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William M. MURRAY

*Recovering rams from the Battle of Actium.
Experimental archaeology at Nicopolis**

EVERYONE ATTENDING THIS SYMPOSIUM knows well that the famous Battle of Actium was fought just outside the straits leading into the gulf, here, on September 2, 31 B.C.¹ The combatants are as well known as the results: Octavian defeated Antony and Cleopatra to emerge the sole ruler of the Roman World, and eventually become the first in a long line of Roman emperors. Locally, he founded Nicopolis to commemorate his victory. As part of this great effort, he consecrated the site of his personal camp – his headquarters during the war in this region – to the gods Neptune and Mars. On the spot where his tent had stood he erected a massive trophy monument, adorned with bronze rams, cut from the bows of the defeated fleet (Fig. 1). As we are all learning from the excavations of Dr. K. Zachos and his team, the Actian Trophy Monument represents one of the first major monuments built by Augustus and preserves important details from its original sculptural decoration.² What you may not know is the fact that the Trophy Monument is equally important for the details it preserves about Hellenistic warships. In fact, Augustus' monument supplies the only sure dimensions we have from the big galleys that dominated the fleets of the Hellenistic Age.³

The evidence is a bit difficult to visualize, but once you understand how it works, the details are sufficient to reconstruct the prows of Antony's ships where the bronze rams attached to the bow. For this reason, Dr. Zachos asked me to join with him in a project to recreate one of the monument's biggest rams so that we could help visitors to the site gain an appreciation for the massiveness of the weapons displayed there. Because our work is an ongoing process, my presentation today must be viewed as a progress report. With this in mind, I will now attempt to explain the process we are following to accomplish the task before us.

Our attempt to fashion a reasonable ram using the memorial's evidence must begin with the sockets because they are the source of our physical dimensions. Today, thanks to the current excavations, one can make out the traces from almost 30 sockets as well as a series of bases that were set in front of the wall to receive the weight of each ram. We can see from

* Funding for this project was provided by the Mary and Gus Stathis Professorship in Greek History established by Mr. and Mrs. Stathis at the University of South Florida. I wish to thank both Gus and his late wife for their generous support of my work.

¹ For the relevant bibliography and a recent attempt to assess the battle, see MURRAY 2002.

² See ZAXOS 2001, for a preliminary description of the site, the recent excavations and the finds. For an English translation of this work, see ZACHOS 2003.

³ See MURRAY 1996.

these bases and from the length of the wall, that the original display included at least 36 rams, surely a tithe or 10% dedication from the 360 ships captured from Antony and Cleopatra during the summer long war (Fig. 2).⁴

The sockets themselves are of 5 or 6 different sizes (Fig. 3).⁵ The largest ones appear on the left end of the façade then decrease in size toward the middle and right where the smallest examples are found (Fig. 4). Since the last socket on the right (Fig. 5) held another large ram equal in size to those on the left, the display may have been laid out like the battle line of Antony's fleet on the day of the final battle, with the bulk of the fleet's large ships on the viewer's left, and the smaller ships in the middle and on the right, save for the flagship on this wing.⁶ Even if I am incorrect in this interpretation, the different sizes must correspond to the differing sizes of Antony's warships, which were considered massive by all accounts and included vessels called *dekereis*, *ennereis*, *oktereis*, *eptereis* and *exereis* («tens», «nines», «eights», «sevens» and «sixes») – ships for which little detail survives but their names.

We think that the numbers imbedded in these terms correspond to the number of men in repeating groups down the lateral side of the ship's hull. Another way to understand what is involved is to count the numbers of files down the lateral half (i.e., the port or starboard half) of the ship. Simply stated, a *trieres*, like the well-known replica *Olympias*, would have three files of men arrayed along the left (port) and right (starboard) sides of the ship.⁷ In the *trieres*, the files were arranged so that each man held an oar and that at each general oar position, there were three levels of oars. You can imagine that as the number of files along each half of the ship increased, the ship's hull became beamier (i.e., wider) and heavier to accommodate the additional lines of men. We think that for ships substantially larger than «threes», the architects introduced multiple man oars set at one, two and three levels to accommodate the extra men. Thus, if the mid-ship cross-section of a «three» looks roughly like the upper drawing in Fig. 6, we might imagine a two-banked «ten» to look like the image in the lower drawing. In this way, we can explain the surviving names of these large warships that dominated the major fleets of the Hellenistic Age. The intent of those who built these larger ships was to produce hulls that were useful for frontal ramming attacks and for naval siege warfare.⁸

In order to use the dimensions of the Actian sockets to recreate a ram that would fit it, we must first understand something of the original rams. By chance, we happen to possess an actual warship ram, which was pulled from the sea at a place called Athlit, Israel, in 1980. Figure 7 shows how this ram would have looked on the bow of its warship. Though smaller than the weapons displayed at Nicopolis and about 150 years older in date, the Athlit ram has been shown to come from a Ptolemaic warship built according to a design that is simi-

⁴ For the significance of this fact, see MURRAY 2002, 340-341.

⁵ See MURRAY & PETSAS 1989, 113-114.

⁶ The preserved dimensions of the eastern-most socket show that its original size was similar to those on the extreme western end of the façade. Its original width was roughly 1.36 m, while the width of its core measures roughly 1 m (0.98 m). These dimensions are similar to those recorded for the first 4 preserved sockets: preserved socket #1 = 1.38 m, 1.07 m; #2 = 1.50 m, 1.15 m; #3 = 1.32 m, 0.95 m; #4 = 1.525 m, 1.105 m. It is also significant that the socket immediately adjacent to the western-most one was smaller in size. If one may judge from the width of the cutting preserved on the third course block (and this may not be enough on which to base an accurate conclusion), it is slightly smaller in size than cutting (B). If preserved sockets #1-#4 are correctly identified with «tens» and «nines», then socket (B) might be appropriate in size for a «seven»; cf. MURRAY & PETSAS 1989, 113.

⁷ A complete presentation of the evidence behind the construction of *Olympias* is published in MORRISON et al. 2000; for the oarsystem of a *trieres*, see their discussion on pp. 131-150.

