Casting moulds are fairly uncommon, but are very important as archaeological evidence as they shed light on metalworking in Olbia during the different periods of the occupation of the city.

During excavations in Sector NGS, over 30 moulds were uncovered. These were used for casting ornaments (ear-rings, pendants, beads and bracelets), religious objects (bucrania) and objects of everyday life such as spindle-whorls and items of horse gear; in short, articles intended for mass consumption.

In the Archaic and Classical periods, various soft rocks were used for making moulds: shale, sandstone and pink slate.\textsuperscript{1150} In the Hellenistic period, moulds came to be manufactured from the handles and walls of predominantly Rhodian amphoras and fragments of Sinopean tiles. These ceramics were made of well-levigated clay, which was able to withstand the high temperature of the molten metal.\textsuperscript{1151}

For casting the articles, different alloys of copper, tin and lead were mostly used, although pure copper, lead or low-grade silver were also employed.\textsuperscript{1152} The metals were imported from Greece, Asia Minor, the Carpathians and the Krivoi-Rog basin.\textsuperscript{1153}

It should be noted that no metalworking workshops have so far been discovered in Sector NGS. Most of the casting moulds were found in the upper layers of the excavations, outside the perimeters of the houses. This circumstance and the fact that many of the moulds have direct parallels among those from Sector I situated in the Upper City above NGS\textsuperscript{1154} suggest a redeposition of some of the casting moulds from the Upper City as a result of landslide processes.

\textsuperscript{1150} Furmans'ka 1958, 53.
\textsuperscript{1151} Furmans'ka 1958, 40; Lejpuns'ka 1984, 68.
\textsuperscript{1152} Furmans'ka 1963, 68-69; Ol'govskij 1981, 75.
\textsuperscript{1153} Furmans'ka 1963.
\textsuperscript{1154} Furmans'ka 1958.
Moulds for casting ear-rings

Rb-1 85-47. Pl. 357
Half of a mould (broken on one side) for casting ear-rings representing an animal's head, made from the handle of a Rhodian amphora. 4.7 x 3.4 x 1.3. Found in square 357, in a yellow clay layer north of Pavement 125 (at a depth of 13-12.2 m). In the same layer was material of the Hellenistic period.

One side of the mould was intended for casting an ear-ring in the animal style. Preserved on the surface is a casting gate, L 1; W 0.5-1; D 0.2. A channel for the withdrawal of air is L 0.7; W 0.3-0.5; D 0.15. A hole for a pin is Ø 0.5; D 0.6. The negative form of a completely preserved pin of the ear-ring, L 2; W 0.4-0.5; D 0.2. In addition, preserved on the surface are two holes, Ø 0.5, D 0.6 and 0.8, for the pins fixing together the halves of the mould. Dimensions of the amphora-shaped pendants of the first group cast in the mould: L 1.3; greatest W 0.7; D 0.3; those of the second group: L 1.8; greatest W 0.7; D 0.35.

Rb-2 87-347. Pl. 357
Fr. of half of a two-piece casting mould made from the handle of a Rhodian amphora. 4.3 x 3.4 x 1.3. Found in square 357, in a yellow clay layer north of Pavement 125 (at a depth of 13-12.2 m). In the same layer was material of the Hellenistic period.

The two surfaces of the mould are both well worked and smoothed. One side of the mould was intended for casting an ear-ring in the animal style. Preserved on the surface is a casting gate, L 1; W 0.5-1; D 0.2. A channel for the withdrawal of air is L 0.7; W 0.3-0.5; D 0.15. A hole for a pin is Ø 0.5; D 0.6. The negative form consists of an incompletely preserved pin of the ear-ring, L 2; W 0.4-0.5; D 0.2. In addition, preserved on the surface are two holes, Ø 0.5, D 0.6 and 0.8, for the pins fixing together the halves of the mould. Dimensions of the amphora-shaped pendants of the first group cast in the mould: L 1.3; greatest W 0.7; D 0.3; those of the second group: L 1.8; greatest W 0.7; D 0.35.

