

Cape Gelidonya: A Bronze Age Shipwreck
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CAPE GELIDONYA: A BRONZE AGE SHIPWRECK

GEORGE F. BASS

University Museum, University of Pennsylvania

With the Collaboration of

PETER THROCKMORTON, JOAN DU PLAT TAYLOR, J. B. HENNESSY, ALAN R. SHULMAN, and HANS-GÜNTER BUCHHOLZ

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PREFACE

This book forms the final report of the underwater excavation which I directed at Cape Gelidonya, Turkey, in 1960, for the University Museum of the University of Pennsylvania. I am indebted to many people for making the excavation and the publication possible, and a brief mention of them here is but small measure of my gratitude.

To Dr. Froelich Rainey, Director of the University Museum, and to the Board of Managers of the Museum, I owe thanks not only for their making the excavation possible, but for enabling me to remain at the Museum while preparing this report, and for a travel grant which allowed me to visit the museums of Syria, Lebanon, Greece, and Cyprus in order that I might study related material at first hand.

The excavation, itself, was further made possible by a number of foundations and individuals who had the vision to see the value of the work at a time when "underwater archaeology" was too often considered only adventure: the American Philosophical Society, Mr. Nixon Griffis, Mr. John Huston of the Council of Underwater Archaeology, and the Lucius N. Littauer Foundation. The preservation and recording of finds was undertaken by the Institute of Archaeology of London University, with funds from the British Academy and the Craven Fund. Our diving equipment was acquired through the generosity of the U. S. Divers Company in America, and La Spirotechnique in France. The British School of Archaeology in Athens also lent us all of its diving equipment, but, unfortunately, this did not reach us during the season because of customs difficulties. Our high-pressure air compressor was made available to us at a greatly reduced price by Bauer Kompressoren of Munich. Photography was made possible by loans of the latest underwater camera by the Nikon Corporation of New York, and of a Polaroid Land Camera with film by the Polaroid Corporation of Cambridge, Massachusetts. An underwater case for the Polaroid camera was designed and constructed by the French Navy's Undersea Research Group. Special polyethylene bags, for preserving perishable finds, were supplied by Anglo-American Plastics, Ltd., of London, and Araldite for treating wood was a gift of CIBA (A.R.L.) of Cambridge, England. For preserving cloth, we were given a supply of Gelvatol 1-30 by the Shawinigan Resins Corporation of Springfield, Massachusetts, but our cloth proved to be a mirage. For various illnesses and poisonous fish stings we had drugs from the Wellcome Foundation, Ltd., of London, and anti-histamine creams from Scientific Pharmacals, Ltd., of Cambridge. Our large, fine dinghy was lent by Baskin Sokullu of the Türk Balik Adamlar Külübü. The underwater metal detector was brought during the last few days of the season by Luis Marden of the *National Geographic* staff.

The formation of such a novel excavation, involving divers and equipment from five countries, took an unusual amount of paperwork. That Mr. Throckmorton's work was continued on a large scale was due especially to the foresight and planning of Mr. John Huston of the Council of Underwater Archaeology in America, and Miss Joan du Plat Taylor in England. In Turkey, we were grateful for the technical advice and assistance given by Mr. Daniel Siglin and the late Mr. Kenneth Sprague. My excellent course in diving was under the instruction of Mr. David Stith, who has since become president of the Underwater Society of America.

The excavation would never have been a success without the ingenuity and hard work, under most adverse conditions, of all the members of the staff: Peter Throckmorton, technical adviser and photographer; Joan du Plat Taylor, in charge of preservation and records; Frédéric Dumas, chief diver; Claude Duthuit and Waldemar Illing, divers; Herb Greer, underwater photographer; Honor Frost, Eric J. Ryan, and Yüksel Eğdemir, underwater draftsmen; Terry Ball, object draftsman; Peter Dorrell, object photographer; and Ann Bass, in charge of cleaning and cataloguing the finds during the last third of the season. Hakki Gültekin and Lütfi Tuğrul represented the Turkish Antiquities Department, and were a constant source of aid and advice. All of the above, with the exceptions of Miss Taylor, Ball, Dorrell, and Tuğrul, worked on the wreck under water. Visitors who also dived and worked on the wreck were Mustafa Kapkin, Rasim Divanli, Roland J. Lacroix, Nixon Griffis, Gernolf Martens, and Luis Marden. At the conclusion of the season, Gottfried Gruben came to Bodrum in order to draw the only preserved section of the hull, as it was being disassembled. John Dereki, captain of *Haji Baba* of Beirut, visited us for a day and took a series of depth readings with his electronic sounding devices.

Following the excavation, I have conversed and corresponded with so many experts in various fields that I cannot hope to give adequate thanks to all. Among those who have provided me with helpful suggestions and information concerning previously unpublished material were Dr. William F. Albright, Dr. Hans-Günter Buchholz, Dr. Hector Catling, Dr. V. d'A. Desborough, Dr. Porphyrios Dikaios, Dr. Marie Farnsworth, Dr. Cyrus Gordon, Dr. Sara A. Immerwahr, Dr. Machteld Mellink, Dr. Hugo Mühlestein, Dr. George Mylonas, Mr. David Owen, Mr. Eric Parkinson, Dr. N. Platon, Professor Claude F. A. Schaeffer, Dr. Alan B. Schulman, and Dr. Arthur Steinberg. At the University of Pennsylvania, I have been able to receive welcomed advice from my professors: Lloyd Daly, G. Roger Edwards, Michael Jameson, Miss Ellen Kohler, and Rodney S. Young. I also received much information about the casting of copper ingots from the Ajax Metal

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Division of H. Kramer and Company, who also kindly analyzed several metal samples for me.

A major part of the report consists of illustrative material drawn by Ball, Miss Frost, Ryan, and Eğdemir during the course of the excavation, and by Laurence Joline and Miss Susan Womer since that time. For permission to reproduce illustrations, I wish also to thank the Griffith Institute, Oxford (figs. 52, 80), the Metropolitan Museum of Art (figs. 69, 70, 73, 74, 75, 76, 77, 81, 83, 88), and the Oriental Institute of the University of Chicago (figs. 89, 90).

The task of putting this material in order fell to Miss Susan Womer, who prepared all of the plates, maps, and diagrams in the work. Her patience and excellent judgment allowed me to leave the entire matter of illustrations in her hands, and for this I am most grateful.

I especially want to thank those who have contributed chapters or parts of chapters to this report: Peter Throckmorton, now a Research Associate of the University Museum; Joan du Plat Taylor of the Institute of Archaeology, London University; J. B. Hennessy, Assistant Director of the British School of Archaeology in Jerusalem; Alan R. Schulman, then of the University Museum, and now at Queens College, New York; Hans-Günter Buchholz, Deutsches Archäologisches Institut, Berlin; Elizabeth K. Ralph, Associate Director of the University Museum's Applied Science Center for Archaeology, and Director of that center's Carbon-14 Laboratory; A. C. Western, Conservator, Ashmolean Museum, Oxford; Mark C. Han, Research Chemist at the University Museum; Robert H. Brill, Administrator, Scientific Research, The Corning Museum of Glass, Corning, New York; Edward V. Sayre of the Brookhaven National Laboratory in Upton, Long Island, New York; Franz R. Dykstra, Vice President of E. J. Lavino and Company, Philadelphia; A. Millet of the Research Laboratory for Archaeology and the History of Art, Oxford; David O'Connor of the Egyptian Section of the University Museum; H. W. Hodges, Lecturer in the Conservation of Archaeological Materials at the Institute of Archaeology, London University; Frédéric Dumas, colleague of Jacques-Yves Cousteau and formerly a civilian research member of the French Undersea Research Group; A. W. D. Larkum, Department of Agriculture, Oxford; A. Eric Parkinson, Chemist of the University Museum; and Elisabeth Crowfoot, the well-known authority on ancient basketry and matting.

My own parts of the report, only slightly revised here, served as my doctoral dissertation at the University of Pennsylvania. I must also bear the responsibility for the translation of Dr. Buchholz's chapter on the cylinder seal from German into English, although parts of it were translated by Waldemar Illing of the Gelidonya staff and Eberhard Wolckenhaar of the graduate school of the University of Pennsylvania; Dr. Buchholz has approved of the final version as published here.

Finally, there are three people for whom I must give a special word of appreciation:

Mr. Peter Throckmorton, whose title of technical director belittles the guiding role he played in all aspects of the expedition, from the discovery of the wreck to the conception, organization, and execution of the excavation.

My professor, Rodney S. Young, who had the confidence in me to suggest that I direct the excavation while I was still a graduate student, and whose wisdom and encouragement since that time have been invaluable.

Most of all, however, my thanks must go to my wife, for whose assistance in every aspect of this study, from the re-examination of all the material in Bodrum through the final preparation of the manuscript, I cannot adequately express my thanks.

University Museum, Philadelphia

GEORGE F. BASS

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ABBREVIATIONS

AA	*Archäologischer Anzeiger.*
AASOR	*Annual of the American Schools of Oriental Research.*
ActaA	*Acta Archaeologica.*
AegOr	H. Kantor, "The Aegean and the Orient in the Second Millennium B.C.," *AJA* **51** (1947).
AJA	*American Journal of Archaeology.*
AJNum	*American Journal of Numismatics.*
ANEP	James B. Pritchard, *The Ancient Near East in Pictures Relating to the Old Testament* (Princeton, 1954).
ANET	James B. Pritchard, *Ancient Near Eastern Texts Relating to the Old Testament* (Princeton, 1955).
AntJ	*Antiquaries' Journal.*
AO	*Der Alte Orient, herausgegeben von der Vorderasiatischen Gesellschaft.*
AOF	*Archiv für Orientforschung.*
AP and P	Ancient Peoples and Places Series.
ArchCl	*Archeologia Classica.*
ArchEph	*Archaiologike Ephemeris.*
AS	O. Weber, *Altorientalische Siegelbilder I und II; Der Alte Orient 17/18* (Leipzig, 1920).
ASAE	*Annales du Service des antiquités de l'Egypte.*
ASAtene	*Annuario della R. Scuola Archeologica di Atene.*
AthMitt	*Mitteilungen des deutschen Archäologischen Instituts, Athenische Abteilung.*
BASOR	*Bulletin of the American Schools of Oriental Research.*
BCH	*Bulletin de correspondance hellénique.*
BdA	*Bollettino d'Arte.*
BiblArch	*The Biblical Archaeologist.*
BibO	*Bibliotheca orientalis.*
Bibl. Nationale	L. J. Delaporte, *Catalogue des cylindres orientaux de la Bibliothèque Nationale* (Paris, 1910).
BMMA	*Bulletin of the Metropolitan Museum of Art,* New York.
BritSchArch	British School of Archaeology in Egypt.
BSA	*British School at Athens, Annual.*
CAH	*Cambridge Ancient History.*
Catling	*Cypriot Bronzework in the Mycenaean World* (Oxford, 1964).
CG	*Catalogue général des antiquités egyptiennes du Musée du Caire.*
CPP	J. G. Duncan, *Corpus of Dated Palestinian Pottery* (London, 1930).
CRAI	*Comptes rendus de l'Académie des inscriptions et belles lettres.*
CretS	V. E. G. Kenna, *Cretan Seals* (Oxford, 1960).
CS	H. Frankfort, *Cylinder Seals* (London, 1939).
Dar.-Sag.	Charles Daremberg and Edmond Saglio, *Dictionnaire des antiquités grecques et romaines* (Paris, 1919).
De Clercq	*Catalogue methodique et raisonne de la collection De Clercq* I (Paris, 1890).
Deltion	*Archaiologikon deltion.*
Deshayes	*Les Outils de bronze, de l'Indus au Danube (IV^e au II^e millénaire)* (Paris, 1960).
Ergon	*To Ergon tes Archaiologikes Hetairias.*
Et. Crét.	*Etudes crétoises publiées sous la direction de l'Ecole Française d'Athenes.*
Expedition	*Bulletin of the University Museum of the University of Pennsylvania.*
FKS	F. Matz, *Die Frühkretischen Siegel* (Berlin, 1928).
IDB	*The Interpreter's Dictionary of the Bible.*
ILN	*Illustrated London News.*
Ist. Forsch.	*Istanbuler Forschungen, herausgegeben von der Abteilung Istanbul des deutschen archäologischen Instituts.*
IstMitt	*Mitteilungen des deutschen archäologischen Instituts, Abteilung Istanbul.*
JAOS	*Journal of the American Oriental Society.*
JCS	*Journal of Cuneiform Studies.*
JdI	*Jahrbuch des k. deutschen archäologischen Instituts.*
JEA	*Journal of Egyptian Archaeology.*
JHS	*Journal of Hellenic Studies.*
JNES	*Journal of Near Eastern Studies.*
KMK²	D. Fimmen, *Die Kretisch-mykenische Kultur* (2nd ed., Berlin, 1924).
KMS	H. Biesantz, *Kretisch-mykenische Siegelbilder* (Marburg, 1954).
MarbWPr	Marburger Winckelmann-Programm.
MDIK	*Mitteilungen des deutschen Instituts für ägyptische Altertumskunde, Kairo.*
MDOG	*Mitteilungen der deutschen Orient-Gesellschaft.*
Mem. Miss.	Mémoires, Mission archéologique française au Caire.
Minoica	Festschrift Sundwall (Berlin, 1958).
MMA	Metropolitan Museum of Art.
MMR²	M. Nilsson, *The Minoan-Mycenaean Religion* (2nd ed., Lund, 1950).
MP	A. Furumark, *The Mycenaean Pottery* (Stockholm, 1941).
NatGeo	*National Geographic Magazine.*
Newell	H. H. von der Osten, *Ancient Oriental Seals in the Collection of Mr. Edward T. Newell* (OIP 22, Chicago, 1934).
OIP	Publications of the Oriental Institute, University of Chicago.
Olympia IV	Adolf Furtwängler, *Die Bronzen und die übrigen kleineren Funde von Olympia* (Berlin, 1890).
OLZ	*Orientalische Literaturzeitung*
OpusArch	*Opuscula Archaeologica.*
OpusAth	*Opuscula Atheniensia.*
PEFQ	*Palestine Exploration Fund Quarterly Statement* (1869–1936, continued as *PEQ*).
PM	Sir Arthur Evans, *The Palace of Minos* (4 v., London, 1921–1935).
Poche	A. Schmidt, *Die Sammlung des Herrn Baron Guillaume Poche, Consul von der Czekoslovakei, Aleppo* (Privately published, no date).
PPS	*Proceedings of the Prehistoric Society.*
PraktAkAth	*Praktika tes Akademias Athenon.*
Praktika	*Praktika tes en Athenais Archaiologikes Hetairias.*
PW	*Paulys Realencyclopädie der classichen Altertumswissenschaft.*
PZ	*Prähistorische Zeitschrift.*
QDAP	*Quarterly of the Department of Antiquities in Palestine.*
RA	*Revue archéologique.*
RAssyr	*Revue d'Assyriologie.*
RBibl	*Revue biblique.*
RevEgyptol	*Revue égyptologique, Paris.*
RevLig	*Revue d'études ligures.*
RHR	*Revue de l'histoire des réligions.*
RV	*Reallexikon der Vorgeschichte* (published by M. Ebert, 1924–1932).

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SB	*Sitzungberichte* (Followed by name of academy, abbreviated, e.g., *SBMünch*).
SCE	*The Swedish Cyprus Expedition,* 1927–1931 (4 v., Stockholm, 1934–1962).
v. Aulock	H. H. von der Osten, *Altorientalische Siegelsteine der Sammlung Han Silvius von Aulock* (Uppsala, 1957).
VRS	A. Moortgat, *Vorderasiatische Rollsiegel* (Berlin, 1940).
VTM	S. Xanthoudides, *The Vaulted Tombs of Messara* (London, 1924).
Ward-Morgan	W. H. Ward, *Cylinders and other Near Eastern Seals in the Library of J. Pierpont Morgan* (New York, 1909).
ZAssyr	*Zeitschrift für Assyriologie.*
ZDPV	*Zeitschrift des deutschen Palästina-Vereins.*

Map and Catalogue Abbreviations:

G	Gulley area
S	Sandy area
P	Platform area
M	Miscellaneous area
E	Extension area

Letters used in catalogue numbers:

B	Bronze
BI	Bun ingot
BM	Basketry and matting
In	Ingot
L	Lead
P	Pottery
Sc	Scarab
SI	Slab ingot
St	Stone
W	Weight
Wd	Wood

Dimensions (always given in meters):

Pres.	Preserved
D.	Diameter
H.	Height
L.	Length
Th.	Thickness
W.	Width

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I. THE DISCOVERY

PETER THROCKMORTON

The chain of events leading to the discovery of the Bronze Age shipwreck at Cape Gelidonya on the southern coast of Turkey in Asia began on August 9, 1953, when Professor George Bean was traveling in Caria and heard that a bronze statue had been brought up from the sea by sponge fishermen. He went to Bitez, a village near Bodrum, and found lying on the beach a bronze bust of Demeter, larger than life, of the fourth century B.C.[1]

The statue was taken to Izmir, where it is one of the principal exhibits of the Archaeological Museum. Hakki Gültekin, director of the museum, persuaded the local diving club to undertake further exploration of the area where the Demeter had been found. Two members of the Izmir Fishmen's Club went to Bodrum in 1954, but found that Ahmet Erbin, captain of the sponge trawler whose nets had hauled up the Demeter, was at sea. They talked to local fishermen, and were convinced that a search for the wreck required more advanced equipment than they then had. The project was dropped.

One of these divers was Mustafa Kapkin, a commercial photographer in Izmir. Because of customs regulations resulting from Turkey's austerity program of that troubled time, it was then impossible to import diving gear, but he and his diving partner, Rasim Divanli, a mechanical engineer at the Turyağ factory in Izmir, had designed and built the first useful underwater equipment made in Turkey. Underwater cameras, diving devices, and spear guns were among their products.

Kapkin and I met in the spring of 1958, and were encouraged by Hakki Gültekin to go to Bodrum, try to find Captain Erbin, and search for the Demeter site. Again Captain Erbin was away at sea, but in the course of conversations with other sponge fishermen we were struck by the quantity of stories about antiquities in the sea, especially amphoras.

Three techniques of sponge fishing were then practiced in Bodrum: dragging (*kangawa*), helmet diving, and naked diving. The sponge dragger, such as that which had raised the Demeter, is equipped with a large winch which is powered by the boat's main engine. A long wire pulls a net along the sea bed. The net is attached to a wheeled axle and has a chain across its lower edge. These draggers work on flat, muddy bottoms at depths down to several hundred meters. As a muddy or sandy bottom below the lower limits of wave action is ideal for preserving archaeological material, the draggers often find the remains of ancient shipwrecks, including fragments of structural wood, which have been preserved under the mud. Whole and broken amphoras are found by the thousands by these draggers and by deep-sea fishing trawlers all over the Aegean. The amphoras are usually thrown overboard, as they take up too much space on the boats' crowded decks. Most often they are smashed before they are thrown back, to prevent their tearing other trawlers' nets. In recent years a great deal of material has appeared in Bodrum *kangawa* nets, including other bronzes and amphoras ranging in date from the sixth century B.C. to the medieval period.

Helmet diving boats are equipped with conventional helmet diving suits, and usually have four or more divers sharing the one suit. They work down to 45 fathoms, about 270 feet, but normally stay within the 5- to 25-fathom range. Sponge divers will sometimes raise material with a high scrap value, such as lead or copper, but in general will not bother with salvage, unless the object is easy to recover, since more money can be made from sponges.

Today this traditional system is being replaced with the *narghile* or *hookah* system in which the helmet is replaced by a simple regulator strapped to the diver's back and fed by a hose from the surface (see chap. II).

The most primitive sponge-diving method is that of the naked divers, who work from small oar-propelled boats without mechanical equipment. The captain looks for sponges through a glass-bottomed bucket. When he sees one, a grain pole or barbed weight on the end of a line is run down to it. The naked diver goes down the pole or line, with the help of a flat stone, pulls off the sponge, and surfaces for air. Traditionally these men work without masks and see very little in their short stays on the bottom. Though it is said that they can go to great depths, those we have seen usually confine themselves to depths under fifty feet and to rocky bottoms, where it is not usual to find material of archaeological interest other than scattered and broken amphoras.

When Kapkin and I returned to Izmir, we discussed our findings with Hakki Gültekin. We all agreed on the value of investigating some of the rumors we had heard in Bodrum. I made a short trip to Italy and, with the assistance of Mr. Franco Ingegnoli of Milan, brought the necessary equipment back to Bodrum in June, 1958.

There Kapkin and I had the good fortune to meet Captain Kemal Aras, who invited us to come aboard his boat, *Mandalinçi* (fig. 1), on a trip down the coast. On that first trip we photographed more than a dozen wrecks or possible wrecks of ancient ships; before the summer was over we had recorded more than thirty, not including the wreck complex at Yassi Ada.[2] These

[1] *ILN* (7 November 1953).

[2] G. F. Bass, *AA* (1962) 537–564.

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wrecks range in date from Hellenistic to Medieval. Most of them carried cargoes of amphoras.

A preliminary report was made during the winter of 1958–1959 and circulated to people directly concerned with the project. This report included information about wrecks we had not actually explored, but which we were convinced existed. The report mentioned Gelidonya:

> Located in the Gulf of Finike, off Anadolu Burnu. Lies off the point of the third small island off Finike, fifteen miles from Finike in the direction of Antalya, where there is a group of six (*sic*) small islands. Depth is 16 fathoms, bottom is rocky. This site was discovered by Kemal Aras four years ago. Kemal Aras was the most reliable of our diving informants and his information has been one hundred per cent accurate to date. He took a bronze spear from this place, which he remembers was very corroded, and at the same time brought up a small bronze box, from his description about the same size as "two cigar boxes together." This he broke open and threw away when it proved to be empty.
>
> One of Kemal's divers remembers that the box was "enamelled" inside. Captain Kemal and two other divers who were on board at the time remembered the place as follows:
>
> "Lying in a hollow of the rocky bottom in a shallow sand bar were six or eight pieces of bronze each one about two meters long by three cm square. There are other bronze objects, so old and deformed that you cannot tell what they are. The whole mass is so stuck together that it cannot be moved."
>
> Captain Kemal had planned to dynamite the bronze in the spring of 1959, but was dissuaded and agreed to show us the place instead. If this site is not investigated and protected within the next year, we feel certain that it will be dynamited and looted and that whatever remains there will certainly be sold for scrap and lost. We are convinced of the reliability of the above information and feel that this site must be investigated in 1959.

Three points in the above account seemed of great importance. The bronze spearpoints were lost; they had been sold for scrap. The divers, however, remembered that they had been bronze, as had been the "knife." This alone would have made the expenditure of considerable effort worth while, as it seemed unlikely that a site which produced bronze tools of two types was other than of the Bronze Age. The second point was the remark that "there are other bronze objects so old and deformed that you cannot tell what they are." Bronze from Roman wrecks is liable to be in fairly good condition, and this site was, therefore, probably much older than any of the other sites we had seen or heard of. Finally, there were the "bronze" pieces. What were they? If the divers had seen copper pieces, the conclusion would have been immediate. Yet both Captain Kemal and diver Mehmet were convinced that they were bronze.

It had been impossible for us to visit the site in 1958. It was more than a hundred miles from our base in Bodrum, and lay off one of the wildest areas of the Turkish coast. Captain Kemal had no intention of going there in the near future, since helmet divers could work there only in the early spring when there was little current. We had photographed and measured other sites from *Mandalinçi's* ten-foot dinghy while Kemal and his men worked nearby, but at Anadolu Burnu we should need a large boat, not dependent on the shore and able to stay in the islands for days while we first located and then surveyed the wreck.



FIG. 1. *Mandalinçi*, near Cape Gelidonya in 1960.

Our interest in the site was reinforced by that of Miss Virginia Grace of the American School of Classical Studies' Agora Excavations in Athens, who had followed our activities from the beginning. Through her I met Stanton Waterman of Princeton, a well-known underwater explorer and film maker, who prevailed upon his friend, Drayton Cochran of New York, to put his seventy-foot steel auxiliary ketch, *Little Vigilant,* at the disposal of the Izmir Museum for an investigation of the bronze wreck site in the spring of 1959.

Anadolu Burnu did not appear on any chart, but Cape Gelidonya (or Khelidonya), the promontory that marks the western end of the Gulf of Adalia, seemed to correspond to Kemal's description. The cluster of islands that lie off the cape are about 115 miles as the crow flies northwest of Cape Arnauti, the westernmost point of Cyprus, and the same distance due east of Rhodes (fig. 2).

Although well known in ancient times, the region has been almost deserted ever since. There is no small-scale chart of the area, and none that shows details of either the islands or the surrounding coast. The region has an ugly reputation among seamen of the coast, especially in the fall and winter, when southerly gales batter the south shore of Anatolia and the islands, and when heavy rains weaken the cliffs and tons of rock crash down from the sheer cliffs onto the narrow beaches or into the sea.

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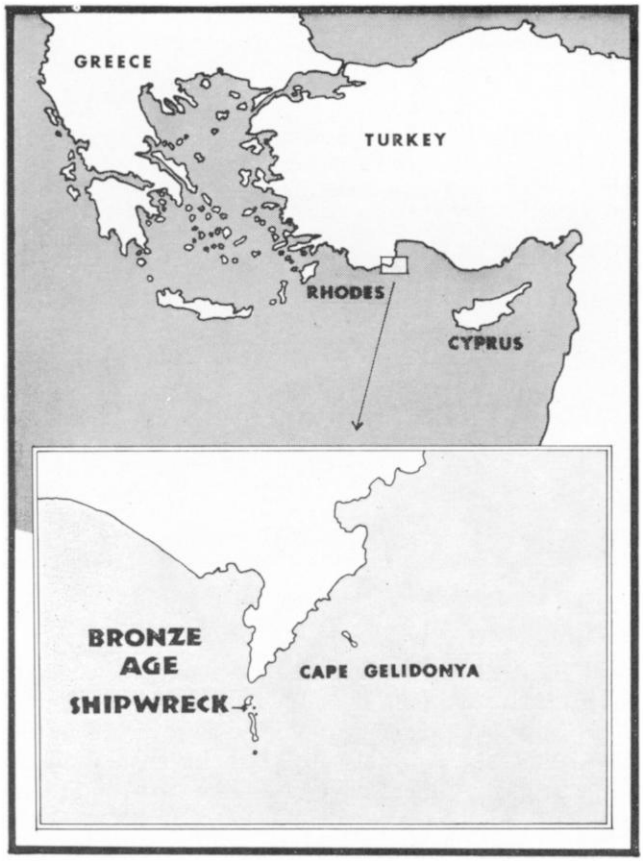


FIG. 2. Location of Cape Gelidonya and Bronze Age shipwreck.

The first charts of the region were made in 1810 by Captain F. Beaufort, F.R.S., of H.M.S. *Fredericksteen,* 32 guns. It is difficult to improve on his remarks about the islands:[3]

Two of these islands are from four to five hundred feet high. The other three are small and barren. Scylax mentions but two, and Strabo but three, and the latter expressly states that they are the same size. If the above mentioned singular appearance has been caused by an earthquake since he wrote, it may not be a very extravagant conjecture, that the same shock has rent the former three into the present number, and that the intermediate parts have altogether disappeared. Pliny accused these islands of being noxious to navigators but we descried no danger. . . .

Pliny had written of the region:[4]

In the Lycian sea are the islands of Illyria, Telendos and Attelbosa, the three barren isles called Cyprae, and Dionesia, formerly called Caretha. Opposite to the promontory of Taurus [i.e., Cape Gelidonya] are the Chelionae, as many in number, and extremely dangerous to mariners.

[3] Francis Beaufort, *Karamania, a Brief Description of the South Coast of Asia Minor* . . . (London, 1818) 2nd ed., 38–39. Beaufort's reference to Scylax: *Scylacis Periplus,* in *Geog. Min. Graec.* (Ed. Oxon., 1698) 39; the reference to Strabo is not noted but is 14.2.1 and 14.3.8.

[4] Beaufort's reference to Pliny: V.35, translated by J. Bostock and H. Riley (London, 1755).

Beaufort continues:

They preserve their ancient name, Chelidonae, among the Greeks, but by the Italian sailors who for centuries were the chief navigators of these seas it was softened into Celidoni, and from thence by an easy transition the Turks have adopted the name Shelidan. It is said by Meletius, that their name was originally derived from the number of swallows by which they were frequented. But during our stay, none were perceived.

Today the islands are called simply Beş Adalar (Five Islands) by the Turks, and the cape is called Adersan, Adrechan, or Anadolu Burnu.

Captain Beaufort's remarks on the current became interesting in the light of our subsequent experiences among the islands:[5]

From Syria to the Archipelago, there is a constant current to the westward, slightly felt at sea, but very perceptible near the shore, along this part of which it runs with considerable but irregular velocity: between Adratchan cape and the small adjacent island, we found it one day almost three miles an hour; and the next, without any assignable cause for such a change, not half that quantity. The configuration of the coast will perhaps account for the superior strength of the current about here: the great body of water, as it moves to the westward, is intercepted by the western coast of the Gulf of Adalia; thus pent up and accumulated, it rushes with augmented violence towards Cape Khelidonia, where, diffusing itself in the open sea, it again becomes equalized.

A recent study of the vertical circulation of the Mediterranean Sea has shown that the Levantine Intermediate Water, a salty layer which is found at depths of between two hundred and six hundred meters all over the Mediterranean, is

formed in February and March on both sides of Rhodes, where at the surface there is a combination of low temperatures and high salinities . . . conditions favorable for . . . vertical convection. From this winter source region of high salinity the Levantine intermediate water spreads out within the core layer to all western basins.[6]

This current is rich in sea life. Dozens of porpoises play off Gelidonya, living on schools of fish which feed in the current as it swings round the cape. At the lower end of the Gelidonya life scale are the sponges which, permanently attached to the rock, filter out the tiny organisms borne to them by the current. The sponge divers say that "current makes sponges and widows," because it is difficult and dangerous to work with their diving equipment where the current runs.

We arrived at the five islands on 17 July, 1959, and found them forbidding and savage. There is no water. In most places the cliffs are perpendicular and it is difficult to land on the brittle rock which has been worn into fangs by the erosion of wind and water. It is impossible to walk barefoot anywhere on the islands, and in most places hard to walk at all, even with heavy boots.

[5] Beaufort, *op. cit.* (*supra.* n. 3) 41–42.

[6] George Wust, *Jour. of Geophysical Research* **66**, 10 (1961) 3261 ff. I am indebted to Dr. David Burden for this reference.

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On board the *Little Vigilant* were Hakki Gültekin of the Izmir Museum, Mustafa Kapkin and Rasim Divanli of the Izmir diving club, myself, Stanton Waterman and the Cochran party: Captain Drayton Cochran, his son John, and Miss Susan Phipps.

Captain Kemal Aras had not been able to come with us, but Mustafa Kapkin and I had spent an afternoon listening to his description of the site and making sketch plans. We felt sure that we could find it.

Two days were spent searching without success. The bottom was a mass of huge boulders, some the size of an automobile, some as large as *Little Vigilant*. After two days we were preparing to leave the islands when John Cochran and Susan Phipps went for a last dive and, quite by chance, discovered the wreck. He managed to chip off two lumps containing bronze and, when cleaned, these proved to be a plowshare and half a bronze double axe, broken at the socket.

When we examined the site carefully the next day, it proved to be exactly as described by Kemal Aras and Mehmet Baaltutan. Everything was so overgrown that it was almost impossible to recognize objects as man made. It was clear that we were dealing with important material, of which a fair sampling ought to be raised. A preliminary examination showed that there were several types of ingots and many kinds of bronze tools. We decided to photograph the site as well as possible, to make a measured plan, and to raise two ingots, a dozen or so tools, and one of two stone bowls.

On the first two days we had no trouble with the current, but on the morning of the third day the *meltem* began to blow and the current began to come through the channel from the west. During the second dive of the day, *Little Vigilant,* anchored near the site, dragged her anchor and was swept eastward through the channel. She was anchored in poor holding ground on the east side of the large island, and we attempted to dive again from the launch. This dive was successful and we managed to break loose two of the large pieces of metal and to attach them to a line running to a buoy on the surface. An anchor watch was kept all that night; *Little Vigilant* could have gone ashore if the wind had shifted or if the current had changed direction.

On the morning of the ninteenth we attempted to raise the two ingots that had been attached the evening before. The current ran so strong that *Little Vigilant* was swept eastwards out of control, the ingots dangling from the rope. All hands heaved on the rope as quickly as possible, but, unfortunately, the rope had been kinked and therefore strained, and as the ingots broke water the rope snapped. The ingots dropped into deep water. Bearings were taken immediately, and several of us dived in turn to recover the objects. I actually saw

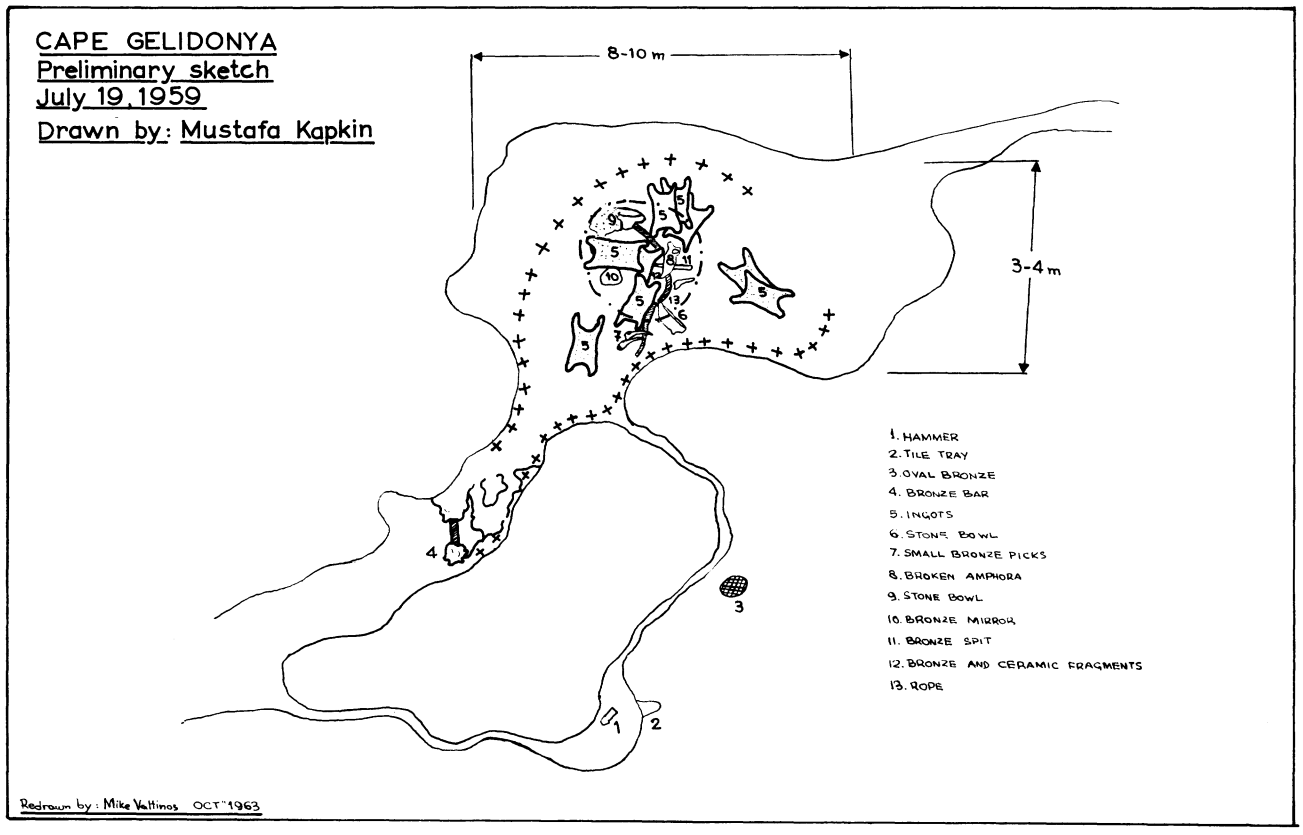


FIG. 3. Sketch-plan made of site on its discovery.

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them at 150 feet, but the current was so strong that it was impossible to attach a line.

We decided to leave them until the current stopped, but it showed no signs of lessening within the next two days. We decided to free two more ingots from the wreck site, which was done with difficulty, the current still increasing in force. Captain Cochran decided that it was unwise to moor behind the island for the night. In any case, we had raised a fair sampling of material. We decided to leave the "lost" ingots, which were recovered the next year. That night we sailed for Rhodes.

We had made many photographs of the site. Mustafa Kapkin had made what proved to be a remarkably accurate sketch plan of those parts of the wreck which were visible (fig. 3). It was clear that further operations were definitely worth while, and that they would have to be carried out by a properly equipped expedition.

On 24 July, Hakki Gültekin, Mustafa Kapkin, Rasim Divanli, and I disembarked in Bodrum. *Little Vigilant* sailed for Greece. Permission was obtained by Hakki Gültekin from the local authorities to convert the Knight's Hall of the crusader castle into a temporary museum, where we deposited all of the material which we had unloaded. Some of the objects had gone on to America as souvenirs, without my knowledge, but these have since been returned to Bodrum.

That week we received a visit from Sir Bernard Burroughs, then the British ambassador to Turkey. He immediately recognized one of the ingots as very similar to one he had seen in the Cyprus Museum. Through Sir Bernard I wrote to Andrew Megaw, then director of the Department of Antiquities on Cyprus, giving measurements of the ingots. He identified them as being almost certainly Cypriot.

In November, Professor Eric Sjöqvist saw a bronze dagger and a spearhead which had been taken to America by the Cochrans. He identified these as being typical of Cypriot armament of the Late Bronze Age.

John Huston of the Council of Underwater Archaeology had been interested in our work for several years. Through him I met Professor Rodney Young of the University Museum, who recognized the importance of the site and delegated George Bass to discuss with me how to approach the novel problem of underwater excavation. He and I worked out a program, which was presented to the museum authorities and accepted by them.[7]

[7] Further information about the finding of the Gelidonya wreck is found in: P. Throckmorton, *Lost Ships* (Boston, Toronto, 1964); *NatGeo* **117** (1960) 682–703; and *Atlantic Monthly* **213** (June 1964) 96 ff., a condensation of *Lost Ships*. Also Stanton A. Waterman, *Explorers Journal* **38**, 3 (1960) 28–35; M. J. Mellink, *AJA* **63** (1959) 73, and *AJA* **64** (1960) 58; Honor Frost, *Antiquity* **34** (1960) 216–218, and *Under the Mediterranean* (London, 1963); J. M. Cook, *Archaeological Reports for 1959–60* (*JHS* suppl.) 28–29; C. Picard, *RA* **2** (1960) 88–91, with figs. 2–3; G. M. A. Hanfmann, *Gnomon* **32** (1960) 701; G. Bass, *Archaeology Under Water*, chapt. 3.

We were able to make our plans with the benefit of several generations of trial and error in underwater archaeology behind us. It seems appropriate to begin the description of the methods used at Cape Gelidonya with a brief review of the work of our predecessors.

The first underwater excavation took place at Antikythera in 1900 and 1901. As in the case of the Gelidonya wreck, the ship was found accidentally by sponge divers. Their captain, Demetrios Kondos of Symi, reported a "heap of statues in the sea" to the Ministry of Education in Athens. He and his men were then hired by the Greek government to salvage the statues.

They went about their job with great courage and skill. The wreck lay over 30 fathoms deep (180 feet), almost beyond the safe working range of compressed-air divers even today. Before the job was finished, one diver was dead of bends and two others were incurably paralyzed from their waists down.

It is no wonder that none of the seven archaeologists, who at various times supervised the work, attempted to dive and inspect the wreck. Although the helmet diving dress invented by August Siebe in 1837 had been in use in the Aegean for over forty years, the principles of diving were little understood. Diving was considered an esoteric skill which could be practiced only by men like the sea peasants of Symi and Kalymnos, who had been trained from childhood in the ways of the sea.

The divers who worked at Antikythera were not educated men. Only two out of eight could read and write at all. The Symiaki spoke a dialect which was probably difficult for professors from Athens to understand. One of the divers was a Turk who scarcely spoke Greek. From the reports of the excavation one gets the impression that the divers could not find words to describe what they saw on the bottom, and that those who were asking the questions could not visualize what the divers were trying to describe. There exists no coherent description of what the divers actually saw on the sea bed. No one measured the wreck, and of course no one photographed it; the first successful scientific underwater photographs had been taken in France, by Louis Boutan, only the year before.

The divers worked as they would have worked salvaging scrap metal. They dug with their hands until they could put a line around an object; then signaled for the piece to be hauled to the surface. The final report of the excavation was written by someone who did not visit the site during the course of the work, and contains no first-hand interview with anyone who actually dived at Antikythera. The divers used existing methods, and one should not criticize them for not using techniques which were yet to be conceived, but the fact remains that they destroyed much more than they salvaged.[8]

[8] The basic sources for Antikythera are *ArchEph* (1902) 146–171; J. N. Svornos, *Ethnikon Mouseion* (1903); and the Greek daily *Asty* for 1900–1901.

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In 1907 another shipload of statues was found by sponge divers, this time off Tunisia. The Mahdia operation was a repetition of Antikythera: Greek sponge divers ripped up what they could and gave the salvaged material to the archaeologists.[9]

In 1928 a trawler hung her nets on an underwater obstruction off the north cape of Euboea. A sponge diver dived twenty-five fathoms to free the net and found the Poseidon (Zeus) of Artemision. An expedition was organized and two more statues were salvaged. Work ended when a diver was killed.[10]

In 1934 the pioneer French underwater explorer and inventor, Le Prieur, founded the first amateur diving club in the Mediterranean. The first archaeologist to take advantage of the improved underwater techniques developed by Le Prieur and others was A. Poidebard, who surveyed Sidon and Tyre from 1935 to 1937, using underwater photography and supervising underwater drawings.[11]

A major advance in diving came in 1943 with the invention of the aqualung by J.-Y. Cousteau and Emile Gagnan; this was the first safe, self-contained underwater breathing apparatus suitable for use by amateur divers. The effect of this invention, which opens the depths of the sea to all who are reasonably healthy and willing to spend a week or ten days learning to dive, has been to encourage the development of many kinds of associated equipment: underwater cameras, waterproof watches, more practical protective suits, and wireless communications systems for divers. Diving, which had been in the province of specialists, became a popular sport. Wide public interest in the underwater world led to the use of the aqualung as a tool of research for all disciplines having to do with the sea.

In archaeology, the implications of the invention of the aqualung were not immediately recognized. In 1950 Professor Nino Lamboglia explored a first-century B.C. Roman wreck at Albenga, Italy, with the help of a clamshell bucket. Fortunately, Lamboglia realized the futility of this approach almost immediately and called a halt in order to develop new and better methods.[12] He realized the necessity of applying methods under water which are normally associated with land excavations, and developed mapping techniques from which we developed the drafting frame built for use at Gelidonya and later perfected at Yassi Ada.[13]

By the summer of 1952, many ancient ships, mostly amphora carriers, had been discovered by the growing clan of amateur aqualungers in the south of France. Commander Cousteau had been detached from his command of the Undersea Research and Development Group of the French Navy in order to take charge of the research vessel *Calypso*; from her he planned to use the aqualung in undersea research, and underwater archaeology was part of his program.

His second in command and chief diver, Frédéric Dumas, had proposed several ancient wrecks for investigation. In collaboration with Professor Fernand Benoit of the Musée Borely in Marseille, the group chose a large amphora carrier of the Roman period. The wreck lay in 140 feet of water at the Grand Congloué, a few miles from their base of operations in Marseille.

An intensive excavation was carried out until 1957; the wreck is still not completely explored. For the first time an underwater archaeological excavation had been undertaken with the intention of applying standards consistent with those of land excavations. Many problems arose. The archaeologist in charge was not a diver, but he followed the work from the surface, sometimes assisted by such esoteric devices as underwater television. He worked in close collaboration with the divers, who were mostly amateurs, all literate, and capable of reporting accurately what they had seen. Professor Benoit has stated the problem clearly in the introduction to his publication of the Grand Congloué excavations:[14]

> Du moins, cette première expérience montre-t-elle avec éclat les énormes difficultés de la fouille sous-marine . . . Elle montre aussi . . . la nécessité d'appliquer à la fouille sousmarine, en un milieu inconsistant, les règles rigoureuses de la fouille terrestre. . . .

By 1960 it was clearly time for a new approach which would take advantage of technical advances made by previous excavators, while avoiding their mistakes. The major weakness of the operations at the Grand Congloué, the most important of the previous excavations, had been the archaeologist's lack of control over divers who had no experience of archaeological techniques and interpretation.[15] This gap between archaeologist and technician left the archaeologist to do his job second hand, so to speak, dependent upon the diver's judgment as to whether or not it was possible to perform specific tasks and techniques under water. As a result, no plan of the site was made, and it was not even clearly established whether there was one shipwreck or two at the Congloué.

By 1957 more than twenty ancient wrecks had been explored in the south of France.[16] Most of these were partially excavated, and all were looted. Philippe Tailliez, then commander of the Groupe Etudes Recherches Sous-

[9] A. Merlin and L. Poinssot, *Cratères et candélabres de marbre trouvés en mer près de Mahdia* (Tunis, 1930); Guy de Frondeville, *Les Visiteurs de la mer* (Paris, 1956) 157–229.

[10] George Karo, *Archaeology* **1**, 4 (1948) 179–185.

[11] A. Poidebard, *Un grand port disparu: Tyr* (2 v., Paris, 1939); A. Poidebard and J. Lauffrey, *Sidon: Amenagements antiques du Port de Saida* (Beirut, 1951).

[12] N. Lamboglia, *RevLig* **18** (1952) 131–236; *Atti del II congresso internazionale di archeologia sottomarina* (Bordighera, 1961) 143 ff.; and 275 ff.

[13] E. J. Ryan and G. F. Bass, *Antiquity* **36** (1962) 252–261.

[14] F. Benoit, *L'Epave du Grand Congloué à Marseille,* Gallia suppl. **14** (Paris, 1961) 25.

[15] Benoit, *RA* **1** (1963) 195–200.

[16] P. Tailliez, *Nouvelles plongées sans câble* (Paris, 1961).

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Marines, of the French Navy,[17] directed the largest of the salvage operations at the Titan wreck in 1958. Using divers and facilities of the French Navy, this excavation followed a carefully conceived program and was the best organized and executed project until that time. Tailliez was not an archaeologist, and as at the Grand Congloué no accurate plans were made of the site. Tailliez, himself, called attention to the defects of the Titan excavation, and in doing so laid down the working principles which governed the Gelidonya expedition:[18]

> If we had been accompanied on the bottom by an archaeologist, he would surely have noted with more care the position of each piece before its raising, and would have gotten imperceptible clues and other information from an examination in place.
>
> At the least, I have shown that beginning and conducting an underwater excavation is a hard task which demands of its participants of all echelons faith, tenacity, and courage. It cannot be carried out well with precarious means, but requires, on the contrary, the employment of appropriate nautical gear and specialized equipment over a long period of time. . . .
>
> It is up to the one in charge of the excavation to . . . [forbid] raising any object unless the information obtainable from its position in the wreck has been recovered.

[17] Tailliez, *Atti (supra,* n. 12) 175–198.

[18] *Ibid.,* 198.

It was our intention, then, to try to begin at Gelidonya where Tailliez and Cousteau had left off. We were very fortunate in that the Underwater Research Group of the French Navy lent us their chief diver, Frédéric Dumas, who had worked for years at the Grand Congloué site and on other ancient wrecks in France; he was one of the founders of underwater archaeology.

We meant, at the same time, to try to avoid the enormous expense which seemed to have been involved in earlier excavations. Antikythera had cost about a quarter of a million drachmas, the equivalent in purchasing power of over two hundred thousand dollars today. Mahdia was probably cheaper, but not much so. The Grand Congloué excavation cost in the region of a quarter of a million dollars or more, and another recent expedition spent one hundred thousand dollars in one season.[19]

All of the above named expeditions had been equipped with large salvage vessels, large crews, and a great deal of complex and expensive equipment. It seemed to us that all of this was not necessary. What was needed was a small, highly trained crew, and sufficient time. Instead of using expensive research vessels, we would camp on shore and use local fishing boats to carry us to and from the wreck site.

[19] K. MacLeish, "Sea Search into History at Caesarea," *Life* **50** (May 5, 1961) 72–82.

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II. THE EXCAVATION

GEORGE F. BASS AND PETER THROCKMORTON

The excavation began on June 14, 1960, after we had pitched our camp on a narrow beach opposite Su Ada.[1] Although only a strip of sand and pebbles, surrounded on all sides by unscalable cliffs, the camp site offered a source of fresh water and a suitable anchorage. It lay nearly twenty miles from the nearest town, Finike, and was a thirty to forty minute sail from the wreck in either of our two Bodrum boats: the *Mandalinçi,* captained by Kemal Aras, and the *Lutfi Gelil* (fig. 4), captained by Nazif Goymen.

Most of the staff slept on mattresses spread out on the sand under a large tent, but shelters were scattered along the beach for the women members. Living conditions were not pleasant. Rocks fell from the cliff during the night, and on one occasion draftsman Honor Frost found a boulder lying on her pillow just before she retired for the night. Flies forced Mr. Ball to draw most of the finds while crouched on the ground under a tiny mosquito net. The heat was intense, often reaching 110° F. in the shade by ten o'clock in the morning. We could spare one of our boats to bring food from Finike only once a week; with no means of refrigeration, meat lasted only a few days even after being cooked and heavily salted. The heat also caused serious problems in the development of film.

In spite of these difficulties, we were able to work with relative efficiency. Two small generators, which furnished power for the darkroom enlarger, also supplied the entire camp with electricity for lights. The darkroom itself was a small cave closed with canvas, and could be used only at night. Other "work rooms," for cleaning finds, filling air tanks, and cooking, were simply small areas of the beach roofed with old parachutes.

The cliffs protected us from the north winds, but by September we had received the first warnings of the seasonal *lodos* blowing from the south. The first time that waves washed across the beach, we were unprepared, and material was buried under sand before it could be moved. From that time, everything in the camp which was not being used was stored on a small hill, which had been formed on the beach by a rock slide some years before. Finally, three months after we had first arrived, the sky was darkened by threatening clouds. Fearing that the first rain of the season might cause another landslide, we broke camp during the night and sailed away in the early hours of the morning. We reached Finike just as the heavens opened and it poured.

[1] Su Ada (Water Island), long noted for its supply of fresh water, is identified by Beaufort (*Karamania,* 39) as "the island of Grambousa (the *Crambusa* of Strabo, and *Dionysia* of Scylax and Pliny)."



FIG. 4. The *Lutfi Gelil* under sail.

During the working season, we sailed each morning in one or both of our boats to the wreck site and moored to a buoy anchored just over the wreck (fig. 5).[2]

I. PROBLEMS OF UNDERWATER EXCAVATION

Underwater archaeology, in general, demands not so much new methods of excavation as adaptation of present land techniques to the underwater environment. We began work at Gelidonya convinced that there were no inherent technical limitations to prevent us from applying the same standards that are considered desirable on land. Almost always in the past, underwater excavations had been no more than salvage operations performed by professional divers. We felt that we must treat this wreck as an archaeological site, and that its



FIG. 5. The *Lutfi Gelil* anchored over the wreck.

[2] Fuller accounts of living conditions and camp life appear in: P. Throckmorton, *NatGeo* **121**, 5 (May, 1962) 697 ff.; *Lost Ships* (Boston and Toronto, 1964); *Atlantic Monthly* **213**, 6 (June, 1964). G. Bass, *Expedition* **3**, 2 (1961) 2 ff.

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location fifteen fathoms below the surface of the Aegean should not be an excuse for improper excavation.

Many unique problems, however, confront the underwater excavator. The time which he may spend daily on each site is often severely limited; the distance from which he can photograph and even see is dependent on the clarity of the water; and the water itself causes optical distortion, which makes everything seem one-third oversize and which affects the diver's judgment of distance. Although diving with the Cousteau-Gagnan aqualung system used at Gelidonya is simple, safe, and easy, the diver is an intruder in an alien and potentially hostile world, where his life may be endangered by a number of factors. Divers were lost at Antikythera, Artemision, and Grand Congloué. The main problems are:[3]

1. PRESSURE

The Greek sponge divers who died at Artemision and Antikythera, and an American diver who was later paralyzed at Yassi Ada,[4] were victims of "the bends." An understanding of the bends depends upon the knowledge that air is compressible while water is not, and that the pressure of water increases with its depth. Regardless of the apparatus he uses, a diver must receive air at a pressure equivalent to the pressure surrounding him in order to breathe. Without air at ambient pressure, a diver's lungs, sinuses, and middle-ear cavities would be squeezed and crushed as the air in them was reduced in size.

Tailliez and his collaborators in the Undersea Research and Development Group of the French Navy define the phenomenon of the bends as follows:

> During his descent and stay below, the diver breathes air at a pressure greater than the atmospheric, and a certain amount of nitrogen is absorbed by the blood each time it passes through his lungs.
>
> The tissues bathed by the blood in turn take up more and more nitrogen, depending on the length of the dive. . . . This phenomenon is reversed during the ascent. The excess nitrogen dissolved in the various tissues is carried back to the lungs by the blood, where it is eliminated during respiration. If the ascent is too rapid, the difference between the pressure of the nitrogen dissolved in the various tissues and the hydrostatic pressure may become so great that bubbles begin to form in the blood, as in a bottle of champagne that has just been opened. These bubbles produce compressed air illness, also known as caisson disease, "the bends," or decompression sickness. . . .[5]

The symptoms of this disease are various and unpleasant, although not always fatal. They range from vague pains in the bones or itching to paralysis, blindness, or unconsciousness.

The only preventative for the bends is a controlled ascent following each dive. Schedules have been prepared which allow the diver to rise to the surface in stages. These schedules, or decompression tables, are based on calculations of the amounts of nitrogen absorbed or lost by different types of tissues at various depths and during various lengths of time.[6] Three decompression tables, similar but differing in detail, are in general use: the British, American, and French. The French Navy repetitive diving tables were used at Cape Gelidonya.[7]

The treatment for the bends is recompression followed by slow decompression, and this must be carried out immediately to be effective. The diver is put under pressure in a chamber until the bubbles which have formed in the circulatory system are reduced in size and the nitrogen can be eliminated normally. During treatment the pressure is reduced very gradually, following predetermined schedules which also appear as tables, to prevent a reoccurrence of the bends.

The wreck lay at depths of 26 to 28 meters. Because of our isolated position, far from the large chamber in Istanbul, and because our portable chamber was held by customs, we added a safety factor and calculated our dives as being at the next deeper depths on the tables. We decided that 11 or 16 minutes of decompression at 10 feet would be too long and tiring for the divers, and, therefore, limited each person's first dive of the day to 40 minutes, with a 6-minute decompression stop at 3 meters following the working time on the bottom.

Six hours after the first dive, we normally made a second dive of 28 minutes on the bottom, followed by another 6-minute decompression stop. When a 6-hour interval between dives was not possible, decompression times were necessarily lengthened.

A timekeeper on the surface kept a careful log of diving times and signalled the divers to ascend by hammering on a length of pipe hung from the side of the boat; one diver in each group usually wore an underwater watch as an added safety measure. After weeks and months of diving, divers tended to become careless, although discipline was usually well kept. The overzealous diver who overstayed his time on the bottom would then find himself being kept on the decompression stop for up to an hour or more, sometimes into the cold twilight; a glance at the tables shows that the

[3] For a more complete coverage of diving and its problems see: *U.S. Navy Diving Manual,* NAVSHIPS 250-538 (Navy Department, Washington 25, D.C., 1959); P. Taillez, F. Dumas, J.-Y. Cousteau, *et al., The Complete Manual of Free Diving* (New York, 1957); B. Empleton, E. Lanphier, J. Young, L. Goff, *et al., The New Science of Skin and Scuba Diving* (New York, 1962).

[4] G. Bass, *NatGeo* **124**, 1 (July, 1963) 156.

[5] P. Taillez, *et al., op. cit.* (*supra,* n. 3) 97–98.

[6] *Ibid.,* 132, "Complete safety can never be had except by prolonging the stops inordinately." Even divers carefully following the tables risk suffering from the bends; B. Empleton, *et al., op. cit.* (*supra,* n. 3) 70.

[7] We now use the new U.S. Navy repetitive tables, which give a higher safety factor than the new French Navy tables, which have, in turn, replaced the French tables used at Cape Gelidonya. At the suggestion of the U.S. Navy doctors, for added safety, we now use the tables for the next deeper depth and the next longer time than we are actually diving.

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required decompression time rises sharply after 35 minutes at our working depth.

Divers complained of minor symptoms of the bends after weeks of daily repetitive dives, but these, whether real or imagined, proved to be of no consequence except where peace of mind was concerned. After a day's rest, divers invariably felt better, and fatigue after dives was reduced by slightly extending decompression times.

Nitrogen narcosis, also caused by breathing air under pressure, was not a serious problem at the depths in which we worked. The mental faculties of some of the divers seemed to have been dulled more than those of others, but advance planning of dives left few decisions to be made by a diver once he was working on the sea bed.

Of the other illnesses caused by pressure or pressure changes, air embolisms are certainly the most important. An embolism is most commonly caused by panic, which might lead a diver to ascend rapidly without exhaling; trapped air can rupture the lungs as it expands, forcing bubbles into the blood. Good training and physical fitness are the best preventatives.

2. OTHER HAZARDS

A diver, dependent on an artificial supply of air, constantly faces the dangers inherent in being in an unfamiliar environment. Drowning is probably the major cause of death among skin divers. Engine exhaust, entering an air hose or a tank being filled, can prove fatal. Strong currents can sweep divers away, or kink their air hoses. Any dizziness or illness which on land would be of no consequence can become most serious under water; a diver who is forced to vomit is in trouble.

At Gelidonya we avoided serious injuries by following the general rules of diving found in most manuals on the subject. All of the divers had been trained in advance in the correct procedures for clearing water from their air hoses, in replacing masks under water where they can be knocked off, and in sharing their mouthpieces with other divers. We generally followed the rule that aqualung divers must never work alone; on several occasions possibly fatal accidents were avoided by the instant reaction of a diver to his partner's kinked air hose or empty tank reserve. Air intakes were kept upwind of running compressors and other engines to prevent carbon-monoxide poisoning. Because of the almost constant current, divers descended and ascended on a line running between the boat and the wreck site; a dinghy with an outboard motor was on hand to rescue any diver who might be swept away.

Sharks do not normally present a danger to divers in the Aegean.[8] Attacks reported in recent years had been almost invariably against people swimming on the surface, where the splashing seems to attract sharks. We discussed the problem with Frédéric Dumas, who has had a great deal of first-hand experience with sharks under water, and it was agreed that if we were bothered by aggressive or overly curious sharks, we would suspend operations until they had gone away. It was never necessary to do this, although at least one diver reported seeing a shark.

Bites from moray eels were avoided by taking care before putting hands into the cracks or holes which might house the creatures.

Our most common complaints stemmed from our being so often in the salt water. Infected ears kept some of the divers out of the water for several days at a time, and even the tiniest cuts and bruises became more severe until the sufferer could let them dry thoroughly over a period of days. We found that a protective coating of collodion allowed wounds to heal more quickly.

3. VISIBILITY

The sea is filled with particles of dirt and organic matter which can severely limit visibility. The Aegean, however, has very little plankton, and thus provides an unusually high range of vision. At Gelidonya, on the clearest days, divers working on the wreck could be seen from the surface by swimmers equipped with masks. Effective range for photography, however, is seldom more than thirty feet; matter suspended in the water, but not noticeable to divers, affects the resolving power of the camera lenses. For good, clear photographs, the maximum range at Gelidonya was nearer fifteen feet, even on clear days.[9]

The index of refraction of water causes objects to appear larger and nearer than they really are, both to the diver and to the lens. The focal length of a lens under water is increased by about one-third; normal lenses become telephoto, and wide-angle lenses become normal. These problems are partially solved by the use of a wide-angle lens, which covers a large area from a short distance away. Such lenses, however, cause distortion when taking photographs from the distance at which they are most useful under water.

Water acts as a blue filter, which progressively absorbs the different colors of the spectrum as the depth increases. Red goes first, being seriously affected for purposes of photography after one meter and disappearing completely after five meters. Orange is affected after two to three meters and disappears after ten. Yellow is affected after five meters, but is still dis-

[8] Hans Haas, in *Men and Sharks* (New York, 1954), describes the difficulties his expedition experienced in trying to attract sharks in the Aegean in 1941. For further studies of shark behavior see: Perry Gilbert, ed., *Sharks and Survival* (New York, 1964).

[9] For an introduction to the problems of underwater photography see: *Encyclopédie Prisma du Monde Sous-Marine* (Paris, 1957), 392 ff.; Dimitri Rebikoff and Paul Cherney, *A Guide to Underwater Photography* (New York, 1957); J. Greenberg, *Underwater Photography Simplified* (2nd ed., Coral Gables, Florida, 1963).

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tinguishable down to thirty or forty meters. On the wreck everything appeared greenish blue. Blood from minor cuts, for example, was green. Artificial lighting, by flash, allowed the camera to record colors which the diver did not normally see. A flash, attached to its underwater camera case by a short arm, as was ours, can harm a picture if mud has been stirred up by excavation in progress; light is reflected almost directly back into the lens from scattered particles between the photographer and his subject. At Gelidonya there was always sufficient light during the daytime for black and white photography.

II. METHODS OF EXCAVATION

1. DIVING

The choices of diving equipment were relatively simple, for the same limitations of time and depth hold true for all compressed-air equipment. Use of gas mixtures, such as helium and oxygen, which can partially overcome some of these limitations, would have proved too complex and costly for our operation. Oxygen rebreathing equipment is generally unsatisfactory in the Aegean because it is limited to a working depth of 30 feet; well-preserved wrecks generally lie below this depth, where they have been protected against wave action.

Although various self-contained underwater breathing devices were developed before Cousteau and Gagnan invented the aqualung in 1943, the helmeted diving dress was standard among divers until that time.[10] The helmet diver wears a rubberized canvas suit with a metal helmet and breastplate. His hands, the only parts of his body exposed to the water, protrude through rubber cuffs. Compressed air, supplied through a heavy hose from a boat above, fills the helmet and expands the suit to just above the diver's waistline, so that his lungs are surrounded by compressed air. His feet are weighted by heavy lead shoes, and the buoyancy of the air which fills the upper part of his suit is compensated for by lead weights strapped around his waist or slung at breast and upper small of his back. He must maintain a vertical position at all times, for if he leans over air is likely to rush to his feet. As the exhaust valve is in the helmet, this can result in his being pulled to the surface out of control by the overly buoyant suit. It requires considerable skill to maintain the balance between the air in the suit and the lead weights, and the diver must continually manipulate the exhaust valve in his helmet.

There are other disadvantages to the helmet suit. Movement is difficult and visibility is poor. Accidental ballooning, a broken faceplate, an entangled hose, or compressor failure combined with a faulty non-return valve on the diver's hose are all possible causes of death which do not face the aqualung diver.

The advantages of this type of dress, however, are many for divers involved in other types of work. The diver is heavy and can perform difficult manual tasks. He can remain warm and dry over long periods of time. He is able to work in mud, and can intentionally balloon himself out if he becomes stuck. At Gelidonya, helmeted sponge divers were used only for such heavy work as swinging a sledge hammer, for they could not work on the actual wreck site without risking damage to delicate material with their heavy shoes, and they could not work at all when the current was running.

The invention of the aqualung revolutionized diving, but its principle is quite simple. Air is supplied to the diver from metal bottles worn on the back and filled with compressed air. The air passes through a regulating device which delivers it to the diver at the same pressure as that of the sea surrounding his lungs. Exhalations are exhausted immediately, so that it is impossible for carbon dioxide to build up in the air supply. The diver's body is surrounded by water, but as the body has approximately the same specific gravity as sea water, the pressure has no affect on it; the only air required is the amount needed for breathing.

When using the aqualung, the diver wears rubber fins on his feet for ease of movement, a plate-glass mask for clear visibility, and weights designed to give him neutral buoyancy. A tight-fitting foam-rubber suit allows water to enter and lie next to the skin, but does not allow it to circulate; this water is soon warmed by body heat and protects the diver against cold. Even in the relatively warm Aegean, the colder water beneath the surface would quickly draw off much of the body heat of a naked diver, especially if he were drawing or performing some other quiet task for forty minutes.[11]

A variation on the aqualung, known as the "hookah" or "narghile," differs from the aqualung only in that the air is supplied from the surface through a hose. The hose joins the same regulator that is otherwise mounted on air tanks (fig. 23).

At Gelidonya, all three systems of diving were used, although the helmeted sponge divers were employed, as has been mentioned, only for the very heaviest work. The aqualung offered great mobility and freedom to its wearers, but it had one major disadvantage. The bottles must be filled with high-pressure air at between 1,800 and 3,000 pounds per square inch (i.e., up to 200 atmospheres). Compressors capable of producing air at such high pressures are delicate devices. Ours ran up to ten hours a day; compressors normally built for such strenuous service are so bulky and heavy that they

[10] Robert H. Davies, *Deep Diving and Submarine Operations* (London, 1955) is the classic handbook on underwater work, especially in regard to the era before the aqualung. For an excellent history of diving see: James Dugan, *Man Under the Sea* (New York, 1956), published in England as *Man Explores the Sea* (Harmondsworth, 1960).

[11] The high heat capacity and heat conductivity of water make suits desirable in temperatures below about 70° F., B. Empleton, *et al., op. cit.* (*supra*, n. 3) 25–26.

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could not have been used at Gelidonya. Our portable four-stage Bauer compressor served us well, but no compressor of its size, overloaded as it was, could have been expected to operate continually under the conditions at Gelidonya. The small compressors which we had brought as reserves proved to be utterly unreliable.

As an emergency measure, while repairs were being made on the high-pressure compressor, we rigged a "narghile" system with air-lift hose running from *Mandalinçi's* diving compressor. This system worked quite well except for the soft hose which, not having been designed for diving, tended to kink in the strong current, cutting off the diver's air supply. Normally the kinks could be shaken out of the hose, or removed by the diver's swimming upward for a few feet to relieve the tension on the hose. When these measures failed, the diver ascended sharing his partner's mouthpiece and air supply. At a last resort, the diver could release his weight belt and, exhaling to prevent an embolism, make a free ascent to the surface.

Mandalinçi's compressor, a low-pressure standard Siebe Gorman diving compressor driven by pulleys and belts from the sponge-boat's one-cylinder diesel engine, proved very reliable and gave trouble only once, when a valve blew out. A new valve was made from a piece of an old shoe and the compressor was running again the next day. This kind of repair work would have been impossible with a precision-made high-pressure compressor.

With proper hose, there are other advantages to using "narghiles" on an excavation. The diver has constant contact with a tender on the surface who can feel predetermined signals pulled on the hose. There is not the danger of running out of air, especially during heavy exertion, which can shorten the working time of a diver breathing from bottles. The major disadvantage is that the diver must be particularly careful not to entangle his hose with another hose or with measuring strings and other obstacles. In a strong current the pull on the diver's hose also makes it difficult for him to move about.

2. PLOTTING THE WRECK

After a preliminary inspection of the site, we began mapping it by making a photographic montage. Overlapping pictures were taken by a diver swimming in an approximately straight line above the wreck. A bubble level and a plumb line attached to his camera assured that the pictures were taken vertically and from a fixed height above the sea bottom; strings stretched across the wreck guided the photographer's path. A two-meter surveying pole, marked in twenty-centimeter segments, was included in each frame to allow the negatives to be enlarged at a fixed scale.

Distortion caused by the index of refraction of water was a serious problem only when the overlap between two photographs was small. Otherwise, the edges of the picture were cropped, leaving the less distorted

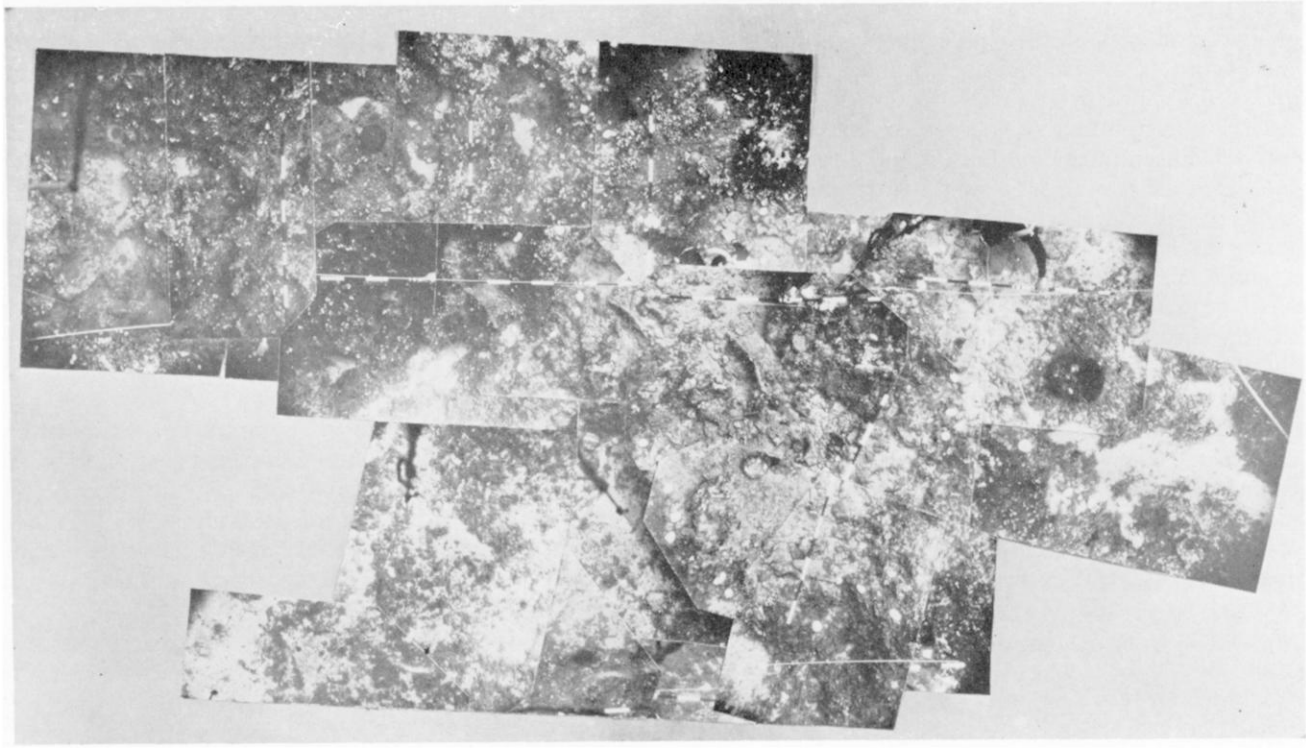


FIG. 6. Photographic montage of entire wreck as when first seen; north at bottom.

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FIG. 7. Photographic montage showing same area as in fig. 6, after excavation.

central portions to be used in the montage. A greater problem was the difference in scale of objects at different levels on the sea bed, which usually prevented truly accurate joining of pictures. This problem could have been diminished by taking the photographs from a greater height, but this would have brought about a loss of clarity.

Two montages of the entire site were made: one at the beginning of the season, when the wreck had not yet been cleaned or seriously disturbed (fig. 6), and a second near the end of the season after much of the cargo had been raised (fig. 7; in this, the sponge seen at the right side [west] of figure 6 is just below the diver's right leg, and the pierced stone "anchor" at the left end [east] of figure 6 has been replaced by a stone with a circle marking the position of the original hole). Neither was intended as an accurate plan from which measurements could be taken, but both served as reliable checks on drawings.

Close-up photographs of objects *in situ,* and a photographic record of our methods of excavation were taken with both color and black and white film. Kodak Ektachrome (High Speed) and Kodachrome were used for color, with the best results from Kodachrome used with clear No. 5 flash bulbs. For black and white pictures, Plus X or Verichrome Pan film was normally exposed for 1/125 second at f/8, but the exposures varied according to the time of day; these were developed daily using D 76 stock solution, mixed with an equal amount of water, for six minutes. Contact prints were made as soon as possible, and pictures were selected for enlargement immediately.

The importance of photography in an underwater excavation cannot be overemphasized, although this necessitates a source of electricity for enlarging even in the most remote areas. The archaeologist on land can inspect his site whenever he wishes, but the time limitations imposed by the decompression problem make this impossible in an underwater excavation. Further, the land archaeologist can watch the excavation in progress and can discuss the work on the spot with members of his staff. Because we seldom dived in groups of more than two or three divers, it was possible for several days to pass before any one diver could be on the site with the archaeological director, the draftsman, or the photographer to show directly a point of interest. For this reason, it was necessary each morning to discuss and plan that day's operations with the aid of photographs taken on the previous day. We took an average of fifty underwater photographs each day, and nearly all have proved of value when consulted during later study of the wreck.

Confused reports, caused by haste or by slight nitrogen narcosis, can often be clarified by photographs. Ideally, these photographs would be shown after each dive to the next team of excavators. A Polaroid camera, mounted in a special housing,[12] showed promise before it was lost in the strong current during the first days of the excavation.

While the photographic plan was being made, we surveyed the wreck with methods similar to those used

[12] The underwater case for the Polaroid camera was designed and constructed by the French Navy's Undersea Research Group (O.F.R.S.).

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on land sites. Iron spikes were driven into the rock around the wreck to serve as permanent bench marks, and objects in the wreck were triangulated from them (fig. 8). This was not completely satisfactory because the horizontal measurements would have been accurate only if the strings and meter tapes used in the triangulations had been horizontal. As there is no horizon under water, and as the weightlessness of the diver's body allows him to stand on a steep slope without realizing that he is not standing upright, visual estimates of the horizontal were meaningless. The only solution to this problem was to keep the pole as parallel as possible to some natural line in the surrounding rocks which appeared to be vertical, and then to move the string attached to the pole up and down until it seemed to be at a right angle. No more than thirty-five measurements could be made in one dive, but by repeated checks, we finally arrived at measurements which seemed to be accurate to within a very few centimeters.

Detailed scale drawings of small areas or groups of objects were recorded on sheets of frosted plastic attached to clipboards. Ordinary pencils were used, but the wooden halves tended to separate under water unless taped in advance (fig. 9).

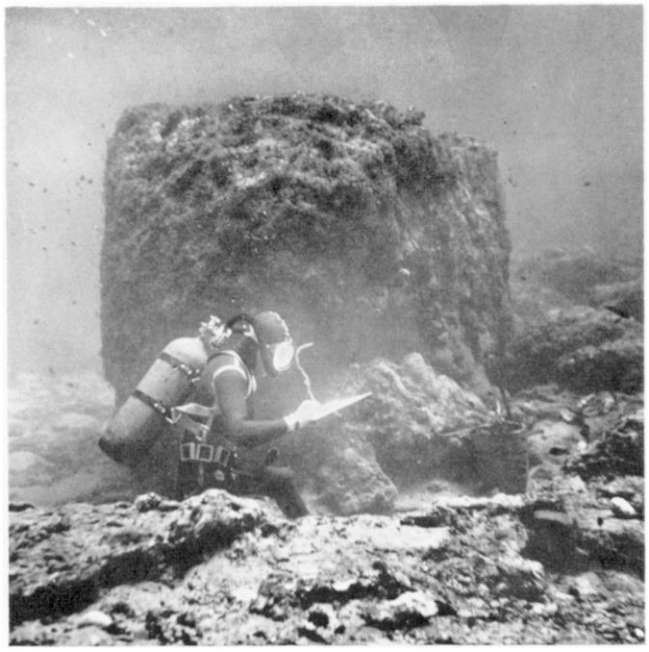


FIG. 9. Duthuit drawing on frosted plastic. Photograph taken from Platform towards Boulder.

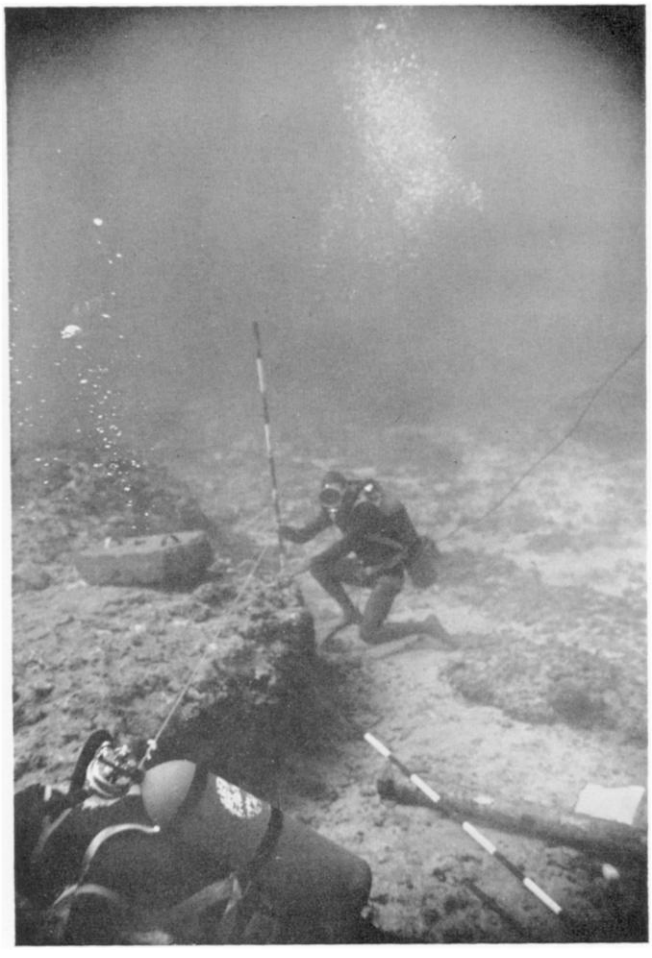


FIG. 8. Triangulating on the sea bed.

Using preliminary measurements and the first photographic montage, we were able to make a working plan of the site while most of the cargo of the ship was still hidden beneath sea growth. The natural contours of the sea bed broke the wreck into easily defined areas, which were labeled according to the divers' most familiar terms for them (fig. 43, key). Thus, Area G was the "gulley" between a large fallen boulder (B) and the base of the cliff which ran up to form the rocky edge of the island. Just west of G and B was a flat "sandy" area (S), which separated the gulley from a rocky "platform" (P), about a meter higher than S. When several objects were discovered still farther west, this new area became E, for "extension," and objects scattered by the current over a large area to the north of all previously named areas were simply from M, or "miscellaneous." There was no need for a grid system, which we had considered using.

When first discovered, the only parts of the wreck that were visible were the copper ingots of the platform and a few scattered pieces which lay on the sand (fig. 6). Everything else was covered with a heavy layer of coralline sea growth. Captain Kemal's original estimate of "two tons of bronze" was based on his assumption that the platform was a solid mass of metal. It was only after some days that we found this was not the case; the northern edge of the platform was merely a stone ledge. At the same time, however, we discovered that the gulley was full of metal.

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FIG. 10. Dumas places stone "anchor" into lifting basket.

3. EXCAVATING THE WRECK

Loose and scattered pieces, after being tagged with identification labels, and then drawn and photographed *in situ,* were placed in small wicker baskets. These baskets, along with individual ingots, were raised to the surface in a steel wire lifting basket by a winch on the *Lutfi Gelil* (fig. 10).

After removing the material which was not solidly cemented together by the sea growth, we were faced with the large masses of metal which had been completely encompassed by the living rock. We found, when cutting with hammer and chisel around pieces of metal, that corrosion products had prevented the concretion touching the metal from becoming rock hard. A chisel placed at the juncture of the rock and the metal so that it acted as a wedge would, when given a sharp blow with a hammer, shear even quite fragile metal objects from the bedrock to which they were attached. A seemingly safer method of removing these objects, by cutting into the concretion around them without touching the actual artifacts, proved to be less practical; we found that fragile metal was sometimes shattered by the continual vibration of heavy blows nearby.

Cutting ingots free of their cases of limestone presented a different problem. If we had tried to chisel free the individual ingots, we would have faced several summers' work, in the course of which much of the material would probably have been damaged. Dumas suggested that an automobile jack placed under a mass of ingots would lift it from the sea bed, shearing not across the metal, but on the line where the metal joined the rock.

We placed a hydraulic jack with a lifting capacity of three tons into a slot chiseled beneath the southern edge of the ingots piled on the platform. Planks and a steel bar over the jack distributed the thrust. The jack was pumped carefully and, when strained almost to capacity, broke off the entire mass exactly at the juncture of the metal and rock.



FIG. 11. Duthuit guides sheet-wrapped lump being lifted by winch from the *Lutfi Gelil.*



FIG. 12. Dumas uses crowbar to pry lump loose from area P; jack handle protrudes in foreground.

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FIG. 13. Bass, Duthuit, Illing, and Throckmorton fit lumps of concretion together at camp.



FIG. 15. Cleaning concretion away from cargo in lumps from area G.

The freed lump was winched to the deck of the *Lutfi Gelil* after a diver had wrapped a bed sheet around it to protect the matting and rope he had seen stuck to its bottom (fig. 11).

After this, raising of "lumps" of concreted cargo, weighing several hundred pounds each, became standard practice. Masses of encrusted metal were studied for what seemed to be the natural lines along which they would break, and cuts were made along these lines before jacking (fig. 12). If a lump failed to break loose, we tried another angle of thrust. No material was damaged by this seemingly violent method.

After cleaning the first mass of cargo almost immediately after it arrived on board the *Lutfi Gelil,* we realized that evidence of lading was being lost. From that time, uncleaned lumps were carried back to the camp and fitted together (fig. 13). After an entire area was reassembled on land as it had rested on the sea bed (fig. 14), the heavy limestone, up to 15 centimeters thick, was knocked away (figs. 15–17). Sandbags were used to prop up individual artifacts as they became free, so that eventually the objects lay in the positions they had held when the ship finally settled and disintegrated on the bottom of the sea.

The draftsmen next drew the objects, which still held their relative positions to one another, and added these details to their plans, which had previously shown only the masses of limestone with occasional corners of protruding metal.

In the gulley were found the only substantial remains of wood, but these protruded from beneath a mass of ingots. We feared to raise this mass by means of the cable and winch on the *Lutfi Gelil* lest she roll slightly during the operation; if this had occurred while the ingots were only a few centimeters above the sea bed, the wood might have been violently crushed. The mass was, therefore, tied to a large plastic balloon which was filled on the bottom with air from a diver's mouthpiece

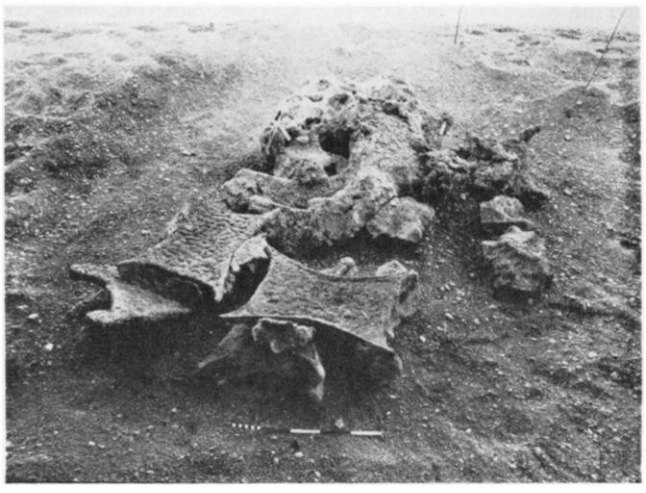


FIG. 14. Lumps and ingots from area G after having been fitted together on land.

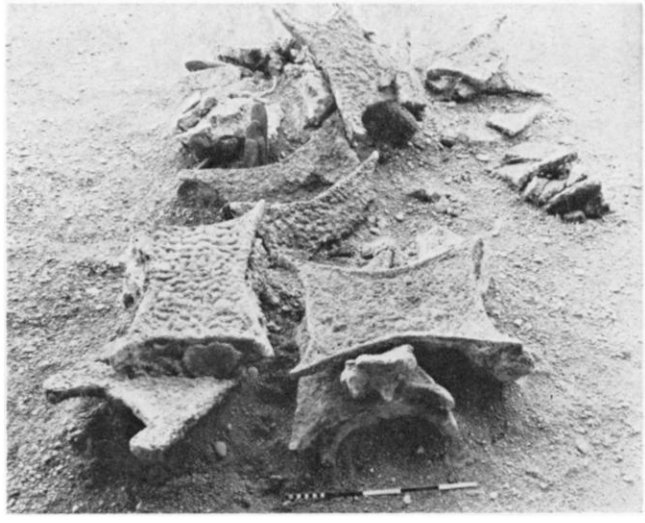


FIG. 16. Lumps from area G when completely cleaned of concretion.

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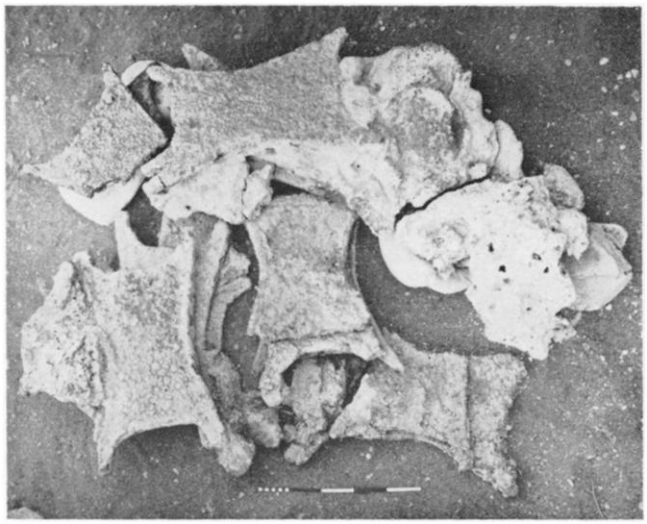


FIG. 17. Lumps from area P when almost completely cleaned; white material on right is tin oxide.

(fig. 18). After filling the balloon with air until its upward thrust reduced the weight of the conglomerate to ten or fifteen pounds, two divers were able to carry the mass carefully away from the area of danger. There a second balloon was attached and filled, and the cargo was borne easily to the surface where it was picked up and winched onto the boat. Each balloon was capable of lifting between three and four hundred pounds, so that no lump was too heavy to be raised in this way during the course of the excavation.

The wood itself, however, was difficult to raise in one piece. The fragments, mostly twigs and branches, lay partially cemented to the rock bottom, which was marble



FIG. 18. Dumas and Duthuit fill lifting balloon in area G.



FIG. 19. Illing attempts to chisel beneath lump containing wood fragments.

overlaid with the usual coralline sea growth (fig. 19). As with the metal cargo of the ancient vessel, we decided that it would be sensible to raise the wood in one unit and to excavate and draw it on land, where both archaeologists and draftsmen would be able to work at their leisure.

This proved to be the most difficult task of the excavation. For three weeks, the entire staff worked in shifts, cutting through the solid bedrock on which the wood lay. An air drill or air hammer would have saved much time, and would have caused less damage to the fragile material; during the weeks of work, with one diver holding the chisel while another swung the sledge hammer, it was impossible to avoid disturbing the wood.

This was the only time that we were aided by *Mandalinçi*'s helmeted sponge divers. Their heavy dress made them well suited to the job of swinging the sledge, but it was often necessary for an aqualung diver to guide their leaden feet through the wreck with his hands. They were unable to work in even moderate currents (fig. 20).

When this lump was finally free, it was installed in a box under water, lashed securely, and raised with *Lutfi Gelil*'s winch. It was carefully taken apart and drawn weeks later in Bodrum (see chap. IV).

Finally there was the job of removing the sand which covered the sea bed, and searching through it for small, loose objects. At first this was done manually by simply lifting handfuls of sand into a bucket, which could be emptied away from the wreck. This proved to be extremely time-consuming, however, and our air lift was lowered onto the site.

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The principle of the air lift is simple. The pressure of the water at lower depths is greater than that of water above. If a pipe runs from the sea bed upward, and air is released into this pipe near its bottom, the air will rise through the pipe toward the surface, expanding as it goes. This expansion, contained and directed only upward by the pipe, causes a suction at the base of the pipe, and this pulls water, sand, and mud with it.

Two air lifts were used at Cape Gelidonya (fig. 21). The larger was ten centimeters in diameter, made of three lengths of light sheet-iron pipe, each five meters long; this was suspended vertically from an oil-drum float. At the lower end was a six-meter length of flexible, but non-collapsible, wire-reinforced rubber hose of the same diameter. Air was pumped from *Mandalinçi*'s compressor through a small hose to an air intake near the lower end of the air lift. A loosely meshed bag tied over the upper end of the air lift caught coarse sand and any tiny objects which were inadvertantly sucked up, but allowed most of the finer sand to be carried away by the current (fig. 22).

Using an air lift for the first time, we ran into several problems. If it was not vertical in the water, the pipe tended to clog with sand. This forced air from the flexible lower end, giving it enough buoyancy to lift its operator off the bottom. The strong current also made positioning of the lift difficult at times.

The second air lift, only five centimeters in diameter but over thirty-five meters long, was able to discharge onto the deck of the boat above.

The air lifts proved to be most valuable tools when used properly, but they were used only for cleaning sand away. We did not want to raise objects with them for two reasons: we feared that fragile pieces would suffer from the trip through the pipe, and objects found only in the air-lift bag or on the deck above could never be placed with accuracy on the plan of the wreck. The lifts were never used directly in the sand, therefore, except in sucking sand from cracks and from beneath the boulder, where it was otherwise impossible to explore. Normally a diver fanned sand gently toward its mouth, searching for and extracting artifacts before they were caught in the strong flow.

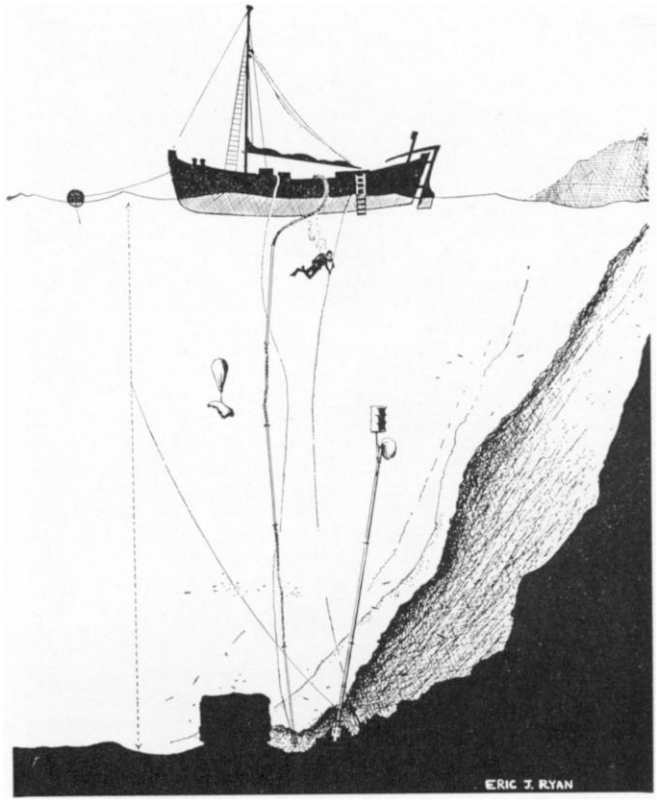


FIG. 21. Both air lifts positioned on wreck with *Lutfi Gelil* above.



FIG. 20. Captain Kemal wearing standard diving dress works with Duthuit.

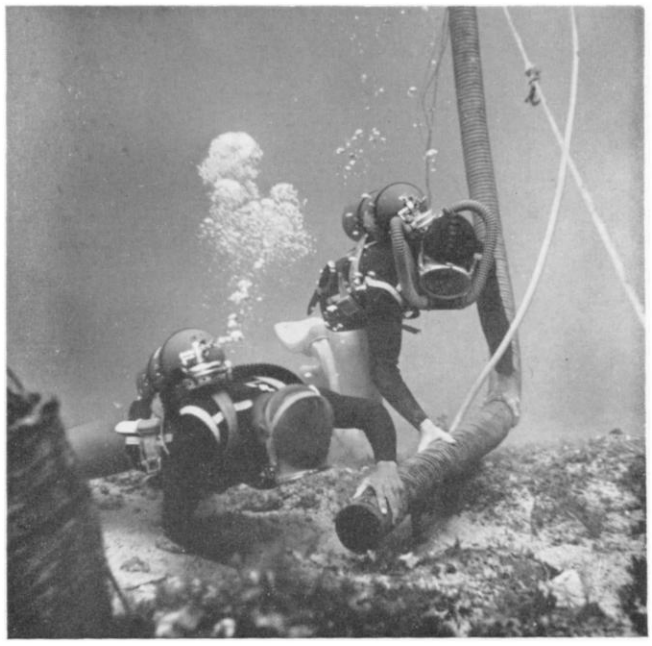


FIG. 22. Martens sweeps sand into mouth of larger air lift held by Bass.

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FIG. 23. Duthuit holds metal detector while diving with *hookah*.

A last searching device was an underwater metal detector (fig. 23) brought by Luis Marden of the National Geographic Society on a visit during the last days of the season. This located several deposits which might otherwise have been missed, and assured us that no major pieces of metal had been overlooked beneath the limestone growing over the wreck and surrounding area. Although delicate and liable to malfunction, these detectors can prove valuable in operations such as ours.

It should be emphasized that the methods of diving and excavating described above were only those used at Cape Gelidonya, a pioneer effort, and many are obsolete at the time this is written. At Yassi Ada, for example, it was found that divers could decompress for twenty-one minutes, twice a day, and that even forty-minute decompression periods were not overly tiring for most divers when they needed to make longer dives. At the same site, new techniques allowed extremely clear photographs to be taken from thirty or more feet above the wreck, and almost all of the mapping was done by photography after methods of correcting distortion and scale differences were devised; the most promising method of mapping is that of photogrammetry, which involves the use of carefully controlled stereophotographs. At larger sites, such as those at Methone, surveying techniques similar to those used on land have been successful, and the lack of a horizon has proved to be no hindrance. More advanced methods of preserving wood and metal finds are now being used, but it is too early to comment on their success. The first results of these excavations are now being published.[13]

4. THE PROGRESS OF THE EXCAVATION

In order to present better the evidence of the excavation, and also to give an idea of the rate at which the work progressed—which may be of help to others scheduling similar operations in the future—a series of plans are appended. These present the work in the three main areas of the site (P, S, and G), broken into several arbitrary phases. These phases are not pretended as true stratigraphic phases as are found on land excavations, but represent the course of excavation and do, therefore, show the relationship of objects to one another.

A word of explanation about the plans is necessary. They are based largely on a series of plans drawn by Miss Frost at the time of excavation, but they have been contracted into fewer phases than originally drawn. Further study of triangulation measurements and photographs has corrected the errors which occurred at the beginning of the excavation, before we had devised a reliable system of plotting. For that reason, the positions of objects in areas G and S can be taken as quite accurate, but the relative positions of some of the remains in area P were judged only after careful study of dozens of photographs.

It should also be noted that the plans cannot truly represent what was seen on the ocean floor. Most of the material was invisible beneath seaweed and concretion, and the positions of many objects were determined only after the lumps of concretion had been raised, cleaned, and redrawn; objects which were not visible on the site are shown with broken lines. Further, areas of sand, rock, and concretion were not defined as clearly on the sea bed as they are in the plans because of overgrowth; these areas became much clearer as the site was cleaned (compare figs. 6 and 7).

General elevations may be found on figure 37.

Area P, Phase 1 (fig. 24)

On June 14, when first seen, only the vague shapes of In 7 and several bun ingots, and the handles of In 13

[13] G. Bass. *AA* (1962) 537–564; *American Scholar* **32**, 2 (1963) 241–254; *NatGeo* **124**, 1 (July, 1963); *Archaeology* **18**, 1 (1965) 7–14; *Archaeology Under Water* (London, New York, 1966) chaps. 6 and 8; E. Ryan and G. Bass, *Antiquity* **36** (1962) 252–261. P. Throckmorton and J. Bullitt, *Expedition* **5**, 2 (1963) 16–23.

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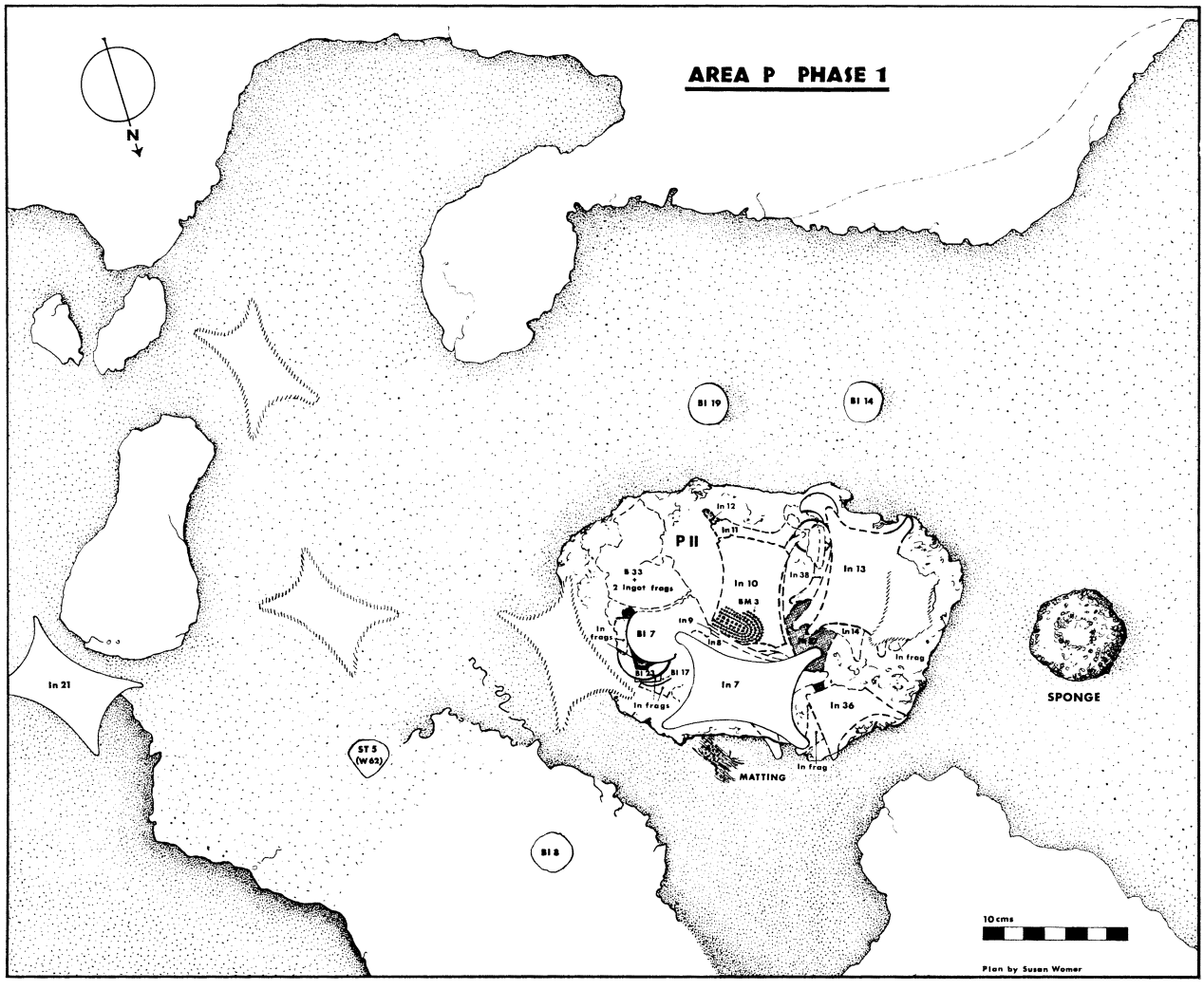


FIG. 24.

and In 36 were visible in the lump of concretion (P II) which encased or covered most of the cargo in the area. On June 17, scattered pieces of broken ingots, tools, and basketry were collected from the sand around P II. Many, if not most, of these pieces had been dislodged during the previous summer when several entire ingots had been broken loose and raised; the impressions of these ingots in the concretion were still clearly visible and are shown on the plan by hatched lines. Two bun ingots (BI 14 and BI 19) may also have been dropped in 1959, and BI 8 was almost surely not *in situ*.

The area was drawn and photographed during the following days, and more metal scraps, mostly unrecognizable, were raised. On June 22, Duthuit and Dumas began to cut around P II so that the entire mass could be raised in one piece. It was not until June 29 that an automobile jack could be placed under P II, to separate it from the sea bed, and the lump of concretion then broke into two pieces; the piece containing In 10 and In 13, and the ingots beneath them, was raised to the surface with a cable.

Area P, Phase 2 (fig. 25)

The remaining half of P II, containing In 7 and other ingots, was moved slightly out of position during the raising of the first half of the lump; thus the exact relationship of In 15 and In 39 to the other ingots was never firmly established. Careful study of photographs, however, has allowed us to accept the relationship shown here with some confidence. The well-preserved bottom of a wicker basket (BM 3, see Phase 1), which had held scraps of broken tools and ingots, although resting on In 10, stuck to concretion which had covered both In 7 and In 10, and was not revealed until June 30, when the rest of P II was raised to the surface.

The large sponge, whose center was often used as a fixed point for measurements, was found to contain half

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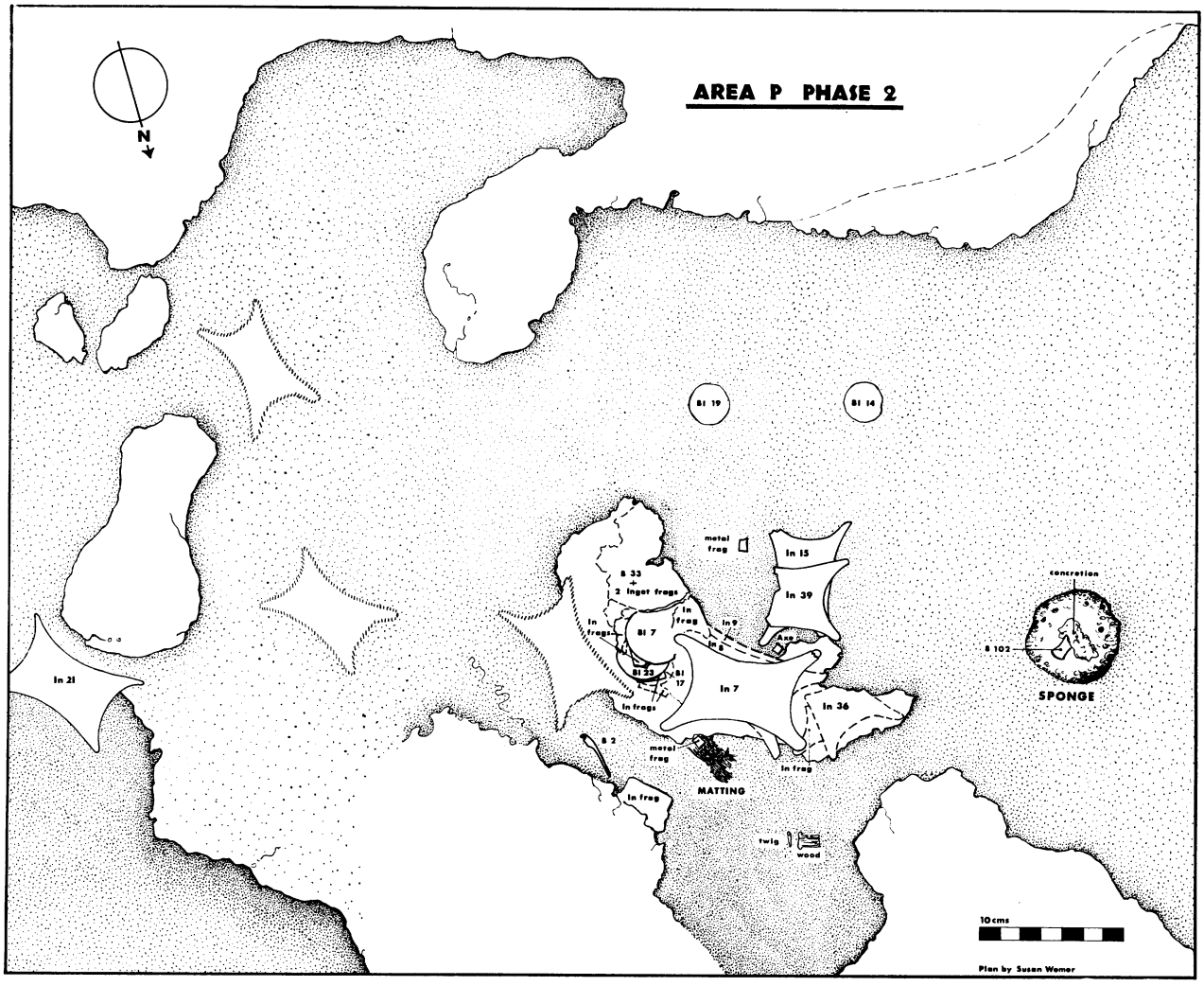


FIG. 25.

of a bronze double axe which may have been dropped in 1959.

