Journal of Danish Archaeology vol. 9, 1990, pp 103–113

A Late Neolithic Hoard from Vigerslev, North Sealand

– An Archaeological and Metal Analytical Classification

by HELLE VANDKILDE

In 1975 a metal-hilted dagger and a flanged axe of copper or bronze were found during construction work in a garden, situated c. 100 ms east of Harrestrup brook and c. 760 ms to the south of the Damhus lake in Vigerslev in the Parish of Copenhagen (sb 68), District of Sokkelund, County of Copenhagen (1). For the find circumstances we have to rely largely on a report made by the finder a year after the discovery: The dagger and the axe lay close together, "within two spits", in sand c. 2 ms below the present surface; however, some 0.7 m fill have been added in recent times. During the construction work the finder noted two layers of sand separated by a peat-like layer, but he did not observe whether the objects were connected with the upper or lower layer of sand. An area of approximately 5 × 3.5 m was searched, but other objects did not appear.

The find circumstances indicate that the dagger and the axe make up a hoard or part of a hoard. In the corroded surface of the metal there are impressions of plants, which have been examined by Claus Malmros of the Scientific Department of the National Museum: The remains are identified as plant roots, possibly rhizomes and leaves, perhaps from grasses. The presence of leaves together with roots can be explained by the fact that the growth of grass leaves may start below the soil surface. The phenomenon is interpreted by Malmros as herbs, that grew on the site where the objects were deposited, rather than material wrapped around the objects. The remains of leaves are too few to justify the latter explanation. Moreover, the nature of the plant remains indicates that the metal objects derive from a moist layer of peat, mud or perhaps sand, that has been penetrated by moor plants. Such an environment is found at the shores of lakes and streams that are in the process of being overgrown, and Malmros points out that it is in good agreement with the immediate topography of the site and with the stratigraphical observations of the finder.

In conclusion, the objects were presumably deposited in wet terrain as a ritual action or part of such action. In that respect the Vigerslev hoard joins the majority of contemporary metal find.

DESCRIPTION AND CLASSIFICATION

The metal-hilted dagger (fig. 1)
The thick corrosion layer with plant remains covers most of the surface, but was partially removed on one side of the hafting-plate, so that the decoration and the casting technique could be studied. The blade point is missing, and the fracture is covered by corrosion. It is thus likely that the point was already missing, when the dagger was hoarded. The preserved length is 20.9 cms; the original length was around 28–29 cms.

The pommel has an approximately circular outline, and it is flat with a slight concavity on top. The transition to the hilt itself is convex and not quite regular. The latter, which has an irregularly oval transverse section, narrows towards the hafting-plate, the shoulders of which are distinctly and evenly rounded. The indentation is mushroom-shaped and closed towards the blade. The terminations of the hafting-plate are oblique with an upwards tilt. The edges of the triangular blade are much damaged, but preserved parts show that the edge outline was slightly concave.

The hilt itself is divided into undecorated and decorated zones. Each decorated zone consists of three, somewhat irregular, horizontal grooves, except the lowest zone, which has four grooves. The distance between the grooves is not quite regular. The lower edge of the hafting-plate is decorated with closely, not very carefully set, shallow strokes. A row of originally around sixteen, small "false" rivets decorates the shoulder. The rib of the blade is tripartite, divided by a relatively broad, straight central rib, flanked by narrower, slightly curved ribs. There are no traces of wear. The decoration appears distinct, and

