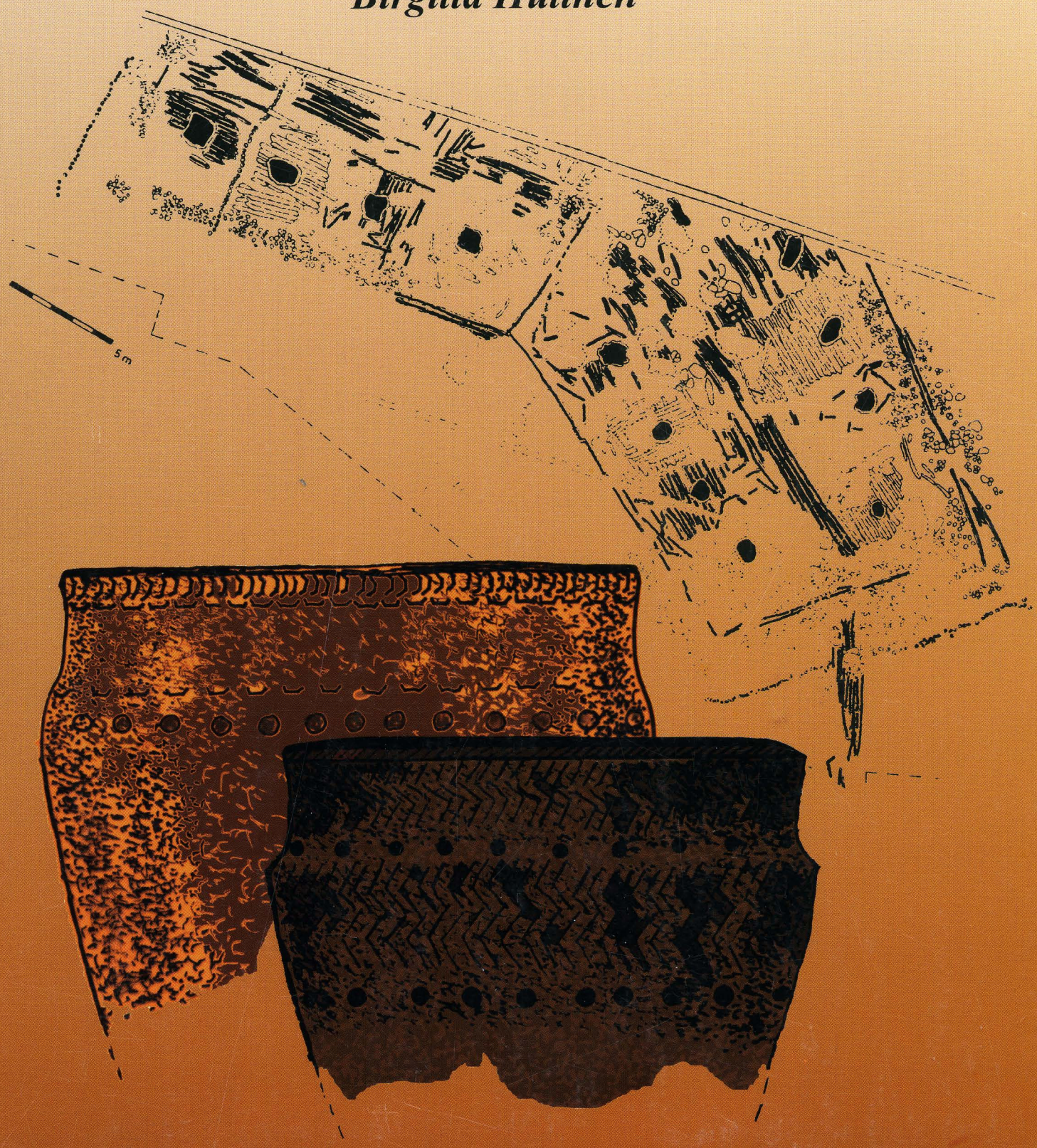
THE ALVASTRA PILEDWELLING POTTERY

by

Birgitta Hulthén



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Monographs 5

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BIRGITTA HULTHÉN

THE ALVASTRA PILE DWELLING POTTERY

An attempt to trace the society behind the sherds.

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ABSTRACT

THE ALVASTRA PILE DWELLING POTTERY

An attempt to trace the society behind the sherds.

The ceramics finds generated during the archaeological investigations conducted by O. Frödin, at Alvasta (1909-1930) represent an old, long untouched, yet well-preserved sherd collection. This paper describes means and methods to revitalise an archaeological pottery material and put it to use in a modern scientific context. It is shown that the obsolete excavation methods constitute no significant obstacle to modern ceramological research methods provided that the original excavation work was carried out in a keen and tidy manner.

Two new main pottery groups at Alvastra (U- and N-) have been established and defined. New light is shed on the puzzling "disappearance" of pottery body mass. It is also shown that pottery finds are well suited for designing a plausible hypothesis concerning social trans-actions on the Pile Dwelling platform.

ACKNOWLEDGEMENTS

I want to express my sincere thanks to those colleagues and friends who have stood behind me and endorsed my work from the beginning to its completion.

At the department of Quaternary Geology, Lund University, Professor Björn Berglund, Dr. Siv Olsson and Dr Ole Stilborg have contributed with most valuable discussions and suggestions. Assoc. Prof. Anders Lindahl, Laboratory for Ceramic Research, the same department, has on a daily basis given very useful comments on the progressing research project and on the manuscript.

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Special thanks to The Swedish Council for Research in the Humanities and Social Sciences (HSFR) for granting the funds necessary for the petrographic microscopy and for the printing and publication of this work.

Lund, March 5, 1998.

THE ALVASTRA PILE DWELLING POTTERY

An attempt to trace the society behind the sherds

INTRODUCTION

Ever since 1909 when the very first excavation of the complex and unique Neolithic construction at Alvastra, V. Tollstad parish, province of Östergötland (Fig.1) took place the ceramic material stood out as one of the most important artefact groups (Frödin 1910). During the following excavations, which were carried out annually (except for 1918) until 1919, the accumulating of ceramics artefacts was very significant (Tab. I) (Fig.2). The next suite of excavations between 1928 and 1930 uncovered further ceramics from the pile dwelling. With the exception of a brief discussion on the ceramic artefacts by O. Frödin (ibid) this important collection, stored in the Museum of National Antiquities, Stockholm, has since never been subject to any objective investigation.

Recent excavations, 1976-1980 (Malmer 1977, 1983) have also contributed sherds to the ceramics material collected from Alvastra.

For details in connection with these archaeological investigations and the achievements by O. Frödin the reader should refer to H. Browall (1986:14 ff).

The aim of the present ceramological project is to revitalise the abundance of information in the Alvastra ceramics find and put it to use in modern scientific context.

PROBLEMS

Many scientifically interesting questions are coupled with the Alvastra pile dwelling pottery:

- Was it locally manufactured?
- Did it originate from a single production unit or does it represent a cross-section of ordinary vessels sets from different habitation sites in the surrounding area?
- Does it consist of a homogeneous or a heterogeneous (technologically as well as typologically) ware?
- Is it possible to determine the actual function of the original vessels?

- Are there possible relations between the megalithic pottery from the Alvastra passage grave and ceramics from other Neolithic sites within the same area?
- Does the pottery indicate any connections between the people of the pile dwelling and sites of more distant areas?

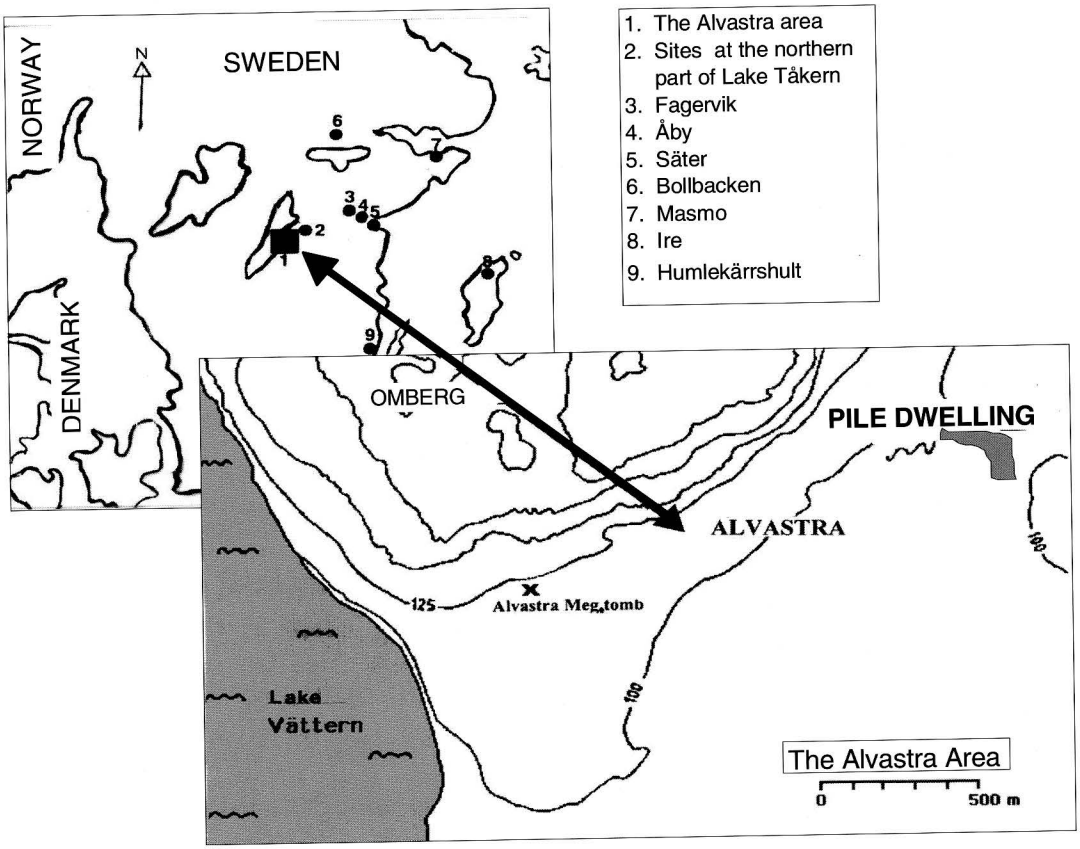


Fig.1. Maps showing the Alvastra and other Neolithic sites from which comparative pottery was studied.

INVESTIGATION MATERIAL

This investigation has concentrated mainly on the sherd collections recovered during the excavations from 1909 to 1930 inclusive. In total about 7000 sherds, weighing approximately 50 kg. were recovered.

The Alvastra material has also been checked by means of comparative analyses involving Neolithic ceramics from relevant areas such as Bollbacken, Åby, Säter, Fagervik, Masmo, Humlekärrshult, Ire, sites on the northern part of Lake Tåkern and from the Megalithic grave at Alvastra. Table I presents

an overview of the amounts of pottery from the different excavations at Alvastra from 1909 to 1930 inclusive.

Fig.2. The excavation of Alvastra pile dwelling during the summer of 1912, conducted by O.Frödin. (Photo made available by ATA (Antikvarisk-topografisla Arkivet) Riksantikvarieämbetet)

METHODS

The following investigation procedures and methods have been applied.

Most of the work outlined bellow has been carried out at the Laboratory for Ceramics Research (KFL), Dept. of Quarternary Geology, Lund University.

Recording and documenting

All sherds have been subject to the recording of finding data, number, weight, thickness, and colour, manufacturing technique, surface treatment, shape and ornamentation. All data have been filed and statistically evaluated in accordance with approved methods (Hulthén 1974).

Typological features - such as shape and decoration - too complex to be recorded by means of numerical codes, were drawn. The documentation contains 200 such sherd drawings. The material

was classified into preliminary groups. The distribution of these groups over the excavated area was then studied in detail.

Sampling
A sample of sherds for further laboratory investigations was selected on the basis of approved statistical methods. The preliminary groups generated in the recording process were also present in the sample, which also contained test sherds from the pottery materials used in the comparative analysis.

Thermal analysis.
In general a small piece of each sampled sherd was subjected to thermal analysis (TCT, Hulthén 1976), in order to test heat resistance, sintering intervals, and to estimate the original firing temperatures.

Microscopy.
Thin sections were produced for petrographic microscopy (thickness = 30 µm) of 20 sherds (Tab.IIb) from the pile dwelling. These thin sections were analysed under a polarising petrographic microscope at magnifications from 25 to 1000 X. An additional 35 further thin sections of sherds from Fagervik, Åby, Säter were also prepared and analysed. Appropriate thin sections from previous investigations by the author at Bollbacken, Masmo and Ire were prepared for comparison.

The clay of the pottery ware was investigated with regard to the content of coarse mineral fractions (sand, silt), presence of calcium carbonate, iron oxides, accessory minerals, diatoms and organic matter. Specific structures in the clay were studied with the main aim of establishing vessel-building techniques and methods for preparing the clay and the temper, and also to identify possible raw clay sources.

The temper material was checked for type, grain size and amount. In particular the relation between tempering method and vessel function was studied. The origin of the temper material was also investigated.

For comparative analysis profiles of further 20 sherds were cut, polished and studied under a stereo microscope with normal light at magnifications of 16 to 40 X. The results were then compared with the more accurate information obtained from the petrographic microscopy of thin sections.

Chemical analysis
A simple HCl-test was carried out to test the presence of calcium carbonate in the locally collected raw clays. This method could not be used on the fired pottery because of the decomposition of the carbonate during firing and the subsequent effect of weathering.

Atomic Absorption Spectrometry (AAS) was used to investigate the presence of phosphorus and potassium in weathered pottery ware.

X-Ray Diffraction Analysis (XRD) was applied for studying certain clay minerals and their transformation during the weathering process.

Clay prospecting.

It was obvious from the very beginning of the ceramic project at Alvastra that questions about local or non-local manufacture of the pottery were of the utmost importance. Since clay is the main raw

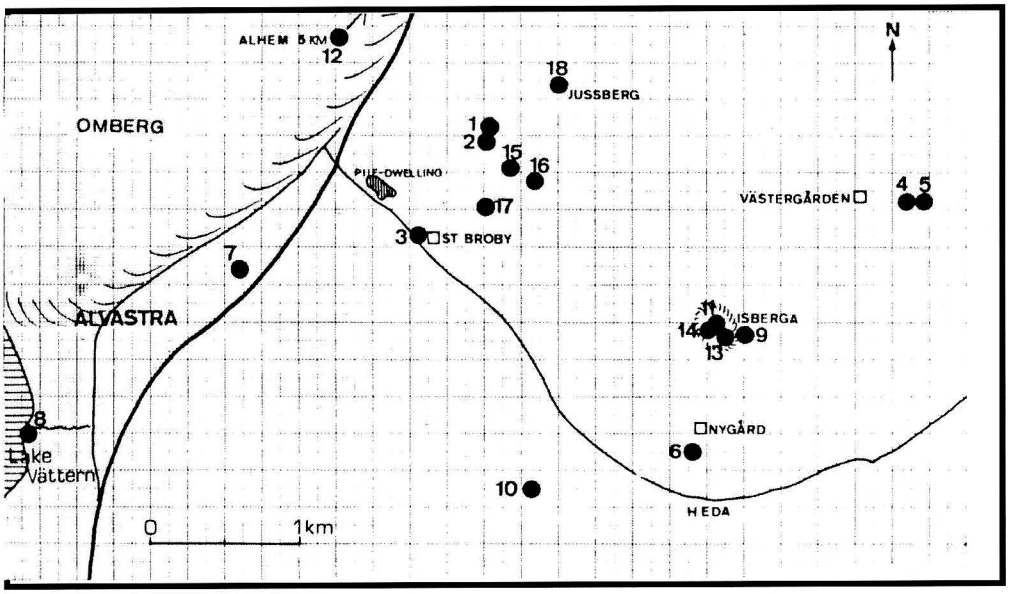


Fig.3. Map showing the clay deposits of the samples 1 - 18 within the area surrounding the Alvastra pile dwelling.

material for ceramics (Hulthén 1993), it was a logical step to investigate the availability of suitable pottery clays within the Alvastra area. Clay prospecting was consequently carried out. The map (fig. 3) shows the distribution of the 27 clay samples taken at different depths at the 18 different deposits (Tab.VIII) based on the official soil type distribution map (SE HJO SO SGU Ser.Ae Nr.44. Jordartskartan, SGU).

The raw clays were analysed by means of sieving for grain size distribution, thermal analysis for testing ceramic properties and the HCl-test mentioned above.

Simulated manufacture.

Briquettes of tempered clay were prepared in order to test the raw clays of the Alvastra area with regard to their suitability for pottery manufacture and their possible correspondence to the ware of ceramic artefacts. The briquettes were fired at different temperatures and the strength was continually tested. Colour changes during firing were recorded and the sintering intervals determined. Cracking tendencies were also recorded. The results of these investigations were compared with the same parameters derived from the sherd material.

Excavation period	Total number of all sherds and sherd fragments.	Total weight of all sherds and sherd fragments. [g]	Total weight of decorated sherds. [g]	Rate of decorated sherds [%]	Weight of N-technique sherds. [g]	Weight of U-technique sherds. [g]	Weight of indeterminable sherds. [g]	**Co-ordinates of the excavated squares(according to Frödin).** Each square was in turn devided into 4 sub-squares [a-d] which are not shown in this presentation.
1909-10	869	5 379	964	18	955	620	132	D:5,6,9;E:4-10;F:5,6,8-11;G:5-12;H:5,6,8,9;I:5-12
1911	2028	11 192	3 809	30	7 301	1 720	628	C:1,2,4;D:1-9;E:1-6,8-11;F:1-5;G:2-4;H:2-4;I:1,3-5,8
1912	135	1 188	299	17	139	732	194	K:8-12;L:10,11;M:7-13;X17
1913-14	863	7 740	3 398	44	1 186	5 531	679	N:8,10;O:11,13,14;P:11-14;Q:11-14;R:11-15;S:13-15; T:12-15;U:12-15;V:15,16
1915	216	1 161	781	67	132	735	245	V:12-16;X:13-16;Y:12,15,16;Z:13-15;Å:16
1916	116	794	126	16	89	445	93	B:I,II,4,5;C:I,II,2,4,5;D:II
1917	599	2 137	260	12	233	525	246	A:II;B:I-V,1-4;C:I-III;V,1,3;D:II-IV;E:I-III;F:I
1919	305	2 481	814	32	1 077	640	619	A:II,V;B:I,III-VII;C:I-VIII;D:I,IV-IX;E:I,III,VI,VII; F:I,VII,VIII;G:I-III;H:I
1928	389	3 113	1 237	40	1 078	1 359	257	P:11-14;Q:11-14;R:11-14;S:11-13,15;T:13-15;U:12,14-16; V:14-16;X:16
1929	766	10 875	2 772	26	2 071	6 943	975	C;2,6;D:3,4,6,9;E:I,2,4,5,7,9;F:1-3,7-12;G:2-6,11;H:1-3, 5-8,10,12,13;I:3-5,7,9-11;K:5-7,10-12;L:5-12;M:7-12; N:8,10,13;O:8,9,11-13;P:9,11;Q:11,13,14;R:13
1930	133	2 316	1 205	52	767	1 544	-	C:2-5,9;D:2-4;E:1-3,5,7,8;F:2,3,5,8,IV;G:3,5;H:4,5,7,8; I:4,6;K:8
Total	6419	48 376	15 165	31	15 028	20 794	4 068	

Table I. The amount and some basic properties of the pottery from different squares of the excavated area emanating from the investigation periods from 1909 through 1930.

RESULTS

The 7000 sherds have been recorded as 1100 ceramic *units* (Hulthén 1974:11). Based on a statistical evaluation of the recorded properties the results have generated rich evidence for the justification of a division of the material into two main groups:

A. Pottery where the vessels were built by means of *U-technique* (Andersen 1975:56; Hulthén 1977:25) (Fig.4).

B. Pottery where the vessels were built by means of *N-Technique* (ibid).

These two groups differ from each other not only with respect to vessel-building methods but also with respect to such fundamental items as raw materials, manufacturing techniques, distribution of sherd thickness, vessel shape and ornamentation (Tab.VI) (Fig.6 and 25). Only one example of modelling as a vessel-building technique was observed: a small, undecorated cup (Fig.5).