Area P, Phase 3 (fig. 26)

When P II had been raised, two clusters of objects were found by In 15 and In 39; these were labeled as sub-areas P V and P VI. It is assumed that they represented the contents of two perishable containers (scraps of matting suggest basketry), and included complete and broken bronze implements, casting waste, and two stone weights. The glass beads were imbedded in encrustation, but had evidently been stored, along with a bronze bracelet, in a pottery container which was found crushed around them (fig. 141). Also in the general area under P II were several lumps of white material, later found to be tin oxide, which had undoubtedly caused the serious damage to In 39 through electrolysis. Sub-areas P V and P VI were excavated mostly between June 31 and July 11, although the lump containing the beads was not raised until August 11.

In early September, a general search of the area with air lift and metal detector located a number of bronzes, which must have come originally from area P, in the crevices under the base of the cliff; this area, an "extension" of area P, was labeled area E.

Areas G and S, Phase 1 (fig. 27)

The "gulley" (area G), between the cliff and the large boulder, and the "sandy" area (area S) as first found (*cf.* fig. 37). In 21, in area S, has been shown in the various phases of area P (figs. 24–26), so that the relationship of the areas in the various plans may be noted. As in area P, most of the ingots were invisible beneath thick layers of concretion and sea growth, and their positions (shown with broken lines) were not actually determined until the lumps containing them were plotted, raised, and broken apart. Roman numerals in this case denote masses which were to be raised intact.

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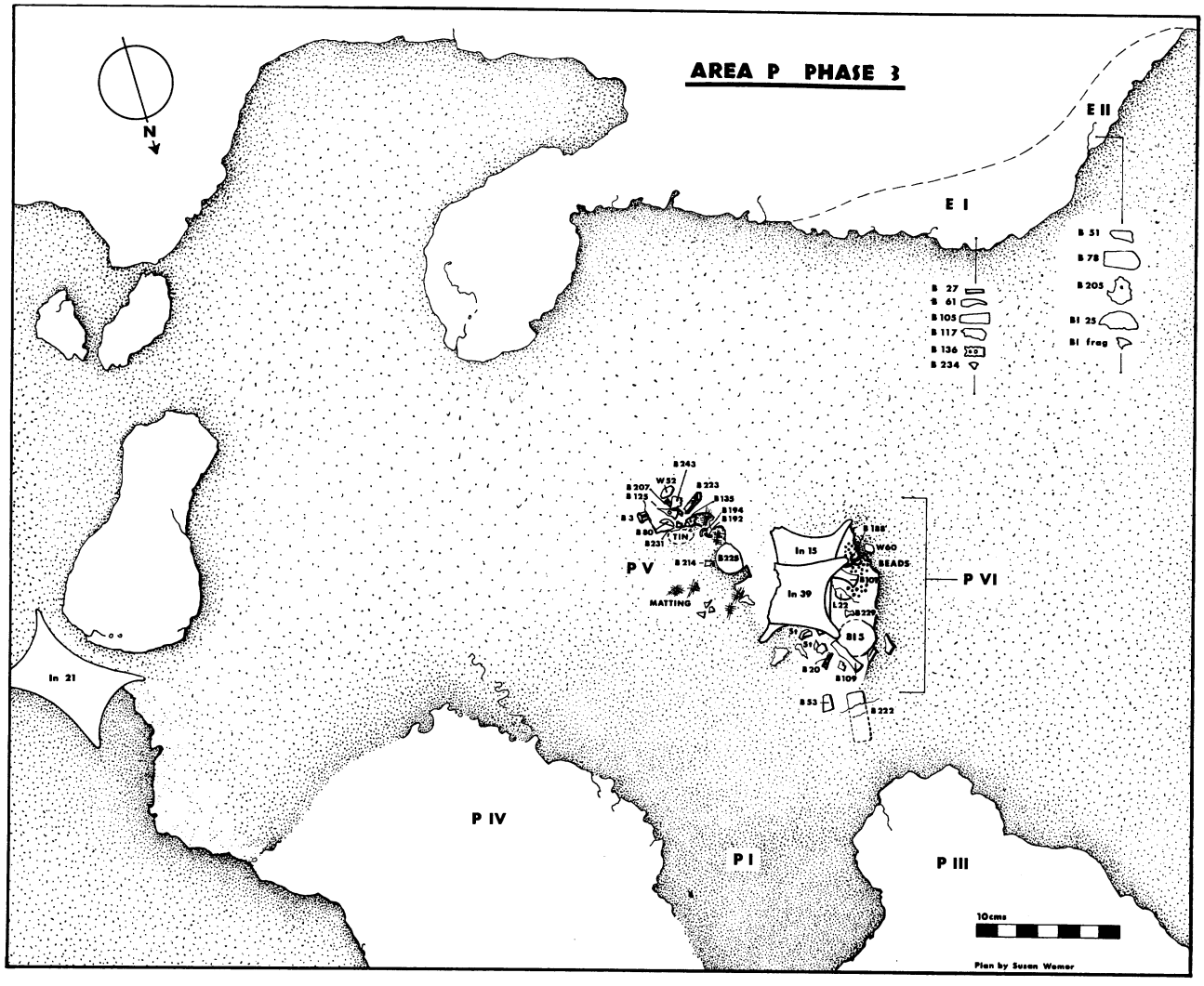


FIG. 26.

Areas G and S, Phase 2 (fig. 28)

On June 18, the concretion between In 19 and In 21, bearing the impression of an ingot raised in 1959, was broken in half and raised. Stuck to its bottom were pieces of pottery (P 14 and a fragment of P 2); BI 15 and the fragment of another bun ingot also came to light. Lumps G I and II were broken away on June 20, revealing bronzes, a slab ingot, and traces of wood beneath G IV. G II was not actually raised until July 6, and on the same day G III (containing In 16–19) was attached to a rope to be raised.

Areas G and S, Phase 3 (fig. 29)

G V (which proved to be only a very large rock) and In 24, resting on G V, were raised on July 9, along with G IV. G VI (containing In 26 and In 27) and G VII were raised two days later, revealing wood fragments and white substance (which prove to be tin oxide), but leaving In 29 *in situ*. The raising of the stone "anvil" (St 7) revealed small bronze and stone objects beneath.

Areas G and S, Phase 4 (fig. 30)

In breaking pieces of concretion away from the south edge of area G, we revealed metal fragments, ballast stones, and the ends of twigs. The air lift was used for the first time on July 15, and by sweeping sand down to it from the area formerly occupied by G III and St 7, we uncovered a number of bronze tools and wood fragments, including twigs.

Areas G and S, Phase 5 (fig. 31)

From July 16 to August 1, work in area G was confined mainly to cleaning the sand from the floor of the "gulley," and it was during this time that the scarabs and the first of the maceheads (St 1) came to light. At the same time, many more twigs were uncovered in the

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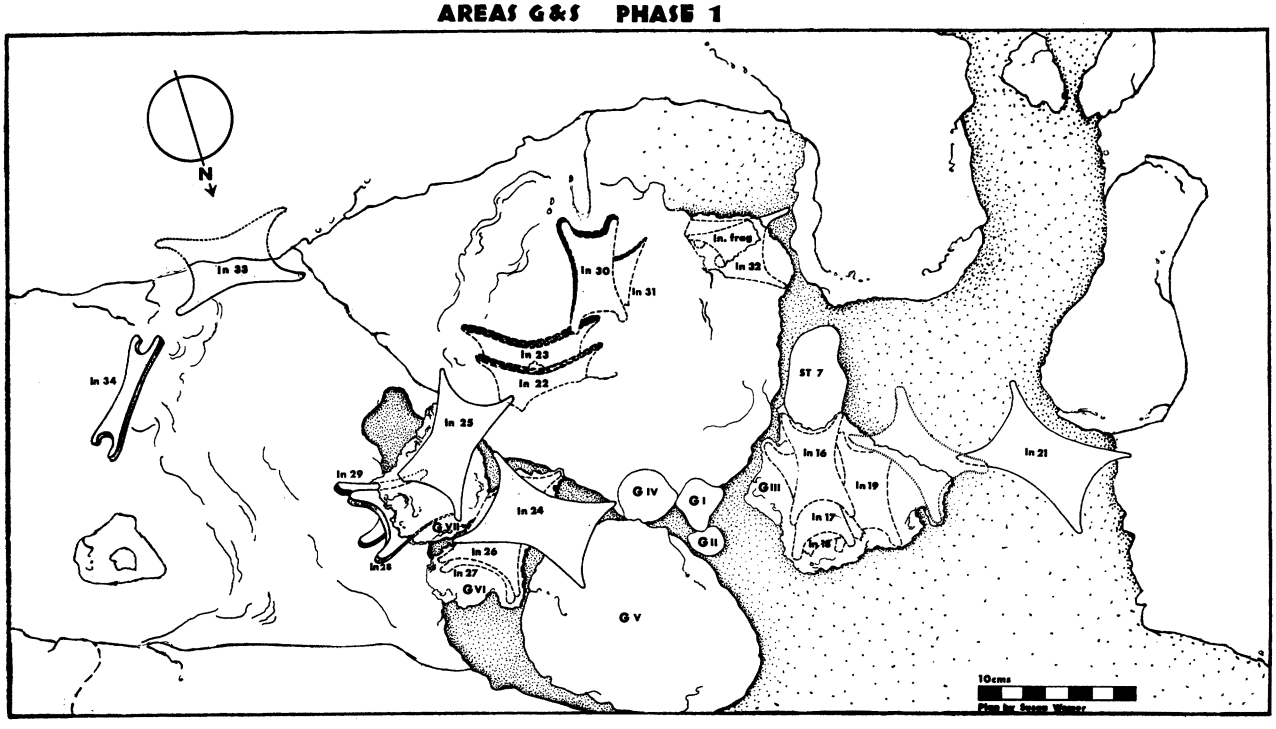


FIG. 27.

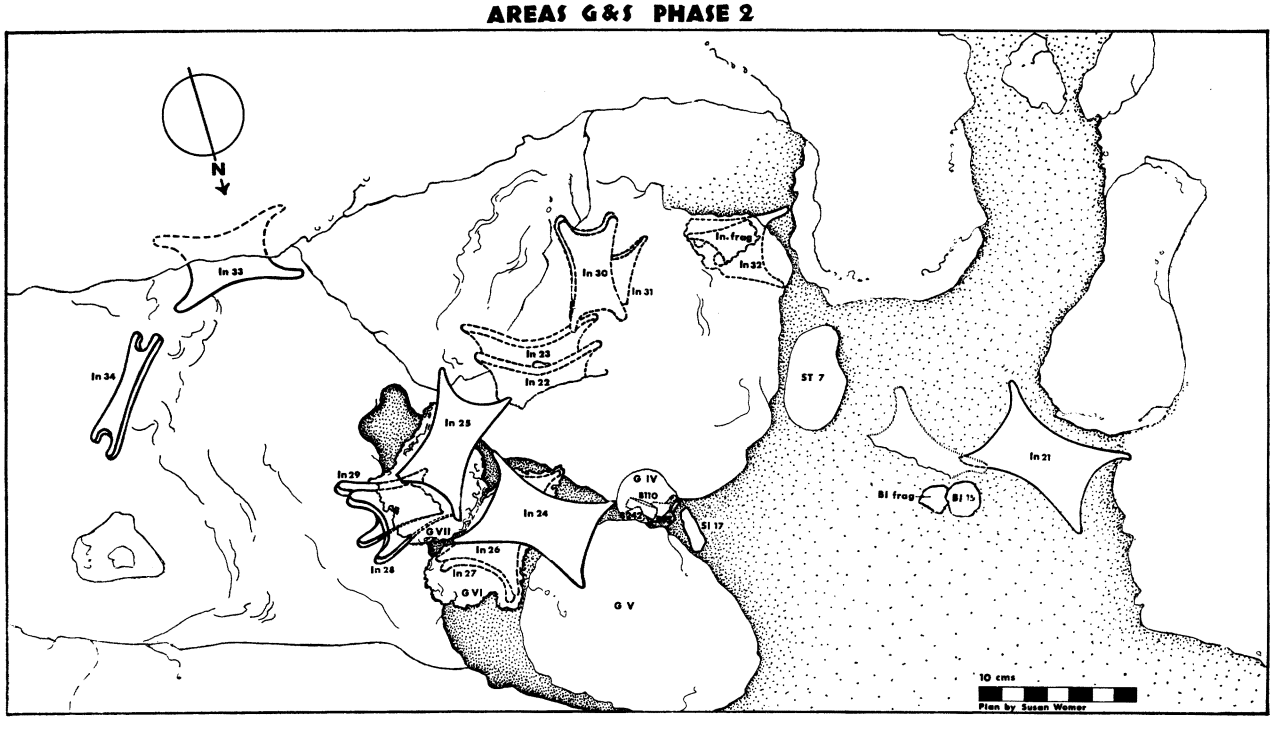


FIG. 28.

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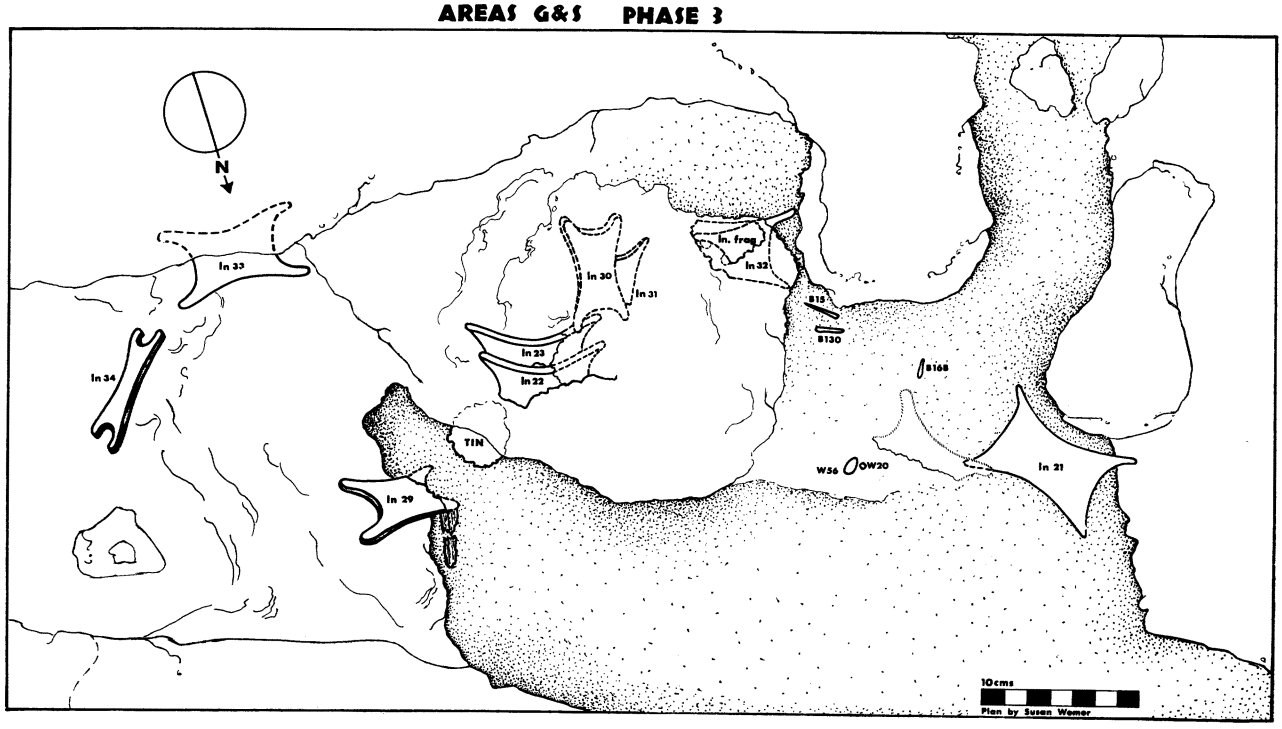


FIG. 29.

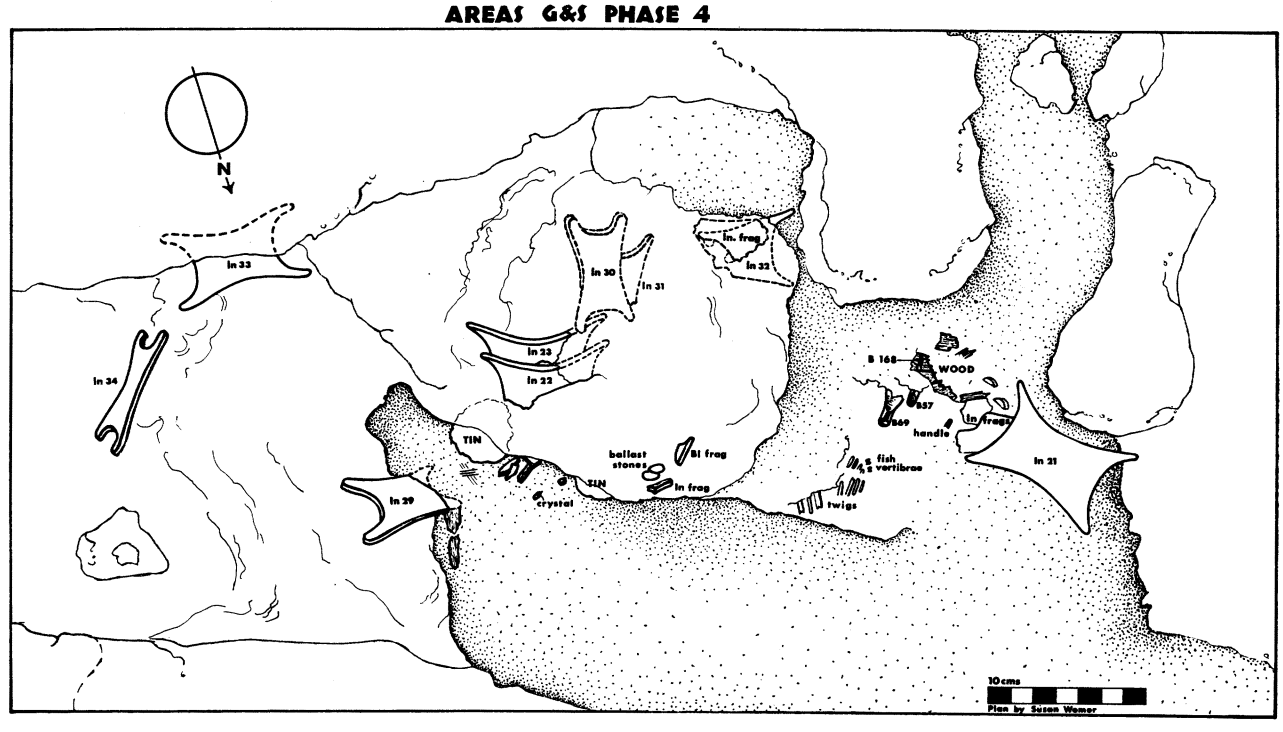


FIG. 30.

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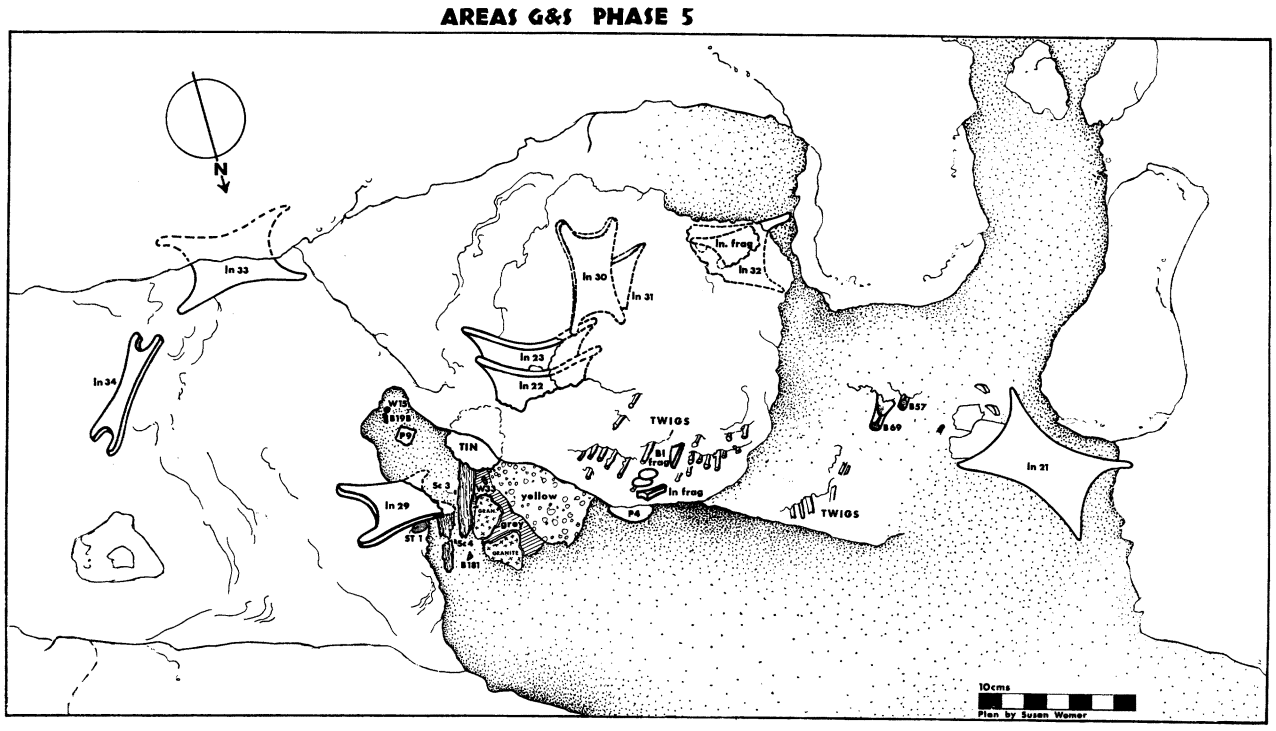


FIG. 31.

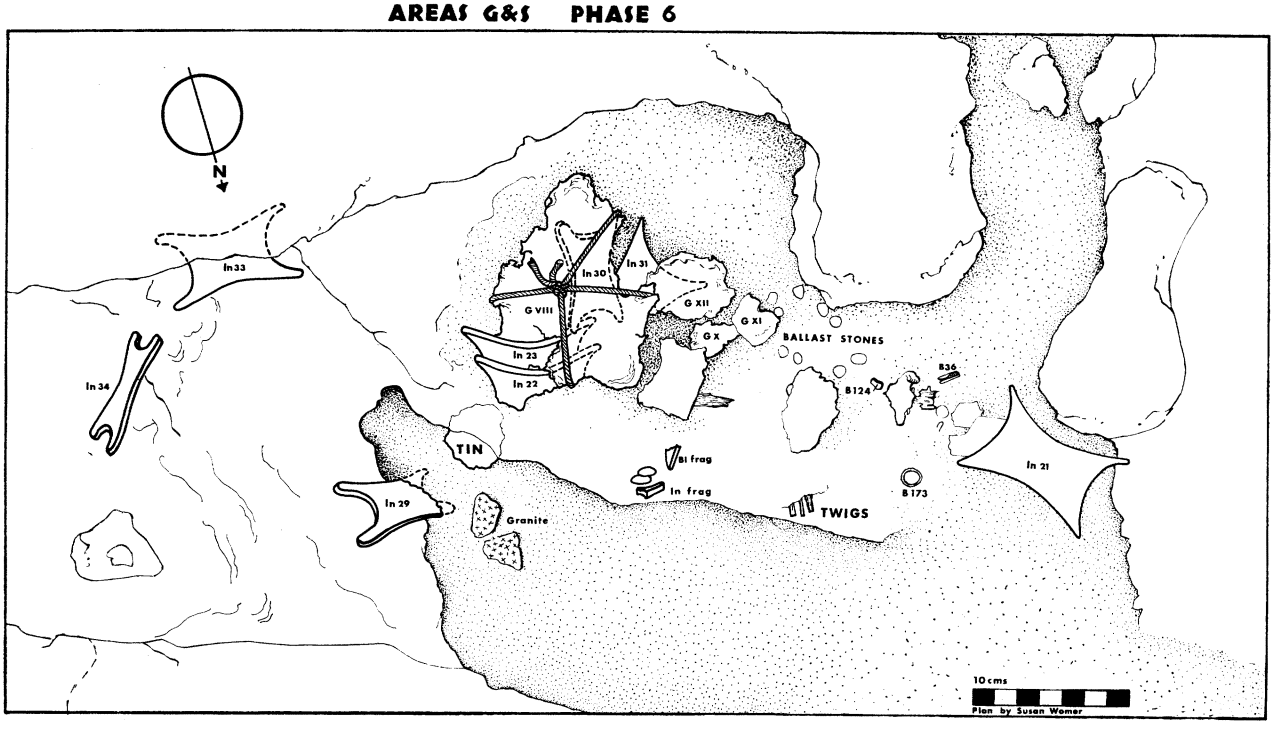


FIG. 32.

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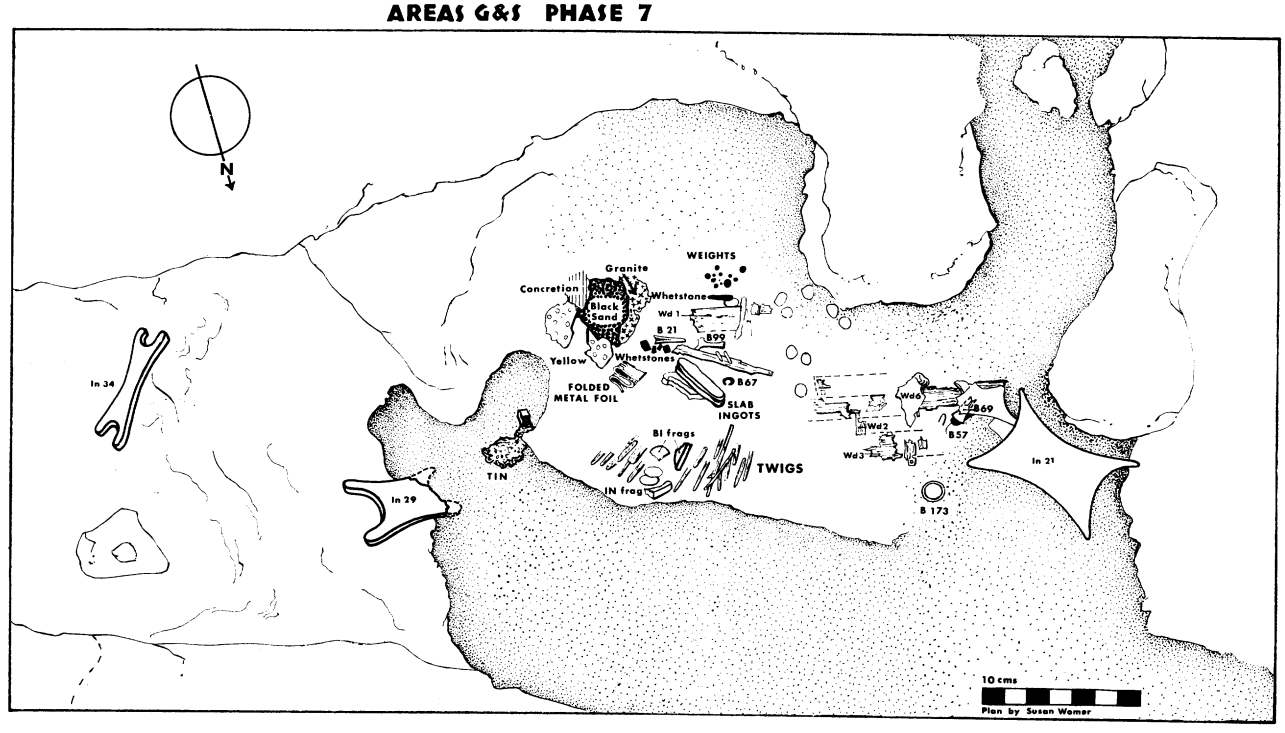


FIG. 33.

breaking away of concretion just below In 22–23, and In 30–32. Some of the wood near In 21 was removed.

Areas G and S, Phase 6 (fig. 32)

We determined to raise the remaining large mass of concreted material (G VIII) from above the remains of wood, and this was chipped loose and tied with ropes by August 2. The following day it was raised to the surface in our first use of lifting balloons during the excavation. In 32, and an adjoining ingot fragment, were also raised; this broke the concretion into smaller lumps (G X, XI, XII) which were raised separately. New wood was appearing near In 21.

Areas G and S, Phase 7 (fig. 33)

The removal of G VIII-XII revealed a jumbled mass of material (including metal foil, slab ingots, whetstones, weights, bronzes, and ballast stones) which had been crushed beneath the ingots and concretion. This material rested on the twigs, which were covered (except for their protruding ends) by a mixture of concretion and sand. Under G VIII was found a large stone which, when removed, revealed that the tin oxide seemed to be coming from a box-like cavity in the concretion. In 33 was removed.

The remainder of the season, until the first week of September, was spent in cutting around and raising the lump which held the twigs. During this time the lamp (P 29) and the second macehead (St 2) were found by In 29. When work was completed, all of the remains had been raised to the surface and the area had been searched with a metal detector for any invisible deposits of bronze.

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III. CONDITION AND TREATMENT OF FINDS

J. du Plat Taylor

The bulk of the objects were mixed together in the cargo and fell into two principal masses on the sea bed. In the course of centuries the objects became cemented together by solid concretion which so completely covered them that they were not easily distinguished in the first dives.

M. Frédéric Dumas comments on this concretion:

In general, ancient wrecks have induced a rapid accumulation of sand which has arrested the formation of concretion. The top of the cargo, where it emerges from the sand, carries a considerable amount of concretion which is still in the process of formation. Under the sand we find dead concretions which diminish in quantity in proportion to the depth in which they are buried beneath the sand.

The case of the Gelidonya wreck is unusual. The wreck lay on a rocky bottom, near the top of a submarine ridge swept by a strong current and was unprotected by any accumulation of sand. The formation of concretion on this wreck has been continuous since the day the ship sank until the excavation. The cargo was entirely masked by concretion, which was of such thickness that it closely resembled the adjoining rocks. In certain areas, particularly area G, the upper layers of concretion were irregular, leaving large hollows; this concretion was spongy and friable and easily broken with the hammer.

The spongy concretion directly overlay either part of the cargo, or more often, a layer of hard, compact and homogeneous concretion in which the cargo was embedded as in the rock. In some places, particularly at the western end of the wreck, there was no spongy concretion and the hard, compact layer could immediately be seen to form an irregular rocky floor and hid completely the shape of the metal objects which it contained.

It should be noted that some isolated ingots were hardly at all covered by concretion.

Mr. A. W. D. Larkum, B.Sc., A.R.C.S., Department of Agriculture, Oxford, reports on samples of concretion:

The concretions consist of a matrix of consolidated fragments of a crystalline carbonaceous material, which is predominantly calcium carbonate in all probability. This forms a homogeneous ground material in which are embedded many skeletons and remains of animals and plants.

Most notable are numbers of Foraminifera, microscopic organisms free-floating in the upper sea which have an enduring siliceous test or shell, and much evidence of the encrusting bottom (benthic) algae of the family Squamariaceae (probably *Lithothamnion* sp.). Also common are Polyzoa, gastropods and the tubes of polychaete worms. These, together with evidence of Porifera, Radiolaria, echinoderms, coral and some small fragments of wood, form the groups identifiable upon macroscopic and microscopic inspection.

Such concretions are interesting in providing fossils of very recent origin which, when compared with those from older deposits, show certain differences, indicating conditions appertaining during deposition.

It is, for example, rare to be able to distinguish so many different forms of former biotic existence. The special circumstances here are recent origin, deposition near a shore line and the lack of any major changes of environment during deposition.

The presence of *Lithothamnion* (?) and the absence of many corals, sponges, etc., limits the maximum depth to 120 feet or less. The occurrence of gastropods, echinoderms, and *Corallina* spp., suggests that there has either been some movement of material from nearby shallower water or that the site itself was at one time within 40 feet or so of the surface.

Since Foraminifera are not common in the Mediterranean plankton of today there is the possibility that the seas have changed since much of the deposition. Foraminifera require silicon to form their tests and this is a minor constituent of drainage water from the land, and is the means by which much of the silicon in the sea is replenished. Since drainage requires rainfall on to a suitable siliceous terrain and remembering that such areas today are largely desert, there is an indication that this part of the Mediterranean was better watered at one time than it is today, though not necessarily at the time of the depositions discussed here.

The origin of the wood is probably from the hull of the ship.

In my conception of the build-up of the concretions two distinct marine groups have played their part, the plankton and the benthon. On the one hand bottom living organisms have grown up, perished and have been quickly succeeded by rivals, over many generations. Much of these remains would disintegrate or dissolve away but as growth was so fast much material would be caught and buried beneath living organisms. On the other hand there would be a steady downpour of planktonic skeletons, Foraminifera, Radiolaria, etc. Mix all this up by the action of wandering and boring animals, e.g. echinoderms and polychaetes, and it is possible to form a picture of how such a varied collection of remains could have been brought together and consolidated with so much homogeneous ground substance.

He further suggests that

the systematic collection of concretions could become a very valuable tool in investigating and reconstructing the submarine environment at the time of a wreck and subsequent changes which have occurred. For detailed, scientific excavations under the sea work of this nature is to be strongly recommended.

However, concretion is a localized occurrence and so such evidence will not always be forthcoming. In the collection of concretion it is recommended that the following points should be taken into consideration:

(1) Complete sections labelled outside and inside are necessary.
(2) Several sections should be collected with details of position and aspect.
(3) Any factors determining the formation of concretion should be noted, e.g. substratum, topography, currents.

THE INGOTS AND IMBEDDED TOOLS

These were for the most part found in two groups, the platform (area P) and the gulley (area G). In the former the ingots were only slightly tilted out of position and were cemented together in a solid mass so that

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only the surface of some, and the edges of others were visible. The concretion was smooth on top, varying in thickness from a thin skin to solid lumps between the ingots as much as 15 cm. thick. On the underside, where the ingots did not rest on the sea bed, the concretion assumed a nobbled effect, especially round the edge of the mass, where it appeared like a fringe.

Some ingots had been detached previously from the mass, but left a clear, whitish mold in the position from which they had been torn.

As has been stated, these masses were cut into sections on the sea bed, and raised. On the shore, after drawing and photographing, the lumps were excavated with hammer and cold chisel. In a wet condition, though the concretion was softer, it was found that the substance was mushy and difficult to detach; whereas in the harder condition after drying for some days or longer, it split and detached itself more easily from the objects.

From the smooth underside of the ingots, the concretion came away cleanly leaving a dark contact layer which appeared uncorroded. On the upper sides and especially on the lugs, there was a thick impregnated layer, green and then white next to the copper, which when detached left a rough surface. Under this the copper had frequently turned to a spongy, black copper compound [1] and tended to break up: if wet it dissolved into a black liquid. The majority of the small fragments were in this condition when broken out of the concretion.

For the most part, this type of concretion could be split away from objects by a gentle hammering (fig. 34) like scaling rust from metal, leaving the object intact to the cuprite skin. Hydrochloric acid was tried in some cases to finish off the cleaning, but some of the concretion was unaffected by the acid available.

The cuprite skin was sometimes a bright red layer, at others gray black; crystals, pinhead to 4–5 mm. in size, covered both bronze tools and ingots, but beneath in almost every case a layer of white atacamite, or black copper compound covered the remaining metal. The ingots in some cases showed good copper, uncorroded in a section cut across one specimen in 1959. This ingot was untreated in any way and left during the year in an open room in Bodrum Castle overlooking the sea. The original surface, still partly covered by concretion, was no different in appearance from those recently recovered from the sea. The cut surface had turned slightly green and powdery, but no rapid corrosion had taken place.

[1] The copper compound samples were examined by the Archaeological Research Laboratories in Oxford, by permission of Dr. E. T. Hall. They were found to contain copper with some lead, tin and iron. The latter may originate from the fabric of the sherd (from which the sample was scraped), as other ceramic constituents (silica, alumina, titania) were also present.



FIG. 34. Bass, Taylor and Dumas clean bronzes next to fresh-water basin.

The bronze tools, however, were almost always covered with an active white, atacamite layer and the metal itself, though hard enough, was brittle and sandy, crystalline in texture, and completely mineralized. The concretion being harder than the metal, it was not easy to remove and, unless it could be split off, it was difficult not to mark the object either with chisel or electric Vibro-Tool. In some objects, notably the small ingots, the metal was completely soft and pulpy beneath the cuprite skin when wet; this dried into powder and the ingots could only be preserved by impregnation.

Objects recovered from beneath these masses were partly imbedded in sand. This had in some cases begun to solidify round them and was heavily stained green to a depth of an inch or more. The sand was much more easily detached from the objects and usually left a reasonably clean surface. Objects recovered from crannies in the rock had been rolled about in the sand and appeared not to be covered with concretion, but were frequently black from the copper compounds which pervaded the sea bed and formed black layers in the sand.

OTHER METALS

Large amorphous lumps of white paste proved to be tin oxide.

A lead disc was found in reasonably good condition with only a thin skin of white corrosion. The net sinkers, on the other hand, were corroded right through and only retained their shape in white matter.

Folded sheets of metal foil, $\frac{1}{2}$ mm. thick, recovered from the gulley (area G), were too thin to detach from the concretion matrix.

POTTERY

Sherds recovered from sand were free of concretion, but were rather brittle. Those imbedded in concretion (fig. 35) were almost impossible to free, as the lime-

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stone could not be chipped off, and attempts at cleaning with acid and sequestering agents tended to remove the surfaces of the sherds further; mechanical means of cleaning, though tedious, were not much more successful.

The general condition of the pottery was poor from rolling on the bottom, and the surfaces were eroded as is mostly the case with pottery from the sea. The two jugs were heavily concreted and their surfaces flaking badly. For the rest ,the body clay remained but most of the surfaces had been destroyed; paint showed only as a shadow mark, especially on the Mycenaean sherds; of these only the base retained some approximation of the old surface.

Sherds beneath the ingots and in the sand were partially impregnated with cupric sulphide, which gave a blackened appearance. This blackening of the sand occurred only in the areas beneath the cargo, and in the crevices of area P and area G, and was derived from the distintegration of the copper ingots under the concretion. Kiln experiments carried out on one of the impregnated sherds showed that this blackening disappeared when refired at about 600° C.

GLASS BEADS

Unless kept wet, these disintegrated into powder.

WOOD AND FIBERS

These retained their shape well when brought up and it was possible to handle the pieces for drawing and cleaning.

TREATMENT

Treatment in camp was confined to general cleaning off of concretion and washing in fresh water. For this purpose two large cement tanks were built below a fresh-water spring in the cliff, and the overflow from one tank to the other kept the water constantly changing.

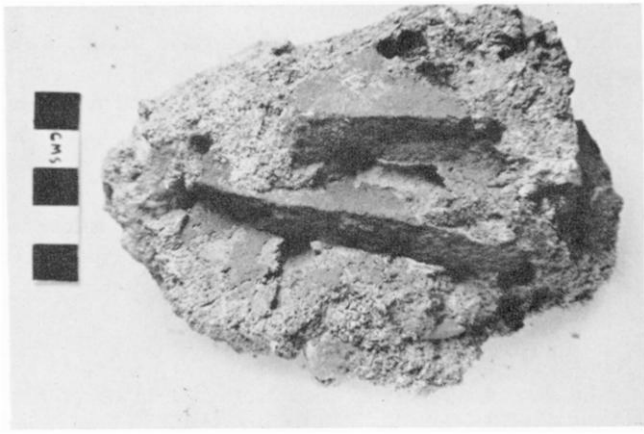


FIG. 35. Sherds of pottery imbedded in concretion.



FIG. 36. Ann Bass coats largest preserved wood fragment with Araldite C at camp.

As the objects were freed from concretion, they were placed in these tanks and left to soak. At the time the writer left, a number of pieces of metal had been soaking for over a month, and were dried in the sun (average temperature 80–90° F.). After these had remained exposed for ten days or more they showed no deterioration and were packed for transport. Other pieces, including the mass of ingots, were not detached from the concretion for more than a month for reasons connected with recording. When freed, they showed no signs of rapid corrosion and much of the spongy copper compound had hardened and was less prone to fall apart. No other metal treatment was tried in camp, other than the impregnation of some of the small ingots with shellac.

Pottery was similarly washed, dried, and packed.

Wood, fibers, and beads were kept wet, at first in the tanks, and then in large polyethylene bags. Smaller items were preserved in polyethylene sample tubes. Some of the wood was impregnated with Araldite C (fig. 36). This worked quite well on spongy pieces, but it was not absorbed readily by harder pieces, especially twigs with bark still preserved, even when thinned considerably with acetone; wood which could not be thoroughly impregnated suffered serious internal warping and shrinking if allowed to dry.[2]

[2] In the summer of 1965, five years after the treatment described above, no further deterioration of the metal objects, now on display in glass cases in the Bodrum Museum, was apparent. Wood samples kept in polyethylene bags, simply folded over and fastened with paper clips, remained in good condition, but still warped rapidly when removed from the bags. The largest fragment of basketry was removed from its bag and allowed to dry with no further treatment; although still in good condition, it is quite brittle and probably should have been impregnated with Araldite C or a similar substance on its removal to open air. G. F. B.

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IMPORTANCE OF RECORDING CONDITIONS IN SITU

Mr. H. W. Hodges, Lecturer in the Conservation of Archaeological Materials at the Institute of Archaeology, examined some of the corroded copper objects in concretions and reports as follows:

The fact that while those areas of copper objects free of concretion were also relatively free from corrosion, while those covered with concretion were normally completely corroded, calls for some explanation. The most obvious conclusion would seem to be that the concretion, during its formation, exuded some compounds heavily corrosive to copper; while those areas free from concretion, washed by sea water, remained uncorroded. This, however, is only an assumption. It could with equal force be said that the concretion was only able to form on already corroded areas, and that its presence then precipitated further corrosion. The nature of the process of corrosion is quite unlike anything met with under conditions of land burial, and although one could speculate about the possible processes that have taken place, it would only be speculative to do so, and it is probably wiser not to attempt such an interpretation.

It is becoming increasingly obvious that the conditions of burial under the sea are as diverse, or possibly even more diverse, as those met with on land, and this, in turn makes it impossible to generalize about how objects will corrode under conditions of sea burial.

Our understanding of what has occurred during sea burial is important not only to archaeologists, but to many natural scientists. Such understanding can only be reached by a comprehensive study of the various phenomena met with during the examination of the site, followed by a detailed study of the materials recovered. This, of course, entails adequate study of an analytical nature. It will probably only be possible to interpret fully the past history of sea burials when we have a sufficiently large volume of records upon which to draw. It is thus, a matter of prime importance that these phenomena should be recorded both *in situ* and given careful analytical treatment later. Without such data the process of recovery lacks an essential fundamental.

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IV. THE SHIP AND ITS LADING[1]

GEORGE F. BASS

Little was preserved of the ship itself, for the rocky sea bottom onto which it sank was covered by only a few centimeters of sand. With no protective coating of mud, most of the hull had disappeared. The arrangement of the heavy cargo (fig. 37) on the sea bed, however, indicates that the ship had not tipped over before sinking, but had settled fairly evenly, probably after taking on water through one or more holes torn by jagged rocks. The keel may have come to rest on the high rock just south of In 21, and broken gradually under the weight of the cargo; this would have allowed the ingots at the two ends of the ship to come to rest as they did in areas G and P, and would explain why the central group of ingots seems to have separated, with most ingots settling into area S, but with two falling to the southwest. (These latter two ingots were raised in 1959, but their positions, indicated by dotted lines on the plan, were determined by the impressions which they had left in the sea bed.) As the ship broke into pieces, various parts of it finally did tip over, to a greater or lesser degree depending on the slope.

Most of the ingots were found still stacked in three major piles, as they must have been in the ship; those that settled on a flat bottom, as in area P, had barely shifted from their original positions (fig. 17). The stacking arrangement in areas G and S were still obvious, although the piles had slid downhill when the side of the ship gave way (fig. 16). Figure 91, in chapter V, presents the most probable order in which the ingots were originally stacked, based on their positions on the sea bed (figs. 38, 39, and 40). Traces of matting found on many of the ingots, especially those in area P, suggest that the ingots were wrapped together, or that there were at least layers of matting between ingots.

Most of the smaller bun and slab ingots also were found in stacks, but some of the bun ingots were found separately. The remainder of the metal cargo, which consisted of complete and fragmentary bronze implements, was scattered throughout the site (fig. 41).

[1] A detailed study of all of the underwater photographs and drawings led to few definite conclusions about the wooden remains. When a better preserved ship of the same period is excavated in the future, a restudy of those records would probably result in the proper identification of some of the wooden remains of this ship.

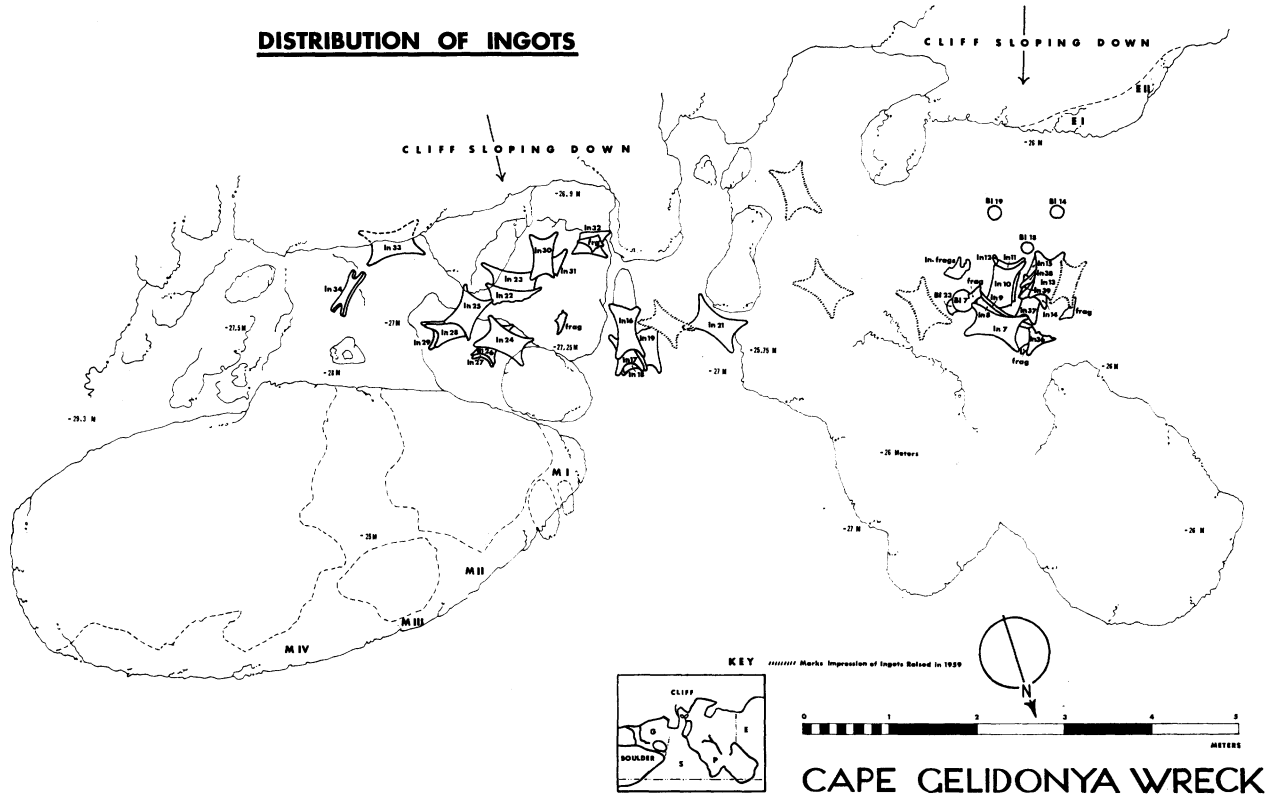


FIG. 37.

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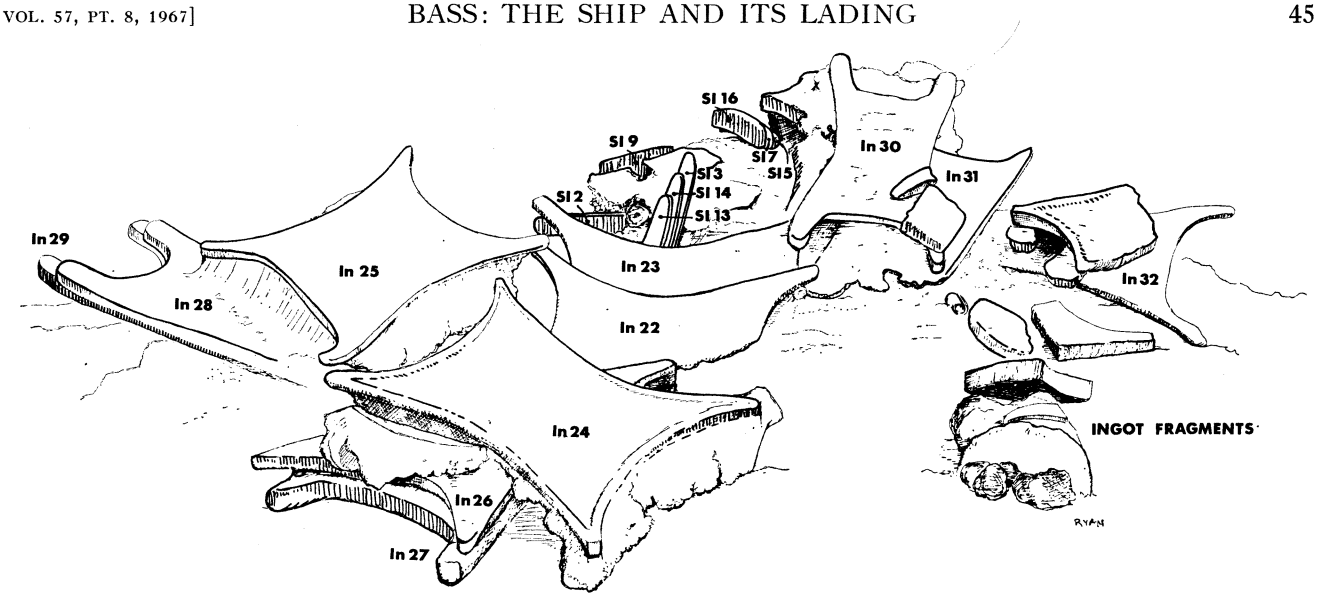


FIG. 38. Ingots from area G as seen from north.

Often the bronzes were found in small groups, which suggested that they had been carried in bags or baskets, and this suggestion was borne out by the discovery of a well-preserved portion of a wicker basket which was tightly packed with bits and pieces of metal.

The distribution of this heavy cargo suggests that the ship was about ten meters long; this is only slightly shorter than the figure of forty feet, based on intervals between oarsmen, suggested by Seymour for a Homeric merchant ship.[2]

Little could be learned from a study of the distribution of pottery in the wreck (fig. 42).

The distribution of what I consider the personal possessions of the captain and his crew—scarabs, the ship's lamp, maceheads, whetstones, an astragal, a cylinder seal, weights, and traces of food (figs. 43 and 44)—gives fairly certain evidence that the living quarters of the ship came to rest in area G. (Some of the smaller pieces were found in crevices under the Boulder, but they were surely carried there from area G by the current.) Although there was nothing to suggest that there was an actual cabin here, we may assume that some sort of shelter was provided and that this was, as is still normal, near the stern. A more tenuous reason for believing that the stern was in area G was the discovery of the triangular, pierced stone which lay farther east than any of the cargo (figs. 6, 10, and 37). Whether or not this was a crude stone anchor was debated throughout the course of the excavation; the consensus, after close examination, was that it was only a natural stone, but it does deserve mention.

It was virtually impossible to determine with any certainty which members of the ship were represented in the jumble of wood. The wider planks generally ran in an east-west direction, which suggested that they were strakes running the length of the ship. The only wood

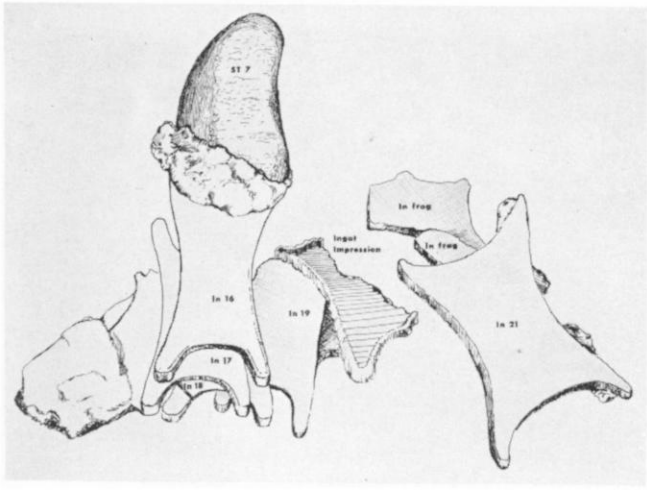


FIG. 39. Ingots from area S as seen from north.

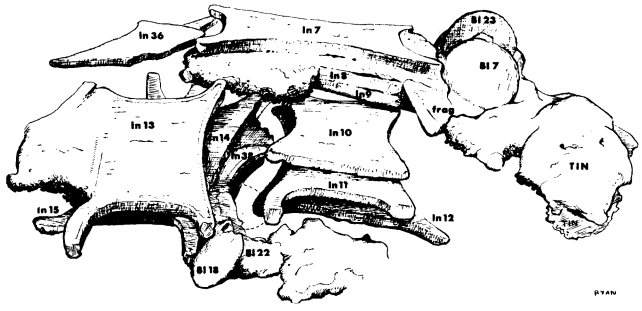


FIG. 40. Ingots from area P.

[2] *Life in the Homeric Age*, 308.

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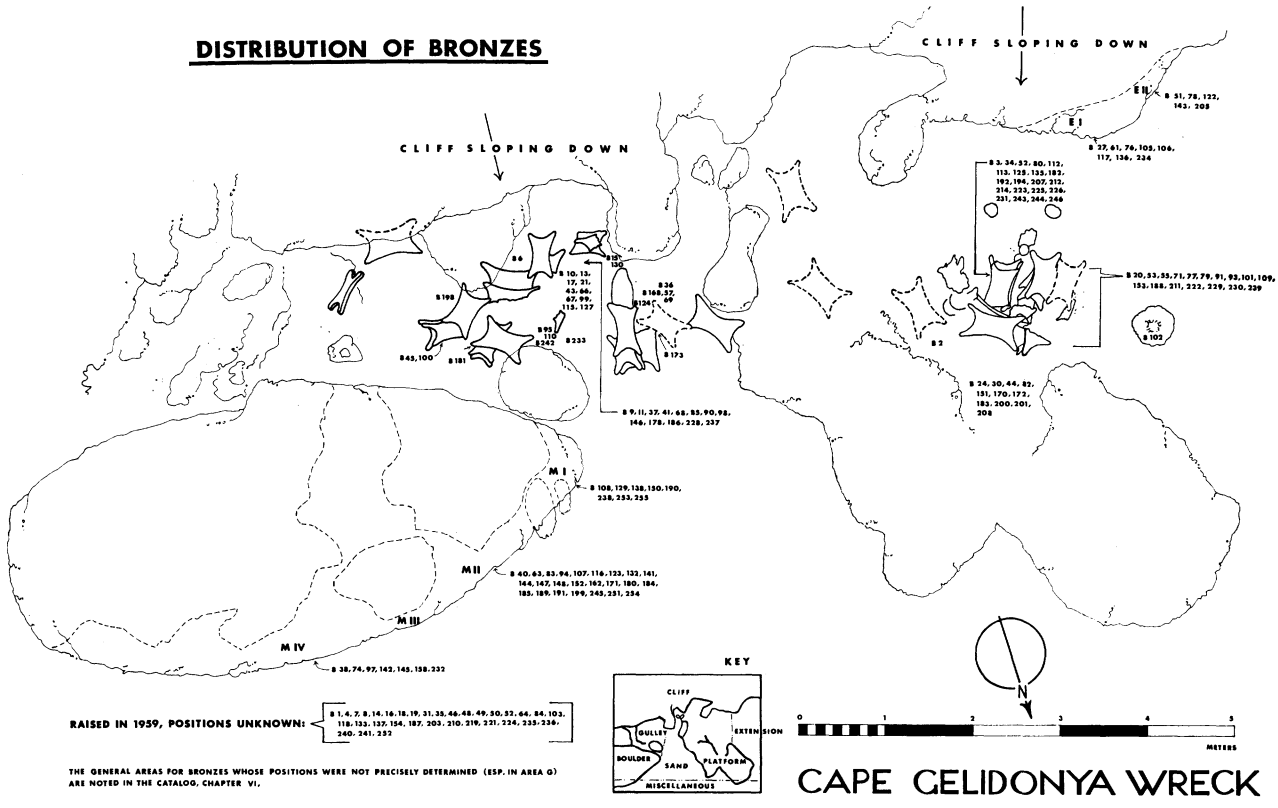


FIG. 41.

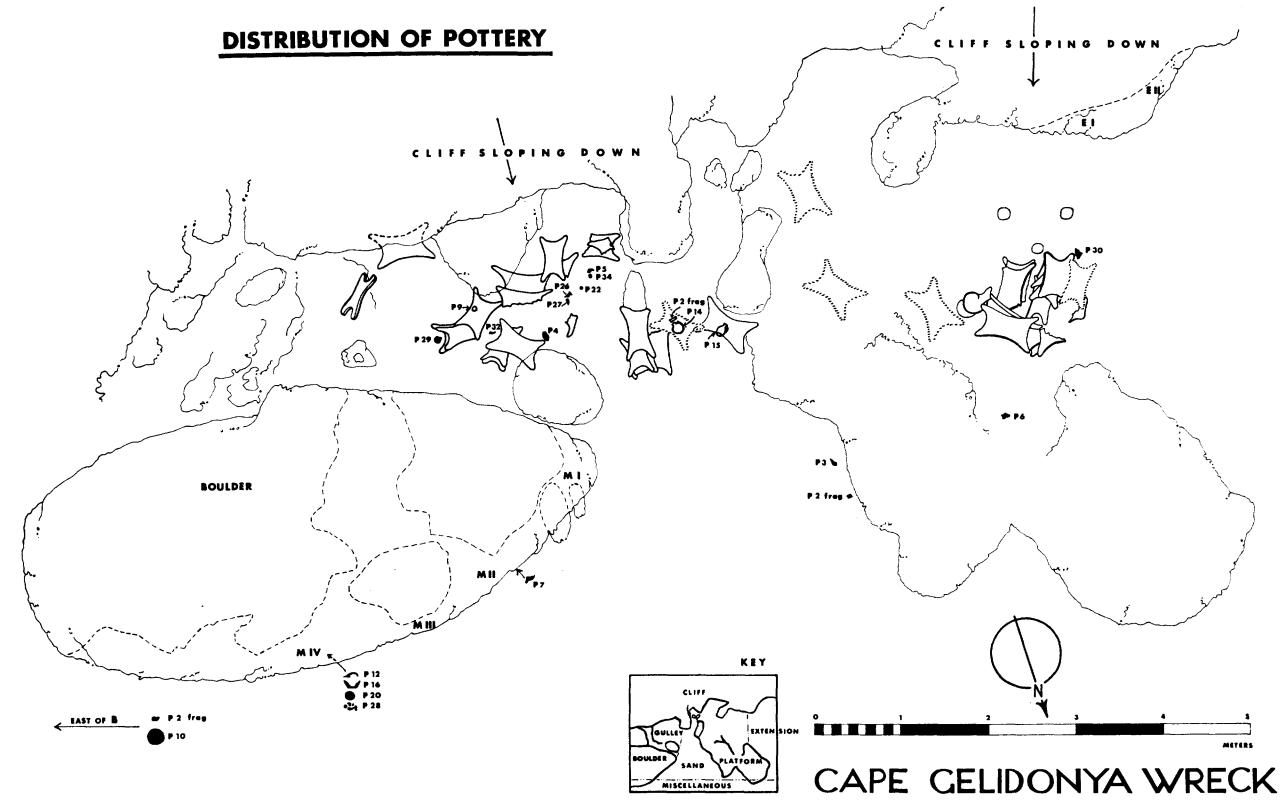


FIG. 42.

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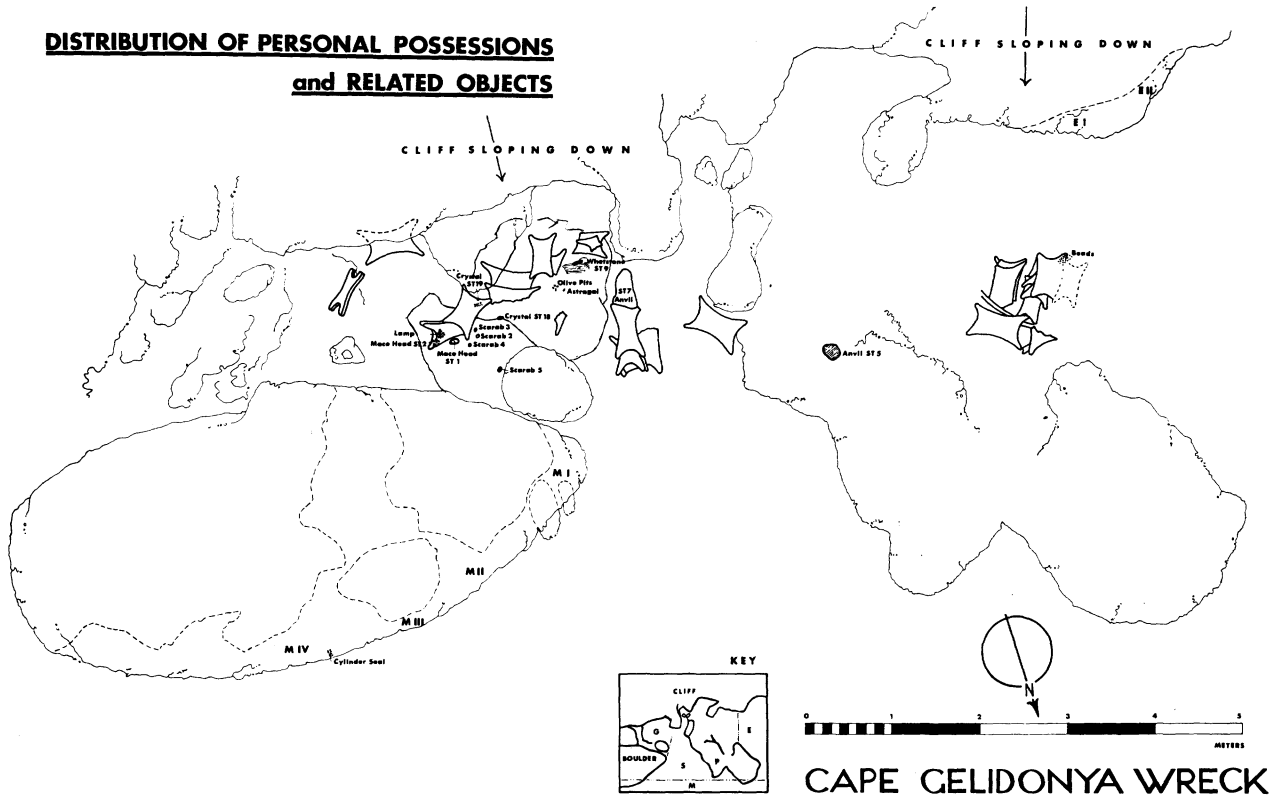


FIG. 43.

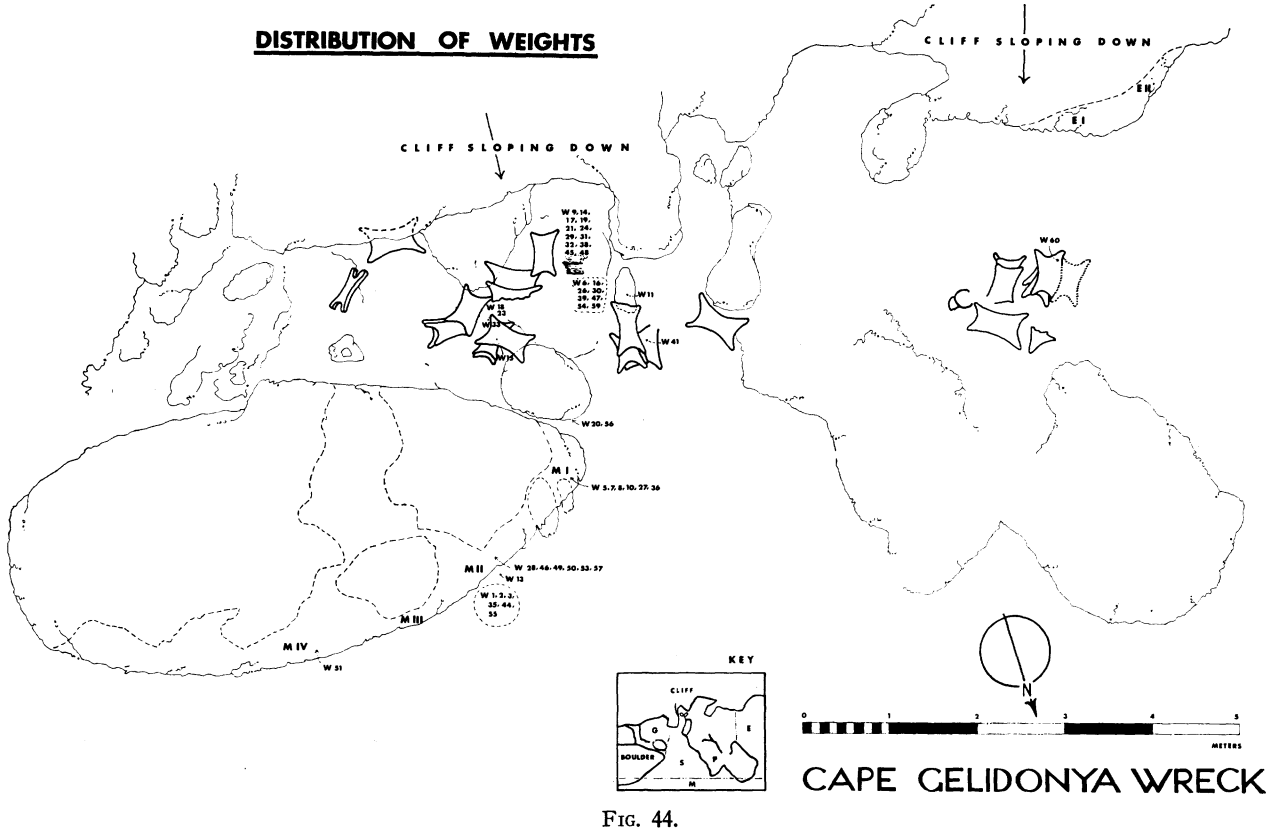


FIG. 44.

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FIG. 45. Eğdemir drawing remains of wood *in situ;* Wd 1 at extreme left.

that was preserved in its original context, however, was that raised in a lump of concretion and disassembled on land (figs. 45 and 46). This showed positively what had been suggested earlier, that the narrower pieces of wood ran perpendicularly *under* the broader pieces, and were fastened to them with treenails (1.5 to 2 cm. in diameter). The spacing of the treenails, or wooden pegs, would have allowed the wider pieces to lie closely side by side, so that we may have remains of the ceiling (the inner lining) of the ship.

Running also in an east-west direction, and higher on the slope on which the wood lay, was a much larger piece of wood (pres. L. .24, W. .143, Th. .057) which may be seen in figures 45 and 46. That it was not part of a gunwale was proved by the discovery of many weights and other objects, including some of the 116 kilograms of ballast stones from the wreck, even higher on the slope; these objects would have settled to the bottom of the ship, and there seems no conceivable way in which they could have reached their positions unless the large piece of wood was either the keel or, more probably, simply a heavier strake. The possibility naturally exists, however, that any of the wood frag-

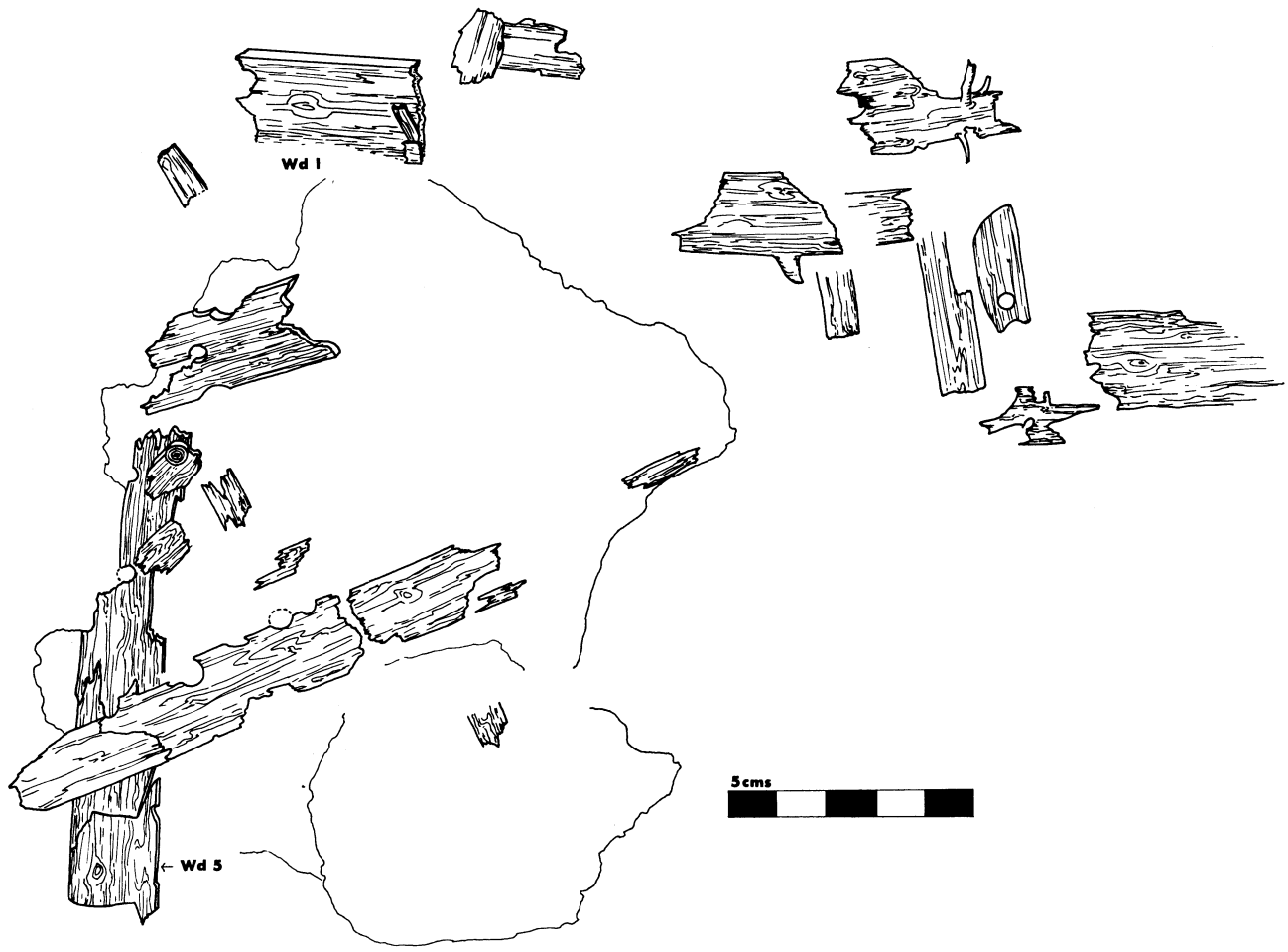


FIG. 46. Wood remains after having been cleaned of concretion on land.

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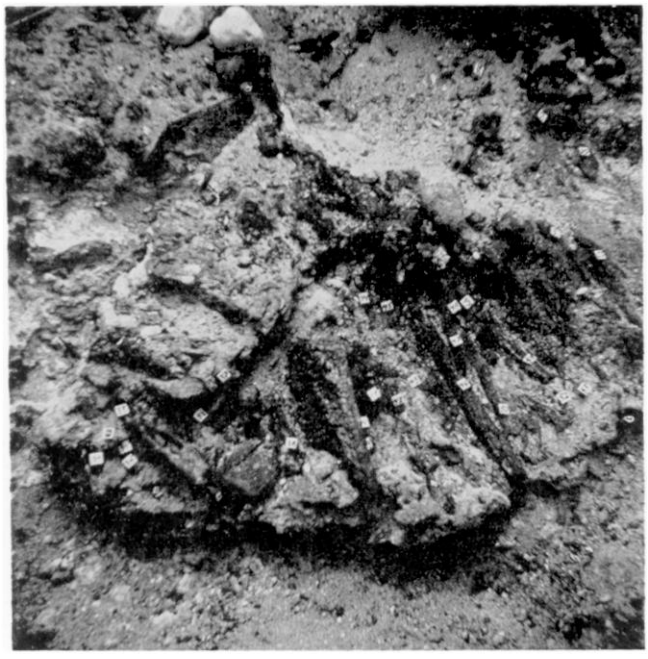


FIG. 47. Brushwood remains resting on south edge of area G.

ments were simply pieces of chests or other furnishings in the ship.

Over the "ceiling strakes," and perpendicular to them, lay a large pile of sticks (figs. 47 and 48). They varied in size, but none was probably ever more than a meter long; their ends were often preserved, cut diagonally across as if by an axe, and bark and twigs remained on most of them. They surely had nothing to do with the construction of the ship, and G. Gruben suggests that they might have served to protect the thin planks against the heavy metal cargo; it is certain that they lay beneath the ingots.

Ships following the same route (see chap. XIV) as did the Gelidonya ship continue this practice of cushioning their cargoes. G. L. Harrington informs me that

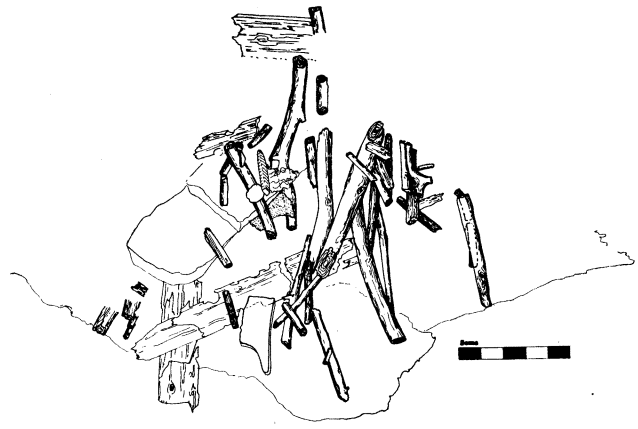


FIG. 48. Detail of some of brushwood still lying across planks of hull after cleaning; *cf.* fig. 47.

the freighter on which he was traveling in 1959 "took on bundles of cuttings either of rushes or of twigs" in Beirut. "Inquiry of what was being done with them received the reply that they were to be used as a type of matting on which later cargo of grapes and citrus fruit would be placed . . . at Cyprus and at Gaza." [3]

The brushwood aids considerably in an understanding of *Odyssey* 5. 256–257, which had previously presented difficulties in translation:

φράξε δέ μιν ῥίπεσσι διαμπερὲς οἰσυΐνῃσι
κύματος εἶλαρ ἔμεν· πολλὴν δ'ἐπεχεύατο ὕλην.

The ὕλη has been considered part of the wattle fencing which Odysseus built as protection against the waves, or at least a backing for such a fence; it has even been translated as ballast or a bed. It now seems that only literal translation is required, for brushwood was probably the usual dunnage in such early ships.

From the cargo and from the few fragments of wood found at Gelidonya, we have gained a picture of a small

[3] From a letter to the author, dated 2 April, 1963.

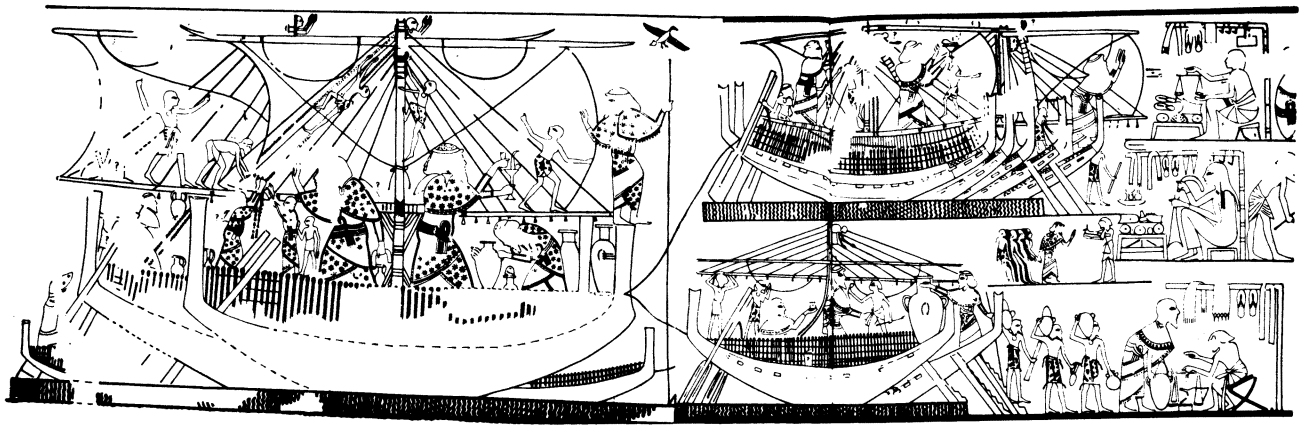


FIG. 49. Syrian merchant ships in port; from Tomb of Kenamon at Thebes (from Davies and Faulkner).

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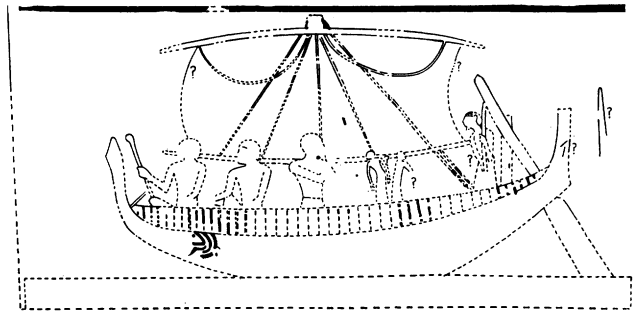


FIG. 50. Syrian ship; from Tomb of Nebamūn at Thebes (from Säve-Söderbergh, courtesy Griffith Institute).

coastal vessel about the same size as those used by sponge fisherman throughout the eastern Mediterranean. It had on board at least a ton of cargo, with, in addition, whatever perishable cargo was contained in its storage jars. Unfortunately, however, the hull itself gives no clue as to the nationality of the ship (*cf.* figs. 49 and 50).[4]

[4] The ships shown here are Syrian. For the scanty evidence we have of the appearance of Bronze Age ships, mostly from fanciful and inaccurate drawings and carvings, see Spyridon Marinatos, "La Marine creto-mycenienne," *BCH* **57** (1933) 170–235, and G. S. Kirk, "Ships on Geometric Vases," *BSA* **44**

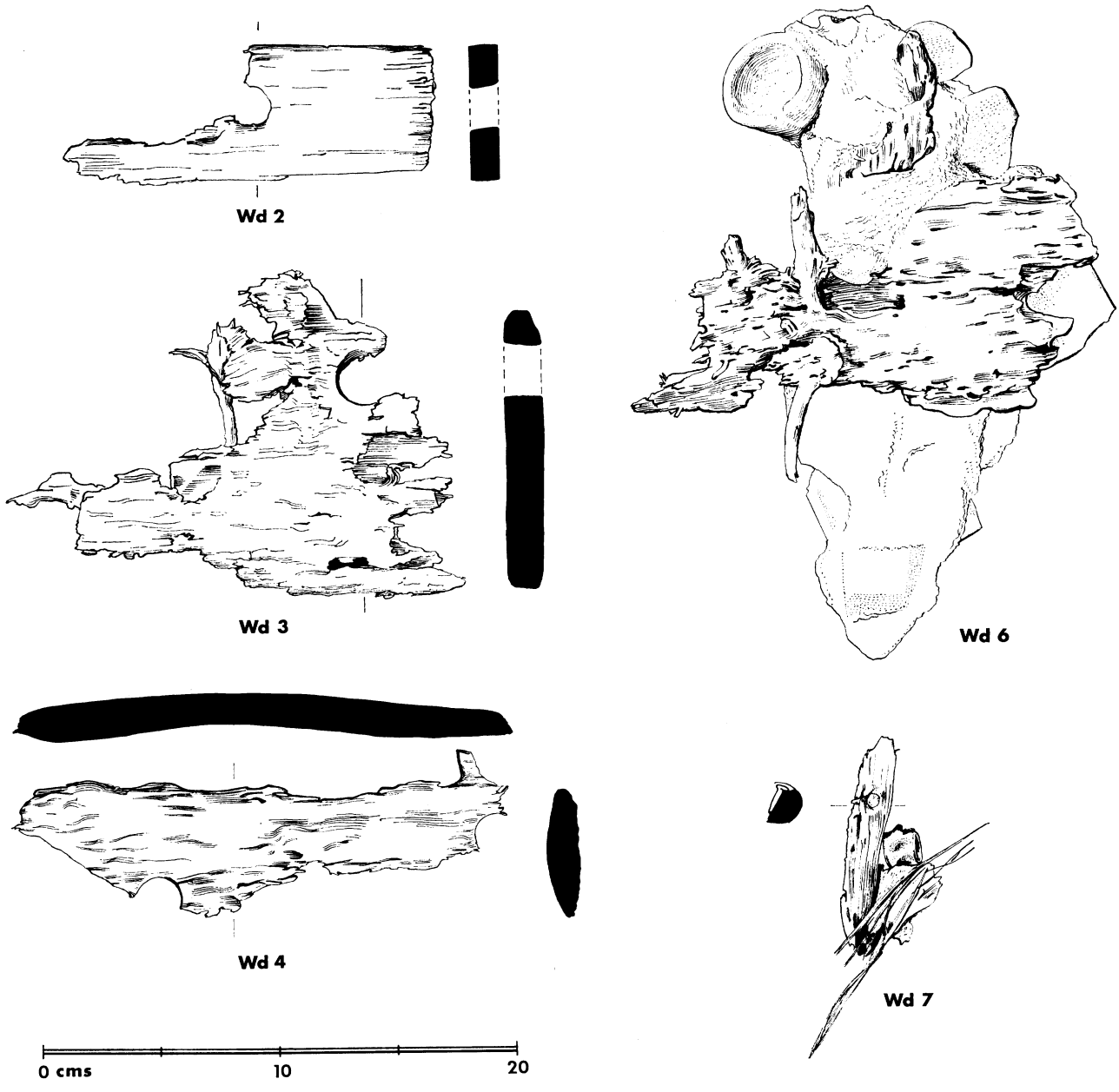


FIG. 51. Wood fragments.

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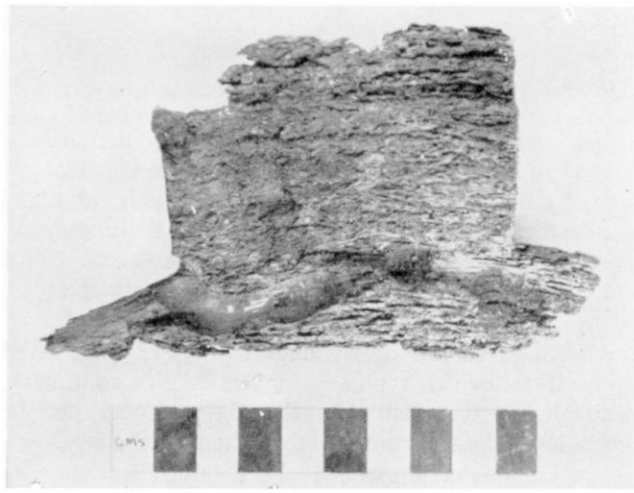


FIG. 52. Wd 5.

Following is a list of representative wood fragments from the wreck; twenty-five other pieces were catalogued, but these were too fragmentary to be meaningful. The original positions of a few of the pieces may be seen in figures 33 and 46, but many of the examples were found loose in the sand and could not be related to other parts of the wreck:[5]

Wd 1. Largest fragment, well preserved on three sides. Pres. L. .24, W. .143, Th. .057. It had badly warped from drying before being photographed or drawn.

Wd 2. Fig. 51. Fragment of a plank with peg hole, and squared edges. Pres. L. .154, W. .053, Th. .013, D. of peg hole .018.

Wd 3. Fig. 51. Ragged fragment of plank, with many knots. Pres. L. .18, W. .135, Th. .018, D. of peg hole .022.

Wd 4. Fig. 51. Fragment of plank with two peg holes. One poorly preserved face with slight convex curve and traces of bark. Knots at either end. Pres. L. .195, W. .05, Th. after some drying .01, D. of peg holes .018, holes .123 apart.

Wd 5. Fig. 52. Short length of plank with ends cut to fit other pieces of plank at either end; its position may be noted in figure 46. Another adjoining piece, extending downward, was seen under water, but it quickly fell away. It would seem that these separate pieces were held in position by the pressure of strakes on either side of them, for they were not fastened together in any way. L. .134, W. .077, Th. .024.

Wd 6. Fig. 51. Large fragment of planking attached to concretion holding two metal tools. Pres. L. .21, W. .19.

Wd 7. Fig. 51. Fragment of split branch with copper or bronze nail through knot; fish bone and fiber attached to concretion. Pres. L. .085, W. .012.

Wd 8. Fig. 53. An assortment of fragments from the brushwood dunnage, drawn to the same scale.

(1949) 116–117, which includes several of this period. To the bibliographies found in these articles may be added James Mellaart, "The Royal Treasure of Dorak," *ILN* **235** (1959) 754, with fig. 2, and the crude graffiti at Enkomi, Schaeffer, *Enkomi-Alasia* 102, with fig. 38, and on Malta, Diana Woolner, "Graffiti of Ships at Tarxien, Malta," *Antiquity* **30** (1957) 60–67.

[5] For identification of types of wood used, see append. 2.

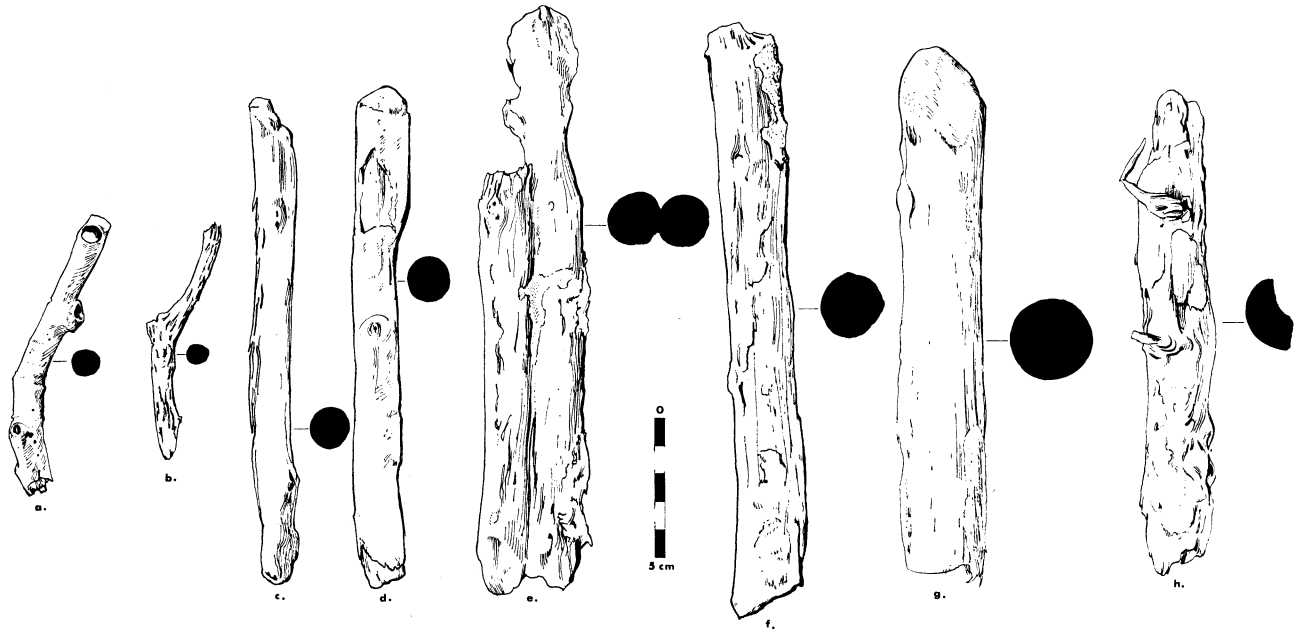


FIG. 53. Selection of twigs from brushwood dunnage.

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V. THE INGOTS

George F. Bass

The bulk of the cargo consisted of copper and bronze ingots and ingot fragments. Three major types were present: so-called "oxhide" ingots, discoid "bun" ingots, and flat oval bar ingots, here called "slab" ingots. The presence of rectangular bars of tin is also probable.

I. "OXHIDE" INGOTS

These are flat, oblong pieces of copper (see append. 3) roughly four centimeters thick and averaging sixty by forty-five centimeters in length and width; each has protrusions or handles at its four corners. One side of each ingot is always rough and bubbly, while the other is much smoother; the smoother side does, however, usually contain low mounds and tiny air holes, and is often outlined by a raised rim.

At least thirty-four ingots of this shape were carried in the ship, stacked in neat piles with matting serving as some sort of wrapping or packing (see chap. IV). They are more or less complete depending on their situation on the site; those lying in contact with tin (figs. 40 and 59: 22), for example, have been badly corroded by the natural electrolysis which took place in the salt water, and some are missing almost half of their original metal.

Five half ingots seem to have been broken or cut in antiquity, although the breaks are often so corroded that it is impossible to know whether in each case the missing half was simply eaten away by corrosion; none of these halves join or are from the same ingot. We may presume that these ingots were fairly carefully cut or sawed in half, however, because twelve ingot corners were found, each of which was certainly cut out with two deliberate strokes running at approximate right angles to one another (fig. 54).[1] (A number of the whole ingots will be seen to consist of joined halves. It is probable that all of these were broken in modern times by the discoverers of the wreck, during attempts to free them from the sea bed.) Lastly, there were almost seventy-five kilograms of ingot fragments which had been cut or broken away at random from complete ingots.



Fig. 54. Ingot handles cut or broken off in antiquity.

All examples are of Buchholz's Type 2 (fig. 55).[2] We shall follow his typology for the sake of continuity, although, as we shall see, these types may not be chronologically separated to the extent he believed.

The Gelidonya ingots may be grouped further into three subtypes. Type *2a* has its sides pinched in to form a waist, but its ends are almost straight across in some cases; the handles are thick extensions of the sides. Type *2b* is the same, except that it has a more pronounced rim on its smoother side. Type *2c* has incurving sides which extend to form outcurving tapering handles; a slight rim on the smoother side is usual.

The rough, bubbly sides of twenty-four of the ingots contain signs which seem to have been stamped into the newly poured, still soft metal, usually at the center of the ingot near one end. In four cases there are additional signs, which also seem to have been made with stamps, on the smoother sides of the ingots; all of these signs are approximately the same, ⊕ or ⊗, and are found in the centers of the ingots. A few of the ingots have, in addition, "secondary signs" which were incised into the metal after it had cooled and hardened. These last signs are, without exception, on the smoother sides.

The following catalogue lists for each ingot the overall length, the maximum width (recorded across the handles), the minimum width (recorded across the waist), and the thickness (usually greatest on handles and at edges). Weights of well-preserved ingots are accepted as being very nearly original, for so little corrosion has often taken place that surface details are still sharp, while shiny copper appears under the scratch of a pin. Original weights of ingots missing handles and other bits have been estimated by placing extra handles and other pieces of matching size and shape on the scales during weighing. The estimates of original weight for badly corroded ingots were almost impossible to make, for in some cases it was possible to drill almost completely through an ingot without striking solid copper; these pieces were always quite light and have lost a great deal of weight.

[1] We have evidence that, at least at Mohenjo-Daro, copper ingots received preliminary saw cuts along which pieces were snapped off. E. J. H. Mackay, *Mohenjo-Daro* I, 452.

[2] Hans-Günter Buchholz, "Keftiubarren und Erzhandel in zweiten vorchristlichen Jahrtausend," *PZ* **37** (1959) 4–6, with fig. 2 on p. 7; "Der Kupferhandel des zweiten vorchristlichen Jahrtausends im Spiegel der Schriftforschung," *Minoica,* 93–95, with fig. 2 on p. 96.

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In 1. Type *2b* (fig. 56, *a* and *b*). L. .61, W. .35, min. W. .22, Th. .045–.05. Complete. Weight 19.95 kg. Impressed sign (fig. 90: 39A or 33A). Signs inscribed near one edge of smoother side (fig. 90: 21B and 22B).

In 2. Type *2b* (fig. 56, *a* and *b*). L. .74, W. .35, min. W. .25. Ingot made of two joining halves. Weight 21.75 kg. Estimated original weight 22.3 kg. Impressed sign (fig. 90: 23A).

In 3. Type *2c* (fig. 56, *a* and *b*). L. .63, W. .45, min. W. 30, Th. .03–.04. One handle missing. Weight 18.5 kg. Est. orig. weight 19.5 kg. Almost no trace of rim. Impressed sign (fig. 90: 24A).

In 4. Type *2c* (fig. 56, *a* and *b*). L. .66, W. .45, min. W. .28, Th. .02–.04. Made of joining halves. Weight 18.15 kg. Est. orig. weight 18.8 kg. Slight rim. Impressed sign (fig. 90: 25A). Traces of fiber on one side.

In 5. Type *2c* (fig. 56, *a* and *b*). L. .58, W. .44, min. W. .26, Th. .04. Made of joining halves. Weight 22 kg. Slight traces of rim. Impressed sign (fig. 90: 26A). Traces of matting on smoother side.

In 6. Type *2b* (fig. 56, *a* and *b*). L. .75, W. .37, min. W. .22, Th. .025–.035. Detached handle joined. Weight 20.7 kg. Impressed sign (fig. 90: 27A). Slightly off center.

In 7. Type *2c* (fig. 57, *a* and *b*). L. .67, W. .45, min. W. .26, Th. .03–.04. Two handles broken. Weight 19 kg. Est. orig. weight 19.1 kg. Very slight traces of rim. Impressed sign (fig. 90: 28A).

In 8. Type *2c* (fig. 57, *a* and *b*). L. .67, W. .44, min. W. .26, Th. .025–.042. Complete except for a few grams missing from one edge. Weight 20.8 kg. Slight rim. Impressed sign (fig. 90: 25A).

In 9. Type *2c* (fig. 57, *a* and *b*). Pres. L. .68, max. pres. W. .44, min. W. .28, Th. .025–.030. Two handles missing. Weight 20.75 kg. Est. orig. weight 22.2 kg. Impressed sign (fig. 90: 25A). Matting adheres to smoother side and one edge.

In 10. Type *2c* (fig. 57, *a* and *b*). Pres. L. .53, W. approx. .43, min. W. .26, Th. .025. Three handles missing. Weight 15.6 kg. Est. orig. weight 16.6 kg. No sign. Traces of rope from netting and basket adhere to one side.

In 11. Type *2b* (fig. 57, *a* and *b*). L. .78, pres. W. .33. min. W. .23, Th. .04. Two handles missing. Weight 16.85 kg. Est. orig. weight 18 kg. Impressed sign (fig. 90: 29A), near base of one handle. Traces of matting on smoother side.

In 12. Type *2c* (fig. 57, *a* and *b*). L. .66, W. approx. .45, min. W. .27, Th. .04. Two handles chipped. Weight 23.4 kg. Est. orig. weight 23.6 kg. Slight rim. Impressed sign (fig. 90: 30A). Matting over smoother side, one edge, and end.

In 13. Type *2a* (fig. 58, *a* and *b*). L. .67, W. .38, min. W. .25, Th. .025–.04. Complete. Weight 25.9 kg. Oval concavity, near center of one edge of rough side, may be a sign or only a blemish.

In 14. Type *2a* (fig. 58, *a* and *b*). L. .70, W. .36, min. W. .23, Th. .023–.04. Complete. Weight 20 kg. Impressed sign (fig. 90: 30A).

In 15. Type *2c* (fig. 58, *a* and *b*). Original L. unknown, W. approx. .45, min. W. .26, Th. .025. Two handles missing; metal in very poor condition. Weight 17.5 kg. Est. orig. weight 19.5 kg. Oval concavity near base of one handle, on rough side, may be sign or only a blemish.

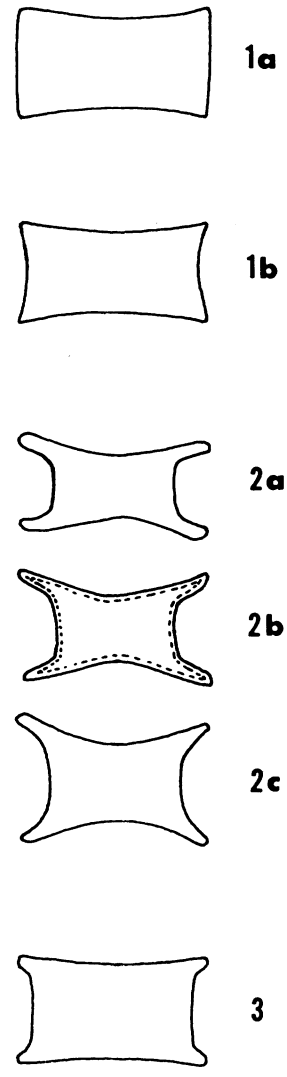
In 16. Type *2b* (fig. 58, *a* and *b*). L. .54, W. 31, min. W. .19, Th. .04–.045. Part of one handle and part of rough surface missing. Weight 20.2 kg. Est. orig. weight 20.35 kg. Any sign would have been obliterated by surface damage through corrosion.

In 17. Type *2b* (fig. 58, *a* and *b*). L. .58, W. .32, min. W. .205, Th. .045. Small area of smoother side missing, but weight taken with 1–1.25 kg. of concretion still adhering. Weight 23.0 kg. Est. orig. weight 21.75–22 kg. Impressed sign (fig. 90: 24A).

In 18. Type *2a* (fig. 58, *a* and *b*). L. approx. .64, W. unknown, min. W. .195, Th. .032–.036. Three handles missing. Weight 17 kg. Est. orig. weight 19 kg. No sign.

In 19. Type *2b* (fig. 59, *a* and *b*). L. .54, W. .315, min. W. .195, Th. .04. Complete. Weight 22.2 kg. Impressed sign (fig. 90: 28A).

In 20. Type *2b* (fig. 59, *a* and *b*). L. .63, W. .365, min. W. .22, Th. .038–.048. Complete. Weight 21.9 kg. Impressed sign (fig. 90: 30A).



Ingot Types Adapted From Buchholz

PZ 37 (1959) p. 7

FIG. 55.

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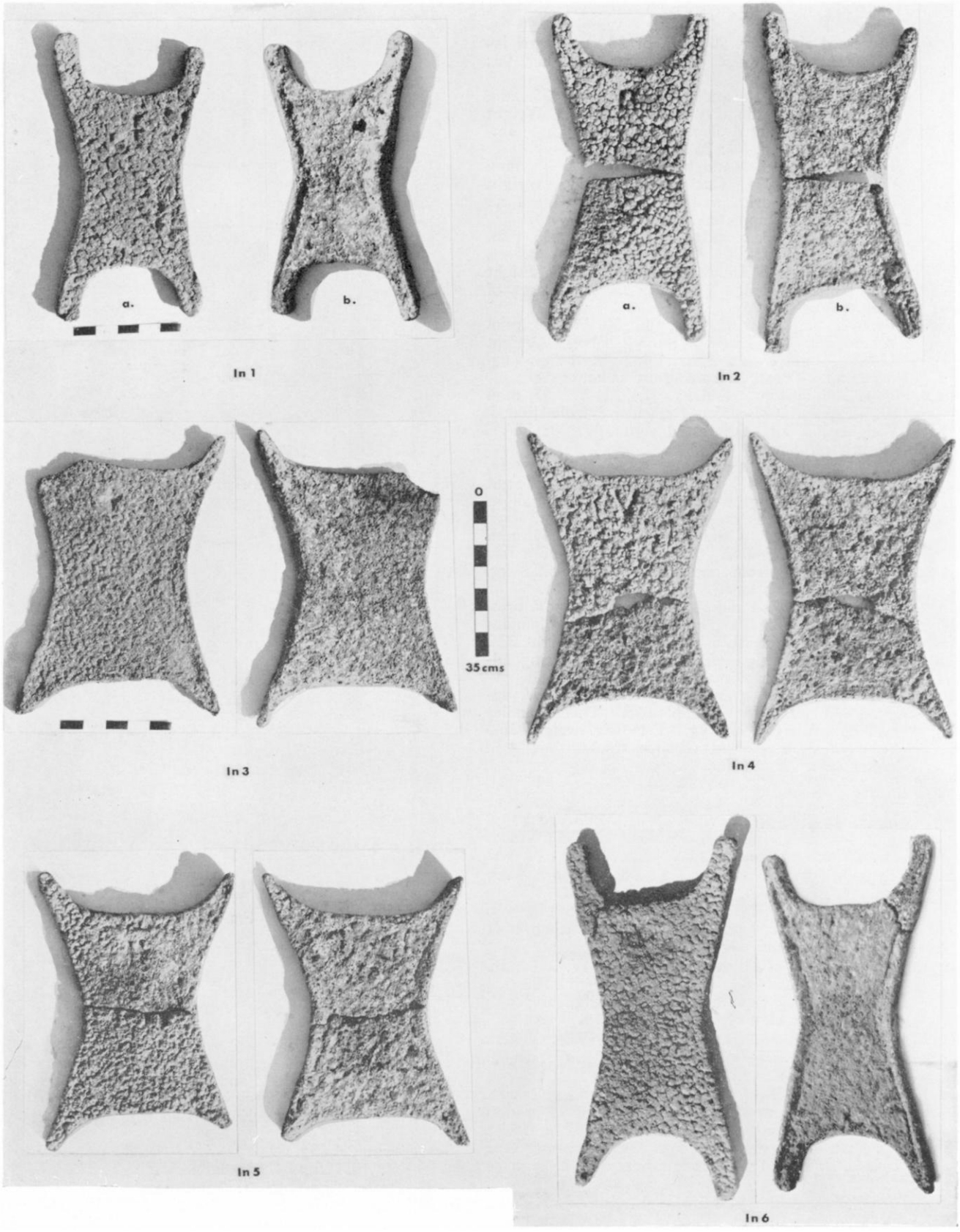


FIG. 56. Ingots In 1–In 6.

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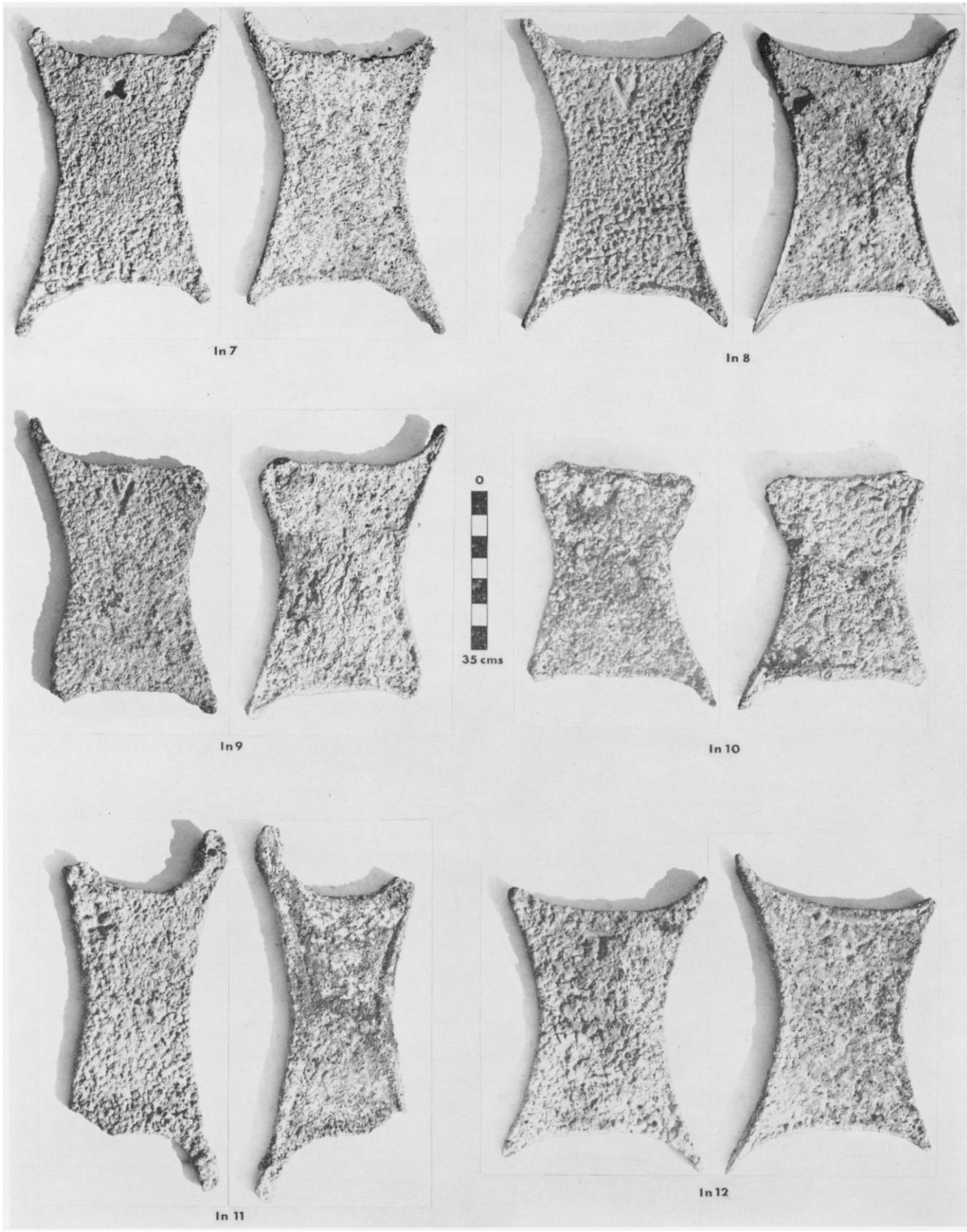


FIG. 57. Ingots In 7–In 12.