Rb-3 89-772, II-2 B 248/8. Pl. 357
Half of a mould for casting ear-rings in the animal style, made from the handle of a Rhodian amphora. 7.7 x 3.2 x 1.9. The surface of the mould is well treated and smoothed. On it is a casting gate for pouring metal, L 1; W of mouth 1.5; a channel for the withdrawal of air, L 0.4; W 0.2; D 0; two holes for pins, Ø 0.4; D 0.5-0.55.

The representation of the ear-ring consists of a rod and a head. The rod is straight, L 4.7; W 0.2-0.4; two thirds is covered by thin oblique incisions. The head, L 1.6, to a length of 0.9 cm, is covered with lengthwise incisions terminating in a semicircle ornamented on the inside with a semi-triangular ledge.

Moulds for casting pendants and beads

Rb-4 92-220, III-1. Pl. 357
Half of a mould for casting ear-rings in the animal style, broken on both sides and made from the handle of a Rhodian amphora. 5.4 x 1.4 x 1.4. Found in squares 115-135 in loose, grey, ashy soil containing materials of the Hellenistic period (at a depth of 14-15 m).

On the well-smoothed surface, a channel for a pin, Ø 0.35; D 0.6, is preserved, as well as a fr. of the pin of an ear-ring, L 2.5; W 0.1-0.2; D 0.15.

Rb-5 90-309. Pl. 357
Half of a mould for casting four amphora-shaped pendants, made from the handle of a Rhodian amphora. 7.2 x 2.7 x 0.9-1.4. Found in squares 342 and 343; in grey clay layer containing humus at a depth of 0.4-0.3 m from the modern surface. The layer contained material of the Hellenistic and Roman periods.

The surface of the mould is carefully worked and smoothed. On it are preserved four casting apertures leading to each pendant, as well as two grooves for the pins uniting the pendants into pairs and used to make holes in them for suspension. Dimensions of the apertures for the first pair: L 1.3; W 0.3-0.7; D 0.15-0.2; dimensions of the gates for the second pair: L 0.85; W 0.2-0.7; D 0.15. Dimensions of the grooves for the pins of the first group of pendants: L 3; W 0.4; D 0.2; for the second pair of pendants: L 3.8; W 0.45; D 0.2. In addition, preserved on the surface are two holes, Ø 0.5, D 0.6 and 0.8, for the pins fixing together the halves of the mould. Dimensions of the amphora-shaped pendants of the first group cast in the mould: L 1.3; greatest W 0.75; D 0.3; those of the second group: L 1.8; greatest W 0.7; D 0.35.

Rb-6 90-557. Pl. 357
Fr. of half of a casting mould for manufacturing two beads and a vonvorka (a strap ornament), made from the handle of a Rhodian amphora. 5 x 3.4 x 2.

The surface of the mould is carefully worked and smoothed. On it, completely preserved, are the negative of one bead, a fragmentary part of another bead and another negative form for a vonvorka. Dimensions of the completely preserved barrel-shaped bead: L 1.7; W 1.3; D 0.9. In the upper and lower parts of the bead, a channel for a pin is cut, W 0.7; D 0.3; in the lower part of the channel for the pin there is a hole for the withdrawal of air, L 1.2; W 0.1. The other negative form of a bead, preserved fragmentally, is also barrel-shaped. It is ornamented with transverse-longitudinal incisions, L 1.8; preserved W 0.5. A casting channel leads to this bead, L 0.7; W 0.4; D 0.2. In the same mould, a conical ribbed vonvorka was also cast (the negative mould is broken) with a reconstructed Ø of 1.7; Ø of the lower hole for a pin 0.9.

Rb-7 94-119, IV-2 B 302/182. Pl. 357
Half of a mould for casting a lunette pendant, made from the handle of a Rhodian amphora. 8.9 x 4.2 x 2.4 x 2.5.

The surface of the mould is carefully smoothed. On it, a casting gate is preserved leading to the top part of a lunette ornament. The channel is L 1.0; W 0.4; D 0.15. The negative of the crescent is carefully carved, L 3.5 (between the tips of the horns); W of upper part 0.9; D 0.15. The surface of the lunette pendant is decorated with lengthwise and
transversal wavy lines. The tips of the crescent are shaped as spherical globules, Ø 0.35.

