

# THE EXLOO NECKLACE: NEW LIGHT ON AN OLD FIND

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**ABSTRACT:** This article presents the results of recent international collaborative research into the Early Bronze Age composite necklace from Exloo, examining its circumstances and location of discovery, the history of its curation and study, its likely date, the provenance of its constituent elements, and its broader significance. The other Dutch Bronze Age faience beads, from Vogelenzang and Den Haag-Bronovo, are also discussed.

**KEYWORDS:** the Netherlands, Exloo, Bronze Age, faience, amber, tin, bronze, beads, necklace.

## 1. INTRODUCTION

The composite necklace from Exloo (plate 1.1) is one of the prime objects in the Drents Museum in Assen. It dates to the Early Bronze Age, and comprises beads of bronze, tin and faience and beads and pendants of amber. Faience is a glass-like material, and the necklace has received much attention over the years following Beck and Stone's assertion (1936) that its faience beads, like most of those found elsewhere in North-west Europe, had probably been imported from Egypt (in this case, *via* Britain), during the 18<sup>th</sup> Dynasty (c. 1400 BC). Others (*e.g.* Newton & Renfrew, 1970) have challenged this view. The provenance of the Exloo faience beads, along with that of its other component elements, has been much debated over the years (*e.g.* Butler, 1990: p. 54–6).

Perhaps surprisingly, since the necklace's acquisition by the Museum in 1881, no research into the circumstances of its discovery has taken place. In the Museum's register all that is recorded is that it was discovered, by Joannes Leutscher, two metres deep in peat near Exloo. The fact that so little was known – and so little published – about such an important find was the reason why one of us (EH) decided to undertake this research for her Master's dissertation at the University of Groningen, presented in February 2004.



Fig. 1. The three findspots of Bronze Age faience beads in the Netherlands.

The following questions were addressed: 1. *Where and how was the necklace discovered?* 2. *What has been found out about this necklace since its discovery?* 3. *Where did the constituent parts of the necklace originally come from, and how can we establish such information?*

In order to answer the first two questions, a search of the archives in the State Archives (Drents Archief, Groninger Archieven and Rijksarchief in Friesland), in the Drents Museum and in the Biologisch-Archeologisch Instituut (BAI) in Groningen was undertaken, followed by an examination of relevant editions of various newspapers, principally the *Provinciaal Groninger Courant* and the *Provinciale Drentse en Asser Courant*. In addition, a review of the previous archaeological research on the necklace was undertaken. The results of this work are presented in chapters 2, 3 and 4. Two other finds of faience beads in the Netherlands are dealt with in chapter 5.

During the course of this research, the opportunity arose to incorporate the Exloo necklace into a major international programme of research into the Bronze Age faience of North-west Europe, co-ordinated for the National Museums of Scotland (NMS) by the co-author of this paper (JAS). Thanks to the kind efforts of EH's supervisor Jan Lanting, the necklace was duly analysed, in Edinburgh, as part of this project. This work addressed the aforementioned question of provenancing the Exloo necklace's constituent parts, and also featured a detailed examination of every bead – not just the faience examples – to investigate methods of manufacture and evidence for use-wear. In addition, the faience bead from Den Haag-Bronovo was examined and analysed in Edinburgh. The results of this work, along with a summary of the currently-available evidence pertinent to the dating of these artefacts, are presented in chapters 6, 7 and 8.

## 2. ACQUISITION OF THE NECKLACE BY THE DRENTS PROVINCIAL MUSEUM, AND ITS SUBSEQUENT HISTORY

### 2.1. Acquisition

Very little is known about the Exloo necklace beyond what is written on the object label in the display case: "Necklace made of beads of tin, amber and faience, ± 1700 BC. Exloërmond".

The Drents Museum register records, in addition, that the necklace was found by a certain Mr Leutscher, and was acquired by the museum in 1881 through the efforts of Mr J.G. Borgesius, who was a member of

the museum's Board of Management.

Further research into the archives of the Drents Museum revealed that Joannes Leutscher had found the necklace two metres deep in peat. His discovery came to the attention of Borgesius, who was also the Mayor of Odoorn and who took a particular interest in archaeological finds. Borgesius approached Leutscher, asking him whether he wished to sell the necklace. Because Borgesius felt that the museum might be interested in acquiring the object, he posted the beads there on 29<sup>th</sup> April 1881 and asked whether they had any archaeological value. He realised that the museum would have to decide promptly, to prevent Leutscher from selling the necklace to another buyer. Borgesius therefore wrote the following letter, probably to Mr G.R.W. Kymmell:

Dear Cousin!

Exloo, 29 April 1881

Here are the beads found by Leutscher under two metres of peat in the Exloërmond. Because I do not know their archaeological worth, I have not purchased them from him myself; but, on behalf of the Management Board of the Museum of Antiquities of Drenthe, I have requested the loan of these items for a few days, on the condition that they will be returned to Leutscher if the museum deems them not to be of archaeological value. Since there are many people who are curious to see these beads and visit Leutscher daily, asking to see them, it is possible that one of them will offer him a considerable sum for the necklace. Speed is therefore necessary, if the Management Board wish to acquire them. Apparently he has been offered 5.00 guilders for them.

Best wishes, J.G. Borgesius

(Drents Archief Inventory no. 0028, entry no 108)

On 1<sup>st</sup> May the Management Board replied by letter that it did indeed want to buy the necklace, and that it would leave it to Borgesius to decide on the price. However, it asked him to be as economical as possible, and to pay Leutscher from his own funds, for subsequent reimbursement by the Museum.

Assen, 1 May 1881

I hereby cordially request you to buy the beads and ornaments for the museum from Leutscher. Please make the smallest offer that is sufficient to secure the necklace. On presentation of a receipt for the expenditure, you will be reimbursed as soon as you next visit Assen".

(Drents Archief Inventory no. 0028, entry no. 18)

On 11<sup>th</sup> May, Borgesius purchased the beads from Leutscher for ten guilders. Borgesius attempted to haggle for a lower sum, but Leutscher was adamant. On 16<sup>th</sup> May Borgesius sent the receipt to the museum.

On this receipt, the beads were described as:

“beads, of amber and paste, with ornaments of silver or other material”

(Drents Archief Inventory no. 0028, entry no. 63).

## 2.2. Registration and photography of the beads

The beads were given the registration number 588. They were described, in the Register-Daybook-Inventory (register IIa) immediately after their acquisition as:

“beads, 14 of amber, 4 of a sort of blue stone, or perhaps paste, 27 of tin or lead and one cylinder of copper, found by a certain Joh. Leutscher in the peatland in Drenthe province near the Exloërmonde, Odoorn municipality. Bought through the intervention of the committee member J.G. Borgesius of Exlo”.

The same description appears in a handwritten list of peatland finds compiled by J.A.R. Kymmell at some time before 1911. In the catalogue of 1891, compiled by Gratama, the beads were listed as:

“a number of beads: of amber, of paste and of an alloy with tin”

From 1917, when Van Giffen re-inventorised the museum collection, the beads were allocated the number 1881/V 1. Van Giffen’s original, handwritten inventory leaflet no longer exists, and was probably discarded after being typed. On the typed inventory leaflet it was recorded that there were 25 beads of tin or lead, rather than the 27 that had been mentioned in the earlier register IIa.

‘The necklace’ is, strictly speaking, the name given to a number of loose beads. Since they had been found, as stated above, two metres deep, there must remain some uncertainty as to whether Leutscher found all the beads that had originally been present: given the small size of some of the tin beads, it is not impossible that additional examples had been missed. Furthermore, we cannot be certain that Leutscher sold all the beads that he found to the museum. He did indeed sell 27 tin beads to the museum, and it seems that two of these beads must have gone astray by the time Van Giffen produced his inventory; but whether what Leutscher sold to the museum constituted the entire necklace, we shall never know.

As currently displayed, the Exloo necklace comprises 43 beads (plate 1.1). It is not known when it was strung in its present configuration. The earliest surviving photograph of the necklace is that published in Beck and Stone’s article on European faience finds

(Beck & Stone, 1936: pl. LXVI, fig. 1, no. 1); it must have been taken around 1935. The necklace had been lent at that time to Beck. The current arrangement of beads is the same as in that photograph, the only difference being that one amber bead that appears in the photograph (lying between the tin beads currently numbered ‘23’ and ‘24’ on plate 1.1) is no longer strung on the necklace, having been broken in 1965 (see below).

Other photographs of the necklace were taken in later years, e.g. when it was lent to the BAI in Groningen in 1942 (Drents Archief inventory number 0028, entry no. 95), and indeed it may have been photographed prior to the 1930s, but no pre-1936 images were found during a search of the relevant relevant archives and publications. Jay Butler’s discussion of the necklace in 1990 lists most of the post-1936 photographs and drawings (Butler, 1990: p. 54); to this can be added the colour photograph that appeared as the frontispiece to Penhallurick’s *Tin in Antiquity* in 1986.

## 2.3. The necklace as currently constituted, and its missing beads

Out of the 46 components that are recorded as having been acquired by the Museum in 1881, 43 are now present in the necklace as currently strung (plate 1.1; the numbers referred to below are those shown in this photo). A full description of each is presented in Appendix 1, and a full discussion is presented in chapter 6. The necklace currently comprises:

- Four segmented faience beads (5, 13, 26 and 35), of which three have three segments (5, 13 and 35) and the fourth has four (26). This last bead had been broken at some time after 1943 (when van Giffen published a photograph showing it intact) and before 1965: it appears on a pre-1965 Drents Museum postcard as broken but glued together. Its reconstruction had been done somewhat clumsily;
- One tubular bead made from sheet bronze (1);
- Twenty five tin beads, of which seven are segmented (3, 8, 14, 27, 29, 31 and 42) and 18 are plano-convex (6, 9, 11, 12, 15, 17, 18, 22–5, 30, 33, 34, 36, 37, 39 and 40);
- Thirteen amber components, of which four are pendants (Nos 2, 4, 38 and 43) and nine are beads (7, 10, 16, 19, 20, 21, 28, 32 and 41). The whereabouts of the fourteenth amber component, a bead, are described below; as stated above, this bead must originally have been strung between tin beads 23 and 24.



1.1

1.2



Pl. 1.1. The Exloo necklace in 2002, with its individual beads and pendants numbered (photo NMS). Full size;

Pl. 1.2. The faience beads from the Exloo necklace: top L, 5; top R, 13; bottom L, 35; bottom R, 26 (photos NMS). Scale 3:1

Several beads have flecks of extraneous material on their surface, some of them black, some blue, and some pink. These will have been acquired in the museum over the years: the black and blue marks look to be of paint or ink, while the pink flecks are probably plasticene. The latter material had been used in the museum to affix items onto glass for display, while the paint may have been applied by accident when a replica of the necklace was made. One such replica is known to have been made in 1942, for instance, by the BAI (BAI: 1942/VII 4). In this, the now-broken amber bead is present, while the faience bead 13 is absent unaccountably.

Recent examination of the beads in Edinburgh using a scanning electron microscope (see below, chapter 6) has also revealed that at least one bead – faience bead 5 – has microscopic fibres of peat still attaching to its surface.

### 2.3.1. *The fourteenth amber bead*

An explanation has recently been provided to account for the aforementioned fourteenth, ‘missing’, amber bead. On 1<sup>st</sup> November 2001, in response to an enquiry from J.N. Lanting, J.D. van der Waals (curator of the museum 1959–67) gave a verbal account of what had happened to this bead. He subsequently provided a written account in April 2003.

In December 1964, the archaeological displays were beginning to be installed in the Drents Museum in what is now the Rijksarchief building. This constituted a re-display of the collections, in which more room was made to accommodate archaeological material and a new style of presentation was used. This redisplay was designed by architects L.C. Roling and J.P. Girod in collaboration with Van der Waals. The new exhibition was opened on 9<sup>th</sup> July 1965. In the final days before the opening, much frantic activity took place in order to ensure that the exhibition would be ready on time. A precise plan determining what objects were to be displayed in which cases had been formulated, but the specific disposition of objects in the cases had been left to be decided at the point when the objects were ready to be installed. Van der Waals, his assistant G. de Leeuw and Mr P.C.A. van der Kamp were involved with the installation, and at the last moment both the architects helped as well.

One of these people was arranging the display in the case dedicated to early bronze age material. The necklace had been pinned to the case’s back-board. The individual concerned was not altogether happy with the way it was hanging: it was not circular enough. To correct this required the addition of an-

other pin. He neglected to remove the necklace from the backboard while hammering in the pin, and consequently the hammer struck one of the amber beads. The bead was so badly shattered that restoration could not be countenanced. The bead figures in earlier photographs of the necklace, from which it is clear that it resembles the other carefully shaped amber beads in the necklace (e.g. Nos 7, 10 and 16: see plate 2.1).

### 2.3.2. *The missing tin beads*

Professor Dr J.M. Jaeger of the Inorganic Chemistry Laboratory of the Rijksuniversiteit Groningen undertook metal analysis of archaeological finds at Van Giffen’s request during the 1920s and 1930s. It may well be that the two tin beads that went missing between 1881 and the re-inventorisation of the collection in or after 1917 had been offered for this (destructive) analysis. There is, unfortunately, no record of any results, and although examination of the BAI correspondence archive for 1920–43 has produced a couple of letters from Jaeger, there is no specific mention of the tin beads and it is unclear as to which items were being discussed.

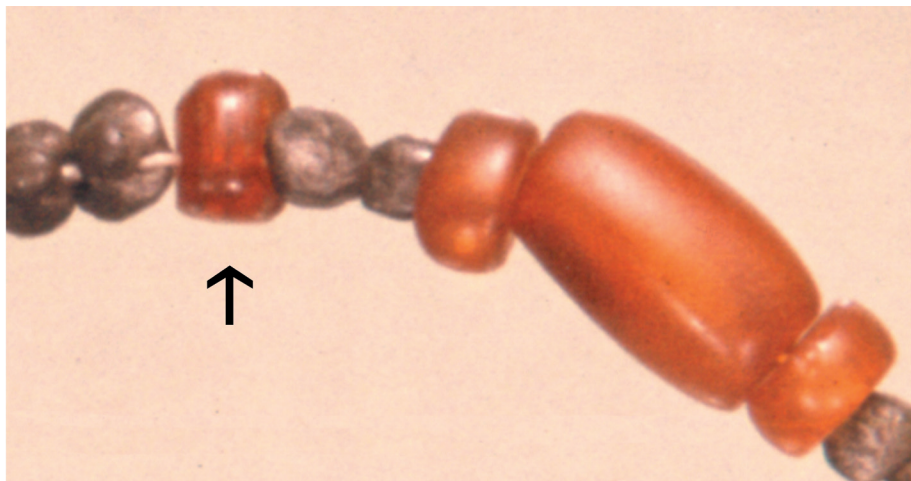
## 3. THE LOCATION OF THE FINDSPOT, THE DATE OF THE DISCOVERY, THE FINDER AND THE SIGNIFICANCE OF THE PURCHASE PRICE

### 3.1. Findspot location and date of discovery

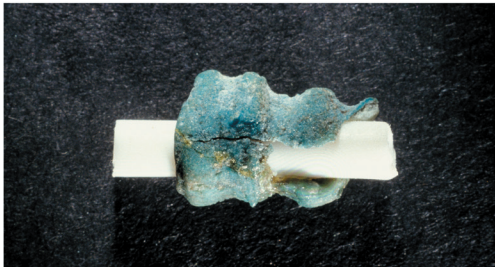
The letters and receipt of 1881 do not mention the exact findspot of the necklace; only that it was found in ‘Exloërmond’. It is a pity that Borgesius and his cousin in Assen (Kymmell?) were not more interested in documenting the find circumstances precisely, since they could have obtained first-hand information.

Thanks to the efforts of the ‘Old News’ project – a voluntary initiative by the Drents Prehistorische Vereniging (Drents Prehistory Group) with Wijnand van der Sanden, researching old newspaper reports for archaeological finds from peatland (Van der Sanden, 2002: p. 96) – the following account of discoveries at Exloërmond (fig. 2) was found in the *Provinciale Drentsche en Asser Courant* for 24 July 1884:

“Nieuw-Buinen, 22 July. At Eerste Exloërmond, *veenplaats* no. 17, the worker *A. van Vondel* found a complete cow or buffalo horn on the sand layer below the peat. Two years ago, in the same *veenplaats*, belonging to Mr *J.A. Niks*, a string of beads had been found”.



2.1



2.2



2.3



2.4



2.5



2.6



2.7



2.8

Pl. 2.1. The missing amber bead, broken in 1965, from a colour slide of 1964 in the collection of the Groningen Institute of Archaeology. Scale 3:1; Pl. 2.2. The faience bead from Den Haag-Bronovo, as currently mounted on a plastic tube. Longitudinal cracking can be seen on the left hand image. Scale 3:1; Pl. 2.3. Exloo amber bead 20, showing tool marks (centre). Scale 3:1; Pl. 2.4. Detail of Exloo amber pendant 4, showing abortive borehole (centre, right); Pl. 2.5–6. End views of Exloo segmented tin bead 8, showing (left, 5) the shape of the organic former, and (right, 6) where one sheet – the ‘upper’ sheet (top left) projects over the end of the other sheet. Scale 3:1; Pl. 2.7. Exloo segmented tin bead 27, showing worn appearance of segments. Scale 3:1; Pl. 2.8. Exloo plano-convex tin bead 24, showing gouge mark (running across bead just below centre) made by tool used to create the perforation. Scale 3:1. Photos NMS.

Although the Exloo necklace had been found in 1881, not in 1882, we take it for granted that the ‘string of beads’ refers to Leutscher’s discovery. No other necklace is known from ‘Exloërmond’. The number of the *veenplaats* and name of the owner allow a more precise reconstruction of the findspot.