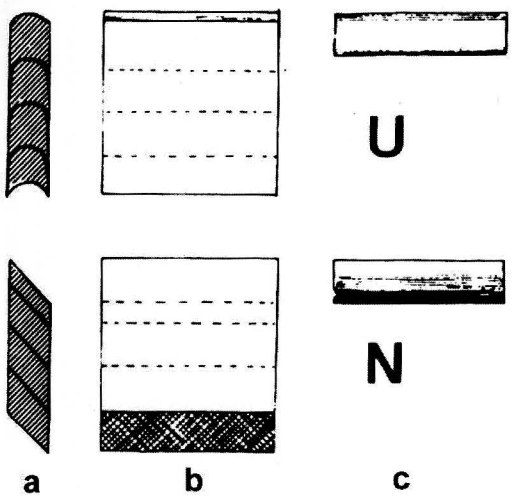


Fig.4.
Schematic presentation of U- and N-technique respectively. a = sherd profile, b = front of the sherd, c = upper sherd edge

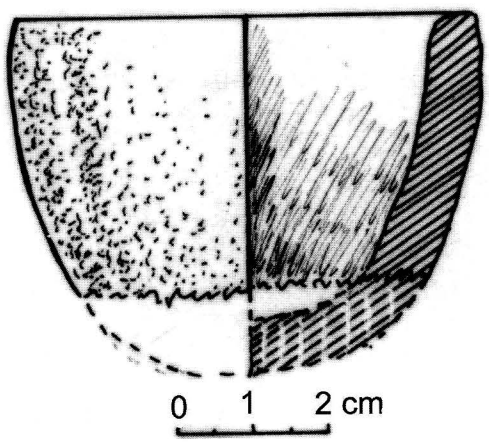


Fig.5.
Small, modelled, undecorated cup from square H5 found together with U-pottery sherds

sherd ID No.	clay										temper							ware group	Vessel-building technique	sherd thickness [mm]	Figure reference No.	notes
	coarse/ fine	sand	silt	iron oxide	iron ox. hyd. conglomerate	calcium carbonate	mica	accessory minerals	diatoms	plant material	natural sand	sandstone	granitic rock	limestone	plant material	grain size [mm]	amount [%]					
217/49	c	•	•	+			+	Zi Am					x			5	20		U	18	16e	Cno
617/95	c	•	•	+			p•	Zi		x			x			6	19		U	16	16a	
387/ -	c	•	+	+			+	Zi Am					x*			6	23		U	18	-	Soot. *Zi+
373a/63	c	•	•	+			•	Am					x*			5	28		U	12	16d	*Bi+
376b/60	c		+	++			•	Am					x*			5	11		U	13	16g	Dense str.*Perth
839/113	c-f*	•	–	+	+		+	Am Ore					x			6	15		U/N	15	-	*Poorly homog.
266/29	c	•	•	+			p+					x	x*			5	17		U	13	16c	*Weathered Cno
511/77	c		+	+			+	Ore+		x		x	x			5	20		U	13	14b	Dense str.
246/47	c	•	+	+	•		+	Zi Am			x		x*			2	12	1	N	8	29b	*Gneiss
62/1	c	•	+	+	•		•	Zi Am			x		x			3	22	1	N	8	30e	
938/141	c	•	+	+	•		p+	Zi Am			x		x*			3	20	1	N	8	31d	*Bi+
53/11	c	+	+	+	•		p•	Am	+		x	x	x			2	20	2	N	6	29c	
52/10	c	+	+	+			p•	Am Ol	+	x	x	x	x			2	20	2	N	9	29g	
125/24	c	–	+	++	+		+	Am					x*			3	14	3	N	12	32a	Dense str.*Bi+
37/21	c	–	+	+	•		•	Zi Am					x			4	15	3	N	12	30a	
850/110	c	+	•	+	+		–	Zi Am		x	x					3		4	N	11	30a	Moraine clay
884/148	c	+	•	+	+		•	Zi Am			x					3		4	N	5	30k	Moraine clay
824/90	f	–	–	+	•	•	+	Am	+				x		x	2	12	5	N	7	30c	Cno
316/34	f	•	•	•		•	+	Zi Am			x		x			3	20	6	N	8	28b	Dense str.
401/5	f		•	+	•	•	•	Zi Am Ore						x	x	4	16	7	N	12	-	

Table IIa. Results of petrographic microscopy of thin sections of test sherds from Alvastra Pile Dwelling. Codes and symbols: x = occurrence, + = abundant, • = medium occurrence, – = scarce. iron ox. hyd. = iron oxi-hydroxide. gran. rock = granitic rock. Cno = clay nodules. str. = structure. Perth. = perthitic. homog. = homogenized. *Minerals*: Am = amphibole. Zi = zircon. p = phlogopite. c-f = irregular lamination of silt and fine clay due to poor homogenization.

Record no.	Decor ref. no.	Excavation sq. code	Excavation year
217	49	E1	1911
617	95	C2	1930
387	-	N11	1912
373a	63	K12	1912
376b	60	M9	1912
839	113	U14c,E2	1914,1929
266	29	E11	1911
511	77	V15,T15,V16	1914-15,
246	47	E4	1911
62	1	F11a	1909-10
938	141	J4	1929
53	11	F9b	1909-10
52	10	F9b	1909-10
125	24	J8c	1909-10
37	21	E10d	1909-10
850	110	V15	1914
884	148	F3	1929
824	90	R12,P13,S14d,T15a	1914, 1928
316	34	G3	1911
401	5	J11.BVd	1909-10,1917

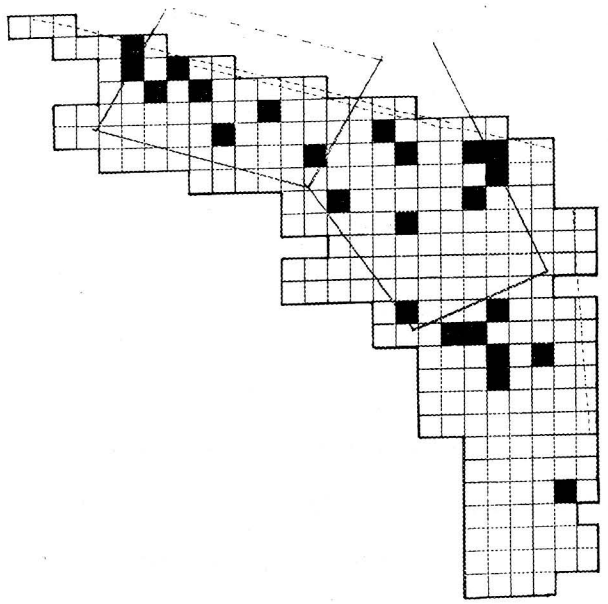


Table IIb. Origin and platform distribution of test sherds subjected to petrographic microscopy.

ERRATA **Further corrections on overleaf:**

ERRATA

Please be advised about the corrections indicated bellow.

Page 22. *Fig. 10b.* Regression line should be a broken grey line [no correlation], Cf. fig. 10a.

Page 31. *Top.* Wrong font. Should appear as: *Ware group 3.*

Page 40. *Second last paragraph* should have the following appearance:

" Certain relations between decorative elements and vessel size are demonstrated by the following observations:

- Small vessels are either undecorated or decorated with rows of pits below the rim (Fig.27a,b).
- Five out of seven upper parts of large vessels are decorated with "fish-bone" pattern or vertical zigzag lines and/or cross marks (Fig.29 a,b,e)
- Horizontal zigzag pattern was recorded on three sherds only……."

Page 47. *Fig.33b.* This figure is not centred. Top letter scale lost. Bottom letter scale applies. Cf. Fig.33a.

Page 56. *Second last paragraph*, *second last sentence*, text-error. Should read:
"…With dating techniques available today it is not possible to accurately date…"
Last paragraph, weight spec. within brackets. Should read: " (W = 2 g.) "

Page 71. *Last line*, *second word*, misspelling. Should read: "….have lain for…"

Page 19 correction on overleaf:

Record no.	Decor ref. no.	Excavation sq. code	Excavation year
217	49	E1	1911
617	95	C2	1930
387	-	N11	1912
373a	63	K12	1912
376b	60	M9	1912
839	113	U14c,E2	1914,1929
266	29	E11	1911
511	77	V15,T15,V16	1914-15,
246	47	E4	1911
62	1	F11a	1909-10
938	141	J4	1929
53	11	F9b	1909-10
52	10	F9b	1909-10
125	24	J8c	1909-10
37	21	E10d	1909-10
850	110	V15	1914
884	148	F3	1929
824	90	R12,P13,S14d,T15a	1914, 1928
316	34	G3	1911
401	5	J11.BVd	1909-10,1917

Table IIb. Origin and platform distribution of test sherds subjected to petrographic microscopy.

U-Pottery.

Manufacturing methods.

The concept of U-pottery is almost synonymous with a homogeneous production of ceramics. The choice of raw material for the production of the U-vessels comprised two qualities of clay. One relatively coarse, sandy and silty clay and another one with a low amount of sand and with a dense structure (may be natural occurrences in the same clay deposit). They are both ferriferous, micaceous and non-calciferous. The clay was tempered with a crushed granitic rock with a maximum grain size between 5 and 6 mm. The more sandy variety has a temper content of about 15%, whereas the clay with less sand was tempered with about 22% of the crushed granite. The raw materials were often poorly homogenised, which in all probability must have caused cracking of the vessels during firing (Fig. 7-9 below).

Sherd thicknesses range between 10 and 20 mm with a mean of 14 mm (N=21 kg) (Fig.6). There is no correlation between the maximum temper grain size and the sherd thickness of the U-pottery (the correlation coefficient ® being 0.21) (Fig.10a). This result means that irrespective of vessel type the

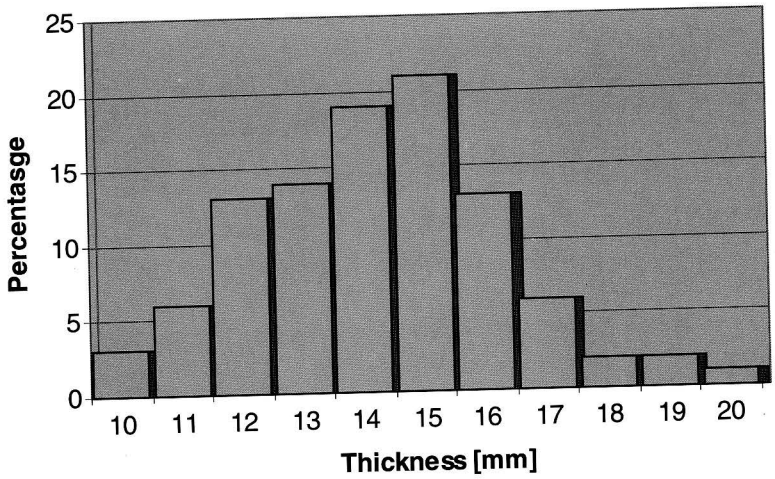


Fig.6. Sherd thickness distribution of U-pottery.
Mean value = 14.0 mm. n = 21 kg.

temper technique was the same. The situation is similar with the N-pottery (with correlation coefficient = 0.42) (Fig.10b). These differences between the two groups, U and N, are negligible.

The surfaces of the U-vessels are smoothened and the ornamentation is impressed below the rim and often on the vessel shoulder. Decoration on the rim edge is rare, but when present it consists of short, oblique notches (Fig.13 c; 15 a).

Vessel firing was carried out in an oxidising atmosphere (open fire) at temperatures around 600°C. The low-fired, rather porous core of the ware is the result of the short firing time.

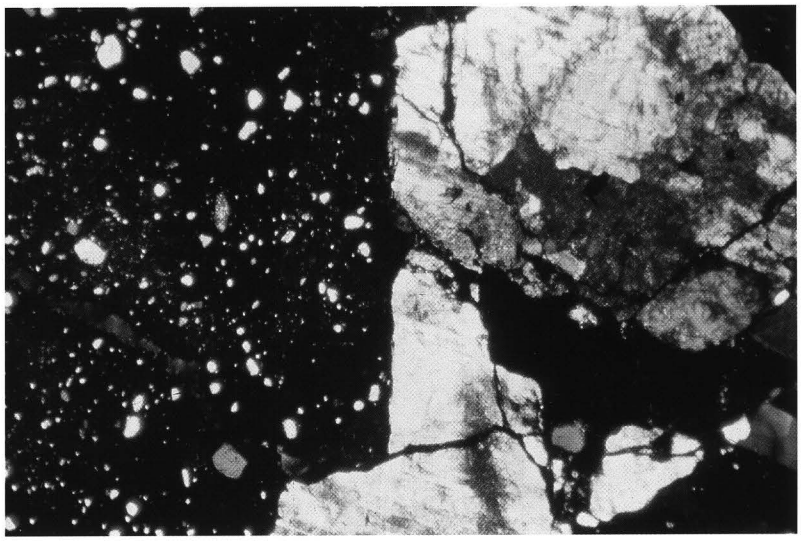


Fig.7. Sherd 217.
A coarse,sandy, silty clay, rich in iron oxides & mica tempered with 20% crushed granite (2 big grains. Max. grain size = 5 mm.

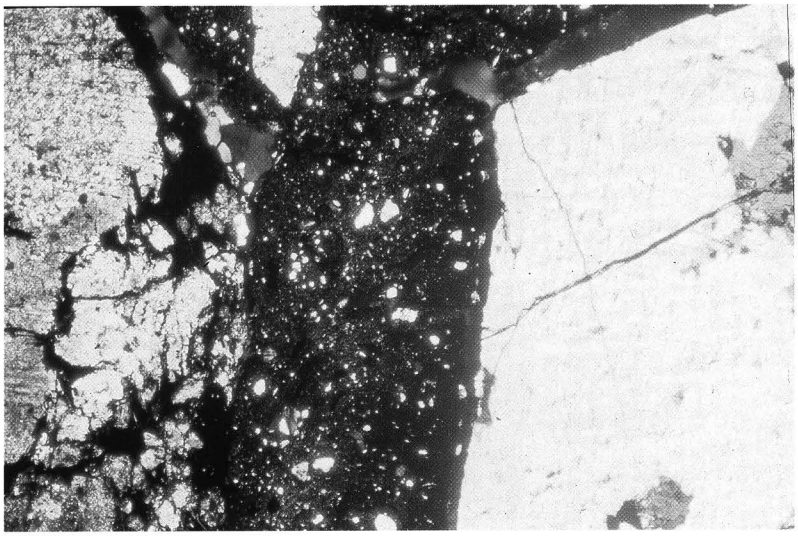


Fig.8. Sherd 373a.
A coarse,sandy, silty, micaceous clay, rich in iron oxides tempered with 28% crushed weathered granite, very rich in biotite.
Max grain size =5 mm.

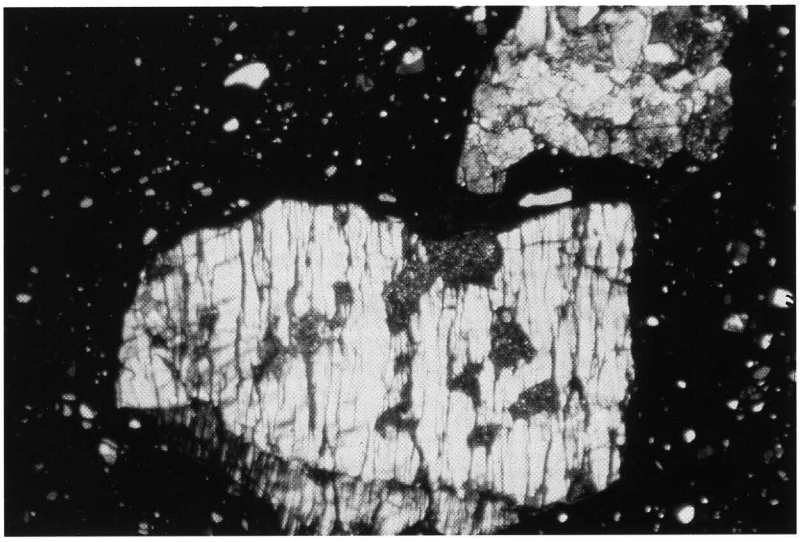


Fig.9. Sherd 376b.
A coarse, silty, micaceous clay, very rich in iron oxides, tempered with 11% crushed, perthitic granite (big grain).
Max grain size = 5 mm.

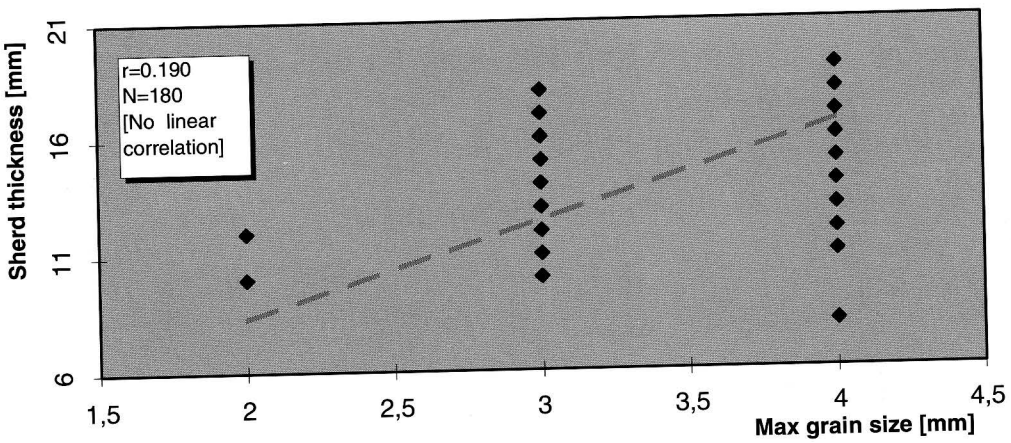


Fig. 10a. Correlation diagram showing U-sherd thickness plotted as a function of maximum grain size.

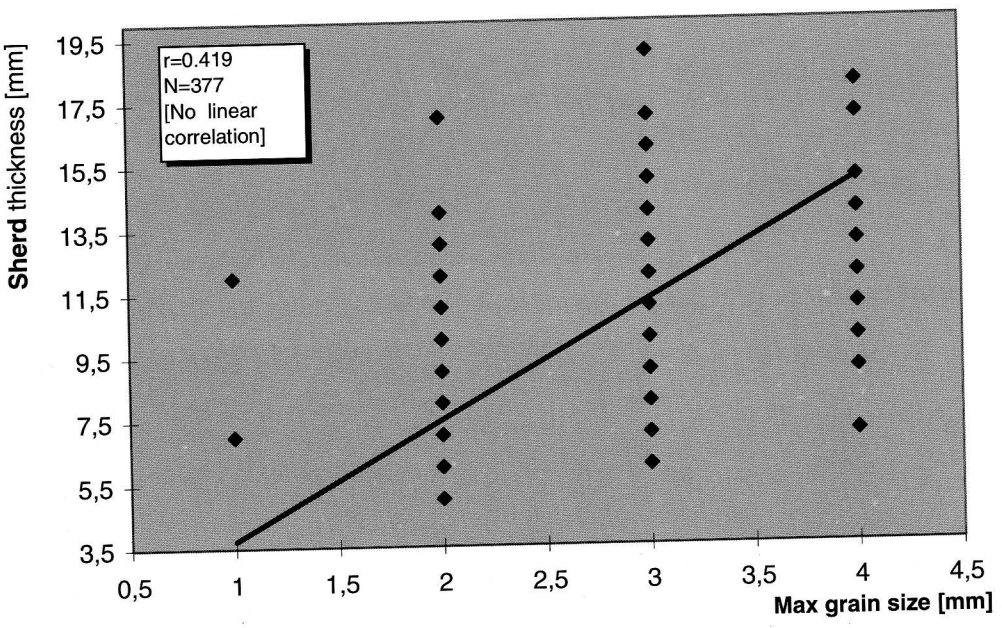


Fig. 10b. Correlation diagram showing N-sherd thickness plotted as a function of maximum grain size.

Vessel shape.

Due to a high degree of fragmentation, reconstructions of complete vessels were not possible. However, the original diameter of several vessel rims were estimated, which made reconstruc-tions of these upper vessel parts justifiable. (Fig.12-15). The shapes of the rim sherds imply that most of the vessels had a straight neck and rim-parts without thickened edges (Fig.11). The rim edges are rounded. In most cases a weakly profiled shoulder forms the transition to the convex body (Fig.14 a-b). Some vessels have had an upper part with a convex shape (Fig. 13e, 14e). Only three bottom sherds have been recovered, all convex.

Rim diameters vary from 11 to 40 cm. Based on the distribution of these measurements, four classes of vessel size could be distinguished and defined:

1. Small. 6 vessels with rim diameters between 11 and 16 cm (Fig.12).
2. Medium size. 8 vessels with diameters between 18 and 24 cm (Fig.13).
3. Large. 7 vessels with diameters between 26 and 32 cm (Fig.14).
4. Extra large. 2 vessels with diameters of 36 and 40 cm (Fig. 15).

There is no apparent correlation between vessel size and sherd thickness among the U-vessels at Alvastra.

Vessel ornamentation

As mentioned above, the U-vessels are decorated with impressed patterns below the rim and sometimes also on the shoulder, but rarely on the edge of the rim. Simple tools such as pegs, nails and bones were used to decorate the vessels. In some cases the bone impressions left specific identifiable patterns (fingerprints) on the ware. On several sherds there are impressions made with the second of the phalanges of a young sheep (Fig.13d). (Personal communication: T. Sjövold, April 1979).

The most frequent ornamentation patterns consist of rows of oblique pits. Bow-shaped imprints of finger-nails and of angled tools occur as well as pattern elements of two oblique imprints in angular position to each other (Fig.12-16).

Various ornamentation elements and patterns are presented in Fig.16. Very seldom do the ornamentation patterns consist of more than one decoration element. Out of 55 investigated vessels only 3 vessels were decorated with patterns containing a second element ($\approx$ 5%). Ring-shaped imprints formed a pattern together with bows in horizontal rows. Drop-shaped pits combined with short strokes and U-shaped imprints occurred together with shallow bone impressed pits (Tab. III). There is no

apparent correlation between decoration type and sherd thickness. Moreover certain connections between various decoration patterns and classes of vessel size have been observed, e.g. two extra large vessels have very similar ornamentation (Fig.15 a-b). This pattern is not found on any other U-vessel sherd. Furthermore, four out of six large vessels size have similar decorations (Fig.14 a-c) not found on vessels of other sizes.