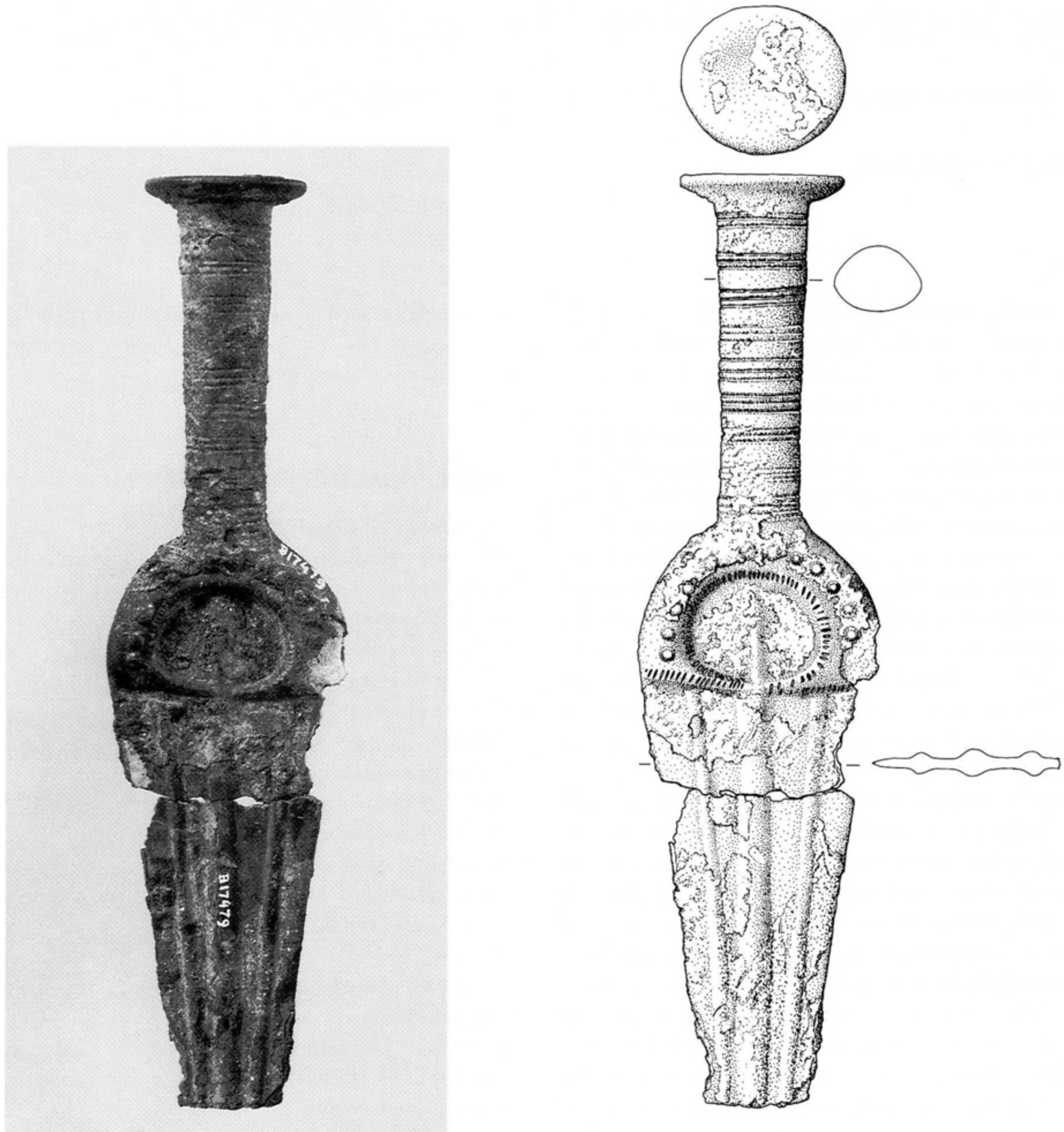

Fig. 1. The Vigerslev metal-hilted dagger, scale 2:3 (P.Delholm photo, E.Morville del.).

preserved parts of the cutting edge are sharp. The weight is 258 grammes.

The Vigerslev dagger belongs typologically to the metal-hilted daggers with triangular blade of the central European Early Bronze Age. Such daggers are normally produced according to one of three methods: 1. Cast in one piece during a single process. 2. Cast in two pieces, joined with rivets. 3. Cast apparently in one piece, but during two phases, *Überfangsguss*. Casting a metal-hilted dagger in one piece during a single process gives a strong product. Technically, however, it must be difficult to deal with such heterogeneous elements as blade and hilt in one process, and this may thus result in variability in regard to the quality of the products. Casting the blade and hilt separately makes the casting easier and more efficient. It gives the opportunity to insert a clay core in the hilt, thus saving metal, but the joint constitutes the weak point of such a dagger. The method of *Überfangsguss* has the advantages of both these methods. Although *Überfangsguss* is known in the late part of the EBA, for instance in the casting of metal-hafted halberds, few of the metal-hilted daggers with triangular blade seem to have been made by this technique (Drescher 1958, 30). They are usually either cast in one piece, or in two pieces, that are joined by rivets.

In the Vigerslev case the second method can be ruled out. All rivets are false, and the transition between hilt and blade is smooth. Several elements suggest the first method. In the indentation the central rib is distinctly narrower than on the blade, and an X-ray photograph (fig. 2) demonstrates that inside the indentation the blade is considerably thinner than outside, which would not be the case if the dagger had been cast by the second or the third technique. This can only be explained by supposing that the dagger was cast during a single process in one piece. The X-ray photo also shows, that the hilt is solid, which is unlikely if blade and hilt had been cast separately or by *Überfangsguss*.

Uenze (1938) has divided metal-hilted daggers with triangular blade into seven types, that have different geographical centres of gravity and also somewhat different chronological positions, as the Úněticean daggers belong to Br.A1b, whereas the southern daggers tend to cover also Br.A2. The Vigerslev dagger does not fit particularly well into any of these types, although it has features in common with all of them (table 1).

The table shows that the Vigerslev dagger has more elements in common with type Aunjetitz than with any of the other types, but there are also important differences. None of the metal-hilted daggers of type Aunjetitz have a tripartite midrib. Tripartite and bipartite midribs are more frequent on Úněticean halberd blades (Otto & Witter 1952, Z729, AZ811, Z919; Ke 367). The daggers of type Aunjetitz are, moreover, usually cast in two or three separate pieces that are joined with rivets (Uenze 1938, 31ff). Type Aunjetitz is most frequent in the central areas of the Únětice culture, in north Bohemia and central Germany, and occurs more sporadically north of this region, as imports (Schubart 1972, Taf. 60N and 101.1) or local copies (Gedl 1980, Taf. 1). A few daggers of type

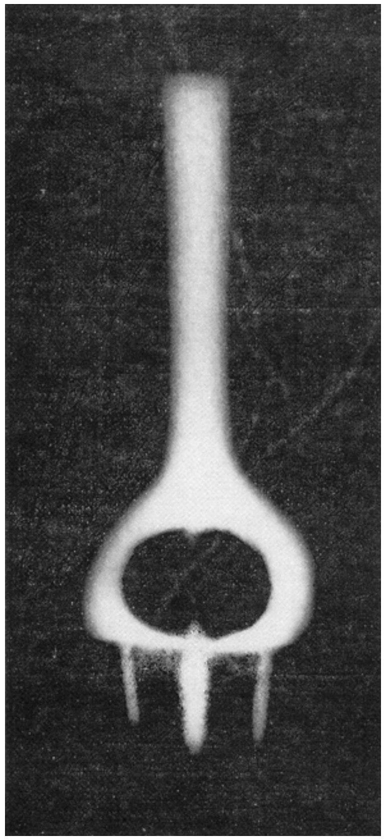

Fig. 2. X-ray photo of the dagger 2:3 (H.Strehle photo).