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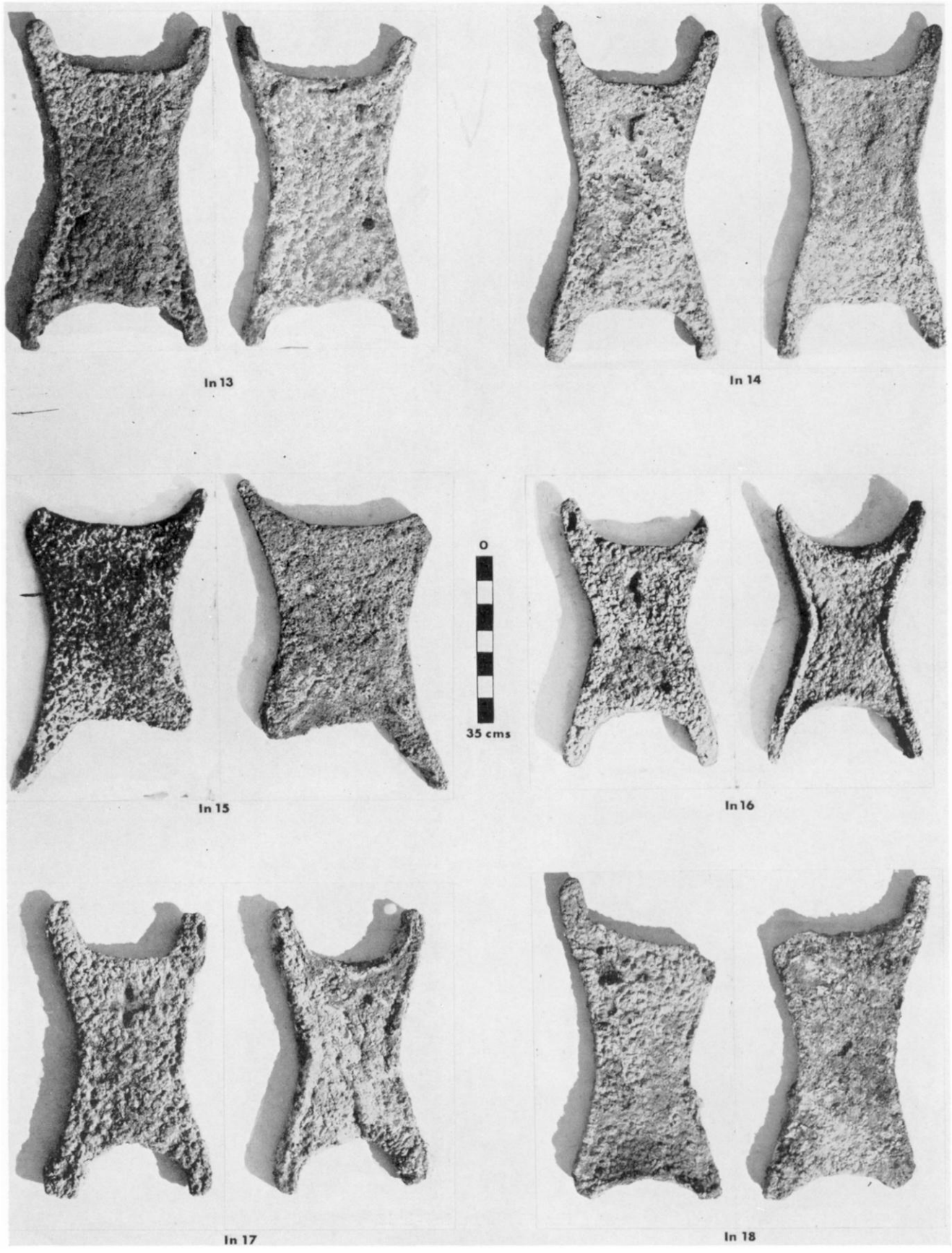


FIG. 58. Ingots In 13–In 18.

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In 21. Type *2c* (fig. 59, *a* and *b*). L. .64, W. .44, min. W. .26, Th. .025–.04. Complete. Weight 19.7 kg. No sign.

In 22. Type *2c* (fig. 59, *a* and *b*). L. .59. No other dimensions preserved. Half of ingot eaten away by contact with tin. Weight 10.7 kg. Est. orig. weight 21 kg. (?) Impressed sign (fig. 90: 28A).

In 23. Type *2c* (fig. 59, *a* and *b*). L. .68, W. approx. .45, min. W. approx. .25, Th. .025–.035. One corner and part of midsection eaten away by contact with tin. Weight 15.5 kg. Est. orig. weight approx. 22 kg. (?) Impressed sign (fig. 90: 27A). Traces of matting on smoother side.

In 24. Type *2c* (fig. 59, *a* and *b*). L. .615, W. .45, min. W. .26, Th. .03–.04. One handle chipped very slightly. Weight 17 kg. Impressed sign (fig. 90: 25A). Impressed sign (fig. 90: 34A), in center of smoother side.

In 25. Type *2c* (fig. 60, *a* and *b*). L. .59, W. .40, min. W. .26, Th. .028–.04. Tip of one handle missing. Weight 21.3 kg. Est. orig. weight 21.45 kg. Impressed sign (fig. 90: 27A). Impressed sign (fig. 90: 35A) in center of smoother side.

In 26. Type *2c* (fig. 60, *a* and *b*). L. .60, W. .43, min. W. .255, Th. .025–.053. Large section of corner missing. Weight 16 kg. Est. orig. weight 18 kg. No sign on rough side. Impressed sign (fig. 90: 35A) in center of smoother side.

In 27. Type *2b* (fig. 60, *a* and *b*). L. .62, W. .37, min. W. .23, Th. .035–.05. Part of one handle missing. Weight 23.8 kg. Est. orig. weight 24.1 kg. Impressed sign (fig. 90: 25A) near center of one edge of rough side. Possible impressed sign (fig. 90: 35A) in center of smoother side, but this may be only a blemish.

In 28. Type *2a* (fig. 60, *a* and *b*). L. .55, W. .37, min. W. .23, Th. .035–.045. Two handles and part of midsection missing. Weight 18 kg. Est. orig. weight 21.5 kg. Very slight ridges. Impressed sign (fig. 90: 36A) in center of rough side.

In 29. Type *2b* (fig. 60, *a* and *b*). Max. pres. L. .455, W. .303, min. W. .22, Th. .035–.055. Two handles eaten away by contact with tin. Weight 16.85 kg. Est. orig. weight 20 kg. Impressed sign (fig. 90: 30A).

In 30. Type *2b* (fig. 60, *a* and *b*). L. .58, W. .345, min. W. 235, Th. .025–.04. Complete. Weight 21.8 kg. Rim sharply delineated by grooves. No sign.

In 31. Type *2c* (fig. 61, *a* and *b*). L. .62, W. .43, min. W. .265, Th. .025–.035. One corner and part of midsection eaten away by corrosion. Weight 14.95 kg. Est. orig. weight approx. 18 kg (?) Incised sign (fig. 90: 39B). Possible impressed O in center of same, smoother side.

In 32. Type *2c* (fig. 61, *a* and *b*). Max. pres. L. .49, W. .43, min. W. .25, Th. .02–.03. One end missing. Weight 12.85 kg. Est. orig. weight approx. 16 kg. (?) Impressed sign (fig. 90: 30A). Incised sign (fig. 90: 38B).

In 33. Type *2b* (fig. 61, *a* and *b*). L. .61, W. .35, min. W. .235, Th. .04–.045. Hole corroded through near one edge. Weight 19.35 kg. Est. orig. weight 19.7 kg. Ingot bent so that rough side arches upward. Impressed sign (fig. 90: 32A).

In 34. Type *2a* or *2b* (fig. 61, *a* and *b*). L. .622, W. .345, min. W. unknown, Th. at handle .05, at edge .04. Extremely corroded metal in many pieces. Weight 10.9 kg. Original weight impossible to estimate. Impressed sign (fig. 90: 39A).

In 35. Type *2c* (fig. 61, *a* and *b*). Half ingot. Max. pres. L. .34, W. .44, Th. .04 at edge, .02 in center. Weight 8.5 kg. Sign (fig. 90: 40B) incised on smoother side near handle; no impressed sign preserved on this half.

In 36. Type *2c* (fig. 61, *a* and *b*). Half ingot. Max. pres. L. .36, W. .45, Th. .026 near center. Weight 8.75 kg. Incised signs (fig. 90: 42B) near base of handle on smoother side; no impressed sign preserved on this half.

In 37. Type *2c* (fig. 61, *a* and *b*). Half ingot. Max. pres. L. .31, W. .40, Th. .025–.045. Weight 8.85 kg. Rim is more pronounced on rough side, but also occurs on smoother side. Impressed sign (fig. 90: 41A).

In 38. Type *2c* (fig. 61, *a* and *b*). Half ingot. Max. pres. L. .33, W. .45, Th. .04. Weight 9.5 kg. Rims on both sides. No sign.

In 39. Type *2c* (fig. 61). Half ingot. Max. pres. L. .37, W. .40, Th. .03. Weight 10 kg. No sign.

Ingots, and representations of ingots, of this general shape have been found scattered widely throughout the Mediterranean area (fig. 92). The following list of actual examples, which must be considered in a study of the Gelidonya ingots, is based on H. G. Buchholz's catalogue,[3] where fuller descriptions and complete bibliographies for each may also be found; I have added my subtype letters where possible to the type numbers which he has given. Dr. Buchholz has kindly supplied me with additional references which he had noted since his study appeared, and I have added the new finds from Mycenae and Zakro, and those newly listed by H. Catling.[4] I have excluded the ingot from Boğazköy [5] as it does not seem to me to be truly related to the others. For these reasons, the numbering here does not coincide with that of Buchholz's original catalogue.

I. *Syria-Palestine*

1. Tell Beit Mirsim.[6] Miniature ingot of Type 1*b*. Broken, but probably originally about .16 long. Dated stratigraphically to the first half of the sixteenth century B.C.
2. Ras Shamra.[7]

II. *Cyprus*

3. Enkomi.[8] Type 3. Primary mark (fig. 90: 18A). Stratigraphy not observed at time of excavation, but later dated to twelfth century B.C. by Schaeffer.
4. Enkomi.[9] Four fragments of unknown type.

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[3] *PZ* **37** (1959) 28–39.

[4] H. Catling, *Cypriot Bronzework*, 267–270.

[5] Buchholz catalogue no. 9, citing K. Bittel, *Boğazköy* III, pl. 21: 3.

[6] W. F. Albright, "Tell Beit Mirsim II," *AASOR* **17**, 1936–37 (1938) 54, with pl. 41: 13.

[7] Dr. Buchholz has informed me of an unpublished fragment from the 1960 excavations.

[8] Buchholz cat. no. 1, with pl. 3:1; Schaeffer, *Enkomi-Alasia*, 30: no. 13, with pl. LXIII: 3.

[9] Catling, *Cypr. Bronze.*, 267, no. 2.

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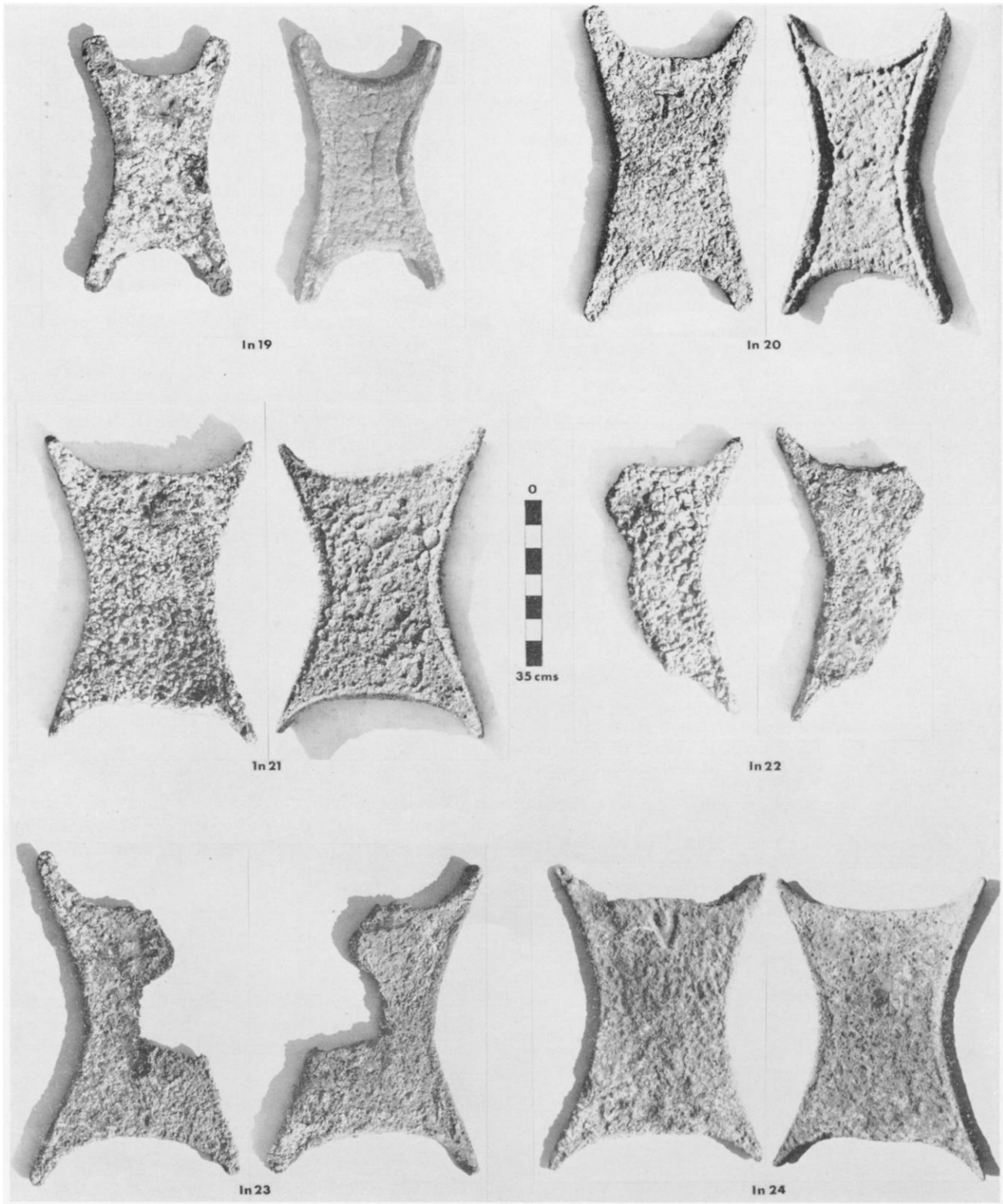


FIG. 59. Ingots In 19–In 24.

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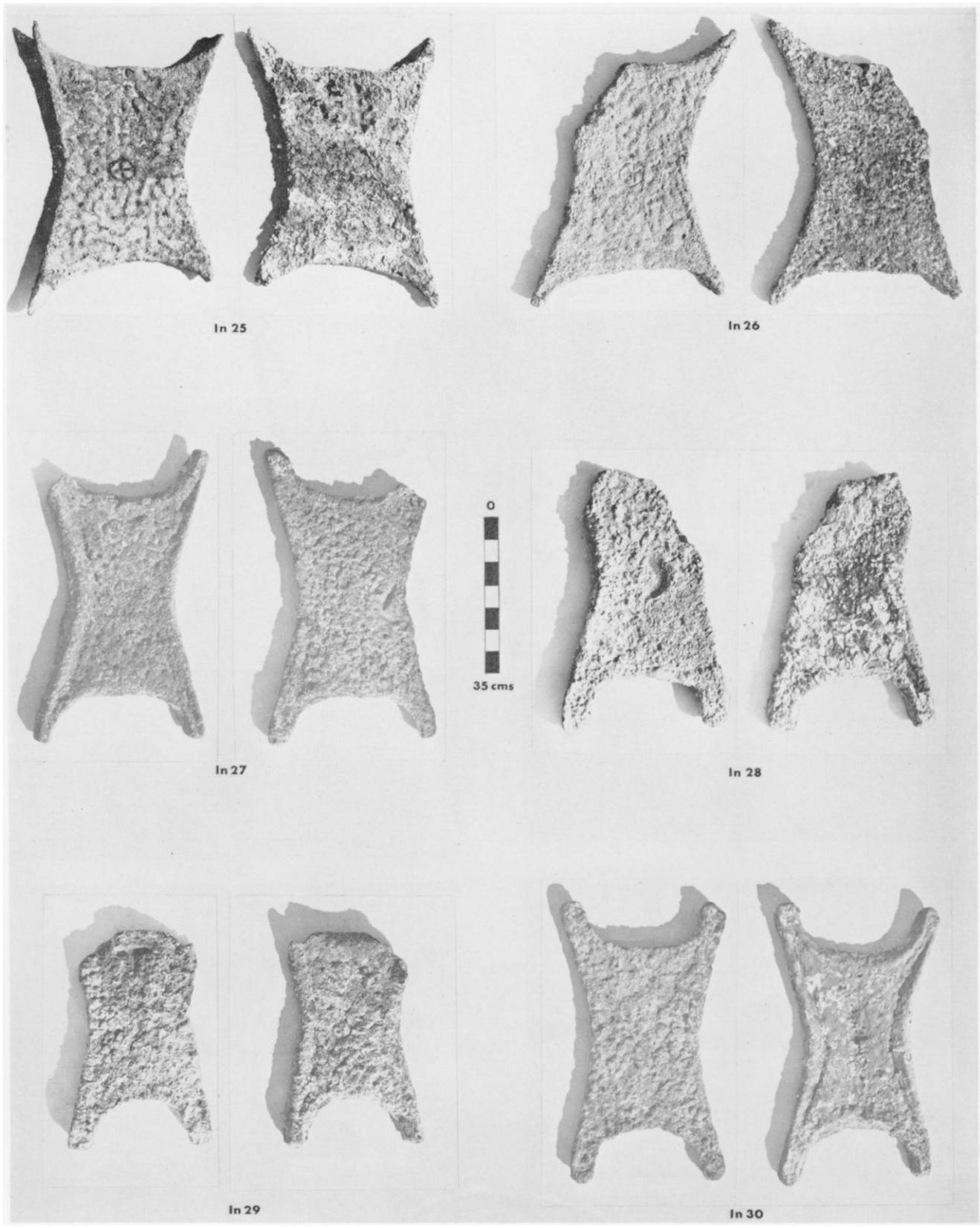


FIG. 60. Ingots In 25–In 30.

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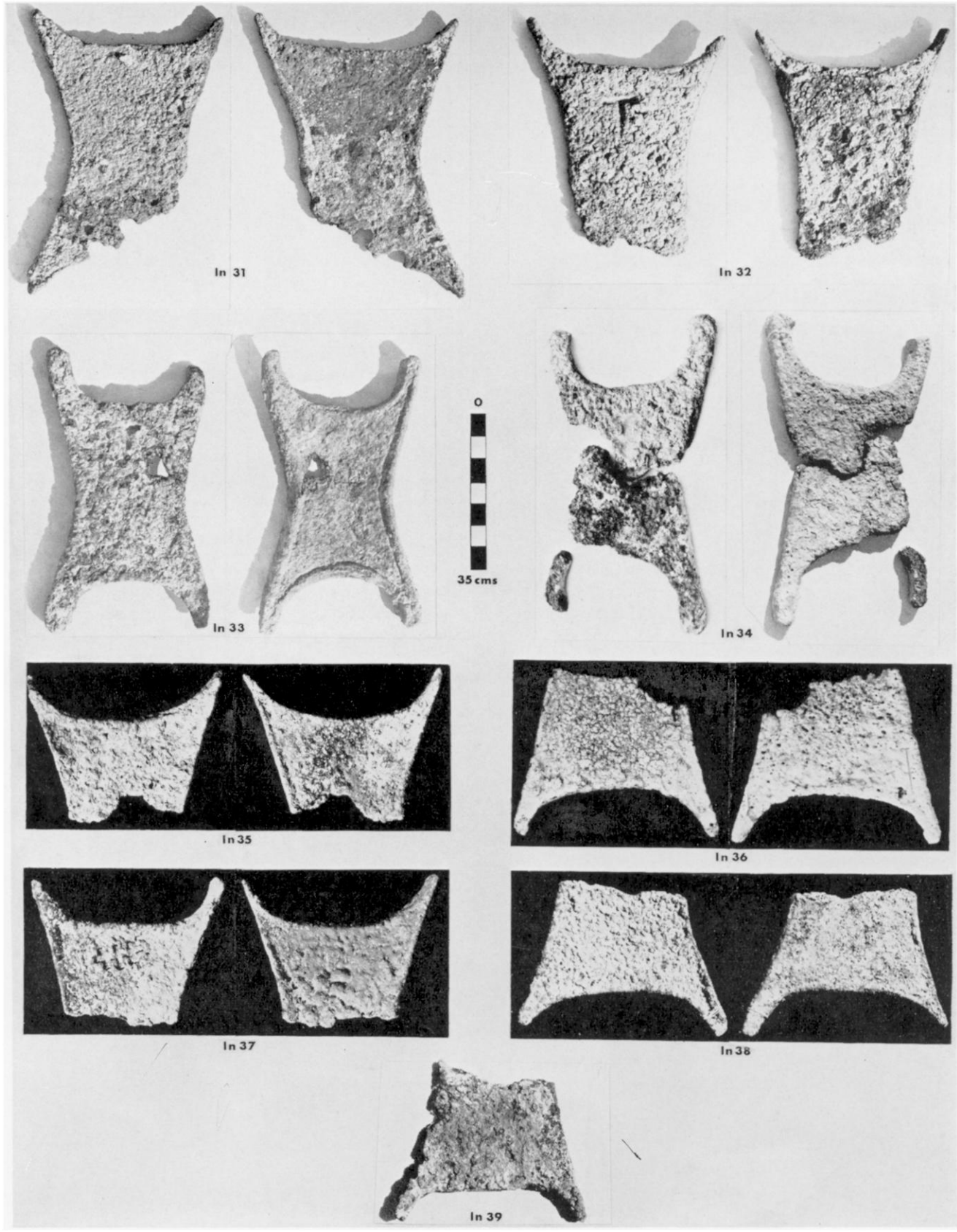


FIG. 61. Ingots In 31–In 39.

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5. Enkomi.[10] Type 3. Primary mark (fig. 90: 19A). Stratigraphy not observed at time of excavation, but later dated to 1400–1200 B.C. by Dikaios, and to Iron Age I (twelfth to eleventh centuries B.C.) by Schaeffer.
6. Probably Enkomi.[11] Type 2. Primary mark difficult to identify. No stratigraphic evidence for date.
7. Enkomi.[12] Type 3. Corner fragment.
8–9. Mathiati.[13] Type 2 or 3. More than twenty fragments of more than two oxhide ingots. No stratigraphic evidence for date.
10. Mathiati.[14] Miniature ingot of Type 2; less than half preserved. No stratigraphic evidence for date.
11. Probably Enkomi.[15] Miniature ingot of Type 2. L. *ca.* .088. No stratigraphic evidence for date. Signs.
12. Bay of Soli. An oxhide ingot, raised from the sea, was described by a commercial diver to Eric Ryan of the Gelidonya staff.
13–17. Enkomi.[16] Two of Type 2, two of Type 3, and one of uncertain type are reported by Catling.

III. *Asia Minor*

18. Near Antalya.[17] Type 1*a*. Found in the sea; no evidence for date.
19. Near Antalya.[18] Type 1*b*. Found in the sea; no evidence for date.
20. Probably from near Antalya.[19] Type 1. Probably from the sea. P. Throckmorton reports that he has talked to sponge divers on Kalymnos who remembered many more ingots from this hoard; pictures drawn for him by these divers all represented ingots of Type 1.

IV. *Crete*

21. Palaikastro.[20] Type and stratigraphic information unavailable.
22. Zakro.[20] Type 1. Ingot fragment. No stratigraphic information.
23. Sitias.[20] No other information available.
24. Mochlos.[20] No other information available.
25. Knossos.[20] Fragment. Late Minoan I/II (*ca.* 1600–1400 B.C.).
26. Tylissos.[21] Type 1*a*. Late Minoan I/II (*ca.* 1600–1400 B.C.).
27–45. Hagia Triada.[22] All Type 1, but at least one seems to approach Type 2*c*. Middle Minoan III or Late Minoan I/II. Inscribed marks (fig. 90: 1–10B).
46–51. Zakros.[23] Types 1*a* and 1*b*, but one approaching 2*c*. No visible signs, but further cleaning planned at the time of this writing. Dated stratigraphically to Late Minoan Ia (*ca.* 1600–1500 B.C.).

V. *Greece*

52. Mycenae.[24] Type 2*b*. Impressed sign (fig. 90: 17A). Fourteenth century B.C.
53. Mycenae.[25] Fragment of Type 2. Late Helladic III B or C.
54. Mycenae.[26] Uncertain type. Sixteen fragments.
55. Mycenae.[27] Handle of uncertain type. No evidence for date.
56–74. Cyme (Euboea).[28] All Type 1 (probably all 1*b*). Two fragmentary. Found in the sea; no evidence for date.

VI. *West of Greece*

75. Makarska, Dalmatian Coast.[29] Miniature of Type 3. L. .066. No evidence for date.
76. Cannatello, Sicily.[30] Fragment. No evidence for dating.
77. San d'Antioco di Bisarcio, Ozieri, Sardinia.[31] Type 2*c*. Impressed sign (fig. 90: 16A). Dated only by comparison with Aegean ingots.
78–82. Serra Ixili, Sardinia.[32] At least two are of Type 2*c*. Marks: see fig. 90: 11–15. No stratigraphic evidence for date.

[10] Buchholz cat. no. 2, with pl. 3:2; P. Dikaios, *Guide Cypr. Mus.*, 100, with pl. XXVI: 1.
[11] Buchholz cat. no. 3. with pl. 3:3; Schaeffer, *Enkomi-Alasia*, 30: no. 11, with pl. LXIII: 1.
[12] Catling, *Cypr. Bronze.*, 268, no. 5, with pl. 49: e.
[13] *Ibid.*, 268, nos. 6 and 7, 284, with pl. 49: f, g; Buchholz cat. no. 5; *SCE* III, g. 328.
[14] Catling, *Cypr. Bronze.*, 269, no. 2, with pl. 52: b: 37; *SCE* III, fig. 374.
[15] Buchholz, *PZ* **37** (1959) 19–20, with fig. 9; *Minoica*, 105–106, with figs. 4a and 4b. Catling, *Cypr. Bronze.*, 268, miniature no. 1.
[16] Catling, *Cypr. Bronze.*, 269.
[17] Buchholz cat. no. 6, with pl. 3: 5; S. Przeworski, *Metall. Anat.*, 92, 103, with pl. XIII: 2.
[18] Buchholz cat. no. 7.
[19] Buchholz cat. no. 8, with pl. 3: 6; G. M. A. Richter, *Grk. Etrusc. and Rom. Bronzes*, 456–457, no. 1810, with fig. on 457.
[20] See Buchholz catalogue for additional scanty references.
[21] Buchholz cat. no. 15; J. Hazzidakis, *Tylissos*, 57, with fig. 31.
[22] Buchholz cat. nos. 16–34, with pls. 3: 8–10, and 4: 1–6.
[23] My thanks to Prof. Platon for providing me with this information shortly after the discovery of the ingots. N. Platon, *Archaeology* **16** (1963) 273; translated as "bronze" on 275.
[24] Buchholz cat. no. 35, with pl. 5: 1–2; C. Seltman, *Athens, its Hist. and Coinage*, 4–5, with figs. 3 and 4.
[25] G. F. Mylonas, *AJA* **66** (1962) 406, with pl. 121: 2; *Archaeology* **15** (1962) 54.
[26] Wace, *BSA* **48** (1953) 7, with pl. 2(a): F. Stubbings, *BSA* **49** (1954) 292, 295; Catling, *Cypr. Bronze.*, 269, 295.
[27] Catling, *Cypr. Bronze.*, 269; in Nauplion Museum.
[28] Buchholz cat. nos. 38–56, with pl. 5: 3–4; Przeworski, *Metall. Anat.*, 92, with n. 6.
[29] Buchholz cat. no. 57, with pl. 5: 5. See, however, Catling, *Cypr. Bronze.*, 269, n. 3.
[30] Buchholz cat. no. 58.
[31] Giovanni Lilliu, *ArchCl* **10** (1958) 192, with pls. 63–64.
[32] Buchholz cat. nos. 59–63. Lord William Taylour, *Myc. Pottery in Italy*, 176, corrects common spelling of Ilixi to Ixili.

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FIG. 62. Tomb 119 at Thebes (after Wreszinski).

VII. *Egypt*

83–86. Four model ingots from foundation deposits at Thebes (see append. 8). Type 2. One with incised cartouche. Late thirteenth or early twelfth century B.C.

VII. *Other*

87–106. Twenty other ingots, from Aigina, Athens, and Sardinia have been reported, but almost nothing is known of these.[33]

All of the ingots which have been analyzed are copper, with the exceptions of numbers 20 and 75, both purchased from dealers and both of which are bronze.

Representational evidence is also important for the study of the ingots. Most general works on Aegean prehistory, when mentioning oxhide ingots, refer to the scenes from the Tomb of Rekh-mi-rē‘ at Thebes. This seems to account for the belief that the ingots were from Keftiu, or are Mycenean in character. Such misleading conclusions result from the lack of a thorough study of Egyptian representations. The following list, which includes representations outside of Egypt, does not pretend to be complete, but it is the fullest compilation to date.[34]

[33] Buchholz cat. nos. 36, 37, 64–81.

[34] It was important, in looking for representations of ingots, to consider carefully the context of each scene. Of the many pictures of food (loaves?) which exactly resemble oxhide and bun ingots, especially when the original colors are not reproduced or mentioned in publication, I give three examples: Nina de G. Davies and A. H. Gardiner, *Tomb of Amenemhēt*, pl. VIII; N. de G. Davies, *The Rock Tombs of Deir el Gebrâwi* II, pl. XX; E. Naville, *The XIth Dyn. Temple at Deir el-Bahari* I, pl. XX. Other objects, including tambourines, also resemble ingots: H. Hickmann, *ASAE* **51** (1951) 317 ff. Such objects have led me to question so-called ingots that lack some metallurgical context, such as those on the seals below.

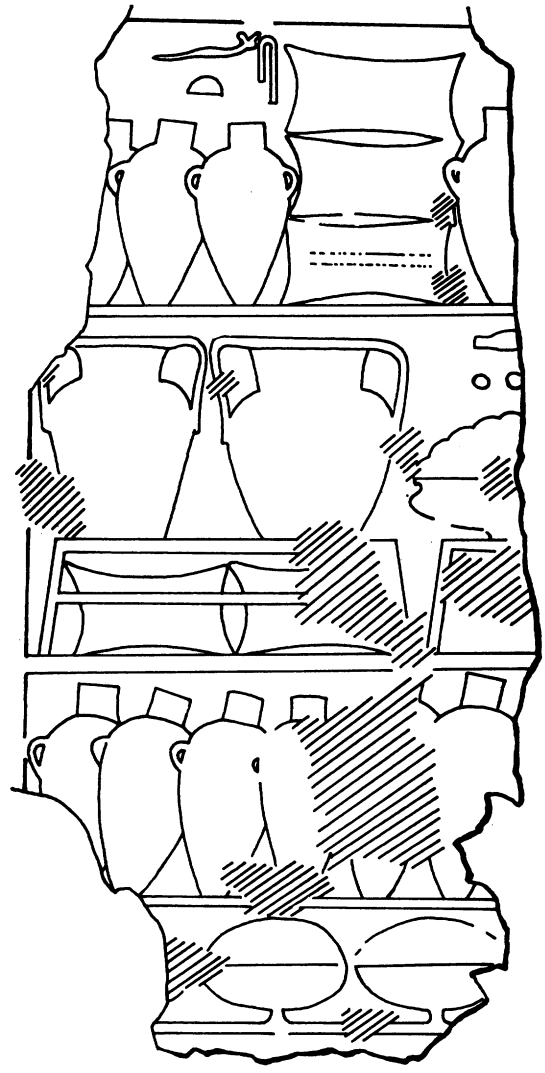


FIG. 63. Tomb of Puyemrê at Thebes (after Davies, courtesy Metropolitan Museum of Art).

I. EGYPTIAN PAINTINGS AND RELIEFS SHOWING OXHIDE INGOTS[35]

Time of Hatshepsut and/or Tuthmosis III (1490–1436 B.C.):

1. Tomb 119 (name lost) at Thebes.
   One scene of Syrians and men of Keftiu bringing products including metal ingots, and another of Syrian vases and metal ingots.[36] A bearded man

[35] Dates of rulers are from W. C. Hayes, *The Scepter of Egypt* II, xv. The numbers of the Theban tombs are the official numbers of the Antiquities Service; more complete bibliographies for the Theban tombs may be found under these numbers in Porter, Moss and Burney, *Topographical Bibliog.* I (2nd ed.), from which I have taken the rulers under whom the tombs were painted.

[36] Porter, Moss, and Burney, *op. cit.* (*supra*, n. 35) 234.

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FIG. 64. Tomb of Useramon (from Davies, courtesy Metropolitan Museum of Art).

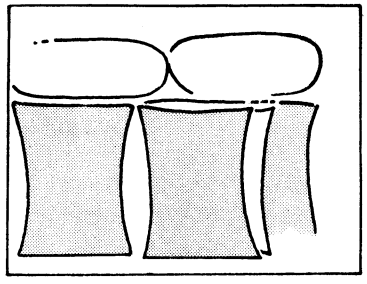


FIG. 65. Tomb of Useramon (after Vercoutter).

may be seen carrying an ingot of Type 1*b* (fig. 62).[37]

2. Tomb of Puyemrê at Thebes (no. 39).
   Tribute containing copper (red) and lead or tin (blue) ingots of Type 1, from men of Retnu (Syria) (fig. 63).[38]
3. Tomb of Useramon at Thebes (no. 131).
   Three registers depict "Reception of the spoil which the might of His Majesty brought from the northern countries, the confines of Asia, and the islands in the midst of the sea. . . .".[39] (Vercoutter translates: ". . . from the northern countries of the confines of Asia.")[40] Those shown bearing raw metal, including copper (light red) ingots of Type 1*b* (fig. 64) are almost certainly those meant by the people from "the confines of Asia,"[41] but whether or not the islanders in the topmost register also carried ingots is not known because of the poor state of preservation.

   Asiatic tribute is also shown after being laid down by the bearers. A stack of ingots of Type 1*a* includes both copper and white metal (lead, tin, or silver?), and above this are oval ingots of white metal (fig. 65).[42]

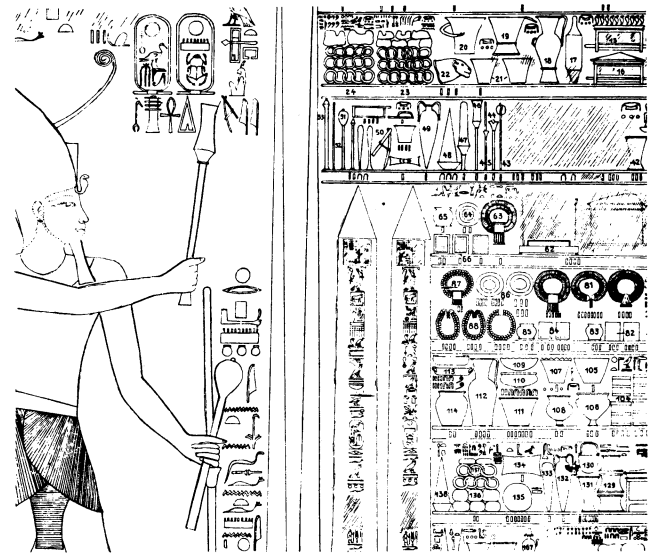


FIG. 66. Relief of Tuthmosis III at Karnak (from Wreszinski).

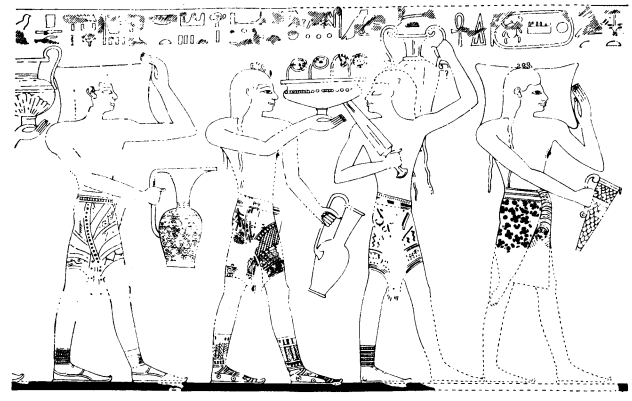


FIG. 67. Tomb of Rekh-mi-rēʿ at Thebes (from Davies, courtesy Metropolitan Museum of Art).

4. Relief of Tuthmosis III at Karnak.
   An ingot of Type 1*b*, identified by Wreszinski as silver, is included in the booty which the king presents to Amon from his Syrian campaigns (fig. 66).[43]

Time of Tuthmosis III or Amenhotep II (1469–1411 B.C.):

5. Tomb of Rekh-mi-rēʿ at Thebes (no. 100).
   Copper ingots of Type 1*b* are brought by "the chiefs of Keftiuland (and) the islands which are within the Great Sea," in the second register of the south side of the west wall of the tomb (fig. 67),[44]

[37] Wreszinski, *Atlas* I, 340; Buchholz, *PZ* **37** (1959) pl. 1: 3–4.

[38] Norman de G. Davies, *Tomb of Puyemrê* I, 80–81, with pl. XXXI.

[39] N. de G. Davies, *BMMA* **21**, 2 (March, 1926) **44**, with fig. 5 on 48.

[40] J. Vercoutter, *L'Égypte et le monde égéen préhellénique*, 130.

[41] N. de G. Davies, *op. cit.* (*supra*, n. 39) 46.

[42] Vercoutter, *op cit.* (*supra*, n. 40) 366, document 501, with pl. LXV.

[43] Wreszinski, *Atlas* II, 33a, and 33b: object 134.

[44] Norman de G. Davies, *The Tomb of Rekh-mi-rēʿ* I, 20; II, pls. XIX, XX. Vercoutter, *op. cit.* (*supra*, n. 40) 57, insists

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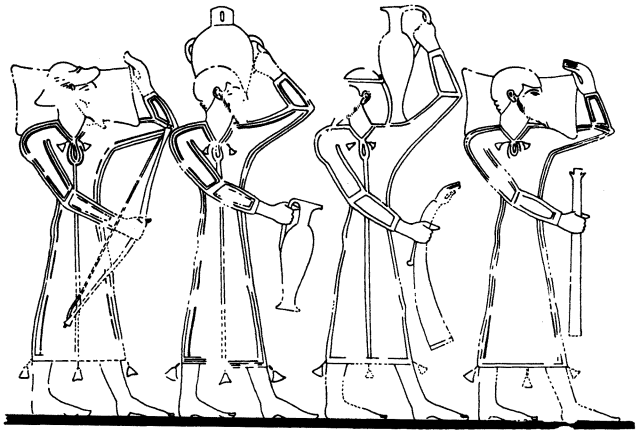


FIG. 68. Tomb of Rekh-mi-rēᶜ (after Davies, courtesy Metropolitan Museum of Art).

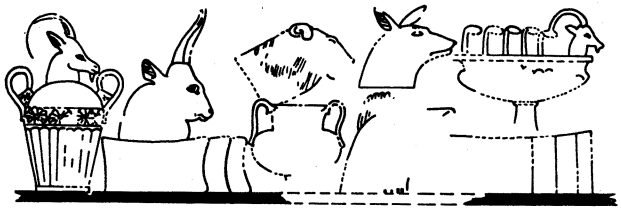


FIG. 69. Tomb of Rekh-mi-rēᶜ (after Davies, courtesy Metropolitan Museum of Art).

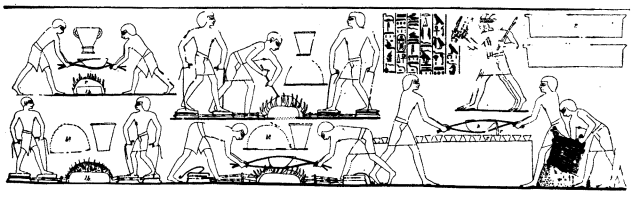


FIG. 70. Casting doors; from Tomb of Rekh-mi-rēᶜ (after Davies, courtesy Metropolitan Museum of Art).

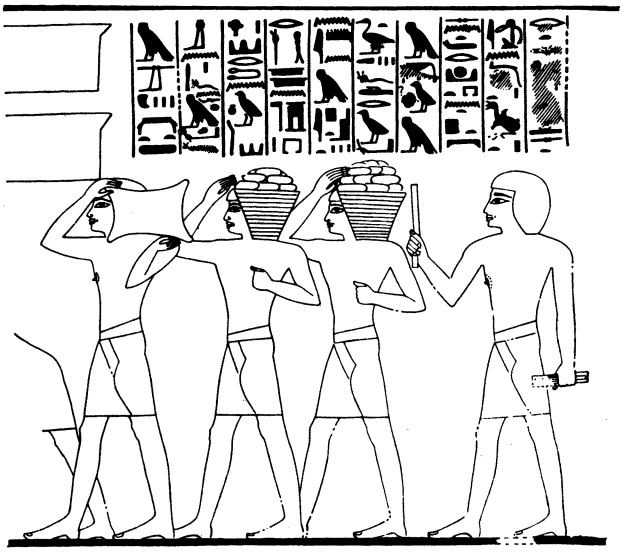


FIG. 71. Bringing copper to metal workers seen in fig. 70 (from Davies, courtesy Metropolitan Museum of Art).



FIG. 72. Tomb of Penḥēt at Thebes (from Wreszinski).

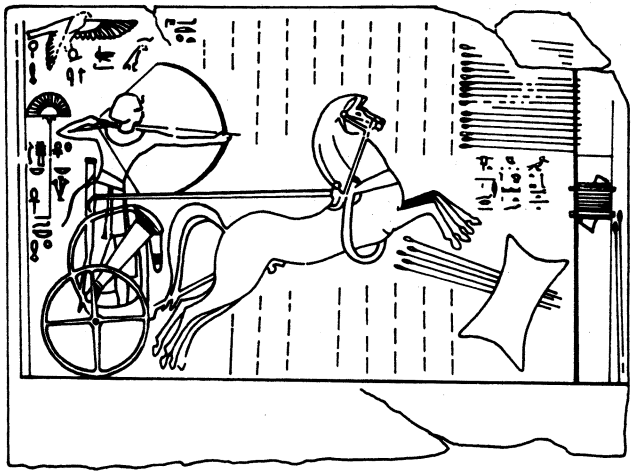


FIG. 73. Relief of Amenhotep II at Karnak (after Chevrier).

while in the fourth register similar ingots are brought by "the chiefs of Retnu and all the lands of Further Asia" (fig. 68).[45] Each line of tribute-bearers approaches a scribe who notes the booty which is piled before him, and in each case ingots have been laid down already. In the pile made by the men of Keftiu are seen four whitish ingots of Type 1*a* (fig. 69).[46] These ingots are slightly more gray than the brick-shaped white ingots which are identified as "silver" above;[47] Vercoutter has suggested that these are possibly of lead or electrum,[48] and I would add the possibility of tin.

On the east half of the south wall is a scene of Egyptian bronze-workers casting a door. Ingots of Type 1*b* are brought to the fire by native porters who are "Bringing Asiatic copper which His

that "and" must be maintained in order that the grammar be correct; island may not modify Keftiu.

[45] Davies, *Tomb of Rekh-mi-rēᶜ* I, 27; II, pls. XXII, XXIII.

[46] Davies, *Paintings from T. of Rekh-mi-rēᶜ*, pl. II.

[47] *Ibid.*; *T. of Rekh-mi-rēᶜ*, I, 21, identifies the ingots of Type 1*a* also as silver.

[48] Vercoutter, *op. cit.* (*supra*, n. 40) 365, document 492.

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Majesty carried off from his victory in the land of Retnu . . ." (figs. 70 and 71).[49]

6. Tomb of Penḥēt at Thebes (no. 239).
   Ingots of Type 2 carried by Syrians as tribute (fig. 72).[50]

Time of Amenhotep II (1436–1411 B.C.):

7. Relief of Amenhotep II at Karnak.
   The king, riding in a chariot, has just pierced a copper ingot of Type 2*c* (or 1*b* ?) with five arrows (fig. 73). The accompanying text leaves no doubt as to the material of the target: "The king, great in strength, who displayed his dexterity before his army, the mighty bowman who shoots at a plate of copper, cleaves it as one does a clump of papyrus. He disdains all wood, as befits his strength." "This is the great plate of mined copper which His Majesty shot, three fingers in thickness. The hero pierced it with many shafts, three handbreadths of them standing out at the back of the plate." [51]
8. Tomb of Nebamūn at Thebes (no. 17).
   Nebamūn is visited by a rich Syrian, who has just arrived by ship (fig. 50). Behind the visitor, bringing gifts or payment for services (Nebamūn was a doctor) are two porters; one carries a copper ingot of Type 1*b* which is almost rectangular (fig. 74).[52]

Time of Tuthmosis IV (1411–1397 B. C.):

9. Tomb of Amen-em-opet at Thebes (no. 276).
   Pink copper ingots of Type 1*b* are brought by Syrians, who also bring lead or tin (?) ingots in a different shape (fig. 75);[53] this is, however, called "Aegean tribute" by Vercoutter.[54]
10. Tomb of Ḥepu at Thebes (no. 66).
    Egyptian bronze-workers seen with copper (red and pink) ingots of Type 1*b* (fig. 76).[55]

Time of Amenhotep III or Amenhotep IV (Akhenaten) (1397–1353 B.C.):

11. The Tomb of Nebamūn and Ipuky at Thebes (no. 181).
    Scene of Egyptian metal-workers with copper ingot, which is damaged in the painting but is

[49] Davies, *Paintings from T. of Rekh-mi-rēᶜ*, pl. XXIII; *T. of Rekh-mi-rēᶜ* I, 53–54; II, pls. LII, LIII.

[50] Wreszinski, *Atlas* I, pl. 373.

[51] N. de G. Davies, *BMMA* **30**, 2 (1935) 51, with 49: fig. 4; H. Chevrier, *ASAE* **28** (1928) 126, with fig. 5.

[52] T. Säve-Söderbergh, *Four 18th Dyn. Tombs*, 25–26, with pl. XXIII; Wreszinski, *Atlas* I, 115; Buchholz, *PZ* **37** (1959) pl. 2: 1.

[53] N. de G. Davies, *BMMA* **27**, section 2 (March, 1932) 62, with fig. 13.

[54] Vercoutter, *op. cit.* (*supra*, n. 40) 364–365, documents 497–500, with pl. LXV.

[55] H. H. Coghlan, *Notes on the Prehist. Metallurgy of Copper and Bronze*, 68–69, with fig. 10; Wreszinski, *Atlas* I, 226 and 229, with inaccurate drawing on 229.



FIG. 74. Tomb of Nebamūn at Thebes (from Säve-Söderbergh, courtesy Griffith Institute).

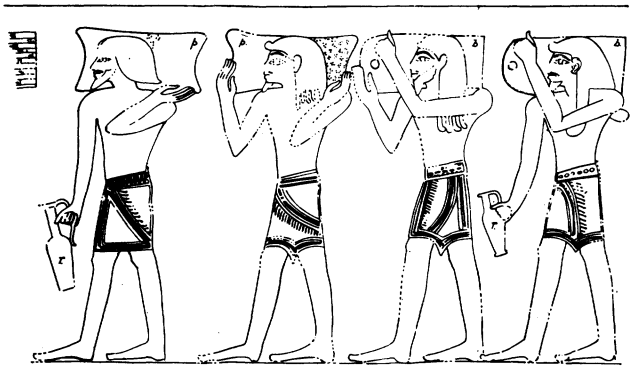


FIG. 75. Tomb of Amen-em-opet at Thebes (from Davies, courtesy Metropolitan Museum of Art).

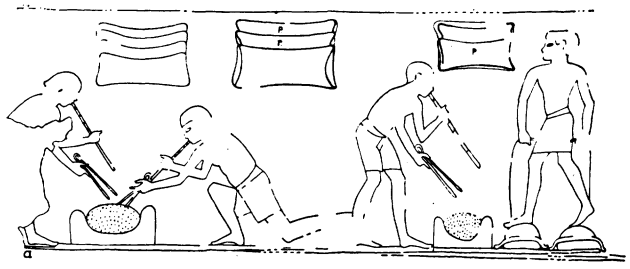


FIG. 76. Tomb of Ḥepu at Thebes (from Coghlan, by Davies).

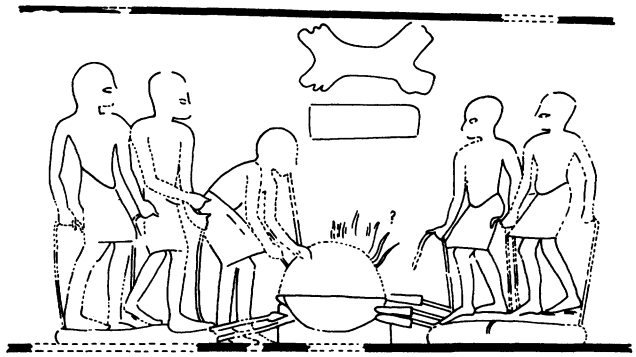


FIG. 77. Tomb of Nebamūn and Ipuky at Thebes (after Davies, courtesy Metropolitan Museum of Art).

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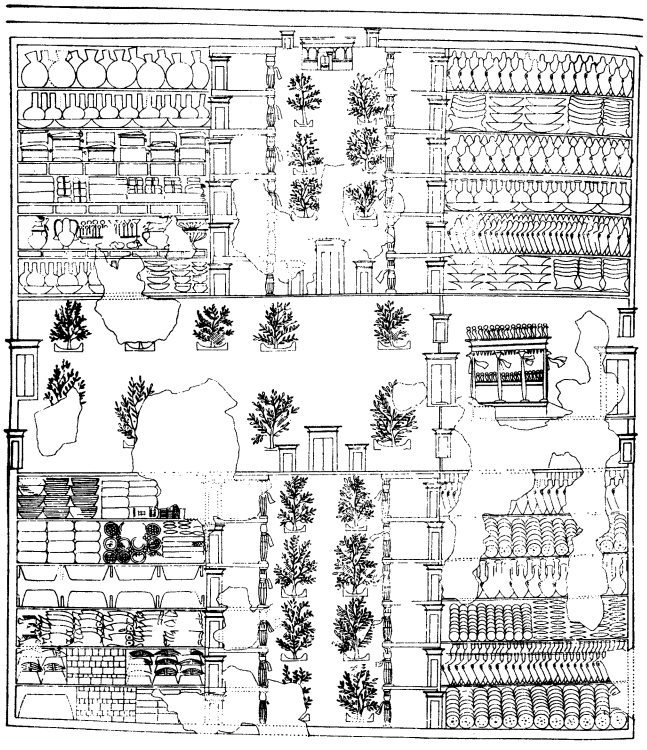


FIG. 78. Tomb of Meryra I at el Amarna; scene of Royal Storehouse (from Davies).

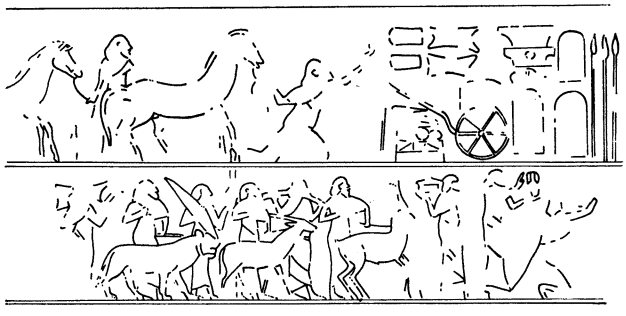


FIG. 79. Tomb of Meryra II at el Amarna (after Davies).

probably of Type 2*a–b*, with rectangular white or blue ingot below (fig. 77).[56] The latter has been identified as lead [57] or tin.[58]

Time of Amenhotep IV (Akhenaten) (1370–1353 B.C.):

12. Tomb of Meryra I at el Amarna.
A scene of the Royal Granary and Storehouse shows stacked ingots of several sizes; the shortest

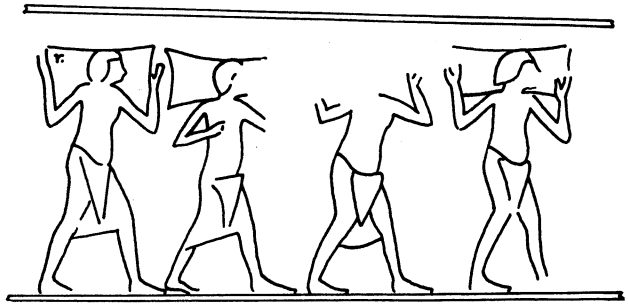


FIG. 80. Tomb of Huya at el Amarna (after Davies).

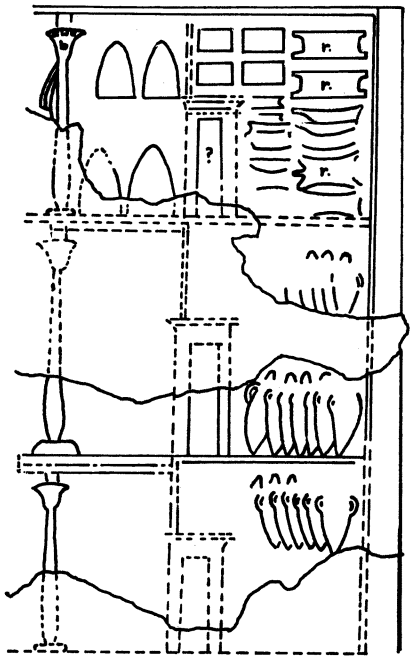


FIG. 81. Tomb of Huya (after Davies).

are Type 1*b*, while the longer could be considered ingots of Type 2 (fig. 78).[59]

13. Tomb of Meryra II at el Amarna.
Ingots of Type 2 are shown as tribute brought by Syrians (fig. 79). An inscription from the tomb of Huya (*infra*, no. 14) tells that this scene represents tribute being brought from places including Syria and the islands of the sea, but here we surely see Syrians.[60]

14. Tomb of Huya at el Amarna.
On the west wall we see the usual lines of foreigners bearing tribute. From Syria are brought copper (red) ingots of Type 1 (fig. 80). These are probably all 1*b*, but one may be 1*a*.[61] The

[56] Norman de G. Davies, *The Tomb of Two Sculptors*, 63, with pl. XI; N. de G. Davies, *BMMA* **15**, section 2 (Dec., 1920) 39, fig. 10; Coghlan, *op. cit.* (*supra*. n. 55) 68–69, with fig. 9. The rectangular ingot is reproduced as bright blue in Virey, *Sept Tombeaux thebaines.*

[57] Davies, *T. of Two Sculptors*, 63.

[58] G. A. Wainwright, *Antiquity* **17** (1943) 96.

[59] N. de G. Davies, *The Tomb of Meryra*, pl. XXXI; Buchholz, *PZ* **37** (1959) 15, with fig. 7.

[60] N. de G. Davies, *The Tombs of Panehesy and Meryra II*, 38, with pls. XXXVII and XXXIX.

[61] N. de G. Davies, *The Tombs of Huya and Ahmes*, 11 (where ingots are identified as sacks), and pl. XIV. The inscription states that tribute is brought from Syria, Kush

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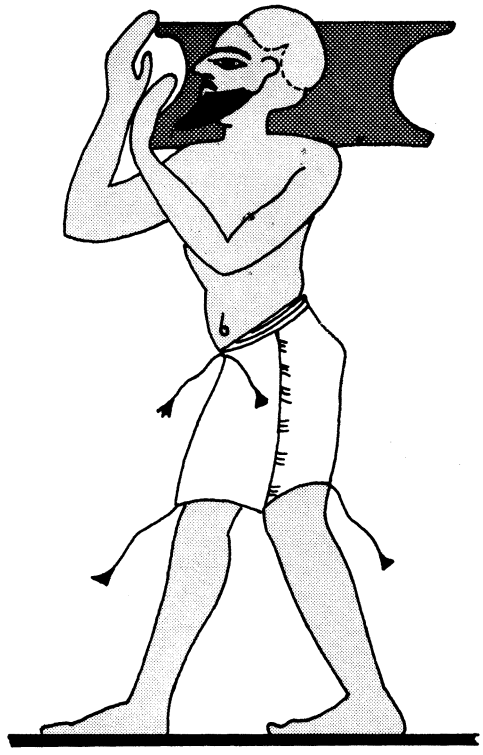


FIG. 82. Tomb of Huy at Thebes (after Davies, courtesy Metropolitan Museum of Art).

north wall of the tomb shows store chambers containing, among other things, red metal ingots (fig. 81).[62] These are of extreme interest, for two are excellent examples of Type 3. Below, however, are what seem to be ingots of Type 2, but one of these has a protrusion which could be the neck of a beast; whether or not this represents a dried skin we will discuss below.

Time of Akhenaten or Tut-ankh-amen (1370–1343 B.C.):

15. Tomb of Huy at Thebes (no. 40).
The chieftains of Retnu (Syria) bring tribute to the king (fig. 82). The copper ingot (reported as deep red or black) is closest to Buchholz's description of Type 3 (almost straight sides), yet he calls it an ingot of Type 2.[63]

Time of Ramesses III (1192–1160 B.C.):

16. Relief of Ramesses III at Medinet Habu.
A relief shows Ramesses III offering a hoard of treasures, including four stacks of ingots of Type 2*a*, with four ingots in each stack, to Amon-Re (fig. 83). A second scene of the same subject shows ingots of Type 2 in three stacks (fig. 84), marked with the hieroglyphs for silver, copper, and lead.[64] At least one scene, and possibly both, was copied directly from the thirteenth-century Ramesseum.[65]

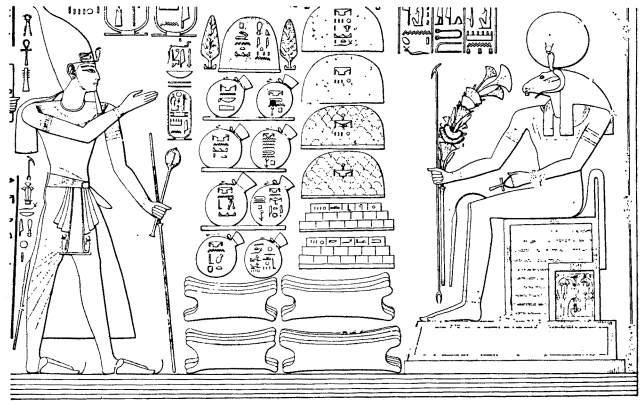


FIG. 83. Relief of Ramesses III at Medinet Habu (from *Medinet Habu* V, courtesy the Oriental Institute).

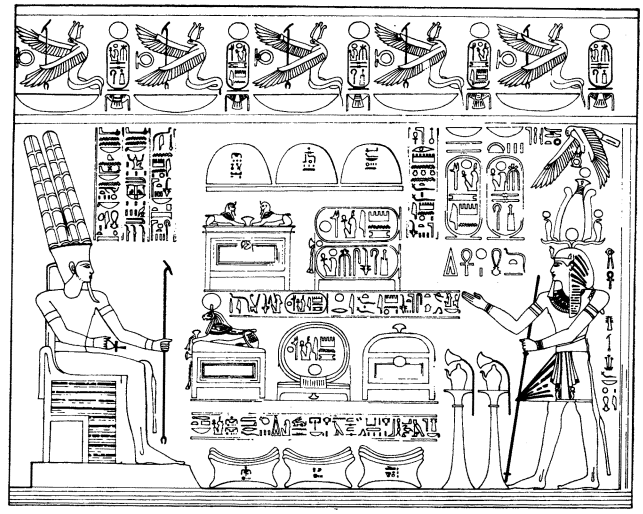


FIG. 84. Relief of Ramesses III at Medinet Habu (after *Medinet Habu* V, courtesy the Oriental Institute).

II. Possible Representations of Oxhide Ingots on Seals

Crete

17. A flat, rectangular bead-seal of green steatite, from Central Crete, presents a possible ingot of Type 1*a* (fig. 85).[66] Actually, the object looks far less like an ingot in the photograph than in the drawing, and I consider Evans' tentative identification as an

(Nubia), the western and eastern countries, and the islands in the middle of the sea. The ingots are carried by the Syrians, according to Davies (pp. 9, 11).

[62] *Ibid.*, pl. XVI.

[63] Nina Davies and A. H. Gardiner, *The Tomb of Huy*, 29, with pl. XIX; Buchholz, *PZ* 37 (1959) pl. 2: 2.

[64] *Medinet Habu* V, pl. 328.

[65] *Ibid.*, pl. 333; Buchholz, *PZ* 37 (1959) 24, fig. 11: d, where they appear as ingots of Type 1.

[66] Arthur Evans, *Scripta Minoa* I, 151: P. 13(b), with pl. I.

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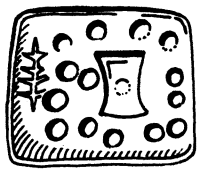


FIG. 85. Bead from Crete (after Evans, *Scripta Minoa* I).

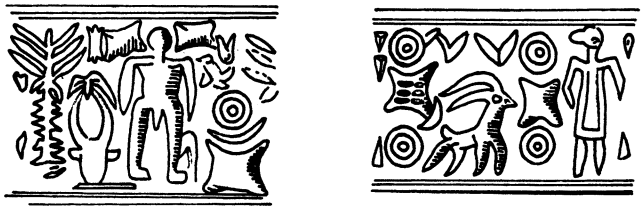


FIG. 86. Seals from Cyprus (after Ward).

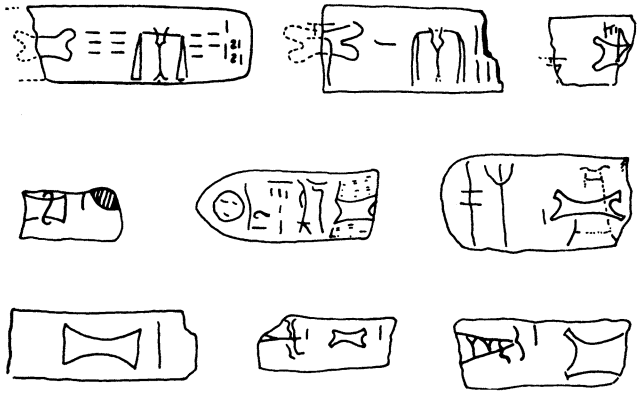


FIG. 87. Tablets from Knossos (after Buchholz, *PZ* 37).

ingot to be improbable. Of interest, however, is the fact that an ox is also depicted on the seal, making a combination found on the following examples from Cyprus.

Cyprus

18. A number of cylinder seals from Cyprus also show possible oxhide ingots of Type 1, with ox's heads above several (fig. 86).[67] O. Masson, who dates one example from Enkomi to 1550–1400 B.C., believes these to be ingots, but I find this identification questionable.[68]

III. REPRESENTATIONS OF OXHIDE INGOTS ON LINEAR B TABLETS (fig. 87)

19–27. Ingots of Types 1*a*, 2*a–b*, and 2*c* seem to be shown on tablets from Knossos, but such crude pictures should probably not be used to identify types. Of interest, however, is the fact that most of the ingots represented have the "legs" or handles of Types 2 and 3, actual examples of which have not been found on Crete.

Two of the tablets indicate weights of ingots in an unknown standard, possibly a talent. Oa 730 states that 60 ingots weigh 52 2/30 units, and Oa 733 states that 10 ingots weigh either 6 or 8 units. On certain of the Sc tablets, corselets have been erased and replaced by ingots, which led Evans to believe that an ingot contained enough copper (or bronze?) to make a corselet.[69] Ingots appear on the following tablets: (Evans' numbers)[70] 225b Nm 01, 730 Oj 01 (LI), 733 Oj 11 (XXXIII), 734a Oh 01 (LI), 734b Oh 01, 247 Nj 81, 248 Nj 86 (XXIV), 249 Nj 85 (XXIX), 246 Nj 82 (XXIX).

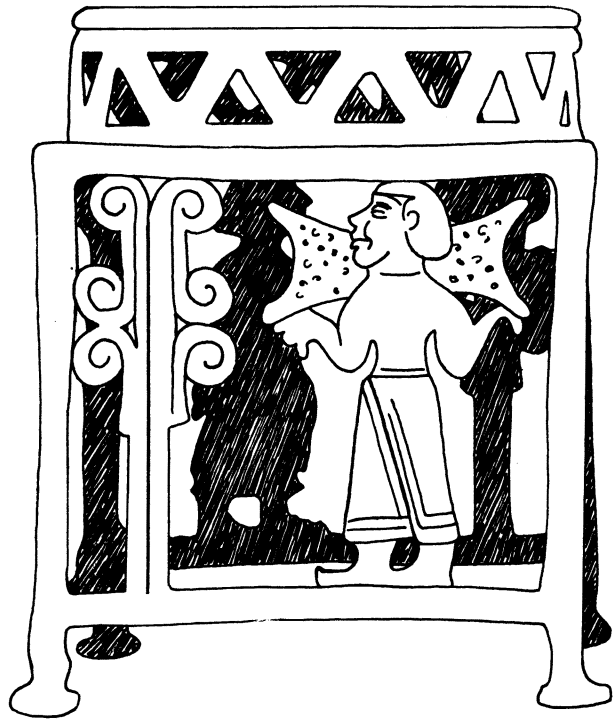


FIG. 88. Bronze stand from Cyprus (after Schaeffer, *Enkomi-Alasia*).

IV. OTHER

28. A bronze stand from Kourion on Cyprus, now in the British Museum, contains four male figures in its openwork sides. One of these carries an ingot of Type 2*c* (fig. 88). According to Harden, "the figures are in Asiatic garb and wear shoes with turned-up toes that suggest Hittite prototypes and occur frequently on north Syrian sculptures down to the ninth century B.C., if not later. This piece was probably made in Cyprus, but is linked artistically with north Syria rather than Phoeni-

[67] W. H. Ward, *The Seal Cylinders of Western Asia*, 346–349.

[68] O. Masson, *BCH* **81** (1957) 7–8, with fig. 1.

[69] Arthur Evans, *Pal. of Min.* IV, 805–806.

[70] Arthur Evans, *Scripta Minoa* II.

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cia."[71] S. Casson says that it is of "pure Mycenean style," but with Babylonian and Egyptian influence,[72] while Watzinger sees a Phoenician origin.[73] It was probably made in the twelfth or eleventh century B.C.

29. C. F. A. Schaeffer, *Antiquity* **39** (1965): p. 56, reports the discovery at Enkomi on Cyprus of a bronze god, .35 high, "standing barefoot upon an ingot of Cypriot type in the form of an ox-hide." PL. xvi*b* shows the statue with horned helmet, shield, and spear. Schaeffer, *AOF* **21** (1966) 59 ff., shows ingot to be of Type 2. The context of the find was Cypriot Iron Age I (LC III), or early twelfth century.

Using the evidence gathered above, we may begin to seek the purpose and origin of what have been called "four-tongued," "double-axe," "pillow-shaped," and "oxhide" ingots. All but the last of these epithets may be easily rejected. Terms based on shape, as Buchholz has pointed out, do not describe all the variations of form found (fig. 55).[74]

The term "oxhide" is widely used by archaeologists and, although it has not been universally accepted, its rejection presents some difficulty. The term arose because of the similarity of the ingot shape to that of a dried skin: each ingot, it was thought, was

> cast in the shape of an ox-hide, dried and stretched. The obverse roughly represents a hairy hide, the reverse the raw inside of a skin with its edges curling inward. Neck and tail are not shown because for practical purposes they are not needed, but the roughened surface of the obverse which represents the hairy hide of the skin is even indicated on Egyptian wall-paintings. . . .[75]

Furthermore, because the ox was a common unit of value in antiquity, it was believed that each ingot equaled the price of one ox in a pre-monetary form of currency.[76]

The oxhide theory has been attacked by many, including the author,[77] and the arguments against it often seem overwhelming. H. G. Buchholz, in the most thorough study of all ingots known before the Gelidonya excavation, has shown that the shape evolved over a number of centuries. The earliest ingots, dated by him from representations in tomb-paintings and from actual examples in stratified excavations, seemed to have no "legs." If the casters had wished to imitate cow skins, it seemed more natural for the earliest examples to have been the most realistic, while later shapes would have become more debased. Conversely, the legs grew longer and became more pronounced, he believed, during the evolution of the shape. He advanced the theory, therefore, that the legs were developed merely for ease of porterage, and the resemblance to a skin was purely fortuitous.[78]

While this is indeed the case, the chronological division of types cannot be clearly defined. Ingots dated in stratified excavations are, as we have seen, the rare exceptions, and evidence for dating from such actual examples must be considered too scanty for drawing conclusions. We must, therefore, turn to representations.

Ingots of Type 2, dated by Buchholz to around 1400 B.C., are seen as early as the mid-fifteenth century in the tomb of Penḥēt,[79] and possibly as late as the twelfth century on the relief of Ramesses III (but see below, p. 164). Ingots of Type 3, dated to around 1200 B.C., are twice depicted in the fourteenth century, in the tombs of Huya and Huy. Ingots of Type 1, dated to around 1500 B.C. by Buchholz, are seen in two fourteenth-century tombs, of Meryra I and Huya, at el Amarna. The most conclusive evidence that the various types were used contemporaneously is found in the latter tomb, where Types 1, 3, and probably 2 are seen together.

We must conclude that the three major types of ingots cannot always be separated chronologically, but we may accept the appearance of ingots without legs as slightly earlier than the appearance of those with legs. Their continuation in use, after the development of handles, has no apparent explanation other than conservative local preference in some areas; those of us who often moved the oxhide ingots from place to place in our camp near Gelidonya are satisfied that the shape with legs is much more easily handled than the block shape of modern ingots.

Attempts have also been made to show that other resemblances to cow skins were merely the fortuitous but quite natural results of casting. While again this

[71] D. Harden, *The Phoenicians,* 195, with pl. 82.

[72] S. Casson, *Anc. Cyprus,* 128, with pl. 8.

[73] Buchholz, *PZ* **37** (1959) 20, with n. 43 for further bibliography, and fig. 4 on p. 12.

[74] *Ibid.,* 1–2.

[75] C. T. Seltman, *Athens, its Hist. and Coinage,* 4–5.

[76] *Ibid.,* 1, 5.

[77] *AJA* **65** (1961) 272–273.

[78] Buchholz, *PZ* **37** (1959) 2, 4; the additional suggestion (p. 2), that the shape was developed for long-distance commerce because round ingots would be impractical for lading on ships, is disproved by the discovery of many round bun ingots at Gelidonya. The opinion that the "legs" were only handles was previously held by H. R. Hall, *Aeg. Archae.,* 67; C. Schaeffer, *Enkomi-Alasia,* 33; Arthur Evans, *Pal. of Min.* II, 625; IV, 653.

[79] The date of the tomb of Penḥēt is important because it is the only fifteenth-century tomb listed with a certain ingot of Type 2. Porter, Moss and Burney, *Top. Biblio.* I, 330, give the time as of Tuthmosis IV to Amenhotep II, which is obviously impossible. This must be a misprint for either Tuthmosis III to Amenhotep II, or Tuthmosis IV to Amenhotep III; I have selected the earlier possibility on the basis of the date of *ca.* 1450 B.C. given by Wreszinski. If this date is incorrect, we would have only the evidence of the Linear B tablets for the existence of ingots of Type 2 before 1400 B.C., which would be an additional point in favor of L. R. Palmer's dating of the tablets from Knossos after 1400 B.C. (Palmer, *Mycenaeans and Minoans*).

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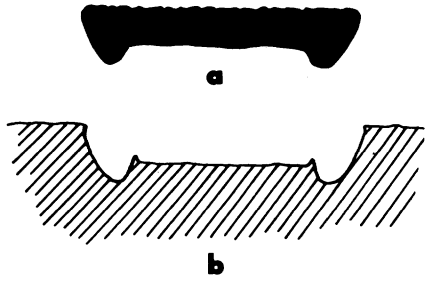


FIG. 89*a*. Usual draft of Cape Gelidonya ingots.
FIG. 89*b*. Section through hypothetical mold shows ridges that must have caused grooves inside ingot rims.

seems to be true, the explanations for these features have been incorrect.[80]

The rough, "hairy" side has been thought to result from the bottom of the mold in which the ingot was cast, which would necessitate that the impressed signs were made by reliefs placed in the molds. Actually, the rough side was upper in the mold, and resulted from the reaction of the solidifying metal with the atmosphere. Its occurrence on bun ingots, where there was certainly no intention of representing hair, is mentioned by Gowland: "This phenomenon is technically termed 'rising' and is seen daily in all copper works." [81] Manufacturers who want smooth surfaces on their copper ingots now obtain these by partially filling the empty molds with powdered charcoal. The charcoal floats to the top of the molten metal, when it is poured, and forms a protective covering against the air.

A further indication that the rough side was the upper side in the mold comes from the Gelidonya ingots. Careful inspection of the ingots revealed that in almost every case the rough surface was larger than the smoother (fig. 89*a*). Only if the draft was made in this manner could the finished and hardened ingot be drawn from its mold without the destruction of the undercut edges of the mold. Authorities have been misled in the past because the usual view of the cross section of an ingot shows the edges beveled in the opposite direction, making the rough surface smaller than the smoother surface.[82] This is decidedly atypical, although it occurs on one of the Gelidonya ingots (21), while two of the ingots (14 and 18) show no draft at all. This suggests that ease of drawing was a convenience rather than a necessity, and that molds may have been made for only one casting apiece. This is further suggested by the fact that no two of the Gelidonya ingots seem to have come from the same mold.

The "curling under of the skin" has been explained as the natural rim left by shrinkage on top of the metal as it cooled and solidified.[83] We have shown that this side of the ingot must have been in the bottom of the mold and must find another explanation. For this I asked a sculptor, Robert Barnes, to make a small mold for an oxhide ingot from a photograph of one from our hoard. First he outlined the shape of the ingot deeply in clay. Most of the clay within this outline was then either dug out or pressed down with his hand. The particular example in the photograph was of one of the ingots without the thick rim on its bottom, so there was no attempt to copy that feature. The outline remained deeper than the rest of the mold, however, and would have produced such a rim. Inadvertantly the cause of the rim was discovered, and also the reason why it appears on most ingots but not on all; the rim simply results accidentally when all of the clay in the mold is not removed to the level of the outline. There is some evidence that the rims were desirable, however, though not mandatory. Some of the rims are sharply delineated by grooves. These grooves would have occurred if the caster, fearing that the outline would be mashed or lost, had not pressed down the clay near the outline (fig. 89*b*). Only two explanations for intentional rims come to mind: the rim was desired to give a better edge for grasping and lifting the ingot, or it was desired to represent the curling under of a cowhide.

The bottom of the mold made by Barnes further retained a number of concavities where it had been pressed or pounded down. These would have caused, in casting, low mounds such as we find on most, but not all, of the Gelidonya ingots.

Agricola, writing in the sixteenth century of the modern era, describes the making of forehearths and dipping pots to catch newly smelted metal, and the procedure was then the same: a mixture of charcoal dust and earth was packed tightly together and then hollowed out with a knife. The concavity was then packed again with a rammer.[84] A mold made in this manner would produce ingots with the various features we have described; it seems quite certain that Bronze Age ingot molds were made in much the same way.

We have shown that the ingots were not necessarily cast with the intention of imitating oxhides. Even more conclusive evidence is the appearance of ingots of the same size and shape, but made of different metals. In the tomb of Rekh-mi-rē‘ are red copper ingots stacked with similar white ingots of lead, electrum, or tin (Vercoutter points out that these unidentified white ingots are grayer than the brick-shaped white ingots in the same painting which are identified by hieroglyphs as silver). In the tribute shown in the tomb of Useramon may be seen similar ingots of copper and lead, silver, or tin again stacked together. At Medinet Habu we have representations of oxhide ingots marked with the hieroglyphs for lead, silver, and copper. We have also seen that at least one actual oxhide ingot, from the Bay of Antalya, was of bronze.

[80] Buchholz, *Minoica,* 95; Seltman, *Athens,* 4, n. 2; Schaeffer, *Enkomi-Alasia,* 31.
[81] W. Gowland, *Archaeologia* **56** (2nd series 6, 1899) 289.
[82] Buchholz, *PZ* **37** (1959) 13, with fig. 5 (after Pigorini).
[83] Seltman, *Athens,* 4, n. 2; Buchholz, *PZ* **37** (1959) 13.
[84] Agricola, *De Re Metallica* (trans. Hoover), 377–378, 386.

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If a copper ingot of a certain size and shape equaled the price of an ox, it is certain that a silver or lead ingot of the same size and shape would *not* also equal the price of an ox.

It would seem that the oxhide theory could be completely discarded, but one disturbing piece of evidence remains. Upon one wall of the tomb of Huya are seen what must be considered red ingots of copper. Those above are of Type 3, while those below are of Type 2. One ingot of Type 2, if it is an ingot, has a protrusion between its handles which resembles the neck of an animal. A comparison with an actual representation of a dried skin on an Egyptian tomb painting, in the tomb of Panehesy,[85] shows that the forms are almost identical. Has either the original artist or the copier made an error, or is it possible that a red skin is shown stored with copper ingots? The latter is improbable, for metal objects are usually found together in such scenes, but in at least one instance we do see metal tribute with panther skins just above.[86] The copy of the scene in the tomb of Meryra II indicates that the painting was in poor condition, and parts of these "ingots" are missing. The shape with the "neck" is missing its other end, but another red shape directly beneath also resembles an ingot of Type 2; in this latter example the end which might also have a neck is gone, but the preserved end shows no evidence of the tail we might expect to see. We must assume that the neck is an error, therefore, but this scene remains the most important piece of evidence which might suggest that cow or ox skins were imitated in copper.

I continue to use the term "oxhide" only because it is so widely spread. Even though it seems to be incorrect, it at least defines a known body of material, as does the term "Minyan" ware. To suggest yet another name at this time would only lead to more confusion.

That the ingots were not cast to imitate oxhides does not negate the possibility that they were a form of currency. Obviously they were used for trade and, possibly, tribute. They were also stored in Egyptian treasuries, as we have seen, but so was grain which was not currency. J. G. D. Clark poses the general problem:

> How far trade was conducted in prehistoric Europe on a basis of pure barter, under which commodities were exchanged for direct consumption only, and how far and when the use of one particular object of barter became so regularized as to become a medium of exchange are questions to which satisfactory answers can hardly be given.[87]

Currency, to me, infers some standard of value which, in the case of raw metal of the same quality, can be based only on weight. Variations in weight among different ingots, where admitted at all,[88] have sometimes been explained as local variations of the standard in use: they

> varied greatly in weight for the simple reason that copper was less easy to ship from place to place than its portable golden equivalent. Consequently in the great "copper-island," Cyprus, where the metal was common, it was needful to pay, as the price of an ox, a far heavier mass of copper than one would pay in Mycenae where, as compared with Cyprus, the copper was scarce. For this reason the Cypriot ingot in the British Museum weighs as much as 37 kilogrammes, while the average weight of the "ox-hide talents" used by the Achaeans in Greece was only 25½ kilogrammes.[89]

A careful study of the weights of the Gelidonya ingots, a closed deposit forming a coherent unit, and by far the largest hoard yet found, has shown that they vary considerably. Even after taking into consideration changes in weight caused by corrosion, we see that the difference between the lightest and heaviest is extreme: 13 kg. There seems to be no ratio in the weight variations. A study of the ingot fragments further indicates that these did not represent fractional parts, by weight, of whole ingots—a fact noted by Wace at Mycenae,[90] and by Hazzidakis at Tylissos.[91]

We have, I believe, evidence from contemporary documents that ingots were of no set weight and needed careful weighing when sold or inventoried. Two of the tablets from Knossos show oxhide ingots with scales and numbers: Oa 730 states that sixty ingots weighed 52 2/30 "talents;" Oa 733 states that ten ingots weighed six or eight "talents."[92] If we assume that the "talent" was a fixed unit, it is quite clear that the average weights of the ingots on the two tablets were not the same. Arthur Evans suggested that the tablets equate copper and bronze talents with a gold unit,[93] for he believed the ingots to have weighed one talent each. It seems more reasonable to conclude that the tablets tell only how many "talents" a number of copper ingots of *no standard weight* weighed.

From the evidence concerning shape and weight, we can be certain that the ingots were not a form of currency. They were merely pieces of raw copper, cast in shapes convenient for carrying, which would be handed over to smiths to cast into objects of copper and bronze. The Gelidonya wreck shows that pieces were broken off indiscriminately as they were needed. T. L. Comparette, in presenting his argument that the large bronze bars usually known as *aes signatum* were not examples of the first Roman coinage, has remarked well

[85] N. de G. Davies, *Tombs of Panehesy and Meryra II*, pl. XVIII.

[86] Nina and N. de G. Davies, *JEA* **26** (1940) 135, and pl. XXIII.

[87] Clark, *Prehist. Europe*, 278.

[88] J. D. S. Pendlebury, *Archae. of Crete*, 212, says that the weights of the ingots are practically uniform. Ventris and Chadwick, *Documents*, 57, speak of average weights of ingots equal to a talent each: ". . . such a talent tends to remain constant, due to its limiting value as the largest ingot which can conveniently be shouldered by one man. . . ."

[89] Seltman, *Greek Coins*, 7–8.

[90] *BSA* **48** (1953) 7, with pl. 2(a).

[91] *Tylissos*, 57.

[92] Ventris and Chadwick, *Documents*, 57.

[93] A. Evans, *Corolla Num.*, 361, with fig. 14.

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on the same phenomenon. Although he speaks of a period almost a millennium after the Gelidonya ship sank, his statements are no less applicable here. The bars, he says, are simply commercial ingots:

> . . . the fact that most of the bars have been found in a fragmentary state has been considered by many scholars as strong proof that they were issued for use as money; for it is held that, whenever it was desired to obtain a sum less than the value of an entire bar, the practice was to break off from it a piece of the necessary weight and value. The absurdity of this theory has been pointed out repeatedly and its chief weakness has been stated above. Considering the bars as money, in any sense, the breaking of them into fragments would be most remarkable; but it is not difficult to understand why commercial ingots should be found in fragments; it is in fact just what an expert worker in bronze would expect. For at the present time, with greatly improved facilities for melting bronze, including an abundance of cheap gas, it is the very common practice to reduce the ingots to fragments because the smaller pieces pack better in the crucible and at the same time the surface directly exposed to the heat is thereby greatly increased.[94]

A number of scenes from Egyptian tomb paintings show oxhide ingots about to be melted down and poured into molds (figs. 76 and 77). Such an end was certainly the sole function of every ingot.

We have remaining the question of the meaning of the ingot signs. We have seen that most, but not all, of the Gelidonya ingots are marked with signs either impressed into the metal while it was still hot and soft, or incised into the metal after it had cooled and solidified. Although we have proved that the majority of the impressed signs were not made, as previously believed, by relief-stamps lying in the bottom of the molds (only the ⊕ signs, on the smoother surfaces, were made in this way), there can still be little doubt that they were made at the place of manufacture. The incised signs could have been made at any time and place thereafter.

It is probable that the primary, impressed marks were related directly either to mining or smelting; none of the bronze bun or slab ingots, which could have been produced anywhere from either copper and tin ingots or scrap bronze, were marked. It is further probable that neither the impressed nor incised marks had much, if any significance after the ingots were sold, for these marks would have been lost as soon as the ingots were broken or cut into pieces.

That the incised marks were made at almost the same time as the primary marks is suggested by their occurrence on some of the complete and broken ingots of the Gelidonya ship, a merchantman undoubtedly not far along its proposed westward voyage. This negates the possibility that the secondary signs were made after receipt in another land. Nor is there any plausible reason why the merchant transporting the ingots should have

[94] *AJNum* 52 (1918).

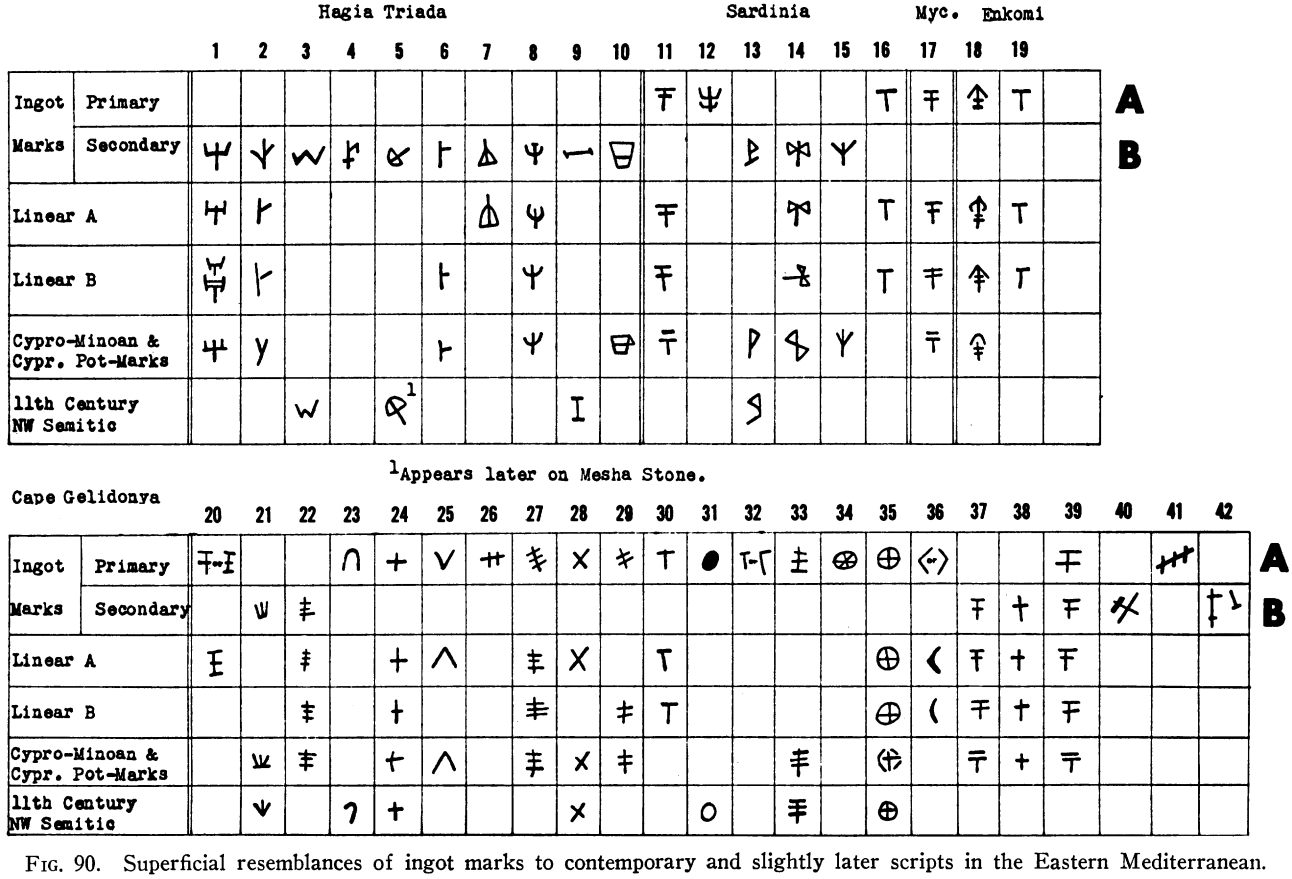


FIG. 90. Superficial resemblances of ingot marks to contemporary and slightly later scripts in the Eastern Mediterranean.

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marked them during the voyage. Primary and secondary marks should, therefore, be considered in the same "script."

This script cannot be identified. Comparisons with Linear A, Linear B, or Cypro-Minoan prove fruitless, for no group of signs is uniquely related to any one of them (fig. 90). The suggestion that primary (impressed) marks are Cypriot in origin, and secondary (incised) marks are Cretan [95] is shown improbable by the appearance of secondary marks in the Gelidonya ship which was undoubtedly sailing *toward* the Aegean. If the signs are Cypro-Minoan, they may be equated with abbreviations for Cypriot place-names given in Near Eastern and Egyptian documents: 𐠎 *si* for Sullu (Soloi) on an Assyrian cylinder seal, or ⊕ *ka* for Kation (Kition) in the Egyptian list of probable Cypriot cities from twelfth-century Medinet Habu.[96] This is only a game, however, which can be played equally well with the eleventh-century North Semitic alphabet and other names from Medinet Habu: 𐤎 *s* for Salomaski (Salamis) and Sali (Soloi), 𐤊 *k* for Kation (Kition) and Kerena (Kerynia), 𐤏 ' for Aimar (Marion), and + or × *t* for Tamassos.

In seeking the meaning of the ingot marks, therefore, we cannot assume that they were phonetic. Most are simple arrangements of lines of the sort used as potter's and mason's marks, and some may even be found on ingots made in medieval Europe.[97] Metal ingots have borne marks from the Bronze Age until the present, and a look at more recent, better understood evidence may provide a clue as to their purpose, whether phonetic or not, on oxhide ingots.

Greek lead ingots from Laurion often were stamped with non-alphabetic trade-marks.[98] Roman ingots bore more information; many were inscribed with abbreviated personal names.[99] A copper bun ingot, found recently in the sea, bears the inscription: *M(etallum)P(ublicum) NOMI(ne)PRIMULI(et)SILONIS CCXCVII PRO (curator)COL(oniae)ONOBENSIS.* This gives the names of the *conductores,* or private lessees, of the mine (Primulus and Silo), the weight of the ingot, the control of the *procurator* representing the public treasury, and the name of the place where the mine existed (Onuba, modern Huelva, in Spain).[100]

Agricola, writing in the sixteenth century of our era, tells us that tin ingots were stamped by the Magistrate

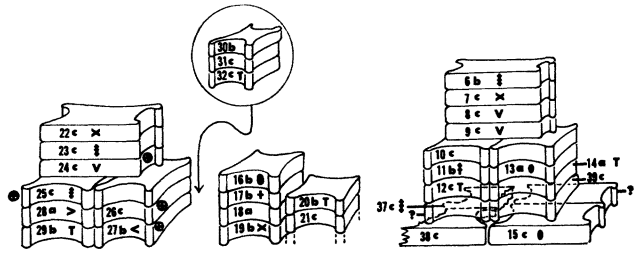


FIG. 91. Restored order of stacking of ingots in ship. Ingots from area P (bow) at right, from area G (stern) at left. Exact orientation of In 15 and In 39 uncertain.

if the ore had been mined, but with an additional mark if "made from tin-stone collected on the ground after washing." [101] Of silver ingots he says that the Royal Inspector, after testing their quality, marked them with "the seal of the King or the Prince or the owner, and, near the same, the amount of the weight." [102]

Copper ingots made today by the Kramer Ingot Company of Chicago and Philadelphia are each stamped with a K; the top ingot in each batch or heat is identified with a tag after the ingots have been stacked. Ingots specially made for a certain customer are marked with stripes of paint along their sides.

In all these cases the mark is associated with value, whether giving the weight, or guaranteeing quality (by identifying source of metal, manufacturer, or inspector).

For the Gelidonya ingots we may immediately conclude that the marks did not designate weight. Ingots weighing the same have different signs, while identical signs appear on ingots of varying weight. It seems also unlikely that the signs identified smelters. One would suppose that the shape of Type 2*a* was preferred by one smelter or locality and Type 2*c* by another, yet identical marks occur on ingots of different types, while ingots which are very nearly "twins" bear different marks.

A second method of trying to determine whether the signs indicated specific smelters or localities has also resulted in negative evidence. If the merchant ship had made several calls in ports along the coast, it would seem likely that the ingots in the bottom of the hold were placed in first, with additional ingots piled on top during later stops. A look at the lading of the ingots (fig. 91) reveals little. We see again that there is almost no pattern based on type, metal content (see append. 3), or signs. The only point of interest is that the ingots marked with ⊕ on their smoother sides were together near the stern of the ship, although these marks were on ingots of different types, of different weights, and bearing different marks on their tops. It is unfortunate that ingots 22 and 23, lying in the same area, were so badly damaged by having been in contact with tin that it is not possible to know whether they also bore this mark.

[95] Buchholz, *Minoica,* 103–104.

[96] *Ibid.,* 104–105; Buchholz also rejects possibilities of reading place-name abbreviations. S. Casson, *Anc. Cyprus,* 130 and 144, discusses the Medinet Habu inscription.

[97] Agricola, fig. on p. 499; R. Forrer, *Germania* **16** (1932) 104. Most of the ingot marks are included in J. L. Myres' list of arbitrary signs in *JHS* **66** (1946) 4.

[98] Daremberg and Saglio, *Dict.,* 1865 (*Metallum*).

[99] Forbes, *Met. in Ant.,* 369.

[100] F. Benoit, *Gallia* **20** (1962) 154–156, with fig. 19. See also R. G. Collingwood, "Roman Britain," *Econ. Survey of Anc. Rome* III, 38.

[101] Agricola (trans. Hoover) 414.

[102] *Ibid.,* 489, with fig. on 488.

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Too many ingots bore primary marks for these to have designated batches or heats; lack of a mark, indeed, might be considered a sign in itself, especially if the signs were not phonetic. Further, analyses of the trace elements in the copper offered nothing to indicate that ingots with the same marks were more closely related in their sources of metal than those with different marks (append. 3); the danger of basing too much on such analyses, however, has been well stated by A. Steinberg.[103]

So far we have no positive evidence for the meaning of the signs, yet they certainly served some rational purpose. The theory tentatively proposed here is that, in spite of metal analyses, whose value has been shown to be questionable, the primary marks identified the source of the copper. Whether a mine, mine-owner, state official, or mining guild was represented I will not venture to guess, but it is more logical that "Type-2*a*-ingot-maker" and "Type-2*c*-ingot-maker" each had some of "ore-merchant ⋕'s" material, which they marked accordingly, than that "smelter ⋕ " was making ingots of Types 2*a*, 2*b*, and 2*c*, while "smelter ⊤ " was making almost identical ingots of the three major types. Less common secondary marks might have been incised on the top ingots of stacks which were inventoried and readied for export, perhaps signifying the inspector who checked them or the merchant who was to receive them, or they may have been scratched on for identification of ownership by the merchant himself after he had bought them. Both marks, as has been shown, lost all value soon thereafter, as ingots were apparently being broken up either before or during the voyage and, therefore, cannot have designated destination.

We may conclude the discussion of marks with the observation that they could be related to either private or state control.[104] The absence of primary marks on the earlier ingots of Type 1 will be discussed below.

We have seen how the ingots were made and for what purpose, but a number of questions remain. Who dealt with them, who manufactured them, and were these necessarily the same people? The first conclusion that may be reached, by a study of their distribution (fig. 92), is that ingots were transported almost exclusively by ship. At the time of this writing, almost a third of all known ingots had been found in the sea and others, with one exception, were found either on islands or at mainland sites not far from the sea (this does not include the four models from Egyptian Thebes).

The almost universal misconception that the presence of these ingots indicates Minoan, Mycenaean, or at least Aegean trade has been mentioned, and references are too numerous to be noted. Such statements as that there is "no doubt that the trade of ox-hide ingots was in late Minoan or Mycenaean hands," [105] are reasonable if one accepts that "all paintings show us the Keftiu bearing hide-form slabs of copper as tribute (or probably a well paid article!) to Egypt. . . ." [106] Indeed, the ingots have been named "Keftiu-ingots" by their most thorough student.[107]

Such claims have little basis. I have found but one instance, in the tomb of Rekh-mi-rē‘, where oxhide ingots may definitely be assoicated with people from Keftiu. Even here Syrian chiefs present similar ingots, and when the ingots are seen in the hands of Egyptian smiths in the same tomb, they are identified as Asiatic copper from Retnu.[108] In eleven other representations we may be certain that the Egyptians considered the ingots to be Syrian.

In Cyprus there may be pictures of ingots on seals, but these are questionable. The one sure representation, on the bronze stand from Kourion, is carried by a figure who may be identified as Syrian or Phoenician.

Lastly we find ingots in Crete on Linear B tablets and, doubtfully, on a seal. These indicate only that ingots had arrived in Crete, which is known from actual examples. This no more suggests a Minoan trade or origin than their appearance in Egyptian storehouse scenes suggests that the ingots were Egyptian.

During the fifteenth century B.C., the only time when we may be sure that men of Keftiu arrived in Egypt with ingots, Keftiu boats (whether built by Keftiuan shipwrights, patterned after ships built in Keftiu, or built in Egypt for the Keftiu trade) were mentioned several times in Egyptian documents.[109] This is not the place to discuss the complex problem of the position

[103] Speaking on "Optical Spectrometry and 'Oriental' Bronzes" at the Annual Meeting of the Archaeological Institute of America in 1963, Mr. Steinberg pointed out that: "There is a certain margin of experimental error on the part of the laboratory that must be taken into account. There are also certain metallurgical phenomena to consider . . . it has been shown that tin, lead, antimony and bismuth, when cooling, tend to segregate and form separate crystals in a eutectic structure: thus a sample taken with a very small drill might completely lack these elements or, inversely, contain a preponderance of them. Furthermore, bismuth and zinc, with melting-points of 271 and 419 degrees Centigrade, respectively, might volatize or blow-off . . . [The melting point of copper is 1083° C]." Steinberg spoke of bronze, but these excerpts would hold true also for copper.

[104] I have not here pursued the evidence for control of metals in the Bronze Age, which should provide a fruitful field for further study. L. R. Palmer, *Myc. and Min.*, 100–101, 103, sees in the Linear B tablets from Pylos an official responsible for metal-workers, but the private nature of smiths in the Hittite world is shown by Hittite laws (176,B and 200,B) translated by Goetze in Pritchard, *ANET*, 195, 197. Both pieces of evidence, however, deal with those who worked with metal which had already been obtained from miners and smelters, and offer no information concerning control of the sources themselves.

[105] Clark, *Prehist. Europe*, 258.

[106] Forbes, *Met. in Ant.*, 341.

[107] Buchholz, *PZ* **37** (1959) 1.

[108] I can see no basis for the suggestion that "Asiatic copper" meant bronze; Wainwright, *Antiquity* **17** (1943) 96, and **18** (1944) 101.

[109] Vercoutter, *op. cit.*, (*supra*, n. 40) 53–55.

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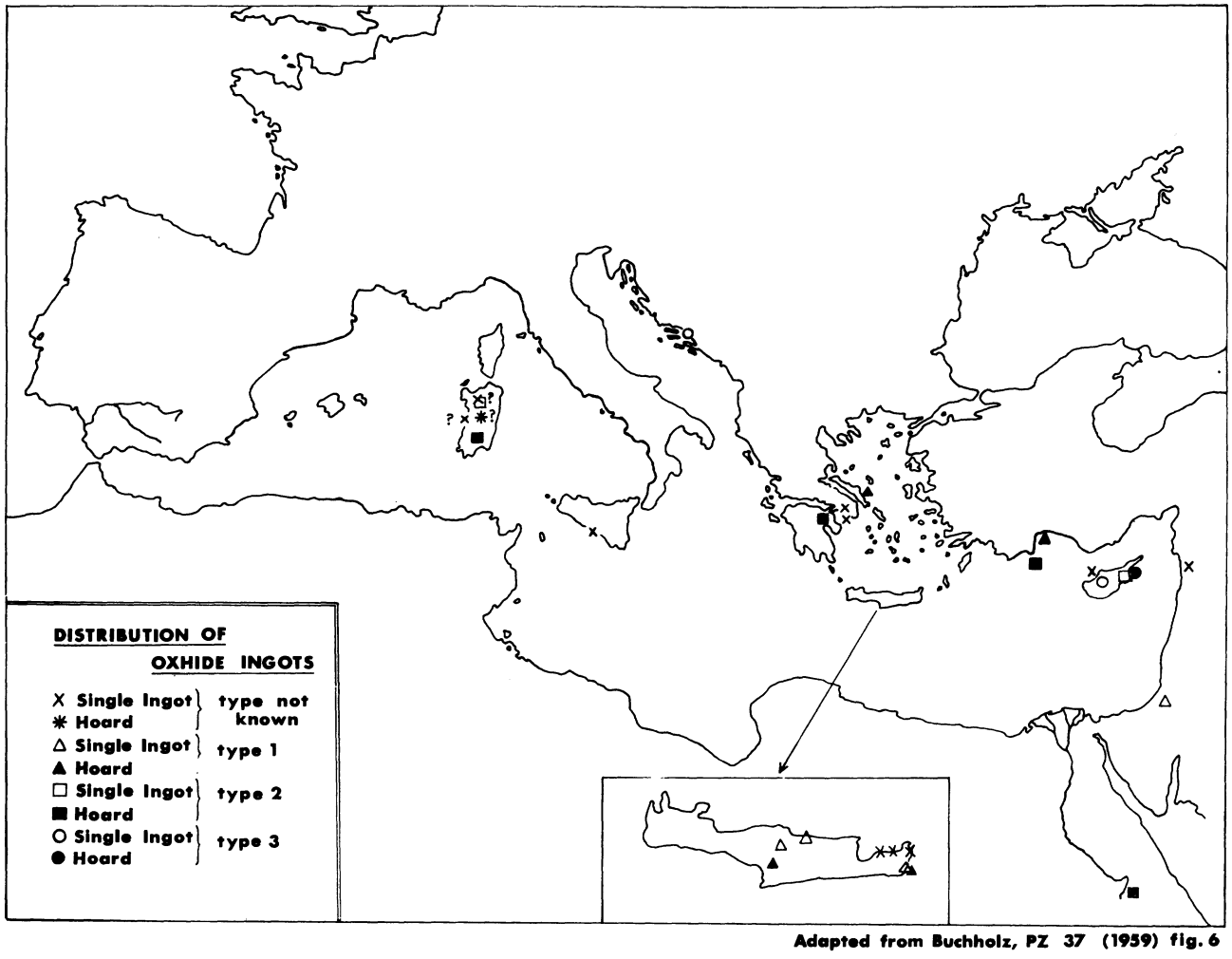


FIG. 92.

of the land of Keftiu, but if these ships were Minoan, or Minoan in character, we may suppose that the Minoans held some part of the trade prior to 1400 B.C. This might also be a partial explanation of why only actual ingots of Type 1, the earliest, have appeared on Crete.

During most of the period covered by the occurrence of ingots, Mycenaean sea traffic is believed to have been intense.[110] The distribution of Mycenaean pottery, like that of the ingots, indicates sea-borne commerce, which is believed to have been almost entirely in the hands of Mycenaean traders.[111] During the same period, however, Syrian merchant-men arrived peacefully in Egypt,[112] and does not Herodotus say of the Phoenicians that "as soon as they had penetrated into the Mediterranean and settled in that part of the country where they are today, they took to making long trading voyages. Loaded with Egyptian and Assyrian goods, they called at various places along the coast, including Argos," some years before the Trojan War?[113] Are we certain that Phoenician sea trade did not expand until "the power of the Minoan and Mycenaean merchant venturers who had dominated the eastern Mediterranean sea routes for many centuries was smashed by northern invaders about 1200 B.C."?[114] Perhaps the spread of oxhide ingots will help to answer this question. Maritime dominance may be surmised by the spread of goods, but who would guess the size and extent of the modern Greek merchant fleet by the number of Greek goods which are left at ports of call today? Middlemen leave few traces.