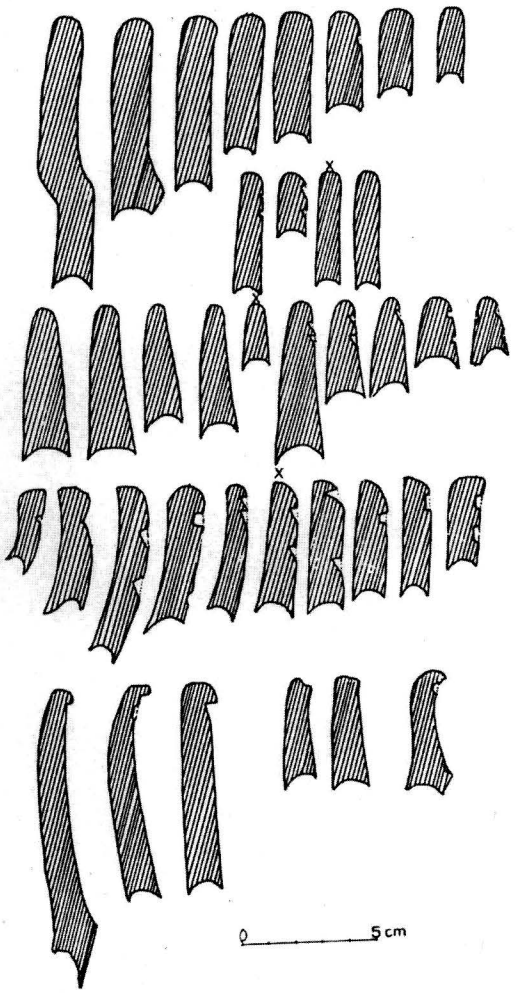


Fig.11. Shapes of profiles of rim sherds of U-vessels. x = decoration on the rim edge.

With regard to the medium-sized vessels, the character of the ornamentation is different from those of the other vessel size classes. Rows of simple, oblique pits or bone impressions are the most frequent decoration in this case (Fig.13 b-e).

Consequently vessels of the same group have both size and decoration type in common

The following properties of the ornamentation on U-vessel sherds may be recorded as specific. The decoration pattern is always impressed, never incised. Decoration tools are of simple shape and never

poly-toothed. Pits are mostly oblique, rarely perpendicular to the vessel wall and never conical. Imprints made with a chisel (strokes) are very rare.

ELEMENT DESCRIPTION	ELEMENTS	↓→	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Oblique angular pits		1															
Oblique rounded pits		2															
Approx. 3/4 of round pits		3															
Triangular pits		4															
Drop-shaped pits		5														x	
U-shaped impressions	U	6										x					
"Seagull-shaped" impress.		7															
"Butterfly-shaped" impress.		8															
Ring-shaped impressions		9													x		
Bone impressions		10						x									
Tooth-shaped impressions		11															
Bow-shaped impressions		12															
Strokes with hooklike ends		13									x						
Oblique, parallel strokes		14					x										
Diffuse shallow impress.		15															

Table III. U-vessel decoration elements and the three instances of combinations of such elements.

The individual decoration elements of the Alvastra U-pottery are often found on Middle Neolithic Pitted Ware pottery (Tab.V). Concerning the ornamentation patterns, however, it is difficult to establish close parallels to other Pitted Ware sherd collections. A few cases of similar elements and patterns have been recorded on sherds from Jonstorp (MH), Scania, Ire, Hangvar parish, Gotland, and from Masmo, Huddinge parish, Södermanland, Humlekärrshult, Döderhults parish, Småland. On the other hand these vessels are built up by means of the N-technique.

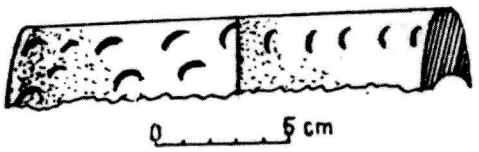


Fig.12. Small vessel with rim diameter = 16 cm. Decoration: Finger-nail impressions on out- and inside of the rim.

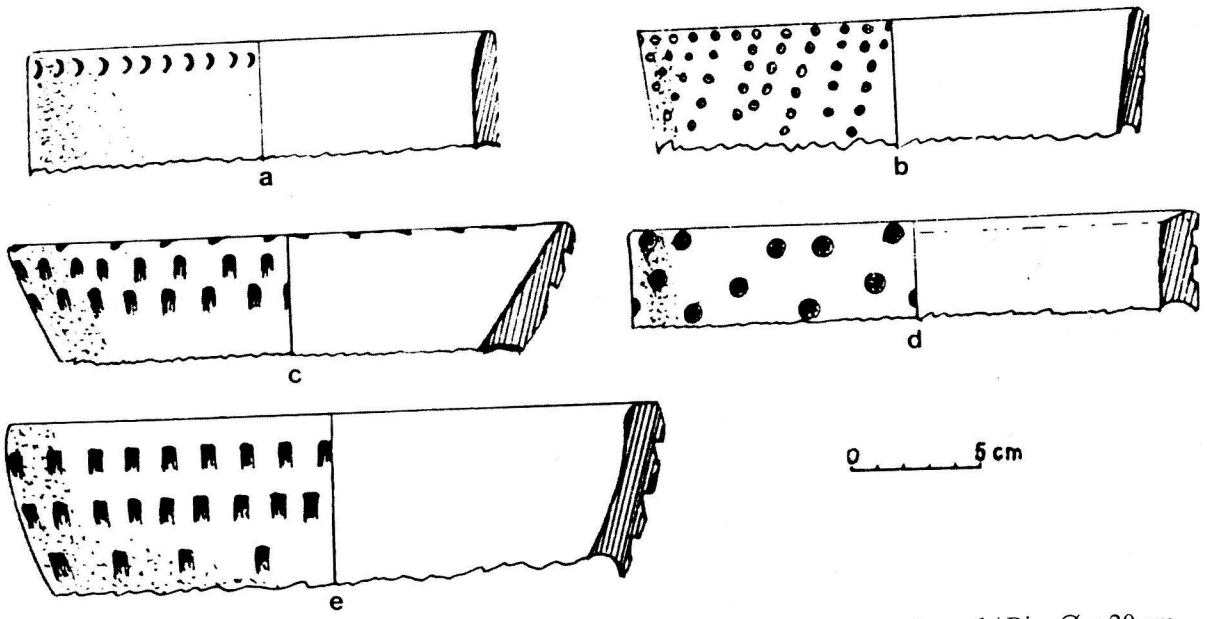


fig.13 a-d. Medium-sized vessels. a/ Rim ∅ = 18 cm. Decoration: Finger-nail impressions. b/ Rim ∅ = 20 cm. Decoration: shallow bone imprints. Triangular impressions on the rim edge. c/ Rim ∅ = 21 cm. Oblique, pits. Strokes on the rim edge. d/ Rim ∅ = 22 cm. Decoration: pits impressed using a bone. e/ Rim ∅ = 24 cm. Decoration: oblique, cornered pits.

Vessel function

The low-burnt, porous core of U-pottery ware resulted in vessels with a well balanced permeability to water. This property is desirable when for instance storing water owing to the cooling effect. The efficiency of pottery for this purpose is well known and has been described in many different parts of the world (Gallay 1979:21,38; Nicklin 1971:18). Vessels of extra large size may have served as fresh-water containers.

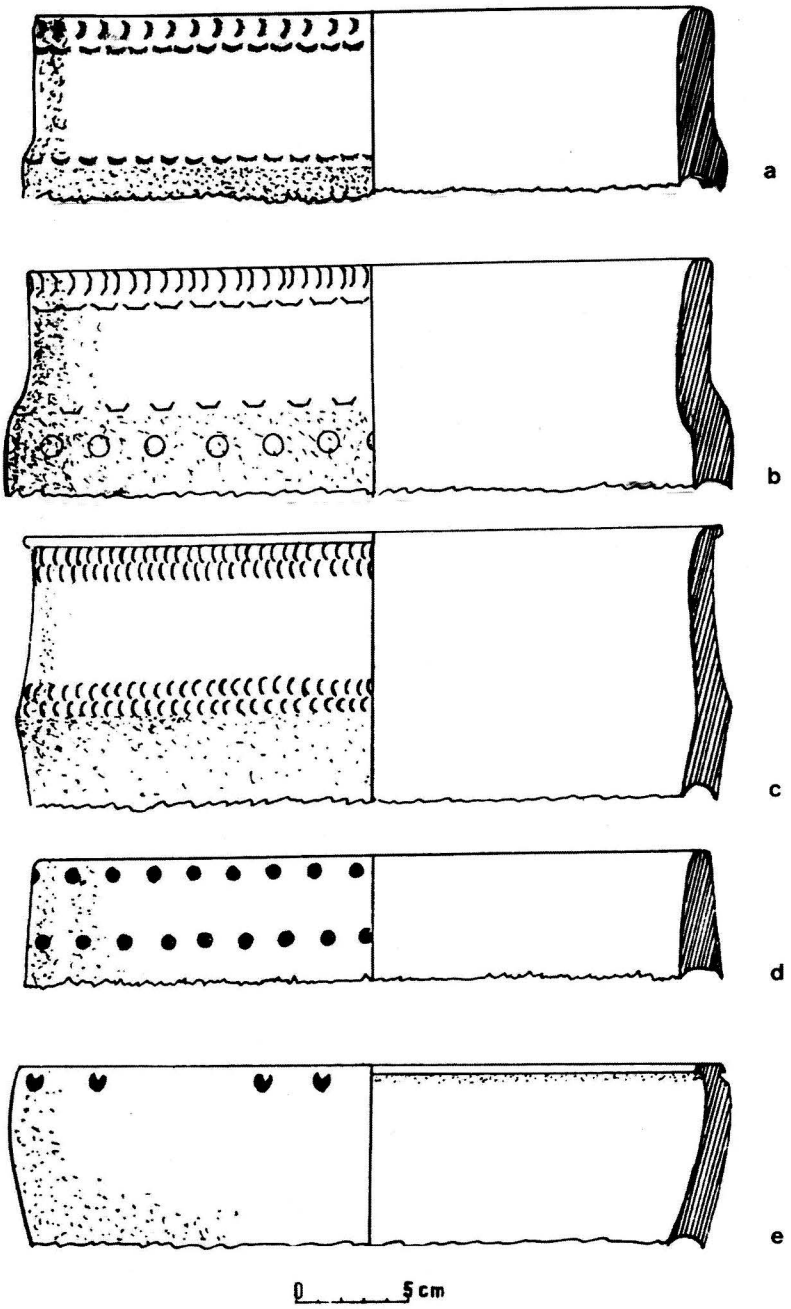


Fig.14 a-e.
Large vessels. Rim ∅ of a-d = 30 cm, e = 31cm. Decorations: a/ Rows of finger-nail impressions under the rim and on the shoulder. b/ Rows of angular bows under the rim and on the shoulder. Row of ring-shaped impression under the transition shoulder/body. c/ Rows of finger-nail impressions under the rim and on the shoulder. d/ Two rows of shallow bone imprints on the neck. e/ Pairs of oblique pits around the rim.

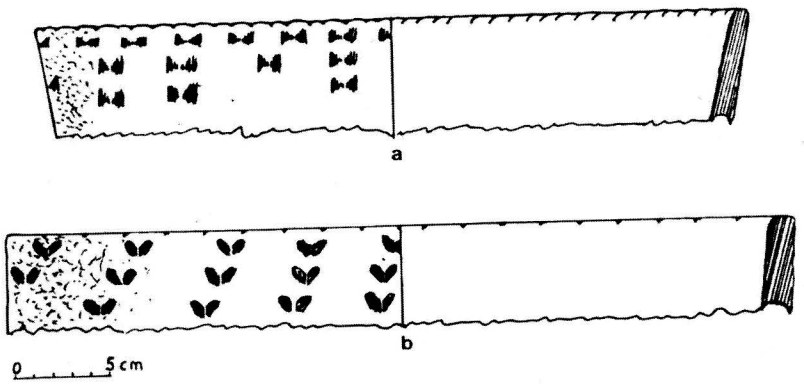


Fig.15 a-b. Extra large vessels. Rim ∅ = 36 resp. 40 cm. Decoration: a/ Horizontal and vertical rows of butterfly-shaped imprints under the rim and oblique strokes on the rim edge. b/ Oblique rows of angular pairs of shallow, oblique pits on the neck. The rim edge is decorated with single, shallow pits.

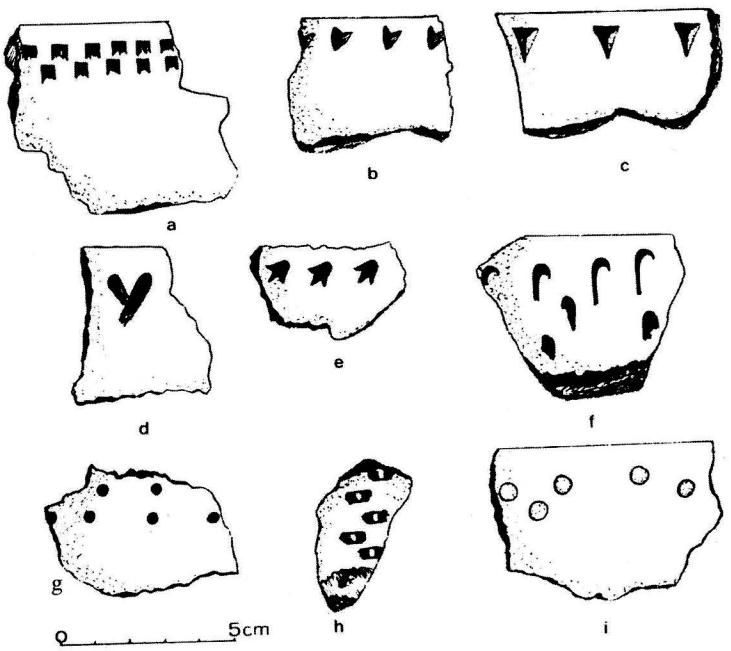


Fig.16. Various impressed decoration patterns of U-vessels. The rings may have been made by means of a cut-off quill.

The porous ware is also suitable for cooking and for fermentation (Hulthén 1977:26, Lindahl 1995:40). Such functions often leave a crust of organic residues on several sherds. The original rim diameter could be determined for 6 of these sherds. 5 of the vessels had a rim diameter of 30 cm and

one vessel had a rim diameter of 18 cm. The vessels of the "large" group could have been used for cooking.

The decoration of sherds with organic residues (N=131) consisted exclusively of the following elements: oblique pits, bone impressions and bow-shaped impressions (including nail imprints). This decoration implies possible, rather standardised types of cooking pots or vessels intended for fermentation (e.g., alcoholic liquids). A usual custom among certain people in for example Zimbabwe and Mali in Africa, is to give not only specific shapes and ornamentation but also purpose-related names to vessels for cooking cous-cous, cooking relish, preparing beer, serving beer and storing water etc. (Gallay 1970:22 ff; Lindahl 1995:39 ff).

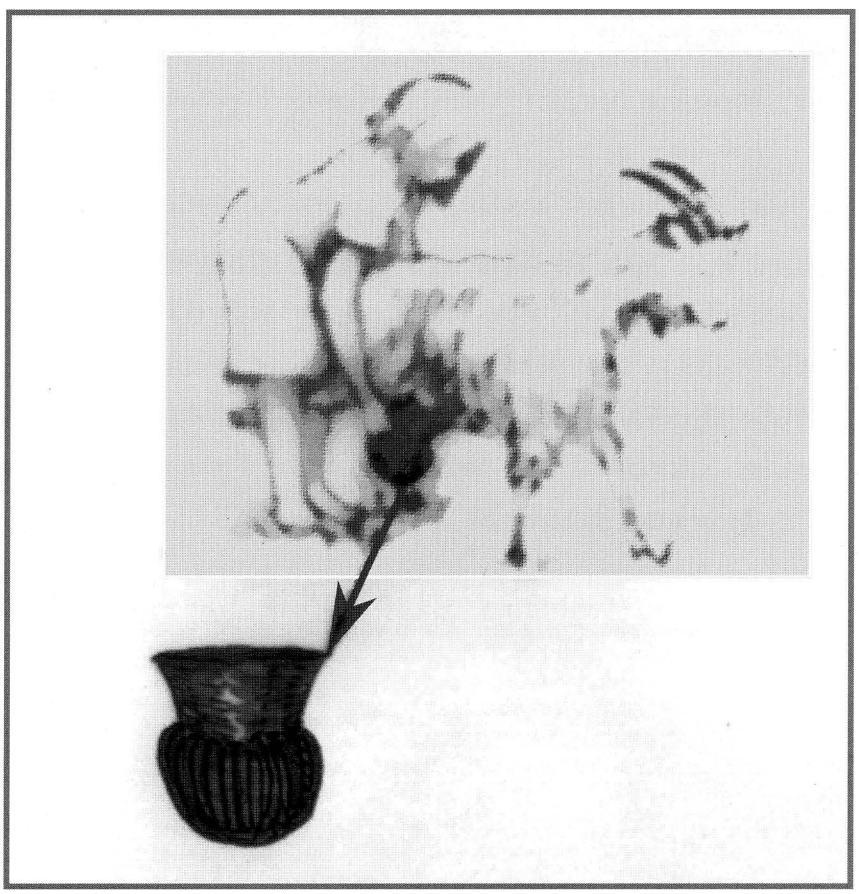


Fig. 17 The way of milking goats an sheep in Somalia.
N.B. the milking JAR is a funnel beaker.

The small vessels, which could easily be gripped and handled with one hand may have been suitable as drinking-bowls and also for milking small bovids like goats and sheep (Cf. The milking methods of the Lapplanders. Svensk Uppslagsbok 1933. Photo: column 920-921) (Hulthén 1995: 6).

Today sheep and goats in e.g. Somalia are milked with the milker standing behind the animal securing the milking bowl (*A funnel beaker!)* with the one hand and milking with the other (personal communication with Ahmed Dualeh Jama, Fil.Lic., archaeologist and son of a pastoral family in Somalia) (Fig.17)

N-Pottery.

In contrast to the rather homogenous U-pottery, the N-pottery contains various ware groups characterised by different raw materials, different tempering methods and a considerable variability in ornamentation types. Vessel shapes are also more varied than in the U-pottery case.

Manufacturing methods.

At least seven different ceramic ware qualities can be distinguished among the N-pottery sherds.

Ware group 1
Sandy, silty, ferriferous, micaceous clay, free of calcium carbonate, containing amphibole and zircon as accessory minerals. The clay is tempered with about 20% crushed granite with a maximum grain size of 3 mm (Fig.18). The decoration patterns of ware group 1 are composed of comb-stamped vertical zigzags, cardium-stamped elements and ring-shaped, shallow pits (Fig. 29b, 30e, 31d) (Tab. IIa : 62/1, 246/47, 938/141). Maximum sherd thickness = 8 mm.

Ware group 2
A coarse, sandy, silty, ferriferous clay, free of clacium carbonate, rich in phlogopite (iron-poor biotite) and diatoms. The clay has been tempered with 20% crushed, weathered granite with a maximum grain size of 2 mm. The natural sand is rich in grains of sandstone (Fig.19). The vessels of ware group 2 were large and are decorated with vertical zigzag ("fish-bone" pattern), pits and horizontal rows of crosses (Fig.29 a,d,e,g) (Tab.IIa : 52/10, 53/11). Maximum sherd thickness varies between 5 and 12 mm.

Ware group 3
A sorted, silty, somewhat sandy, ferriferous, micaceous clay free of calcium carbonates and with a dense structure tempered with about 15% crushed granite with maximum grain size of 4 mm (Fig. 20). Square and rounded oblique pits compose the ornamentation pattern on these vessels (Fig.30g, 32a in the middle at the top). (Tab.Iia: 37/21, 125/24). Maximum sherd thickness varies between 9 and 13 mm.

Ware group 4
This ware was made of an unsorted, sandy, silty, ferriferous coarse moraine clay which is free of calcium carbonate and poor in mica. The natural sand constituted the temper (Fig.21). Vessels of this ware were decorated below the rim with groups of vertical rows of chisel imprints and conical pits, and with shallow round imprints and dots (Fig. 30a,k). (Tab.Iia: 884/148, 850/110). The sherd thickness range is 5 to 11mm.

Ware group 5
A sorted, fine clay with dense structure. It is ferriferous, rich in mica and contains crystals of calcite. Amphibole is present as an accessory mineral. Diatoms and other fossils are frequent and fragments of plant material occur. The clay has been tempered with 12% crushed granite with maximum grain size of 2 mm (Fig.22). Decorations consisting of horizontal rows of chisel imprints below the rim were recorded on pottery sherds of this ware (Fig.30c, d). (Tab.IIa: 824/90). Maximum sherd thickness varies between 5 and 8 mm.

Ware group 6
A sandy, silty, ferriferous, micaceous and somewhat calciferous clay with a dense structure and with zircon and amphibole as accessory minerals. It has been tempered with about 20% crushed granite with a maximum grain size of 3 mm (Fig.23). Vessels of medium size decorated with vertical, parallel zigzag lines below the rim and a zigzag line on the rim edge have been made of this clay and temper (Fig.28b). (Tab.IIa :316/34). Maximum sherd thickness = 8 mm.

