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WRECK W-6. A PRELIMINARY REPORT

THE UNDERWATER ARCHAEOLOGICAL RESEARCH PROGRAMME AT THE POLISH MARITIME MUSEUM, GDAŃSK

When I founded the Maritime Museum in Gdańsk back in 1960, I hoped that one of the ways of acquiring collections of maritime objects of historical interest would be underwater explorations in Polish territorial waters in the Baltic. Since such work had not been undertaken before in Poland, a long-term underwater study programme had to be conceived if my intention that explorations like these were to be a permanent aspect of the Museum's activities was to be realised. Very generally, my programme envisaged two phases of work. In the first instance, I planned to carry out searches to record what wrecks were lying at the bottom of Polish waters. Once these had been mapped, we would go on to the second phase, in which the most interesting, selected wrecks would be explored.¹

At the same time, I thought that if these operations were indeed to become part of the Museum's everyday work, we should have some kind of Department or Centre of Underwater Research, which would have its own ship, team of divers and suitably equipped conservation facilities.

At the start, however, I began the inventory works in yachts and motor launches made available to us by sailing clubs and in vessels loaned by the Gdańsk Port Authority. In the underwater operations I was assisted by the members of amateur diving clubs²,

¹I have described in greater detail the origin and development of the Polish Maritime Museum's underwater research programme in a number of articles, including: *Poszukiwania i badania podwodne w Zatoce Gdańskiej*, "Nautologia" 1976, vol. 11, No 1, pp. 22-31; *Underwater archaeological investigations in Gdańsk Bay*, "Transport Museums" 1979, vol. 6, pp. 48-66; *The genesis, present state and prospects of Polish underwater archaeological investigations in the Baltic*, "Acta Universitatis Nicolai Copernici, Archeologia" 1983, vol. 9, pp. 6-38; *Badania podwodne w Bałtyku w latach 1979-1986*, "Kwartalnik Historii Kultury Materialnej" (abbr. KHKM), 1987, vol. 35, No 3, pp. 465-495.

²At that time, divers from the local diving clubs "Neptun", "Kotwica", and "Rekin" were helping us with our investigations. The "Neptun" club later set up an archaeological section, whose sole purpose was to assist the Museum in its underwater activities and several members of the "Kotwica" club of Gdynia transferred to it. This group of divers was trained by the Museum, and in time became experienced.

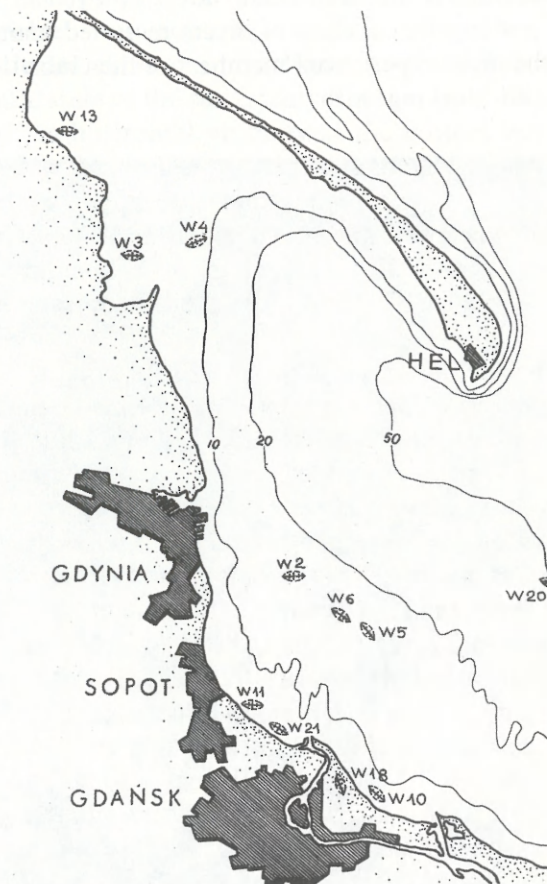


Fig. 1. Chart of the position of the W-6 wreck against the background of some other wrecks in the Gulf of Gdańsk, located during inventory searches conducted by the Museum, or about which the Museum was notified.

Drawn by L. Nowicz

and the objects we recovered were sent for conservation to the Archeological and Ethnographical Museum in Łódź.

At the turn of 1973-1974, the Department of Underwater Research at last began to take shape. The main thing was that at the end of 1973 we acquired our first research vessel. This was a withdrawn, wooden fishing cutter of the B-12 class, belonging to the "Koga" fishery enterprise in Hel. 24 m long and 6,40 m wide, she was fitted with a 3-cylinder 200-225 H.P. Völund engine which worked up a speed of 9 knots. She had 9 bunks in the cabins, a galley, a mess and quite a sizeable hold (which at times served as a dormitory for larger teams of divers). We christened her "Modra Woda". She remained in the Museum's service till 1975, when we

managed to get another cutter of the same class but in much better condition. This vessel we named "Wodnik". After the necessary adaptations, she was a much more comfortable boat and was to be our research vessel for the next 12 years.

At the same time, we began to organise our own conservation laboratory. (At present, 4 chemical engineers and 4 lab. technicians are employed in it). I also got together a team of divers recruited mainly from the most experienced members of the clubs that had been working with us.³

hard currency. This meant that carrying out many simple underwater tasks consumed an excessive amount of time and effort. Many a time, the methods or techniques we employed were dictated by the kind of equipment and devices that were available to us.

Before commencing the underwater work, I studied the archives. This enabled me to draw up a list of emergencies and disasters which had occurred in Polish waters. This list, together with information from fishermen and the inhabitants of seaside villages etc. about wrecks they had noticed,

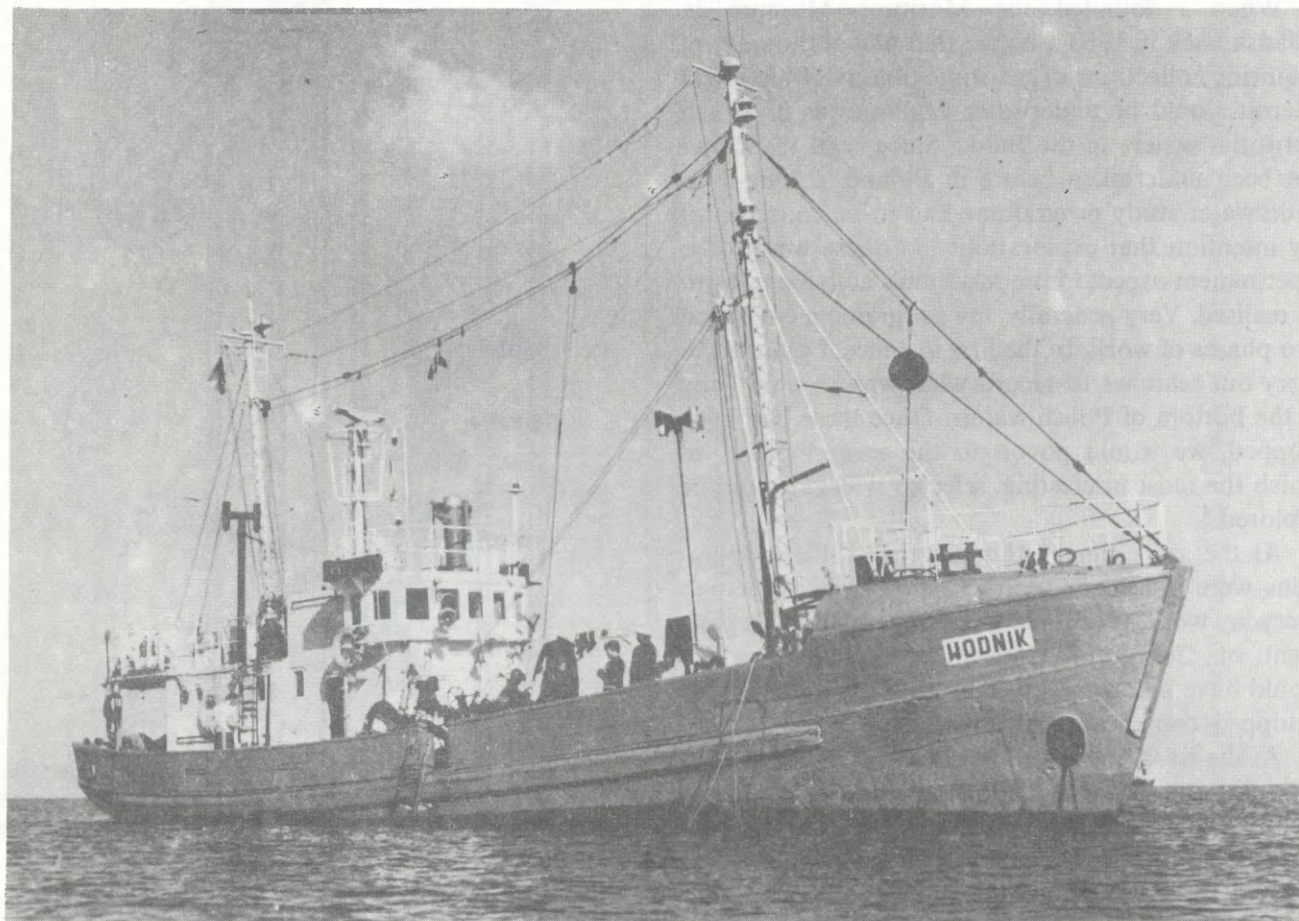


Fig. 2. "Wodnik", the Polish Maritime Museum's research vessel during the years 1975–1986.

Photo. L. Nowicz

So from 1974 onwards, with our own research ship, Conservation Laboratory and trained diving team, we were able to carry on our explorations on a continuous basis, independent of outside assistance.

Unfortunately we were unable to get certain pieces of equipment which can only be purchased for

³The Museum's diving team comprises 3–4 persons. The chief diver, photographer and draughtsman is Mr Lech Nowicz. He has been taking part in our explorations since 1970, first as a member of the "Neptun" club and when the Museum set up its own diving team as our employee. Mr Zbigniew Jarocki has been participating in our work for 16 years, and Mr Ryszard Sucholewski for a slightly shorter time.

and other material on wrecks obtained from port authorities, harbour masters' offices, dredging companies etc., was the point from which we started recording in the late 1960s. We began with Gdańsk Bay, which from the archaeological point of view, may be considered the most interesting section of the Polish territorial waters. I divided the Bay into sectors which are gradually being surveyed.

Wrecks which we have discovered or have been informed about by outside sources are mapped and given a code: W-1, W-2 etc. (= wreck no. 1, wreck no. 2, etc.). Every find receives its own file which contains a report about the find, a map showing the

wreck's position, drawings and sketches, photographs, a written description of the site, and suggestions about what to do with the find.⁴

Although it was my intention to start systematic excavations of the most interesting wrecks only after we had accumulated a sufficient amount of inventory material, circumstances compelled us to deviate from the path we had planned to take.

At the end of the 1960s, work was in progress on the building of the North Port in Gdańsk, and the Port Authority was carrying out technical operations in the area intended to be the anchorage for this port. This work revealed several wrecks, whose existence was reported to the Museum. And when work was started on constructing the transshipment facilities on land and dredging the port basins, more wrecks were come across.

Obviously, this construction work could not be halted, but we were permitted to undertake salvage operations. On the roadstead, however, thanks to the kindness and assistance afforded us by the Gdańsk Port Authority, we were able to carry out a systematic search of number of wrecks.

Circumstances forced us to carry out this salvage work and systematic excavations at the same time. This was an exacting task, especially as in fact we had only just started our underwater activities. So according to the situation, we had to work now on one, now on another wreck. Two of them, however, we regarded as top priorities.⁵ One of them — codename W-6 — is the subject of this article. This wreck was the first larger underwater object which we excavated in a systematic manner.

THE EXCAVATION OF WRECK W-6

Wreck W-6 was discovered on 20th October 1969 in the Gdańsk roadstead during technical preparatory work on the North Port anchorage. The divers of the Polish Ship Salvage Company who had come across the wreck raised 12 cannon from it. Seeing that the wreck was of historical interest, we were informed about it and the cannon were passed on to us.⁶

The preliminary survey which we undertook straight after receiving this information brought the following facts to light.

⁴P. Smolarek, *The genesis...*, p. 14 et seq.

⁵P. Smolarek, *Centralne Muzeum Morskie w Gdańsku w latach 1960–1974*, "Rocznik Gdański" 1974–1975, vol. 34–35, pp. 251, and *Badania i wydobywanie wraka W-5*, KHKM 1979, R. 27, No 3, pp. 291–311.

⁶P. Smolarek, *Odkrycie zabytkowego wraka w Zatoce Gdańskiej*, KHKM 1970, R. 18, No 2, pp. 339–346.

The wreck's position was 54°28'N and 18°42'E, and thus on the approach course to the „old port”, some 3 nautical miles north-east of the mouth of the Vistula. Ships waiting for entry to Gdańsk would cast anchor in this area. The wreck was lying in c. 14–15 meters of water, on a flat, sandy bottom devoid of flora.

The visibility in the water at that time was variable. For example, on 17th November, with moderate cloud cover, a Force 4–5 wind from the south, state of the sea 2, the vertical visibility was 6 m and the horizontal visibility at the bottom was 9 m. On 23rd November, the sky was completely overcast, there was continuous drizzle, a Force 2–3 SE wind, and the state of the sea was 1, visibility was 6 m in the vertical and 3–4 m in the horizontal. The water temperature at the bottom was 6°C, the air temperature was 8°C.

Lying on a SE–NW axis, the wreck at first sight looked like a low hill or heap some 25 m long, 9 m wide and 1,5 m high. This heap was due to the ballast stones which were encrusted with mussels. The fissures between the mussels were filled with sand. Along the edges of these heaps, fragments of the wooden hull construction could be seen. At either end of the “hill” the remains of the stem and stern posts could be made out. What was left of the stern-post protruded from the bottom with a slight list to starboard, and the remains of the stem lay about 5 m in front of the fore part of the wreck. Cannon barrels were lying on the ballast stones, along the sides of the wreck and between the wreck and the stem. The still-legible dates on their first reinforce sections showed that they had been cast at the end of the 16th and at the beginning of the 17th centuries. An inspection of the surface layer of ballast stones revealed other objects of historical interest. It was likely that the wreck was what remained of the hull of a warship which had sunk in the 17th century, possibly in the first half of that century. This was encouragement enough to undertake a systematic exploration — in any case, to leave the wreck where it was, i.e. on the site of the future anchorage, was tantamount to its almost certain destruction.

On the basis of this survey we began to make preparations at the turn of 1969–1970 to explore the wreck in detail.

We began our excavation in the summer of 1970 by “organizing” the site. The Gdańsk Port Authority placed a light-buoy beside the wreck and had a warning for ships printed in its *Wiadomości Żeglarskie* (*Shipping News*). Our research ship, which served as the base for the underwater operations, moored at this buoy. We went down to the bottom at this buoy too. Because of the poor visibility in the water in

summer⁷ and the distance between the buoy and the wreck we laid out a white rope and "signpost" from the anchor of the buoy along the bottom marking the "path" to the wreck. Boards were erected on the seabed showing where the bows and stern of the wreck were.

On the first day that we went down to the wreck I started an "Investigations Log" in which every activity connected with our work on the wreck from the first day to the last was described. The entries included the time the research ship left port, who was in the research team, the time of arrival at the site, the weather conditions at the site, the water temperature, vertical and horizontal visibility in the water, the research tasks for the day and the object of every

individual dive (this included the time of the diver's entry into the water and of his return on board). Immediately after his return on board from the water, the diver gave a verbal report of what he had done, and his observations were entered in the Log. The narrations were illustrated by sketches and drawings made in the Log to elucidate certain operations, measurement techniques etc.⁸

Once the site had been "organized", the next job was to put in place a rigid measurement framing screwed together from metal tubes. This framing comprised a rectangle 33 × 11 m which encompassed the wreck entirely. The two longer sides were numbered at 1-metre intervals from 1 to 33, the shorter ones were lettered from A to K. The metre sections of

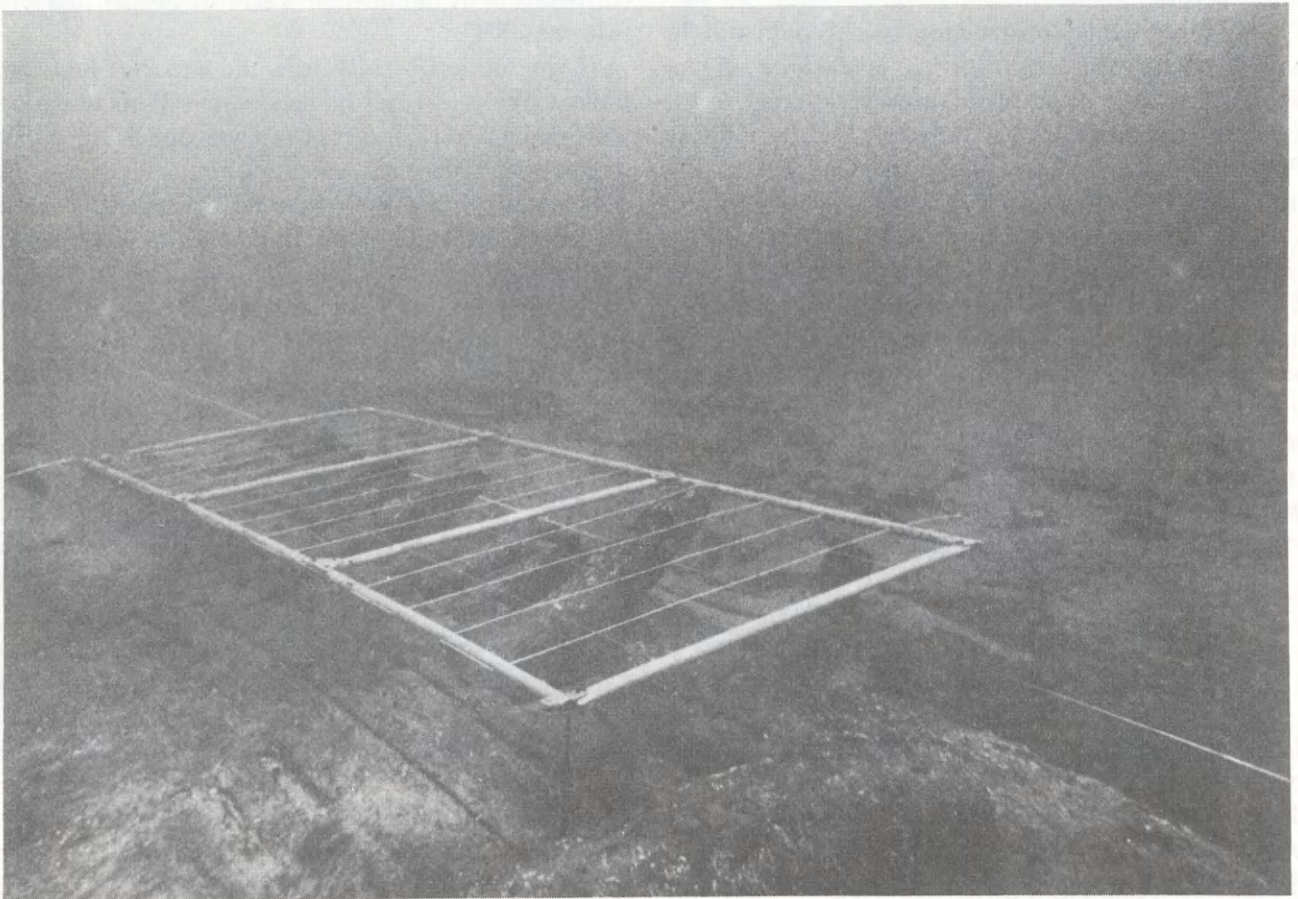


Fig. 3. 1 × 3-m. grid used for drawing details during the exploration of the W-6 wreck.

Photo. L. Nowicz

⁷In the summer months, the warmest and for many reasons the most suitable for underwater work in Gdańsk Bay, the horizontal visibility on site was usually the worst, 2–4 m on average, although there were times when it was worse still (e.g. c. 0,30 m), and also far better (over 5 m). In autumn, from about mid-September onwards, the horizontal visibility improved. For example, in October 1977 it ranged from 6 to 12 m. In the same month in 1978, the horizontal visibility was from 7 to 10 m. Conditions were also good in early spring.

the frame were painted alternately yellow and black. After levelling the framing, ropes were passed horizontally and transversally through hooks welded to the sides of the framing. Where the ropes intersected they were tied with copper wire. In this way the whole

⁸The explorations of wreck W-6 were described in 8 volumes of the "Log". They are in the Museum's archives.

wreck was covered with a network of squares, each 1 m^2 in area. There were 363 squares in all. Each was furnished with a white metal tag with the number of the square, e.g. A 1, B 14 etc. painted in black. When later excavations revealed that some parts of the wreck were lying beyond the frame, around the stern additional squares were laid and given the numbers A 01, A 02, A 03, A 04 etc.