An analogous casting mould was found in 1940 (no. 1016) (Furmans'ka 1958, pl. III.3).

Rb-8 87-482. Pl. 358
Half of a mould for casting four beads, made from the handle of a Rhodian amphora. 9.3 x 3.5 x 1.7. Found in square 360, in a depression north of Basement 89, in yellow, clayey soil (at a depth of 12-11.3 m) with finds of the Hellenistic period. The surface of the mould is carefully worked. On it are preserved two holes for pins, Ø 0.5; D 0.5; one uncompleted channel for a pin, Ø 0.25; D 0.1; a casting gate, L 1.4 cm; W of mouth 0.9. To each of the beads runs a groove for the pins forming the channels of the beads. General dimensions of the grooves: L 2.7-2.9; W 0.3-0.4; D 0.1-0.2. General dimensions of the beads to be cast: L 0.4-0.5; W 0.18-0.25; D up to 0.3. It is noteworthy that the gate of the mould leads only to the first bead, the other having no apertures for casting and neither being interconnected by any channels, i.e. the mould has not been completed or was rejected.

A similar mould was found in Sector I in 1925 together with materials of the 3rd-2nd century BC (no. A-365) (Furmans'ka 1958, pl. IX.2).

Rb-9 94-120. IV-2 B 302/182. Pl. 358
Half of a mould for casting beads, made from the handle of a Rhodian amphora. 7.9 x 3.5 x 2. The surface of the mould is well worked and smoothed. On it are preserved: the casting gate, L 1.2; W of mouth 1.5; the casting channel is L 6.7; W 0.3; D 0.1; the hole for a pin is Ø 0.4; D 0.9. Along the gate channel are arranged two complete negatives of beads and one partly preserved, L 0.6-0.7; W 0.35; D 0.25. Perpendicular to the casting aperture, the channels for pins run through the beads for shaping the holes in them, W of each channel 0.3; D 0.15.

Moulds for casting bracelets

Rb-10 86-53. Pl. 358
Half of a mould for manufacturing a bracelet, made from a Sinopean tile. 8.7-12 x 2.6. Found in squares 78 and 79, in a layer of grey, clayey soil with inclusions of yellow clay and materials of the Hellenistic period (at a depth of 12.44-11.79-11.59 m). The surface of the mould is rudely worked and unsmoothed. On it, the mould has not been completed or was rejected. A fr. of an analogous mould was found in the vicinity of the Agora, in the area of House E-12 (Leipums'ka 1984, 71, figs. 1, 9).

Rb-11 87-188. Pl. 358
Fr. of half a mould for manufacturing two bracelets, made from the wall of a Rhodian amphora. 7.3 x 3.6 x 0.8-1.3. Found in square 357, south of Wall 117, in a layer of grey, clayey soil with yellow clayey inclu-
sions and materials of the Hellenistic period (at a depth of 0.7-1.2 m from the modern surface; absolute height 13.4-12.9 m). The surface of the mould is carefully treated. On it, a hole for a pin, Ø 0.5; D 0.8 is fragmentarily preserved.

In the mould, two bracelets were cast, Ø 6.8 and 4.5 respectively. The larger bracelet was decorated with groups of dots (two in each group) and transversal incisions with dots (three in each group); W of the bracelet 0.5. The smaller bracelet was ornamented with transversal incisions, W 0.4.