⁸ See MURRAY 1999.

lar to the warships whose rams were displayed at Actium.⁹ This amazing weapon, weighing 465 kg and made of high-grade bronze, holds the key to understanding how our Actian sockets worked, and how we should interpret their complex shapes and dimensions. Because its sectional shape is similar to the sockets on the Trophy Monument, we can best understand how the sockets worked by considering how we would mount the Athlit ram on the monument. Since the ram originally sheathed the bow timbers of its ship, we would first have to remove the timbers from inside the ram and cut off the tailpiece. Figure 8 shows the ram from the rear and demonstrates how it would have looked after these tasks had been completed. Our next step would be to carve a groove in the retaining wall wide enough and deep enough to receive the back end of the ram and accommodate its interior dimensions just behind the nosing piece. This sectional dimension is indicated by the letter «A» on Fig. 9, while the horizontal dashed lines represent the average height of the stone course at the Trophy Monument. The part in the middle that is left uncarved – shown as gray and white in the right diagram – corresponds to the space where the timbers inside the ram have been removed. The gray part represents the main timbers inside the ram and its mass determines the ship's ability to generate and absorb the forces of the ramming collisions.

The fact that the sockets' uncarved cores correspond so closely to the timbers within the Athlit ram cannot be coincidental and surely signifies that a similar complex arrangement of timbers existed inside the Actian rams. Stated in another way, our hypothetical Athlit socket is the same shape as the Actian ones because the timbers inside the Actian rams were configured in similar ways. This is important from an architectural point of view because we know from the 16 timbers preserved inside the Athlit ram that the mass of the unit, which I represent as gray rectangles of varying sizes in Fig. 10, is the critical element in determining the warship's power. The larger the rectangle, the more powerful the ship. Since these dimensions represent the best surviving evidence we possess for warships larger than «threes», our attempt to recreate a ram from the monument's sockets may bring us a step closer to appreciating the might of Antony's armada.

Now that we have established the relationship between the Athlit ram and the sockets of the Trophy Monument, we are in a position to consider the methodology we propose to use. Our task was really quite simple. We needed to select a socket that was well preserved and large (we chose the fourth preserved socket from the western end), and then we needed to find a way to expand the Athlit ram to fit into it. Though simple enough in theory, the process required to «expand» the ram involved three Ph.D.s in archaeology, a computer modeler and a VRML («virtual reality markup language») programmer.

Since we could not physically increase the size of the Athlit ram, we resorted to building a 3-dimensional computer model of the weapon, which we constructed from detailed drawings made by J. Richard Steffy when he examined the ram in the 1980's. These drawings, which were made at a scale of 1:10, were digitized and then used to provide coordinates for the x, y and z axes of the wire frame model.¹⁰ Donald Sanders, and a team of computer programmers at

⁹ Although the Athlit ram is too small to fit into the smallest sockets on the Trophy Monument, its cross-sectional details correspond to the sectional details of the sockets; see MURRAY & PETSAS 1989, 34-40. This fact is significant because it demonstrates that the design of the Athlit ship's bow was similar to that for the bows of Antony's largest ships. It is surely not coincidental that both the Athlit ship and Actian ships come from a Ptolemaic tradition of shipbuilding. For the evidence suggesting that the Athlit ram was cast on Cyprus during the reign of Ptolemy V or VI, see MURRAY 1991.

¹⁰ These drawings, which included top, side and cross-sectional views, can be seen in STEFFY 1991, figs. 2-8, 2-9,

the Institute for the Visualization of History, constructed the computer model so that the viewer could rotate the model and approach it from any direction.¹¹ Surface texture was provided from photographs of the ram's actual surface (cf. Fig. 11). Once Sanders and his team had completed the «virtual» (i.e., computer generated) Athlit ram, the next task involved the construction of a «virtual» 3-dimensional model of our socket. This time, the team combined measurements from detailed photographs of the socket and from a series of depth profiles I had recorded in 1986 (Fig. 12A).¹² Again, surface texture was provided from photographs of the socket's actual surface (Fig. 12B).

Once the socket had been modeled, the team scaled up the «virtual» ram to match the size and shape of the socket, making sure that any adjustments to the ram were properly and accurately spread over the entire surface of the model. This process produced a weapon that was correctly sized to fit into the socket, but it also produced a ram that was much too long and incorrectly proportioned (Fig. 13). We must remember that the length of the ram was limited by the base, placed in front of the socket that was clearly designed to support the weapon's ramming head. In order to fix these problems, the team selectively adjusted certain dimensions so that the model was not too long or too massive at the ramming head. Up to this point, we have been able to rely largely on the physical dimensions of the Athlit ram or the socket. We must next contemplate how to fashion the portion of the ram that is not reflected in the socket's dimensions, that is, the portion between the surface of the retaining wall and the end of the base that sits in front of the socket. Since everything in this space involves a «guessing game», we need to find iconographic parallels that will serve to guide our decisions. I believe there are certain clues that indicate other ram models may be preferable to the Athlit ram at this point.

Three separate examples give us important clues concerning the original appearance of the Actian rams. The first example comes from the monument itself, that is, from the sculpted decoration of the great altar atop the monument's podium. Two fragments from a single sculpted ram have been identified which clearly present the ramming head of the weapon (Fig. 14B). They show that the lateral sides of the tri-form head were decorated with three ornamental daggers or sword blades. We see the same decoration on a marble ram, now lost, that was found in the excavations of the stadium conducted by I. Papademetriou in 1940 (Fig. 14C).¹³ The final example or, more properly, class of examples comes from rams included among a mass of naval spolia sculpted in two large panels on a 1st century triumphal arch at ancient Arausio (modern Orange in southern France). The rams are almost a meter in length, are sculpted in great detail and clearly belong to large, bulky ships (Fig. 14A). Not only do they reproduce the blocky appearance seen in the first two examples found at the monument and stadium, they have the additional feature that their rear profiles duplicate the exact profiles found in the sockets of the Trophy Monument (cf. Fig. 12A with Fig. 14A). No other examples from the ancient world so closely match the profiles of the Actium sockets as do the rams from the Arausio arch.¹⁴ For these reasons, I believe that these sculptures were modeled on the

2-10 and 2-11. I would like to thank Prof. Steffy for kindly allowing us to use the original full-size drawings made at 1:10 scale and for permission to adapt his drawing of the Athlit ship for my fig. 7.

¹¹ In addition to Donald Sanders, the team included Eben Gay, Geoffrey Kornfeld and Richard C. Morse.

¹² We used the raw data behind the profile drawing published as MURRAY & PETSAS 1989, fig. 27, 4a-b.