The peatbog east of Exloo had been divided into 78 *veenplaatsen*, which were sold in 1829 on the condition that, after the peat had been extracted, the land would be redeveloped for arable agriculture. Each *veenplaats* was 85 metres wide, and extended over the full width of the bog, from the border with the Buinerveen in the north to the border with Valtherveen in the south. In 1843 the construction of the Noorder Hoofddiep (Northern Main Canal) started; this allowed the exploitation of the *veenplaatsen* to commence. Along this canal the linear settlement of Eerste Exloërmond developed. A couple of years later, the Zuider Hoofddiep (Southern Main Canal) was dug, and this led to the development of Tweede Exloërmond. In the 1880s the settlements along both canals seem to have been referred to simply as “Exloërmond”. According to the Museum receipt for the beads in 1881, the finder, Leutscher, was living in “Exloërmond” (fig. 2).

Each *veenplaats* bordered on to a *wijk*, a side-canal dug at right angle to the main canal to facilitate transport of the dried peat sods by boat. These side canals were not dug over the full length at once, but in stages related to the progress of the peat exploitation.

By the construction of the two main canals each *veenplaats* became divided into three parts. In the case of *veenplaats* 17, the part between the two canals was owned by Mr Jurrien Andries Niks from 1869, with the exception of a small plot bearing the Land Tax map reference number Section D, No. 774, on the northern bank of the Zuider Hoofddiep. Mr Niks lived in the village of Nieuw-Buinen in the neighbouring *gemeente* (municipality) of Borger. His part of *veenplaats* 17 had been divided into four plots, bearing land registry numbers Section D, Nos 1003, 1259, 1465 and 1466 (fig. 3: lower). Comparison between the land tax map and the Ordnance Survey map of 1905 shows that houses had been built on the small plots 1003 and 1259, situated along the Noorder Hoofddiep, and on the narrow plot 1466 bordering on the aforementioned plot 779 along the Zuider Hoofddiep (fig. 3: upper). Given that Niks lived in Nieuw-Buinen, it is not unlikely that permanent labourers employed by him lived in these houses, and Leutscher may have been one of them. Owing to a lack of relevant documentation, however, this cannot be confirmed.

The larger part of Niks’ section of *veenplaats* 17

consisted of plot 1465. This number had been given to this plot in 1881, when the digging of peat commenced. Before that it had been known as Section D, No. 1002. The Ordnance Survey maps make it clear that peat digging on plot 1465 started near the Noorder Hoofddiep. In 1905 only the southern part still consisted of peatland (fig. 3: upper).

To arrive at a better understanding of the exploitation of the peat in the section of *veenplaats* 17 owned by Niks, a search was made of the archives of the *Waterschap* (Water Board) ‘de Veenmarken’, of the *Veenschap* (Peat Association) of Oostermoer/Zuidenveld, and of the *Veenkantoor* (Peat Office) in Groningen. Peat exploiters had to pay the *Waterschap* according to the amount of peat extracted, and the *Veenschap* had to pay the town of Groningen for the use of the *Stadskanaal* (the Town Canal which, as its name suggests, was owned by the town) for the transport of peat by boat.

The *Veenmarken* archives contain information on the Marke of Exloo (Drents Archief, inventory no. 0759. A *marke* is an administrative land division.). There are many lists and record books relating to the first half of the 19<sup>th</sup> century. However, the lists for the period around 1881 are not sufficiently detailed to give the name of individual peat exploiters.

According the archive of the *Veenschap* of the Oostermoerse en Zuidenveldse Veenen (Drents Archief, inventory no. 0055), Niks paid tax on peat extracted from *veenplaats* 17 in 1878, 1879 and 1880. There is no note for the year 1881; the ledger for that year simply gives the overall number of *dagwerken turf* per *marke*. The ledger does not name the peat exploiters. A *dagwerk turf* represents around 10,000 sods of dried peat, and is theoretically the number of sods extracted by a crew of six to nine (depending on the distance to the drying fields) men during one day. The equivalent is about 90 (De Beer, 1998: p. 209) to 110 m<sup>3</sup> (Gerding, 1995) of uncut, but drained peat. In 1880 Niks had sold 50 *dagwerken* of peat sods.

The peat extracted by Niks’ labourers in 1878–80 may have come from the plots 1003 and 1259 (although the houses on these plots were probably built on top on the peat), but more likely from the side canal between *veenplaatsen* 17 and 18, and from drainage ditches, prior to full scale exploitation of plot 1465.

The necklace was reported to Assen on 29<sup>th</sup> April 1881. This was fairly early in the peat cutting season which usually began, subject to appropriate weather, in March (Pelder, 1925: p. 19). According to the *Provinciale Drentsche en Asser Courant* of 3<sup>rd</sup> March 1881, peat-cutting in Musselkanaal that year had com-

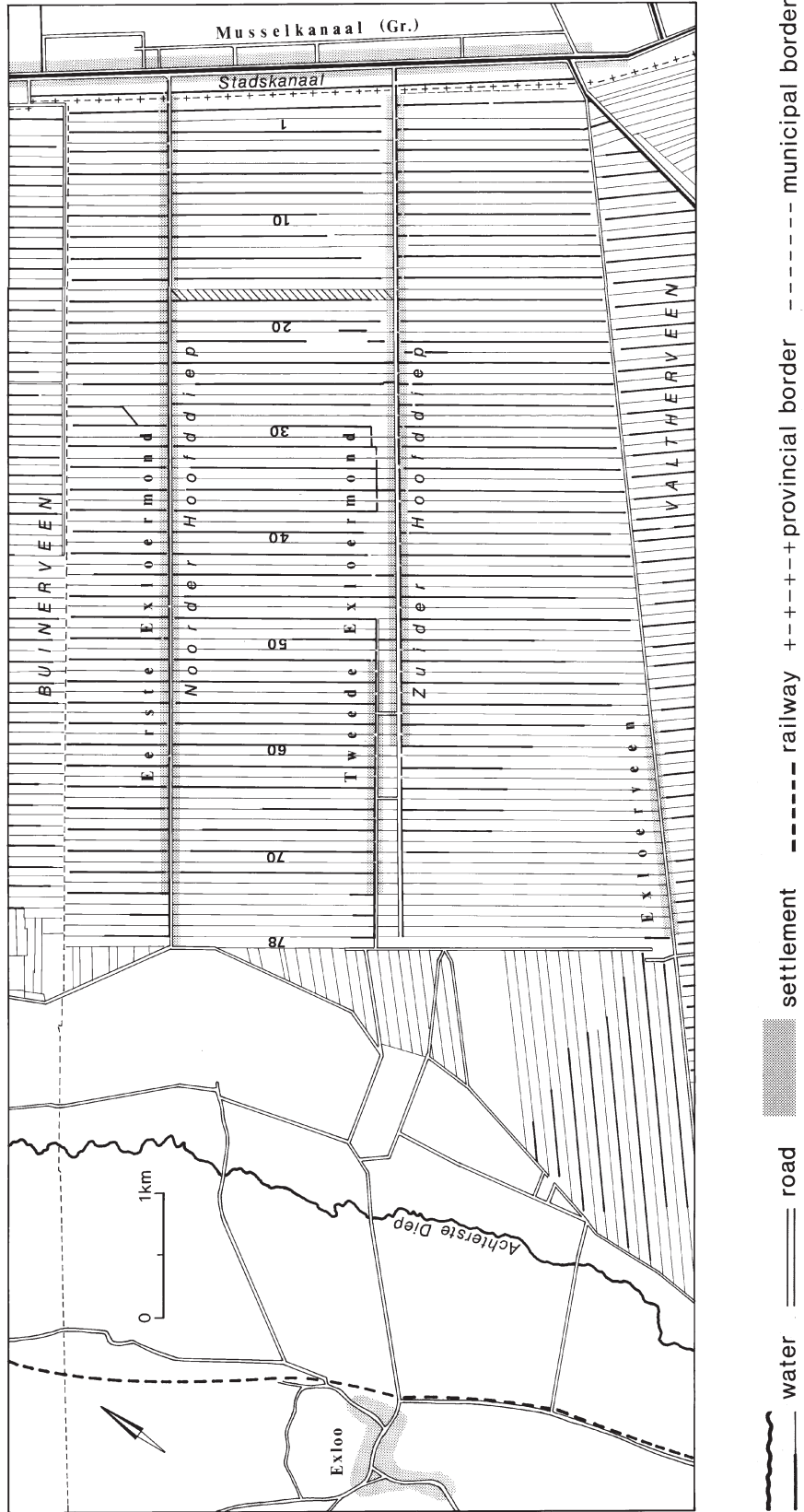


Fig. 2. Generalized map of the Exloërveen, c. 1905.

The part of *veenplaats* 17 shown in fig. 3 is hatched (drawing J.H. Zwier).



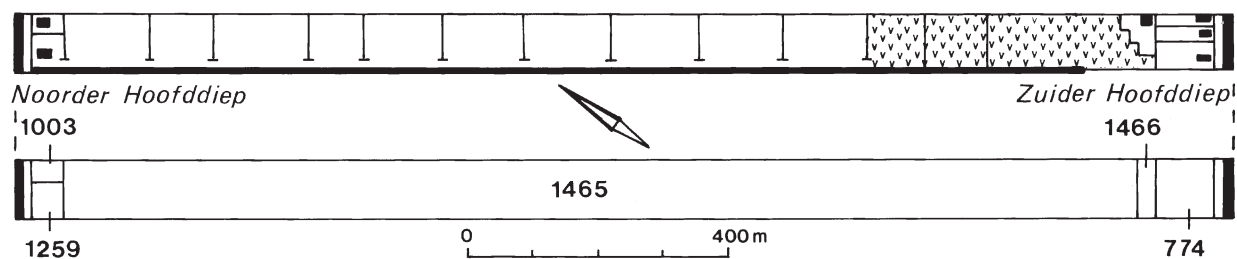


Fig. 3. upper: *veenplaats* 17 between Noorder and Zuider Hoofddiep, according to the Ordnance Survey map of c. 1905. Only part of the *veenplaats* is still covered in peat (shaded). Houses are shown as solid rectangles. lower: parcel numbers (section D) of the same part of *veenplaats* 17, according to the land tax map (drawing J.H. Zwier).

menced around the beginning of March, but progress had been slow because in some shaded places more than thirty centimetres of frost had been encountered, posing a considerable hindrance to the work. The fact that the necklace was found at a depth of two metres, early in the year, seems to indicate that it may have been found during the digging of a *wijk*. In any case, the findspot must have been situated in the northern part of plot 1465, not far from the Noorder Hoofddiep (fig. 3: upper).

### 3.2. The finder

Joannes Leutscher was the sixth child of Berend Janes Leutscher and Baudewina Oosterbaan. He was born on the 4<sup>th</sup> August 1844 at Smilde (Drenthe), and married Klaasje Hoekstra on 21<sup>st</sup> February 1868 in Ooststellingwerf (Friesland) (Leutscher, 1985: pp.180–3). In the Ooststellingwerf municipal archives it is recorded that Joannes and his wife lived in Appelscha, and that their first child was born there on 22<sup>nd</sup> October 1871. On the birth certificate Leutscher's profession is given as "labourer". On 13<sup>th</sup> March 1874 the family moved to the municipality of Odoorn. The Odoorn municipal records also list Leutscher as a "labourer" in 1874; he lived with his family in Exloërmond. On 6<sup>th</sup> May 1876 they moved to Musselkanaal (*gemeente* Onstwedde, province of Groningen), not far from Exloërmond. This was two days after the birth of their daughter Jeske, and indeed it is questionable whether they actually moved on that day, particularly since Leutscher was only registered in Onstwedde on 7<sup>th</sup> June 1876. It is unlikely that Leutscher was still working in Exloërmond when he lived in Musselkanaal; it is more likely that he had accepted a job as a peat cutter there. According to the Onstwedde archives the Leutscher family moved back to Odoorn on 8<sup>th</sup> May 1877. There is no entry for this in the Odoorn archives, because this part of the archives was lost during the Second World War when

the Resistance burnt down the Odoorn Town Hall in Exloo. However, thanks to the fact that the Registers of Births, Marriages and Deaths were updated with new pages every ten years – in the so-called "Ten Year Tables" – it was possible to find a later reference to Leutscher in 1880, when he is again described as a "labourer", living with his family in Exloërveen. Whether this is a mistake (a peat cutters settlement Exloërveen did exist, see fig. 2) is not clear. But a year later Leutscher lived in Exloërmond, according to the receipt of 11 May 1881.

It would appear likely that Leutscher was approached by Niks in 1877, and offered a job as a permanent labourer. In 1877 Niks must have started the preparatory work for peat cutting on his part of *veenplaats* 17, given that he sold his first sods of peat in 1878.

On 29<sup>th</sup> November 1886 Leutscher and his family were struck off the Odoorn registers and recorded as having moved to the municipality of Emmen, but strangely enough he was still living in Exloërmond twelve days later (see below). The Emmen registers record Leutscher as having moved to Emmen in an entry dated 13<sup>th</sup> December 1886; yet again, he is listed as "labourer".

In the Emmen municipal correspondence archives there is an interesting letter written by Leutscher to the authorities on 10<sup>th</sup> December 1886, notifying them that he was about to move to Weerdingerveen (*gemeente* Emmen). He wrote that he was running a business at Eerste Exloërmond as a shopkeeper, retailer and licensed publican, and that he was eager to continue in this profession in Weerdingerveen. Given the fact that, at the same time, he was registered as "labourer", it is likely that his wife was running the shop, to gain additional income (such an arrangement was not uncommon). But it was only in October 1905 that Leutscher finally succeeded in obtaining his liquor licence in Emmen. By then he had managed to become a peat extractor in his own right, employing

thirteen labourers from outside the municipality in 1902. In 1907 he applied for a licence to use a mobile steam engine (which could have provided power for peat-cutting equipment), and in 1908 for a licence to use premises for paid accommodation. He died in Weerdingerveen on 29<sup>th</sup> October 1919, aged 75.

### 3.3. The purchase price

Between 1865 and 1880 peat cutting in Drenthe and eastern Groningen was very profitable, largely because of the demand for fuel by the potato starch industry in the neighbourhood. After 1880 a period of recession started. Between 1880 and 1888 one third of these factories closed down (Gerding, 1995: p. 98). The recession had serious consequences for the peat cutting business. Production stagnated, and wages were lowered.

In the 1870s a peat cutter could earn 10 to 12 guilders per week during the peat cutting season. In 1881 they earned and spent six guilders a week (Welcker, 1978: pp. 145–149), which is 30–35% less than a couple of years earlier. The 10 guilders that the 37-year-old Leutscher received for the ‘necklace’ equated to one and a half week’s wages, and would therefore have been a welcome addition to his income.

## 4. PAST RESEARCH ON THE EXLOO NECKLACE

The Exloo necklace has been the subject of considerable debate regarding the provenance of its constituent components and its date; and both of these questions have been linked with a wider-ranging debate about whether faience beads in Europe represent exotic imports from the near East or eastern Mediterranean, or were made more locally. Space does not permit a full description of this wider debate, a summary of which can be found in Sheridan and Shortland (2004) and also in EH’s dissertation which forms the basis for this part of the article. The following comments will mainly be restricted to key studies of the Exloo necklace itself.

The earliest, and most influential study, was undertaken by Horace Beck and J.F.S. Stone as part of their review of British Bronze Age faience beads and their foreign counterparts (Beck & Stone, 1936). Their attention had been drawn to the necklace by the English prehistorian Christopher Hawkes, who had seen the beads during a visit to the Drents Museum in the spring of 1933. Beck and Stone borrowed the necklace, and Beck produced a report. In this, he commented on the

outstandingly good condition of the beads. Regarding the tin beads, Beck drew attention to a lost segmented tin bead that had been found in Sutton Veny, Wiltshire. Further parallels from Wessex (*i.e.* Wiltshire and adjacent counties) were cited for the segmented faience beads which, he said, were identical (except that one of the Exloo examples had, in their opinion, been better glazed than the southern English beads). He noted that in two of the faience beads, their colour varied from one side to another, and wondered whether this resulted from their manner of manufacture or from their current state of preservation. A further possible Wessex link was cited in the publication (Beck & Stone, 1936: p. 213), where parallels in Dorset were cited for the tubular sheet bronze bead. Beck compared the amber beads with examples from both the eastern Mediterranean and from Ireland. He assumed the original source area to the Baltic, and claimed that the presence of the amber and tin beads lent support to Van Giffen’s argument that there had existed a trade route from the Baltic to England, conveying amber in one direction and tin in the other, passing through Holland (Van Giffen, 1930: pp. 121–122; *cf.* Glasbergen, 1957a: p. 2; 1957b).

Regarding the origin of the faience beads, Beck argued in his report that they could have been exported from Wiltshire, such was their similarity to specimens there. In the publication, however, he and Stone expanded on their hypothesis that the ultimate origin could have been much further afield, with southern England serving as a point of redistribution (Beck & Stone, 1936: p. 231). They based this view on the apparent similarities between segmented beads found in Europe and in Egypt (the latter dating to the 18<sup>th</sup> Dynasty, c. 1400 BC). This view had a long pedigree, having first been expressed by Richard Colt Hoare as early as 1812 in his comments on segmented beads from Wiltshire barrows (Hoare, 1812). Where precisely the European beads had originally been made, Beck and Stone could not say, but Egypt or Palestine seemed the most likely candidate areas to them. This view was strengthened by the results of spectrographic analyses of a few British and Egyptian beads, undertaken for them by a Dr Ritchie just before their article went to press. This seemed to show a close similarity between one segmented bead from Wiltshire and one from Tell el Amarna in Egypt (Beck & Stone, 1936: p. 252).

Subsequent spectrographic analyses of other faience beads from Europe and the Near East and eastern Mediterranean (Stone & Thomas, 1956) were also interpreted as lending support to this ‘orientalist’ view of importation from one or more of these areas. However,

when Newton and Renfrew statistically re-analysed those results and discussed the new chronological information on second millennium BC developments that was emerging from the use of radiocarbon dating (Newton & Renfrew, 1970; *cf.* Renfrew, 1968), they came to a very different conclusion, arguing for local manufacture in various areas. In particular, they noted that a key element differentiating British beads from their counterparts in central Europe and areas to the east and south-east was the presence of appreciable amounts of tin (Newton & Renfrew, 1970: p. 201). Further analyses were to follow (*e.g.* Aspinall *et al.*, 1972; Harding & Warren, 1973; Aspinall & Warren, 1976; Peek & Warren, 1979, using mainly neutron activation analysis), with apparent confirmation for the ‘local manufacture’ hypothesis. However, a contrary position was taken by Scottish researcher Hugh McKerrell, who undertook numerous X-ray fluorescence (XRF) analyses of faience beads in the 1970s, using portable XRF equipment (McKerrell, 1972; 1976). He visited Assen in 1972 and analysed the faience, tin and bronze beads of the Exloo necklace, publishing the results in 1976 (Harsema, 1974: p. 217; McKerrell, 1976: pp. 313–4, table 1).

