BYZANTINE AMPHORAS OF THE NINTH THROUGH THIRTEENTH CENTURIES
IN THE BODRUM MUSEUM OF UNDERWATER ARCHAEOLOGY

A Thesis
by
ELIZABETH LEONA GARVER

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of
MASTER OF ARTS

May 1993

Major Subject: Anthropology
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Approved as to style and content by:

[Signatures]
Frederick H. van Doorninck, Jr.
(Chair of Committee)

George F. Bass
(Member)

Z.S. Kosztolnyik
(Member)

Vaughn M. Bryant, Jr.
(Head of Department)

May 1993

Major Subject: Anthropology
ABSTRACT

Byzantine Amphoras of the Ninth through Thirteenth Centuries in the Bodrum Museum of Underwater Archaeology. (May 1993)

Elizabeth Leona Garver, B.A., University of Arizona

Chair of Advisory Committee:
Dr. Frederick H. van Doorninck, Jr.

This is a study of 59 Byzantine amphoras, dating from the 9th to 13th centuries, in the Bodrum Museum of Underwater Archaeology at Bodrum, Turkey. Nine different classes of amphoras are examined, with emphasis placed on understanding the role of amphoras in the Byzantine economy during the period in which they were used.
Le temps, qui coule irrésistiblement et d'un mouvement ininterrompu, entraîne et emporte avec lui tout ce qui est en passe de devenir pour l'engloutir dans un abîme d'oubli, aussi bien les événements indignes de retenir l'attention que ceux qui sont grands et dignes de mémoire, et, comme dit le tragique, il fait naître ce qui est caché, et ce qui est paru, il le voile. Mais la science de l'histoire est une digue inébranlable qui s'oppose au torrent du temps: elle en arrête en quelque sorte le cours irrésistible des événements qui s'y déroulent; tous ceux qu'elle a pu saisir à la surface, elle les retient dans son étreinte, et ne les laisse pas glisser à jamais aux profondeurs de l'oubli.

Anna Comnena
Alexiade
ACKNOWLEDGEMENTS

This study owes its completion to many people, many of whom are not listed below, and to all I am sincerely grateful.

Above all, I would like to thank Frederick H. van Doorninck, Jr. for suggesting this study, and the Institute of Nautical Archaeology, which partially funded the fieldwork. I would also like to express my appreciation to the Director of the Bodrum Museum of Underwater Archaeology, Oğuz Alpözen, and his wonderful staff, without whose gracious cooperation this study would have been impossible.

I cannot thank Selma Karan enough for her beautiful illustrations, without which this study would have been inconceivable. I would also like to thank Margaret Lynch, Jane Pannell, and Christina van Doorninck for their great help in the field.

A special thank-you goes to Claudia LeDoux for her administrative handiwork, as well as to many of my fellow students, particularly Cheryl Ward Haldane, Michael Fitzgerald, and Cemal Pulak. I would also like to express my appreciation to Margaret Garver Shortridge for all the time and leg-work that she dispensed, despite having pressing obligations of her own.
Finally, my unending gratitude to my mother, Patricia McMillen, and to François Cohen for their loving support and encouragement.
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<td>AA</td>
<td>Archäologischer Anzeiger.</td>
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<tr>
<td>ActaArchHung</td>
<td><em>Acta archaeologica Academiae scientiarum Hungaricae.</em></td>
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<td>ADSV</td>
<td>Antichnaya drevnost' i srednie veka.</td>
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<td>AJA</td>
<td><em>American Journal of Archaeology.</em></td>
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<td>AO...g.</td>
<td>Arheologiya otkritiya...goda.</td>
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<td>ArchEph</td>
<td>Αρχαιολογική Εφημερίς.</td>
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<td>ArchJug</td>
<td>Archaeologia jugoslavica.</td>
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<td>BAR</td>
<td>British Archaeological Reports.</td>
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<td>The Biblical Archaeologist.</td>
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<td>BSA</td>
<td>The Annual of the British School at Athens.</td>
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<td>CahArch</td>
<td>Cahiers Archéologiques.</td>
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<td>CollLatomus</td>
<td>Collection Latomus.</td>
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<tr>
<td>DOP</td>
<td>Dumbarton Oaks Papers.</td>
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<td>HTHR</td>
<td>Harvard Theological Review.</td>
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<tr>
<td>IBAI</td>
<td>Izvestiya na Bulgarskaya arheologicheski institut.</td>
</tr>
<tr>
<td>IJNA</td>
<td>International Journal of Nautical Archaeology.</td>
</tr>
<tr>
<td>IstMitt</td>
<td>Istanbuler Mitteilungen.</td>
</tr>
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<tr>
<td>JARCE</td>
<td>Journal of the American Research Center in Egypt.</td>
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<td>JFA</td>
<td>Journal of Field Archaeology.</td>
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<td>KSIA</td>
<td>Kratkie soobscheniya Instituta arheologii AN SSSR.</td>
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<td>KSIIMK</td>
<td>Kratkie soobscheniya Instituta istorii material'noi kul'turi AN SSSR.</td>
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<tr>
<td>MCA</td>
<td>Materiale si cercetari arheologice.</td>
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INTRODUCTION

Human beings have always been fascinated by earlier civilizations and are rarely able to resist the temptation to collect even the most banal objects of past cultures. Since the invention of SCUBA, formerly pristine archaeological sites, protected by a once hostile aquatic environment, have been looted in order to satisfy the curiosity of the weekend sport diver and the avarice of the seller of antiquities. Fortunately, many objects from shipwrecks find their way to museums, where they may still be of use to archaeologists despite their lack of archaeological provenance. In Turkey, where laws protecting the cultural resources underwater are quite strict, spongers often bring their finds, mostly amphoras, to the local museum; such is the case at the Bodrum Museum of Underwater Archaeology. In fact, it is the spongers' vast knowledge of the Turkish coast that has led to the discovery and identification of many shipwrecks, often clearly marked by a visible mound of amphoras.¹

Amphoras are an important source of evidence on trade and seaborne commerce in the Mediterranean and Black Sea areas. Through their study, much may be learned about the

¹ The American Journal of Archaeology provides the model for format and style.
principal commodities that powered economies. The economic evidence they furnish may sometimes contradict the written historical record or what is understood to have been governmental trading policies of the time. Thus their study provides not only a fuller, but also a more accurate, picture of economic life. Unfortunately, amphoras of the medieval period have yielded relatively little such evidence to date, due to the fact that they remain relatively unstudied in comparison to those of earlier periods.

I present here the study of a group of medieval amphoras from the Bodrum Museum in Turkey. Although the amphoras are without precise provenances, their study was thought worthwhile, because so little is known about the particular types of amphoras involved. In the literature, these amphora types are frequently misidentified, especially when discovered as intrusive finds in earlier habitation layers, and complete descriptions of them are often missing. My investigation was also intended as a parallel study to that being made of amphoras from an 11th-century shipwreck discovered at Serçe Limanı, Turkey.

In the end, I hope to prove that a random collection of unprovenanced Byzantine amphoras can make important contributions to our knowledge of the design, fabrication, and uses of the classes of amphoras to which they belong.
THE AMPHORAS

In this study, there are 59 Byzantine amphoras ranging in date from the 9th to 13th centuries. These vessels may be divided into 9 different classes:

1. Piriform amphoras with handles arching below to slightly above rim level.
2. Large piriform amphoras with handles arching above rim level.
3. Tall piriform amphoras with high-rising handles.
4. Tall ovoid amphoras with round-in-section handles.
5. Small piriform amphoras with high-rising handles.
7. Small piriform amphoras.
8. Flat-bottomed piriform amphoras.

All of the amphoras are now in the Bodrum Museum; the Museum inventory number is given in those cases where the amphora has been catalogued by the Museum. Most of the amphoras are finds by local spongers; however, Amphoras 17 (Class 1, Type 2) and 28 (Class 2) were found on a shipwreck located during the Institute of Nautical Archaeology's 1984 survey at Marmara.
Many of the amphoras share attributes common to wheel-made vessels, as well as decorative techniques, which are mostly functional. Vessel shoulders are often ornamented by wheel ridging, spiral decoration made by a wooden tool, or by combing, a fine-lined decoration applied with a comb-like instrument. The parts of the vessel's body not covered by decoration often bear shallow wheel-troughing, made by the potter's dampened hands as he resumed shaping the vessel. Instances where the handles are grooved by a tool rather than pinched into shape manually are noted in the catalogue. A phenomenon peculiar to certain classes of piriform amphoras in this study is the uneven, and in certain cases abrupt, transition from the upper to lower body. This feature is described in the catalogue as a set off bottom/base.

Most amphoras are covered to some degree by marine encrustation or concretion. Their surface is often channeled with "worm tracks" made by creatures feeding on the organic temper or on some marine animal that had made its home on the vessel's surface.

All measurements of height for the amphoras were taken to the rim and do not include the height of the handles when the latter rise above it.

Amphora capacities were measured with polystyrene beads and/or water. In the latter case, the vessels were first weighed when dry, using a Salter Suspended Weigher
model 235, and then filled and emptied twice. When both methods were used to measure the same vessel, the result of the water capacity was preferred. In either case, the capacities were measured to the top of the rim. This was done in the interests of objectivity; the actual capacity was, of course, somewhat less.

Fabric colors were identified according to the Munsell Soil Color Charts. Descriptions of fabric temper follow those of the Wentworth Scale for sediment sizes: 0-1/4 mm. fine, 1/4-1/2 mm. medium, 1/2-1 mm. coarse, 1-2 mm. very coarse. The hardness of the fabric is described according to the Mohs Scale.

Abbreviations utilized in the catalog are as follows:

Amph  Amphora
approx.  approximately
diam.  diameter
h.  height
Inv. No.  inventory number
kg.  kilogram
l  liter
max.  maximum
pres.  preserved
wgt.  weight

Measurements are in meters, as, for example, h. 0.456.
Class 1

Type 1

Amph 1. Medium-sized piriform.

Ill. 1; pl. 1.

Max. h. 0.385; max. diam. 0.319; h. to max. diam. 0.209-0.211; rim diam. 0.088; capacity 12.46 l;
weight 6.83 kg. Interior of rim chipped on one side between handles. Exterior surface quite eroded.
Eroded surface pink (5YR 7/3); core light reddish brown (2.5YR 6/4). Surface feels rough, with fine to coarse inclusions of sand (quartz; black and red) and grog. Inclusions rounded to subrounded; frequency 10-30% (common). Mohs 4-4.5.

Rim rectangular in section. Chipped area of rim concave in profile and appears to be intentionally carved down. Two handles, their lower ends placed on band of shoulder ridging, joined to neck under rim.

Handles made almost triangular in section by two grooves creating central spine down length on outer face. Handles attached with extra clay smoothed out over neck and shoulders and covering ridging. Three prominent wheel troughs on short neck underscore rim.

Two shallow troughs are followed first by three widely spaced ridges and then by two shallow ridges smudged down to make a blank, smoothed-out area.
Ill. 1. Amph 1.
(Scale 1:4)
Total height of neck and upper shoulder approx. 0.07. Prominent 0.110-wide band of closely spaced ridging covers lower part of shoulder and upper part of body. Ridging extends approx. 0.050 past point of max. diam. Below band of ridging, body and base are wheel troughed. Spacing between troughs reduces gradually toward base. Well-defined wheel troughs decorate base in counter-clockwise spiral to its center. Small lump of clay adheres to interior bottom of vessel. Some traces of pitch on interior walls.

Graffito scratched on shoulder before firing (ill. 2); consists of two parallel, vertical lines crossed by diagonal sloping downwards to right; vertical lines, 0.117 and 0.104 long, incised before diagonal line, 0.117 long.


I1l. 3; Pl. 2.
Max. restored h. 0.405; max. diam. 0.336; rim diam. 0.086. Part of bottom missing. Bottom perforated by hole (diam. 0.015-0.020); exterior and interior edges of hole rounded and eroded. "Worm tracks" on interior and exterior of rim. Both exterior and interior surfaces of amphora badly eroded. Surface exfoliates in some areas: handles, base, and shoulders. Core light reddish brown (5YR 6/4); original surface reddish brown (5YR 5/4). Surface
ILL. 2. Mark 1 (Amph 1).
(Scale 1:1)
feels rough, with very fine inclusions of mica, white grit, sand, and grog. Large stone (0.005 cm across) protruding from side wall and some large pieces of grog are exceptions to a very fine fabric. Inclusions rounded to angular; frequency 5-10%. Mohs 4.5.

Rim, carelessly fashioned, has shallow, concave profile on either side between handles, apparently due to carving. Handles, joined to neck and lower edge of rim, descend to mid- to-lower shoulder. Extra clay for handle attachment smeared over ridges on shoulder. Both handles decorated with two parallel grooves down length on outer face. Crack, approx. 0.035 out from base of neck, delineates location where separate neck joined to shoulder. Base 0.010 thick at junction with side walls, and 0.007 thick elsewhere; wall thickness around hole 0.003. Neck delineated by three wheel troughs. Four troughs followed by blank band 0.035 wide on upper shoulder. Band of severely eroded wheel ridging begins under lower handle attachments and extends past point of max. diam. Wheel troughs cover rest of body and base.

Two grape seeds found among amphora contents (pl. 3).

Ill. 4; pl. 4.

Max. h. 0.367; max. diam. 0.324; rim diam. 0.089-0.083 (slightly oval); h. to max. diam. 0.199-0.210; capacity 11.77 l; weight 5.65 kg. Old chip on rim interior. Interior and exterior of neck and rim have several stress cracks that occurred during drying. Exterior surface highly eroded and covered with encrustation. Eroded surface reddish yellow (5YR 6/6); core reddish yellow (5YR 7/8). Surface feels rough, with medium to coarse quartz-sand inclusions; a few large quartz crystals, some 1 to 2 mm wide, are exceptional. Inclusions rounded, with frequency 30% on body and >30% on neck and rim; unevenly sorted on neck and rim. Greater percentage of sand in neck and rim no doubt cause for stress cracks mentioned above. Core Mohs 3; surface Mohs 4.5.

Lip of rim slightly flared and carelessly fashioned. Handles, joined to neck and lower edge of rim, arch slightly upwards and descend to mid-shoulder. One handle has three parallel grooves running down length on outer face; the other, only two. Handles attached with extra clay smoothed out over neck and shoulders and covering ridging. Three prominent troughs underscore rim on short neck. On
Ill. 4. Amph 3.
(Scale 1:4)
upper shoulder, a small band of shallow wheel troughs are followed by three widely spaced ridges succeeded by a smoothed-out blank band. Junction of neck with body occurs under last of three wheel troughs on shoulder; clay smoothed over on outside of junction. Closely spaced wheel ridging begins beneath lower handle attachment and extends approx. 0.064 past point of max. diam. Below band of wheel ridging, body and base are wheel troughed. Well-defined wheel troughs decorate slightly conical base, rotating in counter-clockwise spiral to its center. No traces of graffiti or pitch. Small lump of clay may be felt on interior bottom.

Ill. 5; pl. 5.
Max. h. 0.402; max. diam. 0.329; h. to max. diam. 0.222 to 0.232; rim diam. 0.093; capacity 14.52 l.
Part of rim and neck missing; edges of break were intentionally smoothed down and rounded off forming concave profile. An almost square hole with smoothed edges cut into lower body of vessel; hole measures 0.023 x 0.028. Surface covered with encrustation and eroded. Eroded surface light reddish brown (5YR 6/4); core pink (5YR 7/4). Fabric feels rough, with very fine inclusions of sand, black grit, and grog. Inclusions rounded; frequency 10-30% (common).
Ill. 5. Amph. 4.
(Scale 1:4)
Eroded surface Mohs 3-3.5.

Vessel has large mouth with well-formed rim. Neck and rim approx. 0.071 tall. Handles joined to neck and rim, rise only slightly and descend to mid-shoulder. Handles have two faint grooves on outer face. Body gradually narrows below max. diam. to a point approx. 0.06 from bottom; here walls become steeper and straighter for approx. 0.035 before turning into base in form of truncated cone. Three large wheel troughs decorate neck under rim; three more on upper shoulder. Closely spaced wheel ridging begins under arches of handles and continues to 0.050 below point of max. diam. Widely spaced wheel troughs cover rest of body, followed by wheel ridges on bottom. Star-shaped crack with four arms curving clockwise in center of bottom.

Amph 5. Medium-sized piriform.

Ill. 6; pl. 6.

Max. h. 0.356; max. diam. 0.282; h. to max. diam. 0.211 to 0.218; rim diam. 0.093; capacity 9.4 l.

Vessel cracked. Surface flaky and highly eroded on one side. Overall surface dark reddish brown (2.5YR 3/4); original surface dark red (2.5YR 3/6); core reddish yellow (5YR 6/6). Fabric feels slightly rough, with very fine to coarse inclusions of grog, small, black stones, and also rare grains of very
Ill. 6. Amph 5.
(Scale 1:4)
coarse quartz. Inclusions rounded (black grains) to angular (grog and quartz); frequency >30%. Grog dark red (10R 3/4 to 10R 2.5/2 and 2.5/1); Mohs 5. Vessel Mohs 4.

Rim thick and well made. H. of rim and neck approx. 0.064. Separate neck joined to upper shoulder under the fifth and sixth wheel troughs below rim. Handles, joined to rim and upper neck, rise slightly without surpassing rim and descend to mid-shoulder; handles channeled by two grooves running down length on outer face, but become somewhat flattened at juncture with neck and rim. Body gradually narrows after point of max. diam. Base ends in truncated cone shape. Seven wheel ridges on neck below rim. Blank band 0.02 wide under arch of handles followed by six more ridges and second 0.02-wide blank band of smoothed down ridges. Wheel ridging resumes under lower handle attachment and extends 0.06 past point of max. diam. Small striations visible in bottom of ridges. Shallow, widely spaced wheel troughs cover rest of vessel to bottom. Traces of crizzled pitch on interior walls.


Pl. 7. Museum Inv. No. 462

Max. h. 0.389; max. diam. 0.303; h. to max. diam. 0.234 to 0.238; rim diam. 0.092; capacity 11.51 l;
wgt. 6.8 kg. Half of rim missing; rebuilt with plaster. Small old chip on rim interior somewhat enlarged by further recent damage; some original patina remains. Surface eroded and partially covered by encrustation; dark spots, on shoulder, neck, and under some concretion, probably original surface. Original surface between reddish brown (2.5YR 4/4) and red (2.5YR 4/6); eroded surface reddish yellow (between 5YR 7/6 and 5YR 6/6); wash very pale brown (10YR 8/4). Surface feels smooth, with fine to medium inclusions of mostly grog, some green and white limestone, and mica. Inclusions rounded to angular; frequency >30%. Less apparent inclusions on handles, and of finer grade. Original surface Mohs 4.5-5; eroded surface Mohs 2.5-3.

Thick, well-defined rim on short neck. Handles joined to neck, rise even with rim before descending to mid- to-lower shoulder. Body gradually narrows below max. diam. to a point approx. 0.062 above bottom; here walls become slightly steeper and straighter for approx. 0.031 before turning into somewhat conical base. Wheel troughs decorate neck and upper shoulder. Closely spaced wheel ridging begins underneath lower handle attachment and extends 0.06 past point of max. diam. Shallow, uneven wheel troughs continue to bottom.
Stamp (ill. 7) impressed on plain area of vessel's upper shoulder consists of six trapezoid-shaped impressions forming rosette (diam. 0.014-0.016). Similar stamp found on vessel at Constantinople.°

Amph 7. Medium-sized piriform.

Ill. 8; pl. 8. Museum Inv. No. 6727

Max. h. 0.382; max. diam. 0.312; h. to max. diam. 0.221 to 0.225; rim diam. 0.091; capacity 12.13 l; wgt. 6.65 kg. Rim chipped on interior; one chip old, the other recent. Surface heavily encrusted and flaky. Original surface reddish brown (2.5YR 4/4); core light red (2.5YR 6/6). Fabric feels soft, with fine to medium inclusions of dark grit. Inclusions subrounded to rounded; frequency 5%. Original surface Mohs 3-3.5.

Rim thick and rectangular in section. Neck short, merely a small transition between body and rim. Handles, joined to neck and rim, rise slightly without surpassing rim before descending to mid-shoulder. Handles decorated by two grooves running down length on outer face. Body gradually narrows below max. diam. to somewhat conical base. Seven wheel troughs decorate neck and upper shoulder. Closely spaced wheel ridging begins at lower handle attachment and extends approx. 0.080 past max. diam.
Ill. 7. Mark 2 (Amph 6).
(Scale 1:1)
Ill. 8. Amph 7 (6727). (Scale 1:4)
Mark 3. (Scale 1:1)
Wheel troughs continue down rest of vessel. Interior discolored black, but no pitch.

Graffito (0.018 x 0.023) scratched on shoulder, under one handle. Has shape of arrow pointing downwards, with a central vertical bar and two V-shaped arms joined together by a crossing horizontal bar (ill. 8). Identical arrows found in Bulgaria at Pliska and Tsarevets.⁷

**Amph 8. Medium-sized piriform.**

Pl. 9. Museum Inv. No. 7419

Max. h. 0.410; max. diam. 0.319; h. to max. diam. 0.210 to 0.214; rim diam. 0.102; capacity 13.24 l; wgt. 6.22 kg. Half of rim and part of neck missing; break old and carved down. Surface covered by encrustation and heavily eroded. Fabric "worm eaten" and exfoliating in places. Original surface reddish brown (between 2.5YR 5/4 and 2.5YR 4/4); eroded surface between light brown (7.5YR 6/4) and reddish yellow (7.5YR 6/6); wash pink (5YR 7/3). Original surface feels rough; eroded surface smooth, with fine to medium inclusions of dark grit and sand.

Inclusions rounded; frequency 30% on body and >30% on neck. Where fabric eroded, inclusion frequency is 5%; inclusions rub easily out of matrix. Original surface Mohs 4.5-5; eroded surface Mohs 2.
Rim not well defined and neck short; h. of rim and neck approx. 0.088. Handles, joined to neck and rim, rise slightly but not beyond rim before descending vertically to mid-shoulder. Handles decorated by two parallel grooves running down length on outer face. Body gradually narrows below max. diam. to slightly conical bottom. Six shallow wheel troughs underscore rim on neck and upper shoulder. Wheel ridging begins at attachment of lower handles and extends approx. 0.131 past point of max. diam. Shallow wheel troughs cover rest of vessel body. Two daubs of wash visible in interior.


Pl. 10.

Max. h. 0.339; max. diam. 0.279; h. to max. diam. 0.200 to 0.205; rim diam. 0.088; capacity 8.65 l.

Amphora broken and repaired. Rim newly chipped on upper edge. Part of vessel covered with encrustation. Original surface weak red (10R 4/4); eroded surface red (2.5YR 4/6). Fabric feels smooth apart from some large inclusions of grog. Inclusions medium to very coarse and angular to rounded; frequency >30%. Some cracks in the vessel walls do not traverse them; most probably caused by fabric drying too fast and largeness of temper. Original surface Mohs 3.5-4.
Rim thick and well made, with flat top and rolled edge; neck short. Handles, joined to neck and rim, rise slightly above rim before descending to mid-shoulder. Handles not grooved. Body gradually narrows from point of max. diam. to slightly conical base. Three wheel troughs decorate neck, followed by three wheel ridges on upper shoulder; ridging raised higher off the body on one side than on the other. Ridging succeeded by 0.030 wide smooth band underneath lower handle attachment. Closely spaced wheel ridging extends from smooth band to point 0.060 below max. diam. Shallow wheel troughs descend to bottom. Traces of pitch on inside walls.

Amph 10. Small piriform.

Pl. 11. Museum Inv. No. 499

Max. h. 0.298; max. diam. 0.227; h. to max. diam. 0.190 to 0.195; rim diam. 0.076; capacity 4.765 l; wgt. 2.92 kg. Amphora almost entirely covered with encrustation.

Wide mouth; rim delicately rolled. Neck short; h. of neck and rim approx. 0.050. Handles, joined to neck, rise to slightly below rim before descending to mid-shoulder. Body gradually narrows from max. diam. to point approx. 0.117 from bottom, where walls become steeper and straighter before turning into rounded base. Body covered by wheel troughs.
Amph 11. Small piriform.

Pl. 12. Museum Inv. No. 480
Max. h. 0.321; max. diam. 0.259; h. to max. diam. 0.188 to 0.191; rim diam. reconstructed 0.082; capacity 6.35 l; wgt. 5.3 kg. Rim and neck missing. Surface covered with encrustation and eroded. Eroded surface reddish yellow (between 5YR 7/6 and 5YR 6/6); core light red (2.5YR 6/8). Fabric feels soft, with fine inclusions of mica, grog, and sand. Inclusions rounded; frequency 30% (mica) and 5% (others). Eroded surface Mohs 2.5.

Upper neck and rim reconstructed. Handles, joined to neck, rise slightly before descending to mid- to-lower shoulder. Handles crested on upper face and rounded below. Body narrows after max. diam. to a point approx. 0.078 from bottom, where walls become steeper and straighter for approx. 0.039 before turning into rounded base. Wheel troughs decorate neck and upper shoulder. Closely spaced wheel ridging begins at lower handle attachment and extends approx. 0.055 past max. diam.; last two revolutions of ridging become wider and deeper. Shallow, widely spaced wheel troughs continue to bottom.


Pl. 13. Museum Inv. No. 7463
Max. h. 0.407; max. diam. 0.319; h. to max. diam. 0.226 to 0.228; rim diam. 0.110; capacity 14.36 l; wgt. 6.16 kg. Rim and neck covered with encrustation; some "worm holes." Surface eroded. Eroded surface reddish yellow (between 5YR 7/6 and 5YR 6/6); wash pale yellow (2.5Y 8/4). Fabric feels fairly smooth, with fine inclusions of grog, some mica, and some sand; one 0.005-long piece of grog exceptional. Inclusions, apart from mica, rounded; frequency 5-10%. Eroded surface Mohs 1-2.

Large mouth. Rim flat on top; wider at bottom. Small groove on rim interior for seating of stopper. Neck fairly tall; h. of rim and neck 0.076. Handles, joined to mid-neck, depart horizontally from neck before making right angle turn and descending to mid shoulder. Handles grooved so that they have five parallel ridges running length on outer face. Body gradually narrows from max. diam. to approx. 0.055 from bottom, where walls become steeper and straighter for approx. 0.022 before turning into slightly conical base. Wheel troughs decorate neck and upper shoulder. Closely spaced wheel ridging begins on upper shoulder beneath arch of handles and extends approx. 0.100 past max. diam. Wheel troughs continue to bottom. Rivulets of pitch on interior walls.
Graffito scratched on shoulder eroded, covered by encrustation, and partially effaced by "worm hole" (ill. 9). Remaining part consists of V-shaped mark with slanted line leaving right bar and crossing vertical line to right. Mark could be M-I, or N-H, or even M-I-H or N-I-H ligature. A similar mark was found in Cherson. 8


Pl. 14. Museum Inv. No. 7670

Max. h. 0.366; max. diam. 0.282; h. to max. diam. 0.216-0.218; rim diam. 0.097; capacity 10.495 l.

Vessel cracked, with hole on one shoulder. Surface eroded and covered with some encrustation. Original surface red (2.5YR 4/6); eroded surface weak red (10R 4/4). Fabric feels smooth, with coarse to very coarse inclusions of dark red (2.5YR 2.5/2) grog. Inclusions rounded to angular; frequency 10-30% (common). Mohs 3.