¹³ ΠΑΠΑΔΗΜΗΤΡΙΟΥ 1940, with figs. 5-6. I am grateful to K. Zachos for alerting me to this important example.

¹⁴ Because no major sea battles had been fought between the victory at Actium and the construction of this arch, Actium still provided the best example of naval spoils for the artists who wanted to signify the emperor's su-

famous Actian rams and, thus, feel justified in using these examples in a reverse sense to guide us in fine-tuning our model.

If I am correct, these sculpted examples from Arausio provide us with clearly defined proportions for the sections of the Actian rams that sat upon the bases in front of the wall. Figure 15 demonstrates how we have started to adjust the model to make it correspond more closely to the actual profile of preserved socket #4 and the overall proportions of the Arausio rams. Although our work is far from concluded, we have produced our first attempt at a ram that might have occupied preserved socket #4 (Fig. 16). Our next task will be to adjust this model so that it more closely resembles the examples we have chosen as our guides. It seems useful to stop at this point and ask an obvious, but important, question. Have we helped you, the viewer, to visualize the great rams from Antony's fleet? And perhaps just as important – have we convinced you that our approach is sound?

Before concluding, let me demonstrate the potential usefulness of the model we are creating. Since our virtual ram is 3-dimensional, we can actually calculate how much our weapon would have weighed were it cast in bronze. If we suppose an average thickness of 1.8 cm, a preliminary analysis shows it would take roughly 4.4 tenths of a cubic meter of bronze to make this ram, and that it would weigh between 3,600 and 3,800 kg.¹⁵ Even if we follow the lesser of the two side wall dimensions of an actual ram fragment found at the site (1.5 cm) then our model produces a weight of roughly 2,300 kg (2,273 kg). This lighter estimate is still almost five times heavier than the Athlit ram.¹⁶ Such was the mass and weight of Antony's largest rams.

In conclusion, Dr. Zachos and I present this model (Fig. 17) to the members of the Symposium for constructive criticism, because after a period of evaluation and adjustment, we would like to produce an actual artifact of dense urethane foam (a plastic-like material) for display somewhere at the site. As I stated at the paper's outset, our goal is to help people visualize what was once the main feature of the Trophy Monument's south façade. Hopefully we will be able to do this, and more.

Περίληψη

William M. MURRAY: *Ανακτώντας έμβολα από τη ναυμαχία του Ακτίου. Πειραματική Αρχαιολογία στη Νικόπολη*

Σωζόμενα στοιχεία από το τρόπαιο της ναυμαχίας του Ακτίου, στις παρυφές του λόφου Μιχαλίτσι, μας παρέχουν σημαντικές πληροφορίες προκειμένου να αποκαταστήσουμε τα μεγέθη και τις μορφές των εμβόλων που λεηλατήθηκαν από το στόλο του Αντωνίου και της Κλεοπάτρας. Μετά τη νίκη του στο Άκτιο, ο Οκταβιανός εξέθεσε 36 έμβολα στην πρόσοψη ενός μακριού αναλημματικού τοίχου. Μία μεγάλη αφιερωματική επιγραφή τοποθετήθηκε στην κορυ-

premacyp over land and sea; see MURRAY & PETSAS 1989, 101 with figs 56-57. For the arch itself, see AMY et al. 1962, particularly plates 24-27 and 84-88.

¹⁵ The density range for standard bronze (at a 10:1 ratio of copper and tin) varies between 8.35-8.65 g/cm³; 0.44 m³ (= 440,000 cm³) of bronze would weigh between 3,674,000 to 3,806,000 g or 3,674-3,806 kg or 3.674-3.806 tons. I am grateful to Cemal Pulak for these data.

¹⁶ The Athlit ram weighs 465 kg. We hope to refine this calculation as we refine our model's dimensions.

φή του τοίχου. Εκτός από ένα μικρό θραύσμα, όλα τα έμβολα έχουν προ πολλού εξαφανιστεί, αλλά παραμένουν οι λαξευμένες υποδοχές που συγκρατούσαν τα έμβολα στην όψη του τοίχου. Χρησιμοποιώντας τις μετρήσεις των πιο καλά διατηρημένων υποδοχών, είναι δυνατόν να αναπαραστήσουμε τα μεγέθη και κατά προσέγγιση τη μορφή πολλών εμβόλων που εκθέτονταν κάποτε στο μνημείο. Η παρούσα ανακοίνωση εκθέτει τη διαδικασία μέσω της οποίας μπορεί να πραγματοποιηθεί αυτή η αναπαράσταση. Η διαδικασία αυτή περιλαμβάνει τρία στάδια:

1. Τη δημιουργία ενός τρισδιάστατου ψηφιακού μοντέλου του εμβόλου του Athlit, βάρους 465 κιλών, χρησιμοποιώντας απευθείας μετρήσεις, σχέδια του εμβόλου σε κλίμακα και φωτογραφίες.
2. Τη δημιουργία ενός τρισδιάστατου ψηφιακού μοντέλου των καλύτερα διατηρημένων από τις μεγάλες υποδοχές στον τοίχο, χρησιμοποιώντας απευθείας μετρήσεις, σχέδια της υποδοχής σε κλίμακα και φωτογραφίες.
3. Τη δημιουργία τρισδιάστατου ψηφιακού μοντέλου ενός εμβόλου του οποίου οι διαστάσεις θα ταιριάζουν με αυτές της ψηφιακής υποδοχής που δημιουργήσαμε στο στάδιο 2.

Τελικός σκοπός αυτής της διαδικασίας είναι να κατασκευάσουμε ένα φυσικό μοντέλο ενός εμβόλου από πυκνό μείγμα πολυουρεθάνης και να το μεταφέρουμε στον αρχαιολογικό χώρο του μνημείου. Το πείραμα αυτό παρέχει όχι μόνο μία εντυπωσιακή εικόνα, αλλά μας βοηθά να κατανοήσουμε τον τρόπο με τον οποίο κατασκευάστηκαν οι πλώρες των πλοίων του Αντωνίου και τη διαδικασία εισχώρησης των εμβόλων στις λαξευμένες υποδοχές τους στο μνημείο.