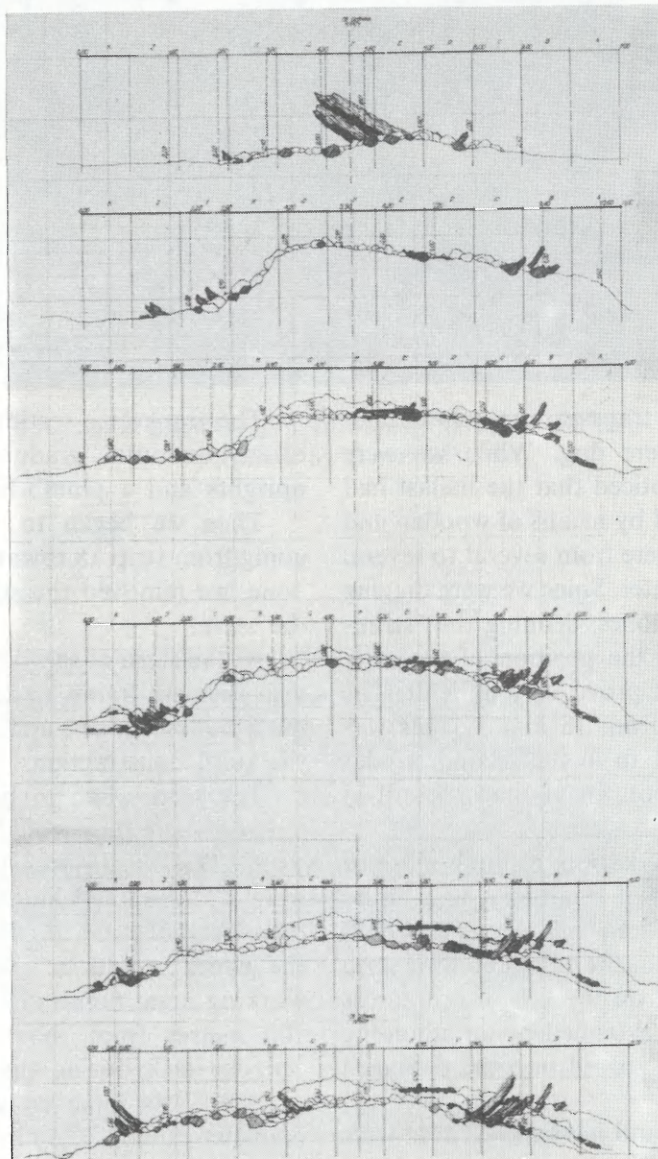
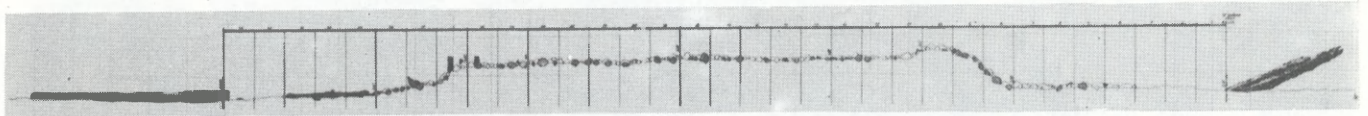
Following this we set about recording the surface layer in photographs and drawings. As the transparency of the water was poor (no better than 30 cm), we began with the drawings. The divers did the

drawings on canvas-covered boards on which every square was marked to scale. Their drawings were then re-drawn on board ship on a general plan to the scale 1:5.

So in August 1970 the first general plan of the wreck, shown in Fig. 4, 5 was ready. Longitudinal and transverse profiles also were drawn.

When the visibility improved, we photographed the surface layer square by square. The final plan of the surface layer was constructed from a comparison of the drawings and photographs.

Before setting out on our next task, we established



Figs. 4. and 5. Longitudinal profile (plotted along the wreck's axis of symmetry) and transverse profiles of the W-6 wreck, carried out in summer 1970.

Drawn by W. Krzyżaniak

a "Field Acquisition Book" in which every object of historical interest found was entered. The entry in the Book included the date it was recorded, a description, information on its position (e.g. number of square, horizontal and vertical position), a drawing with dimensions or a photograph. Every object recovered was given an inventory number.⁹

fewer inner planking strakes preserved here: only 4 on the starboard side, and 9 on the port side.

The trenches dug, we were able to make drawings of the transverse sections of the hull. Together with the profiles and drawings made earlier, they suggested that the ship had come to rest more or less on its keel, with only a slight starboard heel.

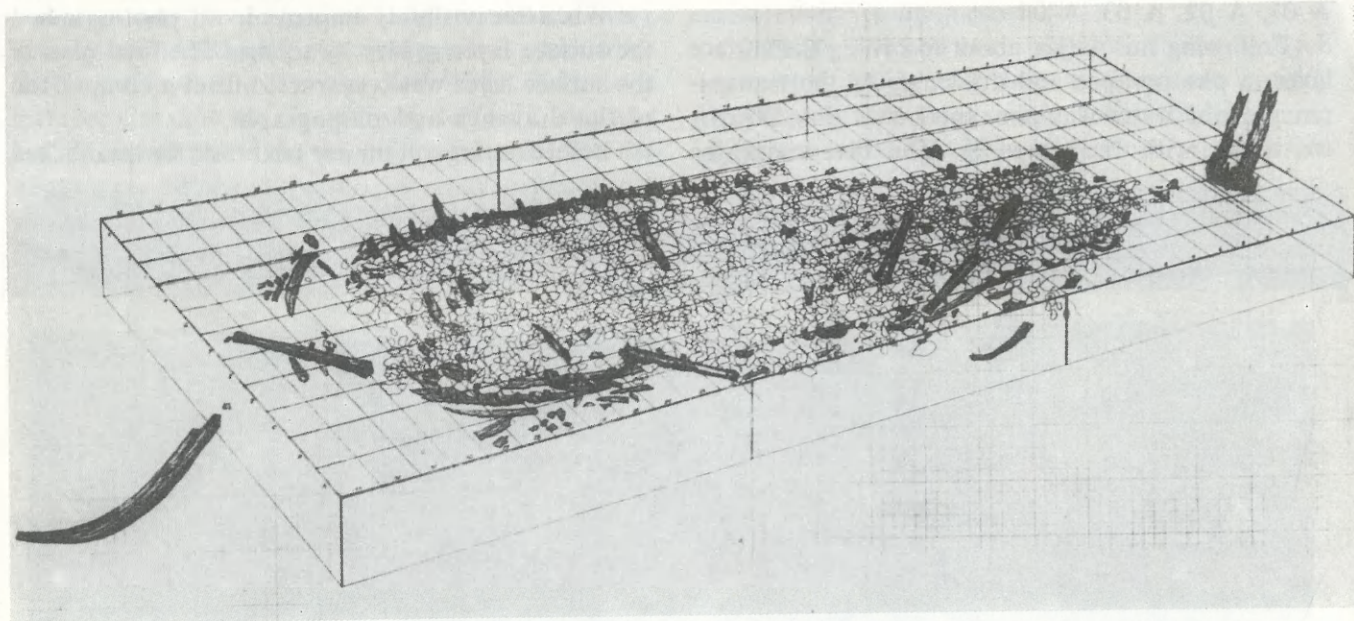


Fig. 6. Measuring frame and overall plan of the W-6 wreck — perspective projection — carried out in summer 1970.
Drawn by W. Krzyżaniak

Now, in lanes 8 and 18 transverse trenches about 1 m wide on average, were dug. While we were removing the stones, we noticed that the ballast had been deliberately reinforced by means of wooden and stone wedges. The stones were from several to several tens of centimetres in diameter. Since we were digging a trench across the large stones, defining the "stratigraphic cross-section" and the position of the artefacts in the ballast did not prove very difficult. The ballast layer we removed from 18 and 8 lanes was higher in the first trench than in the second. Under the stones we found the bottom of the hull still in good condition.

In strip 18 we found the keelson, running more or less along the wreck's axis of symmetry, and either side of it 10 strakes of the inner planking; the tenth strake began the bilge. From the side adjoining strip 17 a bottom timber placed on the keelson ran across the hull. To the left it was extended by an adjoining fragment of a frame which passed into the damaged port side.

The keelson was also found in strip 8. There were

The transverse sections were drawn with the aid of a horizontal graduated tube, resting on two uprights and a plumb-line.

Then we began to remove the ballast stones, going from strip 18 towards the bows. Once that was done, we removed the stones from strip 18 towards the stern.

At the stern of the wreck, between strip 4 and the measurement frame, under a layer of sand, we found more ballast stones, and under these, the remains of the stern construction.

The stones had to be taken from the wreck to a place where they would not interfere with our later work. This meant transporting a very considerable weight. A simple chute with a suitable slope was therefore constructed, down which the stones from the wreck would be rolled to a spot beyond the working area. Some of the stones were taken some 100 metres from the wreck. This was the most onerous task during the entire W-6 project.

Sand was removed with a 100 mm or 70 mm diameter ejector. The air-lift nozzle brought the sand to a basket of wire netting placed along-side the research ship, either hanging from its side, or on the water where attached floats prevented it from sinking.

The removal of the ballast and sand confirmed

⁹Seven "Field Acquisition Books" were compiled during the work on W-6. Like the "Logs", they too are in the Museum's archives.



Fig. 7. Execution of transverse section in strip 18: fragment of kelson and inner floor timber visible.
Drawn by L. Nowicz

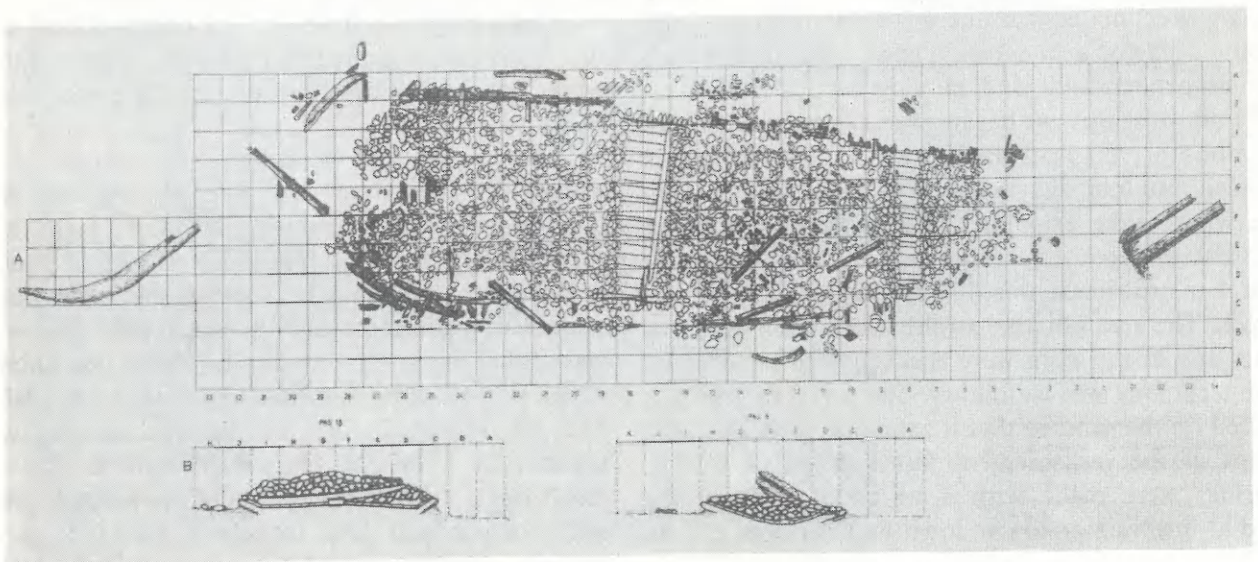


Fig. 8. Plan of the W-6 wreck and transverse sections in strips 8 and 18.
Drawn by L. Nowicz

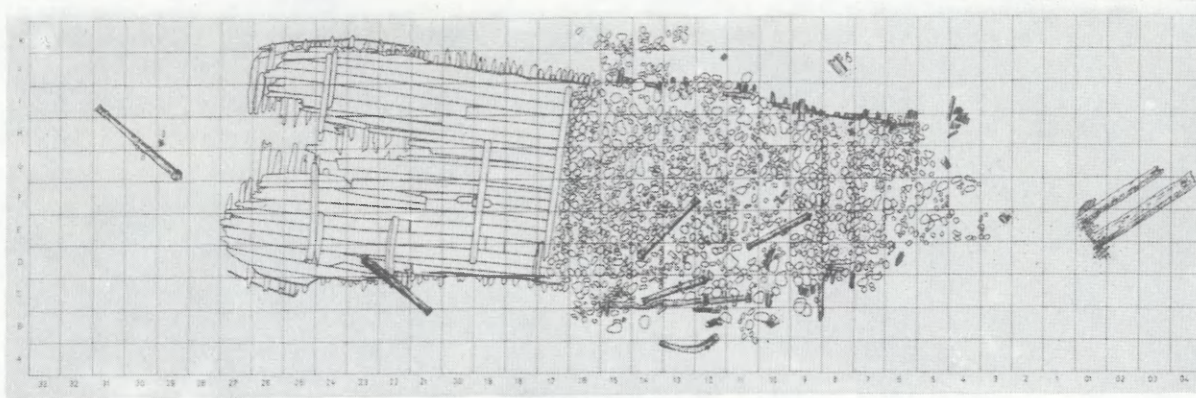


Fig. 9. W-6 wreck after removing ballast stones from bows.
Drawn by L. Nowicz

our suspicions that only the bottom of the hull, in rather better condition on the starboard than on the port side, had been preserved. At the bows, it was very badly damaged, as if it had been ripped off, along the line of the keel in fact. In the stern, we noticed a horizontal crack at the height of strakes 7-6. In comparison with the midships and bows, the stern was embedded deeper in the sea-bottom sand. The whole wreck was in fact resting on the bottom sand, with the exception of the stern: whereas the fore part of the keel was visible in the sand, the stern was lying some 2 m below the bottom of the Bay.

Traces of burning were discernible on many constructional elements, especially in the bows.

The various phases of the excavation were documented in sketches, photographs, and were filmed. A 1 × 3 m grid was used for drawing the details. Each square metre of this grid was divided into 20 × 20 cm squares. The level at which artefacts were lying was estimated with the aid of a levelled tube and a plumb-line or a "measuring square", furnished with a sliding horizontal and moving vertical rod.¹⁰

Following this, we began to search the area within a radius of 100 m from the wreck. This area was divided into four sectors (I-IV). The areas adjoining the wreck were examined most closely. A number of trenches were dug under the sides of the wreck. A c. 1-metre trench was dug around the sides of the wreck. The area adjacent to the trench along the two sides and at the stern were checked with a water jet. The technique was as follows. The 1 × 3 m grid was placed on the sand so that it extended, as it were, the strips of the measurement frame (from 04 to 33). Borings were made with a water jet through the grid at intervals of 20 cm down to a depth of c. 1 m.

The other parts of the various sectors were given a superficial inspection.

During these operations we were able to discern the stratigraphic layers in the area of the site.

So under the sides of the wreck, the top layer consisted of sand mixed up with shells carried there by bottom currents. Below this lay the "culture layer" the colour of grey mud - it varied in thickness. This was where the archaeological remains were found. Underneath this was a strongly compacted, hard, light-coloured sand - substratum. The distance from this sandy substratum to the outer planking of the hull was 60 cm in the midships region. The stratigraphy in the trenches along the sides of the wreck was similar. The "culture layer" was 40-50 cm thick here. Elsewhere in the trench and beyond the resting place of the wreck there were only two layers: the hard, light-coloured sandy substrate, and overlying it, a layer of loose sand of varying thickness.

This sandy substrate was so compact and hard that it was often difficult to push the ejector into it; when that was the case, we additionally employed the water jet.

These operations completed, the surface of the wreck was cleared of sand and photographs were taken for photogrammetric purposes. Here it is worthwhile mentioning that this was the first attempt in Poland to apply the photogrammetric technique to underwater archaeological investigations. This work was done by the Cartographic Office in Gdańsk which was aided by the Polish Surveyors Association and the Museum's divers. The photographs were taken with a 500CM Hasselbald camera. The end result was a 1 : 20 scale drawing of the wreck together with longitudinal and transverse sections, photo-mosaics, descriptions of how this work had been performed, etc.¹¹

¹⁰All the drawings, photographs and films made of W-6 are in the Museum's archives.

¹¹See: Polish Maritime Museum's archives.



Fig. 10. Fragment of port-side stern part of the W-6 wreck, after removing ballast stones and cleaning inner planking.
Photo. L. Nowicz

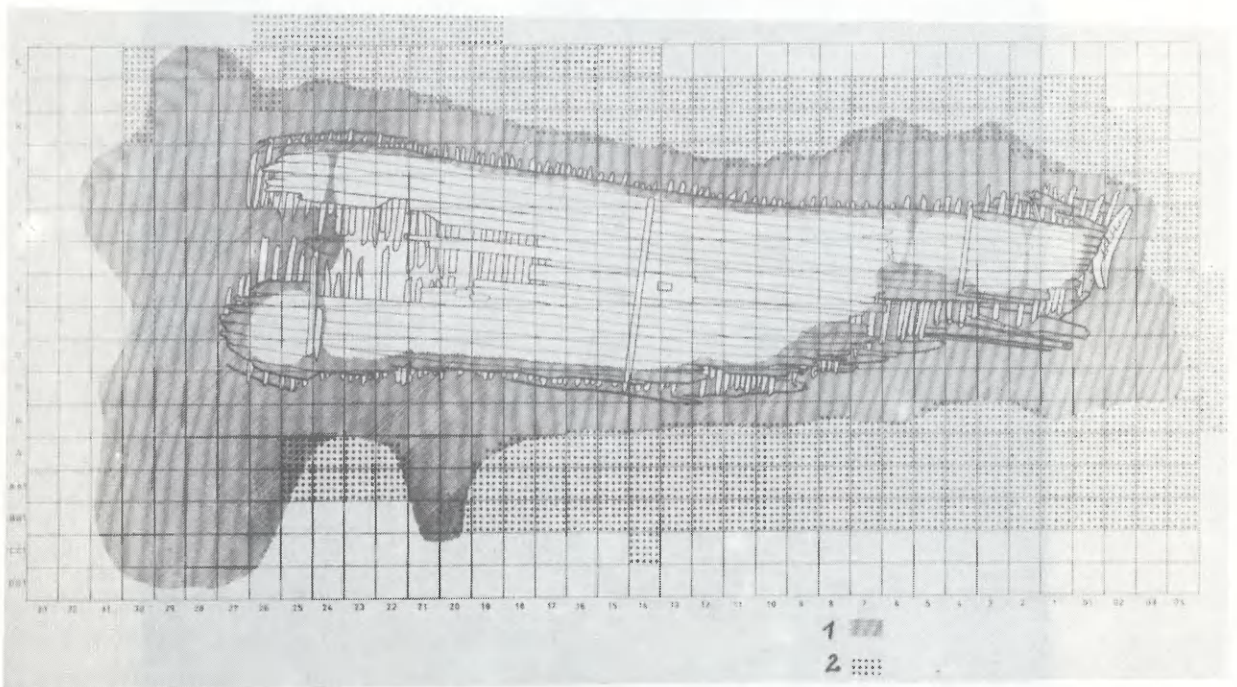


Fig. 11. W-6 wreck after removing ballast stones //// – reach of trench surrounding wreck ∴ – area adjacent to the trench, checked with water jets.

Drawn by L. Nowicz

<http://rcin.org.pl>

As we feared that ships entering the North Port might damage the wreck, we decided to remove it from its original resting place to another, safer location in the Bay.

This operation was planned by the Museum's chief diver, Mr Lech Nowicz. The first thing to do was to test the strength of the hull and to calculate its weight under the water. From this information, the technique of moving the wreck was derived. This was simple, and, as it turned out, easy to perform and wholly successful. The idea was to tow the wreck under the water at a certain height above the bottom. The wreck was towed by the Polish Ship Salvage

Company's tug "Smok". The wreck was got ready for this "voyage" as follows. A strong beam was placed across its stern. A carrying belt, whose two ends were wound round the two ends of the beam, was stretched under the wreck. This simple expedient enabled us to raise the wreck, without the sides collapsing inwards. A pontoon of 8 tons' buoyancy was installed amidships and fixed to that part of the hull. In the bows, which had suffered the most damage and where the sides were not connected to the keel, a beam grid was laid under the hull with carrying belts stretched over the top.