Aunjetitz found in northern Poland and Mecklenburg are actually cast in one piece during a single process (Gedl 1980, Taf. 1.3–1.6) or by *Überfangsguss* (Schubart 1972, 125, Taf. 101.1).

The Vigerslev dagger was most likely manufactured in the Baltic periphery of the Únětice culture as a local imitation of the metal-hilted dagger of type Aunjetitz. This is in harmony with the casting technique, inasmuch as the simple, one-piece casting is very often used in the manufacture of daggers in this region. It is also in accordance with the mixture of elements present in this dagger. In the Baltic region peculiar daggers that cannot easily be classified into Uenze's typology are sometimes encountered (Schubart 1972, Taf. 1D, 50I, 90A; Kersten 1958, Taf. 84: 767, Taf. 99: 879; Gedl 1980, Taf. 5: 28–29). As an example of such syncretistic specimens may be mentioned the dagger from Alt-Schönau, Kr. Waren in Mecklenburg (fig. 3). Its tripartite midrib and its zones of grooves and strokes on the hilt makes it a close parallel to the Vigerslev dagger.

ELEMENTS OF THE VIGERSLEV DAGGER	DAGGER TYPES: Rhône	Italian	Swiss	Aunjetitz	Oder-Elbe	Malchin	Saxon
1. flat pommel	X	X		X	X		
2. hilt widest towards pommel				X	(X)	X	X
3. distinctly rounded shoulders	X	X	X	X		X	X
4. many, small rivets (false?)		X			X		
5. mushrum-shaped indentation	X	(X)	(X)	X		X	
6. closed indentation				(X)		(X)	
7. oblique hilt terminations	(X)	(X)		(X)			(X)
8. broad, slightly curved blade		X	X	X	X		
9. tripartite midrib on blade		(X)					
10. zones of grooves on the hilt	(X)			X	(X)	(X)	(X)
11. strokes on hafting-plate				X	(X)	(X)	(X)
12. cast in one piece				OO	X	X	
13. high tin bronze (class 6)	X	X	X	(X)			
total number of elements min.	4	5	3	7	4	4	2
max.	6	8	4	11	7	7	5

Table 1. Comparison of the Vigerslev dagger to Uenze's dagger types. X = commonly occurring. (X) = occasionally present. OO = seems to occur sometimes, although not mentioned by Uenze (1938).

TIN CLASS	1	2	3	4	5	6	Total
ÚNĚTICEAN REGION:							
1. Baltic	9	8	8	2	2		29
2. Berlin-Brandenburg	3		6		1		10
3. Spree-Neisse			25	3			28
4. Riesa-Dresden-Bautzen		1				1	2
5. Unstrutt-Saale		2		2			4
6. North Bohemia	3	5	2	3	2	1	16
total number of analyses	15	16	41	11	5	2	89

Table 2. Geographical comparison of tin content in Únêticean metal-hilted daggers. Tin class 1: tin free copper; class 2: tin present as an impurity, trace-0.126%; class 3: tin copper, 0.127–2.0%; class 4: low tin bronze, 2.01–4.0%; class 5: medium tin bronze, 4.01–7.95%; class 6: high tin bronze, 7.96–>10%. (Data from Junghans *et al.* 1968–74, SAM 2:3 and 2:4; Otto & Witter 1952).

Whereas Úněticean halberds, irrespective of the various local styles, are very often manufactured in high tin bronze, the high tin percent of the Vigerslev dagger, 15–16% (class 6), is rarely found among Úněticean metal-hilted daggers. In a sample of 89 analyses of metal-hilted daggers only two analyses exhibited such high tin percentages, and they come from central Germany and north Bohemia (table 2). Such an origin for the dagger can, however, probably be ruled out with reference to the archaeological evidence.

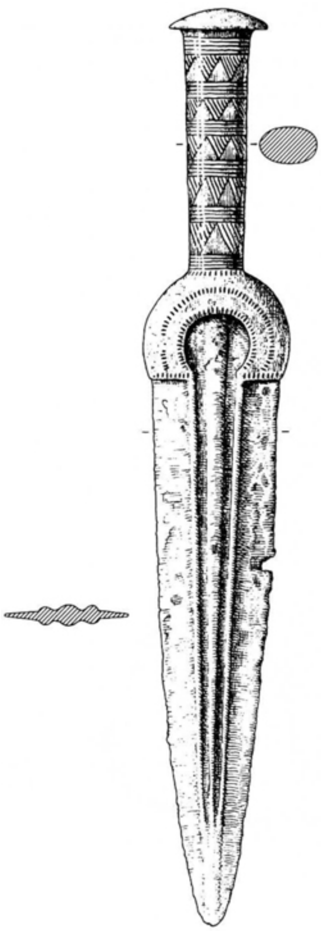

Fig. 3. Metal-hilted dagger from Alt-Schönau, Kr. Waren in Mecklenburg, scale 2:3 (Schubart 1972, Taf. 1D). The dagger has no tin (SAM 2:3, no. 9630).