To cut a long story short, McKerrell claimed that the Exloo faience beads showed a significantly lower tin content than that seen in many British beads and argued “There is thus no question of export of material from [Britain] to the Netherlands, either following manufacture in Britain or through a reflux after importation to Britain from the Near East” (McKerrell, 1976: p. 314). He also stated that their lead content (deriving from the copper-based substance used to give the glaze its turquoise colour) was not comparable with that seen in beads from Eastern Europe, which he took to have been manufactured locally, and so they were unlikely to have been imported from that source. McKerrell concluded; “Thus by exclusion of Britain and Eastern Europe we must perforce turn to the Near East as the only plausible source of the Odoorn necklace faience beads...” (*ibid.*). In support of this view he cited a radiocarbon date that had been obtained from a settlement site at Vogelenzang, where another Bronze Age faience bead had been found (Groenman-van Waateringe, 1966: p. 176 and see below). This date (GrN-2997, cited as 1139±70 bc) calibrated to “between 1250 BC and 1450 BC” and thus tied in with an 18<sup>th</sup> Dynasty date for its supposed Egyptian counterparts. As will be explained below, this date was subsequently rejected by archaeologists as being unreliable.

Many others have discussed the Exloo necklace or the dating of its British *comparanda*. Isobel Smith

(1961: p. 109) claimed that the necklace had been brought to the Netherlands from Southern England by a ‘Hilversum Culture’ immigrant. The English *comparanda* for the Exloo faience beads were discussed by Sabine Gerloff in her 1975 study of the grave goods found in the rich Bronze Age graves of the so-called ‘Wessex Culture’ (Gerloff, 1975). She regarded faience beads as one of the characteristic features of a series of female high-status graves – the ‘Aldbourne series’, named after a cemetery in Wiltshire, and featuring the burial of cremated human remains. In these, faience beads were often part of composite necklaces along with beads of other materials such as amber and shale (*ibid.*: p. 198). Gerloff regarded the ‘Aldbourne series’ to lie fairly late in the overall sequence of high-status Wessex burials (*ibid.*: p. 200). In coming to this conclusion she allowed herself to be persuaded by McKerrell’s arguments to the effect that British faience beads had most probably been imported from Egypt, around 1400 BC, reaching there *via* the western Mediterranean sea and the rivers Aude and Garonne in France (*ibid.*: p. 224).

The tin specialist Roger Penhallurick (1986: p. 67) argued that both the faience and the tin beads in the Exloo necklace had been imported from Southern England, perhaps even from the same workshop. He saw a close formal similarity between the Exloo faience beads and British segmented faience beads, and also cited the lost tin segmented bead from Sutton Veny Downs, Wiltshire, as a parallel for the Exloo segmented tin beads.

Jay Butler discussed the dating of the Exloo necklace and the provenance of its components in his publication on Dutch Bronze Age bronze and amber finds (Butler, 1990). The Exloo example was the earliest of eight necklaces with amber beads from Drenthe dating from the Early and Middle Bronze Age. Butler placed it at the transition between the Early and the Middle Bronze Age in the Netherlands (*ibid.*: p. 48). He drew attention to the similarity between the roughly cylindrical or fusiform amber bead (Butler’s ‘tubular’ bead: plate 1.1, no. 20) and those known from Periods II and III of the Danish Bronze Age, from the Wessex Culture and also from the earliest Bronze Age of central Europe. The trapeze-shaped amber pendants found a parallel, he claimed, in the tumulus of Kernonen in Brittany (*ibid.*: p. 54). Butler argued that the amber beads had not been locally made, since they were of shapes that were widespread in Europe. Furthermore, since there did not seem to be strong links between the Netherlands and Scandinavia at this point in the Bronze Age, he speculated that the amber could have been obtained through links with

central Europe (*ibid.*: p. 53). Regarding the faience beads, Butler cited parallels in Wessex and Brittany, and also Denmark (Fjallerslev, Jutland: Becker, 1954) and the Netherlands (Vogelenzang). He mentioned in passing the new  $^{14}\text{C}$  date that had been obtained for charcoal from Vogelenzang (GrN-14692,  $3470 \pm 60$  BP) and which had produced a calibrated result of 1958–1642 cal BC, much earlier than that of the original date as cited by McKerrell. Butler concluded that the Exloo faience beads are likely to have been “imports from the English Channel littoral area” (*ibid.*: p. 54). Finally, regarding the tin beads from Exloo, he cited the Sutton Veny segmented tin bead as a parallel (*ibid.*: p. 55). Overall, however, Butler did not appear to want to commit himself too firmly to an English source for the faience and tin beads in the Exloo necklace, arguing that even though one could discount the old stereotyped attributions of former days – of the faience to Egypt and the tin to Cornwall – nevertheless “it cannot be said that satisfactory substitutes have been demonstrated” (*ibid.*: p. 54).

One further comment on the Exloo necklace has been provided by Waterbolk (1995) who, in his discussion of some Dutch amber artefacts, suggested that the amber for the Exloo beads and pendants could have been collected from the Dutch coast. Even today amber can be collected along the shores of the Wadden islands along the northern coast of the Netherlands, sometimes even in quite large lumps (Waterbolk & Waterbolk, 1991).

## 5. THE OTHER DUTCH BRONZE AGE FAIENCE BEADS

### 5.1. Vogelenzang

In 1959, on an ancient line of sand dunes, a settlement of the Hilversum Culture was found at Vogelenzang (Groenman-van Waateringe, 1966: p. 81). During the excavation two refuse pits and a number of postholes were found, but the ground had been so badly disturbed that it was impossible to make out the plans of any structures (*ibid.*: p. 82). In the pits, the excavators found animal bones, charcoal, pottery and flint (Ten Anscher, 1990: p. 45). The pottery was decorated in the same style as Hilversum pottery from funerary contexts (Groenman-van Waateringe, 1966: p. 85). Also found was a deposit of flint items including, among other artefacts, scrapers and arrowheads (*ibid.*: p. 86). A faience bead was found by an amateur, Mr K.H. de Raaf. Accounts of the discovery of the faience bead vary, but Robert van Heeringen (1978:

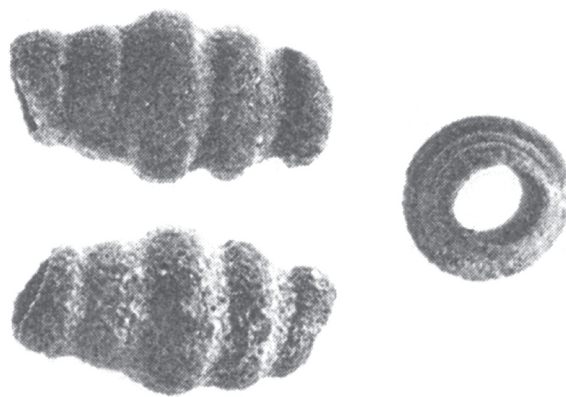


Fig. 4. The ribbed biconical faience bead from Vogelenzang (from Van Heeringen, 1978). Scale 3:1

p. 288) reports that Mr de Raaf stated he had found it during the official excavation and not afterwards, as Groenman-van Waateringe had claimed (1966: p. 176), and that he found it together with a pair of amber beads. According to Jay Butler (1990: p. 55) the beads were found on the spoil heap. Mr de Raaf was allowed to keep them, along with other finds from his own investigation of the unexcavated areas between the trenches (Ten Anscher, 1990: p. 48).

The faience bead (fig. 4) is of a ribbed biconical shape, with five segments (Van Heeringen, 1978: p. 288). Van Heeringen (*ibid.*) describes it as being 14.5 mm long and 5–8 mm in diameter, with a horizontal thread-hole 3–4 mm in diameter. The ends are angled, the bead is tilted slightly along its axis, and in end-view both the outer surface and the thread-hole are very slightly flattened. The grooves forming the segments run around the bead. There is a colour and texture difference from one side of the bead to the other, with one side being blue-green and smooth and the other being a paler blue-green to white and having a slightly uneven texture. As will be seen below, this feature has been noted in many other faience beads from north-west Europe.

The Vogelenzang bead bears a strong resemblance, in both shape and size, to two ribbed biconical beads found in a Bronze Age grave at Boscregan, St. Just in Penwith, Cornwall (Beck & Stone, 1936: pl LXIII; Sheridan & Shortland, 2004: fig. 21.9). The Cornish beads had formed part of a necklace along with ten segmented faience beads. This necklace had accompanied cremated human remains, and been buried under a cairn; four Trevisker Urns had also been found under the same cairn (Borlase, 1879).

Glasbergen, echoing Smith's earlier remarks about the Exloo necklace, claimed that the Vogelenzang

bead had been imported from southern England by a Hilversum Culture immigrant; he pointed out that Hilversum pottery bore a strong resemblance to the biconical urns found in Wessex (Glasbergen, 1969: p. 30). Van Heeringen concurred that it must have been imported from the 'Wessex Culture' of Southern England (Van Heeringen, 1978: p. 288). Sheridan and Shortland subsequently argued (2004: p. 273) that it had probably been imported not from Wessex itself, but rather from the South-West of England, where biconical and fusiform faience beads, imitating the shale and composite beads of Wessex, appear to have been manufactured.

As indicated above, a radiocarbon date – or rather, two dates – were obtained from charcoal from the refuse pits at Vogelenzang. An initial date of 3140±70 BP (GrN-2997) was obtained, and Groenman-van Waateringe reckoned that this equated to 1139±70 BC (1966: p. 83). Bakker (1966: p. 158) subsequently corrected this (by subtracting 1950 from the BP date) to 1190±70 BC, and commented that the date appeared to be rather late. Because some doubt remained as to whether the charcoal sample had actually come from the pits, in the late 1980s a new sample was taken, and dated to 3470±60 BP (GrN-14692; Ten Anscher, 1990: p. 77. This calibrates to 1940–1630 cal BC at 2σ, using OxCal v3.10; this same programme is used throughout this article). This new date accorded better with the general pattern of dating for Hilversum pottery. However, the possibility that this date had been obtained from old wood cannot be ruled out (Lanting & van der Plicht, 2001/02: p. 176). Furthermore, as far as the dating of the bead is concerned, it must be stressed that the original stratigraphic relationship between the dated charcoal and the bead is not known, even though broad contemporaneity is indeed possible.

An attempt was made in January 2002 (by EH) to track down the Vogelenzang bead in order that it might be included in the programme of compositional analysis. Contact was made with Mrs Vester, the daughter of Mr de Raaf, and with her daughter; both are in possession of part of Mr de Raaf's collection. It emerged that the bead is currently in the possession of Mrs Vester's brother in the United States. The family expressed a willingness to return the bead to the Netherlands next time a family visit is made.

## 5.2. Den Haag-Bronovo

Another Hilversum Culture settlement on an ancient line of sand dunes, in the grounds of the Bronovo Hospital in Den Haag, has produced another faience bead (fig. 5, plate 2.2). Sherds of Hilversum pottery



Fig. 5. The segmented faience bead from Den Haag-Bronovo (drawing Marion O'Neil). Scale 3:1

had already been found in 1986 (Hallewas, 1987: p. 311), and new excavations in 1990 uncovered a small segmented bead, among sherds of Hilversum pottery and pieces of flint (Van Ginkel & Magendans, 1991: p. 31). This farming settlement was represented by Bronze Age postholes and pits, but again it proved impossible to identify clear structural plans (Waasdorp, 1991: p. 329). The excavators noted that the main part of the settlement had been located higher up on the beach, but that part had been severely eroded (*ibid.*).

Two radiocarbon dates were obtained from material excavated in 1986. The peaty level underlying the culture level produced a *terminus post quem* date of 3320±35 BP (GrN-15010); and pieces of wood and charcoal from the overlying culture layer produced a date of 3435±35 BP (GrN-15011). However, the latter date is probably too old, due to an 'old wood' effect (Lanting & Van der Plicht, 2001/02: p. 187). The *tpq* date (which calibrates to 1690–1510 cal BC at 2σ) is acceptable in terms of our current understanding of the date of the Hilversum Culture, but the relationship between this date and that of the bead remains uncertain, especially since the bead was found four years after the excavations that produced the dated samples.

The bead is fragmentary and in poor condition, three segments and part of a fourth surviving. In February 2002, by kind permission of Corien Bakker, the Den Haag City Archaeologist, this bead was taken to NMS in Edinburgh for non-destructive analysis. It was subsequently returned in August 2002. A detailed description of this bead is presented in Appendix 1, and the results of this analysis are presented in section 6.2.3.

## 6. NEW RESEARCH ON THE EXLOO NECKLACE AND ON THE DEN HAAG-BRONOVO BEAD

### 6.1. Methodology

When, through the kindness of Jaap Beuker (Drents Museum, Assen), Jan Lanting (Groninger Instituut



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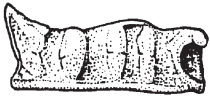
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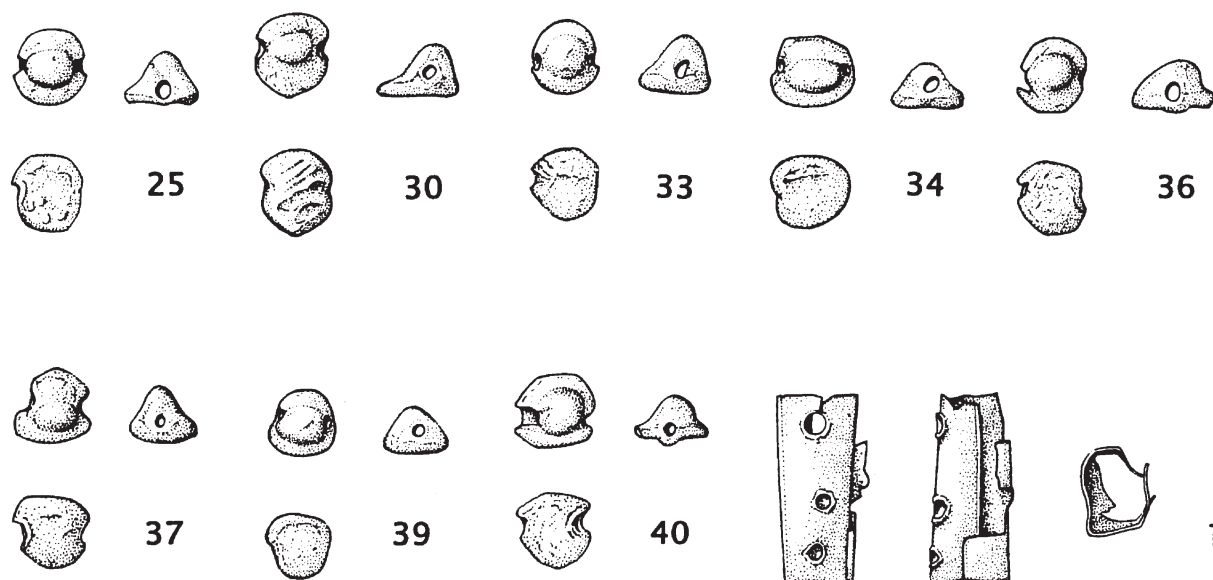


Fig. 6. The faience, tin and bronze beads from the Exloo necklace (drawing Marion O'Neil). Scale 2:1

voor Archeologie) and Corien Bakker (Den Haag City Archaeology Service), the Exloo necklace and the Den Haag-Bronovo bead were lent to NMS in 2002, they were examined and analysed in order to obtain more information on their method of manufacture; degree of wear; composition (in the case of the faience and tin beads); and likely provenance. This work formed part of a wider programme of research into Bronze Age faience and associated ornaments, of which the results so far are summarised in various publications (e.g. Sheridan & Shortland, 2004; Sheridan *et al.*, 2005). In particular, the compositional analysis of the Exloo faience beads was intended to check whether McKerrell's claim that they differed significantly from British faience beads in their tin content (McKerrell, 1976: p. 314) was correct. In the following text, the numbering of the Exloo components corresponds to that shown in Pl. 1.1 and figs 6 and 7.

All the beads and pendants were examined (by JAS) under a binocular microscope at up to  $\times 20$  magnification. In addition, non-destructive compositional analysis using X-ray fluorescence spectroscopy (XRF) was undertaken on all of the faience beads, on the bronze bead (along with a comparative tubular sheet bronze bead from the hoard from Migdale in North-East Scotland) and on six of the tin beads (segmented beads 3, 14 and 42 and plano-convex beads 11, 15, 25). Further non-destructive compositional analysis was carried out on all the faience beads and on four tin beads (segmented beads 3 and 14, plano-convex beads 18 and 37) using a scanning electron microscope

(SEM); this also permitted the photographic recording of the beads' shape and microstructure at high magnification, and helped in determining how the beads had been manufactured. These analyses were carried out by Dr Kathy Eremin (then of NMS Department of Conservation & Analytical Research), and the results are discussed below by Dr Andrew Shortland (then of Oxford University). Fuller details of the analytical methods used, and the results thus obtained, are presented in Appendix 2. Further photomicroscopy and conventional photography were undertaken, and the items were all drawn by Marion O'Neil (figs 1–2).

The amber beads and pendants were not analysed, since previous work by Beck and Shennan (1991) had concluded that all of the amber used for ornaments in Bronze Age Western Europe belongs to the 'Baltic' variety (*succinite*), that is not only found in the Baltic area, but is also washed up on the North Sea coasts of Jutland, North-West Germany, the Netherlands and England. The primary deposit in which this 'Baltic' amber occurs is Lower Tertiary brown coal, formed out of remains of extensive coniferous pine forests. The well-known 'blue earth' in which amber is found along the southern Baltic shore is a secondary deposit, containing amber eroded out of brown coal layers. North Sea amber seems to originate largely from primary Tertiary brown coal layers, pushed up by salt-domes in the subsoil, and eroded by the sea (Waterbolk & Waterbolk, 1991).

