. 139 (Pilin, Early Byzantine).

201 *Pl. 15.* M60.49:2611.

Iron. For metallographic and atomic absorption analyses see Chap. V, Table V.5. Heavily corroded.

L. 13.30; max. W. blade 3.80; max. W tang 0.90; Th. blade 0.40.

AcT E1002.00-1003.00/S1074.00-1075.00 *402.50-401.00 a.s.l. Level II, mixed context.

Back fairly straight sloping down to tip at one end and continuing into tang at other. Edge straight to slightly

concave, with one shoulder sloping up to tang. Tang tapers somewhat.

See Hampel, *Ungarn* I, 93 fig. 120 (Szirák, Early Byzantine).

202 *Pl. 15.* M60.90:2994.

Iron. Corroded; tip missing.

Max. P.L. 12.10; max. W. 1.80; W. haft 0.70.

AcT Trench E E1052.00-1054.00/S1069.00-1081.00 to *389.89 a.s.l. fill.

Narrow blade widening slightly towards the tang. Back is convex, edge concave. Tang tapers and slopes downward from blade.

203 and **204** are similar to **202**:

203 M60.78:2916.

Iron. Heavily corroded; point missing.

Max. P.L. 12.60; max. W. blade 1.90; W. tang 1.00.

AcT Trench C E1084.00-1085.00/S1067.00-1072.00 *400.50 a.s.l. fill.

204 M58.22:224.

Iron. Heavily corroded.

Max. P.L. 12.10; max. W. blade 2.00; L. tang 3.50.

CG SCW local grid E1.00/N9.00 *103.40.

Similar but with two distinct shoulders at junction with tang.

Publ. *Sardis* R1 (1975) 142, fig. 382.

205 *Pl. 15.* M60.36:2467.

Steel. For metallographic and atomic absorption analyses see Chap. V, Table V.5. Corroded.

L. 12.80; max. W. blade 2.50; max. W. tang 1.30; Th. blade 0.20.

AcT Trench A E1008.00-1010.00/S1073.00-1075.00 Level I *404.10-403.60 a.s.l. fill.

Broad blade with slightly concave back; convex edge curving up to point. At other end edge and back slope to tang curved upward and with rectangular section.

206 *Pl. 15.* M62.18:4209. Late Byzantine, ca. A.D. 1204-1453.

Iron. Corroded; point missing.

Max. P.L. 7.10; max. W. blade 1.40; W. tang 0.60.

AcT Room 8 local grid E7.00/N27.00 *403.50 a.s.l. on floor.

Curving blade with convex back, concave edge tapered towards point. At other end are two straight shoulders and a narrow tang.

207 *Pl. 15.* M60.75:2845. Late Byzantine?

Iron. Corroded.

Max. L. 10.00; max. W. blade 2.50; W. tang 0.90. AcT Trench C Cistern E1088.00-1091.00/S1067.00 Level I.

Broad blade widening towards rounded tip. Back slightly concave, edge straight sloping up in single shoulder to short haft with horizontal notch in end.

See Boehmer, *Boğazköy* VII, 148, pl. 48 no. 1343 (unstratified).

208 *Pl. 15.* M60.37:2483.

Steel. For metallographic and atomic absorption analyses see Chap. V, Table V.5. Encrusted over whole surface.

Max. P.L. 10.00; W. blade 1.50; Th. 0.20.

AcT Trench A *403.90 a.s.l. floor and fill Level Ia mixed context.

Straight back and edge with blunt, rounded tip. Back and edge slope up to narrow tang set slightly above back and pierced by one rivet near the end.

Knife Handles

209 *Pl. 15.* M60.33:2449. Hellenistic-Roman.

Copper alloy.

L. 5.10; W. 0.90-0.70; Th. ca. 0.30.

HoB E15.00/S120.00 *101.00 in upper mixed fill.

Flat, hollow tube with rounded closed end. Open end rectangular in section and pierced on each side by a hole to permit rivet to pass through. One side decorated with incised linear pattern.

210 *Pl. 15.* M60.91:2996.

Copper alloy.

H. 2.20; W. 3.00.

AcT Trench C E1079.00-1083.00/S1067.00-1070.00 *401.80 a.s.l. fill.

Flattened ovoid cup made by folding over a strip of metal. In the side is a small hole through which a tack was driven. On surface of opposite side are two pairs of incised horizontal lines. Perhaps served as the end of a handle.

Kitchen Implements

Objects in this category include a chopper of uncertain date (**211**); three pan scrapers (**212-214**) of which the second, at least, is Early Byzantine from the Hardware Shop; two spits (**215, 216**); a strainer (**217**); strainer spoons (**218, 219**); ladles (**220, 221**) and ladle handles

(222-224). Most of these were found in or near the shops and may have been items for sale. Spoons, possibly for table use, have also been found in the shops and in contemporary HoB (225-229).

Chopper

211 *Pl. 16.* M64.13:5966. Roman or later?

Iron. Heavily corroded; small break in center of handle. L. blade 5.10; W. blade 1.20; W. handle 5.60; H. handle 3.20; Th. handle 0.25.

BE-H E10.00-12.00/N58.00-67.00 *98.00 mixed context.

Flat, rectangular blade with straight edge drawn out into points at either side. Back continues into thin, nearly circular handle with square section.

Pan Scrapers

212 *Pl. 16.* Hellenistic or Roman?

Iron. Heavily corroded; edge badly damaged and torn. Max. P.L. with handle 13.30; max. P.L. blade 5.70; W. blade 10.20; Th. handle 0.70.

PN W267.00-272.00/S329.00 to *88.40.

Flat, rectangular blade with straight edge and shoulders. Straight handle in same plane as blade terminating in conical finial.

213 *Pl. 16.* Early Byzantine.

Iron. Heavily corroded; edge of blade broken; handle broken off but repaired.

Max. P.L. 29.50; max. P.W. blade 12.50; max. Th. handle 1.30.

BS E11 E68.00-71.00/S0.00-3.00 *97.20.

Wide flat blade, possibly once ca. square. Narrow handle with square to rectangular section is tapered and flattened to meet the back of the blade.

214 *Pl. 16.* M66.8:7060. Roman or later, possibly modern.

Iron. Heavily corroded; end of handle gone; one side broken.

Max. P.L. 19.50; max. P.W. blade 9.50; W. handle 1.60; Th. handle 1.20.

WRd W59.00-63.00/S3.00-6.00 *97.00-96.50.

Triangular blade with wide straight edge. Narrow straight handle with rectangular section continues from apex of triangle.

A note by the excavator comments that this type of scraper or breadcutter is still used in the local village,

leaving open the possibility that this is a modern implement.

Spits

215 *Pl. 16.* M68.15:7771. Lydian, 7th C. B.C.

Iron. Heavily corroded; broken in several pieces and repaired.

Max. P.L. 107.00; diam. 2.00.

HoB Building H W33.00/S123.00 *98.80 floor.

Long, straight rod tapering at both ends. Knobs due to corrosion over whole surface.

Publ. *BASOR* 199, 28.

216 *Pl. 16.* M60.74:2342.

Iron. Corroded; one end missing.

Max. P.L. 66.40; diam. loop 2.20; Th. 1.00.

AcT Trench A E999.00-1005.00/S1074.00-1077.00 *402.50 a.s.l.

Long, straight rod with loop at one end.

Strainer

217 *Pl. 16.* M67.38:7587. Early Byzantine.

Low zinc brass. Analyzed by emission spectrography, neutron activation and atomic absorption. See Chap. V, Tables V.1, 3, 4a, b. Much of pan missing. In several fragments.

H. pan 5.50; diam. rim 16.00; L. handle 11.80; Th. 0.30.

BS E6 E39.50/S1.59-1.75 *96.86.

Wide shallow pan with small perforations forming triangular patterns all over the surface. Pan has a narrow ledge rim from which extends a flat handle with rounded end.

See Emery, *Ballana and Qustul I*, 82, 358 no. 792; II, pl. 94C Tomb B.4-8 (5th-6th C. A.D.).

Strainer Spoons

218 *Pl. 16.* M59.55:1883. Early Byzantine.

Copper alloy.

L. 31.70; W. spoon 8.40; diam. holes 0.50; Th. handle 0.30.

BS W13 W53.00-57.00/N1.00-4.00 *97.50-96.50.

Ovoid, slightly concave spoon bowl pierced with round holes in a pattern of concentric circles surrounding an equal-armed cross. Handle is made in two pieces joined by two rivets near the center. Handle is widest near the edge of the bowl, then narrows to point of juncture

with second piece. The second (upper) piece is wider than the upper part of the first and terminates in a flat ovoid tab pierced with three suspension holes.

219 *Pl. 16.* M68.8:7691. Early Byzantine?

Copper alloy. Most of handle missing.
Diam. bowl 9.00; W. handle at stump 2.50; Th. handle 1.00.

BS in front of E12 E70.90/S5.40 *98.45.

Round, almost flat spoon bowl perforated with round holes. Stump of handle in one piece with edge of bowl.

Ladles

220 *Pl. 16.* Roman-Byzantine?

Copper alloy. Handle broken in three pieces; bowl broken and corroded.

Max. P.L. handle 16.50; diam. bowl 5.35; D. bowl 1.50.
ERd E117.00-118.00/N3.50-4.50 *97.50-97.00.

Plain bowl with upturned rim and possible spout on one side (obscured by corrosion). Handle is flat and wider at both ends.

221 *Pl. 16.* Early Byzantine.

Iron. Handle broken. Part of bowl missing; corroded.
Max. P.L. 17.00; diam. bowl 10.50; W. handle 2.50; Th. handle 1.10.

BS E11 E70.00-71.00/S0.00-4.00 *97.20.

Plain circular bowl. Flat handle in one piece with edge of bowl. Bits of charred wood adhere to back of bowl.

Find publ. *BASOR* 191, 22.

Ladle handles

222 *Pl. 17.* M61.33:3409. Roman?

Copper alloy.

Max. P.L. 6.60; W. at break 0.90; Th. 0.30; L. head 1.60.

HoB W5.00/S90.00-95.00 *100.00-99.90 mixed context.

Flat vertical handle with rectangular section. At lower end the handle widens and flattens to form transition to bowl. Remains of a small round hole for attachment can still be seen. Upper end curves back and ends in a duck or swan head.

According to Robinson, ladles with handles terminating in swans' heads have a long history going back to the

second millennium B.C. and continuing in popularity through the Roman era.

See Robinson, *Olynthus* X, 194-198 and refs., pl. 50 nos. 613-622 (before 348 B.C.).

223 *Pl. 17.* M58.109:1015. Roman, reused in Early Byzantine era?

Copper alloy.

Max. P.L. 8.00; L. head 1.80; W. handle 0.90; Th. 0.25.
HoB Room 9 *98.09.

Flat ribbon handle rounded and smoothed at lower end. Upper end bent in an S-curve terminating in the head of a deer or dog with ears and eyes in relief, incised mouth and short linear incisions under the ears. Apparently the bend nearest the head is original; the other bend is secondary, perhaps associated with a reuse of the piece and a change in function.

224 *Pl. 17.* M65.14:6950.

Copper alloy. Corroded; broken from a larger object.
Max. P.L. 5.10; H. 1.30; W. head 0.97; W. back 1.10; W. neck 0.50.

HoB W35.00-42.00/S110.00-125.00 to *100.40 in mixed context.

Duck head, perhaps from a handle. Neck area narrow; head flat on under side, curved around top, then sloped down to flattened splayed beak. Eyes punched on both sides. Other details obscured by corrosion.

Spoons

Of five spoons (**225-229**) all but the last are of the same general type. They have elongated, trough-shaped bowls with long tapered handles ending in small bulb-shaped finials. **225** and **226** have bead moldings on the handle just above the bowl; **228** is slightly more elaborate with incised decoration on a plate-like transition between the handle and bowl. All are of copper alloy and **227**, which was analyzed, proved to be brass, making it likely that the others are also. Four were found in the shops and HoB proper (**225-227**, **229**) and must be dated in the Early Byzantine era while **228** came from the MRd and probably should be dated around the same time.

225 *Pl. 17.* M59.5:1253. Early Byzantine.

Copper alloy.

L. 19.50; max. W. bowl 2.15; Th. handle 0.30.
BS W7.

Trough-shaped bowl with bent-up sides, narrowest at tip end. Long, thin handle with ovoid finial at one end; bead and three reels at transition to bowl.

226 M59.40:1650. Early Byzantine.

Copper alloy. Much of bowl missing.
Max. L. 20.20; max. W. bowl 1.60; Th. handle 0.30.
BS W3 W18.00/S2.50-4.00 *97.00.

Similar to **225**.

227 Pl. 17. M59.68:2148. Early Byzantine.

Brass. Analyzed by emission spectrography, neutron activation and atomic absorption. See Chap. V, Tables V.1, 3, 4a, b.

L. 18.80; max. W. bowl 2.50; Th. handle 0.20; L. bowl 7.10; W. at tip 0.40; D. bowl 1.10.

HoB Area 19 E30.00/S60.00 beneath tiles at ca. *96.80.

Similar to **225** but bowl a bit wider near handle. Incised horizontal lines on handle near top of bowl.

228 Pl. 17. M61.50:3602. Early Byzantine?

Copper alloy. Bowl broken and small section missing. End of handle missing.

Max. P.L. 13.00; max. W. bowl 1.80; W. tip 0.30.
MRd E10.00/S26.50 *96.65.

Bowl similar to **225**. At transition to handle is a flat, rectangular plate with notched sides narrowing to a flat tab incised with dendritic pattern, then narrowing again to handle with round section.

229 Pl. 17. M59.66:2115. Early Byzantine.

Copper alloy. One end missing.
Max. P.L. 8.50; diam. bowl 1.50; max. W. handle 1.70.
BS W13 W54.00-57.00/S2.00-4.00 *97.50-97.00.

Small round bowl at one end of a broad, flat handle with incurved and notched sides. At end farthest from this bowl the handle widens to form transition to another spoon bowl, now missing.

Sewing and Spinning Equipment

Needles

Most of the nine needles from Sardis are not well dated with the exception of **230** of Lydian date and **231** from Early Byzantine HoB. Needles are made of either copper alloy or iron and most have flattened heads with

pierced eyes. The better made ones are of copper alloy and have heads that are indented and "split" forming an oblong eye (**234-238**). The type is seen in Byzantine Corinth²⁶ but does not seem to be chronologically distinctive.

230 Pl. 17. Lydian, 6th C. B.C.

Copper alloy.

L. 5.50; W. at eye 0.30.

PN W295.00-297.00/S325.00-331.00 *86.00-85.80.

Tapered shaft with sharp point at one end, rounded head with pierced oval eye at other. The needle belongs to Davidson's Type 1 at Corinth, which, however, is not dated before the Byzantine era at that site.

See Davidson, *Corinth* XII, 173, 176, pl. 78 nos. 1235-1240 (4th C. A.D.-Byzantine).

231 Pl. 17. M59.1:1180. Early Byzantine?

Iron. Corroded.

L. 15.40; Th. at eye 0.60; L. eye 0.90.

HoB Room 6 in fill *99.50-99.30.

Long tapering shaft, pointed at one end, flattened and squared off at other. An oblong eye is pierced through the flattened end.

This belongs to Davidson's Type 2 but similar examples can be found in earlier contexts.

See Davidson, *Corinth* XII, 173, 176, pl. 78 nos. 1241-1243 (Byzantine); Robinson, *Olynthus* X, 362-363, pl. 115 nos. 1750-1752 (before 338 B.C.).

232 and **233** are similar to **231**:

232 M61.88:3908. Roman or later?

Iron. Corroded; end of shaft broken.

Max. P.L. 4.50; Th. shaft 0.20; L. eye 0.50; W. at eye 0.40.

MRd E15.00-20.00/S23.00-25.00 *96.40-96.00 Roman Road but mixed context.

233 M62.27:4224. Byzantine?

Iron. Corroded; bent, cracked.

L. 17.50; W. at eye 0.50; L. eye 0.90.

AcT Cistern local grid E15.00/N25.00 *403.60 a.s.l.

26. Davidson, *Corinth* XII, 176, pl. 78 nos. 1241-1245 and general discussion 173 with refs.

234 *Pl. 17.* Roman or later?

Copper alloy.

L. 12.30; W. at eye 0.40; L. eye 0.70; Th. shaft 0.25.
West Bldg. W106.50/N15.60 *97.05.

Tapered shaft with round section, sharply pointed at one end. At other end the head is flattened to a rectangular section, slightly indented and pierced through with an oblong eye.

See Davidson, *Corinth* XII, 173, 176, pl. 78 nos. 1246-1247 (Byzantine or later); Hampel, *Ungarn* II, 210; III, pl. 169 fig. 5 (Early Byzantine).The following are similar to **234**:**235** M61.24:3279. Byzantine or later?

Copper alloy. Some corrosion.

L. 15.00; W. at eye 0.50; L. eye 0.60; Th. shaft 0.20.
MRd E18.00/S9.00 *97.00 fill above mosaic pavement in N Colonnade.**236** M62.2:4179. Roman or later?

Copper alloy.

L. 5.20; L. eye 0.30; Th. shaft 0.20.
MRd E7.00/S13.50 *97.80.**237** Hellenistic or later?

Copper alloy. Tip missing.

Max. P.L. 9.90; W. at eye 0.30.
HoB E49.00-62.00/S101.00-109.00 *100.20-99.30.

Two incised horizontal lines below eye.

238 Hellenistic or later?

Copper alloy. Corroded.

L. 4.45; Th. 0.15; W. at eye 0.15.
HoB E0.00-5.00/S110.00-115.00 *99.30-99.05.*Shears***239** *Pl. 17.* M63.6:4974. Roman?

Copper alloy. One blade missing.

L. 19.30; diam. finger loops 2.70; L. spools on handle 4.00; diam. spools 0.80; nut 0.80 × 0.90.
PN W241.00/S355.00 *91.00 surface.

Preserved blade is flat and rectangular with one corner extended into a long tapered point. A small, rectangular slit is at the end of the rectangular portion of the blade; a second slit, this at right angles to the first, is at the upper r. corner. The base of the second blade is attached

to the first by a small pivot held by a flat, square nut with decorated surface. The shafts are flat, while the finger grips are circular in section. Between the shafts and the finger grips are cylindrical spools decorated with disk moldings, possibly formed by lathe turning. Across the shafts is a row of small incised circles.

240 *Pl. 17.* M58.20:226. Byzantine or later.Iron. Corroded; ends of finger grips and blades missing.
Max. P.L. 14.00; max. W. 0.75.
CG SCW *103.40.

Two narrow, S-curved handles joined by a pivot where they flatten and straighten into blades. A copper alloy thimble with open top and punctate design on the sides has been slipped onto one handle where it has corroded into place.

While the context in which this pair of shears was found is not stratigraphically significant, the thimble type with open top is known at Corinth in Byzantine and later contexts, and also at Hama in Syria in twelfth or thirteenth century A.D. contexts.

See for thimble Davidson, *Corinth* XII, 175, 178, pl. 79 nos. 1285-1298; Ploug-Oldenburg, *Hama* IV.3, 86, 88, fig. 31.24 no. 6C78 level A3 (A.D. 1170-1260).**241** *Pl. 17.* M62.5:4165. Turkish, 14th C. A.D. or later.

Iron. Corroded.

L. 32.00; W. blades 4.00; W. at tip 1.00; max. W. handles 13.00.

Church E West room inside apse *91.25.

Narrow, tapered blades, narrowing at ends to thinner metal curved around into elongated finger grips. The two pieces of metal are held at the base of the blades by a pivot.

*Spindle Hooks*The spindle hooks (**242-249**) belong to a well-known and virtually ubiquitous type of object with a wide distribution in the Eastern Mediterranean. They consist of small pieces of copper alloy with lower edge hammered flat and wrapped around a narrow dowel or stick to form a conical socket. The upper end is bent over to form a small hook.**242** *Pl. 17.*

Copper alloy. Corroded.

Max. P.L. 3.70; diam. base 0.60.
BE-N E25.00-30.00/N89.00-90.00 to *96.60.

This, like most of the others from Sardis, was not found in a secure context. Similar objects are known from archaic Lindos, classical Olynthus, Byzantine Corinth and elsewhere with virtually no change in form.

See Russell, no. 32 (Anemurium, Early Byzantine). Davidson, *Corinth* XII, 173, 176, pl. 78 nos. 1223-1228 (Byzantine or later); Robinson, *Olynthus* X, 376-377, pl. 119 nos. 1884-1892 (before 348 B.C.); Blinkenberg, *Lindos* I, 135, pl. 13 no. 343 (archaic); British Museum, *Greek and Roman Life*², 132-134, figs. 146-148 (reconstruction drawing and photo showing use).

243 M65.6:6767.

Copper alloy. Hook broken.
Max. P.L. 3.20; diam. base 0.70.
Pa-S E108.60/N24.90 *96.50-96.40.

244

Copper alloy.
L. 2.80; diam. base 0.60.
BE-S E33.00-34.00/N37.00-38.00 *97.25-97.00.

245

Copper alloy. Corroded.
L. 3.10; diam. base 0.55.
MRd E30.00-34.00/S5.70-13.17 *98.40-97.90.

246

Copper alloy. Corroded.
L. 3.15; diam. base 0.70.
HoB Room 1 0.80-1.15 m. below surface.

247

Copper alloy.
L. 2.90; diam. base 0.75.
HoB W30.00/S90.00-95.00 to *100.80.

248

Copper alloy.
Max. P.L. 3.30; diam. base 0.80.
HoB W20.00/S90.00 to *100.50.

249

Copper alloy.
Max. P.L. 3.40.
HoB W35.00-38.00/S120.00-125.00 to *100.60.

Stylus

250 Pl. 17. M59.37:1617. Early Byzantine.

Copper alloy.

L. 10.50; W. 0.75.

HoB Area 6 E20.00-30.00/S70.00 floor *99.60-99.20.

Shaft with rectangular section tapered to sharp point at one end. The other end is flattened and splayed with beveled edges, creased horizontally and bent up slightly above the edge. On the lower end of one side of the shaft are horizontal zigzags in relief.

The type has a fairly long history from Roman through later Byzantine times.

See Deonna, *Délos* XVIII, 253-254, pl. 80.675; Davidson, *Corinth* XII, 185, 186, pl. 83 no. 1349 (Late Roman or Byzantine); Ploug-Oldenburg, *Hama* IV.3, 67 fig. 25.9 no. 6B95 level A1 (A.D. 1302-1401).

ARCHITECTURAL AND STRUCTURAL FITTINGS

Because Sardis is so rich in architecture, particularly in the later periods, a considerable number of the metal finds consists of architectural and structural fittings.

Most numerous are the nails, found in almost every major building and of which only a sampling can be given below (295-325). The major public structures of the Late Antique and Early Byzantine periods were also lavishly revetted on their interiors, and quantities of the pins used to secure the marble slabs to the walls have been found (266-277). Clamps used to link stones together are known since the archaic period at LA and continue into the Late Antique era in the B-Complex and Synagogue (278-291).

Less numerous, but of considerable interest, are the door and window fittings, including decorative bosses and other attachments (258-262), doorpost shoes (251-254), hinges (255, 256), a latch (257) and an iron window grille (263). Leading strips for securing window glass are treated in *Ancient and Byzantine Glass from Sardis* by A. von Saldern.²⁷

Door and Window Fittings*Doorpost Shoes or Pivots*

Remains of four doorpost shoes have been found in HoB proper (251-254), at least two (251, 252) *in situ* in or near doorways. They consist of two parts—a cylindrical iron ring which was fitted around the bottom

27. *Sardis* M6 (1980) no. 673.

of a wooden doorpost, and a large spike which was nailed into the bottom of the post. Similar doorpost shoes have been found *in situ* in the shops and will be treated in the volume on the shops.²⁸

251 *Pl. 18.* Early Byzantine.

Iron. Corroded.

Ext. diam. ring 4.80; H. 3.40; Th. 0.70; L. spike 5.80; diam. head 2.50.

HoB *in situ* W5.00/S150.00 *104.00.

Spike has tapering shaft with square section, and a flat, round head.

The following are similar to **251**:

252 *Pl. 17.* M59.72:2161. Early Byzantine.

Iron. Corroded and fragmentary.

Diam. ring ca. 6.00; H. 4.50; diam. head spike 5.50.

HoB Area 19 near threshold E30.00/S60.00 *96.95.

253 M59.32b:1593. Early Byzantine.

Iron. Ring and spike corroded together. Bits of wood preserved inside ring.

Ext. diam. ring 4.80; H. 3.50; Th. 0.90; diam. head spike 3.70.

HoB Area 13 E30.00/S80.00 floor *97.82.

254 M61.103:4110. Early Byzantine?

Iron. Two rings preserved without spikes.

Ext. diam. 6.90, 6.80; H. 3.40, 3.10.

HoB wall of Unit 7.

Hinges

255 *Pl. 18.* M63.13:5123. Late Roman?

Copper alloy. Traces of burned wood adhere to underside.

Max. W. 5.50; max. H. 3.40; Th. 0.10.

Syn FC E110.00-112.00/N1.50-2.00 *97.00 in burned fill N of door.

"Butterfly" hinge made in two parts, each with two nail heads preserved in the "wing points." Two extensions from the narrow end on the I. piece have been bent in a circle to form sockets; a similar extension from the center of the r. piece fits between them. A cylindrical

pivot has been dropped through the center of these three loops.

256 *Pl. 18.* M63.47:5728. Early Byzantine.

Iron. Corroded.

Max. H. 6.50; H. in center 3.80; max. W. 11.00.

BS E16 E92.00-96.00/S0.00-2.00 *97.25-96.50.

Two flat semicircular plates joined (?) by a narrower section in center. Because of corrosion it is difficult to see whether this is indeed a hinged attachment.

Latch

257 *Pl. 18.* M60.29:2415. Late Roman?

Iron. Corroded.

L. 21.00; L. hook 5.30; L. loop 4.90; H. 2.50; W. 2.10;

Th. 0.70.

AcN local grid E15.00-20.00/N0.00-5.00 *396.00-394.00 a.s.l.

Flat bar extended at one end into a narrow hook. At other end is an eyehole through which is passed an iron loop.

See Boehringer-Krauss, *Pergamon* IX, 125, pl. 60e.10, 11.

Decorative Bosses

258, 259 *Pl. 18.* M62.70a:4706, M67.6:7305.

Pair of Late Roman bosses, probably 4th C. A.D. Iron spikes with solid cast, copper alloy profiled heads.

Shaft of **259** missing; shaft of **258** corroded but complete. **258**: max. diam. 6.25; max. H. 10.50; L. shaft 5.50.

259: max. diam. 6.40; max. P.H. 4.80; diam. knob at top 0.50.

One was found on each side of the crosswall between the MH and FC of the Synagogue, indicating that they were probably used as door ornaments on the N door.

258: Syn FC E100.00/N16.00 a few m. E of N door in crosswall *96.65.

259: Syn MH E93.80/N15.90 in fill between two brick walls blocking N door in crosswall *96.50.

According to A. Seager, "The Building History of the Sardis Synagogue," *AJA* 76 (1972) 433, the crosswall between the FC and MH of the Synagogue was constructed in the fourth century A.D. remodeling of the building (Stage 4). If these bosses belonged to the crosswall door they should also date to the fourth century.

According to Robinson, *Olynthus* X, 260, such bosses were used not only as door ornaments but also on wooden shutters and chests, furniture and shields. They

²⁸ J. S. Crawford, forthcoming study of the Byzantine Shops, Chap. II, "doorways."

have a long history in Greek lands from the archaic period to well into the Roman era.

See Perdrizet, *Delphes* V, 123 figs. 460-464 nos. 669-673 (archaic); Robinson, *Olynthus* X, 260-278 (discussion of types), 271-274, pls. 72-74 nos. 1118-1156 Type III (before 348 B.C.); Davidson, *Corinth* XII, 140 (discussion), 141 fig. 22, pl. 71 nos. 1014-1024 (Hellenistic, Roman); Wiegand-Shrader, *Priene*, 305 fig. 326; Orlandos, I, 106 fig. 71 (Delos), figs. 68-70 (marble tomb doors imitating wooden doors with decorative nailheads).

260 Pl. 18. Late Roman?

Iron spike with copper alloy profiled boss. Spike broken and corroded.

Max. P. H. 6.40; max. diam. 3.90; diam. knob at top 1.00; Th. spike 0.80.

BE-A E10.05/N5.80 *96.77.

Similar to **258** and **259**, but taller and narrower.

Door Attachments?

261 Pl. 18. M62.71:4707. Late Roman?

Iron. Heavily corroded.

Diam. rings: 5.75, 4.70; Th. 0.65, 0.70.

Syn FC E98.20/N16.90 *96.60 on floor in earth next to pivot hole of threshold.

Two interlocked rings; the smaller closed, the larger looped at one end to form a loop through which the other end passes.

262 Pl. 18. Late Roman?

Iron.

Max. L. 11.30; diam. ring 2.20; Th. tab 0.25; max. Th. bar 1.00.

MC in rubble E25.00-33.00/N78.00-85.00 *100.00-99.00.

Bar with square section. At one end is a flat tab for insertion into mortar or plaster. The other end is pierced through horizontally for the suspension of a ring.

Window Grille

263 Pl. 18. Early Byzantine.

Iron. Found complete; now completely corroded and fragmentary.

H. 72.50; W. 47.50.

BS Colonnade in front of Shop E8 E62.50/S5.60 *96.65 presumably from the shop. Leading used to hold glass panes in place was also found in the colonnade in

front of E8, but it is not known whether glass panes can be associated with the grille.²⁹

The grille consists of two long parallel bars crossed at right angles by three shorter bars forming twelve lights. At each of the six junctions of the bars are two short iron points riveted to the bars and projecting into the openings to discourage hands from reaching through.

The grille is closely paralleled by a nearly complete Late Roman (third to fourth century A.D.) example at Hinton St. Mary, Dorset, now in the British Museum. Manning and Painter note that as of 1967 when the Dorset grille was published, known parallels to this specific type were found only N of the Alps in England, Scotland, Wales, France, Switzerland and Germany. Grilles from Pompeii and Herculaneum, the farthest S and E listed, have no cross-points. The example from the BS at Sardis is thus the first recognized in Western Anatolia and fits in type and date with numerous more northern examples.

Publ. J. S. Crawford, forthcoming report on the Byzantine Shops. See W. H. Manning and K. S. Painter, "A Roman Iron Window-Grille from Hinton St. Mary, Dorset," *BMQ* 31 (1967) 122-130, fig. 1, pl. 36a; G. Webster, "Roman Windows and Grilles," *Antiquity* 33 (1959) 10-14, pl. 4.

Plumbing Fixtures

Communication Tap for a Water Pipe System

264 Pl. 18. M66.17:7265. Late Roman.

Leaded tin bronze. Analyzed by emission spectrography, neutron activation and atomic absorption. See Chap. V, Tables V.1, 3, 4a, b. Three pieces which do not now join are preserved.

(A) Max. P.L. 13.10; ext. diam. horizontal pipe 3.30; Th. pipe 0.40; L. vertical pipe 10.70; ext. diam. wider opening 5.80; W. rim 0.90; diam. narrower opening 3.60; Th. rim. 0.25.

(B) L. 4.90; diam. 4.60; W. shaft 2.40; Th. shaft 0.90.

(C) Diam. 4.20; Th. 0.80.

BE-B E18.07/N6.95 *95.96. Found near a fountain and probably once connected with the water pipe system feeding the fountain.

(A) Vertical cylindrical pipe with profiled ends and two circular holes through sides, opposite each other. A conical horizontal pipe joins the center of the vertical pipe at right angles to it, feeding into one hole. The opposite hole has broken edges where another horizontal pipe probably protruded. The narrower end of the

29. See above n. 27.

vertical pipe is profiled on the exterior with a narrow rim. The wider end is profiled on the inside, and a cylindrical sleeve fitting which still moves is set into it with one end projecting above the rim of the pipe. Inside the sleeve fitting are two holes corresponding to those in the pipe. As the sleeve fitting is turned by a spigot that once fitted onto its projecting end (now detached), the solid part of the sleeve masks the holes in the pipe and cuts off the flow of water. When the holes are aligned water can flow from one horizontal pipe to the other. (B) Spigot or cock with rectangular open vertical projection at right angles to disk. On top surface of projection are incised concentric circles. This spigot may have been fitted on the upper part of the sleeve fitting. (C) Smaller disk or covering that may have fitted into the opening at the narrower end of the vertical pipe. On the under side of the disk is a round stump of a shaft. The main parts of this tap correspond to those outlined by Kretzschmer in his discussion of Roman taps and pipe systems. According to Kretzschmer, similar taps in a variety of sizes are known from the Republican era to the end of the Roman Empire.

Publ. *BASOR* 187, 16, fig. 39. See F. Kretzschmer, "La robinetterie romaine," *Revue d'archéologie de l'est et du centre est* 11 (1960) 89-113, esp. 91 fig. 25 r., 92-95 (robinets de communication), 95 fig. 27, 109 fig. 37, 111 fig. 39; W. Piepers, "Armaturen von römischen Wasserleitungen im Rheinischen Landesmuseum Bonn," *Bonn-Jbb* 177 (1977) 611-616; H. Eschbach, "Die gebrauchswasserversorgung des antiken Pompeji," *Antike Welt* 10 (1979) 3-24 (fountains with spigots); E. Fassitelli, *Duemila anni di impianti in Italia. Tubi e valvole dell'antica Roma* (Milan 1972) 92-93 (fountain with on/off valve). I owe several of these references to John P. Oleson.

Tap Ring (?)

265 Pl. 18. M61.39:3528. Late Roman?

Iron. Corroded.

L. 7.50; ext. diam. loop 2.80; Th. rod 0.50; Th. knob 1.00.

RT E8.00-10.00/S25.00 *96.70 in fill.

Single rod of iron bent into loop at one end and closed by wrapping end of rod against the straight part of the rod. The other end terminates in a round to conical knob.

See Boehringer-Krauss, *Pergamon* IX, 125 pl. 60e.7, 9 (similar pieces identified as "Zapfenringe").

Revetment Pins

Common among the architectural finds in the larger Roman and Byzantine buildings were revetment pins

used to clamp marble revetment slabs to the masonry wall behind. Two main types of revetment pin were found at Sardis. The first is a flat band with rectangular section, one end hammered thinner, splayed and slightly notched along the edge; the other end is narrowed to a square or roundish section and bent up to form a prong or hook for securing the revetment slab (**266-274**). The second type is a similar band but with both ends narrowed; some with both ends tapered (**275-276**), some with one end tapered, and the other end forming shoulders sloping into a narrow prong (**277**).

These pins are made in either copper alloy or iron, though copper alloy is most common. Hammer marks are still visible on the better preserved examples.

Most of the revetment pins that have been saved are from Building B and vicinity, including the Marble Court and Synagogue. A number of broken fragments were also found in and around Bath CG, together with remains of grout, pin-holes in the masonry walls showing where revetment was applied, and even in one case, the remains of revetment slabs *in situ*.³⁰

What follows is merely a sampling of the revetment pins found in some of the sectors, illustrating the major types and giving a range of measurements.

Type 1: 266, 267 Pl. 19. M60.57:2652. Late Roman.

Both copper alloy.

266: L. 16.00; W. flat end 2.10.

267: Max. P.L. 15.70; W. flat end 2.30.

MC E30.00/N59.00 above colonnade in fill, *97.00.

268-274 Pl. 19. Late Roman.

All of copper alloy.

268: L. 18.50; W. flat end 2.35; W. prong 0.35.

269: L. 17.80; W. flat end 1.95; W. prong 0.45.

270: L. 16.00; W. flat end 2.20; W. prong 0.25.

271: L. 14.70; W. flat end 2.90; W. prong 0.30.

272: L. 14.20; W. flat end 2.10; W. prong 0.25.

273: L. 13.00; W. flat end 2.60; W. prong 0.40.

274: Not measured.

All found in MC E15.70/N42.00-65.00 *99.00-97.00.

Type 2a: 275 Pl. 19. M62.54:4473. Late Roman.

Copper alloy.

L. 19.70; H. prongs 2.00; max. W. 1.00; Th. 0.40.

BE-S E22.00/N45.80 *97.40.

30. See *Sardis* R1 (1975) 162-163, 187 n. 24 for discussion of revetment technique in CG, and A. Seager, forthcoming report on the Synagogue.

276 *Pl. 19.* M66.14:7171. Late Roman.

Copper alloy.

L. 17.50; max. W. 1.10; Th. 0.40.

MC E30.50-31.00/N74.25-74.75 *96.80.

Type 2b: 277 *Pl. 19.* M63.57a:5873. Late Roman.

Copper alloy.

L. 18.50; W. prongs 0.40, 0.35.

Syn MH E50.00/N19.00 in the side of the N wall, *96.50.

Clamps

Most of the architectural clamps found at Sardis are of the "Pi-type," with dates ranging from the late sixth century B.C. at the LA in AT³¹ to the Late Roman-Early Byzantine eras in the Synagogue and B area (278-290). All clamps found are iron bars with ends bent at right angles to the bar to form prongs. Usage, determined by sectioning the lead casing of some of the clamps, involved cutting cavities in the stones to be joined, pouring some lead into the cavity to form a bedding, setting the iron clamp into it, and pouring more lead around and over the clamp to anchor it in place.³²

Another kind of clamp found is the repair clamp, used to mend such materials as pottery (292-294). The type found is common in the Eastern Mediterranean and has a long history. All are of lead.

Architectural Clamps

278 *Pl. 19.* M70.6:8118. (70 S1/1). Lydian, late 6th C. B.C.

Iron with some leading preserved around it.

L. 25.50; W. 4.20; max. Th. 2.00; Th. iron 1.00.

LA I S side euthynteria W205.10/S1241.15 *97.14.

See *Sardis* R1 (1975) fig. 203 for location.

279 *Pl. 19.* M70.7:8119. (70 S1/2). Lydian, late 6th C. B.C.

Iron with leading preserved.

L. 27.50; max. W. 5.00; Th. 2.75; W. iron 1.40.

LA I S side euthynteria W205.00/S1241.30.

See *Sardis* R1 (1975) fig. 203 for location.

280-287 *Pl. 20.* Late Roman.

All iron, some with leading preserved.

280: Max. L. 23.50; L. iron 20.90; max. W. 5.00; W. iron 1.60; H. prongs 5.30.

281: Max. L. 22.00; L. iron 20.50; W. 1.90; H. prongs 3.00.

282: Max. P.L. 20.50; W. 2.00; H. prong 3.40.

283: L. 16.80; W. 1.80; H. prongs 3.10.

284: L. 16.70; W. 1.80; H. prongs 2.70.

285: Max. L. 16.20; L. iron 14.20; max. W. 6.00; W. iron 1.50; H. prongs 2.90.

286: L. 16.00; W. 2.00; H. prongs 2.50.

287: L. 12.10; W. 2.00; H. prongs 2.00.

All from the Synagogue, various locations.

288-290 *Pl. 20.* Late Roman-Early Byzantine.

All iron, one with leading preserved.

288: Max. L. 30.60; max. W. 3.10; H. prongs 5.40.

289: L. 24.00; W. 2.50; H. prongs 3.80.

290: L. 20.50; W. 3.00; H. prongs 5.00.

BE fill and dump, various locations.

291 *Pl. 20.* M62.79:4827. Late Byzantine, ca. 13th C. A.D.

Lead.

Max. L. 13.00; max. W. 8.00; max. W. "tail" 1.90.

Church E residue from anchoring poured into slot on top of NE column base.

Irregular, flat, lozenge-shaped mass of lead with trapezoidal "tail" at one end. In one side is an impression of an oblong metal clamp over which the lead was poured. This mass differs from the leading used with the preceding clamps in its irregularity of contour and flatness. It seems to have been poured only *over* the clamp and not to have settled into any sizable cutting such as was the case with the Lydian and Late Roman clamps.

Repair Clamps

292 *Pl. 20.* M61.71:3755. Hellenistic or Roman?

Lead.

Max. L. 9.40; max. W. 2.90; W. bar 1.00.

PN W250.00/S380.00 *89.00 under double pipe.

Two horizontal irregular bars connected by two shorter vertical bars near ends. The type is fairly common.

See Robinson, *Olynthus* X, 332-333, pls. 98-99, nos. 1567-1583 (before 348 B.C.).

The following are similar to **292**:

31. For archaic clamps at LA I see *Sardis* R1 (1975) 93-94, figs. 203-207. For dating based on shapes see C. Nylander, "Clamps and Chronology," *Iranica Antiqua* 6 (1966) 130-146.

32. For technique see Orlandos, I, 120 fig. 82.

293 M58.1:10.

Lead. Attached to a fragment of pottery.
Max. L. 6.30; max. W. 2.80.
Trench S Level I (surface).

For Trench S see *Sardis* R1 (1975) 104-107.

294 Lydian?

Lead.
Max. L. 5.10; W. 2.10.
HoB E5.00/S100.00 *99.80-99.60 floor.

Nails, Tacks and Rivets

The nails found at Sardis are too numerous and too badly preserved to catalogue each separately. They are represented in nearly every era and in many sectors, but especially those with major architectural remains of the Roman and Early Byzantine periods (e.g. Building B and adjacent areas, HoB, RT, BS, Building L). While they were not usually very well stratified and were often found in the upper level fills of the buildings in question, most of them probably belong to the main building period of their structures where they were used primarily in the wooden roofing.

All nails found and kept are of iron, and all have tapered shafts of square section and varying length.³³ Five basic types of head can be distinguished (*Pl.* 22):³⁴

1. Round and domed.
2. Round and flat.
3. Square and flat.
4. Rectangular and flat.
5. T-shaped, split and spread.

Other types appear more rarely. Most of the nails found are of Types 1 or 2, though there are many examples of the others.

No distinction in use can be determined from contexts (with the exception of certain nails found in graves which are undoubtedly coffin nails). H. F. Cleere publishes groups of similar nails from a Roman villa on the Isle of Wight³⁵ in which he distinguishes four main

classes and two minor types which correspond in large degree to those found at Sardis. His conclusions on possible function may have some bearing on the Sardis examples.

Cleere suggests that his Type I, which has a pyramidal or truncated conical head and long tapered shaft (6-12 in., 15.24-30.48 cm.), similar to our Type 1, was used for fastening main structural timbers; Type II, a large nail (7-11 in., 17.78-27.94 cm.) with semicircular or triangular head, flat in section, is represented only rarely at Sardis (301). Cleere's Type III, the most common, is 2-6½ in. long (5.08-16.51 cm.) and has a round, flat head ½-1 in. in diam. (1.27-2.54 cm.), similar to Sardis Type 2. It was used for general purposes such as joining smaller timbers and fixing hinges and other fittings. Type IV is a T-shaped nail, similar to our Type 5, although the head is straight across and not "split" and bent to either side as the Sardinian nails are. Cleere suggests that this is a "holdfast" used for insertion into brickwork or mortar, or into end wood. B. Cunliffe³⁶ refers to similar ones from Fishbourne as "T-clamps used to hold vertical box-tiles in position, one clamp between two adjacent tiles." Examples closer to those from Sardis with "split and spread" heads are known from the baths at a Roman fort at Newstead.³⁷ Cleere's Type V, with a flat shaft and convex square head is not represented at Sardis; Type VI, a heavy nail with abruptly tapered shaft and flat head corresponds to some examples within Sardis Types 3 and 4. Cleere suggests that nails of this type were used for hammering into brick or stone.

In addition to nails of varying lengths and head types, a few short nails or tacks were found. These have broad heads, generally round, and short, thin shafts. Two sets (326-337, 338-339) were found in Roman graves of the Imperial period, another (340, 341) in the Byzantine Shops. Four lead objects resembling tacks (342-345) may be some form of rivet or plug.³⁸

Nails

295-300 *Pl.* 21. M61.2:3137. Lydian, 6th C. B.C.

Iron. Shafts broken and corroded with bits of wood adhering.

295: Max. P.L. 9.70; diam. head 2.80.

296: Max. P.L. 7.50; diam. head 2.30.

297: Max. P.L. 5.50; diam. head 2.50.

33. For description of the process of making handmade nails see Bealer, 206-208.

34. For an implement identified as a nailheader see 145.

35. Cleere, 56-59, figs. 1-3a-i. A similar system of classification, with some variation, is also established from some 875,000 nails found at Inchtuthil, a Roman legionary fortress in Scotland. See N. S. Angus, G. T. Brown and H. F. Cleere, "The Iron Nails from the Roman Legionary Fortress at Inchtuthil, Perthshire," *Journal of the Iron and Steel Institute* 200 (1962) 956-968.

36. Cunliffe, *Fishbourne* II, 126-128, figs. 55.1-3.

37. Curle, *Roman Frontier Post*, 289, pl. 67.1, 3.

38. For lead rivets see Healy, 239; Tylecote, 95.

298: Max. P.L. 3.00; diam. head 2.20.

299: Max. P.L. 2.70; diam. head 2.20.

300: Max. P.L. 1.90; diam. head 2.10.

All from Inderese Grave 61.2. Probably coffin nails.

Publ. Greenewalt, "Lydian Graves," 126 no. 24.

301-312 Pl. 21. Late Roman.

All are iron.

301: L. 39.50; Th. under head 0.90; W. head 3.60.

302: L. 25.50; Th. under head 1.50; W. head 5.70.

303: L. 14.30; Th. under head 0.80; diam. head 2.60.

304: L. 11.30; Th. under head 0.90; diam. head 2.20.

305: L. 11.10; Th. under head 0.40; W. head 3.70.

306: L. 10.10; Th. under head 1.00; diam. head 2.10.

307: L. 9.40; Th. under head 0.90; diam. head 3.00.

308: L. 7.90; Th. under head 0.70; diam. head 2.30.

309: Max. P.L. 7.50; Th. under head 1.30; diam. head 3.50.

310: L. 6.40; Th. under head 1.10; diam. head 2.50.

311: L. 6.00; Th. under head 0.20; diam. head 1.30.

312: Max. P.L. 5.00; Th. under head 0.60; diam. head 3.20.

All from BE E20.00-40.00/N50.00-85.00 *100.00-97.00.

301 has flat, vertical head, rivet through shaft; **302** has arched head; **305** (eighth from 1.) has split and spread head; rest have round heads.

See Jacobi, *Saalburg II*, pl. 43 for variety; Cleere, 56-59, fig. 2, Type II for **301**, **302**, Type III fig. 3a-e for rest; Curle, *Roman Frontier Post*, 289, pl. 67.1, 3 for **305**.

313-317 Pl. 22. Late Roman.

All are iron.

313: L. 14.90; Th. under head 1.30; W. head 5.50.

314: L. 11.20; Th. under head 0.90; max. P.W. head 2.70.

315: Max. P.L. 10.40; Th. under head 1.10.

316: Max. P.L. 10.10; Th. under head 1.00.

317: L. 4.20; Th. under head 0.50; diam. head 2.70.

All from BE-H E1.00/N64.00-65.00 ca. *97.75.

Two (**313**, **314**) have split and spread heads; two (**315**, **316**) have missing heads; one (**317**) has round head.

318-325 Pl. 22. Late Roman-Early Byzantine.

All are iron.

318: L. 17.00 (bent); diam. head 2.45.

319: L. 15.80 (bent); W. head 2.40.

320: L. 14.70; W. head 2.25.

321: L. 14.40 (bent); diam. head 2.50.

322: L. 13.20; diam. head 1.90.

323: L. 12.30 (bent); diam. head 2.00.

324: L. 12.20 (bent); W. head 1.75.

325: L. 11.60; diam. head 2.75.

All from Pa-S E86.00-90.00/N20.70-32.70 *97.20-96.20.

319, **320** and **324** have square heads, the rest round.

Tacks

326-337 Pl. 22. M61.87:3899. Roman, ca. 1st-2nd C. A.D.

All iron. All heavily corroded; some broken.

Size range: L. ca. 1.60-1.90; diam. heads ca. 1.00. PN Grave 61.24.

338, **339** Pl. 22. M60.64:2756. Roman, ca. 1st-2nd C. A.D.

Iron.

L. 1.00; diam. head 0.80.

PC Tomb D *91.20.

Small, hemispherical heads, short shafts.

340, **341** Pl. 22. M59.64a:2111. Early Byzantine.

Copper alloy. Corroded and fragmentary.

Max. L. 1.00; diam. heads 2.00.

BS W13 W55.00-57.00 *94.50.

Short shafts; one has a broad, flat head, the other is domed.

Rivets or Plugs?

342-345 M58.108:1050. Roman-Byzantine?

Lead.

342: L. 2.20; diam. head 2.00.

343: L. 1.60; diam. head 1.90.

344: L. 1.70; diam. head 1.80.

345: L. 1.90; diam. head 2.10.

All from Building B area ca. *96.50.

All have short conical shafts and flat round heads.

LOCKS AND KEYS

Locks

A large number of iron and copper alloy locks of the Early Byzantine period were found at Sardis, of which only a sampling are given here. Most are from the Byzantine Shops, but some come from the House of Bronzes and other locations. By far the greatest number

was found in Shop E11, nicknamed the "Lock Shop" or "Hardware Shop," since it appears that locks were manufactured and sold there.³⁹ Locks found in that shop are of both copper alloy and iron, and are divided into two main categories: cylindrical padlocks and rectangular, box-shaped locks that may have been padlocks as well.⁴⁰ Numbers of locks from E11 or adjacent E10 in each category are as follows:

Iron rectangular locks, whole or nearly whole: 54
 Iron rectangular locks, fragments: ±62
 Copper alloy rectangular locks: 4
 Iron cylindrical locks, whole or nearly whole: 18
 Copper alloy cylindrical locks: 3
 Total: ±141.

Many of the locks from E10-11 show signs of having gone through a fire and have a good deal of charred wood attached to their corroded surfaces. Some also show that they were in the process of being manufactured when they were destroyed—unfinished parts, rivets, or bits of the inner mechanism remained sticking through the plates and had not yet been trimmed off or hammered flush (e.g. 347).

Most of the rectangular locks are made of two plates with sides turned down and fitted together to form a box with the mechanism inside. In the face of one plate is the keyhole, usually an oblong slot for the bolt set either horizontally or vertically. There is also usually another vertical slot near the l. edge of the plate set a little higher than the keyhole, and, if the keyhole is near the center of the plate, a second slot on the r. edge as well. If these locks functioned as padlocks these slots may have served to hold the ends of a chain that would be held in place by the bolt,⁴¹ and indeed, several rectangular locks did have the ends of chain preserved or corroded to the cases in or near this position (348, 351). Four round attachment or rivet holes are also usually present—one in each corner of the plate. Where the back plate is preserved one may see another keyhole with a latch or ring protruding from it (e.g. 360, not from E11). In some, where only one plate is preserved, parts of the

mechanism can still be seen, though it is usually in a badly corroded state and difficult to interpret.⁴²

A number of similar rectangular locks were found in other shops (359-362), in HoB proper (363) and the Synagogue (364). Most of these are only partially preserved, but clearly belong to the same general type that prevailed in the "Hardware Shop."

In terms of size, rectangular iron locks seem to fall into three categories: small (346-349, 358), with greatest measurements from 3.80 × 4.10 to 5.00 × 6.00; medium (350-356, 360, 363), ca. 5.50 × 6.60 to 7.60 × 9.70; large (357, 359, 361, 364), 8.00 × 7.00 and larger. Most of the large ones are broken and full dimensions are not available for all.

Of the cylindrical padlocks, most came from the "Hardware Shop" complex (365, 366, 368-378) and one more from Shop E13 (367). In general these locks consist of a cylindrical lock body or case containing the mechanism, and a removable cap at either end, one containing the keyhole, the other with a ring or shackle protruding from the interior which could be attached to a hasp or chain (e.g. 367). Most are fairly shallow, but two (365, 366) from Shop E10, part of the "Hardware Shop" complex, are quite deep and show considerable care in the design of the case. As with the rectangular locks, where mechanisms are preserved at all, they are too corroded to analyze properly.

Rectangular Locks

346-357 Pl. 23. Early Byzantine.

All iron. All corroded; in most cases only the front plate is wholly or partly preserved.

346: H. 4.60; W. 4.80.

347: H. 5.00; W. 4.70; D. 3.00.

348: H. 5.00; W. 6.00.

349: Max. P.H. 4.70; W. 6.00.

350: H. 5.50; W. 6.30.

351: H. 5.10; W. 6.30.

352: Max. P.H. 5.30; W. 7.30.

353: H. 6.10; W. 7.50.

354: H. 6.00; W. 7.10.

355: H. 5.50; W. 6.20.

356: H. 7.00; W. 7.50.

357: Max. P.H. 3.40; W. 9.60.

All from BS E11.

As can be seen from the drawings, parts of the mechanisms are still preserved on all examples, though in

39. See Crawford, forthcoming study of the Byzantine Shops.

40. For terminology, descriptions and illustrations of different kinds of handmade lock mechanisms see Parviz Tanavoli and J. T. Wertme, *Locks from Iran: Pre-Islamic to Twentieth Century: The Parviz Tanavoli Collection* (Washington, D.C. 1976) 30-47; see also Wulff, 65-73, and Frere, *Verulamium* I, 181. The first of these references also contains a wealth of information on the nonutilitarian significance of locks and the role of locksmiths in traditional Iranian culture.

41. For description of a similar, though round, lock see Manning, 411. For a rectangular padlock of somewhat more ornate design see Manning in Cunliffe, *Fishbourne* II, 140-143.

42. A plan to X-ray a number of complete locks to see if their mechanisms could be reconstructed was not carried out.

most cases they are too badly corroded to understand clearly. Judging from the remains in **346**, **350**, **351** and **353**, these would seem to be lever padlocks similar to those found at Caerleon, Fishbourne and Verulamium. It is also possible that at least some of these are tumbler locks, meant to be opened with a T-shaped or L-shaped lift key, but the apparent remains of chains or shackles on **348**, **351** and possibly **354** suggest that these at any rate are lever locks.

Lever padlocks: see Frere, *Verulamium* I, 181-182, fig. 67, no. 71; Manning in Cunliffe, *Fishbourne* II, 140-143; Manning, 410-416, esp. 411 for attachment of chain. For rectangular tumbler locks see Frere, *ibid.*, 181, fig. 67 no. 66; British Museum, *Greek and Roman Life*³, 140 fig. 159; 141-142 (probably from Pompeii).

358 *Pl. 23*. Early Byzantine.

Copper alloy. Only front plate preserved.
H. 3.80; W. 4.10; H. rim 1.30.
BS E11.

Four round rivet holes are preserved—one in each corner. The keyhole is set below center and is shaped like a modern keyhole as a vertical slot with rounded opening at the top. Above the keyhole near the l. edge of the plate is another vertical slot. Across the corners are incised diagonal lines.

There are three other lock plates of copper alloy from the "Hardware Shop" complex; all are larger than **358** but none has been measured. The others are also in a worse state of preservation.

For similar lock plates on wooden caskets see Emery, *Ballana and Qustul* I, 108, 127, 281-282, fig. 99 nos. 429, 450; II, pl. 69A,B Tombs B.47-3, B.80-54 (5th-6th C. A.D.).

359 M62.84:4915. Early Byzantine.

Iron. Heavily corroded; only front plate preserved.
H. 11.00; W. 9.50; H. rim 2.00; H. keyhole 2.50.
BS E13 E77.00-80.00/S1.00-3.00 *96.70-96.30.

Rivet holes visible in three corners.

360 *Pl. 23*. M67.18:7397. Early Byzantine.

Iron. Corroded; mechanism missing.
H. 6.50; W. 7.50; H. rim 1.30.
BS E6 E40.00-41.00/S3.09 *96.84 in fill at foot of stairs, found together with key **402**.

Three nails or rivets preserved, two in lower corners, one in upper r. In position of keyhole is a round hole through which a latch protrudes. Attached to each end of the latch is a round loop. Near l. edge and above the latch is a vertical slot similar to those on the preceding examples.

The following rectangular plates are similar to **360**:

361 Early Byzantine.

Iron. Heavily corroded and broken.
Max. P.H. 9.60; max. P.W. 11.00; H. keyholes 0.80, 1.00; W. keyholes 2.50, 2.20.
BS E7 E44.50/S0.00-3.00 *97.60-97.20.

362 Early Byzantine.

Iron. Fragmentary and corroded.
Not measured.
BS E7 E44.00-49.00/S0.00-4.00 *97.20-96.90.

363 *Pl. 23*. M59.24:1481. Early Byzantine.

Iron. Corroded; only front plate and rim preserved. Impressions of burnt wood remain in corrosion.
H. 7.00; W. 9.00; H. keyhole 2.00.
HoB Area 5 E30.00/S70.00 *97.60 on floor of threshold.

Remains of a nail are preserved in each corner. Keyhole is located to r. of and below center and has a modern shape. Above and near l. edge is a vertical slot.

364 M62.78A:4799. Early Byzantine?

Iron. Corroded. Mechanism partly preserved on reverse.
H. 13.00; W. 14.00; H. rim 1.10; H. keyhole 2.50.
Syn FC E113.50/N6.00 *97.00 in late occupation fill.
Keyhole located near center of plate.

Cylindrical Locks

365, **366** *Pl. 23*. Early Byzantine.

Copper alloy with iron mechanisms. Heavily corroded, especially on int. Cap of **365** is loose and comes off to reveal int. Both caps of **366** corroded on. Dimensions of both nearly identical: L. 7.50; diam. 4.75; H. cap 1.30.
BS E10 E66.45/S2.70 *96.25.

Each one has a slot near one edge and a round opening slightly off center. These correspond to openings in the mechanism to permit the turning and working of parts. In each a pin on either side goes right through the entire piece to hold the parts together. Exteriors of each are decorated with five groups of three raised circumferential lines on the body, another group near the outer edge of each cap. These lines are probably formed by lathe turning.

The remains of the mechanism resemble those of a cylindrical iron lever padlock from Caerleon. In a likely

reconstruction of its operation the circular opening in the Sardis locks would correspond to a cylindrical ward (or wards) which helps support a bolt. This in turn may be shot through the end of a chain inserted into the slot-like opening by turning a key through the ward(s). The main difficulty with this interpretation is the rather small circular opening through the (presumed) wards which does not appear the right size and shape for the insertion of a key of normal shape.

See Manning, 410-416, figs. 1-4; Jacobi, *Saalburg I*, 477 fig. 76.13, 17, 22; British Museum, *Greek and Roman Life*³, 142 fig. 161, 143. For lathe-turned decoration on a similar case see A. Mutz, *Die Kunst des Metalldrehens bei den Römern* (Basel, Stuttgart 1972) 165 no. 486.

367 Pl. 23. M62.81:4864. Early Byzantine.

Iron. Heavily corroded, obscuring most details.

L. 9.50; diam. 5.40; L. chain link 5.90.

BS E13 E79.00-80.00/S3.50 *96.70-96.40.

At one end is a loop to which is attached the end of an iron chain with O-shaped links. In other end are several openings obscured by corrosion. Probably a lever pad-lock similar to **365** and **366**.

See Frere, *Verulamium I*, 182, fig. 67 no. 71 (3rd C. A.D.); Manning, 410-416.

368-378 Early Byzantine.

Iron. Heavily corroded and fragmentary.

368: L. 1.90; diam. 4.50 (back plate missing).

369: L. 2.90; diam. 4.20.

370: L. 2.00; diam. 6.00.

371: L. 2.60; diam. 6.50.

372: L. 3.50; diam. 6.50 (copper alloy ring on back).

373: L. 4.00; diam. 6.50 (mechanism missing).

374: L. 2.40; diam. front 7.50; diam. back 5.50.

375: L. 5.80; diam. 7.50.

376: L. 4.50; diam. 9.50 (*Pl. 24*).

377: L. 4.70; diam. 10.00.

378: L. 5.00; diam. 10.00 (*Pl. 24*).

Fragments of three more and three top or bottom caps or plates were also found; diam. 6.00, 7.00, 8.40. All from BS E11.

See Boucher, 188 no. 513 (no date or provenance); Manning, 410-416, figs. 1-4.

379 Pl. 24. M60.15:2285. Byzantine or later.

Iron. Corroded.

H. 5.70; max. W. 5.20; Th. 0.25.

CG SW corner of CGW local grid W21.00-23.00/ N0.00-4.50 *100.00.

Nearly round plate divided at one end and turned outward to form two squat tabs or legs, each with a rivet through it. A vertical strip runs down the center to hide the keyhole. Part of the mechanism is preserved on the back consisting of three long prongs above the center and part of a spring (?) at the back of the keyhole. The shape of the lock and principle of the locking mechanism are different from the preceding examples.

Decorative Lock Plates

In addition to actual locks, a number of decorative plates were found which most likely served to ornament the locks of boxes or caskets (**380-390**). In most cases no trace of mechanism is preserved with the plate (exceptions being **381** and **382**), nor is there evidence in any case that the existing plate fitted together with a back plate to form a whole lock case. Most examples have attachment holes whereby they could be nailed to a wooden surface. The majority of these decorative lock plates come from Early Byzantine contexts in the shops (**381-383**, **385-387**) and HoB (**380**); the others come from less secure contexts in HoB and on the Acropolis (**384**, **388**), while two (**389**, **390**) were not found in the excavations and come from unidentified contexts. In most cases the style of the unstratified examples is close enough to that of the others to permit a dating in the Early Byzantine era as well. All but one (**387**) are of copper alloy and many have quite elaborate surface decoration proving their essentially ornamental function.

380 Pl. 24. M59.48:1799. Early Byzantine, late 6th-early 7th C. A.D.

Copper alloy. Large jagged hole in left side. Other cracks and breaks repaired.

H. 6.20; W. 10.00.

HoB Area 13 E30.00/S80.00 *96.74 floor.

Rectangular plate with raised border around all four sides. To right a narrow oblong slot, and judging from the character of the break, there was possibly a similar slot on the left. In the center is a model of a sanctuary facade attached to the plate with small rivets. Above the facade is an arch and to either side is a column surmounted by a cross, the one on the left resting on an oblong base; base on the right is missing. In center of the facade is a door with two leaves closed by a vertical bar down the center which opens to reveal the keyhole. The keyhole, of normal shape, is visible on the rear of the plate (see *Pl. 24*). The surface is decorated with hollow circles around the borders, hollow triangles, circles and crosses on the door and facade. These were

perhaps once inlaid, although no trace of inlay now remains. Shallow incised circles are placed in an arc pattern at the corners of the plate.

The piece once formed the lock plate of a small wooden chest that burned in the destruction of HoB in the early seventh century A.D.

381 *Pl. 24.* M68.10:7716. Early Byzantine.

Copper alloy. Fragmentary; most of lower edge missing; upper r. and l. corners, and sections of the plate also missing.

Max. P.W. 10.70; max. P.H. 7.00; W. border strips 0.70; W. keyhole 1.90; H. keyhole 0.40; diam. rivets 0.20. BS E11 E70.00-71.00/S4.50-5.00 *96.30.

Rectangular lock plate with raised border strips made separately and attached by rivets. Near left and right edges are two vertical, oblong slots. Remains of round attachment holes visible in upper and lower l. corners. In center is a horizontal slot for the keyhole. To either side of the keyhole is a decorative "column" with flame-shaped finial on top, oblong base at bottom. The "columns," attached by rivets, are not set symmetrically—the one on the r. is placed lower than the one on the l. On back, near the keyhole, strips of copper alloy are attached, perhaps remains of the lock mechanism or means of attachment. The front surface is decorated with a pattern of incised circles with a small hole punched in the center of each, some of which pierce through the plate. The border strips have zigzags on the outer edges, debased leaf pattern on the inner edges and hollow circles along the center, perhaps once filled with inlay (not preserved). Small rivets through some of the circles attach strips to the plate. Found with the plate were fragments of several flat plain strips of copper alloy, perhaps the remains of box straps.

382 *Pl. 24.* Early Byzantine.

Copper alloy. Surface corroded; part of iron mechanism preserved on back.

H. 4.80; W. 6.00; W. border 0.50; H. column 3.80; W. keyhole 1.20. BS E11.

Rectangular plate with plain raised border strip around edges, made separately and attached with rivets. Circular attachment hole in each corner of the plate. Horizontal oblong keyhole placed to r. of center; narrow vertical slot near l. edge. On either side of the keyhole is a "column" with flame-shaped finial, similar to those on **381** but with plain undecorated surfaces. The r. hand column is placed lower than the one on the l. so that the base overlaps the bottom border of the plate. The whole

piece is very similar in design to **381** but lacks the surface decoration.

383 Early Byzantine.

Copper alloy. Right edge missing.

H. 7.00; W. 8.90; Th. 0.30. BS E11.

Similar to **381** but with plain border and surface. Vertical oblong slot at r. and l. edges; horizontal oblong keyhole near center.

384 *Pl. 24.* M59.23a:1464 Byzantine?

Copper alloy. Edges and corners chipped; upper r. corner missing.

H. 5.00; W. 6.00; Th. 0.10.

HoB E10.00/S60.00 *100.00-99.20 over post-Roman graves g, f, l, m, h in fill.

Rectangular plate with concave edges. To upper l. is a vertical oblong slot; to r. of center is a nearly square L-shaped keyhole. Four round attachment holes are placed assymmetrically, one at top center, one near top r., one bottom l. and one bottom r. Punctate border pattern consists of two rows of dots. A similar row of punched dots surrounds the keyhole; punctate abstract floral pattern springs from lower center.

No trace of mechanism is preserved but the shape of the keyhole suggests that this was the face of a tumbler lock which was opened with a lift or slide key.

For tumbler lock type see Frere, *Verulamium* I, 181, Fig. 67, no. 66.

385 *Pl. 24.* M67.13:7375. Early Byzantine.

Copper alloy. Cracks running through edges.

Diam. 6.00; diam. attachment holes 0.30; H. vertical slot 1.40; W. vertical slot 0.40; H. horizontal slot 0.40; W. 1.10; Th. 0.05. BS E10 E65.50/S3.38 *97.94.

Circular plate with edges cut in a decorative pattern. Four round attachment holes—two on each axis. Vertical oblong slot below center; horizontal oblong slot above center. Surface decorated with two sets of incised concentric circles, the outer passing through the attachment holes, the inner through the slots. In addition there are four sets of incised concentric half circles at the edges opposite the attachment holes.

A similar example was found at Anemurium in an Early Byzantine context. See Russell, no. 17.

386 Early Byzantine.

Copper alloy. Broken in two; heavily diseased.

Diam. 6.50; H. vertical slot 1.30; W. slot 0.70; Th. ca. 0.025.

BS E13 E77.00-79.50/S1.50-3.50 *96.70-96.60.

Similar to **385** but with plain surface.

387 M67.19:7398. Early Byzantine.

Iron. Edges worn; corroded. Stumps of two nails preserved in attachment holes.

Diam. 5.80; H. vertical slot 1.50; W. slot 0.70; W. horizontal slot 1.20; Th. 0.10.

BS E6 E40.00-41.00/S3.09 *96.84.

Similar to **385** but with plain surface and edges.

388 Pl. 24. M61.54:3675. Byzantine?

Copper alloy.

H. 3.20; diam. plate 2.15; L. keyhole 1.40; W. keyhole 0.80; Th. 0.20.

AcT local grid W30.00-35.00/N2.00-7.00 near surface below Room 5.

Nearly circular plate with T-shaped keyhole in center. One side extended to form rectangular tab with square attachment hole. A small knob is at each corner of the tab. Incised scroll pattern on surface of plate.

Shape and design are very similar to **389** and **390**.

389 Pl. 24. NoEx 68.10A. Byzantine?

Copper alloy.

H. 4.00; diam. rim 1.90; L. keyhole 0.70.

Provenance unknown.

Nearly circular plate with T-shaped keyhole through center. One side of plate is extended in an oblong tab with rounded end pierced by attachment hole. Incised linear design on plate and lower part of tab. On back, a raised band at transition from plate to tab.

Very similar in general character to **388**.

390 Pl. 24. NoEx 68.10B. Byzantine?

Copper alloy.

H. 4.00; diam. plate 2.90; L. keyhole 1.50; W. keyhole 0.70; W. tab 1.60.

Provenance unknown.

Circular plate with circular depression in center pierced by vertical oblong keyhole. One side extended to form trapezoidal tab pierced by round attachment hole. Incised linear design on plate and tab.

Keys

A fair number of keys were found at Sardis in both iron and copper alloy. The largest are apparently keys

to door locks or padlocks (**391-394**, **401**, **402**) of both tumbler and lever lock types. The majority of keys found are smaller, however, and were apparently meant as keys for box or casket locks. Several (**395-398**, **400**) were intended to be worn on the finger for safe keeping. None can be matched with any certainty with any of the locks found although one lock and key were found in the same location in Shop E6 (**360**, **402**). Those that can be dated belong by and large to Late Roman-Early Byzantine contexts.

391 Pl. 25. M61.48:3564. Hellenistic-Roman?

Iron. Corroded. Ring broken.

Max. P.L. 12.80; max. W. 2.30; Th. 0.90; bit 2.00 x 1.80.

HoB E5.00-15.00/S110.00 to *100.80 mixed context.

Long stem with flattened and widened handle pierced at one end to form ring. Plain, rectangular bit at right angles to stem, possibly notched on outer edge.

The type corresponds to Davidson's Type a, used in Corinth primarily in the first century A.D., possibly into the second. It is identified by Frere at Verulamium as a tumbler lock slide key and appears there in first to fourth century A.D. contexts. To operate, the key would be pushed through the bolt in the lock to engage a set of tumblers and then used as a handle to slide the bolt along.

See Davidson, *Corinth* XII, 137, 138, pl. 70 nos. 967-969; Frere, *Verulamium* I, 182-184, fig. 68 nos. 75-78.

392 Pl. 25. M61.19:3229. Late Roman?

Iron. Heavily corroded.

Max. P.L. 13.00; W. stem 2.50; W. bit 2.50; L. bit 2.40; diam. hole 0.70.

RT E3.00/S13.00 S of colonnade *96.40 in fill below marble floor, probably from gutter of road.

Flat, broad stem rounded at one end and pierced through with round hole. Bit attached to other end of stem by a short shank. Bit has three notches, now almost obscured by corrosion. Type is similar to **391**.

393 Pl. 25. Roman or later?

Iron. Corroded.

L. stem 3.00; L. bit 2.00; ext. diam. ring 2.50.

HoB E5.00-15.00/S90.00 *101.70-101.50.

Similar to preceding but with more sophisticated bit, having six teeth set at right angles to the bit to engage the tumblers of the lock. It is possible that the bits of **391** and **392** had teeth but that these have been lost through corrosion.

See Cunliffe, *Fishbourne* II, 131, 132, fig. 58, no. 30 (2nd-3rd C. A.D.); Boehmer, *Boğazköy* VII, 157-158, pl. 55, nos. 1645-1651 (unstratified).

394 Roman or later?

Iron.

L. 6.20; W. stem 0.80; ext. diam. ring 2.90; L. bit 2.20.
HoB E20.00-25.00/S90.00 to *100.40.

394 is similar to 393.

395 Pl. 25. M61.26:3353. Early Byzantine.

Copper alloy.

Max. L. 3.00; ext. diam. ring 2.00; W. ring 0.50; L. stem 1.20; L. bit 1.25; W. bit 0.60.

RT in colonnade floor below mosaic paving, E16.00-17.00/S9.00 *96.50. Found with 6th C. A.D. coin.

Short stem with immovable ring at one end. At other end is a short shank with toothed bit at right angles to the stem. Probably used in a tumbler lock.

This key belongs to a common type of small key that can be worn on the finger by means of the ring. It was probably used to lock small chests, caskets and boxes. At Corinth, they appear in contexts ranging from first to fourth century A.D. with most examples coming from the third to fourth century. Contexts of this and 396 at Sardis extend the range at least into the seventh century A.D.

See Davidson, *Corinth* XII, 137, 138, pl. 70 Type b, nos. 970-975; Yadin, *Cave of Letters*, 92-94 and refs., fig. 33, pl. 26, nos. 44, 45 (2nd C. A.D.); Perdrizet, *Delphes* V, 117, fig. 424 no. 621 (Roman).

The following are similar to 395:

396 Early Byzantine.

Copper alloy. Some disease beginning as of 1974.

L. stem 0.85; L. bit 1.20; H. teeth 1.10; diam. ring 2.40; Th. ring 0.20; W. ring 0.45.

BS E2a E18.86/S0.63 *96.00.

Ten tubular teeth in bit; incisions on stem.

397 Roman-Byzantine?

Copper alloy. Ring broken.

L. bit 1.60; H. teeth 0.45.

HoB W10.00-15.00/S110.00-115.00 *100.40.

398

Copper alloy.

Max. L. 2.70; diam. ring 2.30; L. bit 0.90.

PN W300.00-304.00/S323.00-326.00 *85.40-85.00.

399 Pl. 25. M63.59:5874. Roman-Byzantine?

Iron. Heavily corroded and broken in three pieces.

L. stem 2.20; W. bit 1.40; diam. ring 2.80.

Syn FC E113.00-115.00/N2.00-6.00 *97.30-96.80.

Short tubular stem with hole through center set at right angles to ring at one end. At other end is a short, squarish toothed bit. The type is basically similar to the preceding.

See Davidson, *Corinth* XII, 137, 138, pl. 70, no. 975 (iron, 1st or early 2nd C. A.D.).

400 Pl. 25. Roman-Byzantine?

Copper alloy. Part of ring broken.

L. bit 2.00; W. bit 1.50; W. ring 0.60; diam. ring 2.10.

HoB W5.00/S115.00-120.00 to *100.30.

Very short stem ending in broad flat bit pierced by three rectangular openings. The other end of the stem terminates in a broad ring set at right angles to the stem. Surface is decorated with pairs of horizontal and diagonal incised lines. The holes in the bit are apparently made to pass through a warded lock.

See Davidson, *Corinth* XII, 137, 138, pl. 70, no. 977 (3rd-4th C. A.D.).

401 Pl. 25. M73.3:8229. Early Byzantine.

Iron. Most of ring missing; heavily corroded but core of metal remains.

L. 10.20; diam. ring 4.20; L. bit 4.40.

BS E10 E64.40/N2.90 *98.30.

Long stem with square section pierced at one end by a hole through which passes part of a large movable ring. At the other end is a long flat bit with one notch in the vertical edge, another in the horizontal (bottom) edge. Two additional holes pierce the bit between the two notches.

See Anemurium, no. AN 71/73, from period of reuse of large Roman baths, though date is uncertain (unpubl.).

402 M67.18:7397. Early Byzantine.

Iron. Corroded; ring missing.

Max. P.L. 7.40; W. bit 2.05.

BS E6 E40.00-41.00/S3.09 *96.84 found with lock 360.

Similar to 401. Rectangular bit pierced by two rectangular slots.

403 Pl. 25. M72.4:8194. Byzantine?

Copper alloy.

Max. L. 3.40; ext. diam. ring 2.40; W. ring 0.30; Th.

ring 0.20; L. stem 1.50; L. bit 1.00; L. shank 0.95.
BE-C E13.40/N21.15 *97.19.

Short tubular stem with short rectangular notched bit at one end set at right angles to stem. Through the bit is a small round hole. At other end of stem is a large movable ring with flat section, narrower where it passes through hole in upper end of stem. Short incised lines on ring near point of attachment to key.

Keys with movable rings are found at Corinth only in Byzantine contexts of tenth century A.D. and later, though they possibly begin as early as the fourth or fifth century A.D. According to Davidson these ring keys were not intended to be worn on the finger, unlike the Roman keys with immovable rings (395-399). The contexts of most examples from Sardis are not secure, though they do not contradict Davidson's general conclusions. A fragmentary example, probably similar, from one of the shops (407) might put the earliest appearance of this type at Sardis in late sixth to early seventh century A.D.

See Davidson, *Corinth* XII, 137, 138-139, pl. 70 nos. 979-997 (Byzantine, 10th-12th C.); Deonna, *Délos* XVIII, 250, pl. 79 no. 670 (no earlier than Roman period); Anemurium, nos. 71-336, 72-80, Early Byzantine context (unpubl.).

The following are similar to 403:

404

Copper alloy.

Max. L. 3.90; diam. ring 2.80; L. bit 0.80; L. stem 1.80.
BE-B chance find below ca. *96.30.

405 M64.27:6297. Byzantine?

Copper alloy. Corroded.

L. stem 1.70; diam. ring 2.30; bit 0.80 × 0.70.
MRd E116.00-117.00/S13.00-15.00 *97.00-96.50.

Short solid shaft with flat squarish bit pierced by a single round hole.

406 Pl. 25. M60.61:2700. Byzantine?

Copper alloy. Key stem and bit missing; only ring preserved.

Diam. 2.80; Th. 0.60; min. Th. 0.25.

AcT local grid A-C fill below Level I *401.90 a.s.l.

Ring round in section tapering and thinning towards center of one side. Where band is thickest it abruptly narrows to form a short bar on which key stem could be suspended.

See Davidson, *Corinth* XII, 137, 139, pl. 70 no. 994 (4th C. A.D.?).

407 Pl. 25. M59.14:1372. Early Byzantine.

Copper alloy. Key and ring separated.

Diam. ring 2.60.

BS W8 W29.00-26.00/S3.50 *97.75-96.75.

Notched bit with small round hole through tip.

408 Early Byzantine.

Iron. Heavily corroded. Not possible to tell whether ring is movable or not.

Max. L. 4.80; diam. ring 3.30; L. bit 1.90.

BS E9 E57.50/S2.50 *96.40.

BOX AND CASSET FITTINGS

Apart from locks and lock plates, a number of objects have been found which seem to have functioned in various ways as the fittings for wooden boxes or caskets. These consist chiefly of decorative handle attachments (409-411), hasps, clasps and binding straps for securing the contents (412-419) and part of a seal box for guaranteeing the security of the contents (420). Most of these objects, where they can be securely dated, belong to the Late Roman-Early Byzantine era.

Handle Attachments

409, 410 Pl. 25. M63.22a,b:5299. Early Byzantine?

409 is zinc bronze. Analyzed by emission spectrography and neutron activation. See Chap. V, Tables V.1, 3, 4a. Diam. back plate 3.10; W. profile 3.65; W. ear to ear (409) 2.50, (410) 2.90.

Syn P "Restaurant" E119.00/N3.20 *98.25 in top burning above floor.

The two lions' heads are nearly identical in size and design. They are hollow cast with flat, disk-shaped back plates. The heads are geometricized and only perfunctorily modeled. The ears are tubular, eye ridges prominent, and muzzles nearly square. Open sides of mouths behind fangs form circular holes through which a ring handle or handles could be suspended. Traced lines and punched dots indicate surface markings—deep straight vertical lines on muzzles and tops of heads, horizontal lines on cheeks and chins. Zigzag lines on backplates suggest stylized manes embellished with shallow dots. Dots are also closely spaced on muzzles on either side of the lines; deeper dots form the nostrils and pupils of the eyes.

Publ. *BASOR* 174, 47; Crawford, 293, who suggests a date close to that of the destruction of BS (A.D. 616). For similar lion-headed handle attachments see F. Fremersdorf, "Aus der

Tätigkeit des Römisch-germanischen Museums Köln," *Kölner Jahrbuch* 1 (1955) 122, no. 1, fig. 4; pl. 32.7-8, no. 50.202; Comstock-Vermeule, 460-462, nos. 672-674 (Roman); H. Menzel, *Die römischen Bronzen aus Deutschland II Trier* (Mainz 1966) 63-67, pls. 54-55.

411 Pl. 25. M59.4:1193. Early Byzantine.

Copper alloy. Diseased.

Max. H. central plate 4.10; W. 2.40; max. P.W. 7.40; W. band 1.50.

HoB Room 11 fill *100.00-99.00.

Flat oval plate in center narrowing at either side to a flat band bent at right angles to center, descending, then bent at right angles again to form attachment plates. Through one side is a hole with part of an iron loop attached to it. The other end is cut to form three small tabs—the one in the center bent upward, two at the corners bent down at right angles to the band. The front surface is decorated with incised dotted circles.

Clasps and Hasps

412 Pl. 26. M58.35:377. Early Byzantine.

Copper alloy. Ends of cotter pin missing.

L. 7.50; max. W. 1.10.

BS W3 ca. *97.93 (grid not available).

Flat, lozenge-shaped bar with ring at one end, solid, circular tab at other. Through the ring passes the loop of a cotter pin for attaching the hasp to another object. Beneath the narrowest part of the other end is a square tab pierced by a square hole at right angles to the top of the bar. The bolt of a small lock could pass through the open tab to secure a casket or box. The top surface of the bar is decorated with a zigzag pattern cut into the edges but not going all the way through the thickness of the metal.

See Yadin, *Cave of Letters*, 90, fig. 32, pl. 25 no. 37 (2nd C. A.D.).

413 Early Byzantine.

Copper alloy. Broken in four pieces.

Max. P.L. ca. 18.80; max. W. loop 1.30.

BS E2 E15.95/S2.43 *96.94.

Similar to **412**.

414 Pl. 26. M69.12:8022. Byzantine?

Copper alloy. Ends broken.

Max. P.L. 7.40; max. W. 1.80; diam. loop 1.00.

RT S Colonnade E27.00-33.00/S29.00-32.00 *97.00-96.25.

Flat, tapering plate narrowing to thin bar bent into two semicircular curves. Broken end of another bar at center of plate opposite. On under side of the preserved bar is a loop. On surface of the plate are two groups of incised concentric circles.

415 Pl. 26. M63.20:5283. Roman-Byzantine.

Copper alloy.

L. 7.70; max. W. 1.40; Th. 0.10.

PN Unit HL W235.00-237.00/S343.00-345.00 to *88.90.