The Vigerslev dagger is the sixth metal-hilted dagger with triangular blade found in Scandinavia. The daggers from Emb, Brøndum, Säter, and Pile (two specimens) have been treated by Lomborg (1969, 219ff). Apart from the very simple and atypical Emb dagger, which is considered to be local, these daggers belong to Uenze's Saxon type (Brøndum and Pile) and to his Malchin type (Säter). Metal-hilted daggers of Saxon and Malchin type were manufactured in the Baltic region of Mecklenburg and Pomerania (Lomborg 1969, 222; Uenze 1938, 60f, 85, Karte 13; Gedl 1980, 15, 21ff, Taf. 23). Hence, in regard to the place of manufacture the Vigerslev dagger joins the other Úněticean metal-hilted daggers found in south Scandinavia.

The flanged axe (fig. 4)

A thick layer of corrosion covers most of the surface of the axe. Because of the plant remains a removal of the corrosion was not attempted during conservation. The original surface is dark green and slightly uneven. In places near the edge the shining pink colour of the copper is visible.

The axe is 15.5 cms long and seen from the face the sides are parallel from the butt as far as almost midway, whereupon they begin to flare quite widely and concavely towards the cutting edge. Thus, the basic shape of the axe is parallelsided-curved.

The butt-end is 2.9 cms wide and convexly curved. The edge is 6.9 cms wide and quite expanding with a depth of 1.7 cms. The flanges are rounded, and their height does not exceed 0.2 cm; the axe can thus be classified as low-flanged. On the better preserved of the faces (fig. 4: drawing) there is no transverse bevel. The narrow sides are decorated with two longitudinal facets forming a pointed oval, that matches the contour of the profile itself. Decoration is only visible on one face where several, indistinct facets are placed with regular intervals on the lower half of the axe, parallel to the cutting edge. There is also a faint edge bevel. The weight is 431 grammes.

The cutting edge is sharp and does not seem damaged or much resharpened. The faintness of the ornamental facets on the face may suggest wear; on the other hand, the facets of the narrow sides appear rather distinct.

The Vigerslev axe belongs to type Værslev, a group of c. 30 low-flanged, parallelsided-curved axes with Pile style of decoration, named after a hoard in northwest Sealand (Vandkilde 1989, 32, fig. 5; 1990b, 182f, Abb. 5). Type Værslev makes up the essence of Forssander's "Pile Axe" (1936, 169ff). Flanged axes of type Værslev are particularly frequent in east Jutland and northwest Sealand; the type is also found in southern Sweden. The Vigerslev axe has a broader butt in relation to the width than most of the Værslev axes, and it belongs to the variant with hammered facets instead of lines parallel to the cutting edge.

CHRONOLOGY

On the basis of a seriation of 35 hoards of early metal objects a late phase of the Late Neolithic Period (LN II) and two phases of the first period of the Bronze Age (Period IA and Period IB) were distinguished (Vandkilde

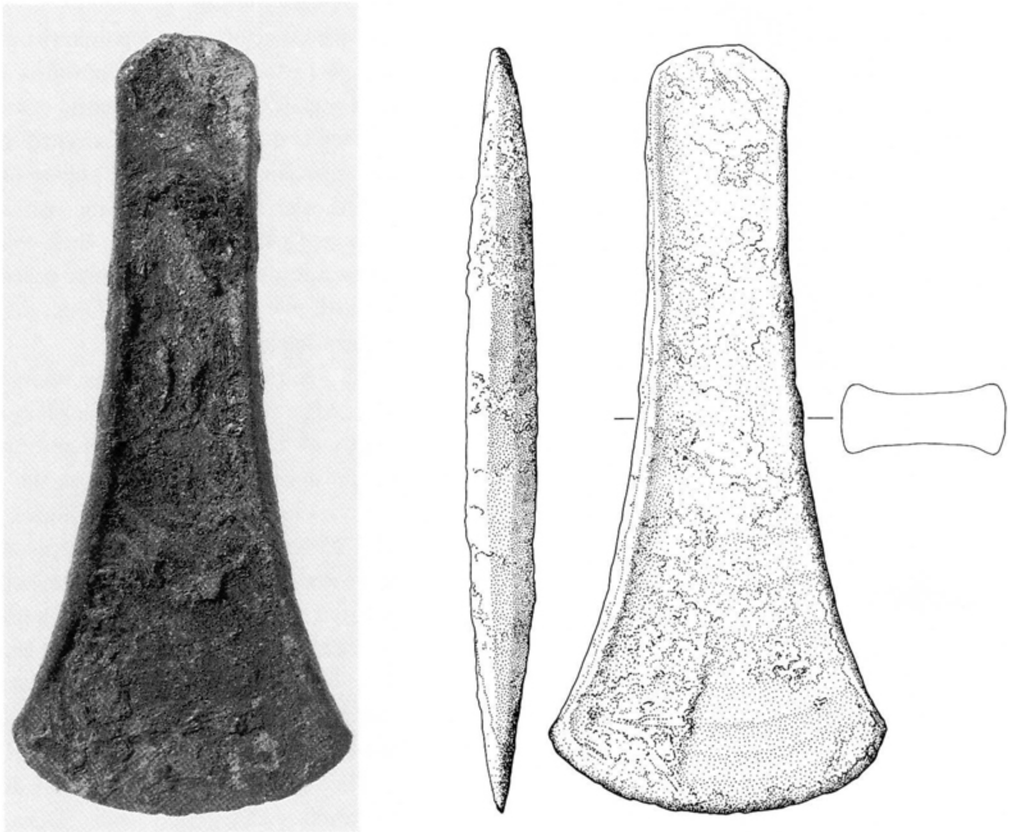

Fig. 4. The Vigerslev low-flanged axe, scale 2:3 (P.Delholm photo, E.Morville del.).