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William M. MURRAY

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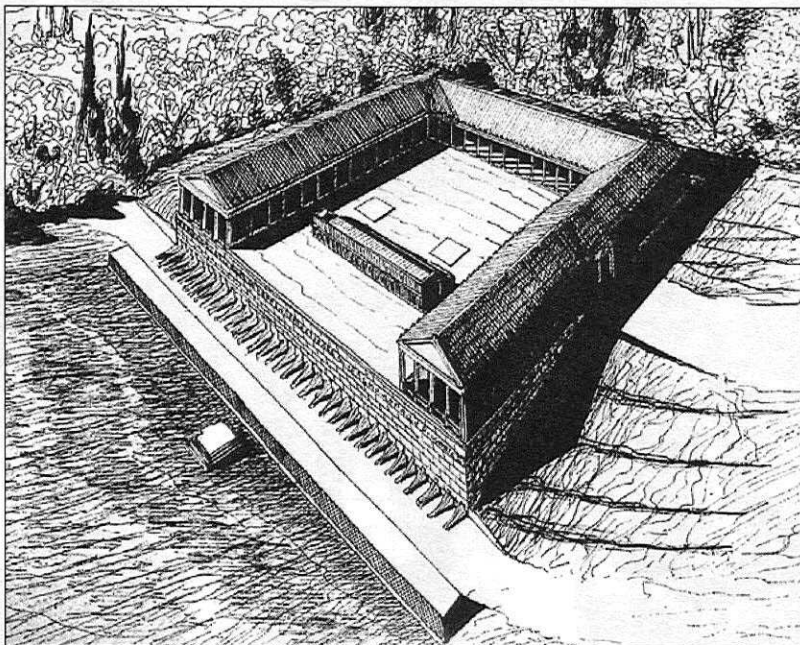


FIGURE 1: *Actian Trophy Monument from the southeast, restored view*



FIGURE 2: *Actian Trophy Monument, ram terrace showing sockets and bases*

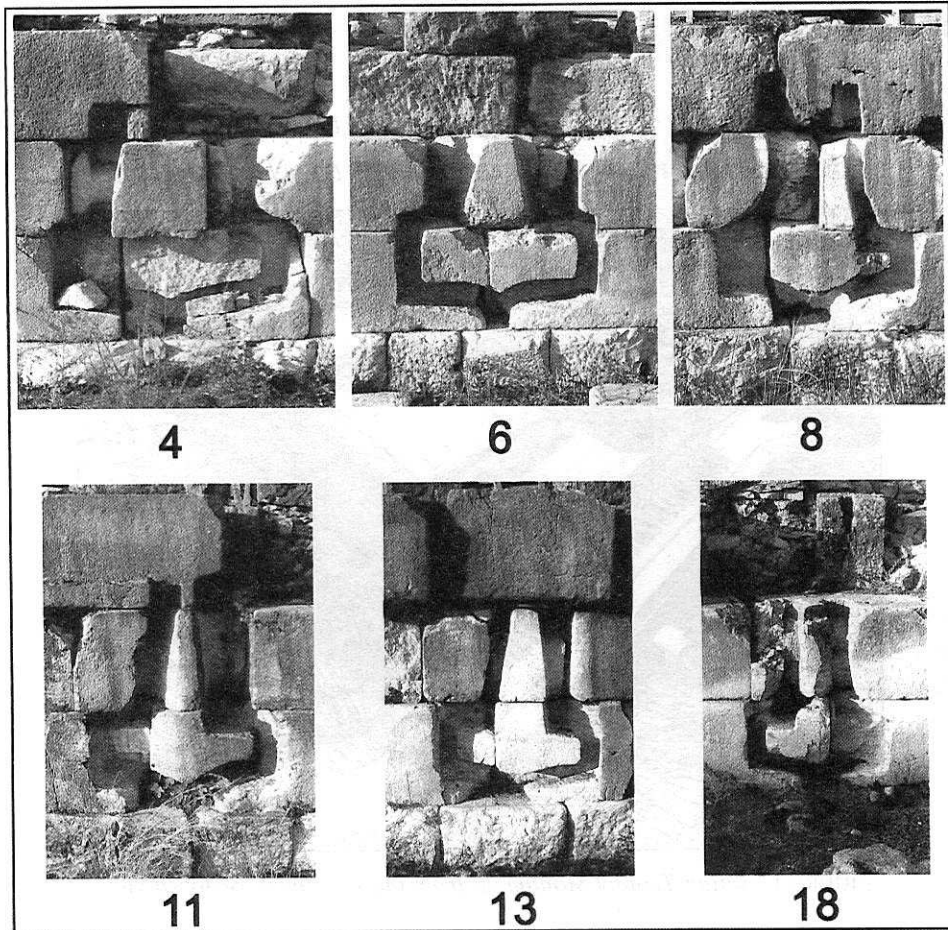


FIGURE 3: *Preserved ram sockets (numbering from the west)*
#4, #6, #8, #11, #13 and #18



FIGURE 4: *Actian Trophy Monument, July 2002*



FIGURE 5: Eastern end of the ram façade, preserved socket block in situ

FIGURE 5: Eastern end of the ram façade, preserved socket block in situ

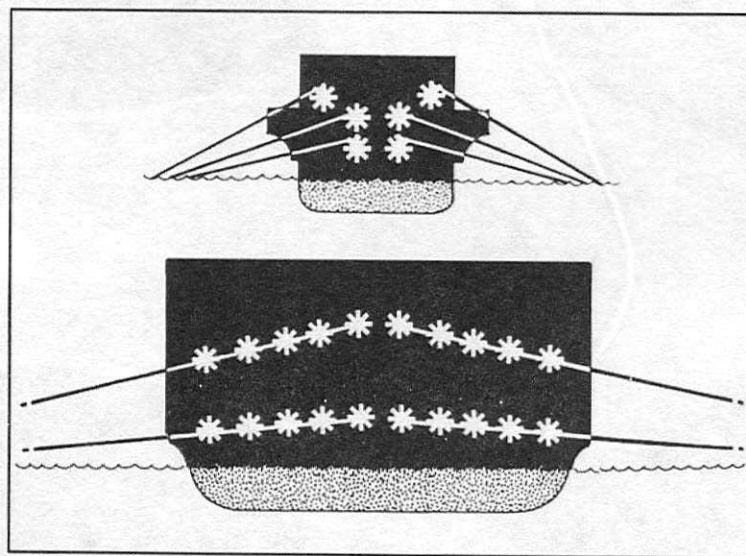


FIGURE 6: Rough cross-sectional mid-ship views of «three» (upper diagram) and a «ten» (lower diagram)