[110] H. Kantor, *AJA* **51** (1947) 17 ff., esp. p. 103.

[111] S. Immerwahr, *Archaeology* **13** (1960) 6, with map (pp. 2–3) showing distribution of Mycenaean pottery.

[112] Säve-Söderbergh, *loc. cit.* (*supra*, n. 52). Norman Davies and R. O. Faulkner, *JEA* **33** (1947) 40 ff.

[113] Herod. I.1, trans. by Aubrey de Selincourt (Penguin ed., 1954).

[114] Harden, *The Phoenicians*, 157–158; W. F. Albright, in *The Bible and the Ancient Near East*, 342, says that Phoenician commercial activity did not expand in the Mediterranean until after *ca.* 1050 B.C.

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The evidence so far indicates that the ingot trade was in the hands of Syrians after 1400 B.C., and at least partially in their hands before that time. This does not, however, suggest that the ingots were of Syrian manufacture.[115] The manufacture belonged to those who mined the copper. Although shipments of unrefined copper and copper ore from Cyprus to Ras Shamra have been suggested, based on the similarity of the slag at Enkomi to that found at Ugarit,[116] it seems certain that the copper was usually smelted and cast into ingots quite near the source of the raw material; the convenience of transporting ingots, with their great saving of weight and volume, instead of unsmelted ore, is obvious.[117]

Where were these copper mines and smelting places? Three of the areas which yielded ingot hoards are known to have produced copper in antiquity: in Sardinia there were copper mines in the Full Nuragic period, but not necessarily during the Bronze Age;[118] copper was mined near the site of the Cyme hoard before Strabo's time;[119] and certainly the island of Cyprus, from which our very word "copper" is derived, was an important mining center during the Bronze Age (attempts to challenge this[120] have long since been disproved[121]). There is also some slight evidence that copper was mined in Crete in Minoan times.[122] Deposits are known in North Syria,[123] but whether or not these were exploited in antiquity is unknown.

Because of the rich copper ores on Cyprus, because miniature "votive" ingots have been found there, and because of the primary (impressed) signs, which he feels are Cypro-Minoan,[124] Buchholz concluded that oxhide ingots probably originated on that island.[125] He felt that the secondary (incised) marks, even those of later date, were closely related to Linear A; this suggested that ingots were marked with secondary signs when imported into Crete, and that they were sold in the western Mediterranean (Sardinia) by Aegean traders.

With the evidence at hand, most of these conclusions were reasonable. Now, however, Buchholz himself has pointed out the miniature ingot from sixteenth-century Palestine. Secondly, the Gelidonya ingots have revealed that primary and secondary marks existed on ingots being carried by a Syrian merchantman which had not yet reached as far west as the Aegean (see chap. XIV). Finally, the study of the purely secondary marks on the earliest ingots is of little value: nearly identical symbols may be found as easily in the contemporary pseudo-hieroglyphic script of Byblos ( ,  , ) as in the Linear A of Crete ( , ), which shows the futility of pursuing such comparisons further in our present state of knowledge. What cannot be denied is that ore-rich Cyprus is a likely source of the copper.

Catling has made a sensible argument against the theory that Cyprus was the original home of the ingots. He believes that the unique oxhide form indicates a strong centralized authority which regulated copper and its trade; the organization for such administrative control was lacking on Cyprus, he feels, during the earliest period of the ingots.[126] He goes on to suggest that prior to 1400 B.C. the ingots were made in Crete, where they occur most often on land, with either imported or local copper; after the fall of Knossos, the "vested interest in the management of Mediterranean copper supplies may be assumed to have passed to the Greeks of the mainland."[127]

The suggestion of a central control is appealing, but ingots were not necessarily produced on Crete. It will be shown (chap. XIV) that the Gelidonya ship was a Syrian merchantman which was carrying a cargo of ingots westward before it sank. The occurrence of ingots of Type 1 in the Bay of Antalya, only a few miles from Cape Gelidonya, indicates that even the earliest ingots were transported along the same route; only the location and excavation of the ship that carried these ingots can prove whether they were being transported westward or, I believe less likely, from Crete eastward. Crete, as Catling points out, was extraordinarily wealthy in copper and bronze objects during this early period,[128] but it was a time when Asiatic and Egyptian imports into Crete outnumbered Minoan imports into Egypt and the Syro-Palestinian coast.[129] The discovery of ingots of Type 1 together with elephant tusks at Kato Zakro[130] is reminiscent of scenes in the tomb of Rekh-mi-rē‘ which show the same objects being borne by men of both Keftiu and Syria;[131] certainly the tusks were not native to Crete, and I would suggest that these two items formed the partial cargo of a typical vessel which sailed that same route, from Syria to Cyprus to the West, as did the later Gelidonya ship.

Ingots of Types 2 and 3 do not appear on Crete possibly only because of that island's decline in purchasing power after 1400 B.C. These ingots differ from the earlier ones in shape, method of marking, and distribu-

[115] Lapis lazuli arrived in Egypt from Keftiu, but we can be sure that it was not native to any of the possible locations of Keftiu itself; Vercoutter, *op. cit.* (*supra*, n. 40) 67.

[116] Schaeffer, *Missions*, 98–101.

[117] Clark, *Prehist. Europe*, 258.

[118] M. Guido, *Sardinia*, 151.

[119] Strabo X. 1. 9. c. 447.

[120] O. Davies, *BSA* **30** (1930) 74 ff.

[121] J. du Plat Taylor, *ILN* (24 February, 1940).

[122] R. W. Hutchinson, *Prehist. Crete*, 40, n. 2; 247, mentions exploitation of copper ore at Chrysokamino during the Middle Minoan period.

[123] G. A. Wainwright, *JEA* **20** (1934) 29 ff.

[124] Buchholz, *Minoica*, 103.

[125] *PZ* **37** (1959) 25.

[126] Catling, *Cypr. Bronze.*, 266, 271.

[127] *Ibid.*, 271.

[128] *Ibid.*

[129] W. F. Albright, *op. cit.* (*supra*, n. 114) 337.

[130] N. Platon, *Archaeology* **16** (1963) 273, 275.

[131] N. Davies, *Tomb of Rekh-mi-rē‘* II, pls. XX and XXIII.

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tion. That they were still being transported by Syrians is proved not only by representational evidence, but also by the Gelidonya ship itself; there is nothing which ties the ingots to the Mycenaeans in any way.

Most of the later ingots which have been found on land have been on Cyprus and Sardinia. Their appearance on Cyprus may be attributed to their having been produced there, but their appearance on Sardinia as the only recognizable import from the East is more difficult, at first, to explain. The arduous transportation of copper from copper-rich Cyprus to copper-rich Sardinia even seems illogical. We admittedly have no evidence of Bronze Age mining on the latter island, but it is reasonable to suppose that men with the ability to find and mine copper on Cyprus, and to sail relatively great distances with it, would have had the ability to locate and work the Sardinian ores; there is no alternative solution to the problem of why hoards of these ingots have been found in such a remote and seemingly otherwise ignored land. To the Classical Greeks the same verb was used for "to explore" and "to mine"; surely a large part of the ancient miner's life was spent, as it is today, exploring and prospecting in the farthest corners of the map.

The two islands had still more in common. Both became prime targets of later Phoenician colonization. Blakeway has shown how Greek colonization followed earlier Greek trade west of Greece,[132] and we must suppose that Phoenician settlements also followed patterns set down by earlier, Levantine trading posts.

Finally we are able to see the central control that Catling has suggested as being necessary for the unique oxhide shape. The ingots on both Cyprus and Sardinia were locally made, perhaps by native labor to fit Syrian specifications, more probably under direct Syrian supervision. Indeed, oxhide ingots could have been produced wherever copper was discovered and mined, and we need no longer look for their "home." Because ingots were made to be melted down and cast soon after reaching their destinations, it is logical that they would be found mostly in the areas where they were made or, in the case of the underwater sites, where they were lost in transport. This is, indeed, the case. They are found not at all in Egypt (except as models for foundation deposits) which country only imported them, and they are found only rarely in Greece.

This brings us to the serious problem of Crete, for a large number of ingots, all of Type 1, have been found on that island. Were it not for the ingots in the Bay of Antalya, Catling's thesis that the earlier ingots were made in Crete would be quite strong. The absence of primary marks on the ingots of Type 1 also needs some explanation. After the appearance of impressed marks on the later ingots of Types 2 and 3, the majority rather than the minority of the ingots became marked, while the rare secondary marks continued to be used only occasionally. It seems, therefore, that the incised marks served the same function during all periods, but that the introduction of impressed marks on most of the later ingots signifies some administrative change which made them necessary.

I suggest that the Minoans and Syrians shared the copper trade until 1400 B.C., but that after the fall of Knossos the monopoly passed into the hands of the Syrians alone. This would explain the administrative change indicated by the new marking system, the occurrence of early ingots on Crete, and the appearance of men from Keftiu bearing oxhide ingots in the fifteenth-century tomb of Rekh-mi-rē'. Such a theory would not be negated by the evidence from the Bay of Antalya, nor by the early representations of Syrians with ingots in Egypt, and it would not contradict Catling's ideas concerning the early connection between oxhide ingots and Crete.

An explanation for the problems raised by Minoans and Semites sharing the earlier copper trade may be at hand. Cyrus Gordon has deciphered Linear A as Northwest Semitic;[133] I am not linguistically competent to judge the validity of his decipherment, which has not been universally accepted, but the theories which would follow that acceptance fit well with the picture we have drawn: "Semitic Minoans," ingot trade and all, were subdued on Crete by Mycenaean Greeks about 1400 B.C.; ancient statements about the Minoan thalassocracy and very early Phoenician traders are more complementary than contradictory; and the third-century "confusion" of Keftiu as Phoenicia[134] no longer necessitates our either ignoring the translation or attempting to move Keftiu from Crete to the Syrian coast.[135]

Before ending the discussion of the oxhide ingots, some mention must be made of Alasia, the great exporter of copper. My belief that Syria controlled the copper trade offers one more objection to the identification of that land as Cyprus. The argument for Cyprus seems most circular. Cyprus has been identified as Asy and Alasia because of the large amounts of copper exported from that country (or countries), but one of the major reasons for believing that this copper hailed directly from Cyprus is the evidence of documents telling of the export! Wainwright's frequently discredited view that Alasia and Asy were in North Syria, even without

[132] A. Blakeway, *BSA* **33 (1933) 202.**

[133] *JNES* **21** (1962) 207–214; *Orientalia* **32** (1963) 292–297.

[134] Vercoutter, *op. cit.* (*supra,* n. 40) 100–101; G. A. Wainwright, *AJA* **56** (1952) 209.

[135] Vercoutter, *op. cit.* (*supra,* n. 40) 14–15, summarizes the views of those who do not accept Crete as Keftiu: Wainwright, *JEA* **17** (1931) 26–43, and *JHS* **51** (1931) prefers Cilicia; Schaeffer, *Ugaritica* I, 34–35, proposes the Aegean-Mycenaean colonies at Ugarit and elsewhere on the Syrian coast; Furumark, *OpusArch* **6** (1950) 243–244, eastern Cilicia; L. Christophe, *RevEgyptol* **6** (1951) 113, sees a country of coastal Cilicia and the Syrian coast north of Ras Shamra. C. Gordon's view that Semitic Minoans were included among those known as "Phoenicians" is explained in his *Before the Bible.*

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the evidence of the oxhide ingots and the additional evidence of the Syrian ship at Gelidonya, has seemed to me far more sensible than the views of his opposition.[136] Catling has recently summarized the issues involved, and also concludes that Alasia was probably on the mainland, possibly in North Syria.[137]

The discovery of tablet KBo XII 38 at Boğazköy [138] has been called the final answer to the problem by those favoring the Cyprus-Alasia relationship.[139] It is said that "ships from Alasia in the midst of the sea" are mentioned, proving that Alasia was an island. This is not necessarily so. The passage in question uses the phrase "in the midst of the sea" twice. The second usage can refer *only* to where fighting took place, and the first can refer as easily to the battles as to Alasia. That ships from Alasia sailed into the midst of the sea three times to do battle proves only that Alasia had a navy, which was already known.[140] The possession of a navy no more implies that Alasia was insular than that it was merely coastal.

II. "BUN" INGOTS

Found among the oxhide ingots were twelve complete and eight almost complete bun ingots, nine broken half ingots, and numerous smaller fragments. The whole ingots were sometimes, and possibly always, stacked, but fragments were probably carried on board the ship in baskets (see chap. IV).

Each bun ingot is a round cake, flat or slightly concave on one side and convex on the other. The flat or concave side is normally very bubbly, which indicates that it was the top when the metal was cast. The convex side is often covered with low mounds, similar to those found on the oxhide ingots, which represent depressions left in the mold when it was packed down into clay. Occasionally, one edge of an ingot is either cut straight across or has a slight protrusion; either feature would seem to indicate the point at which the molten metal flowed from a channel into its dished-out mold.

The bun ingots average about twenty centimeters in diameter and three to four centimeters in thickness, but the weights vary widely. These variations, even among ingots of approximately the same dimensions, are due to the poor state of the metal, which in some instances crumbled under slight pressure. This advanced decay, found in only one of the oxhide ingots, suggested that the bun ingots were of a different composition than the more solid oxhide ingots. The qualitative analysis (append. 3) of the one sample taken showed that this was indeed the case, for only this and the slab ingot in the table contained large proportions of tin. A qualitative analysis [141] revealed that the bun ingot was true bronze,[142] with 87.28 per cent copper and 7.077 per cent tin.[143]

No marks were found on better preserved pieces, which suggests that these ingots were all unmarked.

In the following catalogue, figures represent maximum dimensions:

BI 1. Fig. 93. D. .20, Th. .035. Weight 3.35 kg. Complete. Convex side almost flat.
BI 2. D. .19, Th. .04. Weight 4.5 kg. Complete. One side very convex. Slight projecting lug on one side.
BI 3. Fig. 93. D. .195, Th. .026. Weight 1.35 kg. Complete. One side cut straight across.
BI 4. D. .18, Th. .033. Weight 2.4 kg. Complete.
BI 5. Fig. 93. D. .225, Th. .054. Weight 5.5 kg. Complete. Excrescence on one edge.
BI 6. D. .19, Th. .03. Weight 1.45 kg. Complete. Irregular ridge around flat side, probably caused by metal settling on edge of mold.
BI 7. Fig. 93. D. .26, Th. .038. Weight 3.95 kg. Complete. Small excrescence on one edge.
BI 8. Fig. 93. D. .199, Th. .041. Weight 3 kg. Complete. Large number of bubbles on convex side.
BI 9. D. .205, Th. .036. Weight 3 kg. Complete. One side cut straight across.
BI 10. Fig. 93. D. .24, Th. .04. Weight 2.7 kg. Complete. One side cut across.
BI 11. D. .215, Th. .063. Weight 3 kg. Complete.
BI 12. D. .165, Th. .045. Weight 2.5 kg. Complete.
BI 13. D. .22, Weight 4.5 kg. Badly decayed and encrusted.
BI 14. D. .195, Th. .031. Pres. weight 2 kg. Edge missing in two places. Convex side more bubbly; other side partially concave and partially convex, with traces of matting adhering.
BI 15. D. .135, Th. .03. Most of edge missing.
BI 16. D. .18, Th. .045. Weight 2.65 kg. Edges badly damaged. Both sides convex.
BI 17. D. .23, Th. .031. Weight 2.9 kg. Edge missing in two places.
BI 18. D. .185, Th. .031. Weight 1.2 kg. Part of edge missing.
BI 19. D. .22, Th. .035. Weight 3 kg. Edge missing in places.
BI 20. D. .21, Th. .033. Weight 3.5 kg. Part of edge missing.
BI 21. Fig. 93. D. .18, Th. .035. Weight 1.4 kg. Approximately half preserved.
BI 22. D. .18, Th. .03. Weight 1.05 kg. Approximately half preserved.
BI 23. D. .26, Th. .05. Weight 3.8 kg. Approximately 2/3 preserved.
BI 24. Fig. 93. D. .223, Th. .04. Weight 2.05 kg. Approximately half preserved.

136 Wainwright, *Klio* **14** (1913) 1–36.
137 Catling, *Cypr. Bronze.*, 299–300.
138 H. Otten, *MDOG* **94** (1963) 20–21.
139 M. Mellink, *AJA* **67** (1963) 176.
140 J. Nougayrol, *CRAI* (1960) 166, also places Alasia on Cyprus on the basis of documents which could, I feel, equally point to North Syria.

141 I wish to thank the Ajax Metal Division of H. Kramer and Co. for making this and other analyses for me.
142 Coghlan, *op. cit.* (*supra*, n. 55) 23–24, defines true, as opposed to accidental, bronze as that which contains more than 3 per cent tin.
143 At the time of publication it had been possible to sample only one bun ingot and one slab ingot. Because both proved to be bronze, and because all of each class seemed different from the oxhide ingots, by direct observation, I am assuming that all of the ingots of these two types were bronze.

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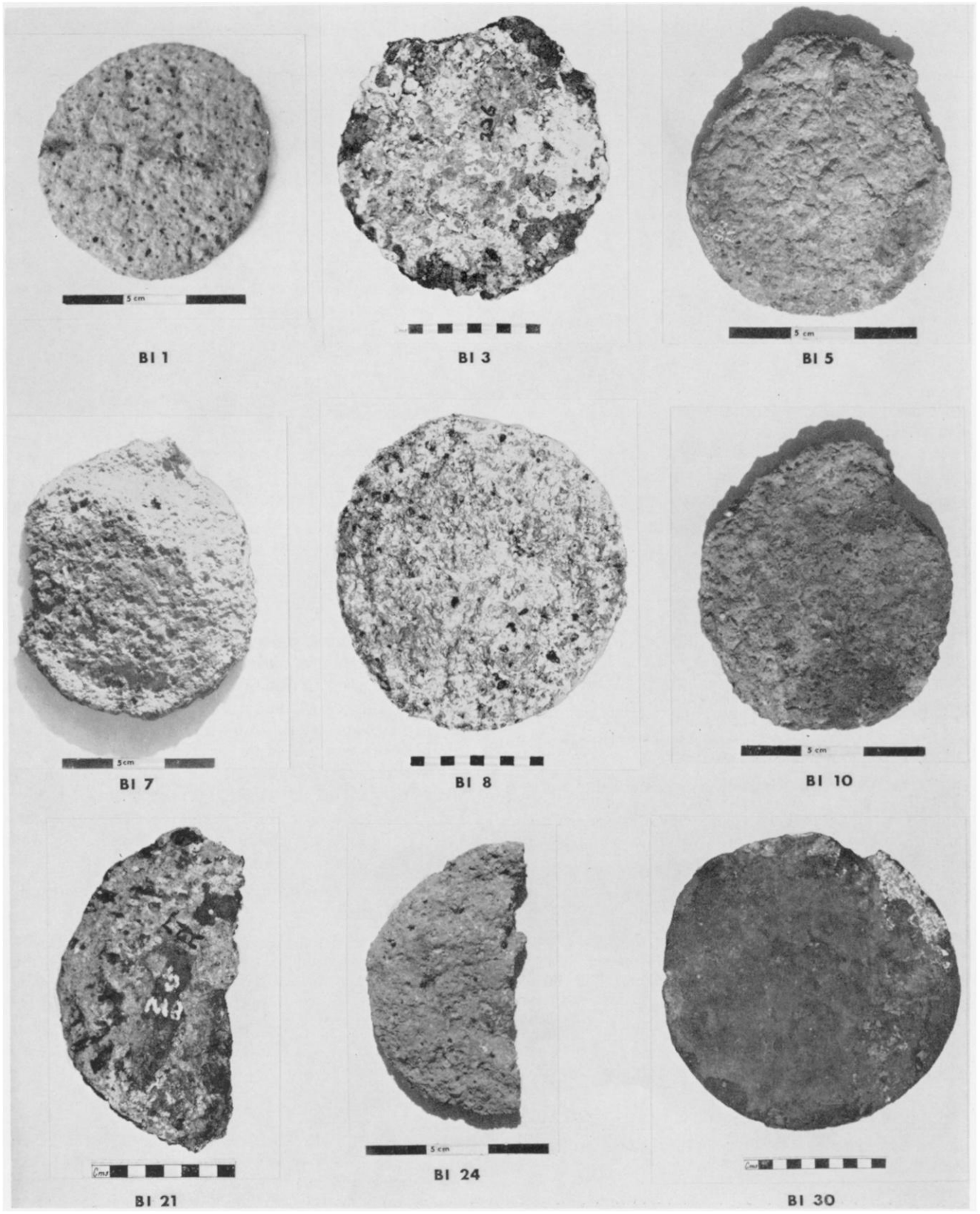


FIG. 93. Bun ingots 1, 3, 5, 7, 8, 10, 21, 24, 30.

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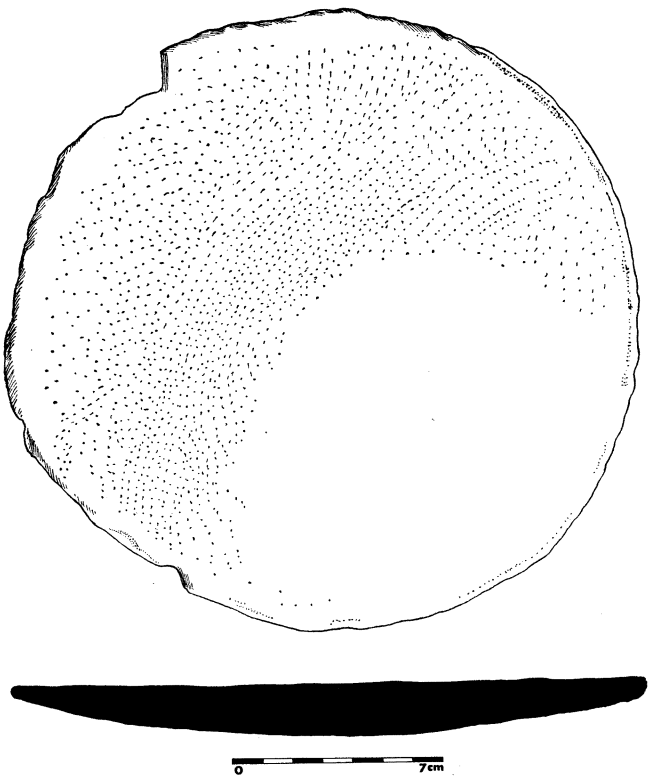
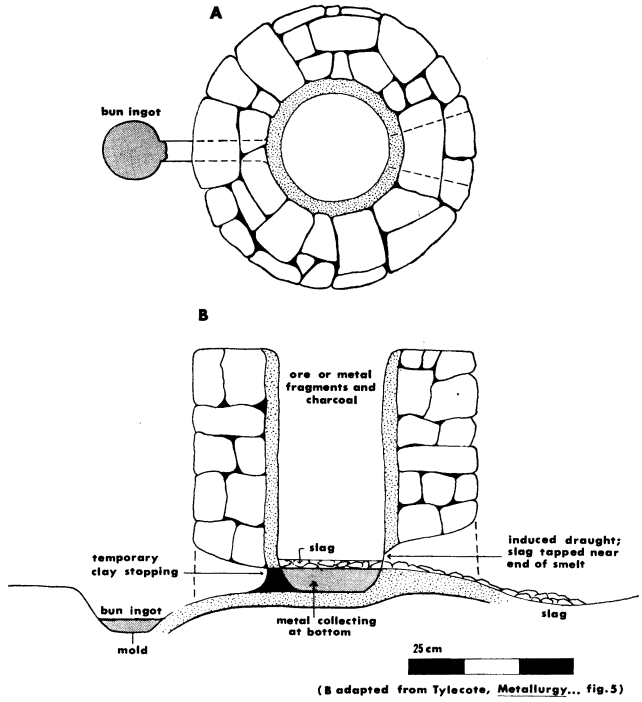


FIG. 94. BI 30.



CONCEPTION OF FURNACE WHICH COULD HAVE MADE COPPER OR BRONZE BUN INGOTS

FIG. 95.

BI 25. D. .205, Th. .04. Weight 2 kg. Slightly less than half preserved.
BI 26. D. .185, Th. .023. Weight 1.1 kg. Approximately half preserved.
BI 27. D. .19, Th. .04. Weight 4 kg. Approximately half preserved.
BI 28. D. .20, Th. .03. Weight 1.8 kg. Approximately half preserved.
BI 29. D. .18. Approximately half preserved.

In addition, there is one piece which is so much more regularly formed that it is difficult to believe that it falls into the same category:

BI 30. Figs. 93 and 94. D. .21, Th. .018. Weight 2.5 kg. Notch in one side. The convex side is very smooth, suggesting that this was formed in a hard mold, perhaps made from the base of a rounded jar; the flat side is likewise extremely smooth and flat, lacking the normal rough surface. The metal of the piece has not been analyzed, so it is not possible to state whether it is copper; if it is, the smooth surface may be "the result of skilful smelting of pure oxidized ores," as in the case of certain Welsh ingots.[144] Smooth surfaces may be obtained by protecting the molten metal from the atmosphere.[145]

Similar plano-convex disk-shaped ingots, in a variety of metals, cover a wide geographical and chronological range.[146] The simplest are merely the cakes which formed in the bottoms of shallow pits over which either ore was smelted or metal melted, and are not in fact ingots at all. Gowland[147] and Percy[148] have recorded the furnaces and operations which produced such pieces in nineteenth-century Japan, Korea, and Sikkim.

The excrescences found on a number of the Gelidonya cakes, as well as on several examples at Mohenjo-daro,[149] indicate that the type of furnace suggested by Tylecote[150] for the manufacture of stamped Roman bun ingots was known at a much earlier date (fig. 95). In such a furnace, the molten metal collected at the bottom, but rather than being allowed to solidify there, it was

[144] R. F. Tylecote, *Met. in Archae.*, 33.

[145] H. Kramer and Co. today produces copper ingots with smooth surfaces by floating powdered charcoal on the molten metal.

[146] Only a partial list, to indicate the wide spread of bun ingots, may be given here. India: Mackay, *Mohenjo-Daro* I, 451; S. R. Rao, *Antiquity* **37** (1963) 99, with pl. 11(a). Susa: *ibid.* Syria: Buchholz, *PZ* **37** (1959) 15. Anatolia: Przeworski, *Metall. Anat.*, 22 f., 108 f., with pl. 3: 1. Cyprus: O. Davies, *BSA* **30** (1930) 78. Crete: Marinatos, *Kadmos* **1** (1962) 91, with pl. 1. The Balkans: Buchholz, *PZ* **37** (1959) 16. Sicily: L. B. Brea, *Sicily*, fig. 48. France, imported from Spain in Roman times: F. Benoit, *Gallia* **20** (1962) 154–157, with figs. 18–19. Germany: P. Reinecke, *Germania* **22** (1938) pl. 1: 1–7. Great Britain in Roman times and earlier: W. Gowland, *Archaeologia* **56** (2nd series 6, 1899) 287–289; Tylecote, *Met. in Archae.*, 21, 24, 29–34, 107.

[147] Gowland, *op. cit.* (*supra*, n. 146) 278–285.

[148] Tylecote, *Met. in Archae.*, 27–28; citing J. Percy, *Metallurgy* . . . , 389.

[149] Mackay, *Mohenjo-Daro* I, 451, with pl. 132, 38–39.

[150] *Met. in Archae.*, 31, 33, with fig. 5.

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run off through a channel into an exterior mold. Some of the metal undoubtedly froze in the channel each time the furnace was tapped, and the resulting excrescences either remained as lugs or were cut off close to the cakes, leaving straight sections on their otherwise curved edges; the latter phenomenon appears not only at Gelidonya but also at Arkolochori.[151]

The commonly known copper bun ingots were the result of smelting, but, as we have seen, the bun ingots at Gelidonya were probably all of bronze.[143] This poses the problem of whether they were produced by smelting copper and tin ores together, or were an alloy made by melting metallic copper and tin. Both methods were possible. Gowland has produced bronze by smelting copper ore and tin ore together in a primitive furnace with a central cavity about the size of an average bun ingot from Gelidonya.[152] Both ores occur in Syria,[153] and in this regard it is interesting to note that Buchholz interprets representational examples in Egypt as Syro-Palestinian in origin.[154]

The occurrence of both metallic copper and tin on the Gelidonya wreck, however, suggests that the bun ingots were the result of the fusion of these two metals. Although the Tomb of the Two Sculptors at Thebes has shown that smiths sometimes worked directly from copper and tin ingots in casting bronze objects,[155] such a procedure might have caused weaknesses in the finished product owing to segregation of the metals;[156] a sounder method would have been the preliminary making of ingots, which would have been remelted for bronze casting.

Not to be overlooked is also the possibility that the ingots were made of scrap bronze, which was so readily available to those who laded the ship with quantities of broken bits and pieces. Brea states that irregular ingots of the Sicilian Adrano hoard, which contained at least one bun ingot, still showed traces of fibulae, bracelets, and other objects which had not completely melted.[157] In this case, the end in view was simply the production of easily handled and bartered units and was not a metallurgical necessity.

As in the case of the oxhide ingots, these cakes were not used as currency, although both forms are seen in great quantities and, apparently, in uniform sizes in the storehouse at Tell el-Amarna.[158] Actual examples show no standards of size or weight, and many were broken into small fragments which would more conveniently fit into crucibles for later melting. Indeed, close examination of copper cakes from Europe has revealed that they were broken up before they had cooled and hardened,[159] a practice still used in Korea, at least during the last century.[160]



FIG. 96. Slab ingots.

The scene of smiths at work in the tomb of Rekh-mi-rē‘ shows that oxhide and bun ingots were used indiscriminately, for both are seen being carried toward the furnace. That oxhide ingots at Gelidonya were copper and the bun ingots bronze seems to have no particular significance for the time; we have seen that some oxhide ingots from other sites were bronze, and that most bun ingots were copper. We may conclude, therefore, that bun ingots were simply convenient cakes which appeared in copper, bronze, iron,[161] and possibly gold and silver or tin.[162]

III. SLAB INGOTS

Nineteen slab ingots (fig. 96) were stacked in neat piles of three or four ingots each. All were found in area G, and all were probably complete at the time the ship sank. They were by far the softest of the ingots, but hardened somewhat after drying; several of the first

[151] Marinatos, *Kadmos* **1** (1962) pl. 1.

[152] Tylecote, *Met. in Archae.*, 28, citing Gowland, *JIM* **7** (1912) 23–49.

[153] Forbes, *Met. in Ant.*, 239–240, doubts that these ores were mined in antiquity.

[154] Buchholz, *PZ* **37** (1959) 15.

[155] Norman Davies, *Tomb of Two Sculptors*, pl. XI. The identification of the white ingot as lead (p. 63) has been rightly corrected by Wainwright, *Antiquity* **17** (1943) 97.

[156] Dr. Robert Maddin, Chairman of the Dept. of Metallurgy at the University of Pennsylvania supplied me with this information.

[157] Brea, *Sicily*, 194, with fig. 48 on p. 193.

[158] N. de G. Davies, *The Tomb of Meryra*, pl. XXXI, describes them as "loaves" (p. 37). It is difficult to interpret such objects, especially when the original colors are not mentioned in publication (*supra*, n. 34).

[159] Childe, *The Bronze Age*, 29.

[160] Gowland, *op. cit.* (*supra*, n. 146) 279.

[161] Forrer, *Germania* **16** (1932) 217–218.

[162] Nina de G. Davies and Norman de G. Davies, *The Tombs of Menkheperrasonb* . . . , 11, with pl. XI.

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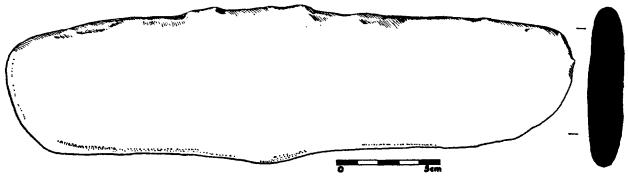


FIG. 97. SI 3.

to be removed from the concretion partially crumbled away.

The slab ingots are somewhat irregular in shape, but all are long, roughly oval pieces of flatish metal which lack the bubbly surfaces seen on oxhide and bun ingots. They are between twenty and thirty centimeters in length, six and eight centimeters in width, and one to one and a half centimeters thick. The qualitative analysis of the only ingot of this type which was sampled indicated that it had a high proportion of tin (append. 3). The quantitative analysis showed that at least that ingot was of true bronze, as was the case with the bun ingot, consisting of 94.01 per cent copper and 5.27 per cent tin.[163]

In the following catalogue, figures represent maximum dimensions. None of the ingots bore marks, but the surfaces of most carried tiny hairline cracks which radiated in clusters from various points.

SI 1. L. .27, W. .07, Th. .015. Pres. weight 1.0 kg. End chipped.
SI 2. L. .265, W. .075, Th. .011. Weight 1.0 kg.
SI 3. Fig. 97. L. .277, W. .074, Th. .012. Weight 1.0 kg.
SI 4. L. .28, W. .07, Th. .012. Weight approx. 1.0 kg.
SI 5. L. .302, W. .075, Th. .013. Weight 1.1 kg., with some concretion.
SI 6. L. .29, W. .056, Th. .017. Pres. weight 1.55 kg. Edge chipped, but some concretion adhering when weighed.
SI 7. L. .29, W. .071, Th. .012. Weight 1.0 kg.
SI 8. L. .297, W. .075, Th. .01. Pres. weight .9 kg., with 10 to 20 grams missing from chip on one side.
SI 9. L. .247, W. .08, Th. .008. Pres. weight 1.0 kg.
SI 10. L. .273, W. .082, Th. .008. Weight 1.0 kg.
SI 11. L. .218, W. .065, Th. .01. Pres. weight .7 kg. One end bent upward.
SI 12. Pres. L. .23, W. .07, Th. .014. Pres. weight .8 kg. End missing.
SI 13. L. .15, W. .055, Th. .012. Pres. weight .35 kg. One end possibly broken off diagonally.
SI 14. L. .206, W. .075, Th. .011. Pres. weight .5 kg. One end chipped.
SI 15. Pres. L. .235, W. .07, Th. .015. Pres. weight 1.0 kg. One end broken off.
SI 16. Pres. L. .209, W. .08, Th. .01. Pres. weight .9 kg. End broken off.
SI 17. L. .215, W. .078, Th. .013. Pres. weight .5 kg. Very worn edges; not known if complete or broken.
SI 18. Pres. L. .085, W. .068, Th. .01. Pres. weight .3 kg. End of ingot. Four impressed holes on convex side; other side flat.
SI 19. Pres. L. .105, W. .075, Th. .005. Pres. weight .2 kg. Ingot end.

[163] My thanks to Mr. M. Stoltz of the Ajax Metal Division for this analysis.

These ingots were first thought to be blanks which were to have been hammered into tools or weapons; actual castings, however, prove to be quite regular and smooth (p. 113). That they are ingots is indicated by their similarity to somewhat earlier silver ingots from Egypt.[164] Although the Egyptian ingots are smaller, they are identical in shape, and gold ingots found with them also bear the small cracks which appear on the Gelidonya ingots; I do not know the cause of these cracks.

Two important factors must be considered in a study of these ingots. The first is that all came from the area of the "captain's cabin." While it is true that metallic cargo was found there, the slab ingots form the only type of metallic object found *only* in that area (area G), which also yields the scarabs, cylinder seal, maceheads, knucklebone, lamp, food, and most of the weights and whetstones. This might indicate only that they were ready to be utilized in making bronze objects, if it were not for the second factor: the unusual regularity of their weights.

Almost all of the complete slab ingots weigh exactly 1.0 kg., with variations in weight among the others explained by the addition of concretion or the subtraction of chips of metal. Slab ingots 18 and 19 may be discounted as fragments, but 14 and 17 seem to be nearly complete and these weigh .5 kg. each, or half the weight of most of the ingots; slab ingot 13 is probably another, broken, "half unit." This leaves only ingot 6, approximately one and a half times the weight of the average ingot.

The poor state of preservation of these ingots, with the resultant unknowns and variables in weight, prohibits definite conclusions, but the strong probability exists that they, of all the ingots, were the most likely to have served as currency; their position on the ship, with the other "personal possessions of the captain," can only strengthen this probability. They are not, it seems, represented in contemporary art,[165] and the conclusions must be based on the evidence of the ingots themselves.

IV. TIN (PROBABLY IN INGOT FORM)

Under the copper ingots of areas P and G were found three piles of white, powdery tin oxide.[166] The single pile in area G, found beneath oxhide ingots 22 and 23, was collected and raised in a plastic bag. When dry, it weighed 8 kg., which was approximately half of what had been preserved on the wreck. The tin oxide, how-

[164] F. B. de la Roque, *Trésor de Tod*, pl. VI, no. 70513 (silver) and pl. IV, no. 70505 (gold).

[165] N. de G. Davies, *Deir el Gebrâwi* I, pl. XIV, shows a man approaching smiths, who are blowing on a fire through tubes, with a basket of red objects (called "food and jars of beer (?)" on p. 20) which resemble slab ingots. The scene is from the Sixth Dyn. tomb of Aba.

[166] My thanks to the Turyağ Laboratories of Izmir for this identification.

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ever, was found only where it had been covered and preserved by masses of copper and sea concretion, and it would be impossible to estimate the amount that might have been washed away from more exposed areas.

Miss Frost noted that the tin oxide in Area G seemed to extend from and below a squarish shell of concretion (fig. 98), which was thought at the time to have been formed over a box. Similar shells of concretion, however, are found over powdery iron oxide on later wrecks,[167] and these shells preserve exactly the original shapes of the corroded metal; if one end has not been covered by concretion, the oxide has sometimes completely disappeared, leaving an empty space. At Gelidonya, therefore, we may have the shape of the end of a tin ingot which was six centimeters on a side; the length of the bar is unknown. Such a shape would correspond to the larger ingot which we have identified as tin in the tomb of Nebamūn and Ipuky (p. 65). The extreme decay of the tin may be explained by the electrolytic action which so badly damaged the copper ingots with which it was in contact (p. 52).

Sources of tin ore throughout the Bronze Age are debated by students of metallurgy. Lucas [168] and Wainwright [169] point to Syria, but Forbes, although not denying its existence, questions its importance there.[170] Przeworski [171] records tin in Anatolia, but Wainwright states that there is no proof that it was mined there at an early date.[172] Wainwright then suggests Crisa, on the north shore of the Gulf of Corinth,[173] but Forbes doubts that ore was ever mined there; [174] the more recent excavations throw no new light on this subject.[175] The presence of copper oxhide ingots on Sardinia, whether imported or manufactured locally, implies that ships such as that wrecked at Cape Gelidonya sailed at least that far west; this would take them far on the way to the tin fields of Spain, but we have no evidence that such voyages took place. Sardinia, itself, has tin ore, but whether it was known at such an early period is not certain.[176] What does seem to be certain is that tin was not mined on Cyprus; J. R. Stewart believes that the tin used there, at least in the Early Bronze Age,

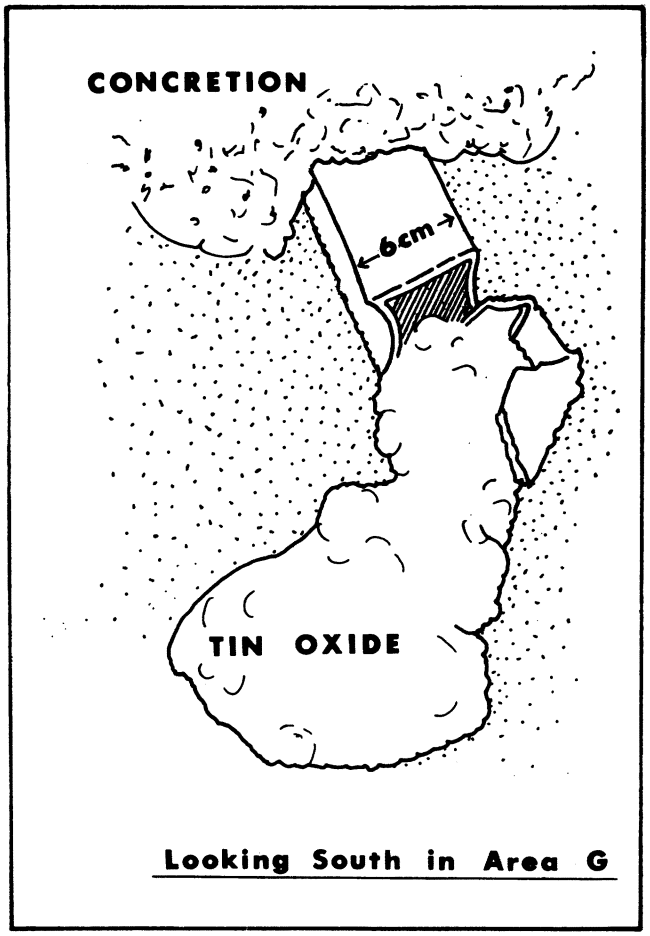


FIG. 98.

was "most likely" from Anatolia, "possibly" from Syria, and "even conceivably" from Central Greece.[177]

Although the tin at Gelidonya is not the earliest known, it is the earliest purely industrial tin; the previously noted lack of tin bars or slabs in founder's hoards [178] may now be explained as due only to the fortunes of excavation. The identification of the rectangular ingot from the tomb of Nebamūn and Ipuky as lead was based largely on the belief that tin ingots did not appear this early. Other re-interpretations in art and literature may now be needed, and Albright has already suggested that the Gelidonya tin provides an additional argument for the identification of *anāku* in the old Assyrian documents from Cappadocia as "tin" rather than "lead," although he points out that these documents are considerably older than the shipwreck.[179]

[167] Bass, *NG* **124** (July 1963) fig. on p. 142. H. Frost, *Under the Med.*, 20–21, 59–60.
[168] Lucas, *Anc. Egypt. Mat. and Industr.*, 288–289.
[169] *JEA* **20** (1934) 29–32; *Antiquity* **18** (1944) 101.
[170] *Met. in Ant.*, 239–240, 252–253.
[171] Przeworski, *Metall. in Anat.*, 91, 101–102.
[172] *Antiquity* **18** (1944) 59.
[173] *Ibid.*; O. Davies, *JHS* **49** (1929) 92–93.
[174] *Met. in Ant.*, 244.
[175] Dor, Jannoray, and H. and M. van Effenterre, *Kirrha*. See more recently S. Benton, "No Tin from Kirrha in Phokis," *Antiquity* **38** (1964) **138.**
[176] Guido, *Sardinia*, **28.**
[177] *SCE* IV, 1A, 242.
[178] Forbes, *Met. in Ant.*, 247.
[179] Letter dated 7 Dec. 1960.

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VI. THE BRONZES

George F. Bass

The study of the bronze tools, weapons, household utensils, and personal objects has profited greatly from two works of major importance which have appeared since the Gelidonya excavation: J. Deshayes, *Les Outils de bronze, de l'Indus au Danube (IV^e–II^e millénaire)*, and H. Catling, *Cypriot Bronzework in the Mycenaean World*.[1] References in this chapter will be abbreviated to "Deshayes" and "Catling." Catling has published a list of the metal objects from Gelidonya,[2] but it will be seen that his identifications differ from mine in a few instances. Some of the differences may be ascribed to personal opinion, but in some cases they are the result of less than complete information which Catling had on hand at the time of his work, through no fault of his own. The unusually difficult conditions under which the objects were first catalogued at our camp on the beach led to incomplete information in some cases, and it was only during the following summers that the pieces could be laid out and grouped for careful restudy in the Bodrum Museum. Indeed, I was not even aware of several objects, which had been raised in 1959, until they were given to me to place in the Bodrum Museum in 1962.

In addition to Deshayes and Catling, a number of studies of individual types, such as those of lugged adzes by R. Maxwell-Hyslop, Aegean knives by N. Sandars, tripods by J. L. Benson, and axe-adzes by C. Schaeffer, have offered great help in supplementing excavation reports.

In the following catalogue, area locations on the site are given in parentheses; (1959) indicates that the object was raised during the summer when the wreck was first investigated, and a precise location is not known. Those pieces which have no area designations were mostly discovered during the breaking open of odd lumps of concretion after the excavation had ended.

Although the uses of some of the implements are ambiguous, the bronzes have been grouped as follows: agricultural tools (I–VII), wood-working tools (VIII–XI), metal-working tools (XII–XIII), light tools, mostly for domestic work (XIV–XVII), weapons (XVIII), personal and household objects (XIX–XXV), and miscellaneous categories, including unfinished castings, unidentified implements, and casting waste (XXVI–XXX). All of the implements are thought to be of bronze, but the reader should bear in mind that only a very few fragments have actually been analyzed.

[1] I wish to express my great thanks to Dr. Catling for supplying me with many references and comments before the publication of his book. Although our conclusions do not agree, I could not have formed mine without the benefit of his work and ideas, for which I am especially grateful.

[2] Catling, 292–294.

I. PICKS

The most numerous tools at Cape Gelidonya were picks (Catling's agricultural tool D).[3] Each was cast as a long, thin bar with a T-shaped end. The sides of the T were rolled over to form an open socket, and the opposite end of the bar was hammered into a point. A sharp point is preserved only on B 15, for the others have been either blunted or broken off. No two picks are exactly alike, but several distinct features may be noted. The bars of some (B 3, B 17, B 18) are rectangular in section; the point of none of these is preserved. Other bars (B 1, B 16, B 19) are round in section; that these have been hammered out of flat bars is apparent from the central grooves, on the same side of the pick as the socket opening, seen on B 20 and B 21. This would suggest that the rectangular bars were simply unfinished, and that their points are missing only because they had not yet been hammered out, were it not for Cypr. Mus. Met. 1708, which is rectangular and pointed. Still other bars (B 15) are flat on the side of the socket opening, but are otherwise rounded. B 6 and B 14 are almost oval in section. B 2 and B 11, while rectangular in section, are not nearly as wide as those first mentioned.

The manner in which the sockets and their bars form angles varies. Sockets of picks most rectangular in section are simply bent in toward the socket openings, so that the bar may lie flat with the socket raised in the air. Others, notably B 1 and B 6, which are round or oval in section, are flattened on the outer sides of their bends, so that they rest naturally with both bar and socket pointing slightly upward.

Forty-seven pieces, mostly fragments, are catalogued. None of the fragments join, but there is the possibility that some of the sockets and bars were originally from the same picks. We may estimate only that the fragments are from a minimum of twenty-four picks.

B 1. Figs. 99 and 101. L. .252, socket D. .033, bar W. .03 tapering to .01, bar Th. .014 to .01, socket Th. .01. Tip broken. Bar round in section, coming to point at end, but is rectangular in section at transition to socket (1959).

B 2. Figs. 99 and 101. L. .245, socket W. .035. Both sides of socket broken (P). Very similar to Cypr. Mus. 1958 VI-24 12, from the Stylianou Hoard.[4]

B 3. Figs. 99 and 101. L. .205, socket D. .032. Socket complete; end missing or unfinished. ↑ incised on socket (P). A number of very similar tools (Met. 1708, with more pointed end, 2164, 2165, 2168, and 2173) are in the Cyprus Museum.[5]

B 4. Figs. 99 and 101. L. .23, socket D. .03. Point missing (1959).

[3] *Ibid.*, 82–83.

[4] *Ibid.*, 82, no. 1, with fig. 7:6 and pl. 4:i.

[5] *Ibid.* nos. 3–8.

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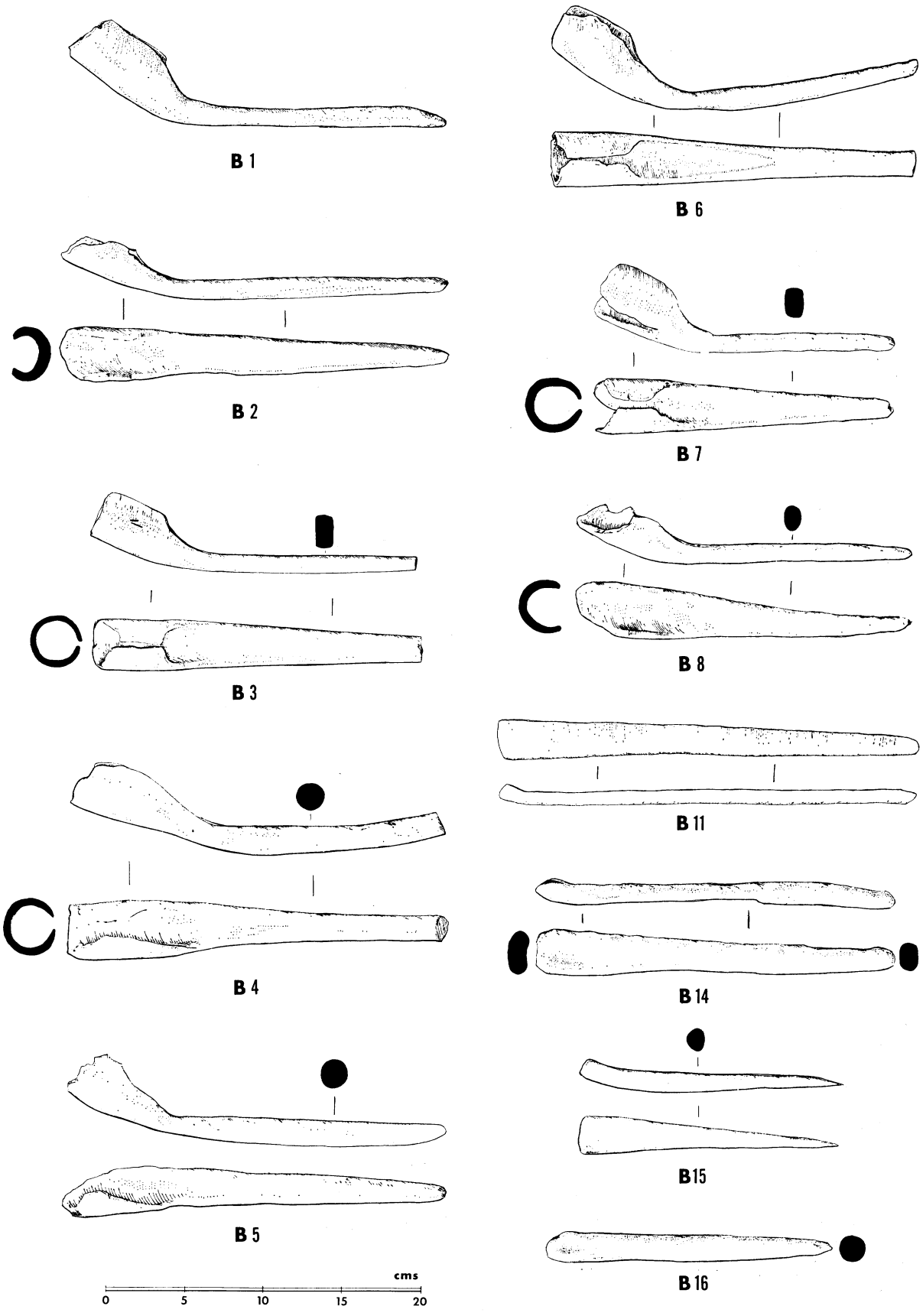


FIG. 99. Bronze picks: B1 to B16.

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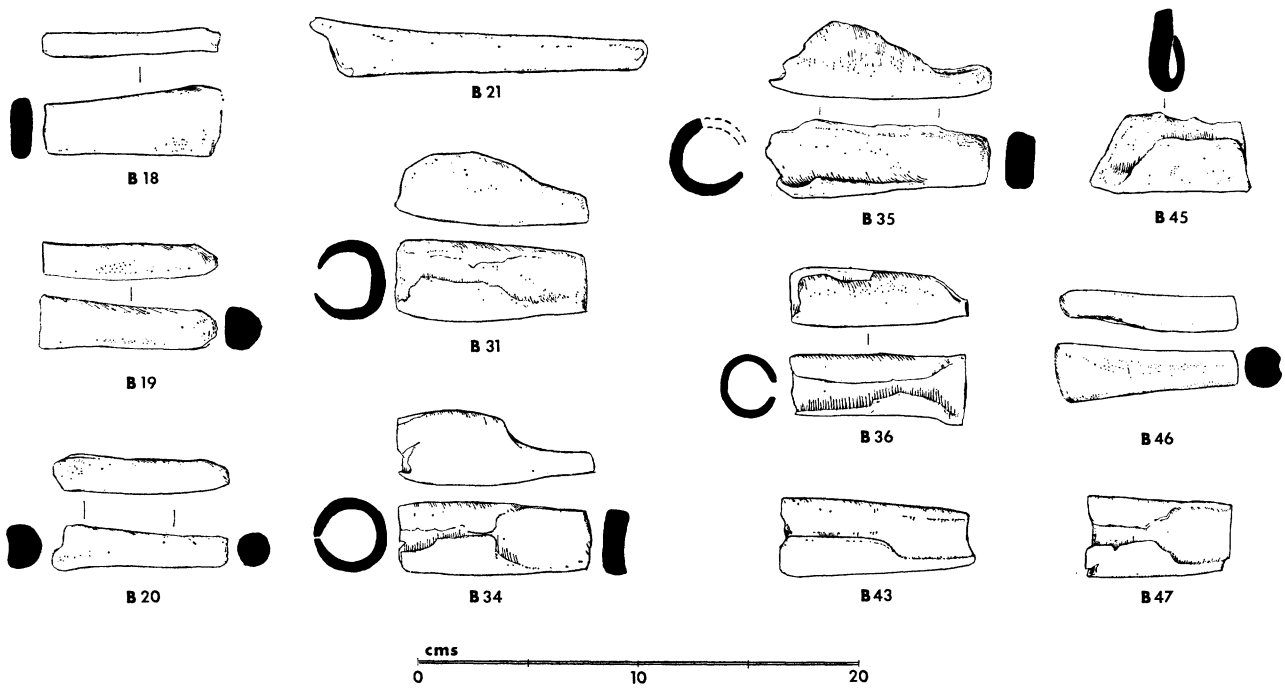


FIG. 100. Bronze pick fragments: B18 to B 47.

B 5. Figs. 99 and 101. L. .14, socket D. .03. Socket chipped (G).
B 6. Figs. 99 and 101. L. .23, socket D. .034. Point missing (G).
B 7. Figs. 99 and 101. L. .19, socket W. .035. Socket cracked; blunt end (1959).
B 8. Figs. 99 and 101. L. .215, socket W. .035. Half of socket missing (1959).

Bar fragments:

B 9. L. .105, max. W. .024. Blunt end (G).
B 10. L. .092, W. .015, Th. .019. Blunt point (G).
B 11. Figs. 99 and 101. L. .265, W. .025, Th. .01. Unusually long (G).
B 12. L. .15, W. .028. Fairly sharp point (S).
B 13. L. .18, W. .018, Th. .011. Blunt point (G).
B 14. Figs. 99 and 101. L. .225, W. .028. Fairly sharp point (1959).
B 15. Figs. 99 and 101. L. .16, W. .025. Very sharp point (G).
B 16. Fig. 99. L. .18, W. .02. Fairly sharp point (1959).
B 17. L. .07, W. .002, Th. .01. Rectangular in section; point missing (G).
B 18. Fig. 100. L. .077, W. .032 tapering to .022. Rectangular in section; point missing (1959).
B 19. Fig. 100. L. .08, D. .023. Unusually thick, blunt point (1959).
B 20. Fig. 100. L. .078, D. .015. Central groove on one side; point missing (P). *Cf.* Cypr. Mus. 1958 VI-24 13, with groove and pointed end, from Stylianou Hoard.
B 21. Fig. 100. L. .15, W. .025. Central groove, blunt point (G). *Cf.* Cypr. Mus. Met. 2174, with groove, and with socket preserved.
B 22. L. .07, W. .016 to .01, Th. .012. Rectangular in section, but with rounded edges, and blunt, rounded end.
B 23. L. .06, max. pres. D. .012. Round in section; tapers to rounded end.
B 24. L. .033, W. .029, Th. .006. Rectangular in section; point missing (P).
B 25. L. .043, W. .019, Th. .011. Rectangular in section; point missing.
B 26. L. .026, W. .021, Th. .013. Almost rectangular in section, but rounded on one side.
B 27. L. .08. (E).
B 28. L. .11, D. .015. Round in section; central groove on one side; point missing (S).
B 29. L. .05, D. .013. Round bar, perhaps pick fragment (G).
B 30. L. .021, pres. W. .026, Th. .008. Rectangular in section (P).

Sockets:

B 31. Fig. 100. L. .085, W. .032. Broken off at transition to bar (1959).
B 32. L. .059, D. .035. Very fragmentary (G).
B 33. L. .08, D. .035. Broken off at transition to bar (P).
B 34. Fig. 100. L. .08, D. .033. Broken off at transition to bar (P).
B 35. Fig. 100. L. .10, W. .03. One side missing; broken off at transition to bar (1959).
B 36. Fig. 100. L. .078, W. .025. Chipped (G).
B 37. Fig. 101. L. .05. Mashed or hammered together (G).
B 38. L. .078, W. .03. Very fragmentary (M).
B 39. L. .05, W. .03. Very fragmentary (M).
B 40. L. .04, W. .03. Very fragmentary (M).
B 41. L. .04, W. .03. Very fragmentary (G).
B 42. L. .045, D. .03, Th. .003.
B 43. Fig. 100. L. .089, D. .034, Th. .003. Broken off at transition to bar (G).
B 44. L. .061, W .033. Very fragmentary (P).
B 45. Figs. 100 and 101. L. .07, W. .035. Part of socket, hammered into flat fold (G).

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B 46. Fig. 100. L. .083, W. .025. (1959).
B 47. Fig. 100. L. .065, D. .035. Broken off at transition to bar (G).

That all, or very nearly all, of these tools were carried for their scrap value is evident. It is of some interest that there are three categories into which the pieces fall: nearly complete picks, bars, and sockets; most of the sockets are nearly complete, but in no case is there a socket with part of the bar preserved. The smith obviously cut the bars off near their sockets, perhaps be-

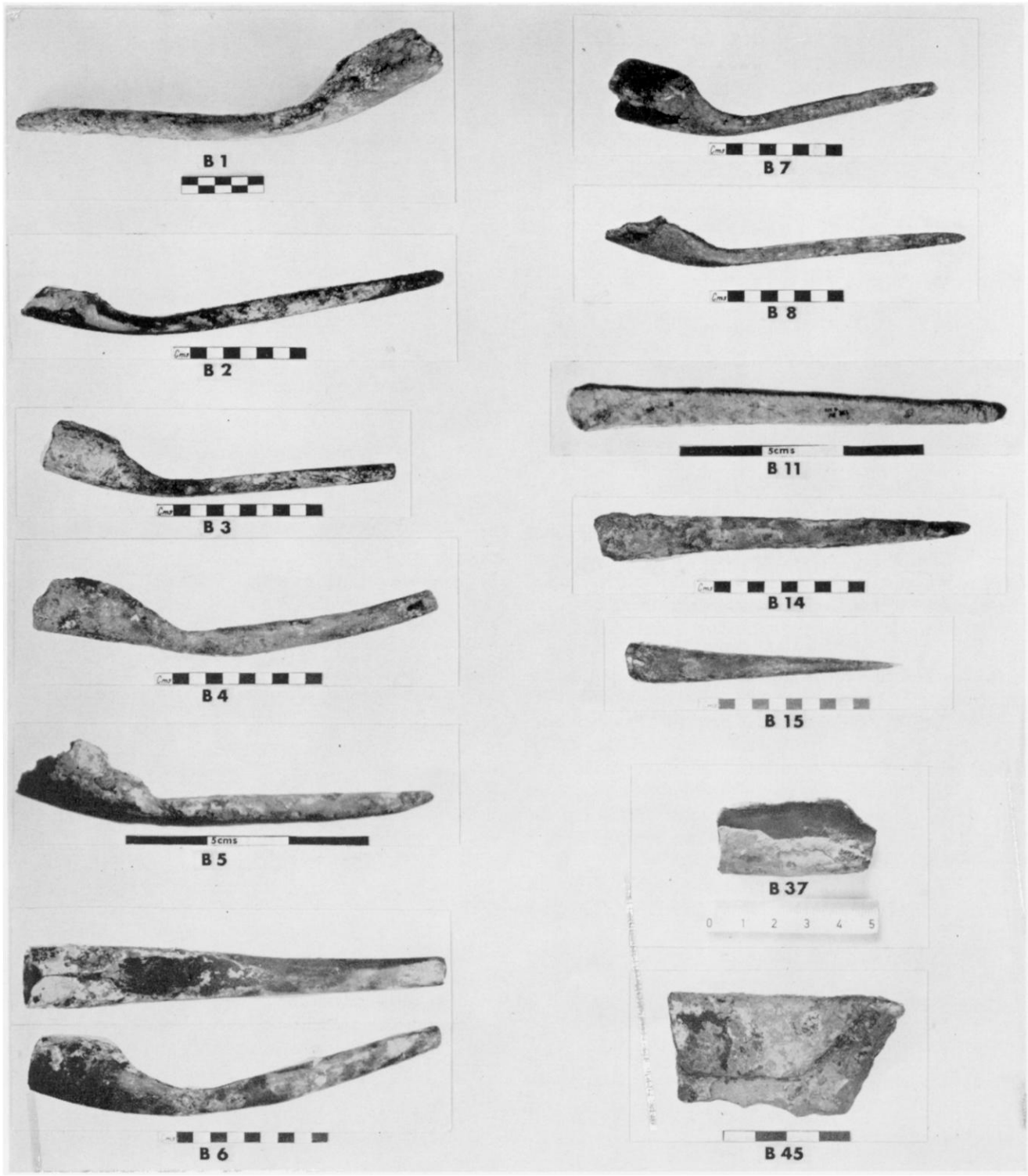


FIG. 101. Picks and pick fragments.

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cause plain bars were easy to work with, and then probably, as is twice seen, hammered the sockets flat; the only explanation for the latter action would be for economy of space in packing the material.

We have seen that picks with both rectangular and round bars are found in Cyprus, and the extremely close similarity leads to the conclusion that the Gelidonya picks are Cypriot in origin (*cf.* Catling, pl. 53:*b* and *c*). Cypriot picks with wide bars (Catling, 82, no. 3, with fig. 7:7; pl. 4:*j*) did not appear on the wreck.

Catling (82–83) points out that such picks, which may have been used in farming or mining, are not known in the Aegean, and suggests that they may be a Cypriot development related to Near Eastern plowshares. Dating depends on the dating of the Cypriot hoards (see chap. XIV), which contained the examples from that island, but a parallel (only .15 long) from Tell el Fara (south) has been dated to *ca.* 1300 B.C.[6]

II. HOES AND SIMILAR SOCKETED BLADES

TYPE 1

Type 1 corresponds closely to Deshayes' open-socketed hoe type B 4,[7] and Catling's agricultural tool C(a),[8] with its long blade tapering toward a rather pointed edge. It finds its closest parallel in Palestine, at Beth Shemesh, in the twelfth or eleventh century B.C.[9] Another Palestinian example, from the end of the second millennium at Tell Beit Mirsim,[10] is fairly close in shape. Less alike, but perhaps related, is a hoe in the Cyprus Museum.[11] A piece from the Founder's Hoard at Enkomi,[12] which Deshayes has listed under his Type B 3*b*,[13] seems to be the same but worn, and Catling lists another fragmentary example from Cyprus.[14]

It is evident that the origin and dating of this type are uncertain. Albright states that iron plowpoints were used in the eleventh century in Palestine,[15] which suggests an earlier date in the last quarter of the second millennium for bronze examples. We may, on the basis of the Beth Shemesh example, tentatively place the Palestinian pieces in the twelfth century. Catling believes the Enkomi Founder's Hoard to be probably not prior to 1200 B.C.[16]

All of the Gelidonya examples were probably in the forward half of the ship (areas P and E). Two may have been complete in antiquity:

B 48. Figs. 102 and 105. L. .215, blade W. .047, max. blade Th. .006. Socket damaged and tip of blade cracked (1959).
B 49. Figs. 102 and 105. L. .21, blade W. .052, blade Th. .006, socket Th. .005. Part of the socket is missing, but at least part of this is newly broken (1959).
B 50. Fig. 105. L. .19, blade W. .065 to .03, socket W. .05, blade Th. .005. Heavily concreted; socket broken (1959).
B 51. Blade only. L. .111, max. W. .05, Th. .008. Similar to B 53. (E).
B 52. Fig. 102. Blade only, similar to B 51. L. .08, W. .033, Th. .005 (1959).
B 53. Fig. 102. Blade only, similar to B 51. L. .075, W. .04, Th. .005 (P).

TYPE 2

The blades of Type 2 swell, rather than taper, toward broad, rounded ends. This shape does not seem to correspond to any listed by Deshayes, but one of his hoes of Type B 3*b* is similar;[17] it is part of the Enkomi Founder's Hoard and its date is, therefore, uncertain. Two parallels found in the Stylianou Hoard are probably from Enkomi,[18] and an example excavated at Enkomi may be dated to the early twelfth century B.C.[19]

All except B 55, from area P, were found in area G and were, therefore, from near the stern of the ship in the "cabin area." Only one may have been complete in antiquity:

B 54. Figs. 102 and 105. L. .135, blade W. .042, blade Th. .004 tapering to edge, socket Th. .0015. Socket chipped (G).

Blades and Blade Fragments:

B 55. Figs. 102 and 105. L. .16, W. .06, Th. .006. Complete blade, broken at socket (P). Larger than B 54, but very similar in shape.
B 56. Fig. 102. L. .085, W. .042, Th. .003. Complete blade with bit of socket preserved (G).
B 57. Fig. 102. L. .158, W. .058, Th. .007. Sides of socket missing, blade chipped (G).
B 58. Fig. 102. L. .06, W. .07, Th. .004. Rounded end of very wide blade (G).

TYPE 3

Blades of Type 3 are short and approximately the same widths as their sockets throughout. They end in blunt, almost straight edges. It is possible that some of these may be only very worn examples of Type 1 which have been continually resharpened.

The closest parallels are from mainland Greek hoards found on the Athenian Acropolis,[20] and at Anthedon in

[6] Petrie, *Beth-Pelet* I, 9, with pl. XXVI, no. 98, called a "spear butt."
[7] Deshayes I, 140, 142.
[8] Catling, 80.
[9] Grant, *Ain Shems* II, 33, no. 49, with pl. XLVII: 41.
[10] Albright, *Tell Beit Mirsim* III, 32, with pl. 62: 4.
[11] Nicosia Mus. No. 164; Gjerstad, *St. Preh. Cypr.*, 237; Catling, 80, no. (a) 1, with fig. 7: 5 and pl. 4: a; Deshayes II, no. 1225.
[12] Schaeffer, *Enkomi-Alasia*, 29, with pl. LXV: 9.
[13] Deshayes I, 139, no. 1218.
[14] Catling, 80, no. (a) 3.
[15] Albright, *Tell Beit Mirsim* III, 32–33.
[16] Catling, 281.
[17] Deshayes I, 139, no. 1217; Catling, 80, no. (b) 2–8, with pl. 4: c.
[18] Catling, 80, nos. (b) 13–14, with fig. 7: 3 and 4, and pl. 4: e and f; *BCH* **83** (1959) 338, fig. 2, shows one of the pieces.
[19] Catling, 80, no. (b) 1, with pl. 4: b.
[20] Montelius, *Grèce Précl.*, 155, with figs. 494 and 495.

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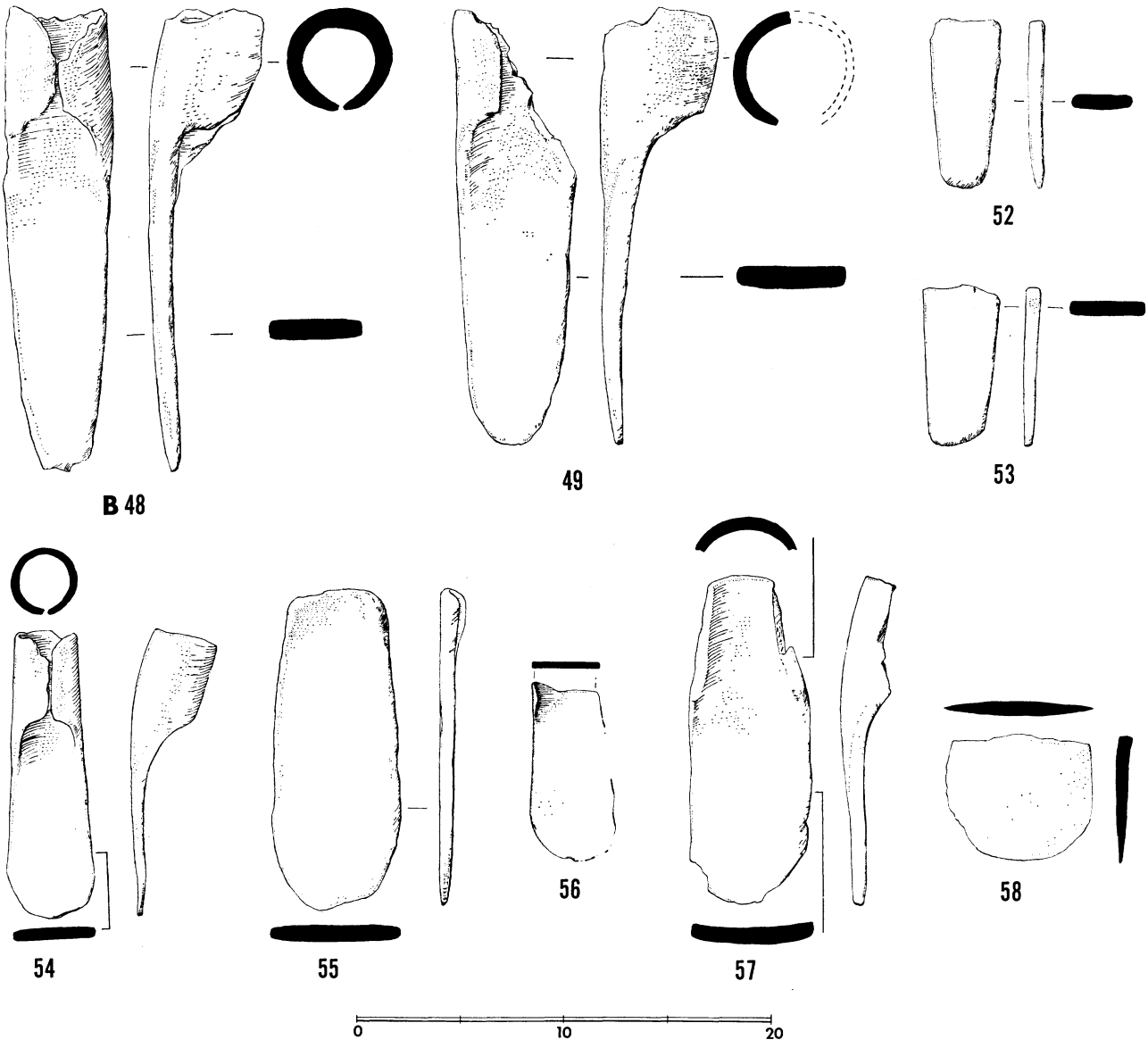


FIG. 102. Bronze hoes and socketed blades: B 48 to B 58.

Boeotia;[21] another similar example, from Cyprus, is shown by Gjerstad.[22] Deshayes has included all of these under his Type B 3*b*, but as we have seen above, the B 3*b* pieces from the Enkomi Founder's Hoard are better fitted into our Types 1 and 2, and his B 3*b* example from Megiddo[23] is quite unlike those from Gelidonya.

As usual, the dating of the hoards is difficult. Only two sherds were published with the Acropolis Hoard, but their date of LH III A2, by Furumark, is not necessarily that of the bronzes.[24] Catling would place that hoard after 1200 B.C.,[25] and Desborough shortly before,[26] but neither states his case with complete confidence. The Anthedon Hoard is dated by Catling in the twelfth century or later on the basis of a tripod fragment, but we shall see that such a late date is uncertain.[27]

The examples at Gelidonya were found in all areas except area G.

B 59. Figs. 103 and 105. L. .165, blade W. .06, socket W. .05, blade Th. .0025. Complete, but blade worn through use. Impressions from casting on upper side of blade and on side of socket (P).

[21] J. C. Rolfe, *AJA* **6**, 1st series (1890) 105, with pl. 15: 5.

[22] Gjerstad, *Stud. Preh. Cypr.*, 237, lower right; Catling, 80, no. (a) 1, with fig. 7: 5 and pl. 4: a, identifies it as being from the Gunnis Hoard.

[23] Deshayes II, no. 1220; Schumacher, *Tell el Mutesellim* I (text), 86–87, fig. 120.

[24] Furumark, *Chronology*, 95, n. 1.

[25] Catling, 297.

[26] Desborough, *Last Mycenaeans*, 49, n. 7.

[27] *Ibid.*, 48, n. 6, but see 49, n. 7. Catling, 297.

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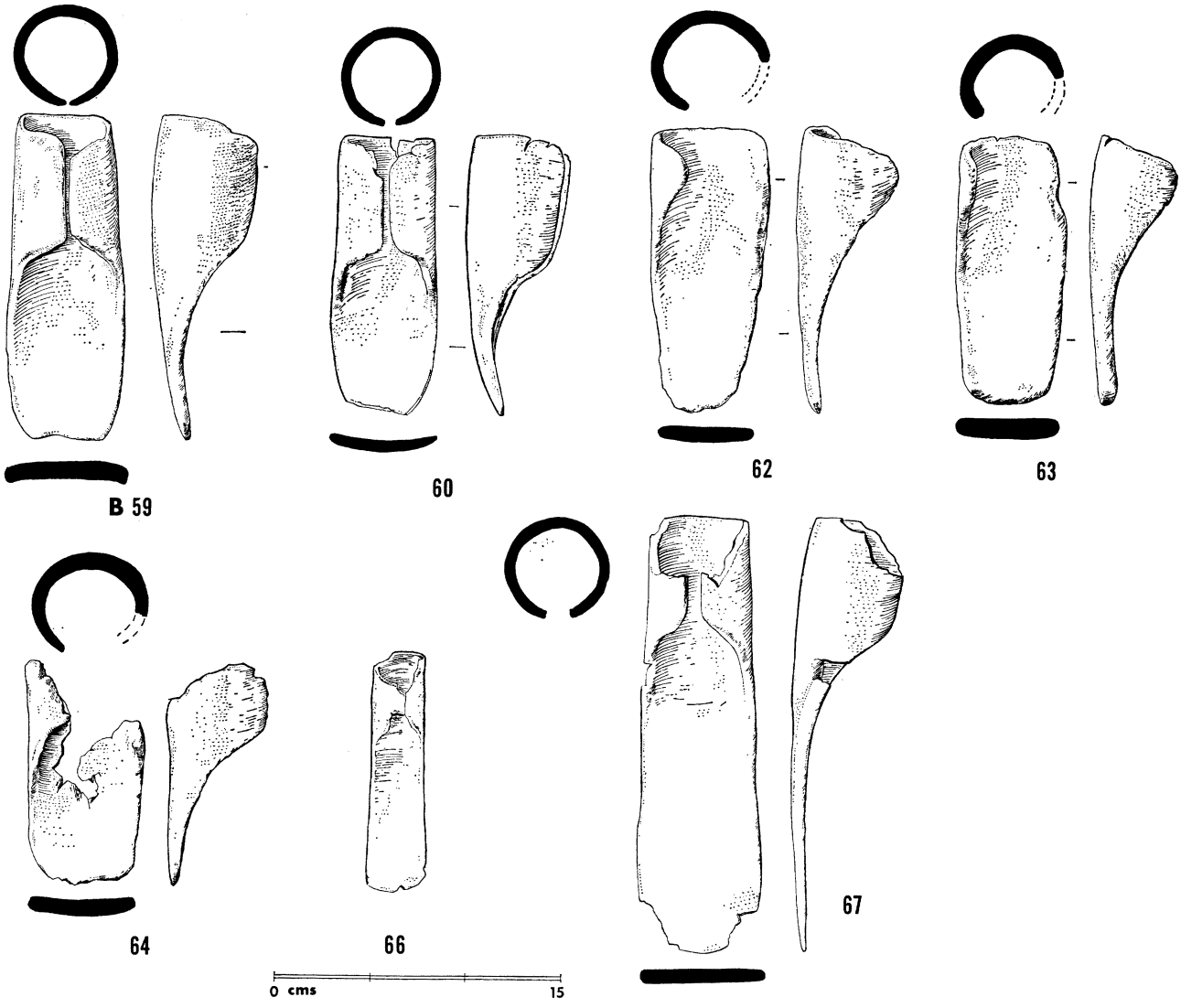


FIG. 103. Bronze hoes and socketed blades: B 59 to B 67.

B 60. Figs. 103 and 105. L. .145, socket W. .048, socket Th. .003. Shattered, but possibly crushed during sinking of ship by weight of ingots above. Piece of edge missing (P).

B 61. L. .13, blade W. .045, socket Th. .004. Impression from casting on outer side of blade (E).

B 62. Figs. 103 and 105. L. .145, socket W. .059, blade Th. .005, socket Th. .003. One side of socket missing. The blunt edge is very rounded and worn; this is possibly a worn example of Type 1 (M).

B 63. Figs. 103 and 105. L. .135, max. W. .068, blade Th. .007, socket Th. .003. Most of socket missing (M).

B 64. Fig. 103. L. .115, W. .06, socket Th. .003. Most of socket missing (1959).

B 65. L. .076, blade W. .044, blade Th. .005. Almost all of socket is missing.

TYPE 4

These hoes, both from area G, are very long in relation to their widths. The blade widens toward a very slightly rounded edge, but does not swell out with curved sides as do blades of Type 2. The most similar blade is on a tool shown, but not identified, by Petrie;[28] the sides of the socket in that case are of the type more usually found in Egypt, with one side passing over the other. It is possible, if not probable, that the two examples from Gelidonya did not serve the same purpose, as one is nearly twice the size of the other.

B 66. Figs. 103 and 105. L. .124, blade W. .026 to .03, socket Th. .003. Probably complete on ship; socket chipped during removal of concretion (G). The small size suggests that it was a socketed spatula.[29]

B 67. Figs. 103 and 105. L. .23, blade W. .065, socket W. .057, blade Th. .008 to sharp edge. Very fragile, found in several fragments, but possibly complete on ship (G).

[28] Petrie, *Tools and Wpns.*, pl. XX: 46.

[29] *Cf.* Catling, 105–106, with pl. 9: i and j.

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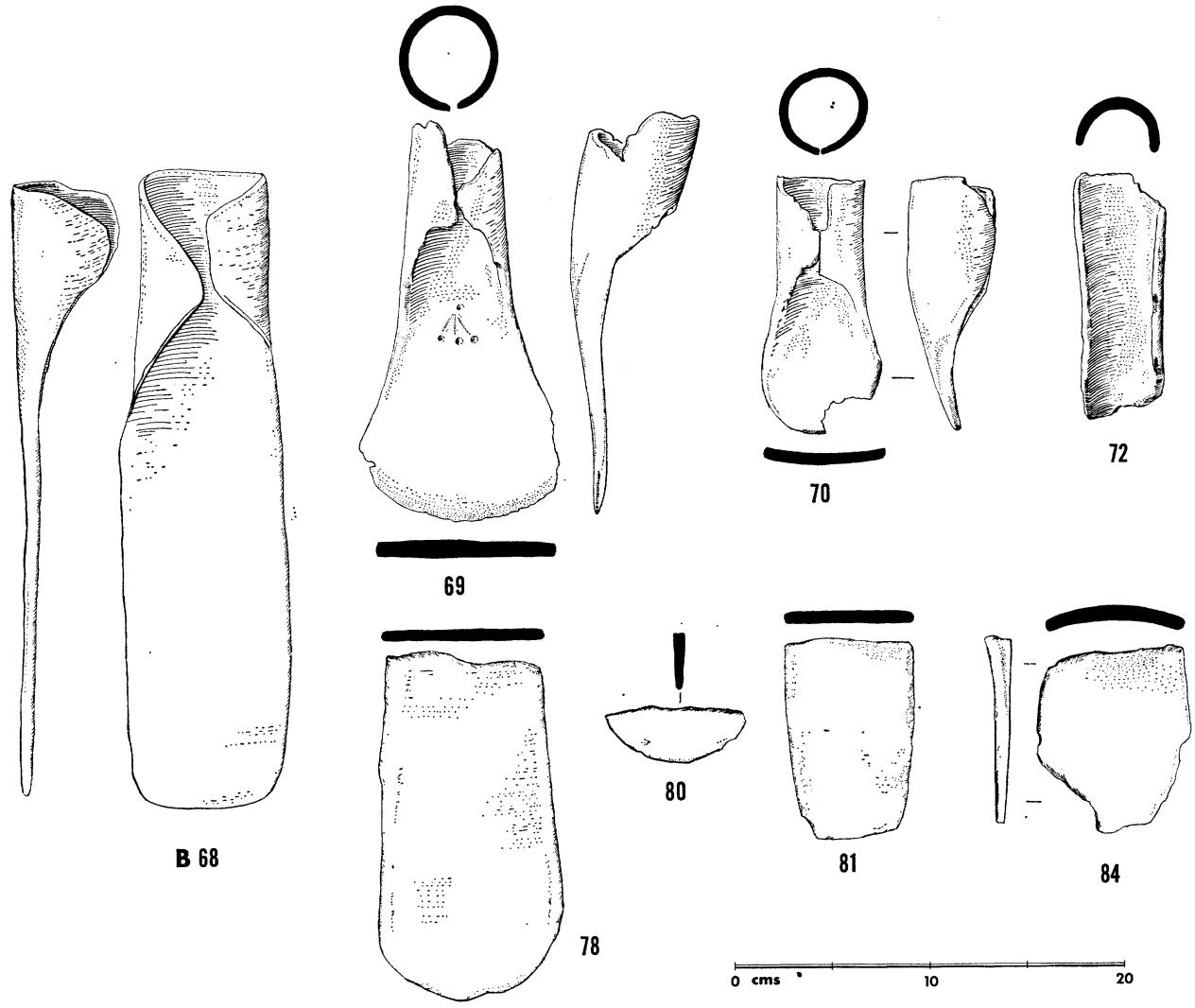


FIG. 104. Bronze hoes and socketed blades: B 68 to B 84.

TYPE 5

The single example at Gelidonya is by far the largest of the hoes. Its long, broad blade has straight sides leading to a blunt, almost straight edge. It is in fragments, but the pieces indicate that it was complete in area G. Its closest parallel is a very sharp tool in Nicosia (Cypr. Mus. 1958 VI-24 8) from the Stylianou Hoard.[30]

B 68. Figs. 104 and 105. L. .316, blade W. .084, socket W. .056, blade Th. .005, socket Th. .005. (G).

TYPE 6

The large blade flares out to form a wide, rounded edge. A similar hoe from the Founder's Hoard at Enkomi lacks the convex edge;[31] without examining the piece, I cannot say whether it was merely worn down through use. Another Cypriot parallel appears in the Mathiati Hoard.[32] The only example at Gelidonya, from area G, is missing only chips from the blade and part of the socket, and may have been complete on the ship.

B 69. Fig. 104. L. .195, max. W. .104, socket W. .05, socket Th. .004. (G). The blade is incised, near its junction with the socket, with a sign which is found in Cypro-Minoan.

TYPE 7

The blade is spoon-shaped and quite small in relation to the size of the socket. The example from Gelidonya may be only a badly worn and often resharpened example of Type 2, but this seems doubtful. Its closest parallel seems to be from thirteenth-century Tell el

[30] *Ibid.*, 80, no. 12, with pl. 4: d.

[31] Schaeffer, *Enkomi-Alasia*, 29, pl. LXV: 2; Catling, 79, no. 1; Deshayes II, no. 3036.

[32] Catling, 79, no. 2, with pl. 52: 8.

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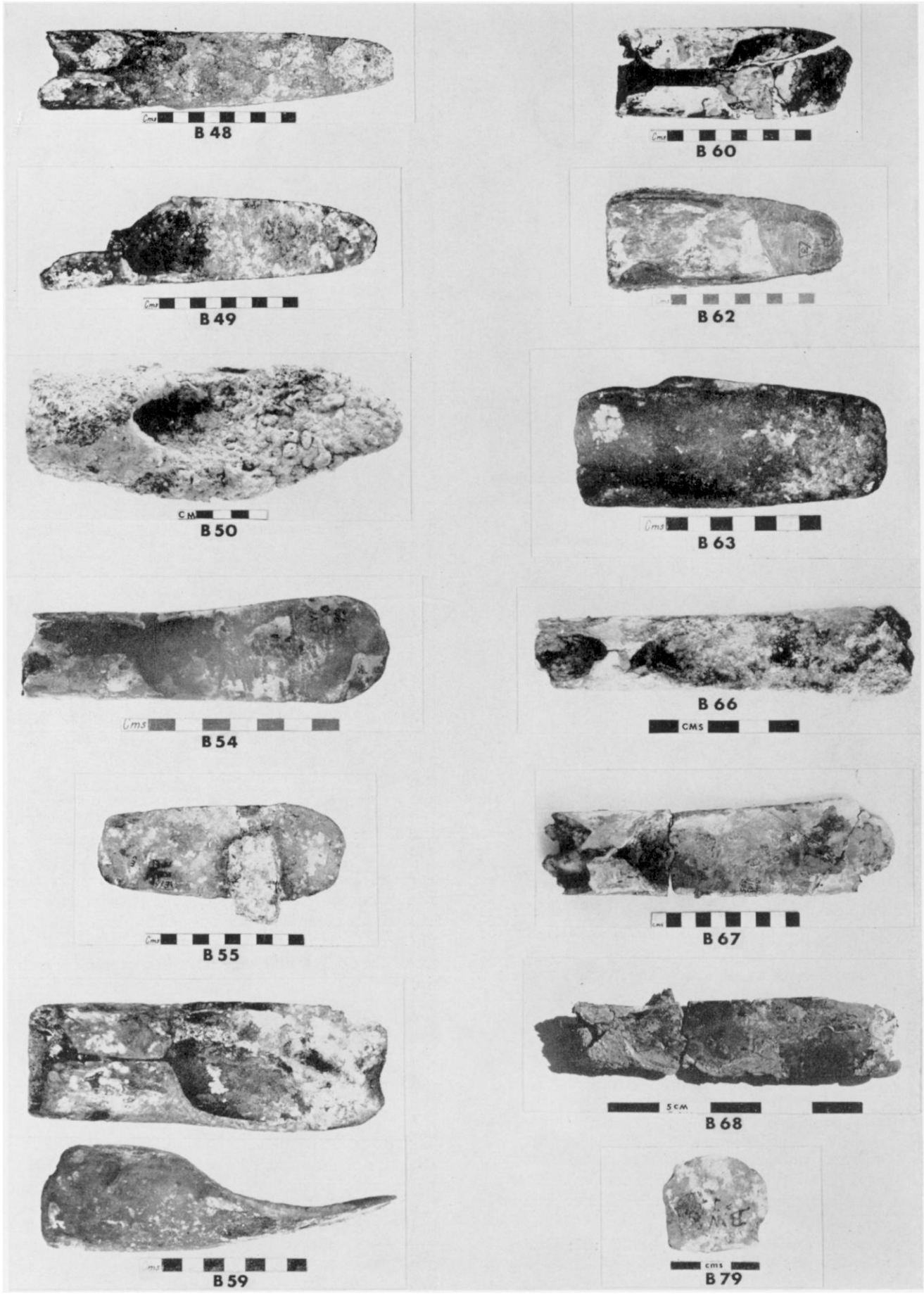


Fig. 105. Bronze hoes and socketed blades.

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Hesy, although no dimensions are published for that piece.[33]

B 70. Fig. 104. L. .13, max. W. .062, socket W. .045, blade and socket Th. .004. Blade and socket chipped (P).

Miscellaneous sockets and socket fragments, probably from hoes:

B 71. L. .142, W. .058, Th. .005 (P).
B 72. Fig. 104. L. .122, pres. W. .035–.038, Th. .0015 to .006. Shows no trace of curving out to form blade; extremely long (S).
B 73. L. .10, W. .044, Th. .004 (G).
B 74. L. .08, W. .055. Very heavily concreted (M).
B 75. L. .075, W. .048, Th. .0025 to .007. Fragment (G).
B 76. L. .085, W. .045, Th. .006. Fragment (E).
B 77. L. .035, W. .04, Th. .004. Fragment (P).

Miscellaneous blades and blade fragments, probably from hoes:

B 78. Fig. 104. L. .18, W. .094, Th. .005. Flat; rounded at one end, but broken off just at socket at other end. Possibly from an extremely large, but relatively short, hoe of Type 2 (E).
B 79. Fig. 105. L. .033, W. .034, Th. .005 thinning toward edge. Rounded edge of very small hoe-like tool (P).
B 80. Fig. 104. W. .07, Th. .008 thinning toward edge. Rounded tip of blade (P).
B 81. Fig. 104. L. .103, W. .065, Th. .006. End of large blade, similar to those of Type 1, but with blunt end (P).
B 82. L. .03, W. .061, Th. .007 thinning to edge. Similar to B 81 (P).
B 83. W. .056, Th. .005. Rounded edge of blade, probably of Type 2 (M).
B 84. Fig. 104. L. .088, W. .075, Th. .005. Probably blade of hoe as large as B 68; trace of socket preserved (1959).
B 85. L. .045, W. .04, Th. .007. Probably from junction of socket and blade of large hoe, similar to B 68 (G).
B 86. L. .027, pres. W. .05, Th. .007 thinning to edge. Very fragmentary, but possible blade from hoe of Type 2.
B 87. L. .021, W. .065, Th. .005 thinning to edge. Probably blade of Type 2 (G).
B 88. L. .135, W. .06–.077, Th. .001 to .005. Large blade, worn on one side of edge, possibly of Type 4.
B 89–B 94. Six fragments of curved metal preserve so little of their original shapes that one may judge only that they were parts of socketed tools which were neither unusually small nor large when compared with the majority of the hoes. Two were from area, G, three from P, and one from M.

CONCLUSIONS

There can be little doubt that most of these were agricultural implements, but whether they were plowshares or hoes remains a question.[34] At least some must have been hoes, mounted on crooked sticks (fig. 106).

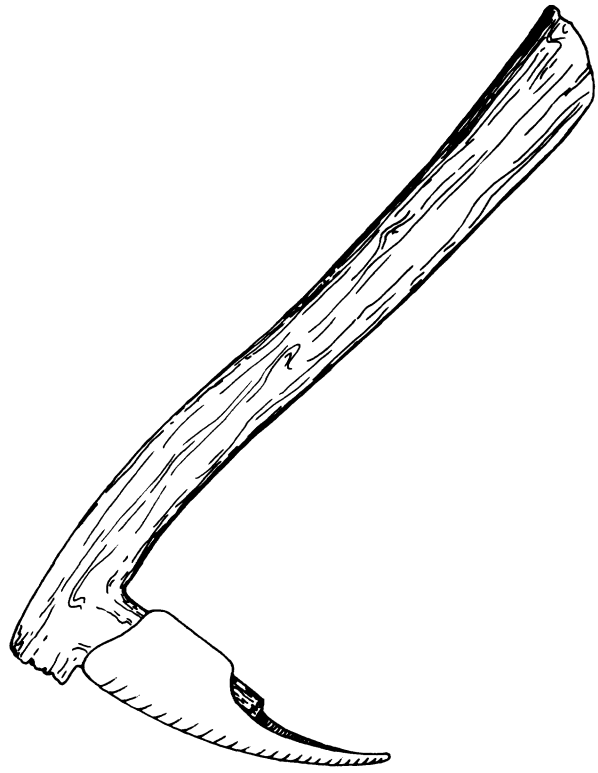


FIG. 106. Possible use of socketed "hoes."

We have noted parallels for the various types from Greece, Cyprus, and Palestine. The hoes in Palestine are related to Mycenaean deposits,[35] but at a time when Ugaritic influences were strong in Palestine,[36] and certainly Ugaritic hoes, whether of the fourteenth century [37] or later,[38] are similar to those noted above. Deshayes suggests Syrian influence on the manufacture of such hoes, for the open-socketed method of hafting is almost unknown in the pre-Hellenic repertoire,[39] and Catling also sees a Near Eastern origin for the hoes.[40]

III. SOCKETED TOOL

Although this is similar in shape to several of the socketed tools catalogued under Hoes, it differs in that the socket tapers toward the blade, and the handle was riveted; both would have prevented the handle from slipping forward, and indicate that some pressure was put on the handle during use of the tool. A somewhat similar tool of the same size is from Gaza.[41]

B 95. Figs. 107 and 108. L. .11, blade W. .02, socket D. .025. Rivet holes (D. .005) pierce socket. End of blade bent and chipped (G).

[33] Bliss, *Tell el Hesy*, 105, with pl. 4, no. 187; Deshayes II, no. 1195.

[34] Desborough, *Last Mycenaeans*, 48; Catling, 79–80; G. E. Wright, *BiblArch* **6** (1943) 35.

[35] Deshayes I, 139–140.

[36] *Ibid.*, and Albright, *Archae. of Palestine*, 187.

[37] Schaeffer, *Ugaritica* III, 254–255; 263, fig. 227; and 267, fig. 232.

[38] Catling, 82.

[39] Deshayes I, 139.

[40] Catling, 81.

[41] Petrie, *Gaza* II, pl. XIX: 265; Deshayes II, no. 1213.

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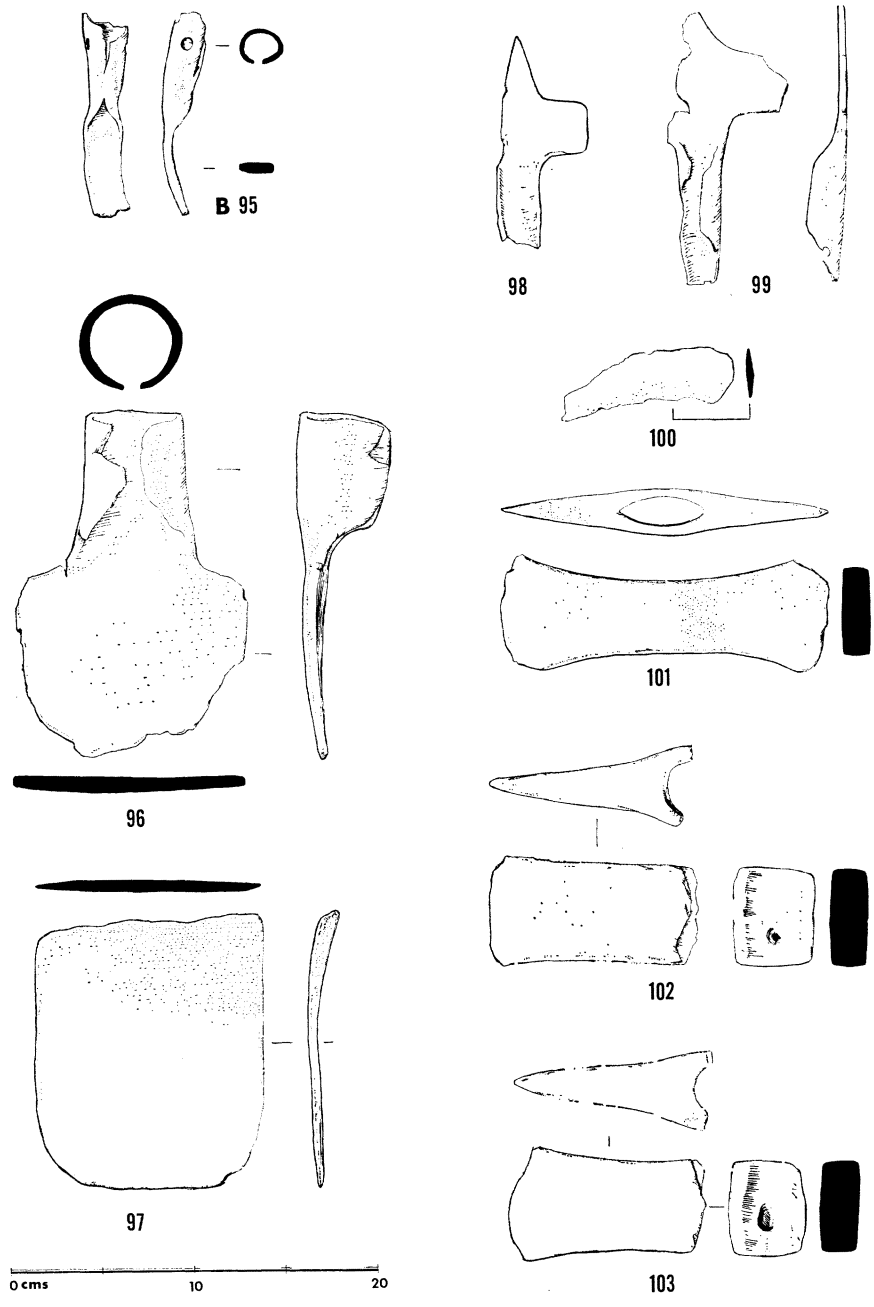


FIG. 107. Bronze tools: B 95 to B 103.

IV. SHOVEL

The chipped edges give the blade a rounded appearance, but it seems likely that it was originally more rectangular and was, therefore, quite similar to an undated shovel from Cyprus.[42]

B 96. Figs. 107 and 108. L. .185, socket D. .063, Th. .004 (G).

[42] Deshayes II, no. 3035; Catling, 78, no. 4, with pl. 3: c; Gjerstad, *Stud. Preh. Cypr.*, 241, 237.

V. MATTOCK

The large blade is nearly duplicated in iron at Gerar,[43] which indicates that the shape was known in the Near East at least at a later date; I know of no bronze parallels.

B 97. Figs. 107 and 108. Pres. L. .145, W. .123, Th. .003. Socket and shoulders missing; slightly curved blade, nearly rectangular but with rounded corners (M).

[43] Petrie, *Gerar*, pl. LXVI.

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VI. PRUNING HOOKS

The small size and delicacy of the pruning hooks, or bill hooks, indicates that they were used for cutting brushwood. They may also have been used on vines, but the pointed blades of the two complete tools from Gelidonya lack the curved "gathering-in shape" [44] found on later vineyard hooks; the unfinished blank (B 219), however, has a slightly curved pointed blade. Each has a wide chopping blade perpendicular to the pointed blade.

B 98. Figs. 107 and 108. L. .115, socket D. .022, Th. .0045. Heavily concreted and very fragile; damage to socket may be modern. Almost rectangular chopping blade; straight pointed blade (G).

B 99. Figs. 107 and 108. Pres. L. .148, Th. .004. Both blades and socket badly chipped. Rivet holes in socket (G).

There can be almost no doubt that the pruning hooks were made in Cyprus. Not only are their best parallels found there,[45] but also two molds for making them; [46] one of these molds would have produced blanks almost exactly like Gelidonya B 219.

VII. SICKLE

B 100. Sickle fragment. Figs. 107 and 108. Pres. L. .085, W. .024, Th. .002. Recurved tip broken, socket or tang missing (G).

Whether this was attached to a handle by rivets, a socket, or a plain tang, its closest parallels may be found in the Mathiati and Stylianou Hoards from Cyprus.[47] The recurved blade is also found on a narrower Mycenaean example from the fourteenth to the twelfth century.[48]

VIII. DOUBLE AXES

Two complete double axes and halves of two others were found:

B 101. Figs. 107 and 108. L. .175, blade W. .06, interior of socket .045 × .017. Complete except for modern chips on edges. Blade tapers evenly from maximum thickness to the two wide, rounded cutting edges; blades flare out in even curve on top and bottom; central groove on one side of blades; biconvex socket (P).

This is of Deshayes' double-axe type B 1*b*, which may have originated in Crete, but which is especially prominent in mainland Mycenaean Greece.[49] I find no exact parallels, for axes which are identical in profile usually have oval, rather than biconvex, sockets; biconvex sockets appear most often on axes of Deshayes' type B 1*a*,[50] whose tops and bottoms are less concave.

B 102. Figs. 107 and 108. Pres. L. .115, blade W. .06, Th. at socket .055. Half of double axe, broken through socket; small depression inside socket runs into blade (E).

The shape conforms with that of Deshayes' double-axe type A,[51] with nearly parallel top and bottom, only slightly rounded blade edge, and round socket; the abrupt thinning of the blade just after the socket further places this under his sub-type A*b*.[52] The closest parallel, published after Deshayes had compiled his list, is from the twelfth-century Weapon Hoard at Enkomi; [53] also similar, but less alike, is an axe "of Minoan type" in the British Museum.[54]

B 103. Figs. 107 and 108. Pres. L. .105, W. .048, Th. at socket .042. Half of double axe, broken through socket; small depression in socket as in that of B 102. Similar to B 102, but slightly smaller and with more rounded, flaring edge of blade (1959).

B 104. Fig. 108. This is one of the two objects from the wreck which have disappeared since being carried to America as souvenirs in 1959; the other pieces were returned to Turkey in 1962 by the Cochrans. It is not possible to identify its type without knowing the shape of the socket.[55]

Study of previously found axes is of little help in assigning dates and places of origin to the Gelidonya tools; axes of Deshayes' type A*b* were known only from undated examples from Naxos [56] until the recent publication of the Cypriot piece. Axes similar to B 101, from the Athenian Acropolis Hoard [57] and the Mycenaean Poros Wall Hoard,[58] are neither exact duplicates nor of certain date.

IX. ADZES

Of the complete adzes, or flat axes, only B 105 is not lugged. All were originally quite similar in size, except for B 110, B 112, B 114, and B 124, which were larger; if B 124 is truly part of an adze, it would have been the widest.

Plain adzes:

B 105. Figs. 109 and 110. L. .15, W. .048 tapering slightly to head, max. Th. .008. Complete; blade may have been worn and resharpened, and it does not widen as do most of the others (E).

B 106. Pres. L. .072, W. .04, Th. .0055. Head missing (E).

Lugged adzes:

B 107. Figs. 109 and 110. L. .178, max. W. .047, W. at lugs .043, W. at head .025, Th. .005. Complete (M).

[44] Petrie, *Tools and Wpns.*, 47.
[45] Catling, 85, with fig. 8: 5 and pl. 5: h, with riveted handle.
[46] *Ibid.*, 272, no. 2, with pl. 50: b; *SCE* III, 665, fig. 374, and Catling, 274, no. 1, with pl. 50: f.
[47] Catling, 83, no. (b) 1, with fig. 8: 2 and pl. 5: c; 84, no. 1, with fig. 8: 3 and pl. 5: f.
[48] *BSA* **48** (1953) pl. 2: b; Deshayes II, no. 2796.
[49] Deshayes I, 257; II, pp. 107–108.
[50] *Ibid.*
[51] *Ibid.*, 255, II, p. 106.
[52] *Ibid.*, 256, II, nos. 2042–2044.
[53] Catling, 88–89, no. 2, with fig. 9: 1 and pl. 6: m.
[54] C. F. C. Hawkes, *BSA* **37** (1936–1937) 145, fig. 2: 2.
[55] S. Waterman, *Explorer's Journal* **38**, 3 (Oct. 1960) 31, with figure.
[56] Deshayes, *loc. cit.* (*supra*, n. 52).
[57] Montelius, *Grèce précl.*, 153, figs. 485–486.
[58] *BSA* **48** (1953) pl. 2: c; Stubbings, *BSA* **49** (1954) 296.