Ware group 7
A sorted, silty, not sandy, ferriferous and calciferous, fine clay which contains amphibole, zircon and ore as accessory minerals. It was tempered with 16% crushed limestone with maximum grain size of 4 mm. As an effect of the dissolved calcium carbonate, due to acid conditions, macroscopic open pores

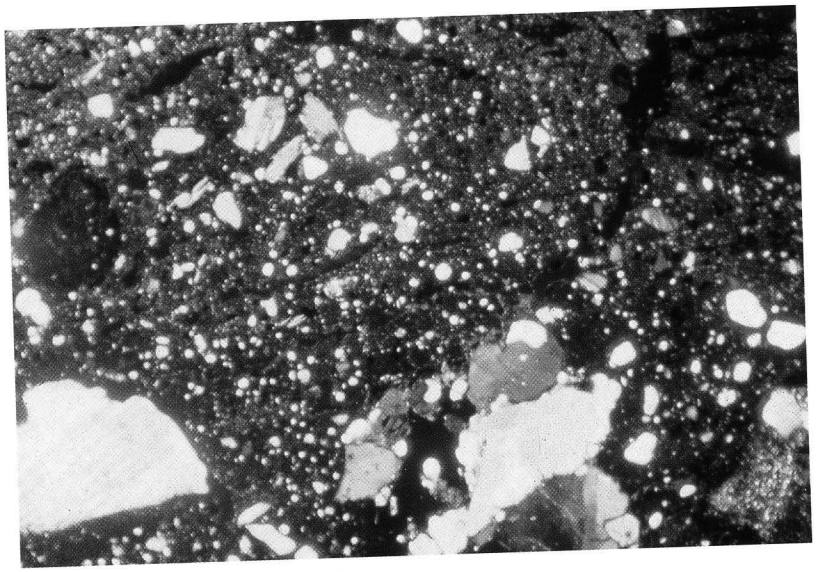


Fig.18. Sherd 938. W.g. 1.
A coarse, sandy, silty clay, rich in iron oxides and mica, tempered with 20% crushed granite very rich in biotite. Max grain size = 3 mm.
W.g. = ware group.

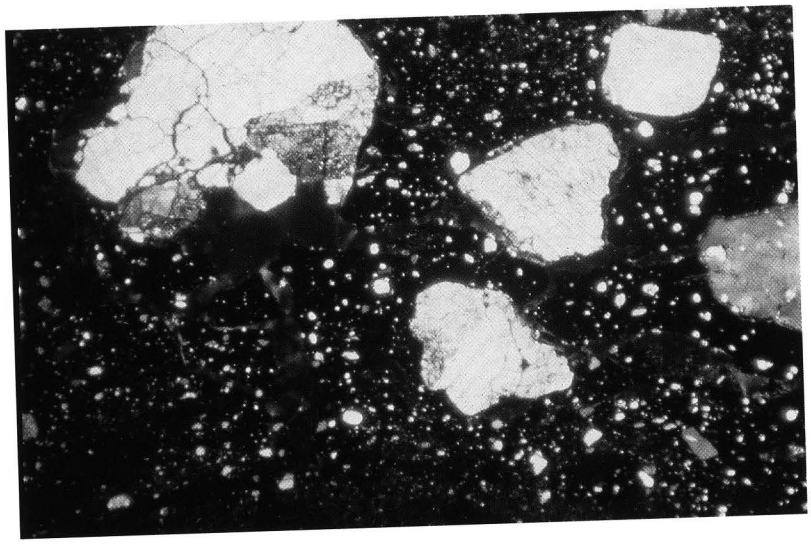


Fig.19. Sherd 52. W.g.2
A coarse, sandy, silty micaceous clay, rich in iron oxides, containing diatoms, tempered with 20% crushed weathered granite and sandstone. Max. grain size = 2 mm

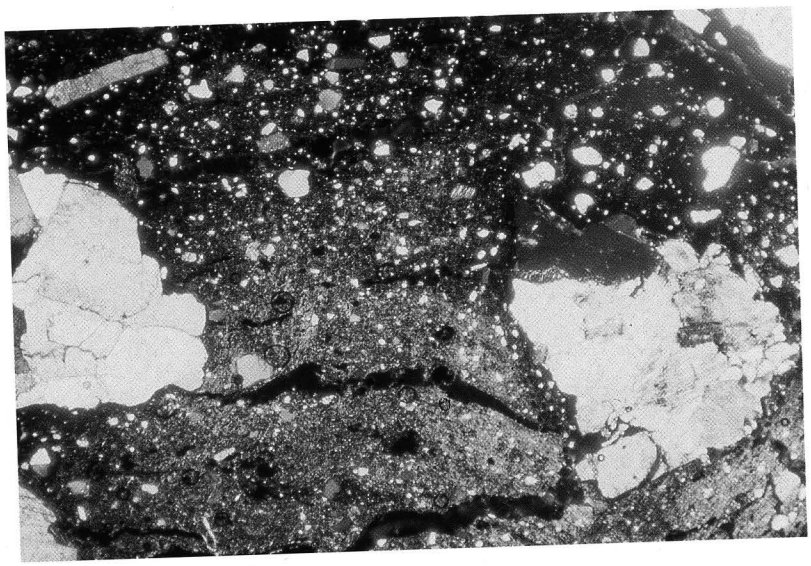


Fig.20. Sherd 125. W.g.3
A coarse, somewhat sandy clay, rich in mica and very rich in iron oxides, with temper of 14% crushed granite rich in biotite. Max. grain size = 3 mm.

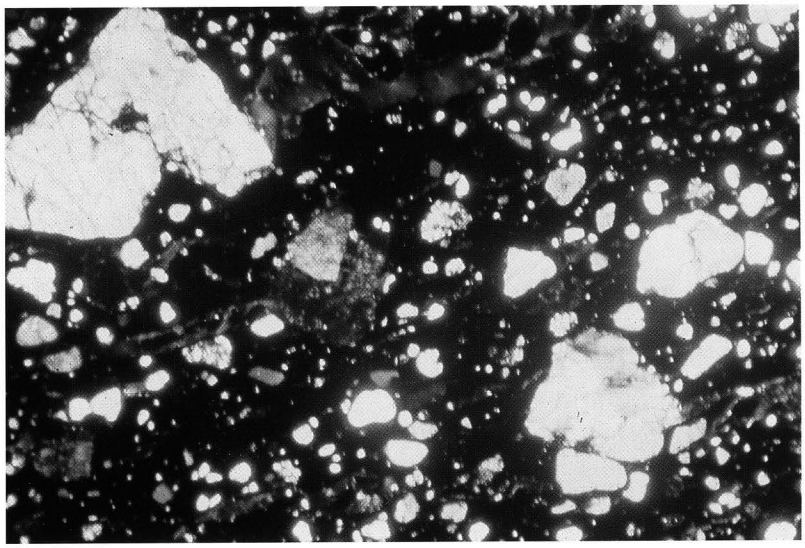


Fig.21. Sherd 850. W.g. 4
An unsorted, coarse, sandy, silty moraine clay rich in iron oxides and poor in mica. The natural sand constitutes the temper. Max. grain size = 3 mm.

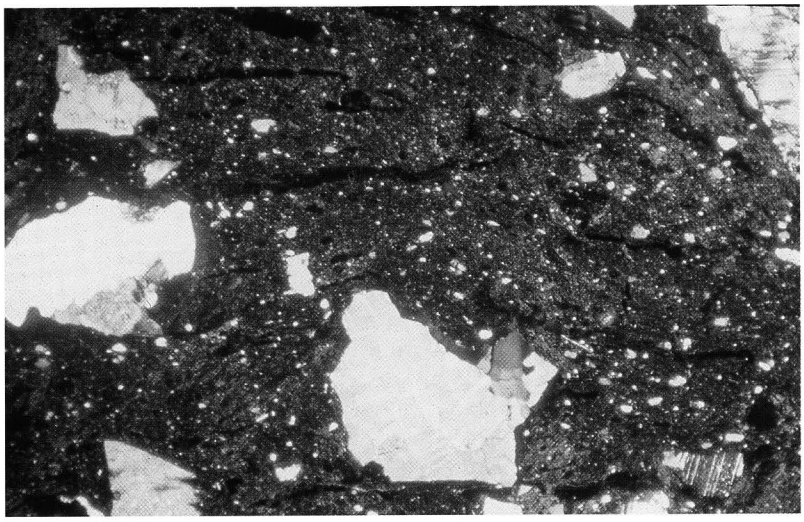
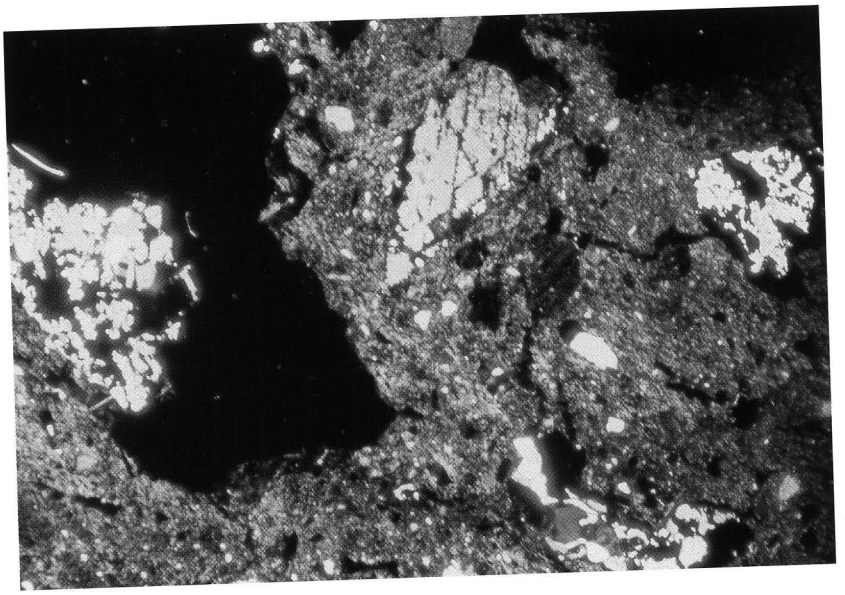


Fig.22. Sherd 824. W.g.5
A fine, sorted, somewhat sandy, silty and calciferous clay rich in iron oxides and mica, containing diatoms, tempered with 12% crushed granite and plant material. Max. grain size = 2 mm

Fig.23. Sherd 316. W.g. 6
A fine, sandy, silty, ferruferous and calciferous clay rich in mica, tempered with 20% crushed granite with max. grain size of 3 mm.



Micrograph: A.Lindahl
Magnification x25

Fig.24. Sherd 401. W.g.7
Poriferous ware. A fine, sorted, silty, micaceous and calciferous clay, rich in iron oxides, containing ore as accessory mineral, tempered with 16% crushed limestone and plant material. Remains of the limestone is seen as white edges around the empty (black) pores.

penetrate the ware. This ware is classified as *poriferous ware* in contrast to *porous* ware, which stands for the microscopic porosity of all non-sintered pottery. Plant material has been added to the clay (Fig.24). A vessel with straight rim part is decorated with oblique strokes below the rim and on the rim edge (Tab.II a : 401/5). Max. sherd thickness = 12 mm.

The author and Dr. A. Lindahl have reviewed the problem of properly denominating the important differences between various kinds of ware porosity. It is suggested that *porous* henceforth should be used to describe ordinary pottery, where the pore structure is not visible to the naked eye. *Poriferous* is kept for ware with open pores which are macroscopically visible, typical to weathered pottery made of calciferous clay and or tempered with calciferous material. A particular case of this type is the weathered, bone-tempered pottery, which is denominated *corky ware* (Henshall 1967), alluding to the specific carinated shape of the pores which gives the ware a cork-like appearance.

It should be mentioned that the occurrence of these seven ware groups indicates another use of the bog platform rather than as an ordinary dwelling place. It seems quite odd that a Neolithic site occupied by one specific family group should contain seven different ware groups as well as vessel types in use. The surface of the N-vessels was smoothed prior to the application of decoration. Like

the U-pottery the N-vessels were fired in an open fire at temperatures around 600°C. The short firing time caused a dark, low-burnt core of the ware (Lindahl 1995:35).

Vessel shape.

What has been said about the fragmentation of U-sherds also holds true for the N-pottery. Therefore, it has not been possible to reconstruct any complete vessel shape with sufficient accuracy. The upper parts of the vessels have, however, whenever appropriate, been reconstructed in order to give some idea of the original vessel shapes and of vessel functions (Fig. 27-29).

The sherd thickness varies between 5 and 18 mm with a mean of 12 mm (Fig.25).

Concerning correlation between sherd thickness and temper grain size cf. "U-pottery" and Fig.10b.

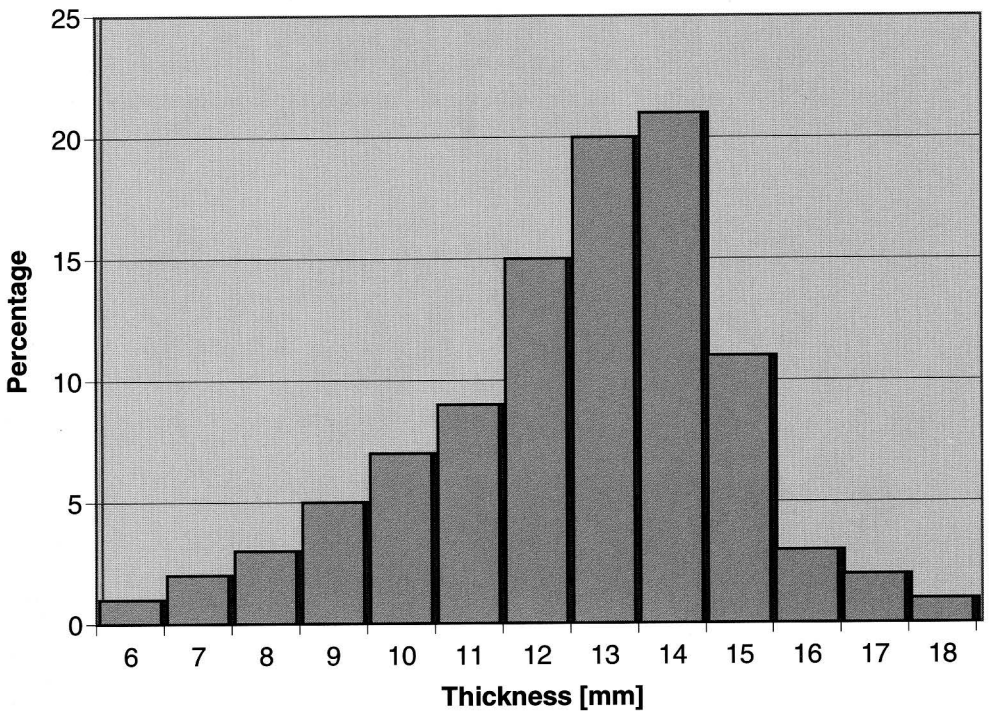


Fig. 25. Sherd thickness distribution of N-pottery. Mean value = 12 mm. n = 15 kg.

The variability in vessel shape is to a certain degree, demonstrated by the rim sherds (Fig.26). Like the U-vessels, the N-vessels mostly have straight necks and rims. There are rounded as well as flat rim edges. Thickening of the edge is rare. The transition between the shoulder and the convex body is either rounded or sharply profiled. Very few base sherds have been recognised among the sherd material. There are parts of some flat bottoms and a few with a convex shape.

Fig.26. Shapes of profiles of rim sherds of N-vessels. x indicates decoration on the rim edge.

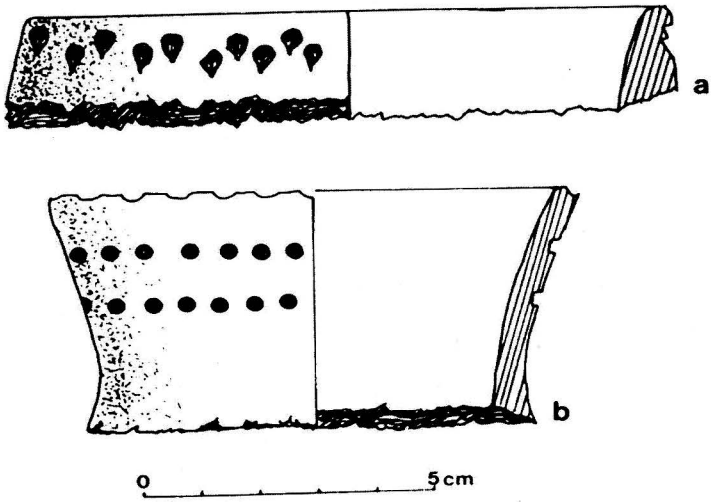


Fig.27 a-b. Reconstructed rim parts of small N-vessels with decoration of pit impressions. ∅ of rims: a = 11cm and b = 9 cm.

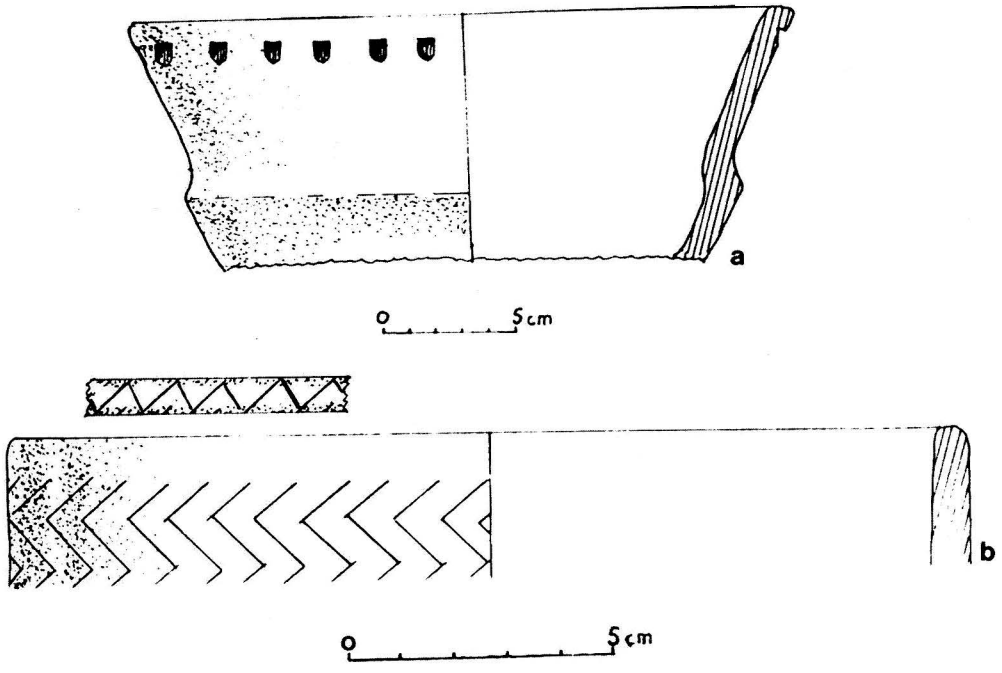


Fig 28 a-b. Reconstructed rim parts of medium-sized N-vessels. Rim ∅ = 24 respectively 18 cm.
Decoration: a/ a row of oblique pits under the rim.
b/ Parallel, vertical zigzag lines under the rim and zigzag line on the rim edge. Ware group 6.