Rim thick and well defined. Neck short; h. of rim and neck 0.059. Some vertical scratches on inside wall of neck; very faint. Handles, joined to rim and neck, extend out horizontally before descending to mid shoulder. Body gradually narrows from point of max. diam. to slightly conical base. Everywhere amphora appears smooth and well made; no obvious joins. Wheel troughing covers neck and upper
Ill. 9. Mark 4 (Amph 12).
(No scale)
shoulder; five on neck. Closely spaced wheel ridging begins on shoulder under arch of handles and extends approx. 0.100 past point of max. diam. gradually becoming deeper and wider. Shallow wheel troughing continues to bottom.


Ill. 10; Pl. 15. 
Museum Inv. No. 7444

Max. h. 0.360; max. diam. 0.301; h. to max. diam. 0.200-0.205; rim diam. 0.087-0.090; capacity 10.14 l; wgt. 7.16 kg. Rim "worm" eaten; edges eroded.

Interior wall covered with encrustation, some also on exterior. Surface highly eroded and "worm" eaten. Eroded surface between pink (5YR 7/4) and light reddish brown (5YR 6/4); core pink (5YR 8/4). Fabric feels rough, with fine to very coarse inclusions of quartz on upper shoulder and fine to medium inclusions of quartz on body. Inclusions angular; frequency >30% on upper shoulder and neck and 10% on body. Differences in temper between upper shoulder and rest of body may be explained by more eroded and pitted appearance of lower body surface. Mohs 4-4.5.

Rim thick and well defined. Neck short; h. of rim and neck approx. 0.040. Handles, joined to under edge of rim and neck, rise only slightly before descending to mid-shoulder. Upper face of handles pinched into a central, longitudinal crest. Join of
Ill. 10. Amph 14.
(Scale 1:4)
separate neck to rest of vessel located on upper shoulder under fifth wheel trough from rim. Body gradually narrows from max diam. to approx. 0.050 from bottom, where vessel walls become steeper and straighter for approx. 0.020 before turning into slightly conical base. Side wall towards base is indented and bulges, as if it had fallen over and extra clay was added to shore up side; perhaps walls were too thin here. Seven wheel troughs under rim on neck and upper shoulder. Closely spaced wheel ridging begins just above lower handle attachments and extends approx. 0.100 past max. diam. Deep wheel troughing continues to bottom.

Graffito, measuring, 0.070 x 0.065, scratched on shoulder (ill. 11); consists of letters K, O, and O or U. Another, measuring 0.048 x 0.035, scratched on opposite shoulder; consists of letter K followed by other illegible letters.

Amph 15. Medium-sized piriform.

Museum Inv. No. 7365

Max. h. 0.381; max. diam. 0.288; h. to max. diam. 0.220-0.222; rim diam. 0.086; capacity 11.875 l; wgt. 6.86 kg. Surface covered with encrustation, especially mouth and shoulders. Original surface reddish brown (between 2.5YR 5/4 and 2.5YR 4/4); eroded surface pink (5YR 7/4). Fabric feels rough,
Ill. 11. Marks 5 and 6 (Amph 14).
(Scale 1:1)
with very fine inclusions of black grit. Inclusions rounded; frequency 10-30% (common). Original surface Mohs 4.5-5.

Poorly fashioned, undefined rim; short neck. Handles, joined to neck, rise only slightly before descending to mid-shoulder. Body gradually narrows after max. diam. Near base, wall's descent becomes steeper and straighter before turning into bottom; interior wall at this point encircled by small crack. Wheel troughs decorate neck and upper shoulders. Closely spaced wheel ridging begins at lower attachment of handles and extends approx. 0.060 past point of max. diam. Shallow wheel troughing covers rest of body to bottom.


Pl. 16. Museum Inv. No. 7665

Max. h. 0.350; max. diam. 0.289; h. to max. diam. 0.205-0.206; rim diam. 0.098; capacity 10.03 l; wgt. 5.48 kg. Vessel cracked. Rim newly chipped on exterior edge. Original surface between reddish brown (2.5YR 4/4) and red (2.5YR 4/6); eroded surface red (2.5YR 5/6); core red (2.5YR 4/8). Fabric feels smooth, with medium to very coarse inclusions of dark red (2.5YR-2.5/2) gog. Inclusions rounded to angular; frequency 10-30%. Original surface Mohs 2.5-3.
Rim thick and well delineated. Neck short; h. of rim and neck approx. 0.068. Handles, joined to rim and neck, extend out horizontally before descending to mid-shoulder. Body gradually narrows after max. diam. to slightly conical bottom. Neck and upper shoulder decorated with wheel troughs. Wheel ridging begins on upper shoulder beneath arches of handles and extends approx 0.090 past point of max. diam., progressively becoming deeper and wider. Widely spaced wheel troughing continues to bottom. Large lump of pitch found inside vessel.

Type 2

Ill. 12; Pl. 17. Museum Inv. No. 3-39-84
H. 0.339; max. diam. 0.302; h. to max. diam. 0.192 to 0.200; rim diam. 0.080; capacity 9.955 l; wgt. 5.74 kg. Rim recently chipped on interior. Surface eroded. Wash very pale brown (10YR 8/3); eroded surface light reddish brown (5YR 6/4) to reddish brown (5YR 7/6). Fabric feels smooth, with mostly fine quartz sand and some coarse inclusions. Inclusions rounded to angular; frequency 30%. Mohs 2.

Rim not well defined. Vertical finger marks on inner surface of rim; inside of rim otherwise smooth. Neck low, with little transition between upper body
and rim. Upper end of handles joined to neck and rim; lower end, to mid shoulder. One handle rises slightly above rim. Inner face of handles have two longitudinal grooves running along length. Profile noticeably bulges at mid shoulder, above lower handle attachment. Large indentation on the lower body partly covered by another layer of clay. Wall probably too thin here and started to sag; potter shored up walls with extra clay and decorated his efforts with a few ridges. Six wheel troughs decorate area under neck; wheel ridging begins on upper shoulder under handle arches. Ridging band approx. 0.148 wide; last three ridges much deeper. Wheel troughs continue to slightly conical bottom. Troughs and ridges smudged or effaced around indentation on lower body. Large, smooth ridge inside base of neck; sharp ridge further down on inside wall approx. under arch of handles. Lump of extra clay on bottom of interior. Pitch on interior walls.


Ill. 13; pl. 18.

Max. h. 0.323; max. diam. 0.258; h. to max. diam. 0.190 to 0.192; rim diam. 0.081; capacity 6.5 l; wgt. 5.18 kg. Surface eroded and covered with encrustation. Eroded surface light brown (7.5YR
(Scale 1:4)
6/4); core pink (5YR 7/3). Fabric feels fairly smooth, with very fine to medium inclusions of black grit and small amounts of quartz sand. Inclusions rounded to subrounded; frequency 10–30% (common). Inclusions seem to be more frequent on handles than on rest of body. Mohs 3.5.

Rim thick, but with little delineation from rest of neck. Neck and rim approx. 0.054 tall. Handles, joined to neck, rise to slightly below rim and descend to middle to lower shoulder. Upper face of handles crested; inner face rounded. Body gradually narrows below max. diam.; base has slightly truncated cone shape. Five wheel troughs decorate upper shoulder under rim; ridging begins where handles are attached and runs approx. 0.025 past point of max. diam. Wheel troughs continue to where side turns into base; at this point, one deep wheel ridge encircles base. Base decorated by closely spaced wheel troughs. Interior bottom of amphora covered with bits of clay.

Graffito (0.105 x 0.14) scratched on shoulder of vessel after firing (ill. 14). Graffito, partially obscured by "worm holes," may consist of letters K, M, and backwards K. Backwards K found at Sarkel9 and Dinogetia.10
(Scale 1:1)
Ill. 15; pl. 19.
Max. h. 0.412; max. diam. 0.359; h. to max. diam. 0.232 to 0.245; rim diam. 0.082; capacity 17.07 l; wgt. 8.5 kg. Part of rim missing; interior of rim chipped. Surface eroded, discolored, and covered with encrustation. Surface reddish yellow (5YR 6/6); core light reddish brown (5YR 6/4). Fabric feels powdery, with very fine inclusions of mica, dark sand, grog, and black grit. Inclusions angular; frequency 5-10%. Fabric surface has some fine pock marks, probably due to inclusions eroded away. However, even where core can be clearly seen, there is no great evidence of temper. Mohs 3.

Rim carved down into characteristic concave profile. Rim sits almost directly on top of upper body, there being very little transition. Juncture of neck and shoulder located midway underneath arch of handles. Upper face of handles decorated by longitudinal ridge; lower face rounded. Handles, joined to neck and rim, rise evenly with existing h. of rim and descend to mid shoulder; one handle–shoulder juncture lower than other. Body gradually narrows below max. diam. to point approx. 0.082 from bottom, where walls become steeper and straighter for approx. 0.047 before turning into base
ILL. 15. Amph 19.  (Scale 1:4)
Mark 8.  (Scale 1:1)
with shape of slightly truncated cone. Two troughs decorate neck below rim and are followed by shallow wheel troughs on upper shoulder. Closely spaced ridging starts just above lower handle attachment and stops at end of shoulder. What looks like a small band of eroded wheel ridging begins approx. 0.200 from bottom and continues for approx. 0.041; wheel troughs continue to bottom, with one deep wheel trough encircling point where walls become steeper and straighter. Small gouge underneath one handle made by finger before firing.

Circular stamp (diam. 0.032 x 0.034) impressed in upper shoulder under neck; one side of stamp impressed more deeply than other (ill. 15). Inside circle are Greek letters: kappa, omega, sigma, and tau.

Identical stamps were found at Constantinople,11 Sarkel,12 Dinogetia,13 Svichtov,14 and Ivan-Gora.15 An analogous composition of letters is found on coins, both silver and gold, manufactured with the monogrammed name of Constantine VII Porphyrogenitus (905-959); it differs from the marks on the amphoras by one element - the presence of the letter nu.16 The abbreviation KOST (Konstantinos) was found on an amphora fragment from Dinogetia.17

Ill. 16; pl. 20. Museum Inv. No. 7403

Max. h. 0.433; max. diam. 0.361; h. to max. diam. 0.268 to 0.280; rim diam. 0.089; capacity 19.02 l.

One handle and part of rim missing; rim and knob of handle intentionally smoothed down and rounded off; mouth "worm" eaten. Vessel covered with encrustation; surface eroded and exfoliating in places. Eroded surface and core reddish yellow (between 5YR 7/6 and 5YR 6/6). Fabric feels rough, with fine and a few medium inclusions of mica, sand, and some grog. Inclusions rounded; frequency 30% on body and 5% on handle. Mohs 3-3.5.

Rim set directly on upper shoulder without transition. Handle, joined to rim and upper shoulder, rises slightly above mouth before descending to mid shoulder. Shoulder humped beneath arch of handle. Neck-shoulder juncture occurs under third or fourth wheel trough from rim. Shoulder dented under lower attachment of one handle. Body gradually narrows below max. diam. to a point approx. 0.090 from bottom, where walls become steeper and straighter for approx. 0.060 before turning into base. Seven wheel troughs under rim on upper shoulder. Closely spaced wheel ridging begins on shoulder under arch of handles and extends approx.
Ill. 16. Amph 20.
(Scale 1:4)
0.080 past max. diam., gradually becoming wider and deeper the last 0.070. Wheel ridging is smeared and partly effaced in one area of shoulder; vessel apparently was leaned, or had fallen, against something while clay still soft. Shallow, widely spaced wheel troughs continue after ridging and are followed by small band of six wheel grooves just above point where walls become steeper. Wheel troughs continue to bottom.

Very eroded graffito (0.118 x 0.084) in form of letter M, with center strokes crossing and forming an X, scratched on shoulder (ill. 17). Similar M's, whose central bars cross forming X, found at Cherson,18 Sarkel19 and Preslav,20 in Nubia,21 and at a monastery in the Northern Sudan.22


Pl. 21. Museum Inv. No. 179

Max h. 0.343; max. diam. 0.290; h. to max. diam. 0.209-0.222; rim diam. 0.084; capacity 10.12 l; wgt. 6.12 kg. Vessel covered with encrustation; surface eroded. Eroded surface between light red (2.5YR 6/6) and red (2.5YR 5/6); core light red (2.5YR 6/6).

Fabric feels fairly smooth, with fine inclusions of grog and some sand. Inclusions rounded; frequency 5%. Eroded surface Mohs 3.
Ill. 17. Mark 9 (Amph 20).
(Scale 1:1)
Rim is thick, heavy and rectangular in section; set directly on shoulders, with only a slight transition. Handles joined to rim and upper shoulder; one rises just short of rim, the other slightly (0.007) above rim, before descending to mid shoulder. Body gradually narrows from max. diam. to a slightly conical bottom. Wheel troughs begin directly under rim and decorate upper shoulder. Closely spaced wheel ridging begins on shoulder, under arch of handles, and extends 0.085 past point of max. diam., gradually becoming wider and deeper past turn of shoulder. Deep, closely spaced wheel troughs continue to bottom.

Amph 22. Medium-sized piriform.

Pl. 22. Museum Inv. No. 488

Max. h. 0.383; max. diam. 0.315; h. to max. diam. 0.239-0.242; rim diam. 0.088; capacity 12.36 l; wgt. 7.46 kg. One handle missing; handle stubs smoothly rounded off. Rim edges and surface eroded. Eroded surface reddish yellow (between 5YR 7/6 and 5YR 6/6); wash yellow (10YR 8/6). Fabric feels soft, with very fine inclusions of mica, grog, and some sand. Inclusions rounded; frequency <5%. Eroded surface Mohs 2.

Rim rounded; groove on inside of rim for seating of stopper. Short neck merely a small transition
from upper shoulder to rim. Handles, joined to rim, neck, and upper shoulder, rise until even with rim before descending to mid shoulder. Handles have a median crest on outer face. Body gradually narrows after point of max. diam. to slightly conical base. Two wheel troughs underscore rim on neck; wheel troughing continues down to upper shoulder. Closely spaced wheel ridging begins underneath lower handle attachments and extends approx. 0.050 past max. diam. Wheel troughing resumes here and continues to bottom, gradually becoming deeper and closer together.

A rosette stamp with eight points (diam. 0.012) was imprinted onto shoulder, one side more deeply than the other (ill. 18). Similar stamps were found at Constantinople,23 Pliska,24 and on a piriform amphora from the 11th century shipwreck at Serçe Limanı.25

Amph 23. Medium-sized piriform.

Pl. 23.

Max. h. 0.385; max. diam. 0.308; h. to max. diam. 0.225-0.230; rim diam. 0.080; capacity 11.21 l.

Vessel surface "worm" eaten and covered with encrustation. Eroded surface reddish brown (5YR 5/4); core light red (2.5YR 6/6). Fabric feels rough due to severity of erosion, with fine inclusions of sand and some mica. Inclusions rounded (mica
Ill. 18. Mark 10 (Amph 22).
(Scale 1:1)
angular); frequency <5%. Eroded surface Mohs 3-3.5. Rim, eroded and "worm" eaten, sits directly on upper shoulder without transitional neck. Handles, joined to rim and upper shoulder, rise slightly higher than rim before descending to mid shoulder. Body gradually narrows after max. diam. Walls become steeper approx. 0.075 from base, and vessel becomes somewhat elongated before turning into slightly conical bottom. Wheel troughs delineate area on upper shoulder under rim. Closely spaced wheel ridging begins at lower attachment of handles and extends approx. 0.050 past point of max. diam., progressively becoming wider and deeper. Widely spaced wheel troughs continue to bottom.

Amphora Types 1 and 2 are variants of a single Class of piriform amphoras. As a rule, the amphoras of Type 1 have a wider rim diameter, a taller neck, and handles that attach to the neck and descend to mid shoulder. The amphoras of Type 2 have shorter necks and handles that attach to both the rim and neck and rise even to, or slightly above, the rim before descending to mid shoulder. In the case of both variants, the side walls abruptly turn into the base, which varies from rounded to slightly conical. The decoration of the two Types is similar; both have wheel ridging on the upper shoulder.
that extends just past the maximum diameter, followed by wheel troughing that continues to the bottom. The handles are similarly grooved, and their lower ends are placed on the wheel ridging.

These two variants are not usually differentiated in the literature. In fact, they often occur together at the same archaeological sites and are dated to the same horizons in time.

The results of the fabric analysis of Type 1 amphoras are not conclusive. The effects of discoloration by encrustation and erosion have changed their color and often eroded away their tempers on the remaining surface. However, it is clear that Amphoras 5, 9, 13, and 16 have the same dark red fabric and large grog temper; it appears very likely that all were manufactured in the same area. The remaining amphoras have diverse, but similar, fabrics. Two main groups stand out. One group has inclusions of sand, grog, and black grit; the other, inclusions of sand, grog and mica particles. Overall, fabric colors range from red-brown to reddish yellow; wash colors, from pale yellow to very pale brown.

Type 1 amphoras were manufactured on a potter's wheel in the following manner:

First step: the turning of the body on the wheel. Unfortunately, the amphoras in this study do not give any clues as to just how this was done; they do not show us
conclusively that the body was fabricated from the top
down or the bottom up, or that it was fabricated in one or
more than one section. The base had to have been
upturned sometime during its formation in order to account
for the spiral troughing on it. There is no evidence
suggesting there is a join between the offset base and the
rest of the body apart from a small crack which encircles
this point on the interior of Amphora 15. The potter may
have just cinched in the waist of the amphora at this
point using his dampened hands as in the troughing process
more thoroughly discussed below. What we do know is that
the potter completed the body, leaving a large hole at the
top for the addition of a separate neck and rim, and then
set it aside to partially dry.

The wheel troughing, which covers the bottom half of
the body, resulted not from any tool, but from simple hand
shaping by the potter while the wheel was turning quickly.
The troughs were produced by the potter, who periodically
resumed the turning of the vessel after re-wetting his
hands. Obviously, no need was felt to smooth out these
grooves.

Second step: assembly of the neck and rim. When the
body had partially dried it was put back on the wheel and
a roll of clay was fastened around the inside of the
opening. The neck was pulled up from this roll of clay
and the rim formed. The bits of clay often found inside
adhering to the center of the base probably come from this process; a lump falling inside could no longer be recuperated. Sometimes a shallow groove was made around the inside of the rim, perhaps in order to better seat a stopper.

Third step: decoration. The decoration of these amphoras was practical as well as aesthetic. The wheel ridging on the shoulders allowed for the firm attachment of the handles, as well as a handy gripping surface when being poured from or carried. The grooves were made by a tool, which left tiny striations in the grooves when it drew out the grains of temper.

Fourth step: attachment of the handles. The handles were formed and then attached. Water and extra bits of clay were used to smooth the join. Were the neck and rim partially dry at this time? It would not have been necessary but seems to have been the case. Amphora 3 has a neck and rim made of a very different clay than does the rest of the body and the handles; the percentage of temper is much greater. If the handles had been attached at the same time as the neck and rim, it would be reasonable to assume that they would have been made from the same batch of clay, which is not the case. The handle fabric is closer to that of the body, which leads one to think that they were fabricated and attached even later. Also, there is not as much deformation of the rim circumference as one
would expect if the handles were attached while the rim was still damp.

Fifth and following steps: marks, wash, and pitch. Often a potter's or owner's mark was stamped or written as a graffito on the shoulder or handles of the vessel. After firing, a wash was applied, and the vessel was pitched if it was to be used for the transport or storage of non-viscous liquids.

There are 16 amphoras in Type 1. They are quite diverse in size; heights range from 0.298 to 0.410 and capacities from 4.8 to 14.5. Size groups are not easily distinguishable, particularly since the amphoras are also quite diverse in shape. Since differences in shape may be a reflection of different time periods and geographic areas, it seems useful to include the ratio of height to maximum diameter as a criterion used in assigning the amphoras to size groups. The adoption of this basic approach in studies of the various classes of Byzantine amphoras might eventually lead to important insights concerning the effect, if any, that time and place of manufacture had on volumetric capacity.

The Type 1 amphoras as a whole are slightly narrower than those of Type 2. Archaeological proof is lacking, but it seems that Class 1 amphoras gradually became proportionally broader over time, emphasizing their piriform shape. Amphoras 10 and 15 are slightly
narrower than the other Type 1 amphoras; their height to maximum diameter ratio is respectively 1.3:1 and 1.32:1. Thirteen Type 1 amphoras have a height to maximum diameter ratio between 1.19:1 and 1.29:1, the most common ratio possessed by such amphoras in archeological reports. Amphora 3 has the most exaggerated piriform shape; its height to maximum diameter ratio is 1.13:1.

The Type 1 amphoras appear to represent at least 4 different capacity sizes (Table 1, Sizes 1-4). The narrowest amphora, Amphora 10, represents Size 1, the smallest size. It has a height of 0.298, maximum diameter of 0.227, and capacity of 4.7 l. The thirteen amphoras of the common-ratio group can be tentatively divided into three larger sizes. Amphoras 9 and 11 belong to the smallest of these, Size 2. Their heights range from 0.321 to 0.339, maximum diameters from 0.259 to 0.279, and capacities from 6.3 to 8.6 l. Amphoras 5, 13, 14 and 16, with a somewhat larger capacity, belong to size 3.

Their heights range from 0.350 to 0.366, maximum diameters from 0.282 to 0.301, and capacities from 9.4 to 10.5 l. The other proportionally narrow amphora, Amphora 15, with a height of 0.381, maximum diameter of 0.288, and capacity of 11.8 l, also belongs to this size. Amphoras 1, 2, 4, 6, 7, 8 and 12 belong to the largest size. Their heights range from 0.389 to 0.410, maximum diameters from 0.303 to 0.336, and capacities from 11.5 to 14.5 l. The
proportionally broad amphora, Amphora 3, with a height of 0.367, maximum diameter of 0.324, and capacity of 11.7 l, also belongs to this size.

Table 1: Size Groups of Type 1 Amphoras

<table>
<thead>
<tr>
<th>SIZE GROUP</th>
<th>HEIGHT</th>
<th>MAX. DIAM.</th>
<th>MAX. DIAM. HEIGHT</th>
<th>RIM DIAM.</th>
<th>WGT.</th>
<th>CAPACITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narrow Size 1</td>
<td>0.298</td>
<td>0.227</td>
<td>0.192</td>
<td>0.076</td>
<td>2.9</td>
<td>4.77</td>
</tr>
<tr>
<td>Size 3</td>
<td>0.381</td>
<td>0.288</td>
<td>0.221</td>
<td>0.086</td>
<td>6.8</td>
<td>11.88</td>
</tr>
<tr>
<td>Medium Size 2</td>
<td>0.321-0.339</td>
<td>0.259-0.279</td>
<td>0.189-0.202</td>
<td>0.082-0.088</td>
<td>5.3</td>
<td>6.35-8.65</td>
</tr>
<tr>
<td>Size 3</td>
<td>0.350-0.366</td>
<td>0.282-0.301</td>
<td>0.203-0.217</td>
<td>0.089</td>
<td>5.5</td>
<td>9.4-10.5</td>
</tr>
<tr>
<td>Size 4</td>
<td>0.389-0.410</td>
<td>0.303-0.336</td>
<td>0.210-0.236</td>
<td>0.092-0.110</td>
<td>6.8</td>
<td>11.51-14.52</td>
</tr>
<tr>
<td>Broad Size 4</td>
<td>0.367</td>
<td>0.324</td>
<td>0.204</td>
<td>0.086</td>
<td>5.6</td>
<td>11.77</td>
</tr>
</tbody>
</table>

Type 1 amphoras have been found along maritime routes linking the center of Byzantium to the eastern shores of the Mediterranean, the rivers of southern Russia, the western shores of the Black Sea, and the eastern shores of the Adriatic: in Turkey at Constantinople,33 on shipwrecks at Sarç Liman;34 and Fethiye,35 as well as in other Turkish museums36 and at Antioch;37 at Tell ‘Arqa38 in Syria; in Israel at Dor;39 in Russia at Sarkel (Belaya-Vezhe);40 in the Ukraine at Cherson,41 Kerch,42 Kiev,43
Kastel,44 Mangup,45 Novii Svet46 and Ivan Gora,47 in Bulgaria at Pliska,48 Preslav,49 Popina,50 Styrmen,51 Varna52 and Silistra;53 in Romania at Dinogetia–Garvan,54 Aegyssus–Tulcea,55 and Capidava;56 in Yugoslavia at Ohrid,57 Belgrade,58 and on a shipwreck near Mljet;59 in Greece at Lemnos60 and Kythera.61

Type 2 amphoras were made from the same fabrics as most of the Type 1 amphoras. The principal fabrics are again those with sand, grog, and black grit inclusions and those with sand, grog, and mica particles. Their fabric colors range from light red to reddish yellow; their wash, from very pale brown to yellow.

The procedures employed in making Type 2 amphoras were the same as those employed for Type 1 amphoras, although an offset base occurs more frequently.

Table 2 presents the size groups of the seven Type 2 amphoras. From the point-of-view of shape, they seem to fall into two distinct groups. Five have a height to maximum diameter ratio between 1.18:1 and 1.25:1, while Nos. 17 and 19 are significantly broader, having height to maximum diameter ratios of 1.12:1 and 1.14:1 respectively.

Four different capacity sizes seem to be represented in the proportionally narrower group. Amphora 18, with a height of 0.323, maximum diameter of 0.258, and capacity of 6.5 l, can be put with the Size 2 amphoras of Type 1. Amphora 21, with a height of 0.343, maximum diameter of
0.290, and capacity of 10.12 l, may belong to Size 3. Amphoras 22 and 23 appear to belong to Size 4. Their heights range from 0.343 to 0.385, maximum diameters from 0.290 to 0.315, and capacities from 10.1 to 12.3 l. Amphora 20, with a height of 0.443, maximum diameter of 0.361, and capacity of 19.02 l, is the largest of the Class 1 amphoras and can be assigned to yet another size category, Size 5.

Turning to the two proportionally broader amphoras, Amphora 17, with a height of 0.339, maximum diameter of 0.302, and capacity of 9.95 l, can be assigned to Size 3. Amphora 19, with a height of 0.412, maximum diameter of 0.359, and capacity of 17.07 l, is possibly another representative of Size 5.