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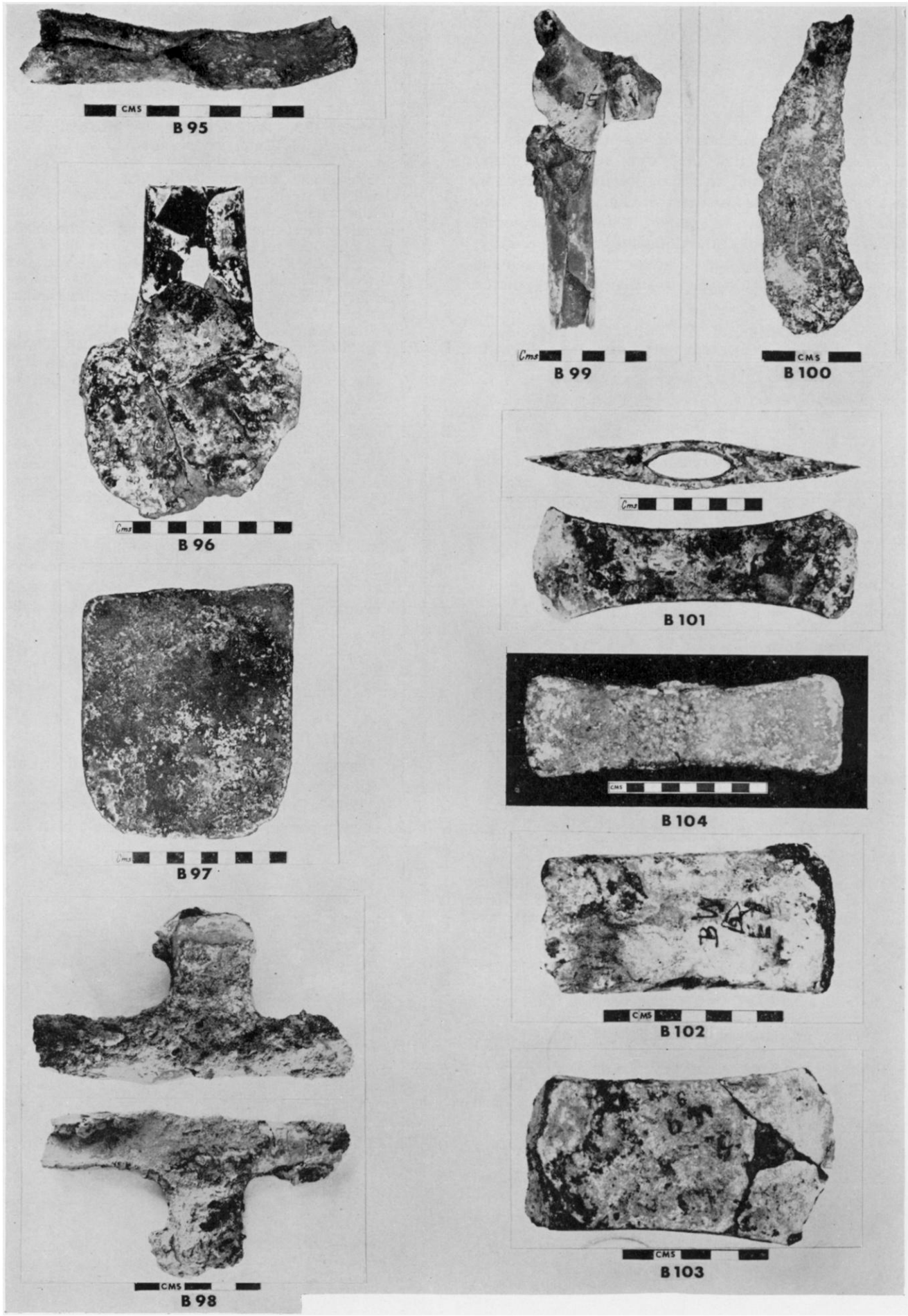


FIG. 108. Socketed tool, shovel, mattock, pruning hooks, sickle, and double axes.

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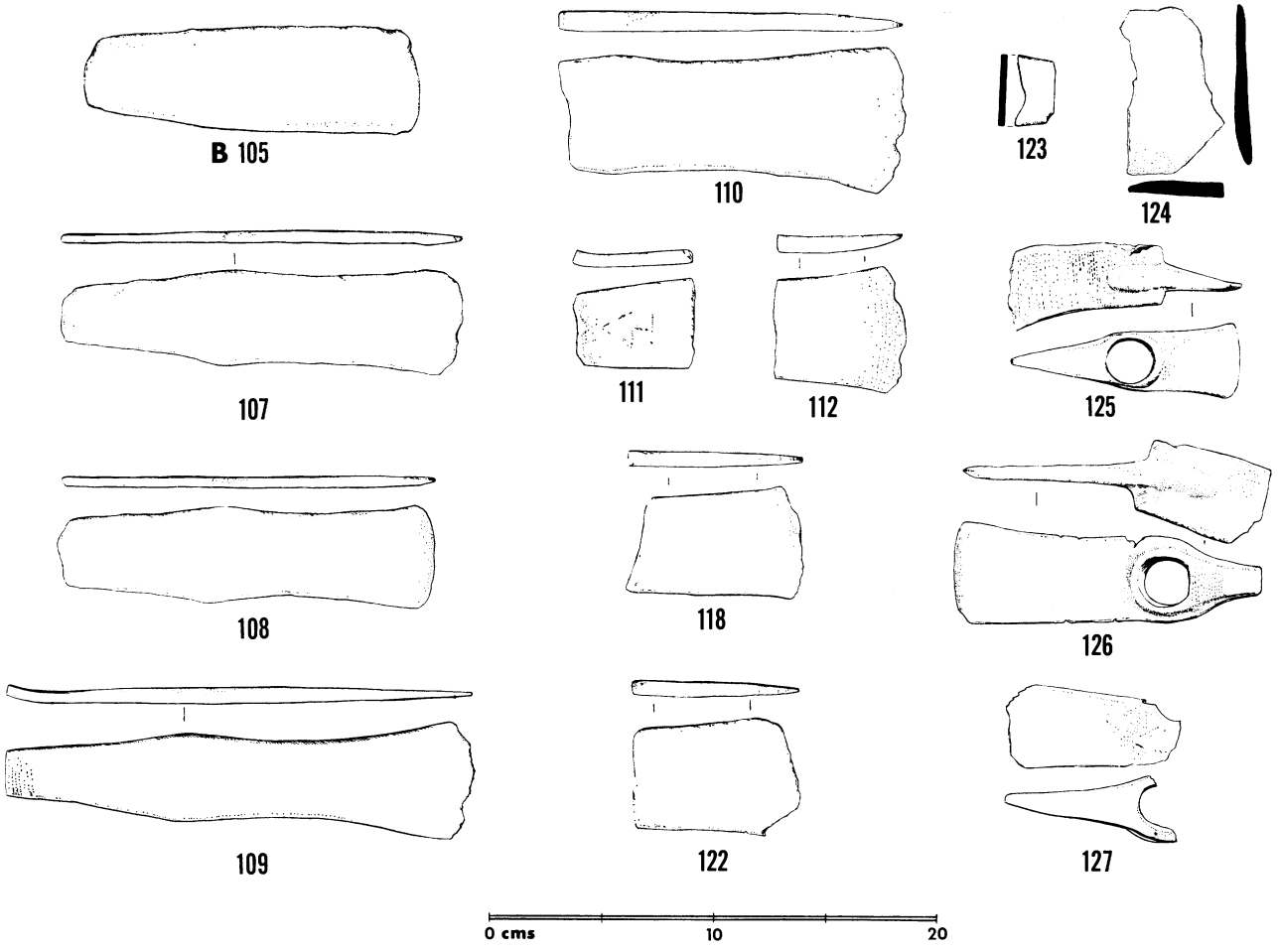


FIG. 109. Bronze adzes and axe-adzes: B 105 to B 127.

B 108. Figs. 109 and 110. L. .17, max. W. .045, Th. .004. Complete; end broken off and found separately (M).
B 109. Figs. 109 and 110. L. .21, W. at edge .06, W. at head .02, Th. .006. Complete. Wood attached to head is not necessarily remains of a handle. Head bent; blade edge slightly chipped (P).
B 110. Figs. 109 and 110. Pres. L. .15, max. W. .064, Th. .008. Missing head (G).

Fragments of either lugged or plain adzes:

B 111. Figs. 109 and 110. Pres. L. .05, W. .033 to .04, Th. .007. Probably head of adze, bent as B 109. Sign inscribed on one side (S).
B 112. Fig. 109. Pres. L. .06, W. at edge .065, Th. .008. Blade fragment; edge chipped (P).
B 113. Pres. L. .055, pres. W. .05, Th. .0074. Body fragment of plain adze (P).
B 114. Pres. L. .088, pres. W. .059, Th. .004 to .006. Edge unevenly burred, as if it had been used on metal rather than wood.
B 115. Pres. L. .063, W. .036, Th. .006. Blade fragment with very little spread at edge (G).
B 116. Pres. L. .054, W. .048, Th. .008 (M).
B 117. Pres. L. .105, pres. W. .045, Th. .0035. Chipped on both sides (E).
B 118. Fig. 109. Pres. L. .08, W. at edge .05, Th. .007. Blade broken obliquely (1959).
B 119. Pres. L. .032, W. .042, Th. .004.
B 120. Pres. L. .056, pres. W. .054, Th. .007 tapering to sharp edge.
B 121. Pres. L. .047, pres. W. .047, Th. .009 thinning to sharp edge.
B 122. Fig. 109. Pres. L. .075, W. .05, Th. .008. Ragged edge of blade (P).
B 123. Fig. 109. W. .028, Th. .003. Head broken from adze of same size as B 108 (M).
B 124. Fig. 109. Pres. L. .04, W. .067, max. Th. .006. Broken at both ends; this is the widest of the blades (G).

The adze, or flat axe, was widely spread during the Bronze Age,[59] but the lugged adzes from Gelidonya are all of Maxwell-Hyslop's Type II, which is most common in Palestine.[60] Of lugged adzes of that type, however, the closest parallels of the Gelidonya adzes are Syrian, from the fourteenth or thirteenth centuries,[61] with but one Palestinian parallel, possibly of the same

[59] R. Maxwell-Hyslop, *Iraq* **15** (1953) 70, map; Schaeffer, *Ugaritica* III, 274.
[60] *Iraq* **15** (1953) 74–75, 81–82.
[61] Schaeffer, *Ugaritica* III, 261, with figs. 234, 235, 236. Deshayes II, nos. 1080 and 1081 are undated, from a collection in Beirut.

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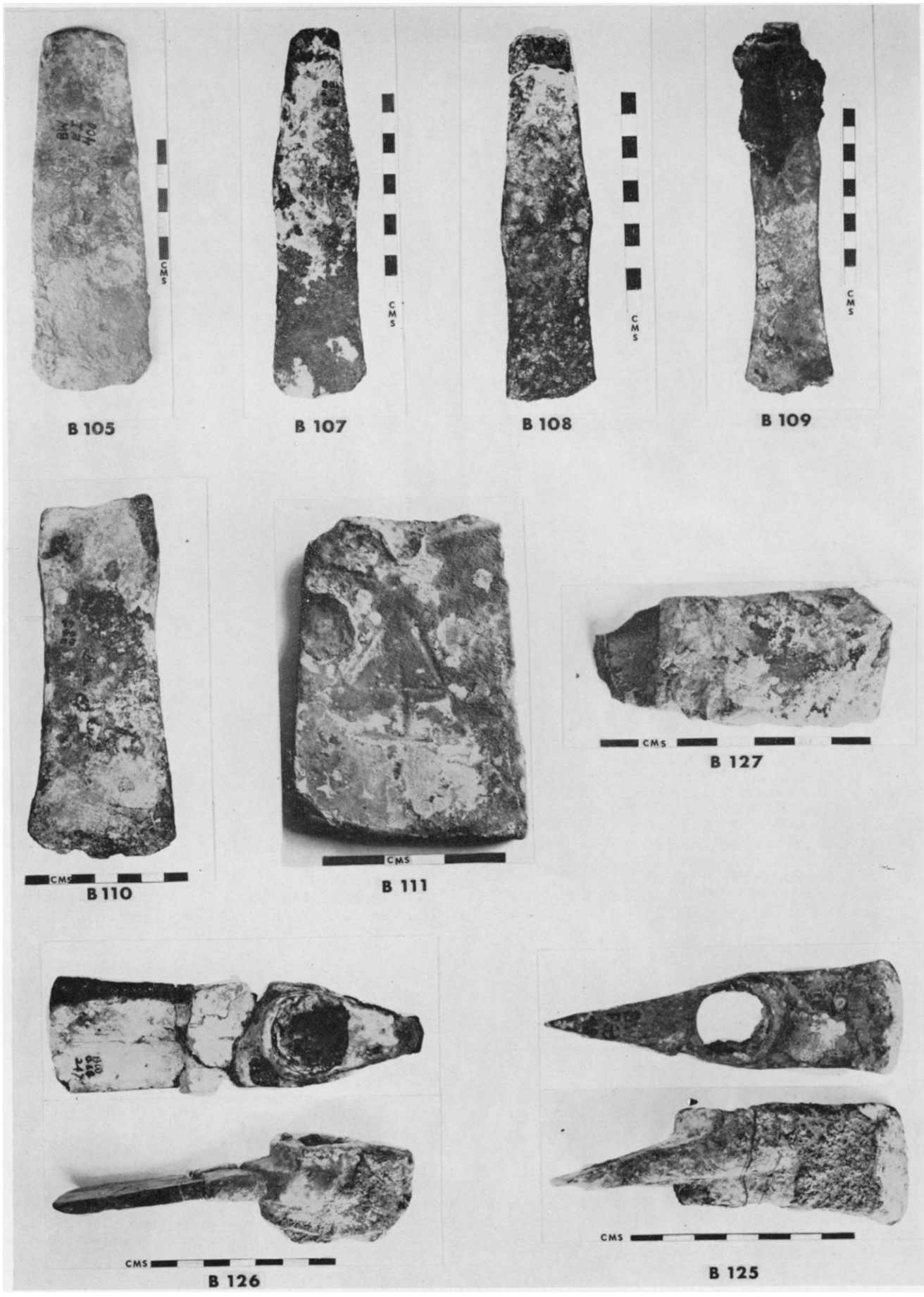


Fig. 110. Adzes and axe-adzes.

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date.[62] The appearance of the two more ubiquitous plain adzes (B 105 and B 106) is not unexpected, for similar pieces are found together with the Syrian lugged adzes.[63]

The possible use of these tools has been discussed,[64] and they have sometimes been called flat axes. It seems most likely that at least those with lugs were adzes, and that these lugs facilitated their being attached to handles in the manner shown on Egyptian tomb-paintings[65] (fig. 111).

X. AXE-ADZES

A complete axe-adze came to light in area P, with fragments of two others in area G. All are noteworthy in that in each case the base of the adze blade seems to be wrapped around the socket, as if it were attached to a single-edged, shaft-hole axe.

B 125. Figs. 109 and 110. L. .108, ext. D. of socket .023, int. D. .019. Small, complete piece, with edges still sharp. The adze blade flares slightly at its edge, and the bottom of the axe blade curves downward (P).

B 126. Figs. 109 and 110. Pres. L. .065, ext. socket D. .025. Axe blade almost entirely missing; adze blade reconstructed from fragments. The adze blade flares slightly at its edge, and is attached to the socket at the same angle as is seen in B 125 (G). There is the doubtful possibility that this originally lacked an axe blade, as does an example in the Trésor de Bronzes at Enkomi.[66]

B 127. Figs. 109 and 110. Pres. L. .078. Adze blade and most of socket missing, and axe blade is chipped (G). Socket seems to be the same size as that of B 125. The axe blade, although spreading slightly toward its edge, does not curve downward as did the two preceding.

B 128. Pres. L. .029, pres. W. .048, max. Th. .008. A fragment of the edge of an axe or an adze, from an unknown part of the wreck; it is possibly from a double axe.

Although larger than B 125 and B 126, the closest parallels are all from Cyprus; at Enkomi, the Gunnis Hoard,[67] the Foundry Hoard,[68] and the Trésor de Bronzes[69] contained very similar axe-adzes, and another was excavated at Pyla (Kokkinokremmos) along with Myc. IIIC1 pottery.[70] The differences, such as the higher attachment of the adze blades to the sockets on all but the piece from the Gunnis Hoard, are minor when compared to those of other known axe-adzes.

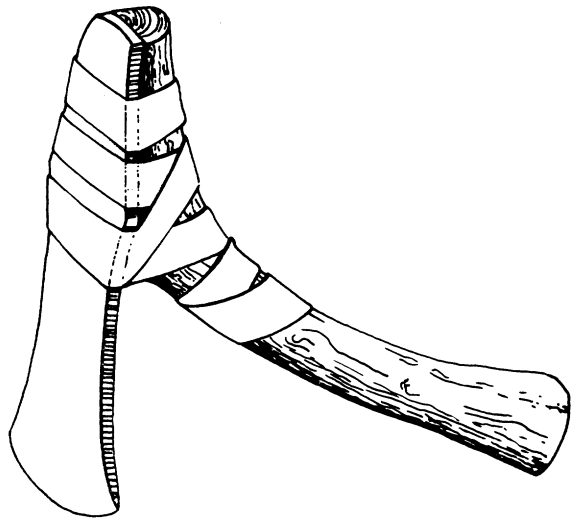


FIG. 111. Probable use of lugs in attaching handle to adze.

The method of attaching the adze blade, typical of Deshayes' subtype B 4,[71] appears earlier at Vaphio, on an otherwise unsimilar piece,[72] which may suggest a Greek mainland influence. The axe-adze is, in general, far too widely spread[73] for further suggestions, but it does seem singularly rare in the Syro-Palestinian region.

Schaeffer has shown that their spread covers areas rich in mineral resources,[74] and variations were certainly used in mining; the delicacy of the Gelidonya tools would indicate rather that they were for the less heavy work of carpentry, in which the axe chopped and split, and the adze squared planks.[75]

XI. CHISELS

Four chisels, of four different types, were found; two small fragments are probably also from chisels, and at least one of these might represent a fifth type:

B 129. Figs. 112 and 113. L. .085, W. .024, Th. .008. Burred head; sides converge slightly toward cutting edge (M). This is a cold chisel or wedge[76] of Deshayes' sub-type B 2,[77] of which there is an undated example at Byblos.[78] Deshayes' type B 1, with parallel sides, is so similar that we should also consider its widespread examples which are concentrated in the eastern Mediterranean: Syria (Ras Shamra)[79] and Palestine (Megiddo)[80] in the four-

[62] Guy and Engberg, *Megiddo Tombs*, 168, fig. 173: 6 and pl. 90: 1. (These are either from eighteenth–seventeenth or fourteenth–thirteenth centuries B.C.)

[63] Schaeffer, *Ugaritica* III, *loc. cit.* (*supra*, n. 61).

[64] *Iraq* **15** (1953) 69, 71; Deshayes I, 126–129.

[65] Norman de G. Davies, *Tomb of Rekh-mi-rēᶜ*, pls. LII, LV.

[66] Schaeffer, *Enkomi-Alasia*, 39, no. 3, with fig. 1, no. 3, and pl. III: 1 and 2.

[67] Catling, 91, no. 3, with fig. 9: 9 and pl. 8: c.

[68] *Ibid.*, nos. 4 and 5, with pl. 8: d and e.

[69] Schaeffer, *Enkomi-Alasia*, 39, no. 2, with fig. 1, no. 2, and pl. III: 5 and 6; Catling, 91, no. 2, with pl. 8: b.

[70] Catling, 91, no. 1, with fig. 9: 8 and pl. 8: a.

[71] Deshayes I, 284–285.

[72] Tsountas, *ArchEph* (1889) col. 155, with pl. VIII: 2.

[73] Schaeffer, *Enkomi-Alasia*, 46–57, with map (fig. 5, p. 45); Deshayes I, 279–280; Catling, 92.

[74] *Enkomi-Alasia*, 48–49.

[75] Deshayes I, 289; R. W. Hutchinson, *PPS* n.s. **16** (1950) 62; Catling, 91.

[76] Catling, 96.

[77] Deshayes I, 87.

[78] Dunand, *Byblos* II, 169, fig. 173, no. 8091; Deshayes II, no. 717.

[79] Schaeffer, *Syria* **18** (1937) pl. XIX; Deshayes II, no. 711.

[80] Guy and Engberg, *Megiddo Tombs*, pl. 127:7; Deshayes II, no. 710.

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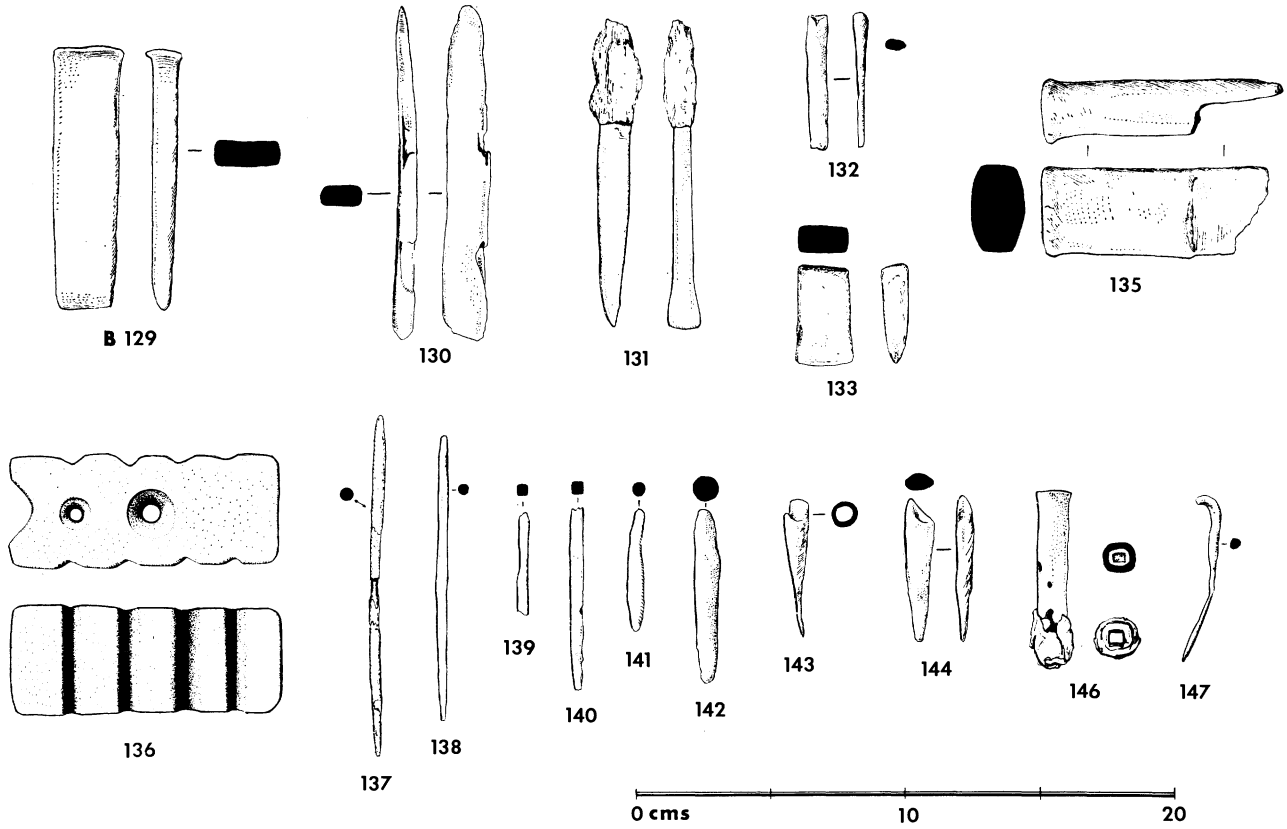


FIG. 112. Bronze tools: B 129 to B 147.

teenth and/or thirteenth centuries, Cilicia (Mersin) [81] in the thirteenth century, Cyprus (Enkomi) [82] in the twelfth century, and Crete (Agia Triadha) [83] of uncertain date; a similar chisel, but with splaying edge, appears in fourteenth-century Egypt.[84]

B 130. Figs. 112 and 113. L. .125, W. .015, Th. .004. Very corroded, but probably with nearly parallel sides coming to blunt point at head, which may have been inserted into a wooden handle (G). Comparisons for such a simple shape are almost meaningless, but a similar tool is from Megiddo, in the thirteenth or twelfth century.[85]

B 131. Figs. 112 and 113. L. .115, W. .012, Th. .004, pres. L. of wood .04, max. pres. W. of wood .014. Head of chisel was inserted into wooden handle, part of which is preserved (G).

This is a deep-bar chisel, in which the cutting edge is perpendicular to the plane of the wider faces of the blade. Petrie has described its use: "The chisel was not only used for cutting but for levering out the pieces cut; this was especially needed in the large amount of mortise cutting, done for the joining of planks edgeways. The weakness of the square bar soon led to deepening it, to gain strength for levering out the chips from the narrow slits of the mortise holes." [86] Pieces similar to the Gelidonya example are widespread, appearing in fourteenth-century Egypt [87] and Syria,[88] twelfth-century Cyprus,[89] and Crete; [90] the Cypriot parallel seems to be the most similar.

B 132. Fig. 112. Pres. L. .045, W. .01, blade Th. .002. Probably tip of small socketed chisel (M). It is similar in size to an undated Cypriot chisel.[91]

B 133. Figs. 112 and 113. L. .034, W. .019 widening to .021 at edge, Th. .01 tapering to .002 at edge. Wedge-shaped fragment; probably chisel end (1959).

B 134. Fig. 113. L. .018, W. .016, Th. .006. Probably rounded edge of some type of small chisel (S).

We may conclude that the dating and place of manufacture of these chisels is uncertain, but that the good Cypriot parallels for B 131 and B 132, both rather distinctive in shape, point to Cyprus.

[81] Garstang, *Preh. Mersin,* 250, fig. 158: 10; Deshayes II, no. 713.

[82] Schaeffer, *Enkomi-Alasia,* 44, fig. 3: 27; Catling, 96, no. 1, with pl. 9: e; Deshayes II, no. 714.

[83] Deshayes II, no. 715.

[84] Petrie, *Tools and Wpns.,* 20, no. 88, with pl. XXII: 88.

[85] Loud, *Megiddo* II, pl. 184: 16.

[86] Petrie, *Tools and Wpns.,* 20. See also Deshayes I, 101–105.

[87] *Ibid.,* pl. XXII: 85 and 86; the latter still with wooden handle.

[88] Schaeffer, *Ugaritica* III, 261, fig. 233: 12; Deshayes II, no. 999.

[89] Schaeffer, *Enkomi-Alasia,* 43, fig. 3: 25; Deshayes II, no. 1000, with pl. XII: 4, which is not an accurate drawing.

[90] Deshayes II, no. 998.

[91] Catling, 98, no. 3, with fig. 10: 9.

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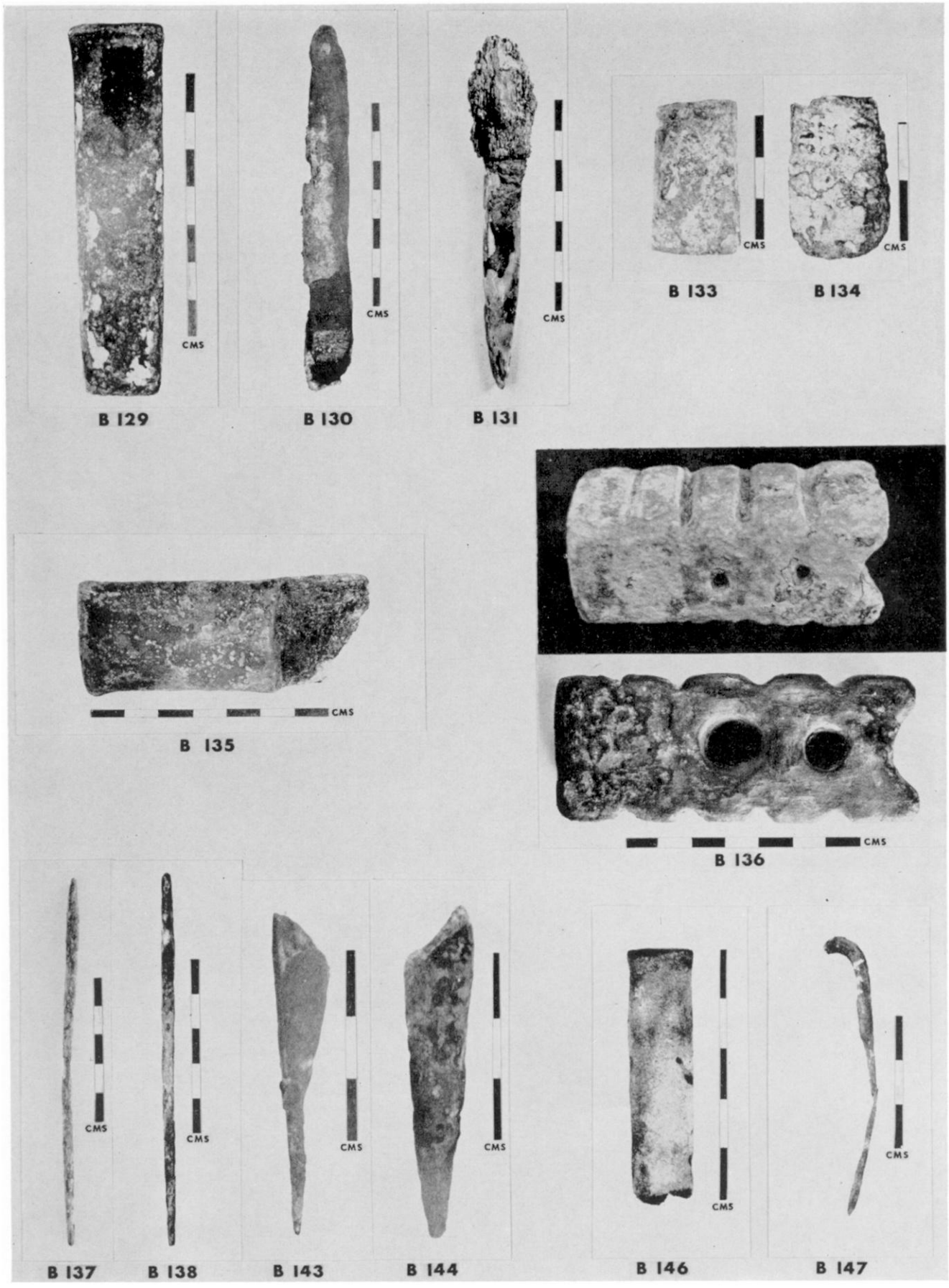


FIG. 113. Bronze chisels, anvil, swage block, awls, punch and needle.

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XII. HAMMER OR ANVIL

The single fragment, which has been called an anvil by Catling (p. 107), is approximately the same size as a hammer with round socket from the Enkomi Foundry Hoard.[92] It is so similar to some types of modern hammers that I would find that identification irresistible were it not for the socket. Although the socket is partly missing, enough is preserved to show that only an extremely thin and, therefore, weak handle could have been inserted. It is possible that rather than a handle, a thin piece of wood ran completely through the socket in order to prevent the tool from sinking into the ground if it were used as an anvil.[93]

B 135. Figs. 112 and 113. Pres. L. .084, H. .032, W. .022. Broken through socket; half missing. Oval, burred face preserved; rectangular socket for very thin haft (P).

XIII. SWAGE BLOCK

B 136. Figs. 112 and 113. L. .10, W. .038, H. .038. Four grooves of graded sizes on each of two opposite sides. Plain sides are pierced by two tapering holes which run through the block; the larger hole is .015 in diameter, tapering to .006, and the smaller is .10 tapering to .004. One end is in the form of a very large groove (E).

The variously sized grooves were used for drawing out pins and similar objects by hammering.[94] The concave surface at one end could have been used to form open sockets, and the size would have produced small sockets of the size found on the two pruning hooks (B 98 and B 99). The use of the tapering holes presents more of a problem; I originally stated that they were for hammering heads on rivets, but there is the possibility that they were dies for drawing out wire of soft metal. Cyril Smith has written[95] of the great power needed for drawing out wires of even soft copper through holes of such small diameter, but I would suggest, without experimentation, that the copper might have been hammered through the holes; if this is possible, the tapering holes would be the earliest known dies for such work. A stone swage block comes from a late twelfth-century level at Enkomi.[96]

XIV. AWLS AND NAILS(?)

B 137. Figs. 112 and 113. L. .125, D. .004 to .002. Corroded in middle at point of smallest diameter; tapers slightly at both ends (1959).

B 138. Figs. 112 and 113. Pres. L. .10, D. .003. Squared tang. Point broken (M).

B 139. Fig. 112. Pres. L. .037, .004 × .004. Fragment; square in section (G).

B 140. Fig. 112. L. .068, .004 × .005. Rectangular in section (P).

B 141. Fig. 112. Pres. L. .043, D. .005. Round section (M).

B 142. Fig. 112. Pres. L. .065, D. .01. Round section (M).

B 143. Figs. 112 and 113. Pres. L. .05, socket D. .01. Socketed awl with sharp point; socket chipped and partly missing (P). *Cf.* Cypr. Mus. Met. 800.

B 144. Figs. 112 and 113. Pres. L. .053, W. .011. Socketed point; socket oval in section (M).

B 145. L. .043, .006 × .006. Fragment of square nail (M).

XV. PUNCH

B 146. Figs. 112 and 113. L. .05, D. .012. Hollow, cylindrical punch with solid, burred head; opening for cutting is square (.005 × .005). Small holes corroded through sides; open end heavily concreted (G).

Powdery material removed from the interior was analyzed in the hope that it might give a clue as to the material on which the punch was used (possibly leather or metal foil), but it proved to be corrosion products from the punch itself. I cannot suggest for what purpose such a large hole was needed.

XVI. NEEDLE

B 147. Figs. 112 and 113. L. .06, max. Th. .0015. Hook-ended pin, pointed at one end; very corroded (M). It seems probable that the hooked end is the broken remains of an eyelet formed by bending the top down as mentioned by Catling (105, with fig. 10:14).

XVII. KNIVES

The knives were in very poor condition and almost all that may be said of them is that most were single-edged:

B 148. Figs. 114 and 115. L. .17, W. .015, Th. .003 to .001 or less at tip. Blade chipped slightly. Flanges on both sides of haft; blade slightly wider than haft, with nearly straight back, but slightly convex cutting edge (M).

Although the flanges are not deep, the absence of rivets indicates that the handle was held in place by the flanges; the knife is, therefore, of Sandars' Type 2,[97] which is especially prominent at Mycenae.

B 149. Figs. 114 and 115. Pres. L. .082, W. .009, Th. .0005. Back curves downward to meet straight, sharp edge at tip. On either side of blade two incised lines follow curve of back, .003 below top and .001 apart. The haft is missing, making the knife difficult to classify; similar decorative bands are found on knives of Sandars' Types 1, 2, and 3.

B 150. Figs. 114 and 115. L. .127, W. .02, Th. .004 at haft to .002 at pointed tip. Tip broken. Triangular haft; straight back; concave blade. No rivet holes (M).

[92] Schaeffer, *Enkomi-Alasia,* pl. LXIV: 5; Catling, 100, pl. 11: c.

[93] Petrie, *Tools and Wpns.,* pl. LXXVIII, nos. 49–52 (Roman examples).

[94] The object was identified by Paul Shaw after I had guessed that it was used for metal-working by its similarity to a small anvil from Great Britain, described by John Evans, *Anc. Bronze Implements,* 182–183, with figs. 217 and 218. See also Coghlan, *Prehist Met. of Copper and Bronze,* 77 and fig. 13.

[95] Letter of 12 March, 1964, in which he suggested the possible use of the concave end of the block for forming sockets.

[96] Catling, 275, with pl. 51: d and e.

[97] N. K. Sandars, *PPS* **21** (1955) 179, with n. 1.

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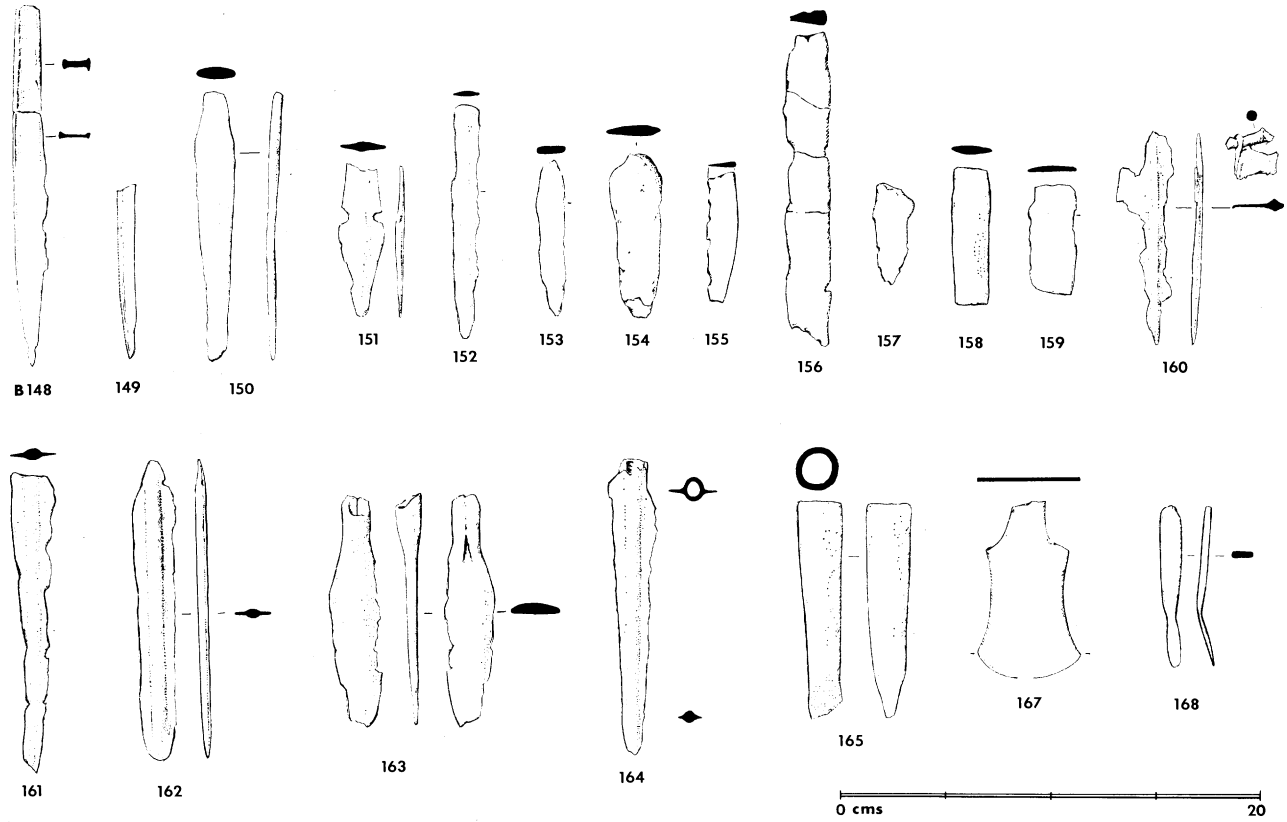


FIG. 114. Bronze knives, spearheads, razor and spatula: B 148 to B 168.

B 151. Figs. 114 and 115. Pres. L. .075, W. .022. Very short blade tapers, with slightly convex sides, to rounded tip. Pair of rivet holes just above shoulder, with possible third hole at break higher up; end of butt missing. Flattened rhomboid in section (P).

Although the shape is basically that of Catling's daggers of type (*a*) from Cyprus,[98] the extremely short blade suggests that this was a knife for household use rather than a dagger.[99]

B 152. Figs. 114 and 115. L. .105, W. .013, Th. .002 at haft to .001 at tip. Midsection slightly thicker than back and edge. Badly worn (M).

B 153. Fig. 114. Pres. L. .073, W. .014, max. Th. .004. Almost straight back, convex edge. Very worn (P).

B 154. Fig. 114. Pres. L. .076, max. W. .025, Th. .002 to .003. Short tang; back nearly straight, but curves downward near tip; convex cutting edge (1959).

B 155. Fig. 114. Pres. L. .062, W. .016, max. Th. .0025. Tip of blade with downcurving back meeting straight cutting edge.

B 156. Figs. 114 and 115. Pres. L. .15, W. .023, Th. .005. Straight back. Blade very worn; made of four fragments, but missing both ends (G).

B 157. Fig. 114. Pres. L. .048, W. .02, Th. .002. End fragment; very worn (P).

B 158. Fig. 114. Pres. L. .065, W. .018, Th. .022 at middle, thinner on both parallel edges. Haft and tip missing. Possibly double-edged, but very worn (M).

B 159. Fig. 114. Pres. L. .052, W. .022, Th. .0015. Possibly worn blade fragment; slightly thinner on one of parallel edges (P).

B 160. Figs. 114 and 115. Pres. L. .10. Seven fragments of ribbed knife; one rivet preserved (P).

B 161. Figs. 114 and 115. Pres. L. .14, pres. W. .02. Very badly damaged, but similar to B 160, with hollow rib (G).

The knives are not so distinctive as to be assigned any certain place of origin.

XVIII. SPEARHEADS

The spearheads at Gelidonya were so poorly preserved that some of those catalogued below may be fragments of daggers or knives. We may see, however, that both open and closed sockets were used:

B 162. Figs. 114 and 115. L. .147, W. .02. Nearly parallel, slightly concave sides; rounded midrib; flat, triangular tang with two rivet holes at shoulder (M). Such objects are usually called daggers, but I feel that they were more probably spearheads.[100]

B. 163. Figs. 114 and 115. Pres. L. .105, W. .018, socket D. .009. Badly concreted and chipped. Open socket formed by wrapping butt of blade; no mid-

[98] Catling, 125–126.

[99] Petrie, *Tools and Wpns.*, 30, mentions small daggers from Spain which were found only in women's graves, indicating a domestic use for the blades.

[100] Spearheads of similar shape are socketed, rather than tanged, but either method of attachment would have been used on spearheads.

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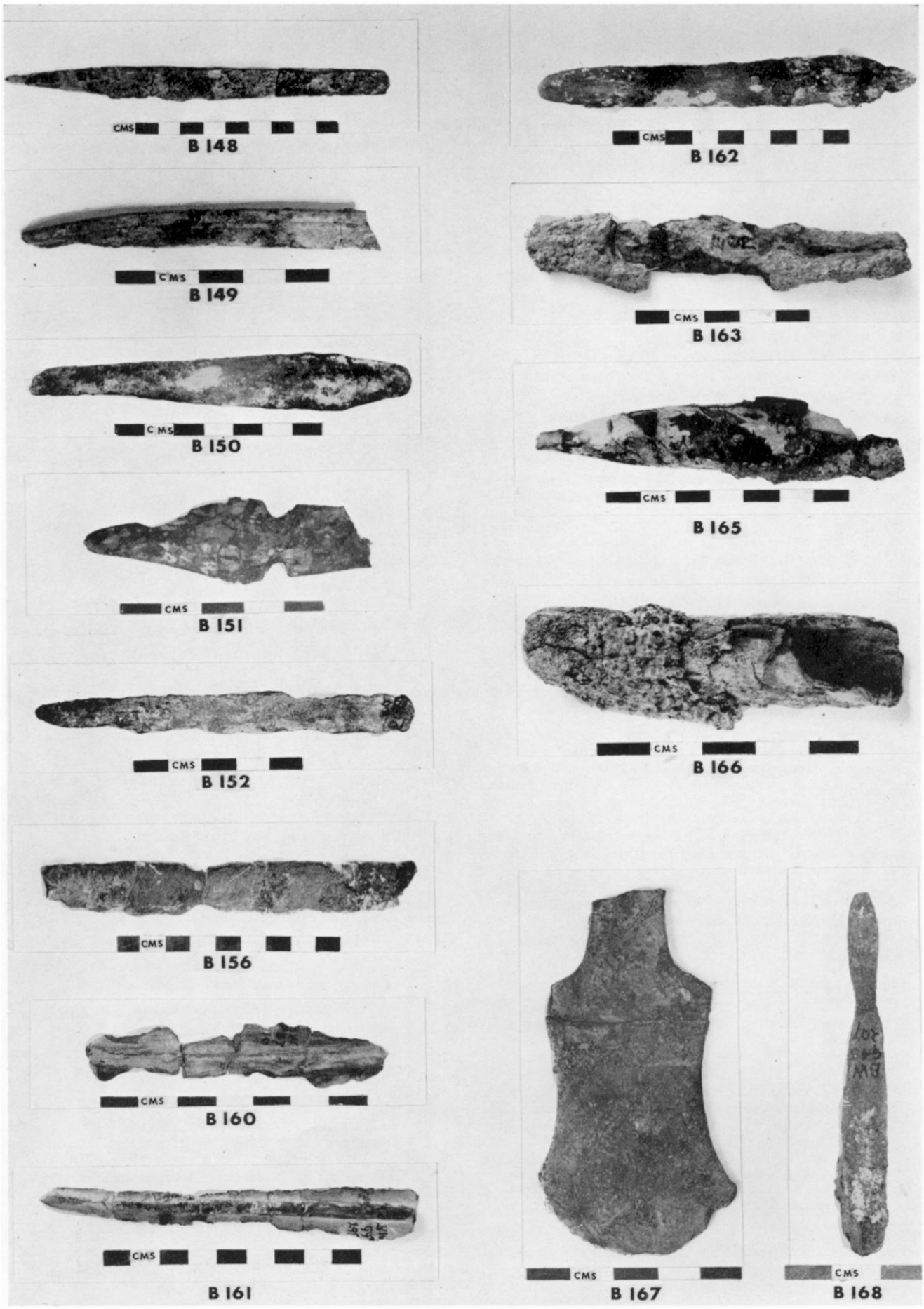


Fig. 115. Bronze knives, spearheads, razor and spatula.

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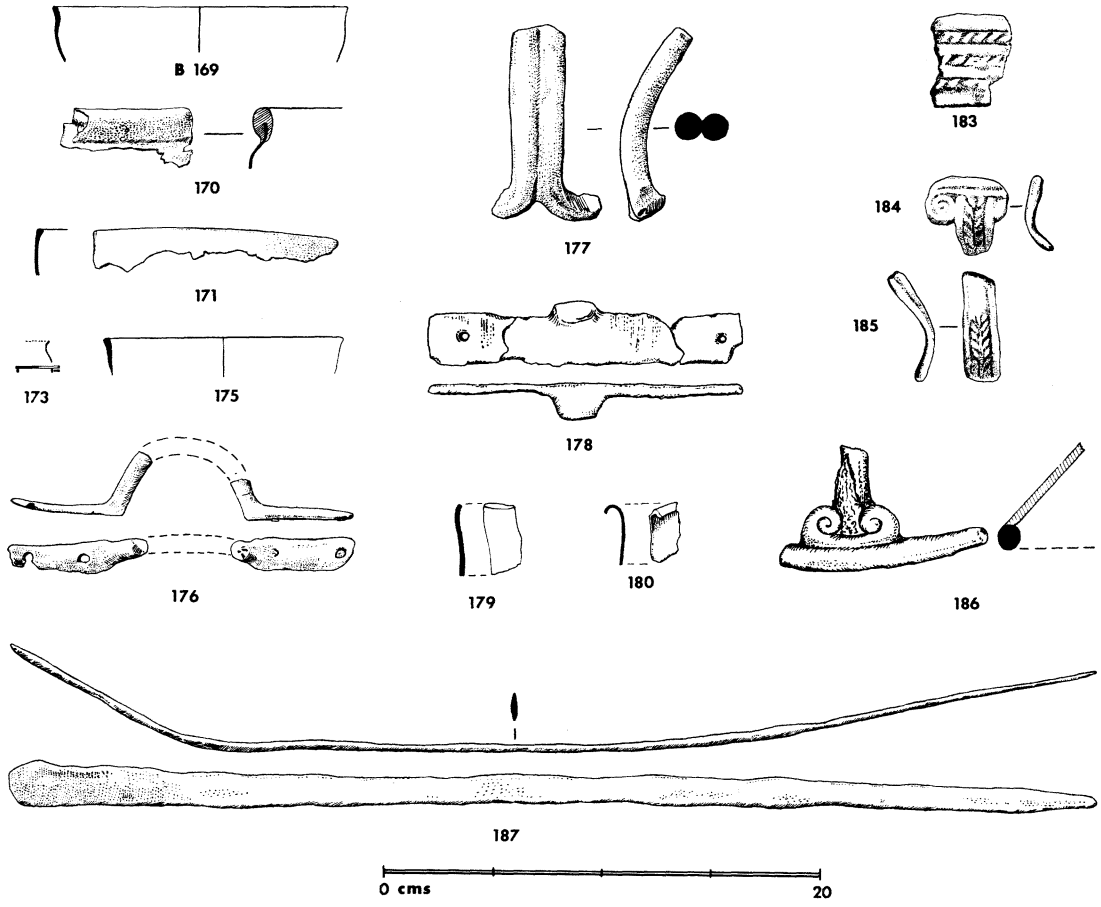


FIG. 116. Bronze vessel, tripod and offering stand fragments, and spit: B 169 to B 187.

rib (S). *Cf.* Catling's spearheads 1 and 2 of type *c*, undated, from Cyprus (118, with fig. 13:8 and pl. 13:*d*).

B 164. Fig. 114. Pres. L. .144, pres. W. .023. Large, hollow midrib leads into socket, which is missing; blade edges badly chipped (G). Too badly damaged to be assigned to any specific type; socketed spearheads existed in both the Near East and the Aegean earlier than on Cyprus, but they were being made on Cyprus by the time of the shipwreck.

B 165. Figs. 114 and 115. Pres. L. .105, D. .022. Socket only; beginning of blade (Th. .005) shows no midrib (P).

B 166. Fig. 115. Pres. L. .07, D. .018. Similar to B 165. Divided socket;[101] fragment of wood preserved inside. Blade is solid at break, with no evidence of hollow midrib (S).

XIX. RAZOR

B 167. Figs. 114 and 115. L. .084, max. W. .046, max. Th. between .001 and .002. Crescent blade with concave sides, sloping shoulders, and tang; tang chipped very slightly during excavation (G).

The shape is similar to that of knives used in cutting leather, from at least the fifteenth century in Egypt to Classical times in Greece,[102] but its thinness suggests that it was a razor of unusual type.[103]

XX. SPATULA

B 168. Figs. 114 and 115. L. .074, W. .01, Th. .003. Small spatula with thickened handle; constriction above oval blade (G). I find no parallels for this piece, which may have been an unguent spoon.

XXI. VESSELS

The vessels were extremely fragmentary; even if we take into account the extreme thinness of their walls, which have in no case been substantially preserved, we must doubt that the rim and handle fragments represent complete bowls on the ship. The sizes of the fragments have made estimates of original diameters impossible in most instances:

Rim and rim fragments:

B 169. Figs. 116 and 117. D. .135, pres. H. .01, rim Th. .0015, wall Th. .0005. Almost complete rim, proba-

[101] Catling, 125, n. 1, explains that such sockets were cast, unlike the sockets of many of the agricultural tools, and were not rolled.

[102] Petrie, *Tools and Wpns.*, pl. LXII; D. B. Thompson, *Archaeology* **13** (1960) 239; Waterer, *Hist. of Tech.* II, figs. 111, 125, 166, 167.

[103] Petrie, *Tools and Wpns.*, pls. LX and LXI, for razors of other types.

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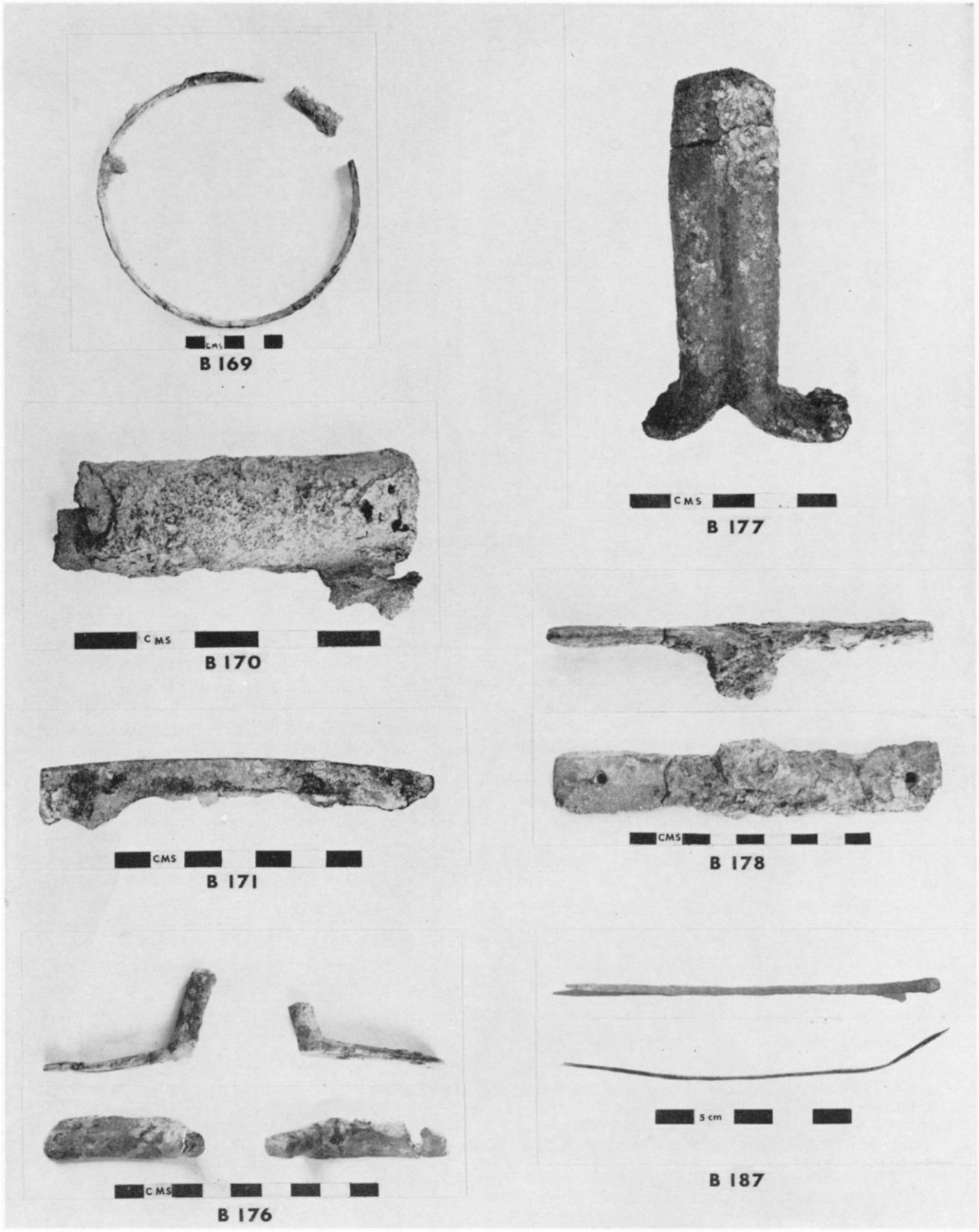


FIG. 117. Bronze bowl rim and handle fragments, and spit.

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bly from hemispherical bowl; rim is slightly thickened *S*-curve at top of wall (P).

B 170. Figs. 116 and 117. Pres. L. .06, rim H. .018, max. rim Th. .012, wall Th. .001. Wall of vessel fits into groove in bottom of thick rim, which was separately made and which is oval in section (P). Catling (p. 125) compares a similar piece from Cyprus.

B 171. Figs. 116 and 117. Pres. L. .11, pres. H. .018, rim Th. .003, wall Th. .00075. Rim fragment curves outward at one end as if to form a spout, but this curve could represent damage to the fragment (M). The flat rim is thickened on its inner side and can be duplicated in Cyprus[104] and the Near East.[105]

B 172. An irregular fragment (.03 × .022) of a rim identical to the preceding one comes from area P; it is possibly part of B 171.

B 173. Fig. 116. Pres. L. .07, Th. .001. Fragments of bowl with outcurved rim; badly mashed, but possibly of larger diameter than B 169. Matting adheres (G).

B 174. Pres. L. .035. Possibly rim fragment (P).

B 175. Fig. 116. Pres. L. .03, pres. H. .025, rim Th. .003, wall Th. .0005 (P).

Handle fragments:

B 176. Figs. 116 and 117. Rivet plates for horizontal loop handle, which was round (D. .008) in section. Each plate is .05 long, .015 wide, and from .003 thick in the center to .002 thick at its edges. Two rivet holes in each plate. Curve of plate indicates vessel was larger than the bowls mentioned above (P).

B 177. Figs. 116 and 117. Pres. L. .09, W. .025. Double bar handle whose divided end forms attachment plates which are mostly missing (P). *Cf.* a similar, but complete, handle from the Cypriot Stylianou Hoard (Cypr. Mus. 1958 VI-24 24), which Catling has compared to cauldron handles from Tiryns and Tell Abu Hawam.[106]

B 178. Figs. 116 and 117. Attachment plate. L. .147, W. .025, max. Th. .006. Single rivet hole (D. .0045) at either end. Only stump of handle preserved; oval in section (.02 × .015). Made of several joining fragments, most of which were found in area G, but one of which was in area P. This may be compared to B 177 in form, but the attachment plate shows no curve; this suggests that if the plate had not been hammered straight at a later time, it came from a rectangular container (the sponge divers reported a metal "box" on the wreck; p. 15) or was attached vertically to a cylindrical vessel.

B 179. Fig. 116. Pres. L. .034, W. .016, Th. .003. Curved strip, possibly fragment of a very thin handle (G).

B 180. Fig. 116. Pres. L. .025, W. .017, Th. .002. Curved strip, possibly fragment of handle of small cup (M).

Body fragments:

B 181. W. .02, Th. .002. Roughly triangular fragment pierced by many pinholes (G). Possibly part of a strainer.[107]

[104] Catling, 147, with fig. 17: 5.
[105] Loud, *Megiddo* II, pl. 190: 9, from 1150–1100 B.C.
[106] Catling, 164, no. 2.
[107] *Ibid.*, 161.

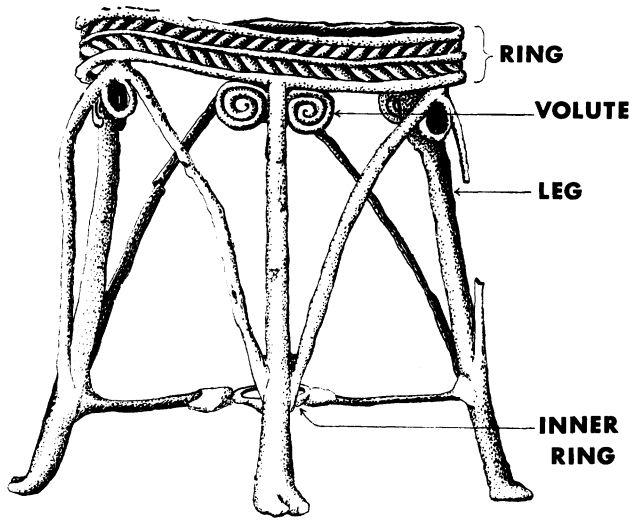


FIG. 118. Rod tripod from Kourion in University Museum.

B 182. Roughly .085 × .07, Th. .005. Very irregular fragment; slightly convex bottom of concave vessel (P). This is possibly part of a mesomphalic bowl.

XXII. TRIPOD AND OFFERING STAND FRAGMENTS

Small fragments of one or two tripods and an offering stand were scattered in areas G, M, and P. As these could have an important bearing on the date of the wreck, they will be discussed in some detail. Figures 118 and 119 show, respectively, a later rod tripod from Kourion and an offering stand from Megiddo, which should allow the reader to visualize the positions of the Gelidonya fragments on complete stands.

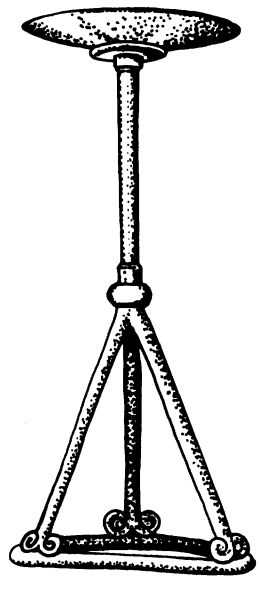


FIG. 119. Offering stand from Megiddo (after *Megiddo Tombs*).

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B 183. Ring fragment (fig. 116). H. .04, L. .036, Th. .003. Short strip of cast ring. Three rope-patterned bands, framed and separated by four plain bands; plain back (P). This finds its closest parallel in a rod tripod from Beth Shan which is tentatively dated to the first half of the twelfth century by its excavators.[108]

B 184. Volutes and ring fragment (fig. 116). H. .035, W. .038, Th. .002. Spacer and small parts of ring and leg preserved; one volute broken. Two vertical rope patterns framed by pair of plain bands on leg, which is bent in sharply from the volutes. This is very probably part of B 185; both were in area M.

B 185. Leg fragment (fig. 116). H. .05, W. .017, Th. .0025. Double twist or double rope pattern on one face, as on B 184, of which this is most probably a part (M). This is very similar to a rod tripod of uncertain date from the Pnyx in Athens.[109]

B 186. Offering stand fragment (fig. 116). H. .038, L. .085; ring oval in section: H. .006, W. .004. Volutes are attached to ring, with double leg rising above; molding of leg and volutes same on both faces of fragment (G).

This was listed as a fragment of a rod tripod with a plain ring by Catling,[110] but the error was based on the insufficient information with which I had supplied him. Later, in restudying the piece, I noted that if the ring was kept horizontal, the leg was directed at a fairly sharp angle toward the center of the ring; this angle was not caused by accidental bending, and could mean only that the Gelidonya fragment was from the base of an offering stand.

We have, it seems, fragments of one or two tripods and one offering stand. The offering stand poses fewer problems and will be discussed first. Such stands are almost certainly Syro-Palestinian for, as Catling points out,[111] eight are known from the Near East, with but one in Cyprus and none in the Aegean. The Cypriot example cannot be accurately dated,[112] but two very close parallels for the Gelidonya fragment, from Ras Shamra[113] and Megiddo,[114] are dated to 1300–1200 B.C. and 1350–1200 B.C., respectively, by the contexts in which they were found. Five other examples from Megiddo, only one of which has volutes,[115] were originally published as being from the tenth century,[116] but these may also fall in Late Bronze II (i.e., 1350–1200 B.C.).[117] Lastly, a stand from a XIX Dynasty building at Beth Shan has been given a tentative date in the first half of the twelfth century by its excavators.[118] We may conclude, therefore, that the surest evidence places the offering stands, which supported pottery bowls,[119] in the thirteenth century B.C.

The evidence for rod tripods and cast or strut tripods is less secure. In the most recent studies, Benson[120] feels that the rod tripod developed, in the twelfth to tenth centuries B.C., from the earlier strut tripod, which he places in the Late Bronze Age;[121] but Catling believes the rod tripod to be the earlier.[122] The unsure footing on which we tread is apparent in Catling's table of chronology and distribution of tripods and stands.[123] Of the twelve Cypriot examples which he has placed in the twelfth century, I feel that only one (Catling, no. 1) can be dated with complete confidence. Two of the rod tripods (Catling, nos. 7 and 9) are placed in the twelfth century because they are probably from the Enkomi Foundry Hoard, but his best evidence for placing that hoard in the twelfth century[124] is the occurrence of the stands themselves and of "the latest form of ox-hide ingot"; we have shown, in the chapter on ingots, that this form appears as early as the fourteenth century. The dating of the three cast (strut) tripods from Myrtou (Catling, nos. 21, 27, 28) depends on a reinterpretation of the excavation report,[125] in which they were believed to have been of the thirteenth century; Catling's reinterpretation is convincing, but dates reached in such a fashion must, necessarily, be subject to some question. The fourth cast tripod (Catling, 200, no. 23; Benson, 12, no. 15) he dates on the evidence of three unseen Mycenaean sherds. Of the five Cypriot four-sided stands which Catling places in the twelfth century, one (Catling, no. 32) is dated by the same unseen sherds; one (Catling, no. 34) by a representation on it of an oxhide ingot, which we have shown cannot be assigned to the twelfth century alone; two (Catling, nos. 38 and 39) because they are from the Enkomi Foundry Hoard, which we mentioned above as not able to provide conclusive dating; and one (Catling, no. 37) because it is from the Stylianou Hoard, which has no independent means of being dated.

For the Near East, the evidence is again uncertain. The dating of the rod tripod (Catling, no. 13) and the offering stand (Catling, no. 50) from Beth Shan in the twelfth century B.C. was considered uncertain even by the excavators. To date the cast tripod from Ras

[108] FitzGerald, *PEFQ* (1934) 133 f., with pl. 7: 3; J. L. Benson, *Grk. Rom. and Byz. Studies* 3, 1 (1960) 12, no. 14, with fig. 6, no. 14; Catling, 196, no. 13, with pl. 29: b. Catling has made the same comparison with the Gelidonya fragment on p. 211, no. 44.

[109] Benson, *op. cit.* (*supra*, n. 108) 11, no. 12, with fig. 6, no. 12; Catling, 194, no. 6, with pl. 28: a.

[110] Catling, 192–193, no. 2, with pls. 27: d and 37: b.

[111] *Ibid.*, 212.

[112] *Ibid.*, no. 48, with pl. 37: a.

[113] Schaeffer, *Enkomi-Alasia*, 65, fig. 18; Catling, 212, no. 49, with pl. 37: b.

[114] May, *Megiddo Cult*, 19 f., pl. XVII; Guy and Engberg, *Megiddo Tombs*, 188, fig. 186: 4, and pl. 119: 1; Catling, 212, no. 51, with pl. 37: c.

[115] Schumacher, *Tell el-Mutesellim* I, 86, fig. 118c; Catling, 213, no. 53.

[116] Watzinger, *Tell el-Mutesellim* II, 91.

[117] May, *Megiddo Cult*, 19, n. 73.

[118] FitzGerald, *PEFQ* (1934) pl. VII, fig. 2, and pp. 133–134; Catling, 212, no. 50.

[119] May, *Megiddo Cult*, 19.

[120] Benson, *op. cit.* (*supra*, n. 108) 16.

[121] *Ibid.*, 13.

[122] Catling, 222.

[123] *Ibid.*, 223.

[124] *Ibid.*, 281.

[125] *Ibid.*, 200.

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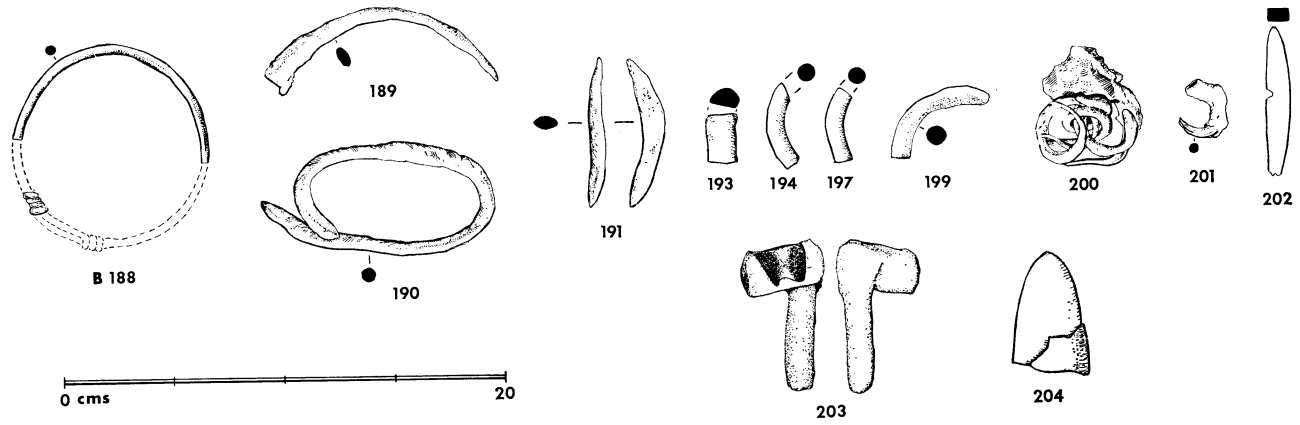


FIG. 120. Bracelets, rings, hooks, and unidentified bronzes: B 188 to B 204.

Shamra (Catling, no. 30) to the twelfth century, instead of the fourteenth, means reinterpreting Schaeffer's excavation report.[126] Only the four-sided stand from Megiddo (Catling, no. 33) seems safely to fall after 1200 B.C. on the basis of its context.[127]

The eleventh- and tenth-century tripods and stands in Catling's table are all well dated by the contexts in which they were found.

We may conclude, therefore, that even the most thorough study of bronze tripods and stands, of the types under discussion, cannot lead to strong conclusions in our present state of knowledge; there is simply not enough material which may be dated by stratigraphy and carefully documented tomb groups. Only the thirteenth-century offering stands may offer a clue to the date of the Gelidonya ship, and that wreck itself may provide new evidence for the dating of tripods.

XXIII. SPIT

B 187. Figs. 116 and 117. L. .505, W. .015, W. of head .021, Th. .003 to .002 at pointed end. Strip of metal with parallel sides, pointed at thinner end, with flat, roughly oval head at thicker end (1959).

This has been called a blade from a pair of smithing tongs by Catling,[128] and Harold Burnham of the Textile Department of the Royal Ontario Museum has pointed out its similarity to "a weaver's sword for use with a vertical warp-weighted loom of classical type."[129]

I think that there can be absolutely no doubt that this is simply a spit, as I first identified it.[130] It is a well-preserved, unbroken piece, identical in all respects to the spits used for making *shish kebab* in modern Turkey. The metal is still quite pliable, and the bend is meaningless and probably accidental.

[126] *Ibid.*, 202.
[127] May, *Megiddo Cult*, 19 f., with pl. XVIII; Catling, 205.
[128] Catling, 99 and 292.
[129] I thank Mr. Burnham for this suggestion, which he wrote to me after having quickly seen a picture of the object in an illustrated lecture.
[130] *AJA* **65** (1961) 274.

XXIV. BRACELETS OR ANKLETS AND RINGS

B 188. Figs. 120 and 121 *a* and *b*. Exterior D .088, Th. .004. Approximately one-third missing. Round in section. Twisted wire knot at one end (P). This was found imbedded among the beads and was undoubtedly carried in the same jar with them. It is almost identical to a bracelet of adjustable size from the Trésor de Bronzes at Enkomi, which would indicate that a second knot or terminal spiral was on the missing portion.[131] Schaeffer[132] and Herzfeld[133] have remarked on the great chronological and geographical spread of this type, but of particular interest are examples from thirteenth-century Megiddo[134] and Ras Shamra,[135] and twelfth- to tenth-century Troy.[136] Catling points out that the type is not found in the Aegean.[137]

B 189. Figs. 120 and 121. Fragment. L. .105, Th. .005 × .004. One end is shapeless and corroded, the other tapering to a point. The tapering end suggests that this may have been similar to B 190.

B 190. Figs. 120 and 121. L. .105, W. .06, Th. .008. Open bracelet with possible, but worn, serpent or duck heads at ends; crushed into oval (M). *Cf.* Cyprus Museum Met. 1992.

In addition, there were small fragments of bronze rings which may have been either open or closed; as in the Trésor de Bronzes at Enkomi,[138] these are round, oval, or flattened on one side in section. It is not possible to say whether they were originally ornaments or simply bullion shaped in a form common in the Bronze Age:[139]

B 191. Fig. 120. L. .07, Th. .01. Tapered and flattened (M).

B 192. L. .03, Th. .009, est. original D. .042 (P).

B 193. Fig. 120. L. .022, Th. .014 × .009. Flattened on one side (S).

[131] Schaeffer, *Enkomi-Alasia*, 43, no. 21, with fig. 2, no. 21 on p. 41.
[132] *Ibid.*, 63, 65–66.
[133] E. Herzfeld, *Iran in the Anc. East*, 148.
[134] Guy and Engberg, *Megiddo Tombs*, 8, with fig. 179.
[135] Schaeffer, *Enkomi-Alasia*, 65.
[136] *Ibid.*, and H. Schmidt, *H. Schliemann's Troj. Altert.*, 261.
[137] Catling, 231.
[138] Schaeffer, *Enkomi-Alasia*, 41–42, with fig. 2.
[139] Herzfeld, *op. cit.* (*supra*, n. 133) 147.

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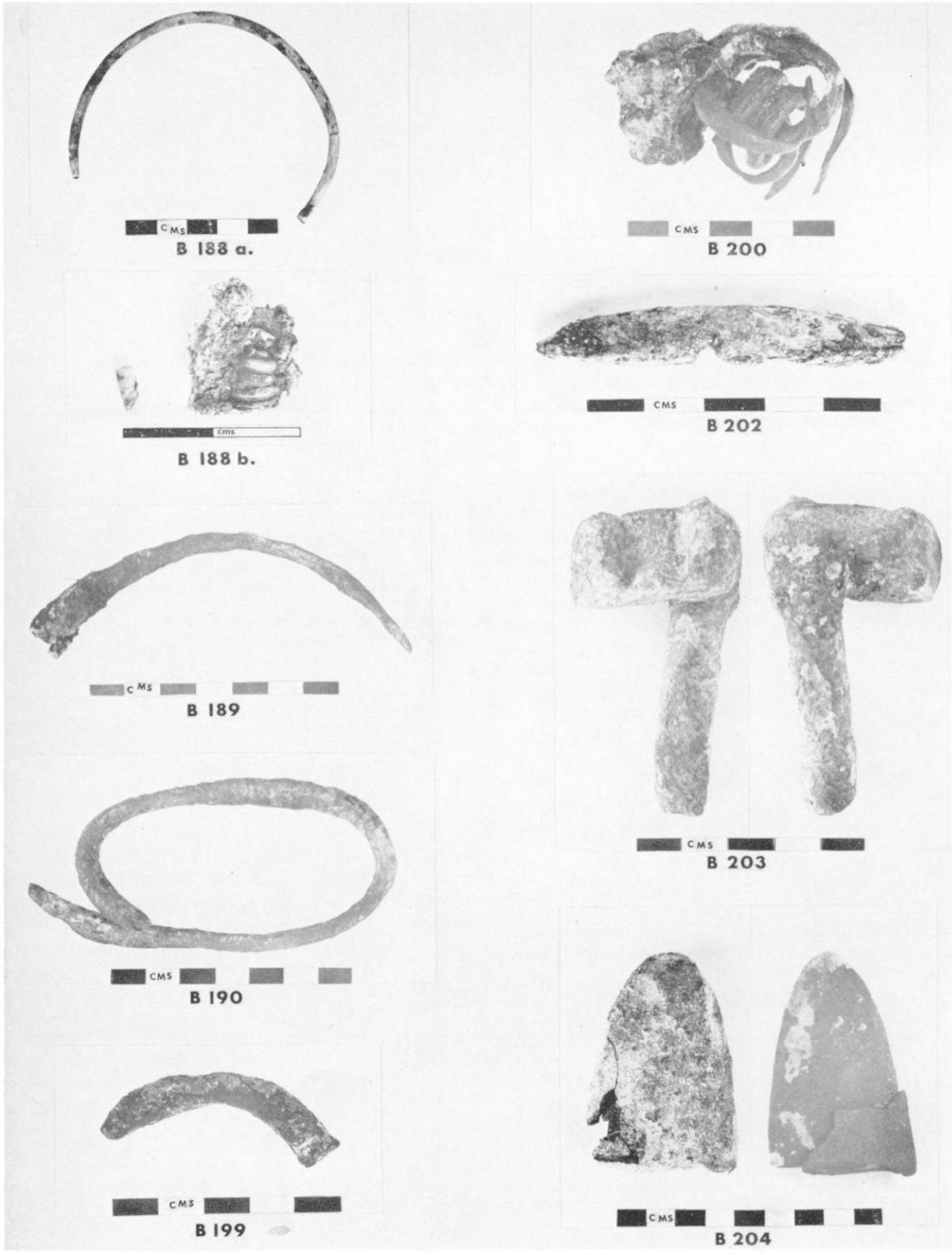


FIG. 121. Bronze bracelets and unidentified objects.

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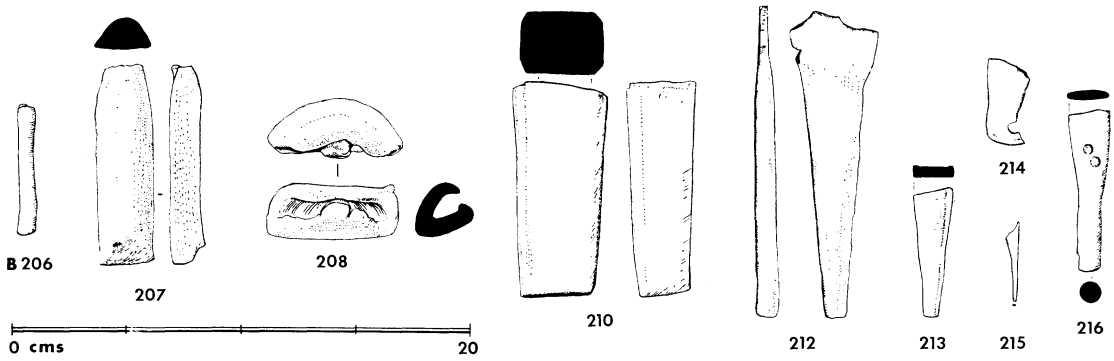


FIG. 122. Bronze attaching devices and unidentified objects: B 206 to B 216.

B 194. Fig. 120. L. .04, Th. .008, est. original D. .051. Round section (P).
B 195. L. .032, Th. .009, est. original D. .048.
B 196. L. .048, Th. .01 × .006, est. original D. .074. Oval in section.
B 197. Fig. 120. L. .039, Th. .008, est. original D. .057.
B 198. L. .04, Th. .014. Except that it is bent, this is very much like a pike end fragment (G).
B 199. Figs. 120 and 121. L. .061, Th. .009 × .006. Oval in section. Tapers at one end; other end flares slightly just at break (M).

XXV. HOOKS

B 200. Figs. 120 and 121. Three hooks (?) tangled together. Each piece is metal about .005 in diameter, and becomes thinner at either end, although the ends cannot be called pointed (P). I can suggest no use for these, but recall a similar bunch of hooks, each sharpened at both ends, from a much later date at Dodona.[140]
B 201. Fig. 120. D. of loop .025, max. D. of metal .004. Small hook, very sharp at one end (P).

XXVI. UNIDENTIFIED BRONZES

These differ from unidentifiable scrap (group XXX) in that they represent complete or fragmentary objects which I cannot identify, but which have distinctive shapes.

B 202. Figs. 120 and 121. L. .067, max. W. .01, Th. .006. Probably bronze, but possibly lead. One straight edge with notch (slightly more than half a circle of .0045 in diameter) in center; other edge curves convexly to meet straight edge. No evidence of break; sides are even.
B 203. Figs. 120 and 121. L. .065, W. .037, D. of rod .01. A short rod is attached (cast on?) at an oblique angle to one end of a roughly rectangular piece which is deeply depressed with a *W*-shaped notch on the face opposite the "handle"; there is no evidence of a break, but there is no certainty that it is complete (1959). I have found no explanation for this object, although it resembles slightly a piece in the Cypriot Mathiati Hoard which Catling has labeled a late intrusion and identified as a "badly modelled ear with dowel for attachment to a life-size statue."[141] I hesitantly suggest, without much conviction, that it may have been some sort of locking device.
B 204. Figs. 120 and 121. L. .056, W. .035, Th. .007 tapering to end. Roughly triangular object, with rounded point. A layer of even concretion was cracked off, inside of which was a layer (Th. .002) of hard green material which evenly encased the object itself, which is very well preserved, with end beveled up from one side. The green material has not been analyzed, but it was unlike any of the natural corrosion products which were found on other objects.
B 205. Fig. 123. Pres. dimensions .13 × .12, Th. .0075. Fragmentary pierced disk (E).
B 206. Fig. 122. L. .058, D. .008. Rod, slightly thickened at either end.
B 207. Figs. 122 and 123. L. .085, W. .025 tapering slightly toward one end, max. Th. .015. Thick strip of metal with rounded back; perhaps unfinished casting (P).
B 208. Figs. 122 and 123. L. .06, max. Th. .007. Semicircular; hollow, with opening on straight side (P).
B 209. Fig. 123. L. .043, .013 × .012. Bar, nearly square in section, with oval knob on one side (G).
B 210. Figs. 122 and 123. L. .088, .03 × .04 at larger end. Bar, rectangular in section but with beveled edges, wider at one end; both ends broken (1959).
B 211. Fig. 123. Original D. approx. .12, Th. .002. Fragmentary. Slightly concave, round plate, with chips from edge of preserved portion (P). It is possible, but far from certain, that this is a scale pan of the type found in Cyprus, Greece, Crete, and the Near East (Catling, pp. 162–163, 185); the chips may represent suspension holes which have broken through the edge.

XXVII. ATTACHING DEVICES (TANGS AND RIVETS)

B 212. Tang. Figs. 122 and 123. L. .14, Th. .01 to .003 at wider end. Tapered. Although the tang is similar to those found on bronze mirrors, the preserved portion suggests that the blade was spatula-shaped (P).
B 213. Tang. Figs. 122 and 123. L. .053, max. W. .02, Th. .005. Same as preceding, but much smaller; broken off obliquely at wider end. Wider faces slightly inset. Very possibly from a bronze mirror,[142] especially if the identification of B 225–

[140] These are, or were, on display in the National Museum in Athens, but with no further identification.
[141] Catling, 283, with pl. 52, no. 26; *SCE* III, 665, fig. 374.
[142] *Cf.* Cypr. Mus. Met. 2506; see also the Cypriot examples in Catling, pl. 40, and Schaeffer, *Enkomi-Alasia,* 181, no. 199, with pl. XLII: 2 (pierced tang); and Egyptian examples in Petrie, *Obj. of Daily Use,* pl. XXVIII.

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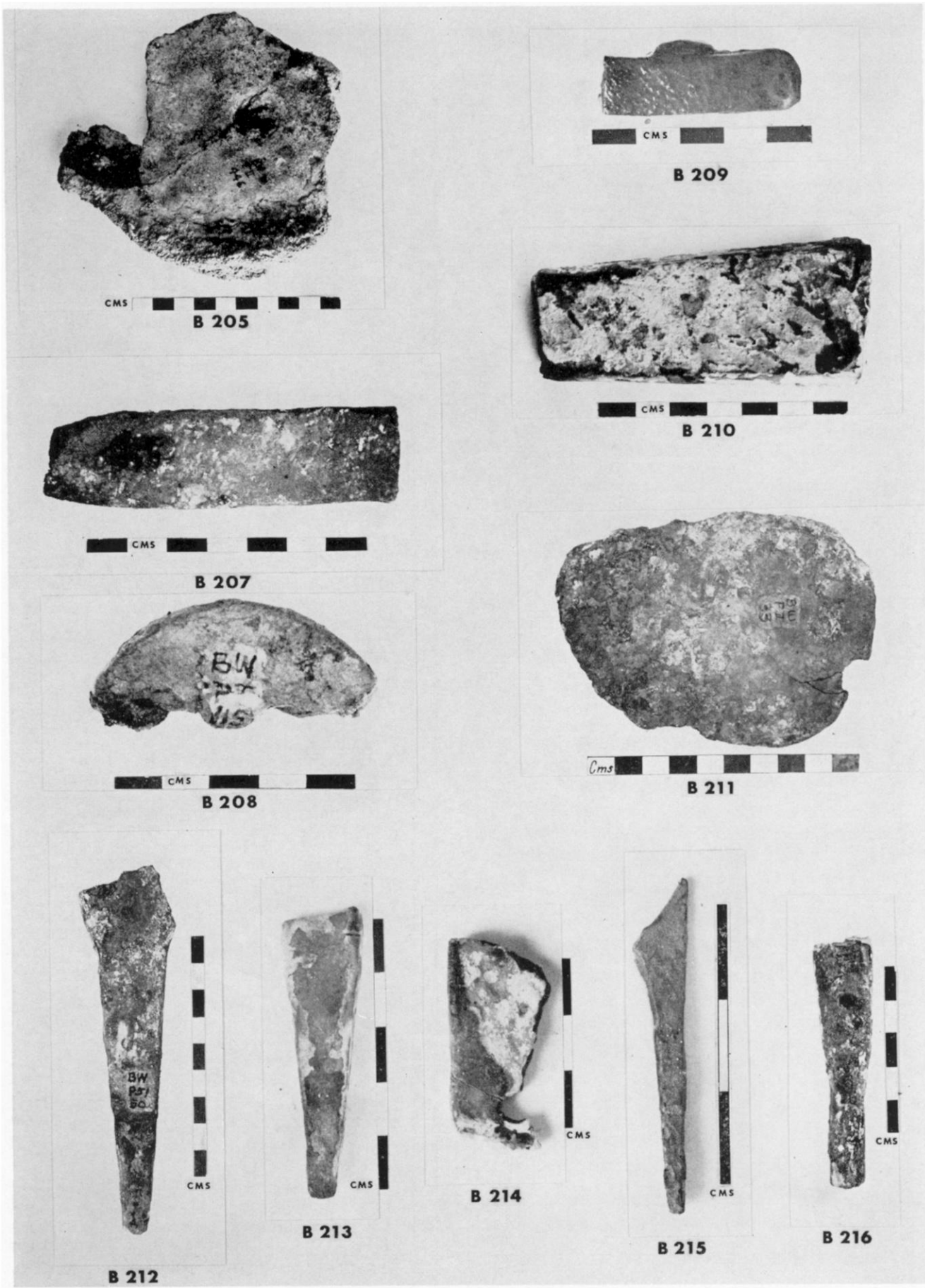


FIG. 123. Bronze attaching devices and unidentified objects.

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B 228 as bronze mirrors is correct. Tangs are not found on Aegean mirrors, except on Rhodes,[143] but are associated with the Near East, having appeared as early as the Old Kingdom in Egypt.[144]

B 214. Pierced tang? Figs. 122 and 123. Pres. L. .037, pres. W. .018, Th. .006. Rivet hole (D. .005) near end. Only parts of two sides preserved.

B 215. Tang. Figs. 122 and 123. L. .036. Very small, square tang, with part of blade preserved. Almost certainly an arrowhead fragment (G).

B 216. Riveted tang. Figs. 122 and 123. L. .071, max. W. .019, Th. .004. Flat tang, pierced by two rivet holes, .016 apart and each .005 in diameter, tapers into round bar (D. .01), which must be part of tool itself.

B 217. Riveted plate. Pres. L. .039, pres. W. .033, Th. .007. Triangular fragment of plate with two rivet holes: one is .004 in diameter, the other .002; the former may have been enlarged through corrosion.

B 218. Rivet fragment or stud. L. .012, max. D. 015. Conical head; pin is .004 in diameter (G).

XXVIII. UNWORKED CASTINGS

Many of the implements, such as the flat, open-socketed hoes and pruning hooks, were cast either in open or multiple molds,[145] and sockets and edges were formed by later hammering. When open molds were used (fig. 124), flat stones probably were used as covers to prevent rough surfaces, which are caused by oxidation (fig. 125).[146]

B 219. Pruning hook casting. Figs. 126 and 127. L. .138, Th. 005. After the sides had been curled over to form a socket, this would have been similar to B 98 and B 99, although the pointed end curves out more strongly in this case (1959). A metal one-piece mold which would have produced almost identical castings is from the Cypriot Mathiati Hoard.[147]

B 220. Hoe casting. Figs. 126 and 127. L. .065, max. W. .06, Th. .006. *T*-shaped piece of flat bronze, with rounded angles to arms. The end of the blade is probably missing (S). Such a casting could have been used in forming hoes of the type found at Gelidonya. A similar piece is from the Mathiati Hoard,[148] and a metal mold for producing such castings is also from Cyprus, in the Gunnis Hoard.[149]

B 221. Hoe casting. Figs. 126 and 127. L. .155, max. W. .09, blade W. .055, Th. .01. The sides of the socket are more rounded than those found on completed tools at Gelidonya (1959).

B 222. Rectangular sheet. Figs. 126 and 127. L. .25, W. .09, Th. .01. Casting for unknown purpose; broken into three pieces (P).

B 223. Rectangular bar. Figs. 126 and 127. L. .135, W. .022, Th. .014. Slightly bent (P).

[143] Catling, 226–227.

[144] Petrie, *loc. cit.* (*supra*, n. 142) and 29.

[145] Two molds from Cyprus, one single and one multiple, but both for similar pruning hooks, show that the caster had a choice. Catling, 272, no. 2, with pl. 50: b, and 274, no. 1, with pl. 50: f.

[146] Tylecote, *Met. in Archae.*, 111–112; Schliemann, *Ilios*, 434.

[147] Catling, 272, no. 2, with pl. 50: b.

[148] *Ibid.*, 276, no. B 1, with pl. 51: g; *SCE* III, 665, fig. 374.

[149] Catling, 272, no. 1, with pl. 50: a.

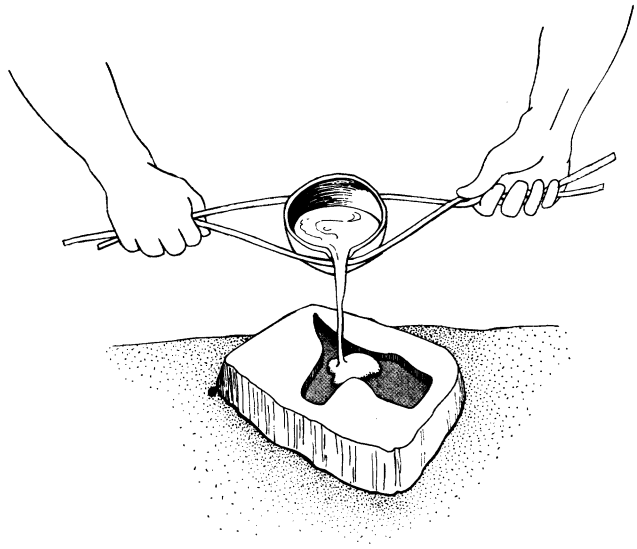


FIG. 124. Hypothetical casting of pruning hook in open mold.

B 224. Metal strip. Figs. 126 and 127. L. .28, W. .038, Th. .008. Thinner at one end, which is bent (1959).

The following pieces, which are the same size as the disks from the Athenian Acropolis Hoard,[150] may be hemispherical bowl castings[151] or, more probably, simply mirror fragments. Although they are thicker than mirrors from Dendra[152] and Cyprus,[153] they are no thicker than some mirrors from Egypt.[154] Further, the straight cut on the more complete disk, B 225, suggests an arrangement for fitting a wooden handle; such handles were attached normally with either rivets piercing the disk, or with a protruding tang.[155] The slightly

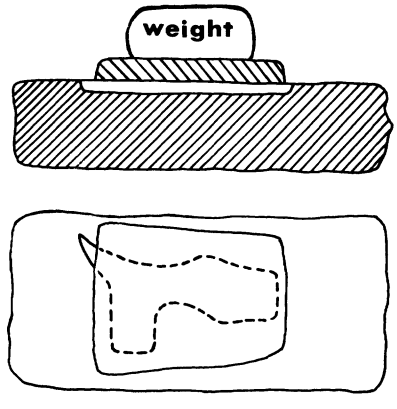


FIG. 125. Stone cover on open mold prevents oxidation on surface of bronze.

[150] Montelius, *Grèce Précl.*, 156, with fig. 497.

[151] Catling, 147 and 293.

[152] Persson, *Royal Tombs at Dendra*, 96, Chamber Tomb no. 20, no. 20.

[153] Catling, 224–225.

[154] Petrie, *Obj. of Daily Use*, 31–32.

[155] Catling, 224–227, discusses methods of attaching handles.

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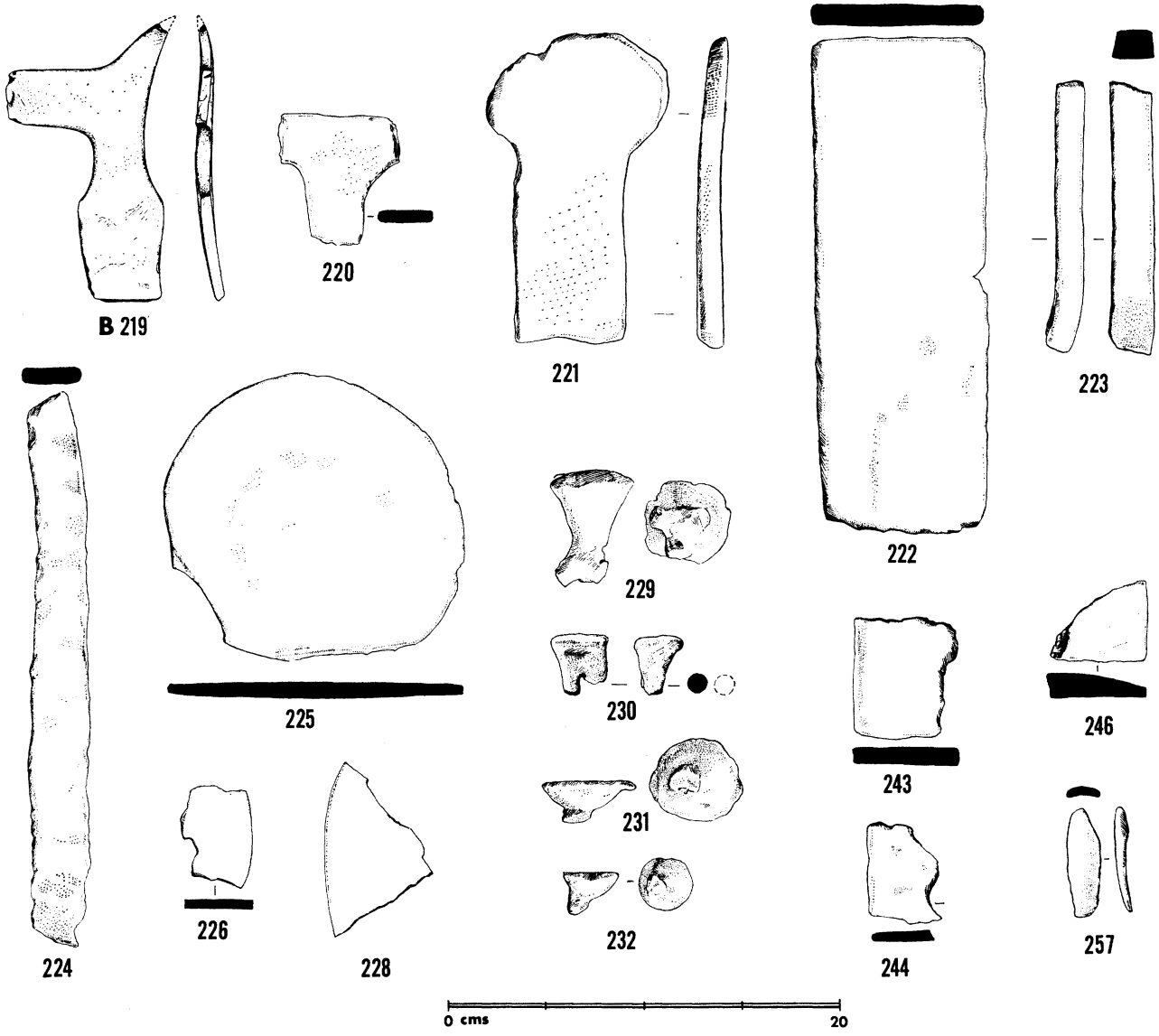


FIG. 126. Unworked bronze castings, casting waste, and unidentifiable scraps: B 219 to B 257.

convex, smoother surfaces, which would seem to make the disks impractical as mirrors, are also found on many Egyptian examples where the use is not in doubt.[156]

B 225. Fig. 126. D. .16, Th. .004 to .003 at rim. Disk with squared rim. Surface beaten on one side; smooth, but slightly convex, on other. Two segments cut off straight across edge in antiquity (P).

B 226. Fig. 126. .05 × .036, Th. .003. Fragment of disk of same diameter and thickness as B 225, also with squared edge (P).

B 227. .049 × .03. Fragment of disk originally the same size as B 225 (G).

B 228. Fig. 126. Max. chord L. .09, Th. .004 at break and .002 at edge. The edge is rounded rather than square, and the diameter was originally larger than those of the preceding (G).

[156] Petrie, *loc. cit.* (*supra*, n. 154).

XXIX. CASTING WASTE

In casting an implement in a closed mold, molten metal was poured from a crucible into a funnel-shaped opening (fig. 128); the metal was carried from this opening through one or more tube-like passages so that it spread evenly throughout the mold. After the casting had solidified, the metal in the opening and channels, known as jets and runners,[157] was cut away and the surface of the implement was ground down and smoothed. One or more openings were also needed to allow the escape of gas from the mold, and the metal which rose in these had the rough, bubbly surface found on the ingots; these risers were also cut away from the

[157] Tylecote, *Met. in Archae.*, 109, points out that the term "jet," which is commonly used by archaeologists, is not used in foundry practice; "gate" is the more accepted term.

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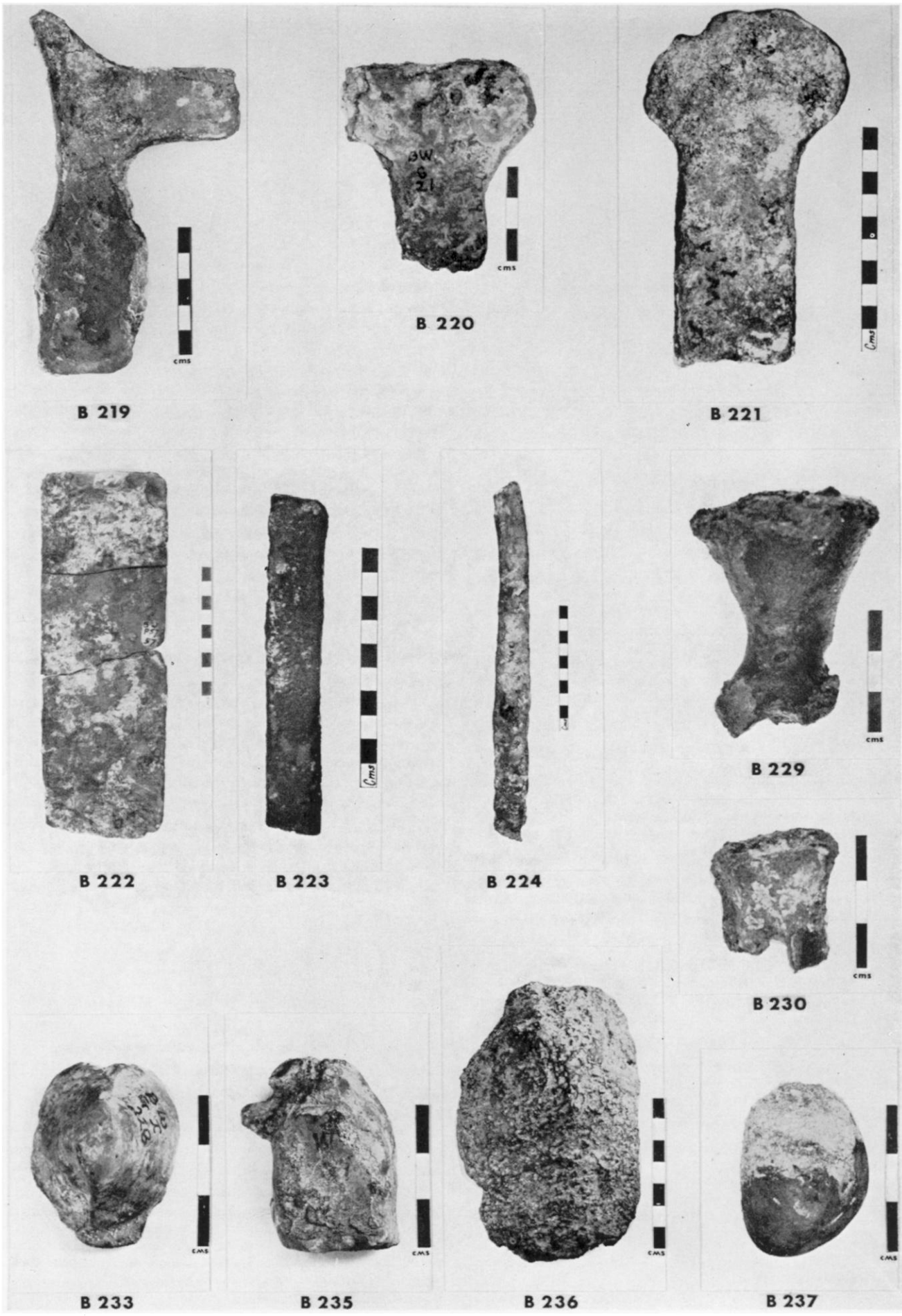


FIG. 127. Blanks for unfinished bronze tools, and casting waste.

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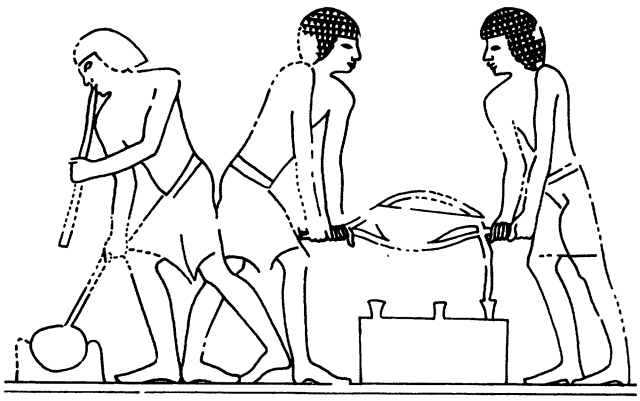


FIG. 128. Casting scene from Tomb of Puyemrê at Thebes (after Davies).

finished product and discarded. Figure 129, which depicts a hypothetical mold for casting a solid figure such as the horned male from Enkomi,[158] shows the various features described.

B 229. Figs. 126 and 127. Conical jet with three runners. H. .05, D. 04. The three runners are broken off quite close to the jet, but enough is preserved to show that they ran off at different angles. A slight ridge of metal protruding upward around the convex top had adhered to the sides of the funnel-like mold opening (P).

B 230. Figs. 126 and 127. Jet with two runners. H. .029, top .03 × .021, runners approx. .008 and .009 in diameter. The pouring cup was not strictly conical, resulting in an oval top on the jet; runners at slight angles to one another (P).

B 231. Fig. 126. Conical jet with one runner. H. .02, D. .045. Slight ridge around top from overflow of metal; runner at slight angle (P).

B 232. Fig. 126. Conical jet with one runner. H. .022, D. .026 (M).

B 233. Fig. 127. Conical jet or riser. H. .03, D. .038. Ridges, or seams, on either side resulted from metal seeping between the two halves of the mold. Slight ridge on one side of top from overflow of metal. Top very rough (G).

B 234. Nearly conical jet or riser. H. .024, top .04 × .032. Oval top slightly concave; bottom rounded off evenly (E).

B 235. Fig. 127. Unfinished and broken tool with runners. L. .04, W. .025, Th. .012. Possible pick end from which runners had never been removed (1959).

B 236. Fig. 127. Casting waste. L. .125, W. .085, Th. .032. Roughly oval lump of metal, rather flat on one side, which may have hardened in a crucible.

B 237. Fig. 127. Dump. L. .033, W. .025. Roughly conical lump of copper or bronze which probably spilled and hardened during casting (G).

B 238. Dump. L. .021, W. .015. Hardened lump of spilled copper or bronze (M).

[158] The illustration, by Susan Womer, is based on modern casting techniques and uses the statuette from Enkomi (Dikaios, *AA* (1962) 1 f., with figs. 18–21; Catling, 255, with pl. 46) only as an example.

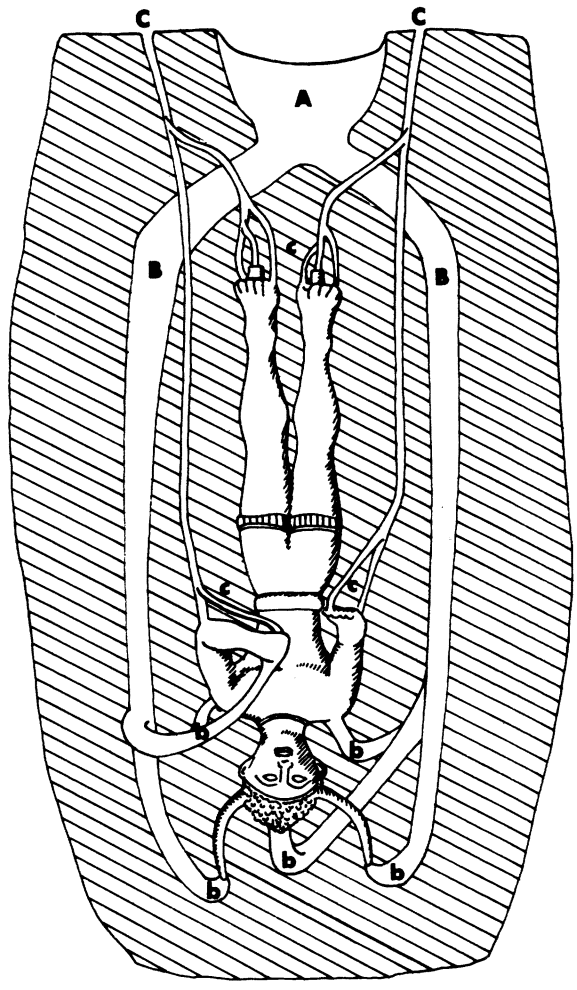


FIG. 129. Hypothetical mold for casting Horned God from Enkomi, by Susan Womer. *A*. Funnel-shaped opening. *B*. Metal runners. *C*. Air vents.

A lead jet, with runners (L 23), also came to light (p. 131).

Such casting waste probably lasted only until it was remelted and used again. It has been found in Cypriot founder's hoards,[159] but was surely not limited to that island.

XXX. UNIDENTIFIABLE SCRAP

Fragments of discarded utensils of unrecognizable shapes were found scattered throughout the cargo; most, presumably, had been contained in baskets which have disappeared. Such scrap metal is usually found in ancient founder's hoards.[160] At Gelidonya, a number

[159] Catling, 276.

[160] Childe, *The Bronze Age,* 45, distinguishes "founders' hoards" from "domestic," "traders'," and "votive" hoards by the "presence of old and broken tools, obviously scrap metal collected for remelting, and often too of metallurgical tools, moulds and ingots of raw metal."