The question of the probable proximate origin of

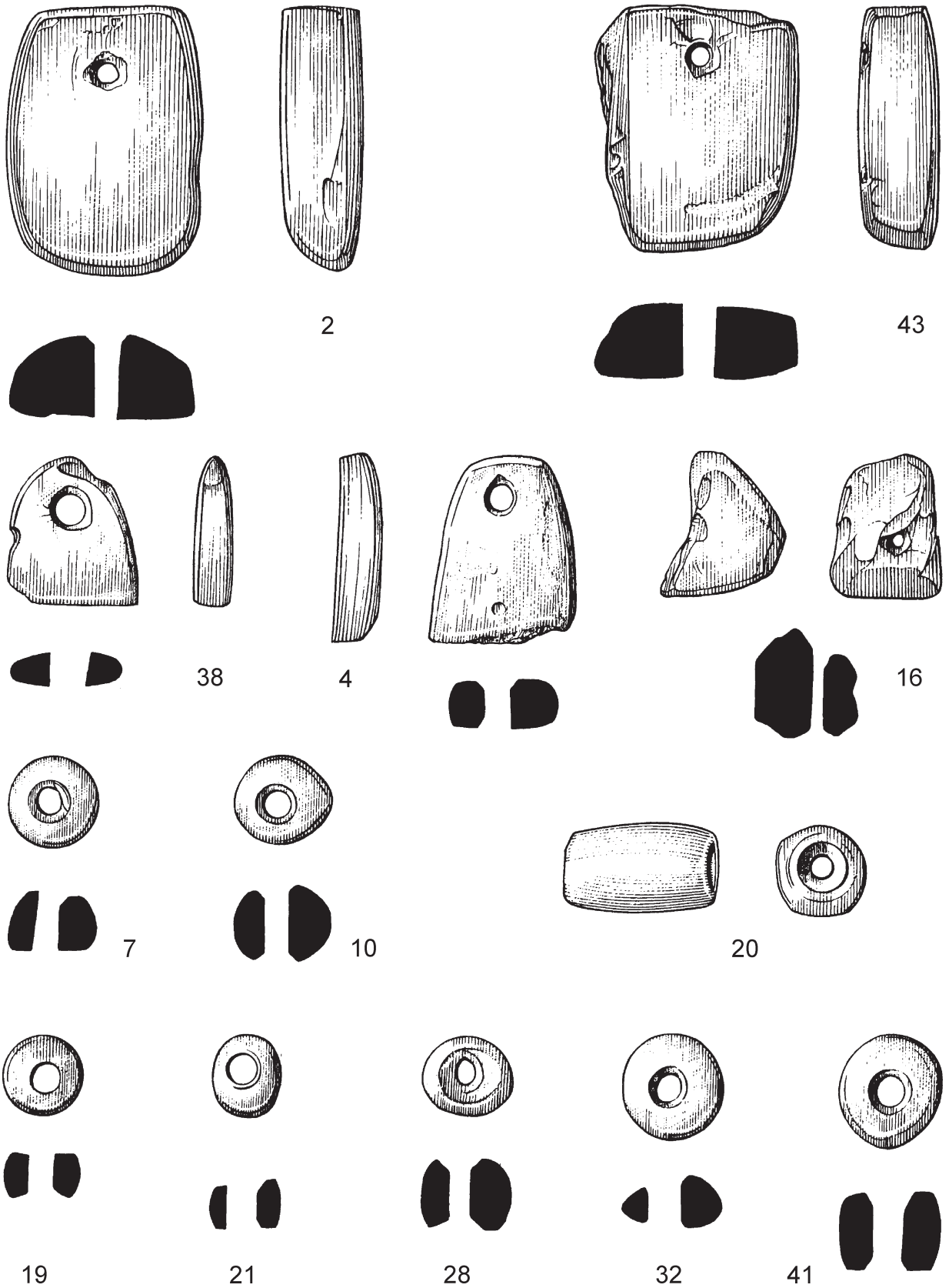


Fig. 7. The amber beads and pendants from the Exloo necklace (drawing Marion O'Neil). Scale 2:1



the Exloo amber beads and pendants is discussed further below.

## 6.2. Results

### 6.2.1. *Morphology, manufacture and wear – the Exloo necklace*

As indicated above, the Exloo necklace currently comprises 43 beads and pendants: one bead of tubular sheet bronze, four faience beads, thirteen beads and pendants of amber, and the remaining beads of tin (the broken amber bead in the Drents Museum was not inspected by JAS; information on this bead has been provided by EH). Detailed descriptions of each item are provided in Appendix 1.

The slightly flattened tubular bronze bead (1; fig. 6) consists of a thin sheet of bronze that had been wrapped around a former, or rolled into a tubular shape, with its edges overlapping. It appears to have been cut down from a longer item, and part of one edge had also been cut off. A row of three small perforations along one side of the bead near its edge, plus a fragmentary hole on the side that overlaps this, suggests that it had probably originally been sewn onto a garment as a dress accessory; *comparanda* and dating evidence for this type of ornament are discussed below. The object was therefore old when it was incorporated into the necklace as a recycled, and probably treasured, 'heirloom' item (*cf.* Woodward, 2002). The amber items (fig. 7) fall into two groups:

1. Those where the shape of the parent material had been minimally modified (namely the pendants 2, 4, 38 and 43, made from flattish pebbles, plus the 'chunky' bead 16).
2. Beads with more extensive shaping, formed into oblate or similar shapes (7, 10, 19, 21, 28, 32, 41 and evidently also the broken amber bead) or roughly cylindrical, slightly fusiform shape (20).

As will be discussed below, it is likely that the latter beads represent 'recycled' components of one or more amber spacer-plate necklace.

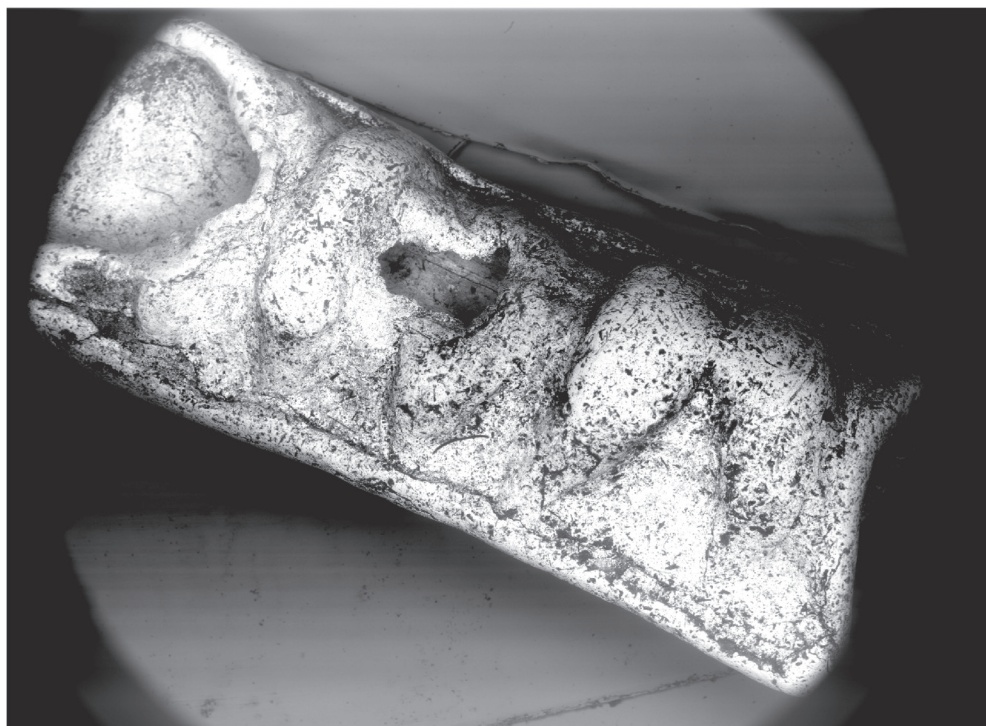
The amber items had originated as small blocks or pebbles – indeed, the pair of large pendants 2 and 43 had almost certainly been made from a single large flat pebble – and in some cases (especially with the minimally-modified items) natural irregularities in the amber's original surface are visible (*e.g.* in 4). Some of these resemble orange peel, while others are larger hollows.

Rare toolmarks on the amber items indicate some

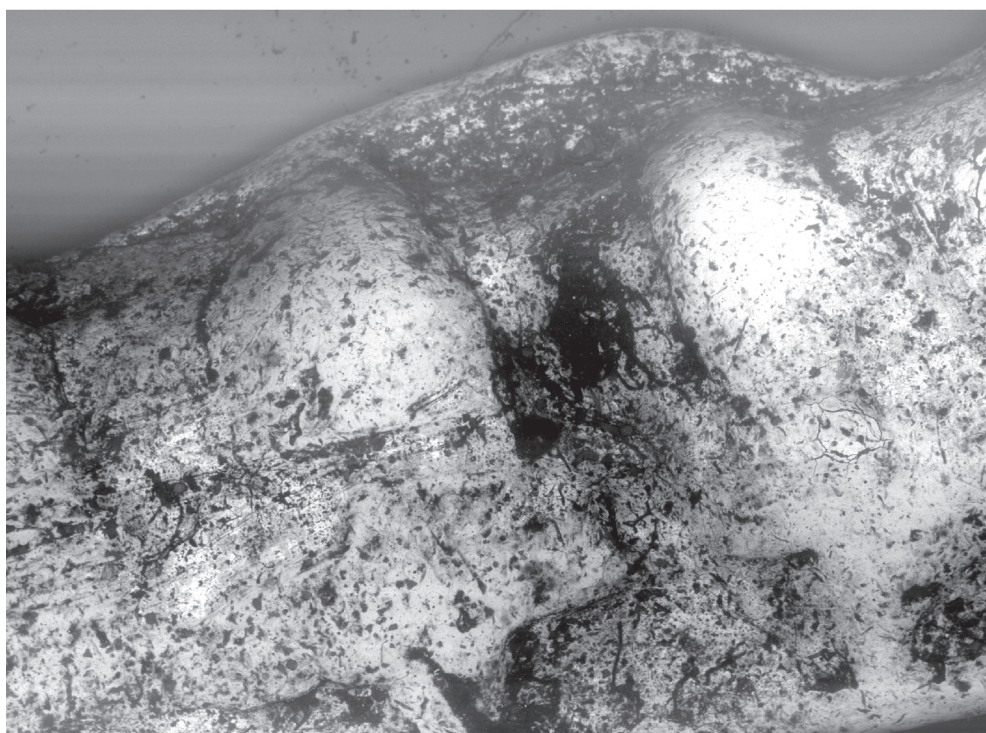
of the manufacture methods involved, although the main method of shaping and smoothing – abrasion using increasingly fine materials – has mostly left no traces and can only be inferred. An exception is the pendant 43, where shallow grinding striations are visible on its top edge: these relate to an attempt to smooth an undulating area. Bead 20 has a small area of different-looking shallow rilled striations, which may have been produced by a narrow, toothed gouge, in a small hollow where the natural pocking of the amber's original surface is visible (plate 2.3). Whether or not the gouging was an attempt to remove this 'orange peel' appearance, the marks have survived because the gouged area is mostly lower than the rest of the bead's surface; too much of the surface would need to have been abraded away to remove this blemish.

As regards perforation of the amber items, an abortive borehole is visible on pendant 4 (plate 2.4), and from this one can infer that a solid, round-tipped drill bit c. 1.8 mm in diameter at its tip had been used here. Variation in the skill and the technique of perforation is discernible between the pendants and chunky bead on the one hand, and the more extensively-worked beads on the other. With the former, chipping around the thread hole suggests insufficient care in drilling; the abortive borehole on pendant 4 has already been mentioned, and on the 'chunky' bead 16 there also appears to have been an unsuccessful attempt at drilling, to effect a pendant shape. In the event, the final boring of bead 16 was achieved by drilling from both sides; they join in a dog-leg. In contrast, the more extensively-worked beads have neater boreholes, with no or minimal chipping. It is likely that they would have been drilled mostly from one side, but with a 'starter' indentation having been made on the other side, to prevent chipping as the drill bit approached the end of the bead. A long 'starter' perforation is visible in the long bead 20, where a ledge can be made out close to one end where the two boreholes failed to meet exactly; and with bead 7, two ledges in the borehole show where the 'starter' indentation ended and the main drill hole progressed. The presence of smooth, cone-shaped facets around most of the boreholes on these beads suggests the use of a material such as sand to aid the drilling.

Evidence that the amber items had been worn before the necklace had been deposited exists mainly in the form of thread-wear. This is usually manifested in the smoothing of the ends of the thread hole, but in some cases is shown by more extensive, localised wearing down of one (or more) area around the thread hole. Another feature that may indicate wear is the partial smoothing of ancient chip and flake scars.



1



2

Fig. 8. Scanning electron microphotographs: 1, of segmented tin bead 14, showing impressions made by a triangular-ended spatulate tool (and also showing the pulled-back upper surface at the top left hand end); 2, of segmented tin bead 3, showing impressions made by a triangular-ended spatulate tool (images NMS).

No example of extreme wear was noted on the amber beads; unfortunately, it is impossible to tell what length of use would have resulted in the observed degree of wear. Amber is a fairly soft material.

The tin beads (fig. 6) also fall into two groups: segmented (represented by seven – or rather, six and a half beads) and plano-convex (represented by 18 beads). The former seem to be skeuomorphs of segmented faience beads; the latter could conceivably also be attempted skeuomorphs of a faience form, namely the small spherical or oblate bead, found mostly in eastern and east central England (*e.g.* at Eagleston Flat, Derbyshire: Barnatt, 1994).

Although greyish-silver and partly matt now, the tin beads would originally have been a bright silver colour, and shiny over most or all of their surfaces.

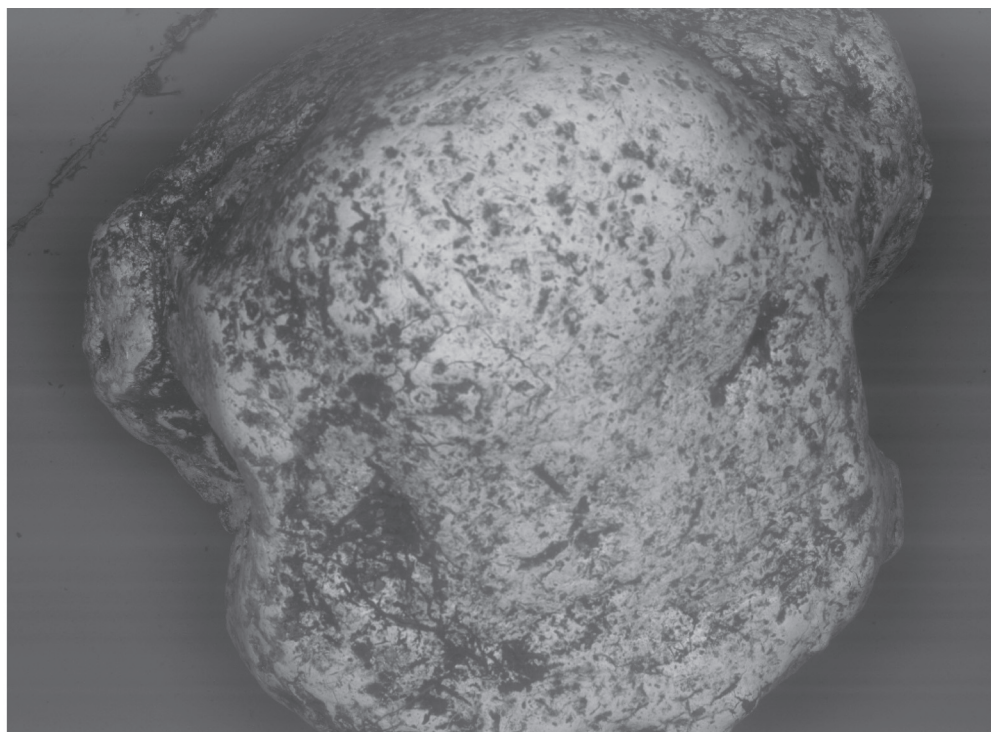
The two types of tin bead would have been manufactured in different ways. The segmented form appears to have been created by uniting two apparently cast sheets of metallic tin, each around 0.5 mm thick in most cases, and indenting the surfaces with a spatulate tool while the metal was still soft, to create false-relief ‘segments’ (the triangular shape of this tool is clearly visible on the SEM photomicrograph of bead 14, fig. 8.1; a squarer-ended tool may have been used on bead 3, fig. 8.2. In each case the tool would have been impressed, on each side, from either long edge of the bead). Uniting the two sheets appears to have been achieved by wrapping them round a round-sectioned former, c. 2 mm in diameter – its outline is visible in ‘ghost’ form along part of the thread hole in several beads (plate 2.5) – and carefully folding the long edges of the sheets over each other, like pastry. This technique can clearly be seen in the fragmentary bead 8, where along one edge the ‘upper’ sheet had been folded down over the ‘lower’, while along the other edge the ‘lower’ sheet had been folded over the ‘upper’ (plate 2.6). The difficulties of working with sheet tin meant that none of the segmented beads achieved the intended cylindrical form; most are elliptical in cross-section. Determining whether these beads had been worn for long before the necklace’s deposition is difficult, but there are hints that the beads had indeed seen some use. The uneven shape of their ends may have resulted – in at least some cases – from bead-against-bead pressure, since tin is a fairly soft metal. In the SEM photomicrograph of bead 14 (fig. 8.1), for example, one side of one end looks to have been pushed back. Similarly, smoothing of the outside of the ends of several beads could have resulted from bead-on-bead rubbing. Thread wear could have been responsible for the smoothing seen on the inside of

the ends of the thread holes; and the fact that bead 8 had part of its length torn off completely in antiquity indicates that this bead was not new when deposited. Finally, the worn appearance of the segments on beads 27 (plate 2.7) and 31 may relate to their having been used for some time before deposition.