Table 2: Size Groups of Type 2 Amphoras

<table>
<thead>
<tr>
<th>SIZE GROUP</th>
<th>HEIGHT</th>
<th>MAX. DIAM.</th>
<th>MAX. DIAM. HEIGHT</th>
<th>RIM DIAM.</th>
<th>WGT.</th>
<th>CAPACITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narrow Size 2</td>
<td>0.323</td>
<td>0.258</td>
<td>0.191</td>
<td>0.081</td>
<td>5.1</td>
<td>6.5</td>
</tr>
<tr>
<td>Size 3</td>
<td>0.343</td>
<td>0.290</td>
<td>0.215</td>
<td>0.084</td>
<td>6.1</td>
<td>10.1</td>
</tr>
<tr>
<td>Size 4</td>
<td>0.383-0.385</td>
<td>0.308-0.315</td>
<td>0.228-0.241</td>
<td>0.080-0.088</td>
<td>7.5</td>
<td>11.2-12.4</td>
</tr>
<tr>
<td>Size 5</td>
<td>0.443</td>
<td>0.361</td>
<td>0.274</td>
<td>0.089</td>
<td>19.02</td>
<td></td>
</tr>
<tr>
<td>Broad Size 3</td>
<td>0.339</td>
<td>0.302</td>
<td>0.196</td>
<td>0.080</td>
<td>5.7</td>
<td>9.95</td>
</tr>
<tr>
<td>Size 5</td>
<td>0.412</td>
<td>0.359</td>
<td>0.238</td>
<td>0.082</td>
<td>8.5</td>
<td>17.07</td>
</tr>
</tbody>
</table>
Type 2 amphorases can be found in a number of Turkish museums. In Constantinople, they were used in the constructions of the aforementioned Mangala Palace, as well as in the Church of Saint Georges and the maritime walls between Indijile Keuchk and the small port of the Chemin de ronde. They were also found on the shipwrecks at Serçe Limani and Hayırsız Ada. In Russia, they occur at Sarkel (Belaya Vezhe) and at Kiev, in the Ukraine. They have been found in Bulgaria at Svischov, Varna, and Silistra. In Yugoslavia, they are said to occur at Ohrid, along with Type 1 amphorases.

Type 1 and 2 amphorases date mainly to the 10th-11th centuries. They were used as dome fill in the Palace of Basil I, in the Mangala quarter of Constantinople, which was built in the late 9th century. They saturated the 10th-century layer in Cherson, where they are well dated by coins to both the 9th- and 10th-century layers. They are found in the Khazar layer of Sarkel and are dated there no later than the 10th century. They date to the 10th-11th centuries in Bulgaria and Romania. Finally, those on the Serçe Limani shipwreck are securely dated to the early 11th century.

Fragments belonging to either Type 1 or 2 amphorases have been discovered at Preslav, Pliska, and Păcuiul lui Soare.
Class 2

Amph 24. Large piriform.

Ill. 19; pl. 24.

Max. h. 0.520; max. diam. 0.421; h. to max. diam. 0.27 to 0.321; rim diam. 0.084; capacity 32.55 l;
wgt. 13 kg. Missing handle broken off in two stages; lower handle stump intentionally rounded off, but break at upper end of handle recent. Concretion and "worm holes" mar exterior. A three-pronged crack near bottom may have been caused by stress during drying. Surface highly eroded; overall surface reddish brown (7.5YR 6/6), core light red (2.5YR 6/6). Fabric feels rough, with fine to coarse inclusions of grog, quartzite, and dark grit. Inclusions well sorted and rounded; frequency >30%.

Surface Mohs 3.5-4.

Well-defined rim chipped next to handle break; small groove on interior for holding stopper. No neck. Handles approximately triangular in section with apex facing towards shoulder; joined to rim, they rise above mouth before descending to mid shoulder. Mid-shoulder profile noticeably bulges. Body gradually narrows from max. diam. to point several centimeters above bottom where walls become steeper and straighter before turning into rounded base. Several prominent wheel grooves on upper
Ill. 19. Amph 24.
(Scale 1:4)
shoulder, underscoring rim, followed by closely spaced wheel ridging covering shoulder and upper half of body; ridging becomes more widely spaced toward bottom. Juncture between separate rim and shoulder located under fourth wheel trough from rim (0.045-0.05 below rim). Small clay mass on the interior bottom. Traces of pitch on interior.

Amphora rare in having three different types of markings on it. An oval stamp (diam. approx. 0.030 x 0.019) appears below rim on upper shoulder; inside oval are three semi-circles, with their open end facing towards the left (ill. 20: pl. 25); this stamp possibly Arabic. Remaining markings eroded, making it impossible to distinguish which marks, if any, were made before firing. Second type of marking, deeply grooved, consists of three groups of Greek letters. Greek letters beta, alpha, and rho, occupying area measuring 0.077 x 0.053, graven on shoulder next to complete handle (ill. 21). A gamma (0.029 x 0.019) is inscribed under one handle; possibly made after firing (ill. 22). Letters delta and nu, carved on shoulder within area measuring 0.059 x 0.012, cover previously scratched mark (ill. 21). An X (0.021 x 0.02) with vertical line attached to upper right end grooved next to broken handle (ill. 22). Scratched marks, the third type of
Ill. 20. Marks 11 and 12 (Amph 24).
(Scale 1:1)
(Scale 1:1)
Ill. 22. Marks 16 and 17 (Amph 24).
(Scale 1:1)
marking, found on shoulder on either side midway between handles. On shoulder under stamp, is large X (0.17 x 0.11) with small T scratched between upper arms; cross (0.046 x 0.073) scratched later over the right corner of the X and T. Identical T - X combination (0.17 x 0.123) found on shoulder on opposite side, except that vertical line of T is crossed by grooved δέλτα - νο combination already mentioned. A fragment of a similar graffito is found at Sarkel.⁸⁰ A similar sign is found in inscriptions in Dobroujda.⁸¹

Amph 25. Large piriform.

Ill. 23; pl. 26.

Max. h. 0.433; max. diam. 0.384; h. to max. diam. 0.263-0.276; rim diam. 0.084; capacity 23.41 l; weight 10 kg. Rim chipped on exterior between handles; damaged area intentionally smoothed down. Bottom three quarters of one handle missing; only ring of clay remains on shoulder where end of handle was joined. Broken handle end covered by concretion; break very flat and may have been carved. Mouth and shoulder cracked from drying; cracks do not traverse thickness of vessel wall. Exterior highly eroded, but traces of wash still adhere to surface. Surface highly concreted. Overall surface color pale brown (10YR 6/3); core light reddish brown (5YR 6/3); wash
Ill. 23. Amph 25.
(Scale 1:4)
light grey (2.5YR 7/2). Surface feels smooth, with medium-to-fine, well-sorted inclusions of dark, almost black, sand. Inclusions rounded to subrounded; frequency >30%. Mohs 4.5-5.

Well-defined rim sits directly on upper shoulder without neck transition. Handles, joined to rim, rise above mouth and descend to mid shoulder; top part of handle closest to rim has pinched central ridge; vertical part of handle has two parallel, off-center grooves. Shoulder profile noticeably bulges under arches of handles. Body gradually narrows after max. diam. to a point several centimeters above base where walls become steeper and straighter before turning into base with truncated-cone shape. Amphora decorated by five troughs on upper shoulder under rim, followed by closely spaced wheel ridging which runs approximately 0.070 past point of max. diam. Below wheel ridging is large, deep groove made by same wheel ridge tool, followed by wheel troughs to bottom. At one point on lower half of vessel, small (diam. 0.020) daub of extremely soft clay covers surface; possibly remains of clay plug, but probing did not reveal hole and some clay is smoothed over local concretion. Slight traces of pitch inside vessel.
Amph 26. Large piriform.

Pl. 27.

Max. h. 0.438; max. diam. 0.365; h. to max. diam. 0.263-0.275; rim diam. 0.078; capacity 20.475 l;
weight 8.65 kg. Surface covered with incrustation
and "worm holes." Eroded surface light reddish brown
(5YR 6/4) to reddish brown (5YR 5/4); core pink (5YR 7/4). Surface feels powdery, with fine inclusions of
grog, mica, and some fine quartz sand. Inclusions
rounded and occasionally angular, with a frequency of
>30%. Mohs 2.5-3.

Rim intact and well shaped; edges eroded. Neck
almost nonexistent; only small transition between
shoulder and rim. Handles, joined to rim, rise above
it and descend to mid shoulder; two grooves run down
outer surface of handles. Body gradually narrows
from max. diam. to a point several centimeters above
base where walls become steeper and straighter before
turning into base with truncated-cone shape. Just
below rim are three grooves, followed by a smooth
area on upper shoulder. Closely spaced wheel ridging
begins midway beneath lower handle attachment and
extends 0.110 past point of max. diam. Below this is
0.043-wide band of four deeper and wider wheel
ridges. Closely spaced wheel troughs cover rest of
vessel.
Graffito (0.09 x 0.062) scratched in wet clay of upper shoulder next to one handle; composite appears to contain anchor shape and Greek letters alpha, eta, and phi (ill. 24; pl. 28).

A graffito terminating in an anchor occurs on a Class 3 amphora from Dinogetia. A fragment from a similar inscription found at Sarkel. A phi inscribed on the leg of another letter is seen on amphoras from Constantinople.

Amph 27. Fragment of large piriform.

Ill. 25; pl. 29.
Rim diam. 0.075. Only rim, handles, and part of shoulder remain. Heavily eroded surface light brown (7.5 YR 6/4); core pink (7.5 YR 7/4). Fabric feels smooth, with medium to fine inclusions of quartz sand and grog. Inclusions rounded; frequency <5% (sparse). Mohs 3-3.5.

Rim sits directly on body with no neck transition from shoulder to rim. Rim marked on underside by four deep finger impressions, as if someone had attempted to pick the vessel up before clay had dried. Handles, joined above to rim and upper shoulder, rise above rim, one higher than the other, and descend to shoulder. One handle was pressed so tightly against body when attached that all of wheel grooving underneath it was obliterated.
Ill. 24. Mark 18.
(Scale 1:1)
Crack on interior circumference, 0.050 from mouth, delineates where separate rim section was joined to shoulder. Edge of opening where shoulder terminated at interface with separate rim had been almost vertical. At juncture, rim thickness 0.020 and shoulder thickness 0.017; thickness, reduced through smoothing to 0.014–0.013 below juncture, becomes 0.010–0.007 at level where handles attached to shoulder and below. One wheel trough delineating area under rim followed by four more on upper shoulder. Wheel ridging begins under handle arches and extends to lower handle attachments. Wheel troughs over rest of extant portion of the body, gradually narrowing downwards.

Graffito in shape of letter F (0.170–0.085) scratched on shoulder; more than probable that mark was letter E and bottom stroke was effaced by breaking of amphora (ill. 26).
(Scale 1:1)
Ill. 27; pl. 30. Museum Inv. No. 4-39-84
Max. h. 0.457; max. diam. 0.380; rim diam. 0.080; h.
to max. diam. 0.266 to 0.296; capacity 21.76 l; wgt.
10.12 kg. Rim eroded and chipped on exterior and
interior midway between handles. Surface eroded and
covered with encrustation. Surface reddish yellow
(5YR 6/6); wash cream in color. Fabric feels
powdery, with fine to medium inclusions of mica
(especially in wash), grog, and some dark sand.
Inclusions rounded; frequency 10-15%. Mohs 2.

Rim unevenly applied. Neck nonexistent; little
transition between shoulder and rim. Both handles
have two parallel grooves on outer face. Upper end
of handles joined to upper shoulder and lower rim;
handles rise slightly above mouth and descend to mid
shoulder. Profile noticeably bulges at mid shoulder,
above lower handle attachment. Body gradually
narrowed from max. diam to approx. 0.088 above bottom
where walls become straight and vertical for 0.033
before turning into base with truncated cone shape.
Neck underscored by three deep wheel troughs.
Shoulder above lower end of handles plain. Closely
spaced band (approx. 0.165 wide) of wheel ridging
decorates lower shoulder and upper body, becoming
more widely spaced toward bottom; last three ridges
Ill. 27. Amph 28 (4-39-84). (Scale 1:4)
Mark 20. (Scale 1:1)
deeper. Lower body covered by widely spaced wheel troughs; last deep wheel trough encircles point where base set off from rest of body (0.088 from bottom). Interior has spiral drying crack around circumference of base and small mass of clay in center with more drying cracks radiating out from it.

Stamp (0.05 x 0.0235) on upper shoulder resembles Arabic calligraphy (ill. 27; pl. 31). Large dot (0.008 x 0.006) to lower left of stamp. Lower portion of stamp impressed deeper in wet clay.

Amph 29. Fragment of large piriform.

Pl. 32.

Rim diam. 0.089. Only rim, handles and upper shoulder remain. Mouth badly worm-eaten and chipped. Surface covered by encrustation. Original surface red (2.5YR 4/6); overall surface reddish brown (5YR 5/4); core reddish yellow (5YR 6/6). Fabric feels smooth, with very fine inclusions of mica, quartz sand, and limestone. Inclusions rounded; frequency 10-30% (common). Mohs 3.5-4.

Rim sits directly on shoulder; no transition from shoulder to rim. Mouth opening wider at top than at bottom, making seating of stopper much easier. Handles, joined to rim and upper shoulder, rise approx. 0.019 above rim and descend onto shoulder. Handles ovoid in section, with central
ridge. Vessel walls much thicker in upper portion; lowest preserved wall segment one-fourth thickness of upper walls. Separate upper shoulder and rim joined to lower shoulder at level where lower end of handles attached; wall thickness at juncture 0.0125. Edge where lower shoulder terminated rounded, forming roll of clay encircling interior surface of vessel at juncture. Edge of upper shoulder at juncture concave to permit its seating onto the rounded edge of lower shoulder; exterior edge extends down to seal juncture. Thirteen closely spaced wheel ridges begin under rim and end midway under handle arches; wheel troughs follow to ends of handles, where wheel ridging begins again, covering rest of shoulder.

Graffito, made after firing, below one handle. Could be either Greek letter lambda or delta; very bottom of graffito may be broken off (ill. 28).


Pl. 33. Museum Inv. No. 200

Max. h. 0.399; max. diam. 0.345; h. to max. diam. 0.256 to 0.260; rim. diam. 0.080; capacity 17.787 l; wgt. 8.09 kg. Rim chipped on the exterior; chip smoothed down intentionally. Several vertical scratches covered with a patina on inside of mouth. Some encrustation covers surface. Original surface reddish brown (2.5YR 4/4); eroded surface reddish
Ill. 28. Mark 21 (Amph 29).
(Scale 1:1)
yellow (between 5YR 7/6 and 5YR 7/8); wash very pale brown (between 10YR 8/4 and 10YR 7/4). Fabric feels smooth, with fine inclusions of mica, sand, and some grog. Inclusions round (mica angular); frequency 30% (common). Lump of purple powder, almost like pigment, imbedded into fabric towards bottom of vessel. Original surface Mohs 3-3.5.

Rim sits directly on upper shoulder, with very little transition. Small indentation on interior of rim for seating of stopper. Handles, joined to rim, rise 0.015 above it and descend to mid shoulder. Body gradually narrows after max. diam. to point approx. 0.100 above bottom where walls become steeper and straighter for approx. 0.075 before turning into base with truncated-cone shape. Three wheel troughs underscore rim. Rim and shoulder juncture located under second wheel trough below rim. Closely spaced wheel ridging begins under lower handle attachments and extends 0.080 past point of max. diam.; last four ridges are wider and deeper. Ridging followed by 0.040-wide blank band and then uneven wheel troughs to bottom.

Several graffiti scratched on vessel after firing; marks eroded (ill. 29). X (0.096 x 0.045) on shoulder. Double horizontal line with two side-by-side, downward-pointing triangles suspended
Ill. 29. Marks 22-26 (Amph 30).
(Scale 1:1)
from it (0.038 x 0.017) added to immediate right of upper end of X. Backward N bisected by vertical line (0.035 x 0.054) near one handle. Backwards C (0.042 x 0.087) with vertical line (0.058) sloping slightly to right between its extremities on shoulder near one handle. Below other handle 0.103-long vertical line with three short projections to right and one to left along length; possibly Runic, a similar mark was found at Dinogetia.  

Faint black coating on portions of inside walls.

Amph 31. Large piriform.

Pl. 34.  
Museum Inv. No. 7651

Max. h. 0.519; max. diam. 0.411; h. to max. diam. 0.328 to 0.334; rim diam. 0.078; capacity 34.25 l; wgt. 15.73 kg. Rim worn down and chipped. Chip old; edges smoothed down intentionally. Surface eroded and covered with encrustation. Original surface weak red (10R 5/4); overall eroded surface reddish yellow (5YR 6/6); core weak red (2.5YR 6/6). Surface feels rough, with medium to coarse inclusions of quartz sand and mica. Inclusions rounded; frequency >30%. Original surface Mohs 3.5-4.

Rim attached directly to upper body, with very little transition. Handles, joined to rim and upper shoulder, rise 0.022 above rim before descending down to mid shoulder. Handles have two parallel grooves
down length of outer face. Body gradually narrows after max. diam. to point approx. 0.075 from bottom, where walls become steeper and straighter for 0.045 before turning into rounded base. Closely spaced wheel ridging begins under rim and extends to approx. 0.173 above bottom. Widely spaced wheel troughs cover rest of vessel.

Four graffiti scratched on vessel (ill. 30). Two parallel lines (length 0.039, 0.038; av. width 0.005) carved on shoulder before firing; horizontal line (length 0.03; width 0.003-0.004) projects to right from center of right line; right line also has horizontal worm hole immediately over it. Theta-like letter (diam. 0.026 0.022) engraved on opposite shoulder of vessel. H (0.029 x 0.033) carved 0.043 to right of theta-like letter on lower shoulder; horizontal bar partly obliterated by "worm hole."

Also on shoulder, graffito with two converging, diagonal lines crossed by a horizontal line; lines 0.043, 0.03, 0.029 long respectively.

Amph 32. Medium-sized piriform.

Pl. 35. Museum Inv. No. 504

Max. h. 0.423; max. diam. 0.388; h. to max. diam. 0.267 to 0.273; rim diam. 0.083; capacity 22.945 l; wgt. 10.7 kg. Part of rim missing; an old break, eroded on the interior. Surface eroded; covered with
Ill. 30. Marks 27-30 (Amph 31).
(Scale 1:1)
encrustation and exfoliating in some places. Eroded overall surface light brown (7.5YR 6/4); wash very pale brown (10YR 8/4); core pink (5YR 7/4). Fabric feels rough, with medium inclusions of quartz and dark sand. Inclusions rounded; frequency 10-30% (common). Eroded surface Mohs 4.

Rim set directly on upper shoulder without neck transition. Handles, joined to rim, rise 0.009 above rim and descend to mid shoulder. Outer face of handles pinched into central ridge. Shoulder bulges under lower handle attachments. Body gradually narrows after max. diam. to a point 0.090 above bottom, where walls become steeper and straighter for approx. 0.060. Base slightly conical. Seven widely spaced wheel troughs decorate shoulder under rim. Separate rim joined to shoulder under third wheel trough below rim on upper shoulder. Wheel ridging begins under lower handle attachment and extends approx. 0.110 past max. diam.; last three wheel ridges wider and deeper than others. Widely spaced wheel grooves cover rest of body.

Amph 33. Large piriform.

Pl. 36. Museum Inv. No. 7656

Max. h. 0.622; max. diam. 0.435; h. to max. diam. 0.312 to 0.319; rim diam. 0.089 approx.; capacity 35.568 l; wgt. 13.88 kg. Rim chipped on one side.
Surface heavily eroded; partly covered with encrustation. Eroded surface light reddish brown (5YR 6/4); core reddish yellow (5YR 7/6). Fabric feels rough, with fine to medium inclusions of quartz sand. Inclusions rounded; frequency 10-30% on upper shoulder and 5-10% on body. Fabric of upper shoulder obviously coarser than that on rest of body, thus delineating where separate rim attached to upper shoulder. Eroded surface 2.5-3.

Rim set directly on upper shoulder without transition. Handles, joined to rim and upper shoulder, rise well above rim and descend to mid shoulder. Shoulder bulges slightly beneath arch of handles. Body gradually narrows after max. diam. to point approx. 0.115 from bottom, where walls change angle of descent and become vertical for approx. 0.065 before turning into slightly conical base. Four deep wheel troughs underscore rim, followed by approx. 0.06 wide band of smoothed out wheel troughs. Rim-to-shoulder juncture occurs under third wheel trough from rim. Closely spaced wheel ridging begins after blank band under arches of handles and extends two-thirds of way down body to approx. 0.200 above bottom; last seven ridges become gradually wider and deeper. Shallow wheel troughs cover rest of body,
with small band of three wheel ridges directly above point where walls change angle of descent.

Stamp in form of rosette (0.015 x 0.017) with five petals impressed on shoulder (ill. 31). Very shallow and eroded K (approx. 0.030 x 0.020) inscribed on lower shoulder. Vertically bisected X (0.070 x 0.045?) scratched on same shoulder; bisected X occurs in Ukraine,86 Russia,87 Bulgaria,88 and Romania.89 Illegible graffito scratched on same shoulder near handle. Four dots in diamond pattern (0.03 x 0.024) below handle, and, directly beneath, four parallel, vertical lines, 0.025-0.030 long, the first line descending from bottom-most dot and the last line located 0.047 to the right; graffito very shallow and eroded. Three marks (ill. 32) scratched on shoulder opposite stamp: a vertical line, 0.085 long, with a 0.034-long diagonal near its bottom sloping downward to the right; a 0.044-long line with two shorter lines sloping slightly downward to the right crossing it, the upper one 0.021 long and the lower one just under half as long; and a very shallow and eroded vertically bisected X (0.070 x 0.041).

Four dots in diamond pattern (0.025 x 0.024) with an X in center, scratched on handle before firing. Beta-like letter (0.023 x 0.012) scratched on bottom of handle; possibly made before firing.
Ill. 31. Marks 31–34 (Amph 33).
(Scale 1:1)
Ill. 32. Marks 35-39 (Amph 33).
(Scale 1:1)
Class 2 consists of amphoras with a large piriform body, no neck, and ovoid- to triangular-in-section handles that attach to the rim and upper body and arch well over the rim before descending to mid shoulder. They often have an offset base; that is, the side walls gradually narrow downwards from the maximum diameter, but at a certain point from the bottom the angle of descent changes abruptly and the walls become steeper and straighter for several centimeters until the walls again turn to form the base, which is either rounded or resembles a truncated cone. This characteristic is also seen on several amphoras of Class 1, but here we have a sometimes exaggerated development.

The fabrics of Class 2 amphoras are, on the whole, similar to those of Amphora Class 1, and have the same temper compositions. Their colors range from weak-red to red-brown; their washes, from light grey to very pale brown.90

The fabrication of Class 2 amphoras seems to have been essentially the same as that of Class 1 amphoras,91 apart from the fact that the opening left for the building on of the rim and upper shoulder was sometimes very large. Amphora 29 has this juncture midway down the shoulder directly below the lower handle attachments. On Amphora 27, however, the juncture is only 5 cm. from the rim.
The ratio of height to maximum diameter for these amphoras has a narrow range between 1.13:1 and 1.24:1. One sees only a general tendency for taller amphoras to be slightly more slender. However, as the later evolution of this class of amphoras suggests (see below, p. 91), there appears to have been some tendency for the body to become proportionally broader over time.

Three capacity sizes seem to be represented by the amphoras of this class (Table 3). The smallest size is represented by only one amphora, Amphora 30. It has a height of 0.399, maximum diameter of 0.345, and capacity of 17.787 l. Its capacity is within the capacity range of the Size 5 amphoras of Class 1. Amphoras 25, 26, 28, and 32 belong to a size group of greater capacity, Size 6. Their height ranges from 0.423 to 0.457, maximum diameter from 0.365 to 0.388, and capacity from 20.475 to 23.410 l. Amphoras 24, 31, and 34, the largest of the Class 2 amphoras, belong to a size group of even greater capacity, Size 7. Their height ranges from 0.519 to 0.622, maximum diameter from 0.411 to 0.435, and capacity from 32.55 to 35.57 l.

These large piriforms evolved from the smaller ones of Class 1 and are dated to the 11th-12th centuries. The closest parallels are found in Turkey at Hayırsız Ada, Sarachane, and in many museum collections; in the Ukraine at Voin and Kiev; in Russia at
Bakozhino; in Romania at Dinogetia and Mangalia; and in Italy at Otranto. In Fustat, Egypt, more than 60 Class 2 amphoras were found beneath a paved level; they appear to date to the period immediately following Fustat's destruction by fire in 1168 A.C.

Table 3: Size Groups of Class 2 Amphoras

<table>
<thead>
<tr>
<th>SIZE GROUP</th>
<th>HEIGHT (m)</th>
<th>MAX. DIAM. (cm)</th>
<th>MAX. DIAM. HEIGHT (cm)</th>
<th>RIM DIAM. (cm)</th>
<th>WGT.</th>
<th>CAPACITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size 5</td>
<td>0.399</td>
<td>0.345</td>
<td>0.258</td>
<td>0.080</td>
<td>8.1</td>
<td>17.79</td>
</tr>
<tr>
<td>Size 6</td>
<td>0.423-0.443</td>
<td>0.365-0.388</td>
<td>0.269-0.281</td>
<td>0.078-0.084</td>
<td>8.6-10.7</td>
<td>20.48-23.41</td>
</tr>
<tr>
<td>Size 7</td>
<td>0.519-0.622</td>
<td>0.411-0.435</td>
<td>0.298-0.331</td>
<td>0.078-0.089</td>
<td>13-15.7</td>
<td>32.55-35.57</td>
</tr>
</tbody>
</table>

In the literature, Class 2 amphoras are often either combined with Class 1 amphoras or confused with other vessels which have similar body shapes but are otherwise very different.

There is a variant of the Class 2 amphoras which has a similar body, but higher-rising handles, which are attached to a short neck with no rim and on the lower shoulder; it existed at the same time and possibly into the 13th century. Such jars are found in Russia at Tanais (Azov) and at the Kovsharovo townsite; in the Ukraine at Cherson, Kiev, Kerch, and Eski-Kermen; and in Romania at Dinogetia-Garvan and...
Noviodunum. A flat-bottomed version also exists of this type of amphora.

The 12th-13th centuries saw a later version of the Class 2 amphoras and the variant type. In the former case, the large piriform shape is retained, and the handles rise high over the rim, bend acutely, and descend onto the lower shoulder. In the latter case, the body is inflated and almost round; the handles, flat in section, rise high over a rimless mouth, bend acutely, and meet the shoulder near the point of maximum diameter. These vessels endured into the 14th century.

In Cherson, the 12th-13th century amphoras were used for storing grains and small fish. The primary product or products for which the Class 2 amphoras were made is unknown; wine is indicated as a possibility, since several are known to have had a resin-coated interior.

Class 3

Amph 34. Tall piriform with high-rising handles.

Ill. 33; pl. 37. Museum Inv. No. 7454
Max. h. 0.532; max. diam. 0.273; h. to max. diam. 0.276-0.291; capacity 9.97 l; wgt. 7.08 kg. One handle broken off; only 0.03 of rim remains. Handle break smooth and straight; rounded off intentionally. Surface eroded and spalling, but some patches of original surface remain. Original surface reddish
Ill. 33. Amph 34 (7454).
(Scale 1:4)
yellow (7.5YR 6/6); eroded surface light reddish brown (2.5YR 6/4); core pale red (10YR 6/4). Fabric smooth, with medium to fine inclusions of quartz sand. Inclusions rounded; frequency 30% on body and 10% on neck and handles. Mohs 3.5-4.

Rim thin with rolled edge. Neck 0.115 tall; widens downwards from rim. Surviving handle, joined to neck from mid neck to rim, rises 0.062 above rim and then descends vertically to lower shoulder close to point of max. diam. Handle flatter in section towards middle, rounder towards ends. Elongated voids in fabric give handle porous look, probably result of an organic temper that burned out during firing. Handles seem to have been merely pushed against body and then fastened with extra clay; only indentation remains on body where missing handle's lower end was attached. Bottom of surviving handle was pinched in on both sides. Body gradually narrows to rounded base. Neck not decorated. Fine and closely spaced wheel combing begins just before lower handle attachment and runs three-quarters of way down body. Widely spaced and eroded wheel troughing begins under combing, approx. 0.254 above bottom, and extends to base, becoming deeper 0.15 from bottom.
Amph 35. Tall piriform with high-rising handles.