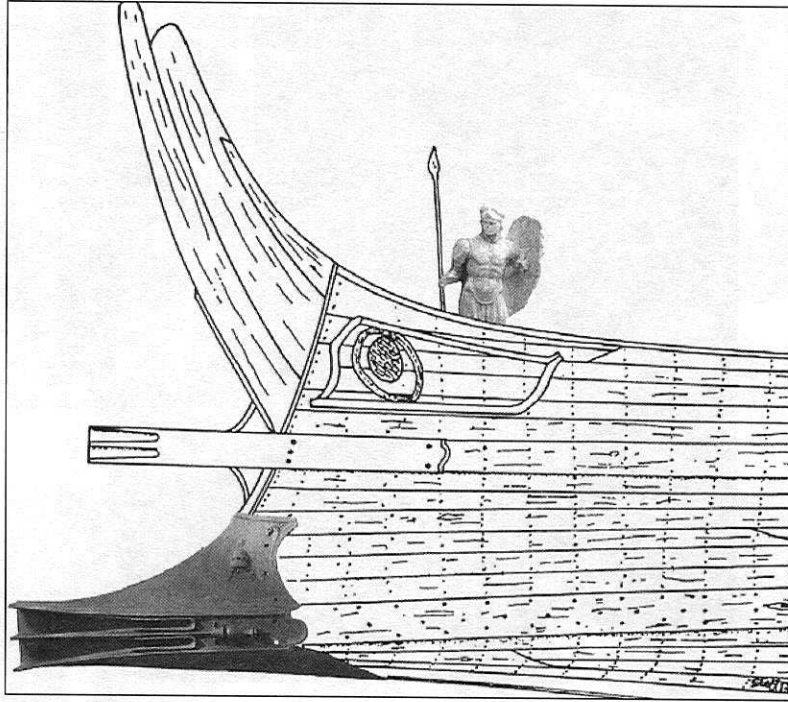


FIGURE 7: *Bow of the Athlit ship (after a drawing by J.R. Steffy), restored view*

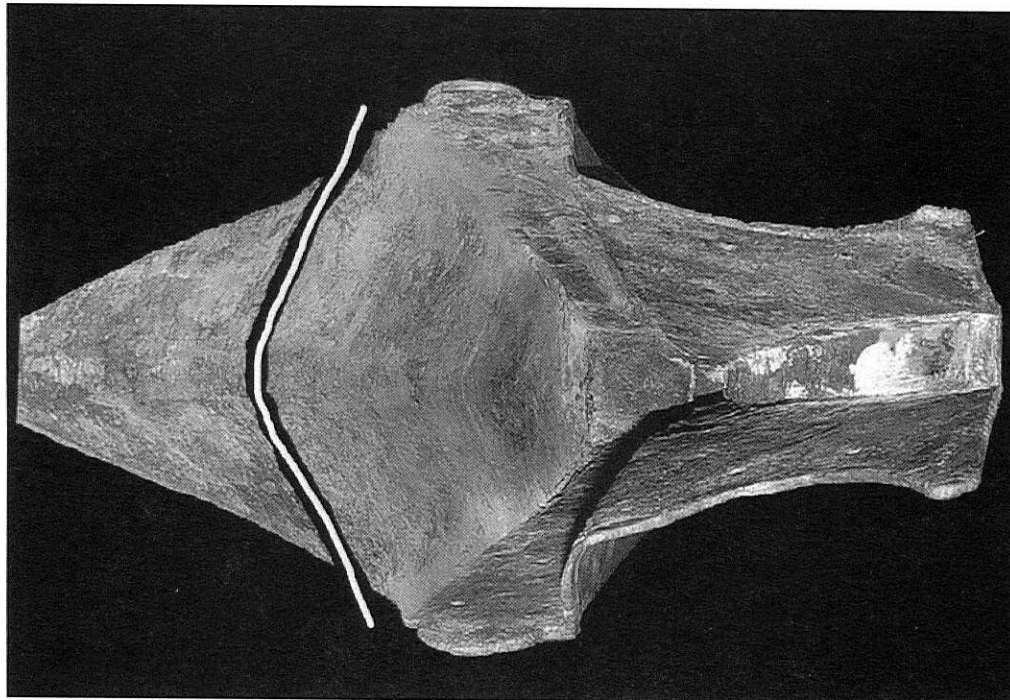


FIGURE 8: *Athlit ram, view of interior from the rear*

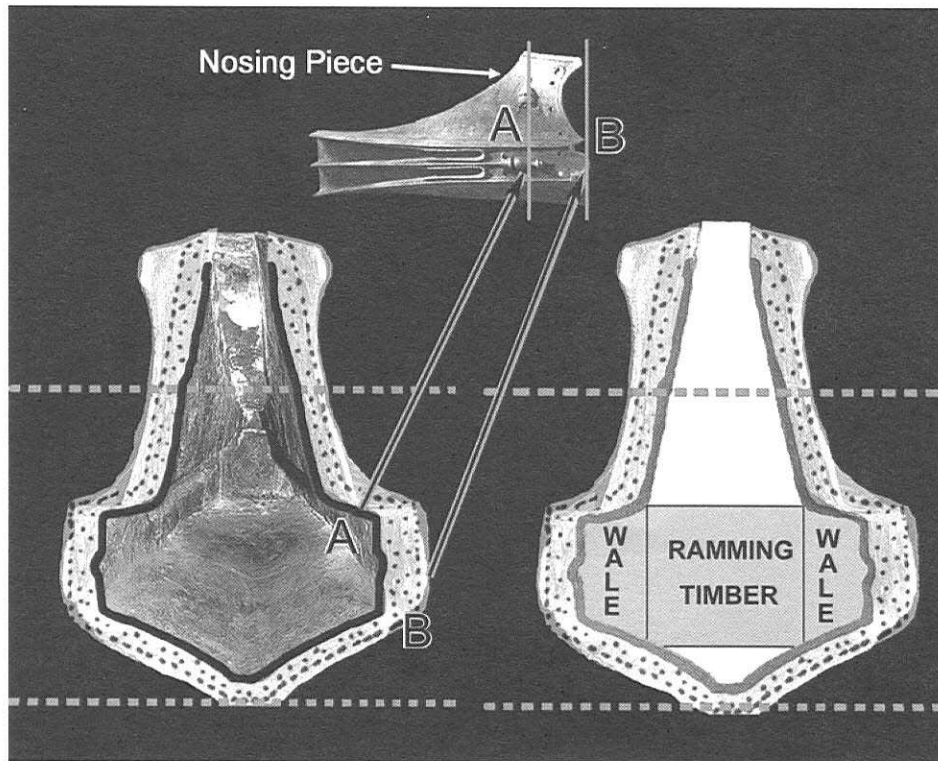


FIGURE 9: *Left: Hypothetical socket to fit the Athlit ram; Right: Core of hypothetical Athlit ram socket showing original configuration of wale/ramming timber unit (shown in gray)*