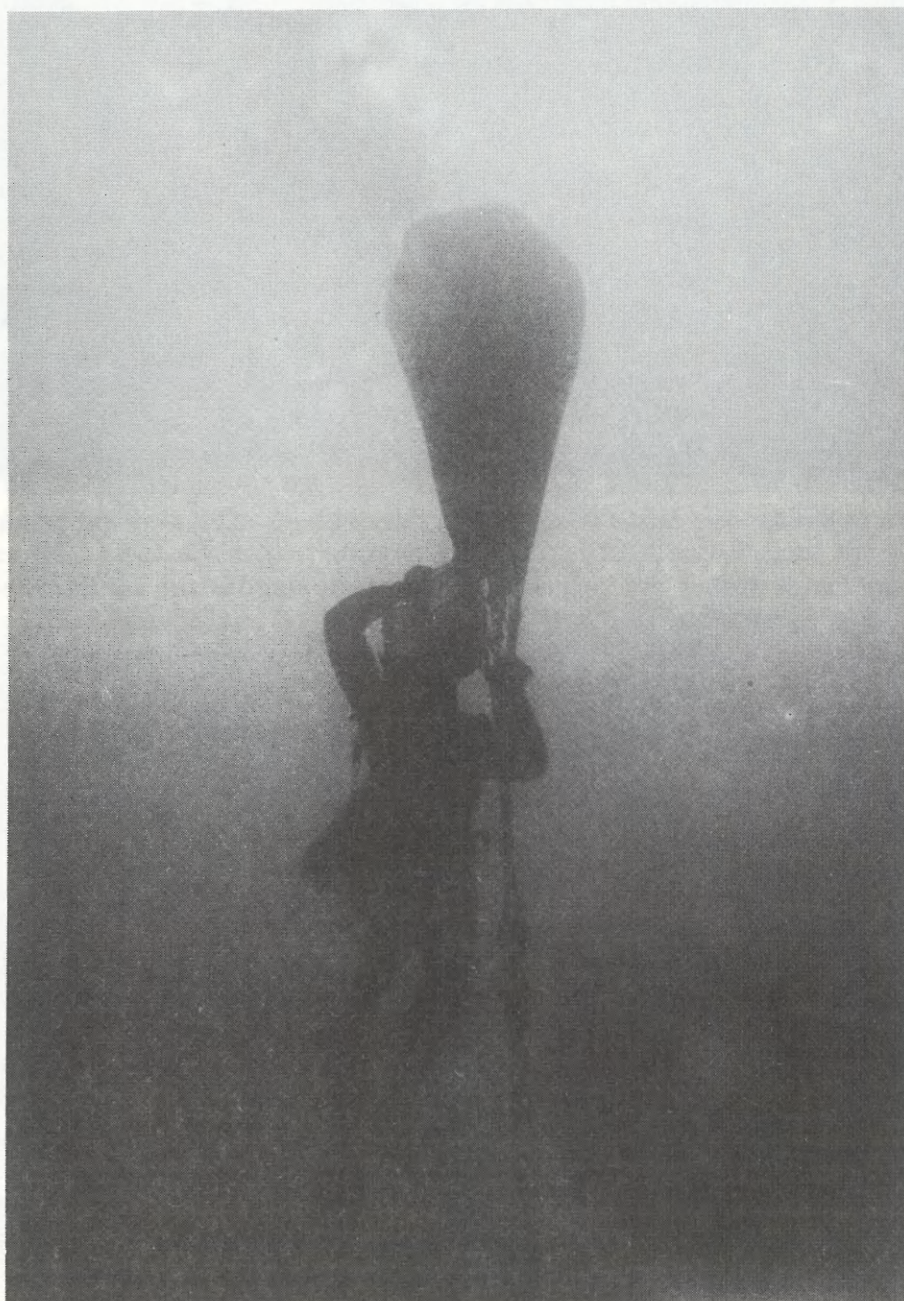


Fig. 12. Some of the artefacts raised from the wreck by means of an air-filled balloon.

Photo. L. Nowicz

Now the carrying belts fore and aft, and the ropes from the pontoon, were affixed to the tug's booms overhanging the port side, and to the side itself. Raised carefully from the bottom on these ropes and belts, and then appropriately balanced, the wreck was moved gently and smoothly to its new resting place at position 18°29'3"E 51°40'2"N which is away from the shipping lanes across the Bay. The wreck is now lying in 15,2 m of water, about 2 nautical miles from the shore off Orłowo. In addition, all the loose constructional elements, suitably numbered, have been placed here.¹² The wreck was made safe in this way so as to prevent possible damage to it by fisherman's nets. Its condition is periodically checked by us.

After the wreck had been moved, the area which had been under the wreck was searched. Our earlier observations about the sequence of layers under the hull were confirmed. The "culture layer" was not of uniform thickness, however, but got thinner and thinner from the sides to the keel. This layer comprised grey mud or very fine sand.

Lastly we were requested by the port authorities (the reader will remember that the site lay on the approach lane to Gdańsk) to prepare a contour drawing of the site showing the new state of the bottom after the wreck's removal. At the same time,

¹²A description of the projects, attempts and operations concerning the hauling of W-6 are in the "Log", vol. 7, pp. 65 et. seq.

we established that the depth of water from the surface to the place where the bows of the wreck had lain was from 14 to 14,8 m. The depth above the stern was from 15 to 16,6 m. The area immediately adjacent to the wreck's resting place was 14,5 m deep. Also, we reduced the height of the heaps of ballast stones to that required by the port authorities.

ITEMS FOUND ON THE SITE OF WRECK W-6

During our excavations we came across numerous objects of historical interest. Most of them were in the wreck itself or in its immediate neighbourhood. Very few artefacts were found beyond the site and the area of boring points. Two cannon found some 40 m from the bows were the objects located furthest from the wreck. Quite a large number of objects were found under the hull, after the wreck had been moved to near Orłowo.

In all the Museum acquired 4378 objects, not counting the wreck itself and its loose constructional elements.¹³ Table 1 lists these objects; I have divided

¹³The figure given includes all the artefacts recovered from the site up to the end of excavations. The number at present in the Museum's possession is different, the difference being due to the fact that a few of the badly damaged objects had broken up into several pieces. In another case, 10-20 potshards were used to reconstruct a smashed ceramic dish, etc.

Table 1

List of historical objects discovered at the site of wreck W-6

Group of objects	Quantity	Specification	Quantity
1	2	3	4
rigging and anchors	148	including: blocks knight thimbles, belaying cleats, pins, parrel truck etc. ropes anchors, mainly boarding	106 1 20 13 8
armaments	975	including: cannon barrels gun carriages (beds, cheeks, wheels, fittings) cannon balls ladles, rammers priming wires muskets (butts, barrels) musket rests (metal forks) musket rests (wooden props) bandoliers powder bags shot for small arms fragments of side arms	20 23 238 6 4 30 4 4 21 113 466 17
cabin equipment and navigational instruments	25	including: cabin equipment navigational instruments	15 10

1	2	3	4
work tools, metal fittings, hooks etc.	213	including:	bosun's, carpenter's, rigger's work tools 16 nails 136 rods and wire 5 hooks and cramps 8 fittings and hoops 26 pieces of sheet metal 5 fragments of chains 5 wooden and stone wedges 7 others (scoop, bell, wooden fittings) 4 bottle from surgeon's chest 1
kitchen-dining utensils, barrels wooden containers, bottles	1318	including:	remains of the ship's galley (incl. bricks) 7 metal kettles, cauldrons 18 barrels, pails and other wooden containers (their staves, bottoms hoops, handles) 160 pegs and bungs 13 potshards and ceramic vessels 1053 tin dishes, plates 9 spoons, forks and knife handles beakers, jars, jugs 21 bottle glass and fragments of other glass vessels 8 29
personal effects	1483	including:	footwear (soles, uppers, heels) 72 spur 1 fragments of clothing 62 buttons 6 buckles 11 fragments of belts 6 hat 1 gloves 10 leather money-bags 5 copper and silver coins 1262 clay pipes 7 boxes 9 needle dolly and box for tooth-picks 2 thimble 1 seal and signets 3 handles from sailors' bags 25
bones	87	including:	human and animal bones 87
unidentified	102	including:	metal 64 wooden 30 other 8
objects which reached the site after the ship had sunk	27	including:	fishermen's sinkers 26 others 1
total	4378	total	4378

them into several groups. A detailed analysis and a description of all the historical material – including the ship itself – will be the subject of a separate article. The following discussion is merely a preliminary, generalised and formal characterisation of the various groups, and of some of the artefacts in the groups.

As I have said, I shall discuss the preserved parts of the hull elsewhere. Here I merely mention that the wreck was an oaken, carvelbuilt threemaster of c. 150 lasts.

I have included elements of rigging and anchors in the first group of artefacts. There were no traces of masts, yards or sails. On the other hand, blocks,

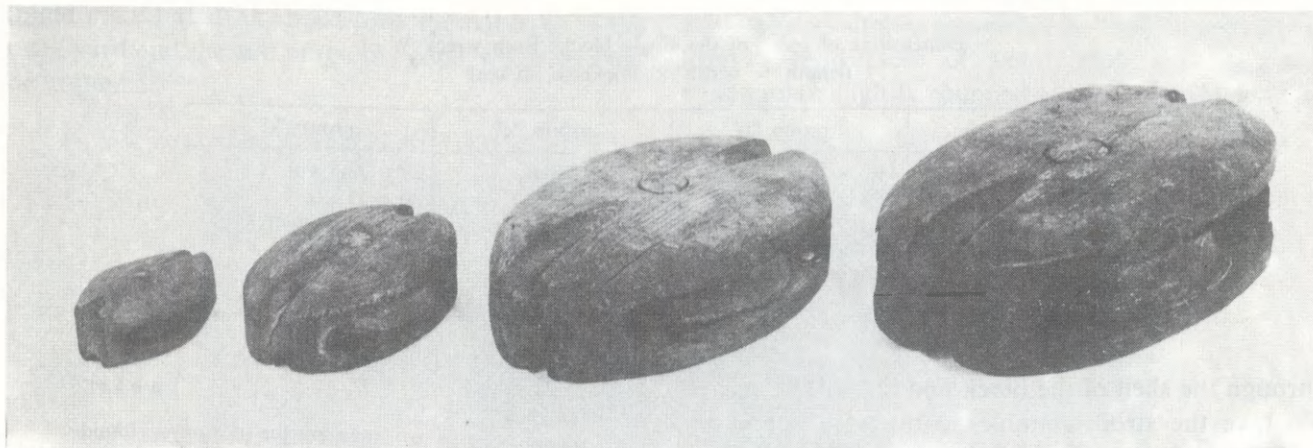


Fig. 13. Single blocks from the W-6 wreck (from the left – “a”, “b”, “c” and “d” group blocks).
Photo. E. Meksiakowa

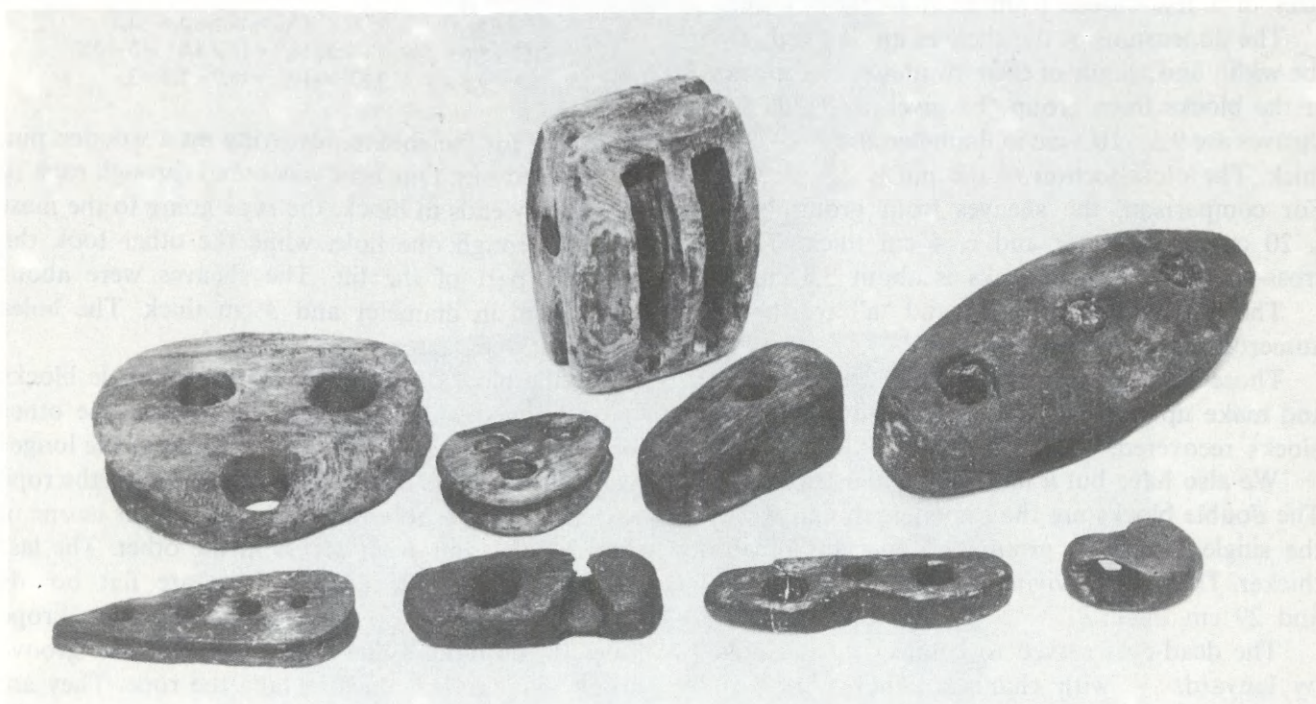


Fig. 14. Selected types of blocks from the W-6 wreck, incl.: – double block, larger and smaller dead-eyes, lift block and other items of the ship's fittings.
Photo. E. Meksiakowa

dead-eyes, thimbles, belaying cleats, a knight, remains of parrels and ropes have been preserved. They are of the kind which medium-sized or smaller three-masted square-rigged ships from the beginning of the modern era were fitted out with.

The largest set of 106 objects in this group are blocks, dead-eyes or their parts. Most of the blocks are single ones, but there are also double and triple blocks, and blocks of other types too. Most of these blocks give the impression of never having been used.

The type, form and dimensions of the blocks are appropriate to their intended function.

Seen from the head end, the single blocks are more or less eggs-haped:¹⁴ they are longer than they are wide. Each block was made from a single piece of wood and housed a sheave. The sheave is gorged around its circumference. A wooden pin passes

¹⁴The smallest blocks (group “a”) are sharper at the two ends than the blocks from the other groups.

Table 2

Dimensions of some of the single blocks from wreck W-6
(length × width × thickness, in cm)

group "a"	group "b"	group "c"	group "d"
10,3 × 7,5 × 4,9	16,3 × 11,9 × 6,4	25,5 × 17 × u	29 × 22,5 × u
11 × 8,2 × 4,9	16,8 × 12,5 × 6,6	25 × 19,5 × 9,7	30 × 21 × u
12,6 × 8,3 × 5,8	17,3 × 13,3 × 7,1	26,2 × 18,5 × 9,7	31,6 × 20,5 × 10,5
13,3 × 8,8 × 5,5	18,2 × 12,7 × 7,3	26,2 × 18,8 × 9,3	32 × 21,5 × 11

u – damage makes accurate measurement difficult or impossible

through the shell of the block and hub of the sheave. To take the strop, suitable acores were cut in the upper and lower parts of the shell.

The single blocks differ in size, being from 10 to 32 cm long, from 7 to 22 cm wide, and from 4,50 to 22 cm thick. One might distinguish several "size-groups" among them. Table 2 gives examples of the sizes of a few blocks from each of these groups.

The dimensions of the sheaves are appropriate to the width and length of their swallows. For example, in the blocks from group "b" given in Table 2, the sheaves are 9,3–10,3 cm in diameter and c. 2–2,3 cm thick. The cross-section of the pin is 2,1 to 2,6 cm. For comparison, the sheaves from group "d" are c. 20 cm in diameter and c. 4 cm thick. The pin cross-section in these blocks is about 3,8 cm.

The blocks in groups "b" and "a" are the most numerous in our material.

Those from groups "c" and "d" are much rarer, and make up less than 10% of the total number of blocks recovered.

We also have but a few double and triple blocks. The double blocks are the same length and width as the single blocks in group "b", but are obviously thicker. The only surviving triple block is 37 cm long and 29 cm thick.

The dead-eyes served to connect the shrouds – by lanyards – with channels. They were usually slightly rounded or elongated. Made from wood, they were pierced by three holes or eyes, through which ropes, the lanyards were passed. One assumes that the diameter of the dead-eye should be roughly half that of the mast which the shrouds supported.¹⁵

The dead-eyes found in the wreck correspond in principle to this pattern. Oval or slightly elongated, they are small or large (see Table 3). In some of them, fragments of ropes were found in the gorge running round the circumference of the dead-eye.

A small number of other blocks were also found.

The lift-blocks, of Dutch type, resemble a spindle with the ends cut off flat. In the middle, widest part,

Table 3

The sizes of some of the dead-eyes found in wreck W-6
(length × width × thickness – diameter of eyes in cm)

Smaller	Larger
9,7 × 8,5 × 2,4 – 2,1	14,6 × 13 × 3,4 – 2,3
9,9 × 9 × 3 – 2–2,2	15,2 × 12,5 × 3,3 – 3,3
10,2 × 8,6 × 2,9 – 2–2,2	18,2 × 18 × 4,8 – 3–3,8
10,3 × 9,5 × 3 – 2,2	19,3 × 18,7 × 5,8 – 3,4

a housing for the sheave, revolving on a wooden pin, was gouged out. One hole was bored through each of the narrow ends of block; the rope going to the mast passed through one hole, while the other took the standing part of the lift. The sheaves were about 10–11 cm in diameter and 3 cm thick. The holes were 2–3 cm across.

Fiddle blocks were made from two single blocks "grown together" as it were; one shorter, the other longer. Each housed sheave, except that in the longer part there was one more hole through which the rope passed. The rope hole was 3 cm in diameter in one of these blocks, and 4 cm across in the other. The last two blocks I shall mention here are flat boards (2–2,3 cm thick), drop-like in shape. There are 4 rope holes in the block's line of symmetry, and a groove around its circumference to take the rope. They are redolent of crow's-foot blocks.

Table 4

Dimensions of "bull's-eyes", fiddle blocks and lift blocks from wreck W-6
(length × width × thickness in cm)

"Bull's-eyes"	Fiddle blocks	Lift-blocks
12,8 × 7,7 × 5,6	37,5 × 12,7 × 7,6	32 × 11,5 × 7
13,8 × 7,9 × 5,1	48 × 11,5 × 8,9	36 × 11 × 9,2

The knight is a massive vertical timber 216 × 22 × 25 cm which, "anchored" to the beams of the upper gun-deck, reached as far as the upper deck. In the part rising above the upper deck, a housing for three sheaves was gouged out. The timber was

¹⁵R. C. Anderson, *Seventeenth-Century Rigging*, London 1955, pp. 36.

crowned with the sculpture of a knight's head. The knight placed abaft the mast took the halyards of the lower yard and the end of the top rope, which hoisted the topmast.¹⁶

Apart from the basic types of blocks, there were a few objects similar somewhat to "bull's-eyes". Made from a solid piece of wood, they are elongated, rectangular, slightly rounded at the ends. Single holes



Fig. 15. The "Knight's" head from the W-6 wreck.
Photo. E. Meksiakowa

¹⁶In "A Treatise on Shipbuilding" published by William Salisbury in c. 1620 we read: "...The main knights and fore knights, so called because they are commonly carved with a head and a helmet, are two short pieces of straight timber bolted to the beams of the upper deck, with several shivers in them for the halyards and top ropes to hoist and lower the main yard and fore yard with their topmasts...", "The Society for Nautical Research Occasional Publications" London 1958, No 6, p. 7.

to take ropes were drilled in these objects. The hole in the head side is 2 cm in diameter in all the objects, and that in the long side is 1,8–2 cm.

Other items of the ship's fittings turned up sporadically: a few belying cleats, pins from the pin rail, a kevel, thimbles, parrel truck and ribs. There were

also a few objects similar to the unidentified objects which Svein Molaug described.¹⁷

Practically nothing has survived of the rigging, except for some short lengths of hempen rope, mostly Z-laid, with three strands. The diameters and circumferences of the better preserved rope lengths are illustrated by the following table.

Table 5

Dimensions of ropes from wreck W-6

Diameter in cm	Circumference in cm
0,7	2,5
0,8	3,5
4,3	14
4,6	16

Besides these, pieces of rope survived in some of the blocks and dead-eyes. In block No 1132/78, the rope was 1,3 cm in diameter, and 5 cm in circumference.

The group of objects comprising the ship's armament consisted of cannon barrels, gun carriages,

cannon balls, powder ladles, ramrods, reamers, and muskets, shot for small arms, musket rests, powder bags, bandoliers and the remains of side-arms. This is undoubtedly the most valuable group of artefacts in the entire find.

20 cannon were found, all cast in bronze. The casting dates or the owner's coat-of-arms were still legible on most of the barrels. These show that 16 of the barrels had been made in Sweden, in the second half of the 16th century and at the start of the 17th for kings John III, Charles and Gustav Adolf. The oldest cannon on which the casting date, coats of arms or the owner's monogram can still be read is from 1570, the newest was cast after 1611 but before 1628. They are mainly smaller calibre guns — from 2,5 to 6 pounds. Two mortars were also found.

Two cannon were cast in Poland. One was a 2¹/₂ pounder which Hans Seger (Seber?) had made in 1560 for king Sigismund August. The other, also a 2¹/₂ pounder, had been made for the magnate family of Radziwiłł.

Table 6

General characteristics of cannon barrels from wreck W-6

Swedish barrels								
year of casting	monogram	coat of Arms	number	weight in kg	total length in cm	bore diameter, in cm	calibre in pounds	name of maker
1570	IRS	Vasa	3	980	308	9,6	5,5	—
1578	IRS	Vasa	17	875	317	8,4	5	—
1578	IRS	Vasa	15	920	310	9,6	5,5	—
1599	—	Vasa	96	610	285	9,3	5	—
1600	CDS	Vasa	—	355	248	7,4	2,5	—
1602	CDS	Vasa	—	710	293	9,4	5	—
1603	CDS	Vasa	101	720	292	9,1	4,5	—
1603	CDS	Vasa	—	760	293	9,1	4,5	—
1604	CDS	Vasa	95	660	290	9,4	5	—
161—	GRS	Vasa	—	900	300	9,6	5,5	—
—	GR	Vasa	38	435	238	9,3	5	—
—	—	Vasa	95	390	258	7,3	2,5	—
—	—	Vasa	—	970	301	9,9	6	—
—	—	Vasa	22	700	304	9,3	5	—
—	—	—	—	250	145	17,9(80)	4/40	—
—	—	—	—	240	155	18,9(94)	6/48	—
Polish barrels								
1560	SA	Jagiellon	14	450	259	7,3	2,5	Hans Seger (Seber?)
—	—	Radziwiłł	105	490	256	7,3	2,5	
"Russian" barrels								
—	—	—	30	740	291	9,6	5	Bogdan
—	—	—	29	740	292	9,3	5,5	Bogdan

— absent or illegible

¹⁷S. M o l a u g, *Gjenstandsmaterialet fra fregatten "Lossen"*, Norsk Sjøfartsmuseum Årsberetning 1974, p. 155.