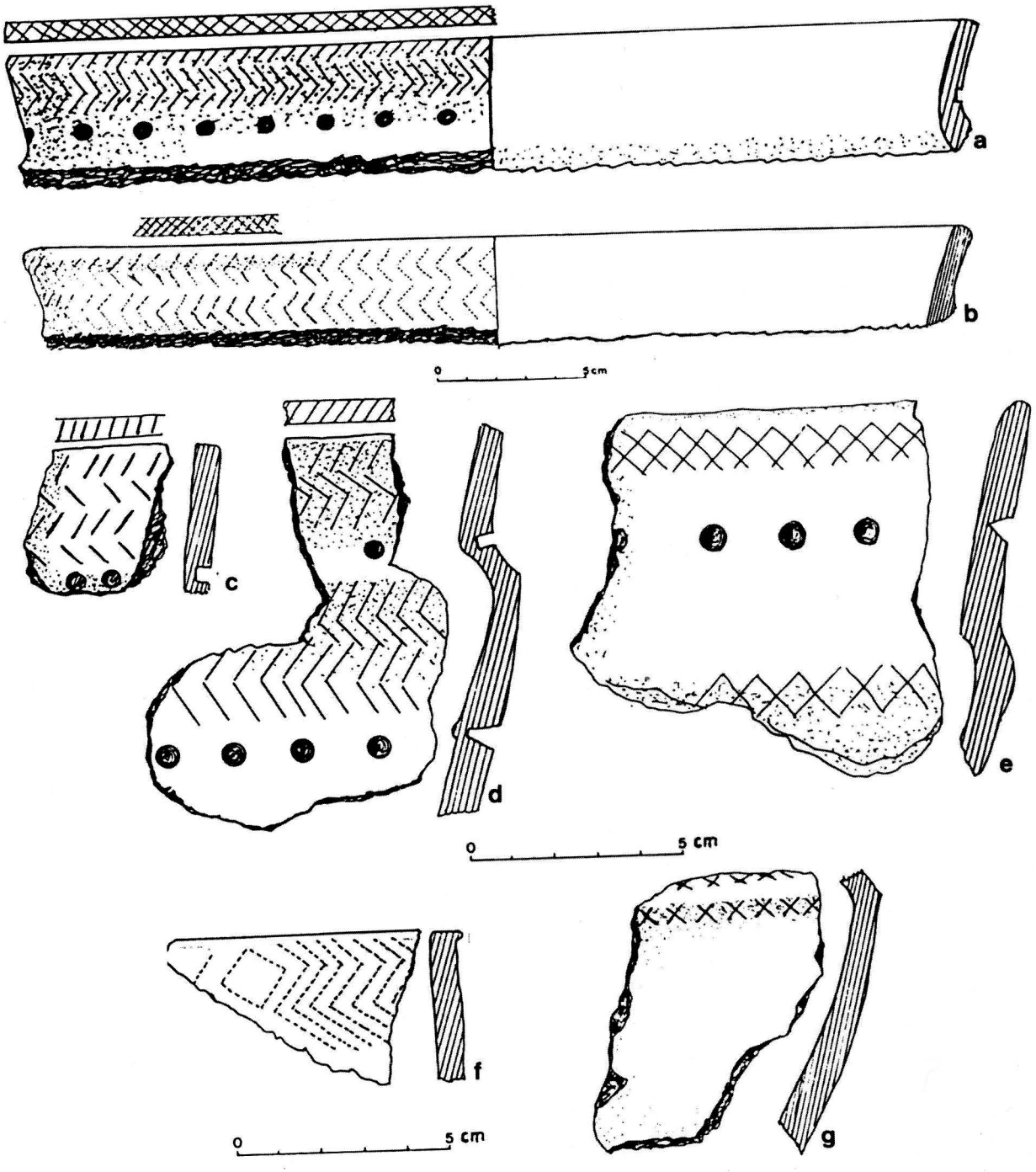


Fig. 29 a-g.
Reconstructed rim parts of large N-vessels (Rim∅ = 32 cm) and sherds with a similar kind of decoration.
Decorations:
a/ Incised, parallel, vertical, zigzag patterns and pit impressions on the neck and crossed strokes on the rim edge (Ware group 2).
b/ Comb-stamped, parallel, vertical, zigzag pattern on the neck and crossed strokes on the rim edge (Ware group 1).
c-g/ Sherds with incised, comb-stamped and impressed variations of the patterns of a and b. The sherds d - e and g represent the ware group 2.

The rim diameters vary between 9 and 36 cm. The size classes, identical to those of the U-pottery, are:

1. Small. 6 vessels with diameters between 9 and 15 cm (Fig.27 a,b)
2. Medium size. 3 vessels with diameter between 18 and 24cm(Fig.28 a,b)
3. Large. 12 vessels with diameter between 26 and 32 cm (Fig.29 a,b)
4. Extra large. One vessel with a diameter of 36 cm, decorated with a row of pits below the rim.

ELEMENTS		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
	1								x		x	x	x	x	x	x	x	x		
	2			x																
	3		x																	
	4																			x
	5																			
	6																			
	7																			
	8	x																		
	9															x		x		
////	10	x																		
	11	x																		
	12	x																		
	13	x																		
	14	x																		
x x x	15	x								x										
	16	x																		
	17	x								x										
	18																			
	19				x															

Tab. IV. N-vessel decoration elements and established combinations of such elements. Cf. tab. V

Vessel ornamentation.

When ornamented the N-vessels are decorated below the rim, on the neck and below the transition from the shoulder to the body. Decoration on the rim edge occurs in most cases on flat edges (Fig. 26). A wide range of decoration tools and techniques as well as ornamentation elements and patterns

was recorded. With tools like pegs, thin bones, shells, nails and toothed stamps etc., the potters produced more or less complex patterns with straight and oblique pits, rings, strokes, zigzag lines, cross marks and bows, angles being the most common ones (Fig.27-30). Various patterns have been made by means of tools with two, three or four teeth of diverse shapes (Fig.30 a,d; 32).

A few sherds found outside the pile dwelling construction have, compared to the other N-ceramics, a different ornamentation (Fig.31 a,b,c,d). A sherd of a funnel-shaped neck is decorated with incised, parallel, angular lines and oblique pits under the rim. A brim-vessel was decorated with vertical parallel lines combined with impressions of a bi-toothed tool. These sherds may have the same origin as the ceramics from the nearby megalithic grave (Hulthén in print). A third vessel had a sharply profiled transition between the shoulder and the body was decorated with strokes and hanging triangles of incised lines. Similar patterns are also found on pitted ware pottery from Hagestad 7:6, Scania (Hulthén 1977:fig.85 and 95) and from Siretorp (Bagge & Kjellmark 1939).

In the square T14 a sherd with a decoration pattern typical for megalithic pottery (Fig.31 d) was found. The ornamentation consists of zip-bands on both sides of a vertical band with parallel angular lines. Such patterns are also found among others on sherds from the passage-grave Fjälkinge 9, Scania (Bagge & Kaelas 1950:fig. XL VII:8).

Combinations of two or more elements in one and the same pattern are frequent within the ornamentation of N-vessels. In 17% of the investigated cases the patterns contain more than one decorative element, most often with pits being one of them (cylindrical and impressed perpendicular to the vessel wall) (Tab.IV).

Certain relations between decorative elements and vessel size are demonstrated by the following observations:

Small vessels are either undecorated or decorated with rows of pits below the rim (Fig.27a,b).
Five out of seven upper parts of large vessels are decorated with "fish-bone" pattern or vertical zigzag lines and/or cross marks (Fig.29 a,b,e).
Horizontal zigzag pattern was recorded on three sherds only.

The rim of two large vessels and one extra large vessel are decorated with square, oblique pits. There is undoubtedly a correlation between pattern elements and sherd thickness. Vessels decorated solely with different kinds of pit impressions have an average wall thickness of 11.0 mm (N=36).

DEC. No cf. Tab.IV	Decorative elements [single or combined]	Cases
1	Pits, perpendicular to the vessel wall	
	small < 3	4
	big ≥ 3 mm	19
2	Oblique pits	33
3	Bone impressions	8
6	Rings	3
7	Nail impressions	2
8	Chisel-impressed strokes	5
10	Incised strokes, not cross or zigzag	5
	Zigzag lines	
11	Horizontally comb-stamped	3
12	Vertically incised	10
13	Vertically comb-stamped	4
14	"Herring bone" pattern	4
15	Cross marks	11
16	Shell impressions	2
17	Impressions with tools with teeth of various cross section shapes	15
18	Different unspecified impressions	7

Tab. V. Frequency of some decorative elements on N-pottery sherds. As far as possible one case is considered = 1 vessel. N = 130 cases. Regarding unspecified impressions cf. Fig 32a.

The corresponding value for vessels with zigzag lines, cross-marks or "fish-bone" patterns is 7.5 mm (N=32). Sherds with chisel-impressed strokes are of lesser thickness, 7.0 mm (Fig.30c,d).

It should be noted that ornamented rim edges were not observed on vessels solely decorated with pits. Also oblique pits are - with the exception of one case - never combined with other decoration elements (Tab.IV). Rim edge decoration is, with only a few exceptions, found on straight, flat edges (Fig.26).

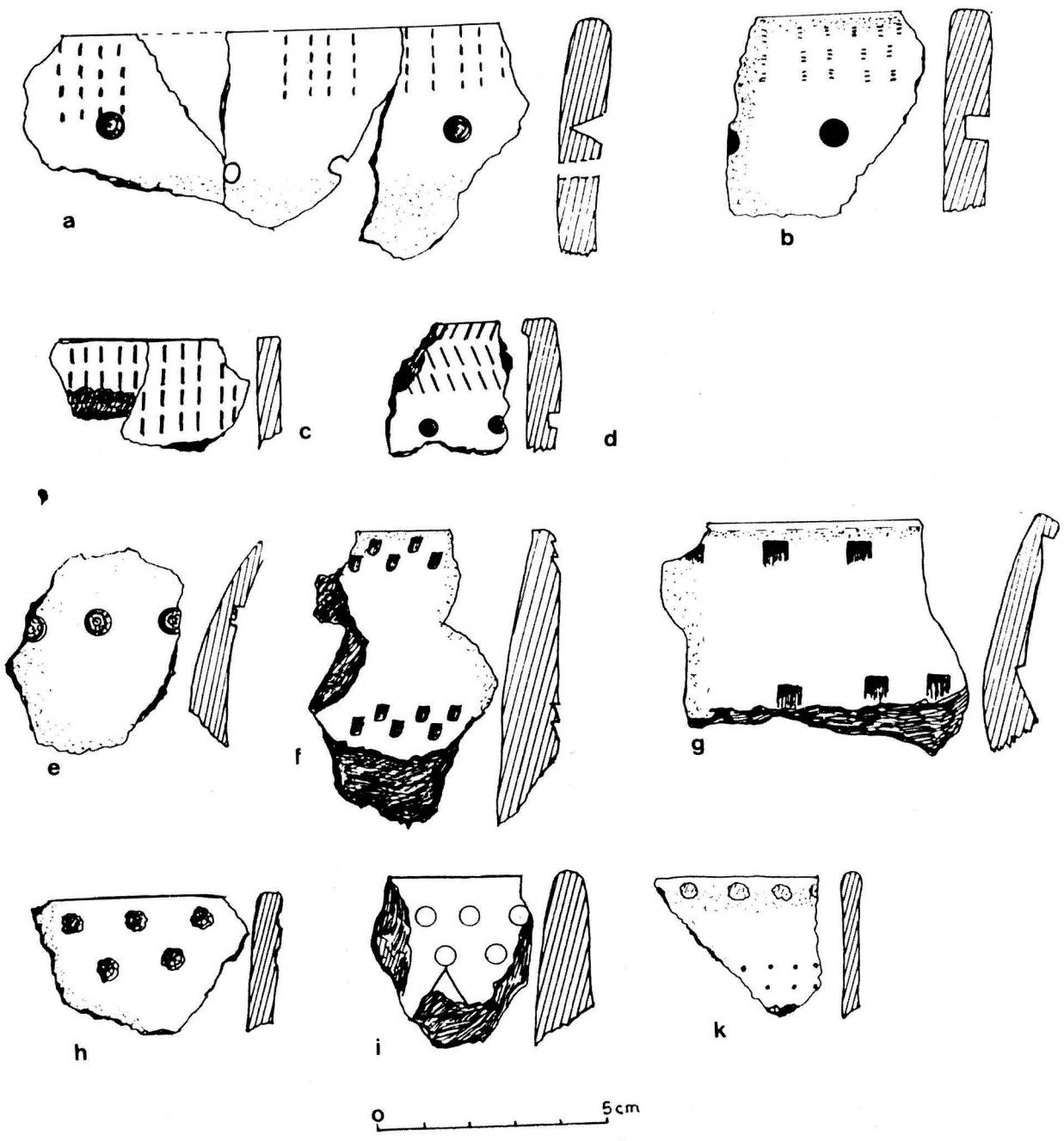


Fig.30 a-k. Sherds of N-vessels with various impressed decorations.
a/ Vertical lines of impressions from a 4-toothed stamp and conical pits under the rim. (Ware group 4).
b/ Impressions of a fine, 3-toothed stamp and cylindrical pits under the rim.
c - d/ Rows of chisel-impressed strokes and pits under the rim. (Ware group 5).
e-f-g/ Straight and oblique pits under the rim, on the neck and on the vessel shoulder. (e = ware group 1; g = ware group 5).
h/ Rim sherd with shallow, bone impressions.
i/ Rows of ring-shaped impressions, possibly made with a cut-off quill.
k/ Rim sherd of an extremely thin-walled vessel decorated with diffuse, shallow impressions under the rim and imprints on the neck made with a bi-toothed tool. (Ware group 4).

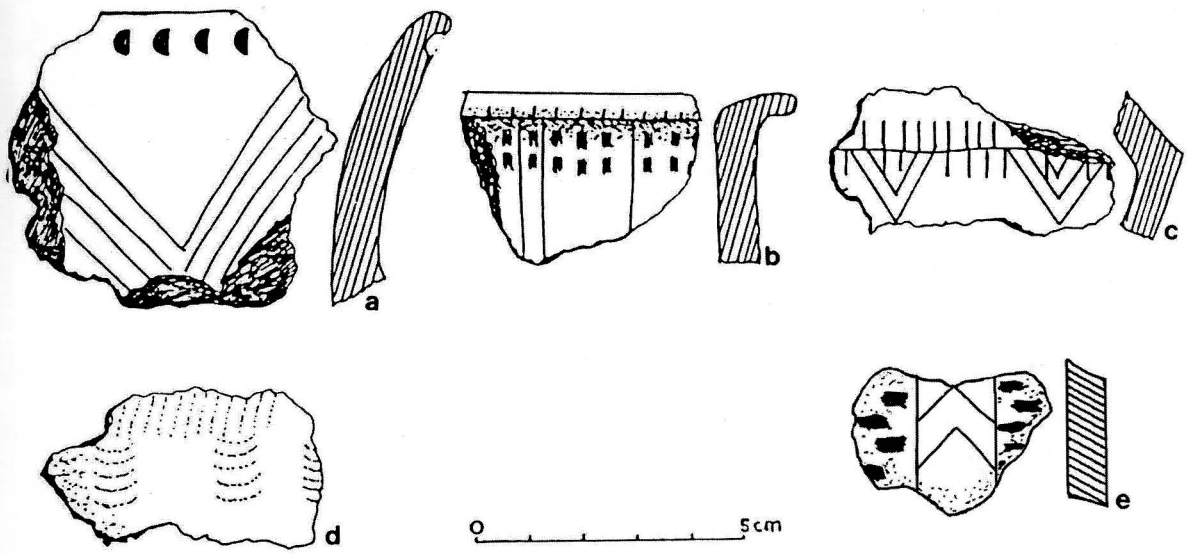


Fig.31 a-d Sherds of N-technique pottery of which shape and/or ornamentation are of unique occurrence Among the Alvastra ceramics. These sherds were found outside the pile dwelling construction.

a/ The funnel-shaped neck has decoration of incised, angular lines and a row of oblique pits under the rim. b/ Sherd of a wide-brimmed vessel decorated with incised, vertical lines and impressions of a bi-toothed tool under the rim.

c/ Sherd of a vessel of which the sharply, profiled transition shoulder/body is decorated with incised triangles and strokes.

d/ Decoration made by means of a cardium shell. (Ware group 1).

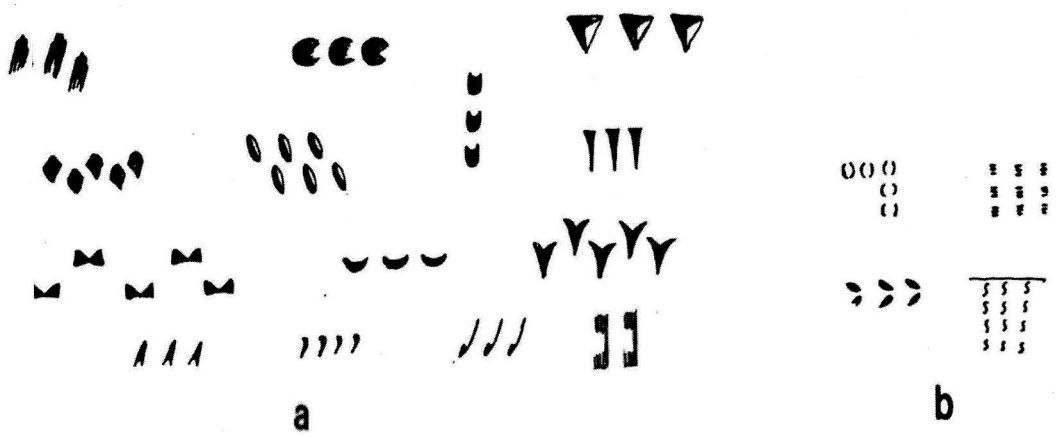


Fig. 32 a-b. Various impressed decoration elements observed on N-pottery and made with

a/ a single tool and

b/ a toothed tool.

The decoration patterns of the Alvastra N-vessels have many characteristics in common with other Neolithic sherd collections. The ceramics from Ire, Gullrum, Hemmor and other Pitted-Ware sites on Gotland as well as those from Fagervik, Vrå, Säter, Humlekärrshult and Masmo on the eastern coast of Sweden contain many decorative elements, patterns and ornamentation techniques (Tab.VI) common to the Alvastra N-pottery.

Vessel function

For the same reasons as already discussed in connection with the U-pottery, the N-pottery, except for the ceramics of calciferous ware, have been suitable for cooking as well as for fermentation and for food storing purposes (organic residues remain on many sherds) and as water containers. The small vessels may, as mentioned above, very well have served as drinking bowls and as milking utensils for goat and sheep (Fig.17).

The calciferous, now poriferous, ware (Fig.24) may have been practical for some type of storing. However, the incidence of this ware is very limited among the investigated sherds. It does probably not represent more than six vessels at the most. Because of the brittleness of the ware, the thin-walled, finely decorated, comb -stamped or stroke-ornamented vessels, they were in all probability not intended for use in the "kitchen" or for other heavy-duty household purposes

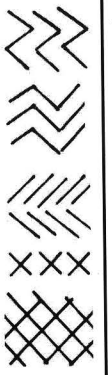
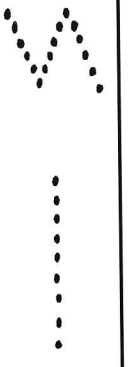
SITES	ORNAMENTATION ELEMENTS AND PATTERNS (cf. Table IV)											
	 Thick bow-shaped (not nail) impressions.	 Drop-shaped impressions at angular positions.	 Two-cornered, oblique chip impressions. Semicurved impressions.	 Shallow, bone impressions.	 Cylindrical pits, impressed perpendicularly to vessel wall surface.	 Oblique rounded pits.	 Rows of small pits (Ø≤2mm).	 Miscellaneous imprint shapes.	 Nail impressions.	 Rows of small strokes impressed with a chisel.	 Vertical or horisontal zigzags. Fishbone. Crosses. Netpatterns.	 Comb-stamp patterns.
Alvastra U-pottery	x	x	x	x	—	—	—	—				
Alvastra N-pottery			—	x	x	x	x	x	x	x	x	x
Alvastra Meg.tomb											✳	✳
Täkern					✳		✳		✳		✳	✳
Fagervik				✳	✳		✳		✳		✳	✳
Säter				✳	✳		✳		✳		✳	
Åby					✳		✳				✳	
Bollbacken				✳	✳		✳		✳		✳	✳
Masmo				✳	✳	✳	✳	✳	✳		✳	✳
Ire			✳	✳	✳	—	✳	✳		✳	✳	✳
Humlekärrshult	—	—	✳	✳	✳		✳	✳	✳	✳	✳	✳

Table VI. Various typical ornamentation elements and patterns of the Alvastra U- and N-pottery compared to the occurrence of such elements and patterns found at other Neolithic sites discussed in the text.

Symbols: x=Occurrence at the Alvastra Pile Dwelling. ✳=Occurrence at other sites. —= Scattered occurrence.

Stratigraphic studies of U- and N-ceramics.