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of nearly square or rectangular pieces of sheet metal may have been cut from unworked castings.

B 239. Nearly square plate. .068 × .065, Th. .005. Tapered edges, very slightly curved (P).
B 240. Nearly square plate. .04 × .04, Th. 007. (1959)
B 241. Nearly square plate. .045 × .045 to .040, Th. .005 to .008. (1959)
B 242. Roughly rectangular plate. .06 × .05, Th. .01. (G).
B 243. Fig. 126. Plate fragment. .06 ×.045, Th. .01. Three straight sides, one broken. (P)
B 244. Fig. 126. Plate frag. .045 × .04, Th. .005. One right angle, two broken sides. (P)
B 245. Plate frag. .035 × .035, Th. .003. (M)
B 246. Fig. 126. Plate frag. .047 × .04. Triangular fragment with one square corner. (P)
B 247. Notched plate frag. .048 × .033. (G)
B 248. Plate frag. .062 × .047, Th. .003. Broken on all sides. (M)
B 249. Plate frag. .05 × .044, Th. .005. Broken on all sides. (G)
B 250. Plate frag. .04 × .22, Th. .008. (G)
B 251. Curved frag. .03 × .025, Th. .002. (M)
B 252. Tool frag. .044 × .032, Th. .006. Shaped shoulder, perhaps spade fragment.
B 253. Plate frag. .07 × .048, Th. .01. (M)
B 254. Tool frag. .044 × .03, Th. .002. Triangular tool fragment. (M)
B 255. Plate frag. .075 × .045. (M)
B 256. Curved strip. L. .052, W. .013, Th. .0015.
B 257. Fig. 126. Irregular frag. L. .055, W. .018.

CONCLUSIONS

It is evident that most of the bronzes were fragmentary and were, therefore, being transported for their scrap value. Whether or not the whole tools, including adzes, hoes, an axe, and an axe-adze, were ready for sale or were also to have been melted down and recast remains a question. Some of the tools may have been for use on the ship itself, as a study of the distribution of the bronze cargo suggests.

Both complete and fragmentary bronzes were found in all areas of the site, showing that the cargo had been packed in the ancient merchantman almost from stem to stern. Although some of the smaller pieces, especially those carried in somewhat buoyant wicker baskets, may have shifted their positions as the ship sank, the concentration of small scarabs, weights, seal, lamp, and whetstones in the "cabin area" of G (spilling into area M) shows that even the lightest objects did not move far. This is possibly significant in that the location of most of the *unique* and *complete* bronzes was in the "cabin area": the razor, punch, spatula, needle, socketed tool B 95, and well-preserved chisels were all from areas G and M. In this category, only the swage block (area E) and, possibly, the spit (raised in 1959) were found elsewhere. We have, therefore, the strong possibility that some of these unbroken pieces were personal possessions of the crew and were not cargo; most could have been used on board a ship.

Unfortunately, these "personal possessions" are exactly the bronzes for which it is most difficult to find parallel objects from other sites, and they are the implements which most likely accompanied the ship from its home port.

The cargo of scrap, however, we may judge to have been Cypriot. By far the best parallels for the picks, shovel, pruning hooks, sickle and axe-adzes, as well as for several of the various types of hoes, chisels, and bracelets, are from Cyprus; that at least some of these parallels were actually made in Cyprus is proved by the discovery of molds for pruning hooks and hoes on that island. Axes, hammer or anvil, swage block, awls and nails, punch, needle, knives, spearheads, razor, spatula, vessels and stands, spit, and miscellaneous bronzes could as well have come from Cyprus as elsewhere. Of the remaining objects, some of the hoes, the socketed tool B 95, the adzes, and possibly the mattock show strong Near Eastern relations. Almost nothing points to an Aegean origin; the hoes of Type 3 from Athens and Anthedon are so much the exception that one must consider them as being imports into Greece. (See figs. 130 and 131.)

A determination of the date of the bronzes poses a number of problems. We have seen that many of the parallels are from hoards which may not be dated by the contexts in which they were found. Properly excavated parallels, on the other hand, are dated mostly to either the thirteenth or twelfth century B.C. This difference in dating is important, for the closely similar bronzes from Gelidonya formed a closed deposit of contemporary material; three possible explanations for the difference come to mind: styles of metal tools and weapons did not change appreciably during a century or more, some of the Gelidonya tools were already quite old when placed in the cargo, or the evidence for dating parallels found on land has been misinterpreted by some of the excavators.

I believe that the first two possibilities may be dismissed. Although some shapes changed little if at all, the large number of variations on such a simple object as the lugged adze, as shown in Mrs. Maxwell-Hyslop's study, and the very few close parallels in her catalogue for the Gelidonya tools, indicates that subtle variations were due to the preference of an individual or of a particular atelier. We may further note that some of the Gelidonya objects which are most perfectly preserved find their best parallels among the earlier, thirteenth-century objects, and it is doubtful that tools would have been preserved so well after years of use. Almost perfect parallels must rather be mostly from the same century, I feel, but whether this was the thirteenth century or the twelfth century must be decided.

Catling, who has collected and presented well all the direct and indirect evidence for dating Late Cypriot bronzes, assigns most of the Cypriot material to the twelfth century. The thesis of his book is that a colonization of Cyprus from the Aegean after 1200 B.C.

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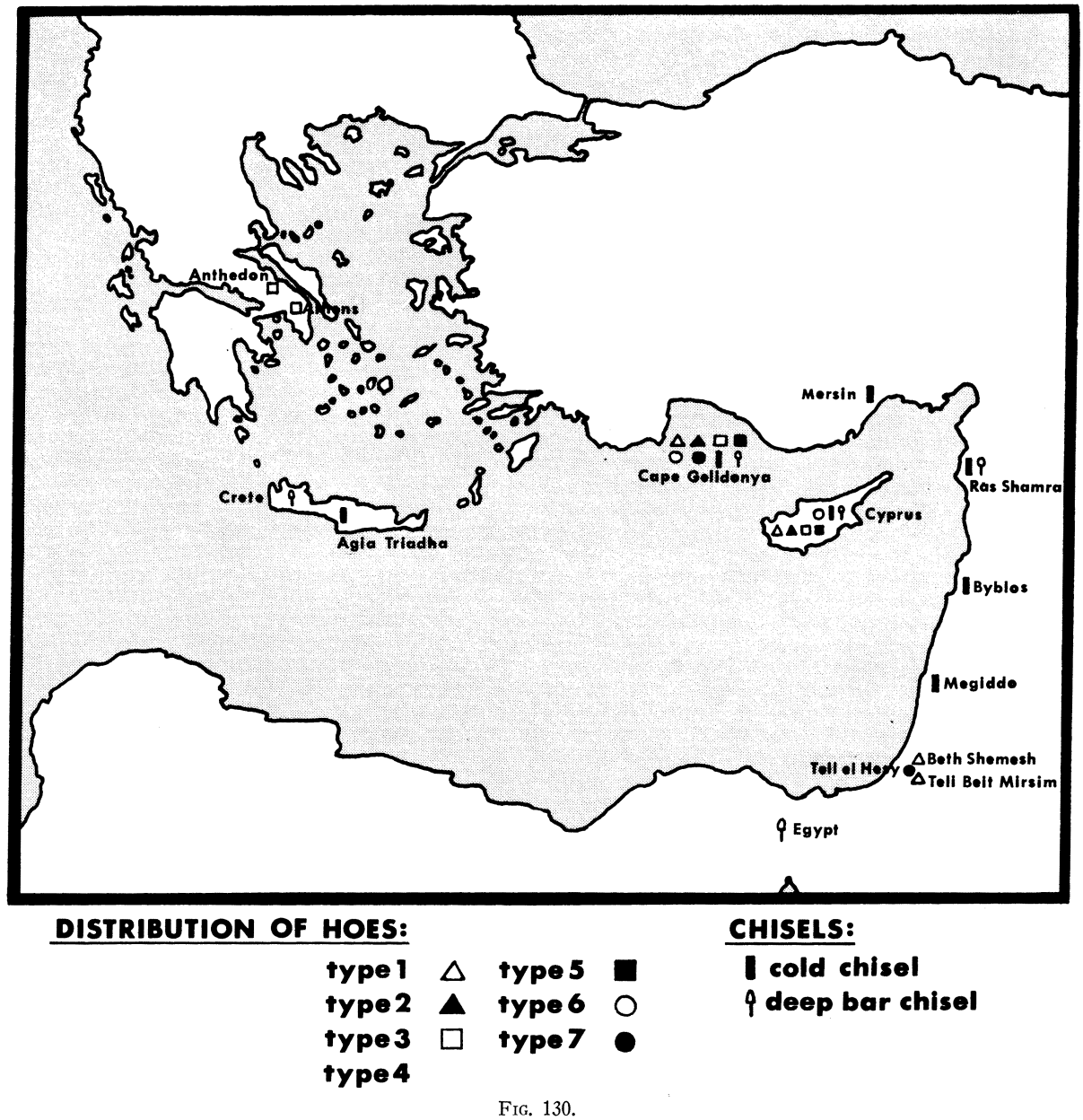


FIG. 130.

brought about the manufacture of a great number of new types of bronzes on that island, and it is these new types which are found so abundantly in hoards. I believe that in stressing Aegean influence on the bronzes, an influence that Desborough also sees,[161] Catling misinterprets some of the evidence which he presents.

Catling concludes that "many" of the Late Cypriot tools "can either be closely matched by Aegean tools of the same type or may reasonably be seen as the end of an Aegean series the final stages of which have yet to be found there."[162] He also states that "several tool forms are evidently of Near-Eastern origin. . . ."[163] Based on the material presented in the same chapter which contains these statements, "many" and "several" should be interchanged. Catling's own conclusions about individual types of tools reveal that more than twice as many find their origins in the Near East as in the Aegean. Similar Near Eastern origins also are found for many or most of the Cypriot statuettes, tripods, personal objects, and miscellaneous bronzes. Catling's suggestions that some bronzes, such as charcoal shovels and tanged mirrors, may have been introduced from the Aegean, where they have not been found, rather than from the Near East, where they have been

[161] Desborough, *Last Mycenaeans*, 49.
[162] Catling, 109.
[163] *Ibid.*

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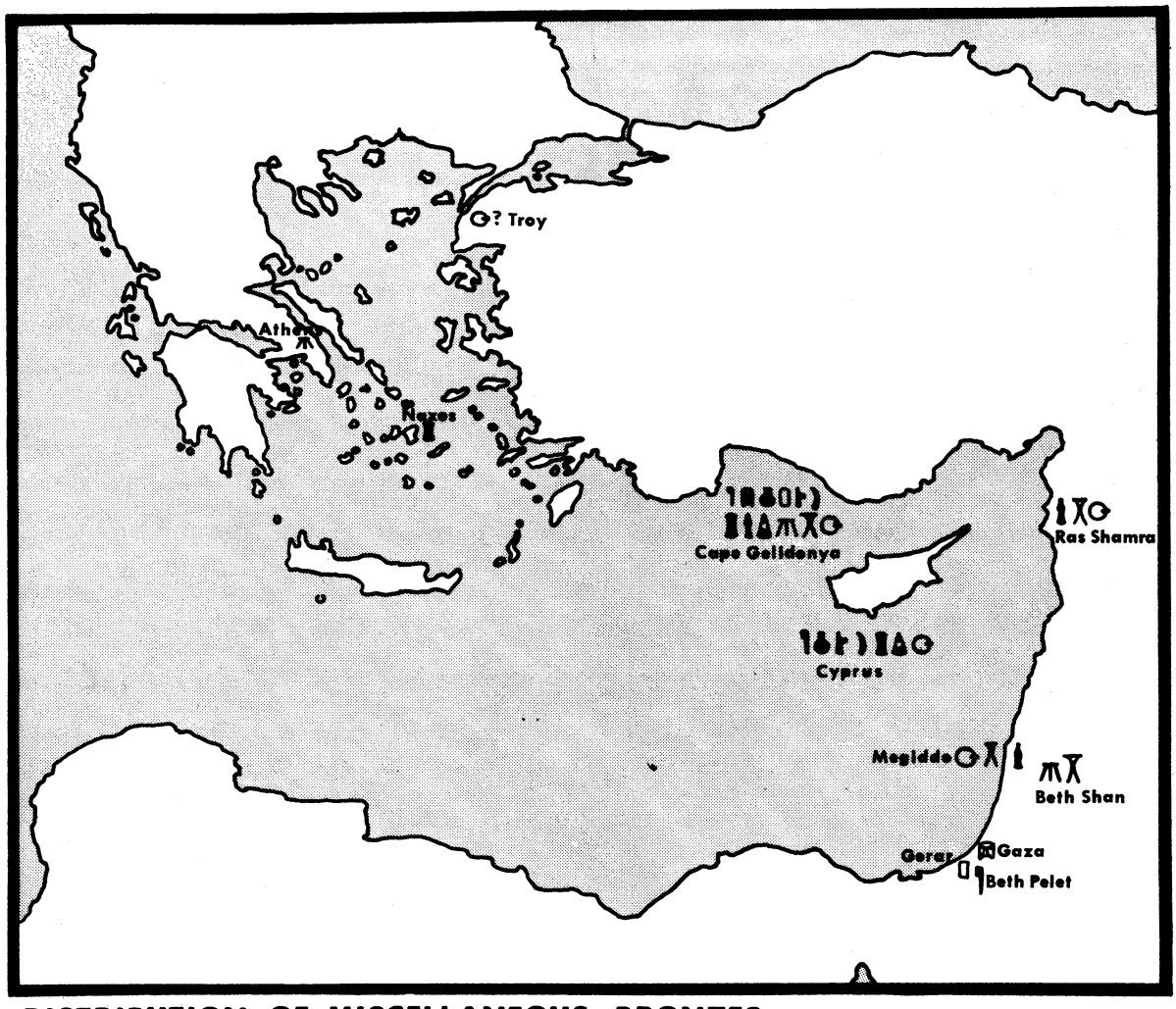


FIG. 131.

found, show the difficulty involved in finding Aegean origins.[164]

A twelfth-century Aegean colonization of Cyprus did not influence the manufacture of bronze implements on the island, therefore, and we may consider the dating of the bronzes independently of such an event. Most of the Cypriot material which is relevant to the Gelidonya cargo is from hoards. Only two of these hoards (the Trésor de Bronzes and the Weapons Hoard) have been dated stratigraphically and, although both are assigned to the twelfth century by their excavators, both are atypical.[165] The evidence for twelfth-century dates for the other hoards is not strong. Catling places the Enkomi Foundry Hoard after 1200 B.C. on the basis of stands and oxhide ingots, which we have shown are not necessarily that late. He places the other hoards after 1200 B.C. by the similarity of the bronzes in them to "twelfth-century" types, but he has dated almost all of these types on the evidence that they came from these same "twelfth-century" hoards. If we

[164] *Ibid.*, 101, 227.

[165] *Ibid.*, 287–288.

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do not begin with the assumption that the hoards are from the twelfth century, however, we see that the best evidence does not point to that date at all. Of the stratified single parallels on Cyprus, more may be dated before the twelfth century than to it, and good Near Eastern parallels are also generally earlier than 1200 B.C.

We have already seen that copper "oxhide" ingots have been misinterpreted almost universally in a like manner, for such ingots did not introduce "a wholly Aegean element into the management of the smelted copper,"[166] and no particular type of ingot suddenly appeared on Cyprus, as Catling believes, about 1200 B.C. Representational evidence, indeed, indicates that it was just at that time that oxhide ingots disappeared forever.[167] The only evidence for ingots existing anywhere after 1200 B.C., in fact, is from the later excavation by Schaeffer of the area which *was supposed* to have produced the Enkomi Ingot Hoard, and the recently published ingot-shaped base for a bronze statue found at Enkomi (p. 69).

Professor Dikaios, on the other hand, has kindly informed me that at least in the parts of Enkomi which he has excavated, copper smelting reached its peak in the thirteenth century, and that it is possible that the bulk of ingots come from that period (Late Cypriot IIB); indeed, he has a fragment of an ingot from as early as LC IIA. The impetus which sent copper working to new heights in the thirteenth century almost stopped when Myc. IIIC:1 pottery appeared late in that century (1230–1200 B.C.). Whether the smelting ceased entirely or was merely moved to a new location is not yet known, but Dikaios feels that the industry generally declined owing to the repeated disasters of the twelfth century.[168]

This reconsideration of the ingots, which have been fully discussed in a separate chapter, is important for the following conclusions. If the ship at Gelidonya was Syrian, as I believe we can show with evidence independent of the ingots or bronzes (chap. XIV), our earlier conclusion that oxhide ingots were dealt with by Syrian merchants is proved. These ingots suddenly ceased to be manufactured around 1200 B.C., after two centuries of uninterrupted use in which not even the slight variations on the shape had changed. That bronze tools, weapons, and other implements of mostly Near Eastern origin were dealt with by the same merchants, which had been suggested by the presence of ingot fragments in hoards of bronzes, is further proved by the Gelidonya wreck.

I believe that some historic event brought about the end of this trade, and that the devastation of the Syro-Palestinian coast by the Peoples of the Sea, at precisely the time the ingots disappeared, is the most likely event. Because the ingots and bronzes are so closely associated that they can scarcely be studied independently, I would further suggest that the trade of the bronzes stopped at the same time; there is not a single hoard on the Greek mainland whose context would suggest a date after 1200 B.C.,[169] and it would seem most unlikely, even without the evidence which we have discussed above, that *none* of the Cypriot hoards, as Catling believes, comes from the extremely rich thirteenth century on Cyprus.

The conclusion that Near Eastern trade with Cyprus and the Aegean ended at the close of the thirteenth century has been reached by a consideration of the copper ingots and bronze implements alone. A previous study of non-metallic material had led Sjöqvist to believe that at this time (LC III) there was "an almost complete break in the peaceable relations with the East,"[170] and Cyprus "turned her face westwards."[171] It seems, then, that increasing Aegean influence affected Cypriot bronze-work more in hastening the end of established, Near Eastern types than in introducing those types.

We have arrived at the same question that arose in our conclusions concerning the oxhide ingots: are we sure that Phoenician sea power and trade did not play a large part in the Aegean before the first millennium?[172] A second question also arises: is there any reason to believe that Phoenician metal workers did not gain their great fame until after the close of the Bronze Age?

The answers, again, are no. Even without the shipwreck at Cape Gelidonya, a close study of the Cypriot copper and bronze industry should have revealed that it was more Syro-Palestinian than Aegean in character, and that many of the metal pieces in mainland Greek hoards were Near Eastern types made on Cyprus. The Gelidonya ship serves only to show that the metal was traded by Near Eastern merchants as well. That the bronzes were cast on Cyprus, as shown by the occurrence there of molds, suggests that, as in the case of the ingots, Syrian or Phoenician smiths were themselves present on the island, nearer the source of the copper which they used; at the least, the bronzes seem to have been made to meet Near Eastern specifications. The earlier occurrence, preceded by prototypes in some cases, of the bronzes in the Near East precludes any suggestion that the examples found in Syria and Palestine were simply imports of native Cypriot handiwork.

[166] *Ibid.*, 302.

[167] We have seen that the only sure twelfth-century representations of ingots, at Medinet Habu, were probably copied directly from the thirteenth-century Ramesseum.

[168] Letter dated 19 February, 1964.

[169] Desborough, *loc. cit.* (*supra*, n. 161), with n. 7.

[170] Sjöqvist, *Problems*, 190.

[171] *Ibid.*, 209.

[172] The prevailing view, that Phoenician maritime commerce expanded only after the close of the Bronze Age, is discussed in chap. XIV.

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I suggest further that the Near Eastern smiths were making the bronzes for their own use, both on Cyprus and, especially, in their homeland where examples are more often complete than not. Most of the objects found at Gelidonya and in Greek hoards, on the other hand, were broken, and there is nothing to suggest that Mycenaean Greece imported complete bronze implements in any quantity. It seems, rather, that Greece preferred to buy only raw materials and scrap metal for their own smiths or for itinerant craftsmen who would cast objects to suit Mycenaean tastes.

In concluding that bronzes of the type found at Gelidonya were made on Cyprus under Near Eastern direction during the thirteenth century, one problem remains. We have passed lightly over the one important hoard which has been dated stratigraphically to the twelfth century: the Trésor de Bronzes from Enkomi. I have stated elsewhere my reluctance to reinterpret excavated material, or to accept the reinterpretation of others, for the excavator is in a much better position to evaluate the context of his finds. I must point out, however, that the Trésor offers the only strong evidence against a thirteenth-century date for the Gelidonya cargo, and the distinctive axe-adze, which is common to both the Gelidonya cargo and the Trésor, finds a close parallel at Pyla (Kokkinokremmos) which may be dated by the pottery found with it to around 1200 B.C. One cannot ignore such a deposit as the Trésor, but, on the other hand, one cannot ignore the much greater mass of evidence that the other hoards were of the thirteenth century.[173]

[173] See chap. XIV, n. 15, below.

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VII. THE POTTERY

J. B. Hennessy and J. du Plat Taylor

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Tarsus II. H. Goldman, *Excavations at Gözlü Küle, Tarsus* II.
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Ugaritica. C. F. A. Schaeffer, *Ugaritica* I–III.

(Letters in parentheses indicate areas where found)

P 1. Cooking pot. Fig. 132. Pres. h. .09, rim diam. *ca.* .155. Sherd only. The drawing is a reconstruction, and there is no evidence for a second handle. Red-brown clay with black and white grit and mica. Wet smoothed. Incised line around base of neck. Blackened on handle and side. (M)
Compare: *Asine:* fig. 250, 3; p. 286. Tripod, one handle.
Tell en-Nasbeh II: pl. 49, 1033; p. 160. Iron Age.

P 2. Water jar. Fig. 132. Est. original h. .62, w. *ca.* .405. Sherds only. Hard red-brown ware with some white grit, fired gray at mid body; red surface, wet smoothed. Groove at base of neck. (S and M)
Compare: *Lachish* II: pls. LVII A, B; p. 91. Structure I–II, Pit 211, 247. 1175–1325 B.C.
Lachish III: pls. 94, 96; pp. 312 ff. 1200–1100 B.C.
Megiddo II: pl. 68, 1. Level VII A. 1350–1100 B.C.
Tarsus II: figs. 326, 387 (nos. 1215, 1216). Late Bronze Age II; 1350–1200/1150 B.C.
Knob base: *Megiddo* II: pls. 64, 8; 71, 13; 83, 3. Levels VII B-VI; 1350–1100 B.C.
Hazor I: pls. CIX, 1; CXXVIII, 10. Late Bronze Age II; 1350–1200/1150 B.C.
Tell en-Nasbeh II: pl. 23, 380; pp. 78, 140. Late Bronze Age II; 1350–1200/1150 B.C.
CPP (Fara): fig. 43, K5.
Ain Shems II: pl. XLI, 12; p. 66. Late Bronze Age II; 1350–1200/1150 B.C.
Ugaritica II: fig. 85, 13. Ugarit récent 2; 1450–1365 B.C.
Plain rim: *Tell en-Nasbeh* II: pl. 17, 284; pp. 75, 137. Early Iron Age I; 1200–1000 B.C.
Ain Shems II: pl. XL, 6; p. 64. Early Iron Age I; 1200–1000 B.C.
CPP (Fara): fig. 43, J6, K5. Early Iron Age I; 1200–1000 B. C.
Tarsus II: fig. 326, no. 1216. Late Bronze Age II.
Megiddo Tombs: pl. 73, 7. Tomb 1090 A; Early Iron Age I; 1200–1000 B.C.

P 3. Water jar. Fig. 132. Est. original h. *ca* .530. Sherds only. Fine hard fabric with shell and fine white grit, fired dark brown-red to gray-black on body, buff-brown with gray core at base. Concreted (S). See comparisons for P 2.

P 4. Water jar. Fig. 132. Pres. h. .130; diam. at shoulder *ca.* .290. Sherd only; upper body and shoulder. Fairly fine fabric, fired brown buff. (G).
Compare: *Megiddo Tombs:* pl. 73, 7, Tomb 1090; pl. 30, 15, Tomb 911; pl. 13, 13, Tomb 877. Late Bronze Age II-Early Iron Age I; 1350–1000 B.C.
Megiddo II: pls. 83, 3; 64, 1. Strata VIII–VI; 1479–1100 B.C.
QDAP **4** (1935) Tell Abu Hawam: pl. XXXVI, 172–174. Stratum IV; *ca.* 1200 B.C.
Gerar: pl. LV, 46e. *Ca.* 1200 B.C.
Lachish III: pl. 94; pp. 312 ff. Type S1; Late Bronze-Early Iron Age.
Hazor I: pl. CIX, 1. Late Bronze Age II; 1350–1200/1150 B.C.
Myrtou-Pigadhes: fig. 23, 318–319.

P 5. Water jar. Fig. 132. Pres. h. .05, rim diam. .11–.12. Neck and rim only. Blackened.
Compare: *Tell en-Nasbeh* II: pl. 14, 246, pp. 74, 136; pl. 16, 271, pp. 75, 136.

P 6. Water jar. Fig. 132. Neck and rim only. Buff fabric (P).
Compare: *Tell en-Nasbeh* II: pl. 17, 285, pp. 75, 137.
Megiddo II: pl. 68, 1. Stratum VII A; 1350–1200 B.C.
Megiddo Tombs: pl. 73, 7. Early Iron I; 1200–1000 B.C.
Lachish III: pl. 96, 494. Type S4. pp. 312 ff. 750–586 B.C.
Ain Shems IV: pl. LIX, 8. Late Bronze II.

P 7. Jar. Fig. 132. Spout and part of shoulder only. Coarse ware, fired buff; blackened on inside. Two holes drilled in spout (M).

[1] Abbreviations used in this catalogue; full references and other abbreviations are found in the general Bibliography and List of Abbreviations (pp. 6–13).

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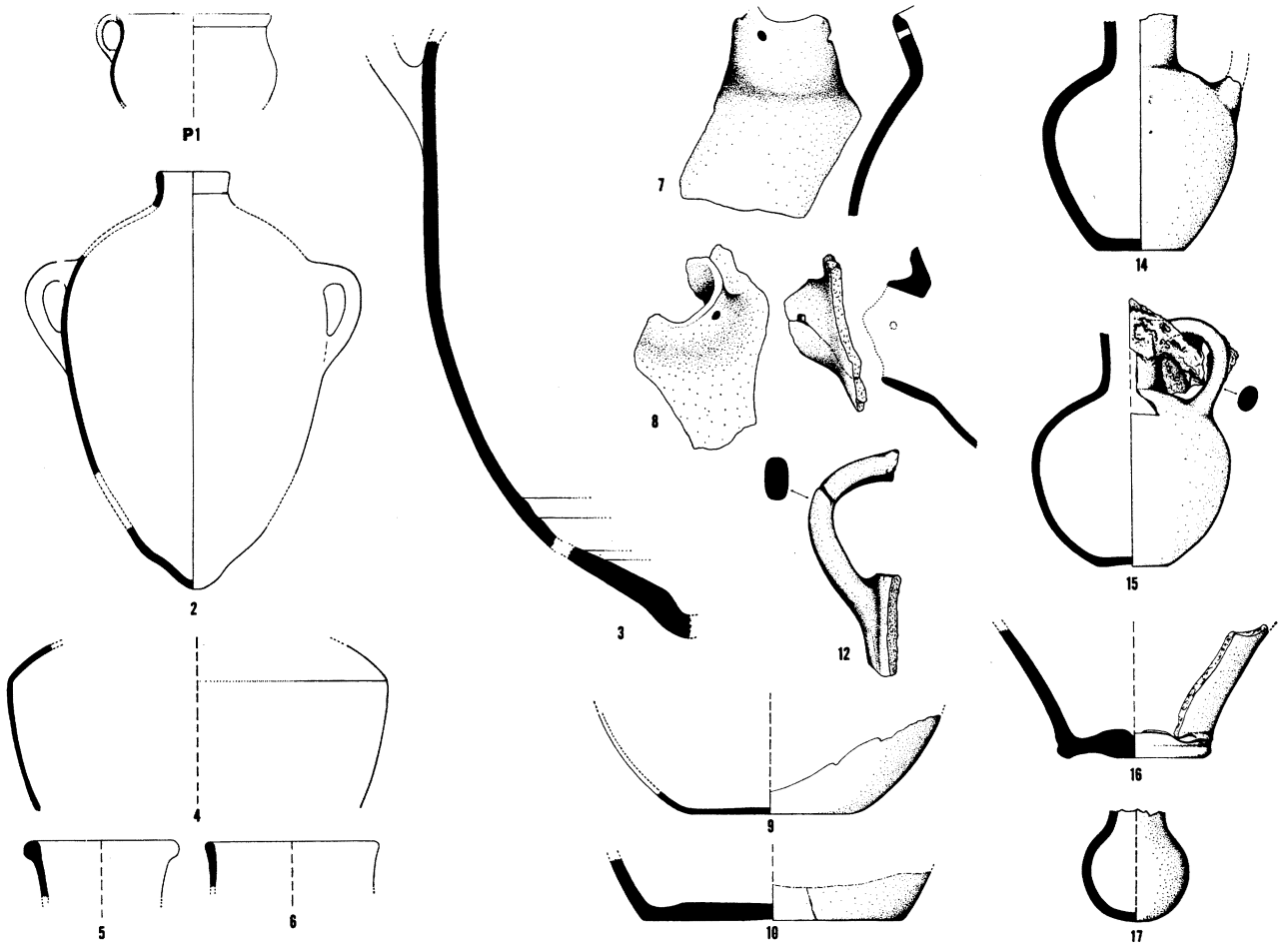


FIG. 132. Pottery: P 1 to P 17.

Compare spout: *BSA* **55** (1960) Minoika in Cyprus: fig. 8, 28; p. 120 for drilled holes in spout.
Tarsus II: figs. 325, 388, no. 1214. Late Bronze II.
Megiddo II: pl. 73, 11. Stratum VI B; 1150–1100 B.C.

P 8. Jar. Fig. 132. Spout only. Coarse ware, fired orange-buff. Hole drilled in spout. (P)

P 9. Base sherd only. Fig. 132. Pres. h. .08. Thin flaky fabric fired brick-red with gray core. (G)

P 10. Base sherd only. Fig. 132. Base diam. *ca.* .210. Medium fabric with much white grit, fired red-brown. (M).

P 11. Base only. Not catalogued.

P 12. Vertical loop handle. Fig. 132. Sherd only. Fairly fine fabric fired buff. (S)

P 13. Vertical loop handle. Sherd only.

P 14. Jug. Fig 132. Pres. h. .170. Rim and most of handle missing. Probably Cypriot plain white wheel-made ware. Fine sandy fabric with black grit, fired buff. (S)
Compare: *Ugaritica* II: fig. 71, 2, 11. Ugarit récent 3; 1365–1200 B.C.
Enkomi-Alasia: fig. 81, 1; p. 167, Tomb 5. Late Cypriot II; 1400–1200 B.C.
QDAP **4** (1935) Tell Abu Hawam: p. 36, no. 225. End of Stratum V.

P 15. Jug. Fig. 132. Pres. h. .220. Probably Cypriot plain white wheel-made ware. Fine sandy fabric fired greenish-buff. Details of neck hidden by heavy concretion. (S).
Compare: *SCE* **1**: pl. CXI:9; p. 496. Enkomi Tomb 6; Late Cypriot II C?; 1275–1230/1200 B.C.

P 16. Base and lower body of jug or amphora. Fig. 132. Possibly Cypriot plain white wheel-made ware. Sandy fabric with much grit, fired reddish-buff with gray inner surface. (S).

P 17. Small jug or bottle. Fig. 132. Reddish clay. Much corroded. (G).

P 18. Lipped bowl. Fig. 133. Sherd only. Coarse, hard fabric fired yellow with gray core; buff slip.

P 19. Carinate bowl. Fig. 133. Upper body and rim sherd only. Very coarse and gritty fabric.
Compare: *Tell en-Nasbeh* II: pl. 52, 1139, pp. 98, 164.
AASOR **21–22** (1941–1943) Tell Beit Mirsim III: pl. 20, 3. Iron Age (Stratum A); eighth century B.C.
Ain Shems IV: pl. LXIII, 22. Early Iron I C; eleventh century B.C.

P 20. Mycenaean stirrup jar? Fig. 133. Base diam. *ca.* .045. Base only. Ring base, section swollen in center. Fine fabric, fired buff. Traces of painted red band above ring. (S)

P 21. Mycenaean body sherd. Fine fabric, fired buff. Broad painted black bands. Probably belongs with P 20. (G)

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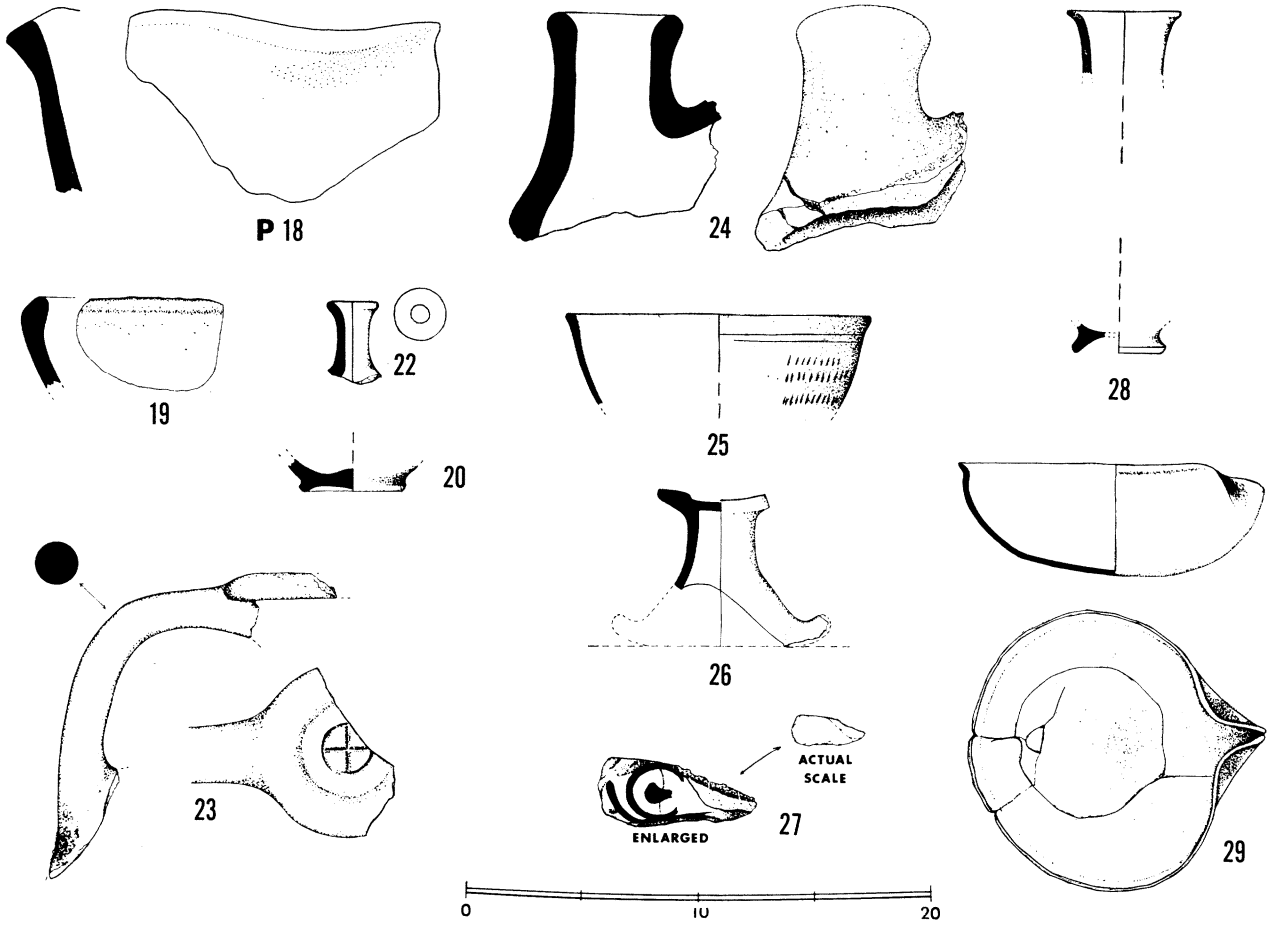


FIG. 133. Pottery: P 18 to P 29.

Broad bands, compare:
Megiddo II: pls. 62, 9; 72, 16. Stratum VIII–VII; 1479–1100 B.C.
Ugaritica II: fig. 122, nos. 4, 19.
Myrtou-Pigadhes: fig. 20, 194–195, 198–199; p. 44. 1260–1240 B.C.
AntJ **32** (1952) Apliki: fig. 5; p. 137. Late Cypriot II C; 1275–1230/1200 B.C.
Enkomi-Alasia: figs. 62, 15; 81, 9. Tombs 11 and 5. Late Cypriot II; 1400–1200 B.C.
SCE I: pl. CXIX, 6; p. 556. Enkomi Tomb 18, S.55. End of Late Cypriot II; *ca.* 1200 B.C.
Excavations Cyprus: fig. 73, 967. Enkomi, Tomb 48. Late Cypriot II C; 1275–1230/1200 B.C.

P 22. Mycenaean stirrup jar. Fig. 133. Neck h. .035. Spout only. Possibly belongs with P 20 and P 21. (G).

P 23. Mycenaean stirrup jar. Fig. 133. Handle with round section and upper part of false neck only. Incised potter's marks on depressed disc. Fine hard fabric with some grit, fired pink to red. (S)
Compare: *SCE* I: pl. CXIX, 6; p. 556. Enkomi Tomb 18, S.55. End of Late Cypriot II; 1200 B.C.
Depressed disc: *BSA* **55** (1960) Karphi: fig. 11, no. 8; p. 17.
Berytus **14** (1961): p. 46, fig. 3. Kourion.
X on disc (painted): *BMCatV* I, pt. 1: pl. XI, nos. 892–893; p. 161. Ialysos Tomb 20; LH III A:2. Nos. 891, 893 have depressed discs.
Syria **13** (1932) Minet el Beida: pl. VII, 1.

P 24. Mycenaean stirrup jar. Fig. 133. Spout only. Coarse fabric with some black and white grit, fired warm yellow-buff.

P 25. Mycenaean bowl or goblet. Fig. 133. Pres. h. *ca.* .04, rim diam. *ca.* .13. Upper body and rim sherd only. Very finely mixed clay fired reddish-buff. Two lightly incised lines around body below rim and three horizontal bands of incised strokes. Either decorated with thin uneven red slip inside and out, or is painted with broad red band on inside and outside of rim and broad red band on body. (P)
Compare: *BCH* **85** (1961) Kouklia: fig. 43:d, p. 290. Late Cypriot II–III; *ca.* 1200 B.C.
Tarsus II: figs. 335, 391, no. 1258. Mycenaean III C:1; Late Bronze Age IIb.

P 26. Mycenaean sherd. Fig. 133. Either neck and part of shoulder of large stirrup jar, or more likely base of Mycenaean pedestal goblet. Completely blackened. (G)
Compare base: *Ugaritica* II: fig. 127:9. Ugarit récent 2 or 3; 1450–1250/1200 B.C.
Myrtou-Pigadhes: fig. 23, 324 and 335. Period VI; *ca.* thirteenth-twelfth centuries B.C.

P 27. Mycenaean sherd. Fig. 133. Traces of black painted spiral. (G)
Compare spiral motif: Furumark, *MP:* Motive 46 H, p. 354.

P 28. Base-ring II or Bucchero ware jug. Fig. 133. Sherds only, including part of neck and rim, base, part of handle and some relief decoration. Reddish-

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buff ware. (S)
Problems: fig. 8, Base-ring II: type 2d or type 6, fig. 13. Bucchero ware, type 3.
Compare: *SCE* I: pl. CXIII, 12; p. 496. Enkomi Tomb 6. Late Cypriot II C; 1275–1230/1200 B.C.
SCE I: pl. CXIII, 10; p. 524. Enkomi Tomb 11. Late Cypriot IIb; 1350–1275 B.C.
Myrtou-Pigadhes: fig. 18, 157, 164.
Enkomi-Alasia: fig. 60, 25. Late Cypriot II.

P 29. Saucer lamp. Fig. 133. Diameter .117. Fine fabric fired black buff. Very thin section. (G).
Compare: *Hazor* II: pl. 139, 18. Stratum 1B; Late Bronze II; 1350–1200 B.C.
Lachish II: pl. XLV B. Structure II–III; 1350–1260 B.C.
Megiddo Tombs: pl. 73:14. Tomb 1090 C. Early Iron Age.

P 30. Sherd. Coarse Brown ware. Indeterminate (P).
P 31. Sherd. Indeterminate.
P 32. Sherd. Rim, or goblet foot. Sandy fabric, fired buff (G).
P 33. Sherd. Red ware. Indeterminate (G).
P 34. Sherd. Red ware. Indeterminate (G).
P 35. Sherd. Fairly coarse fabric with black and white grit, fired red with gray core. Possibly part of large bowl. (S)

CONCLUSIONS

As might be expected from a trading vessel, the pottery has parallels over a wide geographical area, and it would be risky to assign a home port to the vessel on this evidence alone. Any of the pottery could have been obtainable from Lebanese, Syrian or Cypriot ports, but it is more likely that it represents acquisitions from a variety of calling points on the ship's wanderings.

Samples of clay were taken from six of the Mycenaean fragments and subjected to spectrographic analysis at the Archaeological Research Laboratories in Oxford,[2] in the hope that the results might relate to one of the groups of Mycenaean pottery isolated by the Laboratories in recent tests.[3] The results are included below (see append. 7), but they do not correspond with certainty to any of the previously published groups.[4]

The date of the wreck can be suggested, within broad limits, by the pottery, but the uncertainty in identification of many of the fragments makes it difficult to assign a definite date.

The water jar fragments, P 2–P 6, are of a type which have a wide distribution and a long history in Palestine and Syria.[5] The closest parallels to the Gelidonya fragments fall within the general limits of Late Bronze II—Early Iron I, and more specifically within the thirteenth and twelfth centuries B.C. Jars of the same general type have been found in Cyprus (see catalogue) and on the Greek mainland.[6]

The two jugs, P 14 and P 15, are probably Cypriot Plain White Wheel-made Ware. It is not possible, however, to assign narrow limits in time to the Gelidonya examples as the fabric is a common one in the island, particularly on settlement sites during Late Cypriot II B—Late Cypriot III A, and any development within the shape and fabric of the class is not yet evident.[7]

The Mycenaean pottery is, unfortunately, in a very poor state. P 23 and P 24 belong to a class of large stirrup jars, usually coarse in fabric, which have a wide distribution in the Aegean world and the Levant from Late Helladic II A,[8] but similar jars are found as late as the intermediate period in Crete (see catalogue, Karphi). The depressed disc of the Gelidonya jar has parallels in large stirrup jars from Ialysos, two of which have a painted cross decoration or mark on the disc (see catalogue). The depressed disc is again paralleled at Karphi in Crete in a late context.

The small spout is of a type assigned a range of Mycenaean III B–III C early by Furumark.[9]

The broad painted bands of fragments P 21 and P 25 have parallels in Cyprus which are late in Late Cypriot II (thirteenth century; see catalogue), and at Megiddo and Ras Shamra in equally late contexts. I can find no parallels to the incised decoration of P 25.

The fragments, P 28, of a Base-ring II or Bucchero ware jug are again of a late type, but cannot on the evidence presented be confined beyond the general limits of Late Cypriot IIB—Late Cypriot IIIA (1350–1150 B.C.).

The evidence suggests that much of the pottery is of a type common in Palestine, Syria, and Cyprus during the thirteenth century B.C., but there is no piece which is exclusively of the Late Bronze Age as all could equally occur on the mainland in Early Iron Age I contexts or in Cyprus during Late Cypriot III A. There is, however, some evidence that the plain rims of the water jars, in particular, are more common on the mainland during the early Iron Age (see catalogue). A broad date of 1200 B.C. ± 50 years could be suggested for the wreck, with the probability favoring a date after 1200 B.C. rather than before.

---

[2] We are much indebted to Dr. E. Hall, director of the laboratories, for permission to conduct the tests, and to Mrs. A. Millet who analyzed the samples. We are also grateful to Bay Haluk Elbe, Director of the Underwater Archaeological Museum at Bodrum, Turkey, who gave permission to drill the sherds in 1963.

[3] H. W. Catling, E. E. Richards and A. E. Blin Stoyle, *BSA* **58** (1963) 94 ff.

[4] The sherds may have been affected by their long immersion, although comparison with sherds tested by Dr. Catling (see append. 7) shows no unusual features.

[5] C. F. A. Schaeffer, *Ugaritica* II, fig. 86, 5 and 7, of 1600–1450 B.C. and 1450–1365 B.C. G. Loud, *Megiddo* II, pl. 27, 1 (Stratum XII); pl. 42, 3 (Stratum X); pl. 51, 12 (Stratum IX). O. Tufnell, *Lachish* III, pls. 94–96, pp. 312 ff., for development of later types.

[6] J. D. S. Pendlebury, *Aegyptiaca*, 56, nos. 92–94 (Mycenae); 76, nos. 153–156 (Acharnae) found with Late Helladic III and Geometric pottery.

[7] E. Sjöqvist, *Problems* . . . , 87 ff.

[8] J. L. Benson, *Berytus* **14**, 1 (1961) 37 ff; H. W. Catling and V. Karageorghis, *BSA* **55** (1960) 109 ff.

[9] A. Furumark, *MP*, 81, fig. 22.

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VIII. THE STONE OBJECTS

J. DU PLAT TAYLOR

The stone objects from Gelidonya were recovered from area G, with the exception of the two mortars, some of the "hammer" stones and two of the so-called "anvils." Most stones were covered with marine concretions wholly or in part, but it was possible to clean them mechanically. The types of objects are as follows:

I. MACEHEADS

St 1. Figs. 134 and 136. D. .08, H. .052. Spherical; straight socket with traces of bronze lining. Greenish stone. Area G.

St 2. Figs. 134 and 136. D. .062, H. .045. Spherical; collar round one end of socket. Dark stone, probably diabase. Area G.

The collared type is found at Alaca [1] in tomb K.8, at Level VII (Copper Age). The head is of breccia and still attached to the gold mounted staff. A similar head was found at Nuzi in Temple A of stratum II,[2] among others scattered about the Hurrian sanctuary when it was destroyed in the fifteenth century B.C. Rougher specimens are noted from Megiddo, stratum V,[3] and from Tell Beit Mirsim, stratum A.[4] In Cyprus, collared maceheads are found in the Evreti tombs, Kouklia

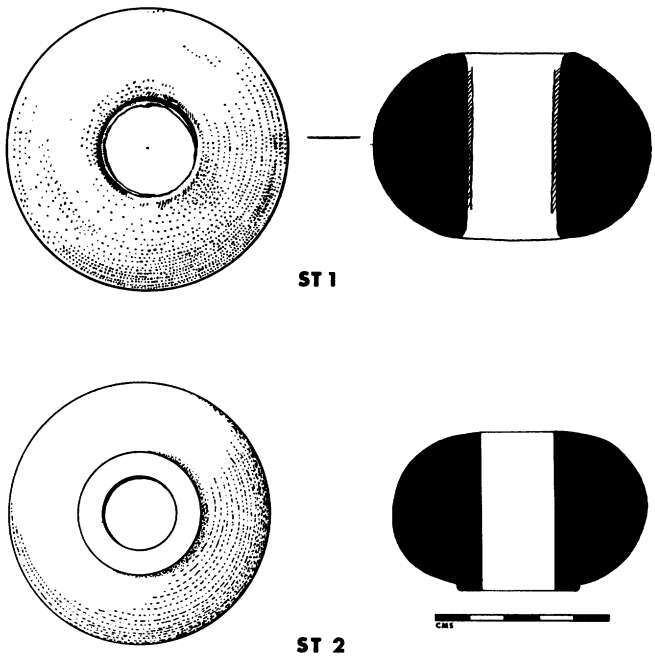
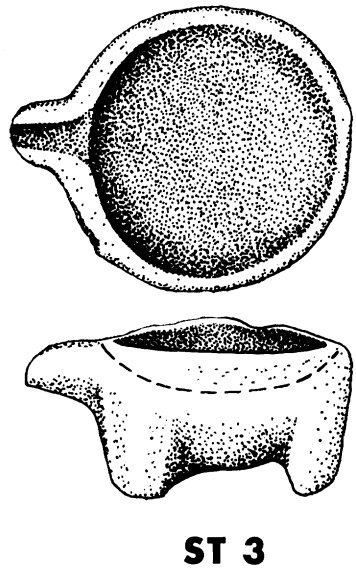


FIG. 134. Stone maceheads: St 1 and St 2.



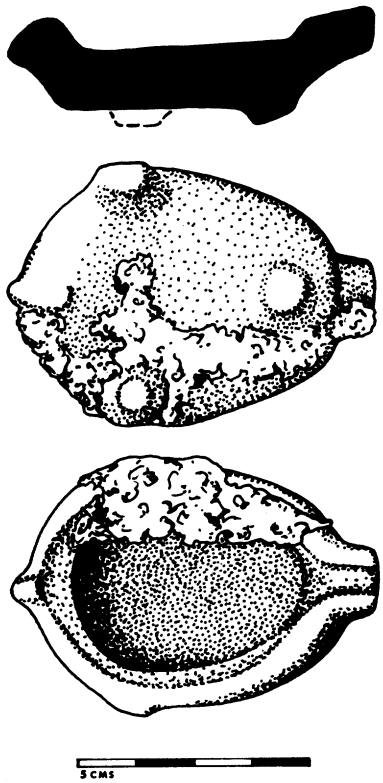


FIG. 135. Mortars: St 3 and St 4.

[1] Hamit Z. Kosay, *Alaca Höyük Kazisi, 1937–1939,* pl. CLXXXII, 1.

[2] R. F. Starr, *Nuzi,* pl. 121 N.

[3] Lamon and Shipton, *Megiddo* I, pl. 95, no. 28.

[4] Albright, *Tell Beit Mirsim* III, pl. 63, no. 3.

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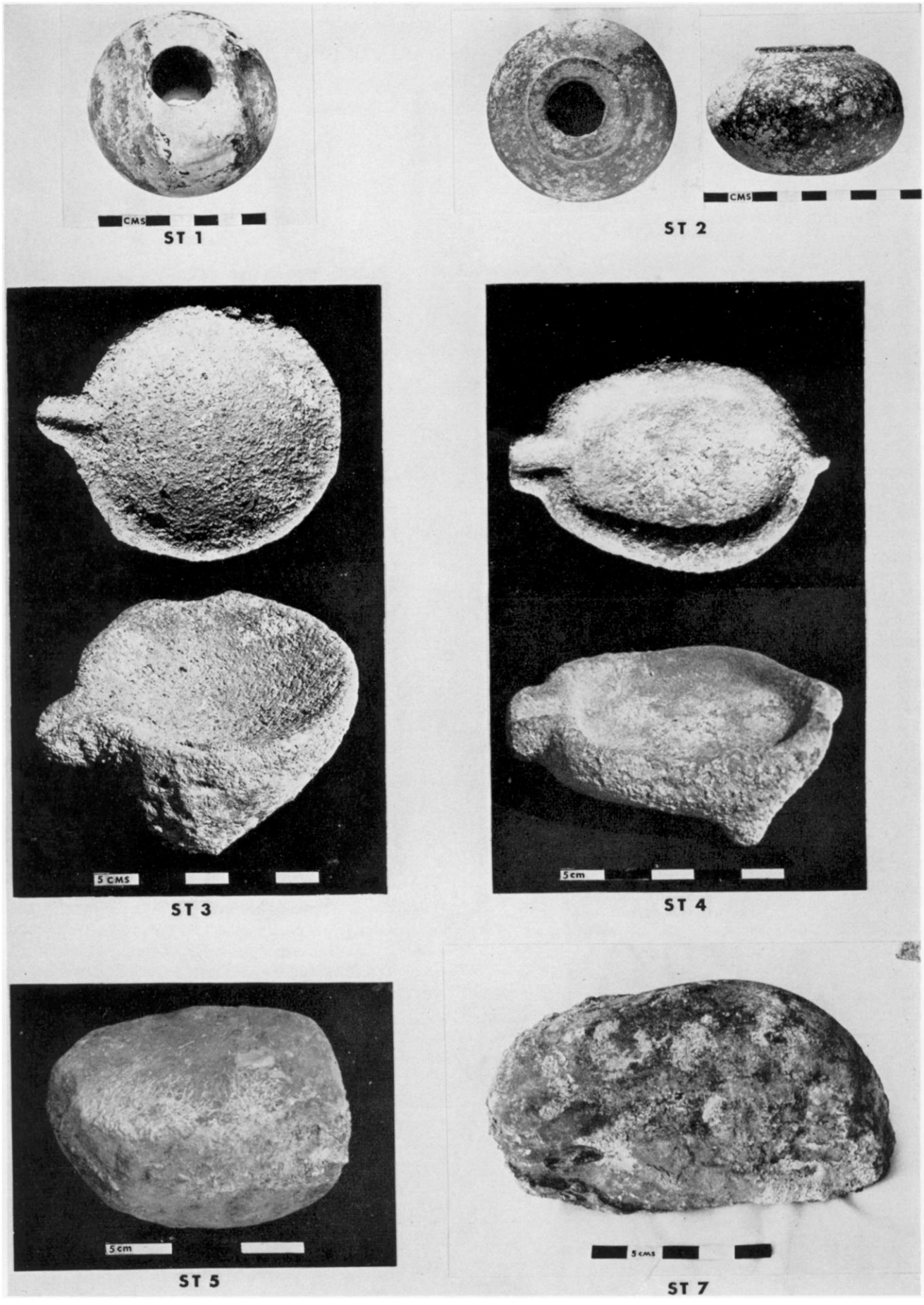


FIG. 136. Stone maceheads, mortars, and "anvils."

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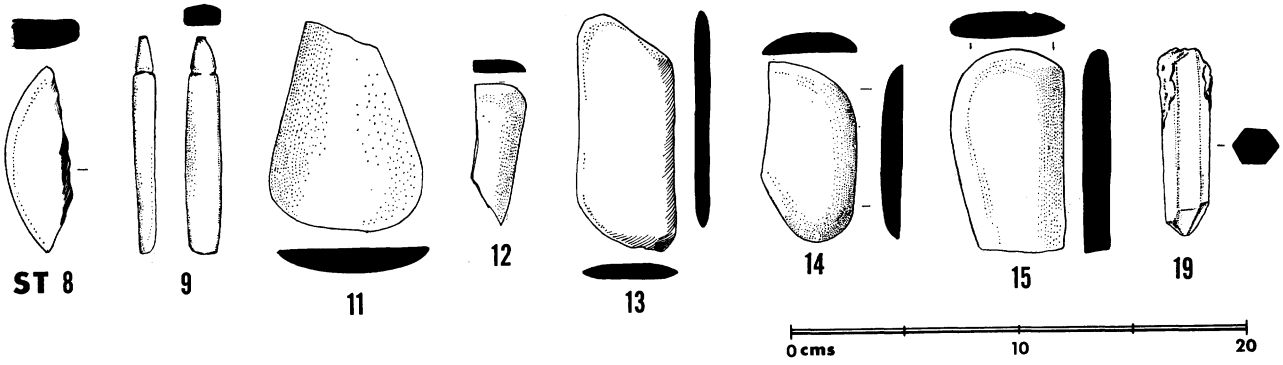


FIG. 137. Stone objects: St 8 to St 19.

(unpublished) and of ribbed basalt at Ay Irini, period III (LC III).[5]

The more common, spherical type is also found at Alaca,[6] Nuzi,[7] and Megiddo, stratum III;[8] in Cyprus, in Lapithos Tomb 316[9] and in Tomb 1, Laxia tou Riou (Ashmolean Museum C. 125), both of Middle Cypriot II date; and in Palestine at Tell Ajjul[10] from the sixteenth century onwards. A copper covered handle for a mace was found at Telloh.[11]

As Yadin has pointed out,[12] maces ceased to be used as offensive weapons with the advent of the helmet and armor. Nevertheless, they remained as symbols of authority of the god and the king. In Mesopotamia they are found as votive gifts in sanctuaries at Nuzi, on sculpture they are depicted as carried by divinities at Malatya[13] and Ugarit[14] and as scepters or status symbols on later sculpture.[15] Our specimens appear to be loot or discards from sanctuaries, sold for the metal mounting on the haft.

II. MORTARS

St 3. Figs. 135 and 136. D. .255, H. .135, W. of feet .07. Circular basin with spout; three squared feet. Rhyolite. Area P.

St 4. Figs. 135 and 136. L. .31, W. .22, H. at spout .11; at tail .10. Shallow, oval basin with spout and "duck tail" at opposite end; three stubby legs, one below spout and two at opposite end. Probably andesite or diorite. Area P? (raised in 1959).

The circular mortar is better known in smaller sizes of fine stone at the end of the Bronze Age; *cf.* a miniature piece from Kouklia, Evreti.[16] Larger sizes, in basalt or rhyolite, are found in a variety of shapes in north Syria and Palestine,[17] but seldom with a spout. They are common from the sixteenth century down to the first millennium B.C.

The shallow, oval basin closely resembles a spoutless example from Tarsus, from the Bronze Age level, and another from Jerablus.[18]

III. ANVILS

St 5. Fig. 136. . 22 × .18 ×.16. Square stone from area P.

St 6. H. .16. Rounded stone.

St 7. Fig. 136. L. .57, weight 73.9 kg. Stone with triangular section. Area G.

These three stones, of andesite or diorite, were too large to be lifted easily, but were of convenient size and shape on which to hammer metal.

IV. LINE OR NET SINKERS

St 8. Figs. 137 and 138. L. .078, Th. .013. Segment of disk with rounded edges, from area G. *Cf. Tarsus* II, fig. 420, 134; *Ancient Gaza* III, pl. XXVII, 69.

St 21. L. .162, W. at base .085, Th. .044. Triangular with linear grooves on both sides. Area G.

Net and line sinkers occur in a variety of shape, both holed and with grooves to retain the cord. Compare: C. Rau, Prehistoric fishing in Europe and North America, in *Smithsonian Contributions to Knowledge,* **25** (Washington, 1884).

V. RUBBERS AND POLISHERS

St 9. Figs. 137 and 138. L. .084, W. .015, Th. .009. Oblong with pointed top; string notch below. From area G. *Cf. Tarsus* II, fig. 418, nos. 93, 96.

[5] *SCE* II, pl. CCXLII, 10 (2023).
[6] Kosay, *Alaca,* pl. CIX, 4–6.
[7] Starr, *Nuzi,* pl. 121 S.
[8] Lamon and Shipton, *Megiddo* I, pl. 107, no. 10.
[9] *SCE* I, pl. CLI.
[10] Petrie, *Ancient Gaza* I, pl. LII, nos. 2–7; III, pl. XXVII, nos. 42–48, limestone.
[11] G. Cros, L. Heuzey and F. Thureau-Dangin, *Nouvelles fouilles de Telloh* I, 77.
[12] Y. Yadin, *The Art of Warfare in Biblical Lands,* 12, 40.
[13] E. Akurgal, *Remarques stylistiques sur les reliefs de Malatya,* 49, figs. 17–18.
[14] Schaeffer, *Ugaritica* II, pl. XXIV.
[15] H. T. Bossert, *Altanatolien,* 888 from Sakcegözü.
[16] *BCH* **87** (1963) 357. Late Cypriot III.
[17] Woolley, *Alalakh,* pl. LXXXIII. M. von Oppenheim, *Tell Halaf* IV, pl. 53, 118, 121. Petrie, *Ancient Gaza* I, pl. LII, 21–23; III, pl. XXVII, 93–94; IV, pl. XL; V, pl. XX, seventeenth century. J. R. Stewart, *Notes on Tell Ajjul,* 27. E. Fugmann, *Hama* II. 1, figs. 143, 188, 216, 245, 269, 310; where mortars are numerous from period G and especially in period E, Batiment II as late as the ninth century.
[18] Goldman, *Tarsus* II, 275, no. 115. H. T. Bossert, *Altanatolien,* 964. Buchholz, Form IV B, *JdI* **78** (1963) 72.

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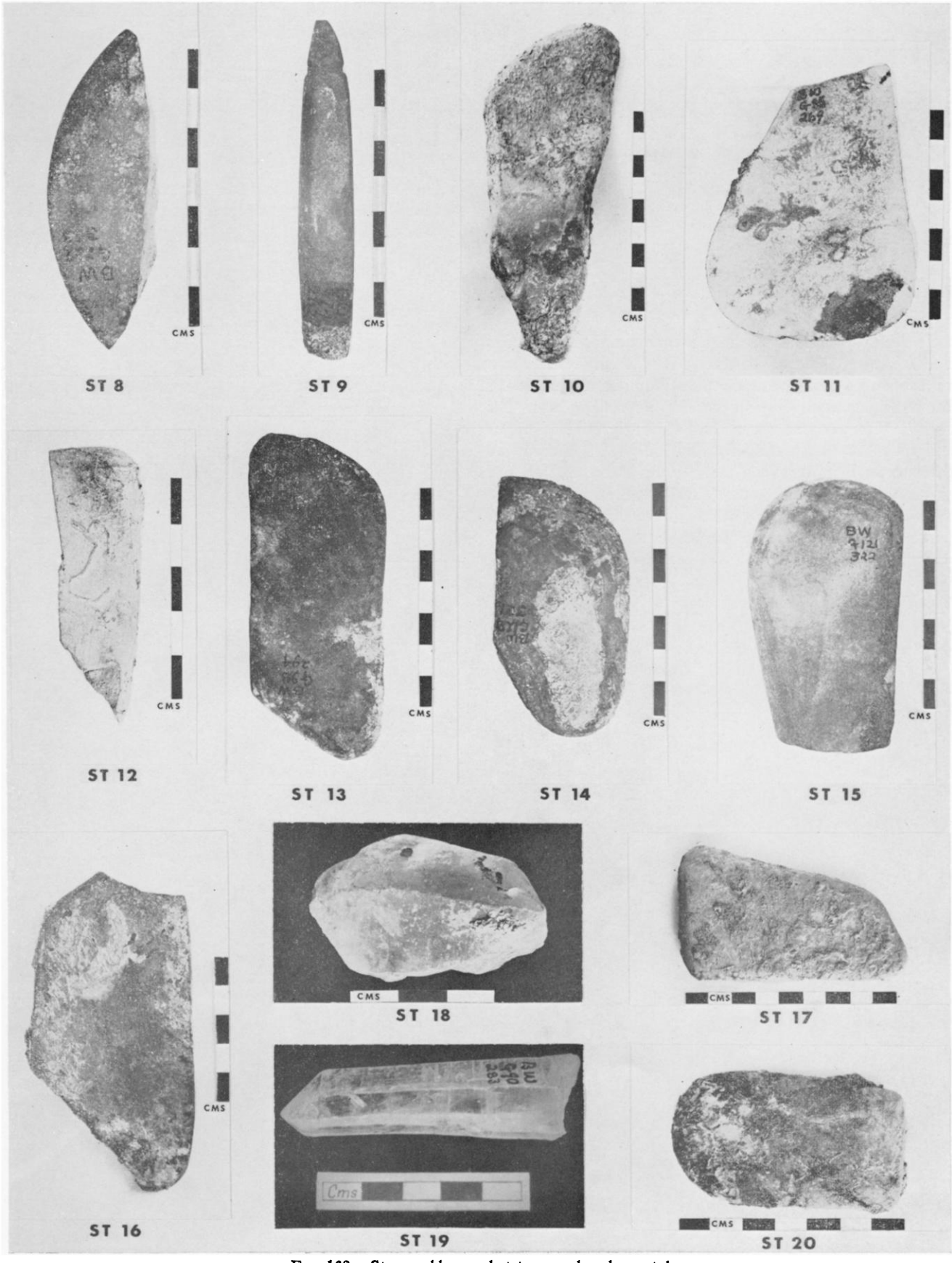


FIG. 138. Stone rubbers, whetstone, and rock crystal.

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St 10. Fig. 138. L. .15, W. .065. Flat, rougher surface. Area G.
St 11. Figs. 137 and 138. L. .09, W. .068. With flat sides and beveled edges; end broken. Limestone? Area G.
St 12. Figs. 137 and 138. L. .065, W. .025, Th. .004. Flat fragment with beveled edge. Limestone? Area G.
St 13. Figs. 137 and 138. L. .105, W. .042, Th. .005. Rhomboid, with sharply beveled edges. Dark flaking, laminated slate? Area G. *Cf. Tarsus* II, fig. 421, no. 141.
St 14. Figs. 137 and 138. L. .078, Th .009. Flat pebble, corroded on one side. Area G.
St 15. Figs. 137 and 138. L. .08, W. .05, Th. .012. Similar to St 14, with rounded edges; broken. Area G.
St 16. Fig. 138. L. .101, W. .058, Th. .0035. Thin, flat, dark gray slate? Broken at end.

St 9 may well be a whetstone, or hone with notch for line to hang it by. But as bronze is normally hammered, rubbed down and polished, the remainder appear to be flat polishers, their edges becoming beveled by use. At Apliki [19] long coarse sherds had similarly beveled edges and may have been used for this purpose. Classed as whetstones at Tarsus in the Middle Bronze Age, the material whether sandstone, limestone, or slate is similar to that from Gelidonya. Though no examples can be quoted from the Late Bronze Age, it is probable that the form of tool did not substantially change until bronze working was superceded by iron.

[19] J. du Plat Taylor, Apliki, *AntJ* **32** (1952) pl. XXIX, 6–7.

VI. ROCK CRYSTAL

St 18. Fig. 138. L. .05, W. .025. Lump, rolled surface. Area G.
St 19. Figs. 137 and 138. L. .08, W. .02, Th. .02. Hexagonal bar. Area G.

This was probably carried for trade and the manufacture of beads, rings or even statuettes. *Cf. Tarsus* II, 342, fig. 456.

VII. HAMMER-STONES

Among the 116 kg. of ballast stones, scattered throughout areas G and P, were a number of irregularly shaped stones of andesite or diorite, both large and small. They may also have been ballast stones, but, in view of the number of similar, miscellaneous stones found at the mining site of Apliki,[20] it seems more likely that they formed part of the craftsman's working tools. They are irregularly shaped pebbles, many with flat sides, but all of convenient size to hold in the hand (see fig. 138, St 17 and St 20). Bronze is chiefly worked by hammering, and that one stone was split in antiquity is perhaps indicative of its use.

[20] *Ibid.*, 162 ff.

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IX. MISCELLANEOUS FINDS

George F. Bass

I. LEAD

Relatively few lead objects were found, and although some of these, such as the net sinkers and conical weight, were not out of place on board a ship, the lead casting jet and pieces of scrap indicate that at least some of the lead was carried for future use in forming other objects

The high silver content of one sample (append. 4) indicates that there had been no attempt to extract the silver from the ore, and that, therefore, the lead was mined for its own use and was not a by-product of silver mining. It is not possible at present, however, to speculate on the source of the ore. Hopefully the further study of isotope distribution ratios in lead will eventually offer a clue as to where it may have been mined (see append. 4). Lead ores are widespread in the Eastern Mediterranean, with a concentration in Asia Minor, but with deposits in Greece and Syria; the Syrian deposits are small, but certainly sufficient to have supplied the lead for the small pieces found on board. Only Cyprus, of the regions of greatest interest in this study, may lack its own lead.[1]

L1–18. Net weights. Fig. 139. Eighteen of these were found concreted together in a cluster in area P. Each of these is a strip of lead, approximately .035 long, .03 wide, and .003 thick, which has been folded over along its longest center line. The occurrence of such weights, which are exactly like those used by modern fishermen in Greece,[2] among the personal objects on a Byzantine shipwreck[3] indicates that they were not necessarily part of the cargo; Homer mentions the use of nets for fishing in the *Odyssey* (22.386). A number of uncatalogued duplicates are in the Cyprus Museum.

L 19. Line sinker. Fig. 139. H. .032, max. W. .017. Pyramidal lead weight, pierced at top; top broken off through hole (area M). This is similar to a sounding lead found on the Byzantine shipwreck at Yassi Ada and to those still in use in the Eastern Mediterranean, but it is much smaller and was probably only a line sinker. The use of lead on a fishing line is mentioned by Homer in the *Iliad* (24.80).

L 20. Whorl. Fig. 139. D. .05, hole D. .01, max. Th. .001. Pierced disk, tapering to edge (area M).

L 21. Weight? Fig. 139. L. .065, max. D. .01. Narrow rod, pointed at ends and flat on one side (area G).

L 22. Disk. .085 × .07, Th .003. Irregular lead disk, probably scrap (area P).

L 23. Jet with two runners (see p. 114). H. .021, max. D. .025. Conical jet, concave on top, with two runners.

L 24. Casting waste. L. .055, W. .017. Oval dump, flat on one side (area P).

L 25. Scrap sheet. .07 × .07, Th. .003 approx. Very irregular.

[1] Forbes, *Met. in Ant.*, 169–201.

[2] Gladys R. Davidson, *Corinth* XII, 190, with pl. 88:1449.

[3] Bass, *AA* (1962) 552.

II. METAL FOIL

Metal foil, folded double and then folded in an *S*-curve, was found under a stack of four slab ingots (SI 1, SI 4, SI 12, SI 15) in area G (figs. 140, 33). It proved impossible to remove the sheet, or sheets, intact from the surrounding concretion, for the foil was only .00075 thick and was extremely brittle. One piece was approximately .35 long, with a shorter, probably separate sheet below. A width of .10 for the foil is only an estimate and could be completely erroneous.

A. E. Parkinson, chemist of the University Museum, has reported on analyses of samples of the foil as follows:

> Spectrographic analysis of a sample by Mark Han showed copper and tin as major metallic constituents, with silicon, silver, iron, manganese, nickle, cobalt and magnesium.
>
> A quantitative analysis of another sample to determine the amounts of copper and tin gave 52.8 per cent of tin dioxide, 19.0 per cent of copper (cupric) oxide and 4.3 per cent of silica. In terms of metal these results are equivalent to 41.6 per cent tin and 15.2 per cent copper in the sample. Spectroscopic analysis of the non-siliceous residue showed the presence of iron, calcium, magnesium and lithium.
>
> The large amount of tin suggests that the original alloy may have been largely tin and may have had a silvery color, although caution must always be observed in drawing conclusions from the composition of a corroded specimen. When tin corrodes it usually forms the very insoluble tin dioxide, whereas copper may form compounds that may be leached out by subsequent solvent action; thus a specimen may become enriched in tin.

The fineness of the material suggests that it was used for making bowls, for it is approximately the same thickness as two of the bowl fragments found on the wreck (B 171 and B 172). That it was already extremely pliable, however, is shown by the manner in which it was folded, and it would have become even thinner in the process of being beaten into bowl shapes. This fineness and apparently high tin content suggest another intended use.

Sara Immerwahr has reported on the apparent use of tin foil to cover certain Mycenaean vases found on the Areopagus, and possibly others from Mycenae, Dendra, Knossos, and Ialysos.[4] She and her collaborator, Marie Farnsworth, have informed me that the purity of the tin and the thickness of the foil are not known in those cases (continued investigation is at

[4] Paper read at the 64th General Meeting of the Archaeological Inst. of America, and summarized in *AJA* **67** (1963) 212–213. Mrs. Immerwahr has since informed me that "the vases I mentioned in my paper from Dendra, Mycenae, and Knossos were also sheathed . . . However, my examples all belong to a fairly restricted period (the early fourteenth century) and occur in wealthy chamber tombs."

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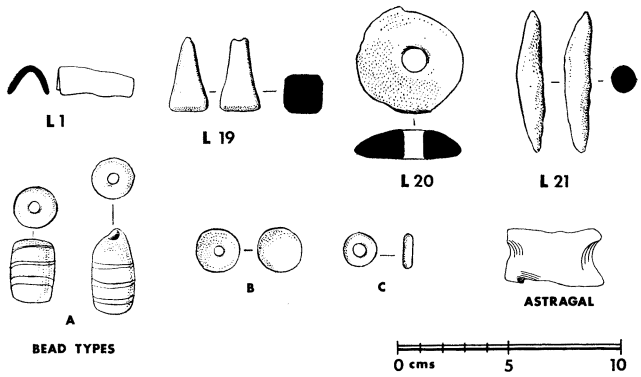


FIG. 139. Lead, glass, and bone objects.

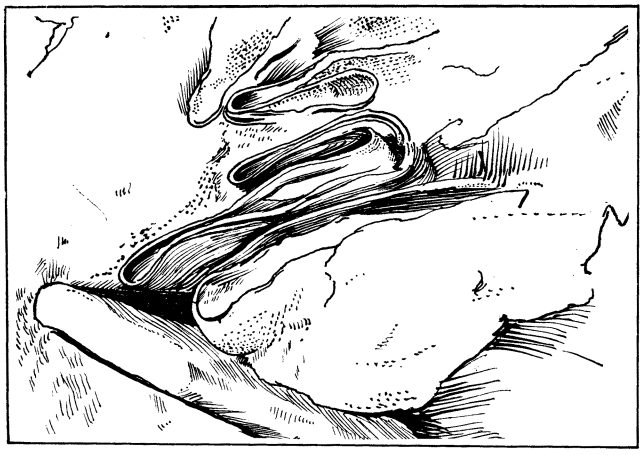


FIG. 140. Metal foil.



FIG. 141. Beads under water.

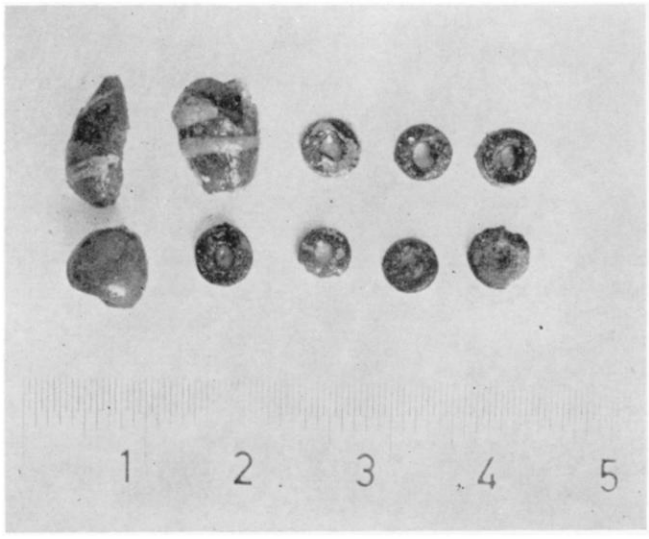


FIG. 142. Beads.

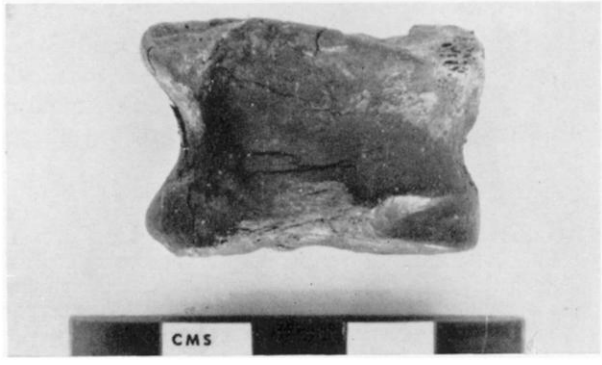


FIG. 143. Astragal.

present underway), but she feels that the Gelidonya sheets would have been rather thick for such sheathing; it is possible, however, that the foil covered wooden or ivory containers, for an ivory pyxis from the North Slope of the Areopagus[5] showed traces of a metal lining which was analyzed as tin by Miss Farnsworth.

III. GLASS BEADS

A lump of concretion in area P contained several hundred beads (fig. 141). Pottery sherds around the lump suggest that the beads had been contained in a vessel which had broken during the sinking of the ship; a bracelet, B 188, was imbedded in the beads and was undoubtedly carried in the same jar. A few beads were removed from the concretion with great difficulty (fig. 142) and these, although they crumbled to dust if allowed to dry, revealed three types:

Type 1. Ovoid. Fig. 139 *a*. *Ca.* .01 long, tapering at ends; white spiral around dark body.

Type 2. Spherical. Fig. 139 *b*. *Ca.* .004 in diameter, but some are slightly piriform; greenish yellow.

[5] *Hesperia* **9** (1940) 286, fig. 27.

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FIG. 144. Fish bones.

Type 3. Discoid. Fig. 139 *c*. *Ca*. .005 in diameter and .0015 thick. Solid dark color, almost black.

Analyses (append. 5*a* and 5*b*) show that at least some of the beads were of glass. The dark coloring may have been due to the copper corrosion products which had permeated the concretion in which the beads were found, staining at least the concretion a very dark green.

Neither the shapes nor the decorative features of the beads are very distinctive. All three types are found in the Near East,[6] and at least Types 1 and 3 are to be seen in the Cyprus Museum; indeed, beads of Type 1 have been retrieved by divers from Swiss lakes, and are undoubtedly found even farther from the Mediterranean.

IV. BONES

1. ASTRAGAL

(Figs. 139 and 143. L. .048.)

A single knucklebone, from area G, was the only large animal bone found on the ship and was, therefore, probably not from a sheep slaughtered for food. The game of knucklebones, similar to dice,[7] is mentioned by Homer,[8] and has been played at least from the time of the eighteenth Egyptian dynasty[9] until the present;[10] the occurrence of such bones in Neolithic Crete suggests that the game may go back much further.[11]

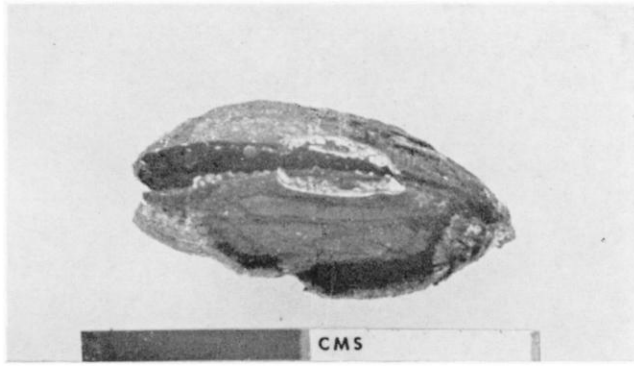


FIG. 145. Olive pit.

Another use for a single astragal on board a ship must be considered. Astragalomancy, in which the fall of the bone indicated divine will, was a later form of divination[12] particularly associated with Hermes, patron of cleromancy,[13] a god with Mycenaean origins in Greece, and, at the same time, god of merchants. Knucklebones seem also to have been used for divination in the Near East.[14] What more suitable talisman was there than a knucklebone for a merchant captain in a time when the sea was feared? We know that divine guidance was sought by the captain before he chose the route which he would sail.[15]

2. FISH BONES

(Fig. 144)

Fish vertebrae and other small bones appeared in area G, which also yielded olive pits, and may have

[6] Tufnell, *Lachish* II, pl. XXXIV shows beads of all three types.

[7] *Oxford Cl. Dict.*, 110.

[8] *Iliad*, 22.88.

[9] Schaeffer, *Ugaritica* IV, 103; P. Fox, *Tutankhamen's Treasure*, pl. 66.

[10] Knucklebones is still played in Europe and the Near East, according to friends who have played it or seen it played in France, Turkey, and Syria. See also W. Deonna, *Le Mobilier Délien*, 332–333.

[11] Montelius, *Grèce Précl.*, 7.

[12] *PW*, suppl. vol. IV (1924) 51 ff., astragalomanteia.

[13] Dar.-Sag. II, 301, Divination.

[14] Tufnell, *Lachish* II, 94.

[15] *Od.* 3.173. Seymour, *Life in the Homeric Age*, 525, lists instances of cleromancy in Homer.

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been further remains of a meal; one diver reported a small, hollow bone which he assumed to have been from a bird, but this was never further identified. Fish vertebrae were often saved in antiquity and sometimes pierced, and have been found in great numbers on land, where they may have served as gaming pieces.[16] The possibility exists that these bones were encased in the concretion which held the olive pits only by chance and had nothing to do with the ship.

V. OLIVE PITS

A number of olive pits were raised from area G, six in the air lift (fig. 145). Olives play a large part in the diet of modern Turkish sailors, and it was believed that some of these pits were simply dropped over the side of *Mandalinçi* while it was anchored over the wreck; the presence of pits deeply imbedded in the concretion from the "cabin area," however, proves that at least those were ancient.

Olives were cultivated in Palestine, Syria, Asia Minor, the Aegean Islands, and the Greek mainland at the time the Gelidonya ship sank, and the existence of the pits, therefore, offers no clue concerning the route of the ship.[17]

VI. CLAY

Two round balls, about .08 in diameter, were found, one in area E and the other concreted to the underside of oxhide ingot 21. These were at first believed to have been ballast stones, but they consisted of fine, buff powder when dry. It seems likely that they were balls of clay which had been luckily protected against the action of the sea water, which may have disintegrated more exposed lumps of clay elsewhere on the ship. Whether or not this represents clay used in making molds for metal objects is impossible to say, but one might expect molds to be found in a cargo like that uncovered at Cape Gelidonya; the clay could equally well, however, have been used for capping jars.

[16] Deonna, *op. cit.* (*supra,* n. 10) 331.

[17] Tufnell, *Lachish* IV, 313; Zeuner, *Hist. of Tech.* I, 359.

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X. THE WEIGHTS

George F. Bass

Every merchant ship undoubtedly carried sets of weights in its cabin, for these would have been needed almost immediately upon arrival at each port (fig. 49).[1] Weights were equally important in any metal-working establishment and are normally shown in scenes of Egyptian smiths at work,[2] including an illustration which shows copper and tin ingots being melted down and cast.[3] Not only did prices of finished artifacts depend on their weights, as they often do today,[4] but proportions of metals to be mixed must have been carefully set in advance. The importance of metal objects being carefully weighed is indicated in Hittite[5] and Ugaritic texts, the latter perhaps mentioning the weighing of ingots;[6] copper ingots are almost invariably depicted with balances on Linear B tablets, again showing the necessity of weighing each one. No complete balance was found on the shipwreck, although one fragment of metal may be the remains of a balance pan (B 211).

Sixty small objects of stone and metal at Gelidonya were catalogued as weights or possible weights. These, with two exceptions (W 52 and W 60), were almost certainly from the cabin of the ship; most of them were found either in area G (the cabin area) or in area M, where many small objects from G seem to have been carried by the current. Only W 60, which was firmly fixed with a number of bronze tools in area P VI, can be considered apart from the others—a consideration of some importance in the study of the objects. A further word of explanation is necessary concerning the proveniences of the weights. They were among the smallest objects on the site and were the most likely to have been discovered out of context; some were found a year after the completion of the excavation when a number of pieces of concretion, discarded after having been broken into small pieces, were pulverized in a last search for small finds. The discovery of five of the unit weights (the smallest and, therefore, most easily missed) of the seven sets of weights used on board, however, indicates that few weights were entirely overlooked (fig. 44).

The weights were in a variety of shapes, including forms commonly found in Aegean and Near Eastern sites: "sphendonoid" (after its superficial resemblance to sling bullets)[7] or spindle-shaped (fig. 146); domed (fig. 147); sugar-loaf shaped, or blunted conical (fig. 147); spherical, with flattened base; cylindrical, with length greater than diameter; discus-shaped; and irregular pieces of stone and metal. Figure 148 gives typical examples of each type.

The weights seem, to the untrained eye, to be mostly of the same material, except for those made of bronze. Chips from two broken weights have been identified as haematite.[8]

In order that the reader may judge the validity of the conclusions reached in the following study, the catalogue lists all possible weights, although some of these have proved to be probably only chips of stone



Fig. 146. Sphendonoid weights.

[1] A scene of Syrian ships arriving in an Egyptian port, with merchants weighing merchandise with balances and weights, is found on the wall of Tomb 162 at Thebes. Norman de G. Davies and R. O. Faulkner, *JEA* **33** (1947) 40–46, with pl. 8; J. B. Pritchard, *ANEP,* 33, fig. 111, and pp. 262–263.

[2] Norman de G. Davies, *The Tomb of Rekh-mi-rēᶜ* I, 52, with pl. LV, row 2. P. E. Newberry, *Beni Hasan* I, 31, pl. 11; Pritchard, *ANEP,* 37, fig. 122, and p. 264. Pritchard, *ANEP,* 40, fig. 133, and p. 265 (Tomb of Mereru-ka at Sakkara, Sixth Dynasty).

[3] N. de G. Davies, *The Tomb of the Two Sculptors,* pl. XL. George Steindorff and Keith C. Seele, *When Egypt Ruled the East,* 185, with fig. 61. For the importance of copper and tin ingots at Gelidonya, *infra,* p. 163.

[4] The prices of almost all items made by the Bodrum blacksmith for the expedition, including objects of pipe, angle-iron, chain, and sheet metal, were based on weight, almost without regard to varying amounts of labor which had gone into them.

[5] J. B. Pritchard, *ANET,* 208.

[6] O. R. Sellers, *Interp. Dict. of the Bible* I, 343; C. H. Gordon, *Ugaritic Literature,* 64; J. A. Montgomery, *JAOS* **54** (1934) 60.

[7] Arthur J. Evans, *Corolla Num.,* 348; *PM* IV, part II, 655. The theory that this shape is Syrian in origin is given by Flinders Petrie, *Ancient Weights and Measures,* 6.

[8] A. Eric Parkinson has reported on one sample: "Roughly spherical. Color dark red. Wt. 146.4 gms. Specific gravity (assuming object a sphere with diam. 3.8 cm.): 5.1; this is within the haematite range. Hardness 5.5–6.0 (correct for massive haematite). Spectroscopic analysis of tiny chips of the small amount of incrustation still attached to the surface showed calcium, iron, copper and possible traces of magnesium and strontium. The incrustation was, therefore, calcareous contaminated with copper salts and containing iron, probably oxide from the haematite."

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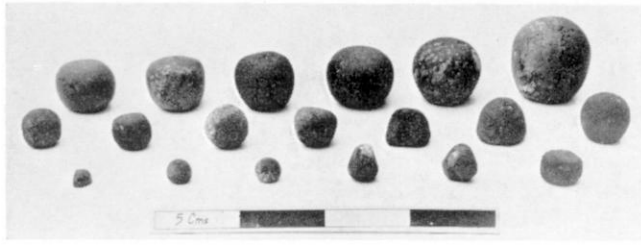


FIG. 147. Domed and blunted conical weights.

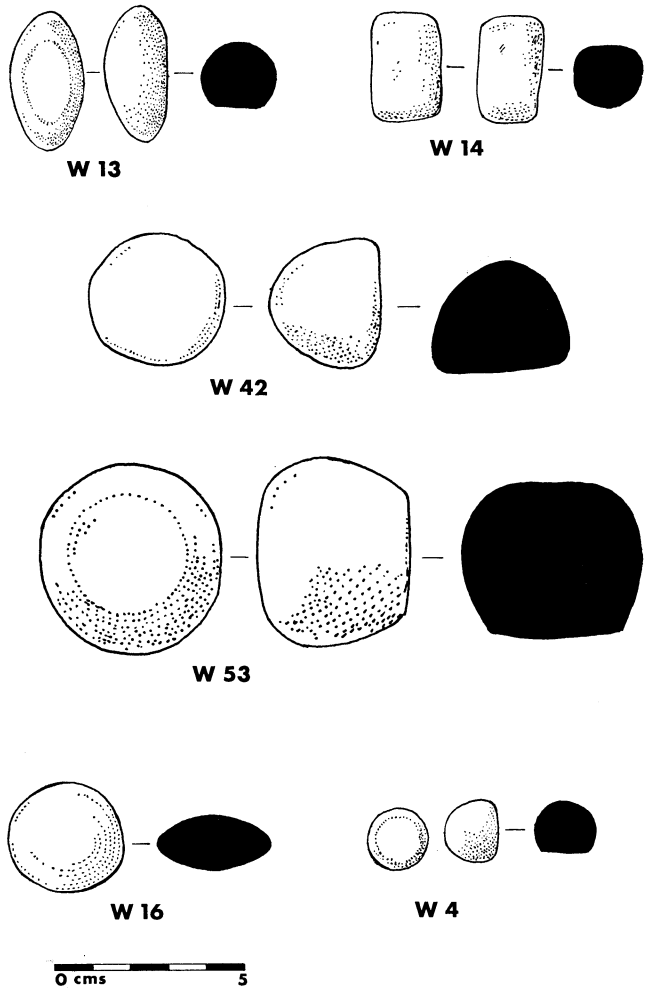


FIG. 148. Typical weights from shipwreck.

or metal. Area location on the wreck follows each entry.

W 1. H. .009, D. .013. Irregular but roughly spherical stone weight. 3.50 grams (M).
W 2. L. .038, W. .012. Sphendonoid stone weight. Straight scratch across top at right angle to long axis. 9.30 grams (M).
W 3. H. .014, D. .016. Spherical stone weight. 9.50 grams (M).
W 4. H. .014, D. .015. Spherical stone weight. 10.30 grams.
W 5. L. .024, D. .010. Cylindrical metal weight with pitted surface. 10.50 grams (M).
W 6. H. .018, D. .018. Spherical stone weight. 12.30 grams.
W 7. L. .034, W. .021. Possible weight. Irregular piece of metal. 16.00 grams (M).
W 8. H. .025, D. .015. Possible weight. Conical piece of metal. 17.80 grams (M).
W 9. D. .025. Discus-shaped stone weight. 20.60 grams (G).
W 10. L. .026, W. .017, Th. .012. Rectangular stone weight with rounded corner. 20.80 grams (M).
W 11. H. 025, D. 025. Conical metal weight. 26.10 grams (G).
W 12. H. .022, D. .020. Domed stone weight; flattened top. 26.20 grams.
W 13. L. .04, W. .02. Sphendonoid weight; highly polished with the appearance of tarnished brass. 28.00 grams (M).
W 14. L. .026, D. .018. Cylindrical stone weight. 29.20 grams (G).
W 15. H. .022, D. .024. Spherical weight of metal. 29.80 grams (G).
W 16. D. .03, Th. .016. Discus-shaped weight of haematite. Broken, but all pieces preserved. 35.00 grams (G).
W 17. H. .018, D. .028. Domed stone weight; flattened top. 36.00 grams (G).
W 18. H. .017, D. .025. Thick disk of stone, rounded on sides. 36.50 grams (G).
W 19. L. .035, W. .025. Irregular chip of stone, probably haematite. 42.70 grams (G).
W 20. H. .024, D. .026. Domed stone weight. 43.80 grams (G).
W 21. L. .04, D. .025. Sphendonoid stone weight with blunt ends. 45.50 grams (G).
W 22. L. .042, W. .021. Sphendonoid weight of metallic stone with crystals showing in break. Tip broken away. Actual weight 44.80 grams. Estimated original weight *ca.* 46.00 grams.
W 23. H. .02, D. .027. Domed stone weight; flattened top. 47.70 grams (G).
W 24. H. .025, W. .025. Roughly cubical stone weight. 48.20 grams (G).
W 25. H. .025, D. .03. Sugar-loaf stone weight. 49.40 grams.
W 26. H. .024, D. .027. Domed stone weight; flattened top. 51.50 grams.
W 27. D. .025. Possible weight. Metal ball, flattened on one side. 54.20 grams (M).
W 28. H. .032, D. .04. Domed stone weight; flattened top. 55.50 grams (M).
W 29. D. .03. Irregular sugar-loaf of stone. 56.00 grams (G).
W 30. L. .034, D. .025. Cylindrical stone weight 57.50 grams.
W 31. H. .025, D. .028. Sugar-loaf of stone. 59.00 grams (G).
W 32. L. .053, W. .025. Rough sphendonoid weight of metallic stone. Humped back. Unfinished? 63.90 grams (G).
W 33. L. .045, W. .028. Sphendonoid stone weight; iron content of stone has corroded on side and one end. *Ca.* 2 grams missing from end. 63.50 grams, with estimated original weight *ca.* 65.50 grams (G).
W 34. L. .043, W. .02. Sphendonoid stone weight with very blunt ends. 65.50 grams (G).
W 35. L. .04, D. .028. Sphendonoid stone weight. 66.50 grams (M).
W 36. L. .053, W. .03. Possible weight. Broken stone in rough sphendonoid shape. 67.50 grams (M).

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W 37. .034, .024, .019. Possible weight. Shapeless lump of metal. 69.00 grams.
W 38. L. .042, W. .025. Roughly cylindrical stone weight. 69.80 grams (G).
W 39. H. .02, D. .032. Sugar-loaf of stone. 76.00 grams (G).
W 40. L. .035,. W. .027. Roughly cylindrical stone weight. 76.70 grams.
W 41. H. .033, D. .037. Possible weight of stone with rough sugar-loaf shape. Badly pitted surface made all of lime concretion impossible to remove. 79.30 grams (S).
W 42. H. .028, D. .033. Sugar-loaf shaped stone weight. 86.00 grams (G).
W 43. H. .025, D. .035. Domed stone weight; flattened top. 92.00 grams.
W 44. H. .03, D. .034. Domed stone weight. 93.20 grams (M).
W 45. H. .028, D. .04. Domed stone weight; flattened top. 99.60 grams (G).
W 46. L. .06, W. .023. Roughly sphendonoid weight of copper or bronze (?). 109.50 grams.
W 47. H. .037, D. .035. Domed haematite weight. 146.40 grams.
W 48. L. .065, W. .033. Rough stone oblong, concave beneath. 177.00 grams (G).
W 49. H. .032, D. .04. Domed stone weight. 185.50 grams (M).
W 50. H. .022, D. .042. Domed stone weight; flat top. 188.00 grams (M).
W 51. H. .035, D. .04. Domed stone weight. 194.00 grams.
W 52. L. .075, W. .033. Stone oblong with rounded ends. 204.00 grams (P).
W 53. H. .04, D. .047. Domed weight of highly polished stone; flattened top. 233.00 grams (M).
W 54. H. .04, D. .04. Spherical (?) stone weight with pitted surface and concretion adhering. 244.00 grams.
W 55. H. .036, D. .047. Domed weight of polished stone. 279.50 grams (M).
W 56. L. .072, W. .038. Sphendonoid stone weight with flattened ends. 284.50 grams (G).
W 57. H. .06, D. .06. Domed stone weight. 457.00 grams (M).
W 58. L. .09, W. .043. Roughly sphendonoid stone weight, with little tapering at ends. Irregular surface contains metallic crystals. 468.00 grams (G).
W 59. L. .07, H. .03, W. .04. Stone oblong with rounded ends. 470.00 grams (G).
W 60. L. .095, W. .056. Sphendonoid weight of haematite. Strongly tapering ends flattened at tips. 501.00 grams (P).

The determination of the standards of the weights seemed important not only for the study of ancient metrology, but also for any light which might be shed on the route of the ship before it sank, and its planned ports of call; it was assumed that the merchant carried standards used in each of the localities he wished to visit.

This task was made more difficult by past excavation reports, for little attention has usually been given to the study of weights by field archaeologists. In early archaeological reports weights were often not recognized as such and some were described as sling bullets.[9] Even after the use of these stone objects had been recognized, some excavators neglected to report their weights,[10] or gave weights of only a few of a larger number,[11] or recorded them inaccurately.[12] Others tell us that certain weights were inscribed with signs, but do not mention which sign coincides with which weight in a given list.[13] Finally, even when weights were presented admirably in catalogues, little study has usually accompanied mere lists.

General articles seem almost unrelated to one another, but it is not the authors who are at fault. A natural confusion arises from the vast number of varieties within standards used in different places and at different times in antiquity. Sellers lists, for example, fourteen weights inscribed with identical notation, but no two of them weigh the same.[14] It does not seem to be overly bold to suggest that only closed deposits, containing sets of weights used by one man at one time, will clear this picture, and that ancient wrecks will offer the best possibilities for such deposits.

An attempt to study the Gelidonya weights with external evidence failed because even such a common standard as the *qedet* has dozens of variations; dividing sixty weights by variations of only hundredths of grams was as unrewarding as it was laborious. Without regard to known standards, therefore, the weights were placed along the edge of a grid and each weight was then divided by appropriate numbers (2 to 15 for the lighter weights, but up to 60 for the heavier pieces). Table 1 is an example of the results.

Using this grid, a frequency count was made of numbers which repeated exactly, and a secondary count was made of numbers which were coincidental to within one-tenth of a gram. The recurrence of 9.32 grams (four times) and 9.33 grams (three times) was immediately apparent (indicated by †); the only marked weight (W 2) was taken to be the unit of this standard, although it is two hundredths of a gram off at 9.30 grams. 7.30 grams also appeared frequently (indicated by ‡), as did 3.50 grams (indicated by *).

Next it was noted when two possible standards could be used for one weight. W 22, for example, is divisible

[9] Heinrich Schliemann, *Troja,* 118; *Ilios: The City and Country of the Trojans,* 436–438. This is a natural error and I had catalogued the first of the Gelidonya weights (W 60) as a sling bullet before being corrected by Miss Taylor; it is remarkable that Schliemann, without realizing their significance, recorded the exact weights of two of his "sling bullets."

[10] C. W. Blegen, *et al., Troy* I, part 1, 359, and throughout Troy publication; precise dimensions are, however, given. Axel W. Persson, *Dendra,* 65 ff.

[11] C. Schaeffer, *Ugaritica* I, 44–45. Professor Schaeffer has very kindly supplied me with information concerning the unpublished weights, which will presumably be published at a later date.

[12] *Infra,* ns. 36 and 37.

[13] C. C. McCown, *Tell en-Naṣbeh,* 259. A weight inscribed with the name *pîm* is mentioned, but not its actual weight.

[14] Sellers, *IDB* **4**, 832. See also F. G. Skinner, *Hist. of Tech.* I, 779 ff., and W. M. F. Petrie, *Ency. Brit.* **15** (1954 ed.), 144–145, for examples of varying conclusions reached by three authorities.

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TABLE 1

EXAMPLE OF GRID USED IN DETERMINING COMMON STANDARDS

Weights		2	3	4	5	6	7	8	9	10	11	12	13	14	15
W1	3.50*	1.75	1.17	.87	.70										
W2	9.30†	4.65	3.10	2.31	1.86	1.55	1.33	1.16	1.03	.93					
W3	9.50	4.75	3.17	2.37	1.90	1.58	1.36	1.19	1.05	.95					
W4	10.30	5.15	3.43	2.57	2.06	1.72	1.47	1.29	1.14	1.03	.94				
W5	10.50	5.25	3.50*	2.62	2.10	1.75	1.50	1.31	1.17	1.05	.95				
W6	12.30	6.15	4.10	3.07	2.46	2.05	1.76	1.54	1.37	1.23	1.12	1.02	.95		
W7	16.00	8.00	5.34	4.00	3.20	2.67	2.29	2.00	1.78	1.60	1.45	1.33	1.23		
W8	17.80	8.90	5.94	4.45	3.56	2.97	2.54	2.22	1.98	1.78	1.62	1.48	1.37		
W9	20.60	10.30	6.86	5.15	4.12	3.43	2.94	2.58	2.29	2.06	1.87	1.72	1.55		
W10	20.80	10.40	6.93	5.20	4.16	3.46	2.97	2.60	2.31	2.08	1.89	1.73	1.60		
W11	26.10	13.05	8.70	6.52	5.22	4.35	3.73	3.26	2.90	2.61	2.37	2.17	2.01		
W12	26.20	13.10	8.73	6.55	5.24	4.37	3.74	3.28	2.91	2.62	2.38	2.18	2.02		
W13	28.00	14.00	9.33†	7.00	5.60	4.67	4.00	3.50*	3.11	2.80	2.54	2.33	2.15		
W14	29.20	14.60	9.73	7.30‡	5.84	4.86	4.17	3.65	3.24	2.92	2.65	2.43	2.25		
W15	29.80	14.90	9.93	7.45	5.96	4.97	4.25	3.72	3.31	2.98	2.71	2.48	2.29		
W16	35.00	17.50	11.66	8.75	7.00	5.83	5.00	4.37	3.89	3.50*	3.18	2.91	2.69	2.50	2.33
W17	36.00	18.00	12.00	9.00	7.20	6.00	5.14	4.50	4.00	3.60	3.27	3.00	2.77	2.57	2.40
W18	36.50	18.25	12.16	9.12	7.30‡	6.08	5.21	4.57	4.05	3.65	3.32	3.04	2.80	2.61	2.43
W19	42.70	21.35	14.23	10.68	8.54	7.12	6.10	5.34	4.75	4.27	3.89	3.56	3.39	3.05	2.85
W20	43.80	21.90	14.60	10.95	8.77	7.30‡	6.25	5.47	4.86	4.38	3.98	3.65	3.37	3.13	2.92
W21	45.50	22.75	15.16	11.37	9.10	7.58	6.50	5.68	5.05	4.55	4.13	3.79	3.50*	3.25	3.03
W22	46.00	23.00	15.33	11.50	9.20	7.67	6.57	5.75	5.11	4.60	4.18	3.83	3.53	3.29	3.07
W23	47.70	23.85	15.90	11.92	9.54	7.95	6.81	5.96	5.30	4.77	4.34	3.98	3.67	3.41	3.18
W24	48.20	24.10	16.07	12.05	9.64	8.03	6.88	6.03	5.36	4.82	4.38	4.02	3.71	3.44	3.21
W25	49.40	24.70	16.47	12.35	9.88	8.23	7.05	6.17	5.49	4.94	4.49	4.12	3.80	3.53	3.29
W26	51.50	25.75	17.17	12.87	10.30	8.58	7.35	6.44	5.72	5.15	4.68	4.29	3.96	3.68	3.43
W27	54.20	27.10	18.07	13.55	10.84	9.03	7.74	6.77	6.02	5.42	4.93	4.51	4.17	3.87	3.61
W28	55.50	27.75	18.50	13.87	11.10	9.25	7.93	6.93	6.17	5.55	5.05	4.63	4.27	3.96	3.70
W29	56.00	28.00	18.67	14.00	11.20	9.33†	8.00	7.00	6.22	5.60	5.09	4.67	4.30	4.00	3.73
W30	57.50	28.75	19.16	14.37	11.50	9.58	8.21	7.18	6.38	5.75	5.23	4.78	4.42	4.11	3.83
W31	59.00	29.50	19.66	14.75	11.80	9.83	8.43	7.38	6.55	5.90	5.36	4.92	4.53	4.21	3.93
W32	63.90	31.95	21.30	15.97	12.78	10.65	9.13	7.99	7.10	6.39	5.81	5.32	4.91	4.56	4.26
W33	65.50	32.75	21.83	16.37	13.10	10.91	9.35†	8.19	7.27	6.55	5.95	5.45	5.04	4.68	4.37
W34	65.50	32.75	21.83	16.37	13.10	10.91	9.35	8.19	7.27‡	6.55	5.95	5.45	5.04	4.68	4.37

by 11.50, 7.67, and 5.75; W 30 is divisible by 11.50 and 5.75, but not by 7.67; and W 40 is divisible by 7.67, but not by 11.50 or 5.75. There is no contradiction here, however, for 7.67 proves to be two-thirds of 11.50, and 5.75 is one-half of 11.50. We have, then, a *shekel* of 11.50 grams, a *pim* (2/3 shekel) of 7.67 grams, and a *beka* (1/2 shekel) [15] of 5.75 grams. Only one standard is involved.

The units and their multiples which occur most frequently are 7.30 grams, 9.32 (or 9.33) grams, 9.50 grams, 10.30 grams, 10.50 grams, and 11.50 grams; 12.30 grams fits into no pattern and is taken to be a unit weight for a seventh standard which was not otherwise represented on board; 501.0 grams, previously noted to have been found separate from the others, also proves to conform to a separate standard. The proof of these systems, for those who might suspect that the weight of any piece of stone might be juggled until it conformed to one or another standard, lies in the fact that most of those weights which were listed as merely "possible weights," including most of those of metal, do not fit any pattern. It is possible that a few of our pieces may have worked out only by chance, but certainly the majority may be accepted with confidence. It should also be noted that changes in the weights from their long submersion in sea water need not be considered, for the polished surfaces which some of them still retain show this to have been negligible.

It may now be shown that all of these units were of common standards. To arrive at these conclusions it was necessary to restudy the weights from the various land sites (using grids as for the Gelidonya weights), for a weight of 92.00 grams might have been described as 10 qedets of 9.33 grams, when in fact it is exactly 8 shekels of 11.50 grams. Below are listed the standards from Gelidonya, based entirely on internal evidence, with the various localities in the Mediterranean where they were used, followed by the evidence for each locality.

(1) 7.30 grams (found at Gelidonya in multiples of 4, 5, 6, 8(?), 9, 15, 20, 28, 32, 64).

[15] Sellers, *supra*, n. 14. R. B. Y. Scott, *BiblArch* 22 (May 1959) 35: ". . . the *beka* is the only weight, the name of which appears both in the Old Testament and on recovered weights, *and* relationship of which to the shekel is given (*cf.* Exod. 38:26)."