The cyrillic inscription "Delal Bogdan" is visible on two of the cannon. They may therefore have come



Fig. 16. So-called “Russian” cannon (after conservation) — on a single-axle gun-carriage reconstructed in the Museum. Fragment of the exhibition in the Polish Maritime Museum at Gdańsk.

Photo. E. Meksiakowa

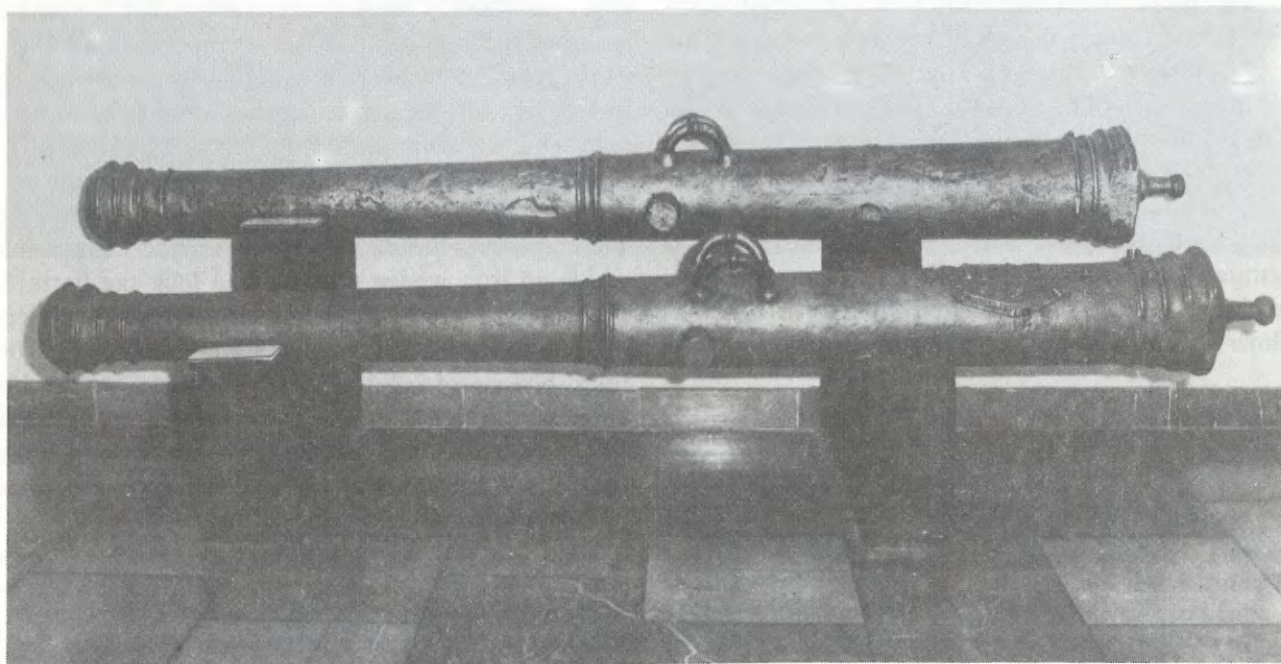


Fig. 17. Polish cannons from the W-6 wreck: lower — bronze cannon cast for King Zygmunt August in 1560, upper — cannon cast for the Radziwiłłs.

Photo. E. Meksiakowa

<http://rcin.org.pl>

from the eastern territories of Poland or western Russia. One of these barrels is a 5 pounder, the other a $5\frac{1}{2}$ pounder.

Table 6 characterises these cannon.¹⁸ The Swedish, Polish and so-called “Russian” cannon can be distinguished already at first sight.

The “Russian” ones are tubes of fairly uniform section, narrowing towards the muzzle. They have no cascabel or dolphins. The rings dividing the tube into sections (a first reinforce, second reinforce etc) are numerous and give the impression of being ornamental.

The Polish barrels are slim. The breech is encircled by four double rings, placed at equal intervals. The next rings, two of them this time, are only 13–15 cm in front of the dolphins. The third and last group of rings – again four pairs of double rings – encircle the muzzle of the barrel. The dolphins are semicircular and have three rings each, evenly spaced along the length of the dolphins: at the points where they meet the barrel and at the uppermost point of the handle. The shields, bearing the coats of arms, placed in the first reinforce, are surrounded by metal plates 2,5–3 cm wide. The cascabels are slim, 12–13 cm in length, and end pommelions 6,5 cm in diameter.

The rings on the Swedish cannon are spaced in the usual way, and their number and method of production is similar in all the barrels. Differences are small, though discernible. The dolphins have the classic shape. There are more easily perceivable differences in the form of the coats of arms from the times of John III, Charles and Gustav Adolf, and also in the shapes of the cascabels. More significant seems to be the differences in weight between cannon of the same calibre (see Table 6). The five-pounder cannon cast in the days of Gustav Adolf is much shorter and lighter than cannon of the same calibre cast in the times of his predecessors.¹⁹

Soon after the cannon had been recovered – one Polish and two Swedish – they were analysed chemically by atomic absorption spectrometry. The individual elements were determined on a Perkin-Elmer spectrometer. The results are shown in Table

7²⁰. The cannon in question had been cast from tin bronze, which differed in composition in each of the cannon.

The Polish cannon is of a bronze alloy considerably enriched with tin, which made it harder and more resistant to wear and tear. Furthermore, enrichment of this alloy with antimony and keeping the sulphur and iron contents low, improved its mechanical properties and its resistance to low and high temperatures and to corrosion. Indeed, this particular barrel is in the best condition of them all.

The two Swedish cannon were cast from bronzes of very similar chemical composition. They do not contain much tin, and, in comparison with the Polish cannon, have a high sulphur and iron content. The large proportion of these undesirable components in the alloy produced a physico-chemically inferior material.²¹

It should be added that the “Russian” cannon give the impression of having barrels of an inferior quality of bronze.

The gun carriages come in two types – four-wheeled (two axles) and two-wheeled (one axle). Their dimensions were appropriate to the size and weight of the cannon.

The best-preserved two-wheeled carriage looks like a heavy bed known as “stocks” but it is made from two massive boards of solid wood: these are the sides. At present they are 185 cm in length, 28–30 cm high and 8,5–9,5 cm thick. At the front and the rear they are joined with wooden transoms, 11 cm wide at the front and 12–24 cm wide at the rear. The sides splay out slightly towards the rear, so that the overall width of the carriage is 41 cm at the front and 51 cm at the rear. At the front, rectangular grooves were cut out of the lower edges of the sides to take the wooden axle. This is held in place from below by strong metal hoops. Above the axle, in the upper edge of the side, a semicircular groove was cut out for the trunnion. These grooves are closed by wide metal clamps into which an iron wedge was fitted to lock the barrel in place. The rear of the carriage supported on runners.

The four-wheeled carriages were also built from thick boards of solid pine which made up the bed and cheeks. As in the two-wheelers, the cheeks splayed out towards the rear. The axles are under the bed, at the front and at the rear. None of these

¹⁸The specifications of the gun barrels and a more detailed description of them will be found in the article by M. I ż e w s k i, *Spiżowe lufy armatnie z “Solena” w zbiorach Centralnego Muzeum Morskiego w Gdańsku*, KHKM 1982, R. 30, No 2, p. 216 et seq.

¹⁹Gustav Adolf modified the armament of Swedish warships. He introduced 5 standard calibres 3, 6, 12, 14 and 48 pounds. On warships smaller cannon were usual. See: O. C e d e r l ö f, *Svenska flottans beväpning 1523–1900*, “Aktuellt från Flöeringen Marinmusei Vänner i Karlskrona” 1971, pp. 17–18; see also: *Sveriges krig 1611–1632*, vol. 1, *Sveriges Sjökrig 1611–1632*, Stockholm 1937, p. 40.

²⁰Mrs Wiesława Młodzianowska from the “Bimet” Company in Gdańsk kindly did the analyses for the Museum.

²¹The comparison of our results with those of the chemical analysis of the bronze cannon from the Swedish warships “Ricksnyckeln” and “Vasa” is interesting. See: Einar M a t t s o n, *Bronskanoner från orlogsskeppen Ricksnyckeln och Vasa – en kemisk och metallografisk undersökning*, “Sjöhistorisk Årsbok”, 1957–1958, p. 65.

Table 7

The chemical analysis of cannon barrels from wreck W-6, [%]

Barrel	Sn	Pb	Fe	P	Si	Al	As	Sb	S	Zn	Cu
Swedish No HZ/706	3,43	1,09	1,16	0,003	0,27	0,030	0,031	0,001	0,383	0,50	93,00
Swedish No HZ/707	2,29	2,55	1,39	0,0030	0,0060	0,0030	0,026	0,018	0,281	0,85	92,46
Polish No HZ/693	8,51	1,46	0,0016	0,0016	0,0064	0,0015	0,19	0,95	0,053	0,017	88,69

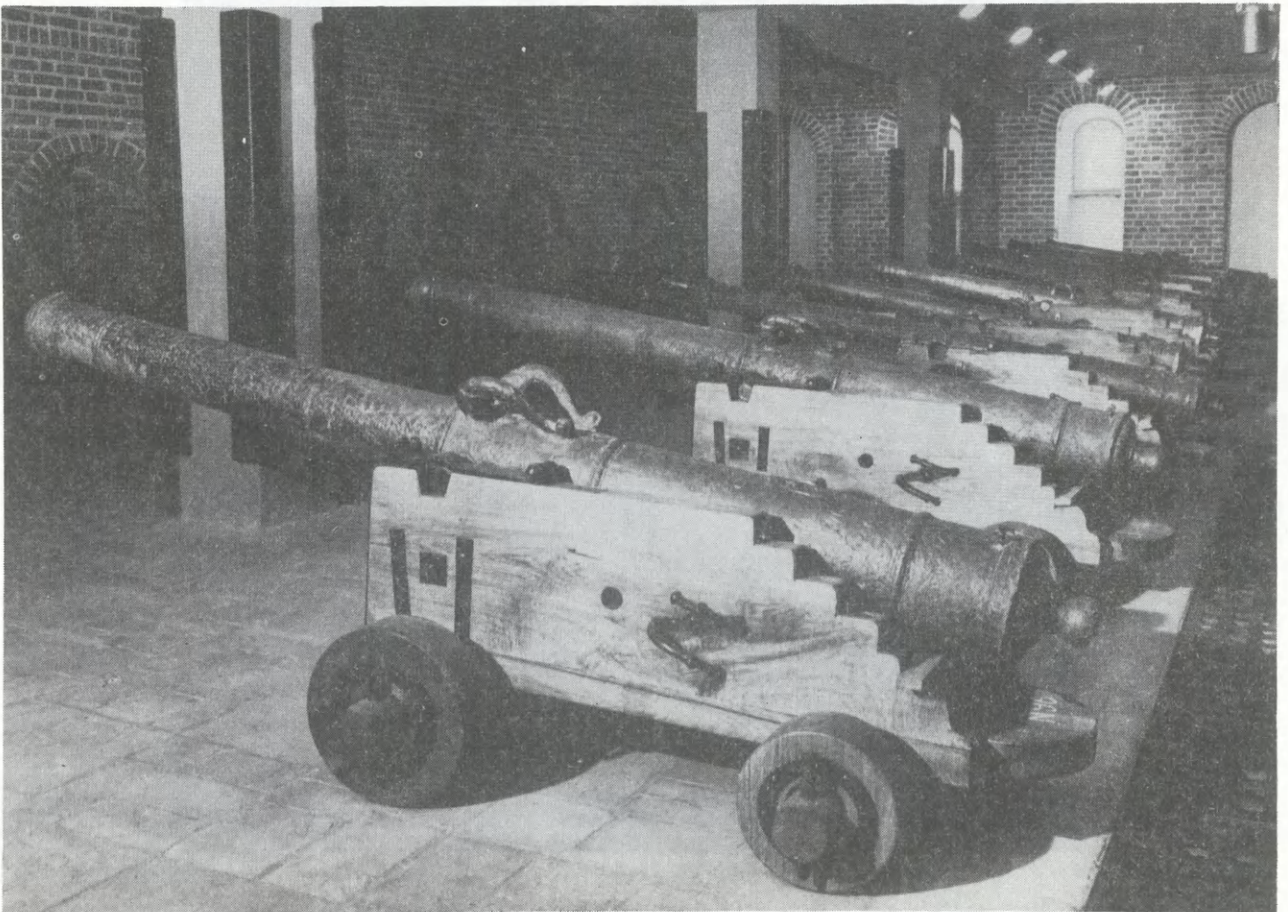


Fig. 18. Swedish cannon on reconstructed twin-axle carriages. Fragment of exhibition in the Polish Maritime Museum.
Photo. E. Meksiakowa

four-wheeled carriages has come down to us in its original condition. One of the surviving beds, for example, is c. 158 cm long, 40 cm wide and about 8 cm thick. The cheeks of another carriage are 40–43,5 cm high and 7–8 cm thick; steps are cut on their rearward end, allowing the barrel to be placed at the desired angle. In the four-wheelers, the front wheels were usually larger than the rear ones. In our material, the loose wheels found are often 40–43 cm across, and 10–14 cm thick, but there are also smaller wheels, e.g. 25–28 cm across and larger

52 cm in diameter. The axle which has survived in its original state is 10 × 10 cm in section.

Most of the 238 cannon balls are for the smaller calibre guns, 4 and 6-pounders, and even lighter ones. Only a few of the balls found were for use with larger barrels – 12- and 18-pounders. The calibre of the cannon balls is thus roughly proportional to that of the recovered barrels. The balls are of various types – ordinary round shot, chain shot, bar-shot, spike-shot and incendiary grenades.

Three powder ladles were found in the wreck.



Fig. 19. Bronze cannon cast for the Swedish King Johan III in 1570. Vasa coat-of-arms and arsenal number visible.
Photo. E. Meksiakowa

They were made in a similar way, and differ only in their dimensions. They had long, wooden poles at the end of which there were wooden heads. These heads had a hole bored through them along their axis of symmetry into which the pole was inserted. The round body of the heads, narrower somewhat at their inner ends, served to fix the metal part of the scoop to the pole. The scoops were made from rectangular sheets of metal bent inwards. The lower part of the scoop, cut off straight, was affixed to the head with copper nails. The upper end was cut semicircularly. The width of the scoop was appropriate to the calibre

of the cannon. One of the scoops found is 42 cm long, 8,9 cm wide at the head and 8,4 cm wide at the other end, and 5,5 cm deep. The smaller scoop is 31 cm long, 6,3 cm wide at the base and 6 cm wide at the open end, and 4 cm deep.

The construction of the cleaning brushes and rammers was quite similar to that of the ladles. Heads were fixed on the wooden staff, except that in brushes, the scoop was replaced by a packing of oakum or fur. One of the rammers was constructed slightly differently: the staff was replaced by a rope.

Reamers for cleaning the touch holes and opening

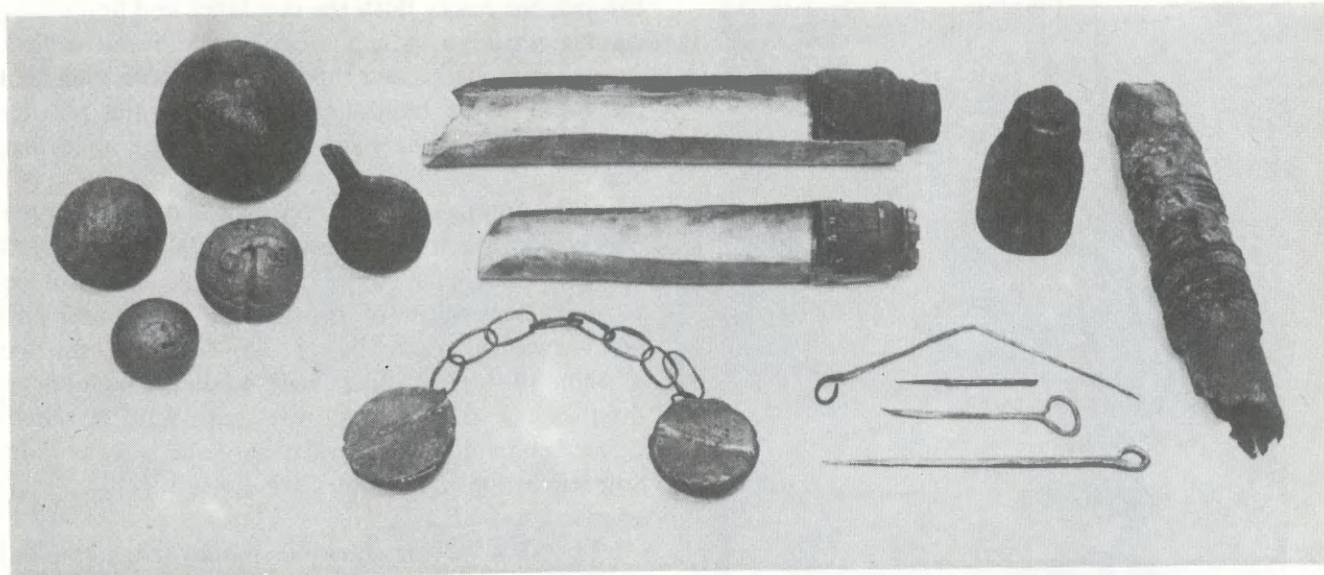


Fig. 20. Cannon balls, powder ladles, rammer head, fragment of cleaning brush and reamers, from the W-6 wreck.
Photo. E. Meksiakowa

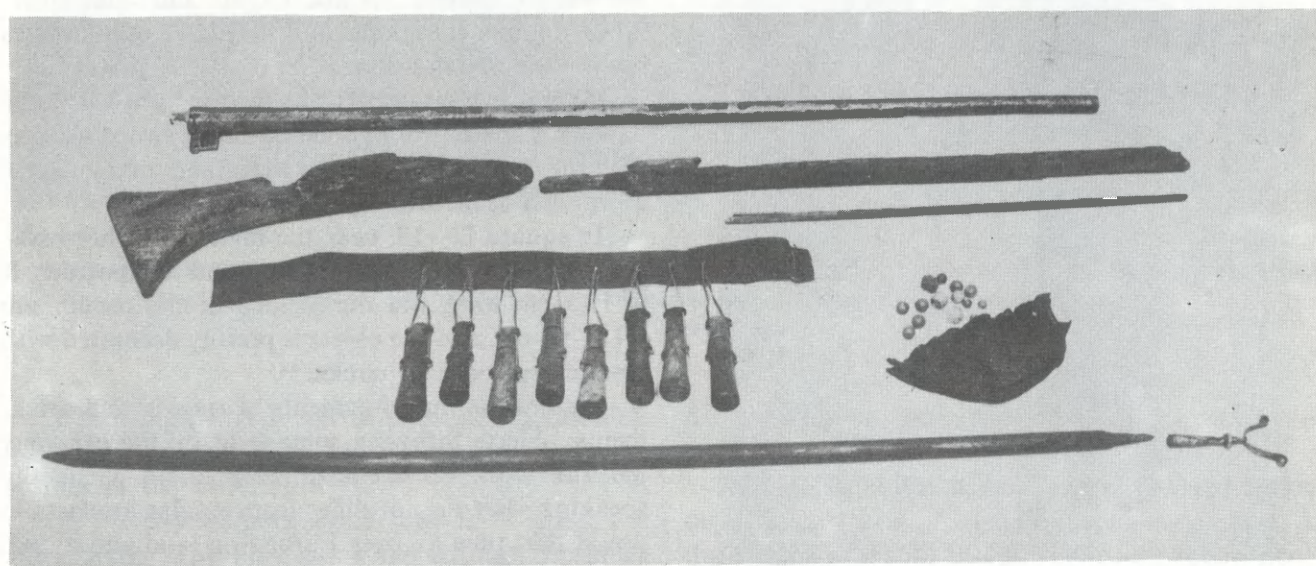


Fig. 21. Musket parts (butt, barrel, stock, cleaning rod), bandolier with powder bags, shot pouch, ammunition and musket rest.
W-6 wreck.
Photo. E. Meksiakowa

grape-shot were of various lengths, e.g. reamer No 78/1095 is 26,5 cm long, another one, No 78/1032 is 29 cm in length. They were made from thin rods of iron, bent round at the top for easier manipulation, and sharpened at the other end. Reamer No 78/1057, of which a 15,5 cm long piece has survived, is of a different type.

Small arms are represented by the component parts of muskets, musket rests, cleaning rods, powder bags, bandoliers, bullet pouches and shot.

The components of the guns indicate that they are all of the same kind of fuse musket. Four butts,

stock, four barrels and one cleaning rod have been preserved. The owners' marks are legible on the butts. Barrel No 78/1097 is 122 cm long, with a muzzle diameter of 1,9–2,1 cm, and now weights 3,7 kg; barrel No 78/1130 is 119 cm long, has a muzzle diameter of 1,8 cm, and weighs 4,7 kg.