Flat oblong plate, slightly tapered and rounded at one end. Other end terminates in a tulip-shaped finial. The rounded end is pierced by a circular hole; a square tab with a circular hole through it is attached to the back of the finial at the other end. The upper surface of the plate is ornamented with punched dots arranged in a leaf pattern.

416 Pl. 26. M68.25:7901. Early Byzantine.

Copper alloy. Corroded.

Max. P.L. 15.60; L. curved section 4.00; W. 0.75; L. flat sections 4.25, 4.10; W. 0.70.

BS E5 E37.00-38.34/S0.00-5.00 *96.50-96.10.

Four narrow bars or segments, hinged together and held by small pins that are still flexible. The end of the last flat segment has a small loop for fitting into another hinge, indicating that there was once at least one more segment.

The two curved sections are solid and are decorated on their upper surfaces with incised lines and crosses. The two flat sections are each pierced with an oblong slot and circular hole along the long axis. A few short incised lines can also be seen near the two ends of each section. The piece probably forms part of the fittings of a small round box or casket like those found at Ballana.

See Emery, *Ballana and Qustul* 1, 278-279, 281-282, figs. 96, 99; II, pl. 69A-C (5th-6th C. A.D.).

Hinges and Binding Straps

417 Pl. 26. M60.20:2362. Byzantine.

Copper alloy. End of strap broken; some disease beginning as of 1974.

Max. P.L. 9.80; max. W. 1.80; Th. 0.35.

AcT Trench A E1001.00-1008.00/S1070.00-1075.00 below Late Byzantine walls.

Flat bar with remains of a broken hinge at widest end. Two holes are pierced through the bar for attachment to surface of box or door. Surface decorated with four large groups of incised concentric circles, each sur-

rounded by four smaller ones. The two perforations cut asymmetrically through the first and fourth of these groups indicating that the perforations are secondary to the decoration.

See Davidson, *Corinth XII*, 133, pl. 67 esp. no. 914 (Byzantine); Ploug-Oldenburg, *Hama IV.3*, 16, fig. 2.4, Level A1 (A.D. 1302-1401); Chavane, *Salamine VI*, 39, no. 112, pl. 13; Colt, *Nessana I*, 54, pl. 22.35 (7th C. A.D. or later); Anemurium, Russell, nos. 13, 14 (Early Byzantine).

418 Pl. 26. M68.26:7903. Late Roman-Early Byzantine?

Copper alloy. Corroded.

Max. P.L. 7.05; diam. end 1.90; max. W. 1.50.

HoB Bldg. R E50.00-51.00/S103.50-105.00 *99.60.

Flat bar widening at one end to a flat, rounded finial pierced by a circular hole. The other end is also rounded and pierced but narrower, and is hinged to a short, flat, rectangular piece. Through the corrosion remains of incised concentric circles can be seen on the main part of the bar and on the circular finial; these are similar to the ones on **417** and suggest that a date in the Late Roman or Byzantine era is most likely. Similar examples from Ballana and Anemurium also argue for the later date.

See Emery, *Ballana and Qustul I*, 280 no. 427, fig. 98 Tomb B.4-9 (5th-6th C. A.D.); Anemurium, no. 72-76, Early Byzantine context (unpubl.).

419 Pl. 26. M60.4:2244. Middle Byzantine or later.

Copper alloy. Both ends broken.

Max. P.L. 5.40; W. 2.10; Th. 0.10.

CG CGC local grid W10.00/N2.00-S5.00 *102.00.

Flat bar tapering towards break which runs through the apparent original center. The preserved end is rounded, then extended to form a narrow bar with a flat (broken) loop at the end. The surface of bar and loop is decorated with punched dots arranged in a dendritic pattern on the bar and in a circle on the loop.

Publ. *Sardis R1*, 142, fig. 379 where it was incorrectly referred to as a "sacral instrument."

Seal Box

420 Pl. 26. M65.4a:6703. Roman.

Copper alloy. Only one-half of original object preserved.

Max. L. 3.00; max. W. 1.60; D. 0.60.

HoB W36.00-39.00/S110.00-120.00 to *100.70 upper mixed fill.

Upper part of small, teardrop-shaped box with edges turned down to form sides of box. Remains of a hinge can be seen in center of widest end; a small, solid drop at

pointed end. Through the center are three holes, each surrounded by an incised circle.

For function see Curle, *Roman Frontier Post*, 308-309, pl. 81.6, 10, 11; Frere, *Verulamium I*, 122, fig. 34 nos. 65-67 (2nd C. A.D.); Cunliffe, *Fishbourne II*, 118, 119 fig. 49 nos. 129-132 (1st-3rd C. A.D.).

Ornamental Attachment

421 Pl. 26. M63.54:5834. Late Roman?

Copper alloy. Torn and diseased.

Max. P.L. 14.50; W. 2.70; Th. 0.05.

Syn MH E55.00-56.00/N3.00-3.50 *96.50 found with **611**.

Thin strip with repoussé pattern of eggs across center between two rows of dots along edges. In the lower r. corner (see *Pl. 26*) is a small attachment hole. The piece perhaps served as a casket or furniture decoration.

See Curle, *Roman Frontier Post*, 309, pl. 81.18; Helmut Buschhausen, *Die spätromischen Metallschreine und frühchristlichen Reliquiare 1. Teil: Katalog Wiener Byzantinistische Studien Bd. IX. Österreichische Akademie der Wissenschaften Kommission für Byzantinistik Institut für Byzantinistik der Universität Wien (Vienna 1971) 23-27, A Taf. 4, 6 (4th C. A.D.).*

FURNITURE AND FURNITURE FITTINGS

Finds of the furnishings of Sardian homes and work places are sparse. Of the earlier phases only the amorphous fragments of an iron burial couch from a Lydian grave (**422**) were identified. Parts of six iron campstool frames came from good Early Byzantine contexts—one from the House of Bronzes (**423**), five from the shops (**424-428**). Some shop owners may have been taking the air on their campstools when the Sassanians attacked—one (**424**) was found just in front of Shop E16—while the owner of Shop E7 may have had a couple of friends in to pass the time since fragments of three frames were found on his premises (**426-428**).

Ornamental finials most likely came from various kinds of furniture (**429-433**). The most interesting is a bull protome (**429**) which may have decorated a bier, and can be dated in the Late Roman-Early Byzantine era. The others have no figurative ornament, and only **431** can be safely dated by context to the Early Byzantine period.

Burial Couch Attachments

422 Pl. 26. M63.44:5638. Lydian, 7th-6th C. B.C.

Iron. Analyzed by atomic absorption. See Chap. V, Table V.5. Several corroded fragments.

Varying sizes.

BT 63.2 on floor in fill of burial chamber.

Two flat rectangular pieces with impressions of cloth adhering to surface and about twenty smaller fragments of various shapes.

It does not seem possible to reconstruct the original shape of the couch from the fragmentary, and for the most part, amorphous remains. The pieces and the remains of textile are being studied by C. H. Greenewalt, Jr.

Campstool Frames

423 Pl. 26. Early Byzantine.

Iron. Heavily corroded.

L. ca. 58.00; W. 39.00; Th. rod 1.00.

HoB Area 13 E30.00/S80.00 floor *97.64.

Two rectangular frames made of rods with rectangular sections, widened at the corners and originally joined in the middle of each of the long sides by a pin which permitted the two frames, when covered with fabric, to be folded and unfolded. On one of the short sides is a narrow rod (Th. 0.50) held to the bar of the frame by four loops. Part of another similar rod is preserved underneath, of which only the stumps of the loops are preserved. These probably had something to do with the attachment of a fabric seat to the frames.

See Emery, *Ballana and Qustul I*, 359-361, fig. 115; II, pl. 95A-C (5th-6th C. A.D.).

424 Pl. 27. M63.49:5730. Early Byzantine.

Iron. Heavily corroded and fragmentary.

L. 61.00; W. 44.00; Th. solid frame 1.00; H. open bar 3.70.

BS E16 outside S wall E95.00-97.00/S4.00-6.00 *97.00-96.50 on mosaic floor.

Pair of rectangular frames with flat sections, joined in center of long sides. One short side of each has an oblong opening through which the fabric seat may be attached. The other short side is solid all around and was intended to rest on the ground.

425 Early Byzantine.

Iron. Fragmentary. Only part of one corner of a frame with slot for fabric is recognizable among the fragments.

BS E17 E98.00/S2.00 *97.25-96.75.

426-428 Early Byzantine.

Iron. Fragmentary parts of three frames preserved.

Only one could be measured: L. 62.50; W. 44.00.

BS E7 E44.50-46.00/S1.05-3.03 *97.10 upper story debris.

The rods differ from the preceding in having round instead of rectangular sections.

Mentioned: *BASOR* 191, 21.

Bull Protome

429 Pl. 27. M64.33:6403. Late Roman-Early Byzantine, perhaps 5th-6th C. A.D.

Zinc bronze. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3. Some disease.

Max. H. (tip of horn to end of leg) 5.60; W. head (nose to back) 2.80; nose to rim 4.50.

ERd E126.00-130.00/N0.00 *96.70-96.65 at level of step E of porch.

Head and forequarters of a bull hollow cast in one piece. Hollow interior forms a socket for attachment to a pole or furniture part. Head and neck massive and almost rectangular in profile; legs extend forward into space on a stiff diagonal ending in molded hooves. Small triangular horns and pointed ears. Minimal modeling of muscles in neck. Rest of surface treatment consists of deeply incised lines indicating eyes, nostrils and mouth; semicircular lines above eyes, an incised hair whorl on forehead and small punched dots on muzzle. The general style, geometricization of forms and surface treatment are strongly reminiscent of the handling of the lion-headed attachments (409, 410), suggesting a similar date.

Such protomes are believed to have served as decorative finials at the ends of poles on biers and chariots. M. C. Ross, following E. Kitzinger, points out that protomes were a popular form of decoration in the fifth to sixth century A.D. in the Mediterranean.

Publ. *BASOR* 177, 19, 20 fig. 19. See M. C. Ross, "A Fifth-Century Bronze Ornament," *JWalt* 12 (1949) 109-111 (panther protome, probably 5th C. A.D.); Emery, *Ballana and Qustul I*, 32, 381, n. 866; II, pl. 107I (Qustul Tomb 2-108, 5th-6th C. A.D., three lions and four lionesses); E. Kitzinger, "The Horse and Lion Tapestry at Dumbarton Oaks," *DOPapers* 3 (1946) 15-20, 49 for discussion of animal protomes.

Finials

430 Pl. 27. Early Bronze Age; late 3rd millennium B.C. One of three found.

Silver. Corroded; azurite incrustation.

L. 7.50; diam. 2.30.

AhT Trench A E48.20/S42.25 *74.49 in fill surrounding pithos burial AT 68.8 near dagger 3.

Cylindrical tube with conical end, formed by hammering

sheet metal around a rod. Intended as finial for a wooden pole or staff.

Publ. *Dergi* 17.1 (1968) 126; *BASOR* 199, 15; Mitten-Yüğrüm, "Ahlatlı Tepecik," 26. See Mellink, "Karataş-Semayük," 322, T. 335 (Karataş); Arik, *Alaca*, 172-175 no. A1.244; 256-257 no. 1081 (mislabelled 1085 in photo).

431 Pl. 27. M67.8:7317. Early Byzantine.

Copper alloy. Some powdery white corrosion. Max. P.H. 12.00; max. W. 4.00; diam. base of knob 3.50; Th. shaft 1.20. BS E7 E49.00/S2.95 *97.88.

Solid shaft at base with rectangular section, widening above. On top of shaft and apparently in one piece with it is a biconical knob on flared base.

Publ. *BASOR* 191, 21.

432 Pl. 27. M67.25:7457. Roman?

Copper alloy. Outer surface heavily corroded. H. 4.40; H. base 2.00; L. base 4.50; W. base 4.50; Th. 0.30; diam. knob 3.00. AhT E4.10/S45.00 *76.67. Found with 489.

Base forms a hollow square with triangular perforations in the sides. To this base is attached a hemispherical knob, the lower part of which was inserted through a hole in the top of the base and hammered against a stake to secure it.

433 Pl. 27.

Iron. One "arm" broken off and replaced. The other "arm" is missing. Heavily corroded. Max. P.H. 18.00; diam. socket 2.00; Th. arm 0.40; diam. knob 1.30. Pa-W E33.80-43.80/W90.00-95.00 *97.10-96.83.

Base a conical hammered open socket the top of which is flattened and split into two curving arms with square sections. The tip of the preserved arm ends in a flat, rounded knob.

Leg or Support

434 Pl. 27. M60.41:2536.

Copper alloy. Top broken. Max. P.L. 8.40; diam. knob 2.10; max. W. peg 1.10. AcN local grid E2.00-5.00/S20.00-24.00 mixed fill ca. *398.30 a.s.l.

Tapering peg with square section at bottom, above which is a round knob set between two disks. Above

the upper disk is another knob pierced with a round hole (now broken).

WEIGHING EQUIPMENT: STEELYARDS, BALANCES, WEIGHTS

A considerable amount of weighing equipment has been found consisting of simple, equal-armed balances and parts of balances (448-465), steelyards or *staterae* and their parts (435-447), and a variety of weights (466-486). While examples of these objects were found in a number of sectors, the largest concentration in each category came from the Byzantine Shops or nearby where they no doubt formed part of the shopkeepers' necessary equipment for carrying on their daily business.

Steelyards (Staterae) and Steelyard Parts

The steelyard goes back at least to the first century B.C. of the Roman era and has survived to the present day as a weighing device. Vitruvius (10.1.6) mentions it as a means of avoiding fraud, and very similar devices can be seen today in the bazaars of the Middle East.⁴³ Basically, the steelyard operates on the principle of the lever in which the lever or beam, divided in two unequal parts, is suspended by a hook which serves as a fulcrum; the object to be weighed is suspended from the short end of the lever on one side of the fulcrum, and is balanced against a movable weight suspended from the longer end on the other side of the fulcrum.⁴⁴ All the Sardis examples are of the multiple fulcrum type in which the lever is fitted with two or three suspension hooks corresponding to different relative lengths of the longer part of the lever, making it possible to weigh a variety of objects of very different weights with the same instrument and weight.⁴⁵ The faces of the longer arm are graduated, the steps marked with incised lines, dots and letters indicating the scale of weights accommodated by each fulcrum hook. Sizes of beams vary from ca. 17.80 cm. in L. (435) to over 71.00 cm. (440). Where weights are preserved, all are either plain lead or lead with a copper alloy casing (435-437, 439, 447). None is of the more decorative figurative type that often appears elsewhere.⁴⁶

43. See Wulff, 64-65, fig. 93.

44. For mode of operation see Hill, 51-55; British Museum, *Greek and Roman Life*³, 152-154; Skinner, 76-77, noting improvements in use and flexibility introduced to steelyard design in the 4th C. A.D.

45. Hill, 52.

46. See e.g. Comstock-Vermeule, 436-441, nos. 641-644; Ross, *DOCat* I, nos. 70, 71, 72, pls. 42, 45.

Of the thirteen catalogued steelyards or steelyard parts—isolated hooks, weights, etc.—nine come from in or near BS and two (442, 443) from the “Restaurant” in the Synagogue Porch and the South Colonnade across the street from the shops respectively. In addition, two hooks from BS E13 and weights from BS E17 and the Synagogue were omitted from the catalogue. Contexts and similarity in type make a date in the late sixth to early seventh century A.D. plausible for most or all of these examples.⁴⁷ The only exceptions are a hook (446) from PN, which could have belonged to a different type of object, and a weight of uncertain date from AT (447), originally misidentified as a plumb bob.

435 *Pl. 28.* M73.1:8224. Early Byzantine.

Copper alloy beam, chains and hooks; lead weight covered with copper alloy case. Weight corroded and broken; parts of suspension chains missing. L. beam 17.80; Th. 0.55; diam. weight 5.00; P.H. weight and hook 7.00; P.L. chain, hooks and U-bar 17.00; L. suspension hooks 5.90, 3.70 (broken). BS E2 ca. E13 (found in cleaning operation).

Small beam with square section divided in two unequal sections; at r. end of longer section is a spherical finial or stop; at the other (l.) end is a biconical one. Suspended from a groove behind the stop on the shorter end is a movable loop or collar attached to a U-shaped bar from which are suspended two chains with hooks at the end—these are for holding the object to be weighed. Three other hooks for suspending the whole apparatus are attached to small movable rings which are fitted around small bars inserted into grooves in three sides of the shorter end of the bar—these serve as fulcrum against which the objects to be weighed were balanced against a weight of fixed quantity. The weight was once spherical and is attached to a ring at the top by which it is suspended from an S-shaped hook which can slide along the beam. The long end of the beam is graduated on three sides by incised lines (now obscured by corrosion). When the beam was suspended by one of the hooks the scale was read on the appropriate side as the weight was slid along the beam.

See Davidson, *Corinth* XII, 207-208, 214-216, pl. 98 nos. 1661-1669 (Roman-Byzantine); Chavane, *Salamine* VI, 43, pls. 14, 61 no. 122 (Roman); Ross, *DOCat* I, 61-63, pls. 42, 44 nos. 71, 73 (Constantinople, 5th-6th C. A.D.). For lead weight in copper alloy casing see Frere, *Verulamium* I, 124, fig. 37 no. 92 (4th-5th C. A.D.).

47. A steelyard similar in type to those catalogued here and allegedly found at Sardis is now in the British Museum; see 993.

436 *Pl. 28.* M62.14:4204. Early Byzantine.

Copper alloy with lead weight. Nearly complete; some disease. Letters on Side 1 faint and difficult to read; on Sides 2 and 3, corroded and obscured.

L. beam 30.20; diam. stops 0.90, 1.25; H. hooks 7.20, 8.10; L. chain and hook 32.80; Max. H. weight (with hook) 13.00; diam. 5.20; Wt. 984 g.
BS E14 E82.60/S1.10 *96.60.

Beam, fulcrum hooks and suspension hooks, chain, collar and U-bar similar to those of 435. Beam graduated on three sides with incised vertical lines and dotted letters. Lead weight is spherical and attached to a hook of copper alloy.

In the photo on *Pl. 28* the weight and suspension hooks are shown in reversed relation to the beam.

Publ. *BASOR* 170, 50.

437 *Pl. 28.* M69.3:7919a-c. Early Byzantine.

Copper alloy beam, parts of six hooks and parts of chain; lead weight with copper alloy casing and iron suspension loop. Parts detached from each other but most preserved.

L. beam 39.00; W. 1.30-0.90; Th. 0.50; max. P.H. weight 7.10; diam. base ca. 7.00.
BS E5 E37.65/S1.77 *96.75.

Beam similar to 435 but with two fulcrum hooks, and graduated on only two sides with incised lines, dots and dotted letters (see *Pl. 28*).

438 *Pl. 28.* M67.31:7481. Early Byzantine.

Copper alloy. Suspension and fulcrum hooks and weight missing.

L. beam 47.80.

BS E7 E49.22-49.91/S1.38-2.10 *96.22, found with 439.

Similar to 437.

Side 1: Long vertical incised lines spaced ca. 3.20 cm. apart. Two shorter lines between every two longer ones. Above every third long line are three dots (see *Pl. 28*). Side 2: Long vertical lines spaced ca. 1.5-1.7 cm. apart with dots forming letters corresponding irregularly to vertical lines (partly corroded and illegible).

439 Early Byzantine.

Copper alloy. Fragments of beam, hooks, chain and lead weight with copper alloy casing.

BS E7 E49.22-49.91/S1.35-2.10 *96.22 found with 438.

Similar to 435.

440 *Pl. 28. M67.26:7472. Early Byzantine.*

Copper alloy. Part of beam preserved with conical stop at long end.

Max. P.L. 71.00; diam. stop 3.00; Th. 1.00.

BS E7 E49.00-50.00/S3.20 *97.24 upper story debris.

Graduations on three sides.

Side 1: Vertical lines ca. 0.90 cm. apart with three dots between every two lines (see *Pl. 28*).

Side 2: Small vertical lines ca. 0.50-0.60 cm. apart; dots apparently forming letters (illegible).

Side 3: Heavily corroded but some graduations ca. 0.20-0.40 cm. apart and some dots visible. Pattern obscure.

441 *Pl. 28. M63.29:5375. Early Byzantine.*

Copper alloy. Most of chains and weight missing.

L. beam 29.50; Th. 0.50; H. fulcrum hook 6.40.

BS E16 E96.80/S0.85 next to E wall of shop *97.50.

Similar to **435** with disk-shaped stop at long end; biconical stop at other. Beam graduated on three sides.

Side 1: Ten vertical lines spaced 1.50-1.70 cm. apart with four dots between every two lines (see *Pl. 28*).

Side 2: Twelve vertical lines spaced 1.60-1.80 cm. apart with shorter lines between (apparently five but most are obscured by corrosion). Some dots in irregular (?) pattern.

Side 3: Twenty vertical lines ca. 0.70 cm. apart. Some dots in irregular (?) pattern.

442 *Pl. 28. M63.38:5520. Early Byzantine.*

Copper alloy. Hooks and chains detached; weight missing. Surface of beam rough and corroded.

L. beam 23.00; Th. 0.40; max. P.L. chain and hook ca. 13.00.

Syn P "Restaurant" E116.80/N1.60-1.90 on mosaic floor next to outside wall of Synagogue *96.75.

Similar to **435**. Beam graduated on three sides.

Side 1: Vertical divisions ca. 1.80 cm. apart with three dots between every two lines (see *Pl. 28*).

Side 2: Vertical divisions ca. 1.10 cm. apart, one shorter line with dot over it between every two longer ones (see *Pl. 28*).

Side 3: Vertical divisions apparently subdivided into eighths by shorter lines between longer ones (see *Pl. 28*). Some dots also appear but their pattern is obscured.

443 *M69.11:8021. Early Byzantine?*

Copper alloy. Only a fragment of short end of beam with one fulcrum ring preserved.

Max. P.L. 4.20; W. 0.90 × 1.70; Th. 1.00; diam. ring 2.70.

RT S Colonnade E27.00-33.00/S29.00-32.00 *97.96.96.25.

444 *Pl. 29. M59.79:2206. Early Byzantine.*

Copper alloy. Movable collar, U-bar, and hanging chain and hook preserved.

Max. P.L. 28.30; W. hook 6.50; L. U-bar and collar 6.50. BW Lat W54.00-51.00/N13.00-17.00 *98.00.

Chain made of figure-eight links.

445 *Pl. 29. M58.34:378. Early Byzantine.*

Copper alloy. Only hook preserved.

Max. L. 8.00; max. W. 6.00; Th. 0.65.

BS W3 ca. *97.93.

S-shaped hook with square section. Pyramidal stop at end of hook; other end flattened and tightly curved into a double loop.

For shape of hook, loop and stop see Ross, *DOCat* I, pl. 74 no. 71 (Constantinople, 5th C. A.D.).

446 *Pl. 29. M67.1:7274. Hellenistic-Roman?*

Copper alloy. Hook only.

Max. L. 7.00; max. W. 3.70; L. loop 3.30; Th. 0.30.

PN W275.00/S332.60 *88.22.

Curved hook with square section. Lower end doubled back and twisted around the stem of the hook twice to form a closed loop. Attached to this is a flat, perforated disk which was broken off another object.

447 *Pl. 29. M72.1:8178.*

Lead with iron ring. Only weight preserved. Remains of iron ring set in loop on top.

Max. H. 7.30; diam. base 5.15; Wt. 1,340 g.

AT Trench 3 under threshold of great E door on top of third foundation course under euthyneria *98.78.

Nearly spherical but with flattened bottom.

Publ. *Sardis* R1, 86, fig. 177 (mis-labeled a "plumb bob").

Balances

Eighteen simple balances or parts of balances, including scale pans, have been found at Sardis. These are, for the most part, fairly small with complete beams ranging from ca. 13.60 cm. in length to ca. 26.80 cm. Most of the balances found are of the same general type—a slender, horizontal beam, tapered at both ends. A movable suspension device is attached to the center of

the beam with a vertical pointer which would be centered between the legs of the suspension device when the two ends of the beam were in equilibrium. Many of the beams and suspension devices (where preserved) are decorated with moldings.

Eight of the balances came from in or near the BS (448, 451-456, 465) while seven, including two scale pans, came from mixed contexts in HoB (449, 450, 457, 460-462, 464). All of the scale pans (462-465) were found separated from the balances, although one (465) was found near a balance (455); the three pans which could be measured were fairly close in size—diam. 3.40-4.00 cm.

While the simple balance has a long history in the ancient world it would appear from similarity of type between those from secure contexts and those from less clear associations that most of the Sardis balances should date within the Late Roman-Early Byzantine eras.

448 Pl. 29. M64.36:6432. Late Roman-Early Byzantine?

Copper alloy. Chains and pans missing.
Max. L. beam 25.00; H. suspension device 11.30; H. pointer 6.60; Th. pointer 0.10.
ERd E129.50/N6.00 *97.50-97.00.

Horizontal beam tapered at both ends to a small perforated disk through which is attached a ring to hold pan chains. Near each end, just behind the disk is a turned bead-and-reel molding (one bead between two pairs of reels). At the center of the beam is a flat, tapered vertical pointer with a hole near the base. A small pin passes through the hole fixing it to the lower ends of the legs of a suspension device, at the top of which is another set of moldings and a loop attached to a ring. This mechanism is still flexible. If held by the suspension device the pointer would be centered between the legs when the pans on either side were in balance.

See Davidson, *Corinth* XII, 208, 216, pls. 98, 99 nos. 1672-1673 (Byzantine or later); Emery, *Ballana and Qustul* I, 379-380 nos. 853-858; II, pl. 105 A-D, esp. C, D (identical suspension device, 5th-6th C. A.D.); Colt, *Nessana* I, 57, pl. 24.5 (complete apparatus including wooden tray for storage, 7th C. A.D. or later); Deonna, *Délos* XVIII, 139-140, fig. 162, pl. LIII. 399, 400. For continuity of this type of balance in the modern Middle East see Wulff, 62-64, figs. 88, 89.

449 M60.43:2561. Late Roman-Early Byzantine?

Low zinc brass. Analyzed by emission spectrography, neutron activation and atomic absorption. See Chap. V, Tables V.1, 3, 4a, b. Beam bent, suspension device and pointer broken and missing.

L. 13.90; max. Th. 0.30.

HoB E20.00/S100.00 *102.00-101.00 mixed upper fill.

Generally similar to 448 but with simple ring moldings near ends.

450-458 are similar to 448:

450 M70.3:8087. Roman or later.

Copper alloy. Only beam preserved. One end broken off; pointer and suspension device gone.

Max. P.L. 23.50; max. Th. 0.40; diam. loop 0.60.

HoB Roman Street W62.00/S109.00 *99.95.

451 Pl. 29. M62.20:4211. Early Byzantine.

Copper alloy. Ends of beam broken off; parts of pointer and suspension device preserved but broken off.

Max. P.L. 12.90; max. Th. 0.40.

BS E14 E83.00/S2.00 *97.10.

Beam tapers to ends where the start of moldings may be discerned. Near the center of the beam, on either side of the stump of the pointer, the beam is also molded.

Find publ. *BASOR* 170, 50.

452 Early Byzantine.

Copper alloy. One end of beam, most of pointer and suspension device gone.

Max. P.L. 12.40; max. Th. 0.27.

BS E7 E44.50-49.00/S? *96.90-96.60.

453 Early Byzantine.

Copper alloy. Badly diseased; suspension device broken but preserved.

L. 18.40; max. Th. 0.50; H. pointer 4.00.

Outside and between BS E7 and E8 E44.00-44.20/S5.35 *96.92.

454 Early Byzantine.

Copper alloy. Broken.

Max. P.L. 15.00; max. Th. 0.30.

BS E4 E28.65/S3.42 *97.45-97.40.

455 M61.57:3710. Early Byzantine?

Copper alloy. Suspension device gone but pointer preserved.

L. 24.00; max. Th. 0.40.

MRd sidewalk E10.00/S28.00 *96.50 in fill over disrupted portion of sidewalk. Found near scalepan 465 and weight 474.

456 Early Byzantine.

Copper alloy. Corroded, diseased and broken.

Max. P.L. 14.00; max. Th. 0.35.

BS E13 or E14 E80.00-84.00/S0.00-4.00 *98.00-96.60.

457 M60.7:2269. Roman-Early Byzantine?

Copper alloy. Beam and base of pointer preserved. Some disease.

L. 13.60; max. Th. 0.20.

HoB E10.00/S105.00 *101.85-101.50 fill.

458 M58.116:754.

Copper alloy. Fragmentary.

Building B. No grid available.

459 Pl. 29. M63.10:5087. Early Byzantine?

Copper alloy. Suspension device missing. Only beam preserved.

Max. L. 26.80; max. Th. beam 0.50; Th. ends 0.30; diam.

loops 0.70; H. pointer 3.80.

Syn FC E110.00/N2.00 N of S doorway *97.25-97.00 in late occupation fill over floor. Found near compass **168**.

Slender beam tapered at both ends and terminating in small loops with suspension ring preserved on one side only. No moldings. Flat pointer in center of beam has two vertical perforations. The broken base of one leg of the suspension device is still held in place by a small pin.

460 Pl. 29. M61.7:3167. Late Roman-Early Byzantine.

Copper alloy. Only suspension device preserved.

Max. H. 5.70; max. W. 0.40; L. legs 3.50; W. 0.20.

HoB W5.00/S95.00 *100.80.

Solid, molded upper part with flat loop at end. Below moldings it is divided into two flat legs each perforated through the lower end to receive the attachment pin to hold it to the pointer.

461 M68.18:7817. Late Roman-Early Byzantine?

Copper alloy. Fragment of a suspension device similar to **460**.

HoB Building R E51.70/S102.10 *99.35.

*Scale Pans***462** Pl. 29.

Copper alloy. Nearly complete.

Diam. 3.70; Th. 0.01.

HoB W30.00-35.00/S120.00-130.00 to *101.80.

Thin disk with three small round holes near edge for attachment to hanging chains. Near center and rim of one side are incised concentric circles.

See Davidson, *Corinth* XII, 208, 217, pl. 98 nos. 1675-1678 (Roman-Byzantine).

463-465 are similar to **462**:

463

Copper alloy. Slight tear and break near one edge.

Diam. ca. 4.00.

PN. No grid available.

464

Copper alloy.

Diam. 3.40; Th. 0.075.

HoB W5.00/S120.00-125.00 *102.00.

Plain, with no incised circles.

465 M61.65:3718. Early Byzantine?

Copper alloy. Corroded.

Diam. 4.00; Th. 0.05.

MRd E14.00-15.00/S27.50-29.00 *96.75 in fill over disrupted sidewalk. Found near balance **455** and weight **474**.

Disk slightly concave with incised concentric circles on inner surface.

Weights

Weights found at Sardis fall into two major categories—inscribed and uninscribed. The inscribed weights are all of copper alloy and come primarily from Late Roman-Early Byzantine contexts in HoB, BS and the Synagogue area. In form they are either small flat rectangles or squares, disks or in one case (**475**), a truncated biconical shape. All are suitable for use with equal-armed balances rather than with steelyards. The inscriptions take the form of incised linear or dotted letters standing for numerals or for measures of weight. Most of those that can be identified conform to the Roman system of weight markings and this is borne out by the actual weights in most cases. This system, outlined below, remained in use throughout Roman Imperial times and into the Byzantine era,⁴⁸ although some of the obviously Byzantine weights do not seem to fit into this series.

48. Roman and Byzantine weight system: Skinner, 64-67; Davidson, *Corinth* XII, 205-207; Hultsch, 144-161.

Divisions of the pound:

1 pound (libra)	= 12 unciae	= 327.45 grams
½ " (semis)	= 6 "	= 163.73 "
⅓ " (triens)	= 4 "	= 109.15 "
¼ " (quadrans)	= 3 "	= 81.86 "
⅙ " (sextans)	= 2 "	= 54.54 "
⅛ " (uncia)	= 1 "	= 27.29 "

Divisions of the ounce (uncia):

½ ounce (semuncia)	= 12 scruples	= 13.65 grams
⅓ "	= 8 "	= 9.10 "
¼ " (sicilici)	= 6 "	= 6.83 "
⅙ " (nomisma or sextula)	= 4 "	= 4.55 "
⅛ "	= 3 "	= 3.41 "
⅜ "	= 2 "	= 2.27 "
⅙ "	= 1 scripulum	= 1.70 "
⅛ "	= 1 scripulum	= 1.14 "
⅜ scruple	= 1 obol	= 0.57 "

Commonly used symbols:

N or N̄	= 1 nomisma	= 4.55 grams
NB	= 2 nomismata	= 9.10 "
NI	= 3 "	= 13.65 "
NA	= 4 "	= 18.20 "
NE	= 5 "	= 22.75 "
NS or NZ	= 6 "	= 27.29 "
ϝ or Γ	= 1 uncia	= 27.29 "

The lightest inscribed weight (**466**) weighs 1.40 g. or about one-twentieth of a Roman ounce; the heaviest (**476**) weighs 161.45 g., or about half a Roman pound. Most of the weights are not precisely accurate, falling slightly under or over their marked weights (e.g. **476** a light half pound, **471** a light nomisma, **473** slightly under three nomismata, **474** slightly over five nomismata). Discrepancies in weight could be owing to corrosion and weight loss during cleaning as well as to original inaccuracies in manufacture or deliberate shortweighting, but most are by and large close to stated weights.

Uninscribed weights vary more in date, material and probably in system. At least two or three are Lydian from PN (**477**, **480**, **481?**), of which the first is a small lead hemisphere with copper alloy casing, and the latter two are flat lead squares. Unfortunately, with so few accurately dated to this period, nothing certain can be said about the Lydian weight system. Several others are of lead (**482**, impressed at the corners; **484**, pierced; **483**, disk-shaped, and **479**, with a copper alloy casing). Only one of the uninscribed weights contains no lead (**478**); it may have been a counter rather than a weight.

Two domed or conical weights, pierced vertically (**485**, **486**) probably functioned as sinkers. Their contexts were unclear and dates uncertain.

Inscribed Weights

466 Pl. 29. M63.32:5409. Late Roman-Early Byzantine.

Copper alloy.

1.00 × 1.00; Th. 0.10; Wt. 1.40 g. (ca. ½ oz.).

PCA E118.00-120.00/S1.00 *97.50-96.75.

Flat square, plain on one side; on other side is an **H** in impressed dots.

According to M. Ross, the **H** should stand for a weight of 8 scruples or ca. 9.09 g. Obviously, the measured weight of this piece in no way conforms to this system.

See Ross, *DOCat* I, 64, pl. 46 no. 75 (Antioch, Syria, 5th-6th C. A.D.); Ernst Babelon and J.-A. Blanchet, *Catalogue des bronzes antiques de la Bibliothèque Nationale* (Paris 1895) 697 no. 2290 (cylindrical, same weight); Dalton, *Early Christian Antiquities* 95 no. 467.

467 Pl. 29. M66.2:7007. Early Byzantine.

Copper alloy.

1.10 × 1.10; Th. 0.20; Wt. 1.60 g. (ca. ⅙ oz.).

Syn P "Restaurant" E120.50-121.50/N0.00-1.00, found in hoard of sixth century A.D. coins.

Flat square incised on one side with equal-armed cross; two triangles at end of each arm, rough circle or half circle at each corner of square (see Pl. 29).

468 Pl. 29. M62.13:4199. Early Byzantine.

Copper alloy.

Diam. 1.00; Th. 0.30; Wt. 2.15 g.

BS E14 E83.00/S2.00 *97.10.

Disk-shaped, concave on one side, convex on other; thin, raised rim. Shallow indentation in center of concave side with incised letter to either side: **I·B**.

See Davidson, *Corinth* XII, 209, pl. 94, no. 1588 (late 4th C. A.D.) with inscribed **I·B**. The example from Corinth, however, is square and weighs much more (10.25 g.).

469 Pl. 29. M65.8:6779. Late Roman?

Copper alloy. Diseased.

0.70 × 0.70 × 0.80; Wt. 3.05 g. (ca. ⅓ oz. or heavy ⅙ oz?).

HoB W0.00-5.00/S100.00-105.00 *98.70-97.70.

Small, nearly cubical weight with **X** incised on one face.

470 Pl. 29. M62.31:4271. Early Byzantine.

Copper alloy.

1.25 × 1.30; Th. 0.30; Wt. (before cleaning) 4.60 g., (after cleaning) 4.30 g. (ca. one nomisma).

BS outside E14 at jamb of entrance and on level of

mosaic outside threshold E82.30-82.50/S5.00 *96.50-96.45. Found near weight 471.

Flat square with N incised on one side; light horizontal lines at right angles to bars of N; faint dotted circle between lower bars (see *Pl. 29*).

Find publ. *BASOR* 170, 50. See Davidson, *Corinth* XII, 205, 209, pl. 94 no. 1589 (late 4th C. A.D. or later).

471 *Pl. 29.* M62.30:4270. Early Byzantine.

Copper alloy. Corroded.

1.20 × 1.20; Th. 0.30; Wt. (before cleaning) 4.50 g., (after cleaning) 4.40 g. (ca. one nomisma).

BS outside E14 at W jamb of entrance and on level of mosaic outside threshold E82.30-82.50/ S5.00 *96.50-96.45. Found near weight 470.

Flat square with N incised on one side, groups of punched dots at ends of strokes (see *Pl. 29*).

See Davidson, *Corinth* XII, 205, 209, pl. 94 no. 1590 (late 4th C. A.D. or later).

472 *Pl. 29.* M65.10:6850 = C65.9. Late Roman-Byzantine.

Copper alloy.

Diam. 1.50; Th. 0.30; Wt. (before cleaning) 4.50 g., (after cleaning) 4.10 g. (ca. one nomisma).

BE-H E7.50/N47.50 ca *99.50 modern surface.

Flat disk, plain on one side. On other side is an incised N with punched dots at corners (see *Pl. 29*).

Davidson points out that the disk-shaped weight is common between the ninth and twelfth centuries A.D. but may be found earlier. The weight system indicated by the inscription continues that of Roman Imperial times.

See Davidson, *Corinth* XII, 206, 210, pl. 94 no. 1605 (Byzantine, "not later than 12th century").

473 *Pl. 30.* M58.60:877. Early Byzantine.

Copper alloy.

Diam. 2.20; Wt. 13.00 g. (slightly under three nomismata).

BS W2 W6.00-8.00/S1.00-4.00, no level available.

Flat disk with raised edges. Center of face incised (see *Pl. 30*).

See Davidson, *Corinth* XII, 206, 210, pl. 94 no. 1607 (9th-11th C. A.D.).

474 *Pl. 30.* M61.59:3712. Early Byzantine?

Copper alloy.

Diam. 2.70; Th. 0.50; Wt. 23.65 g. (slightly over five nomismata).

MRd E14.00-15.00/S27.50-29.00 *96.75. Found near balance 455 and scale pan 465.

Flat disk with raised edges. In center of each side is a punched dot; on face is incised N·E with dots at the corners of the letters, a dotted circle over the N (see *Pl. 30*).

475 *Pl. 30.* M61.18:3214. Early Byzantine.

Copper alloy.

H. 1.50; max. diam. 1.80; diam. end 1.00; Wt. 26.35 g. (a light ounce).

BS W8 ca. W25.00/S0.00-5.00 on top of E wall.

Truncated biconical shape with dot in center of each side. One face is incised with symbol representing one uncia (see *Pl. 30*).

See Davidson, *Corinth* XII, 205, 208, pl. 94 nos. 1585-1586 (Late Roman). According to Davidson (p. 205) this is the earliest type of Roman weight found at Corinth, though it does not predate the early 4th C. A.D. there. See also British Museum, *Greek and Roman Life*³, 150 fig. 168, 152.

476 *Pl. 30.* M63.17:5252. Early Byzantine?

Copper alloy.

4.30 × 4.40; Th. 1.00; Wt. 161.45 g. (light half libra).

Syn P E119.80/N9.00 *96.75 in disrupted area of mosaic floor.

Flat square incised on one side with six concentric circles. On the other side are five concentric circles over which are incised an N, a dotted S and a dotted circle over N. Illegible lines (K?) between N and S (see *Pl. 30*).

Uninscribed Weights

477 *Pl. 30.* M68.16:7774. Lydian.

Copper alloy casing filled with lead. Cracked and corroded.

H. 1.00; diam. 1.60; Wt. 7.30 g.

PN W275.00-275.60/S346.50 *86.10.

Hemispherical shape with small knob on top. Lower edge of casing flanged to hold lead filling.

478 *Pl. 30.* Early Byzantine?

Copper alloy.

Diam. 3.90; Th. 0.80; not weighed.

BS S of shops in debris.

Flat disk with raised edges; small knob in center of each side.

For shape see Davidson, *Corinth* XII, 206, 209-210, pls. 94, 95 nos. 1595-1608 (most are Byzantine).

479 Pl. 30. M63.8:4992. Byzantine?

Copper alloy casing with lead filling.
Diam. 3.30; H. 1.80; Wt. 35.60 g.
Syn 'd', E35.50/N1.20 *96.75 just above stone floor.

Domed "rosette" with eight segments.

See Davidson, *Corinth* XII, 211, pl. 95 no. 1616 (larger and with swirling segments, Byzantine or later).

480 Pl. 30. M60.69:2792. Lydian, 6th C. B.C.?

Lead.
4.60 × 4.80; Th. 1.15; Wt. 253.20 g.
PN Room B *89.50-89.00.

Flat, nearly square shape; corroded surface; plain faces.

If a system based on the mina was the one in use this weight could represent half a mina of about 500 or more g. (See Hulstsch, 398 for a "light" Babylonian mina of ca. 504 g.). Skinner, 54, points out that the gold stater of Croesus weighed ca. 8.16 g. and was about equivalent to the Assyrian and Babylonian shekel of ca. 8.17 g. (p. 37). In the older Near Eastern system the mina comprised 60 shekels, and it is interesting to note that dividing this weight by 8.17 yields 30.99— about half a Babylonian mina in shekels (or Croesian stater).

Similar, though inscribed, weights were found in Greek contexts at Corinth. See Davidson, *Corinth* XII, 204, 208, pl. 94 nos. 1580-1582 (5th-3rd C. B.C.).

481 Pl. 30. M67.40:7594A. Lydian?

Lead. Corroded, uneven surface.
4.70 × 4.80; Th. 1.90; Wt. 182.15 g.
PN W275.00/S227.40 *88.30.

Flat square with no visible markings.

See Lang-Crosby, *Agora* X, 32, pl. 10, LW 74, 76, 79 (Hellenistic and Roman).

482 Pl. 30. M62.80:4860. Roman-Byzantine.

Lead.
4.00 × 3.20; Th. 0.70; diam. depressions 0.70; Wt. 108.10 g. (light 1/3 libra).
Syn FC E111.00/N17.50 *96.50 in burned fill over disrupted mosaic floor.

Flat rectangle with circular depression at each corner of one side, possibly a monogram in depressions but this is unclear.

See Lang-Crosby, *Agora* X, 31, pl. 8, LW 62 (Roman, 3rd C. A.D.).

483 Pl. 30. M63.15:5158. Byzantine?

Lead. Corroded.
Diam. 7.50; Th. 0.60; Wt. 234.60 g.
PN W227.00/S353.00 *90.00-89.70 mixed context.

Plain, flat disk with finished edge.

See Lang-Crosby, *Agora* X, 31, pl. 9, LW 63, 64 (Roman).

484 Pl. 30. M61.15:3204. Hellenistic-Roman?

Lead.
Diam. 3.10; diam. perforation 0.60; Th. 0.80; Wt. 52.15 g.
HoB E0.00/S90.00-95.00 to *100.40 mixed context.

Flat disk with raised edges; round perforation through center.

Sinkers?

485 M63.1:4962. Hellenistic-Roman?

Lead.
Max. diam. 1.80; H. 1.00; Wt. 14.25 g.
HoB W25.00-30.00/S120.00 to *102.90 mixed context.

Conical weight or sinker with round perforation through center.

486 Pl. 30. M62.32:4272. Late Byzantine?

Lead.
Max. diam. 1.80; inner diam. 0.90; H. 1.60; Wt. 31.80 g.
AcT local grid E8.50/N20.50 at threshold of Unit 2, *402.40 a.s.l., Level Ib, mixed context.

Domed weight or sinker with round perforation through center.

VESSELS

The wealth of the Lydian kings is partly attested to by ancient reports of the enormous and elaborate vessels of gold and silver that they dedicated at sanctuaries like Delphi and Ephesus (see Chap. I). While the Harvard-Cornell Expedition has found a large number of metal vessels and vessel parts (eighty-nine objects in all), very few can be dated to the Lydian period and none is of precious metal.⁴⁹

49. For a number of small silver vessels found by the Princeton Expedition and now in the Istanbul Archaeological Museum see 963, 964, 966-969.

The great majority of vessels found are of copper and copper alloy, and are Early Byzantine in date, coming largely from the area of the Byzantine Shops, the colonnade in front of the shops, and the HoB across the road. One gets the sense from the concentration of vessels and related objects (see "liturgical objects") in and around the BS that these shops formed, at least in part, a copper workers' or merchants' quarter similar to that found in many Middle Eastern towns today.

In terms of technique, most of the vessels are made of hammered sheet metal, though some of these have cast handles or other parts. Some thirteen were analyzed; where the part tested was made of hammered sheet metal the majority were found to be of nearly pure copper, while cast parts were invariably alloyed (bronze or brass) to expedite casting (see Chap. V).

In many of the utilitarian vessels and vessel lids two or more sections of copper are often joined by a toothed or dovetailed seam in which "teeth" or tabs cut in the edge of one sheet are fitted into gaps cut in the edge of the other and joined, probably by hard soldering or brazing (e.g. 492, 523, 526, 528, 534).⁵⁰

Bowls

Twenty-four bowls or fairly small or shallow wide-mouthed vessels were found, ranging in date from Lydian (487) to Turkish (508-510). All but 503 and 510 (iron), and 504-507 (lead), are of copper or copper alloy.

All vary in form, though most are rather plain, utilitarian vessels with little or no decoration. Exceptions are 488 (Hellenistic bowl with decorative handles), 489 (small cast bowl with incised linear decoration) and 500 (brass bowl with incised pattern).

487 *Pl. 31. M66.12:7147. Lydian, 7th-6th C. B.C.*

Tin bronze. Analyzed by emission spectrography, neutron activation and atomic absorption. See Chap. V, Tables V.1, 3, 4a, b. Surface covered with green patina. Bottom broken, possibly by a pick.

Max. H. 13.50; H. neck 2.60; H. sides 11.00; diam. base ca. 18.00; diam. rim 22.30; Th. 0.20.

BT dug up by villagers from a grave near Kuş Tepe, reportedly found in a terracotta sarcophagus.

Deep bowl with flattened bottom, slightly convex sides, narrow offset shoulder, concave vertical neck, everted rim with smooth edge. Made by raising.

50. This technique has survived in the modern Middle East and can be seen in many pieces of contemporary copper work from that area. For description of the process as recently practiced in Persia see Wulff, 24.

Publ. *BASOR* 186, 47.

488 *Pl. 31. Hellenistic?*

Copper alloy. Only rim, two handles and base preserved; body missing. Heavily corroded.

Ext. diam. rim 21.00; int. diam. 17.00; W. rim 2.10; diam. base 8.50; Th. base 1.10; H. handle 8.30.

No provenance. Found in a box of NoEx pottery in depot. It is uncertain whether all pieces belong together.

Flat, circular everted rim with beveled edge. Curvature of remaining part of body suggests a shallow bowl (see suggested restoration, *Pl. 31*). Base is flat with relief ridges forming concentric circles on one side. Handles each formed of a single bar of metal twisted into a triple loop at center descending and curving under at each end to terminate in a flattened, leaf-shaped attachment plate.

489 *Pl. 31. M67.24:7456.*

Leaded tin bronze. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3. Part of rim missing.

Ext. diam. rim 7.00; W. rim 0.70; H. 3.50; Th. 0.20.

AhT E4.10/S45.00 *76.67. According to the excavator, D. G. Mitten, the bowl was found in a small hoard of metal objects in an unspecific context which could date anywhere from Lydo-Persian to Islamic periods. Also found with 432, a finial.

Cast hemispherical body with flat, everted rim. Base flat with incised concentric circles; vertical incised rays from base to half-way up body; horizontal lines above rays around midpoint. Int. of bowl is plain and smooth.

490 *Pl. 31. M62.4:4269. Early Byzantine.*

"Pure" copper. Analyzed by emission spectrography, neutron activation and atomic absorption. See Chap. V, Tables V.1, 3, 4a, b. Diseased.

H. 10.50; max. diam. 23.50; W. rim 2.20.

BS E14 at opening E of door E80.90/S4.90 *97.00.

Hammered, hemispherical bowl with slightly convex base, wide flattened rim with slightly bent up edge.

Find publ. *BASOR* 170, 50. See Den Boesterd 61, pl. 9, nos. 211-213 (5th-7th C. A.D.). The vessels in the Rijksmuseum, though similar in form, were analyzed as brass, see Den Boesterd-Hoekstra, 120-122 (table, nos. 211-213).

491 *Early Byzantine.*

Copper alloy. Diseased and about half gone.

Max. P.H. 10.00; ext. diam. rim ca. 22.50; W. rim 2.20.

BS E6 E42.59/S0.00-0.10 *96.39.

Nearly hemispherical with slightly rounded bottom and

nearly straight sides. Everted ledge rim slightly bent up at edge.

492 *Pl. 31. M68.14:7757. Early Byzantine.*

Copper alloy. Badly diseased, dented and cracked.
H. 11.00; diam. rim 14.00; diam. base 13.00; Th. rim 0.30.

BS E5 E35.07/S3.90 *96.77.

Flat base, slightly convex walls. Rim folded inward 0.80 cm. and flattened. Sides made of a single sheet of metal bent in a circle and joined at the ends with a toothed seam.

493 *Early Byzantine.*

Copper alloy. Only base and lower part of body preserved.

Max. P.H. 6.00; diam. base ca. 2.70.

BS E8 E50.00/S3.20 *97.24.

Once apparently hemispherical with slightly concave base.

494 *Early Byzantine?*

Copper alloy. Corroded, flattened and cracked. Rim not preserved.

H. ca. 9.50; diam. base ca. 17.00.

RT E30.00/S30.00 above S Colonnade foundation at *96.75.

Apparently plain with flat base, straight sides.

495 *Early Byzantine?*

Copper alloy.

H. 6.80; diam. base ca. 7.40; Th. 0.40.

RTE grid unavailable *96.70-96.30.

Bottom made of separate piece of metal attached to sides with toothed seam (now detached). Straight sides and rim. Hammer marks visible on surface.

496 *Pl. 31. M67.14:7380. Early Byzantine.*

Copper alloy. Diseased, bent, dented.

Max. P.H. 7.50; max. diam. 16.00.

BS E4 E29.57/S2.05 *97.05.

Flat base, straight sides. Rim formed by folding edge outward and back close to sides.

Find publ. *BASOR* 191, 17 n. 9.

497 *Pl. 31. M60.72:2795. Byzantine?*

Copper alloy. About half-preserved.

Est. H. 10.00; est. diam. rim 11.50; W. rim 0.60.

AcT Trench C E1084.00-1087.00/S1072.00-1074.00 in fill ca. *401.00 a.s.l.

Probably part of a deep bowl. Base apparently flat, though badly bent out of shape. Rim formed by folding upper part of wall outward and bending back close to body. Some hammer marks still visible on surface.

498 *Pl. 31. M63.7:4990. Early Byzantine.*

Copper alloy. Sides broken; bottom dented.

H. 2.65; diam. base 9.00; Th. 0.10.

BS E19 E116.00/S0.00 in doorway of S side of fore-court *97.44.

Round flat base with low, straight sides and straight rim. Small spout bent out on one side of rim.

499 *Pl. 31. M64.7:5937.*

Copper alloy. Corroded, torn.

Ext. diam. rim 10.00; diam. base 6.00; H. 2.00.

BE-S E28.00-32.80/N27.00-35.00 *99.85.

Shallow bowl made in one piece with flat bottom, flaring walls, everted rim.

500 *Pl. 31. M61.95:4051. Byzantine?*

Low zinc brass. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3. Sides flattened but not corroded; some tears in the metal.

H. 3.80; W. at rim 7.60.

BWH W40.00-47.00/N51.00-59.00 *100.00.

Small round dish or bowl with straight rim. Incised overlapping scale pattern on sides; three dotted bands beneath rim connected by short vertical lines. Rays around center of round (?) base.

501 *Pl. 31. M60.32:2447. Byzantine?*

Copper alloy. Torn at edges.

Diam. 8.00; H. 5.10; Th. 0.10.

AcN local grid E12.00/N1.00 Byzantine fill ca. *394.00 a.s.l.

Cylindrical body with plain, slightly inset rim; flat base.

502 *Pl. 32. M61.90:3978. Byzantine?*

Copper alloy. Torn and bent.

Diam. base 5.50; est. diam. rim 8.00; H. rim 2.00; max. H. 4.00; Th. 0.10.

RT E14.00-16.00/S13.00 *99.50 above Early Byzantine road level.

Cup or lid with flat base (top?). Rim made of separate strip of sheet metal crudely attached with rivets.

503 Pl. 32. Early Byzantine?

Iron. Heavily corroded inside and out with evidence of burning and bits of charred wood adhering.
H. 4.80; ext. diam. rim 7.50; Th. rim 0.80.
BS outside E17 E92.00-95.00/S4.50-5.50 *97.50.

Slightly convex base with nearly straight walls sloping slightly inward toward rim. Iron bowls of approximately this shape and size are used at the present time as pitch bowls; they are filled with warm pitch against which sheet metal can be worked in repoussé.

See Untracht, 93, fig. on lower r. no. 1.

504 Pl. 32. M61.41:3530. Roman-Byzantine?

Lead.
H. 4.30; diam. base ca. 5.50; diam. rim 11.20; Th. rim 0.90; L. spout 2.40; W. spout 2.00.
MRd E10.00/S29.25 just N of S Colonnade foundation in fill *96.65.

Concave or dented base rising to flaring sides, flat rim. On one side is a short open spout. Opposite the spout is a thickening in the rim suggesting a missing handle.

505 Pl. 32. M67.30:7476. Early Byzantine.

Lead.
H. 4.00; diam. ca. 11.00-14.00.
BS E9 E61.00/S2.20 *96.89, near doorway in E wall.

Slightly concave base rising to flaring sides with slight carination below rim. Slightly everted rim with edges bent outward. Four triangular lugs attached to rim. When found the bowl was filled with glass fragments.

506 Early Byzantine.

Lead. Corroded. Sides broken and torn.
Diam. base 9.00; diam. rim ca. 12.10; H. 5.20.
BS E11 E71.00-74.00/S0.00-2.50 *97.25-96.40.

Flat base, straight slightly flaring sides; everted rim folded outward and down.

507 Pl. 32. M59.20:1406. Early Byzantine.

Lead. Rim smashed and flattened from fallen debris. One side badly broken.
Max. P.H. ca. 52.00; W. rim ca. 23.00; diam. base 15.00.
HoB Area 5 E30.00/S70.00 *96.74 on floor.

Tall cylindrical vessel with flat base. The function is unknown. Similar but much smaller vessels were apparently used to hold paint at Newstead.

See Curle, *Roman Frontier Post*, 275, pl. 54.8, 10.

508 Pl. 32. Turkish?

Copper alloy. Bottom torn.
Diam. rim 4.60; diam. base 2.30; H. 1.80; Th. 0.10.
PN W267.00/S319.00 *86.30.

Small disk base, flaring walls with carination near rim; straight, slightly inverted rim.

509 Pl. 32. M62.72:4708. Turkish.

"Pure" copper. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3. Mended in antiquity.
Max. diam. ca. 23.50; H. ca. 6.00; Th. 0.20; diam. base patch ca. 11.00.
PN N of room with eagle mosaic in association with Turkish walls *89.60.

Shallow bowl with convex base, flaring sides, straight rim. Base is crudely patched by riveting a large round piece of copper over the bottom from the inside. One side is patched in the same way.

510 Turkish?

Iron with copper alloy repairs.
Diam. ca. 17.00; H. 5.40.
PN W225.00/S380.00 outside apse of Church E, with Turkish workshop dump, *91.00 (see 162, 167 and 519).

Flat base, straight sides. At one side an ancient break has been repaired with a strip of bronze riveted to the ear.

Pans and Pan Handles

Only three examples were found, all from the Byzantine Shops and all in poor condition, though clearly of different types.

511 Pl. 32. M67.37:7586. Early Byzantine.

Copper alloy. Ring foot lead with copper alloy covering. Base detached from body; much of body missing.
H. 11.00; diam. rim 30.00; diam. foot 11.50; L. handle 16.00; W. handle 2.50-4.00; Th. 0.30.
BS E6 E41.42/S1.84 *97.68, debris from upper story.

Smooth, round base with ring foot. Part of originally fluted body with flaring sides remains attached to a long, flat handle pierced through its end for suspension. Handle and rim apparently made in one piece (see suggested restoration, Pl. 32).

512 Pl. 33. M62.89:4928. Early Byzantine.

Copper alloy. Most of pan bowl and base missing.
Est. diam. pan 24.00; L. handle 14.00.
BS E14 E83.00/S2.00 in fill above floor *97.10.

Pan apparently had a shallow bowl and flat rim to which is attached the handle. Handle is flat with raised edges. Towards the end it narrows slightly, then widens to form a round tab, then narrows again to form a bar with square section which is folded into a double loop on the upper side.

Publ. *BASOR* 170, 50.

513 Pl. 33. M63.63:5888. Late Roman-Early Byzantine.

Leaded tin bronze. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3. Corroded; no part of pan preserved.

Max. P.L. 8.00; W. broken end 1.80; max. W. head 2.50; L. head 4.20.

BS E17 E91.00-92.00/S0.00-3.20 *96.00-95.00 in fill over "Hellenistic Steps."

Handle of patera or shallow pan ending in ram's head finial. Shaft of handle apparently formed over a core of other material (perhaps a casting core?). Curved horns and curly hair of ram's head in relief; eyes incised. Ears are not indicated.

For discussion of the type and parallels see Yadin, *Cave of Letters*, 58-63, no. 7, fig. 16, pls. 17, 27 (2nd C. A.D.). Other examples: Frere, *Verulamium* I, 138, figs. 44.148 (unstratified), 45.149 (3rd-4th C. A.D.); Den Boesterd, 25, 28, pls. 4, 13 nos. 68 (late 1st C. A.D.), 72 (late 1st-early 2nd C. A.D.), both analyzed as leaded tin bronzes; see Den Boesterd-Hoekstra, 106 (discussion), 114-115 (table, nos. 68b, 72b).

Cauldrons

Remains of six large, openmouthed vessels were found, one (**514**) from Early Byzantine HoB, four (**515-518**) from the floor level of the colonnade outside the contemporary shops where they had probably been set to attract customers. The sixth (**519**) came from the upper levels of PN and is probably Turkish in date.

Most elaborate in form is **514** with its cast handles riveted to the body of the vessel. The four from the shop colonnade lack handles and seem more strictly utilitarian in form. The bodies of all six are made of hammered sheet metal, two (**515, 516**) showing a strong pattern of hammer marks on the outer surface.

514 Pl. 33. M58.45:883. MANISA 4415. Early Byzantine.

Copper alloy. Surface corroded. Bottom dented and torn.

H. 36.80; diam. rim ca. 47.20 × 43.00; Th. 0.40; W. handles 17.50; H. handles 17.80.

HoB Room 7, 75 cm. from W wall, 30 cm. from column beside door on basement floor level.

Body and base hammered out of one sheet of metal into somewhat deeper than hemispherical shape. Rim slightly thickened, everted and hammered flat. Handles cast separately and riveted to body with large rivets, two in each attachment plate. Handles formed of two solid vertical bars with leaf-shaped flattened plates at bottom, and a third horizontal bar across the top. Molded double horizontal rings encircle the vertical bars just above the transition to the attachment plates and another pair, set vertically, are at the joint between the upper horizontal bar and the vertical bars.

Publ. *BASOR* 154, 27, 26 fig. 12.

515 Pl. 33. M62.52a:4456. Early Byzantine.

"Pure" copper. Analyzed by emission spectrography, neutron activation and atomic absorption. See Chap. V, Tables V.1, 3, 4a, b. Bottom missing; surface corroded but much metal preserved.

Max. P.H. 21.00; max. ext. diam. rim 32.00; W. rim 3.50; diam. base 29.50; Th. 0.20.

BS outside E15 E88.00/S5.30 *96.50 resting on mosaic pavement.

Made of hammered sheet metal. Tall straight sides sloping slightly inwards towards the top. Wide, everted ledge rim with turned up edge. Hammer marks visible on surface.

516 Pl. 33. Early Byzantine.

Copper alloy. Corroded and diseased but with some metal remaining. Bottom missing, possibly deliberately cut out.

Max. P.H. 20.00; diam. rim 33.30; W. rim 3.70; Th. 0.30. BS outside E3 and in colonnade E26.90/S9.90 *96.45 on level of colonnade floor.

Similar to **515**.

517 Pl. 33. Early Byzantine.

Copper alloy. Badly corroded and dented.

H. ca. 24.00; diam. base 35.00-40.00; diam. rim 52.00-57.00; Th. rim 0.75.

BS just outside E5 E38.20/S6.96 *96.50 on colonnade floor and with **518** and **524**.

Bottom originally flat or slightly convex. Sides flare slightly towards top. Rim apparently flat with everted ledge (now mostly bent upwards). Bottom apparently in one piece with the sides, probably raised from a single sheet of metal. Evidence of charring inside.

518 Early Byzantine.

Copper alloy. Only rim and base preserved, possibly not from same vessel.

Max. P.W. base ca. 19.50; diam. disk 11.50; rim fragmentary.

BS just outside E5 E38.20/S6.96 *96.50 on colonnade floor and with 517 and 524.

Low disk base with part of body preserved above it. Rim comes from a straight-sided vessel with upper edge rolled out and back to form rim.

519 Turkish?

Copper alloy. Only rim preserved; bent, corroded, disced.

Original diam. ca. 30.00; W. rim 2.00.

PN W225.00/S380.00 *91.00 outside apse of Church E, possibly part of Early Turkish workshop dump (see 162, 167 and 510).

Authepsae or *Caldaria*

Three examples of *authepsae*—samovar-like water heaters—were found at Sardis: two in the Early Byzantine rooms of HoB and one in BS E6 across the road. All three operated on the principle of providing an outer chamber within the body of the vessel for liquid to be heated, and an inner chamber or chimney through which hot air could rise to warm the liquid surrounding it. Each has an open grille at the bottom of the body of the vessel on which hot coals could be set.⁵¹ Prototypes of the Sardis examples are found at Pompeii where they exist in a variety of complex shapes.⁵²

All have major parts made of hammered sheet metal—in the case of 520, nearly pure copper—with cast handles, feet and bases (the handle of 520 is leaded tin bronze).

520 *Pl. 34.* M67.36:7585. Early Byzantine.

Neck (and body?) "pure" copper; handle leaded tin bronze. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3. Spout missing, neck detached from body.

H. 37.50; max. diam. shoulder 18.00; diam. base 13.20; diam. neck 9.30; diam. chimney 4.30; Th. body 0.10; Th. chimney 0.20; H. handle 22.00.

BS E6 E39.47/S2.01 *97.08 upper floor debris.

51. See A. Mau, *RE* II.2 (Stuttgart 1896) 2594-2595 s.v. "authepsa"; *DarSag* I.1, 585 "authepsa"; I.2, 820-822, figs. 1025-1029 "calda o calida aqua" and "caldarium."

52. Erich Pernice, *Die hellenistische Kunst in Pompeji IV Gefässe und Geräte aus Bronze* (Berlin, Leipzig 1925) 8-9, fig. 7, pls. 2, 7; Tarbell, 115-117, pls. 64-68, nos. 95-104.

Body, neck and chimney made separately of hammered sheet metal; base and handle cast. Body ovoid, tapering downward to base and then flaring outward. Tall, slightly concave neck (now badly dented) with apparently straight or slightly everted lip, possibly spouted opposite the handle. Underside of body is left open and fitted with an iron grille, perforated with round holes, attached to stand and foot by two iron crossbars. Tripod base is decorated with openwork triangles, three between every two feet, and held in place by the iron bars which also secure the grille. Within the vessel is a tall, tubular chimney set directly over the iron grille and firmly attached to it. Between the chimney and the walls of the body is a space into which liquid could be poured and heated by hot air rising through the chimney when hot coals were placed inside the vessel on the grille.

The high, arched handle is cast in three pieces and attached separately at lip and shoulder of the vessel. Just below the highest part of the handle is a curved thumb grip, originally connected to a latch that operated the hinge of the lid of the vessel (lid and latch now missing).

Find publ. *BASOR* 191, 20.

521 *Pl. 34.* M58.92:884. MANISA 4417. Early Byzantine.

Copper alloy. Found in several pieces, now heavily restored with plaster and wire.

Max. H. (without handle) 33.30; max. diam. body at shoulder 17.60; H. base 6.20; diam. base 12.50; diam. rim 9.70; diam. base of neck 10.30; H. neck 9.90; H. chimney 25.50.

HoB Room 1, basement, 120 cm. from E wall, 10 cm. from N wall *97.29, 18 cm. above floor.

Body, neck, and chimney made of hammered sheet metal; handle and base cast separately. Similar in design to 520 but with the following differences: pouring spout preserved in lip opposite handle; stepped profile at base of neck; lions' paw feet on base; incised circumferential lines on exterior of base ring. Inner grille is copper alloy with iron attachment bars. Base of handle ends in an animal's head with raised nose and projecting ears.

Find publ. *BASOR* 154, 22; Hansen, 172-173, pl. XB.

522 *Pl. 34.* M58.93:885. MANISA 4418. Early Byzantine.

Copper alloy. Found in several pieces; heavily restored in plaster.

Max. H. (restored) 34.30; max. diam. body 21.10; restored H. neck 11.10; diam. neck 3.10; diam. lip 3.95; H. base 5.90; diam. base 15.30; diam. hole in side 5.20; H. handle 24.50.

HoB Room 1, 18 cm. from E wall, 10 cm. from N wall *97.29, 18 cm. above floor.

Form differs from that of previous two. Vessel has a tall, profiled neck with rolled, slightly everted rim and pairs of incised rings around the neck. The body is bulging with widest diam. above center, tapering to base. There are incised rings around the circumference of the shoulder. Underneath is an iron grille held in place by a separately cast copper alloy base with three lions' feet. In the side of the vessel is a large hole that once had a raised rim around it. This hole opens on an inner compartment connected to the grille where hot coals could have been placed. The chamber above it is open to the neck and would have contained the liquid to be heated. The form of the handle is similar to the others, though somewhat more elaborately decorated with relief ridges and a dolphin's head at the base.

Find publ. *BASOR* 154, 22; Hansen, 172-173, pl. XB. For a very similar, nearly contemporary example see Emery, *Ballana and Qustul*, I, 357, fig. 114 no. 790; II, pl. 93 D, Tomb B.80-58 (5th-6th C. A.D.).

Jugs, Flasks and Lids

Eleven fairly large, Early Byzantine vessels with relatively narrow necks appear in this category. Nine are from the Byzantine Shops or colonnade in front of the shops (523-528, 531-533), and two are from contemporary HoB (529, 530).

In form these vessels fall into three main subtypes: (1) two large handleless jugs (523, 524), probably for storage; (2) three pouring jugs (525-527)—two with wide cylindrical bodies (525, 526), the third with a low, squat body and taller neck (527); two with trefoil mouths (526, 527), one with round mouth (525); and (3) six flasks with flat bases, cylindrical bodies, narrow necks, iron handles and separately attached copper lids (528-533). Fourteen more lids of the same general type (534-547), most from the shops or their vicinity, are evidence that this was a very common type of flask.

All of these vessels are made of hammered sheet metal; two of the flasks (528, 533), and two of the flask lids (536, 542) were analyzed and proved to be of nearly pure copper.

Jugs and Flasks

523 *Pl. 34.* M67.5:7299. Early Byzantine.

Copper alloy. Diseased; dented out of shape. Max. P.H. 30.00; H. neck 6.00; diam. base 34.00. BS E4 E29.54/S3.16 *96.97.

Body apparently originally cylindrical; base round and convex; horizontal shoulder, cylindrical neck with straight rim. Base and body made of separate pieces of

sheet metal joined with a toothed seam. Hammer marks visible all over the surface in a more or less regular pattern. Shallow incised lines and triangles on the shoulder.

Find publ. *BASOR* 191, 17.

524 *Pl. 34.* Early Byzantine.

Copper alloy. Badly dented and corroded. Max. P.H. 23.00; diam. rim ca. 12.00; diam. shoulder ca. 29.00; diam. base 37.00; H. neck 6.50; Th. 0.20. BS just outside E5 with **517** and **518** E37.73/S7.06 *96.50 on colonnade floor.

Similar to **523**.

525 *Pl. 35.* M67.16:7382. Early Byzantine.

Copper alloy with iron handle and rim band. Body diseased and dented on one side; handle disintegrating. H. 32.50; max. diam. rim 13.00; diam. body 22.80; diam. base 18.00. BS E6 E39.63/S3.08-3.42 *97.77.

Round disk base, narrower than body. Cylindrical body with slightly sloping shoulder. Concave neck with raised ring around center. Straight rim.

Curving iron handle is attached to a circular iron band fitted around the rim and attached with rivets. The lower end of the handle is attached to the body below the shoulder.

See Furtwängler, *Olympia* IV, 213 no. 1372, pl. 71 center (Byzantine).

526 *Pl. 35.* M67.15:7381. Early Byzantine.

Copper alloy with iron handle. Battered; some disease; parts of handle gone. Max. H. 23.80; W. rim 9.00 × 7.00; diam. base 16.00. BS E4 E28.65/S3.42 *97.47-97.40, upper story debris.

Similar to **525** but with flat base, trefoil rim bent inward by hammering. Handle attached beneath rim and below shoulder.

Body is made of two pieces joined by a horizontal toothed seam running below the lower level of the handle (see *Pl. 35*). Hammer marks are visible on the surface of the vessel.

Find publ. *BASOR* 191, 17 n. 9. See Furtwängler, *Olympia* IV, 213 no. 1372, pl. 71 top center; Conze, *Pergamon* I.2, 325 fig. 117 c, 326 (from a Byzantine house); Altmann, 199-200, fig. 32.

527 *Pl. 35.* M62.51a,b:4442. Early Byzantine.

Copper alloy with iron handle. Heavily corroded; much of neck missing; handle detached.

Max. P.H. 22.00; max. diam. 17.80; diam. base 11.20; H. handle 21.50; W. 5.00; Th. 3.50.
BS E14 on floor of shop *96.60 (no grid available).

Thick, low ring foot; very squat cylindrical body widest near base tapering upward to tall cylindrical neck. Trefoil mouth. S-shaped handle once attached to band of iron that fitted around the neck under the rim. Hammer marks on surface form a series of ridges over body and neck.

Find publ. *BASOR* 170, 50.

528 *Pl. 35. M67.29:7475. Early Byzantine.*

Impure copper body and lid with iron handle. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3. Most of handle disintegrated; tears in upper body. H. 20.80; diam. rim ca. 4.00; diam. base 11.00; H. lid ca. 2.70; diam. 4.50.
BS E4 E29.75/S0.89-0.95 *97.29.

Round flat base, cylindrical body with profiled shoulder. Neck tapers upward to round straight rim. Short, cylindrical lid with flat top fits over rim of vessel. Handle once fitted to neck by means of an iron band wrapped under the rim. Body and lid made of hammered sheet metal joined by horizontal and vertical toothed seams. Hammer marks and ridges visible on surface of body and cap. Traces of a carbon-like powder on the inside of the vessel and on the cap, perhaps evidence of burning.

Publ. *BASOR* 191, 17 n. 9.

529 *Pl. 35. M58.61, 61a:937. MANISA 4414. Early Byzantine.*

Copper alloy with iron handle, mostly disintegrated. Max. P.H. 28.50; diam. rim 5.50; diam. neck at base 10.40; diam. shoulder 19.40; diam. center of body 18.10; diam. base 18.00; H. neck 12.50.

HoB Room 1, 10 cm. above floor on ash and charred layer.

Similar to **528** but with the following differences: lid fastened to handle by copper alloy chain; raised rings below rim and above join with shoulder.

Find publ. *BASOR* 154, 22. See Davidson, *Corinth* XII, 65, 74, pl. 52 no. 559 (13th C. A.D.); F. O. Waagé, "Bronze Objects from Old Corinth, Greece, II. Four Late Byzantine Vessels," *AJA* 39 (1935) 86-91, esp. 89 fig. 9; Conze, *Pergamon* I.2, 325 fig. 117a, 326 (from a Byzantine house); Altmann, 199-200, fig. 30.

530 *Pl. 35. M58.91:979. MANISA 4416. Early Byzantine.*

Copper alloy with iron handle. Handle detached but all parts preserved; badly diseased.

H. 25.00; ext. diam. rim 5.00; diam. neck at base 8.80; diam. shoulder 15.40; diam. center of body 14.30; diam. base 14.40; H. lid 3.20; diam. lid 4.90.

HoB Room 1, basement, 18 cm. above floor in burnt debris. Floor at *97.29.

Similar to **529** with the following differences: shoulder has two-stepped profile; neck has raised rings below rim and above join with shoulder. Lid has looped pin attached through hole in top to hold chain attaching it to handle.

531 *M63.56:5871. Early Byzantine.*

Copper alloy with iron handle. Analyzed by neutron activation. See Chap. V, Tables V.1, 4a. Neck and body detached; handle detached and corroded.

H. 20.00; diam. rim 4.00; diam. shoulder 11.50; diam. base 11.00; Th. 0.30.

BS E16 E94.00/S1.20 *96.40 on floor.

Similar to **528** but with the following differences: raised ring at base of neck and under rim; conical neck; flat, curved ribbon handle. Hard thick white deposit inside vessel; possibly hard water scale but altered too much from fire and acid bath to analyze.

Find publ. *BASOR* 174, 45.

532 *Early Byzantine.*

Copper alloy with iron handle. Crumpled; diseased. Coated with scale inside.

Max. P.H. 23.90; H. neck 11.80; diam. base 13.20; diam. shoulder 17.90; H. handle 14.30; W. handle 2.40; Th. 2.20.

BS E5 E35.95/S2.24 *96.64.

Apparently similar to **528**.

533 *Early Byzantine.*

"Pure" copper. Analyzed by emission spectrography, neutron activation and atomic absorption. See Chap. V, Tables V.1, 3, 4a, b. Only neck preserved; corroded and diseased.

Max. P.H. 12.50; diam. rim 4.30.

BS Colonnade E42.00-49.00/S6.75-7.90 *98.00-96.50.

Similar to **528**.

Flask Lids

534 *Pl. 36. M61.79:3803. Early Byzantine.*

Copper alloy.

H. 3.40-3.70; max. diam. base 6.30; diam. top 5.00; Th. 0.10.

MRd E14.40/S12.30 *96.50 in fill at edge of second colonnade step. Found with 535.

Cylindrical lid of hammered sheet metal joined at side with a toothed seam. Flat top made of a second piece of metal joined with a toothed seam to sides. Hole in center of top through which is fitted a small cotter pin. Attached to the loop at the top of the pin are the remains of a chain link.

For relation of such a lid to flask and handle see restoration of 530, *Pl.* 35.

The following are similar to 534:

535 M61.78:3802. Early Byzantine.

Copper alloy.

H. 3.10; diam. 5.10-5.30; Th. 0.10.

MRd E14.20/S12.50 *96.50 in fill at edge of second colonnade step near 534.

Chain and attachment loop missing.

536 M67.7:7313. Early Byzantine.

"Pure" copper. Analyzed by emission spectrography, neutron activation and atomic absorption. See Chap. V, Tables V.1, 3, 4a, b. Loop and chain preserved.

Max. H. 6.20; H. without loop 4.30; diam. top 5.30; diam. base 5.60.

BS E4 E30.50-30.55/S1.86-1.90 *97.22.

537 Early Byzantine.

Copper alloy. Torn, diseased.

H. 2.50; diam. base 4.90.

RTE E80.00-82.50/S45.10 *96.40 in disruption of mosaic sidewalk.

538 Early Byzantine.

Copper alloy.

H. 3.20; diam. base 4.70-5.70; diam. top 5.00.

BS S of E10 E66.20/S6.66 *96.58.

539 M59.11:1355. Early Byzantine.

Copper alloy. Sides corroded and torn.

H. 2.50; diam. base 4.20; diam. top 4.60.

BS W7 W21.20/S? *97.37.

540-542 Early Byzantine.

542 analyzed by emission spectrography as "pure" copper, the rest probably similar. See Chap. V, Tables V.1, 3.

540: Max. P.H. 4.30; diam. ca. 3.80.

541: Max. P.H. 5.00; diam. 4.80.

542: H. 3.30; diam. 5.50.

All from BS E9-10 E61.00/S2.20 *96.89.

543-547 Early Byzantine.

Copper alloy.

No dimensions available.

543: BS E2a E21.81/S2.63 *97.03.

544: BS E4 E29.75/S1.00 *97.29.

545: BS E10 E66.47/S2.70 *96.21.

546: BS E17 (no grid available).

547: BS outside E17 E92.00-95.00/S4.50-5.50 *97.50-97.00.

548 *Pl.* 36. Early Byzantine.

Copper alloy. Corroded; sections of sides missing.

H. 4.10; diam. 14.50; W. handle 2.10.

RTW E32.00/S31.00 S of S Colonnade foundation, *96.75-96.50.

Lid for a larger vessel, perhaps like 523 and 524. Short, cylindrical sides; flat top with two holes for attachment of handle. Flat ribbon handle with pierced, turned out ends made separately and attached by rivets. Part of one rivet preserved in one end of the handle.

549 Early Byzantine.

Copper alloy. Heavily corroded and diseased.

Max. P.H. 7.50; diam. ca. 13.50; Th. 0.10.

BS E9 E57.90/S3.71 *96.57.

Low cylindrical sides. Flat top, slightly indented ca. 2.40 cm. from edge. No handle apparent.

550 Early Byzantine.

Copper alloy. Corroded; sides mostly disintegrated.

H. 0.70; diam. ca. 7.40.

BS E12 or 13 E76.00-80.00/S1.00-3.00 *96.80-96.60.

Low, cylindrical sides, flat top. At base is a slightly everted rim. Stump of handle preserved in top.

551 *Pl.* 36. M63.9a:5086. Late Roman-Early Byzantine?

Copper alloy.

H. 3.50; diam. 9.10.

Syn FC E110.00-112.00/N1.50-2.00 *97.00 in burned fill at S door.

Dome-shaped lid with flat, everted lower edge. Hole in center of top through which is placed a small hook with button under end. Part of a chain attached to outer end of the hook.

552 *Pl. 36.* M63.14:5124. Early Byzantine?

Copper alloy.

H. 2.60; diam. 8.00.

Syn FC E108.00/N2.00-4.00 *97.00-96.75 in earth fill above floor.

Round lid with four profiled tiers. Through center of top is a hole through which is placed a small cotter pin attached on the outside to remnants of a chain.

553 M67.20:7399. Early Byzantine.

Iron. Corroded.

Diam. ca. 9.50; Th. 0.20; W. handle 1.50.

BS E6 E40.00-41.00/S3.09 *96.84.

Circular plate, slightly concave on lower side. Possible stump of handle on one side.

*Handles***554** Early Byzantine.

Iron. Heavily corroded.

No dimensions available.

BS E5? No grid or level available.

Triple curved vertical flask handle with part of band that fit under rim of flask preserved. Similar to handles on **525** and **526**.The following are similar to **554**:**555** M62.51:4442b. Early Byzantine.

Iron. Corroded.

H. 12.00; W. 2.15; Th. 1.60.

BS E13 E81.00/S2.50-3.00 *96.60.

556 Early Byzantine.

Iron. Corroded. Bits of charcoal adhering.

H. 15.50; Th. 2.40.

BS E8 or 9 E55.00-58.00/S0.00-4.00 *96.80-96.00.

S-curved vertical handle with round section; flattened at lower end for attachment to vessel body; upper end split for attachment to lip.

557 *Pl. 36.* M60.22:2365.

Iron. Corroded.

H. 11.50; W. lower end 3.00; Th. 0.70.

AcT Trench B fill with Level IA walls E1012.00-1022.00/S1076.00-1083.00.

Nearly straight, vertical bar, flattened at lower end. Upper end split with one side curving over for attach-

ment to lip of vessel, the other rising to serve as a thumb tab.

558 *Pl. 36.*

Copper alloy. Corroded.

Max. H. 12.00; W. base 1.50; diam. 0.50.

HoB in ditching operations; no grid or level available.

S-curved vertical handle with round section. Lower end flattened and divided into a crude palmette with incisions on outer surface. Upper end forked for attachment to lip of vessel.

559 *Pl. 36.* M59.52a:1857. Roman?

Copper alloy. Corroded.

Max. W. 5.40; Th. 0.45.

PC E of N and S arches at A *91.60.

Small swinging handle from a situla, small vessel or casket. Tapered bar with lozenge-shaped section turned up at ends to form loops. Ends have molded finials.

See Davidson, *Corinth* XII, 132, pl. 66 no. 897 (Roman); Robinson, *Olynthus* X, 207-221, esp. 217-218, Type 1, pl. 58 nos. 737-746; pl. 59 nos. 750, 758 (before 348 B.C.); Furtwängler, *Olympia* IV, 95, no. 664, 138-139, nos. 865-867 (Orientalizing to Greek); Perdrizet, *Delphes* V, 79 nos. 349-355, figs. 276-278; Emery, *Ballana and Qustul* I, 279, fig. 96 (restoration of casket with similar handle from Tomb Q. 3-150, 5th-6th C. A.D.).**560** *Pl. 36.* M60.8:2270. Late Roman?