Pl. 38.

Max. pres. h. 0.580; max. diam. 0.312; h. to max. diam. 0.301 to 0.308; capacity 15.94 l; wgt. 7.7 kg.
One handle missing. Rim completely broken off.
Large hole on shoulder where handle broke off; wall thickness here approx. 0.007. Surface highly eroded and spalling. Eroded surface light reddish brown (5YR 6/4) to reddish brown (5YR 5/3). Fabric feels smooth to rough, with fine to medium inclusions of sand and grog. Inclusions rounded; frequency 10%.

Neck, approx. 0.153 high, appears to be of different fabric than body. Interior roll of clay around base of neck where it was joined to body. Handle, joined to neck from mid neck to where rim broken off, rises 0.066 above max. pres. h. and descends vertically to lower shoulder. Handle h. 0.279. Handle, flattened in mid-section and rounded at ends, has at its upper end two parallel longitudinal grooves, which turn into one groove beyond point where handle arches downwards. Lower end of handle is pinched in. Body gradually narrows to rounded bottom. Fine combing begins on shoulders under handle arches, just where change from neck
fabric to body fabric occurs. Combing best preserved on tops of wheel troughs covering lower body; combing ends 0.182 above bottom. Shallow, widely spaced wheel troughs begin on body after point of max. diam.; deeper band of four wheel troughs approx. 0.074 wide follows combing. Eroded and shallow wheel troughs continue towards bottom.

Graffito (ill. 34) scratched on surface of neck and shoulder after firing; consists of short, slightly diagonal line (0.049) on the left and longer, outward-curving vertical line (0.082) on the right, connected together by horizontal line (0.062) that slopes upward toward the right.

Amph 36. Tall piriform with high-rising handles.

Ill. 35; pl. 39. Museum Inv. No. 2719

H. 0.600; max. diam. 0.302; h. to max. diam. 0.321 to 0.332; rim diam. 0.072; capacity 15.213 l; wgt. 8.39 kg. One handle missing; breaks old and worn down and lower break still conchoidal. Surface highly eroded. Long porous holes, like pores in a bone, occur in neck and handle fabrics. Fabric of original surface reddish yellow (between 7.5YR and 7.5YR 6/6); eroded surface light reddish brown (2.5YR 6/4). Surface feels rough, with medium to very coarse inclusions of quartz sand, shell and grog. Inclusions rounded to angular (shell); frequency 30% on body and >30% on
Ill. 34. Mark 40 (Amph 35).
(Scale 1:1)
Ill. 35. Amph 36 (2719).
(Scale 1:4)
neck. Shell temper occurs only on neck and handles; this explains long porous holes in these areas. Shells all point in one direction indicating that neck was wheel made. Small stress cracks on the lower one-quarter of vessel caused by fabric drying too fast in its leather hard stage. Original surface Mohs 4.5-5; eroded surface Mohs 3.5-4.

Rim thin and rolled. Neck 0.144 tall. Juncture between separate neck and upper shoulder clearly visible as sharp line of demarcation caused by abrupt change in composition of fabric. Handles wide and flat in section, rounding towards lower end. Handles, joined to neck from mid neck to rim, rise high (0.061) above rim and descend vertically to lower shoulder. Handle pinched on both sides at bottom attachment, as if pressed down to attach it better. Body gradually narrows from max. diam. to rounded base. Fine combing begins on upper shoulder below neck and covers body to approx. 0.012 above bottom. Shallow, widely spaced wheel troughs, beginning beyond point of max. diam., become deeper and closely spaced after combing.

Amph 37. Tall piriform with high-rising handles.

Pl. 40.

Max. h. 0.561; max. diam. 0.300; h. to max. diam. 0.324 to 0.337; capacity 13.752 l; wgt. 7.93 kg.
Rim, handles, and part of neck missing; edges of breaks sharp. Fabric 0.008-0.009 thick at neck break. Below shoulder, hole with eroded edges measuring 0.033 x 0.028; fabric 0.01 thick at hole edges. Surface highly eroded. Original surface reddish brown (5YR 5/3-5YR 5/4); overall surface color pink (5YR 7/4). Fabric of original surface feels smooth; eroded surface rough, with medium to very coarse inclusions of sand and shell. Inclusions subrounded (sand) to angular (shell); frequency 30% on body and >30% on neck and handle stubs. Few shells on body as compared to neck. Original surface Mohs 5; eroded surface Mohs 3.5.

Preserved h. of neck approx. 0.098; fabric of neck noticeably different from that of body. Handles joined to mid-to-lower shoulder. Body gradually narrows from point of max. diam. to rounded base. Base dimpled in center; small crack around dimple. Combing begins below neck on upper shoulder and ends approx. halfway down body; erosion severe on lower body. Shallow, widely spaced wheel troughing begins after point of max. diam.; approx. 0.197 from bottom, wheel troughs begin to deepen and narrow in to a band 0.104 wide. Shallow troughing continues to base.

Graffito (ill. 36) in shape of X scratched on neck; mark very eroded. Line going from upper right
Ill. 36. Mark 41 (Amph 37).
(Scale 1:1)
to lower left (0.079 long) scratched before line going from upper left to lower right (0.06 long).

Amph 38. Tall piriform with high-rising handles.

Pl. 41.

Max. pres. h. 0.560; max. diam. 0.276; h. to max. diam. 0.311-0.329; capacity 11.8 l; wgt. 7.89 kg.

Rim, handles, and part of neck missing. Wall 0.006 thick at neck break. Surface, including handle stubs, eroded and covered with encrustation. Fabric on neck and handle stubs pitted, with long thin cavities. Surface light reddish brown (5YR 6/3) to reddish brown (5YR 5/3); core reddish brown (5YR 7/4). Fabric feels smooth, with very fine to medium inclusions of black grit, grog, sand, and some shell. Inclusions rounded (sand) to angular (shell, grog, and black grit); frequency 5-10% (moderate).

Different from the other amphoras of this type, this vessel lacks large number of long pores on neck and handles; use of shell temper less substantial than in the others. Mohs 4.

Incomplete h. of neck is approx. 0.144. Handle joined to neck from mid neck upwards; lower end of handle attaches at mid-to-lower shoulder. Body gradually narrows from point of max. diam. to rounded base. Fine combing extends from upper shoulder to approx. 0.11 from bottom; ten teeth employed in
producing combing. A 0.072-wide band of deep wheel troughs begins 0.177 above base. Wide and shallow wheel troughs continue to base.

Amph 39. Tall piriform with high-rising handles.

Ill. 37; pl. 42. Museum Inv. No. 1936

Max. h. 0.500; max. diam. 0.316; h. to max. diam. 0.255; rim diam. approx. 0.087; capacity 13.54 l.

Rim severely chipped and eroded. Cracks have formed around neck where it was joined to shoulder and 0.070 below on upper shoulder. Handles and neck have small elongated cavities, like pores in a bone, indicative of organic temper. Portion of side walls around max. diam. worn flat and covered by encrustation. Surface highly eroded. Original surface weak red (10R 4/3); eroded surface reddish brown (2.5YR 5/4); wash light brownish gray (2.5Y 6/2). Fabric feels smooth, with medium to very coarse inclusions of shell and coarse sand. Inclusions angular; frequency 10-30% on body and >30% on handles. Shell temper appears to be used exclusively on handles, along with some coarse sand. Mohs 3.5.

Rim thin with rolled edges. Neck tall; h. with rim approx. 0.140. Handles joined to neck from mid neck to rim and rise 0.084 above mouth before descending vertically to mid shoulder. Handles wide and flat in section. Small indentation of a thumb at
(Scale 1:4)
base of one handle. Separate neck joined to shoulder at base of neck. Body gradually narrows after point of max. diam. to rounded bottom. Closely spaced, spiral wheel ridging begins at top of shoulder and extends to approx. 0.106 from bottom. Shallow, widely spaced wheel troughs continue to base.

Graffito in shape of the letter M with its central strokes crossing and forming an X (0.052 x 0.085) scratched on shoulder (ill. 38).

Amph 40. Tall piriform with high-rising handles.

Ill. 39. Museum Inv. No. 1112
Max. remaining h. 0.439; max. diam. 0.326; rim diam. 0.081. Bottom and part of one side missing; wall thickness measures 0.011 at shoulder, 0.010-0.011 along side walls. Surface covered with encrustation, including edges of break, and highly eroded. Eroded surface light reddish brown (5YR 6/3). Fabric feels smooth, with very fine inclusions of sand. Inclusions rounded; frequency <5% on body and 10-30% on neck and handles. Long, thin fissures, resembling pores in a bone, are seen on neck and handles; probably the remains of an organic temper such as shell or straw. Mohs 3.5.

Rim thin with rolled edges. Neck tall; h. of neck and rim approx. 0.160. Handles joined to neck from mid neck to rim and rise approx. 0.054 above
Ill. 38. Mark 42 (Amph 39).
(Scale 1:1)
Ill. 39. Amph 40 (1112).
(Scale 1:4)
mouth before descending down to shoulders. Juncture of separate neck with body appears on interior wall as roll of clay at base of neck. Body gradually narrows from point of max. diam. Closely spaced wheel ridging, uncommon on this type of amphora (combing is the rule), begins at top of shoulder under neck and extends throughout extant portion of body, progressively becoming wider and deeper towards end.

Amph 41. Tall piriform with high-rising handles.
Ill. 40.

H. 0.609; max. diam. 0.289; h. to max. diam. 0.330-0.341; capacity 13.283 l; wgt. 8.84 kg. One handle missing. Rim partly broken off, notably around handle break. Surface covered with encrustation, including edges of handle breaks, and heavily eroded. Eroded surface light reddish brown (5YR 6/4); core reddish yellow (between 5YR 7/6 and 5YR 6/6). Neck and remaining handle covered with long, thin fissures, similar to cavities in bone. Fissures probably due to organic temper such as shell or grass. Neck and handles show little temper apart from that indicated by fissures; sand common on body.

Rim thin with rolled edges; formed after attachment of handles. Neck tall; joined to body at base of neck. Handle, joined to neck from mid neck to rim, rises high above mouth before descending to
Ill. 40. Amph 41
(Scale 1:4)
lower edge of shoulder; base of handle pinched in. Handles oval in section. Body gradually narrows after point of max. diam. to rounded base. Fine wheel combing begins below neck on shoulders and extends three-quarters of way down body.

Letters N and A scratched on neck, possibly after firing (ill. 41). N large (0.108 x 0.048); beneath its diagonal, the smaller A (0.027 x 0.023). Pi-like letter scratched to left of this combination. The same N - A combination (N 0.090 x ? and A 0.025 x 0.034) also scratched on opposite shoulder.

Class 3 amphoras are tall, elongated piriforms with oval-in-section handles that are attached above from mid neck to rim, rise high above the rim, and descend to the lower shoulder. The rim is thin and rolled. With two exceptions, the shoulders and upper part of the body are decorated by fine wheel combing that covers three-quarters of the vessel's body.

This class is also characterized by a unique paste, particularly in the neck and handles. Shell and/or straw was mixed into the paste and then burned out during the kilning process, leaving long narrow fissures in the fabric. This method was necessary in order to lighten the handles, which would normally have been too heavy for the vessel.115
Ill. 41. Marks 43 and 44 (Amph 41).
(Scale 1:1)
These amphorae evolved from another class of piriform amphora with high-rising handles. The latter are smaller in size, only up to 0.500 in height, and have a thick collar-like rim. In the quarter of Manganes at Constantinople, dating to the late 9th-11th centuries, these amphorae represented 75% of all vessels found.¹⁶ They were also discovered in Bisericuta-Garvân and are dated there by coins to the 10th-11th centuries.¹⁷ They are dated to this same period at Cherson and Sarkel. In Cherson, there are two variants of this class of amphora, each manufactured from a different clay. The one variant has a clay with a straw temper; the other a clay with a lime and mussel shell temper. Ceramics and bricks with identical fabrics were found in the same stratigraphic layers at Cherson.¹⁸

The bodies of the tall piriform amphorae were constructed in at least two steps. The body was raised to the base of the neck, leaving a large hole, and then set aside to partially dry. While it cannot be substantiated with the amphorae in this study, it is very likely that these elongated vessels were turned upside down on the potters' wheel. It has also been suggested that they were made in the coil technique, as the perfectly level break of amphora No. 40 might suggest, and then the coils were smoothed out on the potters' wheel.¹⁹
The body, after reaching the leather-hard stage, was then replaced upon the wheel and a roll of clay was placed around the opening left at the top of the shoulder. The neck was pulled up from this roll of clay. The shoulder was then decorated with combing; in at least one case, it could be discerned that the comb had ten teeth. The handles were fabricated and attached to the neck and lower shoulder with some extra clay. The lower end of the handles was almost always pinched in, and often the wall of the amphora was pushed in from the pressure applied to fasten the handles. Only after the placing of the handles could the rim be fashioned. Sometimes these amphorae are found with a wash. While occasionally there are graffiti scratched on the neck or handles, there are never any stamps.

Class 3 amphorae are the most common vessels in the mid 12th- to early 13th-century levels at Sarachahe, Istanbul and also occur in numbers in other collections in Turkish museums. They are found in Syria on a shipwreck in waters off Tartous; in the Ukraine, at Cherson, Voin, Odessa, Kerch, Vladimir Volynskiy, Lenkovskoe towns, Alupka-Isar, Alushta and Kiev; in Russia at Sarkel, Tmutarakan, Kazedii Eric and on the eastern shore of the Black Sea in the Kavkaz; in Belarus at Novogrudok; in Armenia; in Bulgaria at Sozopol.
in Romania at Dinogetia–Garvan,\textsuperscript{141} Noviodunum,\textsuperscript{142} Mangalia\textsuperscript{143} and Ada Marinescu;\textsuperscript{144} in Italy at Otranto;\textsuperscript{145} in Greece at Athens\textsuperscript{146} and the harbors of Marathon,\textsuperscript{147} Anhedon,\textsuperscript{148} Antikythera,\textsuperscript{149} Ay Stephanos,\textsuperscript{150} and Gythion;\textsuperscript{151} in Cyprus at Paphos,\textsuperscript{152} and, finally, in Israel at ‘Atlit Castle\textsuperscript{153} and from the sea near Akko.\textsuperscript{154}

These amphoras date mainly to the 12th century. In Dinogetia they occur in layers dated by coins of Alexius I Comnenus (1081–1118) and John II Comnenus (1118–1193);\textsuperscript{155} they date to this same period in Sarkel.\textsuperscript{156} In Cherson they occur in large quantities in 12th-to-13th, and even as late as 14th-century, habitations.\textsuperscript{157} They were used for resonance in the Church of Mistislav, which was built in the year 1160 at Vladimir Volynskiy.\textsuperscript{158} They date to the 12th–13th century layers in Saraçane, Tmutarakhan\textsuperscript{159} and the Lenkovetskoe townsite.\textsuperscript{160}

Class 3 amphoras were manufactured in quite a number of different sizes, but appear to fall into three clusters of sizes on the basis of height.\textsuperscript{161} Amphoras in the cluster of smallest sizes seem to have ranged between 0.340–0.400 in height and apparently were sometimes used as household storage vessels.\textsuperscript{162} Amphoras in the cluster of medium sizes range from 0.500–0.600 in height; all of the amphoras in the present study group belong to this cluster of sizes. Amphoras ranging from 0.700–0.800 in
height have also been found. The larger sizes were as household vessels as well. In Cherson they were used to store fish and grain. In Dinogetia-Garván more than eighty of the larger amphoras were found in habitations.

It seems that the Class 3 amphoras gradually narrowed through time. Amphora 39 with its emphasized piriform shape and height-to-maximum-diameter ratio of 1.58:1, and perhaps all amphoras of this class with a height-to-maximum-diameter ratio lower than about 1.7:1, appears to be closer in shape to the immediate predecessor of Class 3, the piriform amphora with a collar rim. It even has ridging rather than the combing, as does Amphora 40, which also appears to have had a low height to maximum diameter ratio. Class 3 amphoras with a height to maximum diameter ratio between 1.8:1 to 2.0:1 are the most numerous archaeologically and appear to date mainly from the late 11th to 12th centuries. Amphoras with the narrowest bodies, with a ratio between 2.1:1 and 2.5:1, date principally from the 12th to 13th centuries. However, many of these vessels are of a small capacity, and their narrowness may be directly related to this fact. This evolution towards a narrow body appears to have been a gradual one and not a phenomenon restricted to the 13th century as suggested by GünSenin.
The Class 3 amphoras in Table 4 fall easily into three groups on the basis of their height-to-maximum-diameter ratio. Amphoras 34, 36, 38 and 41 are proportionally the narrowest; their ratio ranges from 1.95:1 to 2.11:1. Amphoras 35 and 37 have intermediate proportions; their ratios are 1.86+:1 and 1.87:1. Amphora 39, with its ratio of 1.58:1, is proportionally the broadest.

This division into groups on the basis of height-to-maximum-diameter ratio yields interesting results. Amphoras 37, 39 and 41, for example, all have almost identical capacities, ranging from 13.28 to 13.75 l, yet each belongs to a different ratio group. This leads us to conclude that the capacity measure followed in the fabrication of these vessels remained remarkably constant for as long as perhaps two centuries.

The amphoras in Table 4 fall easily into four different capacity sizes. Since at least three of these sizes cannot be equated to any of the capacity sizes of the Class 1 and 2 amphoras, a totally different designation has been used for all four sizes. Amphora 34, with a height of 0.532, maximum diameter of 0.273, and capacity of 9.97 l, is the smallest of the amphoras and represents Size A. Amphora 38, with a preserved height of 0.560 and maximum diameter of 0.273, has a just under 2 liters larger capacity of 11.8 l; it represents Size B.
Amphoras 37, 39 and 41, with on average a just under 2 liters larger capacity than Amphora 38, belong to Size C. Their height ranges from 0.500 to 0.609 and maximum diameter from 0.289 to 0.316, but their capacity ranges only from 13.3 to 13.75. Finally, Amphoras 35 and 36, with on average a 2 liter greater capacity than the amphoras of Size C, belong to Size D. Their heights are 0.580 and

Table 4: Size Groups of Class 3 Amphoras

<table>
<thead>
<tr>
<th>SIZE GROUP</th>
<th>HEIGHT</th>
<th>MAX. DIAM.</th>
<th>MAX. DIAM. HEIGHT</th>
<th>RIM DIAM.</th>
<th>WGT.</th>
<th>CAPACITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narrow Size A</td>
<td>0.532</td>
<td>0.273</td>
<td>0.283</td>
<td>7.1</td>
<td>9.97</td>
<td></td>
</tr>
<tr>
<td>Size B</td>
<td>0.560+</td>
<td>0.276</td>
<td>0.320</td>
<td>7.9</td>
<td>11.8</td>
<td></td>
</tr>
<tr>
<td>Size C</td>
<td>0.609</td>
<td>0.289</td>
<td>0.336</td>
<td>8.8</td>
<td>13.29</td>
<td></td>
</tr>
<tr>
<td>Size D</td>
<td>0.600</td>
<td>0.302</td>
<td>0.326</td>
<td>0.072</td>
<td>8.4</td>
<td>15.21</td>
</tr>
<tr>
<td>Medium Size C</td>
<td>0.561</td>
<td>0.300</td>
<td>0.301</td>
<td>7.9</td>
<td>13.75</td>
<td></td>
</tr>
<tr>
<td>Size D</td>
<td>0.580+</td>
<td>0.312</td>
<td>0.305</td>
<td>7.7</td>
<td>15.94</td>
<td></td>
</tr>
<tr>
<td>Broad Size C</td>
<td>0.500</td>
<td>0.316</td>
<td>0.255</td>
<td>0.087</td>
<td>13.54</td>
<td></td>
</tr>
</tbody>
</table>

0.600, maximum diameters 0.312 and 0.302, and capacities 15.94 and 15.21.

No kiln sites for these amphoras have yet been located, but there must have been several around the Black Sea area and elsewhere in the Byzantine empire. Just in
the townsite of Tmutarakan alone, four different fabrics were identified for this type of amphora.¹⁶⁹

Class 4

Amph 42. Medium-sized ovoid.

Ill. 42; pl. 43.  
Museum Inv. No. 7361
Max. h. 0.429; max. diam. 0.295; h. to max. diam. 0.250 to 0.260; rim diam. 0.086; capacity 13.885 l; wgt. 4.8 kg. Old chip on exterior of rim. Surface eroded; some encrustation on body and neck. Eroded surface reddish brown (5YR 4/4 to 2.5YR 5/4); core reddish yellow (5YR 6/8). Fabric feels rough, with very fine to medium inclusions of mica, very hard black grit, and quartz sand. Inclusions angular, with some subrounded; frequency >30%. Eroded surface Mohs 4.

Rim carefully delineated, flat on top and rolled under. Neck short; h. of rim and neck approx. 0.058. Small ridge, followed by groove and smaller ridge, marks transition from neck to upper shoulder. Handles, joined to rim and neck, depart horizontally from neck and then turn down to join mid shoulder. Handles flat in section. Body gradually narrows from point of max. diam. to rounded base. Four wheel troughs decorate neck below rim and upper shoulder. Closely spaced wheel ridging begins slightly above
Ill. 42. Amph 42 (7361).
(Scale 1:4)
where lower end of handles attached and extends approx. 0.10 past point of max. diam.; followed by wheel troughs on lower body and shallow, closely spaced wheel grooves on lowest 0.07 of vessel.

Amph 43. Tall ovoid.
Ill. 43; pl. 44.

Max. h. 0.491; max. diam. 0.293; h. to max. diam. 0.244 to 0.252; rim diam. 0.079; capacity 15.365 l;
wgt. 6.02 kg. Surface stained and highly eroded, with some encrustation. Eroded surface pink (7.5YR 7/4); overall stain reddish yellow (7.5YR 7/6); core pink (5YR 8/4). Surface feels rough, with very fine to fine inclusions of dark sand, mica, and grog.
Inclusions subrounded to rounded; frequency >30%.
Mohs 3.5-4.

Rim small and rounded, underscored by groove.
Neck tall; h. of neck and rim approx. 0.102.
Handles, oval in section, have two parallel grooves down length of outer face, probably made by finger.
Handles depart horizontally from join at neck, under rim and descend to mid shoulder. Body gradually narrows after point of max. diam. to rounded bottom.
Four wheel troughs on neck. Wheel ridging appears only on shoulder, above and at level of lower handle attachments; there are six eroded ridges. Shallow, widely spaced wheel troughs cover rest of body. Base
Ill. 43. Amph 43.
(Scale 1:4)
is grooved.

Amph 44. Medium-sized ovoid.

Pl. 45. Museum Inv. No. 7308
Max. h. 0.410; max. diam. 0.160. Body covered with
encrustation. Fabric pitted. Rim thick and rounded.
Neck tall, widening downwards. Ring handles joined
to mid neck, one slightly higher than the other,
descend to mid-to-lower shoulder. Body gradually
narrow after max. diam. to conical base. Shallow
wheel troughs cover vessel. Base ridged.

Amph 45. Medium-sized ovoid.

Pl. 46. Museum Inv. No. 490
Max. h. 0.429; max. diam. 0.306; h. to max. diam.
0.247; rim diam. 0.071. Vessel covered with patches
of encrustation. Upper body very eroded.

Rim thick and rolled. Neck tall, widening
downwards. Handles, joined to mid neck, descend
vertically to mid-to-lower shoulder. Body gradually
narrow from max. diam. to rounded base. Body is
ridged, beginning on lower shoulder and running
approx. 0.010 past max. diam; base also ridged.

Amph 46. Medium-sized ovoid.

Pl. 47. Museum Inv. No. 7398
Max. h. 0.410; max. diam. 0.250; h. to max. diam.
0.309; rim diam. 0.072 Rim chipped. One large lump
of encrustation on lower body and bottom, another on
lower shoulder and upper body. Surface highly eroded.

Rim thick and rounded. Neck tall. Ring handles joined to neck under rim and to mid shoulder; joins clearly visible. Body gradually narrows after point of max. diam. to rounded base. Ridging, almost totally obliterated by erosion, seems to begin on shoulder at level of lower handle attachments and extend approx. 0.10 past max. diam; base also appears to be ridged.

Class 4 consists of ovoid amphoras with a comparatively tall neck, and either a thick, rolled rim or a thick, shelf-like rim. Their handles are oval or slightly flattened in section, and they attach to the neck underneath the rim and to mid shoulder. The base is rounded.

These vessels are variations of what was once called the Saltov type amphora. They were so named because they were first discovered in the archaeological complex of Saltov, where they were dated to the 8th-9th centuries by Arab coins. However, this term has proven incorrect by the discovery in the Crimea of several of the kilns that baked these amphoras and has been replaced with a much broader, and ineffective, descriptive phrase: medieval Black Sea area amphoras. There are three
recognized variants of this amphora type, two of which are represented by amphoras in this study.

The amphoras of variant one, represented in the study group by Amphora 43, are 50 to 60 cm. in height, with some reaching up to 70 cm. They have a tall neck and either a rim with a flat upper edge or one in the shape of a cylinder-like roller. The handles, decorated by a longitudinal ridge or two longitudinal grooves, are relatively tall, and their upper ends attach slightly below the rim.

These amphoras were manufactured during the 8th-9th centuries in potters' kilns located in the Crimean regions of Soudak, at Chaban-Kule, Miskhor and the Kanaksy gorge, and in Cherson. They are almost exclusively found in the northern Black Sea area: in the Crimea, Azov, and Don areas.

Amphoras of the second variant, represented in the study group by Amphoras 42, 45, and 46, are slightly shorter, ranging from 40-45 cm. in height. They have a shorter neck than the first variant and correspondingly shorter handles, usually attached directly beneath the rim. The amphoras are often decorated with deep, widely spaced grooving.

These amphoras were manufactured in the same Eastern Crimean kilns as the amphoras of the first variant, but they date primarily to the 9th-10th centuries.
This type of amphora was also found in large numbers in the lower layers of Sarkel, which date from the 9th to the beginning of the 10th century - the Khazar period.177

This second variant is found primarily in the Crimea: at Cherson,178 at Chaban-Kule,179 near Aleseevka,180 at Tiritaka,181 at Planersky,182 and at Ptashkino.183 On the Ukraine mainland, they are found at Nadporozhe.184 In Russia, they are found at the Khazar cities of Sarkel,185 Tmutarakan,186 and at a boat burial in Gnezdov, near Smolensk.187 Outside of the northern Black Sea area they are found at Saraçhane,188 near Naples,189 in Dalmatia190 and at the sites of shipwrecks near Bozburun in Turkey191 and Mljet in Yugoslavia.192

The origins of the first and second variants lie in similar vessels of the 4th century. The evolution of these amphoras is easily traced through the archaeological material of the Crimea, where they essentially kept the same form up to the 10th century.193 Although there were always several variations in form of this amphora, through all its stages of development, the trend through time shows a gradual tendency to shorter necks and handles and a filling out of the body.194 Later on, in the first half of the 12th century, an analogous vessel was found in Novogrudok, along with amphoras of Classes 2 and 3. The sole physical characteristic that distinguishes this
vessel from the amphoras of the 9th century is its almost flat bottom.¹⁹⁵

The third variant is represented by vessels with an oval to round body, a clear descendant from the large globular amphoras of the 5th-7th centuries. They date to the 8th-9th centuries, but mainly to the 9th century, and were probably manufactured in the Eastern Crimea.¹⁹⁶

Unfortunately, no exact parallels were found for Amphora 44.