1989, 29f, figs. 2–3; 1990a, 128ff, figs. 13–14; 1990b, 177ff, Abb. 2–3). The Vigerslev hoard is clearly attached to the LN II hoards.

Axes of type Værslev occur mainly as singly deposited pieces, but the type is also known from six hoards: Gallemose (Ke. 5492), Egå (Ke. 5554), Vrold Østergård (Ke. 4554I), Værslev (Ke. 1017), and the Scanian hoards of Pile (Ol. 832) and Balkråka (Ol. 15). All six hoards date to the LN II Period.

Of the five metal-hilted daggers with triangular blade previously found in Scandinavia two have been found in a hoard, Pile, and this hoard is safely dated to the LN II Period. In the Úněticean region metal-hilted daggers with triangular blade are found in hoards of the classical phase, and this period has elsewhere been shown to be synchronous with the LN II Period (Lomborg 1973, 142; Vandkilde 1989, fig. 1; 1990b, 176ff, Abb. 1). Thus, the Vigerslev dagger emphasizes this synchronism.

By far the majority of the LN II metal objects are singly hoarded objects. Less frequent are hoards, containing two or more flanged axes. A small number of hoards, Gallemose, Pile, and Skeldal, contain several different types and characteristically combine locally manufactured flanged axes with foreign imports, just like the Vigerslev hoard. Metal objects in burials are infrequent. A specific pattern for ritual depositions of metal objects thus exists, reflecting aspects of ideology and social organization.

In regard to geographical position the Vigerslev hoard is situated periphercally to the distributional centre of gravity of the Danish LN II metal finds in east Jutland, north Funen and northwest Sealand (Vandkilde 1989, 40, fig. 17; 1990a, fig. 15; 1990b, 192ff).

METAL ANALYSIS

Metal analysis was carried out on the Vigerslev objects as part of an analysis programme, that also included the Skeldal hoard (Vandkilde, this volume). To facilitate comparison with the SAM programme (Junghans *et al.*

1960, 1968, 1974) the objects were analysed quantitatively for the same eleven elements, other than copper (Cu): tin (Sn), arsenic (As), lead (Pb), antimony (Sb), silver (Ag), nickel (Ni), bismuth (Bi), cobalt (Co), gold (Au), zinc (Zn), and iron (Fe).

The analyses were made by two laboratories, and three different methods were used: The Department of Metallurgy and Science of Materials, University of Oxford, used electron probe microanalysis (EPM), and *Risø National Laboratory* used energy dispersive X-ray fluorescence (EDXRF) and induction-coupled plasma-mass spectroscopy (ICP-MS). A sample from the axe was analysed twice by EDXRF and once by EPM and once by ICP-MS. A sample from the blade of the dagger was analysed twice by EDXRF and once by ICP-MS; a sample from the pommel was analysed once by EPM, a total of eight raw analyses (Appendix). This gives a rare opportunity to compare and evaluate different metal analytical