Copper alloy. Bent out of shape.

Max. L. ca. 8.00; Th. at center 0.30.

HoB E5.00/S105.00 *102.25-101.85 upper mixed fill.

Similar to **559** but with simpler terminals.See Robinson, *Olynthus* X, 208-212, pl. 56 nos. 668-698.**561** *Pl. 36.* M63.27:5351. Early Byzantine.

Copper alloy. Broken; corroded.

Max. W. 9.50; W. band 1.30; Th. 0.25.

BS E18 E105.00-109.00/S0.00-2.00 *97.50-97.00.

Flat band curved to form "basket" handle for bowl or bucket. Through each end a hole has been crudely punched leaving rough edges. Rivets of other attachments once passed through holes (now missing).

562 *Pl. 36.* M65.12:6948. Roman or later?

Copper alloy.

H. 7.50; W. 8.20; loop 3.00 × 2.00 × 2.00; plates 1.50 × 2.10.

ERd E125.10/N15.80 E of alignment of Syn porch, lower part of high fill *97.37.

Thick, horizontal, wishbone-shaped handle, thickened at ends then tapering towards central, trapezoidal loop. At either end is a flat, triangular attachment plate.

See Perdrizet, *Delphes* V, 75, fig. 257 bis, no. 320 (Hellenistic or Roman).

563 M63.43:5631. Early Byzantine?

Copper alloy. Fragment.

Max. P.H. 3.40; max. W. 5.20.

Syn P "Restaurant" E117.00-118.00/N5.00-6.00 from portion of disrupted floor in NE corner *96.75-96.50.

Upper part of a vertical band handle with two attachment plates. At center is a vertical leaf in relief. Around base is a horizontal band. Execution rather crude.

564 Pl. 36. Early Byzantine.

Lead and iron. Corroded.

Max. H. 5.10; diam. handle 4.20; diam. band 0.80; W. lead 3.30; H. lead 1.90.

BS E9 E60.00-65.00/S0.00-1.00 *97.40.

Iron ring handle with lead poured around it to anchor it to heavy lid or stone. Lead is spool-shaped with concave profile.

Handle Attachments

565 Pl. 36. M64.31:6375. Hellenistic-Roman.

Copper alloy.

Max. P.H. 4.30; W. 2.30; Th. 0.01.

MTW W20.00-25.00/S140.00-145.00 to *101.58 mixed context.

Flat, leaf-shaped plate narrowing to point at bottom. At top is a flat, vertical extension bent back to form a loop through which the ends of a handle could pass. Such plates could be fixed to the sides of vessels or caskets to receive handles.

566 Pl. 36. M62.74:4733. Early Byzantine.

Copper alloy. Broken at bottom.

Max. P.H. 6.50; W. plate 2.50; W. loop 0.60; Th. 0.40. BS E13 E75.00-80.00/S? *97.00.

Similar to **565** but simpler. Narrow loop at top has square section, thicker than flat plate below.

567 Pl. 36. M60.73:2809. Byzantine?

Copper alloy. Edges torn.

Max. P.H. with loop 7.60, without loop 5.60; max. W. 4.80; W. loop 1.45.

AcT Trench C E1083.00-1085.00/S1069.00-1073.00 fill ca. *401.05 a.s.l.

Plate and loop similar to **566** but loop wider and rolled tighter. Originally there were three rivets in the plate—one through the lower end, two through the widest part (one now missing). The whole is crudely made. It was perhaps attached to something like a large cauldron.

See Davidson, *Corinth* XII, 132, pl. 66, no. 899 (Byzantine).

568 Pl. 36. M60.25:2390.

Iron with lead rivet. Corroded.

Max. H. with loop 9.60; H. without loop 7.50; max. W. 4.00.

AcN local grid E1.00-5.00/S25.00-30.00 *398.00-396.00 a.s.l. in mixed fill with Late Byzantine terracing at walls G, H.

Plate and loop similar to **566** and **567**. Lead rivet through center of widest part of plate.

569 Pl. 36. M60.54:2626.

Iron with lead rivets. Corroded.

H. with loop 11.00; max. W. 3.30.

AcT Trench C E1081.00-1082.00/S1070.00-1072.00 surface.

Flat, leaf-shaped plate constricted at center. Raised horizontal band across center on one side. One end narrows to form flat strip bent back to form attachment loop. Two rolled-up pieces of lead are jammed into holes through the widest parts of the plate, probably functioning as rivets.

See Davidson, *Corinth* XII, 127, pl. 63, no. 847 (Byzantine).

Miscellaneous Vessel Parts

570 Pl. 37. M60.50:2612.

Copper alloy.

Est. diam. 26.00; max. P.L. 20.00; W. 2.80; Th. 0.50. AcT E1002.00-1003.00/S1074.00-1075.00 ca. *402.60-402.50 a.s.l. "Level II."

Cast metal with vertical ribbing; possibly part of the rim of a fairly large vessel.

571 Pl. 37. M58.113:1086. Early Byzantine.

Copper alloy. Thin, fragmentary.

Max. P.W. 5.00.

HoB Room 1, basement, 1.15 m. below upper step in E wall floor *97.19.

Part of rim of small sheet metal vessel with edge rolled outward to form rim. Small round hole in side of larger fragment.

572 *Pl. 37.* M60.84:2974. Byzantine?

Copper alloy. Fragmentary; diseased.

Est. diam. 20.00; W. 4.50; Th. 0.10.

AcT Trench C E1079.00-1096.00/S1066.00-1076.00 *398.35 a.s.l. in Byzantine cistern.

Part of a foot of a large sheet metal vessel. Rim formed by folding edge back ca. 0.15 cm. Chased (?) vertical rays set close together around side set off by plain border.

573 *Pl. 37.* Early Byzantine.

Copper alloy with lead filling.

H. 2.40; diam. 10.80; Th. walls 0.45.

BS E14 E85.00-87.00/S0.00-2.00 *97.30-96.90.

Low disk base with slightly flaring walls which form a plating over lead interior used to give weight to lower part of vessel. Across top is a thin sheet of copper alloy now torn.

574 *Pl. 37.* M73.4:8249. Early Byzantine.

Copper alloy and lead. Corroded and diseased.

Max. H. 8.10; ext. diam. rim 7.80; W. rim 2.00; ext. diam. cylinder 5.00; Th. 0.50; H. lead plug 2.20; top diam. plug 4.50; bottom diam. 3.60; diam. ring handle 2.80.

BS W3 W18.80/S1.22 *96.75. Found in pipe of basin.

Jug stopper. Hollow cylinder of copper alloy with broad flat rim to which is attached a hinged handle with upright ring at end. A lead plug is fitted into an opening in the cylinder.

575 *Pl. 37.* M60.3:2231.

Lead stopper.

Diam. head 2.40; diam. stem 1.70; H. 1.40.

HoB E15.00/S95.00 *101.30 mixed upper fill.

Thick, mushroom-shaped stopper with flat, round head and short, round stem.

576 *Pl. 37.* M60.92:3023. Early Byzantine?

Impure copper. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3.

Max. P.L. 6.14; max. P.W. 3.90; Th. 0.10.

AcT Trench E E1048.00-1051.00/S1075.00-1079.00 fill ca. *400.10 a.s.l.

Repair patch for sheet metal vessel. Roughly leaf-shaped with edges cut into tabs for joining with toothed seams.

LITURGICAL OBJECTS AND CHURCH FURNISHINGS

Objects with apparent liturgical functions were found primarily in two locations—in the rooms of the House of Bronzes and in the Byzantine Shops (see Plans III and IV).

This category includes censers or incense burners (**577-585**), a censer or robe holder (**587**), an incense shovel (**588**), polycandela or lamp holders (**589, 590**) and a variety of triple chains with hooks to suspend lamps and censers (**591-608**).

Judging from their contexts or designs, most of these objects were intended for Christian use. Of course the two menorahs (**610, 611**), both found in the Synagogue, belong to Jewish cult.

Censers and Related Equipment

Nine censers (thymiateria) came to light—three from HoB, four from the Byzantine Shops, and two from the Synagogue. The contexts of all but the two from the Synagogue, which came from upper levels of reuse, allow a dating no later than the early seventh century A.D. This date is consistent with the dates of close parallels from Europe and the Levant.⁵³ The censer lid and censer or robe holder (**586, 587**) from the Byzantine Shops, and the incense shovel from HoB must also be dated similarly.

When in use, the censer would be held in the priest's right hand by chains attached to the upper rim as seen in the mosaic of Justinian and his retinue from San Vitale in Ravenna.⁵⁴ All examples from Sardis have loops for chain attachment in this location and some have chains preserved; all have three feet attached to the base as well.

Compositions of the alloys show considerable variety. Of six analyzed samples, four are of leaded tin bronze (**578, 581, 582, 583**), two of low zinc brass (**577, 580**). In addition, chains and bowls can show different compositions (e.g. **581**). All but **585** are cast.

Censers

Three subtypes are identified.

Type 1: Each of these censers has a cast hexagonal bowl with everted ledge rim, flat bottom and three cast feet. Three of the four examples (**577, 578, 580**) can be

53. For a discussion of censer types and their distribution see Almagro Gorbea, 181-201.

54. For use see Salaville, 147. For Justinian mosaic see André Grabar, *The Golden Age of Justinian* (New York 1967) ill. 171.

dated by context to the Early Byzantine period, making it likely that the fourth (579) should be dated similarly. The type is fairly common, and is distributed from Spain to Egypt and the Levant.

577 Pl. 37. M59.31:1592. Early Byzantine.

Low zinc brass. Analyzed by emission spectrography, neutron activation and atomic absorption. See Chap. V, Tables V.1, 3, 4a, b. One corner and side broken; some traces of burning.

H. 6.00; H. with chain ca. 24.00; diam. 9.50; W. rim 0.55; W. each side bowl 3.70.

HoB Area 5 E30.00/S70.00-80.00 *97.64 on floor.

Three small upright rings are attached to the rim. To these in turn are attached three chains brought together by a single ring at the upper end. Above the base and below the rim of the bowl are small moldings.

Find publ. *BASOR* 157, 24; 174, 45 n. 18; *Sardis* M4 (1976) 43-44, 196 fig. 21a. See Almagro Gorbea, 181-201, pl. I and parallels; Strzygowski, 283, pl. 32 no. 9116 (5th-7th C. A.D.); Furtwängler, *Olympia* IV, 212, pl. 71 no. 1368; Deonna, *Délos* XVIII, 391 no. B 1215-6030 bis, pl. 113.1007 (5th-7th C. A.D.); M. Rostovtseff, "Une trouvaille de l'époque Gréco-Sarmate de Kertch," *MonPiot* 26 (1923) 125-126 (development of polygonal censers).

The following are similar to 577:

578 Pl. 37. M58.40:882. Early Byzantine.

Leaded tin bronze. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3. One leg missing, small holes in side; chain fragmentary.

H. 6.00; diam. 8.50; W. rim 0.50; H. foot 1.50; W. side 3.50.

HoB Room 1, ca. 42 cm. W of E wall, 70 cm. S of N wall *97.29 on basement floor. Found with 583 and 588.

Publ. *BASOR* 154, 24, 31-32, n. 66; Hansen, 173, pl. XC.

579 M63.41:5629. Early Byzantine?

Copper alloy. Diseased. Chain missing.

H. 6.00; diam. 8.50.

Syn P "Restaurant" E122.00/N3.00-4.00 *97.50 found on top of bench built against eastern wall.

Similar to 578 but with narrower rim, stubbier feet.

Find publ. *BASOR* 174, 45 n. 18.

580 M67.32:7482. Early Byzantine.

Low zinc brass. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3.

Max. H. 6.70; H. without loops 6.00; diam. 8.50; W. rim 0.70; Th. rim 0.10.

BS E7 E47.71/S3.72 *97.83.

Type 2: These censers differ from those of Type 1 primarily in having cylindrical instead of hexagonal bowls. In addition, there is some variety among the four examples represented here in surface treatment—581 is plain, while 582-584 have either ribs or incised horizontal lines. 581 also differs from the others in having a projecting ledge around the base of the bowl to balance the rim. As with Type 1, all but one (584) of the four examples can be dated by context to the Early Byzantine period.

581 Pl. 37. M63.60:5876. Early Byzantine.

Bowl: leaded tin bronze; chain: low zinc brass. Analyzed by emission spectrography, neutron activation and atomic absorption. See Chap. V, Tables V.1, 3, 4a, b. Max. H. with loops 6.00, without loops 4.80; W. rim 0.80; Th. rim 0.40; diam. 8.20.

BS E18 E106.00-106.30/S2.50-2.75 *96.50 in burned layer under tiles.

Bowl has everted rim at top and bottom. Three round loops on top rim; three low feet projecting from lower rim. Fragments of chain preserved in loops.

Find publ. *BASOR* 174, 45 and n. 18.

582 Pl. 37. M67.39:7588. Early Byzantine.

Leaded tin bronze. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3. Part of chain preserved separately.

Max. H. 6.00; diam. rim 8.00; diam. base 6.00; H. feet 1.30.

BS E6 E39.80/S2.91 *96.58.

Bowl has wide everted rim with three loops. Three narrow feet project from base. Eight incised circumferential lines around bowl.

Find publ. *BASOR* 191, 20. See Furtwängler, *Olympia* IV, 212, pl. 71 no. 1369; Fitzgerald, *Monastery* 11, pl. III, fig. 2.

583 Pl. 38. M58.39:881. Early Byzantine.

Leaded tin bronze. Analyzed by neutron activation and atomic absorption. See Chap. V, Tables V.1, 4a, b. H. without rings 6.10, with rings 6.70; diam. 9.00; W. rim 0.80; H. foot 1.00.

HoB Room 1, 35 cm. W of E wall, 35 cm. S of N wall *97.29 on basement floor. Found with 578 and 588.

Similar to 582 but with narrower rim; lower ends of feet more everted. Six raised horizontal ribs around the

outside of the bowl, each incised with two horizontal grooves. On ext. of base are incised concentric circles.

Find publ. *BASOR* 154, 24.

584 *Pl. 38.* M63.64:5916. Early Byzantine.

Copper alloy.

H. with loops 7.20, without loops 6.20; diam. rim 8.90; W. rim 0.60; Th. rim 0.15; diam. base 7.50.

Syn FC SE corner E114.60-115.00/N1.40-1.90 *97.25-97.00 above floor from late occupation of FC.

Horizontal ribs around bowl.

Find publ. *BASOR* 174, 45 n. 18.

Type 3: **585** is the only example of this type. It has a hammered sheet metal bowl instead of a cast one. The context and date are similar to those of the others.

585 *Pl. 38.* M67.35:7584. Early Byzantine.

Copper alloy. Damaged on one side and diseased.

H. 5.50; diam. 7.80; H. feet 2.00.

BS E9 E56.19/S0.00-0.80 *96.39.

Hemispherical bowl with straight rim, slight carination below rim. Three high, ridged feet, cast solid. Only one chain loop preserved on rim. Parallel horizontal grooves incised on exterior and interior of bowl. Two concentric circles incised on base.

See Orsi, *Sicilia bizantina* I, 171, 172, pl. XIIa (from Catania, now in Syracuse Museum); Stryzowski, 282, pl. 32 no. 9113 (6th-7th C. A.D.).

Censer Lid

586 *Pl. 38.* Early Byzantine.

Copper alloy. Most of bottom edge gone; heavily corroded.

Max. P.H. 6.80; diam. base 7.30; diam. knob 0.80.

BS E11 E70.66/S2.50 *97.18.

Conical lid flaring out at base with slight carination near rim. Knob at top pierced with a small hole to release incense.

See Davidson, *Corinth* XII, 75, pl. 52 no. 569 (Byzantine); Stryzowski, 300-301 fig. 339, no. 9163.

Censer or Robe Holder

587 *Pl. 38.* M62.90:4929. Early Byzantine.

Copper alloy. Made in two sections; lower part now broken.

H. 21.00; W. upper section 13.00; H. 10.00; cross 2.30 X 2.30.

BS E13 E77.00/S3.50 *96.40 just inside door.

Upper part flat and curved, similar to collar on steelyard (see **435-444**); inner curve apparently meant to fit over a pole or rod. At top is an equal-armed cross. Ends of "collar" narrow, becoming round in section, and bend outward and upward to form loop openings on either side. The lower part is a horseshoe-shaped rod with loops in both ends fitting through the openings in the upper section so that the lower section swings freely. On either side of the lower section is a hook (left one broken off). At the bottom, where the section is broken, the rod appears to be thickened as if for some other projection.

Incense Shovel

588 *Pl. 38.* M58.38:880. MANISA 4419. Early Byzantine.

Copper alloy.

Max. L. 14.00; L. socket 7.10; max. diam. socket 2.80;

D. scoop 6.50; W. scoop 8.20; H. at arch 8.50; W. cross 3.50; H. cross 5.30; H. sides of scoop 1.80.

HoB Room 1 (basement), ca. 57 cm. from E wall, 20 cm. from N wall on floor *97.29. Found with **578** and **583**.

Rectangular scoop with straight sides and hollow socket projecting from back to receive wooden handle. Atop each side of the scoop is a dolphin with high, arching tail. Rising from the upper sides of the tails is an arch with flat section within which is a cross. The top of the cross is attached to the under side of the arch, the bottom of which rises from the upper edge of the opening of the socket. The arms of the cross have concave edges. Round vertical rods below the dolphins' tails connect the tails to the sides. On the face of the arch and cross are incised circles with a small dot in the center of each. There are incised lines on the dolphins' tails; their eyes are raised blobs.

The incense shovel as a type is discussed by Yadin, *Cave of Letters*, 48-58, figs. 11-15, pls. 15, 16, where four examples dating to the early second century A.D. were found. Yadin includes many parallels, including the Sardis piece. Most others are earlier than the Sardis example, ranging from the first through third century A.D., and none of the others have crosses. Distribution is from Gaul to the Levant. It is interesting to note that one of the examples excavated by Yadin in the Cave of Letters (ca. A.D. 135) was analyzed and found to have a high lead content (15-20 percent). This was considered by the analyst to be "accidental" (Yadin, p. 48 n. 21). Actually, as we have found, (see Chap. V, Table V.3) a high lead content is fairly common among Roman bronzes.

Publ. *BASOR* 154, 24, fig. 11, 31 n. 65; G. M. A. Hanfmann and A. H. Detweiler, "New Explorations at Sardis," *Archaeology* 12 (1959) 58, 59 fig. 12; *BASOR* 174, 45 n. 20; Hansen, 173, pl. XIa; *Sardis* M4 (1976) 43-44, 196 fig. 21b.

Polycandela

589 Pl. 38. M59.33:1594. Early Byzantine.

Leaded tin bronze. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3.

Max. diam. disk 22.30; diam. central opening 12.00; diam. side holes 3.00; Max. H. with hook and chains 44.30; Th. disk 0.40.

HoB Area 13 E30.00/S80.00 on floor, *97.82.

Flat disk with large central opening. Six smaller holes spaced evenly around plate ca. 5.70 cm. apart. Three small cotter pins attached to the plate through small holes near the rim support suspension chains. The chains are pulled together at the top and held by a loop attached to the lower end of a long, flat hook.

Find publ. *BASOR* 157, 24, fig. 12; *Sardis* M4 (1976) 196 fig. 21c. The polycandelon or multiple lamp holder is a common Byzantine type. See Ross, *DOCat* 1, 40-42, pl. 30, nos. 42-44 (Constantinople, 6th C. A.D.) with discussion and bibliography; Davidson, *Corinth* XII, 128, pl. 63, nos. 859, 860; Fitzgerald, *Beth Shan* III, 6, 42, pls. 27.4, 37.1-4 (4th-7th C. A.D.).

590 is similar to **589**:

590 Early Byzantine.

Zinc bronze. Analyzed by emission spectrography, neutron activation and atomic absorption. See Chap. V, Tables V.1, 3, 4a, b.

Est. ext. diam. 23.00; int. diam. 9.00; W. plate 4.80; diam. small holes 2.30; Th. plate 0.30.

BS Colonnade E49.00-58.00/S6.75-7.90 *98.00-96.50, found in cleaning operation.

Lamp or Censer Chains and Hooks

Two basic types were found, almost all of them in Early Byzantine contexts in HoB and BS; the rest appeared in mixed contexts that did not preclude an Early Byzantine date.

All the analyzed examples—six in all—contain zinc.

Type 1: These examples consist of three flat plates attached through holes in either end to short lengths of chain, attached in turn to hooks either flat or round in section (**591-599**).

591 Pl. 38. M59.28:1576. Early Byzantine.

Hook: zinc bronze; chain: leaded tin bronze. Analyzed by emission spectrography, neutron activation and atomic absorption. See Chap. V, Tables V.1, 3, 4a, b. Max. L. 39.60; L. bottom hooks 7.40.

HoB Area 5 E30.00/S70.00 on floor, *97.64. Found with length of chain 194.00 cm. long, possibly to suspend whole apparatus from ceiling. Also found near **592** and **601**.

Long suspension hook with twisted shaft at center from which hangs a two-link chain attached to a small, flat hook. From this hook depend three long, narrow, flat plates, widest at center, with attachment holes in both ends. At the lower end of each is a single chain link attached to a flat hook.

For similar types of suspension apparatus see Dalton, *Early Christian Antiquities*, 85 no. 393 (Lampsacus Treasure, 6th-7th C. A.D.); Chavane, *Salamine* VI, 73, pl. 22, nos. 210, 213 (6th-7th C. A.D.); Deonna, *Délos* XVIII, 392 no. B 389-5141, pl. 113.1000 (5th-7th C. A.D.); Colt, *Nessana* I, 54, 306, pl. 22.16 (South Church, 7th C. A.D. or later); D. C. Baramki, "An Early Byzantine Synagogue near Tell es Sulfān, Jericho," *QDAP* 6 (1936-1938) 75, pl. 22 (early 8th C. A.D.); Russell, fig. 22 (Anemurium, Early Byzantine).

592 Pl. 38. M59.23b:1468. Early Byzantine.

Copper alloy. Central hook missing.

Max. P.L. 20.50; L. hook 3.80.

HoB Area 5 E30.00/S70.00 on floor *97.60. Found with **591** and **601**.

Similar to **591** but with longer chain links between parts and short wire hooks at lower end.

The following are similar to **592**:

593 M59.34:1595. Early Byzantine.

Copper alloy. Fragmentary.

BS W3 W4.60-4.70/S0.70 *97.60.

594 M69.4:7929. Early Byzantine.

Low zinc brass. Analyzed by emission spectrography, neutron activation and atomic absorption. See Chap. V, Tables V.1, 3, 4a, b.

L. longest strip 10.00; W. 0.90; L. hook 7.40.

BS E7 E45.61/S3.10 *97.37.

Parts of flat plates and hooks of types similar to preceding.

595 M62.17:4208. Early Byzantine.

Copper alloy. Only plates and hooks preserved; intermediate chains missing.

L. plates 19.50; max. W. 1.10; W. at ends 0.90; Th. 0.20; L. smaller hooks 6.90; Th. 0.20; L. central hook 10.70. MRd E28.00-30.00/S6.00 *97.90 in fill.

596 Early Byzantine.

Copper alloy. Only one plate and hook of original three preserved.

L. plate 15.80; L. hook 4.80.

Building B, S of building outside Room 3; surface to Level II, ca. *99.10-97.86.

597-599 Early Byzantine.

Copper alloy. Fragments of three more.

597: Syn MH E89.00/N6.00 *96.60-96.50.

598: Syn FC E116.00-118.00/N13.00-16.00 *97.00-96.58.

599: Syn FC E113.00/N5.00 *97.00.

Type 2: Lamp chains of this type are similar in general arrangement of parts to those of Type 1, but have rods of round section in place of the flat plates (**600-603**).

600 *Pl. 38.* M62.77:4798. Early Byzantine?

Zinc bronze. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3.

Max. L. 35.00; L. central hook 13.00; L. rod 15.00; L. small hook 6.00.

Syn FC E115.00/N16.00 *98.00-97.50, from late occupation of the Syn.

Long central hook at top with round section connected by single figure-eight shaped links of chain to three long rods with round sections. Single chain links connect rods to shorter hooks with flat sections.

See Deonna, *Délos* XVIII, 141, fig. 165 no. B1316 (Christian epoch); Comstock-Vermeule, 422-423 no. 609 (Assos, Late Roman or Byzantine).

601 *Pl. 39.* M59.23a:1468a. Early Byzantine.

Copper alloy.

Max. L. 43.00; L. small hooks 5.30, 5.00, 5.20; L. central hook 19.00.

HoB Area 5 E30.00/S70.00 on floor *97.60 found with **591** and **592**.

Similar to **600** with more chain links holding lower hooks to suspension rods.

The following are similar to **600**:

602 Early Byzantine?

Copper alloy. One of lower hooks missing.

Max. L. 31.30; L. small hooks 6.20; L. central hook 11.00.

MTE mixed context.

603 Early Byzantine?

Copper alloy.

No measurements available.

HoB E47.00-50.00/S122.00-125.00 *101.50-101.10.

604 *Pl. 39.* Byzantine?

Copper alloy. Broken in several pieces.

Max. P.H. ca. 5.20; L. one bar 13.00.

RT E31.00/S31.00 above S Colonnade *96.80.

Device for suspending six lamps? Three curved bars flattened in center and pierced so that a pin could be driven through to join the three bars into six branching arms. The ends of the arms are curved up into hooks. Parts of spacers or hanging chains were preserved with **604** but may not belong.

Ceiling Chains for Lamps or Censers (?)

605 *Pl. 39.* M59.83:2226a. Early Byzantine. Zinc bronze. Analyzed by emission spectrography, neutron activation and atomic absorption. See Chap. V, Tables V.1, 3, 4a, b. End of chain broken.

Max. P.L. chain 98.50; diam. ring 3.50; L. hook 5.00; L. spacers 4.90, 6.40.

HoB Area 13 E30.00/S80.00 on floor *97.82.

Long chain with two flat, rectangular spacers incorporated along its length. Each spacer is pierced through the center and at each end, where it is attached to the chain. A rivet passes through the central hole of the longer spacer. At the preserved end of the chain is a round ring to which a hook is attached.

For a similar long chain associated with a censer see Almagro Gorbea, 195, pl. I.

606 M58.110:1025. Early Byzantine.

Bronze. Analyzed by emission spectrography, neutron activation and atomic absorption. See Chap. V, Tables V.1, 3, 4a, b. Diseased and fragmentary.

Max. P.L. largest length 27.00; L. hook 11.80; L. large link 3.20; L. small link 2.80.

HoB Room 5.

Parts of a long length of chain with links of varying sizes. At one end is a hook bent in an S-curve with square section. Six other lengths of varying sizes have smaller links.

607 M62.19:4210. Byzantine?

Low zinc brass. Analyzed by emission spectrography and neutron activation. See Chap. V, Tables V.1, 3, 4a. Max. P.L. longest length 30.00; diam. large ring 4.30; diam. smaller ring 2.50.

MRd E25.00/S5.30 in fill *97.00.

Longest length of chain has large circular ring at one end, a small hook (or bent chain link) at other end. A second length of chain has a smaller ring at one end. Chain links are twisted figure-eights.

Lamp Hook?

608 Pl. 39. M62.69:4704. Byzantine?

Copper alloy.

L. 5.40; span of hook 2.20; W. near hole 0.70; Th. 0.10. Syn FC E97.00-99.00/N1.00-3.00 *97.00-96.50 in fill in E room.

Hammered metal with flat section; hole in upper part of straight vertical end; other end narrowed slightly near tip of hook.

Cross used as Spacer in Lamp Chain

609 Pl. 39. M61.58:3711. Early Byzantine or later.

Copper alloy. One horizontal arm broken off; others chipped, diseased.

Max. P.H. 8.50; max. P.W. 3.40; Th. 0.10. PN Grave 61.33.

Cut out of sheet metal and decorated with punched dots along edges on one side. Remains of suspension holes may be seen at the ends of the two best preserved arms.

Find publ. *BASOR* 170, 17. See Almagro Gorbea, 195 pl. I, 196.2 pl. 2, 201 pl. 7, for hanging chains with crosses as spacers. See also Colt, *Nessana* I, 54, 306-307, pl. 22.15, 22, 29 (7th C. or later); Fitzgerald, *Beth Shan* III, 42, pl. 37.4 (4th-7th C. A.D.).

Menorahs

610 Pl. 39. M63.42:5630. Late Roman.

Copper alloy. Fragmentary.

Max. P.H. 8.50; L. spiral 6.50; diam. branch 1.15; Max.

P.H. shaft 8.00; diam. shaft 1.50.

Syn MH NW of pier S 2 E53.00/N2.70 *96.50 above floor.

Upper part of solid-cast vertical shaft with round section. Parts of two curving branches at right angles to shaft and stump of a third, vertical branch rising directly above shaft. A decorative support in the form of a double-spiral is attached to underside of the right-hand branch and to side of shaft. The back is more perfunctorily worked.

Find publ. *BASOR* 174, 36. A nearly complete freestanding menorah dating to the time of Justinian (mid-6th C.) has also been found at 'En Gedi in Israel. See D. Barag and J. Porat, "The Synagogue of 'En-Gedi," *Qadmoniot* 3 (1970) 97, 100; cover photo and p. 99 lower l. I owe this reference to E. Kessin.

611 Pl. 39. M63.55:5835. Late Roman.

Copper alloy. Five joining fragments. Part of one short branch missing.

Max. H. 18.00; max. W. 6.40.

Syn MH E55.00-56.00/N3.00-3.50 *96.50 above floor.

Made of cut-out sheet metal; perhaps a furniture attachment. Flat vertical strip forms shaft at upper end of which are three pairs of curving concentric branches forming six arms of the menorah while the upper part of the central shaft forms the seventh. A horizontal strip connects all the branches at the top. Three round attachment holes pierce the bottom, center, and top of the central shaft.

Find publ. *BASOR* 174, 36.

Candelabra, Lampstands, Zoomorphic Lamp

The following objects may or may not be liturgical in usage,⁵⁵ but it was felt best to group them with the more obviously ritualistic objects because of their relationship in function, and also because most are from the Byzantine Shops and therefore similar in provenance and date to many of the preceding.⁵⁶

55. Certain kinds of candelabra can, of course, be used liturgically; see Salaville, 149-151.

56. A few examples of standard types of metal lamps may be found in the catalogue of lamps from Sardis, in preparation by Jane A. Scott.

Candelabra

612 Pl. 39. M63.25:5343. Late Roman, ca. 4th-5th C. A.D.?

Copper alloy. Base missing.

Max. H. 20.00; W. bottom 7.50; W. top opening 1.00; diam. drip cup 5.50.

PN Unit 9 W215.00-217.00/S340.00-342.00 *89.60-89.20.

Conical hollow shaft made of sheet metal joined with vertical toothed seam. Narrow end left open to hold candle, and protrudes through bottom of a hemispherical drip cup.

613 Pl. 39. M62.53:4472. Early Byzantine.

Iron. Corroded and broken.

Max. P.H. 114.50; Th. 0.80; L. leg 17.80; diam. plate 12.50.

BS E15 E87.50-88.50/S1.50-2.50 *97.30.

Tall, thin vertical shaft balanced on three thin curved legs. A round, flat plate, possibly a drip plate, is preserved separately.

See Emery, *Ballana and Qustul* I, 382 no. 871; II, pl. 100A Tomb B.95-2 (5th-6th C. A.D.).

614 Pl. 40. M67.17:7383. Early Byzantine.

Iron with copper alloy base and candle holder. Corroded and broken in several pieces.

Max. P.H. 143.90; diam. shaft ca. 2.70; W. base 5.90; H. candle holder 8.00.

BS E6 E42.82/S1.57 *96.99.

Long, thin shaft with three curved feet similar to **613**. At bottom of shaft is a hollow, profiled base of copper alloy that had been slipped on over the shaft. At top a small urn-shaped candle holder is fitted over the end of the shaft.

See Emery, *Ballana and Qustul* I, 368 no. 819; II, pl. 100B, Tomb B.10-21 (5th-6th C. A.D.).

Lampstands

615 Pl. 40. M63.5A-D:5353. MANISA 4421. Early Byzantine.

Copper alloy. Found in four sections and restored with modern joins between tripod, base and shaft, one or more of which may not belong together.

Max. H. (as restored) 40.60; Max. H. saucer 10.50; diam. saucer 10.60; H. spool 5.70; W. spool 1.50; H.

shaft 17.00; max. diam. shaft 2.30; diam. base of capital 2.30; W. abacus 3.80; H. capital 4.50; diam. necking ring 2.15; H. pedestal 4.10; max. W. end plates 4.00; W. sides 1.80; H. tripod base 10.00; max. W. without feet 9.50; W. between feet ca. 13.10; diam. upper surface 1.70; W. foot 3.15.

BS E19 found lying on side in several pieces in fallen brick and burned earth between E112.00-118.00/S0.00-2.00 *97.50.

At the top is a shallow, concave saucer with incised concentric circles near rim and around center. From center of upper surface projects a vertical, rectangular spike tapering to a point, for holding a lamp. From center of the saucer's underside descends a spool-like base into which a short pin or tenon was originally fitted. The tenon has a square section where it joins the spool and a round section at the other end which fits exactly into a hole in the upper surface of the "capital" of the shaft. These two pieces, therefore, do belong together. The slender, vertical shaft is hexagonal in section, bulging to maximum diameter below midpoint. The upper part tapers slightly, then spreads to a stylized acanthus capital above a molded necking ring. The capital has two rows of pointed leaves, deeply incised with lines. Four round hollows at the bases of the leaves were perhaps inlaid. Above the capital is a square abacus with knobs at the corners and a round hole in the center of the upper surface to receive the tenon of the saucer. The lower end of the shaft was found broken so the method of joining at that end is less certain. Included in the restoration, although it may not belong in this position, is a tall "pedestal" with rectangular section, widened to a square plate with knobbed corners at top and bottom. In the surface of one plate is a round hole or mortise intended to join with a tenon; the surface of the other plate is smooth. Each of the four vertical sides is incised with a circle with dot at the center. The base or stand has three bird-claw supports with pendant leaves between. From the legs the base tapers upward to a narrow round terminus with smooth surface containing neither mortise nor tenon. Around the narrow "neck" below the upper surface are faintly incised grooves. Again, there is no clear evidence that this base belongs to the shaft and saucer, though proportionately and stylistically, the restoration seems correct.

Find publ. *BASOR* 174, 45. I owe analysis of how the parts fit together to Jack Soultanian, Jr., Sardis Expedition conservator in summer 1974. For similar ancient lampstands see Emery, *Ballana and Qustul* I, 370 no. 826; II, pl. 101D with capital below saucer, Tomb B.3-39 (5th-6th C. A.D.); Ross, *DOCat* I, 33-35, 37-38, pls. 27, 29 nos. 33, 34, 39 (no. 33 is "Egyptian," 5th-6th C., the rest "Syrian," 6th C. A.D.).

616 Pl. 40. M67.28:7474. Early Byzantine.

Copper alloy. Base missing; saucer bent.
Max. P.H. 28.50; diam. saucer ca. 9.50; H. spike 6.00.
BS E6 E41.21/S3.02 *97.79-97.69.

Circular saucer with tapered vertical spike with square section in upper surface. Lower surface is attached to a profiled vertical shaft with lower surface ending in a narrow tenon with round section for fitting into base.

Tripod Base of a Lampstand

617 Pl. 40. M68.4:7624. Early Byzantine.

Copper alloy.
Max. H. 3.60; max. diam. 6.80; diam. inner rim 6.00;
diam. central hole 1.65; diam. feet ca. 1.70.
BS E2 E18.20/S1.38 *96.62.

Flat, horizontal circular plate with offset rim and round hole or mortise through the center attached to three lion's paw feet. Around the hole is a raised rim. The underside of the plate is concave along the rim and curves slightly upward on the outside.

Zoomorphic Lamp

618 Pl. 40. M67.4:7291. MANISA 4342. Late Roman-
Early Byzantine.

Brass. See Chap. V. A few pits and holes in back and "mouth," otherwise in excellent condition. Piece has been chemically cleaned and slightly repatinated to improve appearance.

Max. L. shell to tail 16.40; max. H. 8.30; max. W. 4.00;
max. diam. shell 2.70.
BS E5 E36.45-36.50/S0.91 *97.19.

Lion walking right. Wide open mouth holding shell-shaped spout. Fuel hole in top of head covered with small hinged lid. Just in front of lid is a small vertical loop to which a suspension chain link is attached. On proper l. flank is a horizontal bar meant to slide into bracket of stand or mount. This side is evidently the "back" and the modeling and incised detailing of forms, musculature, mane, etc. is much more perfunctory than on proper r. Mane, hair on legs, ribs on r. side, segments of shell, separation of toes and facial features delineated by incision.

Crawford, who published the piece, suggests a date as early as late third to early fourth century A.D. on the basis of stylistic considerations, though given the context it is possible for the piece to date as late as the early seventh century A.D. when the shops were destroyed.

Publ. *BASOR* 191, 18, fig. 19; Crawford, 291-293 with technical appendix by J. Greaves, 293-294; E. Gazda and G. M. A. Hanfmann, "Ancient Bronzes: Decline, Survival, Revival," in Doeringer, et al. 248, 249, fig. 5.

COSMETIC AND SURGICAL IMPLEMENTS

Many of the objects here classified as "cosmetic implements" may also have been used as surgical or medicinal instruments. This is especially true of certain shapes of cosmetic spoons and spatulas whose obvious functions of stirring, mixing, measuring and spreading of ointments, salves and powders are common to cosmetic and medical as well as other uses. The tweezers (647) and the tubes (644-646) may also have served multiple functions.

Cosmetic Spoons or Probes

About twenty of these common objects, called variously "earspoons," "earpicks," "unguent spoons" and "cosmetic spoons," have been found at Sardis. They can be divided into three main types: (1) those with plain shaft and bowl (619-625); (2) those with molded shaft and plain bowl (626-630), and (3) those with molded shaft and shell-shaped bowl (631-638).

Forms and decoration do not seem to be chronologically distinctive. Similar ones have been identified at a number of other sites in contexts dating from Greek through Roman and Early Byzantine eras. In general, the spoons from Sardis come from contexts that are not securely datable, though one (637) came from the BS and should therefore belong to the Early Byzantine period.

Six spoons, representing all three types, were analyzed (619, 622, 628, 631, 636, 637) and all but 637 contained a fair amount of zinc and very little tin and lead. The presence of zinc in most examples tested is suggestive of a fairly late date for the spoons as a group, though again, it is not in itself conclusive.

Type 1

619 Pl. 41. M68.6:7638. Roman-Byzantine?

Brass. Analyzed by emission spectrography, neutron activation and atomic absorption. See Chap. V, Tables V.1, 3, 4a, b. End of shaft broken.

Max. P.L. 7.10; diam. bowl 0.50; max. Th. shaft 0.20.
LNH 1 E61.20/N106.60 *97.50.

Plain, straight shaft terminating in small oval bowl set at angle to shaft.

See Davidson, *Corinth* XII, 181, 184, pl. 82 nos. 1319-1324 (Roman-Byzantine).

620 *Pl. 41.* M63.19:5281. Roman-Byzantine?

Copper alloy.

L. 10.10; Th. shaft 0.20; diam. bowl 0.50.

HoB W5.00/S115.00 *100.80-100.40.

Similar to **619**. Slender shaft tapering to plain end. Other end flattened and rounded to form small round bowl.

In addition see Perdrizet, *Delphes* V, 108, no. 545, fig. 371 (ca. 30 found); Deonna, *Délos* XVIII, 223-224, pl. 74 no. 602 (archaic through Byzantine); Milne, 77-78, pl. 18.5, 8 (ligulae); Anemurium, nos. 73-78, 71-74, Early Byzantine context (unpubl.).

621 *Pl. 41.*

Copper alloy. End of shaft broken.

Max. P.L. 9.00; diam. bowl 0.50.

HoB E40.00-48.00/S120.00-125.00 *101.40-101.00.

Similar to **620** but bowl is rounder and has beveled edges.

The following are similar to **620**:

622

Low zinc brass. Analyzed by emission spectrography.

See Chap. V, Tables V.1, 3.

L. 11.50; diam. bowl 0.50; Th. shaft 0.30.

HoB W10.00/S85.00 to *99.80.

623 M60.2:2229.

Copper alloy.

L. 12.00; diam. bowl 0.60.

HoB E15.00/S100.00 *101.30 found with **635**.

624

Copper alloy.

Max. P.L. 7.10; diam. bowl 0.70.

MTE E60.00-65.00/S150.00-155.00 to *109.80.

625

Copper alloy.

PN W272.10-277.00/S326.00-329.00 to *87.59.

Type 2

626 *Pl. 41.* M64.30:6341. Roman-Byzantine?

Copper alloy.

L. 12.00; diam. bowl 0.60.

Test pit E of ERd E149.00-152.50/S3.50-5.00 *97.50-97.00.

Straight shaft tapering to plain pointed end. Other end terminates in small rounded bowl with beveled edge. Just above bowl on shaft are two molded rings.

See Frere, *Verulamium* I, 124, fig. 35 no. 70 (3rd C. A.D.); G. Sergi, "La necropoli barbarica di Castel Trosino, part 2," *MonAnt* 12 (1902) 225, fig. 73 (silver, late 6th-early 7th C. A.D.); Russell, fig. 36 (Anemurium, Early Byzantine).

627 M60.38:2560.

Copper alloy.

L. 12.10; diam. bowl 0.50.

HoB E20.00/S100.00 *102.00-101.00.

Similar to **626** with molded ring and bead just above bowl.

628 *Pl. 41.* M61.46:3553.

Brass. Analyzed by emission spectrography, neutron activation and atomic absorption. See Chap. V, Tables V.1, 3, 4a, b.

Max. P.L. 5.10; diam. bowl 0.50.

HoB W20.00/S105.00 *102.50-101.00.

Similar to **626** with two moldings at base of shaft.

629, 630 *Pl. 41.* M61.64:3717.

Copper alloy.

629: Max. P.L. 10.50; diam. bowl 0.50.

630: Max. P.L. 9.00; diam. bowl 0.40.

HoB E5.00 and E10.00/S110.00 to *100.60.

Each has straight shaft with four molded beads just above small round bowl.

Type 3

631 *Pl. 41.* M67.10:7330.

Low zinc brass. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3. End of shaft broken.

Max. P.L. 12.00; diam. bowl 0.60.

PN W279.00-276.00/S325.00-327.00 *87.40-87.15 mixed context.

Straight shaft tapers to end. Small bowl set at angles to opposite end with back molded in shell pattern. At lower end of shaft, above bowl are moldings—a bead between three pairs of reels.

632 *Pl. 41.* M61.62:3715. Late Roman-Byzantine?

Copper alloy.

L. 13.20; diam. bowl 0.45.

HoB W20.00/S90.00 to *100.50 in mixed fill.

Similar to **631** but with three sets of bead-and-reel moldings at lower end of shaft.

See Davidson, *Corinth* XII, 181, 184, pl. 82, esp. no. 1322 (Roman); 1324 (Late Roman-Byzantine); Furtwängler, *Olympia* IV, 181, pl. 65 nos. 1109, 1112, 1113 (Late Roman). These were among some 125 similar objects found at Olympia and dated to the Late Roman-Byzantine eras.

633-638 are similar to **632**:

633 Pl. 41. M60.10:2272.

Copper alloy.

L. 10.10; diam. bowl 0.60; Th. shaft 0.20.

HoB E10.00/S105.00 ca. *101.40 mixed fill.

Three sets of bead-and-reel moldings.

634 Pl. 41. M62.82:4865. Late Roman?

Copper alloy.

L. 12.80; diam. bowl 0.60.

HoB dump.

Similar to **632** but with band of hatched incised lines between two sets of bead-and-reel moldings on lower end of shaft.

See Furtwängler, *Olympia* IV, 181, pl. 65 esp. no. 1113 for similar ornament. For similar design in bone see Davidson, *Corinth* XII, 185, pl. 83 no. 1347 (4th C. A.D.).

635 M60.2:2229.

Copper alloy.

L. 9.60; diam. bowl 0.40.

HoB E15.00/S100.00 *101.30 found with **623**.

Two sets of bead-and-reel moldings at lower end of shaft.

636

Low zinc brass. Analyzed by emission spectrography and neutron activation. See Chap. V, Tables V.1, 3, 4a. No dimensions available.

HoB E20.00/S90.00-95.00 to *100.00.

637 Early Byzantine.

"Pure" copper. Analyzed by neutron activation and atomic absorption. See Chap. V, Tables V.1, 4a, b. Fragmentary.

Max. P.L. 2.40; diam. bowl 0.60.

BS E8 or E9 E55.00-58.00/S0.00-4.00 *96.30.

638 Late Roman?

Copper alloy. End of shaft gone.

Max. P.L. 12.00; diam. bowl 0.70; max. Th. 0.30; max. W. shaft 0.50.

West Bldg. W108.00-110.00/N8.00-10.00 *97.60.

Straight tapered shaft with round section changing to flat and widening near bowl and incised at that point with two parallel horizontal lines. Small, semicircular bowl. Hole pierced through flat part of shaft with small ring through it.

For widened shaft see Furtwängler, *Olympia* IV, 181, pl. 65 no. 1109 (Late Roman).

Spatulas

Five spatulas were recovered (**639-643**). In general their contexts and probable dates are similar to those of the cosmetic spoons. **641** and **642** were analyzed spectrographically and both contain zinc, though the latter has proportionately more tin than the former. All but **639** have shafts ending in a small bulb-like terminal. **643** from BS, the only example that could be reasonably well dated, is somewhat more elaborate than the others and its blade is of a different form.

639 Pl. 41. M60.71:2794.

Copper alloy. Blade broken.

Max. P.L. 9.00; W. blade 0.50; max. P.L. blade 0.90; W. shaft 0.40-0.20.

HoB E15.00-20.00/S95.00-100.00 *101.00-100.00, mixed fill.

Shaft has round hollow section tapering to flat rectangular blade with horizontal shoulders.

640 Pl. 41. M62.41:4346. Late Roman-Early Byzantine.

Copper alloy.

L. 13.30; max. W. blade 1.00.

MRd E84.00/S12.00 just S of N Colonnade foundation *96.00.

Long shaft with ovoid section tapering to end and terminated in small ovoid bulb. Other end is flattened and widened to form a leaf-shaped blade with vertical crease in center. Such an implement could function as a cosmetic, pharmaceutical or surgical implement. It closely resembles the instrument that Milne called a "cyathiscomele," used for stirring, mixing and spreading salves.

See Milne, 61-63, pls. 14.3, 15.1; Emery, *Ballana and Qustul* I, 339 no. 718; II, pl. 85A (5th-6th C. A.D.); Perdrizet, *Delphes* V, 108 no. 546 inv. 1985, 2893, fig. 372 (Late Roman); Colt,

Nessana I, 53-54, pl. 23.7 (7th C. A.D. or later); Anemurium, no. 71-31 2139, Early Byzantine context, (unpubl.).

641 *Pl. 41.* M61.66:3719.

Low zinc brass. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3. Blade broken.

Max. P.L. 11.60; W. blade 1.00; Th. shaft 0.30; Th. bulb 0.35.

HoB E5.00-10.00/S110.00 to *101.00.

Similar to **640** but with molded rings on shaft just above transition to blade.

See Davidson, *Corinth* XII, 184, pl. 82 no. 1334 (probably Late Roman); Emery, *Ballana and Qustul* I, 339-340 nos. 717, 720-721, 724; II, pl. 85A-C (5th-6th C. A.D.).

642 *Pl. 41.* M70.5:8117.

Zinc bronze. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3. Bowl broken. Some corrosion. Max. P.L. 11.00; max. P.W. blade 0.70; Th. shaft 0.20. HoB W5.00-8.00/S112.00-116.00 on floor *97.00. Found with **660**.

Long straight shaft with round section. One end thickened to form ovoid bulb. The other end is flattened to form a spatula-shaped bowl with two raised rings above it on shaft.

643 *Pl. 41.* M62.9:4184. Early Byzantine.

Copper alloy. Lower end of blade broken.

Max. P.L. 14.50; W. blade 1.70; W. shaft 0.50-0.20; L. shaft 10.30.

BS E14 E84.00-85.00/S3.00-4.00 *96.40.

Shaft with square section tapers to round bulb at one end. The other end is flattened and widened to form a flat, rectangular blade with sharp edges. Blade is narrowed and thickened at transition to shaft. Moldings on shaft just above transition to blade.

See Emery, *Ballana and Qustul* I, 339; II, pl. 85A no. 719 (5th-6th C. A.D.); Crowfoot, et al., *Samaria-Sebaste* III, 437, fig. 101a (2nd-3rd C. A.D.); Russell, fig. 37 (Anemurium, Early Byzantine).

Cosmetic Tubes or Probe Cases

644 *Pl. 41.* Roman?

Copper alloy filled with soft black substance. Broken in two and corroded.

Max. P.L. 8.90; diam. 1.10.

PC-LVC at *1.00.

Slender, cylindrical tube with detachable cap at one end. Small knob in center of each end. Surface of tube

decorated with incised circumferential rings, possibly formed by lathe turning. While the object closely resembles the probe cases pictured in Milne, 169, pl. 53.1, 2, which were used to hold an assortment of surgical probes, the presence of the black substance inside this example shows that it could also have been used to contain cosmetics or medicine.

See also Boucher, 207 no. 758.

645

Copper alloy. About half-preserved. Completely corroded.

Max. P.L. 4.50; diam. ca. 1.50.

UT E90.00/S200.00 to *119.68.

Similar to **644**.

646

Copper alloy. Fragmentary.

Max. P.L. 4.00; diam. 1.00.

Syn P E117.50-120.00/N? *96.20-96.00.

Similar to **644**.

Tweezers

647 *Pl. 41.* Late Byzantine or later.

Iron. Heavily corroded.

L. 12.00; Th. ca. 2.50.

AcT local grid LL-oo/g-a near surface.

Two straight legs, sloping shoulders coming together in short shaft and ending in a knob.

For discussion of surgical and cosmetic uses of tweezers, see Milne, 90-93.

Mirrors and Mirror Parts

A few mirror disks (**648**, **649**, **651**, **653**), one mirror complete with handle (**650**), a detached handle (**652**) and a lead mirror frame (**655**) are all that were recovered in this category. Several examples came from graves or otherwise datable contexts, and most seem to be either Roman or Early Byzantine.

The complete mirror (**650**) and handle of the same type (**652**) were analyzed and both proved to be of leaded tin bronze.

648 *Pl. 42.* Late Roman-Early Byzantine.

Copper alloy. Fragmentary, corroded.

Max. W. 4.40.

BT/DU 66.1 Chamber II.

Parts of a disk.

Find publ. *BASOR* 186, 49-50. Found in association with a large number of secondary burials dated ca. A.D. 400-600. See 723-729, 800 and 833 for other objects from these burials.

649 Pl. 42. M58.107:1016. Byzantine?

Copper alloy. Corroded but some metal preserved.
Diam. 14.50; Th. 0.35.
BS near W8 *98.00.

Large flat disk with rivet through it near edge to hold handle (now missing). Rim slightly turned up.

650 Pl. 42. M59.50:1847. Roman, 1st-2nd C. A.D.

Both handle and disk of leaded tin bronze. Analyzed by emission spectrography and neutron activation. See Chap. V, Tables V.1, 3, 4a.
Diam. disk 16.00; max. P.L. handle 12.20.
HoB Grave 'h' E20.00/S60.00 *98.68.

Disk slightly concave with circular perforations around edge. Incised concentric circles on concave side. Surface may have been silvered or tinned as it has weathered differently from the handle. Handle cast separately. Shaft tapers towards lower end (missing) and is decorated with three molded rings. Upper end of shaft forms three-pronged attachment to disk.

For handle see Frere, *Verulamium I*, 144, fig. 50 no. 162. For a complete specimen with silvered surface see *AA* (1980) 140 no. 4 and 142 fig. 4 from Carmona, Spain (now stolen from Carmona Museum).

651 Pl. 42. M60.6:2359. Roman?

Copper alloy. Fragmentary; almost completely mineralized.
Diam. 8.50; Th. 0.25.
PC Zone A at 4 *91.25.

Remains of a flat disk with small round perforations around edge.

652 Pl. 42. NoEx 68.14. Roman?

Leaded tin bronze. Analyzed by emission spectrography and neutron activation. See Chap. V, Tables V.1, 3, 4a. Only handle preserved.
L. 10.50; W. at prongs 5.20; L. vertical prong 2.00; max. W. shaft 0.80.

Similar to handle of **650**.

653 Pl. 42. NoEx 69.42.

Copper alloy.
Diam. 14.40; L. rivet 1.70; Th. rim 0.40.

Grave I Uç Tepeler between Kendirlik and Karayaşlı.

Round disk with raised rim. Handle probably attached to a tab projecting from one side (now broken) where rivet is preserved. One side has blue azurite patina; the other side has green (malachite?). An expedition conservator has suggested that the difference in patination may come from rubbing one side with oils to shine it.

654 Pl. 42. M72.12:8214b. MANISA 183. Early Byzantine.

Copper alloy.
Diam. 2.60; Th. 0.95.
BSH W18.25/N22.30 no level available.

Small disk with raised rim on both sides. On one side glass is mounted with plaster paste. On the other side is an angel (?) in low relief.

*Mirror Frame***655 Pl. 42. M62.55:4474. Roman, 2nd-3rd C. A.D.?**

Lead. Handle broken.
Ext. diam. ring 4.05; W. ring 0.50.
HoB W25.00/S100.00-105.00 to *101.30 mixed fill.

Thin, flat ring with stump of handle projecting from edge at one side. Opposite, the metal is drawn into two thin projections bent around to form a loop with overlapping ends. On back of ring are two flat prongs for attachment to glass (?). The front surface is decorated with zigzags in relief.

This object belongs to a class of small (votive?) mirror frames found in sanctuaries and tombs throughout the Roman Empire but chiefly in northern and eastern Europe. Most seem to date to the second and third centuries A.D. though some have been found in Early Byzantine contexts. According to Tudor, however, the latter are identical to those of uncontestedly earlier date and are unlikely to date much later than the third century.

See D. Tudor, "Le dépôt de miroirs de verre doublé de plomb trouvé à Sucidava," *Dacia* N.S. 3 (1959) 415-432; E. Nowotny, "Gläserne Konvexspiegel," *ÖJhBeibl* 13 (1910) cols. 107-128 esp. fig. 43, col. 117, figs. 44-46 (Aquilaia); Anemurium, no. 72-115 2359 Early Byzantine context (unpubl.).

JEWELRY AND ORNAMENTS

A large quantity of jewelry of various kinds has been found at Sardis. Major classifications include dress fastenings (pins, fibulae, brooches and buckles), ear ornaments (earplugs and earrings), bracelets, finger

rings, pendants, medallions and small decorative attachments such as buttons, bosses and chains.

These finds cover all major periods in the history of Sardis from the Early Bronze Age to Late Byzantine and Turkish.

While very little was found to match the splendor of the Lydian and Persian jewelry of the Princeton Expedition,⁵⁷ a number of finds and groups of finds have some intrinsic interest. The Early Bronze Age objects—straight pins (656-658), earplugs (717, 718), ram pendant (881)—are of interest for their early date. The earplugs are also important for their associations elsewhere in Western Anatolia as well as for their use of gold which may already have been derived from local sources.

Early Iron Age and Lydian material is somewhat disappointing. Chief in interest are probably the fibulae (670-680). Most of these archaic examples are of types believed to have been manufactured elsewhere, and tell more about Lydian contacts with Phrygia and the west coast than about native production. Also from the Lydian era come a couple of straight pins (659, 660), an electrum earring in the form of a reclining lamb (719), a few other earrings of copper alloy (720-722, possibly also 723-726), a gold granulated bead (760) and a silver pendant in the form of a hawk (882), as well as plain gold pendants of wire (883) and sheet metal (884, 885).

Hellenistic and Roman Imperial finds are sporadic, the datable examples comprising chiefly the gold "traffic light" earring of Hellenistic Greek type (731), three Roman fibulae (681-683) and a few minor objects from Roman graves.

The largest group of datable ornaments is Early Byzantine. Here, as with many other classes of material, objects from the Byzantine Shops and HoB proper can be dated by context and related to similar finds from the Acropolis and elsewhere. Of importance are the well-known types of copper alloy buckles (689-712) and inlaid brooches (684-688) now believed to have been made in Constantinople and widely disseminated throughout Europe and the Near East. Other objects include the usual assortment of rings, bracelets, earrings and pendants which continue to be found in Middle and Late Byzantine contexts—chiefly graves.

Of special interest for these later eras are a few objects decorated with obviously Christian motifs—rings with engraved or cross-shaped bezels (833, 834, 841, 842), medallions (898, 899) and reliquary crosses (901, 902).

Straight Pins

Straight pins are not numerous at Sardis but they represent the earliest type of dress fastening in use there.

657 and 658 were found in Early Bronze Age graves at AhT, while 656 was out of context but probably also dates in the late third millennium B.C. The three pins appear to be of different types, although the head of 657 is missing or never existed. 656 and 657 were analyzed and proved to be of arsenical copper, with arsenic content of ca. 1 percent—fairly typical for the period (see Chap. V, Table V.3).

Two roll-headed pins, one (659) certainly of Early Lydian date, the other (660) possibly so, were also found. The first comes from a deep level at HoB and may date as early as the tenth to ninth century B.C., although certain indications point to a date as late as the eighth century B.C. for some material in this level.⁵⁸ 660 comes from a late eighth century B.C. Lydian floor in HoB, although it was found with 642, a spatula containing a significant quantity of zinc indicating that it may date considerably later. Two others, 661 and 662, come from even less secure contexts in HoB and PN and could date as late as the Late Roman era.

A variant of the roll-headed pin is the croisier pin—so-called because the end of the roll turns back slightly making the pin resemble a tiny shepherd's crook or croisier. The three Sardis examples (663-665) come from contexts in MRd and Syn which suggest a rather late date (Late Roman-Early Byzantine), although none was found in a sealed deposit and any or all may be intrusive from earlier periods.

The other four pins (666-669) are all different with respect to the heads—669 is missing a head or never had it. Some (667, 668), by analogy with modern objects of similar form, may not be dress pins at all, but rather may have functioned as engraving tools.⁵⁹ On the other hand, some of the ancient parallels to these objects are in bone rather than metal and thus would seem not to have functioned in such a way.

666 and 667 cannot be dated stratigraphically, although parallels for 667 seem to place it in the Roman-Byzantine era. 668 and 669 come from HoB proper and BS respectively and hence may be dated with some security in the late sixth to early seventh century A.D.

58. See e.g. fibula 670.

59. See Untracht, 111-113. One would need to know the hardness of the "tool" in question in order to make a convincing case for this.

656 Pl. 42. M67.23:7455. Early Bronze Age.

Arsenical copper. Analyzed by emission spectrography, neutron activation and atomic absorption. See Chap. V, Tables V.1, 3, 4a, b.

Max. P.L. 6.40; diam. head 0.80; Th. shaft 0.35.

AhT E13.50/S61.70 *77.40-77.35 not in closed context.

Shaft with round section tapers to point. Head is plain, round, and convex.

See Milojević, *Samos I*, 53 no. 11, pls. 23.4, 50.3 (late 3rd millennium B.C.); Boehmer, *Boğazköy VII*, 86, pl. 17 no. 285 (late 3rd-early 2nd millennium B.C.); H. H. von der Osten, *The Alishar Hüyük Seasons of 1930-32* part I OIP XXVIII, *Researches in Anatolia VII* (Chicago 1937) 198, fig. 195 ("copper age").

657 Pl. 42. M67.21:7425. Early Bronze Age.

Arsenical copper. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3. Head missing or never existed.

Max. P.L. 8.50; Th. upper end 0.30; Th. point 0.20.

AhT Grave E E2.60/N0.10 *74.17.

Tapering shaft with round section.

Find publ. *BASOR* 191, 9.

658 Pl. 42. Early Bronze Age.

Copper alloy. Corroded.

Dimensions unavailable.

AhT pithos burial E46.28/S44.75 *75.07.

Straight shaft with pointed end. Other end slightly convex or domed, perhaps forming a small head.

Roll-Headed Pins

659 Pl. 42. M66.11:7111. Early Iron Age, ca. 10th-8th C. B.C.

Copper alloy. Diseased and broken. Head incomplete:

Max. P.L. 9.80; Th. 0.50-0.30.

HoB Deep Pit W5.00-6.00/S100.00-102.00 *95.35-95.00.

Shaft tapers to point at one end. Other end is bent over to form start of a rolled head (now broken).

The type has a long history beginning in the Early Bronze Age and continuing through Hellenistic times in the Aegean, Eastern Mediterranean and even spreading farther west to Italy.

See e.g. Milojević, *Samos I*, 53 no. 13, pl. 50.6 (Early Bronze Age); Catling, 238, fig. 22.23, 24 (Late Bronze to Early Iron

Age Cyprus); Boehmer, *Boğazköy VII*, 90-91, pl. 20 nos. 435-438 (ca. 15th-14th C. B.C.); Jacobsthal, 122-123, figs. 350 (Thera), 351 (Villanova, ca. 700 B.C.); V. R. d'A. Desborough, *Protogeometric Pottery* (Oxford 1952) 152, 309 (Halos, Thesaly, Late Protogeometric); Boardman, *Chios*, 223-224, nos. 377-380, fig. 145 (8th C. to ca. 630 B.C.); Robinson, *Olynthus X*, 363-364, pl. 115 nos. 1755-1762 (before 348 B.C.); Chavane, *Salamine VI*, 173-174 (discussion and refs.), no. 496 pl. 48 (Hellenistic).

660 Pl. 42. M70.4:8116. Archaic Lydian, late 8th C. B.C. or later?

Arsenical copper. Analyzed by emission spectrography, neutron activation and atomic absorption. See Chap. V, Tables V.1, 3, 4a, b.

L. 8.20; Th. 0.20; diam. roll 0.50.

HoB W5.00-8.00/S112.00-116.00 *97.00 floor, found with **642**, a zinc bronze spatula, probably of Late Roman date.

Tapered shaft with round section. Upper end flattened and tightly rolled.

The level *97.00 floor is now dated by A. Ramage in the late 8th C. B.C. (unpubl. report to the NEH, Chap. V.A) but the association with the zinc bronze spatula throws some doubt on the early date. The roll-top pin is a type with a long history (see **659**) so style alone is an inconclusive criterion for date.

661 Pl. 42.

Copper alloy.

L. 7.10; diam. head 0.65.

HoB E49.00-62.00/S101.00-109.00 *100.20-99.30.

Tapered shaft flattened at one end and bent in a single roll to form head.

662 Pl. 42.

Copper alloy.

L. 7.40; diam. head 0.70.

PN W265.00-267.00/S324.00-329.00 NE edge *88.70-88.00.

Similar to **661**.

Croisier Pins

663 Pl. 42. M62.1:4178. Archaic?

Copper alloy.

L. 7.70; L. eye 0.90; W. eye 0.70; Th. shaft 0.30-0.10.

MRd E8.00/S11.00 *98.00 above colonnade foundation.

Shaft with round section tapers to point at one end. The other end is flattened and bent under to form a tear-shaped eye, then is bent up slightly at very end to form a slight hook.

See Chavane, *Salamine* VI, 174, pls. 48, 70, no. 497 (archaic); Blinkenberg, *Lindos* I, 126, pl. 12 no. 310 (archaic); Jacobsthal, 123, figs. 349 (Lindos), 352 (Bologna).

664 and **665** are similar to **663**:

664 Pl. 42.

Copper alloy.
Max. P.L. 6.40; diam. eye 0.65.
BE-B E28.65/N6.60 *96.50.

665 Pl. 42.

Copper alloy.
L. 7.60; diam. eye 0.70.
BE-A E9.78/N6.60 *96.86.

666 Pl. 42. M64.28:6314. Late Hellenistic-Late Roman.

Copper alloy. Shaft broken and corroded.
Max. P.L. 4.70; diam. head 1.00; Th. shaft 0.10.
MTE E50.00-55.00/S130.00-135.00 *100.90-100.50.

Thin, tapered shaft broken just under head. Head is made separately and attached to upper end of shaft by soldering. It is shaped like a flattened rosette with scalloped edges on upper surface.

667 Pl. 42. Roman-Byzantine.

Copper alloy.
L. 10.10; diam. head 0.50; diam. point 0.10.
BE-C E20.82/N16.82 *97.31.

Tapered shaft with round section. Upper end molded and incised, terminating in a pinecone finial.

For similar heads see Crowfoot, et al., *Samaria-Sebaste* III, 429 fig. 100.17, 18, 23; 430 (two bone, one bronze pin from Tomb E 220, 2nd-3rd C. A.D.); D. C. Baramki, "A Note on the Cemetery at Karm al-Shaikh, Jerusalem," *QDAP* 1 (1932) pl. IX.4 (bone, Grave 44, Roman-Byzantine).

668 Pl. 42. M58.106:1052. Early Byzantine.

Copper alloy.
Max. P.L. 11.50; diam. head 0.40.
HoB Room 5 2 m. from top of W wall.

Tapered shaft, bent near point. Ovoid head set off from shaft by short, straight shoulder. Similar to **667** in size, it could also be similar in function.

See Davidson, *Corinth* XII, 282, pl. 116 no. 2280 (10th C. A.D.).

669 Pl. 42. M63.58:5875. Early Byzantine.

Copper alloy. Head missing or never present.
Max. P.L. 13.00; max. Th. 0.40; Th. point 0.20.
BS E18 E103.00-108.00/S0.00-2.50 *96.40.

From the shape this object could either be the shaft of a pin or the handle of another object like a spoon. The shaft tapers at both ends and is thickest above the midpoint. An incised pattern at the thickest point might be intended to make the shaft easier to grasp.

See Davidson, *Corinth* XII, 280, 286, pl. 120 nos. 2357-2373 (bone, 10th-12th C. A.D.); nos. 2374-2375 (bone, Late Roman-Byzantine). According to Davidson (p. 280) types with only incision or slight thickening at the upper end are typical of the Byzantine period.

Fibulae

Some eleven fibulae or parts of fibulae of Lydian or earlier date were found at Sardis. Although so few have been found they are among the most interesting classes of objects in terms of their stylistic and foreign relations.

The oldest fibula is **670** from a deep layer in the Lydian Trench at HoB. It can probably be dated to the eighth or early seventh century B.C. on the basis of style, and its closest parallels seem to appear primarily in the Aegean Islands, making it very likely that this is an import from the West.⁶⁰

671-675 are archaic types originating in Asia Minor. These types are discussed extensively by C. Blinkenberg (Type XII) and more recently by O. W. Muscarella and R. M. Boehmer in regard to the finds at Gordion and Boğazköy respectively.⁶¹ All but **671** from Trench S at the AT Precinct come from Lydian contexts at HoB (**673-675**) and PN (**672**). According to Muscarella, **671** of Blinkenberg's Type XII.7 is probably a direct import from Phrygia dating to the eighth or early seventh centuries B.C.,⁶² while **672** and **673** belong to Blinkenberg's Type XII.13 and have parallels dating from the eighth to sixth centuries B.C. (Contexts at Sardis are a seventh century level at HoB for **673** and a sixth century level at PN for **672**.) **674** and **675** belong to Blinkenberg's Type XII.14. **674** comes from a late seventh to early sixth century B.C. level at HoB and **675** comes from somewhat

60. Blinkenberg, *Fibules*, Types IV.11, 12.

61. Blinkenberg, *Fibules*, 87-88, 99-102, 204-230; Muscarella, *Phrygian Fibulae*, passim; Boehmer, *Boğazköy* VII, 46-68, distribution map, fig. 30.

62. Muscarella, *Phrygian Fibulae*, 38, pl. VI.84-89.

higher up in the same general area—perhaps dating to the late sixth to early fifth century B.C. Muscarella suggests that most of both Blinkenberg's Types XII.13 and 14 (as well as others of Type XII) are types that originated in Phrygia and were later copied elsewhere.⁶³ Molds for Type XII.13 found at Bayraklı (Old Smyrna) are primary evidence for manufacture of this type in Ionia, and it is interesting to note that while the shapes of the moldings of the Bayraklı examples closely resemble those of Sardis 672 and 673, they are not directly paralleled by any of the Type XII.13 pieces from Gordion or other Phrygian sites.⁶⁴ This raises the possibility that these two Sardis examples were either made locally or imported from Ionia rather than from Phrygia. 664 and 675 of Type XII.14, however, are closer in type to Phrygian examples, although Muscarella remains equivocal as to whether they are of Phrygian, Lydian or East Greek manufacture.⁶⁵ Boehmer, on the other hand, would like to see 674 as Phrygian and 675 as Lydian, though his reasoning seems untenable (see 675).

Even more difficult to assess stylistically are 676-680. All are fragmentary and heavily corroded and most came from poorly stratified contexts. As far as can be told, all had plain arcs without moldings, and some were thickened towards the center or end. 676 came from the best context—a seventh century B.C. level at HoB—while 677, from somewhat higher up, may be sixth century B.C. The rest came from upper mixed fill and cannot be readily dated.

Unfortunately, the number of archaic fibulae found at Sardis remains small and no large caches have been found in the excavated Lydian tombs to rival the finds at Gordion, so the question of an indigenous Lydian type or types must remain unanswered at present. Nor are the results of analyses helpful in this regard. According to several reports, a number of undoubtedly Phrygian fibulae from Gordion have shown a rather high zinc content (ca. 10 percent) and little tin or lead.⁶⁶ Of the Sardis pieces only 672 and 674 were analyzed; the former as tin bronze, the latter as leaded tin bronze. Neither contained significant quantities of zinc (see Chap. V).

Only three fibulae of Roman date were found at Sardis. Of these 681 and 682 are of the aucissa type and

683 is a crossbow type. Both the aucissa examples come from mixed fill in HoB and are not useful for dating purposes. The crossbow fibula came from a third century A.D. tomb on the Acropolis, a context which fits well with the accepted chronology for this type of fibula.

670 Pl. 43. M66.13:7150. 9th/8th C. B.C. or later.

Copper alloy. Part of catchplate and pin missing. H. 3.50; W. 4.60; H. beads 1.00-1.50; Th. 0.30-1.00. HoB W2.50/S103.00 *95.00.

High arc with three biconical beads at peak. One end of arc flattened and widened to form catchplate (once larger); other end bent into spring of which two coils are preserved.

The late G. F. Swift, Jr. who excavated the piece, reported that the level in which it was found contained "very late Mycenaean sherds and Protogeometric sherds" while the level directly above it could be dated to the ninth/eighth century B.C. Stylistic considerations, however, would argue for a later date for the fibula (and hence for the level in which it was found) unless the piece was intrusive.

The fibula is close to Blinkenberg's Types IV.11 and 12, apparently an "Island Type" with parallels at Praisos and Vrokastro in Crete; Lindos, Rhodes; Emporio, Chios; Paros; Thera; Aegina and Delos, as well as Olympia and Tegea on the Greek mainland, and Ephesus on the Ionian coast. More recently a few other examples from Ionia, said to have been found near Izmir, have been published by N. Firatlı. Most of these examples have five or more beads on the arc, either rounded as in Type IV.11 or lenticular as in Type IV.12, while the Sardis example differs in having only three beads. Where reliable chronology is available the fibulae cited seem to range from Geometric to early archaic in date (eighth to seventh century B.C. or later).

Publ. *BASOR* 186, 36, 29 fig. 14; Muscarella, "Phrygian or Lydian," 57 n. 20. See Blinkenberg, *Fibules*, 99-102, Type IV.11, 12; idem. *Lindos* I, 81, pl. 6 nos. 68 (15 examples), 69; Boardman, *Chios*, 207 fig. 137, 210 Type F, nos. 194-205, pl. 86 (8th C. to ca. 600 B.C.); Hogarth, *Ephesus*, 147, Type 5.I, pl. XVII.14; N. Firatlı, News from the Museum, *Annual of the Archaeological Museums of Istanbul* (Istanbul Arkeoloji Müzeleri Villiği) (Istanbul 1958) 75-76, figs. 13.3, 4; Bielefeld, C 51, fig. 6.g ("Island type," Geometric); J. Sundwall, *Die älteren italischen Fibeln* (Berlin 1943) 103, figs. 115-116. I owe a number of these references to Oscar White Muscarella.

671 Pl. 43. M58.3:115. 8th/7th C. B.C.?

Copper alloy. Only part of arc and catchplate preserved. Max. P.L. 3.90; W. 1.10; Th. arc 0.30.

63. Muscarella, *Phrygian Fibulae*, 37-38. Boardman, *Chios*, 206, suggests that most of the archaic fibulae found at Emporio were manufactured locally, though many reflect strong Phrygian influence.

64. Muscarella, *Phrygian Fibulae*, 40.

65. Muscarella, *Phrygian Fibulae*, 44 and idem, "Phrygian or Lydian," 58.

66. See Steinberg. I am grateful to Arthur Steinberg for sending this information.

Trench S at AT Precinct H/11 Level I in mixed surface fill.

Arc has square section and preserved part is plain. Preserved end has three large, square plates alternated with two thin ones between the end of the arc and the catch. The catch is hook-shaped with molded vertical lines in relief along the center. Two horizontal spurs or horns, one broken off, project from the top of the catchplate.

Although the context in Trench S does not provide a secure chronological framework, the piece can be dated stylistically to the eighth/seventh century B.C. As with 672-675 the greatest numbers of parallels come from Gordion (80), but others are also known from Boğazköy, Midas City and Ankara in Anatolia; Lindos and Samos in the Islands; and at Olympia on the Greek mainland. According to Muscarella, few if any of those that can be dated are attributable to contexts later than the early seventh century B.C. and most belong to the eighth century. Given the limited chronological and geographical distribution of this type of fibula, the frequency of the type at Gordion and other Phrygian sites, and its relative scarcity elsewhere, it seems likely that the piece found at Sardis is a direct import from Phrygia, best dated in the eighth or early seventh C. B.C.

For Trench S see *Sardis* R1 (1975) 104-107. For type see Blinkenberg, *Fibules*, 213-214, Type X.11.7; Muscarella, *Phrygian Fibulae*, 16-17, 30 nos. 11-14, pls. III. 15-17, IV. 18-22; idem, "Phrygian or Lydian," 54, pl. III fig. 7 (Gordion, late 8th C. B.C.); Boehmer, *Boğazköy* VII, 51-54, pl. 5 nos. 79-82 (8th/7th C. B.C.), and pls. 5 no. 83, 6 nos. 84-89 (unstratified); Blinkenberg, *Lindos* I, 87, pl. 8 no. 118.

672 Pl. 43. M68.11:7731. 6th C. B.C.

Tin bronze. Analyzed by emission spectrography, neutron activation and atomic absorption. See Chap. V, Tables V.1, 3, 4a, b. Pin and catchplate missing.

Max. span of arc 5.10; max. H. 3.70; Th. arc 0.50; Th. bosses 0.80.

PN W280.00/S322.00 *85.20 Lydian context.

Semicircular arc with three cylindrical bosses—one in top center, one at each end. Bosses are incised with parallel circumferential lines.

As with 671, closest parallels are from the mainland of Anatolia, in particular Gordion (149 examples) dating from eighth to sixth centuries B.C. Two examples in bronze were found at the archaic Artemision at Ephesus and others in gold and silver were also recovered there. Others from Asia Minor were found in eighth/seventh century B.C. contexts near Ankara, at Boğazköy and at Bayraklı (Old Smyrna), and at Larisa on Hermus in a fifth century B.C. or later context, as well as at Midas City in a less well-dated context. A number of examples

are also known from the Aegean Islands (Chios, Samos, Lesbos, Lindos, Thera, Aegina, Paros, Delos), the Greek mainland (Argive Heraeum, Prosymna, Sparta, Olympia, Perachora) and the western Islands (Ithaca and Pithecousae on Ischia). Most of the examples from Gordion and Boğazköy have moldings consisting of a round or biconical bead between two or more reels at each point while examples from Lindos, Thera, Sparta, Argive Heraeum, Perachora and Pithecousae are closer in form to the Sardis examples.

Several seventh century B.C. fibula molds with impressions for moldings or bosses similar to those of the Sardis examples were found at Bayraklı, while over fifty fibulae with similar moldings were found in seventh century B.C. levels at Emporio, Chios.

Type: Blinkenberg, *Fibules*, 219-222, Type XII.13; Hogarth, *Ephesus*, 148, Type 5.IV, pl. XVII.10, 11 (bronze); 98, pl. V.4 (gold); 117, pl. XI.22 (silver); Muscarella, *Phrygian Fibulae*, 21-23, 32, pls. IX-XI.47-60, XVI.83, 84 (8th-6th C. B.C.); Boehmer, *Boğazköy* VII, 59-61, pl. 7 nos. 110-119; Boardman, *Chios*, 209 fig. 138, 210 Type H, nos. 212-221; Blinkenberg, *Lindos* I, 88, pl. 8 no. 111.

673 Pl. 43. 7th C. B.C.

Copper alloy. Heavily corroded and swollen. Pin broken off but partly preserved.

Span of arc 3.00; H. 1.80; diam. boss 0.60.

HoB W4.00-9.00/S109.00-112.00 *98.70-98.55.

Similar to 672. Catchplate small, narrow and hook-shaped with horns or spurs (worn by corrosion). Corrosion on bosses obscures possible incised decoration.

674 Pl. 43. M65.2:6669. Late 7th-early 6th C. B.C.

Leaded tin bronze. Analyzed by emission spectrography, neutron activation and atomic absorption. See Chap. V, Tables V.1, 3, 4a, b. Pin, spring and most of catchplate missing.

Max. H. 2.30; span 3.20; Th. arc 0.30; Th. moldings 0.55.

HoB inside Building D W15.00-20.00/S102.00-106.00 floor to *98.80 Lydian context.

Semicircular arc with round section. Five sets of three molded rings on arc—one at center, one at either end, one on each side between end and center. Catchplate apparently horned.

This and 675 belong to Blinkenberg's Type XII.14 which Blinkenberg considers a development of XII.13 (672, 673). As with 671-673 the closest parallels are Anatolian, and specifically Phrygian. Muscarella publishes numerous examples and variants from Gordion and cites many parallels elsewhere, including the two Sardis pieces, assigning a type range from eighth through sixth centuries B.C. and possibly later. Examples from elsewhere

in Anatolia include Tell Orta Hüyük, Eskişehir, "near Ankara," Boğazköy, Midas City, Kerkeneş, Dagh, Alishar, Cerkeş, Pazırlı and Karlar in the highlands, and Troy and Ephesus near the coast. The islands of Rhodes (Lindos), Chios, Samos and Siphnos, and mainland Greek sites of Olympia, Argive Heraeum, Tegea, Perachora and Sparta as well as Al Mina in Syria, have also yielded fibulae of this type. Muscarella considers this possibly a Phrygian type made in Lydia.

Publ. *BASOR* 182, 13 fig. 8; Muscarella, "Phrygian or Lydian," 57-58; idem, *Phrygian Fibulae*, 25, 33 n. 45, 44, pl. XIV.75, pls. XII-XV (parallels); see also Blinkenberg, *Fibules*, 222-226, Type XII.14; Hogarth, *Ephesus*, 98, pl. V.3 (gold); 171, pl. XI.7 (silver); Boehmer, *Boğazköy* VII, 62-64, pls. 7 nos. 122-124 (10th/9th C. B.C.), 7 nos. 125-132, 8 nos. 133-137 (8th/7th C. B.C.), 8 nos. 138-150 (unstratified); Bielefeld, 51, abb. 6.m (Ionian, Late Geometric).

675 Pl. 43. M65.5:6715. Late 7th-6th C. B.C.

Copper alloy. Heavily corroded and swollen.
Span arc 3.00; Th. 0.50.
HoB W3.00/S100.00 *99.30.

Semicircular arc, flat on one side, convex on other. Arc decorated with five sets of rings, similar to 674 but less clearly defined because of corrosion. Single coil spring; narrow, upturned catchplate apparently without horns.

Boehmer believes 674 to be of Phrygian manufacture while 675 seems closer to three gold examples from Ephesus (classified Type XII.1 by Muscarella and suggested by him to be Lydian on the basis of material). Boehmer's distinctive criteria are the moldings—those with beads that stand out from the arc, like 674, appear to him more typically Phrygian, while those with almost the same diameter as the arc he proposes as Lydian, citing 675 as an example. He also notes a possible distinction in the treatment of the catchplate of 675 which seems in his photo to have less pronounced spurs or horns than more typical Phrygian examples. Two Phrygian fibulae from Boğazköy appear to have comparable treatment of arc and catchplate, and Boehmer suggests on the basis of this resemblance that they are Lydian imports (*Boğazköy* VII, 66, fig. 29b, e). It should be noted, however, that the heavy corrosion and swelling of the bow and catchplate of Sardis 675 (and apparently also of Boğazköy no. 159, fig. 29e) prevents an accurate understanding of the details of its shape and decoration. Muscarella (*Phrygian Fibulae*, 23) also warns that "an analysis of the catches with a view to chronology is not too rewarding for at all periods there are catches with small or incipient horns in the same chronological context with fibulae that have long horns." Furthermore, the Lydian attribution of the gold fibulae from Ephesus on which the whole theory of Lydian type is

predicated, and which Boehmer appears to accept as given, is a highly tentative conjecture on Muscarella's part (*Phrygian Fibulae*, 44; "Phrygian or Lydian," 58) and their similarity to Sardis 675 is not, in any case, very great.