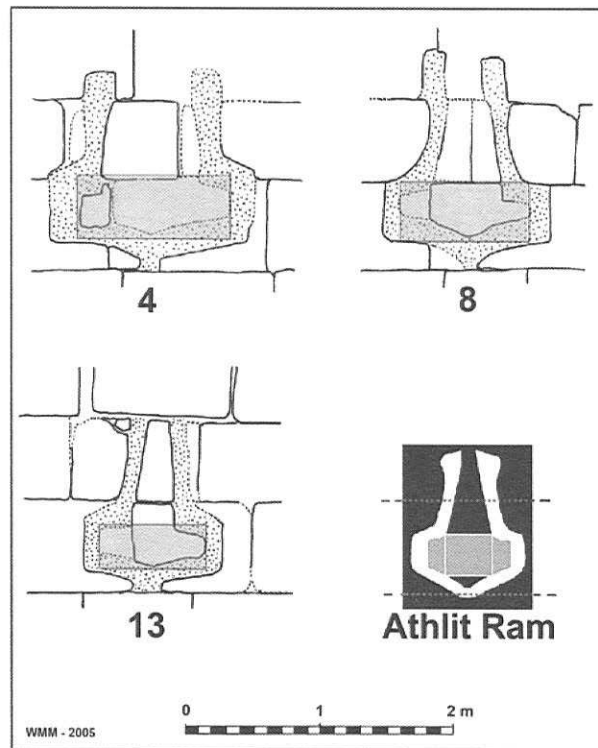


FIGURE 10: *Wale/ramming timber units (shown in gray) for preserved sockets #4, #8, #13 and for the hypothetical socket for the Athlit ram*

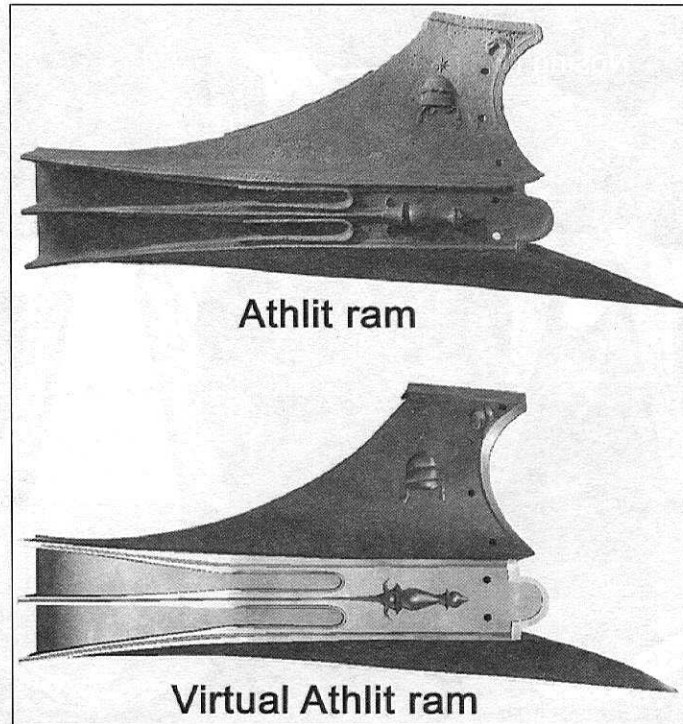


FIGURE 11: *Athlit ram and «virtual» Athlit ram, side view*

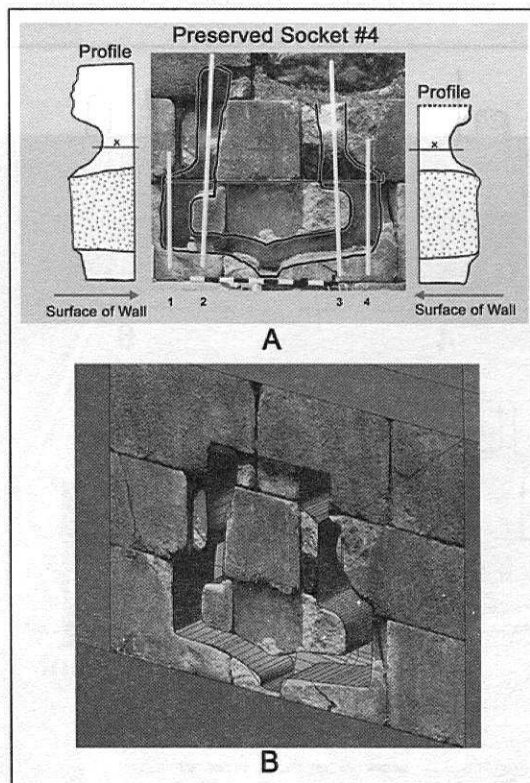


FIGURE 12: *A: Creation of «virtual» socket #4 from profile drawings and photographs; B: «Virtual» socket #4*