The musket rests consist of wooden props and metal forks. The props are from 107 to 123,5 cm long (mostly c. 118 cm), and 1,9 to 2,4 cm in cross-section. Some have had marks of ownership engraved on them. Their lower parts are sharpened to a point but no possible metal fittings were found. The upper parts

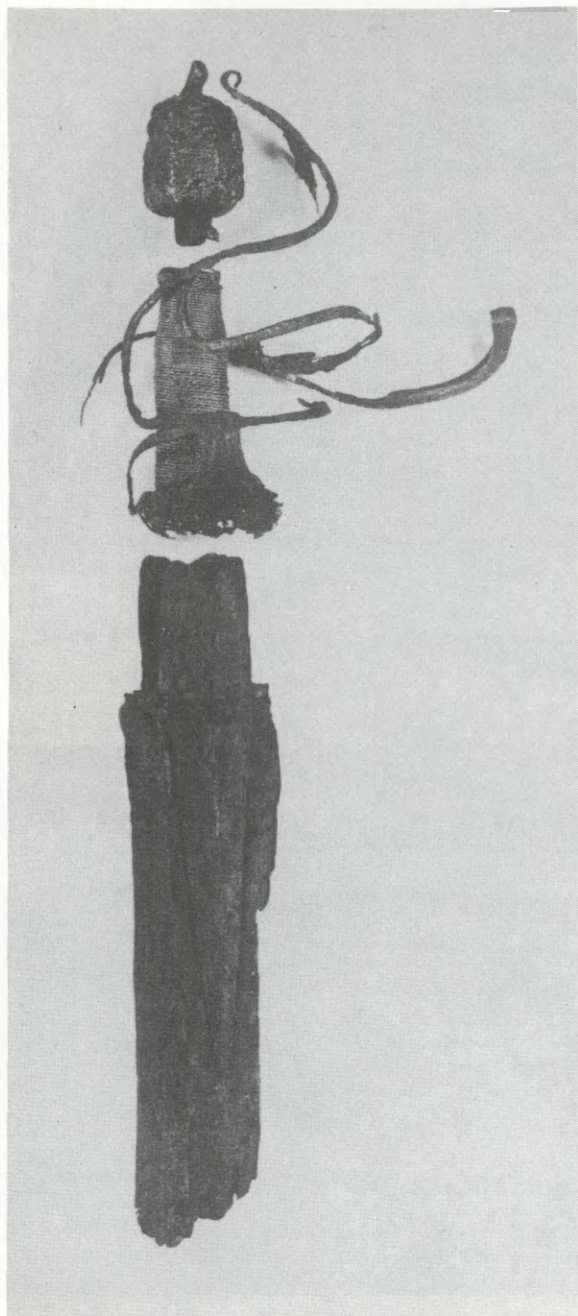


Fig. 22. Fragment of a wooden scabbard and remains of a sword handle.

Photo. E. Meksiakowa

taking metal forks for the musket are tapered. The best-preserved forks are 13,2 cm high; the oval stem of the rest is c. 6 cm high, while the prongs of the fork are c. 4,5 cm apart. The tips of the prongs are bent outwards.

In the after part of the ship a set of 113 powder bags was found; most of them were complete or nearly so. Made of wood, the bags, comprise two parts: a container and a top. The whole object is c. 11–13,5 cm high. Round in cross-section, they are widest at the base (c. 3,3 cm) and get narrower

towards the hood. Both the container and hood have clamps through which holes have been drilled. A leather thong passed through these holes attached the bags to the bandolier. To protect the powder from the damp, the bags were sheathed in leather etuis.

Only fragments have remained of the leather bandoliers; the longest of them is 75 cm long and 6,3 cm wide. The edges of the belts were folded inwards (the width of the fold is c. 0,7 cm) and hand-sewn in place. Every 3,5–5 cm along the mid-line of the belt, holes were made through which the thongs carrying the powder bags were threaded. Other belts are 6,5–7,8 wide; only one is 4 cm wide. Sometimes the thong holes are closer together, 2 cm apart.

The shot pouch resemble money bags (purses) and I was not always able to tell one from the other. They were kept closed by thongs attached to the musketeer's belt.

Most of the small arms shot is 1,7 cm in diameter, but some is smaller, 1,4 and 1,1 cm, and some larger 2,1 cm in diameter. Some of it may have been used as grape-shot or case-shot.

Only a few fragments of side-arms are left: knife handles made of wood, bone or metal, sword handles with the remains of blades in them, and a fragment of a wooden scabbard.

In square D–18, near the midships, a horn was found. This was probably a container for powder. It is 19,5 cm long, the dimensions of the mouth are 6,7 × 5,4 cm, and the object is prettily decorated with rosettes enclosed in circles.²²

Besides the hull, fragments of rigging and armaments, objects throwing some light on the everyday life and work on the ship were found. Generally speaking, they do not differ from similar artefacts in use at that time all over Europe on land and at sea, which have been recovered from other wrecks, are in museum collections, or are illustrated or mentioned in iconographic and written sources. The differences are only in details.

Some of these artefacts appear to have been cabin fixtures — the cabins were situated aft. Thin, leaden frames, in which panes had been set, come from the cabin windows or the ship's lantern. A damaged lock, iron bolts and keys were also found. But we cannot tell whether the lock and keys were meant to lock doors or chests. The iron padlock No 1457/80 served the same purpose. It is interesting that, the padlock apart, all these items were found in the same place — in the stern in squares 1–01/E–C.

²²The possibility that this horn belonged to the sailmaker or the shipwright cannot be ruled out.

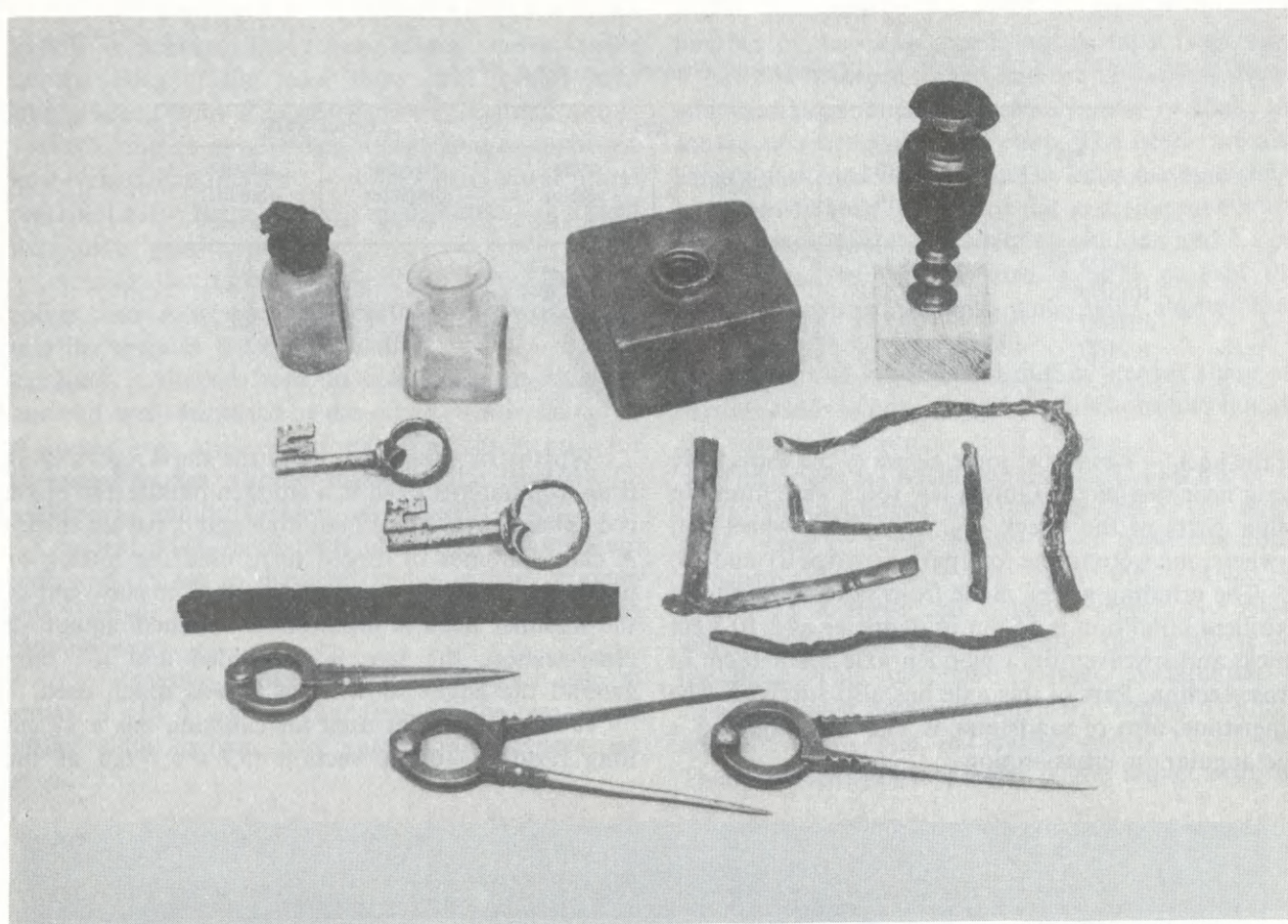


Fig. 23. Small bottle from the ship's doctor's medicine chest (top, left); next — glass ink-pot, tin container, upper part of candlestick; below — keys, lead window-frames, fragment of a cross-staff and three dividers, from the W-6 wreck.

Photo. E. Meksiakowa

A top is all that is left of a bronze candlestick which lit the cabin. This top was screwed into the bottom of the candlestick.²³

Of the two inkpots found, one is of glass, the other of tin. The first has a rectangular container $4,3 \times 4$ cm with a lipped neck of internal diameter 1,6 cm and outer diameter 3,3 cm. The overall height of this inkpot is 5 cm. The second inkpot, made of tin is square ($7,7 \times 7,5$ cm) with a low, tapped neck of internal diameter 2 cm and outer diameter 2,7 cm. The overall height of this inkpot is

4,6 cm. This tin container may well have been used for some other purpose.

Navigational instruments are represented by four dividers, part of a cross-staff and brass gimbals. All these items were found in the after part of the ship, in strips 2,3 and 4 and squares D, E, F 120–200 cm below the bottom of the Bay.

The dividers are of brass and have the following dimensions:

A short, graduated section, $1,1 \times 1,1$ cm is all that remains of the cross-staff. The gimbals consist of two rings, both made from thin, narrow (0,6–0,7 cm) bands of brass. Two such bands held together by brass rivets make a ring. The diameter of the large ring is c. 17,5 cm, that of the smaller one c. 15 cm; they were connected by copper pins.

The next group of objects of historical interest are the tools used by the boatswain, shipwright and sailmaker. Most of these tools were found at the stern of the wreck, i.a. in the fossil layer, where squares 1 E and 01 E meet, from 200 to 260–270 cm below the bottom of the Bay — in other words, in the region

²³Candlesticks of a similar shape were recovered from the wreck of the "Sea Venture", lost in the Bermudas in 1609 (A. J. W i n g o o d, *Sea Venture, An interim report on an early 17th century shipwreck lost in 1609*, International Journal of Nautical Archaeology) abbr. IJNA 1982, vol. 11, (No 4, p. 345), and from the wreck of a cargo ship from the mid-17th century found near Mullion Cove, Cornwall IJNA 1972, vol. 1, No 1, p. 141. For a more detailed comparison with such artefacts from the end of 16th century and the first half of the 17th, see: R. F. M i c h a e l i s, *Old domestic base-metal candlesticks from the 13th to 19th century*, 1979, pp. 62–70.

Table 8

Dimensions of dividers from wreck W-6

No	total length in cm	Legs		Upper part	
		length in cm	cross-section in cm	external diameter in cm	internal diameter in cm
586/77	13,3	9,5	0,8 × 0,5	3,9	2,8
1015/77	13,5	9,5	0,8 × 0,4	3,9	2,7
1023/77	10,5	7,1	0,8 × 0,5	3,3	2,1
1024/77	12,7	9,4		3,5 (?)	2(?)

of the keel – stern-post joint. Some of the tools were lying near this block. Only a few tools were found in other parts of the wreck, e.g. a grinding wheel and a whetstone were in the fore part, in strips 21 and 24.

The grinding wheel, made from sandstone, and in excellent condition is 55 cm in diameter and 10,3 cm thick, and revolved on a wooden axle $5,4 \times 6$ cm in cross-section. Part of this axle has also survived. The whetstone, also of sandstone, is 11,5 cm long, and is rectangular in cross-section.

Worthy of attention among the shipwright's tools is an iron hatchet fixed in a wooden handle (the blade is c. 20 cm long, 10–12 cm high and c. 0,6 cm thick). A claw hammer of forged iron, used for hitting or pulling out nails, has a metal shaft. The claw end of the hammer head is forked and flattened, square in cross-section, the face is four-sided and the burr around the edges shows that it was much used.

A wooden mallet used for caulking has a 37 cm long head of square section ($5,7 \times 5,7$ cm at the

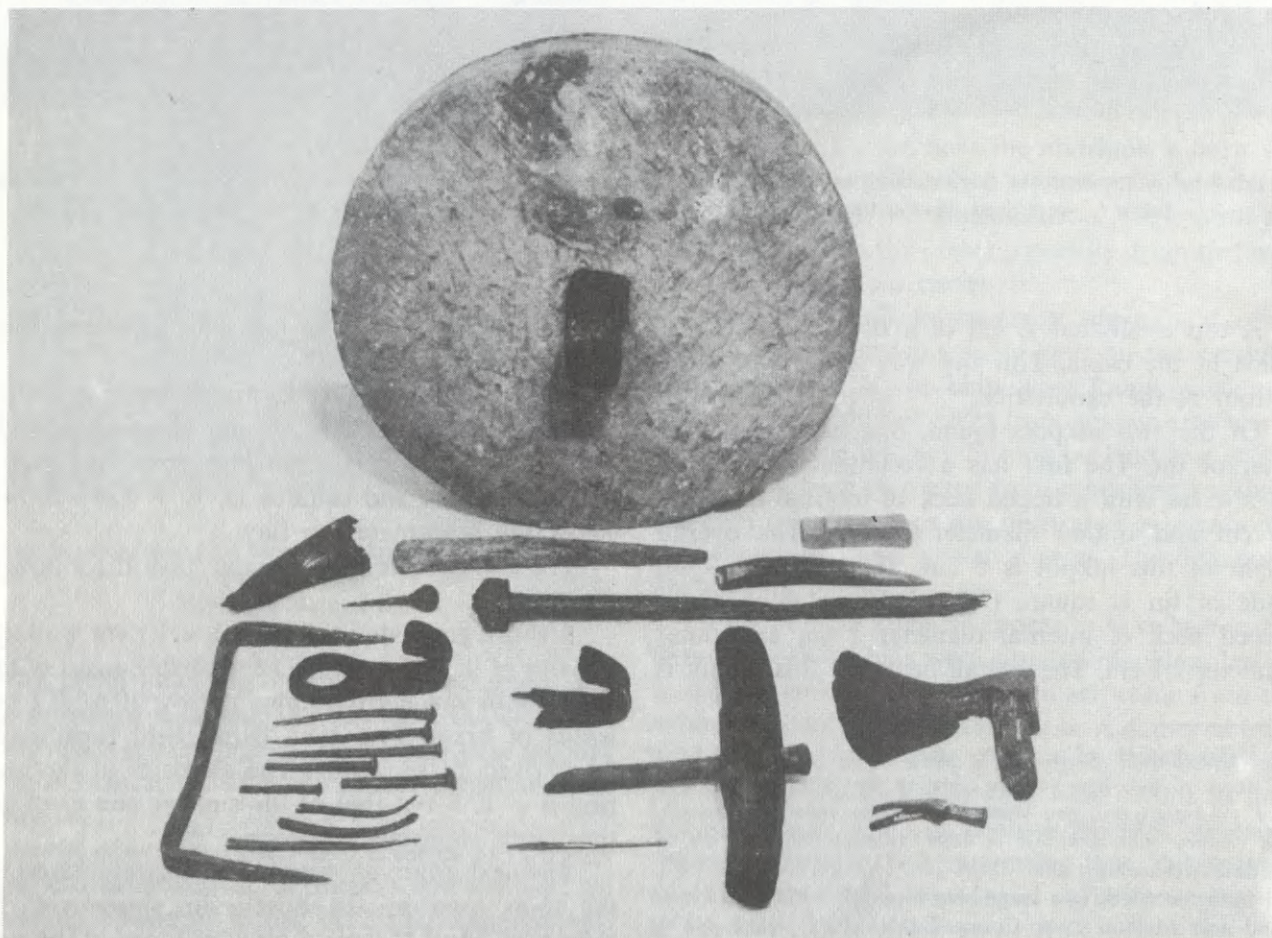


Fig. 24. Tools from the W-6 wreck: grinding wheel and whetstone. Below (from the left): horn for holding needles, awl and two marline spikes. Lower: bolt, clasp, lifting slings, ails, chisel, mallet, claw hammer and hatchet.

Photo. E. Meksiakowa

<http://rcin.org.pl>

handle and $4,5 \times 4,5$ cm at the faces). The wooden handle is broken. The traces of nail holes visible on the sides of the head show that it had been strengthened with a piece of metal. A small chisel, 14,5 cm long, is in good condition. Two cold chisels, however, are damaged — only their lower parts remain. Lastly, there is a rasp made entirely of forged iron, in original condition.

Among the rigger's tools there are 3 marline spikes and a wooden mallet for rope work. The marline spike in the best condition, No 423/78, 22,5 cm long, is shaped from an animal's horn, thick at one end and sharpened at the other. A hole 1,4 cm in diameter was drilled through the thick end for threading thongs. Another marline spike, No 1018/78, made in a similar fashion, is 22,8 cm long.

An awl, 1116/78, consists of an iron spike 7,5 cm long and 0,9 cm in diameter and a turned, wooden knob which is decorated with grooves around its circumference.

Two massive hooks were lying side by side in square 1—01 E. I think that they are the remains of lifting slings, which had various applications on ships.²⁴

which were part of the ship's equipment. A certain number of the nails appear not to have been used.

All the nails are forged and are of varying shapes and sizes, depending on their purpose. The shafts are square or rectangular in section. The heads are also square, flattened or conical. The ends of some shafts have clearly been hammered flat and sharpened. The longest nails, found loose, are 60 cm long and 3,8 cm in cross-section. In any case, a large part of this collection consists of long nails; nails shorter than 6 cm were not found at all.

Among the kitchen and dining utensils there are various kinds of containers for provisions and liquids, and also table crockery and cutlery.

The bricks found in squares 18 C and 18 E, i.e. before the mainmast are probably from the ship's galley. One of them, No 89/74 in good condition, measures $28 \times 15 \times 9$ cm. Near these bricks, in square 18 A there was a metal object, No 90/74, which could have been a hanger affixed above the fire-place. This presumed hanger, rectangular in cross-section is now right-angled in shape; its longer arm is 131 cm long, the shorter one is 35 cm long. There are two pairs of holes in the longer arm, the



Fig. 25. Galley utensils: iron kettle with three legs, hearth brick, cauldrones, tinder-boxes, hanger?, spit.
Photo. E. Meksiakowa

Lastly there are nails, hooks, clasps, fittings, hoops, pieces of metal (mostly copper sheet), chain rods etc. These were lying in and around the whole wreck. Undoubtedly, most of these objects were torn out of or came away from the constructions which they strengthened or held together, or from objects

holes in each pair being the same distance apart.

Tinderboxes were used to strike up a fire — three such objects were found. They represent three different types.

The kettles and cauldrons discovered in the wreck were mostly damaged and dented. The kettle in the best condition, No 1259/79, is made of cast iron and has three legs so that it could be stood on the fire-place, and also two ears for hanging it over the fire. 29 cm tall, this kettle is 34 cm in diameter. Two

²⁴See: J. H. R ö d i n g, *Allgemeines Wörterbuch der Marine*, Hamburg—Leipzig 1799, Bd I, p. 686.

cauldrons in reasonable condition without legs only had ears. Object No 456/77 is a brass vessel, 15,5 cm high, with a flat, oval bottom cut from a single sheet. The basic framing of the vessel consists of two brass rods, one bent to form the circumference of the base, the other forming the rim of the vessel. These rings are joined by two further rods the same height as the tub. The bottom sheet is folded round the lower ring, providing a support and a base for the sides of the tub. These sides were made from two sheet of brass, folded around the vertical rods. The upper edge of the sides is bent outwards and over the upper ring. The ears, made from brass wire, are riveted to the side walls near the rim, at the spot where the sides are folded around the vertical rods. The second cauldron, No 456/78, also of brass, is simpler in construction than the others. Oval in horizontal section, it was made from a single sheet of brass, suitably cut and bent. The ears of this cauldron were fashioned from the same piece of metal.²⁵

Ceramic vessels were also used for cooking or reheating food over the fire.

Because of the condition of the wreck, not many utensils of this kind survived in their original state. Over 1000 potshards were found among and around the ballast stones. They came from vessels of earthenware (some stoneware), from characteristic three-legged utensils, bowls, dishes, plates, pans, jugs, jars and cups. It was possible to reconstruct some of them.

The reconstructed tripod pipkins have tube handles which were extended with a wooden shaft.²⁶ These pipkins differ in size, and to some extent, in form. The largest of them, No HZ/683, 20 cm tall and 16,5 cm across, resembles a deep bowl with a bulbous

²⁵ Metal kettles, with or without legs, have been of interest to researchers and have their own literature see, for example, H. Drescher, *Zu den bronzenen Grapen des 12–16 Jahrhunderts aus Nordwestdeutschland*, [in:] *Aus dem Alltag der Mittelalterlichen Stadt*, "Hefte des Focke Museums" 1982, No 62, pp. 157–174. More literature cited therein. Cauldrons, quite like those found on W-6, with triangular ears, and coming from the 17th–18th century have been discovered i.a. in Lund. See: C. Wahlö, *Om grytor*, "Kulturen" 1985, pp. 110–111.