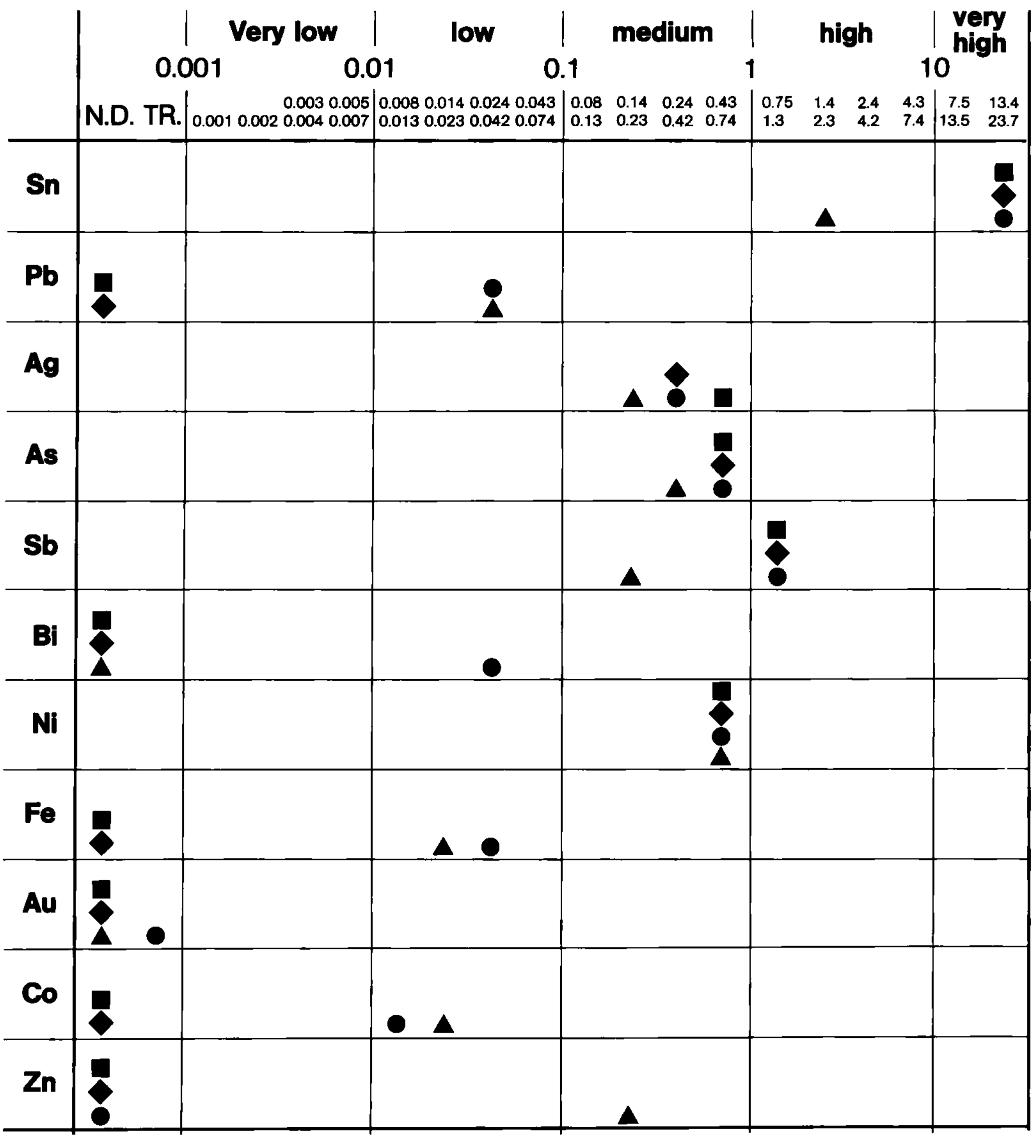

Fig. 5. Waterbolk-Butler diagram presenting the four metal analyses of the Vigerslev dagger by different methods and laboratories. Symbols: ICP-MS = triangle, EPM = circle, EDXRF 1 = rhomb, EDXRF 2 = quadrangle. (J.Kirkeby del.).

methods (2). A brief survey of the comparability and an archaeological evaluation of the analyses are presented below.

The analyses were entered into Waterbolk-Butler worksheet graphs (Waterbolk & Butler 1965) (figs. 5–6). In regard to the most important grouping indicators Ag, As, Sb, and Ni (3) there is a general agreement between the results of the three methods. In regard to Bi, which is also fairly important, there is only a little variability within the lowest ranges. The values of Pb, Fe, Co, and to some degree Zn show dissimilarities, which may be serious, if included in a statistical description. In regard to Pb, Fe, and Co the results of the ICP-MS method are in accordance with the EPM method, whereas they are undetected by the EDXRF method. The Sn values are fairly similar, apart from the ICP-MS analysis of the dagger, which misjudges the tin content completely.