Publ. *BASOR* 182, 13; Muscarella, "Phrygian or Lydian," 57-58; idem, *Phrygian Fibulae*, 25, 33 n. 45, 44, pl. XIV.76; Boehmer, *Boğazköy* VII, 66-67, fig. 29a.

676 Pl. 43. M61.102:4104. 7th C. B.C.

Copper alloy. Corroded. Only part of arc preserved.
Max. P.L. 3.90; Th. at center 0.45; Th. end 0.60.
HoB E5.00/S95.00 *98.00-97.65.

Part of plain, curved arc with round section, thickened near center (?) and at one end. Possibly asymmetrical.

The type has a long history. Parallels stretch back to the Submycenaean and Protogeometric eras (eleventh to tenth century B.C.) and down to classical Greek times. Geometric and archaic examples, in somewhat better condition, are known from Ephesus, Lindos, the Artemis Orthia precinct at Sparta and Perachora.

See Blinkenberg, *Fibules*, 60-62, 65, 73-74, Type II.1, 2, 6, 17; Bielefeld, C 51, abb. 6.b (Bronze through Iron Age), 6.e (Protogeometric); Hogarth, *Ephesus*, 147, Type 4, pl. XVII.17, 19, 20; Blinkenberg, *Lindos* I, 84, pl. 7 no. 93 (97 examples); H. Payne, et al., *Perachora. The Sanctuaries of Hera Akraia and Limenia Excavations of the British School of Archaeology at Athens 1930-1933. Architecture Bronzes Terracottas* (Oxford 1940) 73, pl. 17.11; 169, pl. 72.1, 2 (Geometric); R. M. Dawkins, *The Sanctuary of Artemis Orthia at Sparta* [Society for the Promotion of Hellenic Studies Supplementary Paper no. 5 (London 1929)] 198, pl. 82.o.

677 Early 6th C. B.C.

Copper alloy. Corroded and fragmentary.
No dimensions.
HoB W14.00/S103.00 *99.20.

Pieces of plain arc similar to 676.

678 Lydian?

Copper alloy. Fragmentary.
HoB W30.00/S75.00 and 80.00 *101.50-101.00 mixed context.

Part of plain arc perhaps similar to 676.

679 Lydian?

Copper alloy. Fragmentary.
HoB W20.00-25.00/S80.00-85.00 *100.00.

Part of plain arc, thickened at one end; perhaps remains of a catch.

680 Lydian?

Copper alloy. Fragmentary.

HoB W14.00-16.00/S110.00-112.00 *100.20-99.90.

Parts of plain arc with one coil of spring and part of catch preserved.

681 Pl. 43. M65.7:6778. Roman, ca. 1st-2nd C. A.D.

Copper alloy. Diseased; part of pin missing.

Max. L. 4.10; H. arc 2.20; W. arc 0.40-0.70; hinge 0.90-1.10.

HoB W37.00/S118.00 *100.30 in lower part of fill.

High flat arc with raised mid-ridge along top surface. Arc slopes down to catch which terminates in a profiled knob. Hinged pin. Incised designs on arc and hinge.

The fibula belongs to the *aucissa* type which probably originated in Gaul and eventually spread through Europe and South Russia, having a chronological range of first to second century A.D.See Frisch-Toll, *Dura* IV.4.1, 47-48, pl. 10, nos. 6-11; F. Haverfield, "The *Aucissa* Fibula," *ArchJ* 60 (1903) 236-246; Davidson, *Corinth* XII, 265-266, 270, pl. 113, nos. 2167-2168 (1st C. A.D.).**682** Pl. 43. M70.2:8078. 1st-2nd C. A.D.

Copper alloy. Diseased; pin missing.

Max. L. 5.70; max. W. at hinge 1.40; max. H. 2.00. HoB E49.00-62.00/S101.00-109.00 to *100.00 Roman street.

Similar to **681**. Incised circles on exterior of arc at hinge end. Raised mid-ridge along center of arc decorated with incised lines and small dots; raised lines along edges of arc.**683** Pl. 43. M61.6:3166. Roman, ca. A.D. 200-250.

Copper alloy. Analyzed by emission spectrography, neutron activation and atomic absorption. See Chap. V, Tables V.1, 3, 4a, b. Pin missing.

Max. L. 4.65; W. arc 0.80; W. bar 0.90.

AcT Grave 61.10.

Crossbow type with short cross bar, high, semicircular pin guard with flat end, and rounded clasp. Tiny ivy leaves are molded in relief on both sides of the bar—every two on each side connected by a half circle. The arc appears flat and semicircular when seen from the side; from the top it seems to bulge slightly to each side; top flattened. Holes in underside of both ends of arc. Possible traces of gilding.

The type, with numerous subtypes, is common in places occupied by the Roman army and is especially popular

in the provinces in the third century A.D., a date comparing well with the context in which it was found.

See Frisch-Toll, *Dura* IV.4.1, 51-61, pls. XI-XV, nos. 31-119; Davidson, *Corinth* XII, 266, 270, pl. 113, no. 2171 (4th C. A.D.); I. Peškař, *Fibeln aus der römischen Kaiserzeit in Mähren* (Prague 1972) 135-139, pls. 47-54, esp. 50.1-3 (with molded leaves on bar).*Brooches*Brooches are distinguished from fibulae in having the pin or fastening attached directly to the flat back and at right angles to it, while the fibula with either spring or hinged pin parallel to the arc more closely resembles a safety pin.⁶⁷The earliest (and only) brooches that can be recognized at Sardis postdate the latest fibulae. Four arc circular brooches of copper alloy with compartmentalized fronts, all originally intended to be inlaid in cloisonné technique. A fifth (**688**) is of a different type, but similar date. Three examples, **684-686**, have some or most of their original glass inlay preserved and one, **685**, shows traces of gilding. The two best preserved examples, **684** and **685**, come from the Byzantine Shops, and a third, **687**, is from the contemporary HoB and hence can be dated securely in the Early Byzantine era, most likely late sixth to early seventh century A.D.This type of cloisonné work is well known throughout Europe and the Near East in this era.⁶⁸ It is found in a variety of object types including not only brooches but also buckles (of which Sardis **699** is an example), fibulae, sword mountings, saddle mountings, etc. Matrixes are usually of copper alloy, sometimes gilded like **685**, but are also found in gold, silver or iron. Inlaying material includes glass paste, semiprecious stones and enamel.**684** Pl. 43. J73.1:8221. MANISA 185. Early Byzantine.

Copper alloy set with glass paste. Back corroded and broken in several places; pin or clasp missing.

Diam. back 5.20; diam. setting 5.00; H. rim 0.80.

BS E9 E56.06/S4.40 *97.15 hidden in chink in W wall.

Circular frame with flat back. Front divided into a number of compartments by strips of copper alloy. At center is a square surrounded by four arcs. Tangent to each corner of the square is a circle and between every two circles a triangle with wavy sides. The center square is filled with amber-colored glass, the circles amber to brown, partial circles deep blue to purple, areas around

67. For a good definition of a brooch as distinct from a fibula see H. L. Lorimer, *Homer and the Monuments* (London 1950) 337 n. 4.
68. See e.g. Werner, "Prunkschnalle," 55-61.

circles light green to whitish glass. The glass is set in lime plaster.

Publ. *BASOR* 215, 52, 53, fig. 21. See Werner, "Prunkschmalle," 55-62, figs. 1, 6; idem, *Katalog der Sammlung Diergardt (Völkerwanderungszeitlicher Schmuck)* I *Die Fibeln Römisch-germanisches Museum Köln* (Berlin 1961) 34-36, pls. 36, 37 (Merovingian, 6th-7th C. A.D.); idem, *Langobardischen Fibeln*, 62 Type C, "Scheibenfibeln," pls. 36-37 (7th C. A.D.); Emery, *Ballana and Qustul* I, 262 no. 354 Tomb B.3; II, pl. 60B (saddle mounting, 5th-6th C. A.D.); J. D. Bateson and R. E. M. Hedges, "The Scientific Analysis of a Group of Roman-Age Enamelled Brooches," *Archaeometry* 17 (1976) 177-190 esp. pl. facing p. 178 nos. 11, 13-16, 25 (4th C. A.D.); Condurachi-Daicovicu, 181, fig. 190 (2nd Aphida Treasure, 5th C. A.D.); Colt, *Nessana* I, 53, pl. 23.2 (7th C. A.D. or later).

685 Pl. 43. J73.2:8222. MANISA 184. Early Byzantine.

Copper alloy with glass paste inlay. Originally gilded. Pin broken; frame corroded.
Diam. 3.50; diam. center compartment 1.25; H. rim 0.80.
BS E6 E41.40/S4.40 *97.55.

Similar to **684**, though smaller and with compartments of different shapes. Center is a raised round setting with four tabs holding in place a round piece of blue glass.

686 Pl. 43. Early Byzantine.

Copper alloy and glass inlay. Fragmentary; only one piece of blue glass preserved.
Diam. 3.70; H. rim 0.70.
Syn or BS (tag with provenance lost).

Similar to **684**.

687 Pl. 43. M59.3:1191. Early Byzantine.

Copper alloy. Now completely disintegrated.
Diam. 4.00.
HoB Room 11 in fill *100.00-99.80.

Similar to **684**.

688 Pl. 43. M64.17:6017. Early Byzantine, 6th-7th C. A.D.

Copper alloy. Apparently complete but no visible means of attachment.
Max. L. 5.00; max. H. 5.70; Th. 0.30.
BE-S E25.50/N39.50 *96.80.

Flat back, slightly convex front surface. Highly stylized lion with broad curved head, wide open roaring mouth, arched back with raised rump making rear leg longer than foreleg. Tail shown as small loop with round depression in center. Short incised lines between double curved lines on neck to indicate mane.

The piece belongs to a group of Early Byzantine "Tierfibeln," most of which have pins or loops on the back and were used as brooches.

See Davidson, *Corinth* XII, 134, pl. 68 nos. 934 (lion), 935 (horse); Werner, *Langobardischen Fibeln*, 63 Type F, pl. 51 C (Byzantine, 6th-7th C. A.D.); Chantre, 94, pl. 19.2 (silver lion, "Scytho-Byzantine"); Hampel, *Ungarn* I, 640 figs. 2004-2005 (lions).

Buckles

Twenty-nine buckles and belt ornaments have been found at Sardis in several sectors including the Acropolis (**690, 691, 706, 709**), the Synagogue (**703**), BS (**692, 695, 696, 698, 700-702, 705, 707, 708, 710**), and B area (**689, 699, 712**), MTE (**693, 694**) and PN (**711, 713, 714**). Not all came from easily datable contexts but nearly all of those that did—primarily those from the Byzantine Shops—could be placed within the Late Roman-Early Byzantine era from about the fourth to the early seventh century A.D., with the majority falling in the later part of the period.⁶⁹

The buckles demonstrate a fairly wide variety of forms but most can be shown to belong to groups of closely related types distributed widely throughout Europe and the Near East, generally dated to the sixth and early seventh centuries A.D., and possibly manufactured in Constantinople.⁷⁰ This dating conforms nicely with that of the Sardis examples coming from such contexts as the Byzantine Shops, and it is likely that all or most of the others from Sardis may be similarly assigned.

All but one of iron (**709**) are of copper alloy; seven of these were analyzed and found to show a variety of

69. According to Davidson, *Corinth* XII, 265, buckles first appeared in Roman times and gradually replaced the fibula. The earliest identified buckle at Sardis (**703**, 4th C. A.D.?) postdates the latest fibula (**683**, 3rd C. A.D.).

70. Owing to the finding of numerous examples in barbarian contexts in Hungary, South Russia, Albania, Greece, Romania and Italy, these buckles have been thought to be products of barbarian manufacture. See K. M. Setton, "The Bulgars in the Balkans and the Occupation of Corinth in the Seventh Century," *Speculum* 25 (1950) 502-543, esp. 520-525. Csallány, "Monuments de l'industrie I," 340-348, suggests, however, that their remarkable uniformity of form, decoration, execution and technique points rather to a single center of manufacture—most probably Constantinople—whence these objects were distributed to the barbarian "market." Despite the alleged Constantinopolitan origin, however, the examples from Sardis are among the very few stemming from excavated contexts in western Turkey to be published so far. Csallány refers to a collection of 137 examples from the vicinity of Constantinople, but these were all sporadic finds brought together by an antiquities dealer. In a recent article, J. Russell discusses the significance of some 32 buckles found in Early Byzantine contexts at Anemurium in southeastern Turkey, and reassesses the distribution of the major types (see Russell, Types I-15).

compositions from leaded tin bronze (691) to zinc bronze (689) to brass (690, 694, 698, 701, 702), indicating nothing conclusive as to commonality of manufacture or place of origin.

Three major typological divisions consist of (1) those in which the buckle and plate are cast in one piece; (2) those in which the buckle and plate are made separately and hinged together; and (3) simple buckles without decorative plates. Within each of these main divisions are several subtypes which can be classified by form and decoration. Most of these types and subtypes have been studied in detail by D. Csallány, J. Werner and others.⁷¹ Since no more than a few examples of any subtype are found at Sardis they will only be summarized here.

Plate and Buckle Cast in One Piece

Type 1a: A flat plate of truncated hourglass shape cast together with a thin oval buckle. The upper surface of the plate is decorated with leaf patterns in relief.

The type is a very common one and is found in barbarian graves from the Crimea to southern England. It is sometimes referred to as the "Syrakus type" because some of the earliest examples to be recognized were found in graves at Syracuse on Sicily.⁷² Two examples were found at Sardis (689, 690): one from the Acropolis and one from Building B. Neither was in a securely dated context but both should probably be dated to the late sixth to early seventh centuries A.D. on the basis of closely dated parallels elsewhere.

689 Pl. 44. M72.3:8193. Early Byzantine, late 6th-early 7th C. A.D.

Zinc bronze. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3. Part of buckle missing. Max. P.L. 4.10; L. plate 3.10; max. W. 2.30; Th. 1.50. BE-C E13.40/N21.15 *97.19.

Near center of side nearest buckle is a hole for the tongue. On opposite edge is a small rectangular protrusion. The tongue is still looped through the hole and corroded to the back of the plate. The back surface of the plate is smooth with two perforated tabs for attachment set horizontally between hole and protrusion.

For distribution see Werner, "Byzantinische Gürtelschnallen," 37, 45-47, pl. 5.8, 9, 11, 12, 14-16 and parallels; Csallány,

71. See e.g. Csallány, "Monuments de l'industrie I," 340-348; idem, "Monuments de l'industrie II," 290-291; idem, "Byzantinische Schnallen," 55-77; Werner, "Byzantinische Gürtelschnallen," 36-48.

72. See e.g. Orsi, *Sicilia Bizantina* I, 188, 189 fig. 94.

"Monuments de l'industrie I" 343-344, pls. II.7-9, III.1-7, esp. p. 344 for chronological limits of type; Orsi, *Sicilia bizantina* I, 188, 189 fig. 94 (Syracuse and elsewhere on Sicily); Russell, Type 7 nos. 14-16 (Anemurium, early 7th C. A.D.).

690 Pl. 44. M61.68:3721. Late 6th-early 7th C. A.D.

Low zinc brass. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3. Tongue missing; buckle broken; surface worn.

Max. P.L. 4.50; W. plate 2.30; Th. 0.15.

AcT local grid W20.00-22.00/N4.00-5.00 *400.55 a.s.l. on floor above round pit.

Similar to 689.

Type 1b: Similar to Type 1a but plate is more elongated and is divided into three distinct segments—a disk below two opposed drop shapes—ornamented with geometric and linear relief patterns. Distribution is apparently somewhat more limited than that of 1a.

691 Pl. 44. M62.40:4345. Late 6th-early 7th C. A.D.

Leaded tin bronze. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3. Buckle broken, tongue missing.

Max. P.L. 4.20; W. 2.30; Th. 0.70; H. attachment tab 0.40.

AcT local grid E10.00-12.00/N18.00-20.00 Unit 7, Level Ib floor *402.37 a.s.l.

Attachment tabs on back are set vertically instead of horizontally.

See Csallány, "Monuments de l'industrie II," pl. VI.2 (Hungary), VI.5 (Constantinople); Chavane, *Salamine* VI, 165, pl. 47 no. 473.

Type 2: Plate simpler than Types 1a and 1b, with shorter plate and rather crudely punched and incised circles distributed over the surface. Only one example was found, but the context—in one of the shops—justifies its inclusion within the groupings of Early Byzantine buckles.

692 Pl. 44. M59.19:1399. Early Byzantine.

Copper alloy. Tongue missing.

Max. L. 3.50; W. buckle 2.40; W. plate 1.70.

BS W8 W27.40-26.60/S1.42 *97.80-97.48 upper story debris.

Rounded plate with hole for tongue. Two attachment tabs on back.

Find publ. *BASOR* 157, 33.

Type 3: Four examples belonging to the "Maskenschnallen" or mask type identified by Csallány and generally dated to the second half of the sixth century A.D. were found.⁷³ Although all four are of somewhat different forms all have the characteristic pierced or openwork patterns on the plate with openings arranged to suggest a face or mask.

Of the four, two (693, 694) were found in mixed contexts in MTE and two (695, 696) in the same Early Byzantine Shop W3. 694 and 696 and possibly 695 appear never to have had buckles and may instead have functioned as some other form of belt or strap ornament, closely related to the buckles of similar form.

693 *Pl. 44.* M64.21:6109. Early Byzantine.

Copper alloy.

L. 3.00; W. 2.50; Th. 0.20; diam. attachment loops 0.40. MTE E45.00-50.00/S125.00-130.00 *101.00-100.00 in dump.

Shield-shaped plate with rounded corners, small projection on lower edge opposite tongue hole. Buckle formed of two extensions from upper edge of plate folded over to meet in middle. Tongue is a flat bar fitted through hole in plate and bent up to form loop. On back of plate are two attachment loops. Below tongue hole are three perforations—two small round holes side by side with a larger, shield-shaped opening below.

See Csallány, "Byzantinische Schnallen," pl. I.1, 2, 4 (Constantinople, Hungary 6th C. A.D.); Russell, Type 6, nos. 11-13 (Anemurium, early 7th C. A.D.).

694 *Pl. 44.* M64.34:6409. Late 6th C. A.D.

Brass. Analyzed by emission spectrography, neutron activation and atomic absorption. See Chap. V, Tables V.1, 3, 4a, b. Tongue and buckle missing or never present.

Max. P.L. 2.90; W. 2.50.

MTE E44.00-54.00/S122.00-132.00 to *101.60 found with late 6th C. coins.

Similar to 693 and 695 but tongue hole (?) is a widened heart-shape instead of a round one. Three attachment loops on back; incised dotted circles on front surface. This was possibly a belt or strap ornament rather than a buckle.

For shape see Csallány, "Byzantinische Schnallen," pl. I.5-7 (Egypt, 6th C. A.D.); for ornament see Werner, "Byzantinische Gürtelschnallen," pl. 8.10.

695 *Pl. 44.* M59.45:1682. Early Byzantine.

Copper alloy. Tongue and buckle missing. Some disease. Max. P.L. 2.00; W. 1.90.

BS W3 W15.00-18.00/S3.00-4.50 *97.50-97.00.

Similar to 693.

696 *Pl. 44.* M58.33:390. Early Byzantine.

Copper alloy. Buckle missing or never present.

Max. P.L. 3.30; max. W. 1.70; Th. 0.20.

BS W3 W9.30 "to end"/S0.00-2.50 no level available.

Rectangular plate rounded on one short side and with short extension in center of that side. Other short side straight; long sides slightly concave near straight end, then slightly indented, then gently curving towards rounded end. Openwork pattern in mask configuration. Two attachment loops on back. Perhaps a belt end or ornament rather than a buckle.

See Csallány, "Byzantinische Schnallen," pl. II.4 (Hungary, 6th C. A.D.).

Type 4: Narrow elongated plate with still narrower tab or extension opposite the buckle. Only one example found, unfortunately out of context (697). The type is apparently not common since few parallels are cited in the standard literature on the subject.

697 *Pl. 44.* NoEx 68.13. Early Byzantine.

Copper alloy. Tongue missing.

Max. L. 4.00; W. buckle 2.00; W. plate 1.00.

No provenance.

Oval buckle has depression in one side for tongue. Other side narrows and continues into an elongated plate with double-curved sides terminating in a semicircle with a narrow extension tab. Three deep circles are punched in the semicircular terminal. Two loops for attachment are on the back; hole for the tongue in upper part of the plate.

See Davidson, *Corinth* XII, 268, 272, pl. 114 nos. 2209, 2210 (7th C. A.D.); idem, "The Avar Invasion of Corinth," *Hesperia* 6 (1937) 236 fig. 6F; also similar, Haspels, *Phrygie* III, 8, 13, 18, 95, 150, pl. 41c2 (brass); Russell, Type 10, no. 21 (Anemurium, early 7th C. A.D.).

Plate and Buckle Hinged Together

Type 5: With eagle-headed terminals. Only one example found: a large, handsome brass buckle with double eagle heads at the corners of the plate. The piece comes from one of the shops and is therefore to be dated similarly to the other buckles.

73. Csallány, "Byzantinische Schnallen," 55-77.

Although no exact parallels could be adduced, the general type is widely distributed in eastern Europe, South Russia and the Caucasus and belongs to the same general chronological range as the other buckles in our collection. Stylistically, however, it is not similar to the other Early Byzantine buckles from Sardis and is likely to stem from some other center of manufacture.⁷⁴

698 Pl. 44. M58.59:861. 6th-7th C. A.D.

Low zinc brass. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3. Tongue missing. Max. L. 8.30; W. 4.70; W. at heads 5.00; Th. 0.40. BS W5 in fill W of door, upper debris.

Flat, rectangular buckle formed of three broad, straight sides and a fourth formed of a thin bar. This is linked to a flat plate by two loops bent around the bar to form a hinge. One side of the plate opposite the hinge terminates in two stylized eagle heads facing out. The front surface of both halves is decorated with deeply cut large and small circles arranged in geometric patterns. In some cases, including the eagles' beaks, the circles are completely punched through. The circles were perhaps once inlaid with a contrasting material.

For buckles with eagle decoration see Rusu, 485-523 (illustrated parallels of South Russian/Danubian type of late 6th C. A.D. are not identical). See also Condurachi-Daicoviciu, fig. 193 (Cipău and Fundătura, 6th C. A.D.). For eagle as solar symbol see P. Verdier in Ross, *Arts*, 23-24.

Type 6: One example. The front surface of the plate is divided into cloisons or cells, similar in technique and appearance to brooches **684-687** which can be dated in the same general time frame as the other buckles from Sardis.

699 Pl. 44. J66.1:7020. Early Byzantine, 6th-7th C. A.D.

Copper alloy. Corroded; only buckle plate preserved. W. 3.00; H. 2.50; Th. 1.00. BE-A/BE-B E15.25/N9.20 *96.35.

Kidney-shaped plate with convex surface, concave back with narrow rim around contour.

See Werner, "Prunkschnalle," pl. 11.8, 11, 13 (Germany, Rome, 5th-6th C. A.D.).

Type 7: Solid shield-shaped plate with vertical hinge-loops at the upper corners. Two examples, both from the Byzantine Shops, were recovered.

⁷⁴ Rusu, 513-514, suggests Kertsch (Byzantine Bosphoros) as a possible center.

700 Pl. 44. Early Byzantine, early 7th C. A.D.

Copper alloy.

H. with loops 3.20, without loops 2.50; W. 2.30. BS E2a E20.17/S0.18 *98.08.

Shield-shaped plate with incised floral pattern and linear border all around front. At upper corners are two vertical loops. On back are three loops—one near point, two near top corners.

See Csallány, "Monuments de l'industrie I," 345-346, pls. III.9, IV.1, II.6 ("Group 6, first half of 7th C. A.D."); Werner, "Byzantinische Gürtelschnallen," 39 fig. 4.3, 4; 41, pl. VI.6, 7, 9a, b, c (7th C. A.D.); Russell, Type 12, no. 24 (Anemurium, early 7th C. A.D.).

701 Pl. 44. M64.41:6532. Late 6th-early 7th C. A.D.

Brass. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3. Buckle, tongue and part of tongue hole missing, possibly cast in one piece with plate rather than hinged.

Max. P.L. 3.00; W. 3.10; Th. 0.10; loop 0.40. BS E19 or S of shop E113.00-116.50/S4.00-6.00 *98.00-97.00.

Shield-shaped plate with square-knot pattern in relief at center surrounded by incised border. On back are three attachment loops.

See Werner, "Byzantinische Gürtelschnallen," 41, pl. IV. 1, 9.

Type 8: The single example has an ovoid plate decorated with small punched dots. While the context of the Sardis piece in Shop W3 is Early Byzantine, the dated parallels are somewhat earlier—fourth and fifth centuries A.D.

702 Pl. 44. M58.36:392. Early Byzantine.

Low zinc brass. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3.

Max. L. 3.60; W. 3.30. BS W3 W8.75-12.00 *97.37.

Flat plate attached to oval buckle with round section. Side of buckle to which plate is fastened narrows to thin bar around which a tab extending from the plate is folded. A hole in the center of the tab accommodates the tongue which is bent around the center of the bar. Three small rivets pierce the plate for attachment to another material.

See Ross, *Arts*, 44-45 no. 8c (Hunnish, early 5th C. A.D.); Keller, pl. 16.5 (4th C. A.D.).

Simple Buckles

The next nine examples have no plates, only a buckle loop attached to a straight bar (either in one piece or separate) around which the tongue is fixed. There are three basic shapes: B-shaped (703), D-shaped (704-709) and oval (710-711). Contexts and parallels suggest dating similar to that of the more complex buckles with plates.

703 Pl. 44. M62.68:4703. Late Roman.

Copper alloy.

L. 3.00; W. 2.90; L. tongue 3.10.

Syn FC E93.00-94.00/N18.00-19.00 *97.00-96.00 in context with 4th C. A.D. coins.

B-shaped buckle cast in one piece. Tongue made separately and attached by bending one end around the straight side of the buckle.

704 Pl. 44. M62.11:4186. Late Roman-Early Byzantine?

Copper alloy.

Max. H. 2.00; max. W. 4.00; L. tongue 2.80; Th. 0.60. MRd E83.00/S10.00 in fill above sidewalk *96.75.

D-shaped buckle made in two pieces—a straight bar and a U-shaped bar with ends terminating in loops that fit over the ends of the straight bar. Tongue made separately and looped around the curved bar.

See Deonna, *Délos* XVIII, 296 no. B 1163, pl. 88.758, ("Roman"); Chavane, *Salamine* VI, 161, pl. 46 no. 464; Haspels, *Phrygie* III, 95, 151, pl. 41d4 (low zinc brass); Russell, Type 4, nos. 7, 8 (Anemurium, early 7th C. A.D.).

705-709 are similar to **704**:

705 M58.74:395. Early Byzantine.

Copper alloy. Tongue missing.

Max. H. 3.20; W. 4.10; Th. 0.40.

BS W1 with early 7th C. A.D. coin.

706 M60.23:2366. Early Byzantine?

Copper alloy. Tongue missing.

H. 2.90; W. 4.40.

AcT Trench B E1012.00-1022.00/S1076.00-1083.00 in fill associated with "Level I" walls.

707, 708 Early Byzantine.

Copper alloy.

707: H. 3.60; W. 2.40; L. tongue 3.00.

708: H. 3.30; W. 2.10; tongue missing.

BS E11 E70.00-71.00/S0.00-4.00 *97.20.

709 Pl. 44. M60.59:2659. Early Byzantine?

Iron. Heavily corroded but complete.

H. 5.90; W. 4.50.

AcT Trench C E1079.00-1096.00/S1073.00-1074.00 in fill *400.65-400.50 a.s.l.

Plain, curved D-shaped buckle made in one piece, with tongue looped around straight side.

See Keller, pl. 10.6 (4th C. A.D.).

710 Pl. 44. Early Byzantine.

Copper alloy. Tongue missing.

H. 3.00; W. 2.40.

BS E11 E70.00-71.00/S0.00-4.00 *97.20.

Oval buckle of varying thickness. One side forms a narrow bar with round section to which tongue was once attached.

See Davidson, *Corinth* XII, 266, 270, pl. 113 nos. 2176 (4-6th C. A.D.), 2177 (7th C. A.D.); Colt, *Nessana* I, 53, pl. 23.12 (7th C. A.D. or later); Chavane, *Salamine* VI, 162, pl. 46 no. 465 (6th-7th C. A.D.); Russell, Type 2, nos. 4, 5 (Anemurium, early 7th C. A.D.).

711 Early Byzantine.

Copper alloy. Corroded.

H. 2.00; W. 2.40; L. tongue 2.80.

PN W253.00-260.00/S338.00-340.00 *88.90-88.70.

711 is similar to **710**.

712 Pl. 44. M67.33:7532. Early Byzantine.

Copper alloy. Only tongue preserved.

L. 3.00; Max. W. 0.70; diam. loop 0.45.

LNH 2 E70.00/N103.26 *96.26.

Small bar, flattened at one end, thickening at other. Under the flat end is a small loop for attachment to the buckle plate. The other end curves downward to hook over the buckle. Along the top surface is a pattern of relief lines.

Belt Ends

713 Pl. 45. Ottoman or later?

Copper alloy.

Max. H. 3.00; W. 2.90.

PN W281.00-282.00/S332.00-333.00 *87.80 found with 14th C. A.D. Islamic coins.

Shield-shaped plate with thistle ornament in relief on front surface, thickened border around edges. On back are four prongs for attachment to leather or cloth.

714 Pl. 45. Ottoman?

Copper alloy.

Dimensions unavailable.

PN W285.00-290.00/S330.00-335.00 *87.70-87.20.

Shield-shaped plate with lower edge forming a double-concave curve. Front surface decorated with traced geometric and stylized floral ornament. On back are two prongs for attachment.

*Uncertain Function but Probably Related to Preceding***715 Pl. 45.** Late Roman?

Copper alloy.

Max. L. 2.60; max. W. 1.35; H. loops 0.60.

HoB E55.00-60.00/S99.00-101.00 to *99.40.

Flat, oblong plate with rounded short ends, small indentations on long sides. Openwork ornament consisting of five perforations arranged symmetrically and three, possibly four, impressed circles. On back are two vertical loops for attachment. Possibly served as part of buckle plate or clasp.

716 Pl. 45. M63.46:5643. Early Byzantine.

Copper alloy and iron.

Ext. diam. ring 4.80; Th. 0.70; L. tongue 6.50; diam. loop 2.35.

BS E12 E72.00-73.10/N0.00-0.75 *98.00-97.50 found with 131.

Copper alloy ring with iron tongue looped around one side.

Ear Ornaments

Ear ornaments at Sardis range from the Early Bronze Age gold earplugs (717, 718) through Middle and Late Byzantine earrings (751-759). They vary widely in form, from the figurative Lydian lamb (719) to severely plain hoops (723-726), and in material—gold and electrum, silver and copper alloys, some of them gilded.

The majority of the ear ornaments came from graves, most of them datable by means of other finds.

Earplugs

717, 718 Pl. 45. M69.7:7974, M69.8:7975. MANISA 168, 169. Early Bronze Age II, probably after ca. 2200 B.C.

Argentiferous gold. Analyzed by neutron activation. See Chap. V, Table V.6.

717: L. 2.30; diam. flat end 1.25; diam. conical end 0.90; H. cone 1.00.

718: L. 2.30; diam. flat end 1.35; diam. conical end 0.90; H. cone 0.95.

EB Pitthos Grave 69.3 found under skull with tips pointing downward and ca. 0.11 m. apart. Found with dagger 1 and pendant 881.

Hollow sheet gold formed around a core of dark, sandy material into a bullet-like shape with conical terminal at one end, flattened at other end. Hatched, linear pattern traced in conical end. The tip of each is pierced with a small hole. Lines traced on base of 717.

Publ. *BASOR* 199, 16, fig. 5; Mitten-Yügrüm, "Gygean Lake," 193-194, figs. 4, 7a, b. Similar objects have been found in contemporary contexts elsewhere in Western Anatolia, see M. J. Mellink, "Archaeology in Asia Minor," *AJA* 70 (1966) 148 (Koçumbeli near Ankara and Karayavşan near Polatlı); idem, "Karataş-Semayük," 323-324, pl. 74 fig. 16 (Karataş, child burials); Arik, *Alaca*, pl. 179, A1.317-318 Tomb B.M.; H. Z. Koşay, *Alaca Höyük Kazısı* (Ankara 1951) 162, pl. 155 top, Tomb D no. 25; 167, pl. 186 bottom, no. A1.D.K 16; 171, pl. 204 fig. 2, Tomb S no. 48; R. Duru, "Anadolu'da Bulunmuşaltın kulak Tikaçları," *Bellesten* 36 no. 142 (1972) 123-135 (discussion of type and distribution).

Earrings

719 Pl. 45. J67.3:7400. MANISA 164. Lydian, 6th C. B.C.

Electrum with platinumiridium inclusions. Analyzed by neutron activation. See Chap. V, Table V.6.

Max. H. 1.00; W. 0.70; L. 1.00; H. wire 1.30; Th. wire 0.10.

PN just W of Lydian altar W262.50/S337.00 *86.50.

Recumbent lamb cast solid with legs folded under body, head turned at 90° angle to body. Hair stippled on top of head; eyes, mouth and tail incised. Flat bottom made separately. Wire made separately and probably fastened to back by soldering.

Publ. *BASOR* 191, 13, 14, fig. 13; as example of metal sculpture *Sardis* R2 (1978) 14; for platinumiridium inclusions see Goldstein, *BASOR* 228, 54.

720 Pl. 45. Lydian, 7th-6th C. B.C.

Copper alloy. Corroded; only half-preserved.

Max. P.L. 1.70; max. Th. 0.80; diam. preserved end 0.70. HoB W20.00-23.00/S105.00-110.00 *99.00-98.70.

Hollow pendant part of leech-shaped earring; thickest at center, tapered towards the ends. One preserved end encircled by a raised rim; three other rings around hoop. The type has a history going back into the Bronze Age and is fairly widespread in archaic Asia Minor and the Near East.

See K. R. Maxwell-Hyslop, *Western Asiatic Jewellery: c. 3000-612 B.C.* (London 1971) 238-240, figs. 129, 130 (Ashur); Higgins, 115, 122-123 (discussion), pl. 21F (Ephesus); Hogarth, *Ephesus*, 103-104, pl. VI.46, 47, 50, 51, 58, 60, 64, 67-69, 75 (archaic, gold and electrum examples).

721 Pl. 45. M69.9:8011. Lydian, 6th C. B.C.?

Copper alloy. Ear wire missing.
L. 1.90; Th. 1.00.
PyT.

Thick, solid, crescent-shaped hoop tapered towards ends.
Surface plain.

722 M58.6:150. Possibly Lydian.

Copper alloy. Corroded and broken; ear wire missing.
Max. P.H. 1.30; max. P.W. 1.10; Th. 0.30.
Trench S in AT W188.50/S1275.00 Level IIa *97.30.
For Trench S see *Sardis* R1, 104-107.

723 Pl. 45. J66.2:7092. MANISA 160. Lydian or Late Roman-Early Byzantine.

Gilded copper alloy. Gold is argentiferous. Analyzed by neutron activation. See Chap. V, Table V.6. Copper alloy corroded and swollen, breaking through gilded surface near thickest part of hoop.
Diam. 1.90; Th. at center 0.30; Th. ends. 0.10.
BT/DU 66.1 Chamber II.

Plain, nearly circular hoop thickest at center, tapering towards ends.

This is one of several earrings from the same tomb (see also **724-729**). The original burials in the tomb were Lydian, but the tomb had been extensively reused in the Late Roman-Early Byzantine era and many of the finds can be associated with the period of reuse. Similar hoops from the archaic Artemesion at Ephesus might argue for a Lydian date for this earring, although the form is simple and not telling chronologically.

Publ. *BASOR* 186, 49-50. See Hogarth, *Ephesus*, 103 pl. VI.43-45.

724 Pl. 45. M66.10:7091. Lydian or Late Roman.

Copper alloy.
Diam. 2.00; Th. ends 0.20.
BT/DU 66.1 Chamber II on stone floor.

Similar to **723** but no evidence of gilding.

Find publ. *BASOR* 186, 49-50.

725, 726 Pl. 45. M66.6a:7052; M66.6b:7054. Lydian or Late Roman, probably the latter.

Both are brass. Analyzed by emission spectrography, neutron activation and atomic absorption. See Chap. V, Tables V.1, 3, 4a, b. Parts of two similar hoops: probably a pair.

Diam. ca. 1.80 each; Th. 0.15 each.
BT/DU 66.1 Chamber I found near skull.

In form these are similar to **723** and **724**. The fact that they are brass suggests the later date in the period of reuse of the tomb, although composition is not in itself conclusive since objects analyzed as brass have been found in archaic Gordion.

Find publ. *BASOR* 186, 49-50. See Steinberg, for fibulae with high zinc and tin contents.

727 Pl. 45. M66.4:7052. Late Roman-Early Byzantine.

Gilded copper alloy. Diseased; most of gilt missing.
Ext. diam. 2.30; Th. 0.20; diam. pendant loop 0.40.
BT/DU Tomb 66.1 Chamber II.

Circular hoop with open ends in center of one side.
Pendant hoop attached to lower side.

Find publ. *BASOR* 186, 49-50. See Ross, *Arts*, 24, 25 and figs. showing pendants attached (Byzantine, ca. A.D. 600).

728, 729 Pl. 45. M66.5:7053. Late Roman-Early Byzantine.

728 is brass. Analyzed by emission spectrography and neutron activation. See Chap. V, Tables V.1, 3, 4a. **728** has section of large hoop missing.
Max. diam. 2.10 each; diam. smaller hoop 0.70 each.
BT/DU 66.1.

Each is made in the same way: a single piece of wire is bent into a figure-eight with the smaller section much smaller than the other. The sides of the larger hoop taper to open ends at right angles to the smaller hoop.

See W. W. Rudolph, "Excavations at Porto Cheli . . ." *Hesperia* 48 (1979) 301, 320, fig. 14 no. 58 (Early Byzantine).

730 Pl. 45. M64.37:6484. Late Lydian-Roman?

Copper alloy. Corroded.
Diam. 2.50; Th. 0.10.
PN W273.00-276.00/S347.00 *87.30-87.00.

Plain, thin open band with pointed ends.

731 Pl. 45. J68.2:7824. MANISA 162. Hellenistic, 2nd-1st C. B.C.

Argentiferous gold with garnet, beryl and pearl. Analyzed by neutron activation. See Chap. V, Table V.6.
Diam. top disk 0.70; diam. stone 0.50; diam. middle disk

0.90; second stone 0.65; diam. bottom disk 1.00; stone 0.70; H. ear wire 1.60.

Syn MH E41.43/N13.26 pit 8 *95.23 1.50 m. below floor in Roman terracing fill.

Three circular disks of gold hinged vertically and set with stones—alternating red garnet, green beryl, red garnet. At the sides of the pins linking the disks are tiny pearls, originally six in all, one now missing. The ear wire was made separately and attached to the top disk. Remains of two attachment loops at the bottom show that a fourth element was attached there—probably not another disk as the arrangement of the loops differs from those on the three preserved disks. Parallels from Delos and elsewhere suggest the possible restoration of a winged Eros in this position.

Publ. *BASOR* 199, 51, fig. 42. See T. Hackens and E. Lévy, "Trésor hellénistique trouvé à Délos en 1964," *BCH* 89 (1965) 503-566, esp. 541-546, figs. 6-10, pls. XVII, XX (2nd-1st C. B.C.); Hoffmann-Davidson, 111, fig. 32 (Thessalian? 2nd-1st C. B.C.), 286, fig. 136 (Palaiokastron); Higgins, 186, pl. 58 (Rome, 1st C. A.D. necklace of similar construction). I would like to thank Tony Hackens and J. S. Crawford for these references.

732 Pl. 45. J68.1:7682. MANISA 163. Probably Roman.

Argentiferous gold with pearl. Analyzed by neutron activation. See Chap. V, Table V.6.

Max. H. 1.40; max. diam. 0.40; diam. pearl 0.30; diam. wire loop 0.30.

HoB E1.00/S122.00 *101.20 in mixed Roman fill.

At top is a small open loop with tapered ends. Attached to this is a hollow, truncated cone with a thickened rim at top and bottom. A small pearl of uneven shape depends from the lower end of the cone, pierced vertically and held in place by a gold wire which passes through the pearl and is twisted into a knot at the lower end to form a stop.

See R. Higgins in Strong-Brown, pl. IV upper l. where an object of similar form is shown as the drop or pendant of a larger earring (Roman, 1st-3rd C. A.D.). See also W. Rudolph and E. Rudolph, *Ancient Jewelry from the Collection of Burton Y. Berry: An Introductory Catalogue* Indiana University Art Museum Publication 1973/1 (Bloomington 1973) 152 no. 124b (2nd-3rd C. A.D.).

733 Pl. 45. M59.74:2198. MANISA 157. Roman, 1st-2nd C. A.D. or later.

Argentiferous gold. Analyzed by neutron activation. See Chap. V, Table V.6.

Max. diam. 1.30; max. Th. 0.10; diam. loop 0.40.

HoB Grave 'O' W10.00/S70.00.

Thin wire hoop with one end terminating in a closed loop. Other end is pulled through loop and wrapped

around it twice to close. This is a fairly common Roman type and is found distributed through much of the Eastern Mediterranean.

See V. Karageorghis, "Chronique des fouilles et découvertes archéologiques à Chypre en 1973," *BCH* 98 (1974) 840, fig. 30 (Roman tomb at Silikou Cyprus); *ibid.*, *BCH* 96 (1972) 1024, 1026 fig. 31 (Roman tomb at Khandria, Cyprus); Chavane, *Salamine VI*, 140 (discussion of type and chronological range), pl. 42 no. 409 (late 3rd C. A.D.); J. H. Iliffe, "Vaulted Tomb at Askalon, III-IV cent. A.D.," *QDAP* 2 (1933) pl. 48 nos. 7, 8, 10, 11; *idem*, "A Tomb at el Bassa of c. A.D. 396," *QDAP* 3 (1934) 90, pl. 24.5, 9; Crowfoot, et al., *Samaria-Sebaste III*, 428, 429, fig. 100.15 (Tomb E 220, 2nd-3rd C. A.D.); Goldman, *Tarsus I*, 387-388, Grave 38-1, fig. 262.1 (1st C. A.D.).

734-736 are similar to **733**:

734, 735 Pl. 45. M61.28:3369. Late Roman-Early Byzantine.

Gold.

Diam. ca. 1.30.

PN one found in Peacock Tomb (Grave 61.14), the other found below Grave 61.14 and apparently from dispersed burial E of Grave 61.24.

736 Pl. 45. J63.2:5406. MANISA 155. Roman.

Argentiferous gold. Analyzed by neutron activation. See Chap. V, Table V.6.

Diam. 1.50; Th. spiral 0.10; Th. plain wire 0.05.

HoB W18.00/S124.00 *102.30.

Similar to **734** and **735** but about half of hoop is twisted spirally.

737-740 Pl. 46. M73.5a-d:8265. Late Roman-Early Byzantine, ca. mid-4th-6th C. A.D.

Copper alloy. Badly corroded.

737: H. 2.00; W. 1.50; Th. 0.10; diam. loop 0.30.

738: H. 2.00; W. 1.60; Th. 0.10; diam. loop 0.30.

739: H. 2.00; W. 1.30; Th. 0.10; diam. loop 0.30.

740: H. 2.00; W. 1.05; Th. 0.10; diam. loop 0.25.

PN/E Grave 73.6 (infant girl's burial).

Two pairs of plain wire hoops each with one end bent over to form a small loop, the other end tapered and intended to be drawn through the loop for fastening.

741, 742 Pl. 46. J73.6:8297. MANISA 182. Middle Byzantine, probably 11th C. A.D.

Silver. Corroded; one fragmentary.

H. 2.00; W. 1.50; Th. 0.15; Th. end 0.20.

PN Grave 73.42 (child's grave).

Two wire hoops thickened at one end and terminating in

a small loop. The other end is drawn through and bent to form the fastening.

743 *Pl. 46.* M62.59:4479. Byzantine.

Copper alloy.

Diam. 2.00; diam. bead 0.50.

AcT local grid E12.00-16.00/N10.00-13.00 *402.35-401.85 a.s.l.

Plain, thin hoop with open ends. One end tapered to a point; the other is fitted with a globular, openwork bead.

See Davidson, *Corinth* XII, 252, pl. 109 no. 2024 (silver, 11th-12th C. A.D.).

744, 745 *Pl. 46.* M61.89:3909. Byzantine.

Copper alloy.

Diam. 2.60; diam. bead 1.00.

AcT local grid W20.00/N10.00 in mixed fill *402.75 a.s.l.

A pair—each a plain hoop with open ends, one end terminating in a small closed loop, the other drawn through the loop and bent to catch. Next to the loop are two spools between which is a round, openwork bead with tiny loops on either side.

746, 747 *Pl. 46.* M62.93:4932. Early-Middle Byzantine, A.D. 616-ca. 1000.

Copper alloy. Bead missing from **746**.

Diam. 3.80; L. bead 2.30; W. bead 1.50.

PN Grave 62.32.

Two wire hoops with open ends, one end terminating in a small closed loop, the other tapered (broken in both cases) and probably meant to be drawn through and fastened like **744** and **745**. On hoop is strung a hollow biconical bead with raised band around the widest part. The bead is held in place by fine wire loops wrapped around the hoop at either end of the bead. Additional loops are placed at intervals on the hoops of both earrings and seem to have been intended for additional attachments.

Find publ. *BASOR* 170, 17. For manner of attachment see Davidson, *Corinth* XII, 249, 251, pl. 108 nos. 2014, 2017 (not later than early 12th C. A.D.).

748, 749 *Pl. 46.* Middle Byzantine, after ca. A.D. 1000-1200.

Copper alloy and pearl. One broken in several pieces; heavily corroded.

Diam. 1.90; diam. pearls 0.40, 0.25, 0.30.

PN Grave 62.40 found with **784-796**.

Two plain wire hoops each set with six tiny pearls at the catch. Mechanism of catch obscured by corrosion.

750 *Pl. 46.* M73.6:8286. Roman-Byzantine.

Copper alloy.

Diam. 1.70; bead 0.50 square; Th. hoop 0.15.

PN W246.00/S393.40 near a child's grave but not in one.

Wire hoop tapered at one end; the other end terminating in a small loop. Above the loop are two thickenings, possibly wire wrapped around the hoop but obscured by corrosion. Between the thickenings is a square, openwork bead.

751 *Pl. 46.* J73.3:8275. MANISA 180. Late Byzantine, ca. A.D. 1200 or later.

Gold.

Diam. 1.40; Th. of wire 0.10; Th. hinge 0.30.

PN Grave 73.21 (child's grave).

Two wire semicircles—one with one loop at each end, the other with two loops. The two halves originally were hinged together with small pins or rivets, now preserved on only one side.

Find publ. *BASOR* 215, 41.

752-755 *Pl. 46.* M61.98a:4087. Late Byzantine.

Copper alloy.

Max. H. with loops 2.10; max. W. 1.70; Th. 0.95.

AcT Grave 61.42.

One pair of earring pendants and fragments of two similar ones. Body of pendant is hollow and pouch-like with convex sides, flattened on lower end. A raised ridge or seam of twisted wire follows the joining edge of the two halves. At the center of one side is a small suspension loop; on the flattened side opposite are two pairs of loops, probably for suspension of other pendants.

See Davidson, *Corinth* XII, 250, 254, pl. 108 nos. 2045-2047 (11th or 12th C. A.D.).

756, 757 M61.85:3893. Early to Middle Byzantine.

Copper alloy. Fragmentary.

AcT Grave 61.20.

Fragments of two pendants similar to **752-755**.

758, 759 *Pl. 46.* M61.85:3893. Early to Late Byzantine.

Copper alloy. Halves of two earring pendants.

H. 1.80; W. 1.20.

AcT Grave 61.20 found with **756** and **757**.

Hollow crescents with convex sides made in two parts with a raised seam along the outer edge. At each point of the crescent is a small loop. The two halves do not belong together so are more likely part of a pair.

See Davidson, *Corinth* XII, 250, 254, pl. 108 nos. 2045-2047 (Late Byzantine); Ross, *DOCat* II, 94, pl. 65 no. 135 (gold, 11th-12th C. A.D.); 112, pl. 76 no. 161 (enameled, Russian, 12th C. A.D.).

Beads

As with ear ornaments, most of the beads came from graves. With the exception of the granulated gold Lydian bead (760) all are of copper alloy and rather plain and unimpressive in form.

760 *Pl. 46.* J61.1:3126. MANISA 153. Lydian, ca. 575-540 B.C.

Gold. Analyzed by neutron activation. See Chap. V, Table V.6.

Diam. 1.05; H. 0.95; diam. end rings 0.50; diam. perforation 0.30; Wt. 2.35 g.

Inderese Grave 61.2.

Segmented melon-shaped bead made of fourteen segments separated vertically by single lines of granulations. At either end, around the central perforation is a ring of granules (or beaded wire?). The body of the bead was apparently made in one piece, but small tabs are visible, folded over the inside rim, possibly representing the ends of wires.

Publ. *BASOR* 166, 27 n. 46, 28 fig. 23; Greenewalt, "Lydian Graves," 125 no. 21, 136 pl. 10.1. See also *Sardis* XIII (1925) 17 nos. 25-26, pl. 3 figs. 11, 14 (Tomb 381); Hogarth, *Ephesus*, 101, pl. VI.6, 36 ("pinheads").

761 *Pl. 46.* M64.25:6253. Late Roman.

Copper alloy, gilt.

Max. H. 1.70; diam. 1.00; H. loop 0.40.

PN W250.40/S343.70 *88.67.

Spherical hollow made in two hemispherical parts joined horizontally. A fairly large suspension loop extends from the center of the top; at the bottom is a tiny cluster of four granules. Traces of gilding on the surface.

762-783 *Pl. 46.* M62.28:4225. Late Byzantine or Turkish, 14th-15th C. A.D.

Copper alloy. Corroded; some broken.

Diam. ca. 0.80-0.90; H. with loop 1.10.

PN Grave 62.18 found with **856**

Twenty-two small, hollow, spherical to biconical beads, each made in two halves divided vertically and with a small loop inserted through a hole in the top for stringing or suspension.

784-796 M62.92:4931. Middle Byzantine, ca. A.D. 1000. 13th C.

Copper alloy.

Max. diam. ca. 0.80; H. with loop 1.10.

PN Grave 62.40 found with **748** and **749**.

Similar to **762-783**.

Find publ. *BASOR* 170, 17.

797, 798 Late Byzantine-Turkish, 14th-15th C. A.D.

Copper alloy, gilt.

Diam. 0.80; H. with loop 1.20.

PN Grave 62.1.

Biconical beads with suspension loops similar to **762-796**.

799 *Pl. 46.* M60.56:2647. Middle-Late Byzantine?

Copper alloy.

Diam. 1.30; H. with loop 2.00; W. loop 0.20.

AcN local grid E1.00-3.00/S32.00 in fill ca. *399.25 a.s.l.

Spherical bead made in two halves with horizontal seam. Small loop at top for stringing or suspension.

Bracelets

Only thirteen bracelets were found, mostly fragmentary. Two (**800, 801**) are of silver, the rest of copper alloy. Most are Roman or Byzantine in date.

800 *Pl. 47.* M66.7:7055. Late Roman-Early Byzantine.

Copper alloy. Fragmentary; largely disintegrated.

Diam. 4.50; Th. 0.20.

BT/DU Tomb 66.1 Chamber II.

Twisted wire band with small pendant of wire from which is suspended a bead of blue glass.

See **723-726** for discussion of context. Find publ. *BASOR* 186, 49-50.

801 *Pl. 47.* M61.94:4050. 5th-4th C. B.C.?

Copper alloy. Half missing; diseased.

Diam. 6.00; max. Th. 1.00.

PN W250.00-255.00/S380.00 *82.50-81.90 in well I, from level *87.90 floor of apsidal building.

Solid segment of arc with circular section. Possibly part of a bangle with open ends since band appears to taper slightly.

802 *Pl. 47.* M60.16:2358. Late Roman?

Gilded copper alloy. About half-preserved; diseased.

Est. diam. 5.00; Th. 0.50.

HoB E10.00/S105.00 *100.70-100.20 mixed upper fill.

Three twisted wires forming a segment of an arc with a small knob at the preserved end.

See Davidson, *Corinth* XII, 263, pl. 112 no. 2137 (12th C. A.D.).

803 Pl. 47. M61.17:3211. Late Roman-Byzantine?

Copper alloy. About half-preserved.

Diam. 5.30; W. 0.40; Th. 0.25.

PN W250.00/S360.00 *89.30 with late 6th C. A.D. coin.

Flat band with incised design on upper surface. Decoration consists of a wavy line interspersed with dotted wreaths.

See Keller, pl. 47.4 (4th C. A.D.).

804 Pl. 47. M68.17:7793. Roman or later.

Copper alloy. Two fragments; incomplete.

Max. P.L. 4.15 and 3.00; max. W. 1.50.

HoB Building R E50.00/S105.00 top fill *100.60.

Flat band with one tapered, rounded end preserved. On the upper surface is an incised design of circles, zigzags and horizontal lines.

805 Pl. 47. Late Roman-Byzantine.

Copper alloy. About half-preserved.

Diam. ca. 4.80; W. band 1.15; Th. 0.10.

PN W275.00-280.00/S330.00-335.00 *88.50-87.70.

Flat band tapering towards ends (not preserved). On upper surface is a design of punched dots and incised lines.

See Davidson, *Corinth* XII, 263, pl. 112 nos. 2131-2132 (Late Roman); Ploug-Oldenburg, *Hama* IV.3, 82 fig. 31.13 no. 7B579, Level A (A.D. 1302-1401).

806 Pl. 47. M60.63:2707. Byzantine?

Copper alloy. About half-preserved.

Diam. ca. 4.50; W. 1.10; Th. 0.10.

AcT Trench C E1080.00-1081.00/S1074.00-1075.00 top fill.

Flat band with raised flat border along both edges and a raised flat ridge along the center. Pattern of punched dots along the upper surface.

807 Pl. 47. M61.38:3515. Early Byzantine?

Copper alloy. Nearly complete.

Ext. diam. 5.30; max. P.W. at ends 0.80; Th. band 0.40;

Th. ends 0.03.

AcT Grave 61.21.

Open band with circular section, flattened and widened at ends. Ends decorated with incised leaf pattern.

808 Pl. 47. M61.60:3713. Late Roman-Early Byzantine.

Copper alloy. In three, nonjoining fragments.

Diam. ca. 8.00; W. band 0.80; Th. 0.10.

PN W250.00/S365.00 *87.90 on floor of tank of Late Roman-Early Byzantine bath?

Thin, flat band with raised edge on both sides scored with small transverse lines. One fragment ends in a narrow hook; the second ends in a narrow strip with a flat, pierced tab at the end. The upper surface of all pieces is decorated with a punched, double wavy line.

For the type of clasp see Keller, 96 fig. 28.6 (4th C. A.D.).

809 Pl. 47. M59.29:1577. Roman, 1st-2nd C. A.D.

Copper alloy.

Diam. 3.30, 3.10, 3.40 (linked), 2.05, 4.05 (free); Th. 0.20-0.30.

HoB Grave 'a' found with **860**, **861**, **877** and **878**.

Five hoops and part of a sixth, all with ends tapered and twisted around the hoop to close it. Three of the hoops are linked together; the other three are free.

810 Pl. 47. M62.56:4475. Late Roman or later?

Silver.

Max. L. 11.50; diam. links 0.90; H. "shields" 2.20; W. 1.20.

PN W245.00/S360.00 NE corner of room of the eagle mosaic *90.30.

Two rows of interlocking circular links attached through double perforations to a flat, ovoid link at either end. These in turn are attached to a single circular wire link through a loop in the outer ends. At the extreme ends are flat, shield-shaped plaques or clasps with flanged edges—one with a straight upper edge, the other with a curved edge. In the center of each is a raised triangle. The back of one is slotted, perhaps to function as a catch.

811 Pl. 47. M62.36:4341. Late Roman-Byzantine.

Silver and gilt.

L. 9.50; L. flat link 2.10; diam. circular links 0.90.

PN W233.00/S364.00 *91.00 at level and in area of Byzantine cemetery.

Similar to **810** but without the shield-shaped clasps and connecting links at the ends. Instead, a pair of flattened hooks form clasps.

812 *Pl. 47.* M59.75:2199. MANISA 158. Roman-Byzantine?

Copper alloy. Three fragments preserved. Ends missing. Max. P.L. 5.20, 6.70, 6.30; W. 0.25; Th. 0.08. Pa E40.00/N40.00 *98.00-97.00 in fill.

Thin band scored into small rectangular panels alternately concave with smooth surface and flat with roughened surface.

Finger Rings

Finger rings can be divided into three major classifications: (1) those with bezels but without settings; (2) those with settings for glass or stone and (3) plain rings with neither bezels nor settings. Although a wide variety of different forms appears within each major division, most are not distinctive or common enough to arrange in specific subtypes. Most of the examples that could be dated by context came from Byzantine graves in PN (**822, 827, 856**), Roman graves in HoB (**860, 861**) or KG (**846**) or from the Byzantine Shops (**821, 831, 841, 853, 854, 857, 866**).

*Type 1: Rings with bezels.***813** *Pl. 47.* M65.1:6664. Lydian or later?

Copper alloy.
Ext. diam. 2.00; bezel 1.00 × 0.90; Th. hoop 0.10; H. bezel 0.50.
PN W289.80/S324.80 *86.30.

Closed hoop, slightly convex on outside. Three-tiered pyramidal bezel with incised strokes on lower two tiers.

814 *Pl. 47.* M64.2:5922.

Copper alloy.
Ext. diam. 1.90; W. hoop 0.30; Th. 0.10; W. bezel 0.60.
PN W285.40/S343.10 *87.49.

Thin, closed hoop with flat section widens slightly to narrow oval bezel, slightly raised from hoop and with raised knob in center.

815 *Pl. 47.* M63.34:5462. Lydian, 6th C. B.C.

Copper alloy.
Ext. diam. 2.10; Th. hoop 0.15; L. bezel 1.40; W. bezel 0.60.
HoB W10.00-13.00/S102.00-105.00 Bldg. D *99.40 floor.

Closed hoop with semicircular section. Plain flat bezel in one piece with hoop but demarcated from hoop by grooves around the ends of the bezel.

816 *Pl. 47.* M61.56:3677. Late Roman?

Copper alloy. Hoop broken.
Ext. diam. 1.50; W. hoop 0.25; bezel 0.90 × 0.70.
HoB E10.00/S110.00 *100.70.

Closed hoop with flat section; flat, oval bezel in one piece with hoop.

817 *Pl. 47.* M60.65:2772.

Copper alloy.
Ext. diam. 1.70; Th. hoop 0.10; W. hoop 0.20; bezel 0.60 × 1.20.
AcT Trench C E1080.00-1081.00/S1074.00-1075.00 *400.50 a.s.l.

Closed hoop with triangular section, widened and flattened to form ovoid bezel in one piece with hoop. The bezel is beveled at transition to hoop and is scored with three diagonal strokes on the upper surface.

The following are similar to **817**:

818 M61.10:3179.

Copper alloy.
Ext. diam. 1.60; W. hoop 0.30; Th. 0.10; bezel 0.60 × 1.10.
AcT local grid LL/Ce near pit dug by Shear, in fill.

819 M60.67:2778.

Copper alloy.
Ext. diam. 1.70; Th. hoop 0.10; W. band 0.30; bezel 0.60 × 1.20.
AcT Trench C E1081.00-1082.00/S1070.00-1072.00 surface.

No strokes on bezel.

820 M72.11:8214a.

Copper alloy.
Ext. diam. 1.80; W. hoop 0.30; Th. 0.10; bezel 1.30 × 0.70.
Pa E85.00-86.00/N48.00-50.00 *96.80-96.60 in top fill.

Five incised strokes on bezel.

821 *Pl. 47.* M59.36:1601. Early Byzantine.

Copper alloy. Hoop broken.
Ext. diam. 2.10; bezel 1.50 × 0.70.
BS W3 W16.00-18.00/S4.40 *98.00-97.00 in fill.

Thin hoop with flat section. Flat, oval bezel in one piece with hoop but raised above it. Plain surface.

822 *Pl. 47.* M73.7:8296. Middle Byzantine, ca. A.D. 1000-1200.

Copper alloy.

Ext. diam. 1.85; W. hoop 0.20; Th. band 0.12; bezel 1.40 × 0.65.

PN Grave 73.24.

Plain, closed hoop with semicircular section. Lozenge-shaped bezel in one piece with hoop and beveled at junction. Incised design on bezel now illegible.

See Ploug-Oldenburg, *Hama* IV.3, 78, fig. 30.3 no. 6B142, level A3 (A.D. 1170/91-1260).

The following are similar to **822**:

823 M60.30:2426. Middle Byzantine?

Copper alloy.

Ext. diam. 1.70; Th. hoop 0.10; bezel 1.30 × 0.60.

AcS Trench A at J E1123.00-1134.00/S1106.00-1120.00 *403.30 a.s.l. broken floor.

824 M64.14:5972. Hellenistic-Roman?

Copper alloy.

Ext. diam. ca. 1.90; Th. 0.10.

PN W276.00/S348.00 *87.66 found near a 3rd C. B.C. coin.

825 *Pl. 48.* M59.62:1990. Late Roman?

Copper alloy. Corroded; cracked.

Ext. diam. 2.00; W. hoop 0.65; W. bezel 1.10.

UT E90.00/S200.00 *121.98-121.18.

Slightly convex hoop in one piece with widened bezel. Incised marks on bezel obscured by corrosion.

826 *Pl. 48.* M62.42:4347.

Copper alloy.

Ext. diam. 2.10; Th. hoop 0.25; W. bezel 0.75.

RT E38.00/S31.00 *96.00 in fill over disrupted S Colonnade.

Plain round hoop widening slightly for bezel. Faintly incised lines on bezel now illegible.

827 *Pl. 48.* M62.91:4930. Early Byzantine, ca. A.D. 400-616.

Copper alloy.

Ext. diam. 1.65; W. bezel 0.70; Th. hoop 0.15.

PN Grave 62.47.

Thin hoop with triangular section made in one piece with oval bezel. Incised on bezel is a lozenge within which are two opposed semicircles.

828 *Pl. 48.* NoEx 68.26.

Copper alloy.

Ext. diam. 2.10; W. hoop 0.50; Th. hoop 0.20; bezel 1.70 × 0.90.

Salihli.

Closed hoop widening into flat oval bezel with incised vine pattern.

829 *Pl. 48.* M60.68:2779.

Copper alloy.

Ext. diam. 1.90; Th. hoop 0.10; W. hoop 0.20; diam. bezel 0.70.

AcT Trench C E1079.00-1080.00/S1074-? *401.15 a.s.l. in fill.

Plain, flat open hoop with pointed ends overlapped to close ring. Round bezel made in one piece with hoop. Lightly incised design on surface.

830 *Pl. 48.* M62.23:4220.

Copper alloy.

Ext. diam. ca. 2.00; W. hoop 0.25; bezel 0.90 × 1.10.

AcT local grid W10.00/N30.00 *406.45 a.s.l. (no context; found by architects digging a hole for a marker).

Flat hoop with open tapered ends overlapped to close ring. A nearly rectangular bezel is in one piece with the hoop and decorated with an incised rectangle within which is a wavy line. At shoulders of hoop are incised diagonal lines.

831 *Pl. 48.* M58.31:396. Early Byzantine?

Copper alloy.

Ext. diam. 2.35; W. hoop 0.40; diam. bezel 1.50.

BS W1.

Plain closed hoop slightly convex on ext. Large, nearly round bezel made in one piece with hoop. Faintly incised design on bezel illegible.

832 *Pl. 48.* M67.2:7277. Late Roman-Byzantine?

Copper alloy.

Ext. diam. 2.00; W. hoop 0.40; Th. 0.10; diam. bezel 1.10.

PN W267.30/S328.25 *87.90.

Flat hoop in one piece with nearly round bezel. Incised on bezel is a five-pointed star with a punched dot at the end of each point. Around the circumference is a row of smaller dots.

See Davidson, *Corinth* XII, 229, Type G, 236-238, pls. 103-104 nos. 1845-1876, esp. nos. 1872-1873 with similar dotted stars

(10th-12th C. A.D.). According to Davidson the type ranges from 3rd C. A.D. through the Byzantine period.

833 *Pl. 48.* M66.1:7003. Early Byzantine, ca. A.D. 400-6th C.

Copper alloy.

Ext. diam. 2.50; W. hoop 0.30; Th. hoop 0.20; bezel 1.50 × 1.10.

BT/DU Tomb 66.1 in dromos in soft earth fill; from secondary reuse.

Plain closed hoop with circular section in one piece with oval bezel. On bezel is a crudely incised winged figure in profile facing right and holding a long cross. Behind the figure is a curved row of incised dots.

Publ. *BASOR* 186, 49-50 n. 13, 45 fig. 31. For ring type see Ross, *DOCat* II, 53, pl. 41 nos. 58, 59; Davidson, *Corinth* XII, 229, Type G, pl. 103. For angel or victory type see J. P. C. Kent, "Auream monetam . . . cum signo crucis", *NC* ser. 6, vol. 20 (1960) 129-132, pl. IX, who connects the motif of a victory holding a cross on 5th C. coins to a Roman victory over the Persians in A.D. 421.

834 *Pl. 48.* M66.3:7030. Early Byzantine.

Silver. Broken in several pieces and repaired.

Ext. diam. 2.50; W. hoop 0.20; Th. hoop 0.20; diam. bezel 1.30.

BE-A E16.70-17.70/N9.00-9.38 *96.31.

Plain, closed hoop with round section. Round bezel made separately and soldered on. On bezel is an incised eagle with head turned to l. and uplifted wings. Between wings and above head is a monogram (see *Pl. 48.*).

Publ. *BASOR* 187, 17, 14, fig. 40; 62. See Ross, *DOCat* II, 60, pl. 45 no. 70 with refs. and discussion (Constantinopolitan, 7th C. A.D.). For the type of the eagle with uplifted wings see G. Zacos and A. Vegler, *Byzantine Lead Seals* (Basel 1972) I.1, 489 (most examples dated between A.D. 550 and 750), 490-546; I.3, 1624-1631, pls. 64-72, 195-196 nos. 585-730, 2839-2858.

835 *Pl. 48.*

Copper alloy. Part of hoop missing.

Ext. diam. ca. 1.50; Th. hoop 0.10; W. hoop 0.30; bezel 1.30 × 1.70.

PN W278.20/S321.40 *86.82.

Plain, narrow hoop made separately from bezel. Bezel is round with scored edge. Center is slightly raised above edge and incised with three horizontal lines interspersed with short scorings, perhaps roughening for adhesive to hold gem.

The following are similar to **835**:

836 M64.10:5962. Byzantine or later?

Copper alloy.

Ext. diam. 2.10; W. hoop 0.25; Th. hoop 0.15; bezel 1.90 × 1.50.

PN W251.00/S338.00 *89.40.

Plain bezel.

837 *Pl. 48.* M64.4:5930. Byzantine?

Copper alloy.

Ext. diam. 1.90; W. hoop 0.25; Th. hoop 0.20; bezel 1.70 × 2.15.

PN W257.70/S342.40 *89.43.

Edges of bezel scalloped, not scored. Whitish adhesive still present in center of bezel, probably for attachment of glass or stone gem.

838 *Pl. 48.* M64.18:6027.

Silver. Hoop broken; part missing.

Ext. diam. 2.30; Th. hoop 0.15; diam. bezel 1.00.

MTE E60.00/S152.00 *110.00.

Hoop with round section made separately from plain round flat bezel.

839 *Pl. 48.* M64.5:5931. Byzantine-Turkish?

Copper alloy. Hoop broken and mostly missing.

W. hoop 0.30; Th. hoop 0.10; bezel 2.10 × 1.70.

PN W257.50/S343.00 *89.34.

Stumps of hoop attached to underside of flat, nearly round bezel. Finely incised dendritic pattern on upper surface of bezel; deeper lines on under surface near ends of hoop.

840 *Pl. 48.* M62.7:4167. Turkish.

Copper alloy.

Ext. diam. 2.00; Th. hoop 0.20; bezel 1.80 × 1.20.

PN W245.00/S365.00 *91.00.

Plain closed hoop made in one piece with flat oval bezel. On upper surface of bezel are seven dotted circles.

841 *Pl. 49.* M58.55:792. Early Byzantine.

Copper alloy.

Ext. diam. 2.10; Th. hoop 0.10; W. cross 0.90.

BS W1.

Closed hoop with square section widening to maltese cross as bezel. In center of each arm of the cross is an incised line.

842 Early Byzantine?

Copper alloy. Corroded and partly missing.

Ext. diam. 2.00; W. cross 1.00.

AcT local grid BB-ee 0.80 below surface.

Similar to **841**.

Type 2a: Rings with settings recessed into the hoop.

843 Pl. 49. NoEx 66.21. MANISA 150. Lydian?

Argentiferous gold. Analyzed by neutron activation. See Chap. V, Table V.6.

Hoop crumpled; "gem" detached.

Diam. hoop ca. 2.20; gem 0.90 × 0.70 (top); 0.70 × 0.50

(bot.); Th. 0.20; Wt. 220 mg.

Şeytan Dere.

Hollow hoop made of flattened sheet metal folded over. Place for gem is torn and distorted. Glass gem is oval with beveled edges for mounting. The lower surface is covered with a white substance, perhaps the remains of adhesive.

844 Pl. 49. NoEx 68.12.

Gilded copper alloy. Most of gilding chipped off; stone missing.

Est. diam. 2.10; oval depression 0.70 × 0.50; Th. 0.20; thickest part of hoop 0.60.

Found W of Pactolus in vineyard and field of Suleyuran Otturgut.

Closed hoop with round section, widening near top where there is a roundish depression to serve as setting for a stone.

845 Pl. 49. M63.33:5443. Late Roman?

Copper alloy. Stone missing.

Ext. diam. 2.20; Th. hoop 0.20; W. setting 1.40.

HoB W15.00-25.00/S118.00-120.00 *101.30-100.00 in upper fill.

Closed hoop widening to broad, oval depression to hold stone.

See Davidson, *Corinth* XII, 228 Type A, 234, pl. 102 nos. 1811-1817 (Hellenistic-Byzantine); Marshall, 156 pl. 25 nos. 971, 972 (3rd C. A.D.); 207 pl. 32 no. 1320 (2nd C. A.D.).

846 Pl. 49. M58.58:767. Roman, 2nd-4th C. A.D.

Copper alloy. Stone missing.

Ext. diam. 1.90; W. setting 1.00; Th. hoop 0.10.

KG Grave K.

Plain, closed hoop slightly convex on ext. Hoop widens to oval hollow setting.

Publ. *Sardis* R1 (1975) 127, 128, fig. 330. See Davidson, *Corinth*, XII, 228 Type A, 234, pl. 102 nos. 1811-1817 (Hellenistic-Byzantine); Marshall, 205, 213 pl. 32 nos. 1310, 1373 (shape, 1st C. B.C.-2nd C. A.D.); M. Almagro, *Las Necrópolis de Ampurias II* (Barcelona 1955) 150 fig. 118 no. 2, pl. 10 no. 13 (shape in gold, late 1st C. A.D.).

Type 2b: Rings with settings raised above the hoop.

847 Pl. 49. M64.11:5963.

Copper alloy.

Setting torn; stone missing.

Ext. diam. 1.70; W. hoop 0.20; Th. hoop 0.10; L. setting 1.20.

PN W251.00/S336.00 *89.22.

Flat, narrow hoop with open ends attached to rectangular setting.

848 Pl. 49. M61.9:3178. Roman?

Copper alloy.

Ext. diam. 1.80; W. hoop 0.30; diam. setting 0.90.

PN W250.00/S355.00 *89.90 in fill.

Plain closed hoop widening towards roundish setting. Part of greenish stone preserved in setting.

849 Pl. 49. M61.11:3186. Turkish?

Copper alloy.

Ext. diam. 2.30; W. hoop 0.20; bezel 1.50 × 1.20; W. glass 0.60.

PN W250.00/S355.00 *90.00 in fill.

Plain closed hoop with square section. Oval bezel set with piece of red glass, roughly faceted on sides and flat on top.

850 Pl. 49. M60.81:2969. Turkish?

Copper alloy.

Ext. diam. 1.60; W. hoop 0.20; Th. hoop 0.10; bezel 0.90 × 1.00.

PN *90.50 surface.

Flat, closed hoop split at upper ends and widened to support setting. The setting is a raised, hollow square filled with a fairly soft pinkish-red stone. Applied leaves of thin metal are placed at the sides of the setting, making a transition to the hoop.

851 Pl. 49. M63.4:4971. Turkish.

Copper alloy.

Ext. diam. 1.70; W. band 0.30; diam. setting 1.30.
PN W240.00-230.00/S340.00-350.00 *91.00-90.50
surface.

Hoop is made of thin, sheet metal folded over on the underside and soldered to the round setting. The setting is also made of sheet metal, hollow in the center and with a pattern of semicircular indentations around the edge. The center is filled with a ball of light yellow paste.

See Ploug-Oldenburg, *Hama* IV.3, 77, fig. 29.11 no. 7B615, level A1 (A.D. 1302-1401).

852 *Pl. 49.* M61.36:3512. Roman?

Copper alloy.

Ext. diam. 2.40; Th. 0.10; H. setting 0.40; diam. 0.50.
PN W250.00/S365.00 *89.50 Room 8, in fill below
floor, found with **864** and **865**.

Thin wire hoop with a small, round openwork setting on one side near a break in the hoop. No stone preserved.

Type 2c: Rings with gem mounted on prongs at the ends of the hoop.

853 *Pl. 49.* Early Byzantine.

Copper alloy. Setting and/or gem missing.

Diam. 2.50; Th. 0.30.

BS E12 E75.00/S3.50 *96.50-95.25.

Plain, open hoop with thickened ends, narrowing abruptly to slender prongs for mounting a pierced gem.

854 *Pl. 49.* M59.22a:1452. Early Byzantine.

Copper alloy. Setting and/or gem missing.

Ext. diam. 2.20; W. hoop 0.40; Th. hoop 0.20.

BS W7 W21.50-23.50/S2.00-4.00 *97.25-97.00 found
with **857**.

Open hoop with semicircular section. Ends thickened and crudely shaped in the form of small heads (?). Breaks at the ends indicate possible missing setting or perhaps a pierced gem like **853**.

855 *Pl. 49.* M64.6:5932. Turkish?

Copper alloy. Setting missing.

Ext. diam. 1.70; W. hoop 0.30; Th. 0.15.

PN W266.50/S344.00 *89.47.

Plain hoop with open ends flattened and tapered to form support for a setting or collet to be soldered on.

See Davidson, *Corinth* XII, 228 Type E, 235-236, pl. 103 nos. 1835-1841 (4th C. A.D.-Byzantine).

Type 3: Plain rings with neither bezel nor setting.

856 *Pl. 49.* M62.29:4226. Late Byzantine-Turkish, 14th-15th C. A.D.

Copper alloy and silver. One side broken.

Ext. diam. 1.70; Th. 0.10.

PN Grave 62.18 found with **762-783**.

Two strands—one of silver, one of copper alloy—twisted together to form a small circlet.

See Davidson, *Corinth* XII, 229 Type F (?) 236, pl. 103 nos. 1842-1844 (11th-12th C. A.D.).

857 *Pl. 49.* M59.22b:1452. Early Byzantine.

Copper alloy.

Ext. diam. 2.30; W. hoop 0.30; Th. 0.30.

BS W7 W21.50-23.50/S2.00-4.00 *97.25-97.00 found
with **854**.

Plain closed hoop with semicircular section.

The following are similar to **857**:

858 *Pl. 49.* M67.9:7329. Hellenistic or later?

Copper alloy.

Ext. diam. 2.10; W. 0.40; Th. 0.20.

PN W275.00/S323.30 *87.30.

Slightly thicker on one side.

859

Copper alloy. Green patina.

Ext. diam. 2.70; W. 0.65; Th. 0.20.

MC/CH W2.00/N58.10 *96.95.

860 *Pl. 49.* M59.29:1577. Roman, 1st-2nd C. A.D.

Copper alloy.

Ext. diam. 2.60.

HoB Grave 'a' found with **809**, **861**, **877** and **878**.

Closed hoop with relief lines around perimeter.

861 *Pl. 49.* M59.29:1577. Roman, 1st-2nd C. A.D.

Copper alloy. Broken on one side.

Ext. diam. 1.65.

HoB Grave 'a' found with **809**, **860**, **877** and **878**.

Plain hoop with round section.

The following are similar to **861**:

862 M68.21:7832. Late Roman-Early Byzantine, 4th-7th C. A.D.

Copper alloy. Corroded.

Ext. diam. 2.30; Th. 0.15.

Syn FC E105.50/N4.00 *96.30 below 4th C. mosaic but above subfloor.

Uneven thickness.

863 M59.64:1992. Early Byzantine.

Copper alloy.

Ext. diam. 2.40; Th. 0.20.

BS W13 W55.00-57.00 *94.50.

864, 865 M61.37:3513. Roman?

Copper alloy.

Ext. diam. both 2.10; Th. 0.25, 0.20.

PN W250.00/S365.00 *89.50 in Room 8, fill below pavement. Found with **852**.

866 Pl. 49. M59.6:1273. Early Byzantine.

Copper alloy.

Ext. diam. 2.60; W. 0.15; Th. 0.25.

BS W8 W29.90 *97.77-97.58.

Plain hoop with rectangular section.

The following are similar to **866**:

867 M60.66:2774. Hellenistic-Roman?

Copper alloy.

Ext. diam. 2.10; Th. 0.20.

HoB E20.00/S95.00 *100.00.

868 M59.63:1991. Hellenistic-Late Roman.

Copper alloy.

Ext. diam. 2.70; Th. 0.30.

UT E80.00/S170.00 *119.20 in fill.

869 Pl. 49. M68.5:7637.

Copper alloy. Some disease.

Ext. diam. 2.00; Th. 0.10; W. 0.25.

LNH 1 E63.00/N109.50 *97.50.

Plain flat hoop with slight roughening on outer surface, perhaps indicating a setting or attachment that had broken off.

870 Pl. 49. M69.13:8052. 4th-7th C. A.D.(?)

Copper alloy.

Ext. diam. 1.90; L. projection 0.85; L. slit 0.56.

Syn FC E96.00/N18.00 *96.30 below mosaic but above subfloor.

Plain closed hoop with rectangular section. Attached to one side is a flat, rectangular projection pierced with a slit and decorated with incised lines.

Buttons

871 Pl. 50. Lydian, 7th C. B.C.

Copper alloy. Heavily corroded.

No dimensions available. Max. L. ca. 2.00.

HoB W3.00-7.00/S90.00-95.00 *98.30-97.80 in a level tentatively associated with the Kimmerian destruction of the early 7th C. B.C.

Hollow hemispherical shape with horizontal bar across hollow underside.

For Kimmerian destruction at Sardis see *Sardis* RI (1975) 6; *BASOR* 162, 12, 22-23; 170, 6; 174, 14; 186, 32-33.

872 Pl. 50. M61.101:4101. 6th C. B.C.

Copper alloy. Corroded.

Diam. 2.60; Th. 0.20.

PN W245.00/S380.00 *86.76-86.56.

Round, flat rosette with scalloped edges. Segments indicated by finely incised lines. Round perforation in center.

873 Pl. 50. M61.14:3200.

Copper alloy. Some bronze disease.

Diam. 2.40; H. 0.70; Th. 0.20.

RT E10.00/S7.00 surface of MRd I.

Circular domed stud or button with knob in center of ext. Flat, roughly scalloped rim. Stump of loop or shaft on hollow underside.

Bosses

874 Pl. 50. M59.46:1701. Hellenistic-Late Roman.

Copper alloy. Corroded.

Diam. 5.10; Th. 0.10.

UT E80.00/S216.00 *124.45-123.45 in fill.

Flat disk with round perforation through center. Incised concentric circles on one face—two near outer edge, two near center. Back side plain.

875 M60.44:2586.

Copper alloy. Part missing from one edge; diseased.

Diam. 2.50; H. with knob 0.50; Th. 0.05.

HoB E15.00/S105.00 *100.00 in late mixed fill.

Flat disk with knob on center on one side. On other side are incised concentric circles—two near edge, two near center; punched dot in center.

876 Pl. 50. M59.69:2152.

Copper alloy. Diseased.

Diam. 3.90; H. 0.80; Th. 0.10.
From passage between BE-H and MC E18.00/N62.00 *98.50.

Round flat rim with domed center. Three attachment holes in rim; incised concentric circles on dome.

877 *Pl. 50.* M59.29:1577. Roman, 1st-2nd C. A.D.

Copper alloy. Small hole in one side.

Diam. 2.90; H. 0.90.

HoB Grave 'a' found with **809**, **860**, **861** and **878**.

Tiered disk with raised concentric lines setting off each step. In center is a depression.

Jewelry Chains

878 *Pl. 50.* M59.29:1577. Roman, 1st-2nd C. A.D.

Copper alloy. Corroded through; fragmentary.

Th. 0.30.

HoB Grave 'a' found with **809**, **860**, **861** and **877**.

Thin wire braided in four strands.