²⁶ If, to simplify matters somewhat, one could say that early medieval ceramic utensils of the "universal" type served manifold purposes in the Baltic area (e.g. cooking, eating, storage of food or drink), various types of utensils were produced for these requirements from the 13th century onwards. A tripod pipkin with ears for cooking, now appeared. In time, the ears would be replaced by handle into which a wooden shaft could be inserted. In the 13th–15th centuries these pipkins were glazed on the exterior. During the 15th or in the 16th century, they were glazed on the inside as well. This was more practical – the outer glazing was merely decorative. Pipkins of this type continued to be made up to the end of the 18th century. We may add that a kind of frying pan (skillet) appeared in the 13th century, at first without legs or handle; these were added at the end of the Middle Ages. C. Wahlö, *op. cit.*, p. 109.

body, topped by a wide rim. The inside is glazed an olive colour, the outside, below the rim, is decorated with parallel grooves running horizontally around the pot's circumference. Skillet No HZ/667 looks like a deep frying pan with a long handle. It is 13 cm high and 25 cm across. The inside is glazed an olive colour, some glaze stains are also discernible on the outer surface of the body. The third such tripod object, No HZ/668, is the smallest, and is intermediate in form between the previous two described. The inner surface is glazed dark brown, the outer surface is grooved in the same way as HZ/683.

Item No HZ/711, 13 cm high and 15,5 cm across, is a kind of pot or cauldron on three, short legs. Instead of handles it has ears on opposite sides. The body is biconical and has a rounded base and a thick rim. Inside and out it is glazed a greenish-olive colour. On the outer upper part of the body traces of shallow circumferential grooves are visible under the glaze.

Tableware includes dishes, plates, forks, spoons, knives,²⁷ jars tumblers and cups.

The four reconstructed ceramic dishes are coarse work, turned on a wheel and have a wide rim. The inside surfaces of the dishes were glazed in colours ranging from dark brown, through shades of green to yellowish. The outer surface has splodges of glaze on it. One of the dishes has circumferential grooves engraved on the outer surface; they were probably done with a stick. The decorative motifs include concentric, ever larger circles, vertical lines and full circles. In the bottom parts there are stylized plants, birds etc. These dishes are from 27 to 31,5 cm in diameter. Dish No HZ/674 is smaller, 22 cm across. Some of the dishes have two small holes in them.²⁸

Item No HZ/671 is intermediate in size between a deep dish and a bowl. It has wide ears. Glazed on the inside, it is grooved around the outside.²⁹

²⁷ In the Middle Ages, people used to use their fingers and a knife for eating with. Flat platters or trenchers, round or square, wooden or tin, fulfilled some of the functions of present-day plates. Some courses were eaten straight out of cauldrons, frying-pans (skillets), or out of pots, bowls or dishes with the aid of a spoon or even a bread crust. Forks came into use much later. This way of eating things persisted until the beginning of the modern era. See: P. Zumthor, *Życie codzienne w Holandii w czasach Rembrandta*, Warszawa 1965, p. 66; C. Wahlö, *Keramik 1000–1600 i svensk fynd*, "Archeologia Ludensia" 1976, vol. 6, p. 16; *Hausrat aus Metall*, [in:] *Aus dem Alltag der mittelalterlichen Stadt...* p. 145.

²⁸ In Sweden, large earthenware dishes, used at the beginning of the 16th century, were among the commonest ceramic utensils during the 17th century. C. Wahlö, *Keramik 1000–1600...*, p. 17; I. Kajsér, *Vraket vid Jutholmen, last och utrustning*, Statens Sjöhistoriska Museum Rapport 1983, 17, p. 30.

²⁹ My thanks are extended to Dr Barbara Lepówna of the Institute of Archaeology of the Polish Academy of Sciences for help in classifying the ceramic artefacts from W-6.



Fig. 26. Wooden and ceramic utensils; below right: spoons and spatulas.
Photo. E. Meksiakowa



Fig. 27. Pewter bowls and plates, spoon, fork, stoneware cup and jug.
Photo. E. Meksiakowa

There are two kinds of wooden spoons. In one, (No 1001/78) the bowl is roundish, 4,5 × 4,3 cm, in the other, the bowl is more elongated oval. There are 5 of the second type in the set of spoons that survived.

The ship's officers ate off tin dishes and plates, 9 of which were found. Each dish had the pewter makers mark, but not all of these marks are still legible. Three well preserved dishes are c. 30 cm across, two are 26,5 cm across and one is 16,5 cm in diameter.

The tin spoon No 365/76 has a round bowl and a hexagonal handle.³⁰ It is 17,5 cm long, and the diameter of the bowl is 5,7 cm. The two pronged forks have metal prongs and a shaft which was inserted in a handle of bone or wood. A well-preserved fork (No 1134/78) has a handle 6,6 cm long while the shaft and prongs are 11,4 cm long. Only the wooden handles of knives have survived — the metal blades have corroded away. Two wooden spades were found. They may have been used for spreading butter or fat. The smaller one, No 1166/79, is 18,4 cm long and 4,4 cm wide; the larger measures 33,5 × 12 × 1,4 cm.³¹

Drinking vessels and other containers for liquids were made from wood, ceramics, precious metals or glass. In our material, fragments of broken glasses, fragments of bottle glass and stoneware jugs are mostly all that are left. Only a wooden cup, a tumbler or jar and a stoneware jug has survived intact.

The bottles were square or round in cross-section. The surviving necks are also varied, both as to size and the shape of the mouth. Whereas neck No 1329/79 is c. 10 cm high and 3,6 cm across, neck No 1314/79 is only 2,8 cm high and 2,4 cm across, with the mouth being 3,1 cm across. A cork is still stuck in it. A pewter screw top was also found (No 656/77). One other neck No 1489/80 is 1,6 cm wide, with a 2,5 cm wide mouthpiece.³²

The bottle glass is greenish. The fragments of the cups, glasses or other vessels were made from smoked glass.

³⁰Similar spoons have been found in other 17th and 18th century wrecks, for example, in the "Campan" which ran around near the Middle Needle in 1627. R. L a r n, *The wreck of the Dutch East Indiaman "Campan" on the Needle Rocks, Isle Wight*, IJNA 1985, vol. 14, No 1, p. 21.

³¹Similar spades were found in the wreck of the frigate "Lossen", see: S. M o l a u g, *Gjenstandsmaterialet...*, 1976, p. 153.

³²It is assumed that four-sided bottles, square in cross-section, usually of greenish glass with a wide mouthpiece, appeared in Germany c. 1570–1580, see: R. H. M c N u l t y, *Common beverage bottles: their production, use and forms in seventeenth and eighteenth century Netherlands*, "Journal of Glass Studies" 1971, vol. 13, p. 103. This kind of bottle, often with a metal screw-top, was common in Europe in the 17th century and was also manufactured in Sweden; E. F e x, *Flaskor*, "Kulturen", 1953, p. 170.

The only preserved stoneware jug is 17,6 cm high and has a tin lid. The potshards scattered about the wreck suggest that this was not the only jug of its kind on the ship. The stoneware tumbler No 713/77, 8 cm in height and 4,8 cm in diameter, is glazed inside and out and has an everted lip. The wooden cup No 197/76 is 12 cm tall and 6,5 cm wide. It has a round foot, low stem and a round bowl that broadens towards the top. There were probably more of these cups on board too.³³

This group of objects also includes barrels, tubs, pails etc. Some of them could have been used for food, water and other beverages. Others will have been used in all kinds of deck work, for storing powder, etc.

A number of these containers are in good or almost original condition.

For example, the oaken keg No 1467/80 is 32 cm high and has a diameter of 17,5 cm. It comprises two round bottom pieces and a few broad staves, 1,3 cm thick. Near the top and bottom edges level with the bottom pieces, the keg was held together by pairs of hoops. There are bungs in both bottom pieces.³⁴

The pail No 770/78 is 22,5 cm high with a diameter of 24 cm. It consists of a round bottom-piece and seven wide staves. One of the staves is longer than the rest and has a hole bored through it allowing the pail to be carried. The overall height of the pail together with the handle is therefore 29 cm. The body of the pail was reinforced with hoops.

The tub No 504/77 is 22 cm high and 32,5 cm across. Two of the staves, opposite each other, had holes drilled in them to take a round cross-handle. The tub is bound by three hoops.³⁵

Container No 1082/78 is massive — it is 41,5 cm high, and it has an oval bottom 52 × 30 cm. The staves, 2–2,2 cm thick, are joined by dowels. The handle is a round cross-piece 4 cm in diameter let into thicker sections of two opposite staves, below their upper edges. This container was probably strengthened with hoops.

Many of the bottom-pieces and staves found in the wreck have dimensions similar to those of the keg,

³³A similar kind of jug was found i.a. in the "Vasa" — see: L. A. Kvarning — B. Ohrelius, *The Swedish warship "Vasa"*, London, 1973, p. 27. A vessel similar to the beaker from the W-6 was found in the wreck near Jutholmen — I. K a i j s e r, *Vraket...*, p. 30.

³⁴The comparative material from the "Vasa" is in the collections of the Statens Sjöhistoriska Museum in Stockholm.

³⁵Similar pails from the wreck of the "Kronan", see: "Kronan" book edited by B. A. Johansson, Höganäs 1985, p. 228. Other comparative material from this wreck, such as kitchen and table utensils, and also armaments, interior furnishings, crew's belongings etc. is in the collections of the Kalmar Läns Museum in Kalmar.

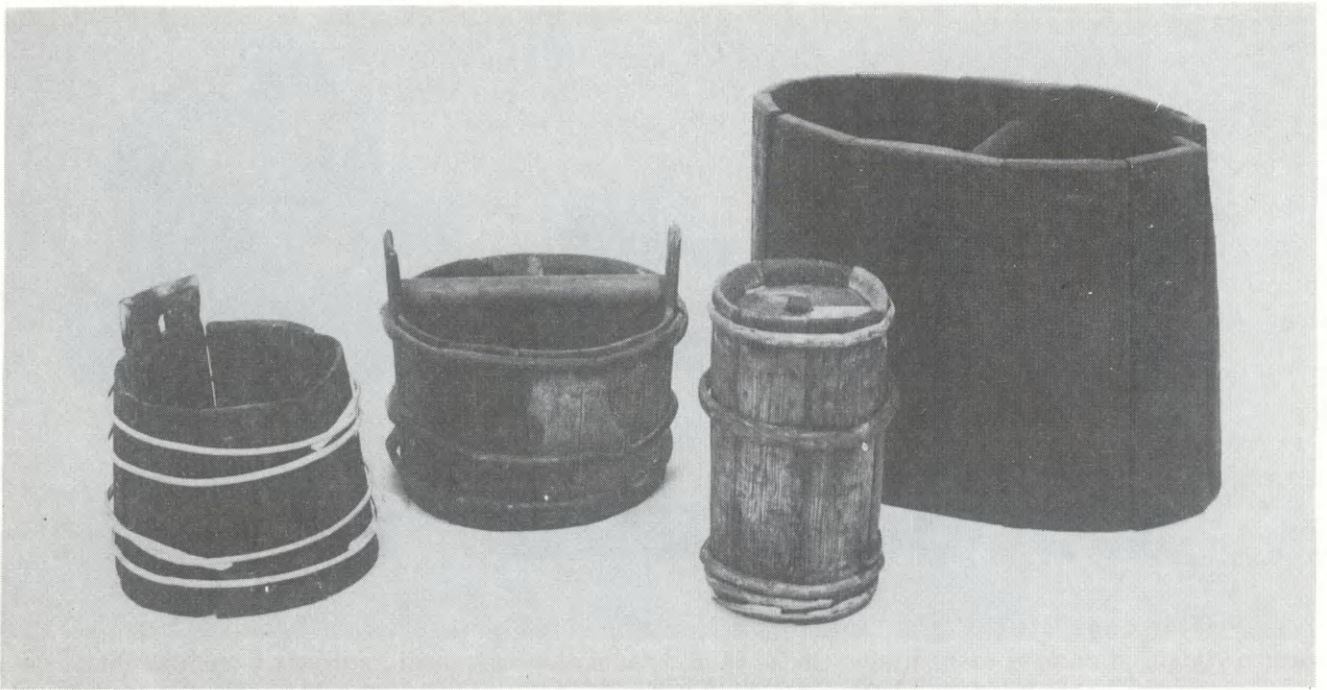


Fig. 28. Wooden pail, tub, keg and large container from the W-6 wreck.
Photo. E. Meksiakowa

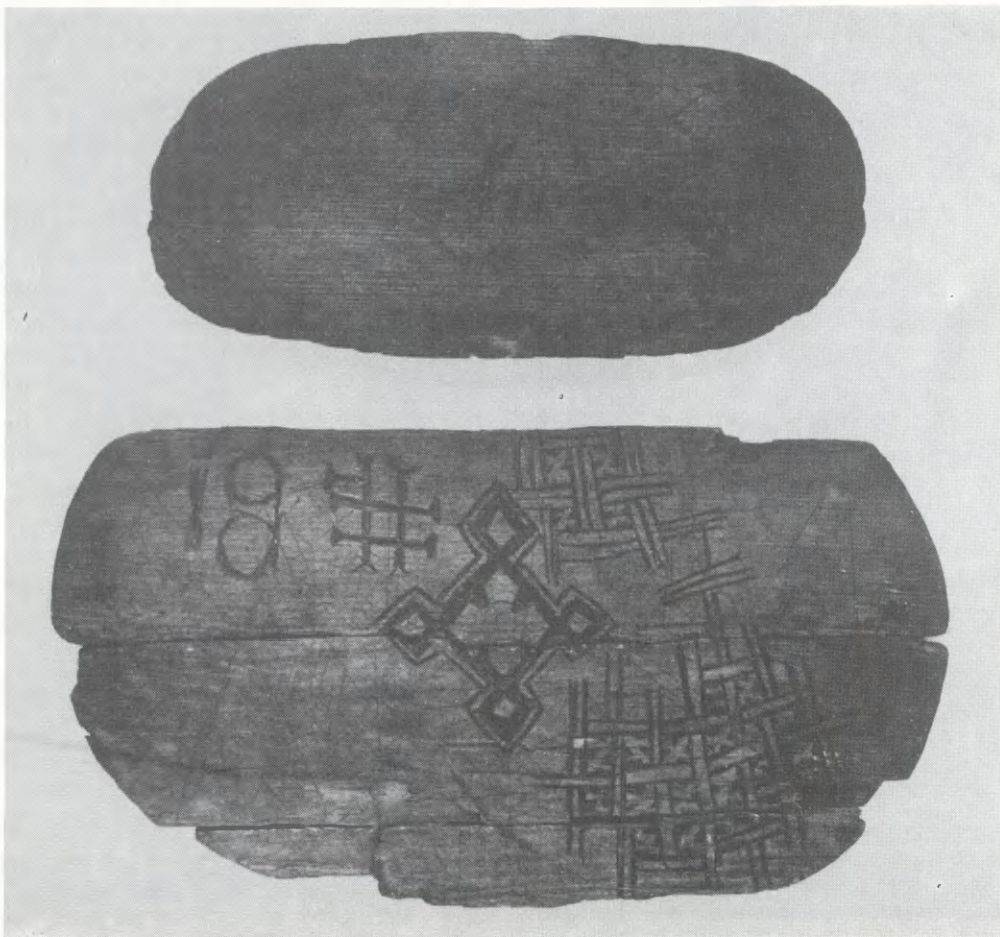


Fig. 29. Owners' marks on the bottom of a wooden keg and box.
Photo. E. Meksiakowa

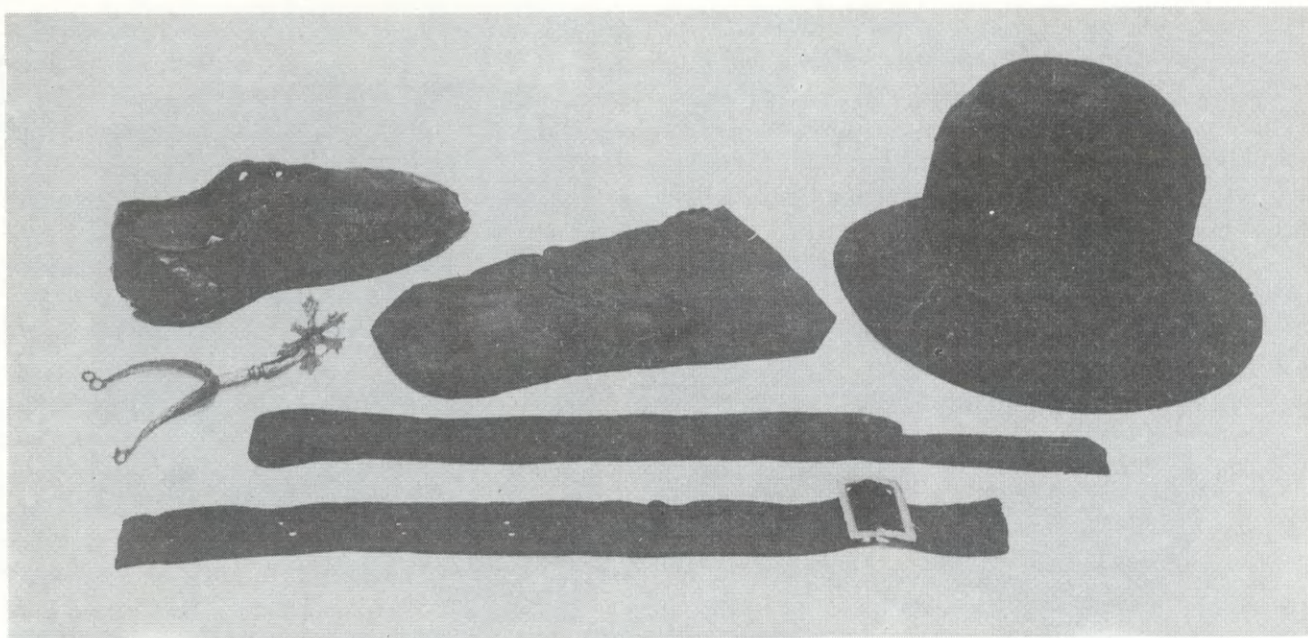


Fig. 30. Spur, also leather shoe, glove, hat and belts from the W-6 wreck.
Photo. E. Meksiakowa

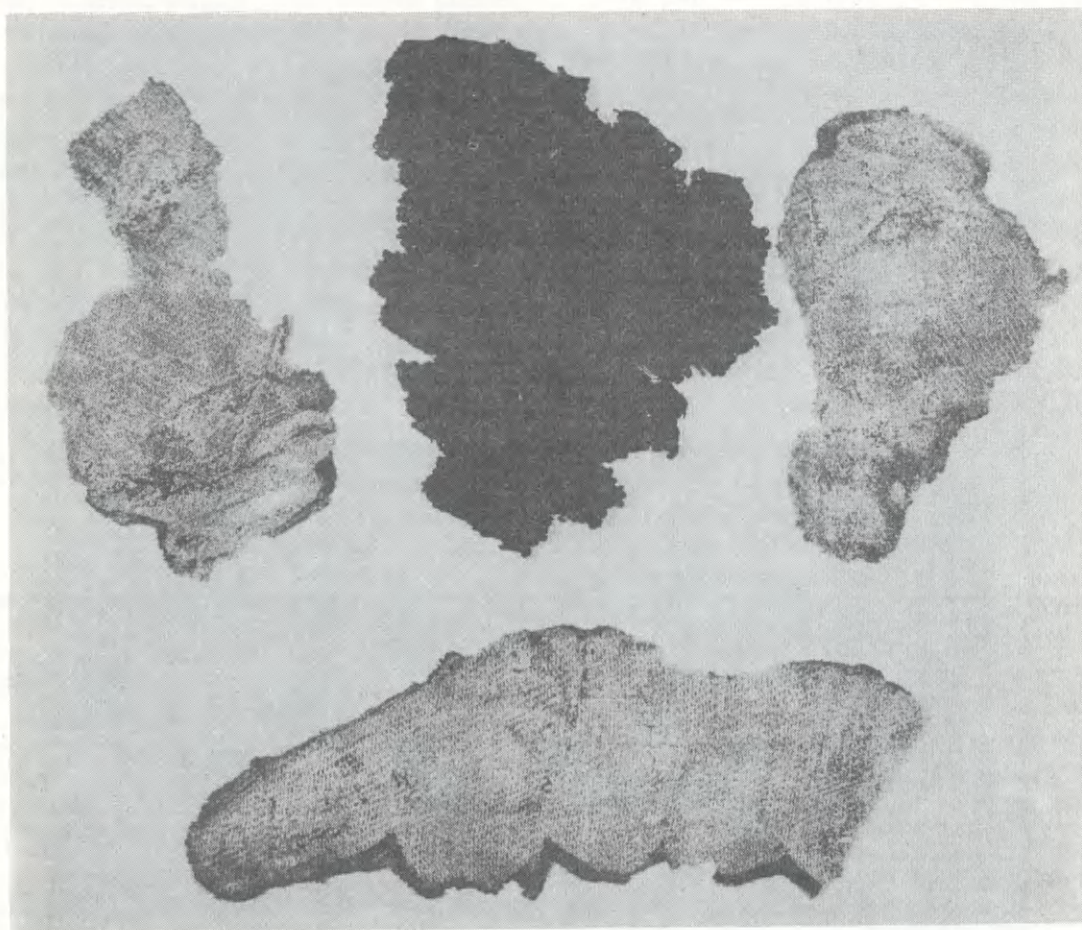


Fig. 31. Fragments of cloth. Top centre - knitted woollen cloth.
Photo. E. Meksiakowa

pail and tub described above. It should be stated, however, that smaller staves, e.g. 16–17 cm long, also occur in our material. Their shapes, suggest they may be from small tubs or small vessels containing provisions.