The assignment of the other Class 4 amphoras in this study to only two variants is too simplistic. The fact is that these amphoras are all unique individuals; each one has its own minor structural or decorative peculiarities. In his amphora typology for Sarachane, Hayes found 11 different types of this general class of ovoid amphora.¹⁹⁷ No other amphora class of the 9th through 14th centuries has so many distinct variations.

Petrographical analyses conducted on this class of amphora in the northern Black Sea area have confirmed that a large percentage of these vessels were fired in neighboring kilns in the Eastern Crimea.¹⁹⁸ Three closely related fabric types were identified, some with a non-plastic material content reaching up to 50%.¹⁹⁹ In another study, where only the pastes of amphoras from Tmutarakan were analyzed, seven different fabrics were identified just for this one class of amphora.²⁰⁰ Taking
into account the number of different fabrics, it is clear that the production of this class of amphora was not confined to one locale.

Class 5
Amph 47. Medium-sized piriform with high-rising handles.
Ill. 44; pl. 48. Museum Inv. No. 4-14-83
Max. h. 0.380; max. diam. 0.207; h. to max. diam. 0.229 to 0.232; capacity 4.950 l. Three quarters of rim and neck and one handle missing. Interior surfaces very concreted; exterior surfaces less so. Original surface red (2.5YR 4/6). Fabric feels rough, with fine to medium inclusions of quartz sand. Inclusions rounded; frequency >30%. Mohs 3.5-4.

Rim small with rolled edge. Neck 0.045 tall. Remaining handle wide and flat in section, with two parallel grooves down length on outer face. Handle, joined to neck 0.017 below rim, rises at a 60 angle 0.023 above rim level and descends vertically to lower shoulder near point of max. diam. Handle attached to shoulder with extra clay; lower stub of missing handle well rounded. Body gradually narrows and elongates, ending in slightly conical base. No wheel ridging present on body, but widely spaced wheel troughs cover entire surface apart from 0.020 band where lower end of handles join shoulder.
Ill. 44. Amph 47 (4-14-83).
(Scale 1:4)
Amph 48. Medium-sized piriform with high-rising handles. Ill. 45; pl. 49.

Max. h. 0.410; max. diam. 0.276; h. to max. diam. 0.225-0.235; capacity 11.958 l; wgt. 4.9 kg. Three fourths of rim, part of neck, and one handle missing. Wall is 0.005 thick where neck broken. Break old and smoothed down except for section near handle that is new and hackly. Lower stub of missing handle has smooth edges with concretion covering surface.

Interior and exterior surfaces eroded. Eroded surface between pink (5YR 7/4) and light reddish-brown (5YR 6/4). Fabric feels rough, with fine inclusions of sand, quartz, and grog. Inclusions rounded; frequency >30%. Mohs 4.

Lip of rim small with rolled edge. Neck 0.051 tall. Handle wide and thin in section, with two parallel grooves down length of outer face; handle height 0.114. Handle, joined to neck 0.017 below rim, rises at 45-degree angle 0.013 above rim level and descends vertically to lower shoulder close to max. diam. Body gradually narrows to a point approx. 0.114 above bottom, begins to widen slightly and narrows again to relatively flat base. Amphora can stand without support; base center is dimpled.

Widely spaced and eroded wheel ridging begins on shoulders underneath arch of handles and stops
Ill. 45. Amph 48.
(Scale 1:4)
halfway down body. Below is band of wheel troughs 0.091 wide, followed by more eroded wheel ridging to bottom. Small horizontal (0.080) crack in fabric runs along most narrow point in body.

Amph 49. Small piriform with high-rising handles.

Ill. 46; pl. 50. Museum Inv. No. 7434

Max. h. 0.349; max. diam. 0.201; h. to max. diam. 0.190 to 0.220; rim diam. 0.047-0.051; capacity 4.45 l; wgt. 3.56 kg. Old chip on rim. Handles have drying cracks. Vessel covered with encrustation both inside and outside; capacity and weight only approx. Surface eroded. Original surface dark red (2.5YR 3/6); eroded surface light red (2.5YR 6/8); core light red (2.5YR 6/8). Fabric feels smooth, with fine to medium inclusions of quartz, sand, and grog. Inclusions rounded; frequency >30%. Original surface Mohs 4.5.

Rim thin with rolled edges and unevenly shaped; lip wider on one side than on other. Neck and rim approx. 0.057 tall. Small knob of clay protruding from one side of neck. Handles, joined to neck, rise at a 45-degree angle approx. 0.013 above rim before descending to lower shoulder. Handles flat and wide in section, decorated by two parallel grooves down length on outer face. Body irregularly shaped with various bulges and flat spots along sides. Vessel
Ill. 46. Amph 49 (7434).
(Scale 1:4)
gradually narrows after max. diam. to point approx. 0.127 above bottom, where walls become steeper and straighter to rounded base. No wheel decoration on vessel aside from shallow wheel troughing beginning at shoulders and extending to base.

Class 5 consists of piriform amphoras with a short neck, thinly rolled rim, and flat handles that rise high over the rim of the vessel. The handles are decorated with two parallel, longitudinal grooves down their lengths. Although fabric color varies, the size, composition, and amount of inclusions are similar for the three amphoras in this study group.

An exact parallel to Amph 49 was found on the 11th-century shipwreck at Serçe Limanı. Analogous amphoras were discovered on a shipwreck near the island of Mljet, Yugoslavia, dated to the 9th-10th centuries, and in the harbor at Antikythera, Greece. A vessel with a similarly shaped body profile, but with a flat base, was found at Cherson, in the Crimea; it is dated to the 11th century. An amphora without provenance from Zadar, Yugoslavia, also belongs in this group.

An amphora that is comparable to those of this class, but with trefoil handles, was found at a shipwreck near Nin, Yugoslavia. This shipwreck is dated to approximately the same time as the one from Mljet.
Neckless types within this class are found in Yugoslavia at Belgrade,\textsuperscript{208} Mljet, Sibenik, Hvar,\textsuperscript{209} and Ras.\textsuperscript{210} They were also discovered at Constantinople\textsuperscript{211} and the area of the lower Don.\textsuperscript{212} These vessels date from the 9th to the 13th centuries.

Apart from those mentioned above, no other parallels for this class of amphora were found. However, amphoras with their handles rising above their rims began to appear in the Byzantine Empire at the end of the 9th century, and this particularity lasted well into the 14th century. It is as if the elongated handles were an effort to refine vessels whose silhouette was becoming more and more compact.

Class 6

Amph 50. Small ovoid.

Ill. 47; pl. 51.

Max. pres. h. 0.281; max. diam. 0.200; h. to max. diam. 0.178 to 0.181; capacity to base of neck 3.7 l; wgt. 2.76 kg. Neck, part of shoulders, and both handles missing. Handle breaks old, but edges still fairly rough. Surface highly eroded, but slight traces of original surface remain. Eroded surface reddish-yellow (5YR 7/6); original surface red (2.5YR 5/6). Fabric feels smooth to the touch, with medium to coarse inclusions of grog, and black, and red
grit. Inclusions rounded and well sorted; frequency 10-30% (common). Mohs 3.5-4.

Fabric thickness at break 0.005. Remnants of handle ends suggest they had been wide and thin in section. Approx. 21 spiral wheel ridges from break to 0.080 past max. diam. Ridges closely spaced on upper shoulder, gradually widening downwards; 0.030-wide band of smoothed down ridges where lower handle attaches at mid shoulder. Below wheel ridging, body covered by wheel troughs. Wheel troughs eroded towards slightly conical base. Large ridge on interior wall just under smoothed-out shoulder ridges; possible indication of join of separate neck to shoulder.


Ill. 48; pl. 52.

Max. h. 0.334; max. diam. 0.250; h. to max. diam. 0.245 to 0.255; capacity to base of neck 7.79 l; wgt. 3.4 kg. Rim, handles, and most of neck missing; handle and rim breaks have sharp edges. No concretion on either exterior or interior surfaces, nor among amphora's contents; amphora found on land. Overall surface color between light reddish brown (5YR 6/4) and reddish yellow (5YR 6/6); wash white (10YR 8/2); core reddish yellow (5YR 6/6). Fabric feels smooth, with fine inclusions of mica and black
Ill. 48. Amph 51.
(Scale 1:4)
grit. Inclusions subrounded to angular; frequency 10-30% (common). Mohs 3.5-4.

Transition from neck to upper shoulder not smooth; roll of clay both below and above transition, delineating juncture between shoulder and separate neck. Handle joined to mid shoulder; sloppily secured with extra clay. Body narrows gradually after point of max. diam. to rounded bottom. Extant portion of neck covered by seven wheel troughs, followed by a blank band 0.03 wide. Spiral wheel ridging begins on shoulder below lower handle attachment and extends 0.110 past point of max. diam. Below ridging band, body covered by shallow, widely spaced wheel troughs.

Residue samples taken from interior contents contain a mixture of charred wheat, lentils, and fire-baked clay (pls. 53-55).

Amph 52. Large ovoid.

Ill. 49; pl. 56. Museum Inv. No. 7363

Max. h. 0.385; max. diam. 0.277; h. to max. diam. 0.238 to 0.244; capacity 11.241 l. One handle, rim, and part of neck missing. Surface is highly eroded and flaking. Original surface reddish brown (2.5YR 5/4); eroded surface between light reddish brown (2.5 YR 6/4) and reddish brown (2.5YR 5/9). Fabric feels fairly smooth, with very fine to medium inclusions of
Ill. 49. Amph 52 (7363).
(Scale 1:4)
dark sand, grog, and mica. Inclusions rounded to angular; frequency 10-30% (common). Eroded surface Mohs 4.

Preserved h. of neck approx. 0.054. Wall of neck thin. Attachment of separate neck takes place at base of neck. Handles do not appear to have arched above rim. Remaining handle is flat and stirrup like; outer face decorated by two parallel grooves down length. Handle, joined to neck, rises only slightly before descending to lower shoulder. Stub of missing handle worn down and smoothed off; tool scrapings are clearly seen. Handle stub consists of a circle of clay; wheel ridges visible underneath; this is extra clay used to fasten handle to body and cover up juncture. Body gradually narrows after point of max. diam. to rounded base. Under arch of handles, shoulder decorated by band of four closely spaced wheel ridges; ridges mirrored on inside wall of vessel. Shallow, widely spaced, eroded wheel troughs cover rest of body to approx. 0.057 above bottom; deep wheel troughs continue to bottom. Some black stains, probably soil stains, on interior walls of vessel.
Class 6 consists of three incomplete amphoras of small to medium size. They are ovoid vessels with flat to slightly oval handles.

Amphoras 50 and 51 may have been smaller versions of Class 4 amphoras or ovoid variants of Class 5 amphoras.

Amphora 51 is the only amphora in this study that was found on land. While the vessel itself possesses no trace of burning, it contains charred wheat, lentils, and bits of baked clay; perhaps the residue from a small kitchen fire was swept up into the already broken amphora, which with its contents was then discarded.

Amphora 52 is similar to a vessel found in Capidava, Romania, dated to the first half of the 11th century.23

Class 7

Amph 53. Small piriform.

Ill. 50; pl. 57.

Max. h. 0.299; max. diam. 0.182; h. to max. diam. 0.165 to 0.175; capacity 3.078 l. Body cracked. Approx. three-quarters of rim and upper half of one handle missing. Concretion covers some parts of exterior and entire inner surface. Fabric appears to be of exceptionally high quality. Surface reddish-yellow (7.5YR 6/6). Fabric smooth, with fine, well sorted inclusions of quartz sand and tiny mica flakes. Inclusions rounded to sub-rounded;
Ill. 50. Amph 53.
(Scale 1:4)
frequency 30% (common). Surface Mohs 3.

Short, narrow neck, handles, and wide mouth combine to form cup-like shape. Rim has delicately rolled lip; broken twice. Larger break is older, made during use-life of amphora; edges appear to have been intentionally smoothed down. Newer break, next to old one, has rough edges. Handles, wide and flat in section with two parallel grooves down length on outer face, extend out horizontally before turning downwards to mid shoulder. One deep wheel groove on upper shoulder, followed by band of nine wheel ridges beginning under lower handle attachment. Body covered by faint wheel grooves below band of ridging. Another small band of eight wheel ridges decorate bottom one-quarter of amphora down to point where walls curve in to form base.

Amph 54. Small piriform.

Ill. 51; pl. 58.

Max. h. 0.312; max. diam. body 0.147, max. diam. at handles 0.0156; h. to max. diam. body 0.174. 0.186 of side wall is missing. Surface covered with encrustation. Fabric, as seen in section of broken wall, shows thin, black layer sandwiched between thin, light brown (7.5YR 6/4) inner-core layer and thicker, light yellowish-brown (10YR 6/4) surface layer. Small voids, caused by air bubbles, visible
Ill. 51. Amph 54.
(Scale 1:4)
in wall section. Fabric smooth, with fine inclusions of mica, small black grit, and crushed shell. Inclusions rounded (black grit) to angular (shell); frequency 10-30% (common). Mohs 3.5-4.

Edge of rim thin; no lip. Neck 0.069 tall. Handles, joined to neck 0.012 below edge of rim, depart from neck horizontally and gradually turn down and inward to mid shoulder. Handles decorated by two longitudinal grooves on outer face. Thickness of neck near shoulder 0.005-0.006; of sidewall 0.008; near bottom 0.006. Clay spirals to center on interior bottom. Apart from handles, no other visible joins in amphora. Wheel ridging starts below lower handle attachment and runs down body for approx. 0.07; ridges 0.005 apart. Wheel troughs continue to rounded base with small button at center.

Amph 55. Small piriform.

Ill. 52; pl. 59.

Max. h. 0.333; max. diam. 0.186; h. to max. diam. 0.209 to 0.215; rim diam. 0.059; capacity 3.58 l; wgt. 1.98 kg. Surface eroded; fabric exfoliating in places. Original surface light brownish gray (10YR 6/2); eroded surface light reddish brown (5YR 6/4); core reddish yellow (5YR 6/6). Fabric feels smooth, with fine to medium inclusions of mica, sand, and grog. Inclusions rounded; frequency 10-30% (common).
Original surface Mohs 2-2.5.

Edge of rim thin, but appears slightly thicker than neck; there is no lip. Small indentation around rim interior to seat stopper. Two vertical scoremarks in mouth. H. of rim and neck approx. 0.050. Handles, joined to neck, rise slightly and curve down to lower shoulder. Handles flat and wide in section. Body gradually narrows from max. diam. to rounded base. Five revolutions of closely spaced wheel ridging begin just above level of lower handle attachments and do not extend to point of max. diam. Another band of five wheel ridges begins approx. 0.052 from bottom and extends to bottom.

Flat, round, and slightly concave lump of pitch was taken from interior bottom; when vessel was pitched, some of excess settled to bottom and hardened.

Amph 56. Small piriform.

Ill. 53; pl. 60.

Max. h. 0.287; max. diam. body 0.158, max. diam. handles 0.172; h. to max. diam. 0.166 to 0.173; rim diam. 0.049; capacity 1.95 l; wgt. 1.12 kg. Original surface reddish brown; eroded surface between pink (5YR 7/4) and reddish brown (5YR 6/4). Fabric feels smooth, with very fine inclusions of dark sand and mica. Inclusions rounded; frequency 30%. Original
ILL. 53. Amph 56.
(Scale 1:4)
surface Mohs 3–3.5.

Cup-shaped rim set directly onto shoulder; rim narrows downwards to join with shoulder. Handles are wide and thin, with two parallel grooves down length on outer face. Handles, joined to rim with one handle placed somewhat higher than the other, extend out horizontally before curving down to mid-to-lower shoulder. Shoulder slightly flattened on one side. Body gradually narrows from point of max. diam. to rounded base. Band of ten wheel ridges beginning under arch of handles and extending to max. diam. is followed by shallow, widely spaced wheel troughs. Another band of five ridges, 0.050 wide, begins 0.090 above bottom.

Small pieces of fiber were found adhering to interior wall of vessel.

Class 7 consists of small piriform amphoras that were carefully manufactured from fine fabrics. These vessels possess either a rim with a small rolled lip or no lip at all, flat-in-section handles, which often project out beyond the maximum diameter of the body, and two bands of decoration, one on the shoulders and another near the bottom. The neck may be either short or tall.

This class of amphora was often referred to as the Kievan type, but now it is widely accepted as
Byzantine. \textsuperscript{215} Vessels belonging to this class date from the 5th century up to the 13th century. \textsuperscript{216}

The closest parallels to the study amphorae date primarily to the 12th–13th centuries and are found in Turkey at Saraçhane; \textsuperscript{217} in Ukraine at Kiev, \textsuperscript{216} Kastel, \textsuperscript{219} Isar-Kaya \textsuperscript{220} and Odessa; \textsuperscript{221} in Russia at Tmutarakan \textsuperscript{222} and Azak; \textsuperscript{223} in Bulgaria at Preslav; \textsuperscript{224} in Romania at Dinogetia; \textsuperscript{225} and in Yugoslavia at Ras. \textsuperscript{226} In terms of fabric color and quality, amphorae from Saraçhane, Kiev, Dinogetia, and Ras are most analogous to those from the study group. A similar amphora is seen in the Arab Theriaque miniature, dated to 1199. \textsuperscript{227}

Class 8

Amph 57. Large flat-bottomed piriform.

Ill. 54; pl. 61. Museum Inv. No. 4248

Max. h. 0.528; max. diam. 0.467; h. to max. diam. 0.246 to 0.258; rim diam. 0.109; capacity 42.255 l.

Amphora cracked; repaired. Hole (0.019 x 0.019) cut intentionally into lower part of vessel; fabric 0.003 thick at hole. Vessel covered by encrustation.

Surface eroded, with fabric spalling in places; some areas consolidated by adhesive. Original surface brown (7.5YR 5/4); eroded surface very pale brown (10YR 7/3); core between pinkish gray (7.5YR 7/2) and pink (7.5YR 7/4). Fabric feels smooth, with very
Ill. 54. Amph 57 (4248).
(Scale 1:4)
fine inclusions of mica, quartz sand. Inclusions rounded; frequency of >30%. Original surface Mohs 4.

Wide mouth. Rim flat on top and well defined. Rim grooved for seating of stopper. Neck tall and wide; h. of neck and rim approx. 0.100. Neck separate and joined at base to shoulder. Wide, flat handles, joined to edge of rim, extend horizontally before turning down to upper shoulder; attached with minimum of extra clay. Two parallel, grooves run down length of handles on outer face. Body gradually narrows after point of max. diam. to flat base dimpled at center. Shallow, widely spaced wheel troughing begins at level of lower handle attachments and continues to bottom. Traces of pitch inside.

Analogous amphoras are found in the 9th-10th century deposits of Cherson in the Crimea. They differ slightly by their rounded bottom but in other respects are identical to Amphora 57. Besides Cherson, where they are rare, they are also found at Sarkel, Russia. Broken fragments at Cherson revealed that these vessels were made in several pieces and then connected together. Fingerprints were seen on the interior seams of the body.
Amph 58. Medium-sized, flat-bottomed piriform.
Ill. 55; pl. 62.
Max. h. 0.425; max. diam. 0.303; h. to max. diam. 0.198 to 0.201; rim diam. 0.106; capacity 13.517 l.
Vessel badly cracked. Small, old chip on exterior surface of rim. Surface covered with encrustation.
Original surface light brown (between 7.5YR 6/4 and 7.5); eroded surface approx. pink (7.5Yr 7/4); core reddish yellow (between 7.5Yr 8/6 and 7.5YR 7/6).
Surface feels smooth, with very fine inclusions of mica and sand. Inclusions rounded; frequency 5-10% (moderate). Original surface Mohs 4.5-5.
Mouth wide and rim well defined; rim and neck grooved on interior for seating of stopper. Neck long; h. of neck and rim approx. 0.111. Wide, flat handles, joined to neck below rim, extend horizontally before descending to lower neck or upper shoulder. Handles grooved. Body gradually narrows after point of max. diam. to flat base, dimpled at center. Nine revolutions of closely spaced wheel ridging begins below lower handle attachments and ends before point of max. diam. Shallow wheel troughing covers rest of vessel to bottom. Traces of pitch adhere to inside walls.
Stamp, diam. 0.011 x 0.011, in form of rosette consisting of four triangles with apexes pointing
ILL. 55. Amph 58.
(Scale 1:4)
toward center impressed on shoulder (ill. 56).
Illegible graffito scratched above the stamp before firing; max. h. 0.040, max. w. 0.057. Arrow, 0.0145 x 0.011, scratched on top of one handle. Similar stamps were found on vessel fragments from Cepina, Bulgaria.231

Parallels for this type of amphora were discovered in the Palace of Basil I at Manganes, Constantinople, dated to the 9th century232 and on a 9th-10th century shipwreck near Mljet, Yugoslavia.233 An upper body fragment was found at the Athenian Agora in a layer dated to the 9th-10th centuries.234 However, a similar upper body fragment was found in an 11th-century level at Sarazhane, Istanbul.235 Six amphoras belonging to several different types all quite similar to this type of amphora were found on the Serçe Limanı shipwreck.236

Class 9
Amph 59. Large piriform with four loop handles.
Ill. 57. Museum Inv. No. 7453
Max. remaining h. 0.432; max. diam. 0.397; h. to max. diam. 0.267-0.278; capacity 28.29 l; wgt. 6.7 kg.
Rim and part of neck missing; wall thickness at break 0.005-0.007. Interior and exterior surfaces covered with encrustation. Original surface reddish brown
Ill. 56. Marks 45-47 (Amph 58).
(Scale 1:1)
Ill. 57. Amph 59 (7453).
(Scale 1:4)
(5YR 4/3); eroded surface light reddish brown (5YR 6/4); core reddish brown (5YR 5/4). Fabric feels rough, with fine inclusions of mica, limestone, grog, and sand. Inclusions rounded, mica and some grog angular; frequency >30%. Mohs 4.5.

Mouth appears to have been wide. Surviving portion of neck curves slightly outward. Four, symmetric loop handles placed vertically on shoulder. Handles flat in section, with two parallel grooves running down length on outer face. Body gradually narrows after point of max. diam. to flat base dimpled at center. Closely spaced wheel ridging begins under upper handle attachments and extends to end of shoulder. Ridging followed by 0.220-wide band of shallow, widely spaced wheel troughing. Ridging begins again approx. 0.102 above bottom and continues to bottom. Fifteen wheel grooves cover base.

No exact parallel was found for this jar. However, it is of the same piriform shape and is decorated in the same manner as the amphoras of Class 2. The flat, dimpled base and the general fabric color and quality are like those of Class 8 amphoras.

Three-handled amphoras were discovered in the Ukraine in 12th-13th century layers at Chersonesos and Eski Kermen. These vessels differ from Amphora 59 by their
horizontally placed handles, flat base with no dimple, and decoration. Yet, the flaring edge of the remaining neck of Amphora 59 could very well have terminated like the bell-socket-shaped neck and rims of the amphoras from Cherson and Eski-Kermen. A similar amphora fragment, but with only two handles, was found at Mljet, Yugoslavia; it is dated to the 9th–10th centuries. Other possible parallels are amphora fragments from an undated deposit at Constantinople, and those from 12th century Azak, in Russia.
CAPACITIES

Unlike many amphoras of the earlier Roman period, Byzantine amphoras rarely have inscribed or stamped on them an indication of their capacity that is recognizable as such to archaeologists who have studied these amphoras. The data to be presented in this chapter suggest that in the case of at least some classes of amphoras, there may not have been a particularly great need for capacity markings, since one could determine fairly closely how much of a particular product an amphora contained simply by weighing it.

An analysis of the data concerning the capacities of Class 1 and 2 amphora has revealed a close relationship between their weights and volume capacities. As we have already seen, it proved possible to divide all of the more or less complete Class 1 and 2 amphoras in this study into seven apparent capacity sizes. In an attempt to determine which known Byzantine volume capacities these different sizes might represent, the amphoras in each size were assigned the largest Byzantine volume capacity that would result in the vessels of that size being as full as possible. The result proved extremely interesting. In a majority of cases, the amphora became filled to about the level of transition from the shoulder to the neck, and its gross weight, which equals the weight of the amphora
itself (the tare weight) plus the weight of its contents (white wine in cases where the *metron* standard of measure, which is based on white wine,\textsuperscript{242} is involved and grain in cases where the *modios* standard of measure, which is based on grain,\textsuperscript{243} is involved), was within only 2 *litrai* of some multiple of 10 *logarikai* *litrai* (1 *logariko* *litra* = 0.320 kg.).\textsuperscript{244}

Table 5 shows that if Amphora 10 (Size 1) were filled with 1/2 *monasterikon metron* of white wine, it would be 86 percent full and its gross weight would be 21.2 *litrai*.

Table 6 shows that if Amphoras 11 and 18 (Size 2) were filled with 1/2 a *thalassion metron* of white wine, they would weigh 31.6 and 31.2 *litrai*. They would only be 80.8 and 78.8 percent full, however, which seems somewhat low.