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This standard agrees most closely with the so-called Phoenician standard of 7.32 grams. It occurs in Egypt,[16] Syria, Palestine, and Crete. At Ras Shamra the system of weights has been reported to be based on a mina of 50 shekels, rather than the 60 shekels of the Babylonian system;[17] if the mina of 439 grams found there, however, was composed of the normal 60 shekels, we would find a shekel of 7.31 grams. From Gezer we see weights of 7.25 and 7.35 grams, but much closer are the weights of 43.75 grams (6×7.29) and 182.75 grams (25×7.31).[18] A lead weight from the Palace at Knossos equals 22.05 grams, or 3 shekels of 7.35 grams,[19] and also from Crete is a lead-filled bronze head of an ox which weighs 73.62 grams,[20] which could be either 8 qedets of 9.20 grams or, more likely, 10 shekels of 7.36 grams A limestone cylinder, from Zakro on Crete, is marked with 6 dots and weighs 220 grams; the dots indicate that the weight is six times a unit of 36.66, and this is described by Evans and Glotz[21] as being the equivalent of 4 qedets of 9.165 grams. It seems more likely that this was in fact a unit of 5 shekels of 7.33 grams. If these calculations are now accepted it is evident that none of the variations of the standard deviate more than six one-hundredths of a gram, while earlier conclusions were based on variations of at least sixteen one-hundredths of a gram for the qedet just mentioned.

(2) 9.32 (or 9.33) grams (found at Gelidonya in multiples of 1, 3, 6, 7(?), 10, 19, 20(?), 25, 30, 49, 50(?), and $25 \times 1/12$).

This is the most common weight for the qedet, the national Egyptian standard.[22] (1/12 qedet = 1 *seal* or *šʿty*, 10 qedets = 1 *deben*, 10 debens = 1 *sep*).[23] It occurs in most countries of the eastern Mediterranean, including Syria, Cyprus, Palestine, the Hittite empire, Troy, and possibly Crete and Greece. At Ras Shamra is a weight of 18.7 grams, marked as a double unit with two strokes.[24] Multiples of 9.33 grams have been found at Enkomi on Cyprus.[25] At Gezer are a qedet of 9.36 grams and debens of 93.69 and 93.45 grams,[26] at Megiddo a weight of 28.00 grams[27] (3 qedets of 9.33 grams), and at Tell en-Naṣbeh a weight of 9.324 grams (marked as a neṣef, but indicating that a unit of 9.32 grams was used).[28] A weight from Boğazköy, of 140 grams,[29] may be considered as 15 qedets of 9.33 grams, and from Troy are two weights of half qedets of 9.33 grams.[30] For Greece the evidence is less solid: a weight from Corinth[31] is lacking its bronze ring (similar to rings on weights from Ras Shamra) and weighs 18 grams (a double qedet with the addition of the ring?). At Malthi in Messenia[32] are Late Helladic weights of *ca.* 7.77 grams (10 seals) and its multiples (7.80 grams, 31 or 4×7.77 grams, 308.80 or 40×7.72 grams); it is significant that actual qedets and debens do not occur here, but the relationship with these mainland weights is at least worth noting. Weights from Crete, as noted in the discussion of the shekel of 7.30 grams, have been recorded as possible qedets, but the deviation from the normal seems too great to allow full acceptance.

(3) 9.50 grams (found at Gelidonya in multiples of 1, 5, 7, 8, 9(?), 30, and $9 \times 1/2$(?)).

The qedet of 9.5 grams occurs in Syria, Cyprus, Palestine, and Crete. At Ras Shamra is a weight of 9.5 grams.[33] At Enkomi on Cyprus are weights of 18.996 grams, or a double qedet of 9.498 grams; and 47.756 grams, or 5 qedets of 9.551 grams.[34] A weight of 95.26 grams, found at Gezer, is marked on its back with a straight scratch (1 deben), and another weight from the same site is 95.22 grams.[35] The famous gypsum weight with octopus reliefs found in the Palace of Knossos has been thrice recorded by Evans as being a talent weighing "almost exactly" 29,000 grams,[36] but its weight has also been recorded as 28,600 grams.[37] This latter weight would yield a unit of 9.53 grams if the talent is 60 minas of 50 units each.[38] On the other hand, if the mina is composed of 60 units on Crete, we may judge the stone weight from Soteia (1,140 grams)[39] to be two minas based on a unit of exactly 9.50 grams; this would indicate the possibility that the "octopus relief" weight was possibly not a weight at all,[40] and it has been suggested that it was in fact a stone anchor,[41] although the material of which it was made makes this last theory unlikely. At any rate, the suggestion of 9.50 grams as the unit on which the Soteia weight was based requires less "juggling" than the suggestion that it was twelve dozen shekels of 7.916 grams.[42] The confusion arises from the use of minas of 25, 50, and 60 shekels in antiquity, and all must be tried on unmarked weights.[43]

(4) 10.30 grams (found at Gelidonya in multiples of 1, 2, 5, 18, and $7 \times 1/2$ and $7 \times 2/3$).

A neṣef of 10.37 grams existed in Syria.[44]

(5) 10.50 grams (found at Gelidonya in multiples of 1, $1 \times 1/3$, $13 \times 1/3$, $5 \times 1/2$, $15 \times 1/2$, $4 \times 2/3$, $5 \times 2/3$, $7 \times 2/3$, and $10 \times 2/3$).

This is perhaps another form of the Palestinian neṣef mentioned above, which has been found ranging between 10.0 and 10.50 grams.[45] It occurs at Tell en-Naṣbeh,[46] as a beka of 5.25 grams in Gezer,[47] and as a third of a shekel at Ras Shamra.[48] In Greece, at Malthi, a weight of 632.00

[16] G. Glotz, *Aegean Civil.*, 192.
[17] Schaeffer, *Ugaritica* I, 44–45.
[18] R. A. S. Macalister, *Gezer* II, 280–283.
[19] Arthur Evans, *Corolla Num.*, 348.
[20] Evans, *PM* IV, part II, 655, and *Corolla Num.*, 353.
[21] Evans, *Corolla Num.*, 346; Glotz, *Aegean Civil.*, 193.
[22] Petrie, *Ency. Brit.* **15** (1954 ed.), 144. This figure is almost universally accepted as the weight of this standard.
[23] Alan Gardiner, *Egypt. Grammar*, 200; Petrie, *Anc. Weights and Meas.*, 13.
[24] Schaeffer, *Syria* **18**, 150.
[25] Evans, *Corolla Num.*, 350–351.
[26] Macalister, *Gezer* II, 282–283.
[27] Lamon and Shipton, *Megiddo* I, pl. 104.
[28] McCown, *Tell en-Naṣbeh* I, 259.
[29] K. Bittel, *Boğazköy* III, 32.
[30] Petrie, *Anc. Weights and Meas.*, 43, and pl. 49.
[31] G. R. Davidson, *Corinth* XII, 204.
[32] N. Valmin, *Poids préhistoriques* . . . , 30–34.
[33] Schaeffer, *Syria* **18**, 150–151.
[34] Evans, *Corolla Num.*, 350–351.
[35] Macalister, *Gezer* II, 282–283.
[36] Evans, *PM* IV, part II, 651; *BSA* **7**, 42; *Corolla Num.*, 342.
[37] Xanthoudides, *ArchEph* (1906) 152; Glotz, *Aegean Civil.*, 191.
[38] Evans, *Corolla Num.*, 343.
[39] Xanthoudides, *ArchEph* (1906) 151 ff., pl. XI, 14.
[40] Evans was overly fascinated by the weight of 29,000 grams, which he supposed to be a unit used in making copper ingots (*Corolla Num.* 357–359). The demonstration that ingots were not made in accordance with a precise weight (*supra*, pp. 71 f.) removes some of the basis for the theory that this was actually a weight.
[41] H. Frost, *Under the Mediterranean*, 46.
[42] Glotz, *Aegean Civil.*, 192.
[43] Skinner, *Hist. of Tech.* I, 780; Sellers, *Interp. Dict. of the Bible* **4**, 830–831.
[44] Skinner, *Hist. of Tech.* I, 781.
[45] Petrie, *Ency. Brit.* **15** (1954 ed.), 144.
[46] McCown, *Tell en-Naṣbeh* I, 276.
[47] Macalister, *Gezer* II, 282–283.
[48] Schaeffer, *Syria* **18**, 150.

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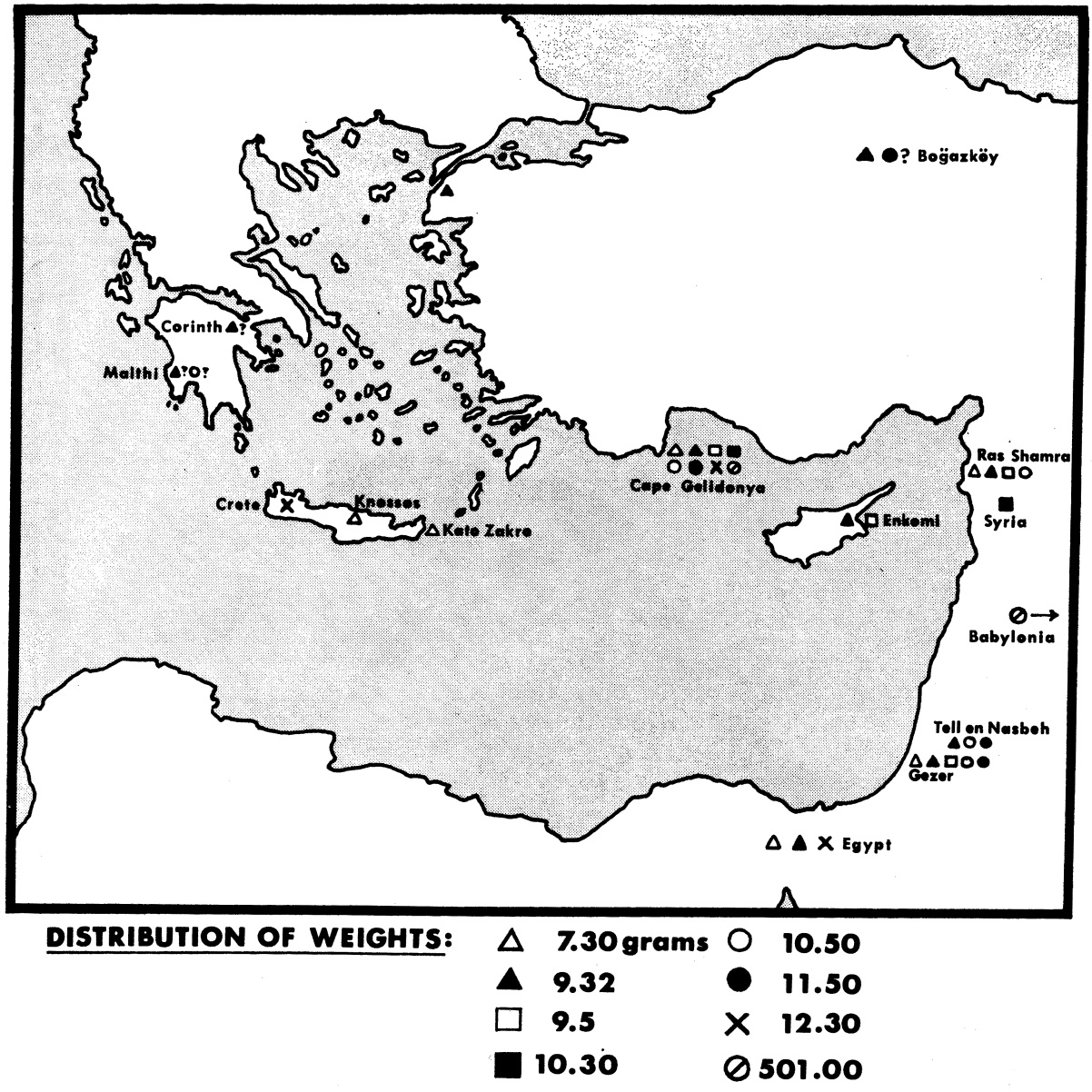


FIG. 149.

grams equals 60 units of 10.53 grams, or perhaps a slightly inaccurate mina.[49]

(6) 11.50 grams (found at Gelidonya in multiples of 4, 5, 6, 8, and 15 × 1/2, 10 × 2/3, and 13 × 2/3).

The Hebrew shekel has been calculated as being around 11.30 to 11.47 grams by some authorities,[50] but Scott reckons the common shekel to have been 11.7, depreciating to 11.4 grams.[51] We find examples of this at Gezer in shekels of 11.51, 11.54, and 11.56 grams, and bekas of 5.78 and 5.77 grams, as well as a double shekel of 23.02 grams.[52] A weight of 7.65 grams from Tell en-Naṣbeh may be considered as one pim.[53] At Boğazköy are weights of 5.76 grams (one beka) and 115.7 grams (10 shekels of 11.57 grams).[54] This weight may have continued as the Persian silver standard of 11.53 grams.[55]

(7) 12.30 grams (found at Gelidonya in multiples of 1, and possibly 4, 7, 9 × 1/2, and 11 × 1/2).

Were it not for the well-preserved weight of 12.30 grams, this would not be considered a standard at Gelidonya. Evans gives this (12.25 grams) as the gold unit of Crete and Egypt,[56] but Glotz's statement that it occurs in Egypt, Crete, Cyprus, and Palestine, between 12.30 and 13.98 grams, is perhaps too loose for consideration here.[57]

(8) 501.0 grams.

[49] Valmin, *Poids préhistoriques* . . . , 34.
[50] Sellers, *IDB*, 831.
[51] Scott, *BiblArch* 22, 39.
[52] Macalister, *Gezer* II, 280–281.
[53] McCown, *Tell en-Naṣbeh* I, 276.
[54] Bittel, *Boğazköy* III, 32.
[55] Skinner, *Hist. of Tech.* I, 781.
[56] Evans, *PM* IV, part II, 665.
[57] Glotz, *Aegean Civil.*, 193.

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This is the Babylonian mina of 502 grams.[58] There were no other examples of this weight and its parts on the Gelidonya ship, but as has been noted, it does not seem to have been in use in the cabin. We can offer no explanation for its having been on board unless, perhaps, it was left over from an earlier trip, or some infrequent commodity was sold only by the mina of 502 grams.

We may now present a list of the Gelidonya weights with their assigned values. In this we have borne in mind the statement by Petrie that "in general we should not accept any multiple which is unlikely, such as 11, 13, 23, 28, 33, 46, which all appear as supposed multiples in a recent paper on weights."[59] A close look at the evidence leaves us with no choice but to accept some such multiples. It is certain that most of the weights belonging to the merchant were recovered, and it is clear that no set was "complete," as having 1, 2, 3, 4, 5, 10, 20, 30, etc., units. Is it not possible that the merchant knew what combinations of various unmatched units would equal the desired and missing figures? In this case the multiples may not be as arbitrary as they seem, but were based on usage over a period of years.

W 1. 3.50 grams. 1/3 shekel of 10.50 grams (M).
W 2. 9.30 grams. 1 qedet of 9.32 grams (M).
W 3. 9.50 grams. 1 qedet of 9.50 grams (M).
W 4. 10.30 grams. 1 shekel of 10.30 grams.
W 5. 10.50 grams. 1 shekel of 10.50 grams (M).
W 6. 12.30 grams. 1 shekel of 12.30 grams.
W 7. 16.00 grams. Conforms to no standard. Probably not a weight (M).
W 8. 17.80 grams. Conforms to no standard. Probably not a weight (M).
W 9. 20.60 grams. 2 shekels of 10.30 grams (G).
W 10. 20.80 grams. Standard not apparent (M).
W 11. 26.10 grams. Conforms to no standard. Probably not a weight (G).
W 12. 26.20 grams. 5 bekas of shekel of 10.50 grams (5.24 for 5.25).
W 13. 28.00 grams. 3 qedets of 9.32 grams (9.33 for 9.32), or 4 pims of shekel of 10.50 grams (M).
W 14. 29.20 grams. 4 shekels of 7.30 grams (G).
W 15. 29.80 grams. Conforms to no standard. Probably not a weight (G).
W 16. 35.00 grams. 5 pims or 10 third-shekels of 10.50 grams (G).
W 17. 36.00 grams. 7 bekas of shekel of 10.30 grams (5.14 for 5.15) (G).
W 18. 36.50 grams. 5 shekels of 7.30 grams (G).
W 19. 42.70 grams. 9 half-qedets of 9.50 grams, or possibly not a weight (G).
W 20. 43.80 grams. 6 shekels of 7.30 grams (G).
W 21. 45.50 grams. 13 third-shekels of 10.50 grams (G).
W 22. 46.00 grams. 4 shekels of 11.50 grams.
W 23. 47.70 grams. 5 qedets of 9.50 grams (9.54 for 9.50) (G).
W 24. 48.20 grams. 7 pims of shekel of 10.30 grams (6.88 for 6.87) (G).
W 25. 49.40 grams. 7 pims of shekel of 10.50 grams (7.05 for 7.00), or 4 shekels of 12.30 grams (12.35 for 12.30).
W 26. 51.50 grams. 5 shekels of 10.30 grams.
W 27. 54.20 grams. Conforms to no standard. Probably not a weight (M).
W 28. 55.50 grams. 9 bekas of shekel of 12.30 grams (6.17 for 6.15) (M).
W 29. 56.00 grams. 6 qedets of 9.32 grams (9.33 for 9.32) (G).
W 30. 57.50 grams. 5 shekels of 11.50 grams.
W 31. 59.00 grams. Possibly 8 shekels of 7.30 grams (7.38 for 7.30) (G).
W 32. 63.90 grams. Conforms to no standard. Unfinished? (G).
W 33. 65.50 grams. Approximately 7 qedets of 9.32 grams, using estimated original weight (G).
W 34. 65.50 grams. 9 shekels of 7.30 grams (7.28 for 7.30) (G).
W 35. 66.50 grams. 7 qedets of 9.50 grams (M).
W 36. 67.50 grams. Possible stone weight, broken. Maybe 11 bekas of shekel of 12.30 grams (6.14 for 6.15) (M).
W 37. 69.00 grams. 6 shekels of 11.50 grams.
W 38. 69.80 grams. 10 pims of shekel of 10.50 grams (6.98 for 7.00) (G).
W 39. 76.00 grams. 8 qedets of 9.50 grams (G).
W 40. 76.70 grams. 10 pims of shekel of 11.50 grams.
W 41. 79.?? grams. Possibly 15 bekas of shekel of 10.50 grams (S).
W 42. 86.00 grams. 15 bekas of shekel of 11.50 grams (11.46 for 11.50), or 9 qedets of 9.50 grams (9.55 for 9.50), or 7 shekels of 12.30 grams (12.28 for 12.30) (G).
W 43. 92.00 grams. 8 shekels of 11.50 grams.
W 44. 93.20 grams. 1 deben (10 qedets of 9.32 grams) (M).
W 45. 99.60 grams. 13 pims of shekel of 11.50 grams (7.65 for 7.67) (G).
W 46. 109.50 grams. 15 shekels of 7.30 grams (M).
W 47. 146.40 grams. 20 shekels of 7.30 grams (7.32 for 7.30) (G).
W 48. 177.00 grams. 19 qedets of 9.32 grams (G).
W 49. 185.50 grams. 18 shekels of 10.30 grams (10.31 for 10.30) or two debens (20 qedets of 9.28 for 9.32 grams) (M).
W 50. 188.00 grams. 2 debens (20 qedets of 9.40 grams) (M).
W 51. 194.00 grams. 25 seals (25 twelfth-qedets of 9.33 grams).
W 52. 204.00 grams. 28 shekels of 7.30 grams (7.28 for 7.30) (P).
W 53. 233.00 grams. 2½ debens (25 qedets of 9.32 grams) or 32 shekels of 7.30 grams (7.28 for 7.30) (M).
W 54. 244.00 grams. Original weight not known exactly. Perhaps 26 qedets of 9.32 grams.
W 55. 279.50 grams. 3 debens (30 qedets of 9.32 grams) (M).
W 56. 284.50 grams. 3 debens (30 qedets of 9.50 grams) (9.48 for 9.50) (G).
W 57. 457.00 grams. 49 qedets of 9.32 grams (M).
W 58. 468.00 grams. 5 debens (50 qedets of 9.32 grams) (9.36 for 9.32) or 64 shekels of 7.30 grams (7.31 for 7.30). Corroded weight (G).
W 59. 470.00 grams. 5 debens (50 qedets of 9.40 grams) (G).
W 60. 501.00 grams. 1 Babylonian mina (8.35×60, for $8.37 \times 60 = 502.20$ grams) (P).

As has been seen, most of the doubtful weights were discarded as not being weights at all, but a few irregular pieces remain. It is possible that these reflect standards only by chance, but their inclusion is based on modern

[58] A. Segrè, *JAOS* **64**, 73.
[59] Petrie, *Anc. Weights and Meas.*, 7.

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usage: today in Bodrum, Turkey, merchants may be seen using irregular, but carefully weighed, field stones to replace lost iron weights in their sets.

One problem remains to be clarified. Small weights were suitable for weighing tools, weapons, and small scraps of metal,[60] but were far too light to be of use in weighing ingots and large ingot fragments. A large stone,[61] possibly an anchor or anvil,[62] was found lying on planks of the ship in area S. In weighing all of the objects from the ship, with the sole intent of estimating its tonnage, this was recorded as weighing just under 74 kilograms. The white ballast stones were weighed as a unit, for individual weights seemed unnecessary, but a squarish diorite stone ($.022 \times .018 \times .016$) from area P IV was catalogued separately because of its size and material; this was also weighed, with no particular purpose other than to add to the estimate of the weight of the total cargo, and proved to be 10.5 kilograms.

The possibility arises that these were also weights, and they are now tentatively added to our list (see also chap. 7):

W 61. (also St 5) *Ca.* 73,900 grams. Possibly two talents of 60 minas of 60 shekels of 12.30 grams (73,800 grams). This standard has been called the "gold standard,"[63] which brings to mind the statement made by Evans that "it can hardly be doubted that some of the tablets from the Palace of Knossos relate to equations between the value of these bronze 'talents' and a gold unit."[64]

W 62. (also St 7) 10,500 grams. This would be one thousand neṣefs of 10.50 grams, which is a standard found at Gelidonya, and a standard which was decimal, "multiplying up to 1,000."[65]

Possibly only one of the two stones should be considered as a weight, for it seems unlikely that two standards would have been used for weighing the ingots; certainly one large weight was needed for this purpose.

CONCLUSIONS

It is immediately apparent that weights of the Late Bronze Age were much more accurately made than has been supposed.[66] The frustration of finding weights bearing identical identification marks, but of varying weights, seems to have been due largely to the fortunes of land excavation, where mixtures of weights of different localities and dates are sometimes difficult to separate. We see that of fifty-two weights belonging to one man and being used in the same year, twenty-six are accurate to within one-hundredth of a gram or less per unit. Six others are inaccurate by only one-hundredth of a gram per unit. Only the presence of two quite accurate weights, W 50 and W 59, based on a qedet of 9.40 grams, halfway between the qedets of 9.32 and 9.50 grams, is difficult to explain. Balances were obviously more sensitive than previously supposed,[67] and weights could be made with great exactness.

The Gelidonya merchant had an intimate knowledge of the weights, for none are marked and none of the shapes seem to correspond particularly to any standard. Only the standard of 9.32 stands out, for most of the qedets are sphendonoid and most of the debens are domed; even here there are exceptions. It is possible that each set was kept in a separate bag, but the scattered proveniences of the weights on the site offer no evidence for this theory.

The weights show that the ship was capable of trading with merchants from Egypt, Syria, Palestine, Cyprus, Troy, the Hittite Empire, Crete, and probably the Greek mainland. This tells us virtually nothing of the route being followed by the ship, but this very freedom of choice is significant in the study of ancient trade. (See fig. 149.)

[60] Similar weights have also been found with bronze scraps on land; Macalister, *Gezer* II, 283.
[61] *Supra,* p. 36, St 7.
[62] *Supra,* p. 128.
[63] Evans, *loc. cit.* (*supra,* n. 56).
[64] Evans, *Corolla Num.,* 361. See, however, *supra,* p. 71.
[65] Petrie, *Ency. Brit.* **15**, (1954 ed.), 144–145.
[66] Skinner, *Hist. of Tech.* I, 781; Sellers, *IDB* **4**, 832.
[67] A. E. Berriman, *JEA* **41** (1955) 50.

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XI. THE SCARABS

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Three scarabs were found by divers in area "G" (the area of the ship's cabin), and two more were recovered via the air lift from the same area. One of the five (Sc 3) is, properly speaking, not a scarab but a scarab-shaped plaque, inscribed on both faces. Another (Sc 5) is incomplete, having been broken at some time along its vertical axis (the break coincides with the hole which was drilled through the scarab's length). The remaining three are complete.

The scarabs were obviously the personal property of one or more members of the ship's crew, and their presence on board may be explained in several ways. A scarab may have the properties of a religious talisman, or may be used as a good luck charm, or may be intended as a seal. It may also be owned, as in our own times, as a memento or a curio. For it to be a seal, it should in some way have the identity or characteristics of its owner, which are then transmitted to the object being sealed through the act of impressing the seal into the clay or wax. This purpose probably does not account for the presence of the five Gelidonya scarabs, for at least three of them, if I may anticipate a conclusion, date to a period several hundred years prior to the sinking of the ship. The possibility of their having been good-luck charms with or without a religious significance is a very strong one, but they may equally have been a souvenir of a voyage to Egypt or Asia; scarabs were, in antiquity and even today, precisely the type of memento one would acquire in Egypt, and as such, were at the end of the Pharaonic period exported abroad in great quantities. However, whether the owner or owners were Egyptians or Syrians who possessed them for religious reasons, or as good luck charms, or were Cypriots or Hellenes who had purchased them as keepsakes of a voyage to Egypt or Asia, must remain in the realm of speculation.

Sc 1. Fig. 150. White frit. L. .018, W. .014, H. .004. Vignette on underside (base) neatly and carefully executed in sunken relief, but no internal details are indicated.

Description of top: Oval shape, but most missing; pierced vertically for suspension.

Description of base: The god Re, represented as a falcon-headed human figure, stands at the left, his right hand hanging down behind him, his left arm terminating in a serpent, a symbol of Egyptian kingship, which rears up in front of him. Over the heads of both god and snake are sundisks, insignia of divinity. Beneath the curve where the left arm of Re turns into the serpent's body is the *nb*-sign, a hieroglyph representing a wicker-work basket and meaning either "lord" or "every." In front of the serpent is a long vertical sign which is not identifiable.

Parallels: SCE II, pl. 248, no. 10; Macdonald, *et al., Beth Pelet* II, pl. 57, nos. 381, 337; pl. 50, nos. 47, 61; pl. 52, no. 164; pl. 55, no. 280; Petrie, *Gaza* II, pl. 7, no. 96; Rowe, *Scarabs,* pl. 18, no. 708 (from Lachish); Petrie and Duncan, *Hyksos and Israelite Cities,* pl. 33, no. 71; Rowe, *Scarabs,* pl. 18, nos. 703–704 (from Tel el Ajull); Newberry, *Timins Collection,* pl. 16, no. 34; pl. 20, no. 36; Tufnell, *Lachish* II, pl. 32, no. 25; *ibid.* IV, pl. 39, no. 367; Petrie, *Beth Pelet* I, pl. 22, no. 200; Cairo CG 36986; Petrie, *Scarabs,* pl. 17, no. 1326; pl. 15, nos. 1007, 1010.

Remarks: The motif of the falcon-headed man is well known and occurs in a number of variants. Its prototype is perhaps to be seen in a motif of the Hyksos period (*ca.* 1675–1567 B.C.). In this, however, the figure frequently has a human rather than a falcon head, and the serpent is held in the left hand and generally, though not always, faces the figure;[1] but the falcon-headed human figure is also known.[2] Scarabs with both of these motifs are found mainly in Palestine-Syria, but are also known in Egypt. By the time of the Egyptian Eighteenth Dynasty (*ca.* 1570–1304 B.C.), the motif of the falcon-headed man has assumed the characteristics of the Gelidonya scarab, and in this form continues in use well into the Nineteenth Dynasty (*ca.* 1304–1200 B.C.). It occurs most frequently on scarabs which can be dated to the reign of Ramesses II (*ca.* 1290–1223 B.C.). It is not known after the reign of his successor Meneptah (1223–1211 B.C.). Throughout the period there are, of course, some variations. A scarab from the late Eighteenth/early Nineteenth Dynasty shows the king, rather than the god, wearing the Blue Crown,[3] and another from Gaza shows the king in the form of a sphinx with the serpent emanating from his chest.[4] Occasionally both hands terminate in serpents,[5] and once or twice the figure is shown seated or kneeling.[6] At times the falcon is shown with the falcon body but wearing the Double Crown.[7] A new variant of the motif appears on a scarab dated to the reign of Ramesses II and continues into the Twentieth Dynasty, although this also has prototypes from the Hyksos period; in this a second serpent seems to be growing out of the extended left foot of the figure.[8] Another important variant which first appears toward the end of the Nineteenth Dynasty shows a projection seemingly growing obliquely out of the left shoulder of the deity;[9] on several scarabs this projection is clearly a wing.[10]

[1] *Cf.* Lamon and Shipton, *Megiddo* I, pl. 69, no. 47; Tufnell, *Lachish* IV, pl. 36, no. 235, and pl. 32, no. 114; Pritchard, *The Br. Age Cemetery at Gibeon,* fig. 71, no. 3; Mackay *et al., Gaza* V, pl. 9, nos. 18–31; Petrie and Duncan, *Hyksos and Israelite Cities,* pl. 9, no. 118; Petrie, *Gaza* IV, pl. 11, no. 395.

[2] *Cf.* Petrie, *Gaza* IV, pl. 5, nos. 46, 64, 79; *Beth Pelet* I, pl. 10, no. 84; *Gaza* III, pl. 3, nos. 19, 25, 26, 58, 67, 86; pl. 4, no. 37; Tufnell, *Lachish* IV, pl. 30, no. 47; Loud, *Megiddo* II, pl. 151, no. 146.

[3] Petrie, *Beth Pelet* I, pl. 12, no. 166.

[4] Petrie, *Gaza* II, pl. 7, no. 102.

[5] Macdonald *et al., Beth Pelet* II, pl. 55, no. 307; pl. 52, nos. 163, 166; Petrie, *Beth Pelet* I, pl. 31, no. 285; Grant, *Ain Shems* I, pl. 51, no. 38; Grant, *Rumeileh,* p. 43, fig. 3, no. 20; p. 29, no. 244.

[6] Macdonald *et al., Beth Pelet* II, pl. 52, no. 166.

[7] *Ibid.,* pl. 57, no. 339; Tufnell, *Lachish* IV, pl. 39, no. 337.

[8] Macdonald *et al., Beth Pelet* II, pl. 52, no. 159; Albright, *Tell Beit Mirsim* II, pl. 32, no. 4; Petrie, *Beth Pelet* I, pl. 12, no. 165; Tufnell, *Lachish* IV, pl. 39, no. 385; *SCE* II, pl. 250, no. 17; *Lachish* IV, pl. 36, no. 241.

[9] Petrie, *Beth Pelet* I, pl. 35, no. 399; Macdonald, *Beth Pelet* II, pl. 52, no. 162; Cairo CG 36606, 36317, 36419.

[10] *SCE* II, pl. 250, no. 28; Petrie, *Beth Pelet* I, pl. 23, no. 363; Petrie and Duncan, *Hyksos and Israelite Cities,* pl. 33, no. 64 (from Tell Er Ratbeh); Cairo CG 36701, 36740.

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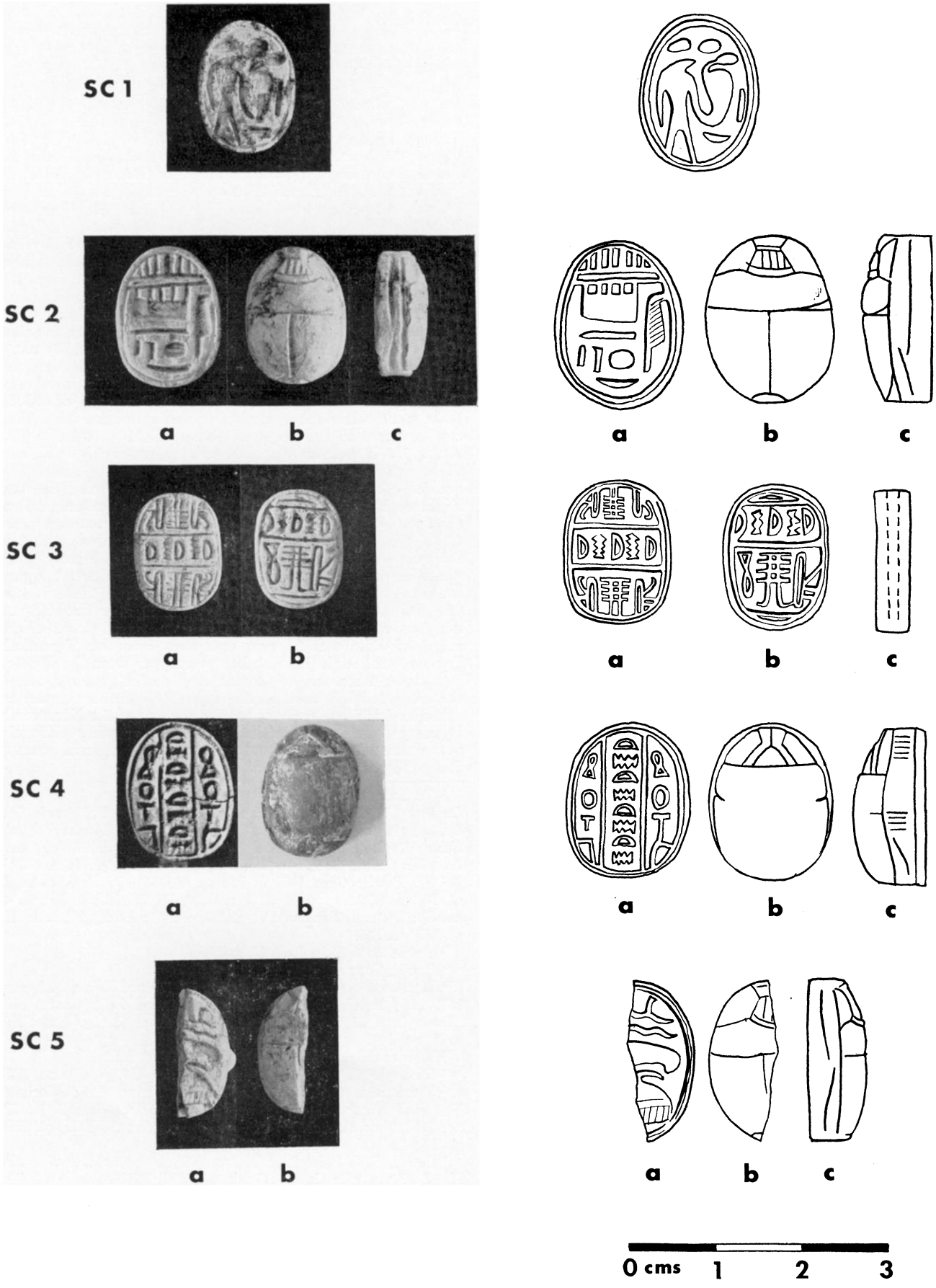


FIG. 150. Scarabs: Sc 1 to Sc 5. (Sc 5 should be viewed horizontally with the broken edge at the top.)

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Sc 2. Fig. 150. White frit, no traces of glaze. L. .018, W. .014, H. .008, hole diam. .002. Inscription on underside (base) neatly executed in sunken relief; anatomical details on top and sides summarily incised.

Description of top: Oval shape; clypeus, head and prothorax occupy one-half of the scarab; clypeus rather small, head separated from prothorax by double curved line, prothorax from elythra by single straight line; wing cases of elythra formed by single dorsal line; no *V*-notches in wing-case; legs crudely outlined on sides; pierced vertically for suspension.

Description of base: The inscription *Jmn-Rʿ nb* "Amun-Re, (the) lord" vertically fills two-thirds of the field; the remaining one-third, separated from it by a double line, has the form of an inverted *nb*-basket with the reed-weaving of the side clearly shown; internal detail of the reed-leaf and the game-board in the group "Amun" is also indicated; to the right of the sundisk are short, apparently meaningless vertical lines.

Parallels: Cairo CG 37136; Dunand, *Byblos* I, pl. 129, no. 1571; Grant, *Ain Shems* I, pl. 51, no. 20; Tufnell, *Lachish* IV, pl. 39, no. 346; *ibid.*, pl. 38, no. 27; *Lachish* III, pl. 43–43a, nos. 12–13; Macdonald, *Beth Pelet* II, pl. 57, no. 382; *cf. ibid.*, nos. 329, 360; Loud, *Megiddo* II, pl. 152, no. 194; *ibid.*, pl. 153, no. 227; Grant, *Ain Shems* I, pl. 51, no. 28; Dunand, *Byblos* II, pl. 200, no. 8630; Petrie, *Beth Pelet* I, pl. 12, nos. 176, 178; *ibid.* II, pl. 50, nos. 70, 103; Petrie, *Gaza* II, pl. 7, no. 36; *ibid.* III, pl. 4, no. 189; Petrie and Duncan, *Hyksos and Israelite Cities,* pl. 33 (Tel Er Ratbeh), no. 19; *ibid.*, pl. 37 (Saft and Gheyta) nos. 15, 25, 26, 29; Lamon and Shipton, *Megiddo* I, pl. 67, no. 5; *ibid.*, pl. 67, no. 20; *ibid.*, pl. 69, no. 51; *ibid.* II, pl. 152, no. 173; Tufnell, *Lachish* II, pl. 32 a–b, no. 7; *ibid.* IV, pl. 38, no. 268, nos. 273–275; McCown, *Tell En-Nasbeh* I, pl. 55, no. 65; Cairo CG 36678, 36687, 37136.

Remarks: A variant of the design shows the inverted *nb*-sign replaced by the hieroglyph representing a jar with water emanating from it, in which case the inscription may be read *wʿb Jmn-Rʿ nb* "Pure is Amun-Re, the lord." For examples of this type, see e.g., *Ain Shems* I, pl. 51, no. 20; *Hyksos and Israelite Cities,* pl. 37, nos. 12–13; *Gaza* II, pl. 7, nos. 28, 40. The two vertical strokes next to the sundisk are sometimes replaced by a second sundisk.

The design is common for the New Kingdom, and is, as attested by the parallels, most frequently found in Palestine and Syria, though it should be noted that examples are known in Egypt proper. However, in view of the frequency of the Asiatic parallels, one would suspect that the Gelidonya scarab is of local, non-Egyptian manufacture.

Sc 3. Fig. 150. White frit, no traces of glaze. L. .017, W. .012, H. .004, diam. of hole .002. Inscriptions on both faces neatly and deeply incised.

Description of top (a): Central vertical column containing alternately the hieroglyphs *r-n-r-n-r*. This is flanked at right angles by lunettes, each containing a symmetric group *n-ḏd-n,* the *n* being written with the sign of the Lower Egyptian crown; pierced vertically for suspension.

Parallels: While no parallels employing exactly the same hieroglyphs in the same arrangement are forthcoming, the motifs, the symmetric arrangement of the hieroglyphs, and their iconography are common. *Cf.,* e.g., Petrie and Duncan, *Hyksos and Israelite Cities,* pl. 4*a*, no. E2; *ibid.*, pl. 8, no. 44; *ibid.*, pl. 9, no. 170; Petrie, *Beth Pelet* I, pl. 39, no. 441 (in a Dynasty 22 grave); Loud, *Megiddo* II, pl. 149, no. 50; Albright, *Tell Beit Mirsim* II, pl. 29, no. 13; Mackay, *et al., Gaza* V, pl. IX, no. 74; Tufnell, *Lachish* IV, pl. 39, no. 390.

Description of bottom (b): The field is divided into three unequal sections. At the extreme right is a narrow lunette containing perhaps a *nb*-basket. In the center is a vertical column of alternate *r-n-r-n-r*. Both right-hand lunette and central column occupy about two-fifths of the field. To the left of this, at a right angle, the group *wꜣḏ-ḏd-n* (the latter written with the hieroglyph of the Lower Egyptian crown) are over a *nb*-basket.

Parallels: As with the inscription on the opposite face, no exact parallel is forthcoming. However, the same symmetric arrangement of the signs is known elsewhere; *cf.,* e.g., Guy and Engberg, *Megiddo Tombs,* pl. 114, no. 16; Macdonald, *et al., Beth Pelet* II, pl. 55, no. 260; Dunand, *Byblos,* B14.471.

Remarks: Stylistically and iconographically the inscriptions are typical of the Hyksos Period. The hieroglyphic inscriptions are meaningless. They were adopted by the Asiatics in imitation of genuine meaningful texts, and indicate a local Asiatic origin or place of manufacture.

Sc 4. Fig. 150. Ivory or bone. L. .018, W. .014, H. .008. Inscription on underside (base) neatly and deeply incised; anatomical details on top not indicated.

Description of top: Oval shape; barely discernible clypeus, prominent head. No lines indicating separation of head from body or prothorax from elythra; wing-cases of elythra not indicated. Legs carved on sides. Pierced vertically for suspension.

Description of base: The field is divided into three vertical columns. The central one contains alternately the signs *r-n-r-n-r-n-r-n-*. The right- and left-hand columns are inscribed *ḥm ʿnḫ* and end with a meaningless right angle facing outward.

Parallels: No exact parallels containing the same signs in the same grouping are known, but the general iconographic scheme is common; *cf.* Dunand, *Byblos* II, pl. 199, no. 7665; *SCE* II, pl. 144, no. 27; Tufnell, *Lachish* IV, pl. 30, no. 26; *ibid.*, pl. 32, no. 70; Petrie, *Gaza* III, pl. 3, no. 17; *ibid.* IV, pl. 7, no. 162, pl. 11, no. 426; *ibid.* V, pl. 9, nos. 70–72; Loud, *Megiddo* II, pl. 151, no. 121, pl. 153, no. 213; Horn, "Shechem," *JNES* 21 (1962) pl. 1, no. 27; Petrie, *Beth Pelet* I, pl. 10, nos. 74, 109; Cairo CG 36468, 37098.

Remarks: The division of the field into three vertical columns and the crude broad writing of the individual signs immediately calls to mind the iconography of the Second Intermediate Period (*ca.* 1785–1567 B.C.). In these, however, the central column usually contains three hieroglyphs. Only the Gelidonya scarab and its parallels from Byblos and Cyprus show two glyphs here. It may also be noted that the latter parallel shows only one sign, repeated twice, in each of the side columns.

There is no doubt that this scarab, like Sc 3, is to be dated to the Second Intermediate Period. The motif, while known on scarabs originating from Egypt, seems more common to Asia.

Sc 5. Fig. 150. L. .018, W. .007. Vignette on underside (base) neatly executed in sunken relief with internal details of figures incised; anatomical details of back and sides molded and then outlined by incision. Perforated vertically for suspension, but broken along perforation.

Description of top: Oval shape; clypeus, head, and prothorax occupy approximately half the length of the scarab. Clypeus rather small; that part of the head which is preserved shows two obliquely vertical lines incised along its length. Prothorax separated from elythra by single incised horizontal line; wing cases of elythra divided by single incised vertical line; no markings on wing cases.

Description of base: The upper half of the vignette, held horizontally, is lost. The interpretation of the lower half is not completely certain. At the left a wide vertical band, crossed by horizontal incisions, ran across the height of the

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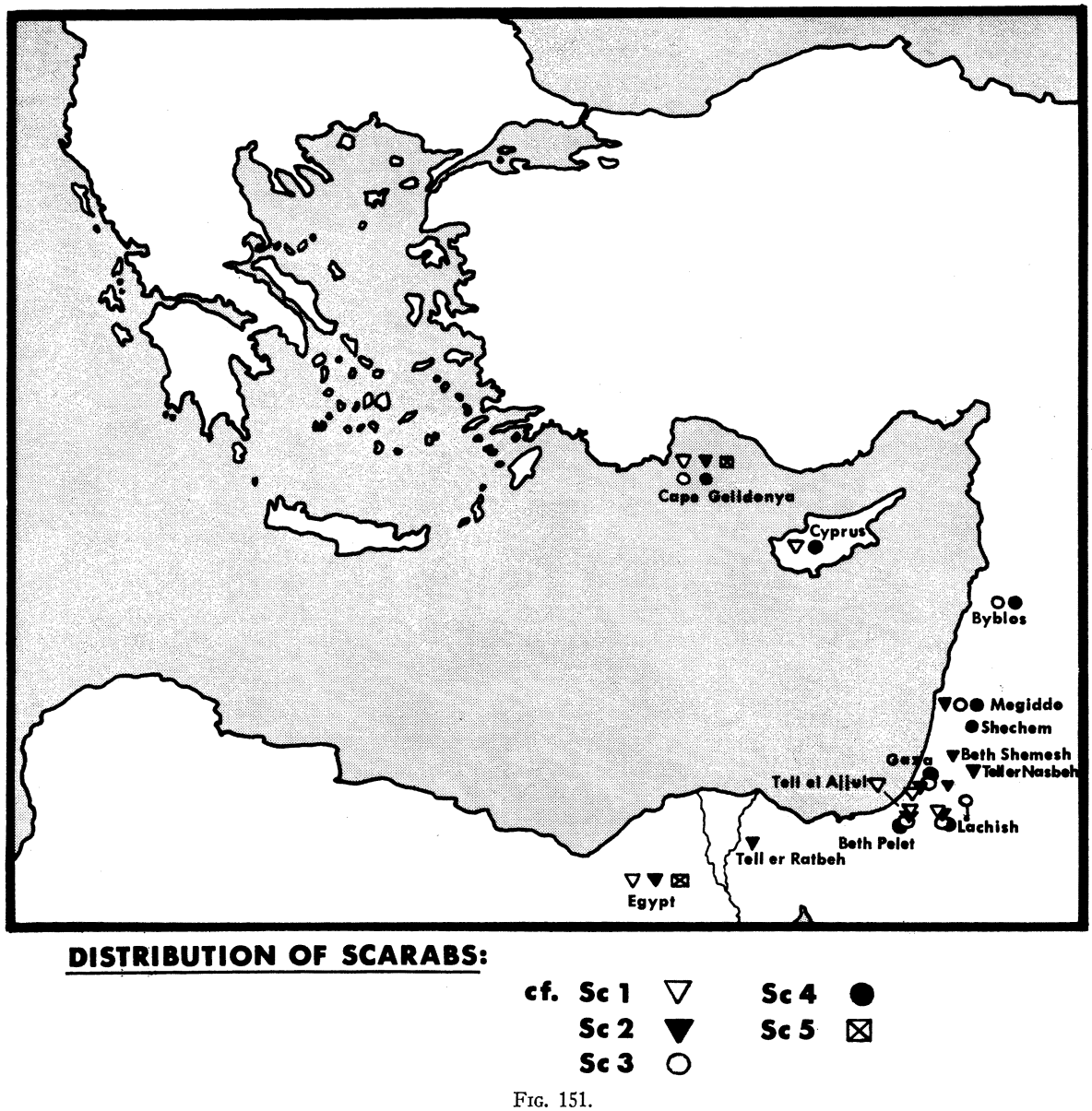


FIG. 151.

scarab. To its right, facing right and filling the central portion of the field is the body of a serpent; the break in the scarab occurs just at its head. In front of the serpent is a group which is not clear, but which may be a crude rendering of the Lower Egyptian Crown.

Parallels: Cairo CG 36889, 37063; compare the following: Cairo CG 36946, 36952, 36938, 37265, 36676, 36960.

Remarks: The majority of the parallels for the dominant motif of the rearing serpent are attested in Egypt, but as was shown by the parallels, a few examples are attested in Palestine. Since the group of signs in front of the snake are unclear, an exact parallel cannot be determined. Some of the examples show a *nfr*-sign, some an *ʿnḫ*, and two Palestinian parallels a reed-leaf. The majority of the loose parallels date to the New Kingdom, but at least one example from Gezer dates to Dynasty 13, i.e., the beginning of the Second Intermediate period. I would tend to assign this earlier date to the Gelidonya scarab because of the internal cross-hatching of the vertical band behind the serpent's tail, and also on the basis of the crude depiction of the red crown before the serpent, assuming that my identification of those carved lines as representing the red crown is correct. In any event, the date of the scarab is certainly earlier than that of Sc 1.

CONCLUSIONS

Inasmuch as the wreck is, so to speak, a "closed group," so that the possibility of a later intrusion among the scarabs is almost non-existent, the dating of them then takes on a special and important significance; for if the date of the latest scarab can be determined with any precision, an approximate *terminus ante quem non* for the date of the ship's sinking may be established. Furthermore, this *terminus* would be a dating criterion independent from the other objects and artifacts found.

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These may be contemporary or later than the scarabs. but certainly not earlier. Two of the scarabs, Sc 3 and Sc 4, on the basis of the iconography and meaningless content of their inscriptions, certainly date to the Second Intermediate Period (*ca.* 1785–1567 B.C.). Two more, Sc 2 and Sc 5, stylistically belong to the early New Kingdom, more specifically to Dynasty 18 (*ca.* 1570–1304 B.C.). Sc 1 is the latest and can be dated to the late Eighteenth or Nineteenth Dynasty. Although it has prototypes already in the latter part of the Second Intermediate Period, the motif of Sc 1 is best known in the late Eighteenth through Nineteenth Dynasties, and is most frequently attested in the latter, in the reign of its second king, Ramesses II (*ca.* 1290–1223 B.C.). This in turn suggests the thirteenth century B.C. as the most probable date of the wreck, although a slightly earlier or slightly later date is possible.

The motifs of the individual scarabs and their more frequent attestation from sites outside of Egypt, specifically in Palestine, Syria, and Cyprus (fig. 151), may be of some significance, particularly in an attempt to determine the origin of the crew or crew members to whom they belonged. Although parallels for all are known in Egypt, in the main they appear to be of local Asiatic, and non-Egyptian manufacture. In connection with this, the fact that the two latest, Sc 1 and Sc 2, are paralleled by examples found in Cyprus is of especial interest.

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XII. THE CYLINDER SEAL

HANS-GÜNTER BUCHHOLZ

(translated from German)

Cylinder seal. Material: haematite.[1] H. .026, D. .012, D. of drill hole .0035. Signs of wear at the upper and lower rim. Figs. 152–154.

The piece was found in area M IV (fig. 43), probably washed to this location from the "captain's quarters." In the same area were found the scarabs (chap. XI) and stone weights (chap. X). The cylinder seal must, therefore, be considered part of the personal belongings of an influential member of the crew; its singular appearance precludes its having been an object of trade.

The seal design, made in strong intaglio without the use of a tubular drill, is of notable delicacy in the reproduction of the physiognomic, anatomic, and ornamental detail. Three figures are crowded into the narrow space, one facing right, the others, opposite it, facing left. The space between them is occupied by animals: at the bottom a bird facing right—probably a falcon with his head turned back—above it a crouching goat, above that a star with eight points, and finally on top a pigeon flying to the left (figs. 153 and 154).

The composition of the picture emphasizes the vertical. The two scepters are the boundaries of the upright rectangular central area toward which the figures on the left and right are correlated (fig. 153).[2]

The figure to the left is depicted in a striding position, wearing a tasseled loincloth and an *atef-crown* (fig. 152). It shows Semitic features, wears two rings on the right forearm, and holds a circular object in the loosely hanging right hand. The left hand holds vertically a scepter with an oval thickening and two slightly curved crosspieces at its upper end. The second figure from the right rests its right foot on the back of a lying sphinx. It holds vertically with its right hand a long scepter, which is crowned with a ball, and rests its left hand on its chest. On the head is a turbanlike headdress, from which come two protuberances. The figure wears a long, patterned, slit skirt; the right leg and both arms are uncovered. On the right thigh the tip of a curved sword or dagger is visible.

The figure standing at the very right—probably a servant to the former—is wearing a long, highly ornamented garment which covers the left arm. The bare right arm seems to be raised. The headdress is also turbanlike. Between the two figures, at hip height, is a twig.

We are dealing with a product of Syrian mixed art in which we find, at least thematically, strong Egyptian influences:[3] The figure at the left (figs. 152–154) is wearing Egyptian costume.[4] The object in its right hand might be an incorrectly drawn *ankh*.[5] On Syrian cylinder seals we find more than once a god with the *atef*-crown, without being able to identify him.[6] In Egypt, during

[1] I have not seen the original; the designation of material is from J. du Plat Taylor: "possibly haematite." On haematite as material for seals see n. 46. The seal has been mentioned previously in *AJA* **65** (1961) 274, with pl. 90:36; *Archaeology* **14** (1961) 85, with fig.; *Expedition* **3**, 2 (1961) 9, with fig.; *Yearbook of the Amer. Philos. Soc.* (1961) 461; *Anatolian Studies* **11** (1961) 27; *Türk Arkeoloji Dergisi* **11** (1961) 8, with pl. 2:6; *Atlantis* (1963) 428, fig. 3; *JHS* **85** (1965) suppl. 33; Weidner, *AOF* **21** (1966) 194; Schachermeyr, *Ägäis und Orient* (1967) 54, pl. 53: 190; Kenna, *Studi Micenei ed Egeo-Anatolici* **3** (1967) 95 f., fig. 2.

[2] Similar composition on a cylinder seal from Boğazköy: Beran, *IstMitt* **9/10** (1959/60) pl. 88, 2. Antithetic composition normally in Syrian glyptics, compare Meck, *BASOR* **90** (1943) 24 ff., figs. 1–4.

[3] *Cf.* Erman, *Die ägyptische Religion*[2] (1909) 217; further, Thomsen, *RV* XIII, 120; Frankfort, *Cyl. Seals,* 292 ff.; Moortgat, *VRS,* 55; Parker, *Iraq* **11** (1949) 10 ff. no. 17 ff. Still further, Brit. Mus. no. 89122 (Wiseman-Forman, *Götter und Menschen im Rollsiegel Westasiens* [1958] no. 47); Macalister, *Excav. of Gezer* I (1912) 312, fig. 163 (basalt cylinder from Grave 29, Jawal eš Šāmi, spirals at the upper and lower borders of the scene filled with hieroglyphs); Dunand, *Fouilles de Byblos* I, Atlas, pl. 124 no. 1551, 1862, and pl. 125 no. 3074; Woolley, *Alalakh,* pl. 66, 135; *Syria* **28** (1951) 9, fig. 3 (Ras Shamra, 1st half of fourteenth century B.C.). Historical connection of Egyptian and Near Eastern cylinder seals in general: v. Bissing, *AOF* **5** (1928/29) 58 ff.; Goedicke *MDIK* **17** (1961) 69 ff., and Wenig, *Zeitschr.f.ägypt. Sprache u. Altertumskunde* **88** (1962/63) 66 ff.

[4] Pointed loincloth also on the stele *Ugaritica* II, 82, fig. 36; further, on the cylinder seals De Clercq no. 387; Newell no. 320; v. Aulock no. 300; Bibl. Nationale no. 483.

[5] Wrongly drawn *ankh* also on the cylinder seal Dunand, *Fouilles de Byblos* II, Atlas, pl. 192 no. 7169. The *ankh*-symbol appears frequently on Syrian cylinder seals: *cf.* Jirku, *Die Welt der Bibel* (1957) 17, pl. 16 below; Jirku, *Geschichte Palästina-Syriens im orientalischen Altertum* (1963) 60 and 118 (seal of Atanaḫ-ili, eighteenth century B.C., from Taanaḫ); Albright, *AJA* **36** (1932) 558, fig. 1 (Egyptianizing cylinder seal of the seventeenth century B.C. from Tell Beit Mirsim); Frankfort, *Cyl. Seals,* 256; Moortgat, *VRS,* 55; Woolley, *Alalakh,* 259; and Franken, *ILN* 17.4.1965, 34 fig. 1 below (from Deir ʾAllā, Jordan). The *ankh* was used in Syria as a good luck symbol; it appears, for example, engraved on an unpublished stone anchor in the Nat. Mus., Beirut.

[6] Frankfort, *Cyl. Seals,* 189, pl. 44 u (seal from Damanhur, Nile Delta: Albright, *Jour. of the Palest. Orient. Soc.* **15** [1934] 217, and Parrot, *Archéologie mésopot.* II [1953] 401 f., fig. 109, 1). Moortgat, *VRS,* no. 548 (=*Syria* **11** [1930] 11 ff.). On the seal impression of Samsu Adad, servant of Jarim-lim, from Tell Atchana VII, appears likewise a god with *atef*-crown, *uas*-scepter, and *ankh*-symbol; *cf. Antiquaries Journal* **28** (1948) pl. 9 left below, and especially Moortgat-Correns, *Zeitschrift für Assyriologie* **51** (1955) 97, with fig. 9 and pl. 2,3; also Nagel-Strommenger, *Jour. of Cuneiform Stud.* **12** (1958) 109 ff.; Matthiae, *Ars Syra* (1962) 103. The *atef*-crown is often otherwise recorded in Syria-Palestine, *cf.* the stelai of Beisan and Balūʿa: A. Rowe, *The Four Canaanite*

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the New Kingdom, this crown is so frequently associated with Osiris that that god is referred to as "he who is adorned with the *atef*-crown";[7] he was also known in Syria.[8] Only recently he has been identified on an imported cylinder seal in Late Bronze Age Attica, where he is enthroned as judge of the dead and is equipped with the *uas*-scepter.[9] In our case the figure must remain unnamed for the present, especially since its scepter is not the usual *uas*-scepter of the Egyptian gods.[10] The crosspieces above the thickening of the scepter can hardly be interpreted as the four plates of the *djet*-column; they appear rather as a plantlike motive.

Among the Egyptianizing elements of the image on the Cape Gelidonya seal we must include the falcon with its head turned back and also the sphinx on which the figure at the right has put its foot (figs. 153–154). The sphinx had already been added to the Syrian stock of motives early in the second millennium B.C. and appears there frequently as late as the beginning of the first millennium B.C.[11] The motive of a man with his foot on a lying sphinx is found also frequently on cylinder seals.[12] Whether or not he can be interpreted as a god cannot be answered; if he represents a god he cannot be identified.

The slit skirt is an ancient Mesopotamian inheritance and was evident from the time of Mesilim onwards.[13] The "turban," however, seems to be a genuinely Syrian headdress. On a cylinder seal of the first Syrian group (Bibliothèque Nationale number 428), it appears to be higher and more voluminous than in the representation

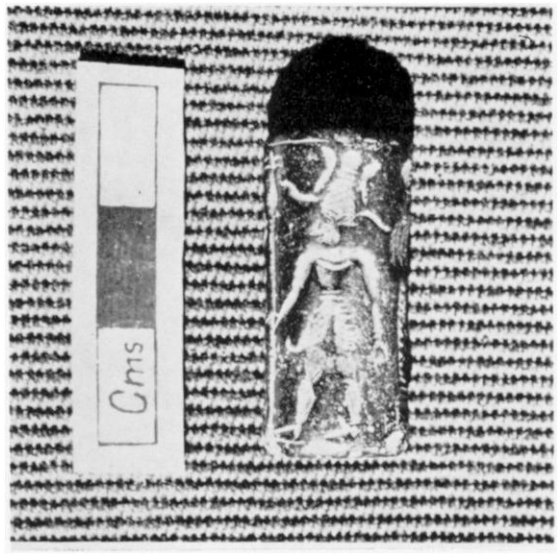


FIG. 152.



FIG. 153.

discussed here.[14] The curved sword is observed invariably with Syrian and also Hittite weather gods.[15]

Rows of animals in a framed area—usually framed by braided bands,[16] although not here—are a distinguishing mark of Syrian glyptic. Goats, however, are found only rarely, rabbits being more frequent.[17] The

Temples of Beth-Shan I (1940) 33, pl. 35, 3; 65a1, and *RBibl* **41** (1932) 417 ff., pl. 11 (=A.-G. Barrois, *Manuel d'Archéologie biblique* II, 152, fig. 233, and 392, fig. 342).

[7] Abu Bakr, *Untersuchungen über die ägyptischen Kronen* (Diss. Berlin, 1937) 7 ff.; Bonnet, *Reallexikon der ägyptischen Religionsgeschichte* (1952) 57 f.

[8] *Cf.*, e.g., a bronze statuette: Dunand, *Fouilles de Byblos* II (1950) Atlas, pl. 161. For Egyptian divinities in Syria in general: Helck, *Die Beziehungen Ägyptens zu Vorderasien im 3. und 2. Jt.v.Chr.* (1962) 480 f.

[9] *Ergon* (1962) 24, fig. 31 (from Perati, Grave 142); *cf.* below p. 157 no. 55.

[10] For this, Bonnet, *op. cit.* (*supra*, n. 7) 840 f.; Schachermeyr, *Ägäis und Orient* (1967) 54 n. 142: Egyptian king or god.

[11] Summarized: A. Dessenne, *Le Sphinx, étude iconographique* (1957) 161 ff.; cf. for linguistic and cultural-historical information: F. Wild, *SBWien* **241** (1963) no. 4, Gryps-Greif-Gryphon (Griffin). For the first and second Syrian seal groups, *cf.* Frankfort, *Cyl. Seals,* 255 f., 265, 272, 302; further, a later cylinder seal of mixed Syrian-Egyptian-Aegean art: Seyrig, *Syria* **33** (1956) 169 with fig. (sphinx with "horns") and *Syria* **6** (1925) 205, fig. 1 (=Contenau, *La Glyptique syro-hittite* [1922] pl. 13, 81, sphinx with "Doppelfederkrone"). Iron Age examples in Galling, *Biblisches Reallexikon,* 485, figs. 1 and 2.

[12] E.g., Newell no. 310 (winged sphinx, *cf.* Frankfort, *Cyl. Seals,* 258); Poche no. 30 (weather god in striding position with one foot on a crouching sphinx).

[13] Moortgat, *VRS,* 20 n. 3.

[14] Frankfort, *Cyl. Seals,* 235, pl. 41 b. To be compared is the "ovaler Kopfschmuck," considered by Wiseman as typically Syrian: Wiseman-Forman, *Götter und Menschen im Rollsiegel Westasiens* (1958) 36.

[15] *Cf.*, e.g., *Syria* **28** (1951) pl. 14, 2.

[16] Considered by Moortgat (*VRS,* 51 and 53) as a typically Syrian motif, *cf.* in opposition: *Falkner, Reallex.d.Assyriologie* III, 84 ff. According to Wiseman, *op. cit.* (*supra,* n. 14) perhaps a symbol for clouds or heavenly waters.

[17] There is no question of a hare, as the comparison with the seal of Haqata (1900 B.C.) shows: Delaporte, *Catalogue des cylindres orientaux, Louvre,* II, no. A914, pl. 96, 12 a.b. *Cf.* Kupper, *RAssyr* **53** (1959) 97 ff.; Nagel, *AOF* **20** (1963) 128 and 130, fig. 6. Further examples of crouching hares: *Syria* **6** (1925) 205, fig. 1; Moortgat, *VRS,* pp. 51 and 53, nos. 532, 537; Woolley, *Alalakh,* pl. 66, 137; Walters, *Brit. Mus.* no. 112 (cylinder seal from Klavdia near Larnaka); *Iraq* **6** (1939) pl. 6 no. 43; Mode, *Archiv Orientalni* **18**, 4 (1950) IV 82 ff., pl. 1, 4 (Coll. Schmidt, Solothurn); *Syria* **33** (1956) 169 with fig.

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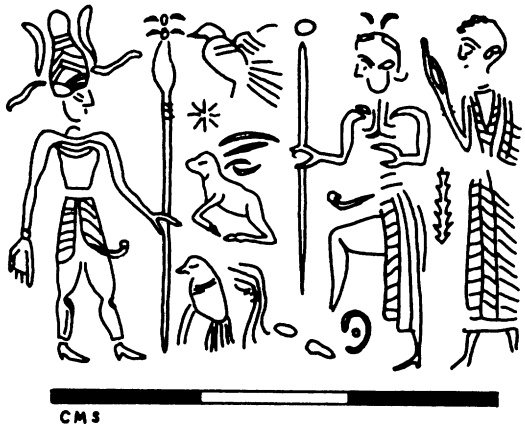


FIG. 154.

flying pigeon, however, is found more than once on cylinder seals.[18]

The question concerning the time of origin of our seal within Syrian glyptics remains to be settled. The rigidly vertical and parallel arrangement of the figures, quality, style, and topic exclude it from the "third Syrian group."[19] Since the discovery of the archives of Alalakh, it becomes more and more apparent that the "first and second Syrian groups" cannot be distinguished to the extent that was attempted by H. Frankfort.[20] For this reason it is difficult to decide into which of the two groups our seal falls. E. Porada places it in the eighteenth or seventeenth century B.C.[21] Along with those thematically related representations which were mentioned in footnote 6, above, we are very much in the eighteenth if not the end of the nineteenth century B.C.[22] The rule that the most recent object establishes the date of an archaeological complex of finds is also applicable to the ship of Cape Gelidonya. The cylinder seal is the oldest of the objects found and its age at the time the ship sank was more than half a millennium. Within the collection of cylinders from Boeotian Thebes there are specimens of different centuries, proving the chronological value of seals to be problematic (catalogue p. 157 f, nos. 61–99). Further on an Oriental cylinder from a Roman grave of S. Felice near Vicenza [23] shows that seals must be counted among the most durable heirlooms and should be used in establishing the age of a discovery only with reservations.

The importance of this newly discovered seal is based on its geographical location: the map (fig. 155) shows the distribution of cylinder seals found near the coast along the most important sea routes. This material from Hellas and the Aegean islands establishes in general a remarkable proof of Aegean-Syrian contacts and mutual influence. That Anatolia participated not at all, or very little,[24] is apparent from the fact that discoveries have been limited to the South of the Aegean Sea, with the clear point of concentration on Crete. Besides cylinders from Troy and Lemnos (compare ns. 43 and 44) an unpublished faience specimen from tomb III near Mega Monasterion in Thessaly is to be considered as the most northern evidence for the distribution of Oriental cylinder seals in Hellas (catalogue p. 156, no. 48).

Since the first knowledge of objects of this kind, cylinder seals have been valued as important indications of cultural relations with the Near East. In fact they are so typically eastern that wherever they appear they signify relations with the Levant. A few even reached the Western Mediterranean.[25] By around 2000 B.C., Eastern cylinder seals had reached India, and since the seventh century B.C. also the Southern part of Russia.[26]

[18] Delaporte, *op. cit.* (*supra,* n. 17) no. 927; Porada-Buchanan, *Corpus,* nos. 911, 934. Pigeon and star also on a cylinder seal of the second half of the second millennium which was acquired in Aleppo: Evans, *PM* IV, 421, fig. 348 b. *Cf.* for the flying pigeon our catalogue nos. 14, 14a and 40.

[19] Frankfort dates the cylinder seal from Damanhur, which likewise shows a god with *atef*-crown, in the fourteenth century B.C. (*Cyl. Seals,* pl. 44 u); this chronological conclusion has been doubted, *cf.* above n. 6. Vertical arrangement alone does not seem to be strong evidence against low dating, since a cylinder seal from Bethel showing this feature is dated about 1300 B.C. by Albright, *The Archaeology of Palestine,* p. 101, fig. 23.

[20] *Cf.* Strommenger, *JCS* **12** (1958) 115 ff.; Kupper, *RAssyr* **53** (1959) 97 ff.; Buchanan, *The Classification of Cylinder Seals—relation to chronology* (1960); Matthiae, *Ars Syra* (1962) 95 ff.; Nagel, *AOF* **20** (1963) 128. New evidence for the early dating of the so-called second Syrian group has resulted from the level in which a corresponding cylinder seal was found at Boğazköy (Beran, *Türk Arkeoloji Dergisi* **11**, 2 [1962] 22).

[21] *AJA* **65** (1961) 274, fig. 46. V. E. G. Kenna comments as follows: "While I agree with many of the stylistic parallels in individual forms Dr. Buchholz has made, and in part agree with the possibility that the cylinder falls within the range of earlier Syrian glyptic, e.g. the 1st Syrian group of Frankfort, the possibility that this cylinder is by the hand of an emigrant craftsman working in Cyprus during the 14th century, should not be overlooked, and might well be reconsidered."

[22] Summarized: Parrot, *Archéologie mésopotamienne* II (1953) 401 ff. Chronological evidence is given by a sealing from a cylinder of the 1st Syrian group and offprints of an early scarab on the same well dated pot from the earliest strata in Balata, Palestine (1900—beginning of the eighteenth century B.C.); Sellin, *ZDPV* (1927) 267, pl. 30, and A. Rowe, *A Catalogue of Egyptian Scarabs* (1936) 234 f. no. S 4, pl. 26.

[23] Milani, *Mus. Arch. di Firenze,* 199, pl. 133,3; Karo, *AthMitt* **55** (1930) 126. *Cf.* also Buchholz, *OLZ* **61** (1966) 125.

[24] Already observed by Nilsson, *Archiv Orientalni* **17**, 2 (1949) 212.

[25] E.g., a Phoenician ivory cylinder from Grave 14, Tharros, Sardinia: Walters, *Brit. Mus.* no. 264, pl. 3; *cf.* also: *P. Gaukler, Cat. du Musée Aloui,* suppl. (1910) p. 352 no. 188 and 189, pl. 105 center; Hogarth, *Hittite Seals* no. 181 (seal of Indilimma, from Sicily); Blanco, *Zephyrus* **11** (1960) 151 ff., fig. 1 (cylinder of second Syrian group in Iron Age context, Velez-Malaga/Spain); P. Amiet, *Cahiers de Byrsa* **5** (1955) 11 ff., and **7** (1957) 26 no. 4 (Carthage); *cf.* Harden, *The Phoenicians* (1962) 215, and Driver, *Semitic Writing from Pictograph to Alphabet* (1948) 81 ff.

[26] E. J. Mackay, *The Indus Civilization,* 192, pl. M 10 and 11, (*cf.* Marshall, *Excavations at Mohenjo-Daro* I, 344, and part II, 371, pl. 114); Piggot, *Antiquity* **18** (1944) 98 f. (surface

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Cylinder seals were frequently imitated in the area of Aegean culture;[27] on Crete they were actually used as seals, as evidenced by the fragmentary impression of a Cypriot (according to another interpretation, "Syro-Hittite") cylinder from the "passage by the Service Stairs" at Knossos.[28] Local production of cylinder seals in Mycenaean Greece is proven, as well as what they were used for: after having written this contribution I received knowledge of an unfinished specimen found in Mycenae itself, and now in a private collection (Coll. Prof. P. R. Franke, Saarbrücken; this piece is not involved in our catalogue below; see addendum on p. 159).

In many cases a technical compromise and a mixture of themes of various kinds make it difficult to decide whether a seal was made on Crete, Cyprus, or in the Levant. For this reason cylinder seals with obviously Aegean components in style or subject have often been regarded as "Cypro-Minoan" or "Levanto-Helladic" products.[29]

A cylinder seal in the Pierpont Morgan Collection, made of alabaster and of unknown provenance, has been recognized by V. E. G. Kenna as genuinely Cretan. If it had come from Syria, it would be evidence that not only motives but entire seals belonged to the flow of cultural exchange which led back to the East.[30] The same applies for a Greek or Cypriot archaic cylinder seal, now in Berlin, which was discovered in Babylon.[31] Some sealings on sherds found at Bamboula in Cyprus are also taken from cylinder seals of clearly Aegean origin, as is indicated by style, composition, and the themes of the pictures.[32]

Originally, cylinder seals from the Aegean were expected to furnish a means of dating objects discovered with them, and a check on chronology.[33] The cylinder seal from the Gelidonya ship now serves as proof of what considerable lengths of time must be taken into account between the manufacture of a seal and its final "loss." The problem, concerning Babylonian cylinder seals from excavations on Crete, has been dealt with in depth by S. Smith;[34] and E. Porada has concerned herself with the dates and place of origin of several faience seals from Mycenae.[35]

The discovery of the Cape Gelidonya seal prompts us to compile a list of cylinder seals from the Aegean cultural sphere.[36] The following catalogue serves as a basis for the distribution map (fig. 155):[37]

find from Maski, Dekkan). For the cylinder seal in the Nagpur Mus. from Central India (cuneiform legend: "Libur-beli, servant of . . ."), *cf.* Suboor, *Jour. Asiat. Soc. Bengal* n.s. **10** (1914) 461 ff.; Lal, *Ancient India* **9** (1953) 101, pl. 24,4. A Persian cylinder seal, *ca.* 1000 B.C., unpublished, is in the Far Eastern Department of the British Museum, as Dr. Kenna told me. Furtwängler (*Antiken Gemmen* pl. 6,25) has published a cylinder from Akra in India, also in the possession of the British Museum; this item was purchased together with a Greek gem from the same source. For the route of stones of this kind to India, *cf.* a sealing of a cylinder seal found in Southern Arabia: *Archaeology* **18** (1965) 231 and fig. For cylinders from South Russia, *cf.* Frankfort, *CS*, 276, fig. 90 (from Northern Caucasus); Przeworski, *Reallex.d.Assyriologie* I, pl. 19; II, 487; and *RV* XIII, 160; *Trudy Moskva* **1** (1962) 202 ff. (preliminary report on the cylinder seals from Tchoga Zanbil); Piotrovskij, *Iskusstvo Urartu* (1962, Russian) 105 f., figs. 70–72 (cylinders from Karmir Blur).

[27] According to Furtwängler, *Die antiken Gemmen* III, 32, "Mycenaean" glyptics were not related to the Eastern cylinder shape; in disagreement: Curtius, *SBMünchen* VII (1912) 66; but see Matz, *Die Frühkretischen Siegel*, 100 n. 4. Kenna, *Cretan Seals*, 30 n. 2, and p. 78, now establishes that a certain predilection for cylinder seals can be observed in the LM IIb period. The eight-sided Middle Minoan seal, Ashmolean no. 1938, 1166 (Kenna, *op. cit.*, 111 no. 165; *Kadmos* **2** [1963] pls. 1 and 2) corresponds in function to Oriental cylinder seals and may be considered as a Cretan innovation inspired by Near Eastern influence.

[28] Evans, *PM* IV, 598, fig. 593. Nilsson, *Archiv Orientalni* **17**, 2 (1949) 210, no. 6, and *MMR*², 385 n. 60, no. 6; further, Furumark, *OpuscAth* **1** (1953) 52 n. 21; Kenna, *Cretan Seals*, 61; Boardman, in Palmer-Boardman, *On the Knossos Tablets* (1963) 72; Popham, *BSA* **58** (1963) 89 n. 2; Kenna *AA* (1964) 915, 936 f. and *Kadmos* **3** (1964) 40.

[29] *Cf.* the following numbers from the catalogue: 13, 14, 20, 36, 52, 55. For cylinder seals showing Aegean influence in Cyprus and Syria, *cf.* Dussaud, *Les Civilisations préhelléniques*² (1914) 272 ff.; Hogarth, *Hittite Seals with particular reference to the Ashmolean Coll.*, 71; Moortgat, *Die bildende Kunst des Alten Orients und die Bergvölker*, 30; Moortgat, *VRS*, 51; Frankfort, *Cyl. Seals*, 226, 266 ff., and 288; Kantor, *AegOr*, 95 ff.; Seyrig, *Syria* **32** (1955) 29 ff., and **33** (1956) 169 ff.; Kenna, *Cretan Seals*, 27 n. 7, and pp. 64 and 78; Kenna, *Brit. Mus. Quart.* **28** (1964) 102 ff., pl. 30; Matthiae, *Ars Syra* (1962) 125; Erlenmeyer, *AOF* **21** (1966) 32 ff. A cylinder seal from Enkomi (Murray, *Excavations in Cyprus*, pl. 4, 743) is Aegean in technique, style, and theme (but *cf.* Catling, *Cypriot Bronzework in the Mycenaean World*, 47 and 151 n. 9). Frankfort, *CS*, 303 f., and Porada, *AJA* **52** (1948) 178 ff., have attempted to determine the specific Cypriot characteristics of the native cylinder seals there. The best pictures of the Enkomi seal, Cyprus Mus. no. 1934 trial 37/2, now in Karageorghis, *Treasures in the Cyprus Museum* (1962) pl. 45,1 and Schachermeyr, *Ägäis und Orient* (1967) 54, pl. 53, 193, and Gill, *AthMitt* **79** (1964) 20 no. 46, pl. 6,2.

[30] It is not likely that the piece was acquired in Greece. At any rate, the place of acquisition will not signify much (*cf.* Weber, *AS*, p. III). Ward-Morgan no. 144; Porada-Buchanan, *Corpus* no. 1109; Kenna, *Cretan Seals*, 7, fig. 9, and 64, fig. 139; Kenna, *BSA* **55** (1960) 123 n. 162. A corresponding significance could be attributed to Aegean cylinder seals—Porada-Buchanan, *Corpus*, no. 1077, pl. 163, and Furtwängler, *Kleine Schriften* II, 119 (called Mycenaean by Kenna, *cf.* Himmelmann-Wildschütz, *MarbWPr* [1961] 5 n. 13; Boardman, *Island Gems*, 135 n. 1)—if their place of finding could be certain.

[31] Boardman, *Island Gems*, 135 K 2.

[32] Benson, in *The Aegean and the Near East*, Studies presented to H. Goldman (1956) 59 ff. and *AJA* **66** (1962) 417.

[33] As still today: *BCH* **78** (1954) 112 (apropos of a discussion of seal 1 from Perati, *cf.* catalogue p. 157 no. 54).

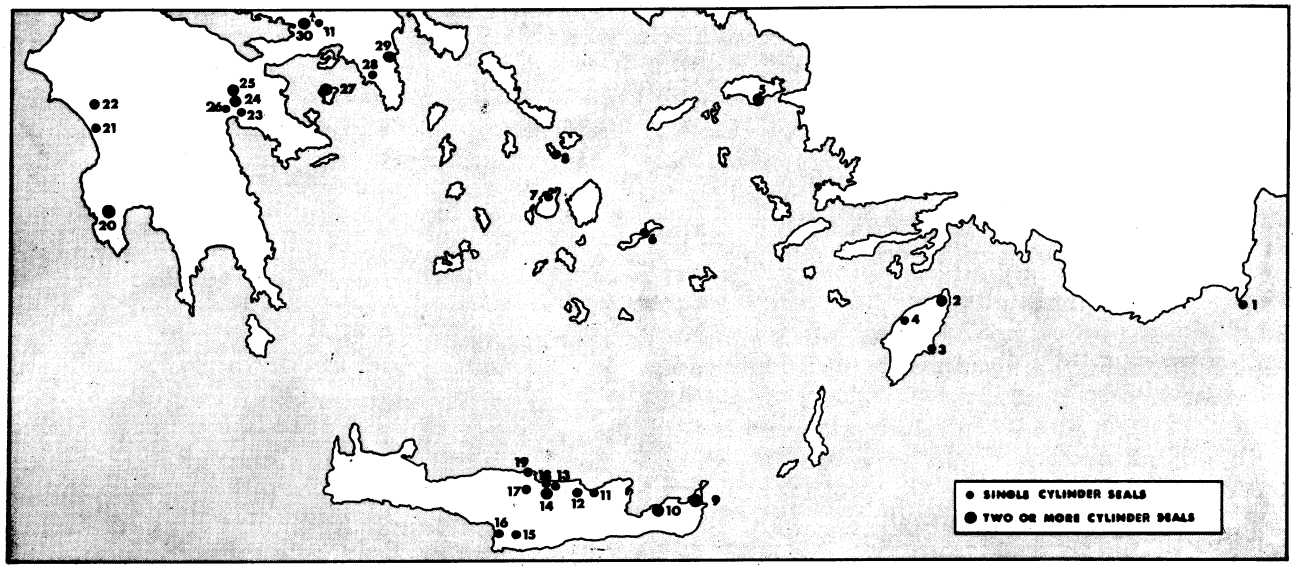
[34] *AJA* **49** (1945) 14 ff. *Cf.* the objection of Matz, *Hdb.d. Arch.* II (1954) 231 n. 2.

[35] *BSA* **52** (1957) 200 ff.

[36] Illustrations are found in the references cited. Descriptions of the seal scenes are found in the same works; only for a few unpublished pieces is a short description attempted here. Dates are obtained from the contexts of the finds; for uncontrolled single pieces from the presumed time of origin. Differences of opinion with regard to material, date and origin have been stated in brief form by the scholars' names.

[37] I am greatly indebted to K. Grundmann for drawing the map. I also want to thank H. B. Safadi, Damascus (until 1966

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Numbers on map:	Locality:	Numbers of catalogue, p. 152 ff.
1	Gelidonya	—
2	Ialysos, Rhodes	4–7
3	Lindos, Rhodes	8
4	Kameiros, Rhodes	9
5	Samos	10, 11
6	Amorgos	3
7	Paros	12
8	Delos	13
9	Palaikastro, Crete	36–38
10	Mochlos, Crete	32, 33
11	Mallia, Crete	29
12	Astrakous, Crete	20
13	Katsamba, Crete	24
14	Knossos: Palace, Sanatorium, Mavrospileio, Zafer Papoura	25–28, 30, 41
15	Platanos, Crete	39
16	Kamilari, Crete	23
17	Tylissos, Crete	40
18	Herakleion, Crete	22
19	Hagia Pelagia, Crete	21
20	Rutsi (Pylos), Peloponnesos	59, 60
21	Kakovatos, Peloponnesos	47
22	Olympia, Peloponnesos	53
23	Tiryns, Argolid	100
24	Prosymna and Argive Heraeum	46
25	Mycenae, Argolid	45, 56–58
26	Argos	49–52
27	Aigina	1–2
28	Vari, Attica	101
29	Perati, Attica	54, 55
30	Thebes, Boeotia	61–99
31	Mega Monasterion, Thessaly	48

FIG. 155. Distribution of cylinder seals in Aegean lands.

GREEK ISLANDS (EXCEPT FOR CRETE)

1. Aigina. Berlin Antiquarium no. 131. Light green steatite; archaic (about 550 B.C.).

   Furtwängler, *Beschreibung der geschnittenen Steine im Antiquarium* (1896) pl. 3, 131, and *Die antiken Gemmen,* pl. 5, 42; Schäfer, *Studien zu den griechischen Reliefpithoi des 8.-6 Jahrhunderts v. Chr.* (1957) 92 f., n. 432; Boardman, *Island Gems* (1963) 77, no. 334, pl. 11.

2. Aigina. Whereabouts unknown. Black steatite; sixth century B.C.

   Furtwängler, *Aigina* I, 434 no. 23; II, pls. 118, 35 and 119, 65; Boardman, *Island Gems,* 135, K 1.

3. Amorgos, vicinity of Kapros. From Early Cycladic Grave D, formerly owned privately in Athens, and now: Oxford Ashmolean no. AE 159. Green steatite (Frankfort), probably chrysoprase (Duemmler), light gray-green calcite (Buchanan), marble with crystalline surface (Kenna[38]). H. .044, H. without loop .033, D. at the base .02, D. of the eye .015. Widens slightly at the base. Amulet (Duemmler), unusual Aegean product to common Syrian type (Frankfort, Kenna), peripheral Jamdat Nasr style (Buchanan). Long use is shown by the traces of wear on the loop. The first publication by Duemmler is mentioned until now only by Blegen.

   Duemmler, *AthMitt* 11 (1886) 20, pl. 1 D 6; Montelius, *La Grèce préclass.* I (1924) 107 fig. 306; Evans, *PM* IV, 496; Frankfort, *CS,* 229, 232, 301 pls. 38 e, 46 v; Bittel, *AOF* 13 (1939–41) 303; v. Kaschnitz-Weinberg, *Prähist. Zeitschr.* 34/35 pt. I (1949/50) 201; Blegen, *Troy* III, 298; Bernabò Brea, *BdA* 42 (1957)

in Berlin), who has discussed with me the chronological arrangement of some seals. I had no opportunity to check the bibliography for Aegean cylinder seals in H. H. v. d. Osten, *Altorientalische Siegelsteine der Sammlung H. v. Aulock,* Studia Ethnographica Upsaliensia XIII (1957).

[38] Information by letter: I wish to thank V. E. G. Kenna for the careful examination of this piece.

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217 n. 14; E.-M. Bossert, *Festschrift für P. Goessler* (1954) 31, and *JdI* 75 (1960) 15 n. 34; Tuchelt, *Ist. Forsch.* 22, 25 n. 70; Buchholz, *OLZ* 61 (1966) 125; Buchanan, *Catalogue of Ancient Near Eastern Seals in the Ashmolean Museum* (1966) 135 no. 741, pl. 48; Renfrew and Charles, *AJA* 71 (1967) pl. 4: 19.

4. Ialysos. Rhodes, Grave 17, "pietro dura," with gold attachment. LH III c (LH III b, Vermeule), Syrian or Anatolian (Frankfort), Near Eastern (Vermeule).

Maiuri, *ASAtene* 6/7 (1923/24) 127 no. 71, fig. 47; V. Müller, *JdI* 42 (1927) 1 n. 3; Karo, *AthMitt* 55 (1930) 126; Frankfort, *CS*, 302 n. 2; Burton-Brown, *The Coming of Iron to Greece* (1955) 151; Vermeule, *Greece in the Bronze Age* (1964) 153 fig. 29 e.

5. Ialysos. Rhodes, Grave 17; agate and glass paste, two specimens, LH III c; from excavation report it is not clear whether seals or beads.[39]

Maiuri, *ASAtene* 6/7 (1923/24) 127 no. 71 and p. 247.

6. Ialysos. Rhodes, Grave 67; black steatite, North Syrian (Jacopi). Perhaps script between the figures, LH IIIc.

Jacopi, *ASAtene* 13/14 (1930/31) 256 and 278 f. no. 6 fig. 24; Spartz, *Das Wappenbild des Herrn und der Herrin der Tiere in der minoisch-mykenischen Kunst* (Diss. Munich 1962) 39 n. 2; Catling, *Cypriot Bronzework in the Mycenaean World* (1964) 138 n. 3.

7. Ialysos. Rhodes, grave find, Brit. Mus. no. 109; faience, LH III, Babylonianizing Hittite style (Furtwängler).

Furtwängler, *Die antiken Gemmen* III, 8 n. 1; V. Müller, *AthMitt* 43 (1918) 155; Walters, *Brit. Mus.* no. 150, pl. 3; Matz, *Die Frühkretischen Siegel*, 100 n. 6.

8. Lindos. Rhodes, faience, ninth/eighth century B.C.; at top three or four signs, not legible, perhaps ornamental. Similar composition on a specimen from Asia Minor in Nat. Mus. Copenhagen no. 5143. The Lindos cylinder: Syro-Hittite (Blinkenberg).

Blinkenberg, *Lindos* I (1931) 370 no. 1363, pl. 59.

9. Kameiros. Rhodes; Brit. Mus. no. 132. Blue faience, Phoenician.

Walters, *Brit. Mus.*, no. 263, pl. 3.

10. Samos. From cella of Heraion. Berlin (West) no. Sa 206; light white, partly bluish chalcedony. H. .04, D. .0165. Bronze piece still fixed to the drill hole. Date: end of ninth/beginning of eighth century B.C. For description and parallels see Diehl.

Diehl, *AA* (1965), 825 f. no. 89, fig. 1a and 2.

11. Samos. From cella of Heraion. Berlin (West) no. Sa 207; green steatite. H. .04, D. .018. Inscription: ana-^{d}bēl-tak-lak. A personality of this name was governor of Isana in 758 B.C.; for stylistic reasons the seal falls in the end of the eighth or first half of the seventh century B.C. For Anabēltaklāk see: Tallqvist, *Assyrian Personal Names* 23 and 62; Forrer, *Die Provinzeinteilung des assyrischen Reiches* 32. For description and parallels see Diehl.

Diehl, *AA* (1965), 825 ff. no. 90, fig. 1b and 3.

12. Paros. Munich, staatl. Münzsammlung no. A 1348 (formerly Coll. Arndt). Yellow white steatite speckled with grey; *ca.* 600 B.C., from Melian workshop.

Ohly, *Münchner Jahrb. d. bildenden Kunst* N.F. 2 (1951) 21, pl. 2, 10; Schäfer, *Studien zu den griech. Reliefpithoi des 8.-6. Jahrhunderts v. Chr.* (1957) 92; Boardman, *Island Gems*, 77 no. 333 and p. 88.

13. Delos. Inventory of finds no. B 7202; dark grey stone with letters or linear symbols. H. .019, D. .01. End of the Bronze Age; Syrian or Hittite (Gallet).

Gallet de Santerre and Tréheux, *BCH* 71/72 (1947/48) 240 ff., no. 99, fig. 39; Gallet de Santerre, *Délos primitive et archaïque* (1958) pl. 26: 60; Laroche, *Minos* 3 (1954/55) 9 n. 4.

CRETE

14. Crete. Without further information about provenance, acquired by purchase, Oxford Ashmolean no. 1938, 1091; haematite; LH II–III, good workmanship, Minoan imitation (Kenna). Cypro-Minoan (Evans).

Evans, *PM* IV, 458 f., fig. 383, p. 498; Pendlebury, *ArchCrete*, 257 n. 1; Frankfort, *CS*, 303 n. 2; Nilsson, *MMR*^{2}, 385 n. 60 no. 5; Kenna, *CretS*, 64 and 139, no. 358, pl. 14; Gill, *AthMitt* 79 (1964) 16 no. 13, pl. 2:6; Davies, *Deciph. of Minoan Linear A*, 247, fig. 234.

14*a*. Crete (?). New York, Metropolitan Mus. no. 26.31.-263; black marble, quasi-talismanic design of flying birds; one diagrammatically expressed with six tubular drill marks in the field; LH II.

Kenna, *AJA* 68 (1964) 11, pl. 1:40; 4:21.

14*b*. Crete (?). Coll. Kenna; elliptical cylinder, quartz, MM III.

Kenna in Matz, *Corpus* VIII (1966) p. ix and p. 183, no. 134.

15. Crete. Without further information of provenance, formerly Giamalakis Collection no. 3533, rock crystal with geometric designs, MM.

Xenaki-Sakellariou, *Etudes crétoises* 10 (1958) 24 no. 134, pl. 21.

16. Crete. Without further information of provenance, formerly Giamalakis Collection no. 3265, chalcedony, LM, encircled obliquely by palmette band; questionable if cylinder seal or piece of jewelry.

Xenaki-Sakelleriou, *Et. crét.* 10 (1958) 36 no. 134, and p. 91, pl. 23.

17. Crete. Without further information of provenance, formerly Giamalakis Collection no. 3264, steatite, figured scene, badly worn, LM.

Xenaki-Sakellariou, *Et crét.* 10 (1958) 59 no. 362, and p. 91, pl. 28.

[39] Bass, *AJA* **67** (1963) 356 nos. 15–17, observed that the distinction between cylinder seals and beads of necklaces sometimes poses difficulties; *cf. BSA* **28** (1926/27) 287 fig. 39,4 (from Mavrospileion) and A. Furtwängler-G. Loeschke, *Mykenische Vasen* (1886) pl. A 16 (from Ialysos).

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18. Crete. Without further information of provenance, Herakleion Mus., "divers cylindres en fer magnétique, percés. La gravure représente trois hommes en vêtements 'assyriens', tombant jusqu'aux pieds. Œuvre hittite (?)."

BCH 45 (1921) 538 no. 1; Xanthoudides, *VTM,* 117; V. Müller, *JdI* 42 (1927) 1 n. 3; Przeworski, *Reallex. d.Assyriologie* I, 43 f.; Weidner, *JHS* 59 (1939) 138; Nilsson, *Archiv Orientalni* 17, 2 (1949) 211 no. 9, and *MMR*², 385 n. 60; Schachermeyr, *Die minoische Kultur des alten Kreta* (1964) 324 n. 19; W. S. Smith, *Interconnections in the Ancient Near East* (1965) 9 and 101.

19. Crete. Without further information of provenance; Brit. Mus. 1945, 10–13, 133, formerly in Southesk Collection. Good Minoan cylinder seal (Kenna, but see now Kenna in Matz, *Corpus VII,* no. 173: from Golgoi, Cyprus, LH IIIa).

Kenna, *CretS,* 64.

20. Astrakous. East of Knossos, Herakleion Mus. no. 1460. Haematite, LM III (Pendlebury) thirteenth century B.C. (Kenna); Cypro-Minoan, but Minoan workmanship, some Syrian motifs (Evans, Kenna, Alexiou), forgery (Dussaud); Aegean-Levantine (Schachermeyr).

Evans, *PM* IV, 425 f., fig. 351; Pendlebury, *ArchCrete,* 257 n. 1; Frankfort, *CS,* 304, fig. 107; Dussaud, *Iraq* 6 (1939) 59 n. 6; Demargne, *La Crète dédalique* (1947) 81 fig. 1; Kenna, *CretS* 64 fig. 138; Spartz, *Das Wappenbild des Herrn und der Herrin der Tiere in der minoisch-mykenischen und frühgriechischen Kunst* (Diss. Munich 1962) 38 f. and p. 104 no. 36; Alexiou, *AA* (1964), 793 n. 15; Schachermeyr, *Ägäis und Orient* (1967) 54, pl. 52:188; Davies, *Deciph.,* 248, fig. 235.

21. Hagia Pelagia. West of Herakleion, Oxford Ashmolean no. 1938, 1090, purchased. Haematite, LM IIIa, forgery (Biesantz, Vermeule, Mellink, Hood), good Minoan work (Kenna, Schachermeyr).

Evans, *PM* IV, 497, fig. 436; Pendlebury, *ArchCrete,* 256, fig. 44 b; Frankfort, *CS,* 320 f., fig. 105; Demargne, *La Crète dédalique,* 82, fig. 2; Biesantz, *KMS,* 117 no. 4, fig. 57; Levi, *ArchEph* (1953/54) pt. III, 54, fig. 4; Mellink, *AJA* 59 (1955) 338; Kenna, *CretS,* 64 and 139 no. 357, pl. 14, also *BSA* 55 (1960) 123 n. 162; Vermeule, *The Art Bulletin* 43 (1961) 245; Gill, *Bull. Inst. Class. Stud. London* 8 (1961) 7 ff., and 10 (1963) 9 no. 16; Hutchinson, *Preh. Crete,* 298; Hood, *JHS* 83 (1963) 197; Buchholz, *OLZ* 61 (1966) 126; Schachermeyr, *Ägäis und Orient* (1967) 54, pl. 53:189.

21*a*. Hagia Triada. Florence, Archaeological Museum.

See special study by P. E. Pecorella; for cuneiform inscription see Sacchi: *Studi Micenei ed Egeo-Anatolici* 1 (1966) 67 ff., and 73 ff.

22. Herakleion. West edge of city; between Herakleion and Halmyros near the sea shore (Beloch). Herakleion Mus. no. 132. Haematite; Babylonian, time of Hammurabi. Inscribed: "Awel-Ištar, son of Mardukmušalim, servant of Nabu."

Beloch, *Griechische Geschichte* I 2² (1913) 123 n. 4; Fimmen, *KMK*², 170; Karo, *RV* IV, 364; V. Müller, *JdI* 42 (1927) 1 n. 3; Evans, *PM* II, 265 f., fig. 158; IV, 54 n. 2; Przeworski, *Reallex.d.Assyriologie* I, 43 f.; Hazzidakis, *Et. crét.* III (1934) 108, pl. 30, 3a; Demargne, *RA* (1936) 85; Demargne, *Ann. de l'école des hautes études de Gand* 2 (1938) 31; Pendlebury, *ArchCrete,* 121 n. 5; Frankfort, *CS,* 155, 252 and 302 n. 2; S. Smith, *AJA* 49 (1945) 16 f.; Kantor, *AegOr,* 19 n. 22; Nilsson, *Archiv Orientalni* 17,2 (1949) 210 no. 3; Parrot, *Archéologie mésopot.* II (1953) 397, fig. 108,2; Matz, *Hdb.d.Arch.* II (1954) 231 n. 2; Karo, *Greifen am Thron* (1959) 115.

23. Kamilari. Tholos tomb near Phaistos, Herakleion Mus. no. F 2652. Light green stone, MM. ". . . l'elementare motivo della serie di trattini orizzontali racchiusi da due righe verticali a maniera di scala, è una forma derivata ovviamente dai sigilli orientali."

Levi, *ASAtene* 39/40 (1961/62) 96 ff., fig. 124, 7 and 133.

23*a*. (?), said to be from tholos tomb near Phaistos. Formerly private coll. y.B. in Celle, Germany. Ivory, H. .014; this is engraved on the circumference like Oriental cylinders, but not on both ends like Early Minoan ivory cylinders. Design corresponds with Oxford no. 1938.790, which is thought to be a forgery (Kenna, *CretS,* pl. 20); therefore fairly clear that this piece also is dubious. For the tholos it is said to come from see Paribeni, *Ausonia* **8** (1913) 24.

Early Art in Greece, Emmerich Gallery, New York (May 7–June 11, 1965) 24, no. 62, with fig.

24. Katsamba. Previously Oxford Ashmolean (Biesantz), not heard of again (Kenna, but later checked by him in Metropolitan Mus. N. Y., no. 26.31.296); haematite, undatable (Frankfort), LM III (Pendlebury), LM II (Kenna), middling workmanship, Minoan style (Evans), forgery (Biesantz).

Evans, *PM* IV, 498, fig. 437; Chapouthier, *ArchEph* (1937) 323 n. 14; Pendlebury, *ArchCrete,* 257 n. 1; Frankfort, *CS,* 303, fig. 106; Demargne, *La Crète dédalique,* 82, fig. 3; Biesantz, *KMS,* 117 no. 5; Kenna, *CretS,* 64 n. 4 and *AJA* 68 (1964) 11, pl. 2:21; Schachermeyr, *Ägäis und Orient* (1967) 54, pl. 52:187.

25. Knossos. Herakleion Mus.; lapis lazuli with gold attachment; third or second millennium B.C. (Przeworski), before MM III (Smith), sixteenth–fifteenth century (Fimmen), probably 1st Syrian group (Frankfort), import from Anatolia (Platon).

Evans, *BSA* 7 (1900/01) 67 f.; Evans, *PM* IV, 423 ff., figs. 349, 350, and p. 497 n. 1; V. Müller, *AthMitt* 43 (1918) 155; Fimmen, *KMK*², 171; Xanthoudides, *VTM,* 117; Przeworski, *Reallex.d.Assyriologie* I, 43 f.; Demargne, *RA* (1936) 85 and 87; Frankfort, *BSA* 37 (1936/37) 118, fig. 20; Frankfort, *CS,* 302 n. 3; Dussaud, *Iraq* 6 (1939) 59; S. Smith, *AJA* 49 (1945) 16; Kantor, *AegOr,* 19 n. 22; Gallet de Santerre and Tréheux, *BCH* 71/72 (1947/48) 242 n. 1; Nilsson, *Archiv Orientalni* 17,2 (1949) 210 no. 4, and *MMR*², 385 n. 60 no. 4; Parrot, *Archéologie mésopot.* II (1953) 397 f., fig. 108,3; Matz, *Hdb.d.Arch.* II (1954) 231 n. 2; Platon, *Guide to the Arch. Mus. of Heraclion* (1955) 97; W. S. Smith, *Interconnections in the Ancient Near East* (1965) 9, fig. 132; Davies, *Decipherment,* 245, fig. 233.

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26. Knossos. Royal Road, excavation Hood; lapis lazuli, LM I; unpublished.

Kenna, *AA* (1964) 934.

26*a*. Knossos. Phrophetes Elias Cemetery, excavation Hood; green serpentine with spiral motive, elliptical cylinder, MM III; not published.

Kenna, *AJA* 68 (1964) 8, and in Matz, *Corpus* VIII (1966) p. ix.

27. Knossos (?). Brit. Mus. no. 1880.4–29.2, carnelian, LM I b (Kenna).

Walters, *Brit. Mus.* no. 149, pl. 3; Blegen, *Prosymna,* 280 n. 2; Kenna, *AA* (1964) 934 n. 76 and in Matz, *Corpus* VII, no. 94.

28. Knossos. Sanatorium Grave 3, Herakleion Mus.; carnelian, well preserved; LM I–II. Minoan workmanship (Kenna), Syro-Phoenician (Hutchinson).

Hood-DeJong, *BSA* 47 (1952) 274 f., no. III 23, fig. 16, pl. 54 c; Kenna, *CretS,* 63; Kenna, *BSA* 55 (1960) 123 n. 162, and *AA* (1964) 934 n. 76; Hutchinson, *Preh. Crete,* 298.

29. Mallia. Surface find, steatite, badly worn; LM III. Aegean imitation (Nilsson).

Chapouthier, *ArchEph* (1937) 321 ff., fig. 1 and 2; Chapouthier, *BSA* 46 (1951) 42 n. 2; Gallet de Santerre and Tréheux, *BCH* 71/72 (1947/48) 242 n. 1; Nilsson, *Archiv Orientalni* 17,2 (1949) 211, and *MMR*², 385 n. 60.

30. Mavrospileio. Grave find, Herakleion Mus. no. 1356. Marble (Forsdyke), ivory or bone (Kenna). Hittite or North Syrian, before 1400 B.C. (Forsdyke); badly worn, therefore dating and determination of provenance impossible (Frankfort). ". . . might be a much older cylinder used for votive purposes" (Kenna).

Forsdyke, *BSA* 28 (1926/27) 262 and 287 f. no. VII A 14, pl. 19; Karo, *AthMitt* 55 (1930) 126; Frankfort, *CS,* 302 n. 2; Kenna, *CretS,* 64 n. 6.

31. Central Crete. Without further information of provenance, Oxford Ashmolean no. 1938, 961; archaic (probably Achaemenid).

Boardman, *The Cretan Collection in Oxford* (1961) 123 ff., no. 540, pl. 46.

32. Mochlos. EM III grave, third or second millennium B.C. (Przeworski), "probably Babylonian" (Seager); "really an import?" (Hood); silver, badly worn and therefore dating and determination of provenance impossible (Frankfort).

Seager, *Explorations in the Island of Mochlos* (1912) 22 no. I n, p. 111, fig. 36; V. Müller, *AthMitt* 43 (1918) 155; Fimmen, *KMK*², 170; Evans, *PM* I, 198; Karo, *RV* IV, 364 and VII, 68; Xanthoudides, *VTM,* 117; Przeworski, *Reallex.d.Assyriologie* I, 43 f.; Demargne, *RA* (1936) 85 n. 1; Frankfort, *CS,* 302 n.2; Nilsson, *Archiv Orientalni* 17,2 (1949) 210 no. 1, and *MMR*², 385 n. 60 no. 1; Matz, *Hdb.d.Arch.* II (1954) 231 n.2; Hood, *JHS* 83 (1963) 197.

33. Mochlos (?). Metropolitan Mus. no. 26.31.285 (Seager bequest). Agate, elliptical cylinder, MM III b (Kenna); green steatite, if identical with Seager, *Mochlos* 75 no. XX 8 fig. 36. Since Porada (*BSA* **52** [1957] 201 f., ns. 27 and 30) mentions no. 26.31.297 in a bequest of seals from Mochlos by Seager, with a bird over the back of a horned animal, there seems to be a third item, because this design does not fit our no. 32 nor no. 33.

Stebbins, *The Dolphin in Literature and Art* (1929) 27; Kenna, *AJA* 68 (1964) 8, pl. 1:24, and in Matz, *Corpus* VIII (1966) p. IX.

34. East Crete. Without further information of provenance, Oxford Ashmolean no. 1938, 1006. Carnelian; LM II b–III a (Kenna), not datable (Frankfort). Motive variously interpreted (*cf.* Frankfort, Kenna). Minoan workmanship.

Evans, *PM* IV, 496 f., fig. 434; Frankfort, *CS,* 303; Kenna, *CretS,* 64, 69, and 139 no. 356, pl. 14; Kenna, *BSA* 55 (1960) 123 n. 162.

35. East Crete. Without further information of provenance, Oxford Ashmolean no. 1938, 1007. Red carnelian; LM (Kenna), not datable (Frankfort). Minoan workmanship (Kenna).

Evans, *PM* IV, 496 f., fig. 435; Pendlebury, *Arch Crete,* 257 n. 1; Frankfort, *CS,* 303; Kenna, *CretS,* 64, 69, and 139 no. 355, pl. 14; Kenna, *BSA* 55 (1960) 123 n. 162; Hafner, *Gesch.d.griech. Kunst,* 36, fig. 23.

36. Palaikastro. Larnax burial, Herakleion Mus. no. 233. Black steatite, LM III. Cypro-Minoan (Evans, Kenna), Minoan imitation (Matz, Chapouthier, Müller, Nilsson).

Bosanquet, *BSA* 8 (1901/02) 302, fig. 18; V. Müller, *AthMitt* 43 (1918) 155; Matz, *FKS,* 100 n. 3; Chapouthier, *ArchEph* (1937) 323 n. 14; Frankfort, *CS,* 303 n. 2; Pendlebury, *ArchCrete,* 257 n. 2; Hutchinson, *BSA* 40 (1939/40) 45 and 47 no. 27 fig. 17; Gallet de Santerre and Tréheux, *BCH* 71/72 (1947/48) 242 n. 1; Majewski, *Archaeologia* 3 (1949) 11 fig. 11; Nilsson, *Archiv Orientalni* 17,2 (1949) 211, and *MMR*², 385 n. 60; Kenna, *CretS,* 64 n. 5; Gill, *AthMitt* 79 (1964) 9 n. 26, p. 16 no. 12, pl. 2:1.