The above description of the U- and the of N-pottery indicate very significant differences regarding the properties of these two main groups. Thus, they differ from each

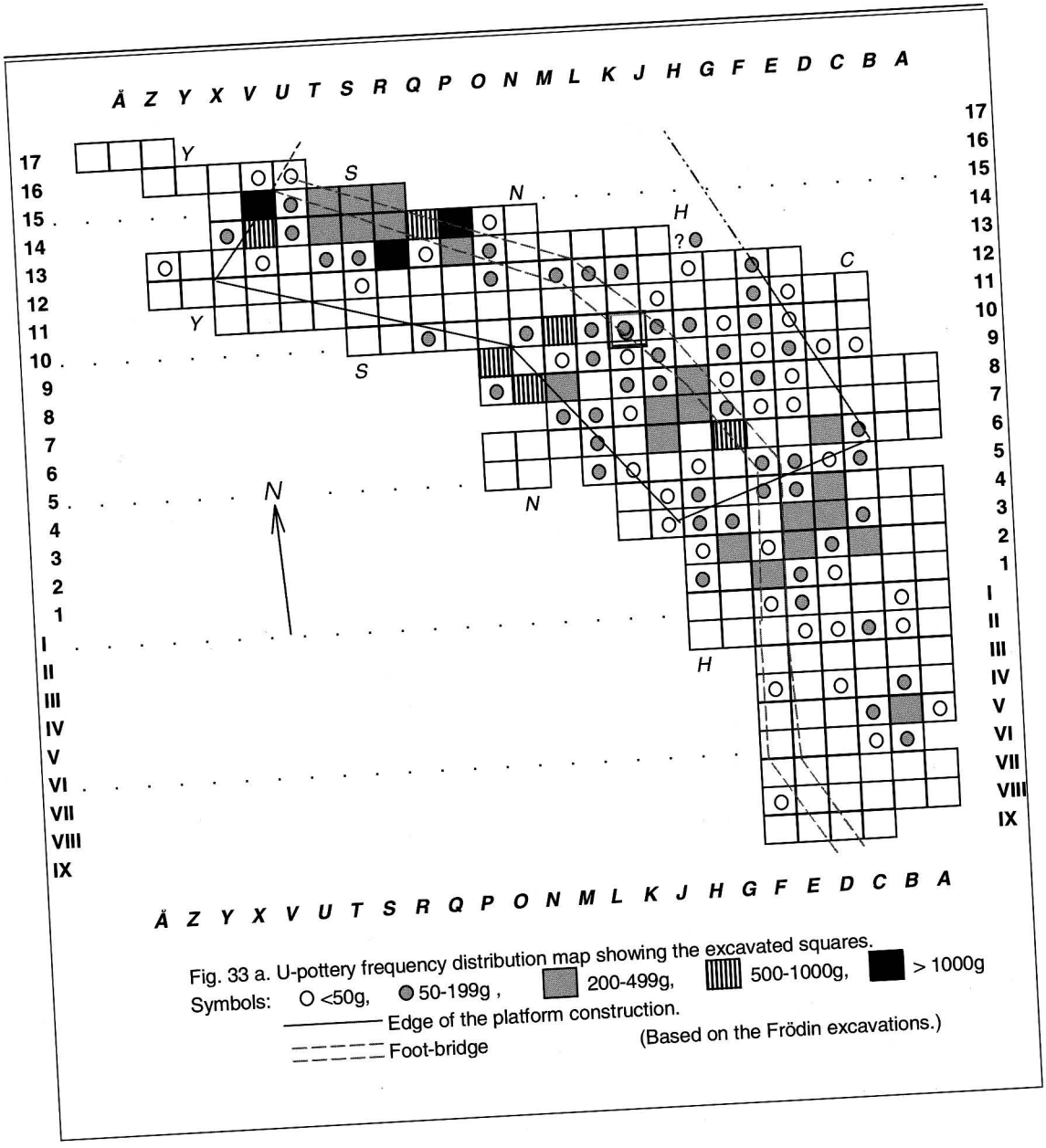


Fig. 33 a. U-pottery frequency distribution map showing the excavated squares.
Symbols: O <50g, ● 50-199g, ▒ 200-499g, ▓ 500-1000g, ■ > 1000g
——— Edge of the platform construction.
= = = = = Foot-bridge
(Based on the Frödin excavations.)

other not only with respect to vessel-building technique but also concerning the tempering ratio (Mean value: U=20%, N=17%) and maximum temper grain size (Mean value: U=6 mm, N=3 mm). When shaping a vessel the U-technique is no doubt less advanced than the N-technique. With the latter it is

possible to make more thin-walled pottery. This is evident from the diagrams showing the sherd thickness of the two groups (Fig.6 and 25). Furthermore, there are also differences regarding vessel shapes and last, but not least, the ornamentation.

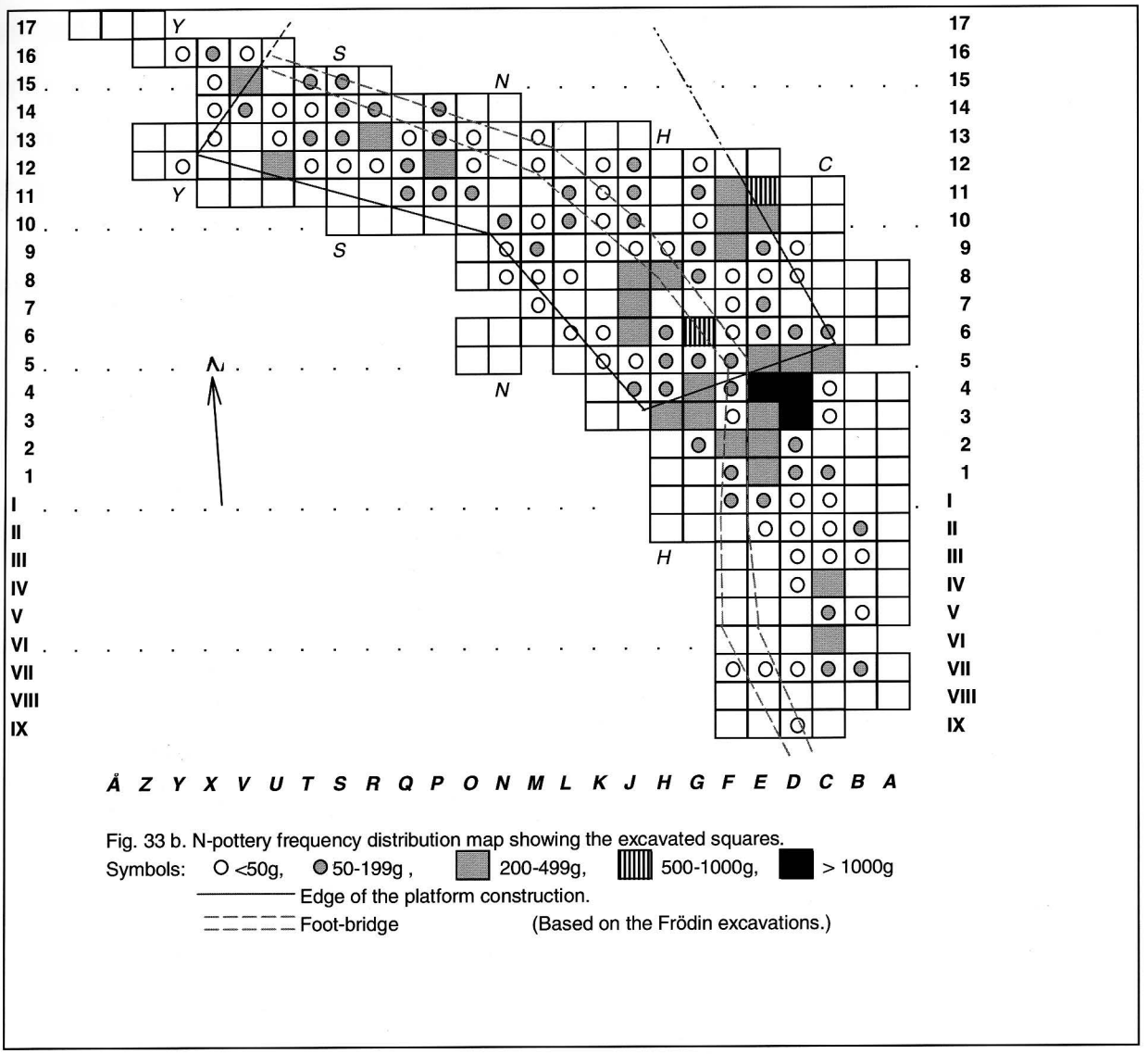


Fig. 33 b. N-pottery frequency distribution map showing the excavated squares.

Through studies of the excavation reports and the recorded find co-ordinates it was possible to map fairly accurately the distribution of the two pottery groups. During the excavation period 1909 through 1930 individual squares were subjected to repeated investigations. Within these squares the stratigraphical relations between N- and U-pottery have been documented.

The concept of *square* needs some comments. The excavations were based on a co-ordinate system with main squares of 2 x 2 m (Fig.33a,b).

Each square was further divided into 4 sub-squares

d	c
b	a

At the excavations starting in 1928 and on, Frödin changed the designations of the sub-squares from a→b and b→a, from d→c and c→d.

c	d
a	b

The reason for this, possibly justified, change is not known but it is not unfair to say that life would have been much easier for archaeologists of today had Frödin kept to the original designations.

The occurrence of ceramics/pottery turned out as follows.

Ceramics of U-technique only	=	43 squares
Ceramics of N-technique only	=	51 squares
U-pottery located below N-pottery	=	19 squares (cf. Tab. VII)
N-pottery located below U-pottery	=	1 square

Two main clusters have been established in the excavated area. The U-pottery, besides an otherwise even distribution, shows a distinct, rise in concentration in the westernmost part of the construction whereas N-pottery is concentrated in the eastern part (Fig. 33 a-b).

As mentioned above, U-pottery is homogeneous with regard to raw materials and manufacturing technique. It was not possible to find any cluster of individual decoration types within the investigated area except for the specific bow-shaped, impressed pattern. Such sherds had gathered in the westernmost area.

In the N-pottery case, specific concentrations of different ornamentation patterns were observed. The chisel-impressed patterns as well as cross-strokes and cross-lines patterns are found on sherds from the westernmost part of the investigation area. The square and oblique pits and zigzag lines are merely found on sherds from the eastern part.

The stratigraphy of U-respectively N-pottery is an important support for the idea of an earlier appearance of the U-ceramics. The very homogeneous character of this ware in turn favours the hypothesis that the people using the U-vessels were one population group of a common origin.

The facts pertaining to the N-ceramics, on the other hand, are very different. There are seven ware qualities, based on various raw materials, related to individual decoration patterns. The pottery groups display a different distribution pattern on the platform area. In contrast to the U-complex it is likely that different groups of people using N-vessels occupied specific parts of the platform area, maybe during reoccurring discrete intervals in time.

Main square	Excavation year	Sub-square	Pottery type	Excavation year	Sub-square	Pottery type	Excavation year	Sub-square	Pottery type
D3	1911	b	**N**	1930	a	**U**			
D6	1909	b	**N**	1911	*all*	**U**			
D9	1909	b,d	**N**	1911	b	**U**	1929	*all*	**U**
E I	1917	c	**N**	1919	c	**U**			
E1	1911	*all*	**N**	1930	>2	**U**			
E2	1911	*all*	**N**	1929	*all*	**U**	1930	*all*	**U**
E3	1911	*all*	**N**	1930	>2	**U**			
E8	1909	b	**N**	1911	b	**U**	1930	a	**U**
E9	1909	d	**N**	1911	d	**U**	1929	c	**U**
F5	1909	b	**N**	1930	a	**U**			
F8	1909	c	**N**	1930	d	**U**			
F9	1909	d	**N**	1929	c	**U**			
F11	1909	a	**N**	1929	b	**U**			
G2	1909	d	**N**	1929	c	**U**			
G3	1909	*all*	**N**	1929	*all*	**U**	1930	*all*	**U**
H3	1911	*all*	**N**	1929	*all*	**U**			
I10	1909	*all*	**N**	1929	*all*	**U**			
V14	1915	a,d	**N**	1928	b,c	**U**			
Q13	1914	d	**N**	1929	c	**U**			

Table VII. Sub-squares where U-pottery was found below N-pottery.
>2 = internal square find co-ordinates could not be restored.

The amount of ceramics finds; a seeming paradox.

In spite of keen recording and documentation of the 7000 pottery sherds, it was only possible to reconstruct the rims and upper parts of vessels. Very few bottom sherds remain. A rough estimate suggests that the investigated material represent about 300 vessels, which were once brought to the platform. Evidently a large quantity of ceramics ware must have disappeared since or during the Neolithic occupation. This fact cannot be explained through normal breaking and discarding of household ware. However, modern ethnoarchaeology, offers a solution to this seeming paradox, which is as simple as it is elegant. It is known that when people move from one site to another (except when triggered by a cataclysmic event) they normally carefully collect and bring along with them, among other belongings, all usable pottery vessels. Even cracked vessels and big sherds which might come in handy for various day to day purposes are collected (Lindahl 1994). Bottom sherds, for instance, are in most cases of thicker ware than are the body sherds and therefore mechanically stronger. In Zimbabwe big bottom sherds, far from being discarded, are used as frying and roasting pans. That would explain why no complete vessels or big sherds and so few bottom sherds were found at Alvastra.

Another phenomena that can the account for the disappearance of pottery ware is weathering. During the Alvastra excavation in 1976-80 a considerable amount of pottery sherds, affected by a peculiar kind of weathering were observed. Different stages of this process, ranging from faint discoloration to a characteristic pink-grayish shade to quite decomposed ware, pulpy in consistency, were observed among the pottery material. Also totally decomposed sherds where nothing else but small concentrations of grains of crushed granite (the remaining temper) were the only remains of the original pottery occurred.

A series of analyses were carried out to study this weathering process and to describe plausible mechanisms behind it. Sherds of unweathered, solid ware (I) of dark brown or gray-brown colour (10YR 4/2)* as well as cracked grayish-pink (5YR 6/3) sherds (II) and pulpy, decomposed mass (III) (5YR 7/2) were selected. Furthermore, simulated manufactured pottery (IV) of Alvastra clay, tempered with crushed granite and fired to 600°C, was included for reference. (*codes according to the Munsell Color Chart System).

It is a well known fact that phosphoric acid has a decaying effect on clay and even on low-fired pottery (Demirel & Davidson 1962; Low & Black 1948). Phosphoric acid particularly attacks illite (clay mineral) by removing potassium (K) and thus causes illite to transform to smectite or vermiculite (clay minerals) (Fig.34).

The material found at Alvastra contained a considerable amount of unburned as well as burned bone (Hydroxyapatite, $(Ca_{10}(OH)_2 (PO_4)_6)$ (Browall 1986:114). It was observed that the pulpy "pottery" was always found in immediate contact with more or less decomposed bone. Another matter of importance was the abundant presence of bark as part of the pile dwelling construction (Browall 1986:Fig. 18). The possibility of release of phosphates from the bone material through the action of tannic acid stemming from the bark has been considered (Riesenfeld 1946). This process is facilitated if the bone is burnt. The phosphate and phosphoric acid, formed in the process, would in turn attack the clay minerals of the pottery.

In an attempt to simulate such a chemical action the following procedures were applied: Pieces of pottery of quality I, II and IV were immersed into a solution of 3% phosphoric acid for up to three weeks at a temperature of 60°C. The heating was deployed in an attempt to simulate about 5000 years of attack at lower temperatures. After 48 hours sherd II was totally decomposed. Only the coarse fraction, mainly quartz, remained unaffected. At this point, sherd I started to show weathering effects on its surface. After another 24 hours the surface of the ready-made pottery (IV) also showed clear signs of weathering. After three weeks sample I and sample IV were totally decomposed. During the experiment the two ceramics had altered their original colours to the typical shade of pale pink-grayish.

The contents of phosphorous and potassium were checked by means of AAS (Atomic Absorption Spectrophotometry) carried out at the R&D-department of Höganäs AB, Höganäs. The results (Tab.VIII) reflect the increasing content of phosphorous from sherd I to sherd IV and further on to the pulpy pottery mass III and the decreasing proportion of potassium in the same material.

XRD (X-Ray Difraction analysis) carried out at SGU, Uppsala by Dr A.- M. Brusewitz, was used to study the contents of different clay minerals in the pulpy pottery. The XRD-curve on a semi-quantitative basis (Fig. 34) demonstrates the low content of illite compared to the vermiculite/smectite minerals.

These results reflect different stages of the same weathering process. Over all they point in the same direction; decomposition of pottery caused by the combined action of tannin and hydroxyapatite on low-fired clay. In other words the triplet of bark-bone-pottery.

Several complementary explanations may account for the low amount (mass) of sherds compared to the number of original vessels represented through the finding material. This investigation suggests

Composition %	Sample I, solid ware	Sample II, cracked ware	Sample III, pulpy ware
P	0.14	0.50	0.65
K_2	0.70	0.80	0.10
Na_2	0.05	0.06	0.03
Colours according to Munsell Color Chart System	10YR 6/4	5YR 6/3	5YR 7/2

Table VIII.
AAS-analysis of fired pottery clays from the Alvastra Pile Dwelling showing the in principle inverted interdependence between presence of alkaline oxides and presence of phosphorus in the silicates of the three pottery samples I - III.

The analysis was carried out through forthcomign at the R&D laboratory at the Höganäs AB, Höganäs.

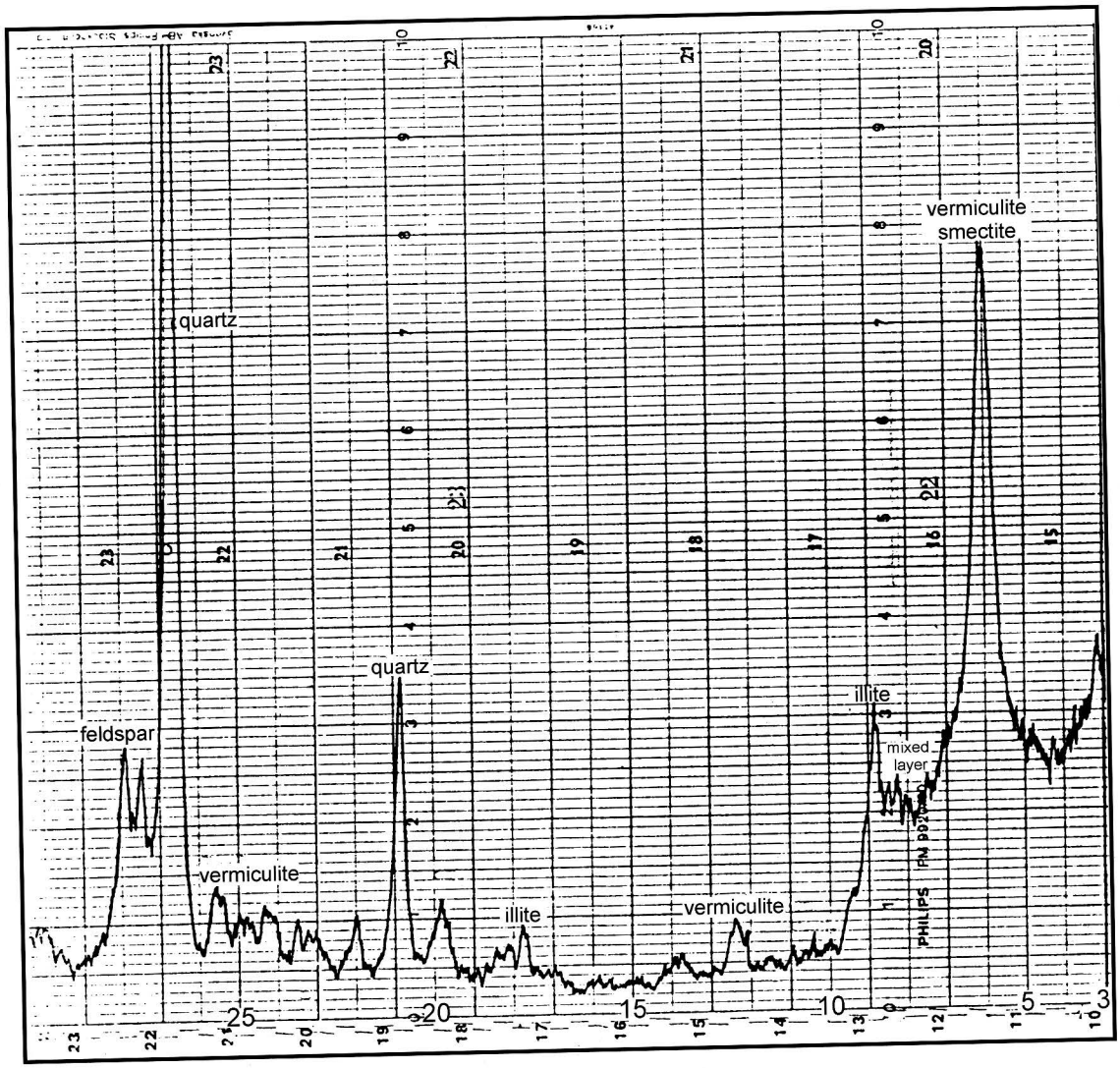


Fig.34. Diagram from the XRD-analysis showing the minor contents of illite (lack of potassium) and the high contents of smectite and vermiculite as an effect of weathering.

that social behaviour and subsequent naturally occurring chemical transformations were among those of special significance. It should also be added that an unknown amount of pottery probably rests on the bottom of the ancient bog, which surrounded the Alvastra pile dwelling.

Considerations concerning local raw clays vs. the ceramic ware.

The investigation of raw clays from the Alvastra area yielded the following results.

Of the 27 clay samples from 18 different clay deposits only 12 were suitable for pottery production (Fig.3) (Tab.IX).

At least three different local clays would correspond to the ware of U-pottery sherds. Clay no. 8 (Tab.IX), from a deposit not far from the shore of Lake Vättern, is one of them. This deposit may have been exploited by medieval brick-makers for the construction of Alvastra Monastery in the 12th century (Holmström & Tollin 1994:40,42). It is good ceramic, fine clay with plasticity and thermal properties suitable for a pottery craft also at a relatively modest level. Clay no.9 is also of the proper type for ceramic purposes. The deposit is situated in the field near Isberga (Fig.3). The sample was taken at a depth of 50 cm under the sod. Another clay with the same properties is no. 17, collected at a depth of 40 cm under the sod in a field not far from the pile dwelling.

Evidently the availability of raw materials does not contradict the assumption of a local manufacture of the U-pottery within the Alvastra area. Generally potters are very keen with their choice of clays - his or her clay - i.e. the clay he or she always used. Maybe it was even used by the preceding generations of potters too. Most potters do not change craft traditions unless absolutely necessary.

The various wares of the N-pottery reflect different requirements on raw materials implying different ideas on manufacturing technique. There is for instance a wide gap between a pottery production based on non-calciferous clays and one using calciferous raw materials. Furthermore there is a considerable difference between the tempering method using crushed granite, which was the most common and wide-spread technique in ancient Scandinavia and the use of limestone for the same purpose. In the latter case potters also had to mix plant material in the clay to avoid severe cracking during firing in open fire (oxidizing atmosphere); a technique familiar to potters on Gotland of that time, where only calciferous clays were available. On the mainland, however, where other clays were accessible, there must have been a particular reason why potters choose a raw material with such negative properties. With a few exceptions the Neolithic, Bronze and Iron Age potters in Scandinavia avoided the calciferous clays. Not until firing in a reducing atmosphere had become a widespread pottery technique the use of calciferous clays become more customary.