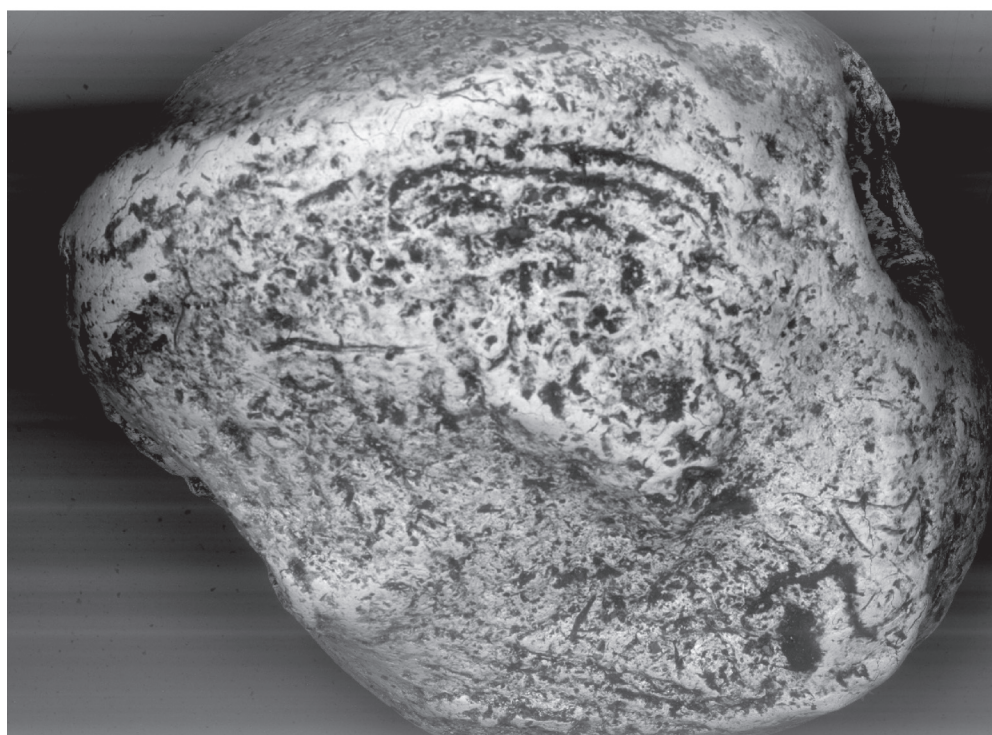
The plano-convex tin beads would have been made by pouring small amounts of molten tin into one-piece moulds, then piercing the casts thus produced to create a thread hole, using a thin tool of circular section. The moulds may well have consisted of wet sand, their shape formed by creating a semi-circular or oval depression recessed beneath a saucer-like disc (the slightly uneven surface of the mould can be seen in fig. 9.1, the SEM microphotograph of bead 37; fig. 9.2 shows rippling on the flat surface of bead 18 that must have occurred as the tin solidified). The end results vary somewhat in shape, but this was due in large part to the vagaries of the casting process. Variations in the shape of the nipple-like projection suggest the use of at least two moulds. That the perforations had been made after casting is indicated by the facts that: it would have been very difficult to cast a perforated bead; the perforation is cleanly defined; and in some cases, the tool has pulled (*e.g.* bead 17), gouged (*e.g.* beads 24, 40) or deformed (*e.g.* beads 12, 15) the metal, or accidentally perforated the base (*e.g.* beads 6, 12), as it was pushed through the bead from one direction (plate 2.8). With a thread-hole diameter of 1.0–1.7 mm, a very narrow tool must have been used: either a metal wire, or a fire-hardened narrow wooden point (Eddie Daughton pers. comm.). Either would have been capable of piercing the metal while it was still soft. The use of narrow metal wire during the Early Bronze Age has been inferred elsewhere in the manufacture of jet (Sheridan & Davis, 2002) and amber (Sheridan *et al.*, 2003) jewellery.

The narrowness of the thread-hole in these plano-convex tin beads would have dictated the thickness of the necklace thread as a whole, and indeed in beads 33 and 37, a narrow channel caused by thread-wear reveals the thickness of the thread to have been c. 0.5 mm. The thread must have been made of a very thin but strong organic material, such as linen, hemp or nettle, of which no trace has survived.

The four faience beads (fig. 6, plate 1.2) comprise three (5, 13 and 35) with three segments and one (26) with four. The latter’s kinked appearance results from it having been broken and clumsily glued since its discovery. Bead 5 appears to be complete, and 13 may also be (see detailed description below); 26 and 35 each have old, worn fracture surfaces at one end, so



1



2

Fig. 9. SEM photomicrographs: 1, of plano-convex tin bead 37, showing uneven convex surface reflecting the irregular surface of the mould; 2, of plano-convex tin bead 18, showing rippling on the flat side (*i.e.* the uppermost side as the tin was poured into the mould) as the tin solidified (images NMS).

had originally been longer.

Their cylindrical shape and their segmentation would have been achieved by wrapping the faience paste round a piece of straw (whose corrugated surface has left its impression in the thread hole of bead 35), then rolling the blank bead over a ribbed implement that may have resembled an old-fashioned butter pat. The consistency in segment shape and size, and in overall and thread hole diameter between beads 5, 13 and 35 suggests that these three beads could have been made in a single batch – indeed, the remarkable similarity between 5 and 35, with their broad outer segments and narrow central segment, suggests that the same tool may have been used to shape both beads. Bead 26 differs slightly from the others in its shape and dimensions. The beads' turquoise colour and (in places) shiny surface appearance results from the use of a copper-based glaze; and the presence of clear glaze drip lines on the interior of beads 13 and 35 indicates that the glaze had been applied to the beads in slurry form, rather than integrated in the paste mix prior to their firing. On bead 35, the smooth glaze is interrupted along one side, revealing the rougher-textured core below (plate 1.2, bottom left). This partial loss of glaze could have happened if the bead had been laid on a flat surface to dry prior to firing.

The hardness of faience beads means that thread wear is generally not detectible. However, the fact that beads 26 and 35 have old, worn fracture surfaces suggests that they were not new when deposited.

#### 6.2.2. *Morphology, manufacture and wear – the Den Haag-Bronovo bead*

This is an incomplete segmented bead (fig. 5, plate 2.2) with three complete segments and part of a fourth present; length 9 mm, external diameter 4.5–6.0 mm; thread-hole diameter 2.5–3 mm. The wall thickness varies from an estimated 0.3 mm to 2.5 mm (at the thickest segment). One end is the bead's original end; the other has a fairly fresh fracture surface, as if broken relatively recently (perhaps during or after excavation); no further fragments are reported to survive. The bead had been mounted on a plastic tube for display purposes, and its mounting in this way has almost certainly caused the major longitudinal cracks visible along the sides of the bead. This tube obscures the interior.

The bead is not a neat cylinder, but is slightly squashed, being a roughly pointed oval in end view. It is likely that this shape results from the joining of the two original edges of the faience paste, as it was wrapped round the cylindrical former; despite sub-

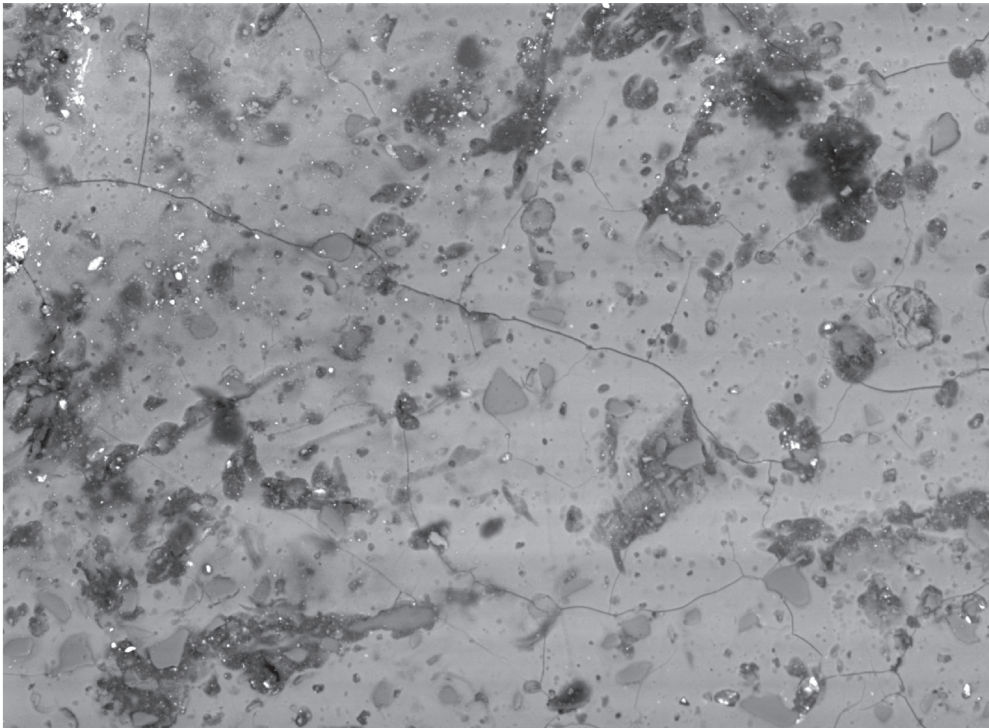
sequent rolling to create the segments, this irregularity in shape was not smoothed out. The segments are variable in their shape and spacing, and in their height and depth around the bead's circumference, but they appear to have been made using the same, 'butter pat', technique as had been noted for the Exloo faience beads.

The bead's colour is a medium turquoise on one side; the colour on the other side is obscured by modern glue. Over part of its circumference, the colour penetrates through the wall; elsewhere the (relatively recently) exposed core is whitish. The surface is matt, and there are only a few small areas of 'glassy' glaze. Individual unfused quartz grains are visible in the glaze and in the core. It is impossible to say whether this bead had been old when discarded.

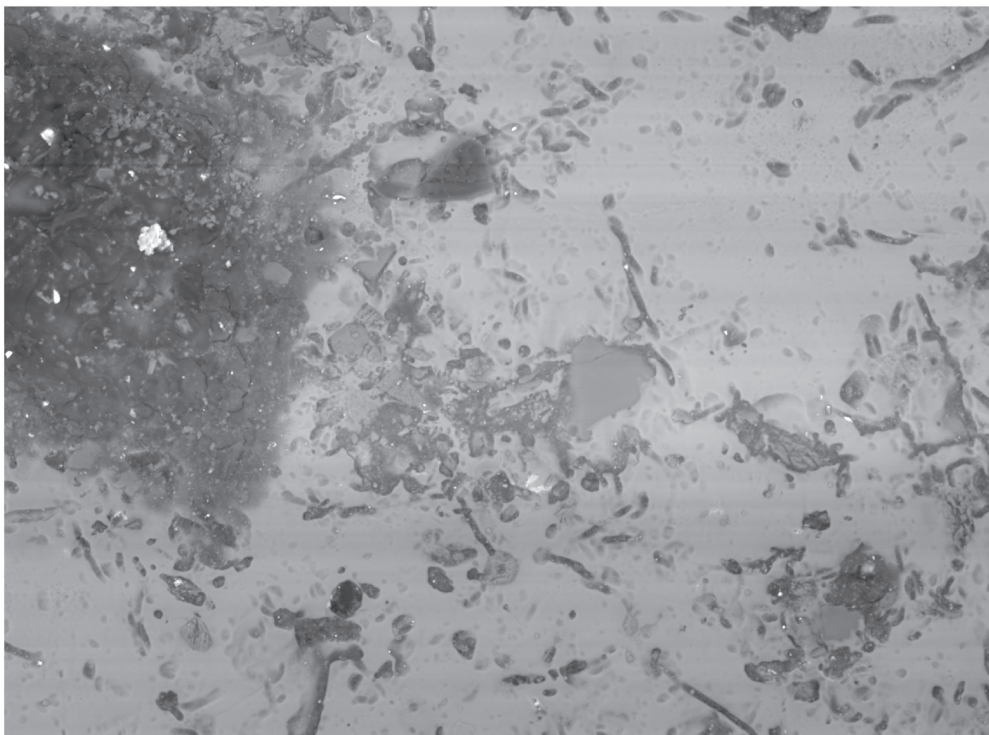
#### 6.2.3. *Results of the compositional analyses of the Exloo components and of the Den Haag-Bronovo bead (JAS, Katherine Eremin & Andrew Shortland)*

The results obtained from the compositional analyses were semi-quantitative (in the case of XRF) and qualitative (in the case of SEM). Use of both XRF and SEM allowed a complementary range of elements to be investigated. Microphotographic imaging using the SEM allowed the identification of features such as hairline cracking in the faience glaze (fig. 10), variability in glaze texture and thickness, and the presence of extraneous peat fibres on one of the faience beads. SEM microprobe analysis allowed the investigation of individual specks of material, such as tiny particles of tin on the surface of the faience beads.

The bronze bead (1) was analysed alongside a tubular sheet bronze bead from the hoard at Migdale, Sutherland, in North-East Scotland (NMS X.DQ 344), using XRF. As expected, both consisted mainly of copper, with some tin; the Exloo bead also contained small amounts of arsenic, iron and nickel, and the Migdale bead traces of arsenic, lead, silver, antimony and possibly nickel. The beads were not dissimilar in composition, but their comparability will have been affected by corrosion, and by previous cleaning and conservation. The analysis was intended solely to check on the overall composition, rather than to attempt sourcing of the raw materials or allocation to a specific bronzeworking tradition; in order to learn any more about their comparability, destructive sampling and metallographic analysis would need to be undertaken.



10



11

Fig. 10. SEM photomicrograph of faience bead 13, showing hairline cracking of the glaze (image NMS).

Fig. 11. SEM photomicrograph of faience bead 26, showing exposed patch of core material (top left); scratches and a few individual unfused quartz grains in the glaze; and white specks, one of which is a tin particle (image NMS).

The tin beads were found to be of pure metallic tin, with traces of lead, arsenic, copper, iron and zinc (some of which could have been caused by contamination from other beads in the necklace, and/or from the depositional environment).

As previously noted, the faience beads from Exloo (along with the bronze bead and some of the tin beads) had already been analysed by Hugh McKerrell in the 1970s, using a portable XRF machine, and he had concluded that “these (faience) beads are very different in tin content from the British examples (the Exloo beads having less tin). There is thus no question of export of material from there to the Netherlands.” (McKerrell, 1976: p. 314). However, the 2002 re-analysis in NMS using XRF and SEM led to a very different conclusion being reached. Comparative XRF analysis of bead 5 with a faience bead from Findhorn in North-East Scotland revealed that both had virtually identical tin contents (the possibility of enrichment from the tin beads in the Exloo necklace could be ruled out, as tin is a less ‘mobile’ element than the others mentioned above). Furthermore, SEM analysis of areas of well-preserved glaze (*e.g.* on bead 26) revealed that the alkaline substance (plant ash) that had been used as a fluxing agent, to aid the fusing of the constituent sand grains during the firing of the beads, was a mixed alkali, having potash and soda in almost equal quantities. The use of a mixed alkali fluxing agent is wholly characteristic of British (and Irish) faience beads and the use of this kind of agent, rather than the high-soda materials used in the Near East and Mediterranean, may well have been learned from central European faience makers (Sheridan *et al.*, 2005: p. 220; *cf.* Robinson *et al.*, 2004 for Early Bronze Age Polish practice). Another point of similarity between the Exloo beads and British examples is the fact that the various constituent elements seem to be poorly mixed: in other words, for example, there were various discrete metallic particles present, visible in SEM microphotographs as bright backscatter specks (fig. 11). Some of these are tin-rich (*e.g.* in beads 13 and 26); one is copper-rich (in 26); one, silver-rich (in 26) and one, lead-rich (in 5). The copper, silver and perhaps lead may well derive from the copper-based colourant (probably bronze) that had been used to give the glaze its distinctive turquoise colour; the tin could have come from the same source, or may have been added separately. Other elements noted from the SEM and XRF analyses included rubidium, strontium and zirconium that had probably been present as impurities in the sand, and alumina, found in significant quantities in the glaze. It was clear from both kinds

of analysis that the beads had been badly weathered through groundwater leaching. Despite this, they retained a significantly higher copper content than the aforementioned Findhorn bead (which had been through a funeral pyre).

Analysis of the Den Haag-Bronovo faience bead using the same techniques confirmed that this bead was also weathered, probably through groundwater leaching, and that it contains appreciable amounts of copper, a little potassium (from the alkali fluxing agent) and a trace of lead (probably from the copper-based glaze colourant). Various impurities in the sand were detected using SEM. It differed from the Exloo beads in having been made using a slightly coarser-textured sand, whose individual grains had fused to a lesser degree in firing (fig. 12; note also the thin surface glaze, probably applied). Its tin content (as determined using XRF) was also significantly lower than that seen in the Exloo beads. Notwithstanding these differences, it is comparable in its composition with some British faience beads (not all of which have high tin contents), and both the texture of the sand and the method of bead manufacture are in keeping with what has been observed for British (and especially southern English) beads.

## 7. LIKELY PROVENANCE OF THE BEADS AND PENDANTS IN THE EXLOO NECKLACE, AND OF THE DEN HAAG-BRONOVO AND VOGELNLANG BEADS

### 7.1. Recapitulation

From the foregoing, and from the detailed descriptions presented in Appendix 1, the following can be concluded about the Exloo composite necklace. It comprises a variety of materials and bead/pendant forms, probably from diverse sources, namely: an old sheet bronze dress accessory, recycled as a bead; four amber pendants made from minimally-modified flat pebbles, of which two had almost certainly been made from the same pebble; a ‘chunky’ bead – a minimally-modified, perforated amber pebble; a group of more extensively-worked, and more skilfully-manufactured amber beads, probably recycled (as argued below) from an amber spacer plate necklace; two sets of tin beads, each made in a consistent manner, with the segmented beads appearing to be a skeuomorph of faience segmented beads, while the plano-convex ones may or may not also be a skeuomorph of a faience form (see below); and four faience beads, of which



Fig. 12. SEM photomicrograph of the Den Haag-Bronovo faience bead showing the grainy appearance of the bead's fracture surface. The lighter area to the left is glaze on the bead's outer surface (image NMS).

three form a set and could have been manufactured in the same batch, and the fourth was manufactured separately.