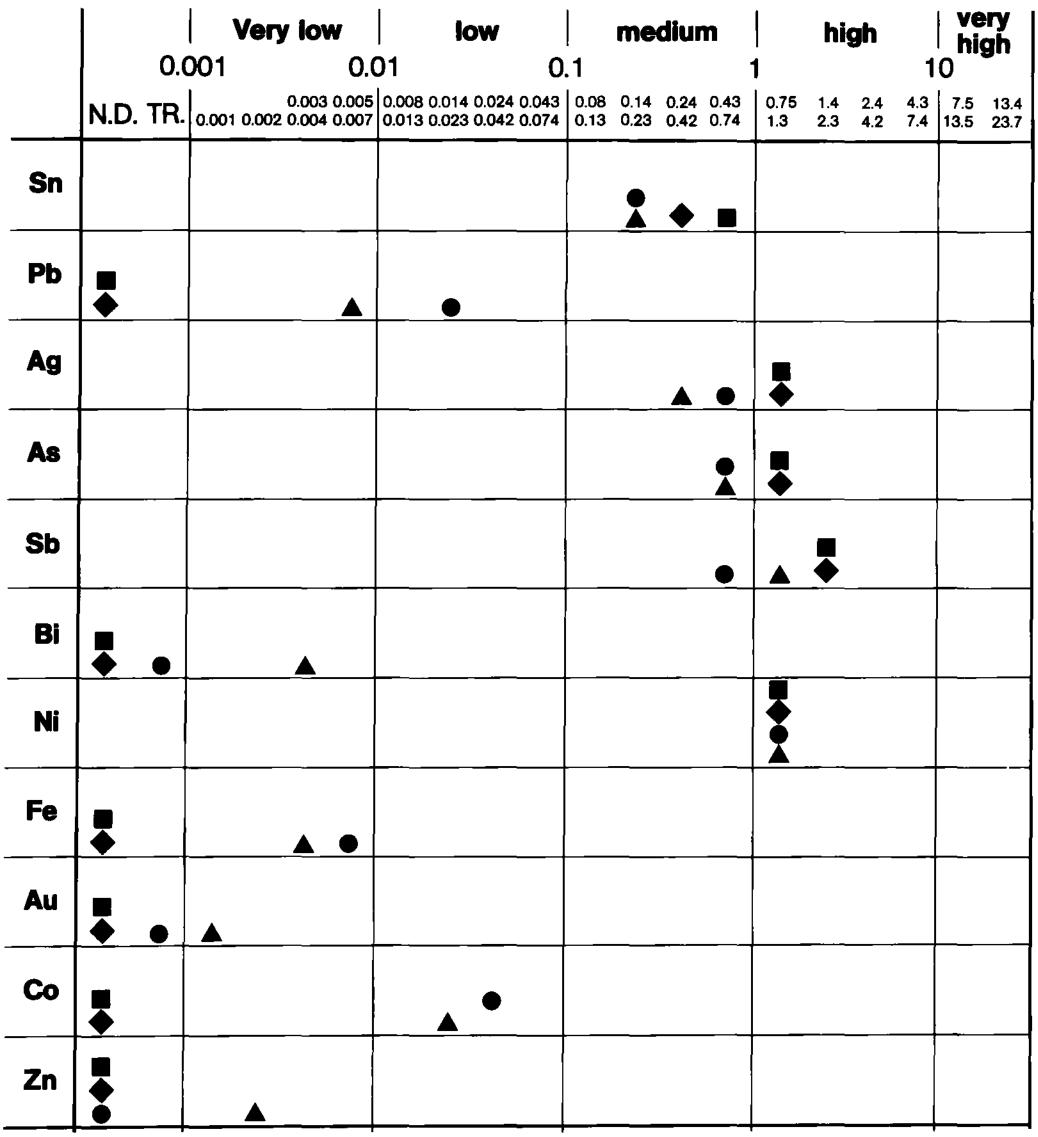

Fig. 6. Waterbolk-Butler diagram presenting the four metal analyses of the Vigerslev axe by different methods and laboratories. Symbols: ICP-MS = triangle, EPM = circle, EDXRF 1 = rhomb, EDXRF 2 = quadrangle. (J.Kirkeby del.).

In conclusion, the results from the three methods show an acceptable agreement in regard to the major impurities of copper. The ICP-MS method has difficulties in measuring larger quantities of tin. Taken the importance of tin as alloying material, such inaccuracy is of course serious. There is good agreement between the two EDXRF analyses; this method, however, appeared to be unable to detect elements occurring in small quantities, which is usually the case with Pb, Bi, Fe, Au, Co, and Zn. This leaves the EPM method as the most accurate of the three methods.

A classification of the eight raw metal analyses into the SAM *Materialgruppen* (fig. 7), based on variability in the content of Ag, As, Sb, Ni, and Bi (cf. Junghans *et al.* 1968, SAM 2,2: Tabelle 1), confirms the homogeneous distribution of these major elements. The results of all three methods refer the dagger to *Materialgruppe* B2 and the axe to *Materialgruppe* A. *Materialgruppe* A and B2 are both high impurity coppers with Ag, As, Sb, and Ni as the principal impurities. The two copper types only differ in the contents of Ni, which is lower in the B2 type; they correspond approximately to the "Singen metal" of Waterbolk and Butler (1965, Graphs 8–9) and Liversage (1989, 59f).

Materialgruppe A and B2 are very common copper types in the LN II Period in Denmark and contemporary central Europe (Vandkilde 1992 (this volume), fig. 7A, figs. 8A-B). They are still frequent in Period IA and Br.A2 (*op. cit.,* fig. 7B and 8C-D), but the tin levels of the Vigerslev objects do not make such a date likely. The dagger has 15–16% tin and the axe 0.2–0.6% tin, tin class 6 and 3 respectively (cf. table 2 and *op. cit.,* 123). In Period IA the tin value is seldom below 4% and rarely above 10%. A combination of highly variable tin values is very characteristic of the classical Únĕticean phase and of the contemporary LN II Period (*op. cit.,* fig. 9A, 10A-B), contrary to the standardization of the succeeding period (*op. cit.,* fig. 9C). The metal groups and the tin content of the Vigerslev objects thus confirm the archaeological determination of chronology and intercultural relations.

According to Spindler (1971, 250f) a low percentage of tin as found in the Vigerslev axe was most likely not added to the copper during the process of manufacture of the axe, but is on the other hand probably too high to be a naturally occurring element of the copper. Tin class 3, (0.127–2.0%) or tin copper is very common in low-flanged axes of the LN II Period, and is probably a result of remelting and mixing copper belonging to various tin classes.

Method of analysis		Dagger	Axe
EPM		B2	A
EDXRF	1	B2	A
EDXRF	2	B2	A
ICP-MS		B2	A

Fig. 7. Table presenting the classification into the SAM 2 *Materialgruppen* of the eigth metal analyses of the Vigerslev hoard by different methods and laboratories (J.Kirkeby del.).

Tin class 6 (7.96–>10%) is high tin bronze, and the dagger is in the upper end of this range, the golden colour visually distinguishing it from the axe. Such high tin bronzes are manufactured in central Europe for the first time in this period, i.e. around 1950–1700 B.C. They are most frequent in the centre of the Únĕtice culture in Thuringia, closest to the tin deposits of the Erzgebirge, the frequency generally decreasing with the distance from the centre (Vandkilde 1992, this volume figs. 10A-B). It may be argued (Vandkilde in press) that the emergence of the Únĕticean centre is closely related to the discovery and exploitation of the Erzgebirge tin and the development of a tin-bronze technology. Distribution of tin, or tin bronze, appears to have been controlled by the centre, and we can be fairly certain that the tin in the dagger and in the axe from Vigerslev originated in the Erzgebirge, and therefore passed the centre at some point in time. In the Danish resource dependent periphery the Vigerslev metal-hilted dagger must have been very valuable, not only because of its prestige value, but also as potential raw material in the local production of flanged axes, the strength and efficacy of which depended on the quality of the metal.

Helle Vandkilde, Institute of Prehistoric Archaeology, University of Aarhus, Moesgård, DK-8270 Højbjerg.