Moulds for casting *bucrania*

Rb-12 97-83. VI-3 B 489/294. Pl. 359
Half of a mould for casting a *bucranium*, made from slate. 6.2 x 5.1 x 1.4. The surface of the mould is uneven and poorly worked. On it are preserved: five holes for pins, Ø 0.7-0.8 (in one of these the remains of a lead pin is preserved); a casting gate, L 0.6; W 0.3; and a channel for the withdrawal of air, L 4.5; W 0.15; D 0.1. Arranged perpendicularly to the casting gate, 0.4 cm below the latter. Originally a *bucranium* and a fish were cast in the mould. During secondary use, at the point of the fish head, a hole for an additional pin was cut. Preserved dimensions of the negative form of the fish: L 1.5; W 0.8; D 0.1. Only the representation of the oval body of the fish is preserved. It is ornamented with an oval incised at its centre and semicircles around it (in imitation of scales), and it is provided with four sharp fins and a forked tail. The negative form of the *bucranium* is completely preserved. It is fairly neat
cut, although showing some carelessness, L (to the tips of the horns) 2.2; W (from the top of the forehead to the tip of the muzzle) 1.6; D up to 0.15. In the treatment of the bull's muzzle there is some vagueness; the horns are rather small, extended horizontally and not crescent-like as usual. The ears are also extended like the horns and are of the same size. The hair on the forehead of the bull is carved as a wavy line. The eyes are rendered by two dots encircled by semicircular carvings; the bridge of nose is rendered by a V-shaped stroke. The tip of the muzzle is formed by two semicircular cuts. Of note is also the absence of sacrificial bands and fillets usually hanging down from the horns of the animal.

Moulds for casting spindle-whorls

Rb-13 86-729. Pl. 359
Half of a mould for casting three conical spindle-whorls, made from the handle of a redware vessel. 6.7 x 2.8 x 1.2. Found in squares 57b, 77b, in a rubbish layer containing a large amount of ceramics and bones (at a depth of 12.7-11.4 m). The surface of the mould is worked fairly roughly. On it there is a casting gate, preserved L 1.2; W of mouth 0.8; D 0.1. Ø of the conical whorls cast 1.2-1.3; D 0.4-0.55. All of the whorls are connected to each other by channels which allow for the admittance of the metal.

Rb-14 87-669. Pl. 359
Fr. of half of a mould for casting a spindle-whorl (chipped on the working surface), at the point of the fish inside, in a fill of Room 487 (at a depth of 12.11-11.96 m).

On the surface, three perforations for pins are preserved, Ø 0.6-0.8. In one of the holes there is a lead pin, L 2.1; Ø 0.9. The head of the pin is shaped as a truncated cone. On the surface of the mould, a cone-shaped gate is also traceable, preserved L 0.8; W of mouth 1.1. The whorl to be cast in the mould was of biconical shape, L 1.4; W 0.6; D 0.7. Through it, a conical pin of circular cross-section runs, L 7.2; W 0.4-0.9; D 0.2-0.5.

Rb-15 91-455. Pl. 359
Fr. of half of a mould for casting a spindle-whorl, made from the handle of a Rhodian amphora. 5 x 3.2 x 2.1. Found in square 96-116 in a layer of yellow, clayey soil with grey, clayey inclu-
sions and materials of the Hellenistic period (at a depth of 13.5-13 m). The conical whorl was cast in the top of the mould, Ø 1.4; D 0.5.

Rb-16 92-600
Half of a mould for casting a spindle-whorl shaped like a wheel with seven spokes, made from the handle of a Rhodian amphora. 3.4 x 3.1
x 1.6. Found in square 115 in a yellow layer of clayey soil with grey, clayey inclusions and Hellenistic materials (at a depth of 13.6-13 m). The surface of the mould is carefully worked and smoothed on all sides. On it there is a casting gate, L 0.6; W 0.3; D up to 0.15, leading to the negative form of the whorl shaped like a wheel with seven spokes, Ø 2.4. In the centre of the form there is a hole for a pin, Ø 0.7-0.8.

An analogous mould was found in Olbia in 1908 (no. 2694) with material of the late Hellenistic period (Furman’ska 1958, pl. VII.2).

Moulds for casting various plaques

Rub-21 94-22, IV-2 B 302/178. Pl. 360
Half of a mould for casting two plaques, made from the handle of a Rhodian amphora. 7.4 x 3.4 x 2.1. On the well-treated surface, the negatives of two round conical plaques, Ø 2; D 0.3, are preserved. The plaques were decorated on their perimeters with straight incisions. The plaques are connected to each other by a casting channel, L 0.8; W 0.3; D up to 0.1. In addition, a hole for the pin, Ø 0.4; D 0.8, is preserved.