If Amphoras 17, 16, 21 and 14 (Size 3) were filled with 1 *monasterikon metron* of white wine, all results would not be similar. In the case of Amphoras 17 and 16 (Table 7), they would be 82.4 and 81.8 percent full and weigh 41.9 and 41.9 *litrai*. Amphoras 21 and 14, on the other hand, would be somewhat under filled (81.1 and 80.8 percent full) and significantly heavier (43.1 and 46.4 *litrai*). However, as Table 8 shows, if the latter two amphoras were filled with 2 *pinakia* (two-thirds a *modios tripinakion*) of grain, they would be 84.5 and 84.1 percent full and weigh 39.1 and 42.4 *litrai* respectively.
Table 5: Amphora with a Theoretical Capacity of 1/2 Monasterikon Metron (4.100 l)

<table>
<thead>
<tr>
<th>No.</th>
<th>Tare Wgt.</th>
<th>Max. Capacity</th>
<th>% Max. Capacity</th>
<th>Wgt. of White Wine</th>
<th>Theoretical Gross Wgt.</th>
<th>Logarikai Litrai</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.</td>
<td>2.92</td>
<td>4.765</td>
<td>86.0</td>
<td>3.84</td>
<td>6.76</td>
<td>21.2</td>
</tr>
</tbody>
</table>

Table 6: Amphorae with a Theoretical Capacity of 1/2 Thalassion Metron (5.125 l)

<table>
<thead>
<tr>
<th>No.</th>
<th>Tare Wgt.</th>
<th>Max. Capacity</th>
<th>% Max. Capacity</th>
<th>Wgt. of White Wine</th>
<th>Theoretical Gross Wgt.</th>
<th>Logarikai Litrai</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.</td>
<td>5.30</td>
<td>6.345</td>
<td>80.8</td>
<td>4.80</td>
<td>10.10</td>
<td>31.6</td>
</tr>
<tr>
<td>18.</td>
<td>5.18</td>
<td>6.500</td>
<td>78.8</td>
<td>&quot;</td>
<td>9.98</td>
<td>31.2</td>
</tr>
</tbody>
</table>
Table 7: Amphoras with a Theoretical Capacity of 1 Monasterikon Metron (8.200 l)

<table>
<thead>
<tr>
<th>No.</th>
<th>Tare Wgt.</th>
<th>Max. Capacity</th>
<th>% Max. Capacity</th>
<th>Wgt. of White Wine</th>
<th>Theoretical Gross Wgt.</th>
<th>Logarikai Litrai</th>
</tr>
</thead>
<tbody>
<tr>
<td>17.</td>
<td>5.74</td>
<td>9.955</td>
<td>82.4</td>
<td>7.68</td>
<td>13.42</td>
<td>41.9</td>
</tr>
<tr>
<td>16.</td>
<td>5.48</td>
<td>10.030</td>
<td>81.8</td>
<td>&quot;</td>
<td>13.16</td>
<td>41.1</td>
</tr>
<tr>
<td>21.</td>
<td>6.12</td>
<td>10.115</td>
<td>81.1</td>
<td>&quot;</td>
<td>13.80</td>
<td>43.1</td>
</tr>
<tr>
<td>14.</td>
<td>7.16</td>
<td>10.143</td>
<td>80.8</td>
<td>&quot;</td>
<td>14.88</td>
<td>46.4</td>
</tr>
</tbody>
</table>

Table 8: Amphoras with a Theoretical Capacity of 2 Pinakia (8.542 l)

<table>
<thead>
<tr>
<th>No.</th>
<th>Tare Wgt.</th>
<th>Max. Capacity</th>
<th>% Max. Capacity</th>
<th>Wgt. of Grain</th>
<th>Theoretical Gross Wgt.</th>
<th>Logarikai Litrai</th>
</tr>
</thead>
<tbody>
<tr>
<td>21.</td>
<td>6.12</td>
<td>10.115</td>
<td>84.5</td>
<td>6.40</td>
<td>12.52</td>
<td>39.1</td>
</tr>
<tr>
<td>14.</td>
<td>7.16</td>
<td>10.143</td>
<td>84.1</td>
<td>&quot;</td>
<td>13.56</td>
<td>42.4</td>
</tr>
</tbody>
</table>
If Amphoras 6, 3, 15, 7, 22, 1, 8 and 12 (Size 4) were filled with 1 *thalassion metron* of white wine, all results again would not be similar. In the case of the first six amphoras (Table 9), they would be from 82.2 to 89.1 percent full, and four of them, Amphoras 6, 15, 7 and 1 would weigh from 50.8 to 51.4 *litrai*. Amphora 3 would be somewhat lighter (47.7 *litrai*); Amphora 22, somewhat heavier (53.3 *litrai*). Amphoras 8 and 12 would weigh 49.4 and 49.3 *litrai* respectively but would be significantly under filled (77.4 and 71.4 percent full). However, as Table 10 shows, if these two amphoras were filled with 1 *modios tripinakion* of grain, they would be 96.8 and 89.2 percent full while maintaining the same gross weight. It is perhaps noteworthy that the largest group of amphoras in this study, the Size 4 amphoras, appear to have a capacity equal to either the primary volume-capacity for wine, the *thalassion metron*, or the primary volume-capacity for grain, the *modios tripinakion*. Table 11 shows that if Amphoras 19 and 30 (Size 5) were filled with 1 1/2 *thalassia metra* of white wine, they would be 90.0 and 86.4 percent full and weigh 71.6 and 70.3 *litrai* respectively.

Table 12 shows that if Amphoras 28, 32 and 25 (Size 6) were filled with 2 *thalassia metra* of white wine, they would be from 87.6 to 94.4 percent full, and two of them, Amphoras 28 and 25, would weigh 91.6 and 91.3 *litrai*,
Table 9: Amphoras with a Theoretical Capacity of 1 Thalassion Metron (10.250 l)

<table>
<thead>
<tr>
<th>No.</th>
<th>Tare Wgt.</th>
<th>Max. Capacity</th>
<th>% Max. Capacity</th>
<th>Wgt. of White Wine</th>
<th>Theoretical Gross Wgt.</th>
<th>Logarikai Litrai</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.</td>
<td>6.80</td>
<td>11.507</td>
<td>89.1</td>
<td>&quot;</td>
<td>16.4</td>
<td>51.3</td>
</tr>
<tr>
<td>3.</td>
<td>5.65</td>
<td>11.772</td>
<td>87.1</td>
<td>&quot;</td>
<td>15.25</td>
<td>47.7</td>
</tr>
<tr>
<td>15.</td>
<td>6.86</td>
<td>11.875</td>
<td>86.3</td>
<td>&quot;</td>
<td>16.46</td>
<td>51.4</td>
</tr>
<tr>
<td>7.</td>
<td>6.65</td>
<td>12.132</td>
<td>85.3</td>
<td>&quot;</td>
<td>16.25</td>
<td>50.8</td>
</tr>
<tr>
<td>22.</td>
<td>7.46</td>
<td>12.355</td>
<td>83.0</td>
<td>&quot;</td>
<td>17.06</td>
<td>53.3</td>
</tr>
<tr>
<td>1.</td>
<td>6.83</td>
<td>12.475</td>
<td>82.2</td>
<td>&quot;</td>
<td>16.43</td>
<td>51.3</td>
</tr>
</tbody>
</table>

Table 10: Amphoras with a Theoretical Capacity of 1 Modios Tripinakion (12.813 l)

<table>
<thead>
<tr>
<th>No.</th>
<th>Tare Wgt.</th>
<th>Max. Capacity</th>
<th>% Max. Capacity</th>
<th>Wgt. of Grain</th>
<th>Theoretical Gross Wgt.</th>
<th>Logarikai Litrai</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.</td>
<td>6.22</td>
<td>13.243</td>
<td>96.8</td>
<td>9.60</td>
<td>15.82</td>
<td>49.4</td>
</tr>
<tr>
<td>12.</td>
<td>6.16</td>
<td>14.365</td>
<td>89.2</td>
<td>&quot;</td>
<td>15.76</td>
<td>49.3</td>
</tr>
</tbody>
</table>
Table 11: Amphoras with a Theoretical Capacity of 1 1/2 Thalassia Metra (15.375 l)

<table>
<thead>
<tr>
<th>No.</th>
<th>Tare Wgt.</th>
<th>Max. Capacity</th>
<th>% Max. Capacity</th>
<th>Wgt. of White Wine</th>
<th>Theoretical Gross Wgt.</th>
<th>Logarithmic Litrail</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>8.50</td>
<td>17.075</td>
<td>90.0</td>
<td>14.40</td>
<td>22.90</td>
<td>71.6</td>
</tr>
<tr>
<td>30</td>
<td>8.09</td>
<td>17.787</td>
<td>86.4</td>
<td>&quot;</td>
<td>22.49</td>
<td>70.3</td>
</tr>
</tbody>
</table>

Table 12: Amphoras with a Theoretical Capacity of 2 Thalassia Metra (20.500 l)

<table>
<thead>
<tr>
<th>No.</th>
<th>Tare Wgt.</th>
<th>Max. Capacity</th>
<th>% Max. Capacity</th>
<th>Wgt. of White Wine</th>
<th>Theoretical Gross Wgt.</th>
<th>Logarithmic Litrail</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td>8.65</td>
<td>20.475</td>
<td>100.1</td>
<td>19.20</td>
<td>27.85</td>
<td>87.0</td>
</tr>
<tr>
<td>28</td>
<td>10.12</td>
<td>21.710</td>
<td>94.4</td>
<td>&quot;</td>
<td>29.32</td>
<td>91.6</td>
</tr>
<tr>
<td>32</td>
<td>10.70</td>
<td>22.945</td>
<td>89.3</td>
<td>&quot;</td>
<td>29.9</td>
<td>93.4</td>
</tr>
<tr>
<td>25</td>
<td>10.00</td>
<td>23.41</td>
<td>87.6</td>
<td>&quot;</td>
<td>29.2</td>
<td>91.3</td>
</tr>
</tbody>
</table>
respectively. Amphoras 32 would have a somewhat greater weight of 93.4 litrai. The other amphora belonging to Size 6, Amphora 26, would be filled to over flowing, and thus may have had another capacity. Indeed, as Table 13 shows, if this amphora were filled with 1 1/2 modia tripinakia of grain, it would be 93.9 percent full and would weigh 72.0 litrai.

Finally, Table 14 shows that if Amphoras 24, 31 and 33 (Size 7) were filled with 3 thalassia metra of white wine, they would be from 86.5 to 89.8 percent full, and one of them, Amphora 24, would weigh 130.7 litrai. Amphora 33 would have a somewhat greater weight of 133.4 litrai, while Amphora 31 would have a substantially higher weight of 139.2 litrai. I am inclined to believe that the abnormal highness of the latter weight is due to either an error in my recording of the amphora's tare weight, or the presence of considerable marine encrustation on the amphora (Plate 34), or both.

In assessing the above results, one should keep in mind the fact that all of the amphoras have surely undergone at least some slight change from their original weight. Minor breakage, wear, erosion, a loss of interior coatings of pitch and destruction of fabric by marine organisms have contributed to weight loss, while concretion deposits that could not be removed and absorption of minerals by the fabric have contributed to weight gain.
Table 13: Amphora with a Theoretical Capacity of 1 1/2 Modios Tripinakion (19.220 l)

<table>
<thead>
<tr>
<th>No.</th>
<th>Tare Wgt.</th>
<th>Max. Capacity</th>
<th>% Max. Capacity</th>
<th>Wgt. of Grain</th>
<th>Theoretical Gross Wgt.</th>
<th>Logarikai Litrai</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td>8.65</td>
<td>20.475</td>
<td>93.9</td>
<td>14.40</td>
<td>23.05</td>
<td>72.0</td>
</tr>
</tbody>
</table>

Table 14: Amphoras with a Theoretical Capacity of 3 Thalassia Metra (30.750 l)

<table>
<thead>
<tr>
<th>No.</th>
<th>Tare Wgt.</th>
<th>Max. Capacity</th>
<th>% Max. Capacity</th>
<th>Wgt. of White Wine</th>
<th>Theoretical Gross Wgt.</th>
<th>Logarikai Litrai</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>13.02</td>
<td>32.550</td>
<td>94.5</td>
<td>28.80</td>
<td>41.82</td>
<td>130.7</td>
</tr>
<tr>
<td>31</td>
<td>15.73</td>
<td>34.252</td>
<td>89.8</td>
<td>&quot;</td>
<td>44.53</td>
<td>139.2</td>
</tr>
<tr>
<td>33</td>
<td>13.88</td>
<td>35.568</td>
<td>86.5</td>
<td>&quot;</td>
<td>42.68</td>
<td>133.4</td>
</tr>
</tbody>
</table>
Despite some uncertainty about the exact original weight of the amphorases, and in some instances even their intended capacity, an overall pattern emerges that permits some important general conclusions to be made about the Class 1 and 2 amphorases. It is quite remarkable how clear the pattern is, especially when one keeps in mind that these amphorases are a random collection that is diverse in terms of both source and chronology.

Their apparent capacities suggest that most of the Class 1 and 2 amphorases had been made to carry wine, but some may have been made to carry grain or other dry goods as their initial contents. There seems to be little doubt that the wine amphorases were manufactured to carry either fractions or multiples of either the monasterikon metron or the thalassion metron; the grain amphorases, fractions or multiples of the modios tripinakion. Furthermore, a controlled interrelationship between the capacities and weights of the amphorases is readily apparent; there is a well-ordered progression of capacities and weights. In the case of the wine amphorases, each increment in capacity is accompanied by an increase of 10 logarikai litrai in gross weight. The 1/2 monasterikon metron amphora has a gross weight of 20 litrai; the 1/2 thalassion metron amphora, 30 litrai; the 1 monasterikon metron amphora, 40 litrai; the 1 thalassion metron, 50 litrai; and so on. It is noteworthy that every 1/2 metron increase in either the
monasterikon or metron system is accompanied by an increase of 20 litrai in gross weight and that every 1/2 modios tripinakion increase in the capacity of grain amphoras appears also to have been accompanied by an increase of 20 litrai in weight. In the case of fractions of 1 modios tripinakion, however, the system appears to have been modified: amphoras with a capacity of 2/3 modios tripinakion (2 pinakia) had a gross weight that was 10 litrai less than that of amphoras with a capacity of 1 modios tripinakion.

In order for such a system to work, the potter would have had to use the same weight of clay for the amphoras of each size: 16 litrai of clay (5.33 kg.) for 1 monasterikon metron amphoras, 20 litrai of clay (6.40 kg.) for 1 thalassion metron amphoras, etc. This does not necessarily imply that the potter actually weighed the clay with a steelyard or the like. A close estimation of weight by hefting the clay may have been deemed sufficient.

Due to the fact that only one of the Class 3 amphoras is reasonably intact, we cannot determine whether there was a similar relationship between capacity and weight in their case. However, their capacity sizes seem to support the generally held belief that they were designed to carry wine, if, that is, we suppose that here again the amphoras were normally filled to the level of transition between
shoulder and neck. When filled to this level, they would be somewhere between 85 and 95 percent full; the larger the amphora, the higher this percentage figure would tend to be. If Amphora 34 (Size A) were filled with 1 monasterikon metron of white wine, it would be 82.2 percent full, or under full. However, if the amphora's capacity had been only 4 percent less, the wine would have attained an acceptable level. If Amphora 38 (Size B) were filled with 1 thalassion metron of white wine, it would be 86.9 percent full. If Amphoras 37, 39 and 41 (Size C) were filled with 1 1/2 monasterika metra, they would be 89.4, 90.8 and 93.0 percent full respectively. If Amphoras 35 and 36 (Size D) were filled with 1 1/2 thalassia metra, the former would be 96.5 percent full, while the latter would have overflowed slightly, its capacity being just under 5 percent less than the former's. It would appear, then, that of the seven Class 3 amphoras whose capacities are known, five would have served well as standard Byzantine wine containers, while the other two have capacities that may have been only slightly off the mark.
AMPHORA EFFICIENCY

An efficient amphora is one that has walls thick enough to protect its contents over a long and sometimes hazardous journey, yet not so thick that the cost of transporting the vessel unnecessarily reduces the profits from the sale of its contents.

Amphora efficiency (liters of capacity per kilogram of the vessel's weight) is a potentially useful economic indicator, because when an economy is flourishing, there is generally less concern with cost-cutting shipping containers. For example, Roman wine amphoras, such as Dressel 1-4, have a low efficiency (Table 15). However, amphoras that were made to carry olive oil are usually very efficient vessels, at least in part because olive oil was not as luxurious a commodity as wine. Therefore, when a relatively expensive product like a quality wine was shipped in efficient amphoras, such as vessel types normally utilized to carry olive oil, it might be a sign that the economy was suffering.

The globular amphoras from the 7th-century shipwreck at Yassi Ada may be an interesting illustration of this (Table 15). These amphoras were very efficient vessels that at one time carried olive oil or olive products but contained wine on their final voyage, a voyage that took place during what is considered to be an economically
difficult period in the Byzantine Empire. It is possible, however, that the wine was of a low quality, since considerable numbers of grape pips were found in the amphoras.245

Table 15: Efficiencies of Some Roman and Byzantine Amphoras

<table>
<thead>
<tr>
<th>AMPHORA TYPE</th>
<th>PRINCIPAL CONTENT246</th>
<th>AVERAGE LITERS PER KILOGRAM247</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dressel 1B</td>
<td>Wine</td>
<td>0.88</td>
</tr>
<tr>
<td>Dressel 2-4</td>
<td>Wine</td>
<td>1.68</td>
</tr>
<tr>
<td>Haltern 70</td>
<td>Defructum</td>
<td>1.67</td>
</tr>
<tr>
<td>Dressel 20</td>
<td>Olive Oil</td>
<td>2.21</td>
</tr>
<tr>
<td>Africana Grande</td>
<td>Olive Oil</td>
<td>3.52</td>
</tr>
<tr>
<td>Tripolitanian</td>
<td>Olive Oil</td>
<td>3.56</td>
</tr>
<tr>
<td>Yassi Ada Hourglass</td>
<td>?</td>
<td>1.91</td>
</tr>
<tr>
<td>Yassi Ada Large Globular</td>
<td>Olive Oil</td>
<td>3.37</td>
</tr>
<tr>
<td>Yassi Ada Small Globular</td>
<td>Olive Oil</td>
<td>3.25</td>
</tr>
</tbody>
</table>

The efficiency of an amphora is also a potential indicator of the purpose for which the vessel was manufactured. For example, ancient aged wines were extremely heat-sensitive, because they were not pasteurized like today's wines.248 It was important that the wine be stored at a low temperature in order to retard the growth of bacteria which would spoil the wine; and thick-walled amphorae would maintain a cooler temperature
than those with thin walls. As a result, aged wines were presumably never stored in skins. In fact, after amphoras fell into disuse and wine came to be stored in wooden barrels, where a lack of air-tightness might have been a more important factor than an ability to keep the wine cool, the practice of aging wine was also discontinued and did not resume significantly before the 18th century, when glass bottles and cork stoppers made it again possible. This sensitivity of aged wines might explain why amphoras were still in use when more economical containers, such as skins, were available. Much less care would have been needed to store and transport either new or inexpensive wines.

As we have seen, the Class 1 through 3 amphoras in this study appear to have served primarily as wine jars. As further evidence of this, we might note that amphoras similar to my Class 1 vessels found on the 11th-century shipwreck at Serçe Limani were probably carrying wine, as were amphoras similar to my Class 3 vessels on the shipwreck near Tartous, Syria. Two of the Class 2 amphoras in the study have traces of pitch on their inside walls, suggesting that they too were wine-carrying vessels.

The efficiencies of more or less complete Class 1-2 amphoras are shown in Table 16. Maximum capacity has been used in calculating amphora efficiency, and the amphoras
Table 16: Efficiencies of Class 1-2 Amphoras

<table>
<thead>
<tr>
<th>NO.</th>
<th>VOLUME</th>
<th>WEIGHT</th>
<th>LITERS PER KILOGRAM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CLASS 1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>4.765</td>
<td>2.92</td>
<td>1.632</td>
</tr>
<tr>
<td>11.</td>
<td>6.345</td>
<td>5.30</td>
<td>1.197</td>
</tr>
<tr>
<td>18.</td>
<td>6.500</td>
<td>5.18</td>
<td>1.255</td>
</tr>
<tr>
<td>17.</td>
<td>9.955</td>
<td>5.74</td>
<td>1.734</td>
</tr>
<tr>
<td>16.</td>
<td>10.030</td>
<td>5.48</td>
<td>1.830</td>
</tr>
<tr>
<td>21.</td>
<td>10.115</td>
<td>6.12</td>
<td>1.653</td>
</tr>
<tr>
<td>14.</td>
<td>10.140</td>
<td>7.16</td>
<td>1.416</td>
</tr>
<tr>
<td>6.</td>
<td>11.507</td>
<td>6.80</td>
<td>1.692</td>
</tr>
<tr>
<td>3.</td>
<td>11.772</td>
<td>5.65</td>
<td>2.084</td>
</tr>
<tr>
<td>15.</td>
<td>11.875</td>
<td>6.86</td>
<td>1.731</td>
</tr>
<tr>
<td>7.</td>
<td>12.132</td>
<td>6.65</td>
<td>1.824</td>
</tr>
<tr>
<td>22.</td>
<td>12.355</td>
<td>7.46</td>
<td>1.656</td>
</tr>
<tr>
<td>1.</td>
<td>12.457</td>
<td>6.83</td>
<td>1.824</td>
</tr>
<tr>
<td>8.</td>
<td>13.243</td>
<td>6.22</td>
<td>2.129</td>
</tr>
<tr>
<td>12.</td>
<td>14.365</td>
<td>6.16</td>
<td>2.332</td>
</tr>
<tr>
<td>19.</td>
<td>17.070</td>
<td>8.50</td>
<td>2.008</td>
</tr>
<tr>
<td><strong>CLASS 2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30.</td>
<td>17.787</td>
<td>8.09</td>
<td>2.199</td>
</tr>
<tr>
<td>26.</td>
<td>20.475</td>
<td>8.65</td>
<td>2.367</td>
</tr>
<tr>
<td>28.</td>
<td>21.710</td>
<td>10.12</td>
<td>2.145</td>
</tr>
<tr>
<td>32.</td>
<td>22.945</td>
<td>10.70</td>
<td>2.144</td>
</tr>
<tr>
<td>25.</td>
<td>23.410</td>
<td>10.00</td>
<td>2.341</td>
</tr>
<tr>
<td>24.</td>
<td>32.550</td>
<td>13.02</td>
<td>2.500</td>
</tr>
<tr>
<td>31.</td>
<td>34.252</td>
<td>15.73</td>
<td>2.177</td>
</tr>
<tr>
<td>33.</td>
<td>35.568</td>
<td>13.80</td>
<td>2.563</td>
</tr>
</tbody>
</table>

have been listed in order of increasing capacity. It will be noticed that there is an irregular but unmistakable trend toward a higher efficiency as capacity increases and that the largest Class 1 and smallest Class 2 amphoras have the same general level of efficiency. Although the lowest efficiency in Table 15 is 1.2, all but three of the amphoras have efficiencies ranging from 1.6 to 2.5. Thus,
generally speaking, these amphoras have just a slightly higher efficiency than do the Dressel 2-4 and Haltern 70 amphora types. I think this may reflect the relatively high but declining level of prosperity in the Byzantine Empire during the general period in which they were used. There was a downturn in the economy after the death of Basil II (976-1025 A.C.). Under Constantine IX Monomachus (1042-1055) the Byzantine nomisma was debased for the first time, and under Michael VII Ducas (1071-1078) "prices had risen so high that a nomisma would no longer purchase a whole medimnus of wheat, but only a medimnus minus a quarter."  

It is clear that the Class 3 amphoras generally had a significantly lower efficiency than did the Class 1-2 amphoras (Table 17). Unfortunately the weight of the only complete Class 3 amphora in the study is not available to me, while the other amphoras belonging to this class with more or less complete bodies have either one or both of their very large handles missing. Nevertheless, Table 17 shows that the smallest of these vessels, Amphora 34, has an efficiency of only 1.408, even with one handle missing, while the largest, Amphora 35, has an efficiency of 2.069, again with one handle missing.  

In view of the fact that these amphoras date mainly to the 12th and 13th centuries, it is tempting to suggest that the low efficiency of these amphoras may somehow be
connected with the then rising level of trade, particularly with the Italian maritime republics. The favorable trade agreements with Byzantium and her close ties with the Crusader states made Venice a major economic power in the Mediterranean at this time. On the other hand, the presence of Class 3 amphoras in the Northern Black Sea area was until the 13th century the result of Byzantine trade with its northern neighbors. In a treaty made between the Genoese and the Byzantines in 1169, however, Genoa was to have unlimited access to all the ports of Byzantium, with the exception of Rossia and Matracha (Tmutarakhan), which were reserved for Byzantine traders only.\textsuperscript{254} Trade with the North was so lucrative - the primary commodity there was an abundant supply of fish - that the Byzantines were willing to protect it for themselves.\textsuperscript{255} After 1204 the Latins traded extensively with the peoples of the Northern Black Sea area.

Table 17: Efficiencies of Class 3 Amphoras

<table>
<thead>
<tr>
<th>NO.</th>
<th>VOLUME</th>
<th>WEIGHT</th>
<th>LITERS PER KILOGRAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>34.</td>
<td>9.970</td>
<td>7.08+</td>
<td>&lt;1.408</td>
</tr>
<tr>
<td>38.</td>
<td>11.802</td>
<td>7.84+</td>
<td>&lt;1.505</td>
</tr>
<tr>
<td>41.</td>
<td>13.283</td>
<td>8.84+</td>
<td>&lt;1.503</td>
</tr>
<tr>
<td>37.</td>
<td>13.752</td>
<td>7.93+</td>
<td>&lt;1.734</td>
</tr>
<tr>
<td>36.</td>
<td>15.213</td>
<td>8.39+</td>
<td>&lt;1.813</td>
</tr>
<tr>
<td>35.</td>
<td>15.935</td>
<td>7.70+</td>
<td>&lt;2.069</td>
</tr>
</tbody>
</table>
The lower efficiency of the Class 3 amphoras was primarily due to their large, high-rising handles. On the ship carrying approximately 5,000 of these amphoras that sank off Tartous, Syria, the amphoras were stacked at least four layers deep with their handles carefully aligned in rows athwartships. This arrangement suggests that these amphoras were very probably designed for mass transport on large ships, as were the Dressel 1-4 amphoras of an earlier age.

Amphoras, like all man-made objects, are a reflection of the time in which they were made and used. Studying their efficiency is a worthwhile task, because at some point there was a conscious decision made to manufacture the amphora in its final form, and this decision was a function of numerous influences. We have touched on three factors influencing efficiency: the economy, vessel purpose, and methods of transport. There were others as well, such as cultural constraints and the limitations of the materials used. The study of amphora efficiencies may also help us to understand why one amphora type was preferred over another, and why changes in amphora shapes came about.

The speculations presented above are meant to be thought provoking and hypothetical in nature; much more work needs to be done to expand our knowledge of the factors influencing potters in the production of amphoras.
REUSE

Throughout their history, amphoras depleted of their contents have been reused in various ways: as storage containers, construction material, and even portable latrines. There is, however, little evidence for their reuse as transport jars until the Byzantine period, or to be more precise, the 7th century.

A study of the amphoras on the 7th-century shipwreck at Yassi Ada, Turkey, has revealed that they had seen earlier use. Graffiti on them indicate a great number of earlier owners, while archeobotanical remains within them suggest a variety of contents within the recent use-life of the vessels.257

While graffiti and archeobotanical research may give us clues regarding a history of earlier use, the amphoras from the 11th-century shipwreck at Serçe Limani, Turkey, exhibit yet another indication of reuse. When the rims or handles of the amphoras were broken, the owners carved down the points of breakage to minimize further damage to broken edges, thus prolonging the use-life of the vessel.258

The same sort of damage control is also found on many of the amphoras of this study group. Thirty-seven (63%) of the amphoras have significantly damaged or missing rims or handles; of these, 11 amphoras exhibit evidence that broken edges were subsequently carved down. In these instances,
rim damage, where it occurs, is restricted to the two quadrants that are between the handles, unless, of course, one or both of the handles had been broken off along with part of the rim.

In two cases (Amphoras 25, and 30), there was exterior rim damage, and the chipped area was meticulously smoothed down through carving. Such damage would have tended to have occurred between the handles, since the latter afford the part of the rim where they are attached greater strength and considerable protection.

In four cases (Amphoras 1, 4, 8, 19), the damage either certainly or quite possibly had occurred primarily to the interior of the rim, and the chipped or broken rim, and sometimes even part of the neck, was carved down into a concave profile.259 Amphora 30 gives us a possible explanation for this type of damage and its location between the handles; several vertical scoremarks inside the mouth of this vessel are evidently the result of someone prying open the stoppered amphora, perhaps while holding on to one handle.260 A recent exercise in experimental archaeology involving "bag-shaped" Byzantine amphoras from Caesarea, Israel, revealed that it can be a "very tedious task" to pry open a stoppered amphora without doing damage to the amphora itself.261

The sharp edges of handle breaks were also intentionally rounded off to avoid further breakage.
(Amphoras 20, 22, 24, and 34). The handle breaking off Amphora 48 also damaged most of the rim and neck, which were then smoothed down, changing the amphora's appearance into that of a pitcher.