37. Palaikastro. Settlement find from House σ5; Herakleion Mus. no. 565. Dark haematite, LM II, Minoan workmanship (Kenna).

Dawkins, *BSA* 10 (1903/04) 215; Hutchinson, *BSA* 40 (1939/40) 45 and 47 no. 26, fig. 16; Nilsson, *Archiv Orientalni* 17,2 (1949) 211, and *MMR*², 385 n. 60; Porada, *BSA* 52 (1957) 202 n. 35; Kenna, *CretS,* 64 n. 5; Kenna, *BSA* 55 (1960) 123 n. 162.

38. Palaikastro. Herakleion Mus. no. 592, purchased. Dark haematite; badly worn, dating and determination of provenance not possible.

Hutchinson, *BSA* 40 (1939/40) 45 and 47, no. 28, fig. 18; Moortgat, *VRS,* 81 n. 1 (several cylinder seals in Herakleion Mus.); Nilsson, *Archiv Orientalni* 17,2 (1949) 211, and *MMR*², 385 n. 60; Kenna, *CretS,* 64 n. 5.

39. Platanos. Tholos tomb B, Herakleion Mus. no. 1098. Haematite, third or second millennium B.C. (Przeworski), MM I, time of Hammurabi or later (De-

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margne, Smith) LH III (Åberg, with reserve). "Das Rollsiegel kann nur nachträglich in den Fund geraten sein" (Matz, comp. Hood).

Xanthoudides, *VTM,* pp. VIII, 92, 116 f., no. 1098; Karo, *AA* (1916) 155 f.; V. Müller, *AthMitt* 43 (1918) 155; Evans, *PM* I, 15, 197 f., fig. 146; II, 265; IV, 54 n. 2; V. Müller, *JdI* 42 (1927) 1 n. 3; Matz, *FKS,* 100 n. 5; Hall, *The Civilisation of Greece in the Bronze Age* (1928) 107, fig. 125; Przeworski, *Reallex.d.Assyriologie* I, 43 f.; Demargne, *RAssyr* (1930) 84 f.; Åberg, *Bronzezeitliche und früheisenzeitliche Chronologie* IV (1933) 13, 270; Hazzidakis, *Et. crét.* III (1934) 108; Demargne, *RA* (1936) 84 f.; Glotz, *La Civilisation égéenne*[2] (1937) 247; Frankfort, *CS,* 302 n. 2; Pendlebury, *ArchCrete,* 121 n. 5; S. Smith, *AJA* 49 (1945) 14 f.; S. Smith, *The Statue of Idrimi* (1950) 68; Kantor, *AegOr,* 19 n. 22; Schaeffer, *Strat.,* 32 f.; Hutchinson, *Antiquity* 22 (1948) 66; Albright, *BibO* 5 (1948) 126; Trendall, *Handbook to the Nicholson Mus.*[2] (1948) 206; Demargne, *RHR* 136 (1949) 103; Moortgat, *BibO* 7 (1950) 175; Nilsson, *Archiv Orientalni* 17,2 (1949) 210 no. 2, *Geschichte d. griech. Relig.* I[2] (1955) 259, and *MMR*[2], 385 n. 60 no. 2; Matz, *Historia* 1 (1950) 173 and 176; Matz, *Hdb.d.Arch.* II, 231 n. 2; Rowton, *JNES* 10 (1951) 201 f.; Hanfmann, *AJA* 55 (1951) 363 n. 1; Parrot, *Archéologie mésopot.* II (1953) 397, fig. 108, 1; Karo, *Greifen am Thron* (1959) 115; Kenna, *CretS* 26 n. 1; Huxley, *Crete and the Luwians* (1961) 52; Hood, *JHS* 83 (1963) 196; Levi, *ASAtene* 19/20 (1957/58) 159; Åstrom, *Kret. Chron.* 15/16 (1961/62) 139; Zois, *ArchEph* (1965) 58; Buchholz, *OLZ* 61 (1966) 127 f.

40. Tylissos. Strata to which the item belongs not well established, Herakleion Mus. no. 380. Gray meteorite. Hittite (Legrain with Hazzidakis, Przeworski, Nilsson), belonging to the younger group of Syro-Hittite seals, *ca.* 1000 B.C. (Fimmen).

Fimmen, *KMK*[2], 170; Xanthoudides, *VTM,* 117; Przeworski, *Reallex.d.Assyriologie* I, 44; Hazzidakis, *Et. crét.* III (1934) pp. VII, 106 f., fig. 19, pl. 30,3 b; Chapouthier, *ArchEph* (1937) 322 n. 5; Nilsson, *Archiv Orientalni* 17,2 (1949) 211 no. 11, and *MMR*[2], 385 n. 60 no. 10.

41. Zafer Papoura. Grave 66, Herakleion Mus. Faience, LM; Mitannian (Kantor, Porada), local imitation (Matz, Karo).

Evans, *Archaeologia* 59 (1905) 71, fig. 81 b; V. Müller, *JdI* 42 (1927) 1 n. 3; Matz, *FKS,* 100 n. 3; Karo, *AthMitt* 55 (1930) 126; Blegen, *Prosymna,* 281 n. 1; Pendlebury, *ArchCrete,* 257 n. 1; Kantor, *AegOr,* 85 n. 29; Porada, *BSA* 52 (1957) 202, pl. 38 c.

GREEK MAINLAND [40]

42. Greece. Without further information of provenance, Berlin Mus. Near Eastern Dept. no. 734, black stone.

Moortgat, *VRS,* 81 n. 1 no. 783, pl. 92.

43. Greece (?). Frankfurt Mus. no. 512, formerly in Furtwängler Collection. White marble; sixth century B.C.

Boardman, *Island Gems,* 135, K 3, p. 162 n. 5, pl. 17.

44. Greece (?). Without further information of provenance, von Schoen Collection (now Munich Mus.), acquired in Greece; hard, gray stone, H. .025. Provincial Greek, probably Archaic. From left to right in the impression: large goose, before which a small goose with head turning back; advancing man and standing man; before the latter a seated he-goat(?). The standing man or the ram holds a staff.

Lullies, *Eine Sammlung griechischer Kleinkunst,* no. 281, pl. 88; Boardman, *Island Gems,* 135 n. 1.

45. Argive Heraion. Athens Nat. Mus. no. 14080. Green steatite, *ca.* 600 B.C.

Waldstein, *The Argive Heraeum* II, 350 no. 59, pl. 139,59; Boardman, *Island Gems,* 77 no. 332, pl. 11.

46. Argos. Larissa, Athens Nat. Mus. Dark haematite with bronze attachment. Syro-Hittite (Roes), Syrian (Kantor), Hurrian (Wace).

Roes, *BCH* 61 (1937), 1 ff., figs. 1–3; Wace-Blegen, *Klio* 32 (1939/40) 137 n. 9; Kantor, *AegOr,* 85 n. 29; Wace, *Mycenae* (1949) 108; Nilsson, *Archiv Orientalni* 17,2 (1949) 211 no. 7, and *MMR*[2], 385 n. 60 no. 7.

47. Kakovatos. From near the tholos tombs, formerly in J. Loeb Collection. Agate. Rising lion, attacked by a man with his sword; behind the male figure, an animal-shaped demon. LM I (Evans), Mycenaean imitation (Müller, Matz).

Wolters, *Münchner Jahrb. der bildenen Kunst* 10 (1916/18) 225; V. Müller, *AthMitt* 43 (1918) 155; Matz, *FKS,* 100 f. n. 6; Evans, *PM* IV, 459 and 462 f., fig. 387; E. Vermeule, *Greece in the Bronze Age* (1964) 132, fig. 25; Marinatos in *Proceedings of the Cambridge Colloquium on Myc. Stud.* (1966) 272, figs. 8 and 9.

48. Mega Monasterion. Thessaly, tomb III; light green faience, LH III a/b.

Theocharis, *Deltion* 19 (1964) Chron. 257, pl. 302 b; Megaw, *JHS* 85 (1965) Suppl. 20; *cf.* above p. 150.

49. Mycenae. From Chamber Tomb 47; Athens Nat. Mus. Haematite, H. .0225, D. .012; determination of provenance and date impossible because badly damaged (Frankfort); Mycenaean imitation (Müller, Karo); Hittite (Przeworski); Eastern (Matz); Syrian (Furtwängler).

Tsountas, *ArchEph* (1888) 154 and 179 f., no. 38, pl. 10; Milchhöfer, *AthMitt* 1 (1876) 326; Furtwängler, *Die Antiken Gemmen* III, 34 n. 1; V. Müller, *AthMitt* 43 (1918) 155; *AJA* 27 (1923) 83; Matz, *FKS,* 100 f., no. 6; Przeworski, *Reallex.d.Assyriologie* I, 44; Karo, *AthMitt* 55 (1930) 126; Frankfort, *CS,* 302 n. 2.

50. Mycenae. Material not known, convex shape;[41] "Schieber" (Furtwängler). Mycenaean imitation (Matz).

[40] Nilsson considered the Syrian cylinder seal (Evans, *PM* IV, 459, fig. 384) in his list as an "Oriental Import," although the piece was acquired in Aleppo and, therefore, had nothing to do with the Aegean (*cf. Archiv Orientalni* 17,2 [1949] 210 no. 5, and *MMR*[2], 385 n. 60 no. 5).

[41] The convex form is rare in the Orient and first became somewhat common in the Iron Age; *cf.* Frankfort, *Cyl. Seals,* 7 f., pl. 2 e; also Weber, *AS,* fig. 1,4; Unger, *RV* IV, pl. 154 a.

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Furtwängler, *Die Antiken Gemmen* III, 47, fig. 24; Evans, *JHS* 21 (1901) 140 f., fig. 24; Curtius, *SBMünch.* VII (1912) 66 n. 1; Matz, *FKS,* 100; Evans, *PM* IV, 499 n. 1; Nilsson, *MMR*², 257, fig. 126; Nilsson, *Gesch.d.griechischen Religion* I² (1955) 280 n. 2, pl. 12,5; Mylonas, *Mycenae and the Mycenaean Age* (1966) fig. 124:20.

51. Mycenae. From North Terrace, Athens Nat. Mus. find no. 39-170. Faience, badly worn; LH III b (thirteenth century B.C.), Syrian, perhaps Hurrian (Wace, Nilsson), Mitannian (Porada).

Wace, *JHS* 59 (1939) 210; Wace, *Mycenae* (1949) 83, 108; Nilsson, *Archiv Orientalni* 17,2 (1949) 211 no. 10, and *MMR*², 385 n. 60 no. 9; *Porada, BSA* 52 (1957) 197 ff., pls. 37 a,b, and 38 a.

52. Mycenae. Grave 517, Athens Nat. Mus. Faience; LH I–II (sixteenth–fourteenth centuries B.C.: Wace, Schaeffer), eleventh century B.C. (Hogarth), perhaps Cilician (Wace), Cypriote (Hall), Syrian (Hogarth), North Syrian (Schaeffer, Porada), stylistically indefinable (Nilsson).

Wace, *Chamber Tombs* (*Archaeologia* 82 [1932]) 73 no. 32, fig. 28, p. 197, pl. 35,32; Wace-Blegen, *Klio* 32 (1939/40) 137; Schaeffer, *Strat.,* 411 n. 5; Demargne, *La Crète dédalique* (1947) 82 n.; Gallet de Santerre-Tréheux, *BCH* 71/72 (1947/48) 243 n. 2; Wace, *Mycenae,* 108, fig. 110 b; Nilsson, *Archiv Orientalni* 17,2 (1949) 211, and *MMR*², 385 n. 60; Porada, *BSA* 52 (1957) 201 ff., pl. 38 b.

53. Olympia. Depository not stated, plaster cast in Berlin; malachite, Assyrian.

Olympia IV, 187; Unger, *RV* IV, pl. 162 c; Kunze, *Kretische Bronzereliefs* (1931) 263; Moortgat, *VRS,* 81 n. 1; Schäfer, *Studien zu den griech. Reliefpithoi des 8.-6. Jhs. v. Chr.* (1957) 93; Dunbabin, *Greeks and their Eastern Neighbours* (1957) 39 n. 5.

54. Perati. Grave 1, haematite, H. .031, D. .014, LH III c context; Anatolian (Cook), Syro-Hittite (Jakovides), Near Eastern (Vermeule).

Schachermeyr, *Anz. f. d. Altertumswiss.* 6 (1953) 218; Cook-Boardman, *JHS* 74 (1954) 147; *BCH* 78 (1954) 112; Jakovides, *Praktika* 1953 (1956) 94, fig. 6; *Ergon* (1962) 24; Vanderpool, *AJA* 67 (1963) 280; Vermeule, *Greece in the Bronze Age* (1964) pl. 48 c; Schachermeyr, *Ägäis und Orient* (1967) 54 n. 142.

55. Perati. Grave 142, haematite, H. *ca.* .032; Anatolian (Vanderpool), Cypro-Minoan with strong Syro-Egyptian influence. Cypro-Helladic signs: ⋕ ⅄. Distinguished workmanship; LH III c context.

Ergon (1962) 24, fig. 31; Vanderpool, *AJA* 67 (1963) pl. 64, 12; Mühlestein, *Kratylos* 9 (1964) 32; Weidner, *AOF* 21 (1966) 194; Jacokovides, *Delt.* 19 (1964) pl. 88:3.

On positive premises this form should be considered as an indication for a forgery: Strommenger, *Berliner Jahrbuch für Vor- und Frühgeschichte* 1 (1961) 196. On cylinder seal forgeries in general: Unger, *Reallex.d.Assyriologie* III, 7; and Porada-Buchanan, *Corpus,* 158 ff., and Porada, *Archaeology* 10 (1957) 143.

56. Prosymna. Chamber tomb 2, Athens Nat. Mus. Carnelian, onyx (Matz), LH II/III, Aegean imitation (Blegen, Nilsson, Kenna).

Karo, *AthMitt* 55 (1930) 126; Blegen, *Prosymna,* 280 no. 20, fig. 595; Nilsson, *Archiv Orientalni* 17,2 (1949) 211, and *MMR*², 385 n. 60; Kenna, *CretS,* 63 f.; Kenna, *BSA* 55 (1960) 123 n. 162 and *AA* (1964) 934 n. 76; Matz, *Corpus* I no. 206.

57. Prosymna. Grave 24, Athens Nat. Mus. White faience, LH III (beginning of fourteenth century B.C.), Syrian (Blegen, Porada).

Blegen, *Prosymna,* 85, 280 no. 21, fig. 596 above; Kantor, *AegOr,* 85 no. 29; Schaeffer, *Strat.,* 411 n. 5; Porada, *BSA* 52 (1957) 203 n. 44.

58. Prosymna. Grave 38, Athens Nat. Mus. White faience; LH III (beginning of fourteenth century B.C.), Syrian (Blegen, Porada).

Blegen, *Prosymna,* 131, 280 f. no. 22, figs. 310,25 and 596 below; Kantor, *AegOr,* 85 n. 29; Schaeffer, *Strat.,* 411 n. 5; Porada, *BSA* 52 (1957) 203 n. 44.

59. Rutsi. Near Pylos, tholos tomb 2; Athens Nat. Mus. no. 8335. Carnelian, H. .021, D. .008; well preserved. LH II, 1500–1430 B.C. (Marinatos), LH II/IIIa (Vermeule). Tree of life, two ibexes, lion, fish, scorpion and winged solar disk. Levanto-Mycenaean workmanship after an eastern prototype (Marinatos), Eastern (Schachermeyr), hybrid Asiatic (Vermeule).

Praktika (1956) pl. 102, 5; *Ergon,* (1956) 92, fig. 92,1; *BCH* 81 (1957) 562 ff., fig. 24; Vanderpool, *AJA* 61 (1957) 283, pl. 85, 12 second from uppermost; *Antiquity* 31 (1957) pl. 7a; v.d.Osten, *Bull. Medelhavsmuseet* 1 (1961) 29; Schachermyer, *AA* (1962) 274; Vermeule, *Greece in the Bronze Age* (1964) 153, fig. 29d; Matz, *Corpus* I no. 284.

60. Rutsi. Near Pylos, tholos tomb 2; Athens Nat. Mus. no. 8334. Sard; LH II, 1500–1430 (Marinatos). H. .017; D. .007. Minor damage on the lower edge of the scene, 'Fadentechnik.' At left a seated griffin with outstretched wings; to its right, facing it, a figure with helmet, loincloth, and raised hand. Levanto-Mycenaean workmanship (Marinatos), Mycenaean (Schachermeyr).

BCH 81 (1957) 562; Vanderpool, *AJA* 61 (1957) 283, pl. 85, 12 above; Schachermeyr, *AA* (1962) 274; Matz, *Corpus* I no. 285; *Antiquity* 31 (1957) pl. 7a.

61–99. Thebes. From Kadmeion, excavation 1963 (Platon); fallen from the upper floor of a hall of the second palace, contents of two wooden boxes: 36 cylinder seals, 32 of them Oriental, the rest Cretan-Mycenaean; unfinished, plain cylinders (11 or even hundreds?). 13 specimens inscribed: 11 Kassite, 1 Old Babylonian, 1 Hittite hieroglyphs, Material: lapis lazuli and agate One of the Old Babylonian pieces worked over, perhaps in Cyprus; the oldest specimen from time of Ur I, another one Akkadian (hero and two bulls), 2 from time of Isin-Larsa; some Kerkuk and Mitanni seals among this collection. The inscription of one of the Kassite cylinders is the name of an official of Burraburiash II, same official: Moortgat, *VRS* no. 554. This important collection not yet published.

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Kathemerini 25.12.1963; Marinatos, *Kathemerini* 17.4. 1964; Paraskevaides, *Kathemerini* 19.4.1964; Bennett, *Nestor* (1964) 304; Larsen, *ibid.*, 335 f.; Vanderpool, *AJA* 68 (1964) 293; Touloupa, *Kadmos* 3 (1964) 25 f., fig. 5–8; Falkenstein, *ibid.*, 108 f.; Lambert, *ibid.*, 182 f.; Finer, *New York Herald Tribune* 25.6.1964; Mühlestein, *Basler Nachrichten* 11./12.7.1964; *Times* 17.7.1964, p. 13 f. and fig.; Lyberopoulos, *Elpida* (Thebes) 25.10.1964, p. 3 ff. and fig.; *Die Welt* 14.11. 1964 and figs.; Ch. Picard, *RA* (1964) II, 77 f.; Platon-Stassinopoulou-Touloupa, *ILN* 28.11.1964, p. 859 ff. and *ibid.* 5.12.1964, p. 896 f.; Nougayrol and Daux, *BCH* 88 (1964) 777 ff. and fig. 3; Porada, *Nestor* (1965) 365; Porada, *AJA* 69 (1965) 173 and *AJA* 70 (1966) 194; Megaw, *JHS* 85 (1965) suppl. 15; Grumach, *Kadmos* 4 (1965) 45; Stölting, *Athene* 25 no. IV (1965) 2 ff. and figs.; Jucker, *Antike Kunst* 8 (1965) 45 n. 43; Catling and Millett, *Archaeometry* 8 (1965) 12; Alexandratos and Wybenga, *Hermeneus* 36, 7 (1965) 165 ff., 218, 235; Nougayrol, *Syria* 42 (1965) 234 n. 1; W. S. Smith, *Interconnections in the Ancient Near East* (1965) 87; *BCH* 90 (1966) 848 ff., figs. 2–4; *Kadmos* 5 (1966) 169 f.; Megaw, *JHS* 86 (1966) suppl. 12; Veenhof, *Phoenix* 12 no. I (1966) 317 ff.; Weidner, *AOF* 21 (1966) 193 ff., fig. 76; Zafiropoulos, *Mead and Wine* (1966) pl. 1; Schachermeyr, *Anz. f. Altertumswiss.* 19 (1966) 12, and *Ägäis und Orient* (1967) pl. 52: 183–184; Touloupa, *Delt.* 19 (1964) pls. 228, 229.

100. Tiryns. From treasure, without chronologically unified context, Athens Nat. Mus. no. 6214. Haematite; Hittite, fifteenth–fourteenth centuries B.C. (Karo, Müller, Nilsson, Przeworski, Al), Mitannian (Kantor, Vermeule).

Philadelpheus, *Deltion* (1916) suppl. 17, fig. 6; Karo, *AA* (1916) 146, fig. 3; V. Müller, *AthMitt* 43 (1918) 155; Müller, *JdI* 42 (1927) 1; Matz, *FKS,* 100 f., n. 6; Przeworski, *Reallex.d.Assyriologie* I, 44; Karo, *AthMitt* 55 (1930) 126, pl. 2,6; Picard, *RA* (1938) 5 ff.; Al, *De mannelijke en de vrouwelijke Godheid van de Boomcultus in de minoische Godsdienst* (1942) 10; Kantor, *AegOr,* 85 n. 29; Nilsson, *Archiv Orientalni* 17,2 (1949) 211 no. 12, *Gesch.d.griech. Relig.* I², p. 259 n.6, and *MMR*², 383 n. 60 no. 11; Vermeule, *Greece in the Bronze Age* (1964) pl. 48 b; Schachermeyr, *Ägäis und Orient* (1967) pl. 52: 185.

101. Vari. Vlastos Collection. Lapis lazuli (faience? *cf.* Evans, *PM* IV, 498), Syro-Hittite (Nilsson), LM III a (Evans), hybrid, undatable (Frankfort).

Evans, *PM* IV, 409, fig. 339, p. 498; Frankfort, *CS,* 303 n. 1; Nilsson, *Archiv Orientalni* 17,2 (1949) 211 no. 8, *Gesch.d.griech. Relig.* I², p. 259 n. 5, and *MMR*², 385 n. 60 no. 8.

Only three cylinder seals, with the exception of the not yet published material from Thebes, have been identified definitely as Babylonian. For a fourth of the material there is agreement of a North Syrian origin; for another fourth we find agreement that they are Aegean imitations of Oriental cylinder seals. About fifteen other pieces seem to be in the same proportion as those groups mentioned. It remains a remarkable fact that in no instance has the relationship of a seal to the Hittite cultural province, to Anatolia, or occasionally to Cilicia remained unchallenged.

The chronology of the Aegean cylinder seals, which still contains a considerable degree of uncertainty, shows a zenith of influx and local production during the LM II–IIIa period, as V. E. G. Kenna has already observed.[42] The cylinder seal from Amorgos is placed by H. Frankfort in the centuries around 3000 B.C.;[43] its correct date may be some centuries later. If Frankfort would be right, the seal had been in use for about a thousand years when it was placed in a Cycladic grave of the end of the third millennium. In the Aegean it appears to be a single displaced item. The same applies to a cylinder seal of Djemdet-Nasr type from Troy.[44] But it must be kept in mind that some decorative patterns on Early Bronze Age pottery from Greece cannot have been produced with anything else than cylinders (comp. K. Müller, *Tiryns* IV, pp. 42 ff., 96 ff., 105 pl. 16, and Milojcic, *Samos* I, pl. 31: 3 and 4). Sealed pictures on archaic relief-pithoi prove knowledge and use of cylinders in Greece as well (see J. Schäfer, *Studien zu den griech. Reliefpithoi des 8.-6. Jhs. v. Chr.* (1957) *passim,* and J. Boardman, *The Cretan Collection in Oxford* (1961) 117 no. 512, pl. 42).

About fourteen of the seals listed here must be dated prior to 1600 B.C. The majority—thirty-six pieces and some of the not yet known specimens from Thebes —belong to the centuries between 1600 and 1200 B.C. Of lesser age are thirteen pieces.[45]

In many cases information of the sorts of stone used for seals is full of contradiction or not given at all; therefore statistics give a clue of provisional value only to origin and date of the items: of the materials used, lapis lazuli, of which more than thirty seals are made,

[42] See above, n. 27.

[43] A critical examination of chronology leads us also to cite an ivory seal from Troy VI: Blegen, *Troy* III, 298 no. 35-478, figs. 296 and 304 (=*AJA* **39** [1935] 580, fig. 24); Bernabò Brea, *BdA* **42** (1957) 217 n. 14.

[44] Dark green stone, Second City, *cf.* Dörpfeld, *Troja und Ilion* (1902) 418, fig. 447; Perrot-Chipiez VI, 207, fig. 55; Schmidt, *Schliemann's Sammlung* no. 8868; Bossert, *Geschichte des Kunstgewerbes* III (1930) 408 fig. 3 and *Altanatolien,* no. 51; Bittel, *AOF* **13** (1939–1941) 299 ff.; v. Kaschnitz-Weinberg, *Prähist. Zeitschr.* **34/35**, pt. I (1949/50) 200; Matz, *Hdb.d. Arch.* II (1954) 213. Fanciful interpretation by Burrage, *AJA* **37** (1933) 109 f. An imported Oriental ivory seal, with figured representations in three zones, from Poliochni, Lemnos, belongs in an Early Bronze Age context (H. .049; D. .018), *cf.* Bernabò Brea, *BdA* **42** (1957) 193, fig. 1, pp. 206 and 208, fig. 25.

[45] Chronological list:

Time	Numbers of Catalogue p. 152 ff.
Before 1600 B.C.	3, 14b, 15, 22, 23, 25, 26a, 32, 39 and about 5 items of the group 61 ff. (Thebes)
1600–1200 B.C.	4–7, 13, 14, 14a, 16, 17, 19–21, 26–30, 34–37, 41, 46–52, 54–60 and the majority of the group 61 ff. (Thebes)
After 1200 B.C.	1, 2, 8–12, 31, 40, 43–45, 53
Unknown	18, 23a (forgery?), 24, 33, 38, 42

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is most common. Following are chalcedony (agate, carnelian, sard), the material of nineteen seals, haematite for fifteen, steatite for nine, and faience and paste respectively for ten. Marble occurs three times, rock-crystal, silver, and ivory once each. According to H. Frankfort, the material may serve at most as secondary evidence for establishing the date of a seal; haematite was generally used from the period of Ur III till the end of the time of Hammurabi, and remained in use even later in Syria, until faience became more popular there during the Mitanni period.[46] The statistics of the materials of seals found in the Aegean area agree with the observation of their predominantly North Syrian origin.

[46] Frankfort, *Cyl. Seals,* 4 f.; *cf.* also Unger, *RV* IV, 366, and Moortgat, *VRS,* 53. In general, on the use of haematite for seals: S. Przeworski, *Die Metallindustrie Anatoliens in der Zeit von 1500–700 v. Chr.* (1939) 158; Marinatos, *PraktAkAth* **24**, 4 (1963) 44. For chronology of cylinder seals under consideration of material, *cf.* W. Andrae, *Hdb.d.Arch.* I (1939) 792 f.

List of materials used:

Materials	Numbers of Catalogue p. 152 ff.
Lapis lazuli	25, 26, 61, 62, 63, 64 ff. (?Thebes), 101
Chalcedony (agate, carnelian, sard)	5, 10, 14b (quartz), 16, 27, 28, 33(?), 34, 35, 47, 56, 59, 60, 94, 95, 96, 97, 98, 99
Haematite	14, 18, 20, 21, 22, 24, 37, 38, 39, 40, 46, 49, 54, 55, 100
Steatite	1, 2, 6, 11, 12, 17, 29, 36, 45
Faience and paste	5, 7, 8, 9, 41, 48, 51, 52, 57, 58
Marble	3, 14a, 43
Rock-crystal	15
Silver	32
Ivory	23a (forgery?), 30
Unknown	4, 13, 19, 23, 31, 42, 44, 50, 53 (malachite?) and 65 ff. (?Thebes)

Addendum

An unfinished cylinder in the collection of Professor Franke, from *Mycenae* (above p. 151), meanwhile has been analyzed by Dr. E. Althaus of the University of Göttingen; the stone is local to Greece, it is a sort of dark brown trachyt in hydrothermal transformation (H. .032, D. .015, without drill hole).

An unpublished cylinder seal from *Knossos* (p. 155, cat. no. 26 a) of green serpentine is not noticed in the list of materials (note 46). A cylinder seal found long ago during Italian excavations on *Kos* (not on map, fig. 155) was published just when this contribution came from press (see Morricone, *ASAtene* 1967).

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XIII. BASKETRY AND MATTING

J. du Plat Taylor

All the fragments of basketry and matting were recovered from area P, with one exception, BM 2, which was found among the ingots in area G. The pieces from P were all found close together, and in addition to the items described below there were a few matting fibers found at BM 8, some more matting and rope at P V (BM 9), and some matting adhering to oxhide ingots 4, 5, 9, 10, 11, 12, and 23.

We are indebted to Miss Elisabeth Crowfoot for the following note on the techniques used:

The techniques present in these fragments are two of the earliest basketry techniques known, and ones that have persisted to the present day in most parts of the world. Good coiled basketry was used in the granaries of the Fayum A period in Egypt and twined matting is found in Badarian graves. The fibres which have been identified here in the wreck, palm, halfa grass and the grass *Phragmites communis,* were used in some of the earliest known examples, and are still used with the same technique today.

CATALOGUE

BM 1. Fragment of coiled basketry with part of a corner turn, indicating a squared or rectangular base; probably reed or grass core, reed wrapping strip; workmanship uneven as in basket BM 3 (fig. 156*a* and *b*).

BM 2. Fragment from coarse coiled basket, core reed or grass, strip larger reed or palm? (fig. 157).

BM 3. Part of the base of an oval basket in coiled basketry of uneven workmanship, the coil probably of small reeds or grasses, with reed strip; the strip sometimes pierces that of the preceding row, sometimes does not (fig. 158).

BM 4. Matting in twined technique; two wefts of 2-ply (*S*) grass rope twined round bundles of three grass rope warps, possibly braided together; the rows of twine occur at intervals of *ca.* .07 (see Jodrell Laboratory report) (fig. 159).

BM 5. Rope, diam. .009–.010, of two strands *S*-plyed; the strands, each diam. .005–.0057, formed of *ca.* 7 grass stems lightly *Z*-twisted together (fig. 160).

BM 6. Two fragments of rope, *ca.* .06 long, grass and palm fibers with slight *Z*-twist in two strands loosely *S*-plyed (see Jodrell Laboratory report).

BM 7. A length of rope, about 1.50 meters, preserved in sand, found in 1959. A sample of this rope, taken from the stirrup jar handle, was identified by Jodrell Laboratory.

It may be noted that in a contemporary context, the coiled basketry was found at Apliki, containing grain; and that the matting baskets are shown in the tomb of Rekh-mi-rēʿ in use for the carriage of grain and charcoal.

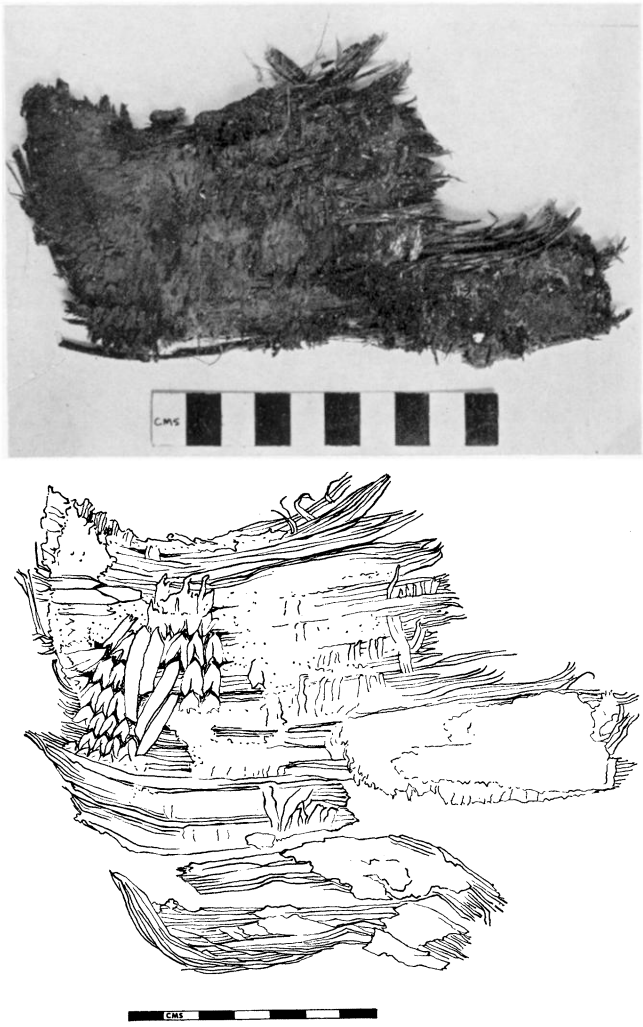


Fig. 156*a* and *b*. BM 1.

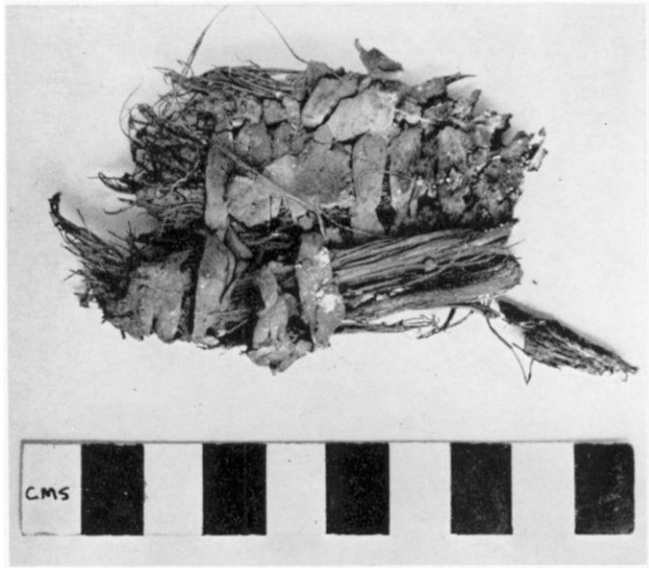


Fig. 157. BM 2.

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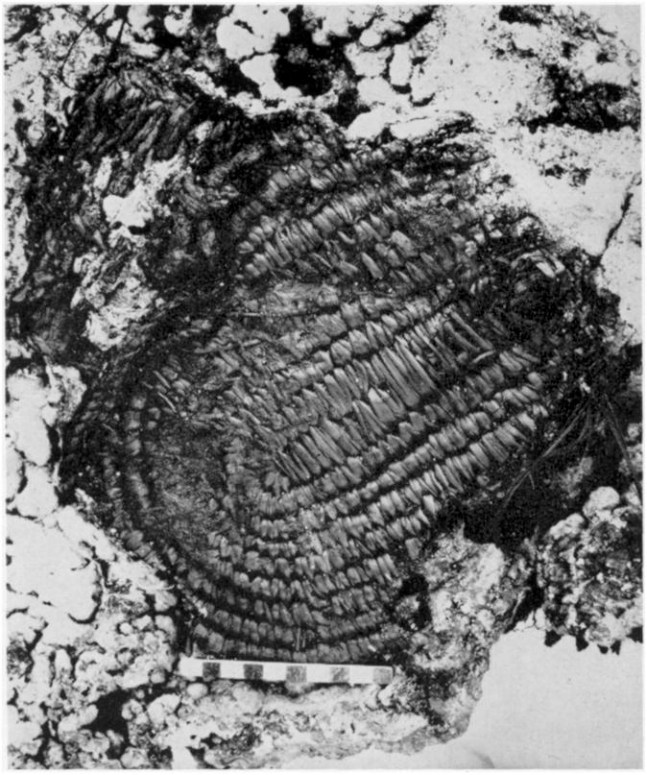


FIG. 158. BM 3.

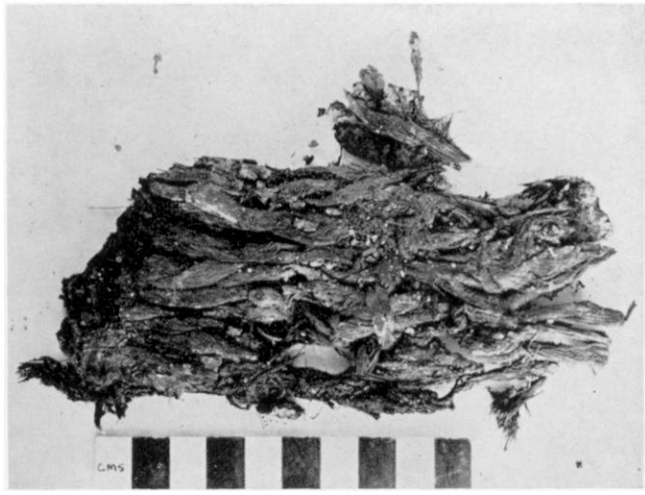


FIG. 159. BM 4.



FIG. 160. BM 5.

IDENTIFICATION OF FIBERS

The samples of fibers have been identified through the kindness of Sir George Taylor and Dr. Metcalfe of the Jodrell Laboratory, Kew Gardens. Identification of the material was very difficult owing to the advanced stage of decomposition (the specimens were completely dry by the time they reached England) which obscured the diagnostic microscopical characters.

BM 7. This rope is made from twisted grass culms (stems). It seems possible that the grass may be *Phragmites communis* var. *isiacus,* but it is impossible to be quite certain because we have been able to obtain only quite small areas of epidermis. The sample seems to agree more closely with this species than any other with which it has been compared.

BM 6. Sample 43. The raw materials from which this rope was made are of mixed origin. One constituent is a grass, but it has not been possible to establish the genus or species. At one stage it was suspected that it might be esparto grass (*Stipa tenacissima L.*) and, whilst this remains a possibility, it is far from being well established. The second component in the rope is a palm leaf. After considerable searching and by adopting special techniques for reviving this material, small fragments of epidermis were revived sufficiently well to show that peltate glands were present. The presence of these glands indicates that the palm belongs to the genus *Hyphaene,* and, of this genus, the most likely species on geographical grounds is the doum palm (*H. thebaica Mart.*). This was commonly used in Ancient Egypt as the source of a leaf fiber.

BM 4. Sample 112. After prolonged searching, small fragments of leaf epidermis were found in this sample in which the stomata and silica-bodies could be clearly seen. These are of precisely the same type as those which occur in halfa grass derived from *Desmostachya bipinnata* (L.) Stapf. (This should not be confused with halfa grass derived from *Imperata cylindrica* (L.) Beauv. in which the structure is quite different.) This seems to establish that sample 112 is at least partly composed of *D. bipinnata.* Other fragments were seen, however, in which the subsidiary cells of the stomata were less triangular in surface view, and the short-cells of the epidermis were not of the same type as those of *D. bipinnata.* These fragments were also characterized by large prickle hairs. It seems possible, although it is still uncertain, that the fragments of this last type may be derived from another grass. This might be *Phragmites* sp., but the matter is far from certain.

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DISTRIBUTION OF IDENTIFIED PLANTS

Miss A. C. Western has made the following report:

Phragmites communis var. *isiacus* is reported by Tackholm [1] as very common in Egypt, and the same is true of Syria and Palestine, according to Post.[2] Greiss [3] states that it occurs all round the Mediterranean and gives a list of the uses of reeds.[4]

Stipa tenacissima does not occur in Egypt, according to Tackholm, nor does Post record it in the Palestine area, though both authors mention various other species from their respective areas. Greiss does not discuss this genus at all.

Hyphaene thebaica is mentioned by Post [5] as occurring in the far south in Sinai and Akaba, while Tackholm [6] gives it as common in the Nile Valley and Oases of the Libyan Desert, rare in the Nile Delta, the Arabian Desert east of the Nile, and in Sinai. It therefore appears to be lacking from most of the Mediterranean coast and to occur inland only and towards the southeast, in areas accessible to the Nile and the Red Sea. Greiss [7] on the whole agrees with this pattern of distribution and states that the doum palm was used for plaited work and basketry.[8]

Desmostachya bipinnata is reported as common by Tackholm [9] and Post [10] along the coast of Palestine and in the Jordan Valley, and by Greiss,[11] who also quotes a number of determinations of rope from archaeological sites [12] and made of this plant. It appears that the use of two or more different fibers in making one object was a quite common practice, as the investigations of Greiss revealed.[13]

[1] V. Tackholm, *Student's Flora of Egypt* (Cairo, 1956) 526–527.

[2] G. Post, *Flora of Syria, Palestine and Sinai* II (Beirut, 1933) 745.

[3] E. A. M. Greiss, *Anatomical Identification of Some Ancient Egyptian Plant Materials* (Memoires de l'Institute d'Egypt, Cairo, 1957) 64.

[4] Greiss, *op. cit.*, 57, 106, 116, 149.

[5] Post, *op. cit.* II, 557.

[6] Tackholm, *op. cit.*, 488.

[7] Greiss, *op. cit.*, 41.

[8] Greiss, *op. cit.*, 111–118, 147.

[9] Tackholm, *op. cit.*, 521.

[10] Post, *op. cit.* II, 752 (under synonym *Eragrostis bipinnata*).

[11] Greiss, *op. cit.*, 7.

[12] Greiss, *op. cit.*, 106–122, 144.

[13] Greiss, *op. cit.*, 115, 116.

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XIV. CONCLUSIONS [1]

GEORGE F. BASS

At the close of the Bronze Age in the Eastern Mediterranean, a nine- or ten-meter merchantman sailed toward Cape Gelidonya, the southernmost point of the Anatolian Peninsula. Her last major port of call had been in Cyprus, where the crew had loaded on a ton of metal cargo. Four-handled copper ingots, weighing about twenty kilograms apiece, were carefully wrapped in matting and stacked in neat piles fore and aft, and bronze bun ingots were stacked among them. Wicker baskets filled with bits and pieces of broken ingots and broken bronze tools were placed wherever they would fit on the layer of brushwood which protected the thin planks of the hull. Tin ingots, scraps of lead, and pieces of unworked crystal may already have been on board. A jar full of colored beads and a bracelet of adjustable size were items of trade, near the bow. The contents of other jars were perishable, but they may have included spices.[2]

At least the more important members of the crew lived near the stern, in an area lit at night by a single oil lamp. Their meals, as those of Mediterranean sailors today, were supplemented with olives and, perhaps, fish which they had caught with lead-weighted lines. Storage jars probably held other food, and wine and water; skins and leather bags may also have contained food, but this we have no way of knowing.[3]

On board was a merchant, prepared to trade in almost any Eastern Mediterranean port. His balance-pan weights, necessary for judging the price of metal in either scrap or finished form, allowed him to deal with other merchants in Egypt, Syria, Palestine, Cyprus, Troy, the Hittite Empire, Crete, and probably the Greek mainland. For official transactions he carried his personal seal, a cylinder which seems to have been an heirloom handed down from generation to generation. He, or perhaps members of the crew, also carried five scarabs as seals, souvenirs, or religious talismans. Religious charms were then, as now, of comfort to travelers,[4] and an astragal in the cabin, if it was not used to while away the hours in the game of knucklebones, offered divine guidance to the captain when he was in doubt.[5]

All of the elements necessary for bronze-making were on board—pure copper, pure tin, and bronze scraps and ingots for being recast—and it is likely that the merchant not only traded with such raw materials, but was a tinker who worked with them himself. Three large, hard, close-grained stones would have served as anvils. A small bronze anvil was broken in antiquity and was only part of the cargo of scrap, which might suggest that a bronze swage block near the bow of the ship was also only part of the cargo were it not for a number of other items in the "cabin" area. There rested two stone "maceheads," which might very well have been examples of the "highly polished and delicate" [6] perforated stone hammers used for forging in the Bronze Age.[7] Nearby were more than half a dozen stone rubbers and polishers, with a whetstone which hung, perhaps from the merchant's neck, by a string. In the "cabin" area also were a bronze cold chisel and a punch. If only the bronze tools had been on board, there would be the possibility that all had been but part of the cargo, for such tools, broken and complete, often appeared in contemporary founders' hoards. The existence of the stone implements, however, makes this unlikely. All that was missing from a traveling smith's complement of material [8] were molds, and these may have existed in the form of soft clay which was washed away by the currents after the ship sank. Only hammering and sharpening and polishing were done on

[1] Statements not annotated in this chapter have been discussed more fully elsewhere in the book.

[2] Ventris and Chadwick, *Documents,* 135–136.

[3] *Odyssey,* 2.354, 5.266.

[4] Wen-Amon carried an idol, a "traveling Amon," on his eleventh-century voyage from Egypt to Phoenicia (Pritchard, *ANET,* 26, n. 12, trans. by John A. Wilson), just as modern travelers carry St. Christopher's medals. For the date of the trip see Albright, *AJA* **54** (1950) 174, with n. 44.

[5] "On their return from the siege of Troy, Menelaus, Nestor, and Diomed at Lesbos (γ 169) 'pondered over the long voyage,' —whether to sail across the open Aegean Sea to the southern end of the island Euboea, about 110 miles, with the island of Psyria for their encouragement, about mid-way,—or to follow the coast of Asia Minor, to the south, and then to skirt the shore of Crete, and thus come up to Peloponnesus from the south,—a route more than twice as long for Diomed, but keeping close to land all the way. Indeed they did not dare 'cleave the open sea' until they received a guiding omen from the gods." Seymour, *Life in the Homeric Age,* 305.

[6] Coghlan, *Preh. Met. of Copper and Bronze,* 77 (see quote, *infra,* n. 8).

[7] Coghlan in *Hist. of Tech.* I, 609. Guido, *Sardinia,* 153, mentions the frequent association of maceheads with mining. The Gelidonya maceheads have been considered too finely made for rough work, such as forging, but only a highly polished hammer could produce a smooth, undented surface on metal.

[8] Coghlan, *op. cit.* (*supra,* n. 6), 76–77: "The basic tools of a modern smith are the forge, anvil, hammers, tongs, chisels, metal saws, fullers, flatters, swages, and a variety of punches. The fullers, swages, and flatters which we illustrate are those of the iron-smith and are generally made and used for far heavier work than was ever dealt with in prehistoric days. However, there is no doubt that the prehistoric smith would have had miniature tools of somewhat similar form with which to carry out his more advanced operations. . . . The forge, anvil, and hammers were very simple . . . an ordinary fire, suitably walled in, would serve for the forge, especially as some measure of artificial draught must have been applied. A heavy block of hard, flat, and close-grained stone would serve as the main anvil; later, for the execution of fine work, the well-known tanged anvil of the Bronze Age came into use . . . excellent hammers appeared as soon as bronze came in. There is ample archaeological evidence to show that stone hammers were also in common use . . . . Very frequently the perforated stone hammer was no rough tool but a highly polished and delicate instrument."

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board; furnaces were quickly made of stone and clay at various stops along the route.[9]

The ship, taking the common route from Syria and Cyprus to the Aegean,[10] followed the coast and took advantage of the westward current which rushes "with augmented violence towards Cape Khelidonia, where, diffusing itself in the open sea, it again becomes equalized." [11] In only a few hours the crew could be taking on fresh water from the abundant supply at Phoenikous (modern Finike), but first the cape and its string of tiny islands, later described by Pliny as "extremely dangerous to mariners," [12] had to be passed. The ship never made it. Attempting to sail between the two large islands nearest the mainland, she ran onto jagged rocks and sank in nearly thirty meters of water.

This much of the story of the ill-fated voyage may easily be deduced from a study of the finds, but a more detailed study reveals that the ship was a Phoenician [13] merchantman which sank around 1200 B.C. while sailing toward the Aegean.

The main cargo of bronze and copper, as we have shown, was picked up in Cyprus, but such a cargo could have been carried in a Mycenaean, Cypriot, Phoenician, Sea-Peoples, or Egyptian bottom; all of these people are known to have been seafaring to a lesser or greater extent during different periods of antiquity. It is not an examination of the cargo, however, but of the personal possessions of the crew and merchant on board which will lead us to discover the nationality of the ship.

The cylinder seal, according to Buchholz, is Syrian. He concludes that, as it was the only one on board, it was not an item of trade but the personal seal of the merchant. Indeed, it would have been strange had there not been one on the ship, for every Eastern merchant had his own seal.[14]

Schulman, in his study of the scarabs, has shown that they are almost certainly Syro-Palestinian imitations of Egyptian scarabs. He points out that they might have been trinkets picked up by the sailors. The importance of divine protection for men of the sea is known, however, from the eleventh-century statue of Amon-of-the-Road carried by Wen-Amon to the well-known libations of the Greeks, and it seems most likely that the scarabs were more than mere souvenirs of a voyage to the East.

The pottery, as Hennessy and Miss Taylor have stated, could have been obtained in a number of Syro-Palestinian or Cypriot ports, and some of it may have been cargo only. The lamp from the cabin area, however, was surely the ship's lamp, which presumably was treated with care, and it is strictly Syro-Palestinian in form.

Although the weights would have allowed the ship to trade in almost any port of the Near East or the Aegean, we have seen that the majority of the standards are Near Eastern, and that the shapes are best paralleled outside of Mycenaean Greece.

The stone maceheads and mortars were used by the crew, and their origins, according to Miss Taylor's study, are also to be sought along the Syro-Palestinian coast or on Cyprus.

Finally, Miss Western has pointed out that the condition of the wood does not permit definite conclusions about the original port of the ship, but the fibers used in the basketry and matting came mainly from the East.

The beads may not be considered personal possessions, for there is nothing to indicate that they were other than cargo for trade. Not only were they stored in a jar with a bracelet, but they were the only possible "personal possessions" which did not come from the "cabin" area, with the exception of the stone mortars.

Thus we see that the individual bits of evidence, studied simultaneously but independently by a number of scholars, all lead to the conclusion that the ship at Gelidonya sailed with a Syrian merchant from a Syro-Palestinian port.

The approximate date of the calamity which befell the ship may be reached also by a number of means:

Miss Ralph states that the most acceptable dates obtained from a carbon-14 measurement of the brushwood on the ship is 1200 B.C. $\pm$ 50 years.

Hennessy and Miss Taylor arrived independently at the same date in their study of the pottery; they prefer a date after 1200 B.C., but point out the difficulty of offering more than a suggestion.

The cylinder seal seems to be much older than the shipwreck and provides no evidence for dating, but Schulman feels that the scarabs suggest "the thirteenth century B.C. as the most probable date of the wreck, although a slightly earlier or slightly later date is possible."

We have seen further that the latest evidence for oxhide ingots is their representation at Medinet Habu in the first half of the twelfth century, but at least one and probably all of these scenes showing ingots were copied directly from the thirteenth-century Ramesseum. There is, therefore, no positive evidence for such ingots later than the thirteenth century, although ingots of the same type appear at least two centuries earlier.[15]

The bronzes have posed a greater problem. Catling dates them to the twelfth century, but I believe that the

[9] Catling, *Cypriot Bronzework*, 302: "The Mathiati hoard suggests an itinerant craftsman who set up a temporary foundry and smithy at the settlements he visited, rather than a local industry."

[10] Lorimer, *Homer and the Monuments*, 60–61, described the route, even mentioning the fresh water supply near Gelidonya, before the wreck was found at Gelidonya.

[11] Beaufort, *Karamania*, 42.

[12] Pliny, V.35.

[13] I prefer to use here the word "Phoenician," in its broad Greek sense, rather than "Canaanite;" the two words are "historically, geographically, and culturally synonymous" (Albright, *The Bible and the Anc. N.E.*, 328).

[14] E.g., G. R. Driver, *Semitic Writing*, 15, 63.

[15] The discovery by C. Schaeffer at Enkomi, after this chapter was written, of a god standing on an oxhide ingot (*Antiquity*, **39**, p. 56) has not yet been fully published; but the date of that ingot seems to fall in the opening years of the twelfth century B.C. (its date is compared to that of the statue of another god from Enkomi, found and published by P. Dikaios, *AA* 1962). Addendum: see *AOF* **21** (1966) 59 ff.

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very early twelfth century is the latest that they may be dated, and feel that a thirteenth-century dating is more probable.

In summation, several independent methods of dating have led to a date for the shipwreck of 1200 B.C. ± 50 years, with more evidence pointing to an earlier rather than a later dating in that range.

Advocates of a Mycenaean monopoly on sea traffic at this early date will be able to explain away each of the personal items, saying that the cylinder seal and scarabs were trinkets picked up with the jar of glass beads *en route,* that the lamp was a replacement for an original broken or traded during the voyage, that the weights were necessary for *any* merchant who might be trading in Near Eastern ports, and that the stone objects and basketry were also purchased in foreign ports. Thus the ship could be Mycenaean or Cypriot as well as Syrian. I must emphasize, therefore, that there is not a single element to suggest that the ship was other than Syrian, and our present conclusions were reached with no preconceived ideas of the nature or date of the wreck, or of Bronze Age shipping in general.

The conclusion that the ship at Gelidonya was a thirteenth- or very early twelfth-century Phoenician merchantman, however, applies to but one ship. This alone has little historical significance, for a single ship, found by chance, does not necessarily represent a merchant fleet. More significant, the excavation at Gelidonya has led to a careful restudy of the types of objects carried on board, and this restudy of parallel material from other sites, even *without* the finds at Gelidonya, would have led to the conclusion that a great deal of commerce was in the hands of Phoenician seamen and merchants during the Late Bronze Age.

The distribution of Mycenaean pottery along coasts and navigable rivers had fostered the prevailing view that, as S. Immerwahr has written, "Mycenaean commerce would thus seem to have been almost entirely in the hands of Mycenaean traders and to have travelled very little farther than they could sail in their seagoing ships." [16] That the pottery was transported by sea cannot be doubted, but a cargo does not indicate the nationality of the ship which carries it; the cargo at Gelidonya, for example, was certainly Cypriot, but there is nothing to suggest that the ship also was Cypriot. Ignored in the theory of a Mycenaean leadership in maritime trade are the equally important westbound cargoes, which we will discuss below.

Far more indicative of the nationality of a ship than its cargo are, as we have suggested, the personal or official possessions on board. Buchholz's study of the distribution of cylinder seals has shown that seals in the Aegean during the second millennium B.C. are most closely associated with Syria, and that they are found along the sea route from the Levant to Cyprus to Southern Anatolia to the Aegean. Naturally the seals are not as numerous as pottery finds for, as on the Gelidonya ship, there would be but one or two seals with each cargo of hundreds of items, whether these be pottery or metal. Further, the seal would remain in the foreign port most probably only if it were lost or if the merchant died while abroad. The distribution of Syrian cylinder seals, therefore, may be stronger evidence for Near Eastern trading ventures than the distribution of Mycenaean pottery for a monopoly of Mycenaean shipping.

Phoenician merchant ships, including that at Gelidonya, would not have returned with empty holds to Cyprus and the Near East, and it is reasonable to assume that their cargoes consisted largely of Mycenaean pottery which often contained perishable goods. But what had the ships originally carried westward on their outbound voyages? No longer must we "resort to guessing the nature of the Syrian merchandise received in exchange" for Mycenaean goods.[17] No longer can we say that "few actual oriental objects have as yet been found in Mycenaean Greece." [18] It was metal, above all, that arrived in Greece, on ships such as that which sank at Gelidonya while carrying its cargo toward the Aegean.

I have shown that copper oxhide ingots were dealt with by Semites, and not by Aegean merchants as commonly supposed.[19] Buchholz has suggested that bun ingots also were associated with Syrians,[20] but that primitive form of bronze seems too widespread to be assigned to any one people.

Hoards of bronzes on the Greek mainland, often containing fragments of oxhide ingots, may now be accepted as Phoenician merchandise. The ingots and broken tools were, to be sure, usually picked up in Cyprus, but the bronzes were most often non-Aegean types which had originated in the Near East, and we have further shown good cause to believe that the oxhide ingots were made to Phoenician specifications.

Ivory and gold and cloth and spices also came from the East, as indicated by Semitic words for these items found on Linear B tablets,[21] and at least the latter may have formed part of the contents of the Canaanite jars which arrived in Greece during the fourteenth and thirteenth centuries.[22]

The absence of greater amounts of Near Eastern pottery in Greece is explained by the nature of this merchandise, for metals and cloth and ivory do not require pottery containers. Indeed, we should expect to find few traces of any of these goods in the Aegean, for the cloth and spices have long since disappeared, and the metals and ivory would be found in altered form if preserved at all. This is borne out by excavation; Near Eastern ingots and implements appear mostly in found-

[16] S. Immerwahr, *Archaeology* **13** (1960) 6. See also footnote 41, *infra.*

[17] Albright, *op. cit.* (*supra,* n. 13) 337.

[18] Barnett, *The Aegean and the N.E.,* 214.

[19] Dussaud had earlier recognized a Phoenician collaboration with Cyprus in the ingot trade. Schaeffer, *Enkomi-Alasia,* 2–4.

[20] Buchholz, *PZ* **37** (1959) 15.

[21] Barnett, *loc. cit.* (*supra,* n. 18); Ventris and Chadwick, *Documents,* 135–136.

[22] Grace, "The Canaanite Jar," *The Aegean and the N.E.;* Wace, *BSA* **50** (1955) 179.

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ers' hoards which had, for one reason or another, been lost before being hammered or recast into typically Aegean forms. We may conclude that the extent of Mycenaean shipping has been highly overrated simply because her chief export commodities, pottery and goods shipped in pottery, left such durable remains. Although the goods received in exchange by the Mycenaeans are no longer so immediately apparent, they were certainly of equal value to the people who traded them.

I do not suggest that the Phoenicians held a monopoly on maritime trade during the Late Bronze Age, but that they played a major part in it. Albright has summarized the history of "the Phoenician problem" during the last century, and has discussed the varying roles allotted to the Phoenicians by past historians;[23] the implications of our present conclusions, that Phoenician commerce was widespread at a date much earlier than that now generally accepted, are many, and we may but touch briefly here on some of these implications which deserve further study.

The allusions to Phoenicians in the *Odyssey* have been considered by Miss Lorimer as the "most important" pieces of evidence for the dating of that poem. She has written that the middle third of the eighth century B.C. "is the period reflected in the picture of Phoenician activities given in the *Odyssey*,"[24] which is in agreement with Nilsson's statement that "in our present state of knowledge the Homeric passages referring to the Phoenicians fit in best with the eighth century, and this is in agreement with the fact that all these passages are found either in the *Odyssey* or in such parts of the *Iliad* as are recognized to be late."[25] Albright has seen earlier, tenth-century Phoenician trade and exploration as influencing the composition.[26] These are but three of the many opinions which must now be reconsidered in the light of still earlier Phoenician voyages in the Mediterranean.

Such voyages took Phoenicians to Cyprus and Sardinia, where we have seen that Semitic commercial activities began in the Bronze Age rather than in the Iron Age. I do not suggest Phoenician colonies at this early date, but "temporary trading 'factories,'" to use Albright's expression for posts of a later period.[27] In these factories copper was smelted and cast into four-handled ingots for export abroad.

In my discussion of the ingots, I pointed out that their manufacture by Syrians on Cyprus began at least by 1400 B.C. and continued until 1200 B.C. It is not coincidental that in those two centuries a tremendous amount of Mycenaean pottery arrived on Cyprus in return for some Cypriot export, which was presumably copper.[28] The great quantity of the imported pottery adds further strength to a thirteenth-century dating of the Cypriot and Greek hoards, as well as of the contemporary Gelidonya ship, for it surely marks the period when copper and bronze production was at its height. There is nothing to suggest that the pottery accompanied Mycenaean colonization; non-ceramic remains, in fact, show that Cyprus was almost totally outside the sphere of Mycenaean influence.[29] Interestingly, the cult places, as on Sardinia, seem to have a Near Eastern flavor.[30]

At the close of the thirteenth century, destruction on Cyprus and the introduction of new elements, including LH IIIC pottery and ashlar masonry, have suggested the arrival of some Mycenaean immigrants for the first time. Cypriot culture was not crushed by the invasion, however, and local pottery continued in use, except at Kition,[31] alongside the newly introduced LH IIIC wares. What did disappear at this time, if we may judge from our completely independent conclusions concerning the production of copper ingots, were the Phoenician refineries. The reason for this is clear, for the invaders, whom we may suppose to have been at least part of the Peoples of the Sea,[32] continued on to the Phoenician homeland. Ugarit was destroyed and did not revive; LH IIIC pottery is not found on the site, so far as is known, because none of the invaders remained and settled there, as they did on Cyprus.[33] This makes it quite certain that the bronze implements in the Gelidonya wreck and, therefore, those in Greek and Cypriot hoards, were made prior to that time, for Ugarit has offered some of the closest parallels for bronzes in the hoards.[34]

The period before 1400 B.C. is less clear. As we have seen in the discussion of ingots, there seems to have been in the fifteenth century some sort of joint Minoan-Phoenician control over copper production and trade. This is too vague to be properly understood and, until the ingot-bearing ship of that date is located and excavated in the Bay of Antalya, I must leave further conclusions to the linguists. I should point out, however, that the Cypriot linear script (Cypro-Minoan),

[23] Albright, *op. cit.* (*supra*, n. 13) 343–349.
[24] Lorimer, *Homer and the Monuments*, 505–506.
[25] Nilsson, *Homer and Myc.*, 135–136.
[26] Albright, *AJA* **54** (1950) 173.
[27] Albright, *op. cit.* (*supra*, n. 13) 348.
[28] Catling, *Cypr. Bronzework*, 36, 49.
[29] Catling, *Cypr. Bronzework*, Chap. II, and "Minoan and Mycenaean Pottery: Composition and Provenance," *Archaeometry* **6** (1963) 5; Desborough, *Last Mycenaeans*, 196.
[30] Catling, *Cypr. Bronzework*, 40; Guido, *Sardinia*, 188, but also 136.
[31] Desborough, *Last Mycenaeans*, 279, after Karageorghis, *ILN*, 22 Dec. 1962, 1012 ff.
[32] *Ibid.*, 238: "It is reasonable to suppose that the disasters in Cyprus were the work of the Land and Sea Raiders. . . . And if this was so, then it is a probable conclusion that at this point of their journey the Land and Sea Raiders were accompanied by a fairly powerful group of Mycenaeans. . . ."
[33] *Ibid.* As may be seen, I have drawn heavily on Desborough's picture of what happened in Cyprus and Syria at the time of the transition from LH IIIB to LH IIIC pottery, which he places around 1200 B.C.
[34] In Chap. VI I pointed out a number of reasons for believing the Cypriot hoards and the Gelidonya cargo to be from the thirteenth century, although single parallel bronzes had often been dated to either the thirteenth or twelfth century. The historical evidence, which was not mentioned at that time, emphasizes at least the contemporaneity of the Cypriot bronzes, for hoards were too vital to the economy to have been preserved as such unless lost in a disaster. In the case of the Cypriot hoards, this disaster was the destruction at the end of the LH IIIB (LC IIC) period.

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which bears closer superficial resemblances to Linear A than to Linear B, appeared on Cyprus in the fifteenth century and lasted until about 1200 B.C., when its last use was on copper ingots and clay tablets; in other words, it appeared with the beginning of Semitic copper production, continued in greater use during the height of that production, and disappeared with the Aegean or Achaean colonization of Cyprus around 1200 B.C. and afterward. This seems more than coincidental, and the generally discredited view that Northwest Semitic influenced Cypriot writing should be re-examined.

Further, the conservatism of some authorities in accepting Cyrus Gordon's discovery that Minoan (Linear A) was Phoenician (Northwest Semitic) has been based largely on their inability to see Semites in the Aegean during the Bronze Age. Our present study offers independent archaeological evidence which disproves the conservative views. It would further confirm Astour's picture of Aegean-Semitic relations, based on an examination of second-millennium onomastica, which I am linguistically incompetent to judge.[35] Astour's study shows a strong North Syrian foothold on Crete and Cyprus by 1500 B.C.; I should mention, however, that his views on Cyprus are based on the common assumption that Alasia and Cyprus are one, an assumption for which, as I have stated, the proof is still lacking.

Turning to the West, we can now state with some confidence that Phoenician copper refineries in the Bronze Age preceded the later and better-known Phoenician colonies. It was not until after deciding that oxhide ingots probably were manufactured under Phoenician supervision on Sardinia as well as on Cyprus (see chap. V) that I read Albright's suggestion that Nora once bore the "Phoenician name 'Tarshish,' meaning 'Smelting Plant, Refinery.'" [36] Deriving the word "tarshish" from an Akkadian word meaning "to melt, be smelted," [37] he further suggested that Biblical Tarshish ships were not ships from Tarsus or Tartessos, as had been speculated earlier, but were the Phoenician ships which carried smelted ores. Although Albright writes of a later period, how well his ideas fit the Gelidonya ship and our conclusions on Sardinian mining.

Mrs. Guido correctly suspected the early Phoenician influence on Sardinia, attributing to a few leaders who had arrived "only a few centuries before the Phoenician trading-posts were established, several features of Sardinian prehistory:" [38] oriental types of armor, copper ingots, nuraghi, and "the introduction of certain religious practices such as the worship of water at sacred wells. . . ." [39] The introduction of ingots and nuraghi have, of course, often been credited to Mycenaean influence.

Miss Lorimer, writing of a later date, traced the route along which the Phoenicians traveled to Sardinia, and mentioned the possible connection between the name Phoenix or Phoenikous and water stations along the way.[40] One Phoenikous she neglected to mention was that within sight of Cape Gelidonya, the modern Finike with its abundant supply of fresh water in an otherwise waterless area. Is it not more than extraordinary coincidence that the only Bronze Age shipwreck known was a Phoenician ship which sank while apparently heading toward that port?

In summation, the excavation of a Bronze Age shipwreck at Cape Gelidonya has shed new light on early metallurgy, metrology, trade, and ship construction, and has shown that proper excavation under water is as possible and necessary as that on land. Above all, however, it has led to a restudy of known artifacts which reveal extensive Phoenician activity in the Mediterranean at a time prior to that usually supposed. Are these the Phoenicians that Homer saw as traders, seafarers, and craftsmen? Was Homer's essentially negative attitude toward them a sign of the times, when Sea Peoples from the Aegean would sweep them from Cyprus and attack their homeland? Further study is necessary, but our findings support the recent statement by Stubbings that "there is no anachronism in Homer's Phoenicians; his picture of the heroic age would indeed be less true without them." [41]

[35] Michael C. Astour, "Second Millennium B.C. Cypriot and Cretan Onomastica Reconsidered," *JAOS* **84** (1964). I wish to thank David I. Owen for bringing this to my attention.

[36] Albright, *op. cit.* (*supra*, n. 13) 347.

[37] Albright, *BASOR* **83** (Oct. 1941) 21–22. In a letter dated 26 April, 1963, Dr. Albright also kindly informed me that he "had recognized in the Egyptian name of a ship, *kura*, a Semitic loan word meaning 'refinery' (Hebrew *kûr*). The word also appears, as I hope to show before long, as a word for a special kind of ship, *kry*, in Ugaritic. The Egyptian word is written with the determinative for 'ship.'"

[38] *Sardinia*, 187–188.

[39] *Ibid.*

[40] Lorimer, *Homer and the Monuments*, 75.

[41] Wace and Stubbings, *Companion to Homer*, 543. John Chadwick (quoted by Grace in "The Canaanite Jar"), basing his opinion on linguistic evidence, wrote: "The generally accepted view that Phoenician influence on Greece was greatest in the ninth–eighth centuries B.C., when the alphabet was borrowed, may have to be revised in the light of this evidence from the thirteenth century." How far such a statement and this study vary from conservative views is only suggested by representative quotations: Nilsson, *Homer and Myc.*, 133: "There was no place for commercial activities of the Phoenicians before the end of the Mycenaean Age." Contenau, *La Civ. phénicienne*, 277: "Jusqu'au XII^e siècle la mer appartient aussi et surtout aux Egéens." Lorimer, *Homer and the Monuments*, 505–506: ". . . the earliest documented appearance of the Phoenicians in the west is in Sardinia, in the first half of the eighth century. There is no evidence that their ships had come even as far as the Aegaean at any earlier date . . ." Albright, *op. cit.* (*supra*, n. 13) 342: "We can state with considerable confidence that Phoenician commercial expansion in the Mediterranean did not seriously begin until after . . . about 1060 B.C." Deshayes, *Utiles de Bronze*, 387: "Avant tout, nous devons insister sur l'importance du commerce mycénien et sur son influence durant la second moitié du II^e millénaire." Kantor, *AJA* **51** (1947) 103: "After the close of the MM II period, and throughout the later part of the second millennium, only the sailors, merchants, and craftsmen of Mycenaean Greece can justifiedly lay claim to the honor of forming the links connecting the Aegean with the Orient."

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APPENDIX

1. CARBON-14 DATES FOR WOOD

E. K. RALPH

A sample of twigs, weighing 42 grams, from the brushwood which lined the hull, was dated by the Radiocarbon Laboratory of the University of Pennsylvania. The results are as follows:

1020 ± 50 B.C. Calculated with 5568 half-life.
1110 ± 50 B.C. Calculated with 5730 half-life.
1200 ± 50 B.C. Calculated with effective half-life, based on measurements of samples of known age.

The half-life tolerance (± 30 for 5568, ± 40 for 5730, and an uncertain amount for the "effective" half-life) have been omitted. The main reason for this is that the change from 5568 to 5730, for example, is 162 years. Therefore, the ± 30 (or ± 40), which is a measure only of the consistency of three half-life determinations, is not realistic.

Since the editors of *Radiocarbon* continue to publish dates calculated with the 5568 half-life, 1020 B.C. is the value to be used for comparison with other dates in this journal. However, since 5730 is now the accepted value for the half-life of C-14, the 1100 B.C. date is closer to the true age of the sample.

In addition to this change, however, the measurements of tree-ring dated samples in this age range indicate that a date of 1200 B.C. is a better fit in relationship to true ages (in this time span). This date of 1200 B.C. has been obtained by multiplying the B.P. date of 2986 (5568 half-life) by 6 per cent.

In other words, the chances are that the sample is not younger than 1060 B.C. (1110 minus 50) and may be as old as 1250 B.C. (1200 plus 50). When more samples of known age from this period of time have been measured, it will be possible to relate the age of this sample to its true age more precisely.

2. IDENTIFICATION OF WOOD

A. C. WESTERN

Two specimens of charcoal were raised from an unidentified portion of the wreck by the air lift. One was identified as a species of *Quercus,* while the other was in too poor condition for determination.

Twelve specimens of damp wood were submitted for identification. Six of these were given the distinguishing letters *A, B, C, E, H* and *L*, and these appeared to be timber of some size, thought to be fragments of the structure of the ship. The other six specimens were pieces of brushwood which had apparently been used as a bed upon which the cargo of copper ingots was stowed. These were given the distinguishing letters *D, F, G, I, J* and *K*. Samples of all the specimens were impregnated with polyethylene glycol (Carbowax 4000) prior to sectioning by razor for examination, but it was found in practice that all the specimens were to a varying extent impregnated with copper salts and metallic copper, which made the process of sectioning very difficult; specimen *L,* in fact, has proved impossible to section by cutting and has had to be impregnated with synthetic resin and ground.

Determinations were as follows:

Worked Timbers

A	Conifer	*Cupressus* sp.
B	Conifer	*Cupressus* sp.
C	Conifer	*Cupressus* sp.
E	Hardwood	*Quercus* sp.
H	Hardwood	probably *Quercus* sp.
L	Hardwood	*Quercus* sp.

Brushwood

D	Hardwood	*Quercus* sp., possibly an evergreen oak.
F	Hardwood	probably *Quercus* sp., but immature branch.
G	Hardwood	*Quercus* sp., but immature.
I	Hardwood	*Quercus* sp.
J	Hardwood	probably *Quercus* sp.
K	Hardwood	possibly *Quercus* sp., but atypical.

The poor condition of the specimens renders it difficult to make more than a "probable" identification in some cases. The wood has been attacked by boring organisms of at least two kinds or sizes, which destroyed parts of the structure and greatly weakened the specimens, which were considerably deformed. The impregnation with metallic copper and copper salts has masked the structure of most specimens, making many anatomical features invisible, although specimens *A* and *B* were little more than stained green.

The brushwood specimens were all immature, and there is therefore the possibility of confusion in deciding whether they are *Quercus* or *Castanea.* The latter grows in southern Europe, North Africa, and Asia Minor. It has apparently been recorded once from Lebanon and Anti-Lebanon,[1] but Holmboe[2] does not report it from Cyprus at all. In immature wood the chief distinguishing feature between these two genera, the broad rays, is absent, but in general these samples correspond more nearly with immature *Quercus* specimens. It is not normally possible to make specific identifications from material of this sort, or indeed to distinguish one species from another within many genera, even in good modern material.

[1] Reported in George E. Post, *Flora of Syria, Palestine and Sinai* (2 vols., 2nd ed., American Press, Beirut 1932–33) **2**, p. 524.

[2] Jens Holmboe, *Studies on the Vegetation of Cyprus,* Bergens Museums Skrifter. Ny. Raekke. (Bergen, 1914) **1**: no. 2.

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From archaeological evidence it appears that the ship was traveling westwards, perhaps to the Aegean and probably from Cyprus, with a main cargo of copper ingots, and on this hypothesis one might suggest that the brushwood also was loaded in Cyprus for the cargo to rest on. The six specimens of brushwood are all identified as *Quercus* species, or probably so, and if one can assume that modern vegetation gives us some guidance as to ancient vegetation, the possible species of Quercus at present found in Cyprus are as follows: *Q. infectoria* Oliv., *Q. alnifolia* Poech., and *Q. coccifera* L., with which is included *Q. palaestina* Ky. If it is considered that the brushwood was loaded at a Syrian or Cilician port all these species of oak except *Q. alnifolia* are also possibilities, together with a number of others: *Q. petraea* Liebl., *Q. ehrenbergii* Ky., *Q. cerris* L., *Q. syriaca* Ky., *Q. libani* Oliv., and *Q. ilex* L.

The question of where the ship was built is a more difficult one than that of where the brushwood came from. The archaeological evidence seems to suggest that the original port was not in the Aegean, but further east. The specimens which may have been part of the structure of the ship comprise three *Quercus* species and three *Cupressus* species. The same species of *Cupressus* are recorded recently for Cyprus as for Syria and Lebanon, and extending northwards to the Amanus Range and beyond, namely *C. sempervirens* L., *C. horizontalis* Mill., and *C. pyramidalis* Nyman., though the spontaneity of the last species in Cyprus is doubtful. Even if the specimens of *Cupressus* could be determined specifically they would give no clue to the port of origin, since the same species grow at present on the island and on the mainland, and we have no reason to suppose that this was not so in the past. The pieces thought to be worked timber and identified as oak might possibly yield more information, because one species, *Quercus alnifolia,* only occurs in Cyprus, and the Lebanon, Amanus and the Taurus mountains produce at present a number of species not found on the island. The difficulty is that these specimens are all deformed and masked by copper deposits and it is unlikely that sufficiently good sections could be prepared from them to reveal adequate detail for a specific determination. In these circumstances the question of port of origin of the ship cannot be answered conclusively from the evidence of the timber.

3. REPORT ON COPPER INGOTS BY SPECTROGRAPHIC ANALYSIS

MARK C. HAN

Object: To determine the trace elements that are present in the ingots, in order to compare any difference among samples bearing different signs or shapes.

Specimen: Copper or copper alloy found 90 feet underwater in the Mediterranean, just off Cape Gelidonya, Turkey.

Method: Samples were excited by DC arc method with graphite electrodes. The resulting spectral lines were identified and compared visually.

Results:

1. Magnesium (Mg), Lead (Pb), Tin (Sn), Nickel (Ni), Cobalt (Co), Barium (Ba), Calcium (Ca), Silicon (Si), and Arsenic (As) were found in all samples.
2. Iron (Fe) was absent in samples: In 20, In 29, and In 36.
3. Zinc (Zn) was absent in samples: In 11, In 34, and In 36.
4. Bismuth (Bi) was absent in samples: In 8, In 34, and BI frag.
5. Titanium (Ti) was present in samples: In 12, In 13, In 17, In 31, In 34, and In 39.
6. Aluminum (Al) was present in samples: In 4, In 5, In 9, In 10, In 12, In 13, In 17, In 20, In 21, In 28, In 31, In 34. and In 39.
7. Manganese (Mn) was absent in samples: In 1, In 6, In 10, In 11, In 18, In 23, In 24, In 25, In 27, In 29, In 33, In 35, In 36, and In 37.

The relative amount of each element present in a sample is indicated by the following order: 5, 4, 3, 2, 1, P, and 0 (absent), as shown in the accompanying table:

TABLE 2

RELATIVE AMOUNTS OF ELEMENTS PRESENT IN GELIDONYA INGOTS

	Mg	Pb	Sn	Ni	Co	Ba	Ca	Si	Fe	Zn	Bi	Ti	Al	Mn	As
In 1	2	3	1	2	2	1	1	2	1	P	1	0	0	0	1
In 2	4	1	P	1	1	2	3	P	1	P	1	0	0	P	P
In 3	5	4	1	2	2	1	4	2	2	P	2	0	0	1	2
In 4	3	3	1	3	3	1	2	3	2	1	1	0	1	1	1
In 5	5	3	1	2	2	1	2	3	2	1	1	0	2	2	2
In 6	1	3	1	2	2	1	P	P	2	P	1	0	0	0	2
In 7	4	3	1	2	2	1	3	2	1	P	1	0	0	2	1
In 8	2	2	3	2	3	P	P	3	3	1	0	0	0	1	P
In 9	4	2	2	3	2	2	2	4	2	1	1	0	P	1	2
In 10	2	1	1	2	2	2	3	2	1	P	1	0	P	0	2
In 11	2	3	1	2	2	1	2	1	2	0	1	0	0	0	1
In 12	3	3	1	2	2	1	2	2	1	1	1	1	1	1	1
In 13	4	2	1	3	3	2	2	3	2	P	1	1	1	P	3
In 14	3	3	1	2	2	2	1	P	1	P	1	0	0	1	1
In 15	No sample was submitted.														
In 16	1	P	1	2	2	2	1	1	1	2	1	0	0	P	1
In 17	5	3	2	2	2	2	3	2	3	1	1	1	2	3	2
In 18	2	P	P	2	2	2	1	P	1	P	1	0	0	P	1
In 19	2	3	2	2	2	1	3	P	3	2	1	0	0	1	2
In 20	4	3	1	2	2	1	3	2	0	1	1	0	1	2	1
In 21	4	1	1	3	3	2	2	3	2	P	1	0	P	P	2
In 22	4	1	P	2	2	2	2	2	1	1	1	0	0	P	2
In 23	4	P	P	2	2	2	2	P	1	P	1	0	0	0	1
In 24	4	3	1	2	2	1	2	2	1	P	1	0	0	0	P
In 25	3	3	1	2	2	1	2	P	2	1	1	0	0	0	1
In 26	5	1	P	2	2	1	P	3	1	P	1	0	0	P	1
In 27	2	3	1	2	2	1	2	P	1	P	1	0	0	0	P
In 28	3	P	1	3	2	1	2	2	1	P	1	0	P	1	2
In 29	1	2	1	2	2	1	1	P	0	P	1	0	0	0	P
In 30	2	3	2	2	2	2	2	P	4	1	1	0	0	P	1
In 31	4	1	1	2	3	2	2	3	1	P	2	1	0	P	2
In 32	3	2	1	3	3	3	2	P	2	1	P	1	0	0	2
In 33	1	2	1	1	1	1	3	P	2	1	P	0	0	0	P
In 34	3	2	1	1	1	1	3	4	3	0	0	1	3	1	1
In 35	2	3	1	2	2	1	P	P	1	P	1	0	0	0	1
In 36	2	3	1	1	1	1	2	P	0	0	1	0	0	0	P
In 37	1	3	1	2	2	1	2	P	2	1	1	0	0	0	P
In 38	4	1	1	3	3	2	2	2	2	P	1	0	0	P	2
In 39	4	2	1	3	3	2	2	4	1	1	2	1	2	2	3
SI 14	3	P	5	2	2	2	3	2	1	P	1	0	0	P	2
BI frag.	2	1	5	2	1	P	1	2	1	P	0	0	0	P	2

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4. CHEMICAL ANALYSIS AND ISOTOPE RATIO EXAMINATION OF LEAD (L 22)

ROBERT H. BRILL

A sample from this fragment was included in a study of lead isotope distribution ratios in archaeological objects made of lead and those of galena ores from mining areas known to have been worked in antiquity.[1] This study has shown that objects made of lead from three broad geographical areas are clearly distinguishable on the basis of isotope measurements. The first area is Roman Britain, the second is Greece, the third includes Spain, Wales, and Sardinia.

The isotope ratios of the lead in sample L 22 are:

$$206/204 = 18.99$$
$$206/207 = 1.1996$$
$$206/208 = 0.4831$$

These values place the sample within a group of about ten samples of varying dates from Athens, Mycenae, Corinth, Ceos, Cyprus, Sardis, and Antioch. These have been designated as Group L leads.

The isotope composition is consistent with this lead having originated from the mines near Laurion, but it could also have come from geologically similar deposits elsewhere. For example, there are some mines in Turkey and Iran which yield this type of lead.

A chemical analysis was also made of the lead sample by a semi-quantitative spectrographic technique. A separate quantitative analysis was made of the silver content. The results are shown below.

The first thing that is apparent about this composition is that the lead is very pure, but this is not unusual for ancient samples. The lead was probably melted from large well-formed crystals of galena ore and thus high purity lead could reasonably be expected to result. The other significant point is that the silver content of 0.04 per cent is somewhat higher than we have found in most of the hundred or so samples analyzed. This probably means that no attempt was made to desilverize this lead. In other words, the miners were probably seeking lead *per se* and the lead was not just a by-product of an operation designed to obtain silver. The Roman smelters were often able to extract silver from lead so efficiently as to leave less than 0.01 per cent of silver remaining, and Hellenistic metallurgists extracted down to at least 0.02 per cent and possibly better. The highest silver content we have found among the few galena ores analyzed was 0.10 per cent silver in a sample taken from a modern working at Kamareza nearby the ancient workings at Laurion.

Lead	Major
Tin	0.00X
Copper	0.0X
Bismuth	0.00X (low)
Antimony	0.00X
Zinc	Not found
Magnesium	Not found
Silicon	Not found
Aluminum	Not found
Silver	0.04 per cent

[1] The sample is sample no. 39 in the study described in R. H. Brill and J. M. Wampler, "Isotope Studies of Ancient Lead," *AJA* 71 (1967) : pp. 63–77.

5a. ANALYSIS OF BEAD

ROBERT H. BRILL

The sample as received was part of a small bead which had been very badly deteriorated during its long submersion. For the most part it had crumbled into flakes of a fragile buff-colored weathering product. Microscopic examination showed that this was the remains of a glass bead, and was not, for example, Egyptian Blue or faience. Near what had originally been the core of the bead was found a very small quantity of the "original" glass, associated with a porous green material which appears to be a weathering product heavily stained with copper salts. By careful dissection under the microscope, it was possible to pick out a few grains of the clear yellowish-green glass. Even these few grains had been spalled into rounded fragments which suggested that they, too, had been partially hydrolyzed and could not be considered representative of unaltered glass. Nevertheless, it seemed worthwhile to attempt a spectrographic analysis. The sample was so small that it was not possible to obtain reliable quantitative results, but the estimates made are given in the table below.

It was borne out that the sample taken was not representative of the original glass. Silica was the major ingredient and copper had been used as a colorant. The alkali, usually Na_2O, has apparently been leached out by the long submersion. The considerable magnesium content is presumed to have been caused largely by exchange from sea water, since the calcium is so low. This effect, the ion exchange of magnesium for calcium, has been observed before in badly weathered glasses. It would not be safe to speculate further on the composition of the glass.

RESULTS OF ANALYSIS

SiO_2	Major
CuO	5–10 per cent
MgO	5–10 per cent
*Al_2O_3	0.X
Fe_2O_3	0.X
PbO	0.0X
Sb_2O_5	0.0X
MnO	0.0X
CaO	0.2

* The estimates of the second group of elements is unreliable. The low values could be the result of deterioration and/or unavoidable contamination with weathering products which would have consisted chiefly of SiO_2.

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5b. ANALYSIS OF BEAD

EDWARD V. SAYRE

Unfortunately for our purposes we came to consider that the bead was not composed of glass *per se*. A microscopic examination revealed its core to be a heterogeneous mass of small particles, of about the size of a fine sand, with a bluish binding material between them. The structure was that of faience, or perhaps a very poorly melted glass. The binding material appeared to have been decomposed throughout through the hydrolytic action of water. It lacked cohesive strength, crumbling easily under light pressure and had the appearance of hydrolyzed vitreous material.

Although we were convinced that the hydrolytic decomposition would have altered the initial composition of the bead greatly, we undertook an analysis of the overall core body, the data of which are presented in the accompanying table. Surprisingly, the analysis is considerably closer to that one would expect from a decomposed glass than of a faience. The only unusual concentration for a decayed glass was the very high concentration of magnesium. Magnesium was determined in this instance by spectrographic analysis in two different spectra ranges, and the average of these two analyses, which were both high but not in close agreement, is reported. We concluded that the magnesium was not uniformly distributed in the bead, and very probably in part had been deposited by the sea water rather than initially having been at this high concentration level. The glass of the period of the bead would have been characterized by a high magnesium oxide concentration, about five per cent MgO, but not as high a concentration as we have found here. The high copper concentration would indicate the bead coating and binding medium had been colored blue by means of this element and the high antimony concentration would indicate it had been deliberately rendered opaque.

Of course, in light of the decayed condition and inhomogeneity of the specimen my conclusions are quite tentative.[1]

PERCENTAGE OF VARIOUS OXIDES IN BEAD

Lithium	Li_2O	0.00045	Chromium	Cr_2O_3	0.0027
Sodium	Na_2O	3.8	Manganese	MnO	0.13
Potassium	K_2O	0.115	Iron	Fe_2O_3	4.85
Rubidium	Rb_2O	<0.00040	Cobalt	CoO	0.015
Magnesium	MgO	12	Nickel	NiO	0.017
Calcium	CaO	6.6	Copper	CuO	9.9
Strontium	SrO	<0.014	Zinc	ZnO	<0.018
Barium	BaO	<0.00085	Zirconium	ZrO_2	0.0041
Boron	B_2O_3	0.066	Silver	Ag_2O	<0.00026
Aluminum	Al_2O_3	2.19	Tin	SnO_2	0.0096
Phosphorous	P_2O_5	0.092	Antimony	Sb_2O_5	0.69
Titanium	TiO_2	0.12	Lead	PbO	0.0044
Vanadium	V_2O_5	0.016	Bismuth	Bi_2O_3	<0.0010

[1] This material and the table were extracted from a letter to the author from Dr. Sayre, dated December 26, 1963.

6. ANALYSIS OF TIN SAMPLE

F. R. DYKSTRA

As described by Dr. Bass (p. 82), three shapeless white masses were discovered beneath a number of oxhide ingots. At one location the material appeared to have flowed or have been washed from a shallow, rectangular void in the concretionary bottom cover. The void, about 6 cm. square, gave the appearance of a mold, possibly representing the original dimensions of an ingot. It was also reported that the copper showed markedly intensified corrosion or deterioration whenever in direct contact with the white material.

When raised to the surface the suspected tin had a consistency of tooth paste. Approximately 8 kgs. were reclaimed and from this a sample of about 12–15 gms. was brought back to Philadelphia sealed in an aluminum film cartridge. By the spring of 1964 this sample had "set-up" into a dull white, sugary-textured body—a sandy agglomerate about the size of a finger tip. The mass could be broken by hand only with some difficulty. No variance in color or banding was evident. The mass appeared homogeneous, indicating that alteration or replacement was essentially complete. The film cartridge showed considerable corrosion inside, to the point of perforation. This attack appeared to be of galvanic origin.

The sample was broken into two approximately equal pieces. One was forwarded to Mr. Ter Braake of Galveston, Texas, and the other submitted for analysis to the laboratories of E. J. Lavino. Unfortunately the former was largely lost in the mails.

A semi-quantitative spectrographic analysis of the remainder showed the following elements to be present:

Ca	(Calcium)	+++	
Sn	(Tin)	++	
Ni	(Nickel)	Tr.	(This was probably residual in the instrument)
Cr	(Chrome)	Tr.	(This was probably residual in the instrument)
Ti	(Titanium)	Tr.	(This was probably residual in the instrument)
Al	(Aluminum)	Tr.	(Result of container deterioration?)
Cu	(Copper)		
Fe	(Iron)		
K	(Potassium)		
Cl	(Chlorine)		
Ag	(Silver)		
S	(Sulfur)		

These data were confirmed by incomplete wet analysis as follows:

$CaCO_3$	(Calcium Carbonate)	71.00%
SnO_2	(Stannous Oxide)	13.84
$Al_2O_3 + Fe_2O_3$	(Alumina + Ferric Oxide)	1.40
SiO_2	(Silica)	1.66
Cu	(Copper)	.01

The inadequate size of the sample precluded more extensive analyses.

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These results seem to confirm that the material was the remnant of what had been at one time metallic tin, largely replaced by calcium carbonate. The evidence of the rectangular void points to a manufactured product. It may be suggested, notwithstanding the vague evidence of the mold, that the tin might have originally been present as unrefined ore. This would have been Cassiterite (SnO_2)—a compound so stable that it would probably have resisted any alteration.

The chemistry of this alteration is not completely clear. The relative positions of calcium and tin in the electro-motive series make electrolysis difficult to picture. It may be conjectured, however, that some condition, possibly related to the presence of copper, allowed for some difference in potential inducing the partial dissolution of the tin and its replacement by what was probably calcium hydroxide—thus the original pasty nature of the sample. Oxidation of the metallic tin probably preceded the calcification. Subsequent exposure to air would account for the conversion of the calcium hydroxide to the carbonate.

Many students maintain that the bulk of the tin of this era was obtained from Cornwall. The analyses above seem to indicate some source other than the British Isles for this particular sample. Traces of germanium and cobalt are reported to be so common in the Cornish ores of tin that their absence here may be regarded as evidence of some other source. (It seems unreasonable to think that, if originally present, all traces of germanium and cobalt would have been completely extracted.)

7. SPECTROGRAPHIC ANALYSES OF POTTERY

A. MILLET

The following results of spectrographic analysis were conducted by the Archaeological Research Laboratories at Oxford with the permission of Dr. E. Hall. The chart shows comparison of two of the Mycenean sherds from the Gelidonya wreck with groups from Arpera Chiflik and Enkomi previously published by Dr. Catling and others (see chap. VII, fn. 3).

	Oxides of:									
	% of Total	Magnesium MgO	Calcium CaO	Aluminium Al_2O_3	Iron FeO	Sodium Na_2O	Titanium TiO_2	Chromium Cr_2O_3	Manganese MnO	Nickel NO
Gelidonya (W9 1)		6.9	24.4	10.3	9.7	1.68	0.77	0.055	0.077	.058
Arpera Chiflik I	100	5.8±1.7	18.3±3.7	11.3±2.5	10.7±2.1	1.48±0.31	0.92±0.21	0.070±0.021	0.095±0.025	0.010±0.002
Gelidonya (282)		5.1	10.1	14.5	10.2	1.58	1.06	0.060	0.049	0.021
Enkomi II	100	5.4±2.2	14.3±3.1	13.5±3.1	9.9±2.0	1.42±0.37	0.96±0.28	0.12±0.09	0.084±0.023	0.014±0.009
Mycenaean Sherds										
Gelidonya		9.9	22.2	10.6	12.1	1.36	1.26	0.076	0.048	0.076
Geldonya (233)		11.2	6.1	12.8	13.8	0.46	1.42	0.115	0.034	0.066
Gelidonya (232)		6.3	15.6	16.2	16.6	0.60	1.27	0.124	0.058	0.037
Gelidonya (467)		4.3	16.6	8.9	11.6	1.47	1.23	0.094	0.038	0.040
Water Jar Sherd										
Gelidonya W.9(12)		14.0	15.9	11.2	26.5	1.89	1.89	>1.0	.117	.041
Plain White Ware Jug										
Gelidonya (144)		7.1	19.5	12.7	3.6	0.71	1.42	0.075	0.055	0.011

8. MODEL INGOTS IN EGYPTIAN FOUNDATION DEPOSITS[1]

DAVID O'CONNOR

During the foundation ceremonies[2] which preceded the erection of an important religious building, the ancient Egyptians customarily deposited in pits groups of materials and objects of a symbolic and magical nature. These foundation deposits were often, but not always, placed at points which were to be covered by corners and doorways and are usually associated with temples dedicated to the royal funerary cult or to the gods. In rare cases foundation deposits are directly associated with royal tombs, either pyramids or rock-cut chamber tombs.[3] In only one instance have I found

[1] There appears to be no detailed study of Egyptian foundation deposits. An excellent general account, with references, is given in H. Bonnet, *Reallexikon*, 263–264, and another discussion is found in P. Montet, *Les énigmes de Tanis*, 144–148.

Very incomplete lists of known foundation deposits are found in: G. A. Reisner, "The Barkal Temples in 1916," *JEA* 4 (1917) 221; K. Bittel and A. Hermann, "Grabungsbericht Hermopolis 1933," *MDIK* 5 (1934) 14 n. 3; A. Rowe, "Discovery of the famous temple and enclosure of Serapis at Alexandria," *ASAE* Cahier no. 2 (1946) 13–19.

[2] For a description of these ceremonies see H. Bonnet, *op. cit.* (*supra*, n. 1) 264–266.

[3] Pyramid of Amenemḥē I, Lisht; H. Winlock, *BMMA*, pt. 2 (Nov. 1921) 16–17.

Pyramid of Senwosrē II, Illahun; W. M. F. Petrie, *Illahun, Kahun and Gurob*, 5.

Tomb of Ḥashepsowe, Thebes; T. M. Davis, H. Carter, *The Tomb of Hâtshopsitû*, 104–107.

Tomb of Tuthmōsis IV, Thebes; H. Carter and P. Newberry, *The Tomb of Thoutmôsis IV*, pp. xxix, 1–5.

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foundation deposits associated with a construction made for the use of a non-royal person.[4] The custom of foundation deposits may have existed in the Old Kingdom,[5] and is certainly attested from Dynasty XI [6] onwards and continued well into Ptolemaic times. Foundation deposits can usually be closely dated, quite apart from the often badly destroyed or denuded buildings with which they are associated, by means of the names of the royal donor which are frequently found on some of the objects in the deposit.

The kinds of materials and objects deposited varied at different periods, but frequently symbolic representations of some of the raw materials (stones, semi-precious stones, faience, metal, wood, etc.) used in building and decorating the temple or tomb were included in the deposit. Amongst these materials were copper and bronze [7] and it is with four specific representations of these materials that this note is concerned.

In 1896 W. M. Flinders Petrie excavated at Thebes two funerary temples, one of King Akhenrēᶜ-setpenrēᶜ Merenptaḥ-siptaḥ and one of Queen Sitrēᶜ-meryamūn Twosre-seteptenmūt.[8] During the course of his work Petrie found seven foundation deposits of Siptaḥ and eight of Twosre. In each of two of Siptaḥ's deposits and two of Twosre's deposits was one probable "sheet copper" [9] model ingot, a total of four model ingots in all. None of the ingots is described as being inscribed, but the inscriptions on the associated objects leave no doubt of the dates of the ingots.[10] Of the four ingots Petrie illustrates only one (*cf.* fig. 161), from Twosre's deposits, but from his text one infers that the four ingots were all of the same type; and, as shall be shown below, one of Siptaḥ's ingots was almost certainly of this type.

Petrie had been forwarding material to the University Museum of the University of Pennsylvania since 1890, when the Museum had begun to make financial contributions to his work. Although he does not specifically say so in his text, it is clear the Petrie gave the University Museum material from the foundation deposits of Siptaḥ, since the Museum's collections contain material identical with material illustrated by Petrie as coming from these deposits.[11]

A model copper or bronze ingot (Museum Catalogue Number E 2029) was cleaned at the writer's request

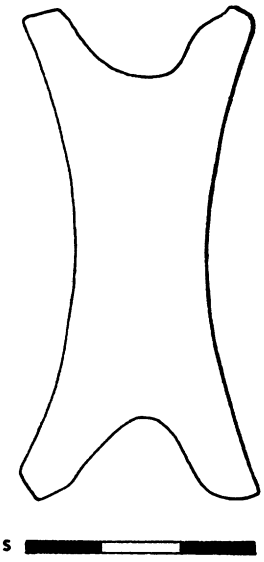


FIG. 161. Model ingot from Twosre's deposits at Thebes (after Petrie).

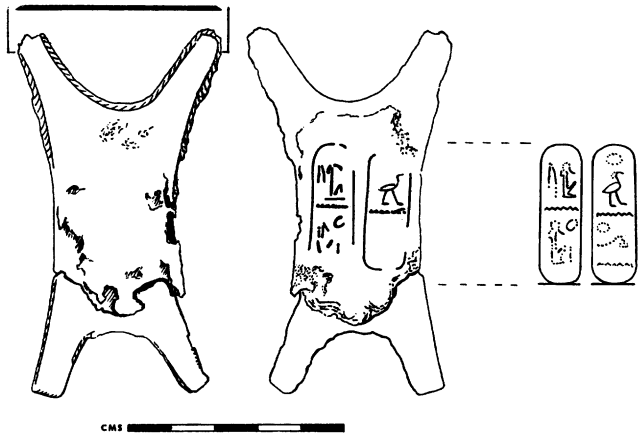


FIG. 162. Model ingot in University Museum.

by Mr. A. E. Parkinson, University Museum Chemist, in the winter of 1965–1966. The cleaning revealed two incised cartouches on one side of the ingot and the remaining traces of the hieroglyphs leave no doubt that they originally read Akhen (rēᶜ-setpenrēᶜ) Merenptaḥ-siptaḥ (see fig. 162), thereby securely dating the ingot.

The provenance of the ingot E 2029 is almost certainly the foundation deposits of Siptaḥ's funerary temple at Thebes. The University Museum catalogue card for E 2029 describes it as a model ingot of unknown period coming from the Ramesseum at Thebes, collected by Sir Flinders Petrie in 1895–1896 and apparently forwarded by the Egyptian Research Account in 1896. In fact, the University Museum did receive in 1896 material from the foundation deposits (of Ramesses II) of the Ramesseum but Quibell, in describing these deposits nowhere refers to the occurrence

[4] The tomb of Senenmūt, Thebes (Dynasty XVIII); H. Winlock, *BMMA*, pt. 2 (Feb. 1928) 38.

[5] G. A. Reisner, *loc. cit.* (*supra*, n. 1).

[6] Nebḥepetrēᶜ Menṭḥotpe II: H. Winlock, *BMMA*, pt. 2 (Dec. 1922) 28–29.

[7] Model tools and representations of raw metal are described in the publications as being of "copper" and "bronze." Since analysis seems hardly ever to have been carried out it is clear that the objects so described may be of either metal.

[8] W. M. F. Petrie, *Six Temples at Thebes*, 13–17.

[9] *Ibid.*, 15.

[10] *Ibid.*, 14, 17 and pls. XVI to XIX.

[11] E.g., University Museum No. E 2104 = Petrie, *op. cit.* (*supra*, n. 8) pls. XVII.23, XIX.10.

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of a model ingot.[12] Since Petrie and Quibell were excavating at Thebes in 1896 in collaboration[13] and material from the different temples presumably arrived simultaneously at the University Museum it seems that the attribution of a Ramesseum provenance to E 2029 was a mistake on the Museum's part. The most likely provenance for a model ingot of Siptaḥ collected in 1896 by Petrie is, of course, the funerary temple of Siptaḥ, where such ingots were found.

The four model ingots of Siptaḥ and Twosre appear to be the only such examples from Egyptian foundation deposits.[14] To my knowledge symbolic representations of copper or bronze as a raw material in foundation deposits occur first in Dynasties XI and XII, when thin rectangular plaques of copper or bronze, as well as other materials, were inserted into sun-dried mud bricks which were then placed in the foundation deposit pit.[15] The next examples I can find are four rectangular "bronze" plaques from a foundation deposit of Ḥashepsowe at Dêr el-Baḥri,[16] while a "bronze model"[17] from a foundation deposit of Amenōphis II at El Kab looks in the illustration as if it might be a fragment of a model ingot similar to those of Siptaḥ and Twosre. The object is, however, more likely to be a crudely shaped model tool; only examination of the actual object might provide a positive identification. Next chronologically come the four ingots of Siptaḥ and Twosre, followed by eight small rectangular "bronze" plaques from a foundation deposit of Ramesses IV.[18]

From Dynasty XXII onwards it appears to have become a standard practice to include small plaques of bronze or copper in foundation deposits, often in Dynasty XXVI and Ptolemaic times accompanied by smaller but thicker "bricks" of copper or bronze.[19]

Studies published by several scholars over the last twelve years[20] have clarified the originally obscure chronological relationship between Siptaḥ and Twosre. Although interpretations still differ in details, the following appears to be a plausible reconstruction of the last reigns of Dynasty XIX.

Siptaḥ was the immediate successor of Sethōs II. In the first year of his reign Siptaḥ's prenomen and nomen were Sekha'-enrēᶜ-setpenrēᶜ Ra'messe-siptaḥ, and these were changed from his second year onwards to Akhenrēᶜ-setpenrēᶜ Merenptaḥ-siptaḥ. Siptaḥ was probably only a boy at his accession and during the six years of his reign the real powers in Egypt seem to have been Twosre, chief wife of Sethōs II, and the Chancellor Bay. At some point, presumably after Siptaḥ's death, Twosre assumed the titles and powers of a king and she probably died in her eighth regnal year. It is uncertain whether Twosre dated her regnal years from the death of Sethōs II,[21] thereby giving a maximum total of eight years for the combined reigns of Siptaḥ and herself, or from the death of Siptaḥ,[22] giving a maximum total of fourteen years for the two reigns. It was at some time during these eight or fourteen years that the foundation deposits were made; unfortunately there is no clear evidence as to the dates of the building of the two funerary temples, but it has been suggested that Twosre's temple must have been begun after Siptaḥ's death.[23]

Egyptologists have not yet reached agreement on the absolute dates to be assigned to these eight or fourteen years and it would be out of place in this brief note to enter into the arguments concerning these dates. Since the general period to which these model ingots belong is more important than the absolute dates of any specific example, I will give here the dates assigned to Siptaḥ and Twosre by the most recent authorities so as to indicate the likely chronological range of these four ingots in absolute terms.

The foundation deposits which contained the four model ingots discussed in this note must, therefore, be dated between 1209 at the earliest and 1185 at the latest.

A. Gardiner[24] 1961	W. Hayes[25] 1962	W. Helck[26] 1962	E. Hornung[27] 1964
Siptaḥ: 1208–1202	Siptaḥ } 1209–1200	Siptaḥ } 1192–1185	Siptaḥ } 1200/1193–1192/85
Twosre: 1202–1194?	Twosre }	Twosre }	Twosre }

[12] J. E. Quibell, *The Ramesseum,* 5, 6 and pl. XV.

[13] *Ibid.,* 2.

[14] My search for parallels has certainly not been exhaustive, but I have examined the published records of approximately one hundred and thirty-five foundation deposits of the period covering the Old Kingdom down to the reign of Ramesses IV, and of a considerable number of foundation deposits of Dynasties XXII to XXVI, the Ptolemaic period and the Napatan-Meroitic period.

[15] Dyn. XI: Nebḥepetrēᶜ Menṯotpe II: H. Winlock, *BMMA,* pt. 2 (Dec. 1922) 28–29, fig. 18.

Dyn. XII: Amenemḥē I: H. Winlock, *BMMA,* pt. 2 (Nov. 1921) 16–17, figs. 9–11.

Dyn. XII: Senwosrē I: W. M. F. Petrie, *Abydos* II, 20, pl. LXII.86, 96, 120, 121.

[16] E. Naville, *The Temple of Deir el Bahari* VI, 9, pl. CLXVIII.

[17] J. E. Quibell, *El Kab,* 16–17, pl. XXI.34.

[18] R. Anthes in U. Holscher, *The Excavation of Medinet Habu* II, 116–117, pl. 58.

[19] For examples, see: P. Montet, *op. cit.* (*supra,* n. 1) 133–143; W. M. F. Petrie, *Nebesheh and Defenneh* (Tanis II), 15, 40–41, 55, with pls. V, XXII–XXIII; Petrie, *Naucratis* I, 28–30, pl. XXV; Petrie, *Abydos* I, 32, pl. LXX.6–9, 11; Dows Dunham, *Royal Cemeteries of Kush II, Nuri,* Chart III.

[20] For most recent studies, with references to preceding studies, see: J. Von Beckerath, "Queen Twosre as Guardian of Siptaḥ," *JEA* **48** (1962) 70–74; C. Aldred, "The Parentage of King Siptaḥ," *JEA* **49** (1963) 41–48.

[21] J. Von Beckerath, *op. cit.* (*supra,* n. 20) 72.

[22] A. Gardiner, *Egypt of the Pharaohs,* 445.

[23] J. Von Beckerath, *op. cit.* (*supra,* n. 20) 71.

[24] A. Gardiner, *loc. cit.* (*supra,* n. 22).

[25] W. Hayes, *CAH* fasc. 4, *Chronology,* 20.

[26] W. Helck, *Ägyptologische Abhandlungen* **5**, 101.

[27] E. Hornung, *Ägyptologische Abhandlungen* **11**, 96–97.

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