As far as the barrels are concerned, they could have been from 70 to 80 cm tall, judging by the length of preserved staves. There are also shorter staves, 40–60 cm long. The staves are of various widths and thicknesses. In the larger barrels the staves were usually 10–13,5 cm wide; there were also narrower ones, 1–1,5 cm thick. The staves of the shorter barrels were mostly 8–11 cm wide and 1–1,2 cm thick. We cannot determine exactly what the diameters of the barrels of each type were. From the preserved bottom pieces we may suppose that they varied in diameter from 30 to 50 cm. Bottom-piece diameters were mostly 30, 40 and 44 cm.

The dowels found in the wreck show that besides the barrels of these dimensions, there were also much larger barrels on board.

The barrels described were of simple construction. The staves were widest at half height and got narrower towards the ends. A groove was hewn out of these ends into which the bottom-piece fitted. The long sides of the staves were matched up. On the outside, the barrels were bound with hazel hoops.

The last group of objects are the personal effects of the sailors and soldiers, and include fragments of clothing, shoes, a hat, pipes, boxes, money, and the remains of sailors' bags.

Knee-boots were not found. Our material consists of 72 uppers, soles and heels from shoes.

Shoe No 1469/80 is in the best condition. Elegant in design, it is c. 24 cm long and had the upper cut from a single piece of leather and sewn together at the heel. The sole was hand-sewn to the upper; the heel has not survived. The shoe has a tongue and was tied at the front with a thong threaded through two pairs of lace-holes. There are traces of mending on the upper and the sole.

Heels were made of leather or wood. Item No 1422/80 shows what the leather heels looked like. In shape, it is similar to that of a fashionable modern shoe – fairly high and rather narrow. It was made of several layers of thin leather held together with wooden sprigs.³⁶

We can assume that at least some of the shoes discovered were akin to the type described. As far as

³⁶Heel No 1422/80 consists of 8 layers of leather, heel No 1271/79 of 5. Heels from the wreck of the "Association", which sank in 1707, were made from 5, 6 or 7 layers. The sole sizes found in that wreck are roughly the same as present-day sizes 6 and 7. R. MORRIS, *More finds from Scilly Islands wrecks*, IJNA 1984, vol. 13, No 3, p. 254.

size goes, the 20 soles preserved in their entirety are from 21 to 28 cm long. The soles 26–28 cm long appear to have come from shoes whose size could be regarded as normal. The smaller shoes – size 20–24 – may have been worn by ship's boys (?).

I have already stated that no knee-boots were found. But there must have been officers on board who wore such boots. The spur No 1106/78 is evidence for this. It had been produced with care, with at the end of each of which there were two holes for threading the straps which held the spur to the boot. The goad had a moulded neck and ended in two prongs holding a six-pointed star.

The fragments of clothing are so small that it is impossible to reconstruct the cut of the trousers, shirts, jackets etc. from them. We can only say that they were made from canvas or woollen cloth or leather.³⁷

The buttons from these clothes are of wood or bone. Their outer surface is smooth, slightly concave or moulded. The four or five holes for sewing the buttons on are variously arranged. One pair of buttons is quite flat, and has a stud on the inner side around which the thread attaching the button to the garment was wound.

The buckles are of brass or tin and come in a variety of shapes and sizes. They were used for holding up trousers, folding over trouser legs (knee breeches), holding up stockings, doing up shoes etc.

The simplest type, rectangular in shape, are the tin buckles. They are also the biggest, being 3,5–3,7 cm wide and 5,4–5,7 cm high. Smaller buckles of the same type made of brass and oblong or square in shape are 3,8 × 4,5 or 2,5 × 2,5 cm. The second type are double buckles, held together by a rivet. Their size is 2,8 × 2,7 cm.

The final type of buckle in our collection are decorative ones, resembling a figure-of-eight. A buckle of this kind is 3 cm wide and 2,6 cm high.

Trouser belts are leather or textile. The leather belts are 2–3 cm wide and 0,3–0,5 cm thick.

Of the 10 gloves found in the wreck 8 are leather working mittens. An appropriately cut-out piece of

³⁷Artefacts telling us what sailors wore were found in the wreck of the "Vasa". One of the mariners wore a jacket of thick, coarse woollen cloth with long sleeves and tails. He had a linen shirt, wide woollen knee-breeches. On his feet he had leather shoes and linen stockings tied below the knees. His trousers were held up by leather belt behind which he had stuck a knife. He also had a leather purse on him. An officer from the same ship wore a felt hat. Danish sailors from the mid-17th century and sailors from other countries were dressed similarly. They sometimes wore sleeveless waistcoats over their jackets. In cooler weather, they put on extra underclothes, trousers and jackets. H. HENNINGSEN, *Sømandens tøj*, "Handels – og Søfartsmuseet på Kronborg Årbog" 1979, p. 10.

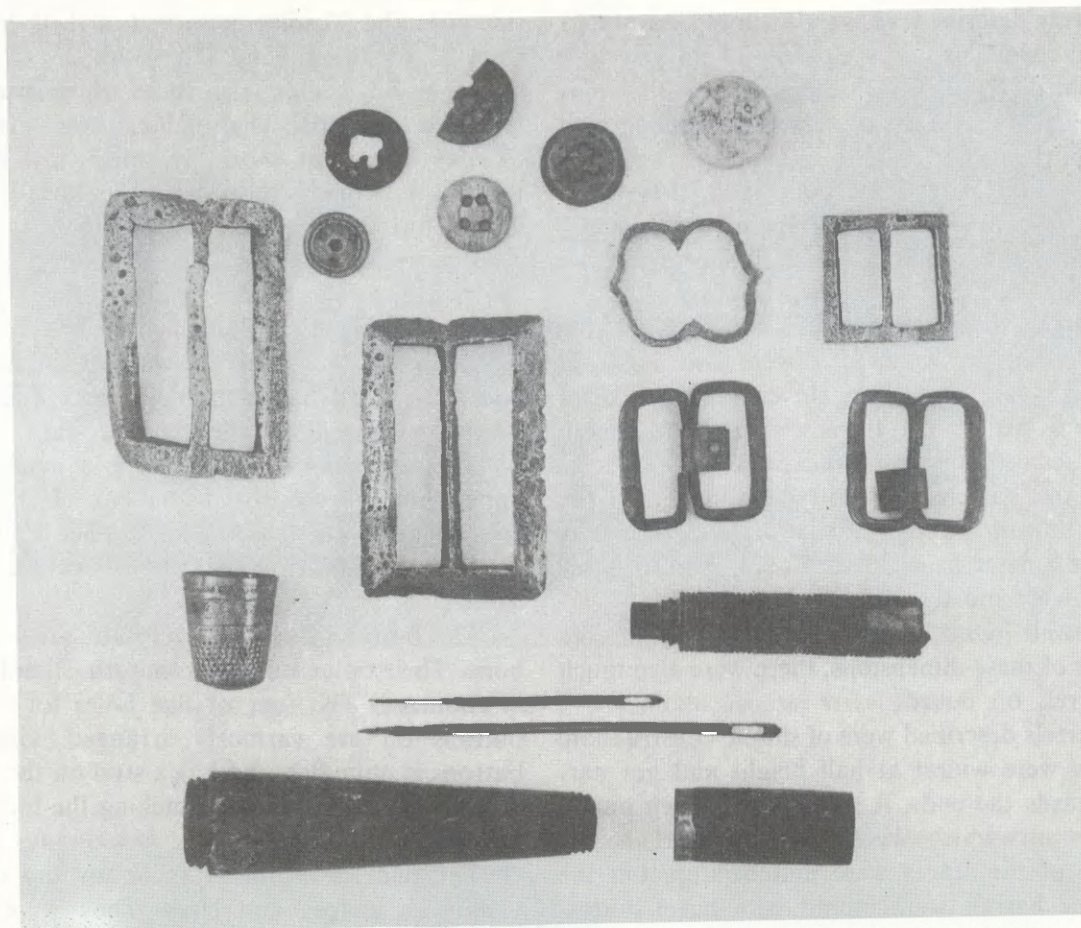


Fig. 32. Buttons, buckles, thimble, tooth-pick container, needle container and needles. From the W-6 wreck.
Photo. E. Meksiakowa

leather was folded, after which the top and one side were sewn together. The thumb was added from another piece of leather. The gloves are of various sizes, e.g. No 1269/79 is 18 cm across at the base and 25,5 cm high. No 1270/79 is 20,5 cm wide at the base and 29,8 cm high.

Only one item of headwear has survived — a hat (No 883/78) of thin dark felt. The round brim is about 6 cm wide while the crown is c. 13 cm high. The diameter of the hat including the brim is 28,5–29,8 cm, that of the crown alone is 17–18,5 cm.

The sailors repaired their clothing and shoes themselves. Proof of this are the traces of mending on the footwear and the fragments of clothing, and also a well-preserved needle dolly. Cylindrical in shape, this is 11 cm long and comprises two parts which were screwed together. The needles are 8,4 and 5,8 cm long — the second one was originally longer. The brass thimble is delicately ornamented.³⁸

³⁸A photograph, taken from the *IJNA* 1974, vol. 3, No 1, pp. 77, and showing some of the many thimbles recovered from a mid-17th-century wreck (which had sunk near Mullion Cove in Cornwall), does not tell us whether they were ornamented or not.

The members of the crew “drank” tobacco. It is assumed that tobacco was brought to western Europe from America in the second half of the 16th century. Used medicinally, tobacco was smoked in pipes in the 1570s. This custom became widespread particularly in England, where smoking had already become commonplace by the end of the 16th century. To a large extent, it was sailors who spread this habit. At the beginning of the 17th century tobacco began to be grown in Europe too.³⁹ A reflection of the rapid spread of this custom are the clay pipes in wrecks which are being studied by archaeologists. Not rarely, they are one of the factors which enable finds to be dated; so we shall devote a little more attention to these objects.

In W-6, 5 clay pipes were found, consisting of bowls and damaged stems, and 2 stems without bowls. These pipes are of two kinds. Four of the pipes have massive stems (0,7–0,8 cm in cross-section at the bend) and bowls inclined forward so that they

³⁹A. Oswald, *Clay pipes for the archaeologist*, BAR 14, 1975, pp. 3–6; A. Åkerhagen, *Kritpipor*, Stockholm 1985, p. 5 et seq.

form an obtuse angle with the line of the stem. The bowls bulge in the middle: that is to say, both the inner and outer outlines are convex.

The height of the bowl in all the pipes is rather similar, in three pipes it is 3,3 cm, in one 2,7 cm, the cross-section is about 1,8 cm, the outer diameter of the mouth of the bowl is 1,4 cm, the inner is 1,1 cm. This kind of pipe can be dated at the beginning of the 17th century.

Another box, round, 6,7 cm in diameter, had a lid lined with an intricately decorated piece of metal and probably belonged to an officer.⁴⁰

Another wooden container, tube-shaped, 5,8 cm long and 1,2 cm in diameter was found. It resembles a tube with a threaded top. The body of this container is decorated with five sets of grooves (four per set) carved at regular intervals. Wooden tooth-picks 4 cm long were found in this container.

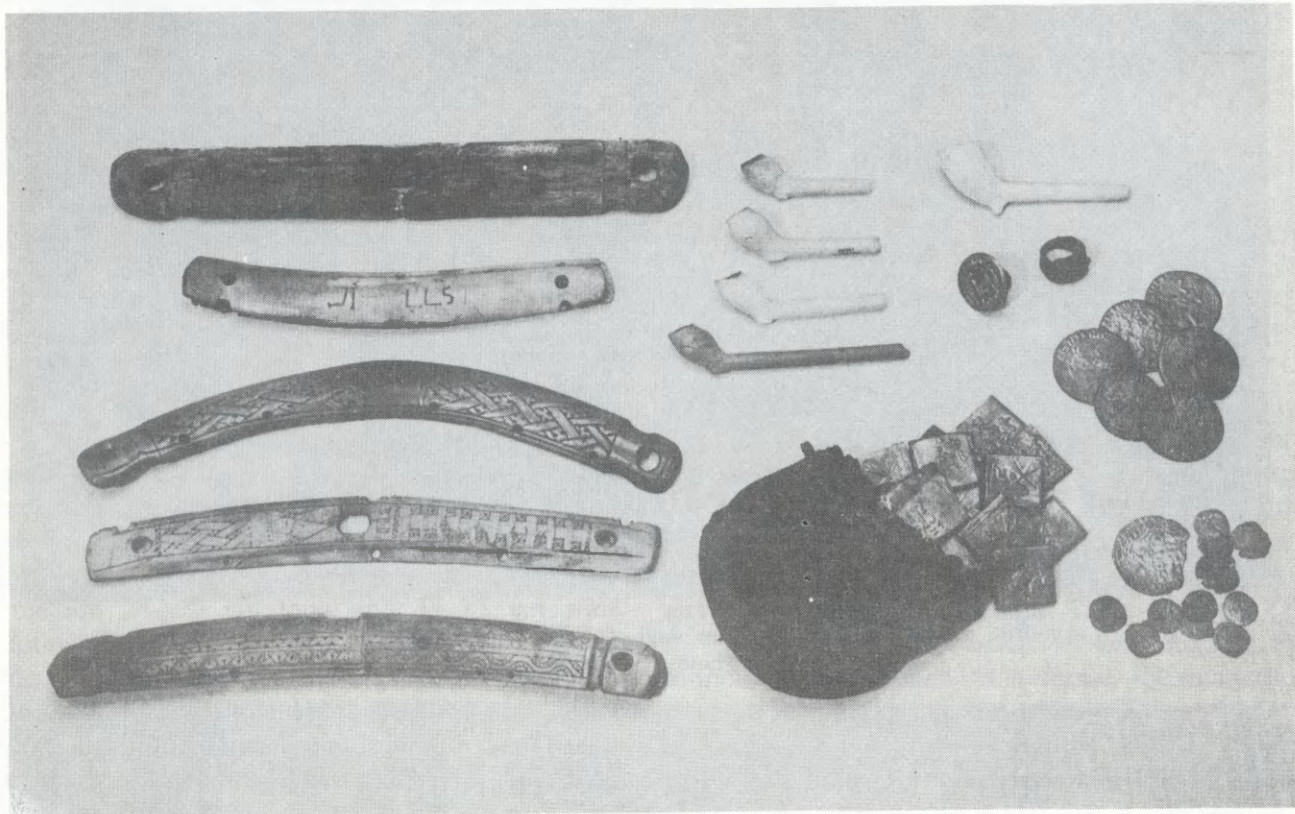


Fig. 33. Handles from sailors' kit-bags (top left — wooden handle, below — bone handles). Right: clay pipes, seal matrix of the Oliwa "wójt"), signet-ring, purse and coins (copper and silver).

Photo. E. Meksiakowa

Item No 1185/79 is a pipe of a different type. In proportion to the bowl, the stem is somewhat slimmer, and the angle at the bend is smaller. The bowl itself, 4,2 cm high, is narrow at the stem, but widens distinctly towards the mouth. The external diameter of the mouth is 2–2,4 cm, the internal 1,7 cm. The lip is cut at a slight angle to the line of the stem. The heel is narrow and high. The bowl is symmetrically decorated with a leaf motifs. On the stem there is another motif or owner's mark (?). Typologically this pipe is much younger than the one described earlier and is similar to pipes from the 18th century and first half of the 19th. I suspect that this pipe got to the site of W-6 after the disaster.

Three wooden boxes will have belonged to ordinary seamen or soldiers. Egg-shaped, they were made from two boards bound with bast. Some of them carry owner's marks.

In square 10 F, at the bottom of the wreck, lay a perfectly preserved brass seal-matrix handle, 3 cm in diameter. The central part of the seal shows a bare-footed man wearing trousers, a shirt, a jacket reaching down to his knees and a hat with an upturned brim. This man is walking and has a staff in his hand. The margin of the seal contains the words SIGILLUM ADVOCATI OLIVENSIS and the date 1599.

The largest number of objects in this group of personal belongings are coins. They are all copper and silver Swedish coins. Most of them are klippingar, well-known from the "Vasa", in denominations of 1 and 2 öre, minted in the province of Dalarna.

⁴⁰The contents of a box discovered on the "Vasa" are shown in the photo published by B. Ohrelius, *Vasa, le navire arrache aux sables*, Paris 1963, p. 65.



Fig. 34. A skin-diver, Zbigniew Jarocki, finds the skull of a sailor under the stern part of the wreck's hull.
Photo. L. Nowicz

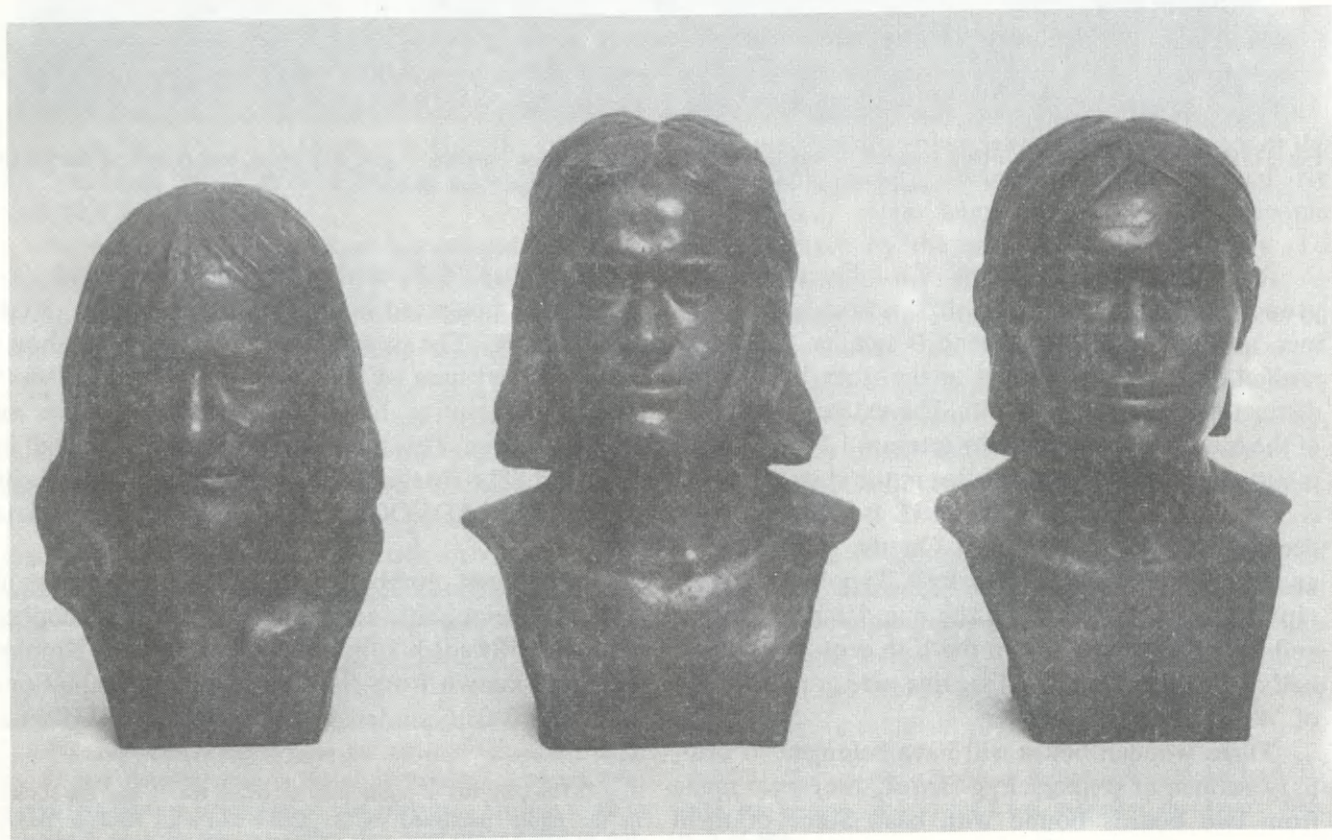


Fig. 35. Reconstructed heads of three persons from the W-6 wreck.
Photo. E. Meksiakowa

The dates of minting and the monograms GARS or GAR (Gustavus Adolphus Rex) are still legible on some of the klippingar, and they show that these coins came into existence in 1620–1627. The silver coins are also like those found on the “Vasa”. The coin of the highest nominal value is a thaler minted in Stockholm in 1618. None of the coins carries a date later than 1627. These coins were of course, an important factor in identifying the wreck.

The coins were scattered in various parts of the site, usually several or several tens at a time. In two places blocks of over 100 coins were found. One was found in square 17 I c. 40 cm below the surface layer and consisted of 115 klippingar. Another one, discovered in square 8 D, some 50 cm from the planking of the ship, contained 130 silver coins.

In a few cases, coins were found in leather purses. Bag No 886/78 was sewn from two flaps of leather. In the upper part of the purse two holes had been made to take the thong that closed the bag. Another purse was sewn from a single, suitable cut piece of leather (e.g. No 832/78).

A lot of interest was generated by the objects which could have been the handles from sailors' bags. They were found in the after part of the wreck and under the hull. There are 25 in all, 22 of bone and three wooden ones. All are slightly crescent-shaped. Some are 24–27 cm long and 3–3,5 cm wide. Another group are 20–22 cm long and 3–3,5 cm wide. They vary in thickness from 0,7 to 1 cm. The wooden handles are thicker. Single holes were drilled at the ends of the handles, and in twelve cases also in the middle of the handle. There are 3–8 smaller holes along the inside edge of the handles, and 2–3 semicircular notches were made in the outer edge. The handles are decorated in various ways. Three also carry the marks and initials of their owners (e.g. JI and LLS).