In the medieval economy, clearly the container was almost as valued as its contents, and great care was given to maintain the amphoras in good condition. But why were these vessels being reused?

As mentioned above, the first example that we have of reuse are the amphoras from the 7th-century Byzantine shipwreck at Yassi Ada. When this ship sank the Byzantine Empire had been undergoing a prolonged period of economic decline, so it is not surprising to see cost-cutting measures, such as the reuse of amphoras, being implemented. However, why do amphoras from the 10th and early 11th centuries exhibit these same signs of reuse, when the empire was experiencing one of its most economically prosperous times ever?²⁶²

Two hypotheses to explain this phenomenon come to mind. One of them is rather simple: the Byzantines acquired the habit of amphora reuse during an economically difficult period and simply continued the custom even after the economy improved. The other hypothesis, suggested by van Doorninck, is that there was a scarcity of amphoras during this time, possibly because of their replacement by skins as the principle shipping container.²⁶³
The Geniza documents indicate that animal skins were the preferred shipping container in Fatimid commerce. There is a good reason for this; skins have the advantage over a clay container in their lightness. An amphora of this same period might weigh 39-83% of the weight of its contents when filled with wine. Perhaps a growing shortage of wood near traditional potters' centers tended to make amphoras more expensive and thus also contributed to a growing scarcity.

If skins were so much more efficient, why were amphoras still being used as transport containers? There may have been several factors involved here. One factor would simply be the inertia of tradition. This would explain why amphoras were more extensively used in the Byzantine, as opposed to the Arab, world. Secondly, the employment of reused amphoras rather than skins may have made economic sense when trade on a modest scale was involved. Goitein observes that it was in large-scale overseas trade that skins were preferred over ceramic containers. Finally, amphoras may have been preferred for higher quality wines (see section on amphora efficiency).
GRAFFITI AND STAMPS

Forty-seven marks (40 graffiti and 7 stamps) have been found on a total of 22 (37%) of the amphoras; these amphoras are restricted to Classes 1 through 3 and 8. Five out of the 16 amphoras in Class 1, Type 1 have marks (Table 18); four out of the seven in Class 1, Type 2 (Table 19); eight out of the ten in Class 2 (Table 20); four out of the eight in Class 3 (Table 21); and one out of the two in Class 8 (Table 22). Seven of the amphoras have more than one mark. Two of them (Amph 14 and 41) have two graffiti; two others (Amph 30 and 31), four graffiti; one (Amph 58), a stamp and two graffiti; one (Amph 24), a stamp and six graffiti; and one (Amph 33) a stamp and seven graffiti. It is noteworthy that four of the amphoras with more than one mark belong to Class 2 and that 62% of all the marks occur on amphoras of this Class.

With the exception of two graffiti on handles (Marks 39 and 45) and two graffiti (Marks 43 and 44) on opposite sides of the neck of a Class 3 amphora, all marks are located on the shoulder area.

Since these amphoras are for the most part isolated finds, made by spongers or sport divers, we can assume that they had been in a more or less exposed position on the seabed. This is also indicated by the fact that they tend
Table 18: Graffiti on Class 1, Type 1 Amphoras

<table>
<thead>
<tr>
<th>No.</th>
<th>Fig.</th>
<th>Amph No.</th>
<th>Type</th>
<th>Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>2.</td>
<td>1.</td>
<td>enigmatic</td>
<td>☑</td>
</tr>
<tr>
<td>2.</td>
<td>7.</td>
<td>6.</td>
<td>stamp</td>
<td>☐</td>
</tr>
<tr>
<td>3.</td>
<td>8.</td>
<td>7.</td>
<td>symbolic</td>
<td>←</td>
</tr>
<tr>
<td>4.</td>
<td>9.</td>
<td>12.</td>
<td>multiple</td>
<td>\H</td>
</tr>
<tr>
<td>5.</td>
<td>11.</td>
<td>14.</td>
<td>multiple</td>
<td>K XXX</td>
</tr>
<tr>
<td>6.</td>
<td>11.</td>
<td>14.</td>
<td>multiple</td>
<td>K O U</td>
</tr>
</tbody>
</table>

Table 19: Graffiti on Class 1, Type 2 Amphoras

<table>
<thead>
<tr>
<th>No.</th>
<th>Fig.</th>
<th>Amph No.</th>
<th>Type</th>
<th>Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.</td>
<td>14.</td>
<td>18.</td>
<td>multiple</td>
<td>K M K</td>
</tr>
<tr>
<td>8.</td>
<td>15.</td>
<td>19.</td>
<td>stamp</td>
<td>KOST</td>
</tr>
<tr>
<td>9.</td>
<td>17.</td>
<td>20.</td>
<td>single letter</td>
<td>M (X)</td>
</tr>
<tr>
<td>10.</td>
<td>18.</td>
<td>22.</td>
<td>stamp</td>
<td>☐</td>
</tr>
<tr>
<td>No.</td>
<td>Fig.</td>
<td>Amph No.</td>
<td>Type</td>
<td>Key</td>
</tr>
<tr>
<td>-----</td>
<td>------</td>
<td>----------</td>
<td>----------------</td>
<td>-----</td>
</tr>
<tr>
<td>11</td>
<td>20.</td>
<td>24.</td>
<td>stamp</td>
<td>222</td>
</tr>
<tr>
<td>12</td>
<td>20.</td>
<td>24.</td>
<td>single letter</td>
<td>X T</td>
</tr>
<tr>
<td>13</td>
<td>21.</td>
<td>24.</td>
<td>single letter</td>
<td>8</td>
</tr>
<tr>
<td>14</td>
<td>21.</td>
<td>24.</td>
<td>multiple</td>
<td>B A P</td>
</tr>
<tr>
<td>15</td>
<td>21.</td>
<td>24.</td>
<td>multiple</td>
<td>D N</td>
</tr>
<tr>
<td>16</td>
<td>22.</td>
<td>24.</td>
<td>enigmatic</td>
<td>( )</td>
</tr>
<tr>
<td>17</td>
<td>22.</td>
<td>24.</td>
<td>single letter</td>
<td>( )</td>
</tr>
<tr>
<td>18</td>
<td>24.</td>
<td>26.</td>
<td>multiple</td>
<td>A H ( \phi ) ( \mu )</td>
</tr>
<tr>
<td>19</td>
<td>26.</td>
<td>27.</td>
<td>single letter</td>
<td>E ?</td>
</tr>
<tr>
<td>20</td>
<td>27.</td>
<td>28.</td>
<td>stamp</td>
<td>( )</td>
</tr>
<tr>
<td>21</td>
<td>28.</td>
<td>29.</td>
<td>single letter</td>
<td>A or A</td>
</tr>
<tr>
<td>22</td>
<td>29.</td>
<td>30.</td>
<td>multiple unrelated</td>
<td>X ( \Delta ) ( \Delta ) or X B</td>
</tr>
<tr>
<td>24</td>
<td>29.</td>
<td>30.</td>
<td>enigmatic</td>
<td>( )</td>
</tr>
<tr>
<td>25</td>
<td>29.</td>
<td>30.</td>
<td>enigmatic</td>
<td>( )</td>
</tr>
<tr>
<td>26</td>
<td>29.</td>
<td>30.</td>
<td>enigmatic</td>
<td>( )</td>
</tr>
<tr>
<td>27</td>
<td>30.</td>
<td>31.</td>
<td>enigmatic</td>
<td>( )</td>
</tr>
<tr>
<td>28</td>
<td>30.</td>
<td>31.</td>
<td>single letter</td>
<td>( )</td>
</tr>
<tr>
<td>29</td>
<td>30.</td>
<td>31.</td>
<td>single letter</td>
<td>( )</td>
</tr>
<tr>
<td>30</td>
<td>30.</td>
<td>31.</td>
<td>enigmatic</td>
<td>( )</td>
</tr>
<tr>
<td>31</td>
<td>31.</td>
<td>33.</td>
<td>stamp</td>
<td>( )</td>
</tr>
<tr>
<td>32</td>
<td>31.</td>
<td>33.</td>
<td>single letter</td>
<td>X</td>
</tr>
<tr>
<td>33</td>
<td>31.</td>
<td>33.</td>
<td>single letter</td>
<td>X</td>
</tr>
<tr>
<td>34</td>
<td>32.</td>
<td>33.</td>
<td>enigmatic</td>
<td>( )</td>
</tr>
<tr>
<td>35</td>
<td>32.</td>
<td>33.</td>
<td>multiple unrelated</td>
<td>( )</td>
</tr>
<tr>
<td>37</td>
<td>32.</td>
<td>33.</td>
<td>multiple</td>
<td>A X X</td>
</tr>
<tr>
<td>38</td>
<td>32.</td>
<td>33.</td>
<td>single letter</td>
<td>B</td>
</tr>
<tr>
<td>39</td>
<td>32.</td>
<td>33.</td>
<td>enigmatic</td>
<td>( )</td>
</tr>
</tbody>
</table>
Table 21: Graffiti on Class 3 Amphoras

<table>
<thead>
<tr>
<th>No.</th>
<th>Fig.</th>
<th>Amph No.</th>
<th>Type</th>
<th>Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>40.</td>
<td>34.</td>
<td>35.</td>
<td>enigmatic</td>
<td>$\uparrow$</td>
</tr>
<tr>
<td>41.</td>
<td>36.</td>
<td>37.</td>
<td>single letter</td>
<td>X</td>
</tr>
<tr>
<td>42.</td>
<td>38.</td>
<td>39.</td>
<td>multiple</td>
<td>M M or M M X</td>
</tr>
<tr>
<td>43.</td>
<td>41.</td>
<td>41.</td>
<td>multiple</td>
<td>N A</td>
</tr>
<tr>
<td>44.</td>
<td>41.</td>
<td>41.</td>
<td>multiple</td>
<td>? A</td>
</tr>
</tbody>
</table>

Table 22: Graffiti on Class 8 Amphoras

<table>
<thead>
<tr>
<th>No.</th>
<th>Fig.</th>
<th>Amph No.</th>
<th>Type</th>
<th>Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>45.</td>
<td>56.</td>
<td>58.</td>
<td>symbolic</td>
<td>$-$</td>
</tr>
<tr>
<td>46.</td>
<td>56.</td>
<td>58.</td>
<td>multiple</td>
<td>K ? T phi X</td>
</tr>
<tr>
<td>47.</td>
<td>56.</td>
<td>58.</td>
<td>stamp</td>
<td>$*$</td>
</tr>
</tbody>
</table>

to be relatively well eroded. As a result, the graffiti themselves are in most cases so eroded that it is impossible to tell if they were made before or after firing. In addition to the seven stamps, possibly five of the graffiti were made before firing, three of them on vessels with multiple graffiti. Thus, about one-quarter of all the marks were made before firing.

It is important to keep in mind that it is quite likely that there had been painted marks or inscriptions (dipinti) on some of the amphoras. At Constantinople in the Palace of Basil I, where amphoras similar to those of
Classes 1 and 8 were found, 76% of all marks were painted.⁶⁶⁸

The graffiti may be divided into two distinct groups: single-mark graffiti and multiple-mark graffiti. Twenty-three, or slightly over half, of the graffiti are single, isolated marks. Twelve of these marks are in alphabetic form. Eight of them (Marks 9, 17, 21, 28, 29, 38 and 41) correspond to letters in the Greek and Cyrillic alphabets; and three (Marks 12, 13 and 33), to letters in the Cyrillic alphabet. These letter-like marks probably represent either the first letter of a name or a number indicating the capacity of the vessel. In one case, the same letter-like mark was written on opposite sides of the vessel. Two of the marks (Marks 3 and 45) take the form of a symbol representing an arrow. The ten remaining marks (Marks 1, 16, 24, 25, 26, 27, 30, 34, 39 and 40) are enigmatic designs. Most consist of a diagonal or horizontal line crossing two or more parallel lines; three of them (Mark 1, 30 and 40) might conceivably be representations of the letter H.

The graffiti in the multiple-mark group consists of 14 inscriptions; they can be divided into two subgroups. In the first subgroup (Marks 22, 23 and 35, 36), one or more marks were added to a mark made at some earlier moment in time.⁶⁶⁹ In the second subgroup (Marks 4, 5, 6, 7, 14, 15, 18, 37, 42, 43, 44 and 46), all of the marks in the
inscription were made at the same time; they probably represent abbreviations of personal names. In one case, the same inscription was written on opposite sides of the vessel.

The seven stamps constitute 15% of all the markings. Four of them (Marks 2, 10, 31 and 47), in the form of a rosette with from four to eight petals, are undoubtedly potter's marks. The remaining three (Marks 8, 11, 20) have multiple letters.

One of the latter stamps (Mark 8), on a Class 1, Type 2 vessel, is clearly the monogram of the Byzantine Emperor Constantine Porphyrogenitus VII (905-5), as has been shown by A. Kibushev. While amphoras stamped with his monogram have been found over a widespread geographical area, this fact hardly constitutes evidence, as some have maintained, for an extensive control of trade by the Byzantine government. Byzantine amphoras with stamps, much less ones bearing an imperial monogram, are too few in number to reflect an imperial system of trade control. It is more likely that amphoras bearing an imperial monogram and their contents were part of the imperial stores and became distributed widely within the Empire and beyond as allocations and gifts to imperial officials and foreign ambassadors. Controller's marks, if present, might have been painted on the vessels or stamped in some manner into the substance used to seal stoppers.
One of the lettered stamps (Mark 20) is in Arabic; another (Mark 11) may be in Arabic. This is to my knowledge the only example of Arabic stamps on Byzantine amphoras that have been published to date. Unfortunately, the stamps have not as yet been examined by anyone with sufficient knowledge to translate or interpret them properly. The amphoras (Amph 24 and 28) that bear the stamps are Class 2 amphoras dating to the 11th-12th centuries. This was a time when the Arab influence was weakening in the Mediterranean, but the presence of numerous Class 2 amphoras at Fustat, Egypt, suggests that such amphoras were well known in at least part of the Arab world. We also know that Arab merchants often enjoyed special trading advantages in Constantinople, and Syrian merchants in particular had the unique privilege of being able to make the Byzantine capital their home. One might suppose that the two amphoras with the Arabic stamps are Arab imitations of Class 2 amphoras. However, the fabrics of the two amphoras do not appear to differ significantly from that of the other Class 2 amphoras in the study group. Perhaps the amphoras were made within the Byzantine Empire, but expressly for Byzantine-Arab trade.

The interpretation of even a letter-like mark can often be problematic. The mark Μ, for example, is a letter in the Greek, Cyrillic, Runic (both Scandinavian and Turkic), and even Glagolitic alphabets, all used by
peoples who engaged in commerce with the Byzantine empire. One of the problematic marks in the study group is $\chi$, present twice on a Class 2 amphora (Amph 33). It occurs once alone and once with two other characters, one of which is a lambda or a lambda-like letter. When standing alone, this mark can be nothing more than an abstract, symbolic design. In the present instance, however, it seems clear that it is a letter, conceivably a Greek chi-iota combination, but probably the Cyrillic letter $X$. Thus it is a distinct possibility that one of the vessel's owners was a Slav.

Another mark that initially presented some uncertainty is the one that resembles an $X$ with a $T$ between its upper crossbars, scratched twice on a Class 2 amphora (Amph 24). One possibility considered was that the mark represented a combination of the Greek letters chi and tau, but I was not able to find any epigraphical examples of such a combination. The mark does occur, however, as an early form of the letter $X$ in the Bulgarian Cyrillic alphabet; two examples occur in Old Bulgarian inscriptions at Murfatlar, Romania.274 If the marks on Amphora 24 are indeed an Old Bulgarian letter, this will be the only amphora yet published with Arabic, Greek and Bulgarian letters impressed and inscribed upon it.
CONCLUDING REMARKS

One of the more striking aspects of a study of Byzantine amphoras from this period is the preponderance of parallels in the Black Sea region and their relative paucity in the Mediterranean world. In part, this is undoubtedly a result of the greater amount of archaeological research that has been devoted to the period in the Black Sea region than has generally been the case in the Mediterranean. However, it may also be a reflection of the relative importance of Black Sea and Mediterranean markets for Byzantine merchants, who offered far greater resistance to the competition of foreign merchants in the former than in the latter area during our period and later.

We see an evident standardization of amphora shapes during the period from the late 9th to the 13th century, especially when compared to the incredible variety of forms present in the 8th to 9th centuries (see Class 4 amphoras), a phenomenon well documented by Yakobson in the Crimea.275 It is impossible to say at present what effect, if any, this standardization of shape had on a standardization of sizes, such as that exhibited by the Class 1-3 amphoras in this study.

Various aspects of this study suggest that while amphoras were becoming increasingly rare, and owners were having to maintain their amphoras in good condition by
smoothing down any chips and breaks, they were also having to reuse the vessels again and again as the jars became transferred from owner to owner, and the variety of stamps and graffiti proves that this was on an international scale. This study also suggests that there were many factors influencing the design of a particular type of vessel; a booming economy, where price was no object, or the necessity of storing quality wine at cool temperatures might influence the thickness of the vessel's walls, thereby making a vessel less efficient. Conversely, a depressed economy or the amphora's intended use for transport of low-quality products might have influenced potters to make more efficient vessels.

Much of what has been stated here is conjecture based on facts gleaned through a study of unprovenanced vessels. I hope that my colleagues will consider the material that is presented here as a thought provoking challenge, one to be either confirmed or refuted on the basis of further study.
NOTES


9. A.M. Scherbak, "Znaki na keramike i kirpichakh iz Sarkela Beloy-Vezhe," *MIA* 75 (Moscow 1959) pl. IV.


11. Demangel and Mamboury (supra n. 6) figs. 201:49, 52.
12. S.A. Pletneva, "Keramika Sarkela - Beloy-Kezhi," MIA 75 (1959) 244, fig. 30; Keramika 74, figs. 44:14, 14a; A.L. Yakobson, Rannesrednevekovie Khersones (MIA 63, Moscow-Leningrad 1959) fig. 170:11; Yakobson (infra n. 40) fig. 7:9.

13. Amforele figs. 1:2, 9; Barnea (supra n. 10) figs. 154:3, 4, 7; T. Barnea, "La céramique byzantine de Dobroudja, Xe-XIIe siècles," BCH-Suppl. 18 (1989) fig. 2; Barnea and Ștefanescu (supra n. 10) figs. 86:3, 4, 7; Popescu (infra n. 17) 271, no. 259.


15. A.I. Kubeshev, "Khronologiya odnovo tipu amphor chasu kiev's'koy rusi," Arheologiya 6 (Kiev 1972) fig. 4:1.


17. E. Popescu, Inscriptiile grecesti si latine din secolele IV-XII descoperite in Romania (Bucharest 1976) 269; Amforele fig. 5:5; Barnea and Ștefanescu (supra n. 10) fig. 87:7.

18. On an amphora fragment dated to the 2nd-1st centuries B.C.: E.I. Solomonik, Graffiti s khori Khersonesa (Kiev 1984); 76, pl. XXXIV.

19. Scherbak (supra n. 9) pl. VII.


23. Demangel and Mamboury (supra n. 6) fig. 201:57.


Shipwrecks: Two Examples of a Reuse of Byzantine Amphoras as Transport Jars," ECH-Suppl. 18 (1989) fig. 3:27.

26. The only exceptions being: Doncheva-Petkova (supra n. 14) 98-102; Changova (supra n. 14) 249-51. Frequently, an illustration of a Type 1 is shown, but the text describes a Type 2, as in B. Alekssova, "Srednevekovna keramika od tsrkvata sveta Sophija vo Ohrid," Glasnik na institutot za nacionalna istorija 4 (Skopje 1960) 202-204, pl. 1:1.

27. In Sarkel, Types 1 and 2 (Pletneva's Type 3) were manufactured from three different pastes, only one of which is considered as imported. Of the three paste types cited, the amphoras of this study group are closest to Pletneva's paste type No. 4: S.A. Pletneva, "Srednevekovaya keramika Tamanskovo gorodischa," in B.A. Ribakov ed., Keramika i steklo: Drevnie Tmutarakani (Moscow 1963) 49-50, fig. 32.

28. Type 1 amphoras with a yellow fabric are described by: Alekssova (supra n. 26) 202; G.D. Belov and A.L. Yakobson, "Kvartal XVII (raskopki 1949 g.)," MIA 34 (1953) 127; Kubishev (supra n. 15) 56; D. Ovcharov, "Raskopki i prouchavaniya na iztochnata stena na vtreshni grad v Preslav (1970-1976)," in D. Anselov et al. eds., Pliska-Preslav 4 (1985) 151; and Pletneva (supra n. 12) 244. I believe that this may be a question of their wash colors rather than fabric colors.

29. However, several authors propose that these amphoras were made in the coiling technique: Kubishev (supra n. 15) 56; B.A. Ribakov, "Remeslo," in N.N. Voronin et al. eds., Istoriya kulturi drevni Rusi I (Moscow 1948) 142.

30. Several authors suggest that these amphoras were made in two separate parts and then joined together. Unfortunately, their terminology is vague; they speak of the upper and lower parts, or the bottom and the upper part, leaving us to wonder if they mean the neck and body join or a lower and upper body join: Changova (supra n. 14) 250; Kubishev (supra n. 15) 56.


32. Narrow, early versions of the Type 1 amphoras were found in Constantinople, Cherson and Pliska. Stanchev believes that these archaic looking amphoras may be considered as earlier, dating towards the second half of the 9th century: S. Stanchev, "Materiali ot dvortsoviya tsentr v Pliska," JBAP 23 (1960) 60, fig. 10:B. An amphora from Constantinople has a very narrow body, with a height to
maximum diameter ratio of 1.35:1, and is dated to the late 9th century: Demangel and Mamboury (supra n. 6) fig. 198:4. Amphoras from Cherson also have narrower bodies, with height to maximum diameter ratios of approximately 1.49:1 and 1.66:1: Keramika figs. 43:3, 4.


34. Bass and van Doorninck (supra n. 4) 126, fig. 9; van Doorninck (supra n. 25) 253, fig. 4:1, 2.


36. Günsenin's Type 1 combines my Class 1 and Class 2 amphoras: N. Günsenin, "Recherches sur les amphores byzantines dans les musées turcs," BCH-Suppl. 18 (1989) 269-71, fig. 3.


40. Some of the Sarkel amphoras of this type have a yellow to light orange fabric and are considered to be imported; others have a coarse red fabric with traces of a grass or straw temper and are considered to be local: Pletneva (supra n. 12) 244, fig. 29:2-4; M.I. Artamonov, "Khazarskaya krepost Sarkel," ActaArchHung 7 (1956) 337-38, fig. 30; Keramika fig. 43:5; A.L. Yakobson, "Srednevekovie amfori severno Prichernomorya," SA 15 (1951) fig. 6:27.

41. A.L. Yakobson, "Goncharsie pech'i srednevekovo Chersonesa," KSIMK 10 (1941) 54; Yakobson (supra n. 8) 155, fig. 91; Yakobson (supra n. 40) 335, fig. 6:25, 26; Keramika 72-73, figs. 43:3, 4.

42. Keramika 73, n. 2, fig. 43:6.

44. V.L. Mits, Ukreplen'iya Tavriki X-XV vv. (Kiev 1991) 85-86, fig. 45:1.


46. I.A. Baranov, Tavriki v epohu rannevo Srednevekov'ya (saltavo-mavatskay kul'tura) (Kiev 1990) fig. 7:2.

47. Where one was found with a storehouse of 12th-century ceramics: Kubishev (supra n. 15) 56, fig. 1:4.

48. Stanchev (supra n. 32) 41 and 60, fig. 10:b; S. Mikhailov, "Arheologicheski materiali ot Pliska," IBAI 20 (1955) 92, fig. 36.

49. V. Ivanova, "Yuzhnata porta na Vutreshniya grad v Preslav, neiniyat gradesh i arhitekturen tip," IBAI 22 (1959) 151, fig. 21; Ovcharov (supra n. 28) 151, fig. 36; Doncheva-Petkova (supra n. 14) 193-94, pl. XXX:356.


52. Changova (supra n. 14) 251, n. 5; Zh. Vuzhvarova and D. Zlatarski, "Srednovekovno selische i nekropol i v gr. Dulgopol Varnenski okrug," Arheologiya 3 (Sophia 1969) 50, fig. 3:b.

53. At Tsar Asen: Changova (supra n. 14) 151; Doncheva-Petkova (supra n. 14) 193, fig. 30:355.

54. Amforela 513-18, fig. 1:1; Barnea (supra n. 10) 249-57, fig. 154:1; Barnea (supra n. 13) fig. 2.

56. Gr. Florescu and R. Florescu, "Şase tururile arheologice de la Capidava," MCA 6 (Bucharest 1959) 626, fig. V:7; Gr. Florescu, R. Florescu, and P. Diaconu, Capidava I (Bucharest 1958) 209.

57. Aleksova (supra n. 26) 202-205, fig. I:1.


62. Güsenin (supra n. 36) 269-71, figs. 2 and 4.

63. Demangel and Mamboury (supra n. 6) fig. 199. Some were also found in the excavations at Sarachane; they are Hayes' Type 54, intermediate group: Hayes (supra n. 33) 73, fig. 24:8.

64. Fifty examples were found of this type: van Doorninck (supra n. 25) 253, fig. 4:1.

65. Where they were found with Class 2 amphoras: Pulak (supra n. 5) 54-55, fig. 8.

66. M.I. Artamonov, "Belaya Vezhi," SA 16 (1952) 65, fig. 19; Artamonov (supra n. 40) 337-38, fig. 30; Pletneva (supra n. 12) 244, fig. 29:1; Pletneva (supra n. 27) figs. 31, 32.

67. Ribakov and Nikolaevna (supra n. 43) 286.
68. Changova (supra n. 50) 140, fig. 126:1; Changova (supra n. 14) 250, fig. 5; Doncheva-Petkova (supra n. 14) 101-102, 194, fig. 30:359, pl. XXX:358.

69. They were found at Kranevo (Changova [supra n. 14] 250; Doncheva-Petkova [supra n. 14] 194) and Duligopol (Doncheva-Petkova [supra n. 14] 194).

70. At Siliстра: Doncheva-Petkova (supra n. 14) 194; at Drustuv: Changova (supra n. 14) 250, n. 1.

71. Aleksova (supra n. 26) 202-204.

72. Demangel and Mamboury (supra n. 6) 39. However, these types mainly date to the 10th-11th centuries at Sarachane: Hayes (supra n. 33) 73-75.

73. Yakobson (supra n. 41) 54, n. 2; Yakobson (supra n. 8) 155; Yakobson (supra n. 40) 335; Keramika 71.

74. Keramika 73; Artamonov (supra n. 66) 65; Artamonov (supra n. 40) 337-38; Pletneva (supra n. 12) 224; Pletneva (supra n. 27) 67-68.