879 M63.53:5833. Roman?

Copper alloy. Fragmentary.

L. 4.50; W. 0.50.

HoB E0.00-10.00/S120.00-128.00 to *102.00 in mixed fill.

Similar to **878**.

880 *Pl. 50.* M61.22a-c:3232. Roman-Byzantine?

Copper alloy. Fragments of chain attached to misc. objects.

Max. P.L. chain fragments 5.20, 5.30; L. "needle" 4.50; diam. large ring 1.40; W. bead 0.65.

PN W250.00-255.00/S360.00 *89.60.

Fine chain of four strands of braided wire similar to **878**. One length is attached to a ring with a faceted copper alloy bead strung on it; another is attached through the eye of a needle-like object with flattened head; a third has a small ring between two lengths of chain.

Pendants

881 *Pls. 45, 50.* M69.6:7973. MANISA 167. Early Bronze Age, after ca. 2200 B.C.

Silver. Analyzed by neutron activation. See Chap. V, Table V.6. Legs missing; light grayish purple corrosion crust.

Max. L. 2.70; max. P.H. 1.00; W. head 0.55; W. body 0.40.

EB Pithos Burial 69.3 found on top of teeth of skeleton near earplugs **717** and **718** and dagger **1** in same burial.

Ram with elongated cylindrical body perforated just above stumps of forelegs. Cylindrical neck at oblique angle to body. Small head with rounded nose; horns in relief curve back and around on either side of head. Tiny tail points downward.

Find publ. *BASOR* 199, 15 fig. 4, 16; Mitten-Yüğürtün, "Gygean Lake," 193, figs. 4, 6.

882 *Pl. 50.* J61.3:3128. MANISA 151. Lydian, ca. 575-540 B.C.

Nearly pure silver. Analyzed by neutron activation. See Chap. V, Table V.6. Blackish gray corrosion crust. Max. H. 3.00; H. without base 1.75; W. base 0.60; L. base 1.05; diam. loop 0.70; L. head 0.40; Wt. 3.40 g. Inderese Cemetery Tomb 61.2.

Bird of prey, probably a hawk, standing on a small, irregularly rectangular base. Wings in relief sweep down back and attach to base. Eyes also shown in relief. Legs separate with feet resting on edge of base. At upper back is a round suspension loop. The piece is similar to a pendant in copper alloy showing three birds of prey on a common base, said to have come from Sardis and now in the Ashmolean Museum, Oxford (see **992**). A number of similar, small silver hawks, without base or suspension loops, were also found in an archaic deposit at Ephesus.

Publ. *BASOR* 166, 27, fig. 21; Greenewalt, "Lydian Graves," 126 no. 23; 135, 143-145, pl. 10.3. See Hogarth, *Ephesus*, 116-117, pl. XI.2-6 (silver "figurines").

883 *Pl. 50.* J61.2:3127. MANISA 152. Lydian, ca. 575-540 B.C.

Gold wire with agate bead. Gold is of a high degree of purity. Analyzed by neutron activation. See Chap. V, Table V.6.

Max. L. 3.00; H. with bead 2.20; diam. loop 0.90; Th. 0.10.

Inderese Cemetery Tomb 61.2.

Wire extends horizontally to two sides to grip barrel-shaped bead through perforations in ends. At the top center the wire is bent into a circular loop soldered where it comes together.

Publ. *BASOR* 166, 27, fig. 22; Greenewalt, "Lydian Graves," 125 no. 22; 135-136, pl. 10.2.

884 *Pl. 50.* J67.4:7530. MANISA 149. Lydian or Byzantine.

Argentiferous gold. Analyzed by neutron activation. See Chap. V, Table V.6. Surface dented.

Diam. 1.10; max. Th. 0.60; H. 1.30.
PN W275.00/S228.50 *85.40.

Hollow, spherical pendant and tubular suspension loop made of one piece of sheet folded over at loop. Edges of each hemisphere are flattened, with one side crimped over the other to secure it. The loop is decorated with five traced grooves. The context seems securely Lydian but the similarity of this piece to the next, **885**, raises the possibility that both are Byzantine, making this one intrusive in its context.

Find publ. *BASOR* 191, 13.

885 *Pl. 50*. NoEx 62.23. MANISA 161. Early or Middle Byzantine, or Lydian.

Argentiferous gold. Analyzed by neutron activation. See Chap. V, Table V.6. Somewhat dented and crumpled. Max. H. 1.80; diam. 1.30; Th. under 0.10; diam. loop 0.30.

S part of Karadut, fortress area.

Form and method of forming similar to those of **884**. It has been suggested that letters have been raised on one surface of the drop but if so they are virtually illegible and possibly fortuitous.

See Russell, no. 41 (Anemurium, Silver, Early Byzantine).

886 *Pl. 50*. M62.33:4294. Roman.

Copper alloy.

Max. W. 1.90; max. H. 3.20.

HoB W15.00/S85.00 to *100.00 mixed context.

Flat, heart-shaped pendant with narrow suspension loop rising from the center of the widest part. Opposite the loop is a narrow point ending in a horizontal ridge above a small solid drop. Possibly a horsetrapping.

See Frisch-Toll, *Dura* IV.4.1, 20, pl. IV.47-49 (before A.D. 256); E. Fabricius and O. von Sarwey, *Der Obergermanisch-Raetische Limes des Roemerreiches im Auftrage der Reichs-Limeskommission* Abteilung B, Bd II no. 31 *Kastellwiesbaden* (Heidelberg 1906) 96, pl. 10 nos. 37, 40.

887 *Pl. 50*. M65.3:6684. Late Roman?

Copper alloy. Suspension loop or hook broken off.

Max. P.L. 2.21; max. W. 1.50; diam. bulb 0.30.

HoB W35.00-36.00/S124.00-125.00 *102.20-101.00 in upper mixed fill together with 3rd-4th C. A.D. coins and Late Roman sherds.

Similar to **886** but with more elongated terminus at bottom ending in a biconical drop.

888 *Pl. 50*. M59.67:2116.

Copper alloy. Heavily corroded.

Diam. 2.10; H. with loop 2.90.

BSH *95.00-94.75 in fill containing Lydian-Early Roman material.

Flat circular pendant in one piece with suspension loop formed of a narrow strip bent back from the disk.

889 *Pl. 51*. M62.63:4556. Early Byzantine?

Copper alloy. Rough, corroded surface.

Diam. 1.70.

RTE E40.00/S34.00 *96.40 in fill N of S Colonnade.

Flat disk with small hole punched through center and small vertical loop at top. Traces of a stamped edge on upper edge of one side; markings in relief around central hole on same side are perhaps deliberate.

890 *Pl. 51*. M61.21:3231. Early Byzantine?

Copper alloy. Fragmentary.

Max. P.W. 4.00; W. loop 0.60.

RT E9.00/S11.70 *97.25 on top of marble statue base.

Flat spade-shaped (?) pendant in one piece with suspension loop. Dotted circle incised around edge of pendant. One whole and parts of two other perforations through pendant. Other side is plain.

891 *Pl. 51*. M63.37:5519. Byzantine-Ottoman.

Copper alloy. Diseased.

Diam. 1.50; H. with tab 2.20.

Church E outside S wall *91.25.

Solid spherical pendant slightly narrowed at top where it flattens to the remains of a disk-shaped tab (part of a suspension loop?). To lower l. side is a small projection.

892 *Pl. 51*. M61.83:3891. Early Byzantine, ca. 6th-early 7th C. A.D.

Copper alloy. Diseased.

Max. H. 3.30; diam. 1.90; Th. 0.70.

AcT Grave 61.12.

Disk-shaped pendant made in two halves like a locket. Ribbed, tubular projection at top edge. Five, smaller ribbed tubular rings around outer edge probably once held a wire strung with glass beads (according to a letter from M. Ross to G. M. A. Hanfmann, 10/22/62). Around the edge of each side is an applied band, partly missing on one side. Within the band on one side is an equal-armed cross made of braided wire with volutes at the end of each arm. In each quadrant is a small hole.

According to M. Ross this is probably an "inexpensive imitation of a type generally in gold or silver," and should probably be dated in the Early Byzantine period, judging from parallels in Egypt.

Find publ. *BASOR* 166, 39. For similar type of cross see Strzygowsky, 335, pl. 38 no. 7039 (earrings).

893 Pl. 51. M61.84:3892. Middle Byzantine?

Copper alloy. Diseased. Part of back missing. H. with loops 2.20; diam. 1.90; Th. 0.70. AcT Grave 61.37.

Circular pendant made in two halves like a locket. Round perforation through center. Around outer edge are one whole loop and stumps of three more small loops. Applied bands around outer edge and inner perforation. Between the two bands are hollow circles, perhaps once inlaid.

894 Pl. 51. M65.4b:6703. Roman?

Copper alloy.
Max. L. 4.90; W. 0.90.
HoB W36.00-39.00/S110.00-120.00 to *100.70 mixed fill.

Plain, flat elongated leaf-shaped pendant with solid drop at one end. At other end is a suspension loop in one piece with pendant.

895 Pl. 51. M63.3:4970. Turkish.

Copper alloy. Diseased.
Max. L. with hook 5.00; max. W. 2.60; Th. 0.15.
PN W218.00/S353.00 *91.30 surface.

Flat, leaf-shaped pendant with narrow hook at top in one piece with pendant. On front surface are a raised outer edge and raised border around a drop-shaped inner section. Within this inner section is a rosette in high relief against a plain background. Between the two borders is a leaf and flower pattern in lower relief. Across the widest part of the back is a straight horizontal depression which appears to have been cut after the piece was made, since it cuts across the raised negative of the central section of the obverse.

896 Pl. 51. NoEx 71.22. Turkish?

Copper alloy. Green patina.
Max. H. 2.70; max. W. 2.60; Th. 0.15.

Flat, heart-shaped pendant with scalloped edges. Circular boss in center with incised line around it. Leaf design in relief around edges and on boss. Small circular perforation through upper border.

897 Pl. 51. M64.1:5920. Turkish?

Copper alloy.
Max. H. 2.90; max. H. perforation 0.90; max. W. 2.20;
W. perforation 1.00; Th. 0.20.
PN W250.00-255.00/S345.00-350.00 surface to *89.53.

Ovoid pendant with flat, raised border around outer edge. Heart-shaped perforation in lower half also surrounded with flat raised rim. At top is a narrow loop.

Medallions

898 Pl. 51. M61.93:4031. Middle Byzantine, probably first half 11th C. A.D.

Copper alloy.
Diam. 4.00; Th. 0.15; H. with tab 4.80.
AcT Grave 61.40.

Round medallion with rectangular perforated tab at top for suspension. Relief designs on both sides.

Side A: An Anastasis scene showing Christ's descent into Hell and return dragging Adam behind him. The draped figure of Christ holds a cross with double transverse bar in his proper r. hand and strides to the l. With proper l. hand he holds the r. hand of a kneeling figure (Adam), while a third figure (Eve) stands behind the kneeling one and is partly cut off by the border of the medallion. To the l. (in front) of Christ is a fourth figure, also standing and wearing some kind of headgear or crown. This is probably David or Solomon.

Side B: A large cross with double transverse bar stands on a stepped base. From the lower part of the stem of the cross spring vines and branches which curve upward to form a border along the upper edge of the medallion.

Publ. *BASOR* 166, 39, fig. 21, n. 66. For the type of the leaved cross see J. Beckwith, *The Art of Constantinople* (London 1961) 87-92, fig. 116 (10th C. A.D.) and refs.; D. Talbot Rice, "The Leaved Cross," *Byzantinoslavica* 11 (1950) 72-81 esp. 72-73, 78 figs. 1, 4, 79 fig. 7. Talbot Rice points out that while the motif begins in the 6th C. A.D. it only becomes popular from the 9th C. on. For a recent summary of the development of the Anastasis scene see P. D. Leveto, "A Byzantine Gold and Rock Crystal Pendant," *Indiana University Art Museum Bulletin* 1/2 (1978) 48-51. Leveto notes the following elements as belonging to the 10th C. or later: Christ moving away from Adam; Christ holding a cross; appearance of David and/or Solomon as subsidiary figures; Adam and Eve to one side of Christ with Eve behind Adam. G. McN. Rushforth, "The Church of S. Maria Antiqua, Appendix: The 'Descent into Hell' in Byzantine Art," *PBSR* 1 (1902) 115 fig. 8 is a 12th C. Greek ms. showing the scene in which Christ carries a cross with double transverse bar near the top and another bar near the bottom. For other discussions of the Anastasis motif see C. R. Morey, *East Christian Paintings in the Freer Collection* (New York

1914) 45-53 and E. Diez and O. Demus, *Byzantine Mosaics in Greece: Hosios Lucas* (Cambridge, Mass. 1931) 69-72, pl. XIV.

899 Pl. 51. J63.1:5231. MANISA 156. Early Byzantine or later.

Argentiferous gold. Analyzed by neutron activation. See Chap. V, Table V.6. Piece missing at top.

Diam. 1.30; Th. under 0.10.
HoB W6.00/S110.00 *99.90.

Flat circular medallion with raised edge of twisted or beaded wire. Woman's head in seven-eighths view and bust down to just below the breasts. Head is large in proportion to bust. She has large eyes, a straight nose, long hair rolled back from the face. A veil over the head falls over the shoulders. She wears a V-necked garment which falls over the breasts. To right of lower part of face is a sign (illegible?).

For the general type see A. Grabar, "L'ímago clipeata chrétienne," in *L'art de la fin de l'antiquité et du moyen âge I* (Paris 1968) 607-613; for slightly asymmetrical, non-frontal view of a female head in a medallion see *ibid.*, vol. III, pl. 149d (miniature of Cosmas Indicopleustes which, according to Grabar, is a 9th C. copy of a 6th C. A.D. original). The bust in the upper l. shows Anne, mother of Mary, with head in the same general position. I owe this reference to my colleague Ronald E. Malmstrom.

900 Pl. 51. M58.117:343. Turkish, 19th C. A.D.?

Lead. Fragmentary.

Diam. ca. 7.00.

Building B no grid or level available.

Thin, flat disk with emblem of the Ottoman Empire in relief within a border of raised dots. Crossed cannon, pile of cannonballs at bottom; crescent moon and stars at top; janissaries' horsehair crests around sides.

I owe the identification of the motif to Crawford Greenewalt, Jr.

Reliquary Crosses

Only two halves of hinged, locket-like crosses of a type known as reliquary crosses are preserved at Sardis, and of these only one has any decoration on it. According to Davidson,⁷⁵ the type is very common throughout the Byzantine world and most are rather poor in quality,

suggesting that they belonged to the lower strata of society.

901 Pl. 52. M60.21:2364. Byzantine, 10th-12th C. A.D.?

Leaded tin bronze. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3. Some disease; hinges broken; only half-preserved.

Max. L. 7.00; W. 4.70.

AcN local grid E7.00-10.00/N1.00-2.00 in fill.

Flat cross with flanged inner edges and broad trapezoidal arms. Remains of hinges on upper and lower edge. On front surface is a lightly incised and crudely drawn figure of a robed saint.

See Davidson, *Corinth XII*, 255-256, 257-258, pl. 110 nos. 2058-2068 (mostly 10th-12th C. A.D. but can be earlier); Dalton, *Early Christian Antiquities*, 112-113 nos. 558-562 (Beirut, Antioch, Smyrna); Conze, *Pergamon I.2*, 325, fig. 116; Boehmer, *Boğazköy VII*, 132, pl. 40 no. 1196 (12th-14th C. A.D.).

902 NoEx 72.28. Byzantine.

Leaded tin bronze. Analyzed by emission spectrography and neutron activation. See Chap. V, Tables V.1, 3, 4a. Only half-preserved.

Max. L. 5.75; max. W. 3.50.

Pa MC.

Similar to **901** but without incised design.

Other Crosses

903 Pl. 52. M60.42:2537. Byzantine.

"Pure" copper. Analyzed by emission spectrography. See Chap. V, Table V.1, 3.

Max. P.L. 5.20; max. W. 2.20; Th. 0.10.

AcT E1001.00-1002.00/S1071.00-1072.00 *403.00 a.s.l. in fill.

Thin, flat plain cross cut out of sheet metal; arms are not aligned and taper slightly inward.

904 Pl. 52. M61.70:3754. Byzantine.

Leaded tin bronze. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3. Possibly cut off another object.

Max. P.H. 6.50; W. 5.70; Th. 1.60.

AcT local grid W26.00/N8.00 *402.31 a.s.l.

Solid cast, segmented cross with octagonal center and four knob-shaped arms, each terminating in a small drop. A short, conical section forms the base or transition to another piece. There are traces of possible saw marks visible on the bottom surface.

75. Davidson, *Corinth XII*, 255.

ORNAMENTAL ATTACHMENTS

This classification includes a variety of objects, linked chiefly by the fact that they all seem to have been designed to be attached to some other object or material, but whose original purpose cannot at present be determined with certainty.

905 *Pl. 52. M62.37:4342. Lydian, 6th C. B.C.*

Copper alloy.

H. 1.80; W. 1.30.

HoB Building A E5.00/S105.00 to *98.50.

Open triangle with flat horizontal bar at apex. Possibly a clothing attachment such as a button or toggle.

906 *Pl. 52. M62.70:4705. Late Roman?*

Copper alloy. Corroded surface.

Diam. 4.90; W. with loops 6.50.

Syn FC E100.00/N2.00 *96.75 on floor.

Flat disk with two projecting loops on opposite sides.

907 *Pl. 52. M62.62:4555. Early Byzantine.*

Copper alloy.

L. 4.50; W. 4.50; Th. 0.20.

BS E13 E77.75/S3.12 *96.40.

Small, flat cast square with stylized leaf projecting from each corner. On back of each leaf is a small attachment loop; in center of front side was soldered a raised ring (now detached) that possibly served as the setting for a gem or inlay.

908 *Pl. 52. M66.15:7187. Byzantine?*

Copper alloy. Edges torn.

Max. P.L. 6.90; W. ends 3.50-3.20; W. center 2.00; Th. 0.02.

SWG W82.10/S220.45 *111.26.

Thin sheet in shape of a stylized leaf, constricted at center and rounded on corners. Surface decorated with incised leaf pattern. Small holes around edges and in center of one end for attachment.

909 *Pl. 52.*

Copper alloy.

Max. P.L. 2.50; diam. disk 1.40.

BCH W0.00-2.00/N64.00-70.00 *98.80-96.60.

Small disk with cylindrical projection from one side (now broken). Surface of disk decorated with incised

pattern—lozenge at center, four half circles along sides, surrounded by a circle.

910 *Pl. 52. M63.9:4993. Byzantine?*

Copper alloy.

Diam. 3.00; Th. 0.50.

BS E19-PCA E116.00-118.00/S0.00-2.00 *98.00-97.25.

Solid crescent with rectangular section.

911 *Pl. 52. M68.13:7756. Early Byzantine?*

Copper alloy. Corroded and diseased.

L. 5.50; diam. spiral 2.00; W. band 0.90.

BS in front of E4 E33.54/S5.56 *96.87.

Flat band with rounded end rolled into a tight spiral at other end.

912 *Pl. 52. M60.53:2619. Byzantine?*

Iron. Corroded.

Max. L. 8.30; W. ends 1.80; Th. 0.50.

AcT Trench B E1012.00-1022.00/S1076.00-1083.00 *403.00 a.s.l.

S-shaped rod with square section flattened at each end into a rough circle with extended point. Perhaps a door or casket ornament.

913 *M62.46:4386. Late Byzantine?*

Iron. Corroded.

Max. P.L. 10.00; diam. end 2.10; Th. 0.40.

AcT local grid W14.00/N13.00 Unit 9 *402.00 a.s.l.

Similar to preceding, but with hole through center of ends for attachment.

FIGURATIVE OBJECTS OR OBJECT PARTS

These few objects are of figurative design (human or animal) but have no apparent connection and in most cases their original purpose is uncertain. Most are fragmentary, but seem to have been intended as part of a larger whole. The equid ear (**916**) was clearly part of a work of sculpture; the others are less clear.

Other figurative objects whose function seems more secure (e.g. the lion lamp, **618**, and brooch, **688**) have been included elsewhere in the catalogue under the appropriate headings.

914 *Pl. 52. Archaic Lydian?*

Silver. Surface corroded. Head and legs missing. No dimensions available.

PN W248.00-249.00/S350.00 no level available. Found with Lydian and East Greek sherds.

Relief plaque showing draped female torso with proper right arm lifted to left breast; left arm hangs down at slight angle, perhaps for hand to cover pudenda. Full hips, narrow shoulders. Little internal detail visible.

915 Pl. 52. M63.67:5918a. Late Roman?

Copper alloy. Surface worn; chin chipped.
H. 2.10; W. 1.20; Th. 1.00.

Syn P "Restaurant" E120.00-122.00/N1.50-2.00 *97.50-96.75.

Human head wearing peaked Persian cap fitted over ears (Attis?). Back flat with round depression at widest part. Mouth, eyes and brows incised with dotted pupils in eyes; mouth is a single deep line. Locks of hair over forehead indicated in shallow relief. Small incised circles over surface of cap. Head was once attached to something else, perhaps a vessel.

916 Pl. 52. M60.12:2253. Roman, 1st-2nd C. A.D.?

Gilded copper alloy. Broken at point of attachment to head.

Max. P.L. 13.00 (life-size); W. 5.20; W. broken end 5.70.
HoB E1.45/S103.00 *100.96 in late mixed fill.

Solid cast, finely modeled ear of equid. Traced lines on inner surface and rim to indicate hair. Traces of gilding on back and inside. Iron bar runs vertically through center for attachment to head.

This is the only remaining evidence for large-scale metal sculpture at Sardis.

Publ. *BASOR* 162, 17. See D. K. Hill, *Catalogue of Classical Bronze Sculpture in the Walters Art Gallery* (Baltimore 1949) 6-7, pl. 4 no. 10 (horse's head in gilded bronze); S. Stucchi, "Gruppo Bronzoe di Cartoceto. Gli elementi al Museo di Ancona," *BdA* 45 ser. 4 (1960) 7-42, esp. figs. 1-4, 49, 50, 52, 79 (bronze horses' heads); H. von Roques de Maumont, *Antike Reiterstandbilder* (Berlin 1958) passim, but esp. 84 fig. 43 (for ear markings); and Oddy, et al., "Gilding," 182-186 for practice of gilding in antiquity. Oddy's suggestion that the gilding of large-scale sculpture did not become common until the 2nd or 3rd C. A.D. may have some bearing on the date of this ear.

917 Pl. 52. M60.60:2699. Roman?

Copper alloy. Possibly broken from a larger object; diseased.

Max. P.L. 3.10; max. P.H. 2.70.
HoB E0.00/S105.00 *99.70.

Apparently a bird's foot formed of three claws set at oblique angles, and a short spur between the two shorter

claws. The stump of the leg is perpendicular to the claws. Alternatively, this could be a clatrop, a weapon used for disabling cavalry.

For caltrop with similar shape in iron see Curle, *Roman Frontier Post*, pl. 38 no. 14. For use see British Museum, *Greek and Roman Life*³, 103.

918 Pl. 52. M68.20:7822. 4th-6th C. A.D.

Leaded tin bronze. Analyzed by emission spectrography. See Chap. V, Tables V.1, 3. One foreleg missing; surface pitted.

Max. L. (nose to tip) 5.40; Th. back 1.00; L. front leg to hind end 4.90.

Syn FC E107.20/N4.70 *96.30 below mosaic but above subfloor, not sealed.

Stylized dog in leaping pose, apparently once attached to another object. Dog has raised head with open mouth. The ears are separated by an incised line from the nose to the tip of the ear. In profile, the figure describes an S-curve from the end of the ears to the lower part of the rump. The forelegs extend horizontally, the belly is slightly convex, and the elongated and undifferentiated hind legs slope back on a straight diagonal.

MISCELLANEOUS

Suspension Devices (?)

919 Pl. 53. M62.83:4883. Lydian.

Copper alloy. Corroded.
3.00 × 3.00.

HoB Lydian Trench W20.00/S100.00 *98.60 in Lydian context.

Flat, equal-armed cruciform object with central perforation. Incised lines around ends of arms.

For use of a similar but better made suspension device see A. K. Orlandos, in *Collection Hélène Stathatos* III, 290, pl. 45 no. 240 (with censer).

920 Pl. 53. M62.86:4925.

Copper alloy.
W. 3.80; diam. holes 0.60.
MC E23.00/N72.80 *97.40.

Roughly triangular piece of sheet metal perforated through center and in each "angle." The edges of the sheet are crimped down as if to attach it to some other object—perhaps a pole or hook passed through the center and other things were suspended from the three lateral holes.

921 *Pl. 53.*

Copper alloy.

L. 3.35; W. lateral projections 2.10; W. rounded end 1.00; W. narrow end 0.40.

PN W247.00/S348.00 ca. *89.70.

Roughly triangular object, hollow on one side, flat on other. Horizontal hole through narrow end with two ridges just below it. At the widest point are two lateral projections with vertical holes through them. Below is a rounded, solid section with three horizontal grooves on one side, impressed dots on other.

922 *Pl. 53.* M68.2b:7611. Early Byzantine.

Copper alloy.

Diam. 2.00.

BS E2 E16.72/S3.09 *96.76 found with **936** and **937**.

Crudely formed disk with four pierced tabs cut away and twisted at right angles to disk. In center of one side of disk is an indentation.

923 *Pl. 53.* M60.83:2973. Hellenistic-Roman?

Copper alloy. Diseased.

L. 6.00; max. W. 3.20; ext. diam. loops 2.10.

HoB E10.00/S90.00-95.00 *102.00-100.50 in mixed fill.

Flat loop with ends twisted at right angles into smaller loops and brought close together.

*Flint Striker?***924** *Pl. 53.* M63.52:5788. Late Roman-Byzantine.

Copper alloy.

L. 3.70; W. 2.20; Th. 0.40.

Syn MH E70.00-75.00/N0.00-2.00 *98.00.

Two similar ones found in BS E13 with censer holder **587** but apparently they do not belong with it.

Flat band with ends bent over to form ovoid loops on either side and a narrow angle where the ends come together.

See Davidson, *Corinth* XII, 190, 195, pl. 88 no. 1468 (iron, 7th C. A.D.).

*Key Ring?***925** *Pl. 53.* M59.35:1600. Early Byzantine.

Copper alloy. Diseased.

Ext. diam. 2.80; max. W. band 1.00; W. bar 0.30.

BS W3 W16.00-18.00/S4.40 *98.00-97.80.

Band widened and brought to a point on one side, tapers and narrows on opposite side to a flat bar (perhaps for a key?). Center of band is thickened and decorated with traced lines on outer surface.

*Empolium***926** *Pl. 53.*

Lead.

Diam. 8.00; H. 6.10; inner rectangle 2.40 × 2.60.

Pa E75.00/N39.00 *96.10.

Slightly more than a hemisphere of metal poured into the ground to form the base for a rectangular pole or rod. Hollow rectangular impression remains within.

*Furnace Attachments***927-932** *Pl. 53.* M59.57:1904. Late Roman?

Leaded tin bronze; lead. Analyzed by emission spectrography and neutron activation. See Chap. V, Tables V.1, 3, 4a.

Plaques with knobs 5.00 × 5.00; diam. knob 1.70; plaques without knobs 5.00 × 4.30; diam. round plaque 3.80.

CG MAE *97.00-96.40 in association with furnace.

Six small plaques; one round, five rectangular to square; one lead, five bronze. The square-rectangular ones were apparently cast solid with beveled edges. Holes were later cut through the centers with a chisel producing crudely cut ragged edges. Crude cylindrical knobs protrude through these holes in two of the squares. The knobs are hammered flat-like rivets on the convex surface of the plate, apparently broken on the (inner?) concave surface.

Publ. *BASOR* 157, 42; *Sardis* R1 (1975) 136, fig. 359.*Spool or Stud***933** *Pl. 53.* M62.10:4185. Roman or later?

Copper alloy.

L. 1.90; diam. disks 1.60, 1.90.

MRd Colonnade E81.50/S7.00 *96.60 fill above mosaic pavement.

Two small disks joined by a short bar passing through holes in the centers of the disks. One disk is fixed to the bar by hammering the end of the bar like a rivet; the other disk is free to slide up and down the bar, but cannot come off it. Possibly, the central hole of the free disk was enlarged fortuitously.

See Anemurium AN 73/82. In unstratified fill of a Byzantine house with coins ranging from late 4th-early 7th C. (unpubl.).

Tube

934 *Pl. 53.* M62.85:4917.

Copper alloy. Incomplete.

Max. P.L. 6.30; diam. 1.00.

Syn FC E110.00/N8.00-10.00 *96.75 in probe trench.

Length of cylindrical tubing, hollow in one end only. On outer surface are three tear-shaped projections.

Panpipes

935 *Pl. 53.* M67.27:7473. Early Byzantine.

Copper alloy. Fragmentary and deteriorating.

Max. P.L. 8.00; diam. one pipe 1.00; Th. 0.05.

BS E10 or 11 E66.21/S2.59 *96.21.

Remains of three straight pipes adhered together with narrow raised bands around each pipe. No apparent finger holes or stops visible. Imprints of cloth and some fiber preserved on the metal surface.

Find publ. *BASOR* 191, 22. For discussion of ancient wind instruments see K. Schlesinger, *The Greek Aulos: A Study of its Mechanism and of its Relation to the Modal System of Ancient Greek Music* (London 1939); for similar finds see N. B. Bodley, "The Auloi of Meroë," *AJA* 50 (1946) 217-240, pls. I-VI.

936 *Pl. 53.* M68.2a:7611. Early Byzantine.

Copper alloy. Fragmentary.

Diam. 4.50; Th. 0.05.

BS E2 E16.72/S3.09 *96.76 found with 922 and 937.

Half-preserved disk with slightly upturned edge. Three incised concentric circles surround a central dot.

937 *Pl. 53.* M68.2c:7611. Early Byzantine.

Copper alloy.

Bot. diam. 2.90.

BS E2 E16.72/S3.09 *96.76 found with 922 and 936.

Lion's paw broken off some larger object like a lamp-stand. Five claws are differentiated with rough areas in between. A straight line is incised across all the claws to indicate the joints. The bottom is concave.

Hasp

938 *Pl. 53.* M61.25:3333. Hellenistic-Roman?

Iron.

Max. P.L. loop 8.90; ext. diam. loop 2.20; W. band 1.10; Th. 0.40; max. P.L. hook 8.60.

HoB E5.00-10.00/S110.00 to *101.50.

Two metal bands with flat section. One is bent double with a loop at the center; the other forms a hook which fits through the loop.

939 *Pl. 53.* M59.42:1659. Early Byzantine?

Iron. Corroded; one end missing.

Max. P.L. 15.60; L. cotter pin 7.40; Th. bar 1.10.

HoB Area 8 E30.00/S60.00-70.00 to *97.50 in E niche.

Straight bar with rectangular section, broken at one end, conical knob at other. Two "cotter pins" are looped around the bar, originally free swinging, now corroded in place.

Handles?

940 *Pl. 53.* M66.9:7070. Byzantine.

Copper alloy. Broken in two pieces, apparently joining. Max. P.L. 19.30; diam. ring 2.40; W. band 0.20; W. cross 1.50.

Pa E40.70/N26.90 *96.26.

Slender shaft with round ring near one end. Ring has a short projection opposite the shaft. The other end of the shaft terminates in an equal-armed cross. Near the break in the shaft the metal thickens and a small piece of metal is attached at this point. The surface of the shaft is incised with dotted wavy lines and horizontal lines.

For a long shaft ending in a similarly shaped cross see Anemurium, no. 68-14, Early Byzantine context (unpubl.).

941 *Pl. 53.* M61.4:3142. Byzantine?

Copper alloy.

Max. P.L. 9.50; diam. wider end 0.50; diam. smaller end 0.30; W. open "cube" 0.50; L. 1.00.

HoB E5.00/S85.00 *100.00.

Tapering bar with circular section hollow at widest end. Other end possibly broken off some other object. Two openwork cubes are found along the bar, 3.40 cm. apart. In each cube is a tiny ball that rolls freely with movement of the bar. The solid part of the bar is decorated with moldings and incised lines—spiral twists and hatchings. Perhaps a decorative handle for a small implement.

Several spatulate implements with similarly decorated though solid handles were found at Corinth and tentatively dated to the Byzantine period.

See Davidson, *Corinth* XII, 188, pl. 84 nos. 1387-1391. A more closely parallel handle with openwork cube and loose ball was

found at Anemurium, no. 73-315, Early Byzantine context (unpubl.).

Hooks and Chains

942 Pl. 54. Lydian?

Iron. Corroded; shaft broken away.

W. 12.00; max. P.H 15.00.

HoB W0.00-5.00/S100.00-103.00 *97.30-97.00 with Lydian and East Greek sherds.

Broad, rounded hook.

943 Pl. 54. M63.38a:5538. Roman or later?

Copper alloy.

L. 10.00; W. hook 3.00; diam. loop 1.70.

Syn MH E57.00/N10.00 *98.00 probably in building debris or later occupation fill.

Hook, shaft and terminal loop made of a metal bar with round section spirally twisted through the shaft. Hook and terminal loop at right angles to each other.

See Yadin, *Cave of Letters*, 90, 89 fig. 32, pl. 25 no. 35 (iron, 2nd C. A.D.).

944 Pl. 54. M60.17:2315. Byzantine-Turkish?

Copper alloy.

H. 5.50; span of hook 2.50; Th. 0.30.

AcT Trench A E995.00-1011.00/S1068.00-1080.00 surface. Found with Turkish and Middle Byzantine material.

Made of metal bar with square section. Shaft above hook widens and spreads into prongs. Above that the shaft splits and curves outward, then inward to form a loop (right side broken away).

945 Pl. 54. M68.3:7612. Early Byzantine.

Copper alloy.

Max. P.L. 26.00; W. links 1.20; L. hook 3.60.

BS E2 E14.23/S3.60 *97.28.

Thirteen heavy chain links of figure-eight type made by bending short bars with round section into shape with open ends meeting at constriction. Attached to one end is a plain hook with round section.

946 Pl. 54. M60.62:2703.

Iron. Corroded and broken.

Max. P.L. 24.00; Th. links 0.40; diam. ring 3.50.

AcT Trench E E1044.00-1047.00/S1063.00-1065.00 *406.00 a.s.l. in fill.

Six chain links of figure-eight type made of iron rings closed by welding or soldering at constriction. At one end is a larger, closed ring.

947 Pl. 54. M61.91:3979. Hellenistic-Roman?

Copper alloy. Some corrosion.

L. 1.75; W. loop 0.50; W. coil 0.30.

HoB E5.00/S110.00 *100.50.

Small chain link made of coiled wire looped at both ends.

OBJECTS ASSOCIATED WITH METALWORKING

Evidence for metalworking at Sardis has been discussed in a general way in Chapter I. What follows is a select catalogue of the objects or paraphernalia that may be associated with these activities: a few molds, a die, a gilding crucible (?), parts of tuyères and a furnace. Possible metalworking tools—hammers, chisels, etc.—are treated above in the section on tools. While the catalogue is not long, and the objects for the most part cannot be related to each other, taken as a whole they testify to a continuity of metallurgical activity at Sardis from archaic through at least Early Byzantine times.

Intaglio Die for Raising Gold Foil

948 Pl. 54. M61.92:4008. Lydian, 6th C. B.C.

Copper alloy.

L. 5.00; W. 5.00; Th. 0.50.

HoB W19.00/S95.00 *99.60 outside S wall of Bldg. C.

Flat square cast plaque with back and edges left rough and irregular. Cut into one surface is a square with patterns in reverse: outer edge bead-and-reel between straight lines; inner square four equal sized two-thirds circles—one against each edge. Circles are dotted in center and have bead-and-reel borders. At center of whole is a dotted circle. Separating elements of the design are diagonal lines beginning in the corners of the inner square and cut by shorter lines tangential to the two-thirds circles. On outer edge the plaque is perforated by a small hole for hanging.

A fragment of gold foil with a very similar (but not identical) design in relief was found in the archaic temple deposit at Ephesus, perhaps a remnant of the wealthy gifts once dedicated by Croesus at this sanctuary.

Publ. *BASOR* 166, 11, 12 fig. 8. See Hogarth, *Ephesus*, 113, pl. X. For use of such a die see Untracht, 82 (Hellenistic); Davidson in Hoffmann-Davidson, 27. For another archaic die

see Higgins, 12, pl. 15c-f (bronze die from Corfu, 7th C. B.C., Oxford, Ashmolean Museum G.437).

Molds

949 Pl. 54. S69.8:7982. Lydian, 6th C. B.C.

Grayish-green steatite. Corner broken.

L. 6.80; W. 4.90; Th. 2.00-2.30.

PN W250.50/S385.70 ca. *87.20.

One-half of a two-piece mold for casting jewelry. Cuttings on the two broadest surfaces.

Side 1: Two holes near corners for securing other half of the mold. Several cuttings for small objects—apparently leech-shaped earrings and pins. Conical pour channels from edges of mold to each object.

Side 2: Four holes irregularly distributed.

Publ. *BASOR* 199, 25-26, fig. 15.

950 Pl. 54. S61.16:3380. Lydian?

Gray-green schist. Corners and edges broken.

Max. P.L. 7.00; max. P.W. 4.50; Th. 1.40.

HoB W5.00/S105.00 *100.00 mixed context.

Part of half of a two-piece mold for casting jewelry. Cuttings for objects to be cast on both broad sides.

Side 1: Cuttings for three leech-shaped earrings, each with a pour channel leading from edge of mold to the thickest part of the hoop.

Side 2: Segment of a circle (bracelet?) and part of another object, perhaps a fibula.

See Muscarella, *Phrygian Fibulae*, pl. XVI.83, 84 (fibulae molds from Bayraklı). For Lydian earrings of this general type see 721 and 722.

951 Pl. 54. S61.17:3397. Lydian, 6th C. B.C.

Schist. About half broken away.

Max. P.L. 7.00; max. P.W. 4.50; Th. 1.40.

HoB Bldg. B W5.00/S100.00 *99.30 floor at foot of wall.

Part of half of a two-piece mold. Cuttings for objects on two broad sides.

Side 1: Cuttings for two leech-shaped earrings with pour channels leading to widest part of hoop. Circular depressions for holding pins to secure other half of mold.

Side 2: Deep circular object, about two-thirds preserved; pour channel from edge to ring; two depressions for securing two halves of mold.

952 Pl. 54. S63.1:4959.

Schist. Edges broken.

Max. P.L. 5.30; max. P.W. 5.10; Th. 0.50.

HoB W20.00/S115.00-120.00 to *102.50.

Part of half of a two-piece mold. Cuttings for objects on two broad sides; edges beveled.

Side 1: A circle and rectangle in relief against a recessed rectangle. At center of each is a centering hole. Around the edge of the circle and rectangle, and within the recessed section are small, deep dots. A lightly inscribed circle is visible on the surface of the rectangle. Pouring channels (?) from edge of recessed rectangle do not seem to lead to edge of mold.

Side 2: Cuttings similar to Side 1 but less well preserved.

953 Pl. 55. S63.6:5008.

Schist. Broken on two sides.

Max. P.L. 3.10; max. P.W. 3.00; Th. 1.35.

HoB W20.00/S110.00-115.00 to *100.90 in Hellenistic and Roman fill.

Part of half of a two-piece mold. Cuttings on one broad side and edges.

Side 1: Shallow crescent-shaped cutting for earring or ring with centering hole and pour channel. Round depression for holding pin to secure other half of mold near upper l. corner.

Shallow cuttings visible in two edges (one is the pour channel).

954 Pl. 55. S62.3:4136. Byzantine?

Slate. One edge broken.

Max. P.L. 14.30; max. P.W. 9.00; Th. background 1.50;

Th. at spoon bowl 2.50; L. spoon 10.00; W. 3.50.

RT E8.00/S8.00 *97.60 on top of mosaic sidewalk.

Half of a two-piece mold for casting a spoon with deep ovoid bowl, curving handle ending in a duck's head. Bowl is carved in relief (about 1.00 cm. high), handle in intaglio. A conical pour channel runs from the edge of the mold to the lower part of the bowl. The spoon is a different type from the actual metal spoons found at Sardis (see 225-229).

Blowpipe

955 Pl. 55. M68.19:7819. Lydian, ca. 600-550 B.C.

Iron. Broken in two joining pieces; heavily corroded.

Max. P.L. 9.00; L. tube 6.70; Th. 0.80; rounded end 2.20 × 2.50.

PN W272.30-277.80/S346.00-346.70 *86.20-85.70, associated with Lydian gold refinery (see Chap. I).

Curved hollow tube with larger end rounded on one side.

Tuyère

956 Pl. 55. T68.16:7825. Lydian, ca. 600-550 B.C.

Terracotta. One of several fragments.
Max. P.L. 12.20; W. 5.20; W. hollow 2.00.
PN W260.00-262.00/S336.00-338.50 NE dump *85.70-85.50 associated with Lydian gold refinery.

Coarse red pottery with curved, concave, funnel-like depression running the length of the fragment, probably part of the air channel. The exterior of the clay is vitrified to a shiny black.

Part of a Furnace?

957 Pl. 55. Hellenistic.

Terracotta, iron with earth incrustation. Fragment.
Max. P.L. 18.00; max. P.W. 6.60; Th. 3.40; int. diam. ca. 21.00; W. iron strap 3.70.
HoB industrial area E5.00/S95.00-106.00 to *99.40.

Section of a bowl-shaped object with traces of glassy slag and dribbles of copper (alloy?) on inside. On the outside an iron strap with a rivet apparently was used to support the walls of the bowl.

Crucible

958 P72.9:8911. Late Roman-Early Byzantine.

Terracotta. Four joining pieces.
Est. diam. ca. 7.00; Th. rim 0.70; max. H. 4.50.
BS W7 W24.00/S6.50 *96.80.

Part of a hard, coarse, dark gray pot with high quartz content in clay body. The ext. is ridged; the int. is covered with black slag containing gold particles. The crust is composed mainly of lead with a trace of iron and silicate slag or scum. This possibly represents the remains of a small-scale gilding operation or the refining of gold.
(Observations on the nature of the slag were made by conservator A. Lins.)

Casting Spill?

959 Pl. 55. M63.12:5089.

Copper (alloy?).

L. 7.20; Th. projection 0.30; W. mass 2.20.
HoB W5.00-10.00/S120.00 *102.00-101.40 in upper fill.

Irregular mass with long, thin projection extending from one side.

Lead "Ingots"

960 Pl. 55. M61.51:3603. Lydian?

Lead. Ends missing.
Max. P.L. 11.00; Th. one strip 0.25.
HoB W15.00/S95.00 *100.00-99.50 in upper fill.

Two strips with square section twisted spirally together. Perhaps intended to be used in small quantities by snipping pieces off the ends, as is present-day solder. Similar strips found elsewhere in HoB (see 961). Pfuhl, discussing similar objects from a grave deposit on Thera, suggests they were religious offerings.

See Blinkenberg, *Lindos I*, 156, pl. 16 no. 460 (archaic, 23 examples); E. Pfuhl, "Der archaische Friedhof am Stadtberge von Thera," *AthMitt* 28 (1903) 78, 237, fig. 80 (Proto-corinthian skyphos from Thera Tomb no. 97 [108] filled with small strips of twisted lead, "purpose unknown," archaic).

961 M62.29a:4257. Lydian?

Lead.
Max. L. ca. 14.00; Th. 0.70.
HoB Bldg. C W20.00/S95.00 to *99.80.

Similar to preceding but with thicker section. This was one of twelve such strips found here, all about the same size, all twisted into random shapes.

962 Pl. 55. Hellenistic?

Lead.
Max. L. 14.50; max. W. end 0.70; W. point 0.40; Wt. ca. 80 g.
AT inside clamp hole on euthynteria block at junction with E wall end and NE anta at *100.20.

Straight strip with square section, tapered on one end. Differs from preceding largely in being tapered and in being straight rather than twisted.

See Stronach, *Pasargadae*, 225, fig. 97.17 (Achaemenid).

IV METALWORK FROM SARDIS IN TURKISH, EUROPEAN AND AMERICAN COLLECTIONS

with a contribution by Andrew Oliver, Jr.

The metalwork found by the Harvard-Cornell Expedition is stored at the site or deposited at the regional Archaeological Museum in Manisa. A number of metal objects of known or alleged Sardian provenance were discovered prior to 1958, the start of the Harvard-Cornell excavations, and are located in several museums and collections in Europe, the United States and Turkey.¹

The bulk of this material was found by the Princeton Expedition, primarily in Lydian tombs, and is now divided among the Istanbul Archaeological Museum, the Metropolitan Museum of Art in New York, the Fogg Art Museum at Harvard University and the Ashmolean Museum at Oxford. Most of this material, with the exception of the gold jewelry published by Curtis,² and a bronze mirror published by Oliver,³ has not been published previously in any detail.

Besides these finds from an authorized excavation, there exist a number of chance finds and purchases from dealers that have been attributed to Sardis but whose provenances must remain more doubtful. These range from a copper alloy pendant in the Ashmolean (992) to a brass steelyard in the British Museum (993) to some gold ornaments in Berlin (994-996) and other ornaments whose present whereabouts are unknown (997-1000).

For the sake of economy, it has been thought best to include in the present study only those objects that have

not been previously published in an easily accessible source.

Silver Objects from the Princeton Expedition in the Istanbul Archaeological Museum (Oliver, Waldbaum)

In June 1974 Andrew Oliver, Jr. and Jane C. Waldbaum visited Istanbul to examine the silver vessels and utensils in the Istanbul Archaeological Museum found at Sardis by Howard Crosby Butler before World War I. Through the courtesy of Necati Dolunay, Director of the Museum, and the late Nezih Fıratlı, then Keeper of Classical Antiquities, permission was graciously granted to photograph and study the objects at first hand. Later, Pieter Meyers, then of the Conservation Department of the Metropolitan Museum of Art in New York, generously agreed to donate his time and arrange the services of Brookhaven National Laboratory to provide neutron activation analysis of samples taken from the silver. His results are reported in Chapter V, Tables V.7 and 8.

Most, if not all, of the Sardian silver was excavated in 1911 from the extensive series of tombs in the hillside nekropolis across the Pactolus stream from the Temple of Artemis. Although some 1,100 tombs were excavated, relatively few objects are preserved from them.

A copy of the inventories of the tomb contents (Chase catalogue) is on file at the Sardis Research Office at Harvard University. Of some twenty pieces of silver listed in these inventories, one was given to the Metropolitan Museum of Art (974), ten were transferred to

1. See Chap. I, ns. 6-13.

2. *Sardis* XIII (1925).

3. Oliver, "Bronze Mirror," 113-120.

Constantinople in 1912 and another ten are missing, presumably lost or destroyed at Sardis during the hostilities that ravaged western Turkey in the early 1920s. Other objects apparently disintegrated during excavation and there is no record of their form.⁴

Several pieces of bronze and silver, including at least two of the lost pieces, are shown in an old photograph of precious objects from Sardis⁵ (*Pl. 56*): the plain phiale between the two mirrors on the bottom shelf, and the jar at the right on the top shelf.⁵ The latter must be identical with either a "pot" or an "ink bottle" both listed in old inventories as coming from Tomb 18. The two spindle-shaped objects, if indeed they are of silver, are likely to be two "stirrers" listed as coming from Tombs 18 and 811. The three saucers shown on the bottom shelf may be a set cited as from Tomb 35, two of which are described in the following catalogue (968, 969), but they could equally well be three lost ones from Tomb A 1. Not shown in any photograph is a mirror from Tomb 816, and a silver bowl, either from Tomb 75 or Tomb 213. It is useless to speculate on their appearance.

All of the preserved objects are from the period of Persian occupation at Sardis (late sixth to fourth century B.C.), and several are either Achaemenid in style or exhibit strong Persian influence. This is stylistically consistent with other objects from this period found throughout Western Asia Minor at sites under Persian dominance.

Phiale Mesomphalos

963 *Pl. 56*. ISTANBUL, ARCHAEOLOGICAL MUSEUM 4539. Late 6th-early 5th C. B.C.

Silver. Analyzed by neutron activation. See Chap. V, Table V.7. Fractured with pieces missing. Exterior cleaned; interior still corroded.

H. ca. 2.70; diam. 15.75.

From Tomb 213, excavated in 1911.

The raised decoration, intended to be seen from the exterior, is in two zones: a radiating fan of flutes in the inner zone; and twenty teardrop-shaped lobes with intervening palmettes in the outer zone. The old group photograph (*Pl. 56*) shows this phiale intact.

No exact parallel is known in any material. Although lobed phialai are common in Achaemenid silver, the lobes usually point inward, and the designs are different.

4. *Sardis I* (1922) 83.

5. This photograph also includes the bronze mirror published by Oliver, "Bronze Mirror," and another bronze mirror at the right on the bottom shelf, the whereabouts of which is now unknown.

Publ. *Sardis I* (1922) 83, 84, fig. 82 also showing the phiale complete; H. Luschej, *Die Phiale* (Bleicherode am Harz 1939) 96, 105, no. 13; Oliver, "Bronze Mirror," 115-116, also mentioning other objects from the same tomb. See also P. Amandry in *Collection Hélène Stathatos III*, 260-261, figs. 156, 157, pl. 37; Pope, IV, pls. 119-120. Luschej, *Die Phiale*, fig. 31a, b includes an example with outward pointing lobes from Asia Minor (now Berlin, Antiquarium); another example in bronze is shown in Moorey, "Iranian Troops," 111 fig. 2 no. 6, from Deve Hüyük in Syria, thought to be of Greek manufacture and dated to the early 5th C. B.C.

Phiale

964 *Pl. 56*. ISTANBUL, ARCHAEOLOGICAL MUSEUM 4540? 5th C. B.C.

Cupriferous silver. Analyzed by neutron activation. See Chap. V, Tables V.7, 8. Intact but with areas of superficial corrosion, especially on one half of the ext. Int. partially cleaned.

H. ca. 5.00; diam. 10.40.

Almost certainly from Tomb 113, excavated in 1911.

Deep bowl with small omphalos 1.30 in diam. Flaring everted lip; sloping neck set off from body. Two horizontal grooves on body below junction of shoulder and neck.

The bowl illustrated here was without inventory number but in all probability corresponds with no. 4540 of the museum's inventory for which there is no other candidate in the Istanbul Museum. A similar phiale from Bulter's excavations at Sardis is in New York, Metropolitan Museum of Art no. 26.164.13 (974).

Unpubl. For similar shape in bronze but apparently without omphalos or horizontal grooves see Schmidt, *Persepolis II*, 94, pl. 68 no. 1 (from the Apadana). Similar also but with taller rim is a piece in the British Museum, see Dalton, *Treasure of the Oxus*, 44-45, fig. 72 no. 182 (identified as "Persian, 5th C. B.C.").

Ladle

965 *Pl. 56*. ISTANBUL, ARCHAEOLOGICAL MUSEUM 4533. 5th C. B.C.

Cupriferous silver. Analyzed by neutron activation. See Chap. V, Tables V.7, 8.

L. 19.00; diam. of bowl 5.30.

Found in Tomb 100, a stone sarcophagus, excavated in 1911. The ladle was found in the spouted dish, 966.

Straight shaft with octagonal cross section becoming round at upper loop and terminating in a calf's head. Shallow, round bowl at right angles to shaft. Crescent-

shaped marks are incised at the top and bottom of the shaft.

Publ. *Sardis* I (1922) 83; Amandry, in *Collection Hélène Stathatos* III, 264-267, fig. 163 left. The following silver ladles with handles terminating in calves' heads are related: Istanbul Archaeological Museum 2243 from Aydin, Turkey, (Amandry, *Collection Hélène Stathatos* III, 264 fig. 163 right); London, British Museum Department of Western Asiatic Antiquities 116410 (= 1923.6-9.2) and 118014; New York, Metropolitan Museum of Art no. 68.11.4 (unknown provenance).

Spouted Dish

966 *Pl. 56.* ISTANBUL, ARCHAEOLOGICAL MUSEUM 4537. 5th C. B.C.

Cupriferous silver. Analyzed by neutron activation. See Chap. V, Tables V.7, 8. Corroded; handle missing. H. 2.40; diam. 8.50; W. including spout 10.20. From Tomb 100, excavated in 1911. Found with ladle **965** (Istanbul 4533).

Rim slightly thickened with edge of the spout thinner than the rim. The old group photograph of silver from Sardis (*Pl. 56*) shows the dish with a horizontal loop handle attached to the rim opposite the spout.

Unpubl. A comparable spouted dish of silver, with loop handle, is in New York, Metropolitan Museum of Art acc. no. 68.11.7 (provenance unknown).

Fluted Jar

967 *Pl. 56.* ISTANBUL, ARCHAEOLOGICAL MUSEUM 4541. Early 4th C. B.C.

Cupriferous silver. Analyzed by neutron activation. See Chap. V, Table V.7. Lower half missing. Int. less corroded than ext.

Diam. body 6.00; diam. top 2.80.

From Tomb A 1. Found with three small silver saucers, now lost but probably those shown in the old photograph (*Pl. 56*), and with the following gold jewelry: earrings and a bracelet with a chalcedony seal, Istanbul, Archaeological Museum 4551, 4542, 4518 respectively; *Sardis* XIII (1925) nos. 79, 80, 101.

The photo in *Pl. 56* shows the jar complete with a slightly squat, ovoid body. Concave fluting raised by hammering and showing in the negative on the int. Engraved "darts" between the rounded tops of the flutes. The fluting resembles the concave fluting on the Persian bowls from Tell el-Maskhuta, Egypt (Oliver, *Silver* no. 7) rather than the convex fluting on Greek bowls and mugs from Macedonia and elsewhere (e.g. Oliver, *Silver* nos. 10 and 25).

Unpubl. No comparable jar known.

Saucers

968 *Pl. 56.* ISTANBUL, ARCHAEOLOGICAL MUSEUM 4535. 5th C. B.C.

Cupriferous silver. Analyzed by neutron activation. See Chap. V, Table V.7. Corroded; two fragments missing. H. 1.10; diam. 6.40.

From Tomb 35, excavated in 1911. This tomb also contained two other saucers, Istanbul 4534 (now lost) and 4536 (**969**) and a cosmetic spoon, Istanbul 4574 (**971**).

Shallow bowl with thickened rim, flat across the top.

Unpubl. Tomb A 1 which yielded the fragmentary jar **967** (Istanbul 4541) contained three similar saucers, now lost. Related saucers are in New York, Metropolitan Museum of Art nos. 66.11.25 and 68.11.6 (provenances unknown), and Istanbul, Archaeological Museum nos. 2240 and 2241 from Aydin, Turkey.

969 *Pl. 56.* ISTANBUL, ARCHAEOLOGICAL MUSEUM 4536. 5th C. B.C.

Cupriferous silver. Analyzed by neutron activation. See Chap. V, Tables V.7, 8. Intact except for a small puncture.

H. ca. 1.20; diam. 6.30.

From Tomb 35, excavated in 1911. See **968** for associations.

A curved line on the ext. marks where the rim of the other saucer lay against it in the tomb. The crescent-shaped area outside this line is more corroded than the gibbous-shaped area, as the latter was shielded by the second saucer.

Cosmetic Spoons

970 *Pl. 56.* ISTANBUL, ARCHAEOLOGICAL MUSEUM 4538. 5th C. B.C.

Cupriferous silver. Analyzed by neutron activation. See Chap. V, Table V.7.

L. 11.70.

From Tomb 381, excavated in 1911. This tomb also contained the following gold jewelry, all now in Istanbul: a chain of 150 beads, inv. 4588, *Sardis* XIII (1925) no. 25, pl. III, fig. 1; a pair of earrings, inv. 4586, *Sardis* XIII (1925) no. 70, pl. VII, fig. 9; and a ring, inv. 4585, *Sardis* XIII (1925) no. 92, pl. IX, fig. 5.

Straight shaft, small bowl. Two lines incised on the back at the junction of bowl to shaft.

Unpubl. Two other silver "cosmetic spoons," now lost, came from Tombs 18 and 811 at Sardis. For similar ones in brass from the Harvard-Cornell Expedition, mostly later in date, see 619-625.

971 *Pl. 56.* ISTANBUL, ARCHAEOLOGICAL MUSEUM 4574. 5th C. B.C.

Cupriferous silver. Analyzed by neutron activation. See Chap. V, Table V.7. Intact but corroded. L. 11.60.

From Tomb 35, excavated in 1911. This tomb also contained three silver saucers, Istanbul 4534 (now lost), 4535 and 4536 (968, 969).

Similar to 970 but with thicker handle shaft.

Metal Objects from the Princeton Expedition in the Metropolitan Museum of Art, New York

In August, 1974 Jane C. Waldbaum visited the Metropolitan Museum of Art to examine the metal objects donated to the museum by the American Society for the Exploration of Sardis; the Society had received the objects in the division of finds recovered by Butler's excavation.

Permission to examine the objects was graciously granted by Dietrich von Bothmer, Curator of Greek and Roman Art, and Joan Mertens, Curator of Greek and Roman Art, generously provided assistance in gaining access to the objects and to the records concerning them.

Sculpture Fragment

972 *Pl. 57.* METROPOLITAN MUSEUM OF ART 26.199.151. Gift of the American Society for the Exploration of Sardis, 1926. Hellenistic-Roman?

Copper alloy. Fragmentary. Max. P.H. 4.50; max. P.W. 7.50; Th. 0.20; W. toe 2.00; H. base 1.50.

Part of small toe and something more of fourth toe of r. foot set on a curved base. Nails of preserved toes indicated. Sculpture was made by hollow casting. This is one of the very few examples of large-scale metal sculpture found by either the Princeton or the Harvard-Cornell Expedition.

Skyphos

973 *Pl. 57.* METROPOLITAN MUSEUM OF ART 26.164.12. Gift of the American Society for the Exploration of Sardis, 1926. Butler number BR 132. Lydian, 7th-6th C. B.C.?

Copper alloy. Handles and foot repaired. H. 11.50; max. diam. rim 10.50; L. handles 3.40; W. handles 3.60; diam. base 4.50. Found in Tomb 723 with several other bronzes and Lydian and Corinthian pottery.

Deep, semi-ovoid cup; raised foot with flaring base; two horizontal loop handles with round section.

The shape is a fairly common one in the Lydian pottery repertoire, though generally with lower foot. See *BASOR* 186, 36 fig. 22 (P66.134:7174); Greenewalt, *Ritual Dinners*, 15-16, pls. XVII.1, XVIII.1-3, XIX.1-3, XX.1, XXII.2, XXIII.2, 3, XXXI; *Sardis I* (1922) ills. 75a, 124, 125.

Phiale

974 *Pl. 57.* METROPOLITAN MUSEUM OF ART 26.164.13. Gift of the American Society for the Exploration of Sardis, 1926. Achaemenid, 5th C. B.C.

Silver. Some small holes in side. H. 5.40; diam. rim 11.40.

Deep bowl with rounded bottom; everted, flaring lip; sloping neck set off from belly. Two horizontal grooves just under junction of neck and shoulder.

Very similar to 964 (Istanbul 4540).

Jugs

The following four jugs are probably what were called "pitchers" and listed in the Chase inventory of tomb contents as coming from Tombs 801, 826, A 1, and SW5. There is no way of ascertaining which of these vessels came from which tomb. A 1 also contained the silver fluted jar (967) and lost silver saucers.

975 *Pl. 57.* METROPOLITAN MUSEUM OF ART 14.30.27. Gift of the Subscribers to the Fund for Excavations at Sardis, 1914. Hellenistic.

Copper alloy. One side of body missing; badly diseased and corroded.

H. 19.90; max. diam. rim 9.00; max. diam. body 17.70; diam. base 12.70.

Found in 1911 in a tomb (number unknown) on Nekropolis Hill.

Wide, flat ring base with incised circles and central depression on inner surface. Globular body widest below center. Tall concave neck, flaring outward and downward to form lip. Lip decorated with molded tongue and dart pattern. No handle preserved.

Publ. *Sardis I* (1922) 82 ill. 77; 84.

976 Pl. 57. METROPOLITAN MUSEUM OF ART 14.30.28. Gift of the Subscribers to the Fund for Excavations at Sardis, 1914.

Copper alloy. Lip and parts of neck missing; body cracked and dented with some holes; badly corroded. Max. P.H. 17.50; diam. base 10.50; diam. body ca. 16.30.

Provenance unknown.

Flat base; plain body widest above center. Conical neck with raised ring at junction of neck and body, and another just under lip. Lip preserved at two points showing that it was apparently plain and straight.

977 Pl. 57. METROPOLITAN MUSEUM OF ART 26.164.11. Gift of the American Society for the Exploration of Sardis, 1926. 5th C. B.C.?

Copper alloy. Some disease on lip; small holes in neck; handle detached from body.

H. without handle 18.80; H. with handle 22.60; diam. rim 7.50; H. handle 16.00; max. diam. body 18.40; diam. base 14.10; W. ring base 1.30.

Provenance unknown.

Flat ring base, wide, squat body widest above center. Sloping shoulder, narrow, low concave neck. Everted rim with molded decoration. Handle made separately and attached with rivets under lip and possibly soldered to lower body. Handle is high swung ribbon type with flat attachment plate at either end. The lower plate is in the form of a palmette with a lotus blossom incised just above it. The upper plate is plain.

Vases of this general form seem most common in Etruscan tombs in Italy where they appear in both metal and ceramic.

For similar shapes in bronze see M. Bieber, *Die antiken Skulpturen und Bronzen des königlichen Museum Fridericianum in Cassel* (Marburg 1915) 89, pl. 52 nos. 393, 394 (= Höckmann, 26, pl. 14 nos. 42, 43) Etruscan, first half of 5th C. B.C., perhaps an imitation of a Greek shape. J. D. Beazley, *Etruscan Vase-Painting* (Oxford 1947) 264-266 lists vases of this shape in ceramic as well as bronze. For other examples see A. Greifenhagen, *CVA Deutschland Bd 22, Berlin Antiquarium fasc. 3* (Munich 1962) pl. 146.1-2 (Attic Red Figure oinochoe no. F 2414, from Locri, ca. 430-420 B.C.) and S. Aurigemma, *La necropoli di Spina I* (Rome 1960) 59, pl. 59 (bronze).

978 Pl. 57. METROPOLITAN MUSEUM OF ART 26.164.14. Gift of the American Society for the Exploration of Sardis, 1926. Hellenistic-Roman?

Copper alloy. Pieces missing near the base; badly corroded and diseased.

H. without handle 18.60; H. with handle 19.80; diam. rim 9.00; diam. base 15.10; W. ring base 3.60; diam. body 16.80; diam. neck 7.50.

Found in 1911 in a tomb (number unknown) on Nekropolis Hill.

Wide ring base; squat body widest at center. Cylindrical neck with raised ring at junction of neck and body. Rolled, everted rim. High swung handle is a flat band with raised edges and a molded center strip attached with rivets to widest part of body and just under rim.

Publ. *Sardis I* (1922) 82 ill. 77; 84.

Arrowheads

In addition to the foregoing vessels a number of arrowheads were also donated to the Metropolitan Museum of Art by the American Society for the Exploration of Sardis. Since all are without findspots and since, for the most part, they conform to types found by the Harvard-Cornell Expedition, it was thought sufficient simply to list them here by type, but without illustration.

979-983 METROPOLITAN MUSEUM OF ART 26.199.293; 26.199.294; 26.199.295; 26.199.296; 26.199.299. Lydo-Persian.

All copper alloy.

Type 1a. See **18-25**.

984 METROPOLITAN MUSEUM OF ART 26.199.292. Hellenistic-Roman.

Copper alloy.

Type 1d. See **38** and **39**.

985, 986 METROPOLITAN MUSEUM OF ART 26.199.297; 26.199.298. Achaemenid.

Copper alloy.

Type 3a. See **41** and **42**.

987 METROPOLITAN MUSEUM OF ART 26.199.291. Probably Achaemenid.

Copper alloy.

Type 5. See **49-51**.

988 METROPOLITAN MUSEUM OF ART 26.199.290. Byzantine.

Iron.

Type 7b. See **58-73**.

Metal Objects from Sardis in the Ashmolean Museum, Oxford

The Ashmolean Museum owns four objects from Sardis which Jane C. Waldbaum was able to examine in August, 1974. She was graciously given assistance, information, and permission to publish them by Michael Vickers, Assistant Keeper of the Department of Antiquities, Ashmolean Museum.

Couchant Lion

989 Pl. 57. ASHMOLEAN 1928.323. Lydian, 6th C. B.C.

Gold.

Max. H. 1.30; W. lion 0.50; L. lion (rump to forepaws) 1.60; W. base 1.05.

Probably found in Tomb 75 with three others now in Istanbul Archaeological Museum.

Presented to Ashmolean Museum by Mr. E. P. Warren.

Couchant lion with head erect and turned to proper right. Tongue protrudes through teeth in open mouth. Ears close to head, eyes in relief, tail looped up around right haunch. Surrounding lion at base is a beaded wire. The base itself is a rectangular plate pierced with twelve holes for attachment to another object or fabric.

Unpubl. but mentioned *Sardis* XIII (1925) 34 no. 86, and see pl. 8.7a-c; *Sardis* R1 (1975) 3; *Sardis* R2 (1978) 14.

Oinochoe Handle

990 Pl. 57. ASHMOLEAN 1937.232. Hellenistic-Roman?

Copper alloy.

Max. H. 14.00; W. band 1.12; Th. band 0.25; diam. lower attachment plate 1.40; W. rim attachment plate 3.10.

Found in a Sardis tomb.

Presented to the Ashmolean by M. W. H. Buckler.

High, flat band handle curving over and down at the top to attach to the rim of a vessel. Rim attachment plate is flattened, thinned and curved with a hole for a single rivet. At base the handle is flattened and rounded and pierced by a single rivet. The outer surface of the band is flattened and the edges are slightly raised. Similar to handle of jug 978, Metropolitan Museum of Art 26.164.14, but plainer.

Mirror Disk

991 Pl. 57. ASHMOLEAN 1937.233.

Copper alloy.

Diam. 10.10; Th. 0.15.

From a Sardis tomb.

Presented to the Ashmolean by M. W. H. Buckler.

Plain, flat disk with no evident place for handle attachment. Some scoring or gouging on surface.

Pendant

992 Pl. 57. ASHMOLEAN 1892.892. Lydian?

Copper alloy.

L. 2.80.

Bought in Izmir by C. J. Chester; allegedly from Sardis.

Cast in one piece. Three birds of prey (hawks?) aligned on a rectangular base. Pendant loop protrudes from the back of the central bird. Eyes and wings shown in relief—eyes protruding, wings folded. No apparent incised detail. The position and appearance of the birds are similar to those of the silver hawk in pendant 882 found in a Lydian grave.

Unpubl. but mentioned in *Sardis* R2 (1978) 17 n. 28.

British Museum, London

Only one object from Sardis is in the British Museum—a steelyard from an unexcavated context. The piece has been published previously and does not differ markedly in form from the steelyards listed (435-444). Since it has recently been analyzed as part of Paul Craddock's much larger analytical project,⁶ it was thought advisable to include a brief mention of it here.

Steelyard

993 BRITISH MUSEUM 83.11.11.2. Roman-Early Byzantine.

Brass.

L. 40.70.

Provenance unknown.

Similar to steelyards from BS and elsewhere (435-444). Analyzed by Craddock as follows: beam and hook: Cu 69.50 percent; Pb 0.80-2.40 percent; Sn 0.07-0.10 percent; Zn 27.50-28.00 percent; Ag 0.02-0.065 percent; Fe 0.05-0.12 percent; Ni 0.02-0.06 percent; Sb tr. This is a considerably higher quantity of zinc than was detected in most of the other Sardis brasses, with the possible exception of the lion lamp (618). See Chap. V, Tables V.3, 4b.

6. See Chap. V.

Publ. Walters, *Bronzes*, 359 no. 2991; Craddock, "Copper Alloys," 173-174 (analysis). I want to thank Craddock for allowing me to mention this information.

Staatliche Museen, Berlin

Three small, gold ornaments of Persian style, said to come from the Sardis area, were reported in Berlin before World War II. Of these, two bracelets are now in West Berlin and one—a finial—is now lost.

Bracelets

994, 995 Pl. 58. BERLIN, ANTIKENMUSEUM, STAATLICHE MUSEEN PREUSSISCHER KULTURBESITZ INV. NO. 30989a,b. Gift of Th. Wiegand. 5th-4th C. B.C.

Gold.

Max. diam. 7.30, 7.50; Wt. 58.60 g., 63.30 g. According to Greifenhagen, both were acquired in 1904; one from a peasant in Sardis, the other about ten days later from A. O. van Lennep in Smyrna who got it from the same source.

The two form a pair. Each is a solid cast open band with traced spiral pattern around the hoop and ends terminating in finely worked antelopes' heads. The heads have curving, twisted horns, and the horns and ears are modeled in the round.

Publ. Luschey, 767 fig. 5, 771; P. Amandry, "Orfèvrerie achéménide," *AntK* I (1958) 14, n. 46 with other, similar bracelets; H. Erdmann, *Iranische Kunst in deutschen Museen* (Wiesbaden 1967) pl. 3B; R. Zahn, *Ausstellung von Schmuckarbeiten in Edelmetall aus den Staatlichen Museen zu Berlin* (Berlin 1932) 22 no. 17a-b; Greifenhagen, *Schmuckarbeiten* II, 41 (with comparisons), pl. 35 nos. 1, 2. I am grateful to Bert Kaeser of the Antiken Museum, Berlin-Charlottenburg, for sending photographs, references and information on these objects. A further parallel may be found in Segall, 10, 15-16, 28, pls. 10, 11 (pair of gold bracelets with antelope heads as finials for smooth hoops). These bracelets are part of a hoard of 4th C. B.C. jewelry which allegedly came from Sardis (see Chap. I, n. 13); Segall dates the bracelets ca. 380 B.C. or a little later. See also Stronach, *Pasargadae*, 168, 173-176, fig. 85.4, pls. 146d-147f (found in a treasure of Achaemenid jewelry, 4th C. B.C.).

Finial

996 Pl. 58. Once BERLIN, STAATLICHE MUSEEN, VORDERASIATISCHES MUSEUM, VA 13366. Lost in World War II. Achaemenid.

Gold. Horns broken.

L. underside 1.65; W. 1.00; P.H. 2.20; socket 0.80 × 0.80. Provenance unknown.

Head and forequarters of a bull or ram with head turned back, forelegs folded under body. At the back is a square socket for attachment to another object. Hair curls and muscles are finely modeled and the general configuration is similar to that of the large-scale bull protomes seen on Achaemenid capitals, although these normally face forward.

Publ. Otto, 9-22, fig. 1a-d who tentatively restores it as part of a sword grip (pp. 12-13, fig. 2). For Achaemenid bull capitals see Pope, IV, pl. 101 (Susa, 4th C. B.C.). For similar creatures with heads turned back as bracelet ends see Dalton, *Treasure of the Oxus*, 37, pl. 20 no. 137. I owe the information on the disappearance of this piece to the kindness of E. Klengel, Direktor, Vorderasiatisches Museum, East Berlin.

Lost (?) Objects

In addition to the foregoing, which are or have been in known European museum collections, there are several objects, allegedly from the Sardis area, whose present whereabouts are unknown.

Small "Pectoral"

997 Pl. 58. Early Bronze Age.

Gold.

H. 5.80; max. W. 6.80.

Allegedly found with **998** and **999** in a tomb near Sardis by Paul Gaudin, Director of the French Smyrna-Cassaba Railway.

Plate of beaten sheet gold of trapezoidal shape but with rounded corners. Decoration consists of two crossing diagonal lines of small bosses in relief executed in repoussé. Each boss pierced with a small hole.

"Medallion"

998 Pl. 58. Early Bronze Age.

Gold.

H. 6.20; W. 7.40.

Allegedly found with **997** and **999**.

Nearly circular disk pierced somewhat above center with a hole 2.00 in diam. From the top of the disk is a projection which is folded over to form a flat loop for suspension or attachment.

Pendant

999 Pl. 58. Early Bronze Age.

Gold.

Diam. 2.00.

Allegedly found with **997** and **998**.

Small disk with loop for suspension projecting from one side. Small repoussé boss pierced with a hole on one surface.

All three publ. Collignon, 188-191, fig. on p. 189. Collignon believed they were "pre-Lyidian" in date because of their extreme simplicity in design and execution. The objects, in fact, are most likely Early Bronze Age. For parallels to 998 especially see W. Rudolf, "A Note on Chalcolithic-Early Bronze Age Jewelry," *Indiana University Art Museum Bulletin* I/2 (1978) 11, figs. 1, 7, 8 no. 12 (Burton Y. Berry Collection, allegedly from the Black Sea area of Anatolia).

Diadem

1000 Pl. 58. Hellenistic.

Gold.

L. 26.00; max. H. 5.50; H. at ends 1.20.

Allegedly found in a sarcophagus at Sardis. Seen in the antiquities market at Smyrna in May, 1917.

Thin, gold leaf cut into an elongated triangle. From the ends hang narrow bands with small rosettes, 0.30 in diam. On the surface of the diadem is a relief decoration of a nude Apollo standing next to a tripod, Nikes, and other figural and floral motifs.

Publ. Walter, "Antikenbericht," 251 no. 9, fig. 140. For similar diadems and dating see Hoffmann-Davidson, 67-68 nos. 7a, b (4th-3rd C. B.C.). Hoffmann (p. 68) points out that this type of diadem seems to have been made for a short time in the late 4th and early 3rd C. B.C. only. For general discussion of type see also G. Becatti, *Oreficerie antiche dalle minoiche alle barbariche* (Rome 1955) 89-90, pl. 86 nos. 348, 349.

Metal Objects in the Fogg Art Museum, Harvard University (acquired prior to the Harvard-Cornell Excavations)

Mrs. Frederick M. Godwin, widow of one of the original members of Butler's expedition to Sardis, presented a number of small objects to the Fogg Art Museum that are allegedly from Sardis. Besides metal objects—mostly of copper alloy—the gift included some pottery, terracottas, and small finds of stone, bone and faience. Findspots and means of acquisition are not known.

None of the metal objects is of great intrinsic value, and most are paralleled by objects found by the present expedition. As such they form a useful supplement to the excavated finds but do not shed new light on metal-working techniques or styles at Sardis.

Arrowheads

1001 Pl. 58. FOGG ART MUSEUM 1964.12.33A. Gift of Mrs. Frederick M. Godwin. Hellenistic?

Copper alloy.

L. 4.90; diam. socket 0.60.

Similar to **38** and **39**. Hole in one side of blade near rib.

1002 Pl. 58. FOGG ART MUSEUM 1964.12.33B. Gift of Mrs. Frederick M. Godwin. Persian period.

Copper alloy. Socket broken.

Max. P.L. 3.50; diam. socket 0.50.

Similar to **41** and **42**.

Spindle Hook

1003 Pl. 58. FOGG ART MUSEUM 1964.12.47. Gift of Mrs. Frederick M. Godwin.

Copper alloy.

H. 3.20; diam. socket 0.50.

Similar to **242-249**.

Bolt and Socket?

1004 Pl. 58. FOGG ART MUSEUM 1964.12.13A+B. Gift of Mrs. Frederick M. Godwin. Roman?

Copper alloy. One end of bolt broken; preserved end fits exactly into opening in socket.

Socket: H. 6.00; W. 5.00; L. 5.00; Th. 0.90.

Bolt: Max. P.H. 6.40; W. 3.40; L. 3.20.

Square socket pierced with square opening. Two rectangular knobs on opposite sides of opening. "Bolt" rectangular in section, tapering to end. Perhaps part of a door fixture? Both pieces of metal are very heavy; perhaps containing lead.

Cosmetic Spoons

1005, 1006 Pl. 58. FOGG ART MUSEUM 1964.12.35A+B. Gift of Mrs. Frederick M. Godwin.

Copper alloy.

1005: L. 15.50.

1006: L. 16.50.

1005: Plain with small bowl and straight shaft.

1006: Similar but with bulb at end of shaft.

Similar to cosmetic spoons of Type 1, **619-625**.

Spatula

1007 Pl. 58. FOGG ART MUSEUM 1964.12.38. Gift of Mrs. Frederick M. Godwin.

Copper alloy.

Max. L. 7.60; diam. end 0.60; L. shaft 6.75; L. blade 0.85; W. blade 0.80.

Conical shaft hollow at widest end, tapering towards blade. Wider end filled with some other substance (remains of a wooden shaft?). Squarish, wedge-shaped blade with sharp edge. Perhaps a small chisel. Similar to 639.

Cosmetic Tube

1008 *Pl. 58.* FOGG ART MUSEUM 1964.12.14. Gift of Mrs. Frederick M. Godwin. Roman?

Copper alloy. One end broken.
Max. P.L. 10.00; diam. 1.90.

Flat disk with incised radial lines inserted just below edge of preserved end. Five groups of lathe-turned ridges around circumference of tube. Similar to 644-646.

Straight Pin

1009 *Pl. 58.* FOGG ART MUSEUM 1964.12.39. Gift of Mrs. Frederick M. Godwin. Roman?

Copper alloy.
L. 10.40.

Straight shaft with small, bulbous head. Corroded surface obscures possible pinecone incision (see 667). Below the head are two pairs of raised ridges separated by incised (?) zigzags.

Buckle

1010 *Pl. 58.* FOGG ART MUSEUM 1964.12.34A. Gift of Mrs. Frederick M. Godwin. Early Byzantine, late 6th-early 7th C. A.D.

Copper alloy. Tongue missing.
Max. L. 3.50; W. buckle 3.50; diam. circular opening 1.30.
Findspot unknown.

Similar in general type to 692, though with more openwork. Punched circles on surface. Back smooth.

Clothing Ornament

1011 *Pl. 58.* FOGG ART MUSEUM 1964.12.34B. Gift of Mrs. Frederick M. Godwin. Early Byzantine?

Copper alloy. No tongue.
Max. W. 5.20; H. 1.60; Th. 0.30; two irregular, pierced openings ca. 1.00 × 0.70.

Straight edge scalloped.

Finger Rings

1012 *Pl. 58.* FOGG ART MUSEUM 1964.12.36B. Gift of Mrs. Frederick M. Godwin.

Copper alloy. Hoop broken; crack down center of bezel.
Diam. hoop 1.90; W. hoop 0.30; bezel 1.00 × 0.60.

Flat, plain oval bezel without decoration. Two relief ridges on either side of bezel.

1013 *Pl. 58.* FOGG ART MUSEUM 1964.12.36A. Gift of Mrs. Frederick M. Godwin.

Copper alloy. Hoop broken.
Diam. hoop 2.10; diam. bezel 1.30.

Plain, flat hoop. Bezel round and raised above surface of hoop. Incised with a device—possibly a letter. See *Pl. 58.*

1014 *Pl. 58.* FOGG ART MUSEUM 1964.12.37B. Gift of Mrs. Frederick M. Godwin.

Copper alloy.
Diam. 2.10.

Plain hoop with open, overlapping ends.

Pendant

1015 *Pl. 58.* FOGG ART MUSEUM 1964.12.40. Gift of Mrs. Frederick M. Godwin.

Copper alloy. Only half-preserved.
H. 2.45; W. 1.40.

Half of a hollow, spherical pendant made originally in two parts. Small closed loop on upper surface. Three deep vertical grooves divide pendant into rough triangular sections.

Flint Striker?

1016 *Pl. 58.* FOGG ART MUSEUM 1964.12.17. Gift of Mrs. Frederick M. Godwin.

Iron.
W. 4.20; L. 2.80.

Open loop of uneven thickness or width. Two ends flattened and bent back into loops. Incised line along center of upper surface.

See Hampel, *Ungarn I*, 111-113 figs. 194-200 (Early Byzantine); Russell, fig. 25 (Anemurium, Early Byzantine).

Other objects include four iron nails or spikes, two flat copper alloy strips of uncertain purpose (perhaps two halves of a tweezers), four scraps of bronze wire and a large copper alloy ring (diam. 4.20).

V CHEMICAL AND METALLURGICAL ANALYSES OF METAL OBJECTS FROM SARDIS

with contributions by Reed Knox, Jr., Robert Maddin, Pieter Meyers, James D. Muhly, George Rapp, Jr. and Leon P. Stodulski

In order to broaden our understanding of the development of the metal industry at Sardis, a series of scientific analytical studies was initiated on selected groups of objects. Several types of analyses were undertaken in different laboratories: copper and copper-based alloys were subjected to emission spectrography, neutron activation and atomic absorption analyses; gold objects were analyzed by neutron activation; silver objects excavated by both the Harvard-Cornell and the Princeton Expeditions were also tested by neutron activation; and iron implements were analyzed metallographically and by atomic absorption. In addition, samples of lead were taken for lead isotope analyses, but these were incomplete at the time of writing and will be published as a separate article. By these means, it was hoped to learn something about the major and minor elemental constituents of various metals, alloying techniques and, in the case of iron, about techniques of manufacture.

These studies are among the few extensive series of metal analyses carried out on material from a single excavated site to be published to date. While usefulness of results varies with method of analysis employed and with quantities of objects sampled, it is hoped that these attempts will begin to shed light on various aspects of metallurgy at Sardis. They also suggest the kinds of questions that can be raised (and, perhaps, answered) by applying different kinds of scientific techniques on a fairly wide scale.

COPPER AND COPPER ALLOYS

The largest analytical program involved the copper and copper alloy objects. Two groups of samples were

taken. The first, consisting of some eighty samples, was submitted to the Center for Conservation and Technical Studies at the Fogg Art Museum, Harvard University, for emission spectrography analysis concentrating on major alloying ingredients. The second group consisting of forty-four samples, was submitted to George Rapp, Jr. of the Archaeometry Laboratory, University of Minnesota, Duluth, for neutron activation analysis of trace elements. In addition, some thirty-four samples of the second group were further subjected to atomic absorption analysis to clarify their major alloying elements.