Sample No.	Finding depth cm	Type of clay	Type of deposit	Pottery grade*
1	30	GC	Moraine/bog	0
2	30	GC	Moraine/bog	0
3	30	CM	Moraine/hill	0
4	40	GC co	Field	4
5	40	GC f	Field	2
6	40	GC cc	Field	0
7a	75	GC cc v	Ditch	0
7b	150	GC cc v	Ditch	0
8	200	GC f	Former clay quarry	5
9a	40		Field	4
9b	50	GC	Field	4
10	300	Gravel	Gravel pit	-
11a	200	GC	Bog	1
11b	100	GC	Bog	0
12	90	GC cc	Hill slope	0
13a	109	PGC	Kettlehole	5
13b	121	PGC	- " -	1
13c	133	PGC	- " -	1
13d	145	PGC	- " -	1
14a	125	PGC	- " -	0
14b	150	PGC	- " -	0
15a	100	PGC f	Field	4
15b	100	PGC f	Field	4
15c	100	PGC f	Field	4
16	220	GC f	Field	5
17	40	PGC f	Field	4
18	300	GC f	Bog	4

Table IX. Samples 1 - 18 from the clay prospecting at Alvastra (Fig. 2b). * The utility for ceramics production is graded after a scale 0 - 5, where 0 = unsuitable,1 - 3 = low suitability, 4 = good and 5 = excellent ceramic clay. Abbreviations: GC = glacial clay; PGC = post-glacial clay; CM = clayey moraine; co = coarse: f = fine: cc = calciferous; v = varved.

The use of coarse moraine clay, which did not need an added temper, was a special and indeed a rational way of vessel production. As a matter of fact, this method of making pottery was very common throughout the Iron Age. A practice facilitated through the fact that moraine clays are frequent in many parts of Sweden.

In relation to the ware groups 1 - 4 it should be noted that the corresponding raw clays, from the very coarse moraine clay to the fine dense structured clay, are all represented among the test clays collected at Alvastra.

The tempering methods are very similar within groups 1-3. The potters of these vessels may very well have had their homesteads not too far from each other. Group no 4, on the other hand, represents another manufacturing technique, clearly springing from another craft tradition.

The three different clays of N-ware of groups 5-7 have no equivalents among the sampled local test clays.

The seven ware groups of N-pottery to a varying extent reflect different traditions within the ancient ceramic craft and most probably represent people belonging to different family groups, tribes etc.

Relations between the Alvastra ceramics find and the selected test sherds from some relevant Neolithic sites

The test material for comparing analyses was chosen with the aim of investigating the possibilities for pottery from other areas to occur within the Alvastra ceramics. The chosen sites are situated at distances from Alvastra, between a few km up to 200 km as the crow flies. Is there any evidence of comparable identity comprising ware, manufacturing technique and decoration between sherds from Alvastra and sherds from the other more or less contemporary Pitted Ware sites (Fig.1a)?

Thin sections were made of pottery with the appropriate ornamentation from Fagervik, Krokek parish, Säter, Kvarsebo parish and Åby, Kvillinge parish, all in the province of Östergötland. In addition thin sections belonging to the research material from key ceramics projects kept in the reference collection of the Laboratory for Ceramic Research were included in the comparison. This collection includes relevant pottery from the megalithic tomb at Alvastra, from Svälinge, Lindön, Sandby and Charlottenborg, on the northern part of Lake Tåkern, from Bollbacken, Tortuna parish, Västmanland, from Masmo, Huddinge parish, Uppland and from Ire, Hangvar parish, Gotland. Moreover, decorated sherds from Humlekärrshult, Döderhult parish, Småland, were included with regard to different ornamentation elements, patterns and vessel-building technique. Unfortunately no thin sections were available from this pottery.

The Alvastra Megalithic tomb.

In the vicinity of the Alvastra pile dwelling site a megalithic tomb was uncovered and investigated in the early 80s (O. Janzon 1984, 1997 (in print)).

The cramics finds (454 sherds, weighing 1107 g) from this excavation were subject to recording and laboratory investigations. Thin sections from 15 sherds were prepared and analysed. These sherds are a sample representative of the total material. Except for one undecorated sherd made out of a calciferous,

coarse clay without any added temper, this megalthic pottery was based on two types of clay. One sorted silty fine clay and one unsorted coarse clay. Highly weathered, crushed granite was used for tempering. In addition many of the sherds also contained crushed doleritic rock as temper. The same ware – clay and temper – was found in pottery from the passage graves at Rössberga, Valltorp parish, Västergötland on the other side of Lake Vättern. There is such a close correspondence between these pottery materials from the two megalithic graves, typologically as well as technolo-gically, that it is reasonable to assume a common origin. Dolerite and doleritic rocks are typical for the bedrock of Västergötland. On the eastern side of Lake Vättern this type of rock is not known to be part of the bedrock. Thus at least some of the Alvastra megalithic pottery was most probably manufactured on the western side of Lake Vättern.

With regard to possible items common to the tomb ceramics and the pile dwelling pottery, it is a fact that, in spite of the close neighbouring conditions, the two sherd collections are entirely different from each other. The ornamentation of the grave pottery is indeed pure megalithic and well known, not only from the passage graves of Västergötlad, but also from equivalent materials from Scania, for instance the passage graves at Fjälkinge (Bagge – Kaelas 1950,1952), at Ramshög (Hulthén 1977) etc. No sherd is decorated with any of the patterns or elements found on the pile dwelling vessels. Therefore, judging by the ceramological evidence, it is plausible that the grave builders never even met the builders of the pile dwelling.

Moreover, the separation in terms of time between the use of the pile construction and the use of the grave may in a historical perspective be short and seemingly negligible. Although it is of course obvious that even a "strategically" occurring delay of an hour or less is sufficient to exclude a real time contact between representatives of the two populations. With dating techniques available today there it is not possible to accurately date archaeological finds beyond a resolution of 100 – 150 years on an absolute time scale. The exception being dendrochronology if suitable wood series are available (Bartholin 1983).

On the pile dwelling construction near the edge of the westernmost part (square T14) a megalithic sherd was found (Fig. 31 e). During the excavations in 1977-79 three small rim sherds (Ö = 2 g.) emanating from a little vessel with a brim were found likewise in the western part of the platform (Pers. communication H. Browall). How and when these megalithic sherds were included into the layers of the pile construction is a question still to be discussed and possibly answered. Another sherd of a brim-vessel (Fig. 31 b) was discovered at the excavations in 1911 outside the south-eastern part of

the platform near the foot-bridge (square G2). In the vicinity, in square E4 , a sherd of a neck and the transition neck to body of a funnel-beaker was found in the same excavation. In 1929 a third TRB-sherd (Fig.31 a) also that one of a funnel-beaker was discovered outside the platform or near its southern edge (square K5). These 3 sherds have probably been lost in the bog or simply discarded. Of course they may indicate some contact (exchange?) with people of TRB-groups.

Sites at the northern part of Lake Tåkern

Investigations of different, Neolithic sites around the northern part of Lake Tåkern were carried out by H. Browall in the early 80:s. Pottery from some of these sites has been recorded and investigated at the Laboratory for Ceramics Research, Lund. A total of 248 sherds (= 1305 g) from Svälinge, Herrestad parish, Lindön, Källstad parish, Sandby, Hov parish and Charlottenberg, Väversunda parish, were subjected to recording, thermal analysis and petrographic microscopy. Moreover 3 local, raw clays have been included in the investigation.

The sherds have been recorded with regard to the same parameters as in the case of the Alvastra ceramics. The thermal analysis has yielded information on firing conditions and qualitative ceramic characteristics.

Thin sections for petrographic microscopy were prepared from 8 sherds from Svälinge and 2 sherds from Lindön. Further on a number of sherd profiles were cut and polished for comparing studies by means of a stereo-microscope. Briefly the results were as follows.

At Svälinge, Lindön and Sandby the neolithic pottery was made out of a sorted, calciferous fine clay rich in iron oxides, but poor in mica. Between 20 and 25% crushed granite and/or limestone was used for tempering. The maximum grain size was 5 mm. The clay of this ware corresponds very well to the locally collected clays No 1 and 2. At Svälinge also a non-calciferous clay was used for the ceramics craft. In this case the clay was tempered solely with granite. The clay and the temper were poorly homogenised leaving concentrations of temper grains as spots in the ware, which means an increased risk of cracking during the drying and firing process. The mean value of sherd thickness is 10 mm and the N-technique was used for vessel building. These values are identical at all 3 sites. Decoration elements and patterns are also more or less the same. Lines of small pits were made by means of a coarse, polytoothed tool, as well as by means of a finer variant of "comb". Imprints of a bitoothed tool also occur. Furthermore there are cylindrical pits, diffuse shallow imprints and cord-stamped

impressions. Nail impressions were observed on the non-calciferous ware from Svälinge. Firing was carried out in an open fire at temperatures of approximately 600°C.

Within this otherwise quite homogeneous material one vessel from Svälinge stands out as in all probability being of foreign provenience. The vessel represented by sherd No 55 had been manufactured of a ferruginous, unsorted coarse clay, rich in mica and tempered with 14% crushed granite with maximum grain size of 3 mm. The homogenising of clay and temper had been carefully done, which is in sharp contrast to the other ceramics from the Tåkern area included in this investigation. The vessel decoration consisted of a row of conical (!) pits and vertical, long (1.5 cm) "chisel" imprints under the rim. The rim edge was decorated with short strokes. Analytical results are all in evidence of the vessel being an "import" to Svälinge.

There are very few similarities between the Tåkern ceramics and the pottery finds from Alvastra pile dwelling. In this latter material calciferous ware is only represented by a few sherds. The decoration of coarsely comb-stamped lines, the most frequent ornamentation at Svälinge, is not present among the Alvastra sherds.

Fagervik

Among the 17 test sherds from Fagervik ware of unsorted, coarse clays without added temper as well as ware made out of sorted fine clays tempered with crushed granite occur. Temper, with a maximum grain size varying from 2 to 4 mm, makes up about 13% of the ware. The vessels are without exception built by means of the N-technique. In one case clay, temper and ornamentation of sherds of a vessel from Alvastra (11/53) and sherds of a vessel among the Fagervik finds (2003) are almost identical. In both instances the raw material of the pottery consists in both instances of sorted, silty, fine clay free of calcium carbonate, but rich in iron oxides. The clay is micaceous and contains diatoms in abundance. Only 3 out of 20 test sherds from the Alvastra investigation material contain diatoms.

The clay is in all cases tempered with 20% crushed sandstone with a maximum grain size of 2 mm. The two sherds have the same decoration pattern, parallel, horizontal rows of angles (Fig.29 c). Otherwise the pottery ornamentation at Fagervik includes several of the patterns found on the N-pottery at Alvastra (Tab. VI). On the other hand, with the exception of bone imprints, none of the typical U-pottery decoration elements occur on the ceramics from Fagervik.

Åby

Thin sections of ten sherds from Åby were subjected to microscopic analyses. Seven of these sherds were made out of a sorted, fine clay tempered with about 15% coarse, granitic sand with a maximum grain size of 2-3 mm.

In three cases the raw material had been an unsorted, coarse clay without added temper. One sherd contained a calciferous and fossiliferous clay.

Both the fine and the coarse clays were rich in iron oxides and contained mica in various amounts. The decorations of the test sherds consist of horizontal rows of pits and vertical rows of nail imprints. U-technique for vessel building was not observed among the sherds from Åby.

Säter

The pottery from Säter also contained some sherds of which a calciferous, fine clay constitutes the raw material. The clay was sorted, silty and rich in iron oxides and mica. The same sort of clay, somewhat sandy and not containing calcium carbonate, was also used for vessel making. In both cases the temper consisted of 20% crushed granite with maximum grain size of 5 mm (the former vessel) and 2 mm (the latter one).

A third clay used for pottery manufacture at Säter was coarse, unsorted, silty and sandy. It was micaceous, free of calcium carbonates and rich in iron oxides. Temper other than the natural silt and sand was not needed nor added. The three vessels from Säter were built up by means of the N-technique. The pottery of calciferous ware was decorated with incised, vertical, parallel, zigzag lines.

Although there are many factors in common between the Åby and Säter ceramics and the investigated material at Alvastra, there is no evidence to suggest that they were made in the same original pottery.

Bollbacken (Hulthén in manus)

The ceramics at Bollbacken represent different periods and culture groups of the Middle Neolithic. "Typical" pitted ware pottery is represented mainly through the ornamentation with "fish bone" pattern and vertical, parallel zigzag lines, comb-stamped or incised. There are two ware groups with these decorations. They both have a sorted, silty, very fine clay, free of calcium, but rich in iron oxides as primary raw material. In the first case the clay was tempered with between 10 and 20% crushed granite. The maximum temper grain size is 3 mm.

In the other ware group burnt, crushed bone was used as temper material also 10 - 20%. The vessels were fired in an open fire at temperatures between 500 and 600°C. Only the N-technique has been observed as an vessel-building method.

The Bollbacken pottery has very few ware properties but some decoration patterns in common with the Alvastra ceramics.

Masmo

A sample of pottery sherds from the excavations of the Middle Neolithic site (RAÄ No 132. Åkerlund, 1996) at Masmo, Huddinge parish, Södermanland, was subjected to various laboratory analyses in the late 80:s.

34 thin sections were prepared and analysed by means of petrographic microscopy. 19 of these sherds contained a ware made out of sorted, fine clay, tempered with crushed granite. In a few cases the raw material was a coarse moraine clay without added temper.

A sorted, calciferous, fine clay tempered with crushed limestone and plant material had constituted the raw material of 10 poriferous test sherds. Today the ware contains a large amount of empty pores due to the dissolution of limestone. The clay contained diatoms typical of an Ancyllus lake (Håkansson & Hulthén 1988). Such clay was available in then near vicinity of the site. All the clays (calciferous and non-calciferous) were micaceous and rich in iron oxides. The N-technique was the only vessel-building technique observed. The pottery had been fired in an open fire at temperatures between 500 and 600°C.

There were distinct differences between the ornamentation technique and patterns from the two main pottery groups. Many of the vessels of non-calciferous ware were decorated with incised or impressed lines, or deep notches, in horizontal zigzag or in cross-ruled patterns and pits. The latter were never oblique and often conical. Ring-shaped impressions were frequent. Except for the rows of pits, which mostly were part of the decoration, the ornamentation of the calciferous pottery was made with poly-toothed tools. Comb-stamped, parallel lines - straight, zigzag or crossed - were the most common patterns, covering the whole surface of the vessel. It has not been possible to find any common denominator between the Masmo ceramics and the pottery finds from the Alvastra pile dwelling.

Ire (Hulthén 1997)

Ceramics, found at the excavations in the 70:s (O. Janzon 1974), were subjected to investigations at the Laboratory for Ceramic Research, Lund during 1979-80.

The investigated material from graves and pits consisted of 2344 sherds. After recording, statistical evaluation and sampling, thermal analysis, chemical analysis and petrographic microscopy were carried out. The results reflected, with few exceptions a very homogeneous pottery regarding raw material and vessel-building and firing techniques. The coarse, silty, more or less sandy, ferruginous clays, very rich in calcium carbonate caused (in conformity with all other Gotlandic clays) constituted the base for the craft. Crushed limestone and plant material were used as temper. In spite of the admixture of plant material, the high contents of calcium carbonate in the ware, in combination with firing in oxidising atmosphere (open fire), caused severe fragmentation of the pottery (mean weight = 0.6 g / sherd).

The most frequent ornamentation elements are the pits, always impressed perpendicular to the vessel surface and always cylindrical except for one sherd with conical pits. This vessel was made of a non-calciferous clay and consequently not of Gotlandic origin.

Patterns of comb-stamped or incised angular or crossed lines on the rim-part and on the shoulder of the vessels are common, as is the decoration of the rim edge. Imprints with textile structure also occur.

Many of the ornamentations found on the Ire pottery are also observed on the Alvastra sherds. Ring-shaped and bone imprints, chisel strokes, imprints made by means of a bi-toothed tool, "fish-bone", triangular pits and the "telephone-receiver"-shaped imprints (Fig. 28,29,31) are some examples. However, the ceramics ware from the Ire site has no true counterparts within the Alvastra material.

Humlekärrshult

The investigation material available from the Neolithic site Humlekärrshult consisted of 100 sherds of a stray find collection. As mentioned previously there are no thin sections available from these sherds. The pottery was recorded with regard to sherd thickness, shape, ornamentation and vessel-building technique. Among the test sherds there are both calciferous and non-calciferous ware. Only the N-technique has been observed.

The calciferous pottery was mostly decorated by means of coarse, comb-stamped patterns of zigzag and crossed lines together with pits. The pits are impressed perpendicular to the surface of the vessel wall. Most often the ornamentation covers the whole sherd surface.

The non-calciferous pottery has in a certain sense, another spectrum of ornamentation elements, many with correspondences in the Alvastra N-pottery material (Fig. 14c, 14b, 15f, 28b, 29a-e, 30a-d, 32b).

A close parallel to the vessel Fig.29a (rim ∅ = 34cm) is a vessel from Humlekärrshult with exactly the same ornamentation, but with a rim diameter of ≈30 cm. The non-calciferous ware has incised or impressed decoration but is never comb-stamped. Although the U-technique was not practised, many of the ornamentation elements typical for the Alvastra U-pottery are present on N-pottery sherds from Humlekärrshult (Tab.VI). Among others bow-shaped imprints, chip-impressed pits, bone imprints, Y-shaped and]-shaped imprints belong to the decorations of vessels from Humlekärrshult.

CONCLUSIONS

As a result of this investigation of the remaining fragments of the once so plentiful vessel collection at the Alvastra Pile Dwelling a very extensive collection of data has been generated and taken into scientific account. With the objective of tracing the ancient way of life this basically meant putting a lot of seemingly disparate information into its proper context. A truly interesting challange.

Basic facts:

1. U-pottery appeared earlier than the N-pottery, which among other things, has been confirmed by the 22 finds of pottery, levelled during the excavations of 1911, 1912, 1913 and 1929 (Tab.X; Tab.VII).
2. N-pottery represents a more advanced pottery craft than the U-pottery.
3. The raw materials used for both the U-pottery and most of the N-pottery were available within an area of 18 km^2.
4. The N-pottery consists of several ceramics groups distinguishable both technologically and typologically. U-pottery, in contrast, stands out as the more homogeneous group.
5. There is no evidence in the investigated ceramics material to indicate long distance contacts, exept for one sherd /vessel from Fagervik.
6. The ceramics found at the nearby megalithic tomb represent a different craft tradition, than do the different groups of pottery from the Pile Dwelling (Hulthén, in print).
7. Short periods of time maybe 10, 50 or even 100 years cannot be resolved by means of the dating techniques available today (dendrochronology is an exception under the provision of certain well defined conditions).

The "dynamic image" which has become visible through the investigation, displays a group of people – neolithic indeed – building with some common objective a wooden platform out in the bog. For what purpose is still any scientist's guess. Several more or less plausible hypotheses have been suggested to answer this exciting question but how would we test them (Göransson 1996)? One piece in this puzzle is the fact that the platform, most probably, was not built as a permanent homestead (Browall 1986:155ff). For some reason people visited the bog-station bringing with them meat, cereals, apples, nuts, wood for firing, tools and pottery vessels for cooking, storing water and other things. Browall has exhaustively discussed the surface structure of the platform and its possible functions. Browall has also divided it into "rooms" (ibid) (Fig.36).

The vessels first brought to the platform, most probably by its builders, clearly represent a beginners phase of a pottery craft. Studies of the vessel ornamentation of 22 ceramics finds levelled by Frödin during the excavations of 1911-13 and 1929, reveal a development from an initial phase to a more skilful state of the craft (Tab. X). The decorations, always under the rim, of the deepest finds from –137 to –63 cm consist of just one or two, often irregular, rows of rather simple, coarse, oblique imprints. From the level of –60 cm and upwards somewhat more composite and well-arranged patterns occur. Imprints are more carefully executed, often arranged in zigzag. From level –51cm two different elements, for instance drop- or "butterfly"-shaped imprints together with short strokes, are combined in the same pattern. Imprints also occur on the inside of the rim. The decorations become more and more skilfully performed as the potters grew more and more experienced. From level –39 cm the U/N and the N-techniques dominate. The marked difference of craft quality between the earliest and the latest deposited pottery is distinctly demonstrated in Table X.

There is no sharp decoration change signifying the transition from U- to N-vessels (U/N). Many of the ornamentation elements on the N-vessels are transferred from the U-vessel patterns but executed in a more advanced and elaborated fashion. This indicates an unbroken tradition line from the earlier to the later phase of the pottery craft at Alvastra.

What we are able to establish may be the starting point of a new activity within a group of people. The background of this could have been social oscillations and also changes caused by external influences. In several regions we have been able to observe the development of the ceramics craft from the Ertebölle over Early Neolithic to Middle Neolithic TRB pottery. Concerning the Pitted Ware ceramics we have mostly investigated vessels from a fully matured craft and never products showing traces of a beginner's phase.