Of the owners of these objects, the soldiers and sailors who drowned in their ship, all that remains is their bones. Scattered among the ballast stones, in the dark, greenish water, they bring to mind melancholy sea-shanties... The better preserved remains of a few men were found in square 10 I, 10 cm below the bottom of the Bay, in squares D 6 and D 5, some 250 cm below the bottom and in square 01–E at a similar depth. In square 4 E–3 E, a man was lying face down, crushed under the hull. Anthropological studies of three complete skulls, carried out after we had finished our excavations, show that one of them belonged to an individual of the Teutonic type (AY), who perished at the age of 35–40. The second belonged to a man of the Sub-Nordic type (ALY), 28–32 years old, and the third was of the same type

and was 25–35 years old. The height of one of the sailors was estimated at 173 cm.⁴¹

In concluding this review of the objects of historical interest found on the site of wreck W–6. I should emphasise once again that I have mentioned only some of the better preserved objects and those which can give us some idea of the nature of the various groups – armaments, work tools, personal belongings etc.

IDENTIFICATION OF WRECK W–6

Observations made during the underwater exploration of the wreck and an analysis of the objects found there allowed us to attempt to identify the ship.

The nature of objects found, especially the number of arms, e.g. the number of cannon, cannon balls and small arms indicate that W–6 is the wreck of a warship.

Most of the gun barrels were cast in Sweden – for the rulers of that country. All the coins – a total of 1262 – come from Sweden. A considerable number at least of the other items found, including the ceramics, are of the same origin. Without going into the details of the other objects from the Swedish cultural area, we can assume that this ship was in the service of the Kingdom of the Three Crowns.

The shot stuck in the barrels of some muskets, the cannon ball embedded in a frame, the numerous traces of burning on the construction elements of the hull suggest that before sinking, the ship had participated in a battle. The skeletons and human bones, and the fire-arms found under the ship's hull, and lastly, the ripped off bows of the wreck appear to confirm this supposition.

The dates preserved on the cannon and coins and other items found on the site enable us to establish when the ship sank.

As I have already mentioned, the gun barrels found in the wreck were cast in the second half of the 16th century and at the beginning of the 17th century. The clay pipes, no doubt belonging to the ship's crew, were manufactured in the first quarter of the 17th century. Together with these objects, the coins are of particular importance in fixing the date of sinking. Those coins on which the date of minting are still

⁴¹At the Museum's request, the bones from W–6 were classified by Dr Alina Wiercińska of the Anthropological Laboratory, State Archaeological Museum, Warsaw, and Dr Małgorzata Nawrocka of the Archaeozoological Laboratory of the same museum. I have made use of their results in my article. The complete classification is in the Polish Maritime Museum's archives.

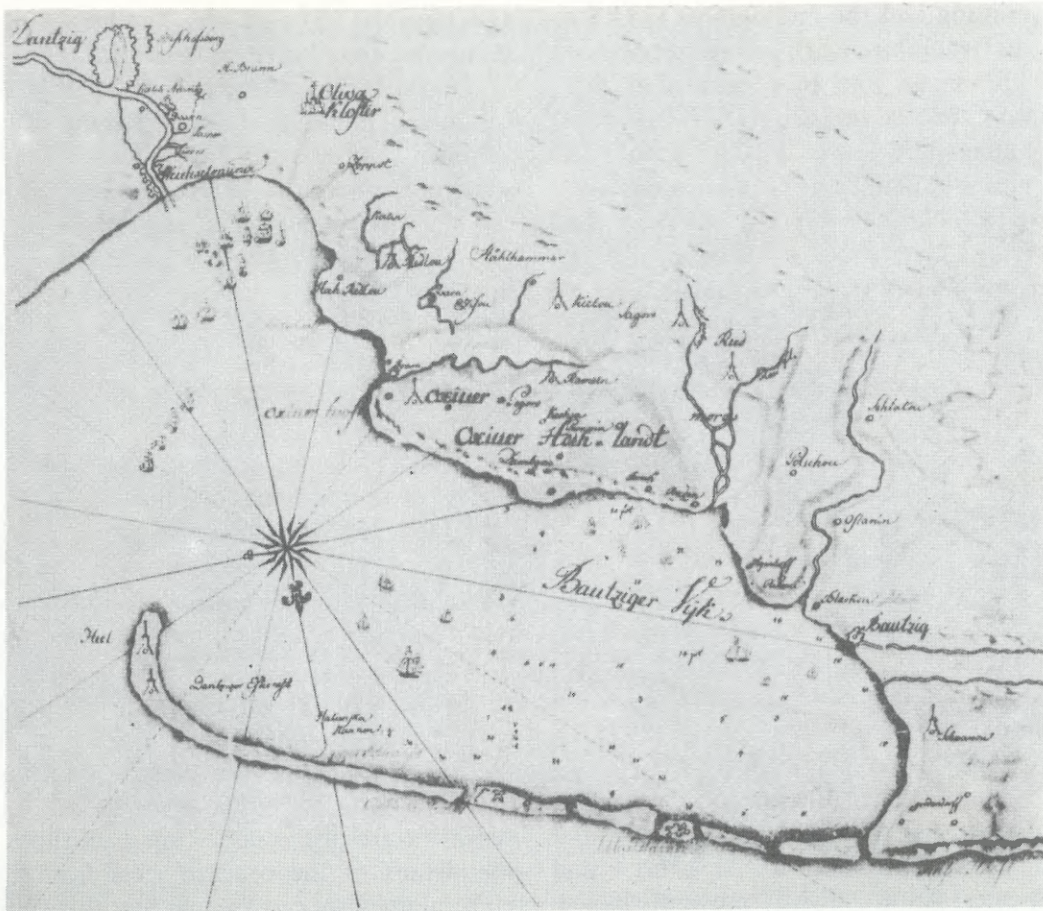


Fig. 36. Battle between the Polish and Swedish fleets in the Gulf of Gdańsk on 28th November 1627. Ink drawing by C. A. Wahrberg from the collection of Kungl. Orlogsmannssällskapet at Karlskrona.

legible came mainly from the 1620s, i.a. 1624, 1625, 1626 and 1627. The year 1627 was the last date that could be read off the coins found in W-6. It is very probable that the ship sank in that year.

Wreck W-6 was found in the area where, on 27th November 1627, a battle was fought between the Swedish and Polish fleets.

This battle was one in the long struggles between Poland and Sweden, started by the dynastic claims of Sigismund III Vasa (elected to the Polish throne in 1587) and renewed in 1611 by Gustav Adolf who wished to extend his territories and influence in the Baltic Sea area. In 1626, the main Swedish forces struck at Prussia, Warmia and Pomorze, while the Swedish fleet began to blockade the port of Gdańsk. I shall not relate the course of this war; suffice it to say that the Swedish squadron blockading Gdańsk in the autumn of 1627 was led by Admiral Niels Stjernskjöld. As the weather was deteriorating in November of that year, the Swedes decided to return to their bases; it was then that the Polish fleet struck. The Poles won the battle and the blockade was raised. Among other things, the Poles captured the Swedish flagship "Tigern" (on which Admiral

Stjernskjöld died). Another Swedish ship, the "Solen", blew up.⁴²

An analysis of the resting place of W-6 showed that the wreck was lying in the region where the battle was fought, where the "Solen" could have sunk. We do not know of any sources which would indicate that in the first half of the 17th century, some other Swedish warship sank in the same area.

All of this evidence suggests that wreck W-6 may be remains of the "Solen".

The "Solen" came into the service of the Swedish navy in 1624. A year earlier, king Gustav Adolf, preparing for war against Poland, had ordered Anton Monier to purchase nine ships in Holland. Among the vessels that arrived in Sweden in the spring of 1624 was the "Solen". In the summer of that year, along with the other ships bought by Monier, she was adapted and armed in Alvsborg, after which she sailed into the Baltic to take part in the Polish

⁴²A. Czółowski, *Marynarka w Polsce*, Lwów 1922, p. 125 et seq.; *Svenska Flottans Historia*, vol. I edited by O. Lybeck, Stockholm 1942, p. 420.



Fig. 37. Battle in the Gulf of Gdańsk — on the left, the explosion of the powder room of the “Solen”. Contemporary print after A. Czołowski.

campaign.⁴³ We know that she also took part in the blockade of Gdańsk. The “Solen” was a three-masted ship of medium size (c. 150 lasts armed with 38 cannon, and was sailed by a crew of ca one hundred men, sailors and soldiers).⁴⁴ Her captain during the battle in the Gdańsk roads was Alexander Forrath.

When attempting to answer the question — Is wreck W-6 the “Solen”? — we must not forget the archival evidence. I have in mind here two reports in particular. The first is a document compiled shortly after the battle by the Royal Ships Commission, relating the course of this encounter.⁴⁵ The second report contains more details. In the opinion of some of the eye-witnesses of the battle, the Poles could have scored a much more handsome victory, had it not

been for the errors or dilatoriness of some of their captains. As a result, the Royal Ships Commission questioned the captains and crews of some of the ships shortly after the battle. In the Library in Gdańsk, there is a manuscript containing the record of these interrogations.⁴⁶

I shall quote from these sources a few excerpts about the circumstances of the “Solen’s” sinking, and then compare this information with a certain feature of wreck W-6.

From the report describing the course of the battle, it seems that the “Solen” was attacked by the Polish ship “Wodnik”. Approaching the “Solen”, the captain of the Polish ship “ordered the four forward guns to fire at her, and then brought the port side round to face her. Then two or three rounds were fired from our port-side guns after which we grappled onto her starboard side. The enemy

⁴³ *Sveriges krig 1611–1632...*, pp. 33 and 153.

⁴⁴ *Ibidem*, p. 233 et seq.

⁴⁵ *Wahrhaftiger und eigentlicher Verlauf des harten Treffens, so zwischen Ihrer Königlichen Majestät zu Polen und Schweden und Herzogs Gustavi Adolphi aus Südermanland Orlogsschiffen vor der Danziger Reide geschehen im Jahr 1627, am ersten Sonntag des Advents*. Printed in M. Krawicz’s book *Walki w obronie polskiego wybrzeża w roku 1627 i bitwa pod Oliwą*, Warszawa 1955, pp. 113–121.

⁴⁶ *Acta commissiorialia annotata per Danielum Forsterum notarium publicum et Commissionis tum temporis actuarium, Anno 1627 and Diarium Commissionis Regiae a 3 November, Anno 1627 usque ad ultimum Augusti Anno 1628 conscriptum per Joannem Heppium Secretarium Commissionis*. Gdańsk Library, Ms. Uph. fol. 45.

was firing like mad, but did us the most damage with powder bags, many of which they threw (onto our deck...)”. The Poles made several attempts at boarding the “Solen”. Three times the Swedes repelled these attacks “...defending themselves from below with pikes. At the same time lots of grenades were being thrown from our ship...”. In the end, however, the Poles, having broken the Swedish resistance, got on to their deck “...Then the Swedish skipper lit a torch, jumped down into the powder room and blew his ship up. 22 of our soldiers and one ship’s boy went up with the ship, and ten had been shot before the explosion. Many Swedes fell like stones into the water”.⁴⁷

Without quoting any more from this narration, we recall that during our excavations we had noticed that the forward part of W-6 was badly damaged and gave the impression of having been ripped off. If W-6 really is the “Solen”, the damaged bows would have to be linked with the explosion in the powder room. But – on the “Vasa” and other warships of that period, the powder room was situated in the after part of the hull.⁴⁸

However, we have evidence that things were different on the “Solen”. This is the testimony of one of the participants in the battle, a Danish member of the “Wodnik’s” crew, Peter Simsen Schiman.

He testified before the Royal Ships Commission, that when he and the other sailors from the “Wodnik” boarded the “Solen”, he saw the Swedish skipper running to the bows with a burning torch. “...Der Feind war damals ganz unten, und hat Zeuge vermeint die Kraut Cammer were hinden, hette er gewust, dass sie fornem gewesen were, wollte er dem Schipper vol gewehret haben, dass ers Pulver nicht hette angestechet, hat... eine Lunte in der Hand gehabt und seij Zeuge um Achterschiffe gewesen, lass dass Vorderschiff aufgeflagen...”.⁴⁹

In my description of the objects raised from W-6 I mentioned two Polish cannon barrels (one from 1570), two so-called “Russian” guns and the seal matrix belonging to the advocatus of Oliwa of 1599.

The Swedes had probably captured the Polish and “Russian” guns during the wars they had waged on Polish territories. We may add that at the same

time, the Polish ships were armed with numerous Swedish guns.⁵⁰

As to the seal matrix, in theory one could assume that it could have belonged to one of the 23 Polish sailors who were killed when the “Solen” blew up. But there is also another possible interpretation. We know that the Swedes blockading Gdańsk made raids on to the land near the city. In the summer of 1626, during one such “excursion”, they plundered Oliwa, the monastery and settlement.⁵¹ It is possible then that the seal matrix became the booty of one of the “Solen’s” soldiers.

The information we have about the “Solen” after the disaster is very scanty and uncertain. By destroying the fore part of the ship, the explosion in the powder room must have weakened the whole construction. The tackle was torn. From the description of the fight between the “Solen” and the “Wodnik” we know that after boarding the enemy ship, the Poles tried to damage her rigging. “...Interim haben unsere leute seine Tackel entzweij gehauben...”.⁵² Incendiary shells fired from both sides, set the sails of both ships on fire. After the “Solen” had sunk, the victorious “Wodnik” was unable to give chase to the other Swedish ships retreating from the battle area because “...Marssegel, Focke und flagge seind Verbrenndt gewesen...”.⁵³

So when the explosion occurred and the “Solen” with destroyed bows probably deprived of her foremast, with torn and partly burnt gear, went down, she must have been vulnerable to the storm waves and currents which began to complete the ship’s destruction.

So when, shortly after the battle had ended, the Royal Commissioners began receiving messages about objects from the “Swedish wreck”, “...mit etlichen Kasten, tawen, Masten, Musqueten und dergleichen...”.⁵⁴ being thrown up on the shore, i.a. near Kolibki, they demanded that “...fragmenta... ex incensa et submersa navi Svetica...” if thrown ashore, be brought in carts to the Royal Commission.⁵⁵

There are certain indications that the Royal Commissioners attempted to recover from the wreck some of the more valuable objects, including the guns. In February 1628, one Walenty Patschke demanded payment for objects he recovered from the “Swedish wreck”.⁵⁶ We cannot say, however, whether

⁴⁷ *Wahrhaftiger...*, pp. 119–120.

⁴⁸ But in the already-quoted “A treatise on shipbuilding” from about 1620, we read: “...The hold is the chiefest part of the ship... it is also for several uses subdivided... into 5 parts. In the fore part thereof a little abaft the foot of the bitts are made three partitions: one for the powder room...”, W. Salisbury, *A treatise...*, p. 11.

⁴⁹ *Diarium Commissionis Regiae...*, p. 133.

⁵⁰ K. Lepsz y, *Inwentarz polskiej floty wojennej z 1629 r.* KHKM 1967, R. 15, No 2, p. 304.

⁵¹ A. Cz o ł o w s k i, *Marynarka...*, p. 122.

⁵² *Diarium Commissionis Regiae...* p. 134.

⁵³ *Ibidem*, p. 140.

⁵⁴ *Ibidem*, p. 160.

⁵⁵ *Ibidem*, p. 175.

⁵⁶ *Ibidem*, p. 197.

any guns were raised and if so, how many. In any case, most of them, 20 in all, stayed where they were until 1969.

THE CONSERVATION OF OBJECTS FROM WRECK W-6

The objects raised from W-6 were — in Polish museum practice — the first, large set of objects from an aquatic environment, from the Baltic, to receive conservation treatment. As I mentioned (p.47), at first we were assisted in this respect by the Archaeological and Ethnographical Museum of Łódź and other museums. Once our own Conservation Laboratory finally got under way in 1974, all the objects recovered from W-6 were treated in our Museum. The various kinds of objects were treated in the following way.⁵⁷

1. Wooden objects

Before commencing the conservation proper of the wooden objects, they had to be prevented from drying out and protected from attack by mould and fungi by immersing them in baths filled with a 0,01% solution of sodium pentachlorophenolate or a 2% solution of a 7:3 mixture of boric acid and borax. Then, depending on the state of preservation of the wood and the size of the object, various treatments were applied.

Flat thin objects made of well-preserved oak-wood, were conserved in the simplest way, by brushing them with a mixture of turpentine and linseed oil.

Large objects like gun carriages were conserved with cold PEG (polyethylene glycol solution) in large covered tanks. The concentration of the conserving solution was gradually raised from 5 to 60%. To prevent the growth of moulds and fungi, a mixture of boric acid and borax was added. Less degraded wood was treated with PEG 1500, but PEG 4000, which has a higher molecular weight and is more penetrating, was applied to timber in bad condition.

Musket butts, powder bags, wooden spoons, parts of barrels, etc. were warm-conserved (i.e. at 60°C) in PEG in small steel tanks. The concentration of PEG was gradually raised from 5 to 90%.

Finally, the dead-eyes, belaying cleats, blocks, powder bags in leather etuis, dowels, fragments of tubs etc. were conserved by freeze drying using a HETO CD12 apparatus.

2. Metal objects

a) iron objects

Most of the iron objects had uniform pitting corrosion. The chloride content in the corrosion products was 1,15–5,99%. Microcorrosion had also occurred. Sodium sesquicarbonate was first used to desalt the object. Later, however, this was replaced by a solution of lithium hydroxide in methanol and an electrochemical method of desalting in a 5% sodium hydroxide solution. These procedures were applied until no chlorides were conductometrically detectable in the eluent. A solution of tannic acid in methanol with added phosphoric acid was used to remove rust, and triethanolamine was used to inhibit further corrosion. Smaller objects were stabilised by reduction with basic sulphate (1:1 0,5 M NaOH + 0,5 M Na₂SO₄). Stabilisation of iron by this method takes a long time but gives extremely good results.

Once chlorides were no longer detectable in the eluent, the object were rinsed several times with hot distilled and demineralised water. Any sulphate left was neutralised with dilute Ba(OH)₂. Water was then removed using acetone; after drying, the objects were coated with paraffin wax.

b) objects of copper and its alloys

The most important copper objects were the gun barrels (bronze) and the Swedish klippingar coins, the brass navigational instruments and objects of everyday use.

Chemical and physical analysis showed that these objects had been attacked by:

- uniform corrosion of secondarily deposited copper and other alloy constituents on the surface of the guns.
- local corrosion caused by the formation of corrosion cells (e.g. covered and screened spots).
- pitting corrosion due to the contamination of brass by e.g. iron.

The greatest conservation problems were posed by the uniform corrosion of secondarily deposited copper, which is extremely reactive chemically. The removal of the corroded surface layer produces new corrosion products already after 24 hours. These take on the colouration typical of disengaged compounds of copper and tin.

In order to give the guns a uniform appearance, treatment was based on the combined electroreduction of corrosion products and inhibitor protection. The corrosion products were electrochemically reduced in 5% Na₂CO₃ with a current of 8 mA/cm², i.a. about 170 A per gun for 20 hours, being passed. The loose products of corrosion were removed mechanically. Once this had been done, and the surface of the guns cleaned, further treatment was with a 2% aqueous solution of benzotriazol. The guns were

⁵⁷The conservation work was directed by Maria Dyrkova, M. Eng.

treated with paraffin wax to prevent atmospheric corrosion.

Small objects were dipped in alkaline glycerol or also cleaned electrolytically in aqueous solutions of NaOH or Na₂CO₃. The final stages of conservation were such operations as mechanical cleaning of the metal surface with a soft hair brush, intensive rinsing in distilled water, drying and impregnation with paraffin wax. Benzotriazol was used as an inhibitor.

c) objects of silver

Silver coins were the most important items in this group. We began their conservation by removing copper products with formic acid. This was followed by electrochemical reduction in 2% sodium hydroxide. Then the objects were dipped in thiourea to remove silver chlorides and sulphides. The last stage involved rinsing in distilled water, degreasing, drying and protecting the surface with paraffin wax.

d) objects of lead and tin

These comprised mostly tableware – plates and spoons. They were conserved by electrochemical reduction in a solution of sodium hydroxide. Objects with traces of deep corrosion were dipped in a solution of sodium sesquicarbonate and then in EDTA. In some cases, this was followed by autolysis in 5% NaOH. The final stage was brushing with glass brushes, intensive rinsing in cold, distilled water, dehydration in acetone and protecting the surface with paraffin wax.

3. Ceramic objects

All ceramic objects were desalted in a solution of sodium sesquicarbonate, after which they were washed in distilled water. Badly damaged objects were reinforced with paraloid B-72.

4. Glass objects

Glass items were cleaned and desalted in distilled water, then dried and reinforced with paraloid B-72 (5–7% solution of xylene).

5. Leather objects

These were rinsed in distilled water, cleaned and conserved with glycerine. This operation hinged upon the slow exchange of water for glycerine and preserving the surface with lanolin in petrol. This method was effective in the conservation of fragments of clothing, footwear, belts and gloves.

Smaller objects of leather were conserved, like some of the wooden items, by freeze-drying.

6. Textile objects

Textile objects, after numerous immersions in distilled water and drying, were impregnated with a 5% solution of glycerine in methanol. Ropes were conserved by freeze-drying or by impregnating with glycerine.

7. Bones

After desalting in distilled water and dehydration, the bones were stabilised in 10% polyvinyl acetate in methanol or in a 7% solution of paraloid in xylene. This method was used to preserve human bones, the handles of sailors' bags, sword handles, forks etc. Horn linings, after bathing in 5% perhydrol were conserved with 20% PEG 1500.⁵⁸

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*Translated by Peter Senn
and captions by Betty Przybylska*

⁵⁸The description of the conservation methods is based on reports by Irena Jagielska, M. Eng., and Longina Felkier, M. Eng., of the Polish Maritime Museum's Conservation Laboratory.