Selection of Objects and Sampling Procedures

Copper alloy objects were selected for sampling according to the following criteria. First, an attempt was made to include several objects from each major period represented at Sardis—Early Bronze Age, Lydo-Persian, Hellenistic, Roman and Early Byzantine. This was to see whether there were any consistent changes in alloying ingredients or trace elements over time. Second, where possible, several objects of the same type and date were sampled to test their homogeneity of composition and to see whether particular types of alloys were favored for particular types of objects. Third, where size and condition of an object warranted, two samples were taken, one of which was submitted for emission spectrography and the other for neutron activation and atomic absorption analyses. This was done to compare the results of different analytical methods on the same or similar objects.

All objects were sampled at Sardis by members of the conservation staff. Two methods of sampling copper

alloy objects were used: removal of small pieces by sawing or snipping, and drilling. Objects of thin or slender metal were in most cases first cleaned down to bare metal with an abrasive wheel, and then small fragments were snipped or sawed from inconspicuous parts. Where the object had been previously damaged or torn, pieces were removed close to the edge of the tear to minimize further disfiguration. Where cross sections were taken—as through handle shafts in 227, 619 and 631—the objects were repaired at the break. For objects in which the remaining metal was thick enough, drillings were taken through representative sections of the piece after first cleaning the surface with an abrasive wheel.

Given the nature of excavated material we are not usually dealing with museum quality objects in pristine condition. Many of the objects had been chemically and/or mechanically cleaned after excavation, and most were mechanically cleaned again before samples were taken. While an effort was made to sample primarily objects that were clean or relatively uncorroded, it is entirely possible that contamination from remaining corrosion or from the cleaning agents themselves has affected several samples. On the other hand, similar objects cleaned in different ways usually showed quite similar results when subjected to the same analytical procedure (see e.g. Table V.3, 725 and 728) suggesting that a certain consistency is likely despite possible hazards.

Table V.1 summarizes the sampling procedures utilized on all copper alloy objects analyzed and shows which type of analysis was performed on each object—emission spectrography (ES), neutron activation (NA) and/or atomic absorption (AA). Originally, the intended scope of the project was somewhat larger, but for various reasons a number of samples submitted for tested yielded no analytical results, and these have not been listed here.

Emission Spectrographic Analyses of Copper Alloys (Waldbaum, Stodulski)

Purpose: This type of analysis was performed to determine the gross chemical compositions of a series of copper alloys. Of primary interest were the use and proportions of the major alloying ingredients—tin, lead, zinc, arsenic—in different periods and for different types of objects.

Semi-quantitative analysis of this kind is not a very precise method and results only in an approximation or estimate of the composition of the sample tested. Furthermore, it has been shown that the compositions and proportions of various constituents of a metal object may change over time, depending on the conditions—corrosion, weathering, etc.—to which the object was

subjected. Therefore, composition of a sample as determined by analysis is unlikely to reflect the exact composition of the alloy when new, and relative amounts of certain constituents may be somewhat altered.¹ Nevertheless, the procedure has yielded interesting information about the use of major alloying ingredients over time and about the presence or absence of a number of minor or trace elements.²

Analytical procedure: Preparation and analysis of all samples were carried out at the Fogg Art Museum by Leon P. Stodulski, then Science Associate for the Center for Conservation and Technical Studies, Fogg Art Museum, Harvard University. The procedures and equipment are briefly outlined below and follow those discussed in detail by Stodulski elsewhere.³

The samples were reduced to as fine a powder as possible with very small (no. 68-70) steel drills. Bronze standards, obtained from the National Bureau of Standards (nos. 37d, 52b, 124d and 157) and British Chemical Standards (nos. 183/3 and 207/1), were similarly prepared. Five milligram portions of the samples from the artifacts or the standard bronzes were thoroughly mixed with 5 mg. of a mixture of 90 weight percent spectrographic grade powder and 10 weight percent ultrapure GeO₂ powder, and were loaded into National SPK L-4200 graphite electrodes. Samples were volatilized for approximately two and a half to three minutes in an Applied Research Laboratories Spectrographic Analyzer with a 10-amp, full-wave unfiltered electrically-ignited arc. The log-sector method was used to estimate

1. See J. Condamin and M. Picon, "Changes Suffered by Coins in the Course of Time and the Influence of these on the Results of Different Methods of Analysis," in E. T. Hall and M. Metcalf, eds. *Methods of Chemical and Metallurgical Investigation of Ancient Coinage* (London 1972) 49-66. For this and other problems in sampling and analysis see also E. R. Caley, "Critical Evaluation of Published Analytical Data on the Composition of Ancient Material," in Boston Museum of Fine Arts Research Laboratory, *Application of Science in Examination of Works of Art. Proceedings of the Seminar: Sept. 7-16, 1965* (Boston 1967) 167-171; idem, *Analysis of Ancient Metals* (New York 1964) 1-15; H. Jedrzejska, "Sampling Precautions in the Analysis of Metallic Antiquities," *Studies in Conservation* 7 (1962) 27-31. W. T. Chase, "Comparative Analysis of Archaeological Bronzes," in C. W. Beck, ed. *Archaeological Chemistry* (Washington, D.C. 1974) 148-185, is an important examination of the possible discrepancies in results owing to the use of different analytical techniques (and analysts) on samples of the same object.

2. For further discussion of trace element determination see section by G. Rapp, Jr. below.

3. Leon P. Stodulski, "The Use of the Emission Spectrograph in the Conservation Laboratory," *Bulletin of the American Institute for Conservation of Historic and Artistic Works* 15 (1975) 66-92, esp. 73-77, 83-85 and Appendix I, p. 91. Eugene Farrell and Richard Newman, of the Fogg Art Museum Center for Conservation and Technical Studies, kindly assisted in the preparation of this discussion.

Table V.1 Methods of sampling copper and copper alloy objects

Catalogue number	Method of sampling	Analytical procedure
3	Fragment sawed with coping saw from broken edge of tang after cleaning with carborundum wheel. Sample may have been contaminated with corrosion products and saw blade contact.	ES
18	Sample snipped from socket with wire cutter after cleaning with carborundum wheel. Previously cleaned electrochemically.	NA, AA
19	3 samples taken; 1 each snipped from socket, rib and broken edge of blade with wire cutter after cleaning with carborundum wheel. Samples 2 and 3 contaminated with corrosion product. Previously electrochemically cleaned.	NA, AA
20	Sample 1: from socket; not free of corrosion. Sample 2: from edge of blade; corroded. Both samples snipped with wire cutter after cleaning with abrasive wheel. Previously electrochemically cleaned.	ES NA, AA
21	Sample snipped from edge of blade with wire cutter; surface partly cleaned of corrosion products.	ES
22	Sample snipped from broken end of socket after cleaning with carborundum wheel. Previously electrochemically cleaned.	ES
29	Sample clipped from tip of blade after surface ground to below original level with carborundum wheel. Appeared to be completely mineralized.	ES
30	Sample snipped from tip of blade after cleaning with carborundum wheel. Previously electrochemically cleaned.	NA, AA
34	Sample snipped from edge of socket after cleaning outer surface with carborundum wheel. Previously partially electrochemically reduced.	ES
38	Sample snipped from edge of blade with wire cutter after incomplete cleaning of surface. Previously electrochemically treated but not fully reduced.	ES
39	Samples snipped from end of socket and edge of blade with wire cutter after cleaning with carborundum wheel. Object was heavily corroded and had been electrochemically reduced. Samples contaminated with corrosion products.	NA, AA
47	Samples drilled from blade with Expo 1.2 mm. bit on Titan drill.	ES
87	Drillings taken from back with Expo 1.6 mm. bit on Titan drill. Object had been previously electrochemically cleaned.	ES
217	2 samples snipped from edge of bowl rim after cleaning with abrasive wheel. Object previously treated.	ES, NA, AA
227	2 samples sawed from central portion of handle with abrasive disk and snippers after cleaning with abrasive wheel.	ES, NA, AA
264	9 drillings taken along rim of main section with Wendt-Sonis style 100, ~47 drill bit. Not previously treated.	ES, NA, AA
409	15 drillings taken from flat back of neck with an Expo 1.6 mm. drill bit. Previously cleaned.	ES, NA
429	Sample sawed from edge of attachment plate at back with abrasive disk after cleaning with abrasive wheel. Previously cleaned.	ES
449	Center of beam clipped in 2 places after cleaning with abrasive wheel.	ES, NA, AA
487	Sample 1: fragments well cleaned with abrasive wheel then pulled off torn edge of bottom with tweezers. Sample 2: partly cleaned fragments pulled from torn edge of bottom with tweezers. Sample 3: uncleaned fragments snipped from torn edge of bottom with wire cutters.	ES NA, AA NA
489	7 drillings from interior of bottom and a fragment of the wall. Drillings taken with Wendt-Sonis style 100 bit on a Titan drill. Fragment sawed off after cleaning area with carborundum disk. Previously cleaned.	ES
490	Samples snipped from edge of rim after cleaning with abrasive wheel. Previously treated.	ES, NA, AA
500	Sample pulled from torn edges of body with tweezers. No attempt to remove surface corrosion.	ES
509	Sample snipped from bottom near edge after cleaning with abrasive wheel.	ES
513	Fragment of handle scraped off with scalpel. Previously chemically treated. Not cleaned before sampling.	ES
515	Samples snipped from broken lower edge. Piece had been reduced in Zn and NaOH and soaked for about 2 years in sodium sesquicarbonate.	ES, NA, AA
520	Sample snipped from edge of neck after cleaning with drill. Section sampled not previously cleaned.	ES
520	4 drillings taken from underside of handle with 1.6 mm. Expo drill bit on Titan drill. Object soaked for 2 days in sodium sesquicarbonate; locally painted with Ag ₂ O in ethanol.	ES
528	Sample removed from edge of lip. Previously cleaned with Ag ₂ O.	ES
531	Sample sawed from wall of vessel with coping saw after cleaning with carborundum stone on electric drill. Previously treated with calgon, Ag ₂ O, Zn and NaOH.	NA

Table V.1 Methods of sampling copper and copper alloy objects (Continued)

Catalogue number	Method of sampling	Analytical procedure
533	Samples snipped from lower edge of neck after partial cleaning of surface with abrasive wheel. Not previously treated; highly corroded.	ES, NA, AA
536	Samples removed from lower edge with tweezers after partial cleaning with abrasive wheel. Previously treated in Zn and NaOH.	ES, NA, AA
542	Sample snipped from broken edge. Previously partially reduced.	ES
576	Sample snipped from edge after cleaning with carborundum wheel. Previously electrochemically reduced.	ES
577	Sample 1: sawed from wall with coping saw. Sample 2: drilled from base and foot with Wendt-Sonis style 100 bit and Titan drill. Not previously treated.	NA, AA ES
578	Sample 1: sawed from break in side wall. Sample 2: 3 drillings from foot taken with Wendt-Sonis style 100 bit on Titan drill. Badly corroded and only partially chemically reduced during treatment.	ES ES
580	Sample snipped from edge of hole in bottom, then cleaned with abrasive wheel. Previously treated.	ES
581	Samples drilled from base with 1.6 mm. Expo drill. Previously cleaned.	ES, NA, AA
581	Samples snipped from chain. Not previously cleaned.	ES
582	12 drillings from base taken with Wendt-Sonis style 100 bit on Titan drill. Previously reduced chemically.	ES
583	Drillings taken from base, foot and inner wall near rim with Wendt-Sonis style 100 bit. Previously chemically reduced.	NA, AA
589	Sample drilled from edge of piece with Expo 1.6 mm. and Wendt-Sonis style 100 (47) drill bits. Previously treated.	ES
590	Samples snipped from edge of fragment after cleaning with abrasive wheel. Not previously treated.	ES, NA, AA
591	Samples snipped from loop after cleaning with abrasive wheel.	ES, NA, AA
591	Samples taken from chain link with chisel and hammer. Not treated or cleaned.	ES, NA, AA
594	Samples clipped from broken edge after cleaning with abrasive wheel. Electrochemically treated.	ES, NA, AA
600	Sample snipped from ends. Electrochemically reduced.	ES
605	Samples snipped from chain link with wire cutter; those sent for ES cleaned with abrasive wheel; that for NA was not.	ES, NA, AA
606	Samples snipped from chain link. Previously electrochemically reduced.	ES, NA, AA
607	Samples snipped from chain link after cleaning with abrasive wheel. Previously treated with Zn and boiling NaOH.	ES, NA
619	Samples snipped from shaft with wire cutter after cleaning with abrasive wheel. Previously mechanically cleaned and chemically treated.	ES, NA, AA
622	Sample snipped from shaft after cleaning. Previously treated.	ES
628	Samples snipped from shaft after cleaning with abrasive wheel. Previously electrochemically reduced.	ES, NA, AA
631	Sample snipped from shaft after cleaning with abrasive wheel. Electrochemically reduced.	ES
636	Samples snipped from shaft.	ES, NA
637	Samples broken from fragment. Previously treated with alkaline Rochelle salt and 5% H ₂ SO ₄ .	NA, AA
641	Sample snipped from blade after partial cleaning with abrasive wheel. Electrochemically reduced.	ES
642	Sample snipped from blade after cleaning with abrasive wheel.	ES
650	Samples snipped from edge after cleaning with abrasive wheel. Previously treated.	ES, NA
650	Samples snipped and sawed from end of handle after cleaning with abrasive disk. Previously treated.	ES, NA
652	Samples snipped from upper end of handle after cleaning with abrasive wheel. Previously treated.	ES, NA
656	Samples sawed from center of shaft and snipped apart after cleaning with abrasive wheel. Not previously treated.	ES, NA, AA
657	Samples sawed from center of shaft after cleaning with abrasive wheel. Not previously treated.	ES
660	Samples sawed from center of shaft after cleaning with abrasive wheel. Previously treated.	ES, NA, AA
672	Samples sawed from 1 end with abrasive disk after cleaning with abrasive wheel. Not previously treated.	ES, NA, AA
674	Samples snipped from 1 end of arc after cleaning with abrasive wheel. Previously cleaned.	ES, NA, AA
683	Samples snipped from interior of arc after cleaning with abrasive wheel. Previously treated.	ES, NA, AA
689	Sample snipped from broken end of loop after cleaning with abrasive wheel. Previously cleaned.	ES

Table V.1 Methods of sampling copper and copper alloy objects (*Continued*)

Catalogue number	Method of sampling	Analytical procedure
690	Sample snipped from broken end of loop after cleaning with abrasive wheel. Previously cleaned.	ES
691	Sample snipped from end of loop after cleaning with abrasive wheel. Previously cleaned.	ES
694	Samples snipped from attachment loop on back after cleaning with abrasive wheel. Previously treated.	ES, NA, AA
698	Sample removed from corner with abrasive disk after cleaning with abrasive wheel.	ES
701	Sample snipped from detached fragment after cleaning with abrasive wheel. Previously cleaned.	ES
702	Sample snipped from tab on back after cleaning with abrasive wheel. Previously treated with caustic soda and Zn.	ES
725	Sample clipped from end of fragment. Badly corroded and previously electrochemically reduced.	ES
726	Sample clipped from end of fragment. Badly corroded and partially reduced electrochemically.	NA, AA
728	Samples snipped from hoop after cleaning with abrasive wheel.	ES, NA
901	Sample drilled from back with Expo 1.6 mm. bit.	ES
902	Samples snipped from loops after cleaning with abrasive wheel. Previously treated.	ES, NA
903	Sample snipped from upper arm after cleaning with abrasive wheel. Previously treated.	ES
904	Sample drilled from base with Expo 1.6 mm. bit. Previously cleaned.	ES
918	Sample drilled from underbelly, and along underside of legs with Dormer 1.0 mm. bit on Titan drill. Previously chemically treated and covered with wax.	ES
927-928	Sample 1: sawed from broken edge of plate (927). Sample 2: drillings from a second plate (928). Sample 3: drillings and sawing from rivet of 928. Contains much corrosion. Drillings taken with Dormer drill bit on Titan drill; sawings with coping saw.	NA ES ES
Not catalogued (sealing)	Sample snipped from edge after cleaning with abrasive wheel. Previously treated.	ES, NA, AA
Not catalogued (amorphous mass)	Drillings taken from piece with Expo 1.2 mm. bit on Titan drill.	ES

the concentrations of the various elements present. The developed films were first scanned to qualitatively identify the elements present in the artifact samples. Calibration curves for tin, lead, zinc, arsenic, iron, antimony and nickel were prepared from the standards and used to estimate the quantities of these elements present in the samples from the artifacts. Silver and cobalt at consistently low concentrations were calculated using ratios of line intensities of unknowns and standards. Copper was determined by difference. The emission lines used with their graphite matrix sensitivities are given in Table V.2. The difficulty of judging the "extinction points" of the tapering emission lines causes the log-sector technique to be less precise than semi-quantitative spectrographic analyses which employ a microdensitometer. In addition, there are other factors which limit the precision of emission spectrographic analyses in general. In order to estimate the overall precision of this particular technique, replicate analyses of each of the bronze standards were carried out. The intensities of particular emission lines for each element analyzed were read from the replicate films, and the standard deviations of these sets

of readings were determined by using the range.⁴ Replicate analyses of the samples from artifacts were not possible owing to limitations in sample sizes, but the

Table V.2 Emission lines and graphite sensitivities

Element	Emission line (Å)	Graphite sensitivity factor*
Pb	2446.19	0.7
Sn	2594.42	0.4
Fe	2720.90	0.01
Sb	2769.94	0.05
As	2780.20	0.015
Zn	3072.06	0.15
Ni	3221.65	0.07
Ag	3382.89	0.00015
Co	3453.51	0.0006

*C. E. Harvey, *Semiquantitative Spectrochemistry* (Glendale, California: Applied Research Laboratories, 1964).

4. E. L. Bauer, *A Statistical Manual for Chemists*, ed. 2 (New York 1971).

values obtained from the standards are probably reasonable estimates of the precision of the data obtained on the samples themselves. The relative standard deviations used to calculate the stated standard deviations in the concentrations given in Table V.3 are: 10 percent for silver and cobalt; 15 percent for tin, arsenic and lead; 20 percent for nickel; and 25 percent for zinc, iron and antimony.

In several cases, some of the elements could not be detected. In these cases an upper limit on their concentrations is reported. These values are obtained from the graphite sensitivity factors of the emission lines employed. In a few cases, the content of arsenic was much greater than that of any of the available standards; in such cases, a lower limit on the concentration of this element is reported (e.g. 656, 657, 660, 672, 22, 34, 694, 701 and 580).

Results: Table V.3 summarizes the results of the spectrographic analyses with the samples arranged chronologically and, where possible, arranged typologically within chronological groups. Estimated presence of various components in the alloys is expressed as weight percent with standard deviation included (except for copper which was arrived at by difference). Description of objects analyzed, and condition and reference to illustrations of individual pieces may be found in the catalogue (Chap. III). A few samples were further tested qualitatively by X-ray fluorescence, and in every case these showed the same components found in the spectrographic analyses. Samples checked in this way are marked on Table V.3 by an asterisk (*).

Neutron Activation and Atomic Absorption Analyses of Copper Alloys (*Rapp*)

Neutron activation (NA) analyses of metal samples from Sardis were made to determine their trace element concentrations. These analyses are part of a large trace element analytical program intended to determine whether trace constituents show any consistent patterns (i.e. "fingerprints") that can be used to identify ore sources or suggest groupings that could signify other relationships. It has recently been shown, for example, that trace elements can be used to identify the geographic sources of native copper used for copper artifacts.⁵ Atomic absorption (AA) analyses were also made on some samples to determine the specific alloying

elements in these copper-based alloys. Arsenic, tin, zinc and lead have all played major roles in the development of Eastern Mediterranean metallurgy. Both sets of analyses, NA and AA, were done on very small samples of less than 50 mg.⁶

"Trace elements" are those elements found in concentrations below 100 ppm (i.e. below the 0.01 percent lower limit of the normal chemical analyses). "Alloying elements" are those chemical constituents in a metal alloy which were purposefully added in concentrations large enough to impart significant changes in the physical characteristics of the material during processing or in the final product. It normally takes in excess of 1.5-2.0 percent of an alloying element to make noticeable changes in the castability, workability or hardness of copper-based alloys.

Trace elements play no significant part in the physicochemical reactions in geological or metallurgical systems. However, by virtue of their residence in the bulk chemical system they will be concentrated in certain phases or dispersed in the geochemical or metallurgical processes that formed an ore or artifact. Unless two artifacts were formed from the same ore by nearly identical metallurgical methods it would be fortuitous for them to have coincident trace element concentrations of six or more elements.

Much more research must be done to establish the sources and the paths of trace element partitions and migrations in smelting operations, and the difficulties in expecting too much from trace element analyses have been pointed out many times. Work is continuing to determine trace element fingerprints of copper and tin ore deposits but the data for the Eastern Mediterranean are still too sparse for provenance determinations. In light of these caveats, the results of NA trace element analyses of the Sardis samples must be considered preliminary and inconclusive. It seems best, however, to include them here so that they will be available to future researchers.

Neutron activation analyses of the samples from Sardis were done by the author using the nuclear reactor facilities at the University of Wisconsin-Madison, and procedures that allowed determination of twenty-nine elements.⁷ Stanley E. Aschenbrenner was instrumental

6. In some cases, the size of the sample was too small to permit AA analysis, hence there are fewer objects in Table V.4b than in Table V.4a.

7. See Rapp, et al., "Analyses," 166-181, esp. 176-178. The neutron activation analyses were supported by the Reactor Sharing Program under grant DOE-EY-76-C-02-2144.A001 to Richard Cashwell, Director, Reactor Laboratory, University of Wisconsin-Madison.

5. G. Rapp, Jr., et al., "Trace-Element Fingerprinting as a Guide to the Geographic Sources of Native Copper," *Journal of Metals* 32 (1980) 35-45.

Table V.3 Emission spectrographic analyses of copper and copper alloy artifacts

Catalogue number	Fogg sample number	Type of object	Date	Cu
3	AL76.143	Dagger	Early Bronze	99.9
656	AL76.130A	Pin	Early Bronze	98
657	AL76.130	Pin	Early Bronze	99
87	AL76.107	Ibex plaque	Lydian	92
Not catalogued	AL76.159	Sealing	Lydian	92
487	AL76.124	Bowl	Lydian	94
660	AL76.146	Pin	Lydian	98
672	AL76.140	Fibula	Archaic	90
674	AL76.121	Fibula	Archaic	88
20	AL76.94	Arrowhead	6th-5th C.	94
21	AL76.101	Arrowhead	6th-5th C.	87
22	AL76.92	Arrowhead	6th-5th C.	89
29	AL76.93	Arrowhead	6th-5th C.	93
34	AL76.129	Arrowhead	6th-5th C.	90
38	AL76.116	Arrowhead	Hellenistic-Roman	91
47	AL76.126	Arrowhead	Hellenistic-Roman	92
264	AL76.125	Plumbing fixture	Late Roman	87
928	AL76.84A	"Furnace plate"	Late Roman	91
928	AL76.84B	"Furnace rivet plate"	Late Roman	90
489	AL76.131	Bowl	Roman?	90
500	AL76.100	Bowl	Roman?	88
513	AL76.115A	Ram's head handle	Roman	85
619*	AL76.139	Cosmetic spoon	Roman-Early Byzantine	91
622	AL76.149	Cosmetic spoon	Roman-Early Byzantine	91
628	AL76.96	Cosmetic spoon	Roman-Early Byzantine	89
631	AL76.128	Cosmetic spoon	Roman-Early Byzantine	91
636	AL76.154	Cosmetic spoon	Roman-Early Byzantine	89
641	AL76.97	Spatula	Roman-Early Byzantine	90

(in weight percent)

Sn	Pb	Zn	As	Fe	Sb	Ni	Ag	Co
<0.08	<0.05	<0.18	<0.035	0.03 ±0.008	0.06 ±0.02	<0.30	0.02 ±0.003	<0.003
<0.08	<0.05	<0.18	>1.0 high	0.20 ±0.05	0.46 ±0.12	<0.30	0.03 ±0.003	<0.003
<0.08	0.07 ±0.01	<0.18	>1.0 high	<0.006	<0.05	<0.30	>0.03	<0.003
6.8 ±1.0	0.75 ±0.11	0.37 ±0.09	0.05 ±0.01	0.14 ±0.04	0.05 ±0.01	<0.30	0.02 ±0.002	0.08 ±0.008
6.9 ±1.0	0.07 ±0.01	<0.18	0.85 ±0.13	0.006 ±0.0002	<0.05	<0.30	0.03 ±0.003	<0.003
5.5 ±0.80	<0.05	<0.18	0.19 ±0.03	0.20 ±0.05	<0.05	<0.30	0.02 ±0.002	0.05 ±0.005
1.2 ±0.20	<0.05	<0.18	>1.0 high	0.24 ±0.06	<0.05	<0.30	0.02 ±0.002	<0.003
8.2 ±1.2	0.07 ±0.01	<0.18	>1.0	0.24 ±0.06	0.14 ±0.04	<0.30	0.03 ±0.003	<0.003
8.5 ±1.3	2.1 ±0.30	<0.18	1.0 ±0.20	0.13 ±0.03	0.09 ±0.02	0.33 ±0.07	0.03 ±0.003	<0.003
2.2 ±0.20	3.4 ±1.1	<0.18	0.13 ±0.02	0.17 ±0.04	<0.04	<0.30	0.02 ±0.002	<0.003
6.0 ±0.90	6.5 ±1.0	0.22 ±0.06	0.035 ±0.005	0.04 ±0.01	0.04 ±0.01	<0.30	0.02 ±0.002	0.017 ±0.002
3.8 ±0.60	6.0 ±0.90	<0.18	>1.0 high	0.02 ±0.006	<0.04	<0.30	0.02 ±0.002	<0.003
7.0 ±1.1	<0.05	<0.18	0.12 ±0.02	0.04 ±0.01	0.06 ±0.02	<0.30	0.02 ±0.002	0.004 ±0.0004
5.2 ±0.80	3.8 ±0.60	<0.18	>1.0	0.30 ±0.08	<0.05	<0.30	0.02 ±0.002	0.02 ±0.002
2.9 ±0.40	5.9 ±0.90	<0.18	0.13 ±0.02	0.12 ±0.03	<0.04	<0.30	0.02 ±0.002	<0.003
3.1 ±0.50	5.0 ±0.80	<0.18	0.05 ±0.01	0.05 ±0.01	<0.05	<0.30	0.01 ±0.001	0.005 ±0.0005
6.2 ±0.90	6.3 ±1.0	<0.18	0.08 ±0.01	0.15 ±0.04	0.11 ±0.03	<0.30	0.02 ±0.002	<0.003
3.2 ±0.50	5.7 ±0.90	<0.18	0.07 ±0.01	0.03 ±0.01	0.10 ±0.03	<0.30	0.03 ±0.003	<0.003
3.0 ±0.50	6.5 ±1.0	<0.18	0.06 ±0.01	0.008 ±0.002	0.10 ±0.03	<0.30	0.03 ±0.003	<0.003
5.3 ±0.80	4.5 ±0.70	<0.18	<0.035	0.01 ±0.004	0.19 ±0.05	<0.30	≥0.03	<0.003
0.08 ±0.01	0.28 ±0.04	11.1 ±2.8	<0.035	0.14 ±0.04	<0.05	<0.30	0.03 ±0.003	<0.003
8.0 ±1.2	6.4 ±1.0	0.45 ±0.11	0.14 ±0.02	0.30 ±0.08	0.12 ±0.03	<0.30	0.03 ±0.003	0.005 ±0.0005
<0.08	<0.05	9.2 ±2.3	0.05 ±0.01	0.28 ±0.07	<0.05	<0.30	0.02 ±0.002	<0.003
<0.08	0.10 ±0.02	8.7 ±2.2	<0.035	0.32 ±0.08	0.06 ±0.01	<0.30	0.03 ±0.003	<0.003
0.10 ±0.02	<0.05	10.1 ±2.5	<0.035	0.31 ±0.08	0.09 ±0.02	<0.30	0.03 ±0.003	<0.003
0.15 ±0.02	0.85 ±0.13	7.8 ±2.0	0.41 ±0.06	0.08 ±0.02	<0.05	<0.30	0.03 ±0.003	0.007 ±0.0007
0.66 ±0.10	1.7 ±0.30	8.5 ±2.1	0.11 ±0.02	0.14 ±0.04	0.07 ±0.02	<0.30	0.03 ±0.003	<0.003
<0.08	1.1 ±0.20	8.5 ±2.1	<0.035	0.16 ±0.04	0.06 ±0.01	<0.30	0.02 ±0.002	<0.003

Table V.3 Emission spectrographic analyses of copper alloy artifacts

Catalogue number	Fogg sample number	Type of object	Date	Cu
642	AL76.147	Spatula	Roman-Early Byzantine	91
650	AL76.85	Mirror disk	Roman 1st-2nd C.	83
650	AL76.83	Mirror handle	Roman 1st-2nd C.	86
652	AL76.141	Mirror handle	Roman	87
683	AL76.158	Fibula	Roman 3rd C.	90
725	AL76.123	Earring	Late Roman?	90
728	AL76.122	Earring	Late Roman-Early Byzantine	92
409	AL76.110	Lion-head attachment	Early Byzantine?	83
429	AL76.118	Bull protome	Late Roman-Early Byzantine	78
918	AL76.142	Dog figurine	Late Roman?	88
217	AL76.137	Strainer	Early Byzantine	93
227	AL76.86	Spoon	Early Byzantine	89
449	AL76.90	Balance	Early Byzantine	94
901	AL76.88	Reliquary cross	Byzantine	85
902	AL76.155	Reliquary cross	Byzantine	84
903	AL76.89	Cross	Byzantine	99.5
904	AL76.99	Cross	Byzantine	80
689	AL76.148	Buckle	Early Byzantine	82
690	AL76.98	Buckle	Early Byzantine	84
691	AL76.104	Buckle	Early Byzantine	85
694	AL76.119	Buckle	Early Byzantine	86
698	AL76.76	Buckle	Early Byzantine	90
701	AL76.120	Buckle	Early Byzantine	87
702*	AL76.74	Buckle	Early Byzantine	89
577	AL76.81	Censer	Early Byzantine	87
578	AL76.75A	Censer bowl	Early Byzantine	86
578	AL76.75B	Censer foot	Early Byzantine	85
580	AL76.133	Censer	Early Byzantine	84

(in weight percent) (Continued)

Sn	Pb	Zn	As	Fe	Sb	Ni	Ag	Co
3.0	1.2	4.6	0.08	0.23	0.10	<0.30	0.03	<0.003
±.50	±.20	±1.2	±.01	±.06	±.02		±.003	
10.0	6.2	<0.18	0.13	0.17	0.17	<0.30	0.02	<0.003
±1.5	±.90		±.02	±.04	±.04		±.002	
7.6	5.7	<0.18	0.12	0.05	0.11	<0.30	0.02	<0.003
±1.1	±.90		±.02	±.01	±.03		±.002	
8.2	4.7	<0.18	0.04	0.06	0.07	<0.30	0.02	<0.003
±1.2	±.70		±.005	±.02	±.02		±.002	
0.42	0.37	9.4	0.04	0.07	<0.05	<0.30	0.03	<0.003
±.06	±.06	±2.4	±.006	±.02			±.003	
<0.08	0.05	9.5	<0.035	0.08	<0.04	<0.30	0.02	<0.003
	±.01	±2.4		±.02			±.002	
<0.08	<0.05	8.5	<0.035	0.02	<0.04	<0.30	0.02	<0.003
		±2.1		±.006			±.002	
4.8	5.5	5.1	1.0	0.17	0.06	<0.30	0.03	0.004
±.70	±.80	±1.3	±.20	±.04	±.02		±.003	±.0004
8.2	6.4	7.0	0.15	0.30	0.08	<0.30	0.02	0.004
±1.2	±1.0	±1.8	±.02	±.08	±.02		±.002	±.0004
4.0	6.0	2.0	0.04	0.13	0.06	<0.30	0.03	0.004
±.60	±.90	±.50	±.005	±.03	±.02		±.003	±.0004
0.33	<0.05	6.8	<0.035	0.02	<0.05	<0.30	0.02	<0.003
±.05		±1.7		±.006			±.002	
<0.08	<0.05	10.9	0.22	0.23	0.08	<0.30	0.03	<0.003
		±2.7	±.03	±.06	±.02		±.003	
0.08	0.37	5.0	0.05	0.05	<0.04	<0.30	0.03	<0.003
±.01	±.06	±1.3	±.01	±.01			±.003	
7.5	5.4	1.0	0.74	0.18	0.13	<0.30	0.03	<0.003
±1.1	±.80	±.30	±.11	±.05	±.03		±.003	
6.6	6.0	2.5	0.57	0.22	0.01	<0.30	0.03	0.014
±1.0	±.90	±.60	±.90	±.06	±.004		±.003	±.001
<0.08	0.06	<0.18	0.32	0.16	<0.04	<0.30	0.03	<0.003
	±.01		±.05	±.04			±.003	
9.2	3.6	5.7	0.78	0.30	0.15	<0.30	0.03	<0.003
±1.4	±.50	±1.4	±.12	±.08	±.04		±.003	
5.2	6.2	5.9	0.35	0.19	0.07	<0.30	0.03	0.005
±.80	±.90	±1.5	±.05	±.05	±.02		±.003	±.0005
1.3	5.7	7.8	1.0	0.16	0.17	<0.30	0.03	0.012
±.20	±.90	±2.0	±.20	±.04	±.04		±.003	±.001
7.0	6.5	1.1	0.08	0.12	0.09	<0.30	0.03	<0.003
±1.1	±1.0	±.30	±.01	±.03	±.02		±.003	
<0.08	2.0	10.1	>1.0	0.13	0.09	0.34	0.03	<0.003
	±.30	±2.5	high	±.03	±.02	±.07	±.003	
<0.08	0.65	8.5	0.12	0.22	0.06	<0.30	0.02	<0.003
	±1.0	±2.1	±.02	±.06	±.02		±.002	
1.5	2.1	8.5	>1.0	0.25	0.14	<0.30	0.03	<0.003
±.20	±.30	±2.1	high	±.06	±.04		±.003	
0.092	1.0	9.0	0.52	0.18	0.06	<0.30	0.03	0.032
±.014	±.20	±2.3	±.08	±.05	±.02		±.003	±.003
1.6	5.0	5.4	0.75	0.28	0.07	<0.30	0.03	0.007
±.20	±.80	±1.4	±.11	±.07	±.02		±.003	±.0007
6.5	3.8	3.2	0.17	0.22	0.11	<0.30	0.03	0.005
±1.0	±.60	±.80	±.03	±.06	±.03		±.003	±.0005
6.6	4.9	3.3	0.18	0.20	0.11	<0.30	0.03	0.009
±1.0	±.70	±.80	±.03	±.05	±.03		±.003	±.0009
0.48	6.3	8.0	>1.0	0.15	0.08	<0.30	0.02	0.004
±.07	±1.0	±2.0		±.04	±.02		±.002	±.0004

Table V.3 Emission spectrographic analyses of copper alloy artifacts

Catalogue number	Fogg sample number	Type of object	Date	Cu
581*	AL76.112	Censer	Early Byzantine	85
581	AL76.113	Censer chain	Early Byzantine	94
581	AL76.114	Censer	Early Byzantine	88
582	AL76.138	Censer	Early Byzantine	90
589	AL76.82	Polycandelon	Early Byzantine	90
590	AL76.157	Polycandelon	Early Byzantine	86
591	AL76.80	Lamp chain	Early Byzantine	89
591	AL76.79	Lamp hook	Early Byzantine	85
594	AL76.144	Lamp chain	Early Byzantine	87
600	AL76.109	Lamp hook	Early Byzantine	89
605*	AL76.87	Lamp chain	Early Byzantine	86
606	AL76.78A	Lamp chain	Early Byzantine	91
606	AL76.78B	Lamp chain	Early Byzantine	92
607	AL76.103	Lamp chain	Early Byzantine?	92
490	AL76.102	Bowl	Early Byzantine	99.9
515	AL76.106	Cauldron	Early Byzantine	99.8
520	AL76.135	Authepsa neck	Early Byzantine	99.8
520	AL76.136	Authepsa handle	Early Byzantine	87
528	AL76.132	Flask	Early Byzantine	99
533	AL76.156	Flask	Early Byzantine	99.8
536	AL76.127	Flask lid	Early Byzantine	99.9
542	AL76.153	Flask lid	Early Byzantine	99.9
576*	AL76.95	Vessel patch	Early Byzantine	99
509	AL76.108	Bowl	Turkish	99.2

*Sample checked by X-ray fluorescence.

(in weight percent) (Continued)

Sn	Pb	Zn	As	Fe	Sb	Ni	Ag	Co
3.7	6.9	3.3	0.47	0.26	0.07	<0.30	0.02	0.008
±0.60	±1.0	±0.80	±0.07	±0.07	±0.02		±0.002	±0.0008
<0.08	0.06	5.7	<0.035	0.01	<0.05	<0.30	0.02	<0.003
	±0.1	±1.4		±0.003			±0.002	
3.0	6.2	3.0	0.32	0.21	0.07	0.45	0.03	<0.003
±0.50	±0.90	±0.80	±0.05	±0.05	±0.02	±0.09	±0.003	
4.3	4.8	0.83	0.20	0.15	0.07	<0.30	>0.03	0.005
±0.70	±0.70	±0.21	±0.03	±0.04	±0.02			±0.0005
3.6	5.4	0.43	0.28	0.20	0.09	<0.30	0.03	0.008
±0.50	±0.80	±0.11	±0.04	±0.05	±0.02		±0.003	±0.0008
4.0	5.4	3.7	0.57	0.17	0.22	<0.30	0.03	0.055
±0.60	±0.80	±0.90	±0.09	±0.04	±0.06		±0.003	±0.006
1.8	3.8	5.3	0.12	0.13	0.08	<0.30	0.03	<0.003
±0.30	±0.60	±1.3	±0.02	±0.03	±0.02		±0.003	
2.9	4.7	7.1	0.035	0.10	0.04	0.30	0.02	<0.003
±0.40	±0.70	±1.8	±0.005	±0.025	±0.01	±0.06	±0.002	
0.37	2.5	9.0	0.51	0.27	<0.05	<0.30	0.03	0.021
±0.06	±0.40	±2.3	±0.08	±0.07			±0.003	±0.002
2.3	3.4	5.4	0.13	0.15	0.06	<0.30	0.03	<0.003
±0.40	±0.50	±1.4	±0.02	±0.04	±0.02		±0.003	
4.7	3.8	5.1	0.09	0.14	0.06	<0.30	0.03	0.010
±0.70	±0.60	±1.3	±0.01	±0.04	±0.01		±0.003	±0.001
0.19	<0.05	8.3	0.29	0.19	<0.04	<0.30	0.02	<0.003
±0.03		±2.1	±0.04	±0.05			±0.002	
0.16	<0.05	7.5	0.52	0.20	<0.04	<0.30	0.02	<0.003
±0.02		±1.9	±0.08	±0.05			±0.002	
<0.08	<0.05	7.5	0.09	0.08	<0.05	<0.30	0.02	<0.003
		±1.9	±0.01	±0.02			±0.002	
<0.08	<0.05	<0.18	<0.035	0.02	<0.05	<0.30	0.03	<0.003
				±0.004			±0.003	
<0.08	0.05	<0.18	0.08	0.02	0.07	<0.30	0.03	<0.003
	±0.1		±0.1	±0.004	±0.02		±0.003	
<0.08	0.05	<0.18	0.06	<0.008	0.05	<0.30	0.03	<0.003
	±0.1		±0.1	±0.01	±0.01		±0.003	
5.5	6.5	0.60	0.20	0.04	0.08	<0.30	0.02	0.005
±0.83	±1.0	±0.15	±0.03	±0.01	±0.02		±0.002	±0.0005
0.18	0.35	0.55	0.05	0.01	<0.05	<0.30	0.03	<0.003
±0.03	±0.05	±0.14	±0.01	±0.004			±0.003	
<0.08	0.05	<0.18	0.04	0.10	0.05	<0.30	0.03	<0.003
	±0.1		±0.006	±0.03	±0.01		±0.003	
<0.08	<0.05	<0.18	0.04	0.05	<0.05	<0.30	0.03	<0.003
			±0.01	±0.01			±0.003	
<0.08	<0.05	<0.18	0.04	<0.006	0.07	<0.30	0.02	<0.003
			±0.006		±0.02		±0.002	
<0.08	0.06	<0.18	0.90	0.02	0.05	<0.30	0.03	<0.003
	±0.1		±0.14	±0.005	±0.01		±0.003	
<0.08	<0.05	<0.18	0.78	<0.006	<0.05	<0.30	0.02	0.01
			±0.12				±0.002	±0.001

in developing the computing aspects of the neutron activation program of the Archaeometry Laboratory. Table V.4a presents results of these analyses on samples of forty-four artifacts ranging in date from Early Bronze Age to Byzantine. Of the elements tested for, three—cadmium (Cd), indium (In) and tellurium (Te)—are more difficult to determine accurately than the others and should be interpreted accordingly. The neutron activation analytical method employed is designed for trace element concentrations. Hence, concentrations reported as greater than 0.1 percent (1,000 ppm) should be treated as qualitative. Table V.4a lists no assessment of the standard deviation of the analytical results because our method of calculating the concentration for each element makes the normal error assessment meaningless. However, it can be assumed that the errors could be quite large, i.e. as much as 100 percent (two times the amount present) for some elements in some ranges.

When no concentration in ppm is reported (as “-”) in Table V.4a it could mean that the concentration was below the limit of detection, or it could mean that the gamma radiation peak to be measured was subject to interference or in some other related way was rejected by a computer examination of peak characteristics. The results are given to two significant figures, which means significant rounding of values was done at the higher concentrations.

A similar analytical program was undertaken on copper and copper alloy artifacts from the Bronze Age, Dark Age and Byzantine site of Nichoria in southwestern Greece.⁸ A general comparison of results might serve to indicate where analyses can be helpful in archaeological interpretations. It must be noted that the analyzed Nichoria artifacts were chiefly from Bronze Age strata and that a majority of the specimens were materials directly from metallurgical processing (fragments, drops, spatters) rather than finished artifacts.

The concentration range of silver in the Sardis artifacts is the same as in the Nichoria materials. A similar relationship holds for the elements gold, cobalt, and nickel. Selenium and iron are noticeably more abundant in the Nichoria artifacts. Antimony is found in greater concentrations in Sardis artifacts than in Bronze Age items from Nichoria but is nearly identical in concentration to the later, Dark Age and Byzantine artifacts from Nichoria. The other elements were not uniformly present and little can be said about them except that the concentrations found were not extraordinary.

There are no major differences in the trace element patterns among the major periods at Sardis. This may indicate that the metal sources for the manufacture of metal objects did not change over time.

Table V.4b presents the results of the atomic absorption analyses for the alloy elements lead, arsenic, tin and zinc. These analyses were done under the direction of Eugene Ruenger at the University of Minnesota, Duluth. With the exception of the single Early Bronze Age object and one archaic pin, there are no arsenical coppers among these samples. The only unalloyed copper artifacts are four related Early Byzantine vessel parts (490, 515, 533, 536) and one Roman/Byzantine cosmetic spoon (637).

Roman and Byzantine brass (greater than 2 percent zinc) was made by smelting zinc carbonate ore with copper under reducing conditions. This technology limits the alloy to less than 20 percent zinc. The maximum zinc content of any of these objects is 18.1 percent.

For Late Roman and Byzantine brass objects, comparisons of the zinc concentrations with the lead concentrations show no discernible patterns. Although there are perhaps too few objects to show a significant correlation there is also no discernible correlation between composition and function apparent in Table V.4b.

Copper Alloying at Sardis—Historical Discussion (Waldbaum)

The following discussion is an attempt to compare the results of the emission spectrography (ES) and atomic absorption (AA) analyses and to place the findings on alloying ingredients at Sardis into historical perspective. For more information on individual objects discussed here see catalogue entries in Chap. III.

Early Bronze Age

Three of the six Early Bronze Age copper-based objects excavated were analyzed by ES: a dagger and two straight pins (3, 656, 657). One of these (656) was analyzed by AA as well. The dagger proved to be nearly pure copper with only traces of other elements, while the two pins each have something over 1 percent arsenic in them and virtually no tin, lead or zinc. Determination of arsenic content by ES was highly imprecise, but the value of 2.10 percent arsenic for 656 as determined by AA is probably fairly accurate.

The presence of arsenic in Early Bronze Age copper alloys is not at all unusual; in fact, it is proving to be quite a common and widespread phenomenon in the ancient world. Objects tested from mainland Greece, Crete, the Cyclades, Cyprus, Anatolia, Iran, Iraq, Syria,

8. Rapp, et al., "Analyses," 166-181, esp. 176-178.

Palestine and Europe have been shown to contain arsenic in quantities ranging from less than 1 percent to nearly 10 percent.⁹

Arsenic in the range of 1 to 5 percent is believed to impart almost the same advantages to casting and working copper that tin does, and for some properties may even be superior to tin: it acts as a deoxidizing agent in casting, increases the strength and hardness of the finished object and allows it to be readily hot or cold worked.¹⁰

The point at which addition of arsenic to copper may be considered deliberate is still somewhat controversial. This has some bearing here since the two Sardis samples have relatively small amounts of arsenic.

Arsenic appears as an impurity in some copper ores, and under certain conditions may alloy "accidentally" with the copper during smelting of the ore.¹¹ Branigan and others believe that an amount of arsenic over 2 percent may be considered a deliberate addition.¹² Biek, however, suggests that amounts of up to 6 to 8 percent could, theoretically at least, be imparted to an alloy from an arsenic-rich copper ore, although other conditions make this unlikely.¹³ Arsenic contents of analyzed bronzes have been shown to drop off significantly beginning in the Middle Bronze Age when tin contents regularly increase, and thereafter arsenic rarely reaches more than 1 percent.¹⁴ This suggests deliberate addition of amounts over 1 percent before the regular utilization

of tin, and deliberate omission thereafter.¹⁵ Since both the Sardis pins seem to contain only small amounts of arsenic, and since the dagger contains no arsenic, although one would expect it to profit more from deliberate addition of a hardening agent than a pin, it seems likely that the arsenic in the Sardis pins is not a deliberate addition. While based on so few samples, this conjecture is perhaps substantiated by the fact that some much later examples of copper alloys at Sardis also contain small amounts of arsenic in addition to other more common alloying ingredients. For example, **22, 34, 409, 580, 660, 672, 674, 694** and **701**, ranging in date from Lydian to Early Byzantine, show arsenic readings of 1 percent or more by ES analysis. Of these, **660, 672, 674** and **694** were also tested by AA. By this method, however, only **660**, a Lydian pin, shows a relatively high arsenic content of over 3 percent (see Table V.4b). Since all of these objects also contain varying proportions of other alloying ingredients—tin, lead and zinc—the arsenic in them most likely resulted from the smelting of arsenic-rich copper ores, or from reusing earlier scrap metal that was high in arsenic. More frequent and more accurate analyses are necessary to provide a clearer understanding of arsenic alloying.

Lydian-Persian

Eleven objects of Lydian or Persian date were analyzed by ES: the ibex plaque (**87**), a sealing (uncatalogued), a bowl (**487**), a straight pin (**660**), two fibulae (**672, 674**), and five arrowheads (**20-22, 29** and **34**). Six of these (**487, 660, 672, 674, 20** and the sealing) as well as three more arrowheads (**18, 19**, and **30**) were analyzed by AA.

In all of the objects analyzed by ES tin is the major alloying ingredient, with significant quantities of lead in five samples (**674, 20, 21, 22, 34**), and arsenic in another five (**660, 672, 674, 22, 34**). None of the samples tested by ES gave significant readings for zinc.

Given the differences in the two methods, most of the objects tested by both ES and AA show reasonable agreement in composition, except for the somewhat higher ES readings for arsenic in **672** and **674**. One major discrepancy exists, however, in the tests of the uncatalogued sealing; it showed 12.7 percent zinc and less than 1 percent tin when tested by AA, but nearly 7 percent tin and less than 1 percent zinc when tested by ES.

Of those objects tested by AA alone, all three contain lead as the major alloying ingredient, and only two (**18, 19**) contain tin.

9. See e.g. K. Bittel, "Beitrag zur Kenntnis anatolischer Metallgefäße der zweiten Hälfte des dritten Jahrtausends v. Chr.," *Jdl* 74 (1959) 33-34 (Troad); Moorey-Schweitzer, 177-198; idem, "Copper and Copper Alloys in Ancient Turkey: Some New Analyses," *Archaeometry* 16 (1974) 112-115; U. Esin, *Kuantitatif Spektrel Analiz Yardımıyla Anadolu'da Başlangıcından Asur Kolonileri Çağına Kadar Bakır ve Tunç Madenciliği* (Istanbul 1969) 121-146; Buchholz, 189-256, esp. 215 and 240-253, Tables 10-16; Eaton-McKerrell, 169-191; C. Renfrew, "Cycladic Metallurgy and the Aegean Early Bronze Age," *AJA* 71 (1967) 1-20, esp. 13-14, 20; Craddock, "Composition 1," 98, 106 (Kythnos); Branigan, *Copper*, 46-48; idem, *Aegean Metalwork*, 71-77, 147-152; J. D. Muhly, review of Branigan, *Aegean Metalwork in Materials Science and Engineering* 19 (1975) 158-159 (with distribution of arsenic coppers and summary of recent literature); Jungmans, et al., *Metallanalysen*; idem, *Kupfer*; Tylecote, 40-41 (Britain); Rapp, et al., "Analyses," 170-171, 174 (Nichoria).

10. J. A. Charles, "Early Arsenical Coppers—A Metallurgical View," *AJA* 71 (1967) 21-24; Eaton-McKerrell, 169-170.

11. Tylecote, 24; Biek, 72; Rapp, et al., "Analyses," 170. See also H. Lechtman, "Issues in Andean Metallurgy," in E. P. Benson, ed., *Dumbarton Oaks Conference on Pre-Columbian Metallurgy of South America* (Washington, D.C. 1979) 4-11 for probable production of arsenical coppers from locally available sulfarsenide copper ores in northern Peru.

12. Branigan, *Aegean Metalwork*, 72-73; idem, *Copper*, 46; Rapp, et al., "Analyses," 170, 174.

13. Biek, 72.

14. Craddock, "Composition 1," 98; Moorey-Schweitzer, 194-195.

15. Craddock, "Composition 1," 98.

Table V.4a Trace element analyses of copper and copper alloy artifacts (in parts per million)

Catalogue number	Minnesota sample number	Type of object	Date	Ag	Au	Cd	Ce	Co	Cr	Cs
656	79-01-01-BR	Pin	Early Bronze	4,800.	4.9	—	—	4.3	—	—
Not catalogued	79-01-01-CY	Sealing	Lydian	340.	22.	—	—	—	—	—
487	79-01-01-BM	Bowl	Lydian	180.	24.	91.	—	580.	—	4.7
660	79-01-01-CI	Pin	Lydian	310.	9.7	—	13.	25.	—	—
672	79-01-01-CD	Fibula	Archaic	1,400.	15.	—	—	36.	—	—
674	79-01-01-BJ	Fibula	Archaic	870.	17.	—	23.	220.	—	—
18	79-01-01-DB	Arrowhead	6th-5th C.	330.	12.	—	—	280.	—	4.6
19	79-01-01-DA	Arrowhead	6th-5th C.	310.	34.	—	—	400.	—	—
20	79-01-01-AL	Arrowhead	6th-5th C.	1,800.	11.	—	—	32.	—	1.2
30	79-01-01-CW	Arrowhead	6th-5th C.	83.	4.3	310.	—	86.	—	—
39	79-01-01-CS	Arrowhead	Hellenistic-Roman	340.	16.	—	—	120.	—	6.6
264	79-01-01-BN	Plumbing fixture	Late Roman	210.	17.	—	—	53.	—	2.8
927	79-01-01-AE	"Furnace plate"	Late Roman	250.	26.	—	—	52.	30.	—
619	79-01-01-CC	Cosmetic spoon	Roman-Early Byzantine	130.	6.5	—	—	1.3	51.	—
628	79-01-01-AN	Cosmetic spoon	Roman-Early Byzantine	290.	30.	—	—	4.8	—	—
636	79-01-01-AM	Cosmetic spoon	Roman-Early Byzantine	1,200.	33.	—	—	26.	—	—
637	79-01-01-CK	Cosmetic spoon	Roman-Early Byzantine	2,300.	130.	—	—	—	—	—
650	79-01-01-AF	Mirror disk	Roman	220.	18.	100.	—	3.4	—	—
650	79-01-01-AD	Mirror handle	Roman	200.	12.	—	16.	36.	—	—
652	79-01-01-CF	Mirror handle	Roman	510.	37.	—	—	4.8	—	—
683	79-01-01-CZ	Fibula	Roman	290.	125.	—	57.	54.	—	—
726	79-01-01-BL	Earring	Late Roman?	120.	13.	85.	—	5.9	—	—
728	79-01-01-BK	Earring	Late Roman-Early Byzantine	450.	7.8	150.	—	5.7	—	5.4
409	79-01-01-BA	Lion-head attachment	Early Byzantine	730.	21.	410.	—	66.	—	5.0
217	79-01-01-BX	Strainer	Early Byzantine	510.	34.	—	—	9.9	34.	0.28
227	79-01-01-AG	Spoon	Early Byzantine	1,200.	5.7	—	—	5.4	28.	—
449	79-01-01-AK	Balance	Early Byzantine	360.	43.	—	—	45.	—	6.5
902	79-01-01-CM	Reliquary cross	Byzantine	970.	31.	—	13.	120.	—	4.8
694	79-01-01-BH	Buckle	Early Byzantine	530.	31.	99.	—	66.	—	7.6
577	79-01-01-AB	Censer	Early Byzantine	700.	21.	—	—	110.	—	—
581	79-01-01-BC	Censer	Early Byzantine	580.	34.	—	18.	110.	—	—
583	79-01-01-DD	Censer	Early Byzantine	780.	25.	—	—	1,400.	—	—
590	79-01-01-CO	Poly-candelon	Early Byzantine	790.	49.	—	—	450.	—	—

Eu	Fe	Hf	Hg	In	Ir	Lu	Ni	Sb	Se	Ru	Ta	Te	Th	W
—	3,000.	3.2	20.0	720.	—	—	—	3,500.	51.	—	—	—	—	—
—	—	2.8	9.4	—	—	—	—	400.	—	11.	—	52.	—	—
—	4,600.	2.5	—	—	—	—	530.	220.	64.	—	—	60.	—	—
—	6,200.	—	20.	—	—	—	8,100.	1,700.	170.	—	—	140.	—	—
—	—	—	9.9	—	—	—	570.	1,200.	72.	—	—	—	—	11.
—	1,300.	—	14.	—	0.34	—	860.	960.	60.	—	—	—	—	—
—	14,000.	—	16.	—	—	—	2,200.	240.	30.	—	—	68.	—	17.
—	1,200.	—	—	7.5	—	—	9,100.	220.	—	—	—	—	—	—
—	—	—	10.	—	0.16	—	310.	280.	52.	—	—	52.	—	—
—	—	—	—	—	—	—	—	17,000.	—	37.	—	—	30.	—
—	—	—	—	—	—	—	713.	1,700.	24.	—	—	—	—	—
—	960.	1.5	9.0	—	0.20	—	500.	1,600.	31.	—	—	—	3.4	—
—	1,300.	—	17.	—	—	—	470.	2,400.	—	—	—	—	5.2	—
—	—	—	—	51.	—	0.64	2,800.	260.	100.	—	—	—	—	33.
0.37	—	—	—	33.	—	—	1,000.	89.	55.	—	—	—	—	—
—	—	—	—	93.	—	—	430.	690.	23.	17.	—	—	—	58.
—	—	—	—	100.	55.	—	—	620.	—	—	—	230.	—	500.
—	2,100.	—	—	—	—	—	510.	1,200.	—	—	—	—	—	—
—	—	—	15.	—	—	—	420.	1,100.	39.	—	—	—	—	—
—	—	—	—	83.	—	—	650.	500.	40.	—	—	—	—	80.
—	1,400.	—	—	—	—	—	1,100.	420.	—	—	—	—	—	—
—	—	—	11.	42.	—	33.	—	100.	53.	13.	—	84.	—	—
—	—	—	6.9	—	—	—	1,200.	75.	16.	—	0.72	—	1.4	—
—	1,250.	4.2	8.6	—	0.092	—	890.	1,100.	31.	5.8	1.2	80.	—	2,200.
—	—	—	—	38.	—	—	1,200.	470.	22.	—	1.1	—	—	95.
—	2,600.	—	—	—	—	—	2,300.	460.	15.	—	—	46.	—	—
0.27	—	—	15.	78.	0.30	—	1,500.	400.	—	—	—	—	—	—
—	2,500.	—	11.	38.	—	—	690.	1,500.	25.	9.5	—	—	—	—
—	—	—	—	—	—	—	3,400.	740.	—	—	—	78.	—	—
0.87	—	3.5	—	86.	—	—	—	1,100.	73.	14.	—	150.	—	83.
—	6,100.	—	5.4	0.13	—	—	1,500.	830.	27.	—	—	—	2.7	—
—	4,100.	—	—	360.	—	—	2,100.	3,800.	37.	—	—	—	—	—
—	—	—	—	64.	—	—	—	3,400.	96.	—	3.5	—	—	—

Table V.4a Trace element analyses of copper and copper alloy artifacts (in parts per million) (Continued)

Catalogue number	Minnesota sample number	Type of object	Date	Ag	Au	Cd	Ce	Co	Cr	Cs
591	79-01-01-AA	Lamp chain	Early Byzantine	360.	28.	—	—	31.	—	—
591	79-01-01-Z	Lamp hook	Early Byzantine	520.	14.	—	—	29.	—	4.0
594	79-01-01-CG	Lamp chain	Early Byzantine	430.	26.	97.	—	180.	57.	13.
605	79-01-01-AH	Lamp chain	Early Byzantine	690.	31.	—	—	130.	—	—
606	79-01-01-Y	Lamp chain	Early Byzantine	200.	19.	—	—	7.2	19.	—
607	79-01-01-AU	Lamp chain	Early Byzantine	380.	5.3	—	—	67.	—	—
490	79-01-01-AT	Bowl	Early Byzantine	440.	35.	—	—	4.5	—	—
515	79-01-01-AW	Cauldron	Early Byzantine	510.	37.	—	—	5.2	—	—
531	79-01-01-CR	Flask	Early Byzantine	1,500.	37.	—	—	2.1	—	—
533	79-01-01-CN	Flask neck	Early Byzantine	500.	37.	—	—	1.9	—	—
536	79-01-01-BP	Flask lid	Early Byzantine	500.	41.	41.	—	3.2	—	—

The relationship of alloying elements to object type is interesting. The ibex plaque (87), an arrowhead (29) and the bowl (487) seem to be the only fairly straightforward tin bronzes containing no other components over 1 percent. The pin (660) has small amounts of tin and arsenic (more arsenic than tin according to the AA analysis). The two fibulae are both tin bronzes, but 674 contains between 1 and 2 percent lead, while 672 has less than 1 percent. One percent or more of arsenic was detected in both fibulae by ES, but was not found by AA analysis. Neither fibula contains significant quantities of zinc.

The lack of zinc in the fibulae may be important because of possible connections with Phrygia. Although they belong to slightly different stylistic types, both fibulae are most closely paralleled by Phrygian examples from Gordion. Recent analyses of several eighth to seventh century Phrygian fibulae by A. Steinberg have shown that they contain over 10 percent zinc, together with some tin, and are in fact an early form of brass.¹⁶ One of the fibulae cited by Steinberg is of the same general type as 674, although its composition is appar-

ently wholly different.¹⁷ The only object of comparable date from Sardis that may contain zinc is the uncatologued sealing. However, the totally divergent readings given by the two analytical methods suggest caution in drawing conclusions about it.

Eight arrowheads were tested, three by AA (18, 19, 30), four by ES (21, 22, 29, 34) and one by both methods (20). Although only one object was checked by two analyses, the results of both sets of analyses on similar objects seem reasonably consistent.

Six of the eight arrowheads tested are of leaded tin bronze (18, 19, 20, 21, 22, 34) with proportions of lead exceeding the tin in four cases (18, 19, 20, 22). In addition, 22 apparently has over 1 percent arsenic. 29 is a tin bronze with no other significant ingredients, and 30 contains lead but no tin. All examples are of the same

17. Three Phrygian style fibulae of unknown provenances were also analyzed by Craddock, "Composition 2," 105, 111; these proved to be tin bronzes with no more than ca. 0.4% zinc. It will be interesting to see in the future whether this early use of zinc in Western and Central Anatolia is found chiefly in objects manufactured at Gordion, and whether the presence of zinc can therefore be used to determine whether Gordion was the place of manufacture.

16. See Steinberg. I am indebted to A. Steinberg for sending me this information. See also Craddock, "Composition 3," 3-4.

Eu	Fe	Hf	Hg	In	Ir	Lu	Ni	Sb	Se	Ru	Ta	Te	Th	W
—	—	—	—	—	0.14	—	—	790.	—	—	—	—	—	—
—	—	2.5	11.	—	—	—	1,400.	1,200.	—	—	—	—	—	—
—	—	—	—	—	—	0.34	1,200.	450.	—	—	—	—	—	—
—	—	—	—	82.	—	—	—	700.	—	—	—	—	—	—
0.27	—	2.2	36.	20.	—	—	—	130.	200.	—	0.60	51.	—	—
—	—	—	—	—	—	—	2,500.	140.	—	7.8	—	—	—	—
—	—	—	—	—	—	—	1,500.	330.	23.	—	—	80.	4.9	—
—	670.	—	—	24.	—	—	470.	480.	—	—	—	131.	—	—
—	—	—	14.	—	0.26	14.	590.	340.	35.	—	—	—	—	—
—	—	—	—	—	—	—	—	530.	—	—	—	—	—	—
—	—	—	10.	—	0.15	—	760.	660.	28.	11.	—	143.	—	—

general type stylistically so the differences in composition are apparently due to lack of strict control in the alloying process.

The effect of adding lead to bronze is primarily to increase the fluidity of the melt during casting. It does not improve the working properties of the cast bronze, and in fact, in too great quantities may be detrimental.¹⁸ Since arrowheads are intended to be expendable, perhaps the lead was added to reduce the amounts of more expensive tin and copper in the alloy, and thereby to cheapen the products.

Until very recently it was thought that lead was not deliberately added to bronzes until the Hellenistic period. As late as 1967, Caley went so far as to suggest that the presence or absence of lead in an alloy could be used as a rough dating criterion.¹⁹ More recent analyses by P. Craddock and others have shown fairly high lead contents in some samples as early as the Early Bronze Age and in most subsequent periods.²⁰ The arrowheads

from Sardis, whether of Lydian or Persian manufacture, and the fibula, whether Phrygian or not, confirm the use of lead in bronzes manufactured well before the Hellenistic period.

Hellenistic

Three arrowheads (38, 39, 47) were the only objects of possible Hellenistic date analyzed. All of these are leaded tin bronzes with less tin than lead, and have generally similar overall compositions despite stylistic differences. 39, the only one tested by AA, shows a substantially higher lead content than the others, but is otherwise not inconsistent. In fact, the composition of these arrowheads does not differ radically from that of

Aegean Metalwork, 73; M. A. Brown and A. Blin-Stoyle, "A Sample Analysis of British Middle and Late Bronze Age Material Using Optical Spectrometry," *ProcPS* 25 (1959) 193-197, 200; Buchholz, 215, 240-255, Tables 10-18; Jungmans, et al., *Metallanalysen*, 116-131; idem, *Kupfer*, vols. 3, 4 passim; M. Picon, et al., "Recherches techniques sur des bronzes de Gaule romaine, III," *Gallia* 26 (1968) 247-251 (Greek and Etruscan); J. Condamin and S. Boucher, "Recherches techniques sur des bronzes de Gaule romaine, IV," *Gallia* 31 (1973) 157, 178; R. E. Jones in M. R. Popham, et al., *Lefkandi I The Iron Age, Text* (London 1980) 447-458.

18. Craddock, "Alloys of the Medieval Islamic World," 74-75.

19. E. R. Caley, "Chemical Composition of Greek and Roman Statuary Bronzes," in Doeringer, et al., 39-41.

20. Craddock, "Composition 1," 106-111 (analytical table); idem, "Composition 2," 103-123; Rapp, et al., "Analyses," 173-174; Branigan,

Table V.4b Analyses of alloying elements in copper alloy artifacts (in percent)*

Catalogue number	Minnesota sample number	Type of object	Date	Pb	As	Sn	Zn
656	79-01-01-BR	Pin	Early Bronze	0.23	2.10	ND	ND
Not catalogued	79-01-01-CY	Sealing	Lydian	0.84	0.14	0.75	12.7
487	79-01-01-BM	Bowl	Lydian	0.20	0.12	3.33	0.001
660	79-01-01-CI	Pin	Lydian	0.26	3.41	0.79	ND
672	79-01-01-CD	Fibula	Archaic	0.30	0.33	10.7	0.038
674	79-01-01-BJ	Fibula	Archaic	1.18	0.16	4.73	0.052
18	79-01-01-DB	Arrowhead	6th-5th C.	8.04	0.19	4.22	0.052
19	79-01-01-DA	Arrowhead	6th-5th C.	15.0	0.23	1.96	0.012
20	79-01-01-AL	Arrowhead	6th-5th C.	2.27	0.12	1.05	0.046
30	79-01-01-CW	Arrowhead	6th-5th C.	7.53	0.07	0.24	0.44
39	79-01-01-CS	Arrowhead	Hellenistic-Roman	26.9	0.31	2.89	0.012
264	79-01-01-BN	Plumbing fixture	Late Roman	21.7	0.14	4.08	0.23
619	79-01-01-CC	Cosmetic spoon	Roman-Early Byzantine	0.06	0.10	0.21	13.3
628	79-01-01-AN	Cosmetic spoon	Roman-Early Byzantine	0.02	0.08	0.29	13.6
637	79-01-01-CK	Cosmetic spoon	Roman-Early Byzantine	0.03	0.09	0.34	0.82
683	79-01-01-CZ	Fibula	Roman	0.39	0.21	3.17	0.01
726	79-01-01-BL	Earring	Late Roman?	0.02	0.15	0.23	11.8
217	79-01-01-BX	Strainer	Early Byzantine	0.18	0.29	2.1	7.57
227	79-01-01-AG	Spoon	Early Byzantine	0.06	0.21	ND	16.5
449	79-01-01-AK	Balance	Early Byzantine	0.81	0.15	0.40	5.82
694	79-01-01-BH	Buckle	Early Byzantine	1.65	0.43	0.18	14.4
577	79-01-01-AB	Censer	Early Byzantine	6.71	0.21	1.38	11.3
581	79-01-01-BC	Censer	Early Byzantine	11.5	0.24	2.94	2.61
583	79-01-01-DD	Censer	Early Byzantine	20.4	0.42	4.69	0.26
590	79-01-01-CO	Poly-candelson	Early Byzantine	14.3	0.18	3.72	5.98
591	79-01-01-AA	Lamp chain	Early Byzantine	4.33	0.13	1.34	3.88
591	79-01-01-Z	Lamp hook	Early Byzantine	4.54	0.17	1.60	5.64
594	79-01-01-CG	Lamp chain	Early Byzantine	1.59	0.17	0.76	11.50
605	79-01-01-AH	Lamp chain	Early Byzantine	4.83	0.09	3.39	5.76
606	79-01-01-Y	Lamp chain	Early Byzantine	0.10	0.13	0.26	18.1
490	79-01-01-AT	Bowl	Early Byzantine	0.04	0.10	0.04	ND
515	79-01-01-AW	Cauldron	Early Byzantine	0.15	0.14	0.03	ND
533	79-01-01-CN	Flask neck	Early Byzantine	0.08	0.11	ND	ND
536	79-01-01-BP	Flask lid	Early Byzantine	0.38	0.12	0.03	ND

ND Not detected, i.e. below the limits of detection which were about 0.02% for tin and about 0.005% for zinc.

*The average % variation for each metal is: lead $\pm 1.0\%$, arsenic $\pm 13\%$, tin $\pm 3.7\%$, zinc $\pm 1.9\%$.

their Lydo-Persian predecessors, suggesting the possibility of continuity in manufacturing technique (the paucity of samples from this period, however, does preclude definite conclusions).

Roman

While very few of the Roman objects can be precisely dated, most seem to be fairly late, and some may even be Early Byzantine.

Twenty-two samples of Roman objects were analyzed by ES, six samples by AA. Two of the latter (637, 726) were not also tested by ES. Of the four objects tested by both ES and AA (264, 619, 628 and 683), 619 and 628 show reasonably consistent compositions by both methods; 264 shows substantially more lead by AA than by ES, but is otherwise consistent and 683 shows completely different compositions.

Groupings of objects by type also reveal some consistency of composition in some categories.

Utilitarian Objects

Three samples of utilitarian objects were analyzed: the plumbing fixture (264) and two parts of a "furnace plate" (928) from the bath furnace in CG. The plumbing fixture, tested by both ES and AA, is a leaded tin bronze, although the AA analysis shows considerably more lead than the ES. The "furnace plate" samples, tested by ES alone, are also leaded tin bronzes, apparently with about twice as much lead as tin. Despite the fact that the "furnace plate" samples were taken from different parts of the same object—one from the plate itself and one from the "rivet" through the center—the overall compositions of the two samples are remarkably similar.

Vessels

Three vessel parts were examined by ES: two bowls and a ram's head handle (489, 500, 513). Alloys of all three differ considerably. The ram's head handle (513) and one of the bowls (489, a casting) are both leaded tin bronzes. The second bowl (500), made of sheet metal, is a brass containing a considerable amount of zinc and very little tin and lead.²¹

21. For a long series of analyses of Roman copper alloy vessels and vessel parts see Den Boesterd-Hoekstra, 100-127. Several ram's head patera handles, similar to Sardis 513 but earlier in date, are also leaded tin bronzes containing little or no zinc (see Den Boesterd-Hoekstra, 106, 114 nos. 68b, 726, 806).

Cosmetic Implements

ES analysis of seven cosmetic spoons and spatulas, probably of Late Roman-Early Byzantine date, shows they are brasses, though compositions differ somewhat from piece to piece. Four of the spoons (619, 622, 628, 631) show fairly high zinc and very low tin and lead concentrations; this is confirmed for 619 and 628 by AA analysis. One spoon (636) and a spatula (641) each have some lead in addition to zinc; the second spatula (642) is a quaternary alloy with low to moderate concentrations of tin, lead and zinc in addition to the copper. The one object analyzed by AA alone (637) has an anomalous composition—it appears to be unalloyed "pure" copper.

Three mirror parts were analyzed by ES. The first two are samples from the disk and separately made handle of the same piece (650), which comes from a first to second century A.D. tomb; the third (652) is a similar handle from a chance find. All three are leaded tin bronzes and, allowing for the standard deviations, all show remarkable similarity of composition.

Jewelry

A third century A.D. fibula (683) and two earrings (725, 728) were analyzed by ES. The fibula was also analyzed by AA, as was another earring (726) that formed a pair with 725. All three objects analyzed by ES show zinc as the major alloying element, as does the earring analyzed by AA. Readings for the fibula, however, diverge radically. According to the ES analysis, the alloy is a brass with less than 1 percent tin; according to AA, it is a low tin bronze without any significant zinc. It is difficult to know which composition, if either, is more likely for this type of Roman fibula.²²

The earrings were all found in a Lydian burial mound at Bin Tepe (BT/DU) but in a disturbed context containing much secondary material from Late Roman burials. The earrings are not distinctive enough in form to be dated stylistically, but the presence of zinc and exclusion of other elements would seem to place them in the later group of material. However, caution must be exercised in doing so since fairly high levels of zinc have been detected in archaic Phrygian objects.²³

22. Similar fibulae analyzed by Craddock were reported as leaded tin bronzes containing no zinc. See Craddock, "Copper Alloys," 166-168.

23. See above, n. 16. It should be noted, however, that the Phrygian brasses, unlike these earrings, also contain tin.

Figurative Objects

A lion-head casket attachment, a bull protome and a figurine of a leaping dog (409, 429, 918) analyzed by ES all were found to contain tin, lead and zinc, though in differing proportions. The lion-head attachment has about 1 percent arsenic as well, almost certainly an accidental inclusion. The lion- and bull-head attachments, both castings, can be tentatively classified as "zinc bronzes" containing more tin and lead than zinc, while the dog, with less than 5 percent zinc, should probably be called a "leaded tin bronze."²⁴

Summary

The most significant feature of the Roman alloys is the regular use of zinc, with or without tin and/or lead. Of twenty-four samples tested, fourteen have significant quantities of zinc (fifteen if the ES analysis of 683 is correct). Nine (500, 619, 622, 628, 631, 683?, 725, 726, 728) seem to have been intended as pure brass with only minor amounts of tin and/or lead; two (636, 641—both cosmetic implements) have only a little lead in addition to zinc and the rest (642, 409, 429, 918) are quarternary alloys with varying amounts of tin, lead and zinc. The remainder of the Roman samples are leaded tin bronzes, with the exception of the apparently unalloyed 637.

While occasional alloying of zinc and copper has been demonstrated in earlier times, it is really only in the Roman era that brass comes into its own.²⁵ In this respect, Sardis conforms with her neighbors, continuing to use this technology in the subsequent Early Byzantine period. As elsewhere in the ancient world, zinc contents of Sardis objects generally are considerably lower than they are in modern brasses.²⁶ None of the samples showed more than 11 or 12 percent zinc when tested by ES, or more than about 13 percent zinc when tested by AA.

Two other catalogued objects of Late Roman-Early Byzantine date were analyzed by other investigators and yielded somewhat different results. The lion lamp (618) was tested by X-ray fluorescence and has a reported zinc content of 22.78 percent and about 1 percent tin.²⁷ A

steelyard (985) in the British Museum, allegedly from Sardis, was analyzed by AA and yielded a reading of ca. 27.5-28 percent zinc.²⁸ The readings for zinc given by these analyses are consistent with results for some other analyzed ancient brasses,²⁹ although they are considerably higher than those for any of the objects tested specifically for this study. We cannot yet be sure whether the discrepancies are due to genuine differences in composition or to differences in the accuracy of the methods used.

The occurrence of ternary and quarternary alloys containing various combinations of copper with zinc, tin and lead is interesting. Craddock points out that the quarternary alloys (equivalent to modern "leaded gunmetal") came into regular use about the third century A.D. and remained popular thereafter, probably because of the working advantages imparted to the copper by addition of all three ingredients: the tin adds strength and hardness to the object, the zinc acts as a deoxidant in casting and the lead increases fluidity in casting.³⁰ Whether this practice is owing to more frequent use of heterogeneous scrap metals or to deliberate alloying is still unclear; present opinion, however, seems to favor use of scrap, at least for those alloys with relatively low zinc.³¹

According to Craddock, the Romans seem to have favored the addition of zinc to alloys used for coins, decorative objects (e.g. jewelry, horsetappings, etc.) and utilitarian objects, although it is never found in mirrors, mirror handles or in statuary bronze.³² With respect to mirrors, at least, these findings are borne out by the results from Sardis, although the Sardinian mirrors contain on average much less tin and lead than those analyzed by Craddock.³³

24. These terms should be used with caution since the compositions of these objects were not checked by AA.

25. Tylecote, 53; Craddock, "Composition 3," 1, 4, 9, 11-14; Caley, 3-8; M. Picon, et al., "Recherches techniques sur des bronzes de Gaule romaine," *Gallia* 24 (1966) 211.

26. Caley, 1; Tylecote, 53.

27. Crawford, 291-294. The piece was analyzed twice; once in Turkey at Maden Tetkik ve Arama Enstitüsü, and again at the University of Delaware by J. M. Schultz. The Turkish laboratory report

gave the composition at 75.59% copper; 1.0% tin; 0.40% lead and 12.78% zinc. These figures were published, however, as 75.59% copper, 1.0% tin, 0.40% lead and 22.78% zinc. On another part of the same sample the Delaware laboratory reported copper between 69 and 67% with most of the remainder zinc (in ratio of 22:10 and 18:9 in two runs) with tin and lead not determined. Samples were taken by drilling after the piece was cleaned. There is a considerable discrepancy between the Turkish analyst's report and the published figures. It appears that in the publication, the zinc content was adjusted upward to bring the total closer to 100%.

28. Craddock, "Copper Alloys," 173-174.

29. E.g. Craddock, "Composition 3," 11, fig. 6; idem, "Copper Alloys," 169-170, 173-174.

30. Craddock, "Composition 3," 1, 14; see also Tylecote, 55.

31. Craddock, "Composition 3," 12-13.

32. *Ibid.*, 13.

33. See Craddock, "Copper Alloys," 150-154.

Early Byzantine and Turkish

Most of the Early Byzantine objects tested were found in the Byzantine Shops or HoB proper; the rest are stylistically datable to the period. Together they represent the largest group of analyzed objects—forty-three samples from thirty-seven objects. Of these, twenty-six samples were analyzed by ES alone, sixteen by ES and AA, and only one by AA alone.

Reported compositions of most objects tested by both ES and AA agree reasonably well, although AA readings for several objects show significantly more zinc or lead than ES readings (higher zinc: **227, 694, 577, 606**; higher lead: **581, 590**). Further discrepancies appear in **217**, which shows about 2 percent tin by AA and less than 1 percent by ES, and in **694** which shows more than 1 percent arsenic by ES, less than 1 percent by AA.

Implements

A strainer, a spoon and a balance (**217, 227, 449**) were all tested by ES and AA and shown to be brasses by both methods. **217** appears to have about 2 percent tin in addition to zinc according to the AA results, but otherwise no significant tin or lead was reported. The relatively low zinc content of these objects (about 16.5 percent at most), and the apparent lack of effort to combine it with tin or lead, suggest that these brasses were made by recasting scrap brass of a higher zinc content together with scrap copper. Other analyses have shown the maximum zinc content of Roman and Late Medieval brasses to be between 22 and 28 percent, but since zinc is very volatile the alloy loses up to 10 percent of its zinc every time it is remelted.³⁴

Decorative Objects

Two reliquary crosses (**901, 902**), two other crosses (**903, 904**) and seven buckles (**689, 690, 691, 694, 698, 701, 702**) were analyzed by ES; **694** was analyzed by AA as well. All but one were found to contain some zinc in addition to tin and lead.

The two reliquary crosses are of similar type and very similar composition—both being quarterternary alloys with relatively low zinc compared to the amounts of tin and lead. The other two crosses are of quite different types. **903**, made out of cut-out sheet metal, is of nearly pure copper with only trace quantities of other elements.

This composition is closely comparable to that of the sheet metal vessels discussed below. The fourth cross (**904**) is a solid casting, again containing tin, lead and zinc, though with a higher proportion of zinc than **901** and **902**.

The seven buckles are all datable to the sixth to seventh century A.D. and their types have a wide distribution. It has been suggested that all such buckles were made in a common center, perhaps Constantinople (see discussion in Chap. III). Composition, however, varies considerably; there are four quarterternary alloys (**689, 690, 691, 701**), two ternary—copper, lead, zinc—(**694, 702**) and one brass with no tin or lead (**698**). In addition, ES readings for three (**690, 694, 701**) show 1 percent or more arsenic, although there is no apparent correlation between this and other major ingredients. It is not possible at this stage to correlate composition and subtype. **689** and **690** are both of the same subtype; while both are quarterternary alloys, **689** seems to have substantially more tin than **690**. Most of the others are of different types, and only one example of each has been tested. It may or may not be significant, however, that the "Eagle Buckle" (**698**), which differs more markedly from the others in form, is the only "pure" brass. It is possible too that the variations are simply owing to a lack of control over the alloys and/or the utilization of scrap metals with varying compositions. Certainly, nothing conclusive can be said about the possibility of common origin based on composition.

Liturgical Objects

Samples of six censers or parts of censers (**577, 578, 580, 581** base, **581** chain, **582**), two polycandela (**589, 590**) and seven lamp chains and hooks (**591, 594, 600, 605, 606** hook, **606** chain, **607**) were analyzed by ES; **577, 581, 590, 591, 594, 604, and 606** were also analyzed by AA, as was **583**.

All but two of the censers (**582, 583**) and one of the polycandela (**589**) contain zinc. All of the censer bowls are cast; three are quarterternary alloys (**577, 578, 581**), one (**580**) is a leaded brass, apparently also with over 1 percent arsenic and two (**582, 583**) are leaded tin bronzes with under 1 percent zinc. A chain from one of the censers (**581**) was also tested and shows a very different composition from the bowl—it is a brass with only traces of tin and lead, while the bowl is a quarterternary alloy. As with the buckles, there is little correlation between composition and form.

The two polycandela also differ somewhat in composition: **589** is a leaded tin bronze with less than 1 percent zinc; **590** is a quarterternary alloy.

34. Craddock, "Composition 3," 10, 12; idem, "Alloys of the Medieval Islamic World," 70, 73; Caley, 99-100.

Of the chains and hooks, three samples (from chains **606, 607**) are brass, similar to the censer chain **581**, one (**594**) is a leaded brass and the rest are quarternary alloys.