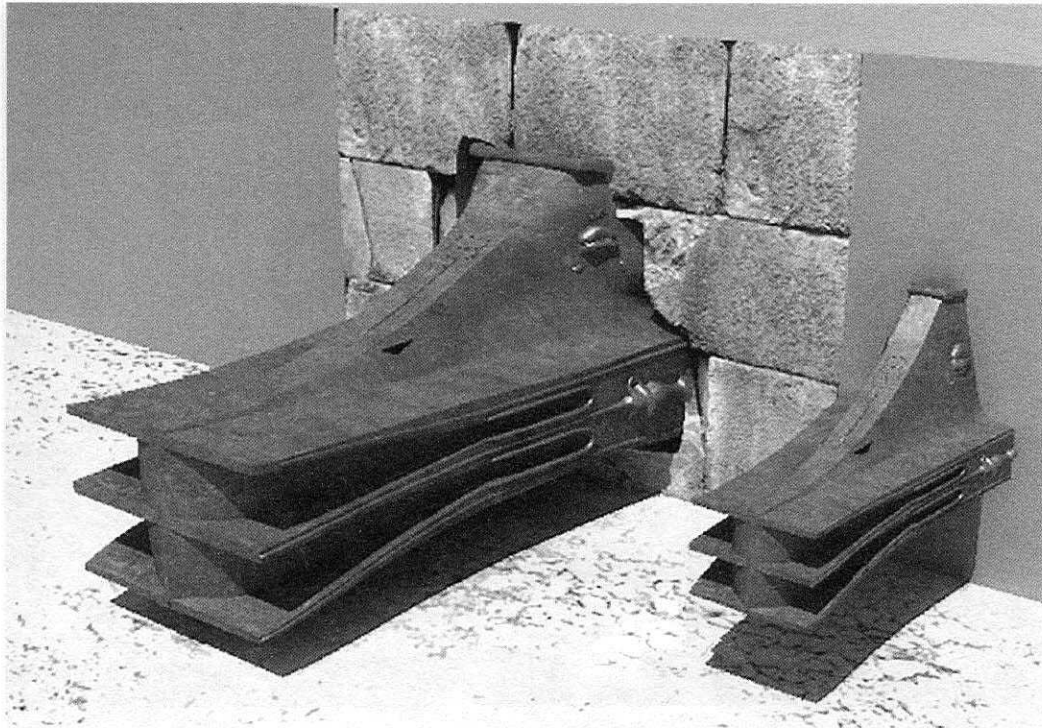


FIGURE 13: *Athlit ram sized for socket #4*

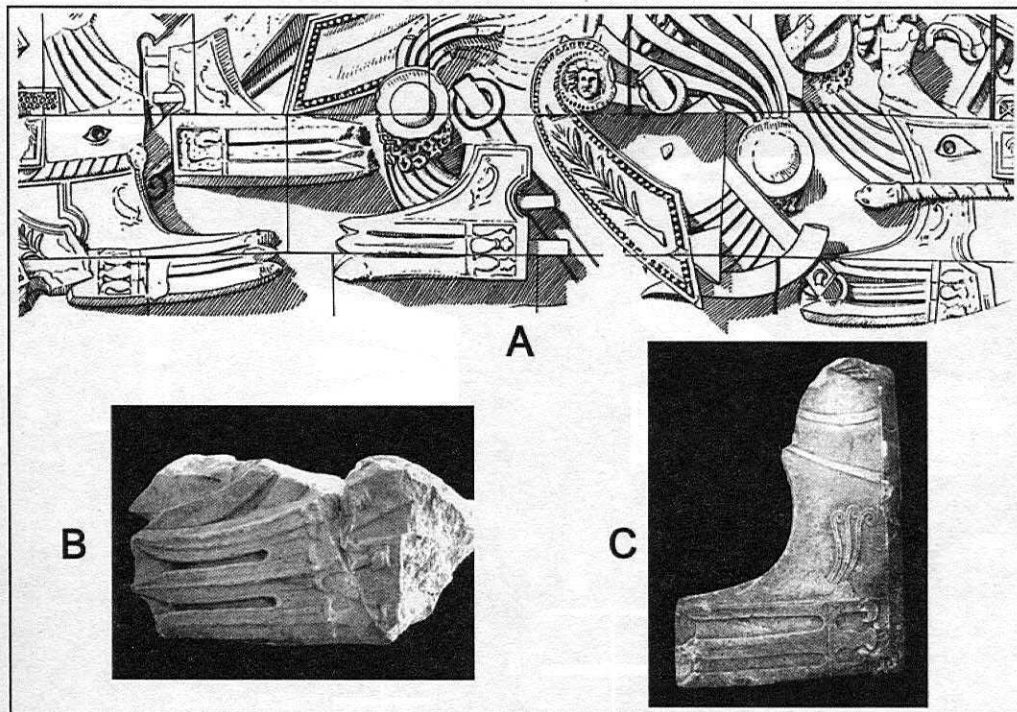


FIGURE 14: *A: Actian (?) rams from the Roman arch at Arausio (modern Orange);
B: Sculpted ram from the Actian Trophy Monument;
C: Sculpted ram (now lost) from the stadium area at Nicopolis*

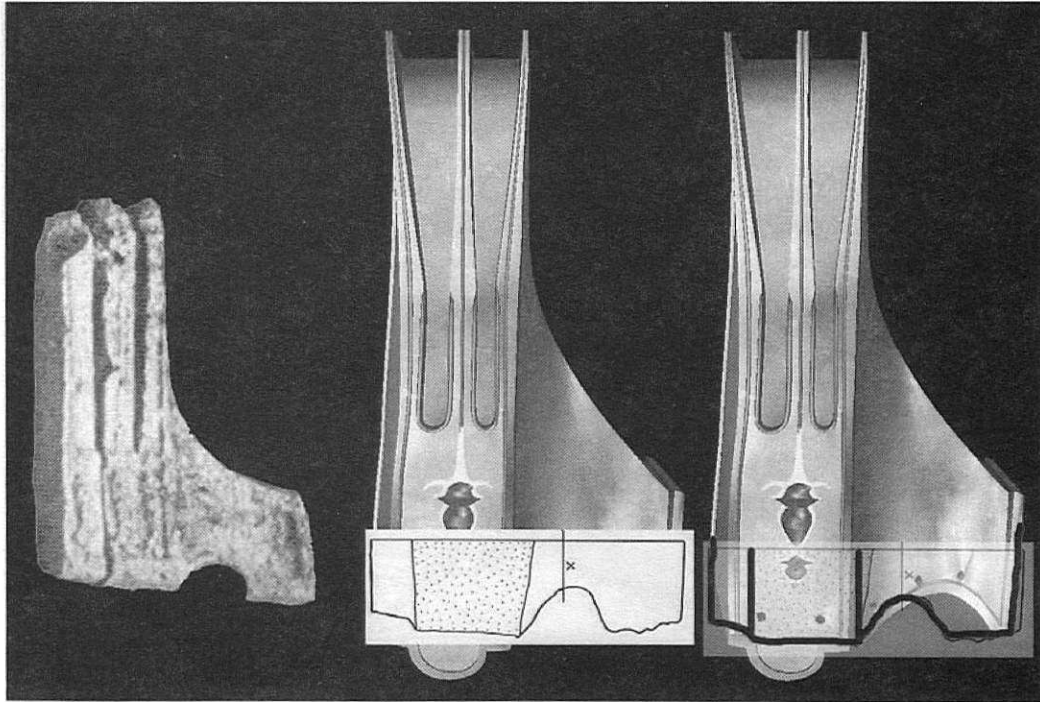


FIGURE 15: *Adjustment of «virtual» ram to match profile and dimensions of Actian rams*