Rub-22 90-349, IV-2 B 280/161
Half of a mould for casting plaques, made from the handle of a Rhodian amphora. 6 x 2.7-2.85 x 2.4-2.6. The surface of the mould is carefully treated. On it is preserved: a casting gate, L 1.8; W of mouth 0.9; D up to 0.15; a hole for a pin, Ø 0.4; D 0.3. The mould was intended for casting cone-shaped plaques, Ø 1.15-1.2; D 0.7-0.8, ornamented on their edges with straight and oblique incisions. The plaques were interconnected by channels for the transmission of the metal, L 0.4; W 0.15. On the surface of the mould there are, in addition, grooves cut through the centres of the plaques for inserting the pins, which served to make holes inside the plaques.

An analogous mould was found in Sector I in 1935 (no. 2333) (Furman’ska 1958, pl. II.4).

Rub-23 86-36. Pl. 360
Half of a mould for casting metal plaques, made from the handle of a Rhodian amphora. 7.7 x 3.9 x 2.5. Found in square 61 in a yellow layer of clayey soil with materials of the Hellenistic period (at a depth of 11.74-11.54 m). The surface of the mould is fairly roughly worked. Approximate dimensions of the plate to be cast in it: 5.7 x 2.3 x 0.2.

Rub-24 87-6 + 90-12. Pl. 360
Two frs. of half of a mould for casting a plaque, made from the handle of a Sinopean amphora. 9.5 x 4.7 x 1.3. Both frs. were found in the humus layer. The mould is roughly made. On the surface is preserved a conical casting gate, L 0.2; W of mouth 1.6; D up to 0.4. In the mould, a rectangular metal plate measuring 6 x 2.4 x 0.3 was cast; poorly discernible grooves are cut on the edge of the negative form of the plate.

Rub-25 90-519. Pl. 360
Half of a mould for casting a flat trapezoidal object (chipped on two sides), made from the handle of a Rhodian amphora. 6.4 x 2.3-3.2 x 1.5. Found in square 110 northeast of Floor 291 in a layer of dark-grey, clayey soil with materials of the Hellenistic period (at a depth of 11.3-11 m). On the surface of the mould are preserved: holes for pins, Ø 0.3 and 0.25; D 0.2 and 0.7; the negative form of a trapezoidal object, preserved L 5.1; W of the narrower part 0.5; W of the broader part 1.4; D 0.4. The casting gate was probably in the upper (broader) part of the object and was of a rectangular shape, preserved L 1.1; W 0.6; D 0.2.

An analogous mould was found in 1948 in Sector I (no. 2108) with materials of the late Hellenistic period (Furman’ska 1958, pl. VIII.2).

Rub-26 93-173. Pl. 361
Half of a mould for casting plaques, made from the handle of a Rhodian amphora. 8.5 x 3.7 x 2.3. Found in square 220 in a layer of grey, clayey soil west of Wall 374 (at a depth of 11.4-10.7 m). The surface of the mould is carefully worked and smoothed. On it is preserved a fragmentary casting gate, L 0.9; W 0.6; D 0.25. In the mould, a plaque measuring 6.5 x 2.3 x 0.1 was cast; on the edge of the plaque there is a groove, W and D up to 0.2. The mould shows traces of burning.

Moulds for casting vorvorki

(strap ornament of horse gear)

Rub-17 87-373. Pl. 359
Fr. of half of a mould for casting a ribbed vorvorka, made from the handle of a Rhodian amphora. 4.8 x 3.3 x 2. Found in square 357 in a yellow, clayey layer north of Pavement 125 with materials of the Hellenistic period (at a depth of 13-12.2 m).

The surface of the mould is carefully worked and smoothed on all sides. On it are preserved a hole for a pin, Ø 0.5; D 0.4 and the form of the vorvorka to be cast, Ø 1.4; D 0.8, ornamented with lengthwise strokes. The form has a hole though it, Ø 0.9; D 1.3.