NOTES

1. I wish to thank the 1. Department of the National Museum for permission to publish the Vigerslev hoard, conservator H.Strehle, Moesgård for discussions regarding the casting technique of the

dagger, and D.Liversage for revision of the English text. The Danish Research Council for the Humanities financed the metal analyses; the EPM analyses were made by P.Northover, the EDXRF and ICP-MS analyses by L.Højslet Christensen and K.Haydorn. The accession numbers in the register of the National Museum are B17479 (dagger) and B17480 (axe). "Ke." refers to numbers in Aner and Kersten 1973ff. "Ol" refers to numbers in Oldeberg 1974. The manuscript was finished august 1989.

2. This material is included in an extensive interlaboratory research programme organised by P. Northover of the Department of Metallurgy and Science of Materials, University of Oxford.
3. Elements that are not alloying additions and are suitable for classification purposes inasmuch as they show some relationship to the metal sources (Northover 1982, 229).

REFERENCES

Aner, E. & K. Kersten 1973ff: *Die Funde der älteren Bronzezeit des nordischen Kreises in Dänemark, Schleswig-Holstein und Niedersachsen.* Band I–IX. (Neumünster).

Drescher, H. 1958: *Der Überfangsguss. Ein Beitrag zur vorgeschichtlichen Metalltechnik.* (Mainz).

Forssander, J. E. 1936: *Der ostskandinavische Norden während der ältesten Metallzeit Europas.* (Lund).

Gedl, M. 1980: *Die Dolche und Stabdolche in Polen.* Prähistorische Bronzefunde VI,4. (München).

Junghans, S., E. Sangmeister & M. Schröder 1960: *Kupferzeitlicher und frühbronzezeitlicher Bodenfunde aus Europa.* SAM 1. (Berlin).

– 1968 (–74): *Kupfer und Bronze in der frühen Metallzeit Europas II.* SAM 2. (Berlin).

Kersten, K. 1958: *Die Funde der älteren Bronzezeit in Pommern.* (Hamburg).

Liversage, D. & M. 1989: A Method for the Study of the Composition of Early Copper and Bronze Artifacts. An example from Denmark. *Helinium* XXIX, pp. 42–76.

Lomborg, E. 1969: Frühbronzezeitliche trianguläre Metalldolche in Dänemark. *Acta Archaeologica* XXXIX, 1968, pp. 219–239.

– 1973: *Die Flintdolche Dänemarks.* (Copenhagen).

Northover, P. 1982: The Analysis of Welsh Bronze Age Metalwork. In: Savory H.N., Guide to the Bronze Age Collections. National Museum of Wales. (Cardiff).

Oldeberg, A. 1974: *Die ältere Metallzeit in Schweden.* Band I. (Stockholm).

Otto, H. & W. Witter 1952: *Handbuch der ältesten vorgeschichtliche Metallurgie in Mitteleuropa.* (Leipzig).

Schubart, H. 1972: *Die Funde der älteren Bronzezeit in Mecklenburg.* (Neumünster).

Spindler, K. 1971: Zur Herstellung der Zinnbronze in der frühen Metallurgie Europas. *Acta Praehistorica et Archaeologica* 2, pp. 199–253.

Uenze, O. 1938: *Die frühbronzezeitlichen triangulären Vollgriffdolche.* Vorgeschichtliche Forchungen 11. (Berlin).

Vandkilde, H. 1989: Det ældste metalmiljø i Danmark. J. Poulsen (ed.), *Regionale forhold i Nordisk Bronzealder.* 5. Nordiske Symposium for Bronzealderforskning på Sandbjerg Slot 1987. (Jysk Arkæologisk Selskabs Skrifter XXIV). Pp. 29–45.

– 1990a: A Late Neolithic Hoard with Objects of Bronze and Gold from Skeldal, Central Jutland. *Journal of Danish Archaeology,* vol. 7, 1988 p. 115–135.

– 1990b: Von der Steinzeit bis zur Bronzezeit in Dänemark. *Zeitschrift für Archäologie,* vol. 23:2 1989, pp. 175–200.

– 1992: The Metal Analysis of the Skeldal Hoard and Aspects of Early Danish Metal Use. *Journal of Danish Archaeology,* vol. 9, 1990 (1992), pp. 114–132.

– in press: Aspekter af teknologi og samfund i overgangstiden mellem sten- og bronzealder i Danmark. *Beretning fra 6. Nordiske Symposium for Bronzealderforskning, Nämforsen 1990.*

Waterbolk, H.T. & J.J., Butler 1965: Comments on the Use of Metallurgical Analysis in Prehistoric Studies. *Helinium* V, pp. 227–251.

APPENDIX

The Raw Metal Analyses of the Vigerslev Hoard

NM B17479 *dagger*	Sn	As	Sb	Pb	Co	Ni	Fe	Ag	Au	Zn	Bi	group
EPM	15.24	0.61	0.75	0.025	0.01	0.47	0.025	0.33	tr.	–	0.025	B2
EDXRF1	16.00	0.54	0.76			0.61		0.34				B2
EDXRF2	20.60	0.48	0.94			0.57		0.44				B2
ICP-MS	1.60	0.365	0.22	0.03	0.015	0.46	0.021	0.19	–	0.196	–	B2
NM B17480 *axe*												
EPM	0.19	0.61	0.66	0.015	0.035	0.92	0.005	0.43	tr.	–	tr.	A
EDXRF1	0.34	0.83	1.37			1.07		0.78				A
EDXRF2	0.59	0.81	1.94			1.06		1.05				A
ICP-MS	0.19	0.72	0.756	0.005	0.017	0.76	0.003	0.33	0.001	0.002	0.003	A