Vessels

Nine samples of eight vessels and vessel parts were analyzed by ES (**490, 515, 520** neck, **520** handle, **528, 533, 536, 542, 576**), four of these by AA as well (**490, 515, 533, 536**). Eight of these are of hammered sheet metal, and one is a cast handle. Both methods show that all the sheet metal parts, whether from vessel bodies or lids, are of unalloyed copper with only traces of other elements. The cast handle (**520**), as might be expected, is of leaded tin bronze. These vessels are all datable to the sixth to early seventh century A.D. and are almost certain to have been manufactured at Sardis.

Turkish Bowl

Only one object, a hammered sheet metal bowl (**509**), was tested by ES. It proved to be unalloyed copper, similar in composition to the Early Byzantine vessels.

Summary

So far, relatively few analyses of Byzantine and later copper alloys have been published, making the Sardis series from this period of special value.³⁵

Two trends seem significant: the continuous use of zinc from Late Roman times for castings, and the use of pure copper for hammered sheet metal objects. There seems to be an increase in zinc usage from Roman times. Of thirty-three samples of alloyed metal, all but four contain zinc in quantities of 1 percent or more. Samples tested by ES did not exceed 10 or 11 percent zinc content; those tested by AA range up to about 18 percent.

Of the twenty-nine Early Byzantine samples containing zinc seven are apparently "pure" brass (**227, 449, 698, 581, 606** chain, **606** hook, **607**); four contain lead and zinc (**694, 702, 580, 594**); one (**217**) apparently has zinc and tin and seventeen are quarternary. This represents a definite proportional increase in quarternary alloys over the Roman period. In general, tin content

seems inversely related to zinc content. This is in keeping with Craddock's findings for Coptic vessels of the sixth to seventh century A.D., contemporary with our Early Byzantine objects.³⁶ In his work on medieval Islamic alloys, Craddock posits a gradual increase over time in the use of zinc in alloys, together with a decrease in tin, perhaps because of the greater availability of zinc ores in the Middle East. According to him, tin bronze was still preferred in the Roman era, the Coptic alloys show a definite preference for zinc (though most of those tested are quarternary alloys) and Islamic alloys—with a few special kinds of objects excepted—are nearly all brass, though sometimes the alloys are ternary or quarternary.

The ten examples of unalloyed copper sheet metal—nine Byzantine and Turkish vessels, one cross—probably owe their composition to function and workability. Since it is softer than alloyed metal, pure copper is more suitable for shaping sheet metal by hammering (forging), and its relatively low hardness and strength would not be so important for vessels or decorative objects. The cast vessel handle, of course, required tin and lead to improve its casting properties and durability.

Conclusion

Although the number of copper alloys sampled from each major period at Sardis is limited, a few definite trends in alloying compositions are clear. In the Early Bronze Age either pure copper or a mild arsenical copper was the main metal used; in the Lydo-Persian era tin bronze, often with lead added to cast objects, was favored; in the Roman period zinc was introduced—sometimes used alone, sometimes combined with tin and/or lead; in the Early Byzantine era use of zinc increased, as did the combination of zinc with other elements.

Certain types of alloys do seem to have been favored for certain types of objects. Lead was regularly added to tin bronze in archaic and probably Hellenistic arrowheads; leaded tin bronze seems also to have been preferred for Roman mirrors. Brass without tin was preferred for Roman-Early Byzantine cosmetic implements and jewelry such as fibulae and earrings, as well as for Early Byzantine hanging chains, while quarternary alloys are more common for Early Byzantine castings such as reliquary crosses, censers and buckles. In no case however, are any of these alloys used exclusively for the

35. Tylecote, 57; see Craddock, "Alloys of the Medieval Islamic World," 76 and a forthcoming note on Coptic bronzes to appear in B. Mitford, *Sutton Hoo* 3. I am grateful to Paul Craddock for providing me with information from the latter.

36. Craddock, "Alloys of the Medieval Islamic World," 76, and forthcoming report on Coptic bronzes. In general, the Coptic vessels analyzed by Craddock contain much greater proportions of zinc and especially lead than the Sardis objects analyzed here.

purposes named; furthermore, discrepancies in findings by different analytical methods suggest caution in regarding these conclusions as final. More analyses by a variety of techniques on greater numbers of well-dated samples would greatly improve our understanding of these trends at Sardis and other sites.

IRON

Iron was frequently employed at Sardis for utilitarian purposes. It was used as early as the beginning of the Iron Age, and continued to be used through all subsequent periods (see Chap. I). Samples of several objects of Early Iron Age, Lydian and Byzantine date were submitted to Robert Maddin of the University of Pennsylvania for metallographic analysis.³⁷ The purpose of the study was to determine when and for what kinds of objects steeling was practiced, and to learn as much as possible about the manufacturing techniques employed by the Sardian smiths.

Selection of Objects and Sampling Procedures

Initially, it was planned to sample all major types of iron tools and weapons from a variety of chronological contexts. Unfortunately, however, selection of samples was severely limited by the poor condition of most of the iron objects, and by the unreliable dating of many of them. Therefore, it was not possible to make as extensive or representative a study of iron as it was of copper and its alloys.

Sampling of all objects at Sardis was carried out by members of the Sardis conservation staff. An attempt was made to obtain a representative cross section of each piece, preferably taken from a place where at least some metal was preserved, though this was not always possible. The desired section was removed with an abrasive disk, hacksaw or snippers, depending on thickness and condition of the piece. In a few examples (e.g. 143 and 180), pieces had already broken off the main body of the object and were simply removed.

Of those objects for which meaningful results could be obtained, one (127) seems particularly important from both historical and technological viewpoints. This is discussed at length by R. Maddin, J. D. Muhly and J. C. Waldbaum. Another eleven objects yielded varying results and are treated separately by R. Knox, Jr.

Technical Definitions (*Maddin, Muhly, Knox*)

Because the scientific study of metal artifacts introduces the archaeologist to a new vocabulary, the following definitions of terms used in describing iron and steel are offered.

Austenite: A solid phase of carbon in iron (i.e. steel) which exists at temperatures in excess of 710° C.

Bainite: A feathery-acicular austenite decomposition structure that forms during fairly rapid cooling in a temperature range below that in which pearlite develops and above that in which martensite forms. It is sometimes mixed with one or with both the other two in the microstructure of steel.

Bloomery iron: In ancient times, the first product of the smelting of iron ore in charcoal, which is a relatively pure iron containing small amounts of slag. The charcoal in the smelt combines with the oxygen in the ore and is given off as a gas, leaving "pure" iron.

Carburization: The process of heating bloomery iron in contact with charcoal, resulting in the absorption of carbon into the iron, converting the areas in which iron and carbon combine into steel.

Decarburization: The process by which carburized iron is heated in an oxidizing atmosphere. The carbon in the surface layers of the object combines with oxygen and is given off as a gas, thus depleting the surface layers of carbon.

Eutectoid steel: An alloy of iron containing 0.8 percent carbon. The eutectoid reaction occurs in the solid state when austenite decomposes into two products through being slowly cooled; these two products are pure iron (ferrite) and a compound of iron and carbon called cementite.

Martensite: The hard and brittle product that arises when austenite is cooled very quickly, as by plunging the object into cold water, thus inhibiting the eutectoid reaction.

Pearlite: The product that arises when austenite is cooled more slowly; the austenite decomposes into an array of alternate lamellae of ferrite and cementite that has a pearly appearance under the optical microscope.

Quenching: The plunging of the hot steel (austenite) or any other hot metal into water or some other cooling medium.

Tempering: The heat treatment of steel to relieve the brittleness of the martensite. Tempering is accomplished by heating the steel to temperatures in excess of 150° C.

37. We wish to thank the Laboratory for Research on the Structure of Matter, University of Pennsylvania, for generously allowing us the use of its facilities.

Widmanstätten structure: In mild steels, a microstructure characterized by a tendency of ferrite to form plates along certain crystallographic planes of the parent austenite during cooling from above the eutectoid temperature of 710° C. Austenite remaining in the interstices between the plates then transforms to pearlite upon cooling through the eutectoid.

Metallurgical Analysis of an Early Iron Age Laminated Iron Tool (Maddin, Muhly, Waldbaum)

The tool discussed here (127) came from the Deep Sounding of the Lydian Trench at HoB, at a level dated to the Early Iron Age, probably no later than the late eleventh or tenth century B.C. A few other iron objects were found in similar contexts, but none was so well preserved as 127.

Unlike most ancient iron objects, the metal of this specimen is well preserved with only a thin veneer of corrosion and isolated patches of corrosive intrusion into the body of the metal. A section of the splayed end of the blade, taken at an angle across the blade, was removed with an abrasive wheel on an electric drill and a coping saw (*Pl. 59, Fig. 1*).

Elemental Analysis

In the laboratory, drillings were taken from sound metal, with corrosion products excluded. These were subjected to elemental analysis by emission spectrography.

The samples were dissolved in acid, evaporated to dryness and ignited in a muffle furnace at 400° C for fifteen to twenty minutes. The resulting oxides were ground to powders. Part of each ground sample was diluted 1:1 with National Spectrographic powder grade SP-2. Both the diluted and undiluted portions of the samples were then packed into crater electrodes. Spex Industries Inc., G-7 Standards were also packed into National electrodes. National pointed electrodes were used as the counter electrodes. The samples and the standards were then exposed on the same plate. The excitation conditions involved a DC arc at 12-14 amperes. A JA 3.4m spectrograph and SA 1 spectroscopic plates 4 × 10 in. were used. After development of the film, transmittance data for the samples and the standards were obtained. Analytical technique curves of percent transmission vs. concentration were plotted. The results of the samples were read from these curves and multiplied by the dilution factor. For results that were less than certain amounts, a visual match of the standards and the analytical line multiplied by the appropriate dilution factor was used.

The following elements, listed by weight percent, were detected, with the remainder being iron: molybdenum 0.1; tin 0.03; aluminum 0.03; arsenic 0.01; copper 0.01; magnesium 0.01; manganese 0.01 and silicon 0.01. The molybdenum reading (0.1) may be erroneously high, since the molybdenum line was partially superimposed on a competing elemental spectrum on the photographic plate and should therefore be taken as a maximum percentage. Carbon content was not analyzed since it varies throughout the sample and part of the carburized layer was lost to corrosion. Therefore, any quantitative statement about carbon content would be misleading.

Metallographic Analysis

A piece was cut from each side of the main sample with a high-speed cut-off wheel so that both the end and the sides could be observed (*Pl. 59, Fig. 1*). The resulting samples, 3.3 cm. and 2.6 cm. long and 0.8 to 1.4 cm. wide, were mounted in thermosetting plastic and polished with graded grit papers and alumina, following standard metallographic procedures. The metal was etched with 3 percent Nital (3 percent concentrated nitric acid in ethyl alcohol), then examined with both optical and scanning electron microscopes.

A seam running the length of the sample can be seen without magnification (*Pl. 59, Fig. 2*). The seam is the interface between the two materials of differing composition—the lower portion darker, the upper lighter—suggesting that the tool was formed by hammering together two blocks or sheets of iron. The lower portion is the more extensively corroded, so the seam is not continuous, being lost in the center and at the tip of the specimen. Microscopic examination clearly shows the differences in the two materials (*Pl. 59, Fig. 3*). The darker metal is carburized iron; an equiaxed ferritic structure (i.e. pure iron, each grain of which has approximately the same dimensions of height, width and depth) without carburization, appears on the other side of the seam. This structure indicates that the two blocks of iron, carburized and uncarburized, were forged together at an elevated temperature. Both portions of the tool contain slag (*Pl. 59, Fig. 4*), much of it phase separated, indicating differences in chemical composition of the slag.

Part of the sample studied shows that iron oxide, a corrosion product of iron, is present at the interface (*Pl. 60, Fig. 5*) and was thus on one of the blocks when the two blocks were hammered together. Examination with the scanning electron microscope confirms that the particles at the interface are iron oxide and slag. Laboratory experiments showed that it is difficult to hammer together iron blocks with different carbon contents unless extensive force and an elevated temperature along

with a reducing atmosphere are used to disintegrate the surface oxide layer. The ancient smith would have bonded the blocks more easily since he heated them in charcoal in a reducing atmosphere, thus decreasing the surface oxidation.

The carburized layer was studied at higher magnifications to determine the treatments that the tool had undergone. Dispersed pearlite appears at grain boundaries (Pl. 59, Fig. 4). Hammering together with the interrupted heating produces the intermittent pearlite lamellae and results in the spheroided appearance of the iron carbide. A heating temperature greater than 550°C, the recrystallization temperature of ferrite, i.e. the temperature above which the grains of ferrite rearrange themselves into a strain-free configuration, accounts for the equiaxed grain structure in the ferrite. The temperature 723°C is below that at which pearlite transforms to austenite. If there had been a single cooling from above 723°C, the pearlite would have exhibited its normal continuous lamellar configuration rather than being dispersed.

Diamond pyramid hardness (DPH) readings were made in both the ferrite and the carburized region of the specimen. The readings in the former range from 112 to 118, typical of annealed ferrite, while those of the latter vary between 154 and 199, which would be expected from an annealed low carbon steel.

The position of the carburized layer on the Sardis tool may help to identify the tool's function. Since the sample submitted for analysis came from the edge of the tool, it is likely that the carburized side represents the working surface. If this is so, it would be appropriate to term the tool an adze, since only one side is known to be of steel. It is possible, however, that a corresponding carburized layer on the other side of the ferrite layer has corroded away completely; if so, the tool could have been used as an axe. At present the identification must remain tentative.

In sum, the Sardis tool was made by a layering technique in which a block of carburized bloomery iron was hot hammered to a block of uncarburized iron (Pl. 60, Fig. 6). Several reheatings and hammerings were necessary to shape the tool. The layering technique provides a way in which the tool could be made strong on its working surfaces by attaching thin blocks or sheets of carburized iron, i.e. steel. Complete carburization of an iron sheet requires less time in the charcoal fire than the carburization of larger blocks of bloomery iron. Thus, the use of steel layered with iron shows that the ancient smith realized the superiority of iron that had been in prolonged contact with charcoal and had developed a practical means of attaching it to the main, untreated body of the tool to improve the efficiency of its working edge. He did not know that the absorption of

carbon rendered his material stronger and may have thought that the fire "purified" the iron.³⁸

Historical Discussion

The Sardis tool is one of the earliest of a growing number of ancient iron objects known or believed to have been made by the layering technique. What follows is an attempt to summarize what is known to date about the history of this technique and to assess the significance of the Sardis tool among the other known objects.

Two iron knives from Idalion in Cyprus, dated ca. 1150-1050 B.C., were examined metallographically by E. Tholander. In addition to normal corrosion, Tholander noted that "gaps . . . had formed between different structural layers . . . which seem not only to be connected with the rust formation but may indicate a kind of piling in the original manufacturing process. . . ."³⁹ The condition of these knives precludes certainty that they had been deliberately laminated. However, the possibility that the layering technique can be found as early as the late twelfth or early eleventh century B.C. in Cyprus is intriguing in light of recent theories suggesting the early development of a sophisticated iron industry on Cyprus.⁴⁰ The dating of the Idalion knives, if correct, places them somewhat earlier than the Sardis tool, and makes them the earliest known iron objects thought to have been made by the layering technique.

In an earlier article, Muhly, Wheeler and Maddin discuss and evaluate the analyses of several more laminated iron objects.⁴¹ The earliest is an Egyptian knife from the Petrie Collection, University College, London.⁴² The knife was analyzed in 1930 by Carpenter and Robertson who dated it ca. 1200 B.C., although they did not note its provenance or archaeological context.⁴³ Muhly, et al., assign the knife to the Ramesseum and suggest that it be redated no earlier than ca. 900-800 B.C.⁴⁴ This dating would make the knife somewhat

38. See Aristotle, *Meteorologica* N:6:383a-b.

39. E. Tholander, "Evidence of the Use of Carburized Steel and Quench Hardening in Late Bronze Age Cyprus," *OpusAth* 10 (1971) 17.

40. See e.g. A. R. Snodgrass, "Cyprus and the Beginnings of Iron Technology in the Eastern Mediterranean," in Republic of Cyprus, Ministry of Communications and Works, Department of Antiquities, *Acts of the International Archaeological Symposium, "Early Metallurgy in Cyprus, 4000-500 B.C." Larnaca Cyprus, 1-6 June, 1981* (Larnaca 1982); Stech-Wheeler, et al., "Iron at Taanach," 265-267.

41. Muhly, et al., "Iron Adze," 156-161.

42. *Ibid.*, 159-160.

43. H. C. H. Carpenter and J. M. Robertson, "The Metallography of Some Ancient Egyptian Implements," *Journal of the Iron and Steel Institute* 121 (1930) 423, 428-430.

44. Muhly, et al., "Iron Adze," 159.

later than the Sardis adze. Although the published evidence demonstrating layering in the knife is incomplete by modern standards,⁴⁵ it is, nevertheless, the first ancient iron object in which a layered structure was observed by analytical techniques.

The other possibly layered objects discussed by Muhly, et al., are all later than the Sardis adze and come from widely scattered provenances. They include Luristan swords from Iran dated in the early first millennium B.C.,⁴⁶ a tripod from Nimrud of the eighth century B.C.,⁴⁷ a chisel from Egyptian Thebes dated to the early seventh century B.C.,⁴⁸ a sixth century B.C. pick from Lachish,⁴⁹ a similarly dated spearhead from Deve Hüyük;⁵⁰ a fifth to fourth century B.C. adze from Al Mina;⁵¹ late fourth century B.C. Sarmatian daggers;⁵² an Etruscan spearhead of the fourth to third century B.C.,⁵³ and a Roman saw and knife from Oxyrhynchus.⁵⁴

To the objects cited by Muhly, et al., may be added a seventh century B.C. Etruscan sword from Vetulonia, composed of alternating layers of harder and milder steel.⁵⁵ Furthermore, A. R. Snodgrass has noticed layered structures in studying Early Iron Age Greek swords and other artifacts, though these have not, as yet, been scientifically examined. Snodgrass' conjecture that "this piled or 'compacted' structure was also common, and

perhaps preferred, in the forging work of the early Greek smiths"⁵⁶ must still be substantiated by microscopic analyses.

Finally, R. Pleiner has recently summarized 175 analyses of iron tools and weapons from Central European Late Hallstatt and Early La Tène sites dating between ca. 700 and 400 B.C. His studies show that about 10 percent of such objects as chisels, axes, swords or daggers, knives and lance- or arrowheads were made by laminating.⁵⁷

As time went on, smiths seem to have gained competence in the layering technique. Several of the later examples noted above, namely the Deve Hüyük spearhead, the Etruscan sword and spearhead, the Sarmatian daggers, the Roman implements, and possibly some of the Early Greek artifacts mentioned by Snodgrass, were made of multi-layered iron sheets, and represent a definite technological advance over the earlier two-layered structure observed in the Sardis tool.⁵⁸

Although ancient layered objects appear to be few in number, and although not all of the examples cited here are shown conclusively to have been deliberately layered,⁵⁹ the known examples do represent a significant proportion of analyzed iron objects. The distribution of the laminated iron objects from Central Europe to Iran, and from the Late Bronze Age to the Roman period, shows that the technique was widespread and continuously practiced, with increasing sophistication over time, although it was by no means universally adopted.⁶⁰

Assuming the interpretation of the Idalion knives to be correct, they and the Sardis adze must be regarded as the earliest known examples of the layering technique. Thus we know that by the very beginning of the Iron Age, the smith was already aware of some of the properties that can be developed in iron and was beginning to manipulate these properties to achieve strength and durability in his products.

45. *Ibid.*, 159-160.

46. *Ibid.*, 160; see also F. K. Naumann in H. Maryon, "Early Near Eastern Steel Swords," *AJA* 65 (1961) 181-183; E. Silikiss in J. Ternbach, "Technical Aspects of the Herzfeld Bent Iron Dagger of Luristan," in M. J. Mellink, ed., *Dark Ages and Nomads c. 1000 B.C.* (Istanbul 1964) 51; V. Bird and H. Hodges, "A Metallurgical Examination of Two Early Iron Swords from Luristan," *Studies in Conservation* 13 (1968) 215-222.

47. Muhly, et al., "Iron Adze," 160; see also Coghlan, *Iron*, 180.

48. Muhly, et al., "Iron Adze," 160; see also A. R. Williams and K. R. Maxwell-Hyslop, "Ancient Steel from Egypt," *JAS* 3 (1976) 295, 303, fig. 5.1-4.

49. Muhly, et al., "Iron Adze," 160; see also Coghlan, *Iron*, 182-183.

50. Muhly, et al., "Iron Adze," 160; see also Coghlan, *Iron*, 180-182.

51. Muhly, et al., "Iron Adze," 157-159.

52. *Ibid.*, 160; see also B. A. Chramko, et al., "On the Fabrication Techniques of Some Sarmatian Swords and Daggers," (in Russian) *Sovetskaja Arheologia* 1 (1974) 185 fig. 3, 187 fig. 4, 189 fig. 5.

53. Muhly, et al., "Iron Adze," 160; see also C. Panseri and M. Leoni, "Research on an Iron Spearhead from the Etruscan Sanctuary of Fanum Voltumnae, Fourth to Third Centuries B.C.," in M. Levy, ed. *Archaeological Chemistry* (Philadelphia 1967) 205-229.

54. Muhly, et al., "Iron Adze," 1670; see also Coghlan, *Iron*, 187-188.

55. C. Panseri, et al., "Ricerche metallografiche sopra alcune lame Etrusche di acciaio," in *La tecnica di fabbricazione delle lame di acciaio presso gli antichi* (Milan 1957) 19-33, 27 fig. 27, 29 fig. 32.

56. A. R. Snodgrass, *The Dark Age of Greece* (Edinburgh 1971) 216.

57. R. Pleiner, "Early Iron Metallurgy in Europe," in T. A. Wertime and J. D. Muhly, eds. *The Coming of the Age of Iron* (New Haven 1980) 388-391, esp. Table II.1 on p. 389.

58. Muhly, et al., "Iron Adze," 160.

59. The lack of published photomicrographs for several of the objects—e.g. the Egyptian knife, the Luristan swords, the Lachish pick—and the poor condition of others—e.g. the Idalion knives and the Nimrud tripod—preclude certainty of interpretation.

60. For example, recent analyses of several objects from Tell Ta'anach in Palestine dated to the 10th C. B.C., from other Palestinian sites and from various Late Assyrian sites in Mesopotamia showed no evidence of layering. See Wheeler, et al., "Iron at Taanach," 249-258; J. Curtis, et al., "Neo-Assyrian Ironworking Technology," *PAPS* 123 (1979) 380.

Table V.5 Atomic absorption analyses of iron samples

	118*	143*	180	201	205	208	14	65
Fe	49.11	67.94	78.24	99.74	99.84	86.90	99.70	99.04
Cu	0.01	0.01	0.02	0.09	0.01	0.09	0.01	0.01
Sb	0.90**	0.17	ND	ND	ND	0.19	ND	ND
Au	0.03	0.07	ND	ND	ND	0.12	ND	ND
Na	0.95	1.27	0.27	0.10	0.51	0.72	0.06	0.10
Ca	0.31	0.21	0.80	ND	0.03	0.07	ND	ND
Mg	0.38	0.26	0.38	ND	ND	ND	ND	ND
Ag	ND	0.02	ND	ND	ND	ND	ND	ND
Mn	ND	0.10	ND	ND	ND	0.01	ND	ND
Pb	ND	0.09	ND	ND	ND	ND	ND	ND

ND Not detected.

*Average of two determinations.

**No Sb detected in second sample.

Metallographic Analyses of Iron Tools and Weapons (*Knox*)

This report summarizes results of a metallographic investigation of samples of eleven iron tools and weapons of various ages.⁶¹

Specimens were prepared by standard metallographic procedures and examined microscopically at various magnifications in both etched and unetched conditions. Photomicrographs and microhardness readings were taken in most cases and the results reported below. The load used in making the microhardness indentations was 100 g. except in the case of the sickle, 118, where a 50 g. load was used. The results of elemental analysis of eight of these samples done by atomic absorption appear on Table V.5.

Tools

Sickle, 118, Early Iron Age: This sickle was excavated in the Lydian Trench at HoB and is roughly contemporary with the adze discussed above. The sample was obtained from the butt end of the tool by sawing with a hacksaw. From this, two transverse sections were mounted for microscopic examination.

Quite a bit of metallic iron survived corrosion in spite of the great age of this object, but the presence of a large amount of hydrated iron oxide in the sample is indicated by the low iron value in the chemical analysis

(see Table V.5). The microstructure of the metal contained some pearlite in two edge areas where the structure tended to take the Widmanstätten form (*Pl. 60, Fig. 7*). Some rather faint banding was present in the ferrite (*Pl. 60, Fig. 7*), and this may indicate phosphorus segregation in solid solution. The ferrite grains were generally equiaxed, except where a component of the Widmanstätten structure was, and had a fairly uniform size of ASTM 5-7, i.e. size numbers 5-7 inclusive on the standard grain size chart for steel of the American Society for Testing Materials.

Three microhardness indentations in the ferrite gave values of 108, 105 and 110 DPH, indicating a comparatively pure iron with minimal cold work.

There was, therefore, no evidence of an attempt to harden the sickle either by quenching or cold work, and the minor carburization shown may have occurred by local contact with hot charcoal during heating for forging.

Sledge Hammer, 143, Lydian: This large Lydian tool was found at HoB. It had one end missing and was in a highly corroded state. Sample chunks already separated by corrosion from the main body of the tool were originally near a shaft hole at the presumed center of the hammer.

Two of the chunks were prepared for metallographic examination and found to contain no metal other than a few particles each a few microns in diameter. Some preserved slag particles were found but no relic carbides or pearlite were detected.⁶²

61. These studies were conducted in the Laboratory for Research on the Structure of Matter, University of Pennsylvania. The assistance of Asha Varma for elemental analysis and Alex Vaskelis for the photography is kindly acknowledged, as are discussions with Robert Maddin which were most helpful.

62. For technique of analysis of severely corroded steel artifacts see R. Knox, "Detection of Iron Carbide Structure in the Oxide Remains of Ancient Steel," *Archaeometry* 6 (1963) 43-45.

These observations indicate that the sledge was made from very low carbon steel or wrought iron.

Because of the great thickness of the tool—3.3 cm.—it is highly probable that considerable metal still exists in the interior.

Knife, 180, Lydian: This knife was found in one of the puppy burials in the Lydian Trench at HoB. It was in a highly corroded condition with the tip missing. A sample was taken at the butt end of the knife by breaking off at an old break that had been glued together.

Atomic absorption analysis indicated the presence of 78 percent iron in the sample which implies that a considerable quantity of surviving metal may be present (Table V.5). However, no metal particles greater than a few millimeters in diameter were found in a microspecimen of the sample.

No evidence of relic pearlite was detected in the polished oxide, but what appears to be relic grain boundary carbide network is prevalent. These observations indicate that the original metal was a low carbon wrought iron that had cooled rather slowly through the critical temperature range so that carbides could grow in ferrite grain boundaries.

An alternative but much less likely explanation of the relic carbide network—given the Lydian date of the knife—is that the network represents a proeutectoid cementite constituent that formed in austenite grain boundaries of the presumably high carbon steel knife prior to water quenching to martensite. One would not expect martensite, unlike pearlite, to leave visible relics in oxide.

Knife, 201, Lydian or Byzantine: This knife was found in a mixed context on the Acropolis and its date is uncertain.

A sample with roughly triangular cross section was taken transversely near the pointed tip. It is assumed that the apex of the triangle is the cutting edge of the knife. Chemical and metallographic specimens were made from the sample.

The microspecimen proved to be generally low in carbon although some fine-grained pearlite areas are present, especially along one edge (*Pl. 61, Figs. 8 and 9*). Ferrite grain size is highly variable and becomes large at the thicker end of the section.

Large slag inclusions are present, and some of these contain a dendritic phase (*Pl. 61, Fig. 8 and Pl. 62, Fig. 10*).

Microhardness of the ferrite was 162 DPH in a coarse-grained area near the wide end of the section and 177 DPH in finer grains near the center of the section.

These values are high for pure iron and probably reflect the presence of ferrite strengthening elements in solid solution.

There is little evidence of any attempt to harden the knife either by quenching or cold working, but the slight amount of fine-grained pearlite along one edge may represent an abortive attempt at carburization. In any case, some carbon was evidently picked up—probably from a charcoal fire—during various reheatings when the knife was forged.

The very fine grains at the carburized edge and larger grains in the interior (*Pl. 61, Fig. 8*) doubtless reflect the presence of a thermal gradient during the final forging blows by the smith. The temperature at the edge had to be slightly above 710°C in order that some austenite could form for later transformation to pearlite (black grains in *Pl. 61, Fig. 9*) during cooling from the final forging temperature.

The coarse ferrite grains at the thicker end of the microspecimen were probably formed by recrystallization of nearly carbon-free ferrite just after hot deformation of perhaps 10 percent by the final forging strikes of the smith. Mild hot deformation coupled with the virtual absence of austenite in this region, owing to a very low carbon content, could have permitted comparatively uninhibited growth of ferrite grains at a temperature of about 800°C.

Knife, 205, undated: This knife was found in a mixed fill on the Acropolis. It was sectioned near the tip of the blade with an abrasive disk. This sample was then cut in two and the section nearer the tip mounted in epoxy for microscopic investigation; the remainder was used for chemical analysis (Table V.5).

Microscopic examination of the mounted specimen after metallographic polishing revealed a rust-filled crack near one end of the section (*Pl. 62, Fig. 11*)—probably the cutting edge of the knife, since the maximum thickness of the section (ca. 1.5 mm.) was at the opposite end.

Etching in Nital disclosed that the microstructure of about one-third of the length of the section adjacent to the presumed cutting edge consists of fine-grained martensite (*Pl. 63, Fig. 12*), indicating that the knife had been hardened by quenching into a fast cooling medium such as water. The microstructure at mid-length in the section is a blend of martensite, pearlite and proeutectoid ferrite, reflecting incomplete hardening in this zone, some of which is included in *Pl. 63, Fig. 12*. The remaining zone, near the thicker end of the section, has a microstructure consisting of nodules of austenite decomposition products imbedded in a ferrite matrix. Such

a structure could only have been produced by quenching from temperatures characteristic of the ferrite-plus-austenite region of the Fe-C phase diagram.

The above observations indicate that a carbon gradient exists between narrow and wide ends of the knife section, which in turn suggests that the smith may have resorted to deliberate controlled carburization of the cutting edge.

Microhardness readings, taken approximately on the axis of the blade section, gave a range for thirteen impressions of 442-515 DPH (493 average) in the all-martensite zone. Several hardness readings taken between the axis and the edge of the section showed little evidence of a transverse hardness gradient.

Although the carbon content of the blade is unknown, the comparatively low hardness of the martensite suggests that some tempering had taken place—either intentionally, by the smith, or inadvertently by heat developed while cutting the sample with an abrasive disk. For this reason, additional hardness readings were taken after about a half millimeter had been ground from the mounted section on a surface grinder removing small amounts of the metal cooled with a large flow of water. After repreparation and etching the microhardness of the martensite zone averaged 507 DPH (48 R_c). This is still suggestive of considerable tempering, since this is the hardness of a fully quenched steel containing only about 0.24 percent carbon. It is difficult to see how such a low average carbon content for the fully hardened zone could have resulted from intentional carburization of so thin a specimen. It is therefore reasonable that the carbon in this zone is in fact considerably higher than 0.25 percent, and that the present hardness resulted from intentional tempering of the quenched knife.

The crack near the narrow end of the section is evidently a quenching crack, and this also suggests higher carbon.

Knife, 208, undated: Like the previous specimen, this sample is from a knife found in a mixed context on the Acropolis.

Sectioning near the tip of the blade revealed a very fine-grained (ASTM 9-10) microstructure consisting of partially spheroidized fine pearlite and ferrite in most areas (*Pl. 63, Fig. 13*) indicating a steel of moderate average carbon content. However, the steel was of at least eutectoid composition in some areas of the section.

Microhardness readings, ranging from 265 DPH in a eutectoid area to 228 DPH in the lowest carbon areas, may reflect some cold working of the metal in view of the presence of some spheroidized cementite, which tends to soften the metal. Moderate amounts of cold work,

however, would be difficult to detect by the optical microscope in a steel of such fine-grained microstructure.

The presence of antimony in the chemical analysis (Table V.5) of this and other Sardis artifacts of presumably different ages may reflect contamination during corrosion in the soil rather than actual occurrences of antimony as an impurity in the iron.

Knife, uncatalogued (M63.36:5513), undated: A sample was removed from the tip of the blade with an abrasive disk. At the time of analysis the sample had deteriorated to numerous tiny rusty pieces. The largest of these (ca. 1.5×8 mm.) was mounted in epoxy and prepared for metallographic examination, which revealed that the specimen was mostly metallic. Etching in Nital disclosed a complex microstructure which indicated a carbon content varying from moderately high to very low (*Pl. 64, Figs. 14 and 15*). Finely spheroidized carbides were prevalent in the higher carbon regions (*Pl. 64, Fig. 15*). Microhardness ranged from 197 DPH in these areas of the microstructure to 119 DPH in entirely ferritic regions.

A tentative explanation of the microstructure is as follows: the object was quenched but, in the sections represented by the microspecimen, the cooling rate was too slow to form a large amount of martensite even in higher carbon regions. Instead, other austenite decomposition products such as ferrite, pearlite and bainite were produced in addition to some martensite. The object was then greatly overtempered at a temperature just below the eutectoid temperature, which produced the spheroidization and low hardness observed.

Chisel, 161, possibly Byzantine: The object came from a fill on the Acropolis. The sample was taken from the blunt end of the shaft which was apparently forged in one piece with the blade.

A polished microspecimen revealed that slag inclusions were highly clustered in some areas. Dark and light slag phases occur mostly in different locations and are rarely mixed.

Etching in 2 percent Nital disclosed a generally fine-grained microstructure in which the amount of pearlite present ranged from nearly zero to almost eutectoid in some corner areas (*Pl. 65, Fig. 16*). No martensite was detected.

Microhardness of the specimen section ranged from 261 DPH in the highest carbon region to 146 DPH in the lowest. An inclusion within a high carbon—i.e. pearlitic—area (*Pl. 65, Fig. 16*) was bordered by an aureole of ferrite which had a microhardness of 163 DPH. The presence of the pearlite-free aureole is easily explainable

if one or more "alloying" elements, such as phosphorus, nickel or tin, are assumed to be dissolved in the metal. Such elements have the effect of raising or lowering the temperature at which austenite transforms to ferrite and pearlite on cooling. Depletion or enrichment of the alloy content of the aureole zone could have resulted from chemical interaction between the inclusion and alloying elements in the surrounding metal. In the present case, the effect of the postulated interaction evidently was to raise the transformation temperature in the aureole zone above that of the surrounding metal. Thus, during cooling after forging austenite first began to transform to ferrite in the zone adjacent to the inclusion, while carbon diffused rapidly into the neighboring untransformed austenite, which later transformed to ferrite and pearlite at a slightly lower temperature.

It is possible that the chisel blade was hardened by quenching. The shaft could have been insulated from the quenching medium during quenching or prevented from reaching the temperature necessary for hardening by incomplete immersion in the fire.

Shovel, 111, possibly Byzantine: This object was found in a fill on the Acropolis, and the date is uncertain. A sample was taken with an abrasive disk along one side of the blade at a distance of several centimeters from the working edge.

A microspecimen prepared from the sample consisted mainly of oxide. However, some large islands of metal remained and these had a microstructure that tended toward a Widmanstätten structure of ferrite and some pearlite (*Pl. 65, Fig. 17*).

Four microhardness determinations made on the two largest metal islands averaged 115 DPH. This hardness is normal for a 0.15 percent carbon steel air cooled from the austenite temperature range, but it is doubtful that the carbon content is this high. The hardness is nevertheless lower than that found on most of the other samples in this report with the exception of **118**, and may reflect an iron of greater purity than the others.

The above observations indicate that no special heat treatment was applied to the shovel. However, no definite conclusion can be reached regarding carburization and/or quenching of the working edge because of the comparative remoteness of the sampling location from this edge.

Weapons

Spearhead, 14, possibly Late Byzantine: This object was found in a mixed context on the Acropolis. A

transverse section from the tip of the blade was removed with an abrasive disk.

Microscopic examination of this sample disclosed that the metal is wrought iron having a highly variable ferrite grain size with many nonmetallic inclusions. Fig. 18 (*Pl. 66*), which shows the entire thickness of the section, includes a weld line along one side. The weld does not extend throughout the section and may represent a crack "healed" in forging rather than an intentional welding of different pieces of metal or a folded individual piece. Some occasional fine colonies of pearlite, carbides and oxides along the weld line have evidently inhibited the growth of the ferrite grains in the weld zone. Microhardness impressions in the fine-grained weld zone and the medium-grained outer zone (*Pl. 66, Fig. 19*) gave readings of 206 DPH and 190 DPH respectively. The hardness of coarse-grained ferrite in the interior was 178 DPH. However, it rose to 203 DPH in a coarse grain adjacent to a large inclusion, a fact that may reflect either the segregation of phosphorus and/or other ferrite hardening elements in the vicinity of the inclusion or the presence of other inclusions below the surface. Fine-grained ferrite near the surface had a hardness of 207 DPH, while a very coarse grain adjacent to the fine-grained zone gave a reading of 171 DPH (average for specimen 193 DPH).

The very coarse grain and some nearby coarse grains contained Neumann bands (deformation twins). These bands require a shock for their formation in ferrite at room temperature and could have been produced by a sharp blow by the smith while putting the finishing touches on the spearhead with a heavy hammer. It seems less likely that the shock occurred in battle, although the object was found with the tang broken off.

Arrowhead, 65, probably Byzantine: This object comes from the area of Building B. It was sectioned transversely near the widest portion of the blade and the end nearest the tip submitted for analysis. The tip itself had broken off, probably because of heavy corrosion.

Microscopic examination of the polished section revealed many coarse, largely two-phased slag inclusions. Etching in Nital showed a fairly coarse-grained, somewhat cold worked ferrite microstructure (*Pl. 67, Fig. 20*). A lack of pearlite indicated that the metal is wrought iron very low in carbon content.

Readings on five microhardness impressions taken at various locations on the polished section ranged from 206 to 236 DPH (average 219). These readings are high for ferrite and reflect cold working and possibly also the presence of phosphorus and/or other elements in solid solution. The work hardening probably resulted mostly

from minor final shaping of the arrowhead by the smith rather than from impact under battle conditions.

Iron Working at Sardis—Historical Summary (Waldbaum)

Although not many iron objects were studied and not all of them are well dated, it is possible to make a few very tentative observations on the development of iron working at Sardis.

Early Iron Age

The two earliest iron tools show different methods of treatment, one considerably more sophisticated than the other. The working edge of the adze (127) was strengthened by hammering layers of uncarburized and carburized (steeled) iron together, while the sickle (118) was apparently only lightly, perhaps accidentally, carburized and not subsequently hardened. Since the sample of the latter was taken from the butt, it is possible that the working edge would have shown a somewhat different treatment. These results show that some experimentation with hardening iron was being attempted at this early date, but was not done in every case.

Lydian

Although both objects are in very poor condition, neither the sledgehammer (143) nor the knife (180) from this period appears to have been more than lightly carburized, and neither was quenched or hardened by hot or cold working. Although both tools come from the full Iron Age, they show that carburizing and hardening techniques were not yet universally applied.

Objects of Uncertain Date, Most Probably Byzantine

This group of objects was the largest tested, consisting of six tools (201, 205, 208, uncatalogued knife, 161, 111) and two weapons (14, 65).

Most of the tools appear to have been carburized and hardened by heat treatment and/or cold working. An exception is knife 201, which may in fact be earlier than Byzantine, and which shows only minimal carburization and no quenching or cold working. Another possible exception is the shovel 111, which is only lightly carburized and not hardened. The fact that the sample of 111 was not taken from the working edge may affect our understanding of this piece. In general, the relatively sophisticated and consistent treatment of these tools

tends to confirm the rather late dates suggested on other grounds.

The two weapons—a spearhead and an arrowhead—were both of wrought iron and may also show some evidence of cold working. Since arrowheads in particular are meant to be expendable in battle, it would not be necessary to treat them with sophisticated and time-consuming techniques. Hence, despite their probable late dates, the structures of these objects are not surprising.

GOLD AND SILVER

Two different groups of precious metal objects were sampled and analyzed by neutron activation. The first consists of samples of gold and silver objects found by the Harvard-Cornell Expedition. These were analyzed by Adon Gordus of the University of Michigan, on behalf of Sidney M. Goldstein of the Corning Museum of Glass. The second group includes silver objects found by the Princeton Expedition, as well as some Lydian silver coins. These were analyzed by Pieter Meyers, formerly of the Metropolitan Museum of Art, now at the Conservation Center of the Los Angeles County Museum of Art.

Neutron Activation of Gold and Silver Objects found by the Harvard-Cornell Expedition (Waldbaum)

Table V.6 shows the results of a neutron activation study of gold and silver objects from Sardis carried out in 1970 by A. Gordus. This study is actually part of a larger project undertaken by S. M. Goldstein with the cooperation of Gordus. When complete, the study will include analyses of samples of gold and other materials from the gold refining operations on the Pactolus as well as of the finished objects. For the present, it was felt best to present only analyses of objects included in Chapter III, leaving fuller discussion and interpretation for Goldstein's forthcoming monograph.⁶³

Objects included in Table V.6 are arranged first chronologically, then typologically where possible. Gold objects are listed first, followed by silver. All samples are rubbings taken by Goldstein in 1969. Only gold, silver and copper were searched for.

63. I would like to acknowledge with gratitude the kind cooperation of Sidney Goldstein in sharing this information with me.

Table V.6 Neutron activation analyses of gold and silver objects

Catalogue number	Type of object Area sampled	Date	Concentrations in percent		
			Au	Ag	Cu
717	Earplug edge of lower end	Early Bronze	84.7	13.6	1.6
717	Earplug edge of neck	Early Bronze	92.4	5.9	1.7
717	Earplug conical tip	Early Bronze	82.9	15.2	1.8
718	Earplug neck	Early Bronze	93.4	6.3	0.3
718	Earplug lower end	Early Bronze	82.4	14.9	2.7
719	Earring wire	Lydian	65.3	31.9	2.8
719	Earring lamb's posterior	Lydian	64.5	32.5	3.0
760	Bead granule	Lydian	96.7	1.7	1.5
760	Bead side	Lydian	97.4	1.2	1.4
843	Ring	Lydian?	89.8	8.7	1.6
883	Pendant wire	Lydian	97.5	1.5	1.0
884	Pendant	Lydian	89.2	8.9	1.9
885	Pendant	Lydian or Byzantine?	91.3	6.6	2.1
723	Earring	Lydian or Late Roman?	95.7	2.4	2.0
731	Earring	Hellenistic	90.3	7.6	2.1
732	Earring	Roman	83.7	14.1	2.2
733	Earring	Roman	89.7	8.1	2.2
736	Earring	Roman	91.9	5.7	2.4
899	Medallion	Byzantine	90.0	8.3	1.6
881	Pendant	Early Bronze	0.099	96.7	3.3
882	Pendant	Lydian	0.014	99.7	0.25

Natural gold from the Pactolus has been found to have a silver content of ca. 17 to 24 percent; that is, it is a natural electrum.⁶⁴

The varying silver content of the samples from different parts of the Early Bronze Age earplugs (717, 718) is noteworthy, since each earplug is believed to have been formed from a single sheet of metal. Assuming the earplugs to have been made of local Pactolus gold, the relatively high silver content in some of the samples seems to indicate that the metal used had not been refined.

64. Unpubl. report by S. M. Goldstein, 1969, based on neutron activation of a sample of gold panned from the Pactolus and tested at the Çekmece Nuclear Research Center in Istanbul. Obviously, more than one sample would be necessary to establish more precisely the range of silver contained in Pactolus gold.

If the estimated silver content of Pactolus gold is fairly accurate, most of the Lydian gold samples included in Table V.6 would seem to have been at least partially refined. One object—the lamb earring, 719—apparently had its silver content deliberately raised in the manner of contemporary electrum coinage.⁶⁵

Most of the objects of Roman and Byzantine date do not differ significantly from the earlier, Lydian ones, while 732 resembles the Early Bronze Age earplugs in having a relatively high percentage of silver.

All samples contain copper as a minor constituent in amounts ranging from 0.3 to 3.0 percent, normal for most gold ores.

65. See above, Chap. I, n. 61.

The two silver objects (881,882), though quite different in date, both contain gold only in trace quantities, and seem more likely to have been made from silver derived from ore than silver refined from natural electrum.⁶⁶ Compositions, in fact, are very close to those of silver Lydian coins tested by neutron activation analysis.⁶⁷

There is no way of knowing, of course, whether any of these objects was made from locally mined gold or silver ores. However, given the tradition of superabundance of local gold in Lydian times, it seems safe to assume that the objects of Lydian date, at least, are of local material. The provenance of the gold used in Roman, Byzantine and Early Bronze Age objects remains more uncertain for the present. Although analyzed compositions of these objects do not vary significantly from those of Lydian date, the analyses reported here were not precise enough in terms of elements searched for to show up any more telling differences.

Elemental Composition of Silver Objects Found by the Princeton Expedition (Meyers)

The elemental compositions of samples from silver objects excavated at Sardis by the Princeton Expedition and now in the Istanbul Archaeological Museum were determined by neutron activation analysis. For comparison, various samples of Lydian silver coins in the British Museum were also analyzed. The analyses were carried out by the author at Brookhaven National Laboratory, Upton, New York. The purpose of this small analytical program was to reveal information on the fineness of the silver and on the sources from which the silver was extracted.

Sampling: The Sardis objects (963-971) were sampled by Andrew Oliver, Jr. and Jane C. Waldbaum at the Istanbul Archaeological Museum in June, 1974. Objects 294, 1415 and 3960 on Table V.7 from the Istanbul Archaeological Museum are not from Sardis, and were sampled for comparative purposes. Rubbing samples of the British Museum coins were taken by Jane C. Waldbaum in August, 1974.⁶⁸

Two kinds of samples were taken: rubbings and scrapings. The first type of sample was obtained by

rubbing a piece of etched quartz tubing against a pre-cleaned area of the object. This action will produce a streak of silver on the quartz, sufficiently large for analysis. Scrapings were taken using a stainless steel scalpel. In a few cases (963, 967 and 968) tiny fragments that had broken off the objects were collected instead. Samples suitable for analysis were extracted from the fragments by drilling. In all instances corroded surface material was removed and where possible uncorroded metal samples were collected.

Analysis: Details of the neutron activation analytical technique applied to silver samples have been reported elsewhere.⁶⁹ Instrumental techniques were used for the determination of the major components silver, copper and gold in rubbing samples as well as in scraping/drilling samples. Quantitative analysis of the elements iridium, zinc, tin, arsenic, antimony, selenium, mercury, iron, cobalt, chromium and scandium was achieved by chemical separations after neutron activation. Trace element analysis was only performed on scraping or drilling samples weighing approximately 0.5 mg. each. No trace element analysis was performed on rubbings as these samples are not considered sufficiently representative of the silver alloy and, therefore, are not expected to give reliable data for all trace elements.

The results on the scraping and drilling samples are shown in Table V.7; the compositions of the rubbings are reported in Table V.8. Since most samples originate at or near the surface, the reported elemental compositions may not always reflect the true compositions of the metal alloy. For example, rubbing analyses are known to show copper values typically 15 percent lower than those of drillings, and gold values typically 20 percent higher than those of drillings. Analyses of multiple samples taken from the same object, often from the same area, clearly show the variation in elemental compositions resulting from surface effects (e.g. compare the analyses of four rubbing and two scraping samples of the ladle 965). Such effects have to be taken into account in the interpretations of the analytical data.

In Table V.7, objects and samples are identified in columns 1-4. Columns 5, 6 and 7 list the concentrations of silver, copper and gold respectively. These elements were determined by instrumental neutron activation

66. Letter from Gordus to Goldstein, Sept. 1970: "... if the silver objects were made from silver separated from gold then I would expect that there would be at least a few percent of gold impurity in the silver objects."

67. Unpubl. report by Gordus, 1970, and see below, Table V.8.

68. Thanks are due to the staff of the British Museum Coin Collection for permitting the samples to be taken and for facilitating this work.

69. P. Meyers, L. van Zelst and E. V. Sayre, "Determination of Major Components and Trace Elements in Ancient Silver by Thermal Neutron Activation Analysis," *Journal of Radioanalytical Chemistry* 16 (1973) 67-78; idem, "Major and Trace Elements in Sasanian Silver," in C. W. Beck, ed. *Archaeological Chemistry, Advances in Chemistry Series* no. 138 (Washington, D.C. 1974) 22-33.

Table V.7 Elemental compositions of silver objects from Sardis

Object	Catalogue number	Sample description Area sampled	Sample number	Concentrations in percent		
				Ag	Cu	Au
Phiale	963	Drilling	SS24	99.7	0.150	0.174
Phiale	964	Scraping rim	SS13	94.0	5.85	0.194
Ladle	965	Scraping handle	SS10	97.2	2.54	0.228
Ladle	965	Scraping rim of bowl	SS22	97.1	2.70	0.208
Spouted dish	966	Scraping rim	SS9	94.8	4.86	0.295
Fluted jar	967	Drilling	SS25	96.6	3.04	0.327
Saucer	968	Drilling	SS26	93.1	6.46	0.441
Saucer	969	Scraping	SS11	95.3	4.24	0.485
Saucer	969	Scraping	SS12	95.4	4.22	0.385
Cosmetic spoon	970	Scraping handle	SS14	98.9	1.04	0.0108
Cosmetic spoon	971	Scraping handle	SS17	97.0	2.89	0.120
Hellenistic jar	294	Scraping	IS15	97.3	2.47	0.268
Hellenistic strainer	1415	Scraping	IS16	95.4	4.22	0.409
Bowl from Gezer	3960	Scraping	IS23	98.1	1.40	0.496

analysis, and their concentrations were calculated based upon the assumption that silver, copper and gold are the only elements present in significant amounts. The accuracy of the concentrations for these elements is estimated to be better than 5 percent of reported values. Columns 8-13 list the concentrations of iridium, zinc, tin, arsenic, antimony and selenium respectively. These elements were determined by a neutron activation analysis procedure that included chemical separations after activation of the samples, but before measurement of gamma ray energy spectra. The concentration levels are expressed in micrograms per gram sample (ppm). The precision of the reported values is estimated at 15 percent, except when the concentration levels approach detection limits; the accuracy, however, is estimated at 25 percent.

Columns 14-18 list the concentrations of mercury, iron, cobalt, chromium and scandium respectively. These elements were determined simultaneously with the previous ones. However, it was found that the elements are distributed inhomogeneously in the silver alloy and that the small sample size does not fairly represent the metal alloy. Although these elements may be of limited use, they are reported here nonetheless for the sake of completeness.

Table V.8 shows concentrations determined by instrumental neutron activation analysis and calculated

based upon the assumption that silver, copper and gold are the only elements present in significant amounts. Samples were obtained by rubbing etched quartz tubing against a cleaned silver surface. In all cases two samples (1) and (2) were obtained from each sampling location. All coins were sampled at their edge.

Discussion: In antiquity most silver was produced from argentiferous lead ores in a two-step process that includes smelting of the lead ore to produce lead metal followed by extraction of the silver from the lead using the cupellation process. Based on comparisons of elemental compositions of silver coins, silver objects and ore samples and using information from geological and archaeological surveys and from literary evidence, it appears that most silver produced in Anatolia, including that excavated at Sardis, was extracted from the ore cerussite (lead carbonate), the major component in the oxidized portions of lead deposits. It is possible that other sources produced small amounts of silver metal. For example, silver metal could in theory have been recovered from the cementation process in which electrum is purified into gold. However, there is no evidence, either directly from archaeological finds or literary sources or indirectly from elemental compositions of Anatolian silver, that silver was produced in this manner.

Concentrations in $\mu\text{g/g}$ (ppm)										
Ir	Zn	Sn	As	Sb	Se	Hg	Fe	Co	Cr	Sc
0.00078	2.4	<29	0.73	0.15	<.38	6.0	≤ 8.9	<.024	1.2	$\leq .0017$
0.26	19	<34	110	11	4.8	9.1	14	<.036	<.22	$\leq .0019$
0.28	24	<42	1.8	0.37	0.92	4.1	52	0.058	1.1	$\leq .0018$
0.17	46	<41	2.2	0.38	0.92	50	150	0.13	0.83	0.12
0.043	93	<34	350	12	12	23	1,100	1.1	0.27	0.023
0.20	66	<26	1.1	0.88	0.81	0.63	16	0.084	0.40	0.0080
0.17	34	<25	6.3	1.6	0.93	7.2	17	0.11	0.21	0.0052
0.088	240	<60	9.7	6.1	1.2	5.6	97	0.30	0.59	0.13
0.16	78	<36	6.5	7.8	0.93	2.9	100	0.21	0.53	0.098
0.025	5.9	<46	0.21	0.15	0.32	0.90	24	0.21	0.56	0.0062
0.015	16	<45	0.59	0.51	1.1	3.0	300	0.28	0.48	0.0046
0.0050	9.5	<27	0.20	0.050	0.24	6.5	18	0.071	0.34	$\leq .0024$
0.034	13	74	16	12	3.0	20	17	0.074	0.26	0.0055
0.034	7,700	<78	7.4	2.0	1.9	120	32	0.32	7.7	—

Before the silver was used for objects or coins, copper was often added to it, typically in amounts of 4 to 10 percent, to improve the mechanical properties of the silver.

In the interpretation of the analytical data reported here it should be realized that only the elements gold and iridium are characteristic for the ore source from which the silver was produced: objects made of silver extracted from the same lead ore body will have similar gold and iridium concentrations; large differences in concentrations of these elements indicate that the silver was obtained from different sources. Copper was added intentionally; zinc, tin, arsenic, antimony and selenium are impurities introduced in the silver primarily by the addition of copper. Other elements determined are inhomogeneously distributed in the silver.⁷⁰

The following observations can be made based on the compositions reported in Tables V.7 and V.8. Most of the samples analyzed show gold and iridium concentration levels similar to those of a number of samples of

presumed Anatolian origin.⁷¹ This silver is characterized by moderately high levels of gold (0.15 to 0.45 percent), and iridium concentrations between 0.005 and 0.40 ppm. Since silver-rich lead ores were readily available in Western Anatolia, it is likely that the silver for these Sardis objects was produced locally, probably from secondary oxidized lead ore deposits (cerussite). The cosmetic spoon 970 is exceptional: its very low gold content indicates a different geographic origin of the silver source, or, possibly, the use of a different ore material. Its composition matches that of silver objects from Macedonia and Thrace.⁷² Therefore, the silver for this spoon or the spoon itself may have been imported. The gold and iridium concentrations of the phiale 963 and the cosmetic spoon 971 may also be out of the range of "Anatolian silver." However, there is insufficient comparative data available to make a reliable conclusion on the provenance of the silver of these objects.

The lack of comparative data also makes it difficult to predict the variations in composition among batches of silver obtained from one single ore source. However,

70. P. O. Harper and P. Meyers, *Silver Vessels of the Sasanian Period, I Royal Imagery* (The Metropolitan Museum of Art, New York City 1981) 150-152.

71. P. Meyers, unpubl. analyses of silver objects, including third millennium B.C. ingots, Hittite and Achaemenid objects.

72. P. Meyers, unpubl. analyses.

Table V.8 Elemental compositions of rubbing samples from silver objects and coins

A. Silver objects from Sardis					
Object	Catalogue number	Sample location	Concentrations in percent		
			Ag	Cu	Au
Phiale	964	rim (1)	92.0	7.7	0.32
		(2)	94.5	5.2	0.33
Ladle	965	handle (1)	97.9	1.8	0.33
		(2)	98.3	1.4	0.34
		rim of bowl (1)	97.2	2.4	0.35
		(2)	96.5	3.2	0.30
Spouted dish	966	rim (1)	83.3	16.4	0.25
		(2)	93.2	6.5	0.28
Saucer	969	under rim (1)	92.2	7.2	0.57
		(2)	89.8	9.5	0.66
B. Lydian silver coins, British Museum Collection					
Coin reference	Concentrations in percent				
	Ag	Cu	Au		
<i>BMC Lydia</i> * 37 (1)	98.9	0.28	0.85		
	(2)	98.7	0.34	0.98	
<i>BMC Lydia</i> 38 (1)	98.8	0.67	0.56		
	(2)	98.9	0.58	0.54	
<i>BMC Lydia</i> 39** (1)	95.5	4.1	0.42		
	(2)	95.1	4.5	0.39	
<i>BMC Lydia</i> 40 (1)	98.2	1.1	0.62		
	(2)	98.1	1.3	0.53	
1948 7 Spink*** 12-8 (1)	98.8	0.61	0.57		
	(2)	98.9	0.52	0.57	
1948 7 Spink 12-9 (1)	98.9	0.48	0.59		
	(2)	98.6	0.87	0.49	
1948 7 Spink 12-10 (1)	99.3	0.22	0.53		
	(2)	99.3	0.25	0.50	
1948 7 Spink 12-11 (1)	98.2	1.2	0.53		
	(2)	98.0	1.6	0.46	
1948 7 Spink 12-12 (1)	98.9	0.44	0.66		
	(2)	98.9	0.51	0.63	
1948 7 Spink 12-13 (1)	99.1	0.44	0.47		
	(2)	99.3	0.31	0.43	
1948 7 Spink 12-14 (1)	98.9	0.42	0.68		
	(2)	99.0	0.48	0.53	
<i>BMC Lydia</i> 41 (1)	99.3	0.18	0.55		
	(2)	99.3	0.21	0.52	
<i>BMC Lydia</i> 43 (1)	98.9	0.48	0.67		
	(2)	99.0	0.34	0.65	
<i>BMC Lydia</i> 44 (1)	98.0	0.73	1.3		
	(2)	98.1	0.57	1.3	

**BMC Lydia* Head, B.V., British Museum Department of Coins and Medals. *Catalogue of the Greek Coins of Lydia* (London 1901).

**Said to be forgery.

***1948 7 Spink = *NumCirc* 1948 no. 7.

the spread in gold and iridium contents is sufficiently large to conclude that the silver used for the objects discussed here originates from a number of different ore sources. Five of the objects—964, 965, 967, 968, and 969—have relatively similar gold and iridium levels. The silver for these objects could have originated from one geographic area. Three other objects—966 and Istanbul 1415 and 3960—have comparable gold and iridium concentrations and could have been made of silver from a common source. All other objects—963, 970, 971 and Istanbul 294—are unrelated in elemental composition.

A comparison of coin and object analyses (Table V.8) shows that the gold content is on average significantly higher in the coins than in the objects. Only four objects—the two saucers 968 and 969, the Hellenistic strainer 1415 and the bowl from Gezer 3960 in Istanbul—have gold concentrations similar to those of Lydian coins. With the possible exception of these four objects, there appears to be no common source of silver for objects and Lydian coins. In addition, the Lydian coins contain very little copper,⁷³ significantly less than most of the objects. All objects, except the phiale 963 contain more than 1 percent copper, indicating a deliberate addition of copper to the silver. Because of the low levels of tin, the copper added to the silver must have been unalloyed, not remelted bronze.

ASSESSMENT OF THE ANALYTICAL PROGRAM AT SARDIS (*Waldbaum*)

The immediate usefulness of the analyses carried out on metal objects from Sardis varies considerably. The most important variables, of course, are the information sought and the reliability of the different tests performed. Materials, age and condition of the objects tested and quantities of samples taken also affect the results.

Probably the most revealing studies are those undertaken to determine the alloying ingredients of the copper alloy objects, since these tests utilized the largest number of samples and the greatest range of object types from all periods. It was possible to corroborate many of the results by subjecting samples to more than one type of analysis, and there is also a fairly large body of published comparative data available to provide a frame of reference for drawing conclusions.

The other series of analyses, on iron, gold and silver, also yielded interesting results, although these were more limited in scope. Since relatively few iron

73. Coin *BMC Lydia* 39 contains a relatively high amount of copper (4.3%). However, this coin is said to be a modern forgery. Its elemental composition—high copper and low gold in relation to the other coins—seems to support this assumption.

objects were sampled, and not all were well dated, the results of iron metallographic analyses tell more about techniques applied to individual objects than about patterns in iron manufacture over time. A larger and more systematic study in the future is highly recommended.

The trace element analyses on gold, silver and copper alloy objects are still somewhat preliminary in their conclusions, and must await the publication of more comparative data from other sites before their usefulness may be fully assessed. The intriguing possibility of identifying ore sources or manufacturing centers for these metals demands a much greater effort and is probably some years away from realization. On a more

local level, study of the ratios of gold, silver and copper in the precious metal objects has raised a number of new and important questions about the manipulation and control of these metals, especially by the Lydians. While not entirely conclusive, these results have shed new light on the gold industry of Sardis in the time of Croesus and given credence to the basis of his legendary wealth.

Taken as a whole, the Sardis analytical program shows the potential for far greater understanding of ancient metalworking and its technology that can be achieved through continued cooperation between scientists and archaeologists. It is the sincere hope of all the contributors to this project that our work will encourage more such cooperation in the future.

CONCORDANCE OF FINDS BY EXCAVATION INVENTORY NUMBERS

<i>Inventory number</i>	<i>Catalogue number</i>	<i>Inventory number</i>	<i>Catalogue number</i>	<i>Inventory number</i>	<i>Catalogue number</i>
<i>Pieces from the excavations catalogued as jewelry</i>					
		M58.38:880	588	M59.11:1355	539
		M58.39:881	583	M59.13:1366	110
J61.1:3126	760	M58.40:882	578	M59.14:1372	407
J61.2:3127	883	M58.45:883	514	M59.18:1396	153
J61.3:3128	882	M58.55:792	841	M59.19:1399	692
J63.1:5231	899	M58.58:767	846	M59.20:1406	507
J63.2:5406	736	M58.59:861	698	M59.21:1411	166
J66.1:7020	699	M58.60:877	473	M59.22a:1452	854
J66.2:7092	723	M58.61,61a:937	529	M59.22b:1452	857
J67.3:7400	719	M58.62:828	80	M59.23:1464	384
J67.4:7530	884	M58.71:581	188	M59.23a:1468a	601
J68.1:7682	732	M58.74:395	705	M59.23b:1468	592
J68.2:7824	731	M58.83:692a	187	M59.24:1481	363
J73.1:8221	684	M58.91:979	530	M59.25:1485	200
J73.2:8222	685	M58.92:884	521	M59.28:1576	591
J73.3:8275	751	M58.93:885	522	M59.29:1577	809, 860, 861, 877,
J73.6:8297	741, 742	M58.106:1052	668		878
		M58.107:1016	649		113, 157
<i>Pieces catalogued as metal</i>					
		M58.108:1050	342-345	M59.30:1591	577
		M58.109:1015	223	M59.31:1592	93
M58.1:10	293	M58.110:1025	606	M59.32A:1593	253
M58.3:115	671	M58.112:505	117	M59.32B:1593B	589
M58.6:150	722	M58.113:1086	571	M59.33:1594	593
M58.20:226	240	M58.116:754	458	M59.34:1595	925
M58.22:224	204	M58.117:343	900	M59.35:1600	821
M58.31:396	831	M58.118:498	194	M59.36:1601	250
M58.32:419	35	M59.1:1180	231	M59.37:1617	226
M58.33:390	696	M59.3:1191	687	M59.40:1650	939
M58.34:378	445	M59.4:1193	411	M59.42:1659	197
M58.35:377	412	M59.5:1253	225	M59.44:1679	695
M58.36:392	702	M59.6:1273	866	M59.45:1682	

<i>Inventory number</i>	<i>Catalogue number</i>	<i>Inventory number</i>	<i>Catalogue number</i>	<i>Inventory number</i>	<i>Catalogue number</i>
M59.46:1701	874	M60.40:2531	54	M61.9:3178	848
M59.48:1799	380	M60.41:2536	434	M61.10:3179	818
M59.50:1847	650	M60.42:2537	903	M61.11:3186	849
M59.52a:1857	559	M60.43:2561	449	M61.12:3193	55
M59.55:1883	218	M60.44:2586	875	M61.14:3200	873
M59.57:1904	927-932	M60.46:2602	18, 27	M61.15:3204	484
M59.62:1990	825	M60.48:2608	161	M61.16:3207	83
M59.63:1991	868	M60.49:2611	201	M61.17:3211	803
M59.64:1992	863	M60.50:2612	570	M61.18:3214	475
M59.64a:2111	340, 341	M60.51:2613	78	M61.19:3229	392
M59.66:2115	229	M60.52:2617	128	M61.20:3230	25
M59.67:2116	888	M60.53:2619	912	M61.21:3231	890
M59.68:2148	227	M60.54:2626	569	M61.22a-c:3232	880
M59.69:2152	876	M60.55:2628	111	M61.24:3279	235
M59.72:2161	252	M60.56:2647	799	M61.25:3333	938
M59.74:2198	733	M60.57:2652	266, 267	M61.26:3353	395
M59.75:2199	812	M60.58:2658	74	M61.28:3369	734, 735
M59.79:2206	444	M60.59:2659	709	M61.31:3400	37
M59.80:2207	198	M60.60:2699	917	M61.32:3401	30
M59.81:2220	95	M60.61:2700	406	M61.33:3409	222
M59.83:2226a	605	M60.62:2703	946	M61.34:3497	164
M60.1:2227	66	M60.63:2707	806	M61.36:3512	852
M60.2:2229	623, 635	M60.64:2756	338, 339	M61.37:3513	864, 865
M60.3:2231	575	M60.65:2772	817	M61.38:3515	807
M60.4:2244	419	M60.66:2774	867	M61.39:3528	265
M60.5:2246	142	M60.67:2778	819	M61.41:3530	504
M60.6:2359	651	M60.68:2779	829	M61.42:3549	44
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M60.8:2270	560	M60.71:2794	639	M61.48:3564	391
M60.10:2272	633	M60.72:2795	497	M61.49:3570	49
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M60.15:2285	379	M60.75:2845	207	M61.53:3674	101
M60.16:2358	802	M60.76:2846	19	M61.54:3675	388
M60.17:2315	944	M60.77:2854	58	M61.55:3676	96
M60.18:2325	63	M60.78:2916	203	M61.56:3677	816
M60.19:2348	59	M60.79:2924	22	M61.57:3710	455
M60.20:2362	417	M60.80:2947	99	M61.58:3711	609
M60.21:2364	901	M60.81:2969	850	M61.59:3712	474
M60.22:2365	557	M60.83:2973	923	M61.60:3713	808
M60.23:2366	706	M60.84:2974	572	M61.62:3715	632
M60.24:2367	88	M60.85:2977	147	M61.64:3717	629, 630
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M60.28:2414	145	M60.88:2991	20	M61.68:3721	690
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M60.37:2483	208	M61.6:3166	683	M61.79:3803	534
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M61.93:4031	898	M62.51a,b:4442	527	M63.15:5158	483
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M62.2:4179	236	M62.60:4480	102	M63.28:5352	193
M62.4:4269	490	M62.62:4555	907	M63.29:5375	441
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M62.17:4208	595	M62.73:4718	16	M63.43:5631	563
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M65.4b:6703	894	M67.29:7475	528	M70.4:8116	660
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M65.6:6767	243	M67.31:7481	438	M70.6:8118	278
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M65.9:6785	196	M67.34:7547	107	M72.1:8178	447
M65.10:6850 (C65.9)	472	M67.35:7584	585	M72.3:8193	689
M65.11:6909	41	M67.36:7585	520	M72.4:8194	403
M65.12:6948	562	M67.37:7586	511	M72.5:8196	140
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M66.6a:7052	725	M68.2c:7611	937	M73.2:8226	71
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M66.7:7055	800	M68.4:7624	617	M73.4:8249	574
M66.8:7060	214	M68.5:7637	869	M73.5a-d:8265	737-740
M66.9:7070	940	M68.6:7638	619	M73.6:8286	750

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M73.7:8296	822	NoEx 68.13	697	<i>Pieces catalogued as stone</i>	
		NoEx 68.14	652	S61.16:3380	950
<i>Pieces from the area of Sardis not excavated by the Harvard-Cornell Expedition</i>		NoEx 68.26	828	S61.17:3397	951
		NoEx 69.42	653	S62.3:4136	954
NoEx 62.23	885	NoEx 71.22	896	S63.1:4959	952
NoEx 66.21	843	NoEx 72.28	902	S63.6:5008	953
NoEx 68.10A	389			S69.8:7982	949
NoEx 68.10B	390	<i>Piece catalogued as pottery</i>		<i>Piece catalogued as terracotta</i>	
NoEx 68.12	844	P72.9:8911	958	T68.16:7825	956

CONCORDANCE OF FINDS BY SECTORS

<i>Sector</i>	<i>Catalogue number</i>	<i>Type of object</i>	<i>Sector</i>	<i>Catalogue number</i>	<i>Type of object</i>
AcN	50, 54	Arrowheads	AcT	210	Knife handle
AcN	88	Harness attachment	AcT	216	Spit
AcN	257	Latch	AcT	233	Needle
AcN	434	Furniture leg	AcT	388	Lockplate
AcN	501	Bowl	AcT	406	Key
AcN	568	Handle attachment	AcT	417	Hinge
AcN	799	Bead	AcT	486	Sinker
AcN	901	Reliquary cross	AcT	497	Bowl
AcS	17	Javelinhead	AcT	557	Handle
AcS	22, 63	Arrowheads	AcT	567, 569	Handle attachments
AcS	823	Ring	AcT	570	Vessel rim
AcT	9, 14, 15	Spearheads	AcT	572	Vessel foot
AcT	18-21, 23, 26-29, 36, 43, 51-53, 55, 56, 58-62, 74, 75, 77, 78	Arrowheads	AcT	576	Vessel patch
AcT	90	Stirrup	AcT	647	Tweezers
AcT	96, 98	Bells	AcT	690, 691, 706, 709	Buckles
AcT	105	Plough	AcT	743-745	Earrings
AcT	111	Spade	AcT	806	Bracelet
AcT	128	Adze	AcT	817-819, 829, 830, 842	Rings
AcT	145	Nailheader	AcT	903, 904	Crosses
AcT	158, 161	Chisels	AcT	912, 913	Ornamental attachments
AcT	201-203, 205-208	Knives	AcT	944	Hook
			AcT	946	Chain links
			AcT Grave 61.10	683	Fibula
			AcT Grave 61.12	892	Pendant

<i>Sector</i>	<i>Catalogue number</i>	<i>Type of object</i>	<i>Sector</i>	<i>Catalogue number</i>	<i>Type of object</i>
AcT Grave 61.20	756-759	Earrings	BE-S	499	Bowl
AcT Grave 61.21	807	Bracelet	BE-S	688	Brooch
AcT Grave 61.37	893	Pendant	BS	71	Arrowhead
AcT Grave 61.40	898	Medallion	BS	478	Weight
AcT Grave 61.42	752-755	Earrings	BS E2	148	Punch
AhT	3	Dagger	BS E2	413	Hasp
AhT	430, 432	Finials	BS E2	435	Steelyard
AhT	489	Bowl	BS E2	617	Lampstand
AhT	656	Pin	BS E2	922	Suspension device
AhT Grave 67.10	2	Dagger			
AhT Grave E	657	Pin	BS E2	936	Disk
AhT Grave	658	Pin	BS E2	937	Finial
AT	447	Steelyard weight	BS E2	945	Chain links
AT	962	Lead ingot?	BS E2a	396	Key
B	197	Knife	BS E2a	543	Flask lid
B	342-345	Rivets or plugs	BS E2a	700	Buckle
B	458	Balance	BS outside E3	516	Cauldron
B	596	Lamp chain	BS E4	454	Balance
B	900	Medallion	BS E4	496	Bowl
B	902	Reliquary cross	BS E4	523, 526,	
BCH	69	Arrowhead		528	Flasks
BCH	909	Ornamental attachment	BS E4	536, 544	Flask lids
		attachment	BS in front of E4	911	Ornamental attachment
BE	65	Arrowhead			
BE	99	Bell	BS E5	4	Dagger
BE	147	Smith's set	BS E5	5	Sword
BE	288-290	Clamps	BS E5	125	Sickle
BE	301-312	Nails	BS E5	130	Axe
BE-A	66	Arrowhead	BS E5	169, 170	Pounders
BE-A	260	Door boss	BS E5	416	Hasp
BE-A	665	Pin	BS E5	437	Steelyard
BE-A	834	Ring	BS E5	492	Bowl
BE-A/BE-B	699	Buckle	BS E5	532	Flask
BE-B	264	Communication tap	BS E5	618	Zoomorphic lamp
BE-B	404	Key	BS E5?	554	Handle
BE-B	664	Pin	BS outside E5	517, 518	Cauldrons
BE-C	403	Key	BS outside E5	524	Flask
BE-C	667	Pin	BS E6	109	Trowel
BE-C	689	Buckle	BS E6	138	Hammer-adze
BE-DD	64	Arrowhead	BS E6	191	Knife
BE-H	67, 68,		BS E6	217	Strainer
	76, 82	Arrowheads	BS E6	360	Lock
BE-H	139	Hammer-axe	BS E6	387	Lockplate
BE-H	211	Chopper	BS E6	402	Key
BE-H	313-317	Nails	BS E6	491	Bowl
BE-H	472	Weight	BS E6	511	Pan
BE-H/MC	876	Boss	BS E6	520	Authepsa
BE-N	242	Spindle hook	BS E6	525	Flask
BE-S	244	Spindle hook	BS E6	553	Flask lid
BE-S	275	Revetment pin	BS E6	582	Censer

<i>Sector</i>	<i>Catalogue number</i>	<i>Type of object</i>	<i>Sector</i>	<i>Catalogue number</i>	<i>Type of object</i>
BS E6	614	Candelabrum	BS E12	189, 192	Knives
BS E6	616	Lampstand	BS E12	716	Buckle?
BS E6	685	Brooch	BS E12	853	Ring
BS E7	361, 362	Locks	BS in front of E12	219	Strainer spoon
BS E7	426-428	Campstool frames	BS E12 or E13	550	Lid
BS E7	431	Finial	BS E13	107	Hoe
BS E7	438-440	Steelyards	BS E13	359, 367	Locks
BS E7	452	Balance	BS E13	386	Lock plate
BS E7	580	Censer	BS E13	555	Handle
BS E7	594	Lamp chain	BS E13	566	Handle attachment
BS outside and between E7 and E8	453	Balance	BS E13	587	Censer holder
BS E8	493	Bowl	BS E13	907	Ornamental attachment
BS in front of E8	263	Window grille	BS E13-14	152	Punch
BS E8 or E9	171	Pounder	BS E13 or E14	456	Balance
BS E8 or E9	556	Handle	BS E14	6	Sword
BS E8 or E9	637	Cosmetic spoon	BS E14	100, 102	Bells
BS E9	408	Key	BS E14	135	Axe-adze
BS E9	505	Bowl	BS E14	436	Steelyard
BS E9	549	Lid	BS E14	451	Balance
BS E9	564	Handle	BS E14	468	Weight
BS E9	585	Censer	BS E14	490	Bowl
BS E9	684	Brooch	BS E14	512	Pan handle
BS E9-10	94	Bell	BS E14	527	Flask
BS E9-10	540-542	Flask lids	BS E14	573	Vessel foot
BS E10	140, 141	Pick-axes	BS E14	643	Spatula
BS E10	144	Sledgehammer	BS outside E14	470, 471	Weights
BS E10	365, 366	Locks	BS E15	613	Candelabrum
BS E10	385	Lock plate	BS outside E15	515	Cauldron
BS E10	401	Key	BS E16	103	Bell
BS E10	545	Flask lid	BS E16	108	Hoe
BS outside E10	538	Flask lid	BS E16	256	Hinge
BS E10-E11	114	Spade	BS E16	424	Campstool frame
BS E10 or E11	935	Panpipes	BS E16	441	Steelyard
BS E11	122, 123	Billhooks	BS E16	531	Flask
BS E11	126	Gardening fork	BS outside E16	195	Knife
BS E11	136, 137	Hammer-adzes	BS E17	193	Knife
BS E11	146	Smith's set	BS E17	425	Campstool frame
BS E11	159	Chisel	BS E17	513	Pan handle
BS E11	213	Knife	BS E17	546	Flask lid
BS E11	221	Ladle	BS outside E17	503	Bowl
BS E11	346-358, 368-378	Locks	BS outside E17	547	Flask lid
BS E11	381-383	Lock plates	BS E18	561	Handle
BS E11	506	Bowl	BS E18	581	Censer
BS E11	586	Censer lid	BS E18	669	Pin
BS E11	707, 708, 710	Buckles	BS E19	498	Bowl
BS E11 Colonnade	115, 116	Spades	BS E19	615	Lampstand
BS E12	131	Axe	BS E19	701	Buckle

<i>Sector</i>	<i>Catalogue number</i>	<i>Type of object</i>	<i>Sector</i>	<i>Catalogue number</i>	<i>Type of object</i>
BS E19-PCA	910	Ornamental attachment	BW Lat	95	Bell
BS W1	187	Knife	BW Lat	198	Knife
BS W1	705	Buckle	BW Lat	444	Steelyard
BS W1	831, 841	Rings	CG	121	Billhook
BS W2	188, 194?	Knives	CG	204	Knife
BS W2	473	Weight	CG	240	Shears and thimble
BS W3	117	Spade	CG	379	Lock
BS W3	226	Spoon	CG	419	Binding strap
BS W3	412	Hasp	CG	927-932	Furnace attachments
BS W3	445	Steelyard			
BS W3	574	Jug stopper	Church E	241	Shears
BS W3	593	Lamp chain	Church E	291	Clamp anchor
BS W3	695, 696,		Church E	891	Pendant
	702	Buckles	EB Grave 69.3	1	Dagger
BS W3	821	Ring	EB Grave 69.3	717, 718	Earplugs
BS W3	925	Function unknown	EB Grave 69.3	881	Pendant
BS W5	698	Buckle	ERd	154	Chisel
BS W7	166	Hand saw	ERd	196	Knife
BS W7	225	Spoon	ERd	220	Ladle
BS W7	539	Flask lid	ERd	429	Bul protome
BS W7	854, 857	Rings	ERd	448	Balance
BS W7	958	Crucible	ERd	562	Handle
BS W8	407	Key	ERd	626	Cosmetic spoon
BS W8	475	Weight	HoB	7	Dagger sheath
BS W8	692	Buckle	HoB	11	Spearhead
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MRd	504	Bowl	PN	446	Steelyard
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Pa	812	Bracelet		880	Jewelry chain
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Pa	940	Shaft with cross		921	Suspension device
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PN Grave 61.33	609	Cross	Syn FC	482	Weight
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PN Grave 62.40	784-796	Beads	Syn FC	862, 870	Rings
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PN Grave 73.21	751	Earring	Syn FC	918	Dog statuette
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RT	873	Button	Syn MH	943	Hook
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ILLUSTRATIONS

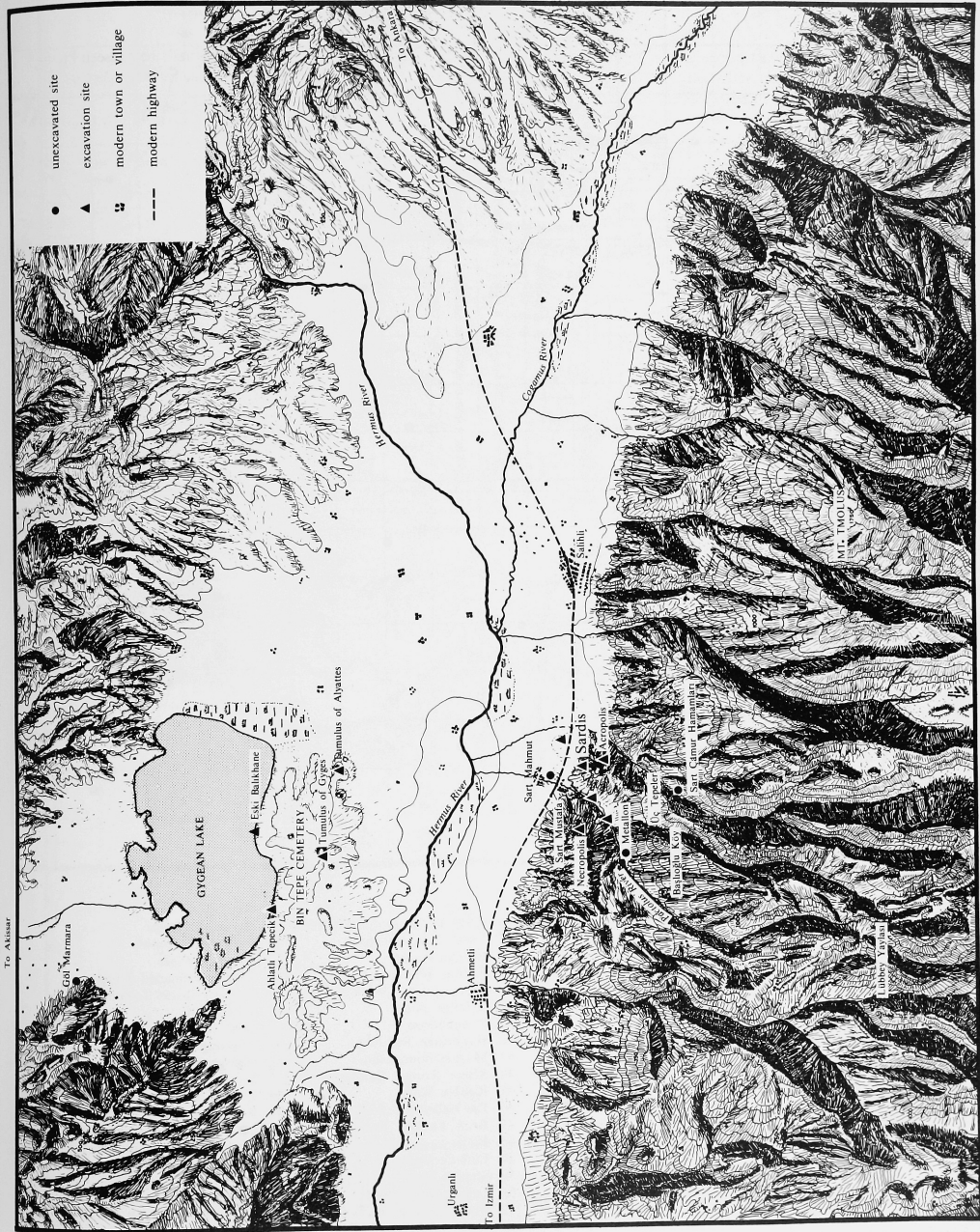
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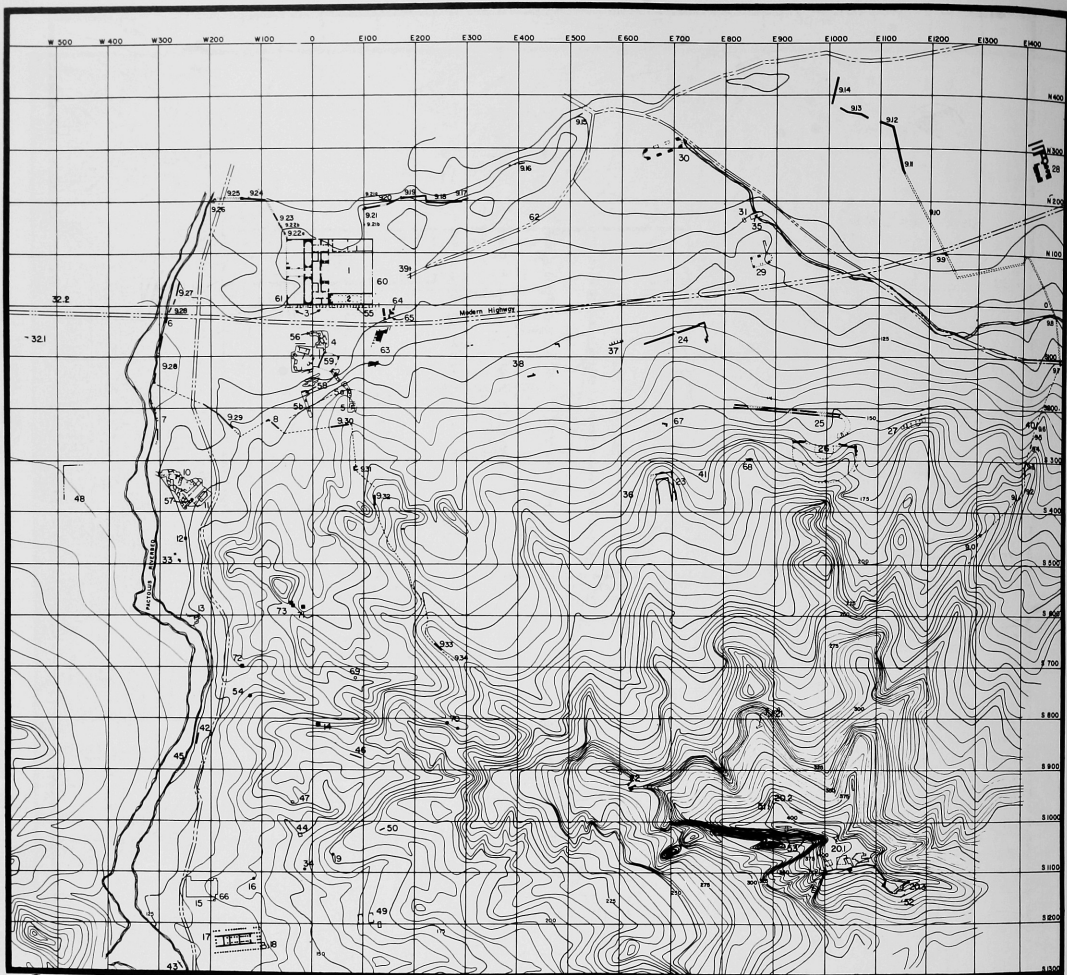
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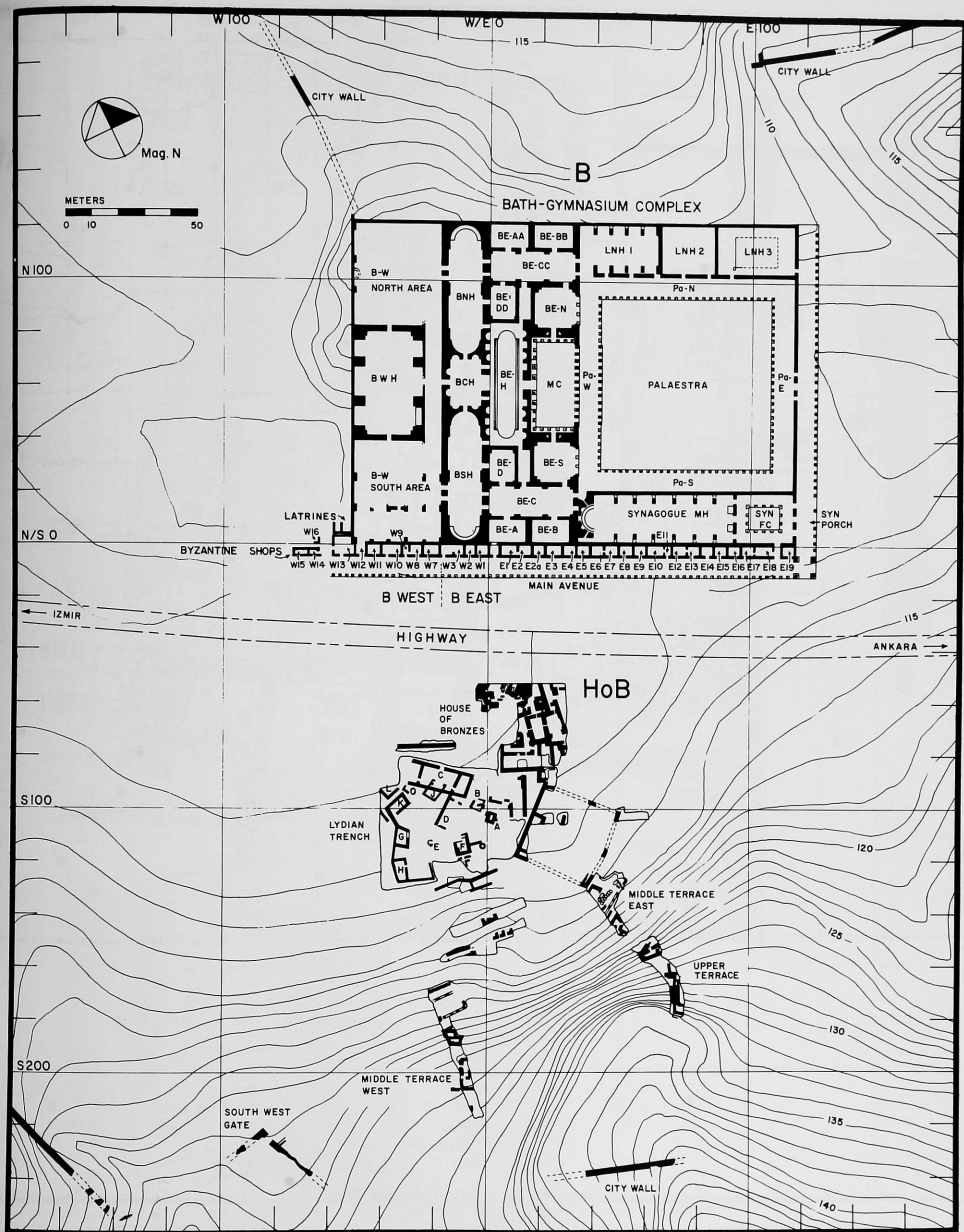
Plan I. Sardis and surrounding region (sites mentioned in text).