How and from where did for instance groups of the Pitted Ware complex in isolated areas obtain knowledge of pottery production? It is not possible to trace a straight transfer of know-how from TRB to Pitted-Ware craft. There may well have been groups with a Neolithic economy but without the use of pottery. In these cases there must have been an initial phase of assumptions, learning and starting just the new craft. Most probably this is what the U-pottery at Alvastra represents. It is furthermore difficult to observe any connection between the advanced Megalithic pottery from the grave and the simple U-vessels at the platform. The former represents another conception of ornamentation patterns and elements. Probably, through contacts with other Pitted Ware groups, the Alvastra people got their

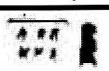
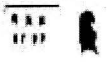
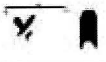
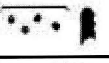
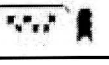
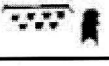
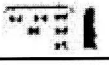
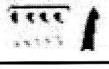
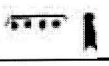
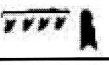
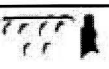
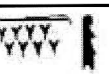
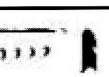
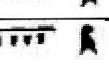
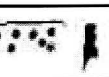
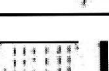
Ornamentation and rim profile	Tech-nique	Find. level	Squ-are	Description of ornamentation
	U-t	-137	N8	2 rows of irregular, oblique, coarse pits b-t-r.
	U-t	-129	H4	2 rows of irregular, oblique, coarse pits b-t-r.
	U-t	-120	D6	1 row of irregular, oblique pits b-t-r
	U-t	-120	E11	1 row of straight pits b-t-r and 1 irregular row of oblique pits on the neck.
	U-t	-101	K12	2 oblique imprints in angular position.
	U-t	-63	J7	Oblique imprints on the rim edge and in irregular rows b-t-r.
	U-t	-60	H1	2 rows of shallow imprints b-t-r.
	U-t	-57	D3	2 rows of oblique pits b-t-r. The upper row has bigger pits than has the lower one.
	U-t	-53	D4	2 rows of oblique pits arranged zigzag b-t-r.
	U-t	-51	H10	Butterfly-shaped imprints b-t-r. Strokes on the rim edge.
	U-t	-50	L12	1 row of drop-shaped pits b-t-r. 1 row of oblique strokes on the neck.
	U-t	-50	E2	1 row of straight pits b-t-r.
	U-t	-49	F1	1 row of well-made, oblique pits b-t-r.
	U-t	-48	E5	Oblique pits, carefully arranged in 2 regular rows b-t-r and on the neck.
	U-t	-46	F10	2 rows of bow-shaped imprints b-t-r and 1 do. row on the inner side of the rim.
	U-t	-43	M11	2 rows of well-made, arrow-shaped imprints in zigzag b-t-r.
	U-t	-42	F9	1 row of crescent-shaped imprints 2 cm b-t-r.
	U-t	-41	E9	1 row of well-made oblique pits b-t-r.
	U/N	-38	F11	Irregularly scattered, shallow bone imprints.
	N-t	-34 -39	F7 O13	Rows of chisel imprints arranged in vertical and horizontal rows.

Table X. Ceramics levelled during the excavations in 1911 through 1929.
b-t-r = bellow the rim

first impulses regarding how to use the plastic soil - the clay - and how to shape pots by means of coiling. It is possible to get a rough idea about these things by observing an exercising potter.

Achieving the all-important dexterity of the hands and fingers is an entirely different matter. This is something that has to be learnt by doing, i.e. through trial and error. Only repeated practising provide the potter with sufficient experience and insight into the possibilities and advantages of the new work. The time needed to obtain such skills very much depends on the trainee potter's natural talent and the time spent on experimenting.

A basic problem in connection with the coiling as vessel-building technique is the fixation between the coils. The most primitive and not very effective way is the H-technique used by the Ertebölle people in an early phase of pottery production (Hulthén 1977: Fig.8, 15). Better even, not to say perfect, is the U-technique practised in connection with the later and more developed Ertebölle vessels and also by the Alvastra potters. Applying this method the vessel wall will, by necessity, be rather thick and lead to comparatively heavy vessels (Fig.6). Thick vessel walls also render the firing more difficult. Gradually, when the fingers had become familiar with the raw material and the competence had increased, the potters were able to shape thin-walled vessels of more sophisticated shapes; firstly by means of a transition stage between the U- and the N-techniques (U/N) and thereafter through pure N-technique (Hulthén 1977). Concurrently with the increasing craft ability also the ornamentation of the vessels displayed a richer variation and a more advanced execution.

Such a step by step improvement of ability and methods is an expected development of a craft starting from scratch. Asuming that the megalithic potters had already deposited their products as grave goods and lost items and left the region (maybe returning to the other side of Lake Vättern) sherds and even vessels of these advanced ceramics must have been available in the area. The people connected to the Pile Dwelling would occasionally have found these items. Sherds must have been brought to the platform, probably considered to be of special significance. But the U-potters did not try to copy these specimens as they were far too advanced. Things most easily to copy would have been the ornamentation. At least some efforts to try to imitate some of the decoration elements of the megalithic sherds ought to have occurred. We have not, however, observed anything like this. The

very first U-pots have decoration details, which we may find on Pitted ware N-pottery, for instance, of the Humlekärrshult collection. Moreover, some of the U-vessel decoration elements are more or less unique (Fig.14 a-b, 15 a-b).

As already mentioned the ability to apply the N-technique for vessel building did not at the same time entail a new concept of ornamentation. Pottery of ware group 3, based on the same raw materials as the U-vessels, also display decorations typical to the U-vessel tradition (Fig. 30 f-h). On top of a more skilful execution of the ornamentation the thickness of the ware gradually became thinner and the vessel shapes become more sharply profiled. Fig. 35 demonstrates this stepwise developing craft and shows the distribution of the maximum sherd thickness of the rather coarse and simply decorated pottery of ware group 3. It varies between 9 and 13 mm. Products of a more advanced N-technique (ware group 2 with clay rich in diatoms), with vessel decoration of vertical, non-comb-stamped zigzag and crosses have a sherd thickness varying between 5 and 11 mm. Fig. 35 also shows the same parameters of ware group 5 of which the vessels have elaborated patterns of chisel imprints below the rim and a maximum sherd thickness interval between 5 and 8 mm. Ware group 2 and 5 clearly represent a matured pottery craft.

Vessels of ware group 4 based on a coarse moraine clay without added temper are also products of a developed pottery with a choice of raw material of its own. The sherd decorated with groups of chisel imprints has conical pits, which is the only example of its kind within the material. Another of these sherds also displays an in the Alvastra context unique ornamentation (Fig. 30 k), along with a thickness of only 4 mm.

These vessel productions could reflect different stages of development within the N-technique. They may at the same time represent different potters or groups of potters belonging to family groups within the area. Potters who had reached different stages of pottery craft ability.

To check if there are notable differences in any of the pottery finds within the applicable sections which in turn could indicate some kind of individualised spaces, the distribution of vessel sherds of four special types have been scrutinised.

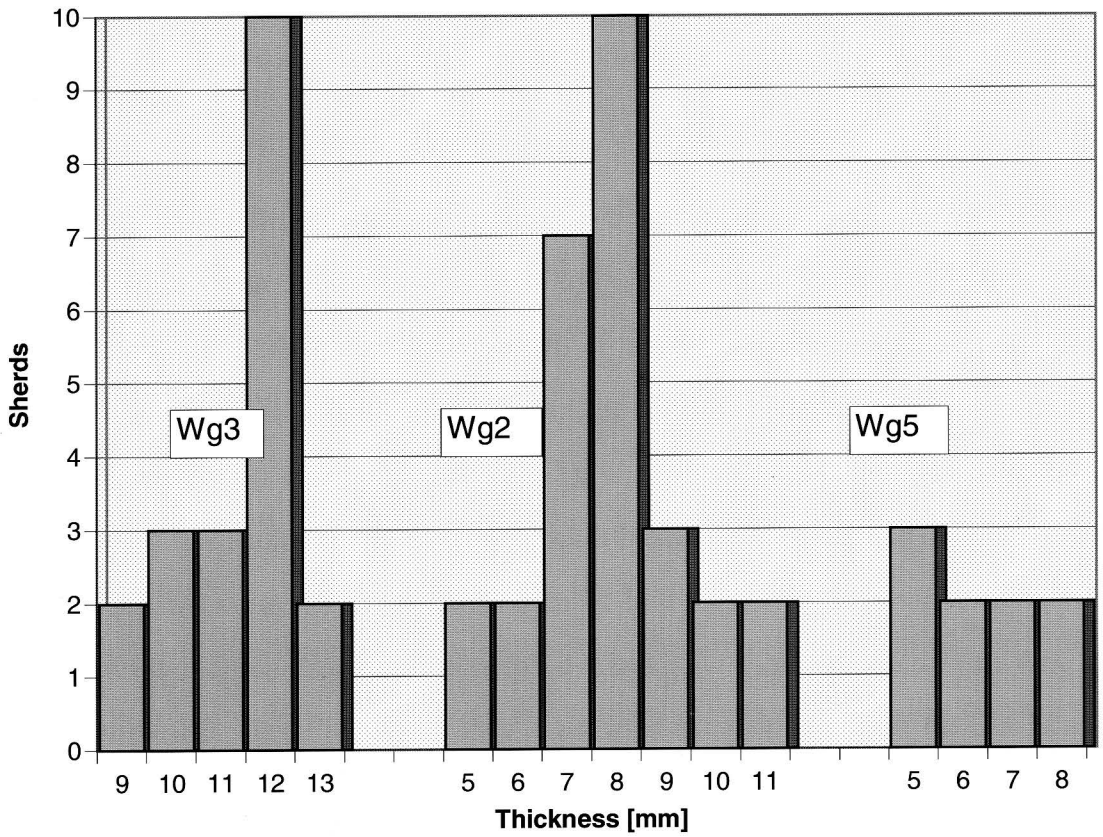


Fig.35. Distribution of sherd thickness of ware group 2 with decoration of parallel, vertical zigzag or of crosses and crossed lines, of ware group 3 and of ware group 5

Fig. 36 illustrates the distribution of vessels of ware group 2, some decorated with vertical zigzag and others decorated with horizontal rows of crosses. Further ware group 3 in fig 36 is decorated with pits whereas vessels of ware group 5 are decorated with horizontal dense rows of chisel imprints. A vessel is represented by one or more sherds depending on whether shape or decoration pattern or ornamentation application render the sherd/sherds a unique appearance. In order to facilitate the orientation among the sections of the platform the sections have been numbered from 1 to 17. Evidently ware group 3 and the zigzag-decorated sherds of ware group 2 occur either alone or together in the same section. Also the cross- and the chisel imprints-decorated sherds occur

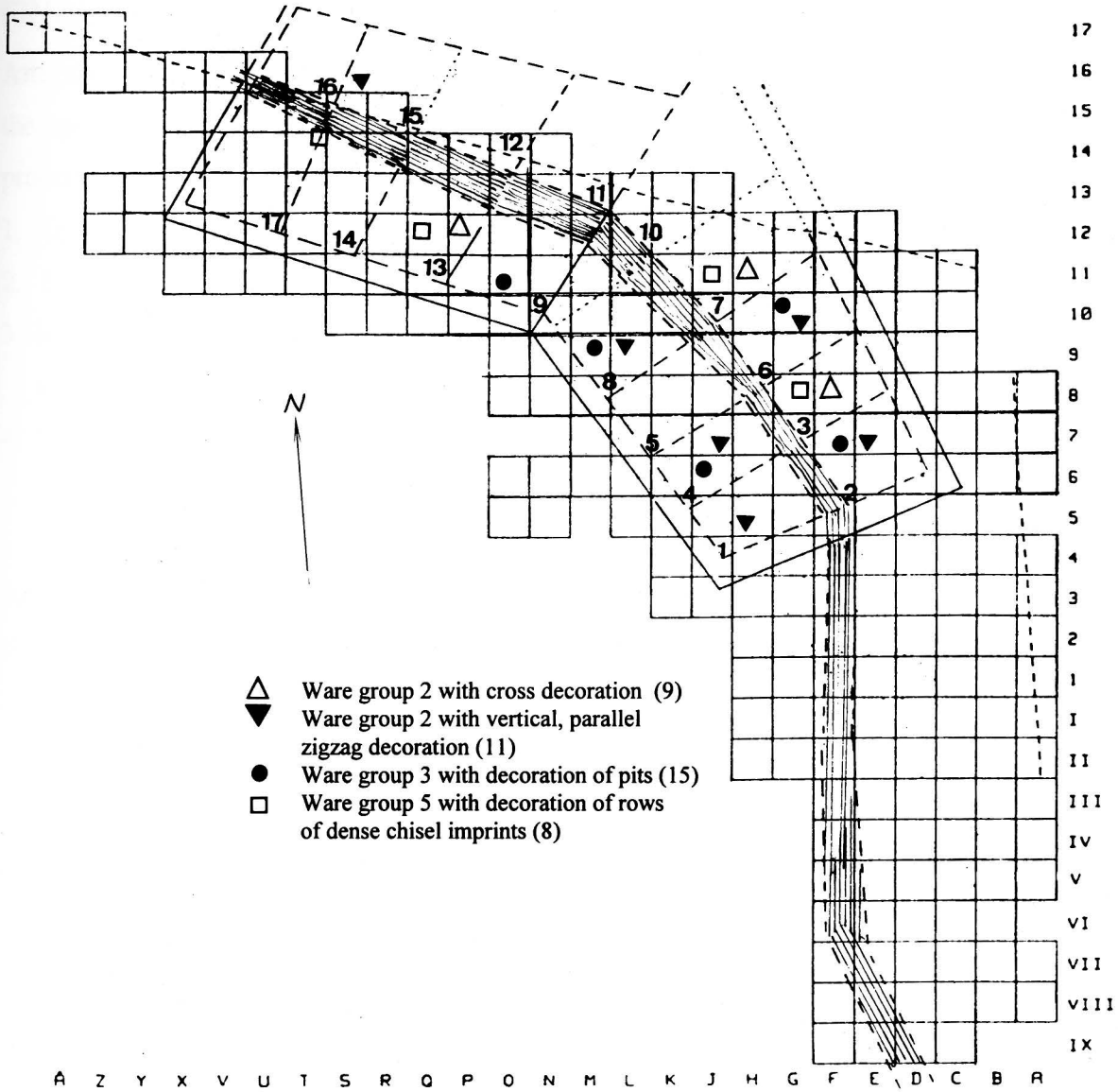


Fig.36. Distribution of 4 special vessel types over the 17 sections of the platform. (C.f. Browall 1986:Fig.43) Figures in brackets indicate the estimated original number of vessels.

together in two sections (3 and 13). The cross- and zigzag-decorated vessels, however, do not occur in the same section.

This may indicate that groups of related individuals occupied small separated domains of their own on the platform. This picture is in accordance with the hypothesis suggested by Browall, implying a division of the pile dwelling platform into different sections (Fig.36), (Browall 1986. Fig. 29).

Section No.	Number of vessels				Σ
	Wg.2 & zigzag dec.	Wg.3 & pit dec.	Wg.2 & cross dec.	Wg.5 & chissel imp. dec	
1	2				2
2	3	2			5
3			1	1	2
4		4			4
6	3	6			9
7			5		5
8	2	2			4
9		1		1	2
13-14			4	7	11
15	1				1
Σ	11	15	10	9	N=45

Tab. XI. Simultaneous appearance of certain vessel types within applicable sections of the bog platform.
Wg.=Ware group, dec.=decoration, zz=zigzag, imp.=imprints.

Figure 36 demonstrates still another example of the ability of pottery to "revive" long forgotten conditions. Another evidence of the conception of pottery as

Fossilized Footprints of Ancient Activities.

FINAL REMARKS

After the Frödin excavations ended in 1930 more than 50 years elapsed before the author undertook the task of revitalising this rich and important legacy in the context of Scandinavian archaeology. The process of revitalising consisted of the following, consecutive steps.

1. Opening up the "sealed boxes" which means systematic recording and documentation.
2. Scrutinising the recorded contents involving laboratory investigations and analyses.
3. Interpretations and deductions with the objective of putting the material into the all important social context.
4. Passing on the results to the archaeological community.

It is, of course, a very time-consuming procedure to sort, measure and describe each separate unit of such a huge collection of pottery. However, this painstaking work does pay off to the investigator in the form of an extremely good outlook on the material and also a profound insight into all its details.

The author is proud to mention that apart from much appreciated limited grants from HSFR no funds have been allocated for this extensive ceramological research project, which has been carried out on a spare-time basis.

The author would like to highlight the following topics covered by this report since they add new and intriguing questions and results to the ongoing scientific discussion.

- A novice stage of ceramics production on display in a Pitted -Ware context.
- An observable, continuous improvement of the craft within the time span of a few decades.
- Ceramic properties which reveal exceptionally well the existing or non-existing transactions between the pile-dwelling and other important sites in eastern Sweden.
- A modern and partly new set of explanations to the puzzling problem concerning the "seemingly paradoxical" disproportionate ratio between the number of original vessels represented through characteristic sherds and the limited, total pottery find material constituting only a small fraction of the original ceramics mass. Further, why are complete vessels in most cases only found in graves?

Apropos of the Frödin excavations many high quality artefact collections remain sadly dormant and have lied for decades in closed boxes in our museum storerooms. The author is not the only one to

advocate a changed attitude to these materials. In an initial stage of an extended excavation it is without doubt very important to be in a position to form an expert opinion about the pattern of what might be expected during the implementation of the excavation face (Browall 1986:18). Yet another indisputable advantage is that this knowledge-base forms an important tool during the subsequent artefact studies.

REFERENCES

Andersen, S.H. 1975 Ringkloster, en jysk inlandsboplads med Ertebøllekultur. Kuml 1973-74:11-108.

Arwidsson, G. 1972 Broderier på skinn från stenåldersboplatsen Ire i Hangvar sn, Gotland. Tor 1972-73.

Bagge, A. - Kaelas, L. 1950 Die Funde aus Dolmen und Ganggräbern in Schonen, Schweden. I, II. Stockholm.

Bagge, A. - Kjellmark, K. 1939 Stenåldersboplatserna vid Siretorp i Blekinge. Kungl. Vitterhets Historie och Antikvitets Akademien.

Bartholin, T. 1983 Traeet i Alvastra. SKALK Nr 4. Höjbjerg.

Browall, H. 1986 Alvastra pålbyggnad. Social och ekonomisk bas. Theses and Papers in North-European Archaeology Stockholm.

Demirel, T. & Davidson. D. 1962 Reaction of phosphoric acid with clay minerals.National Acad. Sci.: Nat. Res. Council Publication No 964.

Frödin, O. 1910 En svensk pålbyggnad från stenåldern. Fornvännen 5. Stockholm.

Gallay, A. 1970 La Poterie En Pays Sarakolé (Mali, Afrique Occidental). Journal de la Société des Africanistes. Fascicule 1. Paris.

Göransson, H. 1996 Lövtäkt och stubbskottsbruk. Kungl. Skogs- och Lantbruksakademien. Ed. H. Slotte, H. Göransson.

Henshall, A. S. 1963 The Chambered Tombs of Scottland. Edinburgh.

Holmström, M. & Tollin, C. 1994 Det medeltida Alvastra. Svenska Kulturminnen. Riksantikvarieämbetet. Stockholm

Hulthén, B. 1974 On Documentation of Pottery. Acta Archaeologica Lundensia, Series in 8° Minore, No 3.

1977 On Ceramic Technology during the Scanian Neolithic and Bronze Age. Theses and Papers in North-European Archaeology 6. Stockholm

1993 Keramik. Nationalencyklopedin, p.592, 593.

1995 Ceramic Artefacts - A Key to Ancient Society. The Ceramics Heritage. Proceedings of the 8th CIMTEC-World Ceramics Congress. Florens 1994 ,Vincenzini, P. (Ed.).

1997 Stenålderskeramiken från Ire, Hangvar parish, Gotland. Till Gunborg. Arkeologiska samtal. Stockholm Archaeological Reports Nr 33.

Janzon, O. G. 1974 Gotlands mellanneolitiska gravar. Studies in North-European Archaeology 6. Stockholm.

1984 A Megalithic grave at Alvastra in Östergötland, Sweden. In: Burenhult 1984. The Archaeology of Carrowmore. Theses and Papers in North-European Archaeology 14. Stockholm.

Lindahl, A. 1994 Studies of African pottery for understanding of prehistoric craft. The Ceramics Cultural Heritage. Proceedings of the International Symposium "The Ceramics Heritage" of the 8th CIMTEC-World Ceramics Congress and Forum on New Materials, Florens, Italy. Ed. P. Vincenzini.

Lindahl, A. (cont.)

1995 Present and Past; Ceramics and Homesteads. An Ethno-archaeological Project in the Buhera district, Zimbabwe. Studies in African Archaeology 11. Uppsala.

Low, P. F. & Black, C. A. 1948 Phosphate-induced decomposition of kaolinite. Soil Science Society of America Proceed. 12.

Malmer, P. M. 1977 Alvastra pålbyggnad. Kungl. Vitterhets, Historie och Antikvitets Akademien Årsbok 1977. Stockholm.

1983 Alvastra pælebyggning. SKALK Nr 4. Höjbjerg.

Åkerlund, A. 1997 Interpretation of expected and unexpected results from multi-method analyses of a PWC pottery context. ISKOS 11. Helsinki.

Monografier (ISSN 1101-9301)

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