Most, if not all of the beads show signs of wear – either from prior use elsewhere, or from having been worn on the Exloo necklace (or both). The necklace thread would have been very narrow (c. 0.5 mm) and organic.

Where might these component parts have come from? And might the faience beads from Den Haag-Bronovo and Vogelenzang have had a similar provenance? This question can be approached in two ways: in terms of the ultimate sources of the raw materials used; and in terms of the proximate provenances – in other words, the areas from which the owners of the necklace and of the individual faience beads could have obtained them. Of these, the second approach is the most promising.

## 7.2. Sources of the raw materials

Regarding the bronze bead, the absence of copper and tin deposits in the Netherlands means that it – or its constituent materials – must have been imported. Unfortunately, however, further investigation of prov-

enance was impossible in the current study as it would necessitate destructive analysis.

With the amber components, previous analytical work on prehistoric amber artefacts by Beck and Shennan (1991) has pointed out that compositional differentiation of material from different source locations in Northern Europe is impossible to achieve, since all the amber has ultimately the same origin: Lower Tertiary pine forests (see also Kars & Boon, 1993: p. 84). Nevertheless, with regard to the Exloo amber, it is relevant to note the observation by Waterbolk (1995: p. 90) that a *potential* local source exists, as amber could readily be collected from along the North Sea coast, where it had been washed up, especially islands on the Wadden (Waterbolk & Waterbolk, 1991). He pointed out that, during the Neolithic and the Bronze Ages in the Netherlands, amber artefacts are only found on the high ground next to the coast.

As regards sourcing of the tin, the main candidate area is South-West England, where the largest western European deposit of tin-bearing rock is found (Penhallurick, 1986; Pernicka, 1998). Other candidate areas are the Erzgebirge, on the border between Saxony and Bohemia; Brittany and the Massif Central



in France; and the north-west Iberian peninsula (there are also a few other, minor, deposits elsewhere in Europe). Various attempts have been made to characterise tin from different source areas by investigating tin isotopes in both natural cassiterite (the commonest parent material: McNaughton & Rosman, 1991; Gale, 1997) and in artefacts containing tin (Gale, 1997). Unfortunately, the results have been disappointing, and so isotopic compositional analysis (which, in any case, would be destructive), cannot determine the source of the tin used for the Exloo beads. All that one can say is that the tin, or the beads, must have been imported.

The pinpointing of source areas for the raw materials used to make the faience beads can be just as difficult, with the NMS project relying on patterns of compositional variability (*e.g.* in the impurities present in the sand) to build a case for small-scale, localised production (Sheridan & Shortland, 2004). However, the fact that the Exloo beads are compositionally (and in other respects) consistent with southern English beads, and that their composition differs from that of Early Bronze Age faience beads from Central Europe (Harding & Warren, 1973), points to Southern England as the most likely source area. Regarding the Den Haag bead, the low tin content does not rule it out as being a candidate for import from this region, as comparable specimens are known from there.

### 7.3. 'Proximate provenances' for the beads

By asking the question 'Where might beads (or indeed necklaces) like these have come from? In other words, where had they already been in use?', we can get closer to a solution.

Regarding the bronze bead (which is unique in the Netherlands: Butler, 1990: p. 54), the use of tubular sheet-metal beads is fairly widespread and long-lived in Chalcolithic and Bronze Age Europe. According to David-Elbiali (2000: p. 256), they first appeared in Late Chalcolithic contexts in the Carpathian Basin and Hungary during (or before) the early third millennium BC. During the Early Bronze Age their use spread from Hungary to South-West Slovakia, then Southern Germany (where they were in use by 2150 BC, at Straubing, for example: Hundt, 1958) and Switzerland, then throughout the Únětice 'Culture' area of East Central Europe. Their use (as beads and/or as dress accessories) continued into the Middle and Late Bronze Ages, as shown by various 'Tumulus Period' examples, of 14<sup>th</sup>/13<sup>th</sup> century BC date, from

central and Northern Europe (David-Elbiali, 2000; Jockenhövel, 1997: pp. 244–6).

In Britain, tubular sheet metal beads were in use (albeit as a rare luxury) from c. 2300/2200 BC. A gold bead in a composite necklace from a grave at Chilton, Hampshire, Southern England is associated with a European Bell Beaker and a date of 3740±80 BP (OxA-1072, 2290–2020 cal BC at 1σ, 2500–1900 cal BC at 2σ; there is also a *terminus ante quem* of 3780±80 BP: Russel, 1990); copper beads from a similar necklace in a Beaker-associated burial at Beggar's Haven (Devil's Dyke), Sussex are assumed to date to 2300–1900 BC; and in Scotland, the bronze beads from the Migdale hoard – which, like the Exloo example, have lateral perforations and which had probably been used as dress accessories – are directly dated to 3655±75BP (OxA-4659, 2140–1930 cal BC at 1σ, 2300–1750 cal BC at 2σ: Sheridan *et al.*, 1995). A set of tubular bronze beads from a woman's grave at Ingleby Barwick in North-East England also dates to the turn of the millennium (Vyner pers. comm.); and from the first half of the second millennium, two tubular bronze beads are known from burials of cremated bones in handled urns at Bere Down and Roke Down, Dorset (Grinsell, 1959: pp. 88–89), and eight narrow bronze examples are known from a composite necklace at Tara, in the east of Ireland, and dated to 3370±60 BP (GrA-19180, 1750–1530 cal BC at 1σ, 1880–1500 cal BC at 2σ: Ó Ríordáin, 1955; Brindley *et al.*, 2005: p. 293; O'Sullivan 2005).

It is therefore conceivable that the old, worn and cut-down Exloo sheet bronze bead could have been imported from Britain (with Ireland as being an unlikely source, since the Tara beads are unique there). Central Europe, however, cannot be ruled out as a candidate area; it is known that other bronze artefacts were being imported to the Netherlands from Central Europe during the first half of the second millennium BC (*e.g.* the flanged axehead from de Kwaalburg, Alphen: Butler, 1963).

Regarding the amber pendants, Butler's claim (1990: p. 54) that close foreign parallels for these exist in Brittany (Kernonen en Plouvorn, Finistère) and Southern England (Wilsford barrow G7, Wiltshire: Beck & Shennan, 1991: fig. 11.16.3) can be challenged, since these *comparanda* are more extensively worked than the Exloo examples (indeed, the same could arguably be said of the north Dutch *comparandum* from Hauwert which Butler illustrates). Given that amber was available in the north of the Netherlands, and in view of the absence of convincing parallels, it seems more likely to the current authors that

these pendants had been made locally, using local amber. The same can be said of the ‘chunky’ amber bead (16). The use of minimally-modified amber pebble beads is known from Bell Beaker contexts in the north of the Netherlands (at Tumulus IV, Garderen, Veluwe and at Tumulus III, Aalden, Drenthe: Lanting & Van der Waals, 1976: figs 11, 14), and so there may conceivably have been a pre-existing tradition in the Netherlands of making such beads.

With the more extensively-worked amber beads, however, a strong case can be made for their having been recycled from a southern English amber spacer plate necklace – a point not made explicit by Butler in his wide-ranging review of possible *comparanda* (*op cit.*: p. 54). Such necklaces appear to have been made in Wessex around the beginning of the second millennium BC, using imported amber, as a way of creating bigger, better, even more prestigious versions of the jet spacer plate necklaces that had been popular in Northern Britain (Sheridan & Davis, 2002). All the forms found at Exloo can be paralleled closely in a necklace such as the one from Upton Lovell Barrow G2e (Beck & Shennan, 1991: fig. 11.15.1); the flat sides noted on many of the beads would have suited their use in such a necklace, where large numbers of such beads were strung in multiple strands, separated by spacer plates. The redeployment of components from amber spacer plate necklaces is well attested from finds in Britain (*e.g.* Knowes of Trotty: Sheridan *et al.*, 2003, and Wessex: Woodward, 2002) and continental Europe, including Greece (Harding, 1984). One parallel for the re-use of beads from a spacer plate necklace in a composite necklace can be cited from Barrow Hills, Radley, Oxfordshire (Barclay, 1999: fig. 5.12).

The tin beads – at least, the segmented form – also suggest a link with Southern England, because of their similarity to the aforementioned lost segmented tin bead from Sutton Veny, Wiltshire (Penhallurick, 1984: fig. 24). That bead could have been made in South-West England, the source area for the tin; however, it is equally, if not more likely, that it had been made by a specialist worker in Wessex, where a range of craft specialists, working with imported raw materials, were evidently based (see Needham, 2000 for a discussion). It appears that south-west English tin was already being exported to continental Europe for use in bronze-working from as early as c. 2200 BC (Pernicka, 1998), and it has been argued that the elite in Wessex had achieved control over its supply by around 2000 BC (Sheridan & Shortland, 2004); so the exportation of segmented tin beads to Exloo

from Wessex appears quite plausible. Even though the plano-convex beads find no obvious parallels – unless an attempt was being made to copy the globular faience beads that are mostly found in East Central England (*ibid.*) – nevertheless they, too, could represent exports from Wessex. Other British tin beads may well have existed, but perished, since it is unusual for prehistoric artefacts of metallic tin to survive; the exceptional conditions at Exloo may have preserved a form that had originally been in wider use.

Regarding *comparanda* for the segmented tin beads, mention must be made of a necklace of 47 such beads, found in a female grave of the Straubing culture at Buxheim, Bavaria (Möslein & Rieder, 1998). The grave can be dated to an early phase of Reinecke A1. The archaeological date seems to be confirmed by the <sup>14</sup>C date on bone collagen: 3705±40 BP (GrA-20281/21373, 2190–2030 cal BC at 1σ, 2210–1960 cal BC at 2σ: Lanting & van der Plicht, 2001/02: p. 128). There is some question over the reliability of the dating, however, since the dated bone collagen content was low (Lanting, pers comm). Although the Buxheim beads could have been made using imported English tin, the date of this grave makes it unlikely that they had been imported as beads, since they pre-date the first appearance of faience segmented beads – the form which they appear to be copying – in Britain. They could, however, be copying the segmented faience beads that were in use in Central Europe at the time. The Buxheim beads do not offer an especially close parallel for the Exloo segmented beads, as they differ in shape (being flat on one side and having triangular projecting ‘segments’ on the other) and had been cast in a segmented-shaped mould, and then perforated lengthwise (Möslein & Rieder, 1998: fig. 33). Therefore, the link with the Exloo beads seems tenuous and it is highly unlikely that the latter had been imported from Central Europe.

As suggested above, the faience beads from Exloo and Den Haag show strong compositional affinities with southern English faience beads. They have also been formed, and glazed, in a manner that is entirely consistent with southern English segmented beads: the segmentation has been effected by rolling a tube of paste against a former shaped like an old-fashioned butter pat, and the glaze has been applied as a thick slurry (see Sheridan & Shortland, 2004, for a discussion of regional variability in faience bead manufacture). This, and the extreme paucity of faience beads (namely six) in the Netherlands, in contrast to their marked abundance in Britain and Ireland (with at least

350 known, mostly in Wessex), militates against their local manufacture and points very strongly at Southern England as the source area. The segmented beads from Exloo and Den Haag could well have been imported from Wessex, while the ribbed biconical bead from Vogelenzang could well have been made in South-West England, where similar beads are known (e.g. from Boscregan, as discussed above in section 5.1 and in Sheridan & Shortland, 2004: p. 273 and fig. 21.9). The thin scatter of faience beads in the Netherlands is part of a wider continental pattern, where 18 beads are scattered around the fringe of continental Europe between Brittany and Denmark, and are separated from the next nearest continental finds by a considerable distance (*ibid.*: fig. 21.5). In every case, exportation from South-West England or from Wessex can be argued (*ibid.*).

Finally if one considers *comparanda* for the necklace as a whole, it is clear that Southern England once again provides the clearest – indeed, the only convincing – examples (see Sheridan, forthcoming, for a detailed discussion). The Exloo necklace is unique in the Netherlands; the presence of a rock crystal bead in the amber necklace from Emmerdennen tumulus (Butler, 1990: fig. 5) does not echo the rich mixture of material found at Exloo. In contrast, at least 35 Early Bronze Age composite necklaces, featuring components of various materials and often including ‘heirloom’ items, are known from Britain and Ireland, with over half of these from Wessex. It is possible to trace their evolution from the early, simple form as seen in the aforementioned late third millennium examples from Chilbolton and Devil’s Dyke, to the more variegated forms as seen in the first half of the second millennium (e.g. at Amesbury Solstice Park, Wiltshire: Sheridan, forthcoming). Constituents of these latter necklaces include beads of amber, jet, shale, faience and stone; wood and shell; and natural geological freaks such as fossils and, in one case, a fragment of stalactite, made into a bead. It is clear that the use of old, ‘heirloom’ components was underway by at least as early as c. 1900/1850 BC, to judge from dated examples from Bedd Branwen in Wales (grave H, 3540±60 BP, GrA-19652, 1950–1750 cal BC at 1σ, 2040–1690 cal BC at 2σ: Lanting, pers. comm.) and Barrow Hills, Radley in Southern England (barrow 16, pit E: 3455±40 BP, GrA-26608, 1880–1690 cal BC at 1σ, 1890–1680 cal BC at 2σ).

Evidently, therefore, the *idea* of using a composite necklace seems likely to have reached the Netherlands from Britain, with Wessex being the most likely proximate source; Wessex also features as a likely

proximate source for most of the necklace’s components. The most plausible interpretation for the Exloo necklace is that it had been imported, as a composite necklace, from Wessex, with the chunky amber bead and the amber pendants constituting locally-made additions to it.

## 8. THE DATING AND SIGNIFICANCE OF THE EXLOO NECKLACE

### 8.1. Dating

Clues as to the likely date of the Exloo necklace are provided by the individual components – especially by the faience beads – and by radiocarbon-dated composite necklaces from Britain and Ireland.

As discussed above, tubular sheet metal beads and dress accessories have a long overall currency, and bronze versions are known from c. 2200 BC onwards. This offers a *terminus post quem* for the Exloo bronze bead; but whether it had been made long after 2200 BC, and just how old it was when it became incorporated in the necklace, is much harder to determine.

Regarding the amber beads that seem to derive from one or more amber spacer plate necklaces: such necklaces are a classic grave find from a series of elite southern English graves conventionally labelled as ‘Wessex 1’ (e.g. Needham, 1996). Although the dating of ‘Wessex series’ graves leaves a great deal to be desired, and there is some disagreement about dating, nevertheless both Stuart Needham (*ibid.*: p. 132) and Lanting & van der Plicht (2001/02: pp. 138–140) have suggested the 19<sup>th</sup>–18<sup>th</sup> centuries BC as a likely bracket for ‘Wessex 1’ graves, and this provides a *terminus post quem* for the Exloo beads. As with the Exloo bronze bead, however, we do not know how old these amber beads were by the time the necklace was deposited. However, we do know, from the radiocarbon-dated composite necklaces from Barrow Hills, Radley and Bedd Branwen, that such beads were already being ‘recycled’ in this way by 1900/1850 BC.

As for the faience beads, the programme of dating initiated by Jan Lanting, and continued in collaboration with the second author (JAS) since 2001, has revealed that faience was being used in Britain and Ireland by the 19<sup>th</sup> century BC and continued to be used until the 15<sup>th</sup> century BC, if not marginally later. Some 28 radiocarbon dates (mostly deriving from this dating programme) are now available for British and Irish specimens (fig. 13), and there are also two dates for Breton finds (Port-Melitte: 3570±70 BP, OxA-647 and Mez-Nabat: 3330±60 BP, Gif-6073),

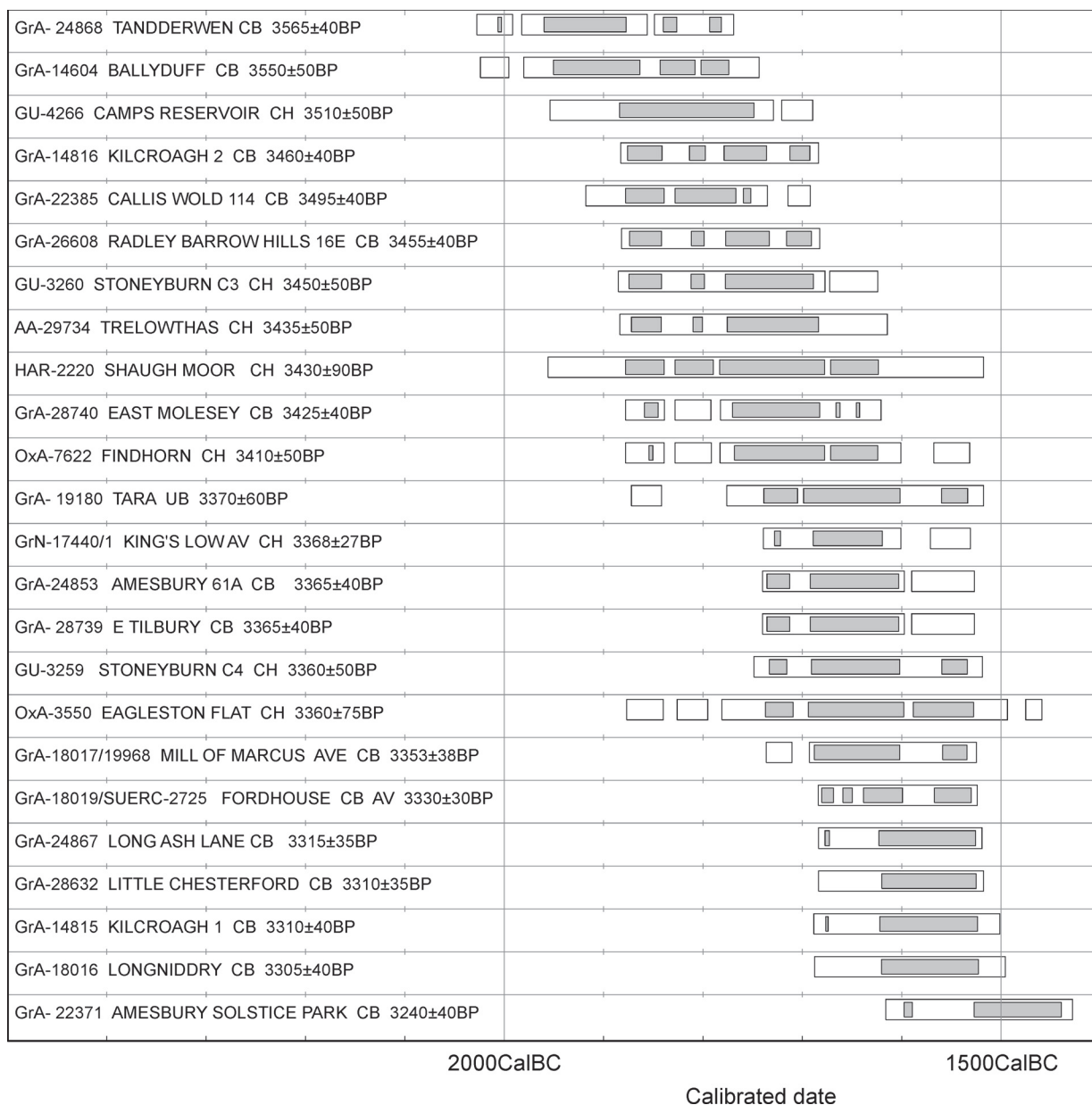


Fig. 13. Chart showing radiocarbon dates for British and Irish faience beads, calibrated using OxCal v.3.10. Three sets of duplicate dates are shown, and a charcoal date for Kilcroagh 2, which is very similar to the cremated bone date shown here, is omitted. Key to material dated: CB = cremated human bone; CH = charcoal; UB = unburnt bone.

plus the aforementioned Dutch dates. (This dating incidentally refutes the traditionally-held view that faience was introduced to Britain and Ireland during the 14<sup>th</sup> century BC by traders from Egypt or the eastern Mediterranean). This date range provides a bracket within which the Exloo faience beads are likely to have been made and used.