 0 50 100 150 200
 meters
 MAG. N

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|------------------------------------|-----------------------------------|------------------------------------|-----------------------------------|
| 1. Bath-Gymnasium | 20.1. Acropolis Top | 36. Road to 'Byzantine Fortress' | 55. Hellenistic Steps |
| 2. Synagogue | 20.2. Acropolis North | 37. Vaulted Substructure | 56. Hellenistic Tombs |
| 3. Byzantine Shops | 20.3. Acropolis South | 38. Roman Agora | 57. Street of Pipes |
| 4. House of Bronzes | 21. Acropolis Tunnels | 39. Rubble Walls East of Gymnasium | 58. HoB Colonnaded Street |
| 5. Upper and Middle Terraces (a,b) | 22. 'Flying Towers' | 40. 'Odeum' Area | 59. Building R and Tetrastylon |
| 6. Roman Bridge | 23. 'Byzantine Fortress' | 41. Foundations | 60. East Road |
| 7. Pactolus Industrial Area | 24. Building A | 42. Hypocaust Building | 61. West Road? |
| 8. Southwest Gate | 25. Stadium | 43. Marble Foundation | 62. Conjectured Ancient Road |
| 9.1-9.34. Byzantine City Wall | 26. Theater | 44. Minor Roman Building | 63. Monumental Mudbrick Structure |
| 10. Pactolus North | 27. Hillside Chambers | 45. Rubble Wall | 64. Lydian Gate? (MMSN) |
| 11. Church E and EA | 28. Bath CG | 46. Pre-Hellenistic Wall | 65. Roman Colonnade |
| 12. Peacock Tomb | 29. Building D (Byzantine Church) | 47. Brick Vaulted Tomb | 66. Lydian Tile Reconstruction |
| 13. Pactolus Cliff | 30. Building C (Roman Basilica) | 48. Walls | 67. Wadi B Ionic Building |
| 14. Pyramid Tomb | 31. Mill | 49. Butler's House | 68. Field 49 Lydian Wall |
| 15. Expedition Headquarters | 32.1. Claudia Antonia Sabina Tomb | 50. Shear's Stoa | 69. "Pot of Gold" Findspot |
| 16. Northeast Wadi | 32.2. Painted Tomb | 51. Lydian Walls (AcN) | 70. Lydian Spring/Cistern |
| 17. Temple of Artemis | 33. Brick Vaulted Tombs | 52. Pre-Hellenistic Walls (AcS) | 71. Chrysanthios Tomb (76.1) |
| 18. Church M | 34. Roman Chamber Tomb | 53. Holes in Acropolis Scarp | 72. Orthostate Tomb (77.1) |
| 19. Kâgırlık Tepe | 35. Road under Mill | 54. Şeytan Dere Cemetery | |

Plan II. Site plan with excavated sectors and identified ruins as of 1981.



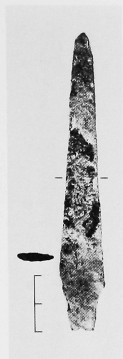
Plan III. Plan of the Bath-Gymnasium Complex (B), the House of Bronzes (HoB) and terrace trenches (UT, MTE, MTW) as excavated in 1974.



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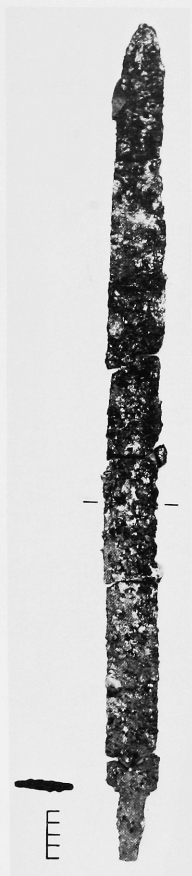
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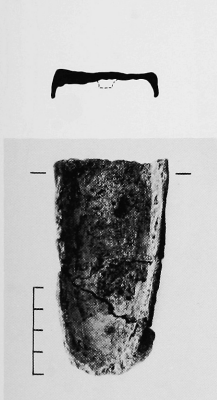


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Dagger Sheaths



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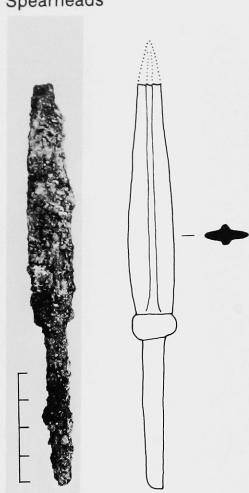
8 Back.

Front.

YPIE
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POV X

Detail of inscription.

Spearheads



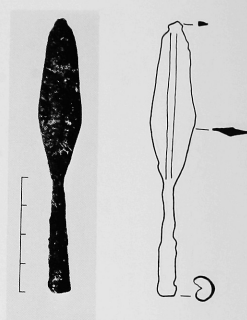
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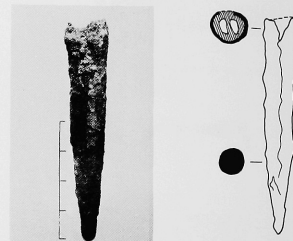


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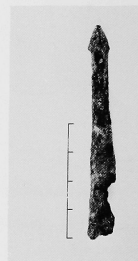
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Spearbutt

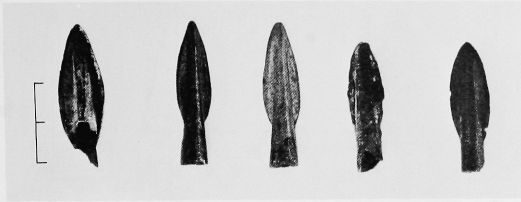


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Javelinhead



17



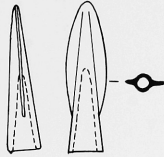
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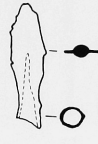
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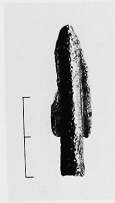
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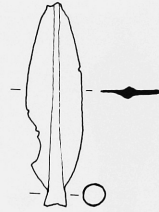
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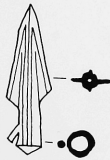
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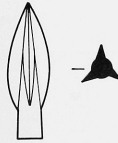
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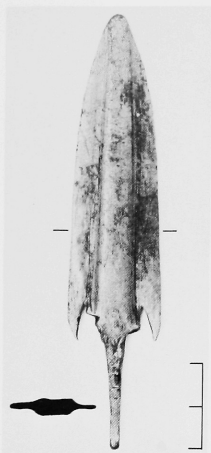


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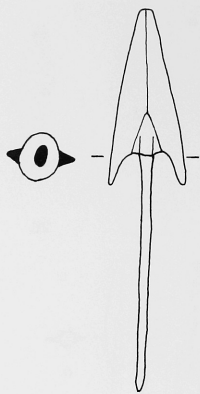




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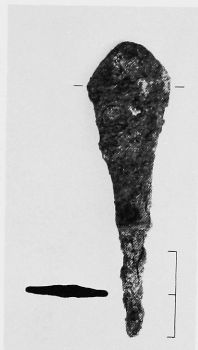
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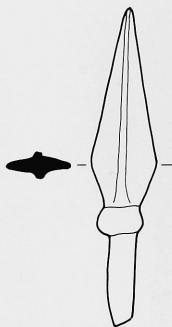
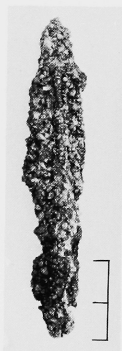
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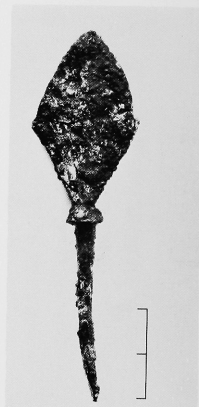
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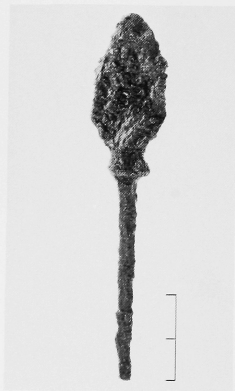
52



53



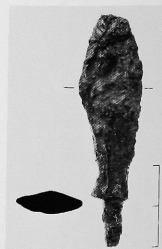
56



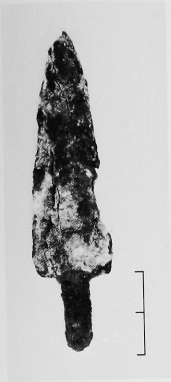
58



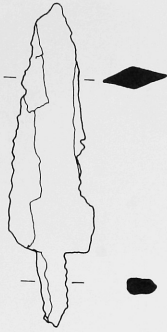
70



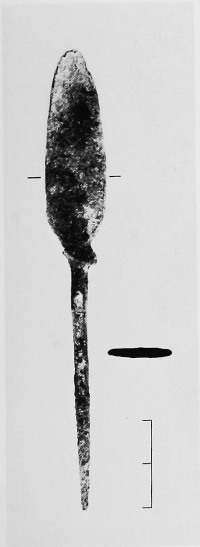
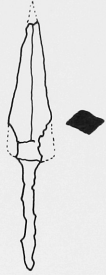
74



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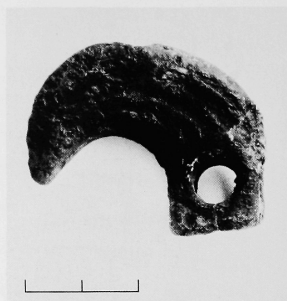


Armor

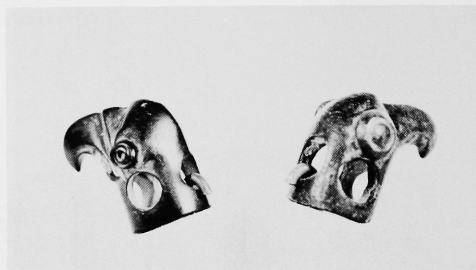
84



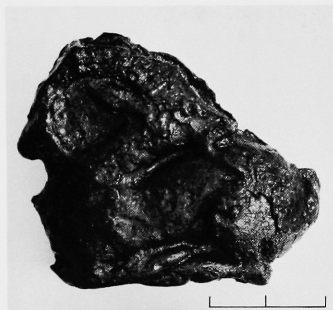
85



86



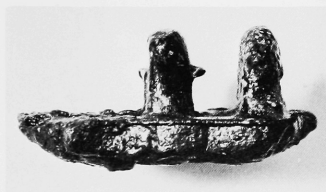
Scythian bridle ornaments, Museum of Fine Arts, Boston 1970.511 and 1970.512.



87 Front.



Back.



87 Side.



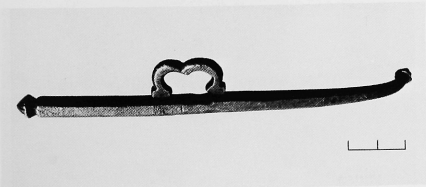
Side.



88



Back.



89



90



91



92



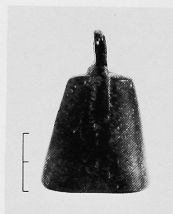
93



96



98



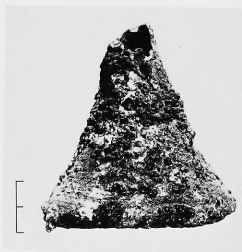
99



100



101



102

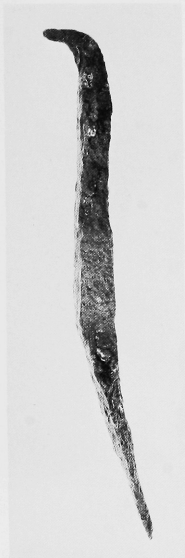


103

Ploughs



104 Top.



Side.



105 Top.



Side.

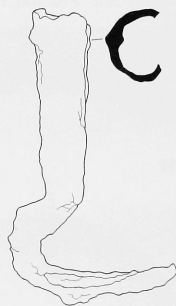
Hoes



106



107



Trowel



109

Spades



111



112

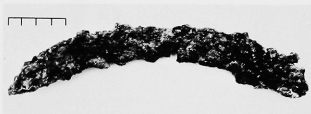


113

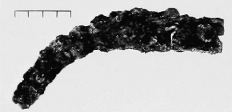


114

Sickles and Pruning Hooks



118



119



120

121



122



123



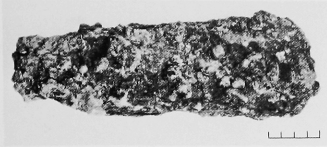
125



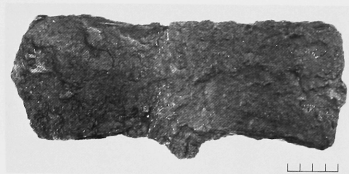
Fork

126





127



129



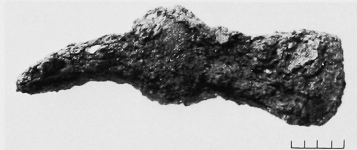
128



130



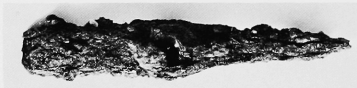
132 Side.



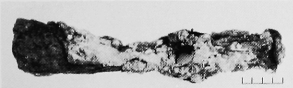
133 Side.



Top.



Top.



136 Top.



137 Top.



139



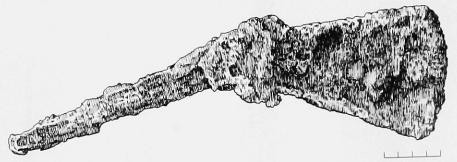
Side.



Side.



140 Side.



141 Side.



Top.



Top.

Miniature Pick



142

Sledgehammers



143



144

Nailheader



145

Smiths' Sets



146



147

Punches



148



149

Chisels



150



151



153



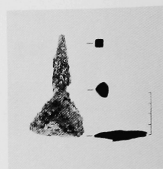
154



155



156

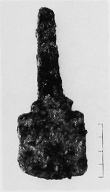


159

Chisels



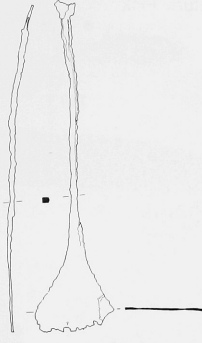
160



161



162



163



Awl



164

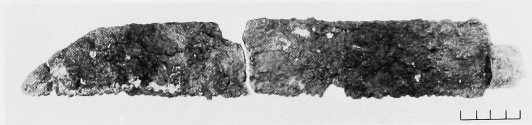
Auger



165



Saw



166

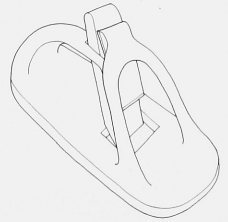
Plane



167 Side.



Bottom.



167 Suggested reconstruction.

Compass



168



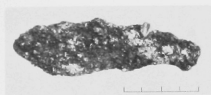
Pounders



169



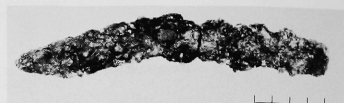
170



172



173



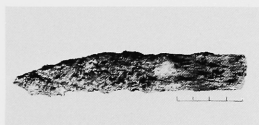
174



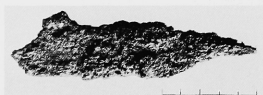
175



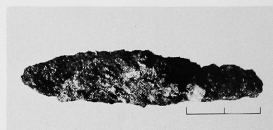
175 with pot hoard and juvenile canid skeleton with which it was excavated.



180



182



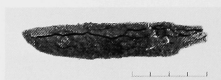
184



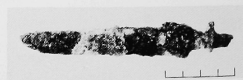
186



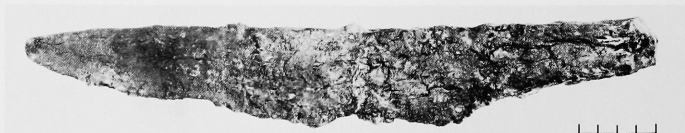
187



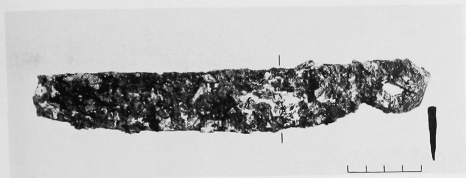
189



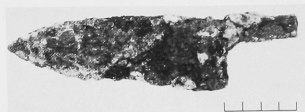
190



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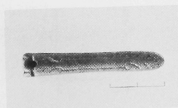


207

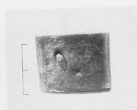


208

Knife Handles



209



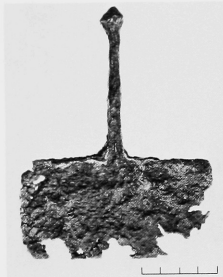
210

Chopper



211

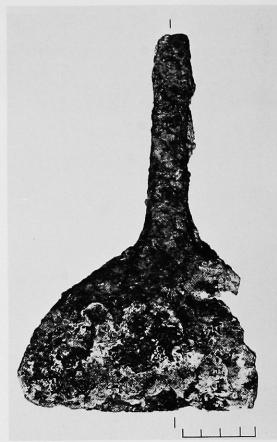
Pan Scrapers



212



213



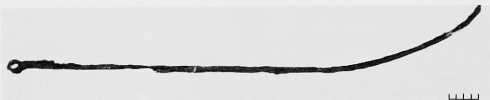
214



Spits



215

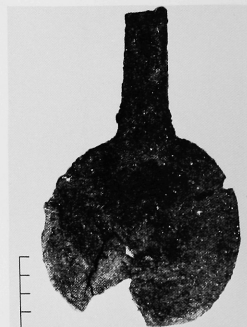


216

Ladles



220



221

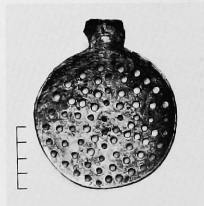
Strainers



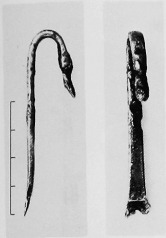
217



218



219



222

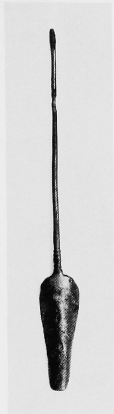


223

224



225 Front.



Back.



227 Front.



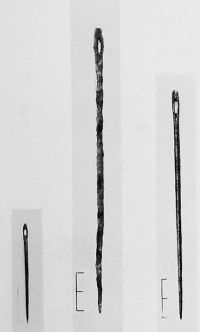
Back.



228



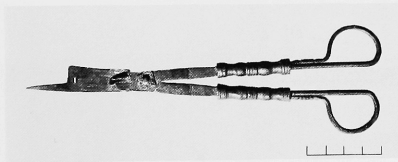
229



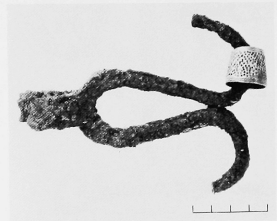
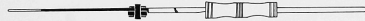
230

231

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242

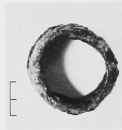


250

Door Fittings



251 Spike.



Iron ring.



255



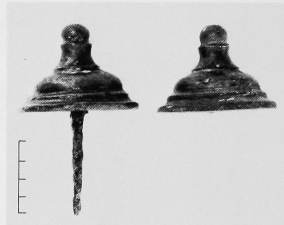
Section from top.



256



257



258 Side.



258 Top.

259 Top.

Window Grille



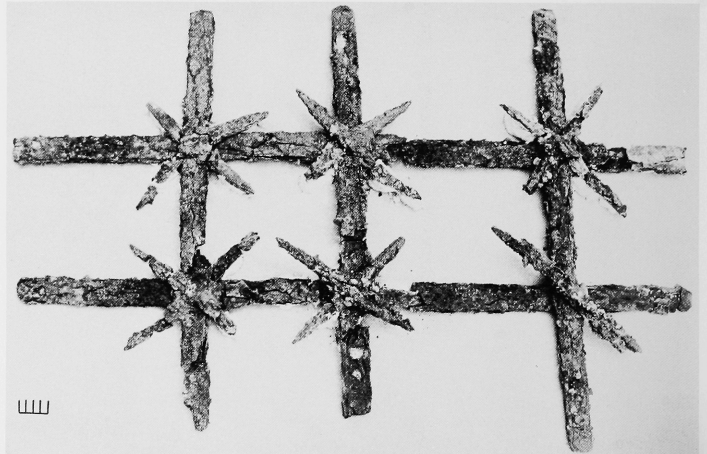
260



261



262



263

Plumbing Fixtures

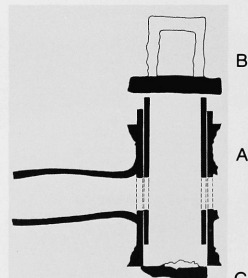


264

A

B

C

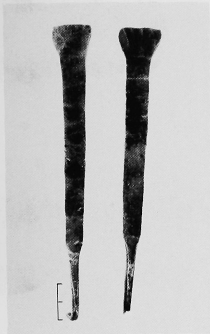


264 Suggested reconstruction.



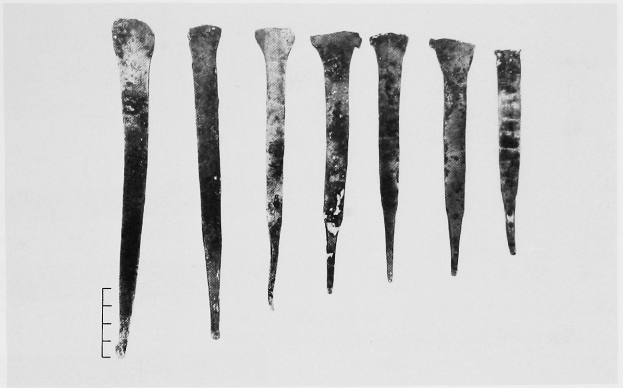
265

Revetment Pins



266

267



268

269

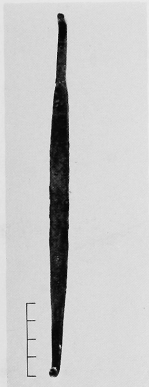
270

271

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273

274



275 Top.



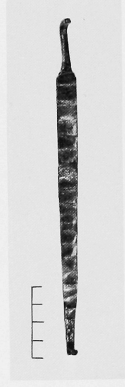
Side.



276 Top.



Side.



277



278 Top.



Side.

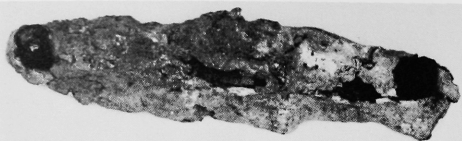


279 Top.



Side.

280



281



282



283



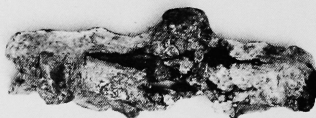
284



285



286



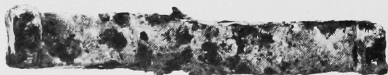
287



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289



290

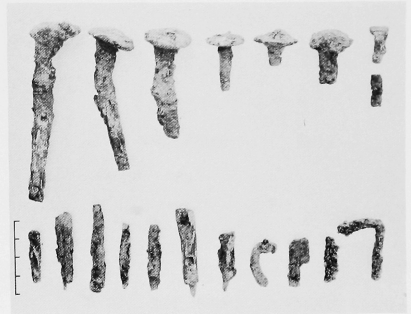
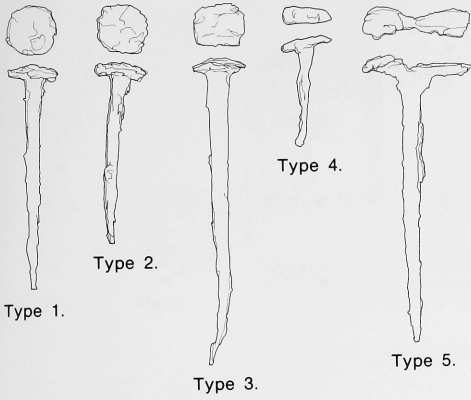


291



292

Nail Types



295-300 and miscellaneous nail fragments.



301

302

303

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311

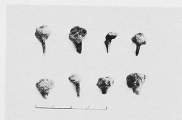
312



313-317



318-325



326-337 Selection of tacks.



338 339



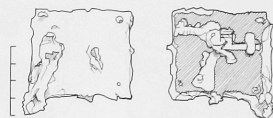
341 340



346 Front. Back.



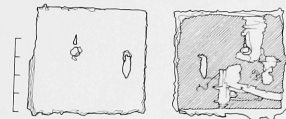
347 Front. Side.



348 Front. Back.



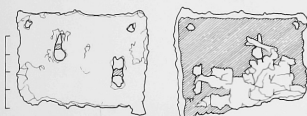
349 Front. Back.



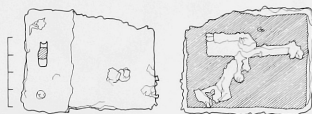
350 Front. Back.



351 Front. Back.



352 Front. Back.



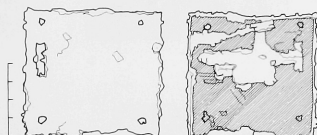
353 Front. Back.



354 Front. Back.



355 Back.



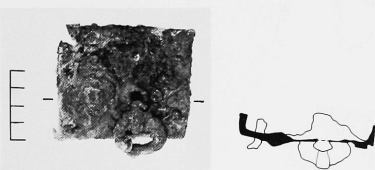
356 Front. Back.



357 Front. Back.



358



360



363

365 Ext. cap.

365 Side

365 Int. cap.



366 Ext. cap.



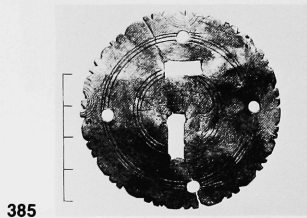
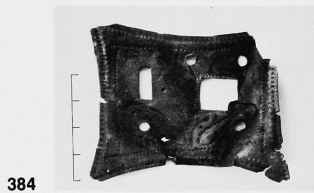
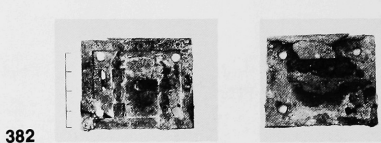
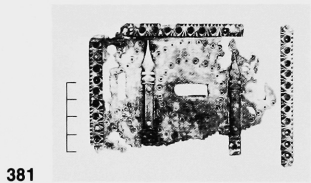
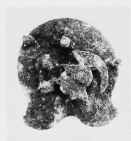
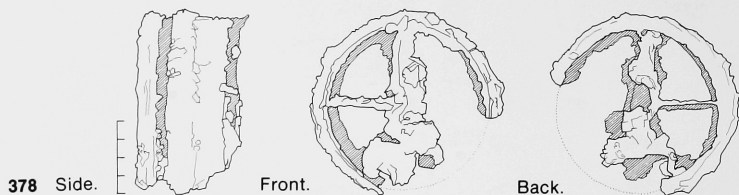
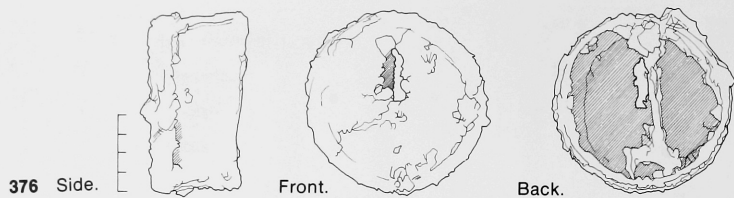
366 Side.



365 Int. body.



367





391



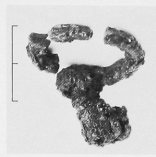
392



393



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399



400



401



403



406

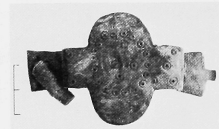


407



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411

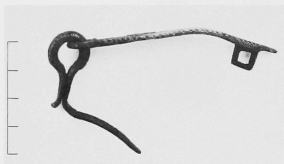


409

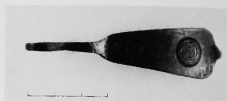
410

Clasps and Hasps

412



414



415

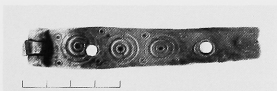


416



Hinges and Binding Straps

417



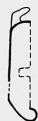
418



419



Seal Box(?)

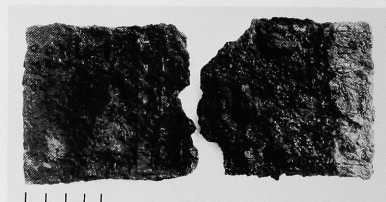


420

Ornamental Attachment



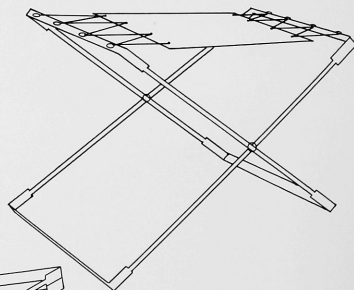
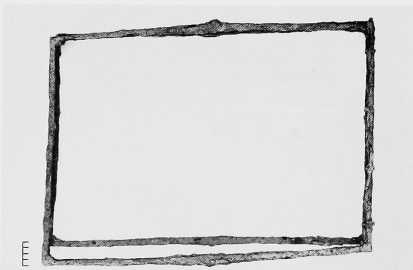
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422

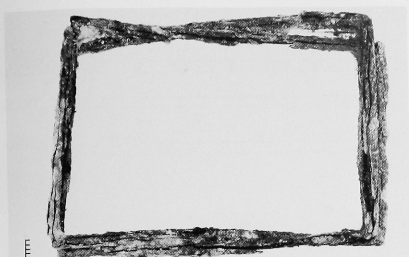
Campstools

423

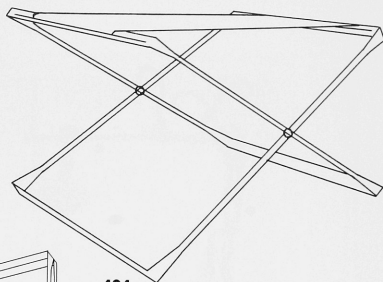


423

Suggested reconstruction (not to scale).

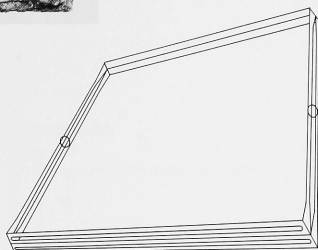


424



424

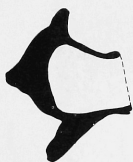
Suggested reconstruction (not to scale).



Protome



429



Finials



431



432



433

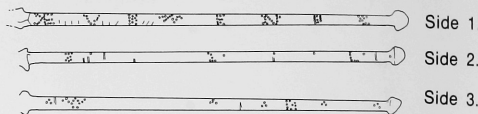
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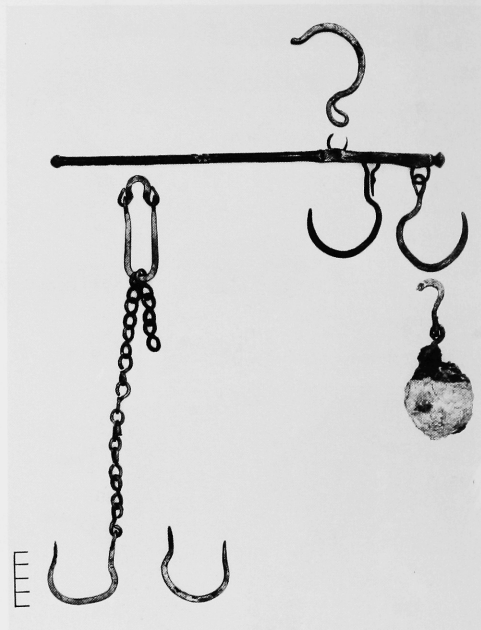
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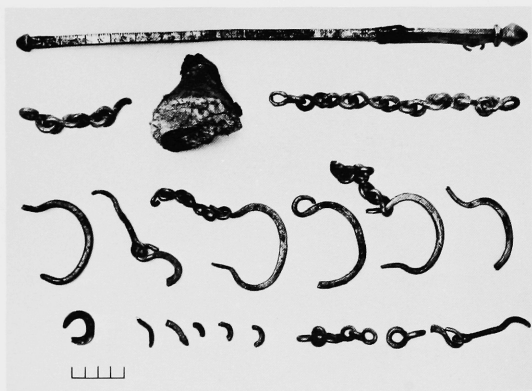
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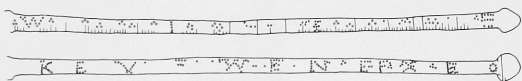
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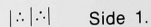
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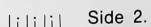
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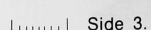
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Side 1.



Side 2.

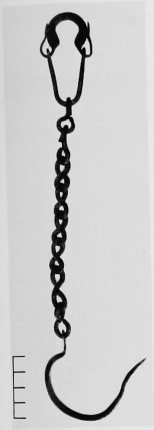


Side 3.

442

Side 1.

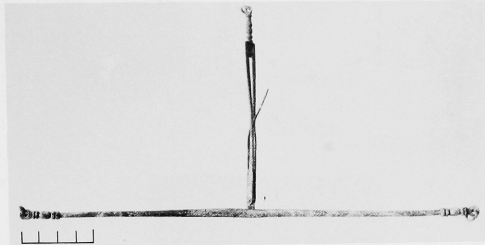
Side 2.



444



446



448



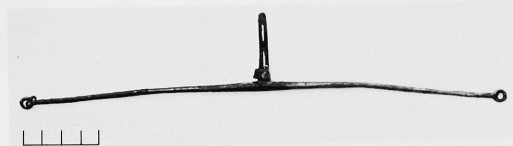
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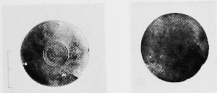
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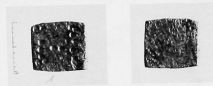
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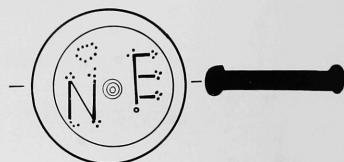
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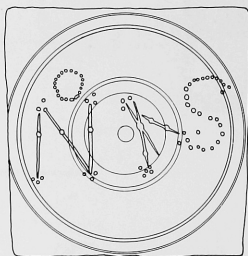
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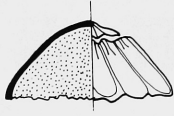
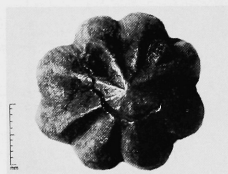
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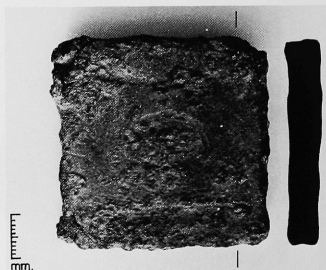
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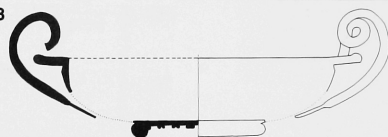
486



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488



488 Suggested reconstruction.



489



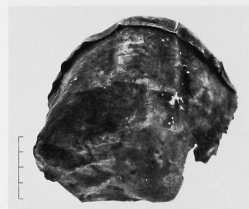
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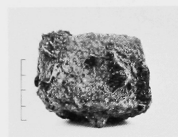
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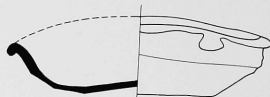
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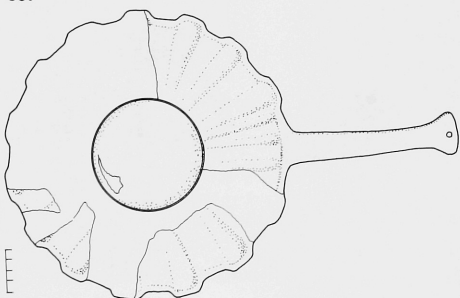
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503



507



511 Top int.



508



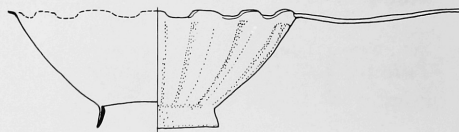
509 Int.



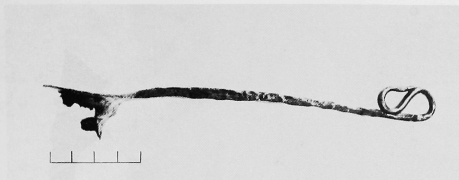
Ext.



509



Pan Handles



512

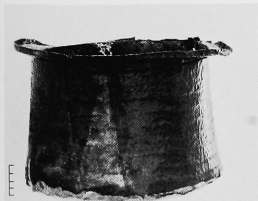
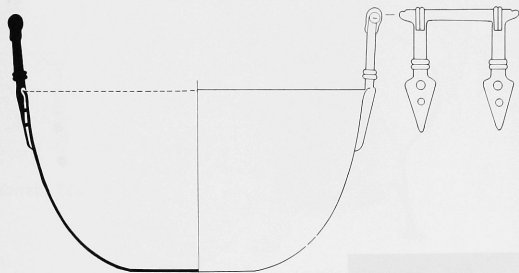


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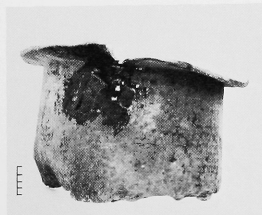
Cauldrons



514



515



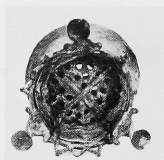
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517



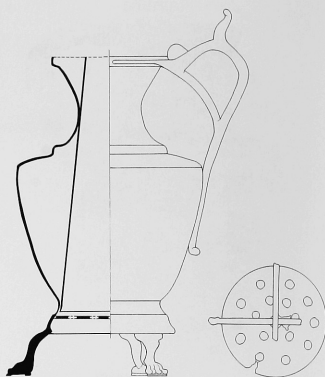
520



Base.



521



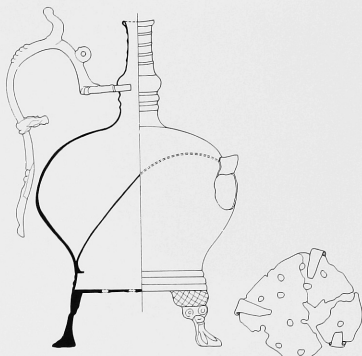
Base.



521 Detail of handle.



522



522 Reconstruction.

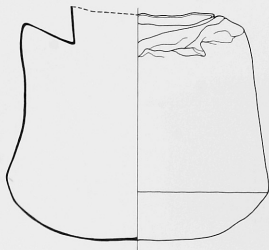
Base.



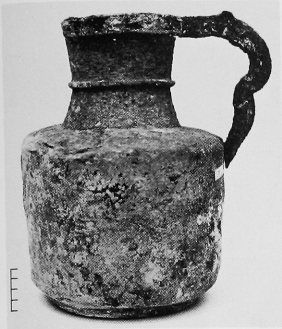
522 Handle.



523



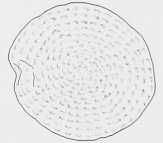
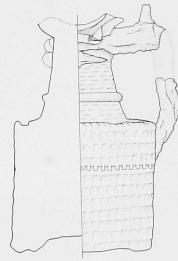
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525



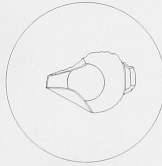
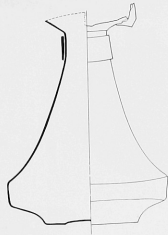
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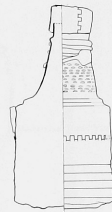
Base.



527



528



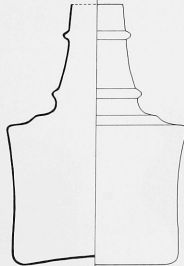
Top of cap.



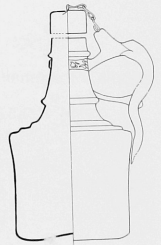
Base.



529



530



530 Reconstruction.



534



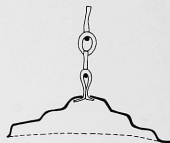
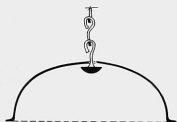
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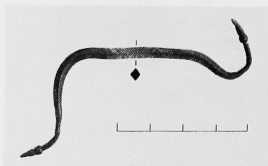
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Handle Attachments



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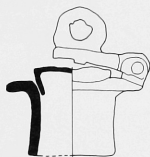
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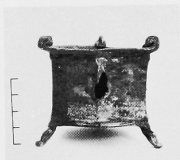
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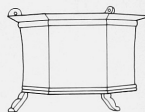
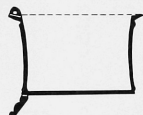
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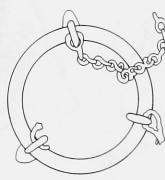
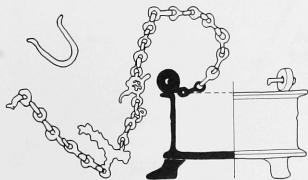
577



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581



581 Top.



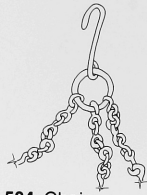
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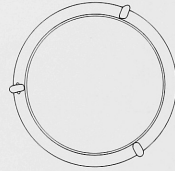
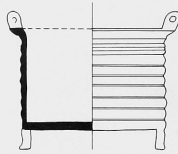
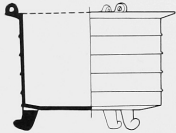
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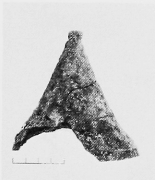
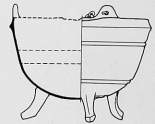
584 Chain.



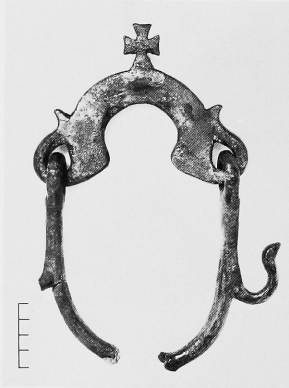
585



584 Top.



586



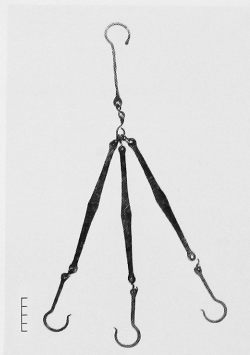
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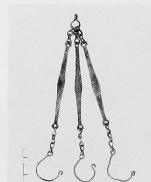
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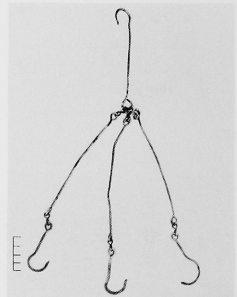
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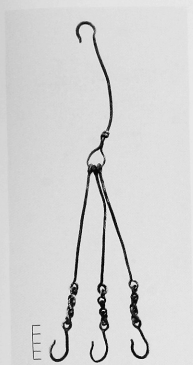
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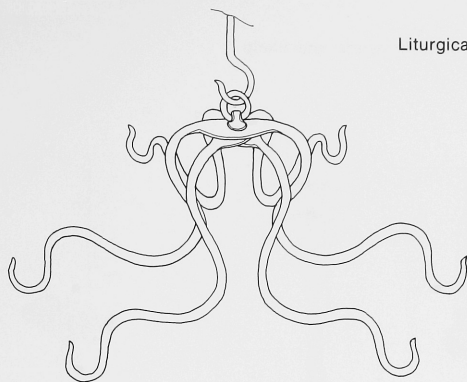
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604 Suggested reconstruction.



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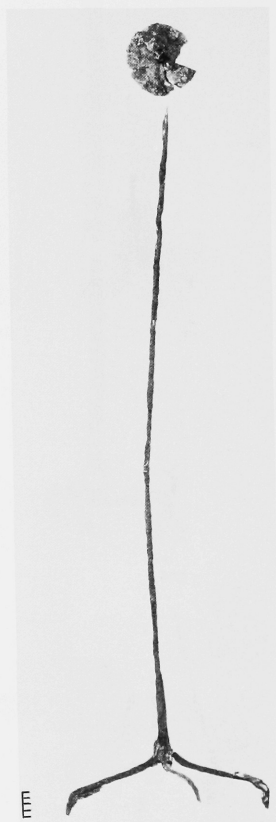
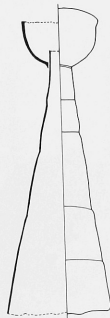
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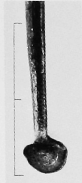
618



Top.



619



619 Detail.



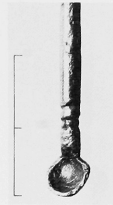
620



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626



626 Detail.



628



629



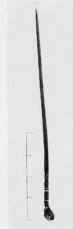
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634 Detail.



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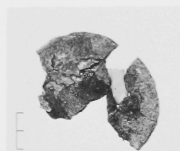
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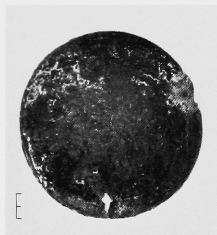
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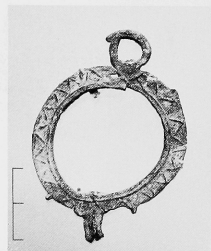
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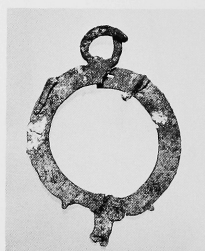
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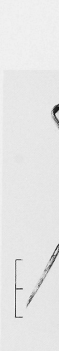
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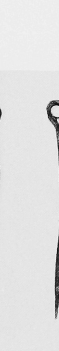
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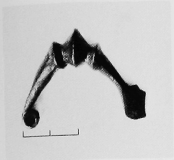
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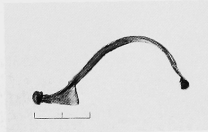
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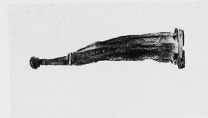
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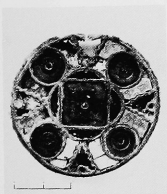
681 Detail.



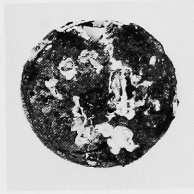
682



683



684 Front.



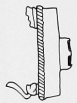
Back.



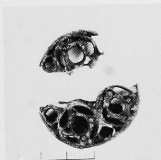
685 Front.



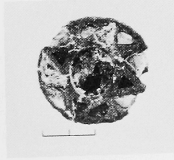
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Side.



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689 Front.



Back.



690 Front.



Back.



691 Front.



Back.



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693 Front.



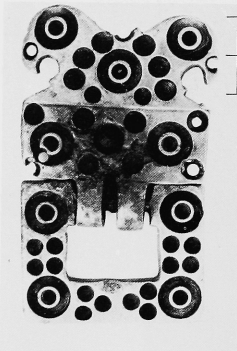
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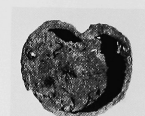
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698 Front.



Back.



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700 Front.



Back.



701 Front.



Back.



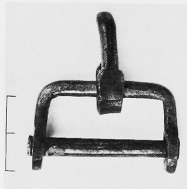
702 Front.



Back.



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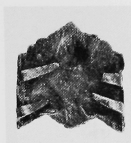
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713 Front.



Back.



714 Front.



Back.



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Contents of Grave 69.3 including 1, 717, 718, 881.



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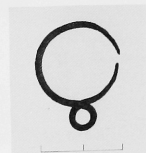
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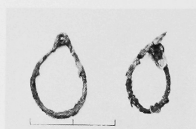


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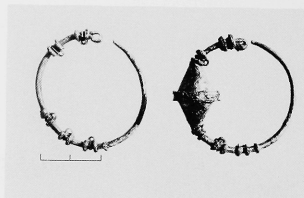


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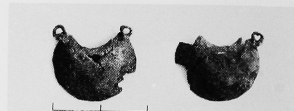
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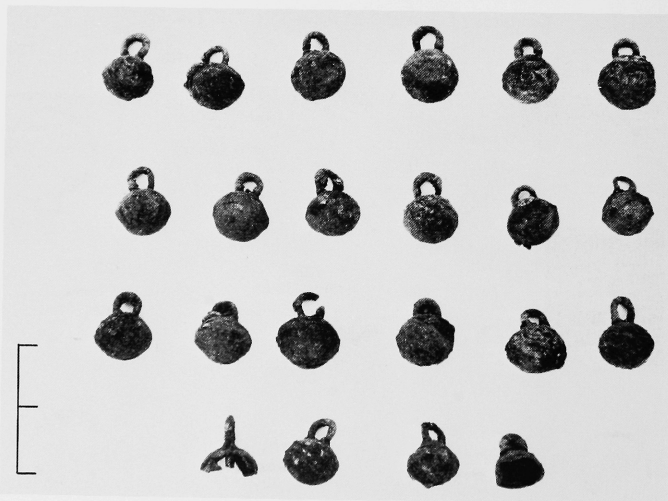
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762-783



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Detail of ends.



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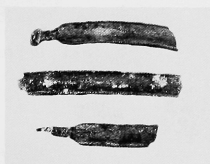
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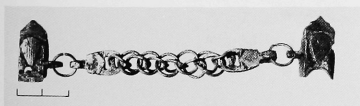
808 Assembled fragments.



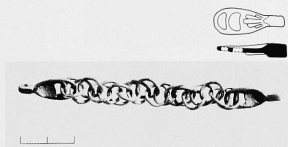
808 Fragments.



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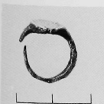
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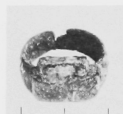


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833 Impression.



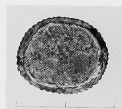
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834 Impression.



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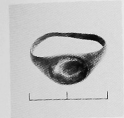
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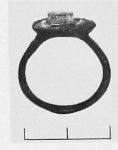
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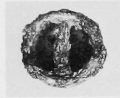
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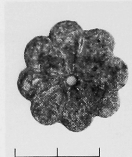
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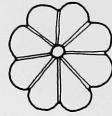
Buttons



871



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Bosses



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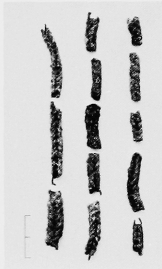


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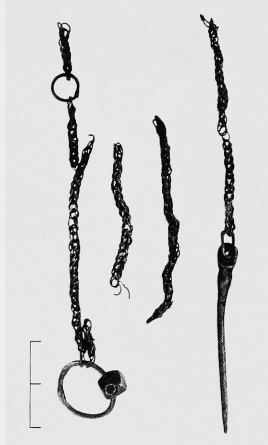


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Jewelry Chains



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Pendants



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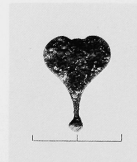
884



885



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887



888



889 Front.



Back.



890



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893



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895 Front.



Back.



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897



898 Side A.



Side B.



899



900



Reliquary and Other Crosses



901 Front.



Back.



903



904

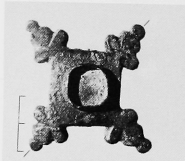
Ornamental Attachments



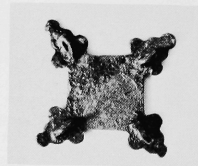
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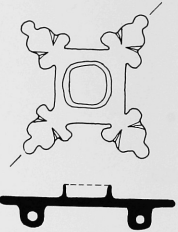
906



907 Front.



Back.



908



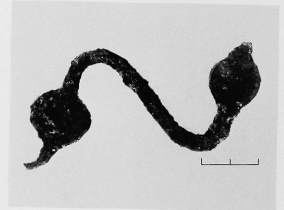
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Figurative Objects



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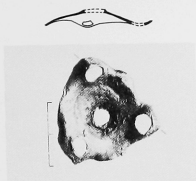
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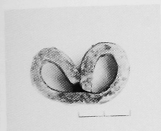
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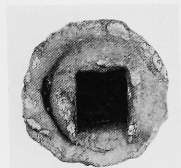
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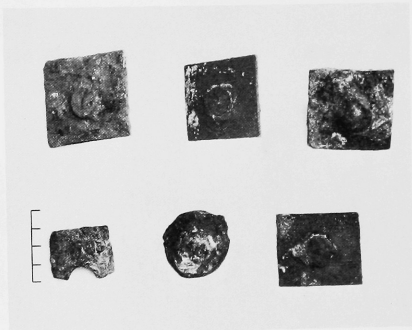
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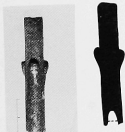
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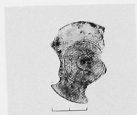
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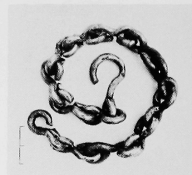
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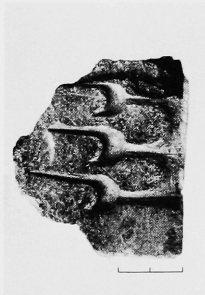


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Molds



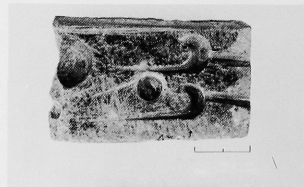
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950 Side 1



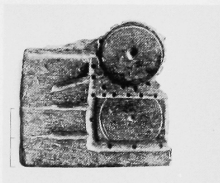
Side 2.



951 Side 1.



Side 2.



952 Side 1.



Side 2.

Molds



953 Side 1.



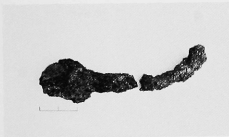
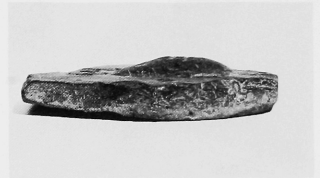
Edge view of pouring channel.



Cuttings in edge.



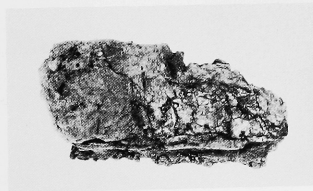
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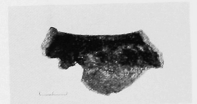
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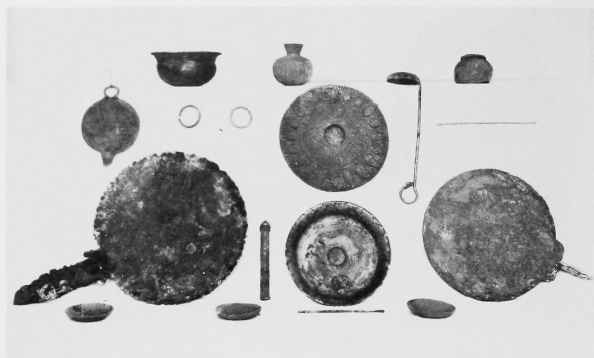
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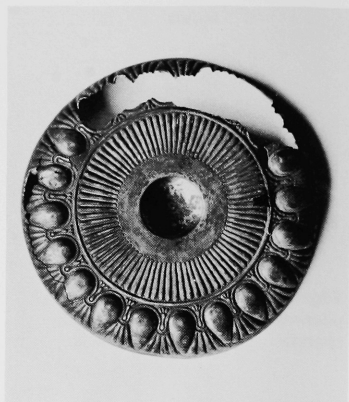
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962



963-971 with other pieces excavated by the Princeton Expedition.



963



965 Detail of handle.



964



965



966 Ext.



Int.



Side.



967



969 Ext.

968



969 Int.



970



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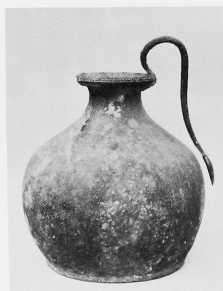
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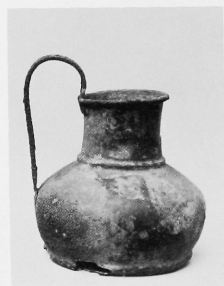
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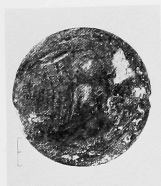
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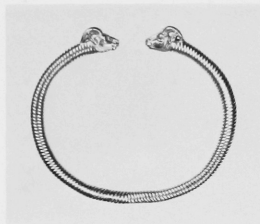


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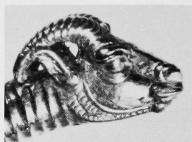


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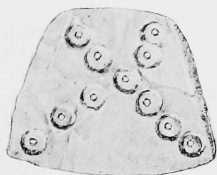
995 Details.



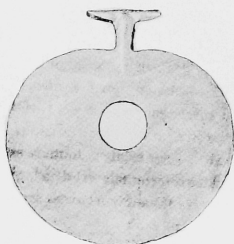
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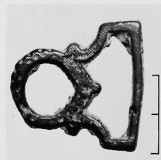
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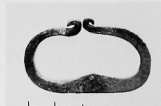
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Fig. 1. **127** Sketch of sampled area. Approximately 1:4.

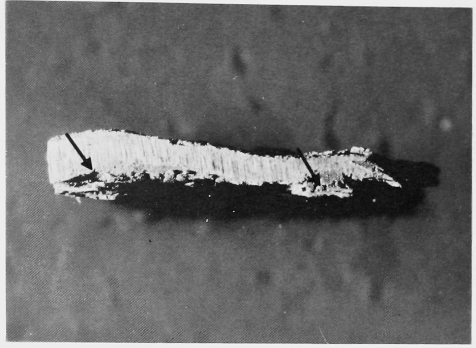


Fig. 2. **127** $\times 1\frac{1}{2}$. View showing seam between carburized (lower) and uncarburized (upper) layers.

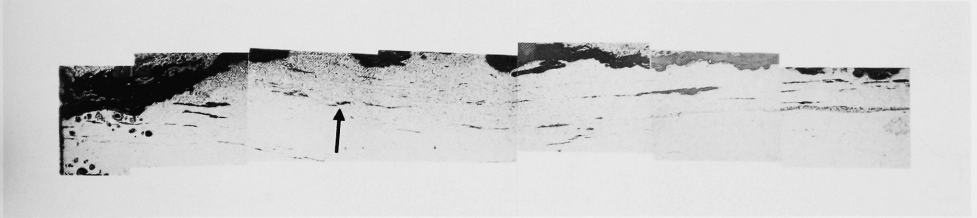


Fig. 3. **127** $\times 10$. Montage of tip (end to left). Arrow indicates weld seam.

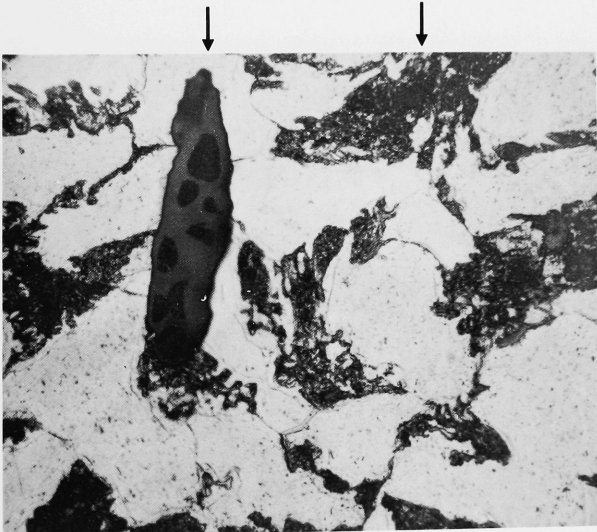


Fig. 4. **127** $\times 1250$, oil immersion. Phase separated slag among pearlite colonies. Left arrow indicates slag, right arrow dispersed pearlite.

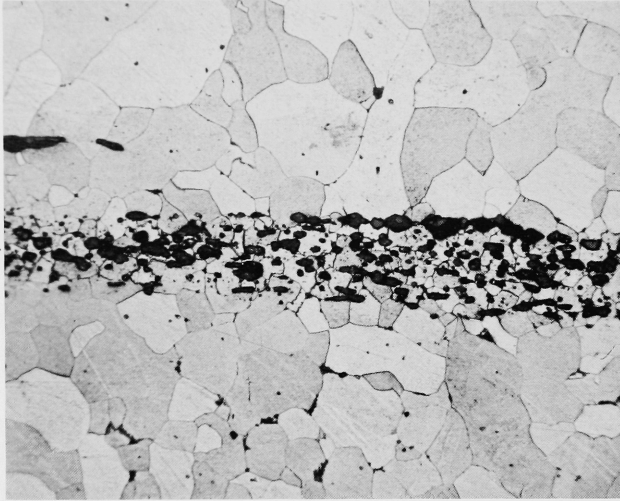


Fig. 5. 127 \times 200. Iron oxide and slag at interface indicated by arrow.

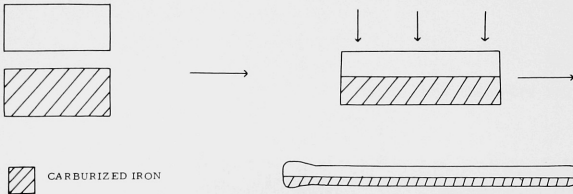


Fig. 6. 127 Simplified reconstruction of fabrication techniques. Not to scale.



Fig. 7. 118 \times 50, Nital etch. Widmanstätten microstructure of ferrite and pearlite with faint horizontal banding possibly indicating phosphorus segregation. This corrosion indented edge view shows the highest carbon area found in this specimen. Arrows point to horizontal banding.



Fig. 8. 201×100 , Nital etch. Microstructure of transverse section near tip showing very fine grained ferrite and pearlite near surface and coarser ferrite grains with substructure in interior.



Fig. 9. 201×200 . Detail of fine grained ferrite and pearlite grains (black patches) and surface oxide.



Fig. 10. 201×500 . Slag inclusions with precipitated dendritic phase—possibly wustite. Arrows indicate slag.

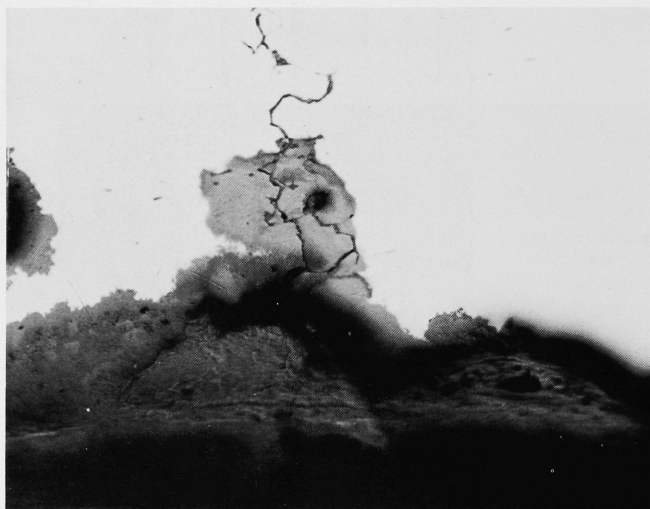


Fig. 11. 205×200 , unetched. Polished section showing oxidized crack near surface. This is evidently an oxidized quenching crack, the outlines of which were later preserved by invading rust.

Fig. 12. 205×100 , 2% Nital etch. Microstructure of cross section between fully hardened and partially hardened zones. Structure is fine grained martensite with some ferrite and pearlite. Arrows indicate ferrite. Oxide patches are visible at opposite surfaces.

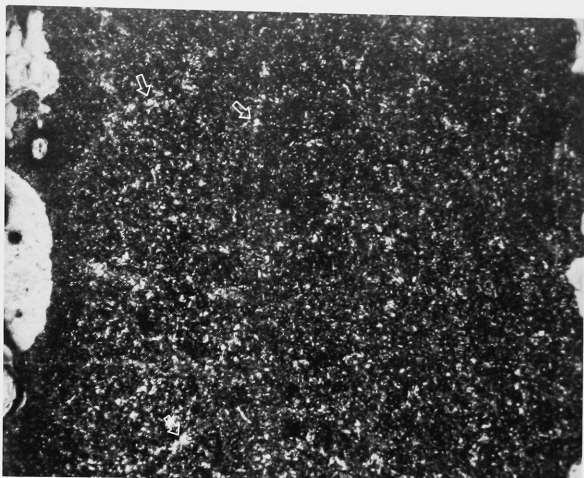
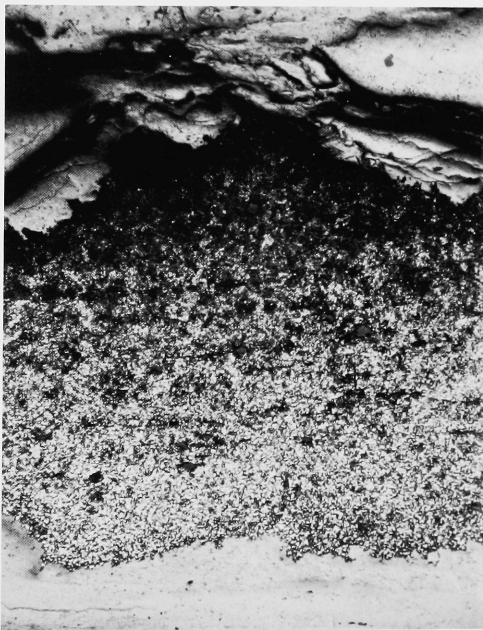


Fig. 13. 208×100 , Nital etch. Microstructure of this section, near tip, is heavily oxidized fine grained steel having a carbon gradient in the surviving metal. Dark area near top of picture is roughly of eutectoid composition and consists of partially spheroidized pearlite. Increasing quantity of fine light ferrite grains toward lower edge reflects decreasing carbon content.



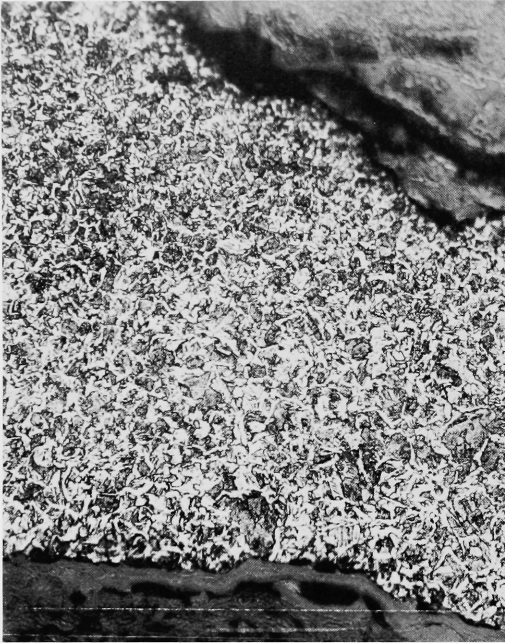


Fig. 14. Uncatalogued object (M63.36:5513) $\times 200$, Nital etch. High carbon area. Prior austenite grains often outlined by proeutectoid ferrite.



Fig. 15. Uncatalogued object (M63.36:5513) $\times 1000$. High carbon area. Microstructure probably consists of overtempered decomposition products—ferrite, pearlite, bainite and possibly some martensite—that were produced by quenching. Evidence for tempering is provided by the finely spheroidized carbides and the low hardness of the specimen.

Fig. 16. 161×100 , Nital etch. Corner area of shaft where amount of pearlite in microstructure reaches a maximum. Arrows indicate aureole of fine ferrite grains surrounding inclusion within high carbon region.

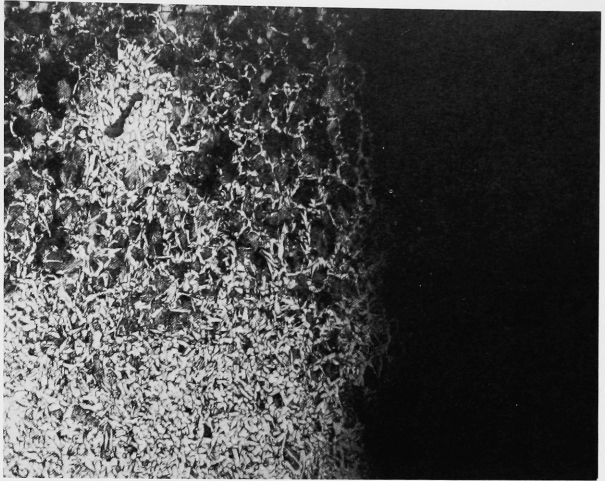
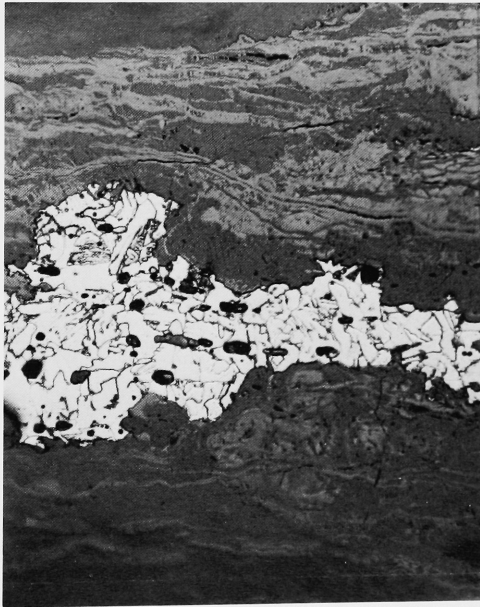


Fig. 17. 111×200 , Nital etch. Microstructure of surviving metal in oxide several centimeters from working edge. Ferrite with some carbides and very small pearlite patches.



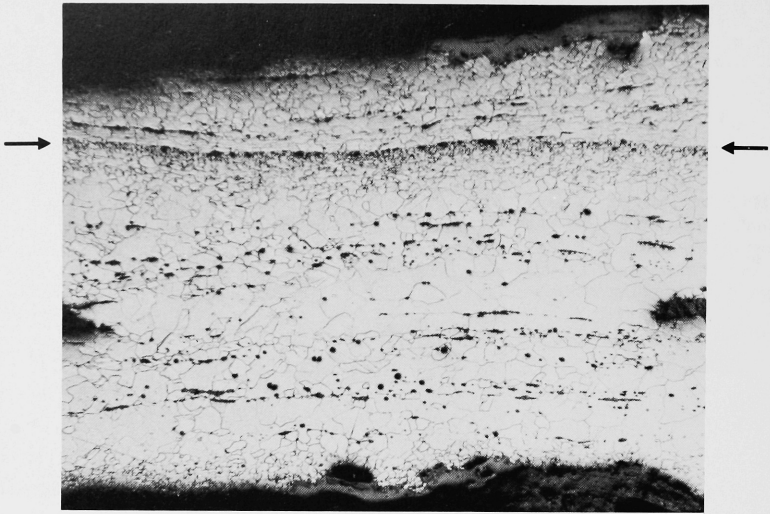


Fig. 18. 14×50 , 2% Nital etch. Transverse section through tip showing a weld line—probably a healed crack—crossing upper half of picture.

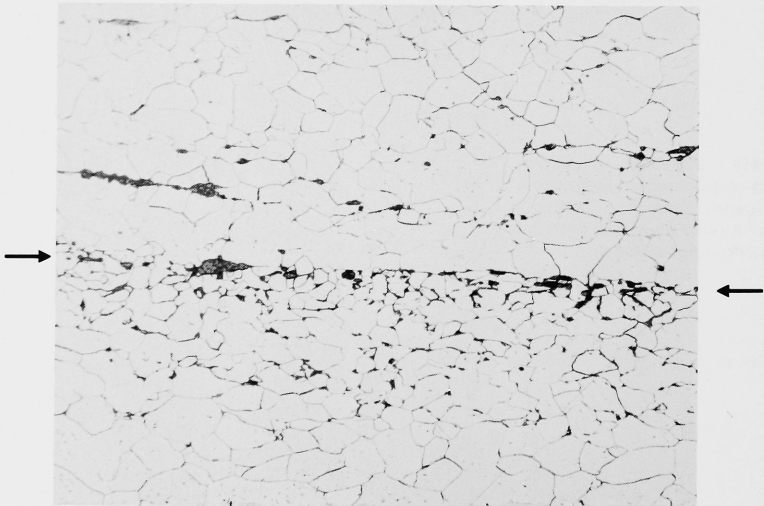


Fig. 19. 14×200 . Detail along weld line indicated by arrows. Fine ferrite grains and oxide inclusions delineate weld zone. Very small colonies of pearlite (black spots in ferrite grain boundaries) near weld indicate some carbon pick-up before welding.

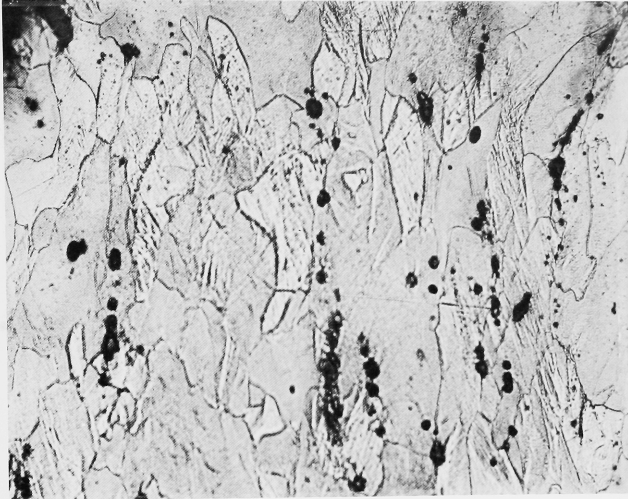


Fig. 20 65×200 , 2% Nital etch. Moderately cold worked ferrite with numerous slag inclusions.