Rub-18 94-131. Pl. 360
Half of a mould for casting two vorvorki, made from the handle of a Rhodian amphora. 5 x 3.2 x 1.8. Found in a layer of yellow, clayey soil with grey, ashy inclusions at the level of Street 407 with materials of the Roman period (at a depth of 11.5-11.3 m). The surface of the mould is well worked and smoothed on both sides. On the main surface, a casting gate is preserved; L 0.7; W of mouth 0.9. It leads to a cone-shaped ornament, Ø 2.1. At a depth of 0.15 cm from the surface of the mould, it is ornamented with another ring, Ø 1.7. Ø of the inner hole of the vorvorka 0.9. The second vorvorka cast in this mould was also cone-shaped, Ø 1.7; Ø of the perforation 0.6; D 1.2. Its negative mould is broken off in the centre. On the reverse surface of the mould, a hole for a pin, Ø 0.9; D 0.4, is preserved.

An analogous mould was found in 1938 (no. 4368) in the Lower City of Olbia in a layer of the Hellenistic period (Furman’ska 1958, pl. III.5).

Rub-19 97-223. Pl. 360
Half of a mould for casting a vorvorka and a rod, made from the handle of a Rhodian amphora. 5.6 x 3.2 x 1.7. Found in a layer of grey, clayey soil with yellow, clayey inclusions southwest of Wall 470 with materials of the 4th-2nd century BC (at a depth of 11.16-10.66 m). In the same layer was found Rub-20. The mould is thoroughly flat on all sides. On the surface, a casting gate for a conical vorvorka is preserved, L 1.4; W of mouth 0.9; Ø of vorvorka 1.55; Ø of the perforation 0.9, which possibly served for a pin. The two other objects cast in the mould were probably small metal rods with holes, L 1.7; W 1.8; Ø 0.3. The rods were interconnected by a groove for inserting the pin, which provided the holes in the rods.

Rub-20 97-223a. Pl. 360
Half of a mould for casting a vorvorka, made from the handle of a Rhodian amphora. 5.7 x 3.1 x 1.8. Found together with Rub-19. The surface of the mould is carefully worked. On it is preserved a conical casting aperture, L 0.4; W of mouth 1.8; D 0.1; Ø of the two holes for pins 0.5; D of the holes 0.65-0.8. Ø of the vorvorka 1.5; Ø of the perforation 1.
Rb-27  97-452, VI-2. Pl. 361
Half of a mould for casting a metal plaque (a blank?), made from the handle of a Rhodian amphora. 9.4 x 4.2 x 2. Found in a heap of stones southeast of Pavement 496 with materials of the 4th-2nd century BC. The mould is thoroughly flat on all sides. On the surface, a conical casting gate is preserved, L 2.6; W of mouth 1; D 0.15. The negative mould of the plaque to be cast is fairly roughly cut, possibly unfinished, 6.9 x 2.5 x 0.05.

Moulds for miscellaneous objects

Rb-28  93-930, III-3 B 368/106. Pl. 361
Half of a mould for casting a metal object, made from the handle of a Rhodian amphora. 3.9 x 3.7 x 3.6. The surface and the edges of the mould are thoroughly flat. On it, a casting gate, L 1.5; W 0.4; D 0.25. Perpendicular to the aperture, a channel for a pin, W 0.8; D 0.5, is cut. The pin was possibly intended for making a bead, Ø 1.1; W 0.4 (the mould is probably unfinished or damaged).

Rb-29  90-574. Pl. 361
A fr. of half of a casting mould (blank), made from the handle of a Rhodian amphora. 4.7 x 3.2 x 1.5. Found in a heap of stones north of Room 301 in a layer of grey, clayey soil (at a depth of 11.1 m). On the carefully worked surface of the mould, a hole for a pin, Ø 0.7; D 0.4, is preserved.

Moulds for making terracottas

Rb-30  88-242
A fr. of a mould for making a terracotta plaque, made from light clay. 12.6 x 8.5 x 1. Found in square B-VII, squares 41 and 42 in ashy soil with inclusions of burnt clay and containing materials of the Hellenistic period. Terracotta plaques with a representation of a lion were shaped in the mould. The body, mane and muzzle of the animal are neatly cut in raw clay. Perhaps a stamp was used for making the mould. The left forepaw of the lion is raised. Above the body of the lion there is a graffito, ΣΟΚΡΑΤΟΥ (plaque [typos] of Sokrates). The preserved edges of the mould are bordered with walls, H and W 0.5.