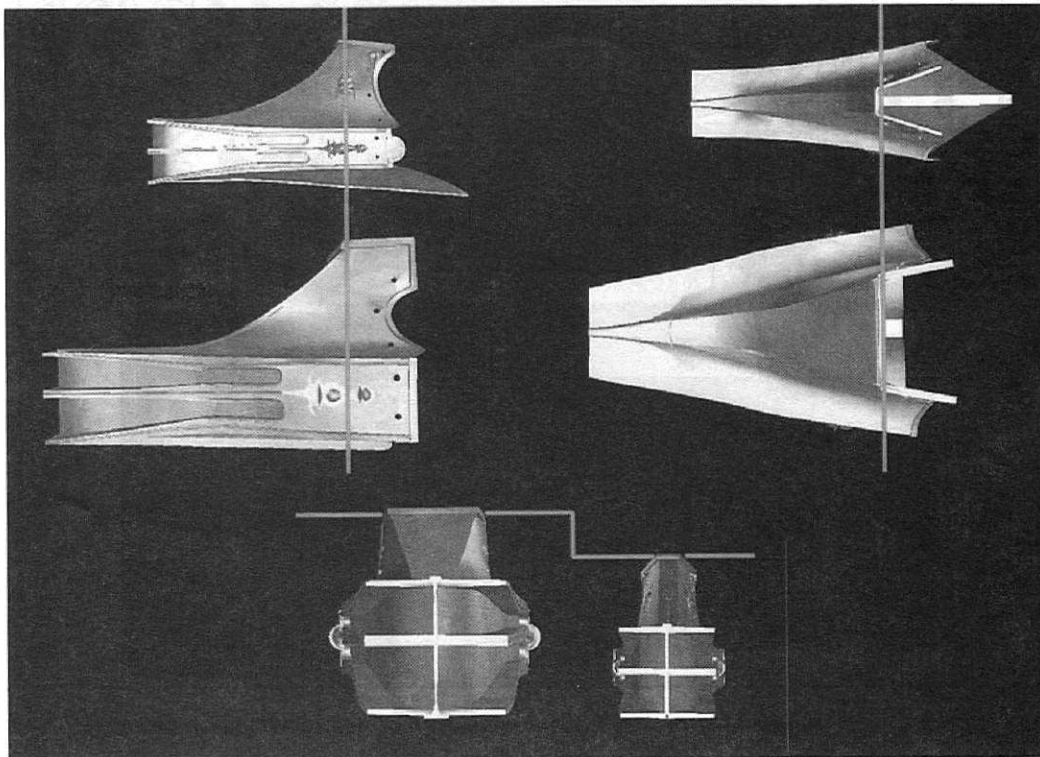


FIGURE 16: *Actian ram model, side, top and front views*

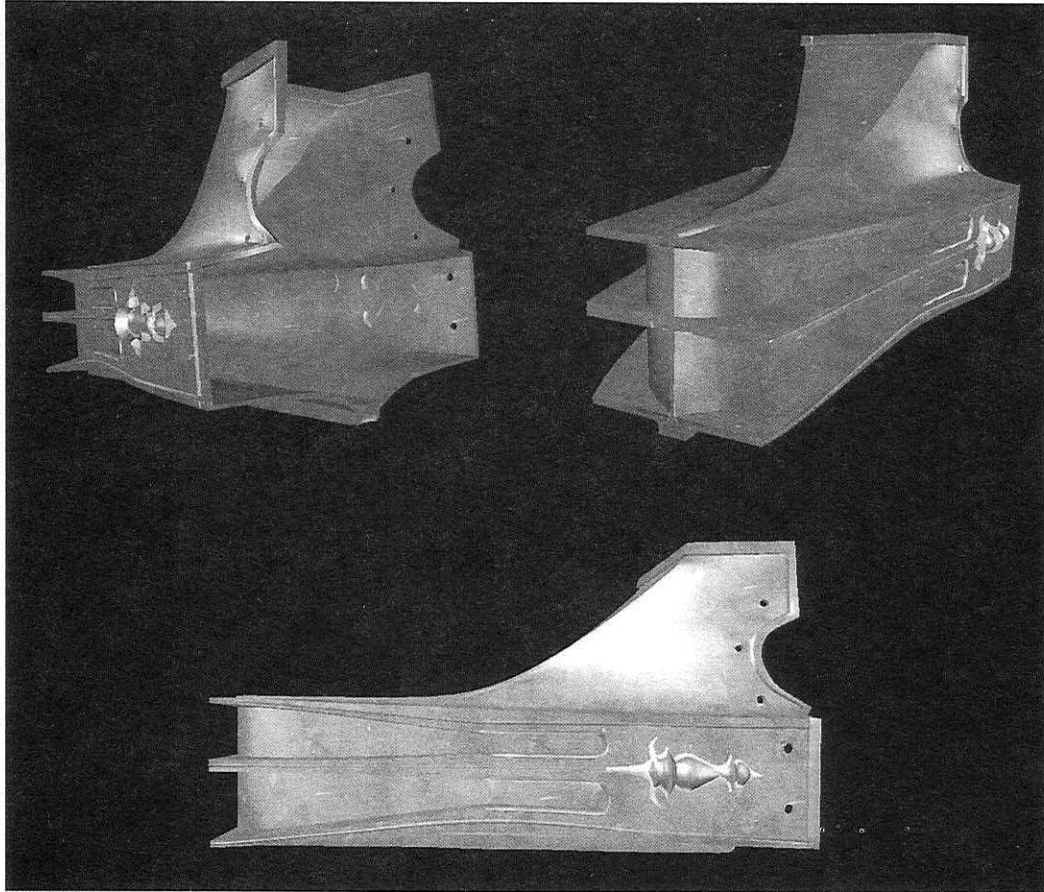


FIGURE 17: *Actian ram model, side, front and rear quarter views*

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