If one accepts that the segmented tin beads are skeuomorphs of English segmented faience beads,

then, on the basis of the British and Irish faience dating, a *terminus post quem* of the 19<sup>th</sup> century BC should apply.

As regards the dating of comparable composite necklaces in Britain and Ireland, there are now six examples whose associated cremated or unburnt human bone has been radiocarbon-dated: these are the aforementioned examples from Bedd Branwen, from Barrow Hills, Radley, and from Tara, plus examples

from Amesbury (barrow 61a), Wiltshire (3365±40 BP, GrA-24853, 1740–1600 cal BC at 1σ, 1740–1520 cal BC at 2σ); Little Chesterford, Essex (3310±35 BP, GrA-28632, 1620–1520 cal BC at 1σ, 1690–1510 cal BC at 2σ); and Amesbury (Solstice Park), Wiltshire (3240±40 BP, GrA-22371, 1600–1430 cal BC at 1σ, 1620–1410 cal BC at 2σ). Together, these suggest a currency for this kind of composite necklace of 1900/1850-c. 1450 BC.

Overall, therefore, it would seem that the earliest plausible date for the Exloo necklace is the 19<sup>th</sup> century BC, and a date between the 19<sup>th</sup> century and the 15<sup>th</sup> century seems likely. Given the fact that the amber ‘spacer plate necklace’ beads are not excessively worn, a date closer to the 19<sup>th</sup> than to the 15<sup>th</sup> century would seem likely to this author.

## 8.2. The significance of the necklace

In Britain and Ireland, Early Bronze Age composite necklaces appear to have been the treasured possessions of the elite, and it is likely that the Exloo necklace would have been regarded as a precious, exotic prestige item. As argued elsewhere (*e.g.* Sheridan, forthcoming; Sheridan & Shortland, 2003; 2004), its significance and value need not have resided solely in the rarity and exotic nature of its components. Rather, the necklace may well have been accorded magical power, and used as an amulet – a form of ‘supernatural power dressing’ – to protect its owner from evil and/or to bring good fortune and health. That the constituent beads could have been accorded special qualities is suggested by: the fact that amber is electrostatic, and warm to the touch, and has been accorded magical properties by many societies around the world; the fact that the manufacture of tin and faience involves an apparently magical transformation from unprocessed raw materials to finished product, and the know-how to effect this may well have been kept a secret; the age of some of the components: old, ‘recycled’ beads could have been imbued with the power of the ancestors who had originally owned them. By adding locally-made amber components to the necklace, the owner may have been wishing to boost the necklace’s amuletic power.

To judge from the available evidence from reliably-sexed skeletons, composite necklaces (and faience beads in general) appear to be an overwhelmingly female association. The only reliably-sexed male association are those from Bedd Branwen and Tara. (The sex of the 14-year-old Tara youth has recently been confirmed as male: Laureen Buckley, pers. comm.). It is therefore likely that the Exloo necklace was (at

some point in its existence) the property of a woman.

The British and Irish composite necklaces have been found in funerary contexts, either directly or (in the case of one from Cossington in Leicestershire) indirectly with the dead. The fact that the Exloo necklace was found as a stray find, in an area that had probably been marshy at the time, suggests that it had probably been deposited as a votive offering. The sacrifice of such a precious object is understandable in terms of our understanding of Early Bronze Age ritual practice in the Netherlands (Butler, 1990).

How the Exloo necklace came to be in the Netherlands is, as we have seen, a question that many have previously tried to answer (such as Isobel Smith, 1961: p. 110: “It is...a reasonable conjecture that the famous necklace found at Exloo arrived from England in the pocket of a Hilversum immigrant”). The concept, originally promoted by Glasbergen (*e.g.* 1957b), of a colonisation of the Southern Netherlands and Northern Belgium by groups from Wessex, is no longer accepted (Theunissen, 1999); but the existence of strong links between these areas, from at least as early as 1800 BC, is undeniable (*ibid.*, esp. p. 198; *cf.* Butler, 1963). And a link with the tin trade – to return to another theme that has been discussed over the decades (*e.g.* Van Giffen, 1930: pp. 121–122) – seems eminently plausible, as the current author has argued elsewhere (*e.g.* Sheridan & Shortland, 2004). Pare (2000) has pointed out that there seems to have been a major upswing in the consumption of tin for bronze manufacture in many parts of Europe from 2000 BC; and it seems likely that this upswing relates to a reorganisation of the tin supply, whereby a monopoly over its movement from the south-west English source area to the rest of Britain and Ireland and into continental Europe was achieved by the elite in Wessex. (A similar reorganisation in the supply of copper seems also to have taken place around the same time: *ibid.*: p.28.) This would (at least in part) account for the wealth of the Wessex elite, and their acts of conspicuous consumption, such as the burial of lavish grave goods (Sheridan & Shortland, 2004; *cf.* Needham, 2000 on other aspects of the Wessex elite phenomenon). It might also help to account for the links with the ‘Hilversum culture’, as a key area around the mouth of the Rhine, one of the principal routes into Central Europe.

The Wessex-‘Hilversum’ connection (as shown, for example, in the shared use of Wessex biconical cinerary urns) could well have been the mechanism for the transmission of the Exloo necklace and the Den Haag-Bronovo bead from England to the Netherlands,

with further connections within the Netherlands being responsible for the necklace's movement northwards to Exloo (as argued above, the Vogelenzang bead had probably arrived from further to the south-west in England, but it could well have travelled as part of the same basic network of contacts). Whether the Exloo necklace was brought across the sea by an immigrant or visitor from Southern England, or a visitor from the Netherlands to Wessex, we shall never know. But the phenomenon of long-distance travel, by artefacts and people and ideas, is well-attested during the Early Bronze Age; and obvious parallels for the long distance travel of artefacts and ideas from Wessex include, for example, the Tara composite necklace in Ireland (Ó Riordáin, 1955; O'Sullivan, 2005) and the 'heirloom' amber spacer plate necklace fragments and amber dress accessories that were found at the Knowes of Trotty in Orkney and that must have been imported directly from Wessex (Sheridan *et al.*, 2003). The Exloo necklace can therefore be understood in terms of the geographically extensive social and economic dynamics of the early second millennium BC.

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APPENDIX 1.  
 DETAILED BEAD DESCRIPTIONS OF THE EXLOO NECKLACE BEADS  
 AND OF THE DEN HAAG-BRONOVO FAIENCE BEAD

The numbers correspond to those shown in plate 1.1 and figs 6–7. Dimensions (all in mm) are presented in table 1.

Table 1. Dimensions of the Exloo beads and pendants.

The shape of the object determined whether length, diameter, width or thickness was recorded.

<i>Bead No.</i>	<i>Length</i>	<i>Max. width</i>	<i>Max. ext. diameter</i>	<i>Max. thickness</i>	<i>Min. threadhole D.</i>
<i>Bronze</i>					
1	12.25	5.4		4.4	4.0
<i>Amber: minimally- modified items:</i>					
<i>Pendants</i>					
2	23.5	16.5		7.4	c. 3
4	16.6	12.4		4.4	c. 1.8
38	13.0	11.3		3.5	c. 3.5
43	21.7	17.9		7.4	2.8
<i>'Chunky' bead</i>					
16	12.7	9.6		9.1	1.0
<i>Amber: more extensively-shaped beads:</i>					
<i>Roughly oblate:</i>					
7			8.0	5.25	2.5
10			8.75	6.4	3.1
19			7.25	3.6	3.0
21			7.35	4.2	3.25
28			6.1	7.5	3.0
32			9.2	5.0	c. 3.3
41			9.4	6.5	c. 3.3
<i>Roughly cylindrical</i>					
20	14.0		8.1		c. 3.2
<i>Tin: segmented</i>					
3	13.3	5.5		2.6	c. 2.1
8 (= frag.)	4.0	4.25		c. 2.9	c. 1.9
14	12.0	4.6		c. 3.0	c. 2.25
27	9.3	c. 5.1		3.25	2.4
29	10.3	4.3		c. 3.5	1.9
31	10.5	4.2		c. 3.5	2.25
42	20.15	4.5		c. 3.3	c. 2.8
<i>Tin: plano-convex</i>					
6			5.1	3.3	1.05
9			3.8	c. 3.6	1.7
11			4.7	3.35	c. 1.35
12			c. 4.2	3.3	1.0
15			4.6	4.1	1.25
17			4.9	3.5	1.1
18			4.7	3.0	1.25
22			5.6	3.3	1.0
23			5.3	3.8	c. 1.1
24			5.8	3.2	1.5
25			5.05	3.3	1.0
30			5.65	3.85	c. 1.0

<i>Bead No.</i>	<i>Length</i>	<i>Max. width</i>	<i>Max. ext. diameter</i>	<i>Max. thickness</i>	<i>Min. threadhole D.</i>
33			4.9	3.35	c. 1.15
34			5.5	3.2	1.3
36			5.0	3.2	1.1
37			5.1	3.65	c. 1.1
39			4.85	3.25	c. 1.3
40			5.0	3.4	c. 1.0
<i>Faience</i>					
5	9.15		4.7		3.0
13	8.7		5.45		3.1
26	12.5		4.3		c. 2.3
35	8.7		5.15		2.8

## 1. THE EXLOO NECKLACE

### Bronze (fig. 6)

1. Slightly flattened tube of thin (0.2 mm) sheet bronze with one long edge slightly overlapping the other. Both ends are slightly uneven, as if they had been cut down from a longer bead, and the overlapping edge has had an irregularly shaped section cut from it. The cutting of this edge had truncated a small perforation, 1.1 mm in diameter, that had been punched from the inner side of the sheet prior to its being rolled into a cylinder. Not far (between 2.2 mm and 2.7 mm) from the bead's other long edge is a line of three similar perforations, again punched from the inner side; these are c. 1.7 mm in diameter, and irregularly spaced. A tear extends from one of these to the end of the bead. A blackish corrosion product covers most of the surface, but an area of this has been rubbed or filed off, possibly at the time when McKerrell was examining the necklace in 1972, to reveal the bead's original bright bronze colour.

### Amber (principal images: fig. 7, plate 1.1)

General comments: most of the amber items are of a dark reddish or orange-red amber; one (7) is a paler, yellowish colour and another (28) a marbled yellowish-red. Most are wholly or mostly opaque (the exceptions being noted below); all have been polished, and show various degrees of sheen; and many exhibit the crazing that is a natural degradation characteristic of amber artefacts.

#### 1.1. Minimally modified items

##### 1.1.1. *Pendants (i.e. items with a thread hole near one edge)*

2. Large pendant. Roughly rectangular with rounded edges, straight sides, and sloping, rounded bottom edge. The 'upper' surface is slightly domed, the 'lower' flatter but slightly

undulating (reflecting natural surface variability). Thread hole mid-way across the pendant and c. 4 mm from its upper edge. This pendant forms a pair with 43 which is made from virtually identical amber, is of roughly the same size and exactly the same thickness. (The similarities are most clearly discernible in fig. 7 and Pl. 1.1.) As argued below (see 43), the two pendants had almost certainly been made from the same parent pebble, sawn and snapped lengthways; the right side of 2 is the most likely candidate for the cut side, even though this edge had been carefully smoothed and polished. The thread hole, not perfectly circular but with parallel sides, has ancient chipping on either side that would have been caused by the drilling process. The interior of the borehole is uneven; it is hard to tell whether the hole had been drilled from one or both sides. There are possible signs of thread pull on either side, extending at a slight angle from the top of the hole as though the pendant had been worn at a slight angle (which would be consistent with its use on the necklace). These consist of smooth depressions at the edge of the perforation. A shallow flake scar on one corner of the 'lower' surface is relatively recent; another along the right edge was produced in antiquity, and may derive from the process of dividing the parent pebble (see 43).

43. Large pendant, forming a pair with 2. Roughly rectangular, with rounded corners and minimally domed surfaces. Upper edge squared off (and with striations visible from the grinding process), but natural hollows from the original edge of the pebble still present. Natural hollows, incompletely ground, also present on both sides and along the right edge; one of the hollows here has an 'orange peel' texture. Left edge slightly ragged, and with straight cut/saw line extending a short distance inwards from the 'upper' surface, as though the pebble had been sawn then snapped in half. This fracture surface is clearly old, but had not been ground smooth. A depression extending from its lower side, with 'orange peel' texture, suggests that the pebble had narrowed naturally at this point, and that advantage had been taken of this feature when sawing and snapping the pebble. The fact that this left edge of the pendant does not match the right edge of pendant 2 exactly need not mean that the two pendants

had not been part of the same parent pebble; the latter has evidently been worked and smoothed more. (The small worn flake scar on the latter may be the last vestige of the process of separation.) Thread hole roughly central, c. 4 mm from top edge. Old chipping around thread hole on either side, probably from the drilling process. Had probably been bored from both sides, and more than one attempt had been made in the same place, as shown by a 'ghost' borehole extending part of the way through the pendant from the lower surface. Shallow striations near the thread hole on one side may result from the grinding of a surface irregularity. Ends of the borehole smoothed through thread wear, especially around the top of the hole; elsewhere, inside of thread hole knobblly.

4. Medium-sized pendant of mottled dark red and orange amber. Roughly trapezoidal shape, with uneven bottom edge appearing to be a worn fracture surface. One side – the 'lower' side – flat; 'upper' side very slightly domed; sides and top gently angled. Thread hole slightly left of centre, and c. 2 mm from the top edge; circular, parallel-sided, smooth sides and edges; unclear whether it had been bored from one side or both. There are also traces of another, abortive borehole at a similar distance from the bottom edge: c. 1.8 mm in diameter, this had been drilled using a solid, round-ended tool (Pl. 2.4). The pendant's surfaces had been smoothed and polished (particularly the flatter surface), but a few small natural surface irregularities are still visible, as pock marks that had not been smoothed away. Slight traces of thread wear at the top of the perforation on both sides of the bead, together with minor ancient chipping in this area on the 'upper' surface. Semi-translucent in parts.

38. Small pendant. D-shaped, closely following the original shape of the pebble, as shown by the incompletely-ground natural hollows along the edges and on both surfaces. Sides rounded off; surfaces marginally domed. Large thread hole roughly central and c. 3.25 mm from the top of the pendant; perpendicular, parallel-sided, and with an old small flake scar on one side attesting to chipping during the boring process. Uncertain whether drilled from one or both sides. Thread wear (indicated by smoothing and by slight localised enlargement of the borehole edge) suggests that the pendant had been worn at an angle; on one side, the thread pull was towards the natural indentation on the pendant's outer edge, while on the other side, the apparent thread pull was lower on the circumference. Minor ancient damage: some chipping to corners and side. Semi-translucent.

### 1.1.2. 'Chunky' bead

16. A pebble of irregular, roughly prismatic shape, minimally modified through the smoothing and polishing of the edges and part of the surface, and by the boring of a narrow, eccentric thread hole. One possible gouge-mark on one edge. Thread hole had been drilled from both sides, and is dog-legged (despite appear-

ing straight from the angle at which it was drawn). At either end its internal surface is smooth, suggesting some thread wear, but for the rest of its length it appears slightly rough. On one side, adjacent to the thread hole, a sizeable chip had been detached in antiquity; this may relate to an unsuccessful attempt to bore through the narrow side of the pebble to create a pendant rather than a bead. The damaged area had been partly smoothed over.

## 1.2. More extensively shaped beads

### 1.2.1. *Roughly oblate or annular*

7. Uneven bun shape, with flat base and small flat area on 'top', yellow amber. Slight surface irregularities on 'lower', flat side, and small natural depression on the 'upper' surface, indicate the original thickness of the pebble. Thread hole eccentric; not quite perpendicular, and not quite parallel-sided; ends in shallow facet on 'upper' side. Profile of thread hole at its upper end shows a tiny ledge on one side, and a small 'undercut' ledge below it on the other side. This indicates that the thread hole had been drilled mainly from the underside of the bead, with a small 'starter' hole at the top; the two perforations had not been exactly in line. Thread wear shown by all-round smoothing of the edge of the thread hole at either end of the bead, plus more marked wear on one side at the top; rest of thread hole slightly rough.