75. At Pliska they are dated by coins of John Tzinisces and seals from the end of the 10th century to the beginning of the 11th century. Several amphoras were also discovered in a habitation that was destroyed by fire in the year 927: Doncheva-Petkova (supra n. 14) 102. In Dinogetia-Garvan one amphora was found in a hut that was burned during the Petchneg invasions of 1036; these vessels are also dated by a coin of Michael IV the Paphlogonian (1034-1041): I. Barnea, "Noi descoperiri din epoca feudalismului timpuriu la Dinogetia-Garvăn, jud. Tulcea (1963-1968)," MCA 10 (1973) 330. In Aegyssus-Tulcea they are dated on the basis of a coin of Roman III (1028-1034): Vasiliiu and Mănucu-Adameșteanu (supra n. 55) 148.

76. The wreck is dated to the early 11th century by coins of Basil II (976-1025) and four Fatimid glass weights: Bass and van Doorninck (supra n. 4) 126; van Doorninck (supra n. 25) 253.

77. S. Stanchev, "Domashnata keramika ot Preslav," Razkopki i prouchnyanja 3 (Sophia 1949) figs. 17, 20.


80. Scherbak (supra n. 9) pl. II.


82. Popescu (supra n. 17) 269, No. 255; *Amforele* fig. 5:1; Barnea (supra n. 10) fig. 161:14.

83. Scherbak (supra n. 9) pl. I.

84. Demangel and Mamboury (supra n. 6) figs. 200:35 and 201:88, 89.

85. Barnea (supra n. 10) 261, fig. 160:11.

86. Found at Cherson on a plate dated to the 3rd-2nd centuries B.C.: Solominik (supra n. 18) pl. XIII:106.

87. Sarkel: Scherbak (supra n. 9) pl. XI. Novgorod: B.A. Kolchin, *Wooden Artefacts from Medieval Novgorod* (BAR S495, Oxford 1989) 266, pl. 24; these are most certainly Cyrillic letters.

88. Pliska, where it occurs on the fortress wall: L. Doncheva-Petkova, "Zapadnata krepostna stena v Pliska (prouchvaniya na yuzhniya sektor 1973 i 1974 g.)," *Pliska-Preslav* 1 (Sophia 1979) figs. 8:13, 9:16; Doncheva-Petkova (supra n. 7) 75 and 107, pls. IX:29a, b, XXVII:33, 34; V.V. Shkorpil, "Znaki na stroitel'nom material'," in *Aboba-Pliska. Izvestiya Arheologicheskovo Instituta v Konstantinopole*, vol. 10 (Sophia 1905) fig. 41:29, pl. XLIX:41, where it occurs with the letters O and L; Doncheva-Petkova (1977) figs. 40:10, 45:33, 46:21, where it occurs on ceramics. Preslav: D. Ovcharov, "Novi epigraphski pametnitsi ot Preslav," *Pliska-Preslav* 1 (Sophia 1979) pl. 2; Doncheva-Petkova (supra n. 14) fig. 40:10, where it occurs on ceramics. Popina: Doncheva-Petkova (supra n. 14) fig. 40:10, where it occurs on ceramics. Tsarevets: Georgieva (supra n. 7) fig. 42.

89. On local vessels at Dinogedia: M. Comşa, "Ceramica locală," in G. Ştefan et al. eds., *Dinogedia I* (Bucharest 1967) 213, fig. 136:8; at Pâceul lui Soare: Diaconu (supra n. 79) fig. 5:5; at Basarabi: Barnea (supra n. 81) figs. 18, 19.
90. This fabric is also analogous to that of a similar type of amphora, a later version of Class 2 vessels, found in the Azak area of the northern Black Sea; see Paste Type 1 of Volkov (infra n. 91) 89. Another fabric also belonging to a later version of Class 2 has a mica and sand temper, but with a light yellow paste color: I.A. Antonova et al., "Srednevekovie amphorì Khersonesu," ARSO 7 (Sverdlovsk 1971) 94.

91. A similar amphora type, which is a later evolution of Class 2 vessels, has a body that was made in three parts. The lower body and base were made first, the upper part of the body second, and the two parts were joined together. Afterwards, the neck was added and formed, and the handles were then stuck on: I.V. Volkov, "Importnaya amphornaya tara zolotoordinskovo goroda Azaka," in G.A. Fedorov-Davidov ed., Severnovo priчерномор'e i povol'z'e vo vzaimootnoschenniam vostoka i zapada v XII-XVI yekakh (Rostov na Donu 1989) 89. It has also been proposed that these amphoras were made in the coiling technique; the bottom and top were manufactured separately, and then fastened together: Yakobson (supra n. 8) 107.

92. Dated by a coin of Issac I Comnenus (1057-1059): Amforele 522; Barnea (supra n. 10) 266; Barnea and Ştefanescu (supra n. 10) fig. 88:3; I. Barnea, O. Iliescu, and C. Nicolescu, Cultura bizantină in România (Bucharest 1971) 153, Cat. No. 205.

93. Along with Class 1, Type 2 amphoras: Pulak (supra n. 5) 54-55, fig. 8.

94. Hayes' Type 54, variant B, occurring in late 11th to early 12th century deposits: Hayes (supra n. 33) 73-75, figs. 9-11.

95. Günseenin's Type 1 encompasses my Classes 1 and 2: Günseenin (supra n. 36) fig. 4.


97. Kubishev (supra n. 15) fig. 2:4; V.V. Voronin, "Pischa i utrav," in B.D. Grekova and M.I. Artamonov eds., Istoriya kulturi drevnei Rusi I (Moscow-Leningrad 1951) 272, fig. 171. The fragment with a 12th-century Russian inscription, which was scratched after firing, also seems to belong to a Class 2 amphora. The inscription seems to
translate as the owner's wish for the korchag (the early Russian word for amphora) to be always abundantly full: M.K. Karger, Drevnei Kiev I (Moscow-Leningrad 1958) 422-25, fig. 103.

98. An interesting flat-bottomed version: Yakobson (supra n. 40) 342, n. 1, fig. 12; Kubishev (supra n. 15) fig. 2:5.

99. Amforele 522, fig. 4:2; Barnea (supra n. 10) 266, fig. 159:6; Barnea, Iliescu, and Nicolescu (supra n. 92) 153, Cat. No. 205; Barnea and Ştefănescu (supra n. 10) 267, fig. 88:3.

100. I. Barnea, "Descoperiri arheologice din epoca feudală la Mangalia," MCA 6 (1959) 905-906, fig. 2:1.


103. Yakobson (supra n. 40) 341, fig. 11:39.


105. Dated to the 12th-13th century levels in Cherson: Yakobson (supra n. 8) 103-104, fig. 53:b; Yakobson (supra n. 104) 123-25, fig. 4:b.

106. From the Mikhailovsk Zlatoverhy Monastery: Karger (supra n. 97) 422-23, pl. LXXV; M.K. Karger, Arheologicheskie issledovaniya drevnevo Kiev otchet i materiali (1936-1947 gg.) (Kiev 1951) 8-9, fig. 3:2; Yakobson (supra n. 104) fig. 4:B.

107. Keramika 113, fig. 69:5.


109. From the last level of the early medieval habitations (11th-12th centuries) at Dinogetia: Amforele
524-25, fig. 3:3; Barnea (supra n. 10) 267, fig. 159:2; Barnea and Ţeşfanescu (supra n. 10) fig. 88.

110. Barnea (supra n. 10) 297.

111. From Eski-Kermen: Keramika 113, fig. 69:2, 3.


114. Keramika 111; Yakobson (supra n. 40) 340.


116. Demangel and Mamboury (supra n. 6) 149, figs. 198:1, 199.
117. Amforele 518-19, fig. 3:1; Barnea (supra n. 10) 259, figs. 159:1, 161:1.

118. Type XXI: Antonova et al. (supra n. 90) 93, n. 48.


120. Covered by a white or yellowish wash: M.V. Malevskaya, "Amphorae Novogrudka, XII-XIII vv.," Tezisi dokladov k konferentsii po arheologii Belo-Russi (Minsk 1969) 185; a light creamy slip: M. Aoyagi and G. Falsone, "Amphorae from a Crusader Ship Found off Tartous Syria," in Operation Committee for the Syrian Coastal Archaeological Excavation (supra n. 119) 66; Barnea and Ştefanescu (supra n. 10) 266.

121. Amforele 519; Barnea (supra n. 10) 261.

122. Hayes (supra n. 33) 76, figs. 26:10, 11, pls. 13:B, C.

123. Type III: Günzenin (supra n. 36) 271-74, figs. 8-11.

124. It is estimated that there are approximately 5,000 Class 3 amphoras at this site. The amphoras were stoppered with wooden plugs: Tanabe, Yoshizaki, and Sakata (supra n. 119) 38.

125. Type XXII: Antonova et al. (supra n. 90) 93, fig. 24; G.D. Belov, "Raskopki v severnoyakhstii Khersonesa v 1931-1933," MIA 4 (1941) 260-61, and 266, fig. 102, 287; Keramika 111-13, fig. 68:5; Yakobson (supra n. 40) 312, fig. 10:36; Yakobson (supra n. 8) 105, figs. 56-58; Yakobson (supra n. 104) 123, fig. 4:d; Romanchuk (supra n. 2) 324, figs. 6:8, 9.

126. Dovzhenok (supra n. 96) 85, pl. XII:1; Goncharov, Bogusevich, and Yura (supra n. 96) 69, pl. 1:2.

127. From the sea, near Odessa: Keramika 111, n. 5, fig. 68:6.

129. Keramika 111, n. 6, fig. 68:8; Yakobson (supra n. 104) 123, fig. 4:G.


131. Mits (supra n. 44) 97-98, fig. 32:6.

132. Mits (supra n. 44) 97-98, fig. 32:10.

133. One of the fragments has a scratched 11th-century Arabic graffito, which appears to be the name of the vessel's owner: Karger (supra n. 97) 425-27, figs. 105, and 106. Khynovskii (supra n. 113) 55, pl. XVII:100; Ribakov (supra n. 113) fig. 97; Yakobson, (supra n. 8) 106, indicates that reconstruction of the lower part of this amphora is incorrect.

134. Pletneva (supra n. 12) 246, fig. 31:5.

135. Pletneva (supra n. 27) fig. 30:1.

136. Gadlo (supra n. 115) 41-44, fig. 18:2.


138. Malevskaya's Type I amphoras were only found in the 12th-century layer at Novogrudok: Malevskaya (supra n. 112) 185, and 188-90, fig. 1:1.

139. This amphora may have been found at Ani: Yakobson (supra n. 8) 105, fig. 59.

140. Extracted from the sea: Changova (supra n. 14) 256, n.7, fig. 11.

141. Amforele 519-22, fig. 3:2; Barnea (supra n. 10) 259-64, fig. 159:4; I. Barnea, Dinotetia (Bucharest 1969) 48, fig. 37; Barnea, Iliescu, and Nicolescu (supra n. 92) 154 (cat. no. 209); Barnea and Ştefanescu (supra n. 10) 266, fig. 88:2; E.M. Condurachi, L'archéologie roumaine au XVe siècle (Bucharest 1963); "Şantierul Garvăn (Dinotetia)," SCIV III (1952) 370, 374-75, fig. 22:11; Ştefan et al. (supra n. 126) 23-25, figs. 5, 6; Ştefan et al., "Şantierul Garvăn-Dinotetia," SCIV 4:1-2 (1953) 245-50, figs. 9-12; Ştefan et al., "Şantierul arheologic Garvăn (Dinotetia)," SCIV 5:1-2 (1954) 170-71; Ştefan et al., "Şantierul arheologic Garvăn-Dinotetia," SCIV 6:3-4 (1955) 749, fig. 19.

143. Barnea (supra n. 100) 907, fig. 2:2.

144. Barnea (supra n. 100) 907, fig. 3:2.

145. Arthur (supra n. 101) 90, fig. 12.

146. Günßenin (supra n. 36) 274, n. 21; Zemer (infra n. 159) 82.

147. F. Braemer and J. Marcadé, "Ceramique Antique et pièces d'ancre trouvées en mer à la pointe de la Kynosoura (Baie de Marathon)," *BCH* 77 (1953) fig. 6:b.


149. Coldstream and Huxley (supra n. 61) 270, pl. 97:19.


152. Megaw (supra n. 112) 334, fig. 27; J. Rosser, "Excavations at Saranda Kolones: Paphos, Cyprus, 1981-1983," *DOP* 39 (1985) 85, Fig. c.


155. *Amforele* 519; Barnea and Ștefanescu (supra n. 10) 266.

156. Where they date to the late 11th to 12th centuries, but primarily to the 12th century: Pletneva (supra n. 12) 246.
157. Keramika 111; Yakobson (supra n. 104) 123; Yakobson (supra n. 40) 342; Antonova et al. (supra n. 90) 93.

158. Keramika 111; Yakobson (supra n. 40) 342; Yakobson (supra n. 8) 106; Amforele 519.

159. Pletneva (supra n. 27) 50-52.

160. Timoschuk (supra n. 135) 257.

161. There is a general difficulty in assessing the heights of the amphoras in the literature, as most authors fail to cite whether the measures taken were to the rim or to the tops of the handles.

162. Antonova et al. (supra n. 90) fig. 24; Yakobson (supra n. 104) figs. 4: g, d; Keramika fig. 68: 5; Yakobson (supra n. 40) figs. 10: 35, 36; Yakobson (supra n. 8) fig. 57; Romanchuk (supra n. 2) figs. 6: 8, 9.

163. Antonova et al. (supra n. 90) 93; Amforele 519; Barnea (supra n. 10) 261; Keramika 111.


165. Amforele 519; Barnea and Ştefanescu (supra n. 10) 266. It has been proposed that these vessels were used for beekeeping (G. Ştefan et al., "Săpăturile dela Garvăn [Dinogotia] raionul Măcin [Galați]," SCTV II: 1 [1951] 24), and Hayes, (supra n. 33) 76, suggests the same.

166. An amphora similar to Amphoras 39 and 40 is now in the Atlantis Hotel on Kos. This vessel most likely came from the same location as the Bodrum amphoras: Operation Committee for the Syrian Coastal Archaeological Excavation (supra n. 119) pl. 7: 7.

167. They may be identified not only by their narrow shape, but also by the position of their handles, which are usually placed at the lower edge of the shoulder.

168. Günzenin (supra n. 36) n. 23.

169. Pletneva (n. 27) 46-52, fig. 32.

40; M.I. Artamonov, *Srednevekovie poselenia na nizhnem Donu* (Leningrad 1935) 71, fig. 35.

171. **Keramika** 32.

172. Amphoras with a roller rim replaced those with a shelf rim, which are probably much earlier in date: **Keramika** 30.


174. Crimean settlements: Yakobson (supra n. 170) 39; **Keramika** 30-31, figs. 12:1, 2, 4-6; D.L. Talis, "Srednevekovaya kleimenaya amphornaya ruchka iz razkopok Bakiinskovo gorodishcha," *Arheologicheskii sbornik* 40 (1966) 99, fig. 1; Azov and Don areas: **Keramika** fig. 12:3; I.I. Lyapushkin, "Slavyanskoe poselenie na territorii khut. Blizhnaya Mel'nitsa," *MIA* 62 (1958) 345, figs. 13, 14; Pletneva (supra n. 12) 244, figs. 28:3, 7; S.A. Pletnuova, "Nomadsky poselica prez VII-IX v. v Priazovieto i basena na R. Don," *Arheologiya* 6:4 (Sophia 1964) 3, fig. 2. A similarly shaped amphora fragment, but without the roller rim, was also found at Sarachane, Istanbul; it is Hayes' Type 53, dated to the early 10th century: Hayes (supra n. 33) 73, fig. 25:12.

175. Yakobson (supra n. 170) 40; **Keramika** 31.

176. An amphora very close in shape to Amphora 42 was found in a boat burial in Gnezdov, near Smolensk, Russia. The burial is dated to the beginning of the 10th century by Arab dirhems: D.A. Avdusin, "Raskopki v Gnezdov," *KSIIMK* 38 (1951) 77, fig. 36:a; D.A. Avdusin and M.N. Tihomirov, "Drevneishaya russkaya nadpis," *Vestnik Akademii Nauk SSSR* 4 (1950) 74, fig. 3.

177. Pletneva (supra n. 12) 266, figs. 28:1, 2.

178. Antonova's Type XVI, occurring with coins from the 9th-11th centuries: Antonova et al. (supra n. 90) 90; V.N. Babenchikov, "Itoji issledovaniya Srednevekovovo poseleliya na Kholme Tepsen," in A.P. Smirnov ed., *Istoriya i arheologiya Srednevekovovo Krima* (Moscow 1958) figs. 21:6, 22:12; Yakobson
(supra n. 8) 105, fig. 60; Yakobson (supra n. 12) 309, fig. 161:3; Romanchuk (supra n. 2) 323-24, figs. 5:3, 4.

179. Yakobson (supra n. 173) 487-93, figs. 2:1, 4-6.


181. Babenchikov (supra n. 178) 131, fig. 21:4; Keramika 31, fig. 13:1; Yakobson (supra n. 40) 332, fig. 5:a; A.L. Yakobson, Srednevekovii Krim (Moscow 1964) fig. 8:a; V.F. Gaidukevich, "Raskopki Tiritaki v 1935-1940 gg.," MIA 25 (1952) 127, fig. 163; V.F. Gaidukevich, "Pamyatniki rannevo srednevekov'ya v Tiritaki," SA 6 (1940) 204, fig. 14.


183. Keramika 30, fig. 13:2.


185. M.I. Artamonov, "Sarkel - Belaya Vezha," MIA 62 (1958) 72, fig. 50; Yakobson (supra n. 40) 332, fig. 5:b; Keramika 31, fig. 13:3; Pletneva (supra n. 12) 244, figs. 28:1, 2.

186. Yakobson (supra n. 40) 332, fig. 6:22; Pletneva (supra n. 27) 47, fig. 28; S.A. Pletneva, "Ot kochevii k gorodischai," MIA 142 (1967) 129-31, fig. 33:1.

187. This amphora was made on the potter's wheel, but, according to the author, in the coiling technique; the Russian word for mustard was scratched onto its shoulder after firing; Avdusin (supra n. 176) 77, fig. 36:a; Avdusin and Tihomirov (supra n. 176) 74, fig. 3; Yakobson (supra n. 40) 333-34, fig. 6:23; T.V. Radvina, "Nadpis na korchage iz Pinski," KSTIMK 70 (1957) fig. 61.

188. Hayes' Type 57, dated to the 11th century; Hayes (supra n. 33) 75, fig. 25:13.

189. Arthur (supra n. 101) 87, fig. 7.


192. In Yugoslavia: Brusić (supra n. 59) fig. II:2.

193. Babenchikov (supra n. 178) 128–32, figs. 21, 22.


195. Malevskaya (supra n. 112) 187–91, fig. I:IV.

196. Yakobson (supra n. 12) 307, figs. 160:1, 2; *Keramika* 32, figs. 13:5–8.

197. Hayes (supra n. 33) fig. 25.


199. Of the 50 amphoras that did not fit into one of the three groups, most contained mica: Kovnurko (supra n. 198) 122. Class 4 amphoras with mica were also found in Cherson: Antonova et al. (supra n. 90) 90.

200. Pletneva (supra n. 27) 46–58.

201. Brusić's Group Va: Brusić (supra n. 59) 41.

202. GW No. 417: H. 0.360; max. diam. 0.199; rim diam. 0.050–0.054; capacity 3.92 l; wgt. 4.84 kg. (van Doorninck [personal communication Nov. 1992]).


204. The authors date it to the 12th century: Coldstream and Huxley (supra n. 61) 269–70, fig. 87:18.

205. Antonova's Type XXV: Antonova et al. (supra n. 90) 95, fig. 30.

207. Brusić's group Vb: Brusić (supra n. 59) 42-43, and 47-48, pl. VI:2; Brusić (supra n. 206) 249, pl. IX:1.

208. Bjelajac's Type II, dated to the 12th-13th centuries: Bjelajac (supra n. 58) 113-15, fig. 3:1, 2.


210. Dated to the third quarter of the 12th century: M. Popović, "Importation et production locale de céramique à Ras (fin XIe - début XIIe siècle)," *BCH*-Suppl. 18 (1989) 128-29, figs. 6:3-5.

211. Demangel and Mamboury (supra n. 6) fig. 198:2.

212. At the Levoberezhny and Potainovsky townsites: Artamonov (supra n. 170) 69-70, figs. 33:6, 7, and 36.

213. Florescu and Florescu (supra n. 56) 626, fig. V:8.


215. *Amforele* 524; Barnea (supra n. 10) 266.

216. Early versions of Class 7 amphoras, dated to the 5th-6th centuries, are found in Bulgaria at Preslav (Changova [supra n. 14] fig. 1:4) and Obzor (Changova [supra n.14] figs. 1:7, and 2).

217. Hayes' Type 65, from late 12th century contexts: Hayes (supra n. 33) 76, fig. 26:6, pl. 13:a.

218. Ribakov (supra n. 214) 137-38, fig. 62:b, according to the author, the vessel was made using the coiling technique; Ribakov (supra n. 29) fig. 97; K. Miatev, *Slavyanska Keramika* (Sophia 1948) 49, fig. 60; A.M. Shovkopylas, "Ranneslavjanskaya keramika s gori kiselevki v Kieve," *MIA* 108 (Moscow 1963) figs. 2:1, 2; the author dates these vessels to the 5th-6th centuries.

219. Mits (supra n. 44) 97, fig. 32:5.

220. Mits (supra n. 44) 97, fig. 32:4.
221. From the sea near Odessa: *Keramika* fig. 43:1b, mislabeled as an amphora-speaking tube from the Ioanna Predtechi Church in Kerch. According to М.М. Никитченко, "Amphori-Golosniki iz ts. Ioanna Predtechi v Kerch," *AO* 1969 g., (1970) 276-78, it is the amphoras of figs. 1:a and 1:v in *Keramika* that are from Kerch.

222. Amphora-like pitchers: Pletneva (supra n. 27) figs. 34:1, 2.

223. Volkov (supra n. 90) 97-98, figs. 15:6, 8.

224. Dated to the 10th-11th centuries: Changova (supra n. 14) 251-52, fig. 4:5; Changova (supra n. 20) pl. VII:3.

225. Dated to the 11th-12th centuries: Amforele 524, fig. 3:4; Barnea (supra n. 10) 264-66, fig. 159:3; Barnea and Ştefanescu (supra n. 10) 267, fig. 88:1.

226. Dated to the 12th century: Popović (supra n. 210) 128, figs. 6:1, 2.

227. See A. Châtelet and B.P. Groslier eds., *Histoire de l'art* (Paris 1990). Other possible parallels were found at Samos (A.M. Schneider, "Samos in frühchristlicher und byzantinischer Zeit," *AM* LIV (1929) fig. 18) and from the sea near Akko, Israel (Zemer [supra n. 159] 86, pl. 26:79).

228. Belov and Yakobson (supra n. 28) 127; G.D. Belov, S.F. Strzeheletskii, and A.L. Yakobson, "Kvartal XVIII, raskopki Kheresona v 1941, 1947 i 1948 gg.," *MIA* 34 (1953) 221, fig. 75:b; Yakobson (supra n. 41) 54; Yakobson (supra n. 8) 155, fig. 91; Yakobson (supra n. 40) 335, fig. 6:28; Yakobson (supra n. 12) 75, fig. 43:7.

229. *Keramika* 75. Possible fragments of these or similar amphoras were found with my Class 3 amphoras at the Lenkovetsky townsite, in Ukraine: Timoschuk (supra n. 135) 257.

230. Yakobson (supra n. 40) 335, n. 3; Yakobson (supra n. 12) 310; *Keramika* 75.


232. Demangel and Mamboury (supra n. 6) 148, fig. 198:3.

234. Robinson (supra n. 3) 120, pl. 34 (M 391).

235. Hayes' Type 58: Hayes (supra n. 33) 75, fig. 25:15.

236. van Doorninck (personal communication, Nov. 1992): GW No. 408; h. 0.360; max. diam. 0.291; rim diam. 0.096; capacity 10.70 l; wgt. 3.66 kg. GW No. 407; h. 0.372; max. diam. 0.306; rim diam. 0.094; capacity 11.420 l; wgt. 3.95 kg. GW No. 410 (Museum Inv. No. 7-23-80); h. 0.412; max. diam. 0.297; rim diam. 0.104; capacity 11.76 l; wgt. 5.240 kg. GW No. 368; h. 0.384; max. diam. 0.310; capacity 12.25 l. GW No. 371 (Museum Inv. No. 69-3-89); capacity 12.17 l. GW No. 773; fragment.

237. Belov (supra n. 125) 250, fig. 84; Yakobson (supra n. 8) 103, fig. 51:a, b; Yakobson (supra n. 40) 342-43, fig. 11:41; Keramika 114, fig. 69:8.

238. Yakobson (supra n. 8) 103, fig. 52; Keramika 114, fig. 69:9; Repnikov (supra n. 108) 280, pl. XLIV:3.


241. Volkov (supra n. 90) 96, fig. 13:6, 7.


243. Schilbach (supra n. 128) 95.

244. I am grateful to Frederick H. van Doorninck, Jr. for pointing out the mechanics of this relationship.


247. For efficiencies of Roman amphoras, see Peacock and Williams (supra n. 246) 52. Efficiencies of Yassi Ada amphoras were calculated by me after cited capacities and weights: G.F. Bass, "The Pottery," in G.F. Bass and F.H. van Doorninck, Jr. eds., Yassi Ada I: A Seventh-Century Byzantine Shipwreck (College Station, Texas 1982) 163.


250. van Doorninck (supra n. 25) 253.

251. Aoyagi and Falsone (supra n. 120).


253. Ostrogorsky (supra n. 252) 346.


255. Heyd (supra n. 254) 207.

256. Operation Committee for the Syrian Coastal Archaeological Excavation (supra n. 119) wreck plans.

257. van Doorninck (supra n. 25) 252.

258. van Doorninck (supra n. 25) 256.

259. A concave profile is also seen on an amphora from Ivan Gora, Ukraine, whose handle stubs also seem to be rounded off. This vessel was discovered in a storehouse with ceramics dating from the 12th-12th centuries; clearly, an effort was made to prolong the use-life of the vessel: Kubishev (supra n. 15) 56, fig. 1:4. An amphora from Kiev again has a rim and neck with a concave profile: Kubishev (supra n. 15) fig. 2:4. An amphora from Belaya-Vezhe also has what appears to be a carved-down rim: Artamonov (supra n. 66) fig. 19.

260. van Doorninck (supra n. 25) 256, figs. 4:3, 4.

261. D. Adan-Bayewitz, "Ceramic remains. B. The pottery from the Late Byzantine Building (stratum 4) and its implications." In L.I. Levine and E. Netzer eds.,

262. This is supported by the finding of amphora Types 1 and 2 over an extremely wide geographic area.

263. van Doorninck (supra n. 25) 256.


265. Goitein, (supra n. 263) 334, notes that during the Fatimid period wood was sufficiently rare in the southern and eastern Mediterranean that it had only a limited use as packing material.

266. Goitein (supra n. 263) 334.

267. Tchernia (supra n. 248) 28-39; Braudel (supra n. 249) 234-35.

268. Demangel and Mamboury (supra n. 6) 149.

269. van Doorninck proposes that such combinations may unite a potter's mark with the amphora's prospective owner (supra n. 25) 256.

270. Kubishev (supra n. 15) 61.

271. The practice of stamping the stopper sealant is well documented in antiquity; see, Peacock and Williams (supra n. 246) 11, fig. 4.

272. Scanlon (supra n. 102).


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