10. Roughly oblate in profile and ovate in plan. 'Lower' surface has very narrow flattish area around the thread hole. Thread hole slightly eccentric; parallel-sided, with narrow smooth facets at either end. Probably drilled from one side, with a 'starter' indentation at the other. Interior of thread hole smooth throughout, possibly due to thread wear. Modern surface alteration and damage: specks of 'blu-tak' on side; one small chip in same area, and another at edge of thread hole on 'upper' surface. Semi-translucent.

19. Annular; one side flattish (actually minimally dished), the other with a small flat area and broad facet extending from the thread hole. Latter very slightly eccentric; perpendicular; parallel-sided. Had probably been drilled from one side (the faceted side), but may have had a 'starter' indentation on the other side, of which no trace survives. Inside of thread hole smooth for entire length, possibly due to thread wear. Two ancient flake scars on the faceted side, and spall missing from edge; speck of blackish, recent encrustation on edge. Translucent.

21. Roughly annular (or rather, minimally wedge-shaped) with flattish sides and convex edge. Thread hole eccentric, perpendicular, parallel-sided, with smooth facet running round most of the circumference at both ends. Probably drilled from one side, with 'starter' indentation on the other. Facets and ends of thread hole smoothed through thread wear; rest of hole slightly rough.

Slightly worn flake scar on one side; hairline crack. Semi-translucent.

28. Chunky annular, with flat areas on either side, and convex edge. One side naturally dished. Thread hole eccentric, running through the junction between two colours in the amber; parallel-sided, with smooth facets at either end. May well have been bored from one side, with just a 'starter' indentation on the other side. Within the hole, traces of horizontal drill marks. Ends of thread hole smooth through thread wear; marked thread wear on one side, where a hollow has been worn at one point around the hole edge. Speck of extraneous brownish material present at one end of borehole, almost certainly deriving from its findspot environment.
32. Bun-shaped, with one side flattish. Thread hole slightly eccentric, perpendicular, parallel-sided, with narrow facet at one end and slight ancient chipping at other end. May well have been bored from one side, possibly with a 'starter' indentation on the other. Ends of thread hole smoothed through thread wear; elsewhere, hole slightly rough. Some very minor ancient chipping around the thread hole on the convex side, and one old chip scar on the flattish side. Semi-translucent.
41. Roughly annular (or rather, very slightly wedge-shaped) with flat sides and convex edge. Thread hole slightly eccentric, perpendicular, parallel-sided, with deep smooth facets at either end. May have been bored from one side, with a 'starter' indentation on the other. Smoothness of the facets may be partly due to thread wear. One small old flake scar on edge, plus natural-looking hollows (*i.e.* signs of the pebble's original surface), most of which have been smoothed to near-obliteration. Trace of extraneous modern 'blu-tak'-type material present. Semi-translucent.

### 1.2.2. *Roughly cylindrical, slightly fusiform*

20. Irregular, slightly faceted cylinder with gently bulging sides. Marks of a gouge-like tool visible on one side (Pl. 2.3), where a patch of the original pebble surface has not been ground flat (as previously discussed). Thread hole roughly central, horizontal, parallel-sided, with deep smooth facets at either end. Drilled from both ends, with imperfect junction so that a small ledge survives. Perforation from one end reaches almost to the other end. Interior of thread hole smooth at ends but elsewhere rough; smoothness due to thread wear.

Tin (principal images: fig. 6, plate 1.1)

### 1.3. Segmented beads

See above for general observations on the manufacture of these beads. General colour: silvery grey, often

lighter in the indentations; latter generally matt, while segments (in relief) have a low metallic sheen.

3. Complete bead, unevenly rectangular with one fairly straight edge and one undulating edge. One end flares widely, and seems to have had a narrow spur of metal folded back on itself. Wall c. 0.5 mm thick. Of variable shape in section: markedly flat at one end, squashed-oval at the other, and with a cylindrical stretch reflecting the original shape of the former over which the two constituent tin sheets had been bent. One side marginally more convex than the other; one side has two holes in it that had probably been there from when the sheet had been cast. On the 'non-holed' side, three clear sets of shallow indentations (plus one less clear set), forming approximately four 'segments'; on the other, traces of five or six indentations, making six or seven segments. Indentations made with roughly triangular-ended tool. On one side of the non-flaring end, the metal has been pulled back (see above for possible cause/s). At one end, parts of the interior of the thread hole are smoothed, possibly through thread wear. Extraneous, post-depositional material attaching: rootlets (probably from peat) and sand grain.
8. Fragment, comprising one end and two segments; had been torn right across in antiquity. Wall thickness c. 0.5 mm at thinnest point. Thread hole circular, following shape of item used as former (Pl. 2.5). Lapping of long edges (one sheet over the other along one edge, the same sheet under the other along the other edge) clearly visible (Pl. 2.6). Interior of perforation smooth, probably through thread wear.
14. Complete bead, unevenly rectangular with one fairly straight edge and one slightly undulating edge, and one slightly flaring end. Thread hole mostly circular. Ends slightly concave, with deep V on one side at the flared end, where metal had been pulled back or (more likely) worn away (the V appears to cut across a segment). Hole in body on the same side, formed during casting of sheet. Six pairs of indentations forming five segments on this side, six pairs (and vestiges of a seventh) forming seven segments on the other. Triangular-ended tool, c. 2.5 mm long and 2 mm across at widest end, used to define segments. It appears, from the SEM image (fig. 8), that the indentation may have taken place before the two sheets were united. The lapping of the two sheets has been neatly executed. The outside of the flared end is mostly very smooth, as if the bead had rubbed against another, and the metal at this end seems to have become folded back on itself slightly. Smoothing of inside of the flared end probably due to thread wear.
27. Complete bead (Pl. 2.7). In plan, an uneven rectangle with both long edges slightly undulating, and with ends slightly concave; in section a squashed tube at one end. Elsewhere the thread hole echoes the shape of the former. The two sheets had been lapped in the same way as in bead 8. Segments are relatively indistinct,

probably through wear. Four pairs of indentations, forming five segments (including the raised areas at the ends), on each side. At one end, the metal looks to have been folded back on itself. Extraneous post-depositional material: trace of fibre, probably from peat; and, of recent origin: glue on one end and speck of blu-tack like material.

29. Complete bead. Rectangular in plan, with one straight edge and one slightly undulating edge; oval in section. Ends uneven; on one side, concave at one end and with small rectangular tear (from thread pull?) at the other. On this side, five sets of indentations (one obscured by concavity of end), forming five segments; on other, four sets, forming five segments. Inside of thread hole smooth, possibly from thread wear; and at the 'concave' end, metal is thin over part of circumference; possible bead-on-bead wear?
31. Complete bead, uneven rectangular shape with one edge undulating; round-ish to oval in section. Ends rounded and uneven, with gaping split or tear on one side at one end. Segments fairly indistinct; surfaces look worn. On one side, four sets of indentations forming five segments (including raised areas at ends); on other, four sets, forming four segments. Unclear whether the tear was caused by thread pull, but at other end two narrow grooves on either side of thread hole might possibly have been produced by thread wear.
42. Complete bead – the longest in the necklace. Curving, slightly angular tube; one side of one end torn off; other end uneven, as if pulled or (perhaps more likely) pushed back. Small hole mid-way along one side, possibly present from time of casting. Sheet thickness variable, up to c. 1.4 mm at one end. On one side, ten sets of indentations, making eleven segments (including raised areas at each end); on other side, seven surviving sets of indentations and seven surviving segments. Possible thread wear at either end, shown by smoothing of the interior. Post-depositional features: one speck of peat-like encrustation; and small area where metal is brighter than elsewhere, suggesting possible surface preparation for analysis in past.
- 1.4. Plano-convex beads (6, 9, 11, 12, 15, 17, 18, 22, 23, 24 (Pl. 2.8), 25, 30, 33, 34, 36, 37, 39, 40):

General observations: in plan, no bead is truly circular, and the protruding globular or oval 'bulb' is often eccentric. In profile, the beads are roughly triangular. The base (which would have been the upper side as the metal was poured into the mould) is sometimes lipped; this would have occurred as the molten metal reached the top of the mould. Perforation was effected from the side of each bead, close to the base, and has sometimes been diagonal rather than horizontal, passing through the base (e.g. 12). Where it is horizontal it

has sometimes pushed the basal surface outwards, as in 40. With 17, the perforation was probably effected from both sides, as the hole is a figure-of-eight shape. The surfaces are of variable smoothness, and have a low metallic sheen.

Slight thread wear noted on almost all of the beads, shown by the smoothing of the end/s of the perforation, and/or by slight enlargement of one or more part of its circumference, usually on its basal side (thread wear to the side and/or top of the thread hole was noted on beads 9, 15, 18, 22, 25, 30, 34 and 36, in some cases in addition to wear to the bottom of the hole). On beads 33 and 37 (fig. 9), there is marked thread wear to the lower edge of the perforation, which has left a groove c. 0.6 and c. 0.5 mm wide respectively, the latter corresponding to the width of the thread.

Fingertip impressions, of variable clarity, noted on the basal surfaces of beads 18, 30, 34 and 36, indicating that the beads had been touched while the metal was still molten. With bead 18, the base is convex and uneven, and it may have been poked with a finger to flatten it after too much tin was poured into the mould. Other evidence for intervention before the metal had hardened (other than the thread-holes) comes in the form of facets on the surfaces of beads 30, 34, 36 and 37, which look to have been created by using a tool, either to loosen the bead from the mould or to help push the molten metal down into it.

Evidence for post-depositional surface alteration: tiny patches of brown encrusted material on 11, 18 and 23, probably peat; blobs of a dark grey extraneous solder-like material on 11, 23 and 24 are harder to identify but seem not to be an original feature, as one blob overlaps the thread-hole on 11; a suspiciously shiny area on 12 may indicate relatively recent abrasion, probably for analytical purposes.

- 1.5. Faience (principal images: fig. 6, plate 1.1, 1.2)
5. Complete three-segment bead, cylindrical, thin-walled, with crisply-defined flat-topped segments (two broad (2.1 and 1.8 mm) segments at either end, a narrower one (1.3 mm) in the middle), and deep, U-shaped indentations between them. 'Collared' ends indicate that the paste had ended in indented areas. Overall shape indicates use of 'butter pat' former to create segments. Ancient 'nibble' damage to part of the circumference of one end. Fine-grained, with several small open vesicles (gas bubbles formed during the firing of the bead). Colour and surface texture vary: over two-thirds of the circumference, rich intense turquoise colour and smooth, glossy surface, indicating

well-formed glaze. Over rest of circumference, paler, slightly greyish turquoise, and matt-textured: may be because most of glaze became concentrated in the other side of the bead as it dried prior to firing (or during firing). Colour of the core is dirty grey, visible over part of the thread hole. Glaze extends a short distance into thread hole at one end of bead, suggesting that the glaze may have been applied by dipping the bead into a glaze slurry. Interior of thread hole smooth; thinness of walls shown by penetration of light into the interior at the indented areas.

13. Three-segment bead, possibly complete but with old damage to one end (fig. 10). Cylindrical, thin-walled. One end appears original and undamaged; other had ancient fracture surface running round most of its circumference, but the presence of a small spur of glaze suggests that only a minimal amount of the bead is missing. Both ends are collared. Segment and indentation shape same as in 5, but widths of segments slightly different (2.25, 2.7, c. 2.1 mm respectively); could conceivably have been made using different part of same 'butter pat' tool. Fine-grained, with a few small open vesicles (showing as 'orange peel' effect in well-glazed area). Colour and surface texture vary: over one-third of circumference, rich turquoise colour and high gloss; elsewhere, matt and of variegated colour ranging from dull turquoise to greyish. Inside thread hole, core of bead is a dirty grey except for one turquoise area (where the rich turquoise of the exterior has penetrated through the wall). Interior of thread hole smooth, but with a glaze drip running along it, indicating that the glaze had been applied, probably by dipping the bead into a glaze slurry (or else – perhaps less likely – by painting it on).
26. (fig. 11) Incomplete bead with four segments; thin-walled. Originally cylindrical; current kinked shape is due to clumsy gluing of fragments following breakage of bead in the past. One end probably original, but obscured by glue; other end has ancient break. Segments are of a different shape from those in 5, 13 and 26: less crisply defined, and varying in shape and width along the bead, and in the depth of the indentations around the bead (indicating that the paste had not been rolled against the 'butter pat' former with even pressure all round). Fine-grained; just one open vesicle visible, at fracture end. Surface colour a variable turquoise around the bead: on one side a mottled greyish-turquoise; fairly glossy all round (but obscured by glue), but not as glossy as parts of the other beads. Core colour visible in the indentations (where it is a dirty grey) and in the weathered fracture surface (where it is whitish). Some glaze has extended from the surface, through the wall, into the thread hole. Hard to see along interior of thread hole.
35. Incomplete bead with three segments which are very similar to those on bead 5 and may have been made using the same 'butter pat' tool. Cylindrical, thin-walled; collared ends. One end probably original, but has worn fracture surface round most of its circumference. Other end has old fracture surface; but bead

need not have been significantly longer originally. Fine-grained, with a few small open vesicles, showing as 'orange peel' surface effect. Thick, glossy turquoise glaze extends all round bead, slightly darker on one side. On the lighter side, small discontinuities in the glaze suggest that the bead had been set flat while the glaze was still wet, leading to minor loss of glaze in this area. Core dark grey. Very shallow rilling in the thread hole indicates that the paste had been wrapped round a piece of straw to form the bead; and the presence of a glaze drip line along the interior indicates that the glaze had been applied as a slurry. The SEM photomicrographs of this bead show the relative smoothness of most of the glazed area and also the glaze discontinuities along one side.

## 2. THE DEN HAAG-BRONOVO FAIENCE BEAD (FIGS 5 AND 12, PLATE 2.2)

Incomplete segmented bead with three complete segments and part of a fourth present; length 9 mm, external diameter 4.5–6.0 mm; thread-hole diameter 2.5–3 mm. Wall thickness varies from an estimated 0.3 mm to 2.5 mm (at the thickest segment). One original end, the other broken relatively recently, perhaps during or after excavation; no further fragments are reported to survive. The bead has been mounted on a plastic tube, and its mounting in this way had almost certainly caused the major longitudinal cracks visible along the sides of the bead. This tube obscures the interior.

The bead is not a neat cylinder, but is slightly squashed, being a roughly pointed oval in end view. It is likely that this shape results from the joining of the two original edges of the faience paste, as it was wrapped round the cylindrical former; despite subsequent rolling to create the segments, this irregularity in shape was not smoothed out. The segments are variable in their shape and spacing, and in their height and depth around the bead's circumference, but they appear to have been made using the 'butter pat' technique.

The bead's colour is a medium turquoise on one side; the colour on the other side is obscured by modern glue. Over part of its circumference, the colour penetrates through the wall; elsewhere the (relatively recently) exposed core is whitish.

The surface is matt, and there are only a few small areas of 'glassy' glaze. Individual unfused quartz grains are visible in the glaze and in the core.

APPENDIX 2:  
DETAILS OF ANALYTICAL EQUIPMENT AND SETTINGS

A. SHORTLAND & K. EREMIN

The two non-destructive techniques of XRF and SEM analysis were intended to produce complementary data on elemental composition. For example, the SEM microprobe is better than XRF for determining potassium and sodium content (key elements in the glaze and fluxing agent). Each technique targets a small area of the item to be analysed, rather than giving a 'whole bead' result.

Energy-dispersive elemental XRF analysis was undertaken using the NMS Oxford Instruments equipment, running XpertEase 2.70 software. The analysed area was irradiated with a primary X-ray beam produced by a Rhodium target X-ray tube. The primary beam was collimated to give an analysed area of c. 4×2 mm; penetration was 1–2 microns from the target surface. Secondary X-rays were detected using a silicon (lithium) solid state detector. The detection limit varies depending on the elements present, matrix and analytical conditions, but is typically in the range of 0.05%–0.2%. As the analytical technique has a limited penetration depth, the reported compositions

may not be representative of the bulk of the item if there is a chemically distinct surface layer. Spectra were collected under the conditions 'Old XRF'. This uses an operating voltage of 46kV and a current of up to 1000µA (set automatically for a 45% deadtime) without a primary beam filter, to ensure detection of all elements of atomic number 19 or above. The presence of air between the detector, X-ray tube and object means that only elements of atomic number 19 or above can be detected. The use of the SEM microprobe was intended to capture information on these lighter elements.

SEM analysis was undertaken using the NMS CamScan MaXim electron microprobe, at 25kV, measuring for 100 seconds. The use of a controlled-pressure chamber in the SEM meant that the items did not have to be carbon-coated for analysis. The target area varied, from spot analysis to investigate specific features such as mineral particles, to general area analysis; the penetration of the beam was less than with XRF.

Table 2. Composition of Exloo faience beads 5, 13 and 26 as determined qualitatively by controlled-pressure scanning electron microscopy with energy dispersive microanalysis; analyses taken on unprepared surface of glaze.

<i>Bead</i>	<i>Reading</i>	SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	CaO	MgO	Na <sub>2</sub> O	K <sub>2</sub> O	Fe <sub>2</sub> O <sub>3</sub>	CuO	SnO <sub>2</sub>	PbO	P <sub>2</sub> O <sub>5</sub>	SO <sub>3</sub>	Cl
5	1	59.8	17.8	1.8	0.4	3.7	4.1	0.5	10.1	0.3	0.0	0.3	0.9	0.3
5	2	71.7	16.5	0.3	0.3	3.0	1.8	0.4	3.9	0.4	0.0	0.4	1.1	0.2
13	1	71.3	11.8	2.0	0.3	1.8	0.6	0.5	7.9	1.3	0.0	0.3	1.3	0.8
26	1	62.7	6.2	1.1	0.3	9.5	5.8	0.3	12.3	0.3	0.0	0.3	0.6	0.5
26	2	62.5	7.1	1.7	0.3	7.8	6.0	0.5	11.4	0.5	0.0	0.5	1.2	0.5
26	3	60.5	8.0	1.9	0.5	7.7	5.9	0.5	11.6	0.6	0.0	0.6	1.5	0.6